HYDROTHERMAL INJECTION PROGRAM -
RAFT RIVER (KGRA) IDAHO - 1982 TEST DATA INDEX

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ABSTRACT

This report presents an index for the Hydrothermal Injection Program test data collected over a three-month testing and monitoring period, starting September 1, 1982 at the Raft River Geothermal Site located in Southern Idaho. The test program consisted of injecting tracer solutions into a geothermal well, and then withdrawing the fluid from the same well, either immediately, or after a quiescent period. These data, stored on tape at the National Technical Information Service (NTIS), U. S. Department of Commerce, Springfield, Virginia, consist of concentrations of injected tracer solutions, natural water chemistry, wellhead temperature, pressure and flow, downhole temperature and conductivity, caliper and spinner data along with wellhead pressure responses of the monitoring wells. The stored data have been screened to ensure that they are reasonable and internally consistent.

CONTENTS

ABSTRACT	ii
INTRODUCTION	1
BACKGROUND AND TEST SUMMARY.	2
TEST DATA DESCRIPTION.	11
REFERENCES	14
TAPE FORMAT DESCRIPTION.	16
FILES AND ASSOCIATED RECORDS	22

FIGURES

1. Raft River Well Locations.	3
2. Raft River RRGP-5 Subsurface Status.	6
3. Raft River RRGP-5 Instrumentation and Piping Schematic	10
4. File Record (Example).	19
5. Injection and Backflow (Example)	23
6. Tracer/Fluid Samples Analysis (Example).	23

TABLES

1. Selected Chemical Data from Raft River Wells.	4
2. Files/Nominal Flow Rates/Test Parameters.	7
3. Tracers Used During Test.	9
4. Methods of Water Analysis	13
5. List of Identifiers for File Records.	25
6. Test 2A1 - File Contents.	28
6A. Test 2A1 - Test Sequence and Objectives	29
7. Test 2A2 - File Contents.	30
7A. Test 2A2 - Test Sequence and Objectives	31
8. Test 2C - File Contents	32
8A. Test 2C - Test Sequence and Objectives.	34
9. Test 4A - File Contents	36
9A. Test 4A - Test Sequence and Objectives.	37
10. Test 4B - File Contents	38
10A. Test 4B - Test Sequence and Objectives.	39
11. Test 4C - File Contents	40

11A. Test 4C - Test Sequence and Objectives.	41
12. Test 4D - File Contents	42
12A. Test 4D - Test Sequence and Objectives.	43
13. Test 2D - File Contents	44
13A. Test 2D - Test Sequence and Objectives.	46
14. Test 5 - File Contents.	47
14A. Test 5 - File Sequence and Objectives	49
15. Monitor Wells - File Contents	51
16. Downhole Logs - File Contents	52

HYDROTHERMAL INJECTION PROGRAM

RAFT RIVER TEST DATA

INTRODUCTION

Injection of spent geothermal fluids may be required for environmental reasons, and can contribute to pressure maintenance in the geothermal reservoir. If injected fluids reach production wells too quickly, however, enthalpy of production fluids may drop causing loss of energy production. Injected fluids may also react with reservoir rocks causing loss of permeability in the injection zone. The U. S. Department of Energy (DOE), Division of Geothermal and Hydropower Technologies, has funded the Hydrothermal Injection Program to develop methods for assessing the effects of injection on geothermal reservoirs. As part of this program, EG&G Idaho, Inc. and the Earth Sciences Laboratory of the University of Utah Research Institute (UURI) carried out a series of field tests at the Raft River geothermal site in Southern Idaho.

This report documents the availability of field test data acquired through the Hydrothermal Injection Program. The report gives a brief description of the Raft River test site location, a condensed history of the well that was used in testing (RRGP-5), basic test procedures, tracers used, analytical methods, and summarizes the data acquisition and quality control procedures.

Information on the computerized field data, in table format, is contained in the section entitled Files and Associated Records. This section covers the computerized data files, file names, records in each file, units of measurement for data and sequence of major test operations throughout each test. These files are stored on tape at the National Technical Information Service at Springfield, Virginia and may be obtained by contacting the NTIS, U. S. Department of Commerce, 5285 Port Royal Road, Springfield, Virginia, 22161.

Additional sources of information on the Raft River Geothermal Site and the Hydrothermal Injection Program are listed in the Bibliography.

BACKGROUND AND TEST SUMMARY

The primary objective of the test sequence was to acquire experimental data that would aid in development of techniques for characterizing fracture-dominated geothermal reservoirs (Downs et al., 1982; Capuano et al., 1983). Techniques would be based on interpretation of mixing between injected tracer solutions and natural reservoir fluid. The test procedure called for varying injection, quiescent, and backflow times in order to test various volumes of the fractured reservoir. The Raft River Site was selected because the area was known to have a fracture-dominated production reservoir. The site was readily available with a monitoring system and the instrumentation set-up in place for the physical and chemical testing.

Between 1975 and 1978, seven geothermal wells were drilled at the Raft River KGRA (Figure 1) under DOE sponsorship (Dolenc, et al. 1981). Five of the wells were considered either exploratory (RRGE-1, RRGE-2, RRGE-3), or for production to supply a 5 MWe power plant (RRGP-4, RRGP-5). Two wells were drilled as injection wells to dispose of the spent geothermal fluids (RRGI-6, RRGI-7). Along with the seven geothermal wells, a number of monitoring wells were drilled and instrumented to measure pressure response or water table fluctuations associated with the injection of spent geothermal fluids.

For the Hydrothermal Injection Program, well RRGE-3 (Figure 1) was used as the supply well with well RRGP-5 designated as the injection well. Well RRGE-1 was monitored later in the test series for a tracer breakthrough of the tracers injected into RRGP-5. Well RRGE-3 was selected as the supply well because the natural chemistry of the water from this well (Table 1) was very different from the water chemistry of RRGP-5, thus, providing natural tracers to monitor fluid mixing.

RRGP-5 was drilled in 1978 (Miller et al., 1979) by Colorado Well Drilling Service. The well has 2 legs (A and B). The first was cemented off, after recovering a twisted-off drill stem, to allow for testing of the upper wellbore. The total depth of Leg A was 4897 ft before a cement plug was placed at 3735 ft. During the drilling of Leg A, a temperature log

5 0861

Figure 1. Raft River Well Locations

TABLE 1. SELECTED CHEMICAL DATA FROM WELLS (BASE LINE)

Well	Specific Conductivity (μ S)	Chemical Concentrations (mg/L)											
		pH	Ca ⁺²	Mg ⁺²	Sr ⁺²	Na ⁺	K ⁺	Li ⁺	HCO ₃ ⁻	SO ₄ ²⁻	Cl ⁻	F ⁻	SiO ₂
Geothermal													
RRGE-1*	2800	7.3	56	0.6	1.4	455	34	1.6	41	36	776	7.9	121
RRGE-2	2500	7.1	42	0.1	1.2	441	38	1.1	41	53	708	8.7	131
RRGE-3	8000	6.9	224	0.5	5.2	1194	105	3.1	44	60	2260	4.9	158
RRGP-4*	4050	7.2	86	---	6.4	753	---	3.1	42	---	1400	6.3	104
RRGP-5	2700	7.5	41	0.1	1.2	484	31	1.6	35	40	800	7.2	133
RRGI-6	10800	7.2	171	1.4	8.0	2200	32	5.1	73	60	3640	5.7	94
RRGI-7	12000	---	350	1.5	---	2200	---	---	32	64	4000	4.9	83
Monitor													
RRMW-1*	11400	7.6	215	0.4	6.3	2200	30	3.7	25	66	3680	3.4	80
RRMW-2	4400	7.4	125	0.5	3.6	1000	25	2.5	26	57	1740	5.4	87
RRMW-3	6200	7.5	155	6.3	1.9	1400	65	3.0	47	60	2460	5.4	60
RRMW-4	7800	7.7	160	0.6	1.4	1520	31	3.7	27	53	2610	5.6	67
RRMW-5	2200	7.6	107	25	0.9	280	14	0.3	120	27	610	0.6	34
RRMW-6	7600	7.3	207	2.4	1.4	1570	56	3.1	50	73	2770	4.9	85
RRMW-7	2300	7.6	95	20	0.9	333	14	0.6	125	33	650	1.1	40
RRPW-5*	---	---	---	---	---	---	---	---	---	---	---	---	---
USGS Monitor													
USGS-1	7400	7.8	230	2.5	1.7	1500	200	0.9	100	45	2800	3.2	85
USGS-2	1960	7.7	51	4.0	0.3	370	34	6.6	216	55	520	2.5	88
USGS-3*	5900	7.7	57	0.5	2.0	1270	14	1.7	77	54	2040	4.8	54
Other Geothermal													
BLM/OFFSET*	3000	7.4	44	0.7	1.5	577	21	1.4	49	65	890	7.6	74

* Wells monitored during testing.

taken showed 275°F with substantial flow at the depth of 4491 ft. After casing was hung and cemented into place, drilling was resumed. During an attempt to drill through the cement plug the drill veered off to the side and a second leg was completed to the depth of 4911 ft. (Figure 2). The second leg never intersected the same high flow fracture as Leg A, and after Leg B was tested, it showed substantially lower temperature and flow than Leg A. (These depths are referenced to the land surface, excluding the 14 ft. to the Kelly Bushing as was reported in the drillers log.)

