HOMESTAKE
Grants Project

Homestake Mining Company of California

Jesse R. Toepfer
Closure Manager

23 June 2016

Mr. Jeff Lewellin
Groundwater Quality Bureau
New Mexico Environment Department
PO Box 26110
Santa Fe, New Mexico 87502

RE: San Andres Well Integrity Report for Homestake's Deep Well Nos. 1 and 2

Mr. Lewellin:

Homestake Mining Company of California (HMC) has completed an evaluation of Deep Well No. 1 and Deep Well No. 2, both of which are wells completed in the San Andres aquifer, and both of which were tested in accordance with the conditions of Discharge Permit (DP) 200. DP-200 was renewed by the New Mexico Environment Department (NMED) in September 2014.

Enclosed with this letter, you will find HMC's report concerning the integrity testing of these wells, along with the associated data logs. The completion of integrity testing for these wells in accordance with the plan approved by NMED marks the last of the San Andres well that were required to be tested.

In a related matter, I would also like to take this moment to inform you that we are currently awaiting a response from the New Mexico Office of the State Engineer (OSE) with respect to the plugging and abandonment plan for Well 928. HMC will make the necessary arrangements to plug and abandon Well 928 once approval from the OSE is obtained.

Thank you for your time and attention on this matter. If you have any questions, please contact me via cell phone at (505) 290-3067.

Sincerely yours,

Jesse R. Toepfer
Closure Manager
Homestake Mining Company of California

Enclosures (1)

xc: Mr. P. Webster, Barrick – Salt Lake City, Utah, w/enclosure
Mr. C. Cadwell, Barrick – Elko, Nevada, electronic copy only
Mr. H. Burns, Barrick – Toronto, Ontario, w/enclosure

Mr. S. Appaji, US EPA Region 6 – Dallas, Texas, w/enclosure
Mr. J. Parrott, US NRC Region IV – Rockville, Maryland, w/enclosure
Ms. D. Barr, US DOE – Grand Junction, Colorado, w/enclosure
Mr. C. Thompson, NM OSE – Santa Fe, New Mexico, electronic copy only
Mr. J. Peterson, NM OSE – Albuquerque, New Mexico, electronic copy only
Mr. G. Hoffman, Hydro-Engineering – Casper, Wyoming, w/enclosure
Mr. D. Rappuhn, NM OSE – Albuquerque, New Mexico, w/enclosure

GRANTS RECLAMATION PROJECT
2nd QUARTER 2016 SAN ANDRES WELL INTEGRITY TESTING

Prepared for:
Homestake Mining Company
P.O. Box 98 – San Mateo Road
Grants, NM 87020

Prepared by:
Hydro-Engineering, LLC
4685 East Magnolia Street
Casper, Wyoming 82604

June 2016

Grants Reclamation Project
2nd Quarter 2016 San Andres Well Integrity Testing

For:

Homestake Mining Company
P. O. Box 98
Grants, New Mexico 87020

By:

Hydro-Engineering, L.L.C.
June 2016

Adam Arguello
Hydro-Engineering, LLC

George L. Hoffman, P.E.
5831 N.M. Hydrologist
6/22/2016

TABLE OF CONTENTS
(continued)

Figures
(Located at the end of each section)

Appendix

TABLE OF CONTENTS

Executive Summary

Well integrity testing is being conducted by Homestake Mining Company of California (HMC) on HMC San Andres wells that are located on the Grants Reclamation Project (GRP). The schedule for this testing program was approved by the New Mexico Environment Department (NMED) on July 6, 2015. This particular report presents the results of the well integrity testing of San Andres wells #1 Deep Well and #2 Deep Well.

Geophysical logging and a video camera were used to evaluate the two aforementioned wells. The report also presents water quality results from monitoring of the four San Andres wells that are being used to supply fresh water for the ground-water restoration program.

- The San Andres well integrity testing for Deep Well #1, which was drilled in 1979, shows that the integrity of this well is good except for a break in the casing at 234 feet. The location of the break is within the Chinle Shale and should not compromise the quality of water from this well. #1 Deep Well is suitable for use as a fresh water supply well.

- The testing of Deep Well #2, which was drilled in 1955, shows considerable damage to the fiberglass sleeve installed in 1998. The video of the well does not show any significant leakage of alluvial water into the well. Therefore, this well is suitable for use as a fresh water supply well for the near future.

- The water quality in existing San Andres supply wells #1, #2, 943 and 951R is unchanged in 2016 and this indicates that well integrity in these wells has not changed. The increase in 2014 and decline in 2015 in uranium concentrations in well 951R is not a function of pumping from this well, because it was continuously pumped over that entire period. The last five uranium concentrations have been steady and low. Therefore, we are confident these four San Andres wells can continue to be used as a fresh water supply.

1.0 Introduction

This report presents the results from the integrity testing of Homestake Mining Company of California's (HMC) San Andres wells #1 Deep Well and #2 Deep Well. These two San Andres wells are located on the Homestake Grants Reclamation Project. HMC's DP-200 required testing in the second quarter of 2016 to evaluate the integrity of HMC's San Andres wells, #1 Deep Well and #2 Deep Well.

San Andres #1 Deep Well and #2 Deep Well are used as a supply for fresh water.

Figure 1-1

Location of San Andres Wells and Water Quality Data for San Andres Aquifer
2016, mg/l

SCALE: 1" = 1000'

C:\PROJECTS\2016-06\1600SAN ada

DATE: 6/9/16

FIGURE 1-1. LOCATION OF SAN ANDRES WELLS AND WATER QUALITY DATA FOR THE SAN ANDRES AQUIFER 2016, mg/l

2.0 San Andres Well Integrity

The integrity of San Andres #1 Deep Well and #2 Deep Well were evaluated in the second quarter of 2016. A video of the wells and geophysical logs were done by Jet West Geophysical Services to assess the integrity of these San Andres wells. Jet West Geophysical Services also provided interpretation of the logs included in the following discussion.

A gamma ray log was used to define the lithology. Gamma curves can be affected by the fill material in a well's annulus, and thus may indicate changes in completion materials. A 3-arm caliper log measures the inside diameter of a well's casing and indicates where scaling or corrosion/erosion may be present.

The sonic-cement bond log (CBL) is composed of four curves: near receiver (3-foot) variable density log (VDL), near first arrival, delta time, and amplitude. The tool consists of a sonic transmitter which emits a 20 kHz sound pulse twice every second, and two receivers which record the degraded sound energy at a distance of 3 and 4 feet. The tool requires fluid in the well to convey the sound energy. The near, or 3-foot, receiver VDL curve is presented in the log, and the last three curves are derived from the VDL curve. Near first arrival is a measure of the initial compressional energy (in micro-seconds of time) from the tool's transmitter to the receiver spaced 3 feet up the tool. Amplitude represents the signal height of the near first arrival and is read qualitatively. High amplitude readings indicate "ringing" steel pipe and lower amplitudes indicate attenuated sound energy or bonded pipe. Delta time is a measurement of "slowness" in micro-seconds per foot (μsec/ft). Slowness is the inverse of velocity (ft/sec). The velocity of sound travelling through steel is approximately 17,500 ft/sec which equates into a slowness of 57 μsec/ft. Slowness is calculated by subtracting the first arrival of the 3-foot receiver from that of the 4-foot receiver.

The 4 Pi log is read qualitatively in a reverse fashion from higher to lower counts with the higher counts indicating lower density materials.

2.1 #1 Deep Well

#1 Deep Well is presently being used to supply fresh water injection for the Grant Site Restoration. The well was logged from the top to a depth of 1026 feet with video camera, gamma ray, 3-arm caliper, sonic, 4 Pi density, and Focused Density.

2.1.1 #1 Deep Well Lithology and Well Completion

#1 Deep Well was drilled in 1979 and cased with 16 inch steel casing to a depth of 300 feet, 9 5/8" steel casing to a depth of 999 feet. The 9 5/8" steel casing was perforated from 919 to 999 feet. The annulus of the well was cemented from 0 to 929 feet by placing a plug at 929 feet, pumping cement through the casing and out of the perforations until cement appeared at the surface, and drilling out the plug. The water level in well #1 Deep Well is representative of the San Andres aquifer. Figure 2-1 presents the well completion details and the lithology for #1 Deep well which indicates the top of the San Andres aquifer is at a depth of 955 feet below the

land surface. The Upper Chinle sandstone is the sandstone from 307 to 319 feet while the Middle Chinle sandstone exists from 433 to 476 feet.

2.1.2 #1 Deep Well Geophysical Logs

Gamma ray, caliper, amplitude, delta time, 4 Pi density, and focused density logs were run on well #1 Deep Well on May 17, 2016 to evaluate the integrity of this well (see Figure 2-2). The caliper log was run on an enhanced scale of 7-17 inches. The caliper log shows an inside diameter of 15.2 inches from the surface to 226 feet. From 226 to 234 feet, there is a decrease in diameter down to 12.2 inches possibly due to buildup on the casing. A break in the casing is shown from 234 to 245 feet. From 245 to 287 feet, the casing measures 14.5 inches in diameter. The casing transitions down to 8.7 inches at 287 feet and remains that diameter until the open hole completion at 987 feet, which extends down to 1028 feet.

The VDL trace showed a higher amplitude at the casing breakout. The delta T arrival times were not close to the ideal value of 57 usec/ft that steel typically is, and is likely due to the growths inside the casing as well as some deterioration of the casing. The near First Arrival appears ahead of the VDL due to adjustment in the VDL shading and also indicates some attenuation along most of the casing.

The 4 Pi Density and the Focused Density both showed the fluid level, the break in casing, casing size change, and the open hole completion. The Focused Density also showed an increase in density from 923 to 989 feet which may be cement.

2.1.3 #1 Deep Well Video

A video of the #1 Deep well was conducted on May 17, 2016 and is presented in Appendix A with the video of #2 Deep Well as well. The video of #1 Deep Well above the water level at 162 feet shows no sign of water from the alluvial aquifer entering the casing. The video shows a break in the casing between 234 and 245 feet. The video shows a fair amount of scaling on the casing interior.

2.1.4 Summary of Well #1 Deep Well Integrity Testing

The geophysical logs and video for the #1 Deep well demonstrate that this well casing integrity is good except for the break from 234 to 245 feet which should not affect the water quality from this well. The well is acceptable to continue to be used as a fresh water injection supply for the Grants restoration program.

2.2 #2 Deep Well

#2 Deep Well is presently being used to supply fresh water injection for the Grants restoration program. The well was logged from the top to a depth of 817 feet with video camera, gamma ray, 3-arm caliper, sonic, and 4 Pi density.

2.2.1 #2 Deep Well Lithology and Well Completion

Figure 2-3 presents the lithologic log for #2 Deep Well which indicates the top of the San Andres aquifer is at a depth of 800 feet below the land surface. The Upper Chinle sandstone exists at a depth of 160 to 170 feet. The #2 Deep Well geophysical log is presented in Figure 2-4. #2 Deep Well was drilled in 1955 and cased with 20" steel casing from the surface to 218 feet, and 15" steel casing from 218 to 853 feet, and an open hole completion from 853 to 870 feet. The well was resleeved in 1980 using a 16" steel sleeve from the surface to 218 feet, and 10 ¾" from 218 to 825 feet. The space between the original casing and new sleeve was grouted between 218 and 400 feet. The bottom 56 feet of the 10 ¾" sleeve was perforated with 1x6" holes 180° apart and the bottom of the sleeve tapered down to an 8 5/8" diameter opening. The well was also resleeved in 1998 using a 12.5" fiberglass sleeve from the surface to 218 feet, a 5" fiberglass sleeve from 218 to 423.5 feet, and 5" fiberglass No. 35 slotted casing from 423.5 to 823.5 feet. Figure 2-5 presents a schematic of the 1980 and 1998 resleevings. The details of the 1980 resleeving are presented in black while the 1998 fiberglass resleeving details are presented in magenta.

2.2.2 #2 Deep Well Geophysical Logs

Gamma ray, caliper, amplitude, delta time, and 4 Pi density logs were run on #2 Deep Well on May 18, 2016 to evaluate the integrity of this well.

The base of the alluvium in thought to be 120 feet below land surface according to the gamma log and 110 according to the lithology log.

The caliper log is presented on a scale from 3 to 13 inches. The log shows a sleeve diameter of 12.5 inches from the surface to 201 feet, a section of squished, split, or pushed in casing exists between 201 and 216 feet. The sleeve goes back to 12.5 inches from 216 to 220 feet where it transitions down to 4.5 inch ID. The 4.5 inch sleeve extends down to 816 feet. Three PVC tubes affected the caliper log from 799 to 816 feet.

The sonic logs show attenuated VDL responses from the water level at 159 feet to 220 feet. The section from 220 to 420 feet shows the highest VDL amplitude that would typically be associated with an unbounded high ringing response. In the fiberglass it may be showing cement behind the casing. The horizontal lines shown on the VDL and amplitude trace are the casing joints in the fiberglass sleeve.

The 4 Pi Density log showed the two casing sizes, the fluid level and the fiberglass collars. The focused density probe was not run on this well.

2.2.3 #2 Deep Well Video

A video of the #2 Deep Well was conducted on May 18, 2016 and is presented in Appendix A with the video of #1 Deep Well. The video was started at 7.8 feet due to the low clearance of the truck boom. The video of #2 Deep Well shows no intrusion of alluvial water into the casing. The video shows the casing joints at 20 foot intervals starting at 19.8 feet. Multiple breaks are shown in the fiberglass from 199 to 216 feet. The reducer is shown from 218 to 220 feet. The smaller diameter sleeve joints are readily apparent at 20 foot intervals starting at 241 feet. The slotted casing is apparent from 424 feet to the bottom of the well. Three smaller diameter pipes are shown in the bottom of the well (one starting at 740 feet, the second at 760 feet, and the third at 780 feet). The camera was unable to reach past 801 feet.

2.2.5 Summary of #2 Deep Well Integrity Testing

The geophysical logs and video for #2 Deep Well demonstrate that the fiberglass sleeve has considerable damage but the video of the well does not show any leakage of alluvial water into the well. The damage to the sleeve is below the base of the alluvium. The use of the #2 Deep Well as a supply for fresh water injection will significantly decline in the near future. Therefore, we are confident the well integrity for #2 Deep Well is adequate, and foresee no reason it cannot be used in a limited capacity as a supply for fresh water injection at least through 2017.

Figure 2-1

#1 Deep Well Completion Details and Lithology

WELL RECORD

#1 Dolp

Section 1. GENERAL INFORMATION

(A) Owner of well United Nuclear-Homestake Partners Owner's Well No. B-28-A (Expl

Street or Post Office Address P.O. Box 98

City and State Grants, New Mexico

Well was drilled under Permit No. B-28-A (Explor.) and is located in the:

a. ___ ¼ ~~NW~~ ¼ ~~NE~~ ¼ ~~SE~~ ¼ of Section 26 Township 12N Range 10W N.M.P.M.

b. Tract No. ___ of Map No. ___ of the ___

c. Lot No. ___ of Block No. ___ of the ___
Subdivision, recorded in ___ County.

d. X= ___ feet, Y= ___ feet, N.M. Coordinate System ___ Zone in the ___ Grant.

(B) Drilling Contractor United Nuclear-Homestake Partners License No. WD-704

Address P.O. Box 98, Grants, NM 87020

Drilling Began 1-14-79 Completed 1-27-79 Type tools ___ Size of hole ___ in.

Elevation of land surface or ___ at well is ≈6575 ft. Total depth of well 1000 ft.

Completed well is ☐ shallow ☒ artesian. Depth to water upon completion of well 137 ft.

