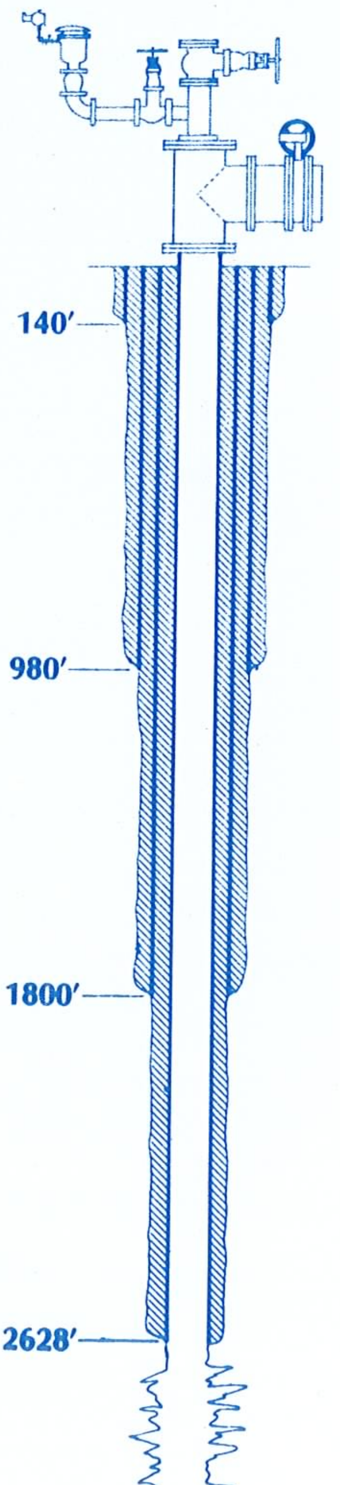
Engineering Report



DRILLING AND TESTING OF THE 8 INJECTION WELLS AND THE 3 MONITORING WELLS

for the South District Regional Wastewater Treatment Plant

of the Miami-Dade Water and Sewer Authority

Dade County, Florida

MDWSA Contract No. S-154
EPA Contract No. C120377020

April 1981
BC 55900.92

CH2M HILL

CH2M HILL
engineers
planners
economists
scientists

May 20, 1981

BC55900.92

Mr. Garrett Sloan, Director
Miami-Dade Water and Sewer Authority
3575 South LeJeune Road
Miami, Florida 33133

Dear Mr. Sloan:

Subject: Drilling and Testing of Injection and Monitoring Wells for the South District Regional Wastewater Treatment Plant Your Contract S-154

It is with great satisfaction that we submit to you this engineering report covering the construction of the referenced project. This report is prepared in accordance with the requirements in paragraph 14 of the provisos included in the construction permits issued by DER, May 5, 1978 for each of the wells. Copies of the permits and the attached provisos for each of the types of wells are included in Appendix 4.A of the report.

Also included in the report is a chapter on the determination of the potentiometric surfaces of the Boulder Zone and the Upper Floridan aquifer and an injection model of the effects expected from the operation of the system at its design capacity. This is in accordance with the requirements of the letter from Mr. Warren G. Shrahm, DER, West Palm Beach, page 1, paragraph 4, dated December 23, 1976. On these two items, we have exercised our best professional judgment in view of the facts that this was the first time the determination of the potentiometric surface of the Boulder Zone has ever been attempted, that the zone starts at approximately 2,500 feet in depth, that it has the highest transmissivity that we have ever encountered (over 100 mgd/ft), that the slope of the surface is almost nil, and that this is an engineering rather than a research project.

We are proud to inform you that each of the injection wells was satisfactorily tested at a slightly higher rate than designed for (14 mgd), that their injection wellhead pressures are lower than anticipated (50 to 60 psi), and that the entire project was completed well within the 800 calendar days scheduled, slightly below the successful low bidder's total estimated cost, and below our estimated cost for construction of the project given to you in 1978.

It is our belief that such achievement was possible due to three main factors: (1) the close cooperation among the contractor, Alsay-Pippin Company of Lake Worth, Florida, the Technical Advisory Group (TAG), your staff, and our firm, (2) the dedication of the field personnel of the contractor, of your organization, and of ours, who kept the project running 24 hours a day, 7 days a week for approximately 2 years, and (3) the direction and guidelines you personally established at the inception of the entire project in 1976.

There are two persons on your staff who were involved in this project since it began and who contributed technically and administratively to its successful completion. They are Tom McCormick, resident inspector at the site, and Herb Kunen, consultants coordinator. To them, to Messrs. Jim Cowgill, Murray Grant, and George King, and to you personally, our sincerest thanks.

Sincerely,

J. I. Garcia-Bengochea, P.E.

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PREFACE

This report covers the construction and testing of eight deep injection, three multizone, and nine shallow monitoring wells for the South District Regional Wastewater Treatment Plant of the Miami-Dade Water and Sewer Authority (MDWSA), Dade County, Florida. The plantsite is located in south Miami, south of S.W. 232nd Avenue, north of Black Creek, and between S.W. 87th and 97th Avenues. The feasibility and final design of this system were developed from the I-5 test-injection well constructed in 1977 at the project site. The completed system encompasses nine injection wells, approximately 3,100 feet in depth, which provide 50 million gallons per day (mgd) average and 112 mgd peak disposal capabilities of secondary treated effluent from the South District plant. Subsurface monitoring is accomplished with three multizone and nine Biscayne aquifer monitoring wells.

Deep-well injection was the only feasible alternative to the effluent discharge from the South District plant. The presence of the Biscayne Bay Underwater National Monument between the mainland coastline and the coral reefs approximately 10 miles east prevented the discharge of effluent into the Bay or its tributaries. It also prevented the construction of an ocean outfall under the Bay to the Straits of Florida.

Funding for this project was provided through the Wastewater Treatment Works Grant Program of the State of Florida Department of Environmental Regulation (DER) and the U.S. Environmental Protection Agency (EPA) in cooperation with MDWSA.

Construction and testing of the wells was completed in accordance with "Contract Documents for Deep Injection and Monitoring Wells" for the South District Regional Wastewater Treatment Plant. Plans and specifications were prepared by CH2M HILL and issued by MDWSA in September 1978.

The Dade County Department of Environmental Resource Management (DERM) and the Florida DER issued the well construction permits consecutively numbered from UIC 13-5378 to UIC 13-5388 on May 5, 1978. Copies of these permits are contained in Appendix 4.A of this report.

At the onset of design and construction of this project, a Technical Advisory Group (TAG) was formed under the leadership of Mr. Roy M. Duke, Jr., of DER. This TAG included representatives of all the regulatory and advisory agencies concerned with the project: DER, DERM, SFWMD (South Florida Water Management District), EPA, U.S.G.S. (United States Geological Survey), and the COE (United States Army Corps of Engineers). TAG's participation in the project was a key factor in its successful completion within the budget and time schedule. Summaries of all the meetings held with TAG since the preconstruction meeting are included in Appendix 4.B. They contain the chronology of events and engineering decisions during construction of the project.

Construction of the eight injection and related monitoring wells was started February 19, 1979, and completed April 7, 1981. Total construction cost was $12,673,133.86.

ACKNOWLEDGEMENTS

Completion of this project within the pre-established cost estimate and time schedule was an outstanding accomplishment considering the nature of the project and the potential for unforeseen factors to be encountered while drilling 11 wells through cavernous limestones and dolomites, mostly under artesian conditions. Nine of the wells were drilled to approximately 0.6 mile in depth, and eight started with a hole diameter of 5 feet and tapered down to 2 feet. The accomplishment was made possible only by the close cooperation, coordination, and understanding of the many organizations and persons involved in the project. This was the result of continuous communication between the executors of the construction of the project and the Technical Advisory Group (TAG). Those who played a key role in this achievement included:

APCO (Alsay-Pippin Corporation): Messrs. Hubert L. Pippin, Russell J. Kerrn, and David N. Cabit.

COE (Corps of Engineers, U.S. Army): Messrs. James N. Hutchinson, William W. Brubaker, and Joseph E. Welsh

Deep Venture Diving Service: Messrs. Larry Hayden and Jim Hayden

DER (Department of Environmental Regulation, State of Florida): Mr. Roy M. Duke, Jr., (West Palm Beach), Chairman of TAG and Mr. Richard Knittel and Ms. Cathy Cash (Tallahassee)

DERM (Dade County Department of Environmental Resources Management): Messers. Bill Brant and Tony Sobrino

EPA (Environmental Protection Agency, U.S. Government): Messrs. Barry Amos, Gene Coker, and Stallings Howell

Halliburton Company: Mr. Gerald Badeaux

MDWSA (Miami-Dade Water and Sewer Authority): Messrs. Garret Sloan, Director; Herbert K. Kunen, Consultants Coordinator; Jim Cowgill, Chief Engineer; George A. King, Resident Engineer; Murray Grant; Tom McCormick; Dick Friberg; Robert V. Celette (retired); Armando Rubio, Joe Mazzarese; John Paxton; and Glen Yoemans

SFWMD (South Florida Water Management District): Messrs. Abe Kreitman, Leslie Wedderburn, and Paul Jakob

U.S.G.S. (U.S. Geological Survey, Water Resource Division, Miami Subdistrict): Mr. Fred W. Meyer

CH2M HILL: Messrs. J.I. Garcia-Bengochea, C.R. Sproul, Udai P. Singh, Jeffrey D. Lehnen, Frank Reynolds, and David G. Snyder

LIST OF REFERENCES

1. BC&E/CH2M HILL, "Engineering Report--Drilling and Testing of the Test Injection Well for the Miami-Dade Water and Sewer Authority," Contract No. S-153, BC&E Project No. 559-7601. December 1977.

2. Jacob, C. E., "Radial Flow in a Leaky Artesian Aquifer," Transactions, American Geophysical Union. Vol. 27, 1946.

3. Meyer, F. W., "Evaluation of Hydraulic Characteristics of a Deep Artesian Aquifer from Natural Water Level Fluctuations, Miami, Florida," Florida Bureau of Geology, Report of Investigation No. 75, 1974.

4. Millero, F. J. et al., "The Density of Seawater Solutions at One Atmosphere as a Function of Temperature and Salinity," Sears Foundation: Journal of Marine Research, Volume 34, No. 1, February 23, 1976.

5. Walton, W. L., Ground Water Resource Evaluation, 1970. McGraw-Hill Series in Water Resources and Environmental Engineering, New York.

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Figure

Section 1

SUMMARY

Chapter 1.1
PROJECT DESCRIPTION

The South District Regional Wastewater Treatment Plant is located in the north half of Section 21, Township 56 south, Range 40 east, in Dade County, Florida, as shown on Figure 1.1-1. The plant has a design capacity of 50 mgd, with peak flow of 112 mgd of secondary treated municipal effluent. The treated effluent will be injected into a highly transmissive aquifer known as the Boulder Zone via eight of nine injection wells, the ninth used as standby. Thus, the peak flow per well will be approximately 10,000 gallons per minute (gpm). Monitoring of the injection zone and overlying aquifers is provided by a multizone well, BZ-1, in which the Boulder Zone is monitored (along with three other zones) using screened and gravel-packed tubes, two FA wells which are completed in the Floridan aquifer, and nine shallow wells in the Biscayne aquifer. The locations of the injection and monitoring wells are shown on Figure 1.1-2. A cross section of the wells showing casing depths, monitoring zones, and open hole intervals is shown on Figure 1.1-3. Important data and results from the construction and testing of the wells are summarized in Table 1.1-1.

DRILLING SITE PREPARATION AND MONITORING

Construction of the well pads began in February 1979, and drilling on the first well, I-6, began in early April of that year. Limestone fill was used to raise the ground surface at each well site to approximately 10 feet above mean sea level (msl). Concrete drilling pads 120 feet by 92 feet with curbs and sumps were constructed at each location to support the drilling rigs and to contain any fluid spills around the wells.

Four 20-foot-deep, 2-inch-diameter PVC monitoring wells were installed at each corner of the drilling pads. These wells were sampled weekly with a depth sampler during drilling operations to record the water quality of the Biscayne aquifer. Also constructed at each pad was an 8-inch water supply well drilled to approximately 40 feet below land surface. These wells were also sampled weekly, and are completed with a 2-inch cap above ground for future monitoring purposes. After construction was completed, the 2-inch wells were capped below land surface and finished such that they can be used in the future if needed.

The water quality in the Biscayne aquifer monitoring wells generally remained near background levels during the drilling of each well. The water supply well chloride levels were slightly higher than the levels in the unpumped 2-inch wells at some well sites, but this would be expected with brackish water near the bottom of the water supply wells (about 40 feet in depth).

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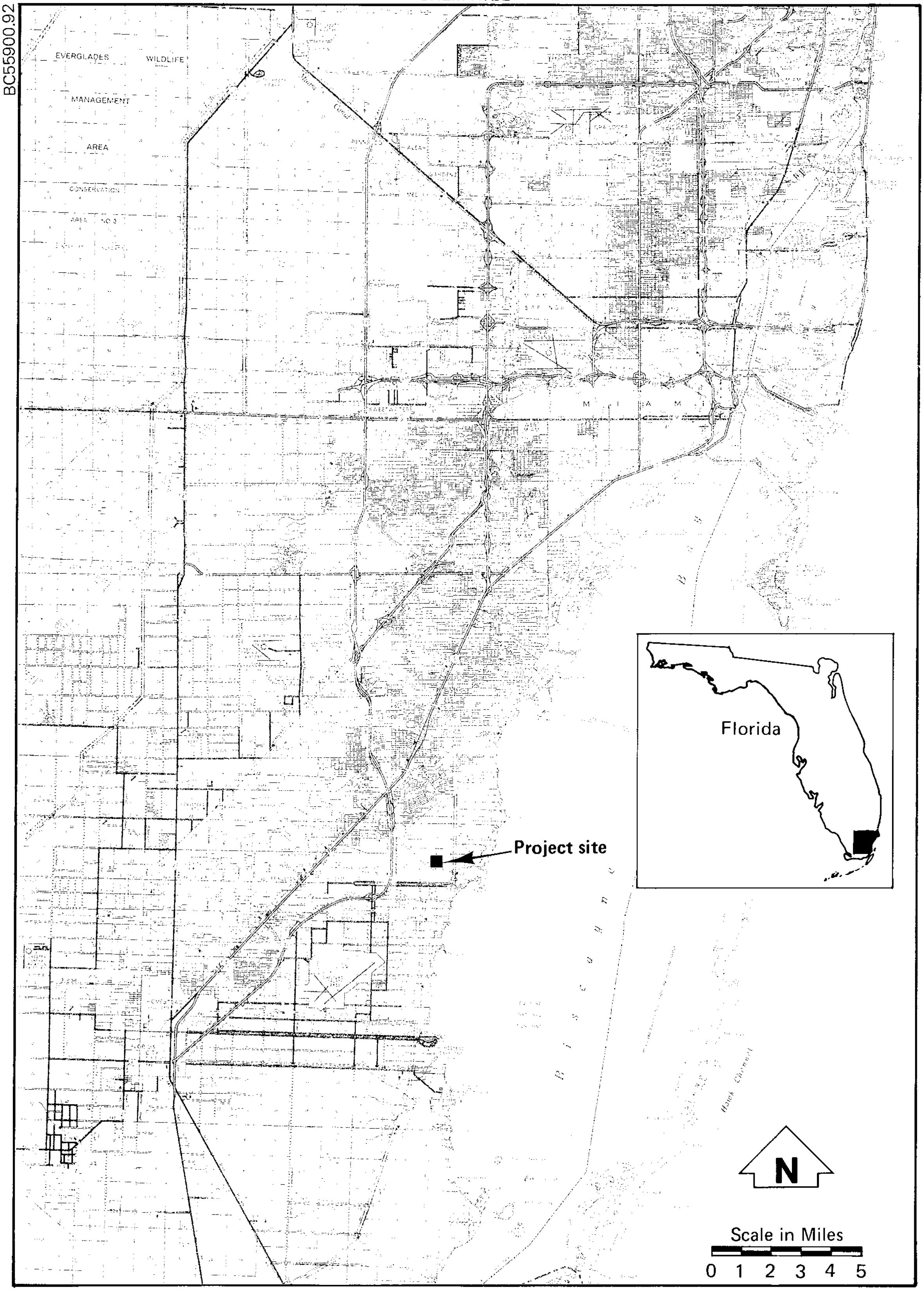


FIGURE 1.1-1. Project location.

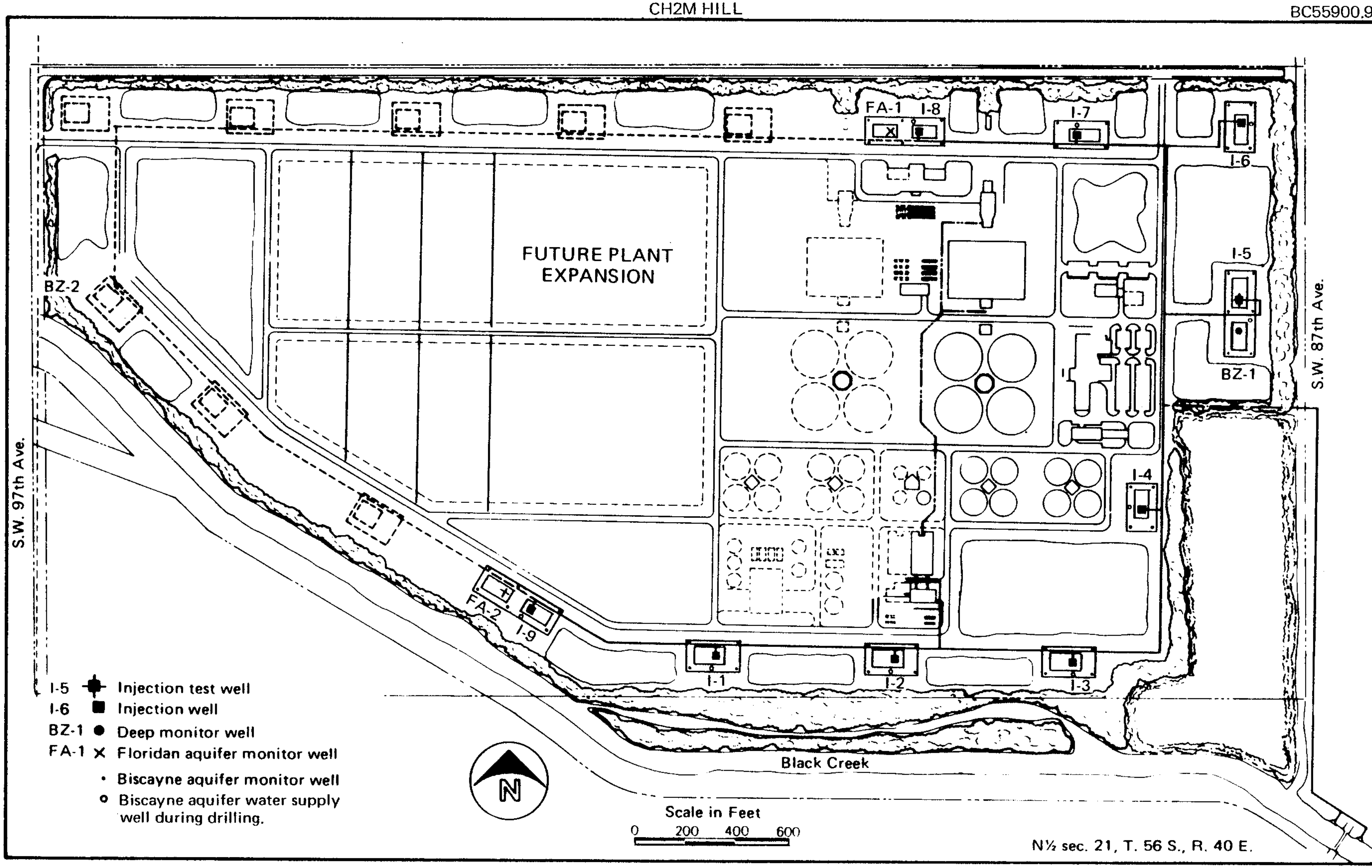
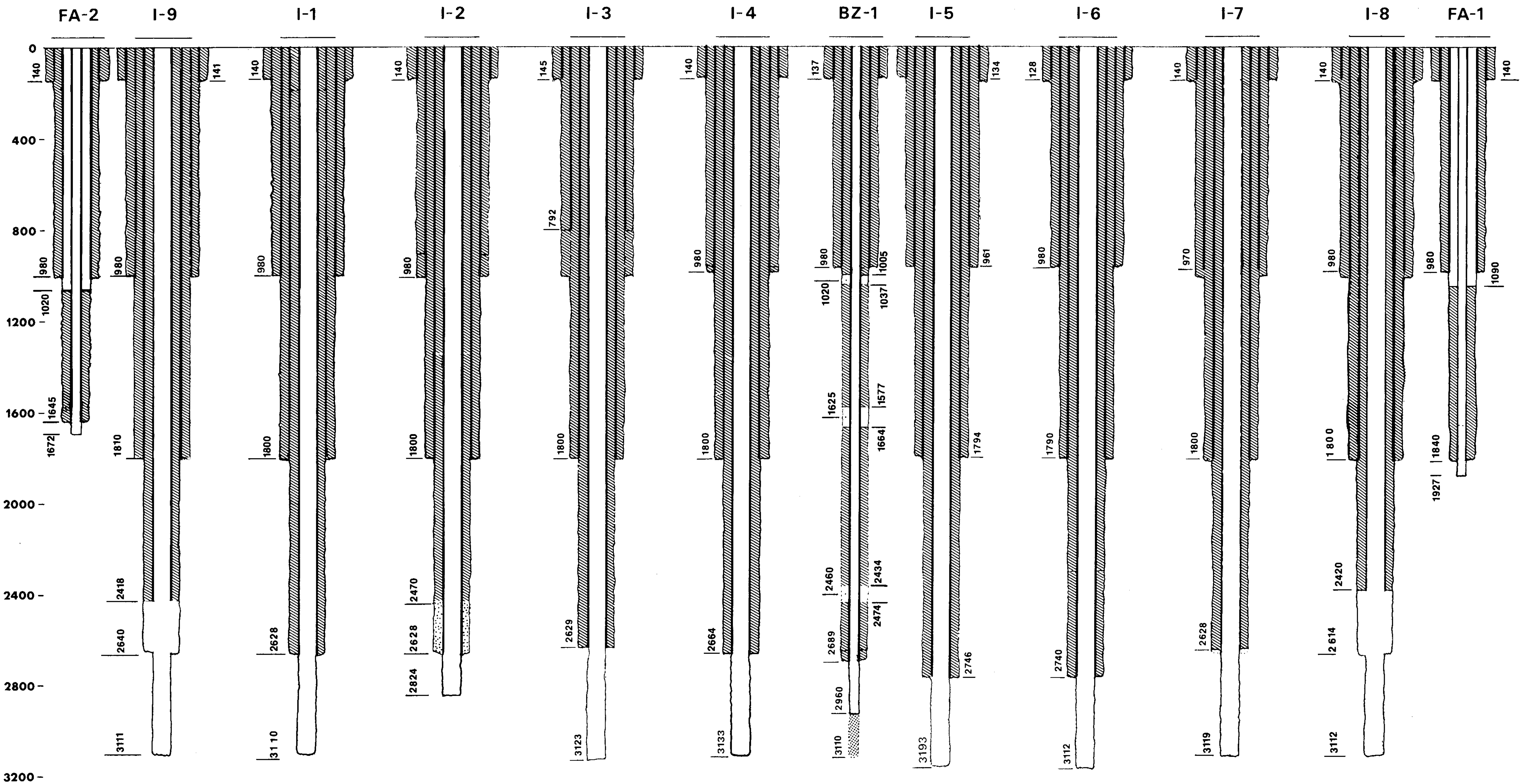


FIGURE 1.1-2. Injection and monitoring well field layout.

Miami-Dade Water & Sewer Authority

INJECTION & MONITOR WELLS

Notice to Proceed 2-19-79
Project Completed 4-7-81



Summary of well construction.

FIGURE 1.1-3.

Table 1.1-1
SUMMARY OF WELL CONSTRUCTION AND TESTING

Well No.	Casing Diameter (inches)	Casing Thickness (inches)	Casing Depth (feet)	Total Depth (feet)	Injection Test Results: Rate of Flow (gpm)	Injection Test Results: Maximum Wellhead Pressure (psi)
I-1	54	0.500	140	3,110	10,100	39.8
	44	0.500	980			
	34	0.500	1,800			
	24	0.500	2,628			
I-2	54	0.500	140	2,824	10,650	38.5
	44	0.500	980			
	34	0.500	1,800			
	24	0.500	2,628			
I-3	54	0.500	145	3,123	10,200	41.0
	44	0.500	792			
	34	0.500	1,800			
	24	0.500	2,629			
I-4	54	0.500	140	3,133	10,700	40.3
	44	0.500	980			
	34	0.500	1,800			
	24	0.500	2,664			
I-5[a]	48	0.500	134	3,193	8,000	55.0
	40	0.625	961			
	30	0.500	1,794			
	20	0.500	2,746			
I-6	54	0.500	128	3,112	10,200	36.9
	44	0.500	980			
	34	0.500	1,790			
	24	0.500	2,740			
I-7	54	0.500	140	3,119	10,900	43.0
	44	0.500	970			
	34	0.500	1,800			
	24	0.500	2,628			
I-8	54	0.500	140	3,112	10,480	37.0
	44	0.500	980			
	34	0.500	1,800			
	24	0.500	2,420			
I-9	54	0.500	141	3,111	10,820	38.0
	44	0.500	980			
	34	0.500	1,800			
	24	0.500	2,418			

Table 1.1-1--Continued

Well No.	Casing Diameter (inches)	Casing Thickness (inches)	Casing Depth (feet)	Total Depth (feet)	Injection Test Results: Rate of of Flow (gpm)	Injection Test Results: Maximum Wellhead Pressure (psi)
BZ-1	30	0.500	137			
	20	0.438	980	2,960	--	--
	6	0.432	2,689			
FA-1	20	0.438	140			
	12	0.375	980	1,927	--	--
	6	0.280[b]	1,840			
FA-2	20	0.438	140			
	12	0.375	980	1,672	--	--
	6	0.280	1,645			

[a] Well I-5 drilled under separate contract (Test/Standby Well).
[b] Casing thickness is 0.280 inch to 1,646 feet and 0.432 inch to 1,840 feet.

In late June 1980, intensive dewatering operations began on the site under a separate contract for the clarifier tanks. It was estimated that over 30,000 gpm, with chloride concentrations of over 5,000 mg/l, were being pumped 24 hours per day in an attempt to keep the excavation dry. The water was discharged into two adjacent manmade lakes within the site. The first lake was immediately north of Injection Well I-3, and the second was between I-6 and I-5. The chloride concentration in the lakes increased rapidly to values of 5,000 mg/l in several months. The effect on the monitoring wells was a slight rise of chloride concentration at sites I-2 and I-8, and a significant alkalinity change in most of the wells being monitored at that time (sites I-2, I-8, I-9, and I-1). This alkalinity increase caused the chloride analysis to yield inaccurate values. The lab procedure was modified to yield accurate chloride values after the problem was identified.

DRILLING EQUIPMENT AND METHODS

The injection wells were constructed with three drilling rigs: a Skytop-Brewster model AT-3 with a rated hook load of 275,000 pounds; a TR-700 with a hook load of 300,000 pounds; and a TR-800 with a hook load of 410,000 pounds. Only the TR-700 and TR-800 rigs were capable of setting the 34-inch casings, and only the TR-800 could set the 24-inch casings. Therefore, nearly all the wells were constructed using at least two and, in some cases, three rigs successively.

The Boulder Zone monitoring well (BZ-1) was drilled with a Failing model 3,000 with a rated hook load of 100,000 pounds. The Floridan aquifer monitoring well (FA-1) was drilled with the AT-3, as was the second Floridan aquifer monitoring well (FA-2) to a depth of 1,651 feet. A Failing model 1,500 was used to drill out the open hole of FA-2.

Rotary drilling with conventional mud circulation was used to approximately 1,000 feet through the Biscayne aquifer and the Hawthorn Formation. The drilling method was then changed to reverse-air closed circulation through the Floridan aquifer, the confining beds, and into the Boulder Zone to total depth (T.D.). This method allowed for more accurate formation and water samples and for more efficient drilling.

The monitoring wells, except for FA-2, were drilled with the same method. On this well, conventional mud circulation was used to 1,000 feet; however, from there to 1,651 feet the well was allowed to flow by open circulation. Water samples were collected in an effort to identify the target zone with a specific conductance of at least 15,000 μmhos/cm. Water samples from the bottom section of the final monitor zone of the completed well have a specific conductance of 17,000 μmhos/cm.

WELL CASINGS

The injection and monitoring wells were constructed using a staged casing system. A small-diameter (8- to 12-inch) pilot hole was drilled to the estimated casing setting depth, and geophysical logs and other tests were performed to determine the final casing setting depth. The hole was then reamed to the appropriate diameter and depth, and the casing with centralizers was then installed and cemented. The pilot hole was then drilled to the next estimated casing setting depth and the process repeated. Finally, the open hole section of the well was drilled out after the innermost casing for that well had been set and cemented.

Surface Casing

The casing settings were chosen in accordance with environmental and construction considerations. The first casings, 54-inch on the injection wells and 30-inch or 20-inch on the monitoring wells, were set below the Biscayne aquifer at approximately 140 feet. The purpose of these casings is to shut off and protect the water in the Biscayne aquifer. The highly transmissive limestone associated with the Biscayne aquifer ends at about 100 feet, where the siltstone, clay, and limestone of the Hawthorn Formation occur.

Second Casing

The second casings, the 44-inch on the injection wells, and the 12-3/4-inch on the monitoring wells, are set near the top of the Floridan aquifer into the Suwannee limestone, at about 980 feet. These are primarily construction casings intended to sustain the clays and other friable material in the Hawthorn Formation.

Third Casing

The third casings of the injection wells were set at approximately 1,800 feet. This is below the brackish/saltwater interface where the total dissolved solids are above 10,000 ppm. These casings are 34-inch-diameter and case out the brackish waters of the Floridan aquifer. Three of the monitoring wells monitor the upper sections of the Floridan aquifer at approximately 1,000 feet in depth, two monitor the lower Floridan at approximately 1,650 feet, and the third monitors below the brackish/saltwater interface at approximately 1,900 feet.

Final Casing

The final casings, 24-inch-diameter, are set above the injection zone in each injection well. These casing settings vary from 2,740 feet to 2,418 feet across the site. During efforts to set the 24-inch casings as close to the top of the injection zone as possible, serious cementing problems were encountered on I-6, I-3, and I-2, i.e., the problems were the loss of cement in the cavernous formation in the upper sections of the Boulder Zone being too close to the hole reamed to set the final casing. The 24-inch casing on Well I-6 was set and cemented at 2,740 feet in depth. Due to fillup difficulties, subsequent 24-inch casings were set between 2,628 and 2,689 feet. I-2 was also set at 2,628 feet and again serious difficulties were encountered in cementing. Gravel had to be used to fill up between cement stages to 2,470 feet, where good cement fill was finally achieved.

Following the cementing difficulties on I-2, and after review of the pumpout test data on I-5, the lower monitoring zone (2,450 feet) was re-evaluated. A thorough evaluation of Well I-5 pumpout test data indicated that this zone (2,450 feet) does not appear to be separated from the injection zone. Based on these factors, it was decided to set the 24-inch casings on I-8 and I-9 above 2,500 feet to avoid potential cement fillup problems and subsequent costs. The 2,450-foot monitoring zone in BZ-1 therefore monitors the upper part of the injection zone.

GYROSCOPIC DIRECTIONAL SURVEYS

Early in the project, the addition of gyroscopic directional surveys to the geophysical logging program was required by the regulatory agencies. The initial funding was for three wells from 1,000 feet to 2,750 feet. Wells I-6, I-3, and I-4 were surveyed under this funding. After these wells were completed and the results reviewed for each well, CH2M HILL recommended the elimination of the gyro surveys in the construction program. The use of staged, multi-bit reamers make sidetracking of the pilot hole very unlikely. During these deliberations, Well I-7 was drilled and because funding approval for more surveys had not been received, no gyroscopic surveys were run. A decision was finally reached to run gyroscopic directional surveys only on the bottom section (from 1,800 to 2,650 feet) in Wells I-1, I-2, I-8, and I-9 .

The purpose of the surveys was to compare the well path of the pilot hole with that of the reamed hole at each site. The reamed hole well path needs to wipe out or at least intersect the pilot hole well path. If the reamer sidetracked the pilot hole, the surveys would indicate two holes drilled side by side which could prevent proper cementing and isolation of the injection zone from the overlying aquifers.

All of the pilot hole and reamed hole surveys run on the wells showed that the reamers tracked the pilot holes indicating the presence of only one hole at each site.

INCLINOMETER

In addition to the gyroscopic surveys, inclinometer surveys were made on the wells at least every 90 feet or every third drill pipe connection. This is a single-shot tool in which the inclination of the drill pipe near the bit, and therefore the hole, is measured. These surveys were made from the surface to T.D. in the pilot and reamed holes. The contractor was required to maintain less than 1° inclination throughout the drilling operations. For additional safety, an inclination of less than 30 minutes was maintained. The contractor did this to provide further assurance that during installation the casings would not become stuck above the specified setting depth.

PILOT HOLE DATA COLLECTION

Lithologic Samples

During the drilling of the pilot holes two sets of lithologic samples were collected every 10 feet from land surface to T.D. of each well. These samples were washed, analyzed, and described, and one set was sent to the State of Florida Bureau of Geology in Tallahassee and the other was kept for MDWSA.

The geology across the site is very consistent down to about 2,450 feet. From that depth to 2,800 feet, varying amounts of dolomitization and associated fracturing and cavity formation occur. This was the cause of the cement losses in these strata. In I-1, I-4, and I-7, no cavity large enough to cause cementing difficulties was encountered; however, on three wells, I-6, I-3, and I-2, large cavities were encountered. The casings for Wells I-8 and I-9 were then set above the 2,450-foot section. From 2,800 to 3,100 feet, the cavity development is fairly consistent throughout the site.

Water Quality

During drilling of the pilot hole for each casing below 1,000 feet, a water sample was collected from the drill pipe every 30 feet (at each pipe connection) to total depth. The purpose of these samples was to obtain representative water quality data from the bottom of the hole. Unfortunately, during normal drilling operations, large quantities of bentonite mud, soda ash, salt, and various other additives were mixed with the circulating fluid to maintain fluid circulation and to keep the wells from flowing. These additives cause the water quality analysis to be non-representative in most cases, though general water quality trends can be seen.

Drilling Rate

As a requirement of the contract, the contractor was required to provide a record of the pilot hole drilling rate. This was done using a continuous recording footage counter, which also recorded the weight on the bit and the torque on the drill string. This information is useful in determining formation changes, type of rock being drilled, and penetration rate. It also proved to be an important record of what was done on a particular work shift, thus enabling the next driller to understand the hole conditions being drilled in.

Geophysics

As each stage of the pilot hole was drilled, geophysical logs, gyroscopic surveys, television surveys, and any additional pumping tests were performed. The geophysical logs were run to evaluate the types of formation and to delineate transmissive zones. CH2M HILL and Schlumberger ran the geophysical logs, Eastman-Whipstock provided the gyroscopic directional surveys, and Deep Venture Diving Service did the underground television surveys.

The correlation of the geophysical logs shows very consistent bedding across the site. Although there are some apparent bedding thickness changes between some of the wells, this could be explained as the result of a karst-type surface in which sinkhole activity offsets the bedding in relatively short distances. Later, dolomitization can also occur at varying depths, sometimes obliterating the original bedding planes. In any case, the stratigraphic correlation through the Floridan aquifer and the confining beds is consistent with the regional pattern.

TV SURVEYS

Underwater closed circuit television surveys were made at various times during construction of the wells. The final survey inspecting the inner casing and open hole on each injection and monitoring well is summarized in Section 2, Well Construction, of the report. The borehole TV surveys provide a record of the integrity of the final casings as well as a subjective tool in evaluating the open hole. The highly transmissive zones are characterized by large cavities, fractures, and rough borehole walls. Non-producing zones typically have smooth borehole walls with occasional enlarging of the diameter over the bit size. This "overdrill" is caused by the soft, friable, chalky nature of this formation. The mechanical and hydraulic action as the bit drills through it causes the formation to wear away, thereby forming a large hole. This does not necessarily indicate transmissivity or permeability, because the hard, fractured rock is where the solution activity occurs, and the soft, homogeneous rock act as confining beds.

Copies of all the geophysical logs and directional surveys and the final TV surveys run on the injection and monitoring wells have been forwarded to the members of the Technical Advisory Group (TAG) for their records. This includes the following agencies: EPA (Atlanta), SFWMD, DER (West Palm Beach, except for TV tapes), DER (Tallahassee), and U.S.G.S. (Miami).

CEMENTING

The casings were cemented from the bottom up to pad level in one pumping operation on the first and second casings in each well by pumping cement down a drill pipe set near the bottom of the casing, out through the bottom, and up the annulus. The casing is sealed during this operation so that pressure can be maintained inside to prevent the casing from collapsing. Enough water is pumped after the cement to displace the cement below the drill pipe, and the cement is then allowed to set. The cement is circulated to the surface on the first and second casings; however, on the deeper casings, the first pumping did not circulate to the surface. The amount of cement and the length of time necessary to pump it requires that the deeper casings (the third and the final) be cemented by stages.

After the first pump or stage of cement on the deeper casings had set for 12 hours, a temperature log was run inside the casing to determine the top of cement outside the casing. The heat of hydration of the cement, detected inside the casing, is used to indicate the top of cement. The following stages are pumped down two tremie pipes set 180° apart in the casing annulus. These pipes are used to tag the top of the first and following stages on both sides before the next stage is pumped. The tag depths are compared to the temperature log and the cement retagged until they agree with the log. This prevents a space from being left uncemented between stages.

In all except the 140-foot surface casings, Class H neat cement was pumped at the bottom of the casings. Only after at least 200 feet of neat cement was placed were the cement mixtures changed to higher yield cement slurries. To aid in distributing the first stage evenly around the bottom of the 24-inch and 6-5/8-inch casings, 2-inch by 2-inch cement ports were cut at 90° around the casing near the bottom. Also, all the casings were centralized to provide open annuli for the cement to fill.

This method of cementing is probably the best assurance of good cement around the casings. In an effort to provide additional assurance of the integrity of the cement around the 24-inch casing in the injection wells and the 6-5/8-inch casing in the monitoring wells, cement bond logs were run. In order to provide a free pipe signal on which to reference the log, the upper 100 feet of the 24-inch casings was left uncemented. After the logs were completed, the casings were cemented to the surface. The cement bond logs were found to be limited in their use in evaluating the quality of the cement outside the casings. Their known limitation is that the tool response is unreliable in casings over about 16 inches in diameter. In most cases the difference between free and cemented casing was discernible, but little else was indicated.

It was for this reason that the U.S.G.S. ran several logs in I-4. Their logs showed the difference between free and cemented pipe also, but in a very subjective fashion. An attempt to gain more information was made by running Wave Train Display logs, but they too were uninformative.

PRESSURE TESTS

After the 24-inch and 6-5/8-inch casings were cemented, a pressure test was performed on each casing to prove that they were properly welded, not damaged or for any other reason leaking, the latter providing a possible short circuit of the confining or monitoring zones. The tests were conducted at 100 psi or greater for at least 1 hour. None of the casings had any measurable pressure loss in these tests.

AQUIFER TESTING

Injection Tests

After the injection wells were drilled to T.D., an injection test was run to determine the injectivity capacity of each well. A barge with two V-12 diesel engines and a turbine pump was used to pump lake water into the wells at approximately 10,000 gpm. The flow was measured with an inline propeller flowmeter and totalizer. The wellhead pressure was measured with a 12-inch precision double revolution, buordon-tube type gauge and the tests run for at least 10 hours. The maximum injection for each wellhead ranged from 85.2 feet of water to 99.4 feet of water, with an average of about 90 feet of water referred to the top of the concrete drilling pads.

Upon completion of each injection test and immediately after pump shutdown, the average residual freshwater head at each well was about 70 feet of water. This residual head was caused by the buoyancy of the fresh injected lake water on the native saltwater. Most of the difference between the injection head and static head is caused by pipe friction; thus the actual pressure at the injection zone is very low, on the order of less than 3 feet of water or 1.3 psi. Table 1.1-2 is a summary of the injection test results.

Table 1.1-2
SUMMARY OF INJECTION TEST RESULTS

Injection Well	Date of Test	Pumping Rate (gpm)	Test Duration (hr)	Maximum Injection Head (ft of water)	Elapsed Time to Reach Maximum Head (min)	Static Freshwater Head (ft of water)
I-1	08/21/80	10,100	10.6	92.0	7	50.2[a]
I-2	11/01/80	10,650	11.5	88.9	3	64.1
I-3	03/25/80	10,200	13	94.8	270	70.0
I-4	03/31/80	10,700	12	93.0	40	69.7
I-5[b]	10/26/77	8,000	10	127.0	25	72.0
I-6	02/13/80	10,200	32.5	85.2	7	66.0
I-7	06/11/80	10,900	12	99.4	7	69.0
I-8	01/03/81	10,480	12	85.5	10	65.1
I-9	01/09/81	6,685[c] 10,820	4.5[c] 7.5	87.7	12	64.7

[a] Standpipe valve open at end of test, static pressure not accurate.
[b] I-5 casing is 20 inches in diameter.
[c] Test run at 6,685 gpm for 4.5 hr, then at 10,820 gpm for 7.5 hr.

I-5 Withdrawal Test

After Injection Well I-6 and Monitoring Well BZ-1 were completed, a withdrawal test was performed on Injection Well I-5. The first test was a step-drawdown test pumping at 2,077, 3,855, and 5,875 gpm from Well I-5. The second test was at a constant rate of about 6,000 gpm from the same well. Wells BZ-1 and I-6 were used to measure drawdowns during this test. The report of the test was completed in March 1980. The test description and conclusions are presented in Chapter 3.1, and the data compiled during the test are included in Appendix 4.C.

POTENTIOMETRIC SURFACES

Upon completion of all the wells, the position of the potentiometric surface of the upper Floridan aquifer and the Boulder Zone was determined. The potentiometric surface of the lower Floridan could not be determined because of the differences in depth between FA-1, FA-2, and the lowest monitoring tube in BZ-1. These differences made surveying of the surface impossible. The potentiometric surface survey of the Boulder Zone is contained in Chapter 3.2, and the water density calculations are presented in Appendix 4.D. The potentiometric surface survey of the upper Floridan aquifer is contained in Chapter 3.3.

INJECTION MODEL

Upon completion of the project, an injection model of the effects of injection on the potentiometric surface of the Boulder Zone was prepared. This model encompasses the 30-year lifespan of the facility and is based on the average flow capacity of 50 mgd from the South District Wastewater Treatment Plant. Chapter 3.4 of the report presents the procedure used and the results obtained from the injection model.

Chapter 1.2
MONITORING PLAN

PURPOSE

Monitoring of the subsurface environment will be conducted using the monitoring wells installed for this project: Wells BZ-1, FA-1, and FA-2. These wells are multizone monitors, each discretely monitoring two or more zones. The wells are arranged in a triangular pattern as shown on Figure 1.1-2, Section 1, for a better determination of the potentiometric surface and the hydraulic characteristics of each zone.

The monitoring wells were constructed to provide a means by which to determine the effects of injection on the subsurface environment. The wells are designed to:

1. Determine the hydraulic effects of injection on the Boulder Zone.

2. Determine the thickness of the effluent lens and the water quality in the Boulder Zone after injection.

3. Detect any upward migration of the injected fluid.

4. Detect any change in the brackish/saltwater interface at the base of the Floridan aquifer.

5. Detect any change of water quality in the Floridan aquifer.

6. Detect any change of water quality in the Biscayne aquifer.

In addition, Well BZ-1 was used to evaluate the aquifer characteristics during the withdrawal test on I-5. All of the monitoring wells were disinfected and sampled after completion; the results are shown in Table 1.2-1. The monitoring zones are described below, along with the associated monitoring wells.

BOULDER ZONE

The top of the highly transmissive strata, known as the Boulder Zone, was thought to start at approximately 2,800 feet below the concrete drilling pads. Evidence from the withdrawal test on I-5 suggests that the original "2,500-Foot Zone," the first transmissive zone above the 2,800-foot depth, is communicated with the Boulder Zone. Further evidence was found in Well I-2 when cementing the 24-inch casing. Gravel had to be used to fill around the 24-inch casing up to 2,470 feet, because fill-up could not be accomplished with cement. This was an indication of extensive cavities up to that level.

Based on this evidence, the remaining 24-inch casings, I-8 and I-9, were set above the "2,500-Foot Zone." BZ-1 was essentially completed before the test results were available and construction difficulties were encountered; Well BZ-1 was therefore constructed as planned.

The open hole portion of BZ-1 is completed from 2,689 feet to 2,960 feet, and a screened and gravel-packed 2-inch monitor line is completed from 2,434 to 2,474 feet.

The purpose of the open hole of the BZ-1 monitoring well, completed in the injection zone, will be:

1. To provide a means of obtaining long-term data on water quality and hydraulic pressure in the injection zone.

2. To provide insight into the rate and direction of movement of the effluent and, therefore, the size of the effluent lens. This data will be supplemented with observations in unused injection wells during the early phase of system operation.

"2,500-FOOT ZONE"

As noted above, this zone was supposed to be the first transmissive stratum above the injection zone. Well BZ-1 was constructed to provide monitoring of this zone. However, since this zone seems to be part of the Boulder Zone and two of the injection wells are completed at about this zone, it no longer has a monitoring function for the upward migration of the injected fluid. Any water quality or pressure change detected could be attributed to either vertical or horizontal migration of the injected fluid in this zone. However, this zone could still be used to determine the thickness and change in water quality of the injected fluid in the Boulder Zone.

SALTWATER INTERFACE--BOTTOM

As a result of the construction modifications previously mentioned, Well FA-1 was deepened in order to monitor the first transmissive zone above the injection zone. This well is cased to 1,840 feet and has an open hole to 1,927 feet. The chloride concentration in this zone is 17,500 mg/l, as shown in Table 1.2-1.

This monitoring zone is the first one above the injection zone and would indicate any vertical migration of the injected fluid if it occurs.

SALTWATER INTERFACE--TOP

The water quality transition zone, or the brackish water/saltwater interface, occurs between 1,600 feet and 1,780 feet in depth at the site. The water quality in this interval changes from brackish (<10,000 mg/l TDS) to salty (>25,000 mg/l TDS), and Wells BZ-1 and FA-2 monitor this zone. There is a screened and gravel-packed 2-inch monitoring line in Well BZ-1 from 1,577 to 1,674 feet, and Well FA-2 is cased to 1,645 feet and has an open hole to 1,672. However, the chloride concentrations in the two wells are slightly different: 6,160 mg/l in FA-2 and 4,200 mg/l in BZ-1, as shown in Table 1.2-1. The fact that the screen is set from 1,620 to 1,630 feet in depth in BZ-1, or slightly higher than the open hole in FA-2 could be the reason for the water quality difference. Monitoring the interface top will detect any change in its position and will indicate upward migration of the injected fluid it if occurs.

FLORIDAN AQUIFER

The most productive and potentially useful zone of the Floridan aquifer is monitored at four locations at the site, extending from a depth of 980 feet to 1,090 feet. Wells FA-1 and FA-2 are completed with open annuli around the 6-5/8-inch inner casings and the 12-3/4-inch secondary casings at 980 feet. Well FA-1 is open from 980 feet to 1,090 feet, and FA-2 is open from 980 feet to 1,020 feet. Between the bottom of each interval and the inner casing bottoms, the annuli are filled with cement.

Wells BZ-1 and I-5 have a screened and gravel-packed 2-inch monitoring line completed from 1,000 feet to 1,037 feet and 1,007 feet to 1,056 feet in depth, respectively.

Monitoring in this aquifer will detect any changes in the artesian head or water quality resulting from injection or other pumping activity.

BISCAYNE AQUIFER

The Biscayne aquifer extends to about 100 feet at the site and contains freshwater to a depth of about 40 feet. Since this aquifer has been designated a sole source aquifer, water quality monitoring and prevention of saltwater intrusion are of paramount importance. After completion of the project, the nine water supply wells located at each drilling pad were completed with 2-inch steel caps. This allows a pump or depth sampler to be used to monitor the water quality at each pad.

During construction of the injection and monitoring wells, four 2-inch PVC wells were constructed to 20 feet in depth at the corners of each drilling pad. There were a total of 35 such wells installed as part of this project; all of which were sampled weekly during the drilling operations at each pad.

Upon completion of the project, these 2-inch wells were finished below grade and buried. If they are needed at a later date, they can be recovered and used.

These precautions are taken in spite of the fact that the project site is just downgradient of the 1,000-mg/l isochlor line established in the area which designates the bottom of the Biscayne aquifer.

OPERATIONAL MONITORING

The operational monitoring system involves the following: injection rate, injection pressure, effluent quality, aquifer pressures, and water quality. It is recommended that at least three complete water quality analyses be run (as shown in Table 1.2-1) immediately prior to system startup in order to provide more reliable background water quality data.

The injection system monitoring parameters are shown in Table 1.2-2, and the ground-water quality sampling schedule is presented in Table 1.2-3. The effluent quality sampling schedule is shown in Table 1.2-4. These monitoring parameters and frequencies are guidelines designed to evaluate the effects of injection on the subsurface environment. In the event of a change in parameters beyond the expected ranges of values, the monitoring plan (including sampling frequencies) may be modified to respond to that specific occurrence.

Table 1.2-2
INJECTION SYSTEM MONITORING PARAMETERS

Parameter	Sampling Point	Frequency
Injection Rate	Effluent pumping station	Continuous
	Each injection well	Continuous
Injection Pressure	Each injection well	Continuous
Boulder Zone Pressure	BZ-1 monitoring well, inner casing[a]	Continuous
Upper Floridan Aquifer Pressure	Annuli of Wells FA-1 and FA-2	Continuous
	Monitoring tube in BZ-1 annulus	Continuous
Lower Floridan Aquifer Pressure, Top of Interface	Monitoring tube in BZ-1 annulus, inner casing of Well FA-2	Continuous
Lower Floridan Aquifer Pressure, Bottom of Interface	Inner casing of Well FA-1	Continuous
Total Volume Injected	Effluent pumping station	Daily

[a] Boulder Zone pressure will also be monitored continuously in Wells I-8 and I-9, both of which could be held out of service until needed.

Table 1.2-3
WATER QUALITY MONITORING PARAMETERS AND FREQUENCY

Monitoring Zone	Sampling Points	Parameter	Frequency
Boulder Zone	Inner casing of BZ-1	1. Basic hydrochemistry BOD_5 Total coliform Fecal coliform pH DO Specific conductance Turbidity Alkalinity Hardness Calcium Magnesium Sodium Potassium Chloride Sulfate Iron Nitrogen species Phosphate Organic carbon	Monthly
		2. Gases Nitrogen Methane CO_2 H_2S	Once per year
Lower Monitoring Zone in BZ-1	BZ-1 monitoring tube	Same as Boulder Zone 1 above	Monthly[a]
		Same as Boulder Zone 2 above	Once per year
Lower Floridan Aquifer (brackish to saline transition zone), top and bottom	BZ-1 monitoring tube	Same as Boulder Zone 1 and 2 above	Once per year
	FA-1 and FA-2 inner casings, BZ-1 monitoring tube	Specific conductance, chloride, temperature	Monthly
Upper Floridan Aquifer	FA-1 and FA-2 annuli, I-5 annulus tubing, and BZ-1 monitoring tube	Same as Boulder Zone 1 and 2 above	Once per year
		Specific conductance chloride, temperature	Monthly

Table I.2-3--Continued

Monitoring Zone	Sampling Points	Parameter	Frequency
Biscayne Aquifer	Nine Biscayne aquifer monitoring wells	Chloride, specific conductance	Monthly
Biscayne Aquifer	Biscayne aquifer monitoring wells; Sites I-8, I-5, and I-9	Basic hydrochemistry (same as Boulder Zone 1 and 2 above)	Once per year

[a]Until effluent is detected, then only once per year including Group 2 (gases).

Table 1.2-4
EFFLUENT QUALITY MONITORING PARAMETERS AND FREQUENCY

Parameter	Frequency
Specific conductance	Continuous
BOD_5	Daily
Suspended solids	
Chlorine residual	
Total coliform	
Fecal coliform	
pH	
DO	
Temperature	
Alkalinity	Monthly
Hardness	
Calcium	
Magnesium	
Sodium	
Potassium	
Chloride	
Sulfate	
Organic carbon	
Nitrate	
Phosphate	
Density	
Trace elements (metals)	Once per year
Pesticides	

Table 1.2-1
RESULTS OF WATER ANALYSES ON SAMPLES COLLECTED FROM
MONITORING WELLS AFTER COMPLETION AND THOROUGH FLUSHING

	FA-2	FA-1	BZ-1		FA-2	FA-1	BZ-1	
Depth Interval in Feet: Top	980	980	1,005	1,577	1,645	1,840	2,434	2,689
Bottom	1,020	1,090	1,037	1,664	1,672	1,927	2,474	2,960
Sample Collected: Date	12-08-80	12-08-80	12-08-80	12-08-80	03-26-81	12-08-80	03-16-81	03-16-81
Time	4:30 p.m.	4:05 p.m.	5:10 p.m.	5:05 p.m.	--	3:55 p.m.	3:40 p.m.	4:10 p.m.
Field Determinations: Water Temperature °C	20.5	21	22	22	21.5[b]	20	23	21.5
pH	7.2	8.15	8.2	7.85	7.35	7.75	7.95	7.60
DO (mg/l)	0.1[a]	0.1[a]	0.1[a]	0.1[a]	0.1[a,b]	0.10[a]	0	0.6[a]
Cl_2 Residual (mg/l)[c]	<0.02	<0.02	<0.02[d]	<0.02[d]	<0.02[b]	<0.02	<0.02[d]	<0.02[d]
Laboratory Determinations: BOD_5 (mg/l)	<1.0	<1.0	<1.0[d]	<1.0[d]	<1.0[d]	<1.0	<1.0[d]	<1.0[d]
Specific Conductance (μmhos/cm)	3,020	3,230	4,870	11,900	17,400	44,900	42,500	42,000
Total Dissolved Solids (TDS)	1,920	1,890	2,750	7,310	3,660	30,500	28,870	28,530
Turbidity, NTU	85[e]	70[e]	3.9[d,e]	2.2[d,e]	45[e]	46[e]	23[d,e]	29[e]
Alkalinity (mg/l as $CaCO_3$)	100	227	159	108[d]	127	122	118	121[d]
Total Hardness (mg/l as $CaCO_3$)	590	456	365[d]	1,440[d]	6,120	5,480	6,130	6,490
Calcium (mg/l)	175	85	52[d]	190[d]	340	460	475	452
Magnesium (mg/l)	37	59	57[d]	235[d]	1,280	1,050	1,200	1,300
Sodium (mg/l)	380	580	1,180[d]	2,260[d]	2,960	9,300	12,000[d]	11,300[d]
Potassium (mg/l)	8.8	20	21[d]	71[d]	94	290	370[d]	400[d]
Chloride (mg/l)	920	820	1,420	4,200	6,160	17,500	20,100	19,700
Sulfate (mg/l)	78	294	304	364	194	2,160	2,710	2,800
Iron (mg/l)	11.7	3.12	0.66[d]	0.38[d]	3.45	7.25	5.80[d]	9.85[d]
Nitrogen (as N): Ammonia	<0.02	0.11	0.10	0.14	0.11	<0.02	<0.02[d]	<0.02[d]
Nitrate and Nitrite	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.15
Total Kjeldahl	1.11	0.29	0.23	0.29	0.11	0.19	<0.02	<0.02
Total Phosphrous (mg/l as P)	<0.008	0.024	0.032	0.016	<0.008	<0.008	<0.008	0.016
Total Organic Carbon, TOC (mg/l)	3.5	6.0	6.0	2.5	2.5	2.5	4.5	4.0
CO_2 (mg/l as $CaCO_3$)	28	6,9	4.4	3.2	2.5	9.5	5.9	13
Hydrogen Sulfide (mg/l)	0.19	0.31	0.21	0.20	.65[b]	0.19	<0.20	<0.20
Coliform Colonies/100 ml	<1	<1	<1	<1	<1	<1	<1	<1
Pesticides (μg/l): Endrin	<0.06	<0.06	<0.2[d]	<0.2[d]	<0.06	<0.06	<0.2[d]	<0.2[d]
Lindane	<1	<1	<2[d]	<2[d]	<1	<1	<2[d]	<2[d]
Methoxychlor	<1.0	<1.0	<5[d]	<5[d]	<1.0	<1	<5[d]	<5[d]
Toxaphene	<2	<2	<3[d]	<3[d]	<2	<2	<3[d]	<3[d]
Herbicides (μg/l): 2, 4-D	<10	<10	<2[d]	<2[d]	<10	<10	<2[d]	<2[d]
2, 4, 5-TP Silvex	<2.0	<2.0	<2[d]	<2[d]	<2	<2	<2[d]	<2[d]
Trace Metals (mg/l): Arsenic	<0.002	0.003	0.002[d]	0.005[d]	0.004	<0.20	<0.20[d]	<0.20[d]
Barium	<0.2	<0.2	<0.2[d]	<0.2[d]	<0.1	<0.2	<0.2[d]	<0.2[d]
Cadmium	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005[d]	<0.0005[d]
Copper	<0.002	<0.002	<0.002[d]	<0.002[d]	<0.002	<0.002	<0.002[d]	<0.002[d]
Lead	<0.002	0.004	0.002[d]	<0.002[d]	<0.002	0.002	0.002[d]	0.002[d]
Manganese	0.98	0.105	0.023[d]	0.042[d]	0.029	0.170	0.310[d]	0.300[d]
Mercury	<0.0002	<0.0002	<0.0002[d]	<0.0002[d]	<0.0002	<0.0002	<0.0002[d]	<0.0002[d]
Selenium	<0.002	<0.002	0.002[d]	0.003[d]	<0.002	<0.20	<0.20[d]	<0.20[d]
Silver	<0.0005	<0.0005	<0.0005[d]	<0.0005[d]	<0.0002	<0.0005	<0.0005[d]	<0.0005[d]
Zinc	0.02	0.01	0.02[d]	0.02[d]	0.25	0.05	0.07[d]	0.04[d]
Chromium, Total	<0.002	<0.002	<0.002[d]	<0.002[d]	<0.002	<0.002	<0.002[d]	<0.002[d]

[a] Instrument reading should be equal to 0.
[b] Sample collected December 8, 1980.
[c] After disinfection.
[d] Sample collected November 21, 1980.
[e] Sample reddish cloudy-high iron.

Section 2

WELL CONSTRUCTION

INTRODUCTION

The construction of the eight injection and three monitoring wells is described in this section. The construction techniques, data collection, and testing are described in Section 1, Summary. This section contains the construction sequence, the casing and cementing data, and all other construction and test data collected for each of the wells.

Each chapter of this section covers an injection or a monitoring well. The location of each is shown on Figure 1.1-2, Section 1, Summary. The construction sequence includes a brief description of the activities during the construction and testing of that well, any particular construction modifications, problems encountered, and testing performed. A summary of the injection test is also presented for each injection well.

The first three tables in each chapter indicate the casing sizes and setting depths, the cement used for the entire well, and a list of all the geophysical logs and well surveys run in the well.

The gyroscopic well path surveys run in the injection wells are included in the fourth table. The first page of this table shows the well path comparison between the follow well (reamed hole) and the target well (pilot hole) surveys. To compare the two paths at a given depth, the feet indicated are the distance between the center lines of the two holes at that given depth, and the direction of a line between the center of the pilot hole to that of the reamed hole is indicated in degrees from north. It should be noted that the diameter of the reamed hole is 42 inches from 1,000 to 1,800 feet, and 32 inches from 1,800 to 2,600 feet. This allows for the centerline of the well paths to be as far as 1.8 feet apart in the 32-inch hole and 2.2 feet in the 42-inch hole, and still only one hole is present. The second page of the table is the record of the survey for the reamed hole in which the casing was installed. In Wells I-6, I-4, and I-3 there are two surveys: one for the 34-inch casings and another for the 24-inch casings. The rest of the wells include only the 24-inch casing survey. The reason for this is given in the paragraph for Gyroscopic Direction Surveys, Chapter 1.1 Project Description.

A descriptive summary of the final TV survey of the casing and open hole is included in the fifth table, followed by a description of the formation samples collected during drilling in the sixth table. The quality of the water samples collected during the drilling of the pilot hole is given in the seventh table.

Chapter 2.1
INJECTION WELL I-1

Injection Well I-1 is located on the southern boundary of the project site, as shown on Figure 1.1-2, Section 1, Summary. It is 760 feet west of I-2 and 860 feet east of I-9. Drilling began on February 12, 1980 and was completed on June 30, 1980. The drilling and casing sequence of I-1 was as follows:

1. Drilled a 60-inch hole to a depth of 150 feet.
2. Set and cemented the 54-inch casing from a depth of 140 feet up to the concrete drilling pad.
3. Drilled a 12-1/4-inch pilot hole to 1,017 feet.
4. Reamed the pilot hole with a 52-inch reamer to a depth of 990 feet.
5. Set and cemented the 44-inch casing from 980 feet up to the concrete drilling pad.
6. Drilled a 12-1/4-inch pilot hole to 1,850 feet.
7. Reamed the pilot hole with a 42-inch reamer to a depth of 1,810 feet.
8. Set and cemented the 34-inch casing from a depth of 1,800 feet up to the concrete drilling pad.
9. Drilled a 12-1/4-inch pilot hole to a depth of 2,640 feet.
10. Reamed the pilot hole with a 32-inch reamer to a depth of 2,628 feet.
11. Set the 24-inch casing from the surface to a depth of 2,628 feet.
12. Cemented the 24-inch casing from 2,628 feet up to 220 feet below pad.
13. Ran a casing pressure test at 120 psi for 1 hour with no pressure loss.
14. Drilled a 22-inch hole to a depth of 3,110 feet.
15. Ran an injection test at 10,100 gpm for 10.6 hours.
16. Ran a cement bond log on the 24-inch casing.
17. Cemented the 24-inch casing to pad level.
18. Completed the wellhead and pad as per specifications.

Casings are black steel, API 5L, Grade B, and ASTM A 139, Grade B. Casing details are summarized in Table 2.1-1. The four casings were cemented with API Class H cement slurries as summarized in Table 2.2-2.

Geophysical logs, directional surveys, and TV surveys run on the well are recorded in Table 2.2-3. The results of the gyroscopic directional surveys for well path comparisons between the pilot and the reamed holes are included in Table 2.1-4. Table 2.1-5 is a descriptive summary of the underwater TV survey after well completion. Results of a lithological examination of the formation samples collected every 10 feet from the pilot hole drilling are presented in Table 2.1-6. Table 2.1-7 presents water quality data from pilot hole drilling.

Figure 2.1-1 presents a summary of data from drilling and logging, including the well construction diagram, lithological descriptions of the formation samples, drilling rate, electric, gamma radiation, caliper, and temperature logs.

Injection Test

Upon completion of the well drilling, an injection test was run to determine the well's injection capacity and its wellhead pressure. Freshwater from an adjacent pond was injected at 10,100 gpm for 10.6 hours. Wellhead injection pressure was measured with a 12-inch precision pressure gauge calibrated in feet of water. The flow rate was measured with a flow meter indicator and volumetric totalizer.

An attempt was made to run a downhole flow meter during the injection test to identify the exit points of the injected water. The tool was working properly at the beginning of the test, but was damaged by the high water velocity soon thereafter. The necessary repairs could not be made by the end of the test.

The wellhead pressure, referred to the top of the pad, rose to a high of 92 feet of water in the first hour and dropped to 89.5 feet of water by the end of the test. When the pump was shut down, the pressure dropped to 50.2 feet of water, a value that is much lower than the observed static freshwater head in the other wells on the site. The fact that the well was partially open for approximately 10 minutes before and after the pump was shut down is the cause of the lower pressure. This occurred when the flow meter was stuck in the temporary standpipe valve during removal and injected freshwater was allowed to flow back.

The injection test results are summarized in Table 2.1-8, and the data collected are presented in Table 2.1-9. The quality of the injected water is given in Table 2.1-10.

Biscayne Aquifer Water Quality Monioring

While drilling the well, water samples were collected and levels measured at each of five shallow monitoring wells installed around the drilling pad. Four of the wells were 2-inch-diameter PVC, approximately 20 feet deep, and located at each corner of the pad. The fifth was 8-inch-diameter steel, approximately 40 feet deep, and was used for supply water during construction. These data are included in Tables 2.1-11 N.E. through 2.1-11 W.S.

Table 2.1-1
SUMMARY OF CASING DATA
WELL I-1

Diameter (inches)	Wall Thickness (inches)	Depth (feet)[a] From	Depth (feet)[a] To	Cemented Section (depth in feet)[a] From	Cemented Section (depth in feet)[a] To
54	.500	0	140	0	140
44	.500	0	980	0	980
34	.500	0	1,800	0	1,800
24	.500	0	2,628	0	2,628

[a]Measured from the top of the concrete drilling pad.

Table 2.1-2
SUMMARY OF CEMENTING OF CASINGS
WELL I-1

Date	Casing Cemented	Type of Cement Used (API)	Number of Sacks Used	Depth Cemented (ft) From	Depth Cemented (ft) To
02/21/80	54"	Class H w/25 lb of gilsonite per sack of cement	450	140	0
03/24/80	44"	Lead: Class H w/12% bentonite	1,700	980	0
		Tail: Class H neat	1,100		
04/12/80	34"	Lead: Class H w/12% bentonite	1,700	1,800	1,002
		Tail: Class H neat	700		
04/14/80	34"	Class H w/12% bentonite	900	1,002	541
04/15/80	34"	Class H w/12% bentonite	920	541	0
05/17/80	24"	Class H neat	2,620	2,628	2,010
05/19/80	24"	Lead: Class H neat	630	2,010	1,029
		Tail: Class H w/2% bentonite	1,259		
05/20/80	24"	Class H w/2% bentonite	1,810	1,029	112
10/12/80	24"	Class H neat	250	112	0

Table 2.1-3
LIST OF GEOPHYSICAL LOGS AND WELL SURVEYS
WELL I-1

Date	Casing Depth and Well Progress	Type of Logs or Surveys Run[a]	Purpose
02/29/80	54" casing to 140' 12-1/4" hole to 1,017'	E, G, C	1. Identify the top of the Floridan aquifer. 2. Establish the setting depth of the 44" casing.
04/01/80	44" casing to 980' 12-1/4" hole to 1,850'	E, G, C, T_s	1. Geohydrological definition of the Floridan aquifer. 2. Define transmissive zones. 3. Establish setting depth of the 34" casing.
04/20/80	34" casing to 1,800' 12-1/4" hole to 2,640'	GYRO, LSN, G, C, T_s	1. Qualitative evaluation of confining beds above the Boulder Zone. 2. Identification of transmissive zones in this interval. 3. Gyroscopic directional survey of the pilot hole for later comparison to the reamed hole. 4. Establish the setting depth of the 24" casing.
05/05/80	34" casing to 1,800' 32" hole to 2,628'	GYRO	1. Gyroscopic directional survey of the reamed hole to compare to the pilot hole.

Table 2.1-3--Continued

Date	Casing Depth and Well Progress	Type of Logs or Surveys Run[a]	Purpose
10/06/80	24" casing to 2,628' 22" hole to 3,110'	TV, DENSITY, WTD, CBL	1. Final visual inspection of the 24" casing and injection zone. 2. Confirm the adequacy of the cement outside the 24" casing.
10/16/80	As above	LSN, G, C, T_s	1. Geohydrological definition of the injection zone.
01/21/81	As above	T_s	1. Temperature profile for potentiometric survey.

[a]Abbreviations for logs and surveys are as follows:

E = single point electric and SP
LSN = long and short normal and SP
G = gamma ray
C = caliper
T_s = temperature, static
T_F = temperature, flowing
FV_s = fluid velocity (flow meter) static
FV_F = fluid velocity (flow meter) flowing
FC = fluid conductivity

GYRO = gyroscopic directional survey
TV = television
CBL = cement bond, variable density
WTD = wave train display
D. IND = dual induction electric and SP
BCS = borehole compensated sonic
Density = formation density
AV = acoustic velocity
GGD = gamma gamma density (0-500 ft)

Table 2.1-4
COMPARISON OF WELL PATHS FROM GYROSCOPIC SURVEYS
WELL I-1

HORIZONTAL DISTANCE AND DIRECTION FROM TARGET WELL TO FOLLOW WELL AT TRUE VERTICAL DEPTHS

FEET	FEET	DIRECTION DEGREES
1800.00	0.02	276.34
1330.00	0.04	246.37
1360.00	0.05	226.72
1890.00	0.11	201.56
1920.00	0.18	218.69
1950.00	0.24	246.49
1780.00	0.26	247.34
2010.00	0.30	236.27
2040.00	0.36	227.51
2070.00	0.41	222.89
2100.00	0.40	232.07
2130.00	0.34	239.52
2160.00	0.40	241.65
2190.00	0.51	235.39
2220.00	0.62	239.59
2250.00	0.71	242.73
2280.00	0.71	245.93
2310.00	0.72	251.21
2340.00	0.72	257.23
2370.00	0.77	257.33
2400.00	0.76	256.65
2430.00	0.74	255.13
2460.00	0.72	250.49
2490.00	0.65	247.40
2520.00	0.58	244.33
2550.00	0.56	250.11
2580.00	0.63	251.55

WELL PATH COMPARISON

FOLLOW WELL: FILE 936.
MIAMI - DADE COUNTY WATER AND SEWAGE AUTHORITY
CH2M HILL; WELL I-1
REAM HOLE; 1800' - 2580'
MAY 5, 1980

TARGET WELL: FILE 952.
MIAMI - DADE COUNTY WATER AND SEWAGE AUTHORITY
CH2M HILL
WELL I-1, PILOT HOLE
0 - 2610'
APRIL 20, 1980

MEASURED DEPTH FEET	DRIFT ANGLE DEG	DRIFT DIRECTION DEG	TRUE VERTICAL DEPTH FEET	RECTANGULAR COORDINATES FEET		DOG LEG SEVERITY DG/100FT
1710.	0.07	197.00	1710.00	0.71 S	0.49 E	0.00
1800.	0.03	232.59	1800.00	0.77 S	0.45 E	0.06
1830.	0.07	143.69	1830.00	0.79 S	0.44 E	0.25
1860.	0.12	111.41	1860.00	0.82 S	0.48 E	0.24
1890.	0.05	186.99	1890.00	0.86 S	0.50 E	0.40
1920.	0.08	310.96	1920.00	0.87 S	0.48 E	0.39
1950.	0.12	330.70	1950.00	0.83 S	0.45 E	0.13
1980.	0.16	123.93	1980.00	0.79 S	0.49 E	0.93
2010.	0.06	156.19	2010.00	0.84 S	0.52 E	0.39
2040.	0.17	160.92	2040.00	0.89 S	0.55 E	0.36
2070.	0.05	112.37	2070.00	0.93 S	0.58 E	0.46
2100.	0.01	84.28	2100.00	0.94 S	0.60 E	0.13
2130.	0.03	139.01	2130.00	0.95 S	0.61 E	0.25
2160.	0.11	173.75	2160.00	1.01 S	0.63 E	0.21
2190.	0.14	107.49	2190.00	1.05 S	0.67 E	0.46
2220.	0.03	248.94	2220.00	1.09 S	0.67 E	0.55
2250.	0.07	108.39	2250.00	1.11 S	0.67 E	0.32
2280.	0.12	344.83	2280.00	1.08 S	0.70 E	0.56
2310.	0.03	329.43	2310.00	1.05 S	0.69 E	0.30
2340.	0.07	147.09	2340.00	1.04 S	0.70 E	0.34
2370.	0.15	164.30	2370.00	1.09 S	0.73 E	0.29
2400.	0.09	114.05	2400.00	1.14 S	0.76 E	0.39
2430.	0.08	280.52	2430.00	1.16 S	0.76 E	0.55
2460.	0.03	147.20	2460.00	1.18 S	0.74 E	0.35
2490.	0.06	101.17	2490.00	1.20 S	0.76 E	0.16
2520.	0.23	173.25	2520.00	1.25 S	0.81 E	0.76
2550.	0.18	164.52	2550.00	1.36 S	0.82 E	0.25
2580.	0.22	163.28	2580.00	1.45 S	0.85 E	0.15

FINAL CLOSURE - DIRECTION: 149.646 DEGS CLOCKWISE FROM NORTH
DISTANCE: 1.69 FEET

2.1-10

RADIUS OF CURVATURE METHOD

RECORD OF SURVEY

MIAMI - DADE COUNTY WATER AND SEWAGE AUTHORITY
CH2M HILL; WELL I-1
REAM HOLE; 1800' - 2580'
MAY 5, 1980

Table 2.1-5
DESCRIPTIVE SUMMARY OF UNDERWATER TELEVISION SURVEY
WELL I-1

RECORD OF UNDERWATER TV SURVEY

Project: Miami Dade Water & Sewer Authority, South District Regional Wastewater Treatment Plant

Well: I-1

Survey By: Deep Venture Diving Service, Perry, Florida HP-4,000 AU

Survey Date: 10/06/80 Total Depth: 3,112 feet

Witnessed By: D. Snyder, T. McCormick, D. Cabit

Reviewed By: J. D. Lehnen Date: 12/31/80

Remarks:

Depth in Feet		Reel Counter		Observations
From	To	From	To	
--	--	0	16	Titles
0	9	16	20	Dry 24" casing
9	2,643	20	582	24" casing
--	2,643	582	--	4:2" x 2" cementing ports
--	2,624	582	590	Changed depth counter to 2,624' (-19 ft)
2,624	2,628	590	594	Bottom of 24" casing
2,628	2,689	594	609	Large diameter hole, friable looking formation
2,689	2,695	609	610	Cavity, highly fractured formation
2,695	2,740	610	621	Large diameter hole, friable looking formation
2,740	2,755	621	624	Fractured formation, large diameter
2,755	2,764	624	626	Smoother borehole, no fractures
2,764	2,771	626	627	Fractures
2,771	2,773	627	628	Cavity
2,773	2,790	628	631	Fractured borehole, some small cavities

Project: Miami Dade Water & Sewer Authority, South District Regional Wastewater Treatment Plant

Well: I-1 Date: 10/06/80 Total Depth: 3,112'

Depth in Feet		Reel Counter		Observations
From	To	From	To	
2,790	2,795	631	633	Smooth borehole walls, some fractures and cavities
2,795	--	633	634	Small cavity
2,795	2,798	634	635	Smooth walls, some fracturing
2,798	2,801	635	637	Cavities
2,801	2,811	637	640	High angle fractures
2,811	2,816	640	643	Large cavity, highly fractured formation
2,816	2,820	643	644	High angle fractures
2,820	2,821	644	644	Cavity
2,821	2,838	644	649	Smooth walls, some fractures
2,838	2,840	649	650	Small cavities
2,840	2,888	650	660	Smooth walls, some small cavities
2,888	2,905	660	665	More cavities
2,905	2,906	665	669	Medium cavity
2,906	2,924	669	673	Smooth walls, numerous cavities, high angle fractures
2,924	2,933	673	676	Highly fractured, large cavities
2,933	2,945	676	680	Rough formation, fractured, solution features
2,945	2,958	680	685	Large cavity, very fractured
2,958	2,972	685	689	Rough formation, some solution features
2,972	2,994	689	697	Smooth walls, high angle fractures

Project: Miami Dade Water & Sewer Authority, South District Regional Wastewater Treatment Plant

Well: I-1 Date: 10/06/80 Total Depth: 3,112'

Depth in Feet		Reel Counter		Observations
From	To	From	To	
2,994	--	697	--	Small cavity
2,994	3,059	697	714	Smooth borehole, some fracturing
3,059	3,065	714	717	Large cavity, rough walls
3,065	3,071	717	718	Smooth walls, fractured
3,071	--	718	--	Cavity
3,071	3,086	718	722	Smooth walls, some fractures, small cavities
3,086	3,088	722	723	Large cavity
3,088	3,112	723	731	Smooth walls, few solution features
3,112	--	731	732	Bottom of the hole
3,112	2,467	732	823	Coming out of the hole
--	2,467	823	--	End of survey

Table 2.1-6
LITHOLOGY FROM PILOT HOLE FORMATION SAMPLES
WELL I-1

Depth Interval (ft) From	To	Description
0	10	Crushed oolitic limerock fill
10	20	Limestone, white to tan, hard, oolitic, fossiliferous
20	30	As above
30	40	Lime sand, tan to white, weathered fragments of oolitic limestone
40	50	As above, finer grained, darker tan
50	60	Lime sand, as above, coarse, shell fragments present, microfossils
60	70	Limestone, white, hard, cemented calcite grains, microfossils, shell fragments
70	80	As above
80	90	As above, darker in color, sandy
90	100	As above
100	110	As above
110	120	As above
120	130	As above, small amount of gray-green siltstone
130	140	Gray-green siltstone
140	150	Sample missing
150	160	Limestone, tan to white, soft, shell fragments, microfossils, gilsonite cement in sample
160	170	Limestone, as above, poorly consolidated
170	180	Limestone, as above
180	190	Limestone, as above
190	200	Limestone, white, poorly consolidated lime sand, shell fragments, gilsonite cement
200	210	Gilsonite cement

Table 2.1-6--Continued

Depth Interval (ft) From	To	Description
210	220	As above
220	230	Gilsonite cement, white oolitic limestone, gray-green silt
230	240	As above
240	250	As above
250	260	As above, very little limestone
260	270	As above, very little limestone
270	280	Silt, fragments of gilsonite cement, gray-green
280	290	As above
290	300	Silt, mixed with limesand, gray-green
300	310	As above
310	320	As above
320	330	As above
330	340	As above
340	350	As above
350	360	As above
360	370	Siltstone, gray-green
370	380	As above
380	390	Siltstone, gray-green
390	400	As above
400	410	As above
410	420	Siltstone, gray-green, mixed with limestone, white, sandy, soft, poorly consolidated
420	430	As above with shell fragments and microfossils
430	440	As above

Table 2.1-6--Continued

Depth Interval (ft) From	To	Description
440	450	As above
450	460	As above
460	470	As above
470	480	As above
480	490	As above
490	500	As above
500	510	As above
510	520	Limestone, buff colored, medium-hard, fossiliferous, shell fragments
520	530	As above, with some gray siltstone
530	540	Limestone, buff colored, medium-hard, sandy, fossiliferous, shell fragments
540	550	As above
550	560	Siltstone, gray-green, very soft
560	570	Limestone, buff to white, medium-hard, fossiliferous, siltstone, gray
570	580	Siltstone, gray, soft with gray-green silt
580	590	As above
590	600	Limestone, buff, sandy, medium-hard, gray-green silt
600	610	As above
610	620	As above
620	630	As above
630	640	Limestone, buff colored, sandy, soft to medium-hard, fossiliferous
640	650	As above
650	660	As above

Table 2.1-6--Continued

Depth Interval (ft)		
From	To	Description
660	670	As above
670	680	As above
680	690	As above
690	700	Limestone, as above, mixed with gray siltstone, soft to medium-hard fossiliferous
700	710	Limestone, buff colored, sandy, soft to medium-hard fossiliferous
710	720	Limestone, as above, trace of clay
720	730	Limestone, as above, trace of clay
730	740	Limestone, as above, trace of clay
740	750	Limestone, as above, trace of clay
750	760	Limestone, buff colored, soft, sandy, gray siltstone, trace of clay
760	770	Limestone, buff colored, medium-hard to hard, sandy, fossiliferous, trace of microfossils
770	780	As above, some clay present
780	790	Limestone, buff colored, soft, silty, some clay, shell fragments, microfossils
790	800	As above
800	810	As above
810	820	As above
820	830	As above
830	840	As above
840	850	As above
850	860	As above
860	870	As above

Table 2.1-6--Continued

Depth Interval (ft)		
From	To	Description
870	880	As above
880	890	As above
890	900	As above
900	910	As above
910	920	As above
920	930	As above
930	940	As above
940	950	As above, less silt and clay, more grannular material
950	960	Limestone, buff to tan, medium-hard, shell fragments, fossiliferous
960	970	As above
970	980	As above
980	990	Limestone, buff colored, soft to medium-hard, clay matrix, microfossils and shell fragments
990	1,000	As above
1,000	1,010	Limestone, buff to tan, soft, silty matrix, microfossils
1,010	1,020	As above
1,020	1,030	Limestone, buff to tan, medium-hard, sand-size grains, cemented with calcite cement matrix
1,030	1,040	As above
1,040	1,050	As above
1,050	1,060	As above
1,060	1,070	As above
1,070	1,080	Limestone, as above, more microfossils present in sample
1,080	1,090	Limestone, as above, cones abundant in sample

Table 2.1-6--Continued

Depth Interval (ft)		
From	To	Description
1,090	1,100	Limestone, as above, harder, microfossils present, appear heavily weathered
1,100	1,110	As above
1,110	1,120	Limestone, buff, hard, microfossils present
1,120	1,130	Limestone, buff to tan, medium-hard, microfossils abundant
1,130	1,140	Limestone, as above
1,140	1,150	As above
1,150	1,160	As above
1,160	1,170	As above
1,170	1,180	As above
1,180	1,190	Limestone, light tan, soft, cones and other microfossils very abundant
1,190	1,200	As above
1,200	1,210	Limestone, buff, soft to medium-hard, microfossils present
1,210	1,220	Limestone fragments in brown lime clay, cement fragments present
1,220	1,230	As above, less clay
1,230	1,240	Limestone, tan, soft, some clay present, few microfossils
1,240	1,250	As above
1,250	1,260	Limestone, buff, medium-hard, microfossils present
1,260	1,270	Limestone, as above
1,270	1,280	As above
1,280	1,290	As above
1,290	1,300	As above

Table 2.1-6--Continued

Depth Interval (ft)		
From	To	Description
1,300	1,310	Limestone, as above mixed with hard, dense, white, recrystallized limestone
1,310	1,320	Limestone, tan to buff, medium-hard, fine-grained, fossiliferous
1,320	1,330	As above
1,330	1,340	As above
1,340	1,350	As above
1,350	1,360	As above
1,360	1,370	As above
1,370	1,380	As above
1,380	1,390	As above
1,390	1,400	As above
1,400	1,410	As above
1,410	1,420	As above
1,420	1,430	As above
1,430	1,440	As above
1,440	1,450	As above
1,450	1,460	As above
1,460	1,470	As above
1,470	1,480	As above
1,480	1,490	As above
1,490	1,500	As above
1,500	1,510	Limestone, tan to buff, medium-hard, fine to medium-grained, fossiliferous
1,510	1,520	As above

Table 2.1-6--Continued

Depth Interval (ft)		
From	To	Description
1,520	1,530	As above
1,530	1,540	As above
1,540	1,550	As above
1,550	1,560	As above
1,560	1,570	As above
1,570	1,580	As above
1,580	1,590	As above
1,590	1,600	As above
1,600	1,610	As above
1,610	1,620	Limestone, tan to gray, medium-hard, fossiliferous, shell fragments present
1,620	1,630	As above
1,630	1,640	As above
1,640	1,650	As above
1,650	1,660	As above
1,660	1,670	As above
1,670	1,680	As above
1,680	1,690	As above
1,690	1,700	Limestone, tan to buff, medium-hard, fossils, porous
1,700	1,710	As above
1,710	1,720	As above
1,720	1,730	As above
1,730	1,740	As above
1,740	1,750	As above

Table 2.1-6--Continued

Depth Interval (ft) From	To	Description
1,750	1,760	As above
1,760	1,770	As above
1,770	1,780	Limestone, buff to gray, medium-hard, porous, fossiliferous
1,780	1,790	As above
1,790	1,800	As above
1,800	1,810	As above
1,810	1,820	As above
1,820	1,830	As above
1,830	1,840	As above
1,840	1,850	As above
1,850	1,860	As above
1,860	1,870	Limestone, tan, soft to medium-hard, some fossils, porous, trace cement
1,870	1,880	As above
1,880	1,890	As above
1,890	1,900	Limestone, cream to tan, dolomitic, soft to hard, fossiliferous
1,900	1,910	Limestone, tan to buff, some dolomitic fragments, medium-hard
1,910	1,920	Limestone, tan to buff, soft to medium-hard
1,920	1,930	As above, with some large fragments
1,930	1,940	As above
1,940	1,950	As above
1,950	1,960	As above
1,960	1,970	As above

Table 2.1-6--Continued

| Depth Interval (ft) | | |
From	To	Description
1,970	1,980	As above
1,980	1,990	As above
1,990	2,000	As above
2,000	2,010	Limestone, tan, large size fragments, some dolomitic fragments
2,010	2,020	Limestone, tan to buff, fossiliferous, some chalky fragments
2,020	2,030	As above
2,030	2,040	As above
2,040	2,050	As above
2,050	2,060	As above
2,060	2,070	As above
2,070	2,080	As above
2,080	2,090	As above
2,090	2,100	As above
2,100	2,110	As above
2,110	2,120	As above
2,120	2,130	As above
2,130	2,140	Limestone, gray to buff, large size fragments medium-hard to soft
2,140	2,150	As above
2,150	2,160	As above
2,160	2,170	As above
2,170	2,180	Limestone, tan, medium-hard, fossiliferous
2,180	2,190	Limestone, buff, soft to medium-hard, chalky, fossiliferous

Table 2.1-6--Continued

Depth Interval (ft)		
From	To	Description
2,190	2,200	As above
2,200	2,210	As above
2,210	2,220	As above
2,220	2,230	As above
2,230	2,240	As above
2,240	2,250	As above
2,250	2,260	As above
2,260	2,270	As above
2,270	2,280	As above
2,280	2,290	As above
2,290	2,300	As above
2,300	2,310	Limestone, tan, soft, chalky, some fossils
2,310	2,320	As above
2,320	2,330	As above
2,330	2,340	As above
2,340	2,350	As above, with some dolomitic gray limestone chips
2,350	2,360	Limestone, buff and dark gray, medium-hard, gray fragments are dolomitic
2,360	2,370	As above
2,370	2,380	As above
2,380	2,390	Limestone, buff, medium-hard
2,390	2,400	As above
2,400	2,410	As above
2,410	2,420	As above

Table 2.1-6--Continued

Depth Interval (ft) From	To	Description
2,420	2,430	As above
2,430	2,440	As above
2,440	2,450	Dolomite, dark gray to brown, hard, some buff, medium-hard limestone
2,450	2,460	Limestone, tan to buff, hard, some crystalline chips
2,460	2,470	As above
2,470	2,480	As above
2,480	2,490	Limestone, tan and gray, hard, dense
2,490	2,500	As above
2,500	2,510	As above
2,510	2,520	As above
2,520	2,530	As above
2,530	2,540	As above
2,540	2,550	As above
2,550	2,560	Limestone, tan to gray, soft, fossiliferous
2,560	2,570	Limestone, tan and gray, soft to hard, some crystalline fragments
2,570	2,580	As above
2,580	2,590	Limestone, buff and gray, hard to soft, some crystalline fragments
2,590	2,600	As above
2,600	2,610	As above
2,610	2,620	As above
2,620	2,630	As above
2,630	2,640	As above
2,640	2,650	Limestone, white, chalky and dense matrix, medium-hard

Table 2.1-6--Continued

Depth Interval (ft) From	To	Description
2,650	2,660	As above
2,660	2,670	As above
2,670	2,680	Limestone, as above, dolomite, tan, very hard
2,680	2,690	As above
2,690	2,700	As above
2,700	2,710	As above
2,710	2,720	As above
2,720	2,730	Limestone, white, chalky and dense matrix, medium-hard
2,730	2,740	Limestone, as above, some tan dolomite in sample
2,740	2,750	As above
2,750	2,760	As above
2,760	2,770	As above
2,770	2,780	Dolomite, tan, gray, brown, crystalline, very hard
2,780	2,790	Dolomite, gray, very hard
2,790	2,800	Dolomite, very hard, limestone, white, medium-hard
2,800	2,810	Dolomite, tan, very hard
2,810	2,820	Dolomite, tan to gray, very hard, limestone, white, medium-hard
2,820	2,830	Dolomite, tan, very hard
2,830	2,840	As above
2,840	2,850	Dolomite, light gray, very hard
2,850	2,860	As above
2,860	2,870	As above
2,870	2,880	As above

Table 2.1-6--Continued

Depth Interval (ft) From	To	Description
2,880	2,890	As above
2,890	2,900	As above
2,900	2,910	As above
2,910	2,920	Dolomite, dark gray-green, very hard, sucrosic crystals
2,920	2,930	As above
2,930	2,940	As above
2,940	2,950	Dolomite, as above and light gray, massive dolomite
2,950	2,960	Dolomite, tan to gray, hard, cryptocrystalline to sucrosic
2,960	2,970	As above
2,970	2,980	As above
2,980	2,990	Dolomite, light gray, hard
2,990	3,000	As above
3,000	3,010	As above
3,010	3,020	As above
3,020	3,030	As above
3,030	3,040	As above
3,040	3,050	As above
3,050	3,060	Dolomite, tan to gray, hard, massive
3,060	3,070	As above
3,070	3,080	As above
3,080	3,090	As above
3,090	3,100	As above
3,100	3,110	As above

Table 2.1-7
WATER QUALITY DATA FROM PILOT HOLE DRILLING
WELL I-1

Date	Time	Depth (ft)	Temperature (°C)	Specific Gravity	Specific Conductance (µmhos/cm)	Chloride (mg/l)
03/29	1056	1,016	25.6	1.0000	2,000	100
03/29	1430	1,051	25.6	1.0125	1,800	100
03/29	1550	1,085	26.7	1.0000	1,800	120
03/29	1745	1,119	25.6	1.0010	2,000	120
03/29	1820	1,151	25.6	1.0020	2,000	140
03/29	1930	1,186	25.6	1.0020	1,800	150
03/29	2230	1,213	25.6	1.0020	1,000	150
03/29	2310	1,243	25.6	1.0010	1,200	150
03/31	0220	1,283	25.0	1.0020	1,200	110
03/31	0245	1,302	25.0	1.0000	1,350	130
03/31	0420	1,337	25.0	1.0000	1,350	130
03/31	0630	1,372	25.0	1.0000	1,800	230
03/31	1100	1,404	25.0	1.0000	1,200	130
03/31	1225	1,438	25.0	1.0000	1,300	190
03/31	1400	1,469	25.0	1.0000	840	110
03/31	1520	1,501	25.0	1.0000	1,000	130
03/31	1810	1,534	25.0	1.0000	800	130
03/31	2045	1,562	25.0	1.0000	1,100	230
03/31	2230	1,595	25.6	1.0000	950	240
04/01	0025	1,630	25.6	1.0000	800	160
04/01	0210	1,661	25.0	1.0001	950	120
04/01	0355	1,690	25.0	1.0000	1,000	250
04/01	0535	1,724	25.0	1.0000	1,175	290

Table 2.1-7--Continued

Date	Time	Depth (ft)	Temperature (°C)	Specific Gravity	Specific Conductance (µmhos/cm)	Chloride (mg/l)
04/01	0710	1,757	25.0	1.0000	950	230
04/01	1145	1,788	25.0	1.0000	840	180
04/01	1415	1,820	25.0	1.0000	850	190
04/01	1615	1,850	25.0	1.0000	850	200
04/17	2200	1,853	25.0	1.0050	16,000	6,700
04/18	0030	1,885	25.0	1.0090	22,000	9,800
04/18	0230	1,914	25.0	1.0050	16,000	6,500
04/18	0445	1,948	25.0	1.0075	19,000	6,800
04/18	0715	1,978	25.0	1.0090	17,000	6,000
04/18	0820	2,010	25.0	1.0100	23,000	7,600
04/18	1010	2,043	25.0	1.0100	22,000	10,600
04/18	1150	2,073	25.0	1.0075	22,500	8,000
04/18	1430	2,104	25.0	1.0110	27,000	10,000
04/18	1600	2,134	25.0	1.0075	20,000	7,400
04/18	1730	2,165	25.0	1.0075	20,000	8,500
04/18	1930	2,198	25.6	1.0145	22,000	10,200
04/18	2100	2,229	25.6	1.0075	18,000	9,600
04/18	2210	2,258	25.6	1.0080	20,000	10,100
04/19	0050	2,290	25.6	1.0100	19,500	9,500
04/19	0200	2,324	25.6	1.0095	19,500	9,600
04/19	0320	2,355	25.6	1.0105	22,000	10,800
04/19	0520	2,387	25.6	1.0120	25,000	12,500
04/19	0650	2,419	25.0	1.0120	25,000	12,600
04/19	1000	2,444	26.0	1.0100	21,000	11,500

Table 2.1-7--Continued

Date	Time	Depth (ft)	Temperature (°C)	Specific Gravity	Specific Conductance (µmhos/cm)	Chloride (mg/l)
04/19	1130	2,480	25.0	1.0105	22,500	11,600
04/19	1330	2,512	27.0	1.0110	26,000	12,800
04/19	1500	2,546	27.0	1.0115	28,000	12,800
04/19	1620	2,578	27.0	1.0140	26,000	12,700
04/20	0100	2,610	27.0	1.0150	20,000	12,200
04/20	0800	2,640	26.0	1.0100	19,500	11,900
06/11	1900	2,670	26.5	1.0100	11,200	9,500
06/11	2100	2,700	27.0	1.0125	12,000	9,900
06/11	2300	2,730	27.0	1.0175	21,000	17,000
06/12	0100	2,760	27.0	1.0200	20,500	16,500
06/13	0630	2,800	27.0	1.0245	30,000	20,374
06/19	0600	2,830	27.0	1.0250	35,000	21,527
06/22	1700	2,857	27.0	1.0255	41,000	20,662
06/24	0630	2,879	27.0	1.0250	39,000	20,757
06/25	0100	2,910	25.0	1.0245	38,000	20,374
06/25	1900	2,940	25.0	1.0250	38,000	20,181
06/26	1800	2,975	24.0	1.0240	44,000	20,181
06/27	1300	3,008	22.0	1.0250	40,000	20,662
06/28	0800	3,039	22.0	1.0250	37,000	21,623
06/29	0300	3,074	22.0	1.0260	36,000	20,000
06/29	1830	3,104	22.0	1.0250	39,000	20,100

Table 2.1-8
SUMMARY OF INJECTION TEST RESULTS
WELL I-1

Pumping Rate	10,100 gpm
Test Duration	10.6 hours
Time Elapsed to Reach Maximum Injection Head After Pumping Started	7 minutes
Maximum Injection Head[a]	92.0 feet of water
Static Freshwater Head[a, b]	50.2 feet of water[c]

[a]Feet of water referred to pad level.
[b]Due to the density difference between injected freshwater and formation saltwater.
[c]Much lower head because well was allowed to flow after injection test was stopped. Actual value should be ±67.0 feet.

