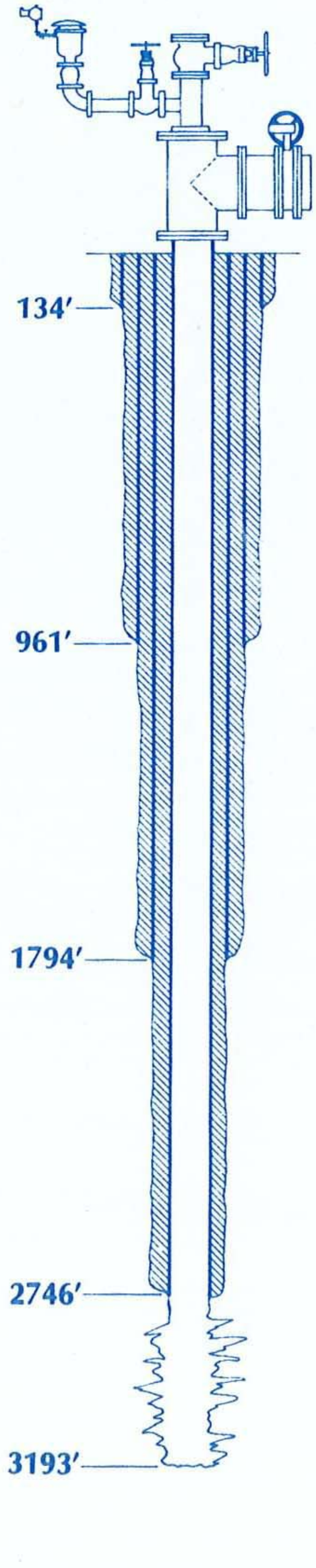
Engineering Report



DRILLING AND TESTING OF THE TEST-INJECTION WELL, I-5

for the Miami-Dade Water and Sewer Authority

Dade County, Florida

MDWSA Contract No. S-153
EPA Contract No. C120377020

December 1977
559-7601

CH2M HILL

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Chapter 1
INTRODUCTION

1.1 SCOPE

This report covers the drilling and testing of a test injection well just completed. The well was designed to determine the feasibility of deep underground injection of wastewaters from the proposed South District Regional Wastewater Treatment Plant of the Miami-Dade Water and Sewer Authority, Dade County, Florida. The report describes the hydrogeological conditions of the area, includes the requirements established by the regulatory agencies for their approval of deep-well injection, and summarizes the hydrogeological data collected as part of the test-construction program. It also includes conclusions derived from analysis of the above data.

All necessary work for the design and construction of the well, the collection of all hydrogeological data, and the preparation of this report was funded under the Wastewater Treatment Works Grant Program of the State of Florida and the U.S. Environmental Protection Agency.

The well was drilled in accordance with our "Specifications for Test Well for Disposal System," Project No. 559-76-01, dated December 1976, revised January 1977, under EPA Project No. C120377020, as approved by the Dade County Department of Environmental Resources Management and the State of Florida Department of Environmental Resources under Permit No. 13-8454-77, dated 8 February 1977.

1.2 GENERAL DESCRIPTION

The test-injection well just completed is located at the NE1/4 of the NE1/4 of section 21, T. 56 S., R. 40 E., Dade County, Florida, as shown on Figure 1-1. If approved as feasible and environmentally sound, the test well would be part of the effluent deep-well injection system for the proposed South District Regional Wastewater Treatment Plant. The nominal capacity of this plant would be 50 million gallons per day (mgd), with estimated peak flows of 112 mgd. The plant is designed to achieve a minimum of 90% reduction in BOD and suspended solids (secondary treatment).

Environmental studies and knowledge of the hydrogeology of the area have pointed to deep-well injection as the most cost-effective and environmentally sound alternative for

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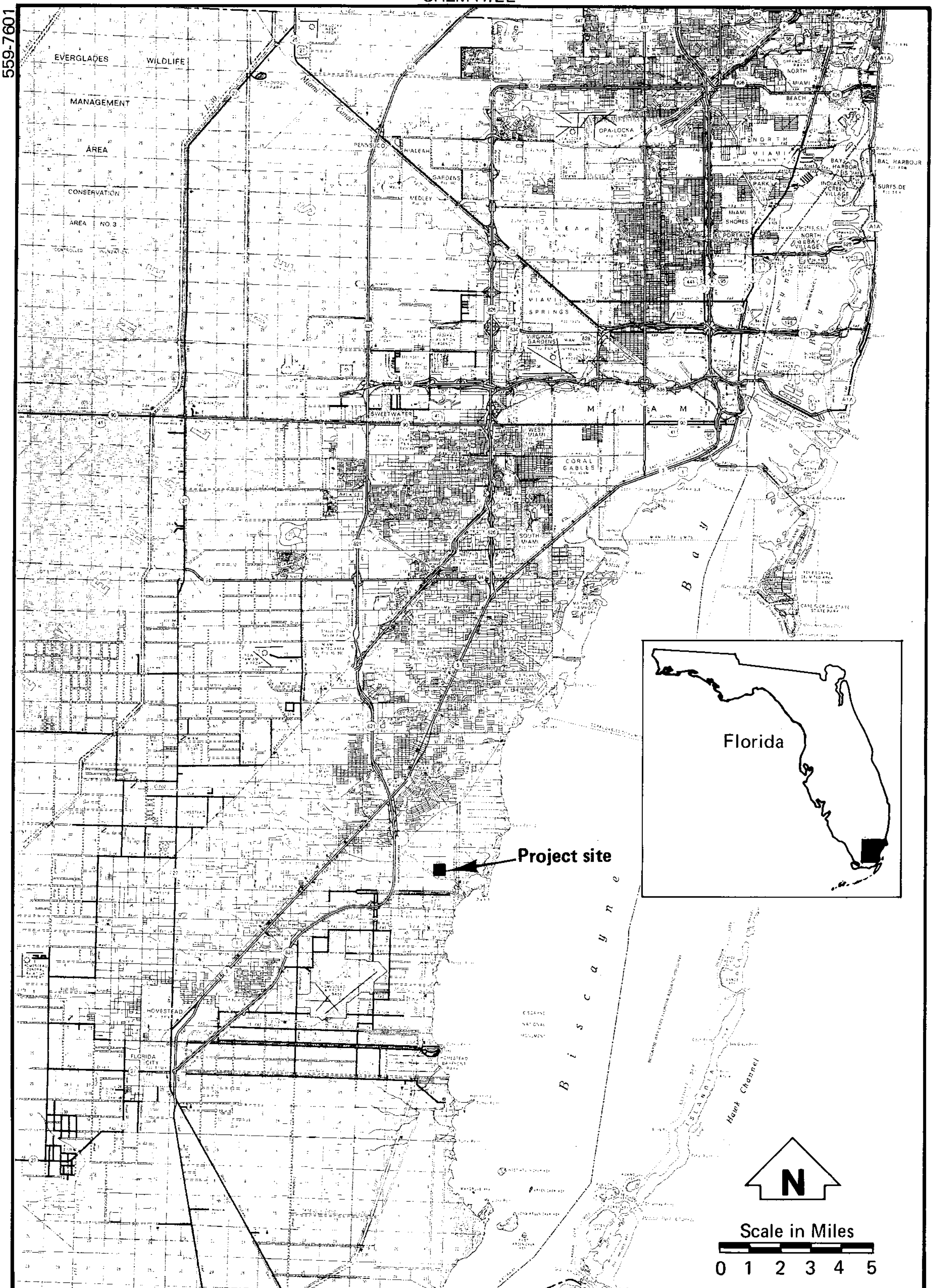


FIGURE 1-1. Project location.

effluent disposal at the South District Plant, provided field testing in the area could confirm basic assumptions (Water Quality Management Plan for Metropolitan Dade County, Florida, 1973).

The proposed well field layout of the deep-well injection system is shown on Figure 1-2. It includes nine deep injection wells, one Boulder Zone (±2,900 feet) monitoring well, and two Floridan aquifer monitoring wells (±1,100 and ±1,600 feet). The system will discharge into highly transmissive saltwater zones between 2,800 and 3,200 feet in depth. It will monitor the containment and/or movement of the injected effluent and monitor transmissive brackish-to-saltwater zones between 1,000 and 1,750 feet in depth. The system will also provide protection of these last transmissive zones and the Biscayne aquifer. This aquifer, or ground-water-bearing zone, extends from approximately 5 to 10 feet below ground level to approximately 100 feet in depth. It is one of the most productive aquifers in the world and is the source of water supply for southeast Florida, including the area served by the Miami-Dade Water and Sewer Authority.

1.3 DEEP-WELL INJECTION

Underground injection of effluents by wells can be successfully achieved only when five general requirements are fulfilled. These requirements are:

1. There is a stratum or strata which can accept the effluent.

2. The hydraulic and structural characteristics of the aquifer will not be significantly reduced by the disposal of the effluent.

3. The disposal of such effluent will not impair the present or future use of the water in such stratum or strata.

4. The disposal of such effluent will not impair the present or future use of the water in adjoining water-bearing strata (aquifers) or surface-water supplies.

5. The installation is properly designed.

The State of Florida is underlain by one of the richest artesian aquifer systems in the world. It consists of a series of ground-water-bearing strata of cavernous limestones and dolomites. The cavernous strata are separated by

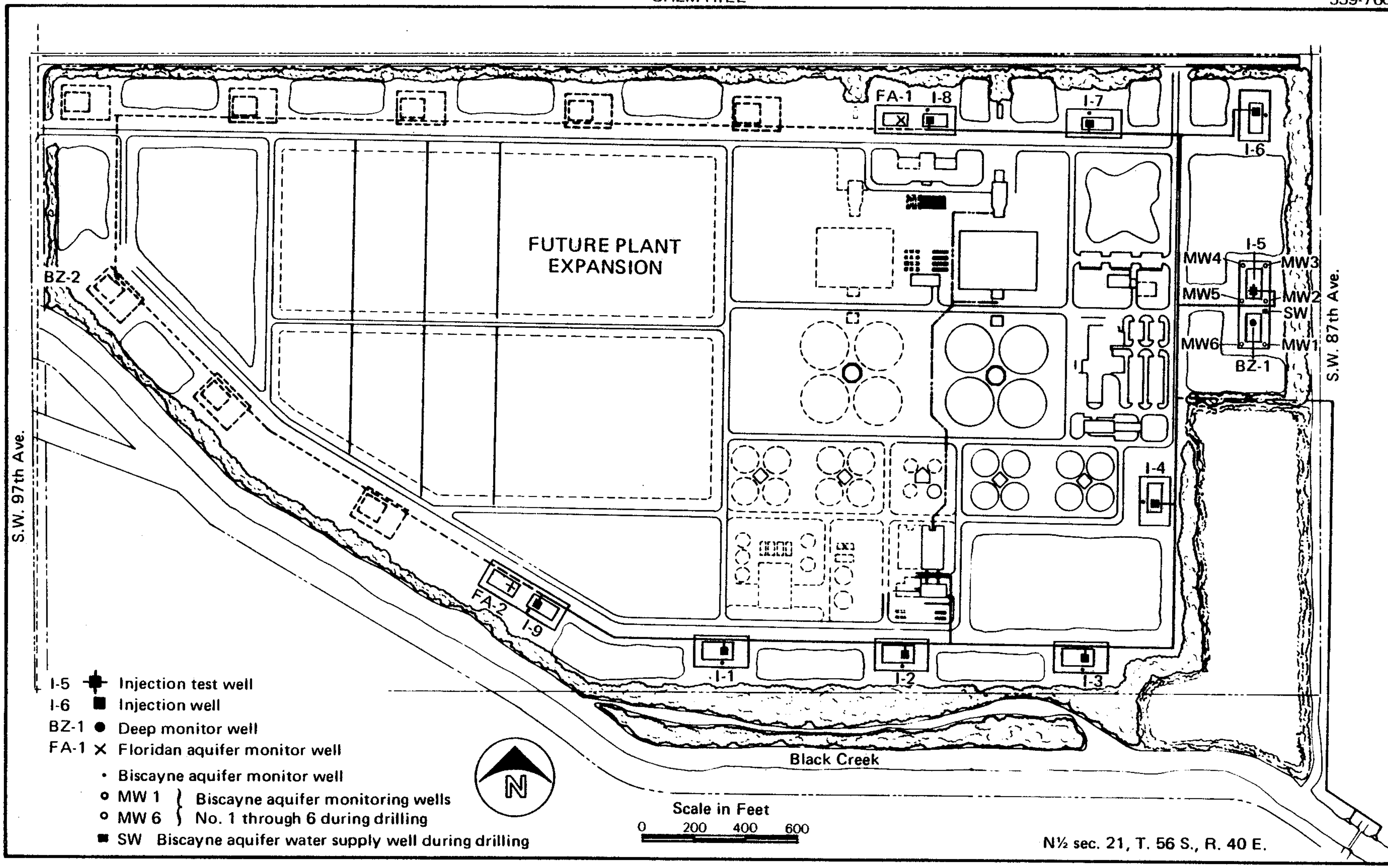


FIGURE 1-2. Injection and monitoring well field layout.

thick and practically impervious layers of marls, dense limestones, and dolomites. Ground water in the deep cavernous strata is highly mineralized in most of southern Florida.

Drilling through the deeper and highly cavernous zones breaks off large fragments of dolomites and limestones and presents serious difficulties similar to drilling through large boulders. For this reason, such strata are referred to as the Boulder Zone. The Boulder Zone extends under most of southern Florida.

The cavernous sections of the Boulder Zone can either produce or accept large volumes of water. Wells penetrating those sections with appropriate borehole size yield several thousand gallons per minute. Thus Requirement 1, above, may be easily fulfilled.

The physical and chemical qualities of the effluent to be injected in the proposed disposal well indicate that the hydraulic and structural characteristics of the aquifer will not be significantly changed. Therefore Requirement 2 is satisfied.

Water in the highly transmissive deep zone refered to as the Boulder Zone is practically seawater, and the discharge into it of secondary treated effluent should not prevent future use, if any, of this water. Requirement 3 is then fulfilled.

In Dade County, the upper sections of the principal artesian aquifer system, commonly referred to as the Floridan aquifer, extend from approximately 900 feet to 1,700 feet. Within these sections, the first water-bearing formations are referred to as the upper part of the Floridan aquifer, usually between 900 and 1,200 feet in depth. Those sections below are referred to as the lower part of the Floridan aquifer, usually between 1,400 and 1,700 feet in depth. The lower sections of the principal artesian aquifer, usually below 2,700 feet in depth, are commonly referred to as the Boulder Zone.

Water from the artesian aquifer system in Dade County is highly mineralized, and chlorides increase with depth until they reach seawater concentration. The high chloride concentrations of the artesian aquifers in this area preclude their use as a source of freshwater. Future use will require some demineralizing process to reduce the chloride content. Such process will remove any additional nitrates or phosphates injected into the aquifer without significant cost increase.

The Boulder Zone, containing chloride concentrations equal to seawater, is overlain by confining beds of several hundred feet in thickness. The effectiveness of the confining beds is discussed in Chapter 4. This condition protects brackish waters in the the Floridan aquifer, which is the logical source for the future if desalinization of water for the area is ever required or considered. Requirement 4 is then satisfied.

The only freshwater aquifer in Dade County is the Biscayne aquifer which, within the area under consideration, extends to approximately 100 feet in depth below. The Biscayne aquifer is completely separated from the Floridan aquifer by approximately 800 feet of marls, very dense limestones, and clayey sand and shells which constitute an effective confining bed. This is evidenced by the following fact: The Floridan aquifer in the Miami area shows chloride concentrations in excess of 700 mg/l with piezometric heads of more than 30 feet above mean sea level. In the same area, chloride concentrations in the Biscayne aquifer are approximately 30 to 40 mg/l, with water-table contours of 2 to 4 feet above mean sea level (USGS, Miami Office, 1968). The separating strata act then as an effective confining bed. Otherwise, the brackish water under pressure in the Floridan aquifer would leak up into the Biscayne aquifer, contaminating it.

One question the reader may ask at this time is: Where does the injected water go? Present technology does not yet offer practical and economical means to directly determine the direction of ground-water flow at considerable depth. However, present knowledge of hydrogeology gives us good indications of what would happen to the injected fluid.

First, we should consider that the fluid to be injected is freshwater with lower specific gravity (lighter) than the high chloride water in the aquifer. Mixing will occur at the start of the injection period, but thereafter a freshwater bubble should begin to form, floating on the salty water and limited above by the confining layers. This is based on the Ghyben-Herzberg principle (Stringfield, V.T., and Cooper, H.H., 1951), which explains the relation between freshwater and saltwater in coastal areas. This principle allows for the recharge of freshwater into saltwater or brackish water aquifers, as has been investigated by the U.S. Geological Survey in Dade County, Florida (Meyer, 1977).

Second, we need to realize that ground water moves in accordance with the hydraulic gradient, following a direction perpendicular to the piezometric contours. If the piezometric surface of the Boulder Zone resembles, as it should, that of the upper part of the Floridan aquifer, the direction of ground-water flow in Dade County is toward the Florida Straits in the Atlantic Ocean.

Finally, it must be considered that ground-water movement in the Floridan aquifer is very slow under natural conditions. Average ground-water velocity in the Floridan aquifer of central Florida has been estimated to be on the order of 20 to 30 feet per year (Hanshaw et al., 1965). Under such conditions, it would take approximately 200 years for a particle of water to move 1 mile, or some 7,000 years for that particle of water to reach its probable point of discharge in the Florida Straits at a depth of approximately 2,600 feet (Uchupi, 1968, plate 3) and 35 miles east of our well location (tides and other physical phenomena could reduce the above figures).

1.4 GOVERNMENTAL REGULATIONS

A permit to drill the test-injection well was obtained prior to its construction from the pertinent regulatory agency: the State of Florida Department of Environmental Regulation (DER). A copy of permit 13-8454-77, dated 8 Feburary 1977, is included in Appendix A of this report.

Also included in Appendix A are summaries of the meetings held among the regulatory agencies from the start of the conceptual design of the well until its completion. Close cooperation of all parties involved was a key factor in the successful completion of the project within the limited time frame available.

1.5 ACKNOWLEDGMENTS

The successful completion of the test-injection well has been the joint effort of many agencies and individuals. Those who played a key role in this endeavor are:

DER (Department of Environmental Regulation, State of Florida): Messrs. W. R. Albritton, Steve Conn, and Roy M. Duke.

DERM (Dade County Department of Environmental Resources Management): Messrs. Tony Clemente and Tony Sobrino.

EPA (Environmental Protection Agency, U.S. Government): Mr. Gene Coker.

Halliburton Company: Mr. Gerald Badeaux.

Miami-Dade Water and Sewer Authority: Messrs. Robert V. Celette, J. F. Cowgill, George A. King, Tom McCormick, Pete Smits and Garrett Sloan.

Progress Drilling and Progress Drilling and Supply Companies (Contractors): Messrs. J. C. Coker, R. E. Ramage, and Keith Wilson.

SFWMD (South Florida Water Management District): Messrs. David Allman and Abe Kreitman.

USGS (U.S. Geological Survey, Water Resources Division, Miami Subdistrict Office): Mr. Fred W. Meyer.

To all of them and to many others who would make the list too long for this report, our sincerest appreciation.

Chapter 2
WELL CONSTRUCTION

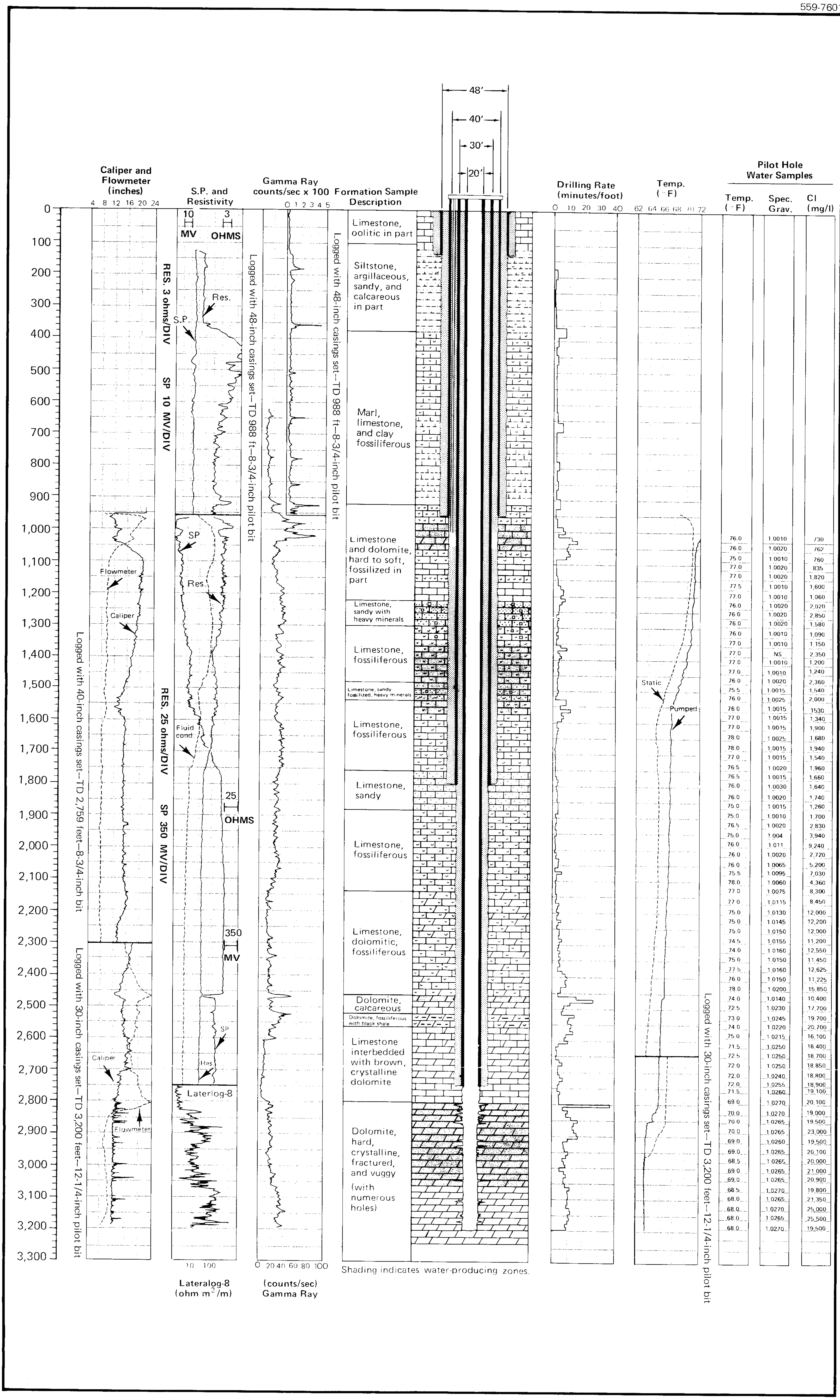
2.1 DRILLING

Before drilling could begin, construction of an access road to the project site was started on 2 May 1977. The entrance of this graded access road was from S.W. 97th Avenue. This was followed by construction of a drilling pad according to the specifications and plans laid out in the contract (Photo 2-1). The pad was 320 feet by 132 feet in dimensions and raised to 10 feet above mean sea level (approximately 8 feet above ground surface). It was constructed mostly of limestone trucked to the site from a nearby quarry and compacted at the site. Moreover, a concrete slab, 120 feet by 98 feet, with suitable curbs and sump to catch saltwater spills, was poured on this pad around the well.

Rotary drilling on the well started 8 July 1977 with an exploratory hole 8-3/4 inches in diameter. This was done to determine the depths at which to set and cement each of the four steel casings specified, as well as to collect all the geotechnical data required, such as formation samples, water samples, and geophysical logs.

The drilling and reaming operation progressed in stages, each stage covering the strata to be sealed off by the 48-inch, 40-inch, 30-inch, and 20-inch casings, respectively.

Drilling (Photo 2-2) was performed by conventional mud circulation to a depth of 974 feet through the Biscayne aquifer and the non-water-bearing aquiclude above the Floridan aquifer. Thereafter it was changed to air-reverse circulation to allow for the collection of water samples. Water samples were collected every 30 feet from the top of the Floridan aquifer (approximately 1,000 feet deep) to total depth (3,200 feet). Collection and analysis of these water samples are discussed in more detail later in this chapter. Geological formation samples were collected at 10-foot intervals from the bottom of the drilling pad to total depth. One set of samples was delivered to the Bureau of Geology, Florida Department of Natural Resources, and another set to Miami-Dade Water and Sewer Authority, while a third set was retained by Black, Crow and Eidsness, Inc., for their analysis. A more detailed discussion of the geological formation data is presented later in this chapter.



Summary of data from drilling and related operations.

FIGURE 2-1.

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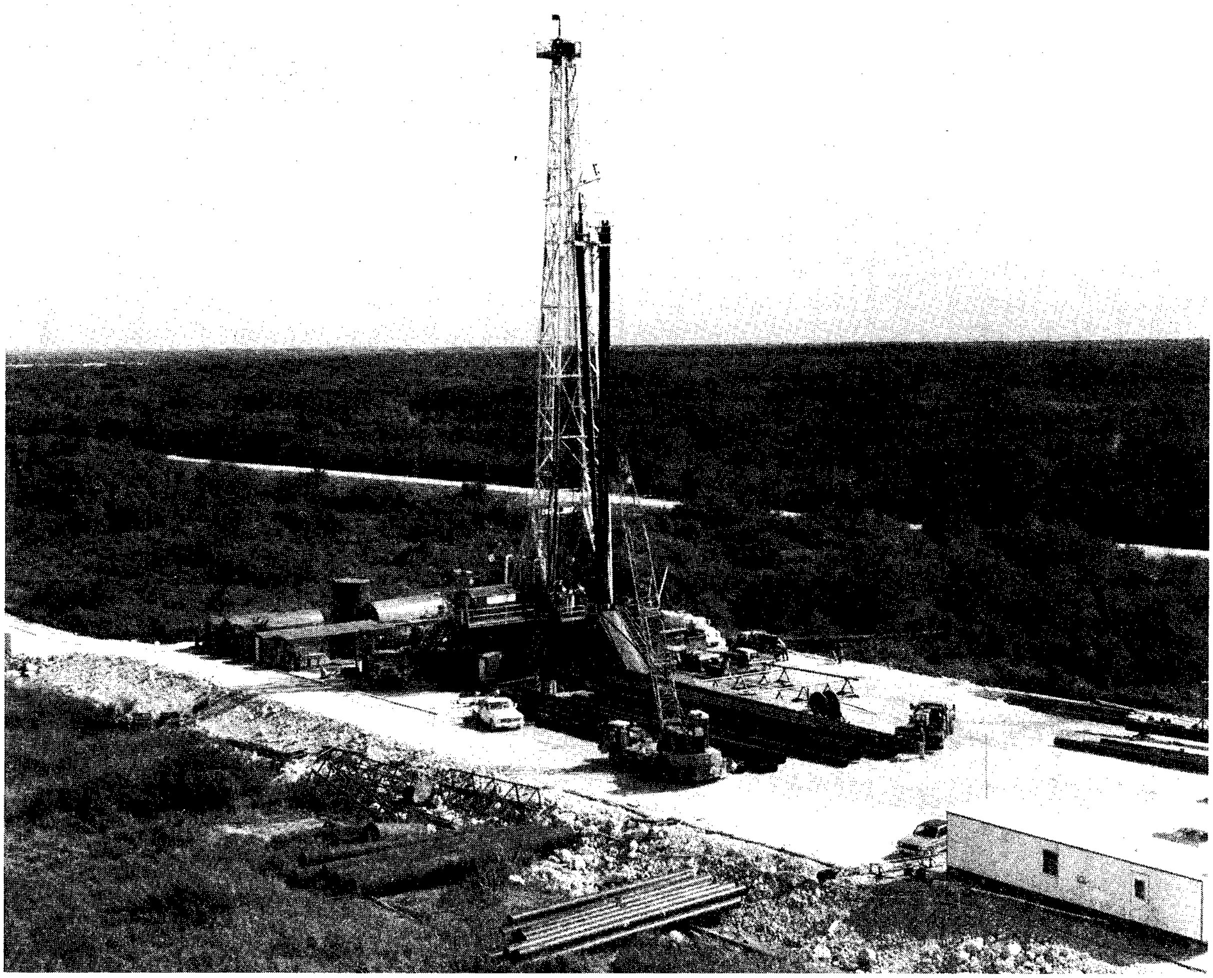

Photo 2-1. View of drilling site.

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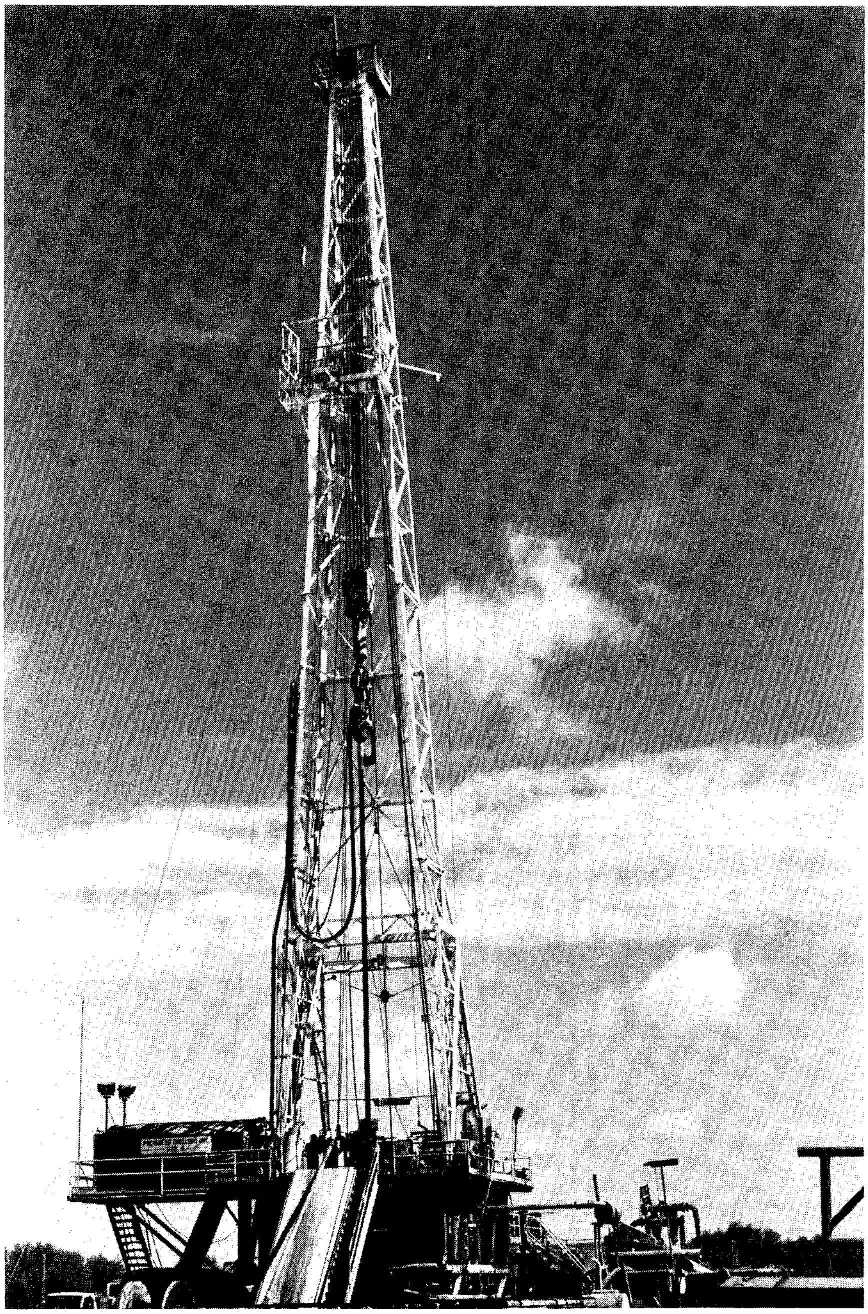

Photo 2-2. View of drilling rig.

The drilling and casing sequence of the test well was as follows:

1. Drilled 8-3/4-inch exploratory hole to 120 feet.

2. Reamed hole to 53-inch diameter to a depth of 135 feet.

3. Reamed hole to 59-inch diameter to a depth of 136 feet, since the Contractor experienced some difficulty in lowering the 48-inch casing in a 53-inch reamed hole.

4. Set and cemented 48-inch casing from the surface to a depth of 134 feet (approximately 30 feet below the bottom of the Biscayne aquifer).

5. Drilled 8-3/4-inch exploratory hole to 988 feet.

6. Reamed hole to 46-inch diameter to a depth of 974 feet.

7. Set and cemented 40-inch casing from the surface to a depth of 961 feet.

8. Drilled 8-3/4-inch exploratory hole to 2,759 feet.

9. Reamed hole to 37-inch diameter to a depth of 1,794 feet.

10. Installed 30-inch casing to a depth of 1,794 feet. First-stage cementing of this casing completed from 1,794 feet to 1,325 feet in depth.

11. Reamed 17-1/2-inch hole to 2,256 feet. The exploratory hole was earlier filled with cuttings from reaming the 37-inch hole and could not be cleaned out with an 8-3/4-inch bit, so the Contractor was allowed to clean out the hole to this depth with a 17-1/2-inch bit.

12. Reamed 12-1/4-inch hole to 2,759 feet. Drilled 12-1/4-inch exploratory hole to 3,200 feet (total depth).

13. Plugged the exploratory hole at 2,770 feet (just above the start of the Boulder Zone).

14. Reamed hole to 26-inch diameter to a depth of 2,746 feet.

15. Installed 20-inch casing to a depth of 2,746 feet. First-stage cementing of this casing completed from 2,746 feet to 2,473 feet.

16. Cemented the 30-inch casing (outside the casing) from 1,325 feet to 1,056 feet. Set 1-1/4-inch-diameter screen with monitoring tube (top and bottom of screen at 1,034 feet and 1,044 feet, respectively) in gravel topped with sand up to 1,007 feet. The tube coming up to the surface out of the 30-inch/40-inch annulus is for monitoring the water from the top of the Floridan aquifer. Cemented the 30-inch/40-inch annulus above 1,007 feet to the surface.

17. Reamed hole to 17-1/2-inch diameter to a depth of 3,193 feet.

18. Cemented the 20-inch/30-inch annulus from 2,473 feet to the surface.

Casings are black steel, AWWA Standard A100-66 and ASTM A-53, Grade B. Casing details are summarized in Table 2-1.

Table 2-1
Summary of Casing Data

Diameter (inches)	Wall Thickness (inches)	Depth in Feet		Cemented Section in Feet	
		From	To	From	To
48	0.500	0	134	134	0
40	0.625	0	961	961	0
30	0.500	0	1,794	1,794	1,056[a]
20	0.500	0	2,746	2,746	0

[a]Gravel was placed between 1,056 feet and 1,018 feet, followed by a sand cap from 1,018 feet to 1,007 feet. A 1-1/4-inch monitoring tube screen was installed between 1,034 feet and 1,044 feet.

Cementing of the four casings was done with API Class H cement as summarized in Table 2-2. Geophysical logging, which is discussed in more detail in Chapter 3, was performed several times during the above sequence, specifically after steps 5, 8, 10, 12, 15, 17, and 18, respectively. Packer tests were conducted after step 8 at selected intervals between 1,800 feet and 2,759 feet to determine the transmissive characteristics of the confining zone between the Floridan aquifer and the Boulder Zone. A 6,000-gpm pump-out test was run after step 17 to determine

Table 2-2
Summary of Cementing of Casings

Date	Casing Cemented	Type of Cement Used (API Class)	No. of Sacks of Cement Used	Depth Cemented (feet) From	To
7/19/77	48-inch	Class H w/25 lb of Gilsonite per sack	725	134	0
8/9/77	40-inch	Lead: Class H w/12% bentonite	1,150	961	0
		Tail: Class H w/2% bentonite	500		
9/6/77	30-inch	Lead: Class H w/12% bentonite	880	1,794	1,325
		Tail: Class H w/2% bentonite	520		
10/8/77	30-inch	Class H w/12% ben-tonite	276	1,325	1,213
10/8/77	30-inch	Class H w/12% ben-tonite	304	1,213	1,105
10/9/77	30-inch	Class H w/12% ben-tonite	100	1,105	1,056
10/9/77	30-inch	Gravel[a] (no cement)	67 (bags of gravel)	1,056	1,018
10/9/77	30-inch	Sand (no cement)	30 (bags of sand)	1,018	1,007
10/10/77	30-inch	Class H neat	150	1,007	995
10/10/77	30-inch	Class H w/12% ben-tonite	424	995	812
10/10/77	30-inch	Class H w/12% ben-tonite	621	812	316
10/11/77	30-inch	Class H w/12% ben-tonite	300	316	0
		Class H neat	150		
10/6/77	20-inch	Lead: Class H w/2% bentonite	750	2,746	2,473
		Tail: Class H neat	400		
10/21/77	20-inch	Class H thixotropic	100	2,473	2,459
10/21/77	20-inch	Class H thixotropic	100	2,459	2,419
10/22/77	20-inch	Class H thixotropic	100	2,419	2,378
10/23/77	20-inch	Class H w/12% bentonite	700	2,378	2,035
10/23/77	20-inch	Class H w/12% bentonite	500	2,035	1,865
10/23/77	20-inch	Class H neat	190	1,865	1,857
10/23/77	20-inch	Class H neat	150	1,857	1,790
10/24/77	20-inch	Class H w/12% bentonite	1,000	1,790	1,047
10/24/77	20-inch	Class H w/12% bentonite	950	1,047	228

Table 2-2--Continued

Date	Casing Cemented	Type of Cement Used (API Class)	No. of Sacks of Cement Used	Depth Cemented (feet) From	To
10/24/77	20-inch	Class H w/12% bentonite	200	228	0
		Class H neat	150		

[a]A 1-1/4-inch monitoring tube screen was installed between 1,034 feet and 1,044 feet in the annulus between 30-inch and 40-inch casings.

the aquifer characteristics of the Boulder Zone. And an 8,000-gpm injection test was conducted after step 18 to confirm well performance under operating conditions. These tests and their results are described in Chapter 4. Television surveys were run in the well after steps 8, 12, and 18, respectively. The first run was made to help decide the depth at which the 30-inch casing was to be installed, as well as to select the packer test intervals. The second run was performed to help decide the depth of the 20-inch casing to be set; and the third TV survey provided a video log of the completed well for permanent record.

Rough drilling was encountered in the hard broken dolomite of the Boulder Zone. During step 17, the bit began locking up and kicking back at a depth of 3,193 feet (7 feet above total depth). So it was decided to terminate the reaming operation at this depth. During the entire drilling operation, a deviation survey of the hole was performed every 60 feet to ensure that the hole did not deviate more than 1 degree from the center.

All the depth levels stated in this report are from the top of the drilling pad (elevation +9.4 feet msl).

2.2 GEOLOGICAL FORMATION DATA

Formation samples were collected at 10-foot intervals to total depth. A detailed description of the samples is presented in Appendix B, "Well Drilling Report." This section summarizes, in general, the findings from these samples.

Hard to medium hard limestone was encountered during the first 100 feet, through the Biscayne aquifer. This was tan to gray in color, and oolitic in part. The upper limestone is tentatively identified as the Miami Limestone and Fort Thompson Formation. Siltstone and clay came next up to approximately 390 feet in depth. The siltstone was argillaceous, sandy and calcareous in part, and olive green in color. These strata are tentatively identified as the Hawthorn Formation of Miocene age. Below this formation to about 920 feet, i.e., nearly to the bottom of the aquiclude above the Floridan aquifer, were soft sandy limestone and clays of the St. Marks Formation. The limestone was tan to buff, poorly to moderately consolidated, with some light-green clay.

The top of the Floridan aquifer is characterized by hard to soft limestone, fossiliferous in part and pale yellowish brown in color. The limestone is granular and is dolomitic at several places; also "cones" (Dictyoconus sp./ Coskinolina sp.) are abundant at a few depths. This stratum, which extends to a depth of about 1,600 feet, includes the Suwannee Limestone of Oligocene age and part of the Avon Park Limestone of middle Eocene age. Some pyrite, sand, and heavy mineral grains found at 1,230 feet to 1,300 feet and 1,480 feet to 1,540 feet in depth probably are present in cavity fill material.

The confining beds below the Floridan aquifer consist principally of soft, chalky, white-to-tan and dark gray limestone from a depth of 1,680 feet to a depth of about 2,500 feet. This stratum becomes progressively harder with depth. Below 2,160 feet, the formation has a "weathered" appearance.

Calcareous dolomite is dominant between 2,460 feet and 2,520 feet, while the formation between 2,520 feet and 2,550 feet is mostly fossiliferous dolomite with black shale. From 2,550 feet to 2,790 feet, limestone is interbedded with brown crystalline dolomite. The strata between the depths of 1,230 feet and 2,790 feet comprise respectively the Avon Park Limestone and the Lake City Limestone of middle Eocene age. These two geologic formations cannot be differentiated on the basis of lithology alone at this site. The main confining zone within these formations extends from approximately 1,680 to 2,790 feet.

The Boulder Zone formation begins at approximately 2,790 feet, and is composed of hard, massive, and crystallized dolomite that is fractured in several places. This formation continues to the total depth of the well (3,200 feet). The Boulder Zone dolomites probably mark the top of the Oldsmar Limestone of lower Eocene age.

Stratigraphically, the Miami-Dade Water and Sewer Authority South District regional deep well disposal site is approximately 100 feet higher than the Sunset Park injection well site (10 miles north) and 30 feet lower than the Florida Power and Light South Dade well site (14 miles south).

2.3 WATER QUALITY DATA

Water samples were collected every 30 feet during the drilling of the exploratory hole with air-reverse circulation, starting with step 8 mentioned in the drilling section of this chapter. Samples were collected directly from the natural artesian flow coming out of the drill pipe (Photo 2-3, top of drill pipe at approximately 29 feet msl), until water density prevented artesian flow. Thereafter they were airlifted. Temperature, specific gravity, pH, total alkalinity, specific conductance, and chloride concentrations of each sample were determined in the field immediately after collection. Results of field analyses for temperature, specific gravity, and chlorides are shown on Figure 2-1. A record of the field analyses and results of laboratory analyses of selected samples are presented in Appendix C, "Water Quality Data From Test Well." Photo 2-4 shows field chemical analyses being performed on the water samples.

Temperatures recorded in the field from water samples collected every 30 feet were not truly representative of temperatures at those depths since the airlifted water became warmer as it traveled up to the surface. However, they do show a trend of decrease in temperature with increase in depth, in particular between approximately 1,100 and 2,200 feet (from 77° F to 75° F), between 2,200 and 2,750 feet (from 75° F to 72° F), and between 2,750 feet and 3,200 feet (from 72° F to 68° F). Temperature logs run in the well confirm this trend and give representative temperatures, as discussed in Chapter 3. Temperature logs with no flow from or into the well showed a drop in temperature between 1,100 and 1,800 feet (from 71° F to 66° F) and another drop (66° F to 63.4° F) between 2,800 and 3,000 feet. Such temperature drops are contrary to the normal ground-water geothermal gradient of approximately 1° F increase per 50 to 100 feet increase in depth. This temperature gradient anomaly, present in southeast Florida, is related to heat transfer from the aquifer ground water into the cold, deep water of the Straits of Florida. Temperatures below 2,000 feet in depth in the Straits are known to be in the range of 45° to 50° F.

The specific gravity of the water in the Floridan aquifer from approximately 1,000 feet to 1,800 feet varies from 1.001 to 1.020. Chlorides range from 700 mg/l to 15,000 mg/l, while total dissolved solids were determined to vary from 2,500 mg/l to 41,000 mg/l. The tabulation of water quality parameters measured while drilling (Figure 2-1) shows the depths at which changes in water quality occurred, although, due to the sampling procedure, the values are integrated for a range of depths. A complete laboratory analysis, including that for pH, alkalinity, specific conductance, color, chloride, fluoride, nitrate, sulfate, sulfide, total hardness, total dissolved solids, total organic carbon, calcium, magnesium, potassium, sodium, strontium, aluminum, arsenic, cadmium, copper, iron, lead,

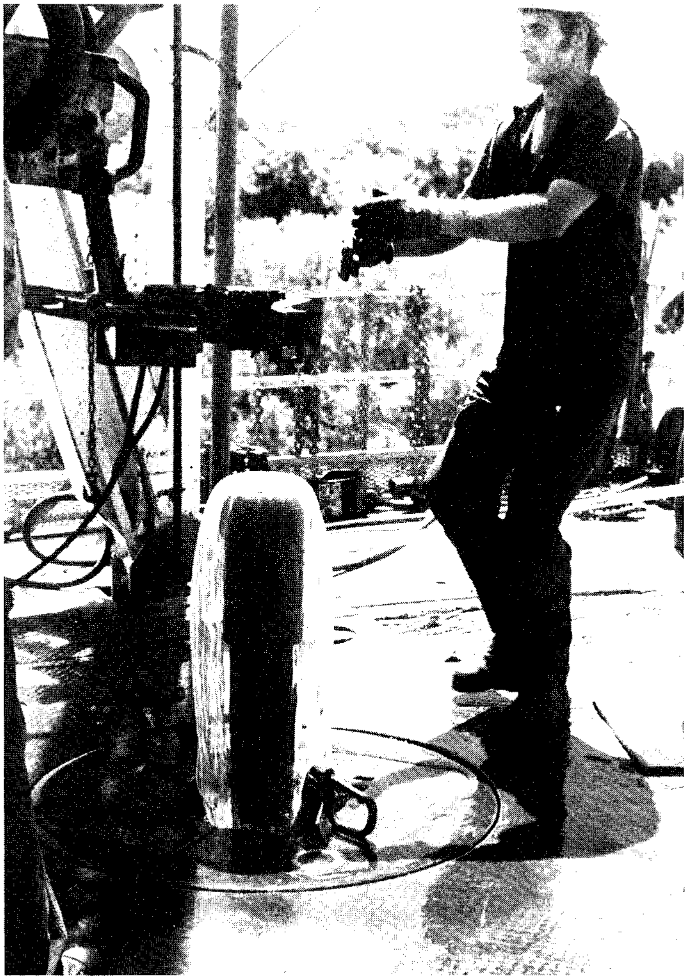

Photo 2-3. Artesian flow while adding drill pipe.

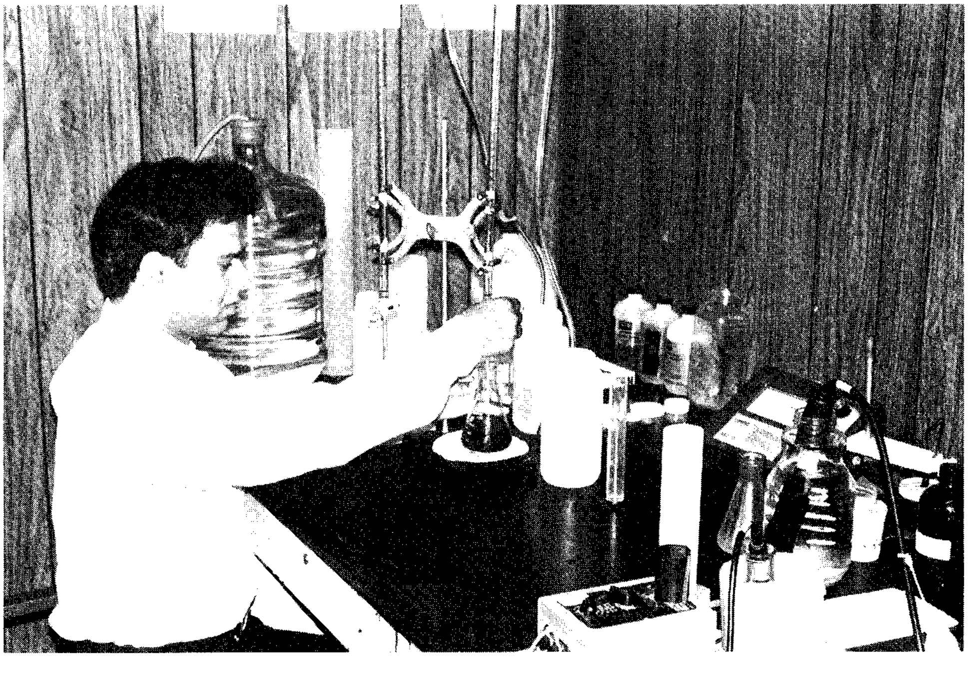

Photo 2-4. Field chemical analysis.

manganese, and mercury, was performed for water samples collected from the test well every 200 feet starting from approximately 1,000 feet in depth. The results are presented in Appendix C.

The specific gravity of the water from the Boulder Zone (from 2,790 feet to total depth) was determined to range from 1.0265 to 1.0270. Chlorides varied between 19,000 mg/l and 25,000 mg/l, while dissolved solids were found to be between 37,000 µg/l and 40,000 µg/l. Table 2-3 shows a comparison of the chemical composition of the water from the Biscayne (shallow) aquifer at the disposal well site, of the water from the Boulder Zone, and of the average composition of seawater at Miami Beach. This comparison shows that the chemical composition of the water from the disposal well (Boulder Zone) is very similar to that of the seawater in the Atlantic Ocean at Miami Beach.

2.4 SALTWATER DISPOSAL

Prior to beginning drilling operations on the test well for deep-well disposal in south Dade County, consideration was given to the problem of saltwater disposal. Five alternatives were considered:

1. Control of flow by heavy fluids (brine or weighted drilling mud) during drilling.

2. Discharge of flow into an adjacent canal.

3. Discharge of flow into seepage pits.

4. Discharge of flow into a shallow (120-foot-deep) well onsite.

5. Discharge of flow into a nearby salt marsh.

Alternative No. 1 was ruled out due to the experimental nature of the project. It would have had adverse effects on the hydrological data collection program because this method of drilling could have prevented obtaining representative samples of water in the formations being drilled through. Alternative No. 2 was rejected because the discharge of saltwater into a freshwater canal would have adverse environmental impacts. Also, existing regulations prevented the discharge of the brackish water into the canals. Alternative No. 3 was ruled out because of the danger of contamination of the local freshwater resources.

Alternative No. 4 seemed reasonable since the U.S. Geological Survey Open File Report 73031 indicates that the Biscayne aquifer at the test well site contains saltwater near its

Table 2-3
Comparison of Chemical Analyses

Constituent	Boulder Zone Water: Sunset Park Deep Well[a]	Boulder Zone Water: Kendale Lakes Deep Well[b]	Boulder Zone Water: Miami-Dade Test Well[c]	Seawater[d]	Biscayne Aquifer Water[e]
Total dissolved solids (mg/l)	33,900	32,400	39,000	35,800	1,200
Chlorides (mg/l)	19,300	19,600	19,400	19,770	417
Sulfate (mg/l)	2,660	2,700	2,800	2,750	61
Bicarbonate (mg/l)	143	144	151	147	
Calcium (mg/l)	457	456	445	423	206
Magnesium (mg/l)	1,290	1,310	1,290	1,324	20.8
Sodium (mg/l)	10,800	10,800	10,800	10,970	
Potassium (mg/l)	415	420	400	429	

[a] Peninsula disposal well, 2,947 feet in depth at Sunset Park plant, December 1969, analysis by U.S. Geological Survey.
[b] Kendale Lakes deep disposal well. Sample from 2,990 feet, December 1971, analysis by Black, Crow and Eidsness, Inc.
[c] Miami-Dade Water and Sewer Authority South District regional wastewater treatment plant test well for disposal system, total depth 3,200 feet, October 1977, analysis by BC&E/CH2M HILL, Inc.
[d] Seawater, average composition at Miami Beach, as reported by Parker et al., 1955 (U.S. Geological Survey Water Supply Paper 1255, Table 65, p. 572).
[e] Biscayne aquifer, shallow water supply well at Miami-Dade test well site, 40 feet deep, 3 July 1977, analysis by BC&E/CH2M HILL, Inc.

base. The 1,000-mg/l isochlor in the Biscayne aquifer is located just west of the site. However, Alternative No. 5 was preferred by the governmental agencies, as this method appeared to be more desirable environmentally. This disposal method called for the pumping of the saltwater through a pipeline across the adjoining canal and levee L31E underneath S.W. 87th Avenue and discharging to the salt marsh. Thereafter, overland flow to Biscayne Bay was to be through about 3/4 mile of marsh vegetation.

This alternative was adopted by installing a 16-inch-O.D. saltwater outfall pipe as planned. All saltwater produced during the drilling and testing of the injection well was pumped through this outfall. In addition, a distribution manifold was incorporated in the outfall to minimize the outfall velocity. This minimized the possibility of turbid water reaching Biscayne Bay.

In order to monitor impact of the project on the Biscayne aquifer, six monitoring wells were drilled around the pad in accordance with the construction permits issued by the Florida Department of Environmental Regulation. These wells were 30 feet deep (from the top of the pad) and cased to a depth of approximately 20 feet. In addition, a water supply well for drilling operations was drilled on the east edge of the pad. This well was 40 feet deep (from top of pad) and cased to a depth of approximately 25 feet. The location of these seven wells is shown in Figure 1-2.

Water from each of these seven Biscayne aquifer wells was monitored daily for temperature, specific conductance, and chlorides. Moreover, water level depths in each of the six monitoring wells were recorded daily. All of these data are presented in Appendix E--"Water Quality Data from Biscayne Monitoring Wells." The purpose of this monitoring program was:

1. To provide data to confirm that no leakage into the Biscayne aquifer was occurring from the test well.

2. To provide data on the effects of any accidental saltwater spills on the Biscayne aquifer in the area.

Figures 2-2 to 2-8 graphically present chloride concentrations in water samples collected daily from the seven Biscayne aquifer wells during the drilling period. Samples from the six monitoring wells, which are 30 feet deep, were collected from the bottom of each well, while those from the 40-foot-deep water supply well were pumped. Water from the first six wells had chloride concentrations of about 100 to 200 mg/l, while the supply well provided water of about 300 mg/l chloride concentration.

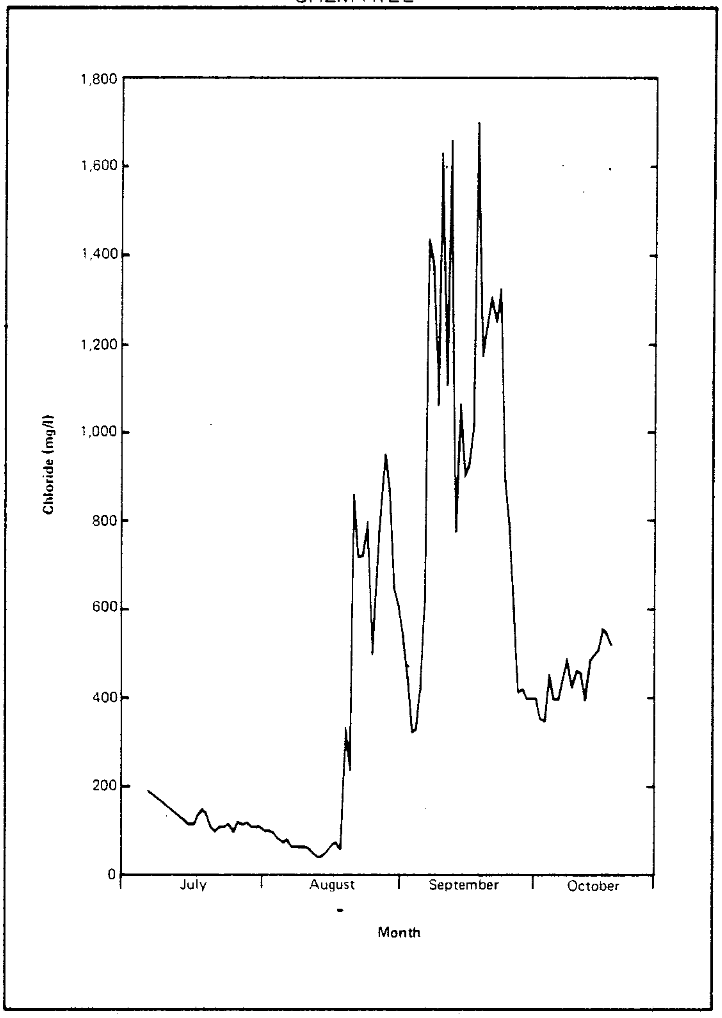

FIGURE 2-2. Chloride concentrations in water from Biscayne aquifer monitoring well No. 1.

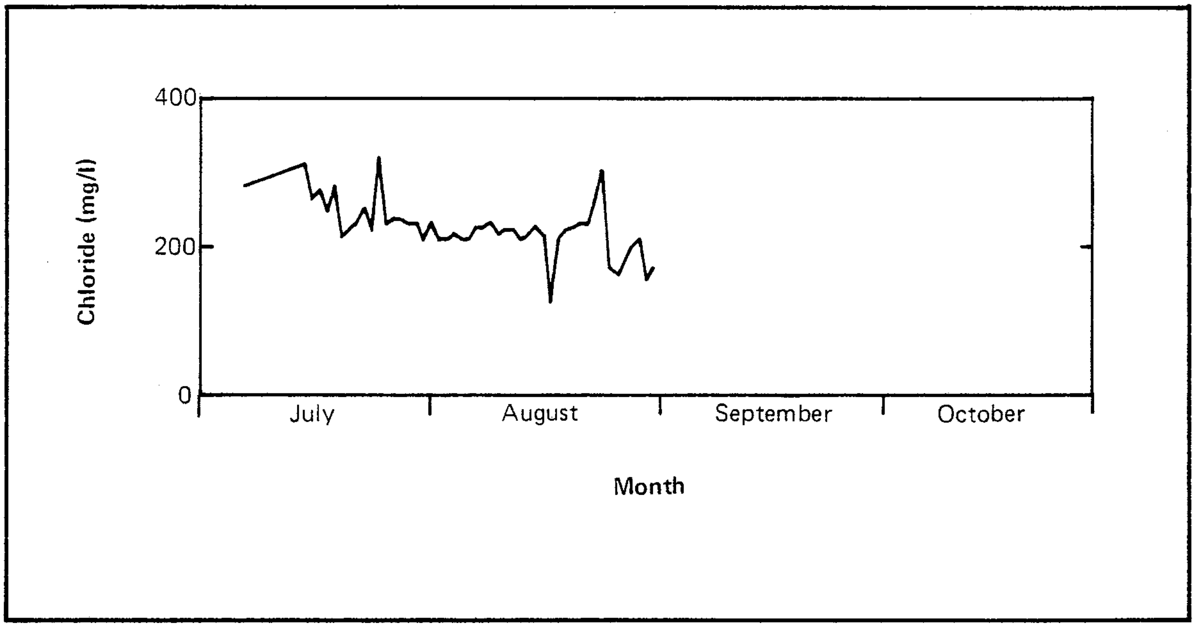

FIGURE 2-3. Chloride concentrations in water from Biscayne aquifer monitoring well No. 2.

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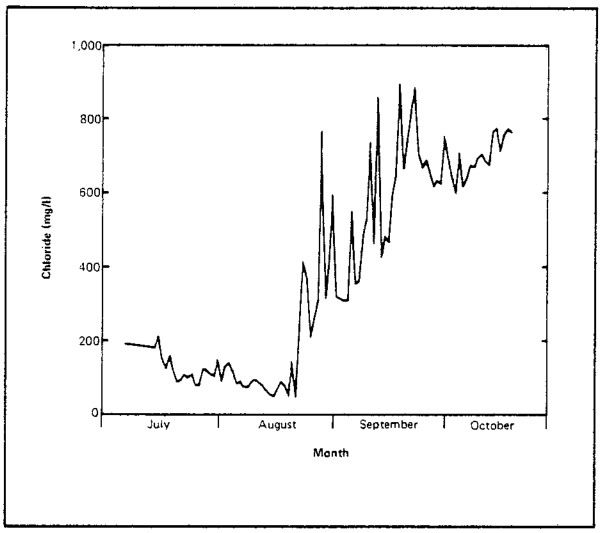

FIGURE 2-4. Chloride concentrations in water from Biscayne aquifer monitoring well No. 3.

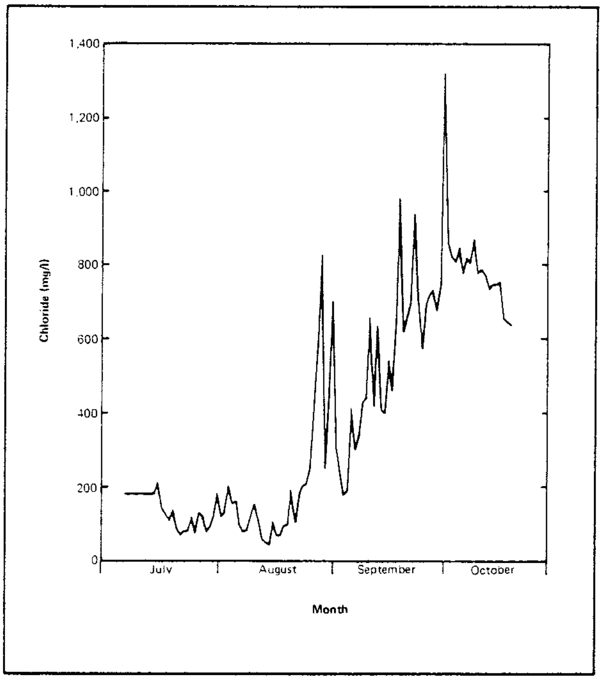

FIGURE 2-5. Chloride concentrations in water from Biscayne aquifer monitoring well No. 4.

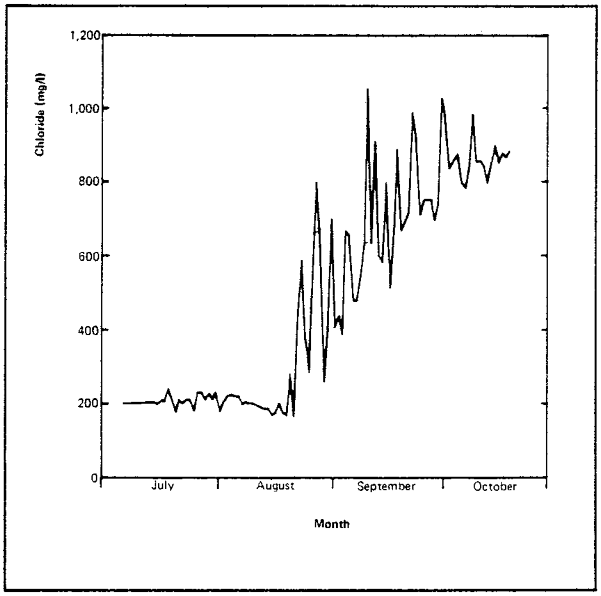

FIGURE 2-6. Chloride concentrations in water from Biscayne aquifer monitoring well No. 5.

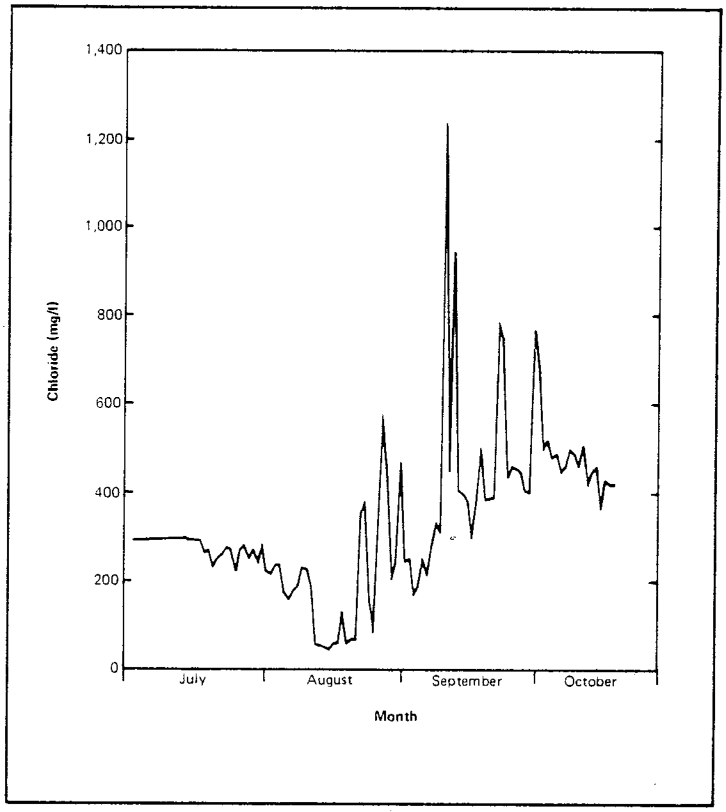

FIGURE 2-7. Chloride concentrations in water from Biscayne aquifer monitoring well No. 6.

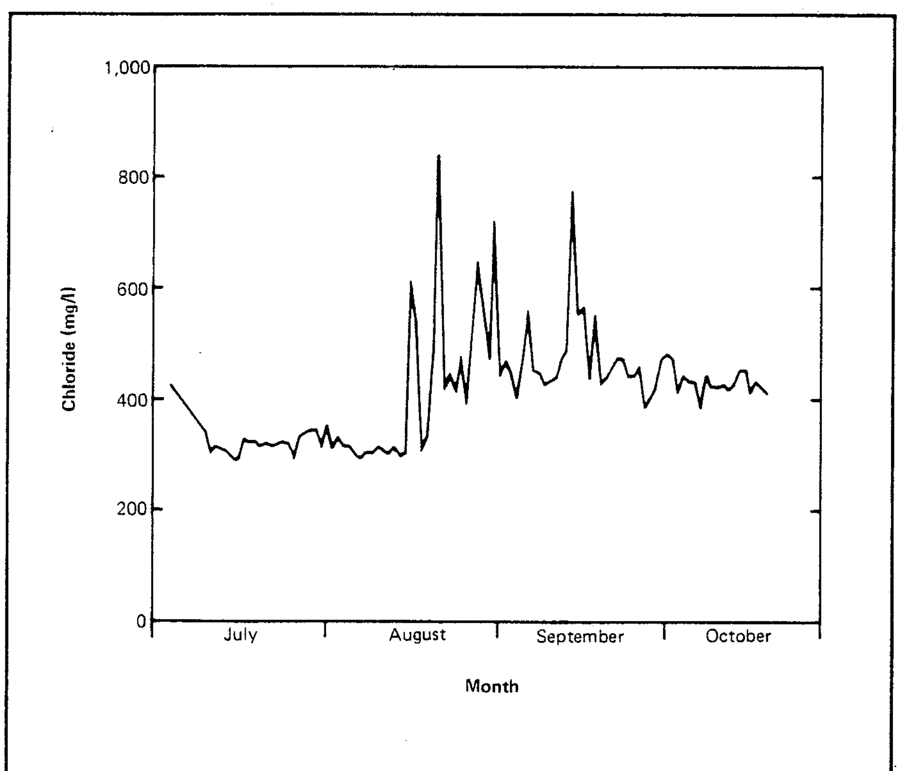

FIGURE 2-8. Chloride concentrations in water from Biscayne aquifer water supply well.

Approximately 50,000 gallons of brackish water from the Floridan aquifer were spilled around the pad during drilling between 15 and 19 August when the cellar pump failed and the flow from the well could not be adequately controlled on several occasions. A corresponding increase in chloride concentrations can be seen on each of the seven graphs during this period. Before these chlorides could dissipate and return to normal levels, another series of small spills of brackish water occurred in a similar manner during the first week of September. Consequently, chloride levels went up even higher, as seen in the graphs. The most pronounced effects were felt on monitoring well No. 1, since it is in the southeast corner of the pad (at the downstream end) and the movement of the water in the Biscayne aquifer is in a southeasterly direction. However, chloride levels were decreasing in October and were expected to return to background levels within a few months.

Data from monitoring well No. 2 could not be collected after August because the well was accidentally run over by a truck and destroyed at that time. Some variations in chloride concentrations were caused by local rainfall and, to a smaller extent, by tides in the neighboring Biscayne Bay (1 mile east of the project site). The increase in chloride concentrations noticed at the project site during drilling did not have any effect on the upstream water resources used for water supply since the site is several miles downstream of these sources and also downstream from the 1,000-mg/l isochlor in the area.

3.1 WELL LOGGING

A series of geophysical logs was run in the test well at each stage of construction to supplement observations made during drilling and testing. The term "geophysical logging," as used in this section, refers to both conventional logging techniques and borehole camera surveys. Conventional logs were run by BC&E and Schlumberger Well Service. Borehole camera surveys (TV and still camera) were performed by Deep Venture Diving, Inc.

Portions of the logs are reproduced on Figure 2-1. A complete set of all logs run plus TV video tapes and stereocamera photographs are on file at the office of the Miami-Dade Water and Sewer Authority, at the office of BC&E, at the West Palm Beach subregional office of the DER, and at the SFWMD office.

Geophysical logging activities are summarized in Table 3-1. Photos 3-1 and 3-2 show geophysical logging being performed.

Significant information obtained from interpretation of geophysical logs run at various stages of drilling and testing the well is discussed in the following paragraphs:

Exploratory Hole to 988 Feet

The top of the Floridan aquifer is picked at a depth of 920 feet from the electric and gamma ray logs. In accordance with customary usage, the first persistent consolidated limestone is designated as the top of the aquifer.

The strata between 920 and 370 feet consist of soft calcareous sediments (marl) with a few thin phosphate-bearing beds. These strata, between 620 feet and 420 feet, apparently contain relatively fresh water (TDS approximately 3,000 mg/l), but are not significantly permeable. Above 370 feet to the bottom of the 48-inch casing, the electric log indicates clay. These strata are undistinguishable on the gamma ray log from the strata between 920 feet and 370 feet.

Exploratory Hole to 2,759 Feet[1]

The upper water-producing zone in the Floridan aquifer, as identified from electric, caliper, flowmeter, and temperature

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[1]Depth measurements shown on the logs are 0.5% too deep due to a mechnical measuring error.

Table 3-1
Geophysical Logging Activities

Trip	Date	Well and Casing Depth	Type Logs Run[a]	Purpose
1	7/23	48" casing to 134 ft 8-3/4" hole to 988 ft	E, GR	1. Identify top of Floridan aquifer 2. Establish setting depth of 40" casing
2	8/24	40" casing to 961 ft 8-3/4" hole to 2,759 ft	E, GR, T_s, T_F, C, FM, FR, TV	1. Geohydrological definition of Floridan aquifer system 2. Establish setting depth of 30" casing 3. Visual qualitative evaluation of confining bed porosity and permeability 4. Establish best intervals for packer testing
3	9/7	30" casing to 1,794 ft cemented--no open hole	T_s	1. Determine top of first-stage cement outside 30" casing
4	9/19-21	30" casing to 1,794 ft 17-1/2" hole to 2,256 ft 12-1/4" hole to 3,200 ft	DIL, VDL, BHC, GR, T_s, T_p, C, FM, TV	1. Geohydrological definition of injection zone and confining beds 2. Visual qualitative evaluation of confining beds and receiving zones 3. Establish setting depth for 20" casing
5	10/7	20" casing to 2,746 ft cemented, no open hole	T_s	1. Determine top of cement outside 20" casing

Table 3-1--Continued
Geophysical Logging Activities--Continued

Trip	Date	Well and Casing Depth	Type Logs Run[a]	Purpose
6	10/17	20" casing to 2,746 ft 17-1/2" hole to 3,193 ft	C, FM	1. Retest to define production zones at higher pump rate than trip 4 above (1,630 gpm versus 800 gpm)
7	10/27	20" casing to 2,746 ft 17-1/2" hole to 3,193 ft (after injection test)	VDL, CBL T_F, FR, TV, 3D	1. Confirm final construction of well 2. Confirm adequacy of cementing of 20" casing 3. Visual evaluation at cavity and fracture geometry 4. Define injection zones

[a]Abbreviations for type logs: E--electric (single point); GR--gamma ray, Ts--static temperature; T_F--flowing temperature; T_p--pumped temperature; C--caliper; FM--flowmeter; FR--fluid resistance; TV--television; DIL--Dual Induction Laterolog; BHC--Compensated Acoustic Log; VDL--Variable Density Acoustic Log; 3D--stereocamera.

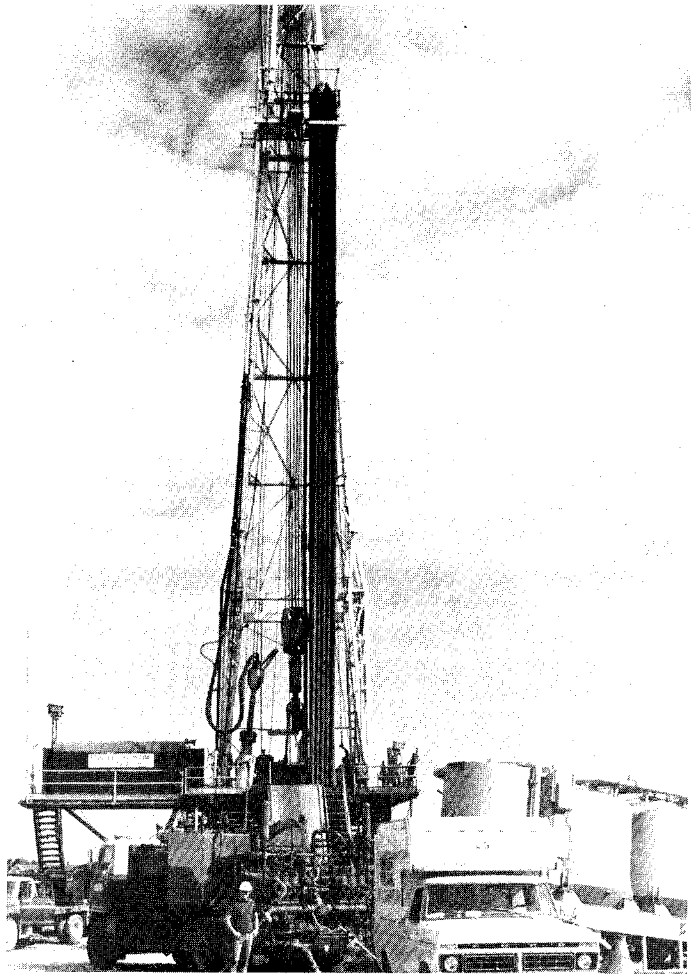

Photo 3-1. Geophysical logging after cementing.

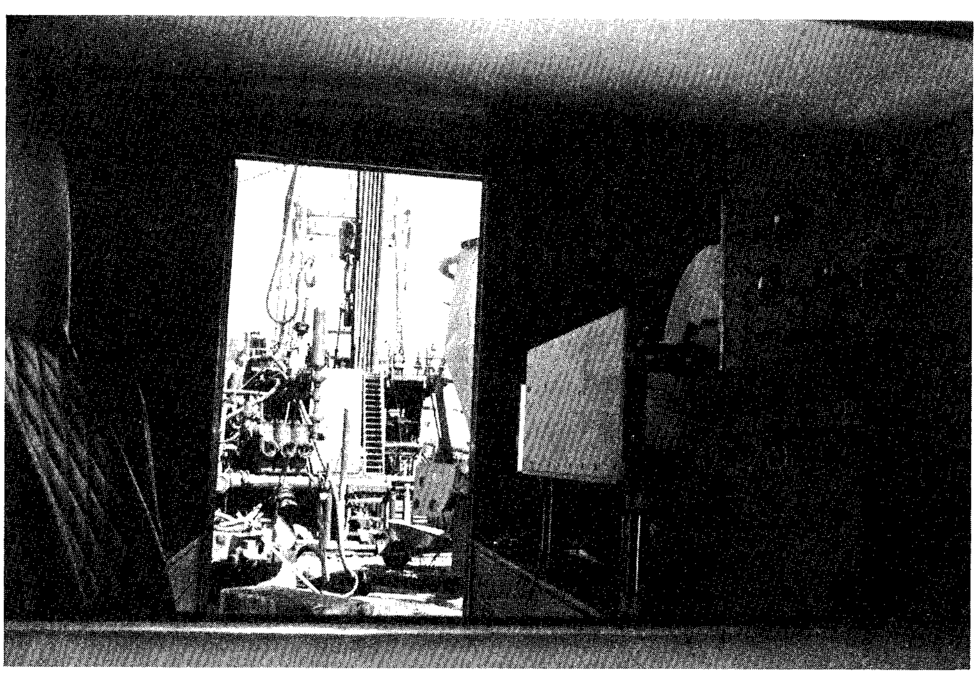

Photo 3-2. Geophysical logger cabin.

logs and the TV survey, extends to a depth of approximately 1,160 feet. The permeability in the main producing zone is due mainly to the presence of large solution openings (cavities). The temperature log shows numerous minor water-producing zones between 1,160 feet and 1,680 feet, the most significant being between 1,420 feet and 1,520 feet.

The strata penetrated from 1,680 feet to 2,465 feet are essentially impermeable and non-water-producing. The electric and fluid conductance logs show a transition in aquifer water quality from brackish to saltwater between 1,670 feet and 1,760 feet in depth.

A water-producing zone is present in the saltwater-bearing strata at a depth of 2,465 feet to 2,535 feet. Electric, gamma ray, and acoustic logs and the TV survey show this strata to consist of a dark, crystalline dolomite with some apparent small fractures. The strata penetrated below 2,535 feet to the bottom of the exploratory hole are essentially non-water-producing.

The borehole TV survey gives subjective confirmation to the more conventional log interpretations. The major producing zones contain large cavities and fractures, while lesser producing zones appear rough, with a few visible small openings. Nonproducing zones are characterized by a smooth borehole, featureless, except for the thin dark bands (possibly lignite) which are present in the Avon Park Limestone.

The interface between brackish and salty water in the borehole is characterized by the blurring of the TV image produced by the mixing of waters of different quality in the transition zone.

<u>30-inch Casing--First-Stage Cementing</u>

The top of the cement, as determined by the temperature log, was 1,370 feet. The grout pipe through which the second-stage cement was placed encountered cement at a depth of 1,325 feet.

<u>Exploratory Hole to 3,200 Feet</u>

The top of the Boulder Zone was penetrated at a depth of 2,790 feet. Electric, caliper, and acoustic logs and the TV survey show this stratum to be a very hard, cavernous, fractured, dark dolomite.

When the well was test pumped at 800 gpm, practically all (90%) of the water produced came from the cavernous strata between 2,830 feet and 3,050 feet. It is estimated that about 10% of the produced water came from the dolomite strata between 2,465 feet and 2,535 feet. The temperature log actually shows a single point of entry in this zone, at 2,472 feet. No other water-producing strata are indicated in the open hole above the Boulder Zone. Figure 3-1 shows the vertical flow profile as calculated from analyses of the caliper, flowmeter, and temperature logs.

The bottom 150 feet of the hole produced practically no water under pumping conditions, and only about 5% of the flow comes from below 2,920 feet. However, flowmeter and temperature logs show that a small uphole flow occurs in this section under nonpumping conditions. This flow, estimated at 20-40 gpm, enters the well bore below 3,170 feet in depth and exits below 3,050 feet.

As anticipated, the subsurface temperature gradient is reversed from the normal gradient, cooling with depth at an average rate of approximately 0.4° F per 100 feet. A slight warming (0.1° F) in the exploratory hole from 3,155 feet to 3,200 feet may indicate that the bottom of the reverse-gradient zone was penetrated.

20-inch Casing--First-Stage Cementing

The top of first-stage cement, as determined from the temperature log, is at 2,473 feet. Cement was tagged by grout pipe at this depth.

