

SOLUTION MINING RESEARCH INSTITUTE

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**MEETING
PAPER**



DIAGNOSTIC ANALYSIS OF THE WEEKS ISLAND SINKHOLE

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**Presented at the SMRI New Orleans
Meeting, May 1&2, 1995**

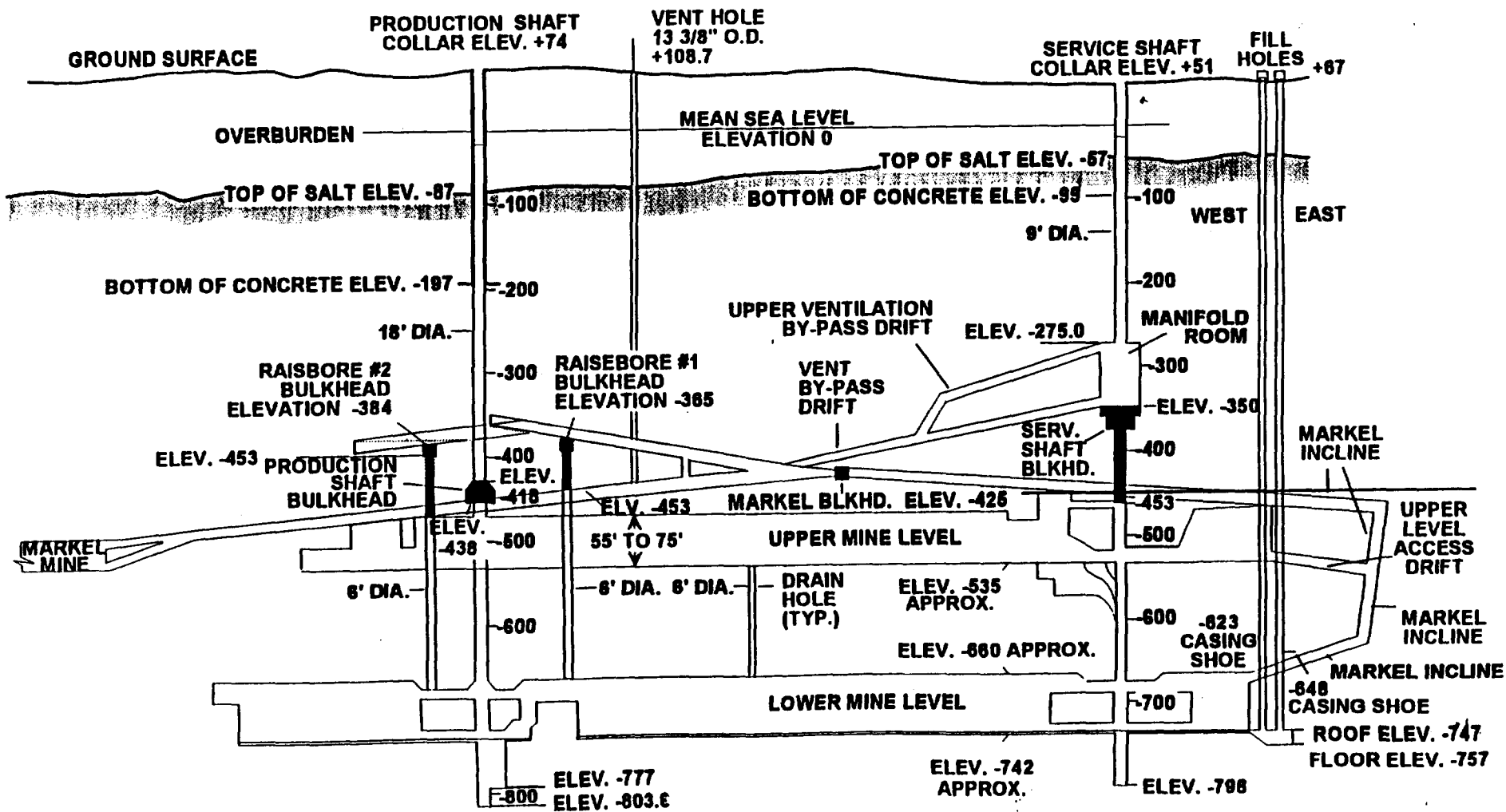
WEEKS ISLAND SINKHOLE

DIAGNOSTIC TOOLS

- O WATER INFLOW**
- O BRINE HYDROCHEMISTRY**
- O ROCK MECHANICS MODELLING**
- O SEISMIC REFLECTION PROFILING**
- O CROSSWELL SEISMIC PROFILING**
- O SLANTHOLE DRILLING**
- O GAS MAPPING**
- O SELF-POTENTIAL SURVEYS**
- O PIEZOMETRIC MONITORING / PERMEABILITY TESTING**
- O SINKHOLE PROGRESSION**

WEEKS ISLAND SCHEMATIC SECTIONAL ELEVATION

DATE: 4/1/95





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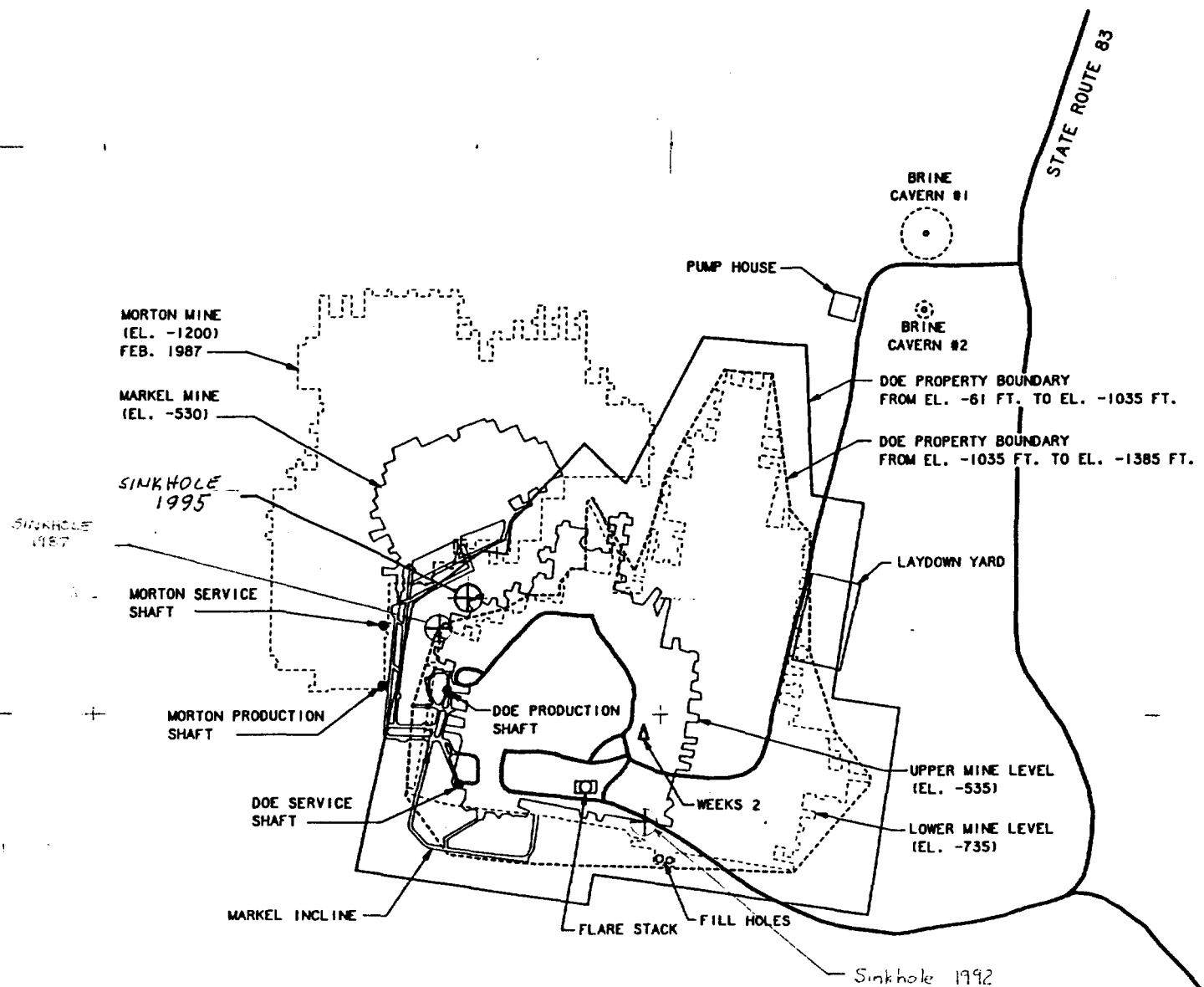
5.000