Table 2.1-9
INJECTION TEST DATA
WELL I-1
(Wellhead pressure measuring point @ 3.0' above pad)

Actual Time	Time Since Pump Started (min)	Flow (gpm)	Wellhead Pressure (feet of water)	Totalizer (gallons x 1,000)	Remarks
0750	0	0	0	87,612	Start injection pump
0751	1	10,000	38.0		
0752	2	9,000	43.0	87,612	Totalizer not functioning
0753	3	9,000	62.0		
0754	4	9,000	70.0		
0755	5	10,000	81.0		
0756	6	10,000	85.0		
0756	7	10,000	89.0		
0757	7	10,000	89.0		
0758	8	10,000	89.0		
0759	9	10,000	89.0		
0800	10	10,000	89.0		
0802	12	10,000	88.5		
0804	14	10,000	88.5		
0806	16	10,000	88.5		
0808	18	10,000	89.0		
0810	20	10,000	89.0		
0820	30	10,000	89.0		
0830	40	10,000	89.0		
0840	40	10,000	89.0		
0850	60	10,000	88.0		
0920	90	10,000	88.0		

Table 2.1-9--Continued

Actual Time	Time Since Pump Started (min)	Flow (gpm)	Wellhead Pressure (feet of water)	Totalizer (gallons x 1,000)	Remarks
0950	120	10,000	88.0		
1020	150	10,000	88.0		
1050	180	10,000	87.0		
1120	210	10,000	87.0		
1150	240	10,100	87.0		
1250	300	10,100	87.0		
1350	360	10,100	87.0		
1450	420	10,100	87.0		
1550	480	10,100	87.0		
1650	540	10,100	86.5		
1750	600	10,100	86.5		
1828	638	0	47.2		Injection pump shut down after flow meter probe stuck in a standpipe valve

Table 2.1-10
QUALITY OF INJECTED WATER
WELL I-1

Date	Time Since Pumping Started (min)	Depth (ft)	Temperature (°C)	Specific Gravity	Specific Conductance (μmhos/cm)	Chloride (mg/l)
08/21	15	--	81	1.0001	5,000	1,522
08/21	60	--	84	1.0001	4,500	1,645
08/21	120	--	84	1.0001	4,500	1,522
08/21	180	--	84	1.0000	4,500	1,616
08/21	240	--	84	1.0000	5,000	1,645
08/21	300	--	84	1.0000	5,000	1,654
08/21	360	--	84	1.0000	5,500	1,748
08/21	600	--	84	1.0000	5,000	1,739

Table 2.1-11 N.E.
WATER QUALITY OF BISCAYNE AQUIFER--N.E. MONITORING WELL
SITE I-1

Date	Time	Temperature (°C)	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
02/06	1500	24.4	600	70	9.80	
02/11	1020	23.9	600	70	9.87	
02/19	1020	23.9	660	80	9.73	
02/25	1520	24.4	740	90	9.86	
03/03	1520	23.3	590	90	10.15	
03/10	1220	23.9	690	100	9.82	
03/17	1200	23.8	650	150	9.80	
03/26	1400	23.9	680	130	9.92	
03/31	1320	23.9	660	140	9.91	
04/07	1600	23.3	590	132	9.75	
04/16	1650	22.0	610	124	9.93	
04/23	1205	23.9	490	85	9.85	
04/25	0900	23.9	500	90	9.89	
05/03	0915	23.9	550	98	9.86	
05/10	0910	23.9	500	95	9.88	
05/17	1600	23.9	550	101	9.85	
05/24	1100	23.9	500	95	9.86	
05/31	1700	23.9	500	95	9.89	
06/07	1800	23.9	550	96	9.86	
06/13	1445	23.9	590	98	9.86	
06/21	0900	23.9	600	95	9.86	
06/28	1000	23.9	650	98	9.85	

Table 2.1-11 N.E.--Continued

Date	Time	Temperature (°C)	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
07/05	1830	25.6	500	38	9.84	Alkalinity change made chloride values inaccurate
07/12	1830	25.6	530	19	9.88	
07/19	1900	24.4	600	75	9.66	Changed lab procedure to yield accurate results
07/26	1900	25.0	480	59	9.97	
08/02	1300	26.1	--	--	10.03	
08/09	1700	26.1	580	78	9.94	
08/16	1800	25.6	560	82	10.00	
08/23	1500	26.7	430	165	9.96	
09/03	1300	26.1	500	155	9.98	
09/06	1600	26.1	520	172	9.96	

Table 2.1-11 N.W.
WATER QUALITY OF BISCAYNE AQUIFER--N.W. MONITORING WELL
SITE I-1

Date	Time	Temperature (°C)	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
02/06	1520	24.4	340	80	9.55	
02/11	1025	23.9	290	100	9.67	
02/19	1000	22.8	360	50	9.48	
02/25	1500	23.3	490	50	9.65	
03/03	1500	22.2	560	60	9.94	
03/10	1200	23.3	875	60	9.55	
03/17	1205	22.8	1,100	80	9.67	
03/26	1405	23.4	1,050	70	9.79	
03/31	1300	23.3	1,200	80	9.67	
04/07	1605	22.8	1,050	72	9.53	
04/16	1630	23.3	1,400	19	9.62	Contaminated with drilling fluid
04/23	1145	24.4	420	53	9.60	
04/25	0905	24.0	440	55	9.65	
05/03	0920	23.9	450	58	9.63	
05/10	0915	23.9	440	56	9.60	
05/17	1605	23.9	460	59	9.65	
05/24	1105	23.9	440	58	9.65	
05/31	1705	23.9	460	57	9.66	
06/07	1805	23.9	460	58	9.65	
06/13	1450	23.9	480	61	9.64	
06/21	0905	23.9	500	62	9.64	
06/24	1005	24.4	520	65	9.62	

Table 2.1-11 N.W.--Continued

Date	Time	Temperature (°C)	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
07/05	1835	26.1	460	39	9.63	Alkalinity change made chloride values inaccurate
07/12	1835	27.2	440	29	9.68	
07/19	1905	26.1	460	46	9.46	Changed lab procedure to yield more accurate results
08/02	1305	28.3	--	--	9.82	
08/09	1705	27.8	500	48	9.73	
08/16	1805	26.1	460	57	9.80	
08/23	1505	27.8	350	62	9.82	
09/03	1305	36.7	400	59	9.80	
09/06	1605	26.1	440	61	9.81	

Table 2.1-11 S.E.
WATER QUALITY OF BISCAYNE AQUIFER--S.E. MONITORING WELL
SITE I-1

Date	Time	Temperature (°C)	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
02/06	1505	24.4	650	70	9.58	
02/11	1005	24.4	665	70	9.65	
02/19	1015	23.9	900	60	9.53	
02/29	1515	25.0	900	70	9.65	
03/03	1515	23.3	790	70	9.92	
03/10	1215	23.9	600	60	9.66	
03/17	1210	23.9	700	100	9.66	
03/26	1410	23.9	680	80	9.79	
03/31	1315	23.9	640	90	9.60	
04/07	1610	23.3	600	68	9.56	
04/16	1645	22.8	720	57	9.72	
04/23	1200	23.9	380	53	9.65	
04/25	0910	23.3	400	55	9.68	
05/03	0910	23.9	440	56	9.65	
05/10	0920	23.9	400	54	9.67	
05/17	1620	23.9	400	58	9.68	
05/24	1115	23.9	400	56	9.65	
05/31	1720	23.9	420	58	9.67	
06/07	1820	23.9	400	55	9.66	
06/13	1505	23.9	440	58	9.68	
06/21	0920	23.9	460	59	9.65	
06/24	1020	24.4	440	55	9.66	

Table 2.1-11 S.E.--Continued

Date	Time	Temperature (°C)	Specific Conductance (µmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
07/05	1840	24.4	480	47	9.62	Alkalinity change made chloride values inaccurate
07/12	1840	26.1	430	29	9.65	Changed lab procedure to yield more accurate results
07/19	1910	24.4	480	51	9.44	
07/26	1910	25.0	440	44	9.74	
08/02	1310	26.1	--	--	9.79	
08/09	1710	26.1	480	49	9.67	
08/16	1810	26.1	470	56	9.68	
08/23	1510	27.8	520	84	9.79	
09/03	1310	27.0	500	80	9.80	
09/06	1620	27.0	520	86	9.79	

Table 2.1-11 S.W.
WATER QUALITY OF BISCAYNE AQUIFER--S.W. MONITORING WELL
SITE I-1

Date	Time	Temperature (°C)	Specific Conductance (µmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
02/06	1515	23.9	310	60	9.95	
02/11	1010	22.2	240	50	9.91	
02/19	1005	22.8	770	50	9.87	
02/25	1505	23.3	850	60	10.05	
03/03	1505	22.2	--	--	--	
03/10	1205	22.2	1,250	60	10.10	Changed measuring point
03/17	1215	22.0	1,200	100	10.20	
03/26	1415	22.6	1,240	90	10.38	
03/31	1305	23.3	1,600	90	10.22	
04/07	1615	22.8	2,000	21	10.06	
04/16	1635	22.0	2,200	15	10.24	
04/23	1150	25.0	390	51	10.20	
04/25	0915	24.4	400	50	10.22	
05/03	0905	24.4	420	49	10.20	
05/10	0925	23.9	400	50	10.22	
05/17	1610	24.4	420	55	10.24	
05/24	1105	23.9	400	51	10.22	
05/31	1710	24.4	400	50	10.24	
06/07	1810	23.9	420	51	10.22	
06/13	1455	23.9	440	56	10.24	
06/02	0910	23.9	460	58	10.20	
06/24	1010	23.9	420	55	10.22	
07/05	1845	26.7	420	47	10.19	

Table 2.1-11 S.W.--Continued

Date	Time	Temperature (°C)	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
07/12	1845	26.7	460	19	10.24	Alkalinity change made chloride values inaccurate
07/19	1915	26.1	460	46	--	Changed lab procedure to yield more accurate results
07/26	1915	26.7	410	42	8.40	Changed measuring point
08/02	1315	27.8	--	--	8.36	
08/09	1715	27.8	460	43	8.23	
08/16	1815	26.7	460	45	8.40	
08/23	1515	26.7	470	52	8.28	
09/03	1315	26.7	460	50	8.30	
09/06	1610	26.7	480	54	8.29	

Table 2.1-11 W.S.
WATER QUALITY OF BISCAYNE AQUIFER--WATER SUPPLY WELL
SITE I-1

Date	Time	Temperature (°C)	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
02/06	1510	25.0	540	140	9.30	
02/11	1000	23.3	650	150	--	
02/19	1010	22.8	770	190	--	
02/25	1510	25.0	750	150	--	
03/03	1510	22.8	630	180	--	
03/10	1210	22.8	480	110	--	
03/17	1220	23.3	580	190	--	
03/26	1420	23.9	550	180	--	
03/31	1310	23.3	400	160	--	
04/07	1620	23.3	500	80	--	
04/16	1640	22.8	440	60	--	
04/23	1155	23.9	420	55	--	
04/25	0920	23.3	440	58	--	
05/03	0925	23.9	460	56	--	
05/10	0930	83.9	460	58	--	
05/17	1615	23.9	440	59	--	
05/24	1110	23.9	460	58	--	
05/31	1715	23.9	450	58	--	
06/07	1815	24.4	440	56	--	
06/13	1500	23.9	460	60	--	
06/21	0915	24.4	500	72	--	
06/24	1015	24.4	600	78	--	

Table 2.1-11 W.S.--Continued

Date	Time	Temperature (°C)	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
07/05	1850	25.6	540	47	9.35	Alkalinity change made chloride values inaccurate
07/12	1850	26.1	500	19	9.39	
07/19	1920	25.6	500	60	9.15	Correct chloride values
07/26	1920	25.6	420	58	9.44	
08/02	1320	26.7	--	--	9.48	
08/09	1720	26.7	420	56	9.38	
08/16	1820	26.1	420	57	9.46	
08/23	1520	26.7	420	65	9.48	
09/03	1320	26.7	400	60	9.52	
09/06	1615	26.7	440	64	9.51	

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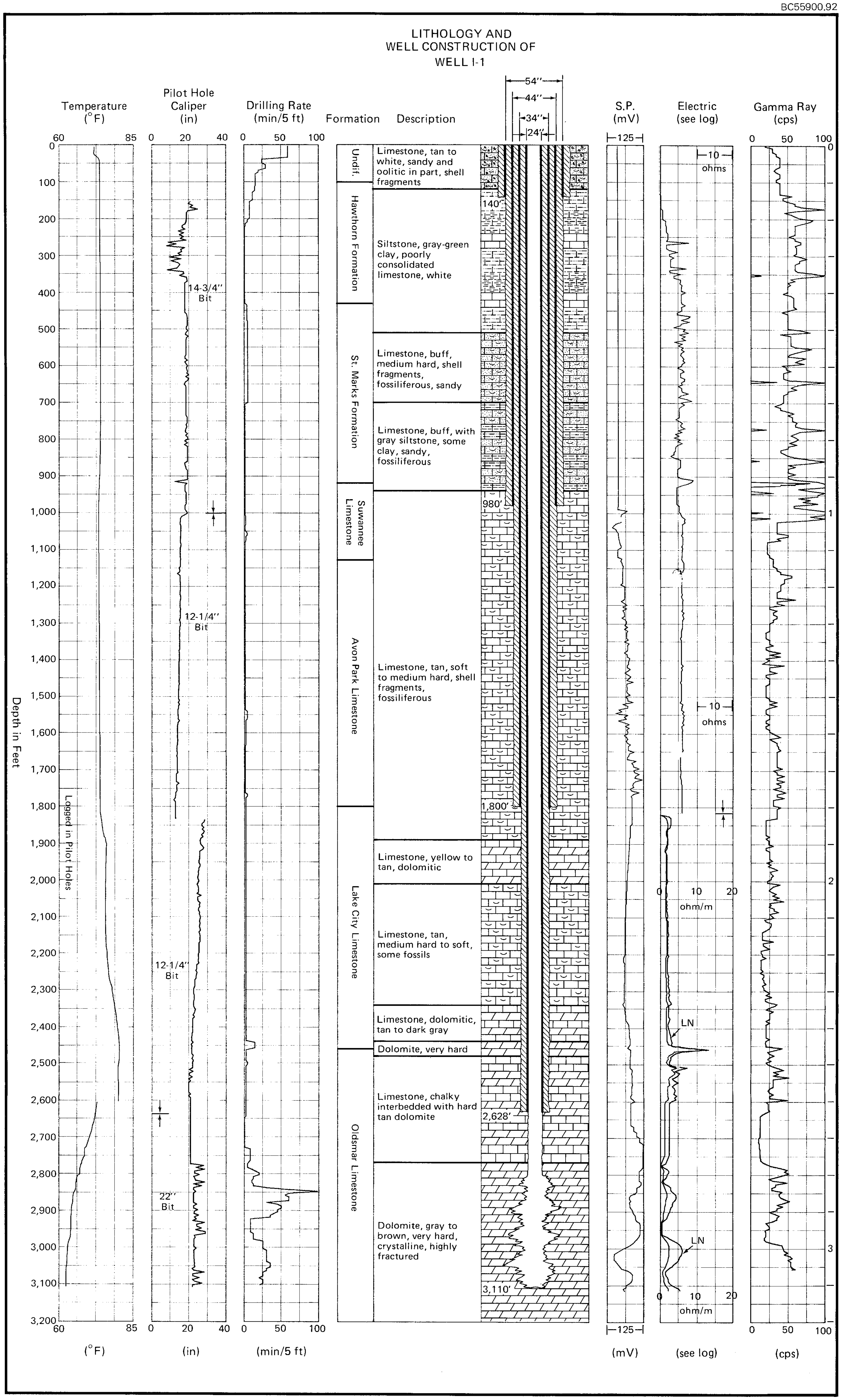


Summary of drilling and logging data—Well I-1.

FIGURE 2.1-1.

Chapter 2.2
INJECTION WELL I-2

Injection Well I-2 is located on the southern boundary of the project site as shown on Figure 1.1-2, Section 1, Summary. It is 760 feet west of I-3 and 760 feet east of I-1. Drilling began on January 22, 1980, and was completed on November 1, 1980. The drilling and casing sequence was as follows:

1. Drilled a 60-inch hole to a depth of 150 feet.
2. Set and cemented the 54-inch casing from a depth of 140 feet up to the concrete drilling pad.
3. Drilled a 14-3/4-inch pilot hole to 1,000 feet.
4. Reamed the pilot hole with a 52-inch reamer to a depth of 990 feet.
5. Set and cemented the 44-inch casing from 980 feet up to the concrete drilling pad.
6. Drilled a 12-1/4-inch pilot hole to a depth of 1,850 feet.
7. Reamed the pilot hole with a 42-inch reamer to a depth of 1,810 feet.
8. Set and cemented the 34-inch casing from a depth of 1,800 feet up to the concrete drilling pad.
9. Drilled a 12-1/4-inch pilot hole to a depth of 2,640 feet.
10. Reamed the pilot hole with a 32-inch reamer to a depth of 2,628 feet.
11. Set and cemented the 24-inch casing from 2,628 feet to 100 feet below pad. Cementing details of this casing are described below.
12. Ran a casing pressure test at 100 psi for 1 hour with no pressure loss.
13. Drilled a 22-inch hole to 2,825 feet.
14. Ran an injection test at 10,650 gpm for 11.5 hours.
15. Ran a cement bond log on the 24-inch casing.
16. Cemented the 24-inch casing to the surface.
17. Completed the wellhead and pad as per specifications.

Casings are black steel, API 5L, Grade B, and ASTM A 139, Grade B. Casing details are summarized in Table 2.2-1. The four casings were cemented with API Class H cement slurries as summarized in Tables 2.2-2 and 2.2-2A with discussion below. Geophysical logs, directional surveys, and TV surveys that were run on the well are listed in Table 2.2-3. The gyroscopic directional well path comparisons between the pilot and reamed holes are included in Table 2.2-4. A descriptive summary of the underwater television survey after well completion is presented in Table 2.2-5. Results of a lithological examination of the formation samples collected every 10 feet from the pilot hole drilling are shown in Table 2.2-6. Water quality data from pilot hole drilling are presented in Table 2.2-7.

Figure 2.2-1 summarizes data from drilling and logging, including the well construction diagram, lithologic description of the formation samples, drilling rate, electric, gamma radiation, temperature, and caliper logs.

The cementing operations on the 54-, 44-, and 34-inch casings encountered no problems; however, cementing difficulties were encountered on the 24-inch casing. The bottom of the 24-inch casing was set at 2,628 feet with four 2-x-2-inch cement ports cut at 2,626 feet. The first stage of 3,000 sacks of neat cement was pumped through a cementing pipe inside the pressurized 24-inch casing, out the ports. This cement was lost into a cavity intersecting the borehole and yielded no fill-up. Efforts to seal the 24-inch casing with cement failed, so gravel was tremied outside the casing. Over 120 cubic yards of gravel and 2,500 sacks of cement were necessary to bring the gravel up to 2,470 feet, where good fill-up with neat cement was possible. Another 6,000 sacks of cement were used to finish cementing to the surface. Table I-2.2A shows the material and stages used to cement the 24-inch casing.

During drilling of the 22-inch open hole below the 24-inch casing, the 14-3/4-inch lead bit twisted off and was lost at a depth of 2,811 feet. Extensive fishing efforts were made with no success. At this point, a TV survey revealed the bit lying sideways at the bottom of the hole. It was determined that the bit could not be retrieved and was, therefore, cemented in place. This required 1,020 sacks of cement to fill 2-1/2 feet of open hole. A new hole bypassing the bit was drilled to 2,898 feet, but gravel from the 24-inch casing plugged the hole back to 2,825 feet. All this work was at the contractor's expense, with no success. A detailed review of the TV survey of the open hole by CH2M HILL indicated potentially sufficient transmissivity for injection. It was agreed that an injection test would be run with the hole open to 2,825 feet to determine if the well would perform within design parameters and, if so, that the well would be left at approximately 2,825 feet in depth.

Injection Test

As noted above, the injection test was run with the bottom of the hole at 2,825 feet. The test was run by injecting freshwater from an adjacent pond at 10,650 gpm for 11.5 hours. Wellhead injection pressure was measured with a 12-inch precision gauge calibrated in feet of water. Flow rate was measured with a flow meter indicator and volumetric totalizer.

The pressure reached a high of 88.9 feet of water, referred to pad level, in the first 10 minutes of the test and then dropped slowly during the rest of the test. The pressure was 82.8 feet of water at the end of the test and dropped to 64.1 feet of water after the pump was shut down. These result indicates that I-2 is one of the best wells on the site, so the well was not drilled deeper. The results of the injection test are summarized in Table 2.2-8 and the data collected are presented in Table 2.2-9. In view of the excellent results obtained from this pumping test, it was agreed to leave the bottom of the well at approximately 2,825 feet in depth and adjust the contract accordingly. Quality of the injected water is given in Table 2.2-10.

Biscayne Aquifer Water Quality Monitoring

While drilling the well, water samples were collected and levels measured at each of five shallow monitoring wells installed around the drilling pad. Four of the wells were 2-inch-diameter PVC, approximately 20 feet deep, and located at each corner of the pad. The fifth was 8-inch-diameter steel, approximately 40 feet deep, and was used for supply water during construction. These data are included in Tables 2.2-11 N.E. through 2.2-11 W.S.

Table 2.2-1
SUMMARY OF CASING DATA
WELL I-2

Diameter (inches)	Wall Thickness (inches)	Depth (feet)[a] From	Depth (feet)[a] To	Cemented Section (depth in feet)[a] From	Cemented Section (depth in feet)[a] To
54	.500	0	140	0	140
44	.500	0	980	0	980
34	.500	0	1,800	0	1,800
24	.500	0	2,628	0	2,470

[a]Measured from the top of the concrete drilling pad.

Table 2.2-2
SUMMARY OF CEMENTING OF CASINGS
WELL I-2

Date	Casing Cemented	Type of Cement Used (API)		Number of Sacks Used	Depth Cemented (ft)	
					From	To
01/31/80	54"	Class H w/25 lb of gilsonite per sack of cement		395	140	0
03/01/80	44"	Lead:	Class H w/12% bentonite	1,450	980	0
		Middle:	Class H w/2% bentonite, 2% $CaCl_2$	150		
		Tail:	Class H neat	500		
05/14/80	34"	Lead:	Class H w/12% bentonite	900	1,800	1,353
		Middle:	Class H w/2% bentonite, 2% $CaCl_2$	200		
		Tail:	Class H neat	600		
05/16/80	34"	Class H w/12% bentonite		2,000	1,353	488
05/18/80	34"	Class H w/12% bentonite		810	488	0
--	24"	See Table I-2.2A				

Table 2.2-2A
24-INCH CASING CEMENTING SUMMARY
WELL I-2

Date	Type of Material Used	Quantity Used	Depth Tagged After Stage (feet)
07/10/80	Neat cement	3,000 sacks	2,627
07/11/80	Thixotropic	200 sacks	2,627
07/12/80	Thixotropic	350 sacks	2,628
07/15/80	Gravel	17 $feet^3$	2,629
07/16/80	Thixotropic	200 sacks	2,622
07/17/80	Thixotropic	93 sacks	2,626
07/24/80	Gravel	1,021 $feet^3$	2,606
07/24/80	Flow Check Thixotropic	550 gallons 30 sacks	2,616
07/26/80	Gravel	355 $feet^3$	2,607
07/26/80	Flow Check Neat w/4% $CaCl_2$	1,000 gallons 50 sacks	2,560
07/27/80	Thixotropic	80 sacks	2,570
07/28/80	Neat cement	150 sacks	2,562
07/29/80	Neat cement	750 sacks	2,564
07/29/80	Thixotropic	240 sacks	2,546
07/30/80	Thixotropic	150 sacks	2,553
07/31/80	Flow Check Neat w/4% $CaCl_2$	1,100 gallons 35 sacks	2,564
08/03/80	Gravel	600 $feet^3$	2,535
08/03/80	Thixotropic	35 sacks	2,529
08/04/80	Neat cement	50 sacks	2,529
08/04/80	Neat cement	50 sacks	2,545
08/07/80	Gravel	1,055 $feet^3$	2,503

Table 2.2-2A--Continued

Date	Type of Material Used	Quantity Used	Depth Tagged After Stage (feet)
08/07/80	Neat cement	33 sacks	2,535
08/09/80	Gravel	231 $feet^3$	2,470
08/09/80	Flow Check Neat w/4% $CaCl_2$	550 gallons 35 sacks	2,448
08/09/80	Neat cement	50 sacks	2,410
08/10/80	Neat cement	480 sacks	2,293
08/10/80	Neat cement	750 sacks	2,138
08/10/80	Neat cement	1,000 sacks	1,873
08/11/80	Neat w/2% bentonite	1,625 sacks	1,100
08/13/80	Neat w/2% bentonite	1,960 sacks	48
12/04/80	Neat cement	110 sacks	0

Table 2.2-3
LIST OF GEOPHYSICAL LOGS AND WELL SURVEYS
WELL I-2

Date	Well Progress and Casing Depth	Type of Logs or Surveys Run[a]	Purpose
02/06/80	54" casing to 140' 14-3/4" hole to 1,000'	E, G, C	1. Identify the top of the Floridan aquifer. 2. Establish the setting depth of the 44" casing.
03/07/80	44" casing to 980' 12-1/4" hole to 1,850'	LSN, G, C, T_s	1. Geohydrological definition of the Floridan aquifer. 2. Define transmissive zone. 3. Establish the setting depth of the 34" casing.
05/25/80	34" casing to 1,800' 12-1/4" hole to 2,640'	GYRO, E, G, C, T_s	1. Qualitative evaluation of the confining beds above the Boulder Zone. 2. Identification of transmissive zones. 3. Gyroscopic directional survey of the pilot hole for later comparison to the reamed hole. 4. Establish setting depth of the 24" casing.
06/03/80	34" casing to 1,800' 32" hole to 2,628'	GYRO	1. Gyroscopic directional survey of the reamed hole to compare to the pilot hole.
07/10/80	24" casing to 2,628'	T_s	1. Identify the top of the first stage cement outside the 24" casing.

Table 2.2-3--Continued

Date	Well Progress and Casing Depth	Type of Logs or Surveys Run[a]	Purpose
07/13/80	As above	T_s	1. Verify tremie pipe tags outside the 24" casing. 2. Identify the depth of the cement plug inside the 24" casing.
07/17/80	As above	T_s	1. Verify tremie pipe tag outside the 24" casing.
08/14/80	As above	T_s	1. Obtain a temperature profile of the cemented casing. 2. Identify cement stages.
10/08/80	24" casing to 2,628' 22" hole to 2,825'	TV	1. View the lost bit and sub at the bottom of the hole.
11/11/80	As above	LSN, G, C, T_s	1. Geohydrological definition of the injection zone.
11/17/80	As above	TV	1. Final visual evaluation of the injection zone. 2. Final inspection of the 24" casing and open hole.

[a]Abbreviations for logs and surveys are as follows:

E = single point electric and SP
LSN = long and short normal and SP
G = gamma ray
C = caliper
T_s = temperature, static
T_F = temperature, flowing
FV_s = fluid velocity (flow meter) static
FV_F = fluid velocity (flow meter) flowing
FC = fluid conductivity

GYRO = gyroscopic directional survey
TV = television
CBL = cement bond, variable density
WTD = wave train display
D. IND = dual induction electric and SP
BCS = borehole compensated sonic
Density = formation density
AV = acoustic velocity
GGD = gamma gamma density (0-500 ft)

Table 2.2-4
COMPARISON OF WELL PATHS FROM GYROSCOPIC SURVEYS
WELL I-2

WELL PATH COMPARISON

FOLLOW WELL: FILE 994.

MIAMI - DADE COUNTY WATER AND SEWAGE AUTHORITY
CH2M HILL
WELL I-2, REAM HOLE, 1800' - 2520'
DON PORTER
BROOKHAVEN

TARGET WELL: FILE 993.

MIAMI - DADE COUNTY WATER AND SEWAGE AUTHORITY
CH2M HILL
WELL I-2, PILOT HOLE, 0 - 2610'
MAY 27,1980

HORIZONTAL DISTANCE AND DIRECTION FROM TARGET WELL TO FOLLOW WELL AT TRUE VERTICAL DEPTHS

FEET	FEET	DIRECTION DEGREES
1829.99	0.03	357.90
1859.99	0.07	329.12
1889.99	0.16	312.65
1919.99	0.25	321.99
1949.99	0.35	320.71
1979.99	0.43	318.71
2009.99	0.46	315.43
2039.99	0.49	312.35
2069.99	0.45	313.17
2099.99	0.44	310.70
2129.99	0.49	307.49
2159.99	0.55	303.36
2189.99	0.62	304.13
2219.99	0.67	302.14
2249.99	0.73	306.24
2279.99	0.79	307.86
2309.99	0.35	306.11
2339.99	0.36	305.57
2369.99	0.34	302.37
2399.99	0.30	302.02
2429.99	0.49	295.04
2459.99	0.59	278.79
2489.99	0.57	272.16
2519.99	0.58	276.94

MIAMI - DADE COUNTY WATER AND SEWAGE AUTHORITY
CH2M HILL
WELL I-2, REAM HOLE, 1800' - 2520'
DON PORTER
BROOKHAVEN

RECORD OF SURVEY

RADIUS OF CURVATURE METHOD

MIAMI - DADE COUNTY WATER AND SEWAGE AUTHORITY
CH2M HILL
WELL I-2, REAM HOLE, 1800' - 2520'

COMPUTATION PAGE NO. 1
TIME 20:40:36 DATE 17-JUL-80

MEASURED DEPTH FEET	DRIFT ANGLE DEG	DRIFT DIRECTION DEG	TRUE VERTICAL DEPTH FEET	RECTANGULAR COORDINATES FEET		CLOSURE DISTANCE FEET	CLOSURE DIRECTION DEG	DOG LEG SEVERITY DG/100FT
1800.	0.22	164.78	1799.99	4.01 S	1.78 E	4.39	156.06	0.00
1830.	0.20	171.29	1829.99	4.12 S	1.80 E	4.50	156.37	0.11
1860.	0.17	157.92	1859.99	4.22 S	1.83 E	4.60	156.54	0.16
1890.	0.14	179.63	1889.99	4.29 S	1.85 E	4.67	156.75	0.22
1920.	0.10	111.31	1919.99	4.35 S	1.88 E	4.74	156.60	0.47
1950.	0.05	207.27	1949.99	4.38 S	1.89 E	4.77	156.62	0.38
1980.	0.11	127.86	1979.99	4.42 S	1.90 E	4.81	156.71	0.38
2010.	0.13	170.49	2009.99	4.47 S	1.93 E	4.87	156.62	0.30
2040.	0.08	183.73	2039.99	4.53 S	1.93 E	4.92	156.85	0.20
2070.	0.29	78.02	2069.99	4.58 S	2.00 E	5.00	156.43	1.06
2100.	0.14	172.50	2099.99	4.64 S	2.08 E	5.08	155.85	1.11
2130.	0.18	157.50	2129.99	4.71 S	2.10 E	5.16	155.99	0.18
2160.	0.13	165.57	2159.99	4.79 S	2.12 E	5.24	156.07	0.16
2190.	0.22	230.11	2189.99	4.87 S	2.10 E	5.30	156.70	0.68
2220.	0.17	82.80	2219.99	4.94 S	2.13 E	5.38	156.69	1.25
2250.	0.10	149.00	2249.99	4.97 S	2.19 E	5.43	156.25	0.52
2280.	0.25	154.00	2279.99	5.05 S	2.23 E	5.52	156.17	0.49
2310.	0.25	153.50	2309.99	5.16 S	2.29 E	5.65	156.12	0.02
2340.	0.22	164.78	2339.99	5.28 S	2.33 E	5.77	156.18	0.18
2370.	0.32	175.84	2369.99	5.42 S	2.35 E	5.91	156.52	0.35
2400.	0.22	131.99	2399.99	5.54 S	2.41 E	6.04	156.46	0.73
2430.	0.40	152.50	2429.99	5.67 S	2.51 E	6.20	156.09	0.69
2460.	0.21	153.01	2459.99	5.81 S	2.59 E	6.36	156.01	0.64
2490.	0.30	133.00	2489.99	5.92 S	2.67 E	6.49	155.74	0.42
2520.	0.13	152.00	2519.99	6.00 S	2.73 E	6.60	155.52	0.60

FINAL CLOSURE - DIRECTION: 155.518 DEGS CLOCKWISE FROM NORTH
DISTANCE: 6.60 FEET

Table I-2.5
DESCRIPTIVE SUMMARY OF UNDERWATER TELEVISION SURVEY
WELL I-2

CH2M HILL

RECORD OF UNDERWATER TV SURVEY

Project: Miami Dade Water & Sewer Authority, South District Regional Wastewater Treatment Plant

Well: I-2

Survey By: Deep Venture Diving Service, Perry, Florida
HP-4,000 AU

Survey Date: 11/17/80 Total Depth: 2,829 feet

Witnessed By: D. Snyder, D. Cabit, T. McCormick

Reviewed By: J. D. Lehnen Date: 12/31/80

Remarks:

Depth in Feet		Reel Counter		Observations
From	To	From	To	
--	--	0	17	Titles
0	7	17	23	Water level in 24" casing
7	2,638	23	581	24" casing, good picture
--	2,638	581	--	4:2" x 2" cement ports
2,638	2,640	581	582	Bottom of casing, correct depth counter to 2,629'
2,639	2,700	587	606	Large diameter hole, fractured formation
--	--	--	--	Numerous cavities, rubblized
2,700	2,753	606	624	Large cavities, highly fractured
2,753	2,760	624	627	Rough borehole
2,760	2,779	627	633	Highly fractured, cavities
2,779	2,793	633	638	Small cavities, rough hole, fractures
2,793	2,800	638	641	Large cavity
2,800	2,816	641	647	Rough hole, solution features
2,816	2,818	647	648	Large cavity

RECORD OF UNDERWATER TV SURVEY

Project: Miami Dade Water & Sewer Authority, South District Regional Wastewater Treatment Plant

Well: I-2 Date: 11/17/80 Total Depth: 2,829'

Depth in Feet		Reel Counter		Observations
From	To	From	To	
2,818	2,822	648	650	Smooth wall
2,822	2,829	650	655	Cavity at the bottom of the hole (no bit visible)
2,829	2,630	657	722	Pulling out of hole
--	2,630	722	--	Bottom of casing
2,630	1,998	722	817	End of survey

Table 2.2-6
LITHOLOGY FROM PILOT HOLE FORMATION SAMPLES
WELL I-2

Depth Interval (ft) From	To	Description
0	10	Crushed limestone fill
10	20	Limestone, tan to gray, hard, mostly limesand and silica sand
20	30	Limestone, light gray, medium-hard, fine grain, mostly limesand and silica sand
30	40	Limesand and silica sand, some very fine grained limestone
40	50	As above
50	60	As above
60	70	As above
70	80	As above
80	90	As above
90	100	As above
100	110	As above
110	120	As above
120	130	As above
130	140	As above
140	150	As above
150	160	Mostly cement cuttings, limestone, tan to gray, hard, some fossils, abundant shell fragments
160	170	As above
170	180	As above, with much silt
180	190	As above
190	200	Cement cuttings and limestone, tan to gray, abundant shells, some limesand
200	210	As above with lime silt

Table 2.2-6--Continued

Depth Interval (ft) From	To	Description
210	220	Limestone, gray, soft, shell fragments, clay, grayish green
220	230	As above
230	240	As above
240	250	Clay, gray to green, shell fragments
250	260	Cement chips mixed with clay and shell fragments, clay is gray/green
260	270	As above
270	280	Green clay with shell fragments
280	290	As above
290	300	As above
300	310	As above
310	320	As above
320	330	As above
330	340	As above
340	350	Limestone, gray, soft, clay with shell fragments
350	360	Limestine and clay, as above
360	370	As above
370	380	Green clay, some limestone and siltstone, gray, medium-hard
380	390	Limestone, gray, medium-hard, green clay
390	400	As above
400	410	As above
410	420	Limestone, tan to gray, moderately consolidated, fossils present
420	430	As above

Table 2.2-6--Continued

Depth Interval (ft)		
From	To	Description
430	440	As above
440	450	As above
450	460	Limestone, gray, moderately consolidated, many fossils and shell fragments
460	470	As above
470	480	As above
480	490	As above
490	500	As above
500	510	As above
510	520	As above
520	530	Limestone, tan to buff, moderately consolidated and medium-hard, fossils and shell fragments present
530	540	As above
540	550	As above
550	560	As above
560	570	As above
570	580	Limestone, gray to tan, medium-hard, poorly consolidated, some fossils, some clay
580	590	As above
590	600	Limestone, tan to buff, poorly consolidated, some fossils and clay, many shell fragments
600	610	As above
610	620	As above
620	630	As above
630	640	As above
640	650	As above

Table 2.2-6--Continued

Depth Interval (ft)		
From	To	Description
650	660	As above
660	670	As above
670	680	As above
680	690	As above
690	700	As above
700	710	As above
710	720	As above
720	730	As above
730	740	As above
740	750	As above
750	760	Limestone, gray, medium-hard, poorly consolidated, lime silt, fossils and shell fragments present
760	770	Limestone, gray to tan, medium-hard, poorly consolidated, some silt and clay, shell fragments and fossils
770	780	As above
780	790	As above
790	800	As above
800	810	Limestone, as above, with more clay present
810	820	As above
820	830	As above
830	840	As above
840	850	As above
850	860	As above
860	870	As above

Table 2.2-6--Continued

Depth Interval (ft) From	To	Description
870	880	As above
880	890	As above
890	900	As above
900	910	Limestone, tan to gray, soft, much clay present, some fossils and shell fragments
910	920	As above
920	930	As above
930	940	As above
940	950	As above
950	960	Clay, light green, silty, poorly consolidated
960	970	As above
970	980	As above
980	990	As above
990	1,000	As above
1,000	1,010	Limestone, gray to buff, moderately hard, some fossil fragments, large sand size fraction
1,010	1,020	Limestone, as above, with metal fragments
1,020	1,030	As above, more porous, fossiliferous
1,030	1,040	Same as above, some metal cuttings
1,040	1,050	Limestone, tan to gray, hard, some fossil fragments, with limesand
1,050	1,060	As above
1,060	1,070	As above
1,070	1,080	Limestone, tan, hard, dense, medium fine grain, cones present and microfossils
1,080	1,090	As above

Table 2.2-6--Continued

Depth Interval (ft)		
From	To	Description
1,090	1,100	As above
1,100	1,110	As above
1,110	1,120	As above
1,120	1,130	As above
1,130	1,140	As above
1,140	1,150	Limestone, tan, hard, dense, medium fine grains, microfossils present
1,150	1,160	As above
1,160	1,170	As above
1,170	1,180	As above
1,180	1,190	As above
1,190	1,200	As above
1,200	1,210	As above
1,210	1,220	As above
1,220	1,230	As above
1,230	1,240	As above
1,240	1,250	As above
1,250	1,260	As above
1,260	1,270	As above
1,270	1,280	As above
1,280	1,290	As above
1,290	1,300	As above
1,300	1,310	As above
1,310	1,320	As above

Table 2.2-6--Continued

Depth Interval (ft) From	To	Description
1,320	1,330	As above
1,330	1,340	Limestone, tan, hard, dense, medium fine grained, microfossils present
1,340	1,350	As above
1,350	1,360	As above
1,360	1,370	Limestone, yellowish tan, medium-hard, traces of clay
1,370	1,380	Limestone, buff, fossiliferous, medium-hard
1,380	1,390	Limestone, buff to white, massive, hard, fossils present, chalky matrix
1,390	1,400	Limestone, tan, hard, fossils present, dense, small to medium size pieces
1,400	1,410	Limestone, buff, fossiliferous, medium-hard
1,410	1,420	Limestone, buff to tan, very hard, some recrystallization
1,420	1,430	As above with more recrystallization and fossils
1,430	1,440	Limestone, tan, very hard to soft and porous, clay, yellowish
1,440	1,450	Limestone, tan, soft to medium-hard, dense, yellow-green clay present
1,450	1,460	Limestone, tan, dense, some recrystallized
1,460	1,470	Limestone, buff, soft, chalky matrix, some limesand
1,470	1,480	Limestone, buff, dense, massive, soft to medium-hard, chalky matrix, fossiliferous
1,480	1,490	As above, some recrystallized, hard
1,490	1,500	Limestone, buff, medium-hard, some recrystallization, some fossils present
1,500	1,510	Limestone, tan, hard, fossiliferous, yellowish clay matrix

Table 2.2-6--Continued

Depth Interval (ft)		
From	To	Description
1,510	1,520	As above
1,520	1,530	As above
1,530	1,540	Limestone, buff, recrystaillized, medium-hard, some fossils
1,540	1,550	As above
1,550	1,560	As above
1,560	1,570	Limestone, white to buff, dense, medium-hard, some recrystallized fragments
1,570	1,580	As above
1,580	1,590	As above
1,590	1,600	As above
1,600	1,610	Limestone, white to buff, soft to medium-hard, abundant fossils
1,610	1,620	Limestone, white to buff, medium-hard to hard, few fossils
1,620	1,630	Limestone, tan to gray, soft, fossiliferous, limesand
1,630	1,640	Limestone, white to buff, soft, massive, porous, fossiliferous, cones, some metal fragments
1,640	1,650	As above, no metal present
1,650	1,660	Limestone, tan to buff, soft to medium-hard, porous, with fossils present
1,660	1,670	As above
1,670	1,680	Limestone, dark tan, soft to medium-hard, abundant fossils
1,680	1,690	As above
1,690	1,700	Limestone, white to buff, medium to very hard, some porous, some recrystallized, some fossils
1,700	1,710	Limestone, tan, yellowish-green, clay matrix, fossils

Table 2.2-6--Continued

Depth Interval (ft)		
From	To	Description
1,710	1,720	Limestone, buff, fossiliferous, medium-hard to hard, chalky matrix, metal cuttings
1,720	1,730	Limestone, tan, yellow-green, clayey matrix, soft to medium-hard, fossils present
1,730	1,740	As above
1,740	1,750	As above, color change to buff
1,750	1,760	Limestone, dark tan, soft to medium-hard, abundant fossils
1,760	1,770	Limestone, buff, soft to medium-hard, chalky matrix, abundant fossils
1,770	1,780	Limestone, tan, soft, yellow-green clay, abundant fossils
1,780	1,790	Limestone, buff, soft to medium-hard, fossils, chalky matrix
1,790	1,800	As above
1,800	1,810	As above
1,810	1,820	Same as above, with larger cones
1,820	1,830	As above
1,830	1,840	As above
1,840	1,850	As above
1,850	1,860	As above, less cones, smaller size specimens
1,860	1,870	As above
1,870	1,880	As above
1,880	1,890	As above
1,890	1,900	As above
1,900	1,910	Limestone, buff, soft to medium-hard, fossiliferous, chalky matrix

Table 2.2-6--Continued

Depth Interval (ft)		
From	To	Description
1,910	1,920	As above
1,920	1,930	As above
1,930	1,940	As above
1,940	1,950	As above
1,950	1,960	As above
1,960	1,970	As above
1,970	1,980	As above
1,980	1,990	As above
1,990	2,000	As above
2,000	2,010	As above
2,010	2,020	As above
2,020	2,030	As above
2,030	2,040	As above
2,040	2,050	As above
2,050	2,060	As above
2,060	2,070	As above
2,070	2,080	As above
2,080	2,090	As above
2,090	2,100	Limestone, light tan, medium-hard, sandy and vuggy, microfossils and shell fragments
2,100	2,110	As above
2,110	2,120	As above, less shell and fossils, some cones
2,120	2,130	As above
2,130	2,140	Limestone, tan, hard to medium-hard, abundant cones

Table 2.2-6--Continued

Depth Interval (ft)		
From	To	Description
2,140	2,150	As above, more limestone, less cones
2,150	2,160	Limestone, fossiliferous, small fragments of shell
2,160	2,170	Limestone, buff to tan, medium-hard, fossiliferous with shell fragments
2,170	2,180	As above
2,180	2,190	As above
2,190	2,200	As above
2,200	2,210	As above
2,210	2,220	As above, larger fragments
2,220	2,230	As above
2,230	2,240	As above
2,240	2,250	As above
2,250	2,260	As above
2,260	2,270	As above
2,270	2,280	As above
2,280	2,290	Limestone, buff, some tan, medium-hard, fossiliferous, small fragments
2,290	2,300	As above
2,300	2,310	As above
2,310	2,320	As above, with some oolitic limestone
2,320	2,330	As above
2,330	2,340	As above
2,340	2,350	As above
2,350	2,360	As above
2,360	2,370	As above

Table 2.2-6--Continued

Depth Interval (ft) From	To	Description
2,370	2,380	As above
2,380	2,390	As above, larger cuttings, medium soft
2,390	2,400	As above
2,400	2,410	As above
2,410	2,420	As above
2,420	2,430	Limestone, buff to tan, medium-hard, fossiliferous, small fragments, traces of dolomite
2,430	2,440	As above
2,440	2,450	As above
2,450	2,460	As above
2,460	2,470	As above
2,470	2,480	Limestone and dolomite, tan to gray, dense, very hard
2,480	2,490	As above
2,490	2,500	As above
2,500	2,510	As above
2,510	2,520	Limestone, white to buff, few dolomite fragments, fossiliferous
2,520	2,530	Dolomite and limestone, white, medium-hard, limestone, gray dolomite, massive, crystalline
2,530	2,540	As above
2,540	2,550	As above
2,550	2,560	As above
2,560	2,570	As above
2,570	2,580	As above
2,580	2,590	As above

Table 2.2-6--Continued

Depth Interval (ft)		
From	To	Description
2,590	2,600	Limestone, buff and white, medium-hard, fossiliferous, with large fragments
2,600	2,610	As above
2,610	2,620	As above
2,620	2,630	As above
2,630	2,640	As above
2,640	2,650	As above
2,650	2,660	As above
2,660	2,670	Limestone, white, soft, chalky and vuggy matrix, dolomite, tan and gray, hard, crystalline to cryptocrystalline
2,670	2,680	As above
2,680	2,690	As above
2,690	2,700	Limestone, white, soft matrix, chalky and vuggy
2,700	2,710	As above
2,710	2,720	As above
2,720	2,730	As above
2,730	2,740	As above
2,740	2,750	As above
2,750	2,760	As above
2,760	2,770	Dolomite, light tan to gray, mixed with white limestone
2,770	2,780	As above
2,780	2,790	As above
2,790	2,800	Dolomite, light tan, soft white limestone
2,800	2,810	Dolomite, tan to gray, hard

Table 2.2-6--Continued

Depth Interval (ft)		
From	To	Description
2,810	2,820	Dolomite, darker brown, with limestone
2,820	2,830	Dolomite, darker brown
2,830	2,840	As above
2,840	2,850	As above
2,850	2,860	Dolomite, tan, hard, crystalline
2,860	2,870	As above
2,870	2,880	As above
2,880	2,890	As above

Table 2.2-7
WATER QUALITY DATA FROM PILOT HOLE DRILLING
WELL I-2

Date	Time	Depth (ft)	Temperature (°C)	Specific Gravity	Specific Conductance (μmhos/cm)	Chloride (mg/l)
03/05	1600	1,023	25.3	1.0002	3,500	1,300
03/05	2030	1,056	25.0	1.0015	3,200	1,700
03/05	2330	1,089	24.5	1.0012	3,250	1,100
03/06	0240	1,120	24.5	1.0016	3,100	1,300
03/06	0545	1,151	25.0	1.0016	3,600	1,600
03/06	0700	1,183	25.0	1.0018	3,200	1,600
03/06	0800	1,211	25.0	1.0004	3,300	1,400
03/06	1000	1,243	25.0	1.0000	3,200	1,400
03/06	1115	1,273	25.0	1.0002	3,150	800
03/06	1330	1,303	25.0	1.0002	3,200	1,000
03/06	1445	1,333	25.0	1.0000	3,050	1,000
03/06	1615	1,363	25.0	1.0000	3,100	1,000
03/06	1900	1,397	25.0	1.0000	2,900	1,000
03/06	2020	1,429	25.0	1.0001	3,000	1,000
03/06	2130	1,460	25.0	1.0000	3,200	1,000
03/06	2300	1,521	25.0	1.0000	3,100	1,000
03/06	2445	1,550	25.0	1.0000	3,050	1,000
03/07	0230	1,580	25.0	1.0000	3,100	1,000
03/07	0500	1,610	25.0	1.0000	3,200	1,000
03/07	0615	1,640	25.0	1.0004	3,200	900
03/07	0700	1,670	25.0	1.0006	2,400	700
03/07	0900	1,700	25.0	1.0004	2,800	900
03/07	1030	1,730	25.0	1.0002	3,000	1,000

Table 2.2-7--Continued

Date	Time	Depth (ft)	Temperature (°C)	Specific Gravity	Specific Conductance (μmhos/cm)	Chloride (mg/l)
03/07	1200	1,760	25.0	1.0000	3,200	900
03/07	1300	1,790	25.0	1.0002	3,100	700
03/07	1410	1,820	25.0	1.0002	3,200	1,000
05/20	2000	1,848	25.0	1.0050	15,000	5,000
05/20	2230	1,880	25.0	1.0050	15,000	5,000
05/21	0130	1,915	25.0	1.0045	13,200	4,500
05/21	0315	1,946	25.0	1.0050	15,000	5,000
05/21	0430	1,977	25.0	1.0050	1,500	5,000
05/21	0610	2,009	25.0	1.0050	14,000	4,650
05/21	0700	2,038	25.0	1.0055	15,000	5,000
05/21	0855	2,070	26.0	1.0050	15,000	5,100
05/21	1250	2,102	26.0	1.0050	15,000	4,950
05/21	1605	2,136	26.0	1.0055	15,000	5,000
05/21	1910	2,166	26.0	1.0050	15,500	4,950
05/21	2120	2,198	27.0	1.0045	16,000	5,000
05/21	2330	2,230	27.0	1.0045	16,000	4,900
05/22	0110	2,260	27.0	1.0045	15,500	5,100
05/22	0230	2,293	27.0	1.0045	16,000	5,350
05/22	0600	2,326	28.0	1.0040	13,500	4,300
05/22	0845	2,359	27.0	1.0040	13,500	4,250
05/22	1045	2,389	28.0	1.0030	12,000	5,000
05/22	1640	2,419	30.0	1.0055	13,200	5,000
05/22	2215	2,451	27.2	1.0060	14,500	5,800
05/23	0510	2,481	27.2	1.0060	13,200	5,600
05/23	1000	2,511	27.8	1.0060	13,200	5,600

Table 2.2-7--Continued

Date	Time	Depth (ft)	Temperature (°C)	Specific Gravity	Specific Conductance (μmhos/cm)	Chloride (mg/l)
05/23	1450	2,544	27.8	1.0120	20,000	8,800
05/24	1000	2,576	27.0	1.0150	26,000	19,000
05/24	1600	2,608	27.0	1.0150	28,000	18,500
05/25	0630	2,640	27.0	1.0165	26,000	15,200
08/24	0345	2,652	27.0	1.0458	60,000	38,130
08/25	1200	2,686	27.0	1.0255	36,000	19,530
08/27	2110	2,618	27.0	1.0250	35,000	19,000
08/29	0001	2,751	27.0	1.0250	30,000	18,600
08/30	1230	2,784	22.0	1.0250	35,000	20,500
08/31	0215	2,817	22.0	1.0250	37,000	20,850
10/20	1600	2,830	22.0	1.0255	44,000	22,300
10/24	0700	2,860	22.0	1.0255	43,500	22,800

Table 2.2-8
SUMMARY OF INJECTION TEST RESULTS
WELL I-2

Pumping Rate	10,650 gpm
Test Duration	11.5 hr
Time Elapsed to Reach Maximum Injection Head After Pumping Started	3 minutes
Maximum Injection Head[a]	88.9 feet of water
Static Freshwater Head[a, b]	64.1 feet of water

[a]Feet of water referred to pad level.
[b]Due to the density difference between injected freshwater and formation saltwater.

Table 2.2-9
INJECTION TEST DATA
WELL I-2
(Wellhead pressure measuring point @ 2.92' above pad)

Actual Time	Time Since Pump Started (min)	Flow (gpm)	Wellhead Pressure (feet of water)	Totalizer (gallons x 1,000)	Remarks
0300	0	--	--	090839	
0301	1	9,000	84.0	090851	
0302	2	10,000	84.0	090876	
0303	3	10,000	86.0	090881	
0304	4	10,000	83.0	090895	
0305	5	10,000	82.0	090902	
0306	6	10,000	82.0	090918	
0307	7	10,000	82.0	090930	
0308	8	10,000	82.0	090937	
0309	9	10,000	82.0	090943	
0310	10	10,000	82.0	090955	
0312	12	10,000	82.0	090973	
0314	14	10,000	81.0	090955	
0316	16	10,000	81.0	091020	
0318	18	10,000	81.0	091038	
0320	20	10,000	81.0	091066	
0325	25	10,000	81.0	091115	
0330	30	10,000	81.0	091167	
0335	35	10,000	81.0	091214	
0340	40	10,000	81.0	091275	
0345	45	10,000	81.0	091328	
0350	50	10,000	81.0	091372	
0355	55	10,000	81.0	091436	

Table 2.2-9--Continued

Actual Time	Time Since Pump Started (min)	Flow (gpm)	Wellhead Pressure (feet of water)	Totalizer (gallons x 1,000)	Remarks
0400	60	10,000	81.0	091499	
0430	90	10,000	81.0	091791	
0500	120	10,000	80.5	092140	
0530	150	10,000	80.0	094480	
0600	180	10,000	80.0	092789	
0630	210	10,000	80.0	093098	
0700	240	10,000	80.0	093347	
0730	270	10,000	80.0	093683	
0800	300	10,000	80.0	093973	
0830	330	10,000	79.6	094327	
0900	360	10,000	79.8	094585	
0930	390	10,000	79.8	094960	
1000	420	10,000	79.8	095287	
1030	450	10,000	79.7	095600	
1100	480	10,000	79.8	095925	
1130	510	10,000	79.8	096259	
1200	540	10,000	80.0	096564	
1230	570	10,000	80.0	096897	
1300	600	10,000	80.0	097221	
1330	630	10,000	80.0	097559	
1400	660	10,000	80.0	097851	
1430	690	10,000	79.9	098187	Shut down injection pump
1434	694	0	61.6	--	

Table 2.2-9--Continued

Actual Time	Time Since Pump Started (min)	Flow (gpm)	Wellhead Pressure (feet of water)	Totalizer (gallons x 1,000)	Remarks
1500	720	0	61.2	--	
0800	1,740	--	58.2	--	
1000	1,860	--	57.9	--	
1200	1,980	--	57.8	--	
1400	2,100	--	57.8	--	
1600	2,220	--	57.8	--	
1800	2,340	--	57.8	--	
0800	3,180	--	57.2	--	

Table 2.2-10
QUALITY OF INJECTED WATER
WELL I-2

Date	Time	Depth (ft)	Temperature (°C)	Specific Gravity	Specific Conductance (µmhos/cm)	Chloride (mg/l)	Remarks
10/31/80	1530	--	28.9	1.0000	1,000	450	Background Pond 21
10/31/80	1530	--	28.9	1.0001	4,500	2,330	Background Pond 20
11/01/80	0230	--	25.0	1.0000	1,900	995	Background Pond 21
11/01/80	0230	--	25.0	1.0000	1,850	900	Background Pond 21
11/01/80	0230	--	25.0	1.0001	4,000	2,100	Background Pond 20
11/01/80	0230	--	25.0	1.0001	3,800	1,900	Background Pond 20
11/01/80	0330	--	25.0	1.0000	1,850	900	First sample injection test
11/01/80	0400	--	25.0	1.0000	2,000	910	
11/01/80	0500	--	26.1	1.0002	2,200	970	
11/01/80	0600	--	26.7	1.0001	2,300	980	
11/01/80	0700	--	26.7	1.0001	2,450	1,020	
11/01/80	0800	--	27.2	1.0000	2,400	1,090	
11/01/80	0900	--	27.8	1.0000	2,000	1,060	
11/01/80	1000	--	27.8	1.0000	2,400	1,120	
11/01/80	1100	--	26.7	1.0000	2,350	980	
11/01/80	1200	--	27.8	1.0000	2,400	1,000	
11/01/80	1300	--	27.8	1.0000	2,300	880	
11/01/80	1400	--	28.9	1.0000	2,350	890	
11/01/80	1430	--	28.9	1.0000	2,350	820	End of test

Table 2.2-11 N.E.
WATER QUALITY OF BISCAYNE AQUIFER--N.E. MONITORING WELL
SITE I-2

Date	Time	Temperature (°C)	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
01/16	1225	25.0	540	55	8.08	
01/23	0910	25.0	720	50	7.98	
01/30	0915	24.4	790	80	8.43	
02/06	1100	25.0	750	90	8.40	
02/13	1315	23.5	485	70	8.15	
02/20	1315	23.9	800	80	8.06	
02/27	1050	23.3	640	60	8.11	
03/05	1200	--	--	--	--	Pipe broken
03/12	1450	23.9	625	70	9.27	Changed measuring point
03/19	1700	--	--	--	--	Pipe broken
03/26	1500	23.9	600	70	8.34	Changed measuring point
04/02	1550	23.9	650	75	7.82	
04/09	1030	23.9	650	75	7.75	
04/16	1900	23.3	680	61	7.85	
04/23	1115	23.9	790	78	7.62	
04/30	1500	23.9	925	109	7.91	
05/07	1745	23.9	880	110	7.89	
05/14	1850	23.9	940	60	7.86	
05/21	1725	23.3	710	68	7.86	
05/28	1730	--	--	--	--	
06/04	1700	--	--	--	--	
06/10	1600	23.9	800	87	7.91	

Table 2.2-11 N.E.--Continued

Date	Time	Temperature (°C)	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
06/17	1600	23.9	860	92	7.89	
06/24	1600	23.9	860	90	7.90	
07/02	1600	--	--	--	--	
07/09	1600	24.4	700	29	7.66	Chlorides incorrect
07/16	1700	24.4	750	19	7.56	
07/23	1600	--	--	--	--	Correct chloride values
07/30	1800	--	--	--	--	
08/06	1800	--	--	--	--	
08/13	1900	--	--	--	--	
08/20	1700	--	--	--	--	
08/25	1520	--	--	--	--	
09/03	1800	26.1	800	96	10.05	Changed measuring point
09/07	1800	26.1	800	101	10.05	
09/16	1800	26.1	800	97	10.05	
09/23	1800	26.1	800	98	10.05	
09/30	1800	26.1	800	100	10.05	
10/08	1200	--	--	--	--	
10/15	1200	--	--	--	--	
10/22	1200	--	--	--	--	
10/29	1400	--	--	--	--	

Table 2.2-11 N.W.
WATER QUALITY OF BISCAYNE AQUIFER--N.W. MONITORING WELL
SITE I-2

Date	Time	Temperature (°C)	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
01/16	1230	25.0	900	130	11.31	
01/23	0915	25.0	870	120	11.21	
01/30	0900	25.6	800	100	11.72	
02/06	1045	25.0	850	100	11.70	
02/13	1300	24.5	660	120	11.40	24-hour pump test on I-6
02/20	1300	24.5	600	110	11.30	
02/27	1055	24.4	680	100	11.36	
03/05	1140	25.0	700	120	11.42	
03/12	1430	24.4	550	100	11.39	
03/19	1650	23.9	550	110	11.46	
03/26	1505	23.9	550	100	11.57	
04/02	1530	24.4	500	117	11.22	
04/09	1035	23.9	560	103	11.42	
04/16	1840	23.8	520	95	11.50	
04/23	1120	24.4	590	87	11.44	
04/30	1505	23.9	640	98	11.51	
05/07	1250	23.9	560	97	11.49	
05/14	1830	23.9	650	82	11.46	
05/21	1745	23.3	690	85	11.44	
05/28	1750	23.9	680	87	11.33	
06/04	1708	23.9	660	86	11.31	
06/10	1605	23.3	560	110	11.51	

Table 2.2-11 N.W.--Continued

Date	Time	Temperature (°C)	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
06/17	1605	23.9	600	120	11.50	
06/24	1605	23.3	580	115	11.49	
07/02	1605	24.4	570	115	11.42	
07/09	1605	24.4	580	32	11.36	Chlorides incorrect
07/16	1705	25.0	560	19	11.33	
07/23	1605	24.4	640	84	11.49	Correct chlorides
07/30	1805	24.4	650	89	11.53	
08/06	1805	25.6	--	--	11.32	
08/13	1905	25.6	700	125	11.56	
08/20	1705	26.1	650	136	11.25	
08/25	1500	27.8	600	139	11.42	
09/03	1805	26.1	1,400	152	11.62	
09/07	1805	26.7	1,300	180	11.60	
09/16	1805	26.1	1,400	160	11.60	
09/23	1805	26.7	1,400	180	11.60	
09/30	1805	26.7	1,400	175	11.60	
10/08	1205	26.7	1,400	175	11.65	
10/15	1205	26.7	1,300	150	11.60	
10/22	1205	28.0	1,350	200	11.00	
10/29	1405	28.0	1,500	250	11.75	

Table 2.2-11 S.E.
WATER QUALITY OF BISCAYNE AQUIFER--S.E. MONITORING WELL
SITE I-2

Date	Time	Temperature (°C)	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
01/16	1220	25.0	535	67	10.10	
01/23	0925	25.6	480	60	10.02	
01/30	0910	25.6	500	60	10.49	
02/06	1055	25.0	520	70	10.45	
02/13	1310	24.5	620	60	10.18	
02/20	1310	24.5	490	80	10.05	
02/27	1105	24.4	420	80	10.12	
03/05	1155	24.4	590	70	10.21	
03/12	1445	25.0	470	80	10.19	
03/19	1705	24.4	450	130	10.26	
03/26	1455	24.0	450	120	10.34	
04/02	1545	23.9	430	77	10.04	
04/09	1040	23.9	440	69	10.28	
04/16	1855	23.3	400	55	10.28	
04/23	1135	23.9	460	54	10.05	
04/30	1510	23.9	450	60	10.29	
05/07	1800	23.9	500	58	10.25	
05/14	1845	23.9	390	45	10.25	
05/21	1725	23.9	500	51	10.22	
05/28	1735	24.4	500	50	10.12	
06/04	1720	24.4	500	52	10.10	
06/10	1610	24.4	480	65	10.29	
06/17	1610	23.9	520	69	10.27	

Table 2.2-11 S.E.--Continued

Date	Time	Temperature (°C)	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
06/24	1610	23.9	500	66	10.28	
07/02	1610	24.4	500	67	10.20	
07/09	1610	25.6	480	31	9.98	Incorrect chlorides
07/16	1710	24.4	600	37	9.93	
07/23	1610	25.6	810	115	10.04	Correct chloride values
07/30	1810	25.6	830	148	10.02	
08/06	1810	26.1	--	--	9.88	
08/13	1910	27.8	850	195	9.85	
08/20	1710	26.7	2,400	1,144	9.86	
08/25	1515	28.9	1,200	400	9.90	
09/03	1810	26.1	6,000	2,660	10.10	
09/10	1810	26.7	1,200	290	10.09	
09/16	1810	26.7	1,400	305	10.09	
09/23	1810	26.7	1,400	300	10.10	
09/30	1810	26.7	1,400	310	10.10	
10/08	1210	26.7	1,400	310	10.15	
10/15	1210	26.7	1,350	240	10.10	
10/22	1210	28.0	1,050	290	10.40	
10/29	1410	28.0	1,700	750	10.35	

Table 2.2-11 S.W.
WATER QUALITY OF BISCAYNE AQUIFER--S.W. MONITORING WELL
SITE I-2

Date	Time	Temperature (°C)	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
01/17	0950	26.7	600	120	10.44	
01/23	0920	25.6	580	75	10.37	
01/30	0905	26.1	580	90	10.86	
02/06	1110	25.6	600	95	10.80	
02/13	1320	24.5	550	90	10.50	
02/20	1320	24.5	600	45	10.43	
02/27	1100	25.0	660	110	10.52	
03/05	1150	24.4	670	120	10.55	
03/12	1435	24.4	580	100	10.56	
03/19	1655	24.4	480	90	10.60	
03/26	1510	24.0	500	100	10.66	
04/02	1535	23.9	480	92	10.41	
04/09	1045	23.9	500	89	10.67	
04/16	1845	22.8	490	71	10.65	
04/23	1125	23.9	420	65	9.68	Changed measuring point
04/30	1515	23.3	485	70	10.00	
05/07	1755	23.9	500	59	9.71	
05/14	1835	23.9	490	57	9.74	
05/21	1740	24.4	520	68	9.70	
05/28	1745	24.4	500	65	9.60	
06/04	1710	24.4	520	67	9.58	
06/10	1615	24.4	520	69	9.78	
06/17	1615	24.4	540	72	9.76	

Table 2.2-11 S.W.--Continued

Date	Time	Temperature (°C)	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
06/24	1615	24.4	540	70	9.76	
07/02	1615	26.1	530	130	9.68	
07/09	1615	25.6	540	29	9.60	Incorrect chloride values
07/16	1715	26.1	500	20	9.50	
07/23	1615	25	520	63	9.72	Correct chlorides
07/30	1815	25.6	650	95	9.72	
08/06	1815	25.6	--	--	9.30	
08/13	1915	26.1	1,750	612	9.50	
08/20	1715	25.6	3,000	1,166	9.26	
08/25	1505	27.8	1,050	380	9.40	
09/03	1815	26.1	6,500	2,700	9.58	
09/10	1815	26.7	7,000	3,400	9.56	
09/16	1815	26.7	6,900	3,200	9.57	
09/23	1815	26.7	7,000	3,250	9.58	
09/30	1815	26.7	4,000	2,300	9.59	
10/08	1215	26.7	3,800	2,200	9.64	
10/15	1215	26.7	3,000	1,200	9.59	
10/22	1215	28.0	3,000	1,250	9.57	
10/29	1415	28.0	3,500	1,250	9.52	

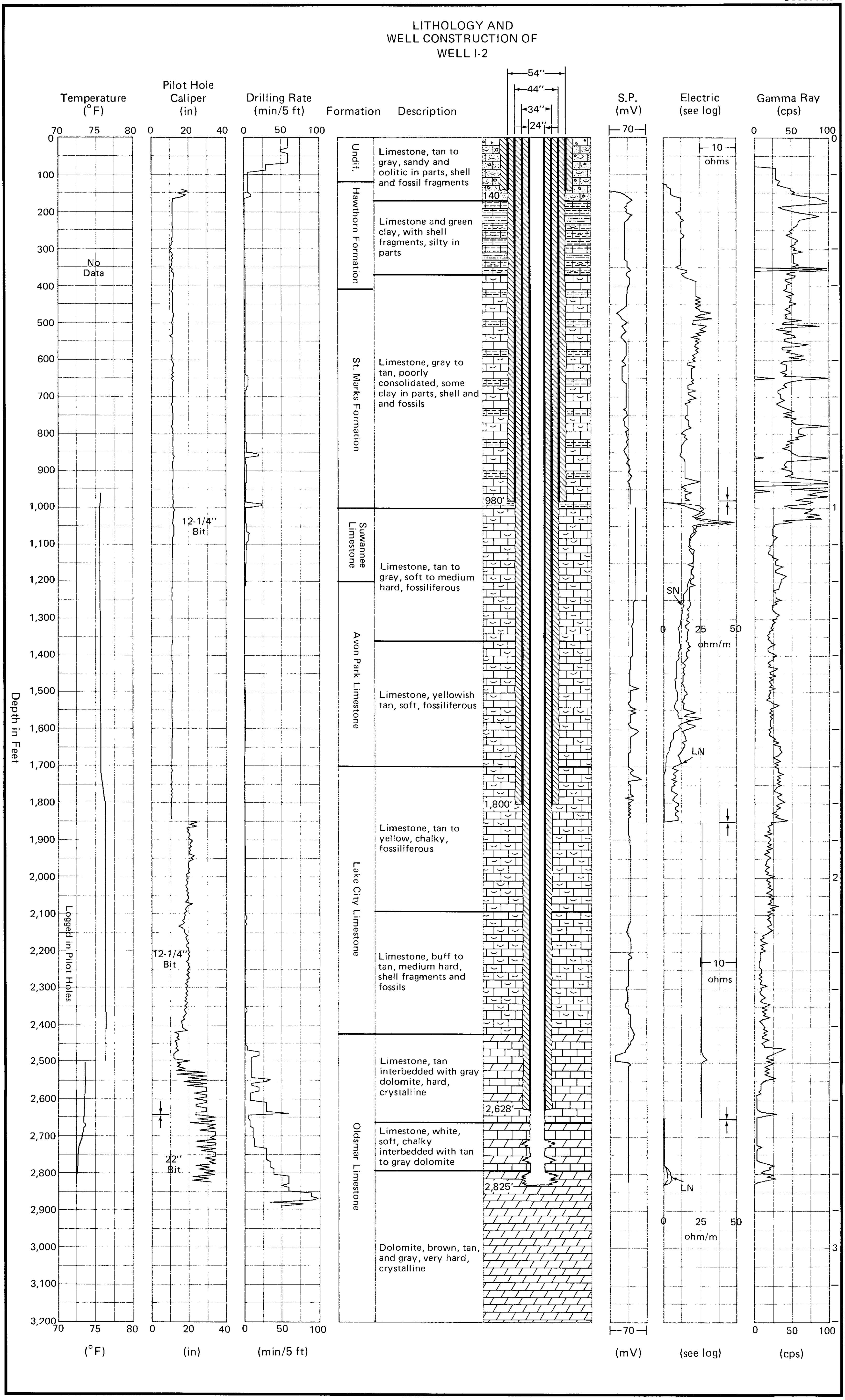
Table 2.2-11 W.S.
WATER QUALITY OF BISCAYNE AQUIFER--WATER SUPPLY WELL
SITE I-2

Date	Time	Temperature (°C)	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
01/16	1235	26.1	525	70	--	Pump hose in well
01/23	0930	23.9	475	60	--	
01/30	0920	23.9	540	100	--	
02/06	1050	24.0	600	110	--	
02/13	1305	23.0	520	70	--	
02/20	1305	23.0	550	700	--	
02/27	1110	23.9	575	80	--	
03/05	1145	23.3	600	110	--	
03/12	1440	22.0	475	80	--	
03/19	1700	23.3	380	90	8.81	
03/26	1515	23.3	400	100	8.90	
04/02	1540	23.3	500	172	8.62	
04/09	1050	23.9	400	85	8.67	
04/16	1850	22.8	350	54	8.79	
04/17	1300	--	440	66	--	
04/23	1130	23.3	340	62	8.80	
04/30	1520	23.3	1,150	247	8.91	
05/07	1800	--	--	--	--	
05/14	1840	23.3	500	38	--	
05/21	1735	23.3	540	54	--	
05/28	1740	23.9	540	52	--	
06/04	1715	23.9	520	50	--	
06/10	1620	24.4	420	55	8.93	
06/17	1620	24.4	440	58	8.90	

Table 2.2-11 W.S.--Continued

Date	Time	Temperature (°C)	Specific Conductance (µmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
06/24	1620	24.4	420	50	8.91	
07/02	1620	--	--	--	--	
07/09	1620	25.6	650	32	--	Incorrect chloride values
07/16	1720	25.6	2,100	47	--	
07/23	1620	26.1	6,100	2,539	--	Correct values
07/30	1820	--	--	--	--	
08/06	1820	26.7	--	--	--	
08/13	1920	26.7	9,600	5,022	--	
08/20	1720	--	--	--	--	
08/25	1510	28.3	13,000	5,480	--	
09/03	1820	--	--	--	--	
09/10	1820	26.7	10,000	5,800	--	
09/16	1820	26.7	10,000	5,900	--	
09/23	1820	26.7	10,000	5,900	--	
09/30	1820	26.7	7,000	3,200	--	
10/08	1220	--	--	--	--	
10/15	1220	--	3,500	1,200	--	
10/22	1220	27.0	7,000	6,500	--	
10/29	1420	27.0	6,000	5,900	--	

BC55900.92



Summary of drilling and logging data—Well I-2.