Section 2. PRINCIPAL WATER-BEARING STRATA

Depth in Feet From	Depth in Feet To	Thickness in Feet	Description of Water-Bearing Formation	Estimated Yield (gallons per minute)
955	999	44	San Andres limestone	850

Section 3. RECORD OF CASING

Diameter (inches)	Pounds per foot	Threads per in.	Depth in Feet Top	Depth in Feet Bottom	Length (feet)	Type of Shoe	Perforations From	Perforations To
16" OD	62.58	Welded	0	300	300			
9 5/8 OD	35	Welded	300	999	699		919	999
face 24"	corrigated culvert pipe	Welded	0	50	50			

Section 4. RECORD OF MUDDING AND CEMENTING

Depth in Feet From	Depth in Feet To	Hole Diameter	Sacks of Mud	Cubic Feet of Cement	Method of Placement
face 0	50	30"		88	Pump
0	300	20"		284	Pump thru center of casing with plug at 929 ft thru 10 ft. of
300	929	12 3/4"		240	perforations until cement came to surface (drilled out plug)

Section 5. PLUGGING RECORD

Plugging Contractor ___

Address ___

Plugging Method ___

Date Well Plugged ___

Plugging approved by: ___
State Engineer Representative

No.	Depth in Feet Top	Depth in Feet Bottom	Cubic Feet of Cement
1			
2			
3			
4			

FOR USE OF STATE ENGINEER ONLY

Date Received 6-8-79

Quad ___ FWL ___ FSL ___

File No. B-28-A-Expl. Use expl. Location No. NW SE NE 26-12N

Section 6. OF HOLE

Depth From	Depth To	Thickness in Feet	Color and Type of Material Encountered
0	120	120	Clay and Sand
120	284	164	Shale
284	307	23	Shale and Sandstone
307	319	12	Sandstone
319	347	28	Shale and Sandstone
347	377	30	Shale
377	395	18	Shale and Sandstone
395	414	19	Sandstone
414	433	19	Shale
433	450	17	Sandstone
450	459	9	Shale
459	476	17	Sandstone
476	596	120	Shale
596	615	19	Sandstone
615	708	93	Shale
708	723	15	Sandstone
723	788	65	Shale and Sandstone
788	812	24	Shale
812	829	17	Sandstone
829	870	41	Shale
870	955	85	Sandstone and Shale
955	999	44	San Andres limestone

Section 7. REMARKS AND ADDITIONAL INFORMATION

The undersigned hereby certifies that, to the best of his knowledge and belief, the foregoing is a true and correct record of the above described hole.

Driller

INSTRUCTIONS: This form should be executed in triplicate, preferably typewritten, and submitted to the appropriate district office of the State Engineer. All sections, except Section 5, shall be answered as completely and accurately as possible when any well is drilled, repaired or deepened. When this form is used as a plugging record, only Section 1(a) and Section 5 need be completed.

Figure 2-2

#1 Deep Well Geophysical Logs

JET WEST
GEOPHYSICAL SERVICES, LLC.

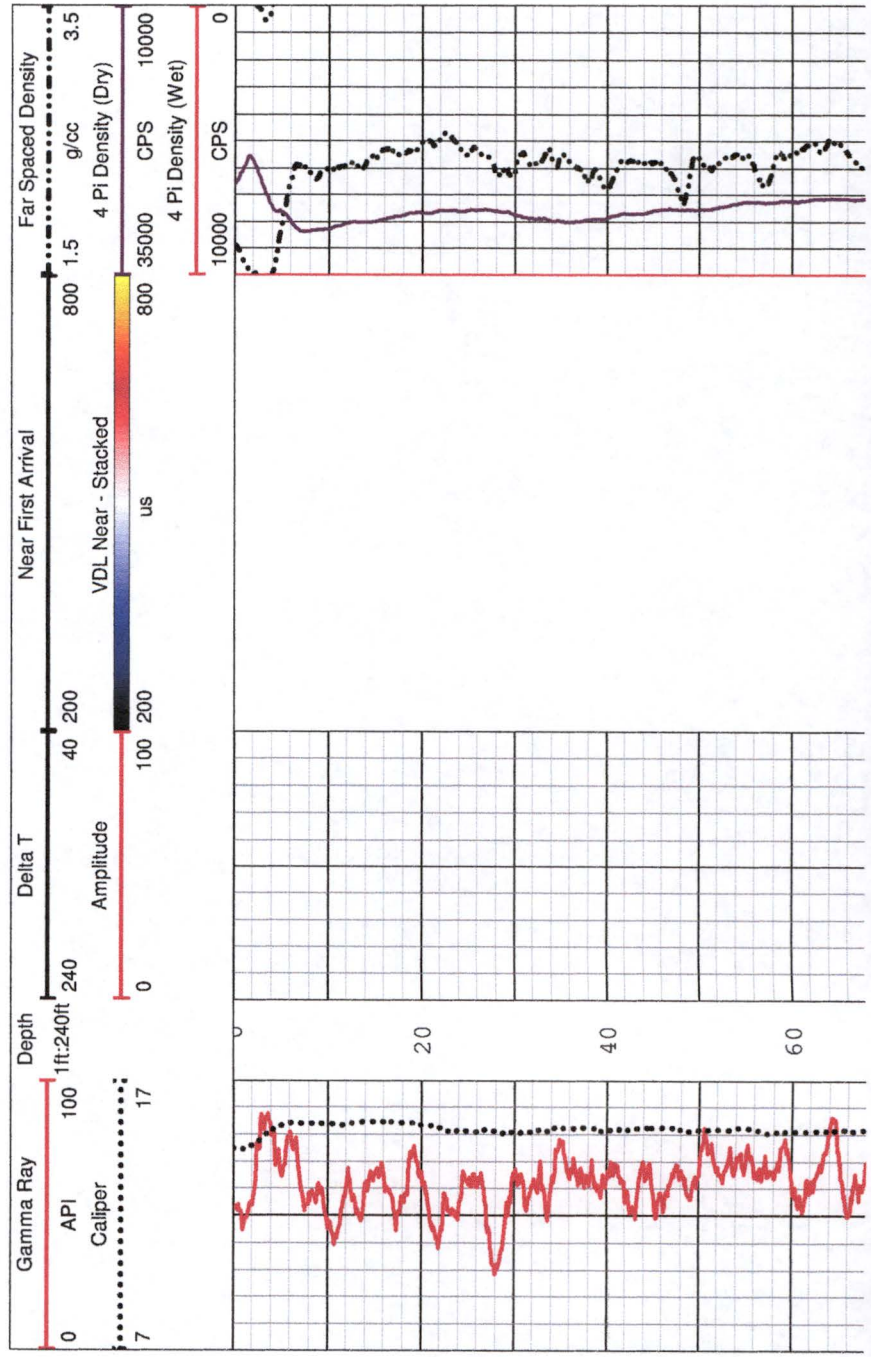
	COMPANY Homestake Mining Company	
	WELL ID #1 Deep	
	FIELD Grants	
	COUNTY Cibola STATE New Mexico	
Northing: Easting:	**TYPE OF LOG: Gamma Ray, 3 Arm Caliper, Sonic, 4 Pi Density**	OTHER SERVICES Video
	LOCATION	
	SEC TWP RGE	API No.

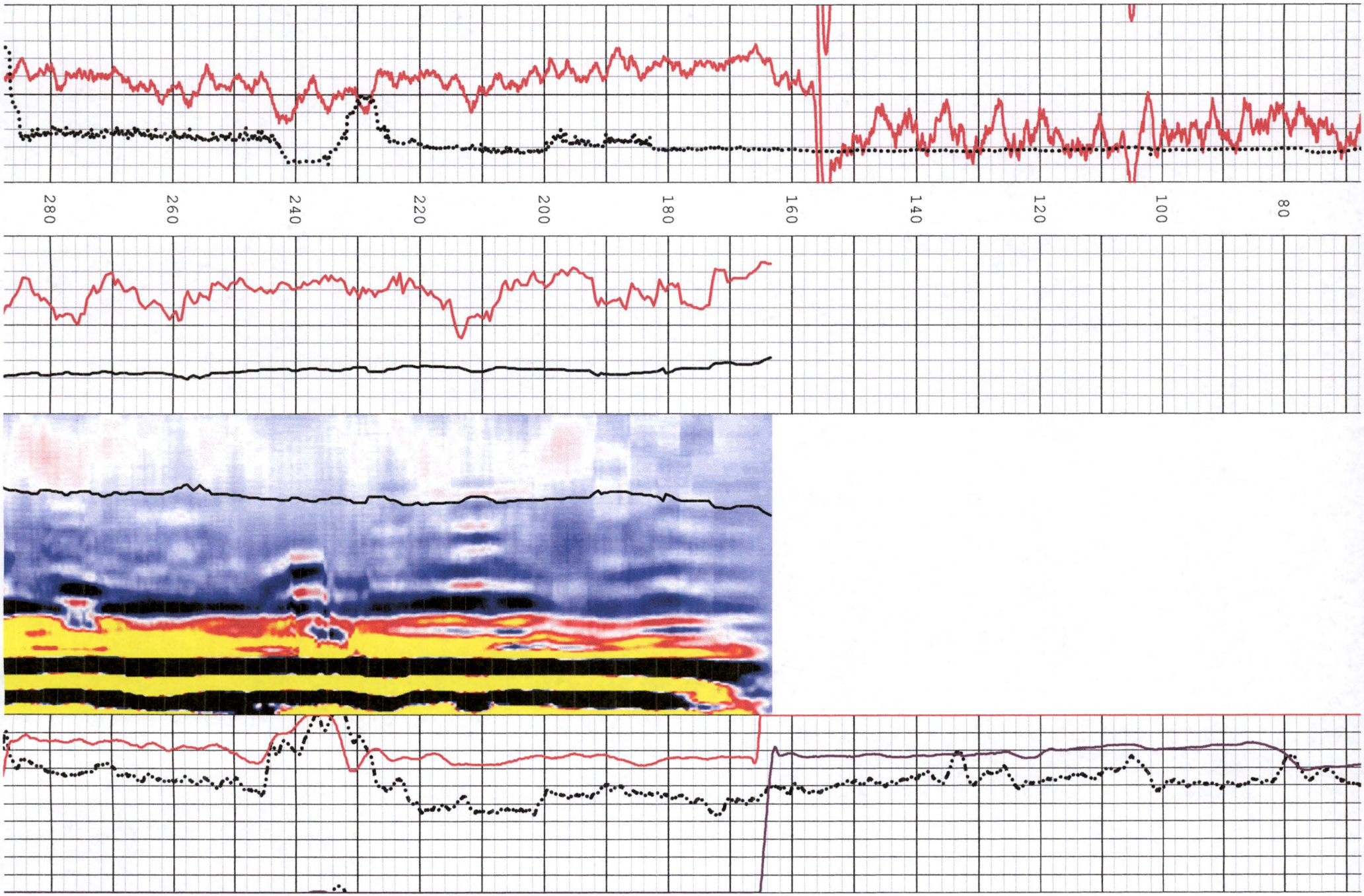
PERMANENT DATUM	Ground Level	ELEVATION	K.B.
LOG MEAS. FROM	Ground Level	ABOVE PERM. DATUM	T.O.C
DRILLING MEAS. FROM	Ground Level		G.L.

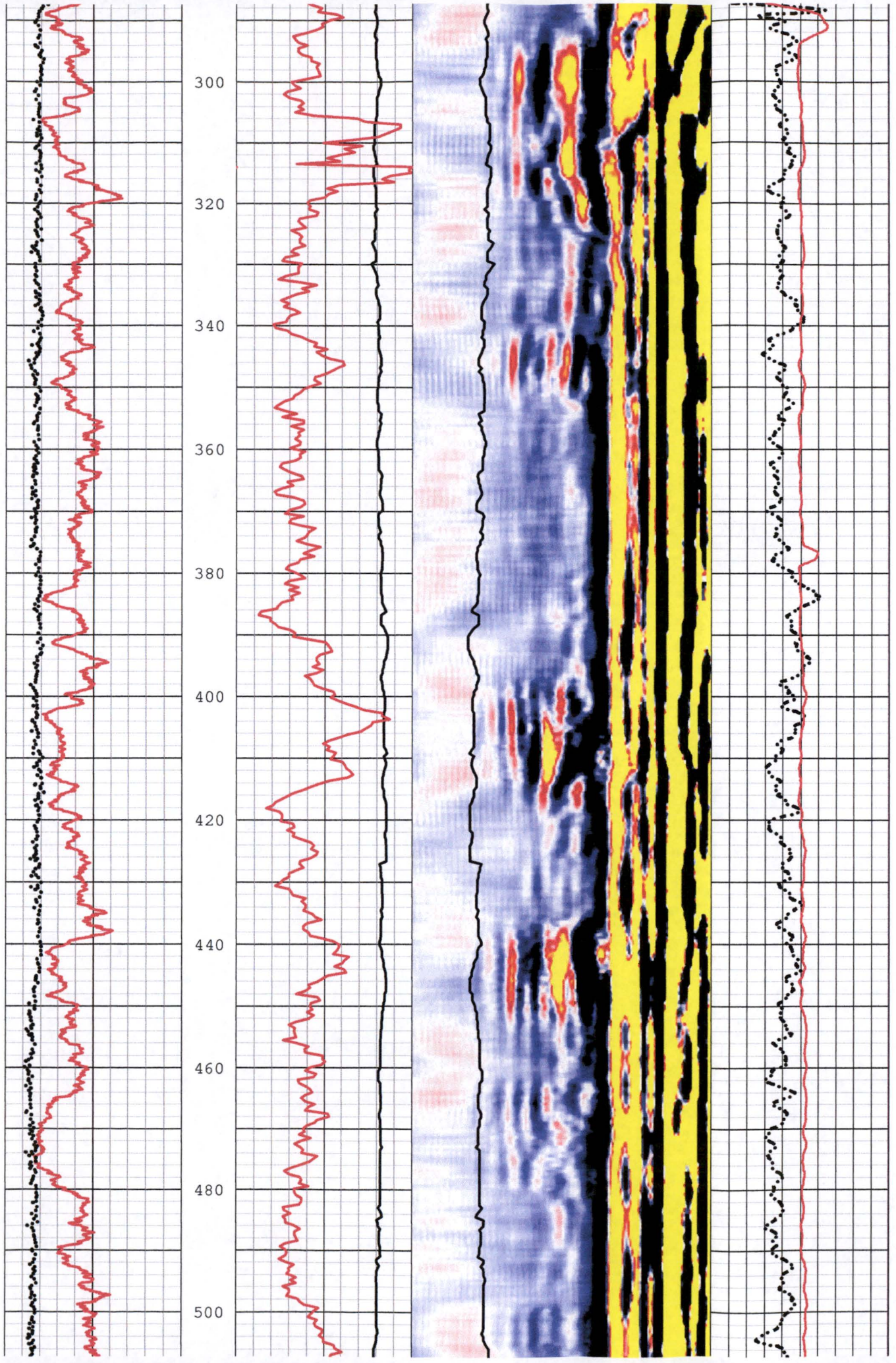
DATE	05-17-2016	TYPE FLUID IN HOLE	water
RUN No.	One	SALINITY	
TYPE LOG	QL-GR-3Arm, 4Pi, Sonic	DENSITY	
DEPTH-DRILLER	1000 ft.	LEVEL	156 ft.
DEPTH-LOGGER	1027 ft.	MAX. REG. TEMP	
BTM LOGGED INTERVAL	1025 ft.	DIGITIZE INTERVAL	0.1 ft.
TOP LOGGED INTERVAL	Surface		
OPERATING RIG TIME			
RECORDED BY	T. Staatz / J. White		
WITNESSED BY	A. Venable		