Y 1987

1,845.000

1,850.000

1,855.000



SCALE 0 1000 2000 FEET

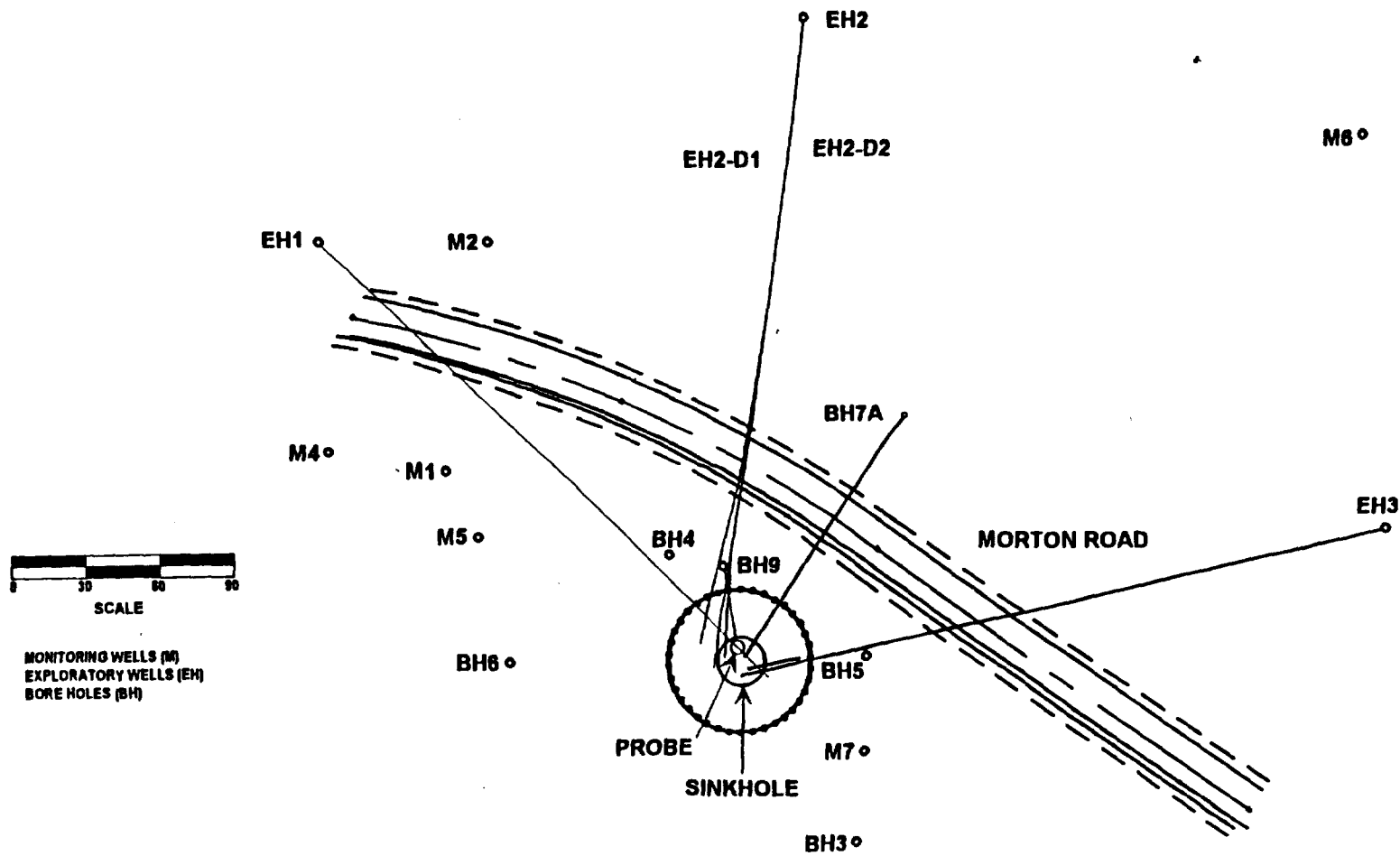
ACRES SANDIA NATIONAL LABORATORIES
WEEKS ISLAND SPR SITE

PLAN OF UNDERGROUND WORKINGS

ACRES INTERNATIONAL CORPORATION
T. R. MAGORIAN

FIGURE 2.3

WEEKS ISLAND SITE PLAN VIEW OF SINK HOLE AREA SHOWING 60 FOOT DIAMETER CONCEPTUAL FREEZE WALL



BRINE INFLOW - 20 DAY AVERAGE Weeks Island Fill Hole Sump

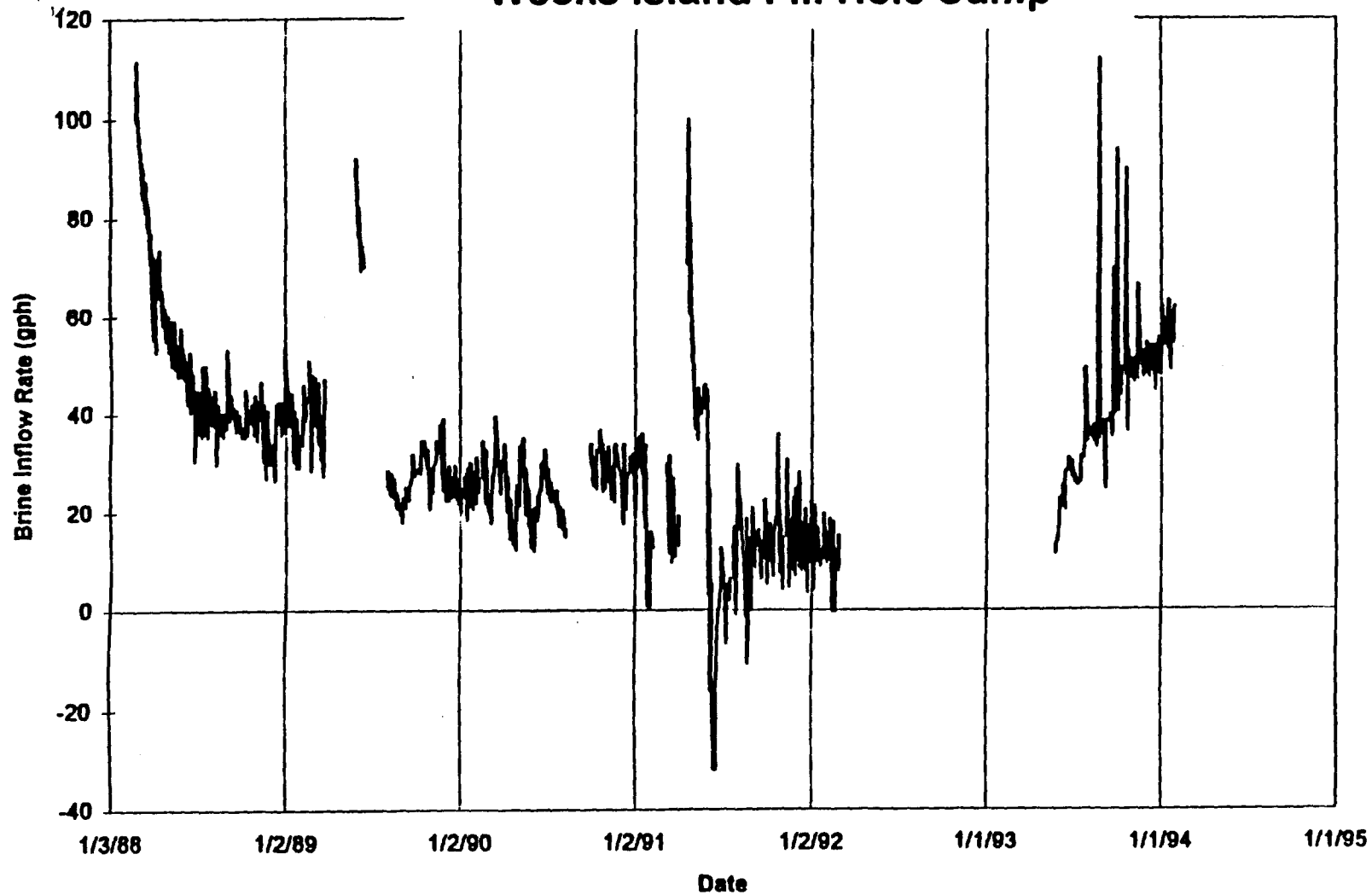
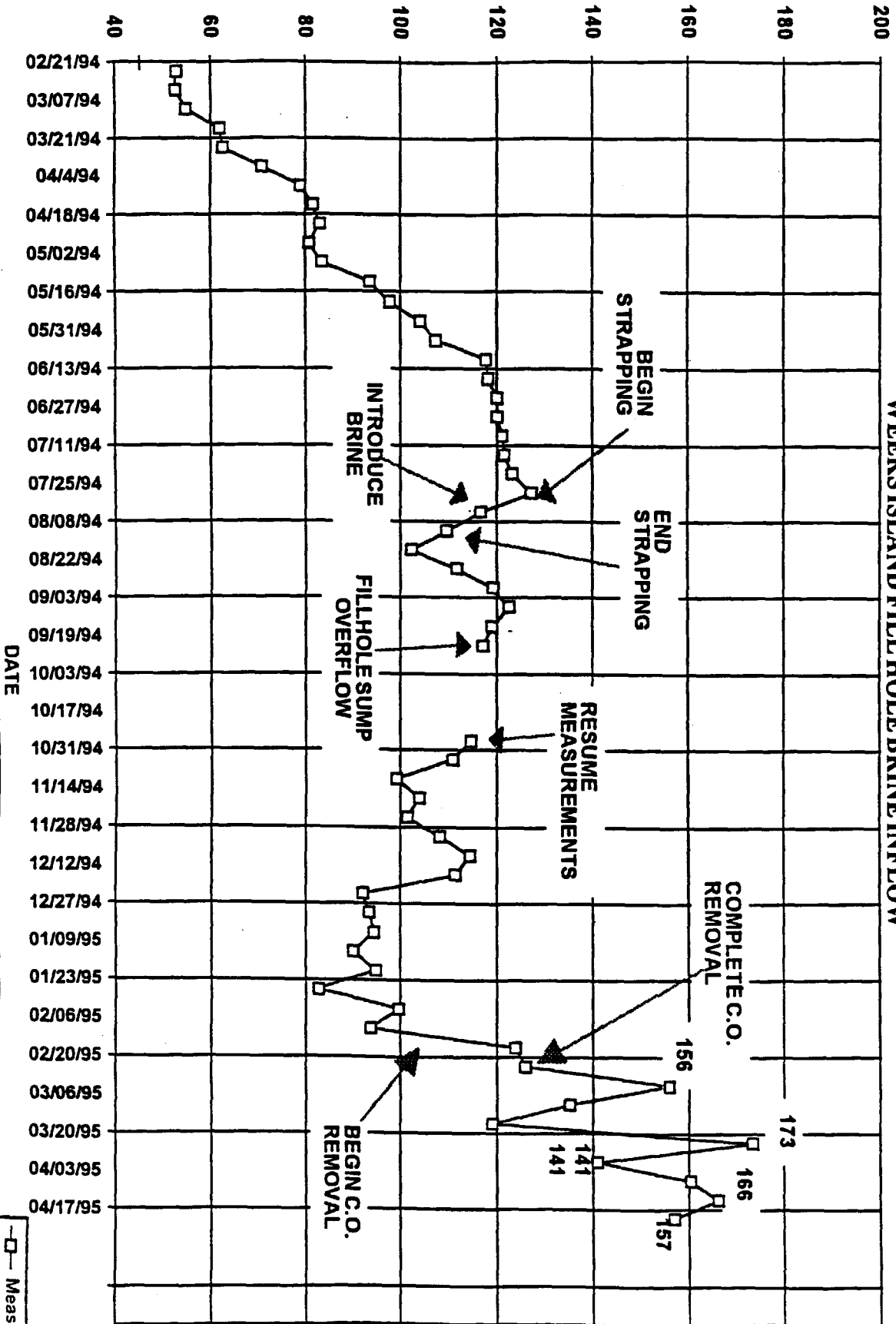


Figure A.6 Adjusted Fillhole Brine Inflow

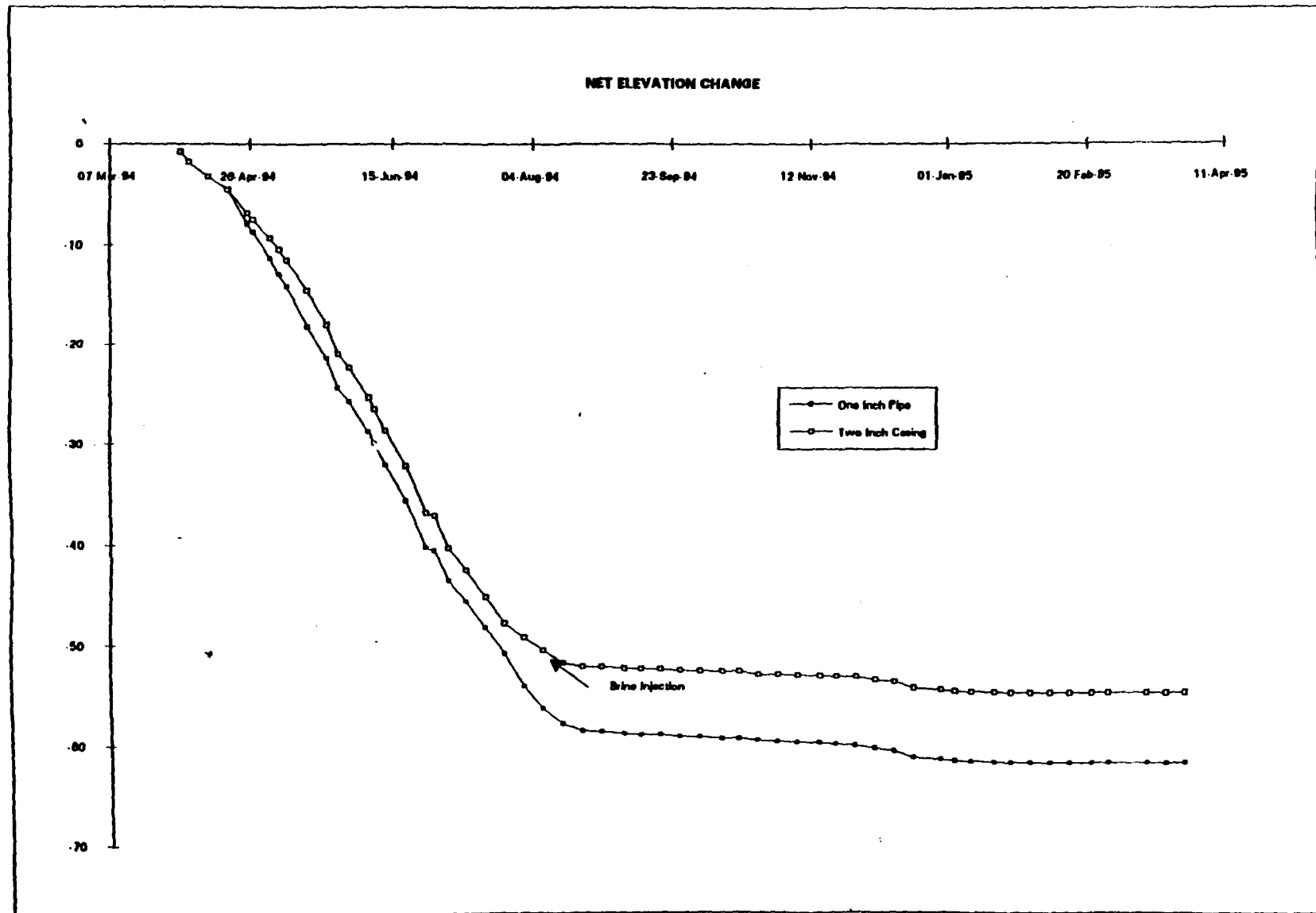
BRINE INFLOW RATE (GPH)

WEEKS ISLAND FILL HOLE BRINE INFLOW

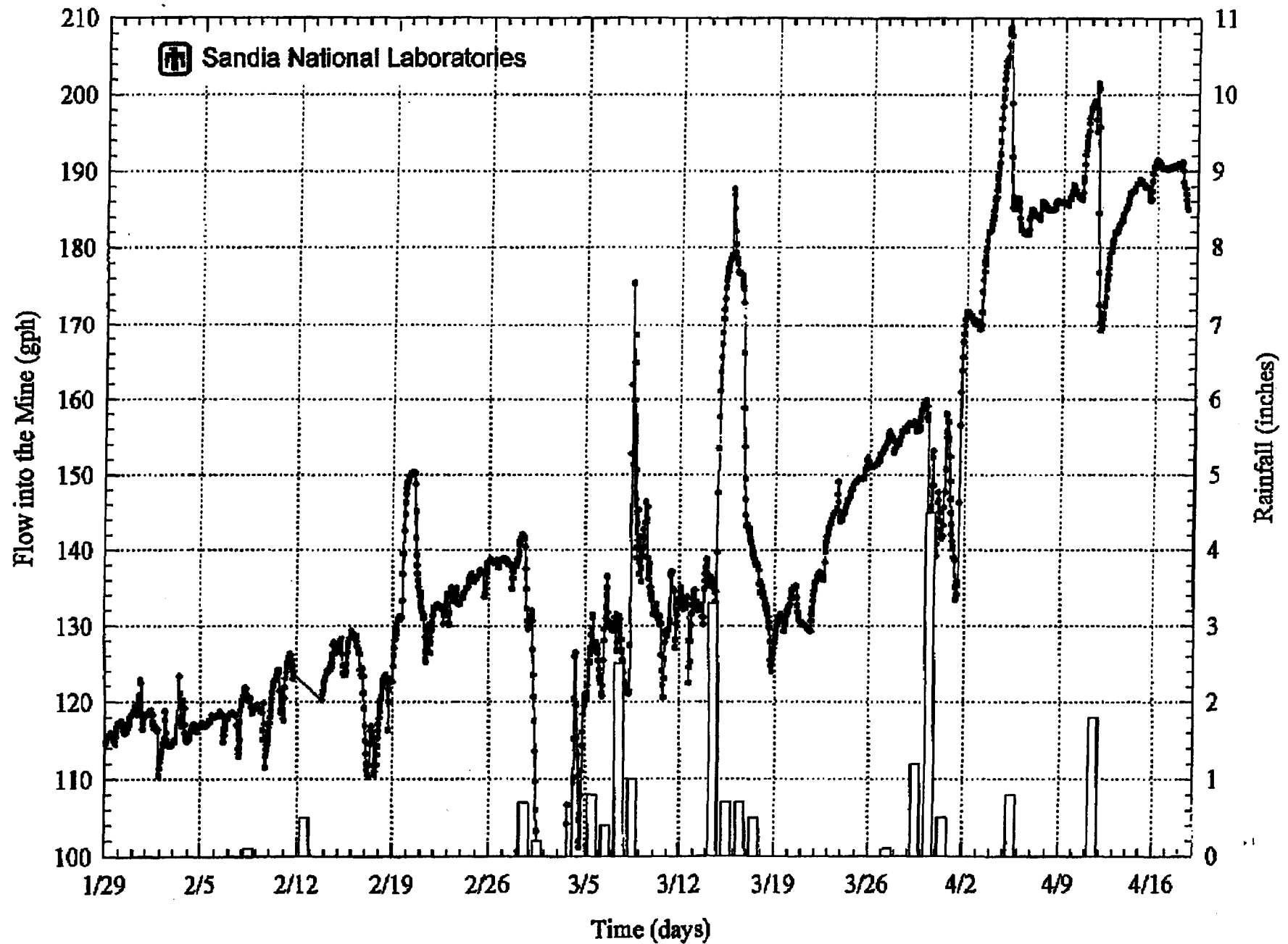


Measured

NET ELEVATION CHANGE



In Situ Permeable Flow Sensor - Weeks Island Sinkhole Site (BH9)



