DPSTD-84-112

SUPPLEMENTAL TECHNICAL DATA SUMMARY

M-AREA GROUNDWATER INVESTIGATION

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1.0 INTRODUCTION AND ACKNOWLEDGEMENTS

A Preliminary Technical Data Summary, M-Area Groundwater Cleanup Facility (Gordon, 1982), was issued in October 1982. The objective of the Preliminary Technical Data Summary (TDS) was to present data that would lead to selection and design of a groundwater cleanup facility as a remedial action for the contamination by volatile degreaser solvents of the groundwater south and west of the M-Area settling basin on the Savannah River Plant (SRP). Since that time additional monitoring wells have been drilled and other sources of contamination have been identified. In addition, the use of recovery wells and an air stripper, which were the remedial measures recommended in the preliminary TDS, have been selected as the best suited clean-up technology. A project to implement these remedial measures is under way. Start-up of a 400 gallon per minute air stripping column with an eleven well recovery network is expected in April 1985. (Editorial Note: The air stripping column began operation in April 1985, and all eleven recovery wells were on line by September 1985.)

Because of the additional investigations and results that have developed in the intervening two years (October 1982 to October 1984), it is appropriate to compile the results of these investigations and issue a supplement to the Preliminary Technical Data Summary. Since investigations of the overall contaminant plume in A and M Areas are continuing, this report is not a final report but only an update of the technical data on this complex situation.

Because the previous TDS covered the topic of treatment of the groundwater once brought to the surface, this supplemental data summary does not address treatment technology at the surface. Primarily, it provides additional geohydrologic and contaminant plume information.

The organization and presentation of the chemical analyses in Appendices B and C and the water level elevations in Appendix F are primarily the work of William Fay, an independant contractor to the Savannah River Laboratory (SRL). John Pickett (SRL) contributed to the interpretation of the results of the inorganic chemical analyses. William Colven and Carl Muska of the Raw Materials Engineering and Technology Department at SRP are the custodians of most of the wells from which data were used in this study and were largely responsible for the collection of much of the data. H. Lee Martin of Raw Materials Technology gathered much of the history of M-Area operations. The groundwater consulting firm of Geraghty & Miller, Inc. conducted and analysed the pumping test on the "Tuscaloosa" aquifer. Envirodyne Engineers, Inc. performed most of the chemical analyses that appear in Appendices B, C, and D.

References for Chapter 1

Gordon, D. E., 1982. **Preliminary Technical Data Summary, M-Area Groundwater Cleanup Facility**, DPSTD 82-69, E. I. du Pont de Nemours and Co., Savannah River Laboratory, Aiken, SC.

2.0 SUMMARY

This supplement to the Preliminary Technical Data Summary (TDS) (Gordon, 1982) presents the state of knowledge on the hydrogeology and contaminant plume characteristics in the vicinity of M Area as of October 1984. As discussed in the previous TDS, the contaminants consist of organic solvents used for metal degreasing, namely trichloroethylene, tetrachloroethylene, and 1,1,1-trichloroethane. Since the issuance of the previous TDS, the groundwater consulting firm of Geraghty & Miller, Inc. has been retained to assist with program strategy, planning, and investigative techniques.

The investigation to October 1984 indicates that there are four main areas or sources of groundwater contamination: 1) the M-Area settling basin, 2) the pipeline extending from the production facilities to the basin, 3) the above ground solvent storage tanks behind Building 321-M, and 4) the sewer outfall to a tributary to Tims Branch.

The major extent of chlorocarbon contamination is primarily contained within the formations of Tertiary age (i.e. Barnwell, McBean, and Congaree) which overlie the regionally important "Tuscaloosa" Formation. The water bearing Tertiary and "Tuscaloosa" Formations are separated by 40 to 60 feet of clays and sandy clays of the Ellenton and Upper "Tuscaloosa" Formations. Several of the water production wells screened in the "Tuscaloosa" Formation have shown low levels of contamination; however, it is believed that this has resulted from a loss of integrity of the cement sheath surrounding the casing and not from a pervasive movement of the contamination into the "Tuscaloosa" Formation. (Editorial Note: Data gathered after October 1984 indicates that there may be other sources for individual wells than faulty cement grout.)

The shape, extent, and concentration of the plume to the west and southwest of the basin and the M-Area production facilities have been fairly well determined using currently available data. At the present time however, the characteristics of the plume to the north, east, and along Tims Branch and its tributary that has received process effluent is based on data from a small number of monitoring wells.

A remedial action program consisting of a series of 11 recovery wells and a 400-gpm air stripping unit is currently being implemented for cleaning up the contaminated groundwater system.

References for Chapter 2

Gordon, D. E., 1982. **Preliminary Technical Data Summary, M-Area Groundwater Cleanup Facility,** DPSTD-82-69, E. I. du Pont de Nemours and Co., Savannah River Laboratory, Aiken, SC.

3.0 GEOHYDROLOGIC SETTING

The geohydrologic setting of the Savannah River Plant (SRP) is described in "Technical Summary of Groundwater Quality Protection Program at Savannah River Plant," (Christensen and Gordon, 1983). Figure 3-1 presents a tentative correlation of stratigraphic terminology and shows a descriptive and graphic log of the subsurface geology near the central part of SRP. The hydrostratigraphic terms used in the present report are those shown on Figure 3-1 except that the term "Tuscaloosa" requires further clarification.

The Tuscaloosa Formation was named by Smith and Johnson (1887, p.98) for exposures of light-colored irregularly bedded non-marine sediments near Tuscaloosa, Alabama. Subsequently, the name was applied to strata thought to be equivalent in Georgia by Spencer (1890) and in South Carolina by Cooke (1936, p. 17), who correlated the Hamburg and Middendorf beds of Sloan (1908) with the Tuscaloosa of Georgia. When the original geologic studies were performed for the building of the Savannah River Plant, Cooke's terminology was used in its entirety. Subsequently, Siple (1967) also used the term Tuscaloosa although he cites other studies that indicate sediments at Middendorf (Chesterfield County), which had been included in the Tuscaloosa, were younger than the age of the Tuscaloosa beds in Alabama. In hydrologic work at SRP the term Tuscaloosa, referring to the principal aquifer in the region, has been quite useful, and its meaning is quite clear. In recent years analysis of pollen found in this formation at SRP have established that it is indeed younger than the Tuscaloosa type section in Alabama. Thus, from a purely stratigraphic point of view, it is improper to continue to use the term Tuscaloosa for these sediments. However, historical usage of the term in a hydrostratigraphic sense is clear, and it would seem that its use should not be hastily changed. As intensive stratigraphic studies in this area are now going on, it is probable that the use of the term Tuscaloosa to designate this large aquifer (which actually consists of two aquifers separated by a confining bed) will be discontinued. However, in this report the term Tuscaloosa Formation will be retained but placed within quotation marks to indicate that it is used as a hydrostratigraphic term and not as a formal stratigraphic term.

Because M Area is updip from the central part of SRP, several changes in the geologic column are present. Figure 3-2 shows a generalized geologic column in M Area. In comparing the stratigraphic column in M Area with that of the central part of the plant, it should be noted that (1) the "Tan Clay" is only about 3 feet thick and lies in the unsaturated zone, (2) the "Calcareous Zone" is not present, (3) the "Green Clay" is discontinuous, (4) the Congaree has fewer separated lenses of clay and lenses of sand and is better described generally as clayey sand even though well-sorted sands do occur, (5) the Ellenton Formation is mostly a gray clayey sand or sandy clay with plentiful mica and the occurrence of marcasite or gypsum, and (6) the "Tuscaloosa" section is similar to that described for the central part of SRP.

As a result of these different geologic features, the subsurface hydrologic characteristics also differ. Since the extensive layers of clay are absent from the Tertiary sediments, head changes are less abrupt and are more gradual than in the central part of SRP. The water table is deeper below the surface. The "Green Clay" is less continuous and therefore does not impede downward water flow as much as in the central part of SRP. Because the Congaree has fewer permeable sands and lateral conduction of water within the Congaree Formation is slower than in the central part of the plant, the head in the Congaree is not drawn down below that of the "Tuscaloosa." Therefore, in A/M Area, heads decline continuously with depth, and there is no head reversal at the Congaree-Ellenton boundary (Figure 3-3). (Figure 3-3 was developed in early 1983 by subtracting contours on a Congaree potentiometric map from those on a "Tuscaloosa" potentiometric map. Data for both of these original potentiometric maps were very sparse. Thus, Figure 3-3 is intended to show the general concept of head reversal and the general area involved. However, it should not be used for quantitative prediction of head reversal at any specific location.)

However, there is sufficient hydraulic impedance in the section such that lateral groundwater flow at the water table may move in one direction and lateral flow in the deeper Tertiary sediments may move in a slightly different direction responding to hydraulic controls from Tims Branch and from Upper Three Runs Creek. Figure 3-4 presents a regional section through M Area to Shell Bluff, Georgia showing the head relationship of the Congaree and the "Tuscaloosa." Although the "Tuscaloosa" head is below that of the Congaree in the vicinity of M Area, as the Savannah River is approached the two potentiometric surfaces cross and the Tuscaloosa becomes the higher of the two. The same relationship would pertain in the direction of Upper Three Runs Creek.

One of the most important hydrologic features of A/M Area is the declining head with depth (Figure 3-2), meaning that water soluble material released at the surface will tend to move to greater depth in the general area. This situation changes as the Savannah River or Upper Three Runs Creek are approached.

References for Chapter 3

Christensen, E. J. and D. E. Gordon, 1983. **Technical Summary of Groundwater Quality Protection Program at Savannah River Plant, Vol. 1** DPST-83-829, E. I. Du Pont de Nemours and Co., Savannah River Laboratory, Aiken, SC.

Cooke, C. W., 1936. **Geology of the Coastal Plain of South Carolina,** U.S. Geological Survey Bulletin 867.

Huddleston, P., 1982. The Development of the Stratigraphic Terminology of the Claibornian and Jacksonian Marine Deposits in Western South Carolina and Eastern Georgia, **Geological Investigations Related to the Stratigraphy in the Kaolin Mining District, Aiken County, South Carolina - Carolina Geological Society Field Trip Guidebook**, pp. 211-33.

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Siple, G. E., 1967. **Geology and Ground Water of the Savannah River Plant and Vicinity, South Carolina,** U.S. Geological Survey Water-Supply Paper 1841.

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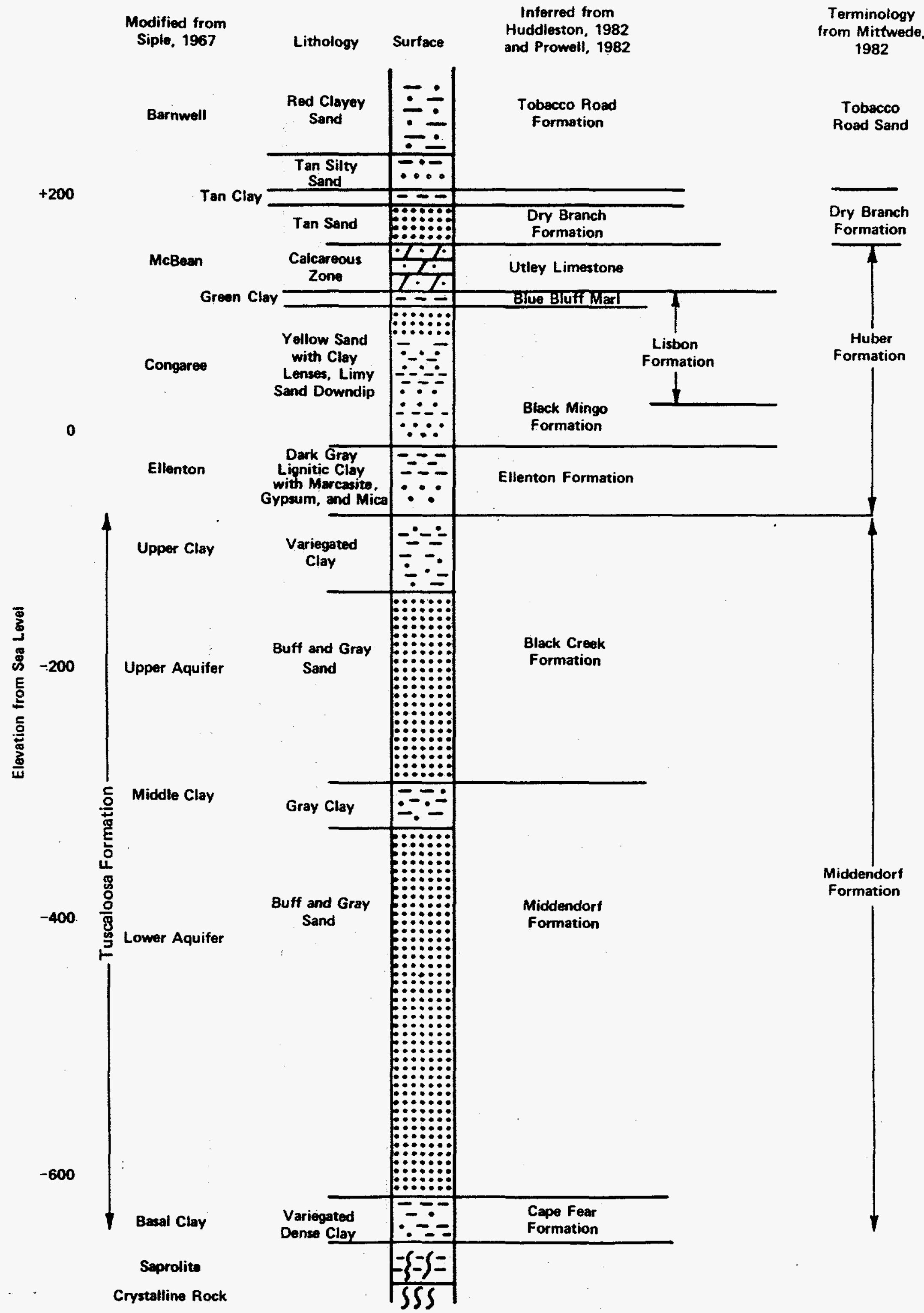


FIGURE 3-1. Tentative Correlation of Stratigraphic Terminology of the Southwestern South Carolina Coastal Plain

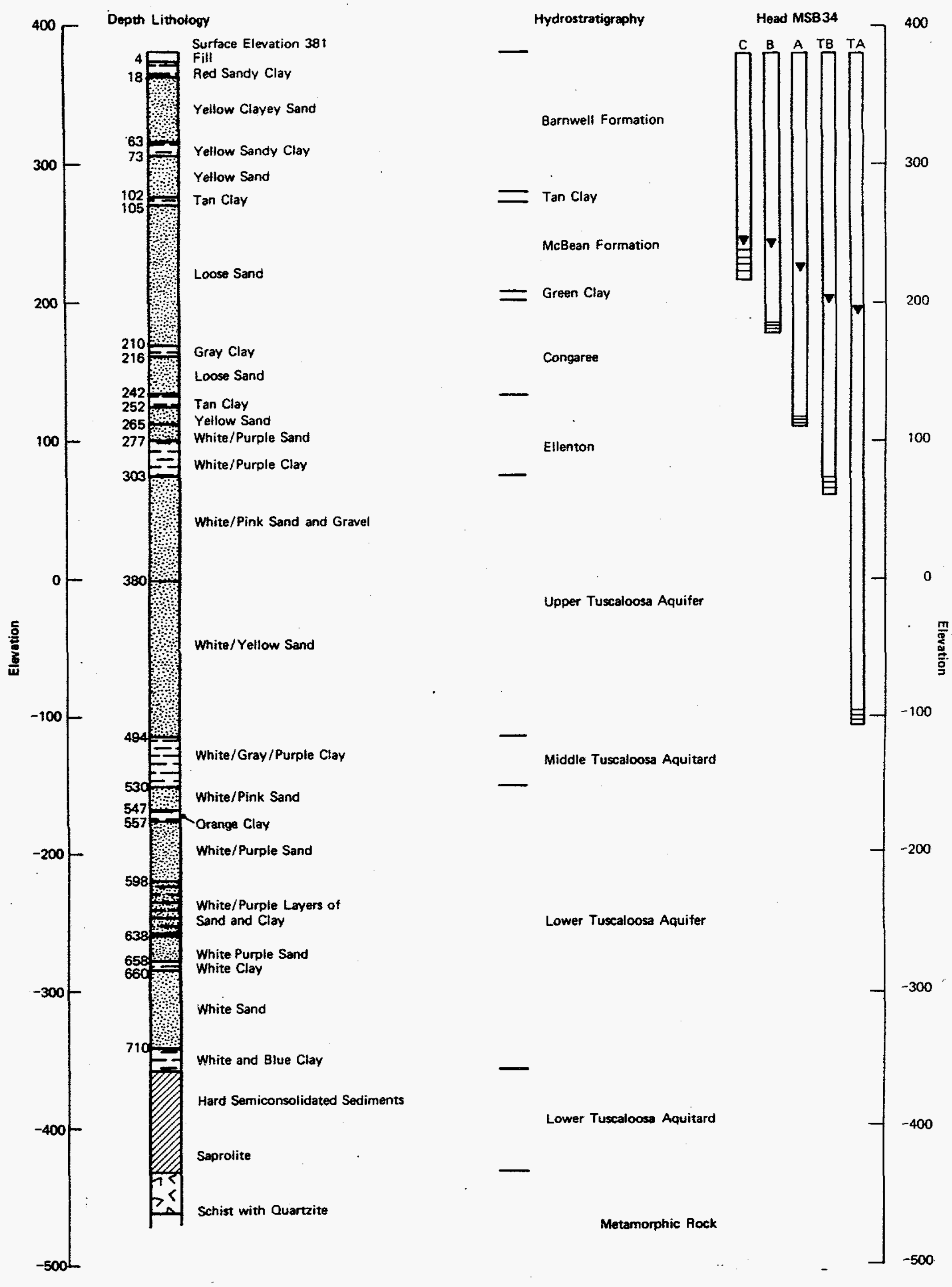


FIGURE 3-2. Geology and Hydrology Near the Center of A/M Area. (Geology and heads above elevation of -280 Feet are from MSB-34TA; -280 to -355 from 905-20A; below -355 feet extrapolated from well P8R Located at MSB-17)

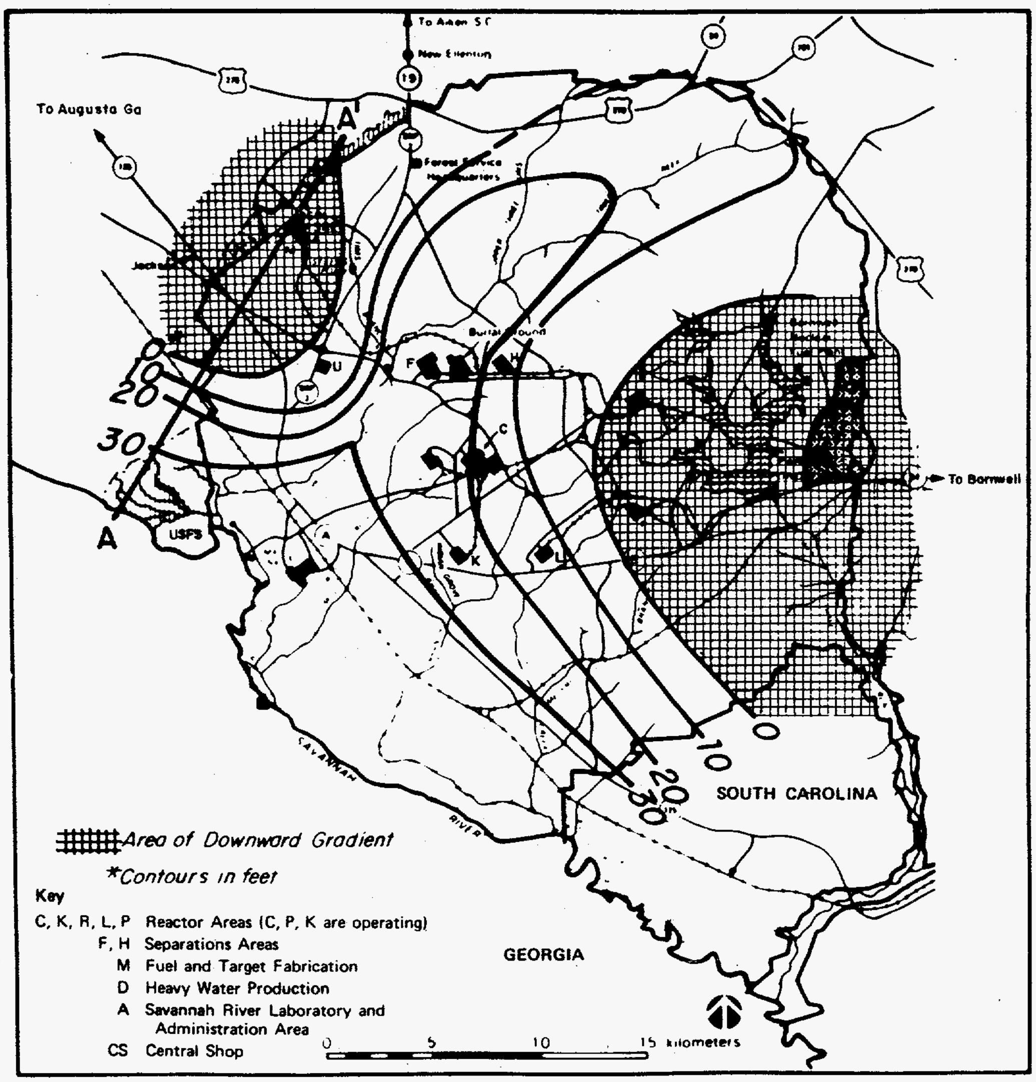


FIGURE 3-3. Generalized Head Difference Between the "Tuscaloosa" and Congaree Formations at SRP.
A-A' is Section Shown on Figure 3-4.

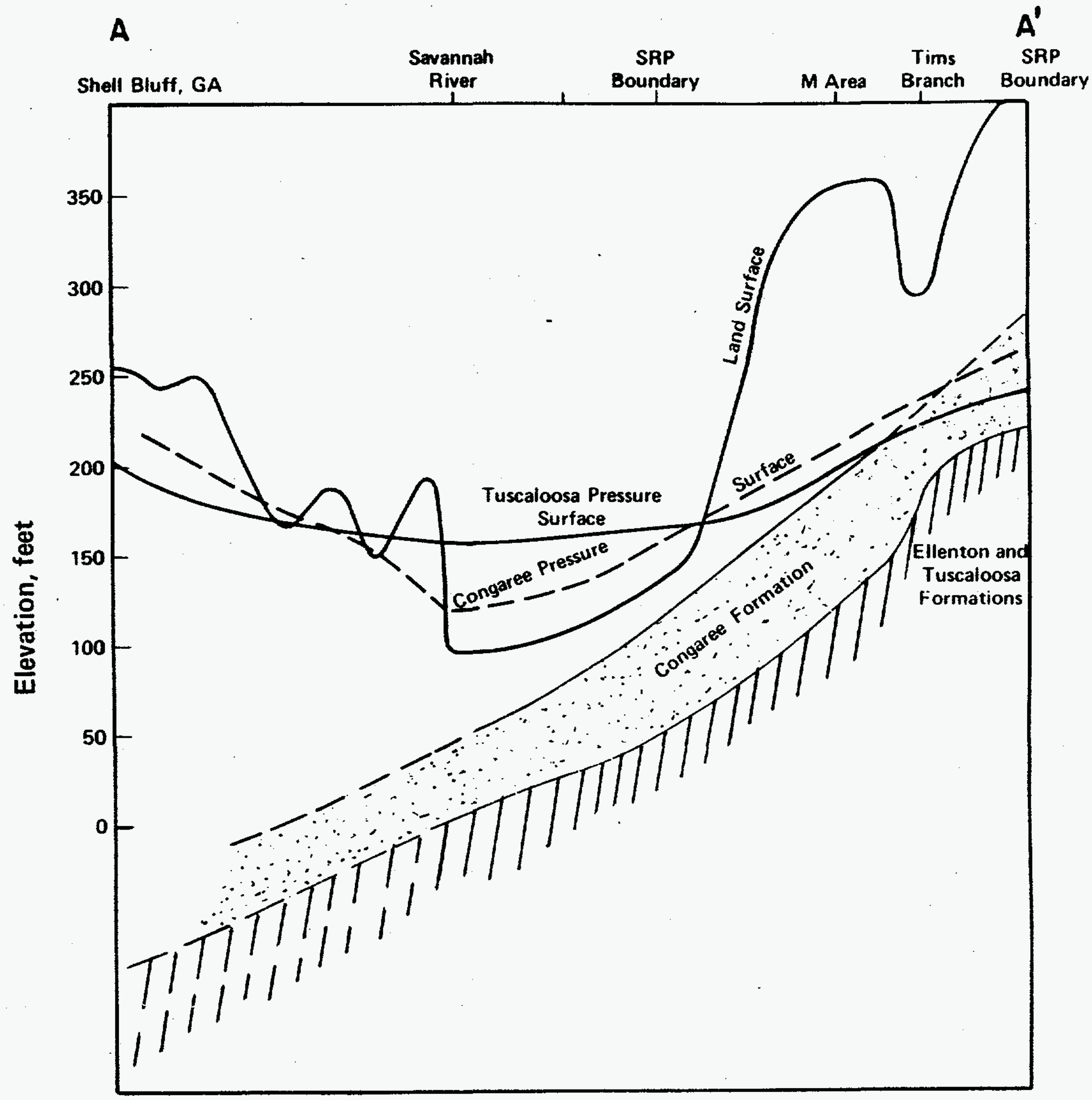


FIGURE 3-4. Hydrologic Section Perpendicular to the Savannah River Through M Area. Location of Section is Shown on Figure 3-3.

4.0 MONITORING WELL INSTALLATION

Since the issuance of the Preliminary Technical Data Summary (DPSTD-82-69) up to September 1, 1984, 27 additional monitoring wells were installed at eleven different drill sites. This brings to 74 the total number of monitoring wells completed as part of the M-Area groundwater investigation. The locations of all the well sites drilled up to September 1984 are shown on Figure 4-1. Clusters MSB-23 through 33 are the sites of the 27 wells drilled between August 1982 and August 1983. Table 4-1 gives the history of this drilling and subsequent drilling up to September 1984. A summary of the well installation data is given on Table 4-2. The well numbering system is discussed in Appendix A. Geologic borings drilled as part of this phase of the program range in depth from 45 to 660 feet with the monitoring well screens set at depths ranging between 45 and 485 feet below the ground surface. Seven of these wells are screened in the "Tuscaloosa" Formation. The locations of the seven "Tuscaloosa" monitoring wells are shown on Figure 4-2. Geologic samples for lithologic classification and, in certain borings, for chemical analysis were collected at each drill site utilizing either standard splitspoon samplers or wireline core barrels. In addition undisturbed samples were collected using a pitcher barrel sampler for laboratory determination of hydraulic conductivity, porosity, and grain size distribution. The undisturbed samples were collected mainly from the clays of the Ellenton and upper "Tuscaloosa" Formations. The results of the laboratory determinations are discussed in Section 5.3.1.

With increased concern for the possibility of contamination of new wells during drilling and installation operations, the procedure of steam cleaning both drilling materials (rods, bits, samplers, etc.) and casing, prior to use in each well, was adopted as part of the standard well installation practice. This procedure was implemented for the installation of the last seven wells drilled to date (MSB-12TA, 12TB, 34TA, 34TB, 34A, 34B, and 34C). The procedure will continue to be used for all future wells drilled as part of the program.

Figure 4-1 also shows locations of wells drilled as part of other programs where data on water levels or chemical analyses in such wells are contributory to this program. Examples of such wells are "ASB", the wells near the Savannah River Laboratory seepage basins; "SRW", wells surrounding the Silverton Road waste site; "AOB", wells around the A-Area oil basin; ABG, A-Area background well; "ACB", wells around the A-Area coal pile runoff containment basin; and "AMB", wells around the metallurgical laboratory basin. Most of these wells were installed near waste sites for monitoring purposes. "LA-4" is an early water production well in the "Tuscaloosa" Formation that was never used. Its number was changed to 905-4M in 1962. Table 4-3 gives a summary of the well installation data for these wells.

As of September 1984, 58 additional monitoring wells in 14 clusters were scheduled to be installed in the Fall of 1984 and the Winter of 1985. (Editorial Note: These wells have been installed and water samples are currently being collected and analyzed.) Figure 4-3 shows the location of these clusters. In the Fall of 1984 well clusters MSB-44, 45, and 46 were installed very close to production wells 905-82A, 20A, and 31A, respectively, (Figure 4-2) to monitor the Tertiary sediment near these "Tuscaloosa" production wells.

TABLE 4-1

History of Investigations of Groundwater Contamination in A/M Area

Nov. 1979 to Feb. 1981	Installed RCRA type wells around M-Area settling basin (MSB-1 through 4), Lost Lake (MSB-5 through 8), A-Area coal pile runoff containment basin (ACB 1 through 4), SRL seepage basins (ASB 1 through 6), and Silverton Road waste site (SRW-1 through 6).
June 9, 1981	Collected first set of groundwater samples from these wells.
June 28, 1981	Analyses received. Contamination around M-Area settling basin and Silverton Road Waste Site by degreaser solvents first identified.
July 21, 1981	Began drilling first well to investigate contaminant plume from M-Area basin.
Dec. 1981	Completed 47 monitoring wells downgradient from basin including geologic sampling and testing for degreaser solvent contamination of soil (MSB-9 through 21).
Mar. 1982	Drilled five exploratory borings in M-Area settling basin.
Apr./May 1982	Completed two rounds of water sampling in monitor wells.
Apr./May 1982	Installed additional Silverton Road waste site monitor wells (SRW-7 through 11).
June 1982	Installed M-Area Production Test Well MPT-1 and conducted 72-hour aquifer test. Installed MSB-22.
Aug. 1982	Completed six additional monitoring wells, three inside the M-Area perimeter fence and three just outside (MSB-23 through 28).
Oct. 1982	Issued Preliminary Technical Data Summary, DPSTD-82-69.
Oct. 18 to Nov. 17, 1982	Conducted 30-day aquifer test on MPT-1
Feb. 1983	Completed installation of 14 monitoring wells (at MSB-23 through 28 and MSB-30 through 33, Figure 4-1).

TABLE 4-1, Contd

Mar./Apr. 1983	Presence of degreaser solvents confirmed in A-Area Water Production Wells 905-53A and 20A.
Mar. 1983	Began operation of Pilot Air Stripper with Well MPT-1.
Apr. 23, 1983	Conducted 33-hour aquifer test on "Tuscaloosa Well" 905-20A.
April-July 1983	Collected several rounds of water samples from monitor wells.
June-Aug. 1983	Installed well clusters in Tertiary and Cretaceous sediments near Well 905-53A (MSB-34) and in the Cretaceous at MSB-12.
Nov. 1983	Installed RWM-2 and 3 and Demonstration Air Stripper inside M Area.
Aug.-Dec. 1983	Installed additional Silverton Road waste site monitor wells in clusters (SRW-2, 9, and 12 to 16).
Jan. 1984	Began operation of Demonstration Air Stripper with RWM-2 and 3.
Apr. 1984	Silverton Road waste site and RCRA type wells added to routine sampling schedule.
May-July 1984	Collected round of water samples from monitor wells.
Sept. 1984	Installed Tertiary monitoring wells as close as possible to "Tuscaloosa" production wells (MSB-44 at 905-82A, MSB-45 at 905-20A, and MSB-46 at 905-31A).
Sept. 1984	Beginning of program to install additional 58 monitoring wells in 14 clusters to further refine the location of the contaminant plume. (At ASB-8, MSB-27, MSB-30, and MSB-33. New clusters MSB-29 and MSB-35 through 43.)

TABLE 4-2

M-Area Piezometer Installation Summary

Well No.	Elevation Ground Surface (ft)*	Elevation Top of Casing (ft)*	Total Drill Depth (ft)	Screen Zone Depth (ft) Top	Screen Zone Depth (ft) Bottom	Screen Zone Elevation (ft)* Top	Screen Zone Elevation (ft)* Bottom	SRP Coordinates North	SRP Coordinates East	Construction Material
AC-1A	260.7	262.1	128.0	115.0	120.0	145.7	140.7	105865.0	42238.8	Steel
AC-1B	261.1	262.0	64.0	59.0	64.0	202.1	197.1	105862.8	42250.5	Steel
AC-2A	342.7	344.7	204.5	196.7	201.7	146.0	141.0	105636.4	46428.6	PVC
AC-2B	342.8	344.8	130.0	106.4	126.4	236.4	216.4	105648.7	46444.5	PVC
AC-3A	300.4	302.3	153.5	146.8	151.8	153.6	148.6	100989.1	42119.8	PVC
AC-3B	300.1	302.5	110.0	86.7	106.7	213.4	193.4	100996.5	42113.6	PVC
MSB-1	-	353.4	131.6	111.6	-	-	-	101824.2	48486.1	Steel
MSB-1A	350.5	352.5	128.0	98.0	128.0	252.5	222.5	101824.2	48468.5	PVC
MSB-2	-	352.3	107.3	85.3	-	-	-	101999.2	48741.9	Steel
MSB-2A	349.7	351.7	128.0	98.0	128.0	251.7	221.7	102021.4	48746.0	PVC
MSB-3	-	359.6	122.7	100.7	-	-	-	102181.6	48530.7	Steel
MSB-3A	357.0	359.0	128.0	98.0	128.0	259.0	229.0	102181.6	48552.1	PVC
MSB-4	-	355.1	116.5	94.5	-	-	-	102010.4	48313.8	Steel
MSB-4A	352.1	354.1	128.0	98.0	128.0	254.1	224.1	101982.7	48312.6	PVC
MSB-5	337.1	339.1	109.4	87.4	-	-	-	101768.7	46983.8	Steel
MSB-5A	341.6	343.6	125.0	93.0	123.0	248.6	218.6	101948.2	46998.8	PVC
MSB-6	-	339.5	1094	87.4	-	-	-	101080.1	46462.6	Steel
MSB-6A	340.8	342.8	130.0	100.0	128	240.8	212.8	101105.1	46328.3	PVC
MSB-7	-	340.7	108.6	86.6	-	-	-	100730.7	46785.9	Steel
MSB-7A	341.9	343.9	130.0	100.0	128.0	241.9	213.9	100563.7	46737.1	PVC
MSB-8	-	339.4	109.2	87.2	-	-	-	100944.0	47145.4	Steel
MSB-8A	341.7	343.7	130.0	100.0	128.0	241.7	213.7	100796.2	47302.8	PVC
MSB-9A	356.7	357.7	242.0	213.0	218.0	143.7	138.7	102236.7	48242.5	Steel
MSB-9B	356.7	357.9	153.0	148.0	153.0	208.7	203.7	102239.4	48251.7	Steel
MSB-9C	357.3	359.1	136.0	116.0	136.0	241.3	221.3	102245.6	48273.0	PVC
MSB-10A	352.9	355.0	248.0	230.0	235.0	122.9	117.9	102451.8	47954.4	PVC
MSB-10B	352.7	354.7	215.0	198.2	203.2	154.5	149.5	102488.2	47943.1	PVC
MSB-10C	354.0	356.0	152.0	144.3	148.5	209.7	205.5	102465.6	47951.1	PVC
MSB-10D	353.5	355.5	125.0	103.8	123.8	249.7	229.7	102476.9	47947.4	PVC
MSB-11A	363.0	364 9	240.0	227.6	232.6	135.4	130.4	102638.9	48577.6	PVC
MSB-11B	362.8	364.8	203.0	197.2	202.2	165.6	160.6	102648.9	48578.5	PVC
MSB-11C	363.0	364.9	186.0	180.6	185.6	182.4	177.4	102658.6	48579.4	PVC
MSB-11D	363.3	365.2	161.5	155.0	160.0	208.3	203.3	102669.5	48579.7	PVC
MSB-11E	363.4	365.2	132.5	112.5	132.5	250.9	230.9	102678.5	48579.6	PVC
MSB-11F	363.0	364.6	141.0	120.5	140.5	242.5	222.5	102629.0	48577.0	PVC
MSB-12A	345.9	347.8	230.0	225.0	230.0	120.9	115.9	102283.2	47138.2	PVC
MSB-12B	346.5	348.4	191.0	185.3	190.3	161.2	156.2	102251.8	47139.6	PVC
MSB-12C	346.0	347.9	168.5	163.1	168.1	182.9	177.9	102274.4	47138.4	PVC
MSB-12D	346.3	348.1	125.0	102.0	122.0	244.3	224.3	102262.2	47139.7	PVC
MSB-12TA	346.3	348.50	660.0	450.0	460.0	-103.7	-113.7	102266.7	47127.3	Steel
MSB-12TB	346.7	348.90	360.0	333.0	353.0	13.7	-6.3	102260.1	47133.0	Steel
MSB-13A	343.3	345.2	246.3	208.4	213.4	134.9	129.9	101725.7	47525.4	PVC
MSB-13B	343.7	345.6	172.5	167.5	172.5	176.2	171.2	101735.7	47523.5	PVC

* Feet above (or below) mean sea level.

TABLE 4-2, Contd

M-Area Piezometer Installation Summary

Well No.	Elevation Ground Surface (ft)*	Elevation Top of Casing (ft)*	Total Drill Depth (ft)	Screen Zone Depth (ft) Top	Screen Zone Depth (ft) Bottom	Screen Zone Elevation (ft)* Top	Screen Zone Elevation (ft)* Bottom	SRP Coordinates North	SRP Coordinates East	Construction Material
MSB-13C	343.6	345.7	125.0	101.0	121.0	242.6	222.6	101745.7	47521.9	PVC
MSB-14A	346.5	348.3	202.0	182.0	202.0	164.5	144.5	101629.5	48521.9	PVC
MSB-14B	346.7	348.7	158.5	153.0	158.0	193.7	188.7	101639.0	48519.1	PVC
MSB-14C	347.0	348.7	125.0	103.3	123.3	243.7	223.7	101648.6	48517.3	PVC
MSB-15A	365.2	367.2	203.0	198.0	203.0	167.2	162.2	102983.5	48827.0	PVC
MSB-15C	364.6	366.6	125.0	104.2	124.2	260.4	240.4	103002.1	48834.0	PVC
MSB-16A	364.9	366.7	203.7	198.7	203.7	166.2	161.2	103693.9	48965.1	PVC
MSB-16C	365.0	366.6	141.0	121.0	141.0	244.0	224.0	103714.1	48970.5	PVC
MSB-17A	356.3	358.0	201.8	196.7	201.7	159.6	154.6	101976.6	46245.7	PVC
MSB-17B	356.4	357.9	172.0	166.4	171.4	190.0	185.0	101994.6	46237.7	PVC
MSB-17C	356.3	358.1	125.0	103.0	123.0	253.3	233.3	102004.6	46234.3	PVC
MSB-18A	338.3	340.2	200.4	176.0	181.0	162.3	157.3	100416.1	46110.4	PVC
MSB-18B	338.5	340.3	167.0	141.5	146.5	197.0	192.0	100424.1	46115.7	PVC
MSB-18C	338.5	340.6	131.5	111.2	131.2	227.3	207.3	100430.9	46121.4	PVC
MSB-19A	298.1	299.5	200.9	178.5	183.5	119.6	114.6	100983.0	50934.4	PVC
MSB-19B	298.2	299.9	155.8	150.8	155.8	147.4	142.4	100999.3	50934.8	PVC
MSB-19C	298.1	300.2	101.0	80.0	100.0	218.1	198.1	100992.1	50942.4	PVC
MSB-20A	351.9	354.0	202.0	190.7	195.7	161.2	156.2	103545.1	46060.5	PVC
MSB-20C	351.2	353.3	142.0	118.8	138.8	232.4	212.4	103556.3	46088.8	PVC
MSB-21A	351.2	353.4	202.0	193.4	198.4	157.8	152.8	103967.0	47217.2	PVC
MSB-21C	351.6	353.4	140.0	119.8	139.8	231.8	211.8	103973.0	47234.6	PVC
MSB-22	356.7	359.0	200.0	115.0	135.0	241.7	221.7	102186.5	48508.8	PVC
MSB-23	370.4	371.77	252.0	120.0	140.0	250.4	230.4	104312.0	49294.0	PVC
MSB-23A	370.4	371.52	318.0	308.0	318.0	62.4	52.4	104314.9	49290.7	PVC
MSB-23B	370.1	371.60	199.0	194.0	199.0	176.1	171.1	104336.6	49286.4	PVC
MSB-24	378.9	380.15	251.0	135.0	155.0	243.9	223.9	104614.4	49842.9	PVC
MSB-24A	379.9	381.58	210.0	200.0	210.0	178.8	168.8	104625.3	49845.3	PVC
MSB-25	364.7	366.93	251.0	120.0	140.0	244.7	224.7	103498.8	49668.9	PVC
MSB-25A	364.7	366.42	207.0	195.0	205.0	169.7	159.7	103504.8	49657.9	PVC
MSB-26	359.5	361.55	202.0	119.0	139.0	240.5	220.5	104612.8	48941.7	PVC
MSB-26A	359.2	360.93	190.0	180.0	190.0	179.2	169.2	104602.3	48440.7	PVC
MSB-27	374.0	375.48	200.0	130.0	150.0	244.0	234.0	104972.8	49487.7	PVC
MSB-27A	373.8	375.15	182.0	170.0	180.0	203.8	193.8	104962.8	49487.8	PVC
MSB-28	352.6	354.41	200.0	122.0	142.0	230.6	210.6	104941.8	48517.3	PVC
MSB-28A	352.6	354.23	200.0	195.0	200.0	157.6	152.6	104947.7	48521.9	PVC
MSB-30A	352.6	354.56	326.0	316.0	326.0	36.6	26.6	105727.4	48004.1	PVC
MSB-30C	352.2	354.04	135.0	115.0	135.0	237.2	217.2	105731.1	48013.7	PVC
MSB-31A	346.0	347.20	334.0	324.0	334.0	22.0	12.0	101979.3	50100.2	PVC
MSB-31B	346.2	347.50	194.0	189.0	194.0	157.2	152.2	101981.3	50078.7	PVC
MSB-31C	346.0	347.30	130.0	110.0	130.0	236.0	216.0	101979.6	50089.9	PVC
MSB-32	252.7	255.26	57.0	35.0	55.0	217.7	197.7	99655.6	52733.9	PVC
MSB-33	254.3	256.63	45.0	25.0	45.0	229.3	209.3	98031.0	51736.3	PVC
MSB-34A	381.8	383.17	273.5	263.5	268.5	118.3	113.3	104954.9	50534.9	PVC
MSB-34B	381.8	383.08	205.0	195.0	200.0	186.8	181.8	104944.7	50534.9	PVC
MSB-34C	381.7	383.19	166.0	141.0	161.0	240.7	220.7	104934.1	50535.5	PVC
MSB-34TA	381.0	382.49	660.0	473.7	483.7	-92.7	-102.7	104905.8	50536.6	Steel
MSB-34TB	381.8	382.77	320.0	306.0	316.0	75.8	65.8	104891.6	50537.9	Steel

* Feet above (or below) mean sea level.

TABLE 4-3

Piezometer Installation Data Summary for Wells from other Program Used to Collect Information for M-Area Investigations

Well No.	Elevation Ground Surface (ft)*	Elevation Top of Casing (ft)*	Total Drill Depth (ft)	Screen Zone Depth (ft) Top	Screen Zone Depth (ft) Bottom	Screen Zone* Elevation (ft) Top	Screen Zone* Elevation (ft) Bottom	SRP Coordinates North	SRP Coordinates East	Construction Material
ABG-1	323.1	324.8	138	108	138	215	185	105939.9	55016.4	PVC
ACB-2A	347.7	349.8	140.0	110.0	140.0	237.7	207.7	102367.4	51561.3	PVC
ACB-3A	357.5	348.3	140.0	110.0	140.0	247.5	217.5	102154.3	51313.3	PVC
AMB-2	377.0	379.3	155.0	125.0	155.0	252.0	222.0	104164.6	51517.9	PVC
AOB-1	338.5	341.07	120.0	90.0	120.0	248.5	218.5	101910.7	50485.9	PVC
AOB-2	343.2	345.4	125.0	93.0	123.0	250.2	220.2	102009.8	50724.7	PVC
ASB-1A	347.1	349.1	130.0	100.0	130.0	247.1	217.1	105535.0	52614.0	PVC
ASB-2A	347.0		130.0	100.0	130.0	247.0	217.0	105608.8	52856.9	PVC
ASB-3	343.2	345.2	125.0	93.0	125.0	250.2	218.2	105712.4	52989.0	PVC
ASB-4	333.6	335.6	107.0	74.5	107.0	259.1	226.6	105840.8	53109.9	PVC
ASB-5A	342.9	345.0	125.0	95.0	125.0	247.9	217.9	105885.5	52865.7	PVC
ASB-6	348.2	350.0	130.0	100.0	130.0	248.2	218.2	105716.0	52675.9	PVC
ASB-7	351.2	353.4	140	120	140	231	211	105771	52626.4	PVC
ASB-8	346.6	348.9	140	120	140	227	207	106382	53136.6	PVC
ASB-9	306.4	308.9	90	70	90	236	216	104589	54226.2	PVC
LA-4	357	357	670	390	600	-33	-243	102131.7	46226.7	Steel
S-15	340		165		165		175	105557.5	47096.8	Steel
SRW-1C	313.2	315.2	115	83	113	230.2	200.2	103706.1	41391.1	PVC
SRW-2C	318.6	320.6	120	88	118	230.6	200.6	103653.2	41611.9	PVC
SRW-3C	329.4	331.4	123	91	121	238.4	208.4	103463.6	41830.4	PVC
SRW-4C	316.1	318.1	120	88	118	228.1	198.1	103240.8	41600.2	PVC
SRW-5C	305.3	307.3	115	83	113	222.3	192.3	103346.0	41227.2	PVC
SRW-6C	306.6	308.6	115	83	113	223.6	193.6	103530.7	41229.3	PVC
SRW-7C	295.1	297.1	101.2	81.2	101.2	213.9	193.9	103466.6	40913.3	PVC
SRW-8C	284.2	286.2	93.0	71.0	93.0	213.2	191.2	103390.9	40438.7	PVC
SRW-9C	249.3	251.3	87.0	55.0	87.0	194.3	162.3	102516.7	41914.1	PVC
SRW-10C	294.7	296.7	108.0	76.0	108.0	218.7	186.7	103615.2	40857.9	PVC
SRW-11C	302.2	304.2	103.0	73.0	103.0	229.2	199.2	103310.5	40933.1	PVC
SRW-2A	319.43	320.92	235.8	220.7	230.5	98.7	88.9	103724.71	41634.96	PVC
SRW-2B	319.56	320.93	171.5	156.6	166.4	163.0	153.2	103733.63	41632.08	PVC
SRW-9A	251.74	253.69	142.4	127.1	137.0	124.6	114.7	103256.60	39692.74	PVC
SRW-9B	252.11	253.79	104.0	89.3	99.1	162.8	153.0	103247.04	39697.31	PVC
SRW-12A	234.58	236.78	135.6	120.4	130.2	114.2	104.4	103716.57	39013.36	PVC
SRW-12B	234.54	236.77	92.7	78.0	87.8	156.5	146.7	103708.92	39020.42	PVC
SRW-12C	234.76	236.77	60.1	35.4	55.2	199.4	179.6	102990.82	40682.42	PVC
SRW-13A	295.98	298.10	207.3	192.1	201.9	103.9	94.1	103005.38	40668.03	PVC
SRW-13B	296.11	298.05	147.2	132.5	142.4	163.6	153.7	102997.93	40675.45	PVC
SRW-13C	296.30	298.02	105.1	70.5	100.1	225.8	196.4	102990.82	40682.42	PVC
SRW-14A	325.31	327.33	221.0	201.2	211.0	124.1	108.3	102835.12	41538.18	PVC
				214.0	217.0					
SRW-14B	325.27	327.23	177.2	162.0	171.8	163.3	153.5	102839.83	41548.55	PVC
SRW-14C	325.75	327.42	132.1	97.0	126.7	228.7	199.0	102827.90	41546.04	PVC
SRW-15A	317.76	319.51	224.6	209.8	219.6	108.0	98.2	104547.28	41608.37	PVC
SRW-15B	317.45	319.50	173.1	155.5	165.3	162.0	152.2	104552.55	41590.51	PVC
SRW-15C	317.67	319.51	135.1	100.0	129.6	217.7	188.1	104550.34	41698.12	PVC
SRW-16A	344.90	347.07	229.6	200.4	225.1	144.5	119.8	103766.25	42831.80	PVC
SRW-16B	344.63	347.07	190.4	174.5	184.3	170.1	160.3	103774.82	42826.67	PVC
SRW-16C	345.83	347.07	148.8	109.6	139.6	236.2	206.2	103772.38	42841.77	PVC

* Elevation above or below (-) mean sea level

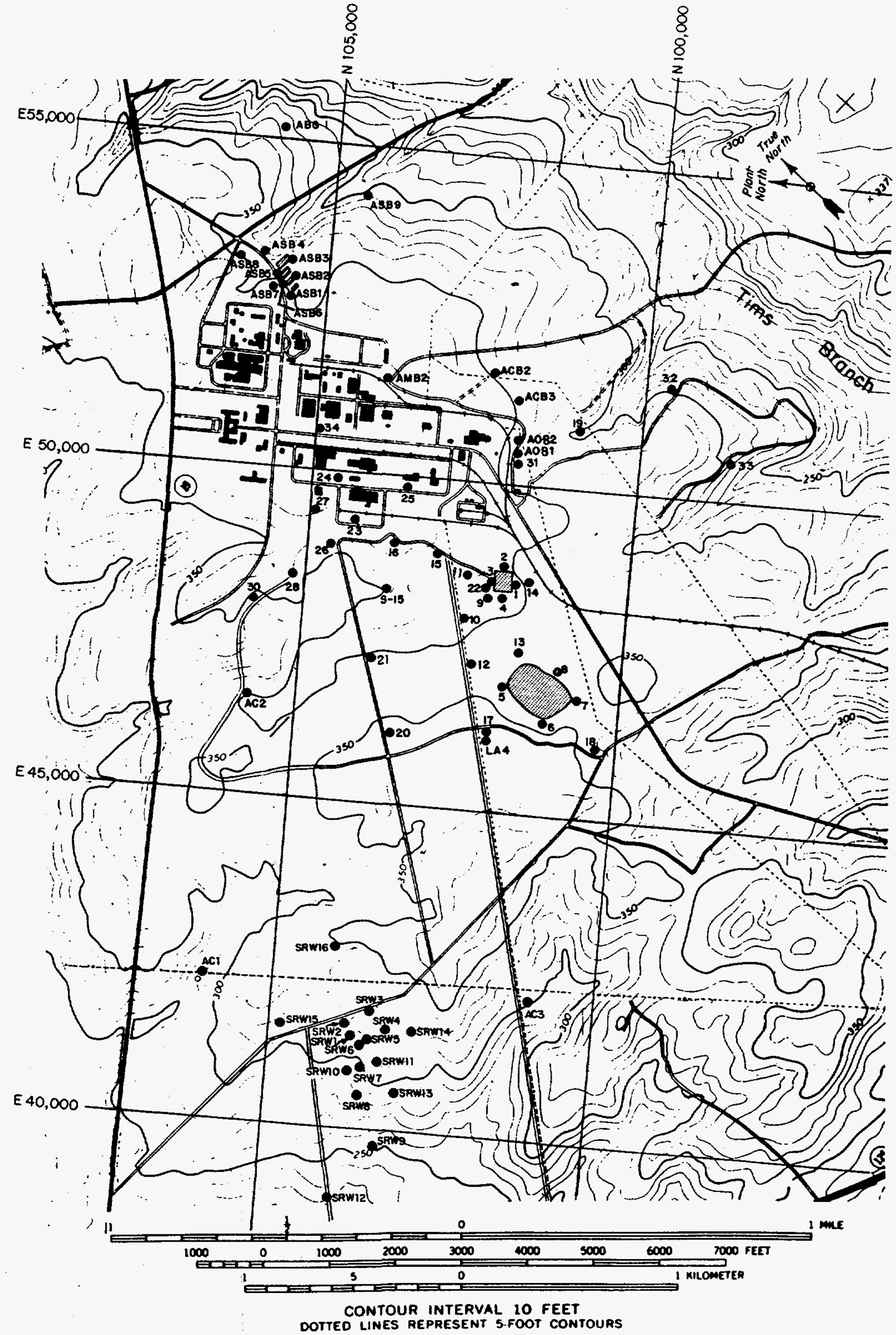


FIGURE 4-1. Location of Existing Wells Used for Groundwater Monitoring
(All wells without prefix letters are in the MSB series.)

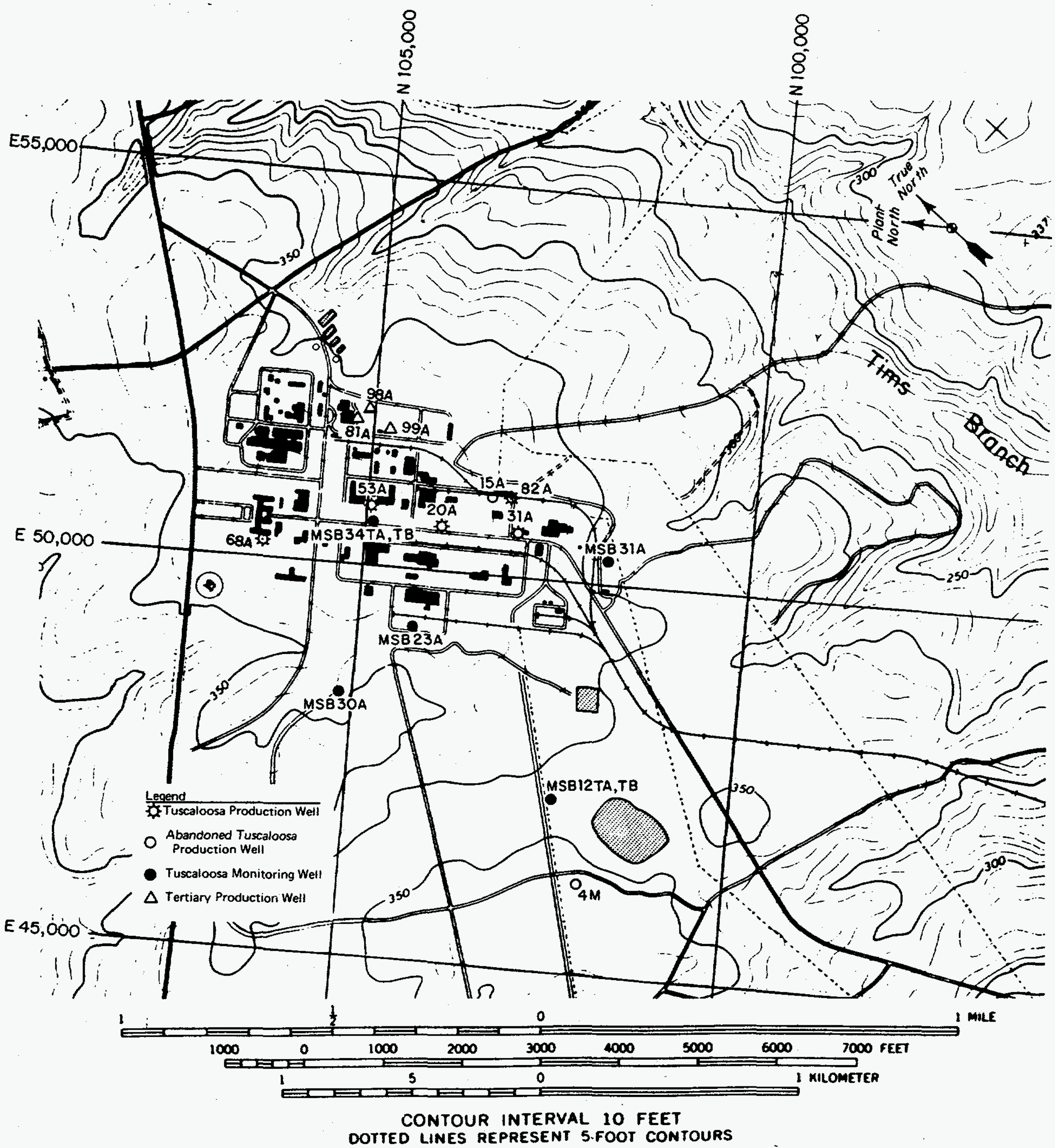
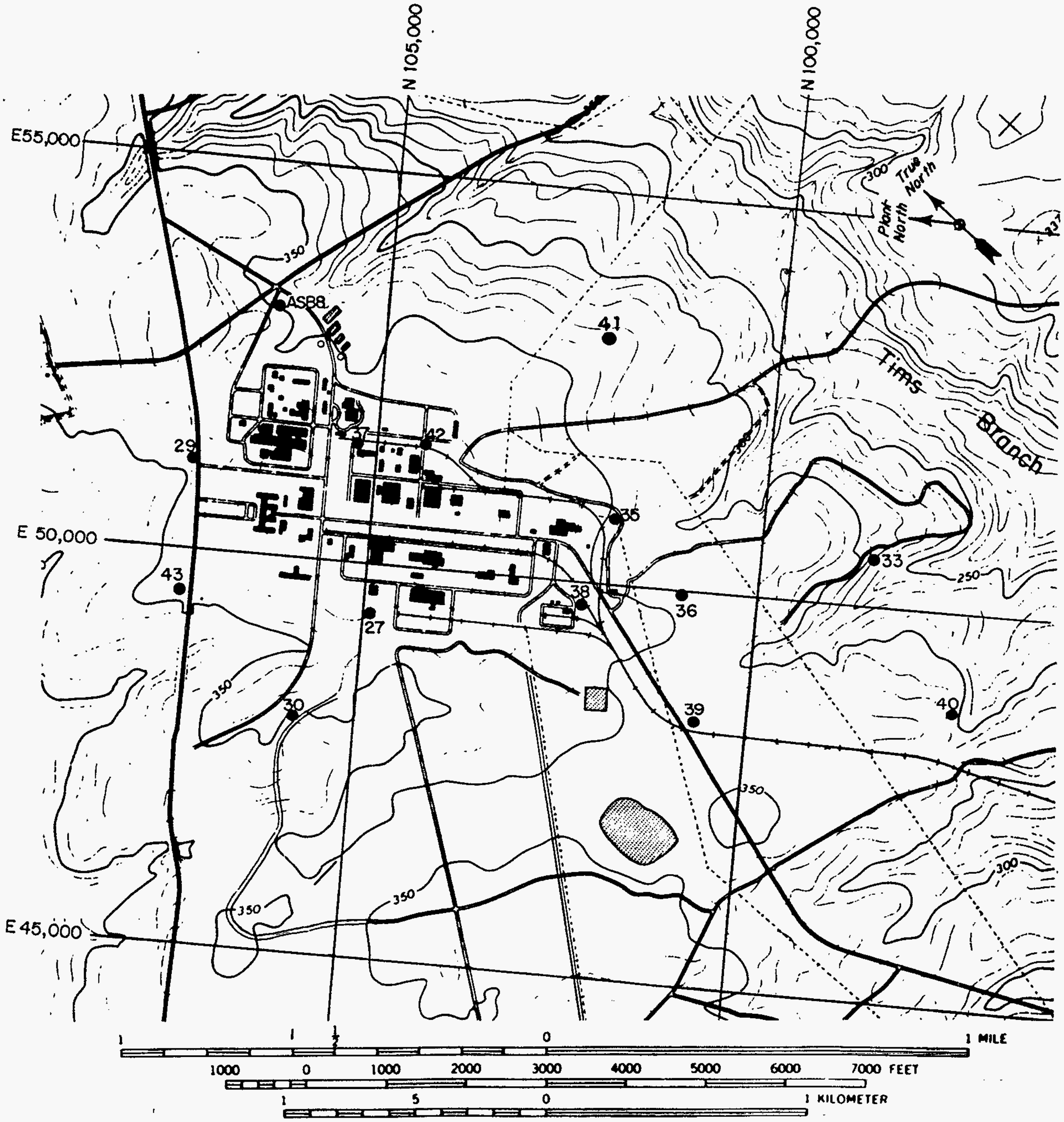


FIGURE 4-2. Location of Production and Monitoring Wells Screened in the "Tuscaloosa" Formation Near M Area and Production Wells Screened in the Tertiary Sediments



CONTOUR INTERVAL 10 FEET
DOTTED LINES REPRESENT 5 FOOT CONTOURS

FIGURE 4-3. Location of Proposed Monitoring Well Clusters
(Clusters are MSB unless Otherwise Noted)

5.0 GEOHYDROLOGY

5.1 Geology

Knowledge of the subsurface geology in the M-Area vicinity was increased significantly with the coring of two borings (MSB-12TA and 34TA) into the lower "Tuscaloosa" Formation (Geraghty & Miller, Inc., 1984). These two borings provided geologic samples from the ground surface to a depth of 660 feet. In addition to providing detailed lithologic logs of the underlying sediments, each boring was also geophysically logged. Geophysical logs obtained include resistivity, gamma ray, neutron, self potential, and caliper. The data obtained from these logs allows more effective extrapolations to be made for zones from which little or no material was recovered during sampling, enabling more effective identification of high permability zones in the formation and optimum selection of screen zones.

The undifferentiated Tertiary age sediments (i.e., Barnwell, McBean, and Congaree Formations) are approximately 250 feet in thickness, and overlie the Ellenton Formation of Cretaceous age (or as now appears more probable, Paleocene age) which is on the order of 40 to 60 feet in thickness and is found between depths of ~240 to 300 feet below the ground surface (Figure 3-2). The Ellenton Formation consists characteristically of dark-gray to black sandy lignitic micaceous clay interbedded with medium to coarse sand. However, the presence of distinct dark gray clays characteristic of the Ellenton Formation was not encountered in each boring that penetrated into the "Tuscaloosa" Formation. In the absence of these dark clays it is difficult to visually distinguish the contact between the Ellenton and the Congaree Formations above and the "Tuscaloosa" Formation below. In the areas where characteristic Ellenton lithologies were not penetrated it is probably due to the fact that M Area is located near the northernmost extension of the formation which is shown pinching out by Siple (1967) along the northwest boundary of SRP. Where these dark clays are present, the Ellenton can generally be easily distinguished from the underlying variegated clays of the upper "Tuscaloosa" Formation.

In general the "Tuscaloosa" is found at a depth of approximately 300 feet below the ground surface in the M-Area vicinity (Figure 3-2). The "Tuscaloosa" Formation consists of beds of fine to coarse grained quartz sand and gravel interbedded and intercalated with kaolonitic clays and silts. The results of both the geologic sampling and the geophysical logging indicate that the "Tuscaloosa" can be divided into two hydrogeologic units, an upper and lower, separated by relatively thick clay units on the order of 35 to 40 feet in thickness between depths of approximately 490 and 530 feet below the ground surface. The continuity of this aquitard is not known although it is present at other drill locations across the plantsite (Figure 3-1). The zone is more of a distinct clay unit at drill site MSB-34 than at MSB-12 where the zone is more of a heterogeneous mixture of clays and sandy, silty clays. Figure 5-1 is a geologic section incorporating three of the "Tuscaloosa" borings sites (MSB-34, MSB-23 and MSB-12). The section is along a north-south line (Figure 4-2) slightly off the regional dip which is to the southeast.

5.2 Subsurface Hydrology

5.2.1 Recharge

It is presumed that in a small area, such as the A/M Area, rain falls uniformly over the entire area. Although this may not be true for individual storms, especially summer thunderstorms, it is undoubtedly true when averaged over a year. The effect of rainfall on recharge to the groundwater is probably even more uniform in space due to the attenuation of individual rainfall events in passing through the unsaturated zone, which is greater than 100 feet thick in the A/M Area. Although buildings and parking lots may cause some redistribution of the entry of rainfall into the ground, this probably does not have a major effect on groundwater recharge. The water diverted from a building or parking lot usually is not transported far from the facility before discharging to the ground. Thus the effect would be quite local even without the attenuation caused by the greater than 100-foot depth to the water table.

The same statements cannot be made about water discharges that do not originate with immediate rainfall. For example, process and cooling water pumped from the "Tuscaloosa" Formation passes through M-Area facilities and is discharged to the M-Area settling basin, thence to a seep area, and on to Lost Lake or to the A-14 or M-2 outfalls (Figure 5-2). These seepage areas provide a continuous recharge to the water table in this particular locality, which is not present in the general area. Thus, this factor probably influences to some extent the shape of water table contours. Figure 5-2 shows the surface locations of seepage areas where water has historically entered the ground in addition to the rainfall that is presumed to be evenly distributed over the area.

The sewer outfall at A-14 receives storm runoff and noncontact cooling water. In addition the A-14 outfall receives storm runoff and noncontact cooling water pumped from outfall M-2 up to a maximum of 650 gallons per minute, which has been the limit of the lift station pumps. Above this maximum the water discharges from M-2 outfall and spreads out as shown on Figure 5-2. A project is in progress to increase the capacity of the lift station pumps to 950 gpm. When this is completed water will rarely overflow to M-2. In the past A-14 has been an important receiver of process sewer waste as well as noncontact cooling water and storm runoff. Initially all process wastes (Buildings 313-M and 320-M) went to A-14. Building 321-M was completed in 1957, and to prevent uranium discharges to surface streams, the settling basin was built and began receiving process waste discharges from Building 321-M. The discharges to the M-Area basin were increased in 1973 and again in 1976, when portions of Building 313-M were tied into the settling basin effluent pipeline to reduce uranium discharges to Tims Branch. Consequently the discharge to the A-14 outfall decreased. In order to eliminate the discharge of low pH water to surface streams, all effluents (including 320-M) except for noncontact cooling water were rerouted to the settling basin on May 22, 1982.

After one or two years of use (i.e., ~1960) the settling basin became partially plugged to water seepage and began to overflow along a ditch that went to Lost Lake. Usually the overflow reached Lost Lake, but occasionally all of the basin overflow seeped into the ground in a low spot between the settling basin and Lost Lake. This was the case in 1979 when the average discharge was about 330 gpm (Martin, 1984) and Lost Lake was completely dry. After the diversion of all process water from A-14 to the settling basin, the flow was about 550 gpm and Lost Lake began to fill. Noncontact cooling water was segregated and sent to outfalls A-14 and M-2 in August 1982. In late September 1982 the depression receiving the water from M-2 began to fill, and water began to spread to the northwest and southwest. In December 1982 a pump was installed to divert water from M-2 outfall to A-14, but the depression still receives storm runoff and noncontact cooling water that is in excess of the pumping capacity (650 gpm), which occurs only during thunderstorms.

As shown on Figure 5-2 water is discharged from the northern part of A Area through the A-1, A-3, A-4, and A-5 outfalls to another tributary to Tims Branch. Several outfalls (A-7, A-8, A-9, and A-11) in the northeastern part of A Area drain to a standing body of water.

Several studies of groundwater recharge have been made in the vicinity of SRP, using regional base stream flow (Cahill, 1982; Hubbard, 1984; Parizek and Root, 1984). These studies all conclude that the recharge is about 15 inches per year. In the absence of specific studies or detailed knowledge of the recharge in A/M Area, it is presumed that 15 inches per year is applicable to this area also.

Recharge to the water table could be affected by the geology of the unsaturated zone. For example, extensive clay layers near the surface might reject recharge in one area and divert it laterally to another area. In addition, this would cause the existence of an extensive perched water table. Geologic samples in numerous areally distributed borings do not indicate the existence of an extensive continuous clay layer in the unsaturated zone of A/M Area, even though the thin "Tan Clay" is encountered at a number of borings. In addition, there is no indication of an extensive perched water body. A temporary perched water body was indicated in one of the early borings around Lost Lake. This perched water body may have even been larger since 1982 when discharge from M Area was increased. However, it is not believed that the existence of these relatively local and, in the absence of enhanced recharge, temporary perched water tables have a significant effect on the quantity or distribution of recharge to the permanent water table.

5.2.2 Potentiometric Maps and Groundwater Velocity

A water-table map constructed from water-level measurements made in July 1984 in monitoring wells installed mainly for the M-Area investigation is presented on Figure 5-3. (Water level data are given in Appendix F.) A total of 44 water levels in water table wells were used in the construction of the map. As can be seen from the map, a water-table high exists northeast of the M-Area basin. The water table is about 115 feet below the ground surface around the settling basin. The water table appears to reflect the increased water disposal at the M-2 outfall (Figure 5-2) and the seep area between Lost Lake and the settling basin.

The water-table gradients range from about 0.002 to 0.008 ft/ft. The steeper gradients are in the direction of Tims Branch which is the nearest discharge point for the water table aquifer. Using the transmissivity of 570 ft^2/day calculated from the 30-day pump test (discussed in Section 5.3) and assuming the average saturated thickness of the Tertiary formations to be 110 feet, an average hydraulic conductivity of 5.18 ft/day (570 ft^2/day ÷ 110 ft) is obtained. The average flow velocity at the water table in the Tertiary formations can be calculated using the expression $V = IK/E$

where:

V = Flow velocity (ft/day)

I = Water table gradient (ft/ft)

E = Effective porosity (dimensionless)

K = Hydraulic conductivity (ft/day)

Using the average hydraulic conductivity of 5.18 ft/day and an assumed effective porosity of 0.20 (Section 5.3.4), the flow velocity would range from about 19 to 75 ft/yr for gradients of 0.002 to 0.008 ft/ft, respectively. This compares to estimated flow velocities of 20 to 25 ft/yr reported in the preliminary technical data summary, which was calculated using results of the 3-day pumping test and a gradient of about 0.003 which exists west of the basin. As mentioned, the higher gradients, and therefore probably the greater velocities, exist in the Tims Branch drainage.

A potentiometric map of the interval between elevations of 146 and 187 feet, or about 50 feet beneath the discontinuous "Green Clay" (within the Congaree Formation) is shown on Figure 5-4. This map shows a gentler gradient than the higher interval but has the same general pattern. A lobe apparently originates in the vicinity of the seep area, which was present but not as prominent in the water table map (Figure 5-3).

The potentiometric map of the interval between elevations 100 and 144 feet i.e., in the basal Tertiary sediments is shown in Figure 5-5. This interval was thought to be at the base of the Congaree Formation, but Paleocene fossils indicate that perhaps it is within the Ellenton Formation. The magnitude of the gradient is much gentler than the interval above. In addition, the direction of gradient has shifted more toward Upper Three Runs Creek, which should be the discharge point for water in this deep Tertiary zone. The water levels in this lower interval are below those in the intermediate zone (Figure 5-4) except for the last well to the south where the lower zone has a water level about 4 feet higher than the intermediate zone. This is approaching the area where the pressure surface of the "Tuscaloosa" becomes higher than that of the Congaree as shown on Figure 3-4.

