GERAGHTY
& MILLER, INC.
Ground-Water Consultants

PF0234CS04
20 December 1988

Margaret Highsmith
Florida Department of
Environmental Regulation
1900 S. Congress Avenue
West Palm Beach, FL 33406

Re: Coral Springs Improvement District Injection Well #1, Radioactive Tracer Test

Dear Peggie,

As requested, this letter details the results of the radioactive tracer survey performed in Injection Well #1 at Coral Springs Improvement District on the night of December 8, 1988. The well is presently in service, so it was necessary to begin the test at night after peak flows to the plant had subsided and complete the test by 6:30 the following morning when morning peak flow would begin. The inflow to the plant was directed into a holding pond during the testing period. The test was successfully completed by 6:20 a.m. and the well was put immediately back into service. Later in the day, after the early peak flows, the treated effluent directed into the holding pond the previous night was pumped down the well.

The test was conducted in strict accordance with both the technical specifications and conditions noted in the letter of approval from the Florida Department of Environmental Regulation (FDER) dated December 1, 1988. All testing was performed in the presence of Ron Atkian, from the FDER's Tallahassee office. Schlumberger Well Services performed the logging and testing, and representatives of the Owner, Engineer, and Consultants were on-site during logging operations.

The radioactive tracer survey results show that the well meets the required criteria for Part II Mechanical Integrity, as defined by Chapter 17-28 (13)(6) FAC.

A combination gamma-ray/temperature/radioactive slug-ejector tool was run into the borehole after the appropriate tool calibrations had been performed and the radioactive material (Iodine 131) had been loaded into the tool. A stripper-head assembly and valve were used to prevent effluent spillage onto the concrete pad while the tool was in the well.

Initially, a temperature log was conducted in the well to the total depth of 3497 feet below pad level (its original drilled depth). The log showed that the water in the well was at a constant temperature of about 82.5 degrees Fahrenheit until reaching a depth of 2972 feet below pad level (almost at the bottom of the casing, which occurred at 2997 feet below pad level). Below 2972 feet, the temperature decreased rapidly to 71 degrees Fahrenheit at a depth of 3100 feet. The reason for this abrupt temperature change is that at this depth the effluent pumped into the well mixes with the cooler natural formation fluid. The temperature below 3100 feet continued to drop gradually to 69 degrees Fahrenheit at a depth of 3260 feet. A slight anomolous temperature increase of about 2 degrees occurred between 3260 feet and 3270 feet. Below 3270 feet to a depth of 3300 feet, the temperature continued to decrease gradually to 66 degrees Fahrenheit. At 3300 feet, the temperature decreased sharply to about 60 degrees Fahrenheit, then remained fairly constant to the bottom of the open borehole at a depth of 3497 feet. The natural formation fluid temperature of the open hole is about 60 degrees, so it was concluded that almost no effluent enters the open borehole below 3300 feet.

Upon completion of the temperature log, a gamma-ray log and casing collar locator log were performed upward in the borehole, from a depth of 3320 feet to 1500 feet. The background gamma-ray log compared very favorably with the log run in the pilot hole of this well during construction on January 24, 1985. The casing collar locator log recorded the bottom of the 12.75-inch-outside-diameter injection casing at 2997 feet below ground level.

After logging up to 1500 feet, the tool was returned to the bottom of the casing. The ejector was located at a depth of 2998 feet, within one foot below the bottom of the casing. (As required by the approval letter, the tool configuration lengths appear on the log; a diagram has been attached which was compiled from this information.) The ejector port was opened for 1000 microseconds in order to release a slug of Iodine 131 into the open borehole under static, non-pumping conditions. File #10 of the attached radioactive tracer log shows the effect of this release. A mark to the left of the log trace shows the point of release.

Within one minute of release, the tracer slug was detected by GRTE, the gamma-ray detector located about 1.8 feet below the lower ejector, and was recorded on the log. During the 30-minute waiting time after ejection, the iodine tracer was not detected at the gamma-ray detector GRSG, located about 12.5 feet below the lower ejector, indicating that the slug had moved laterally into the formation before it had dispersed far enough to be detected by GRSG.