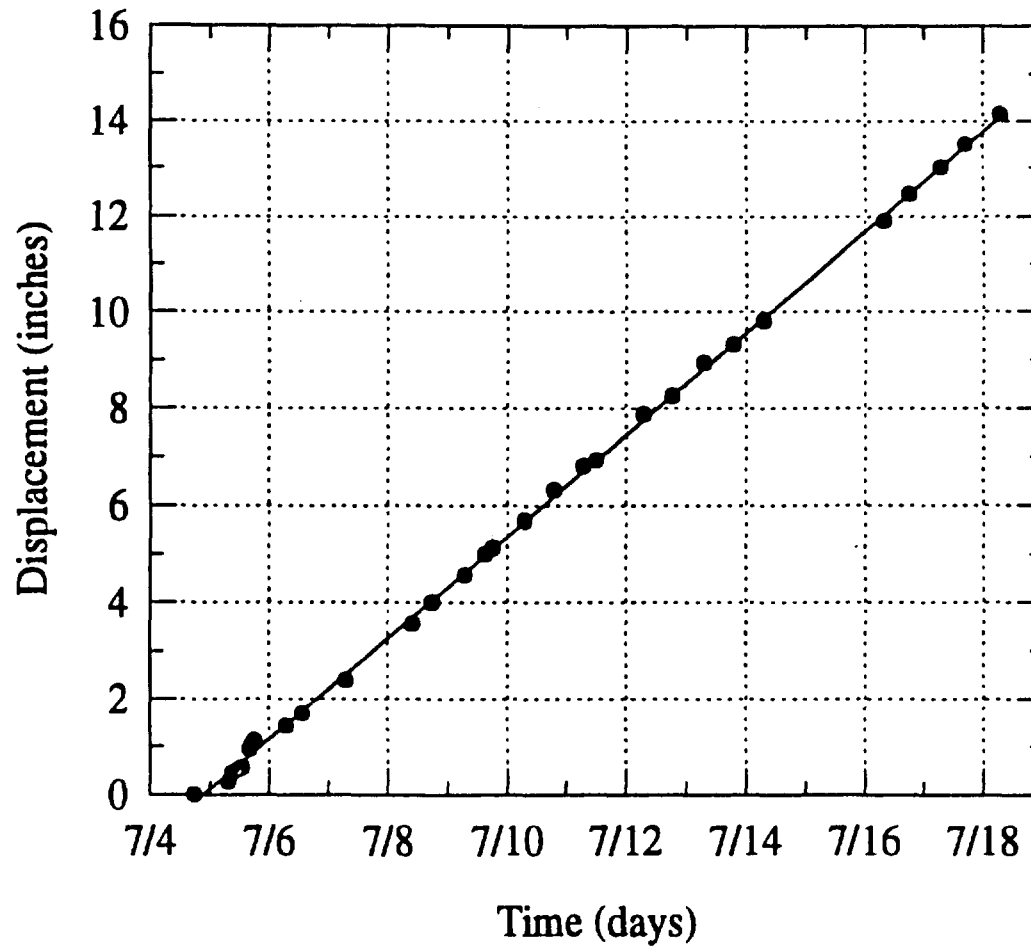


Figure 5 - Tool displacement downhole. Symbols are measured values and the line is a linear least squares fit to the data. The tool was moving downhole at a rate of 1.05 inches/day.

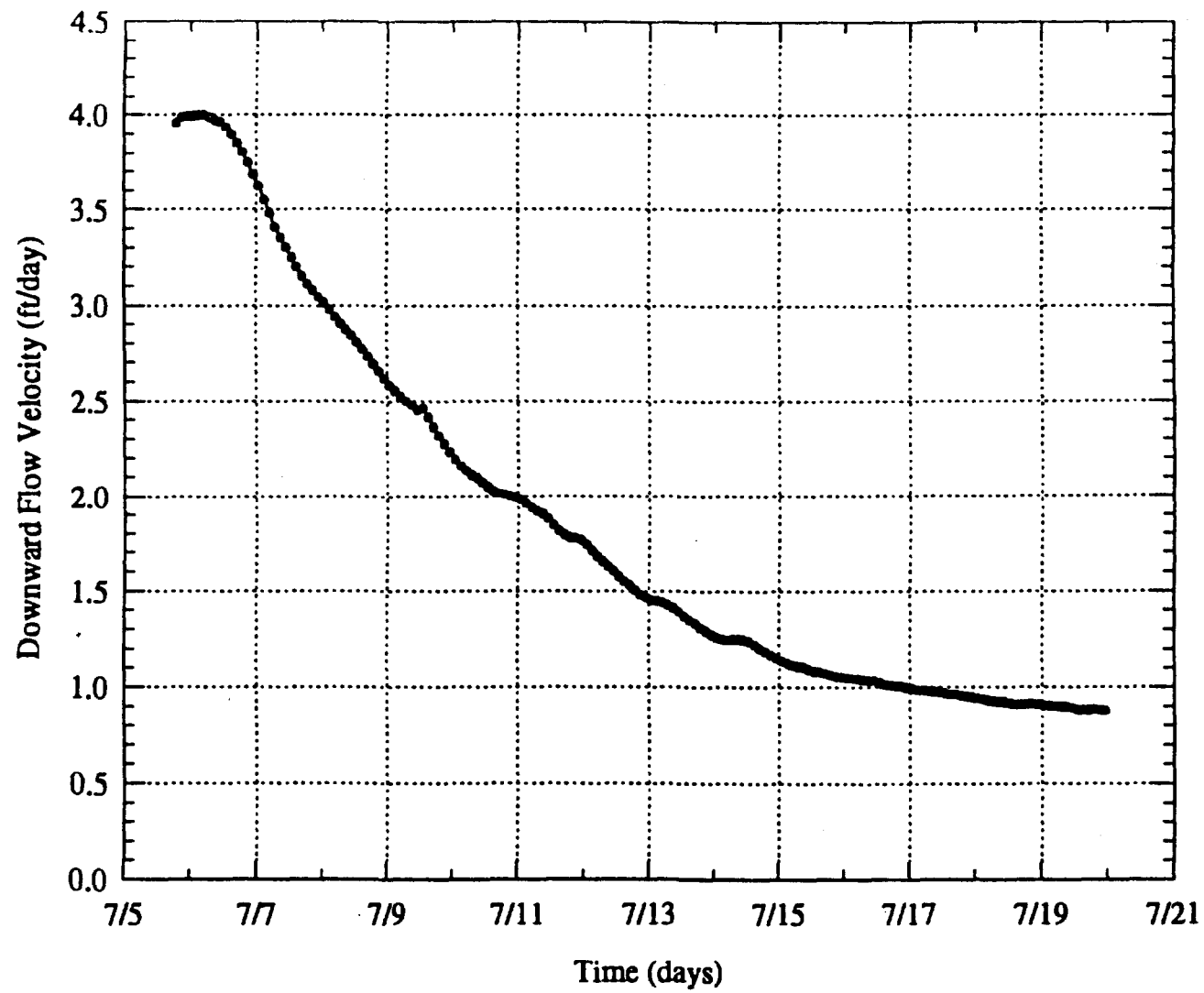
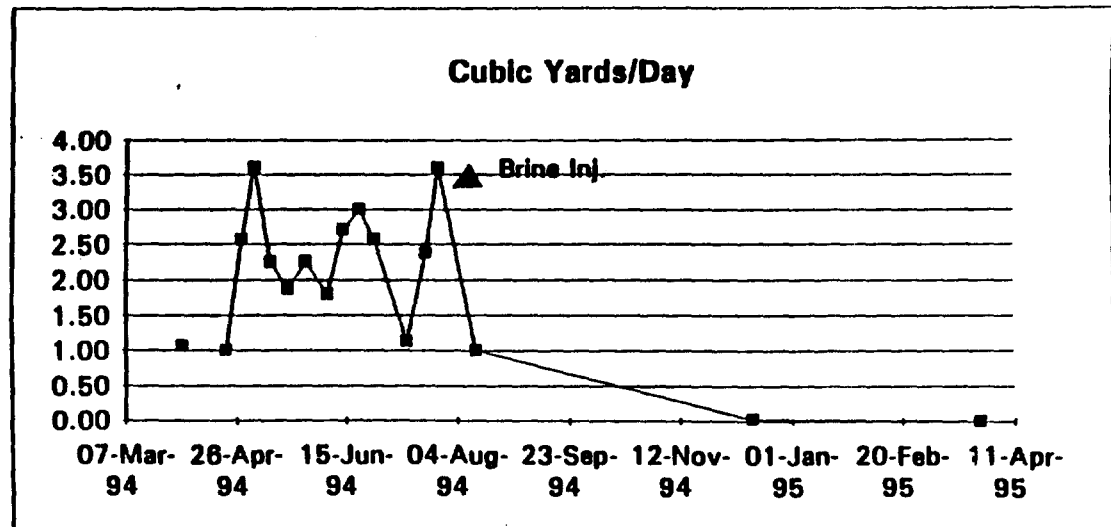
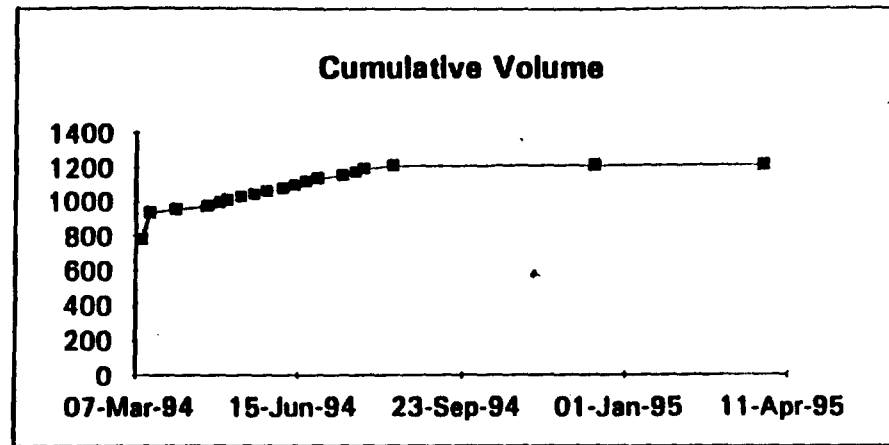
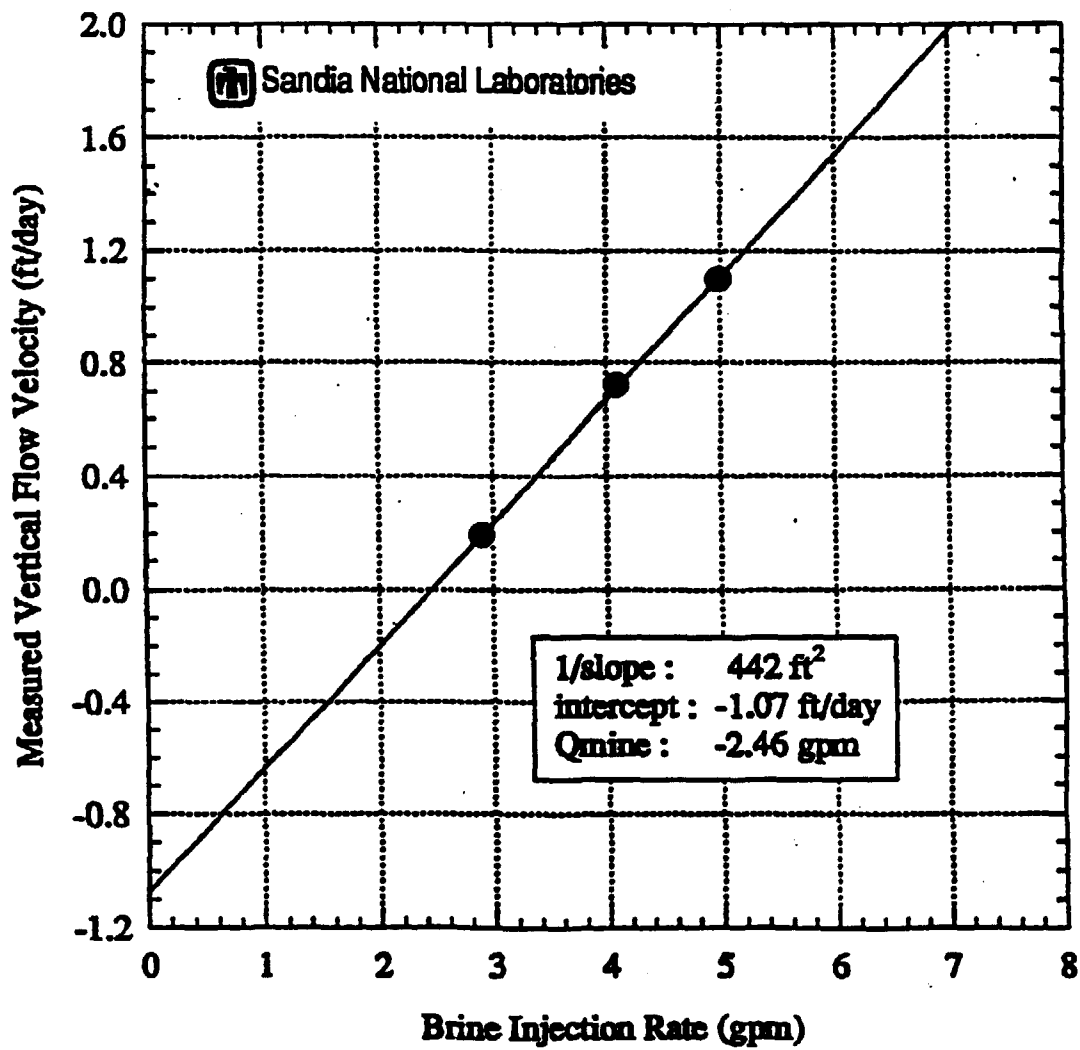


Figure 4 - Magnitude of the downwardly directed vertical flow velocity as a function of time.