The potentiometric map of the upper "Tuscaloosa" Formation, shown in Figure 5-6, indicates a swing back to a more southerly direction under the influence of drainage toward the Savannah River. The "nose" that is prominent in all of the Tertiary maps caused by drainage to Tims Branch, Upper Three Runs Creeks, and the Savannah River swamps is absent from the "Tuscaloosa" map which is only influenced by the Savannah River Valley. This gradient is consistent with the regional gradient (Christensen and Gordon, 1983, Figure 3-11).

The vertical gradients (the potential for water to move downward into underlying formations) can be measured by installing wells in different formations and at increasing depths from the water table. Measurements of water levels taken at different drill sites in the M-Area vicinity showed a continuing decrease in head with increasing depth, indicating that M Area is located within a potential recharge zone of the "Tuscaloosa" Formation. "Tuscaloosa" monitoring wells were installed at several cluster locations (MSB-12, 23, 30, 31, 34) for the purpose of obtaining additional information on the vertical head distribution with depth. The measured vertical hydraulic head distribution at two of these sites are presented on Figures 5-7 and 5-8. These measurements show a head difference of approximately 23 to 25 feet between the base of the Tertiary sediments and the underlying "Tuscaloosa." It is anticipated that this differential would decrease toward the Savannah River Valley and finally reverse.

Using an average vertical hydraulic conductivity for the Ellenton/"Tuscaloosa" clays of 0.0004 ft/day, an average effective porosity of 0.07 (Table 5-1), a hydraulic head drop of 24 feet across the Ellenton (Figures 5-7 and 5-8), and an average clay thickness of 40 feet, a calculated vertical groundwater flow velocity of 1.3 ft/yr is obtained for flow across the Ellenton Formation.

What cannot be estimated from laboratory measurements is the continuity of the clays and the amount of interconnection or communication that may occur across the Ellenton clays between the Tertiary sediments and the "Tuscaloosa" Formation. This can only be determined by pumping test. From the "Tuscaloosa" pumping test conducted by Geraghty & Miller, Inc. (1983), an average leakance value of 1.1×10^{-3} gpd/ft^3 was calculated across the Ellenton Formation. If the Ellenton clay is 40 feet in thickness, the leakance would translate to a hydraulic conductivity of 5.8×10^{-3} ft/day, which is about an order of magnitude higher than the laboratory values. Using this value, the vertical flow velocity should be about 19 ft/yr and water should traverse the Ellenton in about 2 years. This is probably a more applicable calculation than that using the laboratory values.

Using these same values, the leakage through the Ellenton Formation is about 10 gallons per square foot per year. The general A/M Area is about 5000 ft by 5000 ft making an area of 25 million ft^2. Thus in this area about 250 million gallons per year may be recharging the "Tuscaloosa." Pumpage from the "Tuscaloosa" is about 650 million gallons per year from A/M Area. The remainder is made up from lateral flow in the "Tuscaloosa"

The horizontal groundwater velocity in the Tuscaloosa is estimated at 170 ft/yr using a hydraulic conductivity of 40 ft/day (Section 5.3.5), a gradient of 0.0023 (Figure 5-6), and an effective porosity of 20 percent. The horizontal flux in the "Tuscaloosa" through a 5000 foot section of the A/M Area estimated to be 400 feet thick would be 500 million gallons per year.

5.2.3 Water-Level Fluctuations

The horizontal gradients discussed in Section 5.2.2 are generalized and only 5-foot contour intervals are used on Figures 5-3, 5-4, 5-5, and 5-6. Due to fluctuations of several feet in several months, gradients may change but these are only applicable for a brief period of time. Using only the wells around the settling basin from April 1980 to August 1981, the water table gradient under the seepage basin shifted 45° in a generally westward direction with a water level change of 1.6 feet. Such an alteration in gradients should be anticipated in other areas also.

Figures 5-9 through 5-13 show hydrographs of wells in clusters MSB 10, 11, 12, 17, and 34, respectively. The water-level fluctuations shown on these graphs are believed to be typical of the area (i.e., seasonal fluctuations). The longest record on these graphs is 2-1/2 years. A much longer record exists at well S-15, which is about 1500 feet west of the settling basin (Figure 4-1) and screened about 25 feet below the water table. The total fluctuation in the water level in this well is a little over 10 feet as shown on Figure 5-14.

5.2.4 Groundwater Discharge

After flowing both vertically and laterally, groundwater is discharged naturally to springs and seeps in the nearby stream valleys. Water from the water table discharges to Tims Branch and to the swamps southwest of A/M Area. The water table also slopes towards and discharges to Hollow Creek. Water from the lower part of the Tertiary section flows toward and discharges to Upper Three Runs Creek and the swamps southwest of A/M Area. Water from the "Tuscaloosa" discharges to the Savannah River Valley. Three-dimensional numerical simulations are currently being pursued in order to quantify the flow, leakage, and discharge from each of these units.

5.3 Hydraulic Properties

The hydraulic properties of the geologic framework determine rate of groundwater movement, which will be of paramount importance during recovery operations. The properties of most importance are the transmissivity/permeability, porosity, storativity, and leakance.

5.3.1 Laboratory Tests

The results of laboratory tests performed on undisturbed samples taken from the clayey units of the Ellenton and upper

"Tuscaloosa" Formations are presented on Table 5-1. A total of five samples were shipped to Law Engineering Testing Company's soils laboratory in Atlanta, GA for analysis. Parameters measured included unit weight, moisture content, void ratio, specific gravity, porosity (total and effective), permeability (vertical and horizontal), and grain size distribution. Effective porosity and permeability (hydraulic conductivity) are the most important in evaluating the ability of geologic materials to transmit water. Effective porosity is a measure of the amount of interconnected pore space available for fluid transmission, while hydraulic conductivity is a measure of the ease with which water can be transmitted through a porous material. The results of the vertical permeability measurements of the samples ranged from 4.0×10^{-7} to 5.2×10^{-9} cm/sec (1.1×10^{-3} to 1.1×10^{-5} ft/day), and the horizontal permeability measurements ranged from 5.7×10^{-7} to 1.1×10^{-8} cm/sec (1.6×10^{-3} to 3.1×10^{-5} ft/day) indicating that the clays transmit water extremely slowly.

The effective porosities determined for these samples are also low, ranging from 0.024 to 0.137 (dimensionless). These compare to average effective porosities of 0.20 and 0.30 generally used for the Tertiary and "Tuscaloosa" sands, respectively.

5.3.2 Recovery Tests On Observation Wells

Table 5-2 gives the results of tests on individual wells where the recovery of the water level is measured after pumping the well for some period of time. Calculation of transmissivity from these tests is extremely crude because most of the wells have only 10 foot screens, and thus flow to the screen is semi-spherical instead of two-dimensional as assumed in the analysis. Since all the water level measurements are in the same well from which the withdrawal took place, they are also influenced by the development of the well. Thus low apparent transmissivities may be due to inadequate development. Nevertheless the values obtained may be useful because they are areally distributed and do represent an approximate value for transmissivity.

5.3.3 Water Injection Test on Well MPT-1

The 72-hour pumping test reported in the Preliminary Technical Data Summary, DPSTD-82-69, affected observation wells at different depths (Figure 5-15) in an unpredictable manner. Specifically observation well MSB-11F, a water table well 30 feet from the pumping well, showed no drawdown at all. Because there was difficulty in developing well MPT-1, there was speculation that perhaps parts of the screened zone were selectively developed, such that one or a few restricted zones might be yielding all the water. In order to determine how uniformly the screen zone was developed, 60 gpm was injected into the well while making velocity measurements with a vertical, cable hung, vane-type meter. The actual measurements are in revolutions per second of the vanes. The results of this test are shown on Figure 5-16. Measurements were made in the casing at depths of 110, 115, 120, and 125 feet, and these averaged 1.5 revolution per second as shown by the vertical bar on Figure 5-16. This average is taken to represent 100 percent of the flow down the casing. From the measurements shown at various depths within the screen zone on Figure 5-16, an injection profile can be calculated, and this is given in Table 5-3. From this profile, it is concluded that although a zone near the top of the screen accepts 33 percent of the water injected, the acceptance is rather uniformly distributed throughout the length of the screen. If the yield profile of the well is the same as the injection profile, the cause for the unpredictable drawdown in the observation wells during the pumping test must be sought elsewhere than in the selective development of the screened zone.

5.3.4 30-Day Pumping Test in Tertiary Sediments

After completion of the M-Area Production Test Well (MPT-1) in June 1982, an eight-hour step-drawdown and 72-hour pumping test were performed. The results of these tests, which are discussed in the Preliminary Technical Data Summary (DPSTD-82-69), indicate an adjusted transmissivity of 1100 gpd/ft and a coefficient of storage of 0.14. Using these values it was estimated that one recovery well pumping at a rate of 30 gpm (gallons per minute) could influence an area of radius 400 feet.

Between October 18 and November 17, 1982, a 30-day continuous pumping test was conducted utilizing MPT-1 (Bledsoe, 1983). The objectives of this test were: 1) to attempt to physically develop the cone of depression at the water table for comparison with the calculated rate of growth from the 72-hour test, and 2) to obtain additional chemical data and establish a better basis for organic concentration in the feed stream to the reference groundwater treatment process (air stripping). A schematic illustration of the screen zones of the pumping and observation wells is given in Figure 5-15.

As with the 72-hour test, the 30-day test was conducted at a constant discharge rate of 30 gpm. A total of 1.25 million gallons of water was removed from the aquifer during the test.

The drawdown in the pumping well during the 30-day test was similar in shape to that in the 72-hour test except that the drawdown was less (Figure 5-17). The drawdown at the end of the 30-day test was 7 to 9 feet less than that for the 72-hour test, even though both tests were conducted at 30 gpm. The maximum drawdown in the 72-hour test was 35 feet and that in the 30-day test was 27 feet. Observation wells MSB-11B and 11C were the most responsive (Figure 5-18). The drawdown in MSB-11B was 2.02 feet at the end of the 72-hour test and 2.60 feet at the end of the 30-day test. The comparison of drawdowns in the observation wells is what one would expect, i.e., the greater drawdown from the longer test. Coupling of the information from the observation wells and the pumping well indicate that the pumping well underwent some additional development between the two tests. The only event to have occurred at the MPT-1 between the two tests was the injectivity test. This test was described in Section 5.3.3. As can be seen from the two drawdown curves (Figure 5-17), the results closely parallel each other except for the observed drawdowns.

As with the 72-hour test, data from observation well MSB-11C were more amenable to analysis than data from the other observation wells and thus were used for analysis of the 30-day test. The test data for MSB-11C were plotted on log-log paper (Figure 5-19) for analysis using Boulton's (1963) method for unconfined aquifers with vertical movement. The type curve used in the analysis is superimposed on the MSB-11C data points on Figure 5-19. The results of curve matching by SRL yield a calculated transmissivity value of 4200 gpd/ft (570 ft^2/day) and a storage coefficient of 0.27. Adjusting the calculated values to fit the observed field data for MSB-11C after 30 days of pumping produces a transmissivity of 4200 gpd/ft and a storage coefficient of 0.20. This value for transmissivity is higher than most of those given on Table 5-2 for short term tests on monitoring wells for the reasons given in Section 5.3.2.

From the 72-hour data it was estimated that a cone of influence with a radius of approximately 400 feet could be established after pumping continuously for a period of 30 days at 30 gpm with a predicted drawdown of the water table of approximately 0.5 feet. Using the hydraulic parameters calculated from the 30-day test, the maximum calculated radius of the cone of depression would be approximately 350 feet.

Raw field data from the 30-day pumping test were also independently analyzed and evaluated by a Geraghty & Miller hydrogeologist. The results of the Geraghty & Miller analysis indicated a transmissivity of approximately 4300 gpd/ft with a storage coefficient of 0.22 which is in good agreement with the results calculated by SRL.

No water level declines that could be attributed to the pumping well were observed at observation wells more distant than the MSB-11 cluster (30 to 80 feet from the pumping well).

5.3.5 "Tuscaloosa" Aquifer Pumping Test

In order to determine the hydraulic properties of the "Tuscaloosa" aquifer system in M-Area vicinity, an aquifer pumping test was conducted by Geraghty & Miller, Inc. (1983) on April 23-24, 1983. Production Well 905-20A was used as the pumping well and water levels were measured in seven nearby wells including three other production wells which were shut down for the test. Two of the wells are screened in the Tertiary sediments overlying the Ellenton Formation; the other wells are all screened in the "Tuscaloosa" Formation. The locations of the wells utilized in the test are shown in Figure 5-20.

The pumping test included a three-stage step-drawdown test followed by a 33-hour continuous pumping test. The purpose of the step-drawdown test was to determine the efficiency of the pumping well (905-20A). The results of the step-drawdown test, tabulated in Table 5-4, indicate that Well 905-20A is relatively efficient. A plot of water level vs. time for the pumping well throughout both the step-drawdown test and the continuous pumping test is shown on Figure 5-21. During the 33-hour test, Well 905-20A was pumped at a constant discharge rate of 1,035 gpm (gallons per minute). Water-level measurements were taken in the other three "Tuscaloosa" production wells and the four monitoring wells, as well as the pumping well, during the pumping test and for a period of four hours during the recovery period after the pump was shut down. All water-level data were adjusted to eliminate the effects of changes in atmospheric pressure and the preceeding step-drawdown test prior to data analyses.

Geraghty & Miller (1983) analyzed the adjusted water-level data using both Hantush-Jacob (1955) leaky artesian-type curves and the Cooper-Jacob (1946) method. Data from Wells 905-82A, 905-31A, and 905-53A were used to determine transmissivity, storage coefficient, and leakance values for the aquifer. Recovery data from the pumped well (905-20A) were also analyzed to determine transmissivity by the Cooper-Jacob method. Results of the various analyses are presented on Table 5-5. On the basis of these analyses, Geraghty & Miller believes the representative transmissivity, storage coefficient, and leakance values for the "Tuscaloosa" Formation in the M-Area vicinity to be 79,000 gpd/ft, 4.2×10^{-4}, and 1.1×10^{-3} gpd/ft^3, respectively. For comparison, Siple (1967) reports a transmissivity of 90,000 gpd/ft and a storage coefficient of 3×10^{-4} for a test conducted in January 1952 using 905-20A as the pumping well and 905-31A as the observation well.

The screened zone of this well extends from a depth of 417 feet to 675 feet making a screened interval of 258 feet. Using this as the aquifer thickness, the hydraulic conductivity would be 40 ft/day.

"Tuscaloosa" observation wells MSB-23A and MSB-30A located at distances of approximately 1500 and 3000 feet, respectively, from the pumped well (Figure 5-20) were affected only slightly by the pumping and were therefore not analyzed. Hydrographs of these wells are shown on Figure 5-22. Water levels in wells screened at the water table (MSB-23) and within the mid-Tertiary (MSB-23B) also located at a distance of approximately 1500 feet from the pumped well (Figure 5-20) did not reflect the effects of pumping during this test. Hydrographs of these two wells are shown on Figure 5-23.

References For Chapter 5

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TABLE 5-1

Summary of Soil Test Results

BORING # OR LOCATION	SAMPLE NUMBER	SAMPLE DEPTH (FT.)		VISUAL DESCRIPTION	UNIT WEIGHT WET (PCF)	UNIT WEIGHT DRY (PCF)	MOISTURE CONTENT (%)	VOID RATIO e	INITIAL SATURATION (%)	SPECIFIC GRAVITY G_s	POROSITY TOTAL N_t	POROSITY EFFECTIVE N_e		PERMEABILITY FALLING HEAD CM/SEC VERTICAL	PERMEABILITY FALLING HEAD CM/SEC HORIZONT.	PERMEABILITY FT/DAY VERTICAL	PERMEABILITY FT/DAY HORIZONT
MSB-23A	UD	302-304		Light Tan Brown Silty Clayey Medium to Fine Sand	130.9	114.8	14.0	0.447	83.3	2.66				3.2×10^{-7}			
					129.1	112.5	14.8	0.476	82.7						5.4×10^{-7}		
						107.3	19.5				0.370	0.031					
MSB-30A	UD	294-296		Brown Fine Sandy Silty Clay	134.6	112.9	19.2	0.510	100+	2.73				1.5×10^{-8}			
					130.5	109.5	19.2	0.556	94.3						1.6×10^{-8}		
						114.3	17.3				0.362	0.024					
MSB-30A	UD	260-262		White Silty Medium to Fine Sand	131.4	112.7	16.7	0.474	93.7	2.66				4.0×10^{-7}			
					126.1	107.5	17.3	0.545	84.4						5.7×10^{-7}		
						110.3	16.2				0.326	0.084					
MSB-23A	UD	306-308		Light Grey Medium to Fine Sandy Silty Clay	132.4	112.6	17.5	0.486	96.5	2.68				5.2×10^{-9}			
					126.2	106.6	18.4	0.570	86.5						1.1×10^{-8}		
						114.5	12.7				0.306	0.137					
MSB-30A	UD	242-244		Grey Silty Clayey Medium to Fine Sand	137.1	121.1	13.2	0.392	90.9	2.70				4.5×10^{-8}			
											*	*			*		
				Average	130.9	112.0	16.6	0.495	90.2	2.69	0.34	0.07		1.5×10^{-7}	2.8×10^{-7}	4.2×10^{-4}	7.9×10^{-4}

*No Horizontal Permeability and Porosity Test Performed Due to Limited Amount Of Sample

TABLE 5-2

Results of Recovery Tests on Individual Observation Wells in M Area

Test No.	Well No.	Screen Zone Elevation (ft) Top	Bottom	Transmissivity (gpd/ft)
1	MSB-9C	241	221	1900
2	MSB-10A	123	118	4085
3	MSB-10B	155	150	35
4	MSB-10C	210	205	270
5	MSB-11A	135	130	70
6	MSB-11B	165	150	140
7	MSB-11C	182	177	130
8	MSB-11D	208	203	1180
9	MSB-12B	151	156	85
10	MSB-12C	183	178	2435
11	MSB-13A	135	130	2475
12	MSB-14A	164	144	2400
13	MSB-14B	194	189	180
14	MSB-14C	244	224	185
15	MSB-15A	167	162	135
16	MSB-16A	166	161	1350
17	MSB-17A	160	155	2160
18	MSB-17B	190	185	430
19	MSB-18A	162	157	130
20	MSB-18B	197	192	4980
21	MSB-18C	227	207	180
22	MSB-19A	120	115	16,500
23	MSB-19C	218	198	1725
24	MSB-20A	161	156	260
25	MSB-21C	232	212	3800
26	AC-3A	153	148	30

TABLE 5-3

Injection Profile for MPT-1

Depth of Zone from Ground Surface (ft)	Percent of Total Flow Passing Out of Zone
125-130	33.3
130-140	6.7
140-150	13.3
150-160	20
160-170	10
170-180	16.7
180-190	0

TABLE 5-4

Results from the Step-Drawdown Test on Production Well 905-20A Screened in the "Tuscaloosa" Formation

Step Number	Pumping Rate (gpm)	Total Drawdown (ft)	Specific Capacity (gpm/ft)
1	350	15.03	23.29
2	690	29.61	23.30
3	1035	42.70	24.24

TABLE 5-5

Summary of Hydraulic Properties of the "Tuscaloosa" Aquifer as Determined from a Pumping Test on Production Well 905-20A

Well Number	Transmissivity (gpd/ft)	Storage Coefficient	Leakance (gpd/ft^3)	Method Used
905-20A	77,850			Cooper-Jacob (recovery)
905-82A	79,090	4.3×10^{-4}	1.16×10^{-3}	Hantush-Jacob (drawdown)
	79,090	3.7×10^{-4}		Hantush-Jacob (recovery)
	79,970	4.3×10^{-4}		Cooper-Jacob (drawdown)
905-31A	95,520	4.7×10^{-4}	1.09×10^{-3}	Hantush-Jacob (drawdown)
	79,050	4.0×10^{-4}		Hantush-Jacob (recovery)
	85,390	4.2×10^{-4}		Cooper-Jacob (drawdown)
905-53A	84,690	8.2×10^{-4}	3.25×10^{-3}	Hantush-Jacob (drawdown)
	79,050	8.7×10^{-4}		Hantush-Jacob (recovery)
	105,910	6.8×10^{-4}		Cooper-Jacob (drawdown)

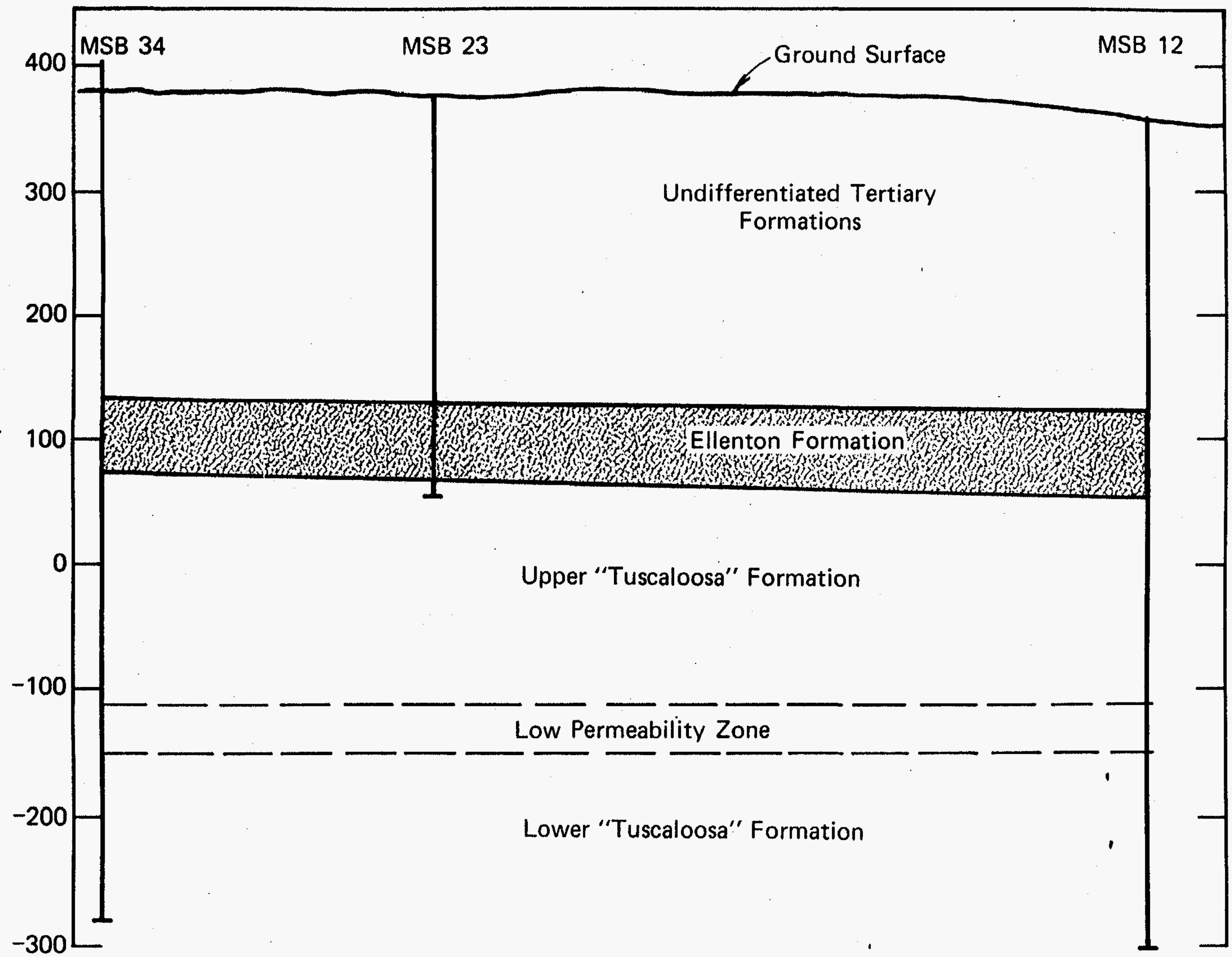

FIGURE 5-1. Geologic Section Emphasizing the Ellenton and "Tuscaloosa" Formations from MSB 34 to MSB 12

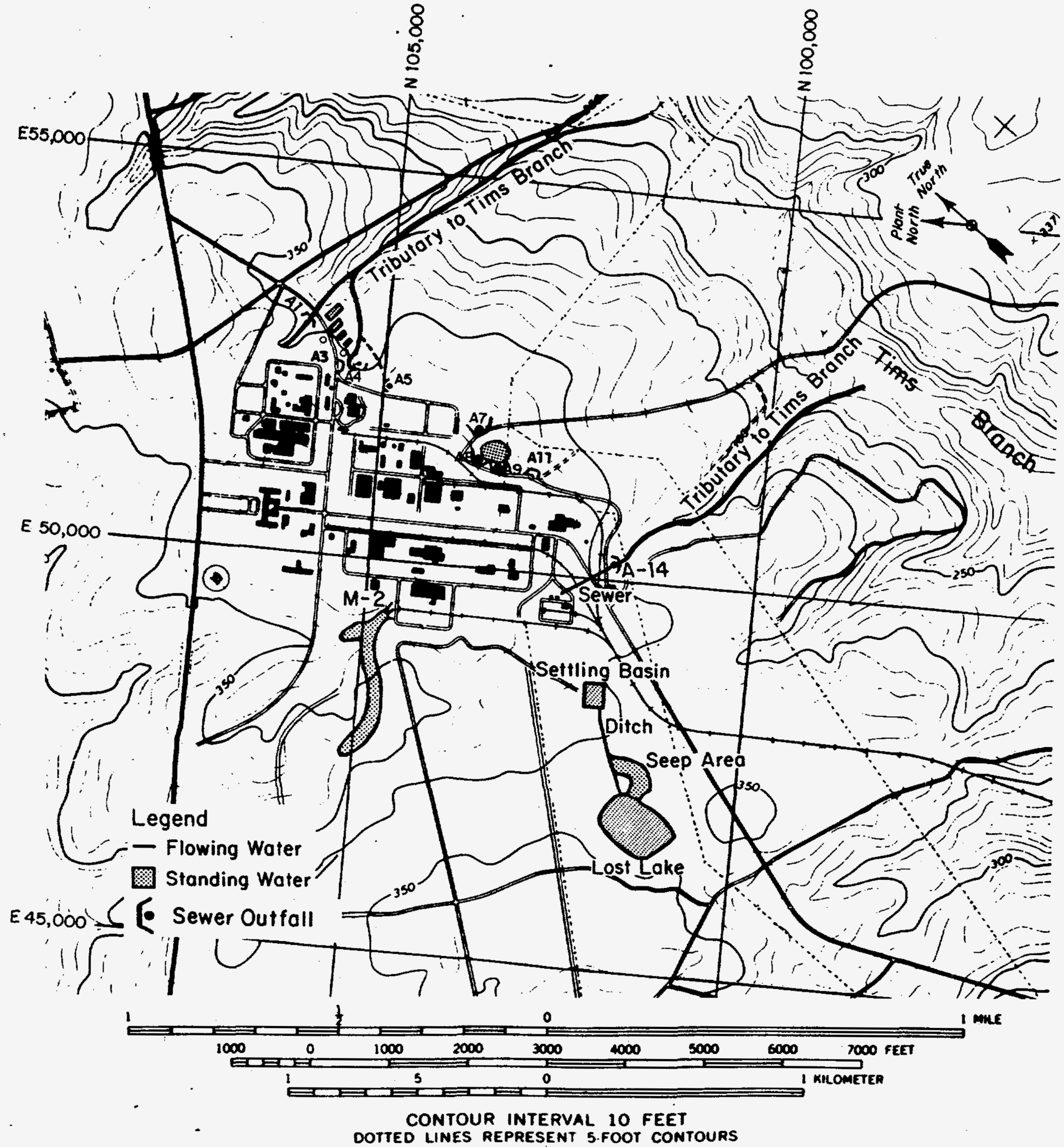

FIGURE 5-2. Location of Water Disposal Areas
(Summer 1984)

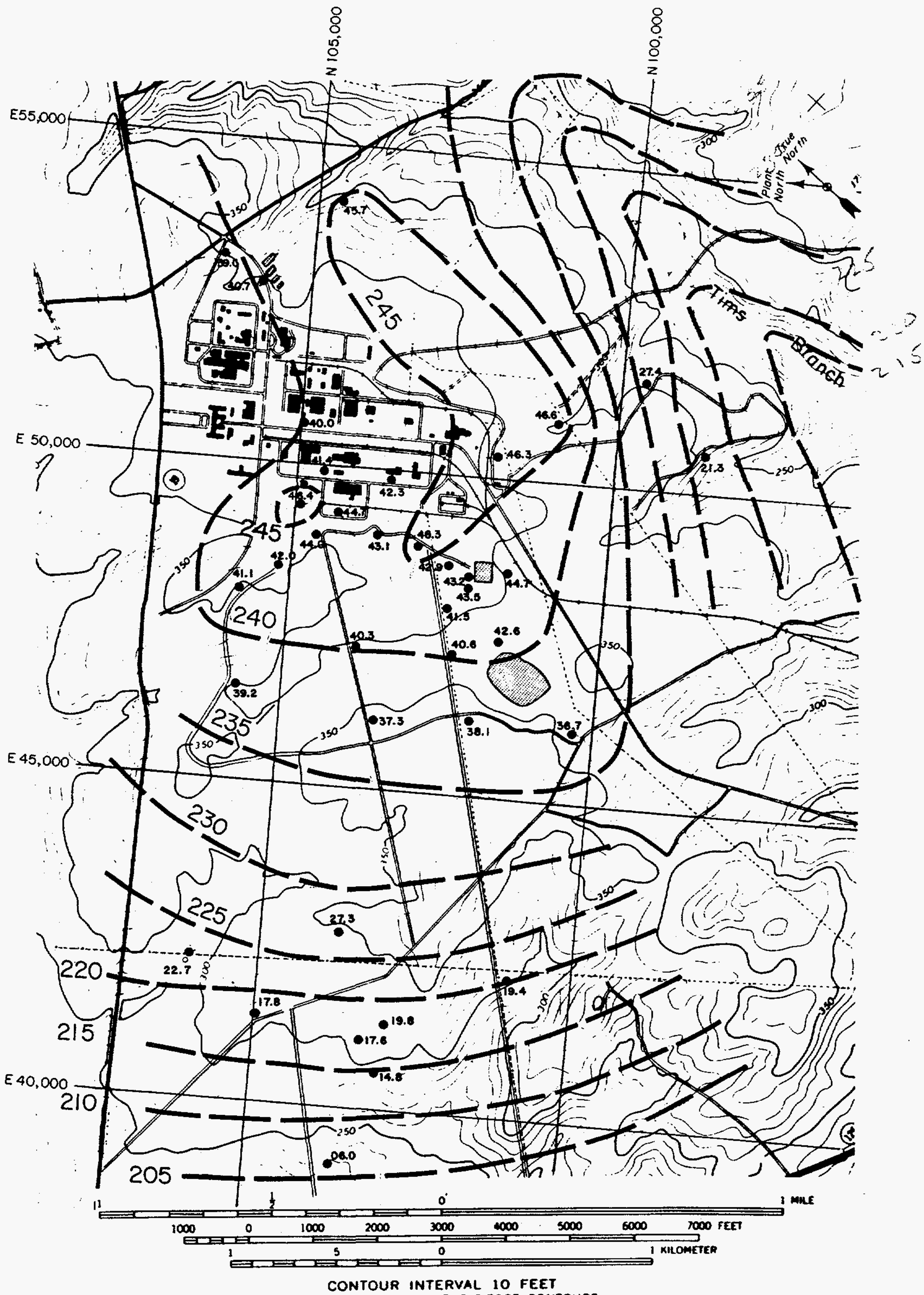

FIGURE 5-3. Water Table Elevation Map for Spring 1984 (Values are in feet. For the data point the first digit, i.e., 200, is omitted to avoid crowding of the numbers.)

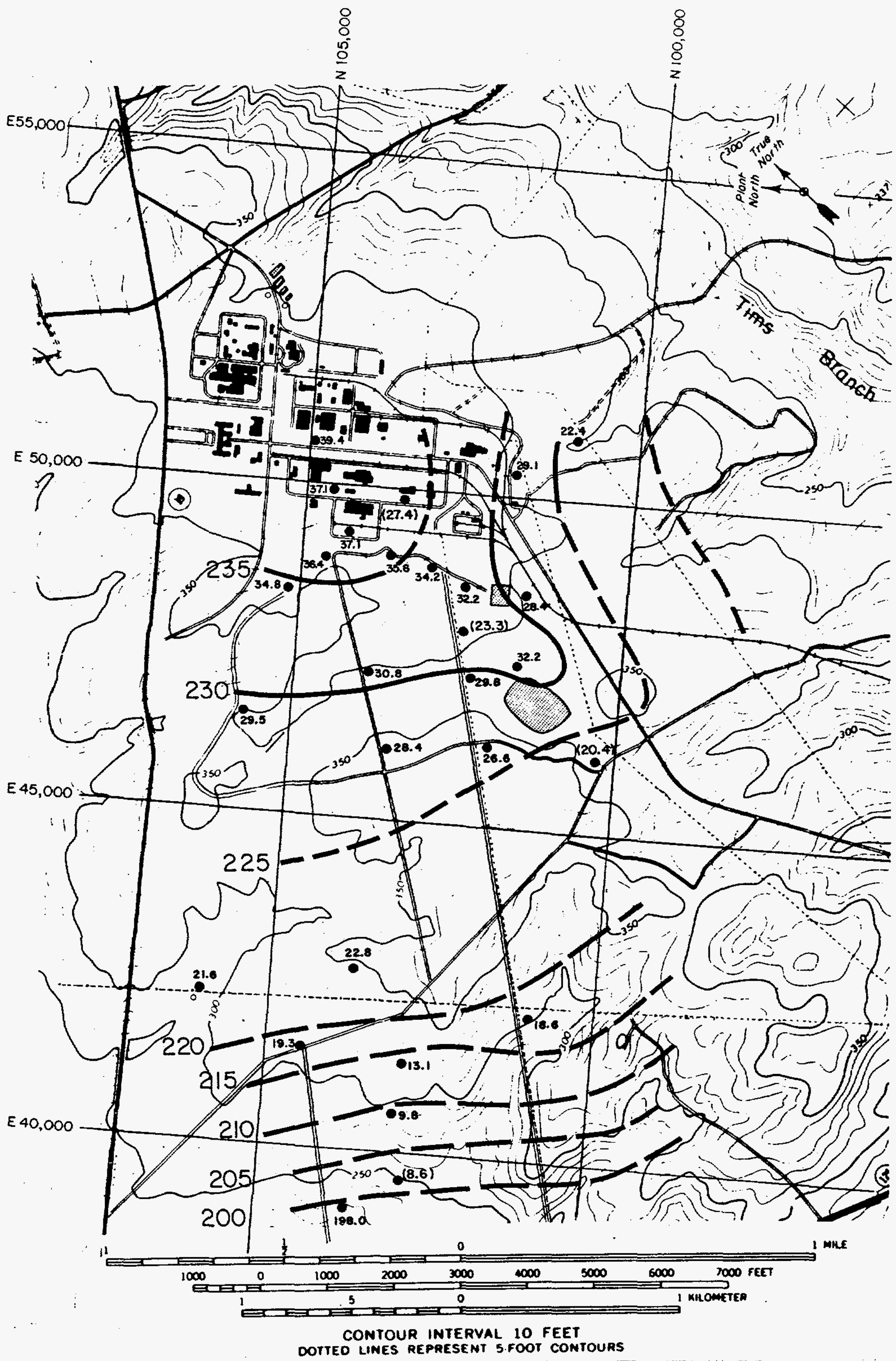

FIGURE 5-4. Potentiometric Map of the Elevation Interval where the Top of Screen is Between 146 and 187 ft, i.e., ~50 ft Below the "Green Clay", for April-June 1984
(Parentheses indicate the water level in a well screened within the elevation interval that is not used in drawing contours. Anomalous water levels within this elevation interval could be caused by local clay layers causing greater head loss for water to enter sand layers. All water levels not used in contouring are lower than those in surrounding wells. None are too high.)

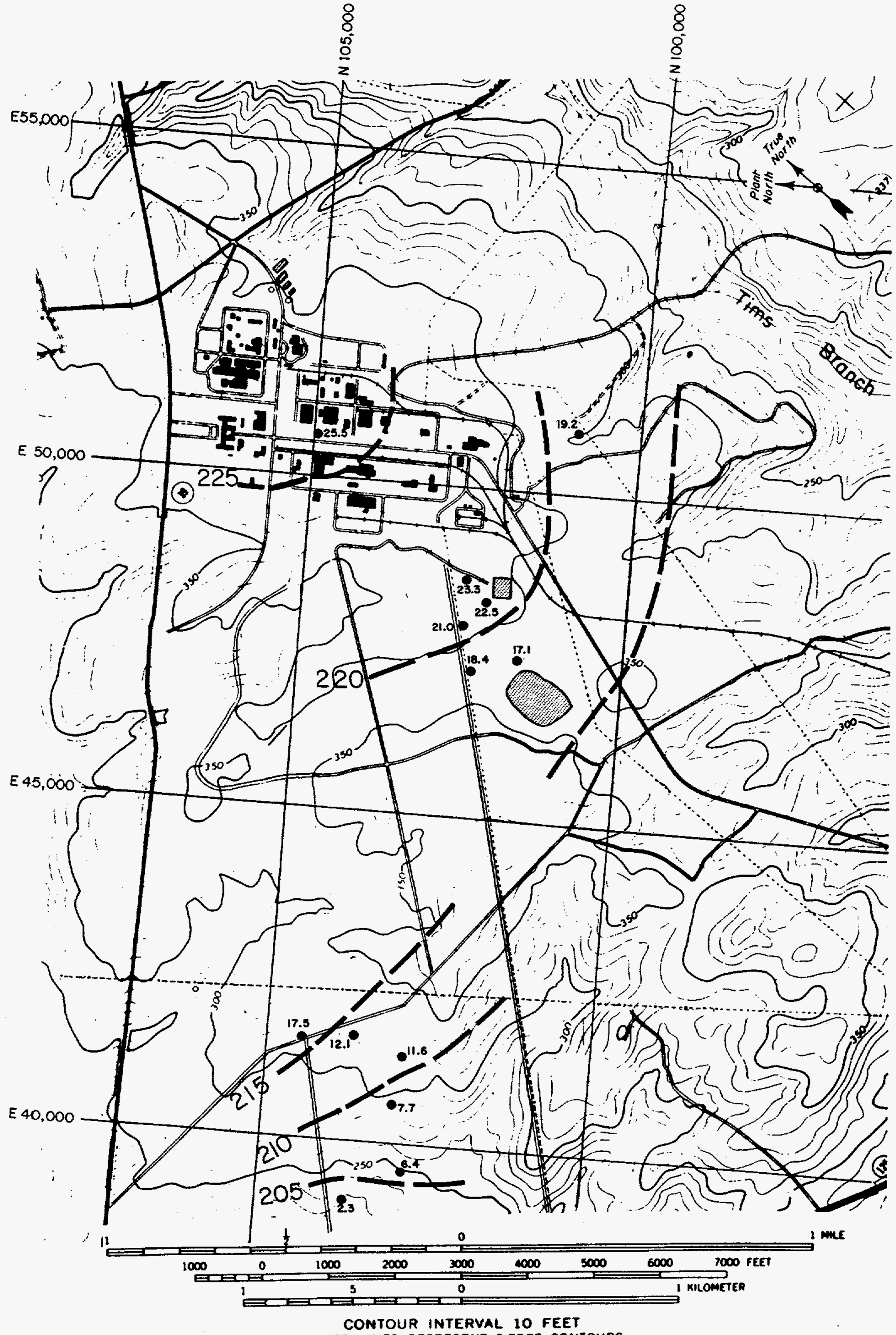

FIGURE 5-5. Potentiometric Map of the Elevation Interval where the Top of Screen is Between 100 and 144 ft, i.e., in Basal Tertiary Sediments, for April-June 1984

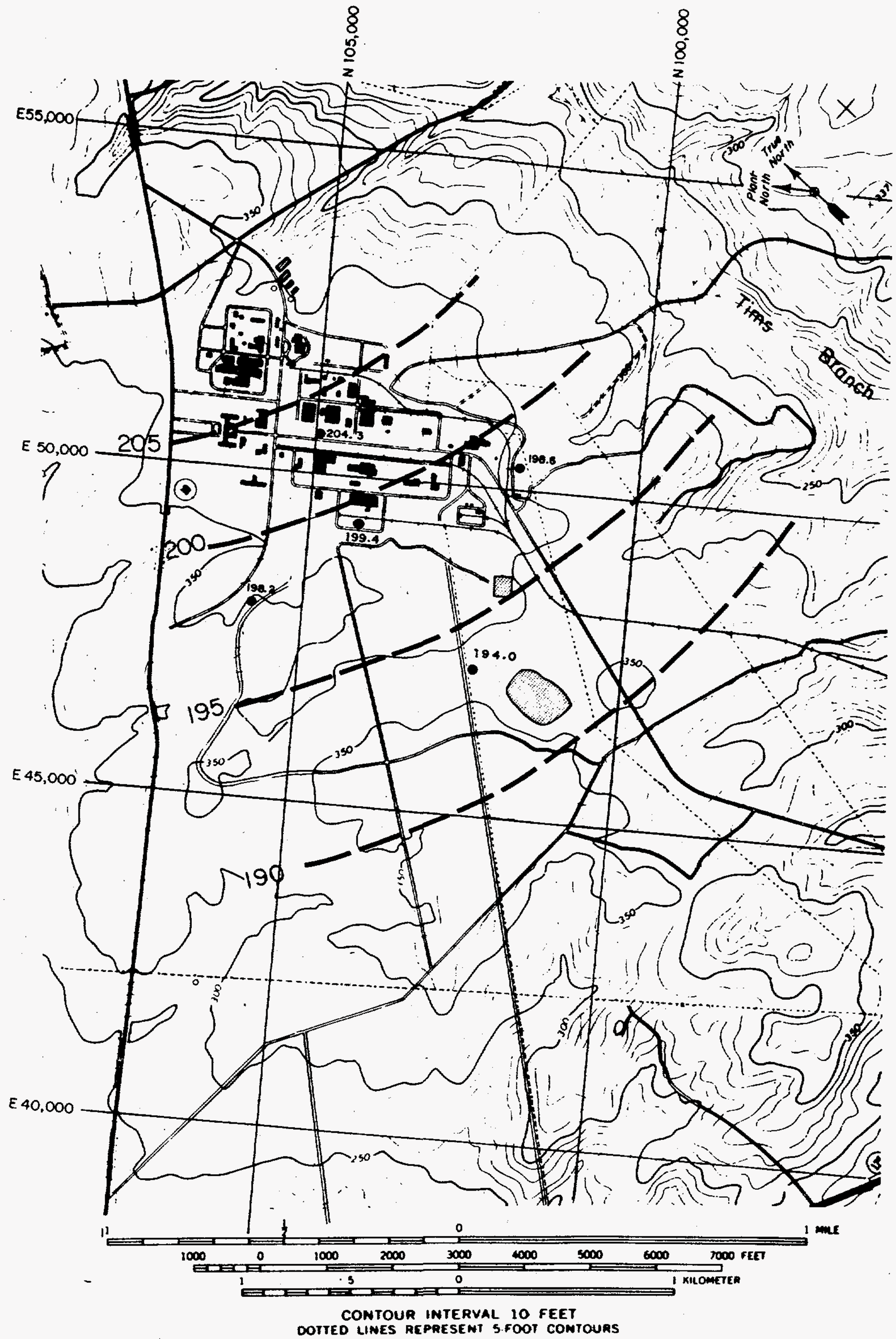

FIGURE 5-6. Potentiometric Map of the Elevation Interval where the Top of the Screen is Between 14 and 76 ft, i.e., Upper "Tuscaloosa" Formation, for May 1984

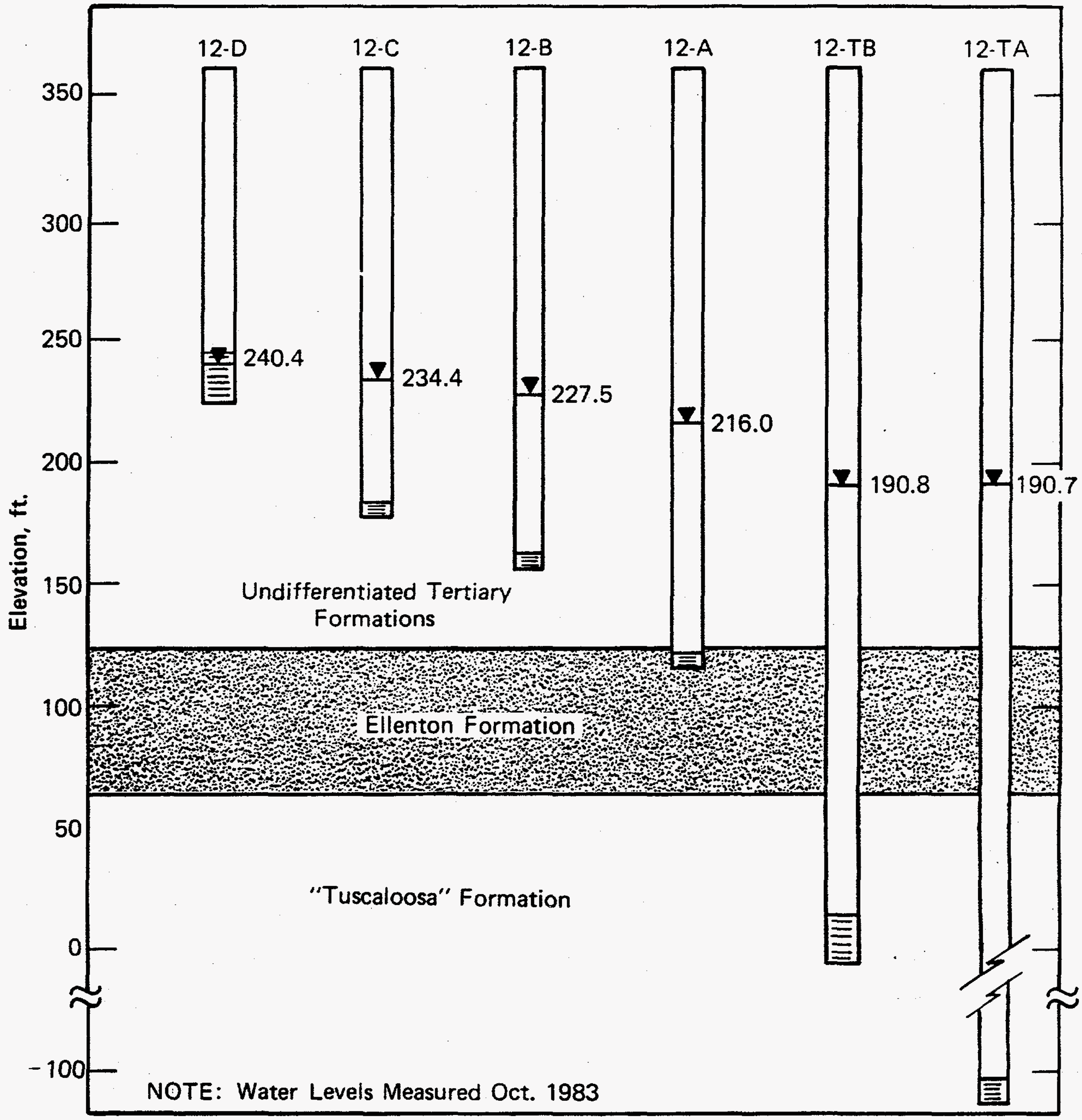

FIGURE 5-7. Water Levels at Selected Depths at MSB-12

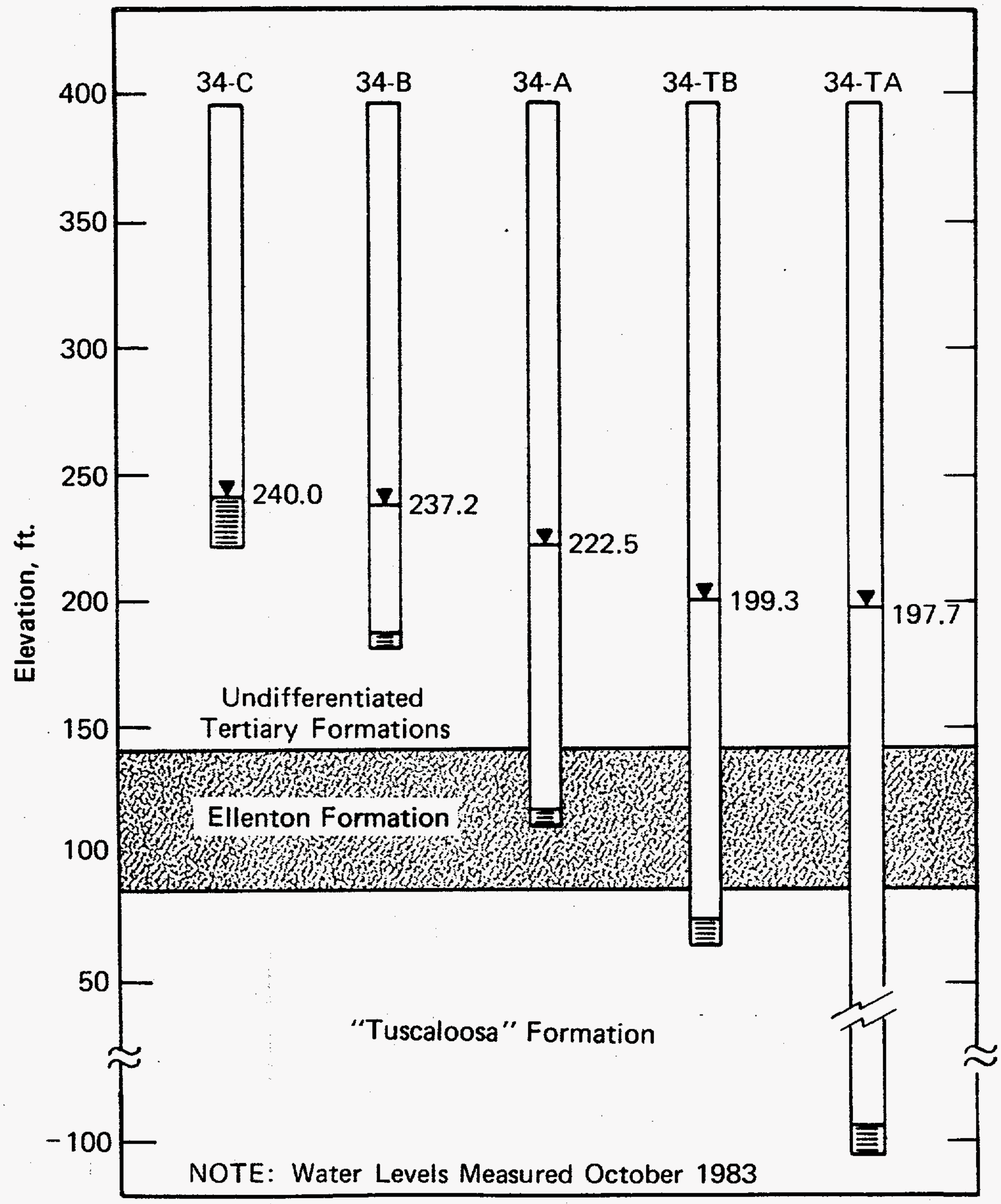

FIGURE 5-8. Water Levels at Selected Depths at MSB-34

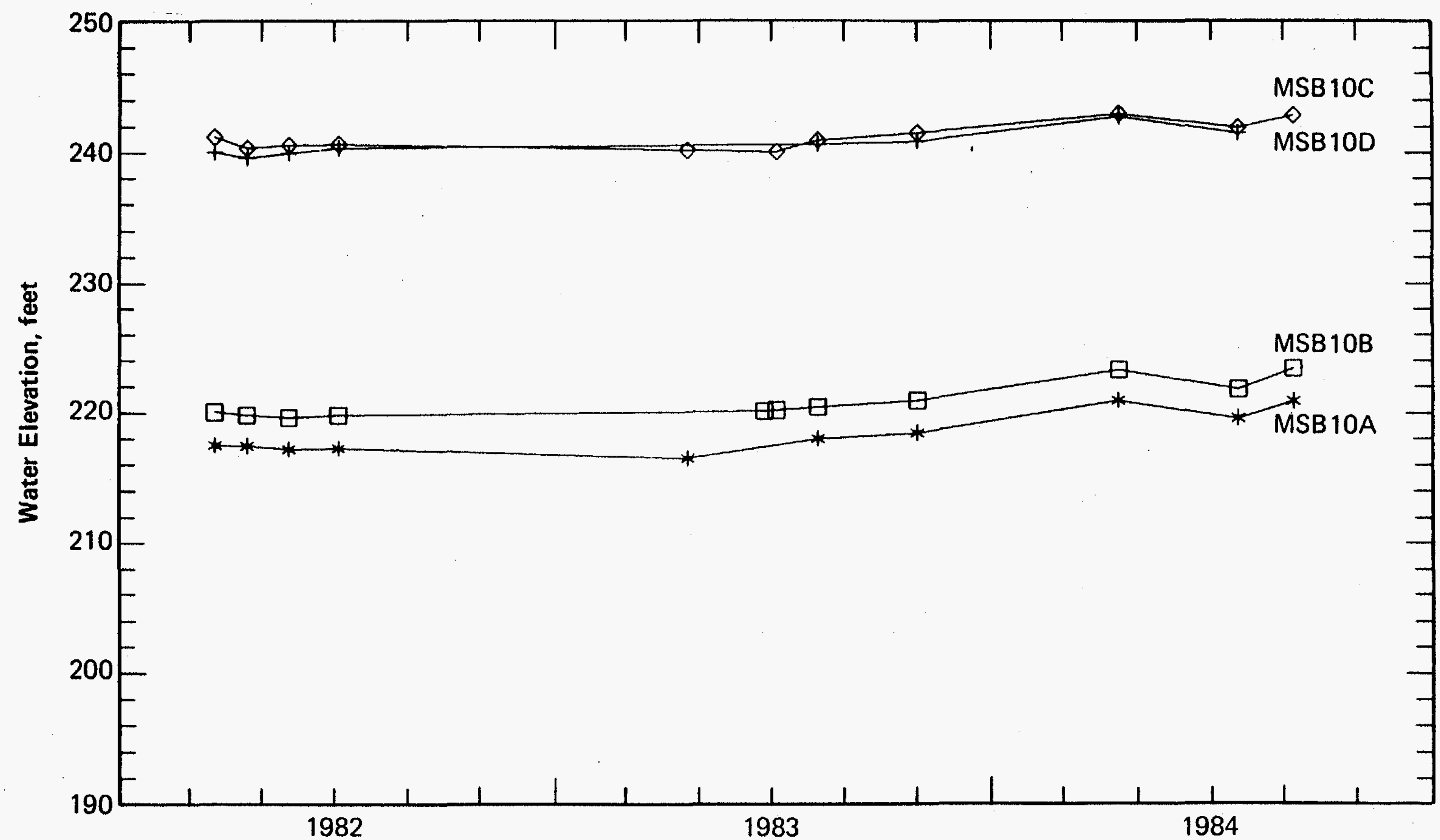

FIGURE 5-9. Hydrographs of Wells in Cluster MSB-10

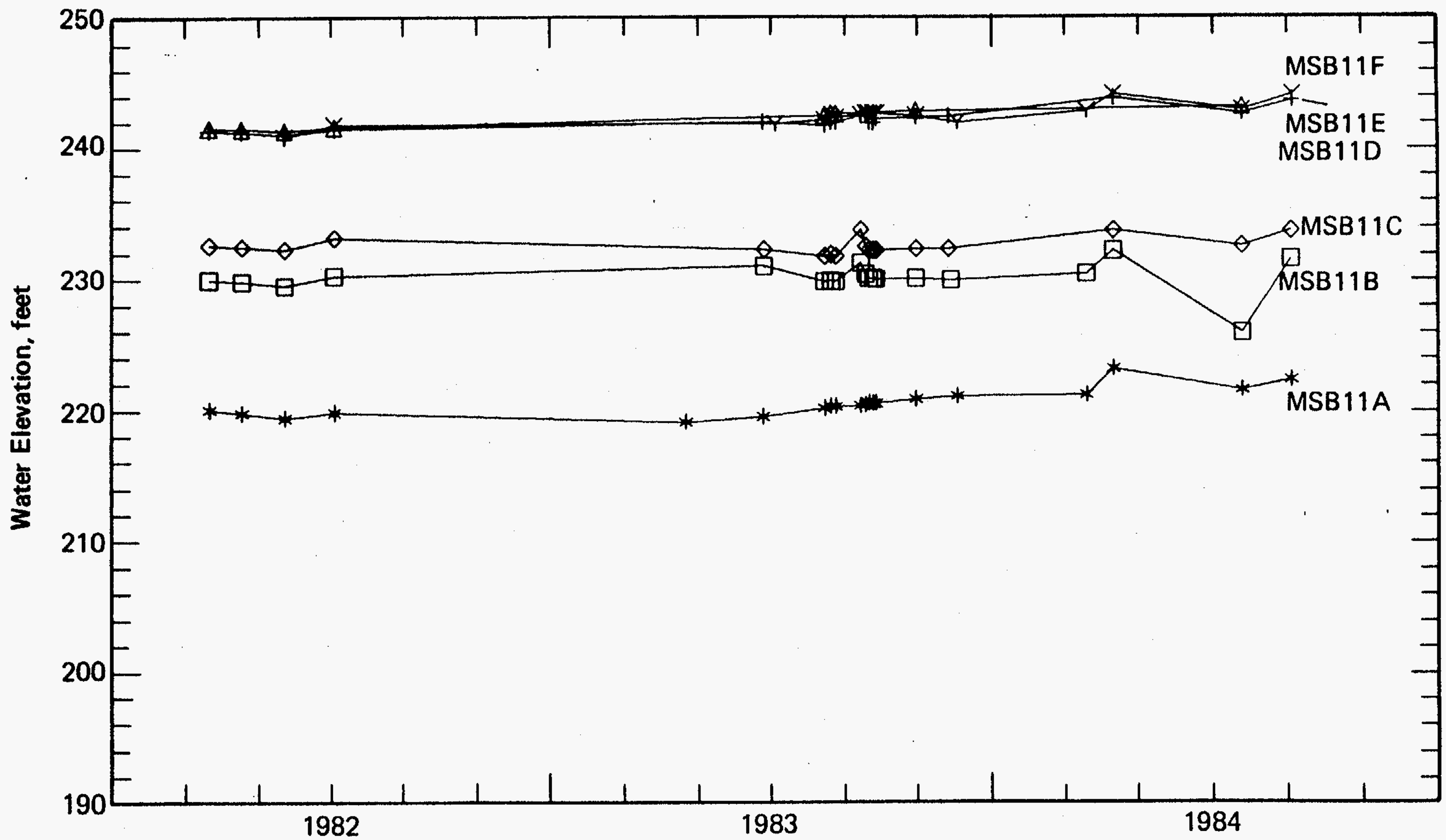

FIGURE 5-10. Hydrographs of Wells in Cluster MSB-11

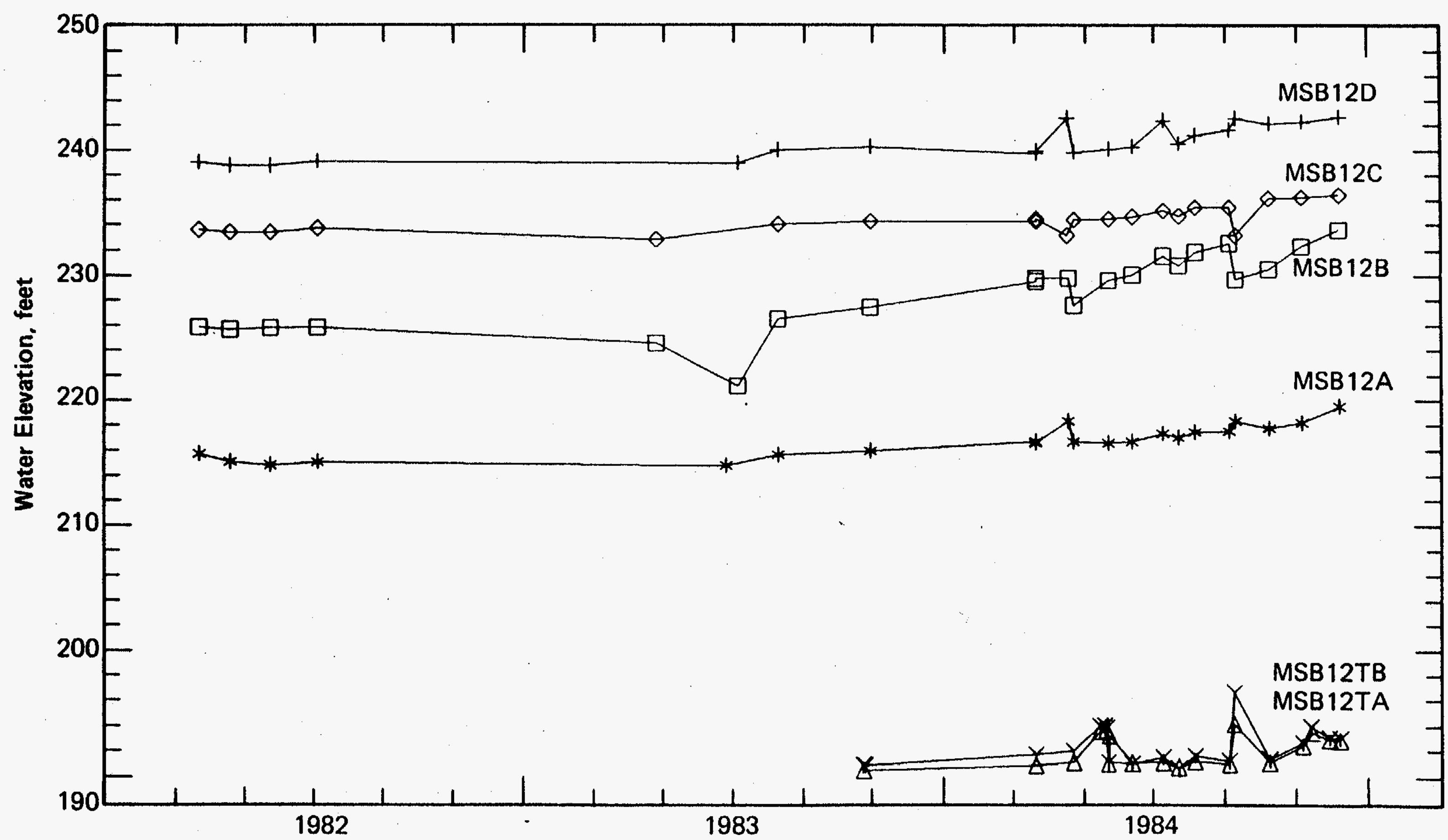

FIGURE 5-11. Hydrographs of Wells in Cluster MSB-12

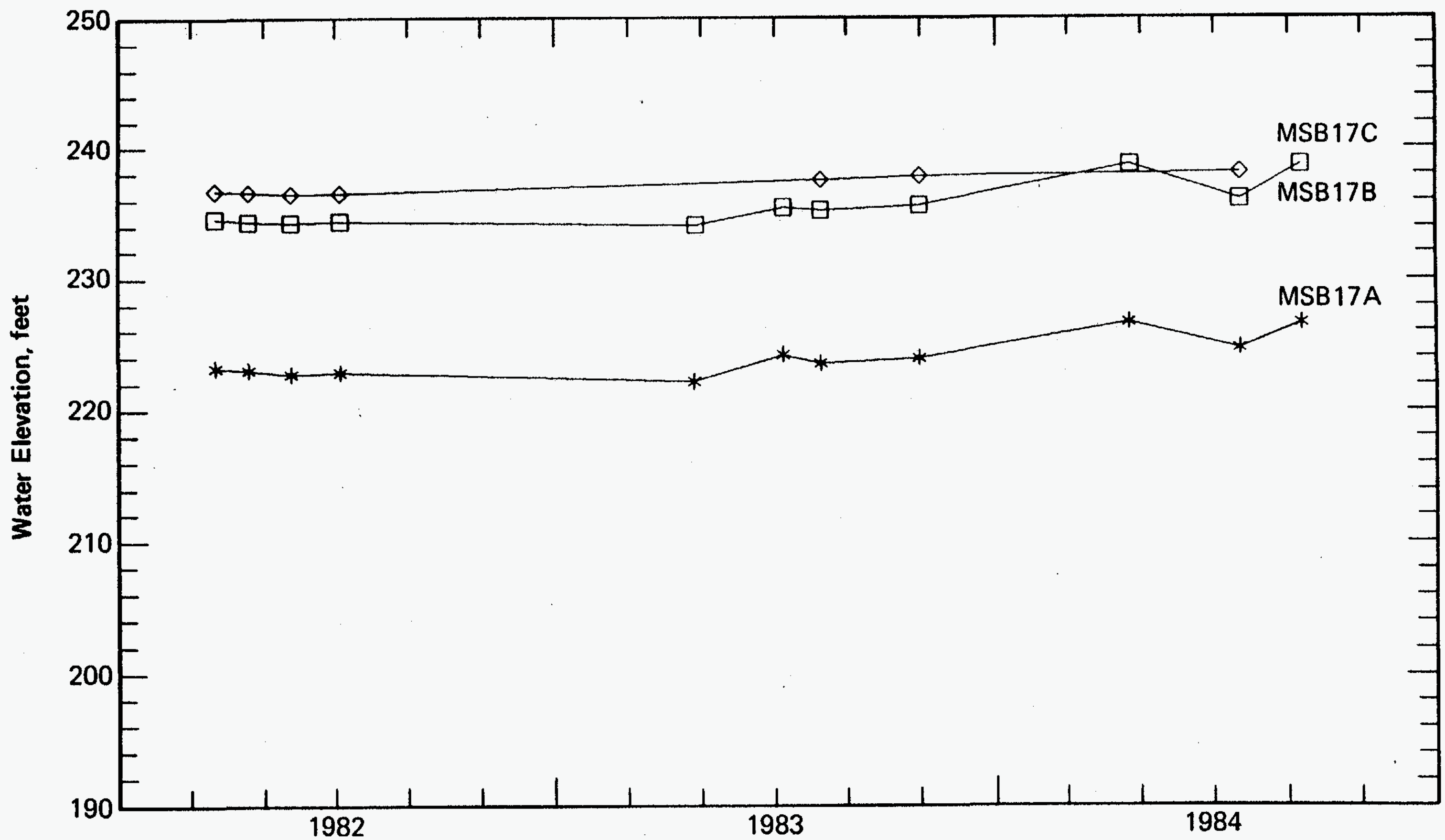

FIGURE 5-12. Hydrographs of Wells in Cluster MSB-17

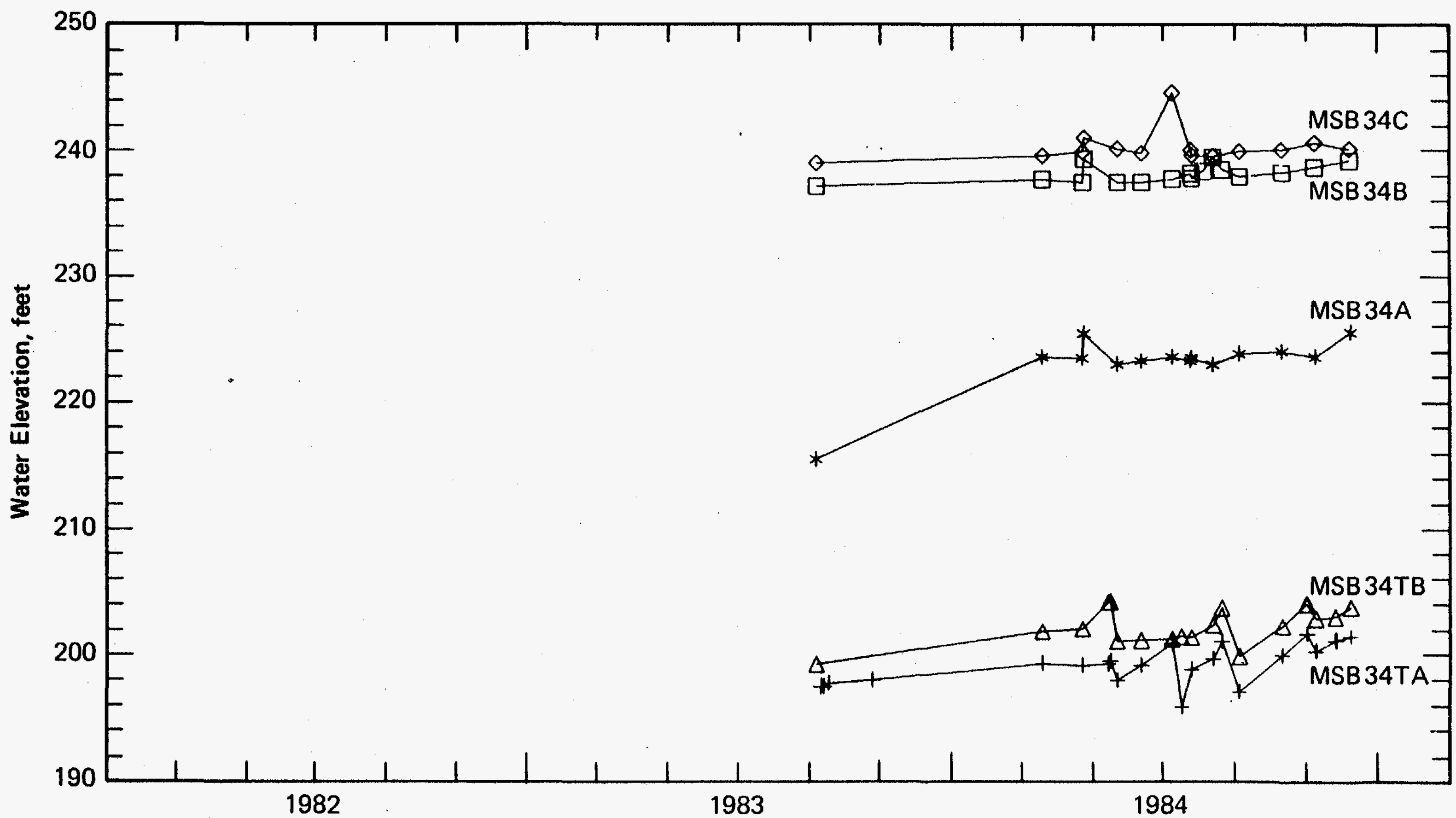

FIGURE 5-13. Hydrographs of Wells in Cluster MSB-34

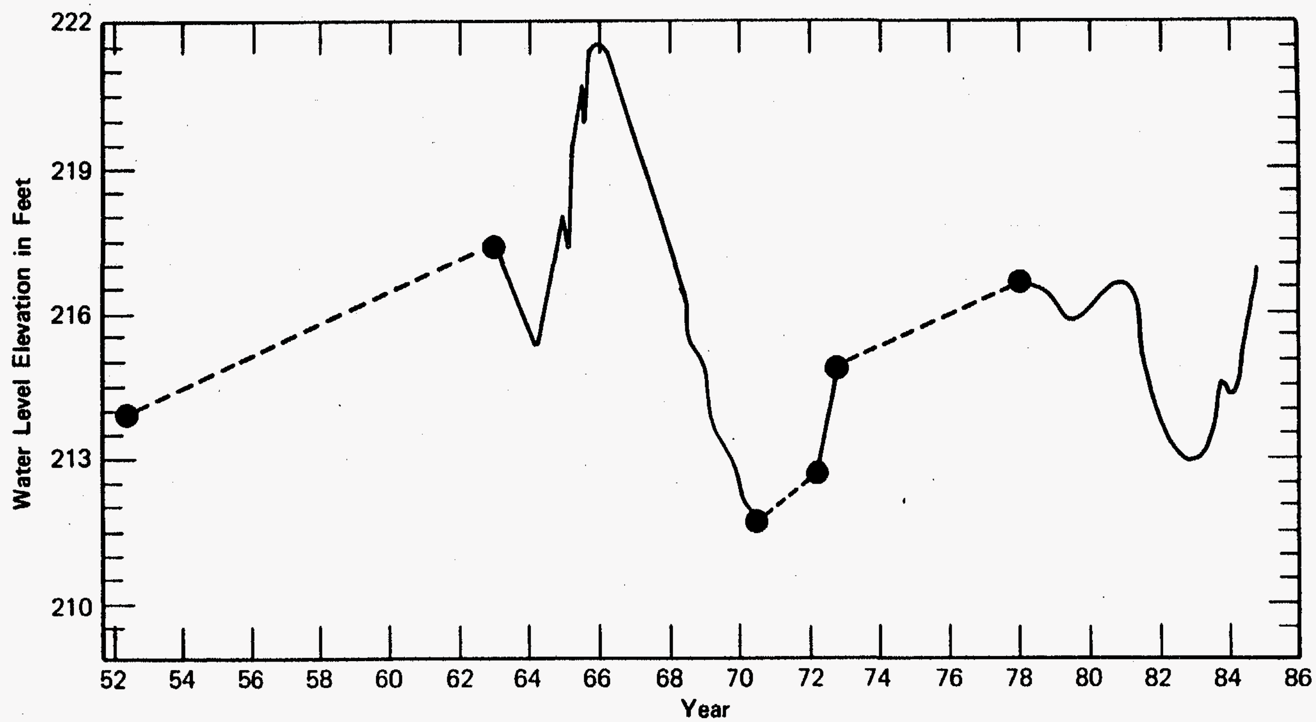

FIGURE 5-14. Hydrograph of Well S-15

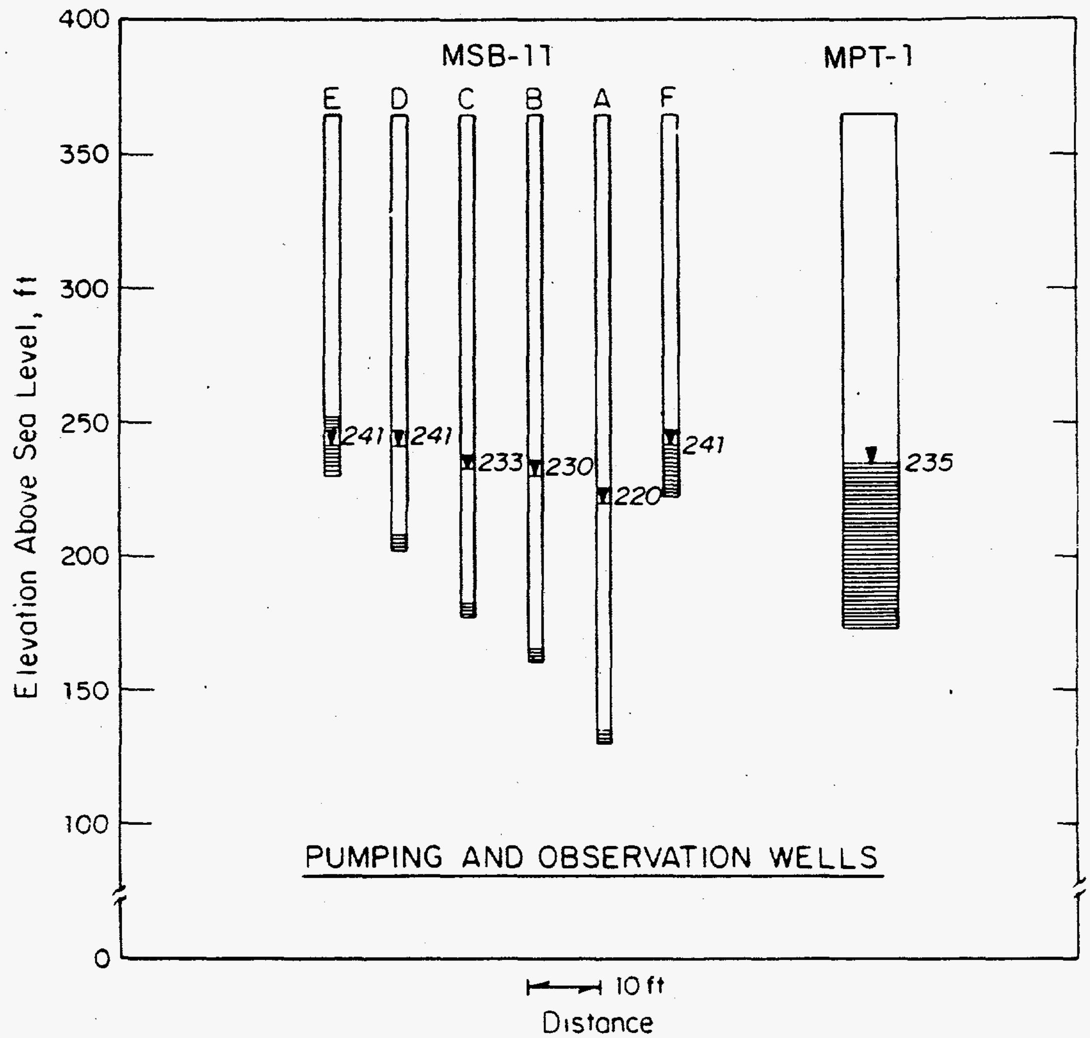

FIGURE 5-15. Schematic Section of Screen Zones and Water Levels of MSB-11 Well Cluster and Production Test Well