Fourteen minutes after release, gamma-ray detector GR, located about 9.7 feet above the lower ejector, began to detect the tracer slug which had dispersed upward into the casing and had reached detector GR in high enough concentrations to be detected. The radioactive iodine reached the detector GRTE about 30 seconds after release from the ejector, so the travel-time for the slug was 3.6 feet per minute. In contrast, the slug reached the upper detector GR after fourteen minutes. The travel-time for the slug to reach the upper detector was equal to 0.69 feet per minute. The dispersion of the iodine was proportionally reduced as distance from the point of release became greater.

It is impossible to determine from this log whether the tracer was detected inside or outside the casing, so file #11 of the attached log was run after flushing the casing with water. If the tracer had migrated up behind the casing, detector GR would still record gamma-radiation above background levels at a depth of about 2985 feet (at a 0.7-ft-per-minute dispersion rate, the radioactive tracer would have moved about 5 feet vertically upward outside the casing in the time taken to flush out the tracer). The log shows, however, that the radioactive tracer had not moved upward outside the casing; the only increased gamma-ray levels were detected by GR below a depth of 2993 feet.

This test shows that the gamma-radiation detected by GR in File 10 was recorded while the tracer was rising <u>inside</u> the casing. File 12 represents a second log run after flushing operations; it was conducted about 25 minutes after the first log. By this time, the radioactive tracer material was detected by GR at a depth of 3030 feet below pad level, approximately 37 feet below its previously recorded depth. Both logs were run up to a depth of 2800 feet, instead of 2500 feet as stated in the technical specifications, with the concurrence of the FDER's on-site representative; no tracer material was detected during these logging runs. This static test determined that the well meets the Part II mechanical integrity testing requirement.

In accordance with the approved technical specifications, the second part of the testing schedule consisted of pumping fresh water into the well at a rate of 37 gpm (approximately 0.1 foot-per-second velocity), then ejecting a slug of radioactive iodine at a depth of 2992 feet below pad level (approximately 5 feet above the bottom of the casing). The tracer was detected at GRTE (1.8 feet below the detector) within 0.5 minutes after release, then at GRSG (about 12.5 feet below the ejector-or at a depth of 3004 feet below pad level) approximately 1.50 minutes after ejection. About 7 minutes after ejection, the tracer has passed GRSG and gamma-ray levels had returned to background (GRSG was located at a depth of 3004 feet). The tracer was not detected subsequently in GRTE or GR, which would have indicated that the tracer had migrated up behind the casing. Levels were monitored for 16 minutes - no changes occurred in the gamma-ray levels during this time.

The tool then was run down to 3080 feet below pad level and gamma-ray levels were monitored and recorded up to a depth of 2900 feet. All elevated levels of radioactivity were observed in all three gamma-ray detectors below a depth of 2997 feet below pad level (below the casing). This test confirms the results of the static test.

The next phase of testing consisted of increasing the rate of the injected water to a much higher level. With the concurrence of the FDER representative, a rate of 1700 gpm was selected. This rate is about 65 percent of the design rate for the well and was selected to reduce the effluent in the holding ponds in order to prolong possible testing time.

The water used for this part of the test was plant effluent which was pumped into the well using one of the plant pumps. A flow rate chart exists in the plant records for this pumping period and is available for inspection if required. During the lower-rate test, a flowmeter was situated in the flow line to the well, and a Geraghty & Miller, Inc., hydrogeologist collected readings of instantaneous and totalizing flow throughout the pumping period. A copy of these records is also available, if requested.

The water was pumped into the well, then a slug of radioactive tracer material was ejected. The ejector was located at a depth of 2992 feet for this portion of the test. The tracer was detected at GRTE approximately 1 second after release and at GRSG about 2 seconds after release, but was not detected by GR during the monitoring period of about 5 minutes. The test was repeated shortly afterwards with similar results. After the second release, the logging tool was lowered to approximately 3100 feet; gamma-ray levels were monitored and recorded up to a depth of 2800 feet. Levels were found to have increased over background below the casing only.