In early to mid 1979, a request was made to formulate a plan under the Geothermal Reservoir Well Stimulation Program (GRWSP) in order to stimulate several wells at the Raft River location. These production wells were considered important to the support of the Raft River Geothermal Energy Project and the geothermal industry.

RRGP-5 was hydraulically fractured in November of 1979 in an attempt to reach the high production zones found in Leg A. Tests performed after stimulation along with USGS acoustic televiewer logs showed that the technique had worked, creating a 140 ft. vertical fracture in the wellbore. The hydrofracture, however, did not reach the production zone of Leg A and there was no increase in productivity or temperature. During the hydraulic fracturing of RRG-5, a sharp pressure spike response was noted at RRGE-1. This indicated a connection between the two wells, and so RRGE-1 was monitored for tracer breakthrough during the Injection Test Series.

Nine injection-backflow tests were conducted on well RRG-5 at the Raft River geothermal site. The conditions under which these tests were run are summarized in Table 2. These tests can be divided into three parametric groups, the 2, 4 and 5 series. In each series, all test variables except one were held constant. The "two" series tests, 2A-1, 2A-2, 2C and 2D, were run with increasingly larger volumes of injected solution. The "four" series tests, 4A, 4B, 4C and 4D, were run with nearly constant injection volumes, but with the lag time between injection and the initiation of backflow varying from 2 to 50 hours. During test 5, a much larger volume of solution was injected compared to the other tests and

INEL 3 3924

Figure 2. Raft River RRG-5 Subsurface Status

TABLE 2. FILES/NOMINAL FLOW RATES/TEST PARAMETERS

Test Title	File Start Time		Nominal Flow Rates Injection/Backflow (gpm)	Test Parameters		
	Name	Date		Injection (Hours)	Quiescence (Hours)	Backflow (Hours)
2A1	RR2A1	Sept 10	150/150	1.00	0.00	1.34
2A2	RR2A2	Sept 15	150/150	4.03	0.00	10.42
2C	RR2C	Sept 21	150/150	48.50	0.00	108.20
4A	RR4A	Sept 28	150/150	2.38	27.55	10.42
4B	RR4B	Oct 03	150/150	2.52	2.00	15.10
4C	RR4C	Oct 08	150/150	2.33	12.00	8.67
4D	RR4D	Oct 13	155/150	2.40	49.50	20.58**
2D	RR2D	Oct 18	155/150	98.33	0.00	236.08
5	RR5	Nov 06	155/150	376.13	103.79	119.70***
Monitor Wells	RRMONIT	Sept 01	N/A	N/A	N/A	N/A
Downhole Logs	DHLOGS	N/A	N/A	N/A	N/A	N/A

* Due to a transit line break from well RRGE-2, well RRGP-5 was needed to supply water to experiments and was flowed at 100 gpm for 127.92 hours. The well was shut-in just prior to Test 2A2 injection.

** Last tracer/fluid sample taken at 20.58 hours backflow time, RRGP-5 was backflowed for another 42.42 hours to clean out wellbore in prep for Test 2D.

*** The well was shut-in for 23 minutes, then opened for a series of backflow pulse-tests consisting of backflow ranging from 75 to 325 gpm for durations of 1 to 118 minutes in length.

the quiescent period was the longest at 103.8 hours. Test 5 was an attempt at breakthrough to nearby well, RRGE-1. Breakthrough was not achieved and RRGP-5 was subsequently backflowed.

During each test (Table 3), the geothermal injectant fluid was inoculated with a known concentration of secondary tracers. These tracer concentrations were monitored during the injection and backflow stages. The tracers were mixed and injected from three large mixing tanks (Figure 3) downstream from the injection pump. Tracer fluid samples were collected through a cooling coil (located in the chemistry trailer) that was attached to a continuous flow-loop with a flow rate of 4 gpm.

RRGP-5 injection system piping and pond were used as supply and disposal routes (Figure 3). The injection supply water from RRGE-3 could be flowed into the lined pond through spargers or valved directly to the suction side of the injection pump. The injection pump was also used as a method of disposal for backflow or warm-up flow fluids which had collected in the RRGP-5 lined pond. RRGP-5 fluids could also backflow directly to RRG-7 lined pond to be injected into well RRG-7.

The surrounding well field (Figure 1) was monitored and the data are presented to allow for interpretation of possible hydraulic pressure interference effects between the test well and the well field during injection and backflow.

Downhole geophysical logs were run prior to and throughout the test series by EG&G. These data are also included.

TABLE 3. TRACERS USED DURING TESTS

<u>Test</u>	<u>Sequence</u>	<u>Tracer</u>
2A1	1	Iodide (I^-) as NaI Magnesium (Mg^{2+}) as $MgCl_2$ Boron (B^{3+}) as Borax Fluorescein Bromide (Br^-) as NaBr
2A2	2	Iodide (I^-) as NaI
2C	3	Magnesium (Mg^{2+}) as $MgCl_2$
4A	4	Iodide (I^-) as NaI
4B	5	Fluorescein
4C	6	Iodide (I^-) as NaI
4D	7	Bromide (Br^-) as NaBr
2D	8	Iodide (I^-) as NaI Boron (B^{3+}) as Borax Magnesium (Mg^{2+}) as $MgCl_2$ Fluorescein
5	9	Iodide (I^-) as NaI Bromide (Br^-) as NaBr Rhodamine B Fluorescein

Figure 3. Raft River RRG-5 Instrumentation and Piping Schematic

INEL 3 0815

TEST DATA DESCRIPTION

This section presents a summary of data acquisition methods, quality control procedures, and data formats of the wellhead, chemical, and geophysical data collected at Raft River during the 1982 Hydrothermal Injection Program.

The wellhead and geophysical data were originally recorded on digiquartz printer tapes, data logger tapes, and a variety of stripcharts. Digiquartz tapes were either key-punched and then entered into the data base, or directly entered into the files from a terminal. All data logger tapes were key-punched for entry. Stripcharts were digitized for entry using either a digitizing tablet or by key punching selectively picked points.

Downhole conductivity/temperature logs and caliper logs run during different phases of the tests are also available. After interpretation of the downhole logs by EG&G, these data were digitized from the stripcharts. The results are reported in either engineering units or, where there were problems with keeping the downhole probes in calibration, as a percentage of the chart span. Those logs reported in percentage are considered usable as indicators of the geohydrologic parameters of the Raft River Geothermal area. The depths of the downhole logs have been corrected using correction factors to meet the USGS reported depths.

During the final test, flow, temperature, well-head pressure, and water chemistry data were also recorded at RRGE-1. Water samples from RRGE-1 were analyzed to look for breakthrough of tracers injected at RRG-5.

During both the injection and backflow portions of injection testing, water samples were collected at intervals ranging from 10 minutes to 4 hours. These water samples were collected at the wellhead after cooling to below boiling. Samples were analyzed for the artificial tracers used in testing and for all other major and minor elements including: Na, K, Ca, Mg, Fe, Sr, Li, B, SiO₂, Cl, F, HCO₃, SO₄, pH, and total dissolved solids. Methods of sample preservation and analysis are compiled in Table 4. In addition to the collection of water samples at regular intervals,

conductivity and fluorescence were monitored continuously with in-line instrumentation during both injection and backflow. Fluorescence allowed monitoring of the organic dye tracers, disodium fluorescein and rhodamine-B.

Precision and detection limits for the analytic procedures used are also listed in Table 4. For the analyses completed by UURI, the precisions were determined through repeat analyses over a period of approximately one month. The accuracy of the analytical procedures used was evaluated through check analyses by other comparable procedures. The precision of analyses completed at the Raft River test site field laboratory is uncertain because of the difficulty of controlling test conditions (such as fluid temperature) in the field. For each sample on which a complete analysis of all major cations and anions was made, the accuracy of each analysis was checked by calculating the cation-anion balance (Hem, 1970). Since aqueous solutions must be electrically neutral, the sum of the cations must equal the sum of the anions. For all samples with complete analyses, charge balance is within $\pm 3\%$.

Table 4. Methods of Water Analysis

ELEMENT	SAMPLE PREPARATION ^a		ANALYTIC TECHNIQUES	DETECTION LIMITS (mg/l)	PRECISION (%)	LABORATORY ^c
	FILTERED ^{a,b}	PRESERVATION ^a				
Na	Yes	20% HNO ₃	ICP ^e	1	--i	ESL
K	Yes	20% HNO ₃	ICP	2	--i	ESL
Ca	Yes	20% HNO ₃	ICP	0.2	--i	ESL
Mg	Yes	20% HNO ₃	ICP	0.5	--i	ESL
Fe	Yes	20% HNO ₃	ICP	0.1	--i	ESL
B	Yes	20% HNO ₃	ICP	0.1	--i	ESL
Sr	Yes	20% HNO ₃	ICP	0.01	--i	ESL
Li	Yes	20% HNO ₃	ICP	0.05	--i	ESL
SiO ₂	Yes	20% HNO ₃	ICP	1	--i	ESL
Cl ⁻	No	None	Mohr Titration ^f	2	3	ESL
F ⁻	Yes	None	Specific Ion Electrode ^k	0.1	5	ESL
SO ₄ ⁼	Yes	1% HCl	Gravimetric	2	3	ESL
HCO ₃ ⁻ , CO ₃ ⁼	No	None	H ₂ SO ₄ Titration ^a	1	--j	RAFT
I ⁻	No	None	Specific Ion Electrode ^k	0.2 ^h	10	ESL
Br ⁻	No	None	Titration	1	--i	ESL
SCN ⁻	No ^m	None	Colorimetric ^g	1	--j	ESL
pH ₁	No	None	pH electrode ^a	±0.1	--j	RAFT
TDS ₁	Yes	None	Gravimetric	5	5	ESL
Na ₂ Fluorescein	No	None	Colorimetric	0.02	--j	RAFT
Rhodamine-B	No	None	Colorimetric	0.01	--j	RAFT

a. Completed immediately after sample collection.

b. 0.45 μ membrane filter.

c. ESL = Earth Science Laboratory, University of Utah Research Institute; RAFT = analyses by EG&G scientific personnel at the Raft River Test Site field laboratory.

d. Iodate analyzed for and not present.

e. ICP = Inductively Coupled Argon Plasma Spectrophotometry.

f. Corrected for I, Br and SCN.

g. Ferric iron complex.

h. Special procedure used for detection limit of 0.1 on samples from test 5.

i. Precision at the detection limit is approximately ± 100% of the given value with a confidence level of 95%. At ten times the detection limit the precision is ± 10% (Christensen et al., 1980).

j. Addressed in text.

k. Method of additions.

l. Total dissolved solids.

m. Sample filtered if cloudy.