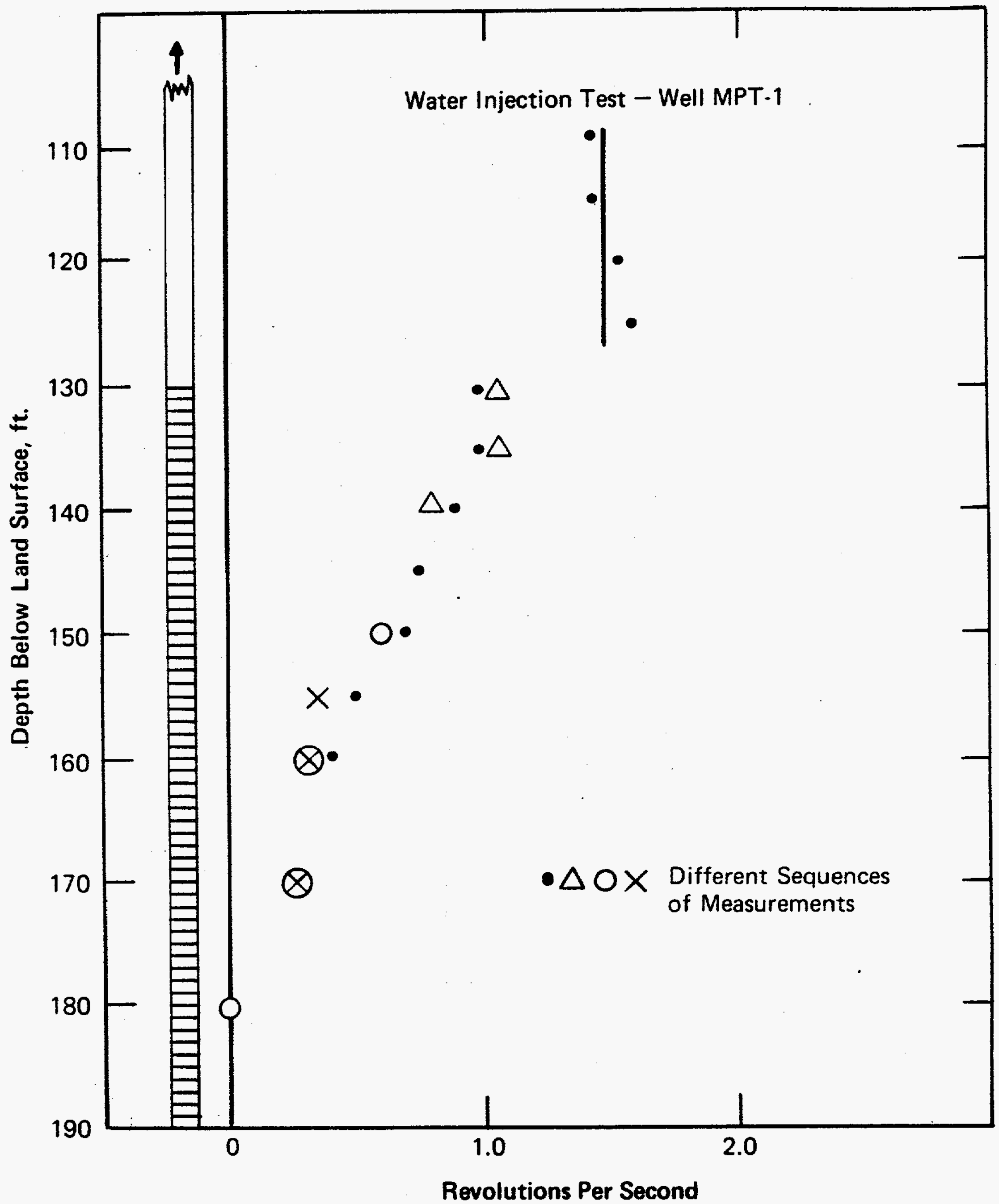

FIGURE 5-16. Results of Water Injection Test on MPT-1

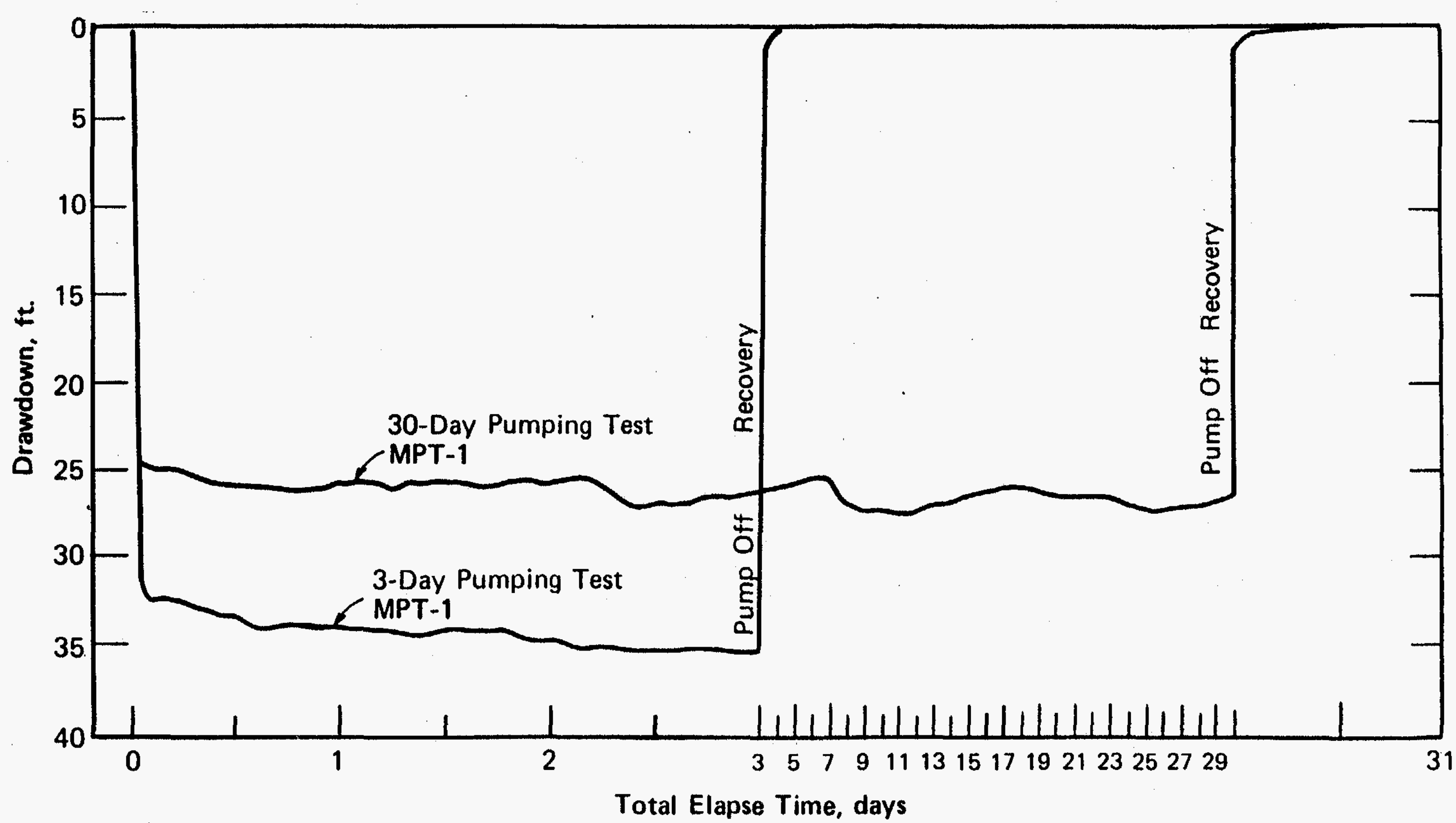

FIGURE 5-17. Comparison of Drawdowns in MPT-1 for 3-Day and 30-Day Pumping Tests

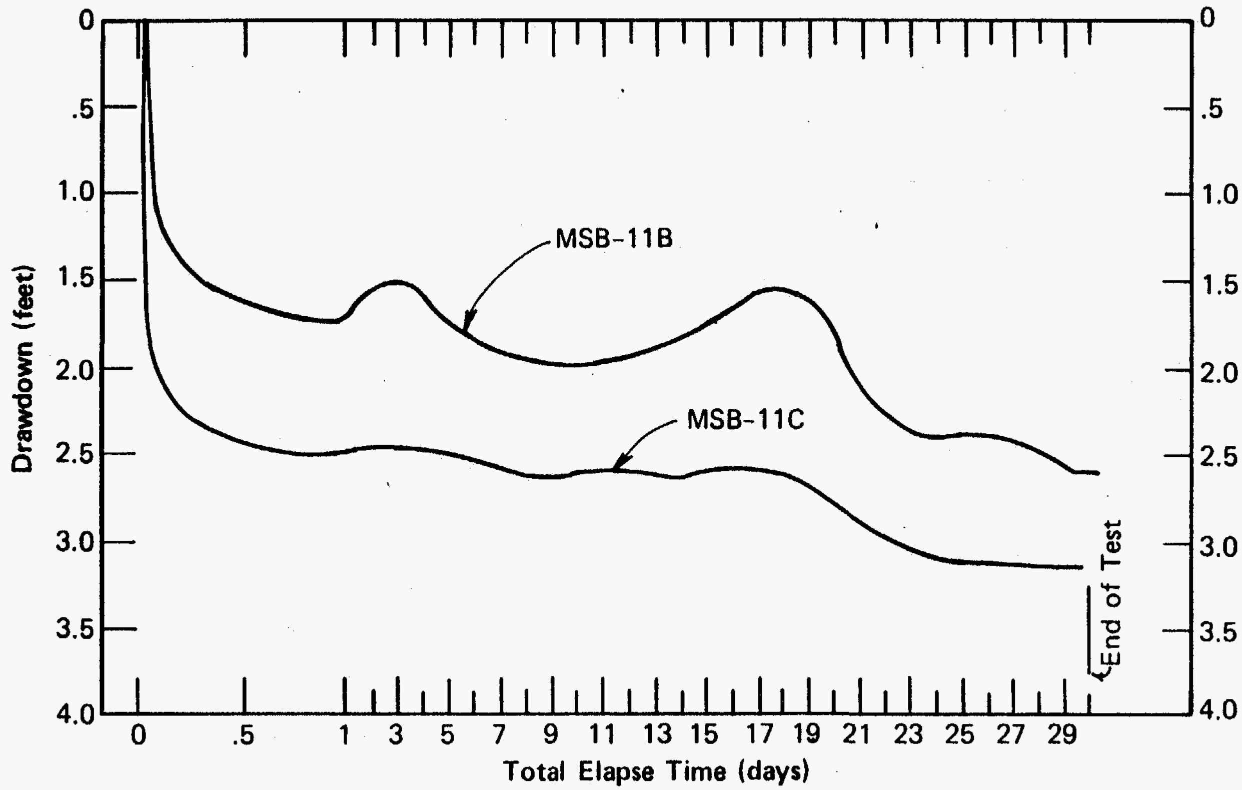

FIGURE 5-18. **Water Levels in Observation Wells MSB-11B and 11C During 30-Day Pumping Test**

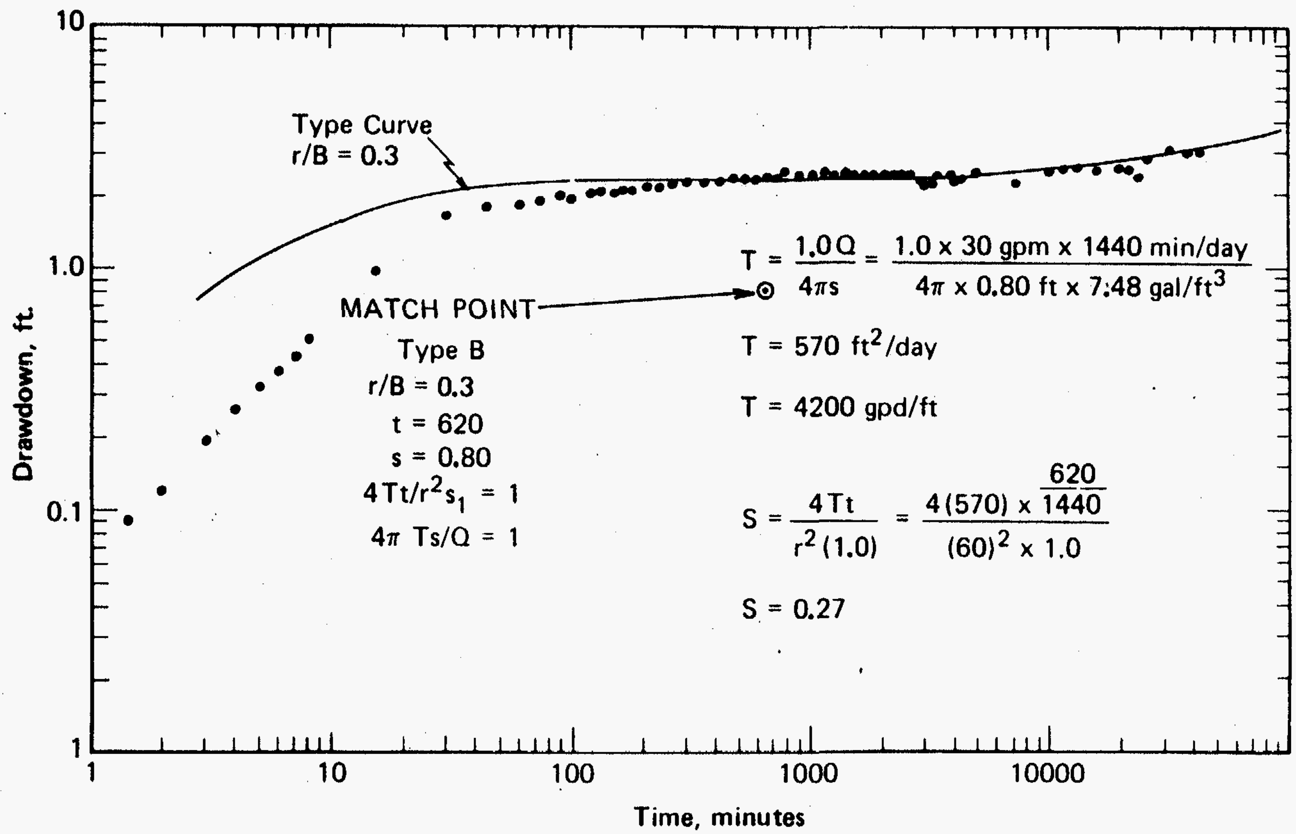

FIGURE 5-19. Log-Log Plot of Drawdown for Observation Well MSB-11C During 30-Day Pumping Test

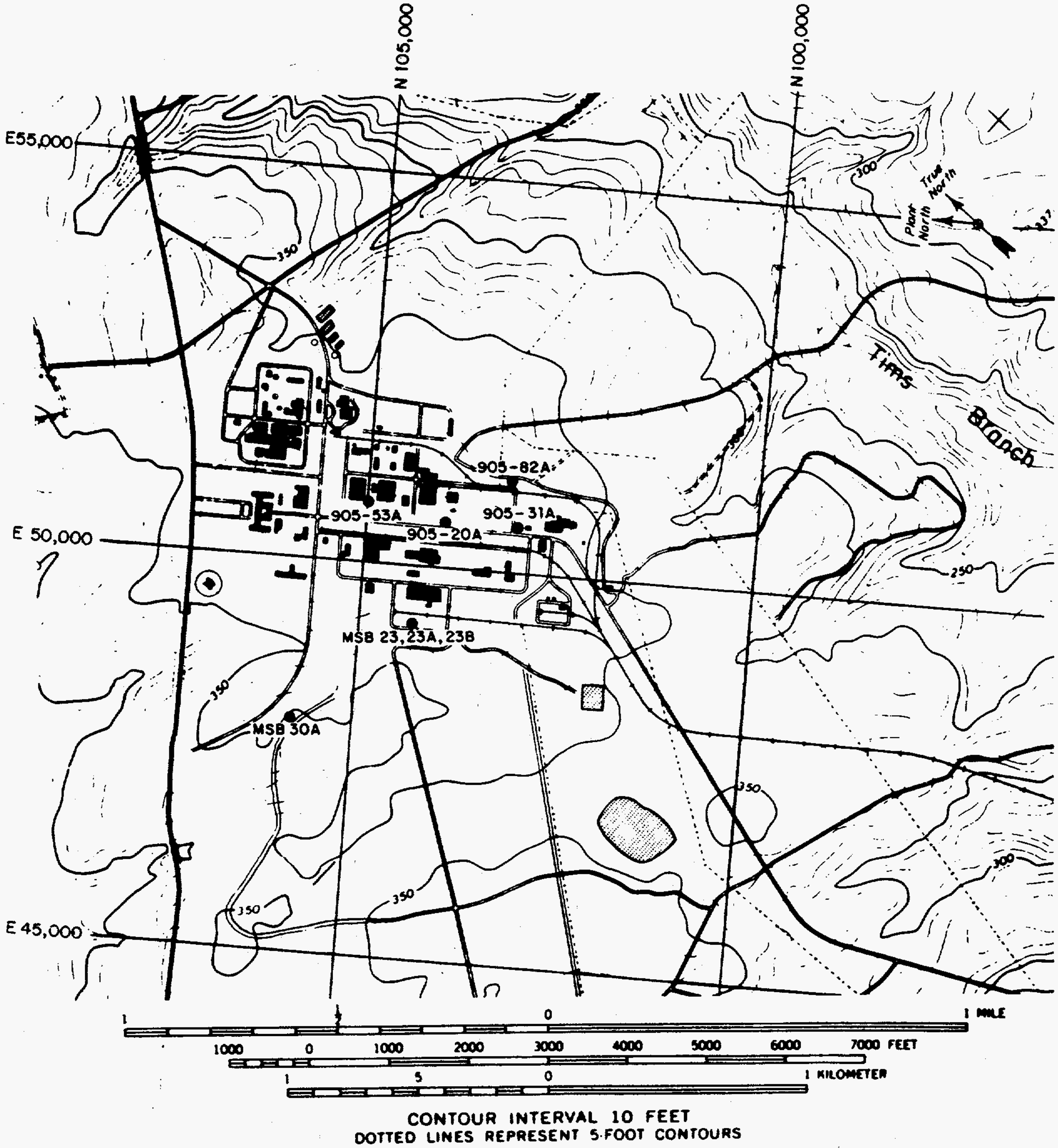

FIGURE 5-20. Location of Wells Utilized in the "Tuscaloosa" Pumping Test

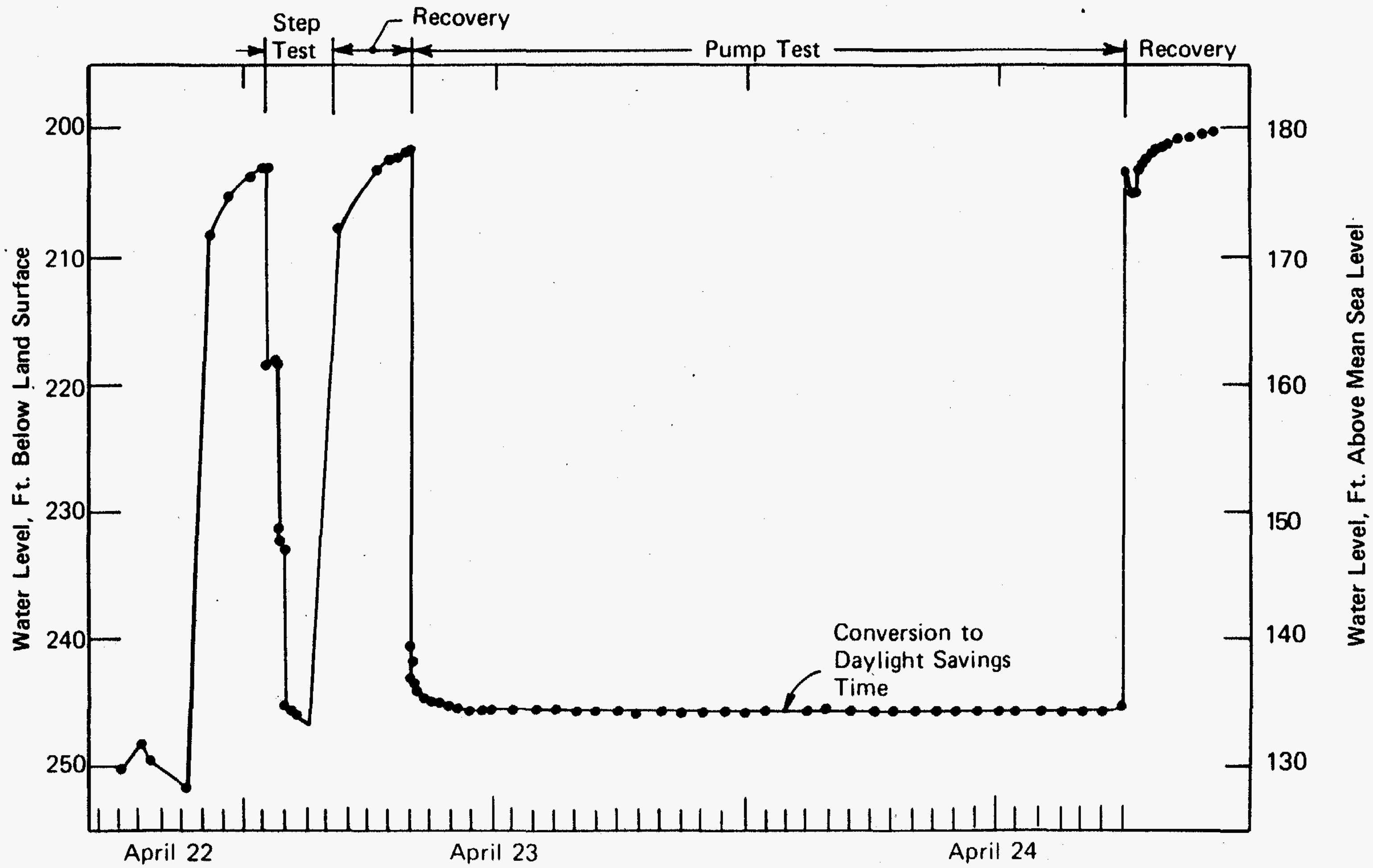

FIGURE 5-21. Hydrograph of Well 905-20A During "Tuscaloosa" Pumping Test

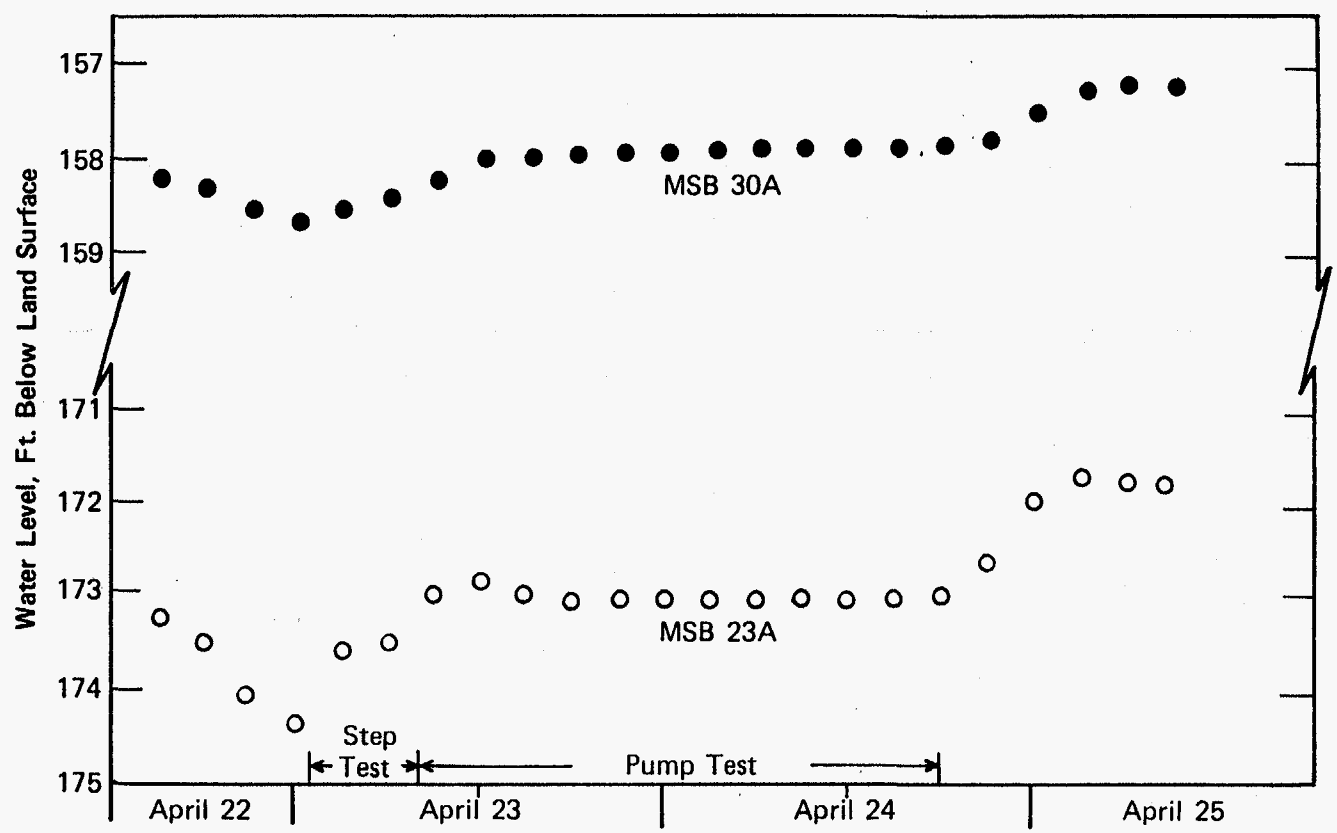

FIGURE 5-22. Hydrographs of Observation Wells MSB-30A and MSB-23A Screened in the "Tuscaloosa"

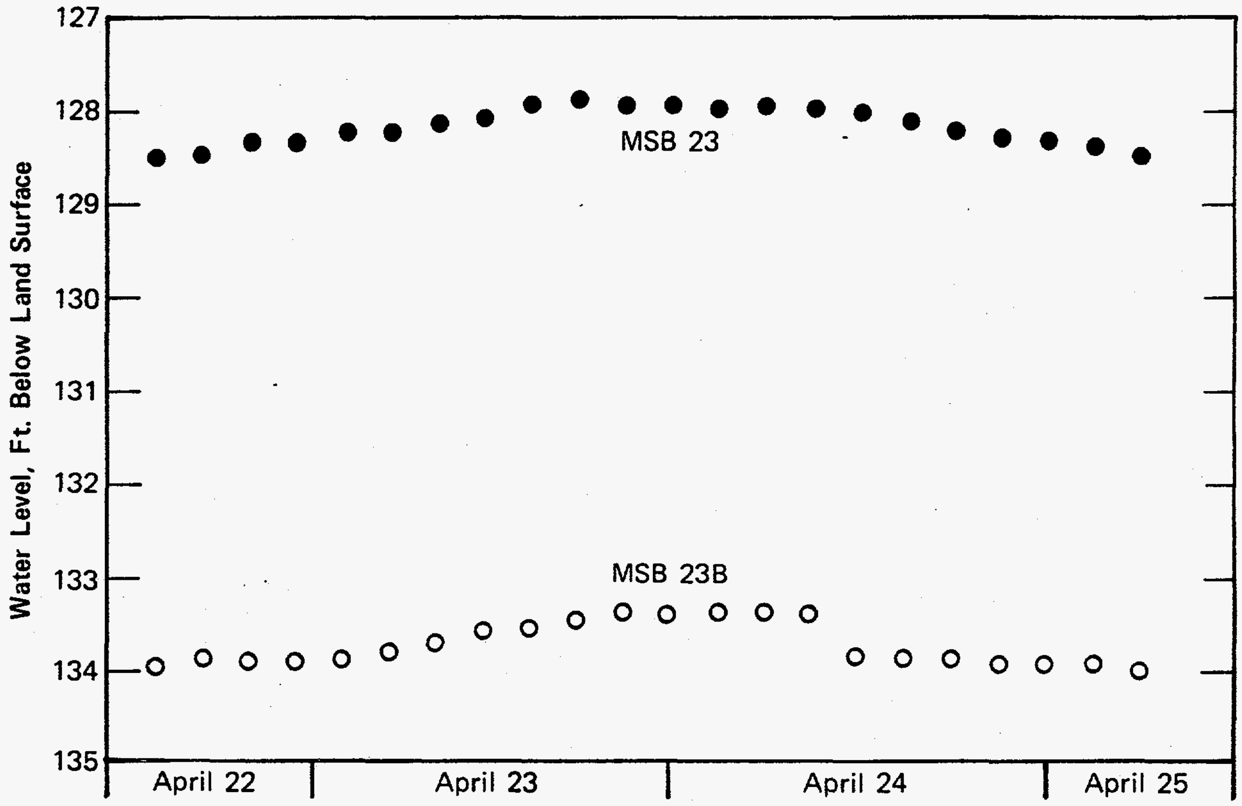

Fig. 5-23. Hydrographs of Observation Wells MSB-23 and MSB-23B Screened in Tertiary Sediments

6.0 POTENTIAL SOURCES OF DEGREASER SOLVENTS

6.1 Introduction

The facilities for fabricating fuel and target elements to be irradiated in SRP reactors are located in the 300-M Area. During fabrication, fuel and target elements are degreased at several stages in the process. They are also cleaned at other stages with hot caustic and hot nitric acid. From 1952 to 1982, M Area used an estimated 13 million pounds of chlorinated degreasing solvents (Table 6-1). Although 50 to 95 percent of the solvents evaporated during degreasing operations, the remainder went to the M-Area process sewer system. It is estimated that 2 million pounds may have been released to the sewer that leads to the M-Area settling basin and about 1-1/2 million pounds to the A-14 outfall (Christensen and Brendell, 1982).

M-Area degreaser facilities are located in Buildings 313-M, 320-M, and 321-M (Figure 6-1). Degreaser facilities consist of large vats partitioned in half. On one side the solvent is boiled and the vapors degrease items exposed to them. These vapors flow to the other half of the vat where they are condensed and collected. After condensation, the degreasing fluid overflows from the cool side of the vat to the hot side where it is again vaporized for use in degreasing. Over time oil and grease extracted from components accumulate in the solvent solution and raise its boiling point. With the same amount of heat input, less solvent vapors are generated and cleaning efficiency drops. Periodically the contents of the large tube cleaning vats in 320-M and 321-M flow through a still to recover solvent. The smaller vats in 313-M are periodically emptied and clean solvent substituted. In the past, spent degreaser solvent was either drained into the process sewers, or pumped into drums and then distilled for reuse. Occasionally, during the seventies, still bottoms, degreaser sludges, and some solvent were collected in drums and stored on concrete pads awaiting distillation recovery. Beginning in 1979, all waste solvents and sludges were drummed and stored in Building 710-U, a hazardous waste storage facility.

6.2 History and Locations of Potential Degreaser Solvent Releases

Much of the information contained in the following section is not contained in verifiable records and cannot be substantiated. It was largely compiled by H. L. Martin (1984), a process engineer in M Area, who obtained it by interviewing several employees who worked or had worked in M Area. The primary uses of the following information are to explain known plume patterns, to provide information for the study of plume migration rates, and to provide information on possible sources of chlorocarbon contamination.

Buildings 313-M and 320-M were operational by the end of 1952 and used trichloroethylene as the degreasing agent. The trichloroethylene was shipped to SRP in tank cars. Although there is not a consensus agreement among employees, it appears that tank cars were used as a storage facility while located on the railroad siding (site "A", Figure 6-1). Solvent was pumped from the tank car into pipelines to 313-M and from there to Building 320-M. Spills are likely to have occurred during tank car unloading operations, but none are documented. A ditch ("B", Figure 6-1) drained the vicinity of 313-M to the back of 320-M and then to a low swampy spot where 321-M was eventually built ("C", Figure 6-1). Waste degreasing solvent from 313-M and 320-M was released to the process sewer ("D", Figure 6-1) that drains to the A-14 outfall. This outfall discharges to a tributary of Tims Branch.

In addition to the use of degreasing solvents in M Area, degreasing solutions were used in the reactors and other areas of the plant. For example, each reactor area had a 1000-gallon degreaser, SRL had two 450-gallon degreasers and the maintenance shops in Building 717-A had one 50-gallon degreaser. However, M Area was the primary user and many shipments of solvent came to M Area before being sent to other areas. To accommodate the shipping of degreasing solvents to other areas of SRP, a drum loading facility was established at the south end of 313-M ("E", Figure 6-1).

Building 321-M was constructed in 1957 with three new degreasers. In order to contain the uranium wastes from the processes in 321-M, the settling basin was built and began receiving process waste which included waste solvents through a second process sewer ("F", on Figure 6-1). After one or two years of use, the basin became partially plugged to water seepage and began to overflow. The overflow traveled along an engineered ditch ("G", Figure 6-1) toward Lost Lake - a natural upland depression (Figure 6-1). (Editorial Note: A recently completed soil survey showed that the soils in the areas that recieved basin overflow do not contain degreaser solvents in significant concentrations [Pickett, 1985].)

Accompanying the operation of 321-M in 1957, a number of changes were made in the handling of degreasing solvents. The solvent storage tank was built behind 321-M. This meant that railroad tank cars were no longer used as the primary solvent storage facility. From the incoming tank cars, the solvent was pumped into the 17,000-gallon storage tank. The drum loading station, however, remained at the south end of 313-M. Spills and leaks probably occurred in the vicinity of the solvent storage tank from off-loading the railroad tank cars and at the drum loading facility that continued to supply other plant areas with solvent. Although no specific spills or leaks were documented, groundwater monitoring data substantiate that significant spills occurred at the solvent storage tank.

Because the area around 321-M was still swampy when 321-M was completed in 1957, a drainfield was installed that discharged to the south and west of the facility ("H", Figure 6-1) but most drainage was still to the natural draw ("I", Figure 6-1) over the head of which 321-M had been built.

In 1962, 313-M redesigned its process and tetrachloroethylene was substituted for trichloroethylene. Trichloroethylene continued to be stored in the solvent tank and was pumped to the drumming facility. Tetrachloroethylene was discharged through the process sewer leading to the A-14 outfall.

During 1971, 320-M and 321-M substituted tetrachloroethylene for trichloroethylene, and the solvent storage tank was changed over to tetrachloroethylene use. By 1972 efforts were under way to limit uranium discharges from 313-M to the A-14 outfall. One of the 313-M sewer lines was connected to the main process sewer going to the settling basin in early 1973. Consequently, about one-half of the solvent going to Tims Branch from 313-M was diverted to the settling basin. Three years later additional changes were made so that all process discharges from 313-M and 320-M went to the settling basin.

In 1979 the use of tetrachloroethylene was stopped, and 1,1,1-trichloroethane was used. On the conversion, the excess tetrachloroethylene was apparently disposed of into the settling basin sewer although no documentation exists.

After degreasing solvents were found in the groundwater below the M-Area basin in 1981, television surveys were made in 1982 of both the process sewer to the settling basin and the one to the A-14 outfall. Some cracks were observed in the terra cotta pipe to the basin ("F", Figure 6-1). In places fine plant roots penetrated into the sewer. The television camera was mounted on a floating sled, so it only observed the upper part of the sewer pipe and not the part covered with liquid. This pipe was relined in 1984. The pipeline to the A-14 outfall also had small cracks over most of its length. Furthermore, the pipe labeled "J" on Figure 6-1 was heavily corroded. The sewer to the A-14 outfall was relined in 1983.

The Savannah River Laboratory has also operated degreasers in the past in the basement of Building 773-A (Figure 6-1), but does not do so at present. In 1954-55, two 450-gallon capacity degreasers were installed in the two chemical cleaning rooms in the Fabrication Laboratory. These degreasers could be used as vapor degreasers or dip vats depending on the object to be degreased. When the vapors were used, the object dried immediately When dipping was used, the object went into a rinse tank after degreasing. Contents of the rinse tank were discharged to the trade waste stream which discharges at the A-1 outfall (Figure 6-1). The degreaser facilities were in use 70 to 80 percent of the time in the 1950's when consumption was 30-40 drums per year. During the 1960's usage declined to 30 percent of the time. In the 1970's. usage declined even further. Each degreaser was equipped with a still. Once or twice soda ash was used to boil out the still bottoms (grease). That solution was discharged to the trade waste stream. In 1962, a 30-gallon capacity degreaser was added at the nickel plating facility. In 1964 because of declining usage, one of the 450-gallon degreasers was removed and in 1973 the small degreaser was removed. Also in about 1973, the solvent used in the one remaining degreaser was changed from trichloroethylene to tetrachloroethylene. In 1979, the solvent was to be changed to 1,1,1-trichloroethane, but usage had so declined by that time, that the old solvent was removed but the degreaser was never loaded with the new solvent. The degreaser has not been used since 1979.

The central maintenance shop is located in Building 717-A (Figure 6-1). A vapor/dip degreaser was located on a concrete pad outside of the eastern corner of Building 717-A, about 10 feet from the wall of the building. It had a capacity of about 50 gallons, and about 50 gallons per year were used. It was underlain by a sump pit which could drain to a storm drain. The degreaser was removed in 1977 but used trichloroethylene as a solvent up until that time.

Although degreasers in the reactor areas were supplied from the M-Area drumming facility, the degreasers in Building 773-A and 717-A were mostly supplied from Central Stores which stocked the solvent. In the 1950's, degreasing solvent could be obtained from chemical stores located in Building 773-A, but in the mid 1960's the dispensing of solvent was transferred to Central Stores in Building 713-A (Figure 6-1). In 1975-76 about 90 gallons per month of trichloroethylene were dispensed from Central Stores. In August, 1977 the solvent was changed to tetrachloroethylene and about 24 gallons per month were dispensed until May 1978 when it was removed from stores. The stock at Stores was in 55-gallon drums from which it was pumped into smaller containers for distribution. The storage facility was in a small building at the north end of 713-A, where paint was also stored.

6.3 Magnitude of Degreaser Solvent Releases

Figure 6-2 shows the time of usage of the three degreaser solvents in M Area. Table 6-1 shows the estimated amount of each of the three degreaser solvents used and released to the settling basin and the A-14 outfall (Christensen and Brendell, 1982). The usage of tetrachloroethylene and 1,1,1-trichloroethane was estimated from former purchase records. Trichloroethylene records are not available and use-estimates are developed from M-Area personnel judgements. Each reactor area has one degreaser of 1000 gallon capacity and received one to two barrels of solvent per month from M-Area stocks. Total allocations from M Area to these facilities were estimated to range from 25,000 to 50,000 pounds of solvent annually. M-Area solvent consumption estimates given in Table 6-1 were adjusted accordingly.

Estimates of the amount of solvent released to the process sewers leading to the settling basin and to the A-14 outfall are given in Table 6-1. The percentage of solvents reaching the M-Area process sewers was estimated based on several factors:

1. Waste solvent and sludge disposal practices

2. Age of degreasers and replacements

3. Change in annual purchases

The solvent discharge estimates include:

- Leakage from degreasers
- Dirty solvents and sludge which were drained from degreasers and distillation tanks
- Spills
- Temporary storage of solvents and sludge which were subsequently discharged to the process sewers.

Figure 6-3 shows the estimates of annual discharges of degreaser solvents to the process sewers leading to the settling basin and the A-14 outfall. It must be emphasized that there are no records of solvent discharges, and these estimates are mostly based on judgements of individuals. However, they are probably the best estimates that will be developed, and they show relative magnitudes.

Apart from the release to the process sewers leading to the settling basin and to the A-14 outfall, it is not possible to estimate the quantities of degreaser solvent, such as spills around the storage tank, that actually penetrated the ground. Locations of these areas are shown in Figure 6-1 and discussed in Section 6.2.

It must be emphasized in summary that although it is believed the major places where solvents could have entered the ground have been identified from the process history of the area, spills may have occurred at other locations also.

From Figure 6-3 and Table 6-1 it is apparent that larger quantities of tetrachloroethylene have been released than of trichloroethylene. However, several studies (Cline and Viste, 1984; Parsons et al., 1984) suggest that tetrachloroethylene degrades anaerobically to trichloroethylene; thus it cannot be assumed that all trichloroethylene found in the ground began as that substance.

6.4 Sources of Substances Other than Degreaser Solvents

Before construction of M Area there was a draw or depression ("C", Figure 6-1) that passed beneath 321-M and then turned northward past 320-M and thence northwestward. One of the first operations of construction in 1952 was to grade the area and fill in this draw. Thus extensive earth moving equipment was employed. At location "K" on Figure 6-1 there was a fuel oil storage depot.

Many of the processes in all three M-Area facilities involve cleaning with caustic (sodium hydroxide) and hot nitric acid. These substances have been discharged to the process sewers. The nitric acid, even if neutralized, is a source of elevated nitrate discharges, some of which have migrated to the groundwater. It has been found in other areas of SRP that effluents high in sodium hydroxide tend to cause soil particles to swell and plug the soil pore spaces. Such discharges may have been responsible for the partial pluggage of the M-Area settling basin about two years after its operation began.

The purpose of the settling basin was to settle out uranium and heavy metals. Elevated concentrations of heavy metals have been found only within the shallow soil beneath the bottom of the basin (Hollod, 1982), indicating that the basin served its intended purpose well.

References For Chapter 6

Christensen, E. J. and C. K. Brendell, 1982. **Chlorinated Solvent Releases to M-Area Process Sewers**, DPST-81-968, E. I. du Pont de Nemours and Company, Savannah River Laboratory, Aiken, SC.

Cline, P. V. and D. R. Viste, 1984. Migration and Degradation Patterns of Volatile Organic Compounds, in **The 5th Conference on Management of Uncontrolled Hazardous Waste Sites**, November 7-9, 1984, Hazardous Materials Control Research Institute, Silver Spring, MD.

Hollod, G. J., I. W. Marine, H. W. Bledsoe, and J. P. Ryan, 1982. **Metals and Organics in the Soil Beneath the M-Area Settling Basin**, DPST-82-721, E. I. du Pont de Nemours and Company, Savannah River Laboratory, Aiken, SC.

Martin, H. L., 1984. Personal Communication.

Parsons, F., P. R. Wood, and J. DeMarco, 1984. **Transformations of Tetrachloroethene and Trichloroethene in Microcosms and Groundwater**, Journal of the American Water Works Associations, February 1984, pp. 56-59.

Pickett, J. B., 1985. **Extended Characterization of M-Area Settling Basin and Vicinity**, DPSTD-85-121, E. I. du Pont de Nemours and Company, Savannah River Laboratory, Aiken, SC.

TABLE 6-1

Estimated Quantity of Degreaser Solvent Released to M-Area Process Sewers

Solvent	Total Used	Estimated Release to Settling Basin	Estimated Release to Tims Branch
Trichloroethylene	3,700	317	383
Tetrachloroethylene	8,700	1,800	1,000
1,1,1-Trichloroethane	670	19	12
Total	13,070	2,136	1,395

Units are 10^3 pounds

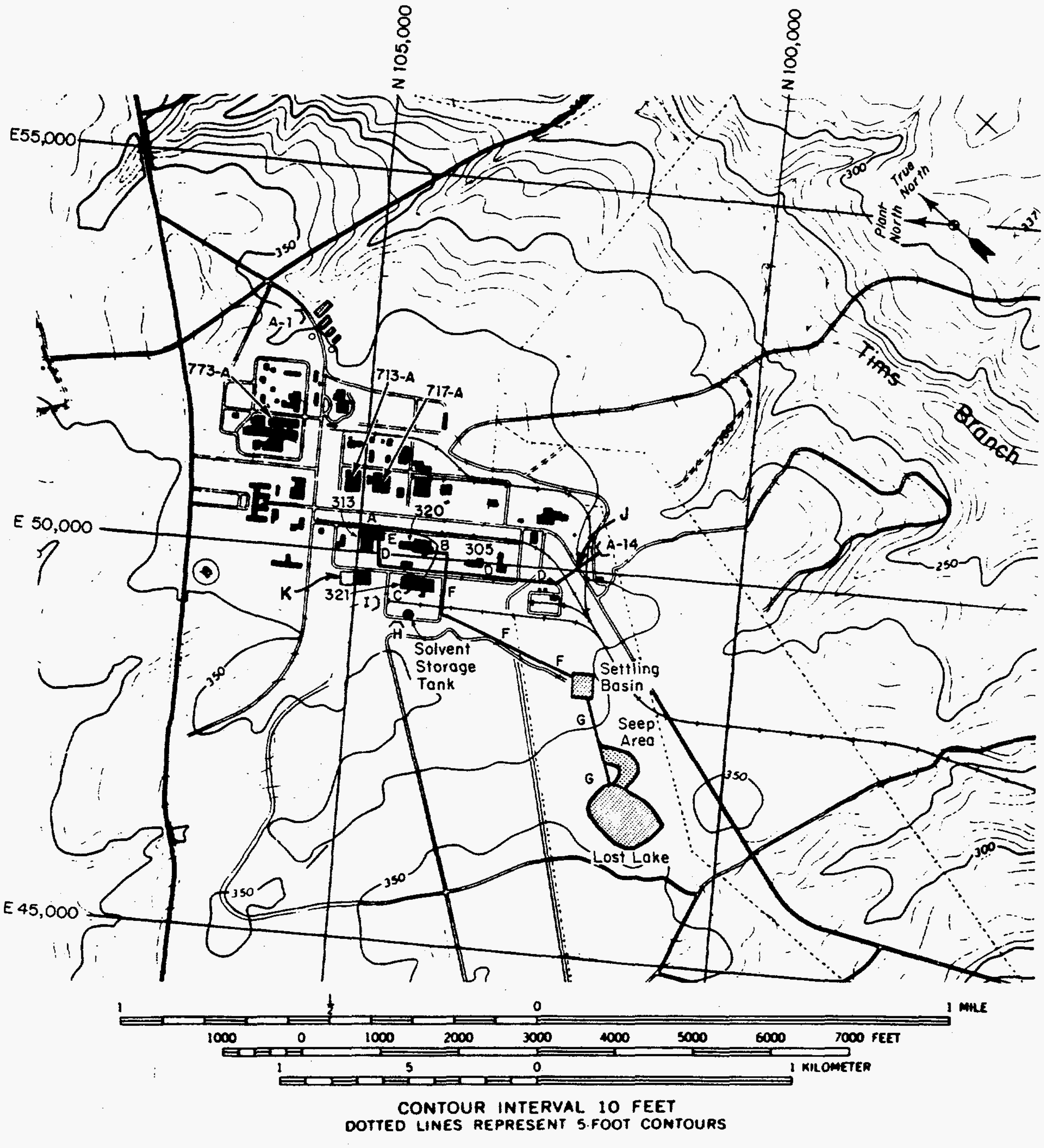

FIGURE 6-1. Locations of Potential or Suspected Contaminant Releases
(See Text Chapter 6 for Discussion of Symbols.)

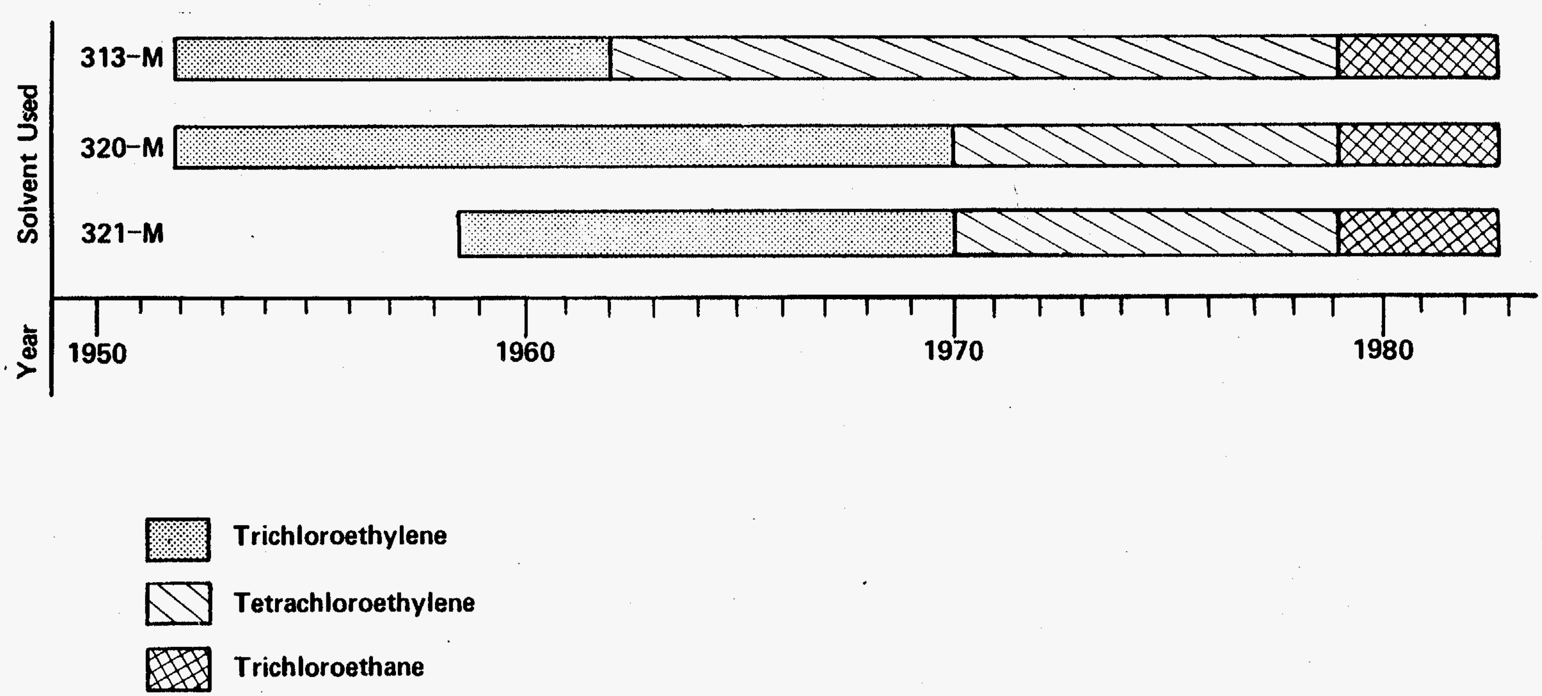

FIGURE 6-2. Degreaser Solvents Used as Metal Degreasers at M-Area Facilities

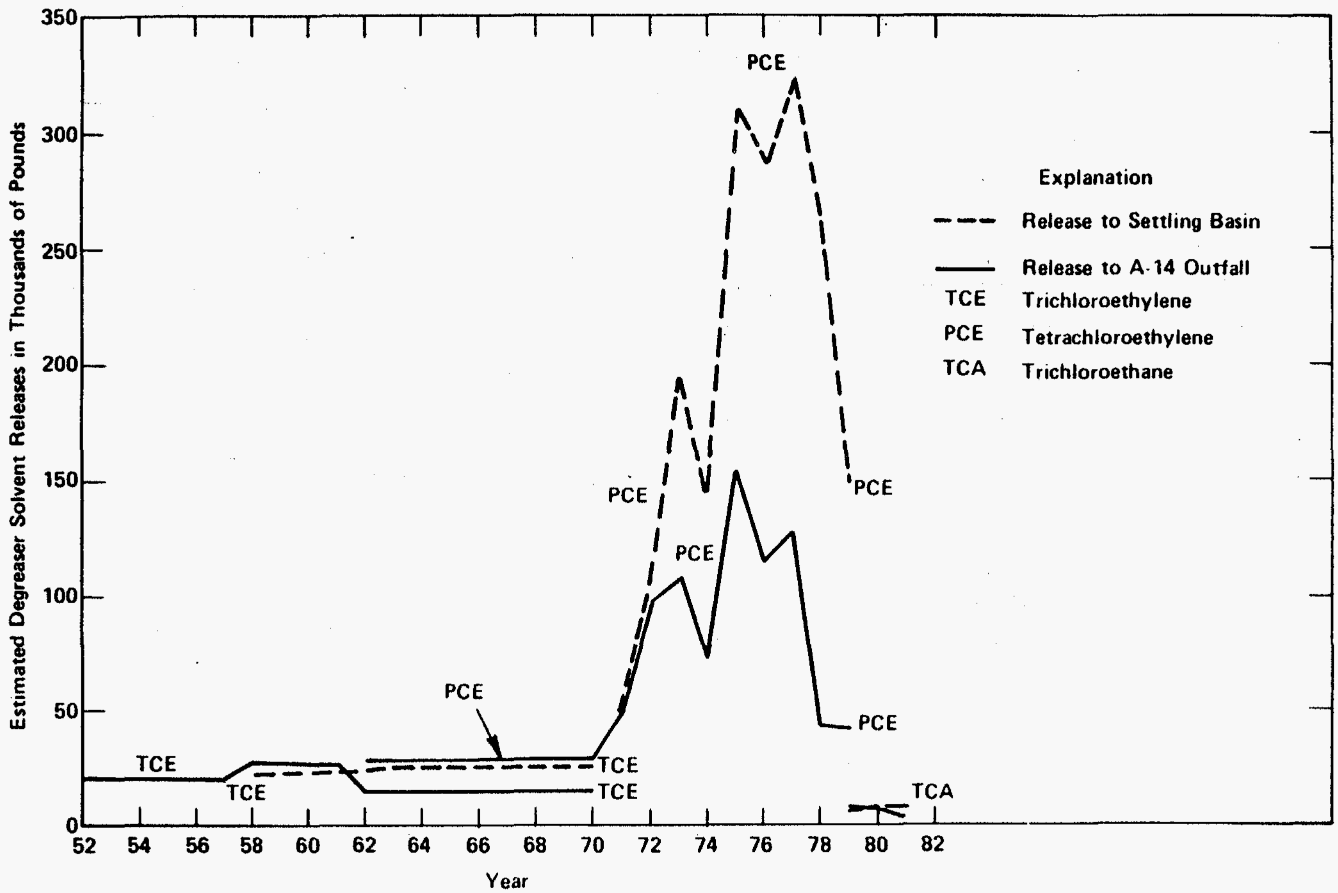

FIGURE 6-3. Estimated Annual Discharge of Degreaser Solvents to the Process Sewers

7.0 GROUNDWATER QUALITY

7.1 Degreaser Solvents in the Tertiary Sediments

The results of the subsurface investigations of the undifferentiated Tertiary sediments indicate that there are three main centers or sources for the groundwater contamination: the M-Area basin and the pipeline from the manufacturing facilities to the basin; the M-Area process facilities apparently centered around the solvent storage tank behind 321-M; and the sewer outfall to the Tims Branch tributary stream near well MSB-31. These areas show the highest concentration of degreaser solvents in both soil and water samples. Total concentrations of degreaser solvents as high as 542,000, 130,000, and 362,000 ppb were obtained from analyses of water samples collected near the basin (MSB-3A), near the solvent storage tank (MSB-23), and near the A-14 sewer outfall (MSB-31C), respectively.

A comparison of the results of the soil and water analyses from wells installed at the same location for this phase of the investigation is shown by bar charts on Figures 7-1 through 7-6. From these graphs, there appears to be a predominance of trichloroethylene over tetrachloroethylene in the water. In the soil analyses the two are about equal. The results of earlier soil analyses compared to water analyses are presented in the Preliminary Technical Data Summary, M-Area Groundwater Cleanup Facility (Gordon, 1982).

The results of the analyses of water samples collected from the monitoring wells for degreaser solvents are presented in Appendix B. During this phase of the investigation a sample collection protocol was prepared and adopted for use in the collection of water samples. A copy of the protocol is presented in Appendix E-1.

A contour map of the vertical average total organic concentrations found in the groundwater between April and July 1984 is presented on Figure 7-7. These contours are at best only an approximation of the horizontal shape and concentration of the groundwater contaminant plume. These maps can only be approximate since there are very little data available at some vertical sections of the map. Also most of the investigative effort to date has concentrated to the west and southwest of the basin and south of the production facilities. At increasing distances from the sources of surface contamination the higher concentrations are generally depressed below the water table. For example, wells located at sites MSB-26 and 27 show very low concentrations of degreaser solvents at the water table, but in the deeper wells at the same locations, the concentration increases to ~34,000 and 62,000 ppb, respectively (Appendix B).

Two vertical sections across the contaminant plume are shown on Figures 7-8 and 7-9. The locations of the two profiles are shown on Figure 7-10. The profiles show the plume sinking and dispersing as the contaminant moves down the groundwater gradient. The sinking of the plume shown on Figure 7-9 is aided by the discharge of noncontact cooling water and storm runoff from the M-2 outfall (Figure 5-2).

The previously referred to maps and profiles provide a generalized view of the contaminant plume, however, a more specific view may be obtained from maps of the contaminant plume at selected levels in the ground. Figure 7-11 is a map of the contaminant plume at the water table for the spring of 1984. Figures 7-12 and 7-13 are maps of the contaminant plume at elevations between 146 and 187 feet above sea level, and between 100 to 144 feet above sea level, respectively. The elevation intervals correspond to those used for the potentiometric maps shown on Figures 5-4 and 5-5. The influence of both clean and contaminated past water discharges can be seen by comparing these maps. In the area where Figure 7-9 shows the vertical section, the influence of the clean water discharge from the M-2 outfall may be seen as it drives the plume to greater depth. The influence of the "seep area" may be seen on the water table concentration map (Figure 7-11). The influence of discharged degreaser solvents at the A-14 outfall and their subsequent migration along the water table gradient may be seen on Figure 7-11.

These three maps show total concentration levels of trichloroethylene plus tetrachloroethylene. It may not be productive at this time to show these degreaser solvents separately because trichloroethylene is a breakdown product of tetrachloroethylene, in addition to being an original source material. Appendix B or Figures 7-1 to 7-6 show that concentrations of trichloroethylene are generally higher in the groundwater than those of tetrachloroethylene, yet Figure 6-3 shows that estimated releases of tetrachloroethylene to the ground have been many times greater than those of trichloroethylene. Thus, transformations, as well as sorption phenomena, may be taking place in the ground after the release of tetrachloethylene, and it is more appropriate for general purposes to map the sum of the two degreaser solvents.

By comparison with these two major degreaser solvents, the concentrations of 1,1,1-trichloroethane in the ground are very small. Only 10 wells consistently show concentrations of 1,1,1-trichloroethane greater than 10 ppb and only two wells, MSB-12B and 12C, show concentrations greater than 100 ppb.

An estimate of the inventory of degreaser solvents within the 100 ppb contour in the saturated zone can be made using the contour maps of concentration at different elevation levels (Figures 7-11, 7-12, and 7-13). Obviously, there is some subjectivity in contouring these concentrations and as more data are obtained, a better estimate of the degreaser solvent inventory can be made. Table 7-1 shows how an inventory estimated at 360,000 pounds in the saturated zone was obtained. The area occupied by the plume of degreaser solvents above 100 ppb in concentration is more widespread in the middle Tertiary zone (360 acres) than at the water table (275 acres). However, there is a greater inventory in the water table zone (244,000 lb) than in the middle Tertiary (113,000 lb) because the maximum concentrations in the water table zone are much higher.

7.2 Inorganic and Other Organic Characteristics of the Water From the Tertiary Sediments

In the Spring of 1983 samples from selected wells were analysed for metals, major cationic and anionic contituents, radioactivity, and certain organic constituents. In the Spring of 1984 samples were collected from every well for analyses of metals, major cationic and anionic constituents, and certain organic substances. The samples from some wells were also analyzed for radioactivity. Table 7-2 gives a list of the elements, compounds, and properties for which samples were analyzed. Appendix C gives the results of most of these analyses for both the 1983 and 1984 samples.

In several instances, the analyses were of a scan type (GC/MS priority pollutant scan) so that the limits of detectability were not as low as could be achieved with greater effort and cost. Since it was considered unlikely that these analytes would be present, it was not deemed worth that effort and cost unless their potential presence was indicated.

Analyses were made on 37 analytes that are not reported in Appendix C. One group is not reported because they are commonly used substances in laboratories, and the laboratory and field blanks had concentrations comparable to or greater than the results reported for the samples. Certain other analytes, although included in the secondary drinking water standards, were thought to be of little value in this study. One group is not reported because their concentration was never above detectability. In the introduction to Appendix C, the analytes which are not reported are listed with the reasons why.

In Appendix C, all wells shown have analyses of samples collected in the spring of 1984. In addition, analyses are given for samples collected in 1983 on selected wells. The protocols by which both of these sets of samples were collected are given in Appendix E-1 for 1983 and E-2 for 1984. The samples collected in 1983 were not filtered for metal analysis, thus high values for metals in 1983 may include suspended solids as well as dissolved solids. For this reason only metal analyses for 1984 should be considered.

Compared to the relatively widespread plume of the two principal degreaser solvents, the general groundwater appears to be relatively free of other contaminants. Exceptions to this statement may exist beneath the principal sources of contamination, such as the settling basin (MSB-3A and 22), the solvent tank (MSB-23) and the A-14 outfall (MSB-31C).

Appendix D presents chronological analyses for potential pollutants in groundwater around the M-Area settling basin (MSB 1-4) and around Lost Lake (MSB 5-8). The protocol for the collection and analysis of these samples is given in Appendix E-3.

In the discussion of individual analytes that follows, an attempt has been made to provide a statement of perspective on each analyte. Where drinking water standards have been promulgated, these usually provide such a perspective. The drinking water standards used are the national interim primary drinking water regulations (1977) and the secondary drinking water regulations (1979) as published by the Environmental Protection Agency (1979). Both of these standards are applicable to water systems that supply public drinking water to communities (except for nitrate which is also applicable to noncommunity water supplies). The primary standards are designed to protect human health. The secondary standards are not health related but cover contaminants that may affect the aesthetics, odor, palatability, or other characteristics of drinking water. The use of these standards for perspective in this report does not imply that the water should meet these standards, as the waters tested are not used for drinking nor are the samples taken from a free flowing outlet to a consumer. The standards are used in the perspective statement only for the purpose of providing a basis for comparison of the analyses given. Because many analytes do not have drinking water standards and also because in many cases the drinking water standard is too high to provide much perspective, other reference points must be given.

Hem (1970) discusses the study and interpretation of the chemical characteristics of natural waters, and this reference has been used for common levels of certain anayltes. Hem (1970) provides a global perspective on this subject, whereas Siple (1967, p.83) provides a more local perspective on the concentration of major constituents of groundwater in the vicinity of SRP. Where none of these references provide a perspective, the level of detectibility used by the contract laboratory that performed the analyses is used.

For certain analytes, such as magnesium, pH, potassium, sodium and total dissolved soilids, the perspective values for limestones in the McBean and Congaree are appreciably higher than those for sands. Even though the geology around M Area is predominantly sand, limy beds and residuum from limy sands do occur. Thus, it seems appropriate to use the limestone value for perspective.

Most monitor wells were equipped primarily to sample for degreaser solvents and included a galvanized steel conductor pipe from the pump. The presence of galvanized steel in the wells, particularly ones with low pH, may affect the resulting sample analyses for cadmium, iron, lead, and zinc even though four well volumes are removed prior to sampling.

A major advance in the interpretation of the spacial distribution of analytes was discovered by Van Price of the Savannah River Laboratory. pH above 10 is not possible without hydroxide being present, which it commonly is not in natural waters on the Coastal Plain. The most available source of hydroxide, causing high pH, is the leaching of the cement sheath that surrounds the casing. If there is cracking in the cement sheath such that water moves through it to the screen zone, the pH will be above 9 and the calcium and total dissolved solids will be high. An additional source could be that cement was not completely set and had entered the screen zone during the construction of the well. Whenever interpretation is being made for the pattern of an analyte, the potential for a leaking cement sheath or cement in the screen zone must be kept in mind. The natural waters in the McBean and Congaree Formations are quite low in pH, 4.2 to 6.1 in the sands and 6.8 to 7.6 in the limestones. Wells with a pH greater than 9, and thus suspected of having the analytes influenced by a leaking cement sheath or the presence of cement in the screen zone, are shown on Table 7-3.

Beyond these elevated values of certain analytes that probably do not represent elevated values in the ground, there are elevated values of certain analytes in the vicinity of the settling basin and in the plume that emanates from it. This region is shown on Figure 7-14, which is a contour map of total dissolved solids at the water table. Another region of elevated total dissolved solids is shown in the vicinity of the M-Area process area on Figure 7-14. Both of these regions are reflected in elevated concentrations of several individual analytes.

The discussions that follow relate to the individual analytes.