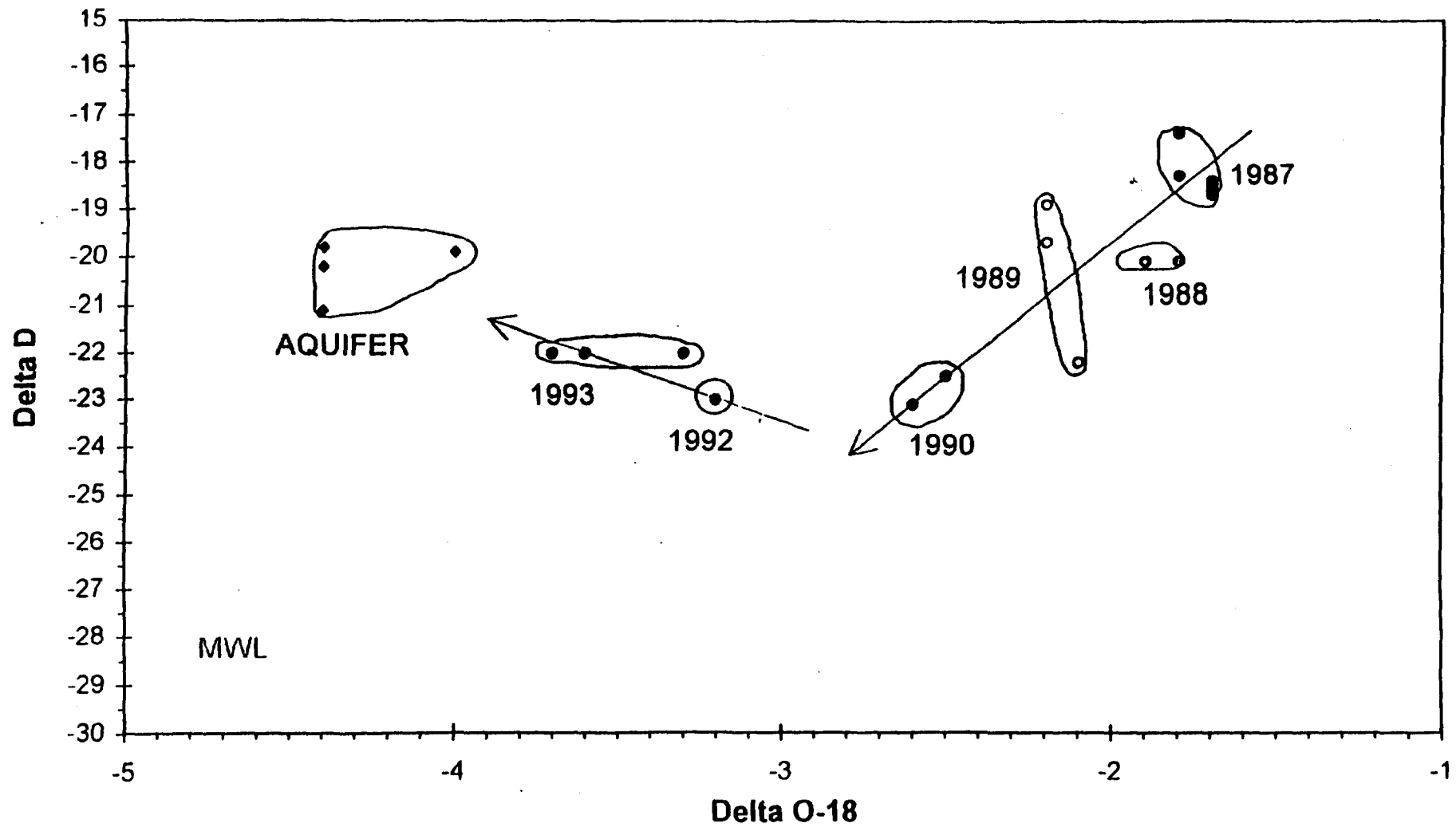
**SINK HOLE MONUMENT
VOLUME of FILL**

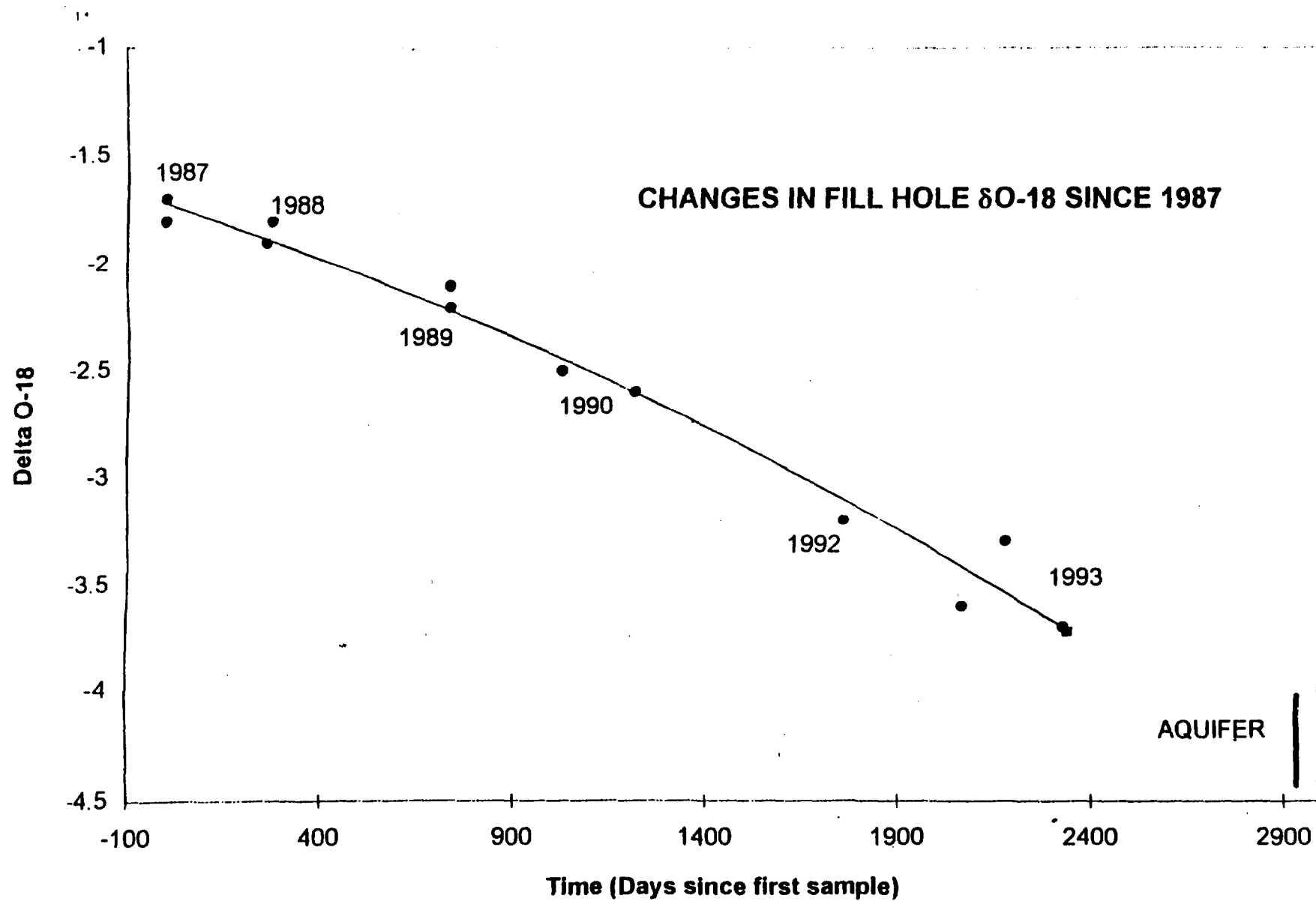
DATE	Cubic Yards	Total	Yd./Day
11-Mar-94	778	778	
16-Mar-94	157	935	
01-Apr-94	19	954	11.06
20-Apr-94	16	970	
21-Apr-94	4	974	1.00
28-Apr-94	18	992	2.57
03-May-94	18	1010	3.60
11-May-94	18	1028	2.25
19-May-94	15	1043	1.88
27-May-94	18	1061	2.25
06-Jun-94	18	1079	1.80
13-Jun-94	19	1098	2.71
20-Jun-94	21	1119	3.00
27-Jun-94	18	1137	2.57
12-Jul-94	17	1154	1.13
20-Jul-94	19	1173	2.38
25-Jul-94	18	1191	3.60
12-Aug-94	18	1209	1.00
14-Dec-94	3	1212	0.02
27-Mar-95	0	1212	0.00

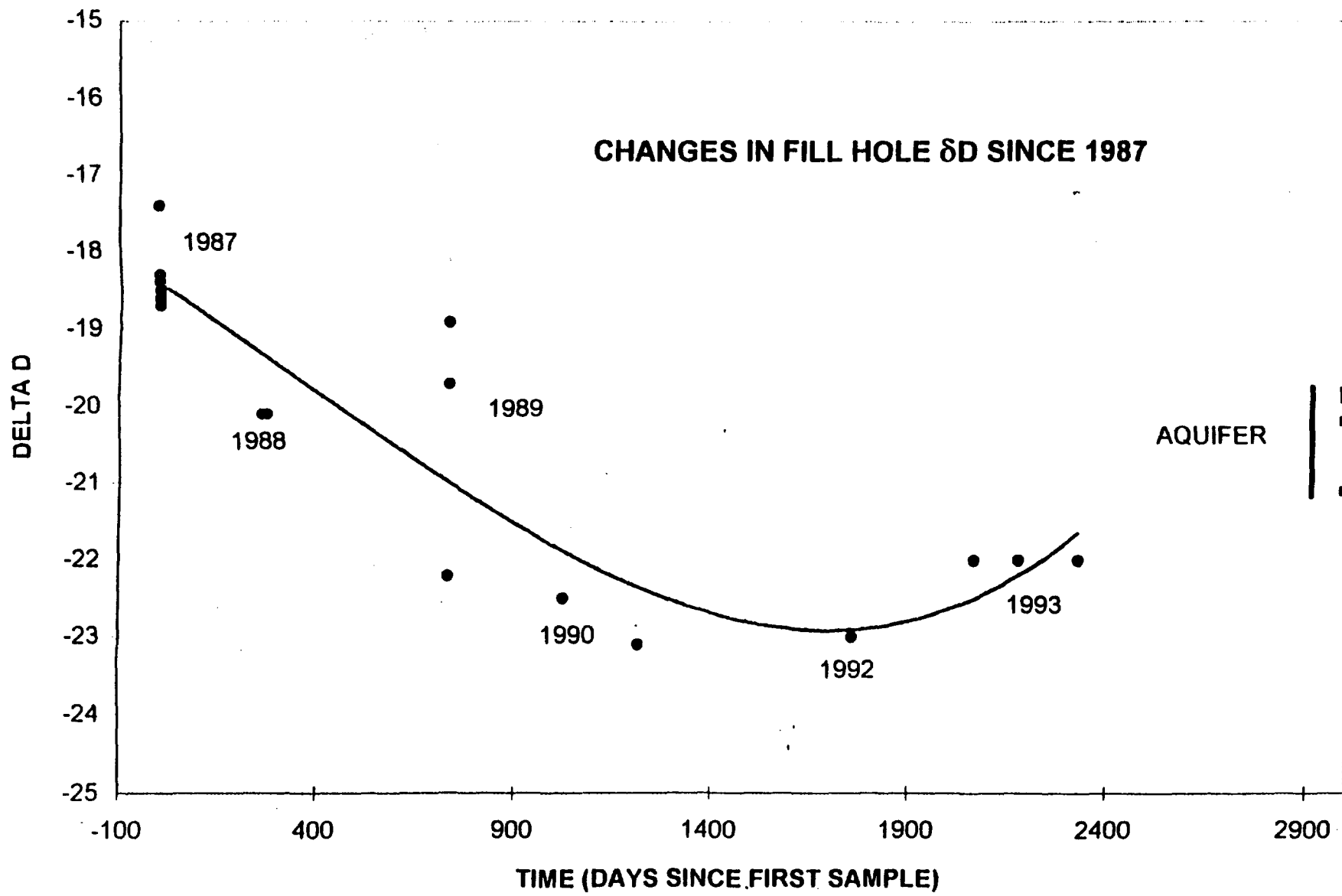




ISOTOPIC EVOLUTION OF BRINE IN FILL HOLES, 1987-1993







Weeks Island Sinkhole BH7a (slanthole)

This hole was initiated to intersect the presumed dissolution feature at top of salt directly below the sinkhole. A 45° inclination was initially desired, but a 61° (29° from vertical) was started for practical reasons involving equipment. The final inclination upon completion was ~68° (22° from vertical). Grab samples were taken by bucket wash, allowing time for settling, rather than screening. Thus samples are only partly representative of in situ sediments.

Coordinates: X: 1,849,906.59; Y: 414,184.70; Elevation: 89.0 msl

Drillsite Geologists: Vogt, Neal, Ehgartner

27, 28 June 94

<u>Footage (slant)</u>	<u>Core / Sample Description</u>	<u>Remarks</u>
41 - 51	sand, fine to medium	10 YR 6/6 (brownish yellow)
51 - 61	" " "	
61 - 131	sand, medium to coarse (coarser than above)	10YR 6/4 (light yellowish brown)
131 - 133.5	sand, medium-fine (finer than above)	
135	per 61 - 131	
135 - 145	no samples	
145 - 165	sand; finer, per 131	
165 - 175	clayey silt (distinctly different facies)	10 YR 3/4 (dark brown)
175 - 195	sand, medium	10YR 5/3 (brown)
195 - 205	sand, medium, with minor wood fragments	10YR 6/4 light yellowish brown)
205 - 215	sand, medium, uniform. <i>Very closely resembles sand in BH9 at 189 ft, but is slightly grayer.</i> (see photos)	10YR 5/2 (grayish brown)
215 - 275	SALT; crystalline, 1-1.5 cm grain size; general absence of any structural features or textural variation, although hint of vertical grain elongation exists occasionally. Core generally crumbly and not suitable for testing. @ 225-235 somewhat more "unconsolidated" @ 235-245 somewhat milky; from 245-255 salt crumbly, only 245-248 intact. From 265-275 clean, clear, salt. @275 + 4" circulation lost and pipe fell 3-4 ft.	essentially continuous core Vertical Depth = 192' (top salt)
275.5	Salt, <i>prior to entering dissolution void</i> (4" piece) <i>filled with sediment.</i> Salt piece shows evidence of erosion.	Vertical Depth = 250'
275 - 280	mud, sludge, sand (mixed with attapulgitite drilling fluid)	
280	sand, medium, stained with limonite; disturbed: (very small sample at bottom stuck on above drilling mud and sediment). <i>This more resembles "formation material" in BH6 than bottom material from BH9 @189 ft)</i>	10YR 5/4 (yellowish brown)

The directional survey on this slanthole shows the bottom to be approximately ~114.5 feet horizontal distance from the wellbore initiation, or ~9.5 feet from the sinkhole centerline. The additional extension downward added another 5.2 ft horizontally, or approximately 4.5 ft from the sinkhole center.

Static Water Level = +1 ft msl, from neutron log, 30 June 94

Rhodamine WT dye (50 lbs in 1000 gallons of brine) was introduced into this hole on July 2, 1994, at an approximate inflow rate of 5 gal/min. This supplements the earlier introduction of 100 lbs in 2000 gallons of brine into BH-9 at -175 ft TVD.

Hydrologic flow measurements were initiated on 3 Jul 94 with the implantation of the Sandia 3-D directional flowmeter by Sanford Ballard. Sensor depth is -287 ft (slant depth), essentially within the apparent dissolution crevasse, determined by this hole to be at least 72-73 feet deep below the top of salt.