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TAPE FORMAT DESCRIPTION

TAPE FORMAT DESCRIPTION

This section describes the characteristics of the Raft River data tape and the format used to store the data. The data is structured into files and data records as presented in the following section. Each record is composed of two channels, a time or depth channel and a parameter channel, with keyword information associated with each channel. All the time or depth data is listed sequentially followed by a group containing the parameter data.

Tape Characteristics

Nine track (odd parity)

6250 bpi

CDC STRANGER FORMAT

ASCII

The following CDC NOS job control language cards define the tape format.

LABEL,TAPE,W,PO=W,NT,F=S,D=GE,CV=AS,L=\$RAFTRIVER\$,VSN=#.

FILE,TAPE,RT=F,BT=K,RB=64,MRL=80,FL=80,CM=yes.

Data Format

The first file on the tape is a directory. The directory is written with the following card contents:

DIRECTORY SECTION

<u>CARD</u>	<u>COLUMN</u>	<u>FORMAT</u>	<u>CONTENTS</u>
#	#		
1	1	A10	"DIRECTORY"
2	1	A40	PERMANENT FILE NAME
	41	A10	USERID
	51	I10	Seq. Position on Tape
	61	I10	First Channel No.
	71	I10	Number of Channels (2 x No. of Records)
3			(same as card 2)
.			.
.			.
.			.
11			(same as card 2)

The subsequent files are composed of the data files listed in the following section, and in the tape directory. The order of the information is as follows:

Channel identifier card 1 for time or depth

Channel identifier card 2 for time or depth

Set of time data cards

Three sets of:

Keyword information card

Keyword data card

Channel identifier card 1 for parameter

Channel identifier card 2 for parameter

Set of parameter data cards

Three sets of:

Keyword information card

Keyword data card

This data structure is repeated for each record. The cards are formatted as follows:

CHANNEL IDENTIFIER CARDS

<u>CARD</u>	<u>COLUMN</u>	<u>FORMAT</u>	<u>CONTENTS</u>
#	#		
1	1	A10	"IDENTIFIER"
	11	I10	Channel Seq. No.
	21	A20	Alphanumeric Identifier
	41	I10	Record No.
	51	A15	"TIME" or "DEPTH"
	66	I15	0
2	1	I10	Eucode ¹
	11	I10	Pack Factor ¹
	21	I10	Block Length
	31	I10	No. of Data Points
	41	-	reserved
	51	I10	No. of Words of Data

¹ Internal EG&G use.

DATA CARDS

FORMAT

5 (E16.9)

KEYWORD INFORMATION CARD

<u>COLUMN</u>	<u>FORMAT</u>	<u>CONTENTS</u>
1	A10	"KEYWORD"
11	I10	Seq. Position
21	A10	Keyword
31	A10	A
41	I10	No. of Words of Keyword Data

KEYWORD DATA CARD

FORMAT

CONTENT

8(A10)

1 to 4 words as given by preceding card

Figure 4 is an example of a file record listing both the time or depth and parameter channels along with their respective identifiers, data and keyword cards.

		Record Name			
		Channel Number	Record Number	Number of Data Points	
IDENTIFIER		27X-AXIS		0TIME	0
DATA		1	12	12	
8.00000000E-02		1.20000000E-01	3.30000000E-01	5.30000000E-01	5.80000000E-01
7.80000000E-01		1.00000000E+00	1.50000000E+00	1.61000000E+00	1.91000000E+00
2.00000000E+00		2.50000000E+00	.00000000E+00	.03000000E+00	.03000000E+00
KEYWORD		1TYPE	A	1	
Data Type -	TIME			1	
KEYWORD		2UNITS	A	1	
Eng. Units -	HOURS			4	
KEYWORD		3TIME	A		
Test Start -	FILE ZERO TIME = 09/10/82 @ 15 00 HOURS			14 POINTER	27
IDENTIFIER		28RR5-MG-2A1			
DATA		1	12	12	
-5.00000000E-01		-5.00000000E-01	1.80000000E+01	1.93000000E+01	1.90000000E+01
1.90000000E+01		-5.00000000E-01	1.90000000E+01	1.80000000E+01	2.00000000E+00
1.00000000E+00		-5.00000000E-01	.00000000E+00	.00000000E+00	.00000000E+00
KEYWORD		1TYPE	A	1	
Data Type -	MAGNESIUM			1	
KEYWORD		2UNITS	A	1	
Eng. Units -	MG/L			4	
KEYWORD		3TIME	A		
Test Start -	FILE ZERO TIME = 09/10/82 @ 15 00 HOURS				
IDENTIFIER		29X-AXIS		0TIME	0
DATA		1	12	12	
8.00000000E-02		1.20000000E-01	3.30000000E-01	5.30000000E-01	5.80000000E-01
7.80000000E-01		1.00000000E+00	1.50000000E+00	1.61000000E+00	1.91000000E+00
2.00000000E+00		2.50000000E+00	.00000000E+00	.03000000E+00	.00000000E+00
KEYWORD		1TYPE	A	1	
KEYWORD		2UNITS	A	1	
KEYWORD		3TIME	A	4	
FILE ZERO TIME = 09/10/82 @ 15 00 HOURS				15 POINTER	29
IDENTIFIER		30RR5-FE-2A1			
DATA		1	12	12	
8.00000000E-01		6.00000000E-01	1.00000000E-01	1.03000000E-01	1.00000000E-01
1.00000000E-01		2.00000000E-01	1.00000000E-01	1.03000000E-01	1.00000000E-01
-1.00000000E-01		1.00000000E-01	.00000000E+00	.03000000E+00	.03000000E+00
KEYWORD		1TYPE	A	1	
KEYWORD		2UNITS	A	1	
KEYWORD		3TIME	A	4	
FILE ZERO TIME = 09/10/82 @ 15 00 HOURS					

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Figure 4. File Record (Example)

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FILES AND ASSOCIATED RECORDS

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FILES AND ASSOCIATED RECORDS

There are nine separate test files, one for each of the tests. The file names consist of location and test number (Table 2). Each file contains pre-test and post-test data as well as actual test time data. There are files on the monitoring of the surrounding well field (Figure 1), RRMONIT, and of geophysical/geochemical baseline data, DHLOGS.

The files on the actual tests contain RRGP-5 well-head pressure, temperature (surface and downhole), injection and backflow rates and duration, and tracer/fluid analyses, both those performed on site and in the laboratory. On the final test, Test 5, flow, temperature, and well-head pressure data were also recorded at RRGE-1, also water samples taken at RRGE-1 were analyzed for breakthrough of tracers injected at RRGP-5. These data were incorporated in the file, RR5, along with data from RRGP-5. However, the RRGE-1 well-head pressure was put into the RRMONIT file, as RRGE-1 is included in the monitoring system. The injection or backflow rate is reported in either + (plus) gpm for injection or - (negative) gpm for backflow. Water chemistry analyses are reported in mg/l. Some of the water samples were not analyzed for a particular species; in this case, the specie sample is reported as a zero (0) (the zero values were included to maintain a record of the sampling frequency). Other specie samples were analyzed and reported with less-than (<) values and are input as - (negative) values. Examples of these data are shown in graphic form in Figures 5 and 6.

The file on the monitoring system, RRMONIT, presents data obtained from RRGE-1, RRMW-1, USGS-3, RRGP-4, RRPW-5, and BLM-OFFSET wells, of possible interference between the test wells and the well field. These data are reported in either psia of head pressure or water level below the measuring point. The file has a zero time on 09/01/82 at 00:00 hours.

Downhole logs were run prior to and throughout the test series by EG&G. The logs run prior to the test series are incorporated into a separate file DHLOGS, while logs run during the test series are included in their respective test file. The file, DHLOGS, contains downhole logs from RRGE-1 and Leg A and B of RRGP-5. The logs of Leg A were run prior to the placement of the cement plug and before Leg B was drilled.

Figure 5. Injection-Backflow (Example)

Figure 6. Tracer/fluid Samples (Example)

Each test file contents are displayed by two reference tables. These are preceded by a list (Table 5) of record name or "identifiers" and the interpretation of these identifiers along with the measurement units of each record.

The first "file" table consists of file name, test well and test number, date of test execution and a listing of records in the file. Each record is identified by name and record number and the appropriate engineering units, if applicable, and the source company, i.e., EGG or UURI. Any discrepancies or noteworthy exceptions to the file records are also noted on this table.