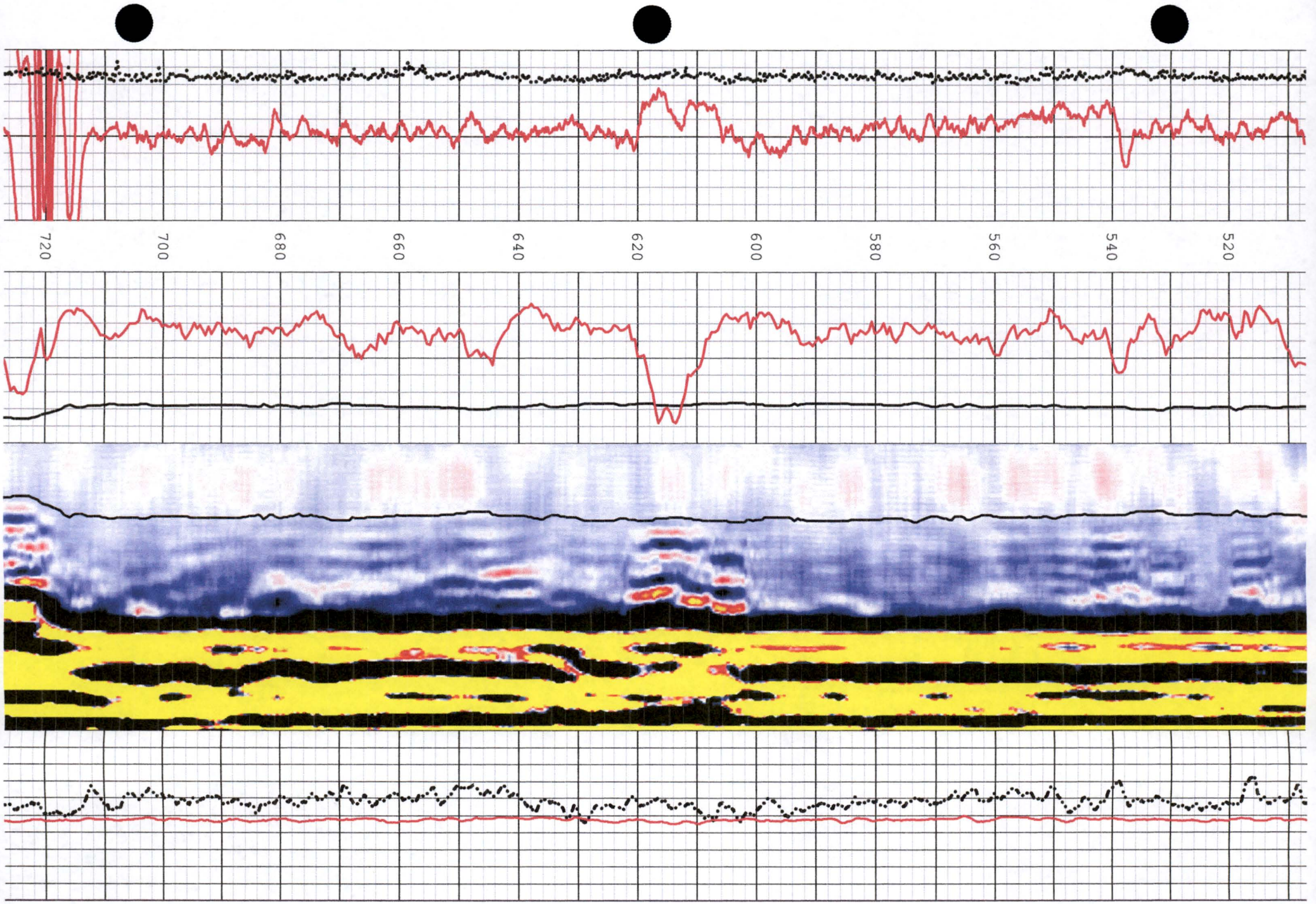
RUN	BOREHOLE RECORD			CASING RECORD			
NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO
1	30 in.	0 ft.	50 ft.	24 in.	Corr. Steel	Surface	50 ft.
2	20 in.	0 ft.	300 ft.	16 in.	Steel	Surface	300 ft.
3	12.75 in.	300 ft.	999 ft.	9.625 in.	Steel	300 ft.	999 ft.

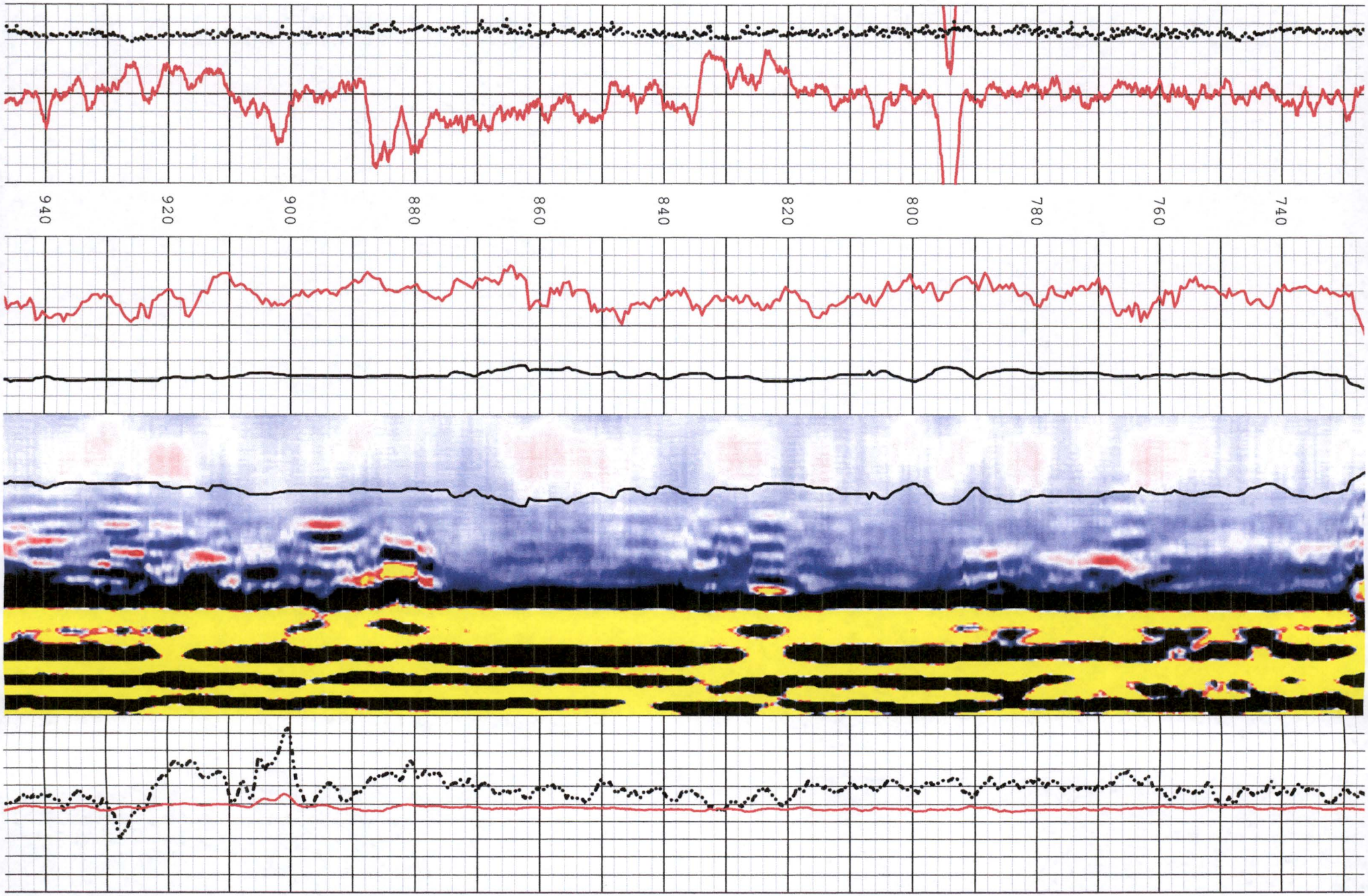
REMARKS:




280
260
240
220
200
180
160
140
120
100
80


300
320
340
360
380
400
420
440
460
480
500


720
700
680
660
640
620
600
580
560
540
520


940
920
900
880
860
840
820
800
780
760
740

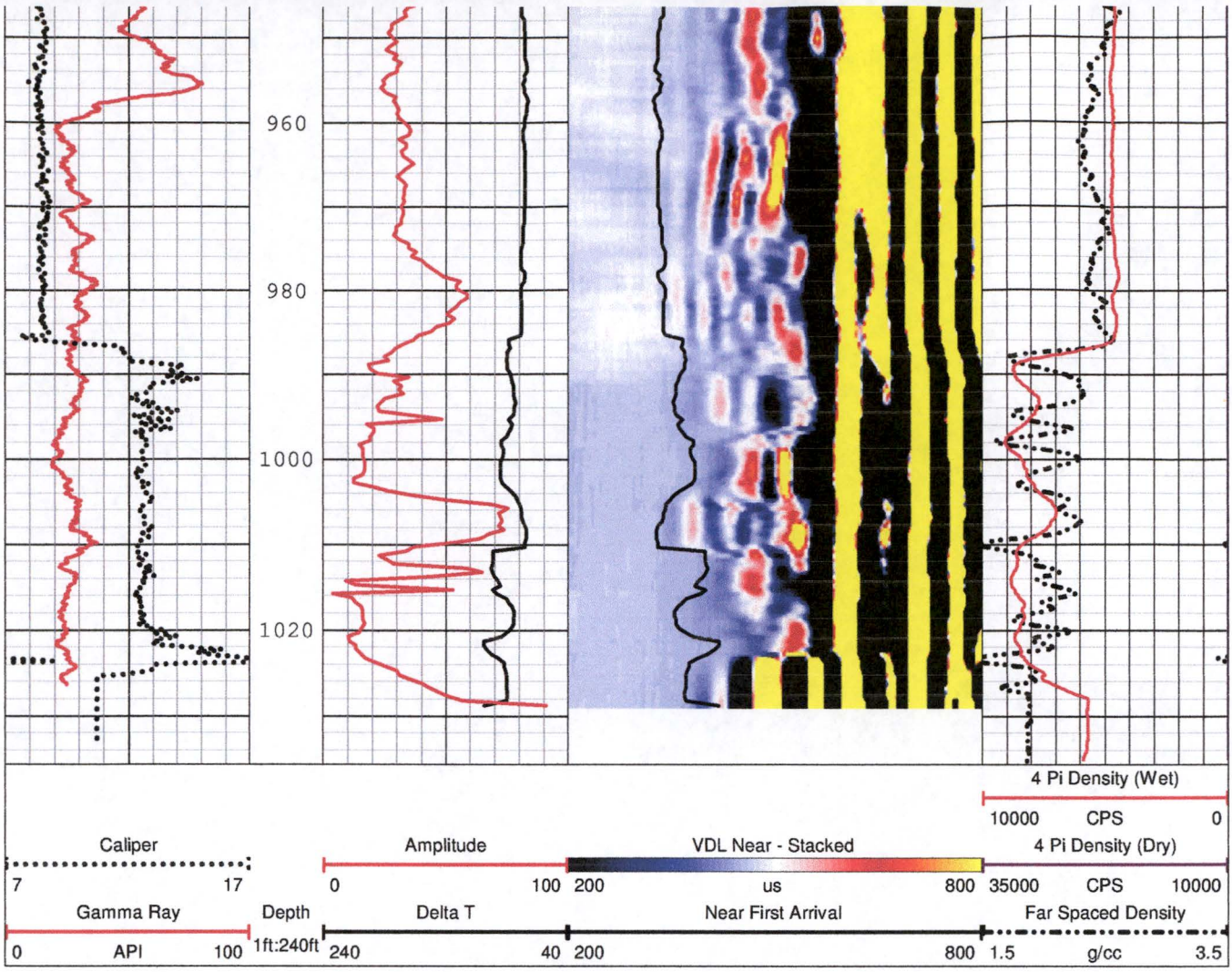

960
980
1000
1020
4 Pi Density (Wet)
10000 CPS 0
Caliper
7 17
Amplitude
0 100
VDL Near - Stacked
200 us 800
4 Pi Density (Dry)
35000 CPS 10000
Gamma Ray
0 API 100
Depth
1ft:240ft
Delta T
240 40
Near First Arrival
200 800
Far Spaced Density
1.5 g/cc 3.5

Figure 2-3

#2 Deep Well Completion Details and Lithology

TABLE 6 (continued)

Stratigraphic unit and material	Thickness (feet)	Depth (feet)
12.10.26.242 Homestake-Sapin Partners (continued)		
TRIASSIC SYSTEM (continued)		
Chinle formation (continued)		
Clay and shale, varicolored, and sandstone ...	115	835
Shale, gray and brown	5	840
Shale, purple and gray	5	845
Shale, purple, gray, and red; and red sandstone	5	850
Clay, light-red, and gray sandstone	5	855
Shale, gray, and sandstone	5	860
Shale, red and gray	20	880
Shale, gray, and sandstone	10	890
Shale, purple and gray, and sandstone	5	895
Sandstone and gray shale	5	900
Shale, purple and red, and sandstone	35	935
Shale, gray, and sandstone	25	960
Shale, gray and red, and boulders	10	970
Shale, purple, red, and gray, and sandstone ..	5	975
PERMIAN SYSTEM:		
San Andres limestone:		
Lost circulation	5	980
12.10.26.322a Homestake-New Mexico Partners		
QUATERNARY SYSTEM:		
Valley fill:		
Sand, grayish-orange, fine to coarse, rounded; chiefly frosted, quartz grains; some grayish-orange clay	10	10
Sand, grayish-orange, fine to coarse, rounded; chiefly frosted quartz	20	30
Sand, light-brown, fine to coarse, rounded; light-brown, frosted quartz	10	40
Sand, light-brown, fine to very coarse, rounded to subrounded; chiefly quartz	10	50
Sand, light-brown, fine to very coarse, 90 percent rounded to angular quartz grains; less than 10 percent light-olive-gray limestone fragments	10	60
Sand, grayish-orange, fine to very coarse, 30 percent subrounded to angular quartz; some medium to very coarse rock fragments; obsidian, and fossil fragments	10	70
Sand, grayish-orange, fine to coarse with granules, quartz 50 percent subrounded to angular quartz grains; some fossils	10	80
Sand, grayish-orange, fine to coarse with granules, 60 percent rounded to angular, frosted quartz grains; some subrounded shell fragments	10	90

TABLE 6 (continued)

Stratigraphic unit and material	Thickness (feet)	Depth (feet)
12.10.26.322a Homestake-New Mexico Partners (continued)		
QUATERNARY SYSTEM (continued)		
Valley fill (continued)		
Sand, grayish-orange-pink, fine to coarse with granules; 30 percent rounded to subangular, frosted quartz grains; some subrounded shell fragments	10	100
Sand, silty, grayish-red; sand is medium to very coarse with granules; 30 percent rounded to angular, frosted quartz	10	110
TRIASSIC SYSTEM:		
Chinle formation:		
Shale, sand, and gravel; 65 percent grayish-red shale; 20 percent fine to coarse, rounded to subangular quartz; 15 percent subrounded to angular gravel	10	120
Shale, sand, and gravel; 70 percent grayish-red shale; 15 percent medium to coarse, rounded to angular, frosted quartz; 15 percent subrounded to angular gravel	20	140
Shale, sand, and gravel; 60 percent grayish-red shale; 20 percent fine to medium, subrounded quartz, sand; 20 percent subrounded gravel	10	150
Shale, sandstone, and gravel; 60 percent grayish-red shale; light-gray, very fine-grained sandstone with subrounded, frosted quartz grains; 20 percent subrounded gravel	10	160
Sandstone, shale, and gravel; 50 percent light-gray, very fine- to fine-grained sandstone with subrounded grains; 25 percent grayish-red shale; 25 percent subrounded gravel	10	170
Shale and sandstone; 80 percent grayish-red shale; 20 percent very fine to fine and subrounded frosted quartz grains	10	180
Shale and sand; 80 percent grayish-red shale; 20 percent very fine to fine, subrounded to angular sand	20	200
Shale and sand; 90 percent grayish-red shale; 10 percent very fine, rounded to angular quartz sand grains	20	220
Shale, grayish-red	70	290
Shale, grayish-red; less than 5 percent frosted grains of very fine; subrounded, quartz sand	10	300
Shale and sandstone; 60 percent grayish-red shale; 40 percent light-gray, frosted quartz, very fine-grained sandstone with rounded to angular, frosted quartz grains	20	320