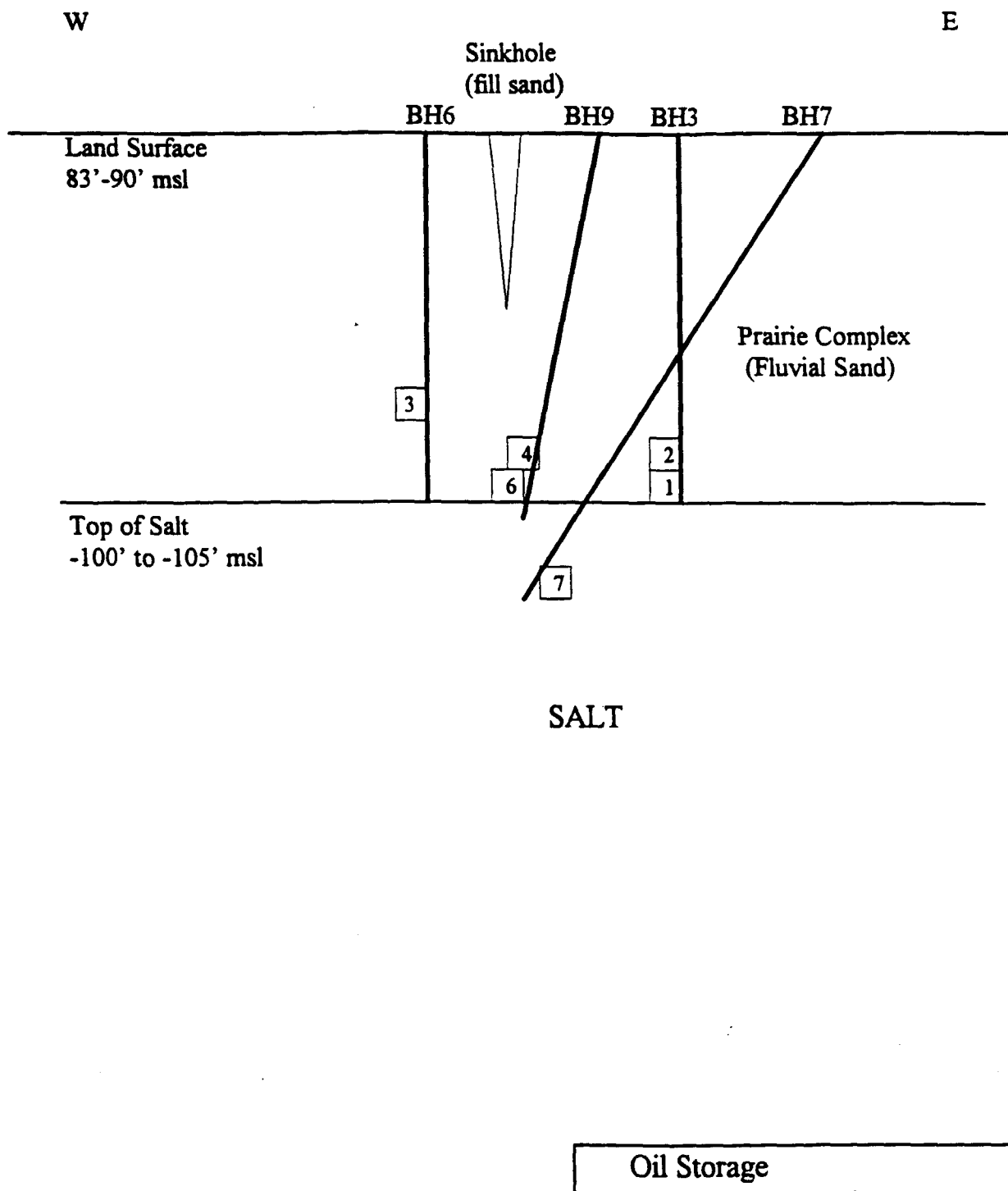


Figure 1. Schematic cross-section showing the locations of the bore holes and samples from Weeks Island.

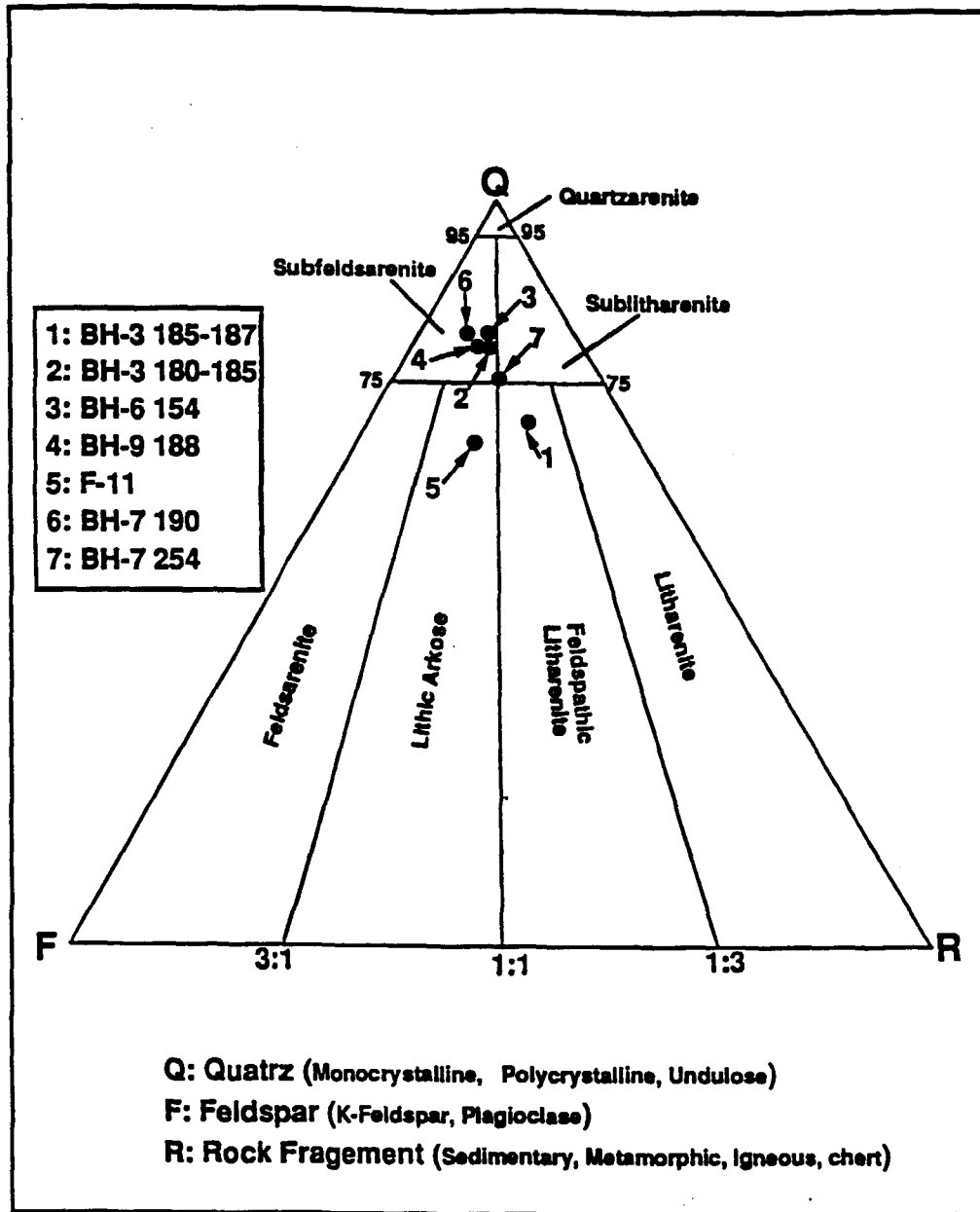
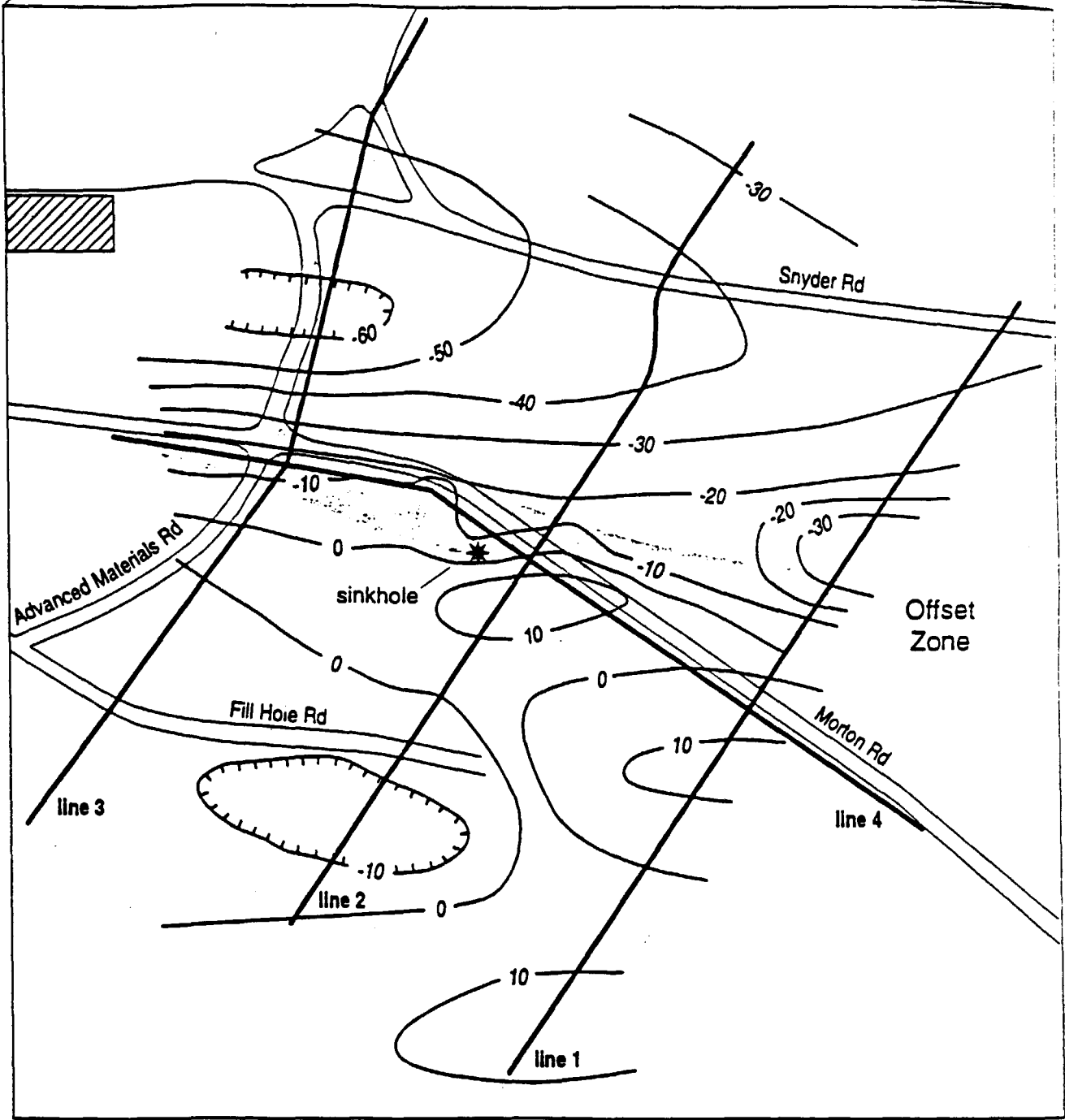


Figure 2. Triangular QFL plot showing mineralogical compositions of sand fractions of samples from the Week Island according to sandstone classification of Folk (1968). Note that Sample 6 (BH7-254) which was recovered in the salt shows a composition between the two end members. Q= the sum of monocrystalline, polycrystalline, and undulose quarts; F= the sum of potassium and plagioclase feldspars; L= the sum of sedimentary, igneous, and metamorphic rock fragments.

CONCLUSIONS

1. The Anhydrite Sand is characterized by predominance of coarse sand grain sizes, high percentage of rounded grains, high amount of chert and sedimentary rock fragments.
2. The Prairie Sand is distinguished by predominance of medium sand grain sizes, low percentage of well rounded grains, and high amount of feldspars.
3. The sand from the sinkhole above the Anhydrite Sand are texturally and compositionally similar to the Prairie Sand, and therefore derived from this sand.
4. The sand from the sinkhole within the salt shows textural and compositional features intermediate between the Anhydrite and Prairie sand and therefore derived from both sand layers.
5. The Fill Sand is compositionally different from the Anhydrite and Prairie sands. Compositionally analyses indicate that the Fill Sand has not yet reached the salt.
6. Compositional and textural analyses of the sands have been useful in characterizing sand bodies and provided information regarding geologic processes in the study area.



— 10 — contours of shallowest reflection

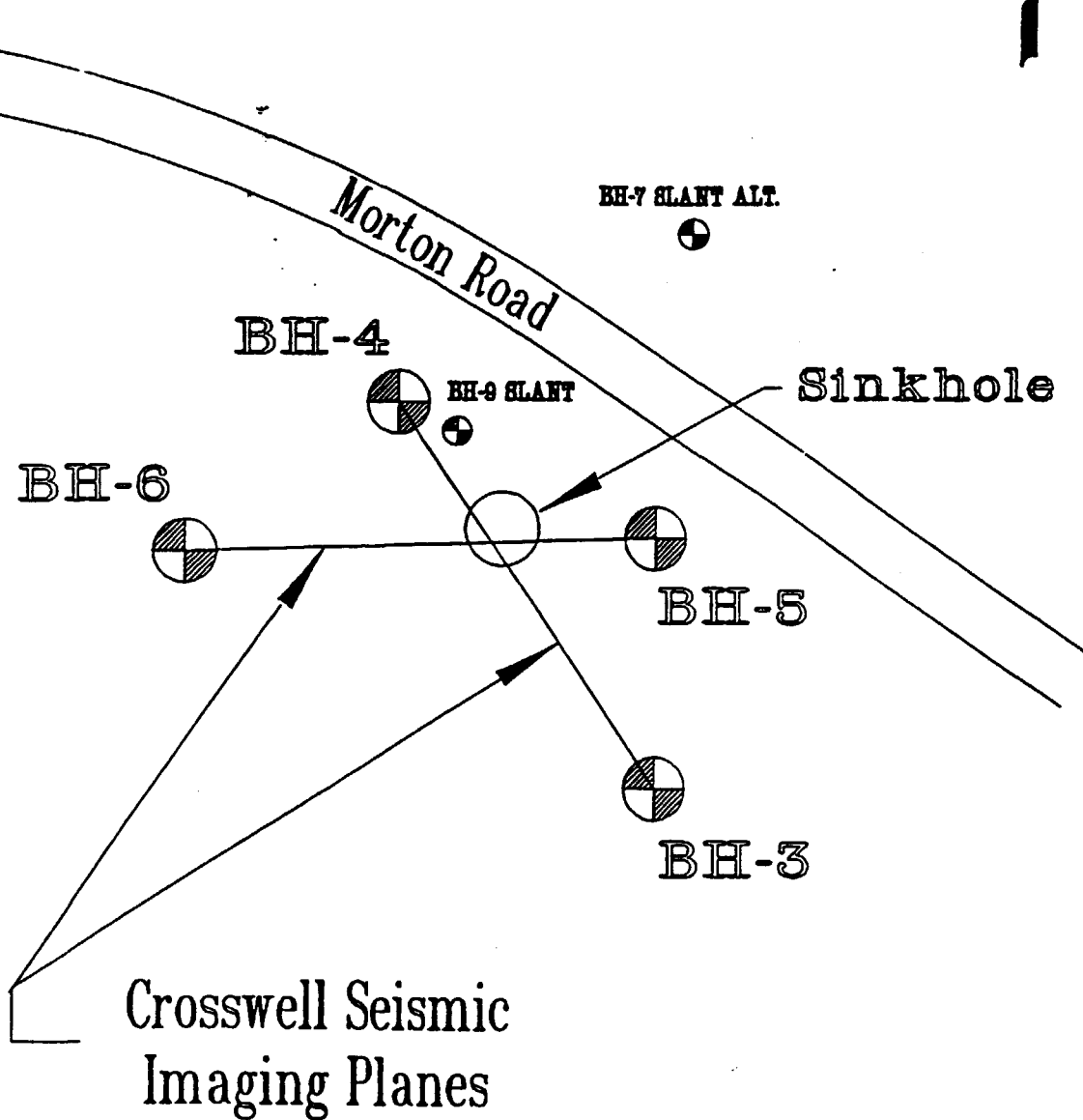
 offset zone (lineament)

 DOE main building

0 200 ft

Figure 10. Linear projection of apparent offset and wavelet change on seismic lines 1, 2, 3, and 4. The lineament intersects the sinkhole and the steep sided ditch on line 1. Based on projections from mine maps, the lineament is consistent with the mine face of both the upper and lower cavities. Control points for the shallowest reflection contours are directly extracted from seismic sections 6F through 9F.