The second "file" table is a sequential listing of major operational events, during or prior to the test, taken from the field log book. This table lists two corresponding times (file/real) for each event. The real time is the actual time of day the events took place. The file time, listed in hours, has a fixed zero-time simultaneous with the beginning of the injection.

Records containing geophysical logging data are also referenced on this table next to the appropriate times of data collection. Geophysical records are referenced more than once where the record contains data from more than one phase of a given test, i.e., injection, quiescence and backflow phases.

Also included on this table are test objectives, and any events that are particular to the test.

TABLE 5. LIST OF IDENTIFIERS FOR FILE RECORDS

The following is a key for interpretation of the records listed on the following "File Contents" tables included in this section. All record names or "identifiers" are segmented into three parts: well, type of data, and descriptor. The formats for the record identifiers are:

"xxx-xxx-xxx"
well / | descriptor
 type of data

with the exception of the downhole log record identifiers which are:

"xxxx xx/xx x"
type of data | sequence
 date (1982)
 mm/dd

or in this format for the DHLOGS file:

"xxxx xxxx xxxxxx"
well | date (prior to 1982)
 mmddyy
 type of data

Also, identifiers for the monitoring wells are:

"xxxxx"

which simply states the well name.

The list below summarizes the identifiers and units used throughout the individual test files:

<u>IDENTIFIERS</u>	<u>WELL</u>	<u>TYPE OF DATA</u>	<u>DESCRIPTOR</u>	<u>UNITS</u>
RR5-XXXX-XXX	RRGP-5	Type of Data	Descriptor	N/A
RR1-XXXX-XXX	RRGE-1	Type of Data	Descriptor	N/A
XXX-TEMP-M	well	Temperature	Manually recorded	°F

TABLE 5. (Continued)

IDENTIFIERS	WELL	TYPE OF DATA	DESCRIPTOR	UNITS
XXX-TEMP-SC	well	Temperature	Stripcharts	°F
XXX-TEMP-DL	well	Temperature	Data logger	°F
XXX-WQ-SC	well	Well flow (+ or -)	Stripcharts	gpm
XXX-WP-D	well	Wellhead pressure	Digiquartz	psia
XXX-PH-DL	well	pH	Data logger	millivolts
XXX-PH-TS	well	pH	Field lab.	standard
XXX-PH-XXX	well	pH	Test #	standard
XXX-COND-DL	well	Conductivity	Data logger	μmho/cm
XXX-COND-TS	well	Conductivity	Field lab.	μmho/cm
XXX-REDOX-DL	well	oxidation-reduction	Data logger	millivolts
XXX-FLUO-TR	well	Fluorescein	Field lab.	mg/l
XXX-FLUO-XXX	well	Fluorescein	Test #	mg/l
XXX-MG-TR	well	Magnesium	Field lab.	mg/l
XXX-MG-XXX	well	Magnesium	Test #	mg/l
XXX-I-TR	well	Iodide	Field lab.	mg/l
XXX-I-XXX	well	Iodide	Test #	mg/l
XXX-BR-TR	well	Bromide	Field lab.	mg/l
XXX-BR-XXX	well	Bromide	Test #	mg/l
XXX-B-TR	well	Boron	Field lab.	mg/l
XXX-B-XXX	well	Boron	Test #	mg/l
XXX-RHODA-TR	well	Rhodamine B	Field lab.	mg/l
XXX-RHODA-XXX	well	Rhodamine B	Test #	mg/l
XXX-CL-TS	well	Chloride	Field lab.	mg/l
XXX-CL-XXX	well	Chloride	Test #	mg/l
XXX-CA-TS	well	Calcium	Field lab.	mg/l
XXX-CA-XXX	well	Calcium	Test #	mg/l
XXX-SCN-TR	well	Thiocyanate	Field lab.	mg/l
XXX-SCN-XXX	well	Thiocyanate	Test #	mg/l
XXX-ALK-TS	well	Alkalinity	Field lab.	mg/l
XXX-NA-XXX	well	Sodium	Test #	mg/l
XXX-K-XXX	well	Potassium	Test #	mg/l
XXX-FE-XXX	well	Iron	Test #	mg/l

TABLE 5. (Continued)

IDENTIFIERS	WELL	TYPE OF DATA	DESCRIPTOR	UNITS
XXX-SI02-XXX	well	Silica	Test #	mg/l
XXX-SR-XXX	well	Strontium	Test #	mg/l
XXX-LI-XXX	well	Lithium	Test #	mg/l
XXX-F-XXX	well	Fluoride	Test #	mg/l
XXX-TDS-XXX	well	Total dissolved solids	Test #	mg/l
XXX-HCO3-XXX	well	Bicarbonate	Test #	mg/l
XXX-SO4-XXX	well	Sulfate	Test #	mg/l

TABLE 6.

TEST 2A1

WELL: RRGP-5

FILE NAME: RR2A1

DATE: 09/10/82

<u>RECORD NAME</u>	<u>#</u>	<u>ENGINEERING UNITS</u>	<u>INSTRUMENT/INTERVAL</u>	<u>SOURCE</u>
RR5-WP-D	1	psia	Digiquartz	EGG
RR5-WQ-SC	2	gpm	Flow Recorder	EGG
RR5-TEMP-M	3	°F	Temperature Indicator	EGG
RR5-B-TR	4	mg/l	UV spectrophotometer	EGG
RR5-I-TR	5	mg/l	SIE	EGG
RR5-MG-TR	6	mg/l	AA	EGG
RR5-PH-DL	7	millivolts	Data Logger	EGG
RR5-COND-DL	8	µmho/cm	Data Logger	EGG
RR5-REDOX-DL	9	millivolts	Data Logger	EGG
RR5-TEMP-DL	10	°F	Data Logger	EGG
RR5-NA-2A1	11	mg/l	ICP	UURI
RR5-K-2A1	12	mg/l	ICP	UURI
RR5-CA-2A1	13	mg/l	ICP	UURI
RR5-MG-2A1	14	mg/l	ICP	UURI
RR5-FE-2A1	15	mg/l	ICP	UURI
RR5-SI02-2A1	16	mg/l	ICP	UURI
RR5-SR-2A1	17	mg/l	ICP	UURI
RR5-LI-2A1	18	mg/l	ICP	UURI
RR5-B-2A1	19	mg/l	ICP	UURI
RR5-CL-2A1	20	mg/l	Mohr Titration	UURI
RR5-F-2A1	21	mg/l	SIE	UURI
RR5-TDS-2A1	22	mg/l	Gravimetric	UURI
RR5-PH-2A1	23	standard	pH electrode	UURI
RR5-HCO3-2A1	24	mg/l	H ₂ SO ₄ Titration	UURI
RR5-SO4-2A1	25	mg/l	Gravimetric	UURI
RR5-I-2A1	26	mg/l	SIE	UURI

TABLE 6A. TEST SEQUENCE AND OBJECTIVES TEST 2A1

Date	Time	
	File/Real	
Sept 09	-30.0/09:00	Final phase of test site preparations
Sept 10	-5.85/09:09	Initiate injection down well RRGP-5 for checkout of systems piping and instruments (water from RRGE-2) (150 gpm)
	-5.53/09:28	Hale pump on (tracer pump)
	-5.5 /09:30	Hale pump off
	-5.43/09:34	Pump A & B (tracer pumps) on
	-5.08/09:55	Pump A & B off
	-4.90/10:06	Completed injection, shut-in RRGP-5
	-4.65/10:21	Initiate backflow from RRGP-5 to RRGP-5 lined pond (150 gpm)
	-3.61/11:20	Completed backflow, shut-in RRGP-5; systems piping and instrument checkout completed
	zerotime/15:00	Initiate injection down well RRGP-5, water from RRGE-3 (148 gpm)
	0.13/15:08	Tracer pump B on
	0.83/15:50	Tracer pump B off
	1.00/16:00	Completed injection, shut-in RRGP-5
	1.18/16:11	Initiate backflow to lined pond (150 gpm)
	2.52/17:31	Completed backflow, shut-in RRGP-5
	2.75/17:45	Initiate backflow from RRGP-5 to experiments and RRG-7 pond due to transit line break in RRGE-2 line which was being used to support experiments. (100 gpm)
Objectives:		
1. System piping and instrumentation checkout.		

TABLE 7.