The final test (File #18 represents the log) consisted of releasing a total of 2.8 millicuries of Iodine 131 while the ejector was positioned at 2998 feet below pad level (within one foot below the bottom of the casing) under static, non-pumping conditions. Detector GRTE (1.8 feet below the ejector) recorded greater-than-background levels of gamma-radiation about 30 seconds after release of the first slug of tracer (a dispersion rate of 3.6 feet per minute) and continued to read these levels for the entire 30 minutes of monitoring. At the end of the period, there was an indication on the log that levels were dropping slightly. The bombardment of gamma-radiation on the tool in these concentrations apparently overwhelmed the detector.

Detector GRSG (about 12.5 feet below the ejector) started to record an increase in gamma-ray levels about 16.5 minutes after the first release (a dispersion rate of 9.75 feet per minute). These levels also remained very high throughout the 30-minute monitoring period.

Levels began to increase in GR (located 9.7 feet above the ejector) approximately 7.5 minutes after the first release (1.29 feet per minute). Once the gamma-radiation levels were detected at GR, levels continued to be recorded at a maximum for the entire 36-minute monitoring period. The rates of dispersion obtained in this test agreed well with the first static test, as expected.

After the 30-minute monitoring period, the casing was flushed with potable water and the logging tool was run down to 3100 feet. Gamma-radiation levels in excess of background levels were recorded below 2950 feet at each of the three gamma-ray detectors after the first logging run, and below 2995 feet after the second logging run, 30 minutes later. The gamma-radiation levels in the well were at the maximum measuring capacity of the detectors, so it is impossible to differentiate individual peaks of radiation in order to detect levels moving up outside the casing. This portion of the test is essentially superfluous, however, because the Part II mechanical integrity requirement had already been satisfactorily determined during the first static test.

A third logging run was made 25 minutes after the second gamma-ray levels in the open borehole were considerably lower than before, and the only significant levels of gamma radiation in the well were detected below the casing. The final logging run (File #22) was performed up to a depth of 1500 feet, as required by the approved technical specifications. The background log run in the well before the start of testing was superimposed on this log. There was good agreement between the two logs conducted before and after testing. No radioactive tracer material seems to have migrated up behind the casing.

Geraghty & Miller Inc., thanks all persons concerned with the performance of this test.

If you should have any questions about the test, or this report, please do not hesitate to call.

Sincerely,
GERAGHTY & MILLER, INC.