TABLE 6 (continued)

Stratigraphic unit and material	Thickness (feet)	Depth (feet)
12.10.26.322a Homestake-New Mexico Partners (continued)		
TRIASSIC SYSTEM (continued)		
Chinle formation (continued)		
Shale and sandstone; 80 percent grayish-red shale; 20 percent light-gray, very fine-grained sandstone with round to angular quartz grains	10	330
Shale, grayish-red	20	350
Shale and sandstone; 60 percent grayish-red shale; 40 percent light-gray, very fine-grained sandstone with rounded to angular, frosted quartz grains	20	370
Shale and sandstone; 80 percent grayish-red shale; 20 percent light-gray, very fine-grained quartz sandstone	40	410
Shale and sandstone; 80 percent grayish-red shale; 20 percent light-gray, very fine-grained sandstone in lenses 2 mm wide banded with shale	20	430
Shale, grayish-red	10	440
Shale and limestone; 80 percent grayish-red shale; 20 percent light-brownish-gray; medium-grained crystalline limestone	40	480
Shale, grayish-red	10	490
Shale and limestone; 90 percent grayish-red shale; 10 percent light-brownish-gray limestone	10	500
Shale, pale-red to grayish-red	20	520
Shale and limestone; 90 percent pale-red to grayish-red shale; 10 percent very light-gray, medium-grained crystalline limestone	10	530
Shale, limestone, and sandstone; 70 percent pale-red to grayish-red shale; 20 percent very light-gray, medium-grained crystalline limestone; 10 percent white, fine-grained sandstone	20	550
Shale and limestone; 90 percent grayish-red shale; 10 percent light-gray, medium-grained, crystalline limestone	10	560
Shale, grayish-red	10	570
Shale and sandstone; 90 percent grayish-red shale; 10 percent pale-greenish-yellow, very fine-grained sandstone	10	580
Shale, sandstone, and limestone; 80 percent grayish-red shale; 10 percent pale-greenish-yellow, very fine-grained sandstone; 10 percent light-gray limestone	10	590
Shale, limestone, and sandstone; 60 percent grayish-red shale; 20 percent light-gray limestone; 20 percent light-greenish-yellow, very fine sandstone	10	600

TABLE 6 (continued)

Stratigraphic unit and material	Thickness (feet)	Depth (feet)
12.10.26.322a Homestake-New Mexico Partners (continued)		
TRIASSIC SYSTEM (continued)		
Chinle formation (continued)		
Shale and limestone; 80 percent grayish-red shale; 20 percent light-gray limestone	10	610
Shale, grayish-red	20	630
Shale, grayish-red; micaceous	30	660
Shale and sandstone; 80 percent grayish-red shale; 20 percent light-greenish-yellow, sandstone, very fine grained	10	670
Shale, grayish-red	10	680
Shale and sandstone; 90 percent pale-red shale; 10 percent light-brownish-red very fine-grained sandstone with calcium carbonate cement	10	690
Shale, pale-red	20	710
Shale and sandstone; 90 percent light-gray shale; 10 percent light-gray sandstone with calcium carbonate cement	10	720
Shale, light-gray	30	750
Shale and sandstone; 70 percent pale-red shale; 30 percent light-gray, very fine-grained sandstone	10	760
Shale, pale-red; sandstone and limestone less than 5 percent	30	790
Shale and silty limestone, 60 percent pale-brown shale; 40 percent light-gray to medium-gray grading to moderate-red, silty limestone with mixed texture	10	800
PERMIAN SYSTEM:		
San Andres limestone:		
Sandstone, shale, and limestone; 70 percent very pale-orange to moderate-red, fine-to very coarse-grained and granule sandstone with subrounded to angular grains; 15 percent grayish-red shale; 15 percent light-gray to medium-gray and moderate-red limestone ...	10	810
Sandstone and limestone; 80 percent light-gray to moderate-red, very fine-to medium-grained sandstone with subrounded to angular grains; light-gray to medium-gray, medium-grained crystalline limestone	10	820
Sandstone and limestone; 90 percent moderate-red, very fine-to medium-grained sandstone with subrounded to subangular grains and calcium carbonate cement; 10 percent light-gray to medium-gray, medium-grained crystalline limestone	10	830

TABLE 6 (continued)

Stratigraphic unit and material	Thickness (feet)	Depth (feet)
12.10.26.322a Homestake-New Mexico Partners (continued)		
PERMIAN SYSTEM (continued)		
San Andres limestone (continued)		
Sandstone and limestone; 95 percent yellowish-orange to moderate-red, fine-to medium-grained sandstone with subrounded to angular grains and calcium carbonate cement; 5 percent light-gray to moderate-gray, medium-grained crystalline limestone	10	840
Sandstone, moderate-red, fine-to medium-grained, subrounded to angular with calcium carbonate cement	10	850
Sand, pale-yellowish-brown, very fine to coarse and granular, rounded to angular; 85 percent frosted quartz	20	870
12.10.27.431 W. A. Murray		
QUATERNARY SYSTEM: well 306		
Valley fill:		
Sandstone, grayish-orange, fine- to very coarse-grained, rounded to subrounded, frosted quartz 70 percent, very friable	10	10
Sandstone, grayish-orange, fine- to very coarse-grained, rounded to subrounded; frosted quartz 70 percent; subangular fragment of moderate-red vesicular lava 1 mm across; very friable	10	20
Same as above, except without lava fragments	20	40
Sand, grayish-orange, fine to coarse, rounded to angular; frosted quartz 60 percent	20	60
Sand, grayish-orange, very fine to medium, rounded to subangular; frosted quartz 60 percent	30	90
TRIASSIC SYSTEM:		
Chinle formation:		
Shale and sand; 80 percent grayish-red shale; 20 percent grayish-orange fine to coarse, subrounded to angular grains of frosted quartz sand	10	100
Shale, limestone, and sand; 90 percent grayish-red shale; 5 percent light-gray limestone; 5 percent fine to coarse, subrounded to subangular frosted quartz sand	20	120
Shale, sandstone, limestone, and sand; 80 percent grayish-purple shale; 10 percent light-gray to light-brownish-gray, very fine-grained, subrounded sandstone; 5 percent light-medium-gray limestone; 5 percent fine to medium, subrounded, frosted quartz sand	30	150

Figure 2-4

#2 Deep Well Geophysical Logs

JET WEST
GEOPHYSICAL SERVICES, LLC.

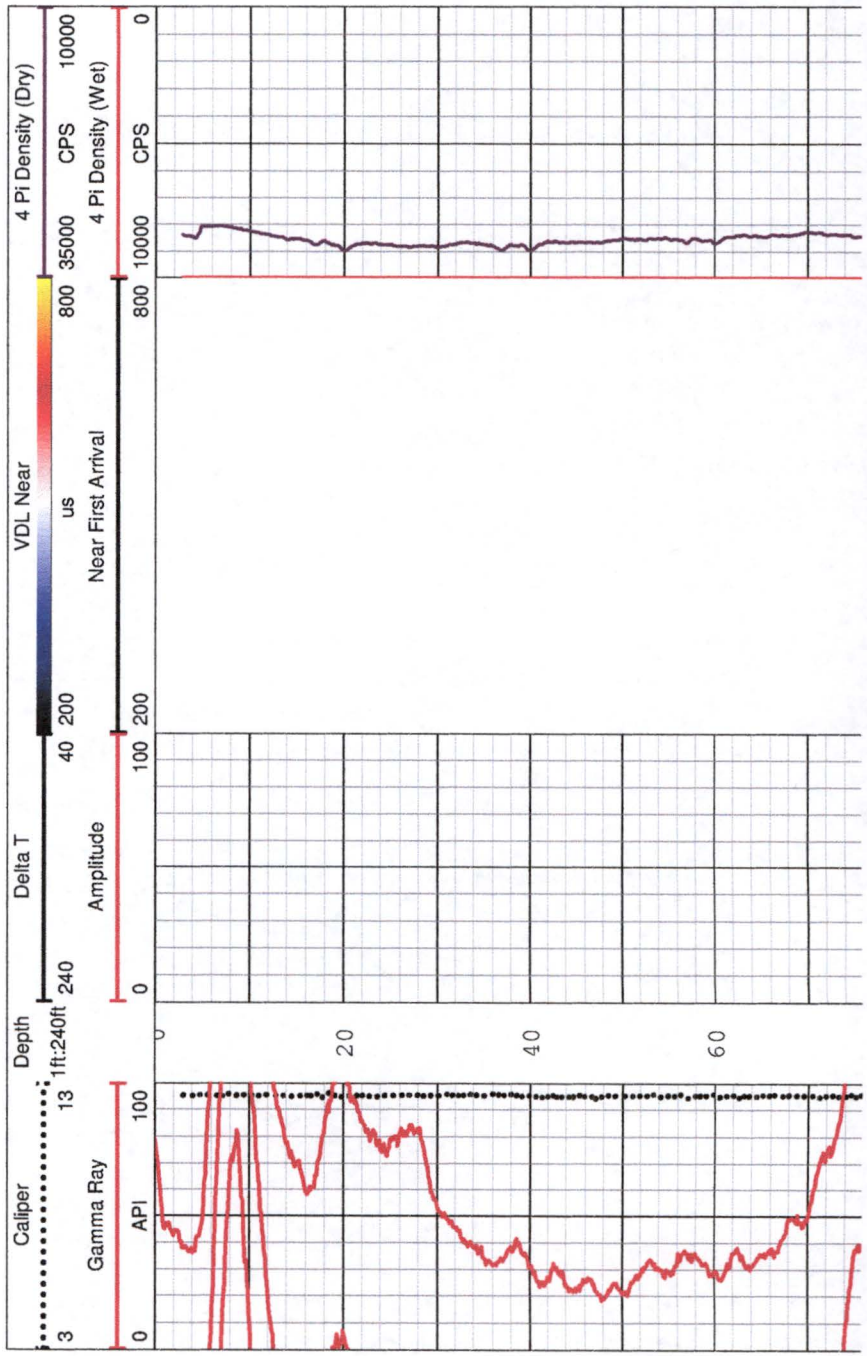
COMPANY	Homestake Mining Company
WELL ID	#2 Deep
FIELD	Grants
COUNTY	Cibola STATE New Mexico
TYPE OF LOG:	**Gamma Ray, 3 Arm Caliper, Sonic, 4 Pi Density**
OTHER SERVICES	Video
LOCATION	
SEC TWP RGE	API No.
Northing: Easting:	

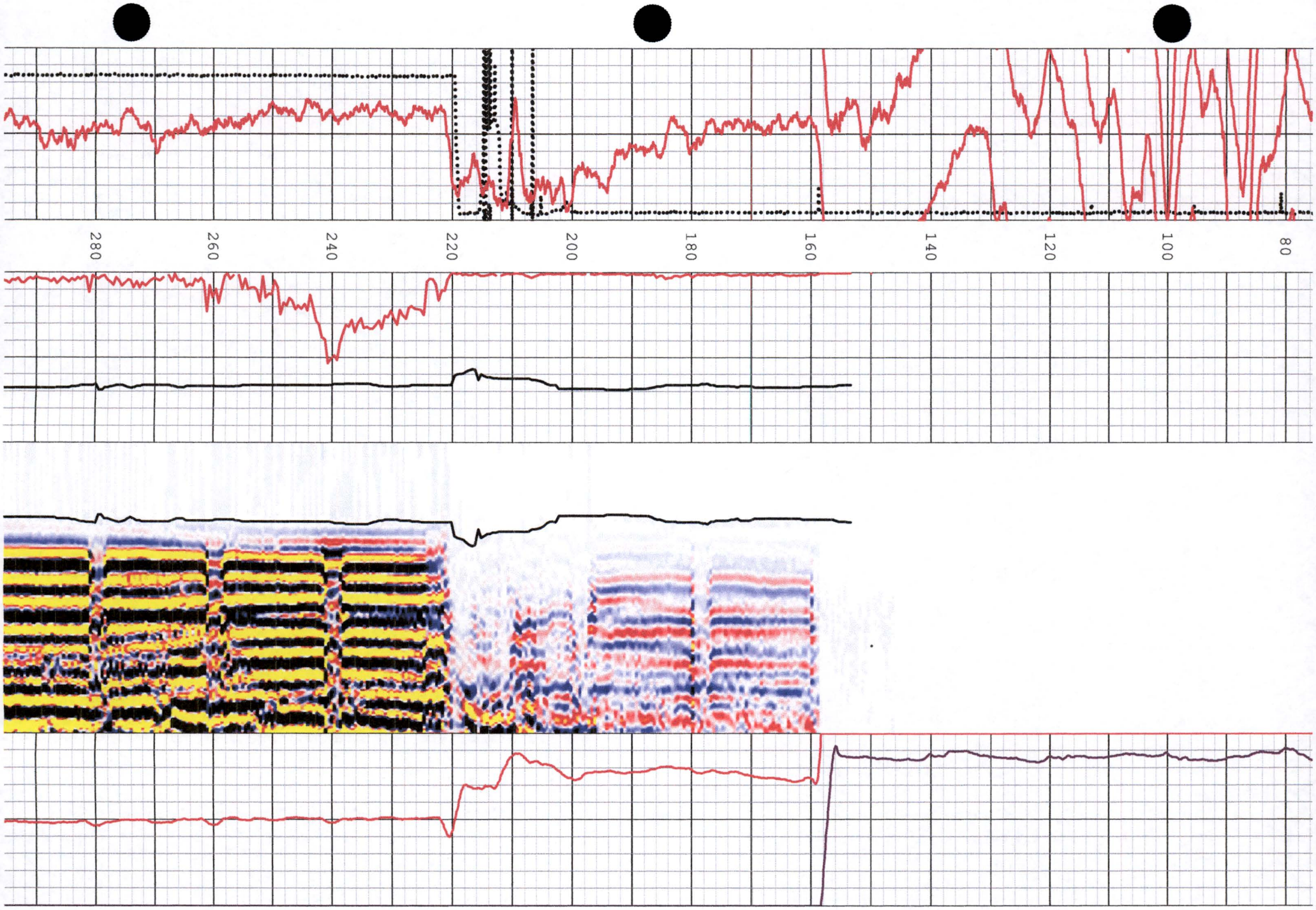
PERMANENT DATUM	Ground Level	ELEVATION	K.B.
LOG MEAS. FROM	Ground Level	ABOVE PERM. DATUM	T.O.C
DRILLING MEAS. FROM	Ground Level		G.L.