FIGURE 2.2-1.

Chapter 2.3
INJECTION WELL I-3

Well No. I-3 is located approximately 700 feet south-southwest of I-4 and 750 feet east of I-2 in the southeast corner of the site, as shown on Figure 1.1-2, Section 1, Summary. Drilling began on May 10, 1979, and was completed on January 5, 1980. The drilling and casing sequence of this injection well was as follows:

1. Drilled 12-1/4-inch pilot hole to 247 feet.
2. Reamed hole to 60-inch diameter to a depth of 153 feet.
3. Set and cemented 54-inch casing from a depth of 145 feet to the concrete drilling pad.
4. Drilled 12-1/4-inch pilot hole to 1,000 feet.
5. Reamed hole to 52-inch diameter to a depth of 985 feet.
6. Set and cemented 44-inch casing from a depth of 792 feet to the concrete drilling pad. This casing was planned to be set to 975 feet, but it stuck at 792 feet and could not be moved.
7. Drilled 14-3/4-inch pilot hole to 1,900 feet.
8. Reamed hole to 42-inch diameter to a depth of 1,810 feet.
9. Set and cemented 34-inch casing from a depth of 1,800 feet to the concrete drilling pad.
10. Drilled 14-3/4-inch pilot hole to 2,700 feet.
11. Reamed hole to 32-inch diameter to a depth of 2,668 feet.
12. Set a cement plug from 2,700 feet to 2,641 feet. Set 24-inch casing at 2,629 feet, and cemented it to surface.
13. Ran a successful casing pressure test (pressurized 24-inch casing to 108 psi; pressure held for 1 hour, with no loss).
14. Drilled 22-inch hole to a depth of 3,123 feet (total depth).
15. Ran injection test at approximately 10,000 gpm for 13 hours.

16. Cleaned cement obstructions out of the open hole to T.D.

17. Completed the wellhead and pad.

Casings are black steel, conforming to standards of API 5L, Grade B, and ASTM A139, Grade B. Casing details are summarized in Table 2.3-1. The four casings were cemented with API Class H cement slurries as summarized in Table 2.3-2. Geophysical logs, gyroscopic, and TV surveys run during the drilling and casing sequence noted above are listed in Table 2.3-3.

The results of the gyroscopic directional surveys for path comparisons between the pilot and the reamed holes are included in Table 2.3-4. A descriptive summary of the underwater television survey after well completion is presented in Table 2.3-5. Results of a lithological examination of the formation samples collected every 10 feet from the pilot hole drilling are presented in Table 2.3-6. Water quality data from pilot hole drilling are found in Table 2.3-7.

Figure 2.3-1 presents a summary of data from drilling and related operations, including the well construction diagram, formation sample description, drilling rate, as well as electric, gamma ray, temperature, and caliper logs.

Several steps were taken to avoid the potential problem of excessive loss of cement while cementing the inner 24-inch casing, similar to the loss that occurred in Well I-6. They were as follows:

1. Drilled 14-3/4-inch pilot hole to 2,700 feet.

2. Ran a flow test after step 1 to identify transmissive zones above 2,700 feet, where potential cement losses could occur. This consisted of running flow meter and temperature logs while the well was being pumped at approximately 500 gpm. In addition, a television survey of the hole and static geophysical logs were then run as listed in Table 2.3-3.

3. Decided to set 24-inch casing at 2,650 feet. Also decided to ream the 32-inch hole for this casing to a depth of 2,668 feet, which would be above the potential cement-loss zones. The casing was actually set to 2,629 feet, because it stuck at this depth.

4. Set a cement plug at the bottom of the hole before running the 24-inch casing. This provided additional assurance that the weight of the cement column above (while cementing the 24-inch casing) would not cause it to break into the transmissive zones below.

These steps helped minimize the excessive loss of cement into transmissive formations at the bottom of the casing.

Injection Test

The injection test, as reported in Item 15 of the sequence above, was run to determine the well injection capacity and its corresponding wellhead pressure. Freshwater from the adjacent pond was injected into the well at a constant rate of approximately 10,200 gpm for 13 hours. Injection pressures were recorded with a high-precision pressure gauge. Flow rates were determined by a flow meter, as well as an inline volumetric totalizer and a stopwatch.

Wellhead pressure reached 94.0 feet of water in 30 minutes after injection began, and steadily rose to a maximum pressure of 94.8 feet of water after 4.5 hours of injection. Thereafter, it dropped slightly to 94.1 feet of water by the end of the test after 13 hours of injection. When injection stopped, the wellhead pressure dropped rapidly to 70.4 feet of water within 5 minutes, and very slowly reached stability at 69.9 feet of water after 3 hours. (All pressures are referred to pad level.) The well was partially opened 15.5 hours after the end of injection and allowed to flow. This backflow lasted approximately 16 hours, with the greatest flow occurring in the first hour.

The results of the injection test are summarized in Table 2.3-8, and the data collected are presented in Table 2.3-9. Quality of the injected water is presented in Table 2.3-10.

The TV survey, after the injection test of this well, revealed the presence of pieces of cement slab around the borehole just below the inner casing. These pieces were left by the drill bit when it went through the cement plug set at the bottom of the reamed hole prior to cementing the inner casing. Because some of these slabs looked unstable and could partially block the bottom hole of the well if they ever fell out in the future, the contractor was asked to move in a drilling rig and clean out the open hole section of this well.

Biscayne Aquifer Water Quality Monitoring

While drilling the well, water samples were collected and levels measured at each of five shallow monitoring wells installed around the drilling pad. Four of the wells were 2-inch-diameter PVC, approximately 20 feet deep, and located at each corner of the pad. The fifth was 8-inch-diameter steel, approximately 40 feet deep, and was used for supply water during construction. These data are included in Tables 2.3-11 N.E. through 2.3-11 W.S.

Table 2.3-1
SUMMARY OF CASING DATA
WELL I-3

Diameter (inches)	Wall Thickness (inches)	Depth (feet)[a] From	Depth (feet)[a] To	Cemented Section (depth in feet)[a] From	Cemented Section (depth in feet)[a] To
54	0.500	0	145	145	0
44	0.500	0	792	792	0
34	0.500	0	1,800	1,800	0
24	0.500	0	2,629	2,629	0

[a]Measured from the top of the concrete drilling pad.

Table 2.3-2
SUMMARY OF CEMENTING OF CASINGS
WELL I-3

Date	Casing Cemented	Type of Cement Used (API)		Number of Sacks Used	Depth Cemented (ft) From	To
05/16/79	54"	Class H w/25 lb of gilsonite per sack of cement		440	145	0
08/05/79	44"	Lead:	Class H w/12% bentonite	1,588	792	0
		Tail:	Class H neat	675		
09/24/79	34"	Lead:	Class H thixotropic	350	1,800	1,360
		Middle:	Class H w/12% bentonite	2,100		
		Tail:	Class H neat	1,500		
09/27/79	34"	Class H w/12% bentonite		2,514	1,360	1,277
09/29/79	34"	Class H w/12% bentonite		2,521	1,277	1,086
10/01/79	34"	Lead:	Class H w/12% bentonite	300	1,086	1,062
		Tail:	Class H thixotropic	450		
10/01/79	34"	Lead:	Class H w/12% bentonite	300	1,062	942
		Tail:	Class H thixotropic	450		
10/02/79	34"	Class H w/12% bentonite		1,570	942	19
11/26/79	Set cement plug below 24" casing	Class H neat		250	2,668	2,641
12/03/79	24"	Class H neat		3,000	2,641	2,312
12/05/79	24"	Lead:	Class H neat	1,300	2,312	2,085
		Tail:	Class H w/2% bentonite and 2% $CaCl_2$	1,150		

Table 2.3-2--Coninued

Date	Casing Cemented	Type of Cement Used (API)	Number of Sacks Used	Depth Cemented (ft)	
				From	To
12/06/79	24"	Class H w/2% bentonite and 2% $CaCl_2$	2,000	2,085	1,474
12/07/79	24"	Class H w/2% bentonite and 2% $CaCl_2$	2,837	1,474	0

Table 2.3-3
LIST OF GEOPHYSICAL LOGS AND WELL SURVEYS
WELL I-3

Date	Casing Depth and Well Progress	Type of Logs or Surveys Run[a]	Purpose
05/11/79	12-1/4" to 247'	E, G	1. Determine depth to saltwater. 2. Identify base of Biscayne aquifer. 3. Establish setting depth of 54" casing.
07/01/79	54" casing to 145' 12-1/4" hole to 1,000'	E, G, C	1. Identify top of Floridan aquifer. 2. Establish setting detph of 44" casing.
08/29/79	44" casing to 792' 14-3/4" hole to 1,900'	LSN, G, T_s, C, FV_s, GYRO	1. Geohydrological definition of Floridan aquifer. 2. Define production zones. 3. Establish setting depth of 34" casing. 4. Gyroscopic well path track of the pilot hole.
09/18/79	44" casing to 792' 42" hole to 1,810'	GYRO	1. Gyroscopic well path track for comparison to the pilot hole track.
10/29/79 to 11/02/79	34" casing to 1,800' 14-3/4" hole to 2,700'	LSN, G, C, T_S, T_F, FV_F, TV, GYRO	1. Qualitative evaluation of confining bed above Boulder Zone, as well as identification of transmissive zones in this interval. 2. Establish setting depth for 24" casing. 3. Gyroscopic well path track of the pilot hole.

Table 2.3-3--Continued

Date	Casing Depth and Well Progress	Type of Logs or Surveys Run[a]	Purpose
11/17/79	34" casing to 1,800' 32" hole to 2,644'	GYRO	1. Gyroscopic well path track for comparison to the pilot hole track.
12/04/79	Completed first-stage cementing of 24" casing set at 2,629'; <u>no open hole</u>	T_S	1. Determine top of first-stage cement outside 24" casing
01/04/80	24" casing to 2,629' 22" hole to 3,123'	TV	1. Check for apparent obstruction (encountered by temperature logging tool) at 2,792'. 2. Visual qualitative evaluation of receiving zones.
02/08/80	24" casing to 2,629' 22" hole to 3,123'	CBL	1. Confirm adequacy of cementing of 24" casing.
04/03/80	As above	TV	1. Visual inspection of the cement slabs in the borehole.
11/10/80	As above (after cleaning to T.D.)	TV	1. Visual inspection of the cleaned out cement slabs.
11/12/80	As above	LSN, G, C, T_S	1. Geohydrological definition of the injection zone.
01/21/81 and 01/24/81	As above	T_s	1. Temperature profiles for potentiometric survey.

Table 2.3-3--Continued

Date	Casing Depth and Well Progress	Type of Logs or Surveys Run[a]	Purpose
02/03/81	As above	TV	1. Final survey of 24" casing and open hole.

[a]Abbreviations for logs and surveys are as follows:

E = single point electric and SP
LSN = long and short normal and SP
G = gamma ray
C = caliper
T_S = temperature, static
T_F = temperature, flowing
FV_S = fluid velocity (flow meter) static
FV_F = fluid velocity (flow meter) flowing
FC = fluid conductivity

GYRO = gyroscopic directional survey
TV = television
CBL = cement bond, variable density
WTD = wave train display
D. IND = dual induction electric and SP
BCS = borehole compensated sonic
Density = formation density
AV = acoustic velocity
GGD = gamma gamma density (0-500 ft)

Table 2.3-4
COMPARISON OF WELL PATHS FROM GYROSCOPIC SURVEYS
Well I-3

HORIZONTAL DISTANCE AND DIRECTION FROM TARGET WELL TO FOLLOW WELL AT TRUE VERTICAL DEPTHS

FEET	FEET	DIRECTION DEGREES
1789.99	0.26	71.41
1819.99	0.34	84.77
1849.99	0.38	104.69
1879.99	0.41	120.30
1909.99	0.42	123.03
1939.99	0.39	122.58
1969.99	0.39	125.82
1999.99	0.37	118.76
2029.99	0.31	121.02
2059.99	0.31	130.81
2089.99	0.36	135.50
2119.99	0.43	130.38
2149.99	0.50	121.63
2179.99	0.56	118.23
2209.99	0.58	116.15
2239.99	0.56	115.03
2269.99	0.53	114.34
2299.99	0.51	112.36
2329.99	0.53	111.68
2359.99	0.56	114.06
2389.99	0.60	119.24
2419.99	0.64	117.84
2449.99	0.61	110.41
2479.99	0.58	99.76
2509.99	0.58	90.01
2539.99	0.60	88.52
2569.99	0.60	91.91
2599.99	0.59	93.92

WELL PATH COMPARISON

FOLLOW WELL: FILE 804

MIAMI - DADE COUNTY WATER AND SEWAGE AUTHORITY
CH2M WELL I-3; REAM HOLE; 1790 TO 2600 FEET
DADE COUNTY, FRORIDA
NOVEMBER 17, 1979

TARGET WELL: FILE 778

MIAMI - DADE COUNTY WATER AND SEWAGE AUTHORITY
WELL I-3, PILOT HOLE---1860 FEET TO 2640 FEET
DADE COUNTY,FLORIDA
OCTOBER 29,1979

5 DEGREE ANGLE UNIT GYRO SURVEY W/T.A.C.

MEASURED DEPTH FEET	DRIFT ANGLE DEG	DRIFT DIRECTION DEG	TRUE VERTICAL DEPTH FEET	RECTANGULAR COORDINATES FEET	
1760.	0.32	350.00	1759.99	3.75 N	1.19 W
1790.	0.13	38.15	1789.99	3.86 N	1.16 W
1820.	0.10	123.25	1819.99	3.87 N	1.10 W
1850.	0.17	220.81	1849.99	3.81 N	1.09 W
1880.	0.06	212.08	1879.99	3.76 N	1.13 W
1910.	0.03	274.21	1909.99	3.75 N	1.15 W
1940.	0.06	265.45	1939.99	3.75 N	1.18 W
1970.	0.13	91.80	1969.99	3.72 N	1.18 W
2000.	0.09	325.30	1999.99	3.76 N	1.15 W
2030.	0.04	249.98	2029.99	3.77 N	1.18 W
2060.	0.04	105.68	2059.99	3.75 N	1.18 W
2090.	0.09	195.82	2089.99	3.72 N	1.17 W
2120.	0.18	62.99	2119.99	3.68 N	1.12 W
2150.	0.03	147.00	2149.99	3.67 N	1.07 W
2180.	0.14	30.41	2179.99	3.67 N	1.04 W
2210.	0.05	42.65	2209.99	3.71 N	1.01 W
2240.	0.10	239.50	2239.99	3.73 N	1.02 W
2270.	0.09	250.54	2269.99	3.71 N	1.06 W
2300.	0.04	224.60	2299.99	3.70 N	1.09 W
2330.	0.05	138.00	2329.99	3.67 N	1.09 W
2360.	0.07	238.00	2359.99	3.64 N	1.10 W
2390.	0.11	129.60	2389.99	3.60 N	1.10 W
2420.	0.16	4.11	2419.99	3.62 N	1.05 W
2450.	0.22	28.23	2449.99	3.71 N	1.02 W
2480.	0.06	357.93	2479.99	3.78 N	1.00 W
2510.	0.13	336.37	2509.99	3.83 N	1.01 W
2540.	0.12	277.00	2539.99	3.87 N	1.06 W
2570.	0.12	285.95	2569.99	3.88 N	1.13 W
2600.	0.00	0.00	2599.99	3.89 N	1.16 W

FINAL CLOSURE - DIRECTION: 343.451 DEGS CLOCKWISE FROM NORTH
DISTANCE: 4.06 FEET

MIAMI - DADE COUNTY WATER AND SEWAGE AUTHORITY
CH2M WELL I-3; REAM HOLE; 1790 TO 2600 FEET
DADE COUNTY, FRORIDA
NOVEMBER 17, 1979

RECORD OF SURVEY

RADIUS OF CURVATURE METHOD

Table 2.3-5
DESCRIPTIVE SUMMARY OF UNDERWATER TELEVISION SURVEY
WELL I-3

CH2M HILL

RECORD OF UNDERWATER TV SURVEY

Project: Miami Dade Water & Sewer Authority, South District Regional Wastewater Treatment Plant

Well: I-3 Final

Survey By: Deep Venture Diving Service, Perry, Florida

Survey Date: 2/03/81 Total Depth: 3,122 feet

Witnessed By: D. Cabit, D. Snyder, T. McCormick

Reviewed By: J. D. Lehnen Date: 2/24/81

Remarks:

Depth in Feet		Reel Counter		Observations
From	To	From	To	
--	--	0	16	Titles
0	2,690	16	341	24" casing
2,690	2,629	341	348	Bottom of casing, adjust depth indicator to 2,629'
2,629	2,640	348	353	Large diameter hole
2,640	2,649	353	371	Cement chunk along borehole side, hole is open
2,649	2,659	371	376	Slab visible along borehole wall
2,659	2,663	376	378	Large hole, wall poorly visible
2,663	2,771	378	436	Large hole, rough walls
2,771	2,793	436	448	Small cavities, some fracturing
2,793	2,840	448	475	Good visibility, fractures and cavities
2,840	2,860	475	485	High angle fractures, solution features
2,860	2,910	485	508	Smoother walls, some fractures
2,910	2,930	508	518	More fractures and cavities
2,930	2,943	518	525	Cavities, highly fractured

RECORD OF UNDERWATER TV SURVEY

Project: Miami Dade Water & Sewer Authority, South District Regional Wastewater Treatment Plant

Well: I-3 Date: 2/03/81 Total Depth: 3,122'

Depth in Feet		Reel Counter		Observations
From	To	From	To	
2,943	2,996	525	551	Large cavities, rubblized formation
2,996	3,044	551	567	Smooth walls, high angle fractures
3,044	3,047	567	568	Cavities
3,047	3,077	568	577	Smooth walls, fractures
3,077	3,122	577	595	Rough walls, fractured, small cavities
--	3,122	595	--	Bottom of hole
3,122	2,584	595	632	Coming out of the hole
--	2,584	--	632	End of tape

Table 2.3-6
LITHOLOGY FROM PILOT HOLE FORMATION SAMPLES
WELL I-3

Depth Interval (ft) From	To	Description
0	10	Rock fill, limestone, buff
10	20	Limestone, hard, tan-buff, dolimite, calcite fragments (lost circ. 20')
20	30	Limestone, as above, with quartz sand, angular sub-angular, coarse to medium fine grain
30	40	Limestone, as above with 40 percent quartz sand
40	50	As above, more sand
50	60	As above
60	70	Sandstone, in calcareous matrix, more frosted grains
70	80	As above (lost circ. 74')
80	90	Limestone, tan-buff, sand and some fossil molds
90	100	Limestone, as above, with very fine grained silty sand, shell fragments
100	110	As above
110	120	Limestone, buff to white, sandy, with some shell fragments
120	130	As above with green siltstone, calcareous
130	140	As above, no siltstone, more shell fragments, 15 percent
140	150	As above
150	160	As above with limestone sand, medium fine
160	170	Limestone, greenish tan, and fine sand size grains, some quartz sand, some shell
170	180	As above, little sand, more tan-buff, light sand
180	190	Gray-green siltstone; limestone, tan-buff, no shell
190	200	As above, some shell fragments
200	210	Siltstone, olive green clay, little limestone, very soft

Table 2.3-6--Continued

Depth Interval (ft)		
From	To	Description
210	220	As above
220	230	As above
230	240	As above
240	250	As above
250	260	Limestone, buff to white, trace of siltstone, as above, 90 percent cement sample
260	270	As above
270	280	As above
280	290	As above, no siltstone, some micro-crystalline, some secondary porosity, chalky
290	300	As above, chalky
300	310	90 percent cement in sample, rock, as above
310	320	Limestone, as above
320	330	As above, with some fossil casts
330	340	Limestone, as above, with quartz sand and trace of green siltstone
340	350	As above, some shell fragments
350	360	As above, no shell fragments
360	370	60 percent cement sample, limestone, as above, and green siltstone
370	380	90 percent cement sample, some shell fragments, sand, limestone, as above
380	390	Cement sample, limestone, as above
390	400	Limestone, sandy, white to buff, some fossil
400	410	As above, white, small fragments
410	420	As above, 50 percent cement sample

Table 2.3-6--Continued

Depth Interval (ft)		
From	To	Description
420	430	As above, with some calcite
430	440	Limestone, as above
440	450	As above, with some gray-tan silty clay
450	460	Limestone, buff to tan, sandy with small casts
460	470	As above, with green silty clay
470	480	As above
480	490	Limestone, buff to tan, with gray-tan silty clay, sticky
490	500	As above, with shell casts and molds
500	510	As above
510	520	As above, with cement in sample
520	530	As above, with no clay, silt size particles abundant
530	540	Limestone, tan-buff, shell fragments, quartz sand
540	550	As above
550	560	As above, with limestone sand
560	570	As above
570	580	Limestone, white-tan, abundant calcite fragments and coarse-fine quartz sand
580	590	As above
590	600	As above, with shell fragments
600	610	Limestone, tan, with shell fragments, little sand
610	620	As above
620	630	Limestone, tan, fine sand size abundant, some quartz sand, sub-angular
630	640	As above
640	650	As above

Table 2.3-6--Continued

Depth Interval (ft)		
From	To	Description
650	660	As above
660	670	As above
670	680	As above
680	690	Limestone, white-buff, abundant calcite, some shell fragments
690	700	As above
700	710	As above, mostly fine sand size particles abundant quartz sand
710	720	As above
720	730	As above
730	740	As above
740	750	As above
750	760	As above
760	770	Limestone, tan, fine sand size, some white shell fragments, quartz sand
770	780	As above
780	790	Limestone, tan to white, some limestone sand, quartz sand
790	800	As above
800	810	As above
810	820	As above
820	830	As above
830	840	As above
840	850	As above
850	860	As above
860	870	As above

Table 2.3-6--Continued

Depth Interval (ft) From	To	Description
870	880	Limestone, tan, fine sand size particles 60 percent some quartz sand
880	890	As above
890	900	As above
900	910	As above
910	920	As above
920	930	As above, very little quartz sand
930	940	Limestone, tan to white, some calcite and fossil
940	950	As above, with abundant cones, fossiliferous
950	960	As above
960	970	As above
970	980	Limestone, tan, fossiliferous, some shell fragments, trace of quartz sand
980	990	Limestone, buff, chalky, some shell fragments, trace of quartz sand
990	1,000	Limestone, buff-white, chalky, some fossils, few shell fragments, medium-soft
1,000	1,010	As above, some calcite fragments, quartz sand
1,010	1,020	As above
1,020	1,030	As above
1,030	1,040	As above
1,040	1,050	Limestone, dolomitic, tan-gray-brown, medium hard, some fossils
1,050	1,060	As above
1,060	1,070	Limestone, sandy, calcite cement, buff, medium soft, some shell fragments
1,070	1,080	As above

Table 2.3-6--Continued

Depth Interval (ft)		
From	To	Description
1,080	1,090	As above
1,090	1,100	As above, with abundant shell fragments, some cones
1,100	1,110	As above
1,110	1,120	Limestone, buff, little quartz sand, shell fragments, some cones, chalky
1,120	1,130	As above
1,130	1,140	As above
1,140	1,150	As above
1,150	1,160	As above
1,160	1,170	As above
1,170	1,180	Limestone, buff, sandy, calcite cement, medium soft some shell fragments, cones
1,180	1,190	As above
1,190	1,200	As above
1,200	1,210	As above
1,210	1,220	As above
1,220	1,230	As above
1,230	1,240	As above
1,240	1,250	As above
1,250	1,260	As above
1,260	1,270	As above
1,270	1,280	As above
1,280	1,290	As above, medium hard, few shell fragments
1,290	1,300	As above

Table 2.3-6--Continued

Depth Interval (ft)		
From	To	Description
1,300	1,310	Limestone, buff, hard, microfossils present, some quartz sand
1,310	1,320	As above
1,320	1,330	As above
1,330	1,340	As above
1,340	1,350	As above
1,350	1,360	As above
1,360	1,370	Limestone, tan-buff, medium hard, some shell fragments, quartz sand, cones
1,370	1,380	Limestone, white, medium soft, chalky, some calcite
1,380	1,390	Limestone, tan-buff, medium soft, quartz sand abundant
1,390	1,400	As above
1,400	1,410	Limestone, white-tan, medium soft, chalky, some calcite
1,410	1,420	As above, fossiliferous
1,420	1,430	As above
1,430	1,440	Limestone, fossiliferous, abundant calcite, tan, little quartz sand
1,440	1,450	Limestone, tan-gray, hard, some fossils, massive
1,450	1,460	As above
1,460	1,470	Limestone, fossiliferous, tan, medium soft
1,470	1,480	As above
1,480	1,490	As above
1,490	1,500	Limestone, white-gray, few fossils, massive
1,500	1,510	As above
1,510	1,520	As above, fossiliferous, quartz sand

Table 2.3-6--Continued

Depth Interval (ft)		
From	To	Description
1,520	1,530	As above
1,530	1,540	Limestone, tan, soft, clayey, fossiliferous, sandy
1,540	1,550	As above
1,550	1,560	Limestone, tan-gray, medium hard, few fossils
1,560	1,570	Limestone, tan, fossiliferous, some quartz sand
1,570	1,580	As above
1,580	1,590	As above, no sand
1,590	1,600	Limestone, white, medium hard, fossils, massive
1,600	1,610	Limestone, as above, white to buff
1,610	1,620	Limestone, as above
1,620	1,630	Limestone, as above
1,630	1,640	Limestone, as above, dark tan, fossils present, massive
1,640	1,650	Limestone, as above, white to buff
1,650	1,660	Limestone, tan, massive, medium hard
1,660	1,670	Limestone, tan to buff, porous, more angular, soft to medium hard, massive
1,670	1,680	Limestone, as above, smaller grains and a few fossils
1,680	1,690	Limestone, as above
1,690	1,700	Limestone, dark tan, hard, massive, porous, rounded fragments
1,700	1,710	Limestone, tan to buff, small grained, microfossils and lime silt present
1,710	1,720	Limestone, tan, hard to medium hard, some lime silt and fine sand
1,720	1,730	Limestone, tan to buff, porous, soft to hard, some lime silt and fine sand

Table 2.3-6--Continued

Depth Interval (ft)		
From	To	Description
1,730	1,740	Limestone, clay, gray to dark gray, soft and lime silt, fine sand
1,740	1,750	Limestone, tan to buff, massive, hard, some recrystallized limestone and fine sand
1,750	1,760	Limestone, chalky, white, massive, hard
1,760	1,770	Limestone, tan to buff, massive, some recrystallized limestone and fine sand
1,770	1,780	As above
1,780	1,790	As above
1,790	1,800	As above
1,800	1,810	As above
1,810	1,820	As above
1,820	1,830	As above
1,830	1,840	As above
1,840	1,850	As above
1,850	1,860	As above
1,860	1,870	As above
1,870	1,880	As above
1,880	1,890	As above
1,890	1,900	Limestone, tan, hard, angular, massive, some recrystallized and dolomite
1,900	1,910	Limestone, tan to dark gray, soft to hard, medium to fine grained
1,910	1,920	Limestone, tan to buff, small grains, hard, some fossils and sand
1,920	1,930	Limestone, tan to buff, angular, medium hard to hard some silt and sand

Table 2.3-6--Continued

Depth Interval (ft) From	To	Description
1,930	1,940	Limestone, buff, soft to medium hard, some sand and a few fossils
1,940	1,950	As above
1,950	1,960	As above
1,960	1,970	As above, some gray limestone
1,970	1,980	As above
1,980	1,990	As above
1,990	2,000	As above with color change to tan
2,000	2,010	As above, buff color
2,010	2,020	Limestone, tan, medium hardness
2,020	2,030	As above
2,030	2,040	Limestone, as above, smaller grains, some gray
2,040	2,050	As above
2,050	2,060	As above
2,060	2,070	As above
2,070	2,080	As above
2,080	2,090	As above
2,090	2,100	Limestone, tan, medium hardness
2,100	2,110	As above
2,110	2,120	As above
2,120	2,130	As above, smaller in size, with hard gray limestone
2,130	2,140	As above
2,140	2,150	As above
2,150	2,160	As above

Table 2.3-6--Continued

Depth Interval (ft) From	To	Description
2,160	2,170	As above
2,170	2,180	Limestone, dolomitic, tan to brown, soft to medium hard, coarse to fine grained
2,180	2,190	Limestone, as above
2,190	2,200	Limestone, as above
2,200	2,210	Limestone, as above
2,210	2,220	Limestone, as above
2,220	2,230	Limestone, as above
2,230	2,240	Limestone, as above
2,240	2,250	Limestone, as above
2,250	2,260	Limestone, as above
2,260	2,270	Limestone, as above
2,270	2,280	Limestone, as above
2,280	2,290	Limestone, as above
2,290	2,300	Limestone, as above
2,300	2,310	Limestone, as above
2,310	2,320	Limestone, as above
2,320	2,330	Limestone, as above
2,330	2,340	Limestone, as above
2,340	2,350	Limestone, buff to gray, soft to medium hard, angular, some sand
2,350	2,360	Limestone, tan, soft to medium hard, fine to coarse grained
2,360	2,370	As above
2,370	2,380	Limestone, buff, gray, and tan, soft to medium hard

Table 2.3-6--Continued

Depth Interval (ft) From	To	Description
2,380	2,390	Limestone, as above
2,390	2,400	Limestone, as above
2,400	2,410	Limestone, as above
2,410	2,420	Limestone, buff, medium hard to hard, some fossils, traces of gray dolomite
2,420	2,430	As above
2,430	2,440	Limestone, tan to buff, medium hard to hard, some recrystallized with traces of dolomite, fossiliferous
2,440	2,450	Limestone, buff to gray, small and angular, medium hard to hard, some silt
2,450	2,460	Dolomite, gray, hard, traces of limestone
2,460	2,470	Dolomite/limestone, hard, brown to gray, crystalline; limestone, tan, medium hard
2,470	2,480	Limestone/dolomite as above
2,480	2,490	Limestone, white, tan, gray, fine grained, medium hard to soft
2,490	2,500	Limestone, white, tan, gray, medium soft to hard, some bitumen
2,500	2,510	Limestone, white, tan, gray, soft to hard, some recrystallization with few dolomite chips
2,510	2,520	As above
2,520	2,530	As above
2,530	2,540	As above
2,540	2,550	As above
2,550	2,560	Limestone, dark tan, dark gray, soft to hard, some recrystallization
2,560	2,570	Limestone, as above
2,570	2,580	Limestone as above

Table 2.3-6--Continued

Depth Interval (ft)		
From	To	Description
2,580	2,590	Samples missing
2,590	2,600	Samples missing
2,600	2,610	Samples missing
2,610	2,620	Samples missing
2,620	2,630	Samples missing
2,630	2,640	Samples missing
2,640	2,650	Samples missing
2,650	2,660	Limestone, buff to gray, medium hard, coarse to fine grains, some recrystallization
2,660	2,670	Limestone, as above, smaller grains, some sand
2,670	2,680	Limestone, white, coarse to fine, soft to medium hard
2,680	2,690	Limestone, tan, fine grained, medium hard
2,690	2,700	Limestone, light to dark gray, recrystallized, hard
2,700	2,710	Same as above
2,710	2,720	Limestone, white, medium hard, mixed with crystalline dolomite and well formed crystal masses
2,720	2,730	As above
2,730	2,740	Limestone, white to gray, medium hard, some dolomite
2,740	2,750	Same as above
2,750	2,760	Same as above
2,760	2,770	Same as above
2,770	2,780	Same as above
2,780	2,790	Same as above
2,790	2,800	Tan to gray dolomite, very hard
2,800	2,810	Dolomite, dark brown, hard, microcrystalline

Table 2.3-6--Continued

Depth Interval (ft) From	To	Description
2,810	2,820	As above
2,820	2,830	As above
2,830	2,840	As above
2,840	2,850	Dolomite, tan, hard, microcrystalline
2,850	2,860	Dolomite, tan, hard, microcrystalline
2,860	2,870	Dolomite, tan, hard, microcrystalline
2,870	2,880	Dolomite, tan, hard, microcrystalline
2,880	2,890	Dolomite, tan to gray, microcrystalline, hard, some soft white limestone
2,890	2,900	As above
2,900	2,910	As above
2,910	2,920	As above
2,920	2,930	As above
2,930	2,940	Dolomite, dark brown and gray, massive, hard, crystalline
2,940	2,950	Dolomite, gray and brown, crystalline; limestone, tan to white, medium hard
2,950	2,960	Dolomite, gray to brown, massive and hard, crystalline
2,960	2,970	Dolomite, tan to brown and gray, hard, microcrystalline in part
2,970	2,980	Dolomite, crystalline, tan to gray, small grains, hard, brittle
2,980	2,990	Limestone, white, hard; dolomite, tan, crystalline
2,990	3,000	Dolomite, tan to gray, hard
3,000	3,010	As above
3,010	3,020	As above

Table 2.3-6--Continued

Depth Interval (ft)		
From	To	Description
3,020	3,030	As above
3,030	3,040	As above
3,040	3,050	Dolomite, as above
3,050	3,060	Dolomite, as above
3,060	3,070	Dolomite, as above
3,070	3,080	Dolomite, as above
3,080	3,090	Dolomite, as above
3,090	3,100	Dolomite, as above
3,100	3,110	Dolomite, as above
3,110	3,120	Dolomite, as above

Table 2.3-7
WATER QUALITY DATA FROM PILOT HOLE DRILLING
WELL I-3

Date	Time	Depth (ft)	Temperature (°C)	Specific Gravity	Specific Conductance (μmhos/cm)	Chlorides (mg/l)
08/13	2130	1,000	27.5	1.0250	5,500	550
08/14	0500	1,031	27.0	--	5,500	200
08/14	1200	1,062	27.0	--	5,000	150
08/14	1600	1,096	27.0	1.0005	5,000	140
08/14	2300	1,127	27.0	1.0010	5,200	180
08/15	0600	1,157	27.0	1.0010	6,000	110
08/15	0900	1,187	27.0	1.0010	5,500	120
08/15	1300	1,217	27.0	1.0010	4,500	200
08/15	1700	1,246	27.0	1.0010	3,700	130
08/15	0500	1,276	27.0	1.0010	3,700	110
08/20	1200	1,307	27.0	1.0010	3,900	100
08/20	1600	1,335	27.0	1.0010	2,000	80
08/21	2330	1,365	27.0	1.0000	1,350	70
08/21	1200	1,401	27.0	1.0000	1,320	120
08/21	1830	1,435	28.0	1.0000	1,600	50
08/21	2330	1,461	27.5	1.0000	1,390	60
08/22	0400	1,491	27.0	1.0000	950	50
08/22	1300	1,522	27.0	1.0000	110	80
08/22	2230	1,549	27.5	1.0000	990	60
08/23	0530	1,580	27.0	1.0000	620	50
08/23	2230	1,610	27.0	1.0050	1,000	58
08/25	2140	1,644	27.0	1.0000	800	52
08/26	2000	1,677	27.0	1.0000	800	140

Table 2.3-7--Continued

Date	Time	Depth (ft)	Temperature (°C)	Specific Gravity	Specific Conductance (μmhos/cm)	Chlorides (mg/l)
8/27	0200	1,708	27.5	1.0000	1,600	330
8/27	0200	1,708	27.5	1.0000	1,600	330
8/27	1200	1,773	27.0	1.0000	625	310
8/27	1600	1,804	27.0	1.0000	460	330
8/27	2000	1,838	26.5	1.0000	1,820	490
8/28	0130	1,872	27.0	1.0000	1,500	410
8/28	0830	1,900	27.0	1.0000	2,000	630
10/19	1600	1,930	27.0	1.0100	25,000	10,300
10/20	0500	1,962	26.0	1.0085	19,500	10,300
10/20	1330	1,992	28	1.0050	18,000	7,100
10/20	1600	2,024	27.5	1.0055	18,500	8,700
10/21	0015	2,059	29.0	1.0085	17,000	8,400
10/21	0630	2,092	26.5	1.0110	14,000	7,100
10/21	0830	2,124	26.0	1.0250	14,500	6,000
10/21	1630	2,154	27.5	1.0050	11,500	6,000
10/22	0200	2,184	25.5	1.0055	13,500	5,500
10/22	0600	2,214	26.5	1.0050	10,000	5,000
10/22	1100	2,250	26.5	1.0050	13,000	6,000
10/23	0300	2,280	25.5	1.0080	10,500	5,600
10/23	0600	2,312	25.0	1.0020	9,000	4,300
10/23	1230	2,344	25.5	1.0040	12,000	5,100
10/23	2000	2,376	25.0	1.0045	13,000	5,500
10/23	0215	2,408	25.0	1.0004	13,400	5,600

Table 2.3-7--Continued

Date	Time	Depth (ft)	Temperature (°C)	Specific Gravity	Specific Conductance (μmhos/cm)	Chlorides (mg/l)
10/24	1045	2,444	26.5	1.0060	14,000	6,300
10/25	0230	2,477	25.0	1.0082	15,500	6,700
10/25	0715	2,508	25.0	1.0084	15,600	6,800
10/25	2030	2,543	26.5	1.0035	7,600	4,500
10/26	0230	2,573	27.0	1.0025	6,250	4,200
10/26	1100	2,606	26.5	1.009	7,000	3,600
10/26	1600	2,637	26.5	1.0085	5,500	3,500
10/27	0330	2,670	26.4	1.0072	5,600	3,600
10/27	0710	2,700 to 1,800	26.4	1.0070	5,650	3,550[a]
10/30	1030	1,800 to 2,700	24.0	1.0150	27,000	11,700
12/12	1840	2,740	21.0	4.0255	55,000	22,000
12/13	0600	2,771	26.0	1.0248	40,000	20,700
12/13	0330	2,804	--	1.0260	45,000	22,000
12/14	1600	2,820	--	1.0280	--	--
12/15	1045	2,838	23.0	1.02500	38,000	20,500
12/17	0200	2,870	23.0	1.02510	35,000	20,500
12/19	1000	2,913	21.5	1.025	42,000	21,200
12/20	0700	2,932	21.5	1.0300	43,000	20,900
12/22	0300	2,988	23.0	1.0260	44,000	21,000
12/22	2000	2,999	19.0	1.0280	41,000	21,200
12/28	1030	3,030	21.0	1.0253	45,000	22,000
12/29	1730	3,060	18.5	1.0254	41,000	23,000

Table 2.3-7--Continued

Date	Time	Depth (ft)	Temperature (°C)	Specific Gravity	Specific Conductance (μmhos/cm)	Chlorides (mg/l)
12/30	0740	3,069	18.5	1.0256	55,000	23,000
12/21	0430	3,093	18.0	1.0254	40,000	23,200
12/31	2045	3,123	18.0	1.0258	39,000	23,200

[a]Composite sample while pumping at 500 gpm.

Table 2.3-8
SUMMARY OF INJECTION TEST RESULTS
WELL I-3

Pumping Rate	10,200 gpm
Test Duration	13 hours
Time Elapsed to Reach Maximum Injection Head After Pumping Started	270 minutes
Maximum Injection Head[a]	94.8 feet of water
Static Freshwater Head[a,b]	70 feet of water

[a]Feet of water referred to pad level.
[b]Due to density difference between injected freshwater and formation saltwater.

Table 2.3-9
INJECTION TEST DATA
WELL I-3
(Wellhead pressure measuring point @ 4.03' above pad)

Actual Time	Time Since Pump Started (min)	Flow (gpm)	Wellhead Pressure (feet of water)	Totalizer (gallons x 1,000)	Remarks
0810	0	0	0	63,731	Start injecting
0811	1	10,000	25.0	63,750	
0812	2	9,000	42.0	63,759	
0813	3	9,000	45.0	63,770	
0814	4	8,000	60.0	63,777	
0815	5	10,000	76.0	63,787	Flow calculated from totalizer = 10,000 gpm
0816	6	9,000	83.0	63,797	
0817	7	9,000	86.0	63,807	
0818	8	10,000	88.0	63,817	
0819	9	10,000	89.0	63,827	
0820	10	10,000	89.0	63,835	Flow calculated from totalizer = 8,000 gpm
0822	12	10,000	90.0	63,846	
0824	14	10,000	89.5	63,866	
0826	16	10,000	89.6	63,887	
0828	18	10,000	89.6	63,907	
0830	20	10,000	89.7	63,927	Flow calculated from totalizer = 10,000 gpm
0835	25	10,000	89.8	63,978	Flow calculated from totalizer = 10,200 gpm
0840	30	10,000	90.0	64,029	10,200 gpm

Table 2.3-9--Continued

Actual Time	Time Since Pump Started (min)	Flow (gpm)	Wellhead Pressure (feet of water)	Totalizer (gallons x 1,000)	Remarks
0845	35	10,000	90.2	64,080	Flow calculated from totalizer = 10,200 gpm
0850	40	10,000	90.2	64,131	10,200 gpm
0855	45	10,000	90.1	64,182	10,200 gpm
0900	50	10,000	90.2	64,233	10,200 gpm
0905	55	10,000	90.2	64,283	10,000 gpm
0910	60	10,000	90.1	64,335	10,400 gpm
0920	70	10,000	90.2	64,433	9,800 gpm
0930	80	10,000	90.1	64,536	10,300 gpm
0940	90	10,000	90.2	64,638	10,200 gpm
0950	100	10,000	90.2	64,740	10,200 gpm
1000	110	10,000	90.3	64,840	10,000 gpm
1010	120	10,000	90.3	64,942	10,200 gpm
1040	150	10,000	90.5	65,248	10,200 gpm
1110	180	10,000	90.6	65,552	10,135 gpm
1140	210	10,000	90.7	65,860	10,270 gpm
1210	240	10,000	90.7	66,166	10,200 gpm
1240	270	10,000	90.8	66,472	10,200 gpm
1310	300	10,000	90.8	66,778	10,200 gpm
1340	330	10,000	90.8	67,084	Flow calculated from totalizer = 10,200 gpm
1410	360	10,000	90.7	67,389	10,170 gpm
1440	390	10,000	90.8	67,694	10,170 gpm
1510	420	10,000	90.8	67,999	10,170 gpm

Table 2.3-9--Continued

Actual Time	Time Since Pump Started (min)	Flow (gpm)	Wellhead Pressure (feet of water)	Totalizer (gallons x 1,000)	Remarks
1540	450	10,000	90.7	68,305	10,200 gpm
1610	480	10,000	90.7	68,611	10,200 gpm
1640	510	10,000	90.7	68,915	10,135 gpm
1710	540	10,000	90.7	69,220	10,170 gpm
1740	570	10,000	90.7	69,525	10,170 gpm
1810	600	10,000	90.7	69,829	10,135 gpm
1840	630	10,000	90.6	70,133	10,135 gpm
1910	660	10,000	90.4	70,438	10,170 gpm
1940	690	10,000	90.4	70,742	10,135 gpm
2010	720	10,000	90.3	71,048	10,200 gpm
2040	750	10,000	90.1	71,356	10,270 gpm
2110	780	10,000	90.1	71,659	Shut off pump at 2110 hours
2112	782	0	66.4	71,659	Total flow average = 10,164 gpm
2113	783	0	66.3	71,659	
2114	784	0	66.3	71,659	
2115	785	0	66.2	71,659	
2120	790	0	66.2	71,659	
2125	795	0	66.2	71,659	
2130	800	0	66.2	71,659	
2200	830	0	66.1	71,659	
2300	890	0	66.0	71,659	
2400	950	0	65.9	71,659	
0100	1,010	0	65.9	71,659	

Table 2.3-9--Continued

Actual Time	Time Since Pump Started (min)	Flow (gpm)	Wellhead Pressure (feet of water)	Totalizer (gallons x 1,000)	Remarks
0200	1,070	0	65.9	71,659	
0300	1,130	0	65.9	71,659	
0400	1,190	0	65.9	71,659	
0500	1,250	0	65.9	71,659	
0600	1,310	0	65.9	71,659	
1230	1,700	0	65.4	71,659	Start backflow at 1233 hours
1234	1,704	0	64.6	71,659	Continue backflow
1235	1,705	0	64.4	71,659	Continue backflow

Table 2.3-9--Continued

Actual Time	Time Since Pump Started (min)	Flow (gpm)	Wellhead Pressure (ft of water)	Remarks
1236	1,706	0	64.2	Continue backflow
1237	1,707	0	63.8	Continue backflow
1238	1,708	0	63.5	Continue backflow
1239	1,709	0	63.0	Continue backflow
1240	1,710	0	62.7	Continue backflow
1245	1,715	0	59.4	Continue backflow
1250	1,720	0	49.5	Continue backflow
1255	1,725	0	39.0	Continue backflow
1300	1,730	0	32.5	Continue backflow
1305	1,735	0	27.0	Continue backflow
1310	1,740	0	23.4	Increase backflow rate; open valve half
1315	1,745	0	15.0	
1520	1,870	0	12.0	Conductance = 31,000 μhos/cm; density =1.019; chloride = 15,900; temperature = 71°F
0530	--	0	0	Bled off

Table 2.3-10
QUALITY OF INJECTED WATER
WELL I-3

Date	Time	Temperature (°C)	Specific Gravity	Specific Conductance (μmhos/cm)	Chloride (mg/l)
03/25	0815	24.5	1.000	850	370
03/25	0900	24.4	1.000	690	150
03/25	1000	24.4	1.000	650	110
03/25	1100	24.4	1.000	650	140
03/25	1200	25.0	1.000	570	130
03/25	1300	25.0	1.000	625	110
03/25	1400	25.0	1.000	620	120
03/25	1500	25.0	1.000	590	180
03/25	1600	25.0	1.000	580	170
03/25	1700	25.0	1.000	600	180
03/25	1800	24.4	1.000	480	220
03/25	1900	24.4	1.000	550	170
03/25	2000	25.0	1.000	550	170
03/25	2100	24.4	1.000	510	140

Table 2.3-11 N.E.
WATER QUALITY OF THE BISCAYNE AQUIFER--N.E. MONITOR WELL
SITE I-3

Date	Time	Temperature (°C)	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
04/20	1838	23.0	650	61	10.87	
04/26	--	22.0	700	77	9.74	
05/01	1225	22.0	810	97	9.60	
05/08	1659	22.0	780	92	9.65	
05/15	1810	22.0	850	120	9.83	
05/22	1315	24.0	850	110	9.84	
05/29	2105	24.0	950	130	9.70	
06/05	2200	24.5	840	140	9.85	
06/12	1650	25.5	900	140	9.83	
06/19	0940	25.5	800	140	8.94	
06/26	0910	25.0	790	130	9.90	
07/03	0840	25.5	1,150	140	9.80	
07/11	0850	26.0	1,080	160	8.10	
07/17	0845	26.7	760	140	8.30	
07/24	1000	27.0	650	130	9.45	
07/31	0930	26.5	700	130	9.40	
08/07	0805	26.5	675	140	9.50	
08/14	1600	27.5	600	130	8.54	
08/21	1005	28.5	650	130	9.35	
08/28	1230	28.0	725	140	9.30	
09/06	1007	28.0	520	140	9.20	
09/11	0936	28.0	420	140	9.40	
09/18	0905	31.0	440	220	9.40	

Table 2.3-11 N.E.--Continued

Date	Time	Temperature (°C)	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
09/25	0945	29.0	650	200	9.45	
10/02	0935	29.0	850	260	9.25	
10/09	0930	29.0	650	200	9.46	
10/16	0910	28.0	600	200	9.22	
10/23	1000	28.0	740	250	9.30	
10/30	0900	29.0	650	150	9.36	
11/06	0700	29.0	710	140	9.34	
11/13	0830	29.0	700	150	9.30	
11/20	0900	28.0	620	160	9.34	
11/27	0900	27.5	610	180	9.30	
12/04	0900	27.0	610	180	9.28	
12/11	0900	27.5	600	180	9.38	
12/18	0900	25.5	580	130	9.42	
12/27	1130	25.5	540	70	9.39	
01/01	1130	25.5	590	100	9.43	
01/08	1000	26.5	580	80	9.56	
01/15	1000	26.5	650	90	9.35	
01/22	1100	26.1	535	100	9.31	
01/29	1100	25.6	500	110	9.46	
02/04	1300	25.0	460	100	9.35	
02/12	1300	25.0	600	140	9.43	
02/19	1300	25.0	570	120	11.62	Changed measuring point
02/26	1300	24.4	530	110	11.85	

Table 2.3-11 N.E.--Continued

Date	Time	Temperature (°C)	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
03/04	1300	23.9	430	100	11.85	
03/11	1400	24.4	400	100	11.91	
03/18	1000	24.4	415	90	11.88	
03/25	1500	24.4	590	150	12.79	

Table 2.3-11 N.W.
WATER QUALITY OF THE BISCAYNE AQUIFER--N.W. MONITOR WELL
SITE I-3

Date	Time	Temperature (°C)	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
04/20	1838	21.0	430	58	12.70	
04/26	1100	22.0	400	58	10.55	
05/01	1216	21.5	390	56	10.46	
05/08	1715	22.0	400	57	10.53	
05/15	1820	22.0	380	61	10.64	
05/22	1315	24.0	380	61	10.66	
05/29	2115	24.5	520	60	10.56	
06/05	2215	25.0	440	60	10.70	
06/12	1720	25.0	450	70	10.69	
06/19	0920	25.5	440	60	10.60	
06/26	0925	25.5	470	60	10.73	
07/03	0845	25.5	850	70	10.60	
07/11	0845	26	700	50	10.50	
07/17	0905	26.5	800	70	10.65	
07/24	1005	26.5	800	80	10.40	
07/31	0925	26.5	620	100	10.80	
08/07	--	--	--	--	--	
08/14	1600	--	--	--	--	
08/21	1000	27.5	2,000	320	--	
08/28	1225	29.0	1,450	230		
09/06	--	--	--	--	--	
09/11	--	--	--	--	--	
09/18	0910	30.0	500	250	10.00	Changed measuring point

Table 2.3-11 N.W.--Continued

Date	Time	Temperature (°C)	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
09/25	0950	28.0	845	210	10.03	
10/02	0945	28.0	800	180	9.83	
10/09	0935	29.0	815	200	10.03	
10/16	0915	28.0	700	180	9.82	
10/23	1005	29.0	750	150	9.85	
10/30	0905	28.0	710	150	9.90	
11/06	0705	28.0	780	90	9.95	
11/12	0835	28.0	800	100	9.90	
11/20	0905	27.0	650	110	9.92	
11/27	0905	27.5	625	120	9.86	
12/04	0905	26.5	625	130	9.88	
12/11	0905	27.5	600	120	9.88	
12/18	0905	25.5	590	80	10.01	
12/27	1140	25.5	550	50	10.10	
01/01	1135	25.5	525	50	9.11	
01/08	1005	26.5	550	50	9.25	
01/15	1005	--	well broken in moving rig			
01/22	1105	25.6	950	240	8.63	Changed measuring point
01/29	1105	25.0	970	210	8.65	
02/01	1305	25.0	800	230	8.51	
02/12	1305	24.4	900	180	8.45	
02/19	1305	23.9	790	170	11.16	Changed measuring point

Table 2.3-11 N.W.--Continued

Date	Time	Temperature (°C)	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
02/26	1305	23.3	720	180	11.30	
03/04	1305	23.3	540	150	11.42	
03/11	1405	23.9	600	130	11.40	
03/18	1005	23.9	580	130	11.36	
03/25	1505	23.9	580	150	11.57	

Table 2.3-11 S.E.
WATER QUALITY OF THE BISCAYNE AQUIFER--S.E. MONITOR WELL
SITE I-3

Date	Time	Temperature (°C)	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
04/20	1838	--	--	--	--	
04/26	1105	--	--	--	--	
04/27	1230	24.0	650	47	9.09	
05/01	1205	23.0	700	64	8.89	
05/08	1644	23.0	680	57	8.99	
05/15	1800	22.0	690	60	9.34	
05/22	1315	25.0	650	61	10.03	
05/29	2120	25.0	775	60	9.96	
06/05	2205	24.5	690	60	10.00	
06/12	1700	25.0	680	65	9.06	
06/19	0915	26.0	650	60	9.90	
06/26	0940	25.5	650	60	10.10	
07/03	0900	25.5	1,000	80	9.98	
07/11	0855	25.5	840	50	10.00	
07/17	0850	26.7	900	80	10.00	
07/24	1025	25.0	800	100	10.00	
07/31	0900	25.5	650	100	10.20	
08/07	0800	26.0	600	100	10.05	
08/14	1600	27.0	540	80	10.08	
08/21	1015	26.0	560	80	9.80	
08/28	1210	27.0	590	80	9.90	
09/06	1017	27.0	500	80	9.85	
09/11	0948	31.0	360	90	9.80	
09/18	0930	27.0	400	160	9.90	

Table 2.3-11 S.E.--Continued

Date	Time	Temperature (°C)	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
09/25	1005	26.5	590	150	10.00	
10/02	1000	27.5	650	150	9.64	
10/09	0950	26.5	700	180	10.09	
10/16	0930	28.0	650	140	9.80	
10/23	1020	27.0	725	180	9.83	
10/30	0920	27.0	700	170	9.91	
11/06	0720	27.0	540	170	9.86	
11/13	0840	27.0	520	165	9.82	
11/20	0915	26.0	650	180	9.89	
11/27	0920	26.5	580	140	9.85	
12/04	0920	26.0	570	150	9.84	
12/11	0920	26.5	580	130	9.88	
12/18	0920	25.5	540	130	9.96	
12/27	1155	25.5	530	110	10.03	
01/01	1150	25.5	490	60	9.45	
01/08	1015	26.0	500	80	10.09	
01/15	1015	26.0	470	80	9.89	
01/22	1120	26.1	480	80	9.84	
01/29	1120	26.1	490	60	10.04	
02/04	1320	25.0	420	50	9.90	
02/12	1315	26.1	510	50	9.99	
02/19	1315	25.0	500	80	12.31	Changed measuring point
02/26	1315	25.0	470	80	12.48	

Table 2.3-11 S.E.--Continued

Date	Time	Temperature (°C)	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
03/04	1315	25.0	390	60	12.46	
03/11	1420	25.6	415	60	12.51	
03/18	1010	25.0	480	70	12.47	
03/25	1510	25.0	470	80	14.25	

Table 2.3-11 S.W.
WATER QUALITY OF THE BISCAYNE AQUIFER--S.W. MONITOR WELL
SITE I-3

Date	Time	Temperature (°C)	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
04/20	1838	21.5	550	60	10.85	
04/26	1100	22.0	640	61	9.84	
05/01	1211	21.5	650	60	9.77	
05/08	1706	22.0	650	60	9.81	
05/15	1815	22.0	640	58	9.84	
05/22	1315	24.0	600	58	9.81	
05/29	2115	24.5	780	60	9.75	
06/05	2210	24.0	600	50	9.81	
06/12	1710	25.0	560	45	9.84	
06/19	0910	26.0	600	40	9.75	
06/26	0930	26.0	530	40	9.88	
07/03	0850	26.0	900	50	9.79	
07/11	0840	27.0	780	50	9.40	
07/17	0900	27.5	920	60	9.90	
07/24	1010	25.5	675	60	9.80	
07/31	0915	26.0	525	80	9.90	
08/07	0815	26.0	540	90	9.80	
08/14	1600	28.0	360	60	9.84	
08/21	1030	28.0	545	80	9.70	
08/28	1220	28.0	540	50	9.65	
09/06	1011	28.0	445	70	9.65	
09/11	1003	32.0	360	90	9.70	
09/18	0920	32.0	360	180	9.70	

Table 2.3-11 S.W.--Continued

Date	Time	Temperature (°C)	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
09/25	0955	30.0	500	150	9.77	
10/02	0950	29.5	500	100	9.60	
10/09	0940	29.5	525	190	9.82	
10/16	0920	29.5	490	110	9.49	
10/23	1010	29.0	540	100	9.50	
10/30	0910	29.0	525	110	9.55	
11/06	0710	29.0	470	100	9.51	
11/13	0845	29.0	480	110	9.45	
11/20	0910	27.5	525	90	9.09	Changed measuring point[a]
11/27	0910	28.0	510	120	9.03	
12/04	0910	26.5	520	100	7.53	Changed measuring point[a]
12/11	0910	27.0	530	100	7.56	
12/18	0910	25.5	520	80	7.67	
12/27	1145	25.0	530	100	7.93	
01/01	1140	25.5	400	50	8.99	Changed measuring point[a]
01/08	1020	26.0	500	100	9.09	
01/15	1020	26.0	480	50	8.81	
01/22	1125	26.1	490	70	8.74	
01/29	1125	25.0	500	55	8.97	
02/04	1325	25.0	420	90	8.85	
02/12	1320	25.0	425	80	8.89	
02/19	1320	23.9	500	80	8.77	

Table 2.3-11 S.W.--Continued

Date	Time	Temperature (°C)	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
02/26	1300	23.3	500	70	8.92	
03/04	1320	23.9	410	70	11.48	Measuring point changed
03/11	1410	23.9	380	50	11.51	
03/18	1015	23.9	440	100	11.48	
03/25	1520	25.0	410	100	12.25	

[a]Pipe broken and reset.

Table 2.3-11 W.S.
WATER QUALITY OF THE BISCAYNE AQUIFER--WATER SUPPLY WELL
Site I-3

Date	Time	Temperature (°C)	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
04/27	1400	23.5	530	69	9.07	
05/11	1157	23.0	600	88	8.91	
05/08	1623	23.0	580	82	9.02	
05/15	1805	23.0	385	41	9.02	
05/22	1315	--	--	--	--	
05/29	2125	25.0	440	50	--	
06/05	2220	25.0	350	40	9.03	
06/12	1730	24.5	400	40	7.10	
06/19	0900	26.0	360	20	9.90	
06/26	0950	25.0	420	40	9.08	
07/03	0855	25.0	900	90	9.00	
07/11	1840	27.00	650	40	7.40	
07/17	0855	25.0	810	100	9.00	
07/24	1015	26.0	1100	100	8.60	
07/31	0905	26.0	385	50	9.10	
08/07	0820	25.5	325	80	9.00	
08/14	1600	26.0	242	100	9.09	
08/21	1020	27.5	285	30	8.95	
08/28	1215	28.0	350	80	8.80	
09/06	1023	27.0	300	50	8.90	
09/11	0955	29.0	280	80	8.90	
09/18	0925	30.0	260	80	8.90	
09/25	1000	28.0	325	110	9.00	

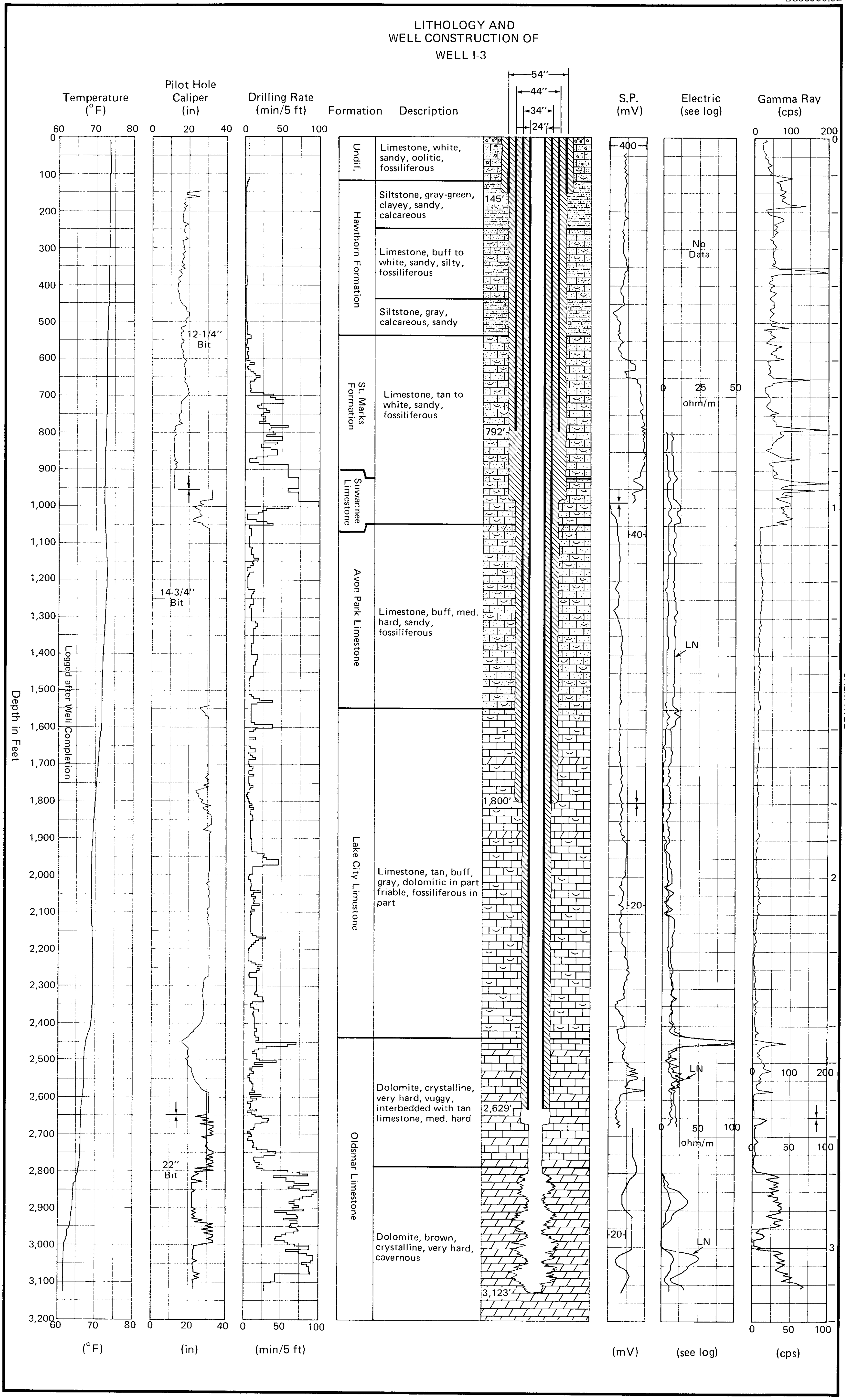
Table 2.3-11 W.S.--Continued

Date	Time	Temperature (°C)	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
10/02	0955	28.0	310	110	8.81	
10/09	0945	28.0	300	100	9.00	
10/16	0925	27.5	600	140		Pump in well; could not get water level
10/23	--	--	--	--	--	
10/30	0915	28.0	650	190	--	
11/06	0715	28.0	600	130	--	
11/13	0855	28.5	620	150	--	
11/20	0920	28.0	520	120	--	
11/27	0915	26.0	520	110	--	
12/04	0915	--	--	--	--	
12/11	0915	--	--	--	--	
12/18	0915	--	--	--	--	
12/27	1150	--	--	--	--	
01/01	1145	--	--	--	--	
01/08	1010	--	--	--	--	
01/15	1010	27.0	400	50	8.84	
01/22	1110	26.7	370	50	8.80	
01/29	1110	26.7	375	50	8.99	
02/04	1310	26.1	300	50	8.85	
02/12	1310	25.6	355	50	8.92	
02/19	1310	25.0	340	70	8.71	
02/26	1310	25.0	330	60	8.90	
03/04	1310	25.0	270	50	8.92	

Table 2.3-11 W.S.--Continued

Date	Time	Temperature (°C)	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
03/11	1415	25.0	290	50	8.95	
03/18	1020	25.0	280	70	8.92	
03/25	1515	25.6	320	90	9.68	

BC55900.92



Summary of drilling and logging data—Well I-3.

FIGURE 2.3-1.

Chapter 2.4
INJECTION WELL I-4

Well I-4 is located 720 feet north-northeast of Well I-3 and 1,000 feet south-southwest of I-5 as shown on Figure 1.1-2, Section 1, Summary. Drilling was begun on September 6, 1979 and was completed on April 4, 1980. The drilling and casing sequence during construction is as follows:

1. Drilled a 12-1/4-inch pilot hole to 176 feet.
2. Reamed the hole with a 60-inch bit to 150 feet.
3. Installed 54-inch casing to 140 feet and cemented it from 140 feet up to the concrete drilling pad.
4. Drilled a 14-3/4-inch pilot hole to 1,014 feet.
5. Reamed the hole with a 52-inch bit to 990 feet.
6. Installed 44-inch casing to 980 feet and cemented to the surface.
7. Drilled a 12-1/4-inch pilot hole to 1,900 feet.
8. Reamed the hole to 42 inches to a depth of 1,810 feet.
9. Installed the 34-inch casing to 1,800 feet, pumped the first stage of cement, and ran a temperature log inside the casing.
10. Cemented the 34-inch casing to the surface.
11. Drilled a 12-1/4-inch pilot hole to 2,700 feet.
12. Installed a test pump and pumped at approximately 700 gpm. Ran temperature and flowmeter logs and a TV survey during pumping.
13. Reamed the hole to 32 inches to 2,664 feet.
14. Installed the 24-inch casing to 2,664 feet.
15. Installed a cement plug below the 24-inch casing.
16. Cemented the casing to 190 feet below pad.
17. Pressure tested the 24-inch casing at 140 psi for 1 hour with no pressure loss.
18. Drilled a 22-inch hole to 3,133 feet.
19. Performed an injection test at 10,000 gpm for 12 hours.
20. Ran a cement bond log on the 24-inch casing.

21. Cemented the 24-inch casing up to the concrete pad.

22. Completed the wellhead and pad as per specifications.

Casings are Black steel, meeting standards API 5L, Grade B, and ASTM A139, Grade B. Casing details are summarized in Table 2.4-1. The casings were cemented with API Class H cement as summarized in Table 2.4-2. Geophysical logs, directional surveys, and TV surveys run on the well are listed in Table 2.4-3.

The results of the gyroscopic directional surveys for path comparisons between the pilot and the reamed holes are included in Table 2.4-4. A descriptive summary of the underwater television survey after well completion is presented in Table 2.4-5. Results of a lithological examination of the formation samples collected every 10 feet from the pilot hole drilling are shown in Table 2.4-6. Water quality data from pilot hole drilling are presented in Table 2.4-7.

Figure 2.4-1 presents a summary of data from the drilling and logging, including the well construction diagram, lithologic description of the formation samples, drilling rate, and electric, gamma radiation, caliper, and temperature logs.

As noted in Item 12 above, a pump test was run on the pilot hole at 700 gpm from 1,800 feet to 2,700 feet. During the test, flow meter and temperature logs were run to determine if there were any large producing zones in the bottom of the hole which could cause excessive cement loss during cementing operations. A TV survey was also run; however, attempts to view the bottom section of the pilot hole were unsuccessful because of the turbidity of the water in that zone.

There was no indication of production in the bottom section of the pilot hole, so the casing setting was chosen to correspond with a ledge on the caliper log.

After the 24-inch casing was set at 2,664 feet, the bottom of the hole was tagged and a cement plug installed below the casing to further ensure minimal cement loss. The first stage of cement, consisting of 2,787 sacks of Class H neat, was pumped down a cement line inside the 24-inch casing out through four 2-inch by 2-inch ports cut 90° apart, 4 feet from the bottom of the casing. This arrangement was used to provide for equal distribution of the cement around the casing, thereby preventing the formation of a channel. The first stage filled up to 2,240 feet, and no difficulties were encountered in cementing to the surface.

I-4 Injection Test

Upon completion of the well drilling, an injection test was performed to determine the well injection capacity and its corresponding wellhead pressure. Freshwater from an adjacent pond was injected at approximately 10,700 gpm for 12 hours. Wellhead injection pressure was measured with a 12-inch precision gauge calibrated in feet of water. Flow rate was determined by a flow meter and a volume totalizer. All pressures are referred to top of pad level. Wellhead pressure reached a high of 93.04 feet of water after 35 minutes of the test. Thereafter, the pressure dropped slowly during the entire test to 91.24 feet of water at the end of the test. This drop could be explained by a steady developing of the injection formation during the test.

After the injection pump was shut down, the pressure dropped to 69.74 feet of water in 20 minutes. The well was then opened and required 24 hours to backflow. The injection test results are summarized in Table 2.4-8, and the data collected are presented in Table 2.4-9. Quality of the injected water is shown in Table 2.4-10.

The TV survey, after the injection test of this well, revealed the presence of pieces of cement slab around the borehole just below the inner casing. These pieces were left by the drill bit when it went through the cement plug set at the bottom of the reamed hole prior to cementing the inner casing. Because some of these slabs looked unstable and could partially block the bottom hole of the well if they ever fell out in the future, the contractor was asked to move in a drilling rig and clean out the open hole section of this well.

Biscayne Aquifer Water Quality Monitoring

While drilling the well, water samples were collected and levels measured at each of five shallow monitoring wells installed around the drilling pad. Four of the wells were 2-inch-diameter PVC, approximately 20 feet deep, and located at each corner of the pad. The fifth was 8-inch-diameter steel, approximately 40 feet deep, and was used for supply water during construction. These data are included in Tables 2.4-11 N.E. through 2.4-11 W.S.

Table 2.4-1
SUMMARY OF CASINGS DATA
WELL I-4

Diameter (inches)	Wall Thickness (inches)	Depth (feet)[a]		Cemented Section (depth in feet)[a]	
		From	To	From	To
54	.500	0	140	140	0
44	.500	0	980	980	0
34	.500	0	1,800	1,800	0
24	.500	0	2,664	2,664	0

[a]Measured from the top of the drilling pad.

Table 2.4-2
SUMMARY OF CEMENTING OF CASINGS
WELL I-4

Date	Casing Cemented	Type of Cement Used (API)	Number of Sacks Used	Depth Cemented (ft) From	To
09/24/79	54"	Class H w/25 lb of gilsonite per sack	455	150	38
09/25/79	54"	Class H pre-mix	37	38	0
10/22/79	44"	Lead: Class H w/12% bentonite	1,600	990	0
		Tail: Class H neat	812		
01/22/80	34"	Lead: Class H w/12% bentonite	1,200	1,810	1,333
		Tail: Class H neat	700		
01/24/80	34"	Class H w/12% bentonite	1,900	1,333	680
01/25/80	34"	Class H w/12% bentonite	1,123	680	0
02/24/80	Plug	Class H neat	13	2,676	2,668
02/25/80	24"	Class H neat	2,987	2,668	2,240
02/26/80	24"	Lead: Class H neat	1,060	2,240	1,828
		Tail: Class H w/2% bentonite, 2% $CaCl_2$	1,300		
02/27/80	24"	Class H w/2% bentonite, 2% $CaCl_2$	2,100	1,828	769
02/28/80	24"	Class H w/2% bentonite, 2% $CaCl_2$	1,350	769	190
10/11/80	24"	Class H Neat	490	190	0

Table 2.4-3
LIST OF GEOPHYSICAL LOGS AND WELL SURVEYS
WELL I-4

Date	Well Process and Casing Depth	Type of Logs or Surveys Run[a]	Purpose
10/06/79	54" casing to 140' 14-3/4" hole to 1,007'	E, G, C	1. Identify top of Floridan aquifer. 2. Establish setting depth of the 44" casing.
11/02/79	44" casing to 980' 12-1/4" hole to 1,900'	GYRO, LSN, G, C, T_s	1. Gyroscopic pilot hole track. 2. Geohydrological definition of the Floridan aquifer. 3. Establish setting depth of 34" casing.
11/13/79	44" casing to 980' 42" hole to 1,810'	GYRO	1. Gyroscopic reamed hole well path comparison to the pilot hole.
01/23/80	34" casing to 1,800'	T_s	1. Determine the top of the first stage cement outside the 54" casing.
02/06/80 to 02/09/80	34" casing to 1,800' 12-1/4" hole to 2,700'	D. IND, BCS, LSN, C, G, T_s, T_F, FV_F, TV, GYRO	1. Qualitative evaluation of confining beds above the Boulder Zone. 2. Identification of transmissive zones in this interval. 3. Establish setting depeth of 24" casing. 4. Gyroscopic pilot hole track.
02/20/80	34" casing to 1,800' 32" hole to 2,664'	GYRO	1. Gyroscopic reamed hole well path comparison to the pilot hole.

Table 2.4-3--Continued

Date	Well Process and Casing Depth	Type of Logs or Surveys Run[a]	Purpose
02/25/80	24" casing to 2,664'	T_s	1. Determine the top of the first stage cement outside the 24" casing.
03/25/80	24" casing to 2,664' 22" hole to 3,133'	LSN, G	1. Qualitative evaluation of the injection zone.
04/02/80	As above	TV	1. Visual evaluation of the injection zone. 2. Identification of cement slab in the borehole, 2,710 feet.
04/15/80	As above	CBL	1. Confirm adequacy of the cementing of the 24" casing.
06/20/80	As above	AV, GGD	1. USGS research on CBL techniques.
11/17/80	As above	TV	1. Final inspection of 24" casing and open hole after clean-out.
01/29/81	As above	C, T_s	1. Qualitative evaluation of the injection zone.

[a]Abbreviations for logs and surveys are as follows:

E = single point electric and SP
LSN = long and short normal and SP
G = gamma ray
C = caliper
T_s = temperature, static
T_F = temperature, flowing
FV_s = fluid velocity (flow meter) static
FV_F = fluid velocity (flow meter) flowing
FC = fluid conductivity

GYRO = gyroscopic directional survey
TV = television
CBL = cement bond, variable density
WTD = wave train display
D. IND = dual induction electric and SP
BCS = borehole compensated sonic
Density = formation density
AV = acoustic velocity
GGD = gamma gamma density (0-500 ft)

Table 2.4-4
COMPARISON OF WELL PATHS FROM GYROSCOPIC SURVEYS
WELL I-4

HORIZON - DISTANCE AND DIRECTION FROM TARGET WELL TO FOLLOW WEL. TRUE VERTICAL DEPTHS

FEET	FEET	DIRECTION DEGREES
30.00	0.06	19.97
60.00	0.17	35.27
90.00	0.21	39.80
120.00	0.22	20.34
150.00	0.27	356.75
180.00	0.28	345.26
210.00	0.23	341.16
240.00	0.12	322.92
270.00	0.10	290.97
300.00	0.08	288.33
330.00	0.07	272.62
360.00	0.04	15.61
390.00	0.14	33.39
420.00	0.18	10.92
450.00	0.24	347.57
480.00	0.31	335.24
510.00	0.41	329.08
540.00	0.43	316.80
570.00	0.37	309.94
600.00	0.26	303.40
630.00	0.18	299.19
660.00	0.08	293.48
690.00	0.07	353.49
720.00	0.12	4.55
750.00	0.18	22.36
780.00	0.23	28.66
810.00	0.28	23.19
840.00	0.35	14.99
870.00	0.40	9.88
900.00	0.44	4.67
930.00	0.38	350.40
960.00	0.32	335.45
990.00	0.35	330.76
1020.00	0.37	327.31
1050.00	0.34	329.16
1080.00	0.22	343.46
1110.00	0.16	16.29
1140.00	0.19	36.66
1170.00	0.29	46.88
1200.00	0.37	44.80
1230.00	0.39	36.56
1260.00	0.34	21.63
1290.00	0.39	8.66
1320.00	0.45	10.83
1350.00	0.44	18.46
1380.00	0.46	18.85
1410.00	0.48	15.71
1440.00	0.49	20.08
1470.00	0.57	23.38
1500.00	0.65	26.18
1530.00	0.66	36.85
1560.00	0.62	44.47
1590.00	0.59	47.25
1620.00	0.56	55.41
1650.00	0.47	71.98
1680.00	0.36	83.47
1710.00	0.33	77.17
1740.00	0.39	67.42
1770.00	0.47	62.87

WELL PATH COMPARISON

FOLLOW WELL: FILE 803

MIAMI - DADE COUNTY WATER AND SEWAGE AUTHORITY
CHM2 WELL I-4; REAM HOLE; 0 TO 1770 FEET
DADE COUNTY, FLORIDA
NOVEMBER 14,1979

TARGET WELL: FILE 799

MIAMI - DADE COUNTY WATER AND SEWAGE AUTHORITY
CHM2 HILL WELL I-4,PILOT HOLE, 0 TO 1830 FEET
DADE COUNTY, FLORIDA
NOVEMBER 5,1979

MEASURED DEPTH FEET	DRIFT ANGLE DEG	DRIFT DIRECTION DEG	TRUE VERTICAL DEPTH FEET	RECTANGULAR COORDINATES FEET	
0.	0.00	0.00	0.00	0.00	0.00
30.	0.09	344.00	30.00	0.02 N	0.01 W
60.	0.05	156.28	60.00	0.03 N	0.02 E
90.	0.08	156.63	90.00	0.01 S	0.04 E
120.	0.11	319.00	120.00	0.03 S	0.01 E
150.	0.09	348.55	150.00	0.02 N	0.01 W
180.	0.04	57.60	180.00	0.05 N	0.00 E
210.	0.09	134.92	210.00	0.05 N	0.03 E
240.	0.12	192.71	240.00	0.01 S	0.05 E
270.	0.12	7.84	270.00	0.00 S	0.01 E
300.	0.07	305.00	300.00	0.04 N	0.01 W
330.	0.06	147.54	330.00	0.02 N	0.03 W
360.	0.15	354.04	360.00	0.04 N	0.01 E
390.	0.05	161.63	390.00	0.04 N	0.04 E
420.	0.11	324.48	420.00	0.03 N	0.02 E
450.	0.07	239.60	450.00	0.04 N	0.03 W
480.	0.07	33.25	480.00	0.06 N	0.05 W
510.	0.19	230.67	510.00	0.09 N	0.08 W
540.	0.02	180.00	540.00	0.06 N	0.12 W
570.	0.12	184.61	570.00	0.02 N	0.12 W
600.	0.14	98.41	600.00	0.03 S	0.08 W
630.	0.06	74.00	630.00	0.03 S	0.03 W
660.	0.07	144.55	660.00	0.04 S	0.00 E
690.	0.07	356.50	690.00	0.03 S	0.03 E
720.	0.01	213.12	720.00	0.01 S	0.03 E
750.	0.12	80.65	750.00	0.00 S	0.06 E
780.	0.01	153.10	780.00	0.00 N	0.09 E
810.	0.07	2.80	810.00	0.03 N	0.10 E
840.	0.06	20.92	840.00	0.06 N	0.10 E
870.	0.10	0.77	870.00	0.09 N	0.11 E

MIAMI - DADE COUNTY WATER AND SEWAGE AUTHORITY
CHM2 WELL I-4; REAM HOLE; 0 TO 1770 FEET
DADE COUNTY, FLORIDA
NOVEMBER 14,1979

RECORD OF SURVEY

RADIUS OF CURVATURE METHOD

MEASURED DEPTH FEET	DRIFT ANGLE DEG	DRIFT DIRECTION DEG	TRUE VERTICAL DEPTH FEET	RECTANGULAR COORDINATES FEET	
900.	0.04	356.03	900.00	0.13 N	0.11 E
930.	0.09	182.37	930.00	0.13 N	0.08 E
960.	0.01	216.23	960.00	0.10 N	0.08 E
990.	0.01	8.91	990.00	0.11 N	0.08 E
1020.	0.07	326.23	1020.00	0.13 N	0.07 E
1050.	0.12	106.75	1050.00	0.16 N	0.09 E
1080.	0.22	115.18	1080.00	0.13 N	0.17 E
1110.	0.11	131.31	1110.00	0.08 N	0.25 E
1140.	0.07	68.34	1140.00	0.07 N	0.29 E
1170.	0.10	21.73	1170.00	0.10 N	0.31 E
1200.	0.06	53.52	1200.00	0.13 N	0.34 E
1230.	0.10	263.22	1230.00	0.16 N	0.33 E
1260.	0.06	270.38	1260.00	0.16 N	0.29 E
1290.	0.11	30.41	1290.00	0.19 N	0.27 E
1320.	0.06	193.12	1320.00	0.18 N	0.30 E
1350.	0.08	58.50	1350.00	0.16 N	0.32 E
1380.	0.06	56.95	1380.00	0.18 N	0.35 E
1410.	0.04	337.79	1410.00	0.21 N	0.36 E
1440.	0.14	106.63	1440.00	0.24 N	0.39 E
1470.	0.09	301.52	1470.00	0.27 N	0.40 E
1500.	0.04	93.54	1500.00	0.30 N	0.41 E
1530.	0.17	92.62	1530.00	0.29 N	0.46 E
1560.	0.08	253.81	1560.00	0.25 N	0.47 E
1590.	0.04	350.98	1590.00	0.26 N	0.45 E
1620.	0.15	97.65	1620.00	0.29 N	0.48 E
1650.	0.12	232.79	1650.00	0.24 N	0.49 E
1680.	0.11	269.22	1680.00	0.22 N	0.43 E
1710.	0.09	20.77	1710.00	0.25 N	0.41 E
1740.	0.03	29.50	1740.00	0.28 N	0.42 E
1770.	0.13	322.00	1770.00	0.33 N	0.42 E

FINAL CLOSURE - DIRECTION: 52.222 DEGS CLOCKWISE FROM NORTH
DISTANCE: 0.53 FEET

HORIZONTAL DISTANCE AND DIRECTION FROM TARGET WELL TO FOLLOW WELL AT TRUE VERTICAL DEPTHS

FEET	FEET	DIRECTION DEGREES
1800.00	0.16	61.90
1830.00	0.12	74.89
1860.00	0.10	106.07
1890.00	0.11	69.11
1920.00	0.14	44.72
1950.00	0.21	22.94
1980.00	0.32	10.76
2010.00	0.41	7.17
2040.00	0.51	9.01
2070.00	0.59	11.03
2100.00	0.69	8.34
2130.00	0.81	5.55
2160.00	0.91	8.89
2190.00	0.99	12.10
2220.00	1.06	10.90
2250.00	1.16	8.31
2280.00	1.24	7.14
2310.00	1.26	6.23
2340.00	1.32	4.10
2370.00	1.40	3.94
2400.00	1.46	4.99
2430.00	1.50	7.16
2460.00	1.53	8.73
2490.00	1.58	10.51
2520.00	1.56	9.01
2550.00	1.49	7.70
2580.00	1.44	5.13
2610.00	1.55	4.60

WELL PATH COMPARISON

FOLLOW WELL: FILE 926

MIAMI - DADE COUNTY WATER AND SEWAGE AUTHORITY
CH2M HILL, WELL I-4; REAM HOLE
FEBRUARY 20, 1980

TARGET WELL: FILE 928

MIAMI DADE COUNTY WATER AND SEWAGE AUTHORITY
CH2M HILL WELL I-4 PILOT HOLE
SURVEY FROM 1860 TO 2640 FT
TIED ON TO SURVEY 0 TO 1830 FT DATED NOV 5 1979
SEE FILE 920
SCOTT - USES AVERAGE OF TAC CORRECTED IN RUN/OUT RUN PAIRS

MIAMI - DADE COUNTY WATER AND SEWAGE AUTHORITY
CHM2 HILL, WELL I-4; REAM HOLE
FEBUARY 20, 1980

TIME 13:42:38 DATE 25-FEB-80

MEASURED DEPTH FEET	DRIFT ANGLE DEG	DRIFT DIRECTION DEG	COURSE LENGTH FEET	TRUE VERTICAL DEPTH FEET	RECTANGULAR COORDINATES FEET		CLOSURE DISTANCE FEET	CLOSURE DIRECTION DEG	DOGLEG SEVERITY DG/100FT
1770.	0.13	322.00	0.	1770.00	0.33 N	0.42 E	0.53	51.84	0.00
1800.	0.09	225.70	30.	1800.00	0.33 N	0.36 E	0.49	47.54	0.55
1830.	0.09	200.12	30.	1830.00	0.29 N	0.34 E	0.45	49.14	0.14
1860.	0.11	183.54	30.	1860.00	0.24 N	0.33 E	0.40	53.85	0.10
1890.	0.13	179.32	30.	1890.00	0.18 N	0.33 E	0.37	60.93	0.08
1920.	0.20	187.85	30.	1920.00	0.10 N	0.32 E	0.33	73.00	0.24
1950.	0.10	186.60	30.	1950.00	0.02 N	0.31 E	0.31	86.01	0.33
1980.	0.16	200.50	30.	1980.00	0.04 S	0.29 E	0.30	98.61	0.22
2010.	0.08	179.15	30.	2010.00	0.11 S	0.28 E	0.30	110.35	0.30
2040.	0.05	173.62	30.	2040.00	0.13 S	0.29 E	0.31	114.80	0.08
2070.	0.11	191.23	30.	2070.00	0.17 S	0.28 E	0.33	121.48	0.20
2100.	0.07	231.38	30.	2100.00	0.22 S	0.26 E	0.34	130.29	0.24
2130.	0.07	165.65	30.	2130.00	0.25 S	0.25 E	0.35	135.55	0.26
2160.	0.12	154.79	30.	2160.00	0.30 S	0.26 E	0.40	138.46	0.17
2190.	0.13	187.79	30.	2190.00	0.36 S	0.27 E	0.45	143.00	0.24
2220.	0.07	171.67	30.	2220.00	0.41 S	0.27 E	0.50	146.59	0.22
2250.	0.02	241.34	30.	2250.00	0.43 S	0.26 E	0.51	148.79	0.21
2280.	0.10	143.95	30.	2280.00	0.46 S	0.26 E	0.53	150.88	0.35
2310.	0.13	224.80	30.	2310.00	0.52 S	0.25 E	0.58	154.02	0.51
2340.	0.01	179.46	30.	2340.00	0.54 S	0.23 E	0.59	157.41	0.41
2370.	0.03	237.01	30.	2370.00	0.55 S	0.21 E	0.59	158.71	0.05
2400.	0.06	215.26	30.	2400.00	0.57 S	0.20 E	0.60	161.02	0.11
2430.	0.03	155.87	30.	2430.00	0.59 S	0.19 E	0.62	161.93	0.16
2460.	0.03	162.00	30.	2460.00	0.61 S	0.20 E	0.64	161.86	0.01
2490.	0.10	114.18	30.	2490.00	0.63 S	0.22 E	0.66	160.82	0.27
2520.	0.06	250.62	30.	2520.00	0.66 S	0.22 E	0.69	161.70	0.49
2550.	0.06	174.86	30.	2550.00	0.68 S	0.20 E	0.71	163.41	0.24
2580.	0.01	48.90	30.	2580.00	0.70 S	0.20 E	0.72	163.66	0.15
2610.	0.17	48.90	30.	2610.00	0.66 S	0.24 E	0.71	160.16	0.54

FINAL CLOSURE - DIRECTION: 160.159 DEGS CLOCKWISE FROM NORTH
DISTANCE: 0.71 FEET

RADIUS OF CURVATURE METHOD

RECORD OF SURVEY

MIAMI - DADE COUNTY WATER AND SEWAGE AUTHORITY
CHM2 HILL, WELL I-4; REAM HOLE
FEBUARY 20, 1980

Table 2.4-5
DESCRIPTIVE SUMMARY OF UNDERWATER TELEVISION SURVEYS
WELL I-4

CH2M HILL

RECORD OF UNDERWATER TV SURVEY

Project: Miami Dade Water & Sewer Authority, South District Regional Wastewater Treatment Plant

Well: I-4

Survey By: Deep Venture Diving Service, Perry, Florida
HP-4,000 AU

Survey Date: 11/17/80 Total Depth: 3,121 feet

Witnessed By: T. McCormick, D. Cabit, D. Snyder

Reviewed By: J. I. Garcia-Bengochea, J. D. Lehnen Date: 11/22/80

Remarks: Final survey after cleaning bottom hole of loose fragments of formation and cement slabs. There is still a large section of slab from 2,664' to 2,673', but looks stable.