HM Madeksho

Helen V. Madeksho
Senior Hydrogeologist

James A Wheatley

J. A. Wheatley
Associate

HVM/JAW:lt

cc: See attached distribution list

Attachments: Radioactive Tracer log
Temperature log
Diagram

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PF0234CS04

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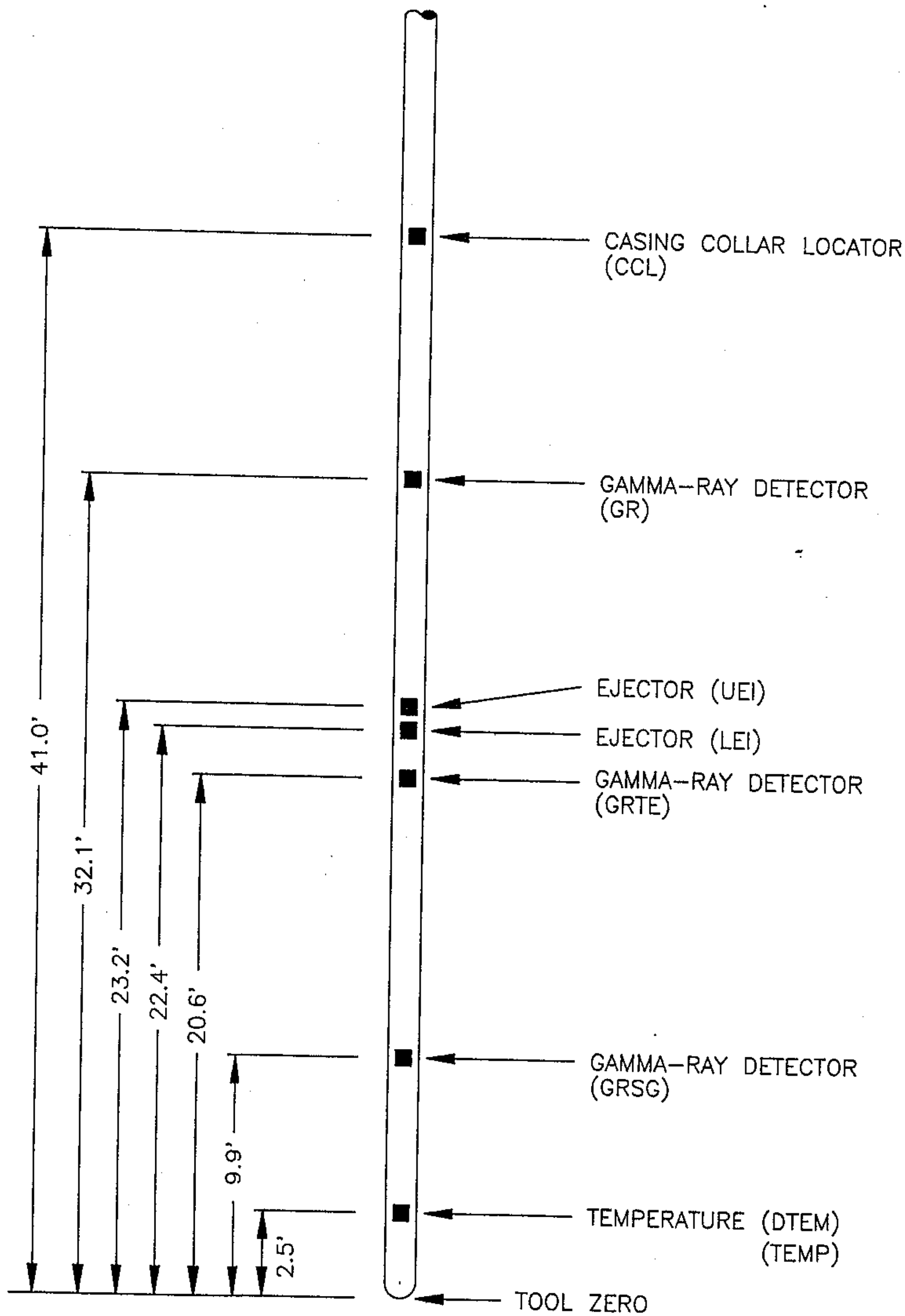
GERAGHTY & MILLER, INC. GROUND-WATER SERVICES	COMPILED BY: H. MADEKSHO	DATE: DEC 88	SCALE: NONE	PREPARED FOR: GEE & JENSON
	PREPARED BY: B. OLIVA	FILE NO: PF0234CS04		
	PROJECT MGR.: J. WHEATLEY			



SUBJECT:

TOOL CONFIGURATION FOR RADIOACTIVE TRACER TEST CSID INJECTION WELL #1

FIGURE

Schlumberger

TEMPERATURE LOG

COUNTY	BROWARD
FIELD	CORAL SPRINGS
LOCATION	
WELL	CORAL SPRINGS IW-1
COMPANY	CORAL SPRINGS IMPROVEMENT DI

COMPANY CORAL SPRINGS IMPROVEMENT DISTRICT

WELL CORAL SPRINGS IW-1

FIELD CORAL SPRINGS

COUNTY BROWARD STATE FLORIDA

LOCATION | Other Services: RTS HRT

API SERIAL NO. | SECT. | TWP. | RANGE

Permanent Datum GROUND LEVEL Elev. | Elev.: K.B. D.F. G.L.

Log Measured From GROUND LEVEL above Perm. Datum

Drilling Measured From GROUND LEVEL

Date	09-DEC-88		
Run No.	1		
Depth Driller	3497.0 F		
Depth Logger (Schl.)	3497.0 F		
Btm. Log Interval	3497.0 F		
Top Log Interval	60.0 F		
Casing-Driller	12.75 @3000.0 F	22 @2000.0 F	@
Casing-Logger	2997.0 F		
Bit Size	12	22	
Type Fluid in Hole	WATER		
Dens. / Visc.	8.30 LB/G		
pH / Fld. Loss			
Source of Sample	FLOWLINE		
Rm @ Meas. Temp.	@	@	
Rmf @ Meas. Temp.	@	@	
Rmc @ Meas. Temp.	@	@	
Source: Rmf / Rmc	MEASURE	MEASURE	
Rm @ BHT	@	@	
TIME Circulation Ended			
TIME Logger on Bottom	0000/21-08		
Max. Rec. Temp.			
Equip. / Location	8183	FT MYERS	
Recorded By	BUCHEL		
Witnessed By	WHEATLEY-MADEKSHO-A		

The well name, location and borehole reference data were furnished by the customer.