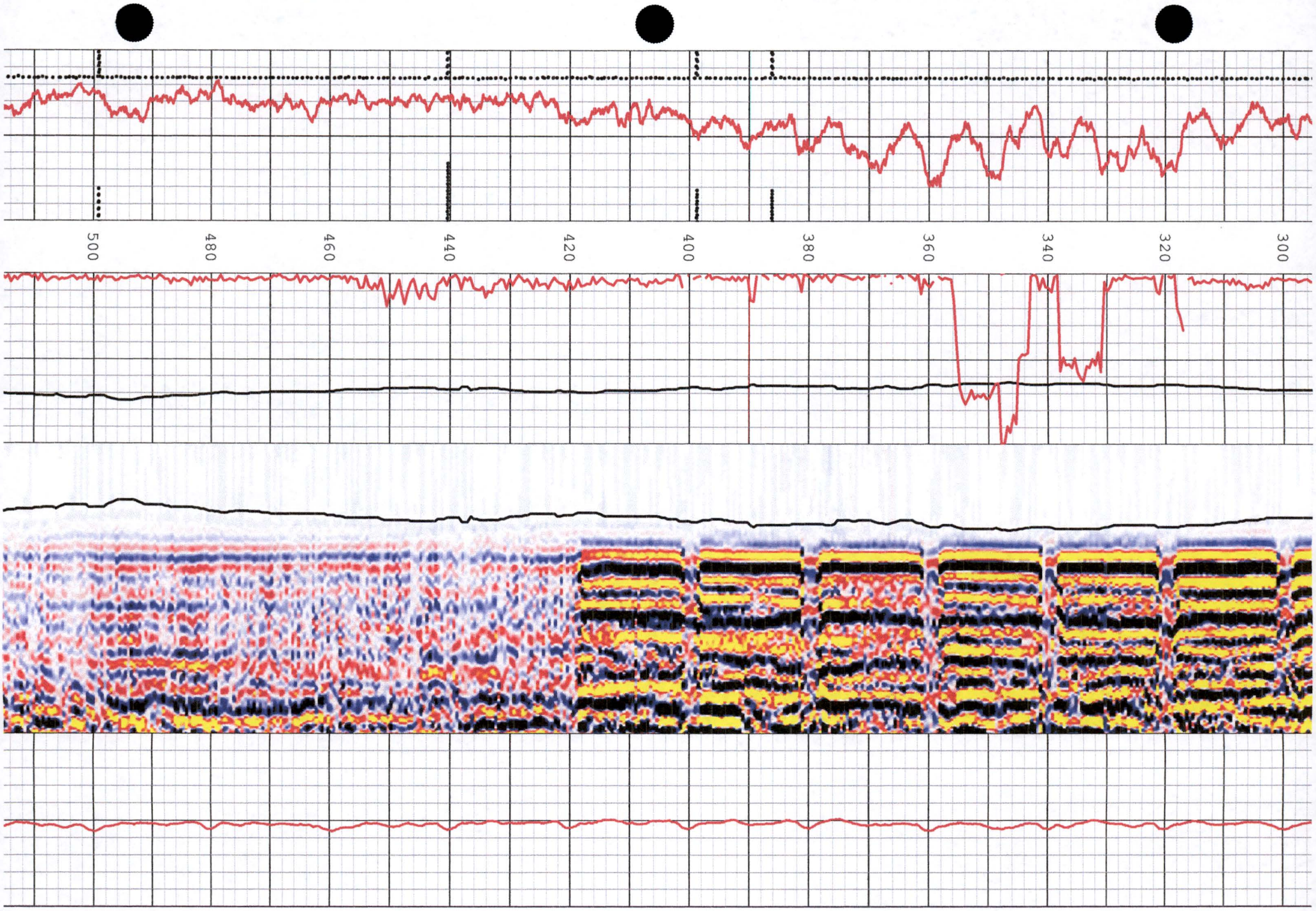
DATE	05-18-2016	TYPE FLUID IN HOLE	water
RUN No.	One	SALINITY	
TYPE LOG	QL-GR-3Arm, 4Pi, Sonic	DENSITY	
DEPTH-DRILLER	823 ft.	LEVEL	156 ft.
DEPTH-LOGGER	817 ft.	MAX. REG. TEMP	
BTM LOGGED INTERVAL	815 ft.	DIGITIZE INTERVAL	0.1 ft.
TOP LOGGED INTERVAL	Surface		
OPERATING RIG TIME			
RECORDED BY	T. Staatz / J. White		
WITNESSED BY	A. Venable		

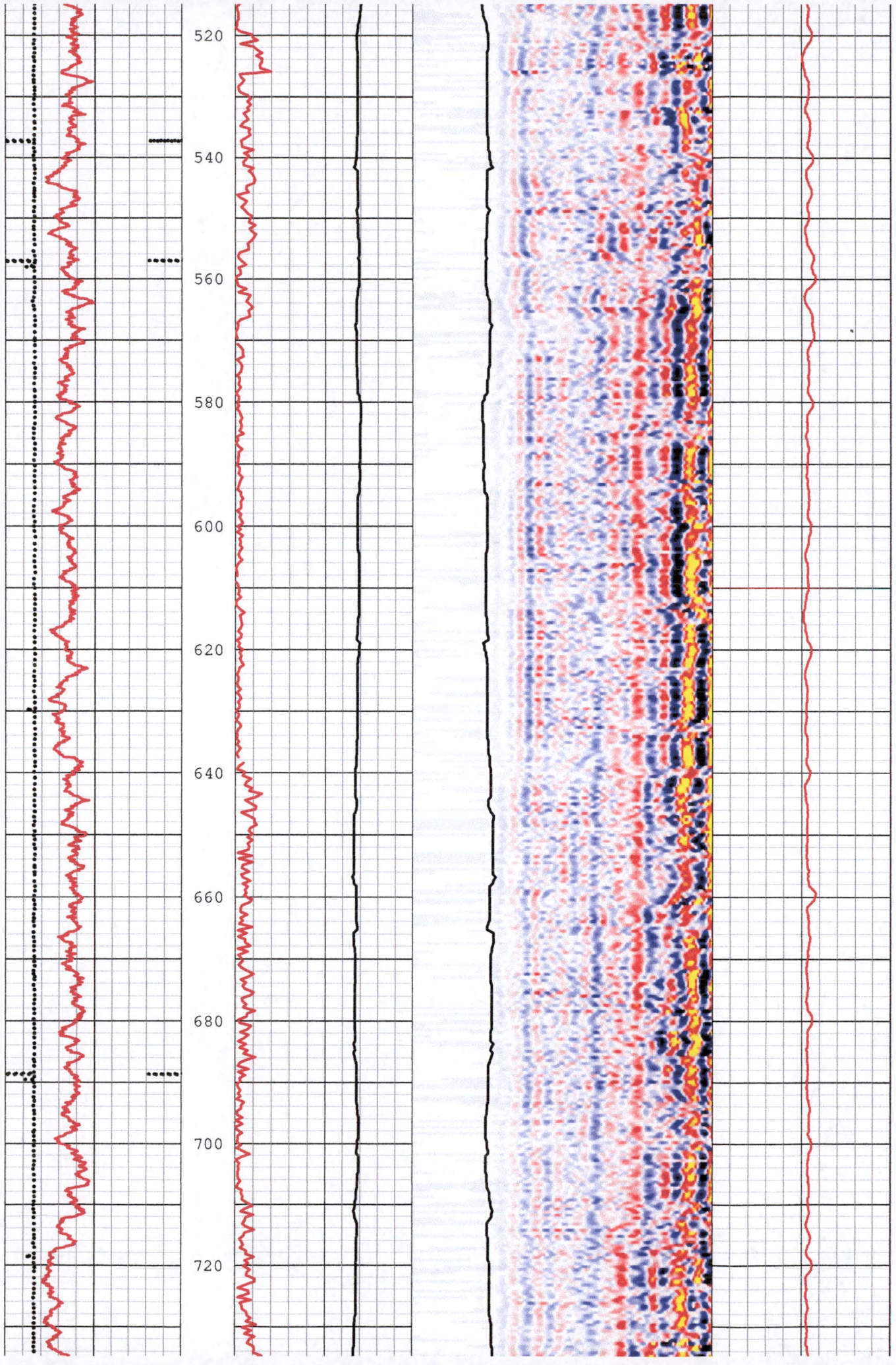
RUN	BOREHOLE RECORD			CASING RECORD			
NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO
1				12.5 in. O.D.	Fiberglass	Surf.	220
2				4.5 in. O. D.	Fiberglass	220 ft.	423 ft.
3				4.5 in. O.D.	Slotted FG	423 ft.	823 ft.

REMARKS:




280
260
240
220
200
180
160
140
120
100
80


500
480
460
440
420
400
380
360
340
320
300


520
540
560
580
600
620
640
660
680
700
720

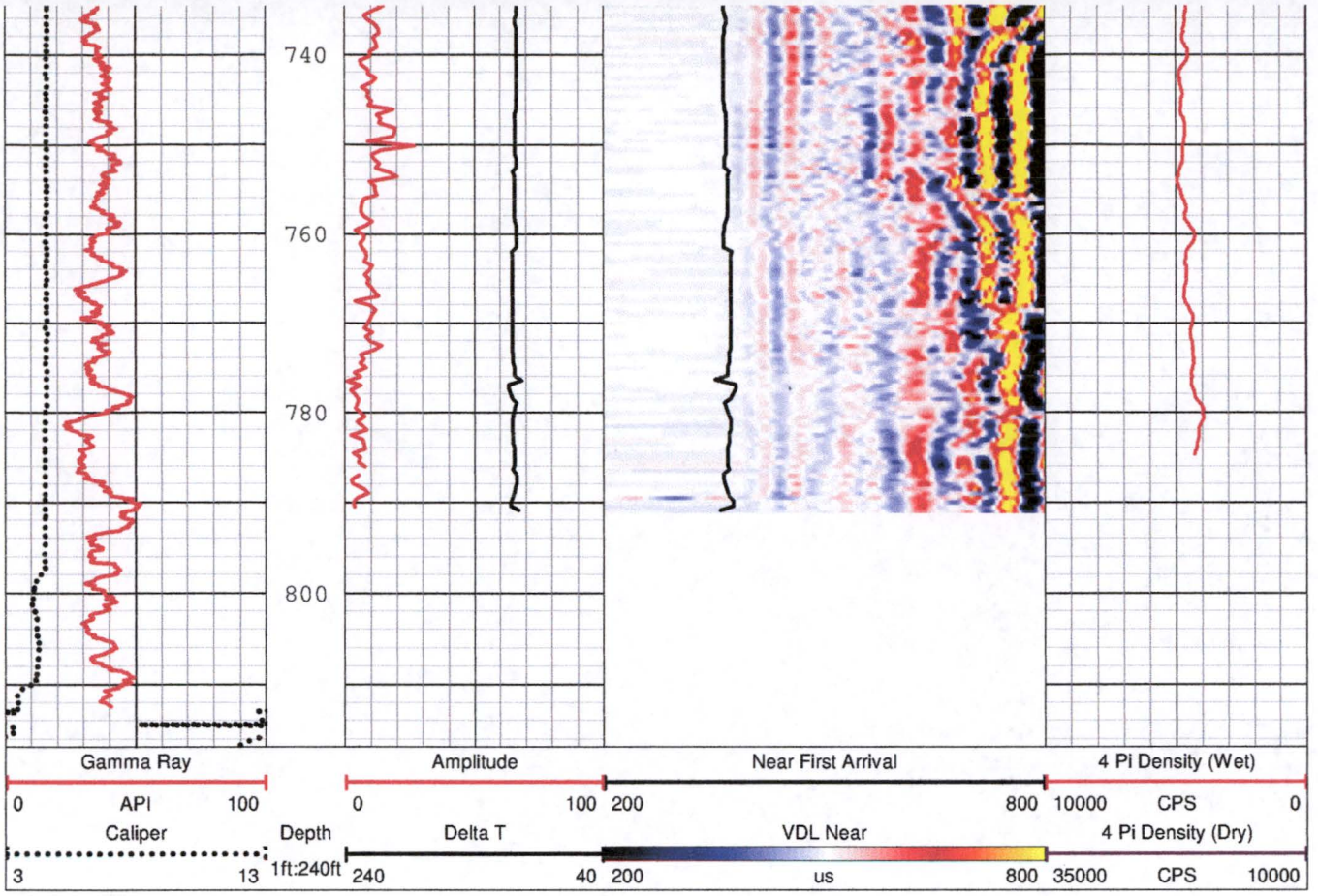
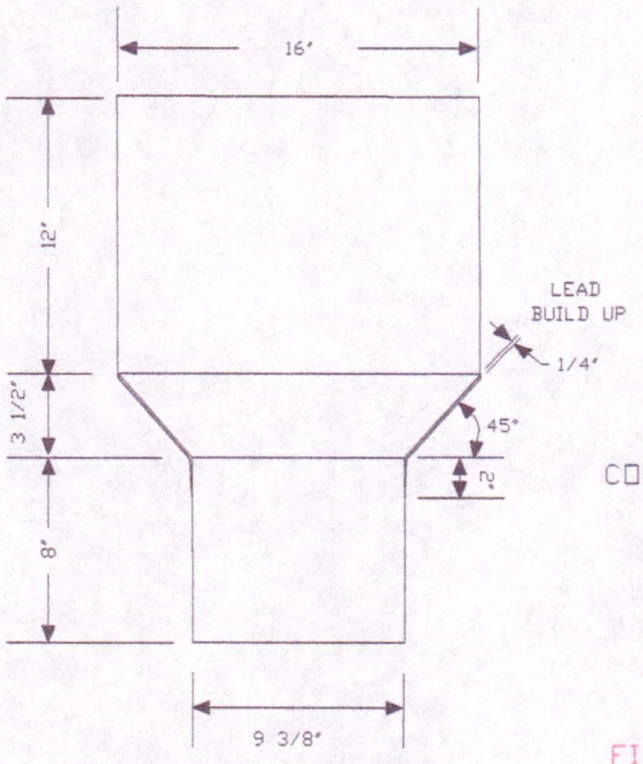
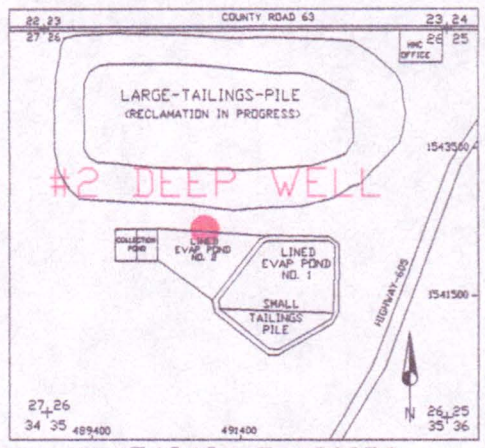

740
760
780
800
Gamma Ray
0
API
100
Caliper
3
13
Depth
1ft:240ft
Amplitude
0
100
Delta T
240
40
Near First Arrival
200
800
VDL Near
200
us
800
4 Pi Density (Wet)
10000
CPS
0
4 Pi Density (Dry)
35000
CPS
10000

Figure 2-5

#2 Deep Well 1980 and 1998 Resleeving Schematic

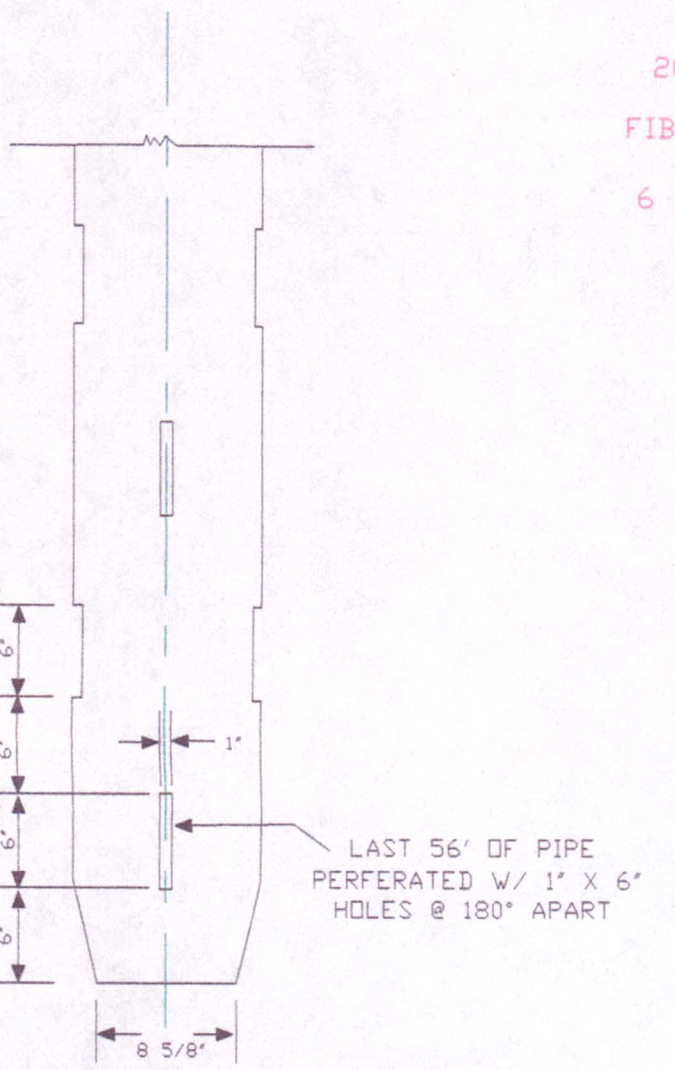


'80 TRANSITION DETAILS



N 1542424 E 490972

SECTION VIEW



'80 PERFERATED HOLE DETAILS

HOMESTAKE MINING COMPANY GRANTS-NM-TOWNSHIP-11&12-N-RANGE-10-W DATE: 04/29/98

1998 RESLEVING FOR #2 DEEP WELL

9706\WELLREP.DWG

3.0 San Andres Ground-Water Quality

Monitoring of San Andres ground-water quality in the Grants project area is being used to determine if any of the San Andres wells currently used to supply fresh water for the ground-water restoration program have exhibited a change in casing integrity that is reflected in water quality changes. Additional monitoring of the four San Andres wells that HMC uses to supply fresh water has been done in 2016. This data will be tabulated in the Annual Performance report, but for convenience, updated water quality plots are presented in this report for the evaluation of these wells.