TEST 2A2

WELL: RRG-5

FILE NAME: RR2A2

DATE: 09/15/82

<u>RECORD NAME</u>	<u>#</u>	<u>ENGINEERING UNITS</u>	<u>INSTRUMENT/INTERVAL</u>	<u>SOURCE</u>
RRG-TEMP-M	1	°F	Temperature Indicator	EGG
RR5-WP-D	2	psia	Digiquartz	EGG
RR5-WQ-SC	3	gpm	Flow Recorder	EGG
RR5-TEMP-SC	4	°F	Temperture RTD Recorder	EGG
RR5-I-TR	5	mg/l	SIE	EGG
RR5-PH-TS	6	standard	pH electrode	EGG
RR5-COND-TS	7	µmho/cm	Conductance cell	EGG
RR5-ALK-TS	8	mg/l	H ₂ SO ₄ Titration	EGG
RR5-PH-DL	9	millivolts	Data Logger	EGG
RR5-COND-DL	10	µmho/cm	Data Logger	EGG
RR5-REDOX-DL	11	millivolts	Data Logger	EGG
RR5-TEMP-DL	12	°F	Data Logger	EGG
COND 09/15	13	Arbitrary	4553'	EGG
TEMP 09/15	14	Arbitrary	4553'	EGG
XCAL 09/16	15	inches	4520' - 4746'	EGG
YCAL 09/16	16	inches	4518' - 4745'	EGG
RR5-NA-2A2	17	mg/l	ICP	UURI
RR5-K-2A2	18	mg/l	ICP	UURI
RR5-CA-2A2	19	mg/l	ICP	UURI
RR5-MG-2A2	20	mg/l	ICP	UURI
RR5-FE-2A2	21	mg/l	ICP	UURI
RR5-SIO ₂ -2A2	22	mg/l	ICP	UURI
RR5-SR-2A2	23	mg/l	ICP	UURI
RR5-LI-2A2	24	mg/l	ICP	UURI
RR5-B-2A2	25	mg/l	ICP	UURI
RR5-CL-2A2	26	mg/l	Mohr Titration	UURI
RR5-F-2A2	27	mg/l	SIE	UURI
RR5-TDS-2A2	28	mg/l	Gravimetric	UURI
RR5-PH-2A2	29	standard	pH electrode	UURI
RR5-HCO ₃ -2A2	30	mg/l	H ₂ SO ₄ Titration	UURI
RR5-SO ₄ -2A2	31	mg/l	Gravimetric	UURI
RR5-I-2A2	32	mg/l	SIE	UURI

TABLE 7A. TEST SEQUENCE AND OBJECTIVES TEST 2A2

Date	Time	
	File/Real	
Sept 13	44.94/12:00	Flow from RRGP-5 for experiments and keep warm flow (100 gpm)
Sept 15	-7.27/01:40	Decreased flow from RRGP-5 to 75 gpm
	-6.15/02:47	Decreased flow from RRGP-5 to 50 gpm
	-4.77/04:10	Decreased flow from RRGP-5 to 25 gpm
	-3.93/05:00	RRGP-5 shut-in except for sample line (4 gpm)
	zerotime/08:56	Initiate injection down well RRGP-5, water from RRGE-3 (150 gpm)
		Ran conductivity and temperature log at wellbore depth of 4553' (Records 13 and 14)
	0.10/09:02	Tracer Pump B on
	3.90/12:50	Tracer pump B off
	4.03/12:58	Completed injection
	4.38/13:19	Initiate backflow from RRGP-5 to lined pond
	14.80/23:44	Completed backflow except for sample line (4 gpm)
Sept 16	25.07/10:00	Ran XY caliper log on RRGP-5 4520' to 4746' (Records 15 and 16)

Objectives:

1. Test downhole Temperature/Conductivity probe.
2. Determine tracer (I^-) recovery from near well formation.

TABLE 8 . TEST 2C WELL: RRG-5
 FILE NAME: RR2C DATE: 09/21/82

<u>RECORD NAME</u>	<u>#</u>	<u>ENGINEERING UNITS</u>	<u>INSTRUMENT/INTERVAL</u>	<u>SOURCE</u>
RR5-TEMP-M	1	°F	Temperature Indicator	EGG
RR5-WP-D	2	psia	Digiquartz	EGG
RR5-WQ-SC	3	gpm	Flow Recorder	EGG
RR5-TEMP-SC	4	°F	Temperature RTD Recorder	EGG
RR5-FLUO-TR	5	mg/l	UV spectrophotometer	EGG
RR5-MG-TR	6	mg/l	AA	EGG
RR5-PH-TS	7	standard	pH electrode	EGG
RR5-COND-TS	8	µmho/cm	Conductance cell	EGG
RR5-ALK-TS	9	mg/l	H ₂ SO ₄ Titration	EGG
RR5-PH-DL	10	millivolts	Data Logger	EGG
RR5-COND-DL	11	µmho/cm	Data Logger	EGG
RR5-REDOX-DL	12	millivolts	Data Logger	EGG
RR5-TEMP-DL	13	°F	Data Logger	EGG
TEMP 09/21 1	14	arbitrary	4550' to 4730'	EGG
COND 09/21 1	15	arbitrary	4550' to 4730'	EGG
TEMP 09/21 2	16	arbitrary	4661' to 4740'	EGG
COND 09/21 2	17	arbitrary	4661' to 4740'	EGG
TEMP 09/21 3	18	arbitrary	4676' to 4730'	EGG
COND 09/21 3	19	arbitrary	4676' to 4730'	EGG
TEMP 09/23 1	20	arbitrary	4553' to 4740'	EGG
COND 09/23 1	21	arbitrary	4553' to 4740'	EGG
TEMP 09/24 1	22	arbitrary	4553' to 4740'	EGG
COND 09/24 1	23	arbitrary	4553' to 4740'	EGG
TEMP 09/25 1	24	arbitrary	4553' to 4740'	EGG
COND 09/25 1	25	arbitrary	4553' to 4740'	EGG
TEMP 09/25 2	26	arbitrary	4553' to 4740'	EGG
COND 09/25 2	27	arbitrary	4553' to 4740'	EGG
TEMP 09/27 1	28	°F	4514' to 4749'	EGG
RR5-NA-2C	29	mg/l	ICP	UURI
RR5-K-2C	30	mg/l	ICP	UURI
RR5-CA-2C	31	mg/l	ICP	UURI
RR5-MG-2C	32	mg/l	ICP	UURI

TABLE 8. (Continued)

<u>RECORD NAME</u>	<u>#</u>	<u>ENGINEERING UNITS</u>	<u>INSTRUMENT/INTERVAL</u>	<u>SOURCE</u>
RR5-FE-2C	33	mg/l	ICP	UURI
RR5-SI02-2C	34	mg/l	ICP	UURI
RR5-SR-2C	35	mg/l	ICP	UURI
RR5-LI-2C	36	mg/l	ICP	UURI
RR5-B-2C	37	mg/l	ICP	UURI
RR5-CL-2C	38	mg/l	Mohr Titration	UURI
RR5-F-2C	39	mg/l	SIE	UURI
RR5-TDS-2C	40	mg/l	Gravimetric	UURI
RR5-PH-2C	41	standard	pH electrode	UURI
RR5-HCO3-2C	42	mg/l	H ₂ SO ₄ Titration	UURI
RR5-SO4-2C	43	mg/l	Gravimetric	UURI
RR5-I-2C	44	mg/l	SIE	UURI
RR5-FLU0-2C	45	mg/l	Colorimetric	UURI

TABLE 8A. TEST SEQUENCE AND OBJECTIVES TEST 2C

Date	Time	
	File/Real	
Sept 21	-10.0/00:00	RRGP-5 shut-in
	zerotime/10:00	Initiated injection down well RRG-5 water from RRG-3 (150 gpm)
	0.03/10:02	Tracer pump B on, pump quit due to plugged suction line.
	0.37/10:22	Restart on tracer pump B
	2.20/12:12	Ran downhole conductivity and temperature logs: 4637' to 4820' (Records 14 and 15)
	2.28/12:17	4750' to 4830' (Records 16 and 17)
	2.38/12:23	4770' to 4820' (Records 18 and 19)
	4.75/14:45	Valved out in-line conductivity, pH and oxidation-reduction probes due to malfunction
	5.17/15:10	Valved probes back in
	10.0/20:00	Problems with tracer pump repaired and functioning properly
Sept 22	30.0/16:00	Tracer tank B filter plugged--repaired
	32.07/18:04	Tracer pump A on
	32.65/18:39	Tracer pump B off, changed filters
	32.83/18:50	Tracer pump B on
	33.07/19:04	Tracer pump A off
Sept 23	40.5/02:30	Tracer pump B off, filter plugged
	40.83/02:50	Tracer pump B on
	41.92/03:55	Tracer pump B off, filter problems
	41.98/03:59	Tracer pump B on
	42.80/04:48	Tracer pump B off, filter problems
	42.88/04:53	Tracer pump B on
	44.0/06:00	Tracer pump A on

TABLE 8A. (Continued)

<u>Date</u>	<u>Time</u>	
Sept 23	44.1/06:06	Tracer pump B off, changed filters
	44.18/06:11	Tracer pump B on
	46.5/08:30	Changed out filter on tank B
	48.25/10:15	Tracer pumps A & B off
	48.5/10:30	Completed injection
	48.58/10:35	Initiate backflow from RRGP-5 to lined pond at RRGP-5 (150 gpm)
	52.92/14:55	All backflow diverted to RRG-7 pond (150 gpm)
	53.07/15:04	Ran downhole conductivity and temperature logs: 4640' to 4830' (Records 20 and 21)
Sept 24	70.58/08:35	Ran downhole conductivity and temperature logs: 4640' to 4830' (Records 22 and 23)
Sept 25	103.0/17:00	Ran downhole conductivity and temperature logs: 4640' to 4830' (Records 24 and 25)
	103.13/17:08	4640' to 4830' (Records 26 and 27)
Sept 27	149.17/15:10	Increased backflow to RRG-7 pond (155 gpm)
	149.5/15:30	Ran downhole temperature log 4514' to 4749' (Record 28)
	156.78/22:47	Decreased backflow from RRGP-5 to RRG-7 pond to 25 gpm to keep system warm

Objectives:

Explore a large volume of the reservoir.

Determine the position in the open bore where the fluid is leaving.

Determine tracer (Mg^{2+}) recovery from a larger volume of the reservoir.