Run No.	1	
Service Order No.		
Drilling Fluid Level	0.0 F	
Salinity		
Rmf @ BHT	@	@
Rmc @ BHT	@	@
Logging Speed	2000.0 F/HR	
EQUIPMENT DATA		
Tool Number 1	ATM 369	
Tool Number 2	ATTB 925	
Tool Number 3	SGT 40	
Tool Number 4	CAL 1103	
Tool Number 5		
Tool Number 6		
Tool Number 7		
Tool Number 8		
Tool Number 9		
Tool Number 10		
Tool Number 11		
Tool Number 12		

REMARKS:

THANK YOU FOR USING SCHLUMBERGER!!!

PARAMETERS

NAME	VALUE	UNIT	NAME	VALUE	UNIT
WMUD	8.30000	LB/G	SGSN	0000A-00011	
CDAT			FCHD	CSID	
PTHR	10.0000	F/MN	NTHR	-10.0000	F/MN
TIRA	.500000		VPCF	.830000	
FDSH	0.0	G/C3	QIOP	FLOW	
TCSH	0.0	IN	BS	8.00000	IN
BHS	CASE				

SENSOR MEASURE POINT TO TOOL ZERO

DTEM	2.5	FEET	MP	1.1	FEET
TEMP	2.5	FEET	CCL	41.0	FEET
CVEL	0.0	FEET	TENS	41.0	FEET
EXT	0.0	FEET	EXP3	0.0	FEET
EXP2	0.0	FEET	EXP1	0.0	FEET
GRSG	9.9	FEET	UEI	23.2	FEET
LEI	22.4	FEET	GRTE	20.6	FEET
GR	32.1	FEET			

0.0 GR (GAPI) 100.00 | 70.000 TEMP(DEGF) 90.000

-19.00 CCL 1.0000

0.0 TEMP(DEGF) 100.00

CP 30.4 FILE 2 08-DEC-88 22:52

5"/100'

CP 30.4 FILE 2 09-DEC-88 00:03

0.0	GR (GAPI)	100.00
-19.00	CCL	1.0000
0.0	TEMP(DEGF)	100.00
70.000	TEMP(DEGF)	90.000

DATA ACQUIRED LOGGING DOWN

BEFORE SURVEY CALIBRATION SUMMARY

PERFORMED: 08-DEC-88 22:41
PROGRAM FILE: PLS (VERSION 30.4 88/08/04 87/11/19)

TETE DETECTOR CALIBRATION SUMMARY

	MEASURED BKGD	MEASURED JIG	CALIBRATED	UNITS
GRTE	65	181	135	GAPI

SGTR DETECTOR CALIBRATION SUMMARY

	MEASURED BKGD	MEASURED JIG	CALIBRATED	UNITS
GRSG	43	160	135	GAPI

MTSC ELECTRONICS CALIBRATION SUMMARY

	MEASURED ZERO	MEASURED PLUS	CALIBRATED ZERO	CALIBRATED PLUS	UNITS
MP	0.0	0.0	0.0	0.0	PSIG

MTSC ELECTRONICS CALIBRATION SUMMARY

	MEASURED ZERO	MEASURED PLUS	CALIBRATED ZERO	CALIBRATED PLUS	UNITS
TEMP	52.1	160.4	.0	200.0	DEGF

ATTB DETECTOR CALIBRATION SUMMARY

	MEASURED BKGD	MEASURED JIG	CALIBRATED	UNITS
GR	87	188	135	GAPI

COMPANY	CORAL SPRINGS IMPROVEMENT DISTRICT			SCHL. FR	3497.0 F
				SCHL. TD	3497.0 F
WELL	CORAL SPRINGS IW-1			DRLR. TD	3497.0 F
				Elev: KB	
FIELD	CORAL SPRINGS			DF	
COUNTY	BROWARD	STATE	FLORIDA	GL	

Schlumberger

TEMPERATURE LOG