Flowmeter Survey

A flowmeter temperature survey was run in the exploratory hole from 2,746 feet to 3,200 feet while pumping at 800 gpm. The survey showed practically no water production below 2,920 feet. However, the geophysical logs show several zones in this interval which appear to be cavernous and which, therefore, should produce water. Consequently, a pumping (pump-out) test was run at a higher rate to confirm data from the previous test. Mechanical problems limited the pumping rate to 1,630 gpm. At this pumping rate, the bottom of the hole (below 3,050 feet) was nonproductive, with most production from the 2,830- to 2,920-foot interval. The retest thus confirmed and refined the original tests in this interval.

A flowmeter survey run under static conditions again confirmed that there is a small but detectable upward flow from 3,170 feet to about 2,980 feet.

Completed Well Record Logs

A TV and stereocamera inspection of the well was performed to confirm final well construction and provide a permanent record of preinjection conditions in the well bore.

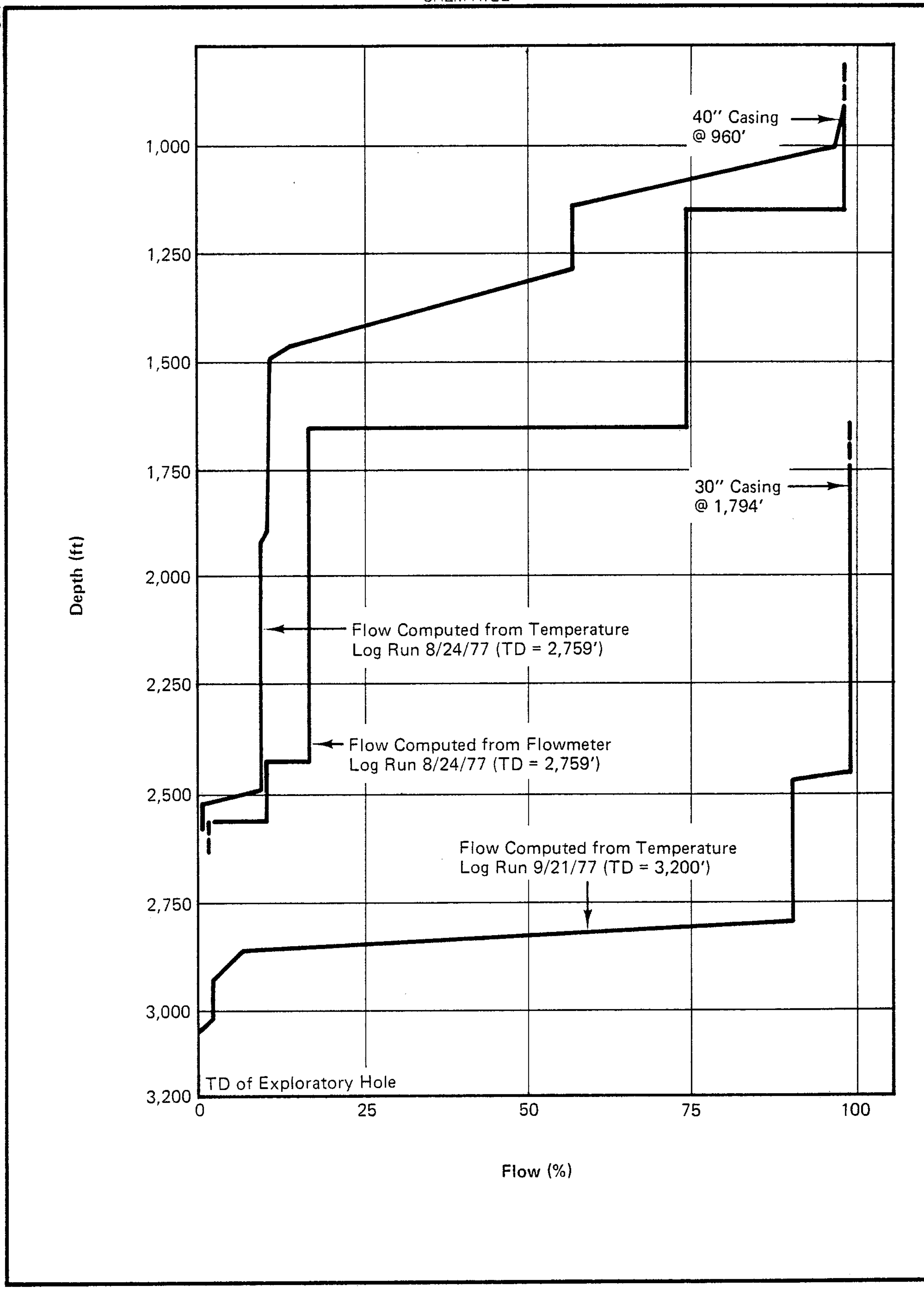

FIGURE 3-1. Vertical flow profile from flowmeter/temperature log analysis.

A cement bond log was run to confirm the cementing of the 20-inch injection casing. The first-arrival amplitude trace on this log shows good bonding throughout the length of the 20-inch casing. However, the variable-density trace indicates that the cement is poorly bonded to the pipe. This anomalous response is probably caused by either the heavy antirust varnish coating on the casing or the method of cement placement (grout pipe), or by a combination of both factors. In any case, the annulus is filled with cement, which forms a barrier to any fluid travel along the casing.

Backflow Test

Approximately 5.2 million gallons of freshwater were injected into the test well on 25 and 26 October. After injection ceased, pressure at the wellhead stabilized at approximately 31 psi, or about 40 feet above sea level. It was necessary to release this freshwater head in order to continue with final testing and logging of the well. Therefore, after discussions with USGS and SFWMD personnel, a backflow test was planned, to obtain data on the response of the aquifer system to injection of freshwater. Approximately 12 hours after termination of the injection test, a propeller flowmeter tool was installed in the well, and the discharge valve was opened. Flow of freshwater from the well began slowly, reached a rate of about 5,000 gpm, and then declined to zero, all in the space of 5 minutes. The reason for the very short backflow period apparently lies in the upward flow, referred to previously, of saltwater from the bottom of the well. This flow had displaced all of the injected freshwater from the immediate vicinity of the well bore. Consequently, when the well was opened saltwater replaced the freshwater in the casing, causing flow to cease when the hydrostatic pressure of the saltwater column balanced the artesian head.

After about 8 hours, the well again began to flow, this time at about 150 gpm. A temperature log was run at this time since the flow rate was too small to conduct the flowmeter test. This flow continued for about 6 hours at a slowly decreasing rate, until it stopped altogether.

The flowing water temperature was 70° F, and specific conductance was 41,000 μmhos/cm. Bottom hole temperature was 63.6° F, and specific conductance was 56,000 μmhos/cm. The temperature increases in steps from 2,944 feet to 2,800 feet, showing that this interval was the receiving zone during the injection test. The bottom hole temperature was unchanged, and the upward flow was again observed from the bottom of the hole. The slight warming trend, noted previously from 3,160 feet to total depth, was again observed.

4.1 GENERAL

Three types of pumping tests were performed during the construction and completion of the test-injection well. These tests were:

1. Packer testing.
2. Pump-out test.
3. Injection test.

The purpose and description of each one of these tests follow.

4.2 PACKER TESTING

The purpose of these tests was to try to determine the effectiveness of the confining layers separating the Boulder Zone at approximately 2,790 feet in depth and the brackish water aquifers above approximately 1,750 feet in depth. Leakance determinations from conventional pumping tests in the receiving zone are not feasible because of the Boulder Zone's very small drawdowns even when subjected to pumping rates of several thousand gallons per minute.

It was decided then to isolate selected zones of the confining interval by the use of high-pressure straddle packers. The isolated zone between two packers was pump-tested with a small submersible pump. Drawdowns were measured in the tubing holding the set of packers and containing the submersible pump. Transmissivity of the isolated sections was determined with time-drawdown log-log plots matched with type curves. The same procedure was repeated for the zones beneath the packer and the bottom of the hole (2,759 feet) before penetratting the receiving zone. Results of the above procedure are shown in Table 4-1. Detailed drawdown tabulations and time-drawdown plots are included in Appendix D. Photo 4-1 shows submersible pump discharge and flowmeter used for packer tests.

Drawdown observations during packer testing were possible with the use of a U.O.P. Johnson Well Analyzer shown on Photo 4-2. This newly developed instrument allowed for the printing in the field of drawdown observations every second. Drawdowns also could be automatically printed every 10 seconds, 1 minute, or 10 minutes. Use of this instrument was possible through the assistance and

Table 4-1
Summary of Data from Packer Testing

Test No.	Date	Start Time	Interval in Feet From	Interval in Feet To	T (gpd/ft)	Q (gpm)
1	8-25-77	0812	2,737	2,759	63	50
2	8-25-77	1225	2,697	2,727	92	4
3	8-25-77	2317	2,367	2,397	140	13/24.5
4	8-26-77	0747	2,407	2,759	350	61
5	8-26-77	1558	1,968	1,998	177	42.5
6	8-26-77	1814	2,008	2,759	653	61
7	8-27-77	1150	2,543	2,573	143	55
8	8-27-77	1628	2,583	2,759	326	33
9	8-28-77	0130	2,692	2,759	264	12
10	8-28-77	0554	2,652	2,682	96	20

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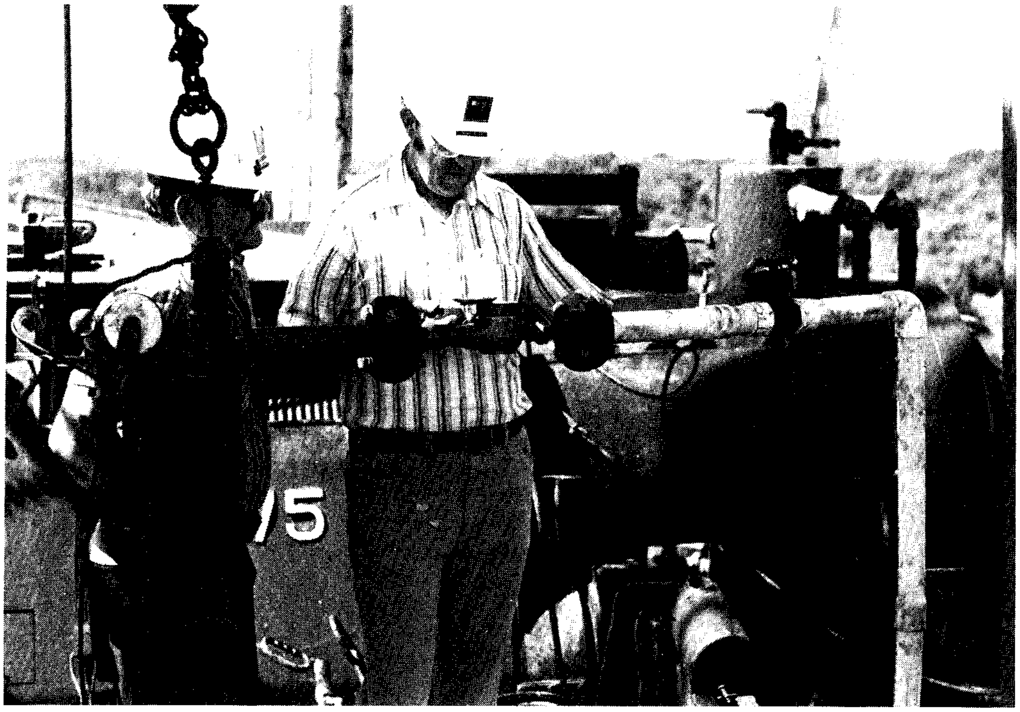

Photo 4-1. Discharge measurements during packer testing.

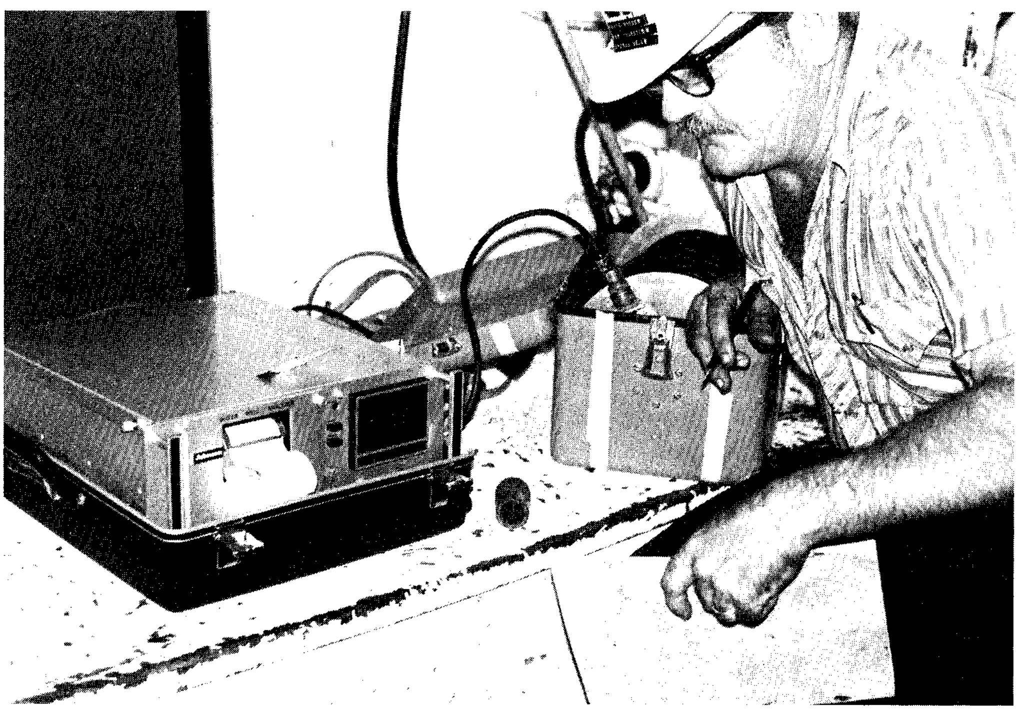

Photo 4-2. Water well analyzer.

collaboration of Mr. Joe L. Mogg, Vice-President of the U.O.P. Johnson Division, St. Paul, Minnesota.

Detailed procedures for conducting packer tests are included under Item 5 of "Procedures of Program for Hydrogeological Testing," attached to Summary of Meeting of 19 August 1977 and included in Appendix A of this report.

Because of the complexity of the partial penetration factor in the isolated zones during packer testing, it was decided to make a graphical representation of the results shown in Table 4-1. This graph is shown on Figure 4-1. A line is drawn on that chart connecting the transmissivity of the tests corresponding to the sections isolated below each packer setting. An extrapolation of this line to cover approximately 1,100 feet in depth (1,690-2,790 feet) indicates an approximate transmissivity of 900 gpd/feet for the entire section.

The figure of 900 gpd/feet has been used to calculate travel time for the approximately 1,100 feet of confining layer (m = thickness of confining layer) separating the injection zone from the next high-transmissive zone above. This travel time is estimated at 343 years in accordance with the following computations:

1. Average T from Figure 4-1--900 gpd/feet.

2. Estimated porosity(θ)--0.25.

3. Estimated upward gradient--20 feet in 1,000 feet, or 0.02.

4. Hydraulic conductivity:

$$K = \frac{T}{m} = \frac{900}{1,100} \quad 0.82 \text{ gpd/ft}^2$$

$$K = \frac{0.82}{7.48} = \frac{ft^3}{day} \times \frac{1}{ft^2} = 0.11 \frac{ft}{day}$$

5. Average velocity:

$$V = \frac{KI}{\theta}$$

$$V = 0.11 \frac{ft}{day} \times 0.02 \times \frac{1}{0.25}$$

$$V = 0.0088 \text{ ft/day or}$$

$$V = 3.21 \text{ ft/year}$$

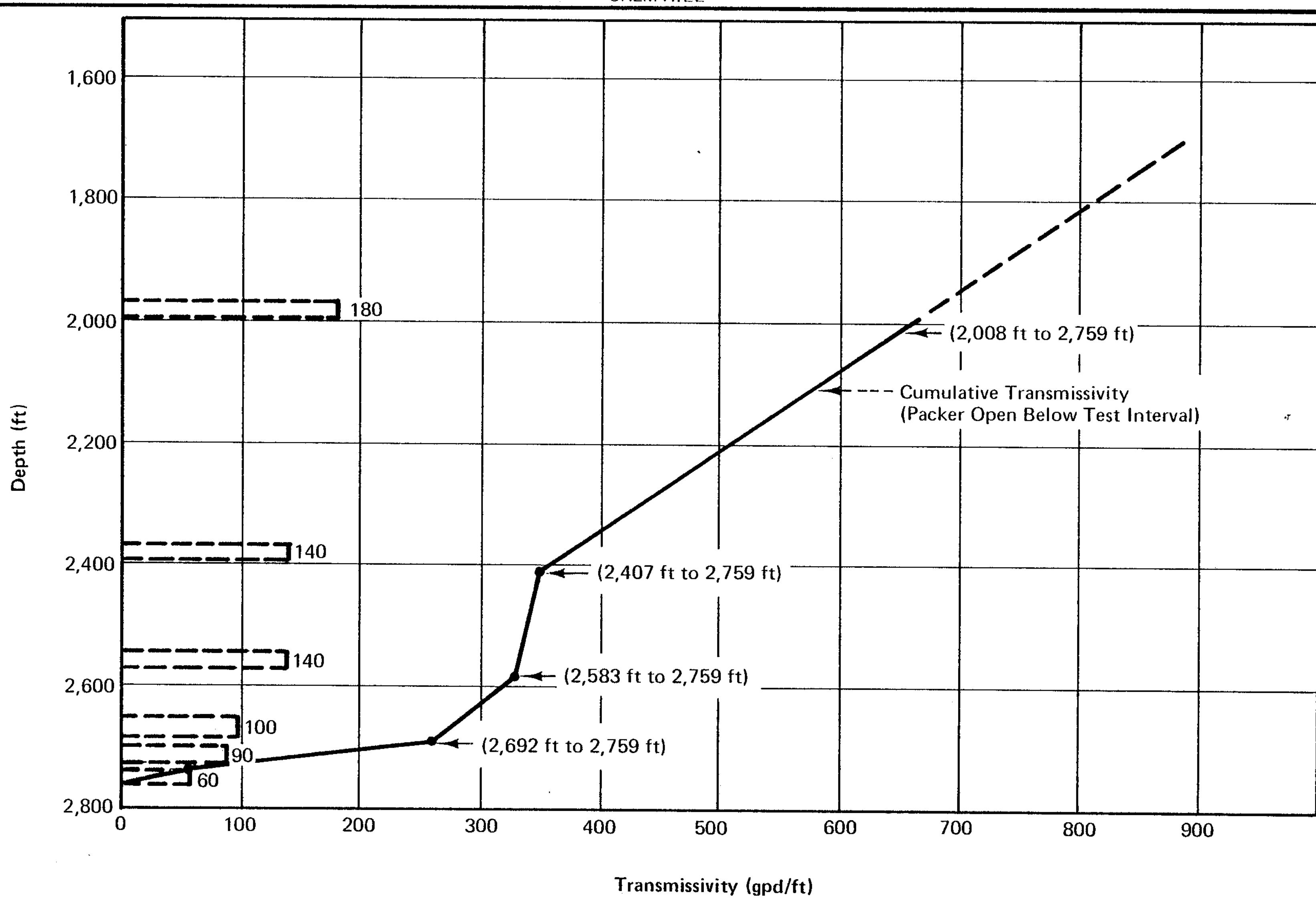

FIGURE 4-1. Summary of data from packer testing.

6. Average travel time:

$$t = \frac{e}{v} = \frac{1,100}{3.21} = 342.7 \text{ years}$$

$$t = 343 \text{ years}$$

The long traveltime, as calculated above, for effluent to reach the lower Floridan aquifer indicates that the presence of the effluent itself is very unlikely to result in any adverse effects on water quality in the Floridan aquifer. Renovation of the effluent to a water quality level compatible with any potential future use of Floridan aquifer water is expected to occur well within the calculated traveltime.

Any adverse effects resulting from effluent movement would more likely be related to displacement of saltwater by the effluent. When fluids of different densities are in contact in a porous medium, gravity will cause the less dense fluid (effluent) to rise relative to the more dense fluid (saltwater). If the effluent moving into the confining bed displaces saltwater upward, the saltwater could migrate into the lower Floridan aquifer and possibly later into the upper Floridan aquifer. Provisions are made in the monitoring system, as described in Chapter 5, to monitor the position of the saltwater at the base of the Floridan aquifer.

Although saltwater migration as described above is considered unlikely, a possible remedial action, consisting of relief wells completed in the lower Floridan aquifer, is discussed in Chapter 6 of this report.

4.3 PUMP-OUT TEST

The purpose of this test was to obtain data for estimating the hydraulic characteristics of the Boulder Zone.

A summary of the procedure followed for this pumping test after completion of installation of the casing and drilling of the well to total depth is as follows:

1. Install 6,000-gpm test pump with approximately 100 feet of column inside of 20-inch casing.

2. Pump out well at approximately 6,000 gpm until drawdown stabilizes.

3. Measure drawdown inside 20-inch casing and in annuli between 30-inch and 40-inch casings as well as between 20-inch and 30-inch casings.

4. Collect water sample at end of test to determine chloride, electrical conductivity, temperature, and density.

5. Stop pump and measure recovery inside 20-inch casing and in annulus between 30-inch and 40-inch casings.

6. Run step-drawdown test pumping well at staged increasing rates and measure drawdowns as per above.

7. Remove test pump.

Flow measurements were made with a pitot tube in a 16-inch discharge line. Drawdown in the pumping well was measured with a bubbler-system and a Heise Gage CMM-12, 0-60 psi. They were also recorded with a Foxboro recorder. Drawdown in the annulus between the 20-inch and 30-inch casings was recorded with a Stevens type F water level recorder. Artesian pressure in the annulus between the 30-inch and 40-inch casings was measured with a Heise Gage CMM-12, 0-60 psi, connected to the top of the 1-1/4-inch tube in that annulus.

Photos 4-3 through 4-7 show several aspects of the pump-out test.

The data obtained from these pump-out tests are presented in Appendix D, "Pumping Tests." Water was pumped out of the well at a steady rate of 6,200 gpm for about 7 hours, followed by a recovery period of about 2 hours. Thereafter, a step-drawdown pumping test was conducted for 70 minutes, followed by a 45-minute recovery period. The step-drawdown test was run in three steps: 2,800 gpm, 4,300 gpm, and 7,600 gpm.

The apparent steady-state drawdowns recorded in the well (inside the 20-inch casing) at each of the pumping rates are presented in Table 4-2.

Table 4-2
Summary of Pump-out Test Data

Flow (gpm)	Drawdown (ft)
2,800	4.02
4,300	9.75
6,200	20.65
7,600	28.88

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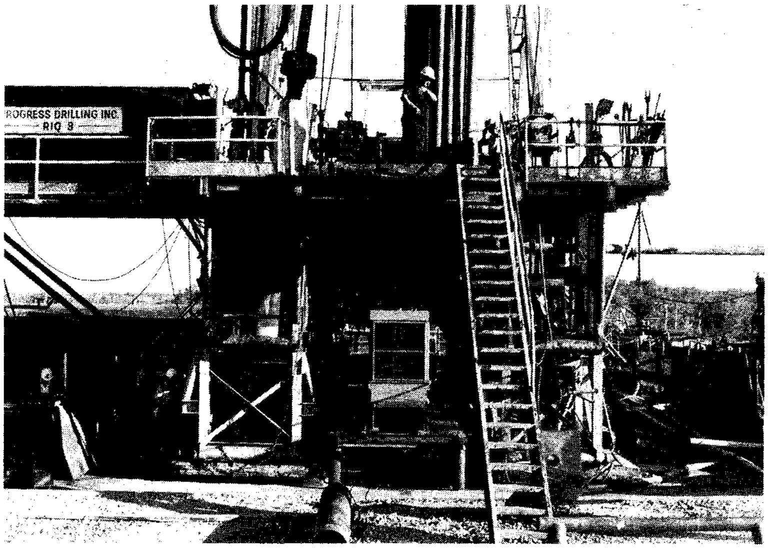

Photo 4-3. Overall view of equipment and instruments.

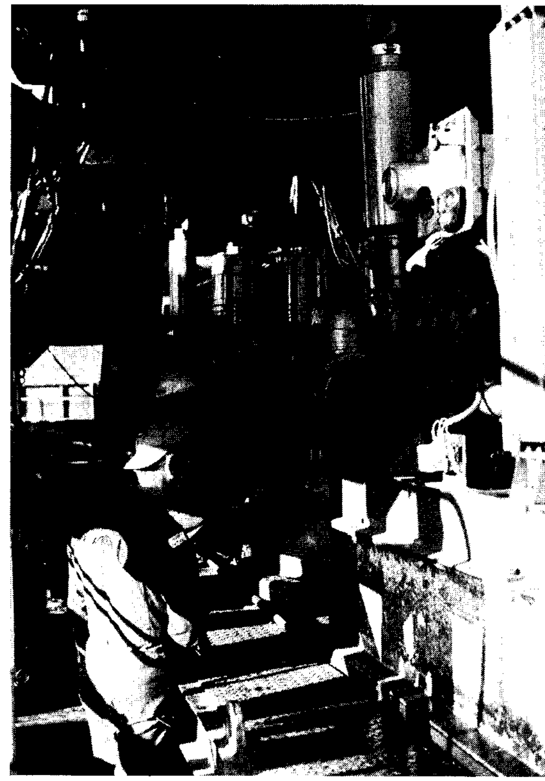

Photo 4-4. Vertical pump with twin engines.

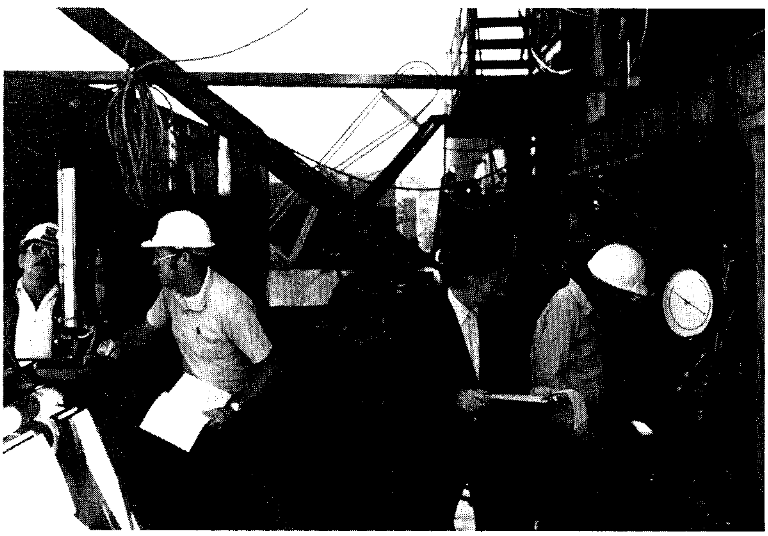

Photo 4-5. Flowmeter and pressure gauges in 1,050-foot zone and pumping well.

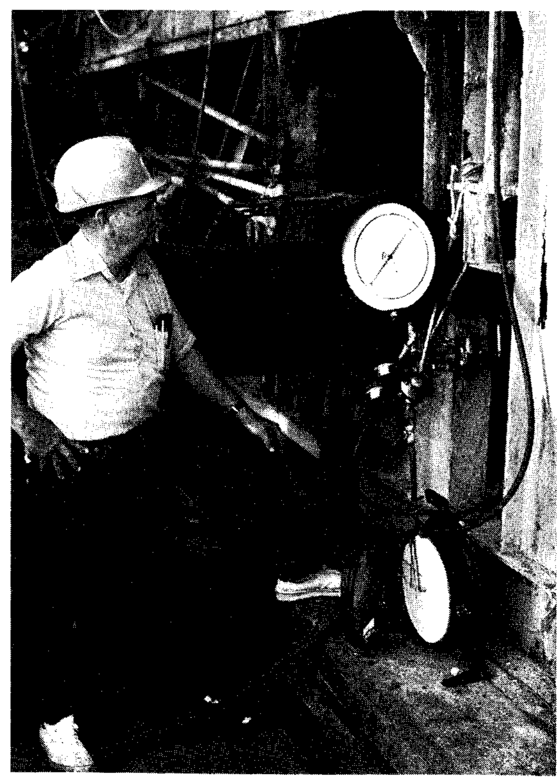

Photo 4-6. Drawdown gauge and recorder for water levels in pumping well.

Photo 4-7. Water level recorder on 2,500-foot monitoring zone.

Most of the drawdown recorded in the well is due to friction losses in the casing and open hole. An analysis of the step-drawdown test yielded a negative aquifer loss (see Appendix D). Since a negative aquifer loss is not probable, it is likely that some of the conditions and assumptions implied in the analysis were not met during the test. It is estimated that at the 6,200-gpm pump-out rate, not more than 1.0 foot of the 20.65-foot drawdown observed was the drawdown in the aquifer after subtracting for the well losses (assuming C = 140).

The transmissivity of the Boulder Zone was determined with time-drawdown, straight line semilog plot as shown in Appendix D, and it was calculated to be 14 x 10^6 gallons per day per foot. Undoubtedly the Boulder Zone in south Florida is one of the most highly transmissive artesian aquifers in the United States. The small drawdowns at high pumping rates (and correspondingly the high transmissivity of the aquifer) certainly indicate that the Boulder Zone at the test well site can accept high rates of flow with only a slight increase in pressure (about 0.5 psi at approximately 6,000 gpm). This was later confirmed during the injection test.

There was no significant response during the pump-out and recovery tests in a water level recorder (Stevens type F) installed in the temporary open annulus between the 20-inch and the 30-inch casings. Top of cement in the annulus was at 2,473 feet in depth during tests.

No change in pressure in the annulus between the 30-inch and 40-inch casings (1,040-foot deep zone) was recorded during the pumping tests. The annulus pressure continued to show readings of 15.1 psi (referred to the top of the pad at the well) during the pump tests and recovery as before. This indicates good cementing of the annulus and also good confining characteristics of the aquiclude between the brackish Floridan aquifer and the Boulder Zone, qualitatively confirming the results obtained from the packer tests.

4.4 INJECTION TEST

An injection test was performed after the pump-out test in order to determine:

1. Injection capacity of the well.

2. Pressures at the well head while injecting at different flow rates.

3. Injection pressures at the receiving aquifer while injecting at different flow rates.

4. Effect of the injection pressure on the annulus pressure (a measure of the head in the upper part of the Floridan aquifer).

The differences between the pressures under 2 and 3 above are caused by the friction losses through the casing and borehole from the well head at ground level to the injection stratum at approximately 2,900 feet in depth. Pressures at the injection stratum were read through 2,865 feet of 5-inch-diameter drill rods temporarily installed in the well during the test to serve as a piezometer.

Water for the injection test was supplied by a vertical pump installed in the canal east of the well field. The quality of this water was as follows: specific conductance--600 μmhos/cm, total dissolved solids--390 mg/l, chlorides--80 mg/l.

Photos 4-8 through 4-15 show several aspects of the equipment and instrumentation during the injection test.

Instrumentation to measure flow rates and pressures are indicated on Figure 4-2.

Flow rates were measured with a pitot tube and a differential manometer.

Pressure gage P_b (Heise CMM-12, 0-60 psi, was connected to the top of a 5-inch drill rod extending to 2,865 feet in depth from the top of the drilling pad. Flowmeter logging on Figure 2-1 indicates that practically all of the water produced (or received) by the well was between 2,830 and 2,920 feet. Increases in pressure at P_b due to pumping into the well indicate the net increase in pressure at the receiving stratum, independent of the friction losses in the casing and borehole.

Pressure gage P_w (Heise CMM-12, 0-100 psi) measures the pressure at the well head, which is the sum of the increase in pressure at the receiving stratum plus friction losses through casing and borehole. Under test conditions, with the 5-inch piping in the hole, friction is slightly higher than under normal operating conditions, when the drill rod would not be present.

Pressure gage P_a (Heise CMM-12, 0-60 psi) indicates the pressure in the annulus (see Figure 4-2). Any significant leak through the 20-inch casing, through the cement seal at its bottom, or through natural channels would cause a change in the artesian pressure of the annulus.

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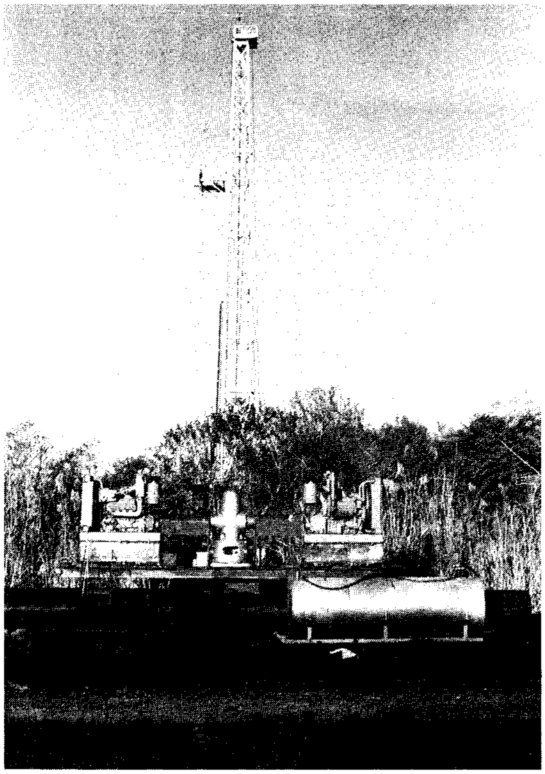

Photo 4-8. Injection pumping equipment.

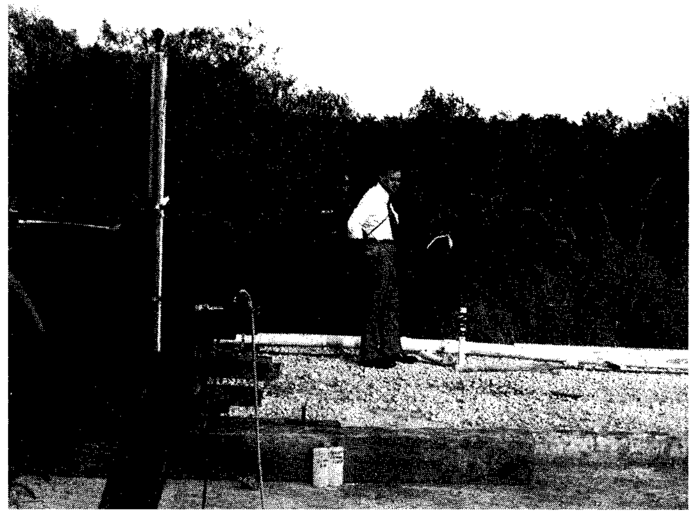

Photo 4-9. Injection supply line and flow metering equipment.

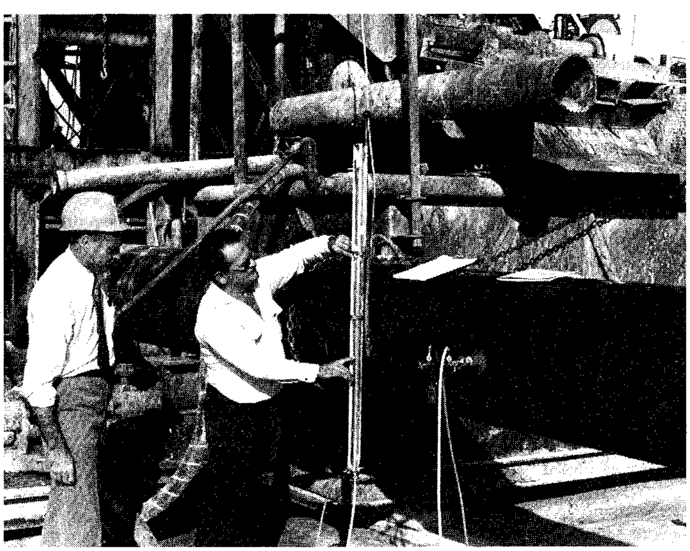

Photo 4-10. Pitot-tube assembly for flow measurements.

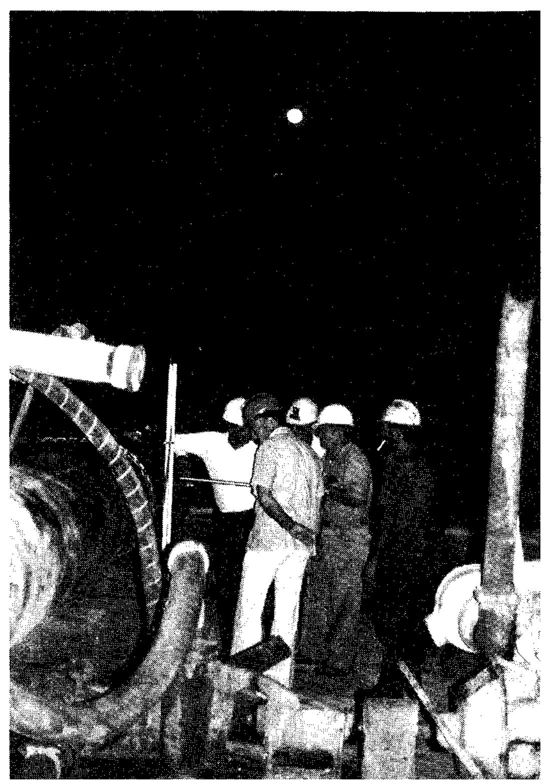

Photo 4-11. Flow measurements at nighttime.

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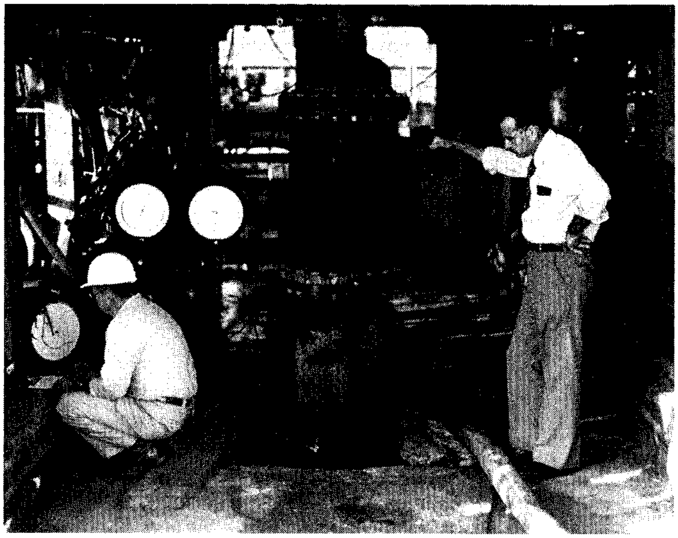

Photo 4-12. Wellhead instrumentation during injection test.

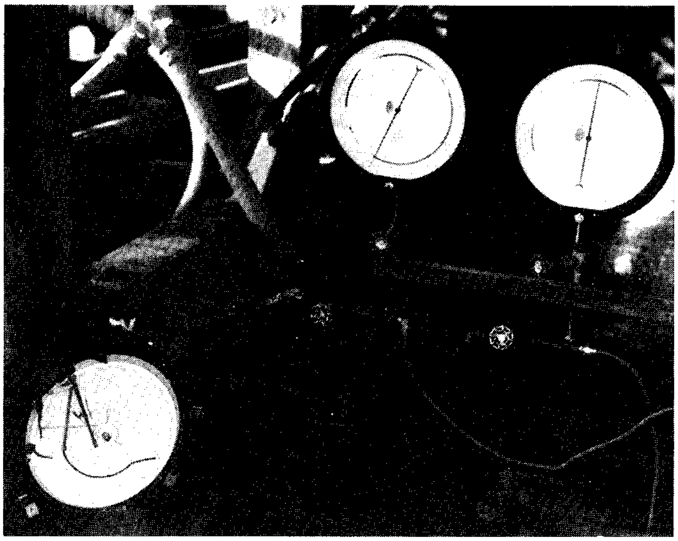

Photo 4-13. Detail of pressure gauges during injection test.

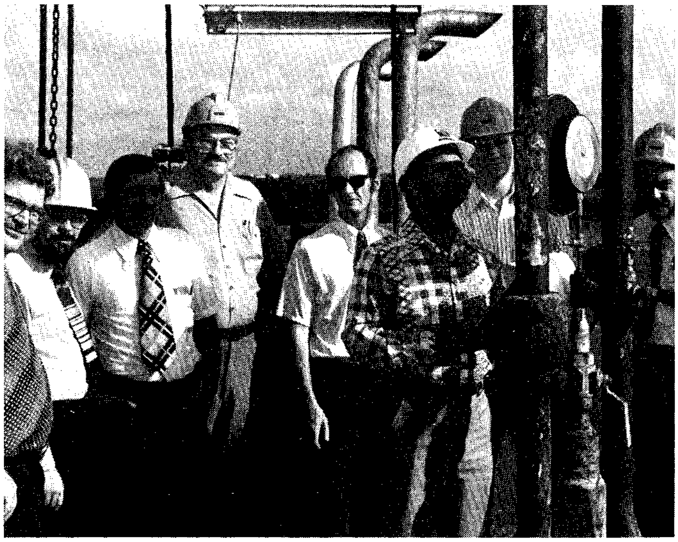

Photo 4-14. Members of regulatory agencies during injection test.

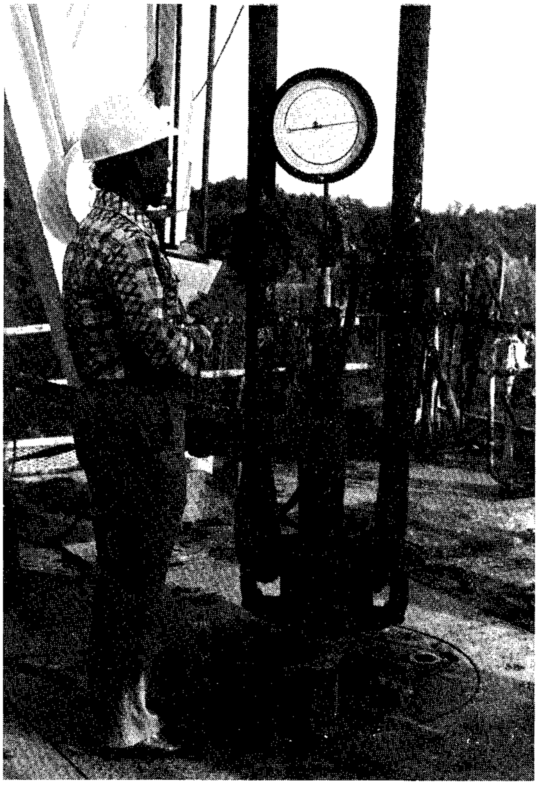

Photo 4-15. Bottom hole pressure gauge.

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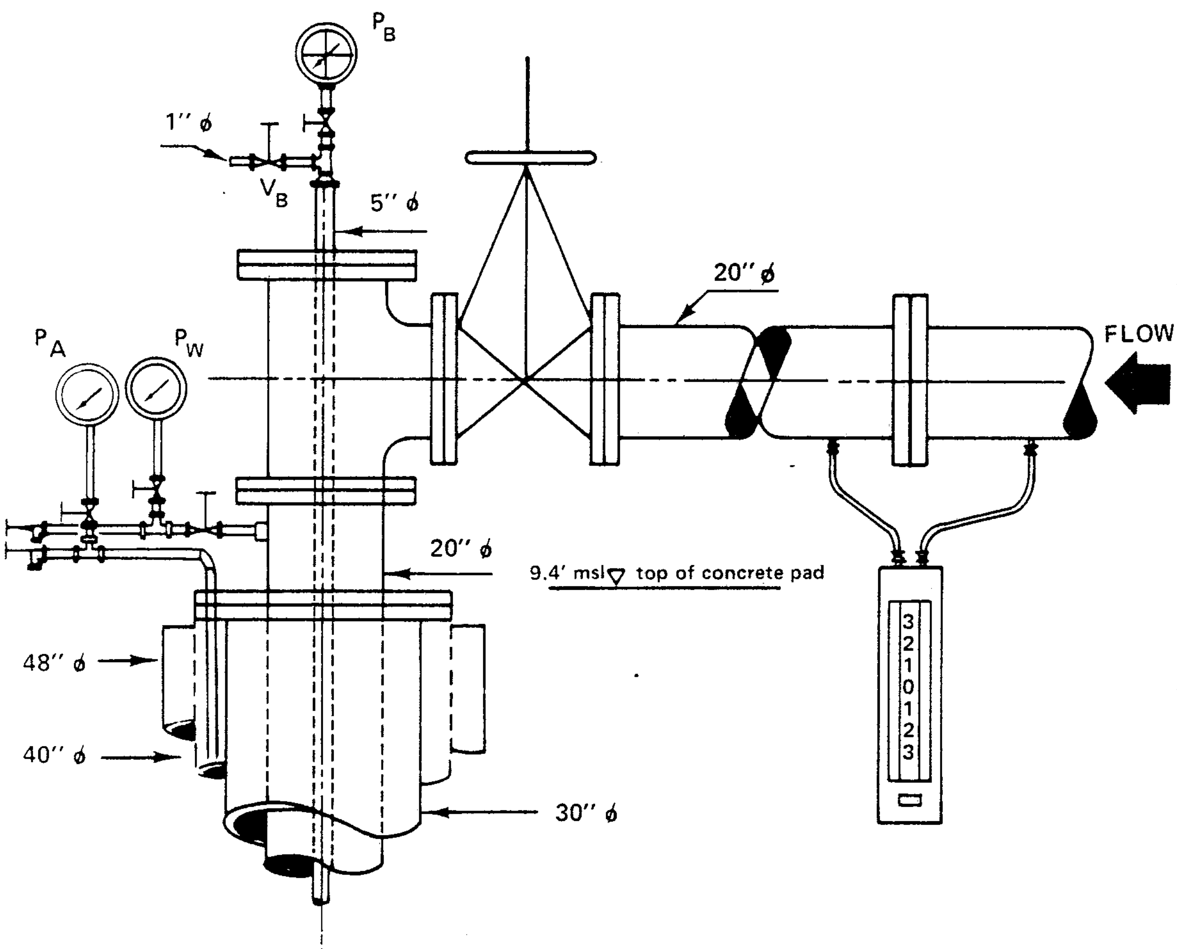

Drawings not to scale.
Heights of pressure gages above top of concrete pad are as follows:

P_A: 3.7 ft
P_W: 3.7 ft
P_B: 23.0 ft

FIGURE 4-2. Instrumentation layout for injection test.

To measure bottom-hole pressure during the injection test, a 5-inch drill rod was lowered into the 20-inch casing and the following procedure was followed:

1. Set bottom of drilling rod at approximately 2,900 feet in depth.

2. Install equipment and well head fittings as per attached Figure 4-2.

3. Inject freshwater through top of 5-inch drill rod until pressure gage reaches a maximum pressure under normal flow. Shut off valve (V_b) and observe pressure for a period of 5 minutes. Pressure should decrease slightly immediately after shutting off valve, and thereafter remain constant (approximately 20 psi). Repeat operation to doublecheck this pressure. Then, open valve (V_b) slowly and a little at a time until next pressure increase. Strangle valve to last setting which did not increase pressure. Leave valve in that position for duration of test. Pressure indicated by gage P_b is static pressure at bottom of drilling rod.

A preliminary injection test was run at variable rates for about 1-1/2 hours on 25 October 1977, while the final injection test was run at a steady rate for about 10 hours.

All data obtained from the injection test are presented in Appendix D, "Pumping Tests." A summary of these data is given in Table 4-3.

Steady-state pressures at the bottom (P_b) and well head (P_w) were reached in less than 1 hour after injection started, and they reached equilibrium within a few minutes after each change in flow rate, indicating the extremely high transmissivity of the receiving aquifer. Small variations in pressures at both P_b and P_w during the day seem to be related to slight changes in the densities of the liquid injected.

The increase in the bottom-hole pressure (P_b) due to an injection rate of about 8,000 gpm is approximately 0.7 psi. This indicates the extremely high transmissivity of the receiving formation (Boulder Zone) and confirms the results of the pump-out tests discussed earlier.

Figure 4-3 graphically shows the relationship between the injection pressures at the well head and the receiving aquifer versus the injection flow rates.

The annulus pressure (P_a) between the 30-inch and 40-inch casings remained constant at 15.8 psi[1] (with respect to the top of the drilling pad at the well) throughout the test.

Table 4-3
Summary of Injection Test Data

Flow Rate	Elapsed Time	Pressure in psi			
(gpm)	(hours)	P_a (Annulus)	P_w (Well Head)	P_b (Bottom)	Remarks
0	-	16.09	-	Gage not working	Start preliminary test on 10/25/77
5,100	0.8	16.10	40.75		Data from preliminary test
3,900	1.1	16.09	39.25		Data from preliminary test
8,400	1.3	16.09	55.95		Data from preliminary test
0	-	15.79	30.48[a]	30.48	Start injection test on 10/26/77
8,200	0.5	15.77	56.35	31.10	
8,300	1.0	15.73	56.35	31.15	
8,200	2.0	15.76	56.55	31.16	
8,100	4.0	15.78	55.35	P_b gage not working	
8,000	6.0	15.79	54.65	31.31	
8,000	8.0	15.79	55.15	31.39	
7,900	9.7	15.79	55.25	31.39	Injection rate decreased to 5,000 gpm after this reading
5,000	0.25[b]	15.75	40.95	31.10	
0	0.1[c]	15.75	31.55	31.21	Recovery
0	0.2[c]	15.75	31.30	31.08	Recovery
0	0.7[c]	15.75	31.10	31.06	Recovery

Note: All pressures are referred to top of concrete pad at the test well.

[a] From P_b under static conditions.
[b] Elapsed time since flow was held steady at 5,000 gpm.
[c] Hours since injection stopped.

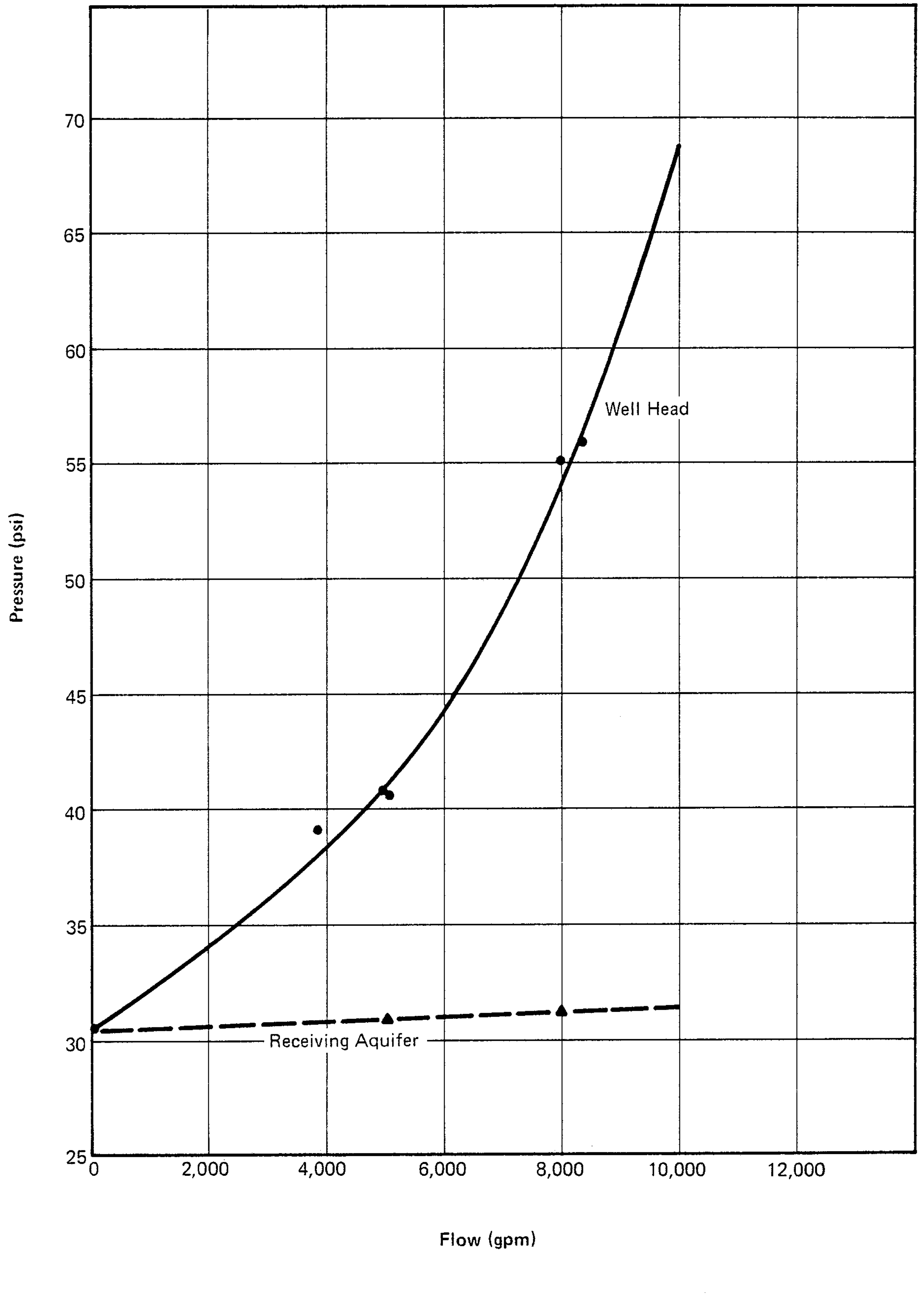

FIGURE 4-3. Injection pressures vs. flow rates.

This indicates that there was no leakage of the injected water into the annulus or the Floridan aquifer and confirms the good confining zone characteristics of the aquiclude (1,680 feet to 2,790 feet) obtained from the packer tests. Attention should be called to the fact that, although the static pressure in the well head or in the receiving aquifer was 30.48 (referred to the top of the drilling pad at the well), it does not necessarily mean a higher piezometric head than that of the annulus between the 30-inch and 40-inch casings, i.e., 15.8 psi. The specific gravity of the water in the annulus is higher than 1.000 and varies with depth (see Appendix C), while that in the well during the test was lower. In order to establish a comparison between piezometric heads, the specific gravity of the water in the annulus and in the well has to be identical for the same column length.

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[1] Annulus pressure was 15.1 psi during the pumping test of 20 October. Continuous flow from this zone prior to the injection test on 26 October resulted in freshening in this zone. Due to the lower density of the fresher water, the artesian pressure is higher.

5.1 PURPOSE AND OBJECTIVE

Treated effluent injected into the Boulder Zone is effectively removed from the physical environment. Therefore, the effects of such injection cannot be directly observed, as is the case with surface discharges. A system of wells penetrating various strata is necessary to allow direct observation of the subsurface. The purpose of the monitoring system is to provide a record of the effects of injection on the subsurface environment and of the operation of the surface facilities.

The objectives of the monitoring system are as follows:

1. To determine the hydraulic effects of injection on the Boulder Zone.

2. To detect any upward migration of the injected fluid.

3. To detect any changes in the saltwater/freshwater relationships at the base of the Floridan aquifer.

4. To detect any changes in water quality in the Floridan Aquifer.

5. To detect any changes in water quality in the Biscayne aquifer.

6. To track the quantity and quality of the injected fluid.

7. To detect any changes in quality of the effluent after injection.

8. To evaluate well performance.

5.2 MONITORING ZONES

Monitoring of five subsurface zones, identified during drilling of the test well, will provide data on the effects of injection. The proposed monitoring wells relating to each zone are arranged in a triangular pattern to define a reference plane for the determination of hydraulic effects of injection. The proposed zones and the designated purpose of each are described below:

Boulder Zone

The injection zone, as identified by geophysical logging, extends from approximately 2,830 feet to 2,920 feet in depth. One monitoring well (BZ-1 on Figure 1-2) will be provided in this zone. Its purpose will be:

1. To function as an observation well during future tests to refine determinations of the hydraulic characteristics of the Boulder Zone and confining beds.

2. To provide a means of obtaining long-term data on water quality and pressures in the Boulder Zone.

3. To provide data on rate and direction of movement of the injected fluid. This function is short-term and will be supplemented by observations in unused injection wells during the first year of system operation.

"2,500-Foot Zone"

This is a dolomitized zone occurring between the depths of 2,465 feet and 2,536 feet. This is the first water-producing zone above the injection zone and is the only stratum having any significant permeability between 1,680 feet and 2,800 feet in depth. Any upward movement of injected effluent will be detected by monitoring at this level. Monitoring will be provided by a gravel-packed annulus tubing installed in well BZ-1.

Saltwater Interface

The transition in aquifer water quality from brackish (<5,000 mg/l Cl) to salty (>10,000 mg/l Cl) occurs between 1,680 feet and 1,780 feet in depth. Monitoring at the top of this zone will detect any change in the position of the interface. Three monitoring points are provided: a gravel-packed tubing in the annulus of BZ-1 and two separate wells, designated FA-1 and FA-2, located as shown on Figure 1-2.

Floridan Aquifer

The most productive and potentially useful part of the Floridan aquifer lies between the depths of 980 feet and 1,100 feet at this site. Monitoring at this aquifer will detect any changes in artesian head or water quality resulting from injection. Monitoring will be provided by a gravel-packed annulus tubing in BZ-1, a gravel-packed annulus tubing in I-5, and open annuli in wells FA-1 and FA-2, located as shown on Figure 1-2.

Biscayne Aquifer

The Biscayne aquifer at the site extends to about 100 feet in depth and contains freshwater to a depth of about 50 feet at the eastern edge of the site. Freshwater probably extends to the bottom of the aquifer at the west property boundary. Any effects of the project on the Biscayne aquifer would be most likely to occur during construction of the injection wells or as a result of operation of the surface facilities. In total, 10 Biscayne aquifer wells are provided to allow monitoring of water quality in this aquifer during the life of the facility. One Biscayne aquifer well (designated by a BA number) is located on each drilling pad. Temporary shallow monitoring wells are also provided at each drilling pad for water quality monitoring during well construc tion.

5.3 MONITORING WELLS

As described in the preceding paragraph, 13 separate, permanent monitoring wells are proposed. These include 10 Biscayne aquifer wells to a depth of approximately 40 feet, one Boulder Zone well with multiple-zone monitoring to a depth of 2,950 feet, and two deep Floridan aquifer monitoring wells to a depth of 1,650 feet. The wells will be located as shown on Figure 1-2. Proposed construction of the wells (except Biscayne aquifer wells) is shown schematically on Figure 5-1.

5.4 OPERATIONAL MONITORING

The operational monitoring system will include monitoring of injection rate, injection pressure, and effluent quality in addition to the monitoring of aquifer parameters. A summary of operational monitoring parameters is given in Tables 5-1 through 5-3.

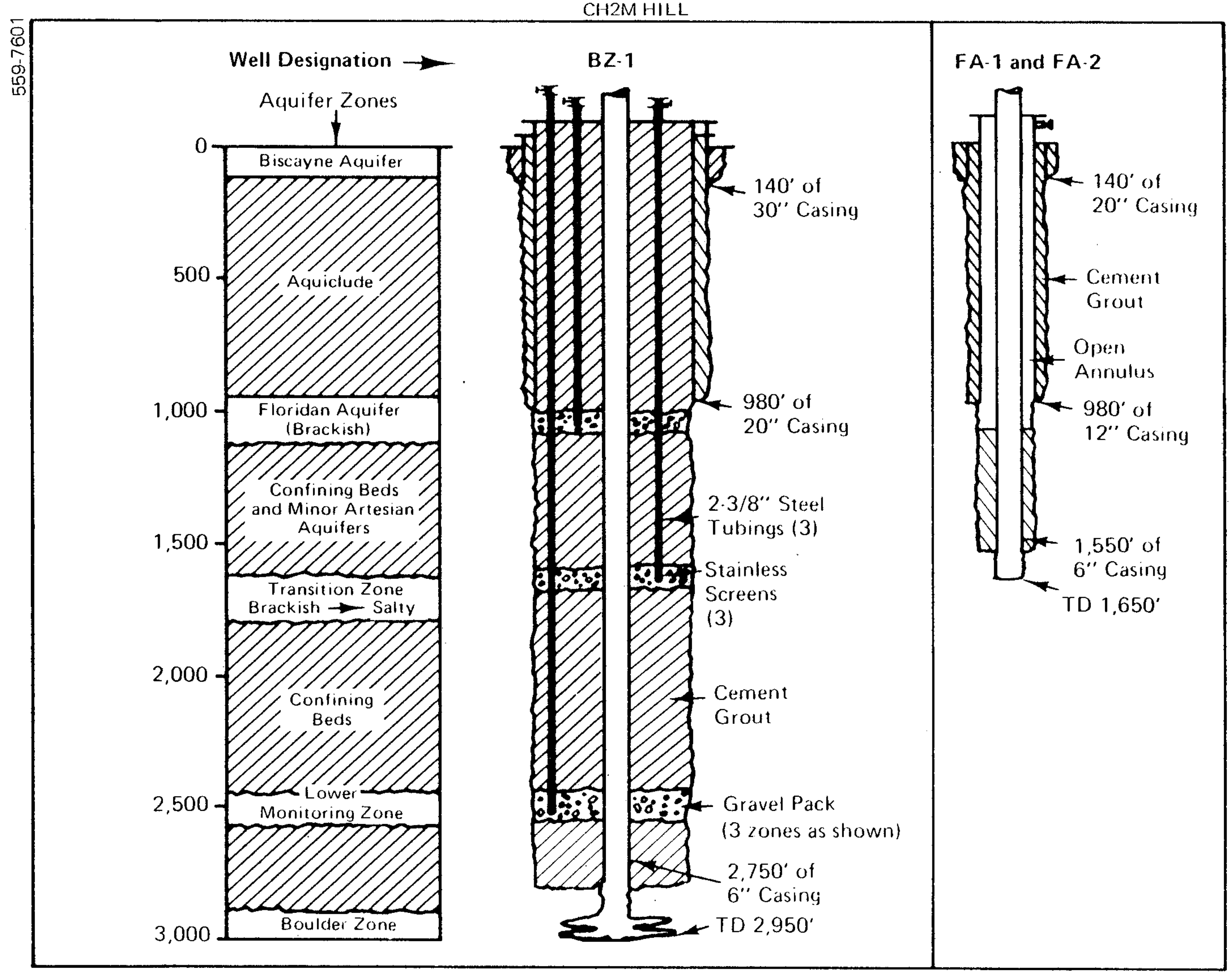

FIGURE 5-1. Proposed construction of monitoring wells.

Table 5-1
Operating Parameters

Parameter Monitored	Sampling Point	Frequency
Injection rate	1. Effluent pumping station 2. Each well	Continuous Continuous
Injection pressure	Each well	Continuous
Boulder Zone pressure	Boulder Zone monitoring well[a]	Continuous
Floridan aquifer pressure	1. Floridan aquifer monitoring wells FA-1 and FA-2 2. Annulus of Boulder Zone monitoring well	Continuous Continuous
Lower monitoring zone pressure (2,500-foot zone)	Annulus of Boulder Zone monitoring well	Continuous
Floridan aquifer (transition zone) pressure	1. Annulus of Boulder Zone monitoring well 2. Floridan aquifer monitoring wells FA-1 and FA-2	Monthly Continuous
Power consumed, kilowatt hours	Effluent pumping station	Daily
Total volume injected	Effluent pumping station	Daily

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

Table 5-2
Aquifer Water Quality

Zone Monitored	Parameters Monitored	Sampling Points	Frequency
Boulder Zone	1. Basic hydrochemistry BOD_5 Cl residual Total coliform Fecal coliform pH DO Specific conductance Turbidity Alkalinity Hardness Calcium Magnesium Sodium Potassium Chloride Sulfate Iron Nitrogen species Phosphate Organic carbon	Boulder Zone monitoring well plus unused injection wells	Monthly
	2. Gases Nitrogen Methane CO_2 H_2S Pesticide	Boulder Zone monitoring well	Twice per year
	3. Trace elements (metals)	Boulder Zone monitoring well	Twice per year
Lower monitoring zone (2,500-foot zone)	Same as Boulder Zone 1, 2, and 3 above	Boulder Zone monitoring well annulus tubing	Monthly
Floridan aquifer (brackish to saline transition zone)	1. Same as Boulder Zone 1, 2, 3 above	Boulder Zone monitoring well annulus tubing	Monthly
	2. Specific conductance, chloride, temperature	Floridan aquifer monitoring wells FA-1 and FA-2	Twice per year

Table 5-2--Continued

Zone Monitored	Parameters Monitored	Sampling Points	Frequency
Floridan aquifer (upper)	1. Same as Boulder Zone 1, 2, and 3 above	FA-1 and FA-2 annulus, I-5 annulus tubing and Boulder Zone monitoring well annulus tubing	Twice per year
	2. Specific conductance, chloride, temperature		Monthly
Biscayne aquifer	Chloride, specific conductance	Biscayne aquifer monitoring wells	Monthly
Biscayne aquifer	Basic hydrochemistry (same as Boulder Zone 1, 2, and 3 above)	Biscayne aquifer monitoring wells	Annually

Table 5-3
Effluent Quality Monitoring
(Sampling Point--Effluent Pumping Station)

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

Chapter 6
SUMMARY AND CONCLUSIONS

6.1 SUMMARY

This report presents the data obtained from drilling and testing of a test injection well for deep underground injection of wastewater effluent from the proposed South District Regional Wastewater Treatment Plant of the Miami-Dade Water and Sewer Authority, Dade County, Florida. Secondary treatment would be provided by this plant having a nominal capacity of 50 million gallons per day (mgd), with estimated peak flows of 112 mgd. The proposed deep-well injection system includes nine deep injection wells and three deep monitoring wells. The system is proposed to discharge into the Boulder Zone at approximately 3,000 feet in depth. This report also examines the feasibility of injecting the effluent from the proposed plant.

Drilling and testing of the well have been directed to meet requirements established by county, state, and federal regulatory agencies.

The test well penetrates through the shallow Biscayne aquifer (approximately 100 feet in depth) and the Floridan aquifer. The well is comprised of four steel casings and an open hole from 2,746 feet to 3,193 feet. The outer 48-inch casing (0.500 inch thick) extends 134 feet in depth, past the hard to medium hard oolitic limestone of the Biscayne aquifer, and is cemented all the way to the surface. A 40-inch casing (0.625 inch thick) is 961 feet deep and penetrates through almost all of the underlying aquiclude. This casing is also cemented all the way to the surface. The aquiclude is formed by soft, sandy limestone, siltstone, and clays. A 30-inch casing (0.500 inch thick) extends to 1,794 feet from the surface through the Floridan aquifer. Chlorides in water from the Floridan aquifer range from 700 mg/l to 15,000 mg/l, while total dissolved solids vary from 2,500 mg/l to 41,000 mg/l. Cementing of this 30-inch casing was done from 1,794 feet to 1,056 feet and from 1,007 feet to the surface. Gravel was placed between 1,056 feet and 1,018 feet, followed by a sand cap from 1,018 feet to 1,007 feet; and a 1-1/4-inch monitoring tube screen was installed between 1,034 feet and 1,044 feet to monitor the water from the top of the Floridan aquifer. The 20-inch inner casing penetrates through the confining zone between the Floridan aquifer and the Boulder Zone to a depth of 2,746 feet and is cemented from this depth to the surface. This aquiclude is formed by fossiliferous and dolomitic limestone as well as by calcareous and fossiliferous dolomite.

The Boulder Zone formation begins at approximately 2,790 feet and is composed of hard, crystallized dolomite that is fractured in several places. This formation continues to the total depth of the well. Chlorides in water from the Boulder Zone range from 19,000 to 25,000 mg/l, while total dissolved solids vary between 37,000 and 40,000 mg/l. The chemical composition of this water is very similar to that of seawater.

It was determined from geophysical logging that practically all of the water produced below the Floridan aquifer to total depth came from the cavernous strata between approximately 2,830 feet and 3,050 feet. The injection zone extends from approximately 2,830 feet to 2,920 feet in depth.

Three types of pumping tests were performed during the construction and completion of the test-injection well. These tests were:

1. Packer testing, performed at selected zones between 1,794 feet and 2,759 feet, to determine the effectiveness of the confining layers between the Floridan aquifer and the Boulder Zone.

2. Pump-out tests, to determine the aquifer characteristics of the Boulder Zone.

3. Injection test, to confirm well performance under operating conditions.

An approximate transmissivity of 900 gpd/ft for the section from 1,690 feet to 2,790 feet was determined from packer testing. This yielded an estimated travel time of 343 years from the top of the Boulder Zone to the bottom of the Floridan aquifer.

The transmissivity of the Boulder Zone was estimated to be 14×10^6 gpd/ft from the data obtained from pump-out tests. The 6,200-gpm pump-out test produced not more than 1.0 foot of drawdown in the aquifer after subtracting for the friction losses in the open hole and casing. A temporary open zone at 2,480 feet did not show a significant response to the pump-out and recovery tests. Also, no change in pressure in the annulus between the 30-inch and the 40-inch casings (1,040-foot-deep zone) was recorded during these pump-out and recovery tests.

Steady-state pressures at the receiving aquifer (Boulder Zone) and well head were reached in less than 1 hour after the start of the injection test, and they reached equilibrium within a few minutes after each change in flow rate, indicating the extremely high transmissivity of the Boulder Zone. The increase in the bottom-hole (receiving aquifer) pressure due to an injection rate of about 8,000 gpm is approximately 0.7 psi, confirming the results of the pump-out tests mentioned above. The annulus pressure between the 30-inch and the 40-inch casings remained constant throughout the injection test, indicating that there was no leakage of the injected water into the annulus or the Floridan aquifer and confirming the good confining zone characteristics of the aquiclude (1,690 feet to 2,790 feet) obtained from packer testing.

6.2 CONCLUSIONS

1. Results of injection tests indicate that the receiving aquifer can accept high rates of flow with only a slight increase in pressure (less than 1 psi at approximately 8,000 gpm).

2. Physical and chemical quality of effluent expected from the Miami-Dade Water and Sewer Authority South Regional Wastewater Plant shows no constituent which may significantly reduce the hydraulic and/or structural characteristics of the receiving aquifer or the confining layer.

3. Disposal of proposed effluent into the receiving aquifer will not impair the present or any foreseeable use of the aquifer.

4. The well as designed and constructed gives maximum protection for the aquifers overlying the injection zone. The possibility of contaminating the Biscayne aquifer from the proposed well and system, under proper operation, is beyond any reasonable expectation. Conservative estimates of the upward movement of the injected effluent indicates that, if any upward movement would take place, it would require approximately 343 years for it to reach the saltwater transition zone at approximately 1,700 feet in depth. Physical and biological reactions in the Boulder Zone and confining beds should provide further treatment.

5. The injected effluent, in our opinion, will tend to move at a very slow rate (a matter of a few feet per year) toward the surrounding seas and will enter them at considerable depth (more than 2,500 feet) some 30 miles from the shoreline. The water level in the completed well stands approximately at land surface (2 feet above mean sea level) under static conditions and when containing high-chloride water (19,000 mg/l). The above hypothesis on the direction of flow and emergence at sea of the ground water in the receiving aquifer is substantiated by the foregoing fact (indicating a

hydraulic gradient toward the sea) and by the following:

a. The abnormal geothermal gradient in the well which resembles that in the nearby Florida Straits (Kohout, 1965, p. 266).

b. The hydrogeology of south Florida.

6. Injection of the freshwater effluent into an aquifer containing saltwater could lead to the formation of an enormous freshwater bubble at the top of the deeper aquifer which would be under the normal artesian pressure. If that takes place, such volume of water could be used for irrigation or for future water supply when shortage of present freshwater sources would justify the cost of treating and reclaiming the stored water. Some research is presently being done elsewhere on such a possibility, but further discussion of this subject falls beyond the scope of our report.

7. Upward migration of saltwater into the brackish part of the Floridan aquifer is not expected to occur, based on the following considerations:

a. It is unlikely that the fluid potential imparted to the saltwater in the aquiclude by the buoyancy (of the injected effluent) alone would be sufficient to raise the saltwater to a position of higher potential (into a less dense fluid, i.e., brackish water).

b. If forces other than gravitational (buoyancy) should result in the upward displacement of saltwater, the displaced saltwater would tend to remain in the lower Floridan aquifer, which is already salty. If saltwater migration should occur as a result of pressure effects of injection, the possible adverse effects of such migration could be limited by withdrawal of water from the lower Floridan aquifer. Such withdrawal would produce an isopotential boundary across which no movement of water could occur.

6.3 RECOMMENDATIONS

Development of the entire disposal system and the gathering of technical and scientific information to provide further assurance of the system's reliability requires, in our opinion, to proceed with the following recommendations:

1. Continue disposal system by drilling wells BZ-1 (Boulder Zone 1) and I-6 (injection well No. 6): BZ-1, at approximately 200 feet south of this test well (I-5); I-6, at approximately 770 feet north of I-5.

2. Modify design of BZ-1 to monitor (pressure and quality) zones at approximately the following depths in feet:

   2,800-3,000
   2,400-2,500
   1,600-1,700
   950-1,050

3. As soon as well I-6 is completed, run pumping test in I-5 and measure drawdowns in the Boulder Zone at I-6 and at the recommended monitoring zones in BZ-1.

4. With data under Recommendation 3, above, calculate new values for transmissivity (T) and storage coefficient (S), if possible. Also, attempt to determine leakance (P'/m), if at all possible. With such information, prepare digital model of the proposed disposal field to estimate pressure increase effects in the Boulder Zone within the area of influence.

5. Run injection test on I-6. Make provisions to run flowmeter, temperature, and fluid conductance logs while well is allowed to backflow.

6. Continue drilling Floridan aquifer monitoring well FA-1 and injection wells I-7 and I-8.

7. Continue drilling other injection wells I-4, I-3, I-2, I-1, I-9, and Floridan aquifer monitoring well FA-2 as dictated by disposal of drilling fluids and availability of water for injection tests (FA-2 would be drilled in lieu of BZ-2).

8. Install, as soon as possible, water level recorder within 20-inch casing of the completed test well and a pressure recorder in its annulus to study tidal fluctuations in both the Boulder Zone and the Floridan aquifer.

The above recommendations should not significantly alter the total cost of the project and would provide most valuable information for the successful operation of the system and for its most refined reevaluation.

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Appendix A

REGULATORY PERMITS, MEETINGS, AND MODIFICATIONS

STATE OF FLORIDA

DEPARTMENT OF ENVIRONMENTAL REGULATION

2562 EXECUTIVE CENTER CIRCLE, EAST
MONTGOMERY BUILDING
TALLAHASSEE, FLORIDA 32301

REUBIN O'D. ASKEW
GOVERNOR

JOSEPH W. LANDERS, JR.
SECRETARY

September 28, 1976

Mr. Diaz Callahan
Project Manager
U.S. Environmental Protection Agency
Region IV
1421 Peachtree Street N.E
Atlanta, Georgia 30309

Re: South Dade C120377
Injection Test Well

Dear Mr. Callahan:

We have scheduled a meeting for October 7, 1976, at 10:00A.M. in our DER Action Center, Room 153, Montgomery Bldg., Koger Executive Center, Tallahassee, Florida in order for interested parties to take part in a presentation and discussion involving the proposed South Dade injection test well program.

A presentation will be given by the Miami-Dade Water and Sewer Authority's consultants, Black, Crow & Eidsness of Gainesville, Florida. We would appreciate your attendance at this meeting and by copy of this letter, we are formally inviting all persons listed as cc's to be present at the meeting and provide us with their expertise and knowledge in setting up the best possible test well program.

Sincerely,

HOWARD L. RHODES, P.E.
CHIEF, BUREAU OF WASTEWATER
MANAGEMENT AND GRANTS

Troy M. Mullis

Troy M. Mullis, P.E., Admin.
Wastewater Engineering Section

HLR/tmh

cc: Chuck Littlejohn
Dr. Tim Stuart
Dan Farley
Steve Lewis
Vicky Tschinkel
Phil Edwards
Warren Strahm
Dade Co. Dept. of Environmental Resource Mgmt.
Central & Southern Flood Control District
U.S.G.S.
Gene Coker
Dr. Jose Garcia
Garrett Sloan

Regulatory

BLACK, CROW & EIDSNESS, INC.

CONSULTING ENGINEERS

PRINCIPAL OFFICE: 7201 N. W. ELEVENTH PLACE, GAINESVILLE, FLORIDA

REGIONAL OFFICES: ATLANTA, GEORGIA / CLEARWATER, FLORIDA
BOCA RATON, FLORIDA / NAPLES, FLORIDA / SAN JOSE, COSTA RICA
HOUSTON, TEXAS / PHILADELPHIA, PENNSYLVANIA / MONTGOMERY, ALABAMA

PLEASE REPLY TO:
GAINESVILLE, FLORIDA 32602
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7201 N. W. ELEVENTH PLACE
904/377-2442
TWX 810/825-2359
CABLE ADDRESS: BCEGNVFLA

October 6, 1976

DER Meeting of October 7, 1976, Tallahassee, Florida
Disposal Well System, South District Regional Wastewater Treatment Plant
Miami-Dade Water & Sewer Authority

Points Needing Agreement:

1. Test well location — I-6 with Biscayne Monit System to begin with I-6; pad & sump around well
2. Test well casing:
   1) diameters ✓ — 20" as close as possible to injection zone (±290...)
   2) depths ✓ except — 900-1300 cement all-the-way
   3) open annuli ✓ — 1800-2000 cement all-the-way but leave monitoring line 2" perforated p...
3. Test well drilling techniques:
   1) mud to ± 900 ft.
   2) reverse air from ± 900 ft. down
4. Test well drilling water disposal:
   1) ~~Bottom of Biscayne~~ aquifer well
   2) Downstream of C - 31E ←
5. Hydrogeological data collection program:
   ✓ 1) Basic data M5 see ...
   ✓ 2) Construction sequency M5 ok
   ✓ 3) Step-pumping test ok
   ✓ 4) Injection test: Source of water canals ok Will require a permit from FCD.
      rate 10,000 gpm
   ✓ 5) Data sharing program - Progress Reports
      5.5.1 To whom? (*) ...
      .2 How often? Monthly below
      .3 Final report? same people as 5.5.1 above
6. Location of other disposal wells
7. Location of monitoring wells
   1) Boulder zone (2) Leave BZ-1 under separate part uncemented annul...
   2) Floridian aquifer (1) ok
   3) Biscayne aquifer (10) 4 more at I-6

(1) Abe Kreitman FCD
(2) DER: Troy Mullis & Jim Poole
(3) DER: District Warren Strahm
(4) USGS John Vecchioli Tally Fred Meyers Miami
(5) DER: Morrissey
(6) EPA: Coker & Callahan

8. Casings, drilling techniques and drilling water disposal:
   1) Other disposal wells (8)
   2) Boulder zone monitoring wells (2) *three cores of confining material*
   3) Floridian aquifer monitoring well (1)

9. Data reporting and sharing *same as test well*

10. Monitoring program for continuous operation.

ATTACHMENT 1

PROPOSED DRILLING AND TESTING PROGRAM

FOR INJECTION WELL FACILITIES AT THE

SOUTH DISTRICT REGIONAL WASTEWATER TREATMENT PLANT

MIAMI-DADE WATER AND SEWER AUTHORITY

1. INTRODUCTION

Effluent disposal at the South District Regional Wastewater Treatment Plant will be by deep well injection. The plant will provide secondary treatment and will have a design capacity of 50 mgd. The projected 4-hour peak flow is 115 mgd. Effluent disposal will be via nine 20-inch "Boulder Zone" disposal wells. The effluent pumping station will be designed to pump at the peak rate into any eight of the wells. Provisions will be made to expand the plant to 100 mgd design capacity and 225 mgd peak.