Depth in Feet		Reel Counter		Observations
From	To	From	To	
--	--	0	16	Titles
--	11	16	22	Dry 24" casing
11	2,664	22	602	24" casing
--	2,664	602	--	Bottom of casing
2,664	2,673	602	605	Hole in cement, smooth walls
2,673	2,700	605	612	Smooth formation, no cavities
2,700	2,706	612	613	Original obstruction cleared
2,706	2,796	613	632	Smooth borehole, some thin dark beds, possible peat
2,796	2,828	632	640	Smooth walls, some small cavities, fractures
2,828	2,833	640	641	More fracturing and numerous cavities
2,833	2,844	641	644	Large cavities, very fractured
2,844	2,872	644	651	Rough walls, small cavities
2,872	2,886	651	655	Large cavities borehole walls faintly visible
2,886	2,907	655	662	Rough borehole, fractured formation

RECORD OF UNDERWATER TV SURVEY

Project: Miami Dade Water & Sewer Authority, South District Regional Wastewater Treatment Plant

Well: I-4 Date: 11/17/80 Total Depth: 3,121'

Depth in Feet		Reel Counter		Observations
From	To	From	To	
2,907	2,970	662	680	Very large cavities, highly fractured
2,970	2,981	680	684	Highly fractured, rubblized
2,981	2,993	684	686	Rough walls, small cavities
2,993	3,064	686	702	Smooth walls, high angle fractures, some solution features
3,064	3,121	702	722	Rough walls, cavernous
--	3,121	722	--	Bottom of the hole
3,121	2,664	722	830	Coming out of the hole
--	--	--	830	End of survey, end of tape

Table 2.4-6
LITHOLOGY FROM PILOT HOLE FORMATION SAMPLES
WELL I-4

Depth Interval (ft) From	To	Description
0	10	Crushed tan limestone fill
10	20	Limestone, tan-gray, hard
20	30	Limestone, tan, hard, oolitic
30	40	Limestone, tan and gray-white
40	50	Limestone, softer as above
50	60	Limestone, grayish-brown, hard, trace sand
60	70	Limestone, tan, trace silica and lime sand
70	80	Limestone, as above
80	90	Limestone, gray, medium-hard, dense
90	100	Limestone, as above
100	110	Siltstone, gray-green, with limestone
110	120	Siltstone, gray-green, some limestone
120	130	Siltstone, olive green, medium-hard
130	140	Clay, olive green, siltstone, moderately hard
140	150	Silty clay, olive green, with hard rounded limestone
150	160	Clay, olive green, with some very hard limestone
160	170	Lime sand, white, fine to medium grained, hard
170	180	Clay, green, silty
180	190	Clay with gray lime sand, silty
190	200	Clay with gray lime sand, silty
200	210	Lime sand, light tan, trace silt, fine
210	220	Clay, same as above
220	230	Clay, same as above

Table 2.4-6--Continued

Depth Interval (ft) From	To	Description
230	240	Clay, olive green, some calcareous sand, silty
240	250	Clay, trace fine silt, sandy
250	260	Clay, as above
260	270	Clay, blue-green, silty, moderate to fine grained calcareous sand and shell
270	300	No sample
300	310	Sand and silt, gray-green, some limestone
310	320	As above
320	350	No sample
350	360	Limestone, white to gray, hard, traces of sand, fine grained
360	370	As above
370	380	As above
380	390	As above, with traces of shell
390	400	As above
400	410	As above
410	420	Limestone, tan, poorly to moderately consolidated, some fossils
420	430	Siltstone, gray-green, soft, traces shell fragments
430	440	Clay, tan, silty, traces of lime sand
440	450	Lime sand, tan, with traces of siltstone and limestone
450	460	Limestone, tan, some lime sand
460	470	As above, but mostly lime sand
470	480	As above, but mostly lime sand
480	490	As above, but mostly lime sand

Table 2.4-6--Continued

Depth Interval (ft)		
From	To	Description
490	500	Limestone, tan to buff, with traces of fossils
500	510	As above
510	520	As above, with some lime sand
520	530	As above
520	530	As above
530	540	No sample
540	550	Limestone, tan to buff, poorly consolidated
550	560	As above, some lime sand
560	570	As above
570	580	Limestone, white to buff, some fossils
580	590	As above with some lime sand
590	600	As above, abundant fossils
600	610	As above
610	620	As above
620	630	As above with some lime sand, some fossils, poorly consolidated limestone
630	640	As above
640	650	As above
650	660	As above
660	670	Clay, light green, with some lime sand
670	680	As above
680	690	Lime sand, light tan, some well consolidated
690	700	Limestone, tan, with some lime sand
700	710	As above

Table 2.4-6--Continued

Depth Interval (ft)		
From	To	Description
710	720	As above
720	730	Clay, tan, silty, trace lime sand
730	740	Clay, tan, with some lime sand
740	750	Lime sand and consolidated limestone, tan
750	760	Lime sand and consolidated limestone, tan, trace clay
760	770	Limestone with some lime sand, tan
770	780	As above
780	790	Limestone, tan, consolidated with light green clay
790	800	As above with fossils present
800	810	Limestone with lime sand, tan, trace clay
810	820	Limestone with lime sand, tan
820	830	As above
830	840	Limestone and fine lime sand
840	850	As above
850	860	Limestone and lime sand, trace clay
860	870	Clay, tan, silty, with some lime sand
870	880	As above
880	890	Clay and silt with traces lime sand, tan
890	900	As above
900	910	Clay, light green soft, silty, trace of lime sand
910	920	As above
920	930	As above
930	940	Lime sand, tan, some well consolidated
940	950	Limestone, tan to gray, traces of fossils

Table 2.4-6--Continued

Depth Interval (ft) From	To	Description
950	960	As above
970	980	As above, with some fine lime sand
980	990	As above
990	1,000	As above
1,000	1,010	As above
1,010	1,020	Limestone, tan to light gray, soft to medium-hard, fossil shell, some lime sand
1,020	1,030	As above
1,030	1,040	As above
1,040	1,050	Cement cuttings, limestone, tan to gray hard lime sand
1,050	1,060	Limestone, tan to buff, medium-hard to hard, porous, some recrystallized fragments, some fossils
1,060	1,070	As above
1,070	1,080	As above
1,080	1,090	As above
1,090	1,100	As above
1,100	1,110	Limestone, tan, porous, medium-hard, very fine cuttings
1,110	1,120	Limestone, buff color, hard, massive, porous to dense
1,120	1,130	Limestone, as above, fossiliferous
1,130	1,140	Limestone, tan, medium-hard to hard, porous, some lime sand
1,140	1,150	Limestone, buff, massive, porous, fossiliferous
1,150	1,160	Limestone, tan to buff, medium hard, porous, some recrystallized fragments, fossiliferous, shells
1,160	1,170	As above, massive size
1,170	1,180	As above

Table 2.4-6--Continued

Depth Interval (ft) From	To	Description
1,180	1,190	As above
1,190	1,200	As above
1,200	1,210	Limestone, yellowish tan, medium-hard, fine to x-fine grains, porous
1,210	1,220	Limestone, buff, medium-hard, porous, fine to massive
1,220	1,230	Limestone, yellowish tan, medium-hard, fine to x-fine grains, porous
1,230	1,240	Limestone, tan to buff, medium-hard, fine to massive, fossiliferous
1,240	1,250	As above
1,250	1,260	As above
1,260	1,270	As above
1,270	1,280	As above
1,280	1,290	As above
1,290	1,300	Limestone, tan, soft to medium-hard, fine, shell and fossil fragments
1,300	1,310	Limestone, yellowish-brown, dolomitic, porous, massive, hard
1,310	1,320	As above
1,320	1,330	As above
1,330	1,340	Limestone, as above, fine grain, more tan in color
1,340	1,350	Limestone, greenish tan, hard, dense to porous, massive to fine grain
1,350	1,360	Limestone, tan, hard, fine grained, some fossils
1,360	1,370	Same as above, with larger grains
1,370	1,380	As above
1,380	1,390	As above

Table 2.4-6--Continued

Depth Interval (ft)		
From	To	Description
1,390	1,400	Clay, yellowish-green, probably drilling mud
1,400	1,410	Limestone, dolomitic, tan, hard, massive, some porous
1,410	1,420	Limestone, yellowish-tan, medium-hard to hard, some fossils, fine grains
1,420	1,430	Limestone, as above with massive porous fragments mixed in
1,430	1,440	As above
1,440	1,450	Limestone, gray to tan, porous, massive, many fossils, hard
1,450	1,460	Limestone, tan, porous, fine grain and fossiliferous
1,460	1,470	As above, larger grains
1,470	1,480	Limestone, dark tan to green, porous, hard, some fossils
1,480	1,490	As above
1,490	1,500	Limestone, dark tan, medium-hard, porous, fossiliferous
1,500	1,510	As above
1,510	1,520	As above
1,520	1,530	Limestone, tan, abundant fossils, dolomitic fragments
1,530	1,540	As above
1,540	1,550	Limestone, dark tan, porous, fossiliferous, recrystallized fragments, fine to massive, medium-hard
1,550	1,560	As above, smaller grains
1,560	1,570	Limestone, dolomitic, dark tan, some fossiliferous fragments, hard
1,570	1,580	Limestone, tan, some dolomitic fragments, medium-hard to hard, fossiliferous fragments
1,580	1,590	As above
1,590	1,600	As above

Table 2.4-6--Continued

Depth Interval (ft)		
From	To	Description
1,600	1,610	As above
1,610	1,620	Limestone, dark tan to olive green, coarse, massive, hard, some fossils
1,620	1,630	As above, finer grains
1,630	1,640	As above, lighter in color
1,640	1,650	As above
1,650	1,660	As above
1,660	1,670	Limestone, dark tan, fine grain, hard, fossil and shell fragments
1,670	1,680	As above
1,680	1,690	Limestone, greenish-tan, massive, fossiliferous
1,690	1,700	Limestone, dark tan, various size grains, medium-hard to hard, some recrystallized, fossiliferous
1,700	1,710	As above
1,710	1,720	As above
1,720	1,730	As above
1,730	1,740	As above
1,740	1,750	Limestone, tan, porous, soft, fossiliferous
1,750	1,760	As above
1,760	1,770	As above
1,770	1,780	As above
1,780	1,790	As above
1,790	1,800	As above
1,800	1,810	As above
1,810	1,820	As above
1,820	1,830	As above

Table 2.4-6--Continued

Depth Interval (ft) From	To	Description
1,830	1,840	As above
1,840	1,850	As above
1,850	1,860	As above, smaller grains
1,860	1,870	Limestone, tan, porous, soft, fossiliferous
1,870	1,880	As above
1,880	1,890	As above
1,890	1,900	As above
1,900	1,910	Limestone, buff, soft to medium-hard, fossiliferous, sand to medium size fragments
1,910	1,920	As above
1,920	1,930	As above
1,930	1,940	As above
1,940	1,950	As above
1,950	1,960	As above
1,960	1,970	Same as above with some hard, dense limestone
1,970	1,980	Limestone, buff, soft to medium-hard, fossiliferous, medium to sand size fragments
1,980	1,990	As above
1,990	2,000	As above
2,000	2,010	Limestone, tan to buff, medium-hard to soft, porous, microfossils present
2,010	2,020	As above
2,020	2,030	As above
2,030	2,040	As above
2,040	2,050	Limestone, buff to light gray, soft to medium-hard, microfossils and shell fragments

Table 2.4-6--Continued

Depth Interval (ft) From	To	Description
2,050	2,060	Limestone, light tan, porous, medium-hard shell fragments and microfossils present
2,060	2,070	As above
2,070	2,080	As above
2,080	2,090	As above
2,090	2,100	Limestone, buff, medium-hard to soft, lime sand, shell fragments
2,100	2,110	As above
2,110	2,120	As above
2,120	2,130	As above
2,130	2,140	As above
2,140	2,150	Limestone, buff to gray, soft, sandy, and chalky, porous, shell fragments, fossils
2,150	2,160	As above, medium-hard
2,160	2,170	As above
2,170	2,180	As above
2,180	2,190	As above
2,190	2,200	As above
2,200	2,210	As above
2,210	2,220	As above
2,220	2,230	As above
2,230	2,240	As above
2,240	2,250	As above
2,250	2,260	As above
2,260	2,670	As above

Table 2.4-6--Continued

Depth Interval (ft) From	To	Description
2,260	2,270	As above
2,270	2,280	As above
2,280	2,290	As above
2,290	2,300	As above
2,300	2,310	Limestone, gray to buff, medium-hard, fine grain
2,310	2,320	As above
2,320	2,330	As above
2,330	2,340	Limestone, tan to buff, soft to medium-hard, poorly consolidated, large grains, some fossils
2,340	2,350	As above
2,350	2,360	As above
2,360	2,370	As above
2,370	2,380	Limestone, gray to buff, medium-hard, fine grain, few fossils
2,380	2,390	Limestone, tan to light buff, medium-hard, some dolomite chips
2,390	2,400	As above
2,400	2,410	As above
2,410	2,420	As above
2,420	2,430	As above
2,430	2,440	Limestone, tan, medium hard, dark gray microcrystalline dolomite chips
2,440	2,450	As above
2,450	2,460	As above
2,460	2,470	Limestone, tan to buff, fine grain, medium-hard with dolomite chips

Table 2.4-6--Continued

Depth Interval (ft) From	To	Description
2,470	2,480	As above
2,480	2,490	As above
2,490	2,500	Limestone, tan to buff, fine grain, medium-hard with dolomite chips
2,500	2,510	Limestone, buff, soft to medium-hard, some recrystallized fragments
2,510	2,520	Limestone, tan to buff, dark gray dolomite chips, soft to medium-hard
2,520	2,530	As above
2,530	2,540	Limestone, buff to tan, medium-hard, few dolomite chips
2,540	2,550	Limestone, buff to dark tan, soft to medium-hard, dolomite chips
2,550	2,560	Same as above, larger fragments, less dolomite
2,560	2,570	As above
2,570	2,580	Limestone, as above, increase in dolomite, some fossils present
2,580	2,590	Limestone, tan to white, dolomite, dark gray, fine to coarse grained
2,590	2,600	As above
2,600	2,610	Limestone, tan to white, soft to hard, some dolomite chips
2,610	2,620	As above
2,620	2,630	As above
2,630	2,640	Limestone, white to gray, some recrystallization, fine to coarse grained, medium-hard
2,640	2,650	As above
2,650	2,660	As above
2,660	2,670	As above

Table 2.4-6--Continued

Depth Interval (ft)		
From	To	Description
2,670	2,680	Same as above, more coarse
2,680	2,690	Limestone, white to gray, soft to hard, fine to coarse grained, some recrystallization
2,690	2,700	As above
2,700	2,710	Limestone, white, medium soft, mixed gray lime and brownish dolomite, some crystals
2,710	2,720	As above
2,720	2,730	As above
2,730	2,740	Limestone, white, very soft
2,740	2,750	Limestone, white, tan, gray, medium-hard
2,750	2,760	As above
2,760	2,770	As above
2,770	2,780	Limestone, white, very soft
2,780	2,790	As above
2,790	2,800	Dolomite, light brown, some white/gray limestone
2,800	2,810	Dolomite, light brown, tan to white, banded microcrystalline, some gray limestone
2,810	2,820	Dolomite, light brown to tan, banded crystalline, very hard
2,820	2,830	As above
2,830	2,840	Same as above, more massive
2,840	2,850	Dolomite, light tan to light brown, crystalline
2,850	2,860	Dolomite, light gray, very hard, massive
2,860	2,870	Dolomite, light gray to light tan, very hard
2,870	2,880	Dolomite, light tan to dark brown, crystallized, some gray, massive to fine, banded

Table 2.4-6--Continued

Depth Interval (ft) From	To	Description
2,880	2,890	As above
2,890	2,900	As above
2,900	2,910	Dolomite, light tan, very hard, flat chips, large to small
2,910	2,920	As above
2,920	2,930	Dolomite, tan, flat chips
2,930	2,940	As above
2,940	2,950	Dolomite, dark gray to buff, large angular, banded, crystallized
2,950	2,960	As above
2,960	2,970	As above
2,970	2,980	Dolomite, light brown to tan, small chips, very hard, crystalline
2,980	2,990	As above
2,990	3,000	As above
3,000	3,010	As above
3,010	3,020	Dolomite, light gray to light buff, crystalline, very hard, trace of soft white limestone
3,020	3,030	Dolomite, as above, no white limestone
3,030	3,040	Dolomite, light tan, angular to flat chips, crystalline, very hard
3,040	3,050	As above
3,050	3,060	Dolomite, gray to light brown, massive, crystalline, very hard
3,060	3,070	Dolomite, gray to light brown, massive, crystalline, very hard
3,070	3,080	As above

Table 2.4-6--Continued

Depth Interval (ft)		
From	To	Description
3,080	3,090	Dolomite, light gray to dark brown, crystalline, some tan banding
3,090	3,100	Dolomite, light tan to light gray and buff massive fragments, some crystalline
3,100	3,130	Dolomite, light gray, very hard

Table 2.4-7
WATER QUALITY DATA FROM PILOT HOLE DRILLING
WELL I-4

Date	Time	Depth (ft)	Temperature (°C)	Specific Gravity	Specific Conductance (μmhos/cm)	Chloride (mg/l)
10/29	0200	1,007	27.0	1.0026	2,700	800
10/29	0930	1,046	26.5	--	3,225	--
10/29	1200	1,076	26.0	--	3,300	--
10/29	1440	1,106	26.0	--	2,800	--
10/29	1700	1,136	26.5	--	2,600	1,100
10/29	1915	1,168	26.5	--	2,675	1,200
10/29	2230	1,200	26.0	1.0050	2,400	900
10/30	0215	1,229	26.0	1.0050	2,400	1,000
10/30	0615	1,260	24.0	1.0050	2,400	1,700
10/30	0945	1,291	26.5	1.0050	2,600	900
10/30	1030	1,322	26.5	1.0050	2,500	1,400
10/30	1230	1,351	26.0	1.0050	2,600	900
10/30	1415	1,382	26.5	1.0050	2,700	1,000
10/30	1715	1,413	26.5	1.0500	2,450	1,000
10/30	1900	1,444	26.5	1.0500	2,500	1,100
10/30	2200	1,474	23.5	1.0105	2,400	900
10/31	0100	1,504	23.5	1.0000	2,400	1,000
10/31	0400	1,534	23.5	1.0030	2,200	700
10/31	0700	1,574	25.5	1.0130	2,200	500
10/31	1030	1,603	27.0	1.0050	2,200	800
10/31	1330	1,632	26.5	1.0050	2,275	850
10/31	1600	1,666	26.5	1.0500	2,200	800
10/31	1830	1,697	26.5	1.5000	2,000	700

Table 2.4-7--Continued

Date	Time	Depth (ft)	Temperature (°C)	Specific Gravity	Specific Conductance (μmhos/cm)	Chloride (mg/l)
10/31	2200	1,728	25.5	1.0000	2,000	1,100
10/31	2315	1,758	24.0	1.0000	2,000	1,100
11/01	0245	1,790	24.5	1.0000	2,000	1,100
11/01	0600	1,820	26.0	1.0000	2,000	1,000
11/01	0700	1,856	26.0	1.0000	2,000	1,000
11/01	1100	1,890	26.0	1.0000	2,100	1,000
01/30	0115	1,919	26.0	1.0080	15,000	7,700
01/30	0530	1,950	26.0	1.0070	13,500	7,800
01/30	1130	1,987	26.0	1.0070	14,000	7,600
01/30	1400	2,020	26.2	1.0075	14,250	6,600
01/30	1915	2,050	26.7	1.0075	15,000	6,700
01/30	2400	2,084	26.2	1.0072	15,500	8,600
01/31	0330	2,114	24.0	1.0080	16,500	8,700
01/31	1030	2,145	26.7	1.0090	17,000	8,200
01/31	1845	2,175	28.9	1.0092	16,500	8,200
01/31	2210	2,208	26.0	1.0091	17,000	8,300
02/01	0215	2,239	25.0	1.0091	16,000	8,300
02/01	0730	2,260	25.0	1.0108	15,000	8,500
02/01	1000	2,290	26.7	1.0108	16,000	8,600
02/01	1745	2,306	26.1	1.0115	16,000	9,600
02/02	0220	2,339	25.0	1.0230	17,000	9,200
02/02	0845	2,372	25.0	1.0120	14,000	20,900
02/02	1400	2,405	25.0	1.0125	18,500	10,800
02/02	1930	2,437	25.0	1.0120	17,000	10,500

Table 2.4-7--Continued

Date	Time	Depth (ft)	Temperature (°C)	Specific Gravity	Specific Conductance (μmhos/cm)	Chloride (mg/l)
02/03	0810	2,470	24.4	1.0170	12,750	11,400
02/03	1530	2,502	24.4	1.0149	17,000	11,700
02/04	0030	2,533	25.0	1.0158	18,000	14,000
02/04	0600	2,565	24.0	1.0156	17,500	14,100
02/04	1200	2,598	22.8	1.0160	22,000	14,500
02/04	2000	2,630	23.0	1.0200	21,500	18,400
02/04	2330	2,662	24.0	1.0170	22,000	14,800
02/05	0415	2,694	13.5	1.0160	20,000	13,500
03/04	2330	2,713	14.0	1.0151	21,000	11,800
03/04	0900	2,738	26.7	1.0120	20,500	10,000
03/04	1230	2,774	26.7	1.0112	23,000	9,700
03/05	0400	2,803	26.0	1.0115	21,000	10,000
03/06	0500	2,837	26.5	1.0185	30,000	14,200
03/07	1230	2,870	26.0	1.0230	35,000	18,900
03/08	0915	2,902	21.1	1.0260	37,000	23,000
03/11	0540	2,932	17.2	1.0265	37,000	19,800
03/18	2100	2,967	18.5	1.0253	35,000	20,400
03/21	1110	3,002	19.0	1.0245	35,000	21,100
03/22	1130	3,032	18.5	1.0255	35,000	21,400
03/23	1010	3,064	18.5	1.0250	30,000	20,500
03/24	0230	3,098	18.0	1.0254	33,000	21,200
03/24	1700	3,131	18.3	1.0265	28,000	21,900

Table 2.4-8
SUMMARY OF INJECTION TEST RESULTS
WELL I-4

Pumping Rate	10,700 gpm
Test Duration	12 hours
Time Elapsed to Reach Maximum Injection Head After Pumping Started	40 minutes
Maximum Injection Head[a]	93.04 feet of water
Static Freshwater Head[a,b]	69.74 feet of water

[a] Feet of water referred to pad level.
[b] Due to the density difference between injected freshwater and formation saltwater.

Table 2.4-9
INJECTION TEST DATA
WELL I-4
(Well head pressure measuring point @ 4.04' above pad)

Actual Time	Time Since Pump Started (min)	Flow (gpm)	Wellhead Pressure (feet of water)	Totalizer (gallons x 1,000)	Remarks
1600	0	--	--	71,597	Start injection pump
1601	1	17,000	30.0	71,604	
1602	2	13,000	42.0	71,617	
1603	3	10,000	50.0	71,627	
1604	4	10,000	62.0	71,637	
1605	5	11,000	73.0	71,648	
1606	6	11,000	74.5	71,659	
1607	7	11,000	77.5	71,670	
1608	8	11,000	80.0	71,681	
1609	9	11,000	81.5	71,692	
1610	10	11,000	82.8	71,703	
1612	12	11,000	88.6	71,725	
1614	14	10,000	88.6	71,746	
1616	16	10,000	88.7	71,768	
1618	18	10,700	88.7	71,790	
1620	20	10,700	88.8	71,812	
1625	25	10,700	88.9	71,866	
1630	30	10,700	88.9	71,921	
1635	35	10,700	89.0	71,976	
1640	40	10,700	89.0	72,031	
1645	45	10,700	88.8	72,086	

Table 2.4-9--Continued

Actual Time	Time Since Pump Started (min)	Flow (gpm)	Wellhead Pressure (feet of water)	Totalizer (gallons x 1,000)	Remarks
1650	50	10,700	88.6	72,141	
1655	55	10,700	88.9	72,193	
1700	60	10,700	88.8	72,278	
1710	70	10,700	88.8	72,358	
1720	80	10,700	88.7	72,464	
1730	90	10,700	88.4	72,572	
1740	100	10,700	88.3	72,680	
1750	110	10,700	88.3	72,788	
1800	120	10,700	88.3	72,896	
1830	150	10,700	88.0	73,219	
1900	180	10,700	88.0	73,541	
1930	210	10,700	88.2	73,864	
2000	240	10,700	88.1	74,187	
2030	270	10,700	88.0	74,512	
2100	300	10,700	87.4	74,827	
2130	330	10,700	87.8	75,148	
2200	360	10,700	87.8	75,469	
2230	390	10,700	87.6	75,790	
2300	420	10,700	87.7	76,114	
2330	450	10,700	87.6	76,436	
2400	480	10,700	87.5	76,753	
0030	510	10,700	87.5	77,079	
0100	540	10,700	87.5	77,399	
0130	570	10,700	87.4	77,721	

Table 2.4-9--Continued

Actual Time	Time Since Pump Started (min)	Flow (gpm)	Wellhead Pressure (feet of water)	Totalizer (gallons x 1,000)	Remarks
0200	600	10,700	87.4	78,042	
0230	630	10,700	87.2	78,364	
0300	660	10,700	87.2	78,684	
0330	690	10,700	87.2	79,006	
0400	720	10,700	87.2	79,326	
0402	722	0	66.4	--	Shut down pump
0404	724	0	66.1	--	
0406	726	0	66.0	--	
0410	730	0	66.0	--	
0420	740	0	65.7	--	
0430	750	--	65.7	--	
0440	760	--	65.7	--	
0450	770	--	65.7	--	
0500	780	--	65.7	--	
0600	840	--	65.6	--	
0700	900	--	65.4	--	
0800	960	--	65.3	--	
0900	1,020	--	65.3	--	Start bleeding off injected water
0930	1,050	--	61.5	--	
1000	1,080	--	60.5	--	
1100	1,170	--	40.5	--	

Table 2.4-9--Continued

Actual Time	Time Since Pump Started (min)	Flow (gpm)	Wellhead Pressure (feet of water)	Totalizer (gallons x 1,000)	Remarks
1200	1,200	--	25.5	--	
1300	1,260	--	10.5	--	
1600	1,440	--	5.5	--	
1900	1,620	--	2.9	--	
2000	1,680	--	2.4	--	

Table 2.4-10
QUALITY OF INJECTED WATER
WELL I-4

Date	Time Since Pump Started (min)	Depth (ft)	Temperature (°C)	Specific Gravity	Specific Conductance (μmhos/cm)	Chloride (mg/l)
03/31	1500	20.0	23.9	1.0000	950	270
03/31	1605	--	25.6	1.0000	900	290
03/31	1705	--	25.6	1.0000	900	280
03/31	1805	--	25.6	1.0000	880	290
03/31	1905	--	25.6	1.0000	860	300
03/31	2005	--	25.6	1.0000	850	330
03/31	2105	--	25.6	1.0000	900	330
03/31	2205	--	25.6	1.0000	850	290
03/31	2305	--	25.6	1.0000	850	300
04/01	0005	--	25.6	1.0000	850	270
04/01	0105	--	25.6	1.0000	850	290
04/01	0205	--	25.6	1.0000	825	310
04/01	0305	--	25.6	1.0000	850	330
04/01	0400	--	25.6	1.0000	850	330

Table 2.4-11 N.E.
WATER QUALITY OF BISCAYNE AQUIFER--N.E. MONITORING WELL
SITE I-4

Date	Time	Temperature (°C)	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
06/14	1100	25.5	1,300	310	11.91	
06/21	0951	25.5	1,200	250	11.91	
06/28	1550	25.5	1,110	220	11.9	
07/05	0920	26.0	1,500	270	12.10	
07/13	0723	26.0	1,050	220	11.82	
07/19	0923	25.5	1,550	230	12.1	
07/26	0942	25.5	1,320	240	12.2	
08/02	0919	25.0	1,440	270	12.3	
08/09	0859	25.0	1,600	250	12.05	
08/16	0909	25.0	1,020	220	12.12	
08/30	0919	25.0	850	150	12.10	
09/06	0909	26.5	900	190	11.80	
09/12	0903	27.0	750	330	11.8	
09/20	1000	26.5	650	300	11.8	
09/27	1644	27.5	900	170	11.75	
10/04	1517	28.0	1,200	200	11.83	
10/11	0957	28	1,150	210	8.34	Changed measuring point
10/18	0920	27	1,500	200	8.7	
10/25	1407	26.5	1,050	190	8.9	
11/01	0932	--	950	130	7.51	
11/08	--	--	--	--	--	
11/15	--	--	--	--	--	

Table 2.4-11 N.E.--Continued

Date	Time	Temperature (°C)	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
11/24	1000	26.0	875	140	8.57	
11/30	0705	25.0	925	135	8.00	
12/06	0710	--	--	--	--	
12/14	--	--	--	--	--	
12/20	1030	24.0	890	160	8.37	
12/27	1350	25.0	840	160	8.46	
01/03	0915	24.0	725	200	8.44	
01/10	0910	24.7	1,050	290	10.02	Changed measuring point
01/17	0915	24.7	750	200	10.12	
01/24	1045	23.9	750	240	10.12	
01/31	1020	24.4	650	230	9.41	
02/07	1030	24.4	800	250	9.38	
02/15	1200	24.4	820	250	9.64	
02/21	1300	24.0	850	230	9.30	
02/28	1045	24.0	840	240	9.38	
03/06	1215	240	850	230	9.39	
03/13	1100	24.0	850	230	9.38	
03/19	1600	24.0	800	220	9.39	
03/27	1420	25.0	770	250	10.45	Changed measuring point
04/03	1415	25.0	750	292	10.15	

Table 2.4-11 N.W.
WATER QUALITY OF BISCAYNE AQUIFER--N.W. MONITORING WELL
SITE I-4

Date	Time	Temperature (°C)	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
06/14	1030	24.0	1,410	330	10.25	
06/21	0926	24.5	1,250	320	10.2	
06/28	1530	25.5	1,256	300	10.39	
07/05	0940	25.0	1,550	300	10.32	
07/13	0717	25.0	1,500	290	9.97	
07/19	0900	25.0	1,480	290	10.46	
07/26	0918	25.0	1,400	300	10.44	
08/02	0856	24.0	1,420	310	10.6	
08/09	0837	24.0	1,500	300	10.42	
08/16	0841	24.5	1,200	260	10.49	
08/30	0850	25.0	1,200	260	--	
09/06	0850	--	--	--	--	
09/12	0930	24.5	750	560	7.85	Changed measuring point
09/27	1620	29.0	1,000	260	7.77	
10/04	1540	29.0	1,250	270	7.9	
10/11	0942	29.0	1,200	270	7.85	
10/18	0920	28.0	1,400	290	7.9	
10/25	1430	28	1,350	270	7.9	
11/01	0915	--	1,300	290	7.40	
11/08	1641	27.0	1,350	280	7.9	
11/15	1425	25.0	1,190	240	7.9	
11/24	1005	26.0	1,200	230	7.90	

Table 2.4-11 N.W.--Continued

Date	Time	Temperature (°C)	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
11/30	0710	25.5	1,250	220	8.00	
12/06	0745	24.5	800	250	8.81	
12/14	1215	25.0	1,100	240	7.88	
12/20	1035	23.5	1,150	240	7.70	
12/27	1345	25.5	1,000	220	7.97	
01/03	0920	24.5	950	240	7.95	
01/10	0925	24.7	1,000	220	7.91	
01/17	0940	24.7	850	240	7.90	
01/24	1100	23.9	650	220	7.95	
01/31	1025	25.0	975	270	8.01	
02/07	1035	23.3	790	260	7.93	
02/15	1220	24.4	800	220	7.96	
02/21	1310	23.5	798	250	7.86	
02/28	1055	24.0	800	230	7.89	
03/06	1225	24.0	800	240	7.87	
03/13	1110	24.0	800	230	7.86	
03/19	1605	24.0	850	230	7.90	
03/27	1425	25.0	790	210	12.55	Changed measuring point
04/03	1420	25.0	800	226	12.20	

Table 2.4-11 S.E.
WATER QUALITY OF BISCAYNE AQUIFER--S.E. MONITORING WELL
SITE I-4

Date	Time	Temperature (°C)	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
06/14	1045	24.5	900	170	10.20	
06/21	0944	25.0	900	170	10.18	
06/28	1545	25.5	850	160	10.17	
07/05	0945	26.0	950	160	11.30	
07/13	0729	26.0	800	150	10.02	
07/19	0917	25.5	950	160	10.3	
07/26	0936	26.0	800	180	10.3	
08/02	0912	26.5	820	160	10.5	
08/09	0851	27.5	970	150	10.31	
08/16	0903	28.0	700	150	10.34	
08/30	0900	28.0	600	130	10.20	
09/06	0904	30.0	600	150	10.06	
09/12	0910	31.0	550	300	10.04	
09/20	0951	28.5	520	330	8.1	Changed measuring point
09/27	1630	29.0	620	180	8.0	
10/04	1525	29.0	860	190	8.1	
10/11	0952	29.0	800	200	8.2	
10/18	0915	28.0	850	170	8.1	
10/25	1414	28.0	880	160	8.1	
11/01	0925	--	780	190	7.80	
11/08	1652	26.0	850	200	7.85	
11/15	1435	27.0	800	240	8.10	
11/24	1010	27.0	800	180	9.16	

Table 2.4-11 S.E.--Continued

Date	Time	Temperature (°C)	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
11/30	0720	26.0	790	205	9.00	
12/06	0720	26.5	520	150	8.01	
12/14	1210	27.0	810	160	8.10	
12/20	1040	26.0	800	160	8.07	
12/27	1340	26.0	800	170	8.18	
01/03	0925	25.5	750	200	8.15	
01/10	0915	26.4	800	180	8.09	
01/17	0925	25.3	725	170	8.06	
01/24	1055	--	--	--	--	
01/31	1015	26.1	760	200	8.21	
02/07	1050	24.4	790	170	8.11	
02/15	1205	25.0	800	200	8.17	
02/21	1315	24.5	890	200	8.08	
02/28	1100	24.4	850	200	8.12	
03/06	1230	24.4	850	200	8.10	
03/13	1115	24.4	850	200	8.08	
03/19	1610	24.0	800	210	8.11	
03/27	1415	24.4	750	190	13.05	Changed measuring point
04/03	1435	24.4	740	213	12.90	

Table 2.4-11 S.W.
WATER QUALITY OF BISCAYNE AQUIFER--S.W. MONITORING WELL
SITE I-4

Date	Time	Temperature (°C)	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
06/14	1040	24.5	1,000	200	10.27	
06/21	0938	24.5	1,000	210	10.23	
06/28	1540	25.5	980	200	10.36	
07/05	0930	27.0	1,050	200	9.77	
07/13	0733	26.0	1,000	190	10.02	
07/19	0912	26.0	1,100	190	10.35	
07/26	0930	--	--	--	10.42	
08/02	0906	27.0	980	190	10.6	
08/09	0851	27.5	1,100	170	10.38	
08/16	0858	28.0	680	150	10.42	
08/30	0914	28.0	850	170	10.2	
09/06	0855	26.5	680	200	10.25	
09/12	0920	31.0	600	320	9.20	
09/20	0941	29.0	530	300	9.2	
09/27	1640	29.0	750	170	9.0	
10/04	1530	29.0	800	140	9.18	
10/14	0948	29.0	800	150	9.36	
10/18	0912	28.0	850	160	9.2	
10/25	1421	25.8	860	140	9.18	
11/01	0920	--	900	170	10.07	
11/08	1645	27.0	1,050	200	10.1	
11/15	1430	--	--	--	--	
11/24	1015	--	--	--	--	

Table 2.4-11 S.W.--Continued

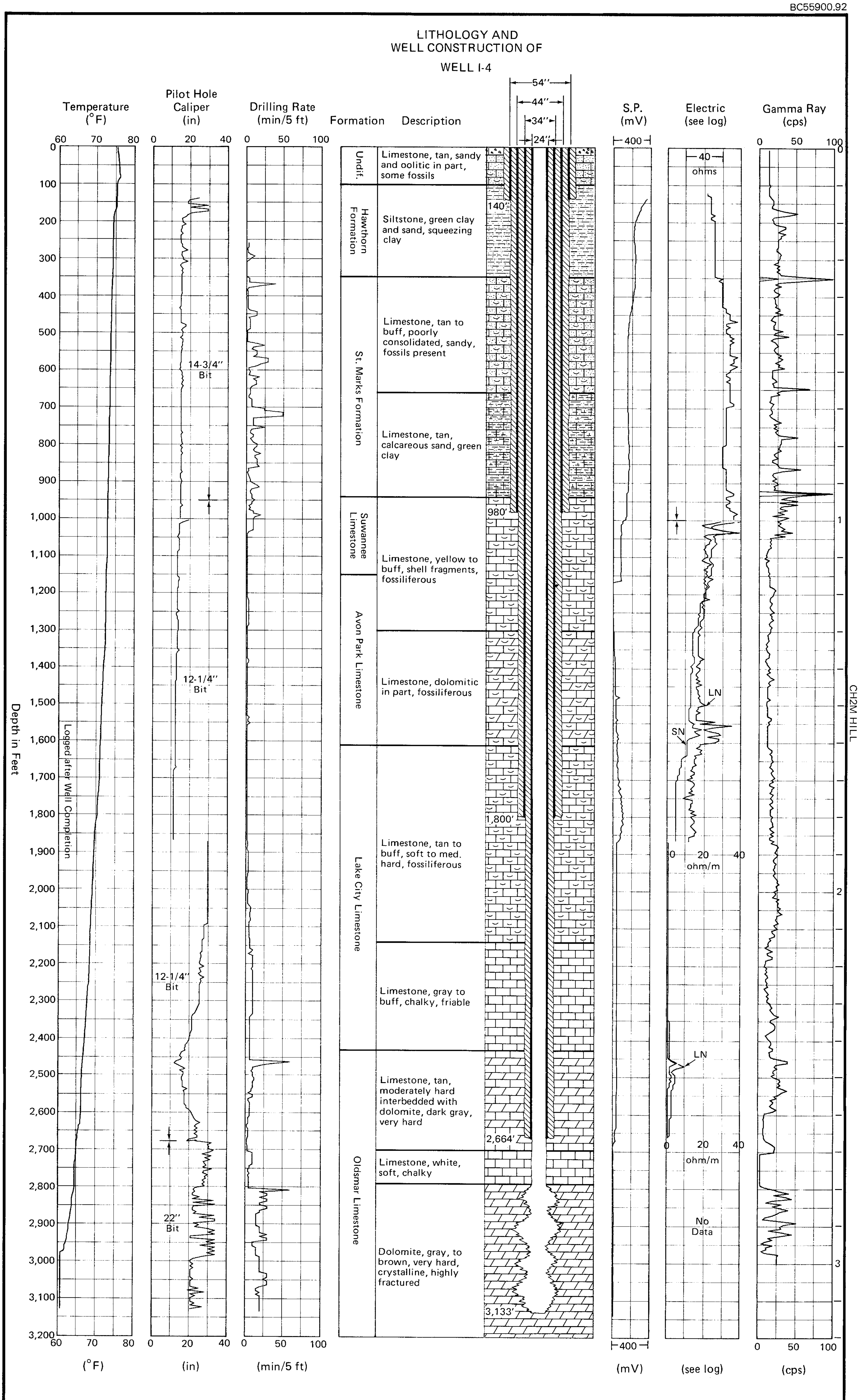
Date	Time	Temperature (°C)	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
11/30	0745	--	--	--	--	
12/06	0730	26.0	600	150	9.40	Changed measuring point
12/14	1200	26.5	680	200	9.44	
12/20	1045	26.0	810	170	9.45	
12/27	1335	26.5	725	160	9.54	
01/03	0930	25.5	750	190	9.44	
01/10	0920	26.1	775	160	9.67	
01/17	0930	26.1	700	170	9.43	
01/24	1110	--	--	--	--	
01/31	1035	26.1	600	190	9.65	Changed measuring point
02/07	1045	24.4	720	170	9.55	
02/15	1210	25.0	790	170	9.54	
02/21	1320	24.5	750	180	9.45	
02/28	1105	24.4	775	170	9.50	
03/06	1210	24.4	750	180	9.47	
03/13	1125	24.4	750	170	9.45	
03/19	1620	24.0	800	190	9.50	
03/27	1435	24.4	720	182	9.57	
04/03	1430	--	--	--	--	

Table 2.4-11 W.S.
WATER QUALITY OF BISCAYNE AQUIFER WATER SUPPLY MONITORING WELL
SITE I-4

Date	Time	Temperature (°C)	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
06/14	0830	23.5	1,400	270	9.7	
06/21	0933	24.0	1,150	220	9.28	
06/28	1535	25.0	1,000	230	9.32	
07/05	0900	24.0	1,200	220	9.40	
07/13	0715	24.0	1,090	215	9.18	
07/19	0907	24.0	1,100	220	9.5	
07/26	0925	24.5	1,080	230	9.46	
08/02	0401	24.0	1,136	250	9.7	
08/09	0840	25	1,300	230	9.42	
08/16	0854	25.0	900	190	9.49	
08/30	0908	25.0	800	180	9.50	
09/06	0850	25.5	900	375	9.50	
09/12	0925	28.0	640	360	9.20	
09/20	0941	27.0	550	390	9.26	
09/27	1621	29.0	880	550	9.22	
10/04	--	--	--	--	--	
10/11	0940	29.0	1,150	260	--	
10/18	0910	29.0	900	300	--	
10/25	1430	27.0	1,000	210	--	
11/01	0920	--	1,350	300	--	
11/08	1652	--	1,500	320	--	
11/15	--	--	--	--	--	
11/24	1020	26.0	1,100	240	9.29	

Table 2.4-11 W.S.--Continued

Date	Time	Temperature (°C)	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
11/30	0830	26.0	1,150	250	--	
12/06	0735	25.0	900	250	9.16	
12/14	1205	25.8	1,000	260	9.22	
12/20	1050	24.5	1,050	260	9.20	
12/27	1330	26.0	900	250	9.31	
01/03	0940	24.5	900	210	9.29	
01/10	--	--	--	--	--	
01/17	0935	24.4	950	250	--	
01/24	1105	23.9	850	220	--	
01/31	1030	26.1	1,000	250	--	
02/07	1040	23.3	900	250	--	
02/15	1205	23.9	850	230	--	
02/21	1305	24.5	900	190	--	
02/28	1050	24.4	860	200	--	
03/06	1220	24.4	900	200	--	
03/13	1140	24.4	860	200	--	
03/19	1625	23.9	900	300	--	
03/27	1430	25.0	700	172	9.55	
04/03	1425	25.0	660	188	9.30	



Summary of drilling and logging data—Well I-4.

FIGURE 2.4-1.

Chapter 2.5
WELL I-5

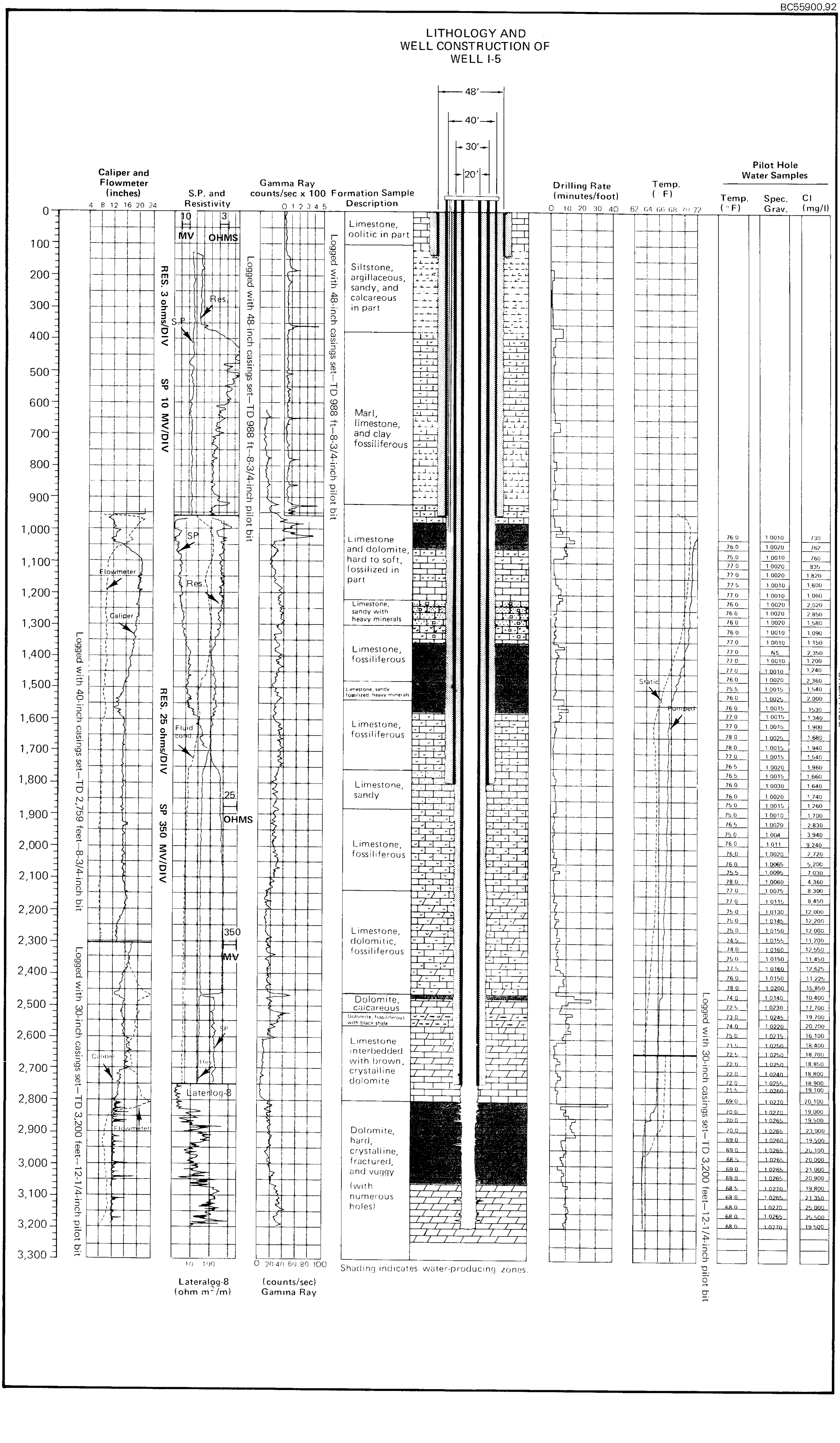
Injection Well I-5 is located on the eastern boundary of the site as shown on Figure 1.1-2, Section 1, Summary. It is 750 feet south of I-6 and 100 feet north of BZ-1. This well, constructed in 1977, is the test injection well drilled to prove the feasibility and determine the final design of the well system.

The Construction report for this well was completed in December 1977 and is entitled "Engineering Report, Drilling and Testing of the Test Injection Well I-5, for the Miami-Dade Water and Sewer Authority." It contains all of the pertinent construction and testing data for this well. Figure 2-1 from that report (designated herein as Figure 2.5-1) is included for convenience. It is a summary of construction and logging data from this well.

An injection test was run to determine the injection capacity of the well and corresponding wellhead pressure. The test was run for about 10 hours at 8,000 gpm. The wellhead pressure reached a high of 127 feet of water during the test. This is higher than the pressures observed in the other injection wells because of the well's 20-inch-diameter inner casing versus 24-inch for the other wells. During the test, the pressure at the injection zone was measured using a 5-inch-diameter drill string as a freshwater piezometer set at 2,865 feet in the well. The pressure at the bottom of the pipe was measured at the surface. The bottom hole pressure, as a result of injecting at 8,000 gpm, was approximately 0.7 psi or 1.6 feet of water.

After the injection pump was stopped, the wellhead pressure stabilized at about 72 feet of water due to the freshwater buoyancy.

For further information on this well refer to the above-mentioned injection well report.



Summary of data from drilling and related operations—I-5.

FIGURE 2.5-1.

Chapter 2.6
INJECTION WELL I-6

Injection Well I-6 is located 700 feet north of I-5 and 700 feet east of I-7 in the northeast corner of the project site as shown on Figure 1.1-2, Section 1, Summary. Drilling began on April 22, 1979, and was completed on April 6, 1980. The drilling and casing sequence was as follows:

1. Drilled 12-1/4-inch exploratory hole to 190 feet.
2. Reamed hole to 60-inch diameter to a depth of 132 feet.
3. Set and cemented 54-inch casing from a depth of 128 feet to the concrete drilling pad.
4. Drilled 12-1/4-inch exploratory hole to 1,004 feet.
5. Reamed hole to 52-inch diameter to a depth of 985 feet.
6. Set and cemented 44-inch casing from a depth of 980 feet to the concrete drilling pad.
7. Drilled 12-1/4-inch exploratory hole to 1,900 feet.
8. Reamed hole to 42-inch diameter to a depth of 1,800 feet.
9. Set and cemented 34-inch casing from a depth of 1,790 feet to the concrete drilling pad.
10. Drilled 12-1/4-inch exploratory hole to 2,763 feet.
11. Reamed hole to 32-inch diameter to a depth of 2,750 feet.
12. Set 24-inch casing from the surface to a depth of 2,740 feet. Cemented this casing from the bottom to a depth of 2,295 feet after encountering serious difficulties described below.
13. Ran a successful casing pressure test (pressurized 24-inch casing to 104 psi; pressure held for 85 minutes, with no loss).
14. Drilled 22-inch hole to a depth of 3,112 feet (total depth).
15. Ran injection test at 10,00 gpm for 32.5 hours.
16. Cemented the 24-inch casing from 2,295 feet to 1,657 feet.

17. Pressurized the 34-inch/24-inch annulus to 30 psi and held for 30 minutes with no loss.

18. Cemented the 24-inch casing from 1,657 ft to 97 ft.

19. Ran a cement bond log on the 24-inch casing.

20. Cemented the 24-inch casing up to the concrete drilling pad.

21. Completed the wellhead and concrete drilling pad.

Casings are black steel API 5L, Grade B and ASTM A139, Grade B. Casing details are summarized in Table 2.6-1. The four casings were cemented with API Class H cement slurries as summarized in Table 2.6-2. Two problems that occurred during step 12 of the above sequence were: (1) excessive loss of cement while cementing the inner 24-inch casing, and (2) accidental loss of tremie pipes in the annulus between the 24-inch and 34-inch casings.

The first problem was probably caused by the fact that, in order to meet regulatory guidelines to set the inner casing as deep as possible, the bottom of the reamed hole was completed too close to the cavernous zone. The weight of the cement column caused it to break into a highly transmissive system. From wells drilled later, it became apparent that transmissive zones start as high as 2,450 feet in depth and are capable of taking a substantial amount of cement. As seen in Table 2.6-2, a significant amount of graveling between cement stages was done up to a depth of 2,681 feet before reasonable fill-up was accomplished with the cement. This problem caused the 24-inch casing setting guidelines on the remaining injection wells to be changed, resulting in casing depths approximately 100 feet higher than on Injection Well I-6. Later, problems on I-2 shortened the casing settings even further.

The sequence of events leading to the accidental loss of two sections of 1-1/2-inch pipe in the annulus between the 34-inch and 24-inch casings of Injection Well I-6 was as follows:

After reaming the hole with a 32-inch bit to a depth of 2,750 feet, the bottom of the inner casing was set at 2,740 feet, and the first stage of cement was pumped down the drill pipe inside the 24-inch casing. After allowing time for the cement to set, the cement line was pulled out and a temperature log was run. This log showed no evidence of fill-up. The driller tried to tag the cement in the annulus with 1-1/2-inch pipe, but no cement was found. When the driller started tripping out the pipe, the hoisting pin cable on the rig broke and 2,750 feet of pipe were lost in the 34-inch to 24-inch annulus. This pipe string consisted of approximately 2,550 feet of 1-1/2-inch pipe with 200 feet of 2-inch pipe at the top. The driller did not succeed in fishing it out. It is believed that the top of the pipe is located at a depth of approximately 400 feet below pad level.

The bottom of Injection Well No. I-6 was then filled with gravel to 2,747 feet. The second stage of cement was pumped down the drill pipe inside the 24-inch casing. The cement inside the 24-inch casing was tagged at 2,733 feet. A string of 1-1/2-inch pipe was run in the annulus to tag the top of the cement, but during this process, when the bottom of the pipe was past 2,300 feet, 524 feet broke off and was lost in the annulus. Possibly, it hit one of the lifting lugs on the 24-inch casing, which resulted in tearing a coupling loose. Again, the driller was unable to fish out the lost pipe. A second attempt to tag the cement in the annulus showed the top of the cement at 2,735 feet. It is believed that the top of the 524-foot section of 1-1/2-inch pipe is located at a depth of 2,200 to 2,300 feet below pad level. The 24-inch casing was cemented up to a depth of 2,295 feet before an attempt to locate the tremie pipes was made with television surveys in the hole and the annulus. After completing the casing pressure test and drilling the open hole to a depth of 3,112 feet, a television survey was run inside the 24-inch casing to total depth. The 2,750-foot tremie pipe was located below the casing. This pipe appeared intact and not cut by the drilling bit. It was visible along the borehole wall from 1 foot to 6 feet below the 24-inch casing. A television survey was then run inside the 24/34-inch annulus. After repeated attempts, the top of the tremie pipe could not be located. Camera depths varied from 57 feet to 753 feet at different locations around the annulus. Tight annular space, lifting lugs, and centralizers prevented the camera from going deeper. Additional testing done during the injection test to evaluate the impact of the tremie pipes in the annulus is described below.

After analysis of the cause of this problem, it was apparent that the use of tremie pipe with square shoulder couplings increased the chances of being damaged or caught by centralizers and casing lifting lugs. At this point, steps were taken to use only flush-joint or integral-joint pipe for cementing and tagging cement in future wells, to prevent reoccurrence of such accidents.

Geophysical logs, directional surveys, and TV surveys run on this well are listed in Table 2.6-3. The results of the gyroscopic directional surveys for path comparisons between the pilot and the reamed holes are included in Table 2.6-4. A descriptive summary of the underwater television survey after well completion is presented in Table 2.6-5. Results of a lithological examination of the formation samples collected every 10 feet from the pilot hole drilling are presented in Table 2.6-6. Water quality data from pilot hole drilling is shown in Table 2.6-7.

Figure 2.6-1 presents a summary of data from drilling and logging and includes the following: well construction diagram, drilling rate, lithologic description, and electric, gamma radiation, temperature, and caliper logs.

Injection Test

In order to provide assurance that the presence of the two pipes in the annulus would not permit the upward migration of effluent, the injection test was run on the well with the inner casing cemented up to 2,295 feet and an open annulus above it. Two monitoring lines were installed in the annulus, one to a depth of 70 feet, and the other to 2,200 feet. In addition to the injection rate and the wellhead pressure, the following parameters were monitored during the test conducted for 32 hours: (1) water quality of the injected fluid (freshwater having 700 to 800 mg/l of chlorides) from an adjacent pond, (2) water levels in each monitoring line, and (3) water quality of samples pumped from each monitoring line (each line was pumped long enough to obtain a representative sample from the corresponding depth). The data on water levels and water quality collected during the test were compared to background measurements before the test. This comparison showed no leakage of freshwater into the annulus. Injection test results are summarized in Table 2.6-8. All the data collected is included in Tables 2.6-9, 2.6-9 W.Q. 270, 2.6-9 W.Q. 2,200, and 2.6-9 W.L. 2,200. The quality of the injected water is given in Table 2.6-10. The injection test demonstrated the injection performance to be well within design parameters and that no upward movement of injected water occurs through the cement lines.

Biscayne Aquifer Water Quality Monitoring

During well drilling, water samples were collected and levels measured at each of five shallow monitoring wells installed around the drilling pad. Four of the wells were 2-inch-diameter PVC, approximately 20 feet deep, and located at each corner of the pad. The fifth was 8-inch-diameter steel, approximately 40 feet deep, and was used for supply water during construction. These data are included in Tables 2.6-11 N.E. through 2.6-11 W.S.

Table 2.6-1
SUMMARY OF CASING DATA
WELL I-6

Diameter (inches)	Wall Thickness (inches)	Depth (feet)[a] From	Depth (feet)[a] To	Cemented Section (depth in feet)[a] From	Cemented Section (depth in feet)[a] To
54	0.500	0	128	128	0
44	0.500	0	980	980	0
34	0.500	0	1,790	1,790	0
24	0.500	0	2,740	2,740	0

[a]Measured from the top of the concrete drilling pad.

Table 2.6-2
SUMMARY OF CEMENTING OF CASINGS
WELL I-6

Date	Casing Cemented	Type of Cement Used (API)	Number of Sacks Used	Depth Cemented (ft) From	Depth Cemented (ft) To
04/26/79	54"	Class H w/25 lb of gilsonite per sack of cement	320	128	0
05/20/79	44"	Lead: Class H w/12% bentonite	1,800	980	0
		Tail: Class H neat	780		
07/07/79	34"	Lead: Class H w/12% bentonite	1,260	1,790	1,375
		Tail: Class H neat	600		
07/10/79	34"	Class H w/12% bentonite	1,194	1,375	1,140
07/11/79	34"	Class H thixotropic	190	1,140	1,121
		Class H w/12% bentonite	451		
07/12/79	34"	Class H thixotropic	400	1,121	1,046
07/13/79	34"	Lead: Class H w/12% bentonite	200	1,046	747
		Tail: Class H thixotropic	400		
07/13/79	34"	Class H w/12% bentonite	1,467	747	0
08/16/79	24"	Spacer: Class H neat	100	No fill-up	
		Lead: Class H w/12% bentonite	900		
		Tail: Class H neat	1,100		
08/23/79	24"	Gravel (no cement)	--	Bottom of hole	2,746
		Sand Cap (no cement)			
08/25/79	24"	Lead: Class H thixotropic	1,100	2,745	2,735
		Tail: Class H neat	950		
08/28/79	24"	Lead: Class H w/12% bentonite	363	2,735	2,734
		Tail: Class H neat	552		

Table 2.6-2--Continued

Date	Casing Cemented	Type of Cement Used (API)	Number of Sacks Used	Depth Cemented (ft) From	To
08/29/79	24"	Class H thixotropic	125	2,734	2,733
08/30/79	24"	Class H thixotropic	200	2,733	2,733
08/31/79	24"	Class H thixotropic	125	2,733	2,733
09/01/79 to 09/04/79	24"	Gravel (no cement)	--	2,733	2,710
09/05/79	24"	Class H neat	130	2,710	2,704
09/06/79	24"	Class H neat	200	2,704	2,704
09/07/79	24"	Gravel (no cement)	--	2,704	2,681
09/08/79	24"	Class H neat	100	2,681	2,675
09/09/79	24"	Class H neat	100	2,675	2,665
09/09/79	24"	Class H neat	400	2,665	2,604
09/10/79	24"	Class H neat	800	2,604	2,377
09/10/79	24"	Class H neat	490	2,377	2,295
03/24/80	24"	Class H neat	600	2,295	2,255
03/25/80	24"	Class H neat	600	2,255	2,210
03/26/80	24"	Class H neat	600	2,210	2,120
03/26/80	24"	Class H neat	600	2,120	2,005
03/27/80	24"	Class H neat	600	2,005	1,918
03/27/80	24"	Class H neat	600	1,918	1,831
03/28/80	24"	Class H neat	600	1,831	1,657
04/03/80	24"	Class H neat	600	1,657	1,360
04/03/80	24"	Class H neat	600	1,360	1,068
04/04/80	24"	Class H, w/2% bentonite, 2% $CaCl_2$	550	1,068	798

Table 2.6-2--Continued

Date	Casing Cemented	Type of Cement Used (API)	Number of Sacks Used	Depth Cemented (ft)	
				From	To
04/04/80	24"	Class H, w/2% bentonite, 2% $CaCl_2$	550	798	500
04/05/80	24"	Class H, w/2% bentonite, 2% $CaCl_2$	550	500	202
04/05/80	24"	Class H, w/2% bentonite, 2% $CaCl_2$	210	202	97
10/12/80	24"	Class H neat	150	97	0

Table 2.6-3
LIST OF GEOPHYSICAL LOGS AND WELL SURVEYS
WELL I-6

Date	Well Progress and Casing Depth	Type of Logs or Surveys Run[a]	Purpose
04/30/79	54" casing to 128'	E, G	1. Identify top of Floridan aquifer. 2. Establish setting depth of 44" casing.
05/30/79	44" casing to 980' 12-1/4" hole to 1,900'	E, G, T_S, GYRO	1. Geohydrological definition of Floridan aquifer. 2. Establish setting depth of 34" casing. 3. Gyroscopic well path track of the pilot hole.
06/12/79	44" casing to 980' 32" hole to 1,800'	GYRO	1. Gyroscopic well path track of reamed hole to compare to the pilot hole track.
07/08/79	Completed first-stage cementing of 34" casing set at 1,790'; <u>no open hole</u>	T_S	1. Determine top of first-stage cement outside 34-inch casing.
07/27/79	34" casing to 1,790' 12-1/4" hole to 2,763'	E, G, T_S, C, FC, GYRO	1. Qualitative evaluation of confining beds above Boulder Zone. 2. Establish setting depth for 24" casing. 3. Gyroscopic well path track of the pilot hole
08/09/79	34" casing to 1,800' 32" hole to 2,740'	GYRO	1. Gyroscopic well path track of reamed hole to compare to the pilot hole.

Table 2.6-3--Continued

Date	Well Progress and Casing Depth	Type of Logs or Surveys Run[a]	Purpose
08/17/79	24" casing to 2,740'	T_S	1. Determine the top of the first stage cement outside the 24" casing.
08/28/79	As above	T_S	1. As above.
10/15/79	24" casing to 2,740' 22" hole to 3,112'	TV (2)	1. Visual qualitative evaluation of receiving zone. 2. Locate bottom of lost tremie pipes, and determine their condition.
10/29/79	24" casing to 2,740' 22" hole to 3,112'	LSN, G, T_S	1. Geohydrological definition of injection zone. 2. Define production zones.
10/18/79	As above	TV	1. Locate the top of the lost tremie pipe in the 34"/24" annulus.
03/24/80	As above	C	1. Verify that hole is open to T.D. after the injection test
04/02/80	As above	TV	1. Final inspection of the well. 2. Visual check of tremie pipe during annulus pressure test.
04/15/80	As above	CBL	1. Confirm adequacy of the 24" casing cement.
01/30/81	As above	C	1. Record borehole diameter and 24" casing.

Table 2.6-3--Continued

Date	Well Progress and Casing Depth	Type of Logs or Surveys Run[a]	Purpose
01/21/81	As above	FC	1. Verify uniform water quality.
01/22/81	As above	T_s	1. Temperature profile for potentiometric survey.
01/23/81	As above	T_s	1. Temperature profile for potentiometric survey.

[a]Abbreviations for logs and surveys are as follows:

E = single point electric and SP
LSN = long and short normal and SP
G = gamma ray
C = caliper
T_s = temperature, static
T_F = temperature, flowing
FV_s = fluid velocity (flow meter) static
FV_F = fluid velocity (flow meter) flowing
FC = fluid conductivity

GYRO = gyroscopic directional survey
TV = television
CBL = cement bond, variable density
WTD = wave train display
D. IND = dual induction electric and SP
BCS = borehole compensated sonic
Density = formation density
AV = acoustic velocity
GGD = gamma gamma density (0-500 ft)

Table 2.6-4
COMPARISON OF WELL PATHS FROM GYROSCOPIC SURVEYS
WELL I-6

WELL PATH COMPARISON

FOLLOW WELL: FILE 699.

MIAMI-DADE COUNTY WATER AND SEWAGE AUTHORITY
WELL I-6 REAM HOLE 0 TO 1710 FEET
DADE COUNTY, FLA.
JUNE 14, 1979

5 DEG. A.U. GYRO SURVEY W/T.A.C.

TARGET WELL: FILE 671.

MIAMI-DADE COUNTY WATER AND SEWAGE AUTHORITY
WELL I-6 PILOT HOLE 0 TO 1882 FEET
DADE COUNTY, FLA.

5 DEGREE A.U. GYRO SURVEY W/FREE CENTRALIZERS

HORIZONTAL DISTANCE AND DIRECTION FROM TARGET WELL TO FOLLOW WELL AT TRUE VERTICAL DEPTHS

FEET	FEET	DIRECTION DEGREES
30.00	0.06	11.22
60.00	0.03	51.64
90.00	0.10	141.24
120.00	0.13	110.65
150.00	0.19	86.44
180.00	0.18	71.00
210.00	0.14	78.83
240.00	0.17	95.82
270.00	0.17	96.84
300.00	0.16	87.71
330.00	0.14	82.56
360.00	0.10	56.02
390.00	0.05	9.44
420.00	0.05	311.90
450.00	0.11	341.46
480.00	0.15	30.31
510.00	0.22	26.85
540.00	0.28	29.64
570.00	0.32	34.02
600.00	0.36	26.61
630.00	0.34	26.58
660.00	0.40	26.29
690.00	0.40	31.29
720.00	0.40	35.50
750.00	0.43	39.31
780.00	0.49	42.46
810.00	0.56	40.63
840.00	0.57	32.30
870.00	0.52	28.78
900.00	0.47	36.04
930.00	0.54	47.11
960.00	0.60	49.89
990.00	0.61	53.35
1020.00	0.63	57.99
1050.00	0.63	57.58
1080.00	0.60	55.68
1110.00	0.64	56.56
1140.00	0.67	55.90
1170.00	0.64	53.80
1200.00	0.64	57.92
1230.00	0.69	60.93
1260.00	0.71	60.83
1290.00	0.71	61.23
1320.00	0.70	59.24
1350.00	0.69	56.12
1380.00	0.72	54.58
1410.00	0.79	52.65
1440.00	0.83	48.56
1470.00	0.75	50.52
1500.00	0.69	48.11
1530.00	0.70	40.74
1560.00	0.69	35.06
1590.00	0.60	29.83
1620.00	0.57	25.00
1650.00	0.63	19.24
1680.00	0.61	15.43
1710.00	0.50	16.07

WELL PATH COMPARISON

FOLLOW WELL: FILE 724.

MIAMI-DADE COUNTY WATER AND SEWAGE AUTHORITY
WELL I-6 REAM HOLE 1725 FEET TO 2745 FEET
DADE COUNTY, FLA.
AUG. 10, 1979

TARGET WELL: FILE 720.

MIAMI-DADE COUNTY WATER AND SEWAGE AUTHORITY
WELL I-6 PILOT HOLE 1725 FEET TO 2745 FEET
DADE COUNTY FLA.
JULY 27, 1979

5 DEG. A.U. GYRO SURVEY W/T.A.C.

SURVEY TIE-IN AT 1710 FEET (FILE 699)

HORIZONTAL DISTANCE AND DIRECTION FROM TARGET WELL TO FOLLOW WELL AT TRUE VERTICAL DEPTHS

FEET	FEET	DIRECTION DEGREES
1725.00	0.00	46.95
1755.00	-0.04	12.18
1785.00	0.08	349.17
1815.00	0.12	326.21
1845.00	0.16	333.71
1875.00	0.16	326.94
1905.00	0.12	306.13
1935.00	0.19	319.61
1965.00	0.29	315.26
1995.00	0.38	302.29
2025.00	0.44	297.29
2055.00	0.46	297.89
2085.00	0.49	293.32
2115.00	0.51	284.51
2145.00	0.48	277.55
2175.00	0.47	276.16
2205.00	0.46	279.20
2235.00	0.54	273.65
2265.00	0.52	265.89
2295.00	0.44	256.78
2325.00	0.38	257.61
2355.00	0.27	254.41
2385.00	0.21	243.95
2415.00	0.20	232.77
2445.00	0.21	217.52
2475.00	0.23	201.03
2505.00	0.23	190.40
2535.00	0.20	181.98
2565.00	0.16	185.46
2595.00	0.10	185.56
2625.00	0.11	156.22
2655.00	0.13	131.40
2685.00	0.18	113.56
2715.00	0.17	108.44

MIAMI-DADE COUNTY WATER AND SEWAGE AUTHORITY
WELL I-6 REAM HOLE 1725 FEET TO 2715 FEET
DADE COUNTY, FLA.

COMPUTATION PAGE NO. 1
TIME DATE
15:50:38 10-AUG-79

MEASURED DEPTH FEET	DRIFT ANGLE DEG	DRIFT DIRECTION DEG	TRUE VERTICAL DEPTH FEET	RECTANGULAR COORDINATES FEET		CLOSURE DISTANCE FEET	CLOSURE DIRECTION DEG
1710.	0.10	126.70	1710.00	0.12 N	0.56 E	0.57	77.91
1725.	0.09	138.60	1725.00	0.10 N	0.58 E	0.59	79.76
1755.	0.07	214.30	1755.00	0.07 N	0.58 E	0.58	83.23
1785.	0.12	202.00	1785.00	0.02 N	0.55 E	0.55	87.73
1815.	0.21	153.60	1815.00	0.06 S	0.56 E	0.56	96.33
1845.	0.10	147.80	1845.00	0.12 S	0.61 E	0.62	100.98
1875.	0.19	182.90	1875.00	0.18 S	0.65 E	0.67	105.73
1905.	0.16	103.30	1905.00	0.26 S	0.70 E	0.75	109.95
1935.	0.10	328.40	1935.00	0.21 S	0.74 E	0.77	106.11
1965.	0.07	237.50	1965.00	0.20 S	0.70 E	0.73	106.27
1995.	0.18	192.30	1995.00	0.26 S	0.66 E	0.71	111.12
2025.	0.06	134.60	2025.00	0.31 S	0.68 E	0.75	114.77
2055.	0.10	153.80	2055.00	0.34 S	0.70 E	0.78	116.10
2085.	0.13	209.30	2085.00	0.40 S	0.70 E	0.81	119.88
2115.	0.29	138.00	2115.00	0.50 S	0.71 E	0.87	125.32
2145.	0.18	194.30	2145.00	0.62 S	0.74 E	0.96	129.89
2175.	0.10	149.40	2175.00	0.69 S	0.75 E	1.02	132.58
2205.	0.18	175.10	2205.00	0.76 S	0.77 E	1.08	134.40
2235.	0.23	192.50	2235.00	0.86 S	0.76 E	1.15	138.54
2265.	0.33	152.30	2265.00	1.01 S	0.78 E	1.28	142.17
2295.	0.07	188.70	2295.00	1.11 S	0.80 E	1.37	144.20
2325.	0.21	139.10	2325.00	1.18 S	0.82 E	1.44	145.17
2355.	0.19	164.30	2355.00	1.27 S	0.87 E	1.54	145.60
2385.	0.19	184.60	2385.00	1.37 S	0.88 E	1.63	147.32
2415.	0.31	166.70	2415.00	1.50 S	0.89 E	1.74	149.39
2445.	0.21	161.30	2445.00	1.63 S	0.93 E	1.88	150.44
2475.	0.31	129.50	2475.00	1.74 S	1.00 E	2.01	150.10
2505.	0.12	166.70	2505.00	1.84 S	1.06 E	2.12	150.00
2535.	0.11	172.50	2535.00	1.90 S	1.07 E	2.18	150.51
2565.	0.04	310.40	2565.00	1.91 S	1.05 E	2.18	151.31

MIAMI-DADE COUNTY WATER AND SEWAGE AUTHORITY
WELL I-6 REAM HOLE 1725 FEET TO 2715 FEET
DADE COUNTY, FLA.
AUG. 10, 1979

5 DEG. A.U. GYRO SURVEY W/T.A.C.

SURVEY TIE-IN AT 1710 FEET(FILE 699)

RECORD OF SURVEY

RADIUS OF CURVATURE METHOD

MIAMI-DADE COUNTY WATER AND SEWAGE AUTHORITY
WELL I-6 REAM HOLE 1725 FEET TO 2715 FEET
DADE COUNTY, FLA.