TABLE 9. TEST 4A WELL: RRGP-5
 FILE NAME: RR4A DATE: 09/30/82

RECORD NAME	#	ENGINEERING UNITS	INSTRUMENT/INTERVAL	SOURCE
RR5-TEMP-M	1	°F	Temperature Indicator	EGG
RR5-WP-D	2	psia	Digiquartz	EGG
RR5-WQ-SC	3	gpm	Flow Recorder	EGG
RR5-TEMP-SC	4	°F	Temperature RTD Recorder	EGG
RR5-I-TR	5	mg/l	SIE	EGG
RR5-PH-TS	6	standard	pH electrode	EGG
RR5-COND-TS	7	µmho/cm	Conductance cell	EGG
RR5-ALK-TS	8	mg/l	H ₂ SO ₄ Titration	EGG
RR5-PH-DL	9	millivolts	Data Logger	EGG
RR5-COND-DL	10	µmho/cm	Data Logger	EGG
RR5-REDOX-DL	11	millivolts	Data Logger	EGG
RR5-TEMP-DL	12	°F	Data Logger	EGG
RR5-NA-4A	13	mg/l	ICP	UURI
RR5-K-4A	14	mg/l	ICP	UURI
RR5-CA-4A	15	mg/l	ICP	UURI
RR5-MG-4A	16	mg/l	ICP	UURI
RR5-FE-4A	17	mg/l	ICP	UURI
RR5-SIO ₂ -4A	18	mg/l	ICP	UURI
RR5-SR-4A	19	mg/l	ICP	UURI
RR5-LI-4A	20	mg/l	ICP	UURI
RR5-B-4A	21	mg/l	ICP	UURI
RR5-CL-4A	22	mg/l	Mohr Titration	UURI
RR5-F-4A	23	mg/l	SIE	UURI
RR5-TDS-4A	24	mg/l	Gravimetric	UURI
RR5-PH-4A	25	standard	pH electrode	UURI
RR5-HCO ₃ -4A	26	mg/l	H ₂ SO ₄ Titration	UURI
RR5-I-4A	27	mg/l	SIE	UURI

TABLE 9A. TEST SEQUENCE AND OBJECTIVES TEST 4A

Date	Time	
	File/Real	
Sept 28	-58.58/00:00	RRGP-5 backflow to RRG-7 pond (25 gpm)
Sept 29	-28.65/05:55	Increased backflow from RRG-5 to 30 gpm
	-16.65/17:55	Diverted RRG-5 backflow to RRG-5 pond to warm up system
Sept 30	-0.23/10:20	Initiate injection down well RRG-5, water from RRG-3 (150 gpm)
	-0.17/10:24	Injection stopped, problems with instrumentation, blew rupture disc at RRG-3
	zerotime/10:34	Initiate injection down well RRG-5 water from RRG-3 (150 gpm)
	0.07/10:38	Tracer pump on
	1.32/11:53	Tracer pump off
	2.38/12:57	Completed injection, shut-in RRG-5
Oct 01	29.93/16:30	Initiate backflow from RRG-5 to lined pond
	30.23/16:48	Problems with in-line conductivity probe, getting it repaired
	30.55/17:07	Conductivity probe now working
Oct 02	45.93/08:30	Completed backflow, shut-in RRG-5
	51.46/14:02	Initiate backflow from RRG-5 to lined pond to keep system warm (undetermined amount)

Objective:

Determine whether a natural hydrological flow system was removing injected solutions from the immediate vicinity of injection well.

TABLE 10. TEST 4B WELL: RRGP-5
FILE NAME: RR4B DATE: 10/07/82

<u>RECORD NAME</u>	<u>#</u>	<u>ENGINEERING UNITS</u>	<u>INSTRUMENT/INTERVAL</u>	<u>SOURCE</u>
RR5-TEMP-M	1	°F	Temperature Indicator	EGG
RR5-WP-D	2	psia	Digiquartz	EGG
RR5-WQ-SC	3	gpm	Flow Recorder	EGG
RR5-TEMP-SC	4	°F	Temperature RTD Recorder	EGG
RR5-I-TR	5	mg/l	SIE	EGG
RR5-SCN-TR	6	mg/l	Ion-chromotography	EGG
RR5-FLUO-TR	7	mg/l	UV spectrophotometer	EGG
RR5-PH-TS	8	standard	pH electrode	EGG
RR5-COND-TS	9	µmho/cm	Conductance Cell	EGG
RR5-ALK-TS	10	mg/l	H ₂ SO ₄ Titration	EGG
RR5-PH-DL	11	millivolts	Data Logger	EGG
RR5-COND-DL	12	µmho/cm	Data Logger	EGG
RR5-REDOX-DL	13	millivolts	Data Logger	EGG
RR5-TEMP-DL	14	°F	Data Logger	EGG
RR5-NA-4B	15	mg/l	ICP	UURI
RR5-K-4B	16	mg/l	ICP	UURI
RR5-CA-4B	17	mg/l	ICP	UURI
RR5-MG-4B	18	mg/l	ICP	UURI
RR5-FE-4B	19	mg/l	ICP	UURI
RR5-SIO ₂ -4B	20	mg/l	ICP	UURI
RR5-SR-4B	21	mg/l	ICP	UURI
RR5-LI-4B	22	mg/l	ICP	UURI
RR5-B-4B	23	mg/l	ICP	UURI
RR5-CL-4B	24	mg/l	Mohr Titration	UURI
RR5-F-4B	25	mg/l	SIE	UURI
RR5-TDS-4B	26	mg/l	Gravimetric	UURI
RR5-PH-4B	27	standard	pH electrode	UURI
RR5-HCO ₃ -4B	28	mg/l	H ₂ SO ₄ Titration	UURI
RR5-SO ₄ -4B	29	mg/l	Gravimetric	UURI
RR5-FLUO-4B	30	mg/l	Colorimetric	UURI
RR5-SCN-4B	31	mg/l	Colorimetric	UURI

TABLE 10A. TEST SEQUENCE AND OBJECTIVES TEST 4B

Date	Time	
	File/Real	
Oct 03	-97.0/12:00	Backflow from RRGP-5 to RRG1-7 pond to keep system warm (undeterminable small amount)
Oct 04	-83.02/01:59	Increased backflow from RRGP-5 to 25 gpm
	-76.25/08:45	Decreased backflow from RRGP-5 to 15 gpm
	-68.05/16:57	Diverted backflow to lined pond at RRGP-5 and increased to 100 gpm
	-66.62/18:23	Shut-in RRGP-5
	-66.5/18:30	Initiate small backflow from RRGP-5 to lined pond (undetermined amount)
Oct 5	-53.0/08:00	Backflow from RRGP-5 to RRG1-7 pond (25 gpm)
Oct 07	-0.05/12:57	Shut-in RRGP-5
	zerotime/13:00	Initiate injection down well RRGP-5, water from RRGE-3 (150 gpm)
	0.02/13:01	Tracer pump B on
	1.52/14:31	Tracer pump B off
	2.52/15:31	Completed injection
	4.52/17:31	Initiate backflow from RRGP-5 to lined pond (150 gpm)
	5.00/18:00	Diverted backflow to RRG1-7 pond
Oct 08	19.62/08:37	Decreased backflow to RRG1-7 to 16 gpm
	21.90/10:54	Diverted backflow to RRGP-5 lined pond and increased to 30 gpm

Objective:

Determine whether a natural hydrological flow system was removing injected solutions from the immediate vicinity of the injection well.

TABLE 11. TEST 4C

WELL: RRGP-5

FILE NAME: RR4C

DATE: 10/08/82

<u>RECORD NAME</u>	<u>#</u>	<u>ENGINEERING UNITS</u>	<u>INSTRUMENT/INTERVAL</u>	<u>SOURCE</u>
RR5-TEMP-M	1	°F	Temperature Indicator	EGG
RR5-WP-D	2	psia	Digiquartz	EGG
RR5-WQ-SC	3	gpm	Flow Recorder	EGG
RR5-TEMP-SC	4	°F	Temperature RTD Recorder	EGG
RR5-I-TR	5	mg/l	SIE	EGG
RR5-PH-TS	6	standard	pH electrode	EGG
RR5-COND-TS	7	µmho/cm	Conductance cell	EGG
RR5-ALK-TS	8	mg/l	H ₂ SO ₄ Titration	EGG
RR5-PH-DL	9	millivolts	Data Logger	EGG
RR5-COND-DL	10	µmho/cm	Data Logger	EGG
RR5-REDOX-DL	11	millivolts	Data Logger	EGG
RR5-TEMP-DL	12	°F	Data Logger	EGG
RR5-NA-4C	13	mg/l	ICP	UURI
RR5-K-4C	14	mg/l	ICP	UURI
RR5-CA-4C	15	mg/l	ICP	UURI
RR5-MG-4C	16	mg/l	ICP	UURI
RR5-FE-4C	17	mg/l	ICP	UURI
RR5-SIO ₂ -4C	18	mg/l	ICP	UURI
RR5-SR-4C	19	mg/l	ICP	UURI
RR5-LI-4C	20	mg/l	ICP	UURI
RR5-B-4C	21	mg/l	ICP	UURI
RR5-CL-4C	22	mg/l	Mohr Titration	UURI
RR5-F-4C	23	mg/l	SIE	UURI
RR5-TDS-4C	24	mg/l	Gravimetric	UURI
RR5-PH-4C	25	standard	pH electrode	UURI
RR5-I-4C	26	mg/l	SIE	UURI

TABLE 11A. TEST SEQUENCE AND OBJECTIVES TEST 4C

Date	Time	
		File/Real
Oct 08	-6.0/12:00	RRGP-5 backflow (30 gpm)
	-1.5/16:30	Shut-in RRG-5
	zerotime/18:00	Initiate injection down well RRG-5 water from RRG-3 (150 gpm)
	0.02/18:01	Tracer pump on
	1.5/19:30	Tracer pump off
	2.33/20:20	Completed injection
Oct 09	14.33/08:20	Initiate backflow from RRG-5 to lined pond (150 gpm)
	23.0/17:00	Completed backflow, decreased to 16 gpm diverted to RRG-7 pond
Oct 10	42.0/12:00	RRGP-5 backflow to RRG-7 pond (16 gpm)

Objective:

Determine whether a natural hydrological flow system was removing injected solutions from the immediate vicinity of the injection well.