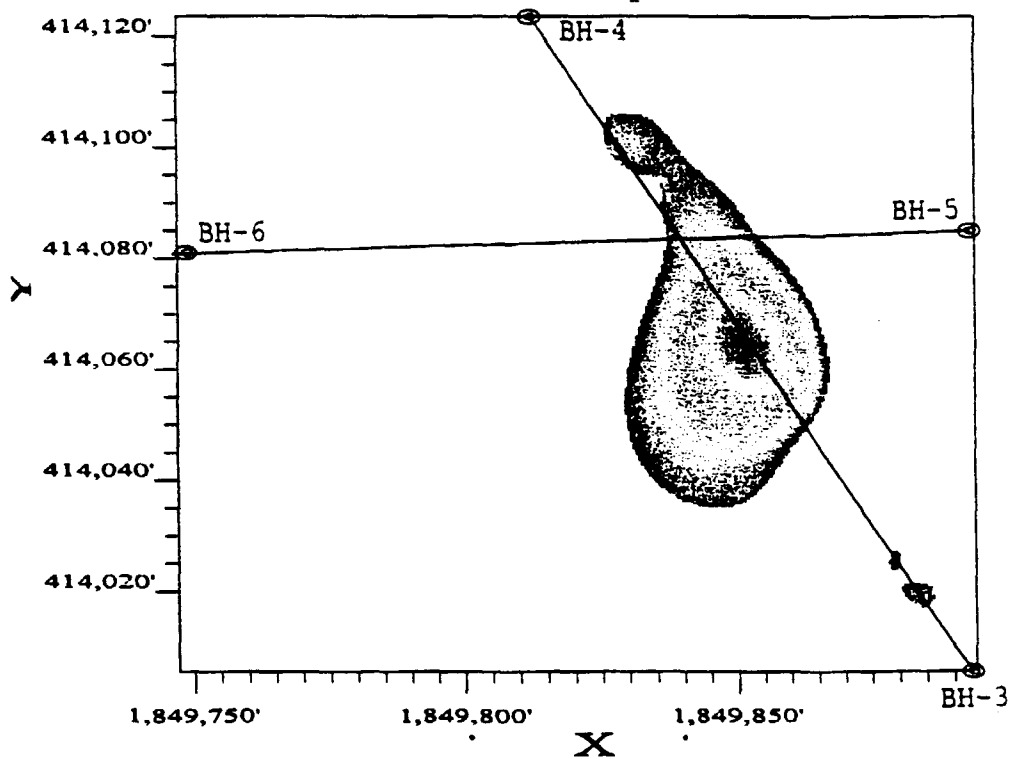
Sandia National Laboratories
Weeks Island Sinkhole Crosswell Seismic Survey
July 1994



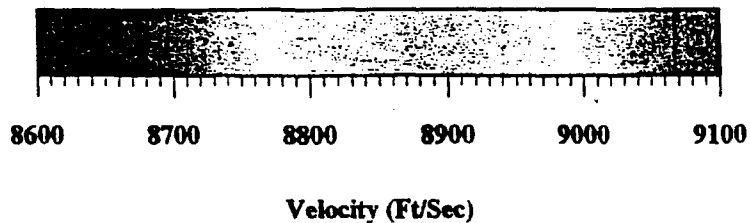
RGK-RSH

Weeks Island Sinkhole Site

Map View of Low Velocity Anomaly
At 195 Ft Depth

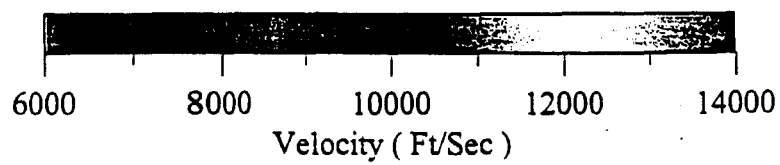
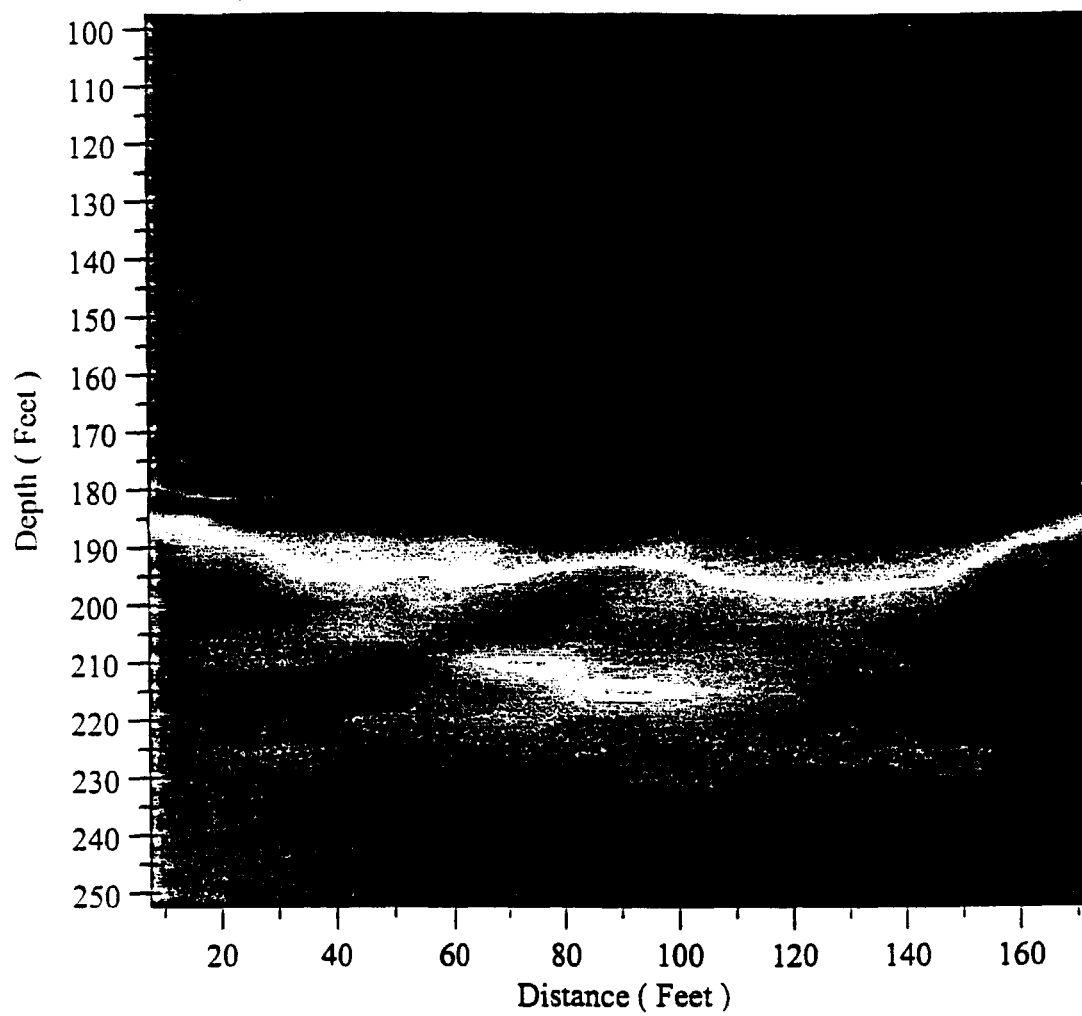


All coordinates are shown in Louisiana State Plane
Coordinate System, South Zone (NAD 27)



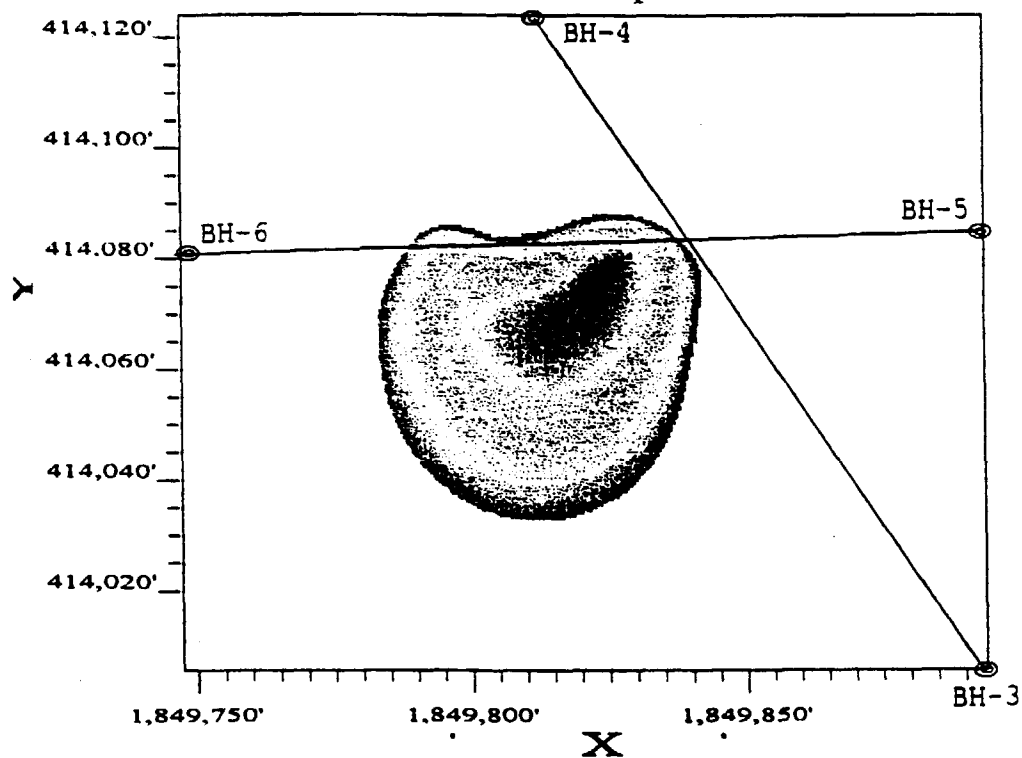
BH-5

BH-6

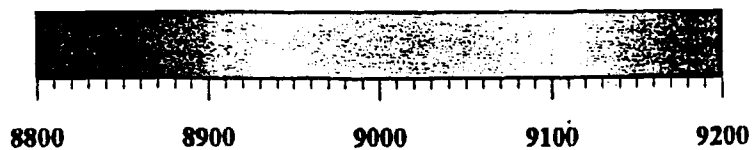


Weeks Island Sinkhole Site

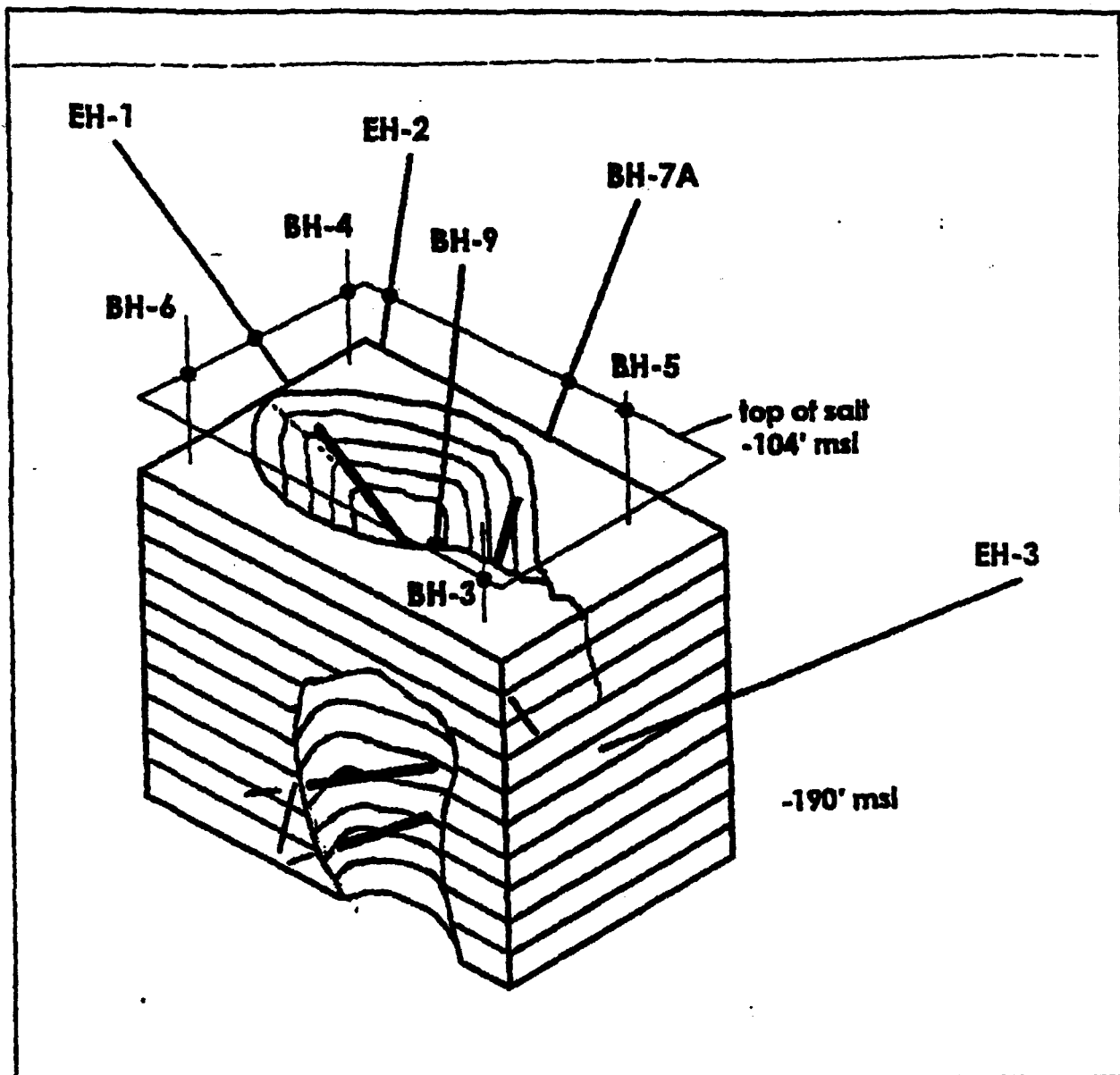
Map View of Low Velocity Anomaly
At 205 Ft Depth