TIME 15:50:38 DATE 10-AUG-79

MEASURED DEPTH FEET	DRIFT ANGLE DEG	DRIFT DIRECTION DEG	TRUE VERTICAL DEPTH FEET	RECTANGULAR COORDINATES FEET		CLOSURE DISTANCE FEET	CLOSURE DIRECTION DEG
2595.	0.17	218.60	2595.00	1.92 S	1.00 E	2.16	152.50
2625.	0.16	223.20	2625.00	1.98 S	0.95 E	2.19	154.44
2655.	0.10	226.50	2655.00	2.02 S	0.90 E	2.21	156.02
2685.	0.17	187.30	2685.00	2.08 S	0.87 E	2.26	157.34
2715.	0.21	240.40	2715.00	2.16 S	0.82 E	2.31	159.20

FINAL CLOSURE - DIRECTION: 159.202 DEGS CLOCKWISE FROM NORTH
DISTANCE: 2.31 FEET

Table 2.6-5
DESCRIPTIVE SUMMARY OF UNDERWATER TELEVISION SURVEY
WELL I-6

CH2M HILL

RECORD OF UNDERWATER TV SURVEY

Project: Miami Dade Water & Sewer Authority, South District Regional Wastewater Treatment Plant

Well: I-6 Final Inspection

Survey By: Deep Venture Diving Service, Perry, Florida
HP-4,000 AU

Survey Date: 4/02/80 Total Depth: 3,103 feet

Witnessed By: T. McCormick, A. Rubio, D. Cabit, J. Lehnen

Reviewed By: J. D. Lehnen Date: 12/18/80

Remarks:

Depth in Feet		Reel Counter		Observations
From	To	From	To	
--	--	0	17	Titles
0	2	17	19	Dry 24" casing
0	200	19	63	Water level, 24" casing, fair picture (re-zeroed)
200	2,740	63	532	Good picture, casing
2,740	--	532	542	Bottom of 24" casing
2,740	2,745	542	545	Large hole, poor visibility
2,745	2,746	545	684	Clear shot of tremie pipe at 3:00 imbedded in a borehole ledge
2,746	2,752	684	686	Hole size changes to smaller diameter
2,752	2,780	686	695	Large cavity, very rough, highly fractured
2,780	2,809	695	702	Rough borehole, numerous solution cavities
2,809	2,814	702	705	High angle fracture across borehole
2,814	2,815	705	706	Cavity
2,815	2,824	706	709	Smoother walls with cavities and solution features
2,824	2,842	709	717	Cavities, high angle fractures

Project: Miami Dade Water & Sewer Authority, South District Regional Wastewater Treatment Plant

Well: I-6 Date: 4/02/80 Total Depth: 3,103'

Depth in Feet		Reel Counter		Observations
From	To	From	To	
2,842	2,857	717	723	Large cavities, severe fracturing
2,857	2,861	723	725	Smoother walls
2,861	--	--	--	Large cavity
2,862	2,894	725	736	High angle fractures, very numerous
2,894	2,928	736	745	Rough walls, less fracturing, mottled appearance
2,928	2,931	745	746	Large cavity
2,931	2,943	746	749	Fractures, smooth walls
2,943	2,964	749	756	Highly cavernous section, very broken formation
2,964	3,000	756	765	Rough walls, mottled appearance, numerous solution features
3,000	3,024	765	770	More cavernous, some large cavities
3,024	3,097	770	787	Smooth walls with solution features, high angle
--	--	--	--	Fractures in the borehole walls, some washouts
3,097	3,103	787	790	Very large cavities
3,103	3,103	790	804	Bottom of the hole
--	--	--	--	
3,103	2,458	804	880	Coming out of the hole
--	2,458	--	880	End of tape

Table 2.6-6
LITHOLOGY FROM PILOT HOLE FORMATION SAMPLES
WELL I-6

Depth Interval From	To	Description
0	10	Rock fill, no sample taken
10	20	Limestone, buff to white, hard, oolitic, recrystallized shell fragments
20	30	Limestone, tan to white, granular to chalky, hard, sandy
30	40	Limestone, tan to white, sandy, granular, hard
40	50	Limestone, as above
50	60	Limestone, as above, very sandy, softer
60	70	Limestone, tan to white, sandy, chalky, soft,
70	80	Sand, quartz, fine, rounded, frosted; Limestone, sandy chalky to granular, very poorly cemented
80	90	Limestone, sandy, as above
90	100	Limestone, as above; siltstone, gray to green, calcareous, poorly cemented
100	110	Limestone, as above
110	120	Limestone, as above
		Note: Lost circulation during pilot hole drilling from 120' to 180'. Samples reported for this interval are from reaming
120	130	Limestone, sandy, soft to moderately hard, chalky, white to buff; siltstone, moderately hard, calcareous, gray to olive green
130	180	No samples
180	190	Limestone, tan to buff, hard, crystalline, trace of siltstone, olive green, clayey, sandy; limestone fraction probably cavings
190	200	Siltstone, olive green, clayey, sandy, soft; and limestone, sandy, chalky, probably cavings
200	210	As above--poor sample, badly mixed with cuttings from higher in the hole

Table 2.6-6--Continued

Depth Interval From	To	Description
210	220	As above
220	230	As above
230	240	As above
240	250	As above
250	260	As above
260	270	Limestone, yellowish tan, crystalline, sandy; some pieces siltstone as above
270	280	As above
280	290	As above
290	300	As above
300	310	As above
310	320	As above
320	330	As above
340	350	As above
350	360	As above
360	370	As above
370	380	Siltstone, greenish gray, very finely sandy, calcareous; some cuttings from above
380	390	Siltstone, as above
390	400	Siltstone as above
400	410	Limestone, yellowish gray, sandy, chalky to finely crystalline; very little siltstone fragments
410	420	Limestone, as above; more chalky, soft
420	430	Limestone, as above
430	440	Limestone, as above
440	450	Limestone, as above

Table 2.6-6--Continued

Depth Interval From	To	Description
450	460	Limestone, as above
460	470	Limestone, as above
470	480	Limestone, as above
480	490	Limestone, as above
490	500	Siltstone, grayish yellow, calcareous and clayey, slightly plastic, very soft, possibly some clay
500	510	As above
510	520	Siltstone, as above, less clay
520	530	Siltstone, as above
530	540	Siltstone, as above
540	550	Siltstone, as above
550	560	Siltstone, as above, more calcareous
560	570	Siltstone and limestone, as above
570	580	Siltstone and limestone, as above
580	590	Limestone, yellowish gray, sandy, silty, moderately hard
590	600	Limestone, as above
600	610	Limestone, as above
610	620	Limestone, yellowish gray, sandy, silty, very soft, chalky
620	630	Limestone, grayish yellow, argillaceous, sandy and silty, very soft
630	640	Limestone, as above, becoming less silty, harder, more sandy, less clay
640	650	Limestone, as above
650	660	Limestone, yellowish gray, sandy, granular to chalky, moderately hard
660	670	Limestone, as above

Table 2.6-6--Continued

Depth Interval From	To	Description
670	680	Limestone, as above
680	690	Limestone, as above
690	700	Limestone, as above
700	710	Limestone, as above
710	720	Limestone, as above
720	730	Limestone, as above
730	740	Limestone, as above
740	750	Limestone, pale yellowish gray, sandy, chalky, moderately hard, much cuttings from above
750	760	Limestone, as above
760	770	Limestone, as above
770	780	Limestone, as above, some darker, silty
780	790	Limestone, pale gray-green, silty and sandy, very soft
790	800	Limestone, as above
800	810	Limestone, as above
810	820	Limestone, as above, chalky
820	830	Limestone, as above
830	840	Limestone, as above
840	850	Limestone, as above, some siltstone
850	860	Limestone, as above, chalky
860	870	Limestone, as above, chalky
870	880	Limestone, as above, chalky
880	890	Limestone, as above, chalky
890	900	Limestone, pale gray-green, soft, silty, chalky
900	910	Limestone, as above with some clay

Table 2.6-6--Continued

Depth Interval From	To	Description
910	920	Limestone, as above with some clay
920	930	Clay or silt, greenish gray, calcareous, soft
930	940	Limestone, pale grayish green, silty, moderately hard
940	950	Limestone, yellow to greenish gray, silty, sandy, soft, some camerinids (Ocala species)
950	960	No sample
960	970	Limestone, tan to buff, recrystallized, hard, granular to massive, numerous microfossils, as above
970	980	Limestone, recrystallized, hard, granular to massive numerous microfossils, and recrystallized shell fragments
980	990	Limestone, granular to chalky, medium hard, fossilerous, some fragments show, ovoid microfossils in micrite cement
990	1,000	Sample missing
1,000	1,010	Limestone, pale grayish yellow, medium hard
1,010	1,020	Limestone, moderately hard, granular, sandy, bearing weathered tests of microfossils and other biogenic fragments in chalky cement
1,020	1,030	Limestone, grayish brown, moderately hard to soft, fine grain, cement is less chalky and more micritic
1,030	1,040	Limestone, tan, moderately hard, granular to chalky, sparsely fossilized
1,040	1,050	Limestone, grayish tan, moderately hard, granular, highly fossilized, grains are microfossils in a chalky cement
1,050	1,060	Limestone, as above, color is less grayish
1,060	1,070	Limestone, as above
1,070	1,080	Sample missing
1,080	1,090	Sample missing
1,090	1,100	Sample missing

Table 2.6-6--Continued

Depth Interval From	To	Description
1,100	1,110	Limestone, as above, grains present but chalky matrix predominates
1,110	1,120	Limestone, as above, grains present but chalky matrix predominates
1,120	1,130	Limestone, light tan, moderately hard, chalky, some distinct grains, but mostly chalky, few fragments of larger fossils and casts
1,130	1,140	Limestone, light tan, hard, chalky to granular, fossils and casts, as above
1,140	1,150	Limestone, light tan, hard, granular, chalky cement, abundant cones
1,150	1,160	Limestone, light tan, hard, granular, chalky to micritic cement, abundant cones
1,160	1,170	Limestone, as above, fewer cones, minor amounts of limestone, very hard, grayish tan to gray, recrystallized, mottled
1,170	1,180	Limestone, light tan, hard, granular, to chalky, numerous cones
1,180	1,190	Limestone, light tan, hard, granular, porous, grains appear to be small, (.1-1 mm) microfossils, mostly cones cemented in a chalky matrix
1,190	1,200	Limestone, as above
1,200	1,210	As above
1,210	1,220	No sample
1,220	1,230	As above
1,230	1,240	As above
1,240	1,250	As above
1,250	1,260	As above, grains less distinct
1,260	1,270	As above, grains less distinct, more matrix
1,270	1,280	As above, grains less distinct, more matrix

Table 2.6-6--Continued

Depth Interval From	To	Description
1,280	1,290	Limestone, hard, very fine grain, sparsely fossilized, large fraction of light sand, as above
1,290	1,300	Limestone, light tan, hard, granular, chalky matrix, porous, grains are mostly small (1-1 mm) microfossils in chalky cement, large fraction with less distinct grains and larger proportion of matrix
1,300	1,310	Granular, as above
1,310	1,320	As above
1,320	1,330	Limestone, light tan, hard, fine grain in chalky to micritic matrix to chalky, most grains are partially altered microfossils, some are calcite crystals.
1,330	1,340	As above, with limestone, hard, grayish tan, massive
1,340	1,350	As above
1,350	1,360	As above
1,360	1,370	As above
1,370	1,380	As above, and limestone, grayish tan to tan, very hard, massive
1,380	1,390	As above
1,390	1,400	As above
1,400	1,410	As above, cream in color
1,410	1,420	Limestone, hard, light tan to grayish tan, granular to massive, grains are small (.1-1 mm) microfossils
1,420	1,430	As above
1,430	1,440	As above
1,440	1,450	As above
1,450	1,460	As above
1,460	1,470	As above
1,470	1,480	No sample

Table 2.6-6--Continued

Depth Interval From	To	Description
1,480	1,490	As above
1,490	1,500	As above
1,500	1,510	As above
1,510	1,520	As above
1,520	1,530	As above
1,530	1,540	As above
1,540	1,550	As above
1,550	1,560	As above
1,560	1,570	As above
1,570	1,580	As above
1,580	1,590	As above
1,590	1,600	As above
1,600	1,610	As above
1,610	1,620	As above with limestone, light brown, friable, finely granular, some fragments show thin laminae of peat
1,620	1,630	Limestone, as above, brown color is due to a brown non-soluble film on grains, trace brown limestone as above
1,630	1,640	As above, with limestone, tan, friable, fine grained, some hard, chalky containing some fine grains of calcareous sand
1,640	1,650	As above
1,650	1,660	As above
1,660	1,670	Limestone, moderately hard to soft, friable, granular (.1-2 mm) with fine laminae of peat, light tan to tan tends to be massive, numerous large (2-5 mm) isolated microfossils with light sand, hard gray fine grained to medium grained, some fragments show both varieties

Table 2.6-6--Continued

Depth Interval From	To	Description
1,670	1,680	Limestone, light tan to gray, soft to medium hard, friable, granular to chalky, thin peaty laminae grains when visible appear to be microfossils partially altered, some recrystallization
1,680	1,690	Limestone, light tan to tan to gray, soft, friable, granular, chalky matrix, peaty laminae, grains are microfossils (.1 mm-1 mm) numerous cones
1,690	1,700	As above
1,700	1,710	As above
1,710	1,720	As above
1,720	1,730	As above
1,730	1,740	As above
1,740	1,750	As above
1,750	1,760	As above
1,760	1,770	As above
1,770	1,780	As above
1,780	1,790	Limestone, as above, abundant cones, most are gray in color
1,790	1,800	As above
1,800	1,810	As above, numerous cones, many weathered
1,810	1,820	As above, weathered
1,820	1,830	As above, very chalky
1,830	1,840	Limestone, as above, very chalky, grains present show much weathering, many show peaty laminae
1,840	1,850	Limestone, as above, less chalky, many peaty fragments, less weathering
1,850	1,860	Limestone, light tan, soft to moderately hard, granular to chalky

Table 2.6-6--Continued

Depth Interval From	To	Description
1,860	1,870	Limestone, light tan, soft to moderately hard, granular, chalky matrix
1,870	1,880	As above
1,880	1,890	As above
1,890	1,900	As above, very chalky
1,900	1,930	Limestone, light tan to white, chalky to very fine grained, very soft to medium hard, many cones
1,930	1,940	Limestone, granular, tan, soft
1,940	1,950	As above, with limestone, gray, hard, massive
1,950	1,960	As above, harder, limestone, grayish brown, hard
1,960	1,970	As above, tan and gray
1,970	1,980	As above
1,980	1,990	As above
1,990	2,000	As above
2,000	2,010	As above
2,020	2,030	As above
2,030	2,040	As above
2,040	2,050	As above
2,050	2,060	As above
2,060	2,070	As above
2,070	2,080	Limestone, tan to light tan, soft, fine grained, large fraction of light sand, gray, hard, massive
2,080	2,090	Limestone, cream, soft to very hard, finely crystalline to chalky, some fossil casts
2,090	2,100	As above

Table 2.6-6--Continued

Depth Interval From	To	Description
2,100	2,110	As above, limestone, light tan, finely crystalline to massive, hard, trace of light bluish gray, limestone, crystalline to massive, very hard
2,110	2,120	Limestone, creamy, light tan, and light bluish gray, as above
2,120	2,130	Limestone, light tan, fine grained to chalky, recrystallized in part, numerous cones
2,130	2,140	Limestone, light bluish gray, fine to medium grained, chalky crystalline in part, numerous cones, moderately weathered
2,140	2,150	Limestone, light tan, fine grained to chalky, soft to hard, numerous cones, moderately weathered
2,150	2,160	As above
2,160	2,170	As above
2,170	2,180	As above
2,180	2,190	As above
2,190	2,200	As above, very chalky
2,200	2,210	As above
2,210	2,220	Limestone, light bluish gray, fine grained to chalky, moderately hard, fine to moderately fine, crystalline in part, few isolated cones
2,220	2,230	As above
2,230	2,240	Limestone, cream, fine grained to chalky, soft to moderately hard, numerous cones, moderately weathered, trace of bluish gray LS as above
2,240	2,250	As above
2,250	2,260	Limestone, light tan to cream to bluish gray, fine grained to chalky, finely crystalline in part
2,260	2,270	Limestone, light tan, fine grained, chalky, soft, numerous cones
2,270	2,280	Limestone, fine grained, chalky, soft to moderately hard, numerous cones

Table 2.6-6--Continued

Depth Interval From	To	Description
2,280	2,290	Limestone, fine grained, chalky, soft to moderately hard, numerous cones
2,290	2,300	Limestone, light tan, fine grained, very chalky, soft, numerous cones
2,300	2,310	Limestone, cream, fine grained to chalky, moderately hard, numerous cones and fossil casts
2,310	2,320	Limestone, as above, with light sand, bluish gray, dolomitic, very hard, crystalline, massive
2,320	2,330	As above
2,330	2,340	As above, smaller proportion of bluish gray light sand
2,340	2,350	Limestone, tan, fine grained to massive, friable to very hard, numerous cones
2,350	2,360	As above, less friable, light tan
2,360	2,370	Sample missing
2,370	2,380	Sample missing
2,380	2,390	Limestone, fine grained to chalky, moderately hard, cream
2,390	2,400	As above
2,400	2,410	As above
2,410	2,420	As above
2,420	2,430	As above
2,430	2,440	As above, bluish gray, with limestone, crystalline massive, hard
2,440	2,450	As above
2,450	2,460	As above
2,460	2,470	As above
2,470	2,480	Dolomite, brown to grayish brown, crystalline, massive, very hard

Table 2.6-6--Continued

Depth Interval From	To	Description
2,480	2,490	Dolomite, as above, some pieces are sucrosic with well formed crystals indicating vugs
2,490	2,500	Limestone, cream, granular to chalky, soft to hard, crystalline in part, cones present, dolomite, crystalline, light brown to grayish brown
2,500	2,510	Limestone, white to cream, moderately hard, chalky, and dolomite, gray to greenish brown, massive to sucrosic, hard
2,510	2,520	Limestone, and dolomite, as above
2,520	2,530	Sample missing
2,530	2,540	Limestone, white, cream to light tan, many fragments show peaty laminae and are very soft
2,540	2,550	Limestone, cream to light tan, moderately hard, chalky to granular to crystalline dolomite, gray, crystalline, massive
2,550	2,560	Limestone, light tan, soft to moderately hard, fine grained, chalky, some dolomite, light brown to gray, hard crystalline, massive to sucrosic
2,560	2,570	Limestone, as above, dolomite, as above
2,570	2,580	Limestone, as above, dolomite, as above
2,580	2,590	Limestone, as above, dolomite, as above, percentage of dolomite increase to 50 percent
2,590	2,600	Limestone, as above, dolomite, as above
2,600	2,610	Limestone, as above, dolomite, as above, percentage of dolomite increase to 50 percent
2,610	2,620	Limestone, as above, dolomite, as above, (20 percent)
2,620	2,630	Limestone, as above, dolomite, as above (20 percent)
2,630	2,640	Limestone, as above
2,640	2,650	Limestone, as above
2,650	2,660	Limestone, as above

Table 2.6-6--Continued

Depth Interval From	To	Description
2,660	2,670	Limestone, as above
2,670	2,680	As above
2,680	2,690	As above
2,690	2,700	Limestone, white, soft to medium hard, some dolomite
2,700	2,710	Limestone, as above
2,710	2,720	As above, with some dolomite
2,720	2,730	As above
2,730	2,740	As above, with increased amount of dolomite
2,740	2,750	As above
2,750	2,760	As above
2,760	2,770	No sample
2,770	2,780	No sample
2,780	2,790	Dolomite, light brown with some dark, some limestone
2,790	2,800	Dolomite, light to dark brown, crystalline, traces limestone
2,800	2,810	Dolomite, as above crystalline
2,810	2,820	As above
2,820	2,830	As above
2,830	2,840	As above
2,840	2,850	As above
2,850	2,860	As above
2,860	2,870	Dolomite, tan, very hard
2,870	2,880	Dolomite, tan, brown, massive, very hard
2,880	2,890	Dolomite, tan, very hard
2,890	2,900	Dolomite, tan, very hard

Table 2.6-6--Continued

Depth Interval From	To	Description
2,900	2,910	As above
2,910	2,920	As above
2,920	2,930	As above
2,930	2,940	As above
2,940	2,950	As above
2,950	2,960	As above
2,960	2,970	As above
2,970	2,980	Dolomite, crystalline, very hard
2,980	2,990	As above
2,990	3,000	Dolomite, gray-tan
3,000	3,010	Dolomite, tan to brown, very hard
3,010	3,020	As above
3,020	3,030	As above
3,030	3,040	As above
3,040	3,050	As above
3,050	3,060	As above
3,060	3,070	As above
3,070	3,080	Dolomite, gray to brown, crystalline, very hard
3,080	3,090	As above
3,090	3,100	As above
3,100	3,110	As above
3,110	3,112 TD	As above

Table 2.6-7
WATER QUALITY DATA FROM PILOT HOLE DRILLING
WELL I-6

Date	Time	Depth (ft)	Temperature (°C)	Specific Gravity	Specific Conductance (µmhos/cm)	Chlorides (mg/l)	Remarks
05/25	0136	1,037	28.0	1.0020	7,000	1,160	Sample mixed with mud
05/25	0400	1,067	30.0	@ 24.0° 1.001	6,500	990	Sample mixed with mud
05/25	1045	1,135	30.0	1.0020	7,000	1,160	Sample mixed with mud decanted
05/25	1415	1,165	30.0	1.0010	7,000	1,150	Sample mixed with mud
05/25	1550	1,190	30.0	1.0010	6,900	1,250	Salt added to drilling fluid
05/25	1800	1,230	30.0	1.0015	7,000	1,250	
05/25	2000	1,260	29.5	1.0015	6,900	1,270	
05/25	2330	1,292	29.0	1.0010	6,900	1,260	
05/26	0100	1,325	28.0	1.0015	6,900	1,360	
05/26	0400	1,355	28.0	1.0020	6,700	1,290	
05/26	0700	1,387	28.0	1.0020	6,700	1,300	
05/26	0900	1,419	26.5	1.0020	6,500	1,350	
05/26	1130	1,451	26.5	1.0015	6,500	1,380	
05/26	1425	1,482	27.0	1.0020	5,900	1,580	
05/26	1622	1,514	27.0	1.0020	6,250	1,460	
05/26	1825	1,547	27.0	1.0020	6,400	1,530	
05/26	2400	1,574	27.1	1.0010	6,400	1,550	
05/26	2300	1,614	27.2	1.0020	6,400	1,628	
05/27	0100	1,634	27.0	1.0015	6,500	1,600	
05/27	0230	1,667	27.0	1.0015	6,500	1,620	

Table 2.6-7--Continued

Date	Time	Depth (ft)	Temperature (°C)	Specific Gravity	Specific Conductance (μmhos/cm)	Chlorides (mg/l)	Remarks
05/27	0330	1,703	27.0	1.0015	6,500	1,640	
05/27	0500	1,737	27.0	1.0015	6,500	1,640	
05/27	0700	1,767	27.0	1.0015	6,300	1,670	
05/27	0830	1,800	26.5	1.0010	5,800	1,670	
05/27	1230	1,832	26.5	1.0020	6,000	1,760	
05/27	1330	1,863	26.5	1.0010	6,900	1,840	
05/27	1500	1,895	26.5	1.0010	7,000	1,900	
07/21		1,820	26.5	1.0100	27,000	9,750	Lab temperature
07/21		1,850	26.5	1.0130	33,000	12,000	Lab temperature
07/21		1,880	26.5	1.0225	55,000	18,150	Lab temperature
07/21	1200	1,921	28.0	1.0150	40,000	14,500	Lab temperature
07/21	1730	1,955	32.0	1.0210	60,000	19,500	Actual temperature
07/21	2200	1,980	30.0	1.0160	43,000	15,700	Lab temperature
07/22	0406	2,015	29.5	1.0210	50,000	19,000	Lab temperature
07/22	1200	2,051	28.0	1.0215	70,000	19,000	Lab temperature
07/22	1500	2,082	28.0	1.0210	59,000	19,500	Lab temperature
07/22	1800	2,114	28.0	1.0175	50,000	16,500	Lab temperature
07/23	0230	2,140	28.0	1.0210	54,000	19,000	Lab temperature
07/23	0300	2,174	30.5	1.0195	53,000	18,000	Actual temperature
07/23	0600	2,205	28.0	1.0185	42,000	16,900	Actual temperature
07/23	1100	2,240	30.0	1.0185	40,000	17,500	Actual temperature
07/23	0245	2,270	28.0	1.0190	50,000	16,800	

Table 2.6-7--Continued

Date	Time	Depth (ft)	Temperature (°C)	Specific Gravity	Specific Conductance (μmhos/cm)	Chlorides (mg/l)	Remarks
07/25	0245	2,531	26.5	1.020	55,000	16,800	
07/25	0635	2,564	26.0	1.0190	55,000	16,800	
07/25	1100	2,596	26.5	1.0190	50,000	17,000	
07/25	1500	2,629	28.0	1.0195	45,000	17,500	
07/25	1900	2,661	26.0	1.0195	45,000	17,000	
07/25	2130	2,695	25.5	1.0200	45,000	17,000	
07/26	0100	2,727	25.5	1.0205	48,000	17,000	
07/26	0430	2,759	25.5	1.0220	55,000	18,500	
09/26	0330	2,785	25.0	1.0255	45,000	23,700	
09/27	0400	2,818	22.5	1.0255	46,000	20,700	
09/28	0345	2,850	23.0	1.0260	30,000	19,600	
09/29	0930	2,888	26.0	1.025	45,000	21,300	
09/30	1845	2,917	22.0	1.0255	45,000	21,100	
10/01	1200	2,940	21.5	1.0270	45,500	22,000	
10/02	0800	2,971	25.0	1.027	46,000	21,500	
10/02	2100	3,004	20.0	1.0255	48,000	20,700	
10/03	1800	3,037	20.0	1.0250	45,000	21,300	
10/04	1600	3,068	20.0	1.0265	45,000	26,000	
10/05	0800	3,098	20.1	1.0260	46,000	27,000	
07/24	0100	2,368	28.0	1.0200	46,000	18,800	
07/24	0530	2,401	28.0	1.0950	45,000	16,400	
07/24	1000	2,430	28.0	1.0195	37,500	15,930	
07/24	1300	2,469	29.0	1.0185	45,000	17,640	
07/24	1830	2,499	28.0	1.0205	50,000	18,600	

Table 2.6-8
SUMMARY OF INJECTION TEST RESULTS
WELL I-6

Pumping Rate	10,200 gpm
Test Duration	32.5 hours
Elapsed Time to Reach Maximum Injection Head After Pumping Started	7 minutes
Maximum Injection Head[a]	85.2 feet of water
Static Freshwater Head[b]	66.0 feet of water

[a]Feet of water referred to pad level.
[b]Due to the density difference between injected freshwater and formation saltwater.

Table 2.6-9
INJECTION TEST DATA
WELL I-6
(Wellhead pressure measuring point @ 6.0' above pad)

Actual Time	Time Since Pump Started (min)	Flow (gpm)	Wellhead Pressure (feet of water)	Totalizer (gallons x 1,000)	Remarks
0935	0	0	0	45,652	Start injecting
0936	1	12,500	33.5		Air bleed until 0935' 45"
0937	2	10,500	35.0		
0938	3	10,000	41.0		Open valve 1/4 turn
0939	4	10,500	52.0		
0940	5	10,000	63.0	45,702	Open valve 1/4 turn
0941	6	9,800	72.0		Open valve 1 turn
0942	7	10,000	78.0		Increase RPM
0943	8	10,500	77.0	45,731	
0944	9	10,500	76.0	45,741	Note: center of pressure gauge is 6.0' above pad
0945	10	10,500	76.0	45,751	
0947	12	10,500	76.0	45,772	
0949	14	10,800	76.2	45,792	
0951	16	10,500	76.2	45,813	
0953	18	10,500	76.2	45,833	
0955	20	10,500	76.2	45,854	
1000	25	10,500	76.2	45,905	
1005	30	10,500	76.2	45,956	
1010	35	10,500	76.4	46,009	

Table 2.6-9--Continued

Actual Time	Time Since Pump Started (min)	Flow (gpm)	Wellhead Pressure (feet of water)	Totalizer (gallons x 1,000)	Remarks
1015	40	10,400	76.5	46,062	
1020	45	10,500	76.6	46,114	
1025	50	10,400	76.6	46,167	
1030	55	10,400	76.6	46,220	
1035	60	10,400	76.6	46,270	
1045	70	10,500	76.6	46,377	
1055	80	10,400	76.6	46,480	
1105	90	10,400	76.6	46,585	
1115	100	10,500	76.6	46,689	
1145	130	10,400	76.7	47,004	
1215	160	10,500	76.8	47,316	
1245	190	10,400	76.9	47,629	
1315	220	10,300	76.4	47,937	
1345	250	10,200	76.2	48,243	
1415	280	10,200	76.6	48,548	
1435	300	10,200	76.7	48,753	
1535	360	10,300	77.2	49,373	
1635	420	10,300	77.2	49,992	
1735	480	10,200	77.3	50,608	
1835	540	10,100	77.3	51,224	
1935	600	10,000	77.3	51,840	
2035	660	10,000	77.3	52,455	
2135	720	10,200	77.7	53,070	
2235	780	10,200	77.8	53,645	

Table 2.6-9--Continued

Actual Time	Time Since Pump Started (min)	Flow (gpm)	Wellhead Pressure (feet of water)	Totalizer (gallons x 1,000)	Remarks
2400	865	10,200	77.8	54,515	
0035	900	10,200	77.8	54,873	
0135	960	10,200	77.9	55,500	
0235	1,020	10,200	78.0	56,158	
0335	1,080	10,200	78.0	56,781	
0435	1,140	10,200	78.3	57,405	
0535	1,200	10,200	78.3	58,032	
0635	1,260	10,200	78.4	58,657	
0735	1,320	10,200	78.4	59,310	
0835	1,380	10,200	78.7	59,944	
0935	1,440	10,200	78.7	60,572	
1200	1,585	10,200	78.8	62,074	
1400	1,705	10,200	78.9	63,330	
1600	1,825	10,200	79.2	64,555	
1800	1,945	0	60.0	65,774	Pump off at 1800 hrs
1804	1,949	0	60.0	65,774	
1809	1,954	0	60.0		
1830	1,975	0	59.95		Pressure leaking off due to leak in wellhead pipe connection
1930	2,035	0	59.10		
0730	2,755	0	58.0		
1530	3,235	0	57.6		

Table 2.6-9--Continued

Actual Time	Time Since Pump Started (min)	Flow (gpm)	Wellhead Pressure (feet of water)	Totalizer (gallons x 1,000)	Remarks
2400	3,745	0	57.3		
0600	4,105	0	57.3		
0900	5,725	0	56.7		
0750	7,095	0	55.6		Start releasing pressure--backflowing
0845	7,150	0	52.7		
1100	7,285	0	31.3		
1830	7,435	0	2.3		

Table 2.6-9 W.Q. 70
WATER QUALITY FROM 70-FOOT MONITOR TUBE IN THE 24"/34" ANNULUS
DURING INJECTION TEST
WELL I-6

Date	Time	Depth (ft)	Temperature (°C)	Specific Gravity	Specific Conductance (μmhos/cm)	Chlorides (mg/l)	Remarks
2/12	1035	70	22.2	1.0215	30,000	17,900	Background W.Q.
2/12	1831	70	22.8	1.0217	32,500	17,800	Background W.Q.
2/13	0505	70	23.0	1.0215	32,750	17,400	Background W.Q.
2/13	2013	70	21.1	1.0210	32,500	17,800	First sample after 10.5 hrs of injecting
2/13	2101	70	20.3	1.0205	34,000	18,000	
2/13	2201	70	20.0	1.0210	32,500	16,900	
2/14	0001	70	21.1	1.0200	33,500	18,000	
2/14	0201	70	21.1	1.0200	32,500	17,500	
2/14	0401	70	21.1	1.0200	30,500	17,700	
2/14	0601	70	21.1	1.0200	32,500	17,700	
2/14	0801	70	21.7	1.0200	35,000	17,600	
2/14	1005	70	21.4	1.0200	34,000	18,000	
2/14	1210	70	21.4	1.0200	34,000	17,000	
2/14	1400	70	21.7	1.0205	35,500	18,100	
2/14	1600	70	21.7	1.0205	34,000	17,500	Last sample before shutdown of pump

Table 2.6-9 W.Q. 2,200
WATER QUALITY FROM 2,200-FOOT MONITOR TUBE IN THE 24"/34" ANNULUS
DURING INJECTION TEST
WELL I-6

Date	Time	Depth (ft)	Temperature (°C)	Specific Gravity	Specific Conductance (μmhos/cm)	Chlorides (mg/l)	Remarks
2/12	1340	2,200	22.8	1.0250	34,000	19,500	Background W.Q.
2/12	1855	2,200	23.9	1.0250	37,500	25,000	Background W.Q.
2/13	0535	2,200	24.0	1.0250	37,500	19,400	Background W.Q.
2/13	2036	2,200	21.5	1.0245	37,500	19,800	First sample after 10.5 hrs of injecting
2/13	2125	2,200	21.3	1.0245	37,500	19,800	
2/13	2225	2,200	21.1	1.0250	37,500	19,700	
2/14	0025	2,200	21.7	1.0250	38,000	23,700	
2/14	0225	2,200	21.7	1.0250	39,000	20,500	
2/14	0425	2,200	21.7	1.0250	40,000	20,600	
2/14	0625	2,200	21.7	1.0245	38,000	20,300	
2/14	0830	2,200	22.2	1.0240	37,500	19,700	
2/14	1030	2,200	22.0	1.0245	37,500	20,300	
2/14	1230	2,200	22.2	1.0245	38,500	21,100	
2/14	1430	2,200	22.2	1.0245	38,500	21,300	
2/14	1430	2,200	22.2	1.0245	38,500	21,300	
2/14	1630	2,200	22.2	1.0250	40,000	20,800	Last sample before shutdown of pump

Table 2.6-9 W.L. 2,200
WATER LEVEL IN 2,200-FOOT MONITOR LINE IN THE 24"/34" ANNULUS
DURING INJECTION TEST
WELL I-6

Time	Elapsed Time (minutes)	Depth to Water (feet)	Δs (feet)	Remarks
0935	0	9.83	--	Static W.L.
0936	1	9.83	--	Injection pump started 0935 hr
0938	3	9.83	--	
0939	4	9.85	.02	
0940	5	9.86	.03	
0941	6	9.89	.06	
0942	7	9.94	.11	
0943	8	9.96	.13	
0944	9	9.98	.15	
0945	10	10.00	.17	
0947	12	10.02	.19	
0949	14	10.11	.28	
0951	16	10.20	.37	
0953	18	10.24	.41	
0955	20	10.40	.57	
1000	25	10.48	.65	
1005	30	10.61	.78	
1010	35	10.72	.89	
1015	40	10.80	.97	
1025	50	10.96	1.13	
1035	60	11.06	1.23	
1050	75	11.20	1.37	
1105	90	11.29	1.46	

Table 2.6-9 W.L. 2,200--Continued

Time	Elapsed Time (minutes)	Depth to Water (feet)	Δs (feet)	Remarks
1120	105	11.37	1.54	
1135	120	11.39	1.56	
1155	140	11.44	1.61	
1205	150	11.45	1.62	
1235	180	11.47	1.64	
1305	210	11.44	1.61	
1335	240	11.39	1.56	
1405	270	11.44	1.61	
1440	305	11.25	1.42	
1505	330	11.19	1.36	
1535	360	11.11	1.28	
1635	420	11.00	1.17	
1705	450	10.95	1.12	
1735	480	10.90	1.07	
1840	45	10.83	1.00	
1905	570	10.81	.98	
1935	600	10.81	.98	
2005	630	10.83	1.00	
2100	685	11.38	1.55	W.L. after checking pump for water samples
2144	729	11.54	1.71	
2200	745	11.53	1.70	
2400	865	11.65	1.82	

Table 2.6-9 W.L. 2,200--Continued

Time	Elapsed Time (minutes)	Depth to Water (feet)	Δs (feet)	Remarks
2430	895	11.19	1.36	
0200	985	11.56	1.73	
0234	1,019	11.98	2.15	
0300	1,045	11.52	1.69	
0400	1,105	11.38	1.55	
0435	1,140	11.31	1.48	
0455	1,160	11.33	1.50	
0600	1,225	11.20	1.37	
0637	1,262	11.35	1.52	
0700	1,285	11.15	1.32	
0800	1,345	11.09	1.26	
0838	1,383	11.12	1.29	
0935	1,440	11.08	1.25	
1000	1,465	11.10	1.27	
1155	1,580	11.56	1.33	
1400	1,705	11.03	1.20	
1450	1,755	10.96	1.13	
1457	1,762	10.95	1.12	
1600	1,825	10.77	.94	
1725	1,910	10.62	.79	
1756	1,941	10.54	.71	
1801	1,946	10.50	.67	Injection pump off at 1800 hrs
1802	1947	10.57	.74	

Table 2.6-9 W.L. 2,200--Continued

Time	Elapsed Time (minutes)	Depth to Water (feet)	Δs (feet)	Remarks
1804	1,949	10.54	.71	
1810	1,955	10.54	.71	
1830	1,975	10.53	.70	
1930	2,035	10.48	.65	

Table 2.6-10
QUALITY OF INJECTED WATER
WELL I-6

Date	Time	Depth (ft)	Temperature (°C)	Specific Gravity	Specific Conductance (µmhos/cm)	Chlorides (mg/l)	Remarks
02/09	1030	6	20.6	1.0006	1,850	740	Background W.Q.
02/13	0950	6	20.0	1.0005	2,100	760	Start injecting at 0935 hrs
02/13	1035	6	20.0	1.0006	2,050	750	
02/13	1135	6	20.3	1.0008	2,050	730	
02/13	1235	6	20.6	1.0010	2,075	740	
02/13	1335	6	20.6	1.0010	2,100	740	
02/13	1435	6	21.1	1.0008	2,050	740	
02/13	1535	6	21.1	1.0010	2,075	740	
02/13	1635	6	21.0	1.0010	2,050	730	
02/13	1735	6	21.0	1.0010	2,050	740	
02/13	1835	6	20.6	1.0008	2,050	780	
02/13	1935	6	20.6	1.0010	2,000	760	
02/13	2110	6	21.0	1.0010	2,600	750	
02/13	2205	6	20.6	1.0010	2,300	700	
02/14	0001	6	20.9	1.0010	2,075	730	
02/14	0201	6	21.1	1.0008	2,025	720	
02/14	0400	6	20.9	1.0008	2,000	740	
02/14	0600	6	20.9	1.0006	2,025	730	
02/14	0800	6	21.7	1.0006	2,100	800	
02/14	1025	6	21.4	1.0002	2,375	820	
02/14	1205	6	21.7	1.0010	2,075	740	

Table 2.6-10--Continued

Date	Time	Depth (ft)	Temperature (°C)	Specific Gravity	Specific Conductance (µmhos/cm)	Chlorides (mg/l)	Remarks
02/14	1400	6	21.7	1.0012	2,300	830	
02/14	1600	6	21.7	1.0006	2,375	820	Last sample taken before injection test pump shutdown

Table 2.6-11 N.E.
WATER QUALITY OF BISCAYNE AQUIFER--N.E. MONITORING WELL
SITE I-6

Date	Time	Temperature (°C)	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
04/20	1430	23.5	940	128	--	
04/21	1830	23.0	950	131	11.06	
04/22	1802	22.5	950	130	11.06	
04/26	1110	22.0	1,000	131	9.48	
04/30	1830	23.5	1,100	145	9.80	
05/07	1620	23.0	1,100	133	9.92	
05/14	0955	23.0	1,100	131	9.93	
05/21	1130	24.0	1,050	134	10.02	
05/28	1110	25.0	1,180	145	10.20	
06/04	1115	25.0	1,160	144	10.08	
06/11	1850	25.0	1,190	190	10.10	
06/18	0925	25.5	1,100	180	9.94	
06/25	0920	26.0	1,100	140	10.06	
07/02	0940	26.0	1,150	130	9.92	
07/09	0945	25.0	1,190	140	9.50	
07/15	0930	26.0	1,190	180	7.90	Changed measuring point
07/23	0910	26.0	--	--	8.20	
07/30	1100	26.0	1,100	180	8.30	
08/06	1200	26.0	1,200	220	7.50	
08/14	1600	25.0	1,000	200	8.27	
08/21	--	--	--	--	--	
08/27	1015	26.0	520	250	8.00	Changed measuring point[a]

Table 2.6-11 N.E.--Continued

Date	Time	Temperature (°C)	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
09/04	1415	26.5	1,200	300	8.10	
09/11	1311	27.0	610	400	7.87	
09/17	0915	25.5	450	230	7.82	
09/24	1000	26.5	850	250	8.00	
10/01	0925	28.0	950	260	7.74	
10/08	0915	25.5	1050	350	7.95	
10/15	--	--	--	--	--	
10/22	0915	26.0	1,050	250	7.78	
10/29	1000	26.5	1,050	270	7.92	
11/06	0615	26.0	1,080	190	7.86	
11/12	0920	26.5	1,000	280	7.70	
11/19	0920	26.0	1,000	230	7.96	
11/26	0915	26.0	1,125	270	7.93	
12/03	0915	25.5	1,000	280	7.93	
12/10	1115	25.5	1,000	250	7.78	
12/17	0915	24.5	1,000	180	7.93	
12/24	0715	25.0	990	230	7.91	
12/31	1145	25.5	900	190	8.10	
01/07	1145	25.5	910	180	7.95	
01/14	1145	25.5	840	190	7.99	
01/21	1015	25.0	810	200	7.95	
01/28	1115	23.9	475	140	7.74	
02/05	1315	24.4	590	140	7.93	
02/11	1315	23.3	700	140	8.05	

Table 2.6-11 N.E.--Continued

Date	Time	Temperature (°C)	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
02/18	1515	23.9	790	180	7.84	
02/25	1315	23.9	850	210	7.96	
03/05	1315	23.9	800	190	7.95	
03/12	1520	23.9	725	250	8.09	
03/10	1725	24.4	810	210	8.11	
03/26	1615	25.0	900	270	11.79	Changed measuring point
04/02	1445	23.9	850	249	11.26	
04/09	1100	23.9	800	229	11.40	

[a]PVC sample pipe broken @ ground level. No cap.

Table 2.6-11 N.W.
WATER QUALITY OF BISCAYNE AQUIFER--N.W. MONITORING WELL
SITE I-6

Date	Time	Temperature (°C)	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
04/20	1430	23.5	1,840	196	--	
04/21	1830	23.0	1,700	193	11.33	
04/22	1755	23.0	1,710	194	11.38	
04/26	1115	22.0	1,700	208	9.98	
04/30	1830	23.0	1,850	216	10.12	
05/07	1613	23.0	2,000	233	10.24	
05/14	0945	23.0	2,100	300	10.18	
05/21	1130	23.5	1,900	210	10.32	
05/28	1115	25.0	1,300	190	10.50	
06/04	1115	24.5	1,500	200	10.40	
06/11	1855	24.5	1,220	200	10.40	
06/18	0920	26.0	1,400	230	10.27	
06/25	0930	25.0	1,400	220	10.39	
07/02	0930	26.0	1,550	240	10.32	
07/09	0950	25.0	1,850	290	10.50	
07/15	0935	26.0	1,500	250	10.15	
07/23	0915	25.0	1,800	290	10.30	
07/30	1120	26.0	1,650	360	10.45	
08/03	1340	25.0	1,500	330	10.15	
08/14	1600	25.5	1,500	400	10.48	
08/20	1030	26.0	1,680	380	10.25	
08/27	1010	26.0	590	340	10.15	
09/04	1405	27.0	1,750	400	10.20	

Table 2.6-11 N.W.--Continued

Date	Time	Temperature (°C)	Specific Conductance (µmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
09/11	1318	28.0	920	530	10.10	
09/17	0920	26.5	725	550	9.98	
09/24	1005	27.0	1,400	510	10.37	
10/01	0930	26.5	1,475	420	9.72	
10/08	0920	26.0	1,600	500	10.25	
10/15	0925	26.0	1,350	450	9.92	
10/22	0920	27.0	1,475	410	10.05	
10/29	1005	27.0	1,575	470	10.20	
11/06	0620	27.0	1,500	420	10.13	
11/12	0930	27.0	1,550	520	10.10	
11/19	0930	26.0	1,500	500	10.20	
11/26	0920	26.0	1,400	400	10.25	
12/03	0920	25.5	1,400	430	10.22	
12/10	1120	25.5	1,400	460	10.07	
12/17	0920	25.5	1,300	400	10.20	
12/24	0725	25.0	1,250	400	10.18	
12/31	1150	25.5	1,500	400	10.36	
02/07	1150	25.5	1,450	410	10.21	
01/14	1150	25.5	1,100	400	10.23	
01/21	1020	25.0	1,130	430	10.18	
01/28	1120	25.0	1,300	400	9.99	
02/05	1320	25.0	1,225	420	9.65	
02/11	1320	23.9	1,200	410	10.30	
02/18	1520	23.9	1,100	500	10.09	

Table 2.6-11 N.W.--Continued

Date	Time	Temperature (°C)	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
02/25	1320	23.9	1,200	420	10.19	
03/05	1320	23.9	950	400	10.20	
03/12	1525	23.9	800	400	10.33	
03/19	1730	23.9	950	400	10.41	
03/26	1635	23.9	950	410	10.56	
04/02	1450	23.9	980	475	10.08	
04/09	1105	24.4	900	466	10.17	

Table 2.6-11 S.E.
WATER QUALITY OF BISCAYNE AQUIFER--S.E. MONITORING WELL
SITE I-6

Date	Time	Temperature (°C)	Specific Conductance (µmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
04/20	1430	23.5	1,400	340	--	
04/21	1830	23.5	1,320	338	11.36	
04/22	1810	22.0	1,300	335	11.39	
04/26	1125	22.0	1,420	295	10.05	
04/30	1830	23.5	1,300	272	10.16	
05/07	1630	22.5	1,500	390	10.25	
05/14	1000	23.5	1,500	340	10.27	
05/21	1130	24.0	1,500	360	10.34	
05/28	1100	24.5	1,600	320	10.52	
06/04	1115	24.5	1,500	340	10.50	
06/11	1840	24.5	1,420	270	10.40	
06/18	0930	25.5	1,350	290	10.29	
06/25	0910	26.0	1,300	280	10.41	
07/02	0950	26.0	2,200	510	10.36	
07/09	0945	25.0	2,900	690	10.50	
07/15	0930	26.0	2,900	760	10.10	
07/23	0900	27.0	2,250	580	10.35	
07/30	1110	26.0	2,500	900	10.50	
08/03	1350	28.0	2,000	800	10.50	
08/14	1600	27.0	2,200	880	10.53	
08/20	1050	28.0	2,400	900	10.30	
08/27	1025	26.5	700	750	10.20	
09/04	1400	27.0	2,000	850	10.10	

Table 2.6-11 S.E.--Continued

Date	Time	Temperature (°C)	Specific Conductance (µmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
09/11	1325	31.0	950	960	10.10	
09/17	0905	31.0	750	1,050	10.14	
09/24	0945	29.0	2,200	850	10.30	
10/01	0915	29.0	2,050	790	10.00	
10/08	0905	29.0	1,700	520	10.34	
10/15	0910	29.0	1,400	610	9.82	
10/22	0905	29.0	1,550	400	10.07	
10/29	0950	29.0	1,600	420	10.06	
11/06	0605	29.0	1,330	430	10.13	
11/12	0905	29.0	1,200	500	10.03	
11/19	0905	28.0	1,600	520	10.27	
11/26	0905	29.0	1,700	570	10.23	
12/03	0905	27.5	1,650	560	10.26	
12/10	1105	27.5	1,700	540	10.10	
12/17	0905	25.5	1,700	480	10.25	
12/24	0700	25.0	1,500	450	10.18	
12/31	1135	26.5	1,400	410	10.40	
01/07	1135	26.5	1,550	410	10.21	
01/14	1135	26.5	1,490	440	10.35	
01/21	1005	26.5	1,300	470	10.26	
01/28	1105	23.9	1,700	460	10.02	
02/05	1305	26.7	1,500	470	10.21	
02/11	1305	24.4	1,500	480	10.35	
02/20	1505	24.4	1,500	590	10.12	

Table 2.6-11 S.E.--Continued

Date	Time	Temperature (°C)	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
02/25	1305	25.3	1,550	540	10.22	
03/05	1305	25.0	1,300	560	10.25	
03/12	1510	24.4	1,300	560	10.37	
03/19	1715	24.4	1,320	590	10.45	
03/26	1620	25.0	1,450	640	10.60	
04/02	1435	24.4	1,600	698	10.15	
04/09	1110	25.0	1,500	697	10.22	

Table 2.6-11 S.W.
WATER QUALITY OF BISCAYNE AQUIFER--S.W. MONITORING WELL
SITE I-6

Date	Time	Temperature (°C)	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
04/20	1430	23.5	1,900	510	--	
04/21	1830	23.0	1,850	470	11.11	
04/22	1822	22.0	1,850	465	11.16	
04/26	1120	22.0	1,850	420	10.00	
04/30	1830	--	--	--	9.30	
05/07	1641	22.5	1,500	450	--	
05/14	1007	23.0	1,150	290	10.03	
05/21	1130	23.5	1,650	350	8.25	Changed measuring point
05/28	1050	24.5	1,800	360	8.50	
06/04	1115	24.5	1,800	360	8.45	
06/11	1835	24.5	1,520	320	8.30	
06/18	0935	25.0	1,550	340	8.17	
06/25	0900	26.0	2,000	530	8.27	
07/02	1020	26.0	2,800	910	8.26	
07/09	0930	27.0	3,500	820	8.40	
07/15	0920	26.0	3,100	810	8.00	
07/23	0920	26.5	2,700	800	8.27	
07/30	1115	26.5	2,700	783	8.40	
08/06	1330	27.5	2,600	800	9.40	
08/14	1600	--	--	--	--	
08/21	1100	28.0	2,500	770	8.15	Changed measuring point
08/27	1030	26.5	650	780	8.00	

Table 2.6-11 S.W.--Continued

Date	Time	Temperature (°C)	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
09/04	1430	27.0	2,000	800	8.20	
09/11	--	--	--	--	--[a]	
09/17	0853	31.0	520	350	8.20[b]	Changed measuring point
09/24	0930	29.0	1,500	580	7.26	
10/01	0905	29.0	1,900	850	7.80	
10/08	0900	30.0	2,000	800	8.03	
10/15	--	--	--	--	--	
10/22	0900	28.0	1,850	540	7.81	
10/29	0945	28.0	1,700	530	7.95	
11/06	0600	28.0	1,400	530	7.30	
11/12	0900	28.0	1,350	520	7.25	
11/19	0900	28.0	1,500	450	8.04	
11/26	0900	28.0	1,500	440	8.01	
12/03	0900	27.0	1,700	550	8.01	
12/10	0100	26.5	1,500	770	7.86	
12/17	0900	26.0	1,450	480	8.00	
12/24	0710	25.0	1,150	350	7.95	
12/31	1130	26.2	1,600	370	8.19	
01/07	1130	25.5	1,400	350	8.05	
01/14	1130	26.5	1,500	330	8.43	
01/21	1000	26.5	1,275	450	7.99	
01/28	1100	23.9	1,250	330	7.79	
02/05	1300	26.7	1,450	430	8.03	

Table 2.6-11 S.W.--Continued

Date	Time	Temperature (°C)	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
02/11	1300	23.9	1,160	330	8.12	
02/18	1500	24.4	1,210	360	7.90	
02/25	1300	25.3	1,225	360	7.99	
03/05	1300	25.0	1,000	320	8.01	
03/12	1505	25.0	1,050	380	8.11	
03/19	1710	25.0	960	360	10.62	Changed measuring point
03/26	1630	25.0	900	400	10.80	
04/02	1430	25.0	1,120	449	10.33	
04/09	1115	25.0	1,100	427	10.44	

[a] Cannot remove cap, vehicle apparently run over.
[b] Cap broken off @ ground level.

Table 2.6-11 W.S.
WATER QUALITY OF BISCAYNE AQUIFER--WATER SUPPLY WELL
SITE I-6

Date	Time	Temperature (°C)	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
04/27	1410	24.0	8,000	2,370	9.19	
04/30	1830	23.0	5,000	1,340	7.70	
05/07	1825	23.0	3,500	1,030	9.25	
05/14	0955	28.0	3,000	840	--	Pump in well; no w.l. available
05/21	1130	28.0	3,000	840	--	
05/28	1105	27.5	7,000	2,200	--	
06/04	1115	28.0	7,000	2,100	--	
06/11	1845	25.0	2,600	720	--	
06/18	0940	26.0	2,550	730	9.31	
06/25	0940	26.0	2,600	700	9.38	
07/02	1030	25.5	3,400	910	9.34	
07/09	0935	25.0	3,250	790	9.50	
07/15	0930	27.0	4,000	1,100	9.15	
07/23	0905	25.0	2,700	740	9.34	
07/30	1105	26.5	2,550	930	9.45	
08/06	1320	25.0	2,750	800	9.40	
08/14	1600	--	--	--	--	
08/14	1600	--	--	--	--	
08/21	1044	26.50	3,000	1,080	9.28	
08/27	1020	27.0	650	780	9.15	
09/04	1435	26.5	2,500	1,100	9.20	
09/11	1331	25.5	950	1,180	9.10	

Table 2.6-11 W.S.--Continued

Date	Time	Temperature (°C)	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
09/17	0910	25.5	850	1,170	8.82	
09/24	0950	29.0	2,150	910	9.36	
10/01	0920	25.5	2,075	900	9.00	
10/15	0915	25.5	1,700	800	8.92	
10/22	0910	26.0	2,100	800	9.06	
10/29	0955	26.0	2,100	760	9.19	
11/06	0610	26.0	1,900	690	9.12	
11/12	0910	26.0	2,000	750	9.05	
11/19	0910	25.5	1,900	740	9.22	
11/26	0910	25.5	2,000	760	9.24	
12/03	0910	25.0	1,950	750	9.23	
12/10	1110	25.5	1,900	780	9.05	
12/17	0910	24.5	1,850	720	9.16	
12/24	0705	26.0	1,800	650	9.16	
12/31	1140	25.5	1,650	660	9.37	
01/07	1140	25.5	1,550	650	9.22	
01/14	1140	25.0	1,620	680	9.36	
01/21	1010	25.0	1,450	660	9.19	
01/28	1110	25.0	1,800	660	8.98	
02/05	1310	25.0	1,675	650	9.17	
02/11	1310	24.4	1,610	640	9.30	
02/18	1510	23.9	1,400	680	9.08	
02/25	1310	25.3	1,550	650	9.12	
03/05	1310	23.9	1,310	660	9.19	

Table 2.6-11 W.S.--Continued

Date	Time	Temperature (°C)	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
03/12	1515	24.4	1,200	710	9.30	
03/19	1720	24.4	1,040	650	9.36	
03/26	1625	24.4	1,400	730	9.56	
04/02	1440	24.4	1,450	772	9.08	
04/09	1120	23.9	1,450	758	9.15	

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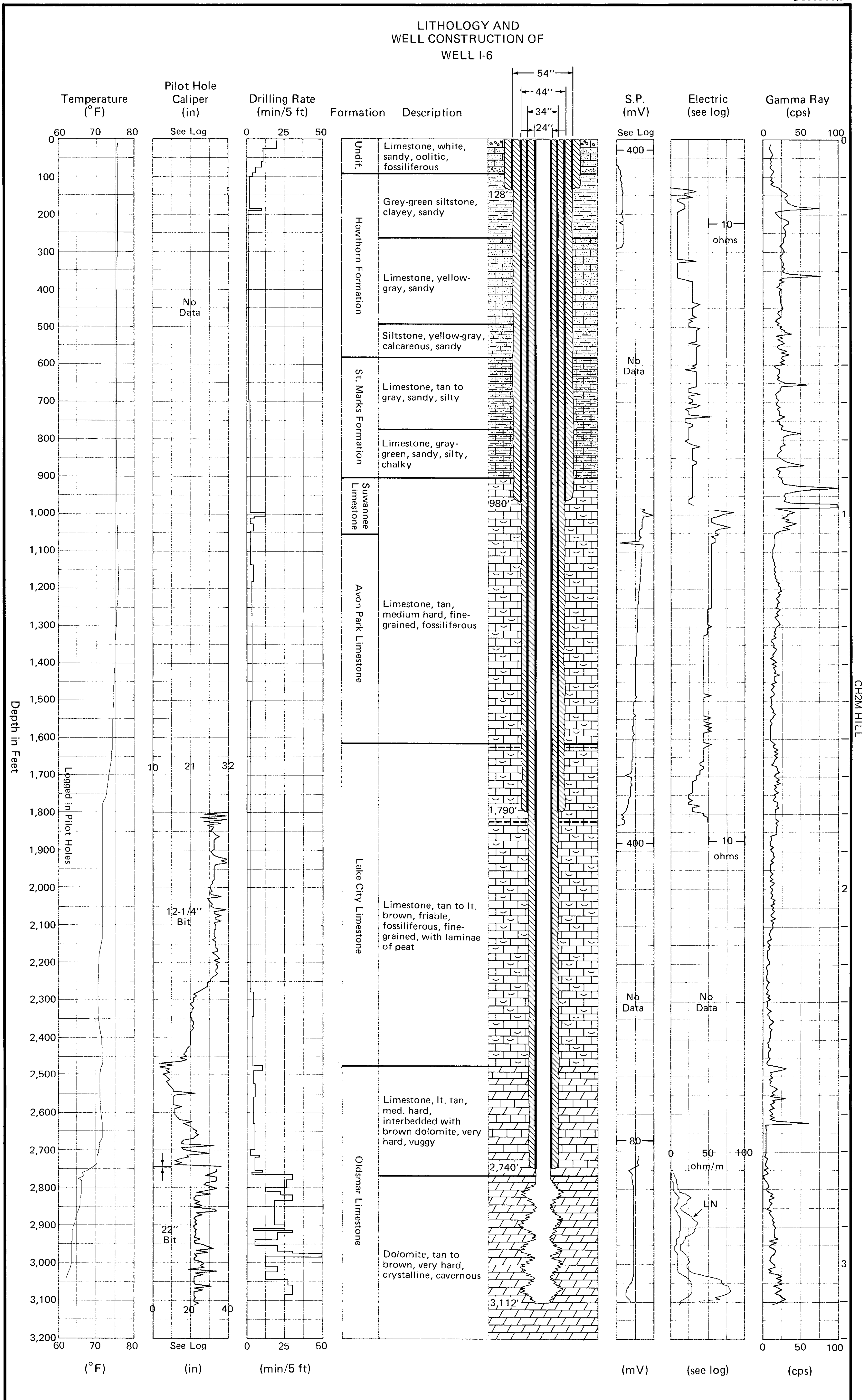

Summary of drilling and logging data—Well I-6.

FIGURE 2.6-1.

Chapter 2.7
INJECTION WELL I-7

Injection Well I-7 is located on the northern boundary of the project site, 700 feet west of I-6 and 760 feet east of I-8, as shown on Figure 1.1-2, Section 1, Summary. Drilling began on October 11, 1979, and was completed on May 9, 1980. The drilling and casing sequence of I-7 was as follows:

1. Drilled a 60-inch hole to a depth of 145 feet.
2. Set and cemented the 54-inch casing from a depth of 140 feet up to the concrete drilling pad.
3. Drilled a 12-1/4-inch pilot hole to 1,000 feet.
4. Reamed the pilot hole with a 52-inch reamer to a depth of 990 feet.
5. Set and cemented the 44-inch casing from a depth of 970 feet up to the concrete drilling pad.
6. Drilled a 12-1/4-inch pilot hole to 1,850 feet.
7. Reamed the pilot hole with a 42-inch reamer to a depth of 1,810 feet.
8. Set and cemented the 34-inch casing from a depth of 1,800 feet up to the concrete drilling pad.
9. Drilled a 12-1/4-inch pilot hole to a depth of 2,700 feet.
10. Reamed the pilot hole with a 32-inch reamer to a depth of 2,628 feet.
11. Set the 24-inch casing at 2,628 feet.
12. Gravelled the pilot hole from 2,698 feet to 2,676 feet and set a cement plug from 2,676 feet to 2,657 feet.
13. Pumped the first stage cement: 2,700 sacks Class H neat, and ran a temperature log indicating the top of cement at 2,213 feet.
14. Cemented the 24-inch casing up to 202 feet.
15. Ran a casing pressure test at 100 psi for 1 hour with no pressure loss.
16. Drilled a 22-inch hole to a depth of 3,119 feet.
17. Ran an injection test at 10,900 gpm for 12 hours.
18. Ran a cement bond log on the 24-inch casing.

19. Cemented the 24-inch casing from 202 feet up to the concrete drilling pad.

20. Cleaned out blockage at 2,840 feet.

21. Completed the wellhead and pad as per specifications.

Casings are black steel, API 5L, Grade B, and ASTM A 139, Grade B. Casing details are summarized in Table 2.7-1. The four casings were cemented with API Class H cement slurries as summarized in Table 2.7-2. The geophysical logs and TV surveys run on the well are listed in Table 2.7-3.

No gyroscopic surveys were run on this well, because funding authorization for that item was received after the 24-inch casing hole had been reamed. Table 2.7-4 is, therefore, omitted on this well.

A descriptive summary of the underwater television survey after well completion is presented in Table 2.7-5. Results of a lithological examination of the formation samples collected every 10 feet from the pilot hole drilling are found in Table 2.7-6. Water quality data from pilot hole drilling are presented in Table 2.7-7.

Figure 2.7-1 presents a summary of data from drilling and testing, including the well construction diagram, formation sample descriptions, drilling rate, and electric, gamma radiation, temperature, and caliper logs.

The purpose of the cement and gravel plug set below the 24-inch casing in Step No. 12 above was to minimize the possibility of losing cement into the formation in the pilot hole. After the 24-inch casing was set, the bottom of the hole was tagged at 2,698 feet, indicating that the pilot hole was not full of cuttings, as would be expected. This situation may have been caused by a cavity intersecting the borehole and allowing the cuttings to wash out. Gravel was placed from 2,698 feet to 2,676 feet and 30 sacks of Class H neat cement pumped in. This stage of plug cement was tagged at 2,681 feet, indicating that the cement had pushed the gravel downhole or into the formation. A second stage of plug cement of 36 sacks was tagged at 2,657 feet.

The first stage cementing of the 24-inch casing (2,700 sacks of Class H neat) yielded good fill-up with minimal cement loss. During the second stage cementing of the 24-inch casing, one of the two tremie pipes outside the 24-inch casing became stuck in cement when a weld on the lifting plug broke and the pipe dropped into the wet cement. Recovery efforts were made, but when the pipe was finally caught, the cement had set, and the pipe broke at 1,133 feet below pad. The bottom of the tremie pipe is at 2,205 feet. Since the tremie pipe was full of cement when dropped, and could not provide an avenue for upward migration of injected fluid, it was decided to continue cementing of the 24-inch casing.

At the end of the third stage, the tremie pipes were pulled up above the expected top of cement and left. When the fourth stage was to be pumped, it was discovered that the two tremie pipes were cemented in. Efforts to free them resulted in breaking one 181 feet below pad and the other 111 feet below pad. The bottoms of the pipes are at 341 feet and 340 feet, respectively.

The presence of the tremie pipes in the 24-inch/34-inch annulus does not affect the integrity of the well. The deeper pipe was full of cement when dropped, and the two shallow pipes are between casings, and also embedded in cement.

Injection Test

Upon completion of the well, an injection test was performed to evaluate the well's capacity under operating conditions. Freshwater from an adjacent pond was injected at approximately 10,900 gpm for 12 hours. Wellhead injection pressure was measured with a 12-inch precision gauge calibrated in feet of water and the flow rate determined with a flow meter and volumetric totalizer. Wellhead pressure reached a high of 99.4 feet of water and stabilized around 98.5 feet of water during most of the test.

After the injection test pump was stopped, the pressure dropped to 69.0 feet of water in several minutes, but continued to fall because of a leaking valve. The well was backflowed after 15 hours and required 48 hours to bleed off at 100 gpm. The results of the injection test are summarized in Table 2.7-8 and the data compiled in Table 2.7-9. The quality of the injected water is given in Table 2.7-10.

The geophysical logging, after the injection test of this well, revealed that the bottom hole was partially plugged at 2,819 feet in depth. Because this could reduce the injection capacity of the well, the contractor was asked to move in a drilling rig and clean out the open hole section of this well.

Biscayne Aquifer Water Quality Monitoring

During well drilling, water samples were collected and levels measured at each of five shallow monitoring wells installed around the drilling pad. Four of the wells were 2-inch-diameter PVC, approximately 20 feet deep, and located at each corner of the pad. The fifth was 8-inch-diameter steel, approximately 40 feet deep, and was used for supply water during construction. These data are included in Tables 2.7-11 N.E. through 2.7-11 W.S.

Table 2.7-1
SUMMARY OF CASING DETAILS
WELL I-7

Diameter (inches)	Wall Thickness (inches)	Depth (feet)[a]		Cemented Section (depth in feet)[a]	
		From	To	From	To
54	.500	0	140	0	140
44	.500	0	970	0	970
34	.500	0	1,800	0	1,800
24	.500	0	2,628	0	2,628

[a]Measured from the top of the concrete drilling pad.

Table 2.7-2
SUMMARY OF CEMENTING OF CASINGS
WELL I-7

Date	Casing Cemented	Type of Cement Used (API)	Number of Sacks Used	Depth Cemented (ft) From	Depth Cemented (ft) To
10/25/79	54"	Class H w/25 lb of gilsonite per sack	395	144	0
11/29/79	44"	Lead: Class H w/12% bentonite	1,580	970	0
		Tail: Class H neat	900		
01/19/80	34"	Lead: Class H w/12% bentonite	1,300	1,810	1,320
		Tail: Class H neat	800		
01/20/80	34"	Class H w/12% bentonite	1,500	1,320	1,015
01/21/80	34"	Class H w/12% bentonite	1,705	1,015	0
04/06/80	24"	Gravel (no cement), 85 cf	--	2,698	2,675
04/08/80	24"	Cement plug: Class H neat below 24" casing	66	2,675	2,657
04/09/80	24"	Class H neat	2,700	2,628	2,214
04/11/80	24"	Lead: Class H neat	1,100	2,214	1,470
		Tail: Class H w/2% bentonite, 2% $CaCl_2$	1,250		
04/13/80	24"	Class H w/2% bentonite, 2% $CaCl_2$	2,100	1,470	201
10/10/80	24"	Class H neat	400	201	0

Table 2.7-3
LIST OF GEOPHYSICAL LOGS AND WELL SURVEYS
WELL I-7

Date	Well Progress and Casing Depth	Type of Logs or Surveys Run[a]	Purpose
11/06/79	54" casing to 140' 12-1/4" hole to 1,000'	LSN, G, C	1. Identify the top of the Floridan aquifer. 2. Establish the setting depth of the 44" casing.
12/20/79	44" casing to 970' 12-1/4" hole to 1,850'	LSN, G, C, FC	1. Geohydrological definition of the Floridan aquifer. 2. Define production zones. 3. Establish setting depth of the 34" casing.
01/29/80	34" casing to 1,800' 12-1/4" hole to 2,700'	LSN, G, C, T_s	1. Qualitative evaluation of confining beds above the Boulder Zone, as well as identification of transmissive zones in this interval. 2. Establish setting depth for 24" casing.
04/10/80	24" casing to 2,628'	T_s	1. Identify the top of the first stage cement outside the 24" casing.
07/20/80	24" casing to 2,628' 22" hole to 3,119'	TV	1. Final inspection of well (revealed blockage at 2,819 feet).
10/06/80	24" casing to 2,628' 22" hole to 3,119'	Density, Wave Train	1. Confirm the adequacy of the cement outside the 24" casing.

Table 2.7-3--Continued

Date	Well Progress and Casing Depth	Type of Logs or Surveys Run	Purpose
10/16/80	As above	TV, LSN, G, C	1. Rerun of final inspection after clean-out operation. 2. Visual qualitative evaluation of the injection zone. 3. Geohydrological definition of the injection zone.
03/04/81	As above	T_s	1. Record equilibrium profile of the well.

[a]Abbreviations for logs and surveys are as follows:

E = single point electric and SP
LSN = long and short normal and SP
G = gamma ray
C = caliper
T_S = temperature, static
T_F = temperature, flowing
FV_S = fluid velocity (flow meter) static
FV_F = fluid velocity (flow meter) flowing
FC = fluid conductivity

GYRO = gyroscopic directional survey
TV = television
CBL = cement bond, variable density
WTD = wave train display
D. IND = dual induction electric and SP
BCS = borehole compensated sonic
Density = formation density
AV = acoustic velocity
GGD = gamma gamma density (0-500 ft)

Table 2.7-5
DESCRIPTIVE SUMMARY OF UNDERWATER TELEVISION SURVEY
WELL I-7

CH2M HILL

RECORD OF UNDERWATER TV SURVEY

Project: Miami Dade Water & Sewer Authority, South District Regional Wastewater Treatment Plant

Well: I-7 Final Survey After Cleanout

Survey By: Deep Venture Diving Service, Perry, Florida
HP-4,000 AU

Survey Date: 11/16/80 **Total Depth:** 3,107 feet

Witnessed By: D. Snyder, D. Cabit, T. McCormick

Reviewed By: J. D. Lehnen **Date:** 12/22/80

Remarks:

Depth in Feet		Reel Counter		Observations
From	To	From	To	
--	--	0	16	Titles
0	7	16	18	Dry 24" casing
7	2,638	18	527	24" casing, fair visibility
--	2,638	--	--	Bottom of casing
2,638	2,642	527	528	Cement borehole walls
2,642	2,628	528	538	Pull back up to casing and adjust depth counter to 2,628
2,628	2,651	538	542	Cement borehole walls, cement is fractured
2,651	2,659	542	544	Cavity, walls not visible
2,659	2,770	544	565	Poor visibility, rough walls
2,770	2,809	565	572	Fair visibility, smoother walls
2,809	2,836	572	577	Some fractures and solution features
2,836	2,852	577	580	Cavities, highly fractured, poor visibility
2,852	2,885	580	588	Rough walls, some small cavities fractures
2,885	2,894	588	590	More cavities, fractures

RECORD OF UNDERWATER TV SURVEY

Project: Miami Dade Water & Sewer Authority, South District Regional Wastewater Treatment Plant

Well: I-7 Date: 11/16/80 Total Depth: 3,107'

Depth in Feet		Reel Counter		Observations
From	To	From	To	
2,894	2,899	590	591	Cavity, borehole walls faintly visible
2,899	2,924	591	596	Smooth walls, fractures
2,924	2,927	596	597	Cavity
2,927	2,955	597	604	Smooth walls, some fractures
2,955	2,961	604	605	Large cavity, walls not visible
2,961	2,995	605	613	Very rough borehole walls, cavities, fractures
2,995	3,011	613	617	Smooth walls, fractures
3,011	3,018	617	617	Large cavity, broken formation
3,018	3,090	618	632	Smooth walls, high angle fractures
3,090	3,106	632	638	Cavities, more solution features, rough walls
3,107	--	638	647	Bottom of hole, something on bottom that doesn't look like formation,
				unidentifiable
3,107	2,695	647	699	Coming out of the hole
--	2,695	--	699	End of survey

Table 2.7-6
LITHOLOGY FROM PILOT HOLE FORMATION SAMPLES
WELL I-7

Depth Interval (ft) From	To	Description
0	10	Crushed limestone fill
10	20	Limestone, oolitic, hard, some sand
20	30	Limestone, white, tan, gray, oolitic, hard recrystallized, fine sand
30	40	Limestone, white, tan, gray, hard, oolitic
40	50	Limestone, white, tan, gray, hard, oolitic, sand and fine sand
50	60	Limestone, tan, hard, oolitic, some sand and shell fragments
60	70	As above, with less shell
70	80	As above with bits of wood
80	90	Limestone, hard, dense, recrystallized shell fragments, wood splinters
90	100	Limestone, light tan to white, hard, dense, less shell, some fine sand,
100	110	Limestone, medium hard, shell larger, some fossil, some gray-green siltstone
110	120	Limestone, light tan to white, medium soft, shell fragments, fossils
120	130	Limestone, medium hard, gray-green siltstone, less fossil and shell fragments
130	140	As above, gray powdered sand, fewer shell fragments
140	150	Limestone, shell fragments and gray clay, peat fragments, fine sand
150	160	Limestone, fossil and shell fragments, gray clay, peat, fine sand
160	170	Gray clay, shell fragments, hard limestone, peat, fine gray sand

Table 2.7-6--Continued

Depth Interval (ft)		
From	To	Description
170	180	Gray clay, limestone, hard, shell fragments, peat, fine gray sand
180	190	Gray clay, peat, white, hard limestone, some shell and fossil fragments, gray fine sand
190	200	Clay, gray, peat, limestone, white, hard, fossil and shell fragments
200	210	Clay, gray-green, white shell and fossil fragments, fine sand, peat
210	220	As above, more gray-green clay
220	230	Clay, as above
230	240	Peat, gray-green clay, shell fragments, sand and silt
240	250	Less peat and clay, more shell and fossil fragments, calcereous sand, quartz sand
250	260	As above
260	270	Peat, gray-green clay, fine sand, shell fragments, quartz sand
270	280	Peat, gray-green clay, fine quartz sand
280	290	As above
290	300	As above
300	310	Quartz sand, gray clay, calcareous sand, some peat
310	320	As above, with shell fragments
320	330	As above
330	340	As above
340	350	Clay, gray-green, quartz sand, shell fragments, some peat
350	360	As above

Table 2.7-6--Continued

Depth Interval (ft)		
From	To	Description
360	370	As above
370	380	As above
380	390	Clay, limestone, medium-hard, shell fragments
390	400	Clay, limestone, medium to soft, fossil fragments
400	410	As above
410	420	As above
420	430	Limestone, tan to gray, fossiliferous
430	440	As above
440	450	As above, smaller in size
450	460	As above, tan to buff
460	470	Limestone, tan, medium-soft, few fossil fragments
470	480	As above, less fossil fragments
480	490	As above, with wood splinters
490	500	As above, no wood
500	510	As above
510	520	As above
520	530	As above
530	540	As above
540	550	As above
550	560	Limestone, gray, some green clay
560	570	As above
570	580	Limestone, gray, friable, with some green clay
580	590	As above

Table 2.7-6--Continued

Depth Interval (ft) From	To	Description
590	600	As above
600	610	Limestone, tan to buff, some shell and fine sand
610	620	Limestone, as above
620	630	Limestone, as above
630	640	Limestone, as above
640	650	Limestone, as above
650	660	Clay, light green, limestone, as above
660	670	Limestone, as above
670	680	Limestone, as above
680	690	Limestone, as above
690	700	Limestone, as above
700	710	Limestone, as above
710	720	Limestone, tan to buff, moderately consolidated, some light green clay
720	730	Limestone, tan to buff, poorly consolidated, some fossils
730	740	Limestone, tan to buff, moderately consolidated, some light green clay
740	750	Limestone, tan to buff, poorly consolidated, fine sand, few fossils
750	760	As above
760	770	Limestone, tan to buff, poorly consolidated, fine limestone sand, soft
770	780	Limestone, as above, some fossils
780	790	Limestone, as above
790	800	Limestone, as above

Table 2.7-6--Continued

Depth Interval (ft) From	To	Description
800	810	Limestone, trace of pale green clay
810	820	Limestone, trace of pale green clay, poorly consolidated, some silt
820	830	Limestone, tan to white, fine silt
830	840	Same as above
840	850	Same as above
850	860	Limestone, tan to white, poorly consolidated
860	870	Same as above
870	880	Same as above
880	890	Limestone, tan, poorly consolidated, some light green clay and silt
890	900	Limestone, tan to buff, poorly consolidated, some silt
900	910	Same as above
910	920	Limestone, tan to buff, clay, light green
920	930	Limestone, yellowish-brown, hard, dolomitic
930	940	As above
940	950	As above
950	960	Limestone, tan to gray, a few fossils, medium-hard
960	970	As above
970	980	As above
980	990	As above
990	1,000	As above
1,000	1,010	Limestone, grayish tan, soft, lime sand
1,010	1,020	As above

Table 2.7-6--Continued

Depth Interval (ft) From	To	Description
1,020	1,030	As above
1,030	1,040	Limestone, tanish-gray, coarse grained, medium-hard, some fossils
1,040	1,050	As above
1,050	1,060	As above
1,060	1,070	As above
1,070	1,080	As above
1,080	1,090	As above
1,090	1,100	As above
1,100	1,110	As above
1,110	1,120	As above
1,120	1,130	As above
1,130	1,140	Limestone, brown, granular, medium-hard, some fossils
1,140	1,150	Limestone, tanish-brown, medium-hard, few fossils
1,150	1,160	As above
1,160	1,170	As above
1,170	1,180	Limestone, light tan, hard, fossil casts
1,180	1,190	Limestone, light brown, hard, coarse grained, fossil casts
1,190	1,200	As above
1,200	1,210	As above
1,210	1,220	Limestone, light tan, fine grained, some fossils, medium-hard
1,220	1,230	As above

Table 2.7-6--Continued

Depth Interval (ft) From	To	Description
1,230	1,240	As above
1,240	1,250	As above, darker in color
1,250	1,260	Limestone, light tan, fine grained, some fossils, medium-hard
1,260	1,270	Limestone, tan, medium-hard, some fossils
1,270	1,280	As above
1,280	1,290	Limestone, light tan, some fossils, medium-hard, chalky
1,290	1,300	As above, darker
1,300	1,310	As above
1,310	1,320	As above
1,320	1,330	As above
1,330	1,340	Limestone, light tan, some fossils, medium-hard, chalky
1,340	1,350	As above
1,350	1,360	As above
1,360	1,370	As above
1,370	1,380	As above
1,380	1,390	As above
1,390	1,400	Limestone, gray, dolomitic, hard, large grain, fossils
1,400	1,410	As above
1,410	1,420	Limestone, light gray, medium-hard, coarse, fossils
1,420	1,430	Limestone, yellowish-brown, medium-hard, coarse, fossils
1,430	1,440	As above, lighter in color
1,440	1,450	As above

Table 2.7-6--Continued

Depth Interval (ft)		
From	To	Description
1,450	1,460	As above
1,460	1,470	As above
1,470	1,480	As above
1,480	1,490	Limestone, gray, medium-hard, some fossils
1,490	1,500	As above, dolomitic
1,500	1,510	As above, with recrystallized fragments
1,510	1,520	As above
1,520	1,530	Limestone, gray, medium-hard, fossils, recrystallized fragments
1,530	1,540	As above
1,540	1,550	As above
1,550	1,560	Limestone, dark tan, hard, recrystallized, dolomitic fragments, fine grain to massive
1,560	1,570	As above
1,570	1,580	As above
1,580	1,590	Limestone, yellowish-tan, hard, coarse grained
1,590	1,600	As above, smaller grain, fossils
1,600	1,610	Limestone, dark tan, soft to medium-hard, coarse, fossils
1,610	1,620	As above
1,620	1,630	As above
1,630	1,640	As above
1,640	1,650	As above
1,650	1,660	Limestone, massive, hard, tan to gray, fossils
1,660	1,670	Limestone, tan, fine grain, some recrystallized fragments, hard, fossils

Table 2.7-6--Continued

Depth Interval (ft) From	To	Description
1,670	1,680	Limestone, as above, larger grains
1,680	1,690	As above
1,690	1,700	As above
1,700	1,710	As above
1,710	1,720	Limestone, tan, coarse grained, hard, fossils
1,720	1,730	As above
1,730	1,740	As above
1,740	1,750	Limestone, dark tan, soft
1,750	1,760	As above, larger grain
1,760	1,770	As above
1,770	1,780	As above
1,780	1,790	As above
1,790	1,800	As above
1,800	1,810	Lime sand, medium soft, light to dark tan, some clay present
1,810	1,820	Limestone, dark tan, high percentage clays present
1,820	1,830	As above
1,830	1,840	As above
1,840	1,850	As above
1,850	1,860	Limestone, light tan, fine grained, porous, some clay present, microfossils
1,860	1,870	As above, no clay present, microfossils
1,870	1,880	Limestone, as above, limestone fragments, lighter in color, soft to medium-hard, fossiliferous

Table 2.7-6--Continued

Depth Interval (ft) From	To	Description
1,880	1,890	Limestone, as above, light tan, soft to medium-hard, porous, limestone, white, fine grain, hard
1,890	1,900	Limestone, as above
1,900	1,910	Limestone, tan to buff, sand to silt size grains, some clay present
1,910	1,920	Limestone, tan to buff, sandy, medium-hard, fossiliferous
1,920	1,930	Limestone, buff colored, silty, medium-hard
1,930	1,940	Limestone, as above, harder, some clay present, microfossils present
1,940	1,950	Limestone, sand-sized grains, darker in color
1,950	1,960	Limestone, as above, lighter in color, fragments of massive hard, dark tan limestone
1,960	1,970	Limestone, tan, silt size grains, medium-hard limestone, light tan, very hard, massive
1,970	1,980	Limestone, as above
1,980	1,990	Limestone, light tan to buff, sand to silt size fragments
1,990	2,000	Limestone, light tan to buff, sand to silt size grains, microfossils present
2,000	2,010	Limestone, as above
2,010	2,020	Limestone, as above
2,020	2,030	Limestone, as above
2,030	2,040	Limestone, as above
2,040	2,050	Limestone, as above
2,050	2,060	Limestone, white, chalky, silty, soft
2,060	2,070	Limestone, as above

Table 2.7-6--Continued

Depth Interval (ft)		
From	To	Description
2,070	2,080	Limestone, tan, sandy and porous, fragments of dark gray partially recrystallized limestone
2,080	2,090	Limestone, tan, silty, limestone, white, smooth and chalky, microfossils present
2,090	2,100	Limestone, white, chalky, soft to medium-hard, some tan limestone, coarse to fine grain
2,100	2,110	As above
2,110	2,120	As above
2,120	2,130	As above
2,130	2,140	As above, limestone, tan, medium-hard, sandy
2,140	2,150	Limestone, less chalky, some recrystallized fragments
2,150	2,160	As above, more recrystallization
2,160	2,170	As above
2,170	2,180	Limestone, white, sandy, medium-hard, less tan, coarse to fine grain rock
2,180	2,190	As above
2,190	2,200	As above
2,200	2,210	As above
2,210	2,220	As above
2,220	2,230	As above
2,230	2,240	As above
2,240	2,250	As above
2,250	2,260	Limestone, tan, sandy, medium-hard, finer grain, more recrystallization
2,260	2,270	As above

Table 2.7-6--Continued

Depth Interval (ft)		
From	To	Description
2,270	2,280	As above
2,280	2,290	Limestone, buff white, coarse grained, medium-hard
2,290	2,300	As above
2,300	2,310	As above
2,310	2,320	As above
2,320	2,330	As above, some darker recrystallized pieces with some clay
2,330	2,340	Limestone, buff, coarse grained, some medium-hard recrystallized fragments, some clay
2,340	2,350	As above
2,350	2,360	As above
2,360	2,370	As above
2,370	2,380	As above
2,380	2,390	As above
2,390	2,400	As above, less clay
2,400	2,410	Limestone, tan to buff, soft to medium-hard, some hard gray to tan limestone, cones present
2,410	2,420	Limestone, tan to buff, soft to medium-hard, some hard gray to tan limestone present, cones present
2,420	2,430	Limestone, as above
2,430	2,440	Limestone, as above
2,440	2,450	As above
2,450	2,460	As above
2,460	2,470	Dolomite, olive green, massive
2,470	2,480	Dolomite, gray to tan, very hard

Table 2.7-6--Continued

Depth Interval (ft) From	To	Description
2,480	2,490	Dolomite, tan, gray, very hard, crystalline, limestone, buff, soft, microfossils present
2,490	2,500	As above
2,500	2,510	As above, with black to gray clay present
2,510	2,520	As above, less clay, more bituminous peat
2,520	2,530	Limestone, buff, soft, granular, limestone, light gray, recrystallized, some fragments of bituminous peat
2,530	2,540	Limestone, tan, granular, soft; dolomite, gray, vuggy, microfossils present
2,540	2,550	Limestone, tan, granular, soft; dolomite, tan, gray, hard
2,550	2,560	Limestone, tan, granular, soft; dolomite, dark gray, shell fragments and microfossils
2,560	2,570	As above, less dolomite
2,570	2,580	As above
2,580	2,590	As above, with clay and black peat
2,590	2,600	Limestone, tan, hard, massive, limestone, buff, soft granular, clay and peat present
2,600	2,610	Limestone, buff to gray, soft, granular, microfossils present
2,610	2,620	As above
2,620	2,630	Limestone, buff to gray, fine grained, soft
2,630	2,640	Limestone, white-tan, granular, soft to medium-hard
2,640	2,650	As above
2,650	2,660	As above
2,660	2,670	As above
2,670	2,680	As above

Table 2.7-6--Continued

Depth Interval (ft) From	To	Description
2,680	2,690	As above
2,690	2,700	As above
2,700	2,710	Limestone, white, soft, mixed with some white to gray dolomite
2,710	2,720	As above
2,720	2,730	As above
2,730	2,740	As above
2,740	2,750	As above
2,750	2,760	As above
2,760	2,770	Limestone, white, soft, chalky
2,770	2,780	Limestone, as above, also some crystalline fragments
2,780	2,790	As above
2,790	2,800	Limestone, white, soft, limestone, gray, trace of tan dolomite
2,800	2,810	Dolomite, light tan, hard; some gray and white limestone
2,810	2,820	Dolomite, tan to light brown, massive, trace of gray limestone
2,820	2,830	Dolomite, light brown to brown, hard, crystalline, trace of white limestone
2,830	2,840	Dolomite, light buff to light gray, hard, trace of gray limestone
2,840	2,850	Dolomite, tan to brown, hard, crystalline
2,850	2,860	Dolomite, tan to light gray, crystalline
2,860	2,870	As above
2,870	2,880	Dolomite, tan to buff, massive, crystalline, some banding

Table 2.7-6--Continued

Depth Interval (ft) From	To	Description
2,880	2,890	As above
2,890	2,900	As above
2,900	2,910	As above
2,910	2,920	Dolomite, tan to buff, some crystalline
2,920	2,930	Dolomite, light buff to gray, hard, some crystalline fragments
2,930	2,940	Dolomite, light gray, massive, some crystalline fragments
2,940	2,950	Dolomite, tan to gray, mostly fine grained
2,950	2,960	As above
2,960	2,970	Dolomite, massive, dark gray to buff, some banded fragments, very hard
2,970	2,980	As above, more brown
2,980	2,990	Dolomite, light brown to light gray, massive, very hard, crystalline
2,990	3,000	Dolomite, light brown, crystalline fragments, very hard, trace of white limestone
3,000	3,010	As above
3,010	3,020	Dolomite, light tan, microcrystalline, very hard, trace of white limestone
3,020	3,030	As above
3,030	3,040	Dolomite, light tan, microcrystalline, very hard, trace of gray limestone
3,040	3,050	Dolomite, light tan to tannish gray, massive, trace of white limestone
3,050	3,060	Dolomite, light tan to buff, trace of white limestone
3,060	3,070	As above

Table 2.7-6--Continued

Depth Interval (ft)		Description
From	To	
3,070	3,080	Dolomite, light tan to grayish, massive, very hard, trace of white limestone
3,080	3,090	Dolomite, tan to grayish, some banding, massive, crystalline, trace of white limestone
3,090	3,100	As above
3,100	3,110	As above
3,110	3,120	As above

Table 2.7-7
WATER QUALITY DATA FROM PILOT HOLE DRILLING
WELL I-7

Date	Time	Depth (ft)	Temperature (°C)	Specific Gravity	Specific Conductance (μmhos/cm)	Chloride (mg/l)
12/15	2200	1,430	26.5	1.0020	6,500	1,350
12/16	0800	1,460	26.0	1.0030	6,300	1,400
12/18	0515	1,481	26.0	1.0025	6,200	1,550
12/18	1200	1,512	21.0	1.0030	6,300	2,800
12/18	1710	1,546	22.5	1.0025	5,700	3,200
12/18	2200	1,582	22.5	1.0035	6,250	2,900
12/19	0130	1,616	22.0	1.0040	6,250	3,000
12/19	0530	1,651	23.0	1.0030	6,300	2,700
12/19	1230	1,685	23.0	1.0010	6,900	3,300
12/19	1000	1,715	23.8	1.0040	6,700	3,150
12/20	0100	1,740	22.5	1.0030	6,600	3,200
12/20	0300	1,770	22.5	1.0050	6,800	3,400
12/20	0430	1,820	22.5	1.0060	6,900	3,500
12/20	0530	1,850	22.5	1.0050	6,800	3,600
01/24	1830	1,867	22.5	1.0032	8,500	4,200
01/24	2300	1,898	22.5	1.0033	8,500	4,300
01/25	0210	1,931	22.0	1.0050	7,900	4,100
01/25	0530	1,962	22.0	1.0058	7,900	4,200
01/25	0900	1,997	29.4	1.0056	9,000	5,000
01/25	1100	2,030	28.9	1.0046	13,000	5,200
01/25	1330	2,064	25.0	1.0052	10,000	5,200
01/25	1530	2,094	25.5	1.0048	10,008	5,200
01/25	1630	2,125	25.6	1.0048	9,500	5,300

Table 2.7-7--Continued

Date	Time	Depth (ft)	Temperature (°C)	Specific Gravity	Specific Conductance (μmhos/cm)	Chloride (mg/l)
01/25	1930	2,149	23.0	1.0056	9,300	5,300
01/25	2300	2,178	24.0	1.0053	9,200	5,300
01/26	0200	2,211	24.0	1.0053	9,300	5,200
01/26	0330	2,242	24.0	1.0054	9,800	5,300
01/26	0430	2,273	24.0	1.0072	11,000	6,400
01/26	0830	2,306	24.0	1.0060	10,000	5,100
01/26	1230	2,339	27.0	1.0050	11,000	5,500
01/26	1200	2,370	27.0	1.0048	10,000	5,200
01/26	1630	2,396	27.0	1.0082	14,000	6,200
01/26	1930	2,428	25.0	1.0095	15,100	8,000
01/27	0100	2,460	25.0	1.0100	14,000	8,300
01/27	0600	2,492	25.0	1.0090	13,500	7,900
01/27	1510	2,525	25.0	1.0135	23,000	12,000
01/27	2030	2,557	25.0	1.0152	24,000	13,300
01/27	2300	2,592	24.0	1.0154	26,000	14,400
01/28	0100	2,624	24.5	1.0153	26,000	14,400
01/28	0300	2,656	24	1.0152	26,500	14,700
01/28	0500	2,687	23.5	1.0153	26,800	14,800
01/28	0620	2,700	23.5	1.0175	22,000	15,600
04/17	0800	2,722	23.9	1.0230	40,000	18,700
04/18	0800	2,755	24.0	1.0220	44,000	18,600
04/18	1205	2,790	24.0	1.0195	40,000	17,400
04/19	1300	2,820	24.0	1.0200	42,000	18,000
04/23	0630	2,852	24.0	1.0215	35,000	18,800

Table 2.7-7--Continued

Date	Time	Depth (ft)	Temperature (°C)	Specific Gravity	Specific Conductance (μmhos/cm)	Chloride (mg/l)
04/24	0930	2,884	24.0	1.0225	45,000	21,000
04/25	0400	2,924	21.1	1.0250	35,000	19,992
04/26	0515	2,949	20.0	1.0225	37,500	18,000
04/28	0730	2,979	20.0	1.0250	41,000	21,000
04/29	1630	3,008	20.0	1.0250	45,000	20,500
05/04	1400	3,038	19.4	1.0250	39,000	20,190
05/04	2200	3,074	20.0	1.0250	40,000	20,500
05/07	1000	3,100	20.0	1.0250	37,000	22,000
05/08	0730	3,119	20.0	1.0250	35,000	21,000

Table 2.7-8
SUMMARY OF INJECTION TEST RESULTS
WELL I-7

Pumping Rate	10,900 gpm
Test Duration	12 hours
Elapsed Time to Reach Maximum Injection Head After Injection Started	7 minutes
Maximum Injection Head[a]	99.4 feet of water
Static Freshwater Head[a, b]	69.0 feet of water

[a]Feet of water referred to pad level.
[b]Due to the density difference between injected freshwater and formation saltwater.