TABLE 12. TEST 4D WELL: RRG-5
FILE NAME: RR4D DATE: 10/13/82

RECORD NAME	#	ENGINEERING UNITS	INSTRUMENT/INTERVAL	SOURCE
RR5-TEMP-M	1	°F	Temperature Indicator	EGG
RR5-TEMP-SC	2	°F	Temperature RTD Recorder	EGG
RR5-WP-D	3	psia	Digiquartz	EGG
RR5-WQ-SC	4	gpm	Flow recorder	EGG
RR5-BR-TR	5	mg/l	Ion-chromotography	EGG
RR5-FLUO-TR	6	mg/l	UV spectrophotometer	EGG
RR5-PH-TS	7	standard	pH electrode	EGG
RR5-COND-TS	8	µmho/cm	Conductance Cell	EGG
RR5-ALK-TS	9	mg/l	H ₂ SO ₄ Titration	EGG
RR5-PH-DL	10	millivolts	Data Logger	EGG
RR5-COND-DL	11	µmho/cm	Data Logger	EGG
RR5-REDOX-DL	12	millivolts	Data Logger	EGG
RR5-TEMP-DL	13	°F	Data Logger	EGG
COND 10/13 1	14	µmho/cm	451' to 4749'	EGG
COND 10/14 1	15	µmho/cm	4514' to 4751'	EGG
COND 10/14 2	16	µmho/cm	4514' to 4751'	EGG
COND 10/14 3	17	µmho/cm	4514' to 4749'	EGG
COND 10/15 1	18	µmho/cm	4514' to 4752'	EGG
RR5-NA-4D	19	mg/l	ICP	UURI
RR5-K-4D	20	mg/l	ICP	UURI
RR5-CA-4D	21	mg/l	ICP	UURI
RR5-MG-4D	22	mg/l	ICP	UURI
RR5-FE-4D	23	mg/l	ICP	UURI
RR5-SI02-4D	24	mg/l	ICP	UURI
RR5-SR-4D	25	mg/l	ICP	UURI
RR5-LI-4D	26	mg/l	ICP	UURI
RR5-B-4D	27	mg/l	ICP	UURI
RR5-CL-4D	28	mg/l	Mohr Titration	UURI
RR5-F-4D	29	mg/l	SIE	UURI
RR5-TDS-4D	30	mg/l	Gravimetric	UURI
RR5-PH-4D	31	standard	pH electrode	UURI
RR5-HCO3-4D	32	mg/l	H ₂ SO ₄ Titration	UURI
RR5-SO4-4D	33	mg/l	Gravimetric	UURI
RR5-FLUO-4D	34	mg/l	Colorimetric	UURI

TABLE 12A. TEST SEQUENCE AND OBJECTIVES TEST 4D

Date	Time	
	File/Real	
Oct 13	-9.05/00:00	RRGP-5 flow to RRG1-7 pond (16 gpm)
	-6.62/02:26	RRGP-5 shut-in
	zerotime/09:03	Initiate injection down well RRG-5, water from RRG-3 (155 gpm)
	0.02/09:04	Tracer pump on
	1.52/10:34	Tracer pump off
	2.40/11:27	Completed injection
	2.45/11:30	RRGP-5 shut-in
	8.47/17:31	Ran downhole conductivity log: 4514' to 4749' (Record 14)
Oct 14	15.45/00:30	4514' to 4751' (Record 15)
	21.82/06:52	4514' to 4751' (Record 16)
	31.54/16:35	4514' to 4749' (Record 17)
Oct 15	39.20/00:15	4514' to 4752' (Record 18)
	51.95/13:00	Initiate backflow from RRG-5 to lined pond (150 gpm)
	53.47/14:31	Split backflow; 40 gpm going to RRG1-7 pond and 110 gpm going to lined pond at RRG-5
	55.12/16:10	RRGP-5 backflow diverted to RRG1-7 pond (150 gpm)
Oct 16	72.53/09:35	Collected last chemistry samples and terminated test. Backflow continues to clean out well (150 gpm).

Objective:

Determine whether a natural hydrological flow system was removing injected solution from the immediate vicinity of the injection well.

TABLE 13. TEST 2D WELL: RRGP-5
 FILE NAME: RR2D DATE: 10/18/82

RECORD NAME	#	ENGINEERING UNITS	INSTRUMENT/INTERVAL	SOURCE
RR5-TEMP-M	1	°F	Temperature Indicator	EGG
RR5-TEMP-SC	2	°F	Temperature Recorder	EGG
RR5-WP-D	3	psia	Digiquartz	EGG
RR5-WQ-SC	4	gpm	Flow Recorder	EGG
RR5-I-TR	5	mg/l	SIE	EGG
RR5-FLUO-TR	6	mg/l	UV spectrophotometer	EGG
RR5-B-TR	7	mg/l	UV spectrophotometer	EGG
RR5-MG-TR	8	mg/l	AA	EGG
RR5-CA-TS	9	mg/l	AA	EGG
RR5-CL-TS	10	mg/l	SIE	EGG
RR5-PH-TS	11	standard	pH electrode	EGG
RR5-COND-TS	12	µmho/cm	Conductance cell	EGG
RR5-PH-DL	13	millivolts	Data Logger	EGG
RR5-COND-DL	14	µmho/cm	Data Logger	EGG
RR5-REDOX-DL	15	millivolts	Data Logger	EGG
RR5-TEMP-DL	16	°F	Data Logger	EGG
TEMP 10/25 1	17	°F	4514' to 4749'	EGG
RR5-NA-2D	18	mg/l	ICP	UURI
RR5-K-2D	19	mg/l	ICP	UURI
RR5-CA-2D	20	mg/l	ICP	UURI
RR5-MG-2D	21	mg/l	ICP	UURI
RR5-FE-2D	22	mg/l	ICP	UURI
RR5-SIO2-2D	23	mg/l	ICP	UURI
RR5-SR-2D	24	mg/l	ICP	UURI
RR5-LI-2D	25	mg/l	ICP	UURI
RR5-B-2D	26	mg/l	ICP	UURI
RR5-CL-2D	27	mg/l	Mohr Titration	UURI
RR5-F-2D	28	mg/l	SIE	UURI
RR5-TDS-2D	29	mg/l	Gravimetric	UURI
RR5-PH-2D	30	standard	pH electrode	UURI
RR5-HCO3-2D	31	mg/l	H2SO4 Titration	UURI
RR5-SO4-2D	32	mg/l	Gravimetric	UURI

TABLE 13. (Continued)

<u>RECORD NAME</u>	<u>#</u>	<u>ENGINEERING UNITS</u>	<u>INSTRUMENT/INTERVAL</u>	<u>SOURCE</u>
RR5-I-2D	33	mg/l	SIE	UURI
RR-FLUO-2D	34	mg/l	Colorimetric	UURI
RR5-RHODA-2D	35	mg/l	Colorimetric	UURI

TABLE 13A. TEST SEQUENCE AND OBJECTIVES TEST 2D

Date	Time	
	File/Real	
Oct 18	-13.5/00:00	RRGP-5 backflow to RRG1-7 pond (150 gpm)
	-9.5/04:00	Shut-in RRGp-5 backflow to RRG1-7, started small warm-up flow
	-2.75/10:45	RRGP-5 shut-in
	zerotime/13:30	Initiate injection down well RRGp-5, water from RRG1-3 (150 gpm)
	0.02/13:31	Tracer pump on, pump off
	0.08/13:35	Tracer pump on
	0.27/13:46	Tracer pump off
	3.60/16:06	Problems with automatic valve 5AV6-5-valve keeps searching causing the injection flow to vary 10 to 15 gpm
Oct 19	24.08/13:35	Tracer pump on
	24.28/13:47	Tracer pump off
Oct 20	48.08./13:35	Tracer pump on
	48.25/13:45	Tracer pump off
Oct 22	92.5/10:00	Tracer pump on
	98.27/15:46	Tracer pump off
	98.33/15:50	Completed injection down well RRGp-5
	98.42/15:55	Backflow started from RRGp-5 to lined pond (145 gpm)
Oct 25	196.0/17:30	Ran temperature log: 4600' to 4840' (Record 17)
Nov 01	334.5/12:00	Shut-in backflow from RRGp-5

Objectives:

Explore a larger volume of the reservoir.

Determine the response of the reservoir to multiple injection of tracer slugs.

Clean-up reservoir in preparation for Test 5.