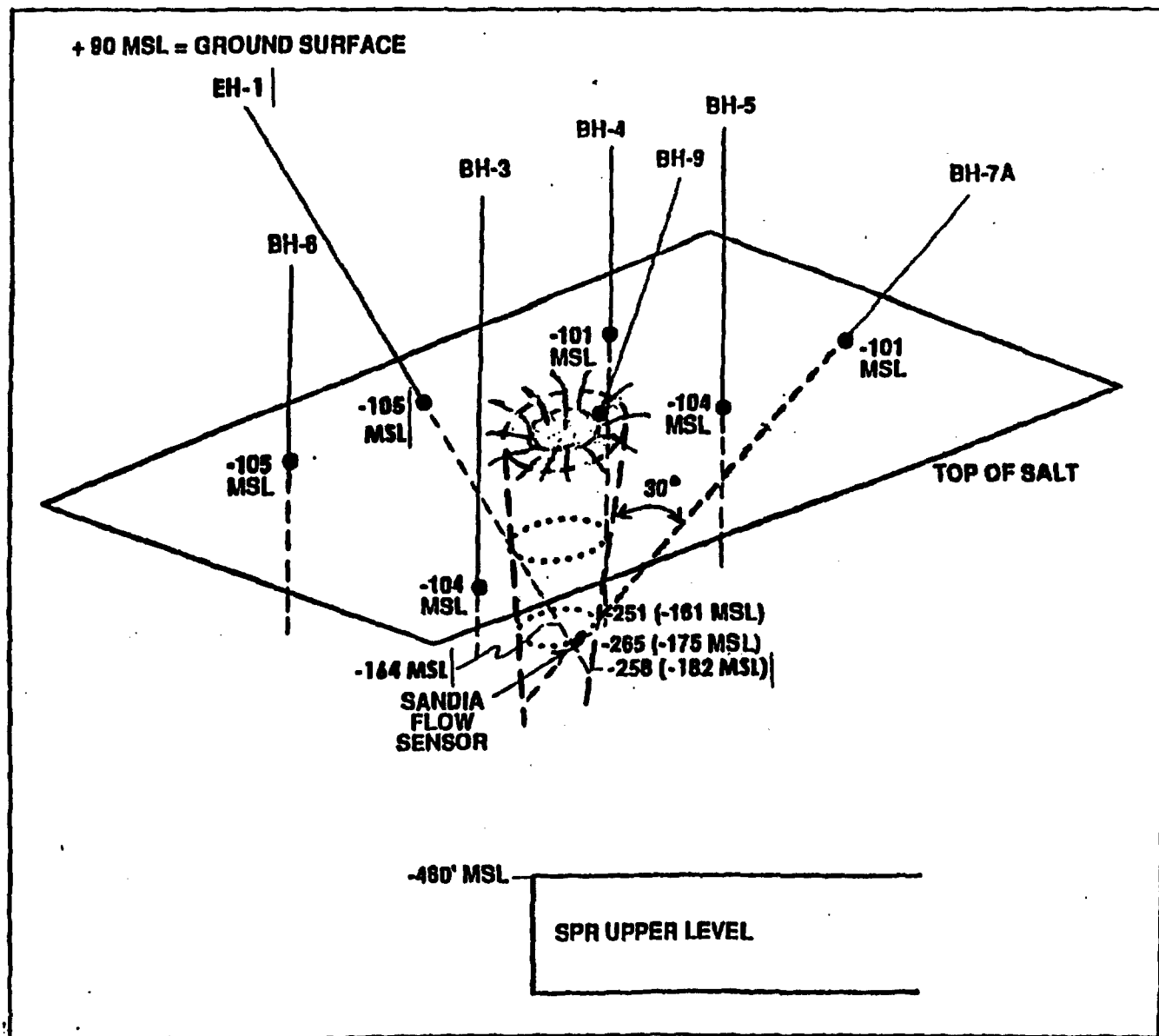
All coordinates are shown in Louisiana State Plane
Coordinate System, South Zone (NAD 27)



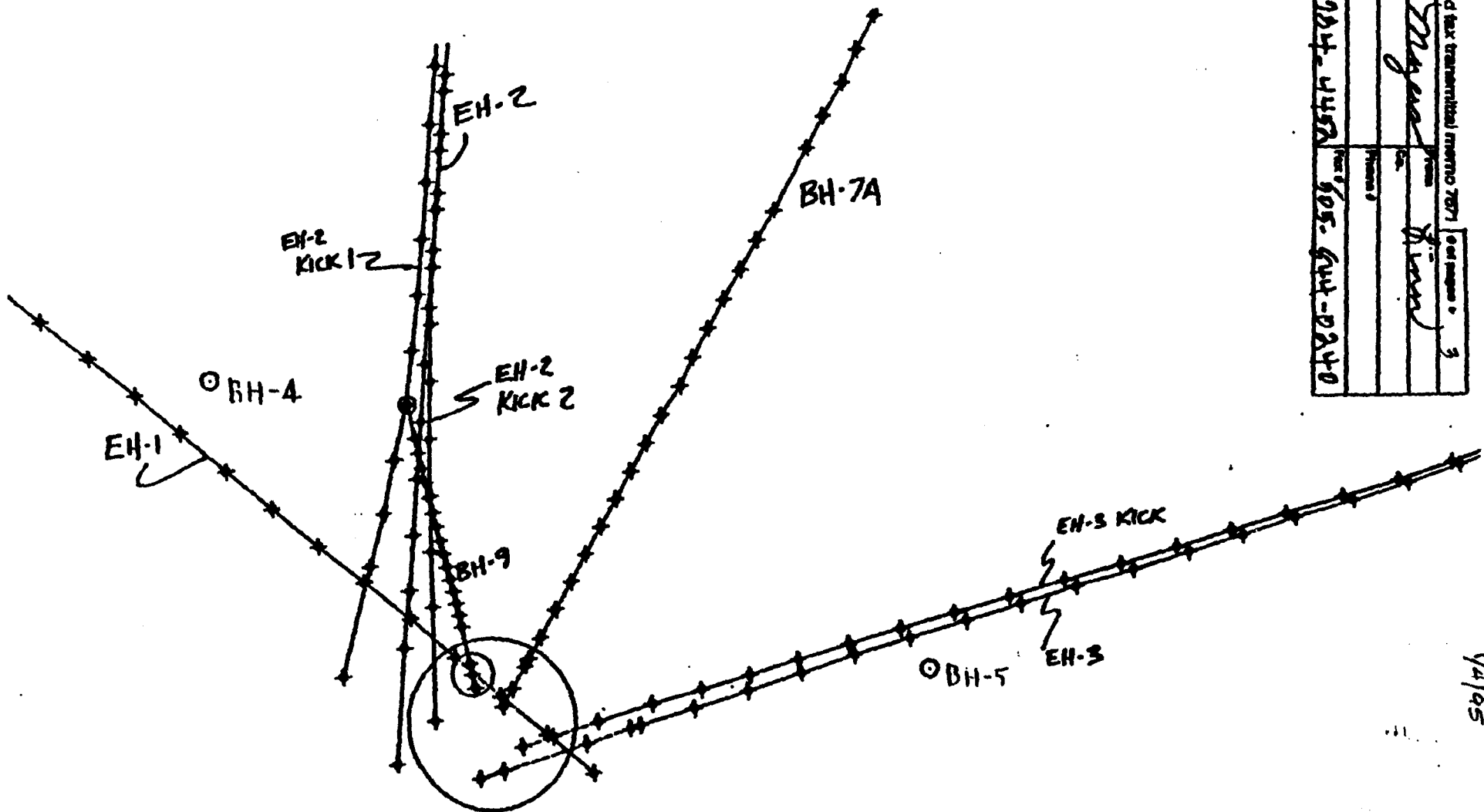
Velocity (Ft/Sec)



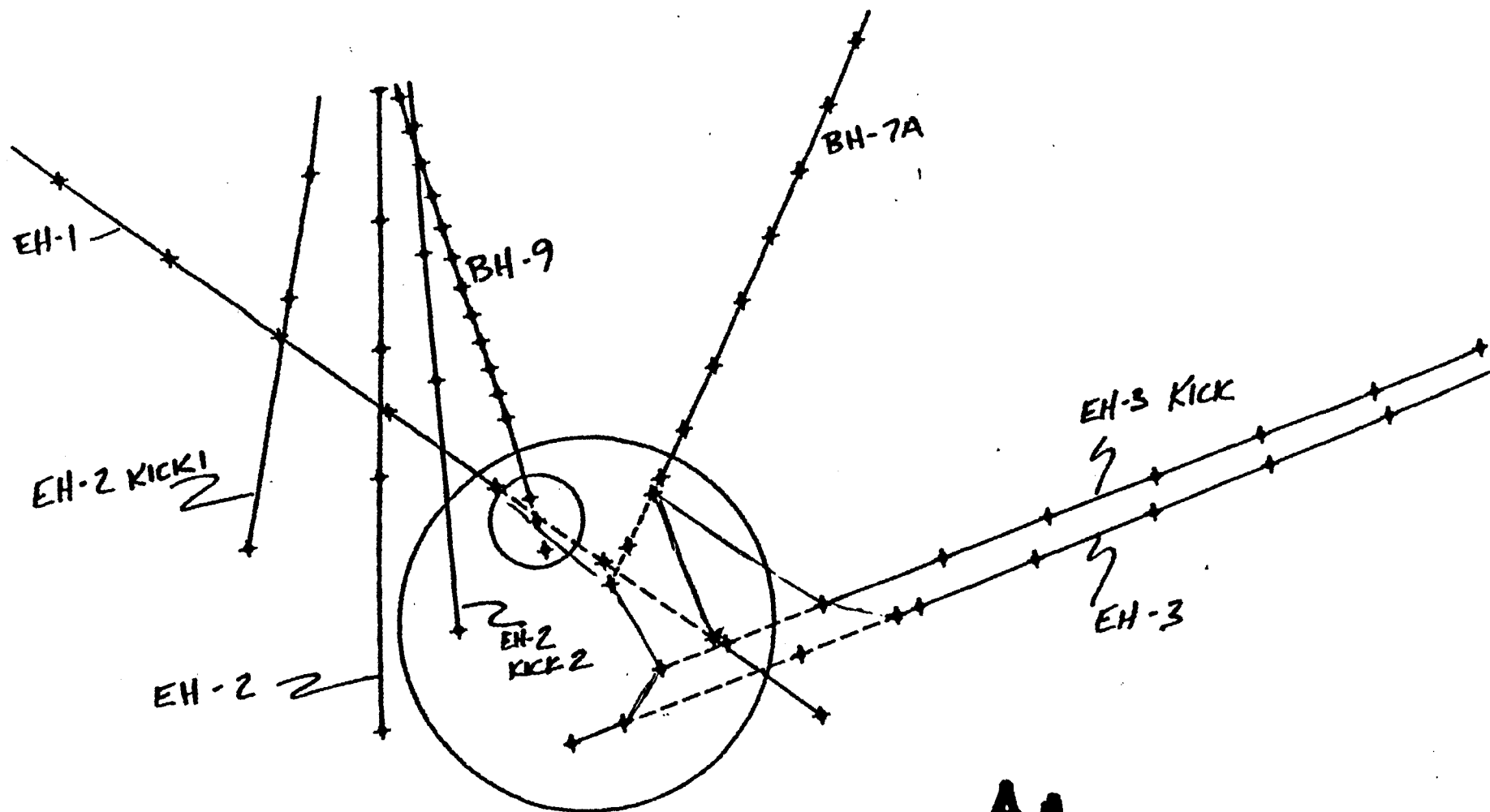
Diagrammatic representation of exploratory drilling and geometry of sinkhole throat. Boreholes BH-3, 4, 5, and 6 were drilled for crosswell seismic tomography; slantholes BH-7A and 9 were drilled for throat definition. EH-1, 2, and 3 further defined the throat and provided decisive information regarding grouting potential.