Table 2.7-9
INJECTION TEST DATA
(Wellhead pressure measuring point @ 3.0 feet above pad)
WELL I-7

Actual Time	Time Since Pump Started (min)	Flow (gpm)	Wellhead Pressure (feet of water)	Totalizer (gallons x 1,000)	Remarks
1314	0000	0	0	79,690	Start pumps
1315	0001	6,000	92.0	--	
1316	0002	11,000	103.0	79,706	
1317	0003	10,000	98.0	79,716	
1318	0004	10,000	94.0	79,728	
1319	0005	10,000	94.0	79,738	
1320	0006	10,000	95.0	79,749	
1321	0007	10,000	96.0	79,762	
1322	0008	10,000	96.0	79,771	
1323	0009	10,000	96.2	79,782	
1324	0010	10,000	96.2	79,793	
1326	0012	10,000	96.2	79,815	
1328	0014	10,000	96.2	79,837	
1330	0016	10,000	96.3	79,858	
1332	0018	10,000	96.3	79,881	
1334	0020	10,000	96.2	79,903	
1339	0025	10,000	96.2	79,957	
1354	0040	10,000	96.0	80,122	
1359	0045	10,000	96.0	80,179	
1404	0050	10,000	96.0	80,232	
1409	0055	10,000	95.0	80,287	
1414	0060	10,000	96.0	80,341	
1424	0070	10,000	95.9	80,451	

Table 2.7-9--Continued

Actual Time	Time Since Pump Started (min)	Flow (gpm)	Wellhead Pressure (feet of water)	Totalizer (gallons x 1,000)	Remarks
1434	0080	10,000	95.4	80,591	
1444	0090	10,000	95.4	80,670	
1454	0100	10,000	95.4	80,778	
1524	0130	10,000	95.4	81,105	
1554	0160	10,000	95.4	81,434	
1624	0190	10,000	95.4	81,762	
1654	0220	10,000	95.4	82,089	
1724	0250	10,000	95.5	--	
1754	0280	10,000	95.5	82,780	
1824	0310	10,000	95.5	83,150	
1854	0340	10,000	95.6	83,417	
1930	0376	10,000	96.3	83,802	
2000	0406	10,000	96.4	84,132	
2030	0436	10,000	96.3	84,464	
2100	0466	10,000	96.3	84,464	
2130	0496	10,000	96.0	85,126	
2200	0526	10,000	96.0	85,480	
2300	0586	10,000	95.8	86,114	
0005	0651	10,000	95.6	86,838	
0100	0706	10,000	95.6	87,441	
0115	0721	10,000	95.5	--	
0116	0722	0	--	87,611	Shut down pump
1165	0005	0	67.0	--	

Table 2.7-9--Continued

Actual Time	Time Since Pump Started (min)	Flow (gpm)	Wellhead Pressure (feet of water)	Totalizer (gallons x 1,000)	Remarks
0117	0001	--	66.0	--	
0118	0002	--	66.0	--	
0119	0003	--	66.0	--	
0120	0004	--	65.8	--	
0121	0005	--	65.8	--	
0122	0006	--	65.6	--	
0123	0007	--	65.5	--	
0124	0008	--	65.5	--	
0125	0009	--	65.4	--	
0126	0010	--	65.4	--	
0131	0015	--	65.0	--	
0136	0020	--	64.8	--	
0141	0025	--	64.8	--	
0146	0030	--	64.6	--	
0156	0040	--	64.4	--	
0206	0050	--	64.2	--	
0251	0095	--	64.0	--	
0351	0155	--	64.0	--	
0451	0215	--	63.9	--	
0551	0275	--	63.9	--	
0651	0335	--	63.9	--	
0751	0395	--	63.8	--	
0851	0455	--	63.8	--	
1605	0889	--	62.3	--	

Table 2.7-10
QUALITY OF INJECTED WATER
WELL I-7

Date	Time	Depth (ft)	Temperature (°F)	Specific Gravity	Specific Conductance (μmhos/cm)	Chloride (mg/l)
06/11	1115	--	80	1.000	1,850	536
06/11	0215	--	80	1.000	2,000	597
06/11	0315	--	81	1.000	2,200	741
06/11	0415	--	81	1.000	2,200	716
06/11	0530	--	81	1.000	2,600	772
06/11	0630	--	81	1.000	2,500	765
06/11	0730	--	81	1.000	2,600	793
06/11	0830	--	82	1.000	2,400	798
06/11	0930	--	82	1.000	2,700	798
06/11	1130	--	82	1.000	2,500	747
06/12	1230	--	82	1.000	2,500	824
06/12	0115	--	82	1.000	2,400	829

Table 2.7-11 N.E.
WATER QUALITY OF BISCAYNE AQUIFER--N.E. MONITORING WELL
SITE I-7

Date	Time	Temperature (°C)	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
10/07	0910	26.0	1,575	590	9.75	
10/15	1635	26.0	1,275	520	9.43	
10/21	1535	26.0	1,500	470	9.63	
10/28	0951	26.0	1,500	390	7.75	
11/05	1525	24.5	1,500	450	9.16	
11/11	0900	25.0	1,500	480	9.11	
11/18	0905	25.5	1,550	480	9.07	
11/26	1050	25.5	1,550	470	9.85	
12/02	1005	25.0	1,500	460	9.80	
12/09	1215	24.5	1,500	350	9.60	
12/16	0905	25.0	1,550	450	9.58	
12/23	1015	25.0	1,500	440	9.76	
12/30	1005	25.0	1,500	440	10.01	
02/06	1005	24.5	1,340	410	9.80	
01/13	1005	25.0	1,390	400	9.80	
01/20	1035	25.0	1,375	400	9.78	
01/27	1105	23.9	1,550	390	9.50	
02/03	1305	23.9	1,320	400	9.74	
02/10	1205	23.9	1,400	430	10.12	
02/17	1205	23.9	1,450	400	9.78	
02/24	1305	23.9	1,400	430	9.75	
03/02	1305	23.3	1,450	450	9.78	

Table 2.7-11--Continued

Date	Time	Temperature (°C)	Specific Conductance (µmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
03/09	1105	23.9	1,375	460	9.87	
03/16	1300	23.9	1,150	460	9.93	
03/23	1,400	23.3	1,100	440	10.02	
03/30	1105	23.9	1,250	450	9.97	
04/06	1330	23.9	1,350	500	9.85	
04/13	1605	23.9	1,250	458	9.82	
04/21	1400	23.9	1,200	398	9.85	
04/29	1300	23.9	1,450	427	10.06	
05/04	1520	23.9	1,550	385	9.98	
05/10	1400	23.9	1,600	385	9.95	
05/18	1500	23.9	1,600	380	10.02	
05/25	1600	24.4	1,400	420	9.70	
06/03	1500	24.4	1,500	405	9.89	
06/10	1500	23.3	1,650	567	9.98	

Table 2.7-11 N.W.
WATER QUALITY OF BISCAYNE AQUIFER--N.W. MONITORING WELL
SITE I-7

Date	Time	Temperature (°C)	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
10/07	0920	26.5	1,000	420	7.88	
10/15	1645	--	--	--	--	
10/21	1545	26.5	450	120	7.72	
10/28	1012	26.0	1,320	360	7.92	
11/05	1745	25.0	1,400	380	7.81	
11/11	0905	25.0	1,350	360	7.90	
11/18	0920	26.0	1,450	400	7.85	
11/26	1100	26.0	1,225	350	7.93	
12/02	1015	26.0	1,450	380	7.86	
12/09	1225	25.0	1,800	490	7.71	
12/16	0920	26.0	1,600	450	7.68	
12/23	1025	25.0	1,500	460	7.88	
12/20	1015	25.0	1,175	390	8.15	
01/06	1015	24.5	1,400	400	7.92	
01/13	1015	25.0	1,500	400	7.90	
01/20	1040	25.0	1,325	400	7.82	
01/27	1120	23.3	700	100	7.61	
02/03	1320	23.9	545	190	7.85	
02/10	1215	23.9	800	230	8.26	
02/17	1215	23.9	565	120	7.79	
02/24	1315	23.9	725	170	7.86	
03/02	1315	23.3	535	110	7.82	

Table 2.7-11 N.W.--Continued

Date	Time	Temperature (°C)	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
03/09	1115	23.9	790	230	10.95	Changed measuring point
03/16	1305	23.9	700	270	10.99	
03/23	1405	23.3	850	290	11.09	
03/30	1115	23.9	630	430	11.10	
04/06	1335	23.9	1,325	562	10.95	
04/13	1610	23.3	1,200	509	10.93	
04/21	1405	23.9	1,500	457	10.94	
04/29	1305	23.9	1,510	530	11.26	
05/04	1515	23.9	1,750	435	11.05	
05/10	1405	23.9	1,850	470	11.15	
05/18	1505	23.9	1,800	476	11.21	
05/25	1605	24.4	1,750	440	10.82	
06/03	1505	24.4	1,700	435	11.24	
06/10	1505	23.3	1,740	577	11.15	

Table 2.7-11 S.E.
WATER QUALITY OF BISCAYNE AQUIFER--S.E. MONITORING WELL
SITE I-7

Date	Time	Temperature (°C)	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
10/07	0905	26.5	1,400	450	8.89	
10/15	1630	26.5	1,200	470	9.64	
10/21	1530	26.5	1,600	400	9.73	
10/28	0950	27.0	1,350	330	8.92	
11/05	1715	25.0	1,600	500	--	
11/11	0910	26.0	1,550	460	9.07	
11/18	0900	25.5	1,550	400	8.97	
11/26	1045	26.0	1,325	430	8.63	
12/02	1000	26.0	1,500	450	8.70	
12/09	1205	25.5	1,200	330	8.39	
12/16	0900	26.0	1,300	400	8.52	
12/23	1010	25.0	1,350	400	6.40	Changed measuring point
12/30	1000	25.0	1,175	390	6.79	
01/06	1000	24.5	1,225	440	6.60	
01/13	1000	25.0	1,100	400	6.58	
01/20	1030	25.0	1,300	430	6.50	
01/27	1100	23.9	1,800	450	6.30	
02/03	1300	23.9	1,650	480	6.64	
02/10	1200	23.9	1,500	480	7.04	
02/17	1200	23.9	1,700	450	6.45	
02/24	1300	23.9	1,500	480	6.55	
03/02	1300	23.9	1,275	470	6.52	

Table 2.7-11 S.E.--Continued

Date	Time	Temperature (°C)	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
03/09	1100	23.9	1,500	510	10.93	Changed measuring point
03/16	1310	23.3	1,200	480	10.97	
03/23	1410	23.3	1,350	480	11.12	
03/30	1100	23.9	1,500	530	11.03	
04/06	1340	23.3	1,350	550	10.90	
04/13	1600	23.3	1,800	496	10.87	
04/21	1410	23.9	1,700	461	10.95	
04/29	1310	23.9	1,700	509	11.17	
05/04	1510	23.9	2,200	452	11.02	
05/10	1410	23.9	2,050	469	11.02	
05/18	1510	23.9	2,250	473	11.10	
05/25	1610	24.4	2,200	477	10.78	
06/03	1510	--	--	--	--	
06/10	1510	24.4	1,900	592	10.95	

Table 2.7-11 S.W.
WATER QUALITY OF BISCAYNE AQUIFER--S.W. MONITORING WELL
SITE I-7

Date	Time	Temperature (°C)	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
10/07	0430	27.75	1,100	420	9.68	
10/15	1650	26.0	850	430	9.28	
10/21	1550	27.0	1,000	340	9.55	
10/28	1001	26.0	1,000	270	9.70	
11/05	1750	25.5	925	220	9.66	
11/11	0920	25.0	1,000	250	9.60	
11/18	0930	25.5	1,100	300	9.45	
11/26	1105	26.5	975	390	9.73	
12/02	1030	26.0	1,000	280	9.70	
12/09	1230	25.0	1,000	270	9.49	
12/16	0930	26.0	1,000	260	9.52	
12/23	1030	25.0	920	330	9.65	
12/30	1020	25.0	975	290	9.50	
01/06	1020	24.5	870	300	9.70	
01/13	1020	25.0	875	280	9.68	
01/20	1045	25.0	790	290	9.61	
01/27	1115	24.4	850	290	9.45	
02/03	1325	23.9	760	290	9.62	
02/10	1220	23.9	800	300	10.01	
02/17	1220	23.9	670	290	9.58	
02/24	1320	23.9	790	250	9.67	
03/02	1320	23.3	760	300	9.61	

Table 2.7-11 S.W.--Continued

Date	Time	Temperature (°C)	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
03/09	1120	23.9	720	310	9.76	
03/16	1315	23.9	600	390	9.81	
03/23	1415	23.8	750	300	9.93	
03/30	1120	23.9	630	280	9.87	
04/06	1345	23.9	700	311	9.75	
04/13	1615	23.9	780	263	9.71	
04/21	1415	23.9	850	242	9.72	
04/29	1315	23.9	700	264	10.08	
05/04	1505	23.9	820	250	9.87	
05/10	1415	23.9	850	312	9.97	
05/18	1515	23.9	900	273	10.02	
05/18	1515	23.9	900	273	10.02	
05/25	1615	24.4	980	258	9.60	
06/03	1515	24.4	950	265	9.78	
06/10	1515	23.3	1,000	371	9.98	

Table 2.7-11 W.S.
WATER QUALITY OF BISCAYNE AQUIFER--WATER SUPPLY WELL
SITE I-7

Date	Time	Temperature (°C)	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
10/07	0915	25.5	2,000	690	8.94	No D.T.W.L. due to pump hose in well
10/15	1640	--	--	--	--	
10/21	1540	--	--	--	--	
10/28	1015	25.0	3,000	830	--	
11/05	1740	24.0	5,000	1,950	--	
11/11	0915	25.0	3,100	1,800	--	
11/18	0910	25.0	3,200	1,900	--	
11/26	1055	24.5	5,500	1,960	--	
12/02	1010	25.5	5,200	1,850	--	
12/09	1715	25.0	5,000	1,960	--	
12/16	0915	25.0	5,500	2,000	--	
12/23	1020	25.0	4,000	1,620	--	
12/30	1010	25.0	4,500	1,910	--	
01/06	1010	24.5	5,000	2,080	--	
01/13	1010	--	--	--	--	
01/20	1040	25.0	4,700	1,980	--	
01/27	1110	25.0	4,500	1,700	--	
02/03	1310	22.8	5,500	2,000	--	
02/10	1210	23.9	4,000	1,590	9.35	
02/17	1210	23.3	3,500	1,600	8.92	
02/24	1310	23.9	3,100	1,550	9.00	

Table 2.7-11 W.S.--Continued

Date	Time	Temperature (°C)	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
03/02	1310	23.3	3,100	1,550	8.95	
03/09	1110	23.9	3,050	1,540	9.09	
03/16	1320	--	--	--	--	
03/23	1420	--	--	--	--	
03/30	1110	23.9	3,900	1,830	--	
04/06	1350	--	--	--	--	
04/13	1620	23.9	4,000	1,830	--	
04/23	1400	25.0	5,000	1,833	--	
04/29	1320	25.0	4,500	1,784	--	
05/04	1500	25.0	5,000	1,600	--	
05/10	1420	25.0	3,200	1,060	--	
05/18	1520	24.4	2,900	903	9.10	
05/25	1620	24.4	2,800	882	8.80	
06/03	1520	24.4	2,800	875	9.08	
06/10	1520	23.3	3,000	1,138	9.27	

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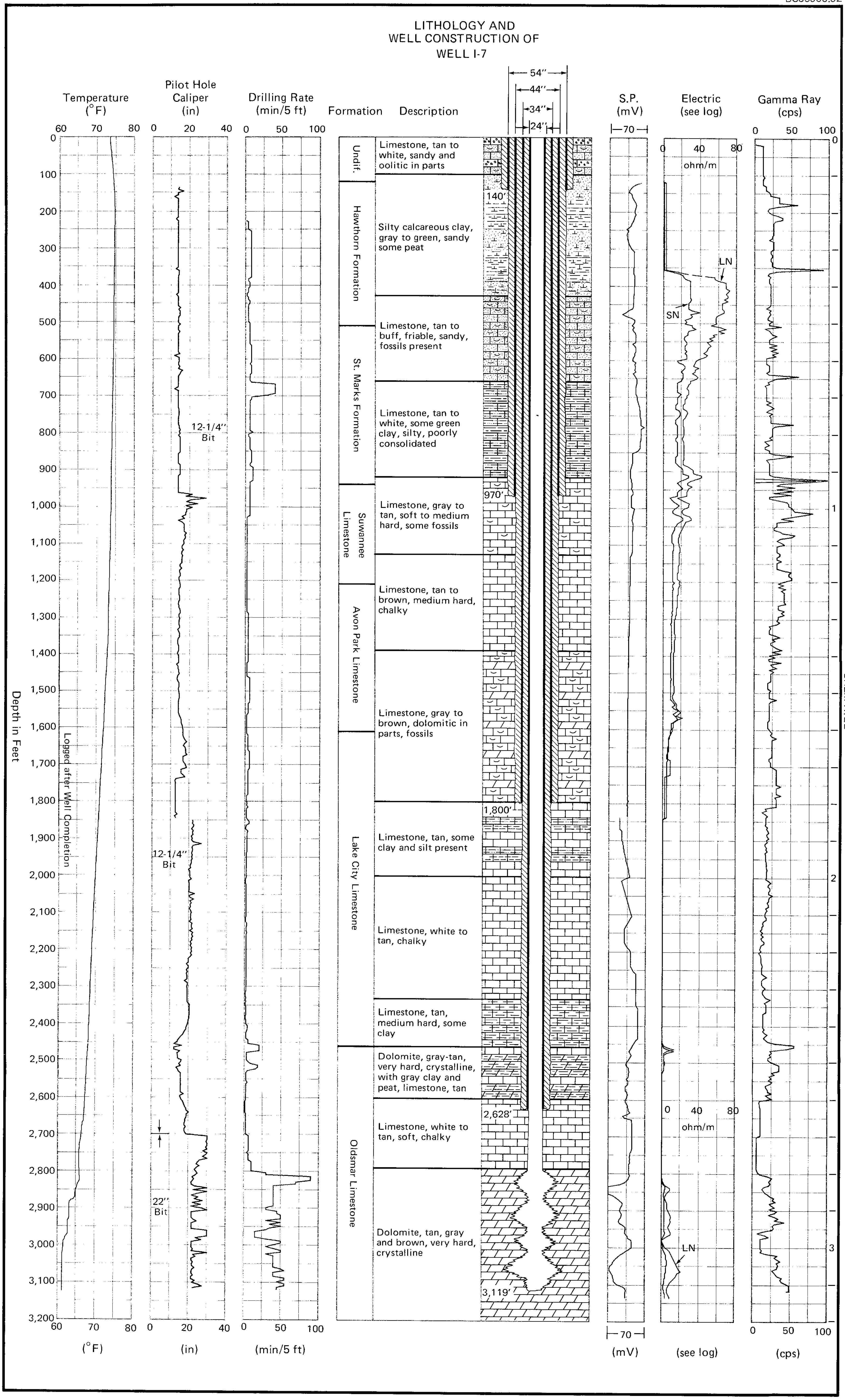

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Summary of drilling and logging data—Well I-7.

FIGURE 2.7-1.

Chapter 2.8
INJECTION WELL I-8

Injection Well I-8 is located on the northern boundary of the project site as shown on Figure 1.1-2, Section 1, Summary. It is 760 feet west of I-7 and 100 feet east of FA-1. Drilling began on November 19, 1979, and was completed on October 10, 1980. The drilling and casing sequence was as follows:

1. Drilled a 60-inch hole to a depth of 145 feet.
2. Set and cemented the 54-inch casing from a depth of 140 feet up to the concrete drilling pad.
3. Drilled a 12-1/4-inch pilot hole to 1,000 feet.
4. Reamed the pilot hole with a 52-inch reamer to a depth of 990 feet.
5. Set and cemented the 44-inch casing from a depth of 980 feet up to the concrete drilling pad.
6. Drilled a 12-1/4-inch pilot hole to a depth of 1,880 feet.
7. Reamed the pilot hole with a 42-inch reamer to a depth of 1,810 feet.
8. Set and cemented the 34-inch casing from a depth of 1,800 feet up to the concrete drilling pad.
9. Drilled a 12-1/4-inch pilot hole to a depth of 2,640 feet.
10. Reamed the pilot hole with a 32-inch reamer to a depth of 2,614 feet.
11. Installed gravel and a sand cap up to 2,421 feet.
12. Set and cemented the 24-inch casing from a depth of 2,420 feet to the surface.
13. Ran a casing pressure test at 250 psi for 1 hour with no pressure loss.
14. Drilled a 22-inch hole to 3,112 feet.
15. Ran an injection test at 10,480 gpm for 12 hours.
16. Ran a cement bond log on the 24-inch casing.
17. Completed the pad and wellhead as per specifications.

Casings are Black steel, API 5 L, Grade B, and ASTM A 139, Grade B. Casing details are summarized in Table 2.8-1. The casings were cemented with API Class H cement slurries, as summarized in Table 2.8-2. Geophysical logs, directional surveys, and TV surveys run on the well are listed in Table 2.8-3. The results of the gyroscopic directional surveys for path comparisons between the pilot and the reamed holes are included in Table 2.8-4. A descriptive summary of the underwater television survey after well completion is presented in Table 2.8-5. Results of a lithological examination of the formation samples collected every 10 feet from the pilot hole drilling are shown in Table 2.8-6. Table 2.8-7 presents water quality data from pilot hole drilling.

Figure 2.8-1 is a summary of data from drilling and logging and includes the following: well construction diagram, drilling rate, lithologic description, electric, gamma radiation, temperature, and caliper logs.

The gravel in Item 11 above was installed to fill in the reamed hole below the revised casing setting. After geophysical logging of the pilot hole to 2,640 feet, a casing setting of 2,614 feet was chosen. Because of the cementing difficulties of the 24-inch casing in I-2 and the response of the 2,450-foot monitor zone on BZ-1 during the I-5 withdrawal test, it was decided that there was no reason to go to the added risks and expense of setting the casing at 2,614 feet. A new casing setting of 2,420 feet was chosen, and the reamed hole was filled with gravel up to 2,421 feet. Four 2" x 2" cement ports were used, cut at 90° near the bottom of the casing for the first stage cementing. No problems were encountered in cementing the 24-inch casing, and the gravel in the hole circulated out easily afterward.

Injection Test

Upon completion of the drilling of the well, an injection test was run to determine the well injection capacity and the corresponding injection pressure. Freshwater from an adjacent pond was injected at 10,480 gpm for 12 hours. Wellhead pressure was measured with a 12-inch precision gauge calibrated in feet of water and the flow rate determined with a flow meter and volumetric totalizer. Wellhead pressure rose to 85.5 feet of water in 10 minutes and stabilized there after 1 hour.

Immediately after stopping the test pump, the pressure dropped to 65.1 feet of water. The well was backflowed rapidly in a matter of hours into the adjacent pond. The results of the injection test are summarized in Table 2.8-8, and the data are compiled in Table 2.8-9. The quality of the injected water is shown in Table 2.8-10.

Biscayne Aquifer Water Quality Monitoring

While drilling the well, water samples were collected and levels measured at each of five shallow monitoring wells installed around the drilling pad. Four of the wells were 2-inch-diameter PVC, approximately 20 feet deep, and located at each corner of the pad. The fifth was 8-inch-diameter steel, approximately 40 feet deep, and was used for supply water during construction. These data are included in Tables 2.8-11 N.E. through 2.8-11 W.S.

Table 2.8-1
SUMMARY OF CASING DETAILS
WELL I-8

Diameter (inches)	Wall Thickness (inches)	Depth (feet)[a]		Cemented Section (depth in feet)[a]	
		From	To	From	To
54	.500	0	140	0	140
44	.500	0	980	0	980
34	.500	0	1,800	0	1,800
24	.500	0	2,420	0	2,420

[a]Measured from the top of the concrete drilling pad.

Table 2.8-2
SUMMARY OF CEMENTING OF CASINGS
WELL I-8

Date	Casing Cemented	Type of Cement Used (API)	Number of Sacks Used	Depth Cemented (ft) From	To
12/03/79	54"	Class H w/25 lb of gilsonite per sack of cement	395	140	0
12/22/79	44"	Lead: Class H w/12% bentonite	1,600	980	0
		Tail: Class H neat	800		
06/15/80	34"	Lead: Class H w/12% bentonite	1,600	1,800	1,250
		Tail: Class H neat	900		
06/17/80	34"	Class H w/12% bentonite	1,050	1,250	1,026
06/18/80	34"	Class H w/12% bentonite	960	1,026	690
06/18/80	34"	Class H w/12% bentonite	1,170	690	0
09/05/80	24"	Class H neat	700	2,420	2,274
09/07/80	24"	Class H w/2% bentonite	1,020	2,274	2,030
09/08/80	24"	Class H w/2% bentonite	1,900	2,030	1,365
09/08/80	24"	Class H w/2% bentonite	1,360	1,365	697
09/09/80	24"	Class H w/2% bentonite	1,220	697	100
01/15/81	24"	Class H neat	250	100	0

Table 2.8-3
LIST OF GEOPHYSICAL LOGS AND SURVEYS
WELL I-8

Date	Well Progress and Casing Depth	Type of Logs or Surveys Run[a]	Purpose
12/10/79	54" casing to 140' 12-1/4" hole to 1,000' 1,000 feet	LSN, G, C	1. Identify the top of the Floridan aquifer. 2. Establish the setting depth of the 44" casing.
01/04/80	44" casing to 980' 12-1/4" hole to 1,880'	LSN, G, C, T_s	1. Geohydrological definition of the aquifer. 2. Define production zones. 3. Establish the setting depth of the 34" casing.
06/26/80	34" casing to 1,800' 12-1/4" hole to 2,640'	E, G, C, T_s, GYRO	1. Qualitative evaluation of the confining beds above the injection zone. 2. Identification of transmissive zones. 3. Gyroscopic directional track of the pilot hole. 4. Establish the setting depth of the 24" casing.
07/05/80	34" casing to 1,800' 32" hole to 2,614'	GYRO	1. Gyroscopic directional track of the reamed hole to compare to the pilot hole track.
09/06/80	24" casing to 2,420'	T_s	1. Identify the top of the first stage cement outside the 24" casing.
11/21/80	24" casing to 2,420' 22" hole to 3,110'	G, C, T_s	1. Geohydrological definition of the injection zone.

Table 2.8-3--Continued

Date	Well Progress and Casing Depth	Type of Logs or Surveys Run[a]	Purpose
12/02/80	As above	CBL	1. Confirm the adequacy of the cement outside the 24" casing.
01/20/81	As above	FC, T_s	1. Verify uniform water quality and record temperature profile for potentiometric survey.
03/04/81	As above	LSN	1. Geohydrologic definition of the injection zone.

[a]Abbreviations for logs and surveys are as follows:

E = single point electric and SP
LSN = long and short normal and SP
G = gamma ray
C = caliper
T_s = temperature, static
T_F = temperature, flowing
FV_s = fluid velocity (flow meter) static
FV_F = fluid velocity (flow meter) flowing
FC = fluid conductivity

GYRO = gyroscopic directional survey
TV = television
CBL = cement bond, variable density
WTD = wave train display
D. IND = dual induction electric and SP
BCS = borehole compensated sonic
Density = formation density
AV = acoustic velocity
GGD = gamma gamma density (0-500 ft)

Table 2.8-4
COMPARISON OF WELL PATHS FROM GYROSCOPIC SURVEYS
WELL I-8

WELL PATH COMPARISON

FOLLOW WELL: FILE 987.
MIAMI - DADE COUNTY WATER AND SEWAGE AUTHORITY
CH2M HILL
WELL I-8, REAM HOLE, 1830' - 2550'
JULY 5, 1980
DON PORTER
BROOKHAVEN

TARGET WELL: FILE 986.
MIAMI - DADE COUNTY WATER AND SEWAGE AUTHORITY
CH2M HILL
WELL I-8, PILOT HOLE, 0' - 2580'
JUNE 25, 1980
BOBBY LOFLAND
BROOKHAVEN

HORIZONTAL DISTANCE AND DIRECTION FROM TARGET WELL TO FOLLOW WELL AT TRUE VERTICAL DEPTHS

FEET	FEET	DIRECTION DEGREES
1830.00	0.05	96.79
1860.00	0.08	90.35
1890.00	0.06	81.68
1920.00	0.03	333.21
1950.00	0.06	260.26
1980.00	0.12	259.48
2010.00	0.08	293.25
2040.00	0.11	254.00
2070.00	0.08	258.97
2100.00	0.03	248.81
2130.00	0.05	74.95
2160.00	0.15	30.13
2190.00	0.26	20.43
2220.00	0.32	15.32
2250.00	0.35	5.94
2280.00	0.36	4.35
2310.00	0.29	15.98
2340.00	0.24	39.03
2370.00	0.31	35.15
2400.00	0.32	32.81
2430.00	0.22	40.75
2460.00	0.22	3.65
2490.00	0.26	338.49
2520.00	0.40	337.84
2550.00	0.59	3.40

MIAMI - DADE COUNTY WATER AND SEWAGE AUTHORITY
CH2M HILL
WELL I-8, REAM HOLE, 1830' - 2550'

COMPUTATION PAGE NO. 1
TIME 13:27:19 DATE 24-JUL-80

MEASURED DEPTH FEET	DRIFT ANGLE DEG	DRIFT DIRECTION DEG	COURSE LENGTH FEET	TRUE VERTICAL DEPTH FEET	RECTANGULAR COORDINATES FEET		CLOSURE DISTANCE FEET	CLOSURE DIRECTION DEG	DOGLEG SEVERITY DG/100FT
1800.	0.17	65.74	0.	1800.00	0.22 N	0.08 E	0.23	19.98	0.00
1830.	0.08	33.19	30.	1830.00	0.26 N	0.13 E	0.29	26.23	0.38
1860.	0.07	79.36	30.	1860.00	0.28 N	0.16 E	0.32	29.23	0.19
1890.	0.12	312.07	30.	1890.00	0.32 N	0.17 E	0.36	27.83	0.56
1920.	0.07	348.08	30.	1920.00	0.36 N	0.14 E	0.39	21.87	0.25
1950.	0.09	257.97	30.	1950.00	0.38 N	0.11 E	0.39	16.24	0.38
1980.	0.10	22.15	30.	1980.00	0.41 N	0.08 E	0.42	11.39	0.56
2010.	0.02	156.17	30.	2010.00	0.41 N	0.11 E	0.43	14.88	0.39
2040.	0.18	334.30	30.	2040.00	0.40 N	0.08 E	0.41	11.18	0.67
2070.	0.08	79.19	30.	2070.00	0.45 N	0.11 E	0.47	13.21	0.72
2100.	0.02	289.47	30.	2100.00	0.46 N	0.13 E	0.48	15.77	0.22
2130.	0.20	95.48	30.	2130.00	0.45 N	0.18 E	0.49	22.20	0.60
2160.	0.17	318.24	30.	2160.00	0.52 N	0.22 E	0.56	22.79	1.13
2190.	0.15	48.49	30.	2190.00	0.59 N	0.22 E	0.63	20.44	0.74
2220.	0.19	260.56	30.	2220.00	0.65 N	0.19 E	0.68	16.55	1.06
2250.	0.10	289.73	30.	2250.00	0.66 N	0.12 E	0.67	10.53	0.36
2280.	0.07	255.54	30.	2280.00	0.66 N	0.07 E	0.66	6.07	0.19
2310.	0.06	136.37	30.	2310.00	0.64 N	0.06 E	0.64	5.67	0.37
2340.	0.05	293.18	30.	2340.00	0.62 N	0.05 E	0.62	4.84	0.36
2370.	0.04	319.05	30.	2370.00	0.63 N	0.03 E	0.63	3.07	0.07
2400.	0.11	148.94	30.	2400.00	0.62 N	0.01 E	0.62	1.06	0.52
2430.	0.14	281.49	30.	2430.00	0.57 N	0.02 W	0.57	357.98	0.79
2460.	0.17	17.94	30.	2460.00	0.64 N	0.06 W	0.64	354.86	0.78
2490.	0.05	242.69	30.	2490.00	0.67 N	0.09 W	0.67	352.15	0.70
2520.	0.05	35.30	30.	2520.00	0.68 N	0.10 W	0.69	351.33	0.32
2550.	0.25	0.52	30.	2550.00	0.75 N	0.08 W	0.76	353.96	0.73

FINAL CLOSURE - DIRECTION: 353.962 DEGS CLOCKWISE FROM NORTH
DISTANCE: 0.76 FEET

RADIUS OF CURVATURE METHOD

RECORD OF SURVEY

MIAMI - DADE COUNTY WATER AND SEWAGE AUTHORITY
CH2M HILL
WELL I-8, REAM HOLE, 1830' - 2550'
JULY 5, 1980
DON PORTER
BROOKHAVEN

2.8-10

Table 2.8-5
DESCRIPTIVE SUMMARY OF UNDERWATER TELEVISION SURVEYS
WELL I-8

CH2M HILL

RECORD OF UNDERWATER TV SURVEY

Project: Miami Dade Water & Sewer Authority, South District Regional Wastewater Treatment Plant

Well: I-8

Survey By: Deep Venture Diving Service, Perry, Florida
HP-4,000 AU

Survey Date: 1/30/81 Total Depth: 3,127 feet

Witnessed By: D. Cabit, D. Snyder, T. McCormick

Reviewed By: J. D. Lehnen Date: 2/20/81

Remarks:

Depth in Feet		Reel Counter		Observations
From	To	From	To	
--	--	0	15	Titles
0	11	15	21	Dry 24" casing
11	2,504	21	483	24" casing (wet)
--	2,504	483	--	Bottom of casing
2,504	2,420	483	488	Correct depth indicator to 2,420'
2,420	2,449	488	494	Large diameter smooth hole
2,449	2,457	494	497	Large cavity, walls not visible
2,457	2,737	497	537	Large hole, smooth walls
2,737	2,807	537	547	Rougher walls
2,807	2,841	547	553	Fractures, cavities, high angle fractures
2,841	2,845	553	554	Large fractured cavity
2,845	2,855	554	555	Rough walls, no cavities
2,855	2,953	555	573	Cavities, high angle fractures, solution features
2,953	2,955	573	574	Large cavity

Project: Miami Dade Water & Sewer Authority, South District Regional Wastewater Treatment Plant

Well: I-8 Date: 1/30/81 Total Depth: 3,127'

Depth in Feet		Reel Counter		Observations
From	To	From	To	
2,955	2,985	574	581	Small cavities, high angle fractures
2,985	3,012	581	587	Rough walls, solution features
3,012	3,026	587	590	Fractures, smooth walls
3,026	3,028	590	--	Large cavity
3,028	3,094	590	604	Smooth walls, few fractures
3,094	3,127	604	611	Rougher walls, small cavities, solution features
--	3,127	611	615	Bottom of hole
3,127	2,543	615	652	Coming out of the hole, end of survey

Table 2.8-6
LITHOLOGY FROM PILOT HOLE FORMATION SAMPLES
WELL I-8

Depth Interval (ft)		
From	To	Description
0	10	Crushed limestone fill
10	20	Limestone, tan to gray, hard, oolitic
20	30	As above
30	40	As above
40	50	As above
50	60	Limestone, tan, hard, fine grain, some sand
60	70	Limestone, light buff, same sand
70	80	As above
80	90	Limestone, gray, small fragments, mostly sand
90	100	As above
100	110	Limestone, gray-green siltstone, sand
110	120	Siltstone, olive green
120	130	Gray-green silt, siltstone, olive green
130	140	As above
140	150	Limestone, sand, mostly cement
150	160	As above
160	170	As above
170	180	Gray silt, sand, some cement, some clay
180	190	As above, with limestone
190	200	Limestone, siltstone, olive green, clayey, sandy
200	210	As above
210	220	As above

Table 2.8-6--Continued

Depth Interval (ft) From	To	Description
220	230	As above
230	240	As above
240	250	Limestone, tan to buff, hard, shell fragments, cement, silt, fine grain
250	260	As above
260	270	As above
270	280	As above, with olive green silt
280	290	As above
290	300	As above
300	310	Limestone, tan to buff, shell fragments, cement particles, small grain, olive gray silt
310	320	Siltstone, gray, silt, cement particles, shell fragments, soft
320	330	As above
330	340	As above
340	350	As above, less cement
350	360	As above
360	370	As above
370	380	Limestone, gray, medium-hard, gray limesand
380	390	Limestone, gray, medium-hard limesand, some fossils
390	400	As above
400	410	As above
410	420	As above
420	430	As above
430	440	As above

Table 2.8-6--Continued

Depth Interval (ft) From	To	Description
440	450	As above
450	460	As above
460	470	As above
470	480	As above
480	490	As above
490	500	As above
500	510	Limestone, tan to buff, limesilt, moderately consolidated, soft/medium-hard fossils
510	520	As above, with more limesilt
520	530	As above
530	540	As above
540	550	As above
550	560	As above
560	570	As above
570	580	Limestone, tan, soft to medium-hard, limesilt
580	590	Limestone, limesilt, tan to buff, fossils, medium-hard
590	600	As above
600	610	As above
610	620	As above
620	630	As above
630	640	As above
640	650	As above
650	660	As above
660	670	As above

Table 2.8-6--Continued

Depth Interval (ft)		
From	To	Description
670	680	As above
680	690	As above
690	700	As above
700	710	Limestone, buff, poorly consolidated, shell fragments and fossils, recrystallized
710	720	As above
720	730	As above
730	740	As above
740	750	As above
750	760	As above
760	770	Limestone, light tan to buff, medium-hard, moderately consolidated, shell fragments and fossils present
770	780	As above
780	790	As above
790	800	As above
800	810	As above
810	820	As above
820	830	As above
830	840	As above
840	850	As above
850	860	As above
860	870	As above
870	880	As above
880	890	As above

Table 2.8-6--Continued

Depth Interval (ft) From	To	Description
890	900	As above
900	910	As above
910	920	Limestone, gray to buff, medium-hard, poorly consolidated, fossils and some clay
920	930	As above
930	940	As above
940	950	As above
950	960	As above
960	970	Limestone, gray to buff, medium-hard, poorly consolidated, fossils, some clay
970	980	As above
980	990	Limestone, gray-green, soft, poorly consolidated, more clay present, fossils present
990	1,000	Limestone, gray, moderately to poorly consolidated, some clay and fossils
1,000	1,010	Limestone, dark tan to gray, some recrystallized, hard, medium consolidated matrix
1,010	1,020	As above
1,020	1,030	As above
1,030	1,040	As above
1,040	1,050	As above
1,050	1,060	As above
1,060	1,070	Limestone, gray, medium-hard, poorly consolidated matrix, some crystallized fragments
1,070	1,080	As above
1,080	1,090	As above

Table 2.8-6--Continued

Depth Interval (ft)		
From	To	Description
1,090	1,100	Limestone, tan/green, clays present and some fossils
1,100	1,110	Limestone, buff, poorly consolidated, soft, fossils and shell fragments
1,110	1,120	As above
1,120	1,130	As above
1,130	1,140	As above
1,140	1,150	As above
1,150	1,160	Limestone, tan to buff, medium-hard, poorly consolidated matrix, fossils and shell fragments
1,160	1,170	As above
1,170	1,180	As above
1,180	1,190	As above
1,190	1,200	As above
1,200	1,210	As above
1,210	1,220	As above, darker tan to brown in color
1,220	1,230	As above
1,230	1,240	As above
1,240	1,250	As above
1,250	1,260	As above
1,260	1,270	As above
1,270	1,280	As above
1,280	1,290	Limestone, gray to buff, hard, moderately consolidated, chalky matrix, few fossils
1,290	1,300	As above
1,300	1,310	As above

Table 2.8-6--Continued

Depth Interval (ft) From	To	Description
1,310	1,320	As above
1,320	1,330	As above
1,330	1,340	Limestone, as above, finer grains
1,340	1,350	Limestone, light gray, small grained, some silty lime, medium-hard, medium consolidated
1,350	1,360	As above
1,360	1,370	As above
1,370	1,380	As above
1,380	1,390	As above, larger grained
1,390	1,400	As above
1,400	1,410	Limestone, gray/olive, hard, moderately consolidated, hard, some sand
1,410	1,420	Limestone, tan/gray, poorly to moderately consolidated, hard, some sand
1,420	1,430	As above
1,430	1,440	Limestone, buff, hard, fine grained, moderately consolidated, fossils and sand present
1,440	1,450	As above
1,450	1,460	As above
1,460	1,470	As above
1,470	1,480	As above
1,480	1,490	As above
1,490	1,500	As above
1,500	1,510	Limestone, as above
1,510	1,520	As above

Table 2.8-6--Continued

Depth Interval (ft)		
From	To	Description
1,520	1,530	As above
1,530	1,540	Limestone, tan/gray, medium-hard, medium consolidated, shell fragments and fossils, some crystallized fragments
1,540	1,550	As above
1,550	1,560	As above
1,560	1,570	As above
1,570	1,580	As above
1,580	1,590	As above
1,590	1,600	Limestone, tan, medium-hard, coarse grains, cones present
1,600	1,610	As above
1,610	1,620	As above
1,620	1,630	Limestone, as above, smaller grains
1,630	1,640	As above
1,640	1,650	Limestone, tan/gray, well consolidated, some recrystallization
1,650	1,660	Limestone, tan, hard, fine grains, well consolidated, fossils present
1,660	1,670	As above
1,670	1,680	As above
1,680	1,690	As above
1,690	1,700	Limestone, as above
1,700	1,710	Limestone, gray, hard, well consolidated, recrystallized fragments
1,710	1,720	As above, tan in color
1,720	1,730	As above

Table 2.8-6--Continued

Depth Interval (ft)		
From	To	Description
1,730	1,740	Limestone, tan to buff, moderately consolidated, coarse grains, quartz sand present
1,740	1,750	As above
1,750	1,760	As above
1,760	1,770	As above
1,770	1,780	As above
1,780	1,790	As above
1,790	1,800	As above
1,800	1,810	As above
1,810	1,820	Limestone, fine grains, hard, tan/buff, fossils present
1,820	1,830	As above
1,830	1,840	As above
1,840	1,850	As above
1,850	1,860	Limestone, as above
1,860	1,870	As above
1,870	1,880	As above
1,880	1,890	Limestone, tan to buff, hard to medium-hard, matrix vuggy
1,890	1,900	As above
1,900	1,910	As above
1,910	1,920	As above
1,920	1,930	As above
1,930	1,940	As above
1,940	1,950	Limestone, tan to buff color, hard, matrix chalky and vuggy, microfossils present

Table 2.8-6--Continued

Depth Interval (ft) From	To	Description
1,950	1,960	As above
1,960	1,970	As above
1,970	1,980	As above
1,980	1,990	As above
1,990	2,000	As above
2,000	2,010	As above
2,010	2,020	As above
2,020	2,030	As above
2,030	2,040	As above
2,040	2,050	As above
2,050	2,060	Limestone, white, medium-hard to hard, microfossils present
2,060	2,070	As above
2,070	2,080	Limestone, tan to buff color, soft, vuggy, microfossils present
2,080	2,090	As above
2,090	2,100	As above
2,100	2,110	As above
2,110	2,120	Limestone, tan to gray, coarse to medium grains and medium-hard, fossiliferous
2,120	2,130	As above
2,130	2,140	As above
2,140	2,150	Limestone, as above, with some hard gray fragments
2,150	2,160	As above

Table 2.8-6--Continued

Depth Interval (ft)		
From	To	Description
2,160	2,170	Limestone, tan, medium grained and hard, some dolomite fragments
2,170	2,180	Limestone, buff, medium grain, moderately hard, fossiliferous
2,180	2,190	As above
2,190	2,200	As above, larger grained
2,200	2,210	As above
2,210	2,220	As above
2,220	2,230	As above
2,230	2,240	As above
2,240	2,250	As above
2,250	2,260	Limestone, tan, soft, medium sized grains, fossiliferous, limestone, gray, hard, coarse to medium sized grains
2,260	2,270	As above
2,270	2,280	As above
2,280	2,290	Limestone, tan, soft to medium-hard, medium to coarse grained, fossiliferous
2,290	2,300	As above
2,300	2,310	Limestone, buff to light tan, medium to coarse grained, vuggy matrix, soft, fossiliferous
2,310	2,320	As above
2,320	2,330	As above
2,330	2,340	As above
2,340	2,350	As above
2,350	2,360	As above

Table 2.8-6--Continued

Depth Interval (ft) From	To	Description
2,360	2,370	As above
2,370	2,380	As above
2,380	2,390	Limestone, tan/buff, vuggy, medium-hard, fossiliferous, limestone, gray, hard, dolomitic, some recrystallized, dense
2,390	2,400	As above
2,400	2,410	As above
2,410	2,420	As above
2,420	2,430	As above
2,430	2,440	As above
2,440	2,450	As above
2,450	2,460	As above
2,460	2,470	Dolomite, gray/brown, hard, medium sized grains, some crystallized limestone, white and soft, chalky
2,470	2,480	As above
2,480	2,490	Limestone, gray/white, tan, medium-hard to hard, fossiliferous dolomite, gray/brown, hard, some crystallized
2,490	2,500	Limestone, tan/gray, hard, gray is massive, tan is soft, vuggy, fossiliverous, some crystallized dolomite chips
2,500	2,510	As above, no dolomite
2,510	2,520	As above
2,520	2,530	As above
2,530	2,540	Limestone, tan/gray, hard, compacted, dolomitic, medium grains, some recrystallized
2,540	2,550	Limestone, tan to gray, hard to medium-hard, medium to coarse grains, tan is fossiliferous, gray is compacted

Table 2.8-6--Continued

Depth Interval (ft)		
From	To	Description
2,550	2,560	As above
2,560	2,570	As above
2,570	2,580	As above
2,580	2,590	As above
2,590	2,600	As above
2,600	2,610	As above
2,610	2,620	As above
2,620	2,630	As above
2,630	2,640	As above
2,640	2,650	As above
2,650	2,660	As above
2,660	2,670	As above
2,670	2,680	As above
2,680	2,690	Limestone, light to dark gray, recrystallized, hard
2,690	2,700	As above
2,700	2,710	As above
2,710	2,720	As above, some crystalline dolomite
2,720	2,730	As above
2,730	2,740	As above
2,740	2,750	As above
2,750	2,760	Limestone, white to gray, medium-hard with some dolomite
2,760	2,770	As above
2,770	2,780	As above

Table 2.8-6--Continued

Depth Interval (ft)		
From	To	Description
2,780	2,790	As above
2,790	2,800	As above
2,800	2,810	As above
2,810	2,820	Dolomite, tan to gray, hard
2,820	2,830	As above
2,830	2,840	As above, with darker brown dolomite
2,840	2,850	As above
2,850	2,860	As above
2,860	2,870	As above
2,870	2,880	Dolomite, tan, hard, microcrystalline
2,880	2,890	As above
2,890	2,900	As above
2,900	2,910	As above, with some white limestone
2,910	2,920	As above
2,920	2,930	As above
2,930	2,940	As above
2,940	2,950	Dolomite, gray to brown, massive, crystalline
2,950	2,960	As above
2,960	2,970	As above
2,970	2,980	As above
2,980	2,990	Dolomite, gray to brown and tan, crystalline, very hard
2,990	3,000	As above
3,000	3,010	As above

Table 2.8-6--Continued

Depth Interval (ft)		
From	To	Description
3,010	3,020	As above
3,020	3,030	As above
3,030	3,040	As above
3,040	3,050	As above
3,050	3,060	As above
3,060	3,070	Dolomite, tan to gray, brown, crystalline, very hard
3,070	3,080	As above
3,080	3,090	As above
3,090	3,100	As above
3,100	3,110	As above
3,110	3,120	As above

Table 2.8-7
WATER QUALITY DATA FROM PILOT HOLE DRILLING
WELL I-8

Date	Time	Depth (ft)	Temperature (°C)	Specific Gravity	Specific Conductance (µmhos/cm)	Chloride (mg/l)
01/01	0800	998	21.0	--	23,500	12,300
01/01	1030	1,030	21.0	--	23,500	12,100
01/01	1330	1,060	21.0	1.0130	25,500	13,300
01/01	1510	1,089	21.0	1.0125	19,000	12,300
01/01	1705	1,120	21.0	--	22,300	12,100
01/01	1815	1,151	21.0	1.0120	18,000	12,300
01/01	2120	1,182	21.5	1.0125	19,500	12,200
01/01	2350	1,216	20.0	1.0125	19,000	12,300
01/02	0335	1,247	20.5	1.0130	20,000	12,500
01/02	0515	1,276	21.0	1.0130	21,000	12,100
01/02	0800	1,305	21.0	1.0130	20,000	12,000
01/02	1005	1,337	21.0	1.0125	19,000	11,700
01/02	1400	1,368	21.0	1.0125	17,000	11,300
01/02	1536	1,401	21.0	1.0110	17,500	10,800
01/02	1715	1,432	21.0	1.0125	17,000	11,000
01/02	2035	1,467	21.5	1.0130	18,500	12,000
01/02	2220	1,498	20.0	1.0135	20,000	12,200
01/03	0015	1,529	20.0	1.0130	21,500	12,300
01/03	0210	1,560	20.5	1.0125	21,000	12,500
01/03	0550	1,591	21.0	1.0125	20,000	12,100
01/03	0730	1,621	20.0	1.0100	19,000	9,100
01/03	1000	1,651	22.2	1.0100	19,000	9,050

Table 2.8-7--Continued

Date	Time	Depth (ft)	Temperature (°C)	Specific Gravity	Specific Conductance (μmhos/cm)	Chloride (mg/l)
01/03	1110	1,681	23.3	1.0100	19,000	8,700
01/03	1230	1,715	23.3	1.0092	18,000	8,500
01/03	1550	1,751	23.3	1.0090	17,000	8,400
01/03	1610	1,781	23.3	1.0085	16,800	8,000
01/03	1800	1,814	23.3	1.0075	15,000	7,500
01/03	2030	1,844	22.8	1.0075	15,000	7,500
01/03	2145	1,880	22.8	1.0075	15,000	6,900
06/21	1230	1,835	23.9	1.0055	5,000	6,000
06/21	0345	1,867	24.0	1.0075	7,500	4,805
06/21	0945	1,899	25.0	1.0095	11,500	9,610
06/21	1420	1,932	25.6	1.0050	8,500	7,208
06/21	1840	1,962	25.6	1.0050	11,000	5,285
06/21	2230	1,996	26.0	1.0055	11,000	5,863
06/21	1230	2,026	26.0	1.0085	18,000	9,418
06/22	0230	2,055	26.0	1.0080	11,000	5,766
06/22	0530	2,090	26.0	1.0100	12,000	5,574
06/22	0730	2,121	26.0	1.0100	12,500	6,055
06/22	1030	2,155	26.0	1.0055	13,000	6,727
06/22	1610	2,187	26.0	1.0085	13,000	6,823
06/22	2330	2,220	26.5	1.0080	11,500	5,574
06/23	0430	2,251	27.0	1.0050	10,000	5,670
06/23	1130	2,282	28.9	1.0030	8,000	4,613
06/23	1500	2,312	28.3	1.0025	6,500	3,650

Table 2.8-7--Continued

Date	Time	Depth (ft)	Temperature (°C)	Specific Gravity	Specific Conductance (µmhos/cm)	Chloride (mg/l)
06/23	1820	2,346	28.3	1.0020	6,500	3,364
06/23	2040	2,379	27.0	1.0020	5,400	3,250
06/24	0001	2,413	27.0	1.0030	6,500	3,650
06/24	0300	2,445	27.0	1.0030	7,000	3,780
06/24	0900	2,478	27.6	1.0025	4,600	2,500
06/24	2100	2,543	27.8	1.0010	5,000	2,115
06/25	0001	2,575	27.8	1.0010	6,200	2,690
06/25	0245	2,606	28.3	1.0015	6,000	2,690
06/25	0600	2,640	27.8	1.0010	6,000	2,750
09/16	1930	2,674	27.8	1.0210	3,000	20,200
09/17	0015	2,700	27.8	1.0215	31,000	19,800
09/17	0400	2,735	27.8	1.0215	30,500	19,100
09/17	1800	2,765	27.8	1.0220	32,000	20,000
09/20	0600	2,795	27.8	1.0230	36,000	23,000
09/23	1000	2,825	27.8	1.0240	34,000	21,000
09/25	2300	2,855	27.8	1.0250	34,000	21,000
09/26	2100	2,880	27.8	1.0250	38,000	22,000
09/30	0935	2,907	27.8	1.0255	38,000	22,500
10/01	1000	2,938	27.2	1.0260	40,000	23,000
10/02	0225	2,971	27.2	1.0260	39,000	23,200
10/07	0800	3,001	27.2	1.0255	39,000	22,800
10/08	1800	3,032	26.1	1.0255	39,000	22,500
10/09	1330	3,061	26.1	1.0250	40,000	23,000
10/10	0330	3,089	26.1	1.0245	38,000	22,200

Table 2.8-8
SUMMARY OF INJECTION TEST RESULTS
WELL I-8

Pumping Rate	10,480 gpm
Test Duration	12 hours
Time Elapsed to Reach Maximum Injection Head After Pumping Started	10 minutes
Maximum Injection Head[a]	85.5 feet of water
Static Freshwater Head[a, b]	65.1 feet of water

[a]Feet of water referred to pad level.
[b]Due to the density difference between the injected freshwater and formation saltwater.

Table 2.8-9
INJECTION TEST DATA
(Wellhead pressure measuring point @ 4.1 feet above pad)
WELL I-8

Actual Time	Time Since Pump Started (min)	Flow (gpm)	Wellhead Pressure (feet of water)	Totalizer (gallons x 1,000)	Remarks
0730	0	10,000	0.0	97,403	Start injection pump
0731	1	10,000	40.0	97,411	
0732	2	10,000	37.0	97,421	
0732	3	10,000	46.0	97,432	
0734	4	10,000	58.0	97,443	
0735	5	10,000	67.0	97,454	
0736	6	10,000	72.4	97,465	
0737	7	10,000	77.0	97,476	
0738	8	10,000	80.0	97,487	
0739	9	10,000	81.2	97,497	
0740	10	10,000	81.4	97,508	
0742	12	10,000	81.4	97,530	
0744	14	10,000	81.0	97,551	
0746	16	10,000	81.0	97,572	
0748	18	10,000	81.0	97,593	
0750	20	10,000	81.0	97,614	
0755	25	10,000	81.0	97,669	
0800	30	10,000	81.0	97,722	
0805	35	10,000	81.0	97,776	
0810	40	10,000	81.0	97,829	
0815	45	10,000	81.2	97,881	

Table 2.8-9--Continued

Actual Time	Time Since Pump Started (min)	Flow (gpm)	Wellhead Pressure (feet of water)	Totalizer (gallons x 1,000)	Remarks
0820	50	10,000	81.2	97,932	
0825	55	10,000	81.4	97,988	
0830	60	10,000	81.4	98,041	
0840	70	10,000	81.4	98,168	
0850	80	10,000	81.4	98,254	
0900	90	10,000	81.3	98,361	
0910	100	10,000	81.4	98,469	
0920	110	10,000	81.4	98,574	
0930	120	10,000	81.4	98,678	
1000	150	10,000	81.4	98,998	
1030	180	10,000	81.4	99,315	
1100	210	10,000	81.4	99,632	
1130	240	10,000	81.4	99,948	
1200	270	10,000	81.4	100,259	
1230	300	10,000	81.4	100,578	
1300	330	10,000	81.4	100,892	
1330	360	10,000	81.4	101,224	
1400	390	10,000	81.4	101,525	
1430	420	10,000	81.4	101,842	
1500	450	10,000	81.4	102,159	
1530	480	10,000	81.4	102,476	
1630	540	10,000	81.6	103,100	
1730	600	10,000	81.6	103,720	
1830	660	10,000	81.4	104,337	

Table 2.8-9--Continued

Actual Time	Time Since Pump Started (min)	Flow (gpm)	Wellhead Pressure (feet of water)	Totalizer (gallons x 1,000)	Remarks
1930	720	10,000	81.4	104,951	Shut down injection pump
1932	2	0	61.6	--	
1934	4	0	61.4	--	
1936	6	0	61.2	--	
1938	8	0	61.0	--	

Table 2.8-10
QUALITY OF INJECTED WATER
WELL I-8

Date	Time	Depth (ft)	Temperature (°C)	Specific Gravity	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Remarks
01/03	0745	--	19.0	1.0002	2,500	900	
01/03	0900	--	20.0	1.0002	1,250	780	
01/03	1100	--	21.0	1.0002	1,200	700	
01/03	1600	--	21.0	1.0001	1,200	560	

Table 2.8-11 N.E.
WATER QUALITY OF BISCAYNE AQUIFER--N.E. MONITORING WELL
SITE I-8

Date	Time	Temperature (°C)	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
11/17	0935	25.0	1,400	380	10.32	
11/24	1125	25.0	1,550	380	10.38	
12/01	0905	25.0	1,550	400	10.34	
12/09	0915	25.1	1,800	470	9.95	
12/15	0905	25.5	1,600	410	9.98	
12/22	1540	24.0	1,600	420	10.28	
12/29	0950	24.0	1,650	410	10.26	
01/05	0940	23.3	1,650	400	10.24	
01/12	1005	24.4	1,450	370	10.40	
01/19	0910	23.9	1,550	350	10.34	
01/26	0945	24.4	1,500	360	10.78	
02/02	1025	24.2	1,550	350	10.32	
09/09	1300	24.0	1,500	360	10.27	
02/16	0920	23.3	1,400	350	10.22	
02/23	0930	23.9	1,450	350	10.24	
03/01	1015	23.9	1,400	360	10.23	
03/08	0925	23.9	1,400	350	10.25	
03/15	1050	23.3	1,100	350	10.43	
03/22	1330	23.9	1,200	350	10.39	
03/29	1115	23.9	1,000	400	10.51	
04/11	1250	23.9	1,180	444	10.48	
04/17	0905	23.9	1,200	430	10.52	
04/23	1515	23.9	1,300	349	10.45	

Table 2.8-11 N.E.--Continued

Date	Time	Temperature (°C)	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
05/01	1500	23.9	1,250	366	10.47	
05/08	0930	23.9	1,200	351	10.42	
05/15	1105	24.4	1,650	384	10.40	
05/22	1355	24.4	1,650	350	10.20	
05/29	1000	24.4	1,650	361	10.21	
06/05	1600	24.4	1,650	352	10.42	
06/13	1400	24.4	1,650	355	10.40	
06/14	1000	24.4	1,600	360	10.40	
06/26	1730	23.9	1,600	365	10.42	
07/03	1800	26.1	1,700	66	10.28	Incorrect chloride values
07/10	1700	26.1	1,600	54	10.61	
07/17	1900	24.4	1,650	29	10.37	
07/24	1700	25.0	2,000	516	10.70	Correct chloride values
08/01	--	--	1,600	516	--	
08/08	1120	27.2	--	--	11.19	
08/14	1920	26.7	1,800	573	10.50	
08/21	1820	25.6	1,500	730	10.40	
08/27	1340	27.8	1,600	513	11.04	
09/04	0955	26.1	1,600	550	11.01	
09/11	1055	26.1	1,600	540	11.00	
09/18	1800	26.1	1,600	520	11.00	
09/25	0900	26.1	1,650	550	11.05	
10/02	1730	26.1	1,600	510	11.00	

Table 2.8-11 N.E.--Continued

Date	Time	Temperature (°C)	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
10/09	1730	26.1	1,600	510	11.00	
10/16	1700	26.1	1,500	490	10.40	
10/23	1700	26.1	1,600	500	10.40	

Table 2.8-11 N.W.
WATER QUALITY OF BISCAYNE AQUIFER--N.W. MONITORING WELL
SITE I-8

Date	Time	Temperature (°C)	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
11/17	0955	24.5	1,500	470	8.61	
11/24	1115	25.5	1,800	450	9.11	
12/01	0920	25.5	1,850	480	8.90	
12/09	--	--	--	--	--	
12/15	--	--	--	--	--	
12/22	1550	24.0	1,750	430	8.75	
12/29	1000	24.0	1,600	460	7.70	Changed measuring point
01/05	0950	23.3	1,550	510	7.63	
01/12	1010	24.2	1,400	470	7.70	
01/19	0900	23.9	1,450	470	7.78	
01/26	0935	23.9	1,400	490	7.61	
02/02	1015	23.9	1,400	490	7.66	
02/09	1245	23.9	1,400	480	7.60	
02/16	0925	23.9	1,500	480	7.59	
02/23	0910	23.9	1,400	480	7.60	
03/01	1000	23.9	1,500	480	7.60	
03/08	0920	23.9	1,500	480	7.61	
03/15	1100	23.3	1,150	530	10.55	Changed measuring point
03/22	1340	23.9	1,100	520	10.50	
03/29	1125	23.9	1,000	540	10.60	
04/11	1255	23.9	1,500	545	10.50	
04/17	0915	23.3	1,350	535	10.45	

Table 2.8-11 N.W.--Continued

Date	Time	Temperature (°C)	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
04/23	1525	23.9	1,500	493	10.54	
05/01	1505	23.3	1,480	502	10.54	
05/08	0935	23.9	1,450	501	10.50	
05/15	1115	24.4	1,900	538	10.50	
05/22	1405	25.0	2,000	529	10.38	
05/29	1010	24.4	1,950	531	10.38	
06/05	1610	24.4	2,000	535	10.50	
06/13	1410	24.4	2,000	540	10.50	
06/14	0950	24.4	2,000	580	10.50	
06/26	1740	23.9	2,000	596	10.52	
07/03	1805	26.1	1,700	198	10.36	Chloride values wrong: affected by alkalinity of ground water
07/10	1705	25.6	1,650	141	10.69	
07/17	1905	25.0	1,800	47	10.45	
07/24	1705	25.0	2,500	753	10.81	Correct chloride values
08/01	--	--	2,200	680	--	
08/08	1125	27.8	--	--	11.25	
08/14	1900	26.1	2,100	729	10.71	
08/21	1825	26.1	1,800	596	10.40	
08/27	1325	27.8	900	175	11.11	
09/04	1000	27.8	1,000	195	11.09	
09/11	1100	27.8	1,000	190	11.10	
09/18	1810	27.8	1,000	205	11.10	

Table 2.8-11 N.W.--Continued

Date	Time	Temperature (°C)	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
09/25	0905	27.8	1,000	210	11.08	
10/02	1735	27.8	1,000	220	11.10	
10/09	1735	27.8	1,000	220	11.10	

Table 2.8-11 S.E.
WATER QUALITY OF BISCAYNE AQUIFER--S.E. MONITORING WELL
SITE I-8

Date	Time	Temperature (°C)	Specific Conductance (µmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
11/17	0920	25.0	1,800	490	10.25	
11/24	1130	25.5	1,600	380	10.25	
12/01	0900	26.0	1,650	410	10.22	
12/09	0905	24.5	2,050	800	9.97	
12/15	0900	26.5	1,600	400	10.18	
12/22	1330	23.0	1,675	400	10.16	
12/29	0945	24.0	1,900	500	10.17	
01/05	0930	23.3	1,900	640	10.22	
01/12	1000	24.2	1,650	600	10.23	
01/19	0915	23.9	1,650	540	10.22	
01/26	0950	24.4	1,700	520	10.30	
02/02	1030	24.2	1,700	540	10.31	
02/09	1255	24.0	1,700	530	10.28	
02/16	0915	23.9	1,700	520	10.10	
02/23	0920	24.0	1,700	530	10.25	
03/01	1010	24.0	1,700	520	10.28	
03/08	0910	24.0	1,700	530	10.30	
03/15	1045	23.3	1,400	550	10.32	
03/22	1325	23.9	1,450	540	10.30	
03/29	1110	23.9	1,150	560	10.41	
04/11	1300	23.9	1,350	550	10.38	
04/17	0900	23.9	1,300	545	10.40	
04/23	1510	23.9	1,700	492	10.32	

Table 2.8-11 S.E.--Continued

Date	Time	Temperature (°C)	Specific Conductance (µmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
05/01	1455	23.9	1,650	500	10.38	
05/02	0925	23.9	1,600	498	10.30	
05/15	1100	25.0	2,200	640	10.30	
05/22	1350	24.4	2,700	784	10.04	
05/29	0955	24.4	2,600	790	10.01	
06/05	1555	24.4	2,700	796	10.35	
06/13	1355	24.4	2,650	799	10.35	
06/14	0945	24.4	2,700	802	10.35	
06/26	1725	24.4	2,750	815	10.35	
07/03	1810	26.1	3,000	75	10.12	Incorrect chloride values
07/10	1710	25.6	3,500	188	10.56	
07/17	1910	24.4	2,500	58	10.31	
07/24	1710	24.4	2,800	796	10.66	Correct chlorides
08/01	--	--	2,300	730	--	
08/08	1130	27.2	--	--	11.16	
08/14	1925	25.6	2,100	719	10.35	
08/21	1830	26.1	2,100	750	10.40	
08/27	1345	27.8	1,800	540	11.04	
09/04	0950	27.8	1,750	570	11.01	
09/11	1050	27.8	1,750	560	11.00	
09/18	1755	27.8	1,800	580	11.00	
09/25	0910	27.8	1,750	590	11.02	
10/02	1740	27.8	1,800	600	11.00	

Table 2.8-11 S.E.--Continued

Date	Time	Temperature (°C)	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
10/09	1740	27.8	1,800	600	11.00	
10/16	1710	26.1	1,600	520	10.40	
10/23	1710	26.1	1,800	600	10.50	

Table 2.8-11 S.W.
WATER QUALITY OF BISCAYNE AQUIFER--S.W. MONITORING WELL
SITE I-8

Date	Time	Temperature (°C)	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
11/17	1515	24.5	1,500	440	7.64	
11/24	1110	25.0	1,500	400	8.69	
12/01	0925	25.5	1,550	420	8.70	
12/09	--	--	--	--	--	
12/15	--	--	--	--	--	
12/22	1555	24.0	1,350	350	8.60	
12/29	1005	24.0	1,325	400	7.65	Changed measuring point
01/05	1000	23.3	1,275	400	7.60	
01/12	1015	24.4	1,350	410	7.75	
01/19	0850	23.9	1,300	450	7.61	
01/26	0930	23.9	1,450	460	7.59	
02/02	1020	23.9	1,450	450	7.61	
02/09	1250	23.9	1,450	450	7.59	
02/16	0930	23.9	1,600	440	7.56	
02/23	0915	23.9	1,550	450	7.58	
03/01	1005	23.9	1,550	440	7.59	
03/08	0915	23.9	1,500	450	7.60	
03/15	1105	22.8	1,300	450	10.57	Changed measuring point
03/22	1345	23.0	1,400	460	10.55	
03/29	1130	23.9	1,000	500	11.65	
04/11	1305	--	--	--	--	
04/17	0920	--	--	--	--	

Table 2.8-11 S.W.--Continued

Date	Time	Temperature (°C)	Specific Conductance (µmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
04/23	1530	23.3	1,640	433	8.48	Changed measuring point
05/01	1515	23.3	1,600	456	8.45	
05/08	0940	23.3	1,600	460	8.42	
05/15	1120	25.0	1,800	504	8.41	
05/22	1410	25.0	2,000	469	8.24	
05/29	1015	25.0	1,950	471	8.21	
06/05	1615	25.0	2,000	480	8.43	
06/13	--	--	--	--	--	
06/14	--	--	--	--	--	
06/26	1745	24.4	1,950	560	8.50	
07/03	1815	25.0	1,500	273	7.97	Incorrect chloride values
07/10	1715	25.6	1,650	147	8.30	
07/17	1915	24.4	1,000	47	8.10	
07/24	1715	25.0	2,000	588	8.40	Correct chlorides
08/01	--	--	1,500	558	--	
08/08	1135	--	--	--	8.92	
08/14	1910	--	--	--	--	
08/21	1835	--	--	--	--	
08/27	1320	27.8	1,500	450	8.76	
09/04	1010	27.8	1,500	505	8.80	
09/11	1110	27.8	1,500	500	8.78	
09/18	1815	27.8	1,600	515	8.80	
09/15	0915	27.8	1,650	500	8.79	

Table 2.8-11 S.W.--Continued

Date	Time	Temperature (°C)	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
10/02	1745	27.8	1,600	525	8.80	
10/09	1745	27.8	1,600	525	8.80	
10/16	1715	27.8	1,400	420	8.40	
10/23	1715	--	--	--	--	

Table 2.8-11 W.S.
WATER QUALITY OF BISCAYNE AQUIFER--WATER SUPPLY WELL
SITE I-8

Date	Time	Temperature (°C)	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
11/17	0945	25.0	6,000	2,040	--	Pump in the well, no depth to water level
11/24	1120	26.5	5,500	1,840	--	
12/01	0910	27.0	6,000	2,000	--	
12/09	0925	24.0	3,000	1,030	--	
12/15	0910	25.0	5,800	1,900	--	
12/22	1545	24.0	2,350	800	--	
12/29	0955	24.0	2,175	770	--	
01/05	0945	23.3	2,200	910	--	
01/12	1009	--	--	--	--	
01/19	0905	24.4	2,100	770	9.41	
01/26	0940	24.4	2,100	790	9.40	
02/02	1035	24.2	2,100	780	9.42	
02/09	1305	24.2	2,100	770	9.40	
02/16	09/20	23.9	1,700	750	9.34	
02/23	0935	23.9	1,800	760	9.38	
03/01	1020	24.0	1,750	760	9.37	
03/08	0930	23.9	1,700	760	9.38	
03/15	1055	23.3	1,600	780	9.55	
03/22	1335	23.3	1,650	790	9.52	
03/29	1120	23.9	1,300	710	9.65	
04/11	1310	23.9	1,600	644	9.60	
04/17	0910	23.3	1,550	665	9.55	

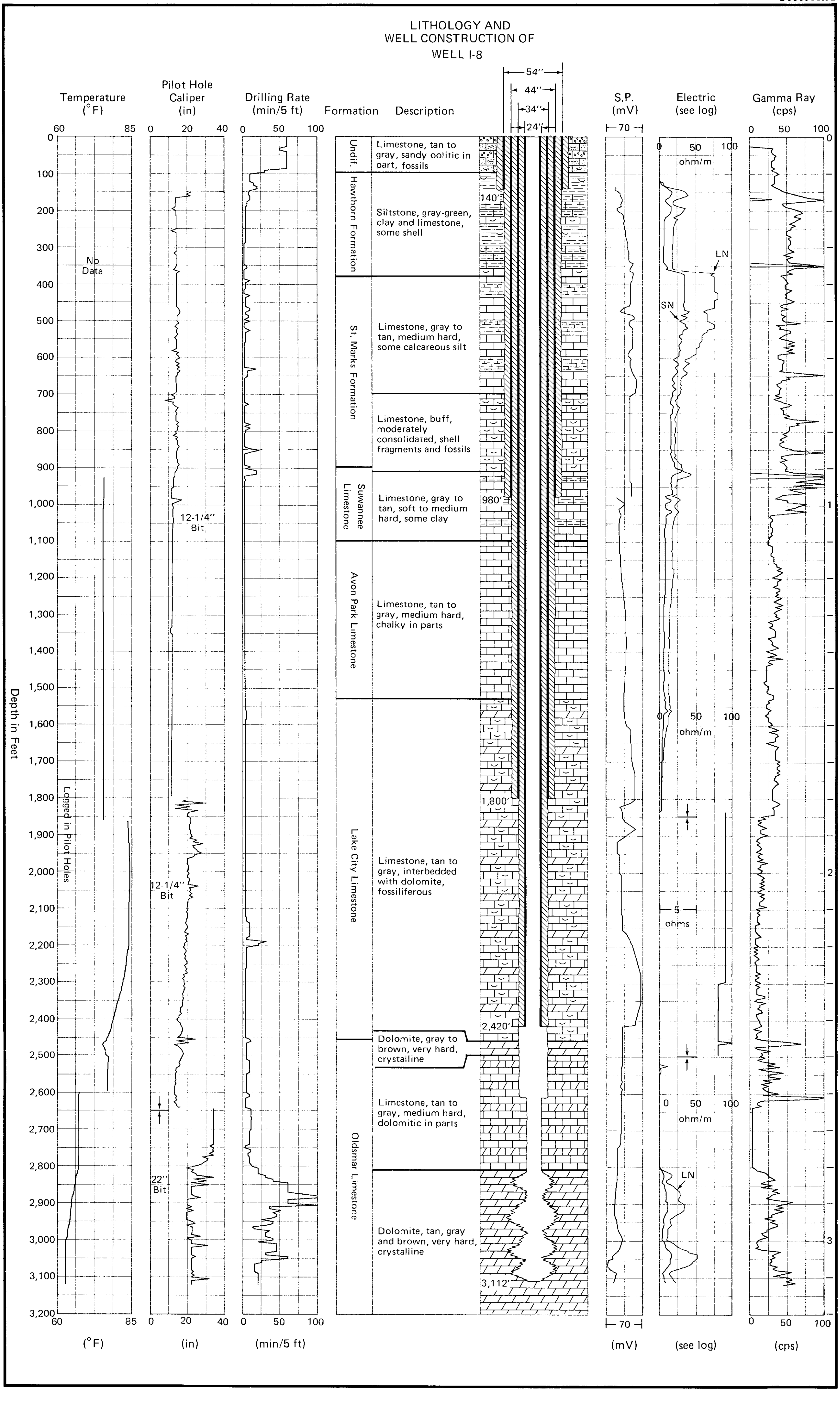
Table 2.8-11 W.S.--Continued

Date	Time	Temperature (°C)	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
04/23	1520	23.9	1,850	529	9.57	
05/01	1510	23.3	1,750	536	9.55	
05/08	0945	23.9	1,700	531	9.51	
05/15	1110	25.6	1,900	562	9.55	
05/22	1400	25.0	1,950	567	9.41	
05/29	1005	25.0	1,900	565	9.40	
06/05	1605	25.0	1,950	571	9.54	
06/13	1405	25.0	1,900	576	--	
06/14	0955	25.0	2,000	591	--	
06/26	1735	25.0	2,000	602	--	
07/03	1820	--	--	--	--	
07/10	1720	25.6	6,000	4,418	9.64	Chloride values incorrect
07/17	1920	24.4	5,800	4,573	9.50	
07/24	1720	24.4	5,900	1,460	9.83	Correct chloride value
08/01	--	--	3,800	1,507	--	
08/08	1140	26.1	--	--	10.30	
08/14	1930	--	--	--	--	
08/21	1840	--	--	--	--	
08/27	1335	28.9	2,200	795	10.04	
09/04	1005	28.9	2,100	780	--	
09/11	1105	28.9	2,100	790	--	
09/18	1805	28.9	2,200	795	--	
09/25	0920	28.9	2,100	800	--	

Table 2.8-11 W.S.--Continued

Date	Time	Temperature (°C)	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
10/02	1750	28.9	2,000	740	--	
10/09	1750	28.9	2,000	740	--	
10/16	1720	28.2	2,000	720	9.80	
10/23	1720	28.2	2,000	800	9.80	

BC55900.92



Summary of drilling and logging data—Well I-8.

FIGURE 2.8-1.

Chapter 2.9
INJECTION WELL I-9

Injection Well I-9 is located on the southern boundary of the project site as shown on Figure 1.1-2, Section 1, Summary. It is 860 feet west-northwest of I-1, and 100 feet south-southeast of FA-2 . Drilling was started on April 7, 1980, and was completed on December 19, 1980. The drilling and casing sequence was as follows:

1. Drilled a 60-inch hole to a depth of 145 feet.
2. Set and cemented the 54-inch casing from a depth of 141 feet up to the concrete drilling pad.
3. Drilled a 22-inch pilot hole to 1,000 feet (22-inch bit used to straighten crooked hole).
4. Reamed the pilot hole to 52-inch diameter to a depth of 990 feet.
5. Set and cemented the 44-inch casing from a depth of 980 feet up to the concrete drilling pad.
6. Drilled a 12-1/4-inch pilot hole to 1,850 feet.
7. Reamed the pilot hole with 42-inch reamers to a depth of 1,810 feet.
8. Set and cemented the 34-inch casing from a depth of 1,801 feet up to the concrete drilling pad.
9. Drilled a 12-1/4-inch pilot hole to 2,640 feet.
10. Reamed the pilot hole with 32-inch reamers to a depth of 2,470 feet.
11. Installed gravel and sand plug up to a depth of 2,417 feet.
12. Set the 24-inch casing at 2,418 feet with cement ports located at 2,414 feet.
13. Cemented the 24-inch casing from 2,418 feet to 55 feet below pad.
14. Ran a casing pressure test at 120 psi for 1 hour with no pressure loss.
15. Drilled a 22-inch hole to a depth of 3,111 feet.
16. Ran an injection test at 6,685 gpm for 4.5 hours, then increased the rate to 10,820 gpm for another 7.5 hours.
17. Ran a cement bond log on the 24-inch casing.

18. Cemented the 24-inch casing to the surface.

19. Completed the well head and pad.

Casings are Black steel, API 5L, Grade B, and ASTM A 139, Grade B. Casing details are summarized in Table 2.9-1. The four casings were cemented with API Class H cement slurries as is summarized in Table 2.9-2. Geophysical logs, gyroscopic directional surveys, and TV surveys run on the well are listed in Table 2.9-3. The gyroscopic well path comparisons between the pilot and reamed holes are included in Table 2.9-4.

A descriptive summary of the underwater television survey after well completion is presented in Table 2.9-5. Results of a lithological examination of the formation samples collected every 10 feet from the pilot hole drilling are shown in Table 2.9-6. Water quality data from pilot hole drilling is presented in Table 2.9-7.

Figure 2.9-1 presents a summary of data from drilling and testing, including the well construction diagram, formation sample descriptions, drilling rate, and electric, gamma radiation, temperature, and caliper logs.

After the pilot hole was drilled to 2,640 feet in Item No. 9 above, reaming with 32-inch bits was begun. The reamers were stopped at 2,470 feet pending a casing setting decision. After reviewing the problems encountered on I-2 and the response of the 2,450-foot monitor zone during the I-5 withdrawal test, the casing setting was chosen to be 2,418 feet.

The reamed hole was then filled with gravel and sand up to a depth of 2,417 feet, and the casing was set at 2,418 feet. Four ports located 90° apart, 4 feet from the bottom of the casing, were used for the first stage cement. This allowed for equal distribution of the cement around the casing.