The plant and well site are located so as to provide maximum protection of the Biscayne aquifer. Both will be located downstream from 1,000 mg/l isochlor. The injection well casing program is designed to provide maximum protection to both the Biscayne aquifer and the brackish water part of the Floridan aquifer. A monitoring system will be provided to monitor the fate of the effluent underground.

As the first construction phase, it is proposed to drill a prototype injection well at the site. An intensive geotechnical data collection program will accompany the drilling of the prototype well. After completion of the well, a high-rate injection test well be run. Final design of the remaining eight injection wells, the monitoring wells, and the effluent pumps will be based upon data from the prototype well.

The proposed test program and design considerations are presented below. The purpose of this presentation is to allow all interested technical and regulatory agencies opportunity to comment and provide their input on the proposed program before beginning of design.

2. PROJECT SITE

The treatment plant and well field are located in the northern half of Section 21, T56, R40E, as shown on Attachment 2.

Natural elevations at the site range from two to four feet above mean sea level. The site is subject to inundation by storm tides. Site soil conditions consist of one to two feet of calcareous silty sand (marl) overlying limestone. The water table is at or near ground surface most of the time.

The 1,000 milligrams per liter (mg/l) isochlor in the Biscayne aquifer is located just west of the site. The 1,000 mg/l isochlor is defined as a line seaward of which water at the base of the aquifer contains more than 1,000 mg/l of chloride

3. WELL FIELD LAYOUT

A tentative layout of the injection and monitoring well facilities is shown on Plan Sheet M-1 (Attachment 3). Each well is located on a 160'x200' pad build of compacted fill to an elevation of 10 feet above mean sea level.

4. TEST WELL

A test well is to be drilled at the site prior to beginning construction of the injection and monitoring wells. In order to obtain optimum information about design parameters for future injection wells and the injection pumping station, it is proposed that the test well be a prototype injection well. The design and construction of the test well will be such that the geologic and hydrologic conditions at the site can be determined during drilling and testing. The test well will be drilled in the northeast corner of the site (Injection Well No. 6 on Attachment 3).

The well will be of the general design shown on Attachment 4, Injection Well Diagram. Design of the prototype well is based on hydrogeologic conditions found at the Sunset Park and Kendale Lakes injection wells, and the Florida Power and Light Company research test well at Turkey Point. Four casing strings are provided as follows:

<u>Outer Casing</u>:	42-inch through the Biscayne aquifer, into the underlying aquiclude (estimated 200 feet)
<u>Short Middle Casing</u>:	36-inch through the aquiclude, a few feet into the underlying limestone (estimated 900 feet)
<u>Long Middle Casing</u>:	30-inch through the brackish part of the Floridan aquifer, to the saltwater interface (estimated 1,700 feet)
<u>Inner Casing and Injection Casing</u>:	20-inch into the dense dolomite overlying the Boulder Zone (estimated 2,500 feet)

The 42-inch and 36-inch casings will be cemented to the surface. The 30-inch and 20-inch casings will be cemented from the bottom up, as far as possible, to the next overlying lost circulation zone.

The well will be drilled by the reverse circulation rotary method. Salt water from the drilling and testing, or from natural artesian flow, will be contained in steel tanks or lined pits until disposed of by injection into a saltwater disposal well at the site.

5. SALTWATER DISPOSAL

USGS Open File Report 73031 indicates that the Biscayne aquifer at the site contains salt water near its base. Therefore, it is proposed to drill a well at the site of the test well for the disposal of salt water. Present data indicate that this well will be approximately 120 feet deep, with 40 feet of 20-inch casing. Construction of the saltwater disposal well is shown on Attachment 5. This well may also be used to supply water for the injection test, if adequate fresh water cannot be obtained, as described later in this presentation.

The alternative method of saltwater disposal is to pipe the water across the canal and Levee L31E, just east of the site. We believe this to be a less satisfactory method because of cost and the necessity of interrupting traffic on S.W. 87th Avenue. Another alternative, drilling with a closed system, is less desirable because of adverse effects on the geotechnical data collection program.

Salt water from each of the injection wells drilled subsequent to completion of the test well can be piped back to an existing injection well for disposal.

6. CONSTRUCTION SEQUENCE AND DATA REQUIREMENTS

Before beginning construction, a drilling pad 200'x160' will be built up to an elevation of 10 feet, with compacted material excavated at the site. The excavation will be dug to a depth of 10 to 12 feet, and will serve as a source of drilling water. If adequate capacity is available, water from the excavation will also be used for the injection test.

A geohydrologist or hydrologic representative will be on-site at all times during drilling to direct the geotechnical data collection program. Basic data requirements are as follows:

1. Well cuttings: Collect at not greater than 30-foot intervals, and at each formation change.
2. Water Samples: Collect at 30-foot intervals and at each flow test. Run field determinations for conductance, temperature and chloride on each sample as collected. Perform laboratory analyses on selected samples for the constituents listed in Table 1.
3. Geophysical Logs: As listed in Table 2.
4. Coring: Coring of selected intervals will be done during drilling of the deep monitoring wells. Intervals of interest will be selected on the basis of data from the prototype well.

Upon completion of the well, a step-pumping test will be run to obtain an estimated transmissivity value for the Boulder Zone at this site. Following this test, an injection test will be run using fresh water from the borrow excavation. A summary of the test pumping program is given in Table 3.

Proposed construction sequency is as follows:

1. Construct access and drilling pad for the prototype test well;
2. Drill saltwater disposal well;
3. Drill prototype test well;
   a. Set outer casing to 200 feet and cement
   b. Drill test hole to top of Floridan and run logs
   c. Ream test hole, set and cement 36-inch casing

TABLE 1
HYDROCHEMISTRY

Sample No.	Sample Source/Description/Frequency	Approx. Number	Constituents Determined
1	Borrow pit for test well drilling pad. Initial sample.	1	pH Specific conductance TDS Alkalinity Hardness Calcium Magnesium Sodium Potassium Chloride Sulfate Nitrate Color
2	Borrow pit, daily samples during construction and testing	300	Specific conductance Chlorides
3	Saltwater disposal well. Initial sample.	1	Same as Sample No. 1
4	Prototype test well, samples from reverse rotary drilling 900 feet, 3,200 feet	80	Specific conductance Chlorides Temperature
5 ✓	Prototype test well, sample by natural flow from 8-inch test hole at 1,000 feet, 1,200 feet, 1,400 feet, 1,600 feet, 1,800 feet	5	Same as Sample No. 1 plus the following: Total organic carbon H_2S Strantium Iron Manganese Lead Copper Arsenic Mercury Cadmium Aluminum Fluoride
6	Prototype test well, 8-inch test hole to 1,800 feet. Composite flow plus depth samples at selected intervals.	6	Same as Sample No. 1

TABLE 1 - (continued)

Sample No.	Sample Source/Description/Frequency	Approx. Number	Constituents Determined
7	Prototype test well, sampled by pumping through drill pipe at 2,000 feet, 2,200 feet, 2,400 feet, 2,600 feet, 2,800 feet, 3,000 feet, TD.	7	Same as Sample No. 5
8	Prototype test well, composite pumped sample 1,700 feet to 3,200 feet, plus selected interval samples.	6	Same as Sample No. 1
9	Prototype test well, pumped sample from completed well.	3	Same as Sample No. 5
10.	Biscayne aquifer water supply wells Sample daily during drilling operations.	300 to 600	Specific conductance Chloride
11.	Injection wells (8). Sample at 30-foot intervals during drilling	640	Specific conductance Chloride Temperature
12.	Injection wells. Sample during flow tests.	8	Same as Sample No. 5
13.	Boulder Zone and Floridan aquifer monitor wells. Sample at 30-foot intervals.	200	Specific conductance Chloride Temperature
14.	All monitoring wells, post-construction background samples.	17	Same as Sample No. 5

TABLE 2

GEOPHYSICAL LOGGING

Well or Interval Logged	Type Log
1. Prototype test well, 8-inch test hole to 900 feet	Electric Gamma Ray Caliper
2. Prototype test well, 8-inch test hole to 1,800 feet	Electric Gamma Ray Caliper Flowmeter Temperature Fluid Resistance
3. Prototype test well, 30-inch casing after cementing	Temperature
4. Prototype test well, 8-inch test hole to 3,200 feet	"Coreband" series (Schlumberger) Caliper Flowmeter Temperature Borehole TV Borehole Stereophotography
5. Prototype test well, 20-inch casing after cementing	Cement Bond Temperature
6. Prototype test well, completed well	Caliper Flowmeter Temperature
7. Injection Wells 1, 2, 3, 4, 5, 7, 8, 9 and Boulder Zone Monitoring Wells	Same as items 1-6, with depths adjusted to suit field conditions. <u>NOTE</u>: Coreband series includes radioactive logging. May be deleted for safety reasons.
8. Floridan aquifer monitoring well	Electric Gamma Ray Caliper Flowmeter Temperature Fluid Resistance

TABLE 3

TEST PUMPING SUMMARY

Test No.	Description of Test	Approximate Duration, hrs	Observation Wells	Parameters Obtained
1	Test pump of flow prototype test well. 8-inch test hole to 1,800 feet.	6	pumped well	Producing zones, transmissivity estimate
2	Test pump prototype test well. 8-inch hole to 3,200 feet	6	pumped well	Producing zones, transmissivity estimate
3	Test pump prototype test well. Step test. High rate 4,000-5,000 gpm	12	pumped well and annulus	Well losses, refine transmissivity estimate
4	Injection test. Fresh water from pit or canal. High rate 9,000-10,000 gpm	24 hours or until water supply is exhausted	pumped well and annulus	Injection pressure, well losses
5	Pump or flow test each monitoring well	6-12	pumped well	Producing zones, transmissivity estimate
6	Pump injection well No. 5. High constant rate	48-72	pumped well, prototype test well, Boulder Zone monitoring wells, Floridan aquifer monitoring well, Annulus monitoring points	Aquifer constants
7	Injection wells 1, 2, 3, 4, 7, 8, and 9. Step drawdown tests	12	All wells previously completed	Specific capacity, well losses

   d. Drill test hole to ≈1,800 feet and run logs
   e. Ream test hole, set and cement 30-inch casing
   f. Drill test hole to TD (≈3,200 feet) and run logs
   g. Ream test hole, set and cement 20-inch casing
   h. Drill 18-inch hole to TD
   i. Run pumping test
   j. Run injection test
   k. Evaluate test data and compile in report
   l. Finalize design of injection and monitoring wells

4. Complete site grading and drilling pad construction;
5. Drill Boulder Zone monitoring well No. 1;
6. Drill Floridan aquifer monitoring well;
7. Drill injection well No. 5;
8. Run pumping test;
9. Drill injection wells 1, 2, 3, 4, 7, 8, and 9; capacity test each well as drilled.

7. MONITORING WELLS

Three monitoring wells are provided as shown on Attachment 3 to detect rate of horizontal movement or possible vertical migration of the injected effluent.

Two monitoring wells penetrate the Boulder Zone and are of the same general construction as the injection wells, but smaller diameter, as shown on Attachment 6. In addition to Boulder Zone monitoring, these two wells also provide annulus monitoring points for the lower Floridan (saline zone) and upper Floridan (brackish zone) aquifer.

One Floridan aquifer monitoring well, in the brackish zone of the aquifer, is provided. Construction of this well is shown on Attachment 7.

A total of 10 Biscayne aquifer monitoring wells are provided, one at each injection well site and one at the remote Boulder Zone monitoring site (BZ-2). Nine of the Biscayne aquifer wells are in the upper (fresh water) part of the aquifer. They will serve as water supply wells, and to monitor possible saltwater spills during drilling. The other Biscayne aquifer well will be cased below the saltwater interface. Its principal use will be as an indicator of the position of the interface. In addition to the monitoring wells, two additional monitoring points will be provided in the open annulus in each of the nine injection wells. As shown on the construction diagram (Attachment 4), open annuli between the 30- and 36-inch casings and the 20- and 30-inch casings provide access to the upper Floridan and lower Floridan aquifer zones, respectively.

Access to the lower (saline) zone will be deleted in favor of a fully-cemented annulus if geologic conditions permit.

8. MONITORING PROGRAM

The objectives of the monitoring program are to provide documentation of the following performance criteria:

a. That the secondary treatment process can consistently remove 90 percent or more of the BOD_5 and suspended solids from the plant influent.

b. That the injection wells can provide a dependable 100 percent ~~backup~~ system for effluent disposal with minimal adverse environmental effects to the receiving saltwater aquifer and little, if any, vertical migration of the injected [redacted] effluent. To accomplish these objectives, the program outlined hereafter is designed to:

-- Obtain hydraulic data on the injection zone and affected formations.

-- Determine effects of imposing pressure on the hydrogeologic system by a long-term injection test.

-- Detect movement of injected (emplaced) fluid.

-- Determine changes in native water quality caused by the injection process.

-- Use data to logically establish operational procedures, and revise if necessary.

Proposed monitoring data and frequency of monitoring is summarized in the following Tables (Tables 4, 5, and 6).

TABLE 4

EFFLUENT QUALITY MONITORING
(Sampling Point - Effluent Pumping Station)

Parameter Monitored	Frequency
BOD_5	Daily
suspended solid	Daily
Chloride residual	Daily
Total Coliform	Daily
Fecal Coliform	Daily
pH	Daily
DO	Daily
Specific Conductance	Continuous ✓
Turbidity	Continuous ✓
Alkalinity	Monthly
Hardness	Monthly
Calcium	Monthly
Magnesium	Monthly
Sodium	Monthly
Potassium	Monthly
Chloride	Monthly
Sulfate	Monthly
Organic Carbon	Monthly
Nitrate	Monthly
Phosphate	Monthly
Trace Elements (metals)	Monthly
temperature	daily
density	monthly
pesticides	twice per year

TABLE 5

OPERATIONAL MONITORING

Parameter Monitored	Sampling Point	Frequency
Flow rate	1. Effluent pumping station 2. Each well	Continuous ✓ Continuous ✓
Injection pressure	Each well	Continuous ✓
Boulder Zone pressure	Boulder Zone monitoring wells 1 and 2	Continuous ✓
Floridan aquifer pressure	1. Floridan aquifer monitoring well 2. Annulus of Boulder Zone monitoring wells	Continuous ✓ Continuous ✓
Power consumed, Kilowatt hours	Effluent pumping station	Daily ✓
Total volume injected	Effluent pumping station	Daily ✓
Specific Conductance	Each annulus pipe	Continuous flow

Daily determination or continuous

Distribute Cra[illegible]

TABLE 6

AQUIFER WATER QUALITY

Zone Monitored	Parameters Monitored	Sampling Points	Frequency
Boulder Zone	1. Basic Hydrochemistry - BOD_5 - Cl residual - ~~total coliform~~ - fecal coliform - pH - DO - specific conductance - turbidity - alkalinity - hardness - calcium - magnesium - sodium - potassium - chloride - sulfate - iron - nitrogen species - phosphate - organic carbon	Boulder Zone monitoring wells	monthly ~~weekly~~
	2. Gases - nitrogen - methane - CO_2 - H_2S pesticide 3. Trace elements (metals)	Boulder Zone monitoring wells	twice a year ~~monthly~~
Lower Floridan (saline zone)	Same as 1, 2, and 3 above	Annulus, Boulder Zone monitoring wells	monthly
Lower Floridan (saline zone)	Specific conductance Temperature - Iron	Annulus, Injection wells	daily (alternate - continuous by sensor in annulus)
Upper Floridan	Basic Hydrochemistry as above Gases as above trace metals as above	Floridan aquifer monitoring well	monthly

TABLE 6 - (continued)

Zone Monitored	Parameters Monitored	Sampling Points	Frequency
Upper Floridan (brackish zone)	Chloride Specific conductance Iron	Boulder Zone monitoring well, Annulus (2), Injection well annulus (9)	monthly
Biscayne aquifer	Chloride Specific conductance	Biscayne aquifer monitoring wells	monthly
Biscayne aquifer	Basic Hydrochemistry	Biscayne aquifer monitoring wells	annually

BLACK, CROW & EIDSNESS, INC.
CONSULTING ENGINEERS
PRINCIPAL OFFICE: 700 SOUTHEAST THIRD STREET, GAINESVILLE, FLORIDA
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PLEASE REPLY TO
GAINESVILLE, FLORIDA 32602
700 S. E. THIRD STREET
P. O. BOX 1647, 904/378-1531
TWX 810/825-2359
CABLE ADDRESS: BCEGNVFLA

October 13, 1976

MEMORANDUM

RE: DER Meeting of October 7, 1976, Tallahassee, Florida
Disposal Well System, South District Regional Wastewater Treatment Plant
Miami-Dade Water & Sewer Authority

Points Discussed and Agreed upon in Meeting

From: J. I. Garcia-Bengochea

To: Attendance as follows:

Howard Rhodes)
Troy Mullis)
Charles Jackson) DER -
Lathan H. Collins II) Tallahassee
G. J. Thabaraj)
Gene Nowak)
Jim Pool)

Gene Coker)
Diaz Callahan) EPA-Atlanta

Fred Williams)
George King) Miami-Dade

Jerry Hughes - USGS, Tallahassee
Fred Meyer - USGS, Miami

Abe Kreitman - Central & So. FL FCD

Ross Sproul - BC&E

---

1. Test Well Location: At site I-6, NW corner Sec 21, T56S, R40E. Have Biscayne aquifer monitoring wells drilled around I-6 prior to drilling test well. Purpose of these wells is to monitor possible spillage from drilling and related operations. Have drilling pad designed to collect in sump any possible spillage. Have spillage pumped across and downstream of Levee 31-E.

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3. Test Well Drilling Techniques: OK mud to ± 900 feet (bottom of confining beds;) reverse air from there down.

4. Test Well Drilling Water Disposal: Pipe to downstream of Levee 31-E (salt water marsh).

5. Hydrogeological Data Collection Program: As per Attachment 1, page 5 and following (to BC&E Memo of 9/29/76), except: .1) Add gases and pesticides to Sample No. 5, Table 1, page 6; .2) Add fluid resistivity to Item 6, Table 2, page 8.

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Abe Kreitman makes comment that to obtain fresh water from canal along SW 87th Avenue will require permit from Central & Southern Florida FCD.

On a data-sharing program, monthly progress report and a summary report at completion of test well project shall be submitted to:

.1 C&SFFCD, Abe Kreitman
.2 DER-District, Warren Strahm
.3 DER-Tallahassee, Troy Mullis & Jim Pool
.4 DERM-Dade County, Colin Morrissey
.5 EPA-Atlanta, Diaz Callahan & Gene Coker
.6 USGS-Miami, Fred Meyers
.7 USGS-Tallahassee, John Viccioli

6. Location of Other Disposal Wells: As per Attachment 3 (BC&E Memo of 9/29/76), except: .1) Drill I-5 first; .2) then BZ-1; .3) then run pumping test on I-5 making observations on I-6 and BZ-1 to confirm aquifer characteristics.

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8. Casings, Drilling Techniques and Drilling Water Disposal:

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9. Data Reporting and Sharing: Same as for Test Well.

Points Discussed and Agreed upon in Meeting of October 7, 1976

10. Monitoring Program for Continuous Operation: As per Attachment 1, page 11 and following (BC&E Memo 9/29/76), except: .1) Delete backup on second line from bottom of page 8; .2) Delete tertiary from first line, top of page 8; .3) Add to Table 4, page 13, the following:

Suspended Solids	Daily
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Density	Monthly
Pesticides	Twice per year

.4 Add to Table 5, page 14, the following:

Specific Conductance - Each Annulus Pipe - Continuous Flow

JIGB:rbs

cc: Phil Edwards, DER, Fort Myers
Warren Strahm) DER, West Palm Beach
Richard Tash)
Colin Morrissey - DERM, Dade County
Garrett Sloan - Miami-Dade W&S Authority
Clyde Conover - USGS, Tallahassee

CENTRAL AND SOUTHERN FLORIDA

FLOOD CONTROL DISTRICT

JOHN R. MALOY, Executive Director

P. O. BOX V
WEST PALM BEACH
FLORIDA 33402
Telephone (305) 686-8800

IN REPLY REFER TO: 9-1-5D (8303)

October 19, 1976

J. I. Garcia-Bengochea
Black, Crow & Eidsness, Inc.
700 SE Third Street
P.O. Box 1647
Gainesville, FL 32602

RE: Disposal Well System, South District Regional Wastewater Treatment Plant, Miami-Dade Water & Sewer Authority

Dear Garcia:

We are in receipt of your memo dated October 13, 1976, summarizing the results of the subject referenced meeting.

In the remarks attributed to me, you correctly summarized the points concerned with taking water from L-31 for injection well testing. However, the minutes did not reflect the special circumstances concerned with crossing the canal with a discharge line for pumped water disposal on the east side of the canal during other phases or testing and construction.

Additionally, the subject memorandum should be corrected, revised, or an addendum issued, to accurately reflect the substantial efforts I made to explain that the drilling of a "prototype well" concurrent with the exploratory work is inappropriate and unacceptable to the District; and further, the memorandum should reflect the District's position that an exploratory test hole drilled as a slim hole for the explicit purpose of gathering hydrogeological, geophysical, and other data must be constructed prior to any other construction work, and that the data derived from the exploratory work when collated, correlated, and interpreted in detail, focusing on local and regional impacts of injection among other parameters, may be the only basis upon which the District will review this deep well injection proposal and indeed may be the basis upon which District permit approval is possible.

Very truly yours,

ABE KREITMAN, Director
Groundwater Division
Resource Planning Department

AK/js

cc: Phil Edwards - DER, Fort Myers
Warren Strahm, Richard Tash - DER, West Palm Beach
Howard Rhodes, Troy Mullis, Charles Jackson, Lathan H. Collins II, G. J. Thabaraj, Gene Nowak, Jim Pool - DER, Tallahassee
Gene Coker, Diaz Callahan - EPA, Atlanta
Clyde Conover - USGS, Tallahassee
Fred Meyer - USGS, Miami
Garrett Sloan - Miami-Dade Water & Sewer Authority
Colin Morrissey - DERM, Dade County
Ross Sproul - Black, Crow & Eidsness

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904/377-2442
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CABLE ADDRESS: BCEGNVFLA

X-1-notebook

October 25, 1976

FCD Re: 9-1-5D (8303)

Mr. Abe Kreitman, Director
Groundwater Division - Resource & Planning Department
Central & Southern Florida Flood Control District
Post Office Box V
West Palm Beach, Florida 33402

Re: Disposal Well System
South District Regional Wastewater Treatment Plant
Miami-Dade Water & Sewer Authority

Dear Abe:

My memo of October 13, referred to in your letter of October 16, was intended to summarize the points discussed and agreed upon in our meeting at DER, Tallahassee, on October 7. I did not intend to produce minutes of a 6-hour meeting.

During our discussions on the sizes for the test-well casing (slim hole vs. prototype well), I thought we had made clear the advantages of the prototype well vs. the slim hole. A prototype well will produce the following data which cannot be produced by a slim hole:

1. Actual injection capacity;

2. Actual injection pressure;

3. Actual increase in pressure at injection zone;

4. Better value of the transmissivity (T) of the receiving zone;

5. With above T we can determine more accurately the spacing between the prototype well and the next well to be drilled under the next phase. This, in turn, will allow us to determine other hydrogeological characteristics of the receiving zone for the proper spacing of the remaining seven disposal wells.

The slim hole cannot give us any of the first three points above. The value of T determined from the slim hole can be quite affected by the reduced flow rate that could be pumped from it and by the heterogenity of the formation.

In addition to the above, the prototype well will produce actual information on the problems of installing and cementing the larger casings of the disposal wells. The slim hole will not produce that information.

As we explained at the meeting of reference, the drilling, the installation and the cementing of each of the casings of the test-prototype well, will be preceded by a test hole that will produce any information that a slim hole could produce.

At the meeting of reference I got the impression from you that the objection to the prototype well could be from the District Board because of the pressures that could be exerted at the completion of the project (due to the expenditures made) to accept a well that is not wholly acceptable. I cannot understand such a position because I do not think that the District Board will accept something that is unacceptable to the District, regardless of pressure. Besides, as we explained to you at the meeting, the Miami-Dade Water & Sewer Authority needs a total of eight disposal wells plus one standby, so one well cannot solve their disposal needs -- not even for the very first flows they are to receive.

If we are to comply with the proposed EPA regulations for the State Underground Injection Control (UIC) Program (and we must by December 16, 1977), we will have to furnish information on: "...injection rate and injection pressure of the fluid to be injected" (Section 146.24(h)). This information cannot be obtained from a slim hole. Therefore at the completion of the slim hole we would have had only as much information as we now have for that purpose: just an educated guess.

The purpose of the slim hole is to confirm the geology of the area and to set your casing and cementing schedule. We already have a good idea of the geology of the area from the two General Waterworks wells on Kendall Drive and the one at Turkey Point for Florida Power & Light Company. All three are nearby. In the first two we were directly involved; in the third one we worked as a review consultant for FP&L.

The only way we can obtain for our clients accurate data to comply with the proposed UIC regulations is by the actual testing of the prototype well. This well would provide the same information and opportunities as the slim hole, in addition to those required by the UIC program which the slim hole would not.

If, in spite of the above reasons, the District insists upon drilling a slim hole first, we would strongly recommend to our client to include, under EPA Phase II of this project, the construction of the slim hole first and then, at its completion and upon approval by the regulatory agencies (including the District), to proceed immediately with the construction of a test-prototype well. This is the only way that we would be able to honestly comply with the proposed UIC regulations and to obtain the necessary data to proceed on firm ground with Phase III. Such action would increase both total cost and time of completion as follows:

	Estimated	
Original Proposal - Phase II	Cost	Time for Completion
Construction of Prototype-Test Well	$ 994,000	120 days
Roadway for access & drilling pad	150,000	30 days
Hydrogeological services	140,000	30 days (1)
Total	$1,284,000	180 days
Modified Proposal - Phase II		
Construction of Slim-Hole Well	$ 335,000	110 days
Roadway for access & drilling pad	150,000	30 days
Hydrogeological services for above	130,000	30 days (1)
Waiting for Regulatory Review of above	65,000 (2)	30 days
Construction of Prototype-Test Well	994,000	120 days
Drilling pad	30,000	15 days
Hydrogeological services for Prototype-Test Well	110,000	20 days (1)
Total	$1,814,000	355 days

(1) Days in addition to those for construction.
(2) Drill rig dry watch.

Abe, we need to resolve this matter as soon as possible. We would appreciate very much if we could set a meeting not later than next week so that we could continue our work and meet the deadlines established for our client.

Very truly yours,

BLACK, CROW AND EIDSNESS, INC.

J. I. Garcia-Bengochea

JIGB:rbs

cc: Mr. Garrett Sloan
Mr. Phil Edwards
Mr. Warren Strahm
Mr. Richard Tash
Mr. Howard Rhodes
Mr. Troy Mullis
Mr. Charles Jackson
Mr. Lathan H. Collins II
Mr. G. J. Thabaraj
Mr. Gene Nowak
Mr. Jim Pool
Mr. Gene Coker
Mr. Diaz Callahan
Mr. Clyde Conover
Mr. Fred Meyer
Mr. Colin Morrissey
Mr. Ross Sproul

State of Florida
DEPARTMENT OF ENVIRONMENTAL REGULATION

INTEROFFICE MEMORANDUM

For Routing To District Offices And/Or To Other Than The Addressee	
To:	
To:	
Location:	
From:	Date:

-7601
Regulatory

October 29, 1976

TO: Chuck Littlejohn

THRU: Paul Beam

FROM: James Pool

SUBJECT: Disposal Well System South District Regional Wastewater Treatment Plant, Miami-Dade Water and Sewer Authority

The attached memo from J. I. Garcia-Bengochea (marked Attachment A) accurately reflects the points discussed and agreed upon in the subject meeting. However, I have the following clarifications and additional comments:

1. Permanent hardened guttered pads for all well sites must be provided and designed to collect in sump for disposal of any spillage during construction, testing, repair, logging, workover, or abandonment. Disposal of the spillage into another injection well is acceptable subject to No. 8 below.

2. There is no objection to the requirement to construct an exploratory slim hole prior to construction of the prototype-test well as detailed in the attached memo (marked Attachment B) to BC&E from Abe Kreitman of FCD. However this does not relieve the owner from obtaining data adequate to design a safe and effective injection system.

3. Weekly written reports during drilling and testing should be provided to John Plappert at Bureau of Water Resources Management in Tallahassee in addition to the other (monthly) progress reports.

4. The casing program specified by No. 8 of Attachment A to this memo is O.K. except the installation of a monitor tube to monitor the lower Floridan aquifer and grouting of all annuli in each injection well should be done as described for the No. 6 injection well (prototype well) by No. 2 of Attachment A.

If the installation of the monitor pipe in the annulus to the Lower Floridan is not successful and operable, drilling of a Lower Floridan monitor well (4-inch minimum size) close to the injection well should be required.

5. The casing program for the Boulder Zone monitor wells (BZ1 and BZ2) see No. 8.2 of Attachment A must be altered to extend the inner casing to the top of the Boulder Zone as provided for in No. 2 of Attachment A.

6. The annulus of each injection well, i.e., the monitor tube to the Lower Floridan aquifer in each injection well must be monitored continuously by monitoring a continuous flow for specific conductance. (This is to clarify the intent of No. 10.4 of Attachment A).

7. Monitoring using fluid resistivity logging and down hole sampling in the injection zone in 4 or 5 injection wells while injecting into the other injection wells must be done to establish the mixing and dispersion characteristics of the waste in the injection zone. This monitoring would be done after completion of all the injection and monitoring wells, and would be continued until the full capacity of the injection system is needed. A detailed report must be prepared of this work. For the purpose of this monitoring the injection zone must be pumped to remove to the degree possible all non native quality water injected during construction and testing.

The proposed specifications for this monitoring should be presented with the specifications for construction of the injection wells. A suitable tracer(s) to aid in characterizing mixing and dispersion in the injection zone should be used.

JRP/ll
Attachments

cc: Troy Mullis
Gene Coker
Fred Williams
J. I. Garcia-Bengochea
Charles Jackson
Lathan H. Collins II
Jerry Hughes
G. J. Thabaraj
Paul Philips
Warren Strahm
Phil Edwards
Gene Nowak
George King
Ross Sproul
Diaz Callahan
Fred Meyer
Howard Rhodes
Abe Kreitman

BLACK, CROW & EIDSNESS, INC.
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October 13, 1976

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To: Attendance as follows:

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Fred Williams, George King — Miami-Dade

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JIGB:rbs

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Warren Strahm) DER, West Palm Beach
Richard Tash)
Colin Morrissey - DERM, Dade County
Garrett Sloan - Miami-Dade W&S Authority
Clyde Conover - USGS, Tallahassee

CENTRAL AND SOUTHERN FLORIDA

FLOOD CONTROL DISTRICT

P. O. BOX V
WEST PALM BEACH
FLORIDA 33402
Telephone (305) 686-880

IN REPLY REFER TO: 9-1-5D (8303)

October 19, 1976

J. I. Garcia-Bengochea
Black, Crow & Eidsness, Inc.
700 SE Third Street
P.O. Box 1647
Gainesville, FL 32602

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Attachment B

on local and regional impacts of injection among other parameters, may be the only basis upon which the District will review this deep well injection proposal and indeed may be the basis upon which District permit approval is possible.

Very truly yours,

ABE KREITMAN, Director
Groundwater Division
Resource Planning Department

AK/js

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Richard Tash)
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Colin Morrissey - DERM, Dade County
Ross Sproul - Black, Crow & Eidsness

BLACK, CROW & EIDSNESS, INC.

CONSULTING ENGINEERS

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CABLE ADDRESS: BCEGNVFLA

October 29, 1976

Mr. Abe Kreitman
Central and Southern Florida
Flood Control District
Post Office Box V
West Palm Beach, Florida 33402

Re: South Dade Wells
Project No. 559-7601-1

Dear Abe:

This letter is to document our conversation of October 28, and to clear up some apparent misunderstandings as to what is meant by the terms "exploratory test hole" or "test well" as used in recent correspondence regarding the above referenced project.

The drilling of an exploratory test hole is included in the drilling sequence proposed for the prototype test well. The proposed sequence is described in Attachment 1, Proposed Drilling and Testing Program, presented at the October 7th meeting in Tallahassee on this subject. This program calls for the drilling, logging and testing of an exploratory hole prior to setting each of the three inner casings (36-inch, 30-inch, and 20-inch). Drilling of the exploratory test hole, which we anticipate would be a nominal 8-inch diameter hole, is called out on Page 5 (Step 3a) and Page 10 (Steps 3d and 3f) of Attachment 1.

It is our intent that the District, and all other agencies having an interest in this project, would have an opportunity to review the test data and concur in the recommended casing program before the actual setting of any casings below 800 feet. This concept would also apply to the selection of injection and monitoring levels.

As you know, the exploratory test hole approach as outlined above was successfully applied to the drilling of the Belle Glade well. This same approach can be applied to the south Dade testing.

I would appreciate your comments on the procedure described above, and its acceptability to the District, as soon as possible. As Dr. Garcia noted in his letter of October 25, it is imperative that this matter be resolved so that we can meet the deadlines established for our client.

Very truly yours,

BLACK, CROW AND EIDSNESS, INC.

C. Ross Sproul, C.P.G.S.

CRS/mfl
xc: Mr. Phil Edwards
Mr. Warren Strahm
Mr. Richard Tash
Mr. Howard Rhodes
Mr. Troy Mullis
Mr. Charles Jackson
Mr. Lathan H. Collins II
Mr. G. J. Thabaraj
Mr. Gene Nowak
Mr. Jim Pool
Mr. Gene Coker
Mr. Diaz Callahan
Mr. Clyde Conover
Mr. Fred Meyer
Mr. Garrett Sloan
Mr. Colin Morrissey
Dr. J. I. Garcia-Bengochea

1) A lithologic and stratigraphic log prepared by a resident geologist competent and qualified by training and experience to collect and describe drill cuttings, identify stratigraphic units, and in general make the many necessary decisions required during the progress of drilling operations that will lead successfully to meeting the objectives of the exploratory work. Appropriate commentary related to unusual hole conditions, hard or dense layers, extent of solution channels, fractures, etc., must be included.

2) Geolograph or equal indicating as a minimum, drilling time vs. down time, bit weight and trip time.

3) Flume (ditch) samples taken every 5 feet, fully labeled and identified and depth correlated for up-hole lag time. A full set of samples will be retained by the owner or his consultant until permit application review for permanent facilities is completed. In this interim period, the District may require that a complete suite of samples as described above be delivered to the District's geologists for analysis.

4) Cores in quantity and at depths as considered appropriate and necessary by the owner or his consultant. The decision to take cores at a particular depth would normally be determined on the basis of conditions found during drilling operations. Of specific interest to the District are: a) impervious zones (or aquicludes) lying above anticipated injection horizons, and b) potential monitoring horizons lying above potential injection horizons. The applicant should recognize that cores may be specified during subsequent construction of the injection well, if approved, and will essentially be dependent on data derived from the test hole. Cores will serve to confirm confining beds, injection zones or other features of pertinent hydrogeologic interest. The applicant should recognize that although the taking of cores is discretionary, it can, under certain circumstances, be one of the essential determinants in demonstrating the viability of any injection system. It is, therefore, in the applicant's best interest to carefully review the planning of the exploratory program relative to this requirement.

5) Geophysical logs: Logging shall, as a minimum, include the following surveys covering the <u>entire</u> depth of the drilled hole:

   a) Continuous bore hole fluid conductivity
   b) Spontaneous potential
   c) Gamma Ray
   d) Caliper
   e) Combination temperature and differential temperature
   f) Short and long normal resistivity
   g) Lateral resistivity
   h) Dual induction
   i) Gamma-gamma density
   j) Neutron
   k) In lieu of "i" and "j" above, the owner may substitute an accoustic (sonic) porosity log. The decision to run surveys relative to "i", "j", and "k" rests with the owner and will be determined on the basis of hole conditions and other site factors.

6) Water quality: Water quality shall be determined during test hole drilling operations in a manner, and using techniques, that will provide an accurate chemical analysis of water found at various depths throughout the bore hole. Of specific concern is that area at the bottom of, or underlying, the Hawthorn Formation and extending to the "Boulder Zone" of the Oldsmar and Cedar Keys limestone. Water quality determinations are required to be taken in the uppermost part of the "Floridan Aquifer" (or bottom of the Hawthorn Formation), identifying the water quality of the topmost water bearing zone. Subsequent samples shall be taken in all significant water bearing zones extending into the "Boulder Zone" such that a clear and accurate hydrogeo-chemical gradient can be established. Associated with the water sampling program, shut in-head pressure shall be taken and integrated into the sampling program. Such measurements shall be made in all major water bearing zones, such that an accurate potentiometric head gradient can be established.

7) All of the above data shall be assembled in report form in which all the items listed above are fully described and interpreted in detail as to their relevance and impact on local and regional geology and hydrology, and which shall include a section on the impact of these features on the design and possible impact on the efficacy, maintenance, and operation of any subsequent injection well.

8) The guidelines given above are meant to describe minimum data requirements that will be necessary at such times as the owner makes application for permanent injection well facilities. It is not intended to be an exhaustive or inclusive list, but rather, is intended to inform the owner as to those factors that the District considers essential in reviewing deep well injection projects. Additional data derived from prior study or on-site test hole drilling that is considered relevant to evaluating such projects should be incorporated into the data package.

These minimum requirements are considered to be essential in order for the District to discharge its responsibilities under existing legislation in protecting the water resources. They are also consonant with regulations published in the Federal Register, Vol. 39, No. 69, dated April 9, 1974, concerned with subsurface emplacement of fluids - Administrator's Statement No. 5, and Vol. 41, No. 170, dated August 31, 1976, which addresses certain aspects of the Safe Drinking Water Act.

BLACK, CROW & EIDSNESS, INC.
CONSULTING ENGINEERS
PRINCIPAL OFFICE: 7201 N. W. ELEVENTH PLACE, GAINESVILLE, FLORIDA
REGIONAL OFFICES: ATLANTA, GEORGIA / CLEARWATER, FLORIDA
BOCA RATON, FLORIDA / NAPLES, FLORIDA / SAN JOSE, COSTA RICA
HOUSTON, TEXAS / PHILADELPHIA, PENNSYLVANIA / MONTGOMERY, ALABAMA

PLEASE REPLY TO:
GAINESVILLE, FLORIDA 32602
POST OFFICE BOX 1647
7201 N. W. ELEVENTH PLACE
904/377-2442
TWX 810/825-2359
CABLE ADDRESS: BCEGNVFLA

November 3, 1976

Mr. Abe Kreitman, Director
Groundwater Division - Resource & Planning Department
Central & Southern Florida Flood Control District
Post Office Box V
West Palm Beach, Florida 33402

Re: Disposal Well System
South District Regional Wastewater Treatment Plant
Miami-Dade Water & Sewer Authority

Dear Abe:

This is to confirm our telephone conversation of yesterday on the subject of slim hole vs. prototype test well. We understand now that the required test well can be drilled as a prototype well provided an opportunity is given to the District to review information and approve suggestions as to where to seat each of the inner casing strings.

Information is to be obtained from the test hole described on page 5 of Attachment 1 to our memorandum of September 29, 1976. Data will be collected as per District's requirements. As soon as information is collected, it will be presented to the District with our suggestions as to where to set and cement each string of casing. We are to receive an answer from the District within ten (10) working days after information and suggestions are presented to the District.

Please let us know as soon as possible if above is an accurate understanding of your office's position.

Sincerely,

BLACK, CROW AND EIDSNESS, INC.

J. I. Garcia-Bengochea

JIGB:rbs

cc: (See attached)

cc: Mr. Garrett Sloan, Miami-Dade Water & Sewer Authority/ P. O. Box 330316, Miami - 33148

Mr. Phil Edwards - DER, 2180 West 1st Street, Suite 401, Fort Myers - 33901

Mr. Warren Strahm)
Mr. Richard Tash) DER, PO Box 3858, West Palm Beach 33402

Mr. Howard Rhodes)
Mr. Troy Mullis)
Mr. Charles Jackson) DER - 2562 Exec. Center Circle, Eas
Mr. Lathan H. Collins II) Tallahassee - 32301
Mr. G. J. Thabaraj)
Mr. Gene Nowak)
Mr. Jim Pool)

Mr. Gene Coker)
Mr. Diaz Callahan) EPA - ~~1421 Peachtree St. NE, Suite 300~~ 345 Courtland St. NE
Atlanta, Georgia ~~30309~~ 30308

Mr. Clyde Conover - USGS, 325 John Knox Road, Suite F-240 Tallahassee - 32303

Mr. Fred Meyer - USGS, 901 S. Miami Avenue, Miami - 33130

Mr. Colin Morrissey - Dade County Department of Environmental Resource Management
909 SE First Avenue
Miami - 33131

Mr. Ross Sproul - BC&E, Gainesville - 32602 bc: Jerry Price

BLACK, CROW & EIDSNESS, INC.

CONSULTING ENGINEERS

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BIRMINGHAM, ALABAMA / BOCA RATON, FLORIDA / NAPLES, FLORIDA
SAN JOSE, COSTA RICA / PHILADELPHIA, PENNSYLVANIA / MONTGOMERY, ALABAMA

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7201 N. W. ELEVENTH PLACE
904/377-2442
CABLE ADDRESS: BCEGNVFLA

November 12, 1976

Mr. Abe Kreitman
Central and Southern Florida
Flood Control District
Post Office Box V
West Palm Beach, Florida 33402

Dear Abe:

Since Dr. Garcia will be out of the country for several weeks, I have been asked to respond to your letter of November 3, regarding the District's standards on data requirements for injection well programs. The following comments on the standards may be regarded as informal, in accordance with your request. However, if these or comparable standards are to be adopted as rules of the District, I would appreciate the opportunity to respond formally.

I agree with the concept stated in your letter, that standards should be broad to allow maximum flexibility to design a program that is comprehensive. However, in some respects the standards themselves are very specific and have the opposite effect. This criticism applies especially to the paragraph on geophysical logs.

My comments on specific points in the standards, in the order in which they appear, are as follows:

<u>Paragraph 3, Flume (formation) Samples</u>:

As a practical matter, a sample interval of 5 feet is too frequent. The mass of samples accumulated from a deep well (20 per hundred feet, 600 for a 3,000-foot well) would yield no stratigraphic or other data not obtained from a somewhat longer interval. If only to reduce the amount of rock to be transported, examined, and stored, I recommend a 10-foot interval be substituted.

<u>Paragraph 3, Geophysical Logs</u>:

This is the section which I consider to be much to specific. A geophysical logging program must be tailored to fit particular situations, rather than presented like a shopping list. A statement of purpose and intent, similar to the paragraph on coring, would be more appropriate.

If it is felt that a "shopping list" is necessary to fulfill the need for standards on this subject, I suggest that the list include only those logs which over the years have proven almost universally useful in evaluating the Floridan section, leaving the selection of specialized logs to the owner or his consultant. My suggestions for revising the shopping list would be as follows:

Items (a) through (f) leave as is, <u>except</u>:

(1) Delete differential temperature from item (e). The differential temperature log has very specialized applications, principally as a means of using injected fluid as a tracer. It might be useful as a part of an engineered injectivity study, but to just "run a differential temperature log" would be out of order in a rationally developed logging program. The development of the necessary instrumentation to run differential temperature logs has in fact reduced the need for this log. The sensitive "differential" type probe can resolve very small temperature changes, and a gradient temperature log run with one of these tools is usually more useful than the differential log.

(2) Add a flowmeter survey to the list. I presume the primary purpose of the logging program is to differentiate productive and non-productive zones, and to quantify the productivity of individual aquifer zones. This is the best done with a combination of flowmeter, caliper and temperature logs. The other logs listed are primarily "lithology" logs, and do a rather poor job of identifying water producing zones.

Item (g) and (h). Delete from the list. The lateral resistivity log and the induction log measure the same parameters as short and long normals (item f). The lateral and induction logs are useful under circumstances which require that they be used, but in a relatively small water-filled hole (less than 12-inch) in a limestone section, the short and long normals would be the best choice. The lateral device is a deep-looking tool intended for use where the formations of interest are likely to be deeply invaded by drilling fluid, an uncommon situation in the Floridan section. The device has poor efficiency in highly resistive rocks, and does not resolve thin beds. The induction log is most applicable where the formations of interest contain hydrocarbons. It has the same limitations as the lateral logs, and in addition requires a very large and heavy tool and is usually available only from an "oil-well" type logging service.

Items (i), (j) and (k). Delete from the list and substitute "porosity log." The gamma-gamma, neutron, and acoustic logs are all basically porosity logs. The gamma-gamma and neutron logs can be used for identification of lithology and pore fluid. These functions are not particularly useful in the Floridan section, since the lithology is almost universally carbonate and the pore fluid is water. Radiation logging (except natural gamma ray) is quite expensive, in relation to its benefits, in our area, and imposes costs and risks far out of proportion to any benefits. I am sure that you are aware that if a radiation source is accidentally lost in a well it must either be recovered or the well plugged with cement. Further drilling could not be allowed, because of the danger of breaking open the tool and releasing the radioactive material. I understand that item (k) allows the substitution of an acoustic log for the radiation logs; however, I believe that the use of radioactive materials should be discouraged, and limited to cases where there is a clear need for the data generated. The listing of the radioactive logs as first choices, with acoustic logging as a substitute, seems to encourage the use of the former.

One other comment on item (5) and I will close this dissertation: What is meant by the statement regarding the surveys "covering the entire depth of the drilled hole?" If this is taken to mean the entire section from ground surface to the total depth of the hole is to be logged as open hole, I am sure you recognize the inappropriateness and lack of cost effectiveness of application of the "shopping list" concept. In reality, some of the logs mentioned would be applicable only to the artesian system. I presume the statement is intended to indicate that logging should be carried out to the total depth of the well, in which case I fully agree.

I hope these comments may prove helpful in drafting final guidelines. I appreciate the opportunity to comment on this subject, and will also appreciate being advised when the guidelines are finally drafted and proposed as formal rules.

Very truly yours,

BLACK, CROW AND EIDSNESS, INC.

C. Ross Sproul, C.P.G.S.

CRS/mfl

xc: Dr. J. I. Garcia-Bengochea

BLACK, CROW & EIDSNESS, INC.
CONSULTING ENGINEERS

PRINCIPAL OFFICE: 7201 N. W. ELEVENTH PLACE, GAINESVILLE, FLORIDA
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PLEASE REPLY TO:
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POST OFFICE BOX 1647
7201 N. W. ELEVENTH PLACE
904/377-2442
CABLE ADDRESS: BCEGNVFLA

November 16, 1976

Mr. Abe Kreitman
Central and Southern Florida
Flood Control District
Post Office Box V
West Palm Beach, Florida 33402

Re: Miami-Dade Test Well
Project No. 559-7601-1

Dear Abe:

Enclosed are two sets of Plans and Specifications for the above referenced well. Two copies of the Project Description, which details the geotechnical data collection program, are also enclosed. These documents are also being submitted to the Department of Environmental Regulation with the application for the construction permit.

The well design and data collection program are essentially as discussed at the October 7 meeting in Tallahassee, with the following exceptions:

1. Method of saltwater disposal is confirmed as piping to the salt marsh.

2. Four Biscayne aquifer monitoring wells are added.

3. All well casings are grouted to the surface.

4. Inner casing is extended to the top of the Boulder Zone.

5. Agency input following test hole drilling is explicitly stated.

As we understand the current procedure, the Application for a Permit to Construct is to be submitted to the DER, who will act on the application with District Board concurrence.

As we discussed in our telephone conversation yesterday, our goal is to have the permitting of this well considered by your Board at its December meeting. Our purpose, therefore, in sending you this information at this time is so that your staff can begin its review in time to place this item on the meeting agenda.

Very truly yours,

BLACK, CROW AND EIDSNESS, INC.

Ross

C. Ross Sproul, C.P.G.S.

CRS/mfl

xc: Mr. Garrett Sloan
Mr. George King
Mr. Dan Farley
Dr. J. I. Garcia-Bengochea

STATE OF FLORIDA

DEPARTMENT OF ENVIRONMENTAL REGULATION

CENTRAL AND SOUTHERN DISTRICT
3301 GUN CLUB ROAD
POST OFFICE BOX 3858
WEST PALM BEACH, FLORIDA 33402

REUBIN O'D. ASKEW
GOVERNOR

JOSEPH W. LANDERS, JR.
SECRETARY

December 23, 1976

Dade County
Deep Injection Well -
South Dade Regional STP

Miami-Dade Water and Sewer Authority
3575 South LeJeune Road
Post Office Box 330316
Miami, Florida 33133

Dear Sirs:

Re: Miami-Dade Water and Sewer Authority - Application for Permit to Drill Prototype Test Well to Boulder Zone

This is to acknowledge receipt of an application for the referenced source and to advise you that it is incomplete.

1 You propose to drill a shallow well at the site for the disposal of the salt water associated with the drilling of the prototype. We are opposed to the disposal of the salt water generated from the prototype well by this method. Disposal of the salt water by this method would negate the accurate monitoring of the ambient waters in the Biscayne Aquifer. Furthermore, if the total dissolved solids at this site are less than 10,000 ppm, your proposed disposal method would be in direct violation of 40 CFR 126.24(E).

2 Your proposed alternate method of salt water disposal is a pipeline across the canal and levee L31E into the mangrove estuary. We are also opposed to this method as you have not described your means of controlling the turbid conditions at the discharge to the Class III waters of the estuary. The outfall discharge must meet the State standards for Class III waters.

3 The applicant shall consider and ~~demonstrate~~ forecast the injection rate, injection pressure, and injection volume over the life of the project and shall demonstrate the approximate potentiometric surface of the receiving aquifer in both magnitude and extent on an accurate map.

4 The applicant shall show, on the map, all water wells; surface bodies of water, oil, gas, exploratory or test wells, other injection wells; surface mines and quarries, and other pertinent surface features including bedrock out crops, and faults and fractures within the potentiometric influence.

5 The applicant shall show current maps and cross sections illustrating the regional geologic setting within the potentiometric influence.

6. The applicant shall include maps and cross sections indicating the vertical and lateral limits of aquifers containing 3,000 mg/l and 10,000 mg/l TDS water quality levels, above and below the injection zone and direction of movement of the water in every underground drinking water source (10,000 mg/l) which may be affected by the proposed injection.

7. The applicant shall provide geological and physical characteristics of the injection interval and the overlying and underlying confining beds including:

- Thickness
- Areal extent; vertical and horizontal
- Lithology; transmissibility
- Location, extent and effects of known or suspected faulting, fracturing and natural solution channels
- Formation fluid chemistry, including total dissolved solids
- Fracturing gradients

The applicant shall ~~demonstrate~~ estimate and provide expected changes in pressure, native fluid displacement and direction of movement of injected fluid; and contingency plans to cope with all shut-ins or well failures to prevent endangerment of underground drinking water sources.

9. The applicant shall consider and demonstrate the effect of underground currents, if any, to solution channels which may lead to migration to any area other than the North Atlantic Ocean.

10. The applicant shall demonstrate that the surface injection pressure will be limited to preclude the possibility of fracture of any confining strata.

11. The applicant shall demonstrate the provisions which are made for correcting leaks in the system within the potentiometric influence zone.

12 The applicant shall show provisions for preventing interaquifer migration.

13 The applicant shall present a written evaluation of alternative disposal practices in terms of maximum environmental protection.

14 The applicant shall demonstrate the satisfaction of the design requirements by calculations and discussions including the following:

a. The inspection procedure to be used to reject the use of any pipe segment having a wall thickness less than 0.438 inch.

b. The design formulas used for determing the casing selection.

c. The weld inspections program to be used to assure 100% weld certification.

d. The cathodic protection, soil neutralization or corrosion inhibition system to be used to provide the corrosion resistance for a minimum life of forty (40) years.

NOTE: The application proposes a 20-inch diameter with a 0.438 inch wall steel pressurized inner casing.

15 Consideration of this proposed selection under the most favorable conditions would seem to indicate the expectation of underground joint rupture in the ninth year of system life. The favorable conditions considered include:

- ASTM A-53 grade B material
- Manufacturers minus tolerance on pipe wall
- Operating pressure rating of above ground pipe and fittings
- 100% weld strength rating obtained by full radiographic inspection
- Nominal corrosion and erosion losses

16 The proposed coating of the exterior casing surface (surface casing) does not appear to consider alternate fresh and sea water immersion, placement and burial in soil, and exposure to brine, sewage, alkalies, and chemical attack. The proposed coating appears to be that which is used for steel structures at or near the surface in fresh water areas.

If there are any questions, please contact Mr. William Albritton of this office, telephone 305/689-5800.

Sincerely,

Warren G. Strahm
Subdistrict Manager

WGS:WRA:fs

cc: Howard L. Rhodes
Jim Pool
Phil Edwards
Robert S. Lewis
Fred Meyers, USGS
Abe Kreitman, FCD

State of Florida
DEPARTMENT OF ENVIRONMENTAL REGULATION

INTEROFFICE MEMORANDUM

For Routing To District Offices And/Or To Other Than The Addressee
To: ______
To: ______
Location: ______
From: ______ Date: ______

TO: Warren Strahm

THRU: Paul Beam and Chuck Littlejohn

FROM: James Pool

DATE: January 24, 1977

SUBJECT: Inj.-Test Well proposed for South Dade Regional STP

Following is the result of the meeting on the above well held on 1-11-77 in the DER office in West Palm Beach:

Persons attending the meeting: (See attached attendance list)

The meeting was requested by Mr. George Collins, EPA Atlanta, to help clarify the permitting requirements of the Regulatory agencies for the test well and to work out a reasonable time table.

The attached letter of December 23, 1976 to Miami-Dade Water and Sewer Authority and the "Contingencies" in the attached letter of December 15, 1976 to Mr. Kutzman of the U.S. Environmental Protection Agency were discussed.

Listed below by item are the agreements reached on each letter:

Letter of December 23, 1976 to Miami-Dade Water and Sewer Authority

Item No.	Agreement
1.	This item is not applicable since a saltwater disposal well will not be used.
2.	Turbidity control of waters discharged during construction and testing will be accomplished. Discharge into the ditch on the bay side of the S.W. 87th Avenue right-of-way (Levee) using a manifold to distribute the flow will be done.
3.	This item will be done. However, the work "demonstrate" is changed to "<u>forecast</u>".
4.	The area to be considered will be the area of influence after injecting 50 mgd for 20 years.
5.	This has been submitted previously in sufficient detail.

6. This will be done using presently available information.

7. This will be discussed.

8. This will be discussed. However, the word "demonstrate" is changed to "estimate".

9. The direction of movement of water in the injection zone will be estimated following completion of the first stage of the project by evaluating the results of a survey of the completed wells using down-hole pressure measuring devices.

10. This will be discussed.

11. The applicant will plug abandoned wells which, because of the injection, are allowing upper waters to be polluted by saline waters or the injected sewage effluent.

12. This will be discussed.

13. This will be discussed by reference to specific parts of the Environmental Impact Statement.

14. a. A copy of the mill certificate for any pipe used in a well will be provided.

    b. This will be provided.

    c. The applicant will show why 100% weld certification (X-ray) is not needed (considering ASME guidelines).

    d. This will be done.

15. These items will be considered when answering Item 14.

16. This will be discussed.

Contingencies in letter of December 15, 1976 to Mr. Kutzman.

Note: By copy of this letter to Mr. Howard Rhodes, I recommend that the following items be considered for transmittal to EPA as clarifications and alterations of the contingencies:

Item No.	Agreement
1.	Instead of eliminating the gravity drain pipes as indicated in the contingencies the applicant may close off the drain pipes with a blind flange during well construction or any work on the wells which could result in spillage from the well.
2.	Change the words ". . . shall be at the complete discretion of" to "must be approved by".
3.,4.,5., 6.,7.,8., 9.,10.,	This will be done.
11.	Submit the daily logs once each week.
12.	This must be done prior to issuing the contruction permit.
13.	This must be done prior to issuing the operating permit.
14.,15.	This will be done.
16.	This must be done prior to issuing the operating permit.
17.,18., 19.	These will be done.

The schedule agreed on for the test well program is as follows:

2 wks.	6 wks.	6 wks.	75 days (spread over 15 wks.	2 wks.	2 wks.	SFWMD	DER
To answer comments	To advertise	To consider bids	drilling	test	report	Board hearing within 6 wks.	Construction Permit for Inj. wells

These two will overlap (To answer comments ↔ To advertise)

Therefore, the estimated minimum time to issuance of the DER construction permit is 31 weeks.

JRP/11

Attachments

cc: Meeting attendees (see attached list)
Howard Rhodes
John Bottcher

LIST OF ATTENDANTS

Gene Coker	EPA	Atlanta, GA
Geoge King	MDWSA	Miami
John Plappert	DER	Tallahassee
Dick Rogers	SFWMD	
Paul Phillips	DER	W.P.B.
Jerry Pierce	EPA	Atlanta
Dick Tash	DER	W.P.B.
Warren Strahm	DER	W.P.B.
F. W. Meyer	USGS	Miami
Garrett Sloan	MDWSA	Miami
Abe Kreitman	WMD	W.P.B.
J. I. Garcia-Bengochea	BC&E	Gainesville
Ross Sproul	BC&E	Gainesville
Jim Pool	DER	Tallahassee
Tony Clemente	DERM	Dade County
George Collins	EPA	
Tony Sobrino	DERM	Dade County

BC&E
CH2M HILL
engineers
planners
economists
scientists

February 2, 1977

Mr. Warren Strahm
Dept. of Environmental Regulation
Post Office Box 3858
West Palm Beach, Florida 33402

Re: Miami-Dade Water & Sewer Authority
Test Well
Project No. 559-7601

Dear Mr. Strahm:

This is in response to your letter of December 23, 1976, regarding application for permit to construct the above referenced test well. In your letter, you indicate that the application is incomplete with respect to fifteen (15) specified items. In the following response to these fifteen items, each item is identified by the index number on the attached copy of the subject letter (Attachment 1).

1. Disposal of salt water via a shallow well on-site is not the proposed disposal method. (Reference: Memorandum of DER meeting of October 7, 1976, Item 4; and page 1-4, Paragraph 1-05 of the Specifications. It will be pumped through a pipeline across canal and levee L31E as discussed in Paragraph 2 below.

2. The saltwater outfall proposed does not discharge to a surface water body, but to a salt marsh. Overland flow to Biscayne Bay will be through about 3/4 mile of marsh vegetation. The Dade County Department of Environmental Resources Management (DERM) has proposed that a distribution manifold be provided to minimize outfall velocity. A manifold has been incorporated in the outfall, as shown on the Plans. This will minimize the possibility of turbid water reaching Biscayne Bay. Further turbidity control will be provided, if needed, by seepage pits on the saltwater side of L-31E.

3. Preliminary well design parameters are as follows:

   a. Injection rate, design capacity: 50 MG.

   b. Peak hour at design capacity: 113 MG.

Gainesville Office Black, Crow and Eidsness, Inc. 7201 N.W. Eleventh Place, P.O. Box 1647, Gainesville, Florida 32602
904/377-2442 Cable: BCEGNVFLA A division of CH2M HILL

c. Injection pressure: Estimated 70 to 75 psi at well head less than 10 psi at receiving zone.

d. Injection volume: 4.9×10^{10} cu ft (average 50 mgd for 20 years).

e. Potentiometric surface: There is at present no map of the potentiometric surface of the receiving aquifer, nor enough data available to prepare a map. We believe it to be nearly flat, with a slight east to southeast slope. Potentiometric level is expected to be 1 foot or less above sea level. The attached map (Attachment 2) shows the computed change in head in the injection zone after 20 years injection at an average rate of 50 mgd. Calculations are based on a transmissivity of 3.2×10^6 ft^2 day^{-1} and a storage coefficient of 1.5×10^{-5} (Meyer, 1974), and the assumption of non-leaky artesian conditions. The effect of a probable discharge boundary located approximately 30 miles east of the site was also disregarded in preliminary calculations. As a simplification, it was also assumed the total flow concentrated in one well in the center of the well field. This assumption gives more intense effects near the center of the field and approximately the same values away from the field. The changes shown on Attachment 2 are, therefore, expected to represent maximum values (values based on the presence of the boundary are shown in parentheses).

4. Locations of pertinent wells are shown on Attachment 3. Wells shown are those which penetrate to or near the injection zone within the potentiometric influence. The outcrop of the injection zone occurs about 30 miles east of the site, under the Atlantic Ocean, in the Straits of Florida. There are no pertinent on-shore outcrops, mines, quarries, surface water bodies, or faults. The offshore escarpment bounding the Straits of Florida is thought to have been formed in part by faulting (Uchupi, 1964).

5. Attachment 4 is a hydrologic cross section encompassing the area of potentiometric influence.

6. Vertical and lateral water quality limits in the artesian system and injection zone are shown on Attachment 4. Attachments 5 and 6 show chloride distribution in the Biscayne aquifer. The direction of water movement in both the artesian and nonartesian systems is approximately east-southeast.

7. The parameters requested in this item are projected from existing data as follows:

   a. Thickness

      1) Injection interval: 50 to 100 feet of cavernous dolomite in the upper part of the lower Eocene Oldsmar limestone.

      2) Overlying confining beds: Total 1,900 feet in two intervals; 850 feet between the disposal zone and Floridan aquifer, and 1,050 feet between the Floridan aquifer and Biscayne aquifer (see Attachment 4).

      3) Underlying confining beds: undefined.

   b. Areal Extent

      1) Injection interval: Peninsular Florida, generally south of a line from Melbourne on the east coast to Venice on the west coast.

      2) Overlying confining beds: same as 1 above.

      3) Underlying confining beds: Same as 1 above, except where anhydrite in the lower Eocene limestones form a definite base to the zone.

   c. Lithology

      1) Injection interval: Hard crystalline dolomite with fracture and cavernous porosity and permeability.

      2) Overlying confining beds: Limestone and dolomite, clay and siltstone.

      3) Underlying confining beds: Dolomite, probably gypsum impregnated at depth.

d. Transmissivity

1) Injection interval: 3.2×10^6 ft^2/day (Meyer, 1974).

2) Overlying confining beds: Very low. Did not produce any significant amount of water when drilling Sunset Park and Kendale Lakes injection wells near Coral Gables.

3) Underlying confining beds: Very low. Of no significant importance for project.

e. Faulting, Fracturing, Natural Solution Channels

1) Injection interval: Probably faulted at seaward boundary. Fractures and natural solution channels are responsible for the high transmissivity of the zone. Discharge from the interval is probably through solution channels emerging on the sea bottom in the Straits of Florida.

2) Overlying confining beds: Probably terminated by a fault forming the edge of the continental shelf about 30 miles east of the site. No on-shore faults, fractures of solution channels are known or expected.

3) Underlying confining beds: None known.

f. Formation Fluid Chemistry

1) Injection interval: See Attachment 7.

2) Overlying confining beds: Essentially the same as injection interval.

3) Underlying confining beds: Similar to above, becoming more highly mineralized with depth.

g. Fracturing Gradients

All Beds: Since the area is tectonically relaxed, the actual fracture gradient is estimated to be about 1 psi per foot of depth. For design purposes, a conservative value of 0.55 psi per foot is used.

8. Computed change in artesian head after injection for 20 years at an average rate of 50 mgd is shown on Attachment 2. Calculation is based on the assumption that no leakage occurs through the overlying or underlying confining beds. The numbers in parentheses are computed changes when the effect of a discharge boundary in the Straits of Floride is included. Native fluid will initially be displaced laterally, and ultimately to discharge in the Straits of Florida. The injected fluid will also move radially away from the injection site. The rate at which the injected fluid will move down the potentiometric gradient (east-southeast) is not known, but will probably be very slow. The position of injected fluid front after 20 years of injection at an average rate of 50 mgd will be about 8.6 miles from the site, if it is assumed there is no leakage and that the fluid moves through a 50-foot thick zone having an effective porosity of 30 percent. The subject of this application is a test well; therefore, the question of shut-ins will not arise. In the case of the future injection wells, a standby well, standby power generation, and an emergency outfall are provided to take care of any emergencies which could arise.

9. All indications are that the hydraulic gradient in the injection zone is toward the Atlantic Ocean, and that this will be the direction of movement of the injected fluid. However, an investigation of several possible means of measuring horizontal flows in the well bore is being conducted. If any of these proves feasible, a direct measurement of the horizontal component of flow will be attempted.

10. The facility is equipped with alarms and automatic shutdown equipment which will prevent injection pressure from exceeding the fracturing pressure of any confining strata.

11. The annulus monitoring system and the on-site monitoring wells would detect any leaks which might occur in the system. The provisions for correction would depend on the nature of the leak. If around an injection well casing, the well would be repaired or plugged, as necessary. In the case of a leak due to some previously unknown abandoned well or test hole penetrating the injection zone, the well would be plugged.

12. The primary barrier to interaquifer migration of injected fluid is the extension of the inner casing to a depth as near the top of the receiving zone as practicable, as provided in the Specifications.

13. Alternative disposal practices are evaluated in the March 1973 Environmental Impact Statement prepared by the EPA. In that report, deep well injection was recommended for the South District WWTP. Alternative disposal practices are also considered in the 201 Facilities Plan being prepared by Post, Buckley, Schuh & Jernigan.

14a. The contractor will be required to furnish mill certificates attesting that the pipe supplied meets the appropriate specification (see page DW-4, paragraph DW-05 (a-3) of the Test Well Specifications). In addition, the thickness of the pipe as delivered will be measured at the end of each length.

14b. The critical factors governing the casing string design for the subject well are collapse strength and corrosion resistant.

During grouting operations, each casing will have an external pressure imposed upon it by the column of cement in the annulus. The external pressure is given by:

$$\Delta p = h_a \frac{SWa}{144} - h_i \frac{SWi}{144}$$

Where h_a and h_i are, respectively, the heights of fluid in the annulus and inside the casing, and SWa and SWi are, respectively, the specific weights of fluid filling the annulus and casing. The ability to withstand the external pressure during grouting depends upon the collapse pressure of the casing being grouted. The critical collapse pressure is given by:

$$P_E = \frac{46.95 \times 10^6}{(D/t)[(D/t) - 1]^2}$$

(API Bulletin SC3 "Formulas and Calculations for Pipe Properties"), where P_E is the critical collapse pressure, D is the nominal casing diameter, and t is the nominal casing wall thickness. A summary of collapse pressure calculations for each casing diameter is given in Attachment 8. It is usually impractical in large diameter wells to provide for casing strings strong enough to allow grouting in one stage. Therefore, sizes are selected to provide an annular space large enough to allow staging of cement through an annulus grout pipe. The large annulus also gives more assurance that each casing can be lowered to the required depth.

14c. Welding will be done by qualified welders and in accordance with recognized pipeline welding methods. Radiographic examination of the casing is not planned and in our opinion is not necessary. Each casing will be pressure tested before drilling the cement plug to assure that it does not leak.

14d. The exterior of the casing is protected from corrosion by encasement in cement, except in the monitoring interval between the 20-inch casing and 30-inch hole. The 20-inch casing through this interval is protected by a coating of coal tar epoxy paint. Performance properties of this material is described in COE Manual EM 1110-2-3400 (see Attachment 9). Other factors which limit the extent of external corrosion are the absence of oxygen in the subsurface environment and the lack of fluid circulation around the will casing.

The interior of the injection casing will be exposed to fresh water (effluent) with a pH probably between 7.4 and 7.8. No significant corrosion is expected to occur on the interior surface of the casing.

The required service life of the well is provided by the casing wall thickness. Cathodic protection or other external corrosion protection systems are not provided, and in our opinion are not necessary.

15. Severe direct chemical corrosion of the exterior of the well casings is not expected, for the reasons noted in item 14d above. The 20-inch casing through the monitoring zone will be coated with a coal tar epoxy to give additional corrosion protection to this uncemented interval. The coating is suitable for submerged

saltwater service, and has a high degree of resistance to mechanical damage during installation. Engineering properties of the proposed coating system are described in detail in attachments 9 and 10.

If you have any questions regarding these items, please call.

Very truly yours,

C. Ross Sproul, C.P.G.S.

CRS/mfl

Attachments
1. DER Letter of December 23, 1976
2. Map: Change in artesian pressure
3. Map: Location of deep wells
4. Hydrogeologic cross-section
5. Chloride distribution in Biscayne aquifer (horizontal)
6. Chloride distribution in Biscayne aquifer (vertical)
7. Water quality in injection zone
8. Summary of casing calculations (collapse pressure)
9. Manual EM-1110-2-3400 (Corps of Engineers)
10. Pipe coating information

xc: Mr. Garrett Sloan
Mr. George Collins
Mr. Tony Clemente
Dr. J. I. Garcia-Bengochea

STATE OF FLORIDA

DEPARTMENT OF ENVIRONMENTAL REGULATION

CENTRAL AND SOUTHERN DISTRICT
3301 GUN CLUB ROAD
POST OFFICE BOX 3858
WEST PALM BEACH, FLORIDA 33402

REUBIN O'D. ASKEW
GOVERNOR

JOSEPH W. LANDERS, JR.
SECRETARY

December 23, 1976

Dade County
Deep Injection Well -
South Dade Regional STP

Miami-Dade Water and Sewer Authority
3575 South LeJeune Road
Post Office Box 330316
Miami, Florida 33133

Dear Sirs:

Re: Miami-Dade Water and Sewer Authority - Application for Permit to Drill Prototype Test Well to Boulder Zone

This is to acknowledge receipt of an application for the referenced source and to advise you that it is incomplete.

1 You propose to drill a shallow well at the site for the disposal of the salt water associated with the drilling of the prototype. We are opposed to the disposal of the salt water generated from the prototype well by this method. Disposal of the salt water by this method would negate the accurate monitoring of the ambient waters in the Biscayne Aquifer. Furthermore, if the total dissolved solids at this site are less than 10,000 ppm, your proposed disposal method would be in direct violation of 40 CFR 126.24(E).

2 Your proposed alternate method of salt water disposal is a pipeline across the canal and levee L31E into the mangrove estuary. We are also opposed to this method as you have not described your means of controlling the turbid conditions at the discharge to the Class III waters of the estuary. The outfall discharge must meet the State standards for Class III waters.

3 The applicant shall consider and demonstrate the injection rate, injection pressure, and injection volume over the life of the project and shall demonstrate the approximate potentiometric surface of the receiving aquifer in both magnitude and extent on an accurate map.

MIAMI-DADE
WATER AND SEWER AUTHORITY
RECEIVED
DEC 27 1976
ENGINEERING
DIVISION

4 The applicant shall show, on the map, all water wells; surface bodies of water, oil, gas, exploratory or test wells, other injection wells; surface mines and quarries, and other pertinent surface features including bedrock out crops, and faults and fractures within the potentiometric influence.

5 The applicant shall show current maps and cross sections illustrating the regional geologic setting within the potentiometric influence.

6 The applicant shall include maps and cross sections indicating the vertical and lateral limits of aquifers containing 3,000 mg/l and 10,000 mg/l TDS water quality levels, above and below the injection zone and direction of movement of the water in every underground drinking water source (10,000 mg/l) which may be affected by the proposed injection.

7 The applicant shall provide geological and physical characteristics of the injection interval and the overlying and underlying confining beds including:

- Thickness
- Areal extent; vertical and horizontal
- Lithology; transmissibility
- Location, extent and effects of known or suspected faulting, fracturing and natural solution channels
- Formation fluid chemistry, including total dissolved solids
- Fracturing gradients

8 The applicant shall demonstrate and provide expected changes in pressure, native fluid displacement and direction of movement of injected fluid; and contingency plans to cope with all shut-ins or well failures to prevent endangerment of underground drinking water sources.

9 The applicant shall consider and demonstrate the effect of underground currents, if any, to solution channels which may lead to migration to any area other than the North Atlantic Ocean.

10 The applicant shall demonstrate that the surface injection pressure will be limited to preclude the possibility of fracture of any confining strata.

11 The applicant shall demonstrate the provisions which are made for correcting leaks in the system within the potentiometric influence zone.

12 The applicant shall show provisions for preventing interaquifer migration.

13 The applicant shall present a written evaluation of alternative disposal practices in terms of maximum environmental protection.

The applicant shall demonstrate the satisfaction of the design requirements by calculations and discussions including the following:

a. The inspection procedure to be used to reject the
14 use of any pipe segment having a wall thickness less than 0.438 inch.

b. The design formulas used for determing the casing selection.

c. The weld inspections program to be used to assure 100% weld certification.

d. The cathodic protection, soil neutralization or corrosion inhibition system to be used to provide the corrosion resistance for a minimum life of forty (40) years.

NOTE: The application proposes a 20-inch diameter with a 0.438 inch wall steel pressurized inner casing.

Consideration of this proposed selection under the most favorable conditions would seem to indicate the expectation of underground joint rupture in the ninth year of system life. The favorable conditions considered include:

- ASTM A-53 grade B material
- Manufacturers minus tolerance on pipe wall
- Operating pressure rating of above ground pipe and fittings
- 100% weld strength rating obtained by full radiographic inspection
- Nominal corrosion and erosion losses

15 The proposed coating of the exterior casing surface does not appear to consider alternate fresh and sea water immersion, placement and burial in soil, and exposure to brine, sewage, alkalies, and chemical attack. The proposed coating appears to be that which is used for steel structures at or near the surface in fresh water areas.

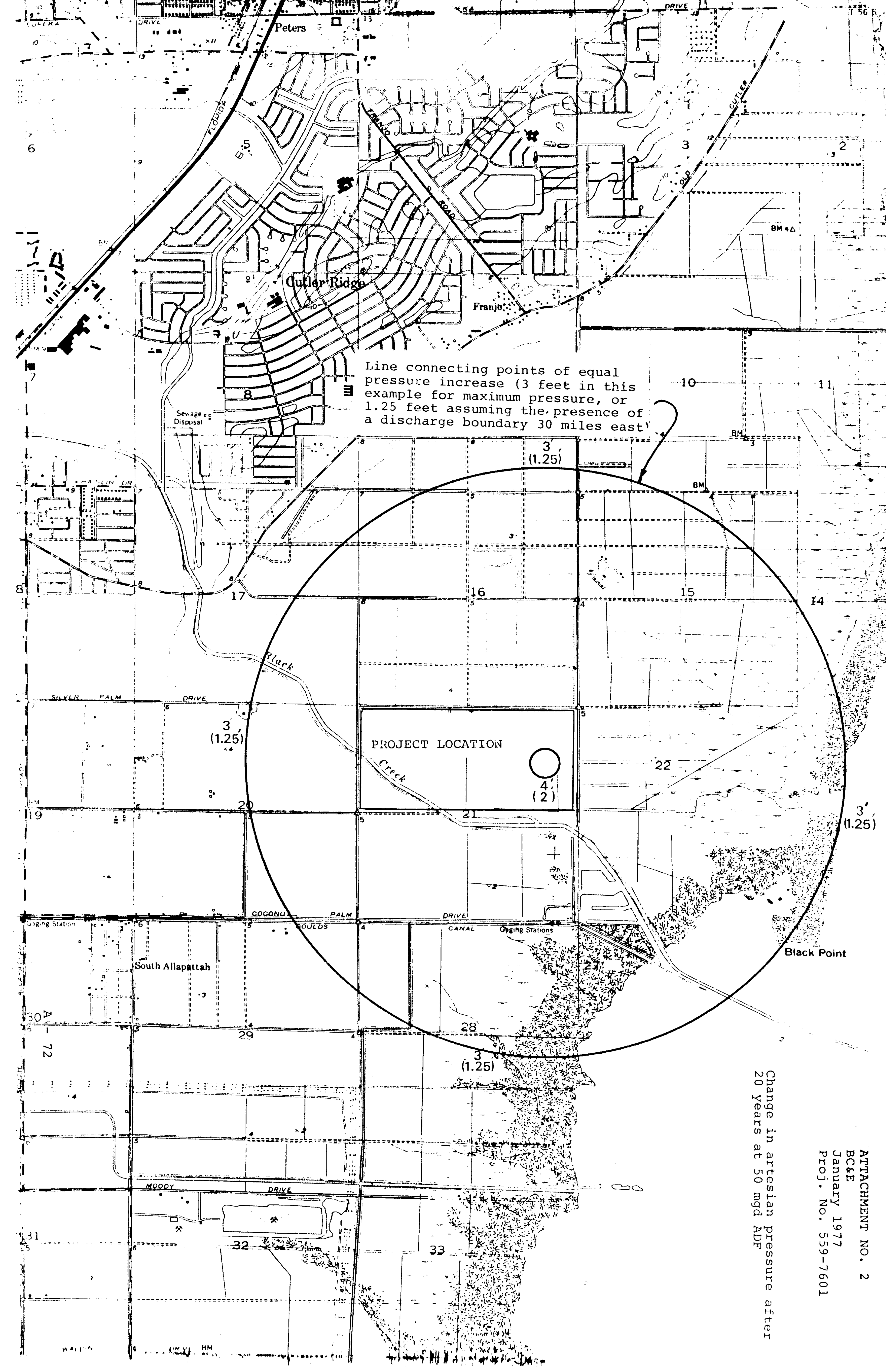
If there are any questions, please contact Mr. William Albritton of this office, telephone 305/689-5800.