Project: Grand tax (transmission) memo 7071		of pages: 3
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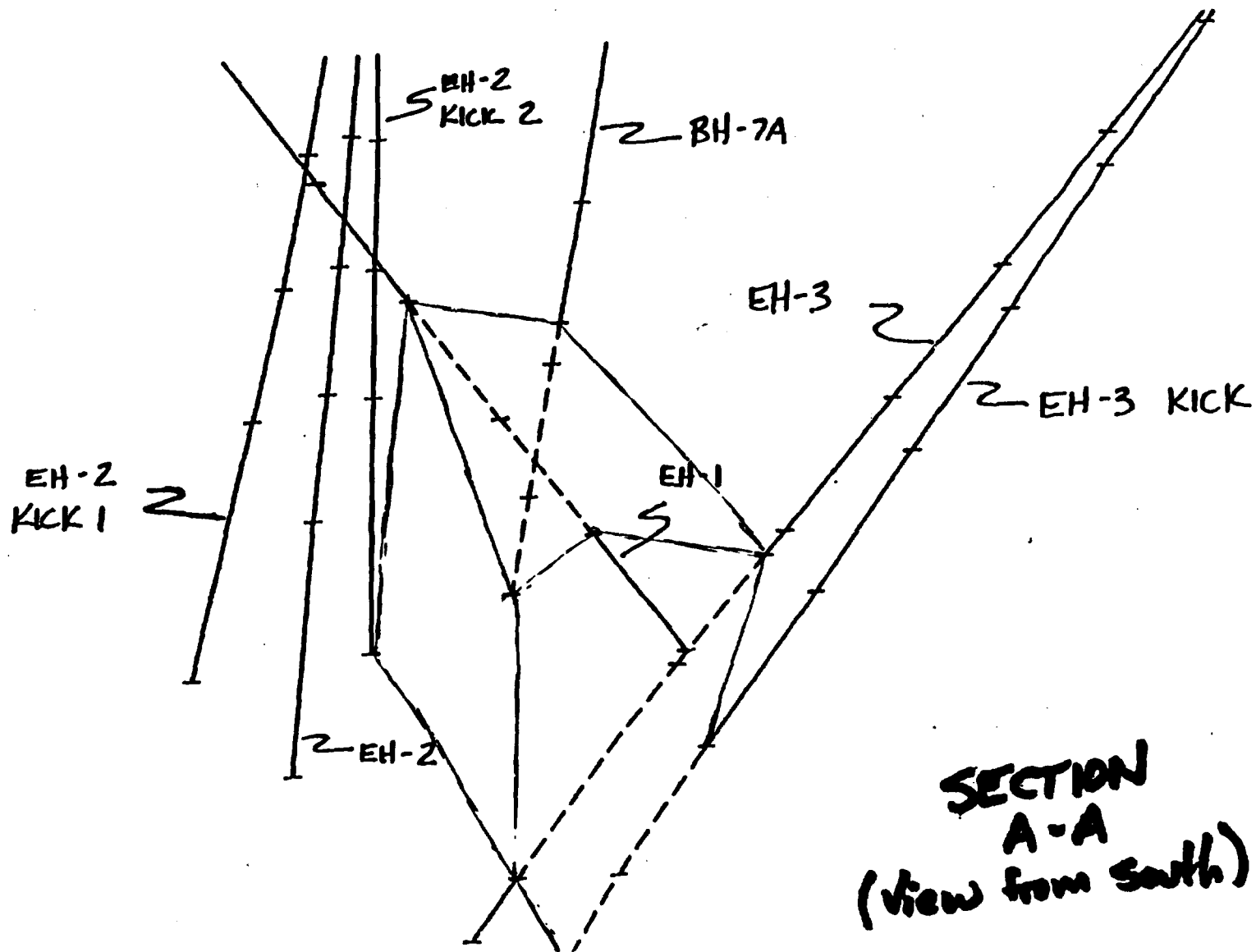
1/4/95



A ↑

20 diameter centered on sinkhole

↑ A



WEEKS ISLAND SPR SITE Near-Surface GAS-MAPPING SURVEY Transects:

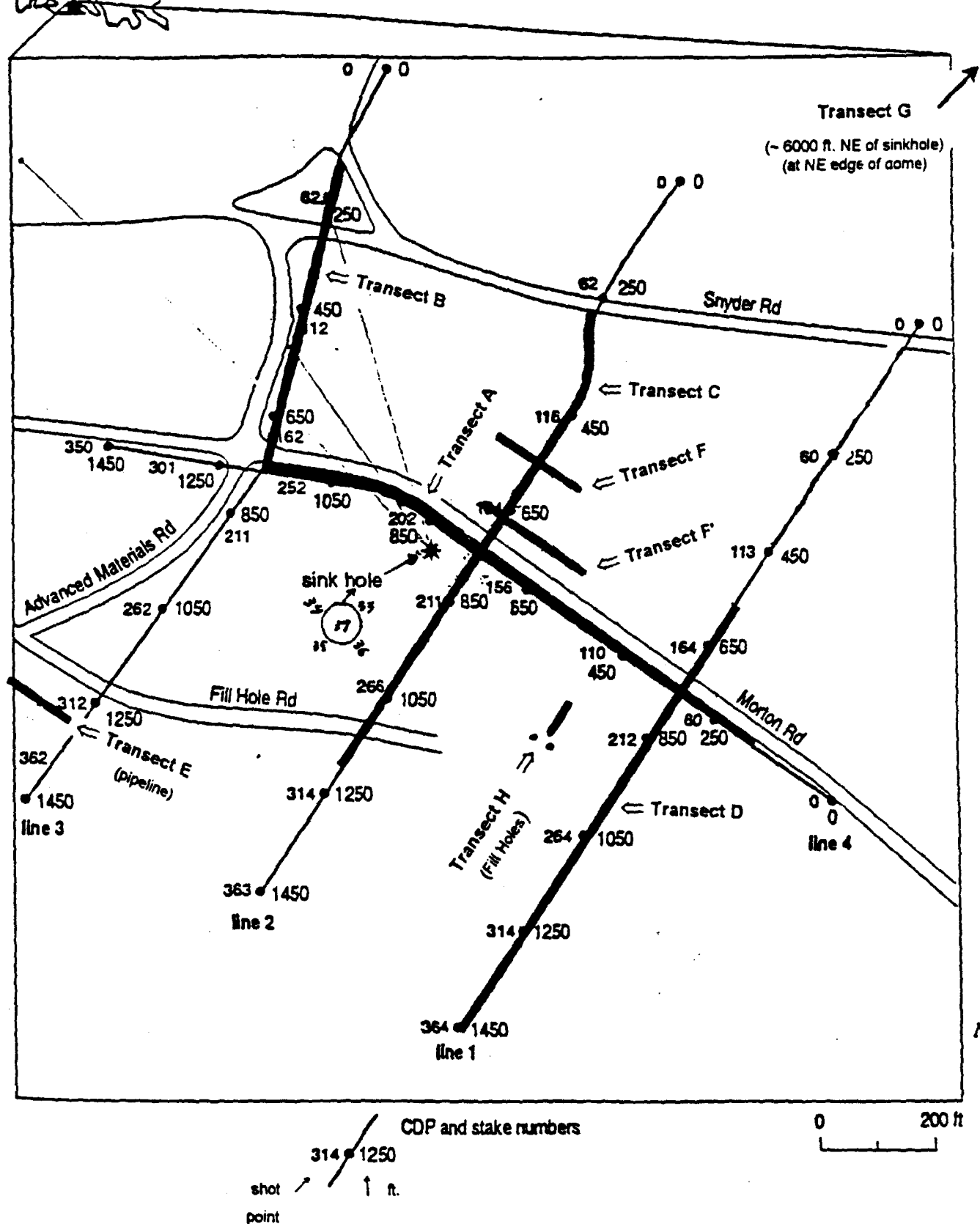
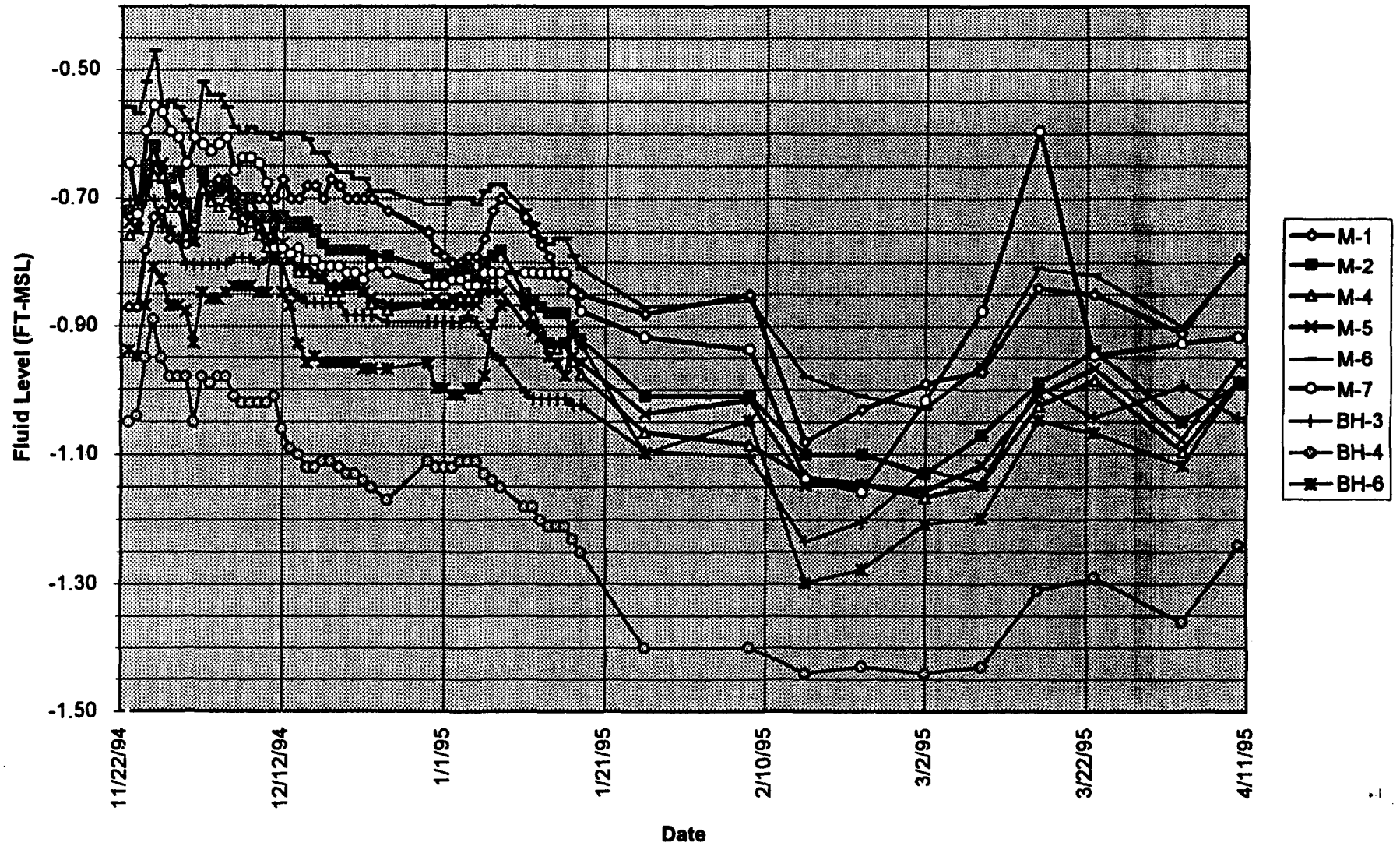


Figure 2. Site Map & Seismic Lines # 1-4

WEEKS ISLAND WELL WATER LEVELS



Drawdowns during Weeks Island Pumping Test at 13 hours from start of test

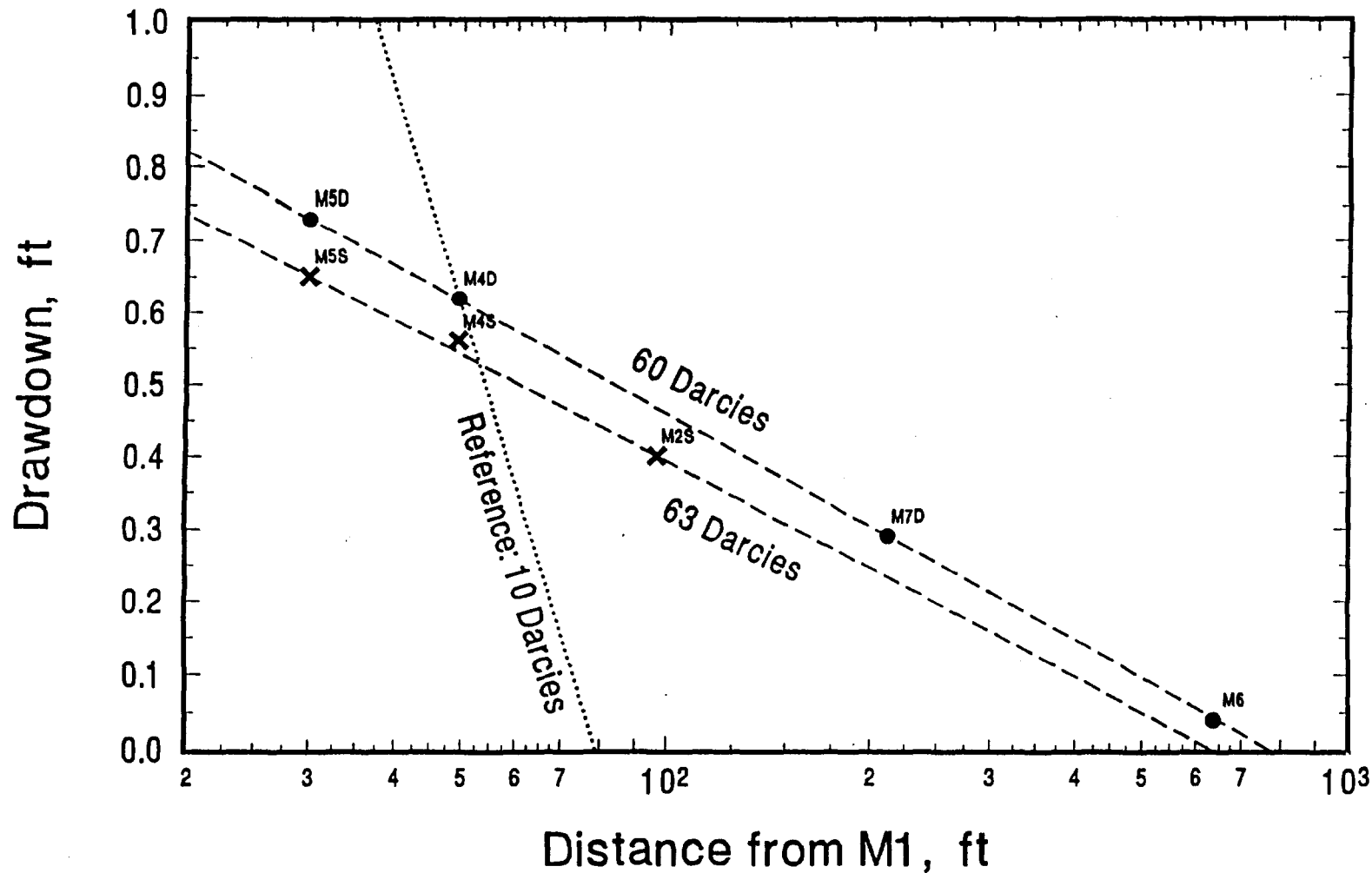


Table 1 Permeabilities from Weeks Island Well Tests

<u>Well</u>	<u>Permeability, Darcies</u>			
	<u>Sandia</u>		<u>Virogroup</u>	
	<u>Drawdown</u>	<u>Recovery</u>	<u>Drawdown</u>	<u>Recovery</u>
M1	-	63	-	70
M2	58	66	56	63
M4	53	63	61	56
M5	57	56	56	56
M7	-	63	-	-
BH4	44	45	-	-
BH5	-	70	46	-
BH6	68	57	-	-