Aluminum

Aluminum is a common rock forming element and concentrations of a few tenths of a part per million are common in natural water. Waters of low pH may have elevated concentrations of aluminum. Concentrations of aluminum above a part per million occured in wells AC-3B, MPT-1, MSB-11F, MSB-24, MSB-30C, MSB-34B, SRW-14B, SRW-15A in the spring of 1984. Of these AC-3B, MSB-24, and MSB-30C are associated with elevated pH which may indicate hydroxide arising from leaching of the cement sheath surrounding the well casing. With the exception of MSB-34B, SRW-14B, and SRW-15A, and the wells with elevated pH, the other wells that show concentrations of aluminum above 1 mg/L are in the immediate vicinity of the settling basin.

Antimony

The detection limit for antimony was 3 micrograms per liter. Only the concentration at well MSB-3A, adjacent to the settling basin, is appreciably above the detection limit.

Arsenic

None of the 1984 analyses are above detectibility.

Barium

The maximum contaminant level for community water systems is 1000 micrograms per liter (Environmental Protection Agency, 1977, p. 5). No analyses exceed this level. The median concentration for barium in public water supplies reported by Hem (1970) was 43 micrograms per liter. The concentration in M-Area monitor wells bracketed this median with samples from wells MPT-1, MSB-10A, MSB-11C, MSB-12C and D, MSB-16A, MSB-22, and MSB-34B appreciably above the median value. Barium is not used in M-Area operations, and does occur naturally in Aiken County.

Beryllium

In 1984 analyses, the only detectible beryllium occurred in MSB-22, adjacent to the M-Area settling basin.

Bromodichloromethane

There was no consistent detection of bromodichloromethane.

Cadmium

The drinking water limit for cadmium is 10 micrograms per liter (Environmental Protection Agency, 1977, p. 5). No concentrations have been found to exceed this concentration. A number of analyses have detection limits of 1 or 2 micrograms per liter, but for a number of samples, analytical methods were used that only had a detectibility limit of 20 micrograms per liter.

Calcium

Calcium is a major constituent of natural water. Natural calcium concentrations in water from the McBean sands in this area are about one ppm, whereas those from water in the limy beds of the McBean may be around 30 ppm (Siple, 1967). In 1984, concentrations greater than about 30 ppm occur in water from well MSB-22, MSB-23, MSB-24, MSB-30C, and SRW-15A. Wells MSB-24 and MSB-30C have elevated pH which may indicate leaching of the cement sheath around the well casing.

Carbon, Dissolved Organic

Detectibility is generally 5 mg/L. Only well, SRW-12A, is appreciably above this value.

Carbon, Total Organic

Most wells have total organic carbon concentration of less than 5 mg/L, the usual detection limit. The only wells that are above this in the 1984 analyses are MSB-3A, adjacent to the basin, MSB-13B near Lost Lake and two wells at the Silverton Road waste site, SRW-12A and SRW-13C.

Carbon Tetrachloride

Carbon tetrachloride was detected in wells MSB-19C, MSB-24, MSB-27A, MSB-31C, MSB-34B and C. None of these wells are near the settling basin. The highest concentration is in wells MSB-24 and MSB-34B and C.

Chloride

The secondary drinking water limit for water supplies is 250 mg/L (Environmental Protection Agency, 1979). Chloride concentrations in samples from several wells around the Savannah River Laboratory seepage basin slightly exceed the median natural concentration of 2.7 mg/L (Siple, 1967, p. 83), reaching concentrations of 8.5 mg/L in well ASB-7. Also, chloride concentrations exceed this median in several wells around the M-Area settling basin and Lost Lake reaching a maximum of about 42 mg/L in well MSB-3A.

Chlorobenzene

Concentration of chlorobenzene is either below or only slightly above detectibility of 5 micrograms per liter except in well MSB-3A, adjacent to the M-Area settling basin; MSB-16C adjacent to process sewer line going to the settling basin; and MSB-24 in the M-Area process area.

Chromium

The drinking water standard for chromium is 50 micrograms per liter (Environmental Protection Agency, 1977, p. 5). Only concentrations at well MSB-24 in the M Area process area exceed this limit. Wells MSB-11F and MSB-14B, near the settling basin show concentration of about 37 micrograms per liter. All other concentrations are either below detectibility or only slightly above.

Conductivity

Electrical conductivity is an indication of the concentration of dissolved ionic species in water. Values of over 100 micromhos per centimeter are common in natural water from the McBean and Congaree Formations. Wells AC-3B, MSB-9B, MSB-10C, MSB-13C, and MSB-30C have conductivities that exceed 100 µmho/cm but also have pH greater than 10 indicating that leaching of cement may be present. In addition, elevated conductivities occur in wells surrounding the M-Area settling basin; namely, wells MPT-1, MSB-3A, 4A, and 5A, MSB-9C, MSB-11C, MSB-14B and C, and MSB-22. Elevated conductivities that may reflect movement of groundwater are present in wells MSB-10C, MSB-12B and C, MSB-17A and B, and RWM-3 (one of two demonstration recovery wells). Elevated conductivities at wells MSB-23, MSB-24, MSB-25, and MSB-34B may represent contributions of ionic species from other sources.

Copper

The secondary drinking water standard for copper is 1000 micrograms per liter. No analyses exceed this level. The highest concentration of copper (95 μg/L) is found in well MSB-24.

Cyanide

The 1962 Public Health Service drinking water standard for cyanide was 200 micrograms per liter. All samples are below detectibility of 5 micrograms per liter except for wells MSB-9B and 13B, which are 21 and 57 micrograms per liter, respectively.

Fluoride

The maximum contaminant level of fluoride in community water systems ranges from 1400 to 2400 micrograms per liter depending on the temperature of the water (Environmental Protection Agency, 1977, p. 5). Natural waters from the McBean and Congaree sands may range up to 300 micrograms per liter (Siple, 1967, p. 83). Only water from wells MPT-1, MSB-3, and MSB-22, adjacent to the settling basin appreciably exceeds the natural concentration of fluoride in the McBean and Congaree sands.

Grease and Oil

Detectability is generally 5 mg/L. Only well ASB-4 is appreciably above this value.

Gross Alpha

The drinking water limit for gross alpha is 15 picocuries per liter (Environmental Protection Agency, 1977, p.7). Analyses were made on wells near the settling basin and pipe line, at the solvent tank and process area and downgradient from this area, and at the A-14 outfall. The drinking water limit was exceeded in three analyses from wells adjacent to the settling basin (MPT-1, MSB-3A,) and MSB-4A), but other analyses from the two wells showing the highest values (MPT-1 and MSB-3A) showed values less than the drinking water limit. The other well (MSB-4A) is 16 picocuries per liter only slightly above the drinking water standard. Several areas in the coastal plain of South Carolina have groundwaters that are naturally very high due to the presence of uranium and thorium minerals.

Gross Beta

The same wells that showed elevated levels of gross alpha show elevated levels of gross beta.

Iron

The secondary drinking water standard for iron is 300 micrograms per liter (Environmental Protection Agency, 1979), however the maximum reported by Siple (1967, p. 83) from McBean and Congaree sands is 1840 micrograms per liter. The only 1984 analysis in the A/M Area that approaches the concentration reported by Siple is from well SRW-16B. Some of the small variation in analytical results may be due to corrosion of the galvanized steel conductor pipe in the wells even though four well volumes of water are removed before sampling.

Lead

The drinking water standard for lead is 50 micrograms per liter (Environmental Protection Agency, 1977, p. 5). The only well that appreciably exceeds this value is MSB-24 in the M-Area process area. This well is high in pH (11.7) and is suspected of being influenced by cement. The high pH would solubilize lead that might be present. Several other wells barely exceed 50 micrograms per liter, namely MSB-2A next to the M-Area settling basin, MSB-20C which is half way between M Area and the Silverton Road waste site, MSB-34B near the M-Area process area, and SRW-13C at the Silverton Road waste site. Thus there does not appear to be a consistent pattern of lead distribution. Corrosion from the galvanized steel conductor pipe which is present in all wells except MSB-1 through 8 (MSB-1A through 8A) may contribute to this inconsistent pattern. In addition, the 1983 samples were not filtered and so may contain suspended lead.

Magnesium

The magnesium concentrations in natural waters from McBean and Congaree sands may range up to 4000 micrograms per liter whereas those from limy beds in those formations may range up to 9000 micrograms per liter (Siple, 1967, p.83). No analyses exceed these values. The only wells in the M-Area vicinity that approach these values are MPT-1, MSB-4A, MSB-9C, and MSBS-14B, all near the settling basin, and SRW-14B at the Silverton Road waste site.

Manganese

The secondary drinking water standards for manganese is 50 micrograms per liter (Environmental Protection Agency, 1979). The only wells that appreciably exceed this value are MPT-1, MSB-3A, MSB-11D and MSB-22, all near the M-Area settling basin, and SRW-14B and 16B at the Silverton Road waste site.

Mercury

The maximum contaminant level for mercury in community water systems is 2 micrograms per liter (Environmental Protection Agency, 1977, p. 5). No wells exceed this value.

Nickel

The median concentration of nickel in North American Rivers was 10 micrograms per liter (Hem, 1970, p. 201). This value is only exceeded at wells MPT-1, MSB-3A and 4A, MSB-9A, MSB-11D and F, MSB-14B and C, and MSB-22, all in the immediate vicinity of the M-Area settling basin. For some analyses, detection limits were 40 micrograms per liter.

Nitrate

Nitrate is reported in milligrams of nitrogen per liter, and as such the drinking water standard is 10 mg/L (Environmental Protection Agency, 1977, p. 5). Because nitrate has been a significant constituent of the effluent discharge from M Area, a map of the concentration at the water table is presented in Figure 7-15. Elevated concentrations are principally confined to the immediate vicinity of the settling basin. Elevated concentrations also occur near the solvent tank (MSB-23), in the M-Area process area (MSB-24), and at well SRW-13C at the Silverton Road waste site. Slightly elevated concentrations occur at the MSB-12 and 17 sites.

Nitrite

No well shows a nitrite concentration consistently above detectibility.

pH

Natural waters from the McBean and Congaree sands range from 4.2 to 6.1 and from the limestones from 6.8 to 7.6 (Siple, 1967, p. 83). Thus, these waters are naturally acidic. The only well that produces water of pH less than 4 is MPT-1. On the other hand, several wells produce water of pH greater than 9. There is no pattern to these wells, and it is suspected that these elevated pH values may represent a leaching of the cement sheath surrounding the casing or an invasion of cement into the screen zone during the construction of the well. The wells with a pH above 9 are: AC-3B, MSB-9B, MSB-10C, MSB-13B, MSB-20C, MSB-24, and MSB-30C. The correlation of several analytes with pH is shown on Table 7-3.

Phenanthrene

No analysis for phenanthrene shows a value above detectibility of 1 microgram per liter.

Phenol

Phenol was found at levels slightly above detection limits at wells near the settling basin (MPT-1, MSB-3A, MSB-9C), near the pipe line (MSB-15A, MSB-16A), and in the process area (MSB-24).

Phosphate

Sources of phosphate are the dissolution of certain rocks, pollution from fertilizer or organic sewage, or the use of phosphates to break down the mud cake when attempting to develop a well. Normal well drilling practices at SRP do not include phosphate treatment; however, well MPT-1 was difficult to develop and three treatments with sodium phosphate were used. The water presently produced from this well contains only 40 μg/L, indicating most of the phosphate has been removed. Wells that have phosphate concentrations greater than 100 μg/L are MSB-9A, MSB-11A, B, and F, MSB-14C, MSB-25, MSB-31C and SRW-14B. These wells do not fit into a readily recognizable pattern.

Potassium

Potassium is commonly a major constituent in natural water. Concentrations up to 5,000 μg/L are not unusual (Hem, 1970, p. 151), but potassium and sodium together from the McBean and Congaree sands rarely exceed 2400 micrograms per liter and from the limestones 19,000 μg/L. The only wells that have concentrations of potassium that appreciably exceed 19,000 μg/L are MSB-13B and MSB-28A.

Radium-226

The drinking water standard for radium is 5 picocuries per liter, but natural waters from the Coastal Plain sediments show a large range in radium content. Of nine analyses of natural waters given by Siple (1967, p. 87), five exceed the drinking water limit. The highest of these was 72 picocuries per liter. Radium analyses were made only at wells near the settling basin (MPT-1, MSB-3A and MSB-4A). The highest of these was 35 picocuries per liter at MPT-1.

Radium, Total

Total radium was measured in 16 wells. The only analyses appreciably above 5 picocuries per liter were MPT-1 and MSB-3A.

Selenium

No selenium concentrations exceed detectability of 1 or 2 micrograms per liter. Maximum contaminant level for community water systems is 10 micrograms per liter (Environmental Protection Agency, 1977, p. 5).

Silica

Silicon is second only to oxygen in abundance in the earth's crustal rocks. Silica is a common constituent of natural waters and concentrations commonly range from 1 to 30 mg/L (Hem, 1970, p. 109). Concentrations of silica in the analyses reported in Appendix C range from 3 to 50 mg/L with no particular pattern apparent.

Silver

The maximum contaminant level for silver is 50 micrograms per liter (Environmental Protection Agency, 1977, p. 5). Additional analyses for silver are given in Appendix D. None of these analyses in either table exceed detectability except for well MSB-5A on 2-8-84, which was 3 micrograms per liter.

Sodium

As mentioned under the discussion of potassium, these two analytes combined rarely exceed 19 mg/L in limestones of the McBean and Congaree Formations and 2.4 in the sands (Siple, 1967, p. 83). Wells whose analyses exceed 19 mg/L of sodium are in the vicinity of the settling basin and Lost Lake, such as MSB-3A, 4A, and 5A, MSB-9B and C, MSB-13B and C, MSB-14B, and MSB-22; wells MSB-10C, MSB-12C, and MSB-17B also show elevated sodium concentrations.

Strontium

Analyses of 200 underground and surface public water supplies in the U.S. had a median concentration of strontium of 100 μg/L (Hem, 1970, p. 197). Several wells in close proximity of the settling basin contain elevated concentrations of strontium for this area although only at concentrations about equal to the median for public drinking water mentioned above. These wells are MPT-1, MSB-11B and C, and MSB-22. Several wells with elevated pH, perhaps indicating leaching of cement, also show elevated strontium concentration. These wells are AC-3B, MSB-9B, MSB-10C, MSB-13B, MSB-20C, MSB-24, and MSB-30C (Table 7-3). In addition, well MSB-23 at the solvent tank shows an elevated strontium concentration.

Sulphate

The secondary drinking water limit for sulphate is 250 mg/L (Environmental Protection Agency, 1979), but natural waters around SRP are commonly between <2 and 14 mg/L (Siple, 1967, p. 83). Well MSB-3A, adjacent to the settling basin, shows an elevated concentration of sulphate (~100 mg/L). Well MSB-11A showed a level of 192 mg/L in 1984 analyses but less than 5 mg/L in 1983. Well MSB-11A does not show elevated concentrations of other analytes, and it is suspected that the 1984 analysis is spurious.

Surfactants

The detection limit of surfactants is 10 micrograms per liter. Wells with detectible surfactants are AC-1A, ASB-9, MPT-1, MSB-3A, MSB-9A, B, and C, MSB-10A, MSB-11D and F, MSB-12A and D, MSB-13B, MSB-25A, MSB-28, and MSB-30C. Of these MPT-1, MSB-3A, MSB-9A, B, and C, and MSB-11D and F are near the settling basin. Wells MSB-9B MSB-13B and MSB-30C show elevated pH values (Table 7-3). But in general there seems to be no consistent pattern to the occurrence of surfactants, and reported levels are extremely low.

Thallium

Thallium is everywhere below the detectible limit of 2 or 3 μg/L except at MSB-3A near the settling basin where it is 5 μg/L.

Total Dissolved Solids

The secondary drinking water standard for total dissolved solids is 500 mg/L (Environmental Protection Agency, 1979). Total dissolved solids reported by Siple (1967, p. 83) in water from the sands of the McBean and Congaree Formations range from 20 to 29 mg/L, but from the limestones they range from 75 to 192 mg/L. The usual range of the wells reported in Appendix C is from about 12 to about 100 mg/L. Wells that are over 100 mg/L can be categorized into four groups -- (1) Those wells with high pH possibly indicating leaching of cement in the well annulus including AC-3B, MSB-9B, MSB-10C, MSB-13B, MSB-24, MSB-30C; (2) wells in the immediate vicinity of the settling basin or Lost Lake including MPT-1, MSB-3A, 4A, and 5A, MSB-9B and C, MSB-11C and D, MSB-13B, MSB-14B and C, and MSB-22; (3) wells in the plume of groundwater movement from the basin including MSB-12B and C, MSB-17A and B, and (4) wells that represent sources of dissolved solids different from the settling basin including wells MSB-23 at the solvent tank and MSB-27 and RWM-3 in the plume from the process area. Figure 7-14 shows concentration of total dissolved solids at the water table.

Total Organic Halogen

As might be expected, wells with elevated concentrations of degreaser solvents show elevated levels of total organic halogen. These include wells near the settling basin (MPT-1, MSB-3A, and MSB-11C and F), wells at the solvent tank and downgradient from the solvent tank (MSB-23 and 23B, MSB-26A, MSB-27A and RWM-2), wells in the process area (MSB-24A, MSB-34B and C, and RWM-3), and a well at the A-14 outfall (MSB-31C).

Trans 1,2-Dichloroethylene

Trans 1,2-dichloroethylene is a break-down product from trichloroethylene (Cline and Viste, 1984). Thus it is not surprising that wells which show elevated concentrations of trichloroethylene also show elevated concentrations of trans 1,2-dichloroethylene. These wells are ASB-8; MPT-1; MSB-1A, 2A, 3A, and 4A; MSB-9B and C; MSB-10C; MSB-11C, D, and F; MSB-14A and B; MSB-22; MSB-23B; MSB-26A; MSB-27A; MSB-28A; MSB-31C; MSB-34B and C; RWM-2 and 3; and SRW-2A.

Uranium

The common level of detectability for uranium in these analyses is 0.2 milligrams per liter. The only samples that exceed this value are from wells MSB-11C and MSB-22 adjacent to the settling basin, and MSB-24 and RWM-3 in the process area.

Vinyl Chloride

The detection limit for vinyl chloride for the analyses given in Appendix C is 10 g/L. The only detectible concentrations of vinyl chloride are at wells MSB-3A (58 g/L) and 4A (11 g/L), immediately adjacent to the settling basin. Since vinyl chloride has been reported as a possible degradation product from tetrachloroethylene and trichloroethylene through dichloroethylene, its presence is not surprising.

Zinc

The secondary drinking water limit for zinc is 5000 micrograms per liter (Environmental Protection Agency, 1979). The concentration of zinc in the 1984 analyses in Appendix C have a range from 18 to 6,670 g/L with no readily apparent pattern. Wells that have values above 5000 micrograms per liter are MSB-11D, 12A, 13C, 26A, 31A, and SRW-3C. Some variation in zinc may result from the presence of galvanized steel conductor pipes in the wells even though four well volumes of water were removed before sampling.

1,1-Dichloroethane; 1,1-Dichoroethylene; 1,1,2,2,-Tetrachloroethane; 1,2-Dichlorobenzene; and 1,4-Dichlorobenzene

Analyses for nearly all wells are below detectibility for these five organic compounds. Exceptions are that well MSB-3A, adjacent to the settling basin, has an elevated concentration of 1,1-dichloroethylene and that well MSB-4A, also adjacent to the settling basin, has low concentrations of 1,1-dichloroethane and 1,1- dichloroethylene. Well MSB-9C, also adjacent to the basin, shows a barely detectible concentration of 1,1-dichloroethane. Well MSB-17B shows a detectible level of 1,1-dichloroethylene. Since dichloroethylene is a degradation product of trichloroethylene, its presence is not surprising.

7.3 Recovery Wells

A second objective of the 30-day pumping test (discussed in Section 5.3.4) conducted from October 18 to November 17, 1982, was to obtain additional chemical data for design of a groundwater treatment process. For this, a total of 31 water samples were collected from the pumping well (MPT-1) during the 30-day test period. Table 7-4 presents the results of the organic analyses, temperature, pH, and conductivity measurements taken in the field as well as the approximate elapsed time and the cumulative volume pumped at the time the sample was obtained. For each sample collection two vials were obtained for organic analysis by SRL. The results given on Table 7-4 are the average of the two analyses. As can be seen on Table 7-4, the analyses for both trichloroethylene and tetrachloroethylene are relatively constant, and approximately equal in concentration. The average trichloroethylene concentration for the 31 samples was 196 ppm and the average concentration of tetrachloroethylene was 154 ppm producing an average total organic concentration of 350 ppm. No 1,1,1-trichloroethane was detected in any of the samples analyzed. The concentration of total organics in water later produced from MPT-1 and analysed by a different laboratory was about 115 ppm as shown on Figure 7-16.

Measurements of pH obtained at the time the sample was collected range between 3.4 and 3.8 (Table 7-4). The pH of natural groundwater from the McBean and Congaree sands is normally between 4.2 and 6.1.

The temperature of the samples determined in the field at the time of collection ranged between 18° and 20.5°C, and electrical conductivity averaged about 500 micromhos/cm, somewhat higher than the conductivity given in Appendix C for this well.

Inorganic chemistry data were obtained on 10 of the 31 samples by Environmental and Chemical Sciences, Inc. under contract to SRL. The results of these analyses are presented on Table 7-5. Table 7-5 shows that the nitrate plus nitrite content, expressed as nitrogen, of the groundwater from MPT-1 is approximately 60 ppm. This is 70 percent higher than the value given in Appendix C. Conductivity measured is about 60 percent higher than the value given in Appendix C. Phosphate was 160 percent higher, but all other results, while not identical, are within the same range.

From the results of this pumping test, a pilot air stripper was designed to be operated with inlet feed from well MPT-1. Pilot operation of this system began in January 1983, and it has been operated virtually continuously since then through October 1984. Analyses of the well discharge water for degreaser solvents are given on Figure 7-16. The total degreaser solvent concentration in water from well MPT-1 during the pilot operation was about 120 ppm, about one half the concentration observed during the pumping test.

These differences could be partially due to the fact that 4 months elapsed between the pumping test and the pilot stripper operation and the analytical laboratories were changed from SRL to 320-M. The purpose of operating the pilot system was to obtain design parameters with which to design a full scale unit. Degreaser solvent concentration in water is reduced in the stripper as a function of column length, air flow, and water flow. The effluent concentration in the final design of the remedial stripper will be less than 1 ppb.

Subsequent to tests on MPT-1, two additional demonstration recovery wells were drilled (RWM 2 and 3, Figure 7-17). Discharges from these two wells were pumped into a prototype air stripper (capacity 50 gpm) starting in the Fall of 1983 for further refinement of design parameters. Graphs of the concentration of degreaser solvents in these two wells are shown on Figures 7-18 and 7-19. The effluent concentration from the prototype stripper was less than 1 ppb. By mid-October 1984, 17,830 pounds of degreaser solvent had been removed from well MPT-1 after pumping about 15 million gallons of water, 2,160 pounds from RWM-2 after pumping about 5.5 million gallons of water, and 9,290 pounds from RWM-3 after pumping about 10 million gallons. Thus almost 30,000 pounds of degreaser solvent had been removed from the groundwater as of mid-October 1984.

From the data gathered from the operation of these three test recovery wells and their associated air strippers, an eleven-well recovery system was designed. The locations of these wells are shown on Figure 7-17. The system including the air stripper is designed for a capacity of 400-gallons per minute.

7.4 Water Quality in the "Tuscaloosa" Formation

In March of 1983, two water supply wells in A/M Area were found to have low concentrations of degreaser solvents. Wells 905-53A and 20A (Figure 4-2) showed trichlorethylene concentrations up to 26 ppb and 8 ppb, respectively. As a result of these analyses wells 905-53A and 20A were taken out of service.

Well cluster MSB-34 was installed 250 feet from well 905-53A and showed degreaser solvent concentrations in water ranging from about 53,900 ppb at the water table to 642 ppb near the base of the Tertiary sediments (Appendix B). The degreaser solvents in the Tertiary sediments in the immediate vicinity of well 53A are probably the source of these substances in water produced from this "Tuscaloosa" well.

A series of tests were made on well 905-53A to determine the conditions in the well itself. The well is 670 feet deep and screened intermittently from 387 to 670 feet. The results of these tests were:

1. A TV camera survey indicated no gross casing breaks.

2. Packer tests indicated that the casing does leak (the possibility always exists of a poor packer setting that might negate this conclusion).

3. A cement bond log indicated that there were extensive areas where the cement sheath around the casing, whose purpose is to seal the casing to the ground, was not bonded to the casing. Such areas of poor bond could provide avenues for contaminated water from the Tertiary sediments to migrate directly to the screened sections of the Tuscaloosa.

4. A vertical water velocity survey showed that water inside the screened zone moves from about 430 feet down to about 640 feet at a velocity of about 7 feet/minute or at about 28 gallons per minute in the 10-inch casing. This water movement has gone on continuously since the pump was shut down in April 1983.

5. Samples collected by a thief sampler every 50 feet from a depth of 180 feet (water level) to 680 feet showed tritium concentrations in all samples to be less than the detectable level of 0.02 picocuries per gram (20 picocuries per liter). All tetrachloroethylene concentrations on the same set of samples were less than 1 ppb. Trichloroethylene concentrations in the same set of samples were less than 1 ppb except for the samples at 430 and 480 feet which were 3 and 4 ppb, respectively.

The conclusion from these tests is that there is a strong probability that the presence of degreaser solvents in water from the "Tuscaloosa" is very localized and occurred only at the site of the water production well.

Even before the degreaser solvents were discovered in 905-53A, three monitoring wells (MSB-23A, 30A, and 31A) had been drilled (February 1983) to explore the potential for movement of degreaser solvents vertically from the Tertiary sediments through the Ellenton into the "Tuscaloosa". No solvents had been found in any of these wells. Subsequent to the discovery of the solvents in the two production wells, four more "Tuscaloosa" monitoring wells were drilled (MSB-12TA, 12TB, 34TA, and 34TB).

The locations of the "Tuscaloosa" monitoring wells are shown on Figure 4-2, and the total depth and screened interval for each well are tabulated on Table 4-2. The first "Tuscaloosa" monitoring well (MSB-23A) was installed in the vicinity of the solvent storage tank at Building 321-M in an area of elevated concentrations of degreaser solvents in the Tertiary sediments. The second well (MSB-30A) was drilled approximately 2000 feet west of MSB-23A between M Area and the plant boundary. A third "Tuscaloosa" well (MSB-31A) was installed adjacent to the A-14 sewer outfall leading to Tims Branch. Two "Tuscaloosa" wells (MSB-12TA and 12TB) were installed at existing well cluster site MSB-12 southwest of the M-Area basin. Well cluster MSB-34 was installed as close as reasonably possible to production well 905-53A to assess the source of the degreaser solvents in this supply well. This cluster was located approximately 250 feet from Well 905-53A in the direction of M Area. The cluster consists of three Tertiary wells and two "Tuscaloosa" wells in order to obtain vertical head data as well as water quality data. The results of the chemical analyses from the "Tuscaloosa" monitoring wells are given in Appendices B and C.

During 1983 no degreaser solvents were found in any "Tuscaloosa" monitoring well (Appendix B), and it was concluded that the low concentrations at the production wells were caused by (1) inadequate seals by the cement sheath between the casing and the ground opposite the Tertiary sediments and (2) the increased head differential between the water in the Tertiary and that in the "Tuscaloosa" caused by the drawdown at the production well. Although the concentrations of degreaser solvents are quite high in the Tertiary sediments at the solvent tank (MSB-23, Figure 7-1), the levels in soil samples from the Ellenton Formation attenuate rapidly with depth. The concentration at the top of the Ellenton is 268 ppb and attenuates to 10 ppb (Table 7-6) at the bottom of the "Tuscaloosa" clay, which underlies the Ellenton. (Editorial Note: During the drilling of a replacement well for MSB-23A in July 1985, 18 soil samples were collected in the Ellenton and upper "Tuscaloosa" Formations between depths of 250 and 325 ft. Analyses of these samples show less than 10 ppb total chorocarbons, the detection limit, for all samples.)

In 1984 (Appendix B) positive results for trichloroethylene began to appear in the fluid samples of well MSB-23A. There is, however, a very definite possibility that the cement sheath between the casing and the ground at this well may also be imperfect even though the analysis given in Appendix C is not high in the constituents listed on Table 7-3. Other analyses from this well show that pH is highly dependant on the amount of water pumped prior to sampling.

It appears that it simply took over a year for the solvents to migrate through the fine cracks or poor bonding of the cement sheath. It is planned to plug this well and install another one. (Editorial Note: A replacement well was installed in July 1985.) No degreaser solvents have been found in the "Tuscaloosa" at any other monitor well location during the first half of 1984. Although some analyses in Appendix B show slight positive results, these are not consistent and subsequent analyses show negative results. These are, therefore, thought to be spurious analyses. Thus, it appears that prevasive contamination of the "Tuscaloosa" from the Tertiary plume has not occurred. It also appears that, based on data collected up to October 1984, where degreaser solvents are present in "Tuscaloosa" water, it is related to well construction. (Editorial Note: In the drilling program of the Fall of 1984, 14 additional "Tuscaloosa" monitoring wells were drilled. Only one of these wells (MSB-37TA) showed chlorocarbons appreciably above the detectable limit. A faulty cement seal can be ruled out as the cause for this concentration because concentrations in the Tertiary sediments above are lower. The cause of the presence of chlorocarbons in the "Tuscaloosa" at this location is being vigorously investigated.)

7.5 Movement of Degreaser Solvents

Results of analyses for degreaser solvents are quite variable. Figures 7-20 to 7-24 show time/concentration graphs for water from wells in clusters MSB-9, 14, and 19, and wells MSB-26A and 28A. These plots are somewhat typical for the variability of analyses at other well clusters. From these graphs it is difficult to draw definitive conclusions about degreaser solvent movement. More analyses to establish time trends are required.

However, some conclusions can be drawn about degreaser solvent movement from the present shape of the plume. Figure 6-1 shows the potential or suspected distribution of sources. The principal sources seem to be at the solvent tank, the settling basin, and the A-14 outfall.

These sources are reflected on Figure 7-11 as places where the water table concentrations of over 10,000 ppb of trichloroethylene plus tetrachloroethylene occur. From these locations the solvents move in the direction of the groundwater gradient which is downward as well as laterally. Thus on Figure 7-12, which is a horizontal slice through the ground at a level about 60 to 100 feet below the water table, two lobes of solvents appear that are not present in the concentration map of the water table.

The lobe of elevated concentrations centered in the vicinity of the solvent tank and drum storage locations matches a potentiometric lobe in the water table. Currently, there are insufficient data to determine if this piezometric lobe is also present at an elevation of 60 to 100 feet below the water table. The vertical descent of degreaser solvents in this lobe is shown on Figure 7-9.

The second lobe of solvents in the vicinity of the settling basin (Figure 7-12) also generally follows the gradient of the water table (Figure 5-3) or that of the zone 60 to 100 feet below the water table (Figure 5-4) except that the lobate shape is accentuated by the low concentrations at MSB-10. The effect of these low concentrations at MSB-10 also influences the shape of the average concentration map (Figure 7-7). (Editorial Note: Subsequent studies of the geology of this area indicate that well MSB-10B may be in a sand that is not correlative with other sands in this zone.)

The degreaser solvents in the deepest Tertiary zone (Figure 7-13) appear to be not as high in concentration nor as extensive as the middle zone (Figure 7-12), although mapping control on the deepest zone is not as great as on the middle zone. Nevertheless the areas of highest concentration in the deepest Tertiary zone are those directly under the major surface sources of degreaser solvents.

7.6 Conclusions

Degreaser solvents have entered the groundwater in the Tertiary sediment from several surface sources. The probable primary surface sources are the M-Area settling basin, the solvent storage tank area, and the A-14 sewer outfall (Figure 6-1). Other possible sources are the pipeline leading to the settling basin and the process area including a discontinued solvent drumming facility. The maximum concentration of degreaser solvents, 542 ppm, occurs at the water table (Figure 7-11) under the settling basin. High concentrations also occur at the water table under the other surface sources. At a greater depth (about 75 feet below the water table), the maximum concentration has decreased to 61 ppm but the plume occupies a larger area than it does at the water table (Figure 7-12). Near the base of the Tertiary sediments (120 feet below the water table) both the maximium concentration and the area of the plume have decreased greatly, being restricted to the general area beneath the surface sources (Figure 7-13).

Although low concentrations of degreaser solvents have been detected from production and monitoring wells that are screened in the "Tuscaloosa" Formation, there is evidence in each case of a faulty well seal. Based on the evidence to date, there does not appear to be a prevasive passage of degreaser solvents even at low concentrations into the "Tuscaloosa" Formation. (Editorial Note: As mentioned in the editorial note at the end of Section 7.4, well MSB-37TA indicates chlorocarbons in the "Tuscaloosa" that have not come through a faulty well seal.)

Plumes of elevated concentrations of total dissolved solids (Figure 7-14) occur in the vicinity of the M-Area settling basin and in the M-Area process area (vicinity of Building 321-M). These same two areas are underlain by plumes of elevated nitrate concentrations at the water table (Figure 7-15). In the wells immediately adjacent to the M-Area settling basin there are somewhat elevated concentrations of aluminum, chloride, fluoride, magnesium, manganese, nickel, sodium, strontium, and trans 1,2-dichloroethylene. The significance of these findings is not clear at this time but is being investigated as part of the ongoing groundwater assessment program.

Additional investigations of the hydrogeology and the contaminant plume are presently being vigorously pursued. In addition, the full-scale remedial action program (400 gpm air stripper and 11 recovery wells) is scheduled to begin in April 1985. (Editorial Note: The air stripper started operation on April 19, 1985 and the entire system was operational on September 9, 1985.)

References For Chapter 7

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TABLE 7-1

Estimate of Inventory of Degreaser Solvents in the Saturated Zone

Elevation Interval (ft) From	To	Thickness (ft)	Concentration Range (mg/L) From	To	Average	Area of Concentration ($10^6 ft^2$)	Volume* of Degreaser Solvent (ft^3)	Mass** of Degreaser Solvent ($10^3 lb$)
Water-Table (240)	187	53	132	10	71	1.5	1919	195.7
			10	1	5.5	4.2	416	42.4
			1	.1	.55	6.3	62	6.3
187	146	41	36	10	23	1.9	609	62.1
			10	1	5.5	5.8	444	45.3
			1	.1	.55	8.0	61	6.2
146	100	46	.3	.1	.2	2.0	6	.6
Total		140				15.7	3517	358.6
						360 Acres within 100 microgram per liter contour in middle Tertiary zone		

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* A soil total porosity of 34 percent is used (Table 5-1)

** A density 102 lb/ft^3 is used (Gordon, 1982).

TABLE 7-2

Elements, Compounds, and Properties for Which Analyses were Made on Samples of Water Collected from Monitoring Wells

(Results for those preceeded by an astrisk are not reported in Appendix C, and the reason for not reporting them is given in the introduction to the appendix.)

Metals

Antimony
Arsenic
Beryllium
Cadmium
Chromium
Copper
Lead
Mercury
Nickel
Selenium
Silver
Thallium
Uranium
Zinc

Organics

*Acrolein
*Acrylonitrile
*Benzene
*Bis (2-ethylhexyl) Phthalate
Bromodichloromethane
*Bromoform
*Bromomethane
Carbon Tetrachloride
Chlorobenzene
*Chloroethane
*2-Chloroethylvinyl Ether
*Chloroform
*Chloromethane
Cyanide
*Dibromochloromethane
1,2-Dichlorobenzene
1,4-Dichlorobenzene
1,1-Dichloroethane
*1,2-Dichloroethane
1,1-Dichloroethylene
*2,4-Dichlorophenoxyacetic Acid
*1,2-Dichloropropane
*1,3-Dichloropropylene
*Diethyl Phthalate
*Di-n-Butyl Phthalate
*Ethylbenzene
*Fluoranthene
*Methylene Chloride
*Naphthalene
*Nitrobenzene
Phenanthrene
Phenol
*Pyrene
1,1,2,2-Tetrachloroethane
*Toluene
Trans-1,2-Dichloroethylene
*Trichorofluoromethane
Vinyl Chloride

TABLE 7-2, Contd

Cations

Aluminum
Barium
Calcium
Iron
Magnesium
Manganese
Potassium
Sodium
Strontium

Anions

Chloride
Fluoride
Nitrate
Nitrite
Phosphate
Sulphate
*Sulphide

Radioactivity

Gross Alpha
Gross Beta
Radium 226
Radium Total

Pesticides

*Endrin
*Lindane
*Methoxychior
*Silvex
*Toxaphene

Properties

Conductivity
pH
*Color
*Corrosivity
*Fecal Coloform
*Odor
*Turbidity

Other

Carbon, Dissolved organic
Carbon, Total Organic
Grease and Oil
Silica
*Silicon
Surfactants
Total Dissolved Solids
Total Organic Halogens

TABLE 7-3

Wells Where Leaching of Cement May Be Influencing the Concentration of Analytes

Well	pH	conductivity (μmho/cm)	Aluminum (mg/L)	Calcium (mg/L)	Strontium (μg/L)	Total Dissolved Solids (mg/L)
perspective value	4.2-6.1	100	~1	1-30	110	100
AC-3B	10.8	224	2.5	33	105	142
MSB-9B	10.4	260	<.3	10	126	120
MSB-10C	9.4	215	<.3	32	497	182
MSB-13B	9.5	213	<.3	8	168	160
MSB-20C	10.3	147	.7	40	106	78
MSB-24	11.7	960	5.5	115	408	322
MSB-30C	10.5	175	1.6	40	496	100

TABLE 7-4

Analyses of Degreaser Solvents, pH, Temperature, and Conductivity During 30-Day Pumping Test on MPT-1 (10-18-82 to 11-17-82)

Sample No.	Approx. Cumulative Gal Pumped	Approx. Cumulative Time	Average Trichloro-ethylene (ppm)	Average Tetrachloro-ethylene (ppm)	Average Total Organics (ppm)	pH	Temp (°C)	Conductivity (μmho/cm)
1	1800	1 hr	191	208	399	-	-	-
2	3600	2 hr	152	140	292	3.80	20.0	-
3	5300	4 hr	164	150	314	3.75	19.2	-
4	10600	6 hr	162	162	324	3.75	19	-
5	15900	9 hr	165	147	312	3.80	18	-
6	21550	13 hr	139	126	265	3.40	19	-
7	32200	19 hr	155	144	299	3.75	19.5	-
8	43000	24 hr	170	150	320	3.65	20.5	-
9	64400	35 hr	162	139	301	3.60	19.2	-
10	85700	48 hr	164	135	299	3.60	20	-
11	107200	59 hr	111	102	213	3.60	20	-
12	128950	72 hr	132	114	246	3.60	20	-
13	162300	90 hr 10 min	138	126	264	3.50	18.5	-
14	181200	101 hr 30 min	210	170	380	3.50	19	-
15	207600	116 hr 10 min	211	172	383	3.55	19	-
16	252600	141 hr 50 min	202	159	361	3.60	19	-
17	292600	165 hr	132	158	290	3.70	19	-
18	338000	190 hr	189	199	388	3.70	19	-
19	385350	216 hr	191	173	364	3.75	19.5	470
20	427500	239 hr 15 min	219	173	392	3.45	-	480
21	511250	284 hr 50 min	324	256	580	3.40	19.5	550
22	551700	307 hr	166	84	250	3.70	19	550
23	598600	334 hr	185	124	309	3.70	19.5	525
24	671550	380 hr 55 min	237	160	397	3.50	19.5	520
25	729700	432 hr 30 min	281	190	471	3.45	19	475
26	806300	475 hr 35 min	330	209	539	3.55	18.5	475
27	902950	529 hr	262	149	411	3.40	19.5	420
28	985100	575 hr	216	130	346	3.50	19	490
29	1072750	621 hr 40 min	245	143	388	3.60	19	475
30	1164300	671 hr 55 min	230	134	364	3.80	19	490
31	1247800	717 hr 35 min	250	136	386	3.60	18	465

TABLE 7-5

Analyses of Inorganic Chemistry of Selected Water Samples from MPT-1 During 30-Day Pumping Test

(see Table 7-4 for identification of sample numbers)

Sample	pH	ORP* (mV)	Cond (μmho/cm)	NO_2+NO_3=N (mg N/L)	Chloride (mg/L)	SO_4 (mg SO_4/L)	Ortho P (mg P/L)
4	3.38	490	450	54.5	5.00	0.4	0.141
8	3.32	410	460	59.0	4.50	0.2	0.105
14	3.30	410	460	57.5	4.25	<0.2	0.132
17	3.32	410	420	56.0	4.25	<0.2	0.124
20	3.35	415	465	67.5	4.50	<0.2	0.141
22	3.38	490	500	63.0	4.50	<0.2	0.136
24	3.39	480	495	65.5	4.50	<0.2	0.121
26	3.42	480	420	51.5	4.00	<0.2	0.105
28	3.40	480	480	62.0	4.00	<0.2	0.116
31	3.38	420	425	62.0	4.00	<0.2	0.106

*Oxidation - Reduction potential measured at 25°C, referenced to hydrogen electrode

Sample	Al (mg/L)	Ca (mg/L)	Cu (mg/L)	Fe (mg/L)	K (mg/L)	Mg (mg/L)	Na (mg/L)	Ni (mg/L)	Zn (mg/L)
4	10.6	35.3	<0.005	0.091	0.94	7.01	10.6	0.09	0.10
8	10.7	36.1	<0.005	0.085	1.14	7.40	10.9	0.16	0.11
14	9.3	36.1	<0.005	0.077	1.06	8.56	12.1	0.09	0.10
17	7.6	35.3	<0.005	0.064	0.98	7.96	9.7	0.10	0.09
20	8.0	42.5	<0.005	0.063	1.16	9.98	11.8	0.11	0.10
22	7.5	43.9	<0.005	0.048	1.19	10.23	11.3	0.09	0.09
24	7.6	41.6	<0.005	0.053	1.18	10.11	11.0	0.06	0.09
26	5.9	35.9	<0.005	0.040	1.04	9.10	8.8	0.08	0.06
28	6.7	41.4	<0.005	0.041	1.22	10.76	13.8	0.11	0.07
31	5.9	44.3	<0.005	0.037	1.21	11.04	11.6	0.09	0.07

TABLE 7-6

Results of Soil Analyses for Degreaser Solvents in the Ellenton Formation at Monitor Well MSB-23A (Figure 7-1)

	Concentrations (μg/L)			
Depth (ft)	1,1,1-Trichloroethane	Trichloroethylene	Tetrachloroethylene	Total Degreaser Solvents
250	<10	<10	54	54
255	<10	97	171	268
278	<10	32	21	53
281	<10	45	40	85
283	<10	45	35	80
293	<10	44	36	80
298	<10	23	22	45
308	<10	<10	10	10

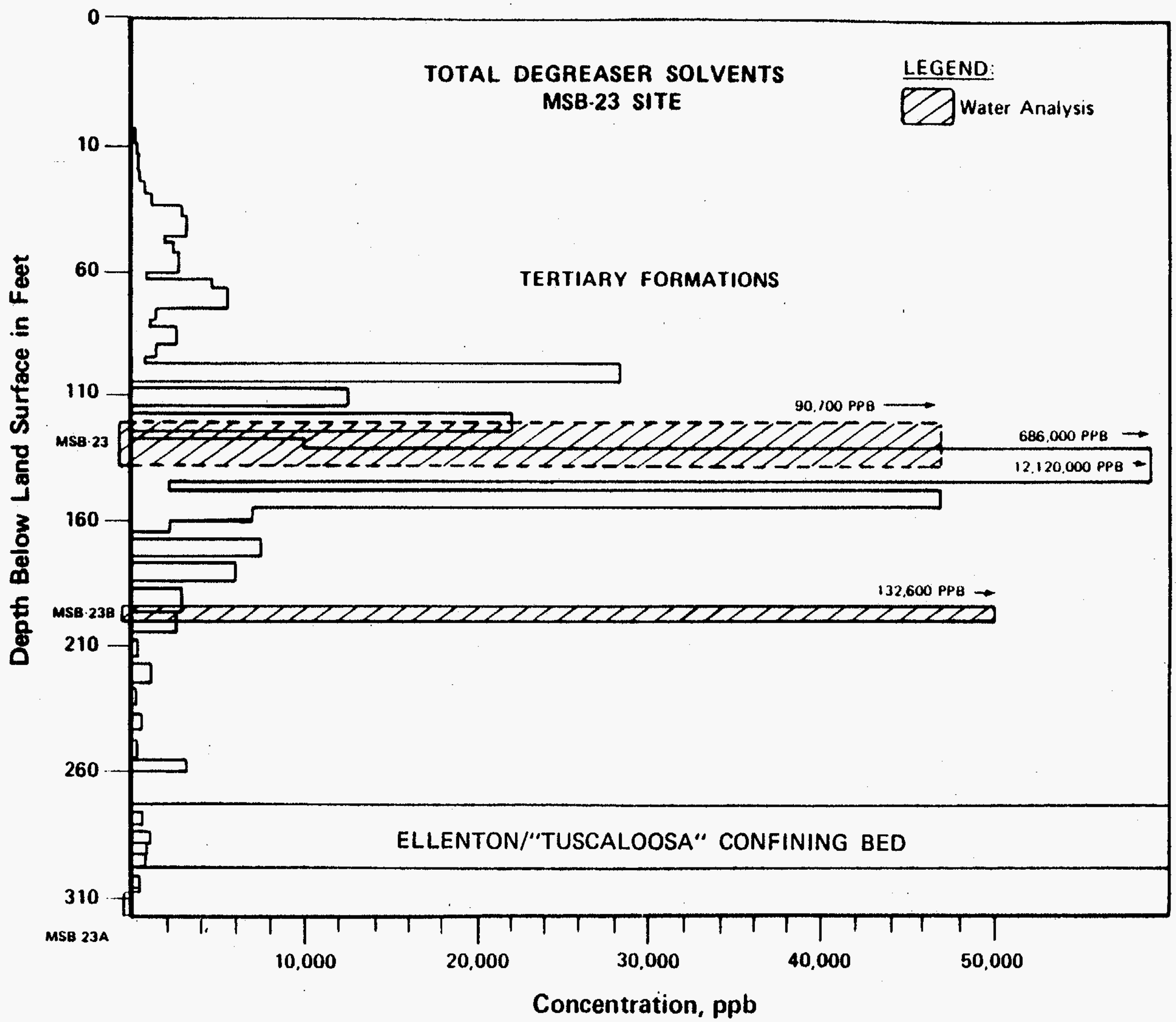

FIGURE 7-1. Concentration Profiles of Total Degreaser Solvents From Soil and Water Samples at Well Cluster MSB-23.

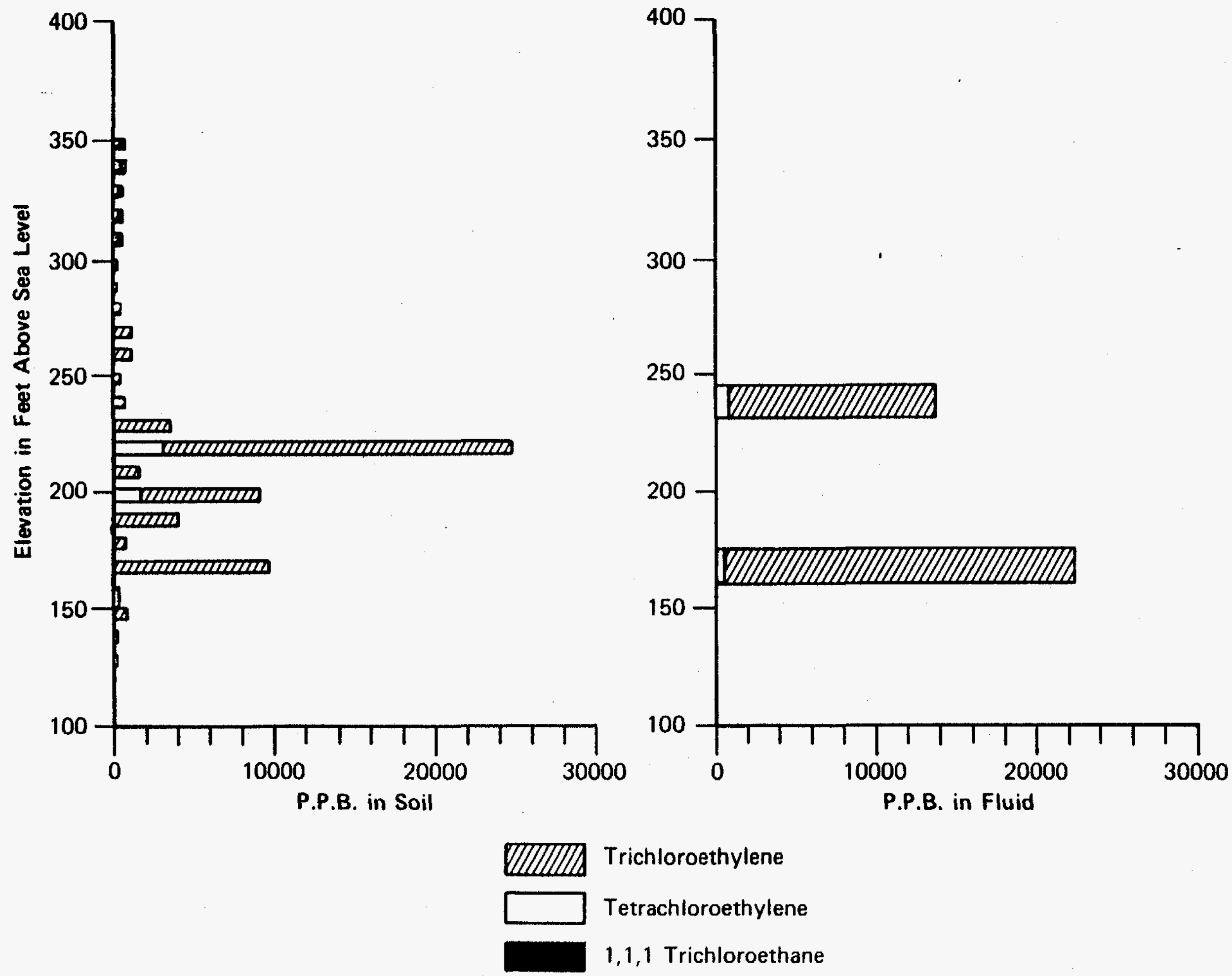

FIGURE 7-2. Results of Soil and Water Analyses for Degreaser Solvents at Site MSB-24

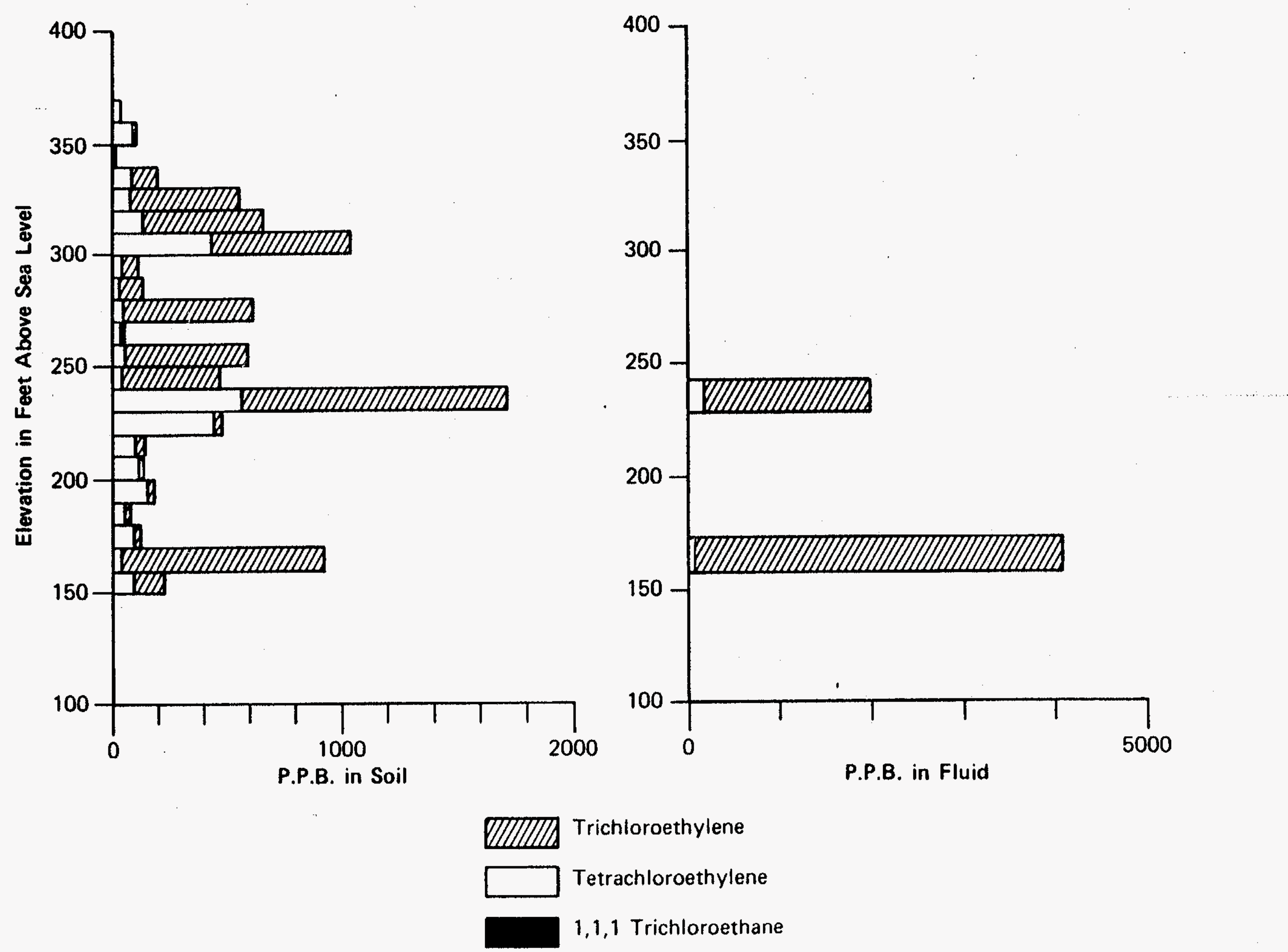

FIGURE 7-3. Results of Soil and Water Analyses for Degreaser Solvents at Site MSB-25

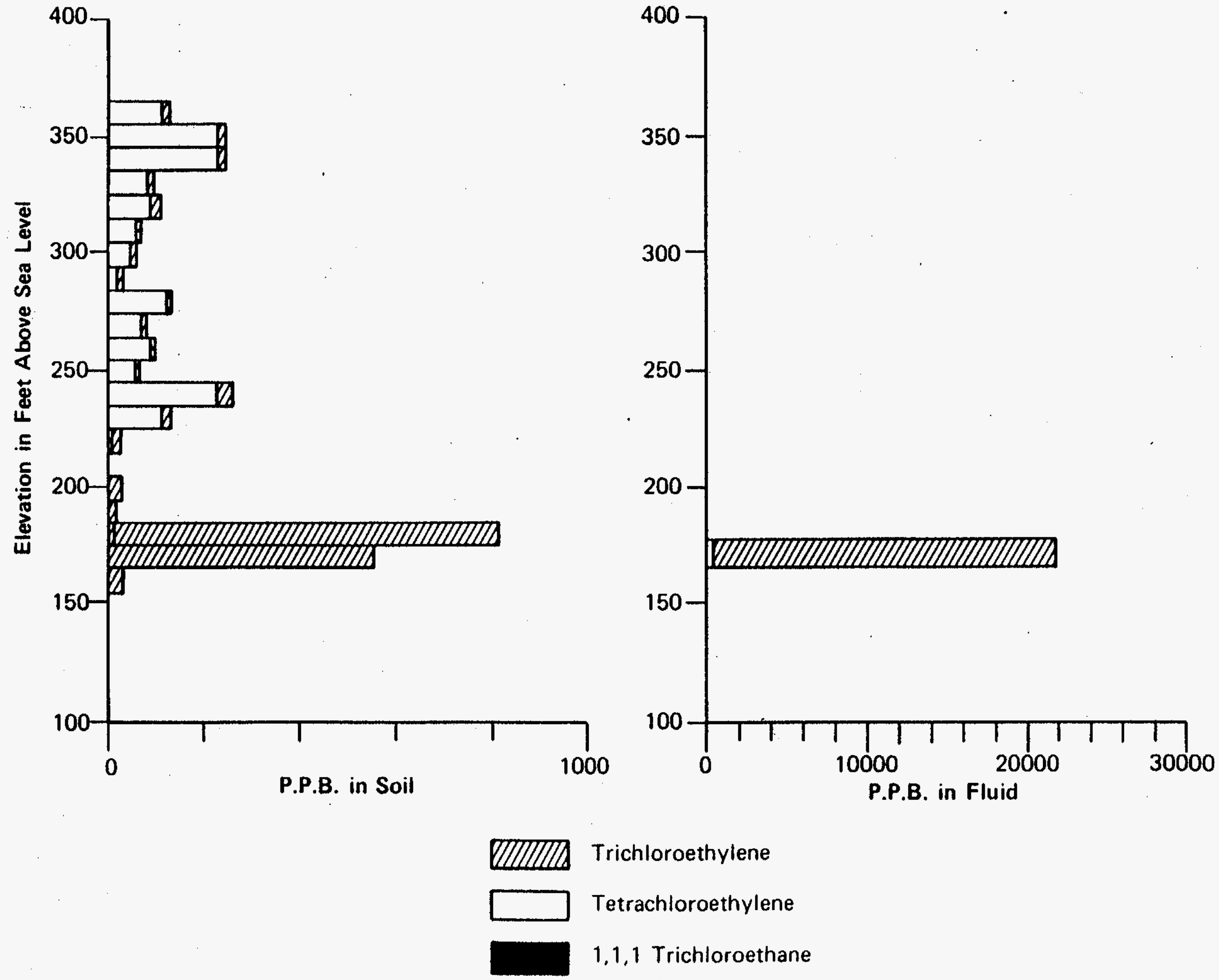

FIGURE 7-4. Results of Soil and Water Analyses for Degreaser Solvents at Site MSB-26

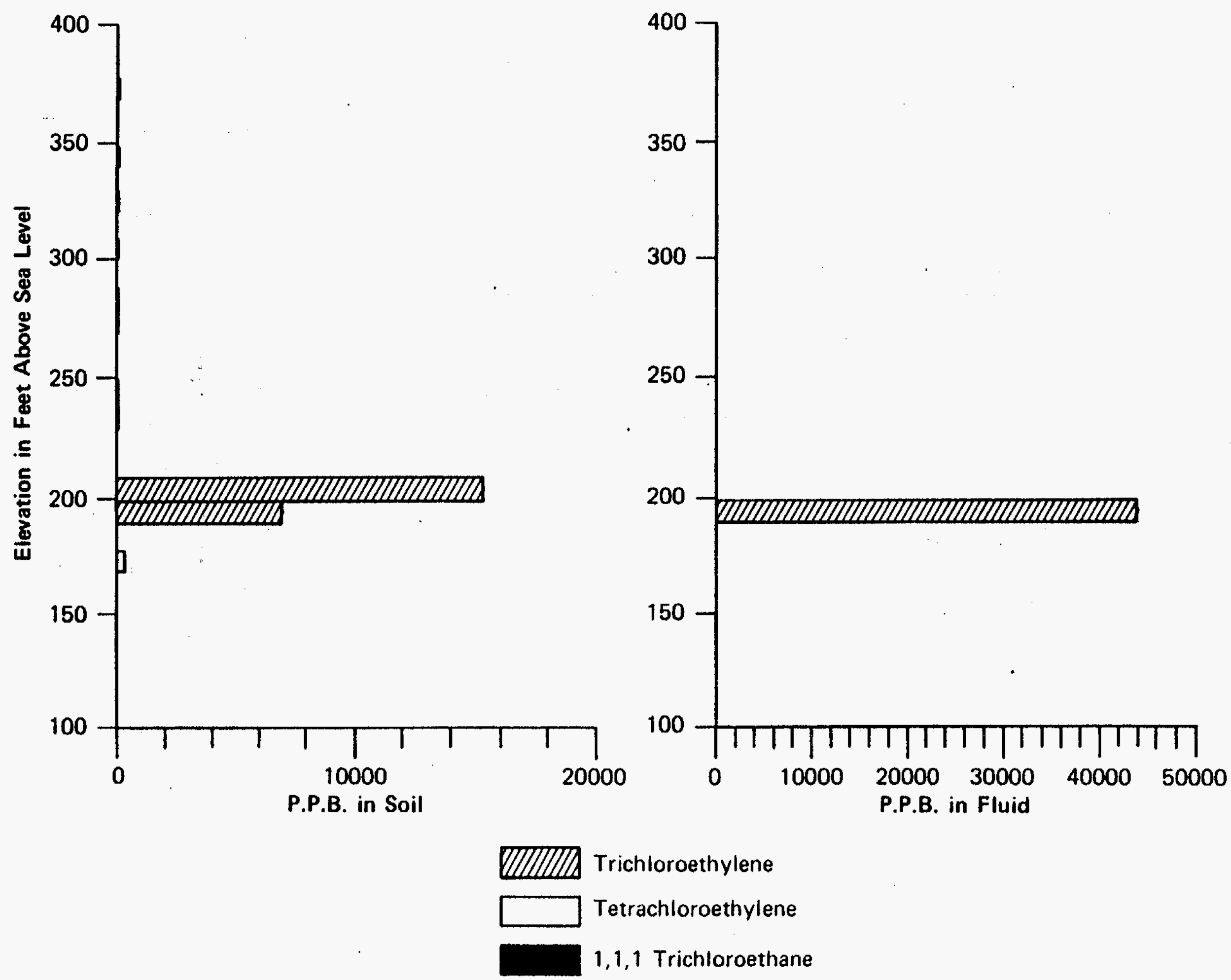

FIGURE 7-5. **Results of Soil and Water Analyses for Degreaser Solvents at Site MSB-27**

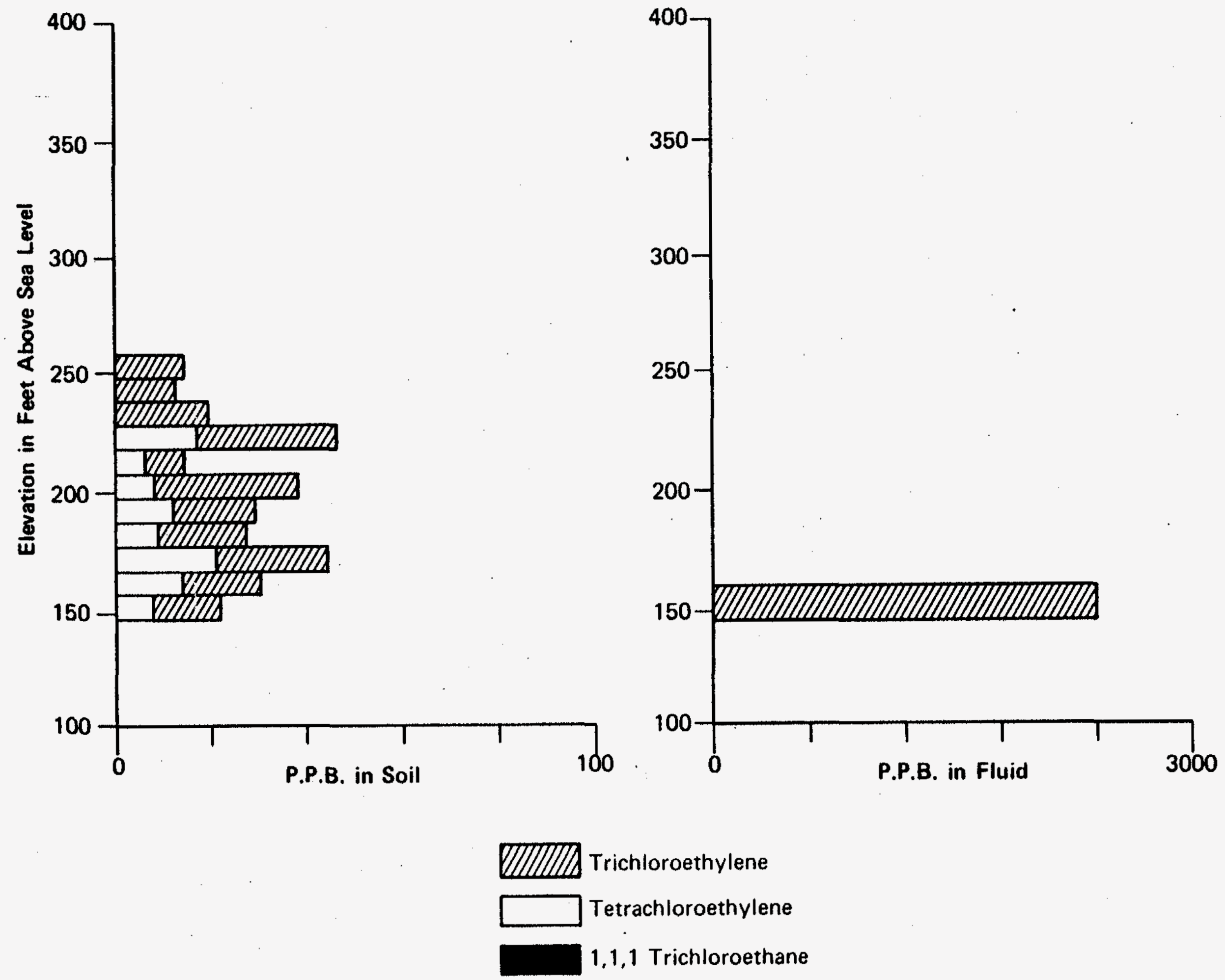

FIGURE 7-6. Results of Soil and Water Analyses for Degreaser Solvents at Site MSB-28

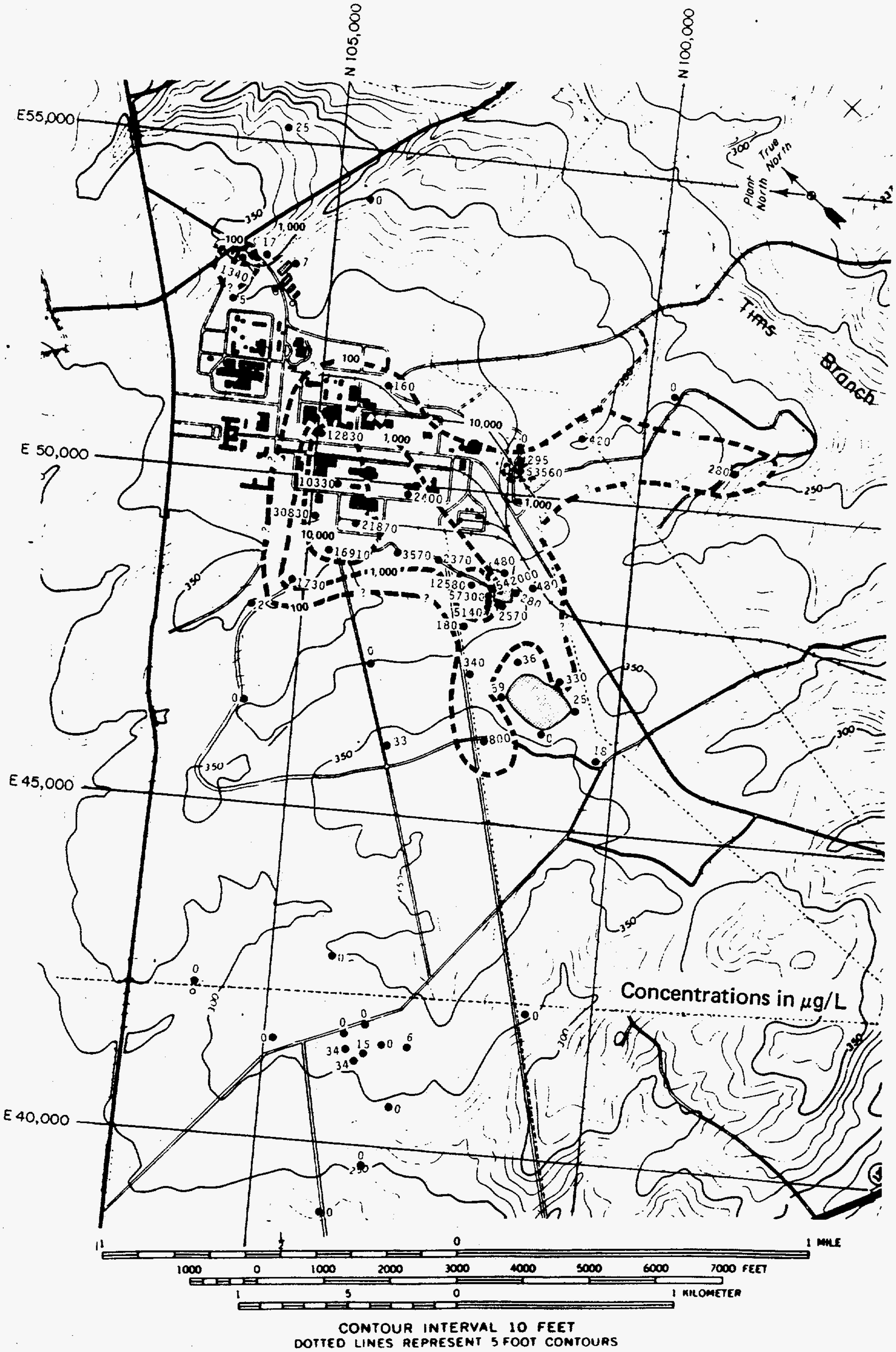

FIGURE 7-7. Contour Map of Vertical Averaged Concentration of Total Degreaser Solvents from Fluid Samples
(April-July 1984)

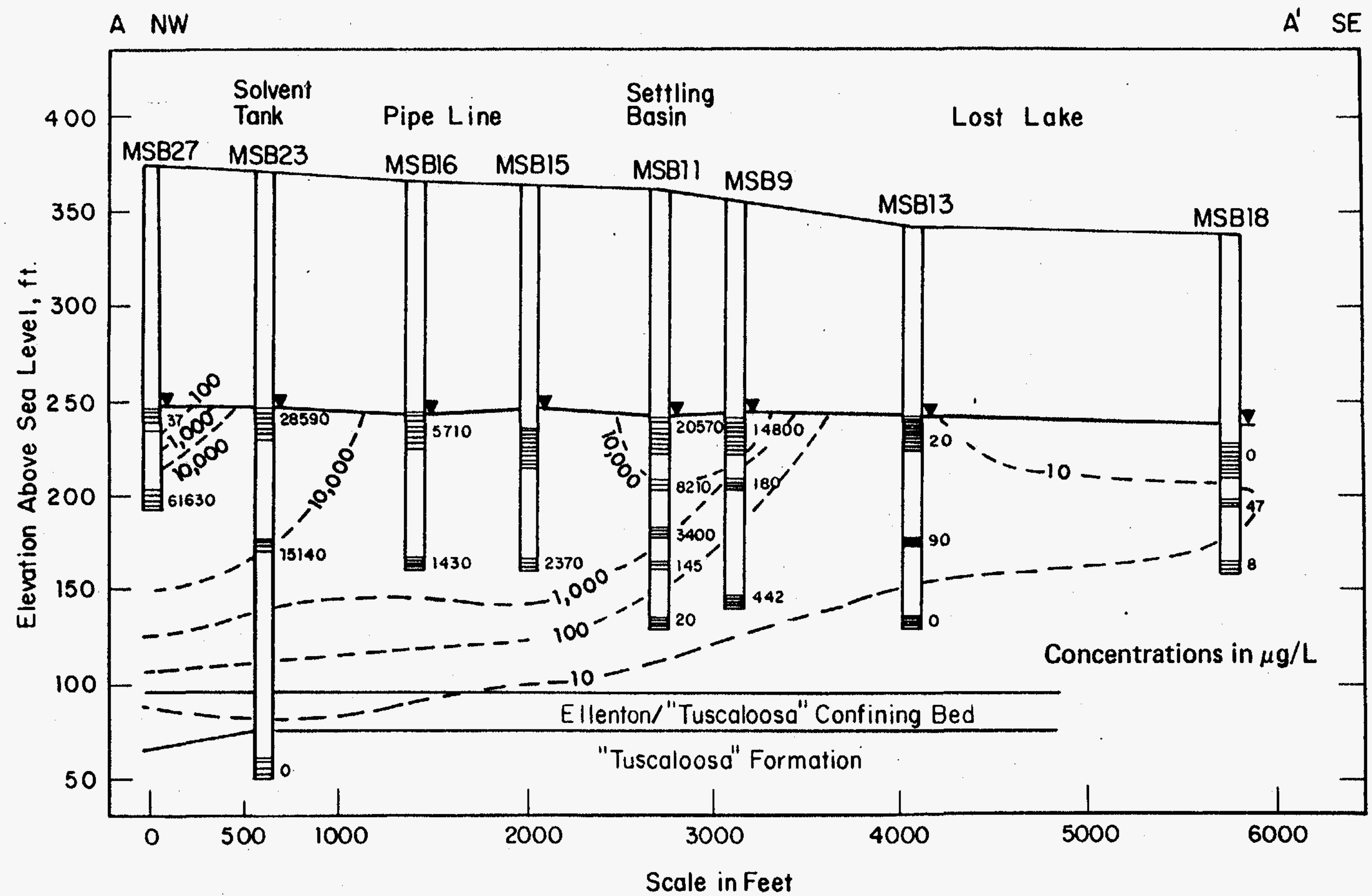

FIGURE 7-8. Vertical Section Passing Through Solvent Storage Tank, Settling Basin, and Lost Lake Showing Concentrations of Total Degreaser Solvents in Groundwater, July 1984
(Editorial Note: Dipping the 10 g/L contour into the Ellenton/"Tuscaloosa" confining bed is not supported by more recent data.)