Sincerely,

Warren G. Strahm
Subdistrict Manager

WGS:WRA:fs

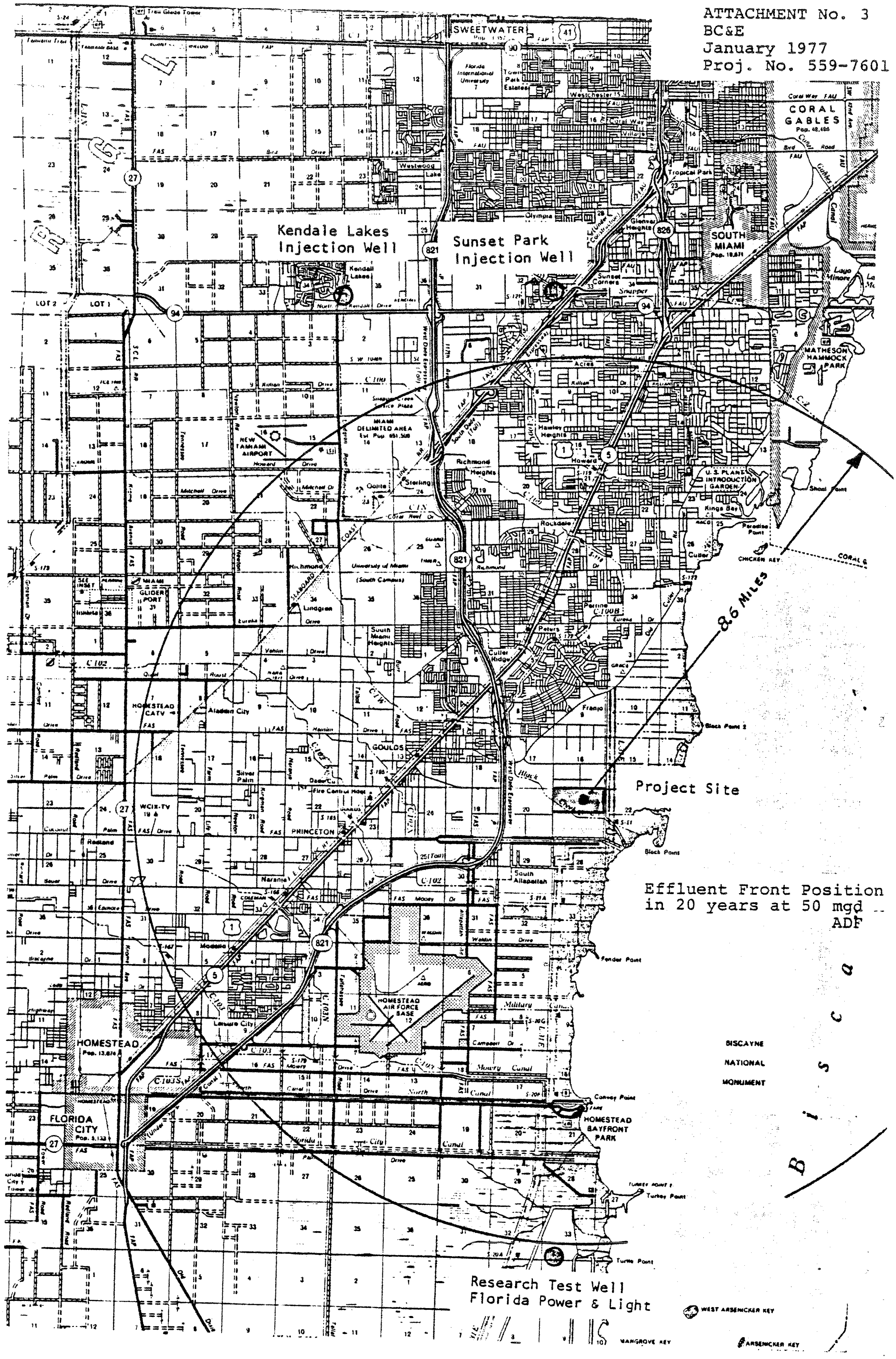
cc: Howard L. Rhodes
Jim Pool
Phil Edwards
Robert S. Lewis
Fred Meyers, USGS
Abe Kreitman, FCD

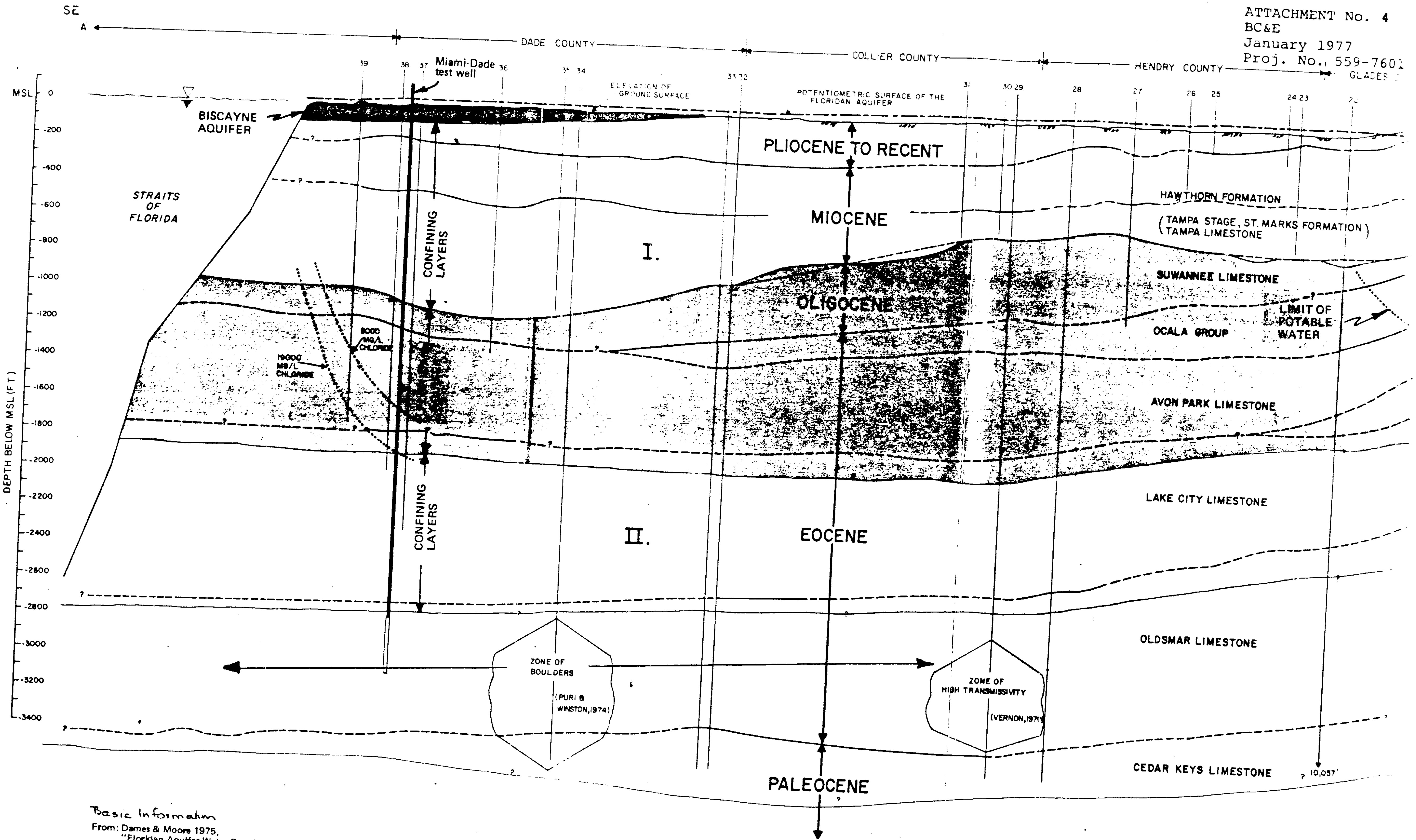


ATTACHMENT NO. 2
BC&E
January 1977
Proj. No. 559-7601

Change in artesian pressure after 20 years at 50 mgd ADF

ATTACHMENT No. 3
BC&E
January 1977
Proj. No. 559-7601

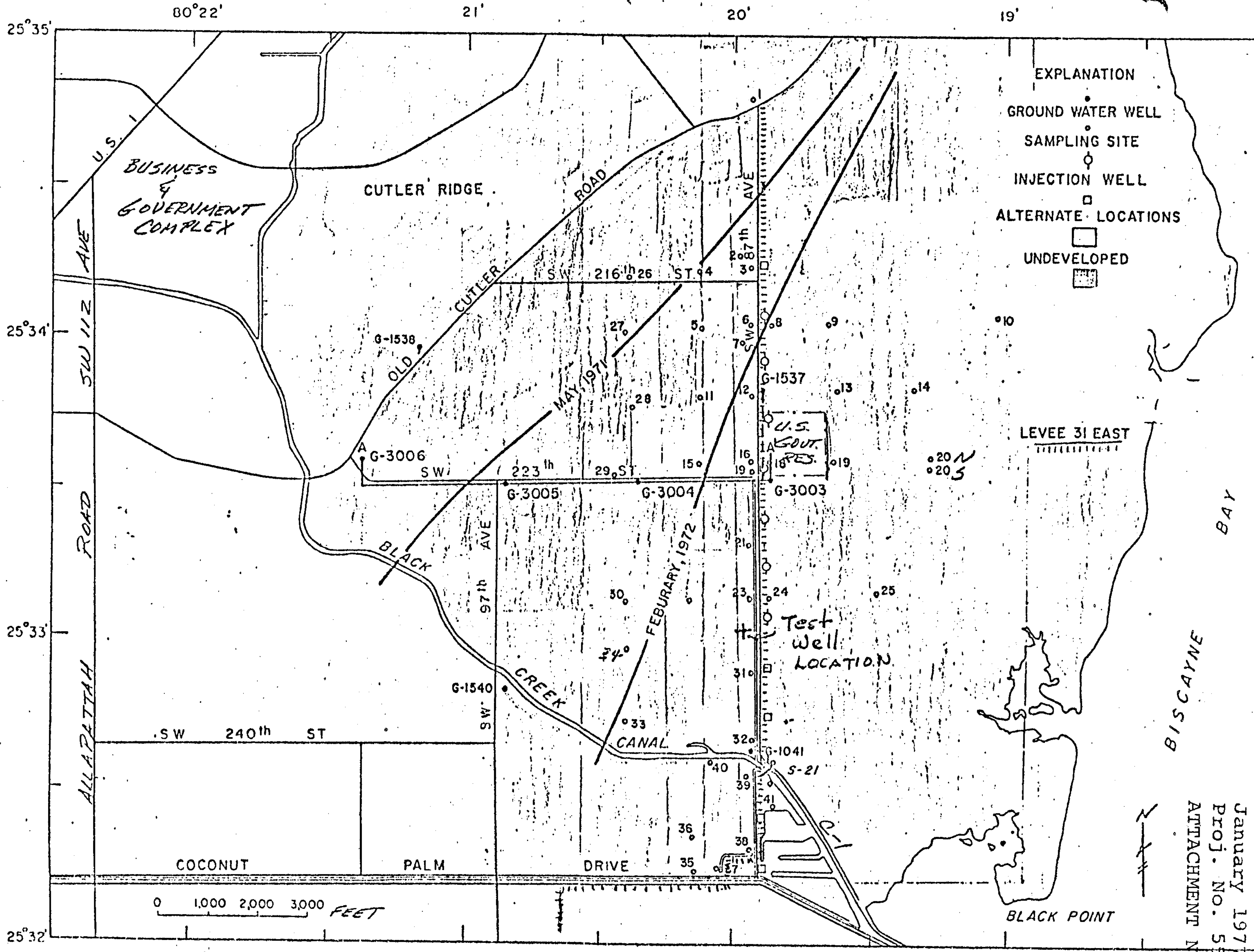




Basic Information

From: Dames & Moore 1975,
"Floridan Aquifer Water Supply Investigation, Turkey Point Area, Dade County, Florida"

HYDROLOGIC CROSS SECTION

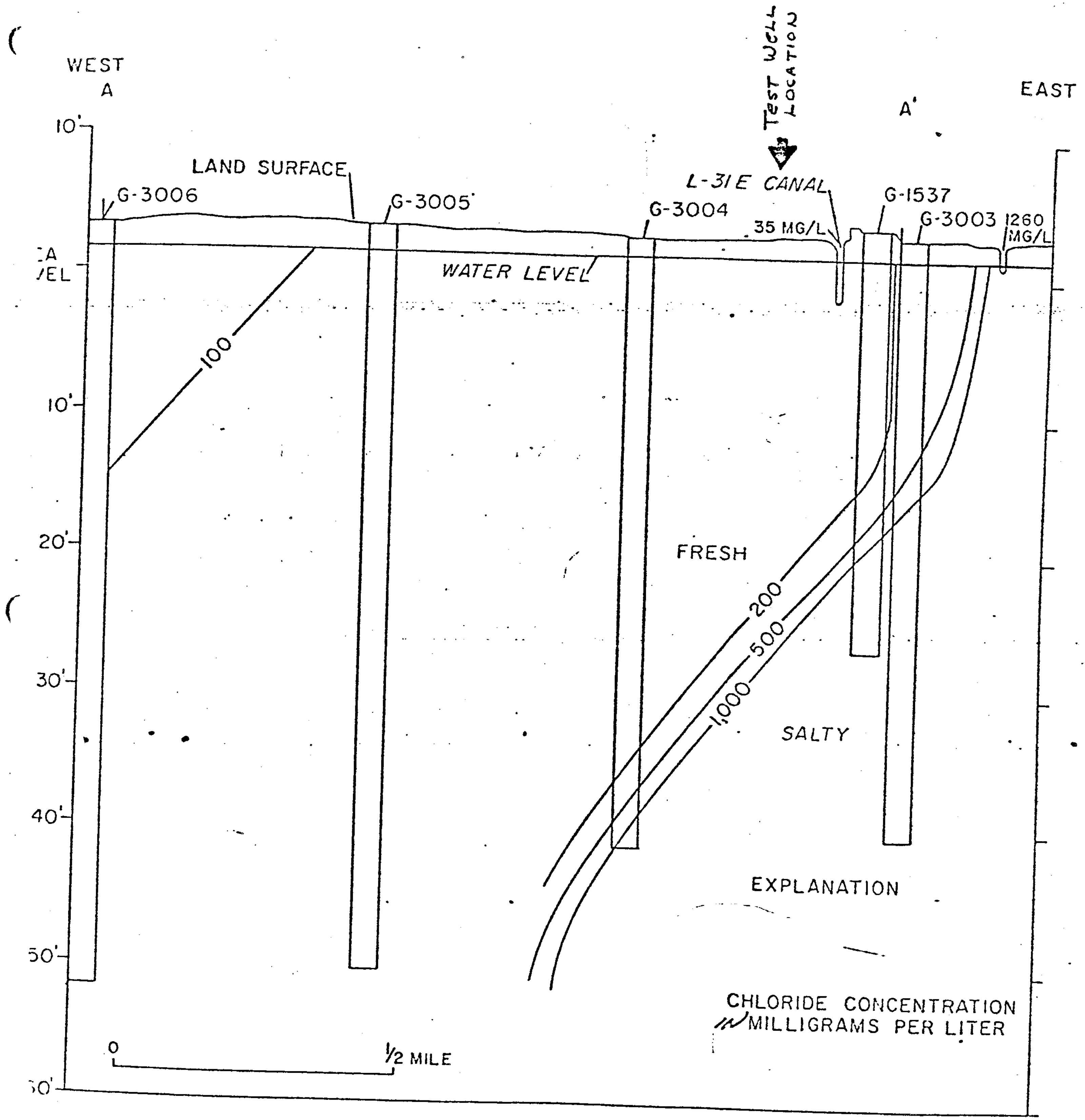


SALTWATER FRONT IN BISCAYNE AQUIFER

Earle & Meyer, 1972 (USGS open-file report)

A - 75

BCAD
January 1977
Proj. No. 559-76
ATTACHMENT NO. 5



Salt front in Biscayne aquifer along line A-A' on August 3, 1972. Earle & Meyer 1972

TABLE 2-1

COMPARISON OF CHEMICAL ANALYSES

Constituent	Deep Well[1]	Deep Well[2]	Sea Water[3]
Total dissolved solids	32,400	33,900	35,800
Chlorides as Cl	19,600	19,300	19,770
Sulfate as SO_4	2,700	2,660	2,750
Bicarbonate as HCO_3	144	143	148
Calcium as Ca	456	457	449
Magnesium as Mg	1,310	1,290	1,320
Sodium as Na	10,800	10,800	10,970
Potassium as K	420	415	429

[1] Kendale Lakes deep disposal well. Sample from 2,990 feet.
[2] Sunset Park deep disposal well. Sample from 2,947 feet.
[3] Average composition of sea water at Miami Beach (Parker, et al, 1955, Table 65, p. 572).

MOWSA TEST WELL
Project No 559-7601

JAN 31, 1977
CRS

1. Summary of Casing collapse pressure calculations:

Theoretical elastic collapse pressure is given by:

$$P = \frac{2E}{1-\nu^2} = \frac{1}{(D/t)[(D/t)-1]^2}$$

where P = Theoretical Collapse Pressure
E = Elastic Modulus (30×10^6 psi)
ν = Poissons Ratio (0.3)
D = Outside Diameter of Pipe
t = Wall thickness of Pipe

The minimum value (P_E) for critical collapse pressure is taken as 71.25% of the above. (API Bulletin 5C3: Formulas and Calculations for pipe properties). The minimum collapse pressure is given by

$$P_E = \frac{46.95\times10^6}{(D/t)[(D/t)-1]^2}$$

∴ P_E for 48" Pipe × 0.500 wall

$D/t = 96$

$$P_E = \frac{46.95\times10^6}{96\times(95)^2}$$

$$= \frac{46.95\times10^6}{8.66\times10^5}$$

$= 54$ psi

P_E for 40" Pipe × 0.500' wall

$D/t = 80$

$$P_E = \frac{46.95\times10^6}{80\times(79)^2}$$

$= 94$ psi

0.625 wall pipe

$D/t = 64$

$$P_E = \frac{46.95\times10^6}{64\times(63)^2}$$

$P_E = 185$ psi

P_E for 30" pipe × 0.500 wall

$D/t = 60$

$$P_E = \frac{46.95\times10^6}{60\times(59)^2}$$

$= 225$ psi

P_E for 20" x 0.500" wall pipe

$D/t = 40$

$$P_E = \frac{46.95 \times 10^6}{40 \times (39)^2}$$

$= 772$ psi

2. Summary of External Pressures During Cementing (ΔP_{max}.

48" Casing, $P_E = 54$ psi

Depth = 120'

Grout Specific Weight = 102 #/ft³

$\Delta p = 120\left(\frac{102}{144}\right) - 120\left(\frac{64.3}{144}\right)$

$\Delta p = 85 - 53$

$= 32$ psi ΔP safe with salt water filling casing

40" Casing, $P_E = 94$ psi

Depth 900'

Grout Spec. wt = 96 #/ft³ (0 to 619') and 115 #/ft (619' to 900')

Mud spec. wt = 78.54 #/ft³

$\Delta p = 619\left(\frac{96}{144}\right) + 281\left(\frac{115}{144}\right) - 900\left(\frac{78.54}{144}\right)$

$= 413 + 224 - 491$

$= 146$ psi Δp not safe for 1-stage grouting. Adjust in the field for mud weight of 87.60 #/ft³ or place cement in 2 stages, or use 0.625" wall pipe ($P_E = 185$ psi)

30" Casing, $P_E = 225$ psi

Depth: 1700'

Grout Spec. Wt = 96 #/ft³ (1200 to 1500) 115 #/ft³ (1500' to 1700'),

Mud spec. wt = 62.83 #/ft (brackish water)

$\Delta p = 300\left(\frac{96}{144}\right) + 200\left(\frac{115}{144}\right) + 1200\left(\frac{62.83}{144}\right) - 1700\left(\frac{62.83}{144}\right)$

$= 200 + 159 + 523 - 741$

$= 141$ psi ∴ ΔP_{max} safe for first stage cement. Adjust in field for different value of Mud Spec. Wt.

Depth: 1200' to Surface

Cement in stages not greater than 800'/stage

20" Casing, P_c = 772 psi

Depth: 2800'
Grout spec wt: 115 #/ft³ (Class H + 2% Bentonite)
Mud spec wt: 63.90 #/ft³ (salt water)

1st stage to ~ 2000'

$$\Delta p = 800\left(\frac{115}{144}\right) + 2000\left(\frac{63.90}{144}\right) - 2800\left(\frac{63.9}{144}\right)$$

$= 638 + 887 - 1243$

$= 282$ psi ∴ ΔP safe for 1st stage cement. Adjust subsequent stages in accordance with hole conditions. Do not exceed 425 psi Δp for any stage.

3. Collapse Pressure Under Axial Tensile Stress (P_{CA})

$$P_{CA} = \left[\sqrt{1 - .75\left(S_A/Y_P\right)^2} - 0.5\left(S_A/Y_P\right)\right] P_{co}$$

For 20" casing before 1st stage cement

S_A = Axial tension stress, psi = 2720
P_{co} = Collapse pressure, no axial stress = 772 psi
Y_P = Yield strength of pipe = 35000 psi (ASTM A53 B)
Weight of pipe = 104.13 #/ft × 800' = 83,304 #
Cross sectional area of pipe wall = 30.63 in²

$$\therefore P_{CA} = \left[\sqrt{1 - 0.75\left(\frac{2720}{35000}\right)^2} - 0.5\left(\frac{2720}{35000}\right)\right] 772$$

$$= \left[\sqrt{0.995} - 0.039\right] 772$$

$$= [.997 - 0.039]\, 772$$

P_{CA} = 740 psi vs P_{co} = 771 psi

∴ Axial tensile stress has virtually no effect on collapse pressure of casings in this well.

NOT INCLUDED:

Attachment No. 9

Engineering and Design Paint Manual
New Construction and Maintenance
U.S. Corps of Engineers Manual EM 1110-2-3400, 31 May 1967
Pages 20i(7)a to 20j(3)b

Attachment No. 10

Special Coatings, Chemical and Corrosion Resistant
413 Tneme-Tar
A coal tar-epoxy for steel and concrete
Tnemec Co. Inc., 123 W 23rd Avenue, North Kansas City, Mo. 64116

BLACK, CROW & EIDSNESS, INC.
CONSULTING ENGINEERS

PRINCIPAL OFFICE: 7201 N. W. ELEVENTH PLACE, GAINESVILLE, FLORIDA
REGIONAL OFFICES: ATLANTA, GEORGIA / CLEARWATER, FLORIDA
BIRMINGHAM, ALABAMA / BOCA RATON, FLORIDA / NAPLES, FLORIDA
SAN JOSE, COSTA RICA / PHILADELPHIA, PENNSYLVANIA / MONTGOMERY, ALABAMA

PLEASE REPLY TO:
GAINESVILLE, FLORIDA 32602
POST OFFICE BOX 1647
7201 N. W. ELEVENTH PLACE
904/377-2442
CABLE ADDRESS: BCEGNVFLA

February 7, 1977

Mr. Paul Phillips
Central and Southern District
Dept. of Environmental Regulation
P. O. Box 3858
3301 Gun Club Road
West Palm Beach, FL 33402

Dear Mr. Phillips:

Re: Miami-Dade Water and Sewer Authority
Test Well for Disposal System
Project No. 559-76-01 (C120377020)
Deep Injection and Monitoring Wells
Project No. 559-76-02 (C120377030)
Pumping Station for Effluent Disposal
Project No. 559-76-03 (C120377030)
Effluent Piping System to Disposal Wells
and Discharge Point
Project No. 559-76-04 (C120377030)

At the request of Dr. Garcia, we are sending to you today by UNITED PARCEL SERVICE one (1) set of Plans and Specifications for each of the four referenced project.

Very truly yours,

BLACK, CROW AND EIDSNESS, INC.

M. Frances Boley (Miss)

MFB:lj

xc: Mr. Garrett Sloan
Dr. J. I. Garcia-Bengochea

then-file

STATE OF FLORIDA

DEPARTMENT OF ENVIRONMENTAL REGULATION

2562 EXECUTIVE CENTER CIRCLE, EAST
MONTGOMERY BUILDING, TALLAHASSEE, FLORIDA 32301

DIRECTOR, WATER DIVISION
ENVIRONMENTAL PROTECTION AGENCY, REGION IV
345 COURTLAND STREET N.E.
ATLANTA, GEORGIA 30308

DATE: March 24, 1977

RE: C120 377020 Test Well
Miami S. District

ATTENTION: Bob Freeman

JOB NO. S-153

ITEM(S) CHECKED BELOW HAVE BEEN REVIEWED AND APPROVED AND ARE FORWARDED FOR YOUR ACTION. ITEM(S) MARKED WITH ASTERISKS (*) ARE APPROVED FOR TECHNICAL CONTENT ONLY; OUR APPROVAL DOES NOT CONSTITUTE APPROVAL FOR A GRANT INCREASE. 2 COPIES SUBMITTED UNLESS OTHERWISE SPECIFIED.

- ☐ Addenda No. ______
- ☐ Acceptance of Grant/Increase
- ☐ Bid Bond
- ☐ Bid Proposal
- ☐ Bid Tabulation
- ☐ Certification by proposed prime or subcontractor regarding equal employment opportunity
- ☐ Change Order(s) ______
- ☐ Civil Right's Compliance
- ☐ Consultants Recommendation of contract award
- ☐ Contract documents and specifications ☐ Executed
- ☐ Contractor's insurance certificate
- ☐ Engineer Invoices
- ☐ I/I Analysis
- ☐ Industrial cost recovery system
- ☐ Labor Compliance certificate
- ☐ Notice to Proceed
- ☐ Operation and Maintenance (Draft-Final)
- ☐ Part B, Offer and Acceptance
- ☐ Periodic estimate No. ______
- ☐ Plans (construction drawings, final)
- ☐ Power of attorney with certification
- ☐ Progress Chart (Bar Graph)
- ☐ Project Review and Cost Summary
- ☐ Progress Report ______
- ☐ Proof of advertising
- ☐ Proof of bond sale
- ☐ Proof of funds
- ☐ Public hearing
- ☐ Request for grant increase/payment
- ☐ Resolution for application
- ☐ Resolution of award
- ☐ Resolution of governing body authorizing the application and designating the official representative
- ☐ Sewer system evaluation report with supporting documents
- ☐ Sewer Use Ordinance
- ☐ Site certificate - unqualified
- ☐ Users Charge System
- ☒ Other Notice of tentative award of contract to the lowest bidder.

LHC/bh

C.C. Black, Crow & Eidsness
Garrett Sloan
Richard Friberg
Richard Tash

DER CONTRACT Lathan H. Collins, II

SINCERELY,

[signature]

HOWARD L. RHODES, P. E., CHIEF
BUREAU OF WASTEWATER MANAGEMENT AND GRANTS

COPY 3 - CONSULTING ENGINEER

STATE OF FLORIDA

DEPARTMENT OF ENVIRONMENTAL REGULATION

SOUTH FLORIDA SUBDISTRICT
3301 GUN CLUB ROAD
POST OFFICE BOX 3858
WEST PALM BEACH, FLORIDA 33402

REUBIN O'D ASKEW
GOVERNOR

JOSEPH W. LANDERS, JR.
SECRETARY

JUN 2 '77 AM

BLACK, CROW & EIDSNESS, INC.
RECEIVED

May 27, 1977

Mr. Garrett Sloan, Director
Miami Dade Water and Sewer Authority
Post Office Box 316
Miami, Florida 33133

Re: Amendments to construction permit #13-8454-77 for test injection well

Dear Mr. Sloan:

Our Tallahassee staff has recommended certain amendments to the subject permit with reference to the cement grouting and geophysical logging programs. We feel these amendments are imperative due to the characteristics of the proposed location of the well and recently experienced anomolies in similar facilities in South Florida.

The Department realizes there will be an increase in costs by requiring the afore-mentioned amendments. We feel, however, that the additional requirements will preclude operational problems which are very expensive to resolve; will extend the life of the facility and will provide additional assurance that the environment will be protected.

We are at your disposal should you wish to discuss this matter prior to the pre-construction meeting of June 3, 1977. Please contact Mr. Roy Duke or Mr. W. R. Albritton of this office, telephone (305) 689-5800.

Sincerely,

Warren G. Strahm
Subdistrict Manager

WGS:WRA:lmd

cc: H. Rhodes - DER Tallahassee
J. Pool - DER Tallahassee
S. Lewis - DER Tallahassee
J. I. Garcia - Bengochea - Black, Crow & Eidsness
A. Kreitman - S.F.W.M.D.
F. Meyer - U.S.G.S., Miami

AMENDED GEOPHYSICAL LOGGING PROGRAM

The following surveys shall be conducted, except as noted, in an open uncased hole at the intervals indicate. The actual depths may vary somewhat with site and specific geologic conditions.

The permittee shall use prudent judgment in the use of radio-active probes required to perform the down-hole logging. Should conditions exist that would indicate a high potential of loss of such probes, the permittee shall immediately notify the Department and furnish detailed engineering data relative to the risk of loss of a radio active probe and/or the feasibility of recovery of a lost probe which may be a source of contamination is the permittee's responsibility. If recovery is not possible, the Department may require that the well be abandoned according to Department rules and regulations and/or any other action the Department deems necessary to protect the environment.

	SURVEY	DEPTH
1-	Drilling Time	0' to Total Depth (Geolograph or equal)
2-	Electric and Natural Gamma Ray	0' to Total Depth (in pilot hole prior to reaming)
3-	Natural Gamma Ray	0' to Total Depth (after well is completed)
4-	Caliper	0' to Total Depth (after reaming prior to setting casings; and of completed well)
5-	Temperature	0' to Total Depth (in each test hole prior to reaming; after well completed and prior to injection test to establish geothermal gradiend; also following each cementing operation to establish top of cement)
6-	Spinner Flowmeter	900' - Total Depth (in pilotholes prior to reaming while pumping well; and of completed well while pumping.
7 -	Fluid Resistivity	900' to Total Depth (in pilot holes while pumping well; and of completed well while pumping)
8 -	Cement Bond	All casings except surface (sand casing; Done prior to cement drill out)

AMENDED GROUT REQUIREMENTS

Sulfate resistant cement shall be a prime importance for casing below the Hawthorn formation.

For cementing through waters having a sulfate content of:

1500 p.p.m. or greater,

A.P.I. class G or other cement with less than 3% Tri-calcium aluminate shall be used.

500 to 1500 p.p.m.,

A.P.I. class B or more sulfate resistant shall be used.

250 to 500 p.p.m.,

For cementing casing string through waters less than 250 p.p.m., Gel cement grout may be used.

All additives especially gel (Bentonite) which reduces sulfate resistance of setting cement shall not be used for grouting through waters with greater than 250 p.p.m. sulfate content.

Recommended locations of Biscayne Aquifer Monitoring Wells:

The locations of Biscayne Aquifer monitoring wells, shall be located to reflect the down gradient of the Aquifer, therefore at least (2) two wells shall be located about S.63° E. from the injection wells. Distance ?

(NOTE: Because of the damage which could result to the bond of the cement to the well casing, pressure testing of the well casings following cementing at more than 150% of the operating injection pressure must not be done.)

9 –	Carbonate Analysis Log *Included only 1800' to 3200' p 1-13 item 4. Could be done from 900 to 3200 if we drill exploratory hole once from 900 to 3200*	900' – Total Depth (Computer analyzed log of total porosity, secondary porosity, density, and lithology; done in pilot holes; "Coriband" or equal)
10 –	TV Recording *Included only 1800' to 3200' p. 1-13 item 4. Could be done from 900' to 3200' if we drill exploratory hole once from 900' to 3200'*	900' – Total Depth (in pilot holes) *Item 4 p I-*
11 –	TV Recording *Included in test hole*	0' – Total Depth (of completed well) *cased to 280[illegible] Item 4 p I-1[illegible]*
12 –	Stereophotography *Included in Item 4 p 1-13*	1800' to Total Depth (of selected fractures and caverns in the confining and injection zones; in pilot hole prior to setting inner casing. *Item 4 p I-13*

SUMMARY OF MEETING
Date: 3 June 1977, 8:00 a.m.-12:00 Noon

RE: Precontruction Meeting-Test Well for Disposal System, Miami-Dade Water and Sewer Authority, South District Regional Wastewater Treatment Plant, Contract No. S-153 BC&E Project No. 559-7601-3

AT: Board Room, Miami-Dade Water and Sewer Authority, 3575 LeJeune Road, Miami, Florida

Attending:
DER, West Palm Beach--W. R. Albritton, R. M. Duke
DER, Tallahassee--Jim Pool
DERM, Dade County--Tony Sobrino
EPA, Atlanta--Gene Coker, Jerry Pierce
Halliburton, Ft. Myers--Gerald Badeaux
Laurel, MS--Charles V. Hunt
Miami-Dade Water and Sewer Authority--Robert V. Celette, J. F. Cowgill, Richard E. Friberg, G. A. King, Garrett Sloan, G. F. Williams, Jr.
Progress Drilling, West Palm Beach--Richard Knittel
Progress Supply Inc., Houston--R. E. Ramage
Progress Drilling & Progress Supply, Ft. Myers--Keith E. Wilson
SFWMD, West Palm Beach--David Allman, Abe Kreitman
USGS, Miami--F. W. Meyer
BC&E, Gainesville--J. I. Garcia-Bengochea
Miami--Frank Reynolds, Udai P. Singh, David Snyder
Miami-Gainesville--C. Ross Sproul

1. Reviewed program for hydrogeological data collection and test well construction inspection proposed by B&CE on behalf of the Miami-Dade Water and Sewer Authority Agreed on program with the following amendments:

   a. Send reports under Table 1 of program with mailing frequency established, except daily reports to be mailed weekly (on Fridays). These reports to summarize daily activities and formations penetrated.

b. Add density determinations to those listed under sample No. 3 of Table 2, Hydrochemistry.

2. Reports under No. 1 above to be mailed to:

   DER, Tallahassee--Jim Pool, Howard Rhodes
   West Palm Beach--Roy Duke
   DERM--Tony Sobrino
   EPA, Atlanta--Gene Coker
   SFWMD, West Palm Beach--Abe Kreitman
   USGS, Miami--Fred Myer

3. Setting and cementing of 48" outer casing to penetrate not less than 30 feet into Hawthorn formation will not require previous approval of regulatory agencies.

4. Setting and cementing of 40" casing to be reported by phone (and confirmed in writing) to regulatory agencies.

5. Setting and cementing of 30" and 20" casings will require approval of DER and SFWMD. A meeting is to be held at job site as soon as information is available to make such decisions. Participants to be notified as quickly as possible, preferably 2 working days in advance.

6. Miami-Dade Water and Sewer Authority will contact South Florida Water Management District to confirm authority of Mr. Abe Kreitman to approve setting and cementing 30" and 20" casings at meetings without further administrative procedures.

7. Concerned agencies referred to in Proviso No. 11 of DER permit No. 13-8454-77 (February 8, 1977) are those listed in No. 2 above.

8. Provisos 12, 13, 14, and 16 of above permit refer to operation of the final facilities and not to the construction of the test well.

9. Provisos 15, 17, and 18 refer to both construction of test well and operation of final facilities.

10. All other permit provisos refer to construction of test well.

11. One permanent monitor well referred to as BA in drawing No. 2 of BC&E project 559-7601-3 will be located about S63°E from each drilled injection well and preferably outside of drilling pad. This was requested in Mr. Fred Meyer's letter of May 5, 1977.

12. Reviewed letter to Mr. Garrett Sloan from Mr. Warren G. Strahm of May 27, 1977, Re: amendments to Construction Permit No. 13-8454-77 for test injection well and agreed to:

a. Use sulfate resistant cement with not more than 5% tri-calcium aluminate for cementing through waters of more than 250 mg/l of sulfate content.

b. Use bentonite (gel cement) up to 12% and calcium chloride as required per project specifications.

c. Follow amended geophysical logging program except for:

4. Caliper: logging shall be required only in exploratory hole. Other caliper logging shall be optional to the engineer.

5. Temperature: not required in 48" and 40" casings.

8. Cement Bond: shall be required only for 20" casing. It is doubtful it would work in larger casings.

9. Carbonate Analysis Log: as required per amendments in exploratory hole from 900 feet to total depth, if hole drilled in one single operation. If not, only from approximately 1,800 feet (or bottom of 30" casing) to total depth.

Meeting adjourned at 12:00 noon.

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SUMMARY OF MEETING
Date: 19 August 1977, 10:00 a.m.-12:00 noon

RE: Progress Meeting-Test Well for Disposal System, Miami-Dade Water and Sewer Authority, South District Regional Wastewater Treatment Plant, Contract No. S-153, BC&E Project No. 559-7601-3

AT: Board Room, Miami-Dade Water and Sewer Authority, 3575 LeJeune Road, Miami, Florida

Attending:
DER, West Palm Beach--Warren Strahm, Steve Conn
Lynes, Inc. (Packers and Specialty Tools), Midland, Texas--Jerry Hynes
Miami-Dade Water and Sewer Authority--Robert V. Celette, J. F. Cowgill, Peter Smits, Garrett Sloan, G. F. Williams, Jr.
Progress Supply, Inc., Houston--R. E. Ramage
Progress Drilling & Progress Supply, Ft. Myers--Keith E. Wilson
SFWMD, West Palm Beach--David Allman
USGS, Miami--F. W. Meyer
BC&E, Gainesville--J. I. Garcia-Bengochea
Miami--Udai P. Singh
Miami-Gainesville--C. Ross Sproul

1. Reviewed progress to date. Exploratory hole at 2,060 feet in depth after cementing 48" and 40" casings. Very large artesian flow (+2,500 gpm) mainly from between 1,040 and 1,050 feet in depth (Cl $\pm$760 mg/l). Not possible to control artesian flow by pumping through saltwater outfall. Artesian flow killed with bentonite and salt. Details in previous weekly reports.

2. Discussion on anticipated setting depth of 30-inch casing. Plan to reach 2,600- to 2,800-foot level early next week and have available data to discuss setting depth by late next week. The following points were agreed under this item of discussion:

   a. Have meeting at rig trailer (project site) as soon as data below are available. Give minimum 24-hour notice.

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b. The following individuals or their representatives are to be at that meeting:
DER - Warren Strahm
SFWMD - David Allman
USGS - Fred Meyers
Plus representatives from Owner and BC&E.

c. Data to be available for meeting:
Drilling Report
Water Quality Report
Logs: Electric
Gamma
Temperature
Caliper
Fluid Resistivity
Flowmeter (natural artesian flow and same plus air lifting if possible)
TV-Camera Survey if possible

d. Target depth of well 2,700 feet ±100 feet, depending on geology.

e. Decision on setting depth of 30-inch casing will be made at meeting if all above data are available, clear, and no unforeseen conditions are present.

3. Review of Program for Hydrogeological Testing. Program procedures were revised and final form is per attached.

4. Table 1, Summary of Program Pumping Tests, was also revised as per attached.

5. Mr. Jerry Hynes, Mid-Continent Regional Manager of Lynes, Inc., Midland, Texas, described the operation of the proposed packer system.

6. BC&E showed the U.O.P. Johnson Water Well Analyzer to be used during tests and described its operation.

Meeting adjourned at 12:00 noon.

Project site was visited by the participants after brief lunch.

PROCEDURES OF PROGRAM FOR HYDROGEOLOGICAL TESTING FOR THE DEEP-WELL DISPOSAL FACILITIES OF THE MIAMI-DADE WATER AND SEWER AUTHORITY SOUTH REGIONAL WASTEWATER TREATMENT PLANT

(Revised 19 August 1977)

1. Steps 1 to 5 of BC&E specifications (Section 1, pages 1-7 and 1-8) are completed. Second casing (40-inch O.D.) is scheduled to be cemented with bottom at 960 feet in depth.

2. Drill second stage of exploratory well as per Step 6 but continue beyond 1,800 feet to penetrate major confining zone above Boulder Zone (estimated drilling depth 2,700 feet ±100 feet depending on drilling samples).

3. Run geophysical logs as follows:

   a. Electric.

   b. Natural gamma radiation.

   c. Temperature.

   d. Caliper.

   e. Fluid resistivity.

   f. T.V.-Camera Survey if possible.

4. Proceed with Step 7 of the specifications as follows:

   a. Run flowmeter log under natural artesian flow.

   b. Repeat flowmeter log increasing natural artesian flow with air lifting.

   c. Repeat temperature and fluid resistivity logs with flow increased by air lifting.

   d. Take depth samples at producing zones under maximum flow conditions.

5. Run packer testing as follows:

   a. Select approximately four (4) intervals from the major confining zones (estimated two intervals per each of the two expected zones).

   b. Use two (2) Lynes No. 303-04 straddle open hole dual seal packers on 5 9/16-inch drill pipe to isolate selected zones.

c. Lower packer assembly to deepest interval to be tested.

d. Set packers. Open ports between packers to test interval.

e. Install transducer of Johnson Water Well Analyzer Model No. 1 inside drill pipe at 160 feet in depth.

f. Install 4-inch submersible pump inside drill pipe with suction at 100 feet below top of pad. Provide pump discharge with 2-inch throttling valve and volumetric turbine meter.

g. Measure static head inside drill pipe.

h. Run pump-out test for approximately 1 to 2 hours at maximum possible rate. Measure flow rate and drawdown in drill pipe.

i. Collect water sample at end of test to determine chloride, electrical conductivity, temperature, and density.

j. Stop pump and measure recovery in drill pipe for approximately 1 to 2 hours.

k. Remove submersible pump.

l. Deflate packers, reset at next upper interval, and repeat packer testing as per above.

6. Continue exploration hole to penetrate Boulder Zone (estimated depth 2,900-3,200 feet, Step 10 of the specifications).

7. Run geophysical logging (BC&E) as follows:

a. Electric.

b. Natural gamma radiation.

c. Temperature.

d. Caliper.

e. Fluid resistivity.

f. Carbonate analysis (Schlumberger).

8. Go back to Step 8 of the specifications, reaming with 38-inch diameter to depth indicated by preceding testing to approximately 100 feet below the bottom of the brackish zone of the Floridan aquifer (TDS $>$ 10,000 mg/l, estimated depth 1,700 feet).

9. Continue with Step 9 of the specifications, setting and cementing 30-inch casing, but complete only first stage of cementing (to ±1,200 feet). Run temperature log. Delay second stage until completion of well (Steps 23-24).

10. Continue with Step 13 of the specifications, reaming with 28-inch diameter to approximately 100 feet above the proposed injection zone. Run caliper log. Plug exploratory hole.

11. Install 6,000-gpm test pump with approximately 100 feet of column inside of 30-inch casing. Run pump-out (step-drawdown) test for maximum of four (4) hours at maximum possible rate. Measure drawdown inside 30-inch casing and in annulus between 30-inch and 40-inch casings. Collect water sample at end of test to determine chloride, electrical conductivity, temperature, and density. Stop pump and measure recovery inside 30-inch casing and in annulus between 30-inch and 40-inch casings. Remove test pump. Run flowmeter log while pumping.

12. Set and cement 20-inch casing in reamed hole above (Steps 14 and 15 of the specifications). Run temperature log.

13. Ream bottom of well into Boulder Zone (Step 16 of the specifications).

14. Continue with Steps 20 through 22.

15. Run T.V.-Camera Survey of completed bottom hole and casing.

16. Go back and complete Steps 17 through 19.

17. Complete well as per Steps 23 and 24.

18. To measure bottom hole pressure during injection test, lower 3-inch drill rod into 20-inch casing and proceed as follows:

    a. Set bottom of drilling rod at approximately 2,900 feet in depth.

    b. Install equipment and well head fittings as per attached Figure 1.

    c. Inject freshwater through top of 3-inch drill rod until pressure gage reaches a maximum pressure under normal flow. Shut off valve (V_b) and observe pressure for a period of 5 minutes. Pressure should decrease slightly immediately after shutting off valve, and thereafter remain constant (approximately 20 psi). Repeat operation to doublecheck this pressure. Then, open valve (V_b) slowly and a little at a time until next pressure increase. Strangle valve to last setting which did not increase pressure. Leave valve in that position for duration of test. Pressure indicated by gage P_b is static pressure at bottom of drilling rod.

Table 1
Summary of Pumping Tests

Item No.[a]	Step No.[b]	Pump	Flow Rate (gpm)	Flow Measuring Device	Flowmeter Log Estim. From-To	Potentiometric Level Measurements Point	Method
4	7	out	800	Ac. Tu. 8"d.	960'-2,600'	40" casing	M-Scope (electric tape) or Johnson Watermarker
7	11	out	800	Ac. Tu. 8"d.	2,600'-3,700'	40" casing	M-Scope (electric tape) or Johnson Watermarker
9	-	out	0-100	Vol. Tu. 2"d.	-	Drill pipe	Johnson Water Well Analyzer Model No. 1 + tape
13	-	out	0-6,000	Ac. Tu. 16"d.	-	30" casing	Johnson Water Well Analyzer Model No. 1
						30"-40" annulus	Heise gage CMM-12 0-60 psi
16	20	out	6,000	Ac. Tu. 24"d.	2,800'-3,200'	20" casing	Johnson Water Well Analyzer Model No. 1
						20"-30" annulus	Stevens type F Recorder
						30"-40" annulus	Heise gage CMM-12 0-60 psi
16	22	in	10,000	Ac. Tu. 24"d.	-	Bottom hole	Heise Gage CMM-12 0-60 psi
						well head	Heise Gage CHM-12 0-100 psi

[a]Numbers correspond to paragraphs in the procedures of this program.
[b]Numbers correspond to steps of Section 1 of BC&E specifications.

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SUMMARY OF MEETING
Date: 26 August 1977, 10:00 a.m.-3:00 p.m.

RE: Progress Meeting--Test Well for Disposal System, Miami-Dade Water and Sewer Authority, South District Regional Wastewater Treatment Plant, Contract No. S-153, BC&E Project No. 559-7601-3

AT: Field Office at Project Site

Attending:
DER, Tallahassee--John Plappert
DER, West Palm Beach--Roy Duke, Steve Conn,
EPA, Atlanta--Gene Coker
Miami-Dade Water and Sewer Authority--Robert V. Celette, Peter Smits, Tom McCormick
SFWMD, West Palm Beach--David Allman
USGS, Miami--F. W. Meyer
BC&E, Gainesville--J. I. Garcia-Bengochea
Miami--Udai P. Singh
Miami/Gainesville--C. Ross Sproul

1. Reviewed progress to date. Exploratory hole to 2,772 feet. Reviewed geophysical logs (electric, gamma, caliper, flowmeter, temperature, and fluid resistance). Reviewed TV camera survey. All above from bottom of 40-inch casing (960 feet) to total depth.

2. Agreed to set bottom of 30-inch casing at 1,780 feet in depth.

3. Agreed to consider option of setting and cementing 30-inch casing before continuing exploratory hole to total depth. This option is presently underway.

4. Agreed to substitute carbonate analysis log (Schlumberger Coriband) with sonic and dual induction-lateral logs.

5. Agreed to have preliminary data on packer testing for meeting proposed to decide setting depth of 20-inch casing. Also to have TV camera survey of exploratory hole from 2,772 to total depth if possible.

6. Proposed meeting to decide setting depth of 20-inch casing is tentatively scheduled for week of 19 September 1977.

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SUMMARY OF MEETING

DATE: 22 September 1977, 10:00 a.m.-3:00 p.m.

RE: Progress Meeting--Test Well for Disposal System, Miami-Dade Water and Sewer Authority, South District Regional Wastewater Treatment Plant, Contract No. S-153, BC&E Project No. 559-7601-3

AT: Field Office at Project Site

Attending:
DER, West Palm Beach--Roy Duke, Steven Conn
EPA, Atlanta--Gene Coker
Miami-Dade Water and Sewer Authority--Robert V. Celette, Peter Smits, Tom McCormick
SFWMD, West Palm Beach--David Allman
USGS, Miami--F. W. Meyer
Progress Drilling, Fort Myers--Keith Wilson
BC&E, Gainesville--J. I. Garcia-Bengochea
Miami--Frank Reynolds, Udai P. Singh, Dave Snyder, C. Ross Sproul

1. Reviewed progress to date. Bottom of 30-inch casing set at 1,794 feet in depth. Casing cemented from bottom up to 1,462 feet with tail-end cement and to 1,270 feet with gel cement. (All measurements are from top of concrete-floor pad.) Reached total depth of 3,200 feet with 12-1/4-inch exploratory drill bit.

2. Reviewed geophysical logs and TV camera survey from ±1,800 to 3,200 feet. Top of highly transmissive zone at 2,790 feet. It extends down to bottom of hole (temperature 63.4° F or 17.4° C, chloride ±20,000 mg/l). Reviewed results of 10 packer tests (five settings). Transmissivity of the total zone between 1,790 and 2,770 feet is approximately 1,200 gpd/foot.

3. Agreed to set bottom of 20-inch casing at 2,745 feet and cement it up all the way to surface. Then plan monitoring of next overlying aquifer in Boulder Zone Monitoring Well 1 (BZ-1), 200 feet south of test well (I-5). Agreed to plan BZ-1 to monitor zones at ±2,800-3,200 feet, ±2,500 feet (not very transmissive), and ±1,600 feet. Install monitoring tube (1-1/4-inch) of test well (I-5) in annulus between 30-40-inch casings. Follow plans and specifications except set screen and gravel pack between 1,020 and 1,050 feet.

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4. Agreed to plan BZ-2 similar to BZ-1 above. Also to leave 1-1/4-inch monitoring line in 30-40-inch annulus of at least four of the disposal wells in the system, following I-5 as per above.

5. Agreed to ream below 20-inch casing with full diameter to bottom of well and to eliminate pump-out test under item 11 (revised program, 19 August 1977).

6. Agreed to try to reduce bowl size for pump-out test of completed hole to allow flowmeter logging while pumping out. Also to measure drawdowns in pumping well and pressure in 30-40-inch annulus.

7. Agreed to have next meeting during final injection test, approximately during week of 10 October.

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SUMMARY OF MEETING

DATE: 26 October 1977, 10:00 a.m.-2:30 p.m.

RE: Progress Meeting--Test Well for Disposal System, Miami-Dade Water and Sewer Authority, South District Regional Wastewater Treatment Plant, Contract No. S-153, BC&E Project No. 559-7601-3

AT: Field Office at Project Site and Bilbao Restaurant, 5910 S.W. 8th Street

Attending:
DER, Tallahassee--Craig Helpling, Don Kell
DER, West Palm Beach--Roy Duke, Steven Conn
DERM, Miami--Isaac Sznol
EPA, Atlanta--Gene Coker
Miami-Dade Water and Sewer Authority--Robert V. Celette, Peter Smits, George King, Garrett Sloan, James Cowgill, Herbert Kunen
SFWMD, West Palm Beach--David Allman, Abe Kreitman
USGS, Miami--F. W. Meyer
Progress Drilling, Fort Myers--Keith Wilson, Ray Ramage
BC&E, Gainesville--J. I. Garcia-Bengochea, Udai P. Singh, C. Ross Sproul

1. Meeting started with actual witnessing part of first hour of injection test. Injection rate 8,300 gpm, well head pressure 56.35 psi, bottom hole pressure 31.15 psi.

2. Reviewed progress since last meeting of 22 September: cementing of 20-inch casing, geophysical logs, and results of pump-out test.

3. Adjourned at project site to reconvene at Bilbao Restaurant. Reviewed TV survey after well completion, played back from cassette tape on a 19-inch TV set.

4. Discussed next step to obtain permit to proceed with rest of project (wells, plant, and piping).

5. BC&E proposes to have preliminary draft of report on the construction and testing of the well by 10 November 1977. Report, although in rough form, will include all data collected during construction and related operations.

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It will be submitted in that form for the review and input of the agencies involved. BC&E suggested to have another meeting the week of 28 November, possibly in West Palm Beach, to discuss comments and input from all parties concerned.

6. Copies of preliminary draft are to be sent as follows:

DER--West Palm Beach	1 copy
DER--Tallahassee	1 copy
DERM--Miami	2 copies
EPA--Atlanta	2 copies
MDWSA--Miami	2 copies
SFWMD--West Palm Beach	1 copy
USGS--Miami	1 copy
	10 copies

7. Roy Duke, DER, expressed that permit to construct complete project will be given by DER as soon as final test well report is accepted by DER (with input from SFWMD and USGS) and final plans and specifications of entire project are submitted.

8. Roy Duke, DER, also expressed that DER plans to issue only one operating permit for the entire system including wells, and not one for each well. Construction permits for wells, however, will be one per well. Final report will be required before permitting other wells.

9. Gene Coker, EPA, states that a completion certification by the Engineers will be necessary. Such certification will need to state that construction and testing were performed as per plans and specifications. Also, he stated that the Engineers will have to provide as-built plans. Agreed that report on the construction and testing could be used to satisfy such requirement provided all necessary data are included.

10. David Allman requested Engineering Report to include projected impact of injection on the "Boulder Zone."

11. Duke stated that most important item in the Engineering Report is to give special attention to permanent monitoring program.

12. Fred Meyer requested that, if possible, fluid conductance, temperature, and flowmeter loss be run after the injection test is completed and the well is allowed to flow back.

13. Sincerest appreciation was expressed by the MDW and SA and the Engineers to all members of the regulatory agencies, USGS, and the Contractor.

14. Meeting adjourned at 2:30 p.m.

Appendix B

WELL DRILLING REPORT

BLACK, CROW AND EIDSNESS, INC.
Engineers
Gainesville, Florida
Project No. 559-7601-3

Test Well for Disposal System for
South District Regional WWTP,
Miami-Dade Water and Sewer Authority
Date 8-21 July Page 1

WELL DRILLING REPORT

Note: All depths are referred to top of concrete pad at well (9.4 ft msl).

Date	Time	Depth Interval (ft) from	Depth Interval (ft) to	Sample No.	Description	Observer's Initials
7/8	1730	0	10	1	Crushed limestone-fill	CRS
7/8	1930	10	20	2	Limestone, hard, tan to gray	CRS
7/8	2130	20	30	3	Limestone, hard, oolitic, tan	CRS
7/8	2230	30	40	4	Limestone, hard, tan, gray, white	CRS
7/9	0025	40	50	5	Limestone, as above, softer	CRS
7/9	0230	50	60	6	Limestone, medium hard, tan to gray, some sand	CRS
7/9	0430	60	70	7	Limestone, as above	CRS
7/9	0515	70	80	8	Limestone, as above	CRS
7/9	0545	80	90	9	Limestone, medium hard, gray, dense, recrystallized	CRS
7/9	0550	90	100	10	Limestone, as above	CRS
7/14	0900	100	110	11	Limestone, as above, some gray-green siltstone	SFR
7/14	1030	110	120	12	Siltstone, grey-green, some limestone	SFR
7/14	1100	120	130	13	Siltstone, olive-green, moderately hard	SFR
7/21	1615	133	143	14	Siltstone/clay, olive-green, moderately hard	SFR
7/21	1640	143	153	15	Clay, olive-green, silty, with hard, rounded white lime gravel	SFR
7/21	1700	153	163	16	Clay, olive-green, with hard limestone	SFR
7/21	1750	163	173	17	Clay, as above	SFR
7/21	1815	173	183	18	Clay, as above, with fine-to-medium grains of hard white limestone, some fossils	SFR
7/21	1830	183	193	19	Clay, olive-green, abundant medium-to-hard calcareous sand and gravel, some shell	SFR
7/21	1905	193	203	20	Clay, same as above	SFR
7/21	1915	203	213	21	Clay, same as above	SFR
7/21	1930	213	223	22	Clay, same as above	SFR
7/21	2015	223	233	23	Clay, olive-green, silty, with fine calcareous sand and some coarse quartz sand	SFR
7/21	2023	233	243	24	Clay, same as above	SFR
7/21	2030	243	253	25	Clay, as above, less sandy	SFR

BLACK, CROW AND EIDSNESS, INC.
Engineers
Gainesville, Florida
Project No. 559-7601-3

Test Well for Disposal System for
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Date 21-22 July Page 2

WELL DRILLING REPORT

Date	Time	Depth Interval (ft) from	Depth Interval (ft) to	Sample No.	Description	Observer's Initials
7/21	2100	253	263	26	Clay, as above	SFR
7/21	2105	263	273	27	Clay, as above	SFR
7/21	2115	273	283	28	Clay, olive-green, silty, moderate-to-fine grained calcareous sand and shell	SFR
7/21	2130	283	293	29	Clay, same as above	SFR
7/21	2140	293	303	30	Clay, as above	SFR
7/21	2145	303	313	31	Clay, as above	SFR
7/21	2230	313	323	32	Clay, olive-green, calcareous	SFR
7/21	2240	323	333	33	Clay, as above	SFR
7/21	2243	333	343	34	Clay, as above	SFR
7/21	2245	343	353	35	Clay, as above	SFR
7/21	2300	353	363	36	Clay, as above	SFR
7/21	2330	363	373	37	Clay, as above	SFR
7/22	0015	373	383	38	Clay, as above	SFR
7/22	0020	383	393	39	Clay, as above, some poorly consolidated limestone	SFR
7/22	0040	393	403	40	Limestone, tan, poorly-to-moderately con-solidated, sparsely fossiliferous	SFR
7/22	0130	403	413	41	Limestone, as above, abundantly fossiliferous	SFR
7/22	0200	413	423	42	Limestone, as above, moderately fossiliferous	SFR
7/22	0230	423	433	43	Limestone, as above, poorly consolidated	SFR
7/22	0250	433	443	44	Limestone, as above	SFR
7/22	0340	443	453	45	Limestone, as above	SFR
7/22	0350	453	463	46	Limestone, as above	SFR
7/22	0420	463	473	47	Limestone, as above	SFR
7/22	0435	473	483	48	Limestone, as above	SFR
7/22	0443	483	493	49	Limestone, as above	SFR
7/22	0535	493	503	50	Limestone, as above	SFR

BLACK, CROW AND EIDSNESS, INC.
Engineers
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Project No. 559-7601-3

Test Well for Disposal System for
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Date 22 July Page 3

WELL DRILLING REPORT

Date	Time	Depth Interval (ft) from	Depth Interval (ft) to	Sample No.	Description	Observer's Initials
7/22	0545	503	513	51	Limestone, as above	SFR
7/22	0557	513	523	52	Limestone, as above	SFR
7/22	0558	523	533	53	Limestone, tan to buff, poorly-to-moderately consolidated, sparsely fossilized	SFR
7/22	0640	533	543	54	Limestone, as above	SFR
7/22	0650	543	553	55	Limestone, as above	SFR
7/22	0740	553	563	56	Limestone, tan to buff, poorly-to-moderately consolidated, some fossils	SFR
7/22	0830	563	573	57	Limestone, as above	SFR
7/22	0840	573	583	58	Limestone, as above	SFR
7/22	0850	583	593	59	Limestone, as above	SFR
7/22	1005	593	603	60	Limestone, as above	SFR
7/22	1015	603	613	61	Limestone, as above	SFR
7/22	1030	613	623	62	Limestone, as above	SFR
7/22	1100	623	633	63	Limestone, as above	SFR
7/22	1120	633	643	64	Limestone, as above	SFR
7/22	1135	643	653	65	Limestone, as above	SFR
7/22	1205	653	663	66	Clay, light green, with inclusions of tan limestone	SFR
7/22	1230	663	673	67	Limestone/clay, as above	SFR
7/22	1255	673	683	68	Limestone, tan to buff, poorly consolidated, moderately fossilized	SFR
7/22	1330	683	693	69	Limestone, as above	SFR
7/22	1400	693	703	70	Limestone, as above	SFR
7/22	1410	703	713	71	Limestone, as above	SFR
7/22	1420	713	723	72	Limestone, as above	SFR
7/22	1435	723	733	73	Limestone, as above	SFR
7/22	1500	733	743	74	Limestone, as above	SFR
7/22	1505	743	753	75	Limestone, as above, some clay	SFR

WELL DRILLING REPORT

Date	Time	Depth Interval (ft) from	Depth Interval (ft) to	Sample No.	Description	Observer's Initials
7/22	1515	753	763	76	Limestone, as above, some clay	SFR
7/22	1620	763	773	77	Limestone, as above, some clay	SFR
7/22	1630	773	783	78	Limestone, as above	SFR
7/22	1647	783	793	79	Limestone, tan to buff, moderately consolidated, with some light green clay	SFR
7/22	1705	793	803	80	Limestone, tan to buff, moderatley consolidated, fossilized	SFR
7/22	1730	803	813	81	Limestone, as above, some clay	SFR
7/22	1755	813	823	82	Limestone, as above, some clay	SFR
					NOTE: Lost circulation 823-923	
7/22	1835	823	833	83	Limestone, as above, some clay	SFR
7/22	1855	833	843	84	Limestone/clay, poorly consolidated, tan to light green	SFR
7/22	1915	843	853	85	Limestone, tan to light green, poorly consolidated, slightly fossilized, some clay	SFR
7/22	1945	853	863	86	Limestone, as above	SFR
7/22	2000	863	873	87	Limestone, tan, poorly consolidated	SFR
7/22	2015	873	883	88	Limestone, tan to light green, poorly consolidated, some clay and silt	SFR
7/22	2035	883	893	89	Limestone, as above, greater amount of clay and silt	SFR
7/22	2115	893	903	90	Limestone, as above	SFR
7/22	2125	903	913	91	Clay, light green, calcareous and silty poorly consolidated	SFR
7/22	2135	913	923	92	Clay, as above	SFR
					NOTE: Circulation regained	
7/22	2200	923	933	93	Limestone, tan, well consolidated, fossilized	SFR
7/22	2235	933	943	94	Limestone, as above	SFR
7/22	2300	943	953	95	Limestone, tan to gray, well consolidated, fossilized	SFR
7/22	2350	953	963	96	Limestone, as above	SFR
7/22	0040	963	973	97	Limestone, as above	SFR
7/22	0110	973	983	98	Limestone, as above	SFR

WELL DRILLING REPORT

Date	Time	Depth Interval (ft)		Sample No.	Description	Observer's Initials
		from	to			
8/11	1650	980	990	99	Limestone, pale yellowish-brown, medium hard, granular	CRS
8/11	1700	990	1,000	100	Limestone, grayish-brown, granular, chalky matrix	CRS
		1,000	1,010	101	No sample	
8/13	1040	1,010	1,020	102	Limestone, as above, softer	CRS
8/13	1835	1,020	1,030	103	Limestone, pale yellowish-brown, moderately hard, granular	CRS
8/13	2110	1,030	1,040	104	Limestone, dolomitic, grayish-brown, hard	CRS
8/14	0015	1,040	1,050	105	Limestone, dolomitic, as above	CRS
		1,050	1,060	106	No sample	
8/14	2220	1,060	1,070	107	Limestone, yellowish-brown, granular, medium hard	CRS
8/14	2320	1,070	1,080	108	Limestone, as above, "cones" abundant	CRS
8/14	2355	1,080	1,090	109	Limestone, as above, very soft	CRS
8/15	0008	1,090	1,100	110	Limestone, as above, few "cones"	CRS
8/15	0036	1,100	1,110	111	Limestone, as above	CRS
8/15	1249	1,110	1,120	112	Limestone, as above, harder	CRS
8/15	1257	1,120	1,130	113	Limestone, pale yellowish-brown, granular	CRS
8/15	1307	1,130	1,140	114	Limestone, as above	CRS
8/15	1355	1,140	1,150	115	Limestone, as above, "cones" abundant	CRS
8/15	1411	1,150	1,160	116	Limestone, yellowish-brown, granular, hard	CRS
8/15	1427	1,160	1,170	117	Limestone, as above	CRS
8/15	1609	1,170	1,180	118	Limestone, as above	CRS
8/15	1643	1,180	1,190	119	Limestone, as above	CRS
8/15	1719	1,190	1,200	120	Limestone, as above	CRS
8/15	1845	1,200	1,210	121	Limestone, as above	CRS
8/15	1925	1,210	1,220	122	Limestone, as above	CRS
8/15	1955	1,220	1,230	123	Limestone, as above	CRS

WELL DRILLING REPORT

Date	Time	Depth Interval (ft) from	to	Sample No.	Description	Observer's Initials
8/16	0003	1,230	1,240	124	Sand, quartz, fine to very fine, clear, subangular, with some heavy mineral grains and pyrite	CRS
8/16	0024	1,240	1,250	125	Sand, as above	CRS
8/16	0043	1,250	1,260	126	Limestone, pale yellowish-brown, (cuttings very fine) with about 30% sand, as above	CRS
8/16	0158	1,260	1,270	127	Limestone and sand, as above	CRS
8/16	0217	1,270	1,280	128	Limestone and sand, as above, percentage of sand decreasing	CRS
8/16	0232	1,280	1,290	129	Limestone, yellowish-brown, cuttings very fine	CRS
8/16	0403	1,290	1,300	130	Limestone, as above	CRS
8/16	0417	1,300	1,310	131	Limestone, pale yellowish-brown, medium soft, granular, flood of "cones"	CRS
8/16	0433	1,310	1,320	132	Limestone, tan, medium hard, moderately fine grain, abundant "cones"	SFR
8/16	0537	1,320	1,330	133	Limestone, tan, medium hard, very fine grain, fine grain quartz sand, pyrite, and microfossils	SFR
8/16	0554	1,330	1,340	134	Limestone, tan, medium hard, abundant very fine quartz, sand and very fine pyrite grains	SFR
8/16	0604	1,340	1,350	135	Limestone, as above	SFR
8/16	1220	1,350	1,360	136	Limestone, tan, medium hard, moderately fine grain, abundant "cones"	SFR
8/16	1302	1,360	1,370	137	Limestone, tan, medium hard, moderately fine-grained, abundant "cones"	SFR
8/16	1320	1,370	1,380	138	Limestone, as above	SFR
8/16	1427	1,380	1,390	139	Limestone, as above	SFR
8/16	1455	1,390	1,400	140	Limestone, as above	SFR
8/16	1515	1,400	1,410	141	Limestone, as above, with some large grains	SFR
8/16	1634	1,410	1,420	142	Limestone, as above, fine-grained	SFR
8/16	1653	1,420	1,430	143	Limestone, as above	SFR
8/16	1711	1,430	1,440	144	Limestone, tan to buff, fine grained to coarse, medium hard to hard, "cones" present	SFR
8/16	1846	1,440	1,450	145	Limestone, tan to brown, soft to medium hard, very fine heavy mineral grains, abundant "cones"	SFR

WELL DRILLING REPORT

Date	Time	Depth Interval (ft) from	Depth Interval (ft) to	Sample No.	Description	Observer's Initials
8/16	1905	1,450	1,460	146	Limestone, tan, fine grain, medium soft, abundant "cones"	SFR
8/16	1920	1,460	1,470	147	Limestone, as above	SFR
8/16	2052	1,470	1,480	148	Limestone, tan, coarse to fine, medium hard, abundant "cones"	SFR
8/16	2108	1,480	1,490	149	Limestone, tan, medium hard, fine grain to coarse, some recrystallized fragments	SFR
8/16	2122	1,490	1,500	150	Limestone, as above	SFR
8/16	2234	1,500	1,510	151	Limestone, tan, very fine-grained, some very fine heavy minerals and quartz sand	SFR
8/16	2247	1,510	1,520	152	Limestone, as above	SFR
8/17	0430	1,520	1,530	153	Limestone, tan, very fine-grained, medium hard, abundant "cones"	SFR
8/17	0532	1,530	1,540	154	Limestone, tan to gray, soft, very fine-grained, some very fine sand	SFR
8/17	0617	1,540	1,550	155	Limestone, tan, medium hard, very fine-grained, abundant "cones"	SFR
8/17	0645	1,550	1,560	156	Limestone, as above	SFR
8/17	0840	1,560	1,570	157	Limestone, tan, medium hard, moderately fine-grained, abundant "cones"	SFR
8/17	0910	1,570	1,580	158	Limestone, as above	SFR
8/17	0948	1,580	1,590	159	Limestone, tan, white to gray, fine to coarse, moderately hard, abundant "cones"	SFR
8/17	1230	1,590	1,600	160	Limestone, as above	SFR
8/17	1245	1,600	1,610	161	Limestone, tan, white to gray, fine grained, medium hard, abundant "cones"	SFR
8/17	1300	1,610	1,620	162	Limestone, as above	SFR
8/17	1414	1,620	1,630	163	Limestone, as above	SFR
8/17	1430	1,630	1,640	164	Limestone, brown, tan to buff, fine grain to coarse, abundant "cones"	SFR
8/17	1445	1,640	1,650	165	Limestone, as above	SFR
8/17	1625	1,650	1,660	166	Limestone, as above	SFR
8/17	1645	1,660	1,670	167	Limestone, as above	SFR
8/17	1655	1,670	1,680	168	Limestone, as above	SFR
8/17	1755	1,680	1,690	169	Limestone, as above	SFR
8/17	1805	1,690	1,700	170	Limestone, as above	SFR

WELL DRILLING REPORT

Date	Time	Depth Interval (ft) from	Depth Interval (ft) to	Sample No.	Description	Observer's Initials
8/17	1815	1,700	1,710	171	Limestone, as above, no coarse grains	SFR
8/17	1955	1,710	1,720	172	Limestone, as above	SFR
8/17	2023	1,720	1,730	173	Limestone, as above	SFR
8/17	2030	1,730	1,740	174	Limestone, as above	SFR
8/17	2135	1,740	1,750	175	Limestone, as above	SFR
8/17	2147	1,750	1,760	176	Limestone, as above	SFR
8/17	2155	1,760	1,770	177	Limestone, as above	SFR
8/17	2315	1,770	1,780	178	Limestone, tan to buff, medium soft, very fine grain, some recrystallization and fine quartz sand	SFR
8/17	2320	1,780	1,790	179	Limestone, as above	SFR
8/17	2335	1,790	1,800	180	Limestone, as above	SFR
8/17	2353	1,800	1,810	181	Limestone, as above	SFR
8/18	0103	1,810	1,820	182	Limestone, as above	SFR
8/18	0120	1,820	1,830	183	Limestone, as above	SFR
8/18	0128	1,830	1,840	184	Limestone, as above	SFR
8/18	0258	1,840	1,850	185	Limestone, as above	SFR
8/18	0313	1,850	1,860	186	Limestone, as above	SFR
8/18	0335	1,860	1,870	187	Limestone, as above	SFR
8/18	0445	1,870	1,880	188	Limestone, as above	SFR
8/18	0504	1,880	1,890	189	Limestone, as above	SFR
8/18	0523	1,890	1,900	190	Limestone, buff, tan to dark gray, moderately fine to fine, moderately hard to very hard, fossils are mostly "cones," mostly recrystallized	SFR
8/18	0714	1,900	1,910	191	Limestone, as above	SFR
8/18	0730	1,910	1,920	192	Limestone, as above	SFR
8/18	0830	1,920	1,930	193	Limestone, as above	SFR

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WELL DRILLING REPORT

Date	Time	Depth Interval (ft) from	Depth Interval (ft) to	Sample No.	Description	Observer's Initials
8/18	0840	1,930	1,940	194	Limestone, as above	SFR
8/18	0858	1,940	1,950	195	Limestone, as above	SFR
8/18	1205	1,950	1,960	196	Limestone, as above	SFR
8/18	1217	1,960	1,970	197	Limestone, as above	SFR
8/18	1227	1,970	1,980	198	Limestone, as above	SFR
8/18	1308	1,980	1,990	199	Limestone, as above	SFR
8/18	1320	1,990	2,000	200	Limestone, as above	SFR
8/18	1330	2,000	2,010	201	Limestone, as above	SFR
8/18	1707	2,010	2,020	202	Limestone, as above	SFR
8/18	1720	2,020	2,030	203	Limestone, as above	SFR
8/18	1743	2,030	2,040	204	Limestone, as above	SFR
8/18	1900	2,040	2,050	205	Limestone, as above	SFR
8/18	1919	2,050	2,060	206	Limestone, as above	SFR
8/18	1928	2,060	2,070	207	Limestone, as above	SFR
8/20	1320	2,070	2,080	208	Limestone, tan to gray, medium hard to hard, recrystallized in part	SFR
8/20	1335	2,080	2,090	209	Limestone, tan to gray, medium hard to hard, some recyrstallization, coarse to fine grain	SFR
8/20	1350	2,090	2,100	210	Limestone, tan to brown, medium hard to hard, some recrystallization, coarse to fine grain	SFR
8/20	1510	2,100	2,110	211	Limestone, as above	SFR
8/20	1525	2,110	2,120	212	Limestone, as above	SFR
8/20	1535	2,120	2,130	213	Limestone, as above	SFR
8/20	1710	2,130	2,140	214	Limestone, as above	SFR
8/20	1727	2,140	2,150	215	Limestone, as above	SFR
8/20	1741	2,150	2,160	216	Limestone, tan to gray, medium hard to hard, recrystallized and dolomitic	SFR
8/20	1855	2,160	2,170	217	Limestone, same as above	SFR
8/20	1919	2,170	2,180	218	Limestone, as above	SFR

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WELL DRILLING REPORT

Date	Time	Depth Interval (ft) from	Depth Interval (ft) to	Sample No.	Description	Observer's Initials
8/20	1935	2,180	2,190	219	Limestone, as above	SFR
8/20	2110	2,190	2,200	220	Limestone, as above	SFR
8/20	2130	2,200	2,210	221	Limestone, as above	SFR
8/20	2147	2,210	2,220	222	Limestone, as above	SFR
8/20	2309	2,220	2,230	223	Limestone, as above, very fine grain	SFR
8/20	2328	2,230	2,240	224	Limestone, as above, very fine grain	SFR
8/20	2347	2,240	2,250	225	Limestone, buff to tan, medium hard to hard, very fine grain, dolomitic fossilzed	SFR
8/21	0138	2,250	2,260	226	Limestone, as above	SFR
8/21	0201	2,260	2,270	227	Limestone, as above	SFR
8/21	0225	2,270	2,280	228	Limestone, buff to tan, medium hard, fine to coarse, fresh and weathered "cones"	SFR
8/21	0342	2,280	2,290	229	Limestone, as above	SFR
8/21	0407	2,290	2,300	230	Limestone, as above	SFR
8/21	0431	2,300	2,310	231	Limestone, as above	
		2,310	2,320	232	No sample	
8/21	0639	2,320	2,330	233	Limestone, as above	SFR
8/21	0703	2,330	2,340	234	Limestone, buff, tan to gray, hard, fine to coarse, a few weathered "cones"	SFR
8/21	0847	2,340	2,350	235	Limestone, buff to tan, medium hard, fine to coarse, many weathered "cones," some gray	
					limestone	SFR
8/21	0912	2,350	2,360	236	Limestone, as above	SFR
8/21	0939	2,360	2,370	237	Limestone, as above	SFR
8/21	1113	2,370	2,380	238	Limestone, as above	SFR
8/21	1151	2,380	2,390	239	Limestone, as above	SFR
8/21	1237	2,390	2,400	240	Limestone, gray, buff and tan, coarse to fine, medium soft to hard, some weathered "cones"	SFR
8/21	1406	2,400	2,410	241	Limestone, buff to tan, fine grain, medium hard to hard, weathered cones	SFR
8/21	1451	2,410	2,420	242	Limestone, buff to tan, fine to medium grain, soft to hard	SFR

WELL DRILLING REPORT

Date	Time	Depth Interval (ft) from	Depth Interval (ft) to	Sample No.	Description	Observer's Initials
8/21	1538	2,420	2,430	243	Limestone, buff, tan and gray, fine grain, soft to medium hard, weathered "cones"	SFR
8/21	1818	2,430	2,440	244	Limestone, as above	
8/21	1852	2,440	2,450	245	Limestone, as above	SFR
8/21	1912	2,450	2,460	246	Limestone, as above	SFR
8/21	2101	2,460	2,470	247	Dolomitic/limestone, hard, brown to gray, crystalline, limestone, tan, medium hard	SFR
8/21	2317	2,470	2,480	248	Limestone/dolomite, as above	SFR
8/22	0016	2,480	2,490	249	Limestone, white, tan, gray, fine grain, medium hard to soft, weathered "cones"	SFR
8/22	0223	2,490	2,500	250	Limestone, white, tan, gray, medium soft to hard, weathered "cones," some bitumen	SFR
8/22	0258	2,500	2,510	251	Limestone, white, tan, gray, fine to coarse, soft to hard, weathered "cones," some	
					recrystallization	SFR
8/22	0329	2,510	2,520	252	Limestone, as above, some dolomite	SFR
8/22	0555	2,520	2,530	253	Limestone, buff, tan, gray, soft to hard, some crystals, black shale and dolomite	SFR
8/22	0653	2,530	2,540	254	Limestone, as above	SFR
8/22	0741	2,540	2,550	255	Limestone, as above	SFR
8/22	1007	2,550	2,560	256	Limestone, white and gray, medium hard to hard, some crystals, dolomitic, fine to coarse	SFR
8/22	1106	2,560	2,570	257	Limestone, as above	SFR
8/22	1216	2,570	2,580	258	Limestone, as above	SFR
8/22	1355	2,580	2,590	259	Limestone, as above	SFR
8/22	1437	2,590	2,600	260	Limestone, as above	SFR
8/22	1531	2,600	2,610	261	Limestone, as above	SFR
8/22	1747	2,610	2,620	262	Limestone, as above	SFR
8/22	1803	2,620	2,630	263	Limestone, tan, medium soft, fine-grained, recrystallized in part	SFR
8/22	1821	2,630	2,640	264	Limestone, tan, medium hard to soft, fine grain, recrystallized in part	SFR
8/22	1948	2,640	2,650	265	Limestone, white, tan to gray, soft to medium hard, fine to coarse, recrystallized in part	SFR
8/22	2003	2,650	2,660	266	Limestone, white, tan to gray, soft, fine to coarse, recrystallized in part	SFR

WELL DRILLING REPORT

Date	Time	Depth Interval (ft) from	to	Sample No.	Description	Observer's Initials
8/22	2031	2,660	2,670	267	Limestone, white, tan, gray, soft to medium hard, fine to coarse, some recrystallization	SFR
8/22	2230	2,670	2,680	268	Limestone, tan to white, fine to coarse, medium soft to hard, some brown crystalline masses	SFR
8/22	2253	2,680	2,690	269	Limestone, white, soft, medium fine grain, some gray and brown lime, well formed crystal	
					aggregates present	SFR
8/22	2310	2,690	2,700	270	Limestone, white, soft to medium hard, fine grain, some brown lime or dolomite, some	
					gray lime	SFR
8/23	0053	2,700	2,710	271	Limestone, white, medium soft, mixed with gray lime and brownish dolomite, some crystals	SFR
8/23	0058	2,710	2,720	272	Limestone, white, medium hard, mixed with crystalline dolomite and well formed crystal	
					masses	SFR
8/23	0220	2,720	2,730	273	Limestone, white, tan, gray, medium hard, some dolomite	SFR
8/23	0230	2,730	2,740	274	Limestone, as above, finer texture	SFR
8/23	0245	2,740	2,750	275	Limestone, as above, finer texture	SFR
		2,750	2,760	276	No sample	
		2,760	2,770	277	No sample	
9/15	0842	2,770	2,780	278	Limestone, white, very soft, some soft gray limestone	SFR
9/15	0925	2,780	2,790	279	Limestone, white, gray, some dolomite	SFR
9/15	1205	2,790	2,800	280	Limestone, as above, + dolomite, tan to gray, crystalline	SFR
9/15	1508	2,800	2,810	281	Dolomite, very hard, crystalline, light to dark brown	SFR
9/15	1626	2,810	2,820	282	Dolomite, very hard, massive, light brown	SFR
9/15	1853	2,820	2,830	283	Dolomite, as above	SFR
9/15	2045	2,830	2,840	284	Dolomite, as above	SFR
9/16	0015	2,840	2,850	285	Dolomite, tan, brown, hard, massive, crystallized in part	SFR
9/16	0331	2,850	2,860	286	Dolomite, tan, hard, massive	SFR
9/16	0600	2,860	2,870	287	Dolomite, same as above	SFR
9/16	0812	2,870	2,880	288	Dolomite, tan, massive, very hard	SFR

WELL DRILLING REPORT

Date	Time	Depth Interval (ft) from	Depth Interval (ft) to	Sample No.	Description	Observer's Initials
9/16	1136	2,880	2,890	289	Dolomite, gray, brown, very hard, massive and crystalline	SFR
9/16	1418	2,890	2,900	290	Dolomite, brown, tan, very hard, massive and crystalline	SFR
9/16	1709	2,900	2,910	291	Dolomite, light brown, very hard, massive	SFR
9/16	1942	2,910	2,920	292	Dolomite, as above	SFR
9/16	2109	2,920	2,930	293	Dolomite, tan, very hard, massive, crystallized in part	SFR
9/16	2229	2,930	2,940	294	Dolomite, as above	SFR
9/17	0050	2,940	2,950	295	Dolomite, gray, very hard, massive, crystalline	SFR
9/17	0240	2,950	2,960	296	Dolomite, brown, tan, gray, very hard, crystalline, massive	SFR
9/17	0419	2,960	2,970	297	Dolomite, as above, mostly crystalline	SFR
9/17	0704	2,970	2,980	298	Dolomite, gray and brown crystalline, tan, massive, very hard	SFR
9/17	0825	2,980	2,990	299	Dolomite, as above	SFR
9/17	1014	2,990	3,000	300	Dolomite, gray crystalline, very hard	SFR
9/17	1157	3,000	3,010	301	Dolomite, brown crystalline, very hard	SFR
9/17	1327	3,010	3,020	302	Dolomite, as above	SFR
9/17	1508	3,020	3,030	303	Dolomite, as above	SFR
9/17	1743	3,030	3,040	304	Dolomite, as above, some white limestone	SFR
9/17	1909	3,040	3,050	305	Dolomite, as above, some tan dolomite and white limestone	SFR
9/17	2035	3,050	3,060	306	Dolomite, gray to brown, crystalline, very hard	SFR
9/17	2320	3,060	3,070	307	Dolomite, as above	SFR
9/18	0111	3,070	3,080	308	Dolomite, as above	SFR
9/18	0307	3,080	3,090	309	Dolomite, as above	SFR
9/18	0634	3,090	3,100	310	Dolomite, as above	
9/18	0807	3,100	3,110	311	Dolomite, as above, more brown dolomite	SFR
9/18	1000	3,110	3,120	312	Dolomite, as above	SFR
9/18	1238	3,120	3,130	313	Dolomite, as above	SFR