3.1 Sulfate Concentrations

Sulfate is a major constituent that has been used to track water quality changes at the Grants Reclamation Project. Figure 3-1 presents an updated plot of the sulfate concentrations in San Andres wells 943, 951, 951R, #1 and #2. This plot has been presented in the Annual Performance report. Figure 3-1 shows sulfate concentrations for the 1st half of 2016 for wells 943, 951, 951R, #1 and #2, and reveals that these concentrations are consistent with the concentrations measured since 2011 except for a high value from well 943 in late 2015. The values prior and after the higher value are consistent and indicate that it is an outlier. There was no measurable change in sulfate concentration in 2016, and this is indicative of no change in the well integrity for any of these four San Andres supply wells in 2016.

Figure 3-2 presents the plot of sulfate for irrigation supply wells 806R and 938 and two of the Milan supply wells (wells 532 and 999). No 2016 samples have been taken for these wells.

3.2 TDS Concentrations

TDS is also a major parameter that has been used to track water quality changes at the Grants project. Figure 3-3 presents a plot of the TDS concentrations in San Andres wells 943, 951, 951R, #1 and #2. This plot shows that the 2016 TDS concentrations are very similar to previous values for wells. The late 2015 value from well 943 is thought to be an outlier. This plot does not indicate any change in the well integrity for any of these four San Andres supply wells in 2016.

Figure 3-4 presents the plot of sulfate for irrigation supply wells 806R and 938 and Milan supply wells 532 and 999. No 2016 samples have been taken for these wells.

3.3 Chloride Concentrations

Chloride is a major constituent that typically moves very conservatively and has been used to track water quality changes at the Grants Reclamation Project. Figure 3-5 presents a plot of the chloride concentrations in San Andres wells 943, 951, 951R, #1 and #2. This plot shows that the 2016 chloride concentrations are very similar to previous values. This plot does not indicate any change in the well integrity for any of these four San Andres supply wells in 2016.

Figure 3-6 presents the plot of chloride for irrigation supply wells 806R and 938 and Milan supply wells 532 and 999 through 2015. Samples for these wells have not been taken in 2016.

3.4 Uranium Concentrations

Uranium is a minor constituent that is very important relative to ground-water restoration at the Grants project. Figure 3-7 presents a plot of the uranium concentrations in San Andres wells 943, 951, 951R, #1 and #2. This plot shows that the recent uranium concentrations are very similar to previous values. The increase in uranium concentration in well 951R that was observed in 2014 prior to the 2015 decline is not thought to be a function of changes in well integrity in 951R, but is attributed to changes in the San Andres aquifer water quality in this area. The uranium concentration was higher in the late 2015 sample from well 943, but values before and after that sample indicate it is an outlier. This plot does not indicate any change in the well integrity for any of the San Andres supply wells in 2016.

Figure 3-8 presents the plot of uranium from 2000 through 2015 for irrigation supply wells 806R and 938 and two of Milan supply wells 532 and 999. 2016 samples have not been taken for these wells.

3.5 Selenium Concentrations

Selenium is also a minor constituent that is important relative to ground-water restoration at the Grants project. Figure 3-9 presents a plot of the selenium concentrations in San Andres wells 943, 951, 951R, #1 and #2. This plot shows that the most recent selenium concentrations are very similar to previous values. The higher value from well 943 in late 2015 is thought to be an outlier. This plot does not indicate any change in the well integrity for any of these four San Andres supply wells in 2016.

Figure 3-10 presents the plot of selenium for irrigation supply wells 806R and 938 and two of Milan supply wells 532 and 999. 2016 samples have not been taken for these wells.

Figure 3-1

Sulfate Concentrations for San Andres Wells 943, 951, 951R, #1 Deep Well, and #2 Deep Well

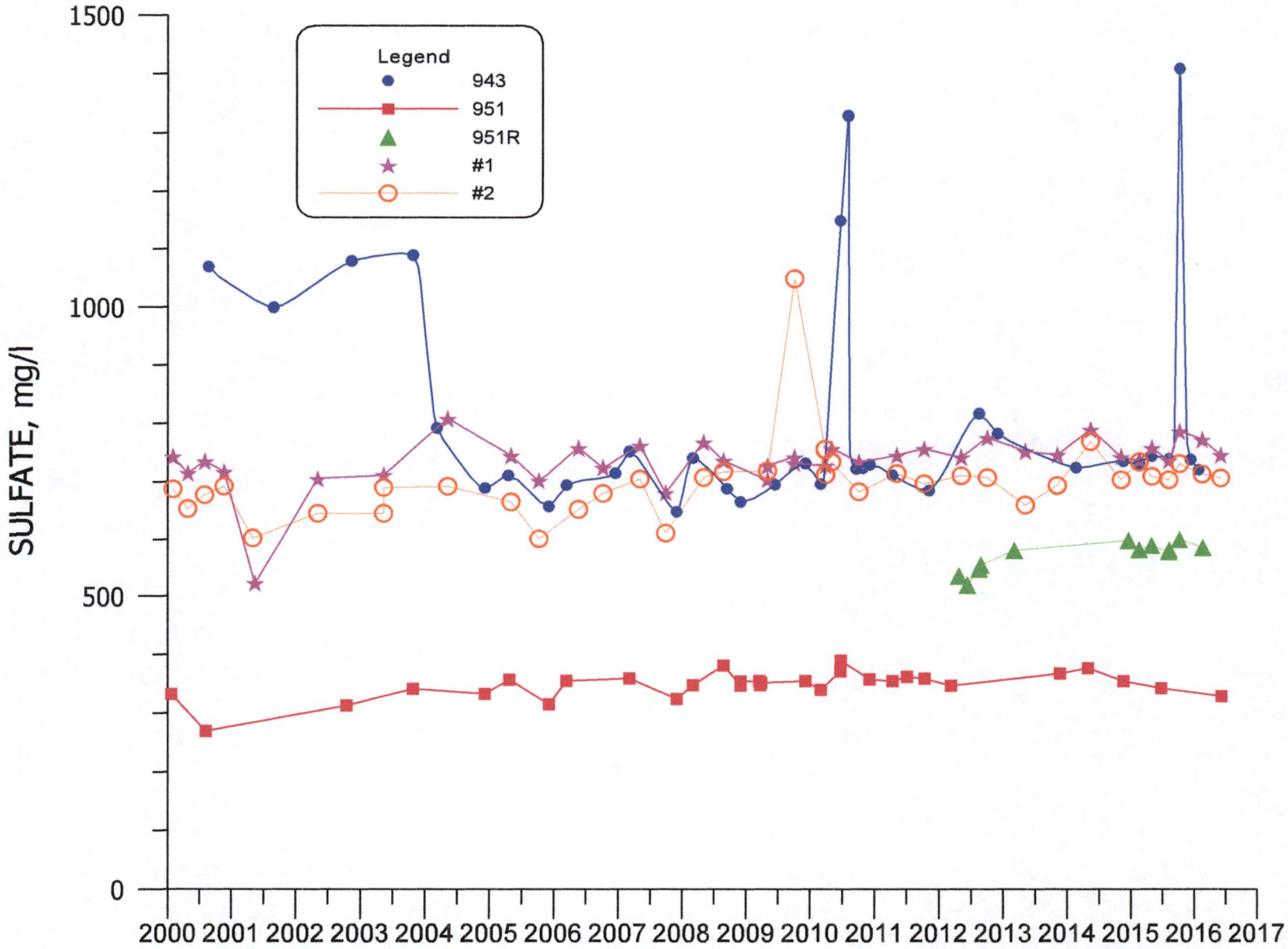


FIGURE 3-1. SULFATE CONCENTRATIONS FOR SAN ANDRES WELLS 943, 951, 951R, #1 & #2.

Figure 3-2

Sulfate Concentrations for San Andres Wells 532, 806R, 938, and 999

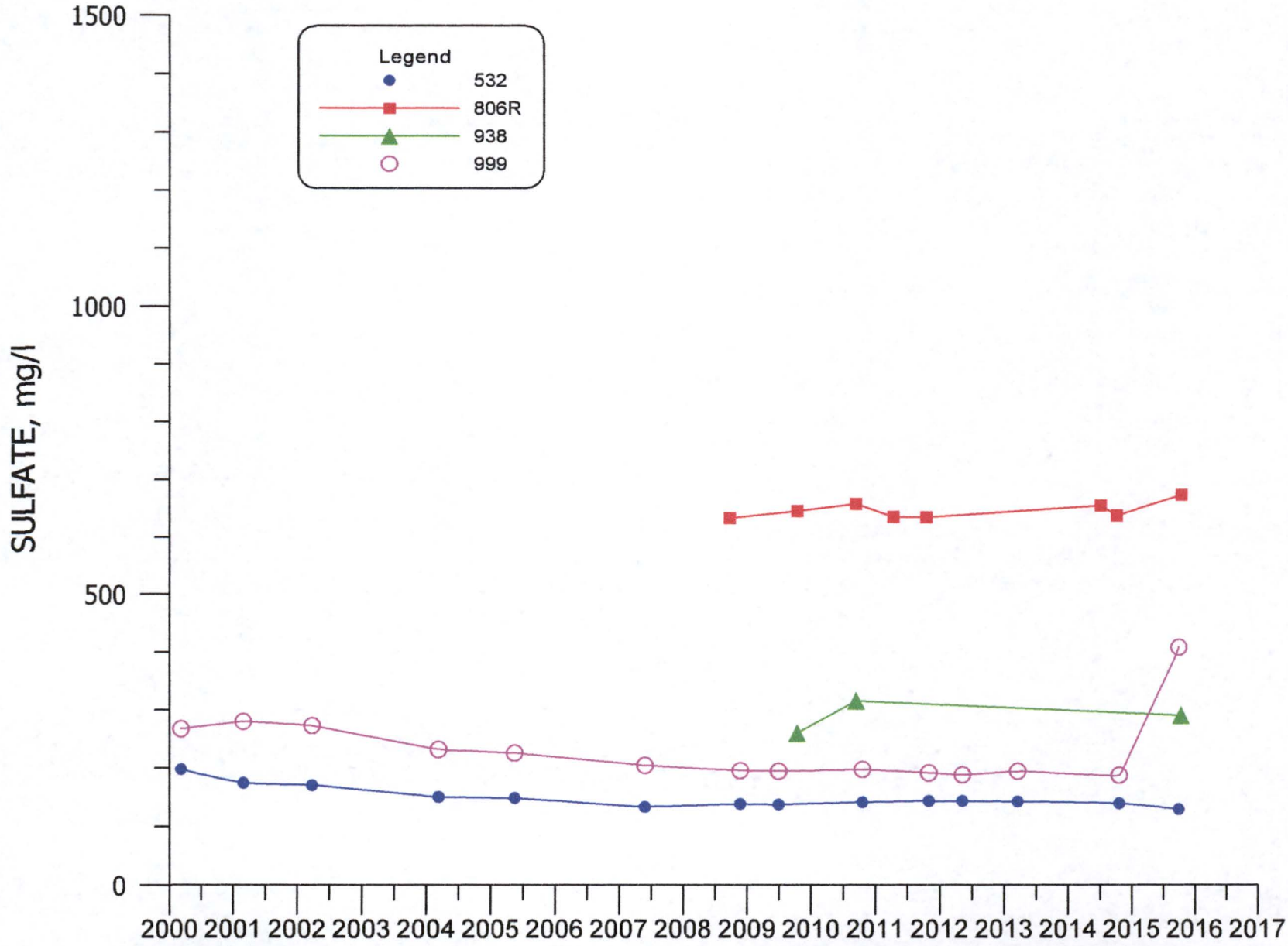


FIGURE 3-2. SULFATE CONCENTRATIONS FOR SAN ANDRES WELLS 532, 806R, 938 & 999.

Figure 3-3

TDS Concentrations for San Andres Wells 943, 951, 951R, #1 Deep Well, and #2 Deep Well

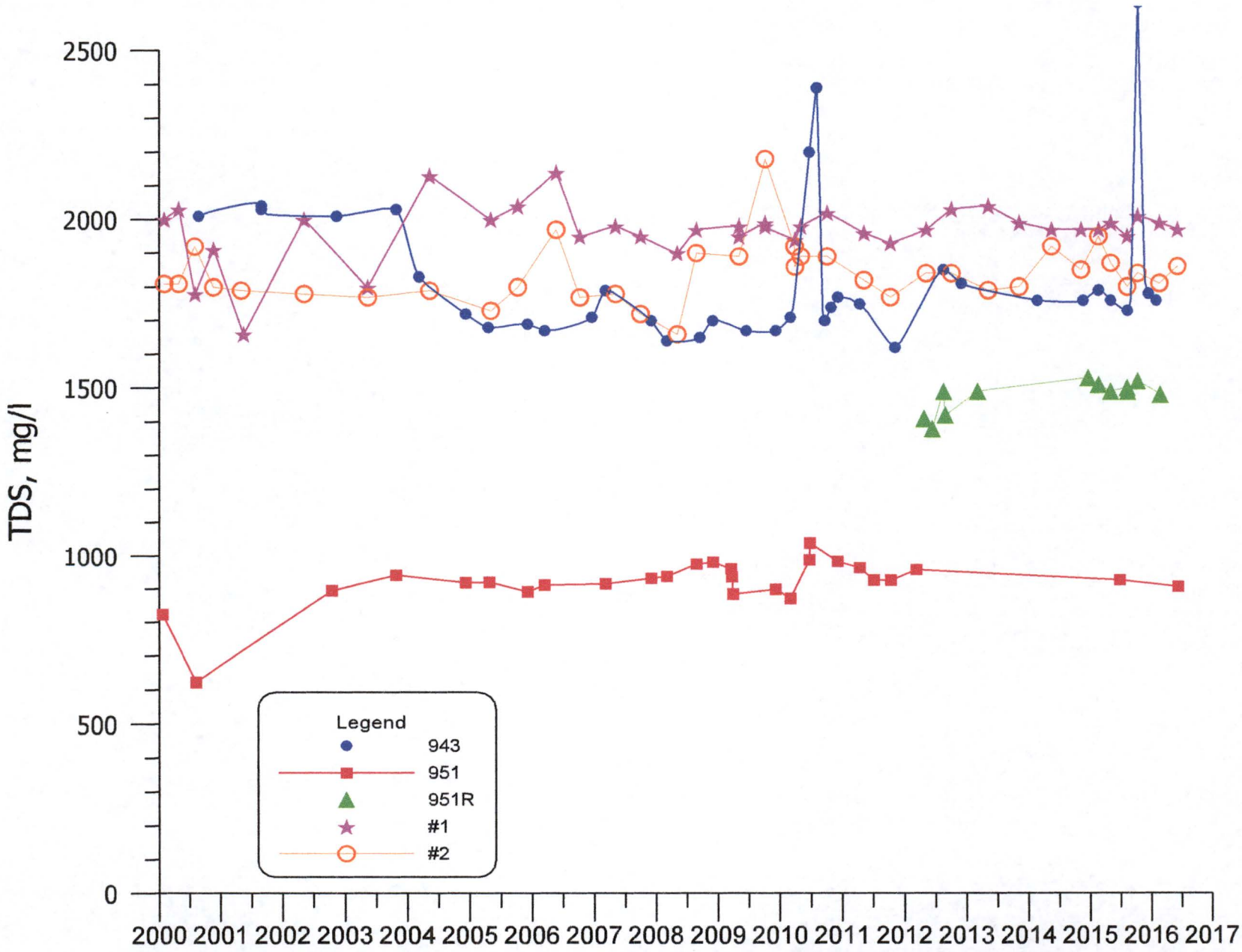


FIGURE 3-3. TDS CONCENTRATIONS FOR SAN ANDRES WELLS 943, 951, 951R, #1 & #2.