Injection Test

An injection test was run on the well to determine the well's injection capacity and corresponding injection pressure. Wellhead pressure was measured using a 12-inch precision gauge calibrated in feet of water and the flow rate was determined with a flow meter and volumetric totalizer. A flow meter log of the open hole was run to determine the exit points of the injected water. To avoid damaging the probe, the injection rate was set at 6,685 gpm during the logging. When the probe was out of the well, the rate was increased to 10,820 gpm.

During the first 4.5 hours of the test the injection rate was 6,685 gpm and the wellhead pressure reached a high of 74.0 feet of water. After the rate was increased to 10,820 gpm, the pressure rose to 87.7 feet of water and stabilized. This rate was maintained for 7.5 hours.

After the pump was stopped, the pressure dropped to 64.7 feet of water. The well was then backflowed into the adjacent pond.

The results of the injection test are summarized in Table 2.9-8, and the data are compiled in Table 2.9-9. The quality of the injected water is given in Table 2.9-10.

Biscayne Aquifer Water Quality Monitoring

While drilling the well, water samples were collected and levels measured at each of five shallow monitoring wells installed around the drilling pad. Four of the wells were 2-inch-diameter PVC, approximately 20 feet deep, and located at each corner of the pad. The fifth was 8-inch-diameter steel, approximately 40 feet deep, and was used for supply water during construction. These data are included in Tables 2.9-11 N.E. through 2.9-11 W.S.

Table 2.9-1
SUMMARY OF CASING DATA
WELL I-9

Diameter (inches)	Wall Thickness (inches)	Depth (feet)[a]		Cemented Section (depth in feet)[a]	
		From	To	From	To
54	.500	0	141	0	141
44	.500	0	980	0	980
34	.500	0	1,801	0	1,801
24	.500	0	2,418	0	2,418

[a]From the top of the concrete drilling pad.

Table 2.9-2
SUMMARY OF CEMENTING OF CASINGS
WELL I-9

Date	Casing Cemented	Type of Cement Used (API)	Number of Sacks Used	Depth Cemented (ft) From	To
04/19/80	54"	Class H w/2% bentonite, 2% $CaCl_2$	520	141	0
06/01/80	44"	Lead: Class H w/12% bentonite	1,500	980	0
		Tail: Class H neat	915		
07/20/80	34"	Lead: Class H w/12% bentonite	1,300	1,801	1,210
		Tail: Class H neat	820		
07/27/80	34"	Class H w/12% bentonite	928	1,210	853
07/28/80	34"	Class H w/12% bentonite	1,500	853	0
08/22/80	24"	Class H neat	700	2,418	2,175
08/24/80	Plug Inside 24" Casing	Class H w/2% bentonite	25	2,416	2,401
08/25/80	24"	Class H w/2% bentonite	1,020	2,175	1,811
08 25 80	24"	Class H w/2% bentonite	1,700	1,811	672
08/26/80	24"	Class H w/2% bentonite	1,020	672	55
01/15/81	24"	Class H neat	175	55	0

Table 2.9-3
LIST OF GEOPHYSICAL LOGS AND WELL SURVEYS
WELL I-9

Date	Well Progress and Casing Depth	Type of Logs or Surveys Run[a]	Purpose
04/30/80	54" casing to 141' 22" hole to 1,000'	LSN, G	1. Identify the top of the Floridan aquifer. 2. Establish the setting depth of the 44" casing.
06/10/80	44" casing set to 980' 12-1/4" hole to 1,850'	E, G, C, T_s	1. Geohydrological definition of the Floridan aquifer. 2. Define production zones. 3. Establish setting depth of the 34" casing.
08/06/80	34" casing set to 1,801' 12-1/4" hole to 2,640'	GYRO, E, G, C, T_s, FV_s	1. Qualitative evaluation of confining beds above the Boulder Zone. 2. Identification of transmissive zones in this section. 3. Establish the setting depth of the 24" casing. 4. Gyroscopic directional track of the pilot hole.
08/14/80	34" casing set to 1,801' 32" hole to 2,470'	GYRO	1. Gyroscopic well path comparison to the pilot hole survey.
08/25/80	24" casing set to 2,418' No open hole	T_s	1. Identify the top of cement outside the 24" casing.

Table 2.9-3--Continued

Date	Well Process and Casing Depth	Type of Logs or Surveys Run[a]	Purpose
01/15/81	24" casing set to 2,418' 22" hole to 3,100'	CBL	1. Verify the integrity of the cement outside the 24" casing.
01/09/81	As above	FV_F	1. Flow meter log run during the injection test to evaluate the exit points of the injected water.
01/20/81 01/21/81 01/22/81 01/23/81	As above	T_s FC T_s T_s	1. Temperature profiles for use during the potentiometric survey. 2. Verify uniform water quality for potentiometric survey.
01/23/81	As above	G, C, T_s	1. Geohydrological definition of injection zone.
01/31/81	As above	TV	1. Visual qualitative evaluation of the injection zone. 2. Final inspection of the 24" casing and open hole.

Table 2.9-3--Continued

Date	Well Process and Casing Depth	Type of Logs or Surveys Run[a]	Purpose
03/03/81	As above	T_s, LSN	1. Geohydrological definition of the Boulder Zone. 2. Equilibrium temperature profile for potentiometric surface survey.

[a]Abbreviations for logs and surveys are as follows:

E = single point electric and SP
LSN = long and short normal and SP
G = gamma ray
C = caliper
T_s = temperature, static
T_F = temperature, flowing
FV_s = fluid velocity (flow meter) static
FV_F = fluid velocity (flow meter) flowing
FC = fluid conductivity

GYRO = gyroscopic directional survey
TV = television
CBL = cement bond, variable density
WTD = wave train display
D. IND = dual induction electric and SP
BCS = borehole compensated sonic
Density = formation density
AV = acoustic velocity
GGD = gamma gamma density (0-500 ft)

Table 2.9-4
COMPARISON OF WELL PATHS FROM GYROSCOPIC SURVEYS
WELL I-9

HORIZ L DISTANCE AND DIRECTION FROM TARGET WELL TO FOLLOW W AT TRUE VERTICAL DEPTHS

FEET	FEET	DIRECTION DEGREES
1829.99	0.03	323.99
1859.99	0.03	349.60
1889.99	0.05	111.83
1919.99	0.10	129.32
1949.99	0.14	146.80
1979.99	0.19	162.75
2009.99	0.26	152.70
2039.99	0.34	150.25
2069.99	0.36	148.68
2099.99	0.39	145.17
2129.99	0.40	147.09
2159.99	0.46	150.96
2189.99	0.51	148.68
2219.99	0.52	146.74
2249.99	0.54	149.47
2279.99	0.59	147.70
2309.99	0.64	146.26
2339.99	0.71	146.27
2369.99	0.79	150.87
2399.99	0.88	155.18

WELL PATH COMPARISON

FOLLOW WELL: FILE 3.

MIAMI - DADE COUNTY WATER AND SEWAGE AUTHORITY
CH2M HILL
WELL I-9, REAM HOLE, 1800' - 2400'
AUGUST 14, 1980
BOBBY LOFFLAND
BROOKHAVEN

TARGET WELL: FILE 2.

MIAMI - DADE COUNTY WATER AND SEWAGE AUTHORITY
CH2M HILL
WELL I-9, PILOT HOLE, 0' - 2580'
AUGUST 6, 1980
BOBBY LOFFLAND
BROOKHAVEN

MEASURED DEPTH FEET	DRIFT ANGLE DEG	DRIFT DIRECTION DEG	TRUE VERTICAL DEPTH FEET	RECTANGULAR COORDINATES FEET	
1800.	0.10	76.62	1799.99	3.03 S	3.26 E
1830.	0.10	3.45	1829.99	2.99 S	3.29 E
1860.	0.10	42.46	1859.99	2.95 S	3.31 E
1890.	0.09	41.80	1889.99	2.91 S	3.34 E
1920.	0.10	61.26	1919.99	2.88 S	3.38 E
1950.	0.03	264.03	1949.99	2.86 S	3.38 E
1980.	0.17	347.19	1979.99	2.83 S	3.34 E
2010.	0.15	68.25	2009.99	2.76 S	3.37 E
2040.	0.06	51.85	2039.99	2.73 S	3.42 E
2070.	0.13	24.16	2069.99	2.69 S	3.45 E
2100.	0.22	6.40	2099.99	2.61 S	3.48 E
2130.	0.11	343.65	2129.99	2.52 S	3.47 E
2160.	0.05	25.05	2159.99	2.48 S	3.47 E
2190.	0.21	28.53	2189.99	2.42 S	3.50 E
2220.	0.25	1.69	2219.99	2.31 S	3.53 E
2250.	0.24	18.34	2249.99	2.18 S	3.55 E
2280.	0.18	356.26	2279.99	2.07 S	3.57 E
2310.	0.22	3.59	2309.99	1.96 S	3.57 E
2340.	0.24	0.26	2339.99	1.84 S	3.57 E
2370.	0.22	17.40	2369.99	1.73 S	3.59 E
2400.	0.26	3.51	2399.99	1.61 S	3.61 E

FINAL CLOSURE - DIRECTION: 113.965 DEGS CLOCKWISE FROM NORTH
DISTANCE: 3.95 FEET

RADIUS OF CURVATURE METHOD

RECORD OF SURVEY

MIAMI - DADE COUNTY WATER AND SEWAGE AUTHORITY
CH2M HILL
WELL I-9, REAM HOLE, 1800' - 2400'
AUGUST 14, 1980
BOBBY LOFFLAND
BROOKHAVEN

Table 2.9-5
DESCRIPTIVE SUMMARY OF UNDERWATER TELEVISION SURVEY
WELL I-9

CH2M HILL

RECORD OF UNDERWATER TV SURVEY

Project: Miami Dade Water & Sewer Authority, South District Regional Wastewater Treatment Plant

Well: I-9

Survey By: Deep Venture Diving Service, Perry, Florida
JVC HP-4,000 AU

Survey Date: 1/31/81 Total Depth: 3,128 feet

Witnessed By: D. Cabit, D. Snyder, T. McCormick

Reviewed By: J. D. Lehnen Date: 2/17/81

Remarks: LSN probe in the bottom of the hole.

Depth in Feet		Reel Counter		Observations
From	To	From	To	
--	--	0	16	Titles
3	11	16	18	Dry 24" casing
11	2,486	18	446	24" casing
--	2,486	--	446	4:2" x 2" cement ports
2,486	2,490	446	449	Casing
2,490	2,418	449	454	Corrected depth indicator from 2,490' to 2,418'
2,418	2,477	454	468	Large diameter hole reamed for 24" casing (32" bit)
2,477	2,496	468	472	Smaller hole (drilled with 22" bit) chalky formation
2,496	2,506	472	473	Rougher formation, darker mottled appearance, small cavities
2,506	2,524	473	477	Smooth formation
2,524	2,615	477	497	Chalky looking formation
2,615	2,711	497	517	Rougher formation, friable looking
2,711	2,789	517	531	Small solution features, very smooth borehole
2,789	2,802	531	535	Cavities, highly fractured formation

Project: Miami Dade Water & Sewer Authority, South District Regional Wastewater Treatment Plant

Well: I-9 Date: 1/31/81 Total Depth: 3,128'

Depth in Feet		Reel Counter		Observations
From	To	From	To	
2,802	2,805	535	536	Smooth walls, high angle fractures
2,805	2,815	536	538	Cavities, fractured formation
3,040	3,062	593	599	Smooth walls, some solution features
3,062	3,079	599	603	Rougher walls, more small cavities
3,079	3,080	603	603	Cavity
3,080	3,093	603	605	Rough walls, small solution features
3,093	3,095	605	606	Cavity
3,095	3,116	606	611	Smooth walls
3,116	--	611	--	Top of lost LSN probe at 8:00
--	3,122	--	617	Small cavity
--	3,125	--	619	Bottom of probe resting on a small ledge
--	3,128	--	621	Bottom of hole
3,128	2,273	622	714	Pulling out of hole, end of tape

Table 2.9-6
LITHOLOGY FROM PILOT HOLE FORMATION SAMPLES
WELL I-9

Depth Interval (ft) From	To	Description
0	10	Crushed limestone fill
10	20	Limestone, tan to gray, oolitic, medium-hard, some silica sand
20	30	As above
30	40	As above
40	50	As above
50	60	As above
60	70	As above
70	80	As above
80	90	As above
90	100	As above, with some dark gray clay
100	110	As above
110	120	Limestone, buff to gray, oolitic, medium-hard, fine-sandy lime
120	130	As above, with sandstone and shell fragments
130	140	As above
140	150	As above
150	160	As above
160	170	As above
170	180	As above
180	190	As above
190	200	Limestone, white, hard, recrystallized, gray-green siltstone present in small amounts, shell fragments few microfossils
200	210	As above

Table 2.9-6--Continued

Depth Interval (ft) From	To	Description
210	220	As above
220	230	As above
230	240	As above
240	250	As above
250	260	As above
260	270	As above
270	280	As above
280	290	As above
290	300	As above
300	310	Limestone, as above, shell fragments, high percent of gray-green siltstone, some phosphate present
310	320	As above
320	330	Limestone, white, hard, shell fragments, sandstone, hard to medium-hard, gray-green siltstone present in small amounts
330	340	Limestone, gray to tan, gray to green dolomitic limestone in small amounts
340	350	As above with fragments of hard white limestone
350	360	As above
360	370	As above
370	380	As above
380	390	Limestone, gray-green, dolomitic, medium-hard, limestone, white, hard, shell fragments cemented with calcite
390	400	As above
400	410	Limestone, white to buff, medium-hard, shell fragments, cemented with calcite
410	420	As above

Table 2.9-6--Continued

Depth Interval (ft)		
From	To	Description
420	430	As above
430	440	As above, some siltstone
440	450	As above
450	460	As above
460	470	As above
470	480	As above, more siltstone, less shell
480	490	As above
490	500	As above
500	510	Limestone, white to buff, medium-hard, shell fragments abundant
510	520	As above
520	530	As above
530	540	As above
540	550	As above
550	560	As above
560	570	As above
570	580	As above
580	590	As above, less shell fragments, some siltstone
590	600	Siltstone, large shell fragments, hard and fine-grained, well consolidated
600	610	As above
610	620	As above
620	630	As above
630	640	As above
640	650	As above

Table 2.9-6--Continued

Depth Interval (ft) From	To	Description
650	660	As above
660	670	As above
670	680	As above
680	690	As above, less large shell, siltstone, microfossils present
690	700	Clay, olive green mixed with limestone
700	710	Limestone, white to buff/tan, small shell fragments
710	720	As above
720	730	As above
730	740	As above
740	750	Siltstone, microfossils, olive green clay
750	760	As above
760	770	As above
770	780	As above
780	790	Limestone, siltstone, buff, fossiliferous, small shell fragments
790	800	As above
800	810	As above
810	820	As above
820	830	As above
830	840	As above
840	850	Sandstone, buff, some siltstone, some limestone, hard, white
850	860	As above
860	870	As above, some olive green clay

Table 2.9-6--Continued

Depth Interval (ft)		
From	To	Description
870	880	As above, more siltstone
880	890	As above
890	900	Clay, olive green, some limestone, medium-hard
900	910	Siltstone, buff, with limestone, buff, some shell fragments
910	920	As above
920	930	As above, abundant fossils
930	940	As above
940	950	As bove
950	960	As above
960	970	As above
970	980	As above
980	990	As above
990	1,000	As above
1,000	1,010	Limestone, tan, soft, medium grains, microfossils, sample mostly cement
1,010	1,020	As above
1,020	1,030	As above
1,030	1,040	Limestone, tan, medium-hard, some silt, shell fragemnts, and fossils
1,040	1,050	As above
1,050	1,060	As above
1,060	1,070	As above
1,070	1,080	As above
1,080	1,090	Limestone, tan/buff, soft, fossiliferous, porous, vuggy matrix, microfossils

Table 2.9-6--Continued

Depth Interval (ft)		
From	To	Description
1,090	1,100	As above
1,100	1,110	As above
1,110	1,120	Limestone, buff, soft, fossiliferous, porous, vuggy, limestone, light gray, dense and hard, microfossils
1,120	1,130	As above
1,130	1,140	As above
1,140	1,150	Limestone, tan, soft, fossiliferous, porous and vuggy matrix, poorly consolidated, microfossils
1,150	1,160	As above
1,160	1,170	As above
1,170	1,180	As above
1,180	1,190	As above
1,190	1,200	As above
1,200	1,210	As above
1,210	1,220	As above
1,220	1,230	As above
1,230	1,240	As above
1,240	1,250	As above
1,250	1,260	As above
1,260	1,270	As above
1,270	1,280	Limestone, buff, medium-hard, vuggy, few microfossils, soft lime, siltstone present in sample
1,280	1,290	As above
1,290	1,300	As above
1,300	1,310	As above

Table 2.9-6--Continued

Depth Interval (ft) From	To	Description
1,310	1,320	As above
1,320	1,330	As above
1,330	1,340	As above
1,340	1,350	As above
1,350	1,360	As above
1,360	1,370	As above
1,370	1,380	As above
1,380	1,390	Limestone, buff, hard, large percent of sample is recrystallized, microfossils present
1,390	1,400	As above
1,400	1,410	Limestone, buff to white, soft to medium-hard, recrystallized and vuggy, microfossils present
1,410	1,420	As above
1,420	1,430	As above
1,430	1,440	As above
1,440	1,450	Limestone, as above, with a small amount of hard gray limestone
1,450	1,460	As above
1,460	1,470	As above
1,470	1,480	Limestone, buff, hard, matrix chalky to silty, some siltstone or clay present
1,480	1,490	Limestone, buff to gray, recrystallized and vuggy, microfossils present
1,490	1,500	Lime siltstone, buff, soft
1,500	1,510	As above
1,510	1,520	Limestone, white, buff and tan, microfossils abundant, recrystallization evident

Table 2.9-6--Continued

Depth Interval (ft)		
From	To	Description
1,520	1,530	As above
1,530	1,540	As above
1,540	1,550	As above
1,550	1,560	As above
1,560	1,570	As above
1,570	1,580	As above
1,580	1,590	As above
1,590	1,600	As above
1,600	1,610	As above
1,610	1,620	As above
1,620	1,630	As above
1,630	1,640	As above
1,640	1,650	As above
1,650	1,660	As above
1,660	1,670	As above
1,670	1,680	As above
1,680	1,690	As above
1,690	1,700	Limestone, tan to gray, portions recrystallized and massive, microfossils abundant
1,700	1,710	As above
1,710	1,720	As above
1,720	1,730	As above
1,730	1,740	As above
1,740	1,750	As above

Table 2.9-6--Continued

Depth Interval (ft)		
From	To	Description
1,750	1,760	Limestone, tan, porous and vuggy, microfossils present, limestone is medium-grained and soft, some recrystallized
1,760	1,770	As above
1,770	1,780	As above
1,780	1,790	As above
1,790	1,800	As above
1,800	1,810	As above
1,810	1,820	As above
1,820	1,830	As above
1,830	1,840	As above
1,840	1,850	Limestone, tan, soft and vuggy, fossiliferous, limestone, gray, hard, massive
1,850	1,860	As above
1,860	1,870	As above
1,870	1,880	As above
1,880	1,890	As above
1,890	1,900	As above
1,900	1,910	As above
1,910	1,920	As above
1,920	1,930	Limestone, tan to buff, medium-hard, fossiliferous, vuggy
1,930	1,940	As above
1,940	1,950	Limestone, buff, fine to medium grains, soft, vuggy, fossiliferous
1,950	1,960	Limestone, tan, medium-hard, fossiliferous, vuggy, some recrystallized fragments

Table 2.9-6--Continued

Depth Interval (ft) From	To	Description
1,960	1,970	As above
1,970	1,980	As above
1,980	1,990	As above
1,990	2,000	As above
2,000	2,010	As above
2,010	2,020	Limestone, tan to gray, medium hard, vuggy and fossiliferous, some compacted
2,020	2,030	Limestone, tan, soft, vuggy, fossiliferous, some recrystallized fragments
2,030	2,040	As above
2,040	2,050	As above
2,050	2,060	As above
2,060	2,070	As above
2,070	2,080	Limestone, tan to buff, soft, chalky matrix, some fossiliferous fragments, fine to medium grains
2,080	2,090	As above
2,090	2,100	As above
2,100	2,110	Limestone, tan to gray, medium-hard to hard, some porous, some compacted and dolomitic, part recrystallized
2,110	2,120	As above
2,120	2,130	As above
2,130	2,140	As above
2,140	2,150	As above, with massive fragments, recrystallized
2,150	2,160	As above
2,160	2,170	Limestone, buff, fine to medium grains, soft, fossiliferous, vuggy matrix, poorly consolidated

Table 2.9-6--Continued

Depth Interval (ft) From	To	Description
2,170	2,180	As above
2,180	2,190	As above
2,190	2,200	As above
2,200	2,210	Limestone, white to buff, medium-hard, fossiliferous, vuggy
2,210	2,220	Limestone, as above, with soft, white, chalky limestone
2,220	2,230	Limestone, buff color, soft, fossiliferous, chalky matrix
2,230	2,240	As above
2,240	2,250	As above
2,250	2,260	As above
2,260	2,270	As above
2,270	2,280	As above
2,280	2,290	As above
2,290	2,300	Limestone, buff to white, matrix chalky to vuggy, microfossils present
2,300	2,310	As above
2,310	2,320	As above
2,320	2,330	As above
2,330	2,340	As above
2,340	2,350	Limestone, buff to white, matrix chalky to vuggy, microfossils
2,350	2,360	As above
2,360	2,370	As above
2,370	2,380	As above
2,380	2,390	As above

Table 2.9-6--Continued

Depth Interval (ft) From	To	Description
2,390	2,400	As above
2,400	2,410	Limestone, as above, with fragments of dense, gray, recrystallized limestone
2,410	2,420	As above
2,420	2,430	Limestone, buff to white, matrix chalky, microfossils present
2,430	2,440	Limestone, white, matrix chalky, limestone dense gray and recrystallized, dolomite, gray-green, sucrosic
2,440	2,450	Limestone, white chalky matrix interbedded with sucrosic dolomite, gray, green, and brown crystals
2,450	2,460	Limestone, buff, soft, silty to chalky matrix
2,460	2,470	As above
2,470	2,480	As above
2,480	2,490	As above
2,490	2,500	Dolomite, dark gray, crypto-crystalline, very hard limestone, white, hard
2,500	2,510	Limestone, lime clay and dolomite crystals
2,510	2,520	Limestone, white, medium-hard, chalky matrix, dolomite, green, crystalline
2,520	2,530	Limestone, white, chalky, soft
2,530	2,540	Limestone, white, chalky, medium-hard, some calcareous clay, dolomite, gray, hard, massive
2,540	2,550	As above
2,550	2,560	Dolomite, tan, gray, green, massive, limestone, medium-hard, white, chalky
2,560	2,570	Limestone, medium-hard, white, chalky to vuggy matrix, dolomite, gray, hard, massive
2,570	2,580	Limestone, medium-hard, white to buff, chalky to vuggy matrix, calcareous clay mixed with dolomite crystals, dark gray

Table 2.9-6--Continued

Depth Interval (ft) From	To	Description
2,580	2,590	Limestone, white, chalky, medium-hard, calcareous clay mixed with dolomite crystals, dolomite, gray
2,590	2,600	Limestone, white to buff, medium-hard to soft, granular matrix, dolomite, dark gray, hard
2,600	2,610	As above
2,610	2,620	As above
2,620	2,630	Limestone, white, chalky, soft, some clear calcite crystals present
2,630	2,640	As above
2,640	2,650	As above
2,650	2,660	As above
2,660	2,670	As above
2,670	2,680	As above
2,680	2,690	As above
2,690	2,700	As above
2,700	2,710	As above
2,710	2,720	As above
2,720	2,730	As above
2,730	2,740	As above
2,740	2,750	Limestone, light tan, mixed with dolomite
2,750	2,760	Limestone, light tan, with dolomite
2,760	2,770	Limestone, tan, soft, with some dolomite
2,770	2,780	Limestone, gray and white, soft with dolomite, tan and gray
2,780	2,790	Dolomite, tan to gray, very hard
2,790	2,800	Dolomite, with traces of limestone

Table 2.9-6--Continued

Depth Interval (ft)		
From	To	Description
2,800	2,810	Limestone, tan, hard, trace of dolomite
2,810	2,820	Limestone and dolomite, light brown to tan
2,820	2,830	Dolomite, dark brown, very hard, trace tan dolomite
2,830	2,840	Dolomite, dark gray/brown
2,840	2,850	As above
2,850	2,860	Dolomite, tan, very hard, massive
2,860	2,870	Dolomite, light tan to gray, massive and very hard, some soft white limestone present, no microfossils
2,870	2,880	Dolomite, light tan to white, mostly sand sized fragments, some white limestone present
2,880	2,890	Dolomite, light tan, hard, massive, some dark tan, microcrystalline dolomite present, no microfossils
2,890	2,900	As above
2,900	2,910	As above
2,910	2,920	As above
2,920	2,930	Dolomite, dark tan to brown, microcrystalline, hard, some fragments of gray, massive dolomite
2,930	2,940	As above
2,940	2,950	As above
2,950	2,960	As above
2,960	2,970	As above
2,970	2,980	Dolomite, gray, hard, massive
2,980	2,990	Dolomite, light tan, hard, massive
2,990	3,000	Dolomite, light tan, hard, massive
3,000	3,010	As above
3,010	3,020	Dolomite, light brown, massive

Table 2.9-6--Continued

Depth Interval (ft)		
From	To	Description
3,020	3,030	Dolomite, dark gray, very hard
3,030	3,040	Dolomite, light tan to gray, finely crystalline, hard
3,040	3,050	As above
3,050	3,060	Dolomite, light tan to gray, hard, microcrystalline
3,060	3,070	As above
3,070	3,080	As above
3,080	3,090	Dolomite, darker tan to gray, very hard, massive
3,090	3,100	Dolomite, light tan to gray, hard, massive
3,100	3,110	As above

Table 2.9-7
WATER QUALITY DATA FROM PILOT HOLE DRILLING
WELL I-9

Date	Time	Depth (ft)	Temperature (°C)	Specific Gravity	Specific Conductance (μmhos/cm)	Chloride (mg/l)
06/07	0100	1,018	26.9	1.0000	1,500	237
06/07	0310	1,048	28.9	1.0000	1,500	403
06/07	0850	1,087	28.9	1.0002	1,400	258
06/07	1800	1,117	28.9	1.0004	1,500	302
06/07	2100	1,144	28.0	1.0004	1,400	266
06/07	2400	1,176	28.5	1.0004	1,500	296
06/08	0300	1,207	28.9	1.0004	1,200	471
06/08	0600	1,238	28.5	1.0006	1,300	360
06/08	0440	1,271	20.0	1.0004	1,350	505
06/08	0945	1,304	28.0	1.0004	1,400	505
06/08	1200	1,335	28.0	1.0006	1,400	402
06/08	1430	1,399	28.0	1.0002	1,250	297
06/08	2000	1,433	27.5	1.0000	1,000	302
06/08	2215	1,466	27.5	1.0004	1,200	360
06/09	0001	1,498	27.0	1.0000	1,300	356
06/09	0310	1,531	27.0	1.0002	1,400	360
06/09	0645	1,562	27.0	1.0000	1,000	302
06/09	1150	1,618	27.0	1.0000	1,200	315
06/09	1410	1,664	26.7	1.0000	900	497
06/09	1845	1,698	27.0	1.0002	1,300	360
06/09	1930	1,720	27.5	1.0000	900	490
06/09	2130	1,756	27.0	1.0000	850	500
06/10	0130	1,785	27.0	1.0000	800	496

Table 2.9-7--Continued

Date	Time	Depth (ft)	Temperature (°C)	Specific Gravity	Specific Conductance (μmhos/cm)	Chloride (mg/l)
06/10	0230	1,821	27.0	1.0000	1,100	502
06/10	0400	1,850	27.0	1.0000	1,000	510
08/01	1000	1,878	27.0	1.0010	30,000	10,058
08/01	0145	1,911	27.0	1.0007	24,000	7,144
08/01	0515	1,943	27.0	1.0007	25,000	8,137
08/01	0830	1,974	27.0	1.0007	24,000	7,440
08/01	1100	2,010	27.0	1.0007	24,000	7,900
08/01	1400	2,040	27.0	1.0007	24,000	7,394
08/01	1630	2,071	27.0	1.0007	26,000	8,600
08/02	1030	2,103	27.0	1.0007	23,000	7,900
08/02	1600	2,132	27.0	1.0007	21,000	6,277
08/02	1730	2,165	27.0	1.0007	22,000	6,603
08/02	1858	2,199	27.0	1.0006	21,000	6,370
08/03	1000	2,232	27.0	1.0004	20,000	6,045
08/03	1200	2,262	27.0	1.0004	19,000	5,905
08/03	1500	2,296	27.0	1.0004	18,500	6,464
08/03	2000	2,363	27.0	1.0004	7,200	4,300
08/03	2059	2,393	27.0	1.0004	8,500	5,115
08/03	2330	2,425	27.0	1.0008	11,000	5,170
08/04	0215	2,455	27.0	1.0004	8,000	4,370
08/04	0330	2,488	27.0	1.0004	9,100	5,050
08/04	1100	2,518	27.0	1.0003	8,000	4,000
08/04	1905	2,553	27.0	1.0003	6,800	2,325
08/04	2330	2,588	27.0	1.0003	4,100	2,139

Table 2.9-7--Continued

Date	Time	Depth (ft)	Temperature (°C)	Specific Gravity	Specific Conductance (μmhos/cm)	Chloride (mg/l)
08/05	0200	2,621	27.0	1.0003	5,000	2,418
11/26	0115	2,653	25.0	1.0014	1,800	1,050
12/01	1300	2,685	25.0	1.0012	1,250	570
12/02	0705	2,716	25.0	1.0240	23,000	18,800
12/03	1200	2,749	25.0	1.0260	23,000	18,600
12/02	1645	2,781	25.0	1.0222	22,000	17,200
12/04	1000	2,811	26.0	1.0222	22,300	17,500
12/05	0600	2,842	25.0	1.0240	25,000	20,000
12/08	0500	2,872	25.0	1.0245	29,000	20,000
12/11	0530	2,911	21.0	1.0255	33,000	20,500
12/15	1500	2,941	24.0	1.0260	34,000	20,600
12/16	1030	2,972	25.0	1.0265	29,000	20,000
12/17	0700	3,002	25.0	1.0265	33,000	21,000
12/18	0530	3,037	25.0	1.0265	35,000	21,200
12/18	1630	3,070	25.0	1.0270	35,500	21,500
12/19	1000	3,100	25.0	1.0270	35,500	21,500

Table 2.9-8
SUMMARY OF INJECTION TEST RESULTS
WELL I-9

Pumping Rate	6,685, 10,820 gpm
Test Duration	12 hours
Time Elapsed to Reach Maximum Injection Head at 6,685 gpm	12 minutes
Maximum Injection Head[a]	87.74 ft of water
Static Freshwater Head[a, b]	64.74 ft of water

[a]Feet of water referred to pad level.
[b]Due to the density difference between injected freshwater and formation saltwater.

Table 2.9-9
INJECTION TEST DATA
WELL I-6

Actual Time	Time Since Pump Started (min)	Flow (gpm)	Wellhead Pressure (feet of water)	Totalizer (gallons x 1,000)	Remarks
0645	0	0	--	103,824	Start injection test
0646	1	6,000	28.4	103,829	
0647	2	6,000	24.6	103,837	
0648	3	6,000	30.2	103,843	
0649	4	6,000	30.6	103,850	
0650	5	6,000	43.0	103,856	
0651	6	6,000	50.0	103,865	
0652	7	6,000	54.0	103,872	
0653	8	6,000	61.6	103,879	
0654	9	6,000	65.0	103,886	
0655	10	6,000	68.2	103,893	
0657	12	6,000	69.8	103,907	
0659	14	6,000	69.8	103,920	
0701	16	6,000	69.8	103,934	
0703	18	6,000	69.8	103,948	
0705	20	6,000	69.8	103,962	Running flowmeter log
0710	25	6,000	69.8	103,997	
0715	30	6,000	69.8	104,030	
0720	35	6,000	69.8	104,065	
0725	40	6,000	69.8	104,099	
0730	45	6,000	69.8	104,133	

Table 2.9-9--Continued

Actual Time	Time Since Pump Started (min)	Flow (gpm)	Wellhead Pressure (feet of water)	Totalizer (gallons x 1,000)	Remarks
0735	50	6,000	69.8	104,167	
0740	55	6,000	69.8	104,201	
0745	60	6,000	69.8	104,235	
0755	70	6,000	69.8	104,305	
0805	80	6,000	69.8	104,383	
0815	90	6,000	69.9	104,444	
0825	100	6,000	69.9	104,511	
0835	110	6,000	69.9	104,579	
0845	120	6,000	69.9	104,648	
0915	150	6,000	69.9	104,858	
0945	180	6,000	69.9	105,050	
1015	210	6,000	69.9	105,261	
1045	240	6,000	68.4	105,447	
1115	270	6,000	68.4	105,629	Average flow = 6,665 gpm
1115	--	--	--	105,629	
1116	271	10,000	84.2	105,641	Finish log, increase flow rate
1117	272	10,000	83.8	105,651	
1118	273	10,000	83.8	105,662	
1119	274	10,000	83.6	105,672	
1120	275	10,000	83.4	105,683	
1121	276	10,000	83.4	105,694	
1122	277	10,000	83.4	105,705	

Table 2.9-9--Continued

Actual Time	Time Since Pump Started (min)	Flow (gpm)	Wellhead Pressure (feet of water)	Totalizer (gallons x 1,000)	Remarks
1123	278	10,000	83.4	105,716	
1124	279	10,000	83.4	105,7276	
1125	280	10,000	83.4	105,738	
1127	282	10,000	83.4	105,760	
1129	284	10,000	83.4	105,782	
1131	286	10,000	83.4	105,804	
1133	288	10,000	83.4	105,825	
1135	290	10,000	83.4	105,848	
1140	295	10,000	83.4	105,902	
1145	300	10,000	83.6	105,957	
1150	305	10,000	83.6	106,012	
1155	310	10,000	83.6	106,067	
1200	315	10,000	83.6	106,122	
1205	320	10,000	83.6	106,176	
1210	325	10,000	83.6	106,232	
1215	330	10,000	83.6	106,293	
1245	360	10,000	83.6	106,614	
1315	390	10,000	83.6	106,942	
1345	420	10,000	83.6	107,270	
1415	450	10,000	83.1	107,650	
1445	480	10,000	83.6	107,959	
1515	510	10,000	83.6	108,263	
1545	540	10,000	83.6	108,586	
1615	570	10,000	83.6	108,904	

Table 2.9-9--Continued

Actual Time	Time Since Pump Started (min)	Flow (gpm)	Wellhead Pressure (feet of water)	Totalizer (gallons x 1,000)	Remarks
1645	600	10,000	83.6	109,216	
1715	630	10,000	83.6	109,540	
1745	660	10,000	83.6	109,864	
1815	690	10,000	83.6	110,177	
1845	720	10,000	83.6	110,498	Shut down injection pump
1846	721	0	61.4	--	Static head
1847	722	--	61.2	--	
1849	724	--	61.0	--	
1851	726	--	60.8	--	
1853	728	--	60.6	--	
1857	732	--	60.6	--	
1859	734	--	60.5	--	
1901	736	--	60.4	--	
1903	738	--	60.4	--	
1905	740	--	60.4	--	

Table 2.9-10
QUALITY OF INJECTED WATER
WELL I-9

Date	Time	Depth (ft)	Temperature (°C)	Specific Gravity	Specific Conductance (μmhos/cm)	Chlorides (mg/l)	Remarks
01/08	1330	--	22.0	1.0010	1,400	600	Background
01/08	1330	--	22.0	1.0008	1,100	680	Background
01/09	0700	--	18.0	1.0016	1,300	720	Start test at 0645 hrs
01/09	0800	--	18.0	1.0010	1,300	720	
01/09	0900	--	19.0	1.0010	1,250	800	
01/09	1000	--	20.0	1.0014	1,200	740	
01/09	1100	--	21.0	1.0000	1,400	700	
01/09	1200	--	21.0	1.0010	1,250	640	
01/09	1300	--	21.0	1.0011	1,300	670	
01/09	1400	--	21.0	1.0012	1,350	740	
01/09	1500	--	21.0	1.0011	1,300	720	
01/09	1600	--	21.0	1.0011	1,250	650	
01/09	1700	--	20.0	1.0011	1,250	640	
01/09	1800	--	20.0	1.0011	1,250	640	End test at 1845 hrs

Table 2.9-11 N.E.
WATER QUALITY OF BISCAYNE AQUIFER--N.E. MONITORING WELL
SITE I-9

Date	Time	Temperature (°C)	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
03/17	1305	23.3	650	80	9.80	
03/24	1300	23.9	650	90	9.90	
04/01	1705	23.9	640	80	9.95	
04/09	1000	24.4	550	65	9.84	
04/15	1700	23.9	500	57	10.12	
04/22	1100	23.9	350	48	9.90	
04/29	1100	24.4	440	53	9.87	
05/06	1815	24.4	420	52	9.81	
05/12	1600	24.4	465	46	9.90	
05/20	1500	24.4	460	52	9.83	
05/27	1500	24.4	480	52	9.86	
06/03	1400	25.0	460	52	9.96	
06/10	1400	24.4	370	54	9.79	
06/17	1400	25.6	450	62	9.95	
06/24	1400	25.0	460	65	9.96	
07/02	1400	25.6	540	70	9.90	
07/08	1400	25.6	420	29	9.95	
07/16	1025	26.7	460	10	9.78	
07/23	1800	26.7	520	51	10.16	
07/30	1500	26.7	440	47	9.70	
08/06	1825	26.7	450	53	9.85	
08/19	1300	27.8	390	99	9.89	
08/25	1440	29.4	450	68	10.02	

Table 2.9-11 N.E.--Continued

Date	Time	Temperature (°C)	Specific Conductance (µmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
09/03	1500	28.3	450	65	10.10	
09/10	1530	278	1,000	105	10.06	
09/29	1500	27.8	950	100	10.20	
10/07	1500	27.8	950	100	10.20	
10/15	1300	27.2	900	95	10.18	
10/22	1300	27.8	950	100	10.38	
11/25	1000	27.8	950	100	10.40	
12/04	1300	27.6	1,000	100	10.37	
12/10	1530	27.8	980	98	10.38	
12/17	1400	27.5	980	100	10.40	

Table 2.9-11
WATER QUALITY OF BISCAYNE AQUIFER--N.W. MONITORING WELL
SITE I-9

Date	Time	Temperature (°C)	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
03/17	1300	23.9	570	60	10.73	Rigging up
03/24	1305	--	--	--	--	
04/01	1700	23.9	550	60	7.45	Changed measuring point
04/09	1005	23.9	675	55	7.38	
04/15	1705	23.3	720	54	7.69	Drilling
04/22	1105	23.9	580	55	7.48	
04/29	1105	23.9	630	59	7.45	
05/06	1820	23.9	450	51	7.37	
05/12	1605	23.9	520	49	7.45	
05/20	1505	23.9	510	54	7.40	
05/27	1505	24.4	540	52	7.49	
06/03	1405	24.4	520	51	7.58	
06/10	1405	24.4	500	67	7.37	
06/17	1405	--	--	--	--	
06/24	1405	--	--	--	--	
07/02	1405	25.0	610	60	8.07	Changed measuring point
07/08	1405	--	--	--	8.25	Chloride values incorrect
07/16	1030	25.6	480	29	8.05	
07/23	1805	25.6	520	78	8.48	Corrected values
07/30	1505	25.6	--	--	8.53	
08/06	1830	26.7	530	60	8.16	

Table 2.9-11 N.W.--Continued

Date	Time	Temperature (°C)	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
08/19	1305	27.8	490	88	8.20	
08/25	1445	27.8	520	65	8.37	
09/03	1505	26.7	540	68	8.42	
09/10	1535	26.7	520	65	8.40	
09/29	1505	26.7	520	70	8.50	
10/07	1505	26.7	520	70	8.50	
10/15	1305	26.2	500	65	8.48	
10/22	1305	26.8	520	70	8.65	
11/25	1005	26.8	540	80	8.70	
12/04	1310	26.8	520	85	8.70	
12/10	1535	27.0	540	85	8.71	
12/17	1405	26.8	540	88	8.70	

Table 2.9-11 S.E.
WATER QUALITY OF BISCAYNE AQUIFER--S.E. MONITORING WELL
SITE I-9

Date	Time	Temperature (°C)	Specific Conductance (µmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
03/17	1310	21.1	1,200	130	--	
03/24	1310	23.9	1,500	160	10.99	
04/01	1710	23.3	1,480	150	11.06	
04/09	1010	24.4	1,900	80	10.95	Drilling fluid contaminated; chloride values inaccurate
04/15	1710	23.9	1,900	6	11.25	
04/22	1110	23.9	490	51	11.05	Correct values
04/29	1110	24.4	460	54	11.02	
05/06	1835	--	--	--	--	
05/12	1610	--	--	--	--	
05/20	1510	--	--	--	--	
05/27	1510	25.0	470	49	11.03	
06/03	1410	25.0	460	51	11.09	
06/10	1410	25.0	460	59	10.88	
06/17	1410	26.1	360	60	11.05	
06/24	1410	25.0	420	61	11.02	
07/02	1410	25.0	460	70	11.05	
07/08	1410	26.7	420	31	11.07	Incorrect chloride values
07/16	1035	26.7	440	10	10.87	
07/23	1810	26.7	480	45	11.28	Values corrected
07/30	1510	25.6	430	37	11.30	
08/06	1835	27.8	410	40	10.94	

Table 2.9-11 S.E.--Continued

Date	Time	Temperature (°C)	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
08/19	1310	26.7	460	56	10.98	
08/25	1435	28.9	500	75	10.05	
09/03	1510	28.9	420	70	10.20	
09/10	1525	28.9	500	75	10.10	
09/29	1510	28.9	500	70	10.30	
10/07	1510	28.9	500	70	10.30	
10/15	1310	28.2	460	65	10.20	
10/22	1310	28.0	520	75	10.44	
11/25	1010	28.0	550	85	10.50	
12/04	1310	28.0	560	80	10.48	
12/10	1540	27.9	565	85	10.49	
12/17	1410	28.0	540	85	10.49	

Table 2.9-11 S.W.
WATER QUALITY OF BISCAYNE AQUIFER--S.W. MONITORING WELL
SITE I-9

Date	Time	Temperature (°C)	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
03/17	1320	23.3	1,350	200	9.37	Rigging up
03/24	1315	23.9	1,500	180	9.36	
04/01	1715	23.9	1,480	170	9.43	
04/09	1015	23.9	2,800	78	9.30	Drilling fluid contaminated; chloride values inaccurate
04/15	1715	23.3	2,800	21	9.60	
04/22	1115	23.9	280	60	9.45	Correct values
04/29	1115	23.9	340	58	9.39	
05/06	1825	23.9	320	52	9.29	
05/12	1615	24.4	335	51	9.38	
05/20	1515	24.4	320	53	9.32	
06/03	1415	--	--	--	--	
06/10	1415	24.4	380	58	10.48	Changed measuring point
06/17	1415	25.0	340	64	10.65	
06/24	1415	25.0	360	62	10.62	
07/02	1415	24.4	410	70	10.42	
07/08	1415	24.4	560	30	10.65	Chloride values inaccurate
07/16	1040	--	--	--	10.44	
07/23	1815	25.0	440	49	10.88	Corrected values
07/30	1515	25.6	--	--	10.88	
08/06	1840	25.6	410	45	10.52	

Table 2.9-11 S.W.--Continued

Date	Time	Temperature (°C)	Specific Conductance (µmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
08/19	1315	25.6	420	53	10.56	
08/25	1425	27.8	440	52	10.76	
09/03	1515	26.1	480	55	10.80	
09/10	1545	26.1	460	54	10.78	
09/29	1515	26.1	600	78	10.20	
10/07	1515	26.1	600	78	10.20	
10/25	1315	25.5	480	55	10.70	
10/22	1315	26.0	500	65	10.95	
11/25	1015	26.0	500	70	11.00	
12/04	1325	26.5	510	80	11.09	
12/10	1550	27.0	510	75	11.00	
12/17	1415	26.8	510	80	11.00	

Table 2.9-11 W.S.
WATER QUALITY OF BISCAYNE AQUIFER--WATER SUPPLY WELL
SITE I-9

Date	Time	Temperature (°C)	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
03/17	1315	24.4	330	110	8.88	Rigging up
03/24	1320	--	--	--	--	
04/01	1720	--	--	--	--	
04/09	1020	25.0	460	65	--	
04/15	1720	24.4	500	54	--	
04/22	1120	23.9	460	51	--	
04/29	1120	25.0	390	54	--	
05/06	1830	25.0	480	53	--	
05/12	1620	24.4	480	53	--	
05/20	1520	24.4	500	57	--	
05/27	1520	24.4	490	48	--	
06/03	1420	--	--	--	--	
06/10	1420	24.4	520	60	--	
06/17	1420	25.6	410	62	--	
06/24	1420	25.0	480	65	8.90	
07/02	1420	26.7	--	--	--	
07/08	1420	--	--	--	--	Incorrect chlorine values
07/16	1045	26.7	540	10	--	
07/23	1820	--	--	--	--	Values corrected
07/30	1520	--	--	--	--	
08/06	1845	26.7	400	54	--	
08/19	1320	--	--	--	--	
08/25	1430	29.4	600	74	--	

Table 2.9-11 W.S.--Continued

Date	Time	Temperature (°C)	Specific Conductance (µmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
09/03	1520	26.1	550	70	9.20	
09/10	1550	26.1	600	75	9.20	
09/29	1520	26.1	600	78	9.20	
10/07	1520	26.1	600	78	9.20	
10/15	1320	26.5	500	72	9.18	
10/25	1320	26.0	550	80	9.35	
11/25	1020	26.0	560	80	9.40	
12/04	1335	26.0	540	75	9.42	
12/10	1555	27.0	560	80	9.37	
12/17	1420	26.9	560	80	9.38	

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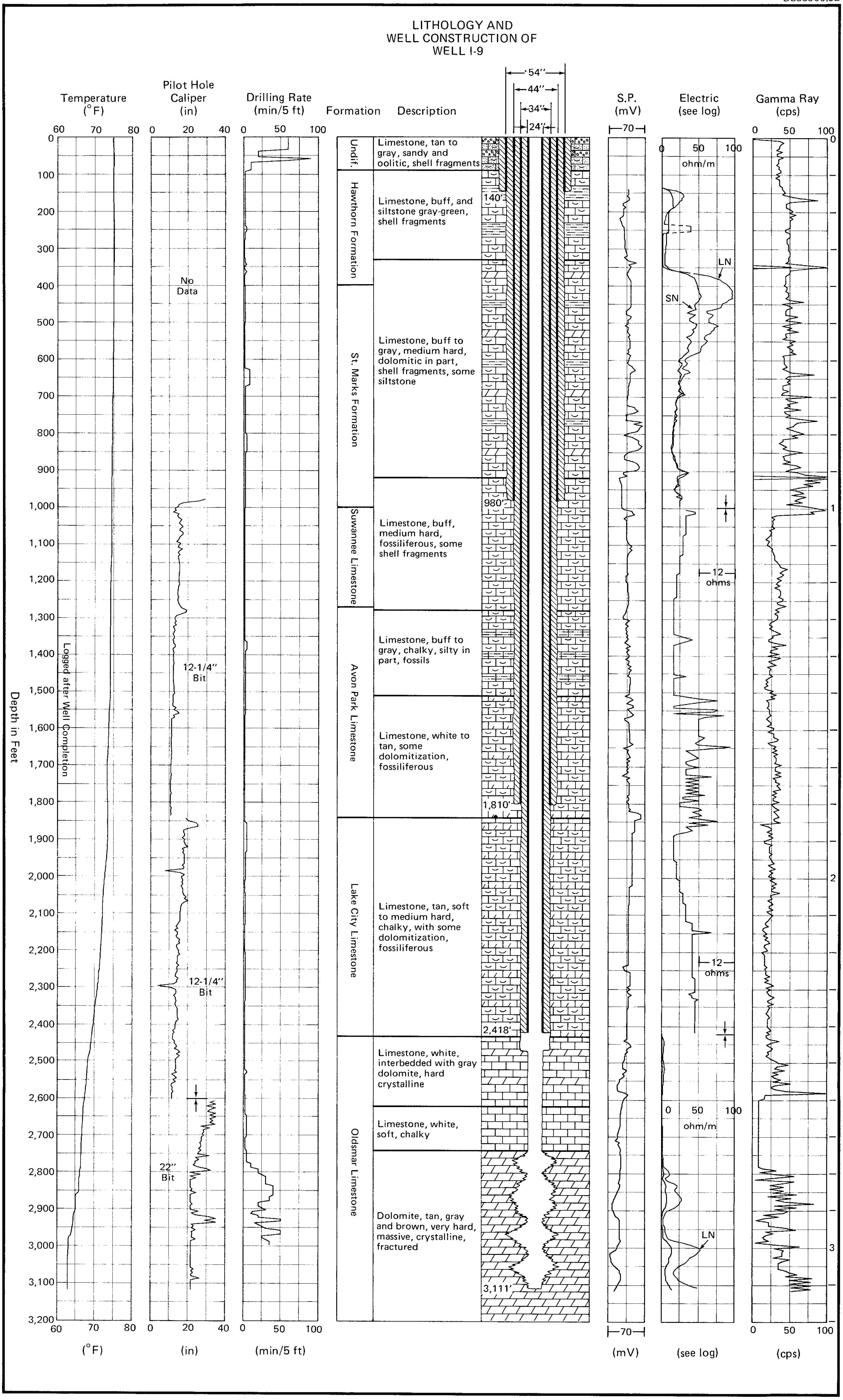

Summary of drilling and logging data—Well I-9.

FIGURE 2.9-1.

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Chapter 2.10
MONITORING WELL BZ-1

Monitoring Well No. Boulder Zone 1 (BZ-1) penetrates the Boulder Zone. It is located 100 feet south of I-5 on the east boundary of the site, as shown on Figure 1.1-1, Section 1, Summary. Drilling started on May 21, 1979, and was completed on December 3, 1979. The drilling and casing sequence was as follows:

1. Drilled 12-1/4-inch exploratory hole to 160 feet.

2. Reamed hole to 38-inch diameter to a depth of 144 feet.

3. Set and cemented 30-inch casing from a depth of 139 feet up to the concrete drilling pad.

4. Drilled 12-1/4-inch exploratory hole to 991 feet.

5. Reamed hole to 28-inch diameter to a depth of 989 feet.

6. Ran 20-inch casing inside reamed hole to a depth of 453 feet, but it had to be pulled out of the hole because it would not go any deeper. Reamed the hole again to 28-inch diameter to a depth of 991 feet.

7. Set and cemented 20-inch casing from a depth of 980 feet up to the concrete drilling pad.

8. Drilled 18-inch hole to 2,750 feet. During this operation, coring with a 4-inch core barrel was performed at 10 intervals: 1,506 feet to 1,517 feet, 1,840 feet to 1,850 feet, 2,180 feet to 2,190 feet, 2,398 feet to 2,408 feet, 2,460 feet to 2,466 feet, 2,497 to 2,507, 2,556 feet to 2,566 feet, 2,636 feet to 2,650 feet, 2,730 to 2,740 feet, and 2,750 feet to 2,759 feet.

9. Backfilled hole with gravel to a depth of 2,716 feet. Capped gravel with 26 feet of cement (2,690 feet to 2,716 feet).

10. Installed 6-5/8-inch casing to 2,689 feet, after applying anti-corrosive paint coating to the casing at the three monitor intervals.

11. Cemented the 6-5/8-inch casing from its bottom to a depth of 2,474 feet.

12. Installed 2-inch-diameter monitoring tubing and screen (top and bottom of the screen at 2,455 feet and 2,465 feet, respectively). Installed gravel pack and capped with sand up to 2,434 feet.

13. Cemented the 6-5/8-inch casing from 2,434 feet up to 1,664 feet.

14. Installed 2-inch-diameter monitoring tubing and screen between 1,620 feet and 1,630 feet; installed gravel pack and capped with sand up to 1,575 feet.

15. Cemented the 6-5/8-inch casing from 1,575 feet up to 1,037 feet.

16. Drilled 5-5/8-inch hole to a depth of 3,110 feet (total depth).

17. Installed 2-inch-diameter monitoring tubing and screen, between 1,015 feet and 1,025 feet, gravel packed and capped with sand up to 1,000 feet.

18. Cemented the 6-5/8-inch casing from 1,000 feet to the surface.

19. Installed casing packer at a depth of 2,680 feet. Ran a successful casing pressure test; (pressurized 6-5/8-inch casing to 139 psi; pressure held for 1 hour, with no loss).

20. Completed the wellhead and pad as per specifications.

21. Disinfected and sampled the well as per specifications.

Casings are black steel, of standard API 5L, Grade B. Casing details are summarized in Table 2.10-1. A brief description of each of the four monitoring zones in this well is presented in Table 2.10.2.

Monitoring tubings are 2.375 inch O.D. steel API 5A, Grade S-55. The screens are heavy duty, Schedule 80 PVC with a pipe base. The 6-5/8-inch tubing was field cleaned, primed, and coated with two coats of coal tar epoxy over each 40-foot section exposed in the graveled annulus.

The three casings were cemented with API Class H cement slurries as summarized in Table 2.10-3. Geophysical logs and TV surveys run on the well are listed in Table 2.10-4. It was after step 19 of this sequence during a logging operation that it was discovered that the hole is bridged at a depth of 2,960 feet. This was confirmed with a television survey of the hole. It was decided, however, that the monitoring effectiveness of the injection zone was not affected by the presence of this bridge and, therefore, the well was not cleaned out.

Rock cores were taken at ten depth intervals between 1,500 feet and 2,760 feet. A brief description of these cores is presented in Table 2.10-5. Selected sections of the cores were tested by Wingerter Laboratories, Miami, Florida, and Core Laboratories, Houston, Texas, for the following information: (1) lithologic classification, (2) uniaxial, unconfined compressive strength, (3) Young's modulus, (4) porosity, (5) permeability, (6) specific yield, and (7) specific gravity. This information is listed in Tables 2.10-6 and 2.10-7.

A summary of the TV survey run on the open hole from 980 feet to 2,739 feet is presented in Table 2.10-8. The summary of the final survey of the casing and open hole is also included. Results of a lithological examination of the formation samples collected every 10 feet from the pilot hole drilling are shown in Table 2.10-9. Water quality data from pilot hole drilling is found in Table 2.10-10.

Figure 2.10-1 presents a summary of data from drilling and related operations, including the well construction diagram, formation sample description, drilling rate, as well as electric, gamma radiation, caliper, and temperature logs.

Biscayne Aquifer Water Quality Monitoring

During drilling of the well, water samples were collected and levels measured at each of five shallow monitoring wells installed around the drilling pad. Four of the wells were 2-inch-diameter PVC, approximately 20 feet deep located at each corner of the pad. The fifth was 8-inch-diameter steel, approximately 40 feet deep and was used for supply water during construction. These data are included in Tables 2.10-11 N.E. through 2.10-11 W.S.

Table 2.10-1
SUMMARY OF CASING DATA
WELL BZ-1

Diameter (inches)	Wall Thickness (inches)	Depth (feet)[a] From	Depth (feet)[a] To	Cemented Section (feet)[a] From	Cemented Section (feet)[a] To
30	0.500	0	139	139	0
20	0.438	0	980	980	0
6-5/8	0.432	0	2,689	2,689 2,434 1,575 1,000	2,474 1,664 1,037 0

[a]Measured from the top of the concrete drilling pad.

Table 2.10-2
SUMMARY OF DATA ON MONITORING ZONES
WELL BZ-1

Zone Monitored	Monitored Depth Interval (feet)[a] From	Monitored Depth Interval (feet)[a] To	Gravel and Sand-Packed Section Depth (feet)[a] From	Gravel and Sand-Packed Section Depth (feet)[a] To	Remarks
Upper Floridan Aquifer	1,015	1,025	1,000	1,037	10-foot screen installed
Lower Floridan Aquifer	1,620	1,630	1,575	1,664	10-foot screen installed
2,500-Foot Zone	2,455	2,465	2,434	2,474	10-foot screen installed
Boulder Zone	2,689	2,960			Open hole below 6-inch casing

[a]Measured from the top of the concrete drilling pad.

Table 2.10-3
SUMMARY OF CEMENTING OF CASINGS
WELL BZ-1

Date	Casing Cemented	Type of Cement Used (API)	Number of Sacks Used	Depth Cemented (ft) From	To
05/28/79	30"	Class H w/25 lb of gilsonite per sack	290	139	0
06/24/79	20"	Lead: Class H w/12% bentonite	800	980	120
		Tail: Class H neat	330		
06/24/79	20"	Class H w/12% bentonite	144	120	0
09/15/79	Set cement plug below 6-5/8" casing	Cal-seal	35	2,715	2,690
09/16/79	6-5/8"	Class H neat	400	2,690	2,619
09/17/79	6-5/8"	Class H w/12% bentonite	200	2,619	2,474
09/21/79 to 09/24/79	6-5/8"	Gravel (no cement)		2,474	2,439
09/25/79	6-5/8"	Sand (no cement)		2,439	2,434
09/26/79	6-5/8"	Class H neat	1,380	2,434	2,015
09/30/79	6-5/8"	Class H neat	650	2,015	1,817
10/03/79	6-5/8"	Class H neat	535	1,817	1,664
10/04/79 to 10/09/79	6-5/8"	Gravel (no cement)		1,664	1,580
10/10/79	6-5/8"	Sand (no cement)		1,580	1,575
10/11/79	6-5/8"	Class H neat	1,827	1,575	1,167
10/12/79	6-5/8"	Class H neat	475	1,167	1,102
10/13/79	6-5/8"	Class H neat	200	1,102	1,037

Table 2.10-3--Continued

Date	Casing Cemented	Type of Cement Used (API)	Number of Sacks Used	Depth Cemented (ft) From	To
11/14/79 to 11/26/79	6-5/8"	Gravel (no cement)	--	1,037	1,005
11/26/79	6-5/8"	Sand (no cement)	--	1,005	1,000
11/26/79	6-5/8"	Class H w/2% bentonite and 2% $CaCl_2$	650	1,000	475
11/27/79	6-5/8"	Class H w/2% bentonite and 2% $CaCl_2$	575	475	0

Table 2.10-4
LIST OF GEOPHYSICAL LOGS AND WELL SURVEYS
WELL BZ-1

Date	Well Progress and Casing Depth	Type of Logs or Surveys Run[a]	Purpose
06/06/79	30" casing to 139' 12-1/4" hole to 991'	E, G, C	1. Identify top of Floridan aquifer. 2. Establish setting depth of 20" casing.
08/19/79	20" casing to 980' 18" hole to 2,758'	LSN, G, T_F, C, FC, FV_F, TV	1. Geohydrological definition of Floridan aquifer system. 2. Visual qualitative evaluation of confining bed porosity and permeability. 3. Select monitoring depth intervals after defining production zones. 4. Establish setting depth of 6-5/8" casing.
12/05/79	6-5/8" casing to 2,689' 5-5/8" hole to 3,110'	LSN, G, T_F, T_s, C, FV_F, TV	1. Geohydrological definition injection zone. 2. Define production zones. 3. Confirm final construction details of well. 4. Visual qualitative evaluation of the 6-5/8" casing and the receiving zones.

Table 2.10-4--Continued

Date	Well Progress and Casing Depth	Type of Logs or Surveys Run[a]	Purpose
02/06/80	6-5/8" casing to 2,689' 5-5/8" hole to 2,960'	CBL	1. Confirm adequacy of cement outside the 6-5/8" casing.
01/20/81	As above	FC, T_s	1. Verify uniform water quality and record temperature profile in the well for the potentiometric survey.

[a]Abbreviations for logs and surveys are as follows:

E = single point electric and SP
LSN = long and short normal and SP
G = gamma ray
C = caliper
T_s = temperature, static
T_F = temperature, flowing
FV_s = fluid velocity (flow meter) static
FV_F = fluid velocity (flow meter) flowing
FC = fluid conductivity

GYRO = gyroscopic directional survey
TV = television
CBL = cement bond, variable density
WTD = wave train display
D. IND = dual induction electric and SP
BCS = borehole compensated sonic
Density = formation density
AV = acoustic velocity
GGD = gamma gamma density (0-500 ft)

Table 5
DESCRIPTION OF CORES COLLECTED

Core No.	Date	Core Depth Interval (ft)		Description
		From	To	
1	7/05/79	1,506	1,517	Limestone, light tan, microfossils present, some grey recrystallized fragments
2	7/10/79	1,840	1,850	Limestone, light brown, some fine dark bedding, very porous, permeable, medium hardness, friable, coarse sand texture, some quartz sand;
				Limestone, tan, very porous, medium permeability, some medium-fine to coarse sand size L.S. particles, few shell fragments
3	7/19/79	2,180	2,190	Limestone, buff, medium soft, sandy, quartz and limestone particles, very porous
4	7/22/79	2,398	2,408	Limestone, light tan, chalky, very sandy, quartz grains, friable, some vugs
5	7/23/79	2,460	2,466	Limestone, buff, chalky, medium hard, finely bedded, very porous, some sandy grains
				Dolomite, brown, very hard, dense, possible residual bedding, very low porosity
6	7/26/79	2,497	2,507	Limestone, tan, medium hard, chalky, some sand, low permeability, porosity;
				Dolomite, grey-brown, very hard, vuggy, up to 4 mm openings, calcite crystals in vugs, microcrystaline

Table 2.10-5--Continued

Core No.	Date	Core Depth Interval (ft) From	To	Description
7	7/29/79	2,556	2,566	Dolomite, calcareous, buff, medium hard, some medium-grained limestone, some blue-grey streaks, medium porosity and permeability
				Dolomite, blue-grey and buff, very hard, dense, microcrystaline, very vuggy, filled with buff calcareous dolomite, medium hard, sandy, blue-grey dolomite has well developed secondary porosity, buff has low porosity and low permeability
8	8/01/79	2,636	2,650	Limestone, dolomitic, buff to tan, medium hard, medium permeability, very vuggy, secondary permeability
9	8/12/79	2,730	2,740	Dolomite, calcareous, white, medium soft, friable, sand size particles, medium porosity
10	8/18/79	2,750	2,759	Dolomite, grey, brown, tan, rose, very hard, microcrystaline, very vuggy, well developed secondary porosity, rose-colored crystal-filled cavities, up to 4 mm crystals, grey-tan banding apparent in dolomite.

Table 2.10-6
MDWSA MONITORING WELL BZ-1, SOUTH DISTRICT WWTP
RESULTS OF TESTS ON CORE SAMPLES
WINGERTER LABORATORIES, INC., MIAMI, FLORIDA
JUNE 30, 1980

Depth of Sample (feet)	Core Length (inches)	Diameter (inches)	Lab No.	Uniaxial Unconfined Compressive Strength (psi)	Young's Modulus (psi)	Density, Saturated (pcf)	Density, Oven Dry (pcf)	Moisture Content (% DW)	Specific Gravity, Bulk	Specific Gravity, Solids	Porosity (percent)	Estimated Permeability (cm/sec)	Estimated Specific Yield (percent)	Compressive Strength: Ultimate Failure (psi)	Compressive Strength: Corrected L/D (psi)
1,841	5-5.5	4	9501	--	--	--	--	--	--	--	--	--	--	--	--
1,841A	9-9.5	4	11435	577.5	98,500	118.8	99.4	19.5	1.593	2.374	32.7	10×10^{-3}	15	--	--
			11436	--	98,530	--	109.0	17.8	--	--	--	--	--	529.5	514.8
1,845	5-5.25	4	9503	--	--	117.6	98.5	19.4	1.578	2.180	27.4	5×10^{-3}	8	--	--
1,845A	8-8.25	4	11433	--	--	--	--	--	--	--	--	--	--	--	--
1,848	10.5-12	4	11431	577.5	89,200	119.7	101.6	17.8	1.628	2.210	26.1	5×10^{-3}	8	--	--
			11432	--	89,200	--	106.6	16.5	--	--	--	--	--	585.7	577.5
2,189	6.5-7	4	9505	--	--	117.2	97.5	20.2	1.562	2.196	28.7	10×10^{-3}	15	--	--
2,406	6	4	9507	--	--	--	--	--	--	--	--	--	--	--	--
2,466	36	4	--	--	--	169.1	168.5	0.4	2.701	2.737	1.1	0	0	--	--
2,498	2.75-3.25	4	9513	--	--	--	--	--	--	--	--	--	--	--	--
2,502	5.5-6	4	9515	--	--	--	--	--	--	--	--	--	--	--	--
			9516	--	--	--	--	--	--	--	--	--	--	--	--
2,563	4-4.5	4	9517	--	--	--	--	--	--	--	--	--	--	--	--
2,565	3-5	4	9519	--	--	--	--	--	--	--	--	--	--	--	--
			9520	--	--	--	--	--	--	--	--	--	--	--	--
2,636	6-6.5	4	9521	--	--	131.1	117.2	11.9	1.878	2.256	16.5	0.5×10^{-3}	1	--	--
2,730	11.5-12	4	11439	--	--	--	--	--	--	--	--	--	--	--	--
2,737	8-8.5	4	9523	--	--	125.6	108.5	15.8	1.738	2.267	23.5	0.5×10^{-3}	1	--	--
2,740	6.5-7	4	11437	--	--	139.5	132.4	5.4	2.132	2.451	13.2	0.1×10^{-3}	0.2	--	--

Note: Values for Compressive Strength; Uniaxial Unconfined, Ultimate Failure, and Corrected L/D have been shown to be unrepresentative of in situ values.

Table 2.10-7
RESULTS OF HYDRAULIC TESTS
ON CORES COLLECTED FROM WELL BZ-1
(By Core Laboratories, Houston, Texas)

Special Core Analysis Study

for

CH2M HILL

Monitor Well BZ-1

7501 STEMMONS FREEWAY, BOX 47547, DALLAS, TEXAS 75247 · 214/631-8270

June 6, 1980

CORE LABORATORIES, INC.
Special Core Analysis

CH2M Hill
P.O. Box 1647
Gainesville, Florida 32602

Attention: Mr. Russ Sproul

Subject: Special Core Analysis Study
Monitor Well BZ-1
File Number: SCAL-308-80128

Gentlemen:

On August 1, 1979, a representative of CH2M Hill requested that Caprock Analyses consisting of Vertical Water Permeability Determinations and Threshold Pressure Measurements, and additional Specific Water Permeability Determinations be performed on core material obtained from the subject well. Results of these tests are reported herein. The samples used in this study are lithologically described and identified as to sample number and depth interval on Page 1.

Four full-diameter well core segments representing depth intervals ranging from 1845 feet to 2730 feet were submitted for use in this study. The samples had been preserved, but some drying had occurred. The core segments were therefore saturated with simulated seawater which had been prepared from water analysis data obtained for use in this study. Each full-diameter well core segment was loaded into a high-pressure core holder, and this entire system was placed in a controlled-temperature air bath. The specific vertical water permeability was determined for each sample at a known pressure drop by measuring the rate of flow of water through the sample. The direction of flow through the full-diameter well core segments was along the longitudinal axis of the core, which is in the vertical direction with respect to the well.

Upon completion of the water permeability determinations, threshold pressure tests were made using a gas-water system. Gas was charged to one face of each of the samples. The pressure level in the gas phase was increased incrementally until water flow was observed in a micropipette attached to the downstream end of the sample, or a maximum pressure of 1000 psi was attained. The results of the vertical water permeability determinations and the threshold pressure measurements are presented in tabular form on Page 2. Only the sample representing a depth interval of 2502 feet exhibited the characteristics generally associated with caprock.

At the completion of the caprock analyses, a horizontal core plug was obtained from each core segment using a diamond core drill with water as the bit coolant and lubricant. The core plugs were extracted of salt using methyl alcohol and dried. Air permeability and Boyle's Law porosity were determined on each horizontal core plug. The samples were then evacuated and pressure-saturated with simulated seawater. Specific permeability to the simulated seawater was determined on each core plug, and the results of these tests are presented in tabular form on Page 3.

It has been a pleasure performing this study on behalf of CH2M Hill. Should there be any questions concerning the test results, or if we could be of any further assistance, please do not hesitate to contact us.

Very truly yours,

Core Laboratories, Inc.

Catherine A. Dottle

Catherine A. Dottle
for Duane L. Archer, Manager
Special Core Analysis

CAD:fm
7 cc. - Addressee

CORE LABORATORIES, INC.

Petroleum Reservoir Engineering

DALLAS, TEXAS 75247

File SCAL-308-80128

Company CH2M Hill

Well Monitor Well BZ-1

Field

Formation

County

State

Identification and Description of Samples

Sample Number	Depth, feet	Lithological Description
1	1845	Ls, dk yel-tan, muddy, v/foss, fri
1A	1845	Ls, dk yel-tan, muddy, v/foss, fri
2	2406	Ls, lt yel tan, muddy, foss, fri
2A	2406	Ls, lt yel tan, muddy, foss, fri
3	2502	Dol, dk yel grn, dense w/vugs filled w/dol rhombs
3B	2502	Dol, dk yel grn, dense w/vugs filled w/dol rhombs
4	2730	Ls, lt yel-tan, fri
4A	2730	Ls, lt yel-tan, fri

CORE LABORATORIES, INC.
Petroleum Reservoir Engineering
DALLAS, TEXAS 75247

File SCAL-308-80128

Caprock - Threshold Pressure

Sample Number	Depth, feet	Vertical Permeability, md	Threshold Pressure,* psi
1	1845	251	2.0
2	2406	127	2.0
3	2502	6.5×10^{-5}	>1000
4	2730	263	0.50

*Gas Displacing Water.

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Petroleum Reservoir Engineering
DALLAS, TEXAS 75247

File SCAL-308-80128

Liquid Permeability Data

Type of Liquid Simulated Seawater

Sample Number	Porosity, Percent	Permeability, millidarcies to Air	Permeability, millidarcies to Liquid	Liquid/Air Permeability Ratio
1A	43.7	3880	3460	0.89
2A	40.9	154	73	0.47
3B	3.8	59	0.0036	0.000061
4A	36.7	1400	1170	0.83

Table 2.10-8
SUMMARY OF UNDERWATER TELEVISION SURVEY
MONITORING WELL BZ-1

RECORD OF UNDERWATER TV SURVEY

Project: Miami Dade Water & Sewer Authority, South District Regional Wastewater Treatment Plant

Well: BZ-1 (2 tapes)

Survey By: Deep Venture Diving Service, Perry, Florida
HP-4,000 AU

Survey Date: 8/21/79 Total Depth: 2,739 feet

Witnessed By: J. Lehnen, J. Kerrn, T. McCormick

Reviewed By: J. D. Lehnen Date: 12/30/80

Remarks: Flow test; open hole 980' to 2,759', flowing at approximately 2,700 gpm

Depth in Feet		Reel Counter		Observations
From	To	From	To	
--	--	0	17	No picture (tape #1)
0	988	17	393	20" casing
988	--	393	411	Bottom of 20" casing
988	996	44	418	Large diameter hole
996	1,036	418	443	Dark formation, rough walls
1,036	1,037	443	444	Cavity, water flow pushing camera aside
1,037	1,048	444	449	Rough borehole walls
1,048	1,059	449	482	Water entry, temperature difference causing hazy water, cavities
1,059	1,060	482	485	Cavity, water velocity appears to be much lower below
1,063	1,218	485	572	Rough formation, large diameter hole in places
1,218	1,468	572	655	Smoother form, large diameter in places
1,468	1,475	655	658	Small cavities, contributing water, picture hazy
1,475	1,540	658	672	Rough formation, no cavities
1,540	1,570	672	678	Small cavities, rough borehole walls

Project: Miami Dade Water & Sewer Authority, South District Regional Wastewater Treatment Plant

Well: BZ-1 Date: 8/21/79 Total Depth: 2,739'

Depth in Feet		Reel Counter		Observations
From	To	From	To	
1,570	1,572	678	681	Hazy water, water production
1,572	1,640	681	708	Some solution features, formation mildly fractured
1,640	--	708	--	Small cavity
1,640	1,674	708	723	Rough walls, small cavities
1,674	1,820	723	771	Smooth walls
1,820	1,854	771	792	Water cloudy, little movement, large diameter hole
1,854	1,890	792	807	Smaller diameter hole, water very dirty
1,890	1,930	807	816	Cleaner water, minor water production
1,930	2,098	816	862	Clean water, smooth borehole, minor solution features
0	--	862	--	Depth scale lost, reset to zero = 2,098'
0	(2,193) 95	862	890	Smooth borehole, end of tape, actual depth = 2,193'
97	(2,456) 358	0	151	Tape #2: smooth borehole
358	(2,461) 363	151	190	Dirty water, cavity, water flow pushes camera against borehole wall;
363	(2,465) 367	190	195	Water is swirling around in borehole
367	(2,472) 374	195	204	Rough formation
374	(2,474) 376	204	211	Cavity, little water movement
376	(2,516) 418	211	267	Moderately rough formation, no cavities
418	(2,566) 468	267	302	Small cavities, some fracturing and solution features
468	(2,624) 524	302	336	Larger diameter hole, water partly cloudy

Project: Miami Dade Water & Sewer Authority, South District Regional Wastewater Treatment Plant

Well: BZ-1 Date: 8/21/79 Total Depth: 2,739'

Depth in Feet		Reel Counter		Observations
From	To	From	To	
524	(2,733) 635	336	448	Rough borehole walls, no water movement, large diameter, dirty water
635	(2,739) 641	448	458	Poor visibility, bottom of hole, pulling out
641	(980) 8,894	458	651	Bottom of casing
8,894	(28) 7,930	651	758	End of survey

CH2M HILL

RECORD OF UNDERWATER TV SURVEY

Project: Miami Dade Water & Sewer Authority, South District Regional Wastewater Treatment Plant

Well: BZ-1

Survey By: Deep Venture Diving Service, Perry, Florida

HP-4,000 AU

Survey Date: 12/08/79 Total Depth: 2,960 feet

Witnessed By: R. Sproul, J. Kerrn, T. McCormick

Reviewed By: J. D. Lehnen Date: 12/31/80

Remarks: Final inspection (hole blocked = 2,958'), depth error at 2,679', actual 2,789':+10', at 2,943, actual 2,960':+17'

Depth in Feet		Reel Counter		Observations
From	To	From	To	
--	--	0	14	No picture
0	10	14	22	Dry 6-5/8" casing
--	10	--	--	Water level
10	2,679	22	644	6-5/8" casing bottom, actual = 2,689' (+10')
2,679	2,681	644	646	Cement chunks along borehole
2,681	2,691	646	651	Smooth borehole, probably cement
2,691	2,694	651	653	Cavity or broken out cement
2,694	2,735	653	670	Large diameter hole, previously drilled 20" pilot hole
2,735	2,759	670	680	Smaller hole, light color formation, very vuggy
2,759	2,780	680	688	Fractures and small cavities, otherwise smooth
2,780	2,781	688	688	Cavity
2,781	2,789	688	691	Smooth formation, small solution features
2,789	2,791	691	692	Cavity
2,791	2,794	692	693	Smooth borehole

Project: Miami Dade Water & Sewer Authority, South District Regional Wastewater Treatment Plant

Well: BZ-1 Date: 12/08/79 Total Depth: 2,960'

Depth in Feet		Reel Counter		Observations
From	To	From	To	
2,794	2,797	693	694	Small cavities
2,797	2,799	694	696	Large cavity, rubblized formation
2,799	2,801	696	698	Smooth formation
2,801	2,814	698	709	Numerous large cavities, very fractured
2,814	2,816	709	712	Smoother borehole
2,816	2,834	712	726	Numerous large cavities, very fractured
2,834	2,857	726	742	Smooth borehole, small cavities, solution features
2,857	2,866	742	749	Large cavity rubblized
2,866	2,876	749	756	Highly fractured, high angle fractures, small cavities
2,876	2,878	756	757	Large cavities
2,878	2,882	757	761	Fractured formation, solution features
2,882	2,886	761	764	Small cavities, smoother walls
2,886	2,914	764	784	Numerous solution features, small cavities
2,914	2,918	784	787	High angle fractures
2,918	2,921	787	790	Large cavity
2,921	2,928	790	795	Smooth walls
--	2,928	795	--	High angle fracture cutting through the borehole
2,928	2,934	795	799	Rougher walls, vuggy
2,934	2,943	799	806	Large cavity, rubblized

RECORD OF UNDERWATER TV SURVEY

Project: Miami Dade Water & Sewer Authority, South District Regional Wastewater Treatment Plant

Well: BZ-1 Date: 12/08/79 Total Depth: 2,960'

Depth in Feet		Reel Counter		Observations
From	To	From	To	
--	2,943	806	815	Bottom of cavity, borehole plugged (actual depth = 2,960')
2,943	2,685	815	886	Coming out of the hole
--	2,685	886	--	Bottom of casing, end of tape error = -4'

Table 2.10-9
LITHOLOGY FROM PILOT HOLE FORMATION SAMPLES
WELL BZ-1

Depth Interval (ft) From	To	Description
0	10	Limestone fill
10	20	Limestone, tan to buff to gray, hard, oolitic, chalky matrix, recrystallized,
20	30	Limestone, tan, gray, hard, oolitic, white, some sand
30	40	Limestone, tan, gray, hard, oolitic, white, some sand
40	50	Limestone, white to tan, hard, oolitic, shell fragments, fossiliferous
50	60	Limestone, as above
60	70	Limestone, as above
70	80	Limestone, white, gray, softer, shell fragments, fossiliferous
80	90	Limestone, white, tan, gray, some sand, hard
90	100	Limestone, white, tan, gray, hard, recrystallized
100	110	Limestone, as above
110	120	Limestone, as above, some gray-green siltstone
120	130	As above
130	140	Limestone, hard, dense, gray-green siltstone, soft to hard
140	150	Sample missing
150	160	Limestone, hard, gray-green siltstone, limestone pebbles with rounded edges
160	170	As above
170	180	Limestone, hard, gray-green siltstone, hard, gray-green sand with limestone fragments
180	190	As above
190	200	Sample missing

Table 2.10-9--Continued

Depth Interval (ft)		
From	To	Description
200	210	Gray-green sand and silt, some soft gray-green siltstone, few rounded limestone pebbles
210	220	Gray-green sand and silt, some limestone fragments
220	230	As above
230	240	As above
240	250	As above
250	260	As above
260	270	Gray-green sand and silt as above with increase in size and percentage of silica grains, also larger limestone fragments
270	280	Gray-green sand and silt as above, small limestone fragments, some soft gray-green siltstone
280	290	As above
290	300	Gray-green sand and silt as above, some soft gray-green siltstone, some hard fragments, gray-green siltstone
300	310	Gray-green sand and silt, few small limestone fragments
310	320	Gray-green sand and silt, hard gray-green siltstone, limestone fragments, hard
320	330	Gray-green sand and silt
330	340	Gray-green sand and silt, hard gray-green siltstone fragments, silica grains increase in size and percent, limestone fragments
340	350	As above
350	360	Gray-green sand and silt, soft gray-green siltstone limestone fragments, white, hard
360	370	Gray-green sand and silt, hard gray-green siltstone, hard white to gray limestone
370	380	As above
380	390	Gray-green siltstone, hard, white limestone, hard

Table 2.10-9--Continued

Depth Interval (ft) From	To	Description
390	400	As above
400	410	As above
410	420	Gray-green siltstone, hard; white limestone, hard, shell fragments
420	430	Gray-green siltstone, soft
430	440	Some gray-green siltstone, soft, some lime sand, shell fragments, limestone, white, hard
440	450	As above
450	460	As above
460	470	As above
470	480	As above
480	490	As above
490	500	As above
500	510	As above
510	520	Some gray-green siltstone, white to tan limestone, some lime sand
520	530	Limestone, white to tan, soft; siltstone, poorly consolidated, soft
530	540	Limestone, white to tan, some lime sand
540	550	As above
550	560	Limestone, white to tan, some gray siltstone
560	570	Limestone, white to tan
570	580	Limestone, white to tan, soft
580	590	As above
590	600	As above
600	610	As above

Table 2.10-9--Continued

Depth Interval (ft)		
From	To	Description
610	620	As above
620	630	Limestone, white to tan, hard to soft, some clay present
630	640	As above, more clay
640	650	As above
650	660	As above
660	670	Limestone, white to tan, some clay present
670	680	As above
680	690	As above
690	700	As above
700	710	As above, darker in color
710	720	Limestone, white to tan, some clay
720	730	As above, some shell fragments
730	740	As above
740	750	Limestone, soft, poorly consolidated, some clay
750	760	As above
760	770	Limestone, some clay, poorly consolidated and soft, siltstone, gray
770	780	Limestone, white to buff, soft, chalky
780	790	Limestone, white to buff, soft and chalky
790	800	As above
800	810	As above
810	820	As above
820	830	As above
830	840	As above

Table 2.10-9--Continued

Depth Interval (ft) From	To	Description
840	850	As above
850	860	Limestone fragments and lime sand, gray to tan
860	870	Gray-green siltstone, soft
870	880	As above
880	890	Limestone, gray-green, soft and silty
890	900	As above
900	910	As above, lighter in color, more silt
910	920	As above, some clay
920	930	As above
930	940	As above
940	950	Limestone, gray-green, silty, some shell fragments
950	960	Limestone, white to tan, hard, abundant shell fragments, fossiliferous
960	970	Limestone, gray-green, silty and soft, fossiliferous
970	980	As above
980	990	Limestone, white to tan, hard, fossiliferous
990	1,000	Limestone, light tan with granular matrix, rounded silica grains, some gray-green siltstone
1,000	1,010	Limestone, as above, less siltstone present
1,010	1,020	Limestone, as above, no siltstone, some dark gray dolomite
1,020	1,030	Limestone, as above, darker grayish tan color
1,030	1,040	Light gray dolomitic limestone
1,040	1,050	Limestone, tan with granular matrix, plus light gray dolomitic limestone
1,050	1,060	Limestone, tan, some dolomite, microfossils present

Table 2.10-9--Continued

Depth Interval (ft) From	To	Description
1,060	1,070	Limestone, tan, abundant truncated cone microfossils
1,070	1,080	Limestone, tan as above, medium hard
1,080	1,090	Limestone, as above, softer with grayish tan coloration, small dolomite chips, many microfossils
1,090	1,100	Limestone, light tan color, soft granular matrix, no dolomite present, microfossils present
1,100	1,110	No sample
1,110	1,120	Limestone, light tan, medium hard, granular matrix, light gray dolomite chips, microfossils present
1,120	1,130	Limestone, light tan, as above, mcuh harder, microfossils present
1,130	1,140	Limestone, light tan as above, very hard, microfossils present
1,140	1,150	Limestone, as above, darker tan, microfossils present
1,150	1,160	Limestone, as above
1,160	1,170	Limestone, as above
1,170	1,180	Limestone, as above
1,180	1,190	No sample
1,190	1,200	Limestone, light tan, granular matrix, medium hard, few dolomite chips
1,200	1,210	Limestone, as above, fewer dolomite chips
1,210	1,220	Limestone, darker grayish tan, very hard, microfossils present
1,220	1,230	Limestone, as above
1,230	1,240	Limestone, light tan, soft, some gray-green siltstone very fine cuttings, abundant cones and other microfossils
1,240	1,250	Limestone, granular matrix, soft, some gray-green siltstone