WELL DRILLING REPORT

Date	Time	Depth Interval (ft) from	Depth Interval (ft) to	Sample No.	Description	Observer's Initials
9/18	1452	3,130	3,140	314	Dolomite, as above	SFR
9/18	1718	3,140	3,150	315	Dolomite, as above	SFR
9/18	2316	3,150	3,160	316	Dolomite, as above	SFR
9/19	0120	3,160	3,170	317	Dolomite, as above	SFR
9/19	0330	3,170	3,180	318	Dolomite, as above	SFR
9/19	0603	3,180	3,190	319	Dolomite, as above	SFR
9/19	0750	3,190	3,200	320	Dolomite, as above	SFR

Appendix C

WATER QUALITY DATA FROM TEST WELL

FIELD ANALYSES

Miami-Dade Water & Sewer Authority
Test Well for Disposal System for South District Regional Wastewater Treatment Plant
Contract No. S-153 BC&E Project No. 559-7601-3

WATER QUALITY DATA FROM TEST WELL

Date	Time	Depth (ft)	Temperature		Density	Specific Conductance (μmhos/cm)	Chloride (mg/l)	pH	Total Alkalinity (mg/l as $CaCO_3$)	Remarks	Observer's Initials
			°F	°C							
8/13/77	2200	1,025	76	24.5	1.001	3,000	730	7.3	219		SFR
8/14/77	0640	1,055	75	24	1.001	3,000	762	7.5	214		SFR
8/14/77	2320	1,085	75	24	1.001	2,900	760	7.0	210		CRS
8/15/77	0100	1,114	75	24	1.001	2,900	665	7.2	204		SFR
8/15/77	1340	1,144	77	25	1.002	3,200	835	7.5	230		DGS
8/15/77	1455	1,175	77	25	1.002	7,000	1,820	7.5	251		DGS
8/15/77	1800	1,204	77.5	25	1.001	6,100	1,600	7.5	214		UPS
8/15/77	2035	1,234	77	25	1.002	4,200	1,060	7.5	242		UPS
8/16/77	0130	1,264	76	25	1.002	7,200	2,020	7.5	220		SFR
8/16/77	0345	1,291	76	25	1.002	9,200	2,850	7.4	180		SFR
8/16/77	0440	1,321	76	25	1.002	4,600	1,580	7.3	210		SFR
8/16/77	0645	1,351	76	25	1.001	4,600	1,090	7.6	225		SFR
8/16/77	1330	1,381	77	25	1.001	3,800	1,150	6.9	280	Sample from discharge--airlifted	CRS
8/16/77	1400	1,381	77	25	NS	7,000	2,350	6.7	280	Sample from drill pipe--natural flow	CRS
8/16/77	1600	1,411	77	25	1.001	5,200	1,620	6.8	240	Airlifted sample from discharge	CRS
8/16/77	1609	1,411	77	25	1.001	3,800	1,200	6.9	280	Flow sample from drill pipe	CRS
8/16/77	1825	1,441	77	25	1.001	4,100	1,240	6.95	240	Flow sample	CRS

Miami-Dade Water & Sewer Authority
Test Well for Disposal System for South District Regional Wastewater Treatment Plant
Contract No. S-153 BC&E Project No. 559-7601-3

WATER QUALITY DATA FROM TEST WELL

Date	Time	Depth (ft)	Temperature		Density	Specific Conductance (μmhos/cm)	Chloride (mg/l)	pH	Total Alkalinity (mg/l as $CaCO_3$)	Remarks	Observer's Initials
			°F	°C							
8/16/77	2030	1,471	76	25	1.002	7,000	2,360	6.6	280		CRS
8/16/77	2209	1,501	75.5	25	1.0015	4,900	1,540	6.7	300		CRS
8/17/77	0440	1,531	76	25	1.0025	6,200	2,000	7.4	230		UPS
8/17/77	0725	1,562	76	25	1.0015	4,900	1,530	7.7	254		UPS
8/17/77	1025	1,592	77	25	1.0015	4,600	1,340	7.35	240	Airlift sample	CRS
8/17/77	1330	1,622	77	25	1.0015	5,400	1,900	7.4	240	Flow sample	CRS
8/17/77	1545	1,652	78	25.5	1.0015	5,700	1,680	7.3	180	Flow sample, alkalinity sample filtered	SFR
8/17/77	1745	1,682	77	25	1.0030	8,500	3,320	8.4	150	Water does not flow over drill pipe (first time)	CRS
8/17/77	1820	1,682	78	25	1.0015	5,500	1,940	7.15	--	Sample circulated from bottom by airlift	CRS
8/17/77	1910	1,713	77	25	1.0015	5,100	1,540	7.2	190	Flow sample, alkalinity sample filtered	SFR
8/17/77	2120	1,743	76.5	25	1.002	6,500	1,960	7.4	180	Flow sample, alkalinity filtered	SFR
8/17/77	2300	1,771	76.5	25	1.0015	5,800	1,660	6.90	180	Flow sample, alkalinity filtered	SFR
8/18/77	2440	1,801	76	24.5	1.0015	4,750		7.30		Airlift	DGS
8/18/77	0105	1,801	76	24.5	1.003	5,900	1,640	7.1	180	Flow sample	DGS
8/18/77	0300	1,834	76	24.5	1.002	5,800	1,740	6.8	188	Flow sample	DGS
8/18/77	0445	1,863	75	24	1.0015	4,800	1,260	6.9	142	Flow sample	DGS
8/18/77	0705	1,893	75	24	1.001	5,800	1,700	7.2	300	Flow sample	DGS

Miami-Dade Water & Sewer Authority
Test Well for Disposal System for South District Regional Wastewater Treatment Plant
Contract No. S-153 BC&E Project No. 559-7601-3

WATER QUALITY DATA FROM TEST WELL

Date	Time	Depth (ft)	Temperature °F	°C	Density	Specific Conductance (μmhos/cm)	Chloride (mg/l)	pH	Total Alkalinity (mg/l as $CaCO_3$)	Remarks	Observer's Initials
8/21/77	1738	2,436	78.0	25.5	1.020	40,000	15,850	6.3	214	Airlift sample	SFR
8/21/77	1940	2,466	74.0	23.5	1.014	28,000	10,400	7.4	238	Discharge line (airlift)	DGS
8/22/77	0140	2,496	72.5	23	1.0230	48,000	17,700	7.2	132	Discharge (filtered)	CRS
8/22/77	0500	2,526	73	23	1.0245	50,000	19,700	7.5	126	Airlift sample--filtered	CRS
8/22/77	0930	2,557	74	22.5	1.0220	50,000	20,700	7.5	140	Airlift sample--filtered	UPS
8/22/77	1325	2,587	75	24	1.0215	49,000	16,100	7.6	160	Airlift sample--filtered	UPS
8/22/77	1650	2,617	71.5	22	1.025	53,000	18,400	6.4	160	Airlifted sample--filtered	SFR
8/22/77	1945	2,646	72.5	23	1.025	50,000	18,700	6.5	118	Airlifted sample--filtered after connection	SFR
8/22/77	2300	2,678	72.0	22	1.025	50,000	18,850	6.3	28	Airlifted sample--filtered after connection	SFR
8/23/77	0020	2,708	72.0	22	1.024	50,000	18,800	6.3	120	Airlifted sample--filtered	SFR
8/23/77	0250	2,739	72.0	22	1.0255	52,000	18,900	6.3	163	Airlifted sample--filtered	SFR
8/23/77	0720	2,759	71.5	22	1.0260	53,000	19,100	6.3	116	Airlifted sample--filtered TD	SFR
8/24/77	0945	Composite Flow	73	21.5		16,500	5,300			Composite sample (up to TD)	UPS
8/26/77	0730	2,357	74	22.5	1.0035	11,000	3,200			Composite sample up to 2,357 ft (which is top of top element of packer)	UPS
8/26/77	1245	Composite	72	22	1.006		5,320	7.1		Composite sample 1 hour after packers were deflated	DGS
8/26/77	1715	1,900-960	73.5	23	1.0025					Composite flow 760-1,900 ft packer inflated	CRS

Miami-Dade Water & Sewer Authority
Test Well for Disposal System for South District Regional Wastewater Treatment Plant
Contract No. S-153 BC&E Project No. 559-7601-3

WATER QUALITY DATA FROM TEST WELL

Date	Time	Depth (ft)	Temperature °F	Temperature °C	Density	Specific Conductance (μmhos/cm)	Chloride (mg/l)	pH	Total Alkalinity (mg/l as $CaCO_3$)	Remarks	Observer's Initials
8/18/77	0830	1,923	76.5	25	1.002	8,700	2,830	7.6	320	Flow sample	UPS
8/18/77	1145	1,956	75	24	1.004	12,000	3,940	7.6	230	Flow sample circulated ≃ 2 hr before taking sample	UPS
8/18/77	1305	1,986	76	24.5	1.011	27,000	9,240	7.85	360	Airlifted sample (no flow over drill pipe)	UPS
8/18/77	1655	2,015	76	24.5	1.002	8,400	2,720	7.3	250	Airlift sample	SFR
8/18/77	1700	2,045	76	24.5	1.0065	15,500	5,200	7.5	350		SFR
8/18/77	2040	2,076	75.5	24.0	1.0095	21,000	7,030	7.2	300	Airlift sample	SFR
8/20/77	1458	2,105	78.0	25.5	1.006	12,300	4,360	6.8	220	Flow sample	DGS
8/20/77	1630	2,137	77	25	1.0075	17,500	8,300	7.7	No end point	Airlift sample--no flow	CRS
8/20/77	1845	2,167	77	25	1.0115	22,000	8,450	7.65	172	*Retain for lab airlift sample--no flow	CRS
8/20/77	2020	2,197	75	24	1.0130	26,000	12,000	7.40	162	Airlift sample (filtered)	CRS
8/20/77	2145	2,227	75	24	1.0145	30,000	12,200	7.8	148	Airlift sample (filtered)	CRS
8/21/77	0120	2,255	75	24	1.0150	32,000	12,000	7.5	180	Airlift sample	UPS
8/21/77	0325	2,285	74.5	24	1.0155	30,000	11,200	7.7	180	Flow sample	UPS
8/21/77	0555	2,315	74	23.5	1.0160	33,000	12,550	7.6	160	Flow sample	UPS
8/21/77	0755	2,344	75	24	1.0150	31,000	11,450	7.7	170	Flow sample	UPS
8/21/77	1050	2,374	77.5	25.5	1.0160	35,000	12,625	6.5	170	Airlift sample	SFR
8/21/77	1330	2,405	76.0	26	1.0150	31,000	11,225	7.1	160	Airlift sample	SFR

Miami-Dade Water & Sewer Authority
Test Well for Disposal System for South District Regional Wastewater Treatment Plant
Contract No. S-153 BC&E Project No. 559-7601-3

WATER QUALITY DATA FROM TEST WELL

Date	Time	Depth (ft)	Temperature °F	Temperature °C	Density	Specific Conductance (μmhos/cm)	Chloride (mg/l)	pH	Total Alkalinity (mg/l as $CaCO_3$)	Remarks	Observer's Initials
8/26/77	1717	1,970-2,000	74	23.5	1.0255	52,000				Packer internal sample Q = 520 gpm	CRS
8/27/77	1945	Composite sample to 2,549	73	21.5	1.006	15,000				Composite sample to 2,549 ft flow = 1,150 gpm	UPS
8/27/77	2300	Composite sample to 2,772	72.5	21.5	1.006	15,500				Composite sample to TD (packers deflated) flow = 1,060 gpm	SFR
8/25/77	0815	2,737 to 2,772			1.026					From packer test no. 1	UPS
8/26/77	0300	2,367 to 2,397	74	22.5	1.026	50,000	16,200			From packer test no. 4	UPS
8/26/77	0915	2,407 to 2,772(TD)	74	22.5	1.026	55,000	18,200			From packer test no. 5	UPS
8/26/77	1630	1,968 to 1,998	74	22.5	1.0255	52,000				From packer test no. 6	UPS
8/27/77	1340	2,543 to 2,573	73	22	1.025	52,000	15,600			From packer test no. 8	UPS
8/27/77	1800	2,583 to 2,772(TD)	73	22	1.0260	59,000	17,700			From packer test no. 9	UPS
8/28/77	0345	2,692 to 2,772(TD)	73	22	1.0265	58,000	20,700			From packer test no. 10	UPS
8/28/77	0800	2,652 to 2,682	73	22	1.026	54,000	20,800			From packer test no. 11	UPS
8/28/77	0910	960-2,682	73	22	1.0065	16,200	5,900			Composite sample 960-2,682 packers inflated. Flow 940 gpm	CRS
8/28/77	1730	960-2,772	73	22	1.0065	16,000	5,900			Composite sample 960-2,772. Drill pipe out of hole. Flow 1,040 gpm	CRS

Miami-Dade Water & Sewer Authority
Test Well for Disposal System for South District Regional Wastewater Treatment Plant
Contract No. S-153 BC&E Project No. 559-7601-3

WATER QUALITY DATA FROM TEST WELL

Date	Time	Depth (ft)	Temperature		Density	Specific Conductance (μmhos/cm)	Chloride (mg/l)	pH	Total Alkalinity (mg/l as $CaCO_3$)	Remarks	Observer's Initials
			°F	°C							
9/15/77	1100	2,795	69	21	1.0270	56,000	20,100	6.0	60.0	Airlifted sample--filtered	SFR
9/15/77	1800	2,825	70	21	1.0270	56,000	19,000	6.1	55.0	Airlifted sample--filtered	SFR
9/16/77	0205	2,855	70	21	1.0265	58,000	19,500	7.5	114	Airlifted sample--filtered	UPS
9/16/77	1100	2,885	70	21	1.0265	56,000	23,000	6.1	120	Airlifted sample--filtered	CRS
9/16/77	1850	2,916	69	21	1.0260	50,000	19,500	6.1	184	Airlifted sample--filtered	DGS
9/17/77	0030	2,946	69	20.5	1.0265	57,000	20,100	6.11	110	Airlifted sample--filtered	SFR
9/17/77	0600	2,976	68.5	20.0	1.0265	58,000	20,000	6.0	104	Airlifted sample--filtered	SFR
9/17/77	1124	3,006	69	20.5	1.0265	57,000	21,000	6.7	118	Airlifted sample--filtered	UPS
9/17/77	1630	3,036	69	20.5	1.0265	56,000	20,900	6.2	120	Airlifted sample--filtered	CRS
9/17/77	2240	3,066	68.5	20	1.0270	55,000	19,800	6.7	122	Airlifted sample--filtered	CRS
9/18/77	0510	3,095	68	20	1.0265	56,000	21,350	6.4	137	Airlifted sample--filtered	DGS
9/18/77	1130	3,125	68	20	1.0270	56,000	25,000	6.0	112	Airlifted sample--filtered	SFR
9/18/77	1900	3,155	68	20	1.0265	57,000	25,500	6.0	118	Airlifted sample--filtered	UPS
9/19/77	0500	3,185	68	20	1.0270	57,000	19,500	6.1	120	Airlfited sample--filtered	CRS

LAB ANALYSES

Parameter/Description	Laboratory Sample Numbers No. 7938	No. 7939	No. 7940	No. 7941	No. 7942
Well description	Test well	Test well	Test well	Test well	Test well
Depth sampled in feet	1,025	1,204	1,411	1,801	1,956
Date collected	8-13-77	8-15-77	8-16-77	8-18-77	8-18-77
Time	10:00 p.m.	6:00 p.m.	4:00 p.m.	1:05 a.m.	11:45 a.m.
Type of sample	Flow	Flow	Airlift	Flow	Flow
pH	8.10	7.75	7.80	7.70	7.80
Alkalinity (mg/l as $CaCO_3$)	226	235	594	725	222
Calcium (mg/l)	I.S.	211	118	186	143
Chloride (mg/l)	663	1,920	1,070	1,080	4,160
Color (APHA units)	2	2	2	0	3
Conductivity (μmhos/cm)	2,600	5,050	3,650	5,100	11,400
Fluoride (mg/l)	2.00	1.98	2.00	1.92	1.72
Total hardness (mg/l as $CaCO_3$)	I.S.	961	621	840	1,270
Magnesium (mg/l)	I.S.	78	65	91	182
Nitrate (mg/l as N)	0.04	0.06	0.04	0.03	0.04
Potassium (mg/l)	I.S.	72	36	60	120
Sodium (mg/l)	I.S.	945	702	972	2,430
Dissolved solids (mg/l)	2,616	3,752	2,396	3,224	7,528
Strontium (mg/l)	I.S.	11.0	5.4	7.8	6.7
Sulfate (mg/l)	280	290	286	324	535
Sulfide (mg/l)	0.24	0.63	0.33	0.22	0.11
Metals (mg/l)					
Aluminum	0.09	3.76	0.96	3.70	2.20
Arsenic	<0.006	<0.006	<0.006	<0.006	<0.006
Cadmium	<0.004	0.440	0.009	0.023	0.008
Copper	0.002	0.830	0.052	0.119	0.066
Iron	0.96	140	5.90	15.8	6.60
Lead	0.040	0.030	0.054	0.028	0.216
Manganese	<0.040	<0.040	0.055	0.090	0.060
Mercury	<0.0002	0.0027	0.0050	0.0022	0.0018

Note: I.S.= insufficient sample.

Parameter/Description	Laboratory Sample Numbers				
	No. 7943	No. 7944	No. 7945	No. 7946	No. 7947
Well description	Test well	Test well	Test well	Test well	Test well
Depth sampled in feet	2,167	2,255	2,405	2,557	2,759
Date collected	8-20-77	8-21-77	8-21-77	8-22-77	8-23-77
Time	6:45 a.m.	1:20 a.m.	1:30 p.m.	9:30 p.m.	7:20 a.m.
Type of sample	Airlift	Airlift	Airlift	Airlift	Airlift
pH	8.20	7.60	7.90	7.75	7.70
Alkalinity (mg/l as $CaCO_3$)	250	546	370	342	637
Calcium (mg/l)	229	378	273	322	409
Chloride (mg/l)	8,260	12,300	11,500	17,700	19,300
Conductivity (μmhos/cm)	21,900	31,200	29,000	41,600	46,700
Fluoride (mg/l)	1.20	0.88	0.95	0.67	0.62
Total hardness (mg/l as $CaCO_3$)	2,100	3,840	3,900	5,980	5,470
Magnesium (mg/l)	364	546	546	780	858
Nitrate (mg/l as N)	0.06	0.02	0.04	0.04	0.08
Potassium (mg/l)	252	384	390	342	456
Sodium (mg/l)	3,726	5,238	5,076	7,020	7,668
Dissolved solids (mg/l)	15,212	21,900	21,544	31,874	37,180
Strontium (mg/l)	11.2	9.5	8.4	8.4	7.0
Sulfate (mg/l)	1,140	1,700	1,660	2,360	2,580
Sulfide (mg/l)	*	0.07	0.23	0.05	<0.01
Metals (mg/l)					
Aluminum	1.31	0.99	0.53	0.55	0.39
Arsenic	<0.006	<0.006	<0.006	<0.006	<0.006
Cadmium	<0.004	0.006	<0.004	<0.004	0.007
Copper	0.030	0.033	0.013	0.008	0.016
Iron	2.95	6.10	1.68	0.86	4.08
Lead	0.076	0.560	0.160	0.060	0.174
Manganese	0.060	0.090	<0.040	<0.040	<0.040
Mercury	0.0008	0.0008	0.0003	<0.0002	0.0002

*Parameter not requested.

Parameter/Description	Laboratory Sample Numbers				
	No. 7948	No. 8101	No. 8102	No. 8103	No. 8105
Well description	Test well	Test well	Test well	Test well	Test well
Depth sampled in feet	960-2,759	2,697-2,727	2,267-2,397	2,407-2,759	960-2,759
Date collected	8-24-77	8-25-77	8-26-77	8-26-77	8-27-77
Time	9:45 a.m.	3:30 p.m.	2:55 a.m.	9:00 a.m.	11:00 p.m.
Type of sample	Composite	Packer test	Packer test	Packer test	Composite
gpm					1,060
pH	7.65	7.40	7.40	7.40	*
Alkalinity (mg/l as $CaCO_3$)	176	120	122	120	*
Calcium (mg/l)	136	384	322	307	*
Chloride (mg/l)	5,650	19,400	19,400	19,600	5,050
Color (APHA units)	2	0	0	0	*
Conductivity (μmhos/cm)	14,600	45,300	44,700	45,500	*
Fluoride (mg/l)	1.31	0.57	0.51	0.57	*
Total hardness (mg/l as $CaCO_3$)	2,050	6,640	6,550	6,600	*
Magnesium (mg/l)	260	884	832	910	*
Nitrate (mg/l as N)	0.04	0.12	0.05	0.12	*
Potassium (mg/l)	494	494	380	456	*
Sodium (mg/l)	3,132	7,506	7,344	7,992	*
Dissolved solids (mg/l)	10,884	36,700	37,000	36,100	10,200
Strontium (mg/l)	7.0	7.5	8.6	7.7	*
Sulfate (mg/l)	830	2,620	2,600	2,760	*
Sulfide (mg/l)	*	Interference	40.10	0.40	*
Metals (mg/l)					
Aluminum	*	0.62	<0.03	<0.03	*
Arsenic	*	0.006	0.006	0.006	*
Cadmium	*	0.005	<0.004	0.014	*
Copper	*	0.160	0.062	0.022	*
Iron	*	16.8	4.40	3.32	*
Lead	*	0.336	0.036	0.082	*
Manganese	*	0.087	<0.040	<0.040	*
Mercury	*	0.0002	0.0002	0.0002	*

*Parameter not requested.

Parameter/Description	Laboratory Sample Numbers No. 8106	No. 8107	No. 8108	No. 8109	No. 8110
Well description	Test well	Test well	Test well	Test well	Test well
Depth sampled in feet	960-2,533	1,970-2,000	2,567-2,597	960-1,960	960-2,759
Date collected	8-27-77	8-26-77	8-27-77	8-26-77	8-27-77
Time	7:45 p.m.	5:17 p.m.	1:40 p.m.	5:15 p.m.	12:45 p.m.
Type of sample	Packer test	Packer test	Packer test	Composite	Composite after packers deflated
gpm	1,150			520	
pH	*	7.50	7.45	*	*
Alkalinity (mg/l as $CaCO_3$)	*	132	122	*	*
Calcium (mg/l)	*	310	319	*	*
Chloride (mg/l)	5,050	19,700	19,200	2,080	4,950
Color (APHA units	*	0	0	*	*
Conductivity (μmhos/cm)	*	44,500	44,800	*	14,000
Total hardness (mg/l as $CaCO_3$)	*	6,800	6,670	*	*
Magnesium (mg/l)	*	845	871	*	*
Nitrate (mg/l as N)	*	0.06	0.06	*	*
Potassium (mg/l)	*	361	380	*	*
Sodium (mg/l)	*	7,560	7,560	*	*
Dissolved solids (mg/l)	9,840	36,200	36,300	4,640	10,348
Strontium (mg/l)	*	11.6	*	*	*
Sulfate (mg/l)	*	2,640	2,740	*	*
Metals (mg/l)					
Aluminum	*	0.07	*	*	*
Arsenic	*	<0.006	*	*	*
Cadmium	*	<0.004	*	*	*
Copper	*	0.018	*	*	*
Iron	*	2.72	*	*	*
Lead	*	0.052	*	*	*
Manganese	*	<0.04	*	*	*
Mercury	*	<0.0002	*	*	*

*Parameter not requested.

Parameter/Description	Laboratory Sample Numbers				
	No. 8111	No. 8112	No. 8113	No. 8524	No. 8526
Well description	Test well	Test well	Test well	Test well	Test well
Depth interval in feet	2,652-2,682	2,692-2,759	2,607-2,759	2,746-3,200	2,746-3,200
Date collected	8-28-77	8-28-77	8-27-77	10-20-77	10-20-77
Time	7:55 p.m.	3:55 a.m.	6:15 p.m.	2:00 p.m.	6:00 p.m.
Temperature				65.4° F	
Type of sample		Packer test	Packer test	6 hours after pumping	End of pump test
Density				1.027 (@ 64.5° F)	
gpm				6,000	
pH	7.70	7.50	7.60	7.55	7.70
Alkalinity (mg/l as $CaCO_3$)	120	130	124	124	120
Calcium (mg/l)	310	409	322	450	450
Chloride (mg/l)	19,500	19,500	19,500	19,700	19,400
Color (APHA units)	0	0	0	1	1
Conductivity (μmhos/cm)	42,900	43,600	43,600	50,500	50,100
Fluoride (mg/l)	*	*	*	0.61	*
Total hardness (mg/l as $CaCO_3$)	6,700	6,670	6,670	6,370	6,450
Magnesium (mg/l)	884	884	882	1,270	1,290
Nitrate (mg/l as N)	0.15	0.02	0.05	0.235	*
Potassium (mg/l)	380	395	380	400	410
Sodium (mg/l)	7,992	7,776	8,014	10,800	10,900
Dissolved solids (mg/l)	37,000	37,600	38,700	39,800	38,300
Strontium (mg/l)	*	*	*	7.64	*
Sulfate (mg/l)	2,760	2,760	2,620	2,760	2,840
Sulfide (mg/l)	*	*	*	0.50	*
Metals (mg/l)					
Aluminum	*	*	*	<0.03	*
Arsenic	*	*	*	<0.006	*
Cadmium	*	*	*	<0.004	*
Copper	*	*	*	<0.002	*
Iron	*	*	*	0.51	*
Lead	*	*	*	<0.020	*
Manganese	*	*	*	<0.040	*
Mercury	*	*	*	<0.0002	*

*Parameter not requested.

Parameter/Description	Laboratory Sample Numbers		
	No. 8396	No. 8397	No. 8398
Well description	Test well	Test well	Test well
Depth interval in feet	1,800-2,600 while pumping	1,800-2,960 while pumping	1,800-3,200 while pumping
Date collected	9-21-77	9-21-77	9-21-77
Temperature	66° F	63.5° F	66° F
Type sample	Total depth of well 3,200 ft	Total depth of well 3,200 ft	Total depth of well 3,200 ft
gpm	800	800	800
pH	7.45	7.15	7.55
Alkalinity (mg/l $CaCO_3$)	120	120	120
Calcium (mg/l)	455	450	460
Chloride (mg/l)	19,500	19,400	19,500
Color (APHA units)	2	0	0
Conductivity (μmhos/cm)	50,700	50,200	50,500
Fluoride (mg/l)	0.6	0.59	0.61
Total hardness (mg/l as $CaCO_3$)	6,420	6,370	6,430
Magnesium (mg/l)	1,280	1,270	1,280
Nitrate (mg/l as N)	0.110	0.233	0.145
Potassium (mg/l)	400	390	400
Sodium (mg/l)	11,200	11,100	11,250
Dissolved solids (mg/l)	40,000	38,500	37,300
Strontium (mg/l)	7.80	7.50	7.70
Sulfate (mg/l)	2,720	2,710	2,650

Parameter/Description	Laboratory Sample Numbers No. 8399	No. 8400	No. 8525
Well description	Test well	Test well	Test well
Depth sampled in feet	2,795	3,006	3,193
Date collected	9-15-77	9-17-77	10-17-77
Temperature			66° F
Time	11:00 a.m.	11:24 a.m.	9:30 a.m.
Type of sample	Airlift	Airlift	Airlift
pH	8.05	7.65	7.85
Alkalinity (mg/l as $CaCO_3$)	416	394	130
Calcium (mg/l)	520	495	445
TOC (mg/l)	17.0	2.5	*
Chloride (mg/l)	19,400	18,800	19,400
Color (APHA units)	0	1	2
Conductivity (μmhos/cm)	50,300	50,400	49,200
Fluoride (mg/l)	0.56	0.58	0.59
Total hardness(mg/l as $CaCO_3$)	6,750	6,600	6,440
Magnesium (mg/l)	1,320	1,300	1,290
Nitrate (mg/l as N)	0.050	0.155	0.335
Potassium (mg/l)	370	380	400
Sodium (mg/l)	10,200	10,600	10,800
Dissolved solids (mg/l)	37,500	38,000	39,000
Strontium (mg/l)	8.40	8.04	7.20
Sulfate (mg/l)	2,660	2,670	2,800
Sulfide (mg/l)	0.85	0.73	*
Metals (mg/l)			
Aluminum	0.41	0.16	0.05
Arsenic	<0.006	<0.006	<0.006
Cadmium	<0.004	<0.004	<0.004
Copper	0.019	0.004	0.004
Iron	3.20	3.30	3.32
Lead	0.128	0.034	<0.020
Manganese	<0.040	<0.040	<0.040
Mercury	0.0006	0.0006	<0.0002

*Parameter not requested.

Parameter/Description	Laboratory Sample Numbers No. 7627	No. 7628	No. 7692	No. 7693	No. 7694
Well description	MW No. 6	Water supply well	Water supply well	Water supply well	Water supply well
Depth sampled	30 feet	Pumped sample	20 feet	30 feet	40 feet
Temperature	24° C	24° C	25° C	25.5° C	25° C
Date collected	7-9-77	7-9-77	7-3-77	7-3-77	7-3-77
Time	12:15 p.m.	3:00 p.m.	11:05 a.m.	11:55 a.m.	2:40 p.m.
pH	11.70	8.00	I.S.	7.90	7.85
Alkalinity (mg/l as $CaCO_3$)	364	376	I.S.	I.S.	I.S.
Calcium (mg/l)	92.0	112	1,480	143	206
Chloride (mg/l)	233	251	187	279	417
Color (APHA units)	3	13	I.S.	I.S.	I.S.
Conductivity (μmhos/cm)	1,270	1,250	I.S.	I.S.	I.S.
Fluoride (mg/l)	0.13	0.13	I.S.	I.S.	I.S.
Total hardness (mg/l as $CaCO_3$)	243	365	3,750	468	602
Magnesium (mg/l)	2.85	20.4	11.5	26.6	20.8
Nitrate (mg/l as N)	0.06	0.02	0.50	0.10	0.18
Potassium (mg/l)	9.60	6.80	I.S.	I.S.	I.S.
Sodium (mg/l)	151	153	I.S.	I.S.	I.S.
Dissolved solids (mg/l)	640	844	I.S.	I.S.	I.S.
Strontium (mg/l)	0.77	0.89	3.13	0.89	1.03
Sulfate (mg/l)	34	48	52	46	61
Sulfide (mg/l)	1.04	0.89	*	*	*
Metals (mg/l)					
Aluminum	1.24	0.036	*	*	*
Arsenic	0.024	0.014	0.051	<0.006	0.009
Cadmium	<0.002	<0.002	*	*	*
Copper	0.006	0.004	*	*	*
Iron	0.384	0.300	*	*	*
Lead	0.012	0.010	*	*	*
Manganese	0.005	0.012	*	*	*
Mercury	<0.0002	<0.0002	*	*	*

Note: I.S. = insufficient sample.

*Parameter not requested.

Appendix D

PUMPING TESTS

PACKER TESTING

DATA FROM PACKER TEST NO. 1 (2,737' to 2,759')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/25/77 Page 1 of 7

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Start test	0812:05	101.5	--	0	50
	0812:07	100.7	0.8	2	50
	0812:08	99.3	2.2	3	50
	0812:10	98.9	2.6	5	50
	0812:12	97.0	4.5	7	50
	0812:13	95.1	6.4	8	50
	0812:15	94.2	7.3	10	50
	0812:16	93.3	8.2	11	50
	0812:17	92.4	9.1	12	50
	0812:18	91.6	9.9	13	50
	0812:19	90.9	10.6	14	50
	0812:20	90.3	11.2	15	50
	0812:21	89.5	12.0	16	50
	0812:22	88.7	12.8	17	50
	0812:23	88.1	13.4	18	50
	0812:24	87.2	14.3	19	50
	0812:25	86.5	15.0	20	50
	0812:27	85.7	15.8	22	50
	0812:28	84.9	16.6	23	50
	0812:29	84.3	17.2	24	50
	0812:30	83.8	17.7	25	50
	0812:31	82.9	18.6	26	50
	0812:32	82.1	19.4	27	50
	0812:33	81.5	20.0	28	50
	0812:35	80.5	21.0	30	50

DATA FROM PACKER TEST NO. 1 (2,737' to 2,759')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/25/77 Page 2 of 7

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	0812:36	79.9	21.6	31	50
	0812:37	79.2	22.3	32	50
	0812:38	78.4	23.1	33	50
	0812:39	77.7	23.8	34	50
	0812:40	77.7	23.8	35	50
	0812:41	76.9	24.6	36	50
	0812:42	76.2	25.3	37	50
	0812:43	75.6	25.9	38	50
	0812:44	74.9	26.6	39	50
	0812:45	74.2	27.3	40	50
	0812:46	73.0	28.5	41	50
	0812:47	72.5	29.0	42	50
	0812:49	72.3	29.2	44	50
	0812:50	71.2	30.3	45	50
	0812:51	70.5	31.0	46	50
	0812:52	69.8	31.7	47	50
	0812:53	69.2	32.3	48	50
	0812:54	68.4	33.1	49	50
	0812:56	67.8	33.7	51	50
	0812:57	67.1	34.4	52	50
	0812:58	66.4	35.1	53	50
	0812:59	65.8	35.7	54	50
	0813:00	65.1	36.4	55	50
	0813:02	64.4	37.1	57	50
	0813:03	63.8	37.7	58	50

DATA FROM PACKER TEST NO. 1 (2,737' to 2,759')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/25/77 Page 3 of 7

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	0813:04	63.1	38.4	59	50
	0813:05	62.5	39.0	60	50
	0813:06	61.8	39.7	61	50
	0813:07	61.3	40.2	62	50
	0813:09	60.6	40.9	64	50
	0813:10	60.2	41.3	65	50
	0813:11	59.5	42.0	66	50
	0813:12	58.7	42.8	67	50
	0813:13	58.0	43.5	68	50
	0813:15	57.4	44.1	70	50
	0813:16	56.7	44.8	71	50
	0813:17	56.1	45.4	72	50
	0813:19	55.5	46.0	74	50
	0813:20	55.0	46.5	75	50
	0813:21	54.2	47.3	76	50
	0813:23	53.4	48.1	78	50
	0813:24	52.9	48.6	79	50
	0813:25	52.2	49.3	80	50
	0813:27	51.7	49.8	82	50
	0813:28	51.0	50.5	83	50
	0813:29	50.6	50.9	84	50
	0813:30	50.1	51.4	85	50
	0813:31	49.6	51.9	86	50
	0813:32	49.1	52.4	87	50
	0813:33	48.5	53.0	88	50

DATA FROM PACKER TEST NO. 1 (2,737' to 2,759)

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/25/77

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	0813:34	48.0	53.5	89	50
	0813:36	47.5	54.0	91	50
	0813:37	47.0	54.5	92	50
	0813:38	46.5	55.0	93	50
	0813:39	45.9	55.6	94	50
	0813:40	45.4	56.1	95	50
	0813:41	45.0	56.5	96	50
	0813:42	45.0	56.5	97	50
	0813:43	44.5	57.0	98	50
	0813:44	43.9	57.6	99	50
	0813:45	43.3	58.2	100	50
	0813:46	42.9	58.6	101	50
	0813:47	42.5	59.0	102	50
	0813:48	42.1	59.4	103	50
	0813:50	41.5	60.0	105	50
	0813:51	41.1	60.4	106	50
	0813:52	40.5	61.0	107	50
	0813:53	40.1	61.4	108	50
	0813:54	39.5	62.0	109	50
	0813:55	39.1	62.4	110	50
	0813:56	38.6	62.9	111	50
	0813:58	38.2	63.3	113	50
	0813:59	37.8	63.7	114	50
	0814:00	37.5	64.0	115	50
	0814:01	36.9	64.6	116	50

DATA FROM PACKER TEST NO. 1 (2,737' to 2,759')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/25/77 Page 5 of 7

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	0814:02	36.4	65.1	117	50
	0814:03	35.9	65.6	118	50
	0814:05	35.5	66.0	120	50
	0814:06	35.0	66.5	121	50
	0814:07	34.5	67.0	122	50
	0814:08	34.2	67.3	123	50
	0814:09	33.7	67.8	124	50
	0814:10	33.3	68.2	125	50
	0814:11	32.8	68.7	126	50
	0814:12	32.4	69.1	127	50
	0814:14	32.0	69.5	129	50
	0814:15	31.6	69.9	130	50
	0814:16	31.1	70.4	131	50
	0814:17	30.7	70.8	132	50
	0814:18	30.3	71.2	133	50
	0814:19	29.9	71.6	134	50
	0814:20	29.4	72.1	135	50
	0814:22	29.0	72.5	137	50
	0814:23	28.6	72.9	138	50
	0814:24	28.3	73.2	139	50
	0814:25	27.9	73.6	140	50
	0814:26	27.5	74.0	141	50
	0814:27	27.0	74.5	142	50
	0814:28	26.6	74.9	143	50
	0814:30	26.2	75.3	145	50

DATA FROM PACKER TEST NO. 1 (2,737' to 2,759')

Test Well for Deep Disposal System for Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/25/77 Page 6 of 7

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	0814:31	25.8	75.7	146	50
	0814:32	25.4	76.1	147	50
	0814:33	25.0	76.5	148	50
	0814:34	24.7	76.8	149	50
	0814:35	24.3	77.2	150	50
	0814:36	24.0	77.5	151	50
	0814:37	23.7	77.8	152	50
	0814:38	23.3	78.2	153	50
	0814:39	22.8	78.7	154	50
	0814:40	22.8	78.7	155	50
	0814:41	22.4	79.1	156	50
	0814:42	22.1	79.4	157	50
	0814:43	21.7	79.8	158	50
	0814:44	21.3	80.2	159	50
	0814:45	21.0	80.5	160	50
	0814:46	20.6	80.9	161	50
	0814:47	20.2	81.3	162	50
	0814:48	19.8	81.7	163	50
	0814:49	19.5	82.0	164	50
	0814:50	19.2	82.3	165	50
	0814:51	18.8	82.7	166	50
	0814:53	18.4	83.1	168	50
	0814:54	18.0	83.5	169	50
	0814:55	17.6	83.9	170	50
	0814:56	17.3	84.2	171	50

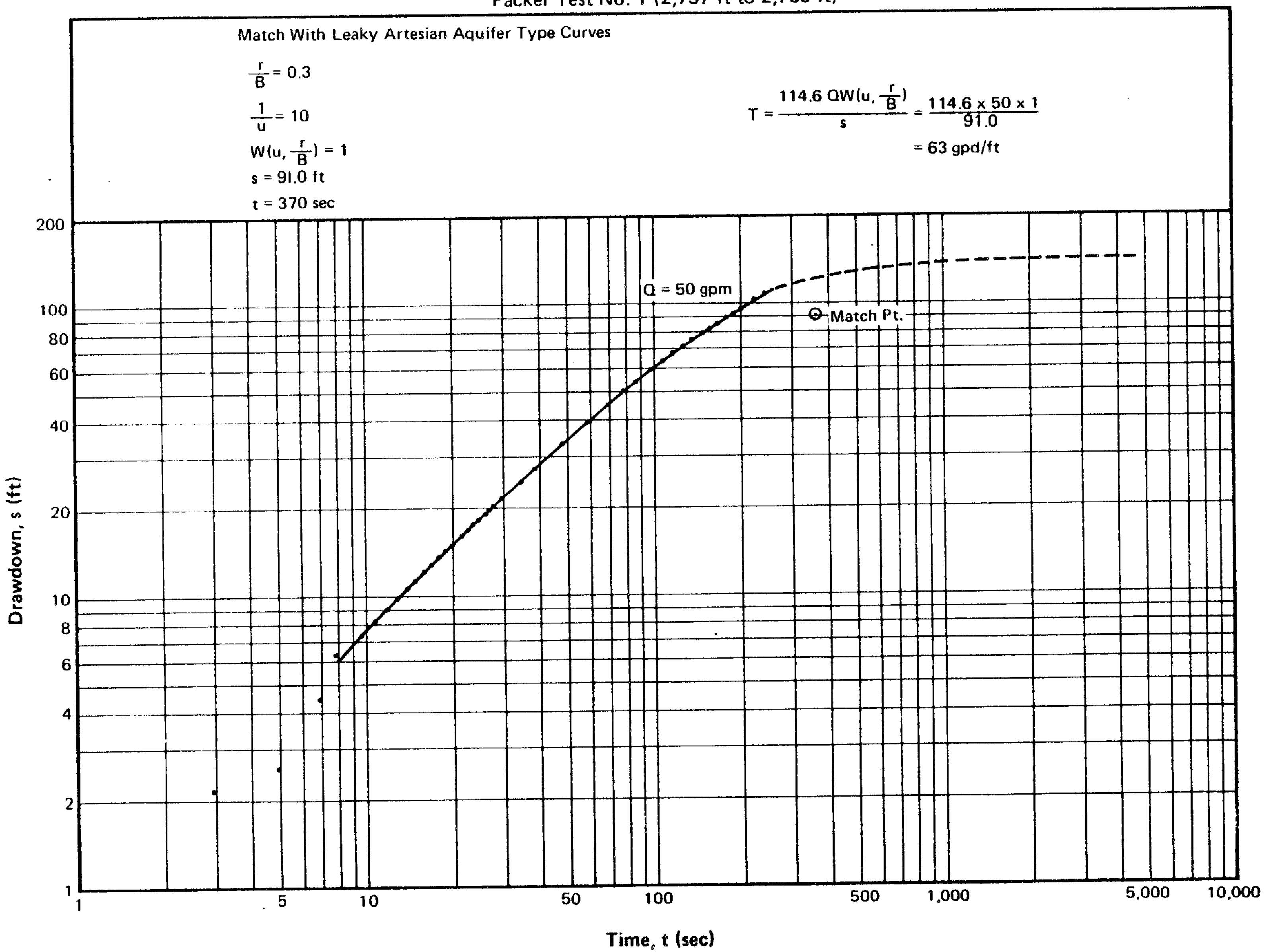
DATA FROM PACKER TEST NO. 1 (2,737' to 2,759')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/25/77 Page 7 of 7

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	0814:57	16.9	84.6	172	50
	0814:58	16.5	85.0	173	50
	0814:59	16.2	85.3	174	50
	0815:00	16.2	85.3	175	50
	0815:01	15.7	85.8	176	50
	0815:02	15.3	86.2	177	50
	0815:03	14.9	86.6	178	50
	0815:04	14.6	86.9	179	50
	0815:06	14.2	87.3	181	50
	0815:07	13.8	87.7	182	50
	0815:08	13.4	88.1	183	50
	0815:09	13.1	88.4	184	50
	0815:10	12.9	88.6	185	50
	0815:20	9.9	91.6	195	50
	0815:30	7.0	94.5	205	50
	0815:40	4.2	97.3	215	50
	0815:50	1.5	100.0	225	50
	0816:00	1.0	100.5	235	50
	0816:10	-1.9	103.4	245	50
Shut off pump	0817:10	Not recorded			

Packer Test No. 1 (2,737 ft to 2,759 ft)



Time-drawdown graph, Miami-Dade Water and Sewer Authority, test well for deep disposal system.

DATA FROM PACKER TEST NO. 2 (2,697' to 2,727')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/25/77 Page 1 of 7

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Start test	1225:10	87.5	--	0	4.4
	1225:11	87.5	0.0	1	4.4
	1225:12	87.3	0.2	2	4.4
	1225:14	86.8	0.7	4	4.4
	1225:15	87.0	0.5	5	4.4
	1225:16	86.8	0.7	6	4.4
	1225:18	86.6	0.9	8	4.4
	1225:19	86.5	1.0	9	4.4
	1225:20	86.6	0.9	10	4.4
	1225:21	86.6	0.9	11	4.4
	1225:23	86.7	0.8	13	4.4
	1225:25	86.4	1.1	15	4.4
	1225:26	86.3	1.2	16	4.4
	1225:28	86.3	1.2	18	4.4
	1225:30	86.5	1.0	20	4.4
	1225:31	86.3	1.2	21	4.4
	1225:35	86.0	1.5	25	4.4
	1225:36	86.1	1.4	26	4.4
	1225:37	86.0	1.5	27	4.4
	1225:39	85.9	1.6	29	4.4
	1225:40	85.9	1.6	30	4.4
	1225:42	85.7	1.8	32	4.4
	1225:43	85.7	1.8	33	4.4
	1225:45	85.8	1.7	35	4.4
	1225:46	85.6	1.9	36	4.4

DATA FROM PACKER TEST NO. 2 (2,697' to 2,727')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/25/77 Page 2 of 7

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	1225:48	85.6	1.9	38	4.4
	1225:49	85.4	2.1	39	4.4
	1225:50	85.4	2.1	40	4.4
	1225:51	85.2	2.3	41	4.4
	1225:53	85.4	2.1	43	4.4
	1225:54	85.2	2.3	44	4.4
	1225:55	85.2	2.3	45	4.4
	1225:57	85.3	2.2	47	4.4
	1225:58	85.2	2.3	48	4.4
	1226:00	85.0	2.5	50	4.1
	1226:10	84.9	2.6	60	4.1
	1226:20	84.4	3.1	70	4.1
	1226:30	84.0	3.5	80	4.1
	1226:40	84.0	3.5	90	4.1
	1226:50	83.4	4.1	100	4.1
	1227:00	83.1	4.4	110	4.1
	1227:10	83.2	4.3	120	4.1
	1227:20	82.8	4.7	130	4.1
	1227:30	82.7	4.8	140	4.1
	1227:40	82.4	5.1	150	4.1
	1227:50	82.1	5.4	160	4.1
	1228:00	82.1	5.4	170	4.1
	1228:10	81.8	5.7	180	4.1
	1228:20	81.6	5.9	190	4.1
	1228:30	81.4	6.1	200	4.1

DATA FROM PACKER TEST NO. 2 (2,697' to 2,727')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/25/77 Page 3 of 7

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	1228:40	81.4	6.1	210	4.1
	1228:50	81.3	6.2	220	4.1
	1229:00	80.7	6.8	230	4.1
	1229:10	80.8	6.7	240	4.1
	1229:20	80.8	6.7	250	4.1
	1229:30	80.8	6.7	260	4.1
	1229:40	80.4	7.1	270	4.1
	1229:50	80.2	7.3	280	4.1
	1230:00	80.1	7.4	290	4.1
	1230:10	80.0	7.5	300	4.1
	1230:20	79.8	7.7	310	4.1
	1230:30	79.8	7.7	320	4.1
	1230:40	79.7	7.8	330	4.1
	1230:50	79.6	7.9	340	4.1
	1231:00	79.5	8.0	350	4.1
	1231:10	79.4	8.1	360	4.1
	1231:20	79.3	8.2	370	4.1
	1231:30	79.3	8.2	380	4.1
	1231:40	79.2	8.3	390	4.1
	1231:50	79.3	8.2	400	4.1
	1232:00	79.1	8.4	410	4.1
	1232:10	79.1	8.4	420	4.1
	1232:20	78.7	8.8	430	4.1
	1232:30	78.7	8.8	440	4.1
	1232:40	79.0	8.5	450	4.1

DATA FROM PACKER TEST NO. 2 (2,697' to 2,727')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/25/77 Page 4 of 7

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	1232:50	78.8	8.7	460	4.1
	1233:00	78.7	8.8	470	4.1
	1233:10	78.6	8.9	480	4.1
	1233:20	78.5	9.0	490	4.1
	1233:30	78.8	8.7	500	4.1
	1233:40	78.4	9.1	510	4.1
	1233:50	78.4	9.1	520	4.1
	1234:00	78.4	9.1	530	4.1
	1234:10	78.4	9.1	540	4.1
	1234:20	78.4	9.1	550	4.1
	1234:30	78.0	9.5	560	4.1
	1234:40	78.2	9.3	570	4.1
	1234:50	78.2	9.3	580	4.1
	1235:00	78.2	9.3	590	4.1
	1235:10	78.1	9.4	600	4.1
	1235:40	78.1	9.4	630	4.1
	1236:10	77.9	9.6	660	4.1
	1236:40	77.8	9.7	690	4.1
	1237:10	77.9	9.6	720	4.1
	1237:40	77.9	9.6	750	4.1
	1238:10	77.6	9.9	780	4.1
	1238:40	77.7	9.8	810	4.1
	1239:10	77.5	10.0	840	4.1
	1239:40	77.6	9.9	870	4.1
	1240:10	77.4	10.1	900	4.1

DATA FROM PACKER TEST NO. 2 (2,697' to 2,727')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/25/77 Page 5 of 7

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	1240:40	77.3	10.2	930	4.1
	1241:00	77.3	10.2	950	4.1
	1242:00	77.3	10.2	1,010	4.1
	1243:00	77.2	10.3	1,070	4.1
	1244:00	77.4	10.1	1,130	4.1
	1245:00	77.2	10.3	1,190	4.1
	1250:00	77.0	10.5	1,490	4.1
	1254:00	76.8	10.7	1,730	4.1
	1300:00	76.5	11.0	2,090	3.6
Adjust pump to 4.4 gpm	1310:00	76.1	11.4	2,690	4.4
	1317:03	73.6	13.9	3,113	4.4
	1320:00	73.8	13.7	3,290	4.4
	1330:00	74.0	13.5	3,890	4.4
	1340:00	74.3	13.2	4,490	4.4
	1350:00	74.2	13.3	5,090	4.4
Adjust pump to 7.9 gpm	1353:00	74.1	13.4	5,270	7.9
	1353:10	73.8	13.7	5,280	7.9
	1353:20	73.5	14.0	5,290	7.9
	1353:30	72.9	14.6	5,300	7.9
	1353:40	72.4	15.1	5,310	7.9
	1353:50	72.1	15.4	5,320	7.9
	1354:00	71.6	15.9	5,330	7.9
	1355:00	69.6	17.9	5,390	7.9
	1356:00	68.2	19.3	5,450	7.9
	1357:00	66.9	20.6	5,510	7.9

DATA FROM PACKER TEST NO. 2 (2,697' to 2,727')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/25/77 Page 6 of 7

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	1358:00	66.0	21.5	5,570	7.9
	1359:00	65.4	22.1	5,630	7.9
	1400:00	64.8	22.7	5,690	7.9
	1401:00	64.4	23.1	5,750	7.9
	1402:00	64.0	23.5	5,810	7.9
	1403:00	63.8	23.7	5,870	7.9
	1404:00	63.5	24.0	5,930	7.9
	1405:00	63.5	24.0	5,990	7.9
	1410:00	63.2	24.3	6,290	7.9
	1415:00	63.1	24.4	6,590	7.9
	1420:00	63.0	24.5	6,890	7.9
Adjust pump to 23 gpm	1424:00	63.0	24.5	7,130	23.0
	1424:10	61.9	25.6	7,140	23.0
	1424:20	60.1	27.4	7,150	23.0
	1424:30	58.6	28.9	7,160	23.0
	1424:40	57.0	30.5	7,170	23.0
	1424:50	55.7	31.8	7,180	23.0
	1425:00	54.3	33.2	7,190	23.0
	1425:30	50.5	37.0	7,220	23.0
	1426:00	47.1	40.4	7,250	23.0
	1426:30	44.1	43.4	7,280	23.0
	1427:00	41.5	46.0	7,310	23.0
	1427:30	39.0	48.5	7,340	23.0
	1428:00	36.9	50.6	7,370	23.0
	1429:00	33.3	54.2	7,430	23.0

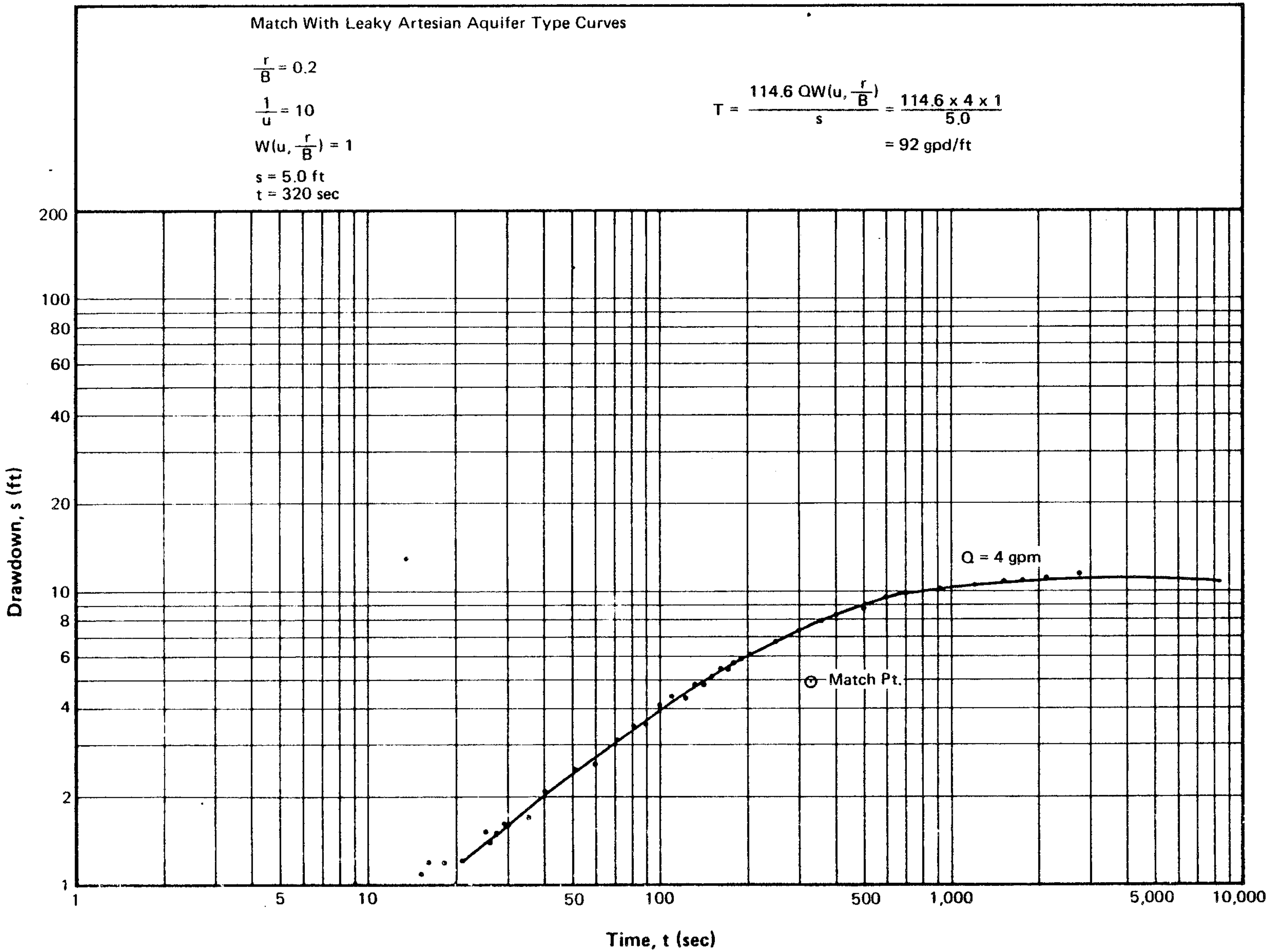
DATA FROM PACKER TEST NO. 2 (2,697' to 2,727')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/25/77 Page 7 of 7

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	1430:00	30.3	57.2	7,490	23.0
	1431:00	28.1	59.4	7,550	23.0
	1432:00	26.2	61.3	7,610	23.0
	1433:00	24.7	62.8	7,670	23.0
	1434:00	23.6	63.9	7,730	23.0
	1435:00	22.6	64.9	7,790	23.0
	1440:00	19.8	67.7	8,090	23.0
	1445:00	19.0	68.5	8,390	23.0
	1450:00	19.1	68.4	8,690	23.0
	1455:00	19.2	68.3	8,990	23.0
	1500:00	19.2	68.3	9,290	23.0
	1510:00	19.5	68.0	9,890	23.0
	1520:00	20.0	67.5	10,490	23.0
Shut pump off	1538:00	20.3	67.2	11,570	24.7

Packer Test No. 2 (2,697 ft to 2,727 ft)



Time-drawdown graph, Miami-Dade Water and Sewer Authority, test well for deep disposal system.

DATA FROM PACKER TEST NO. 3 (2,367' to 2,397')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/25-26 1977 Page 1 of 18

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Start test (part 1)	2317:20	90.1	--	0	12.8
	2317:22	88.5	1.6	2	12.8
	2317:23	88.3	1.8	3	12.8
	2317:25	88.5	1.6	5	12.8
	2317:26	88.2	1.9	6	12.8
	2317:28	88.2	1.9	8	12.8
	2317:29	88.2	1.9	9	12.8
	2317:30	88.3	1.8	10	12.8
	2317:31	88.0	2.1	11	12.8
	2317:32	88.0	2.1	12	12.8
	2317:33	88.0	2.1	13	12.8
	2317:35	88.0	2.1	15	12.8
	2317:36	88.0	2.1	16	12.8
	2317:37	87.9	2.2	17	12.8
	2317:38	87.9	2.2	18	12.8
	2317:39	87.7	2.4	19	12.8
	2317:40	87.8	2.3	20	12.8
	2317:41	87.7	2.4	21	12.8
	2317:42	87.5	2.6	22	12.8
	2317:43	87.6	2.5	23	12.8
	2317:44	87.7	2.4	24	12.8
	2317:45	87.7	2.4	25	12.8
	2317:46	87.3	2.8	26	12.8
	2317:47	87.5	2.6	27	12.8
	2317:48	87.4	2.7	28	12.8

DATA FROM PACKER TEST NO. 3 (2,367' to 2,397')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/26-27 1977 Page 2 of 18

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	2317:50	86.9	3.2	30	12.8
	2317:51	87.9	2.2	31	12.8
	2317:52	87.2	2.9	32	12.8
	2317:53	86.8	3.3	33	12.8
	2317:54	87.0	3.1	34	12.8
	2317:55	87.3	2.8	35	12.8
	2317:56	86.9	3.2	36	12.8
	2317:57	86.8	3.3	37	12.8
	2317:58	86.9	3.2	38	12.8
	2317:59	86.9	3.2	39	12.8
	2318:00	86.7	3.4	40	12.8
	2318:01	86.7	3.4	41	12.8
	2318:02	86.8	3.3	42	12.8
	2318:03	86.7	3.4	43	12.8
	2318:04	86.7	3.4	44	12.8
	2318:05	86.6	3.5	45	12.8
	2318:06	86.6	3.5	46	12.8
	2318:07	86.4	3.7	47	12.8
	2318:08	86.7	3.4	48	12.8
	2318:09	86.4	3.7	49	12.8
	2318:10	86.2	3.9	50	12.8
	2318:11	86.2	3.9	51	12.8
	2318:12	86.1	4.0	52	12.8
	2318:13	86.3	3.8	53	12.8
	2318:14	86.1	4.0	54	12.8

DATA FROM PACKER TEST NO. 3 (2,367' to 2,397')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/26/27 1977 Page 3 of 18

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	2318:15	86.0	4.1	55	12.8
	2318:16	86.1	4.0	56	12.8
	2318:17	86.1	4.0	57	12.8
	2318:18	86.0	4.1	58	12.8
	2318:19	86.0	4.1	59	12.8
	2318:20	85.8	4.3	60	12.8
	2318:21	85.9	4.2	61	12.8
	2318:22	85.8	4.3	62	12.8
	2318:23	85.6	4.5	63	12.8
	2318:24	85.7	4.4	64	12.8
	2318:25	85.5	4.6	65	12.8
	2318:26	85.6	4.5	66	12.8
	2318:27	85.6	4.5	67	12.8
	2318:28	85.4	4.7	68	12.8
	2318:29	85.5	4.6	69	12.8
	2318:30	85.4	4.7	70	12.8
	2318:31	85.4	4.7	71	12.8
	2318:32	85.3	4.8	72	12.8
	2318:33	85.2	4.9	73	12.8
	2318:34	85.3	4.8	74	12.8
	2318:35	85.3	4.8	75	12.8
	2318:36	85.2	4.9	76	12.8
	2318:37	85.2	4.9	77	12.8
	2318:38	85.1	5.0	78	12.8
	2318:39	85.1	5.0	79	12.8

DATA FROM PACKER TEST NO. 3 (2,367' to 2,397')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/26-27 1977 Page 4 of 18

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	2318:41	85.0	5.1	81	12.8
	2318:42	85.1	5.0	82	12.8
	2318:43	85.2	4.9	83	12.8
	2318:44	84.9	5.2	84	12.8
	2318:45	84.9	5.2	85	12.8
	2318:46	85.1	5.0	86	12.8
	2318:47	84.9	5.2	87	12.8
	2318:48	85.0	5.1	88	12.8
	2318:49	84.9	5.2	89	12.8
	2318:50	84.8	5.3	90	12.8
	2318:51	84.6	5.5	91	12.8
	2318:52	84.5	5.6	92	12.8
	2318:53	84.6	5.5	93	12.8
	2318:54	84.5	5.6	94	12.8
	2318:55	84.6	5.5	95	12.8
	2318:56	84.6	5.5	96	12.8
	2318:57	84.5	5.6	97	12.8
	2318:58	84.4	5.7	98	12.8
	2318:59	84.3	5.8	99	12.8
	2319:00	84.3	5.8	100	12.8
	2319:10	83.9	6.2	110	12.8
	2319:20	83.4	6.7	120	12.8
	2319:30	83.0	7.1	130	12.8
	2319:40	82.5	7.6	140	12.8
	2319:50	82.1	8.0	150	12.8

DATA FROM PACKER TEST NO. 3 (2,367' to 2,397')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/26-27 1977 Page 5 of 18

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	2320:00	81.6	8.5	160	12.8
	2320:10	80.9	9.2	170	12.8
	2320:20	80.6	9.5	180	12.8
	2320:30	80.5	9.6	190	12.8
	2320:40	80.0	10.1	200	12.8
	2320:50	79.7	10.4	210	12.8
	2321:00	79.7	10.4	220	12.8
	2321:10	79.5	10.6	230	12.8
	2321:20	79.4	10.7	240	12.8
	2321:30	79.2	10.9	250	12.8
	2321:40	79.1	11.0	260	12.8
	2321:50	79.0	11.1	270	12.8
	2322:00	79.0	11.1	280	12.8
	2322:10	79.0	11.1	290	12.8
	2322:20	79.0	11.1	300	12.8
	2322:30	78.7	11.4	310	12.8
	2322:40	78.5	11.6	320	12.8
	2322:50	78.5	11.6	330	12.8
	2323:00	78.3	11.8	340	12.8
	2323:10	78.2	11.9	350	12.8
	2323:20	78.3	11.8	360	12.8
	2323:30	78.1	12.0	370	12.8
	2323:40	77.9	12.2	380	12.8
	2323:50	78.0	12.1	390	12.8
	2324:00	77.9	12.2	400	12.8

DATA FROM PACKER TEST NO. 3 (2,367' to 2,397')

Test Well for Deep Disposal System for
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Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	2324:10	78.0	12.1	410	12.8
	2324:20	77.7	12.4	420	12.8
	2324:30	77.7	12.4	430	12.8
	2324:40	77.6	12.5	440	12.8
	2324:50	77.7	12.4	450	12.8
	2325:00	77.5	12.6	460	12.8
	2325:10	77.4	12.7	470	12.8
	2325:20	77.2	12.9	480	12.8
	2325:30	77.1	13.0	490	12.8
	2325:40	77.2	12.9	500	12.8
	2325:50	77.1	13.0	510	12.8
	2326:00	77.0	13.1	520	12.8
	2326:10	76.9	13.2	530	12.8
	2326:20	77.2	12.9	540	12.8
	2326:30	76.8	13.3	550	12.8
	2326:40	76.8	13.3	560	12.8
	2326:50	76.8	13.3	570	12.8
	2327:00	76.8	13.3	580	12.8
	2327:10	76.7	13.4	590	12.8
	2327:20	76.6	13.5	600	12.8
	2327:30	76.7	13.4	610	12.8
	2327:40	76.3	13.8	620	12.8
	2327:50	76.4	13.7	630	12.8
	2328:00	76.3	13.8	640	12.8
	2328:10	76.3	13.8	650	12.8

DATA FROM PACKER TEST NO. 3 (2,367' to 2,397')

Test Well for Deep Disposal System for
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Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	2328:20	76.4	13.7	660	12.8
	2328:30	76.2	13.9	670	12.8
	2328:40	76.3	13.8	680	12.8
	2328:50	76.1	14.0	690	12.8
	2329:00	76.1	14.0	700	12.8
	2329:10	76.2	13.9	710	12.8
	2329:20	76.1	14.0	720	12.8
	2329:30	76.1	14.0	730	12.8
	2329:35	76.0	14.1	740	12.8
	2329:40	75.9	14.2	750	12.8
	2329:50	75.9	14.2	760	12.8
	2330:00	75.9	14.2	770	12.8
	2330:10	75.9	14.2	780	12.8
	2330:20	75.9	14.2	790	12.8
	2330:30	75.7	14.4	800	12.8
	2330:40	75.8	14.3	810	12.8
	2330:50	75.7	14.4	820	12.8
	2331:00	75.6	14.5	830	12.8
	2331:10	75.7	14.4	840	12.8
	2331:20	75.7	14.4	850	12.8
	2331:30	75.6	14.5	860	12.8
	2331:40	75.6	14.5	870	12.8
	2331:50	75.6	14.5	880	12.8
	2332:00	75.9	14.2	890	12.8
	2332:10	75.7	14.4	900	12.8

DATA FROM PACKER TEST NO. 3 (2,367' to 2,397')

Test Well for Deep Disposal System for
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Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	2332:20	75.4	14.7	910	12.8
	2332:30	75.6	14.5	920	12.8
	2332:40	75.7	14.4	930	12.8
	2332:50	75.5	14.6	940	12.8
	2333:00	75.6	14.5	950	12.8
	2333:10	75.6	14.5	960	12.8
	2333:20	75.5	14.6	970	12.8
	2333:30	75.4	14.7	980	12.8
	2333:40	75.7	14.4	990	12.8
	2333:50	75.6	14.5	1,000	12.8
	2334:00	75.5	14.6	1,010	12.8
	2334:10	75.4	14.7	1,020	12.8
	2334:20	75.4	14.7	1,030	12.8
	2334:30	75.4	14.7	1,040	12.8
	2334:40	75.5	14.6	1,050	12.8
	2334:50	75.3	14.8	1,060	12.8
	2335:00	75.2	14.9	1,070	12.8
	2335:10	75.3	14.8	1,080	12.8
	2335:20	75.3	14.8	1,090	12.8
	2335:30	75.4	14.7	1,100	12.8
	2335:40	75.3	14.8	1,110	12.8
	2335:50	75.3	14.8	1,120	12.8
	2336:00	75.5	14.6	1,130	12.8
	2336:10	75.4	14.7	1,140	12.8
	2336:20	75.5	14.6	1,150	12.8

DATA FROM PACKER TEST NO. 3 (2,367' to 2,397')

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Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	2336:30	75.4	14.7	1,160	12.8
	2336:40	75.4	14.7	1,170	12.8
	2336:50	75.4	14.7	1,180	12.8
	2337:00	75.4	14.7	1,190	12.8
	2337:10	75.4	14.7	1,200	12.8
	2337:20	75.5	14.6	1,210	12.8
	2337:30	75.4	14.7	1,220	12.8
	2337:40	75.6	14.5	1,230	12.8
	2337:50	75.5	14.6	1,240	12.8
	2338:00	75.6	14.5	1,250	12.8
	2338:10	75.4	14.7	1,260	12.8
	2338:20	75.5	14.6	1,270	12.8
	2338:30	75.5	14.6	1,280	12.8
	2338:40	75.5	14.6	1,290	12.8
	2338:50	75.4	14.7	1,300	12.8
	2339:00	75.5	14.6	1,310	12.8
	2339:10	75.4	14.7	1,320	12.8
	2339:20	75.6	14.5	1,330	12.8
	2339:30	75.4	14.7	1,340	12.8
	2339:40	75.5	14.6	1,350	12.8
	2339:50	75.6	14.5	1,360	12.8
	2340:00	75.5	14.6	1,370	12.8
	2340:10	75.6	14.5	1,380	12.8
	2340:20	75.5	14.6	1,390	12.8
	2340:30	75.5	14.6	1,400	12.8

DATA FROM PACKER TEST NO. 3 (2,367' to 2,397')

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Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	2340:40	75.4	14.7	1,410	12.8
	2340:50	75.6	14.5	1,420	12.8
	2341:00	75.6	14.5	1,430	12.8
	2341:10	75.6	14.5	1,440	12.8
	2341:20	75.7	14.4	1,450	12.8
	2341:30	75.4	14.7	1,460	12.8
	2342:00	75.5	14.6	1,490	12.8
	2343:00	75.6	14.5	1,550	12.8
	2344:00	75.6	14.5	1,610	12.8
	2345:00	75.5	14.6	1,670	12.8
	2346:00	75.7	14.4	1,730	12.8
	2347:00	75.7	14.4	1,790	12.8
	2348:00	75.6	14.5	1,850	12.8
	2349:00	75.5	14.6	1,910	12.8
	2350:00	75.7	14.4	1,970	12.8
	2351:00	75.7	14.4	2,030	12.8
	2352:00	75.6	14.5	2,090	12.8
	2353:00	75.7	14.4	2,150	12.8
	2354:00	75.5	14.6	2,210	12.8
	2355:00	75.7	14.4	2,270	12.8
	2356:00	75.7	14.4	2,330	12.8
	2357:00	75.7	14.4	2,390	12.8
	2358:00	75.7	14.4	2,450	12.8
Pump shut off	2359:00	75.7	14.4	2,510	12.8
Start test (part 2)	0031:13	82.5	--	0	24.5

DATA FROM PACKER TEST NO. 3 (2,367' to 2,397')

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Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	0031:14	81.4	1.1	1	24.5
	0031:15	82.5	0.0	2	24.5
	0031:16	82.0	0.5	3	24.5
	0031:17	81.4	1.1	4	24.5
	0031:18	81.6	0.9	5	24.5
	0031:19	81.5	1.0	6	24.5
	0031:20	81.8	0.7	7	24.5
	0031:21	81.0	1.5	8	24.5
	0031:22	81.0	1.5	9	24.5
	0031:23	81.1	1.4	10	24.5
	0031:24	80.8	1.7	11	24.5
	0031:25	80.7	1.8	12	24.5
	0031:26	80.6	1.9	13	24.5
	0031:27	80.4	2.1	14	24.5
	0031:28	80.4	2.1	15	24.5
	0031:29	80.1	2.4	16	24.5
	0031:30	80.0	2.5	17	24.5
	0031:31	79.9	2.6	18	24.5
	0031:32	79.9	2.6	19	24.5
	0031:33	79.7	2.8	20	24.5
	0031:34	79.5	3.0	21	24.5
	0031:35	79.4	3.1	22	24.5
	0031:36	79.1	3.4	23	24.5
	0031:37	79.1	3.4	24	24.5
	0031:38	79.1	3.4	25	24.5

DATA FROM PACKER TEST NO. 3 (2,367' to 2,397')

Test Well for Deep Disposal System for
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Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	0031:39	79.0	3.5	26	24.5
	0031:40	79.0	3.5	27	24.5
	0031:41	79.0	3.5	28	24.5
	0031:42	79.0	3.5	29	24.5
	0031:43	78.8	3.7	30	24.5
	0031:44	78.7	3.8	31	24.5
	0031:45	78.0	4.5	32	24.5
	0031:46	78.2	4.3		24.5
	0031:46	77.9	4.6	33	24.5
	0031:47	77.7	4.8	34	24.5
	0031:48	77.9	4.6	35	24.5
	0031:49	77.6	4.9	36	24.5
	0031:50	77.4	5.1	37	24.5
	0031:51	77.2	5.3	38	24.5
	0031:52	76.9	5.6	39	24.5
	0031:53	76.7	5.8	40	24.5
	0031:54	76.6	5.9	41	24.5
	0031:55	76.4	6.1	42	24.5
	0031:56	76.3	6.2	43	24.5
	0031:57	76.2	6.3	44	24.5
	0031:58	76.0	6.5	45	24.5
	0031:59	75.9	6.6	46	24.5
	0032:00	75.7	6.8	47	24.5
	0032:01	75.5	7.0	48	24.5
	0032:02	75.3	7.2	49	24.5

DATA FROM PACKER TEST NO. 3 (2,367' to 2,397')

Test Well for Deep Disposal System for
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Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	0032:03	75.2	7.3	50	24.5
	0032:04	74.9	7.6	51	24.5
	0032:05	74.7	7.8	52	24.5
	0032:06	74.7	7.8	53	24.5
	0032:07	74.5	8.0	54	24.5
	0032:08	74.4	8.1	55	24.5
	0032:09	74.2	8.3	56	24.5
	0032:10	74.1	8.4	57	24.5
	0032:11	74.0	8.5	58	24.5
	0032:12	73.9	8.6	59	24.5
	0032:13	73.7	8.8	60	24.5
	0032:14	73.5	9.0	61	24.5
	0032:15	73.4	9.1	62	24.5
	0032:16	73.4	9.1	63	24.5
	0032:17	73.3	9.2	64	24.5
	0032:18	73.3	9.2	65	24.5
	0032:19	73.1	9.4	66	24.5
	0032:20	73.1	9.4	67	24.5
	0032:21	72.8	9.7	68	24.5
	0032:22	72.6	9.9	69	24.5
	0032:23	72.6	9.9	70	24.5
	0032:24	72.5	10.0	71	24.5
	0032:25	72.3	10.2	72	24.5
	0032:26	72.3	10.2	73	24.5
	0032:27	72.4	10.1	74	24.5

DATA FROM PACKER TEST NO. 3 (2,367' to 2,397')

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Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	0032:28	72.1	10.4	75	24.5
	0032:29	72.0	10.5	76	24.5
	0032:30	71.9	10.6	77	24.5
	0032:31	71.8	10.7	78	24.5
	0032:32	71.7	10.8	79	24.5
	0032:33	71.6	10.9	80	24.5
	0032:34	71.6	10.9	81	24.5
	0032:35	71.4	11.1	82	24.5
	0032:36	71.4	11.1	83	24.5
	0032:37	70.9	11.6	84	24.5
	0032:38	71.1	11.4	85	24.5
	0032:39	71.1	11.4	86	24.5
	0032:40	71.1	11.4	87	24.5
	0032:41	71.0	11.5	88	24.5
	0032:42	70.8	11.7	89	24.5
	0032:43	70.8	11.7	90	24.5
	0032:44	70.6	11.9	91	24.5
	0032:45	70.5	12.0	92	24.5
	0032:46	70.3	12.2	93	24.5
	0032:47	70.3	12.2	94	24.5
	0032:48	70.3	12.2	95	24.5
	0032:49	70.2	12.3	96	24.5
	0032:50	70.1	12.4	97	24.5
	0032:51	69.9	12.6	98	24.5
	0032:52	69.9	12.6	99	24.5

DATA FROM PACKER TEST NO. 3 (2,367' to 2,397')

Test Well for Deep Disposal System for
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Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	0032:53	70.0	12.5	100	24.5
	0032:54	70.0	12.5	101	24.5
	0032:55	69.8	12.7	102	24.5
	0032:56	69.7	12.8	103	24.5
	0032:57	69.7	12.8	104	24.5
	0032:58	69.6	12.9	105	24.5
	0032:59	69.5	13.0	106	24.5
	0033:00	69.5	13.0	107	24.5
	0033:10	69.0	13.5	117	24.5
	0033:20	68.3	14.2	127	24.5
	0033:30	67.9	14.6	137	24.5
	0033:40	67.5	15.0	147	24.5
	0033:50	67.0	15.5	157	24.5
	0034:00	66.9	15.6	167	24.5
	0034:10	66.6	15.9	177	24.5
	0034:20	66.3	16.2	187	24.5
	0034:30	66.0	16.5	197	24.5
	0034:40	65.9	16.6	207	24.5
	0034:50	65.7	16.8	217	24.5
	0035:00	65.7	16.8	227	24.5
	0035:10	65.5	17.0	237	24.5
	0035:20	65.3	17.2	247	24.5
	0035:30	65.2	17.3	257	24.5
	0035:40	65.1	17.4	267	24.5
	0035:50	65.0	17.5	277	24.5

DATA FROM PACKER TEST NO. 3 (2,367' to 2,397')

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Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	0036:00	65.2	17.3	287	24.5
	0036:10	65.0	17.5	297	24.5
	0036:20	64.9	17.6	307	24.5
	0036:30	64.9	17.6	317	24.5
	0036:40	65.0	17.5	327	24.5
	0036:50	64.9	17.6	337	24.5
	0037:00	64.9	17.6	347	24.5
	0037:10	64.8	17.7	357	24.5
	0037:20	64.8	17.7	367	24.5
	0037:30	64.8	17.7	377	24.5
	0037:40	64.8	17.7	387	24.5
	0037:50	64.7	17.8	397	24.5
	0038:00	64.8	17.7	407	24.5
	0038:10	64.8	17.7	417	24.5
	0038:20	64.7	17.8	427	24.5
	0038:30	64.7	17.8	437	24.5
	0038:40	64.7	17.8	447	24.5
	0038:50	64.7	17.8	457	24.5
	0039:00	64.7	17.8	467	24.5
	0040:00	64.7	17.8	527	24.5
	0041:00	64.8	17.7	587	24.5
	0042:00	64.7	17.8	647	24.5
	0043:00	65.0	17.5	707	24.5
	0044:00	64.7	17.8	767	24.5
	0045:00	64.9	17.6	827	24.5

DATA FROM PACKER TEST NO. 3 (2,367' to 2,397')

Test Well for Deep Disposal System for
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Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	0046:00	64.8	17.7	887	24.5
	0047:00	65.1	17.4	947	24.5
	0048:00	65.0	17.5	1,007	24.5
	0049:00	65.3	17.2	1,067	24.5
	0050:00	65.2	17.3	1,127	24.5
	0051:00	65.5	17.0	1,187	24.5
	0052:00	65.5	17.0	1,247	24.5
	0053:00	65.7	16.8	1,307	24.5
	0054:00	65.7	16.8	1,367	24.5
	0055:00	65.6	16.9	1,427	24.5
	0056:00	65.8	16.7	1,487	24.5
	0057:00	66.0	16.5	1,547	24.5
	0058:00	65.9	16.6	1,607	24.5
	0059:00	66.2	16.3	1,667	24.5
	0100:00	65.9	16.6	1,727	24.5
	0101:00	66.0	16.5	1,787	24.5
	0102:00	66.1	16.4	1,847	24.5
	0102:00	66.1	16.4		24.5
	0110:00	65.2	17.3	2,327	24.5
	0120:00	67.0	15.5	2,927	24.5
	0130:00	68.3	14.2	3,527	24.5
	0140:00	69.6	12.9	4,127	24.5
	0150:00	69.6	12.9	4,727	24.5
	0200:00	69.7	12.8	5,327	24.5
	0210:00	70.2	12.3	5,927	24.5

DATA FROM PACKER TEST NO. 3 (2,367' to 2,397')

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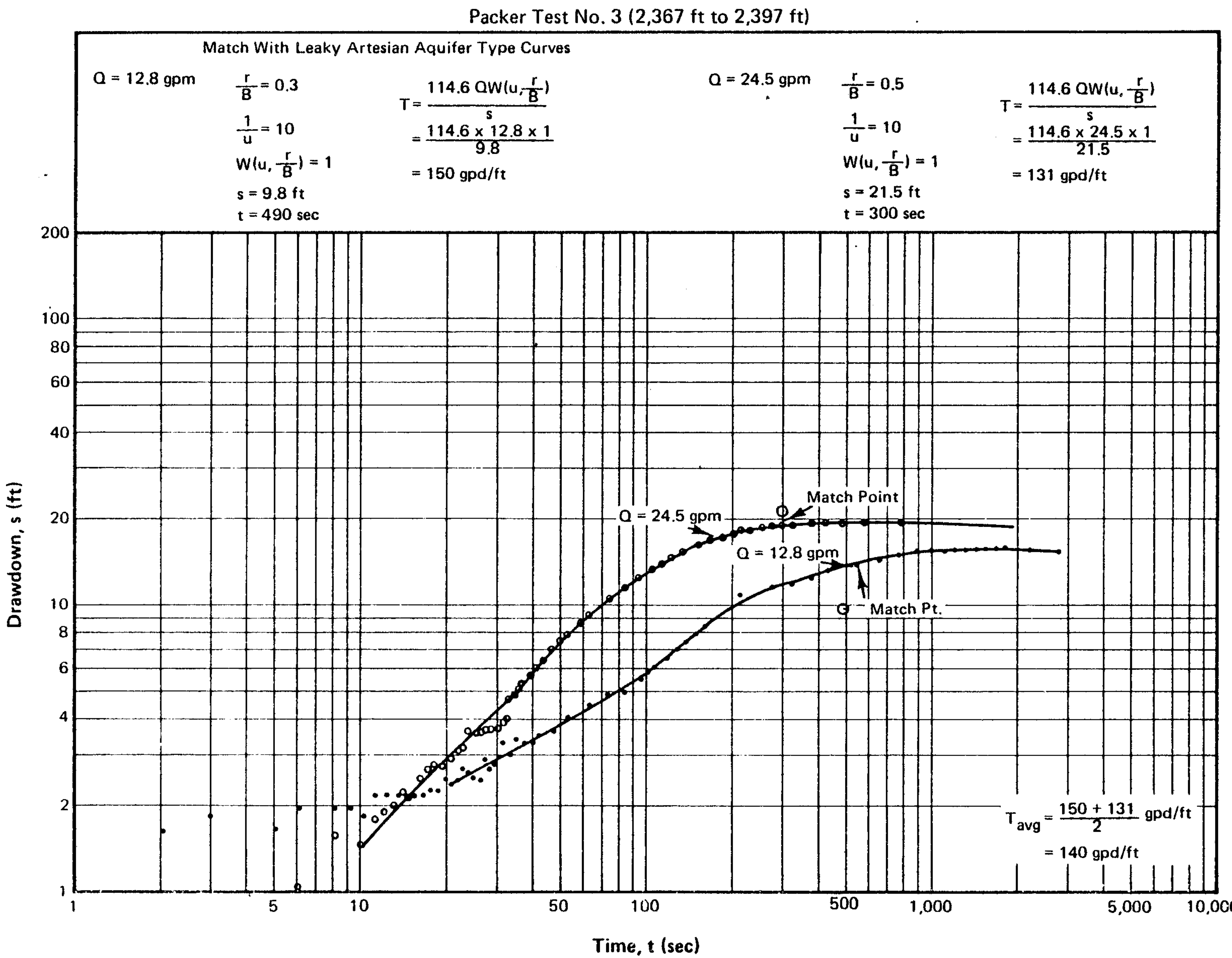
Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	0220:00	70.2	12.3	6,527	24.5
	0230:00	70.6	11.9	7,127	24.5
	0240:00	70.9	11.6	7,727	24.5
	0250:00	70.6	11.9	8,327	24.5
	0300:00	70.9	11.6	8,927	24.5
	0307:00	71.1	11.4	9,347	24.5
	0308:00	71.1	11.4	9,407	24.5
	0309:00	71.2	11.3	9,467	24.5
Pump shut off	0309:01	71.0	11.5	9,468	24.5



Time-drawdown graph, Miami-Dade Water and Sewer Authority, test well for deep disposal system.