Figure 3-4

TDS Concentrations for San Andres Wells 532, 806R, 928, and 999

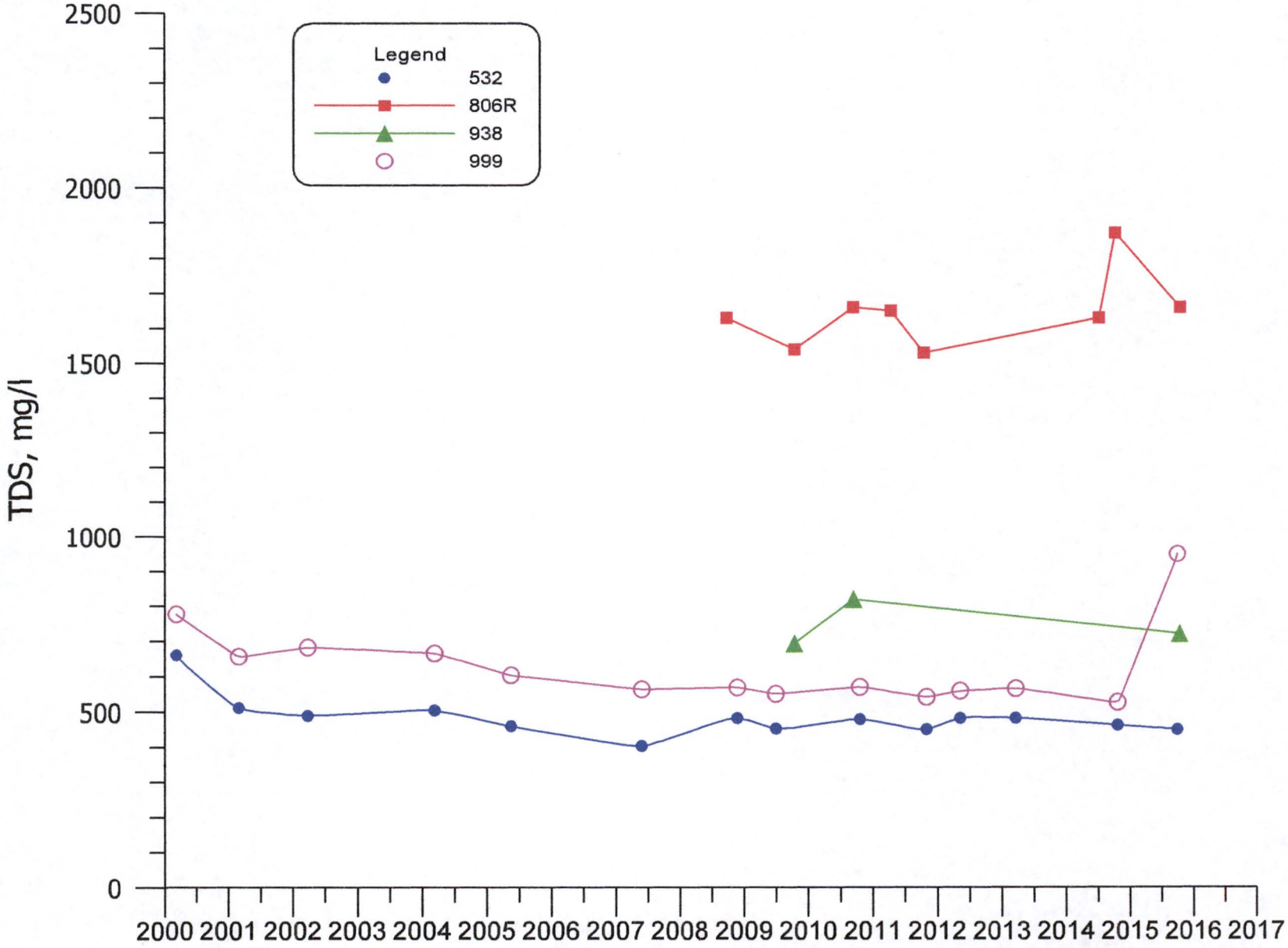


FIGURE 3-4. TDS CONCENTRATIONS FOR SAN ANDRES WELLS 532, 806R, 938 & 999.

Figure 3-5

Chloride Concentrations for San Andres Wells 943, 951, 951R, #1 Deep Well, and #2 Deep Well

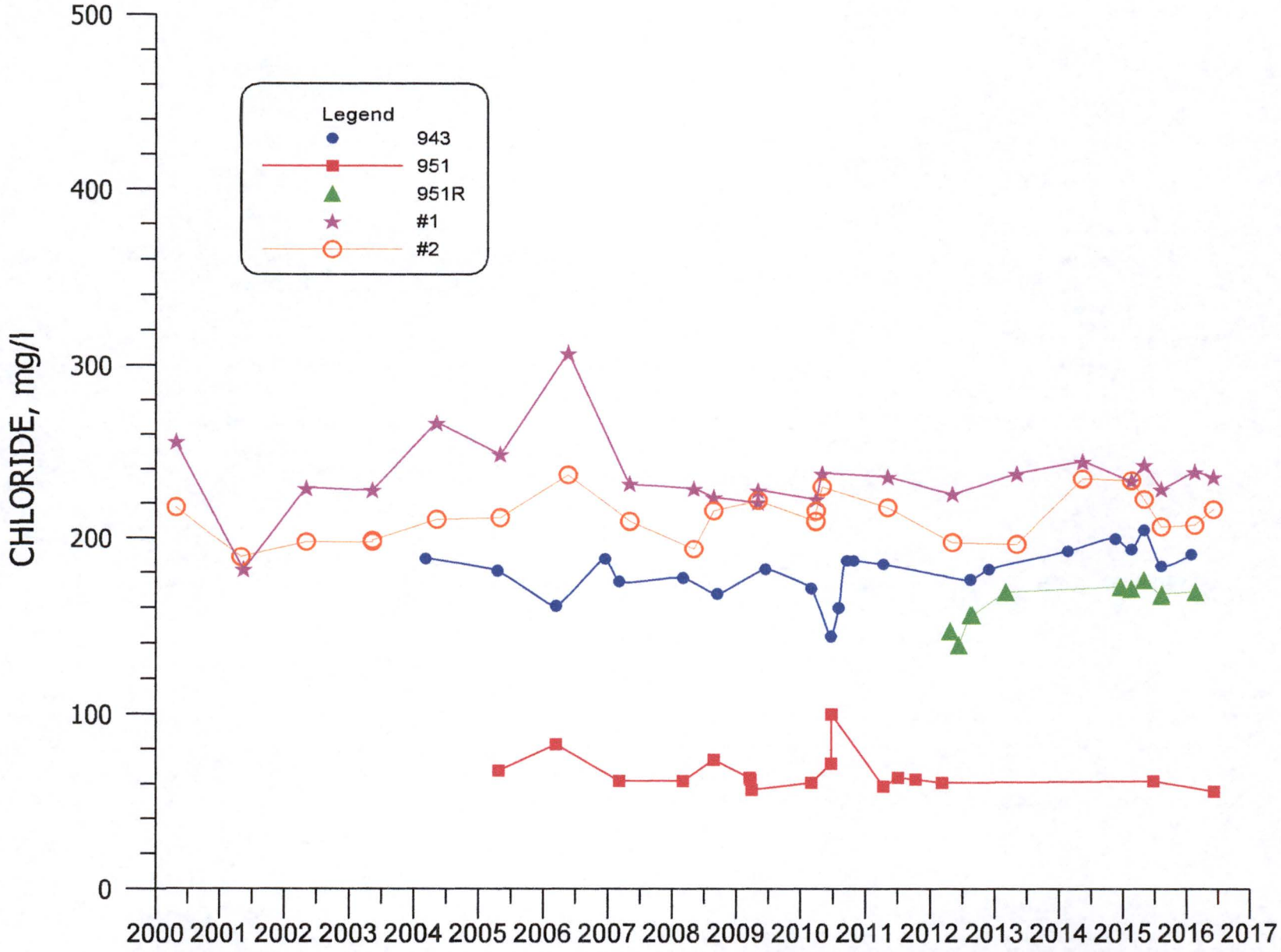


FIGURE 3-5. CHLORIDE CONCENTRATIONS FOR SAN ANDRES WELLS 943, 951, 951R, #1 & #2.

Figure 3-6

Chloride Concentrations for San Andres Wells 532, 806R, 938, and 999

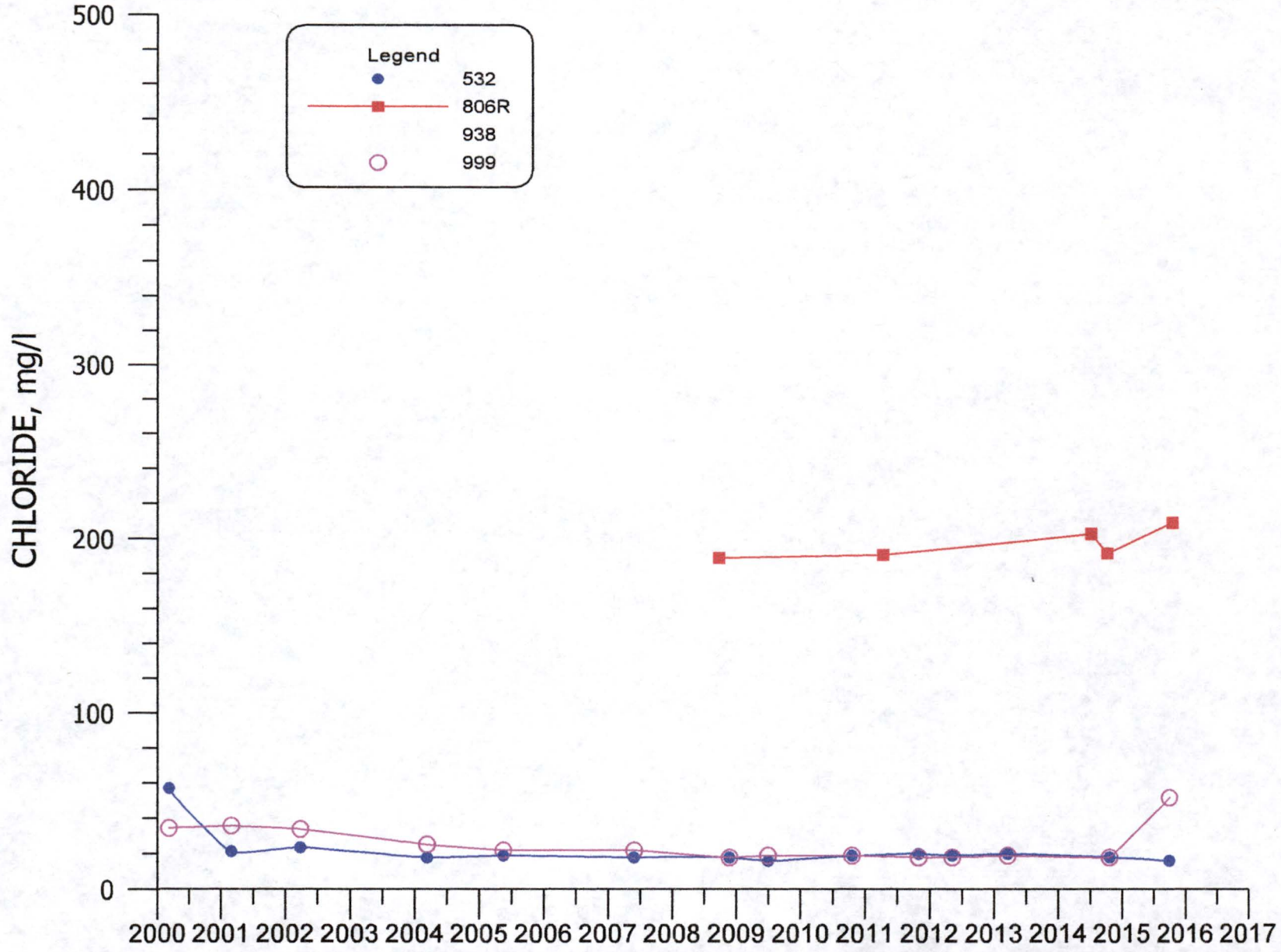


FIGURE 3-6. CHLORIDE CONCENTRATIONS FOR SAN ANDRES WELLS 532, 806R, 938 & 999.