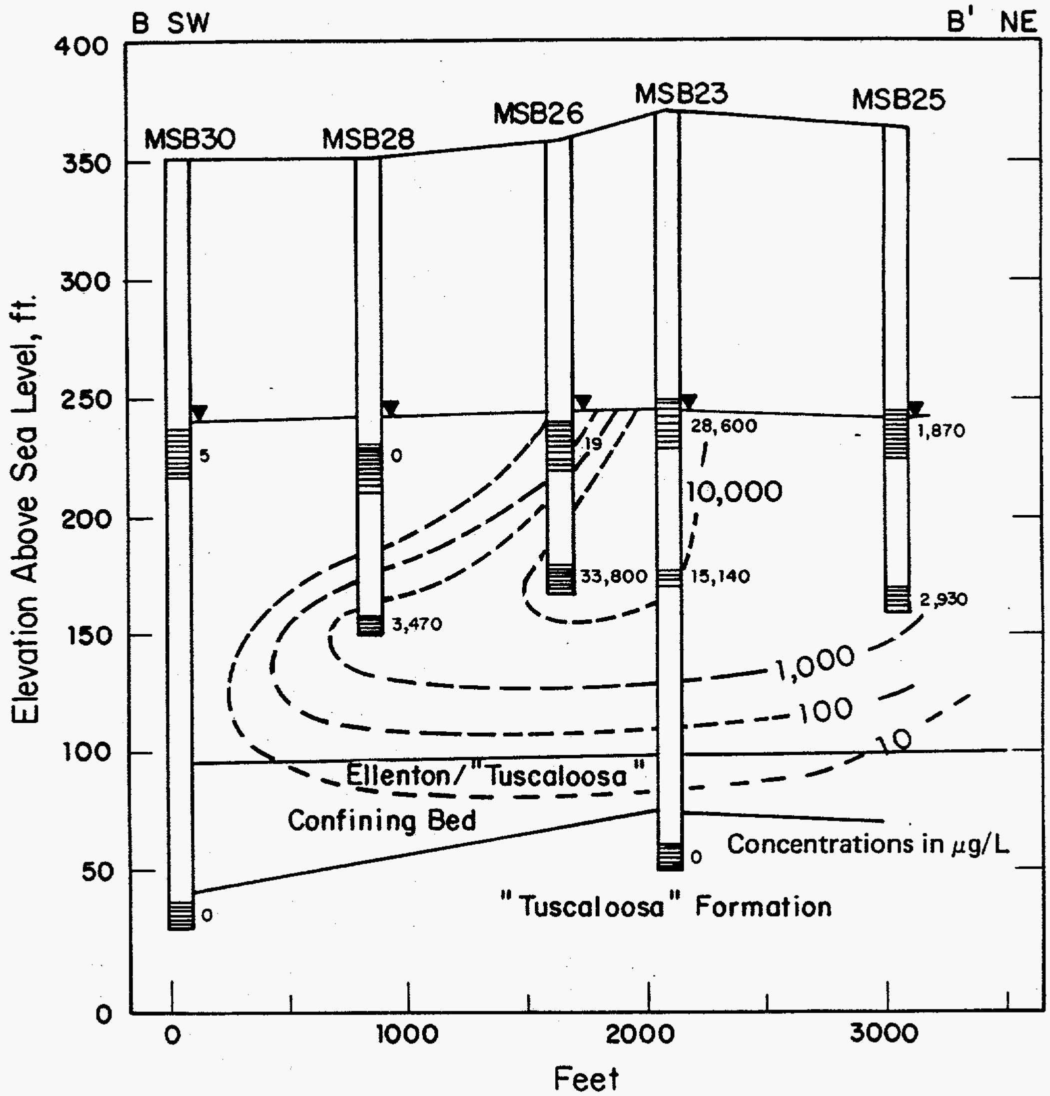

FIGURE 7-9. Vertical Section Along Groundwater Gradient from the Solvent Storage Tank Showing Concentrations of Total Degreaser Solvents in Groundwater, July 1984
(Editorial Note: Dipping the 10 g/L contour into the Ellenton/"Tuscaloosa" confining bed is not supported by more recent data.)

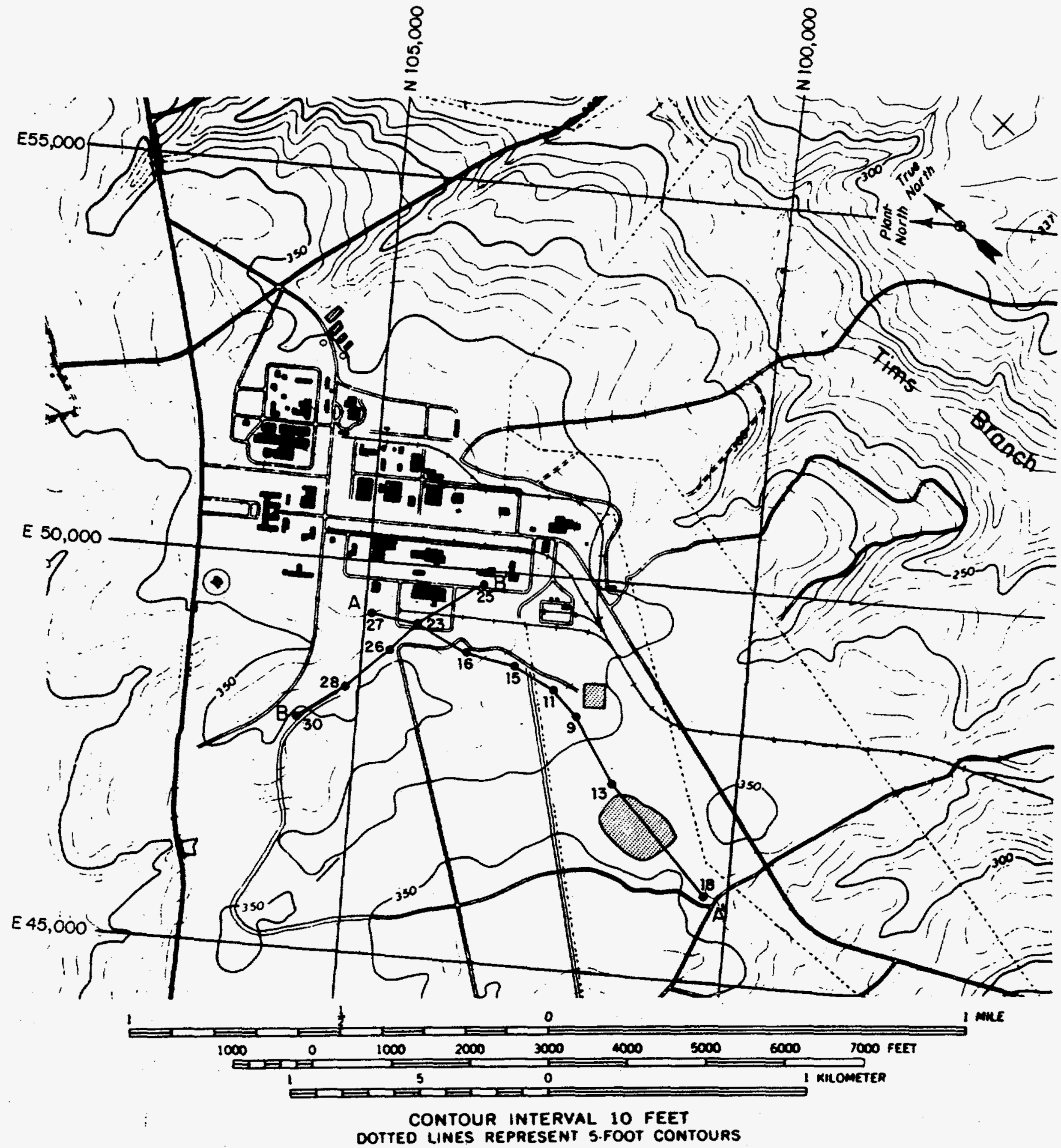

FIGURE 7-10. Location of Vertical Sections Shown on Figures 7-8 and 7-9

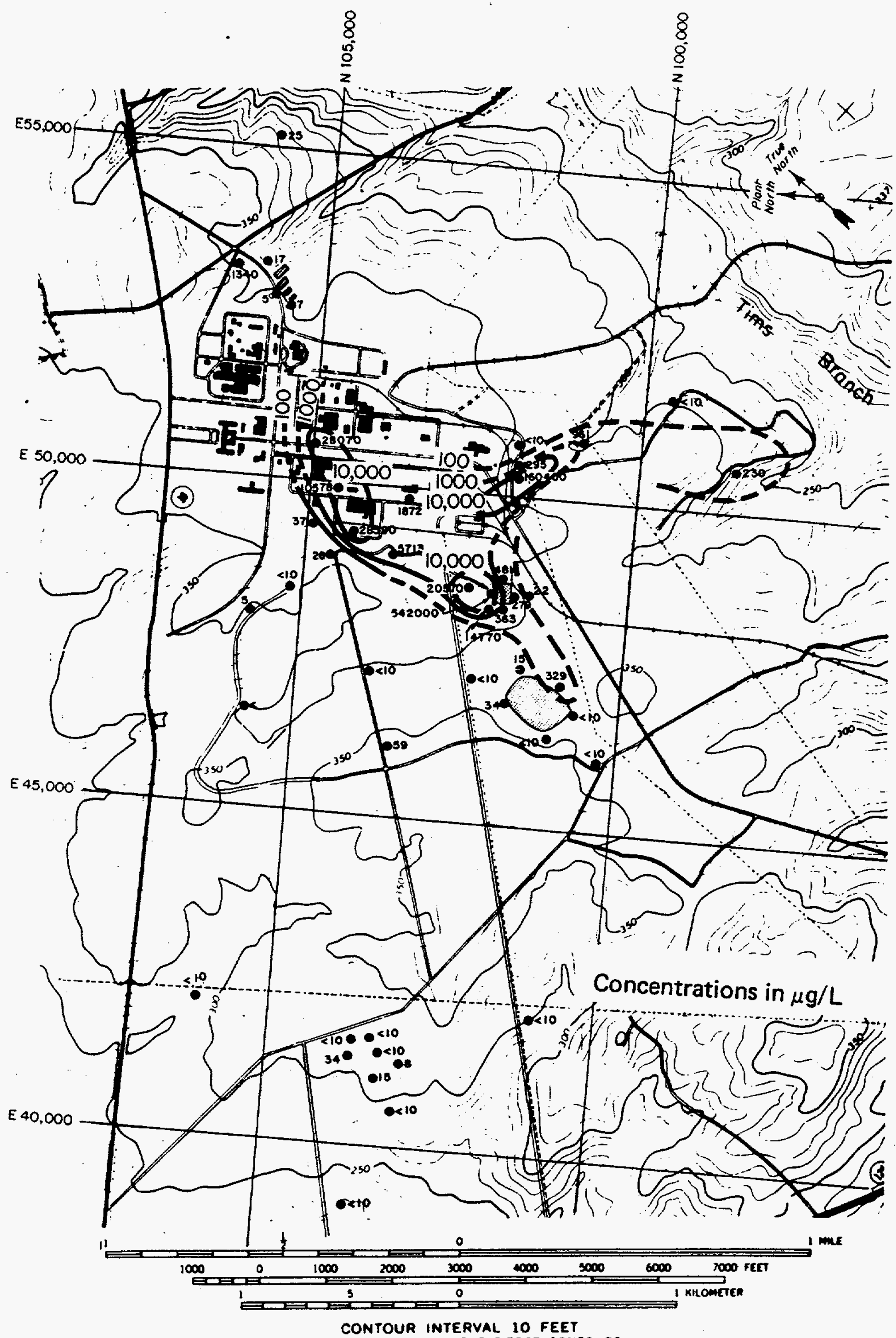

FIGURE 7-11. Contour Map of Concentrations (Spring 1984) of Total Degreaser Solvents at the Water Table

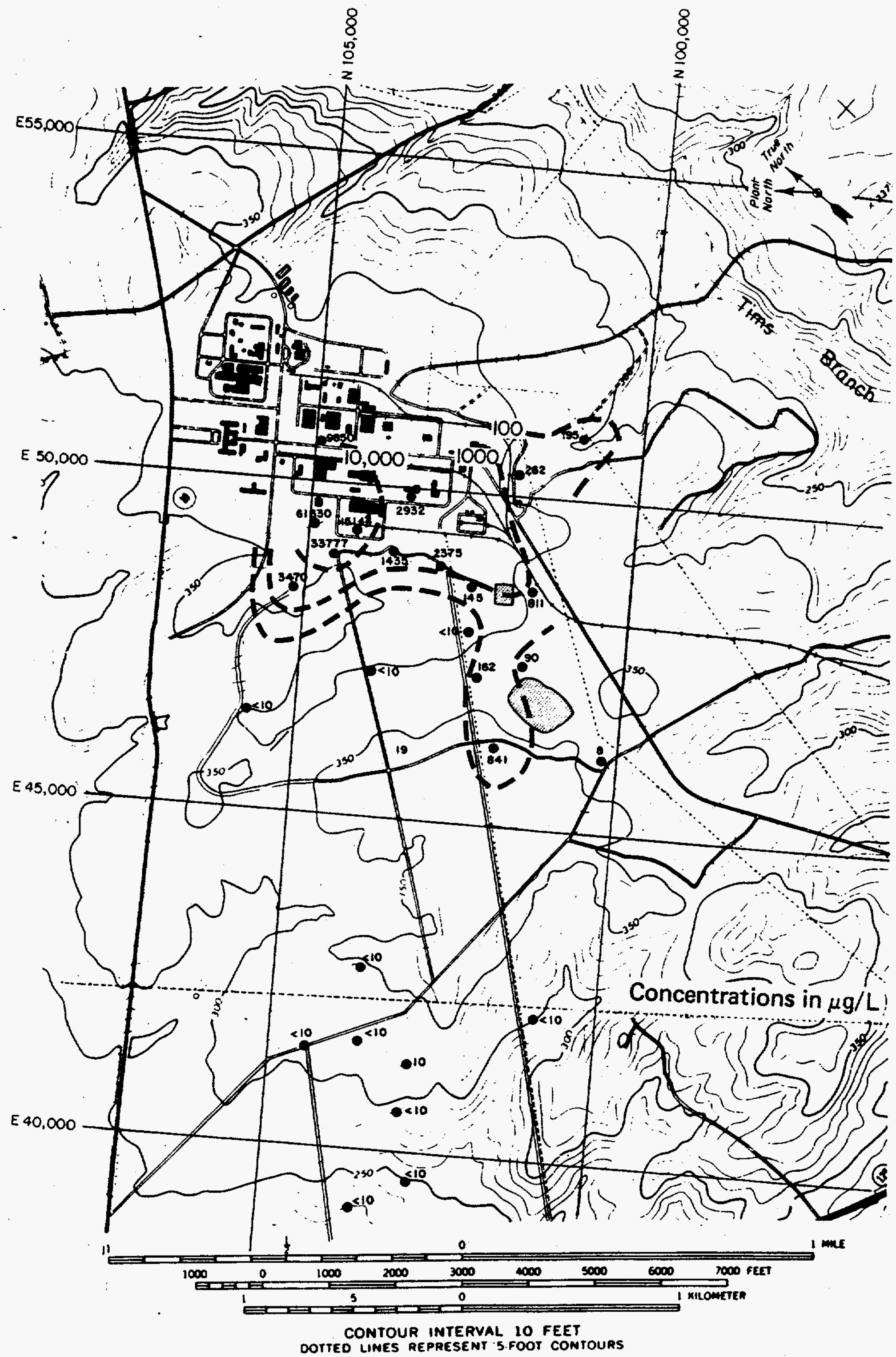

FIGURE 7-12. Contour Map of Concentrations (Spring 1984) **of Total Degreaser Solvents Between Elevation 146 and 187 ft, i.e., ~50 ft Below the "Green Clay", Using the Same Wells as Used for the Potentiometric Map of this Interval** (Figure 5-4)

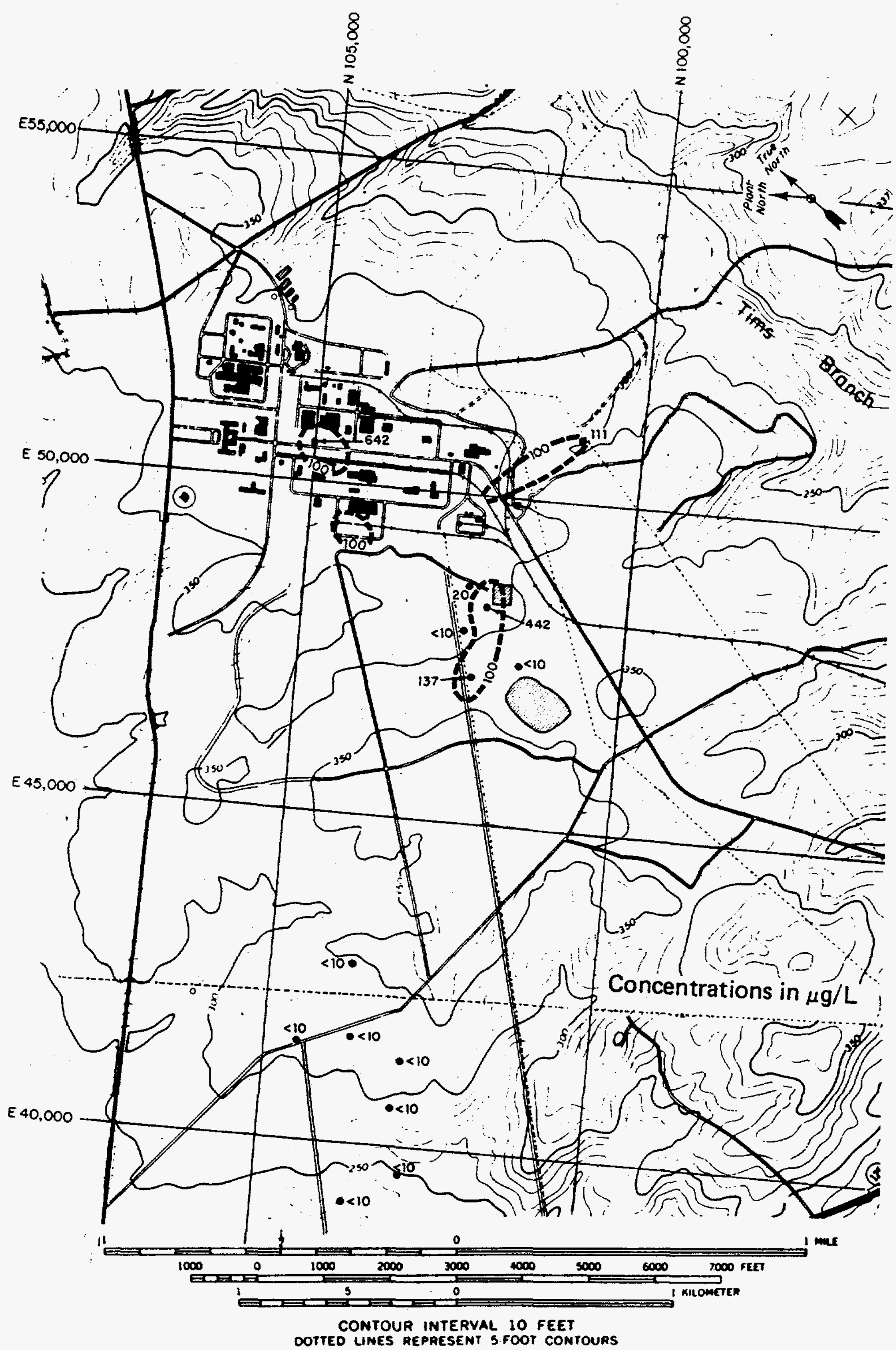

FIGURE 7-13. Contour Map of Concentrations (Spring 1984) **of Total Degreaser Solvents Between Elevation 100 and 144 ft, i.e., In Basal Tertiary Sediments, Using the Same Wells as Used for the Potentiometric Map of this Interval** (Figure 5-5)

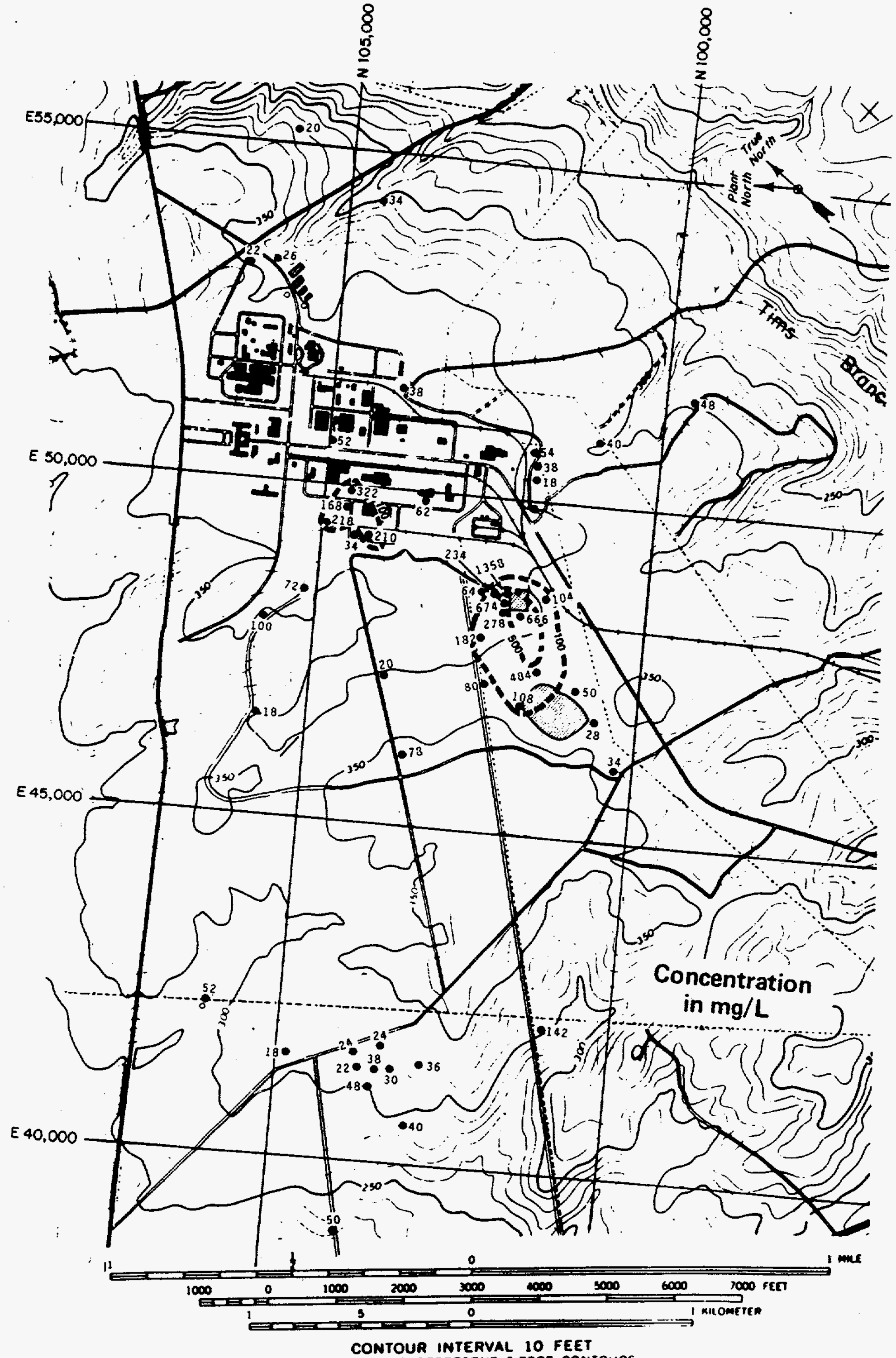

FIGURE 7-14. Contour Map of Concentration (Spring 1984) of Total Dissolved Solids at the Water Table

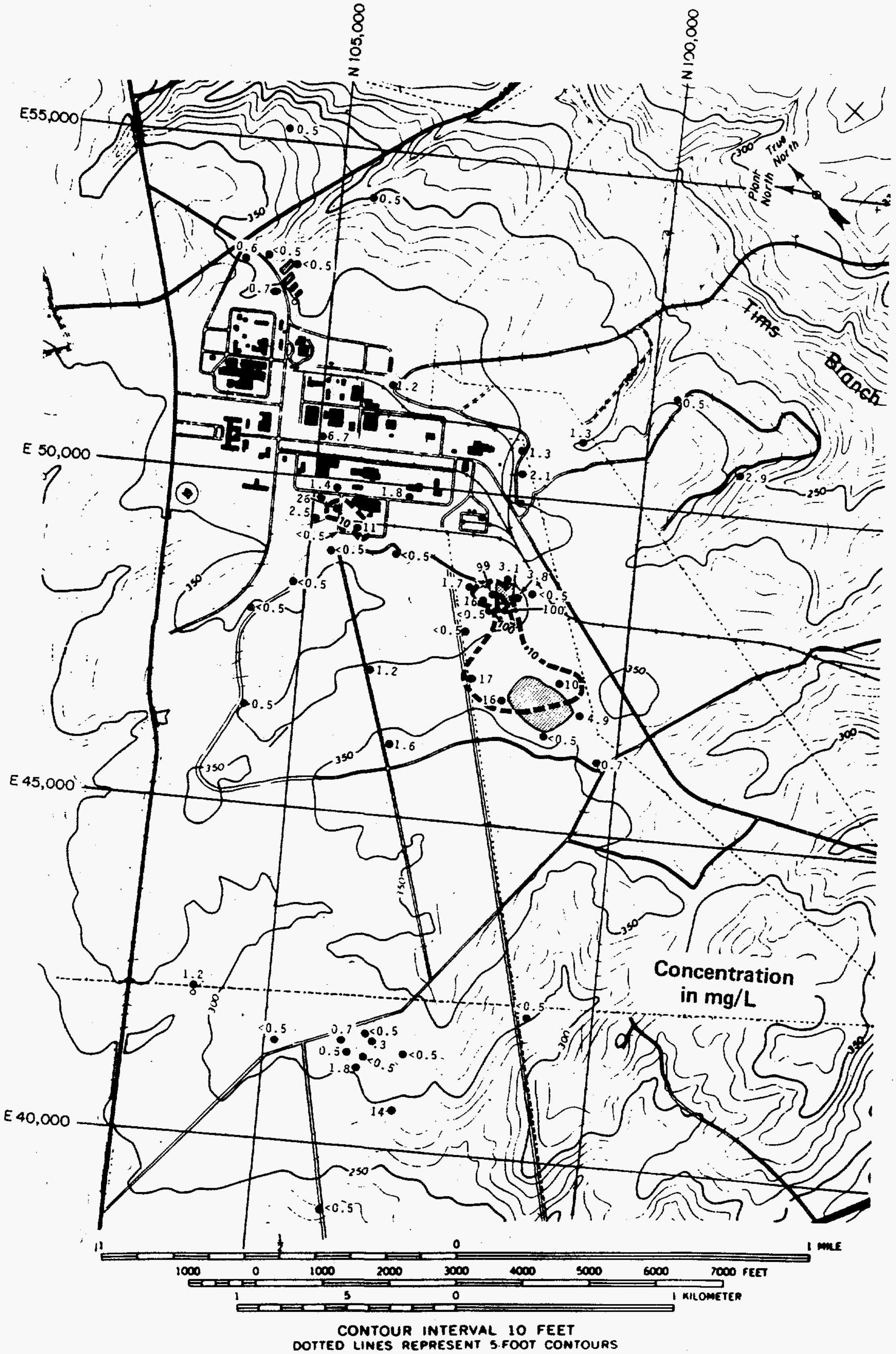

FIGURE 7-15. Contour Map of Concentration (Spring 1984) **of Nitrate at the Water Table** (Reported as Nitrogen)

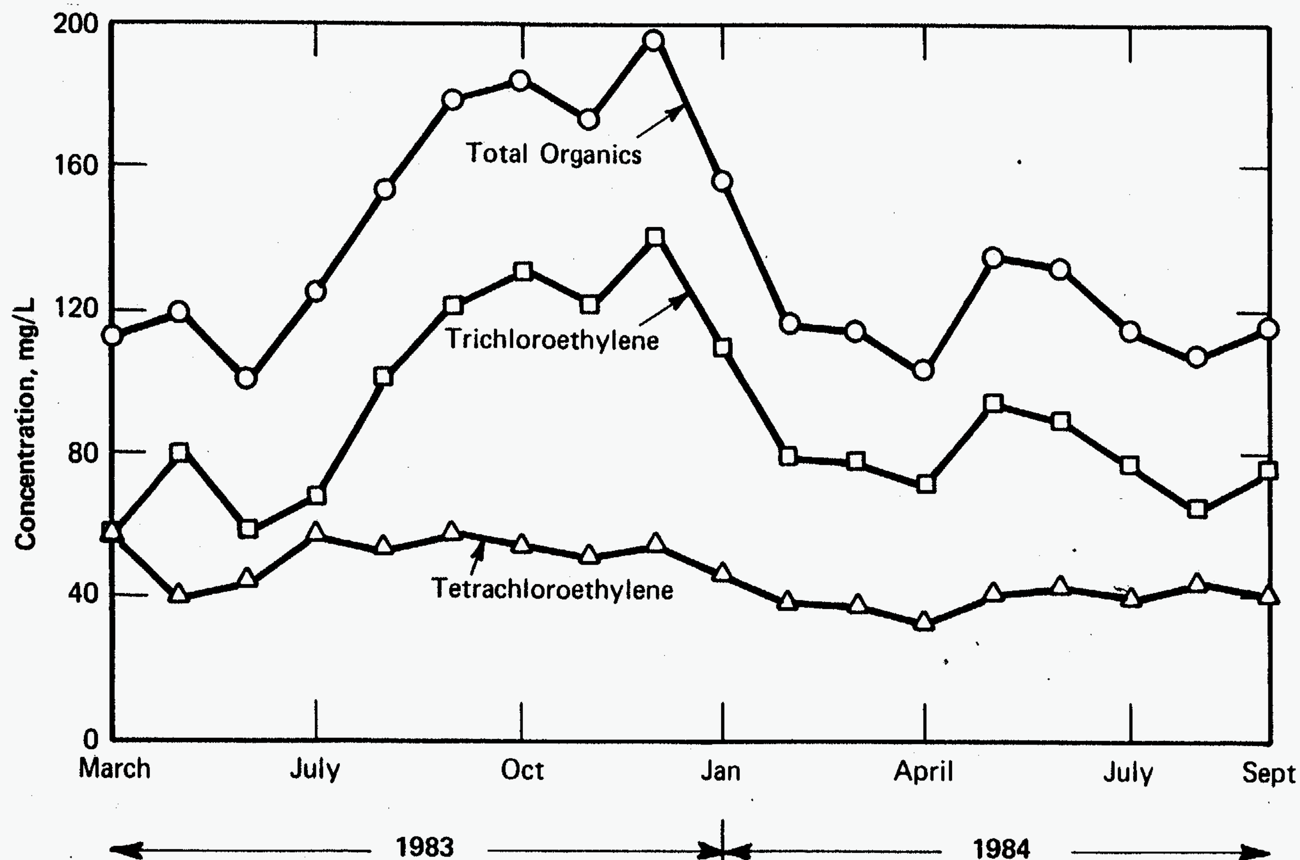

FIGURE 7-16. Graph of Concentration of Degreaser Solvents vs. Time at Well MPT-1

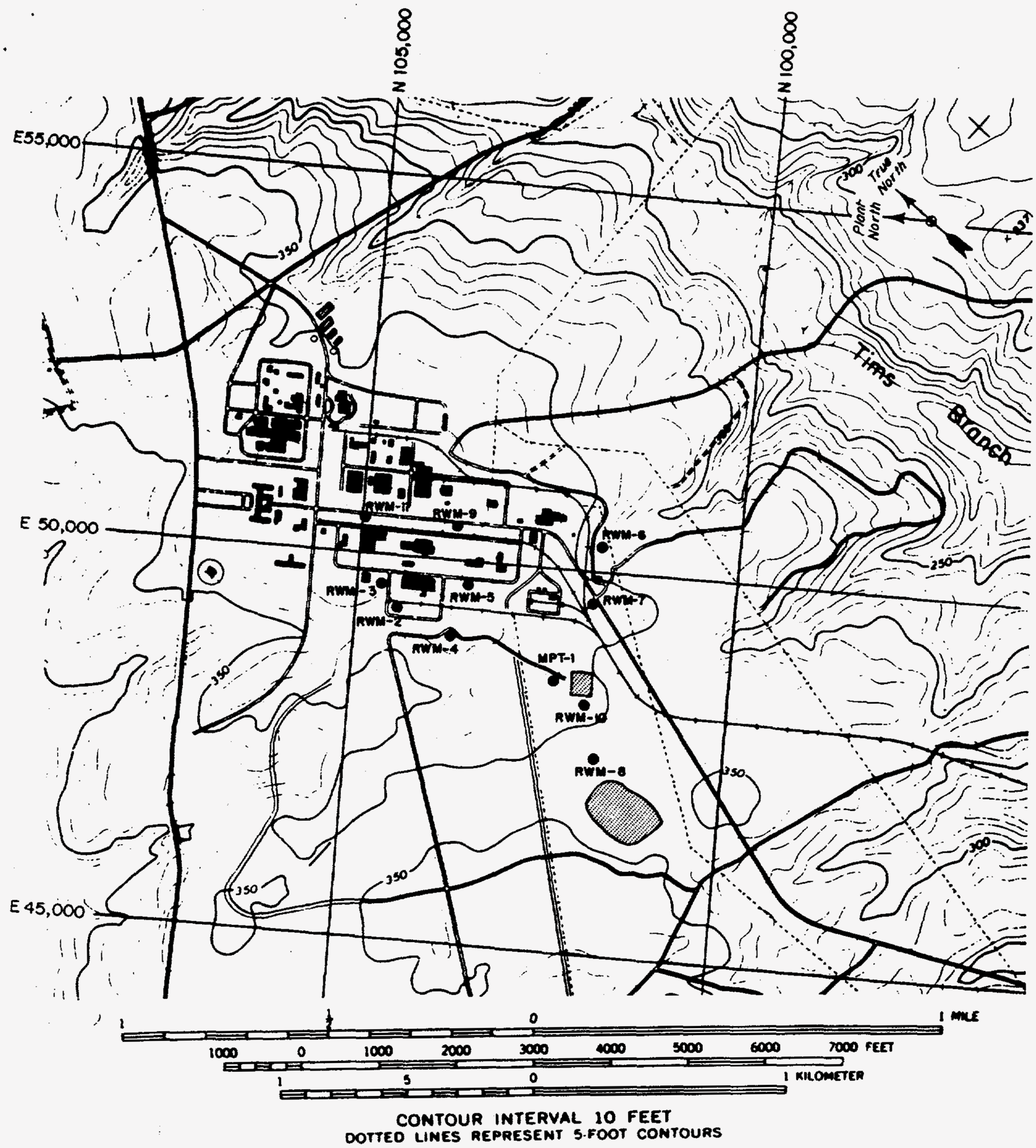

FIGURE 7-17. Location of Pilot (MPT-1), Demonstration (RWM 2,3), and Recovery (RWM 4-11) Wells for Removal of Degreaser Solvents from Groundwater

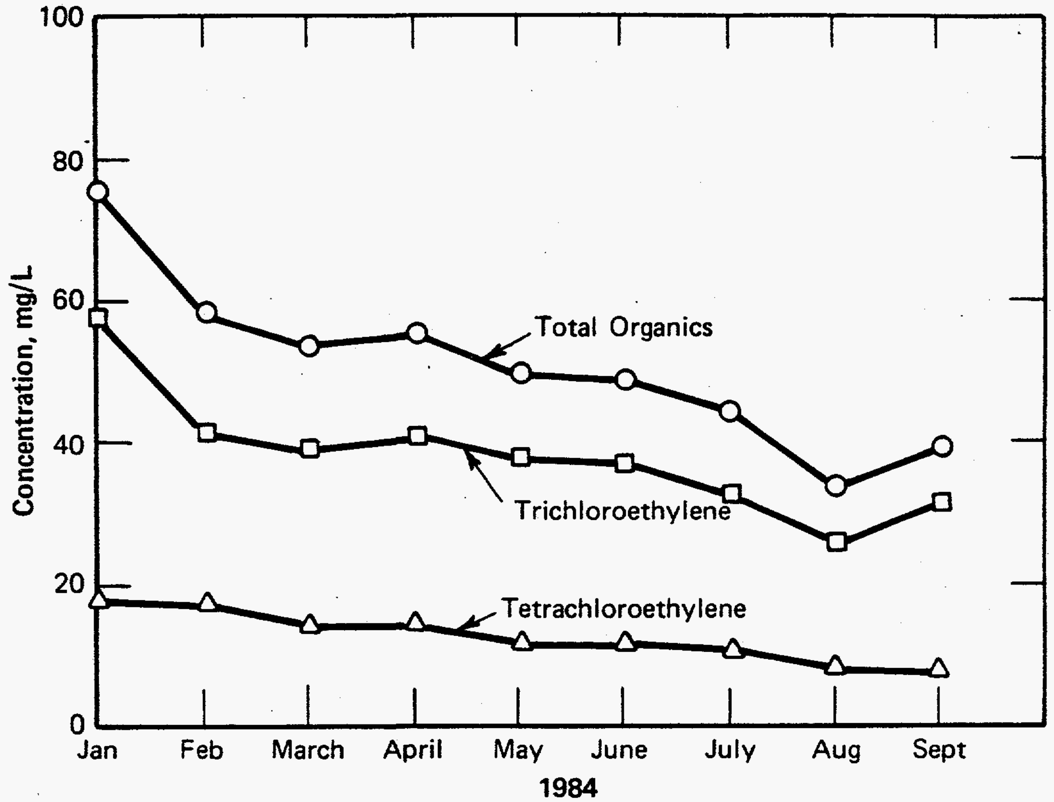

FIGURE 7-18. Graph of Concentration of Degreaser Solvents vs. Time at Well RWM-2

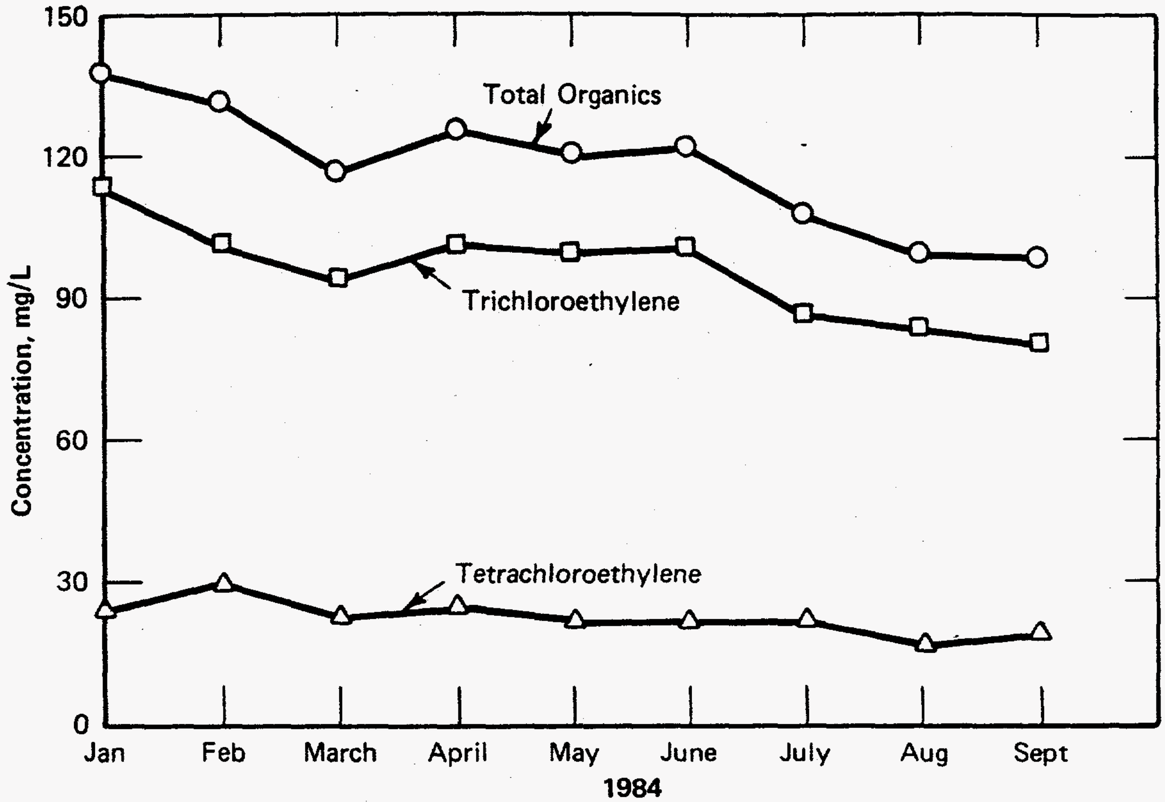

FIGURE 7-19. Graph of Concentration of Degraser Solvents Vs. Time at Well RWM-3

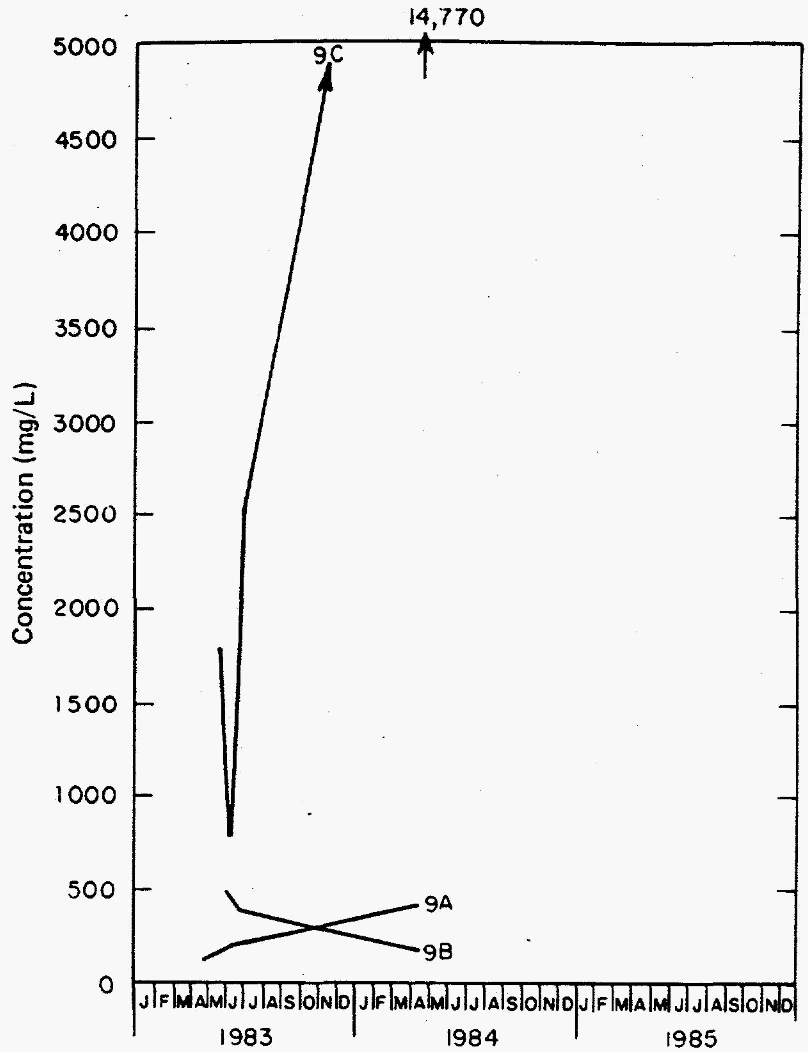

FIGURE 7-20. Graph of Time/Concentration for Trichloroethylene Plus Tetrachloroethylene in Water from Wells in Cluster MSB-9

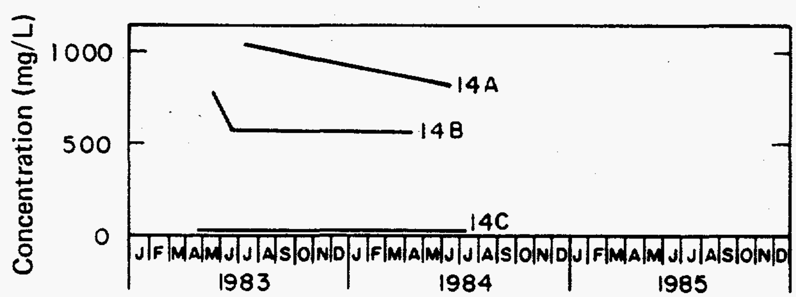

FIGURE 7-21. Graph of Time/Concentration for Trichloroethylene Plus Tetrachloroethylene in Water from Wells in Cluster MSB-14

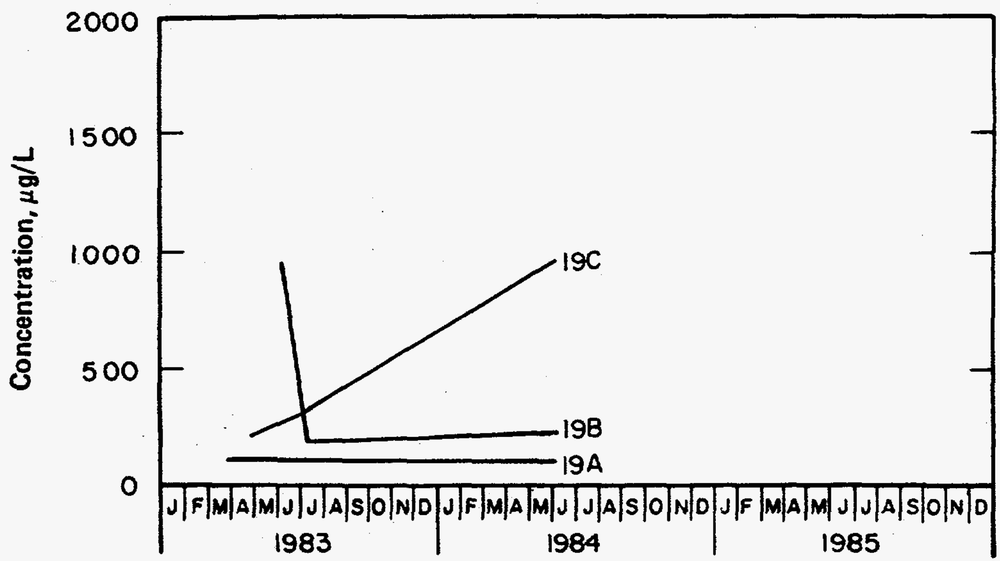

FIGURE 7-22. **Graph of Time/Concentration for Trichloroethylene Plus Tetrachloroethylene in Water from Wells in Cluster MSB-19**

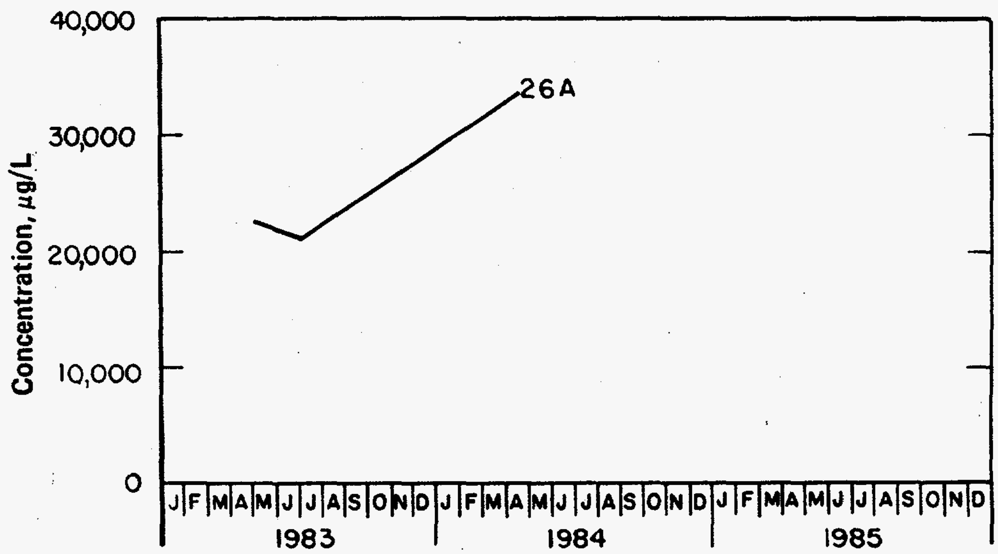

FIGURE 7-23. **Graph of Time/Concentration for Trichloroethylene Plus Tetrachloroethylene in Water from Well MSB-26A**

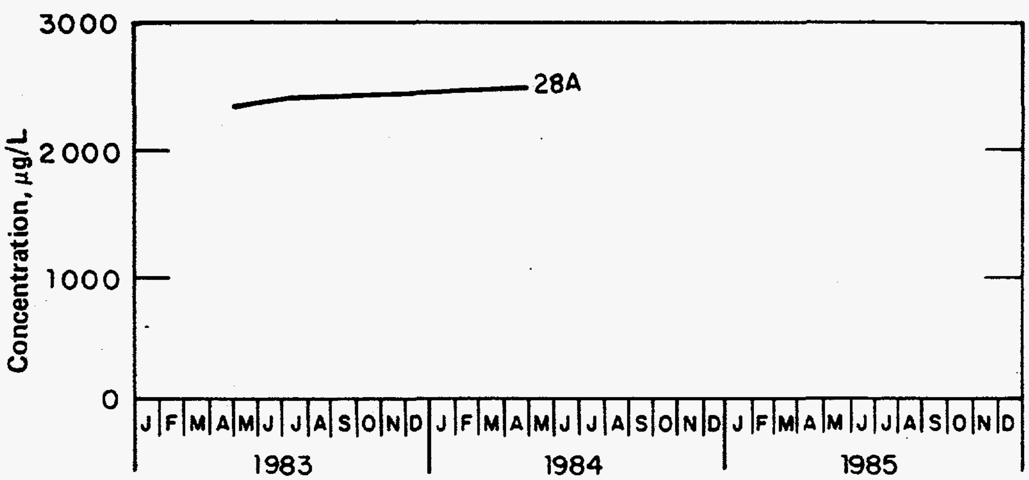

FIGURE 7-24. Graph of Time/Concentration for Trichloroethylene Plus Tetrachloroethylene in Water from Well MSB-28A

APPENDIX A. WELL NUMBERING SYSTEM

At SRP, identifying well numbers are assigned according to the project or purpose for which the wells were installed. Although the location coordinates on the SRP wells are known, the identifying number is not based on the location of the well. The identifying well number generally consists of three parts: (1) a series of three letters that identify the project or purpose of the well, (2) a serial number of up to three digits identifying its sequence position in the project, (3) up to two letters that identify an individual well's relative depth if it is part of a cluster of wells at the same location. The well "A" is generally the deepest well in a cluster, "B" the next deepest, etc; so that "F" or "G" may be the shallowest. This is done because usually the first well in a cluster (A) is cored to a predetermined depth and the depth of other wells in the cluster are selected from the geological and geophysical logs of that hole. Occasionally there is a need to drill a well deeper than the original cored hole and such a well may receive a two letter suffix (such as TA). For example:

- MSB 9A is the deepest well in the ninth location drilled for investigating the contaminant plume at the M-Area settling basin.
- AC-2B is the shallower of two wells at the second location drilled in the A-Area cluster series.
- MSB-34 TA is the deepest well in the "Tuscaloosa" Formation at the 34th location in the MSB series.

The project series that are included in A/M Area are given in Table A-1.

TABLE A-1

Prefix Letter and Project Series in A/M Area

AC - A-Area Cluster

ASB - A-Area Seepage Basins now called SRL Seepage Basins

ACB - A-Area Coal Pile Runoff Containment Basin

MSB - M-Area Settling Basin. Initially consisted of 4 wells around settling basin and 4 wells around Lost Lake. Subsequently included wells drilled to investigate the plume of contamination thought to be originating from the M-Area basin, Lost Lake, effluent pipeline, or Tims Branch (MSB 9-22). The same prefix was used to designate any plume definition wells installed in the general A/M Area, including wells inside the M-Area fence, in A Area, and additional wells in the Tims Branch area (MSB-23 to 34).

The original wells MSB-1 through 8 had galvanized steel casings, which affected the chemical analyses of water samples. These steel case wells were plugged, abandoned, and replaced in the Fall of 1982. The replacement wells were cased with PVC and received the designation MSB-1A, 2A, 3A, etc. The Suffix A designates the replacement well of approximately the same depth (Water Table). These wells are not in clusters.

SBA changed to AMB, August 1984 - A-Area Metallurgical Laboratory Basin

ABG changed to ABW, September 1984 - A-Area Background Well

ABP - A-Area Metals Burning Pit

AOP changed to AOB, August 1984 - A-Area Oil (Pit) Basin near Building 715-A

LA changed to 905 in 1962 - original water production wells drilled by Layne Atlantic, Co. during construction of SRP. Shown as PW (Production Well) in Well Data File.

905 reads PW in Well Data File - Water Production Well. For these wells the suffix A stands for the A Area not deepest well in cluster; G stands for gate house or general area. These wells are not in clusters.

SR changed to SRW, September 1984 - Silverton Road Waste Site

TABLE A-1, Contd

S - Wells previously existing when SRP took over property in 1951.

MPT - M-Area Production Test Well

RWM - Recovery Well M Area

ARP - A-Area Burning Rubble Pits

P - Bedrock Piezometer

The following project series consist of foundation exploration borings that were subsequently closed without installing wells.

ESM - DuPont Engineering Department Soil Map Borings

ESN - Also DuPont Engineering Department Soil Map Borings

IM - Foundation Investigation Borings M-Area (U.S. Army, Corps of Engineers)

IMV - Foundation Investigation Borings (U.S. Army, Corps of Engineers)

IXM - Foundation Investigation Borings (U.S. Army, Corps of Engineers)

APPENDIX B. CONCENTRATIONS OF DEGREASER SOLVENTS IN WATER FROM MONITORING WELLS

The table in this appendix gives the concentration of 1,1,1-trichloroethane, trichloroethylene, tetrachloroethylene, and the total of these in water samples from monitoring wells. The locations of the monitoring wells are shown on Figure 4-1.

Analysis is by gas chromatograph except that analyses performed on samples from 4-84 to 7-84 were by GC/MS. Results are given by well and then by sampling date. Results are given in micrograms per liter (parts per billion). LT stands for "less than". N stands for "not reportable".

Except for the samples from well MSB-23A on 6/27/84 and 7/10/84, all samples are pumped from the well by a dedicated pump. The sampling protocol is given in Appendix E-1.

Samples from well MSB-23A, an upper Tuscaloosa monitoring well were taken by the method given in the protocol (Appendix E-1) except for the samples on 6/27/84 and 7/10/84. Samples on these dates were collected by the bailer method. It was suspected that the cement sheath in the annulus between the casing and the ground was leaking, causing contaminated water from the Tertiary sediments above to migrate downward to the "Tuscaloosa" Formation. Bailer samples were collected to provide more information on this hypothesis. Although investigation into this topic is ongoing, it appears that the hypothesis is correct, and the positive results are dependent on the volume of water removed from the well.

Even with all the quality assurance methods that have been applied, the degreaser solvent concentration in some wells varies many fold with different samples. Thus, conclusions about changing concentrations with time must be carefully examined. Wells that vary more than two-fold in trichloroethylene are MSB-2A, 3A, 9A, 9C, 11A, 11B, 11D, 11F, 12B, 12C, 13C, 16C, 17A, 17B, 19B, 20C, 22, 23, 23B, 24A, and 34B. The analyses for all these wells are reported; however, only the results of future sampling will determine if these variations are those that exist in the ground or whether they are due to some variation in the sampling/analysis system.

APPENDIX B. CONCENTRATIONS OF DEGREASER SOLVENTS IN WATER FROM WELLS REPORTED IN MICROGRAMS PER LITER (PPB).

WELL		SAMPLE DATE	1,1,1 TCE		TRICHLORO-ETHYLENE		TETRACHLORO-ETHYLENE		TOTAL
ABG	1	06/12/84	LT	5		13		12	25
AC	1A	05/02/83		4	LT	1	LT	1	4
AC	1A	07/12/83	LT	1	LT	1	LT	1	0
AC	1B	04/27/83	LT	1	LT	1	LT	1	0
AC	1B	07/12/83	LT	1	LT	1	LT	1	0
AC	1B	06/18/84	LT	5	LT	5	LT	5	0
AC	2A	04/23/83	LT	1		2	LT	1	2
AC	2A	07/11/83	LT	1		2		2	4
AC	2A	06/13/84	LT	5	LT	5	LT	5	0
AC	2B	05/10/83		2		4	LT	1	6
AC	2B	07/11/83	LT	1	LT	1	LT	1	0
AC	2B	05/01/84	LT	5	LT	5	LT	5	0
AC	3A	04/29/83		1		1		1	3
AC	3A	07/12/83	LT	1	LT	1	LT	1	0
AC	3A	06/07/84	LT	5	LT	5	LT	5	0
AC	3B	04/29/83		1		1		1	3
AC	3B	07/12/83	LT	1	LT	1	LT	1	0
AC	3B	06/07/84	LT	5	LT	5	LT	5	0
AMB	2	06/11/84	LT	5		161	LT	5	161
AOB	1	06/11/84	LT	5		169		126	295
AOB	2	06/11/84	LT	5	LT	5	LT	5	0
ASB	3	05/14/84	LT	5		7	LT	5	7
ASB	4	06/12/84	LT	5		17	LT	5	17
ASB	7	05/14/84	LT	5	LT	5		5	5
ASB	8	05/30/84	LT	5		1340	LT	5	1340
ASB	9	06/20/84	LT	5	LT	5	LT	5	0
MSB	1A	07/16/83		2		125		85	212
MSB	1A	07/16/83		6		133		84	223
MSB	1A	05/03/84	LT	5		194		85	279
MSB	2A	07/16/83		33		1300		1014	2347
MSB	2A	05/03/84	LT	5		303		178	481
MSB	3A	06/06/83		.		87400		133500	.
MSB	3A	07/16/83	LT	.		161000		269000	430000
MSB	3A	05/03/84		45		115000		427000	542045
MSB	4A	07/16/83		47		402		617	1066
MSB	4A	05/03/84		203		453		1910	2566
MSB	5A	07/16/83		42		3		69	114
MSB	5A	05/10/84		25	LT	5		34	59
MSB	6A	07/16/83		1	LT	1	LT	1	1
MSB	6A	05/10/84	LT	5	LT	5	LT	5	0
MSB	7A	07/16/83		46		3		27	76
MSB	7A	05/10/84		25	LT	5	LT	5	25
MSB	8A	07/16/83		6		95		149	250
MSB	8A	05/10/84	LT	5		83		246	329
MSB	9A	04/24/83	LT	1		104		3	107
MSB	9A	06/03/83		.		179		7	.
MSB	9A	07/07/83	LT	1		207		7	214
MSB	9A	04/13/84	LT	5		432		10	442
MSB	9B	06/03/83	LT	1		204		274	478

APPENDIX B. CONCENTRATIONS OF DEGREASER SOLVENTS IN WATER FROM WELLS REPORTED IN MICROGRAMS PER LITER (PPB).

WELL	SAMPLE DATE	1,1,1 TCE		TRICHLORO-ETHYLENE		TETRACHLORO-ETHYLENE		TOTAL
MSB 9B	06/29/83		10		188		200	398
MSB 9B	06/29/83		8		194		199	401
MSB 9B	04/17/84	LT	5		143		37	180
MSB 9C	05/16/83		10		495		1280	1785
MSB 9C	06/02/83		.		533		258	.
MSB 9C	06/02/83		.		556		259	.
MSB 9C	06/29/83		41		1264		1267	2572
MSB 9C	04/16/84		29		11000		3770	14799
MSB 10A	04/24/83	LT	1	LT	1	LT	1	0
MSB 10A	04/17/84	LT	5	LT	5	LT	5	0
MSB 10B	05/26/83		2		33		1	36
MSB 10B	06/27/83	LT	1		8	LT	1	8
MSB 10B	07/07/83	LT	1		3	LT	1	3
MSB 10B	04/18/84	LT	5	LT	5	LT	5	0
MSB 10C	04/24/83		5		113		540	658
MSB 10C	07/07/83	LT	1		132		413	545
MSB 10C	04/18/84	LT	5		175		313	488
MSB 10D	06/17/83	LT	1		156		79	235
MSB 11A	04/24/83	LT	1		98		4	102
MSB 11A	05/25/83		1		.		7	.
MSB 11A	06/27/83		2		67		3	72
MSB 11A	04/12/84	LT	5		20	LT	5	20
MSB 11B	05/24/83		2		263		107	372
MSB 11B	06/28/83	LT	1		464		30	494
MSB 11B	04/12/84	LT	5		138		7	145
MSB 11C	05/24/83		2		38500	LT	100	38502
MSB 11C	06/28/83		13		22000		11	22024
MSB 11C	04/12/84	LT	5		34000	LT	5	34000
MSB 11D	05/24/83	LT	1		6130		180	6310
MSB 11D	06/27/83	LT	1		34000		56	34056
MSB 11D	04/12/84	LT	5		7340		866	8206
MSB 11F	06/17/83		5		22200		3970	26175
MSB 11F	07/07/83	LT	1		50000		3300	53300
MSB 11F	04/12/84	LT	5		17900		2670	20570
MSB 12A	05/24/83		3		86	LT	1	89
MSB 12A	06/27/83	LT	1		118	LT	1	118
MSB 12A	04/19/84	LT	5		137	LT	5	137
MSB 12B	04/27/83		225		30		537	792
MSB 12B	07/07/83		237		39		270	546
MSB 12B	04/19/84		509		15		147	671
MSB 12C	04/27/83		233		16		529	778
MSB 12C	07/07/83		257		29		262	548
MSB 12C	04/18/84		282		37		223	542
MSB 12D	06/16/83		3	LT	1	LT	1	3
MSB 12D	07/07/83		3	LT	1	LT	1	3
MSB 12D	07/07/83		3	LT	1	LT	1	3
MSB 12D	04/18/84	LT	5	LT	5	LT	5	0
MSB 12TA	10/24/83	LT	1	LT	1	LT	1	0
MSB 12TA	10/25/83	LT	1	LT	1	LT	1	0

APPENDIX B. CONCENTRATIONS OF DEGREASER SOLVENTS IN WATER FROM WELLS REPORTED IN MICROGRAMS PER LITER (PPB).

WELL	SAMPLE DATE	1,1,1 TCE		TRICHLORO-ETHYLENE		TETRACHLORO-ETHYLENE		TOTAL
MSB 12TA	10/26/83	LT	1	LT	1	LT	1	0
MSB 12TA	05/22/84	LT	1	LT	1	LT	1	0
MSB 12TA	05/25/84	LT	5	LT	5	LT	5	0
MSB 12TA	06/19/84	LT	5	LT	5	LT	5	0
MSB 12TB	10/24/83	LT	1	LT	1	LT	1	0
MSB 12TB	10/25/83	LT	1	LT	1	LT	1	0
MSB 12TB	10/25/83	LT	1	LT	1	LT	1	0
MSB 12TB	10/26/83	LT	1	LT	1	LT	1	0
MSB 12TB	05/17/84	LT	5		N	LT	5	.
MSB 12TB	06/19/84	LT	5	LT	5	LT	5	0
MSB 13A	04/28/83		2		1		1	4
MSB 13A	07/12/83	LT	1	LT	1	LT	1	0
MSB 13A	04/20/84	LT	5	LT	5	LT	5	0
MSB 13B	06/03/83		16		39		88	143
MSB 13B	07/05/83	LT	1		75		155	230
MSB 13B	04/20/84	LT	5		76		14	90
MSB 13C	04/28/83		186		5		17	208
MSB 13C	07/12/83		97		38		12	147
MSB 13C	04/20/84		5		6		9	20
MSB 14A	06/16/83		6		954		77	1037
MSB 14A	07/11/83		1		938		98	1037
MSB 14A	06/14/84	LT	5		732		79	811
MSB 14B	05/25/83		3		320		400	723
MSB 14B	06/29/83		10		264		304	578
MSB 14B	04/13/84	LT	5		225		346	571
MSB 14C	04/27/83		63		11		6	80
MSB 14C	07/11/83		50		15		6	71
MSB 14C	04/13/84		32		15		7	54
MSB 15A	04/28/83		4		2350		2	2356
MSB 15A	05/26/83		7		2840		4	2851
MSB 15A	06/27/83	LT	1		2700	LT	1	2700
MSB 15A	04/16/84	LT	5		2370	LT	5	2370
MSB 16A	04/23/83		3		1620		4	1627
MSB 16A	05/25/83		7		1980		3	1990
MSB 16A	06/27/83		N		N		N	.
MSB 16A	04/17/84	LT	5		1430		5	1435
MSB 16C	04/24/83		3		9630		1140	10773
MSB 16C	05/26/83		34		10000		693	10727
MSB 16C	06/28/83		9		11000		676	11685
MSB 16C	04/17/84	LT	5		4980		733	5713
MSB 17A	04/28/83		171		62		335	568
MSB 17A	07/11/83	LT	1		131		500	631
MSB 17A	04/23/84	LT	5		50		791	841
MSB 17B	04/29/83		38		28		273	339
MSB 17B	07/11/83		51		28		380	459
MSB 17B	04/24/84		124	LT	5		641	765
MSB 18A	06/02/83	LT	1		8	LT	1	8
MSB 18A	06/28/83		1		9	LT	1	10
MSB 18A	06/28/83		1		9	LT	1	10

APPENDIX B. CONCENTRATIONS OF DEGREASER SOLVENTS IN WATER FROM WELLS REPORTED IN MICROGRAMS PER LITER (PPB).

WELL	SAMPLE DATE	1,1,1 TCE	TRICHLORO-ETHYLENE	TETRACHLORO-ETHYLENE	TOTAL
MSB 18A	04/23/84	LT 5	8	LT 5	8
MSB 18B	04/28/83	71	2	47	120
MSB 18B	07/12/83	31	5	43	79
MSB 18B	04/23/84	27	5	15	47
MSB 18C	04/28/83	1	1	1	3
MSB 18C	07/12/83	2	LT 1	LT 1	2
MSB 18C	07/12/83	1	LT 1	LT 1	1
MSB 18C	04/23/84	LT 5	LT 5	LT 5	0
MSB 19A	04/30/83	5	104	LT 1	109
MSB 19A	07/08/83	2	110	LT 1	112
MSB 19A	06/08/84	LT 5	111	LT 5	111
MSB 19B	06/08/83	LT 1	468	484	952
MSB 19B	06/08/83	LT 1	453	487	940
MSB 19B	07/11/83	LT 1	191	5	196
MSB 19B	06/08/84	LT 5	195	LT 5	195
MSB 19C	04/30/83	2	195	8	205
MSB 19C	07/11/83	LT 1	313	17	330
MSB 19C	06/13/84	LT 5	808	153	961
MSB 20A	04/23/83	LT 1	4	LT 1	4
MSB 20A	04/27/83	LT 1	5	LT 1	5
MSB 20A	06/08/83	LT 1	5	LT 1	5
MSB 20A	07/06/83	LT 1	7	LT 1	7
MSB 20A	07/06/83	LT 1	7	LT 1	7
MSB 20A	04/24/84	LT 5	19	LT 5	19
MSB 20A	04/24/84	LT 5	7	LT 5	7
MSB 20C	04/23/83	LT 1	69	LT 1	69
MSB 20C	04/27/83	LT 1	505	LT 1	505
MSB 20C	06/08/83	1	443	LT 1	444
MSB 20C	07/06/83	1	338	LT 1	339
MSB 20C	04/24/84	LT 5	59	LT 5	59
MSB 21A	04/23/83	LT 1	5	LT 1	5
MSB 21A	07/11/83	LT 1	3	LT 1	3
MSB 21A	04/25/84	LT 5	LT 5	LT 5	0
MSB 21C	04/23/83	1	LT 1	LT 1	1
MSB 21C	07/11/83	LT 1	LT 1	LT 1	0
MSB 21C	04/24/84	LT 5	LT 5	LT 5	0
MSB 22	05/24/83	2	67000	85000	152002
MSB 22	06/27/83	2	79000	94000	173002
MSB 22	04/13/84	LT 5	20600	36700	57300
MSB 23	05/09/83	LT 1	123000	6800	129800
MSB 23	06/01/83	N	81500	5240	.
MSB 23	06/07/83	1	50000	5600	55601
MSB 23	07/06/83	1	49000	4900	53901
MSB 23	05/11/84	LT 5	27000	1590	28590
MSB 23A	04/11/83	LT 1	LT 1	LT 1	0
MSB 23A	05/09/83	LT 1	LT 1	LT 1	0
MSB 23A	06/07/83	3	LT 1	LT 1	3
MSB 23A	07/06/83	LT 1	LT 1	LT 1	0
MSB 23A	05/11/84	LT 5	LT 5	LT 5	0

APPENDIX B. CONCENTRATIONS OF DEGREASER SOLVENTS IN WATER FROM WELLS REPORTED IN MICROGRAMS PER LITER (PPB).