DATA FROM PACKER TEST NO. 4 (2,407' to 2,759')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/26/77

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Start test	0747:00	89.2	--	0	61
	0747:01	88.2	1.0	1	61
	0747:02	88.2	1.0	2	61
	0747:03	87.9	1.3	3	61
	0747:04	86.1	3.1	4	61
	0747:05	85:8	3.4	5	61
	0747:06	85.0	4.2	6	61
	0747:07	84.7	4.5	7	61
	0747:08	81.8	7.4	8	61
	0747:09	82.5	6.7	9	61
	0747:10	81.9	7.3	10	61
	0747:11	81.0	8.2	11	61
	0747:12	80.4	8.8	12	61
	0747:13	79.7	9.5	13	61
	0747:14	79.2	10.0	14	61
	0747:15	79.3	9.9	15	61
	0747:16	78.3	10.9	16	61
	0747:17	78.3	10.9	17	61
	0747:18	77.7	11.5	18	61
	0747:19	77.3	11.9	19	61
	0747:20	77.3	11.9	20	61
	0747:21	76.5	12.7	21	61
	0747:22	75.8	13.4	22	61
	0747:23	75.7	13.5	23	61
	0747:24	75.5	13.7	24	61

DATA FROM PACKER TEST NO. 4 (2,407' to 2,759')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/26/77 Page 2 of 10

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	0747:25	75.1	14.1	25	61
	0747:26	74.8	14.4	26	61
	0747:27	74.4	14.8	27	61
	0747:28	74.1	15.1	28	61
	0747:29	73.9	15.3	29	61
	0747:30	73.6	15.6	30	61
	0747:31	73.2	16.0	31	61
	0747:32	73.1	16.1	32	61
	0747:33	72.9	16.3	33	61
	0747:34	72.4	16.8	34	61
	0747:35	72.2	17.0	35	61
	0747:36	72.0	17.2	36	61
	0747:37	71.8	17.4	37	61
	0747:38	71.4	17.8	38	61
	0747:39	71.2	18.0	39	61
	0747:40	71.0	18.2	40	61
	0747:41	70.9	18.3	41	61
	0747:42	70.7	18.5	42	61
	0747:43	70.3	18.9	43	61
	0747:44	70.1	19.1	44	61
	0747:45	69.9	19.3	45	61
	0747:46	69.7	19.5	46	61
	0747:47	69.6	19.6	47	61
	0747:48	69.4	19.8	48	61
	0747:49	69.2	20.0	49	61

DATA FROM PACKER TEST NO. 4 (2,407' to 2,759')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/26/77

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	0747:50	69.1	20.1	50	61
	0747:51	68.8	20.4	51	61
	0747:52	68.6	20.6	52	61
	0747:53	68.5	20.7	53	61
	0747:54	68.3	20.9	54	61
	0747:55	68.1	21.1	55	61
	0747:56	67.9	21.3	56	61
	0747:57	67.8	21.4	57	61
	0747:58	67.7	21.5	58	61
	0747:59	67.5	21.7	59	61
	0748:00	67.2	22.0	60	61
	0748:01	67.1	22.1	61	61
	0748:02	67.0	22.2	62	61
	0748:03	66.8	22.4	63	61
	0748:04	66.7	22.5	64	61
	0748:05	66.6	22.6	65	61
	0748:06	66.4	22.8	66	61
	0748:07	66.2	23.0	67	61
	0748:08	66.0	23.2	68	61
	0748:09	66.0	23.2	69	61
	0748:10	65.8	23.4	70	61
	0748:11	65.7	23.5	71	61
	0748:12	65.7	23.5	72	61
	0748:13	65.5	23.7	73	61
	0748:14	65.4	23.8	74	61

DATA FROM PACKER TEST NO. 4 (2,407' to 2,759')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/26/77

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Cotinue test	0748:15	65.3	23.9	75	61
	0748:16	65.1	24.1	76	61
	0748:17	65.0	24.2	77	61
	0748:18	64.9	24.3	78	61
	0748:19	64.8	24.4	79	61
	0748:20	64.7	24.5	80	61
	0748:21	64.6	24.6	81	61
	0748:22	64.6	24.6	82	61
	0748:23	64.3	24.9	83	61
	0748:24	64.3	24.9	84	61
	0748:25	64.2	25.0	85	61
	0748:26	64.1	25.1	86	61
	0748:27	64.0	25.2	87	61
	0748:28	63.9	25.3	88	61
	0748:29	63.7	25.5	89	61
	0748:30	63.7	25.5	90	61
	0748:31	63.6	25.6	91	61
	0748:32	63.5	25.7	92	61
	0748:33	63.5	25.7	93	61
	0748:34	63.4	25.8	94	61
	0748:35	63.4	25.8	95	61
	0748:36	63.3	25.9	96	61
	0748:37	63.1	26.1	97	61
	0748:38	63.1	26.1	98	61
	0748:39	63.0	26.2	99	61

DATA FROM PACKER TEST NO. 4 (2,407' to 2,759')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/26/77 Page 5 of 10

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	0748:40	62.9	26.2	100	61
	0748:41	62.8	26.4	101	61
	0748:42	62.8	26.4	102	61
	0748:43	62.7	26.5	103	61
	0748:44	62.7	26.5	104	61
	0748:45	62.6	26.6	105	61
	0748:46	62.5	26.7	106	61
	0748:47	62.4	26.8	107	61
	0748:48	62.4	26.8	108	61
	0748:49	62.3	26.9	109	61
	0748:50	62.2	27.0	110	61
	0748:51	62.1	27.1	111	61
	0748:52	62.1	27.1	112	61
	0748:53	62.1	27.1	113	61
	0748:54	62.0	27.2	114	61
	0748:55	61.9	27.3	115	61
	0748:56	61.9	27.3	116	61
	0748.57	61.8	27.4	117	61
	0748:58	61.7	27.5	118	61
	0748:59	61.7	27.5	119	61
	0749:00	61.6	27.6	120	61
	0749:10	61.2	28.0	130	61
	0749:20	60.7	28.5	140	61
	0749:30	60.4	28.8	150	61
	0749:40	60.2	29.0	160	61

DATA FROM PACKER TEST NO. 4 (2,407' to 2,759')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/26/77 Page 6 of 10

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	0749:50	60.0	29.2	170	61
	0750:00	59.7	29.5	180	61
	0750:10	59.6	29.6	190	61
	0750:20	59.5	29.7	200	61
	0750:30	59.4	29.8	210	61
	0750:40	59.3	29.9	220	61
	0750:50	59.2	30.0	230	61
	0751:00	59.2	30.0	240	61
	0751:10	59.2	30.0	250	61
	0751:20	59.1	30.1	260	61
	0751:30	59.1	30.1	270	61
	0751:40	59.1	30.1	280	61
	0751:50	59.1	30.1	290	61
	0752:00	59.1	30.1	300	61
	0752:10	59.0	30.2	310	61
	0752:20	59.1	30.1	320	61
	0752:30	59.1	30.1	330	61
	0752:40	59.2	30.0	340	61
	0752:50	59.2	30.0	350	61
	0753:00	59.2	30.0	360	61
	0753:10	59.3	29.9	370	61
	0753:20	59.2	30.0	300	61
	0753:30	59.1	30.1	390	61
	0753:40	59.1	30.1	400	61
	0753:50	59.1	30.1	410	61

DATA FROM PACKER TEST NO. 4 (2,407' to 2,759')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/26/77 Page 7 of 10

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	0754:00	59.1	30.1	420	61
	0754:10	59.1	30.1	430	61
	0754:20	59.0	30.2	440	61
	0754:30	59.0	30.2	450	61
	0754:30	59.1	30.1	460	61
	0754:50	59.1	30.1	470	61
	0755:00	59.2	30.0	480	61
	0755:30	59.5	29.7	510	61
	0756:00	59.6	29.6	540	61
	0756:30	59.8	29.4	570	61
	0757:00	60.0	29.2	600	61
	0757:30	60.0	29.2	630	61
	0758:00	60.1	29.1	660	61
	0758:30	60.1	29.1	690	61
	0759:00	60.2	29.0	720	61
	0759:30	60.1	29.1	750	61
	0800:00	60.2	29.0	780	61
	0801:00	60.2	29.0	840	61
	0802:00	60.3	28.9	900	61
	0803:00	60.4	28.8	960	61
	0804:00	60.3	28.9	1,020	61
	0805:00	60.3	28.9	1,080	61
	0806:00	60.4	28.8	1,140	61
	0807:00	60.4	28.8	1,200	61
	0808:00	60.3	28.9	1,260	61

DATA FROM PACKER TEST NO. 4 (2,407' to 2,759')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/26/77

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	0809:00	60.7	28.5	1,320	61
	0810:00	60.3	28.9	1,380	61
	0811:00	60.3	28.9	1,440	61
	0812:00	60.3	28.9	1,500	61
	0813:00	60.2	29.0	1,560	61
	0814:00	60.2	29.0	1,620	61
	0815:00	60.2	29.0	1,680	61
	0816:00	60.1	29.1	1,740	61
	0817:00	60.2	29.0	1,800	61
	0818:00	60.4	28.8	1,860	61
	0819:00	60.5	28.7	1,920	61
	0820:00	60.3	28.9	1,980	61
	0821:00	60.4	28.8	2,040	61
	0822:00	60.5	28.7	2,100	61
	0823:00	60.5	28.7	2,160	61
	0824:00	60.6	28.6	2,220	61
	0825:00	60.5	28.7	2,280	61
	0826:00	60.8	28.4	2,340	61
	0827:00	60.9	28.3	2,400	61
	0828:00	61.0	28.2	2,460	61
	0829:00	61.5	27.7	2,520	61
	0830:00	61.6	27.6	2,580	61
	0831:00	61.7	27.5	2,640	61
	0832:00	61.7	27.5	2,700	61
	0833:00	61.8	27.4	2,760	61

DATA FROM PACKER TEST NO. 4 (2,407' to 2,759')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/26/77 Page 9 of 10

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	0834:00	61.9	27.3	2,820	61
	0825:00	61.8	27.4	2,880	61
	0836:00	61.9	27.3	2,940	61
	0837:00	61.8	27.4	3,000	61
	0838:00	61.9	27.3	3,060	61
	0839:00	61.9	27.3	3,120	61
	0840:00	61.8	27.4	3,180	61
	0841:00	61.9	27.3	3,240	61
	0842:00	61.8	27.4	3,300	61
	0843:00	61.9	27.3	3,360	61
	0844:00	61.9	27.3	3,420	61
	0845:00	61.8	27.4	3,480	61
	0846:00	61.6	27.6	3,540	61
	0847:00	61.6	27.6	3,600	61
	0848:00	61.5	27.7	3,660	61
	0849:00	61.6	27.6	3,720	61
	0850:00	61.5	27.7	3,780	61
	0851:00	61.5	27.7	3,840	61
	0852:00	61.5	27.7	3,900	61
	0853:00	61.5	27.7	3,960	61
	0854:00	61.5	27.7	4,020	61
	0855:00	61.6	27.6	4,080	61
	0856:00	61.9	27.3	4,140	61
	0857:00	61.9	27.3	4,200	61
	0858:00	62.0	27.2	4,260	61

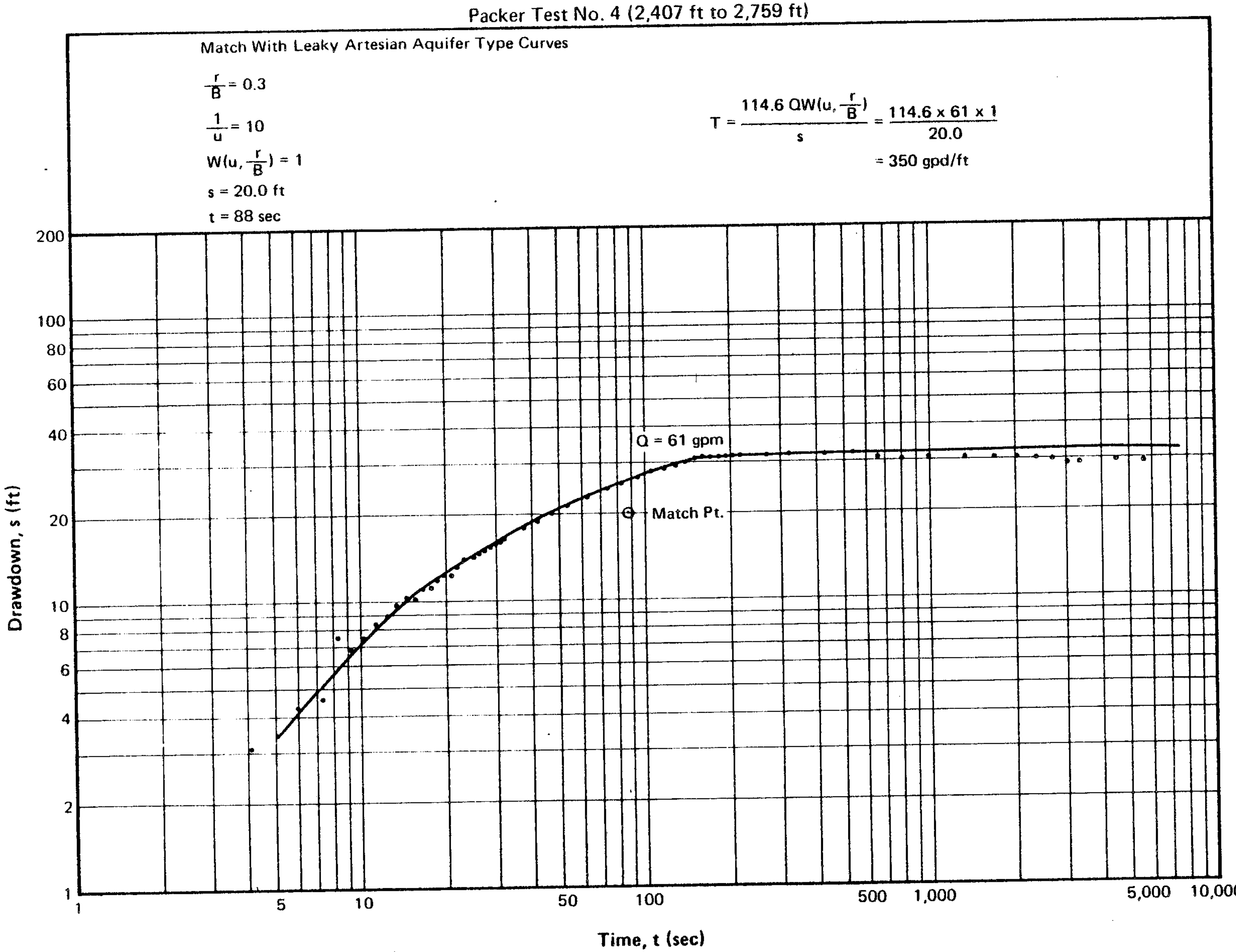
DATA FROM PACKER TEST NO. 4 (2,407' to 2,759')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/26/77 Page 10 of 10

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	0859:00	61.8	27.4	4,320	61
	0900:00	61.8	27.4	4,380	61
	0901:00	62.0	27.2	4,440	61
	0902:00	62.5	26.7	4,500	61
	0903:00	62.4	26.8	4,560	61
	0904:00	62.0	27.2	4,620	61
	0905:00	62.0	27.2	4,680	61
	0906:00	61.9	27.3	4,740	61
	0907:00	61.9	27.3	4,800	61
	0908:00	61.7	27.5	4,860	61
	0909:00	61.8	27.4	4,920	61
	0910:00	61.8	27.4	4,980	61
	0911:00	61.7	27.5	5,040	61
	0912:00	61.7	27.5	5,100	61
	0913:00	61.8	27.4	5,160	61
	0914:00	61.7	27.5	5,220	61
	0915:00	61.7	27.5	5,280	61
	0916:00	61.7	27.5	5,340	61
	0917:00	62.0	27.2	5,400	61
	0918:00	61.9	27.3	5,460	61
	0919:00	61.9	27.3	5,520	61
Pump shut off	0920:00	61.8	27.4	5,580	61

Packer Test No. 4 (2,407 ft to 2,759 ft)



Time-drawdown graph, Miami-Dade Water and Sewer Authority, test well for deep disposal system.

DATA FROM PACKER TEST NO. 5 (1,968' to 1,998')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/26/77 Page 1 of 7

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Start test (part 2)	1558:00	90.1	--	0	42.5
	1558:02	90.1	0	2	42.5
	1558:03	91.5	-1.4	3	42.5
	1558:04	88.8	1.3	4	42.5
	1558:05	92.1	-2.0	5	42.5
	1558:06	88.8	1.3	6	42.5
	1558:07	90.3	-0.2	7	42.5
	1558:08	88.6	1.5	8	42.5
	1558:09	88.4	1.7	9	42.5
	1558:10	88.4	1.7	10	42.5
	1558:11	88.3	1.8	11	42.5
	1558:12	88.6	1.5	12	42.5
	1558:13	88.3	1.8	13	42.5
	1558:14	88.2	1.9	14	42.5
	1558:15	87.1	3.0	15	42.5
	1558:16	86.6	3.5	16	42.5
	1558:17	86.0	4.1	17	42.5
	1558:18	85.9	4.2	18	42.5
	1558:19	85.4	4.7	19	42.5
	1558:20	84.9	5.2	20	42.5
	1558:21	84.7	5.4	21	42.5
	1558:22	83.7	6.4	22	42.5
	1558:23	83.5	6.6	23	42.5
	1558:24	83.2	6.9	24	42.5
	1558:25	82.9	7.2	25	42.5

DATA FROM PACKER TEST NO. 5 (1,968' to 1,998')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/26/77

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	1558:26	82.5	7.6	26	42.5
	1558:27	82.1	8.0	27	42.5
	1558:28	81.7	8.4	28	42.5
	1558:29	81.3	8.8	29	42.5
	1558:30	80.8	9.3	30	42.5
	1558:31	80.5	9.6	31	42.5
	1558:32	80.2	9.9	32	42.5
	1558:33	79.8	10.3	33	42.5
	1558:34	79.5	10.6	34	42.5
	1558:35	79.1	11.0	35	42.5
	1558:36	78.8	11.3	36	42.5
	1558:37	78.3	11.8	37	42.5
	1558:38	78.1	12.0	38	42.5
	1558:39	77.8	12.3	39	42.5
	1558:40	77.5	12.6	40	42.5
	1558:41	77.0	13.1	41	42.5
	1558:42	77.0	13.1	42	42.5
	1558:43	76.8	13.3	43	42.5
	1558:44	76.4	13.7	44	42.5
	1558:45	76.2	13.9	45	42.5
	1558:46	75.8	14.3	46	42.5
	1558:47	75.4	14.7	47	42.5
	1558:48	75.1	15.0	48	42.5
	1558:49	74.7	15.4	49	42.5
	1558:50	74.4	15.7	50	42.5

DATA FROM PACKER TEST NO. 5 (1,968' to 1,998')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/26/77

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	1558:51	74.1	16.0	51	42.5
	1558:52	73.7	16.4	52	42.5
	1558:53	73.5	16.6	53	42.5
	1558:54	73.2	16.9	54	42.5
	1558:55	72.9	17.2	55	42.5
	1558:56	72.9	17.2	56	42.5
	1558:57	72.7	17.4	57	42.5
	1558:58	72.3	17.8	58	42.5
	1558:59	72.2	17.9	59	42.5
	1559:00	71.8	18.3	60	42.5
	1559:05	70.5	19.6	65	42.5
	1559:10	69.4	20.7	70	42.5
	1559:20	67.2	22.9	80	42.5
	1559:30	65.1	25.0	90	42.5
	1559:40	63.2	26.9	100	42.5
	1559:50	61.5	28.6	110	42.5
	1600:00	60.0	30.1	120	42.5
	1600:10	58.6	31.5	130	42.5
	1600:20	57.5	32.6	140	42.5
	1600:30	56.4	33.7	150	42.5
	1600:40	55.5	34.6	160	42.5
	1600:50	54.5	35.6	170	42.5
	1601:00	53.7	36.4	180	42.5
	1601:10	52.9	37.2	190	42.5
	1601:20	52.1	38.0	200	42.5

DATA FROM PACKER TEST NO. 5 (1,968' to 1,998')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/26/77 Page 4 of 7

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	1601:30	51.5	38.6	210	42.5
	1601:40	50.9	39.2	220	42.5
	1601:50	50.4	39.7	230	42.5
	1602:00	49.9	40.2	240	42.5
	1602:10	49.5	40.6	250	42.5
	1602:20	49.1	41.0	260	42.5
	1602:30	48.6	41.5	270	42.5
	1602:40	48.3	41.8	280	42.5
	1602:50	48.0	42.1	290	42.5
	1603:00	47.6	42.5	300	42.5
	1603:10	47.2	42.9	310	42.5
	1603:20	46.9	43.2	320	42.5
	1603:30	46.6	43.5	330	42.5
	1603:40	46.4	43.7	340	42.5
	1603:50	46.1	44.0	350	42.5
	1604:00	45.6	44.5	360	42.5
	1604:10	45.3	44.8	370	42.5
	1604:20	45.1	45.0	380	42.5
	1604:30	44.8	45.3	390	42.5
	1604:40	44.6	45.5	400	42.5
	1604:50	44.2	45.9	410	42.5
	1605:00	44.1	46.0	420	42.5
	1605:10	43.8	46.3	430	42.5
	1606:00	43.1	47.0	480	42.5
	1607:00	42.4	47.7	540	42.5

DATA FROM PACKER TEST NO. 5 (1,968' to 1,998')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/26/77 Page 5 of 7

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	1608:00	41.9	48.2	600	42.5
	1609:00	41.6	48.5	660	42.5
	1610:00	41.4	48.7	720	42.5
	1611:00	41.2	48.9	780	42.5
	1612:00	41.1	49.0	840	42.5
	1613:00	40.9	49.2	900	42.5
	1614:00	40.9	49.2	960	42.5
	1615:00	40.7	49.4	1,020	42.5
	1616:00	40.6	49.5	1,080	42.5
	1617:00	40.5	49.6	1,140	42.5
	1618:00	40.4	49.7	1,200	42.5
	1619:00	40.4	49.7	1,260	42.5
	1620:00	40.5	49.6	1,320	42.5
	1621:00	40.3	49.8	1,380	42.5
	1622:00	40.3	49.8	1,440	42.5
	1623:00	40.3	49.8	1,500	42.5
	1624:00	40.4	49.7	1,560	42.5
	1625:00	40.2	49.9	1,620	42.5
	1626:00	40.3	49.8	1,680	42.5
	1627:00	40.2	49.9	1,740	42.5
	1628:01	40.3	49.9	1,800	42.5
	1629:00	40.2	49.9	1,861	42.5
	1630:00	40.3	49.8	1,920	42.5
	1631:00	40.3	49.8	1,980	42.5
	1632:00	40.3	49.8	2,040	42.5

DATA FROM PACKER TEST NO. 5 (1,968' to 1,998')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/26/77 Page 6 of 7

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	1633:00	40.2	49.9	2,100	42.5
	1634:00	40.2	49.9	2,160	42.5
	1635:00	40.1	50.0	2,220	42.5
	1636:00	40.1	50.0	2,280	42.5
	1637:00	40.1	50.0	2,340	42.5
	1638:00	40.1	50.0	2,400	42.5
	1639:00	40.2	49.9	2,460	42.5
	1640:00	40.1	50.0	2,520	42.5
	1641:00	40.0	50.1	2,580	42.5
	1642:00	40.0	50.1	2,640	42.5
	1643:00	40.0	50.1	2,700	42.5
	1644:00	40.0	50.1	2,760	42.5
	1645:00	40.0	50.1	2,820	42.5
	1646:00	40.0	50.1	2,880	42.5
	1647:01	39.9	50.2	2,941	42.5
	1648:00	40.0	50.1	3,000	42.5
	1649:00	40.0	50.1	3,060	42.5
	1650:00	39.9	50.2	3,120	42.5
	1651:00	39.9	50.2	3,180	42.5
	1652:00	39.8	50.3	3,240	42.5
	1653:01	39.9	50.2	3,301	42.5
	1654:00	39.9	50.2	3,360	42.5
	1655:00	39.8	50.3	3,420	42.5
	1656:00	39.8	50.3	3,480	42.5
	1657:00	39.8	50.3	3,540	42.5

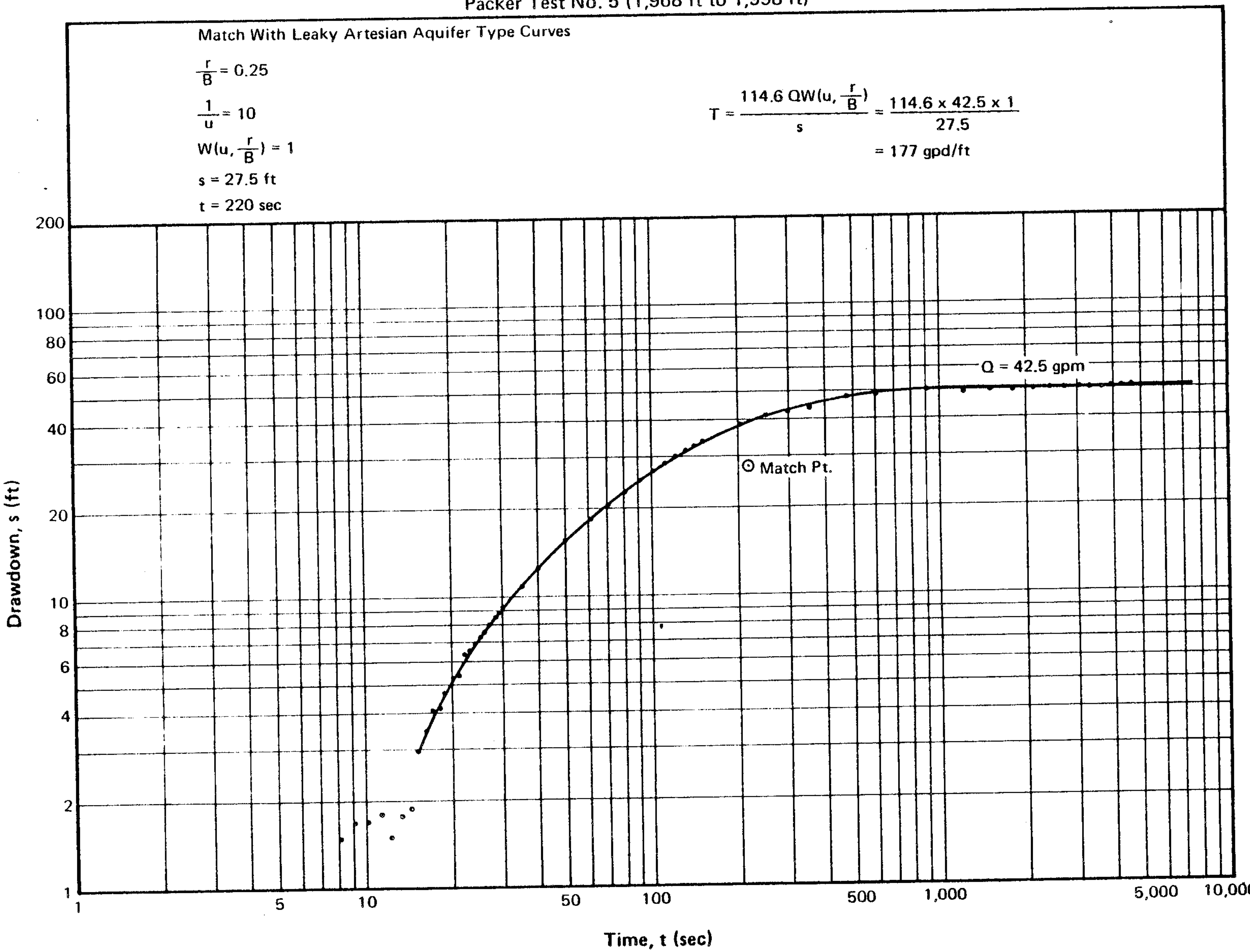
DATA FROM PACKER TEST NO. 5 (1,968' to 1,998')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/26/77 Page 7 of 7

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	1658:00	39.8	50.3	3,600	42.5
	1659:00	39.7	50.4	3,660	42.5
	1700:00	39.8	50.3	3,720	42.5
	1701:00	39.8	50.3	3,780	42.5
	1702:01	39.7	50.4	3,841	42.5
	1703:00	39.7	50.4	3,900	42.5
	1704:00	39.7	50.4	3,960	42.5
	1705:00	39.9	50.2	4,020	42.5
	1706:00	39.8	50.3	4,080	42.5
	1707:00	39.9	50.2	4,140	42.5
	1708:00	39.8	50.3	4,200	42.5
	1709:00	39.7	50.4	4,260	42.5
	1710:00	39.6	50.5	4,320	42.5
	1711:00	39.7	50.4	4,380	42.5
	1712:00	39.7	50.4	4,440	42.5
	1713:00	39.7	50.4	4,500	42.5
	1714:00	39.8	50.3	4,560	42.5
	1714:20	39.7	50.4	4,580	42.5
	1714:30	39.7	50.4	4,590	42.5
	1714:40	39.7	50.4	4,600	42.5
	1714:50	39.7	50.4	4,610	42.5
Pump shut off	1715:00	39.7	50.4	4,620	42.5

Packer Test No. 5 (1,968 ft to 1,998 ft)



Time-drawdown graph, Miami-Dade Water and Sewer Authority, test well for deep disposal system.

DATA FROM PACKER TEST NO. 6 (2008' to 2759')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/26/77 Page 1 of 6

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Start test	1814:00	89.9	--	0	61
	1814:01	87.3	2.6	1	61
	1814:02	94.1	--	2	61
	1814:03	85.5	4.4	3	61
	1814:04	87.8	2.1	4	61
	1814:05	87.4	2.4	5	61
	1814:06	87.1	2.8	6	61
	1814:07	85.9	4.0	7	61
	1814:08	85.6	4.3	8	61
	1814:09	85.2	4.7	9	61
	1814:10	84.6	5.3	10	61
	1814:11	83.6	6.3	11	61
	1814:12	84.0	5.9	12	61
	1814:13	83.3	6.6	13	61
	1814:14	82.6	7.3	14	61
	1814:15	82.4	7.5	15	61
	1814:16	82.0	7.9	16	61
	1814:17	81.5	8.4	17	61
	1814:18	81.4	8.5	18	61
	1814:19	80.9	9.0	19	61
	1814:20	80.6	9.3	20	61
	1814:21	80.4	9.5	21	61
	1814:22	80.1	9.8	22	61
	1814:23	80.0	9.9	23	61
	1814:24	79.6	10.3	24	61

DATA FROM PACKER TEST NO. 6 (2008' to 2759')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/26/77 Page 2 of 6

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	1814:25	79.2	10.7	25	61
	1814:26	79.0	10.9	26	61
	1814:27	79.0	10.9	27	61
	1814:28	78.8	11.1	28	61
	1814:29	78.3	11.6	29	61
	1814:30	78.2	11.7	30	61
	1814:31	78.0	11.9	31	61
	1814:32	77.8	12.1	32	61
	1814:33	77.5	12.4	33	61
	1814:34	77.3	12.6	34	61
	1814:35	77.4	12.5	35	61
	1814:36	77.1	12.8	36	61
	1814:37	76.9	13.0	37	61
	1814:38	76.7	13.2	38	61
	1814:39	76.5	13.4	39	61
	1814:40	76.4	13.5	40	61
	1814:41	76.1	13.8	41	61
	1814:42	76.0	13.9	42	61
	1814:43	75.9	14.0	43	61
	1814:44	75.7	14.2	44	61
	1814:45	75.7	14.2	45	61
	1814:46	75.4	14.5	46	61
	1814:47	75.3	14.6	47	61
	1814:48	75.1	14.8	48	61
	1814:49	75.0	14.9	49	61

DATA FROM PACKER TEST NO. 6 (2008' to 2759 ')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/26/77 Page 3 of 6

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	1814:50	74.8	15.1	50	61
	1814:51	74.7	15.2	51	61
	1814:52	74.6	15.3	52	61
	1814:53	74.5	15.4	53	61
	1814:54	74.5	15.4	54	61
	1814:55	74.2	15.7	55	61
	1814:56	74.2	15.7	56	61
	1814:57	74.2	15.7	57	61
	1814:58	73.9	16.0	58	61
	1814:59	74.0	15.9	59	61
	1815:00	73.7	16.2	60	61
	1815:10	72.7	17.2	70	61
	1815:20	71.7	18.2	80	61
	1815:30	70.7	19.2	90	61
	1815:40	69.7	20.2	100	61
	1815:50	69.0	20.9	110	61
	1816:00	68.1	21.8	120	61
	1816:10	67.4	22.5	130	61
	1816:20	66.8	23.1	140	61
	1816:30	66.5	23.4	150	61
	1816:40	66.0	23.9	160	61
	1816:50	65.6	24.3	170	61
	1817:00	65.2	24.7	180	61
	1817:10	65.1	24.8	190	61
	1817:20	65.0	24.9	200	61

DATA FROM PACKER TEST NO. 6 (2008' to 2759')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/26/77 Page 4 of 6

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	1817:30	64.6	25.3	210	61
	1817:40	64.4	25.5	220	61
	1817:50	64.0	25.9	230	61
	1818:00	63.7	26.2	240	61
	1818:10	63.4	26.5	250	61
	1818:20	63.2	26.7	260	61
	1818:30	62.8	27.1	270	61
	1818:40	62.7	27.2	280	61
	1818:50	62.5	27.4	290	61
	1819:00	62.1	27.8	300	61
	1819:10	61.8	28.1	310	61
	1819:20	61.4	28.5	320	61
	1819:30	61.2	28.7	330	61
	1819:40	60.8	29.1	340	61
	1819:50	60.7	29.2	350	61
	1820:00	60.4	29.5	360	61
	1820:10	60.2	29.7	370	61
	1820:20	59.8	30.1	380	61
	1820:30	59.6	30.3	390	61
	1820:40	59.7	30.2	400	61
	1820:50	59.4	30.5	410	61
	1821:00	59.3	30.6	420	61
	1821:10	59.3	30.6	430	61
	1821:20	59.2	30.7	440	61
	1821:30	59.0	30.9	450	61

DATA FROM PACKER TEST NO. 6 (2008' to 2759')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/26/77 Page 5 of 6

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	1821:40	58.9	31.0	460	61
	1821:50	59.0	30.9	470	61
	1822:00	59.0	30.9	480	61
	1822:10	58.8	31.1	490	61
	1822:20	58.9	31.0	500	61
	1822:30	58.9	31.0	510	61
	1822:40	58.8	31.1	520	61
	1822:50	58.8	31.1	530	61
	1823:00	58.9	31.0	540	61
	1823:10	58.9	31.0	550	61
	1823:20	58.7	31.2	560	61
	1823:30	58.8	31.1	570	61
	1823:40	58.9	31.0	580	61
	1824:00	58.8	31.1	600	61
	1825:00	58.8	31.1	660	61
	1826:00	58.9	31.0	720	61
	1827:00	58.9	31.0	780	61
	1828:00	58.9	31.0	840	61
	1829:00	59.0	30.9	900	61
	1830:00	59.0	30.9	960	61
	1831:00	59.0	30.9	1,020	61
	1832:00	59.0	30.9	1,080	61
	1833:00	58.9	31.0	1,140	61
	1834:00	58.8	31.1	1,200	61
	1835:00	59.0	30.9	1,260	61

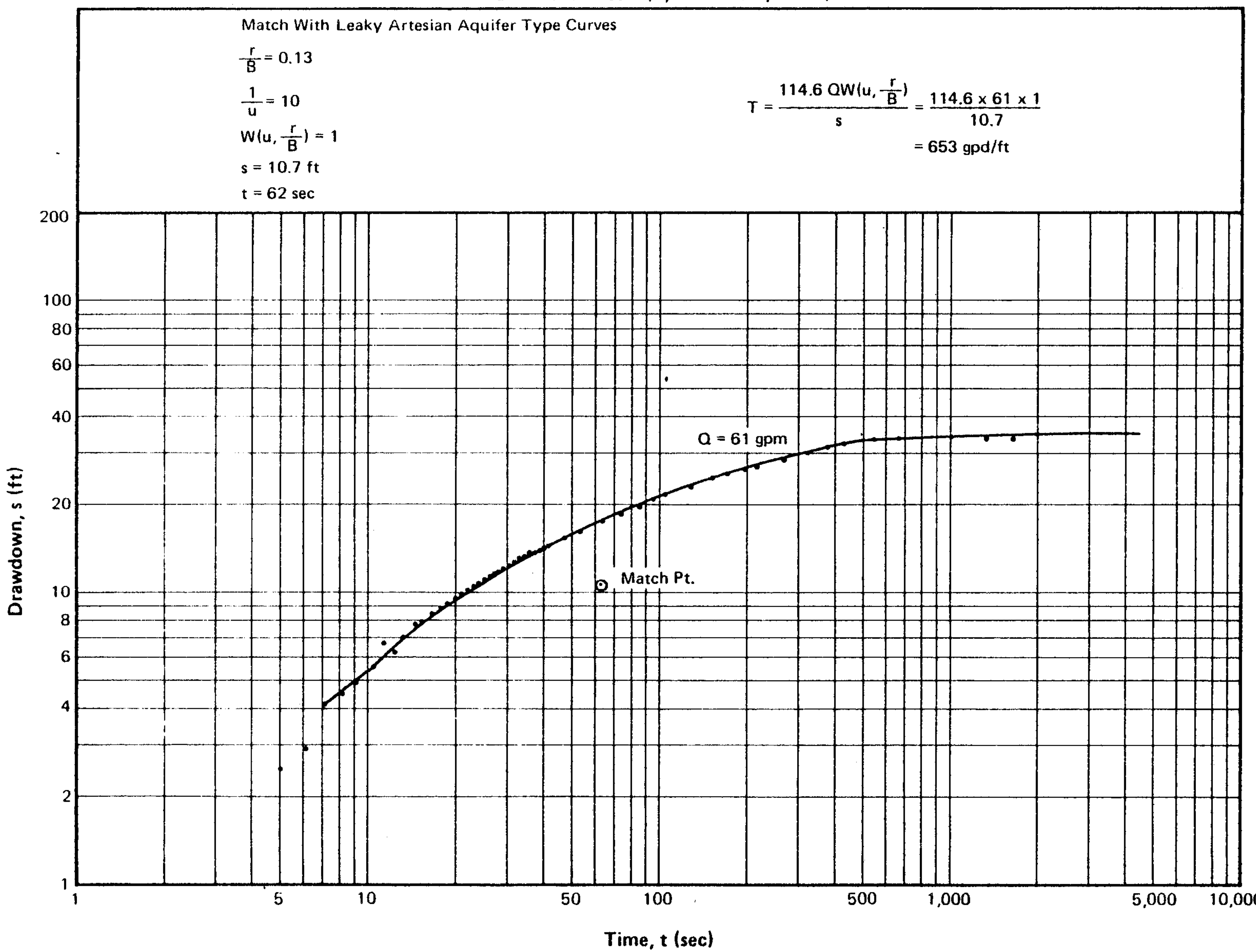
DATA FROM PACKER TEST NO. 6 (2008' to 2759')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/26/77 Page 6 of 6

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	1836:00	58.7	31.2	1,320	61
	1837:00	58.9	31.0	1,380	61
	1838:00	58.8	31.1	1,440	61
	1839:00	58.6	31.3	1,500	61
	1840:00	58.3	31.6	1,560	61
	1841:00	58.3	31.6	1,620	61
	1842:00	58.4	31.5	1,680	61
	1843:00	58.3	31.6	1,740	61
	1844:00	58.3	31.6	1,800	61
	1845:00	58.5	31.4	1,860	61
Pump shut off	1845:20	58.6	31.3	1,880	61

Packer Test No. 6 (2,008 ft to 2,759 ft)



Time-drawdown graph, Miami-Dade Water and Sewer Authority, test well for deep disposal system.

DATA FROM PACKER TEST NO. 7 (2543' to 2573')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/27/77 Page 1 of 13

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Start test (part 2)	1150:00	111.0	--	0	56.6
	1150:02	109.4	1.6	2	56.6
	1150:03	104.8	6.2	3	56.6
	1150:04	110.3	0.7	4	56.6
	1150:05	107.8	3.2	5	56.6
	1150:06	110.4	0.6	6	56.6
	1150:07	108.9	2.1	7	56.6
	1150:08	108.1	2.9	8	56.6
	1150:09	107.8	3.2	9	56.6
	1150:10	106.3	4.7	10	56.6
	1150:11	106.3	4.7	11	56.6
	1150:12	104.1	6.9	12	56.6
	1150:13	105.1	5.9	13	56.6
	1150:14	104.9	6.1	14	56.6
	1150:15	105.3	5.7	15	56.6
	1150:16	104.1	6.9	16	56.6
	1150:17	103.8	7.2	17	56.6
	1150:18	103.0	8.0	18	56.6
	1150:19	103.2	7.8	19	56.6
	1150:20	102.4	8.6	20	56.6
	1150:21	102.3	8.7	21	56.6
	1150:22	101.4	9.6	22	56.6
	1150:23	101.3	9.7	23	56.6
	1150:24	100.9	10.1	24	56.6
	1150:25	100.2	10.8	25	56.6

DATA FROM PACKER TEST NO. 7 (2543' to 2573')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/27/77

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	1150:26	99.9	11.1	26	56.6
(part 2)	1150:27	99.4	11.6	27	56.6
	1150:28	98.9	12.1	28	56.6
	1150:29	98.3	12.7	29	56.6
	1150:30	98.1	12.9	30	56.6
	1150:31	97.8	13.2	31	56.6
	1150:32	97.3	13.7	32	56.6
	1150:33	97.0	14.0	33	56.6
	1150:34	97.0	14.0	34	56.6
	1150:35	96.2	14.8	35	56.6
	1150:36	95.6	15.4	36	56.6
	1150:37	95.3	15.7	37	56.6
	1150:38	94.6	16.4	38	56.6
	1150:39	94.3	16.7	39	56.6
	1150:40	94.3	16.7	40	56.6
	1150:41	93.6	17.4	41	56.6
	1150:42	93.2	17.8	42	56.6
	1150:43	92.7	18.3	43	56.6
	1150:44	92.5	18.5	44	56.6
	1150:45	91.8	19.2	45	56.6
	1150:46	91.3	19.7	46	56.6
	1150:47	91.1	19.9	47	56.6
	1150:48	90.8	20.2	48	56.6
	1150:49	90.5	20.5	49	56.6
	1150:50	90.4	20.6	50	56.6

DATA FROM PACKER TEST NO. 7 (2543' to 2573')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/27/77

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	1150:51	89.4	21.6	51	56.6
(part 2)	1150:52	89.2	21.8	52	56.6
	1150:53	88.9	22.1	53	56.6
	1150:54	88.4	22.6	54	56.6
	1150:55	88.2	22.8	55	56.6
	1150:56	88.0	23.0	56	56.6
	1150:57	87.4	23.6	57	56.6
	1150:58	87.0	24.0	58	56.6
	1150:59	86.8	24.2	59	56.6
	1151:00	86.4	24.6	60	56.6
	1151:01	86.2	24.8	61	56.6
	1151:02	85.9	25.1	62	56.6
	1151:03	85.5	25.5	63	56.6
	1151:04	85.3	25.7	64	56.6
	1151:05	84.7	26.3	65	56.6
	1151:06	84.4	26.6	66	56.6
	1151:07	84.1	26.9	67	56.6
	1151:08	83.7	27.3	68	56.6
	1151:09	83.2	27.8	69	56.6
	1151:10	82.9	28.1	70	56.6
	1151:11	82.7	28.3	71	56.6
	1151:12	82.5	28.5	72	56.6
	1151:13	82.2	28.8	73	56.6
	1151:14	81.9	29.1	74	56.6
	1151:15	81.7	29.3	75	56.6

DATA FROM PACKER TEST NO. 7 (2543' to 2573')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/27/77 Page 4 of 13

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	1151:16	81.5	29.5	76	56.6
(part 2)	1151:17	80.9	30.1	77	56.6
	1151:18	80.7	30.3	78	56.6
	1151:19	80.4	30.6	79	56.6
	1151:20	80.2	30.8	80	56.6
	1151:21	79.9	31.1	81	56.6
	1151:22	79.6	31.4	82	56.6
	1151:23	79.0	32.0	83	56.6
	1151:24	79.0	32.0	84	56.6
	1151:25	78.7	32.3	85	56.6
	1151:26	78.2	32.8	86	56.6
	1151:27	78.0	33.0	87	56.6
	1151:30	77.3	33.7	90	56.6
	1151:31	77.1	33.9	91	56.6
	1151:32	76.5	34.5	92	56.6
	1151:33	76.3	34.7	93	56.6
	1151:34	76.1	34.9	94	56.6
	1151:35	75.8	35.2	95	56.6
	1151:36	75.5	35.5	96	56.6
	1151:37	75.3	35.7	97	56.6
	1151:38	75.1	35.9	98	56.6
	1151:39	74.9	36.1	99	56.5
	1151:40	74.5	36.5	100	56.6
	1151:41	74.2	36.8	101	56.6
	1151:42	73.9	37.1	102	56.6

DATA FROM PACKER TEST NO. 7 (2543' to 2573')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/27/77 Page 5 of 13

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	1151:43	73.7	37.3	103	56.6
(part 2)	1151:44	73.4	37.6	104	56.6
	1151:45	73.2	37.8	105	56.6
	1151:46	73.1	37.9	106	56.6
	1151:47	72.7	38.3	107	56.6
	1151:48	72.5	38.5	108	56.6
	1151:49	72.4	38.6	109	56.6
	1151:50	72.2	38.8	110	56.6
	1151:51	72.0	39.0	111	56.6
	1151:52	71.6	39.4	112	56.6
	1151:53	71.4	39.6	113	56.6
	1151:54	71.0	40.0	114	56.6
	1151:55	70.8	40.2	115	56.6
	1151:56	70.4	40.6	116	56.6
	1151:57	70.4	40.6	117	56.6
	1151:58	70.2	40.8	118	56.6
	1151:59	70.1	40.9	119	56.6
	1152:00	69.6	41.4	120	56.6
	1152:01	69.6	41.4	121	56.6
	1152:02	69.3	41.7	122	56.6
	1152:03	69.0	42.0	123	56.6
	1152:04	68.8	42.2	124	56.6
	1152:05	68.6	42.4	125	56.6
	1152:06	68.6	42.4	126	56.6
	1152:07	68.1	42.9	127	56.6

DATA FROM PACKER TEST NO. 7 (2543' to 2573')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/27/77 Page 6 of 13

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	1152:08	68.1	42.9	128	56.6
(part 2)	1152:09	67.7	43.3	129	56.6
	1152:10	67.5	43.5	130	56.6
	1152:11	67.2	43.8	131	56.6
	1152:12	67.1	43.9	132	56.6
	1152:13	67.1	43.9	133	56.6
	1152:14	66.7	44.3	134	56.6
	1152:15	66.5	44.5	135	56.6
	1152:16	66.3	44.7	136	56.6
	1152:17	66.2	44.8	137	56.6
	1152:18	65.9	45.1	138	56.6
	1152:19	65.6	45.4	139	56.6
	1152:20	65.6	45.4	140	56.6
	1152:21	65.3	45.7	141	56.6
	1152:22	65.1	45.9	142	56.6
	1152:23	64.8	46.2	143	56.6
	1152:24	64.7	46.3	144	56.6
	1152:25	64.4	46.6	145	56.6
	1152:26	64.3	46.7	146	56.6
	1152:27	64.0	47.0	147	56.6
	1152:28	63.8	47.2	148	56.6
	1152:29	63.6	47.4	149	56.6
	1152:30	63.4	47.6	150	56.6
	1152:40	61.7	49.3	160	56.6
	1152:50	60.1	50.9	170	56.6

DATA FROM PACKER TEST NO. 7 (2543' to 2573')

Test Well for Deep Disposal System for Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/27/77 Page 7 of 13

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	1153:00	58.4	52.6	180	56.6
(part 2)	1153:10	56.9	54.1	190	56.6
	1153:20	55.2	55.8	200	56.6
	1153:30	53.8	57.2	210	56.6
	1153:40	52.6	58.4	220	56.6
	1153:50	51.3	59.7	230	56.6
	1154:00	50.2	60.8	240	56.6
	1154:10	49.0	62.0	250	56.6
	1154:20	47.8	63.2	260	56.6
	1154:30	46.7	64.3	270	56.6
	1154:40	45.8	65.2	280	56.6
	1152:50	44.9	66.1	290	56.6
	1155:00	43.9	67.1	300	56.6
	1155:10	43.0	68.0	310	56.6
	1155:20	42.1	68.9	320	56.6
	1155:30	41.4	69.6	330	56.6
	1155:40	40.6	70.4	340	56.6
	1155:50	39.8	71.2	350	56.6
	1156:00	39.2	71.8	360	56.6
	1156:10	38.6	72.4	370	56.6
	1156:20	38.0	73.0	380	56.6
	1156:30	37.3	73.7	390	56.6
	1156:40	36.7	74.3	400	56.6
	1156:50	36.2	74.8	410	56.6
	1157:00	35.7	75.3	420	56.6

DATA FROM PACKER TEST NO. 7 (2543' to 2573')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/27/77 Page 8 of 13

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	1157:10	35.2	75.8	430	56.6
(part 2)	1157:20	34.7	76.3	440	56.6
	1157:30	34.3	76.7	450	56.6
	1157:40	33.8	77.2	460	56.6
	1157:50	33.5	77.5	470	56.6
	1158:00	33.0	78.0	480	56.6
	1158:10	32.6	78.4	490	56.6
	1158:20	32.2	78.8	500	56.6
	1158:30	32.0	79.0	510	56.6
	1158:40	31.6	79.4	520	56.6
	1158:50	31.2	79.8	530	56.6
	1159:00	30.9	80.1	540	56.6
	1159:10	30.6	80.4	550	56.6
	1159:20	30.3	80.7	560	56.6
	1159:30	30.0	81.0	570	56.6
	1159:40	29.7	81.3	580	56.6
	1159:50	29.4	81.6	590	56.6
	1200:00	29.2	81.8	600	56.6
	1200:10	28.7	82.3	610	56.6
	1200:20	28.5	82.5	620	56.6
	1200:30	28.1	82.9	630	56.6
	1201:00	27.3	83.7	660	56.6
	1202:01	25.8	85.2	721	56.6
	1203:00	24.5	86.5	780	56.6
	1204:00	22.9	88.1	840	56.6

DATA FROM PACKER TEST NO. 7 (2543' to 2573')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/27/77 Page 9 of 13

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	1205:00	21.3	89.7	900	56.6
(part 2)	1206:00	19.7	91.3	960	56.6
	1207:00	18.1	92.9	1,020	56.6
	1208:00	16.8	94.2	1,080	56.6
	1209:00	15.8	95.2	1,140	56.6
	1210:00	15.2	95.8	1,200	47.6
	1211:00	14.7	96.3	1,260	47.6
	1212:00	14.3	96.7	1,320	47.6
	1213:00	14.2	96.8	1,380	47.6
	1214:00	14.0	97.0	1,440	47.6
	1215:00	13.8	97.2	1,500	47.6
	1216:00	13.8	97.2	1,560	47.6
	1217:00	13.7	97.3	1,620	47.6
	1218:00	13.6	97.4	1,680	47.6
	1219:00	13.5	97.5	1,740	47.6
	1220:00	13.4	97.6	1,800	47.6
	1221:00	13.4	97.6	1,860	47.6
	1222:00	13.3	97.7	1,920	47.6
	1223:00	13.2	97.8	1,980	47.6
	1224:00	13.1	97.9	2,040	47.6
	1225:00	13.1	97.9	2,100	47.6
	1226:00	13.1	97.9	2,160	47.6
	1227:00	13.1	97.9	2,220	47.6
	1228:00	13.1	97.9	2,280	47.6
	1229:01	12.9	98.1	2,341	47.6

DATA FROM PACKER TEST NO. 7 (2543' to 2573')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/27/77 Page 10 of 13

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	1230:00	12.6	98.4	2,400	47.6
(part 2)	1231:00	12.5	98.5	2,460	47.6
	1233:00	12.8	98.2	2,520	47.6
	1234:00	12.8	98.2	2,580	47.6
	1235:00	12.9	98.1	2,640	44.6
	1236:00	12.9	98.1	2,700	44.6
	1237:00	12.9	98.1	2,760	44.6
	1238:00	13.0	98.0	2,820	44.6
	1239:00	13.0	98.0	2,880	44.6
	1240:00	13.0	98.0	2,940	44.6
	1241:00	13.0	98.0	3,000	44.6
	1242:00	13.0	98.0	3,060	44.6
	1243:00	13.0	98.0	3,120	44.6
	1244:00	12.9	98.1	3,180	44.6
	1245:00	13.0	98.0	3,240	44.6
	1246:00	12.9	98.1	3,300	44.6
	1247:00	12.9	98.1	3,360	44.6
	1248:00	12.9	98.1	3,420	44.6
	1249:00	12.9	98.1	3,480	44.6
	1250:00	12.9	98.1	3,540	44.6
	1251:00	12.8	98.2	3,600	44.6
	1252:00	13.0	98.0	3,660	44.6
	1253:00	12.3	98.7	3,720	44.6
	1254:00	12.3	98.7	3,780	44.6
	1255:00	12.2	98.8	3,840	44.6

DATA FROM PACKER TEST NO. 7 (2543' to 2573')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/27/77 Page 11 of 13

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	1256:00	12.2	98.8	3,900	44.6
	1257:00	12.2	98.8	3,960	44.6
	1258:00	12.4	98.6	4,020	44.6
	1259:00	12.4	98.6	4,080	44.6
	1300:00	12.5	98.5	4,140	44.6
	1301:00	12.4	98.6	4,200	44.6
	1302:00	12.4	98.6	4,260	44.6
	1303:00	12.6	98.4	4,320	44.8
	1304:00	12.8	98.2	4,380	44.8
	1305:00	12.9	98.1	4,440	44.8
	1306:00	12.9	98.1	4,500	44.8
	1307:00	12.9	98.1	4,560	44.8
	1308:00	12.9	98.1	4,620	44.8
	1309:00	12.8	98.2	4,680	44.8
	1310:00	12.8	98.2	4,740	44.8
	1311:00	12.7	98.3	4,800	44.8
	1312:00	12.6	98.4	4,860	44.8
	1313:00	12.6	98.4	4,920	44.8
	1314:00	12.7	98.3	4,980	44.8
	1315:00	12.7	98.3	5,040	44.8
	1316:00	12.7	98.3	5,100	44.8
	1317:00	12.7	98.3	5,160	44.8
	1318:00	12.7	98.3	5,220	44.8
	1319:00	12.7	98.3	5,280	44.8
	1320:00	12.6	98.4	5,340	44.8

DATA FROM PACKER TEST NO. 7 (2543' to 2573')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/27/77 Page 12 of 13

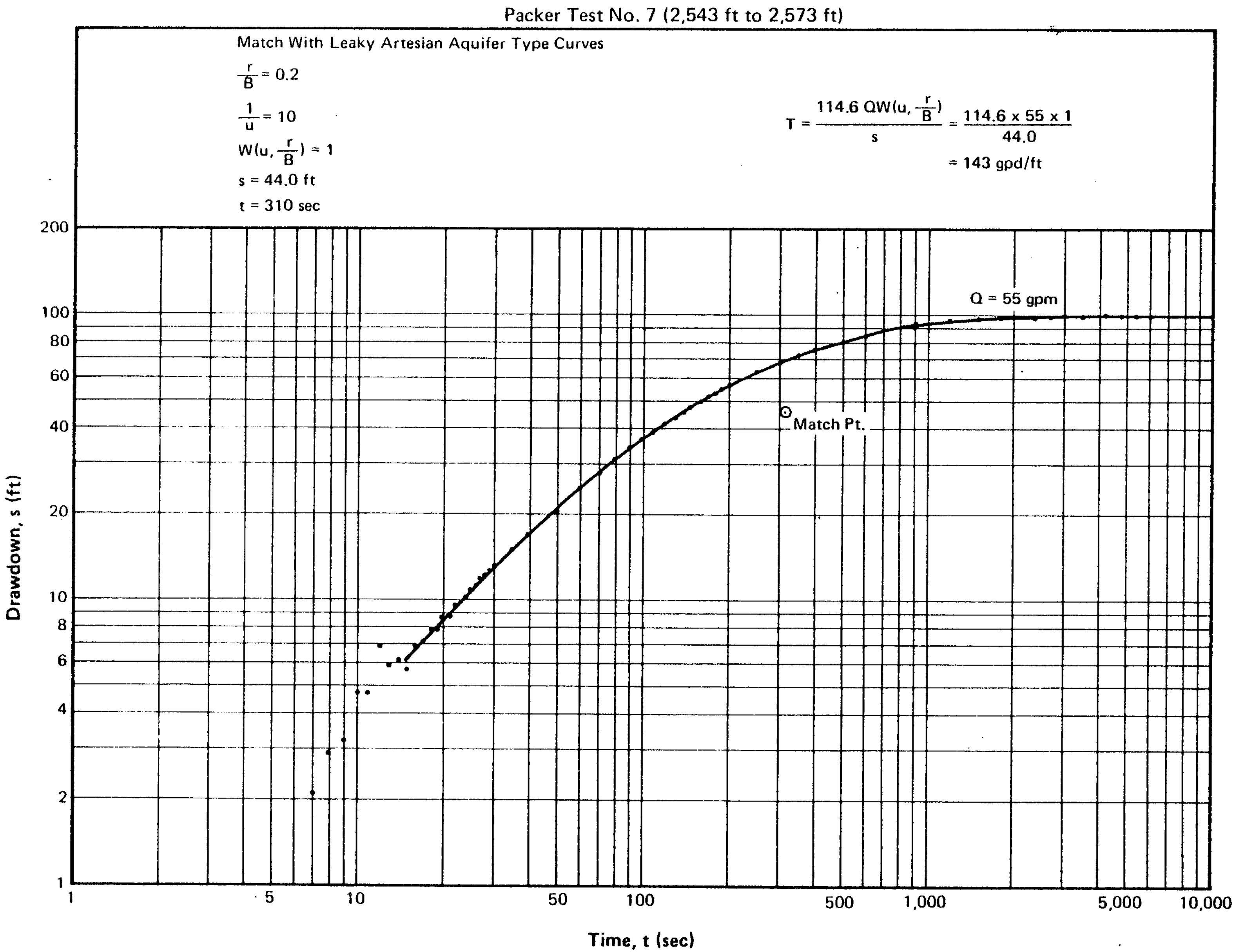
Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	1321:00	12.4	98.6	5,400	44.8
	1322:00	12.2	98.8	5,460	44.8
	1323:00	12.0	99.0	5,520	44.8
	1324:00	11.8	99.2	5,580	44.8
	1325:00	11.7	99.3	5,640	44.8
	1326:00	11.7	99.3	5,700	44.8
	1327:00	11.9	99.1	5,760	44.8
	1328:00	12.0	99.0	5,820	44.8
	1329:00	12.2	98.8	5,880	44.8
	1330:00	12.3	98.7	5,940	44.8
	1331:00	12.3	98.7	6,000	44.8
	1332:00	12.4	98.6	6,060	44.8
	1333:00	12.6	98.4	6,120	45.4
	1334:00	12.8	98.2	6,180	45.4
	1335:00	12.9	98.1	6,240	45.4
	1336:00	12.9	98.1	6,300	45.4
	1337:00	13.0	98.0	6,360	45.4
	1338:00	13.0	98.0	6,420	45.4
	1239:00	13.1	97.9	6,480	45.4
	1340:00	13.1	97.9	6,540	45.4
	1341:00	13.0	98.0	6,600	45.4
	1342:00	13.1	97.9	6,660	45.4
	1343:00	13.0	98.0	6,720	45.4
	1343:40	13.0	98.0	6,760	45.4
	1343:50	15.2	95.8	6,770	45.4

DATA FROM PACKER TEST NO. 7 (2543' to 2573')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/27/77 Page 13 of 13

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Pump shut off	1344:00	15.2	95.8	6,780	45.4



Time-drawdown graph, Miami-Dade Water and Sewer Authority, test well for deep disposal system.

DATA FROM PACKER TEST NO. 8 (2,583' to 2,759')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/27/77 Page 1 of 15

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Start test	1628:00	89.1	--	0	33
	1628:02	97.6	--	2	33
	1628:03	92.1	--	3	33
	1628:04	87.2	1.9	4	33
	1628:05	87.1	2.0	5	33
	1628:06	86.9	2.2	6	33
	1628:07	86.0	3.1	7	33
	1628:08	85.2	3.9	8	33
	1628:09	85.0	4.1	9	33
	1628:10	85.5	3.6	10	33
	1628:11	85.2	3.9	11	33
	1628:12	84.8	4.3	12	33
	1628:13	84.1	5.0	13	33
	1628:14	84.0	5.1	14	33
	1628:15	83.8	5.3	15	33
	1628:16	83.4	5.7	16	33
	1628:17	83.2	5.9	17	33
	1628:18	83.1	6.0	18	33
	1628:19	82.5	6.6	19	33
	1628:20	82.4	6.7	20	33
	1628:21	82.1	7.0	21	33
	1628:22	81.9	7.2	22	33
	1628:23	81.6	7.5	23	33
	1628:24	81.6	7.5	24	33
	1628:25	81.3	7.8	25	33

DATA FROM PACKER TEST NO. 8 (2,583' to 2,759')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/27/77 Page 2 of 15

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	1628:26	81.0	8.1	26	33
	1628:27	80.8	8.3	27	33
	1628:28	80.7	8.4	28	33
	1628:29	80.4	8.7	29	33
	1628:30	80.3	8.8	30	33
	1628:31	80.1	9.0	31	33
	1628:32	79.8	9.3	32	33
	1628:33	79.7	9.4	33	33
	1628:34	79.7	9.4	34	33
	1628:35	79.5	9.7	35	33
	1628:36	79.2	9.9	36	33
	1628:37	79.1	10.0	37	33
	1628:38	79.0	10.1	38	33
	1628:39	78.8	10.3	39	33
	1628:40	78.9	10.2	40	33
	1628:41	78.6	10.5	41	33
	1628:42	78.3	10.8	42	33
	1628:43	78.4	10.7	43	33
	1628:44	78.2	10.9	44	33
	1628:45	78.1	11.0	45	33
	1628:46	78.0	11.1	46	33
	1628:47	77.9	11.2	47	33
	1628:48	77.7	11.4	48	33
	1628:49	77.7	11.4	49	33
	1628:50	77.6	11.5	50	33

DATA FROM PACKER TEST NO. 8 (2,583' to 2,759')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/27/77 Page 3 of 15

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	1628:51	77.4	11.7	51	33
	1628:52	77.2	11.9	52	33
	1628:53	77.1	12.0	53	33
	1628:54	77.1	12.0	54	33
	1628:55	76.9	12.2	55	33
	1628:56	76.9	12.2	56	33
	1628:57	76.7	12.4	57	33
	1628:58	76.7	12.4	58	33
	1628:59	76.6	12.5	59	33
	1629:00	76.4	12.7	60	33
	1629:01	76.5	12.6	61	33
	1629:02	76.3	12.8	62	33
	1629:03	76.1	13.0	63	33
	1629:04	76.2	12.9	64	33
	1629:05	76.2	12.9	65	33
	1629:06	76.0	13.1	66	33
	1629:07	75.9	13.2	67	33
	1629:08	75.9	13.2	68	33
	1629:09	75.8	13.3	69	33
	1629:10	75.7	13.4	70	33
	1629:11	75.5	13.6	71	33
	1629:12	75.5	13.6	72	33
	1629:13	75.5	13.6	73	33
	1629:14	75.4	13.7	74	33
	1629:15	75.3	13.8	75	33

DATA FROM PACKER TEST NO. 8 (2,583' to 2,759')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/27/77 Page 4 of 15

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	1629:16	75.1	14.0	76	33
	1629:17	75.2	13.9	77	33
	1629:18	75.2	13.9	78	33
	1629:19	75.1	14.0	79	33
	1629:20	74.9	14.2	80	33
	1629:21	75.0	14.1	81	33
	1629:22	74.9	14.2	82	33
	1629:23	74.8	14.3	83	33
	1629:24	74.9	14.2	84	33
	1629:25	74.7	14.4	85	33
	1629:26	74.7	14.4	86	33
	1629:30	74.5	14.6	90	33
	1629:40	74.1	15.0	100	33
	1629:50	73.6	15.5	110	33
	1630:00	73.2	15.9	120	33
	1630:10	73.0	16.1	130	33
	1630:20	72.7	16.4	140	33
	1630:30	72.4	16.7	150	33
	1630:40	72.3	16.8	160	33
	1630:50	72.2	16.9	170	33
	1631:00	72.1	17.0	180	33
	1631:10	72.0	17.1	190	33
	1631:20	72.0	17.1	200	33
	1631:30	71.9	17.2	210	33
	1631:40	71.9	17.2	220	33

DATA FROM PACKER TEST NO. 8 (2,583' to 2,759')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/27/77 Page 5 of 15

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	1631:50	71.7	17.4	230	33
	1632:00	71.8	17.3	240	33
	1632:10	71.7	17.4	250	33
	1632:20	71.8	17.3	260	33
	1632:30	71.7	17.4	270	33
	1632:40	71.6	17.5	280	33
	1632:50	71.6	17.5	290	33
	1633:00	71.6	17.5	300	33
	1633:10	71.6	17.5	310	33
	1633:20	71.5	17.6	320	33
	1633:30	71.6	17.5	330	33
	1633:40	71.5	17.6	340	33
	1633:50	71.6	17.5	350	33
	1634:00	71.6	17.5	360	33
	1634:10	71.5	17.6	370	33
	1634:20	71.6	17.5	380	33
	1634:30	71.6	17.5	390	33
	1634:40	71.7	17.4	400	33
	1634:50	71.6	17.5	410	33
	1635:00	71.7	17.4	420	31.8
	1635:10	71.7	17.4	430	31.8
	1635:20	71.6	17.5	440	31.8
	1635:30	71.6	17.5	450	31.8
	1635:40	71.6	17.5	460	31.8
	1635:50	71.6	17.5	470	31.8

DATA FROM PACKER TEST NO. 8 (2,583' to 2,759')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/27/77 Page 6 of 15

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	1636:00	71.5	17.6	480	31.8
	1636:10	71.5	17.6	490	31.8
	1636:20	71.5	17.6	500	31.8
	1636:30	71.6	17.5	510	31.8
	1636:40	71.5	17.6	520	31.8
	1636:50	71.6	17.5	530	31.8
	1637:00	71.6	17.5	540	31.8
	1637:10	71.5	17.6	550	31.8
	1637:20	71.6	17.5	560	31.8
	1637:30	71.6	17.5	570	31.8
	1637:40	71.6	17.5	580	31.8
	1637:50	71.6	17.5	590	31.8
	1638:00	71.6	17.5	600	34.3
	1638:10	71.5	17.6	610	34.3
	1638:20	71.4	17.7	620	34.3
	1638:30	71.5	17.6	630	34.3
	1638:40	71.5	17.6	640	34.3
	1638:50	71.5	17.6	650	34.3
	1639:00	71.5	17.6	660	34.3
	1639:10	71.4	17.7	670	34.3
	1639:20	71.4	17.7	680	34.3
	1639:30	71.4	17.7	690	34.3
	1639:40	71.4	17.7	700	34.3
	1639:50	71.4	17.7	710	34.3
	1640:00	71.3	17.8	720	34.3

DATA FROM PACKER TEST NO. 8 (2,583' to 2,759')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/27/77 Page 7 of 15

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	1640:10	71.2	17.9	730	34.3
	1640:20	71.2	17.9	740	34.3
	1640:30	71.3	17.8	750	34.3
	1640:40	71.2	17.9	760	34.3
	1640:50	71.3	17.8	770	34.3
	1641:00	71.3	17.8	780	34.3
	1641:10	71.2	17.9	790	34.3
	1641:20	71.3	17.8	800	34.3
	1641:30	71.1	18.0	810	34.3
	1641:40	71.2	17.9	820	34.3
	1641:50	71.2	17.9	830	34.3
	1642:00	71.2	17.9	840	34.3
	1642:10	71.1	18.0	850	34.3
	1642:20	71.1	18.0	860	34.3
	1642:30	71.1	18.0	870	34.3
	1642:40	71.2	17.9	880	34.3
	1642:50	71.1	18.0	890	34.3
	1643:00	71.0	18.1	900	34.3
	1643:10	71.1	18.0	910	34.3
	1643:20	71.1	18.0	920	34.3
	1643:30	71.1	18.0	930	34.3
	1643:40	71.1	18.0	940	34.3
	1643:50	71.0	18.1	950	34.3
	1644:00	71.0	18.1	960	34.3
	1644:10	70.9	18.2	970	34.3

DATA FROM PACKER TEST NO. 8 (2,583' to 2,759')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/27/77 Page 8 of 15

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	1644:20	71.0	18.1	980	34.3
	1644:30	71.0	18.1	990	34.3
	1644:40	71.0	18.1	1,000	34.3
	1644:50	71.0	18.1	1,010	34.3
	1645:00	71.0	18.1	1,020	34.3
	1645:10	71.0	18.1	1,030	34.3
	1645:20	70.9	18.2	1,040	34.3
	1645:30	70.9	18.2	1,050	34.3
	1645:40	70.9	18.2	1,060	34.3
	1645:50	71.0	18.1	1,070	34.3
	1646:00	71.1	18.0	1,080	34.3
	1646:30	70.9	18.2	1,110	34.3
	1647:00	71.0	18.1	1,140	34.3
	1647:30	71.1	18.0	1,170	34.3
	1648:00	71.0	18.1	1,200	34.3
	1648:30	71.0	18.1	1,230	34.3
	1649:00	71.0	18.1	1,260	34.3
	1649:30	71.0	18.1	1,290	34.3
	1650:00	71.0	18.1	1,320	34.3
	1650:30	71.0	18.1	1,350	34.3
	1651:00	71.0	18.1	1,380	34.3
	1651:30	71.0	18.1	1,410	34.3
	1652:00	70.9	18.2	1,440	34.3
	1652:30	70.9	18.2	1,470	34.3
	1653:00	70.9	18.2	1,500	34.3

DATA FROM PACKER TEST NO. 8 (2,583' to 2,759')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/27/77 Page 9 of 15

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	1654:00	71.0	18.1	1,560	34.3
	1655:00	70.8	18.3	1,620	34.3
	1656:00	70.9	18.2	1,680	34.3
	1657:00	70.8	18.3	1,740	34.3
	1658:00	70.6	18.5	1,800	32.0
	1659:00	70.6	18.5	1,860	30.8
	1700:00	70.4	18.7	1,920	33
	1701:00	70.5	18.6	1,980	33
	1702:00	70.4	18.7	2,040	33
	1703:00	70.6	18.5	2,100	33
	1704:00	70.4	18.7	2,160	33
	1705:00	70.6	18.5	2,220	33
	1706:00	70.6	18.5	2,280	33
	1707:00	70.6	18.5	2,340	33
	1708:00	70.6	18.5	2,400	33
	1709:00	70.6	18.5	2,460	33
	1710:00	70.5	18.6	2,520	33
	1711:00	70.4	18.7	2,580	33
	1712:00	70.5	18.6	2,640	33
	1713:00	70.5	18.6	2,700	33
	1714:00	70.5	18.6	2,760	33
	1715:00	70.6	18.5	2,820	33
	1716:00	70.5	18.6	2,880	33
	1717:00	70.5	18.6	2,940	33
	1718:00	70.4	18.7	3,000	33

DATA FROM PACKER TEST NO. 8 (2,583' to 2,759')

Test Well for Deep Disposal System for Miami-Dade Water and Sewer Authority.