Figure 3-7

Uranium Concentrations for San Andres Wells 943, 951, 951R, #1 Deep Well, and #2 Deep Well

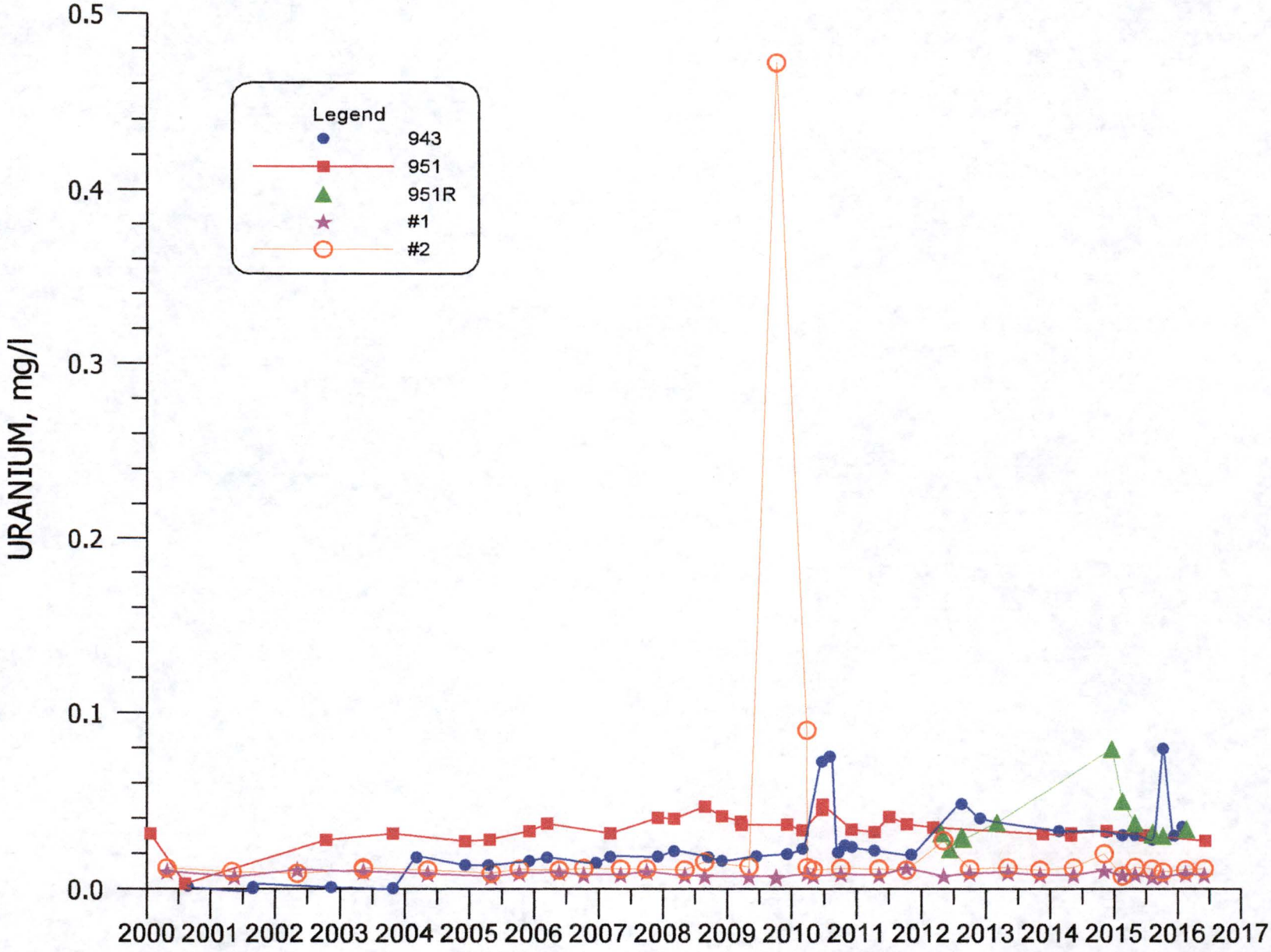


FIGURE 3-7. URANIUM CONCENTRATIONS FOR SAN ANDRES WELLS 943, 951, 951R, #1 & #2.

Figure 3-8

Uranium Concentrations for San Andres Wells 532, 806R, 938, and 999

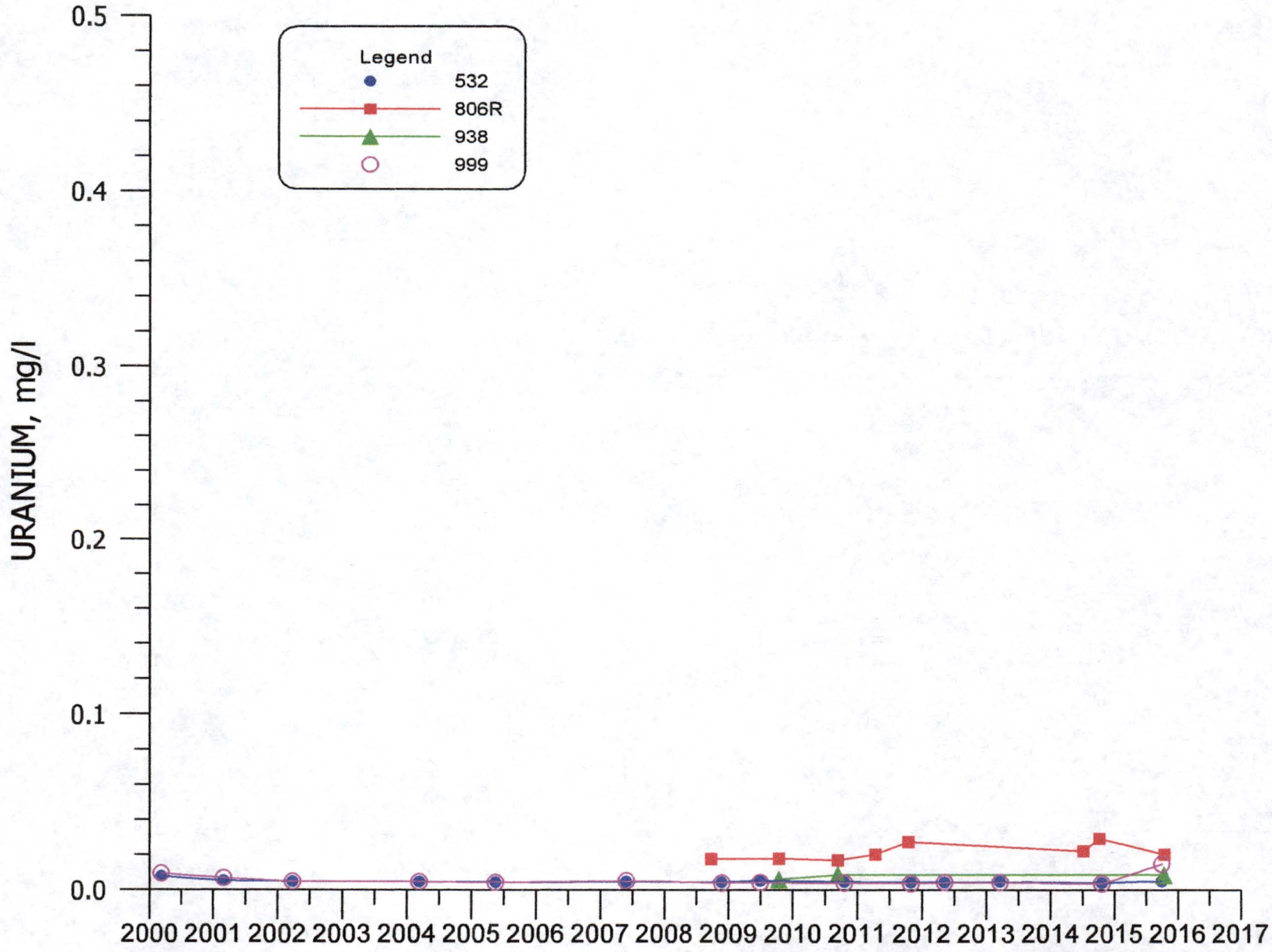


FIGURE 3-8. URANIUM CONCENTRATIONS FOR SAN ANDRES WELLS 532, 806R, 938 & 999.

Figure 3-9

Selenium Concentrations for San Andres Wells 943, 951, 951R, #1 Deep Well, and #2 Deep Well

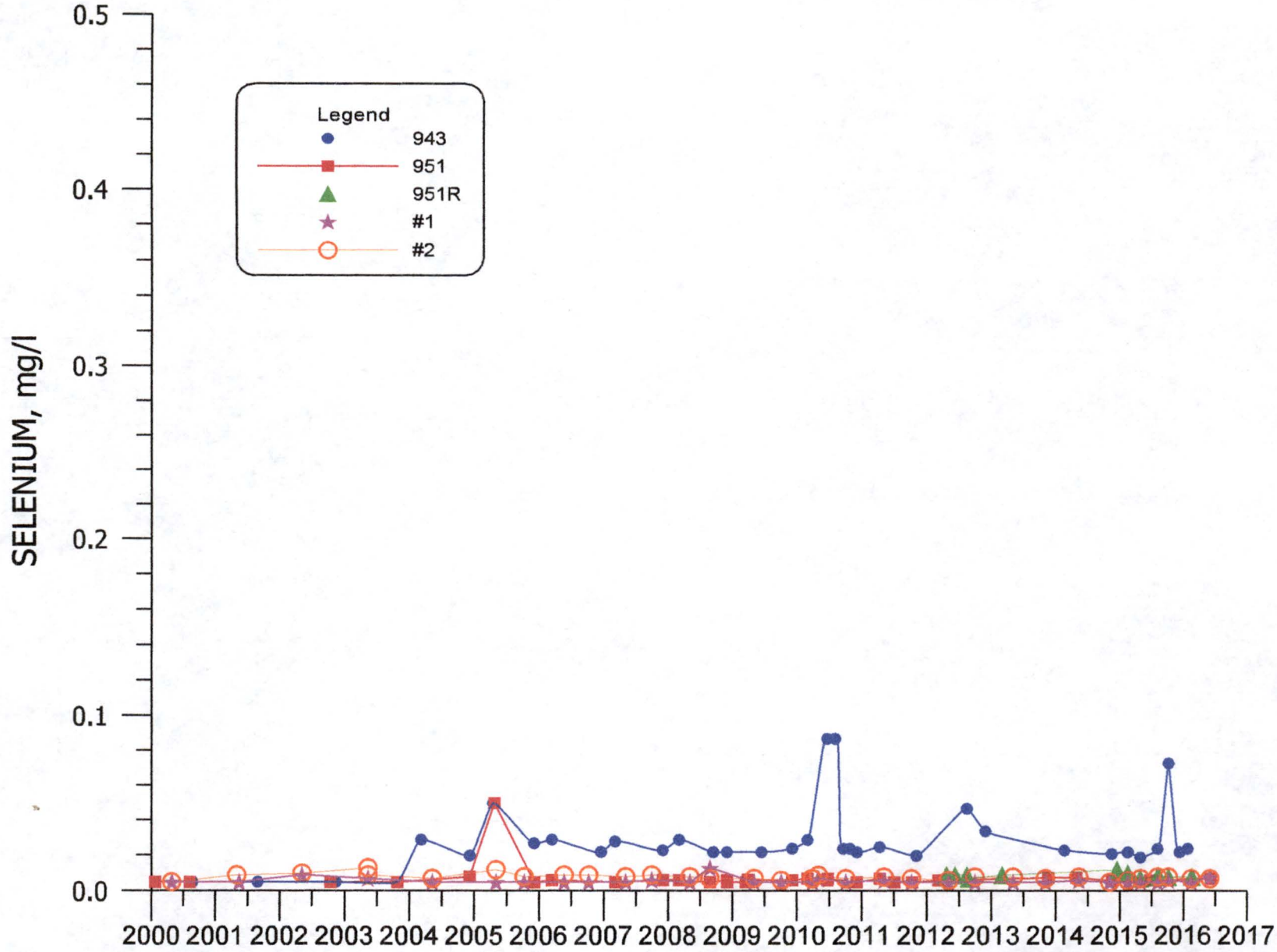


FIGURE 3-9. SELENIUM CONCENTRATIONS FOR SAN ANDRES WELLS 943, 951, 951R, #1 & #2.

Figure 3-10

Selenium Concentrations for San Andres 532, 806R, 938, 999

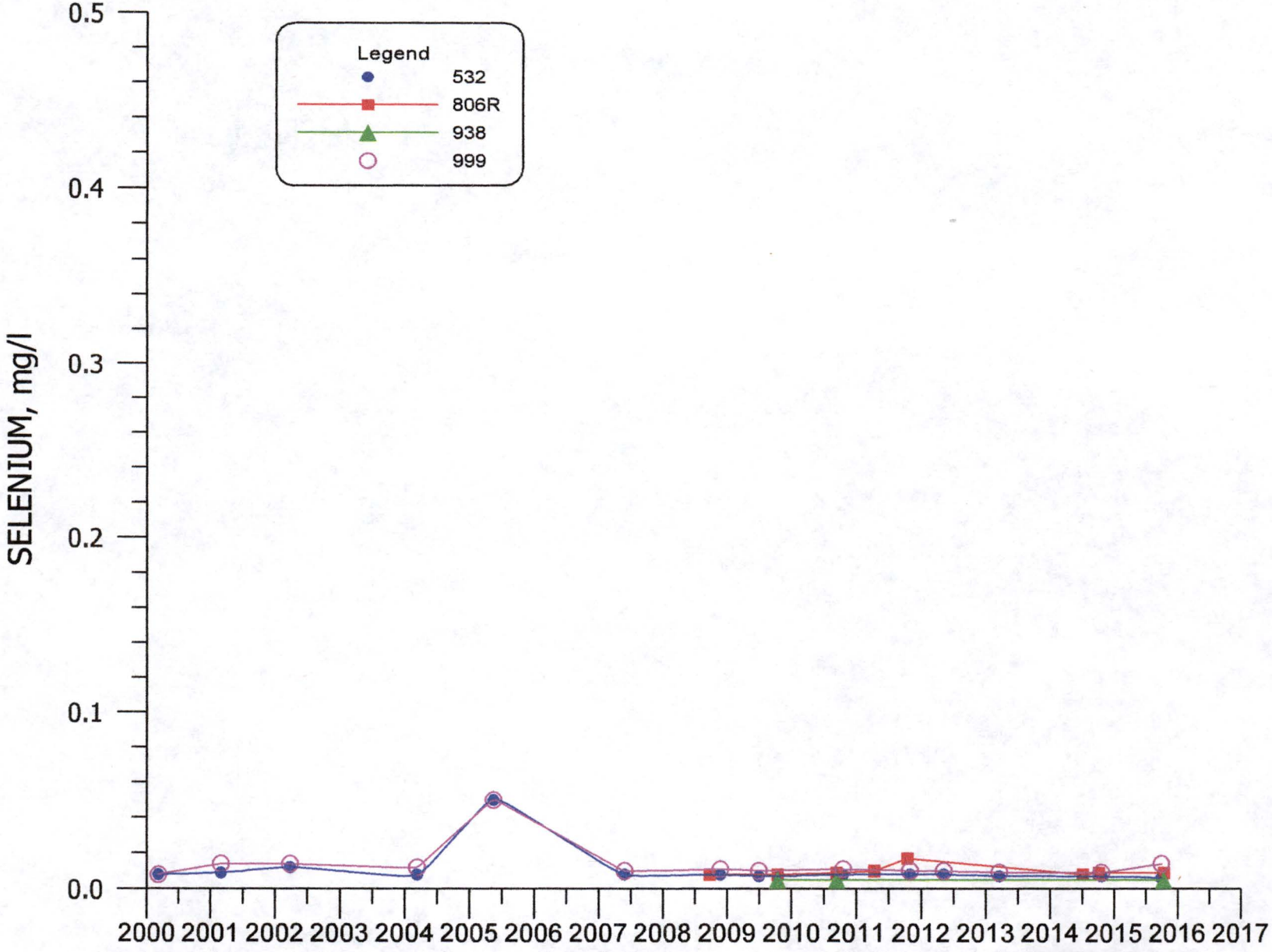


FIGURE 3-10. SELENIUM CONCENTRATIONS FOR SAN ANDRES WELLS 532, 806R, 938 & 999.

4.0 Conclusion

The San Andres well integrity testing for #1 Deep Well shows that the integrity of this well is good except for the casing break at 234 feet which does not compromise the well relative to water quality. We are confident #1 Deep Well can be used as a fresh water supply well. The casing in San Andres #2 Deep Well has considerable damage but the video of the well does not show any leakage of alluvial water into the well; and thus, the well integrity for Deep Well #2 is believed to be adequate for its continued use as a fresh water injection supply well for the near future. The San Andres monitoring in 2016 does not indicate that the integrity of the existing San Andres supply wells #1 and #2 well has changed.

5.0 References

Hydro-Engineering, L.L.C., 2016, Grants Reclamation Project, 2015 Annual Monitoring Report/Performance Review for Homestake's Grants Project Pursuant to NRC License SUA-1471 and Discharge Plan DP-200. Consulting Report for Homestake Mining Company of California.

APPENDIX A

Video of #1 Deep Well and #2 Deep Well
(see CDs)