WELL	SAMPLE DATE	1,1,1 TCE		TRICHLORO-ETHYLENE		TETRACHLORO-ETHYLENE		TOTAL
MSB 23A	05/29/84	LT	5	LT	5	LT	5	0
MSB 23A	06/05/84	LT	1	LT	1	LT	1	0
MSB 23A	06/26/84	LT	5	LT	5	LT	5	0
MSB 23A	06/26/84	LT	5	LT	5	LT	5	0
MSB 23A	06/27/84	LT	5		181	LT	5	181
MSB 23A	06/27/84	LT	5		163	LT	5	163
MSB 23A	07/10/84	LT	1		497		6	503
MSB 23A	07/10/84	LT	1		499		7	506
MSB 23B	05/09/83	LT	1		78000		1390	79390
MSB 23B	06/01/83		N		46200		2060	.
MSB 23B	07/06/83	LT	1		36000		510	36510
MSB 23B	05/11/84	LT	5		15000		144	15144
MSB 24	06/02/83		87		11700		788	12575
MSB 24	07/07/83		48		14000		280	14328
MSB 24	05/15/84	LT	5		9980		598	10578
MSB 24A	04/29/83		1		15010		108	15119
MSB 24A	06/01/83		78		41100		350	41528
MSB 24A	07/07/83	LT	1		9900		175	10075
MSB 24A	05/15/84	LT	5	LT	5	LT	5	0
MSB 25	05/16/83		3		1150		181	1334
MSB 25	07/12/83	LT	1		2400		146	2546
MSB 25	05/15/84	LT	5		1730		142	1872
MSB 25A	05/16/83		3		3150		24	3177
MSB 25A	07/12/83	LT	1		4900		26	4926
MSB 25A	05/15/84	LT	5		2910		22	2932
MSB 26	05/10/83	LT	1		30	LT	1	30
MSB 26	07/11/83		1		34	LT	1	35
MSB 26	04/26/84	LT	5		19	LT	5	19
MSB 26A	05/10/83		2		22000		402	22404
MSB 26A	07/11/83		67		21000		195	21262
MSB 26A	04/26/84	LT	5		33500		297	33797
MSB 27	05/16/83	LT	1	LT	1	LT	1	0
MSB 27	06/10/83		.		1		.	.
MSB 27	07/11/83	LT	1		1	LT	1	1
MSB 27	04/26/84	LT	5		37	LT	5	37
MSB 27A	05/10/83	LT	1		53000		753	53753
MSB 27A	06/06/83		2		.		397	.
MSB 27A	06/06/83		30		48600		289	48919
MSB 27A	07/11/83	LT	100		28000		254	28254
MSB 27A	06/13/84	LT	5		61400		230	61630
MSB 28	05/12/83		1		4	LT	1	5
MSB 28	07/11/83		1		4	LT	1	5
MSB 28	04/30/84	LT	5	LT	5	LT	5	0
MSB 28A	05/12/83		2		2350		3	2355
MSB 28A	07/11/83	LT	1		2400	LT	1	2400
MSB 28A	04/30/84	LT	5		3470	LT	5	3470
MSB 30A	05/12/83		1	LT	1	LT	1	1
MSB 30A	05/31/83	LT	1	LT	1	LT	1	0
MSB 30A	07/05/83	LT	1	LT	1	LT	1	0

.APPENDIX B. CONCENTRATIONS OF DEGREASER SOLVENTS IN WATER FROM
. WELLS REPORTED IN MICROGRAMS PER LITER (PPB).

.WELL	SAMPLE DATE		1,1,1 TCE		TRICHLORO-ETHYLENE		TETRACHLORO-ETHYLENE	TOTAL
MSB 30A	07/12/83	LT	1	LT	1	LT	1	0
MSB 30A	04/30/84	LT	5		5	LT	5	5
MSB 30A	05/21/84	LT	1	LT	1	LT	1	0
MSB 30A	06/25/84	LT	5	LT	5	LT	5	0
MSB 30A	06/25/84	LT	5	LT	5	LT	5	0
MSB 30C	05/12/83	LT	1		8	LT	1	8
MSB 30C	05/31/83	LT	1		5	LT	1	5
MSB 30C	07/05/83	LT	1		7	LT	1	7
MSB 30C	07/05/83	LT	1		7	LT	1	7
MSB 30C	04/30/84	LT	5		5	LT	5	5
MSB 31A	06/02/83	LT	1	LT	1	LT	1	0
MSB 31A	06/29/83	LT	1	LT	1	LT	1	0
MSB 31A	10/10/83	LT	1	LT	1	LT	1	0
MSB 31A	10/10/83	LT	1	LT	1	LT	1	0
MSB 31A	05/09/84	LT	5	LT	5	LT	5	0
MSB 31A	05/22/84	LT	1	LT	1	LT	1	0
MSB 31B	06/01/83		1		349		.	.
MSB 31B	06/29/83		N		N		N	.
MSB 31B	08/31/83	LT	1		278		2	280
MSB 31B	09/01/83	LT	1		345		51	396
MSB 31B	05/09/84	LT	N		262	LT	5	262
MSB 31C	06/01/83		.		84000		33000	.
MSB 31C	06/28/83		5		105000		90000	195005
MSB 31C	08/31/83		7		135000		106000	241007
MSB 31C	09/01/83		6		158000		204000	362006
MSB 31C	05/09/84		12		76500		83900	160412
MSB 32	05/02/83		5	LT	1	LT	1	5
MSB 32	06/28/83		2	LT	1	LT	1	2
MSB 32	06/14/84	LT	5	LT	5	LT	5	0
MSB 33	05/02/83		8		131		169	308
MSB 33	06/28/83		5		90		93	188
MSB 33	05/09/84	LT	5		178		102	280
MSB 34A	08/16/83	LT	1		650		38	688
MSB 34A	08/23/83	LT	1		690		38	728
MSB 34A	08/25/83	LT	1		440		33	473
MSB 34A	08/27/83	LT	1		509		39	548
MSB 34A	09/08/83	LT	1		703		37	740
MSB 34A	09/08/83	LT	1		703		37	740
MSB 34A	04/25/84	LT	5		607		35	642
MSB 34B	08/16/83		12		31000		5300	36312
MSB 34B	08/23/83	LT	1		28000		5400	33400
MSB 34B	08/25/83	LT	1		N		N	.
MSB 34B	08/27/83	LT	1		27000		3600	30600
MSB 34B	09/08/83	LT	1		32500		3000	35500
MSB 34B	09/08/83	LT	1		32500		3000	35500
MSB 34B	04/25/84	LT	5		8480		1370	9850
MSB 34C	08/27/83	LT	1		29300		4100	33400
MSB 34C	09/08/83	LT	500		48500		5400	53900
MSB 34C	09/08/83	LT	1		48500		5400	53900

.APPENDIX B. CONCENTRATIONS OF DEGREASER SOLVENTS IN WATER FROM WELLS REPORTED IN MICROGRAMS PER LITER (PPB).

.WELL	SAMPLE DATE	1,1,1 TCE	TRICHLORO-ETHYLENE	TETRACHLORO-ETHYLENE	TOTAL
MSB 34C	04/25/84	LT 5	24800	3210	28010
MSB 34TA	08/08/83	LT 1	LT 1	1	1
MSB 34TA	09/12/83	LT 1	LT 1	LT 1	0
MSB 34TA	09/12/83	LT 1	LT 1	LT 1	0
MSB 34TA	09/19/83	LT 1	LT 1	LT 1	0
MSB 34TA	09/19/83	LT 1	LT 1	LT 1	0
MSB 34TA	09/19/83	LT 1	LT 1	LT 1	0
MSB 34TA	09/19/83	LT 1	LT 1	LT 1	0
MSB 34TA	10/26/83	LT 1	LT 1	LT 1	0
MSB 34TA	05/16/84	LT 5	N	LT 5	.
MSB 34TA	05/18/84	LT 5	LT 5	LT 5	0
MSB 34TA	06/20/84	LT 5	LT 5	LT 5	0
MSB 34TA	06/20/84	LT 5	LT 5	LT 5	0
MSB 34TB	09/08/83	LT 1	LT 1	LT 1	0
MSB 34TB	09/08/83	LT 1	LT 1	LT 1	0
MSB 34TB	05/16/84	LT 5	LT 5	LT 5	0
MSB 34TB	05/18/84	LT 5	LT 5	LT 5	0
MSB 34TB	06/21/84	LT 5	LT 5	LT 5	0
MSB 34TB	06/21/84	LT 5	LT 5	LT 5	0
SRW 1C	05/04/84	LT 5	7	27	34
SRW 2A	05/02/84	LT 5	N	N	.
SRW 2A	07/25/84	LT 1	LT 1	LT 1	0
SRW 2B	05/02/84	LT 5	LT 5	LT 5	0
SRW 2C	05/02/84	LT 5	LT 5	LT 5	0
SRW 3C	05/02/84	LT 5	LT 5	LT 5	0
SRW 4C	06/18/84	LT 5	LT 5	LT 5	0
SRW 5C	05/04/84	LT 5	6	9	15
SRW 6C	05/04/84	LT 5	10	24	34
SRW 9A	06/01/84	LT 5	LT 5	LT 5	0
SRW 9B	06/04/84	LT 5	LT 5	LT 5	0
SRW 12A	06/04/84	LT 5	LT 5	LT 5	0
SRW 12B	06/04/84	LT 5	LT 5	LT 5	0
SRW 12C	06/06/84	LT 5	LT 5	LT 5	0
SRW 13A	05/31/84	LT 5	LT 5	LT 5	0
SRW 13B	05/31/84	LT 5	LT 5	LT 5	0
SRW 13C	06/01/84	LT 5	LT 5	LT 5	0
SRW 14A	05/07/84	LT 5	LT 5	LT 5	0
SRW 14B	05/04/84	LT 5	LT 5	10	10
SRW 14C	05/04/84	LT 5	LT 5	8	8
SRW 15A	05/07/84	LT 5	LT 5	LT 5	0
SRW 15B	05/07/84	LT 5	LT 5	LT 5	0
SRW 15C	05/01/84	LT 5	LT 5	LT 5	0
SRW 16A	05/08/84	LT 5	LT 5	LT 5	0
SRW 16B	05/07/84	LT 5	LT 5	LT 5	0

APPENDIX C. ANALYTES DETECTED IN EACH WELL

The tables in this appendix give the analytes detected in water samples from each monitoring well as part of the M-Area plume definition program. Additional analytical results for wells MSB-1 through 8 collected as part of the quarterly monitoring program are given in Appendix D. The locations of these wells are shown on Figure 4-1 and construction details are given on Table 4-2. The units used are MG/L - milligrams per liter (PPM), UG/L - micrograms per liter (PPB), PC/L - picocuries per liter, UMHOS/CM - micromhos per centimeter, PH - pH units. The analytical methods used are gravimetric for the total dissolved solids, electrometer for pH and conductivity, wet chemistry of the ionic species, atomic absorption for metals, inductively coupled plasma emission spectroscopy for metals, gas chromatography and GC/MS for organic compounds, beta-gamma proportional counting for gross beta, and alpha scintillation counting for gross alpha and radium.

Analytes are arranged alphabetically across the top of the page in groups of nine to a page, and the wells are arranged alphabetically and numerically along the side of the page in eight pages before a new group of analytes is begun. The analyses of field blanks are given at the beginning of each list of wells.

Negative sign indicates that the concentration was below the limit of detectability which is indicated by the number following the negative sign. A dot indicates that no analysis was made for that analyte on that sample. The sampling protocol used for the 1983 analyses are described in Appendix E-1 and that for 1984 analyses in Appendix E-2. Because the 1983 samples for metals analyses were not filtered, it is considered that the 1984 analyses are more reliable, and the 1983 analyses for metals should be considered with great caution.

The laboratories used are:

Envirodyne Engineers, Inc. for organic and inorganic analyses

Teledyne Isotopes, Inc. for radioactive analytes on samples collected in 1983 except for well MPT 1 on 9-22-83 which was done by Controls for Environmental Pollution, Inc.

Controls for Environmental Pollution, Inc. for radioactive analytes on samples collected in 1984.

The following is a list of the analytes not reported. They are arranged according to the reason for not reporting them.

- Secondary drinking water standard of little value in this study.

  Color
  Corrosivity
  Fecal Coloform
  Odor
  Turbidity

- Lab blank and or field blank at comparable concentration to samples.

  Benzene
  Bis (2-ethylhexyl) phthalate
  Chloroform
  Diethyl Phthalate
  Di-n-Butyl Phthalate
  Ethylbenzene
  Methylene Chloride
  Nitrobenzene
  Toluene
  Trichlorofluoromethane

- Not detected by the method used

  Acrolein
  Acrylonitrile
  Bromoform
  Bromomethane
  Chloroethane
  Chloromethane
  Dibromochloromethane
  Endrin
  Fluoranthene
  Lindane
  Methoxychlor
  Naphthalene
  Pyrene
  Silvex
  Sulphide
  Toxaphene
  1,2-Dichloroethane
  1,2-Dichloropropane
  1,3-Dichloropropylene
  2-Chloroethylvinyl Ether
  2,4-Dichlorophenoxyacetic Acid

- Not of significance

  Silicon

APPENDIX C. ANALYTES IN EACH WELL

NEGATIVE NUMBERS REPRESENT DETECTIONS LIMITS. DOTS REPRESENT ANALYSES NOT PERFORMED

		NAME OF ANALYTE								
		ALUMINUM MG/L	ANTIMONY UG/L	ARSENIC UG/L	BARIUM UG/L	BERYLLIUM UG/L	BROMODICHLOROMETHANE UG/L	CADMIUM UG/L	CALCIUM MG/L	CARBON DISSOLVED ORGANIC MG/L
		RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT
WELL	SAMPLE DATE									
FB	05/26/83	.	.	.	.	.	.	.	.	.
	06/02/83	.	.	.	.	.	-1.000	.	.	.
	06/06/83	.	.	.	.	.	.	.	.	.
	04/19/84	.	.	.	.	.	-5.000	.	.	.
	04/20/84	.	.	.	.	.	-5.000	.	.	.
	04/27/84	.	.	.	.	.	-5.000	.	.	.
	04/30/84	.	.	.	.	.	-5.000	.	.	.
	05/07/84	.	.	.	.	.	-5.000	.	.	.
	05/16/84	.	.	.	.	.	-5.000	.	.	.
	05/17/84	.	.	.	.	.	-5.000	.	.	.
	05/18/84	.	.	.	.	.	-5.000	.	.	.
	05/26/84	.	.	.	.	.	-5.000	.	.	.
	05/31/84	.	.	.	.	.	-5.000	.	.	.
	06/08/84	.	.	.	.	.	-5.000	.	.	.
	06/18/84	.	.	.	.	.	-5.000	.	.	.
	06/19/84	.	.	.	.	.	-5.000	.	.	.
ABG 1	06/12/84	-0.030	-3.000	-1.000	-4.000	-2.000	-5.000	-2.000	0.074	-5.000
AC 1A	06/28/84	-0.100	-3.000	-2.000	4.000	-2.000	.	-20.000	2.920	-5.000
AC 1B	06/18/84	0.029	-3.000	-1.000	10.000	-2.000	-5.000	-2.000	1.410	-5.000
AC 2A	06/13/84	0.223	-3.000	-2.000	6.000	-2.000	-5.000	-2.000	4.790	-5.000
AC 2B	05/01/84	0.028	-3.000	-1.000	6.000	-2.000	-5.000	-2.000	2.110	-5.000

(CONTINUED)

APPENDIX C. ANALYTES IN EACH WELL

NEGATIVE NUMBERS REPRESENT DETECTIONS LIMITS. DOTS REPRESENT ANALYSES NOT PERFORMED

		NAME OF ANALYTE								
		ALUMINUM MG/L	ANTIMONY UG/L	ARSENIC UG/L	BARIUM UG/L	BERYLLIUM UG/L	BROMODICH-LOROMETHA-NE UG/L	CADMIUM UG/L	CALCIUM MG/L	CARBON DISSOLVED ORGANIC MG/L
		RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT
WELL	SAMPLE DATE									
AC 3A	06/07/84	0.206	-3.000	-1.000	14.000	-2.000	-5.000	-2.000	2.870	-5.000
AC 3B	06/07/84	2.470	-3.000	-1.000	17.000	-2.000	-5.000	-2.000	32.700	-5.000
AMB 2	06/11/84	0.274	-3.000	-1.000	10.000	-2.000	-5.000	-2.000	3.690	-5.000
AOB 1	06/11/84	0.233	-3.000	-1.000	18.000	-2.000	-5.000	-2.000	2.540	-5.000
AOB 2	06/11/84	0.140	-3.000	-1.000	8.000	-2.000	-5.000	-2.000	1.280	-5.000
ASB 3	05/14/84	0.026	-3.000	-1.000	19.000	-2.000	-5.000	-2.000	5.430	-5.000
ASB 4	06/12/84	0.200	-3.000	-1.000	20.000	-2.000	-5.000	-2.000	4.450	-5.000
ASB 7	05/14/84	0.035	-3.000	-1.000	9.000	-2.000	-5.000	-2.000	1.450	-5.000
ASB 8	05/30/84	0.184	-3.000	-1.000	8.000	-2.000	-5.000	-2.000	0.798	-5.000
ASB 9	06/20/84	0.024	-3.000	-1.000	23.000	-2.000	-5.000	-2.000	2.190	-5.000
MPT 1	06/06/83	2.940	.	3.000	-50.000	6.000	.	-1.000	19.190	1.000
	09/22/83	4.630	.	-2.000	184.000	21.000	.	-2.000	111.400	2.000
	04/12/84	3.500	-3.000	-2.000	150.000	-10.000	-5.000	-1.000	21.400	-5.000
MSB 1A	05/03/84	0.043	-3.000	-1.000	16.000	-2.000	-5.000	-2.000	2.520	-5.000
MSB 2A	05/03/84	0.198	-3.000	-1.000	8.000	-2.000	-5.000	-2.000	1.380	-5.000
MSB 3A	06/06/83	1.880	.	-2.000	-50.000	-5.000	.	-1.000	3.510	5.000
	05/03/84	0.104	25.000	-1.000	44.000	-2.000	-5.000	-2.000	6.930	-5.000
MSB 4A	05/03/84	0.096	3.000	-1.000	26.000	-2.000	-5.000	-2.000	6.670	6.000
MSB 5A	05/10/84	0.024	-3.000	-1.000	12.000	-2.000	-5.000	-2.000	3.620	-5.000
MSB 6A	05/10/84	0.034	-3.000	-1.000	6.000	-2.000	-5.000	-2.000	0.852	-5.000
MSB 7A	05/10/84	0.038	-3.000	-1.000	11.000	-2.000	-5.000	-2.000	1.230	-5.000

(CONTINUED)

APPENDIX C. ANALYTES IN EACH WELL

NEGATIVE NUMBERS REPRESENT DETECTIONS LIMITS. DOTS REPRESENT ANALYSES NOT PERFORMED

		NAME OF ANALYTE								
		ALUMINUM MG/L	ANTIMONY UG/L	ARSENIC UG/L	BARIUM UG/L	BERYLLIUM UG/L	BROMODICH-LOROMETHA-NE UG/L	CADMIUM UG/L	CALCIUM MG/L	CARBON DISSOLVED ORGANIC MG/L
		RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT
WELL	SAMPLE DATE									
MSB 8A	05/10/84	0.030	-3.000	-1.000	6.000	-2.000	-5.000	-2.000	2.800	-5.000
MSB 9A	06/03/83	-0.100	.	-2.000	-50.000	-5.000	.	-1.000	4.610	2.000
	04/13/84	-0.300	.	-3.000	-100.000	-10.000	-5.000	-20.000	7.000	-5.000
MSB 9B	04/17/84	0.300	-3.000	-3.000	-100.000	-10.000	-5.000	-20.000	10.400	8.000
MSB 9C	06/02/83	-0.100	.	-2.000	-50.000	-5.000	.	-1.000	2.420	2.000
	04/16/84	-0.300	-3.000	-3.000	-100.000	-10.000	-5.000	-20.000	16.400	-5.000
MSB 10A	04/17/84	-0.300	-3.000	-3.000	200.000	-10.000	-5.000	-20.000	0.730	-5.000
MSB 10B	04/18/84	-0.300	-3.000	-3.000	-100.000	-10.000	-5.000	-20.000	1.060	-5.000
MSB 10C	04/18/84	-0.300	-3.000	-3.000	-100.000	-10.000	-5.000	-20.000	32.000	-5.000
MSB 11A	05/25/83	0.450	.	-2.000	-50.000	-5.000	.	-1.000	9.080	1.000
	04/12/84	-0.300	-3.000	-2.000	-100.000	-10.000	-5.000	-1.000	8.300	-5.000
MSB 11B	04/12/84	-0.300	-3.000	-2.000	-100.000	-10.000	-5.000	-1.000	12.300	-5.000
MSB 11C	04/12/84	0.237	-3.000	-1.000	133.000	-2.000	-5.000	-2.000	27.100	-5.000
MSB 11D	04/12/84	.	-3.000	-2.000	-100.000	-10.000	-5.000	1.000	8.200	-5.000
MSB 11F	04/12/84	1.600	-3.000	-2.000	-100.000	-10.000	-5.000	-1.000	1.820	-5.000
MSB 12A	04/19/84	-0.300	-3.000	-3.000	100.000	-10.000	-5.000	-20.000	0.470	-5.000
MSB 12B	04/19/84	-0.300	-3.000	-3.000	-100.000	-10.000	-5.000	-20.000	2.240	-5.000
MSB 12C	04/18/84	-0.300	-3.000	-3.000	400.000	-10.000	-5.000	-20.000	2.870	-5.000
MSB 12D	04/18/84	-0.300	-3.000	-3.000	300.000	-10.000	-5.000	-20.000	10.300	-5.000
MSB 12TA	05/25/84	.	.	.	.	.	-5.000	.	.	.
MSB 12TB	05/17/84	0.025	-3.000	-1.000	6.000	-2.000	-5.000	-2.000	4.700	-5.000

(CONTINUED)

APPENDIX C. ANALYTES IN EACH WELL

NEGATIVE NUMBERS REPRESENT DETECTIONS LIMITS. DOTS REPRESENT ANALYSES NOT PERFORMED

		NAME OF ANALYTE								
		ALUMINUM MG/L	ANTIMONY UG/L	ARSENIC UG/L	BARIUM UG/L	BERYLLIUM UG/L	BROMODICH-LOROMETHA-NE UG/L	CADMIUM UG/L	CALCIUM MG/L	CARBON DISSOLVED ORGANIC MG/L
		RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT
WELL	SAMPLE DATE									
MSB 13A	04/20/84	-0.300	-3.000	-3.000	-100.000	-10.000	-5.000	-20.000	0.840	-5.000
MSB 13B	04/20/84	-0.300	-3.000	-3.000	-100.000	-10.000	-5.000	-20.000	8.330	-5.000
MSB 13C	04/20/84	-0.300	-3.000	-3.000	-100.000	-10.000	-5.000	-20.000	2.230	-5.000
MSB 14A	06/14/84	0.364	-3.000	-1.000	38.000	-2.000	-5.000	2.000	7.350	-5.000
MSB 14B	04/13/84	-0.300	-3.000	.	-100.000	-10.000	-5.000	-1.000	12.000	-5.000
MSB 14C	04/13/84	-0.400	-3.000	-2.000	-100.000	-10.000	-5.000	-1.000	15.200	-5.000
MSB 15A	05/26/83	1.170	.	-2.000	-50.000	-5.000	.	3.000	13.800	2.000
	04/16/84	-0.300	-3.000	-3.000	-100.000	-10.000	-5.000	-20.000	10.000	-5.000
MSB 16A	05/25/83	0.730	.	-2.000	-50.000	-5.000	3.000	-1.000	2.350	2.000
	04/17/84	-0.300	-3.000	-3.000	700.000	-10.000	-5.000	-20.000	5.300	-5.000
MSB 16C	05/26/83	-0.100	.	-2.000	-50.000	-5.000	.	-1.000	0.340	2.000
	04/17/84	-0.300	-3.000	-3.000	-100.000	-10.000	-5.000	-20.000	0.470	-5.000
MSB 17A	04/23/84	-0.300	-3.000	-3.000	-100.000	-10.000	-5.000	-20.000	3.810	-5.000
MSB 17B	04/24/84	-0.300	-3.000	-3.000	-100.000	-10.000	-5.000	-20.000	1.540	-5.000
MSB 18A	04/23/84	-0.300	-3.000	-3.000	-100.000	-10.000	-5.000	-20.000	0.300	-5.000
MSB 18B	04/23/84	-0.300	-3.000	-3.000	-100.000	-10.000	-5.000	-20.000	2.810	-5.000
MSB 18C	04/23/84	-0.300	-3.000	-3.000	-100.000	-10.000	-5.000	-20.000	0.100	-5.000
MSB 19A	06/08/84	0.211	-3.000	-1.000	8.000	-2.000	-5.000	-2.000	2.130	-5.000
MSB 19B	06/08/84	0.064	-3.000	-1.000	6.000	-2.000	-5.000	-2.000	0.801	-5.000
MSB 19C	06/13/84	0.070	-3.000	-1.000	5.000	-2.000	-5.000	3.000	.	-5.000
MSB 20A	04/24/84	-0.300	-3.000	-3.000	-100.000	-10.000	-5.000	-20.000	0.440	-5.000

(CONTINUED)

APPENDIX C. ANALYTES IN EACH WELL

NEGATIVE NUMBERS REPRESENT DETECTIONS LIMITS. DOTS REPRESENT ANALYSES NOT PERFORMED

		NAME OF ANALYTE								
		ALUMINUM MG/L	ANTIMONY UG/L	ARSENIC UG/L	BARIUM UG/L	BERYLLIUM UG/L	BROMODICH-LOROMETHA-NE UG/L	CADMIUM UG/L	CALCIUM MG/L	CARBON DISSOLVED ORGANIC MG/L
		RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT
WELL	SAMPLE DATE									
MSB 20C	04/24/84	0.700	-3.000	-3.000	-100.000	-10.000	-5.000	-20.000	39.860	-5.000
MSB 21A	04/25/84	-0.300	-3.000	-3.000	-100.000	-10.000	-5.000	-20.000	0.240	-5.000
MSB 21C	04/24/84	-0.300	-3.000	-3.000	-100.000	-10.000	-5.000	-20.000	0.470	-5.000
MSB 22	04/13/84	-1.200	-3.000	-2.000	109.000	15.000	-5.000	-1.000	87.200	-5.000
MSB 23	06/01/83	0.560	.	-2.000	-50.000	-5.000	.	-1.000	3.790	4.000
	05/11/84	0.057	3.000	-1.000	37.000	-2.000	-5.000	-2.000	58.600	-5.000
MSB 23A	05/11/84	0.050	-3.000	-1.000	14.000	-2.000	-5.000	-2.000	5.570	-5.000
MSB 23B	06/01/83	0.300	.	-2.000	-50.000	-5.000	.	-1.000	5.350	3.000
	05/11/84	0.035	-3.000	-1.000	6.000	-2.000	-5.000	-2.000	3.970	-5.000
MSB 24	06/02/83	3.930	.	10.000	-50.000	-5.000	.	-1.000	173.600	6.000
	05/15/84	5.550	4.000	-1.000	15.000	-2.000	-5.000	-2.000	115.400	-5.000
MSB 24A	06/01/83	-0.100	.	-2.000	-50.000	-5.000	-1.000	-1.000	0.930	4.000
	05/15/84	0.110	-3.000	-1.000	-4.000	-2.000	5.000	-2.000	1.730	-5.000
MSB 25	05/15/84	0.478	-3.000	-1.000	12.000	-2.000	-5.000	-2.000	23.400	-5.000
MSB 25A	05/15/84	0.054	-3.000	-1.000	4.000	-2.000	-5.000	-2.000	1.980	-5.000
MSB 26	04/26/84	-0.300	-3.000	-3.000	-100.000	-10.000	-5.000	-20.000	0.120	-5.000
MSB 26A	04/26/84	-0.300	-3.000	-3.000	-100.000	-10.000	-5.000	-20.000	0.280	-5.000
MSB 27	06/10/83	-0.100	.	-2.000	-50.000	-5.000	.	-1.000	2.170	2.000
	04/26/84	-0.300	-3.000	-3.000	-100.000	-10.000	-5.000	-20.000	1.000	-5.000
MSB 27A	06/06/83	-0.100	.	-2.000	-50.000	-5.000	.	-1.000	0.720	3.000
	06/13/84	0.099	-3.000	-1.000	13.000	-2.000	-5.000	7.000	1.140	-5.000

(CONTINUED)

APPENDIX C. ANALYTES IN EACH WELL

NEGATIVE NUMBERS REPRESENT DETECTIONS LIMITS. DOTS REPRESENT ANALYSES NOT PERFORMED

		NAME OF ANALYTE								
		ALUMINUM MG/L	ANTIMONY UG/L	ARSENIC UG/L	BARIUM UG/L	BERYLLIUM UG/L	BROMODICH-LOROMETHA-NE UG/L	CADMIUM UG/L	CALCIUM MG/L	CARBON DISSOLVED ORGANIC MG/L
		RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT
WELL	SAMPLE DATE									
MSB 28	04/30/84	0.212	-3.000	-1.000	6.000	-2.000	-5.000	-2.000	9.280	-5.000
MSB 28A	04/30/84	0.032	-3.000	-1.000	6.000	-2.000	-5.000	-2.000	1.460	-5.000
MSB 30A	04/30/84	0.032	-3.000	-1.000	6.000	-2.000	-5.000	-2.000	1.180	-5.000
MSB 30C	04/30/84	1.620	-3.000	-1.000	36.000	-2.000	-5.000	-2.000	40.300	-5.000
MSB 31A	05/09/84	0.049	-3.000	-1.000	4.000	-2.000	-5.000	-2.000	0.840	-5.000
MSB 31B	06/01/83	-0.100	.	-2.000	-50.000	-5.000	16.000	-1.000	2.140	9.000
	05/09/84	-0.020	-3.000	-1.000	5.000	-2.000	-5.000	-2.000	1.170	-5.000
MSB 31C	06/01/83	0.350	.	-2.000	-50.000	-5.000	.	-1.000	12.570	3.000
	05/09/84	-0.020	-3.000	-1.000	11.000	-2.000	-5.000	-2.000	7.690	-5.000
MSB 32	06/14/84	0.043	-3.000	-1.000	-4.000	-2.000	-5.000	-2.000	0.827	-5.000
MSB 33	05/09/84	0.049	-3.000	-1.000	6.000	-2.000	-5.000	-2.000	0.680	-5.000
MSB 34A	04/25/84	-0.300	-3.000	-3.000	-100.000	-10.000	-5.000	-20.000	0.140	-5.000
MSB 34B	04/25/84	3.900	-3.000	-3.000	120.000	-10.000	-5.000	-20.000	1.350	-5.000
MSB 34C	04/25/84	-0.300	-3.000	-3.000	-100.000	-10.000	-5.000	-20.000	1.160	-5.000
MSB 34TA	05/16/84	0.144	-3.000	-1.000	5.000	-2.000	-5.000	-2.000	16.600	-5.000
MSB 34TB	05/16/84	0.025	-3.000	-1.000	4.000	-2.000	-5.000	-2.000	5.690	-5.000
RWM 2	05/18/84	0.044	-3.000	-1.000	-4.000	-2.000	-5.000	-2.000	0.376	-5.000
RWM 3	05/18/84	0.038	-3.000	-1.000	10.000	-2.000	-5.000	5.000	2.190	-5.000
SRW 1C	05/04/84	0.039	-3.000	-1.000	6.000	-2.000	-5.000	-2.000	0.240	-5.000
SRW 2A	05/02/84	0.033	-3.000	-1.000	7.000	-2.000	-5.000	-2.000	0.172	-5.000
SRW 2B	05/02/84	0.026	-3.000	-1.000	6.000	-2.000	-5.000	-2.000	1.330	-5.000

(CONTINUED)

APPENDIX C. ANALYTES IN EACH WELL

NEGATIVE NUMBERS REPRESENT DETECTIONS LIMITS. DOTS REPRESENT ANALYSES NOT PERFORMED

		NAME OF ANALYTE								
		ALUMINUM MG/L	ANTIMONY UG/L	ARSENIC UG/L	BARIUM UG/L	BERYLLIUM UG/L	BROMODICH-LOROMETHA-NE UG/L	CADMIUM UG/L	CALCIUM MG/L	CARBON DISSOLVED ORGANIC MG/L
WELL	SAMPLE DATE	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT
SRW 2C	05/02/84	0.067	-3.000	-1.000	6.000	-2.000	-5.000	-2.000	0.704	-5.000
SRW 3C	05/02/84	0.039	-3.000	-1.000	5.000	-2.000	-5.000	-2.000	0.240	-5.000
SRW 4C	06/18/84	-0.057	-3.000	-1.000	16.000	-2.000	-5.000	-2.000	2.290	-5.000
SRW 5C	05/04/84	0.034	-3.000	-1.000	10.000	-2.000	-5.000	-2.000	1.020	-5.000
SRW 6C	05/04/84	0.030	-3.000	-1.000	8.000	-2.000	-5.000	-2.000	1.070	-5.000
SRW 9A	06/01/84	0.213	-3.000	-1.000	7.000	-2.000	-5.000	4.000	1.960	-5.000
SRW 9B	06/04/84	0.142	-3.000	-1.000	8.000	-2.000	-5.000	5.000	0.983	-5.000
SRW 12A	06/04/84	0.107	-3.000	-1.000	8.000	-2.000	-5.000	4.000	0.793	37.000
SRW 12B	06/04/84	0.164	-3.000	-1.000	10.000	-2.000	-5.000	5.000	1.920	-5.000
SRW 12C	06/06/84	0.227	-3.000	-1.000	7.000	-2.000	-5.000	6.000	0.122	-5.000
SRW 13A	05/31/84	0.102	-3.000	-1.000	5.000	-2.000	-5.000	3.000	0.992	-5.000
SRW 13B	05/31/84	0.226	-3.000	-1.000	8.000	-2.000	-5.000	3.000	2.650	-5.000
SRW 13C	06/01/84	0.187	-3.000	-1.000	7.000	-2.000	-5.000	8.000	1.620	-5.000
SRW 14A	05/07/84	0.024	-3.000	-1.000	15.000	-2.000	-5.000	-2.000	6.350	-5.000
SRW 14B	05/04/84	3.560	-3.000	-1.000	79.000	-2.000	-5.000	-2.000	14.000	-5.000
SRW 14C	05/04/84	0.034	-3.000	-1.000	6.000	-2.000	-5.000	2.000	1.180	-5.000
SRW 15A	05/07/84	1.660	-3.000	-1.000	37.000	-2.000	-5.000	-2.000	42.600	-5.000
SRW 15B	05/07/84	-0.020	-3.000	-1.000	6.000	-2.000	-5.000	-2.000	0.552	8.000
SRW 15C	05/01/84	0.027	-3.000	-1.000	6.000	-2.000	-5.000	-2.000	1.020	-5.000
SRW 16A	05/08/84	0.040	-3.000	-1.000	9.000	-2.000	-5.000	-2.000	1.340	-5.000
SRW 16B	05/07/84	0.020	-3.000	-1.000	10.000	-2.000	-5.000	-2.000	1.570	8.000

APPENDIX C. ANALYTES IN EACH WELL

NEGATIVE NUMBERS REPRESENT DETECTIONS LIMITS. DOTS REPRESENT ANALYSES NOT PERFORMED

		NAME OF ANALYTE								
		CARBON TOTAL ORGANIC MG/L	CARBON TETRACHLORIDE UG/L	CHLORIDE MG/L	CHLOROBENZENE UG/L	CHROMIUM UG/L	CONDUCTIVITY UMHOS/CM	COPPER UG/L	CYANIDE UG/L	FLUORIDE UG/L
		RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT
WELL	SAMPLE DATE									
FB	05/26/83	.	.	.	.	.	.	.	.	.
	06/02/83	.	.	.	.	.	.	.	.	.
	06/06/83	.	.	.	.	.	.	.	.	.
	04/19/84	.	-5.000	.	-5.000	.	.	.	.	.
	04/20/84	.	-5.000	.	-5.000	.	.	.	.	.
	04/27/84	.	-5.000	.	-5.000	.	.	.	.	.
	04/30/84	.	-5.000	.	-5.000	.	.	.	.	.
	05/07/84	.	-5.000	.	-5.000	.	.	.	.	.
	05/16/84	.	-5.000	.	-5.000	.	.	.	.	.
	05/17/84	.	-5.000	.	-5.000	.	.	.	.	.
	05/18/84	.	-5.000	.	-5.000	.	.	.	.	.
	05/26/84	.	-5.000	.	-5.000	.	.	.	.	.
	05/31/84	.	-5.000	.	-5.000	.	.	.	.	.
	06/08/84	.	-5.000	.	-5.000	.	.	.	.	.
	06/18/84	.	-5.000	.	-5.000	.	.	.	.	.
	06/19/84	.	-5.000	.	-5.000	.	.	.	.	.
ABG 1	06/12/84	-5.000	-5.000	4.000	-5.000	-4.000	24.200	-4.000	-5.000	-100.000
AC 1A	06/28/84	-5.000	.	-5.000	.	-40.000	28.400	-40.000	-5.000	200.000
AC 1B	06/18/84	-5.000	-5.000	3.760	-5.000	-4.000	27.600	-4.000	-5.000	-100.000
AC 2A	06/13/84	-5.000	-5.000	2.500	-5.000	-4.000	35.000	-4.000	-5.000	-100.000
AC 2B	05/01/84	-5.000	-5.000	4.000	-5.000	-4.000	32.900	-4.000	-5.000	-100.000

(CONTINUED)

APPENDIX C. ANALYTES IN EACH WELL

NEGATIVE NUMBERS REPRESENT DETECTIONS LIMITS. DOTS REPRESENT ANALYSES NOT PERFORMED

		NAME OF ANALYTE								
		CARBON TOTAL ORGANIC MG/L	CARBON TETRACHLORIDE UG/L	CHLORIDE MG/L	CHLOROBENZENE UG/L	CHROMIUM UG/L	CONDUCTIVITY UMHOS/CM	COPPER UG/L	CYANIDE UG/L	FLUORIDE UG/L
		RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT
WELL	SAMPLE DATE									
AC 3A	06/07/84	-5.000	-5.000	3.000	-5.000	-4.000	61.300	9.000	-5.000	180.000
AC 3B	06/07/84	-5.000	-5.000	4.000	-5.000	6.000	224.000	10.000	-5.000	-100.000
AMB 2	06/11/84	-5.000	-5.000	4.550	-5.000	-4.000	35.500	34.000	-5.000	-100.000
AOB 1	06/11/84	-5.000	-5.000	4.050	-5.000	-4.000	29.100	14.000	-5.000	180.000
AOB 2	06/11/84	-5.000	-5.000	2.500	-5.000	-4.000	27.100	11.000	-5.000	130.000
ASB 3	05/14/84	-5.000	-5.000	7.500	-5.000	-4.000	48.600	-4.000	-5.000	-100.000
ASB 4	06/12/84	-5.000	-5.000	5.500	-5.000	-4.000	43.400	4.000	-5.000	160.000
ASB 7	05/14/84	-5.000	-5.000	8.500	-5.000	-4.000	43.200	7.000	-5.000	-100.000
ASB 8	05/30/84	-5.000	-5.000	6.000	-5.000	4.000	55.100	10.000	-5.000	110.000
ASB 9	06/20/84	-5.000	-5.000	5.000	-5.000	-4.000	25.300	-4.000	-5.000	-100.000
MPT 1	06/06/83	5.000	.	2.900	.	-1.000	337.000	20.000	-5.000	970.000
	09/22/83	4.000	.	3.910	.	-8.000	.	11.000	-5.000	670.000
	04/12/84	-5.000	-5.000	3.700	-5.000	5.000	302.000	30.000	-5.000	200.000
MSB 1A	05/03/84	-5.000	-5.000	5.500	-5.000	-4.000	42.800	5.000	-5.000	-100.000
MSB 2A	05/03/84	-5.000	-5.000	3.500	6.000	-4.000	42.100	19.000	-5.000	-100.000
MSB 3A	06/06/83	20.000	.	14.700	.	8.000	1134.000	17.000	40.000	750.000
	05/03/84	10.000	-5.000	41.990	1920.000	-4.000	1734.000	9.000	48.000	710.000
MSB 4A	05/03/84	-5.000	-5.000	13.000	5.000	-4.000	784.000	14.000	-5.000	-100.000
MSB 5A	05/10/84	-5.000	-5.000	6.500	-5.000	5.000	157.000	8.000	-5.000	-100.000
MSB 6A	05/10/84	-5.000	-5.000	7.500	-5.000	-4.000	31.000	8.000	-5.000	-100.000
MSB 7A	05/10/84	-5.000	-5.000	6.000	-5.000	-4.000	65.900	9.000	-5.000	-100.000

(CONTINUED)

APPENDIX C. ANALYTES IN EACH WELL

NEGATIVE NUMBERS REPRESENT DETECTIONS LIMITS. DOTS REPRESENT ANALYSES NOT PERFORMED

		NAME OF ANALYTE								
		CARBON TOTAL ORGANIC MG/L	CARBON TETRACHLORIDE UG/L	CHLORIDE MG/L	CHLOROBENZENE UG/L	CHROMIUM UG/L	CONDUCTIVITY UMHOS/CM	COPPER UG/L	CYANIDE UG/L	FLUORIDE UG/L
WELL	SAMPLE DATE	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT
MSB 8A	05/10/84	-5.000	-5.000	6.000	-5.000	-4.000	89.100	-4.000	-5.000	-100.000
MSB 9A	06/03/83	4.000	.	2.900	.	1.000	61.800	15.000	-5.000	280.000
	04/13/84	-5.000	-5.000	3.700	-5.000	-3.000	47.900	-40.000	-5.000	-100.000
MSB 9B	04/17/84	-5.000	-5.000	6.600	-5.000	-6.000	260.000	-40.000	21.000	200.000
MSB 9C	06/02/83	4.000	.	4.900	6.000	-1.000	139.600	13.000	-5.000	200.000
	04/16/84	-5.000	-5.000	7.000	-5.000	-33.000	307.000	-40.000	-5.000	-100.000
MSB 10A	04/17/84	-5.000	-5.000	2.900	-5.000	-3.000	.	-40.000	-5.000	250.000
MSB 10B	04/18/84	-5.000	-5.000	2.900	-5.000	-6.000	46.300	-40.000	-5.000	-100.000
MSB 10C	04/18/84	-5.000	-5.000	4.800	-5.000	-3.000	215.000	-40.000	-5.000	200.000
MSB 11A	05/25/83	4.000	.	2.000	.	-1.000	63.400	4.000	-5.000	200.000
	04/12/84	-5.000	-5.000	2.900	-5.000	-3.000	55.200	25.000	-5.000	-100.000
MSB 11B	04/12/84	-5.000	-5.000	2.200	-5.000	-3.000	63.500	-1.000	-5.000	-100.000
MSB 11C	04/12/84	-5.000	-5.000	5.000	-5.000	8.000	395.000	2.000	-5.000	200.000
MSB 11D	04/12/84	-5.000	-5.000	3.400	-5.000	-3.000	120.400	3.000	-5.000	-100.000
MSB 11F	04/12/84	-5.000	-5.000	3.400	-5.000	38.000	81.900	16.000	-5.000	-100.000
MSB 12A	04/19/84	-5.000	-5.000	3.200	-5.000	-3.000	33.500	-40.000	-5.000	-100.000
MSB 12B	04/19/84	-5.000	-5.000	4.800	-5.000	-3.000	180.000	-40.000	-5.000	-100.000
MSB 12C	04/18/84	-5.000	-5.000	5.300	-5.000	-3.000	175.100	-40.000	-5.000	-100.000
MSB 12D	04/18/84	-5.000	-5.000	3.400	-5.000	-3.000	85.300	-40.000	-5.000	-100.000
MSB 12TA	05/25/84	.	-5.000	.	-5.000	.	.	.	.	.
MSB 12TB	05/17/84	-5.000	-5.000	5.000	-5.000	-4.000	38.300	-4.000	-5.000	-100.000

(CONTINUED)

APPENDIX C. ANALYTES IN EACH WELL

NEGATIVE NUMBERS REPRESENT DETECTIONS LIMITS. DOTS REPRESENT ANALYSES NOT PERFORMED

		NAME OF ANALYTE								
		CARBON TOTAL ORGANIC MG/L	CARBON TETRACHLO-RIDE UG/L	CHLORIDE MG/L	CHLOROBEN-ZENE UG/L	CHROMIUM UG/L	CONDUCTIV-ITY UMHOS/CM	COPPER UG/L	CYANIDE UG/L	FLUORIDE UG/L
		RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT
WELL	SAMPLE DATE									
MSB 13A	04/20/84	-5.000	-5.000	2.700	-5.000	-3.000	29.700	-40.000	-5.000	-100.000
MSB 13B	04/20/84	13.000	-5.000	9.600	-5.000	-8.000	213.000	-40.000	57.000	200.000
MSB 13C	04/20/84	-5.000	-5.000	5.800	-5.000	-25.000	573.000	-40.000	-5.000	-100.000
MSB 14A	06/14/84	-5.000	-5.000	3.500	-5.000	-4.000	97.200	12.000	-5.000	-100.000
MSB 14B	04/13/84	-5.000	-5.000	4.800	-5.000	37.000	174.800	3.000	-5.000	-100.000
MSB 14C	04/13/84	-5.000	-5.000	4.000	-5.000	-3.000	132.000	2.000	-5.000	-100.000
MSB 15A	05/26/83	4.000	.	2.900	.	-1.000	69.100	181.000	-5.000	190.000
	04/16/84	-5.000	-5.000	3.900	-5.000	-3.000	61.200	-40.000	-5.000	-100.000
MSB 16A	05/25/83	3.000	.	2.000	.	-1.000	37.600	1.000	-5.000	200.000
	04/17/84	-5.000	-5.000	3.700	-5.000	-3.000	44.400	-40.000	-5.000	100.000
MSB 16C	05/26/83	3.000	.	2.900	.	2.000	21.500	4.000	-5.000	190.000
	04/17/84	-5.000	-5.000	3.900	40.000	-3.000	31.500	-40.000	-5.000	100.000
MSB 17A	04/23/84	-5.000	-5.000	5.500	-5.000	-5.000	178.000	-40.000	-5.000	170.000
MSB 17B	04/24/84	-5.000	-5.000	6.300	-5.000	-5.000	167.600	-40.000	-5.000	180.000
MSB 18A	04/23/84	-5.000	-5.000	4.500	-5.000	-5.000	34.300	-40.000	-5.000	180.000
MSB 18B	04/23/84	-5.000	-5.000	6.300	-5.000	-5.000	115.400	-40.000	-5.000	180.000
MSB 18C	04/23/84	-5.000	-5.000	2.900	-5.000	-5.000	29.000	-40.000	-5.000	210.000
MSB 19A	06/08/84	-5.000	-5.000	2.500	-5.000	-4.000	65.400	15.000	-5.000	-100.000
MSB 19B	06/08/84	-5.000	-5.000	3.000	-5.000	4.000	21.400	13.000	-5.000	-100.000
MSB 19C	06/13/84	-5.000	11.000	4.000	-5.000	-4.000	36.200	5.000	-5.000	160.000
MSB 20A	04/24/84	-5.000	-5.000	3.500	-5.000	-5.000	.	-40.000	-5.000	120.000

(CONTINUED)

APPENDIX C. ANALYTES IN EACH WELL

NEGATIVE NUMBERS REPRESENT DETECTIONS LIMITS. DOTS REPRESENT ANALYSES NOT PERFORMED

		NAME OF ANALYTE								
		CARBON TOTAL ORGANIC MG/L	CARBON TETRACHLORIDE UG/L	CHLORIDE MG/L	CHLOROBENZENE UG/L	CHROMIUM UG/L	CONDUCTIVITY UMHOS/CM	COPPER UG/L	CYANIDE UG/L	FLUORIDE UG/L
WELL	SAMPLE DATE	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT
MSB 20C	04/24/84	-5.000	-5.000	2.300	-5.000	-5.000	147.000	-40.000	-5.000	130.000
MSB 21A	04/25/84	-5.000	-5.000	3.400	-5.000	-5.000	19.300	-40.000	-5.000	160.000
MSB 21C	04/24/84	-5.000	-5.000	2.900	-5.000	-5.000	26.100	-40.000	-5.000	160.000
MSB 22	04/13/84	-5.000	-5.000	5.500	-5.000	9.000	563.000	4.000	-5.000	2000.000
MSB 23	06/01/83	10.000	.	2.900	.	-1.000	45.200	5.000	-5.000	200.000
	05/11/84	-5.000	-5.000	6.500	-5.000	-4.000	279.000	-4.000	-5.000	-100.000
MSB 23A	05/11/84	-5.000	-5.000	4.800	-5.000	-4.000	65.600	4.000	-5.000	100.000
MSB 23B	06/01/83	7.000	.	2.900	.	-1.000	57.800	18.000	-5.000	190.000
	05/11/84	-5.000	-5.000	5.500	-5.000	-4.000	48.900	-4.000	-5.000	-100.000
MSB 24	06/02/83	9.000	.	2.900	26.000	69.000	1497.000	33.000	-5.000	200.000
	05/15/84	-5.000	47.000	5.000	-5.000	95.000	960.000	95.000	-5.000	180.000
MSB 24A	06/01/83	6.000	.	2.900	.	-1.000	41.800	3.000	-5.000	190.000
	05/15/84	-5.000	-5.000	4.500	-5.000	8.000	63.400	-4.000	-5.000	-100.000
MSB 25	05/15/84	-5.000	-5.000	6.000	-5.000	-4.000	122.300	-4.000	-5.000	-100.000
MSB 25A	05/15/84	-5.000	-5.000	5.500	-5.000	-4.000	34.700	4.000	-5.000	-100.000
MSB 26	04/26/84	-5.000	-5.000	3.500	-5.000	-5.000	26.500	-40.000	-5.000	140.000
MSB 26A	04/26/84	-5.000	-5.000	4.800	-5.000	-5.000	50.000	-40.000	-5.000	120.000
MSB 27	06/10/83	3.000	.	4.900	.	-1.000	42.900	12.000	-5.000	230.000
	04/26/84	-5.000	-5.000	5.800	-5.000	-5.000	47.700	-40.000	-5.000	150.000
MSB 27A	06/06/83	11.000	.	3.900	.	-1.000	35.300	1.000	-5.000	390.000
	06/13/84	-5.000	10.000	4.000	-5.000	7.000	38.300	15.000	-5.000	-100.000

(CONTINUED)

APPENDIX C. ANALYTES IN EACH WELL

NEGATIVE NUMBERS REPRESENT DETECTIONS LIMITS. DOTS REPRESENT ANALYSES NOT PERFORMED

		NAME OF ANALYTE								
		CARBON TOTAL ORGANIC MG/L	CARBON TETRACHLO-RIDE UG/L	CHLORIDE MG/L	CHLOROBEN-ZENE UG/L	CHROMIUM UG/L	CONDUCTIV-ITY UMHOS/CM	COPPER UG/L	CYANIDE UG/L	FLUORIDE UG/L
		RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT
WELL	SAMPLE DATE									
MSB 28	04/30/84	-5.000	-5.000	3.500	-5.000	-4.000	77.600	-4.000	-5.000	-100.000
MSB 28A	04/30/84	-5.000	-5.000	4.500	-5.000	11.000	22.400	-4.000	-5.000	-100.000
MSB 30A	04/30/84	-5.000	-5.000	5.750	-5.000	-4.000	26.000	-4.000	-5.000	-100.000
MSB 30C	04/30/84	-5.000	-5.000	0.990	-5.000	6.000	175.000	-4.000	-5.000	260.000
MSB 31A	05/09/84	-5.000	-5.000	5.500	-5.000	7.000	32.200	-4.000	-5.000	-100.000
MSB 31B	06/01/83	4.000	.	2.900	.	3.000	37.600	10.000	-5.000	200.000
	05/09/84	-5.000	-5.000	4.500	-5.000	-4.000	25.400	-4.000	-5.000	-100.000
MSB 31C	06/01/83	16.000	.	4.900	.	5.000	92.900	4.000	-5.000	280.000
	05/09/84	-5.000	8.000	6.000	-5.000	-4.000	81.000	-4.000	-5.000	-100.000
MSB 32	06/14/84	-5.000	-5.000	4.000	-5.000	-4.000	40.800	9.000	-5.000	-100.000
MSB 33	05/09/84	-5.000	-5.000	7.000	-5.000	-4.000	46.500	4.000	-5.000	-100.000
MSB 34A	04/25/84	-5.000	-5.000	4.300	-5.000	-5.000	33.700	-40.000	-5.000	160.000
MSB 34B	04/25/84	-5.000	144.000	3.400	-5.000	-5.000	158.000	-40.000	-5.000	390.000
MSB 34C	04/25/84	-5.000	84.000	4.100	-5.000	-5.000	89.800	-40.000	-5.000	210.000
MSB 34TA	05/16/84	-5.000	-5.000	8.500	-5.000	-4.000	94.400	-4.000	-5.000	160.000
MSB 34TB	05/16/84	-5.000	-5.000	4.500	-5.000	-4.000	65.100	-4.000	-5.000	-100.000
RWM 2	05/18/84	-5.000	-5.000	4.500	-5.000	-4.000	28.100	-4.000	-5.000	110.000
RWM 3	05/18/84	-5.000	-5.000	5.000	-5.000	-4.000	221.000	-4.000	-5.000	200.000
SRW 1C	05/04/84	-5.000	-5.000	4.000	-5.000	-4.000	23.100	-4.000	-5.000	-100.000
SRW 2A	05/02/84	-5.000	-5.000	4.000	-5.000	7.000	21.000	-4.000	-5.000	110.000
SRW 2B	05/02/84	-5.000	-5.000	3.000	-5.000	-4.000	27.900	-4.000	-5.000	-100.000

(CONTINUED)

APPENDIX C. ANALYTES IN EACH WELL

NEGATIVE NUMBERS REPRESENT DETECTIONS LIMITS. DOTS REPRESENT ANALYSES NOT PERFORMED

		NAME OF ANALYTE								
		CARBON TOTAL ORGANIC MG/L	CARBON TETRACHLO-RIDE UG/L	CHLORIDE MG/L	CHLOROBEN-ZENE UG/L	CHROMIUM UG/L	CONDUCTIV-ITY UMHOS/CM	COPPER UG/L	CYANIDE UG/L	FLUORIDE UG/L
		RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT
WELL	SAMPLE DATE									
SRW 2C	05/02/84	-5.000	-5.000	5.500	7.000	-4.000	25.300	-4.000	-5.000	-100.000
SRW 3C	05/02/84	-5.000	-5.000	4.500	-5.000	7.000	22.500	-4.000	-5.000	-100.000
SRW 4C	06/18/84	-5.000	-5.000	6.450	-5.000	-4.000	56.000	4.000	-5.000	-100.000
SRW 5C	05/04/84	-5.000	-5.000	5.500	-5.000	-4.000	41.400	-4.000	-5.000	-100.000
SRW 6C	05/04/84	-5.000	-5.000	6.500	-5.000	-4.000	48.200	-4.000	-5.000	-100.000
SRW 9A	06/01/84	-5.000	-5.000	2.000	-5.000	-4.000	20.400	15.000	-5.000	-100.000
SRW 9B	06/04/84	-5.000	-5.000	2.500	-5.000	-4.000	20.800	11.000	-5.000	-100.000
SRW 12A	06/04/84	52.000	-5.000	2.500	-5.000	-4.000	20.800	9.000	-5.000	-100.000
SRW 12B	06/04/84	-5.000	-5.000	2.500	-5.000	4.000	55.100	12.000	-5.000	-100.000
SRW 12C	06/06/84	-5.000	-5.000	3.000	-5.000	-4.000	18.000	12.000	-5.000	-100.000
SRW 13A	05/31/84	-5.000	-5.000	2.500	-5.000	-4.000	18.400	13.000	-5.000	-100.000
SRW 13B	05/31/84	-5.000	-5.000	2.500	-5.000	-4.000	29.700	14.000	-5.000	-100.000
SRW 13C	06/01/84	13.000	-5.000	3.000	-5.000	6.000	28.500	12.000	-5.000	-100.000
SRW 14A	05/07/84	-5.000	-5.000	4.500	-5.000	-4.000	48.600	-4.000	-5.000	-100.000
SRW 14B	05/04/84	-5.000	-5.000	3.000	-5.000	-4.000	31.800	8.000	-5.000	100.000
SRW 14C	05/04/84	-5.000	-5.000	3.500	-5.000	-4.000	25.700	-4.000	-5.000	-100.000
SRW 15A	05/07/84	-5.000	-5.000	6.000	-5.000	-4.000	170.000	-4.000	-5.000	-100.000
SRW 15B	05/07/84	-5.000	-5.000	4.000	-5.000	-4.000	27.100	-4.000	-5.000	-100.000
SRW 15C	05/01/84	-5.000	-5.000	2.500	-5.000	-4.000	21.600	-4.000	-5.000	-100.000
SRW 16A	05/08/84	-5.000	-5.000	8.000	-5.000	-4.000	63.400	-4.000	-5.000	-100.000
SRW 16B	05/07/84	-5.000	-5.000	3.500	-5.000	-4.000	45.300	-4.000	-5.000	100.000

APPENDIX C. ANALYTES IN EACH WELL

NEGATIVE NUMBERS REPRESENT DETECTIONS LIMITS. DOTS REPRESENT ANALYSES NOT PERFORMED

WELL	SAMPLE DATE	GREASE AND OIL MG/L RESULT	GROSS ALPHA PC/L RESULT	GROSS BETA PC/L RESULT	IRON UG/L RESULT	LEAD UG/L RESULT	MAGNESIUM UG/L RESULT	MANGANESE UG/L RESULT	MERCURY UG/L RESULT	NICKEL UG/L RESULT
FB	05/26/83	.	.	.	.	.	.	.	.	.
	06/02/83	.	.	.	.	.	.	.	.	.
	06/06/83	.	.	.	.	.	.	.	.	.
	04/19/84	.	.	.	.	.	.	.	.	.
	04/20/84	.	.	.	.	.	.	.	.	.
	04/27/84	.	.	.	.	.	.	.	.	.
	04/30/84	.	.	.	.	.	.	.	.	.
	05/07/84	.	.	.	.	.	.	.	.	.
	05/16/84	.	.	.	.	.	.	.	.	.
	05/17/84	.	.	.	.	.	.	.	.	.
	05/18/84	.	.	.	.	.	.	.	.	.
	05/26/84	.	.	.	.	.	.	.	.	.
	05/31/84	.	.	.	.	.	.	.	.	.
	06/08/84	.	.	.	.	.	.	.	.	.
	06/18/84	.	.	.	.	.	.	.	.	.
	06/19/84	.	.	.	.	.	.	.	.	.
ABG 1	06/12/84	5.000	.	.	22.000	-4.000	492.000	-2.000	-0.200	-4.000
AC 1A	06/28/84	-5.000	.	.	-40.000	4.000	304.000	-2.000	0.460	-4.000
AC 1B	06/18/84	-5.000	.	.	30.000	-4.000	550.000	10.000	0.200	-4.000
AC 2A	06/13/84	-5.000	.	.	22.000	6.000	363.000	4.000	0.200	-4.000
AC 2B	05/01/84	9.000	.	.	28.000	15.000	714.000	5.000	0.780	-4.000
AC 3A	06/07/84	-5.000	.	.	26.000	4.000	194.000	2.000	-0.200	5.000

(CONTINUED)

APPENDIX C. ANALYTES IN EACH WELL

NEGATIVE NUMBERS REPRESENT DETECTIONS LIMITS. DOTS REPRESENT ANALYSES NOT PERFORMED

WELL	SAMPLE DATE	GREASE AND OIL MG/L RESULT	GROSS ALPHA PC/L RESULT	GROSS BETA PC/L RESULT	IRON UG/L RESULT	LEAD UG/L RESULT	MAGNESIUM UG/L RESULT	MANGANESE UG/L RESULT	MERCURY UG/L RESULT	NICKEL UG/L RESULT
AC 3B	06/07/84	5.000	.	.	12.000	6.000	169.000	-2.000	-0.200	7.000
AMB 2	06/11/84	5.000	.	.	40.000	38.000	469.000	19.000	-0.200	8.000
AOB 1	06/11/84	-5.000	.	.	29.000	16.000	690.000	13.000	-0.300	9.000
AOB 2	06/11/84	5.000	.	.	22.000	12.000	511.000	11.000	-0.200	6.000
ASB 3	05/14/84	-5.000	.	.	29.000	5.000	1120.000	8.000	0.460	-4.000
ASB 4	06/12/84	35.000	.	.	197.000	6.000	1820.000	35.000	-0.200	8.000
ASB 7	05/14/84	-5.000	.	.	43.000	34.000	828.000	27.000	-0.360	-4.000
ASB 8	05/30/84	-5.000	.	.	214.000	17.000	355.000	22.000	-0.200	-4.000
ASB 9	06/20/84	-5.000	.	.	19.000	11.000	774.000	24.000	-0.200	-4.000
MPT 1	06/06/83	-5.000	14.000	19.000	-50.000	5.000	6240.000	129.000	-0.200	69.000
	09/22/83	13.000	113.000	52.000	27.000	-10.000	8500.000	141.000	0.700	52.000
	04/12/84	-5.000	.	.	60.000	3.000	7610.000	120.000	0.690	39.000
MSB 1A	05/03/84	-5.000	.	.	35.000	19.000	576.000	19.000	0.320	10.000
MSB 2A	05/03/84	-5.000	.	.	42.000	61.000	492.000	8.000	0.380	6.000
MSB 3A	06/06/83	-5.000	37.000	27.000	819.000	22.000	1140.000	589.000	-0.200	8.000
	05/03/84	6.000	9.000	187.000	52.000	28.000	688.000	286.000	0.380	27.000
MSB 4A	05/03/84	-5.000	16.000	18.000	66.000	41.000	3160.000	28.000	0.570	16.000
MSB 5A	05/10/84	6.770	.	.	39.000	28.000	654.000	22.000	0.950	6.000
MSB 6A	05/10/84	10.810	.	.	44.000	34.000	234.000	6.000	1.110	-4.000
MSB 7A	05/10/84	6.300	.	.	33.000	22.000	468.000	20.000	1.190	-4.000
MSB 8A	05/10/84	7.530	.	.	36.000	27.000	634.000	12.000	-0.200	-4.000
MSB 9A	06/03/83	-5.000	-0.500	0.960	809.000	11.000	460.000	-20.000	-0.200	43.000

(CONTINUED)

APPENDIX C. ANALYTES IN EACH WELL

NEGATIVE NUMBERS REPRESENT DETECTIONS LIMITS. DOTS REPRESENT ANALYSES NOT PERFORMED

		NAME OF ANALYTE								
		GREASE AND OIL MG/L	GROSS ALPHA PC/L	GROSS BETA PC/L	IRON UG/L	LEAD UG/L	MAGNESIUM UG/L	MANGANESE UG/L	MERCURY UG/L	NICKEL UG/L
WELL	SAMPLE DATE	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT
MSB 9A	04/13/84	-5.000	.	.	-40.000	6.000	290.000	-20.000	-0.200	-40.000
MSB 9B	04/17/84	-5.000	.	.	80.000	34.000	80.000	-20.000	0.420	-40.000
MSB 9C	06/02/83	-5.000	6.900	7.300	-50.000	68.000	3330.000	-20.000	-0.200	-2.000
	04/16/84	-5.000	.	.	70.000	26.000	4700.000	40.000	0.200	-40.000
MSB 10A	04/17/84	-5.000	.	.	-40.000	17.000	130.000	-20.000	0.320	-40.000
MSB 10B	04/18/84	-5.000	.	.	-40.000	14.000	220.000	-20.000	0.380	-40.000
MSB 10C	04/18/84	-5.000	.	.	-40.000	15.000	1740.000	-20.000	0.260	-40.000
MSB 11A	05/25/83	-5.000	-0.600	1.300	-50.000	4.000	400.000	-20.000	-0.200	-2.000
	04/12/84	-5.000	.	.	40.000	35.000	292.000	-20.000	-0.200	-3.000
MSB 11B	04/12/84	-5.000	.	.	50.000	1.000	277.000	-20.000	-0.200	3.000
MSB 11C	04/12/84	-5.000	.	.	46.000	14.000	14500.000	80.000	1.240	-4.000
MSB 11D	04/12/84	-5.000	.	.	70.000	16.000	1800.000	60.000	0.610	17.000
MSB 11F	04/12/84	5.000	.	.	120.000	16.000	1208.000	70.000	0.220	97.000
MSB 12A	04/19/84	-5.000	.	.	50.000	21.000	90.000	-20.000	0.360	-40.000
MSB 12B	04/19/84	-5.000	.	.	70.000	24.000	1000.000	20.000	0.510	-40.000
MSB 12C	04/18/84	-5.000	.	.	60.000	23.000	1300.000	-20.000	0.440	-40.000
MSB 12D	04/18/84	-5.000	.	.	50.000	8.000	500.000	-20.000	0.530	-40.000
MSB 12TA	05/25/84	.	.	.	.	.	.	.	.	.
MSB 12TB	05/17/84	-5.000	.	.	70.000	9.000	230.000	16.000	0.360	-4.000
MSB 13A	04/20/84	-5.000	.	.	40.000	23.000	180.000	-20.000	0.470	-40.000
MSB 13B	04/20/84	9.000	.	.	-40.000	20.000	20.000	-20.000	0.400	-40.000
MSB 13C	04/20/84	-5.000	.	.	130.000	22.000	360.000	30.000	0.360	-40.000

(CONTINUED)

APPENDIX C. ANALYTES IN EACH WELL

NEGATIVE NUMBERS REPRESENT DETECTIONS LIMITS. DOTS REPRESENT ANALYSES NOT PERFORMED

WELL	SAMPLE DATE	GREASE AND OIL MG/L RESULT	GROSS ALPHA PC/L RESULT	GROSS BETA PC/L RESULT	IRON UG/L RESULT	LEAD UG/L RESULT	MAGNESIUM UG/L RESULT	MANGANESE UG/L RESULT	MERCURY UG/L RESULT	NICKEL UG/L RESULT
MSB 14A	06/14/84	-5.000	.	.	29.000	24.000	2420.000	10.000	0.200	-4.000
MSB 14B	04/13/84	-5.000	.	.	60.000	36.000	4305.000	30.000	-0.200	52.000
MSB 14C	04/13/84	-5.000	.	.	40.000	3.000	686.000	-20.000	-0.200	40.000
MSB 15A	05/26/83	-5.000	-0.600	0.970	116.000	25.000	590.000	-20.000	-0.200	-2.000
	04/16/84	-5.000	.	.	60.000	22.000	400.000	-20.000	-0.200	-40.000
MSB 16A	05/25/83	-5.000	-0.400	-0.800	135.000	15.000	440.000	-20.000	0.300	-2.000
	04/17/84	-5.000	.	.	50.000	22.000	300.000	-20.000	-0.200	-40.000
MSB 16C	05/26/83	-5.000	0.570	1.800	3147.000	14.000	330.000	-20.000	-0.200	-2.000
	04/17/84	-5.000	.	.	110.000	18.000	120.000	-20.000	0.220	-40.000
MSB 17A	04/23/84	-5.000	.	.	40.000	46.000	2800.000	-20.000	-0.200	-40.000
MSB 17B	04/24/84	-5.000	.	.	60.000	43.000	1600.000	-20.000	0.320	-40.000
MSB 18A	04/23/84	-5.000	.	.	-40.000	14.000	130.000	-20.000	0.420	-40.000
MSB 18B	04/23/84	-5.000	.	.	-40.000	21.000	750.000	20.000	0.420	-40.000
MSB 18C	04/23/84	-5.000	.	.	50.000	25.000	200.000	-20.000	0.650	-40.000
MSB 19A	06/08/84	5.000	.	.	16.000	9.000	310.000	5.000	0.240	11.000
MSB 19B	06/08/84	5.000	.	.	12.000	5.000	268.000	3.000	-0.200	8.000
MSB 19C	06/13/84	-5.000	.	.	15.000	13.000	372.000	3.000	0.200	-4.000
MSB 20A	04/24/84	-5.000	.	.	100.000	22.000	230.000	-20.000	0.320	-40.000
MSB 20C	04/24/84	-5.000	.	.	710.000	53.000	140.000	-20.000	0.360	-40.000
MSB 21A	04/25/84	-5.000	.	.	-40.000	16.000	150.000	-20.000	0.510	-40.000
MSB 21C	04/24/84	-5.000	.	.	1070.000	44.000	360.000	-20.000	0.530	-40.000
MSB 22	04/13/84	6.000	.	.	40.000	11.000	1172.000	170.000	-0.200	76.000

(CONTINUED)

APPENDIX C. ANALYTES IN EACH WELL

NEGATIVE NUMBERS REPRESENT DETECTIONS LIMITS. DOTS REPRESENT ANALYSES NOT PERFORMED

		NAME OF ANALYTE								
		GREASE AND OIL MG/L	GROSS ALPHA PC/L	GROSS BETA PC/L	IRON UG/L	LEAD UG/L	MAGNESIUM UG/L	MANGANESE UG/L	MERCURY UG/L	NICKEL UG/L
WELL	SAMPLE DATE	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT
MSB 23	06/01/83	-5.000	-0.600	1.300	-50.000	15.000	600.000	-20.000	-0.200	-2.000
	05/11/84	6.010	.	.	95.000	8.000	340.000	8.000	0.330	-4.000
MSB 23A	05/11/84	-5.000	.	.	31.000	9.000	304.000	8.000	0.210	-4.000
MSB 23B	06/01/83	-5.000	-0.600	-0.900	-50.000	25.000	360.000	-20.000	-0.200	-2.000
	05/11/84	-5.000	.	.	16.000	36.000	124.000	12.000	0.360	-4.000
MSB 24	06/02/83	-5.000	-4.000	3.600	950.000	1093.000	190.000	-20.000	-0.200	4.000
	05/15/84	7.450	.	.	27.000	130.000	36.000	-2.000	-0.200	-4.000
MSB 24A	06/01/83	-5.000	-0.500	1.900	-50.000	25.000	640.000	-20.000	-0.200	-2.000
	05/15/84	-5.000	.	.	44.000	-4.000	11.000	-2.000	-0.200	-4.000
MSB 25	05/15/84	9.360	.	.	10.000	11.000	390.000	-2.000	-0.200	-4.000
MSB 25A	05/15/84	5.230	.	.	88.000	50.000	546.000	2.000	-0.200	-4.000
MSB 26	04/26/84	-5.000	.	.	-40.000	33.000	100.000	-20.000	0.860	-40.000
MSB 26A	04/26/84	-5.000	.	.	60.000	22.000	270.000	-20.000	0.910	-40.000
MSB 27	06/10/83	-5.000	-0.600	-0.900	364.000	24.000	1040.000	-20.000	-0.200	3.000
	04/26/84	-5.000	.	.	70.000	16.000	640.000	-20.000	1.680	-40.000
MSB 27A	06/06/83	-5.000	-0.500	-0.800	-50.000	29.000	540.000	-20.000	-0.200	5.000
	06/13/84	-5.000	.	.	20.000	18.000	442.000	16.000	0.200	10.000
MSB 28	04/30/84	-5.000	.	.	12.000	-4.000	268.000	-2.000	0.630	-4.000
MSB 28A	04/30/84	-5.000	.	.	82.000	9.000	248.000	12.000	0.630	8.000
MSB 30A	04/30/84	-5.000	.	.	14.000	12.000	248.000	17.000	0.760	-4.000
MSB 30C	04/30/84	-5.000	.	.	42.000	-4.000	180.000	-2.000	0.370	-4.000
MSB 31A	05/09/84	-5.000	.	.	44.000	23.000	184.000	11.000	1.110	7.000

(CONTINUED)

APPENDIX C. ANALYTES IN EACH WELL

NEGATIVE NUMBERS REPRESENT DETECTIONS LIMITS. DOTS REPRESENT ANALYSES NOT PERFORMED

		NAME OF ANALYTE								
		GREASE AND OIL MG/L	GROSS ALPHA PC/L	GROSS BETA PC/L	IRON UG/L	LEAD UG/L	MAGNESIUM UG/L	MANGANESE UG/L	MERCURY UG/L	NICKEL UG/L
WELL	SAMPLE DATE	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT
MSB 31B	06/01/83	-5.000	-2.000	-1.000	3268.000	16.000	580.000	22.000	-0.200	-2.000
	05/09/84	-5.000	.	.	4.000	-4.000	280.000	6.000	1.060	4.000
MSB 31C	06/01/83	-5.000	-0.800	1.100	196.000	2.000	490.000	-20.000	-0.200	3.000
	05/09/84	-5.000	.	.	40.000	8.000	544.000	9.000	0.720	4.000
MSB 32	06/14/84	-5.000	.	.	29.000	7.000	145.000	2.000	0.200	-4.000
MSB 33	05/09/84	-5.000	.	.	26.000	24.000	624.000	4.000	1.090	-4.000
MSB 34A	04/25/84	-5.000	.	.	-40.000	19.000	130.000	-20.000	0.380	-40.000
MSB 34B	04/25/84	-5.000	.	.	70.000	60.000	1180.000	40.000	0.300	40.000
MSB 34C	04/25/84	12.000	.	.	60.000	37.000	1190.000	-40.000	0.260	-40.000
MSB 34TA	05/16/84	5.630	.	.	80.000	5.000	210.000	4.000	-0.200	-4.000
MSB 34TB	05/16/84	-5.000	.	.	22.000	10.000	222.000	5.000	1.910	-4.000
RWM 2	05/18/84	5.330	.	.	67.000	5.000	388.000	7.000	0.200	-4.000
RWM 3	05/18/84	-5.000	.	.	23.000	6.000	420.000	28.000	0.510	-4.000
SRW 1C	05/04/84	-5.000	.	.	23.000	7.000	360.000	21.000	0.500	-4.000
SRW 2A	05/02/84	-5.000	.	.	40.000	20.000	240.000	10.000	0.860	6.000
SRW 2B	05/02/84	-5.000	.	.	13.000	8.000	300.000	29.000	0.530	-4.000
SRW 2C	05/02/84	-5.000	.	.	48.000	23.000	444.000	5.000	0.480	-4.000
SRW 3C	05/02/84	-5.000	.	.	59.000	4.000	304.000	13.000	0.500	7.000
SRW 4C	06/18/84	-5.000	.	.	36.000	20.000	1590.000	13.000	0.200	4.000
SRW 5C	05/04/84	-5.000	.	.	102.000	16.000	892.000	16.000	0.480	-4.000
SRW 6C	05/04/84	-5.000	.	.	24.000	9.000	800.000	8.000	0.500	-4.000
SRW 9A	06/01/84	-5.000	.	.	30.000	36.000	329.000	7.000	-0.200	5.000

(CONTINUED)

APPENDIX C. ANALYTES IN EACH WELL

NEGATIVE NUMBERS REPRESENT DETECTIONS LIMITS. DOTS REPRESENT ANALYSES NOT PERFORMED

		NAME OF ANALYTE								
		GREASE AND OIL MG/L	GROSS ALPHA PC/L	GROSS BETA PC/L	IRON UG/L	LEAD UG/L	MAGNESIUM UG/L	MANGANESE UG/L	MERCURY UG/L	NICKEL UG/L
WELL	SAMPLE DATE	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT
SRW 9B	06/04/84	-5.000	.	.	15.000	-40.000	229.000	15.000	-0.200	9.000
SRW 12A	06/04/84	-5.000	.	.	18.000	-40.000	326.000	7.000	-0.200	7.000
SRW 12B	06/04/84	-5.000	.	.	10.000	-40.000	182.000	10.000	-0.200	9.000
SRW 12C	06/06/84	9.000	.	.	22.000	-4.000	199.000	8.000	-0.200	7.000
SRW 13A	05/31/84	-5.000	.	.	15.000	-40.000	318.000	9.000	-0.200	6.000
SRW 13B	05/31/84	-5.000	.	.	54.000	18.000	284.000	24.000	-0.200	9.000
SRW 13C	06/01/84	5.000	.	.	19.000	72.000	236.000	13.000	-0.200	6.000
SRW 14A	05/07/84	-5.000	.	.	12.000	8.000	18.000	10.000	1.080	-4.000
SRW 14B	05/04/84	-5.000	.	.	552.000	30.000	6580.000	82.000	0.820	6.000
SRW 14C	05/04/84	-5.000	.	.	35.000	4.000	192.000	18.000	0.500	-4.000
SRW 15A	05/07/84	-5.000	.	.	27.000	10.000	448.000	-2.000	1.040	-4.000
SRW 15B	05/07/84	-5.000	.	.	-4.000	-4.000	184.000	17.000	0.860	-4.000
SRW 15C	05/01/84	-5.000	.	.	8.000	6.000	672.000	22.000	0.470	-4.000
SRW 16A	05/08/84	-5.000	.	.	127.000	8.000	478.000	44.000	0.750	-4.000
SRW 16B	05/07/84	-5.000	.	.	1790.000	-4.000	352.000	65.000	0.770	-4.000

APPENDIX C. ANALYTES IN EACH WELL

NEGATIVE NUMBERS REPRESENT DETECTIONS LIMITS. DOTS REPRESENT ANALYSES NOT PERFORMED

		NAME OF ANALYTE								
		NITRATE AS N MG/L	NITRITE AS N MG/L	PH	PHENANTHR-ENE UG/L	PHENOL UG/L	PHOSPHATE UG/L	POTASSIUM UG/L	RADIUM 226 PC/L	RADIUM TOTAL PC/L
WELL	SAMPLE DATE	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT
FB	05/26/83	.	.	.	-1.000	-1.000	.	.	.	.
	06/02/83	.	.	.	.	.	.	.	.	.
	06/06/83	.	.	.	-1.000	.	.	.	.	.
	04/19/84	.	.	.	.	.	.	.	.	.
	04/20/84	.	.	.	.	.	.	.	.	.
	04/27/84	.	.	.	.	.	.	.	.	.
	04/30/84	.	.	.	.	.	.	.	.	.
	05/07/84	.	.	.	.	.	.	.	.	.
	05/16/84	.	.	.	.	.	.	.	.	.
	05/17/84	.	.	.	.	.	.	.	.	.
	05/18/84	.	.	.	.	.	.	.	.	.
	05/26/84	.	.	.	.	.	.	.	.	.
	05/31/84	.	.	.	.	.	.	.	.	.
	06/08/84	.	.	.	.	.	.	.	.	.
	06/18/84	.	.	.	.	.	.	.	.	.
	06/19/84	.	.	.	.	.	.	.	.	.
ABG 1	06/12/84	0.500	-0.500	4.900	.	.	-100.000	520.000	.	.
AC 1A	06/28/84	.	.	5.400	.	.	-100.000	219.000	.	.
AC 1B	06/18/84	1.200	-0.500	5.510	.	.	-100.000	280.000	.	.
AC 2A	06/13/84	0.500	-0.500	6.100	.	.	-100.000	600.000	.	.
AC 2B	05/01/84	0.550	-0.500	6.200	.	.	-20.000	390.000	.	.
AC 3A	06/07/84	-0.500	-0.500	6.350	.	.	-100.000	6290.000	.	.