Table 2.10-9--Continued

Depth Interval (ft) From	To	Description
1,250	1,260	Limestone, as above
1,260	1,270	Limestone, light tan, large, very hard angular cuttings, abundant microfossils
1,270	1,280	Limestone, light tan, very soft, cuttings very fine, abundant microfossils present
1,280	1,290	Limestone, light tan, medium hard, microfossils present
1,290	1,300	Limestone, as above
1,300	1310	Limestone, light tan, soft, cuttings very fine, very abundant microfossils
1,310	1,320	Limestone, medium hard, granular matrix, fine cuttings mixed with large fragments of very hard dense limestone
1,320	1,330	Limestone, medium hard, granular matrix, as above, with no dense limestone present
1,330	1,340	Limestone, light grayish tan, hard, abundant microfossils
1,340	1,350	Limestone, light tan to white, cuttings much smaller, very abundant microfossils (many cones), medium hard
1,350	1,360	Limestone, light tan, medium hard, abundant microfossils (many cones)
1,360	1,370	Limestone, as above, some larger cuttings
1,370	1,380	Limestone, as above
1,380	1,390	Limestone, as above with some gray limestone chips, abundant microfossils (cones very abundant)
1,390	1,400	Limestone, as above, darker tan color
1,400	1,410	Limestone, light tan to white, gray chips not present, abundant cones and other microfossils
1,410	1,420	Limestone, as above, gray chips present
1,420	1,430	Limestone, as above, darker tan with high percentage of lime sand
1,430	1,440	Limestone, as above, lighter tan

Table 2.10-9--Continued

Depth Interval (ft) From	To	Description
1,440	1,450	Limestone, tan, fossiliferous, abundant cones, with high percentage of lime sand, larger fragments of lighter colored limestone present
1,450	1,460	Limestone, as above, large fragments of limestone no longer present
1,460	1,470	Limestone, as above
1,470	1,480	Limestone, as above
1,480	1,490	No sample
1,490	1,500	Limestone, as above, lighter color larger fragments
1,500	1,510	Limestone, light tan, microfossils present, some gray recrystallized fragments
1,510	1,520	Limestone, lighter in color, fewer cones and microfossils present
1,520	1,530	Limestone, light tan color, soft to medium hard with lime sand and few cones
1,530	1,540	Limestone, light tan to white, medium hard, angular, small percentage of lime sand and relatively few microfossils present
1,540	1,550	Limestone, tan, very soft, fine cuttings, few microfossils, no cones
1,550	1,560	Limestone, as above
1,560	1,570	Limestone, as above
1,570	1,580	Limestone, color unchanged, higher percentage of large fragments, microfossils present, a few cones present
1,580	1,590	Limestone, as above, plus fragments of gray-green limestone
1,590	1,600	Limestone, as above without grey-green stone
1,600	1,610	Limestone, tan, soft, granular, abundant microfossils
1,610	1,620	Limestone, as above, darker tan

Table 2.10-9--Continued

Depth Interval (ft) From	To	Description
1,620	1,630	Limestone, brown, sandy, microfossils and cones present
1,630	1,640	Limestone, as above, intermixed with darker gray stone
1,640	1,650	Limestone, brown, sandy
1,650	1,660	Limestone, brown, sandy, cuttings fine, with soft white limestone
1,660	1,670	Limestone, brown, sandy, soft, abundant microfossils
1,670	1,680	No sample
1,680	1,690	Limestone, very soft, abundant microfossils
1,690	1,700	Limestone, as above, mixed with fragments of soft, very fine grained, pale tan limestone
1,700	1,710	Limestone, as above
1,710	1,720	Limestone, buff colored, very fine grained, very soft, microfossils present, cones abundant
1,720	1,730	Sample missing
1,730	1,740	Light tan limestone, very fine grained, very soft, mixed with fragments of hard gray recrystallized limestone, microfossils present
1,740	1,750	Limestone, brown and sandy, soft, microfossils present
1,750	1,760	Limestone, brown and sandy, soft, microfossils present
1,760	1,770	Limestone, as above, harder, mixed with fragments of hard recrystallized white limestone
1,770	1,780	Limestone, brown, recrystallized, mixed with very hard gray recrystallized limestone, microfossils present
1,780	1,790	Limestone, as above
1,790	1,800	Limestone, as above, lighter in color
1,800	1,810	Limestone, as above
1,810	1,820	Limestone, as above, hard gray fragments no longer present

Table 2.10-9--Continued

Depth Interval (ft) From	To	Description
1,820	1,830	Limestone, as above
1,830	1,840	Limestone, light tan, soft, fine grained, microfossils present
1,840	1,850	Sample missing, zone cored
1,850	1,860	Limestone, light tan, soft, very fine grained, microfossils present
1,860	1,870	Limestone, as above
1,870	1,880	Limestone, as above
1,880	1,890	Limestone, as above, darker in color
1,890	1,900	Sample missing
1,900	1,910	Limestone, light tan, soft, very fine grained, fossiliferous
1,910	1,920	Limestone, as above
1,920	1,930	Limestone, as above, with light gray fragments recrystallized
1,930	1,940	Limestone, soft, white, very fine grained, microfossils present
1,940	1,950	Limestone, dark grayish brown, few microfossils banded brown lime mud/clay present
1,950	1,960	Limestone, light tan, fine grained, soft, microfossils abundant
1,960	1,970	Limestone, as above
1,970	1,980	Limestone, darker tan, soft, fine grained, microfossils present, but not abundant
1,980	1,990	Limestone, as above
1,990	2,000	Limestone, as above
2,000	2,010	Limestone, light tan, fine grained and soft to medium hard, some gray recrystallized fragments

Table 2.10-9--Continued

Depth Interval (ft) From	To	Description
2,010	2,020	Limestone, as above
2,020	2,030	Limestone, as above
2,030	2,040	Limestone, as above, mixed with white very fine grained limestone
2,040	2,050	Limestone, light tan, very fine grained, soft microfossils present
2,050	2,060	Limestone, as above
2,060	2,070	Limestone, light tan, fine grained and soft, mixed with limestone, white, very fine grained and soft, microfossils present
2,070	2,080	Limestone, as above
2,080	2,090	Limestone, as above
2,090	2,100	Limestone, light tan, fine grained, soft, fossiliferous fragments of hard gray recrystallized limestone present
2,100	2,110	Limestone, as above, plus very fine grained soft white limestone
2,110	2,120	Limestone, as above, with hard dark gray recrystallized limestone
2,120	2,130	Limestone, light tan, soft, fine grained, cones very abundant
2,130	2,140	Limestone, as above
2,140	2,150	Limestone, buff colored, soft, fossiliferous, oolitic
2,150	2,160	Limestone, buff colored, soft and sandy, fossiliferous
2,160	2,170	Lime sand, cones very abundant
2,170	2,180	Lime sand as above, plus fragments of light gray recrystallized limestone
2,180	2,190	Lime sand as above, zone cored
2,190	2,200	Lime sand with buff colored soft and sandy limestone

Table 2.10-9--Continued

Depth Interval (ft) From	To	Description
2,200	2,210	Limestone, buff to white, very fine grained fossiliferous
2,210	2,220	Limestone, as above
2,220	2,230	Limestone, as above, harder
2,230	2,240	Limestone, as above and mixed with fragments of tan sandy limestone
2,240	2,250	Limestone, buff to white, fine grained, fragments, varies from soft to hard (slight color difference)
2,250	2,260	Limestone, light tan, fine grained and soft, fragments of dolomitic limestone, fossiliferous
2,260	2,270	Limestone, light tan to white, hard, microfossils present
2,270	2,280	Limestone, as above, with darker tan fine grained recrystallized limestone
2,280	2,290	Limestone, light tan, soft, fine grained, fossiliferous limestone, white, hard, fine grained
2,290	2,300	Limestone, as above
2,300	2,310	Limestone, white, hard, porous crystallized
2,310	2,320	Limestone, light tan, fine grained, medium hard, microfossils present
2,320	2,330	Limestone, as above, lighter in color
2,330	2,340	Limestone, as above
2,340	2,350	Tan limestone, very soft, very fine grained, fossiliferous
2,350	2,360	Tan limestone, sandy, medium hard, cutting size much larger than above
2,360	2,370	Light tan limestone, soft, cutting size smaller
2,370	2,380	Limestone, as above, harder, cutting size larger
2,380	2,390	Limestone, tan to white, medium hard, fine grained, recrystallized limestone fragments, hard, dark gray

Table 2.10-9--Continued

Depth Interval (ft)		
From	To	Description
2,390	2,400	Limestone, as above, higher percentage of sand in sample
2,400	2,410	Limestone, buff colored, soft, fine grained
2,410	2,420	Limestone, as above
2,420	2,430	Limestone, tan, fine grained, soft, cutting size small
2,430	2,440	Limestone, light tan to white, soft and fine grained fragments of light to dark gray recrystallized limestone
2,440	2,450	Limestone, as above
2,450	2,460	Limestone, as above, plus fragments of light gray dolomite, zone cored
2,460	2,470	Sample missing
2,470	2,480	Limestone, light tan to white, some gray dolomite, microfossils present, but not abundant
2,480	2,490	Limestone and dolomite as above, some dolomite chips, much darker in color
2,490	2,500	Limestone, white to very light gray, soft microfossils present, no dolomite
2,500	2,510	Limestone, white to gray, dark inclusions in some fragments, few microfossils, formation is soft
2,510	2,520	Lime siltstone, white color, soft, few microfossils
2,520	2,530	Lime siltstone, as above, gray to white, dolomite crystals and fragments in sample
2,530	2,540	Limestone, gray to white, and dolostone of dark gray to green microcrystals (appear weathered) partially cemented with lime
2,540	2,550	Limestone, white to gray, hard, gray dolomite and dolostone, as above
2,550	2,560	Sample missing
2,560	2,570	Limestone, light tan, fine grained plus recrystallized hard gray limestone, some dark gray dolomite present

Table 2.10-9--Continued

Depth Interval (ft) From	To	Description
2,570	2,580	Limestone, as above, cones and other microfossils present
2,580	2,590	Limestone, as above, higher percentage of recrystallized gray limestone, microfossils present
2,590	2,600	Limestone, white to tan, fine grained and soft, gray limestone fragments cemented with white lime
2,600	2,610	Lime siltstone, gray, poorly consolidated, very soft, composed of sand to silt grains with some peat, some dolomite
2,610	2,620	Limestone, white, hard, fine grained, fossiliferous
2,620	2,630	Limestone, as above, a few chips of dolomite
2,630	2,640	Limestone, white, very fine grained, dolomite chips
2,640	2,650	Limestone, white, very fine grained, some dolomite, some massive gray limestone
2,660	2,670	Limestone, white to tan, soft, very fine grained, microfossils present
2,670	2,680	Limestone, white, fine grained, gray limestone, massive and recrystallized present
2,680	2,690	Limestone, white, chalky and soft, limestone, gray, massive, and recrystallized
2,690	2,700	Limestone, as above
2,700	2,710	Limestone, soft, white and chalky
2,710	2,720	As above
2,720	2,730	As above
2,730	2,740	As above
2,740	2,750	Limestone, light tan, mixed with dolomite
2,750	2,760	Limestone, light tan with dolomite
2,760	2,770	Limestone, tan, soft, with some dolomite

Table 2.10-9--Continued

Depth Interval (ft)		
From	To	Description
2,770	2,780	Limestone, gray and white soft
2,780	2,790	Limestone, white, tan with some dolomite
2,790	2,800	Limestone, tan trace dolomite
2,800	2,810	No sample
2,810	2,820	No sample
2,820	2,830	Dolomite, dark brown, very hard, trace tan dolomite
2,830	2,840	Dolomite, tan, very hard, mixed brown dolomite
2,840	2,850	Same as above
2,850	2,860	Dolomite, tan, very hard, massive
2,860	2,870	Dolomite, light tan to gray, massive and very hard, some soft white limestone present, no microfossils
2,870	2,880	Dolomite, light tan to white, mostly sand sized fragments, some white limestone present
2,880	2,890	Dolomite, light tan, hard, massive, some dark tan, microcrystalline dolomite present, no microfossils
2,890	2,900	Dolomite, as above
2,900	2,910	Dolomite, as above, lighter in color, no microcrystalline dolomite present in sample
2,910	2,920	Dolomite, as above
2,920	2,930	Dolomite, dark tan to brown, microcrystalline, hard, some fragments of gray massive dolomite
2,930	2,940	Dolomite, as above
2,940	2,950	Dolomite, light tan to gray, hard, no microfossils present
2,950	2,960	Dolomite, dark tan to brown, microcrystalline
2,960	2,970	Dolomite, as above
2,970	2,980	Dolomite, gray, hard, massive

Table 2.10-9--Continued

Depth Interval (ft) From	To	Description
2,980	2,990	Dolomite, dark tan to gray, hard microcrystalline to massive
2,990	3,000	Dolomite, light tan, hard, massive
3,000	3,010	Dolomite, as above
3,010	3,020	Dolomite, dark tan, finely crystalline to microcrystalline, hard
3,020	3,030	Dolomite, as above
3,030	3,040	Dolomite, light tan to gray, finely crystalline, hard
3,040	3,050	Dolomite, as above
3,050	3,060	Dolomite, light tan to gray, hard, finely crystalline
3,060	3,070	Dolomite, as above
3,070	3,080	Dolomite, as above
3,080	3,090	Dolomite, darker tan to gray, very hard, massive
3,090	3,100	Dolomite, light tan to gray, hard, massive
3,100	3,110	Dolomite, as above, cuttings very fine, mostly sand size grains
		Total depth of well drilled = 3,110'
		Subsequently found bridged at 2,960 feet Total depth left at 2,960 feet

Table 2.10-10
WATER QUALITY DATA FROM PILOT HOLE DRILLING
WELL BZ-1

Date	Time	Depth (ft)	Temperature (°C)	Specific Gravity	Specific Conductance (μmhos/cm)	Chlorides (mg/l)	Remarks
7/01	0300	1,050	30.0	1.0060	14,500	44,500	Salt added to drilling fluid
7/01	0900	1,080	30.0	1.025	50,000	20,000	Salt added to drilling fluid
7/01	1300	1,115	30.0	1.028	62,000	21,000	Salt added to drilling fluid
7/02	0750	1,147	28.5	1.0265	60,000	20,000	Salt added to drilling fluid
7/02	1630	1,179	29.0	1.0160	40,000	13,800	
7/02	2230	1,210	28.5	1.0150	35,000	11,700	
7/03	0540	1,241	28.0	1.0110	29,000	9,700	
7/03	1330	1,273	29.0	1.0090	29,000	12,400	
7/03	1840	1,304	28.0	1.0100	21,500	6,800	
7/03	2205	1,335	27.0	1.0060	18,000	5,400	
7/04	0300	1,363	27.0	1.0045	14,000	4,200	
7/04	0730	1,396	27.0	1.0035	14,000	4,200	
7/04	1300	1,427	28.5	1.0018	11,000	3,200	
7/04	1645	1,458	27.0	1.0025	11,000	3,500	
7/04	2100	1,498	27.0	1.0025	9,000	3,100	
7/07	0400	1,522	26.0	1.0004	10,900	3,300	
7/07	1030	1,550	27.0	1.0015	10,600	3,580	
7/07	2030	1,580	27.0	1.002	10,750	3,400	
7/08	0940	1,609	27.5	1.0015	10,000	4,700	
7/08	1440	1,617	27.0	1.0000	6,000	2,500	
7/08	1800	1,642	27.0	1.0015	7,500	2,600	

Table 2.10-10--Continued

Date	Time	Depth (ft)	Temperature (°C)	Specific Gravity	Specific Conductance (μmhos/cm)	Chlorides (mg/l)	Remarks
7/09	0100	1,684	26.0	1.0045	15,000	5,600	
7/09	0600	1,717	26.5	1.000	5,600	1,540	
7/09	0930	1,750	27.0	1.000	6,000	1,580	
7/09	1200	1,770	27.0	1.0005	9,400	3,500	
7/09	1530	1,804	26.5	1.0000	5,400	1,710	
7/09	2000	1,840	26.5	1.0000	4,000	1,210	
7/15	1030	1,870	23.5	1.0055	14,000	4,400	Drilling water being discharged to outfall
7/15	2140	1,899	23.0	1.0040	11,500	4,100	
7/16	0330	1,929	23.0	1.0040	11,750	4,000	
7/16	1030	1,960	23.0	1.004	13,000	4,560	
7/16	1700	1,993	23.5	1.004	12,900	4,540	
7/16	2045	2,021	23.0	1.0050	15,000	5,500	
7/17	0100	2,050	24.0	1.0045	15,000	5,100	
7/17	0415	2,085	23.0	1.0050	15,500	5,800	
7/17	1130	2,117	23.0	1.0055	15,900	5,380	
7/17	1610	2,148	23.0	1.0080	18,750	7,430	
7/17	1915	2,180	22.5	1.0050	24,000	6,700	
7/20	1400	2,211	22.5	1.0130	34,000	11,800	
7/20	1615	2,242	22.5	1.0160	35,000	13,700	
7/20	2110	2,273	22.5	1.0140	33,000	13,800	
7/21	0130	2,303	25.5	1.0156	35,000	13,760	
7/21	0700	2,334	26.5	1.0175	40,000	14,500	

Table 2.10-10--Continued

Date	Time	Depth (ft)	Temperature (°C)	Specific Gravity	Specific Conductance (μmhos/cm)	Chlorides (mg/l)	Remarks
7/22	0245	2,366	21.5	1.0210	42,000	16,000	
7/22	0245	2,366	21.5	1.0210	42,000	16,000	
7/22	0300	2,374	21.5	1.0230	50,000	16,300	
7/22	0611	2,396	21.0	1.0215	46,000	16,400	
7/23	1000	2,425	22.0	1.0230	59,000	16,000	
7/23	1350	2,460	23.0	1.0130	28,000	11,400	
7/26	1100	2,497	23.0	1.0245	55,000	21,000	
7/27	2350	2,519	21.5	1.0250	54,000	15,200	
7/28	0700	2,550	21.0	1.0250	52,000	20,000	
7/31	2100	2,590	26.0	1.0255	50,000	24,300	
8/01	0200	2,618	21.0	1.0250	50,000	21,650	
8/01	0530	2,636	21.0	1.0250	50,000	28,300	
8/03	1200	2,652	22.0	1.0230	52,000	22,300	
8/03	1930	2,682	21.0	1.0250	55,000	25,500	
8/04	0500	2,718	21.0	1.0240	47,000	29,000	
10/18	0715	2,735	23.0	1.0255	53,000	20,000	
10/19	0445	2,767	22.0	1.0265	58,000	23,700	
10/19	0700	2,797	21.0	1.0265	47,000	23,600	
10/20	1600	2,827	20.5	1.026	50,000	21,000	
10/30	1800	2,860	22.0	1.0250	32,000	21,000	
11/07	1300	2,890	22.00	1.0250	18,000	21,700	
11/07	0015	2,930	23.0	1.0255	31,000	23,500	
11/08	1100	2,954	22.0	1.025	39,000	21,000	
11/09	0730	2,980	22.0	1.035	45,000	22,100	

Table 2.10-10--Continued

Date	Time	Depth (ft)	Temperature (°C)	Specific Gravity	Specific Conductance (μmhos/cm)	Chlorides (mg/l)	Remarks
11/09	1600	3,015	22.0	1.0250	45,000	19,500	
11/10	0400	3,045	22.0	1.0250	45,000	19,400	
11/10	1200	3,075	22.0	1.0250	35,000	21,500	
11/10	1730	3,100	21.0	1.0255	35,000	21,500	Final depth

Table 2.10-11 N.E.
WATER QUALITY OF BISCAYNE AQUIFER--N.E. MONITORING WELL
SITE BZ-1

Date	Time	Temperature (°C)	Specific Conductance (µmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
4/30	1800	24.0	2,200	562	10.50	
5/02	1138	24.0	2,050	620	10.34	
5/09	1030	24.0	2,000	516	10.69	
5/16	0920	24.5	1,230	390	10.50	
5/24	1420	25.0	2,200	585	11.46	
5/29	2225	25.0	1,500	380	11.00	
6/06	1640	26.0	1,950	520	10.70	
6/13	1415	25.0	1,800	460	11.18	
6/20	0900	25.0	1,700	480	10.55	
6/27	0900	25.0	1,800	490	10.80	
7/04	1105	26.0	2,100	490	10.72	
7/11	0900	26.0	2,100	440	10.4	
7/18	0920	26.0	2,400	740	10.65	
7/25	0930	26.0	2,000	500	10.70	
8/01	1000	26.0	2,200	730	10.70	
8/08	0933	26.0	2,300	750	10.7	
8/15	0945	26.5	1,550	630	10.7	
8/22	0939	27.0	1,950	610	10.62	
8/29	0910	27.0	1,900	600	10.4	
9/05	0928	28.0	1,250	700	10.43	
9/19	0848	31.0	650	900	9.50	
9/25	0910	27.5	1,750	860	10.55	
10/03	0930	28.0	1,150	600	9.98	

Table 2.10-11 N.E.--Continued

Date	Time	Temperature (°C)	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
10/10	0900	28.0	2,000	720	10.53	
10/17	0900	28.0	1,600	700	10.25	
10/24	0900	28.0	2,175	810	10.40	
10/31	0900	28.0	2,150	750	10.30	
11/08	1544	27.0	2,100	750	10.67	
11/14	0900	27.0	1,900	720	10.42	
11/21	0900	28.0	1,900	650	10.59	
11/28	0900	27.0	1,950	680	10.48	
12/05	1000	26.0	1,900	670	10.46	
12/12	0900	27.0	1,900	680	10.39	
12/19	1100	26.5	2,100	650	10.45	
12/27	1000	26.0	1,900	600	9.73	Changed measuring point
1/02	0930	25.0	1,925	654	9.55	
1/09	0930	25.5	1,900	630	9.53	

Table 2.10-11 N.W.
WATER QUALITY OF BISCAYNE AQUIER--N.W. MONITORING WELL
SITE BZ-1

Date	Time	Temperature (°C)	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
4/30	1800	24.0	720	122	10.63	
5/02	1120	24.5	770	110	10.60	
5/09	1030	24.0	1,500	357	10.70	
5/16	0915	24.0	750	138	10.90	
5/24	1437	25.0	2,400	590	11.74	
5/30	2220	25.0	990	190	11.37	
6/06	1620	27.0	1,800	440	11.10	
6/14	0805	26.0	1,650	440	12.75	
6/20	0930	26.0	1,500	360	11.20	
6/27	0840	26.0	1,800	470	11.70	PVC broken and replaced at new height
7/04	1025	27.0	2,200	470	11.32	
7/11	0905	26.0	2,300	460	11.3	
7/18	0930	29.0	2,000	490	10.90	
7/25	0950	29.0	2,200	700	11.20	
8/01	1015	29.0	1,800	580	11.30	
8/08	0922	28.0	2,000	570	11.2	
8/15	0930	29.0	1,400	550	11.39	
8/22	0930	29.0	1,900	610	11.54	
8/29	0905	29.0	1,600	470	8.22	Measuring point changed.
9/05	0942	28.0	850	610	8.95	
9/19	0856	30.0	650	950	8.80	

Table 2.10-11 N.W.--Continued

Date	Time	Temperature (°C)	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
9/26	0905	29.0	1,400	610	9.20	
10/03	0925	28.0	1,500	560	9.60	
10/10	0915	29.0	1,500	580	9.97	
10/17	0915	28.0	1,350	540	10.14	
10/24	0915	28.0	1,700	600	9.96	
10/31	0915	28.0	1,600	580	9.88	
11/08	1530	28.0	1,600	480	9.90	
11/14	0915	27.5	1,600	580	10.09	
11/21	0915	28.0	1,700	600	10.17	
11/28	0915	27.0	1,700	590	9.88	
12/05	1015	27.0	2,400	580	9.64	
12/12	0915	27.0	1,700	540	9.42	
12/19	1115	26.5	1,900	590	9.40	
12/27	1050	26.5	1,550	510	9.76	
1/02	0950	24.5	1,650	540	9.00	
1/09	0950	26.5	1,700	580	8.73	

Table 2.10-11 S.E.
WATER QUALITY OF BISCAYNE AQUIFER--S.E. MONITORING WELL
SITE BZ-1

Date	Time	Temperature (°C)	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
4/28	--	24.0	740	127	10.55	
5/02	1130	24.5	790	133	10.25	
5/09	1030	24.0	1,000	175	10.61	
5/16	0900	24.0	410	39	10.49	
5/24	1427	25.0	1,600	330	10.68	
5/30	2215	25.0	470	50	10.47	
6/06	1635	26.0	600	80	10.65	
6/13	1425	26.0	580	80	10.52	
6/20	0910	26.0	540	60	10.46	
6/27	0855	26.0	630	90	10.63	
7/04	--	--	--	--	--	
7/11	0910	27.3	2,000	390	9.80	Changed measuring point
7/18	0925	27.0	1,700	360	10.25	
7/25	0945	26.5	1,450	390	10.30	
8/01	1010	27.0	3,650	1,470	10.35	
8/08	0927	26.5	5,500	2,100	10.30	
8/15	0937	26.0	2,800	2,350	10.39	
8/22	0934	26.0	2,900	960	10.20	
8/29	0922	26.0	2,800	830	10.06	
9/05	0936	28.0	1,250	690	10.03	
9/19	0853	29.0	625	660	9.10	
9/26	0920	28.0	1,475	700	10.15	

Table 2.10-11 S.E.--Continued

Date	Time	Temperature (°C)	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
10/03	0920	28.5	2,000	670	10.18	
10/10	0910	27.75	1,200	650	10.13	
10/17	0910	27.75	850	250	9.77	
10/24	0910	27.75	1,050	260	9.96	
10/31	0910	27.0	1,150	310	10.05	
11/08	1539	27.0	2,300	560	10.07	
11/14	0910	25.5	2,400	680	9.98	
11/21	0910	27.0	2,000	650	10.19	
11/28	0910	26.0	2,200	670	10.07	
12/05	1010	25.5	2,300	760	10.07	
12/12	0910	25.5	1,500	600	10.00	
12/19	1110	24.0	2,000	450	10.10	
12/22	1040	24.0	975	350	9.12	
1/02	0945	24.0	1,350	370	10.19	
1/09	0940	25.0	2,500	1,070	10.18	

Table 2.10-11 S.W.
WATER QUALITY OF BISCAYNE AQUIFER--S.W. MONITORING WELL
SITE BZ-1

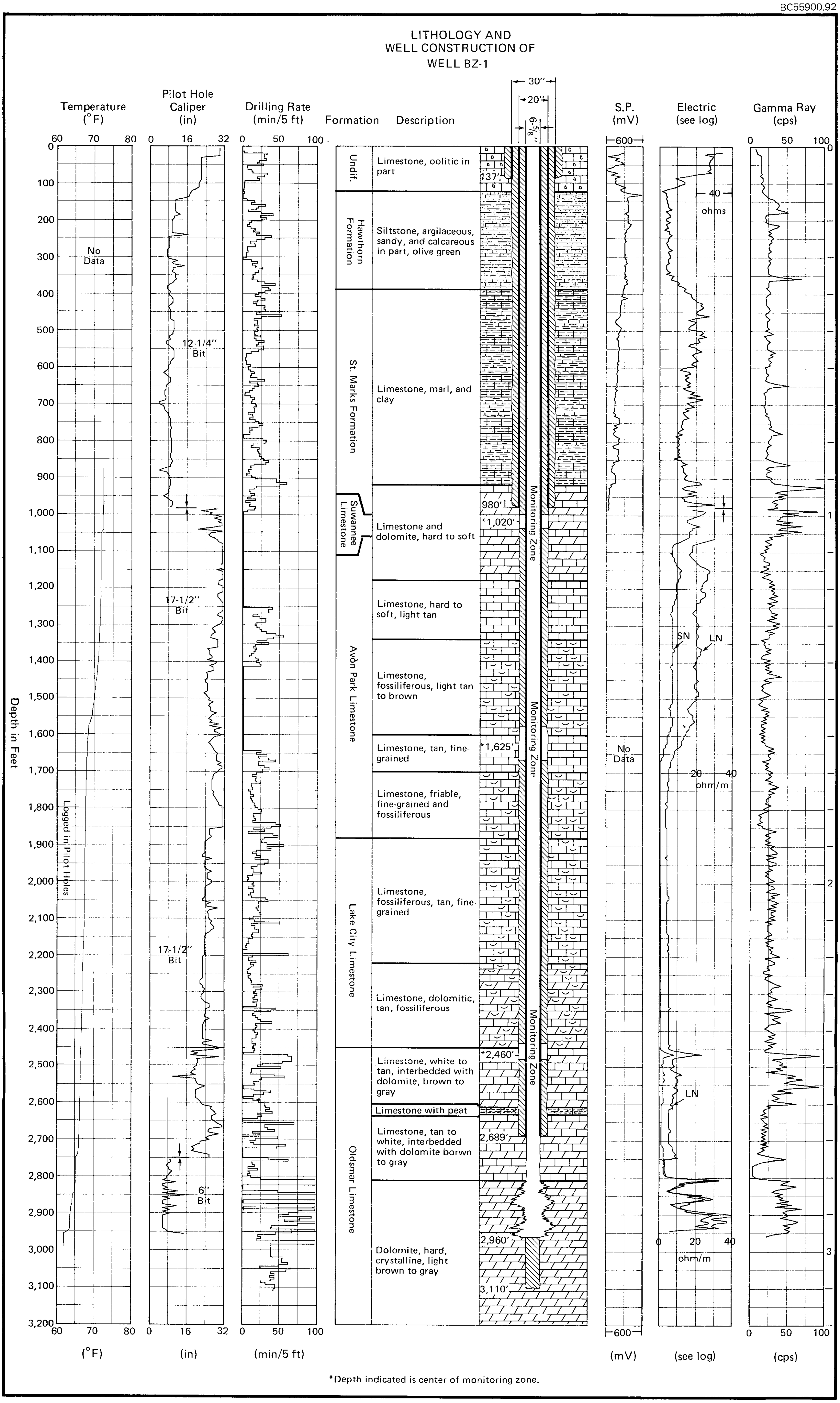
Date	Time	Temperature (°C)	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
4/28		24.0	2,100	510	10.63	
5/02	1125	24.0	1,850	520	10.36	
5/09	1030	24.0	1,700	395	10.72	
5/16	0910	24.0	1,500	370	10.59	
5/24	1432	24.0	2,000	410	10.75	
5/30	2230	25.0	1,350	300	10.57	
6/06	1630	25.5	1,750	390	10.70	
6/13	1430	26.0	1,600	330	10.61	
6/20	0920	25.0	1,300	370	10.54	
6/27	0850	25.0	1,500	370	10.83	
7/04	--	--	--	--	--	No sample--PVC broken, sampler stuck in well
7/11	--	--	--	--	--	
7/18	--	--	--	--	--	
7/25	--	--	--	--	--	
8/01	--	--	--	--	--	
8/08	--	--	--	--	--	
8/15	--	--	--	--	--	
8/22	--	--	--	--	--	
8/29	--	--	--	--	--	
12/27	--	--	--	--	--	
1/08	--	--	--	--	--	

Table 2.10-11 W.S.
WATER QUALITY OF BISCAYNE AQUIFER--WATER SUPPLY WELL
SITE BZ-1

Date	Time	Temperature (°C)	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
4/30	1800	24.0	2,700	688	--	No water levels available, pump in the well
5/02	1143	26.0	2,350	590	--	
5/09	1030	24.0	2,700	675	--	
5/16	0925	24.5	2,800	840	--	
5/24	1440	24.5	3,200	815	--	
5/30	2235	25.0	2,800	670	--	
6/06	1645	26.0	2,950	780	--	
6/13	1440	39.0	2,800	765	--	Hose exposed to sun
6/20	0935	25.0	2,600	770	--	
6/27	0905	27.0	2,300	650	--	
7/04	1110	29.0	3,200	680	--	
7/11	0900	26.0	2,600	580	--	
7/18	0920	27.0	2,450	790	--	
7/25	0940	26.5	2,700	810	--	
8/01	1005	26.0	2,500	830	--	
8/08	0935	26.0	2,000	650	--	
8/15	0940	27.0	600	570	--	
8/22	0940	27.0	2,000	560	--	
8/29	0921	27.0	1,700	610	--	
9/05	0930	--	1,350	790	--	
9/19	0850	30.0	750	1,170	--	

Table 2.10-11 W.S.--Continued

Date	Time	Temperature (°C)	Specific Conductance (µmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
9/26	0915	26.5	1,950	910	--	
10/03	0925	29.0	2,500	810	--	
10/10	0905	27.75	2,250	800	--	
10/17	0905	27.75	1,850	780	--	
10/24	0905	28.0	2,650	910	--	
10/31	0905	27.75	2,400	750	--	
11/08	1545	28.0	2,550	670	--	
11/14	0905	22.0	2,600	710	--	
11/21	0905	26.0	2,300	700	--	
11/28	0905	26.5	2,200	720	--	
12/05	1005	25.5	2,200	700	--	
12/12	0905	24.5	2,200	710	--	
12/19	1105	24.0	2,500	710	--	
12/27	1015	21.5	2,150	650	--	
1/02	0940	19.0	2,200	700	--	
1/09	0935	25.5	1,850	600	--	



Summary of drilling and logging data—Monitoring Well BZ-1.

FIGURE 2.10-1.

Chapter 2.11
MONITORING WELL FA-1

Monitoring Well FA-1 is located on the northern boundary of the project site, 100 feet west of I-8 as shown on Figure 1.1-2, Section 1, Summary. FA-1 is completed in the lower Floridan aquifer with open annulus monitoring in the upper Floridan aquifer. Drilling was begun on July 31, 1980, and was completed on September 9, 1980. The drilling and casing sequence was as follows:

1. Drilled a 28-inch hole to a depth of 145 feet.
2. Set and cemented the 20-inch casing from a depth of 140 feet up to the concrete drilling pad.
3. Drilled a 19-inch hole to a depth of 990 feet.
4. Set and cemented the 12-3/4-inch casing from 980 feet up to the concrete drilling pad.
5. Drilled an 11-inch hole to a depth of 1,880 feet.
6. Set the 6-5/8-inch casing at 1,840 feet.
7. Cemented the 6-5/8-inch casing from 1,840 feet to 1,090 feet.
8. Pressure tested the 6-5/8-inch casing at 100 psi for 1 hour with no pressure loss.
9. Drilled a 5-1/4-inch hole to 1,926 feet.
10. Developed the well and annulus by air lifting.
11. Ran cement bond log on 6-5/8-inch casing.
12. Completed the wellhead and pad.
13. Disinfected and sampled the well as per specifications.

Casings are black steel, API 5L, Grade B, and ASTM A 139, Grade B casing data are summarized in Table 2.11-1. The three casings were cemented with Class H cement slurries as summarized in Table 2.11-2. Geophysical logs and TV surveys run on the well are listed in Table 2.11-3. Table 2.11-4 presents a descriptive summary of the underwater television survey run in this well. Table 2.11-5 describes the formation sample collected during pilot hole drilling. The quality of the water samples collected during drilling is shown in Table 2.11-6. Figure 2.11-1 is a summary of drilling and testing and includes the following: construction diagram, lithologic log, drilling rate, electric, gamma radiation, and caliper logs.

The TV survey run in this well after drilling and cementing was completed showed what appeared to be a length of PVC air-line at 1,867 feet in depth. This prevented reaching the total depth of the well (1,927 feet) with the TV camera. The contractor was asked to clean the bottom of the hole, and a new TV survey showed the bottom clean to a depth of 1,918 feet.

Biscayne Aquifer Water Quality Monitoring

During drilling of the well, water samples were collected and levels measured at each of five shallow monitoring wells installed around the drilling pad. Four of the wells were 2-inch-diameter PVC, approximately 20 feet deep, and located at each corner of the pad. The fifth was 8-inch-diameter steel, approximately 40 feet deep, and was used for supply water during construction. These data are included in Tables 2.11-7 N.E. through 2.11-7 S.W. The same water supply well was used for FA-1 as for I-8, therefore, water quality data are contained in Table 2.8-11 W.S.

Table 2.11-1
SUMMARY OF CASING DATA
WELL FA-1

Diameter (inches)	Wall Thickness (inches)	Depth (feet)[a]		Cemented Section (depth in ft)[a]	
		From	To	From	To
20	.438	0	140	0	140
12-3/4	.375	0	980	0	980
6-5/8[b]	.280	0	1,840	1,090	1,840

[a]Measured from the top of the concrete drilling pad.
[b].432-inch wall pipe was run from 1,646 feet to 1,840 feet on the same string of 6-5/8-inch casing.

Table 2.11-2
SUMMARY OF CEMENTING OF CASINGS
WELL FA-1

Date	Casing Cemented	Type of Cement Used (API)	Number of Sacks Used	Depth Cemented (ft) From	To
08/04/80	20"	Class H w/25 lb gilsonite per sack of cement	200	140	0
08/13/80	12-3/4"	Lead: Class H w/2% bentonite	600	980	0
		Tail: Class H neat	190		
08/27/80	6-5/8"	Class H neat	600	1,840	1,295
08/28/80	6-5/8"	Class H neat	300	1,295	1,198
08/28/80	6-5/8"	Class H neat	200	1,198	1,090

Table 2.11-3
LIST OF GEOPHYSICAL LOGS AND WELL SURVEYS
WELL FA-1

Date	Well Progress and Casing Depth	Type of Logs or Surveys Run[a]	Purpose
08/25/80	12-34" casing to 980' 11" hole to 1,880'	E, G, C, T_S, FC	1. Geohydrological definition of the Floridan aquifer. 2. Establish setting depth of the 6-5/8" casing.
10/16/80	6-5/8" casing to 1,840' 5-1/4" hole to 1,926'	TV	1. Visual inspection of the 6-5/8" casing and monitor zone.
11/10/80	6-5/8" casing to 1,840' 5-1/4" hole to 1,926'	LSN, G, C, T_S, TV	1. Geohydrological definition of the monitor zone. 2. Visual inspection of the 6-5/8" casing and the monitor zone.
12/02/80	As above	CBL	1. Confirm the adequacy of the cement outside the 6-5/8" casing.
03/18/81	As above	TV	1. Final visual inspection of the casing and open hole after clean-out.

[a] Abbreviations for logs and surveys are as follows:

E = single point electric and SP
LSN = long and short normal and SP
G = gamma ray
C = caliper
T_S = temperature, static
T_F = temperature, flowing
FV_S = fluid velocity (flow meter) static
FV_F = fluid velocity (flow meter) flowing
FC = fluid conductivity

GYRO = gyroscopic directional survey
TV = television
CBL = cement bond, variable density
WTD = wave train display
D. IND = dual induction electric and SP
BCS = borehole compensated sonic
Density = formation density
AV = acoustic velocity
GGD = gamma gamma density (0-500 ft)

Table 2.11-4
SUMMARY OF UNDERWATER TELEVISION SURVEY
WELL FA-1

CH2M HILL

RECORD OF UNDERWATER TV SURVEY

Project: Miami Dade Water & Sewer Authority, South District Regional Wastewater Treatment Plant

Well: FA-1

Survey By: Deep Venture Diving Service, Perry, Florida

Survey Date: 3/18/80 **Total Depth:** 1,118 feet

Witnessed By: D. Snyder, D. Cabit, T. McCormick

Reviewed By: J. D. Lehnen **Date:** 3/30/81

Remarks: Survey run after clean-out

Depth in Feet		Reel Counter		Observations
From	To	From	To	
--	--	0	17	Titles
0	5	17	30	Dry 6-5/8" casing
5	1,833	30	490	6-5/8" casing
1,833	1,840	490	504	Bottom of casing, correct depth indicator to 1,840 feet
1,840	1,846	504	510	Large diameter hole, cement slab along borehole wall approximately 9:00
1,846	1,850	510	513	Slab along borehole wall approximately 6:00
1,850	1,853	513	514	Smaller diameter hole
1,853	1,857	514	518	Fractured formation, rough borehole walls
1,857	1,900	518	545	Gauge hole, smoother
1,900	1,914	545	556	Water getting more cloudy, visibility fair
1,914	--	556	--	Small cavity, water very cloudy below
1,914	1,918	556	575	Visibility poor, bottom of visibility, T.D. of hole is 1,934'
1,918	1,829	575	591	Coming out of the hole; end of survey

Table 2.11-5
LITHOLOGY FROM PILOT HOLE FORMATION SAMPLES
WELL FA-1

Depth Interval (ft) From	To	Description
0	10	Limestone, white to buff, shell fragments, microfossils, hard and grainy matrix
10	20	As above
20	30	As above
30	40	As above
40	50	As above
50	60	As above
60	70	As above
70	80	As above
80	90	As above
90	100	Sample missing
100	110	As above
110	120	As above
120	130	As above
130	140	As above
140	150	As above
150	160	Some limestone, sample primarily cement
160	170	As above
170	180	As above
180	190	As above
190	200	As above
200	210	As above
210	220	As above

Table 2.11-5--Continued

Depth Interval (ft) From	To	Description
220	230	As above
230	240	As above
240	250	As above
250	260	As above
260	270	As above
270	280	As above
280	290	Limestone, buff colored to white, hard, shell fragments, microfossils present, granular matrix
290	300	As above
300	310	As above
310	320	As above
320	330	As above
330	340	As above
340	350	As above
350	360	As above
360	370	As above
370	380	As above
380	390	As above
390	400	As above
400	410	As above
410	420	As above
420	430	As above
430	440	Limestone, white to gray, hard, silt to clay matrix, shell fragments, fossils and microfossils present
440	450	As above

Table 2.11-5--Continued

Depth Interval (ft)		
From	To	Description
450	460	As above
460	470	As above
470	480	As above
480	490	As above
490	500	As above
500	510	As above
510	520	Limestone, buff color, soft to medium-hard, silty matrix, shell fragments, microfossils
520	530	As above
530	540	As above
540	550	As above
550	560	As above
560	570	As above
570	580	As above
580	590	As above
590	600	As above
600	610	As above
610	620	As above
620	630	As above
630	640	As above
640	650	As above
650	660	As above
660	670	As above
670	680	As above

Table 2.11-5--Continued

Depth Interval (ft) From	To	Description
680	690	As above
690	700	As above
700	710	As above
710	720	As above
720	730	Limestone, buff, medium-hard, fine to medium grained, silty matrix with shell fragments
730	740	As above
740	750	As above
750	760	As above
760	770	As above
770	780	Clay, mixed with soft tan limestone, some shell fragments, fine to medium grained
780	790	As above
790	800	As above
800	810	As above
810	820	As above
820	830	As above
830	840	As above
840	850	As above
850	860	As above
860	870	As above
870	880	As above
880	890	As above
890	900	As above
900	910	As above

Table 2.11-5--Continued

Depth Interval (ft) From	To	Description
910	920	Clay, light green, silty, some soft tan limestone with shell fragments
920	930	As above
930	940	As above
940	950	As above
950	960	Limestone, tan, medium-hard, fossiliferous, some fine silty clays, shell fragments
960	970	As above
970	980	As above
980	990	As above
990	1,000	Limestone, tan to gray, porous, vuggy, fossiliferous, abundant shells and microfossils, some silt
1,000	1,010	As above, with cement cuttings
1,010	1,020	As above
1,020	1,030	As above, mixed with clay
1,030	1,040	As above
1,040	1,050	As above
1,050	1,060	Limestone, tan to buff, soft, vuggy, fossiliferous, porous, some shells
1,060	1,070	As above
1,070	1,080	As above
1,080	1,090	Limestone, tan, soft to medium-hard, porous, fossiliferous, some hard crystalline fragments
1,090	1,100	Limestone, buff, soft to medium-hard, porous and vuggy, fossiliferous
1,100	1,110	Limestone compacted with calcite crystals, tan to buff, medium-hard, some fossiliferous grains

Table 2.11-5--Continued

Depth Interval (ft)		
From	To	Description
1,110	1,120	As above
1,120	1,130	As above
1,130	1,140	As above, with microfossils present
1,140	1,150	As above
1,150	1,160	As above
1,160	1,170	As above
1,170	1,180	As above
1,180	1,190	As above
1,190	1,200	As above
1,200	1,210	As above
1,210	1,220	As above
1,220	1,230	As above
1,230	1,240	As above
1,240	1,250	As above
1,250	1,260	As above
1,260	1,270	As above
1,270	1,280	As above
1,280	1,290	As above
1,290	1,300	Limestone, buff, medium-hard, fossiliferous, vuggy matrix, shell fragments
1,300	1,310	As above
1,310	1,320	As above
1,320	1,330	As above
1,330	1,340	As above

Table 2.11-5--Continued

Depth Interval (ft)		
From	To	Description
1,340	1,350	Limestone, as above, with gray, very hard, massive limestone
1,350	1,360	Limestone, tan to buff, medium-hard, fossiliferous, vuggy, shell fragments
1,360	1,370	Limestone, tan to brown, medium-hard, vuggy, fossiliferous, shell fragments
1,370	1,380	As above
1,380	1,390	As above
1,390	1,400	As above
1,400	1,410	Limestone, white to buff, medium-hard to soft, vuggy matrix, granular to chalky
1,410	1,420	Limestone, as above with massive gray limestone, very hard
1,420	1,430	Limestone, white to buff, medium-hard to soft, vuggy matrix, granular to chalky
1,430	1,440	As above
1,440	1,450	As above
1,450	1,460	As above
1,460	1,470	Limestone, tan to brown, medium-hard to soft, chalky to granular and vuggy matrix, some brown clay present
1,470	1,480	As above
1,480	1,490	Limestone, white to buff, medium-hard to soft, chalky matrix, microfossils, cement present in sample
1,490	1,500	As above
1,500	1,510	As above
1,510	1,520	As above
1,520	1,530	As above
1,530	1,540	As above

Table 2.11-5--Continued

Depth Interval (ft)		
From	To	Description
1,540	1,550	As above
1,550	1,560	Limestone, tan, very hard, massive, some vugs, limestone, tan, medium-hard to soft, granular to chalky matrix
1,560	1,570	As above
1,570	1,580	Limestone, tan, soft, granular and vuggy matrix, microfossils
1,580	1,590	Limestone, as above with white medium-hard limestone with chalky to silty matrix
1,590	1,600	As above
1,600	1,610	As above
1,610	1,620	As above, limestone, dark gray, very hard, massive and vuggy
1,620	1,630	Limestone, tan, soft, granular to silty, vuggy, fragments of dark gray limestone
1,630	1,640	As above
1,640	1,650	As above
1,650	1,660	As above
1,660	1,670	As above
1,670	1,680	Limestone, tan to brown, medium-hard to soft, granular, some clay present, microfossils present
1,680	1,690	As above
1,690	1,700	Limestone, buff colored, medium-hard, chalky to granular and vuggy
1,700	1,710	Limestone, tan, medium-hard, weathered microfossils present, some fossiliferous limestone
1,710	1,720	As above
1,720	1,730	As above

Table 2.11-5--Continued

Depth Interval (ft) From	To	Description
1,730	1,740	As above
1,740	1,750	Limestone, tan, medium-hard, granular, fossiliferous
1,750	1,760	Limestone, as above, buff to light gray
1,760	1,770	As above
1,770	1,780	As above
1,780	1,790	As above
1,790	1,800	As above
1,800	1,810	Limestone, tan to buff, some hard compacted gray limestone, mostly medium-hard, fossiliferous and sandy
1,810	1,820	As above
1,820	1,830	As above
1,830	1,840	As above
1,840	1,850	As above
1,850	1,860	As above
1,860	1,870	As above
1,870	1,880	Limestone, tan to buff, porous, some recrystallized
1,880	1,890	As above
1,890	1,900	As above
1,900	1,910	As above, with some dolomitized fragments
1,910	1,920	Limestone, buff, small grains, some fossils
1,920	1,930	As above

Table 2.11-6
WATER QUALITY DATA FROM PILOT HOLE DRILLING
WELL FA-1

Date	Time	Depth (ft)	Temperature (°C)	Specific Gravity	Specific Conductance (µmhos/cm)	Chlorides (mg/l)	Remarks
08/17	0445	1,003	28.9	1.0505	80,000+	46,570	Added 200 sacks of salt
08/17	1130	1,035	28.9	1.0470	79,000	42,780	
08/17	1330	1,069	28.9	1.0445	71,000	39,897	
08/17	1545	1,099	28.9	1.0415	70,000	37,200	
08/17	1700	1,130	28.9	1.0420	71,000	36,635	
08/17	1950	1,162	27.8	1.0350	60,000	34,410	
08/17	2250	1,194	27.8	1.0335	55,000	29,760	
08/18	0050	1,224	28.3	1.0265	49,000	25,668	
08/18	0235	1,254	27.8	1.0250	49,000	22,320	
08/18	0400	1,283	27.8	1.0250	49,000	23,000	Added salt to kill well
08/20	0400	1,315	27.8	1.0250	40,000	22,560	
08/20	1430	1,350	27.8	1.0300	50,000	31,000	
08/20	1830	1,381	27.8	1.0345	52,000	31,020	
08/20	2300	1,412	27.8	1.0230	38,000	20,680	
08/21	0125	1,443	27.8	1.0200	34,000	20,210	
08/21	0300	1,477	27.8	1.0150	31,000	14,100	
08/21	1600	1,522	27.8	1.0085	18,000	8,460	
08/22	0130	1,541	27.8	1.0075	18,000	10,340	
08/22	0500	1,575	27.8	1.0075	18,000	11,000	
08/22	1200	1,609	27.8	1.0075	18,000	11,000	
08/24	2100	1,647	27.8	1.0240	4,000	22,506	
08/29	0100	1,678	27.8	1.0151	3,200	14,415	

Table 2.11-6--Continued

Date	Time	Depth (ft)	Temperature (°C)	Specific Gravity	Specific Conductance (μmhos/cm)	Chlorides (mg/l)	Remarks
08/29	0245	1,709	27.8	1.0150	3,000	12,369	
08/29	0500	1,740	27.8	1.0120	22,000	8,928	
08/29	0810	1,772	27.8	1.0057	1,575	7,626	
09/10	0955	1,805	27.8	1.0059	1,800	7,905	
09/10	1140	1,830	27.8	1.0053	1,050	7,440	
09/10	1400	1,861	27.8	1.0056	1,580	7,533	
09/10	1700	1,880	27.8	1.0051	1,000	9,393	

Table 2.11-7 N.E.
WATER QUALITY OF BISCAYNE AQUIFER--N.E. MONITORING WELL[a]
SITE FA-1

Date	Time	Temperature (°C)	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
07/25	1715	25	2,200	790	10.81	
08/08	1100	27.8	--	--	11.25	
08/14	1900	26.1	2,100	729	10.71	
08/21	1800	26.1	1,800	596	10.40	
08/27	1325	27.8	900	175	11.11	
09/04	1000	27.8	1,000	195	11.09	
09/11	1100	27.8	1,000	190	11.10	

[a]This well is also the N.W. monitoring well for I-8.

Table 2.11-7 N.W.
WATER QUALITY OF BISCAYNE AQUIFER--N.W. MONITORING WELL
SITE FA-1

Date	Time	Temperature (°C)	Specific Conductance (µmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
07/25	1710	25.6	1,800	651	10.33	
08/08	1105	26.7	--	--	10.72	
08/14	1905	26.1	2,000	680	9.76	
08/21	1805	26.1	1,900	630	10.34	
08/27	1330	27.8	1,800	550	10.60	
09/04	1015	27.8	1,800	545	10.58	
09/11	1115	27.8	1,800	550	10.60	

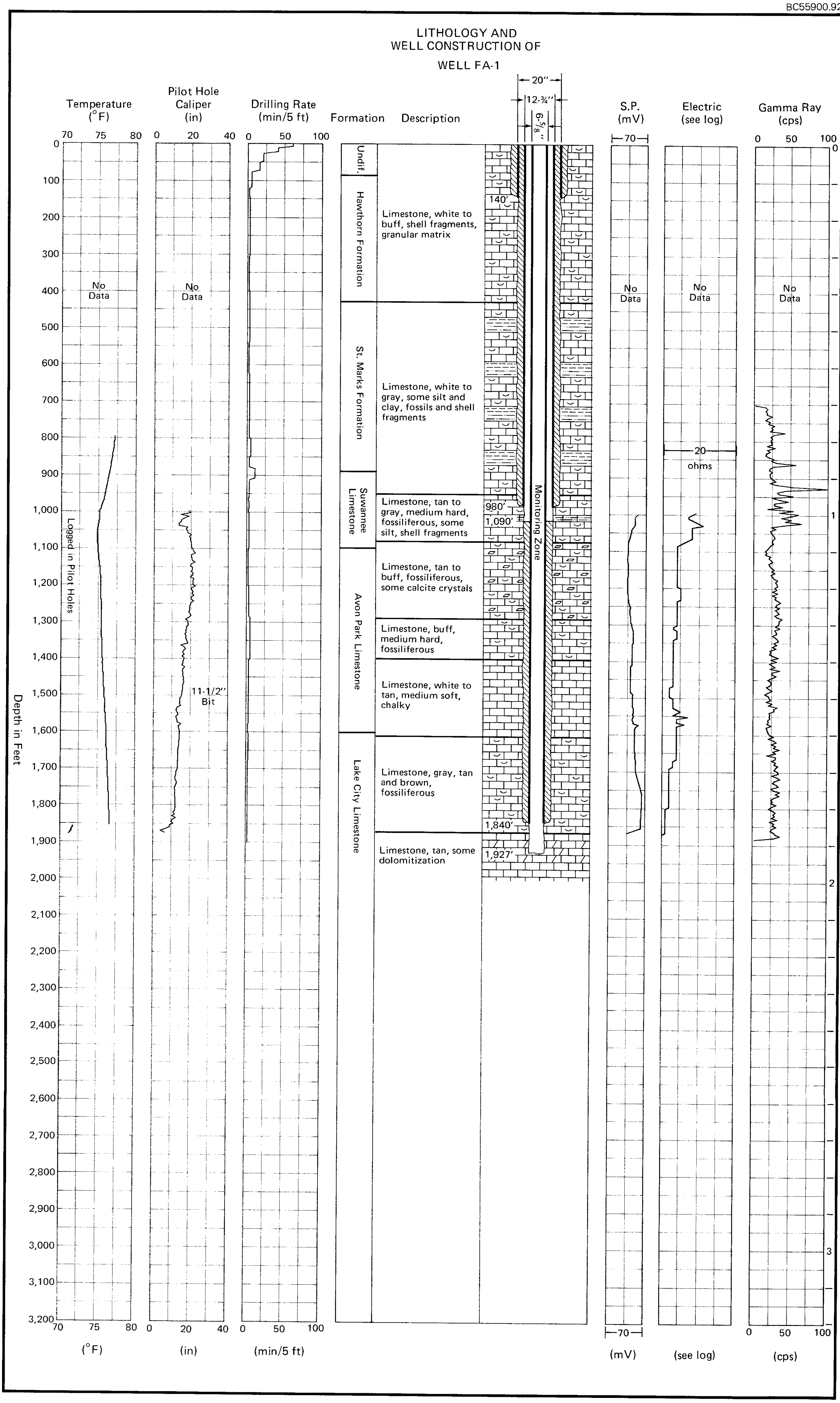
Table 2.11-7 S.E.
WATER QUALITY OF BISCAYNE AQUIFER--S.E. MONITORING WELL[a]
SITE FA-1

Date	Time	Temperature (°C)	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
07/25	1705	25.0	1,030	316	8.41	
08/08	1110	--	--	--	8.92	
08/14	1910	--	--	--	--	
08/21	1810	--	--	--	--	
08/27	1320	27.8	1,500	450	8.76	
09/04	1010	27.8	1,500	505	8.80	
09/11	1110	27.8	1,500	500	8.78	

[a]This well is also the S.W. monitoring well for I-8.

Table 2.11-7 S.W.
WATER QUALITY OF BISCAYNE AQUIFER--S.W. MONITORING WELL
SITE FA-1

Date	Time	Temperature (°C)	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
07/25	1700	26.1	2,000	726	10.70	
08/08	1115	27.8	--	--	12.92	Changed measuring point
08/14	1915	26.7	3,000	1,165	11.40	
08/21	1815	25.6	2,400	1,070	12.42	
08/27	1315	28.9	1,000	495	12.81	
09/04	1020	28.9	1,700	515	12.80	
09/11	1120	28.9	1,650	500	12.80	



Summary of drilling and logging data–Monitoring Well FA-1.

FIGURE 2.11-1.

Chapter 2.12
MONITORING WELL FA-2

Monitoring Well FA-2 is located 100 feet northwest of I-9 on the southern boundary of the project site as shown on Figure 1.1-2, Section 1, Summary. The well was started on June 26, 1980, and was completed on November 21, 1980. The drilling and casing sequence was as follows:

1. Drilled a 28-inch hole to 140 feet.
2. Set and cemented 20-inch casing from a depth of 140 feet up to the concrete drilling pad.
3. Drilled a 19-inch hole to 1,000 feet.
4. Set and cemented the 12-3/4-inch casing from a depth of 980 feet up to the concrete drilling pad.
5. Drilled an 11-1/2-inch hole on open circulation to a depth of 1,651 feet.
6. Installed the 6-5/8-inch casing to a depth of 1,645 feet.
7. Cemented the 6-5/8-inch casing from 1,645 feet to 1,020 feet.
8. Pressure tested the 6-5/8-inch casing at 100 psi for 1 hour with no pressure loss.
9. Drilled a 5-7/8-inch hole to TD of 1,671 feet.
10. Developed the well and annulus by air lifting.
11. Ran a cement bond log on the 6-5/8-inch casing.
12. Completed the pad and wellhead as per specifications.
13. Disinfected and sampled the well as per specifications.

Casings are Black steel, API 5L, Grade B, and ASTM A 139, Grade B. The casing data are summarized in Table 2.12-1. The three casings were cemented with Class H cement slurries as summarized in Table 2.12-2. Geophysical logs and TV surveys run on the well are listed in Table 2.12-3. Table 2.12-4 gives a descriptive summary of the underwater television surveys run in this well. Table 2.12-5 presents the lithology of the formation samples collected during drilling. The quality of water samples collected during drilling is shown in Table 2.12-6. Figure 2.12-1 is a summary of the well's construction, and includes the well construction diagram, lithologic log, drilling rate, electric, gamma radiation, temperature, and caliper logs.

The TV survey run in this well after drilling and cementing was completed showed a centralizer blocking the hole at 1,653 feet in depth. This prevented reaching the total depth of the well (1,671 feet) with the TV camera. The contractor was asked to clean the bottom of the hole, and a new TV survey showed the bottom cleaned to a depth of 1,671 feet.

The first survey in Table 2.12-7 is of the open hole from 980 feet to 1,657 feet. The second survey is of the completed well after clean-out.

<u>Biscayne Aquifer Water Quality Monitoring</u>

During drilling of the well, water samples were collected and levels measured at each of five shallow monitoring wells installed around the drilling pad. Four of the wells were 2-inch-diamter PVC, approximately 20 feet deep located at each corner of the pad. The fifth was 8-inch-diameter steel, approximately 40 feet deep and was used for supply water during construction. These data are included in Tables 2.12-7 N.E. through 2.12-7 W.S.

Table 2.12-1
SUMMARY OF CASING DATA
WELL FA-2

Diameter (inches)	Wall Thickness (inches)	Depth (feet)[a]		Cemented Section (depth in feet)[a]	
		From	To	From	To
20	.438	0	140	0	140
12-3/4	.375	0	980	0	980
6-5/8	.280	0	1,645	0	1,020

[a]Measured from the top of the concrete drilling pad.

Table 2.12-2
SUMMARY OF CEMENTING OF CASINGS
WELL FA-2

Date	Casing Cemented	Type of Cement Used (API)	Number of Sacks Used	Depth Cemented (ft)	
				From	To
06/29/80	20"	Class H w/25 lb gilsonite per sack of cement	210	140	0
07/10/80	12-3/4"	Class H w/2% bentonite	600	980	0
07/22/80	6-5/8"	Class H neat	1,042	1,645	1,408
07/23/80	6-5/8"	Class H neat	692	1,408	1,129
07/24/80	6-5/8"	Class H neat	332	1,129	1,020

Table 2.12-3
LIST OF GEOPHYSICAL LOGS AND WELL SURVEYS
WELL FA-2

Date	Well Progress and Casing Depth	Type of Logs or Surveys Run[a]	Purpose
07/07/80	20" casing to 140' 12" hole to 1,000'	E, G, C	1. Identify the top of the Floridan aquifer. 2. Establish the setting depth of the 12-3/4" casing.
07/20/80	12-3/4" casing to 980' 11-1/2" hole to 1,651'	E, G, C, T_F, FC_F, FV_F, TV	1. Geohydrological definition of the Floridan aquifer. 2. Visual evaluation of the Ocala group. 3. Establish the setting depth of the 6-5/8" casing.
12/02/80	6-5/8" casing to 1,645' 5-7/8" hole to 1,671'	CBL	1. Confirm the adequacy of the cement, outside the 6-5/8" casing.
01/28/81	As above	E, G, C, T_F	1. Geohydrological definition of the monitor zone.
01/31/81	As above	TV	1. Visual inspection of the 6-5/8" casing and monitor zone.

Table 2.12-3--Continued

Date	Well Progress and Casing Depth	Type of Logs or Surveys Run[a]	Purpose
03/26/81	As above	TV	1. Final visual inspection of the casing and open hole after clean-out.

[a]Abbreviations for logs and surveys are as follows:

E = single point electric and SP
LSN = long and short normal and SP
G = gamma ray
C = caliper
T_S = temperature, static
T_F = temperature, flowing
FV_S = fluid velocity (flow meter) static
FV_F = fluid velocity (flow meter) flowing
FC = fluid conductivity

GYRO = gyroscopic directional survey
TV = television
CBL = cement bond, variable density
WTD = wave train display
D. IND = dual induction electric and SP
BCS = borehole compensated sonic
Density = formation density
AV = acoustic velocity
GGD = gamma gamma density (0-500 ft)

Table 2.12-4
SUMMARY OF UNDERWATER TELEVISION SURVEY
WELL FA-2

CH2M HILL

RECORD OF UNDERWATER TV SURVEY

Project: Miami Dade Water & Sewer Authority, South District Regional Wastewater Treatment Plant

Well: FA-2

Survey By: Deep Venture Diving Service, Perry, Florida
HP-4,000 AU

Survey Date: 7/19/80 Total Depth: 1,687 feet

Witnessed By: D. Cabit, T. McCormick, D. Snyder

Reviewed By: J. D. Lehnen Date: 2/20/81

Remarks: Surveyed while flowing, depth error = +30 feet in open hole section.

Depth in Feet		Reel Counter		Observations
From	To	From	To	
--	--	0	16	Blank tape
8	--	16	30	Camera stationary
8	13	30	37	Lower camera through packing assembly
13	15	37	41	Flow line "T" at 9:00
15	--	41	44	Kill line "T" at 3:00
15	1,010	44	368	Flowing 12-3/4" casing
1,010	--	368	370	Bottom of casing, correct depth = 980', +30' error
--	1,026	370	377	Large diameter hole, rough and mottled appearance
1,026	1,027	377	378	Larger hole, cavity
1,027	1,100	378	425	Mottled appearing hole, rough, no cavities
1,100	1,580	425	708	Smoother borehole walls, friable looking
1,580	1,600	708	720	Rough walls, mottled looking, small cavities, solution features
1,600	1,660	720	760	Friable walls, no cavities
1,660	1,683	760	770	Some minor solution activity

Project: Miami Dade Water & Sewer Authority, South District Regional Wastewater Treatment Plant

Well: FA-2 Date: 7/19/80 Total Depth: 1,687'

Depth in Feet		Reel Counter		Observations
From	To	From	To	
1,683	--	770	--	A strap of metal is laying in the hole at 1,683' corrected = 1,653'
--	1,687	--	778	Appears to be a centralizer, camera goes past
--	1,687	778	780	Bottom of the hole corrected = 1,657'
9,997	--	780	784	Depth indicator lost, correct count TD = 0000
9,997	9,640	784	884	Centralizer at 9,997', pulling out of hole
				End of tape

CH2M HILL

RECORD OF UNDERWATER TV SURVEY

Project: Miami Dade Water & Sewer Authority, South District Regional Wastewater Treatment Plant

Well: FA-2

Survey By: Deep Venture Diving Service, Perry, Florida
HP-4,000 AU

Survey Date: 3/26/80 Total Depth: 1,671 feet

Witnessed By: D. Snyder, D. Cabit, T. McCormick

Reviewed By: J. D. Lehnen Date: 3/30/81

Remarks: Survey run while well flowing at approximately 10 gpm after clean out

Depth in Feet		Reel Counter		Observations
From	To	From	To	
--	--	0	16	Titles
0	1,638	16	544	6-5/8" casing
--	1,638	544	--	Cement ports, 4:2" x 2"
1,642	1,645	546	554	Bottom of casing, adjust depth indicator to 1,645 feet
1,645	1,651	554	558	Smooth hole in cement
1,651	1,652	558	561	Large diameter hole
1,652	1,653	561	565	A rock and welding rod lay in the hole at 12:00
1,653	1,656	565	567	Large, rough hole
1,656	1,663	567	573	Smaller diameter hole, rough borehole walls
1,663	1,668	573	577	Cloudy water, smooth borehole
1,668	1,671	577	580	Rough borehole, vuggy
1,671	--	580	584	Bottom of hole, soft material
1,671	1,652	584	600	Coming out of the hole
1,652	--	600	605	Viewing the rock and welding rod no obstruction

RECORD OF UNDERWATER TV SURVEY

Project: Miami Dade Water & Sewer Authority, South District Regional Wastewater Treatment Plant

Well: FA-2 Date: 3/26/80 Total Depth: 1,671'

Depth in Feet		Reel Counter		Observations
From	To	From	To	
1,652	1,646	605	607	Coming out of hole, end of survey

Table 2.12-5
LITHOLOGY FROM PILOT HOLE FORMATION SAMPLES
WELL FA-2

Depth Interval (ft) From	To	Description
0	10	Limestone fill, white, coarse
10	20	Limestone, white to tan, coarse, oolitic, fossiliferous
20	30	As above
30	40	As above
40	50	Limestone, light gray to green, hard, fossiliferous
50	60	As above
60	70	As above
70	80	As above
80	90	Limestone, tan to buff, fine to medium grained, shell fragments
90	100	As above
100	110	As above
110	120	As above
120	130	As above
130	140	Siltstone, gray-green, soft, some clay and shell fragments
140	150	As above
150	160	Limestone, tan, fine grained, sandy, shell fragments
160	170	As above
170	180	As above
180	190	Clay, gray-green, sandy, some shell fragments
190	200	As above
200	210	Limestone, tan to gray, hard, shell fragments present, some sand

Table 2.12-5--Continued

Depth Interval (ft) From	To	Description
210	220	As above
220	230	Clay, green, silty, some sand and shell fragments
230	240	As above
240	250	Limestone, tan, fine grained, shell fragments, silica sand
250	260	As above
260	270	As above
270	280	As above
280	290	As above
290	300	As above
300	310	As above
310	320	As above
320	330	Clay, gray-green, limestone, tan to gray, hard, some shell fragments
330	340	Limestone, tan to gray, medium-hard, fossiliferous, shell fragments
340	350	As above
350	360	As above
360	370	As above
370	380	As above
380	390	As above
390	400	As above
400	410	As above
410	420	As above
420	430	As above

Table 2.12-5--Continued

Depth Interval (ft) From	To	Description
430	440	Limestone, tan to buff, soft, poorly consolidated, fossils present
440	450	As above
450	460	As above
460	470	As above
470	480	As above
480	490	As above
490	500	As above
500	510	As above
510	520	As above
520	530	As above
530	540	As above
540	550	As above
550	560	As above
560	570	As above
570	580	As above
580	590	As above
590	600	As above
600	610	Limestone, tan to buff, soft, fine grained, some shell fragments
610	620	As above
620	630	As above
630	640	As above
640	650	As above
650	660	As above

Table 2.12-5--Continued

Depth Interval (ft)		
From	To	Description
660	670	Limestone, tan to light gray, poorly consolidated, soft, some shell fragments
670	680	As above
680	690	As above
690	700	As above
700	710	As above
710	720	As above
720	730	As above
730	740	As above
740	750	As above
750	760	As above
760	770	As above
770	780	Limestone, tan to buff, medium grained, fossiliferous, shell fragments
780	790	As above
790	800	As above
800	810	As above
810	820	As above
820	830	As above
830	840	As above
840	850	As above
850	860	As above
860	870	As above
870	880	As above
880	890	As above

Table 2.12-5--Continued

Depth Interval (ft) From	To	Description
890	900	Limestone, greenish tan, soft, clayey, some shell fragments, cones present
900	910	As above
910	920	As above
920	930	As above
930	940	As above
940	950	As above
950	960	As above
960	970	As above
970	980	As above
980	990	As above
990	1,000	As above
1,000	1,010	Limestone, brown, hard, well consolidated, some fossils
1,010	1,020	Limestone, gray, coarse grained, hard, some shell fragments
1,020	1,030	As above, with some brown clay
1,030	1,040	Limestone, tan, medium-hard, shell fragments
1,040	1,050	As above
1,050	1,060	As above
1,060	1,070	As above
1,070	1,080	As above
1,080	1,090	As above
1,090	1,100	As above
1,100	1,110	As above
1,110	1,120	As above

Table 2.12-5--Continued

Depth Interval (ft)		
From	To	Description
1,120	1,130	As above
1,130	1,140	As above, with gray to green clay
1,140	1,150	As above
1,150	1,160	As above
1,160	1,170	As above
1,170	1,180	Limestone, tan to buff, medium-hard, shell fragments
1,180	1,190	As above
1,190	1,200	As above
1,200	1,210	As above
1,210	1,220	As above
1,220	1,230	As above
1,230	1,240	As above
1,240	1,250	As above
1,250	1,260	As above
1,260	1,270	As above
1,270	1,280	As above
1,280	1,290	As above
1,290	1,300	Limestone, tan to buff, poorly consolidated, friable, some fossils
1,300	1,310	As above
1,310	1,320	As above
1,320	1,330	As above
1,330	1,340	As above
1,340	1,350	As above

Table 2.12-5--Continued

Depth Interval (ft) From	To	Description
1,350	1,360	Limestone, tan and gray, moderately consolidated
1,360	1,370	As above
1,370	1,380	As above
1,380	1,390	As above
1,390	1,400	As above
1,400	1,410	As above
1,410	1,420	As above
1,420	1,430	As above
1,430	1,440	Limestone, tan, some shell fragments
1,440	1,450	As above
1,450	1,460	As above
1,460	1,470	As above
1,470	1,480	Limestone, tan, soft, chalky, shell fragments
1,480	1,490	As above
1,490	1,500	As above
1,500	1,510	Limestone, light tan, microfossils present, some gray recrystallized fragments
1,510	1,520	Limestone, cones and microfossils present
1,520	1,530	Limestone, light tan, soft to medium-hard with lime sand and few cones
1,530	1,540	Limestone, light tan to white, medium-hard, angular, small percentage of lime sand and few microfossils present
1,540	1,550	Limestone, tan, very soft, fine cuttings, few microfossils, no cones
1,550	1,560	As above

Table 2.12-5--Continued

Depth Interval (ft)		
From	To	Description
1,560	1,570	As above
1,570	1,580	Limestone, color unchanged, higher percentage of large fragments, microfossils present, a few cones present
1,580	1,590	As above
1,590	1,600	Limestone, as above
1,600	1,610	Limestone, tan, soft, granular, abundant microfossils
1,610	1,620	Limestone, as above, darker tan
1,620	1,630	Limestone, brown, sandy, microfossils and cones present
1,630	1,640	Limestone, as above, intermixed with darker gray limestone
1,640	1,650	Limestone, brown, sandy
1,650	1,660	Limestone, tan to gray, medium-hard, fossiliferous
1,660	1,670	As above

Table 2.12-6
WATER QUALITY DATA FROM PILOT HOLE DRILLING
WELL FA-2

Date	Time	Depth (ft)	Temperature (°C)	Specific Gravity	Specific Conductance (μmhos/cm)	Chlorides (mg/l)	Remarks
07/13	2250	1,014	25.0	1.0000	2,800	664	Drilling: open circulation
07/14	0305	1,042	25.0	1.0000	2,800	729	
07/14	0500	1,076	25.0	1.0000	2,800	691	
07/15	0930	1,108	25.0	1.0010	3,200	799	
07/15	2100	1,137	25.0	1.0010	2,800	686	
07/15	2400	1,170	25.0	1.0010	2,800	719	
07/16	1400	1,202	24.5	1.0010	2,800	752	
07/16	2130	1,237	245	1.0010	3,000	710	
07/17	0200	1,269	245	1.0010	3,000	823	
07/17	0640	1,297	34.5	1.0010	3,500	1,287	
07/17	1035	1,331	24.5	1.0010	4,200	1,561	
07/17	1230	≅1,360	--	--	4,000	1,137	Sample from discharge
07/17	1740	1,362	24.5	1.0012	4,000	1,578	
07/17	2000	1,395	24.5	1.0015	4,900	1,655	
07/17	2345	1,428	24.5	1.0020	5,200	1,815	
07/18	0430	1,460	24.0	1.0010	5,200	1,786	
07/18	0830	1,491	24.0	1.0010	6,500	1,927	
07/18	1100	1,523	24.0	1.0010	7,000 7,400	1,970	
07/18	1730	1,557	23.3	1.0020	6,800	3,025	
07/19	0206	1,589	23.9	1.0040	8,000	3,472	
07/19	1100	1,651	23.9	1.0040	8,100	3,560	

Table 2.12-7 N.E.
WATER QUALITY OF BISCAYNE AQUIFER--N.E. MONITORING WELL[a]
SITE FA-2

Date	Time	Temperature (°C)	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
06/23	1600	--	--	--	--	
06/30	1600	25.0	560	70	8.07	
07/08	1600	--	--	--	8.25	No sample contaminated with diesel
07/16	0900	25.6	440	29	8.19	Incorrect chloride values
07/16	1000	25.6	480	29	8.05	
07/23	1700	25.6	520	78	8.48	Correct chloride values
07/30	1830	25.6	480	60	8.53	
08/06	1800	26.7	530	60	8.16	
08/12	1200	27.8	490	88	8.20	
08/25	1445	27.8	520	65	8.37	
09/03	1400	26.7	540	68	8.42	
09/10	1535	26.7	520	65	8.40	
09/29	1400	26.7	520	90	8.50	
10/07	1400	26.7	520	70	8.50	
10/15	1230	26.2	500	65	8.48	
10/22	1230	26.8	520	70	8.65	

[a]This well is also the N.W. monitoring well for I-9.

Table 2.12-7 N.W.
WATER QUALITY OF BISCAYNE AQUIFER--N.W. MONITORING WELL
SITE FA-2

Date	Time	Temperature (°C)	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
06/23	1605	26.7	650	60	9.57	
06/30	1605	26.1	610	60	9.55	
07/08	1605	26.7	600	40	9.95	
07/10	0905	26.7	420	28	9.65	Incorrect chloride values
07/16	1005	26.7	400	10	9.55	
07/23	1705	26.7	480	45	9.98	Correct chloride values
07/30	1835	26.7	460	39	10.02	
08/06	1805	27.8	450	40	9.65	
08/19	1205	28.9	385	59	9.69	
08/25	1415	30.0	500	62	9.90	
09/03	1405	28.9	490	60	9.92	
09/10	1540	28.9	500	60	9.90	
09/24	1505	26.7	520	70	8.50	
10/07	1405	28.9	500	60	10.00	
10/15	1235	28.2	480	58	9.98	
10/22	1235	28.7	500	70	10.12	

Table 2.12-7 S.E.
WATER QUALITY OF BISCAYNE AQUIFER--S.E. MONITORING WELL[a]
SITE FA-2

Date	Time	Temperature (°C)	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
06/23	1610	25.6	340	68	10.45	
06/30	1610	24.4	420	70	10.42	
07/08	1610	24.4	560	29	10.65	Incorrect chloride values
07/10	0910	26.1	420	26	10.56	
07/16	1010	--	--	--	--	
07/23	1710	25.0	440	49	10.88	Correct chloride values
07/30	1840	25.6	380	49	10.88	
08/06	1810	25.6	410	45	10.52	
08/17	1210	25.6	420	53	10.56	
08/25	1425	27.8	440	52	10.76	
09/03	1410	26.1	480	55	10.80	
09/10	1545	26.1	460	54	10.78	
09/29	1410	26.1	500	60	10.80	
10/07	1410	26.1	500	60	10.80	
10/15	1240	25.5	480	55	10.78	
10/22	1240	26.0	500	65	10.95	

[a]This well is also the S.W. monitoring well for I-9.

Table 2.12-7 S.W.
WATER QUALITY OF BISCAYNE AQUIFER--S.W. MONITORING WELL
SITE FA-2

Date	Time	Temperature (°C)	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
06/23	1615	26.7	750	58	9.91	
06/30	1615	26.7	760	60	9.85	
07/08	1615	--	--	--	10.15	
07/10	0915	26.7	700	27	10.00	Incorrect chloride values
07/16	1015	26.7	620	19	9.85	
07/23	1715	26.7	760	68	10.29	Corrected chloride values
07/30	1845	27.2	600	56	10.64	
08/06	1815	27.8	550	58	9.92	
09/14	1215	28.3	510	55	9.96	
08/25	1415	29.4	580	58	9.20	
09/03	1415	28.9	480	55	9.22	
09/10	1545	28.9	500	56	9.20	
09/29	1415	28.9	500	60	9.20	
10/07	1415	28.9	500	60	9.20	
10/15	1245	28.3	480	54	9.18	
10/22	1245	28.9	500	70	9.33	

Table 2.12-7 W.S.
WATER QUALITY OF BISCAYNE AQUIFER--WATER SUPPLY WELL[a]
SITE FA-2

Date	Time	Temperature (°C)	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Depth to Water Level (ft)	Remarks
06/23	1620	--	--	--	--	Pump in well
06/30	1620	26.7	520	60	--	
07/08	1620	--	--	--	--	
07/10	0920	--	--	--	--	
07/16	1020	26.7	540	10	--	Incorrect chloride values
07/23	1720	--	--	--	--	
07/30	1850	--	--	--	--	
08/06	1820	26.7	400	54	--	Corrected values
08/19	1220	--	--	--	--	
08/25	1430	29.4	600	74	Hose	
09/03	1420	26.1	550	70	9.20	
09/10	1550	26.1	600	75	9.20	
09/29	1420	26.1	600	78	9.20	
10/07	1420	26.1	600	78	9.20	
10/15	1250	25.5	500	72	9.18	
10/22	1250	26.0	550	80	9.35	

[a]This well is also the water supply well for I-9.

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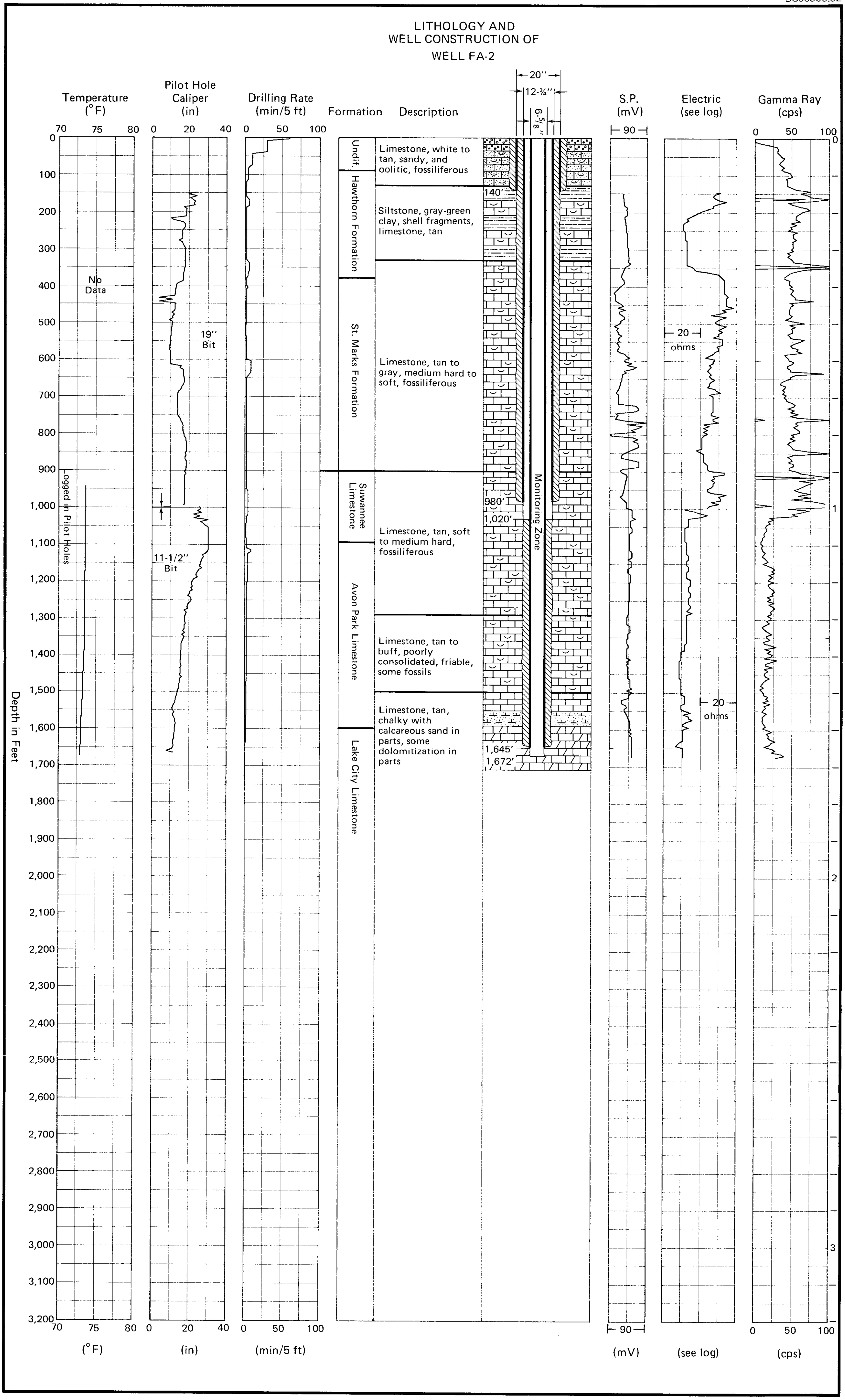

Summary of drilling and logging data—Monitoring Well FA-2.

FIGURE 2.12-1.