Project No. 559-7601-3
Date 8/27/77 Page 10 of 15

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	1719:00	70.3	18.8	3,060	33
	1720:00	70.1	19.0	3,120	33
	1721:00	70.2	18.9	3,180	33
	1722:00	70.1	19.0	3,240	33
	1723:00	70.1	19.0	3,300	33
	1724:00	70.2	18.9	3,360	33
	1725:00	70.1	19.0	3,420	33
	1726:00	70.1	19.0	3,480	33
	1727:00	70.2	18.9	3,540	33
	1728:00	70.0	19.1	3,600	33
	1729:00	70.1	19.0	3,660	33
	1730:00	70.1	19.0	3,720	33
	1731:00	70.1	19.0	3,780	33
	1732:00	70.1	19.0	3,840	33
Increase flow to 60 gpm	1733:00	70.1	19.0	3,900	60.0
	1733:01	70.0	19.1	3,901	60.0
	1733:02	68.5	20.6	3,902	60.0
	1733:03	69.8	19.3	3,903	60.0
	1733:04	69.6	19.5	3,904	60.0
	1733:05	69.3	19.8	3,905	60.0
	1733:06	69.1	20.0	3,906	60.0
	1733:07	68.9	20.2	3,907	60.0
	1733:08	68.4	20.7	3,908	60.0
	1733:09	68.3	20.8	3,909	60.0
	1733:10	68.1	21.0	3,910	60.0

DATA FROM PACKER TEST NO. 8 (2,583' to 2,759')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/27/77 Page 11 of 15

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	1733:11	67.8	21.3	3,911	60.0
	1733:12	67.6	21.5	3,912	60.0
	1733:13	67.4	21.7	3,913	60.0
	1733:14	67.1	22.0	3,914	60.0
	1733:15	66.8	22.3	3,915	60.0
	1733:16	66.7	22.4	3,916	60.0
	1733:17	66.3	22.8	3,917	60.0
	1733:18	66.2	22.9	3,918	60.0
	1733:19	66.0	23.1	3,919	60.0
	1733:20	66.0	23.1	3,920	60.0
	1733:21	65.6	23.5	3,921	60.0
	1733:22	65.3	23.8	3,922	60.0
	1733:23	65.2	23.9	3,923	60.0
	1733:24	64.9	24.2	3,924	60.0
	1733:25	64.8	24.3	3,925	60.0
	1733:26	64.6	24.5	3,926	60.0
	1733:27	64.3	24.8	3,927	60.0
	1733:28	64.2	24.9	3,928	60.0
	1733:29	64.2	24.9	3,929	60.0
	1733:30	63.9	25.2	3,930	60.0
	1733:31	63.6	25.5	3,931	60.0
	1733:32	63.3	25.8	3,932	60.0
	1733:33	63.2	25.9	3,933	60.0
	1733:34	63.0	26.1	3,934	60.0
	1733:35	62.9	26.2	3,935	60.0

DATA FROM PACKER TEST NO. 8 (2,583' to 2,759')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/27/77 Page 12 of 15

Description	Time of Day	Wâter Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	1733:36	62.6	26.5	3,936	60.0
	1733:37	62.4	26.7	3,937	60.0
	1733:38	62.3	26.8	3,938	60.0
	1733:39	62.2	26.9	3,939	60.0
	1733:40	61.9	27.2	3,940	60.0
	1733:41	61.7	27.4	3,941	60.0
	1733:42	61.5	27.6	3,942	60.0
	1733:43	61.4	27.7	3,943	60.0
	1733:44	61.2	27.9	3,944	60.0
	1733:45	61.0	28.1	3,945	60.0
	1733:46	61.0	28.1	3,946	60.0
	1733:47	60.7	28.4	3,947	60.0
	1733:48	60.6	28.5	3,948	60.0
	1733:49	60.5	28.6	3,949	60.0
	1733:50	60.2	28.9	3,950	60.0
	1733:51	60.2	28.9	3,951	60.0
	1733:52	60.0	29.1	3,952	60.0
	1733:53	59.9	29.2	3,953	60.0
	1733:54	59.7	29.4	3,954	60.0
	1733:55	59.6	29.5	3,955	60.0
	1733:56	59.5	29.6	3,956	60.0
	1733:57	59.3	29.8	3,957	60.0
	1733:58	59.1	30.0	3,958	60.0
	1733:59	59.2	29.9	3,959	60.0
	1734:00	59.0	30.1	3,960	60.0

DATA FROM PACKER TEST NO. 8 (2,583' to 2,759')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/27/77 Page 13 of 15

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	1734:01	58.9	30.2	3,961	60.0
	1734:02	58.7	30.4	3,962	60.0
	1734:03	58.6	30.5	3,963	60.0
	1734:04	58.3	30.8	3,964	60.0
	1734:05	58.3	30.8	3,965	60.0
	1734:06	58.1	31.0	3,966	60.0
	1734:07	58.1	31.0	3,967	60.0
	1734:08	57.9	31.2	3,968	60.0
	1734:09	57.9	31.2	3,969	60.0
	1734:10	57.7	31.4	3,970	60.0
	1734:11	57.7	31.4	3,971	60.0
	1734:12	57.5	31.6	3,972	60.0
	1734:13	57.3	31.8	3,973	60.0
	1734:14	57.3	31.8	3,974	60.0
	1734:15	57.1	32.0	3,975	60.0
	1734:16	57.1	32.0	3,976	60.0
	1734:17	57.0	32.1	3,977	60.0
	1734:18	57.1	32.0	3,978	60.0
	1734:19	57.1	32.0	3,979	60.0
	1734:20	57.1	32.0	3,980	60.0
	1734:30	55.8	33.3	3,990	60.0
	1734:40	55.0	34.1	4,000	60.0
	1734:50	54.4	34.7	4,010	60.0
	1735:00	53.8	35.3	4,020	60.0
	1735:10	53.3	35.8	4,030	60.0

DATA FROM PACKER TEST NO. 8 (2,583' to 2,759')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/27/77 Page 14 of 15

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	1735:20	52.8	36.3	4,040	60.0
	1735:30	52.4	36.7	4,050	60.0
	1735:40	52.1	37.0	4,060	60.0
	1735:50	51.9	37.2	4,070	60.0
	1736:00	51.6	37.5	4,080	60.0
	1736:10	51.5	37.6	4,090	60.0
	1736:20	51.4	37.7	4,100	60.0
	1736:30	51.2	37.9	4,110	60.0
	1736:40	51.2	37.9	4,120	60.0
	1736:50	51.1	38.0	4,130	60.0
	1737:00	50.9	38.2	4,140	60.0
	1737:10	51.0	38.1	4,150	60.0
	1737:20	50.8	38.3	4,160	60.0
	1737:30	50.8	38.3	4,170	60.0
	1737:40	50.8	38.3	4,180	60.0
	1737:50	50.7	38.4	4,190	60.0
	1738:00	50.7	38.4	4,200	60.0
	1738:30	50.5	28.6	4,230	60.0
	1739:00	50.3	38.8	4,260	60.0
	1739:30	50.4	38.7	4,290	60.0
	1740:00	50.4	38.7	4,320	60.0
	1741:00	50.5	38.6	4,380	60.0
	1742:00	50.2	38.9	4,440	60.0
	1743:00	50.4	38.7	4,500	60.0
	1744:00	50.2	38.9	4,560	60.0

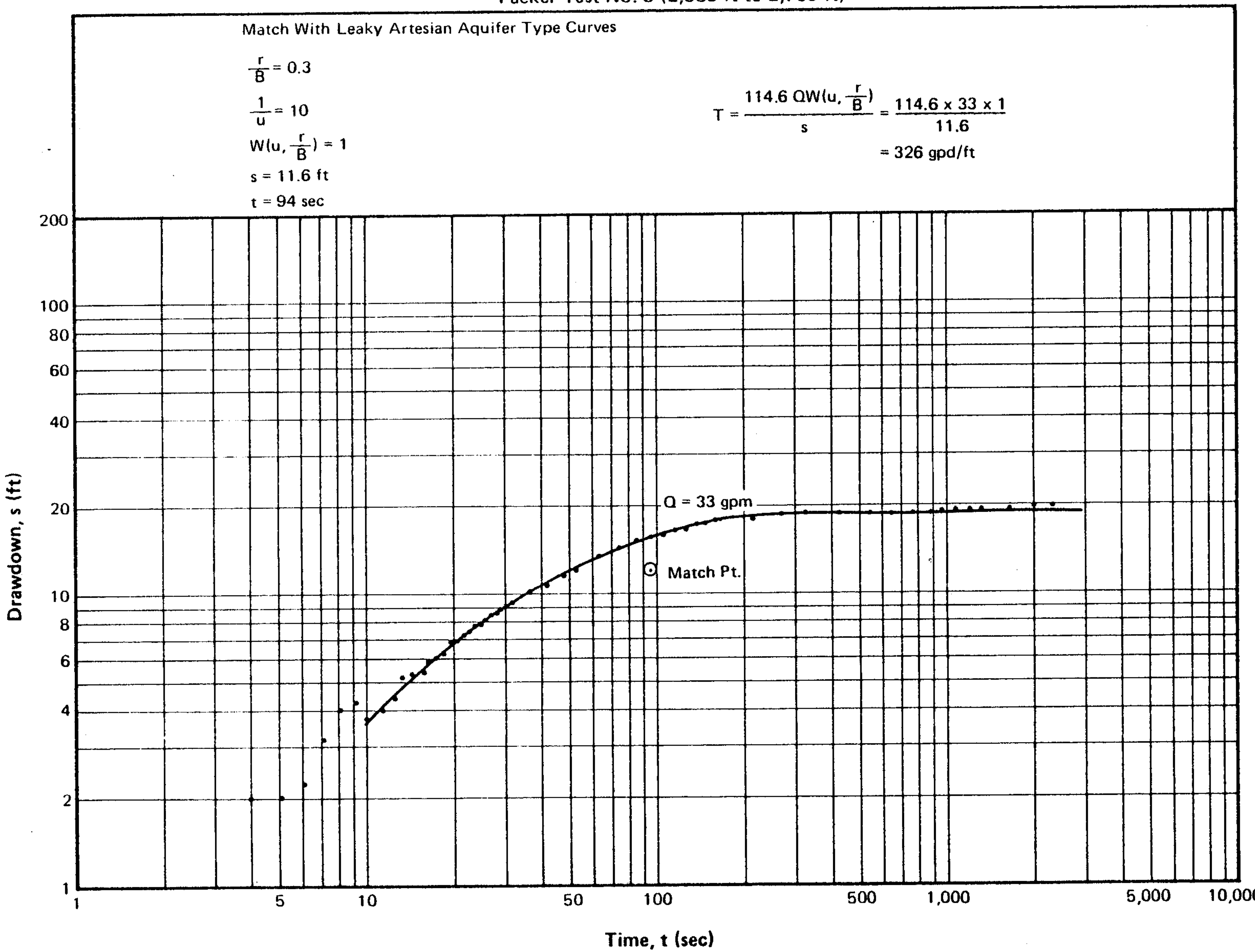
DATA FROM PACKER TEST NO. 8 (2,583' to 2,759')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/27/77 Page 15 of 15

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	1745:00	50.3	38.8	4,620	60.0
	1746:00	50.2	38.9	4,680	60.0
	1747:00	50.4	38.7	4,740	60.0
	1748:00	50.3	38.8	4,800	60.0
	1749:00	50.4	38.7	4,860	60.0
	1750:00	50.4	38.7	4,920	60.0
	1752:00	50.7	38.4	5,040	60.0
	1754:00	50.5	38.6	5,160	60.0
	1756:00	50.5	38.6	5,280	60.0
	1758:00	50.6	28.5	5,400	60.0
	1800:00	50.6	38.5	5,520	60.0
	1802:00	50.4	38.7	5,640	60.0
	1804:00	50.3	38.8	5,760	60.0
	1806:00	50.2	38.9	5,880	60.0
	1808:00	50.5	38.6	6,000	60.0
	1810:00	50.8	38.3	6,120	60.0
	1812:00	50.6	38.5	6,240	60.0
Pump shut off	1814:00	50.6	38.5	6,360	60.0

Packer Test No. 8 (2,583 ft to 2,759 ft)



Time-drawdown graph, Miami-Dade Water and Sewer Authority, test well for deep disposal system.

DATA FROM PACKER TEST NO. 9 (2,692' to 2,759')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/28/77

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Start test	0113:00	94.2	--	0	12
	0113:02	94.0	0.2	2	12
	0113:03	91.5	2.7	3	12
	0113:04	91.6	2.6	4	12
	0113:05	91.7	2.5	5	12
	0113:06	93.9	0.3	6	12
	0113:07	89.4	4.8	7	12
	0113:08	89.3	4.9	8	12
	0113:09	90.1	4.1	9	12
	0113:10	90.7	3.5	10	12
	0113:11	90.6	3.6	11	12
	0113:12	90.8	3.4	12	12
	0113:13	90.2	4.0	13	12
	0113:14	90.1	4.1	14	12
	0113:15	90.1	4.1	15	12
	0113:16	90.0	4.2	16	12
	0113:17	90.3	3.9	17	12
	0113:18	90.0	4.2	18	12
	0113:19	90.1	4.1	19	12
	0113:20	90.0	4.2	20	12
	0113:21	89.7	4.5	21	12
	0113:22	90.1	4.1	22	12
	0113:23	90.1	4.1	23	12
	0113:24	89.9	4.3	24	12
	0113:25	90.1	4.1	25	12

DATA FROM PACKER TEST NO. 9 (2,692' to 2,759')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/28/77 Page 2 of 24

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	0113:26	90.1	4.1	26	12
	0113:27	90.2	4.0	27	12
	0113:28	89.8	4.4	28	12
	0113:29	90.0	4.2	29	12
	0113:30	90.2	4.0	30	12
	0113:31	90.1	4.1	31	12
	0113:32	89.9	4.3	32	12
	0113:33	89.9	4.3	33	12
	0113:34	89.8	4.4	34	12
	0113:35	89.7	4.5	35	12
	0113:36	89.8	4.4	36	12
	0113:37	89.3	4.9	37	12
	0113:38	89.7	4.5	38	12
	0113:39	89.8	4.4	39	12
	0113:40	89.8	4.4	40	12
	0113:41	89.4	4.8	41	12
	0113:42	89.6	4.6	42	12
	0113:43	89.6	4.6	43	12
	0113:44	89.3	4.9	44	12
	0113:45	89.2	5.0	45	12
	0113:46	89.3	4.9	46	12
	0113:47	89.1	5.1	47	12
	0113:48	89.0	5.2	48	12
	0113:49	89.2	5.0	49	12
	0113:50	89.4	4.8	50	12

DATA FROM PACKER TEST NO. 9 (2,692' to 2,759')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/28/77

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	0113:51	89.2	5.0	51	12
	0113:52	89.2	5.0	52	12
	0113:53	89.0	5.2	53	12
	0113:54	89.0	5.2	54	12
	0113:55	88.9	5.3	55	12
	0113:56	89.1	5.1	56	12
	0113:57	88.9	5.3	57	12
	0113:58	88.8	5.4	58	12
	0113:59	88.9	5.3	59	12
	0114:00	88.7	5.5	60	12
	0114:01	88.7	5.5	61	12
	0114:02	88.5	5.7	62	12
	0114:03	88.6	5.6	63	12
	0114:04	88.6	5.6	64	12
	0114:05	88.5	5.7	65	12
	0114:06	88.6	5.6	66	12
	0114:07	88.5	5.7	67	12
	0114:08	88.4	5.8	68	12
	0114:09	88.2	6.0	69	12
	0114:10	88.4	5.8	70	12
	0114:11	88.3	5.9	71	12
	0114:12	88.3	5.9	72	12
	0114:13	88.3	5.9	73	12
	0114:14	88.3	5.9	74	12
	0114:15	88.1	6.1	75	12

DATA FROM PACKER TEST NO. 9 (2,692' to 2,759')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/28/77

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	0114:16	88.0	6.2	76	12
	0114:17	88.1	6.1	77	12
	0114:18	88.2	6.0	78	12
	0114:19	87.8	6.4	79	12
	0114:20	87.8	6.4	80	12
	0114:21	87.9	6.3	81	12
	0114:22	87.9	6.3	82	12
	0114:23	87.8	6.4	83	12
	0114:24	87.8	6.4	84	12
	0114:25	87.8	6.4	85	12
	0114:26	87.8	6.4	86	12
	0114:27	87.7	6.5	87	12
	0114:28	87.4	6.8	88	12
	0114:29	87.5	6.7	89	12
	0114:30	87.3	6.9	90	12
	0114:31	87.1	7.1	91	12
	0114:32	87.5	6.7	92	12
	0114:33	87.3	6.9	93	12
	0114:34	87.3	6.9	94	12
	0114:35	86.9	7.3	95	12
	0114:36	87.1	7.1	96	12
	0114:37	87.0	7.2	97	12
	0114:38	87.0	7.2	98	12
	0114:39	86.9	7.3	99	12
	0114:40	86.9	7.3	100	12

DATA FROM PACKER TEST NO. 9 (2,692' to 2,759')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/28/77 Page 5 of 24

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	0114:41	86.8	7.4	101	12
	0114:42	86.6	7.6	102	12
	0114:43	86.7	7.5	103	12
	0114:44	86.9	7.3	104	12
	0114:45	86.6	7.6	105	12
	0114:46	86.5	7.7	106	12
	0114:47	86.6	7.6	107	12
	0114:48	86.4	7.8	108	12
	0114:49	86.3	7.9	109	12
	0114:50	86.5	7.7	110	12
	0114:51	86.3	7.9	111	12
	0114:52	86.3	7.9	112	12
	0114:53	86.1	8.1	113	12
	0114:54	86.2	8.0	114	12
	0114:55	86.1	8.1	115	12
	0114:56	86.0	8.2	116	12
	0114:57	85.9	8.3	117	12
	0114:58	86.1	8.1	118	12
	0114:59	85.9	8.3	119	12
	0115:00	85.9	8.3	120	12
	0115:10	85.5	8.7	130	12
	0115:20	85.2	9.0	140	12
	0115:30	85.1	9.1	150	12
	0115:40	84.7	9.5	160	12
	0115:50	84.5	9.7	170	12

DATA FROM PACKER TEST NO. 9 (2,692' to 2,759')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/28/77

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	0116:00	84.5	9.7	180	12
	0116:10	84.3	9.9	190	12
	0116:20	83.9	10.3	200	12
	0116:30	84.0	10.2	210	12
	0116:40	83.7	10.5	220	12
	0116:50	83.2	11.0	230	12
	0117:00	83.1	11.1	240	12
	0117:10	83.0	11.2	250	12
	0117:20	82.7	11.5	260	12
	0117:30	82.5	11.7	270	12
	0117:40	82.3	11.9	280	12
	0117:50	82.3	11.9	290	12
	0118:00	82.2	12.0	300	12
	0118:10	82.2	12.0	310	12
	0118:20	81.8	12.4	320	12
	0118:30	81.8	12.4	330	12
	0118:40	81.6	12.6	340	12
	0118:50	81.6	12.6	350	12
	0119:00	81.1	13.1	360	12
	0119:10	81.3	12.9	370	12
	0119:20	81.3	12.9	380	12
	0119:30	81.0	13.2	390	12
	0119:40	81.0	13.2	400	12
	0119:50	80.9	13.3	410	12
	0120:00	81.0	13.2	420	12

DATA FROM PACKER TEST NO. 9 (2,692' to 2,759')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/28/77 Page 7 of 24

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	0120:10	80.9	13.3	430	12
	0120:20	80.7	13.5	440	12
	0120:30	80.3	13.9	450	12
	0120:40	80.7	13.5	460	12
	0120:50	80.5	13.7	470	12
	0121:00	80.6	13.6	480	12
	0121:10	80.5	13.7	490	12
	0121:20	80.5	13.7	500	12
	0121:30	80.4	13.8	510	12
	0121:40	80.4	13.8	520	12
	0121:50	80.3	13.9	530	12
	0122:00	80.3	13.9	540	12
	0122:10	80.3	13.9	550	12
	0122:20	80.4	13.8	560	12
	0122:30	80.3	13.9	570	12
	0122:40	80.3	13.9	580	12
	0122:50	80.1	14.1	590	12
	0123:00	80.2	14.0	600	12
	0123:10	80.1	14.1	610	12
	0123:20	80.2	14.0	620	12
	0123:30	79.9	14.3	630	12
	0123:40	80.0	14.2	640	12
	0123:50	80.0	14.2	650	12
	0124:00	80.0	14.2	660	12
	0124:10	79.9	14.3	670	12

DATA FROM PACKER TEST NO. 9 (2,692' to 2,759')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/28/77 Page 8 of 24

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	0124:20	79.8	14.4	680	12
	0124:30	79.9	14.3	690	12
	0124:40	79.8	14.4	700	12
	0124:50	79.7	14.5	710	12
	0125:00	79.7	14.5	720	12
	0125:10	79.6	14.6	730	12
	0125:20	79.6	14.6	740	12
	0125:30	79.6	14.6	750	12
	0125:40	79.6	14.6	760	12
	0125:50	79.6	14.6	770	12
	0126:00	79.4	14.8	780	12
	0126:10	79.4	14.8	790	12
	0126:20	79.3	14.9	800	12
	0126:30	79.4	14.8	810	12
	0126:40	79.4	14.8	820	12
	0126:50	79.3	14.9	830	12
	0127:00	79.2	15.0	840	12
	0127:10	79.4	14.8	850	12
	0127:20	79.1	15.1	860	12
	0127:30	79.3	14.9	870	12
	0127:40	79.0	15.2	880	12
	0127:50	79.1	15.1	890	12
	0128:00	78.9	15.3	900	12
	0128:10	78.9	15.3	910	12
	0128:20	78.9	15.3	920	12

DATA FROM PACKER TEST NO. 9 (2,692' to 2,759')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/28/77 Page 9 of 24

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	0128:30	78.9	15.3	930	12
	0128:40	79.0	15.2	940	12
	0128:50	78.9	15.3	950	12
	0129:00	78.8	15.4	960	12
	0129:10	78.9	15.3	970	12
	0129:20	78.7	15.5	980	12
	0129:30	78.7	15.5	990	12
	0129:40	78.7	15.5	1,000	12
	0129:50	78.7	15.5	1,010	12
	0130:00	78.7	15.5	1,020	12
	0130:10	78.4	15.8	1,030	12
	0130:20	78.6	15.6	1,040	12
	0130:30	78.4	15.8	1,050	12
	0130:40	78.3	15.9	1,060	12
	0130:50	78.3	15.9	1,070	12
	0131:00	78.3	15.9	1,080	12
	0131:10	78.3	15.9	1,090	12
	0131:20	78.5	15.7	1,100	12
	0131:30	78.1	16.1	1,110	12
	0131:40	78.3	15.9	1,120	12
	0131:50	78.3	15.9	1,130	12
	0132:00	78.2	16.0	1,140	12
	0132:10	78.0	16.2	1,150	12
	0132:20	78.1	16.1	1,160	12
	0132:30	78.1	16.1	1,170	12

DATA FROM PACKER TEST NO. 9 (2,692' to 2,759')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/28/77

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	0132:40	77.9	16.3	1,180	12
	0132:50	78.0	16.2	1,190	12
	0133:00	78.0	16.2	1,200	12
	0133:10	77.9	16.3	1,210	12
	0133:20	77.9	16.3	1,220	12
	0133:30	77.9	16.3	1,230	12
	0133:40	77.9	16.3	1,240	12
	0133:50	77.9	16.3	1,250	12
	0134:00	77.8	16.4	1,260	12
	0134:10	77.9	16.3	1,270	12
	0134:20	77.9	16.3	1,280	12
	0134:30	77.8	16.4	1,290	12
	0134:40	77.9	16.3	1,300	12
	0134:50	77.8	16.4	1,310	12
	0135:00	77.6	16.6	1,320	12
	0135:10	77.7	16.5	1,330	12
	0135:20	77.7	16.5	1,340	12
	0135:30	77.6	16.6	1,350	12
	0135:40	77.6	16.6	1,360	12
	0135:50	77.7	16.5	1,370	12
	0136:00	77.5	16.7	1,380	12
	0136:10	77.5	16.7	1,390	12
	0136:20	77.7	16.5	1,400	12
	0136:30	77.5	16.7	1,410	12
	0136:40	77.4	16.8	1,420	12

DATA FROM PACKER TEST NO. 9 (2,692' to 2,759')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/28/77

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	0136:50	77.3	16.9	1,430	12
	0137:00	77.4	16.8	1,440	12
	0137:10	77.5	16.7	1,450	12
	0138:00	77.4	16.8	1,500	12
	0139:00	77.3	16.9	1,560	12
	0140:00	77.1	17.1	1,620	12
	0141:00	77.0	17.2	1,680	12
	0142:00	77.1	17.1	1,740	12
	0143:00	76.9	17.3	1,800	12
	0144:00	76.8	17.4	1,860	12
	0145:00	76.9	17.3	1,920	12
	0146:00	76.9	17.3	1,980	12
	0147:00	76.9	17.3	2,040	12
	0148:00	76.7	17.5	2,100	12
	0149:00	76.9	17.3	2,160	12
	0150:00	76.8	17.4	2,220	12
	0151:00	76.9	17.3	2,280	12
	0152:00	77.0	17.2	2,340	12
	0153:00	76.7	17.5	2,400	12
	0154:00	76.7	17.5	2,460	12
	0155:00	76.6	17.6	2,520	12
	0156:00	76.5	17.7	2,580	12
	0157:00	76.8	17.4	2,640	12
	0158:00	76.6	17.6	2,700	12
	0159:00	76.5	17.7	2,760	12

DATA FROM PACKER TEST NO. 9 (2,692' to 2,759')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/28/77

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	0200:00	76.7	17.5	2,820	12
	0201:00	76.8	17.4	2,880	12
	0202:00	76.5	17.7	2,940	12
	0203:00	76.6	17.6	3,000	12
	0204:00	76.6	17.6	3,060	12
	0205:00	76.6	17.6	3,120	12
	0206:00	76.8	17.4	3,180	12
	0207:00	76.6	17.6	3,240	12
	0208:00	76.7	17.5	3,300	12
	0209:00	76.4	17.8	3,360	12
	0210:00	76.6	17.6	3,420	12
	0211:00	76.5	17.7	3,480	12
	0212:00	76.5	17.7	3,540	12
	0213:00	76.5	17.7	3,600	12
	0214:00	76.5	17.7	3,660	12
	0215:00	76.4	17.8	3,720	12
	0216:00	76.5	17.7	3,780	12
	0217:00	76.6	17.6	3,840	12
	0218:00	76.7	17.5	3,900	12
	0219:00	76.7	17.5	3,960	12
	0220:00	76.7	17.5	4,020	12
	0221:00	76.7	17.5	4,080	12
	0222:00	76.7	17.5	4,140	12
	0223:00	76.6	17.6	4,200	12
	0224:00	76.8	17.4	4,260	12

DATA FROM PACKER TEST NO. 9 (2,692' to 2,759')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/28/77 Page 13 of 24

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	0225:00	76.6	17.6	4,320	12
	0226:00	76.7	17.5	4,380	12
	0227:00	76.7	17.5	4,440	12
	0228:00	76.5	17.7	4,500	12
	0229:00	76.8	17.4	4,560	12
	0230:00	76.6	17.6	4,620	12
	0231:00	76.6	17.6	4,680	12
	0232:00	76.6	17.6	4,740	12
	0233:00	76.4	17.8	4,800	12
	0234:00	76.7	17.5	4,860	12
	0235:00	76.6	17.6	4,920	12
	0236:00	76.4	17.8	4,980	12
	0237:00	76.5	17.7	5,040	12
	0238:00	76.6	17.6	5,100	12
	0238:10	76.6	17.6	5,110	12
	0238:20	76.6	17.6	5,120	12
	0238:30	76.8	17.4	5,130	12
	0238:40	76.5	17.7	5,140	12
	0238:50	76.5	17.7	5,150	12
Increase flow to 40 gpm	0239:00	76.6	17.6	5,160	40
	0239:01	76.7	17.5	5,161	40
	0239:02	76.2	18.0	5,162	40
	0239:04	75.8	18.4	5,164	40
	0239:05	75.5	18.7	5,165	40
	0239:06	75.3	18.9	5,166	40

DATA FROM PACKER TEST NO. 9 (2,692' to 2,759')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/28/77

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	0239:07	74.8	19.4	5,167	40
	0239:08	74.8	19.4	5,168	40
	0239:09	74.6	19.6	5,169	40
	0239:10	74.6	19.6	5,170	40
	0239:11	74.0	20.2	5,171	40
	0239:12	73.8	20.4	5,172	40
	0239:13	73.6	20.6	5,173	40
	0239:14	73.2	21.0	5,174	40
	0239:15	72.9	21.3	5,175	40
	0239:16	72.7	21.5	5,176	40
	0239:17	72.4	21.8	5,177	40
	0239:18	72.0	22.2	5,178	40
	0239:19	71.7	22.5	5,179	40
	0239:20	71.6	22.6	5,180	40
	0239:21	71.3	22.9	5,181	40
	0239:22	71.1	23.1	5,182	40
	0239:23	71.0	23.2	5,183	40
	0239:24	70.8	23.4	5,184	40
	0239:25	70.4	23.8	5,185	40
	0239:26	70.3	23.9	5,186	40
	0239:27	70.2	24.0	5,187	40
	0239:28	69.9	24.3	5,188	40
	0239:29	69.7	24.5	5,189	40
	0239:30	69.6	24.6	5,190	40
	0239:31	69.3	24.9	5,191	40

DATA FROM PACKER TEST NO. 9 (2,692' to 2,759')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/28/77

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	0239:32	69.1	25.1	5,192	40
	0239:33	69.0	25.2	5,193	40
	0239:34	68.7	25.5	5,194	40
	0239:35	68.5	25.7	5,195	40
	0239:36	68.5	25.7	5,196	40
	0239:37	68.2	26.0	5,197	40
	0239:38	68.1	26.1	5,198	40
	0239:39	67.9	26.3	5,199	40
	0239:40	67.7	26.5	5,200	40
	0239:41	67.5	26.7	5,201	40
	0239:42	67.4	26.8	5,202	40
	0239:43	67.2	27.0	5,203	40
	0239:44	67.1	27.1	5,204	40
	0239:45	66.8	27.4	5,205	40
	0239:46	66.7	27.5	5,206	40
	0239:47	66.7	27.5	5,207	40
	0239:48	66.4	27.8	5,208	40
	0239:49	66.3	27.9	5,209	40
	0239:50	66.1	28.1	5,210	40
	0239:51	66.0	28.2	5,211	40
	0239:52	65.8	28.4	5,212	40
	0239:53	65.8	28.4	5,213	40
	0239:54	65.5	28.7	5,214	40
	0239:55	65.4	28.8	5,215	40
	0239:56	65.2	29.0	5,216	40

DATA FROM PACKER TEST NO. 9 (2,692' to 2,759')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/28/77 Page 16 of 24

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	0239:57	65.0	29.2	5,217	40
	0239:58	64.8	29.4	5,218	40
	0239:59	64.6	29.6	5,219	40
	0240:00	64.6	29.6	5,220	40
	0240:01	64.5	29.7	5,221	40
	0240:02	64.4	29.8	5,222	40
	0240:03	64.0	30.2	5,223	40
	0240:04	64.0	30.2	5,224	40
	0240:05	64.0	30.2	5,225	40
	0240:06	63.7	30.5	5,226	40
	0240:07	63.5	30.7	5,227	40
	0240:08	63.3	30.9	5,228	40
	0240:09	63.3	30.9	5,229	40
	0240:10	63.3	30.9	5,230	40
	0240:11	63.1	31.1	5,231	40
	0240:12	63.0	31.2	5,232	40
	0240:13	62.8	31.4	5,233	40
	0240:14	62.5	31.7	5,234	40
	0240:15	62.4	31.8	5,235	40
	0240:16	62.3	31.9	5,236	40
	0240:17	62.1	32.1	5,237	40
	0240:18	62.0	32.2	5,238	40
	0240:19	61.9	32.3	5,239	40
	0240:20	61.7	32.5	5,240	40
	0240:21	61.6	32.6	5,241	40

DATA FROM PACKER TEST NO. 9 (2,692' to 2,759')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/28/77

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	0240:22	61.4	32.8	5,242	40
	0240:23	61.3	32.9	5,243	40
	0240:24	61.2	33.0	5,244	40
	0240:25	61.1	33.1	5,245	40
	0240:26	61.0	33.2	5,246	40
	0240:27	60.8	33.4	5,247	40
	0240:28	60.6	33.6	5,248	40
	0240:29	60.5	33.7	5,249	40
	0240:30	60.5	33.7	5,250	40
	0240:31	60.3	33.9	5,251	40
	0240:32	60.1	34.1	5,252	40
	0240:33	60.0	34.2	5,253	40
	0240:34	59.9	34.3	5,254	40
	0240:35	59.7	34.5	5,255	40
	0240:36	59.5	34.7	5,256	40
	0240:37	59.4	34.8	5,257	40
	0240:38	59.2	35.0	5,258	40
	0240:39	59.1	35.1	5,259	40
	0240:40	59.0	35.2	5,260	40
	0240:41	58.8	35.4	5,261	40
	0240:42	58.8	35.4	5,262	40
	0240:43	58.7	35.5	5,263	40
	0240:44	58.5	35.7	5,264	40
	0240:45	58.4	35.8	5,265	40
	0240:46	58.3	35.9	5,266	40

DATA FROM PACKER TEST NO. 9 (2,692' to 2,759')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/28/77 Page 18 of 24

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	0240:47	58.1	36.1	5,267	40
	0240:48	58.0	36.2	5,268	40
	0240:49	57.9	36.3	5,269	40
	0240:50	57.8	36.4	5,270	40
	0240:51	57.7	36.5	5,271	40
	0240:52	57.5	36.7	5,272	40
	0240:53	57.4	36.8	5,273	40
	0240:54	57.3	36.9	5,274	40
	0240:55	57.2	37.0	5,275	40
	0240:56	56.9	37.3	5,276	40
	0240:57	56.7	37.5	5,277	40
	0240:58	56.6	37.6	5,278	40
	0240:59	56.5	37.7	5,279	40
	0241:00	56.5	37.7	5,280	40
	0241:01	56.3	37.9	5,281	40
	0241:10	55.3	38.9	5,290	40
	0241:20	54.1	40.1	5,300	40
	0241:30	53.0	41.2	5,310	40
	0241:40	51.9	42.3	5,320	40
	0241:50	50.8	43.4	5,330	40
	0242:00	49.8	44.4	5,340	40
	0242:10	48.8	45.4	5,350	40
	0242:20	48.8	45.4	5,360	40
	0242:30	47.0	47.2	5,370	40
	0242:40	46.1	48.1	5,380	40

DATA FROM PACKER TEST NO. 9 (2,692' to 2,759')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/28/77

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	0242:50	45.3	48.9	5,390	40
	0243:00	44.5	49.7	5,400	40
	0243:10	43.8	50.4	5,410	40
	0243:20	43.1	51.1	5,420	40
	0243:30	42.4	51.8	5,430	40
	0243:40	41.8	52.4	5,440	40
	0243:50	41.3	52.9	5,450	40
	0244:00	40.9	53.3	5,460	40
	0244:10	40.4	53.8	5,470	40
	0244:20	39.9	54.3	5,480	40
	0244:30	39.4	54.8	5,490	40
	0244:40	39.0	55.2	5,500	40
	0244:50	38.6	55.6	5,510	40
	0245:00	38.1	56.1	5,520	40
	0245:10	37.8	56.4	5,530	40
	0245:20	37.4	56.8	5,540	40
	0245:30	36.9	57.3	5,550	40
	0245:40	36.6	57.6	5,560	40
	0245:50	36.2	58.0	5,570	40
	0246:00	35.9	58.3	5,580	40
	0246:10	35.6	58.6	5,590	40
	0246:20	35.3	58.9	5,600	40
	0246:30	35.1	59.1	5,610	40
	0246:40	34.7	59.5	5,620	40
	0246:50	34.5	59.7	5,630	40

DATA FROM PACKER TEST NO. 9 (2,692' to 2,759')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/28/77 Page 20 of 24

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	0247:00	34.3	59.9	5,640	40
	0247:10	34.1	60.1	5,650	40
	0247:20	33.9	60.3	5,660	40
	0247:30	33.6	60.6	5,670	40
	0247:40	33.4	60.8	5,680	40
	0247:50	33.3	60.9	5,690	40
	0248:00	33.1	61.1	5,700	40
	0248:10	32.9	61.3	5,710	40
	0248:20	32.9	61.3	5,720	40
	0248:30	32.8	61.4	5,730	40
	0248:40	32.6	61.6	5,740	40
	0248:50	32.6	61.6	5,750	40
	0249:00	32.5	61.7	5,760	40
	0249:10	32.4	61.8	5,770	40
	0249:20	32.3	61.9	5,780	40
	0249:30	32.3	61.9	5,790	40
	0249:40	32.3	61.9	5,800	40
	0249:50	32.1	62.1	5,810	40
	0250:00	32.1	62.1	5,820	40
	0250:10	32.0	62.2	5,830	40
	0250:20	32.2	62.0	5,840	40
	0250:30	31.9	62.3	5,850	40
	0250:40	31.8	62.4	5,860	40
	0250:50	31.9	62.3	5,870	40
	0251:00	31.9	62.3	5,880	40

DATA FROM PACKER TEST NO. 9 (2,692' to 2,759')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/28/77

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	0251:10	31.7	62.5	5,890	40
	0251:20	31.6	62.6	5,900	40
	0251:30	31.6	62.6	5,910	40
	0251:40	31.5	62.7	5,920	40
	0251:50	31.4	62.8	5,930	40
	0252:00	31.4	62.8	5,940	40
	0252:10	31.3	62.9	5,950	40
	0252:20	31.3	62.9	5,960	40
	0252:30	31.3	62.9	5,970	40
	0252:40	31.2	63.0	5,980	40
	0252:50	31.1	63.1	5,990	40
	0253:00	31.1	63.1	6,000	40
	0253:10	31.1	63.1	6,010	40
	0253:20	31.1	63.1	6,020	40
	0253:30	31.0	63.2	6,030	40
	0253:40	31.0	63.2	6,040	40
	0253:50	31.0	63.2	6,050	40
	0254:00	31.0	63.2	6,060	40
	0255:00	30.9	63.3	6,120	40
	0256:00	30.7	63.5	6,180	40
	0257:00	30.6	63.6	6,240	40
	0258:00	30.4	63.8	6,300	40
	0259:00	30.3	63.9	6,360	40
	0300:00	30.5	63.7	6,420	40
	0301:00	30.6	63.6	6,480	40

DATA FROM PACKER TEST NO. 9 (2,692' to 2,759')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/28/77 Page 22 of 24

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	0302:00	30.8	63.4	6,540	40
	0303:00	30.8	63.4	6,600	40
	0304:00	30.9	63.3	6,660	40
	0305:00	30.6	63.6	6,720	40
	0306:00	30.5	63.7	6,780	40
	0307:00	30.5	63.7	6,840	40
	0308:00	30.4	63.8	6,900	40
	0309:00	30.5	63.7	6,960	40
	0310:00	30.5	63.7	7,020	40
	0311:00	30.6	63.6	7,080	40
	0312:00	30.5	63.7	7,140	40
	0313:00	30.6	63.6	7,200	40
	0314:00	30.6	63.6	7,260	40
	0315:00	30.6	63.6	7,320	40
	0316:00	30.5	63.7	7,380	40
	0317:00	30.7	63.5	7,440	40
	0318:00	30.8	63.4	7,500	40
	0319:00	30.9	63.3	7,560	40
	0320:00	30.7	63.5	7,620	40
	0321:00	30.7	63.5	7,680	40
	0322:00	30.6	63.6	7,740	40
	0323:00	30.5	63.7	7,800	40
	0324:00	30.2	64.0	7,860	40
	0325:00	30.0	64.2	7,920	40
	0326:00	29.8	64.4	7,980	40

DATA FROM PACKER TEST NO. 9 (2,692' to 2,759')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/28/77 Page 23 of 24

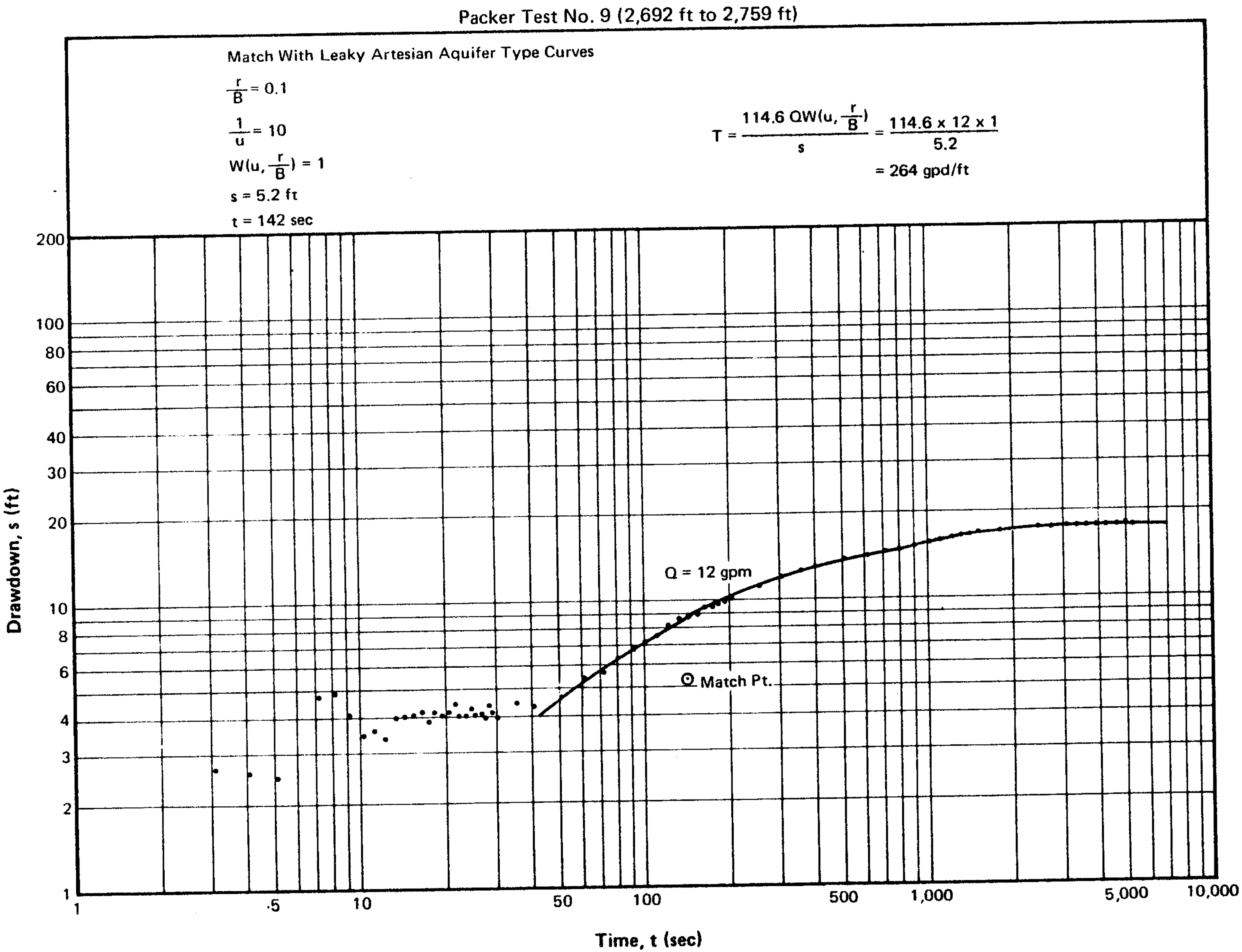
Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	0327:00	29.8	64.4	8,040	40
	0328:00	29.7	64.5	8,100	40
	0329:00	29.7	64.5	8,160	40
	0330:00	29.7	64.5	8,220	40
	0331:00	29.6	64.6	8,280	40
	0332:00	29.6	64.6	8,340	40
	0333:00	29.5	64.7	8,400	40
	0334:00	29.4	64.8	8,460	40
	0335:00	29.6	64.6	8,520	40
	0336:00	29.7	64.5	8,580	40
	0337:00	30.1	64.1	8,640	40
	0338:00	30.3	63.9	8,700	40
	0339:00	30.4	63.8	8,760	40
	0340:00	30.5	63.7	8,820	40
	0341:00	30.5	63.7	8,880	40
	0342:00	30.5	63.7	8,940	40
	0343:00	30.3	63.9	9,000	40
	0344:00	30.1	64.1	9,060	40
	0345:00	30.1	64.1	9,120	40
	0246:00	29.9	64.3	9,180	40
	0347:00	29.7	64.5	9,240	40
	0348:00	29.7	64.5	9,300	40
	0349:00	29.6	64.6	9,360	40
	0350:00	29.5	64.7	9,420	40
	0351:00	29.5	64.7	9,480	40

DATA FROM PACKER TEST NO. 9 (2,692' to 2,759')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/28/77

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	0352:00	29.5	64.7	9,540	40
	0353:00	29.5	64.7	9,600	40
	0354:00	29.5	64.7	9,660	40
	0355:00	29.5	64.7	9,720	40
	0356:00	29.5	64.7	9,780	40
	0357:00	29.4	64.8	9,840	40
	0358:00	29.4	64.8	9,900	40
	0359:00	29.4	64.8	9,960	40
	0359:10	29.4	64.8	9,970	40
	0359:20	29.4	64.8	9,980	40
	0359:30	29.3	64.9	9,990	40
	0359:40	29.4	64.8	10,000	40
	0359:50	29.4	64.8	10,010	40
Pump shut off	0400:00	29.4	64.8	10,020	40



Time-drawdown graph, Miami-Dade Water and Sewer Authority, test well for deep disposal system.

DATA FROM PACKER TEST NO. 10 (2,652' to 2,682')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/29/77

Description	Time of Day	Water Level. Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Start test	0554:00	85.2	--	0	20
	0554:02	91.0	-5.8	2	20
	0554:03	83.3	1.9	3	20
	0554:04	84.6	0.6	4	20
	0554:05	84.7	0.5	5	20
	0554:06	84.6	0.6	6	20
	0554:07	84.0	1.2	7	20
	0554:08	84.7	0.5	8	20
	0554:09	83.5	1.7	9	20
	0554:10	83.5	1.7	10	20
	0554:11	83.9	1.3	11	20
	0554:12	83.7	1.5	12	20
	0554:13	83.4	1.8	13	20
	0554:14	83.7	1.5	14	20
	0554:15	82.9	2.3	15	20
	0554:16	83.2	2.0	16	20
	0554:17	82.8	2.4	17	20
	0554:18	82.8	2.4	18	20
	0554:19	82.7	2.5	19	20
	0554:20	82.4	2.8	20	20
	0554:21	82.1	3.1	21	20
	0554:22	81.8	3.4	22	20
	0554:23	81.6	3.6	23	20
	0554:24	81.8	3.4	24	20
	0554:25	81.2	4.0	25	20

DATA FROM PACKER TEST NO. 10 (2,652' to 2,682')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/29/77

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	0554:26	81.0	4.2	26	20
	0554:27	81.1	4.1	27	20
	0554:28	80.8	4.4	28	20
	0554:29	80.7	4.5	29	20
	0554:30	80.6	4.6	30	20
	0554:31	80.2	5.0	31	20
	0554:32	80.1	5.1	32	20
	0554:33	80.0	5.2	33	20
	0554:34	79.8	5.4	34	20
	0554:35	79.6	5.6	35	20
	0554:36	79.3	5.9	36	20
	0554:37	79.3	5.9	37	20
	0554:38	79.2	6.0	38	20
	0554:39	78.9	6.3	39	20
	0554:40	78.8	6.4	40	20
	0554:41	78.7	6.5	41	20
	0554:42	78.3	6.9	42	20
	0554:43	78.3	6.9	43	20
	0554:44	78.1	7.1	44	20
	0554:45	78.1	7.1	45	20
	0554:46	77.9	7.3	46	20
	0554:47	77.7	7.5	47	20
	0554:48	77.6	7.6	48	20
	0554:49	77.4	7.8	49	20
	0554:50	77.4	7.8	50	20

DATA FROM PACKER TEST NO. 10 (2,652' to 2,682')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/29/77 Page 3 of 17

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	0554:51	77.1	8.1	51	20
	0554:52	77.0	8.2	52	20
	0554:53	77.1	8.1	53	20
	0554:54	76.7	8.5	54	20
	0554:55	76.6	8.6	55	20
	0554:56	76.5	8.7	56	20
	0554:57	76.4	8.8	57	20
	0554:58	76.2	9.0	58	20
	0554:59	76.2	9.0	59	20
	0555:00	75.9	9.3	60	20
	0555:01	75.8	9.4	61	20
	0555:02	75.8	9.4	62	20
	0555:03	75.6	9.6	63	20
	0555:04	75.5	9.7	64	20
	0555:05	75.3	9.9	65	20
	0555:06	75.1	10.1	66	20
	0555:07	75.1	10.1	67	20
	0555:08	74.9	10.3	68	20
	0555:09	74.8	10.4	69	20
	0555:10	74.9	10.3	70	20
	0555:11	74.5	10.7	71	20
	0555:12	74.4	10.8	72	20
	0555:13	74.4	10.8	73	20
	0555:14	74.2	11.0	74	20
	0555:15	74.2	11.0	75	20

DATA FROM PACKER TEST NO. 10 (2,652' to 2,682')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/29/77

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	0555:16	74.2	11.0	76	20
	0555:17	73.8	11.4	77	20
	0555:18	73.8	11.4	78	20
	0555:19	73.7	11.5	79	20
	0555:20	73.5	11.7	80	20
	0555:21	73.4	11.8	81	20
	0555:22	73.4	11.8	82	20
	0555:23	73.2	12.0	83	20
	0555:24	73.1	12.1	84	20
	0555:25	73.0	12.2	85	20
	0555:26	72.9	12.3	86	20
	0555:27	72.9	12.3	87	20
	0555:28	72.8	12.4	88	20
	0555:29	72.7	12.5	89	20
	0555:30	72.5	12.7	90	20
	0555:31	72.5	12.7	91	20
	0555:32	72.3	12.9	92	20
	0555:33	72.1	13.1	93	20
	0555:34	72.0	13.2	94	20
	0555:35	72.1	13.1	95	20
	0555:36	72.1	13.1	96	20
	0555:37	71.9	13.3	97	20
	0555:38	71.7	13.5	98	20
	0555:39	71.5	13.7	99	20
	0555:40	71.5	13.7	100	20

DATA FROM PACKER TEST NO. 10 (2,652' to 2,682')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/29/77 Page 5 of 17

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	0555:41	71.6	13.6	101	20
	0555:42	71.5	13.7	102	20
	0555:43	71.5	13.7	103	20
	0555:44	71.5	13.7	104	20
	0555:45	71.2	14.0	105	20
	0555:46	71.1	14.1	106	20
	0555:47	71.0	14.2	107	20
	0555:48	70.9	14.3	108	20
	0555:49	71.0	14.2	109	20
	0555:50	70.8	14.4	110	20
	0555:51	70.9	14.3	111	20
	0555:52	70.8	14.4	112	20
	0555:53	70.7	14.5	113	20
	0555:54	70.8	14.4	114	20
	0555:55	70.7	14.5	115	20
	0555:56	70.8	14.4	116	20
	0555:57	70.6	14.6	117	20
	0555:58	70.6	14.6	118	20
	0555:59	70.6	14.6	119	20
	0556:00	70.7	14.5	120	20
	0556:10	70.5	14.7	130	20
	0556:20	70.3	14.9	140	20
	0556:30	69.6	15.6	150	20
	0556:40	68.9	16.3	160	20
	0556:50	68.0	17.2	170	20

DATA FROM PACKER TEST NO. 10 (2,652' to 2,682')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/29/77

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	0557:00	67.1	18.1	180	20
	0557:10	66.3	18.9	190	20
	0557:20	65.8	19.4	200	20
	0557:30	65.3	19.9	210	20
	0557:40	64.7	20.5	220	20
	0557:50	64.3	20.9	230	20
	0558:00	63.8	21.4	240	20
	0558:10	63.5	21.7	250	20
	0558:20	63.2	22.0	260	20
	0558:30	62.8	22.4	270	20
	0558:40	62.4	22.8	280	20
	0558:50	62.1	23.1	290	20
	0559:00	61.8	23.4	300	20
	0559:10	61.7	23.5	310	20
	0559:20	61.4	23.8	320	20
	0559:30	61.3	23.9	330	20
	0559:40	61.1	24.1	340	20
	0559:50	60.8	24.4	350	20
	0600:00	60.7	24.5	360	20
	0600:10	60.5	24.7	370	20
	0600:20	60.4	24.8	380	20
	0600:30	60.2	25.0	390	20
	0600:40	60.0	25.2	400	20
	0600:50	60.0	25.2	410	20
	0601:00	59.9	25.3	420	20

DATA FROM PACKER TEST NO. 10 (2,652' to 2,682')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/29/77 Page 7 of 17

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	0601:10	59.6	25.6	430	20
	0601:20	59.7	25.5	440	20
	0601:30	59.5	25.7	450	20
	0601:40	59.5	25.7	460	20
	0601:50	59.3	25.9	470	20
	0602:00	59.3	25.9	480	20
	0602:10	59.2	26.0	490	20
	0602:20	58.9	26.3	500	20
	0603:30	59.1	26.1	510	20
	0602:40	59.2	26.0	520	20
	0602:50	59.0	26.2	530	20
	0603:00	58.9	26.3	540	20
	0603:10	59.0	26.2	550	20
	0603:20	59.0	26.2	560	20
	0603:30	58.9	26.3	570	20
	0603:40	58.9	26.3	580	20
	0603:50	58.8	26.4	590	20
	0604:00	58.9	26.3	600	20
	0604:10	58.9	26.3	610	20
	0604:20	58.7	26.5	620	20
	0604:30	58.8	26.4	630	20
	0604:40	58.7	26.5	640	20
	0604:50	58.7	26.5	650	20
	0605:00	58.6	26.6	660	20
	0605:10	58.7	26.5	670	20

DATA FROM PACKER TEST NO. 10 (2,652' to 2,682')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/29/77 Page 8 of 17

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	0605:20	58.8	26.4	680	20
	0605:30	58.8	26.4	690	20
	0605:40	58.7	26.5	700	20
	0605:50	58.7	26.5	710	20
	0606:00	58.7	26.5	720	20
	0607:00	58.8	26.4	780	20
	0608:00	58.7	26.5	840	20
	0609:00	58.7	26.5	900	20
	0610:00	58.7	26.5	960	20
	0611:00	58.8	26.4	1,020	20
	0612:00	58.6	26.6	1,080	20
	0613:00	58.7	26.5	1,140	20
	0614:00	58.5	26.7	1,200	20
	0615:00	58.5	26.7	1,260	20
	0616:00	58.6	26.6	1,320	20
	0617:00	58.4	26.8	1,380	20
	0618:00	58.5	26.7	1,440	20
	0619:00	58.5	26.7	1,500	20
	0620:00	58.5	26.7	1,560	20
	0621:00	58.5	26.7	1,620	20
	0622:00	58.6	26.6	1,680	20
	0623:00	58.7	26.5	1,740	20
	0624:00	58.8	26.4	1,800	20
	0625:00	58.8	26.4	1,860	20
	0626:00	58.7	26.5	1,920	20

DATA FROM PACKER TEST NO. 10 (2,652' to 2,682')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/29/77 Page 9 of 17

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Increase flow to 40 gpm	0627:00	58.8	26.4	1,980	40
	0627:05	58.0	27.2	1,985	40
	0627:06	57.8	27.4	1,986	40
	0627:07	57.6	27.6	1,987	40
	0627:08	57.4	27.8	1,988	40
	0627:09	57.0	28.2	1,989	40
	0627:10	56.7	28.5	1,990	40
	0627:11	56.6	28.6	1,991	40
	0627:12	56.4	28.8	1,992	40
	0627:13	56.1	29.1	1,993	40
	0627:14	55.7	29.5	1,994	40
	0627:15	55.7	29.5	1,995	40
	0627:16	55.3	29.9	1,996	40
	0627:17	55.2	30.0	1,997	40
	0627:18	54.9	30.3	1,998	40
	0627:19	54.6	30.6	1,999	40
	0627:20	54.5	30.7	2,000	40
	0627:21	54.1	31.1	2,001	40
	0627:22	54.0	31.2	2,002	40
	0627:23	53.8	31.4	2,003	40
	0627:24	53.4	31.8	2,004	40
	0627:25	53.3	31.9	2,005	40
	0627:26	53.0	32.2	2,006	40
	0627:27	52.9	32.3	2,007	40
	0627:28	52.7	32.5	2,008	40

DATA FROM PACKER TEST NO. 10 (2,652' to 2,682')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/29/77

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	0627:29	52.4	32.8	2,009	40
	0627:30	52.2	33.0	2,010	40
	0627:31	52.0	33.2	2,011	40
	0627:32	52.0	33.2	2,012	40
	0627:33	51.7	33.5	2,013	40
	0627:34	51.5	33.7	2,014	40
	0627:35	51.3	33.9	2,015	40
	0627:36	51.2	34.0	2,016	40
	0627:37	50.9	34.3	2,017	40
	0627:38	50.7	34.5	2,018	40
	0627:39	50.5	34.7	2,019	40
	0627:40	50.3	34.9	2,020	40
	0627:41	50.2	35.0	2,021	40
	0627:42	49.9	35.3	2,022	40
	0627:43	49.7	35.5	2,023	40
	0627:44	49.5	35.7	2,024	40
	0627:45	49.3	35.9	2,025	40
	0627:46	49.2	36.0	2,026	40
	0627:47	49.1	36.1	2,027	40
	0627:48	49.0	36.2	2,028	40
	0627:49	48.7	36.5	2,029	40
	0627:50	48.7	36.5	2,030	40
	0627:51	48.3	36.9	2,031	40
	0627:52	48.2	37.0	2,032	40
	0627:53	48.1	37.1	2,033	40

DATA FROM PACKER TEST NO. 10 (2,652' to 2,682')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/29/77 Page 11 of 17

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	0627:54	47.9	37.3	2,034	40
	0627:55	47.6	37.6	2,035	40
	0627:56	47.6	37.6	2,036	40
	0627:57	47.4	37.8	2,037	40
	0627:58	47.3	37.9	2,038	40
	0627:59	47.0	38.2	2,039	40
	0628:00	47.0	38.2	2,040	40
	0628:10	45.5	39.7	2,050	40
	0628:20	44.0	41.2	2,060	40
	0628:30	42.4	42.8	2,070	40
	0628:40	40.9	44.3	2,080	40
	0628:50	39.6	45.6	2,090	40
	0629:00	38.2	47.0	2,100	40
	0629:10	36.9	48.3	2,110	40
	0629:20	35.5	49.7	2,120	40
	0629:30	34.3	50.9	2,130	40
	0629:40	33.2	52.0	2,140	40
	0629:50	32.3	52.9	2,150	40
	0630:00	31.5	53.7	2,160	40
	0630:10	30.9	54.3	2,170	40
	0630:20	30.1	55.1	2,180	40
	0630:30	29.6	55.6	2,190	40
	0630:40	29.0	56.2	2,200	40
	0630:50	28.4	56.8	2,210	40
	0631:00	27.9	57.3	2,220	40

DATA FROM PACKER TEST NO. 10 (2,652' to 2,682')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/29/77 Page 12 of 17

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	0631:10	27.5	57.7	2,230	40
	0631:20	27.0	58.2	2,240	40
	0631:30	26.7	58.5	2,250	40
	0631:40	26.2	59.0	2,260	40
	0631:50	25.9	59.3	2,270	40
	0632:00	25.5	59.7	2,280	40
	0632:10	25.2	60.0	2,290	40
	0632:20	24.8	60.4	2,300	40
	0632:30	24.5	60.7	2,310	40
	0632:40	24.2	61.0	2,320	40
	0632:50	24.0	61.2	2,330	40
	0633:00	23.7	61.5	2,340	40
	0633:10	23.5	61.7	2,350	40
	0633:20	23.3	61.9	2,360	40
	0633:30	23.1	62.1	2,370	40
	0633:40	22.8	62.4	2,380	40
	0633:50	22.6	62.6	2,390	40
	0634:00	22.4	62.8	2,400	40
	0634:10	22.2	63.0	2,410	40
	0634:20	21.9	63.3	2,420	40
	0634:30	21.6	63.6	2,430	40
	0634:40	21.4	63.8	2,440	40
	0634:50	21.1	64.1	2,450	40
	0635:00	20.9	64.3	2,460	40
	0635:10	20.6	64.6	2,470	40

DATA FROM PACKER TEST NO. 10 (2,652' to 2,682')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/29/77 Page 13 of 17

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	0635:20	20.4	64.8	2,480	40
	0635:30	20.2	65.0	2,490	40
	0635:40	20.0	65.2	2,500	40
	0635:50	19.8	65.4	2,510	40
	0636:00	19.6	65.6	2,520	40
	0636:10	19.4	65.8	2,530	40
	0636:20	19.3	65.9	2,540	40
	0636:30	19.1	66.1	2,550	40
	0636:40	19.0	66.2	2,560	40
	0636:50	18.9	66.3	2,570	40
	0637:00	18.8	66.4	2,580	40
	0638:00	18.2	67.0	2,640	40
	0639:00	17.7	67.5	2,700	40
	0640:00	17.4	67.8	2,760	40
	0641:00	17.2	68.0	2,820	40
	0642:00	16.9	68.3	2,880	40
	0643:00	16.6	68.6	2,940	40
	0644:00	16.4	68.8	3,000	40
	0645:00	16.3	68.9	3,060	40
	0646:00	16.1	69.1	3,120	40
	0647:00	15.9	69.3	3,180	40
	0648:00	16.0	69.2	3,240	40
	0649:00	15.9	69.3	3,300	40
	0650:00	15.8	69.4	3,360	40
	0651:00	15.9	69.3	3,420	40

DATA FROM PACKER TEST NO. 10 (2,652' to 2,682')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/29/77 Page 14 of 17

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	0652:00	15.9	69.3	3,480	40
	0653:00	15.9	69.3	3,540	40
	0654:00	15.9	69.3	3,600	40
	0655:00	15.8	69.4	3,660	40
	0656:00	15.9	69.3	3,720	40
	0657:00	15.8	69.4	3,780	40
	0658:00	15.7	69.5	3,840	40
	0659:00	15.8	69.4	3,900	40
	0700:00	16.1	69.1	3,960	40
	0701:00	16.4	68.8	4,020	40
	0702:00	16.9	68.3	4,080	40
	0703:00	17.2	68.0	4,140	37.5
	0704:00	17.4	67.8	4,200	37.5
	0705:00	17.3	67.9	4,260	40
	0706:00	17.2	68.0	4,320	40
	0707:00	17.0	68.2	4,380	40
	0708:00	17.1	68.1	4,440	40
	0709:00	17.0	68.2	4,500	40
	0710:00	17.0	68.2	4,560	40
	0711:00	16.8	68.4	4,620	40
	0712:00	16.6	68.6	4,680	40
	0713:00	16.0	69.2	4,740	40
	0714:00	15.8	69.4	4,800	40
	0715:00	15.6	69.6	4,860	40
	0716:00	15.4	69.8	4,940	40

DATA FROM PACKER TEST NO. 10 (2,652' to 2,682')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/29/77 Page 15 of 17

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	0717:00	15.2	70.0	4,980	40
	0718:00	15.1	70.1	5,040	40
	0719:00	15.0	70.2	5,100	40
	0720:00	14.9	70.3	5,160	40
	0721:00	14.7	70.5	5,220	40
	0722:00	14.5	70.7	5,280	40
	0723:00	14.6	70.6	5,340	40
	0724:00	14.4	70.8	5,400	40
	0725:00	14.3	70.9	5,460	40
	0726:00	14.4	70.8	5,520	40
	0727:00	14.4	70.8	5,580	40
	0728:00	14.4	70.8	5,640	40
	0729:00	14.5	70.7	5,700	40
	0730:00	14.6	70.6	5,760	40
	0731:00	14.7	70.5	5,820	40
	0732:00	14.8	70.4	5,880	40
	0733:00	15.2	70.0	5,940	40
	0734:00	15.4	69.8	6,000	40
	0735:00	15.6	69.6	6,060	40
	0736:00	16.4	68.8	6,120	40
	0737:00	16.6	68.6	6,180	40
	0738:00	16.5	68.7	6,240	40
	0739:00	16.0	69.2	6,300	40
	0740:00	15.7	69.5	6,360	40
	0741:00	15.5	69.7	6,420	40

DATA FROM PACKER TEST NO. 10 (2,652' to 2,682')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/29/77

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	0742:00	15.4	69.8	6,480	40
	0743:00	15.5	69.7	6,540	40
	0744:00	15.7	69.5	6,600	40
	0745:00	15.5	69.7	6,660	40
	0746:00	15.2	70.0	6,720	40
	0747:00	15.0	70.2	6,780	40
	0748:00	14.7	70.5	6,840	40
	0749:00	14.7	70.5	6,900	40
	0750:00	15.1	70.1	6,960	40
	0751:00	15.4	69.8	7,020	40
	0752:00	15.2	70.0	7,080	40
	0753:00	14.9	70.3	7,140	40
	0754:00	14.9	70.3	7,200	40
	0755:00	14.9	70.3	7,260	40
	0756:00	15.4	69.8	7,320	40
	0757:00	15.8	69.4	7,380	40
	0758:00	16.2	69.0	7,440	40
	0759:00	16.1	69.1	7,500	40
	0800:00	15.8	69.4	7,560	40
	0801:00	15.6	69.6	7,620	40
	0802:00	15.5	69.7	7,680	40
	0803:00	15.7	69.5	7,740	40
	0804:00	16.1	69.1	7,800	40
	0805:00	16.3	68.9	7,860	40
	0806:00	16.1	69.1	7,920	40

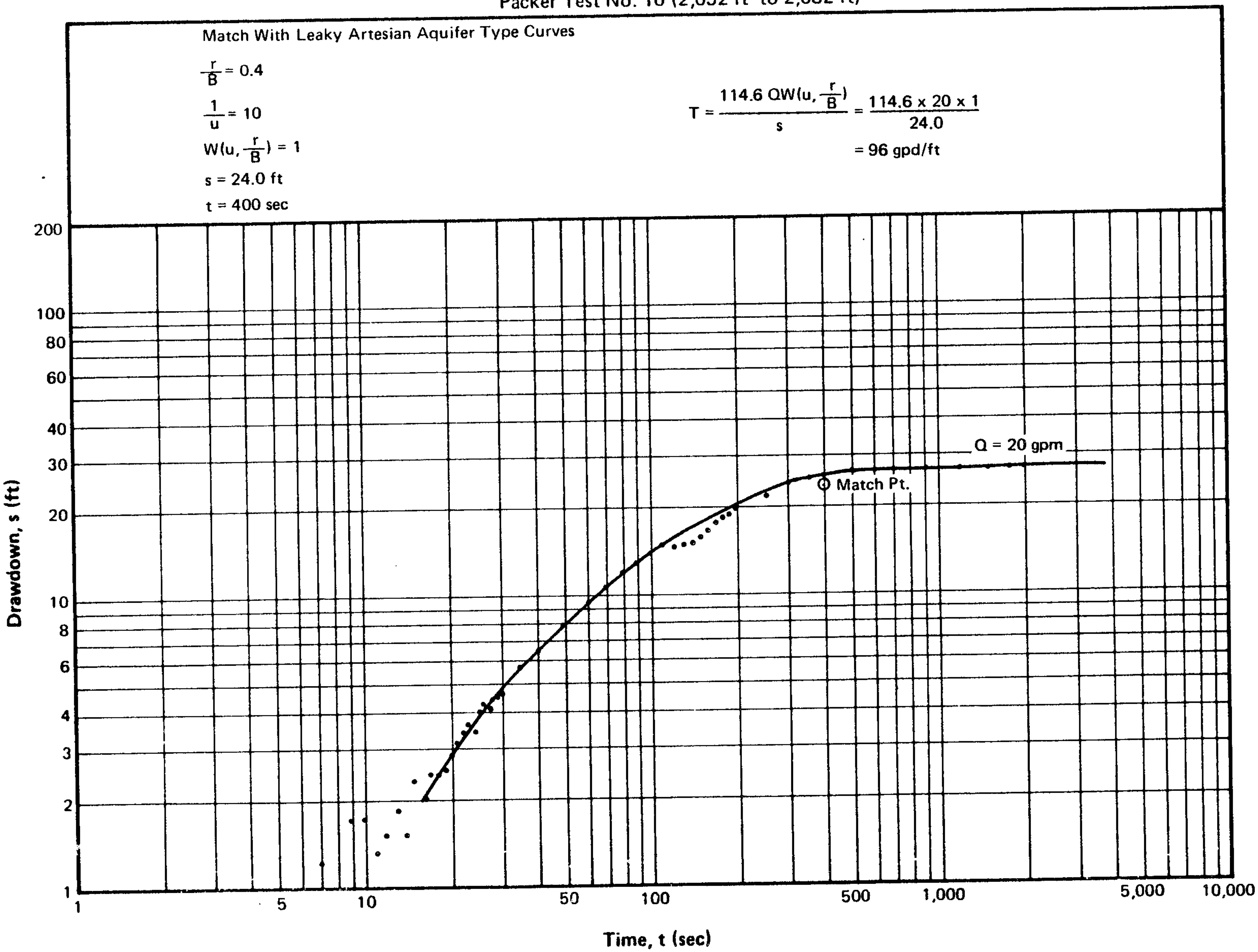
DATA FROM PACKER TEST NO. 10 (2,652' to 2,682')

Test Well for Deep Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 8/29/77 Page 17 of 17

Description	Time of Day	Water Level Reading (feet)	Drawdown (feet)	Time t (seconds)	Flow Q (gpm)
Continue test	0807:00	15.9	69.3	7,980	40
	0808:00	15.7	69.5	8,040	40
	0809:00	15.7	69.5	8,100	40
	0810:00	15.7	69.5	8,160	40
	0811:00	15.8	69.4	8,220	40
	0812:00	15.8	69.4	8,280	40
	0813:00	15.5	69.7	8,340	40
	0814:00	15.4	69.8	8,400	40
	0815:00	15.1	70.1	8,460	40
	0815:20	15.2	70.0	8,480	40
	0815:30	15.2	70.0	8,490	40
	0815:40	15.3	69.9	8,500	40
	0815:50	15.3	69.9	8,510	40
Pump shut off	0816:00	15.3	69.9	8,520	40

Packer Test No. 10 (2,652 ft to 2,682 ft)



Time-drawdown graph, Miami-Dade Water and Sewer Authority, test well for deep disposal system.