(CONTINUED)

APPENDIX C. ANALYTES IN EACH WELL

NEGATIVE NUMBERS REPRESENT DETECTIONS LIMITS. DOTS REPRESENT ANALYSES NOT PERFORMED

WELL	SAMPLE DATE	NITRATE AS N MG/L RESULT	NITRITE AS N MG/L RESULT	PH RESULT	PHENANTHR-ENE UG/L RESULT	PHENOL UG/L RESULT	PHOSPHATE UG/L RESULT	POTASSIUM UG/L RESULT	RADIUM 226 PC/L RESULT	RADIUM TOTAL PC/L RESULT
AC 3B	06/07/84	-0.500	-0.500	10.800	.	.	-100.000	1750.000	.	.
AMB 2	06/11/84	1.250	-0.500	5.200	.	.	-100.000	260.000	.	.
AOB 1	06/11/84	.	.	5.100	.	.	-100.000	430.000	.	.
AOB 2	06/11/84	1.300	-0.500	5.300	.	.	-100.000	780.000	.	.
ASB 3	05/14/84	-0.500	-0.500	5.920	.	.	-100.000	490.000	.	.
ASB 4	06/12/84	-0.500	-0.500	5.600	.	.	-100.000	1120.000	.	.
ASB 7	05/14/84	0.750	-0.500	5.160	.	.	-100.000	4330.000	.	.
ASB 8	05/30/84	0.650	-0.500	5.100	.	.	-100.000	590.000	.	.
ASB 9	06/20/84	5.000	-0.500	5.400	.	.	-100.000	400.000	.	.
MPT 1	06/06/83	35.000	-0.100	4.000	-1.000	-1.000	-20.000	880.000	.	17.000
	09/22/83	38.700	-1.000	3.800	-1.000	4.000	60.000	2170.000	35.000	.
	04/12/84	-0.500	-0.500	4.370	.	.	40.000	1010.000	.	.
MSB 1A	05/03/84	3.850	-0.500	5.060	.	.	-100.000	710.000	.	.
MSB 2A	05/03/84	3.100	-0.500	4.210	.	.	-100.000	230.000	.	.
MSB 3A	06/06/83	116.300	1.350	4.500	-1.000	4.000	-20.000	950.000	.	38.000
	05/03/84	99.000	-0.500	5.750	.	.	-100.000	1050.000	9.000	.
MSB 4A	05/03/84	100.000	-0.500	5.210	.	.	-100.000	1370.000	17.000	.
MSB 5A	05/10/84	16.000	-0.500	5.540	.	.	-100.000	5130.000	.	.
MSB 6A	05/10/84	-0.500	-0.500	5.310	.	.	-100.000	230.000	.	.
MSB 7A	05/10/84	4.900	-0.500	5.330	.	.	-100.000	324.000	.	.
MSB 8A	05/10/84	10.000	-0.500	5.510	.	.	-100.000	661.000	.	.
MSB 9A	06/03/83	0.900	-0.100	6.300	-1.000	-2.000	90.000	560.000	.	0.490

(CONTINUED)

APPENDIX C. ANALYTES IN EACH WELL

NEGATIVE NUMBERS REPRESENT DETECTIONS LIMITS. DOTS REPRESENT ANALYSES NOT PERFORMED

		NAME OF ANALYTE								
		NITRATE AS N MG/L	NITRITE AS N MG/L	PH	PHENANTHR-ENE UG/L	PHENOL UG/L	PHOSPHATE UG/L	POTASSIUM UG/L	RADIUM 226 PC/L	RADIUM TOTAL PC/L
WELL	SAMPLE DATE	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT
MSB 9A	04/13/84	-0.500	-0.500	6.390	.	.	120.000	570.000	.	.
MSB 9B	04/17/84	-0.500	-0.500	10.450	.	.	20.000	5360.000	.	.
MSB 9C	06/02/83	14.800	-0.100	5.300	-1.000	9.000	-20.000	790.000	.	6.900
	04/16/84	-0.500	-0.500	5.660	.	.	-20.000	1260.000	.	.
MSB 10A	04/17/84	2.400	-0.500	6.410	.	.	-20.000	750.000	.	.
MSB 10B	04/18/84	-0.500	-0.500	5.790	.	.	-20.000	960.000	.	.
MSB 10C	04/18/84	-0.500	-0.500	9.440	.	.	20.000	2210.000	.	.
MSB 11A	05/25/83	0.500	-0.100	6.200	1.000	-1.000	150.000	1290.000	.	-0.500
	04/12/84	.	.	6.220	.	.	140.000	1120.000	.	.
MSB 11B	04/12/84	-0.500	-0.500	6.390	.	.	150.000	1410.000	.	.
MSB 11C	04/12/84	33.500	-0.500	5.420	.	.	-20.000	1580.000	.	.
MSB 11D	04/12/84	-0.500	-0.500	5.610	.	.	-20.000	630.000	.	.
MSB 11F	04/12/84	1.750	-0.500	5.830	.	.	200.000	640.000	.	.
MSB 12A	04/19/84	19.500	-0.500	6.890	.	.	20.000	370.000	.	.
MSB 12B	04/19/84	17.250	-0.500	6.830	.	.	-20.000	680.000	.	.
MSB 12C	04/18/84	16.000	-0.500	7.250	.	.	50.000	810.000	.	.
MSB 12D	04/18/84	17.500	-0.500	6.460	.	.	40.000	690.000	.	.
MSB 12TA	05/25/84	.	.	.	.	.	.	.	.	.
MSB 12TB	05/17/84	-0.500	-0.500	8.520	.	.	-100.000	640.000	.	.
MSB 13A	04/20/84	1.750	-0.500	6.210	.	.	40.000	520.000	.	.
MSB 13B	04/20/84	0.750	-0.500	9.490	.	.	40.000	20900.000	.	.
MSB 13C	04/20/84	.	-0.500	7.430	.	.	-20.000	820.000	.	.

(CONTINUED)

APPENDIX C. ANALYTES IN EACH WELL

NEGATIVE NUMBERS REPRESENT DETECTIONS LIMITS. DOTS REPRESENT ANALYSES NOT PERFORMED

		NAME OF ANALYTE								
		NITRATE AS N MG/L	NITRITE AS N MG/L	PH	PHENANTHR-ENE UG/L	PHENOL UG/L	PHOSPHATE UG/L	POTASSIUM UG/L	RADIUM 226 PC/L	RADIUM TOTAL PC/L
		RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT
WELL	SAMPLE DATE									
MSB 14A	06/14/84	8.500	-0.500	5.400	.	.	-100.000	1530.000	.	.
MSB 14B	04/13/84	-0.500	-0.500	5.660	.	.	-20.000	1620.000	.	.
MSB 14C	04/13/84	-0.500	-0.500	8.030	.	.	220.000	1530.000	.	.
MSB 15A	05/26/83	0.800	-0.100	6.600	-1.000	3.000	-20.000	1030.000	.	-0.700
	04/16/84	29.500	-0.500	6.330	.	.	70.000	570.000	.	.
MSB 16A	05/25/83	0.550	-0.100	5.900	-1.000	5.000	-20.000	550.000	.	-0.500
	04/17/84	9.000	-0.500	7.550	.	.	20.000	650.000	.	.
MSB 16C	05/26/83	0.400	-0.100	5.500	-1.000	-2.000	-20.000	980.000	.	0.510
	04/17/84	-0.500	-0.500	6.680	.	.	20.000	1050.000	.	.
MSB 17A	04/23/84	15.000	-0.500	5.790	.	.	-20.000	470.000	.	.
MSB 17B	04/24/84	14.950	-0.500	6.600	.	.	-20.000	290.000	.	.
MSB 18A	04/23/84	1.050	-0.500	5.690	.	.	-20.000	300.000	.	.
MSB 18B	04/23/84	1.350	-0.500	5.870	.	.	-20.000	210.000	.	.
MSB 18C	04/23/84	0.750	-0.500	5.680	.	.	90.000	8000.000	.	.
MSB 19A	06/08/84	0.750	-0.500	5.500	.	.	-100.000	245.000	.	.
MSB 19B	06/08/84	0.550	-0.500	5.600	.	.	-100.000	254.000	.	.
MSB 19C	06/13/84	1.300	-0.500	5.700	.	.	-100.000	520.000	.	.
MSB 20A	04/24/84	1.400	-0.500	6.330	.	.	-20.000	170.000	.	.
MSB 20C	04/24/84	1.650	-0.500	10.290	.	.	-20.000	390.000	.	.
MSB 21A	04/25/84	0.800	-0.500	5.390	.	.	-20.000	160.000	.	.
MSB 21C	04/24/84	1.200	-0.500	8.640	.	.	-20.000	120.000	.	.
MSB 22	04/13/84	16.500	-0.500	6.910	.	.	-20.000	950.000	.	.

(CONTINUED)

APPENDIX C. ANALYTES IN EACH WELL

NEGATIVE NUMBERS REPRESENT DETECTIONS LIMITS. DOTS REPRESENT ANALYSES NOT PERFORMED

		NAME OF ANALYTE								
		NITRATE AS N MG/L	NITRITE AS N MG/L	PH	PHENANTHR-ENE UG/L	PHENOL UG/L	PHOSPHATE UG/L	POTASSIUM UG/L	RADIUM 226 PC/L	RADIUM TOTAL PC/L
WELL	SAMPLE DATE	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT
MSB 23	06/01/83	0.800	-0.100	5.700	-1.000	-2.000	-20.000	330.000	.	0.650
	05/11/84	11.250	-0.500	6.540	.	.	-100.000	1453.000	.	.
MSB 23A	05/11/84	-0.500	-0.500	6.440	.	.	-100.000	2180.000	.	.
MSB 23B	06/01/83	0.550	-0.100	6.000	-1.000	-1.000	60.000	750.000	.	-0.500
	05/11/84	0.800	-0.500	5.960	.	.	-100.000	290.000	.	.
MSB 24	06/02/83	1.800	-0.100	11.700	1.000	33.000	30.000	3850.000	.	-0.500
	05/15/84	1.400	-0.500	11.650	.	.	-100.000	7200.000	.	.
MSB 24A	06/01/83	2.500	-0.100	5.400	-1.000	-2.000	-20.000	320.000	.	-0.600
	05/15/84	2.700	-0.500	6.690	.	.	-100.000	100.000	.	.
MSB 25	05/15/84	1.850	-0.500	9.880	.	.	120.000	70.000	.	.
MSB 25A	05/15/84	1.450	-0.500	6.770	.	.	-100.000	4250.000	.	.
MSB 26	04/26/84	-0.500	-0.500	5.490	.	.	-20.000	150.000	.	.
MSB 26A	04/26/84	2.050	-0.500	5.540	.	.	-20.000	140.000	.	.
MSB 27	06/10/83	2.250	-0.100	6.050	-1.000	-1.000	-20.000	220.000	.	0.560
	04/26/84	2.500	-0.500	5.630	.	.	-20.000	90.000	.	.
MSB 27A	06/06/83	1.100	-0.100	5.300	-1.000	-1.000	60.000	440.000	.	0.340
	06/13/84	1.250	-0.500	5.600	.	.	-100.000	520.000	.	.
MSB 28	04/30/84	-0.500	-0.500	8.200	.	.	20.000	1050.000	.	.
MSB 28A	04/30/84	-0.500	-0.500	5.400	.	.	-20.000	32000.000	.	.
MSB 30A	04/30/84	-0.500	-0.500	6.500	.	.	-20.000	250.000	.	.
MSB 30C	04/30/84	-0.500	-0.500	10.500	.	.	-20.000	3300.000	.	.
MSB 31A	05/09/84	-0.500	-0.500	6.090	.	.	-100.000	280.000	.	.

(CONTINUED)

APPENDIX C. ANALYTES IN EACH WELL

NEGATIVE NUMBERS REPRESENT DETECTIONS LIMITS. DOTS REPRESENT ANALYSES NOT PERFORMED

		NAME OF ANALYTE								
		NITRATE AS N MG/L	NITRITE AS N MG/L	PH	PHENANTHR-ENE UG/L	PHENOL UG/L	PHOSPHATE UG/L	POTASSIUM UG/L	RADIUM 226 PC/L	RADIUM TOTAL PC/L
WELL	SAMPLE DATE	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT
MSB 31B	06/01/83	0.850	-0.100	6.000	1.000	-1.000	30.000	370.000	.	-0.800
	05/09/84	0.900	-0.500	5.840	.	.	-100.000	230.000	.	.
MSB 31C	06/01/83	1.750	-0.100	6.900	1.000	-2.000	130.000	830.000	.	-0.600
	05/09/84	2.100	-0.500	6.410	.	.	-100.000	390.000	.	.
MSB 32	06/14/84	0.500	-0.500	5.300	.	.	-100.000	2190.000	.	.
MSB 33	05/09/84	2.900	-0.500	5.600	.	.	-100.000	370.000	.	.
MSB 34A	04/25/84	1.000	-0.500	5.630	.	.	-20.000	120.000	.	.
MSB 34B	04/25/84	13.500	-0.500	4.230	.	.	-20.000	270.000	.	.
MSB 34C	04/25/84	6.750	-0.500	5.390	.	.	-20.000	120.000	.	.
MSB 34TA	05/16/84	-0.500	-0.500	9.100	.	.	-100.000	770.000	.	.
MSB 34TB	05/16/84	-0.500	-0.500	7.600	.	.	-100.000	630.000	.	.
RWM 2	05/18/84	-0.500	-0.500	6.020	.	.	-100.000	290.000	.	.
RWM 3	05/18/84	26.000	-0.500	4.740	.	.	-100.000	510.000	.	.
SRW 1C	05/04/84	0.550	-0.500	5.560	.	.	-100.000	220.000	.	.
SRW 2A	05/02/84	-0.500	-0.500	5.400	.	.	-100.000	620.000	.	.
SRW 2B	05/02/84	-0.500	-0.500	5.810	.	.	-100.000	580.000	.	.
SRW 2C	05/02/84	0.700	-0.500	5.140	.	.	-100.000	240.000	.	.
SRW 3C	05/02/84	-0.500	-0.500	6.100	.	.	-100.000	240.000	.	.
SRW 4C	06/18/84	3.050	-0.500	4.780	.	.	-100.000	730.000	.	.
SRW 5C	05/04/84	-0.500	-0.500	5.380	.	.	-100.000	710.000	.	.
SRW 6C	05/04/84	1.800	-0.500	5.800	.	.	-100.000	410.000	.	.
SRW 9A	06/01/84	0.750	-0.500	5.900	.	.	-100.000	580.000	.	.

(CONTINUED)

APPENDIX C. ANALYTES IN EACH WELL

NEGATIVE NUMBERS REPRESENT DETECTIONS LIMITS. DOTS REPRESENT ANALYSES NOT PERFORMED

		NAME OF ANALYTE								
		NITRATE AS N MG/L	NITRITE AS N MG/L	PH	PHENANTHR-ENE UG/L	PHENOL UG/L	PHOSPHATE UG/L	POTASSIUM UG/L	RADIUM 226 PC/L	RADIUM TOTAL PC/L
		RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT
WELL	SAMPLE DATE									
SRW 9B	06/04/84	-0.500	-0.500	5.800	.	.	-100.000	320.000	.	.
SRW 12A	06/04/84	8.500	-0.500	5.500	.	.	-100.000	540.000	.	.
SRW 12B	06/04/84	-0.500	-0.500	5.160	.	.	-100.000	680.000	.	.
SRW 12C	06/06/84	-0.500	-0.500	5.750	.	.	-100.000	460.000	.	.
SRW 13A	05/31/84	0.800	-0.500	6.200	.	.	-100.000	320.000	.	.
SRW 13B	05/31/84	0.500	-0.500	5.900	.	.	-100.000	450.000	.	.
SRW 13C	06/01/84	14.500	-0.500	5.900	.	.	110.000	650.000	.	.
SRW 14A	05/07/84	1.100	-0.500	6.490	.	.	100.000	584.000	.	.
SRW 14B	05/04/84	0.950	-0.500	5.960	.	.	140.000	780.000	.	.
SRW 14C	05/04/84	-0.500	-0.500	6.010	.	.	-100.000	340.000	.	.
SRW 15A	05/07/84	0.800	-0.500	6.080	.	.	-100.000	3460.000	.	.
SRW 15B	05/07/84	-0.500	-0.500	5.930	.	.	-100.000	310.000	.	.
SRW 15C	05/01/84	-0.500	-0.500	6.200	.	.	-20.000	360.000	.	.
SRW 16A	05/08/84	1.150	-0.500	5.980	.	.	-100.000	648.000	.	.
SRW 16B	05/07/84	0.700	-0.500	6.130	.	.	-100.000	830.000	.	.

APPENDIX C. ANALYTES IN EACH WELL

NEGATIVE NUMBERS REPRESENT DETECTIONS LIMITS. DOTS REPRESENT ANALYSES NOT PERFORMED

		NAME OF ANALYTE								
		SELENIUM UG/L	SILICA MG/L	SILVER UG/L	SODIUM MG/L	STRONTIUM UG/L	SULPHATE MG/L	SURFACTAN-TS UG/L	THALLIUM UG/L	TOTAL DISSOLVED SOLIDS MG/L
		RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT
WELL	SAMPLE DATE									
FB	05/26/83	.	.	.	.	.	.	.	.	.
	06/02/83	.	.	.	.	.	.	.	.	.
	06/06/83	.	.	.	.	.	.	.	.	.
	04/19/84	.	.	.	.	.	.	.	.	.
	04/20/84	.	.	.	.	.	.	.	.	.
	04/27/84	.	.	.	.	.	.	.	.	.
	04/30/84	.	.	.	.	.	.	.	.	.
	05/07/84	.	.	.	.	.	.	.	.	.
	05/16/84	.	.	.	.	.	.	.	.	.
	05/17/84	.	.	.	.	.	.	.	.	.
	05/18/84	.	.	.	.	.	.	.	.	.
	05/26/84	.	.	.	.	.	.	.	.	.
	05/31/84	.	.	.	.	.	.	.	.	.
	06/08/84	.	.	.	.	.	.	.	.	.
	06/18/84	.	.	.	.	.	.	.	.	.
	06/19/84	.	.	.	.	.	.	.	.	.
ABG 1	06/12/84	-1.000	6.400	-10.000	2.110	5.000	-5.000	-10.000	-3.000	20.000
AC 1A	06/28/84	-1.000	9.800	-100.000	-0.100	-20.000	10.000	25.000	-2.000	26.000
AC 1B	06/18/84	-1.000	8.600	-10.000	2.210	6.000	-5.000	-10.000	-2.000	52.000
AC 2A	06/13/84	-1.000	7.800	-10.000	1.390	36.000	-5.000	-10.000	-3.000	48.000
AC 2B	05/01/84	-1.000	9.900	-10.000	1.240	6.000	-5.000	-10.000	-2.000	-20.000

(CONTINUED)

APPENDIX C. ANALYTES IN EACH WELL

NEGATIVE NUMBERS REPRESENT DETECTIONS LIMITS. DOTS REPRESENT ANALYSES NOT PERFORMED

		NAME OF ANALYTE								
		SELENIUM UG/L	SILICA MG/L	SILVER UG/L	SODIUM MG/L	STRONTIUM UG/L	SULPHATE MG/L	SURFACTAN-TS UG/L	THALLIUM UG/L	TOTAL DISSOLVED SOLIDS MG/L
WELL	SAMPLE DATE	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT
AC 3A	06/07/84	-1.000	8.500	-10.000	6.160	99.000	-5.000	-10.000	-3.000	70.000
AC 3B	06/07/84	-1.000	8.800	-10.000	1.940	105.000	-5.000	-10.000	-3.000	142.000
AMB 2	06/11/84	-1.000	6.700	-10.000	7.540	-20.000	-5.000	-10.000	-3.000	38.000
AOB 1	06/11/84	-1.000	7.800	-10.000	1.940	-20.000	-5.000	-10.000	-3.000	38.000
AOB 2	06/11/84	-1.000	7.700	-10.000	2.110	-20.000	-5.000	-10.000	-3.000	54.000
ASB 3	05/14/84	-1.000	8.000	-10.000	2.520	37.000	-5.000	-10.000	-2.000	-20.000
ASB 4	06/12/84	1.000	4.800	-10.000	2.370	48.000	-5.000	-10.000	-3.000	26.000
ASB 7	05/14/84	-1.000	8.000	-10.000	4.950	9.000	-5.000	-10.000	-2.000	-20.000
ASB 8	05/30/84	-1.000	10.300	-10.000	4.620	-20.000	-5.000	-10.000	-3.000	22.000
ASB 9	06/20/84	-1.000	3.000	-10.000	1.680	14.000	3.350	25.000	-2.000	34.000
MPT 1	06/06/83	-2.000	.	-1.000	9.570	.	-5.000	-10.000	.	280.000
	09/22/83	-2.000	.	-4.000	9.400	.	-5.000	-10.000	.	300.000
	04/12/84	-1.000	11.400	-1.000	9.100	100.000	-5.000	26.000	-3.000	234.000
MSB 1A	05/03/84	-1.000	10.300	-10.000	4.460	10.000	-5.000	-10.000	-2.000	-20.000
MSB 2A	05/03/84	-1.000	9.900	-10.000	3.140	4.000	-5.000	-10.000	-2.000	-20.000
MSB 3A	06/06/83	-2.000	.	-1.000	276.100	.	100.000	38.000	.	901.000
	05/03/84	-1.000	10.600	-10.000	377.900	6.000	133.000	68.000	5.000	1358.000
MSB 4A	05/03/84	-1.000	12.800	-10.000	154.000	26.000	-5.000	-10.000	-2.000	666.000
MSB 5A	05/10/84	-1.000	10.600	-10.000	26.000	19.000	-5.000	-10.000	-2.000	108.000
MSB 6A	05/10/84	-1.000	9.900	-10.000	4.920	4.000	-5.000	-10.000	-2.000	-20.000
MSB 7A	05/10/84	-1.000	9.200	-10.000	9.760	8.000	-5.000	-10.000	-2.000	28.000

(CONTINUED)

APPENDIX C. ANALYTES IN EACH WELL

NEGATIVE NUMBERS REPRESENT DETECTIONS LIMITS. DOTS REPRESENT ANALYSES NOT PERFORMED

		NAME OF ANALYTE								
		SELENIUM UG/L	SILICA MG/L	SILVER UG/L	SODIUM MG/L	STRONTIUM UG/L	SULPHATE MG/L	SURFACTAN-TS UG/L	THALLIUM UG/L	TOTAL DISSOLVED SOLIDS MG/L
		RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT
WELL	SAMPLE DATE									
MSB 8A	05/10/84	-1.000	10.300	-10.000	12.400	12.000	-5.000	-10.000	-2.000	50.000
MSB 9A	06/03/83	-2.000	.	-1.000	3.890	.	-5.000	-10.000	.	59.000
	04/13/84	-1.000	13.900	-1.000	2.240	27.000	-5.000	24.000	-3.000	44.000
MSB 9B	04/17/84	-1.000	4.400	-1.000	35.500	126.000	5.000	50.000	-3.000	120.000
MSB 9C	06/02/83	-2.000	.	-1.000	12.570	.	-5.000	-10.000	.	124.000
	04/16/84	-1.000	11.300	-1.000	33.400	38.000	-5.000	28.000	-3.000	278.000
MSB 10A	04/17/84	-1.000	15.600	-1.000	1.550	24.000	-5.000	22.000	-3.000	36.000
MSB 10B	04/18/84	-1.000	49.900	-1.000	2.850	24.000	7.500	-10.000	-3.000	88.000
MSB 10C	04/18/84	-1.000	10.200	-1.000	16.960	497.000	-5.000	-10.000	-3.000	182.000
MSB 11A	05/25/83	-2.000	.	-1.000	3.370	.	-5.000	-10.000	.	46.000
	04/12/84	-1.000	22.000	-1.000	1.900	46.000	192.000	-10.000	-3.000	62.000
MSB 11B	04/12/84	-1.000	11.900	-1.000	1.700	108.000	-5.000	.	-3.000	76.000
MSB 11C	04/12/84	-1.000	11.700	-1.000	6.100	135.000	-5.000	-10.000	-2.000	284.000
MSB 11D	04/12/84	-1.000	8.800	-1.000	7.100	26.000	-5.000	24.000	-3.000	118.000
MSB 11F	04/12/84	-1.000	11.200	1.000	3.440	-20.000	-5.000	20.000	-3.000	64.000
MSB 12A	04/19/84	-1.000	21.700	-1.000	1.523	-20.000	-5.000	34.000	-3.000	46.000
MSB 12B	04/19/84	-1.000	11.900	-1.000	1.394	-20.000	-5.000	-10.000	-3.000	156.000
MSB 12C	04/18/84	-1.000	11.000	-1.000	28.300	22.000	-5.000	-10.000	-3.000	154.000
MSB 12D	04/18/84	-1.000	16.100	-1.000	3.450	-20.000	-5.000	20.000	-3.000	80.000
MSB 12TA	05/25/84	.	.	.	.	.	.	.	.	.
MSB 12TB	05/17/84	-1.000	21.700	-10.000	2.240	27.000	-5.000	-10.000	-2.000	46.000

(CONTINUED)

APPENDIX C. ANALYTES IN EACH WELL

NEGATIVE NUMBERS REPRESENT DETECTIONS LIMITS. DOTS REPRESENT ANALYSES NOT PERFORMED

		NAME OF ANALYTE								
		SELENIUM UG/L	SILICA MG/L	SILVER UG/L	SODIUM MG/L	STRONTIUM UG/L	SULPHATE MG/L	SURFACTAN-TS UG/L	THALLIUM UG/L	TOTAL DISSOLVED SOLIDS MG/L
WELL	SAMPLE DATE	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT
MSB 13A	04/20/84	-1.000	21.100	-1.000	1.840	-20.000	-5.000	-10.000	-3.000	52.000
MSB 13B	04/20/84	-1.000	25.700	-1.000	24.640	168.000	7.500	100.000	-3.000	160.000
MSB 13C	04/20/84	-1.000	10.600	-1.000	113.200	-20.000	5.000	-10.000	-3.000	484.000
MSB 14A	06/14/84	-1.000	6.200	-10.000	4.020	32.000	-5.000	-10.000	-3.000	.
MSB 14B	04/13/84	-1.000	11.200	-1.000	792.400	22.000	-5.000	.	-3.000	152.000
MSB 14C	04/13/84	-1.000	13.500	-1.000	13.900	114.000	-5.000	.	-3.000	104.000
MSB 15A	05/26/83	-2.000	.	-1.000	4.890	.	-5.000	-10.000	.	38.000
	04/16/84	-1.000	12.500	-1.000	2.190	64.000	-5.000	-10.000	-3.000	66.000
MSB 16A	05/25/83	-2.000	.	-1.000	3.900	.	-5.000	-10.000	.	-20.000
	04/17/84	-1.000	13.600	-1.000	2.640	45.000	-5.000	-10.000	-3.000	46.000
MSB 16C	05/26/83	-2.000	.	-1.000	3.210	.	-5.000	-10.000	.	-20.000
	04/17/84	-1.000	9.500	-1.000	1.860	-20.000	-5.000	-10.000	-3.000	34.000
MSB 17A	04/23/84	-1.000	13.600	-1.000	12.100	40.000	-5.000	.	-3.000	136.000
MSB 17B	04/24/84	-1.000	11.000	-1.000	20.140	20.000	-5.000	.	-3.000	110.000
MSB 18A	04/23/84	-1.000	36.600	-1.000	2.050	-20.000	-5.000	-10.000	-3.000	58.000
MSB 18B	04/23/84	-1.000	11.700	-1.000	9.800	44.000	-5.000	-10.000	-3.000	90.000
MSB 18C	04/23/84	-1.000	9.200	-1.000	1.030	-20.000	-5.000	.	-3.000	34.000
MSB 19A	06/08/84	-1.000	9.100	-10.000	1.920	-20.000	-5.000	-10.000	-3.000	30.000
MSB 19B	06/08/84	-1.000	11.100	-10.000	1.550	-20.000	-5.000	-10.000	-3.000	36.000
MSB 19C	06/13/84	-1.000	8.200	-10.000	2.880	20.000	-5.000	-10.000	-3.000	40.000
MSB 20A	04/24/84	-1.000	12.100	-1.000	1.470	-20.000	-5.000	.	-3.000	20.000

(CONTINUED)

APPENDIX C. ANALYTES IN EACH WELL

NEGATIVE NUMBERS REPRESENT DETECTIONS LIMITS. DOTS REPRESENT ANALYSES NOT PERFORMED

		NAME OF ANALYTE								
		SELENIUM UG/L	SILICA MG/L	SILVER UG/L	SODIUM MG/L	STRONTIUM UG/L	SULPHATE MG/L	SURFACTANTS UG/L	THALLIUM UG/L	TOTAL DISSOLVED SOLIDS MG/L
WELL	SAMPLE DATE	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT
MSB 20C	04/24/84	-1.000	10.300	-1.000	2.540	106.000	-5.000	.	-3.000	78.000
MSB 21A	04/25/84	-1.000	10.300	-1.000	1.640	-20.000	-5.000	-10.000	-3.000	-20.000
MSB 21C	04/24/84	-1.000	10.300	-1.000	1.600	-20.000	-5.000	.	-3.000	20.000
MSB 22	04/13/84	-1.000	16.100	-1.000	27.600	113.000	-5.000	.	-3.000	674.000
MSB 23	06/01/83	-2.000	.	-1.000	4.630	.	-5.000	-10.000	.	20.000
	05/11/84	-1.000	8.800	-10.000	4.520	350.000	-5.000	-10.000	-2.000	210.000
MSB 23A	05/11/84	-1.000	19.800	-10.000	3.670	92.000	5.000	-10.000	-2.000	28.000
MSB 23B	06/01/83	-2.000	.	-1.000	6.200	.	-5.000	-10.000	.	28.000
	05/11/84	-1.000	11.700	-10.000	3.270	22.000	-5.000	-10.000	-2.000	-20.000
MSB 24	06/02/83	-2.000	.	-1.000	8.900	.	-5.000	-10.000	.	436.000
	05/15/84	1.000	7.300	-10.000	12.500	408.000	15.000	-10.000	-2.000	322.000
MSB 24A	06/01/83	-2.000	.	-1.000	6.270	.	-5.000	-10.000	.	-20.000
	05/15/84	-1.000	11.400	-10.000	0.228	6.000	-5.000	-10.000	-2.000	38.000
MSB 25	05/15/84	1.000	14.300	-10.000	2.880	80.000	-5.000	-10.000	-2.000	62.000
MSB 25A	05/15/84	-1.000	12.100	-10.000	4.480	7.000	-5.000	30.000	-2.000	-20.000
MSB 26	04/26/84	-1.000	11.000	-1.000	2.690	-20.000	-5.000	.	-3.000	-20.000
MSB 26A	04/26/84	-1.000	13.200	-1.000	4.060	-20.000	-5.000	-10.000	-3.000	24.000
MSB 27	06/10/83	-2.000	.	-1.000	5.150	.	-5.000	-10.000	.	44.000
	04/26/84	-1.000	9.700	-1.000	3.560	-20.000	-5.000	-10.000	-3.000	218.000
MSB 27A	06/06/83	-2.000	.	-1.000	4.890	.	-5.000	-10.000	.	42.000
	06/13/84	-1.000	9.200	-10.000	3.240	5.000	-5.000	-10.000	-3.000	30.000

(CONTINUED)

APPENDIX C. ANALYTES IN EACH WELL

NEGATIVE NUMBERS REPRESENT DETECTIONS LIMITS. DOTS REPRESENT ANALYSES NOT PERFORMED

		NAME OF ANALYTE								
		SELENIUM UG/L	SILICA MG/L	SILVER UG/L	SODIUM MG/L	STRONTIUM UG/L	SULPHATE MG/L	SURFACTANTS UG/L	THALLIUM UG/L	TOTAL DISSOLVED SOLIDS MG/L
WELL	SAMPLE DATE	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT
MSB 28	04/30/84	-1.000	14.300	-10.000	2.360	53.000	-5.000	26.000	-2.000	72.000
MSB 28A	04/30/84	-1.000	12.700	-10.000	1.980	8.000	-5.000	-10.000	-2.000	30.000
MSB 30A	04/30/84	-1.000	18.300	-10.000	1.540	7.000	-5.000	-10.000	-2.000	44.000
MSB 30C	04/30/84	-1.000	12.100	-10.000	4.280	496.000	10.000	38.000	-2.000	100.000
MSB 31A	05/09/84	-1.000	10.600	-10.000	1.320	5.000	-5.000	.	-2.000	-20.000
MSB 31B	06/01/83	-2.000	.	-1.000	4.290	.	-5.000	-10.000	.	25.000
	05/09/84	-1.000	11.000	-10.000	1.800	4.000	-5.000	-10.000	-2.000	-20.000
MSB 31C	06/01/83	-2.000	.	-1.000	8.920	.	-5.000	-10.000	.	55.000
	05/09/84	-1.000	11.700	-10.000	4.500	29.000	-5.000	-10.000	-2.000	-20.000
MSB 32	06/14/84	-1.000	6.500	-10.000	3.690	-20.000	-5.000	-10.000	-3.000	48.000
MSB 33	05/09/84	-1.000	9.900	-10.000	5.950	6.000	-5.000	-10.000	-2.000	-20.000
MSB 34A	04/25/84	-1.000	11.000	-1.000	2.090	-20.000	-5.000	-10.000	-3.000	-20.000
MSB 34B	04/25/84	-1.000	9.900	-1.000	3.660	44.000	-5.000	-10.000	-3.000	70.000
MSB 34C	04/25/84	-1.000	9.900	-1.000	5.460	30.000	-5.000	-10.000	-3.000	52.000
MSB 34TA	05/16/84	-1.000	12.100	-10.000	2.950	67.000	-5.000	-10.000	-2.000	56.000
MSB 34TB	05/16/84	-1.000	11.700	-10.000	3.530	20.000	-5.000	-10.000	-2.000	42.000
RWM 2	05/18/84	.	9.200	-10.000	3.670	4.000	-5.000	-10.000	-2.000	34.000
RWM 3	05/18/84	.	12.100	-10.000	3.820	25.000	-5.000	-10.000	-2.000	168.000
SRW 1C	05/04/84	-1.000	9.900	-10.000	1.750	8.000	-5.000	-10.000	-2.000	22.000
SRW 2A	05/02/84	-1.000	16.800	-10.000	1.500	10.000	-5.000	-10.000	-2.000	36.000
SRW 2B	05/02/84	-1.000	10.600	-10.000	2.580	22.000	-5.000	-10.000	-2.000	36.000

(CONTINUED)

APPENDIX C. ANALYTES IN EACH WELL

NEGATIVE NUMBERS REPRESENT DETECTIONS LIMITS. DOTS REPRESENT ANALYSES NOT PERFORMED

		NAME OF ANALYTE								
		SELENIUM UG/L	SILICA MG/L	SILVER UG/L	SODIUM MG/L	STRONTIUM UG/L	SULPHATE MG/L	SURFACTAN-TS UG/L	THALLIUM UG/L	TOTAL DISSOLVED SOLIDS MG/L
		RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT
WELL	SAMPLE DATE									
SRW 2C	05/02/84	-1.000	10.300	-10.000	1.820	4.000	-5.000	-10.000	-2.000	24.000
SRW 3C	05/02/84	-1.000	8.000	-10.000	1.320	4.000	-5.000	-10.000	-2.000	24.000
SRW 4C	06/18/84	-1.000	9.300	-10.000	4.490	11.000	-5.000	-10.000	-2.000	30.000
SRW 5C	05/04/84	-1.000	17.400	.	1.860	6.000	-5.000	-10.000	-2.000	38.000
SRW 6C	05/04/84	-1.000	20.900	-10.000	3.650	6.000	-5.000	-10.000	-2.000	48.000
SRW 9A	06/01/84	-1.000	11.200	-10.000	1.660	-20.000	-5.000	-10.000	-3.000	20.000
SRW 9B	06/04/84	-1.000	10.600	-100.000	1.820	-20.000	-5.000	-10.000	-3.000	-20.000
SRW 12A	06/04/84	-1.000	16.900	-100.000	1.590	-20.000	-5.000	-10.000	-3.000	26.000
SRW 12B	06/04/84	-1.000	8.800	-100.000	1.220	-20.000	-5.000	-10.000	-3.000	-20.000
SRW 12C	06/06/84	-1.000	6.400	-10.000	2.460	-20.000	-5.000	-10.000	-3.000	50.000
SRW 13A	05/31/84	-1.000	13.200	-100.000	1.640	-20.000	-5.000	-10.000	-3.000	-20.000
SRW 13B	05/31/84	-1.000	8.700	-10.000	2.080	-20.000	-5.000	-10.000	-3.000	-20.000
SRW 13C	06/01/84	-1.000	12.500	-100.000	4.680	-20.000	-5.000	-10.000	-3.000	40.000
SRW 14A	05/07/84	-1.000	14.300	-10.000	2.390	48.000	-5.000	-10.000	-2.000	52.000
SRW 14B	05/04/84	-1.000	11.700	-10.000	5.120	86.000	-5.000	-10.000	-2.000	62.000
SRW 14C	05/04/84	-1.000	10.600	-10.000	2.770	9.000	-5.000	-10.000	-2.000	36.000
SRW 15A	05/07/84	-1.000	13.600	-10.000	2.950	504.000	-5.000	-10.000	-2.000	64.000
SRW 15B	05/07/84	-1.000	9.200	-10.000	2.350	13.000	-5.000	-10.000	-2.000	32.000
SRW 15C	05/01/84	-1.000	10.300	-10.000	2.740	13.000	-5.000	-10.000	-2.000	-20.000
SRW 16A	05/08/84	-1.000	12.100	-10.000	3.920	17.000	-5.000	-10.000	-2.000	24.000
SRW 16B	05/07/84	-1.000	10.300	-10.000	3.820	26.000	-5.000	-10.000	-2.000	62.000

APPENDIX C. ANALYTES IN EACH WELL

NEGATIVE NUMBERS REPRESENT DETECTIONS LIMITS. DOTS REPRESENT ANALYSES NOT PERFORMED

		NAME OF ANALYTE								
		TOTAL ORGANIC HALOGENS MG/L	TRANS-1,2-DICHLOROE-THYLENE UG/L	URANIUM MG/L	VINYL CHLORIDE UG/L	ZINC UG/L	1,1-DICHLOROE-THANE UG/L	1,1-DICHLOROE-THYLENE UG/L	1,1,2,2-TETRACHLO-ROETHANE UG/L	1,2-DICHLOROB-ENZENE UG/L
		RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT
WELL	SAMPLE DATE									
FB	05/26/83	.	.	.	.	.	.	.	.	.
	06/02/83	.	.	.	.	.	.	.	.	.
	06/06/83	.	.	.	.	.	.	.	.	.
	04/19/84	.	-5.000	.	-10.000	.	-5.000	-5.000	-10.000	.
	04/20/84	.	-5.000	.	-10.000	.	-5.000	-5.000	-10.000	.
	04/27/84	.	-5.000	.	-10.000	.	-5.000	-5.000	-10.000	.
	04/30/84	.	-5.000	.	-10.000	.	-5.000	-5.000	-10.000	.
	05/07/84	.	-5.000	.	-10.000	.	-5.000	-5.000	-10.000	.
	05/16/84	.	-5.000	.	-10.000	.	-5.000	-5.000	-10.000	.
	05/17/84	.	-5.000	.	-10.000	.	-5.000	-5.000	-10.000	.
	05/18/84	.	-5.000	.	-10.000	.	-5.000	-5.000	-10.000	.
	05/26/84	.	-5.000	.	-10.000	.	-5.000	-5.000	-10.000	.
	05/31/84	.	-5.000	.	-10.000	.	-5.000	-5.000	-10.000	.
	06/08/84	.	-5.000	.	-10.000	.	-5.000	-5.000	-10.000	.
	06/18/84	.	-5.000	.	-10.000	.	-5.000	-5.000	-10.000	.
	06/19/84	.	-5.000	.	-10.000	.	-5.000	-5.000	-10.000	.
ABG 1	06/12/84	0.029	-5.000	-0.200	-10.000	45.000	-5.000	-5.000	-10.000	.
AC 1A	06/28/84	-0.005	.	-0.200	.	493.000	.	.	.	.
AC 1B	06/18/84	-0.005	-5.000	-0.200	-10.000	1280.000	-5.000	-5.000	-10.000	.
AC 2A	06/13/84	0.006	-5.000	-0.200	-10.000	354.000	-5.000	-5.000	-10.000	.
AC 2B	05/01/84	-0.005	-5.000	-0.200	-10.000	2890.000	-5.000	-5.000	-10.000	.

(CONTINUED)

APPENDIX C. ANALYTES IN EACH WELL

NEGATIVE NUMBERS REPRESENT DETECTIONS LIMITS. DOTS REPRESENT ANALYSES NOT PERFORMED

		NAME OF ANALYTE								
		TOTAL ORGANIC HALOGENS MG/L	TRANS-1,2-DICHLOROE-THYLENE UG/L	URANIUM MG/L	VINYL CHLORIDE UG/L	ZINC UG/L	1,1-DICHLOROE-THANE UG/L	1,1-DICHLOROE-THYLENE UG/L	1,1,2,2-TETRACHLO-ROETHANE UG/L	1,2-DICHLOROB-ENZENE UG/L
		RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT
WELL	SAMPLE DATE									
AC 3A	06/07/84	0.011	-5.000	-0.200	-10.000	.	-5.000	-5.000	-10.000	.
AC 3B	06/07/84	-0.010	-5.000	-0.200	-10.000	32.000	-5.000	-5.000	-10.000	.
AMB 2	06/11/84	0.065	8.000	-0.200	-10.000	211.000	-5.000	-5.000	-10.000	.
AOB 1	06/11/84	0.150	-5.000	-0.200	-10.000	93.000	-5.000	-5.000	-10.000	.
AOB 2	06/11/84	0.009	-5.000	-0.200	-10.000	162.000	-5.000	-5.000	-10.000	.
ASB 3	05/14/84	-0.005	-5.000	-0.200	-10.000	119.000	-5.000	-5.000	-10.000	.
ASB 4	06/12/84	0.020	-5.000	-0.200	-10.000	95.000	-5.000	-5.000	-10.000	.
ASB 7	05/14/84	0.013	-5.000	-0.200	-10.000	162.000	-5.000	-5.000	-10.000	.
ASB 8	05/30/84	0.740	17.000	-0.200	-10.000	626.000	-5.000	-5.000	-10.000	.
ASB 9	06/20/84	0.007	-5.000	-0.200	-10.000	94.000	-5.000	-5.000	-10.000	.
MPT 1	06/06/83	29.000	.	.	.	100.000	.	.	.	10.000
	09/22/83	.	.	.	.	48.000	.	.	.	3.000
	04/12/84	32.000	200.000	-0.300	-10.000	105.000	-5.000	-5.000	-10.000	.
MSB 1A	05/03/84	0.280	24.000	-0.200	-10.000	469.000	-5.000	-5.000	-10.000	.
MSB 2A	05/03/84	0.270	21.000	-0.200	-10.000	195.000	-5.000	-5.000	-10.000	.
MSB 3A	06/06/83	94.000	.	.	.	2895.000	.	.	.	7.000
	05/03/84	89.000	2490.000	-0.200	58.000	3050.000	-5.000	1020.000	-10.000	.
MSB 4A	05/03/84	2.200	152.000	-0.200	11.000	164.000	18.000	34.000	-10.000	.
MSB 5A	05/10/84	0.036	-5.000	-0.200	-10.000	59.000	-5.000	-5.000	-10.000	.
MSB 6A	05/10/84	0.016	-5.000	-0.200	-10.000	25.000	-5.000	-5.000	-10.000	.
MSB 7A	05/10/84	0.029	-5.000	-0.200	-10.000	42.000	-5.000	-5.000	-10.000	.

(CONTINUED)

APPENDIX C. ANALYTES IN EACH WELL

NEGATIVE NUMBERS REPRESENT DETECTIONS LIMITS. DOTS REPRESENT ANALYSES NOT PERFORMED

		NAME OF ANALYTE								
		TOTAL ORGANIC HALOGENS MG/L	TRANS-1,2-DICHLOROE-THYLENE UG/L	URANIUM MG/L	VINYL CHLORIDE UG/L	ZINC UG/L	1,1-DICHLOROE-THANE UG/L	1,1-DICHLOROE-THYLENE UG/L	1,1,2,2-TETRACHLO-ROETHANE UG/L	1,2-DICHLOROB-ENZENE UG/L
		RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT
WELL	SAMPLE DATE									
MSB 8A	05/10/84	0.220	-5.000	-0.200	-10.000	101.000	-5.000	-5.000	-10.000	.
MSB 9A	06/03/83	0.270	3.000	.	.	881.000	.	.	.	.
	04/13/84	0.230	-5.000	-0.200	-10.000	690.000	-5.000	-5.000	-10.000	.
MSB 9B	04/17/84	0.130	10.000	-0.200	-10.000	220.000	-5.000	-5.000	-10.000	.
MSB 9C	06/02/83	1.200	.	.	.	2594.000	.	.	.	1.000
	04/16/84	5.200	20.000	-0.300	-10.000	.	9.000	-5.000	-10.000	.
MSB 10A	04/17/84	0.068	-5.000	-0.200	-10.000	2410.000	-5.000	-5.000	-10.000	.
MSB 10B	04/18/84	0.044	-5.000	-0.200	-10.000	2400.000	-5.000	-5.000	-10.000	.
MSB 10C	04/18/84	0.380	56.000	-0.200	-10.000	60.000	-5.000	-5.000	-10.000	.
MSB 11A	05/25/83	0.070	4.000	.	.	274.000	.	1.000	1.000	.
	04/12/84	0.022	-5.000	0.200	-10.000	1287.000	-5.000	-5.000	-10.000	.
MSB 11B	04/12/84	0.260	-5.000	-0.200	-10.000	341.000	-5.000	-5.000	-10.000	.
MSB 11C	04/12/84	16.000	374.000	1.000	-10.000	3314.000	-5.000	-5.000	13.000	.
MSB 11D	04/12/84	6.300	118.000	-0.200	-10.000	5795.000	-5.000	-5.000	-10.000	.
MSB 11F	04/12/84	14.000	32.000	-0.200	-10.000	4084.000	-5.000	-5.000	-10.000	.
MSB 12A	04/19/84	0.170	-5.000	-0.200	-10.000	6360.000	-5.000	-5.000	-10.000	.
MSB 12B	04/19/84	0.350	-5.000	-0.200	-10.000	4640.000	-5.000	-5.000	-10.000	.
MSB 12C	04/18/84	0.420	-5.000	-0.200	-10.000	2790.000	-5.000	-5.000	-10.000	.
MSB 12D	04/18/84	0.030	-5.000	0.200	-10.000	2240.000	-5.000	-5.000	-10.000	.
MSB 12TA	05/25/84	.	-5.000	.	-10.000	.	-5.000	-5.000	-10.000	.
MSB 12TB	05/17/84	0.010	-5.000	-0.200	-10.000	2190.000	-5.000	-5.000	-10.000	.

(CONTINUED)

APPENDIX C. ANALYTES IN EACH WELL

NEGATIVE NUMBERS REPRESENT DETECTIONS LIMITS. DOTS REPRESENT ANALYSES NOT PERFORMED

		NAME OF ANALYTE								
		TOTAL ORGANIC HALOGENS MG/L	TRANS-1,2-DICHLOROETHYLENE UG/L	URANIUM MG/L	VINYL CHLORIDE UG/L	ZINC UG/L	1,1-DICHLOROETHANE UG/L	1,1-DICHLOROETHYLENE UG/L	1,1,2,2-TETRACHLOROETHANE UG/L	1,2-DICHLOROBENZENE UG/L
		RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT
WELL	SAMPLE DATE									
MSB 13A	04/20/84	0.044	-5.000	-0.200	-10.000	2190.000	-5.000	-5.000	-10.000	.
MSB 13B	04/20/84	0.130	6.000	-0.200	-10.000	160.000	-5.000	-5.000	-10.000	.
MSB 13C	04/20/84	0.110	-5.000	-0.200	-10.000	6670.000	-5.000	-5.000	-10.000	.
MSB 14A	06/14/84	0.860	73.000	-0.200	-10.000	1700.000	-5.000	-5.000	-10.000	.
MSB 14B	04/13/84	0.320	26.000	0.200	-10.000	1654.000	-5.000	-5.000	-10.000	.
MSB 14C	04/13/84	0.070	-5.000	-0.200	-10.000	48.000	-5.000	-5.000	-10.000	.
MSB 15A	05/26/83	2.400	.	.	.	446.000	.	.	.	.
	04/16/84	1.400	-5.000	-0.200	-10.000	640.000	-5.000	-5.000	-10.000	.
MSB 16A	05/25/83	0.970	6.000	.	.	947.000	.	.	.	.
	04/17/84	1.400	-5.000	-0.200	-10.000	2100.000	-5.000	-5.000	-10.000	.
MSB 16C	05/26/83	7.200	.	.	.	2190.000	.	.	.	.
	04/17/84	5.100	-5.000	-0.200	-10.000	3620.000	-5.000	-5.000	-10.000	.
MSB 17A	04/23/84	0.320	-5.000	-0.200	-10.000	2900.000	-5.000	-5.000	-10.000	.
MSB 17B	04/24/84	0.390	-5.000	-0.200	-10.000	2110.000	-5.000	12.000	-10.000	.
MSB 18A	04/23/84	0.089	-5.000	-0.200	-10.000	1800.000	-5.000	-5.000	-10.000	.
MSB 18B	04/23/84	0.087	-5.000	-0.200	-10.000	3590.000	-5.000	-5.000	-10.000	.
MSB 18C	04/23/84	0.021	-5.000	-0.200	-10.000	2920.000	-5.000	-5.000	-10.000	.
MSB 19A	06/08/84	0.044	-5.000	-0.200	-10.000	667.000	-5.000	-5.000	-10.000	.
MSB 19B	06/08/84	0.070	7.000	-0.200	-10.000	1810.000	-5.000	-5.000	-10.000	.
MSB 19C	06/13/84	0.940	9.000	-0.200	-10.000	3480.000	-5.000	-5.000	-10.000	.
MSB 20A	04/24/84	0.120	-5.000	-0.200	-10.000	1160.000	-5.000	-5.000	-10.000	.

(CONTINUED)

APPENDIX C. ANALYTES IN EACH WELL

NEGATIVE NUMBERS REPRESENT DETECTIONS LIMITS. DOTS REPRESENT ANALYSES NOT PERFORMED

		NAME OF ANALYTE								
		TOTAL ORGANIC HALOGENS MG/L	TRANS-1,2-DICHLOROE-THYLENE UG/L	URANIUM MG/L	VINYL CHLORIDE UG/L	ZINC UG/L	1,1-DICHLOROE-THANE UG/L	1,1-DICHLOROE-THYLENE UG/L	1,1,2,2-TETRACHLO-ROETHANE UG/L	1,2-DICHLOROB-ENZENE UG/L
		RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT
WELL	SAMPLE DATE									
MSB 20C	04/24/84	0.170	-5.000	-0.200	-10.000	840.000	-5.000	-5.000	-10.000	.
MSB 21A	04/25/84	-0.005	-5.000	-0.200	-10.000	1590.000	-5.000	-5.000	-10.000	.
MSB 21C	04/24/84	0.051	-5.000	-0.200	-10.000	1900.000	-5.000	-5.000	-10.000	.
MSB 22	04/13/84	8.500	269.000	3.200	-10.000	1797.000	-5.000	-5.000	-10.000	.
MSB 23	06/01/83	26.000	.	.	.	1143.000	.	.	.	.
	05/11/84	9.000	12.000	-0.200	-10.000	1170.000	-5.000	-5.000	-10.000	.
MSB 23A	05/11/84	0.060	-5.000	-0.200	-10.000	3320.000	-5.000	-5.000	-10.000	.
MSB 23B	06/01/83	9.600	.	.	.	1735.000	.	.	.	.
	05/11/84	7.200	174.000	-0.200	-10.000	4480.000	-5.000	-5.000	-10.000	.
MSB 24	06/02/83	6.000	.	.	.	1813.000	.	.	.	.
	05/15/84	4.100	-5.000	4.300	-10.000	242.000	-5.000	-5.000	-10.000	.
MSB 24A	06/01/83	15.000	.	.	.	2150.000	.	.	.	.
	05/15/84	16.000	-5.000	-0.200	-10.000	18.000	-5.000	-5.000	-10.000	.
MSB 25	05/15/84	1.300	-5.000	-0.200	-10.000	18.000	-5.000	-5.000	-10.000	.
MSB 25A	05/15/84	2.900	-5.000	-0.200	-10.000	2170.000	-5.000	-5.000	-10.000	.
MSB 26	04/26/84	0.026	6.000	-0.200	-10.000	2600.000	-5.000	-5.000	-10.000	.
MSB 26A	04/26/84	15.000	208.000	-0.200	-10.000	6210.000	-5.000	-5.000	-10.000	.
MSB 27	06/10/83	2.400	.	.	.	1050.000	.	.	.	.
	04/26/84	0.012	-5.000	-0.200	-10.000	1460.000	-5.000	-5.000	-10.000	.
MSB 27A	06/06/83	23.000	307.000	.	.	2278.000	.	.	.	.
	06/13/84	24.000	268.000	-0.200	-10.000	5050.000	-5.000	-5.000	-10.000	.

(CONTINUED)

APPENDIX C. ANALYTES IN EACH WELL

NEGATIVE NUMBERS REPRESENT DETECTIONS LIMITS. DOTS REPRESENT ANALYSES NOT PERFORMED

		NAME OF ANALYTE								
		TOTAL ORGANIC HALOGENS MG/L	TRANS-1,2-DICHLOROE-THYLENE UG/L	URANIUM MG/L	VINYL CHLORIDE UG/L	ZINC UG/L	1,1-DICHLOROE-THANE UG/L	1,1-DICHLOROE-THYLENE UG/L	1,1,2,2-TETRACHLO-ROETHANE UG/L	1,2-DICHLOROB-ENZENE UG/L
WELL	SAMPLE DATE	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT
MSB 28	04/30/84	0.048	-5.000	-0.200	-10.000	84.000	-5.000	-5.000	-10.000	.
MSB 28A	04/30/84	2.700	16.000	-0.200	-10.000	2700.000	-5.000	-5.000	-10.000	.
MSB 30A	04/30/84	0.023	-5.000	-0.200	-10.000	960.000	-5.000	-5.000	-10.000	.
MSB 30C	04/30/84	0.029	-5.000	-1.600	-10.000	55.000	-5.000	-5.000	-10.000	.
MSB 31A	05/09/84	-0.005	-5.000	-0.200	-10.000	6560.000	-5.000	-5.000	-10.000	.
MSB 31B	06/01/83	2.500	-1.000	.	.	730.000	.	.	.	.
	05/09/84	0.150	-5.000	-0.200	-10.000	669.000	-5.000	-5.000	-10.000	.
MSB 31C	06/01/83	66.000	.	.	.	83.000	.	.	.	.
	05/09/84	70.000	24.000	-0.200	-10.000	1040.000	-5.000	-5.000	-10.000	.
MSB 32	06/14/84	0.006	-5.000	-0.200	-10.000	382.000	-5.000	-5.000	-10.000	.
MSB 33	05/09/84	0.120	6.000	-0.200	-10.000	954.000	-5.000	-5.000	-10.000	.
MSB 34A	04/25/84	0.390	10.000	-0.200	-10.000	2420.000	-5.000	-5.000	-10.000	.
MSB 34B	04/25/84	13.000	27.000	-0.800	-10.000	2000.000	-5.000	-5.000	-10.000	.
MSB 34C	04/25/84	17.000	18.000	-0.200	-10.000	3280.000	-5.000	-5.000	-10.000	.
MSB 34TA	05/16/84	0.019	-5.000	-0.200	-10.000	512.000	-5.000	-5.000	-10.000	.
MSB 34TB	05/16/84	0.017	-5.000	-0.200	-10.000	1860.000	-5.000	-5.000	-10.000	.
RWM 2	05/18/84	15.000	68.000	-0.200	-10.000	34.000	-5.000	-5.000	-10.000	.
RWM 3	05/18/84	39.000	46.000	5.000	-10.000	1030.000	-5.000	-5.000	-10.000	.
SRW 1C	05/04/84	0.052	-5.000	-0.200	-10.000	1720.000	-5.000	-5.000	-10.000	.
SRW 2A	05/02/84	0.021	18.000	-0.200	-10.000	1970.000	-5.000	-5.000	-10.000	.
SRW 2B	05/02/84	-0.005	-5.000	-0.200	-10.000	1840.000	-5.000	-5.000	-10.000	.

(CONTINUED)

APPENDIX C. ANALYTES IN EACH WELL

NEGATIVE NUMBERS REPRESENT DETECTIONS LIMITS. DOTS REPRESENT ANALYSES NOT PERFORMED

		NAME OF ANALYTE								
		TOTAL ORGANIC HALOGENS MG/L	TRANS-1,2-DICHLOROE-THYLENE UG/L	URANIUM MG/L	VINYL CHLORIDE UG/L	ZINC UG/L	1,1-DICHLOROE-THANE UG/L	1,1-DICHLOROE-THYLENE UG/L	1,1,2,2-TETRACHLO-ROETHANE UG/L	1,2-DICHLOROB-ENZENE UG/L
		RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT
WELL	SAMPLE DATE									
SRW 2C	05/02/84	0.041	-5.000	-0.200	-10.000	2340.000	-5.000	-5.000	-10.000	.
SRW 3C	05/02/84	0.026	-5.000	-0.300	-10.000	5820.000	-5.000	-5.000	-10.000	.
SRW 4C	06/18/84	0.025	-5.000	0.300	-10.000	1820.000	-5.000	-5.000	-10.000	.
SRW 5C	05/04/84	0.120	-5.000	-0.200	-10.000	3960.000	-5.000	-5.000	-10.000	.
SRW 6C	05/04/84	0.082	-5.000	-0.200	-10.000	2080.000	-5.000	-5.000	-10.000	.
SRW 9A	06/01/84	-0.005	-5.000	-0.200	-10.000	1410.000	-5.000	-5.000	-10.000	.
SRW 9B	06/04/84	-0.005	-5.000	-0.200	-10.000	1240.000	-5.000	-5.000	-10.000	.
SRW 12A	06/04/84	-0.005	-5.000	-0.200	-10.000	2400.000	-5.000	-5.000	-10.000	.
SRW 12B	06/04/84	0.006	-5.000	-0.200	-10.000	1370.000	-5.000	-5.000	-10.000	.
SRW 12C	06/06/84	-0.005	-5.000	0.200	-10.000	764.000	-5.000	-5.000	-10.000	.
SRW 13A	05/31/84	-0.005	-5.000	-0.200	-10.000	1550.000	-5.000	-5.000	-10.000	.
SRW 13B	05/31/84	-0.005	-5.000	-0.200	-10.000	1530.000	-5.000	-5.000	-10.000	.
SRW 13C	06/01/84	-0.005	-5.000	-0.200	-10.000	2810.000	-5.000	-5.000	-10.000	.
SRW 14A	05/07/84	-0.005	-5.000	-0.200	-10.000	295.000	-5.000	-5.000	-10.000	.
SRW 14B	05/04/84	0.029	-5.000	0.600	-10.000	85.000	-5.000	-5.000	-10.000	.
SRW 14C	05/04/84	0.046	-5.000	-0.200	-10.000	1600.000	-5.000	-5.000	-10.000	.
SRW 15A	05/07/84	0.021	-5.000	-0.200	-10.000	56.000	-5.000	-5.000	-10.000	.
SRW 15B	05/07/84	0.076	-5.000	-0.200	-10.000	1510.000	-5.000	-5.000	-10.000	.
SRW 15C	05/01/84	-0.005	-5.000	.	-10.000	917.000	-5.000	-5.000	-10.000	.
SRW 16A	05/08/84	0.010	-5.000	-0.200	-10.000	2300.000	-5.000	-5.000	-10.000	.
SRW 16B	05/07/84	0.008	-5.000	-0.200	-10.000	1090.000	-5.000	-5.000	-10.000	.

APPENDIX C. ANALYTES IN EACH WELL

NEGATIVE NUMBERS REPRESENT DETECTIONS LIMITS. DOTS REPRESENT ANALYSES NOT PERFORMED

WELL	SAMPLE DATE	NAME OF ANALYTE: 1,4-DICHLOROBENZENE UG/L — RESULT
FB	05/26/83	.
	06/02/83	.
	06/06/83	.
	04/19/84	.
	04/20/84	.
	04/27/84	.
	04/30/84	.
	05/07/84	.
	05/16/84	.
	05/17/84	.
	05/18/84	.
	05/26/84	.
	05/31/84	.
	06/08/84	.
	06/18/84	.
	06/19/84	.
ABG 1	06/12/84	.
AC 1A	06/28/84	.
AC 1B	06/18/84	.
AC 2A	06/13/84	.

(CONTINUED)

APPENDIX C. ANALYTES IN EACH WELL

NEGATIVE NUMBERS REPRESENT DETECTIONS LIMITS. DOTS REPRESENT ANALYSES NOT PERFORMED

WELL	SAMPLE DATE	NAME OF ANALYTE: 1,4-DICHLOROBENZENE UG/L RESULT
AC 2B	05/01/84	.
AC 3A	06/07/84	.
AC 3B	06/07/84	.
AMB 2	06/11/84	.
AOB 1	06/11/84	.
AOB 2	06/11/84	.
ASB 3	05/14/84	.
ASB 4	06/12/84	.
ASB 7	05/14/84	.
ASB 8	05/30/84	.
ASB 9	06/20/84	.
MPT 1	06/06/83	1.000
	09/22/83	-1.000
	04/12/84	.
MSB 1A	05/03/84	.
MSB 2A	05/03/84	.
MSB 3A	06/06/83	.
	05/03/84	.
MSB 4A	05/03/84	.
MSB 5A	05/10/84	.