TABLE 14. TEST 5

WELL: RRGP-5 and RRGE-1

FILE NAME: RR5

DATE: 11/06/82

<u>RECORD NAME</u>	<u>#</u>	<u>ENGINEERING UNITS</u>	<u>INSTRUMENT/INTERVAL</u>	<u>SOURCE</u>
RR5-TEMP-M	1	°F	Temperature Indicator	EGG
RR5-WP-D	2	psia	Digiquartz	EGG
RR5-WQ-SC	3	gpm	Flow recorder	EGG
RR5-I-TR	4	mg/l	SIE	EGG
RR5-FLUO-TR	5	mg/l	UV spectrophotometer	EGG
RR5-BR-TR	6	mg/l	Ion-chromatography	EGG
RR5-RHODA-TR	7	mg/l	UV spectrophotometer	EGG
RR5-PH-DL	8	millivolts	Data Logger	EGG
RR5-COND-DL	9	µmho/cm	Data Logger	EGG
RR5-REDOX-DL	10	millivolts	Data Logger	EGG
RR5-TEMP-DL	11	°F	Data Logger	EGG
RR5-NA-5	12	mg/l	ICP	UURI
RR5-K-5	13	mg/l	ICP	UURI
RR5-CA-5	14	mg/l	ICP	UURI
RR5-MG-5	15	mg/l	ICP	UURI
RR5-FE-5	16	mg/l	ICP	UURI
RR5-SI02-5	17	mg/l	ICP	UURI
RR5-SR-5	18	mg/l	ICP	UURI
RR5-LI-5	19	mg/l	ICP	UURI
RR5-B-5	20	mg/l	ICP	UURI
RR5-CL-5	21	mg/l	Mohr Titration	UURI
RR5-F-5	22	mg/l	SIE	UURI
RR5-TDS-5	23	mg/l	Gravimetric	UURI
RR5-PH-5	24	standard	pH electrode	UURI
RR5-HCO3-5	25	mg/l	H ₂ SO ₄ Titration	UURI
RR5-SO4-5	26	mg/l	Gravimetric	UURI
RR5-I-5	27	mg/l	SIE	UURI
RR5-FLUO-5	28	mg/l	Colorimetric	UURI
RR5-RHODA-5	29	mg/l	Colorimetric	UURI
RR1-TEMP-M	30	°F	Temperature Indicator	EGG
RR1-TEMP-SC	31	°F	Temperature recorder	EGG
RR1-WQ-SC	32	gpm	Flow recorder	EGG
RR1-I-TR	33	mg/l	SIE	EGG

TABLE 14. (Continued)

<u>RECORD NAME</u>	<u>#</u>	<u>ENGINEERING UNITS</u>	<u>INSTRUMENT/INTERVAL</u>	<u>SOURCE</u>
RR1-MG-TS	34	mg/l	AA	EGG
RR1-CA-TS	35	mg/l	AA	EGG
RR1-PH-TS	36	standard	pH electrode	EGG
RR1-COND-TS	37	$\mu\text{mho/cm}$	Conductance cell	EGG
RR1-ALK-TS	38	mg/l	H ₂ SO ₄ Titration	EGG
RR1-PH-DL	39	millivolts	Data Logger	EGG
RR1-REDOX-DL	40	millivolts	Data Logger	EGG
RR1-COND-DL	41	$\mu\text{mho/cm}$	Data Logger	EGG
RR1-TEMP-DL	42	°F	Data Logger	EGG
RR1-NA-5	43	mg/l	ICP	UURI
RR1-K-5	44	mg/l	ICP	UURI
RR1-CA-5	45	mg/l	ICP	UURI
RR1-MG-5	46	mg/l	ICP	UURI
RR1-FE-5	47	mg/l	ICP	UURI
RR1-SIO2-5	48	mg/l	ICP	UURI
RR1-SR-5	49	mg/l	ICP	UURI
RR1-LI-5	50	mg/l	ICP	UURI
RR1-B-6	51	mg/l	ICP	UURI
RR1-CL-5	52	mg/l	Mohr Titration	UURI
RR1-F-5	53	mg/l	SIE	UURI
RR1-TDS-5	54	mg/l	Gravimetric	UURI
RR1-PH-5	55	standard	pH electrode	UURI
RR1-HCO3-5	56	mg/l	H ₂ SO ₄ Titration	UURI
RR1-SO4-5	57	mg/l	Gravimetric	UURI
RR1-I-5	58	mg/l	SIE	UURI

TABLE 14A. TEST SEQUENCE AND OBJECTIVES TEST 5

Date	Time	
	File/Real	
Nov 06	-10.08/00:00	RRGP-5 shut-in
	-0.32/09:46	RRGE-1 backflowing to RRGE-1 pond (300 gpm)
	zerotime/10:05	Initiate injection down well RRGP-5, water from RRGE-3 (155 gpm)
	0.10/10:11	Tracer pump on
	0.20/10:17	Tracer pump off
Nov 07	13.92/00:00	Noticed pH on data logger at RRGE-1 not working properly
	20.92/07:00	RRGP-5 conductivity recording high offscale, could be instrumentation problems
Nov 08	52.75/14:50	RRGE-1 shut-in due to well logging problems, packer flapper valve partially closed
Nov 09	71.75/09:50	Injecting down well RRGP-1 in attempt to pressurize well enough to force packer flapper valve open (250 gpm)
	72.58/10:40	Shut-in to RRGE-1
	73.33/11:25	Initiate backflow from RRGE-1 to RRGE-1 pond (300 gpm)
Nov 16	244.70/14:47	Injection at RRGP-5 stopped due to power dip
	244.75/14:50	Injection back on down well RRGP-5 (155 gpm)
Nov 22	376.13/02:13	Completed injection down well RRGP-5
	376.47/02:41	RRGE-1 decreased backflow from 300 gpm to 30 gpm
Nov 26	479.92/10:00	Initiate RRGP-5 backflow to lined pond (145 gpm)
	484.75/14:50	Diverted backflow from RRGP-5 to RRGI-7 pond (145 gpm)
	485.55/15:38	Initiate backflow from RRGE-1 to RRGE-1 pond
	486.17/16:15	RRGE-1 backflow stabilized at 200 gpm
Nov 30	581.43/15:31	RRGE-1 shut-in
Dec 01	599.62/09:42	RRGP-5 shut-in, prep for Pulse tests
	600.00/10:05	Backflow from RRGP-5 (75 gpm)
	600.02/10:06	RRGP-5 shut-in

Table 14A. (Continued)

<u>Date</u>	<u>Time</u>	
	File/Real	
Dec 01	600.07/10:09	Backflow from RRGP-5 (75 gpm), Pulse Test 1
	600.38/10:28	RRGP-5 shut-in
	600.57/10:39	Backflow from RRGP-5 (125 gpm), Pulse Test 2
	600.83/10:55	RRGP-5 shut-in
	600.98/11:04	Backflow from RRGP-5 (222 gpm) decreased to 162 gpm
	601.00/11:05	Increased to 175 gpm
	601.02/11:06	RRGP-5 shut-in
	601.07/11:09	Backflow from RRGP-5 (250 gpm) decreased to 170
	601.09/11:10	RRGP-5 shut-in
	601.15/11:14	Backflow from RRGP-5 (170 gpm), Pulse Test 3
	601.53/11:37	RRGP-5 shut-in
	601.70/11:47	Backflow from RRGP-5 (225 gpm), Pulse Test 4
	601.98/12:04	RRGP-5 shut-in
	603.95/14:02	Backflow from RRGP-5 (276 gpm), Pulse Test 5
	604.50/14:35	RRGP-5 shut-in
	604.73/14:49	Backflow from RRGP-5 (325 gpm), Pulse Test 6
	604.77/14:51	RRGP-5 shut-in
	604.88/14:58	Backflow from RRGP-5 (300 gpm), Pulse Test 7
	604.93/15:01	RRGP-5 shut-in, end of Pulse tests

Objectives:

Determine whether breakthrough from RRGP-5 to RRGE-1 can be accomplished in 18 to 21 days.

Determine whether the extent of fluid flow can be traced using spontaneous potential or resistivity surveys.

Determine reservoir pressure recovery as a function of flow rate.

TABLE 15. TEST: N/A WELL: Monitoring
 FILE NAME: RRMONIT DATE: 09/01/82

<u>RECORD NAME</u>	<u>#</u>	<u>ENGINEERING UNITS</u>	<u>INSTRUMENT/INTERVAL</u>	<u>SOURCE</u>
RRGE-1	1	psia	Digiquart	EGG
RRMW-1	2	psia	Digiquartz	EGG
USGS-3	3	psig	Pressure gauge	EGG
RRGP-4	4	psia	Digiquartz	EGG
RRPW-5	5	ft	Stevens recorder	EGG
BLM-OFFSET	6	ft	Stevens recorder	EGG

TABLE 16.

TEST: N/A

WELL: RRGE-1, RRG-5

FILE NAME: DHLOGS

DATE: 1978, 1982

<u>RECORD NAME</u>	<u>#</u>	<u>ENGINEERING UNITS</u>	<u>INSTRUMENT/INTERVAL</u>	<u>SOURCE</u>
RRGE1 SPIN 11/08	1	%	3600' to 5040'	EGG
RRGE1 SPIN 09/17	2	%	3600' to 5046'	EGG
RRGE1 TEMP 09/17	3	°F	3442' to 4964'	EGG
RRGE1 TEMP 09/21	4	°F	3542' to 4964'	EGG
RR5A XCAL 070678	5	inches diameter	4391' to 4591'	EGG
RR5A YCAL 070678	6	inches diameter	4391' to 4591'	EGG
RR5B TEMP 08/25	7	°F	4124' to 4751'	EGG

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