PUMP OUT TESTS

PUMPING TEST RECORDS

Pump-Out Test

Test Well for Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 10/20/77 Sheet 1 of 6

Record of flow and water level in pumping zone (inside 20-inch casing)
Measuring Point: center of gage, 14.4 feet above msl (5.0 feet above pad at well)

Time	t Elapsed Time (minutes)	Flowmeter ΔH (inches H_2O)	Flowmeter Q (gpm)	Bubbler System Pressure (psi)	Bubbler System Δs (feet)	Remarks
0730				18.28		
0745				18.28		
0800	0			18.27		Start pump
0800:30	0.5			3.45	33.30	
0801	1.0			3.54	33.10	
0801:30	1.5			4.55	30.83	
0802	2.0	49.0	6,200	5.24	29.28	
0802:30	2.5			6.24	27.03	
0803	3.0			6.99	25.35	
0803:30	3.5			7.84	23.44	
0804	4.0	48.5	6,200	8.65	21.62	
0804:30	4.5			8.64	21.64	
0805	5.0			8.60	21.73	
0805:30	5.5			9.20	20.38	
0806	6.0	47.5	6,200	9.05	20.72	
0806:30	6.5			9.06	20.70	
0807	7.0			9.21	20.36	
0807:30	7.5			9.02	20.79	
0808	8.0	47.5	6,200	9.12	20.56	
0808:30	8.5			9.14	20.52	
0809	9.0			9.16	20.47	
0809:30	9.5			9.13	20.54	
0810	10.0	48.0	6,200	9.10	20.61	
0810:30	10.5			9.14	20.52	
0811	11.0			9.16	20.47	

PUMPING TEST RECORDS

Pump-Out Test

Test Well for Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 10/20/77 Sheet 2 of 6

Record of flow and water level in pumping zone (inside 20-inch casing)
Measuring Point: center of gage, 14.4 feet above msl (5.0 feet above pad at well)

Time	t Elapsed Time (minutes)	Flowmeter		Bubbler System		Remarks
		ΔH (inches H_2O)	Q (gpm)	Pressure (psi)	Δs (feet)	
0811:30	11.5			9.14	20.52	Continue test
0812	12.0	48.0	6,200	9.10	20.61	
0812:30	12.5			9.12	20.56	
0813	13.0			9.09	20.63	
0813:30	13.5			9.08	20.65	
0814	14.0	48.5	6,200	9.09	20.63	
0814:30	14.5			9.18	20.43	
0815	15.0			9.15	20.49	
0815:30	15.5			9.12	20.56	
0816	16.0	48.0	6,200	9.11	20.58	
0816:30	16.5			9.10	20.61	
0817	17.0			9.11	20.58	
0817:30	17.5			9.13	20.54	
0818	18.0	48.5	6,200	9.10	20.61	
0818:30	18.5			9.12	20.56	
0819	19.0			9.11	20.58	
0819:30	19.5			9.08	20.65	
0820	20.0	49.0	6,200	9.08	20.65	
0820:30	20.5			9.10	20.61	
0821	21.0			9.09	20.63	
0821:30	21.5			9.11	20.58	
0822	22.0	49.0	6,200	9.08	20.65	
0822:30	22.5			9.08	20.65	
0823	23.0			9.09	20.63	
0823:30	23.5			9.08	20.65	

PUMPING TEST RECORDS

Pump-Out Test

Test Well for Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 10/20/77 Sheet 3 of 6

Record of flow and water level in pumping zone (inside 20-inch casing)
Measuring Point: center of gage, 14.4 feet above msl (5.0 feet above pad at well)

Time	t Elapsed Time (minutes)	Flowmeter		Bubbler System		Remarks
		ΔH (inches H_2O)	Q (gpm)	Pressure (psi)	Δs (feet)	
0824	24.0	49.0	6,200	9.11	20.58	Continue test
0824:30	24.5			9.10	20.61	
0825	25.0			9.09	20.63	
0826	26.0	48.5	6,200	9.09	20.63	
0827	27.0			9.07	20.67	
0828	28.0	49.5	6,250	9.07	20.67	
0829	29.0			9.10	20.61	
0830	30.0	49.0	6,200	9.09	20.63	
0832	32.0			9.08	20.65	
0834	34.0			9.12	20.56	
0836	36.0			9.07	20.67	
0838	38.0			9.11	20.58	
0840	40.0	50.0	6,250	9.08	20.65	
0843	43.0			9.08	20.65	
0846	46.0			9.07	20.67	
0850	50.0	49.5	6,250	9.08	20.65	
0855	55.0			9.07	20.67	
0900	60.0	50.5	6,300	9.03	20.77	
0910	70.0	50.5	6,300	9.06	20.70	
0920	80.0	50.1	6,280	9.05	20.72	
0930	90.0	49.9	6,250	9.15	20.49	
0940	100.0			9.16	20.47	
1000	120.0	50.3	6,300	9.16	20.47	
1020	140.0			9.17	20.45	
1030	150.0	50.1	6,280			

Test Well for Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 10/20/77 Sheet 4 of 6

Record of flow and water level in pumping zone (inside 20-inch casing)
Measuring Point: center of gage, 14.4 feet above msl (5.0 feet above pad at well)

Time	t Elapsed Time (minutes)	Flowmeter		Bubbler System		Remarks
		ΔH (inches H_2O)	Q (gpm)	Pressure (psi)	Δs (feet)	
1040	160.0			9.18	20.43	Continue test
1100	180.0	49.8	6,250	9.18	20.43	
1120	200.0			9.20	20.38	
1130	210.0	50.7	6,300			
1140	220.0			9.20	20.38	
1200	240.0	48.7	6,200	9.20	20.38	
1220	260.0			9.20	20.38	
1230	270.0	48.6	6,200			
1240	280.0			9.22	20.34	
1300	300.0	48.0	6,200	9.28	20.20	
1305	305.0	48.4	6,200			
1320	320.0			9.15	20.49	
1325	325.0	47.6	6,200			
1330	330.0	48.1	6,200			
1340	340.0	48.7	6,200	8.80	21.28	
1400	360.0	50.4	6,300	8.95	20.94	
1420	380.0			9.00	20.83	
1430	390.0	51.3	6,350			
1440	400.0			9.07	20.67	
1444	404.0					Pump shut down accidentally
1444	0		0	9.07	0	Start recovery
				(estimated)		
1445	1.0			14.20	11.53	
1445:30	1.5			14.40	11.98	
1446	2.0			14.75	12.76	

PUMPING TEST RECORDS

Pump-Out Test

Test Well for Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 10/20/77 Sheet 5 of 6

Record of flow and water level in pumping zone (inside 20-inch casing)
Measuring Point: center of gage, 14.4 feet above msl (5.0 feet above pad at well)

Time	t Elapsed Time (minutes)	Flowmeter		Bubbler System		Remarks
		ΔH (inches H_2O)	Q (gpm)	Pressure (psi)	Δs (feet)	
1446:30	2.5		0	15.20	13.78	Continue recovery
1447	3.0			15.55	14.56	
1447:30	3.5			16.02	15.62	
1448	4.0			16.47	16.63	
1448:30	4.5			16.91	17.62	
1449	5.0			17.30	18.49	
1449:30	5.5			17.70	19.39	
1450	6.0			17.98	20.02	
1450:30	6.5			18.00	20.07	
1451	7.0			18.01	20.09	
1452	8.0			18.01	20.09	
1453	9.0			18.01	20.09	
1454	10.0			18.01	20.09	
1455	11.0			18.01	20.09	
1500	16.0			18.02	20.11	
1505	21.0			18.02	20.11	
1510	26.0			18.02	20.11	
1515	31.0			18.03	20.13	
1520	36.0			18.03	20.13	
1525	41.0			18.04	20.16	
1529	45.0			18.06	20.20	
1534	50.0			18.07	20.22	
1539	55.0			18.07	20.22	
1544	60.0			18.07	20.22	
1554	70.0			18.07	20.22	

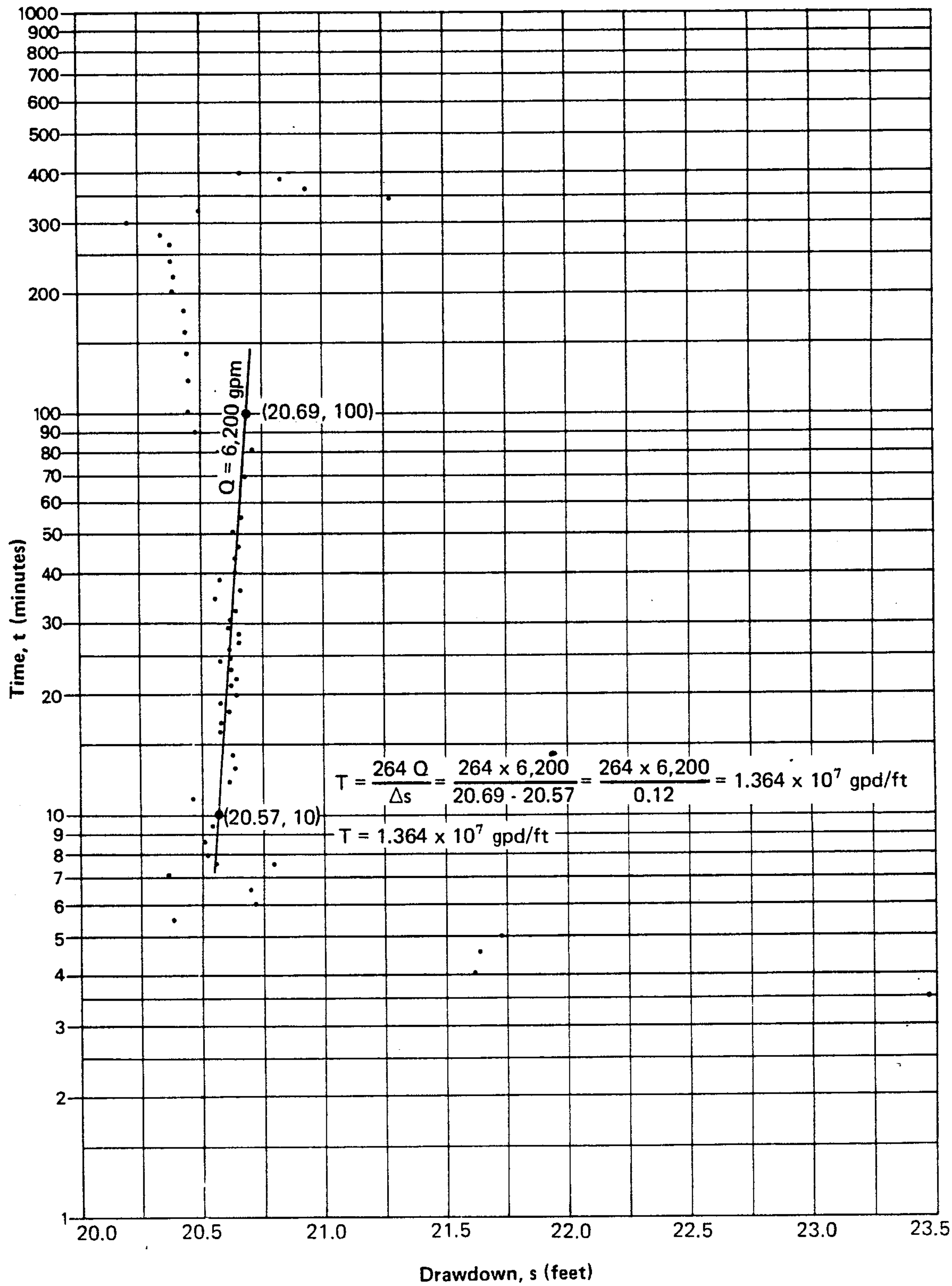
Pump-Out Test

Test Well for Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 10/20/77 Sheet 6 of 6

Record of flow and water level in pumping zone (inside 20-inch casing)
Measuring Point: center of gage, 14.4 feet above msl (5.0 feet above pad at well)

Time	t Elapsed Time (minutes)	Flowmeter		Bubbler System		Remarks
		ΔH (inches H_2O)	Q (gpm)	Pressure (psi)	Δs (feet)	
1604	80.0		0	18.07	20.22	Continue recovery
1614	90.0			18.08	20.25	
1624	100.0			18.09	20.27	
1630	106.0			18.10	20.29	End of recovery test



Pump-Out Test of Well: Drawdown in Pumping Zone (Inside 20-inch Casing)

PUMPING TEST RECORDS

Step-Drawdown Test

Test Well for Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 10/20/77 Sheet 1 of 5

Record of flow and water level in pumping zone (inside 20-inch casing)
Measuring Point: center of gage, 14.4 feet above msl (5.0 feet above pad at well)

Time	t Elapsed Time (minutes)	Flowmeter		Bubbler System		Remarks
		ΔH (inches H_2O)	Q (gpm)	Pressure (psi)	Δs (feet)	
1650	0			18.09	--	Start pump
1650:30	0.5			14.32	8.47	
1651	1.0	9.1	2,700	14.62	7.80	
1651:30	1.5			15.28	6.31	
1652	2.0			15.75	5.26	
1652:30	2.5			16.31	4.00	
1653	3.0			16.49	3.60	
1653:30	3.5			16.45	3.69	
1654	4.0			16.42	3.75	
1654:30	4.5			16.28	4.07	
1655	5.0	9.8	2,800	16.37	3.87	
1655:30	5.5			16.35	3.91	
1656	6.0			16.37	3.87	
1656:30	6.5			16.42	3.75	
1657	7.0			16.30	4.02	
1657:30	7.5			16.37	3.87	
1658	8.0			16.35	3.91	
1659	9.0			16.30	4.02	
1700	10.0	10.1	2,800	16.27	4.09	
1701	11.0			16.25	4.13	
1702	12.0			16.20	4.25	
1704	14.0			16.10	4.47	
1705	15.0	10.8	2,900			
1706	16.0			16.11	4.45	
1708	18.0	9.4	2,750	16.51	3.55	

PUMPING TEST RECORDS

Step-Drawdown Test

Test Well for Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 10/20/77 Sheet 2 of 5

Record of flow and water level in pumping zone (inside 20-inch casing)
Measuring Point: center of gage, 14.4 feet above msl (5.0 feet above pad at well)

Time	t Elapsed Time (minutes)	Flowmeter		Bubbler System		Remarks
		ΔH (inches H_2O)	Q (gpm)	Pressure (psi)	Δs (feet)	
1710	20.0	9.1	2,700	16.48	3.62	Continue test
1712	22.0			16.42	3.75	
1714	24.0			16.45	3.69	
1715	25.0	9.1	2,700	16.45	3.69	Step up pump rate
1715:30	25.5			12.35	12.90	
1716	26.0	23.0	4,250	12.82	11.84	
1716:30	26.5			13.34	10.67	
1717	27.0			13.76	9.73	
1717:30	27.5			13.82	9.60	
1718	28.0			13.93	9.35	
1718:30	28.5			13.85	9.53	
1719	29.0			13.75	9.75	
1719:30	29.5			13.82	9.60	
1720	30.0	24.3	4,400	13.83	9.57	
1721	31.0			13.85	9.53	
1722	32.0			13.84	9.55	
1723	33.0			13.80	9.64	
1724	34.0			13.77	9.71	
1725	35.0	23.3	4,300			
1726	36.0			13.79	9.66	
1728	38.0			13.80	9.64	
1730	40.0	22.9	4,250	13.77	9.71	
1732	42.0			13.79	9.66	
1734	44.0			13.78	9.69	
1735	45.0	23.1	4,250			

PUMPING TEST RECORDS

Step-Drawdown Test

Test Well for Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 10/20/77 Sheet 3 of 5

Record of flow and water level in pumping zone (inside 20-inch casing)
Measuring Point: center of gage, 14.4 feet above msl (5.0 feet above pad at well)

Time	t Elapsed Time (minutes)	Flowmeter ΔH (inches H_2O)	Flowmeter Q (gpm)	Bubbler System Pressure (psi)	Bubbler System Δs (feet)	Remarks
1736	46.0			13.77	9.71	Continue test
1738	48.0			13.78	9.69	
1740	50.0	23.3	4,300	13.75	9.75	Step up pump rate
1740:30	50.5	Offscale	Estimated Flow =	2.10	35.93	Flow estimated from rpm rate of
			7,600 gpm ↓			the pump
1741	51.0			2.35	35.37	
1741:30	51.5			2.70	34.58	
1742	52.0			3.10	33.69	
1742:30	52.5			3.52	32.74	
1743	53.0			3.93	31.82	
1743:30	53.5			4.32	30.94	
1744	54.0			4.71	30.07	
1744:30	54.5			5.12	29.15	
1745	55.0			5.22	28.92	
1745:30	55.5			5.25	28.85	
1746	56.0			5.27	28.81	
1746:30	56.5			5.26	28.83	
1747	57.0			5.27	28.81	
1747:30	57.5			5.25	28.85	
1748	58.0			5.28	28.79	
1748:30	58.5			5.25	28.85	
1749	59.0			5.26	28.83	
1749:30	59.5			5.23	28.90	
1750	60.0			5.25	28.85	
1751	61.0			5.26	28.83	

PUMPING TEST RECORDS

Step-Drawdown Test

Test Well for Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 10/20/77 Sheet 4 of 5

Record of flow and water level in pumping zone (inside 20-inch casing)
Measuring Point: center of gage, 14.4 feet above msl (5.0 feet above pad at well)

Time	t Elapsed Time (minutes)	Flowmeter		Bubbler System		Remarks
		ΔH (inches H_2O)	Q (gpm)	Pressure (psi)	Δs (feet)	
1752	62.0		7,600	5.26	28.83	Continue test
1753	63.0			5.24	28.88	
1754	64.0			5.27	28.81	
1756	66.0			5.24	28.88	
1758	68.0			5.24	28.88	
1800	70.0			5.24	28.88	Shut off pump
1800	0		0	5.24	0	Start recovery
1800:30	0.5			11.65	14.40	
1801	1.0			11.50	14.07	
1801:30	1.5			11.64	14.38	
1802	2.0			11.88	14.92	
1802:30	2.5			12.35	15.98	
1803	3.0			12.90	17.21	
1803:30	3.5			13.35	18.22	
1804	4.0			13.89	19.44	
1804:30	4.5			14.44	20.67	
1805	5.0			14.90	21.71	
1805:30	5.5			15.50	23.06	
1806	6.0			16.02	24.22	
1806:30	6.5			16.55	25.42	
1807	7.0			17.07	26.58	
1807:30	7.5			17.62	27.82	
1808	8.0			17.98	28.63	
1809	9.0			17.99	28.65	
1810	10.0			17.99	28.65	

PUMPING TEST RECORDS

Step-Drawdown Test

Test Well for Disposal System for
Miami-Dade Water and Sewer Authority

Project No. 559-7601-3
Date 10/20/77 Sheet 5 of 5

Record of flow and water level in pumping zone (inside 20-inch casing)
Measuring Point: center of gage, 14.4 feet above msl (5.0 feet above pad at well)

Time	t Elapsed Time (minutes)	Flowmeter		Bubbler System		Remarks
		ΔH (inches H_2O)	Q (gpm)	Pressure (psi)	Δs (feet)	
1811	11.0		0	17.99	28.65	Continue recovery
1812	12.0			17.99	28.65	
1813	13.0			17.99	28.65	
1814	14.0			17.99	28.65	
1815	15.0			17.99	28.65	
1816	16.0			18.02	28.72	
1820	20.0			18.00	28.67	
1830	30.0			18.04	28.76	
1840	40.0			18.04	28.76	
1845	45.0			18.04	28.76	End of recovery test

```
C       PROGRAM FASTEP
C
C       STEP DRAWDOWN TEST ANALYSIS
C
C       ******************************************************************
C       *                                                                *
C       *                                                                *
C       *        INPUT DATA FOR FASTEP                                   *
C       *                                                                *
C       *        CARD    DATA                                            *
C       *                                                                *
C       *        1.      ANY NAME OF 80 CHARACTERS OR LESS(8A10)         *
C       *                                                                *
C       *        2.      THE NO. OF PUMPING TESTS,AND THE NO. OF         *
C       *                PUMPING STEPS. (FREE FORMAT)                    *
C       *                                                                *
C       *        3.      DISCHARGE AND DRAWDOWN FOR FIRST STEP.          *
C       *                (FREE FORMAT)                                   *
C       *                                                                *
C       *        4.      REPEAT DATA AS IN CARD 3 FOR REMAINING          *
C       *                PUMPING STEPS IN FIRST TEST.                    *
C       *                                                                *
C       *        5.      FOR ADDITIONAL TESTS REPEAT CARDS 1 TO 4        *
C       *                                                                *
C       *                                                                *
C       ******************************************************************
C
C
        DIMENSION Q(10),SW(10),LTIT(40)
        NP=0
        CALL SEQIN(2,'SPECIFY INPUT DEVICE OR FILENAME',32)
        CALL SEQOUT(3,'SPECIFY OUTPUT DEVICE OR FILENAME',33)
C
C-READ INPUT DATA
C
105     READ(2,110)LTIT
110     FORMAT(40A2)
        WRITE(3,115)LTIT
115     FORMAT('1 ',40A2,/)
        READ(2,120)LP,N
120     FORMAT(2I)
        READ(2,124)(Q(I),SW(I),I=1,N)
124     FORMAT(2F)
        WRITE(3,125)
125     FORMAT(6X,'Q(I)',6X,'SW(I)')
        WRITE(3,130)(Q(I),SW(I),I=1,N)
130     FORMAT(2F10.2)
        NP=NP+1
        F=1.E8
        DELTP=1.
        P=1.1
C
C-EVAULATE PARAMETERS B AND C FOR THE GIVEN P
C
        A11=0.
        D1=0.
        DO 135 I=1,N
        A11=A11+(Q(I)**2)
135     D1=D1+SW(I)*Q(I)
140     E=0
```

```
      DO 145 I=1,N
145   E=E+(ABS(B*Q(I)+C*Q(I)**P-SW(I)))**2.
      IF(E-F)150,150,155
150   F=E
      CSTAR=C
      BSTAR=B
      PSTAR=P
      GO TO 165
155   IF(ABS(DELTP)-.005)170,170,160
160   DELTP=-DELTP*.1
      F=E
C
C-ITERATE P
C
165   P=P+DELTP
      GO TO 140
170   WRITE(3,175)
175   FORMAT(//1X,'OPTIMAL P',10X,'B',10X,'C',7X,'MINIMUM ERROR')
      WRITE(3,180)PSTAR,BSTAR,CSTAR,F
180   FORMAT(1X,2E12.3,2E12.3,//)
      IF(NP-LP)105,190,190
190   CONTINUE
      CALL EXIT
      END
      SUBROUTINE CRAMER(Q,SW,N,P,B,C,A11,D1)
      DIMENSION Q(1),SW(1)
      A12=0.
      A22=0.
      D2=0.
      DO 105 I=1,N
      A12=A12+(Q(I)**(P+1.))
      A22=A22+(Q(I)**(2.*P))
105   D2=D2+SW(I)*(Q(I)**P)
      A21=A12/A11
      C=(D2-A21*D1)/(A22-A21*A12)
      B=(D1-C*A12)/A11
      RETURN
      END
```

MIAMI DADE TEST INJECTION WELL - STEP DRAWDOWN TEST

Q(I)	Sw(I)
2800.00	4.09
4300.00	9.71
7600.00	28.85

OPTIMAL P	B	C	MINIMUM ERROR
0.174E+01	-0.666E-03	0.589E-05	0.146E-06

$$S = BQ + CQ^P$$

where

S = drawdown in the well

B = aquifer loss coefficient

C = well loss coefficient

P = exponent indicating severity of well loss

INJECTION TEST

BLACK, CROW AND EIDSNESS, INC.
Engineers
Gainesville, Florida
Project No. 559-7601-3

Test Well for Disposal System for
South District Regional WWTP,
Miami-Dade Water and Sewer Authority
Date 10/26/77 Page 1/5
Measuring Points:
P_A 3.7 ft above top of pad at well
P_W 3.7 ft above top of pad at well
P_B 23.0 ft above top of pad at well

Injection Test
PUMPING TEST REPORT

Actual Time	Time Since Pump Started (minutes)	Pressures in PSI			Flow (gpm)	Remarks
		P_A Annulus	P_W Well Head	P_B Bottom		
0920	0	14.04	--	20.52	0	Started pump
0921	1			20.20		
0922	2	14.04	35.00	20.13	9,400	
0923	3	14.04	36.00	20.63	9,100	
0924	4	14.04	41.00	20.68	8,800	
0925	5	14.04	45.00	20.72	8,400	
0926	6	14.04	49.50	20.73	8,300	
0927	7	14.04	53.00	20.76	8,100	
0928	8	14.03	53.50	20.75	8,200	
0929	9	14.02	54.00	20.78	8,100	
0930	10	14.01	54.00	20.90	8,100	
0931	11	14.01	54.20	20.85		
0932	12	14.00	54.20	20.90		
0933	13	14.01	54.30	20.92		
0934	14	14.01	54.30	20.97		
0935	15	14.00	54.40	21.00	8,200	
0936	16	14.00	54.40	21.04		
0937	17	14.00	54.40	21.05		
0940	20	13.98	54.40	21.07	8,100	
0942	22			21.11		
0945	25	14.01	54.60	21.10	8,300	
0950	30	14.02	54.60	21.14	8,200	
0955	35	14.02	54.60	21.16	8,300	
1000	40	14.02	54.60	21.13	8,300	
1005	45	14.02	54.60	21.15		

Injection Test

PUMPING TEST REPORT

Actual Time	Time Since Pump Started (minutes)	Pressures in PSI P_A Annulus	P_W Well Head	P_B Bottom	Flow (gpm)	Remarks
1010	50	14.02	54.60	21.18		
1015	55	14.01	54.60	21.19	8,300	
1020	60	13.98	54.60	21.19		
1025	65			21.20		
1030	70			21.21	8,200	
1045	85			21.20	8,100	
1050	90	14.01	54.70			
1100	100			21.20	8,100	
1115	115			21.15	8,200	
1120	120	14.01	54.80			
1130	130				8,200	
1145	145				8,100	P_B gage not working properly
1150	150	14.02	53.90			
1200	160				8,100	P_B gage not working properly
1220	180	14.03	53.90			
1230	190				8,100	P_B gage not working properly
1250	210	14.02	53.60			
1300	220				8,100	P_B gage not working properly
1320	240	14.03	53.60			
1330	250				8,100	P_B gage not working properly
1350	270	14.03	53.60			
1400	280				8,100	P_B gage not working properly
1420	300	14.04	53.00			
1430					8,100	P_B gage not working properly
1450	330	14.04	52.90			

BLACK, CROW AND EIDSNESS, INC.
Engineers
Gainesville, Florida
Project No. 559-7601-3

Test Well for Disposal System for
South District Regional WWTP,
Miami-Dade Water and Sewer Authority
Date 10/26/77 Page 3/5

Injection Test

PUMPING TEST REPORT

Actual Time	Time Since Pump Started (minutes)	Pressures in PSI			Flow (gpm)	Remarks
		P_A Annulus	P_W Well Head	P_B Bottom		
1500	340				8,000	
1520	360	14.04	52.90			
1530	370				8,000	
1545	385			21.35		
1550	390	14.04	53.00			
1600	400			21.35	8,000	
1615	415			21.37		
1620	420	14.04	53.40			
1630	430			21.37	8,000	
1645	445			21.35		
1650	450	14.04	53.50			
1700	460			21.39	7,900	
1715	475			21.43		
1720	480	14.04	53.40			
1730	490			21.42	8,000	
1745	505			21.44		
1750	510	14.04	53.50			
1800	520			21.41	8,000	
1820	540	14.04	53.50			
1830	550			21.40	7,900	
1850	570	14.04	53.50			
1900	580			21.43	7,900	
1905	585			21.44	7,900	Flow decreased
1906		13.98	44.50	21.21	5,000	
1907				21.14	5,200	

BLACK, CROW AND EIDSNESS, INC.
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Test Well for Disposal System for
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Date 10/26/77 Page 4/5

Injection Test
PUMPING TEST REPORT

Actual Time	Time Since Pump Started (minutes)	Pressures in PSI P_A Annulus	P_W Well Head	P_B Bottom	Flow (gpm)	Remarks
1908		14.00	39.70	21.13	5,100	
1909				21.13		
1910		14.00	39.50	21.14	5,000	
1911				21.13		
1912				21.14		
1913				21.13		
1914				21.15		
1915		14.01	39.20	21.16	5,100	
1916				21.14		
1917				21.14		
1918				21.14		
1919				21.15		
1920	0	14.00	39.20	21.14	5,000	Shut down pump Start recovery
1920:30	0.5		29.80		0	
1921	1		30.00			
1921:30	1.5		30.50			
1922	2		30.60			
1923	3		30.30			
1924	4		30.10			
1925	5		29.90			
1926	6	14.00	29.80	21.25		
1927	7		29.70	21.15		
1928	8		29.60	21.15		
1929	9		29.55			
1930	10		29.55			

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Test Well for Disposal System for
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Injection Test
PUMPING TEST REPORT

Actual Time	Time Since Pump Started (minutes)	Pressures in PSI			Flow (gpm)	Remarks
		P_A Annulus	P_W Well Head	P_B Bottom		
1931	11			21.12	0	Continue recovery
1932	12		29.55			
1935	15		29.45			
1938	18			21.12		
1940	20	14.00	29.35	21.11		
1945	25			21.10		
2000	40			21.10		
10/27/77 0800		13.96	29.50			
0845		14.00	29.50			

Appendix E

WATER QUALITY DATA FROM BISCAYNE AQUIFER MONITORING WELLS

FIELD ANALYSES

WATER QUALITY DATA FROM BISCAYNE MONITORING WELL No. 1 (Total depth=30'

Date	Time	Temperature °C	Specific Conductance (µmhos/cm)	Chloride (mg/l)	Remarks	Observer's Initials
7/6/77	0900	26	970	190		UPS
7/14/77	0935	24.5	860	125		UPS
7/15/77	1035	23	850	115		UPS
7/16/77	1620	24	740	115		UPS
7/17/77	2015	24	810	135		UPS
7/18/77	1515	26	800	150		CRS
7/19/77	1035	26	770	140	Depth to water level below top of 2" casing (DTWL)=9.12'	CRS
7/20/77	1050	25.5	770	110	DTWL=9.09'	UPS
7/21/77	1430	26	740	100	DTWL=8.80'	CRS
7/22/77	0845	26	710	110	DTWL=8.98'	UPS
7/23/77	1140	26.5	700	110	DTWL=9.09'	UPS
7/24/77	1745	26	700	115	DTWL=8.92'	UPS
7/25/77	0945	27	690	100	DTWL=9.09'	CRS
7/26/77	1600	26	740	120	DTWL=9.15'	SFR
7/27/77	1220	26	740	115	DTWL=9.20'	UPS
7/28/77	1415	26	760	120	DTWL=9.32'	CRS
7/29/77	1800	25.5	720	110	DTWL=9.22'	DGS
7/30/77	1415	25.5	780	110	DTWL=9.23'	SFR
7/31/77	1205	26	730	110	DTWL=9.10'	UPS
8/1/77	0730	25	780	100	DTWL=9.00'	DGS
8/2/77	1203	26	790	100	DTWL=9.03'	CRS
8/3/77	1500	25	780	95	DTWL=9.28'	SFR
8/4/77	1225	26	730	85	DTWL=8.99'	UPS
8/5/77	1220	27	700	75	DTWL=9.30'	UPS
8/6/77	1235	27.5	680	80	DTWL=9.45'	UPS
8/7/77	1510	26	620	65	DTWL=9.06'	DGS

WATER QUALITY DATA FROM BISCAYNE MONITORING WELL No. 1

Date	Time	Temperature °C	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Remarks	Observer's Initials
8/8/77	1620	27.5	610	65	DTWL=9.17'	CRS
8/9/77	1710	27.5	600	65	DTWL=9.22'	UPS
8/10/77	1210	27.5	620	65	DTWL=9.29'	UPS
8/11/77	1515	28	620	60	DTWL=9.36'	SFR
8/12/77	1730	26	540	50	DTWL=9.00'	SFR
8/13/77	1215	26	460	40	DTWL=8.77'	UPS
8/14/77	1240	26.5	490	45	DTWL=8.86'	UPS
8/15/77	1140	27	560	55	DTWL=8.97'	DGS
8/16/77	1046	27	490	70	DTWL=9.06'	DGS
8/17/77	1645	27	540	75	DTWL=9.23'	CRS
8/18/77	1355	27	580	60	DTWL=9.09'	UPS
8/19/77	1302	28	1,460	335	DTWL=9.06'	SFR
8/20/77	1145	27	2,500	240	DTWL=9.27'	DGS
8/21/77	1715	27	3,500	860	DTWL=9.14'	SFR
8/22/77	1200	27	2,700	720	DTWL=9.34'	UPS
8/23/77	1735	27	2,500	725	DTWL=9.25'	UPS
8/24/77	1845	27	3,000	800	DTWL=9.04'	UPS
8/25/77	1455	27	2,100	500	DTWL=9.22'	UPS
8/27/77	1605	27	2,600	800	DTWL=9.29'	CRS
8/28/77	1644	27	3,400	950	DTWL=10.78'	CRS
8/29/77	1810	27	3,200	880	DTWL=9.17'	UPS
8/30/77	1305	27	2,450	645	DTWL=8.85'	UPS
8/31/77	1500	28	2,400	610	DTWL=8.62'	SFR
9/1/77	1415	27	2,000	540	DTWL=8.70'	UPS
9/2/77	1430	26	1,700	440	DTWL=8.60'	SFR

WATER QUALITY DATA FROM BISCAYNE MONITORING WELL No. 1

Date	Time	Temperature °C	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Remarks	Observer's Initials
9/4/77	1645	26	1,320	330	DTWL=8.85'	CRS
9/5/77	1507	26	1,520	420	DTWL=8.93'	CRS
9/6/77	1349	26	2,200	635	DTWL=9.06'	DGS
9/7/77	1400	26.5	5,200	1,440	DTWL=9.11'	UPS
9/8/77	1345	27	4,900	1,380	DTWL=9.21'	UPS
9/9/77	1335	27.5	3,700	1,065	DTWL=9.25'	UPS
9/10/77	1525	27.5	5,900	1,630	DTWL=9.36'	SFR
9/11/77	1350	27	3,800	1,110	DTWL=9.37'	UPS
9/12/77	1900	27	6,000	1,660	DTWL=9.45'	SFR
9/13/77	1102	27	2,600	780	DTWL=9.20'	DGS
9/14/77	1325	26.5	3,800	1,065	DTWL=9.27'	UPS
9/15/77	1910	27	3,200	900	DTWL=9.26'	SFR
9/16/77	1600	27	4,000	930	DTWL=9.11'	DGS
9/17/77	1435	26.5	3,400	1,020	DTWL=8.96'	UPS
9/18/77	1630	27	5,800	1,700	DTWL=8.98'	SFR
9/19/77	1415	27	4,300	1,175	DTWL=9.11'	DGS
9/21/77	1315	27	4,300	1,310	DTWL=9.17'	UPS
9/22/77	1900	27	4,200	1,250	DTWL=8.96'	UPS
9/23/77	1650	27	4,400	1,325	DTWL=9.13'	UPS
9/24/77	1515	27	3,050	895	DTWL=9.07'	UPS
9/25/77	1655	27	2,600	790	DTWL=9.05'	UPS
9/26/77	1105	27	2,400	605	DTWL=9.80'	DGS
9/27/77	1400	27	1,400	415	DTWL=9.06'	DGS
9/28/77	1430	27	1,600	422	DTWL=8.99'	DGS
9/29/77	1320	27	1,450	400	DTWL=10.80'	DGS

WATER QUALITY DATA FROM BISCAYNE MONITORING WELL No. 1

Date	Time	Temperature °C	Specific Conductance (µmhos/cm)	Chloride (mg/l)	Remarks	Observer's Initials
9/30/77	1635	28	1,370	400	DTWL=9.08'	UPS
10/1/77	1440	28	1,400	400	DTWL=8.95'	UPS
10/2/77	1350	27.5	1,550	355	DTWL=9.10'	DGS
10/3/77	0930	28	1,350	350	DTWL=9.04'	CRS
10/4/77	1620	28	1,650	460	DTWL=9.08'	UPS
10/5/77	1020	27	1,600	400	DTWL=9.24'	DGS
10/6/77	1605	27.5	1,600	400	DTWL=9.25'	DGS
10/7/77	1725	27.5	1,630	450	DTWL=9.09'	UPS
10/8/77	1450	27.5	1,830	495	DTWL=9.26'	UPS
10/9/77	1835	27.5	1,600	430	DTWL=9.22'	UPS
10/10/77	1345	27.5	1,800	465	DTWL=9.33'	DGS
10/11/77	1406	27.5	1,800	460	DTWL=9.39'	DGS
10/12/77	1340	27.5	1,400	400	DTWL=9.41'	DGS
10/13/77	1805	27	1,780	485	DTWL=9.46'	UPS
10/14/77	1450	27	1,800	500	DTWL=9.55'	CRS
10/15/77	1410	27	1,800	510	DTWL=9.33'	DGS
10/16/77	1720	27	2,100	560	DTWL=9.39'	UPS
10/17/77	1520	27	2,000	550	DTWL=9.39'	CRS
10/18/77	1615	27	2,000	525	DTWL=9.30'	UPS

WATER QUALITY DATA FROM BISCAYNE MONITORING WELL No. 2 (Total depth=3

Date	Time	Temperature °C	Specific Conductance (µmhos/cm)	Chloride (mg/l)	Remarks	Observer's Initials
7/6/77	1000	25	1,300	280		UPS
7/14/77	0945	24.5	1,300	310		UPS
7/15/77	1045	24	1,320	265		UPS
7/16/77	1630	24	1,370	270		UPS
7/17/77	2008	24	1,240	250		UPS
7/18/77	1525	25	1,200	280		CRS
7/19/77	1050	26.5	1,150	210	Water level-9.49'below top of 2" casing	CRS
7/20/77	1115	25	1,190	220	Depth to water level below top of casing (DTWL)=9.41'	UPS
7/21/77	1435	26	1,150	230	DTWL=9.92'	CRS
7/22/77	0855	25.5	1,180	250	DTWL=9.32'	UPS
7/23/77	1155	24.5	1,060	220	DTWL=9.35'	UPS
7/24/77	1755	24.5	1,400	320	DTWL=8.40'	UPS
7/25/77	0948	27	1,360	230	DTWL=9.47'	CRS
7/26/77	1600	25	1,350	235	DTWL=9.55'	SFR
7/27/77	1230	25	1,350	235	DTWL=9.59'	UPS
7/28/77	1421	25	1,260	230	DTWL=9.70'	CRS
7/29/77	1810	25	1,220	230	DTWL=9.61'	DGS
7/30/77	1425	24.5	1,220	210	DTWL=9.66'	SFR
7/31/77	1210	24.5	1,210	230	DTWL=9.49'	UPS
8/1/77	0735	25	1,220	210	DTWL=9.72'	DGS
8/2/77	1213	26	1,230	210	DTWL=9.67'	CRS
8/3/77	1510	25	1,220	215	DTWL=9.67'	SFR
8/4/77	1235	25	1,250	210	DTWL=9.70'	UPS
8/5/77	1225	24.5	1,230	210	DTWL=9.69'	UPS
8/6/77	1245	24.5	1,220	225	DTWL=9.98'	UPS
8/7/77	1505	25	1,250	225	DTWL=9.46'	DGS

WATER QUALITY DATA FROM BISCAYNE MONITORING WELL No. 2

Date	Time	Temperature °C	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Remarks	Observer's Initials
8/8/77	1625	26	1,230	230	DTWL=9.64'	CRS
8/9/77	1720	24.5	1,100	215	DTWL=9.59'	UPS
8/10/77	1220	25	1,240	220	DTWL=9.60'	UPS
8/11/77	1520	24	1,240	220	DTWL=9.74'	SFR
8/12/77	1735	24	1,280	210	DTWL=9.35'	SFR
8/13/77	1220	24.5	1,240	215	DTWL=9.13'	UPS
8/14/77	1250	24.5	1,270	225	DTWL=9.25'	UPS
8/15/77	1220	26	1,270	215	DTWL=9.34'	DGS
8/16/77	1041	26	910	125	DTWL=9.47'	DGS
8/17/77	1648	26	1,180	210	DTWL=9.60'	CRS
8/18/77	1400	25	1,240	220	DTWL=9.51'	UPS
8/19/77	1310	25	1,350	225	DTWL=9.45'	SFR
8/20/77	1152	25.5	1,300	230	DTWL=9.37'	DGS
8/21/77	1720	25	1,450	230	DTWL=9.55'	SFR
8/22/77	1205	24.5	1,400	260	DTWL=9.74'	UPS
8/23/77	1740	24.5	1,430	300	DTWL=9.64'	UPS
8/24/77	1850	24.5	700	170	DTWL=9.45'	UPS
8/25/77	1502	26	700	160	DTWL=9.30'	UPS
8/27/77	1610	26	490	200	DTWL=9.15'	CRS
8/28/77	1634	26	570	210	DTWL=9.58'	CRS
8/29/77	1815	25	590	155	DTWL=9.55'	UPS
8/30/77	1310	25	620	170	DTWL=9.20'	UPS
8/31/77	1455	25.5	270	39	DTWL=8.99'	SFR
9/1/77	1420	25	240	40	DTWL=9.05'	UPS
9/2/77					Well plugged	SFR

WATER QUALITY DATA FROM BISCAYNE MONITORING WELL No. 2

Date	Time	Temperature °C	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Remarks	Observer's Initials
9/4/77					Not in use--run over by truck--down after this date	
						CRS

WATER QUALITY DATA FROM BISCAYNE MONITORING WELL No. 3 (Total depth=30')

Date	Time	Temperature °C	Specific Conductance (µmhos/cm)	Chloride (mg/l)	Remarks	Observer's Initials
7/6/77	1100	25	1,050	190		UPS
7/14/77	0955	25	1,040	180		UPS
7/15/77	1110	23.5	1,080	210		UPS
7/16/77	1635	25	880	150		UPS
7/17/77	2002	25	800	125		UPS
7/18/77	1530	26	820	160		CRS
7/19/77	1059	26	830	120	Water level-10.32' below top of 2" casing	CRS
7/20/77	1125	26	700	90	Depth to water level below top of casing (DTWL)10.24'	UPS
7/21/77	1440	26	800	95	DTWL=9.99'	CRS
7/22/77	0900	26.5	710	110	DTWL=9.88'	UPS
7/23/77	1205	27	680	100	DTWL=10.29'	UPS
7/24/77	1800	26	700	110	DTWL=10.11'	UPS
7/25/77	0950	27	670	80	DTWL=10.28'	CRS
7/26/77	1600	26.5	660	80	DTWL=10.36'	SFR
7/27/77	1240	26.5	810	125	DTWL=10.40'	UPS
7/28/77	1428	26	800	120	DTWL=10.51'	CRS
7/29/77	1822	25	730	110	DTWL=10.44'	DGS
7/30/77	1435	25.5	840	105	DTWL=10.46'	SFR
7/31/77	1220	26	920	150	DTWL=10.34'	UPS
8/1/77	0740	25	820	90	DTWL=10.56'	DGS
8/2/77	1215	25	930	130	DTWL=10.48'	CRS
8/3/77	1515	25	990	140	DTWL=10.52'	SFR
8/4/77	1245	25.5	930	120	DTWL=10.53'	UPS
8/5/77	1230	26	780	85	DTWL=10.51'	UPS
8/6/77	1255	27	770	90	DTWL=10.74'	UPS
8/7/77	1500	26	700	75	DTWL=10.27'	DGS

WATER QUALITY DATA FROM BISCAYNE MONITORING WELL No. 3

Date	Time	Temperature °C	Specific Conductance (µmhos/cm)	Chloride (mg/l)	Remarks	Observer's Initials
8/8/77	1630	27	690	75	DTWL=10.23'	CRS
8/9/77	1730	26.5	770	90	DTWL=10.43'	UPS
8/10/77	1230	26.5	800	95	DTWL=10.46'	UPS
8/11/77	1525	27	830	90	DTWL=10.56'	SFR
8/12/77	1750	26	740	80	DTWL=10.16'	SFR
8/13/77	1225	26.5	640	65	DTWL=9.99'	UPS
8/14/77	1255	26.5	610	55	DTWL=10.04'	UPS
8/15/77	1215	27	580	50	DTWL=10.17'	DGS
8/16/77	1046	27	650	70	DTWL=10.30'	DGS
8/17/77	1654	27	810	90	DTWL=10.40'	CRS
8/18/77	1405	27	680	80	DTWL=9.96'	UPS
8/19/77	1315	27	620	50	DTWL=10.36'	SFR
8/20/77	1158	27	1,000	145	DTWL=10.32'	DGS
8/21/77	1725	27	700	50	DTWL=10.42'	SFR
8/22/77	1210	26.5	1,210	240	DTWL=10.61'	UPS
8/23/77	1745	26.5	1,800	415	DTWL=10.59'	UPS
8/24/77	1855	26.5	1,620	370	DTWL=10.35'	UPS
8/25/77	1514	27	1,100	210	DTWL=9.92'	UPS
8/27/77	1614	26.5	1,280	310	DTWL=9.80'	CRS
8/28/77	1630	27	2,700	770	DTWL=10.14'	CRS
8/29/77	1820	26	1,360	315	DTWL=10.42'	UPS
8/30/77	1315	26	1,780	415	DTWL=10.13'	UPS
8/31/77	1450	27	2,500	595	DTWL=9.86'	SFR
9/1/77	1425	26.5	1,400	320	DTWL=10.00'	UPS
9/2/77	1735	25.5	1,400	315	DTWL=9.98'	UPS

WATER QUALITY DATA FROM BISCAYNE MONITORING WELL No. 3

Date	Time	Temperature °C	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Remarks	Observer's Initials
9/4/77	1650	26	1,300	310	DTWL=9.92'	CRS
9/5/77	1514	26	2,300	500	DTWL=10.00'	CRS
9/6/77	1353	26	1,800	355	DTWL=10.11'	DGS
9/7/77	1405	27.5	1,620	365	DTWL=10.36'	UPS
9/8/77	1350	26.5	1,880	485	DTWL=10.43'	UPS
9/9/77	1340	27	2,080	530	DTWL=10.51'	UPS
9/10/77	1520	27	3,000	740	DTWL=10.39'	SFR
9/11/77	1355	26.5	1,850	465	DTWL=10.59'	UPS
9/12/77	1855	27	3,400	865	DTWL=10.42'	SFR
9/13/77	1110	26.5	1,400	430	DTWL=11.16'	DGS
9/14/77	1330	26.5	1,600	485	DTWL=10.51'	UPS
9/15/77	1905	27	3,100	470	DTWL=10.37'	SFR
9/16/77	1605	27	1,620	605	DTWL=9.90'	DGS
9/17/77	1445	26	2,300	650	DTWL=10.21'	UPS
9/18/77	1635	27	3,200	900	DTWL=10.25'	SFR
9/19/77	1425	27	2,400	670	DTWL=9.86'	DGS
9/21/77	1320	26.5	3,100	830	DTWL=10.40'	UPS
9/22/77	1905	26.5	3,100	890	DTWL=10.19'	UPS
9/23/77	1655	26	2,550	705	DTWL=10.40'	UPS
9/24/77	1520	26.5	2,400	670	DTWL=10.35'	UPS
9/25/77	1700	26.5	2,450	690	DTWL=10.30'	UPS
9/26/77	1117	27	2,500	655	DTWL=9.66'	DGS
9/27/77	1409	27	2,500	620	DTWL=9.64'	DGS
9/28/77	1436	27	2,450	635	DTWL=10.23'	DGS
9/29/77	1337	27.5	2,500	630	DTWL=9.66'	DGS

WATER QUALITY DATA FROM BISCAYNE MONITORING WELL No. 3

Date	Time	Temperature °C	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Remarks	Observer's Initials
9/30/77	1640	27	2,700	760	DTWL=10.36'	UPS
10/1/77	1445	27	2,500	700	DTWL=10.26'	UPS
10/2/77	1400	26.5	2,500	645	DTWL=9.88'	DGS
10/3/77	0938	27	2,400	600	DTWL=9.80'	CRS
10/4/77	1625	27	2,550	715	DTWL=10.41'	UPS
10/5/77	1025	26.5	2,500	620	DTWL=10.90'	DGS
10/6/77	1615	27	2,500	645	DTWL=9.77'	DGS
10/7/77	1730	27	2,500	680	DTWL=10.36'	UPS
10/8/77	1455	27	2,500	675	DTWL=10.53'	UPS
10/9/77	1840	26.5	2,550	700	DTWL=10.50'	UPS
10/10/77	1352	27	2,500	710	DTWL=9.95'	DGS
10/11/77	1418	27	2,100	690	DTWL=9.86'	DGS
10/12/77	1349	26.5	2,100	680	DTWL=10.12'	DGS
10/13/77	1810	26.5	2,800	770	DTWL=10.72'	UPS
10/14/77	1500	27	2,900	780	DTWL=10.90'	CRS
10/15/77	1418	27	2,900	720	DTWL=10.15'	DGS
10/16/77	1725	26	2,800	765	DTWL=10.67'	UPS
10/17/77	1525	26	2,800	780	DTWL=10.98	CRS
10/18/77	1620	26	2,800	770	DTWL=10.57'	UPS

WATER QUALITY DATA FROM BISCAYNE MONITORING WELL No. 4 (Total depth=30')

Date	Time	Temperature °C	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Remarks	Observer's Initials
7/6/77	1135	25	1,030	180		UPS
7/14/77	1010	24	1,010	180		UPS
7/15/77	1100	23	1,070	210		UPS
7/16/77	1440	24.5	920	140		UPS
7/17/77	1953	25	800	125		UPS
7/18/77	1540	25.5	800	110		CRS
7/19/77	1105	26	920	135	Water level-9.80' below top of 2" casing	CRS
7/20/77	1135	26	760	85	Depth to water level below top of casing (DTWL)=9.91'	UPS
7/21/77	1445	26	710	70	DTWL=10.00'	CRS
7/22/77	0910	27	700	80	DTWL=9.54'	UPS
7/23/77	1210	27.5	680	80	DTWL=10.30'	UPS
7/24/77	1810	26.5	790	120	DTWL=10.71'	UPS
7/25/77	0955	27	670	75	DTWL=10.33'	CRS
7/26/77	1545	27	850	130	DTWL=10.42'	SFR
7/27/77	1250	26.5	800	120	DTWL=10.45'	UPS
7/28/77	1434	26.5	710	80	DTWL=10.57'	CRS
7/29/77	1830	26	720	90	DTWL=10.49'	DGS
7/30/77	1445	25	960	120	DTWL=10.53'	SFR
7/31/77	1225	25	1,020	180	DTWL=10.39'	UPS
8/1/77	0748	25	900	120	DTWL=10.59'	DGS
8/2/77	1220	26	930	130	DTWL=10.54'	CRS
8/3/77	1520	25	1,190	200	DTWL=10.55'	SFR
8/4/77	1250	25.5	1,080	155	DTWL=10.58'	UPS
8/5/77	1240	25.5	1,070	160	DTWL=10.55'	UPS
8/6/77	1300	27	790	100	DTWL=10.80'	UPS
8/7/71	1455	26	730	80	DTWL=10.36'	DGS

WATER QUALITY DATA FROM BISCAYNE MONITORING WELL No. 4

Date	Time	Temperature °C	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Remarks	Observer's Initials
8/8/77	1631	27	710	85	DTWL=10.50'	CRS
8/9/77	1740	26	900	120	DTWL=10.41'	UPS
8/10/77	1240	26.5	1,000	150	DTWL=10.54'	UPS
9/11/77	1530	26	900	110	DTWL=10.62'	SFR
8/12/77	1800	26.5	680	60	DTWL=10.24'	SFR
8/13/77	1235	26.5	660	50	DTWL=9.99'	UPS
8/14/77	1300	27	650	45	DTWL=10.10'	UPS
8/15/77	1208	27	880	105	DTWL=10.22'	DGS
8/16/77	1035	27	660	70	DTWL=10.35'	DGS
8/17/77	1700	27	740	70	DTWL=10.53'	CRS
8/18/77	1410	27	800	95	DTWL=10.28'	UPS
8/19/77	1320	27	880	98	DTWL=10.32'	SFR
8/20/77	1203	27	1,200	190	DTWL=10.39'	DGS
8/21/77	1730	28	900	105	DTWL=10.41'	SFR
8/22/77	1215	27.5	830	180	DTWL=10.37'	UPS
8/23/77	1750	26.5	1,080	205	DTWL=10.42'	UPS
8/24/77	1900	26.5	1,100	210	DTWL=10.28'	UPS
8/25/77	1520	28	1,220	245	DTWL=10.44'	UPS
8/27/77	1620	27	2,200	580	DTWL=10.39'	CRS
8/28/77	1625	27	2,300	825	DTWL=10.29'	CRS
8/29/77	1830	27	1,190	250	DTWL=10.42'	UPS
8/30/77	1320	26.5	1,700	450	DTWL=10.09'	UPS
8/31/77	1445	28	2,700	700	DTWL=9.88'	SFR
9/1/77	1435	27	1,360	310	DTWL=9.95'	UPS
9/2/77	1740	25.5	1,220	250	DTWL=9.90'	UPS

WATER QUALITY DATA FROM BISCAYNE MONITORING WELL No. 4

Date	Time	Temperature °C	Specific Conductance (µmhos/cm)	Chloride (mg/l)	Remarks	Observer's Initials
9/4/77	1655	26	1,050	190	DTWL=10.02'	CRS
9/5/77	1517	26	1,220	415	DTWL=10.08'	CRS
9/6/77	1403	26	1,100	300	DTWL=10.28'	DGS
9/7/77	1410	27.5	1,430	340	DTWL=10.32'	UPS
9/8/77	1355	28	1,640	430	DTWL=10.43'	UPS
9/9/77	1345	27.5	1,660	440	DTWL=10.48'	UPS
9/10/77	1515	27.5	2,650	660	DTWL=10.59'	SFR
9/11/77	1400	27	1,600	420	DTWL=10.62'	UPS
9/12/77	1850	27	2,600	665	DTWL=10.67'	SFR
9/13/77	1115	27	1,420	410	DTWL=10.45'	DGS
9/14/77	1335	27	1,410	400	DTWL=10.53'	UPS
9/15/77	1900	27	2,200	540	DTWL=10.49'	SFR
9/16/77	1610	27	1,780	461	DTWL=10.99'	DGS
9/17/77	1450	26.5	2,300	650	DTWL=10.23'	UPS
9/18/77	1640	27	3,500	980	DTWL=10.25'	SFR
9/19/77	1430	27	2,300	620	DTWL=10.37'	DGS
9/21/77	1325	26.5	2,500	700	DTWL=10.44'	UPS
9/22/77	1910	26.5	3,100	940	DTWL=10.23'	UPS
9/23/77	1700	26	2,450	700	DTWL=10.38'	UPS
9/24/77	1525	26.5	2,100	575	DTWL=10.34'	UPS
9/25/77	1705	26.5	2,450	695	DTWL=10.28'	UPS
9/26/77	1130	26.5	2,700	720	DTWL=10.03'	DGS
9/27/77	1417	26.5	2,800	735	DTWL=10.16'	DGS
9/28/77	1440	27	2,550	680	DTWL=10.19'	DGS
9/29/77	1346	27	2,800	750	DTWL=10.11'	DGS

WATER QUALITY DATA FROM BISCAYNE MONITORING WELL No. 4

Date	Time	Temperature °C	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Remarks	Observer's Initials
9/30/77	1645	27.5	4,200	1,320	DTWL=10.34'	UPS
10/1/77	1450	27.5	2,800	860	DTWL=10.23'	UPS
10/2/77	1409	27	3,000	825	DTWL=10.40'	DGS
10/3/77	0955	27	2,800	810	DTWL=10.30'	CRS
10/4/77	1630	27.5	2,800	850	DTWL=10.38'	UPS
10/5/77	1030	27.5	2,800	780	DTWL=10.49'	DGS
10/6/77	1621	27.5	2,900	820	DTWL=10.36'	DGS
10/7/77	1735	27	2,750	810	DTWL=10.38'	UPS
10/8/77	1500	27.5	3,000	870	DTWL=10.51'	UPS
10/9/77	1845	27	2,700	780	DTWL=10.48'	UPS
10/10/77	1401	27	2,780	790	DTWL=10.35'	DGS
10/11/77	1424	27	2,780	775	DTWL=10.43'	DGS
10/12/77	1400	26	2,700	740	DTWL=10.66'	DGS
10/13/77	1815	26.5	2,450	750	DTWL=10.73'	UPS
10/14/77	1506	26	2,500	750	DTWL=10.77'	CRS
10/15/77	1429	26.5	2,500	755	DTWL=10.53'	DGS
10/16/77	1730	26.5	2,400	660	DTWL=10.66'	UPS
10/17/77	1530	26	2,400	650	DTWL=10.69'	CRS
10/18/77	1625	26	2,350	640	DTWL=10.59'	UPS

WATER QUALITY DATA FROM BISCAYNE MONITORING WELL No. 5 (Total depth=30')

Date	Time	Temperature °C	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Remarks	Observer's Initials
7/6/77	1110	25	1,020	200		UPS
7/14/77	1020	24	1,080	205		UPS
7/15/77	1050	23	1,080	200		CRS
7/16/77	1630	23	1,000	210		CRS
7/17/77	1945	24	1,050	205		CRS
7/18/77	1545	25	1,060	240		CRS
7/19/77	1455	25	1,010	210	Water level-9.89' below top of 2" casing	CRS
7/20/77	1150	25	1,000	180	Depth to water level below top of casing=9.86'	UPS
7/21/77	1450	25	1,070	210	DTWL=9.01'	CRS
7/22/77	0920	26	1,010	200	DTWL=8.29'	UPS
7/23/77	1230	25	1,030	210	DTWL=8.60'	UPS
7/24/77	1820	25.5	1,050	210	DTWL=8.57'	UPS
7/25/77	0959	27	1,040	180	DTWL=7.97'	CRS
7/26/77	1530	25	1,120	230	DTWL=7.30'	SFR
7/27/77	1300	26	1,120	230	DTWL=8.93'	UPS
7/28/77	1438	26	1,080	210	DTWL=8.94'	CRS
7/29/77	1838	27	1,100	225	DTWL=9.39'	DGS
7/30/77	1455	24	1,200	210	DTWL=9.10'	SFR
7/31/77	1235	25	1,180	230	DTWL=9.29'	UPS
8/1/77	0752	25	1,170	180	DTWL=9.00'	DGS
8/2/77	1225	26	1,180	205	DTWL=8.54'	CRS
8/3/77	1530	25	1,210	220	DTWL=9.35'	SFR
8/4/77	1255	24.5	1,250	225	DTWL=9.52'	UPS
8/5/77	1245	24.5	1,240	220	DTWL=9.54'	UPS
8/6/77	1305	24.5	1,200	220	DTWL=9.61'	UPS
8/7/77	1450	25	1,120	200	DTWL=8.28'	DGS

WATER QUALITY DATA FROM BISCAYNE MONITORING WELL No. 5

Date	Time	Temperature °C	Specific Conductance (µmhos/cm)	Chloride (mg/l)	Remarks	Observer's Initials
8/8/77	1635	27	1,190	205	DTWL=8.80'	CRS
8/9/77	1750	26	1,130	200	DTWL=9.54'	UPS
8/10/77	1250	25	1,120	200	DTWL=9.55'	UPS
8/11/77	1535	25	1,190	194	DTWL=9.48'	SFR
8/12/77	1805	26	1,170	190	DTWL=9.09'	SFR
8/13/77	1240	26.5	1,170	185	DTWL=9.04'	UPS
8/14/77	1310	26.5	1,140	185	DTWL=9.15'	UPS
8/15/77	1200	26.5	1,120	170	DTWL=9.16'	DGS
8/16/77	1030	27	1,000	175	DTWL=8.57'	DGS
8/17/77	1705	26	1,180	200	DTWL=9.26'	CRS
8/18/77	1415	26	1,000	175	DTWL=9.38'	UPS
8/19/77	1325	26	900	168	DTWL=9.18'	SFR
8/20/77	1209	27	1,400	280	DTWL=10.92'	DGS
8/21/77	1735	26	1,200	165	DTWL=9.37'	SFR
8/22/77	1220	26	1,900	450	DTWL=9.70'	UPS
8/23/77	1800	25.5	2,400	590	DTWL=9.43'	UPS
8/24/77	1905	26	1,660	375	DTWL=9.20'	UPS
8/25/77	1526	26	1,480	285	DTWL=8.92'	UPS
8/27/77	1626	26	2,800	800	DTWL=8.88'	CRS
8/28/77	1620	26	2,700	670	DTWL=9.28'	CRS
8/29/77	1835	26	1,620	260	DTWL=9.40'	UPS
8/30/77	1325	26	1,800	400	DTWL=9.05'	UPS
8/31/77	1440	27	3,000	700	DTWL=8,87'	SFR
9/1/77	1440	26	1,820	405	DTWL=8.93'	UPS
9/2/77	1745	25	1,900	440	DTWL=8.81'	UPS

WATER QUALITY DATA FROM BISCAYNE MONITORING WELL No. 5

Date	Time	Temperature °C	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Remarks	Observer's Initials
9/4/77	1658	26	2,500	670	DTWL=9.31'	CRS
9/5/77	1720	26	2,600	660	DTWL=9.10'	CRS
9/6/77	1409	26	2,000	480	DTWL=8.54'	DGS
9/7/77	1415	26.5	2,100	480	DTWL=9.34'	UPS
9/8/77	1400	26.5	2,200	550	DTWL=9.48'	UPS
9/9/77	1350	26.5	2,450	630	DTWL=9.47'	UPS
9/10/77	1510	26.5	4,000	1,050	DTWL=9.37'	SFR
9/11/77	1405	25.5	2,500	635	DTWL=9.53'	UPS
9/12/77	1845	26	3,700	910	DTWL=9.40'	SFR
9/13/77	1119	25.5	2,400	600	DTWL=9.00'	DGS
9/14/77	1340	26	2,400	585	DTWL=9.50'	UPS
9/15/77	1855	26	3,200	800	DTWL=9.52'	SFR
9/16/77	1615	26	2,400	516	DTWL=8.78'	DGS
9/17/77	1455	26.5	2,600	680	DTWL=9.27'	UPS
9/18/77	1645	26.5	3,300	890	DTWL=9.20'	SFR
9/19/77	1430	27	2,600	670	DTWL=9.65	DGS
9/21/77	1330	26	2,700	720	DTWL=9.40'	UPS
9/22/77	1915	26	3,500	990	DTWL=9.12'	UPS
9/23/77	1705	26	3,400	920	DTWL=9.43'	UPS
9/24/77	1530	26	2,600	715	DTWL=9.40	UPS
9/25/77	1710	26	2,750	755	DTWL=9.20'	UPS
9/26/77	1140	26	3,000	755	DTWL=8.86'	DGS
9/27/77	1423	26	3,000	755	DTWL=8.43'	DGS
9/28/77	1448	27	2,750	700	DTWL=8.53'	DGS
9/29/77	1400	27	3,000	745	DTWL=8.64'	DGS

WATER QUALITY DATA FROM BISCAYNE MONITORING WELL No. 5

Date	Time	Temperature °C	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Remarks	Observer's Initials
9/30/77	1650	26.5	3,600	1,030	DTWL=9.37'	UPS
10/1/77	1455	27	3,500	980	DTWL=9.27'	UPS
10/2/77	1417	26.5	3,200	840	DTWL=8.86'	DGS
10/3/77	1000	27	3,400	860	DTWL=8.80'	CRS
10/4/77	1635	27	3,400	880	DTWL=9.41'	UPS
10/5/77	1040	27	3,100	800	DTWL=8.88'	DGS
10/6/77	1629	27	3,000	785	DTWL=9.02'	DGS
10/7/77	1740	26	3,150	840	DTWL=9.39'	UPS
10/8/77	1505	26.5	3,500	985	DTWL=9.70'	UPS
10/9/77	1850	26	3,200	855	DTWL=9.51'	UPS
10/10/77	1410	26	3,300	860	DTWL=8.83'	DGS
10/11/77	1430	26	3,100	845	DTWL=9.02'	DGS
10/12/77	1412	26	2,700	800	DTWL=9.04'	DGS
10/13/77	1820	26	3,100	850	DTWL=9.71'	UPS
10/14/77	1515	26	3,100	900	DTWL=9.88'	CRS
10/15/77	1438	26	3,000	855	DTWL=8.98'	DGS
10/16/77	1735	26	3,200	880	DTWL=9.76'	UPS
10/17/77	1540	26	3,100	870	DTWL=9.85'	CRS
10/18/77	1630	25.5	3,200	885	DTWL=9.66'	UPS

WATER QUALITY DATA FROM BISCAYNE MONITORING WELL No. 6 (Total depth=30')

Date	Time	Temperature °C	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Remarks	Observer's Initials
7/2/77	0940	25	990	290		UPS
7/14/77	1030	25	920	295		CRS
7/15/77	0915	24	930	290		CRS
7/16/77	1630	24	910	290		CRS
7/17/77	1938	25	910	290		CRS
7/18/77	1555	24.5	920	265		CRS
7/19/77	1500	25	950	270	Water level-9.89' below top of 2" casing	UPS
7/20/77	1205	26	850	230	Depth to water level below top of casing (DTWL)=9.89'	UPS
7/21/77	1455	26	900	250	DTWL=8.65	CRS
7/22/77	0930	26	900	260	DTWL=8.94'	UPS
7/23/77	1255	26	990	275	DTWL=9.98	UPS
7/24/77	1830	25.5	980	270	DTWL=8.52'	UPS
7/25/77	1000	26	940	220	DTWL=10.00'	CRS
7/26/77	1405	25	1,220	270	DTWL=9.85'	SFR
7/27/77	1315	26	1,210	280	DTWL=10.11'	UPS
7/28/77	1433	26	980	250	DTWL=10.22'	CRS
7/29/77	1847	26.5	1,090	270	DTWL=10.12'	DGS
7/30/77	1505	24	1,200	240	DTWL=10.15'	SFR
7/31/77	1240	25	1,220	280	DTWL=9.13'	UPS
8/1/77	0759	25	1,150	220	DTWL=10.25'	DGS
8/2/77	1229	25	1,020	215	DTWL=10.17'	CRS
8/3/77	1540	25	1,180	235	DTWL=10.23'	SRF
8/4/77	1300	25.5	1,190	235	DTWL=10.18'	UPS
8/5/77	1255	25	980	175	DTWL=10.20'	UPS
8/6/77	1315	25	930	160	DTWL=10.44'	UPS
8/7/77	1445	25	990	180	DTWL=9.99'	DGS

WATER QUALITY DATA FROM BISCAYNE MONITORING WELL No. 6

Date	Time	Temperature °C	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Remarks	Observer's Initials
8/8/77	1640	26.5	1,020	190	DTWL=10.10'	CRS
8/9/77	1800	25	1,240	230	DTWL=10.14'	UPS
8/10/77	1300	24.5	1,220	225	DTWL=10.17'	UPS
8/11/77	1545	25.5	990	185	DTWL=10.25'	SFR
8/12/77	1810	24.5	700	57	DTWL=10.86'	SFR
8/13/77	1245	26	690	55	DTWL=9.65'	UPS
8/14/77	1315	26	670	50	DTWL=9.74'	UPS
8/15/77	1150	26.5	640	45	DTWL=9.86'	DGS
8/16/77	1020	26.5	605	60	DTWL=9.99'	DGS
8/17/77	1710	27	690	60	DTWL=9.14'	CRS
8/18/77	1420	25	820	130	DTWL=10.02'	UPS
8/19/77	1330	25.5	710	60	DTWL=9.94'	SFR
8/20/77	1214	27	900	70	DTWL=10.20'	DGS
8/21/77	1740	26.5	740	68	DTWL=10.02'	SFR
8/22/77	1230	26	1,580	350	DTWL=10.29'	UPS
8/23/77	1805	26	1,600	380	DTWL=10.13'	UPS
8/24/77	1910	26	910	160	DTWL=9.92'	UPS
8/25/77	1539	26	800	85	DTWL=10.17'	UPS
8/27/77	1620	26	2,100	580	DTWL=10.08'	CRS
8/28/77	1614	26	1,750	450	DTWL=10.00'	CRS
8/29/77	1845	26	1,090	205	DTWL=9.98'	UPS
8/30/77	1330	26.5	1,250	245	DTWL=9.74'	UPS
8/31/77	1435	26	2,150	470	DTWL=9.53'	SFR
9/1/77	1450	26	1,250	245	DTWL=9.60'	UPS
9/2/77	1720	26	1,250	250	DTWL=9.61'	UPS

WATER QUALITY DATA FROM BISCAYNE MONITORING WELL No. 6

Date	Time	Temperature °C	Specific Conductance (µmhos/cm)	Chloride (mg/l)	Remarks	Observer's Initials
9/4/77	1704	26	1,050	190	DTWL=9.60'	CRS
9/5/77	1575	26	1,120	250	DTWL=9.60'	CRS
9/6/77	1418	26	900	215	DTWL=9.82'	DGS
9/7/77	1420	26.5	1,300	285	DTWL=9.96'	UPS
9/8/77	1405	26.5	1,330	330	DTWL=10.09'	UPS
9/9/77	1355	26.5	1,340	310	DTWL=10.14'	UPS
9/10/77	1500	26.5	4,800	1,230	DTWL=10.14'	SFR
9/11/77	1410	26	1,800	450	DTWL=10.24'	UPS
9/12/77	1840	26	3,700	945	DTWL=10.30'	SFR
9/13/77	1124	26	1,420	405	DTWL=10.12'	DGS
9/14/77	1345	26.5	1,500	395	DTWL=10.18'	UPS
9/15/77	1850	26	1,800	380	DTWL=10.34'	SFR
9/16/77	1620	26	1,300	300	DTWL=9.97'	DGS
9/17/77	1500	26.5	1,650	390	DTWL=9.89'	UPS
9/18/77	1650	26.5	2,200	500	DTWL=9.92'	SFR
9/19/77	1440	26.5	1,610	385	DTWL=10.04'	DGS
9/21/77	1335	26	1,600	390	DTWL=10.06'	UPS
9/22/77	1920	26	2,700	790	DTWL=9.82'	UPS
9/23/77	1710	26	2,700	750	DTWL=10.00'	UPS
9/24/77	1535	26	1,680	435	DTWL=10.01'	UPS
9/25/77	1715	26	1,700	460	DTWL=9.92'	UPS
9/26/77	1150	26	2,000	455	DTWL=9.89'	DGS
9/27/77	1430	26	1,850	445	DTWL=9.80'	DGS
9/28/77	1457	27	1,800	405	DTWL=9.87'	DGS
9/29/77	1410	26.5	2,000	400	DTWL=9.70'	DGS

WATER QUALITY DATA FROM BISCAYNE MONITORING WELL No. 6

Date	Time	Temperature °C	Specific Conductance (µmhos/cm)	Chloride (mg/l)	Remarks	Observer's Initials
9/30/77	1655	26.5	2,700	770	DTWL=9.99'	UPS
10/1/77	1500	26.5	2,500	690	DTWL=9.85'	UPS
10/2/77	1426	26.5	2,100	500	DTWL=9.86'	DGS
10/3/77	1006	26	2,200	520	DTWL=9.81'	CRS
10/4/77	1640	26.5	1,830	480	DTWL=9.99'	UPS
10/5/77	1048	26	2,000	490	DTWL=10.13'	DGS
10/6/77	1639	26	1,900	450	DTWL=10.12'	DGS
10/7/77	1745	26.5	1,760	460	DTWL=10.01'	UPS
10/8/77	1510	27	1,920	500	DTWL=10.14'	UPS
10/9/77	1855	26.5	1,900	490	DTWL=10.09'	UPS
10/10/77	1418	27	1,820	460	DTWL=10.22'	DGS
10/11/77	1438	27	2,000	510	DTWL=10.29'	DGS
10/12/77	1420	27	1,400	420	DTWL=10.24'	DGS
10/13/77	1825	25	1,790	450	DTWL=10.35'	UPS
10/14/77	1520	25	1,800	460	DTWL=10.44'	CRS
10/15/77	1446	26.5	1,800	365	DTWL=10.19'	DGS
10/16/77	1740	25	1,740	430	DTWL=10.30'	UPS
10/17/77	1545	25	1,700	420	DTWL=10.41'	CRS
10/18/77	1635	25	1,700	420	DTWL=10.20'	UPS

WATER QUALITY DATA FROM BISCAYNE MONITORING WELL Water Supply Well (Total depth=40 feet)

Date	Time	Temperature °C	Specific Conductance (µmhos/cm)	Chloride (mg/l)	Remarks	Observer's Initials
7/3/77	1105	25	800	150	Depth = 20' from top of pad	UPS
7/3/77	1155	25	1,450	330	Depth = 30'	UPS
7/3/77	1440	25	1,700	420	Depth = 40'	UPS
7/9/77	1500	24	1,350	340	Pumped sample	UPS
7/10/77	1400	24	1,360	300	Pumped sample	UPS
7/11/77	1800	24	1,350	310	Pumped sample	UPS
7/12/77	1530	24	1,320	305	Pumped sample	UPS
7/13/77	1500	23.5	1,310	300	Pumped sample	UPS
7/14/77	1705	23.5	1,250	290	Pumped sample	UPS
7/15/77	1130	23	1,300	290	Pumped sample	UPS
7/16/77	1630	25.5	1,400	325	Pumped sample	UPS
7/17/77	1955	27	1,390	320	Pumped sample	UPS
7/18/77	1600	24	1,380	320	Pumped sample	CRS
7/19/77	1500	26	1,350	310	Pumped sample	CRS
7/20/77	1215	26	1,380	315	Pumped sample	UPS
7/21/77	1457	26	1,400	310	Pumped sample	CRS
7/22/77	0940	26.5	1,390	315	Pumped sample	UPS
7/23/77	1245	24.5	1,420	320	Pumped sample	UPS
7/24/77	1825	24	1,410	315	Pumped sample	UPS
7/25/77	1010	26	1,410	290	Pumped sample	CRS
7/26/77	1530	26	1,450	330	Pumped sample	SFR
7/27/77	1245	24.5	1,470	335	Pumped sample	UPS
7/28/77	1450	--	1,500	340	Pumped sample	CRS
7/29/77	1845	26	1,490	340	Pumped sample	DGS
7/30/77	1530	26	1,520	310	Pumped sample	SFR
7/31/77	1345	25.5	1,580	350	Pumped sample	UPS

WATER QUALITY DATA FROM BISCAYNE MONITORING WELL Water Supply Well (Total depth=40 feet)

Date	Time	Temperature °C	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Remarks	Observer's Initials
8/1/77	0800	26	1,600	310	Pumped sample	DGS
8/2/77	1230	26	1,550	325	Pumped sample	CRS
8/3/77	1525	26	1,530	310	Pumped sample	SFR
8/4/77	1240	25	1,550	310	Pumped sample	UPS
8/5/77	1230	24	1,500	295	Pumped sample	UPS
8/6/77	1300	25.5	1,400	290	Pumped sample	UPS
8/7/77	1515	25.5	1,430	300	Pumped sample	DGS
8/8/77	1645	25.5	1,410	300	Pumped sample	CRS
8/9/77	1735	24.5	1,540	310	Pumped sample	UPS
8/10/77	1240	25	1,500	305	Pumped sample	UPS
8/11/77	1535	25	1,580	300	Pumped sample	SFR
8/12/77	1755	24.5	1,500	310	Pumped sample	SFR
8/13/77	1225	24.5	1,490	295	Pumped sample	UPS
8/14/77	1310	25	1,510	300	Pumped sample	UPS
8/15/77	1250	26.5	2,450	610	Pumped sample	DGS
8/16/77	1010	26	1,990	535	Pumped sample	DGS
8/17/77	1715	--	1,640	305	Pumped sample	CRS
8/18/77	1430	25	1,590	335	Pumped sample	UPS
8/19/77	1335	30	2,000	482	Pumped sample	SFR
8/20/77	1225	29	2,800	840	Pumped sample	DGS
8/21/77	1730	29.5	2,210	415	Pumped sample	SFR
8/22/77	1225	25.5	1,800	440	Pumped sample	UPS
8/23/77	1800	24	1,780	410	Pumped sample	UPS
8/24/77	1915	24	2,000	475	Pumped sample	UPS
8/25/77	2240	24.5	1,660	390	Pumped sample	UPS
8/27/77	1640	--	1,640	650	Pumped sample	CRS

WATER QUALITY DATA FROM BISCAYNE MONITORING WELL Water Supply Well (Total depth=40 feet)

Date	Time	Temperature °C	Specific Conductance (µmhos/cm)	Chloride (mg/l)	Remarks	Observer's Initials
8/28/77	1700	--	7,800	--	Pumped sample	CRS
8/29/77	1840	24.5	1,900	470	Pumped sample	UPS
8/30/77	1335	25	2,700	720	Pumped sample	UPS
8/31/77	1430	27.5	1,950	440	Pumped sample	SFR
9/1/77	1455	25	1,900	465	Pumped sample	UPS
9/2/77	1600	25	1,900	445	Pumped sample	SFR
9/3/77	1545	25.5	1,800	400	Pumped sample	SFR
9/4/77	1715	25	1,900	470	Pumped sample	CRS
9/5/77	1540	25	2,000	560	Pumped sample	CRS
9/6/77	1527	25.5	2,000	450	Pumped sample	DGS
9/7/77	1430	25	1,830	445	Pumped sample	UPS
9/8/77	1410	25	1,700	425	Pumped sample	UPS
9/9/77	1400	25.5	1,750	430	Pumped sample	UPS
9/10/77	1530	25.5	1,820	435	Pumped sample	SFR
9/11/77	1415	25	1,880	470	Pumped sample	UPS
9/12/77	1830	25	2,200	485	Pumped sample	SFR
9/13/77	1132	25.5	2,800	775	Pumped sample	DGS
9/14/77	1350	25.5	2,000	550	Pumped sample	UPS
9/15/77	1915	25.5	2,400	560	Pumped sample	SFR
9/16/77	1629	25.5	1,900	435	Pumped sample	DGS
9/17/77	1505	25.5	2,150	550	Pumped sample	UPS
9/18/77	1655	25.5	2,000	425	Pumped sample	SFR
9/19/77	1455	25.5	1,990	435	Pumped sample	DGS
9/21/77	1340	25.5	1,780	470	Pumped sample	UPS
9/22/77	1925	25	1,770	470	Pumped sample	UPS

WATER QUALITY DATA FROM BISCAYNE MONITORING WELL Water Supply Well (Total depth=40 feet)

Date	Time	Temperature °C	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Remarks	Observer's Initials
9/24/77	1540	25.5	1,690	440	Pumped sample	UPS
9/25/77	1720	25.5	1,700	455	Pumped sample	UPS
9/26/77	1158	25.5	1,450	385	Pumped sample	DGS
9/27/77	1439	25.5	1,610	400	Pumped sample	DGS
9/28/77	1500	25.5	1,820	420	Pumped sample	DGS
9/29/77	1418	25.5	1,810	470	Pumped sample	DGS
9/30/77	1700	25	1,800	480	Pumped sample	UPS
10/1/77	1505	25	1,780	470	Pumped sample	UPS
10/2/77	1430	25.5	1,800	410	Pumped sample	DGS
10/3/77	1010	--	1,800	440	Pumped sample	CRS
10/4/77	1647	25.5	1,700	430	Pumped sample	UPS
10/5/77	1052	25.5	1,800	430	Pumped sample	DGS
10/6/77	1443	25.5	1,600	385	Pumped sample	DGS
10/7/77	1750	25	1,720	440	Pumped sample	UPS
10/8/77	1455	24.5	1,650	420	Pumped sample	UPS
10/9/77	1900	24.5	1,670	420	Pumped sample	UPS
10/10/77	1426	25	1,740	425	Pumped sample	DGS
10/11/77	1443	25	1,800	415	Pumped sample	DGS
10/12/77	1428	24.5	1,660	425	Pumped sample	DGS
10/13/77	1830	24.5	1,750	450	Pumped sample	UPS
10/14/77	1525	24.5	1,700	450	Pumped sample	CRS
10/15/77	1450	24.5	1,800	410	Pumped sample	DGS
10/16/77	1745	24.5	1,680	430	Pumped sample	UPS
10/17/77	1600	24	1,600	420	Pumped sample	CRS
10/18/77	1640	24	1,600	410	Pumped sample	UPS

LAB ANALYSES

Parameter/Description	Laboratory Sample Numbers No. 7622	No. 7623	No. 7624	No. 7625	No. 7626
Well description	MW No. 1	MW No. 2	MW No. 3	MW No. 4	MW No. 5
Depth in feet	30	30	30	30	30
Temperature	24° C	24° C	24° C	24° C	24° C
Date collected	7-9-77	7-9-77	7-9-77	7-9-77	7-9-77
Time	1:50 p.m.	2:00 p.m.	2:00 p.m.	2:10 p.m.	2:15 p.m.
pH	7.90	7.60	7.84	7.95	7.80
Alkalinity (mg/l as $CaCO_3$)	260	328	255	240	499
Calcium (mg/l)	109	126	141	105	170
Chloride (mg/l)	97	250	135	112	165
Color (APHA units)	15	20	25	10	30
Conductivity (μmhos/cm)	783	1,210	937	811	977
Fluoride (mg/l)	0.16	0.12	0.15	0.17	0.14
Total hardness (mg/l as $CaCO_3$)	313	402	390	309	493
Magnesium (mg/l)	9.60	20.8	10.8	11.2	16.3
Nitrate (mg/l as N)	0.06	0.07	1.45	0.05	0.13
Potassium (mg/l)	4.80	7.00	13.8	9.50	5.00
Sodium (mg/l)	65.0	149	77.5	77.0	102
Dissolved solids (mg/l)	598	814	696	532	630
Strontium (mg/l)	0.72	0.84	0.89	0.70	0.86
Sulfate (mg/l)	37	42	99	71	32
Sulfide (mg/l)	1.20	0.84	0.11	0.20	0.76
Metals (mg/l)					
Aluminum	0.240	0.200	1.36	0.288	2.90
Arsenic	0.031	0.029	<0.006	0.016	0.012
Cadmium	<0.002	<0.002	<0.002	<0.002	0.003
Copper	0.006	0.005	0.007	0.005	0.011
Iron	0.230	0.224	0.770	0.270	2.12
Lead	0.022	<0.008	0.008	0.026	0.018
Manganese	0.010	0.016	0.011	0.016	0.037
Mercury	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002

Parameter/Description	Laboratory Sample Numbers No. 7627	No. 7628	No. 7692	No. 7693	No. 7694
Well description	MW No. 6	Water supply well	Water supply well	Water supply well	Water supply well
Depth sampled	30 feet	Pumped sample	20 feet	30 feet	40 feet
Temperature	24° C	24° C	25° C	25.5° C	25° C
Date collected	7-9-77	7-9-77	7-3-77	7-3-77	7-3-77
Time	12:15 p.m.	3:00 p.m.	11:05 a.m.	11:55 a.m.	2:40 p.m.
pH	11.70	8.00	I.S.	7.90	7.85
Alkalinity (mg/l as $CaCO_3$)	364	376	I.S.	I.S.	I.S.
Calcium (mg/l)	92.0	112	1,480	143	206
Chloride (mg/l)	233	251	187	279	417
Color (APHA units)	3	13	I.S.	I.S.	I.S.
Conductivity (μmhos/cm)	1,270	1,250	I.S.	I.S.	I.S.
Fluoride (mg/l)	0.13	0.13	I.S.	I.S.	I.S.
Total hardness (mg/l as $CaCO_3$)	243	365	3,750	468	602
Magnesium (mg/l)	2.85	20.4	11.5	26.6	20.8
Nitrate (mg/l as N)	0.06	0.02	0.50	0.10	0.18
Potassium (mg/l)	9.60	6.80	I.S.	I.S.	I.S.
Sodium (mg/l)	151	153	I.S.	I.S.	I.S.
Dissolved solids (mg/l)	640	844	I.S.	I.S.	I.S.
Strontium (mg/l)	0.77	0.89	3.13	0.89	1.03
Sulfate (mg/l)	34	48	52	46	61
Sulfide (mg/l)	1.04	0.89	*	*	*
Metals (mg/l)					
Aluminum	1.24	0.036			
Arsenic	0.024	0.014	0.051	<0.006	0.009
Cadmium	<0.002	<0.002			
Copper	0.006	0.004			
Iron	0.384	0.300			
Lead	0.012	0.010			
Manganese	0.005	0.012			
Mercury	<0.0002	<0.0002			

Note: I.S. = insufficient sample.

*Parameter not requested.

Appendix F

INVENTORY AND WATER QUALITY OF SURROUNDING ARTESIAN WELLS

Inventory and Water Quality of Surrounding Artesian Wells in Dade County and Key Largo, Florida

Well No.	Location	Owner	Use	Casing Diameter (inches)	Casing Depth (feet)	Total Depth (feet)	Specific Conductance (µmhos/cm)	Chloride (mg/l)	Sulfate (mg/l)	pH	Date	Remarks
1	Indian Creek Country Club Miami Beach 524234cc1	Indian Creek Country Club	–	8	876	906	–	2,100	–	–	7/2/69	Capped.
2	Indian Creek Country Club Miami Beach 524234cc2	Indian Creek Country Club	Irrigation	8	–	945	5,360	1,541	415	7.65	7/28/77	Output blended with city water.
3	N.W. Miami Ct. and 14th Street 534136ad	City Ice and Fuel Company	Industrial	12	730	1,088	–	2,800	–	–	4/29/59	Abandoned.
4	1600 N. Miami Ave. 534136cb	Gas Plant	Industrial	10-12	–	1,300	–	1,590	–	–	4/29/59	Abandoned.
5	Deering Estate 3250 S. Miami Ave. 534140cb	City of Miami or Deering	Landscape	8	–	980	–	970	–	–	10/15/18	Could not locate. Not used.
6	776 W. 54th St. Miami Beach	LaGorce Country Club	Irrigation	8	–	885	–	3,750	–	–	5/20/69	Temporarily capped.
7	Blackhawk and 51st Terrace	LaGorce Country Club	Irrigation	8	–	1,000	–	1,850	–	–	–	Buried.
8	11th St. and Jefferson Ave. Miami Beach 534232da	Miami Beach	–	–	–	1,501	–	–	–	–	–	Buried.
9	8618 W. Flagler 544110bc	Church	Irrigation	6	798	817	5,200	1,410	–	–	7/12/69	Did not recover.
10	S.W. 16th Terr. and 24th Ave. 544004bc	City of Miami	–	6	–	990	–	1,790	–	–	4/30/59	Buried.
11	8100 S. Dixie Highway 544125dd	Down South Nursery	Not used	6	480	1,065	4,900	1,350	–	–	5/69	Could not sample.
12	47 N.W. 6th St. 544137db	Gardner	Fountain	10	–	1,165	5,500	1,504	545	7.70	7/28/77	Flowing.
13	Palm Ave. at Palm Island	Miami Beach	–	8	–	1,000	–	1,450	–	–	1940	Abandoned.

Well No.	Location	Owner	Use	Casing Diameter (inches)	Casing Depth (feet)	Total Depth (feet)	Specific Conductance (µmhos/cm)	Chloride (mg/l)	Sulfate (mg/l)	pH	Date	Remarks
14	Key Biscayne 554206bb	Underwood (Matheson)	–	4	–	957	–	1,400	–	–	5/1/59	Did not recover.
15	Chekika State Rec. Area 553725	State of Florida	Recreation	12	487	1,259	4,820	1,165	475	7.90	7/30/77	Flowing 1,000 gpm.
16	Royal Palm Hammock S.P. 583714	USGS	–	8	620	1,333	–	2,700	–	–	1969	Did not recover.
17	Kendale Lakes WWTP 543935cc	General Waterworks	Injection	24 16	758 2,266	1,742 3,170	8,200 – 508	2,640 19,600 65	690 2,700 58	7.9 – 7.3	1/18/77 1972 1/18/77	Annulus 14 psi. Injection zone 34 psi.
18	Sunset Park WWTP 544032d	General Waterworks	Injection	22 16	545 1,810	1,678 2,947	9,450 – 510	2,870 19,300 61	625 2,660 47	7.9 – 7.7	1/18/77 1970 1/18/77	Annulus 14.5 psi. Injection zone 48 psi.
19	Production Test Area, South Tallahassee Rd. 583926c	Florida Power and Light production test well	Test well	20	1,126	1,400	8,900	2,659	600	7.80	7/29/77	
20	Production Test Area, South Tallahassee Rd. 583926c	Florida Power and Light observation well A	Test well	14 8-5/8 5-1/2	1,116 1,535 2,098	1,350 1,930 2,300	7,400 18,040 60,000	2,190 6,098 21,000	555 975 2,950	7.9 8.15 7.0	12/74 7/29/77 12/74	Could not sample. No flow. Could not sample.
21	Production Test Area, South Tallahassee Rd. 583926c	Florida Power and Light observation well B	Test well	8-5/8 5-1/2	1,098 1,498	1,410 1,700	7,720 16,100	2,474 5,498	250 915	8.70 7.30	7/29/77 7/29/77	
22	Production Test Area, South Tallahassee Rd. 583926c	Florida Power and Light observation well C	Test well	8-5/8 5-1/2	1,122 1,535	1,360 1,700	7,910 14,370	2,474 4,898	375 865	8.05 8.20	7/29/77 7/29/77	
23	Key Largo 594035a	Florida Power and Light observation well D	Test well	8-5/8–7 5-1/2	1,070 1,450	1,400 1,727	11,255 44,834	3,758 18,359	769 2,559	7.8 7.3	12/74 12/74	Did not sample. Did not sample.
24	Key Largo 594107	Ocean Reef Club	Irrigation	10	1,100	1,206	9,040	2,749	740	6.80	7/28/77	Output to RO plant.
25	Hialeah 534012	Hialeah Treatment Plant	Test well	–	–	1,200	–	–	–	–	–	Did not locate.

Well No.	Location	Owner	Use	Casing Diameter (inches)	Casing Depth (feet)	Total Depth (feet)	Specific Conductance (μmhos/cm)	Chloride (mg/l)	Sulfate (mg/l)	pH	Date	Remarks
26	Turkey Point 584028	Florida Power and Light research test well	Test well	9-5/8	995	2,000	11,290	3,489	710	7.75	7/28/77	Flowing.
27	Pennekamp State Park Key Largo	USGS	Recreation	6	–	1,330	8,370	2,574	525	7.85	7/28/77	Flowing 580 gpm.