(CONTINUED)

APPENDIX C. ANALYTES IN EACH WELL

NEGATIVE NUMBERS REPRESENT DETECTIONS LIMITS. DOTS REPRESENT ANALYSES NOT PERFORMED

WELL	SAMPLE DATE	NAME OF ANALYTE: 1,4-DICHLOROBENZENE UG/L RESULT
MSB 6A	05/10/84	.
MSB 7A	05/10/84	.
MSB 8A	05/10/84	.
MSB 9A	06/03/83	.
	04/13/84	.
MSB 9B	04/17/84	.
MSB 9C	06/02/83	1.000
	04/16/84	.
MSB 10A	04/17/84	.
MSB 10B	04/18/84	.
MSB 10C	04/18/84	.
MSB 11A	05/25/83	.
	04/12/84	.
MSB 11B	04/12/84	.
MSB 11C	04/12/84	.
MSB 11D	04/12/84	.
MSB 11F	04/12/84	.
MSB 12A	04/19/84	.
MSB 12B	04/19/84	.
MSB 12C	04/18/84	.

(CONTINUED)

APPENDIX C. ANALYTES IN EACH WELL

NEGATIVE NUMBERS REPRESENT DETECTIONS LIMITS. DOTS REPRESENT ANALYSES NOT PERFORMED

WELL	SAMPLE DATE	1,4-DICHLOROBENZENE UG/L RESULT
MSB 12D	04/18/84	.
MSB 12TA	05/25/84	.
MSB 12TB	05/17/84	.
MSB 13A	04/20/84	.
MSB 13B	04/20/84	.
MSB 13C	04/20/84	.
MSB 14A	06/14/84	.
MSB 14B	04/13/84	.
MSB 14C	04/13/84	.
MSB 15A	05/26/83	.
	04/16/84	.
MSB 16A	05/25/83	.
	04/17/84	.
MSB 16C	05/26/83	.
	04/17/84	.
MSB 17A	04/23/84	.
MSB 17B	04/24/84	.
MSB 18A	04/23/84	.
MSB 18B	04/23/84	.
MSB 18C	04/23/84	.

(CONTINUED)

APPENDIX C. ANALYTES IN EACH WELL

NEGATIVE NUMBERS REPRESENT DETECTIONS LIMITS. DOTS REPRESENT ANALYSES NOT PERFORMED

WELL	SAMPLE DATE	NAME OF ANALYTE: 1,4-DICHLOROBENZENE UG/L RESULT
MSB 19A	06/08/84	.
MSB 19B	06/08/84	.
MSB 19C	06/13/84	.
MSB 20A	04/24/84	.
MSB 20C	04/24/84	.
MSB 21A	04/25/84	.
MSB 21C	04/24/84	.
MSB 22	04/13/84	.
MSB 23	06/01/83	.
	05/11/84	.
MSB 23A	05/11/84	.
MSB 23B	06/01/83	.
	05/11/84	.
MSB 24	06/02/83	.
	05/15/84	.
MSB 24A	06/01/83	.
	05/15/84	.
MSB 25	05/15/84	.
MSB 25A	05/15/84	.
MSB 26	04/26/84	.

(CONTINUED)

APPENDIX C. ANALYTES IN EACH WELL

NEGATIVE NUMBERS REPRESENT DETECTIONS LIMITS. DOTS REPRESENT ANALYSES NOT PERFORMED

		NAME OF ANALYTE
		1,4-DICHLOROBENZENE UG/L
		RESULT
WELL	SAMPLE DATE	
MSB 26A	04/26/84	.
MSB 27	06/10/83	.
	04/26/84	.
MSB 27A	06/06/83	.
	06/13/84	.
MSB 28	04/30/84	.
MSB 28A	04/30/84	.
MSB 30A	04/30/84	.
MSB 30C	04/30/84	.
MSB 31A	05/09/84	.
MSB 31B	06/01/83	.
	05/09/84	.
MSB 31C	06/01/83	.
	05/09/84	.
MSB 32	06/14/84	.
MSB 33	05/09/84	.
MSB 34A	04/25/84	.
MSB 34B	04/25/84	.
MSB 34C	04/25/84	.
MSB 34TA	05/16/84	.

(CONTINUED)

APPENDIX C. ANALYTES IN EACH WELL

NEGATIVE NUMBERS REPRESENT DETECTIONS LIMITS. DOTS REPRESENT ANALYSES NOT PERFORMED

WELL	SAMPLE DATE	NAME OF ANALYTE: 1,4-DICHLOROBENZENE UG/L RESULT
MSB 34TB	05/16/84	.
RWM 2	05/18/84	.
RWM 3	05/18/84	.
SRW 1C	05/04/84	.
SRW 2A	05/02/84	.
SRW 2B	05/02/84	.
SRW 2C	05/02/84	.
SRW 3C	05/02/84	.
SRW 4C	06/18/84	.
SRW 5C	05/04/84	.
SRW 6C	05/04/84	.
SRW 9A	06/01/84	.
SRW 9B	06/04/84	.
SRW 12A	06/04/84	.
SRW 12B	06/04/84	.
SRW 12C	06/06/84	.
SRW 13A	05/31/84	.
SRW 13B	05/31/84	.
SRW 13C	06/01/84	.
SRW 14A	05/07/84	.

(CONTINUED)

APPENDIX C. ANALYTES IN EACH WELL

NEGATIVE NUMBERS REPRESENT DETECTIONS LIMITS. DOTS REPRESENT ANALYSES NOT PERFORMED

		NAME OF ANALYTE: 1,4-DICHLOROBENZENE UG/L
WELL	SAMPLE DATE	RESULT
SRW 14B	05/04/84	.
SRW 14C	05/04/84	.
SRW 15A	05/07/84	.
SRW 15B	05/07/84	.
SRW 15C	05/01/84	.
SRW 16A	05/08/84	.
SRW 16B	05/07/84	.

APPENDIX D. RESULTS OF MONITORING WELL ANALYSES FOR M-AREA SETTLING BASIN

Appendix D contains a time sequence of analyses from water-table wells adjacent to the M-Area settling basin and Lost Lake. Although these wells are not as spacially distributed as those in Appendix C, the time sequence may be of value. The protocol for collecting these samples is given in Appendix E-3.

APPENDIX D

Results of Monitoring Well Analyses for M-Area Settling Basin

MSB 1 and 1A Background	Plant Coordinates:	MSB 1	MSB 1A
		N 101824.2	101824.23
		E 48486.1	48468.50
	Casing Elevation (ft):	353.4	352.53

Parameter	Units	Maximum Contaminant Levels	3/10/82	4/15/82	7/28/82	10/12/82	1/11/83	4/13/83	7/16/83	11/24/83	2/8/84	3/20/84	4/13/84	7/5/84
Casing Material			Steel	Steel	Steel	Steel	PVC	PVC	PVC	PVC	PVC	PVC	PVC	PVC
Sampling Technique			Bail	Bail	Bail	Bail	Bail	Bail	Pump	Pump	Pump	Pump††	Pump	Pump Filter††
Water Table Elevation	Ft		243.9	244.4	243.9	243.6	242.0	241.0	242.3	244.5	242.4	242.6	242.5	242.6
Coliform B	#/100 ml	4	0	0	0	0	23	-	-	-	-	-	-	-
Color	CU		3		3	5	2	3	-	0†	0	-	-	-
Corrosivity			No	No	No	No	No	-	-	-	No	-	-	-
Odor			1	0	0	0	4	-	-	-	4	-	-	-
Field pH	pH		10.6	7.6	8.6	6.0	4.5	**	6.1	4.8	4.6	5.3	5.3	4.4
Field Conductivity	μmho/cm		252	163	221	111	40	41	77	27	27	41	38	77
TDS	mg/L		101	107	71	87	20	52	59	48†	18	-	48	68
Temp	°C		22.5	18.7	21.6	18.9	17.8	21.5	20.3	18.7	18.0	19.0	19.2	18.8
Turbidity	NTU		4.1	7.5	3.4	0.1	0.2	3.4	-	0†	0	-	-	-
Ag	mg/L	0.05	<0.001	<0.001	<0.001	<0.001	<0.001	-	-	-	<0.001	<0.001	-	-
As	mg/L	0.05	<0.002	0.003	<0.002	<0.002	<0.002	-	-	-	<0.003	<0.003	-	-
Ba	mg/L	1.0	<0.05	<0.05	<0.05	0.49	<0.05	-	-	-	<0.10	<0.10	-	-
Be	mg/L		<0.005	<0.005	<0.010	<0.005	<0.005	-	-	-	<0.01	<0.01	-	-
Cd	mg/L	0.01	0.029	0.004	0.008	0.004	0.006	-	-	-	<0.001	<0.001	-	-
Cr	mg/L	0.05	0.005	0.010	0.003	0.024	0.039	0.007	0.003	0.004	<0.003	<0.003	<0.003	<0.005
Cu	mg/L		0.029	0.011	0.008	0.025	0.008	-	-	-	0.005	0.007	-	-
Fe	mg/L		1.46	1.20	1.185	16.86	93.42	-	-	-	0.474	<0.04	-	-
Hg	mg/L	0.002	<0.002	0.0002	<0.0002	0.0002	<0.0002	-	-	-	<0.0002	<0.0002	-	-
Mn	mg/L		<0.02	0.016	0.033	0.25	0.16	-	-	-	<0.02	0.033	-	-
Na	mg/L		-	14.30	15.70	9.32	6.49	-	-	-	4.72	4.60	-	-
Ni	mg/L		0.008	0.010	0.009	0.020	0.014	-	-	-	0.019	0.009	-	-
Pb	mg/L	0.05	0.553	0.158	0.082	0.152	0.015	0.005	***	0.036	0.017	0.002	0.006	0.008
Se	mg/L	0.01	<0.002	<0.002	<0.002	<0.002	<0.002	-	-	-	<0.003	0.003	-	-
Zn	mg/L		76.4	20.28	11.46	18.08	0.751	-	-	-	0.187	0.136	-	-
Cl	mg/L		3.0	4	4.6	3.5	2.3	5.3	1.6	3.5†	3.4	-	3.9	3.8
CN	mg/L		0.008	0.012	<0.005	<0.005	<0.005	-	-	-	<0.005	-	-	-
F	mg/L	1.6*	0.5	0.14	0.15	0.13	0.01	-	-	<0.01	0.01	-	-	-
Foaming Agents	mg/L		0.01	<0.01	<0.01	<0.01	<0.01	-	-	-	<0.01	-	-	-
H_2S	mg/L		<1.0	<1.0	<1.0	<1.0	<1.0	-	-	-	<1	-	-	-
NO_3(as N)	mg/L	10	1.4	0.8	3.29	3.75	3.01	-	-	-	2.9	3.1	-	-
SO_4	mg/L		20	<5	<5	5	<5	-	-	<5	<5	-	-	-
Gross Alpha	pCi/L	15	0	0.3	0.7	0.74	2.2	6.8	1.56	<2†	<2†††	-	-	-
Gross Beta	pCi/L		45	4	10.1	0.45	3.1	6.9	4.62	10†	11†††	-	-	-
Ra	pCi/L	5	<0.26	<0.18	<0.45	0.51	0.77	-	-	-	<1	-	-	-
DOC	mg/L		7.0	5	4	2	5.5	2	<1	<5	<5	-	<5	<5
GC SCAN	μg/L		<66	<40	56	<40	129	-	-	-	40	-	-	-
Phenols	mg/L		<0.002	<0.002	<0.002	0.003	<0.002	-	-	-	<0.002	-	-	-
TOC	mg/L		-	4	2	5	21.3	13	2	5	<5	-	<5	<5
TOH	mg/L		-	0.970	0.400	216	0.21	0.49	0.160	0.140	0.190	-	0.2	0.150
Endrin	μg/L	0.2	<0.003	<0.54	<0.04	<0.04	<0.04	-	-	-	<0.04	-	-	-
Lindane	μg/L	4	<0.003	<0.17	<1	<1	<1	-	-	-	<1	-	-	-
Methoxychlor	μg/L	100	<0.035	<2.5	<20	<20	<20	-	-	-	<20	-	-	-
Toxaphene	μg/L	5	<0.5	<6.0	<1	<1	<1	-	-	-	<1	-	-	-
24D	μg/L	100	<17.73	<0.31	<20	<20	<20	-	-	-	<20	-	-	-
245TP	μg/L	10	<0.007	<0.14	<2	<2	[illegible]	-	-	-	<2	-	-	-

APPENDIX D Contd

Results of Monitoring Well Analyses for M-Area Settling Basin

MSB 2 and 2A Downgradient	Plant Coordinates:	MSB 2	MSB 2A
		N 101999.2	102021.39
		E 48741.9	48746.0
	Casing Elevation (ft):	352.3	351.72

Parameter	Units	Maximum Contaminant Levels	3/11/82	4/15/82	7/28/82	10/12/82	1/11/83	4/13/83	7/16/83	11/24/83	2/8/84	3/20/84	4/13/84	7/5/84
Casing Material			Steel	Steel	Steel	Steel	PVC	PVC	PVC	PVC	PVC	PVC	PVC	PVC
Sampling Technique			Bail	Bail	Bail	Bail	Bail	Bail	Pump	Pump	Pump	Pump††	Pump	Pump Filter††
Water Table Elevation	Ft		241.1	240.8	241.9	241.8	241.7	241.7	242.0	-	241.8	242.8	242.6	242.8
Coliform B	#/100 ml	4	0	0	0	100	33	-	-	-	-	-	-	-
Color	CU		5	5	5	5	2	5	-	55†	7	-	-	-
Corrosivity			No	No	No	No	No	-	-	-	No	-	-	-
Odor			1	2	1	0	4	-	-	-	0	-	-	-
Field pH	pH		6.1	5.6	7.1	6.3	3.4	**	4.1	4.1	3.7	4.5	4.3	3.5
Field Conductivity	µmho/cm		498	155	220	238	62	77	114	29	32	42	40	79
TDS	mg/L		324	104	136	157	38	91	50	26†	20	-	24	62
Temp	°C		17.2	19.0	20.3	19.2	17.5	20.6	21.0	18.7	18.0	19.3	19.5	18.4
Turbidity	NTU		17.0	13.6	14.4	0.1	0.1	1.6	-	0†	-	-	-	-
Ag	mg/L	0.05	<0.001	<0.001	<0.001	<0.001	<0.001	-	-	-	<0.001	<0.001	-	-
As	mg/L	0.05	<0.002	0.003	<0.002	0.006	<0.002	-	-	-	<0.003	<0.003	-	-
Ba	mg/L	1.0	0.39	<0.05	0.21	0.18	0.06	-	-	-	<0.10	<0.10	-	-
Be	mg/L		<0.005	<0.005	<0.010	<0.005	<0.005	-	-	-	<0.01	<0.01	-	-
Cd	mg/L	0.01	0.008	0.014	0.019	0.022	0.011	-	-	-	<0.001	<0.001	-	-
Cr	mg/L	0.05	0.275	0.075	0.022	0.115	0.031	0.007	0.002	0.006	0.005	<0.003	<0.003	0.008
Cu	mg/L		0.064	0.010	0.044	0.107	0.011	-	-	-	0.015	0.012	-	-
Fe	mg/L		97.6	18.24	12.34	111.4	56.72	-	-	-	0.90	0.07	-	-
Hg	mg/L	0.002	0.0003	0.0002	<0.0002	0.0006	<0.0002	-	-	-	0.0002	<0.0002	-	-
Mn	mg/L		1.235	0.424	1.615	3.09	0.08	-	0.06	-	<0.02	<0.02	-	-
Na	mg/L		-	18.74	19.42	24.49	6.32	-	-	-	3.50	2.63	-	-
Ni	mg/L		0.114	0.042	0.039	0.032	0.018	-	0.012	-	0.018	0.015	-	-
Pb	mg/L	0.05	0.040	0.026	0.032	0.065	0.021	<0.001	***	0.039	0.040	0.013	0.012	0.016
Se	mg/L	0.01	<0.002	<0.002	<0.002	<0.002	<0.002	-	-	-	<0.003	<0.003	-	-
Zn	mg/L		3.765	-	-	-	-	-	-	-	0.038	0.023	-	-
Cl	mg/L		4.0	3	5.8	3.4	30.6	6.0	7.0	3.0†	3.4	-	3.8	4.3
CN	mg/L		0.007	0.013	<0.005	0.007	<0.005	-	-	-	<0.005	-	-	-
F	mg/L	1.6*	0.2	<0.10	0.20	0.13	0.05	-	-	<0.10	0.01	-	-	-
Foaming Agents	mg/L		0.02	<0.01	0.20	0.04	<0.01	-	-	-	0.04	-	-	-
H_2S	mg/L		<1.0	<1.0	<1.0	<1.0	<1.0	-	-	-	<1.0	-	-	-
NO_3(as N)	mg/L	10	2.26	0.30	3.16	3.01	6.23	-	-	-	2.95	2.85	-	-
SO_4	mg/L		33	<5	<5	5	90	-	-	<5	<5	-	-	-
Gross Alpha	pCi/L	15	2	3.2	2.0	1.98	4.8	3.9	7.90	8.0†	7†††	-	-	-
Gross Beta	pCi/L		8	7	10.4	9.53	2.2	3.8	8.44	44.0†	12†††	-	-	-
Ra	pCi/L	5	1.95	1.17	1.08	0.97	4.14	-	-	-	6	-	-	-
DOC	mg/L		13.0	19	6	6	7.0	2	5	5	<5	-	<5	<5
GC SCAN	µg/L		41.0	280	206	197	1217	-	-	-	93	-	-	-
Phenols	mg/L		0.004	<0.002	0.014	0.003	<0.002	-	-	-	<0.002	-	-	-
TOC	mg/L		-	16	14	39	36.8	28	8	5	<5	-	<5	<5
TOH	mg/L		-	0.190	4.7	50	2.1	0.98	1.50	0.360	0.320	-	0.40	0.810
Endrin	µg/L	0.2	-	<0.54	<0.04	<0.04	<0.04	-	-	-	<0.04	-	-	-
Lindane	µg/L	4	-	<0.17	<1	<1	<1	-	-	-	<1	-	-	-
Methoxychlor	µg/L	100	-	<2.5	<20	<20	<20	-	-	-	<20	-	-	-
Toxaphene	µg/L	5	-	<6.0	<1	<1	<1	-	-	-	<1	-	-	-
24D	µg/L	100	-	<0.31	<20	<20	<20	-	-	-	<20	-	-	-
245TP	µg/L	10	-	<0.14	<2	<2	<2	-	-	-	<2	-	-	-

APPENDIX D Contd

Results of Monitoring Well Analyses for M-Area Settling Basin

		MSB 3	MSB 3A
MSB 3 and 3A Downgradient	Plant Coordinates:	N 102181.6	102181.57
		E 48530.7	48552.08
	Casing Elevation, (ft)	359.6	359.03

Parameter	Units	Maximum Contaminant levels	3/8/82	4/15/82	7/28/82	10/12/82	1/11/83	4/13/83
Casing Material			Steel	Steel	Steel	Steel	PVC	PVC
Sampling Technique			Bail	Bail	Bail	Bail	Bail	Bail
Water Table Elevation	Ft		242.6	242.6	243.1	243.2	242.0	242.2
Coliform B	#/100 ml	4	0	0	0	0	0	-
Color	CU		15	7	5	70	5	3
Corrosivity			No	No	No	No	No	-
Odor			4.0	2	2	165	128	-
Field pH	pH		5.0	4.9	5.7	5.8	3.8	**
Field Conductivity	µmho/cm		200	254	482	148	1198	1178
TDS	mg/L		228	147	507	355	877	938
Temp	°C		18.2	19.8	22.7	19.4	18.9	19.6
Turbidity	NTU		-	7.4	2.1	2.6	0.3	1.5
Ag	mg/L	0.05	<0.001	<0.001	<0.001	<0.001	<0.001	-
As	mg/L	0.05	<0.002	<0.002	<0.002	<0.002	<0.002	-
Ba	mg/L	1.0	0.24	0.07	0.35	<0.05	0.05	-
Be	mg/L		<0.005	<0.005	<0.010	<0.005	<0.005	-
Cd	mg/L	0.01	0.013	0.008	0.090	0.258	0.026	-
Cr	mg/L	0.05	0.184	0.100	0.029	0.052	0.025	0.014
Cu	mg/L		0.062	<0.002	0.014	0.015	0.030	-
Fe	mg/L		35.45	33.42	29.17	34.74	49.10	-
Hg	mg/L	0.002	<0.0002	0.0010	<0.0002	0.003	<0.0002	-
Mn	mg/L		0.0448	0.674	1.331	0.74	0.56	-
Na	mg/L		-	11.70	12.04	93.7	230.0	-
Ni	mg/L		0.047	0.084	0.079	0.179	0.042	-
Pb	mg/L	0.05	0.100	0.043	0.038	0.051	0.008	0.004
Se	mg/L	0.01	<0.002	<0.002	<0.002	<0.002	<0.002	-
Zn	mg/L		12.72	5.020	7.56	3.71	0.373	-
Cl	mg/L		5.0	4	7.7	13.8	16.3	21.1
CN	mg/L		0.005	0.028	<0.005	0.011	0.077	-
F	mg/L	1.6*	<0.10	0.13	<0.10	0.14	0.63	-
Foaming Agents	mg/L		<0.01	<0.01	<0.01	<0.01	0.09	-
H_2S	mg/L		<1.0	<1.0	<1.0	<1.0	<1.0	-
NO_3(as N)	mg/L	10	74.98	10.62	4.18	54.35	129.4	-
SO_4	mg/L		3	<5	<5	10	<5	-
Gross Alpha	pCi/L	15	1	5.3	0.2	2.8	1.7	1.7
Gross Beta	pCi/L		10	32	7.3	19.7	8.3	7.7
Ra	pCi/L	5	1.33	3.07	7.99	4.61	9.96	-
DOC	mg/L		10.0	11	9	10	4.2	4
GC SCAN	µg/L		160000	81070	70835	41882	85870	-
Phenols	mg/L		0.048	0.056	0.031	0.040	0.024	-
TOC	mg/L		-	27	23	1100	100.5	25
TOH	mg/L		-	6.200	16.0	64	78.0	79.0
Endrin	µg/L	0.2	<0.003	<1.4	<0.04	<0.04	<0.04	-
Lindane	µg/L	4	<0.003	<0.2	<1	<1	<1	-
Methoxychlor	µg/L	100	<0.035	<7.3	<20	<20	<20	-
Toxaphene	µg/L	5	<0.5	<60.0	<1	<1	<1	-
24D	µg/L	100	<2.45	<0.31	<20	<20	<20	
245TP	µg/L	10	<0.007	<0.14	<2	<2	4.5	

Parameter	7/16/83	11/24/83	2/15/84	3/20/84	3/84¶	4/13/84	7/5/84
Casing Material	PVC	PVC	PVC	PVC	PVC	PVC	PVC
Sampling Technique	Pump	Pump	Pump	Pump††	Pump	Pump	Pump Filter††
Water Table Elevation	242.0	-	242.0	242.0	-	242.1	242.1
Coliform B	-	-	-	-	-	-	-
Color	-	35†	50	-	-	-	-
Corrosivity	-	-	No	-	-	-	-
Odor	-	-	8	-	-	-	-
Field pH	4.3	4.4	4.7	5.3	5.6	5.2	4.3
Field Conductivity	925	1325	~1400	1100	900	960	1320
TDS	832	1016†	1176	-	-	1390	946
Temp	21.4	19.8	22	20	-	19.8	19.8
Turbidity	-	0†	-	-	-	-	-
Ag	-	-	<0.001	<0.001	-	-	-
As	-	-	<0.003	<0.003	-	-	-
Ba	-	-	<0.10	<0.10	0.064	-	-
Be	-	-	<0.01	<0.01	-	-	-
Cd	-	-	0.002	<0.001	-	-	-
Cr	0.017	0.011	0.008	<0.003	-	0.013	<0.005
Cu	-	-	0.033	0.033	0.065	-	-
Fe	-	-	1.47	0.11	-	-	-
Hg	-	-	0.0002	<0.0002	-	-	-
Mn	0.080	-	0.384	0.318	0.333	-	-
Na	-	-	300.2	311.2	357	-	-
Ni	0.057	-	0.026	0.055	0.093	-	-
Pb	***	0.046	0.109	0.041	0.075	0.033	0.034
Se	-	-	<0.003	<0.003	-	-	-
Zn	-	-	5.28	2.77	-	-	-
Cl	11.8	16.1†	11.1	-	23.2	40	19.9
CN	-	-	0.036	-	-	-	-
F	0.20	0.20	0158	-	-	-	-
Foaming Agents	-	-	<0.01	-	-	-	-
H_2S	-	-	<1.0	-	-	-	-
NO_3(as N)	-	-	130	148	181	-	-
SO_4	83	100	103	-	288	-	-
Gross Alpha	3.32	30†	21†††	-	-	-	-
Gross Beta	12.18	36†	222†††	-	-	-	-
Ra	-	-	15	-	-	-	-
DOC	15	5	11	-	-	8	<5
GC SCAN	90000	-	54,130	-	-	-	-
Phenols	0.010	-	0.018	-	-	-	-
TOC	31	12	10	-	-	8	6
TOH	120	140	130	-	-	160	94¶¶
Endrin	-	-	<0.04	-	-	-	-
Lindane	-	-	<1	-	-	-	-
Methoxychlor	-	-	<20	-	-	-	-
Toxaphene	-	-	<1	-	-	-	-
24D	-	-	<20	-	-	-	-
245TP	-	-	<2	-	-	-	-

APPENDIX D Contd

Results of Monitoring Well Analyses for M-Area Settling Basin

		MSB 4	MSB 4A
MSB 4 and 4A Downgradient	Plant Coordinates:	N 102010.4 E 48313.8	101982.66 48312.57
	Casing Elevation (ft):	355.1	354.05

Parameter	Units	Maximum Contaminant Levels	3/11/82	4/15/82	7/28/82	10/12/82	1/12/83	4/14/83	7/16/83	11/24/83	2/8/84	3/20/84	4/13/84	7/5/84
Casing Material			Steel	Steel	Steel	Steel	PVC	PVC	PVC	PVC	PVC	PVC	PVC	PVC
Sampling Technique			Bail	Bail	Bail	Bail	Bail	Bail	Pump	Pump	Pump	Pump††	Pump	Pump Filter††
Water Table Elevation	Ft		242.6	242.6	242.7	243.6	242.0	241.0	241.9	241.7	241.7	242.6	242.1	242.4
Coliform B	#/100 ml	4	0	0	0	500	27	-	-	-	-	-	-	-
Color	CU		50	-	3	3	5	7	-	140†	0	-	-	-
Corrosivity			No	No	No	No	No	-	-	-	No	-	-	-
Odor			4	4	2	1	32	-	-	-	4	-	-	-
Field pH	pH		4.8	-	6.1	5.3	4.3	**	4.5	4.7	4.2	4.9	4.7	4.1
Field Conductivity	μmho/cm		135	-	33	42	98	76	161	616	715	590	435	590
TDS	mg/L		86	-	98	109	110	98	124	444†	468	-	666	522
Temp	°C		19.2	-	24.5	19.1	17.0	19.2	20.6	18.9	18.9	19.5	20.0	18.6
Turbidity	NTU		19.0	-	3.1	2.2	0.4	1.3	-	1†	0	-	-	-
Ag	mg/L	0.05	<0.001	0.001	<0.001	<0.001	<0.001	-	-	-	<0.001	<0.001	-	-
As	mg/L	0.05	0.017	<0.002	<0.002	0.004	<0.002	-	-	-	<0.003	<0.003	-	-
Ba	mg/L	1.0	1.31	0.21	0.17	0.06	<0.05	-	-	-	<0.10	<0.10	-	-
Be	mg/L		0.014	0.017	<0.010	<0.005	<0.005	-	-	-	<0.01	<0.01	-	-
Cd	mg/L	0.01	0.034	0.040	0.042	0.024	0.012	-	0.001	-	<0.001	<0.001	-	-
Cr	mg/L	0.05	1.908	0.649	0.096	0.179	0.041	0.006	<0.001	0.007	0.005	<0.003	0.008	<0.005
Cu	mg/L		0.211	0.240	0.477	0.109	0.019	-	0.003	-	0.11	0.022	-	-
Fe	mg/L		712.0	201.0	80.35	92.8	104.1	-	-	-	0.70	0.17	-	-
Hg	mg/L	0.002	0.002	0.0002	0.1025	0.0136	<0.0002	-	-	-	0.0003	<0.0002	-	-
Mn	mg/L		3.232	0.963	0.950	0.88	0.40	-	0.10	-	0.028	0.028	-	-
Na	mg/L		-	0.99	1.04	15.77	11.03	-	-	-	114.6	109.7	-	-
Ni	mg/L		0.611	0.301	0.297	0.090	0.024	-	0.011	-	0.018	0.017	-	-
Pb	mg/L	0.05	0.167	0.639	0.265	0.437	0.010	0.005	***	0.031	0.033	0.018	0.016	0.014
Se	mg/L	0.01	<0.002	<0.002	<0.002	<0.002	<0.002	-	-	-	<0.003	<0.003	-	-
Zn	mg/L		14.54	43.0	11.24	21.78	0.293	-	-	-	0.079	0.078	-	-
Cl	mg/L		8.0	-	4.0	3.5	4.8	5.1	8.0	8.6†	4.2	-	12.5	9.1
CN	mg/L		0.009	0.018	<0.005	0.006	<0.005	-	-	-	<0.005	-	-	-
F	mg/L	1.6*	0.1	<0.1	0.17	0.27	0.01	-	-	0.02	0.02	-	-	-
Foaming Agents	mg/L		0.024	<0.01	0.02	0.22	<0.01	-	-	-	0.08	-	-	-
H_2S	mg/L		<1.0	<1.0	<1.0	<1.0	<1.0	-	-	-	<1.0	-	-	-
NO_3(as N)	mg/L	10	0.48	0.61	0.43	3.63	10.11	-	-	13	70	55	-	-
SO_4	mg/L		12	<5	<5	5	<5	-	-	5	<5	-	-	-
Gross Alpha	pCi/L	15	7	12.9	0.5	1.9	5.7	5.1	4.19	29†	13†††	-	-	-
Gross Beta	pCi/L		46	59	3.9	10.6	16.7	8.9	4.62	28†	39†††	-	-	-
Ra	pCi/L	5	1.01	1.80	1.66	1.32	1.83	-	-	-	25	-	-	-
DOC	mg/L		7.0	7	15	32	5.3	<1	4	6	<5	-	<5	<5
GC SCAN	μg/L		<6.6	170	166	126	177	-	270	-	309	-	-	-
Phenols	mg/L		0.016	0.035	<0.002	<0.002	<0.002	-	-	-	0.006	-	-	-
TOC	mg/L		-	28	14	140	96.0	26	6	6	<5	-	<5	<5
TOH	mg/L		-	0.170	0.520	0.17	0.74	0.73	1.10	1.40	1.50	-	1.50	1.10
Endrin	μg/L	0.2	<0.003	<0.014	<0.04	<0.04	<0.04	-	-	-	<0.04	-	-	-
Lindane	μg/L	4	<0.003	<0.002	<1	<1	<1	-	-	-	<1	-	-	-
Methoxychlor	μg/L	100	<0.035	<0.073	<20	<20	<20	-	-	-	<20	-	-	-
Toxaphene	μg/L	5	<0.5	<0.61	<1	<1	<1	-	-	-	<1	-	-	-
24D	μg/L	100	<18.94	<0.31	<20	<20	<20	-	-	-	<20	-	-	-
245TP	μg/L	10	<0.007	<0.14	<2	<2	<2	-	-	-	<2	-	-	-

APPENDIX D Contd

Results of Monitoring Well Analyses for M-Area Settling Basin

		MSB 5	MSB 5A
MSB 5 and 5A Downgradient	Plant Coordinates:	N 101768.7 E 46983.8	101948.21 46998.81
	Casing Elevation (ft):	339.1	343.63

Parameter	Units	Maximum Contaminant Levels	3/10/82	4/22/82	7/28/82	11/23/82	1/12/83	4/13/83	7/16/83	11/25/83	2/8/84	4/16/84	7/9/84
Casing Material			Steel	Steel	Steel	PVC	PVC	PVC	PVC	PVC	PVC	PVC	PVC
Sampling Technique			Bail	Bail	Bail	Bail	Bail	Bail	Pump	Pump	Pump	Pump	Pump Filter††
Water Table Elevation	Ft		240.3	240.1	240.9	238.6	238.1	238.6	238.5	239.3	239.3	239.2	239.7
Coliform B	#/100 ml	4	0	0	0	16	79	-	-	-	-	-	-
Color	CU		20	30	7	10	2	2	-	45†	0	-	-
Corrosivity			No	No	No	No	No	-	-	-	No	-	-
Odor			2	6	4	14	1	-	-	-	2	-	-
Field pH	pH		6.2	5.2	5.9	6.1	5.0	**	5.2	4.7	4.8	5.3	4.7
Field Conductivity	µmho/cm		434	120	203	189	169	95	179	152	149	105	110
TDS	mg/L		320	100	143	175	137	124	134	96†	112	136	98
Temp	°C		19.2	18.1	21.0	17.4	15.3	19.5	20.8	17.4	15.2	18.9	18.2
Turbidity	NTU		-	12.0	79	10.0	0.4	1.6	-	2†	8	-	-
Ag	mg/L	0.05	<0.001	<0.001	<0.001	<0.001	<0.001	-	-	-	0.003	-	-
As	mg/L	0.05	0.02	<0.002	<0.002	<0.002	<0.002	-	-	-	<0.002	-	-
Ba	mg/L	1.0	0.46	<0.05	<0.050	0.06	<0.05	-	-	-	<0.10	-	-
Be	mg/L		0.019	<0.010	<0.010	<0.005	<0.005	-	-	-	<0.01	-	-
Cd	mg/L	0.01	0.01	0.017	0.004	0.002	0.006	-	-	-	<0.001	-	-
Cr	mg/L	0.05	0.275	0.004	0.037	0.027	0.027	<0.001	0.005	<0.002	<0.003	0.004	<0.005
Cu	mg/L		0.108	0.021	0.048	0.007	0.007	-	-	-	0.111	-	-
Fe	mg/L		111.0	7.68	29.04	53.04	49.64	-	-	-	1.26	-	-
Hg	mg/L	0.002	<0.0002	<0.0002	<0.0002	0.0003	<0.0002	-	-	-	<0.0002	-	-
Mn	mg/L		2.253	0.536	0.791	0.13	0.21	-	-	-	<0.02	-	-
Na	mg/L		-	25.74	24.07	40.2	34.0	-	-	-	26.6	-	-
Ni	mg/L		0.099	0.010	0.009	0.022	0.018	-	-	-	0.006	-	-
Pb	mg/L	0.05	0.213	0.034	0.080	0.013	0.019	0.006	***	0.048	0.033	0.019	0.008
Se	mg/L	0.01	<0.002	<0.002	0.002	<0.002	<0.002	-	-	-	<0.003	-	-
Zn	mg/L		30.1	4.120	8.78	0.139	0.134	-	-	-	0.083	-	-
Cl	mg/L		6.0	5	8.1	4.1	4.6	4.8	5.1	5.0†	4.8	5.8	4.3
CN	mg/L		0.013	<0.005	<0.005	<0.005	<0.005	-	-	-	<0.005	-	-
F	mg/L	1.6*	0.10	<0.10	<0.10	0.10	0.03	-	-	0.01	<0.01	-	-
Foaming Agents	mg/L		0.016	<0.01	<0.01	<0.01	<0.01	-	-	-	0.06	-	-
H_2S	mg/L		<1.0	<1.0	<1.0	<1.0	<1.0	-	-	-	<1.0	-	-
NO_3(as N)	mg/L	10	10.46	5.25	7.76	8.57	18.31	-	-	10	14.8	-	-
SO_4	mg/L		14	<5	10	12	<5	-	-	<5	<5	-	-
Gross Alpha	pCi/L	15	5	3.7	3.9	1.5	1.1	0.0	1.27	6.0†	-	-	-
Gross Beta	pCi/L		38	14	4.2	9.0	2.6	2.1	2.25	4.0†	-	-	-
Ra	pCi/L	5	2.26	0.46	0.82	-	0.90	-	-	-	41	-	-
DOC	mg/L		13.0	4	5	4	5.3	1	2	5	7	<5	<5
GC SCAN	µg/L		<66	<40	<40	<40	<40	-	-	-	140	-	-
Phenols	mg/L		0.004	0.004	0.002	0.003	<0.002	-	-	-	0.002	-	-
TOC	mg/L		-	6	16	11	16.0	7	7	47	<5	<5	<5
TOH	mg/L		-	0.280	0.180	-	0.11	0.31	0.079	0.050	0.069	0.046	0.039
Endrin	µg/L	0.2	<0.003	<0.54	<0.04	<0.04	<0.04	-	-	-	0.04	-	-
Lindane	µg/L	4	<0.003	<0.17	<1	<1	<1	-	-	-	<1	-	-
Methoxychlor	µg/L	100	<0.035	<2.5	<20	<20	<20	-	-	-	<20	-	-
Toxaphene	µg/L	5	<0.5	<6.0	<1	<1	<1	-	-	-	<1	-	-
24D	µg/L	100	<4.44	<0.31	<20		<20	-	-	-	<20	-	-
245TP	µg/L	10	<0.007	<0.14	<2		<2	-	-	-	<2	-	-

APPENDIX D Contd

Results of Monitoring Well Analyses for M-Area Settling Basin

MSB 6 and 6A Downgradient	Plant Coordinates:	MSB 6	MSB 6A
		N 101080.1	101105.06
		E 46462.6	46328.28
	Casing Elevation (ft):	339.7	342.8

Parameter	Units	Maximum Contaminant Levels	3/10/82	4/22/82	7/28/82	11/18/82	1/12/83	4/13/83	7/16/83	11/25/84	2/9/84	4/18/84	7/9/84
Casing Material			Steel	Steel	Steel	PVC	PVC	PVC	PVC	PVC	PVC	PVC	PVC
Sampling Technique			Bail	Bail	Bail	Bail	Bail	Bail	Pump	Pump	Pump	Pump	Pump Filter††
Water Table Elevation	Ft		237.4	237.0	237.2	234.9	234.8	234.8	235.9	236.5	236.9	236.4	237.3
Coliform B	#/100 ml	4	0	0	0	>16	33	-	-	-	-	-	-
Color	CU		15	10	5	15	5	5	-	0†	0	-	-
Corrosivity			No	No	No	No	No	-	-	-	No	-	-
Odor			1	17	17	16	8	-	-	-	4	-	-
Field pH	pH		7.9	5.3	6.0	5.2	4.3	**	5.1	5.3	5.1	5.1	4.1
Field Conductivity	µmho/cm		264	94	148	66	30	24	60	27	21	28	38
TDS	mg/L		180	76	100	64	30	34	41	16†	26	20	34
Temp	°C		20.7	18.9	20.7	16.6	16.4	19.5	21.5	17.0	18.0	19.2	18.4
Turbidity	NTU		-	2.5	7.5	3.5	0.6	1.1	-	0†	0	-	-
Ag	mg/L	0.05	<0.001	<0.001	<0.001	<0.001	<0.001	-	-	-	<0.001	-	-
As	mg/L	0.05	0.02	<0.002	<0.002	<0.002	<0.002	-	-	-	<0.002	-	-
Ba	mg/L	1.0	6.59	0.104	0.19	0.24	0.47	-	-	-	0.010	-	-
Be	mg/L		0.195	<0.010	<0.010	<0.005	<0.005	-	-	-	<0.01	-	-
Cd	mg/L	0.01	0.102	0.004	0.007	0.001	0.016	-	-	-	<0.001	-	-
Cr	mg/L	0.05	1.906	0.005	0.017	0.014	0.016	<0.001	-	<0.002	<0.003	<0.003	<0.005
Cu	mg/L		0.4	0.014	0.043	0.013	0.008	-	-	-	0.007	-	-
Fe	mg/L		901.0	5.89	16.93	13.98	18.79	-	-	-	0.248	-	-
Hg	mg/L	0.002	0.002	<0.0002	<0.0002	0.0003	<0.0002	-	-	-	<0.0002	-	-
Mn	mg/L		45.94	0.483	0.836	0.42	0.34	-	-	-	<0.02	-	-
Na	mg/L		-	35.96	37.56	12.92	6.93	-	-	-	7.14	-	-
Ni	mg/L		1.598	0.011	0.014	0.046	0.031	-	-	-	0.003	-	-
Pb	mg/L	0.05	0.76	0.042	0.085	0.030	0.013	<0.001	***	0.001	0.028	0.013	0.015
Se	mg/L	0.01	<0.002	<0.002	0.002	<0.002	<0.002	-	-	-	<0.003	-	-
Zn	mg/L		243.0	2.595	14.87	0.196	0.152	-	-	-	0.010	-	-
Cl	mg/L		5.0	4	4.7	5.2	4.4	5.1	6.3	5.5†	6.3	6.3	5.4
CN	mg/L		0.014	<0.005	<0.005	<0.005	<0.005	-	-	-	<0.005	-	-
F	mg/L	1.6*	0.1	<0.10	0.18	<0.10	0.06	-	-	0.04	<0.01	-	-
Foaming Agents	mg/L		0.032	0.02	0.30	0.02	<0.01	-	-	-	0.06	-	-
H_2S	mg/L		<1.0	<1.0	<1.0	<1.0	<1.0	-	-	-	<1.0	-	-
NO_3(as N)	mg/L	10	0.06	0.33	0.23	0.46	0.61	-	-	6	<0.5	-	-
SO_4	mg/L		21	<5	<5	<5	<5	-	-	<5	<5	-	-
Gross Alpha	pCi/L	15	9.0	0.8	1.6	1.4	1.8	1.4	0.68	3.0†	<2	-	
Gross Beta	pCi/L		62	4	15.3	2.1	4.8	2.2	0.94	<3.0†	<3	-	-
Ra	pCi/L	5	2.23	0.57	0.88	-	0.27	-	-	-	2	-	-
DOC	mg/L		10.0	6	6	5	7.5	1	<1	6	<5	<5	<5
GC SCAN	µg/L		<66	110	<40	<40	<40	-	-	-	<40	-	-
Phenols	mg/L		0.002		<0.002	0.002	<0.002	-	-	-	<0.002	-	-
TOC	mg/L		-	2	3	16	15.3	8	3	8	<5	<5	<5
TOH	mg/L		-	0.530	0.250	0.37	0.008	0.36	0.028	0.014	0.019	0.013	0.015
Endrin	µg/L	0.2	<0.003	<0.54	<0.04	<0.04	<0.04	-	-	-	<0.04	-	-
Lindane	µg/L	4	<0.003	<0.17	<1	<1	<1	-	-	-	<1	-	-
Methoxychlor	µg/L	100	<0.035	<2.5	<20	<20	<20	-	-	-	<20	-	-
Toxaphene	µg/L	5	<0.5	<6.0	<1	<1	<1	-	-	-	<1	-	-
24D	µg/L	100	<7.31	<0.31	<20	<20	<20	-	-	-	<20	-	-
245TP	µg/L	10	<0.007	<0.14	<2	<2	<2	-	-	-	<2	-	-

APPENDIX D Contd

Results of Monitoring Well Analyses for M-Area Settling Basin

		MSB 7	MSB 7A
MSB 7 and 7A Downgradient	Plant Coordinates:	N 100730.7	100563.73
		E 46785.9	46737.06
	Casing Elevation (ft):	340.7	343.93

Parameter	Units	Maximum Contaminant Levels	3/11/82	4/22/82	8/3/82	11/18/82	1/12/83	4/13/83	7/16/83	11/25/84	2/8/84	4/8/84	7/ 9/84
Casing Material			Steel	Steel	Steel	PVC	PVC	PVC	PVC	PVC	PVC	PVC	PVC
Sampling Technique			Bail	Bail	Bail	Bail	Bail	Bail	Pump	Pump	Pump	Pump	Pump Filter††
Water Table Elevation	Ft		237.7	238.7	239.2	237.5	237.4	236.4	237.0	238.7	238.8	237.9	238.6
Coliform B	#/100 ml	4	0	0	0	>16	79	-	-	-	-	-	-
Color	CU		10	5	3	15	2	8	-	0†	0	-	-
Corrosivity			No	No	No	No	No	-	-	-	No	-	-
Odor			8	2	2	16	4	-	-	-	2	-	-
Field pH	pH		4.9	5.4	5.9	5.4	4.5	**	4.9	5.1	4.7	5.2	4.4
Field Conductivity	µmho/cm		287	169	131	74	33	21	98	37	61	50	68
TDS	mg/L		186	117	94	95	36	44	66	60†	54	62	50
Temp	°C		19.2	18.6	19.9	16.7	16.4	18.8	20.9	18.3	17.5	18.5	17.9
Turbidity	NTU			2.2	1.7	6.2	0.5	4.7	-	0†	0	-	-
Ag	mg/L	0.05	<0.001	<0.001	<0.001	<0.001	<0.001	-	-	-	<0.001	-	-
As	mg/L	0.05	0.006	<0.002	<0.002	<0.002	<0.002	-	-	-	<0.002	-	-
Ba	mg/L	1.0	0.12	<0.050	<0.05	0.26	0.46	-	-	-	<0.10	-	-
Be	mg/L		0.006	<0.010	<0.010	0.007	<0.005	-	-	-	<0.01	-	-
Cd	mg/L	0.01	0.158	0.007	0.016	0.002	0.025	-	-	-	<0.001	-	-
Cr	mg/L	0.05	0.015	0.025	0.017	0.046	0.040	0.012	0.003	0.014	<0.003	0.004	0.010
Cu	mg/L		0.016	0.001	0.014	0.010	0.009	-	-	-	0.007	-	-
Fe	mg/L		37.23	6.240	21.20	62.98	48.14	-	-	-	0.284	-	-
Hg	mg/L	0.002	0.0002	<0.0002	<0.0002	0.0003	<0.0002	-	-	-	0.0002	-	-
Mn	mg/L		2.265	0.620	0.963	0.31	0.17	-	-	-	0.026	-	-
Na	mg/L			8.14	4.02	12.48	5.45	-	-	-	12.58	-	-
Ni	mg/L		0.978	1.051	0.937	0.024	0.023	-	-	-	<0.003	-	-
Pb	mg/L	0.05	0.026	0.143	0.031	0.025	0.020	0.011	***	0.003	0.023	0.010	0.014
Se	mg/L	0.01	<0.002	<0.002	0.002	<0.002	<0.002	-	-	-	<0.003	-	-
Zn	mg/L		9.72	2.110	1.964	0.173	0.121	-	-	-	0.024	-	-
Cl	mg/L		3.0	4	6.7	3.8	2.6	7.2	5.4	4.5†	4.8	5.3	4.3
CN	mg/L		0.007	<0.005	<0.005	<0.005	<0.005	-	-	-	<0.005	-	-
F	mg/L	1.6*	0.2	0.16	0.36	<0.10	<0.01	-	-	0.03	0.02	-	-
Foaming Agents	mg/L		0.02	0.07	<0.01	0.02	<0.01	-	-	-	0.03	-	-
H_2S	mg/L		<1.0	<1.0	<1.0	<1.0	<1.0	-	-	-	<1.0	-	-
NO_3(as N)	mg/L	10	0.12	0.04	0.06	1.01	1.11	-	-	5.5	6.4	-	-
SO_4	mg/L		<3	<5	10	<5	<5	-	-	5	<5	-	-
Gross Alpha	pCi/L	15	2.0	0.7	1.2	5.9	3.0	3.0	2.63	5.0†	-	-	-
Gross Beta	pCi/L		17	12	11.3	9.9	10.0	3.4	4.06	4.0†	-	-	-
Ra	pCi/L	5	1.84	0.79	0.83	-	0.78	-	-	-	2	-	-
DOC	mg/L		15.0	6	6	5	7.5	1	2	5	<5	<5	<5
GC SCAN	µg/L		<66	<40	<40	<40	<40	-	-	-	<40	-	-
Phenols	mg/L		0.034	<0.002	<0.002	0.002	<0.002	-	-	-	<0.002	-	-
TOC	mg/L		-	2	9	28	26.0	26	5	5	<5	<5	<5
TOH	mg/L		-	0.079	0.210	0.39	0.031	<0.005	0.047	0.031	0.032	0.038	0.039
Endrin	µg/L	0.2	<0.003	<0.54	<0.04	<0.04	<0.04	-	-	-	<0.04	-	-
Lindane	µg/L	4	<0.003	<0.17	<1	<1	<1	-	-	-	<1	-	-
Methoxychlor	µg/L	100	<0.035	<2.5	<20	<20	<20	-	-	-	<20	-	-
Toxaphene	µg/L	5	<0.5	<6.0	<1	<1	<1	-	-	-	<1	-	-
24D	µg/L	100	<8.93	<0.31	<20	<20	<20	-	-	-	<20	-	-
245TP	µg/L	10	<0.007	<0.14	<2	2	<2	-	-	-	<2	-	-

APPENDIX D Contd

Results of Monitoring Well Analyses for M-Area Settling Basin

MSB 8 and 8A Downgradient	Plant Coordinates:		MSB 8	MSB 8A
		N	100944.0	100796.20
		E	47145.4	47302.80
	Casing Elevation (ft):		339.4	343.72

Parameter	Units	Maximum Contaminant Levels	3/10/82	4/22/82	8/3/82	11/17/82	1/12/83	4/13/83	7/16/83	11/24/84	2/8/84	4/18/84	7/5/84
Casing Material			Steel	Steel	Steel	PVC	PVC	PVC	PVC	PVC	PVC	PVC	PVC
Sampling Technique			Bail	Bail	Bail	Bail	Bail	Bail	Pump	Pump	Pump	Pump	Pump Filter††
Water Table Elevation	Ft		241.4	241.4	241.9	241.1	241.2	239.7	240.0	240.6	240.5	240.5	240.7
Coliform B	#/100 ml	4	0	0	0	>16	120	-	-	-	-	-	-
Color	CU		25	30	5	15	2	10	-	0†	0	-	-
Corrosivity			No	No	No	No	No	-	-	-	No	-	-
Odor			40	2	0	16	4	-	-	-	0	-	-
Field pH	pH		4.8	5.6	6.0	5.4	4.9	**	4.9	4.8	4.6	5.1	4.3
Field Conductivity	µmho/cm		277	198	201	76	29	28	99	65	77	-	120
TDS	mg/L		98	141	151	116	39	57	70	60†	54	82	104
Temp	°C		16.7	17.7	18.8	16.9	15.4	18.4	21.0	17.8	17.0	18.0	17.9
Turbidity	NTU		-	31	59	5.1	0.4	1.8	-	0†	0	-	-
Ag	mg/L	0.05	<0.001	<0.001	<0.001	<0.001	<0.001	-	-	-	<0.001	-	-
As	mg/L	0.05	<0.002	<0.002	<0.002	<0.002	<0.002	-	-	-	<0.002	-	-
Ba	mg/L	1.0	0.15	<0.050	<0.05	0.12	0.70	-	-	-	<0.10	-	-
Be	mg/L		0.006	<0.010	0.052	<0.005	0.006	-	-	-	<0.01	-	-
Cd	mg/L	0.01	0.002	0.010	<0.001	<0.001	0.005	-	-	-	<0.001	-	-
Cr	mg/L	0.05	0.138	0.001	0.010	0.040	0.046	0.001	<0.001	0.002	<0.003	0.003	<0.005
Cu	mg/L		0.031	0.005	0.030	0.012	0.038	-	-	-	0.003	-	-
Fe	mg/L		47.22	7.925	9.05	90.8	299.4	-	-	-	0.017	-	-
Hg	mg/L	0.002	0.0003	<0.0002	<0.0002	0.0007	0.0002	-	-	-	0.0002	-	-
Mn	mg/L		0.796	0.226	0.262	0.32	0.54	-	-	-	<0.02	-	-
Na	mg/L		-	27.76	24.48	14.92	5.06	-	-	-	14.46	-	-
Ni	mg/L		0.637	0.412	0.391	0.052	0.036	-	-	-	<0.003	-	-
Pb	mg/L	0.05	0.021	0.101	0.043	0.007	0.024	0.002	***	0.017	0.024	0.010	0.008
Se	mg/L	0.01	<0.002	<0.002	0.002	<0.002	<0.002	-	-	-	<0.003	-	-
Zn	mg/L		1.946	0.742	0.072	0.071	0.208	-	-	-	0.026	-	-
Cl	mg/L		5.0	6	9.5	2.5	1.3	3.7	3.8	3.5†	4.3	4.3	3.8
CN	mg/L		0.007	<0.005	<0.005	<0.009	<0.005	-	-	-	<0.005	-	-
F	mg/L	1.6*	<0.10	0.10	0.20	<0.10	0.01	-	-	0.01	0.02	-	-
Foaming Agents	mg/L		<0.01	0.03	<0.01	<0.01	<0.01	-	-	-	0.03	-	-
H_2S	mg/L		<1.0	<1.0	<1.0	<1.0	<1.0	-	-	-	<1.0	-	-
NO_3(as N)	mg/L	10	2.23	7.00	10.39	4.39	2.11	-	-	6.5	9.0	-	-
SO_4	mg/L		12	<5	<5	<5	<5	-	-	5	<5	-	-
Gross Alpha	pCi/L	15	2.0	2.4	3.5	5.6	13.9	5.9	1.27	7.0†	-	-	-
Gross Beta	pCi/L		24	6	18.2	9.3	14.3	9.4	2.75	3.0†	-	-	-
Ra	pCi/L	5	0.71	0.23	1.14	-	0.68	-	-	-	4	-	-
DOC	mg/L		16.0	5	14	4	4.2	2	<1	5	9	<5	<5
GC SCAN	µg/L		<66	<40	<40	<40	43	-	-	-	<40	-	-
Phenols	mg/L		<0.002							-	<0.002	-	-
TOC	mg/L		-	6	11	24	31.5	9	7	5	<5	<5	<5
TOH	mg/L		-	0.074	0.270	0.48	0.20	0.27	0.15	0.150	0.18	0.250	0.035
Endrin	µg/L	0.2	<0.003	<0.54	<0.04	<0.04	<0.04	-	-	-	<0.04	-	-
Lindane	µg/L	4	<0.003	<0.17	<1	<1	<1	-	-	-	<1	-	-
Methoxychlor	µg/L	100	<0.035	<2.5	<20	<20	<20	-	-	-	<20	-	-
Toxaphene	µg/L	5	<0.5	<6.0	<1	<1	<1	-	-	-	<1	-	-
24D	µg/L	100	<4.03	<0.31	<20	<20	<20	-	-	-	<20	-	-
245TP	µg/L	10	<0.007	<0.14	<2	<2	<2	-	-	-	<2	-	-

Footnotes to the monitoring well analyses Tables.

* MCL at 21.5 to 26.2°C.

** Not reported (Field measurement not confirmed by laboratory measurement).

*** Not reported (Field blank high).

† Envirodyne analysis of these parameters started 4th quarter, 1983 (previously determined by SRL-Health Protection).

†† Filtered thru 0.45 μm membrane.

††† Special Resample, (Samples taken first quarter of 1984).

¶ Special sample analyzed by ICP and IC at SRL.

¶¶ Assumed reporting error; changed 9.4 mg/L to 94 mg/L.

APPENDIX E. SAMPLING AND ANALYTICAL PROTOCOLS FOR GROUNDWATER QUALITY ANALYSES

All of the analyses reported in Appendices B, C, and D were collected by using a sampling protocol, but these differed over time and depending on the purpose of the sampling.

Appendix E-1 contains a sampling protocol developed in April 1983 and directed primarily toward obtaining samples for analysis of volatile organics. Thus it was used for the 1983 samples which were analyzed for degreaser solvents reported in Appendix B. It was also used, however, for the 1983 samples analyzed for metals, major cationic and anionic constituents, radioactivity, and certain other organic constituents reported in Appendix C. It should be noted that the protocol does not contain a requirement for filtering the sample, which can greatly affect the results for metal concentrations.

Appendix E-2 contains the sampling protocol formally issued in October 1984; however, it was the protocol used in collecting the samples April to July 1984, which are reported in Appendix C. This protocol is broadly based and addresses the collection of samples for any reason. It contains a procedure for filtering the sample for metal analysis. The full protocol contains a section on analytical procedure for samples analyzed at SRP. This is not included because all of the results given in Appendix C are from a contractor laboratory which maintains its own protocol and follows Environmental Protection Agency procedures.

Appendix E-3 contains the sampling protocol for the analytical results reported in Appendix D.

M-AREA GROUNDWATER SAMPLING PROCEDURES

PURPOSE

The technique for collecting groundwater samples for chemical analysis is critically important especially in the identification of volatile organic compounds. The primary concerns in collecting samples are: 1) to obtain representative samples by evacuating stagnant water from the well casing prior to obtaining the sample, and 2) to assure that contamination of the sample does not occur as part of the sampling technique. The purpose of this procedure is to provide complete instructions for the sampling of monitoring wells as part of the M-Area Groundwater Program.

INTRODUCTION

Newly installed monitoring wells are developed by the addition of large volumes of clean water and pumping with compressed air until the water being produced by the well is clear and free of sediments. After initial development approximately 1000 gallons of water is removed from the well by use of a submersible pump. Since volatile organics are a major concern, pumping with air is NOT used to remove this volume as this method would strip the organic compounds from the water during pumping.

Once the development of the well is completed, water samples for laboratory analysis can be collected. The South Carolina DHEC recommends four to six well-volumes be evacuated from a monitoring well prior to obtaining a sample for analysis. The sample should be collected immediately after evacuation. Because of the relative large diameter (4") of the monitoring wells and the depth of the wells (up to 300' or more), the evacuation of the minimum 4 well volumes is best accomplished with a submersible pump. Therefore, in order to prevent cross contamination and to facilitate the sampling operation, dedicated pumps are installed in each well to be sampled. The procedures to be followed in the collection of M-area groundwater samples as detailed in this document are in agreement with DPSOL 271-1-323, Well Water Sampling Procedure for Nonradioactive Parameters.

SAFETY

1) Personnel will wear safety glasses and rubber gloves when performing all phases of the sampling and handling procedures.
2) Housekeeping must be maintained at all sites.
3) Any unsafe conditions or hazards should be reported to supervision immediately.
4) When pumping, all equipment must be properly grounded.

PUMP SAMPLING

1) Obtain copies of groundwater sample data collection sheets from supervision. Attachment 1.
2) Obtain sample vials, field blanks, and coolers from 320-M laboratory. Obtain frozen ice packs and place in separate coolers for transport to the field.
3) Hook generator to vehicle. All pumps are 115-volt.
4) Proceed to the monitoring well with equipment. Wear safety glasses and rubber gloves for your personal protection at each site. Gloves also protect the sample since personal contact with equipment can introduce chemical contaminants.
5) Position generator near well to be sampled, but on opposite side of well discharge line.
6) Using an electric water level indicator, measure the depth to water (DTW) from the top of the well casing by inserting the probe into the 1/2" standpipe installed in each well for this purpose. Record the DTW in Column C of the data sheet.
7) Determine the water column in the well by subtracting the DTW (Column C) from the total depth of the well (Column B). Record in Column D.
8) Determine the amount (gallons) of water to be pumped from the well in order to evacuate 4 well volumes by multiplying the water column (Column D) by 2.6. Record in Column E.
9) Connect flow meter to discharge line.
10) Ensure pump switch is OFF and then connect pump cord to power source. [Note: More than one well at a sample site may be pumped at the same time]. Ensure system is grounded.
11) Check all valves, gages, etc. The discharge line valve must be open.
12) Record the flow meter reading in Column F.
13) Start generator.
14) Turn pump switch to ON and remove four well volumes as determined in Column E.
15) After removing 4 well volumes fill sample vials from the 1/4" sample nipple located on the discharge line from the pump. Since the primary concern is volatile organics, the water sample should have minimum contact with air and should not splash into the receiving container. The sample vial must be filled to overflowing before capping to purge all air from the vial. [Note: Handle sample vials only with clean gloves, not ones used to handle pump equipment].
16) After collecting sample turn pump switch to OFF and record the ending meter reading in Column G.
17) Note the exact amount of water removed in Column H by subtracting Column G from Column F.
18) Label sample vials with well number and date collected.

19) Record the collection date in Column I and sign Column J.
20) Ensure there is no leak in the sample vial and place sample in cooler.

Note: For wells that will not provide 4 well volumes, i.e., the total column of water is evacuated while pumping, allow the well to fully recover (measure water level again). When recovery is complete, throttle pump by partially closing discharge valve and proceed with sampling. If possible, more than one volume of water should be evacuated. Samples should be collected immediately after well recovery.

21) When sampling is complete at each site, unplug pump/pumps from power source.
22) Perform housekeeping around site, load samples and equipment, and proceed to next site.
23) Repeat steps 5 through 22 for each well being sampled.
24) At end of day return all samples collected to 320-M laboratory.

Approved by Horace W. Blakeslee Jr   Date 4/22/83
Donald E. Gordon
John C. Corey

HB:cf

M-AREA GROUNDWATER SAMPLING PROGRAM
SAMPLE COLLECTION SHEET

A	B	C	D	E	F	G	H	I	J
Well No.	Total depth of well (ft)	Depth to water (ft)	Water Column Col. B-Col. C (ft)	Volumn of water to be pumped Col D x 2.6 (gal)	Meter Readings Beginning	Meter Readings Endings	Actual Vol. Pumped Col. F-Col. G (gal)	Date Sampled	Collected By
AC-1A	120								
AC-1B	64								
AC-2A	202								
AC-2B	126								
AC-3A	151								
AC-3B	106								
MSB-9A	218								
MSB-9C	136								
MSB-10A	235								
MSB-10C	149								
MSB-11A	232								
MSB-12B	190								
MSB-12C	168								
MSB-13A	213								
MSB-13C	121								
MSB-14A	202								
MSB-14C	123								
MSB-15A	203								
MSB-16A	203								
MSB-16C	141								
MSB-17A	201								
MSB-17B	171								
NSB-18B	146								
MSB-18C	131								
MSB-19A	183								
MSB-19C	100								
MSB-20A	195								
MSB-20C	138								
MSB-21A	198								
MSB-21C	140								
MSB-23	140								
MSB-23A	318								
MSB-23B	199								
MSB-24	155								
MSB-24A	210								
MSB-25	140								

M-AREA GROUNDWATER SAMPLING PROGRAM
SAMPLE COLLECTION SHEET

A	B	C	D	E	F	G	H	I	J
Well No.	Total depth of well (ft)	Depth to water (ft)	Water Column Col. B-Col. C (ft)	Volumn of water to be pumped Col D x 2.6 (gal)	Meter Readings Beginning	Endings	Actual Vol. Pumped Col. F-Col. G (gal)	Date Sampled	Collected By
MSB-25A	205								
MSB-26	119								
MSB-26A	180								
MSB-27	130								
MSB-27A	170								
MSB-28	122								
MSB-28A	200								
MSB-30A	316								
MSB-30C	135								
MSB-31A									
MSB-31B									
MSB-31C									
MSB-32	55								
MSB-33									

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APPENDIX E-2

GROUNDWATER MONITORING WELL SAMPLING PROCEDURES FOR SELECTED PHYSICAL AND CHEMICAL PARAMETERS (PUMPED SAMPLES)

A. PURPOSE

The technique for collecting groundwater samples for chemical analysis is critically important. The primary concern in collecting samples is to protect sample integrity and minimize error. The procedures described here are designed: 1) to obtain representative samples by evacuating nonequilibrated water from the well casing or sample tap prior to obtaining the sample, 2) to assure that contamination of the sample does not occur as part of the sampling technique, 3) to provide sample preservation, and 4) to follow chain of custody requirements and proper documentation specifications. In addition, these sampling procedures are designed to comply with applicable regulations and guidelines (Ref. 1-5), and to provide consistency with Savannah River Plant sitewide procedures (DPSOP 254, Hydrogeologic Data Collection). These procedures have been written to minimize loss of volatile organic compounds when sampling wells with effervescent water. Bladder pumps should be used for these wells while turbine pumps can be used for all others.

B. INTRODUCTION

Water samples are routinely collected for analysis of volatile organic compounds (VOC), full-scan priority pollutants (FSPP), and other chemical parameters from monitoring wells.

The proper sampling procedures for these collections are described herein and are organized as follows:

1) Safety
2) Chain of Custody
3) General Considerations
4) Collection Methods and Field Measurements
5) Analyte Specific Requirements
   5.1) volatile organic compounds
   5.2) full scan priority pollutants
   5.3) other chemical parameters
6) Shipping and Delivery of Samples

The personnel responsible for sampling the groundwater monitoring wells should read carefully the pertinent sections and meticulously follow the protocol. A copy of these field procedures should be available at the sampling location for review. Supervision (or project manager) is responsible for requesting the collection of groundwater samples and for maintaining auditable files on sample collection and custody records. The sampler will provide a summary report each week of samples collected during the week, and a projected schedule for the following week. A bound field notebook will be maintained which documents daily instrument calibration, instrument service, wells sampled and field observations. Each page of the notebook will be dated and signed by the sampler.

C. PROCEDURES

1. Safety

1. Personnel will wear goggles and disposable gloves when performing all phases of the sampling and handling procedures.
2) Housekeeping must be maintained at all sites.
3) Any unsafe conditions or hazards should be reported to supervision immediately.
4) When pumping monitoring wells, all equipment (e.g., portable generators and pumps) must be properly grounded.

2. Chain of Custody

The primary objective of these procedures is to create an accurate written record that can be used to document and trace the possession of a sample from the moment of its collection through its analysis. The resulting information aids in scientific data interpretation and is required if the sample is used as legal evidence. In chain of custody procedures, each custodian must sign and date each transfer. The following description of "bulk transfer" procedures conforms to that of the EPA Office of Enforcement.[6]

Samples must be accompanied by the Custody Transfer Record (similar to Attachment 1) which includes the sampler's signature and initials, sample identification, date, the "return to" address (e.g., "name of supervision", "auditable file location"), and the relevant transfer and shipping history of the sample containers. Attachment 1 was designed for ease of use and to facilitate computer entry and tracking. The sampler should fill in each appropriate space in ball-point pen. Subsequent transfers are recorded by signature and initials. Shipping receipts along with a copy of on-site custody transfer sheets shall be maintained in a specified location with copies sent to SRL and supervision in M Area. Outside laboratories should return a signed copy of the custody transfer record along with a summary of their internal chain of custody to M-Area supervision. Any unusual incidents (e.g., broken or partially full bottles, or missing information) should be noted and reported to supervision immediately. If only a portion of the sample vial are transffered, the item numbers or appropriate information should be noted. Additionally, a form OSR-14-31 (Analysis Request - SRP) must be submitted to on-site labs with the samples.

3. General Considerations

3.1 Regulated Areas

- o Personnel entering Regulated Areas must familiarize themselves and comply with all safety rules and protective clothing procedures.
- o Health Protection area supervision must be notified prior to sampling wells inside regulated areas.
- o When moving from one well site to another inside regulated areas, the technician will remove shoe covers when entering vehicle and put on shoe covers prior to dismounting from vehicle.
  [NOTE: Shoe covers and any other Regulated Area protective equipment will be disposed of in approved receptacles.]
- o Vehicle tires must be checked prior to leaving a Regulated Area. The vehicle must not leave the area until Health Protection (Area Survey) gives permission.

3.2 Equipment Required - all sources of equipment and individual items are to be approved by supervision (or the project manager).

- o Generator, gasoline can & control box (used when pumping with portable generator).
- o Bladder pump controller and compressed gas (air or nitrogen) source (used when pumping deep wells which effervesce).
- o Measuring tape, steel 200 ft and/or electric water level indicator (calibrated within 6 months).
- o Tape, one roll, filament
- o Field data Sheets and Chain of Custody Sheets
- o Pens (2), water resistant ink and ball point
- o Thyac (if needed)
- o Distilled water to rinse equipment
- o Aluminum foil (to protect water level tape from contact with ground)
- o Flow meter

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- o Laboratory grade thermometer
- o Hand air/vacuum pump
- o .45 m filter and holder
- o Properly prepared bottles (See Attachment #2)
- o Coolers: received from laboratory and containing sample bottles and frozen ice packs. [NOTE: Sample blanks should be treated as samples. They are shipped on ice and should be kept cold after inspection. If a vial is broken, the remainder of blanks in the same canister should be discarded. Coolers should be clean.] Some of the sample containers submitted to on-site labs are kept in stores. Contact lab personnel for caption and bin numbers.
- o Water quality monitors calibration standards, rinse bottle, beakers and laboratory wipes. [NOTE: Normally, separate pH and conductivity meters will be used. These should be kept in plastic bags with dessicant and calibrated each day, and at each site as described in Attachment 3. Calibration records will be kept in the bound field notebook.]
- o Preservative (See Attachment #2)
- o Rubber gloves, leather gloves, safety glasses, disposablee plastic gloves
- o Regulated Area: Follow posted requirements
- o A copy of the field procedures
- o Clip board
- o Correct bound field notebook.

4. <u>Collection of Methods and Field Measurements</u>

a) Obtain copies of the Custody Transfer Sheet (Attachment #1 or similar) and the field data sheet from supervision (or the project manager). Normally, an OSR 24-C241A (Water Sample Collection Field Data Form) will be used (Attachment #3). References in this procedure pertain to these forms. Also, obtain a list of wells (sampling order and location), specific samples needed and the destination laboratory location from supervision.

b) Obtain sample vials, field blanks, and coolers from designated area. Obtain frozen ice packs and place in coolers for transport to the field.

c) Obtain all other equipment listed in Section C.

d) All pumps are 115 single phase 120 volt AC except the pressure operated bladder pumps in the Tuscaloosa Wells.

e) Proceed to the monitoring well with equipment. Wear safety glasses and rubber gloves for your personal protection at each site. Gloves also protect the sample since personal contact with equipment can introduce contaminants. Wear leather gloves when working with machinery or sharp objects, rubber gloves when working with strong acids or bases, and disposable gloves for other sample manipulations.

f) Position generator or compressed gas source and control box near well to be sampled, but on side opposite to discharge line of pump.

g) Fill in date on field form. Sign, date and initial top of custody transfer record.

h) Fill in well number, date and duplicate ID (if required) on both field forms and custody transfer record. Record time on field forms. Record will number, date and duplicate ID (if required), and time in bound field notebook.

i) Fill in total well depth on the field form (Column A). Obtain well depth information from supervision (or project manager).

j) Using an electronic water level indicator or steel measuring tape (DPSOP 254), measure the depth to the water (DTW) from the top of the well casing. The tape or probe should be inserted into the 1/2" standpipe installed in each well. Record the DTW on the field forms (Column B). Place aluminum foil on ground to protect tape. Wash tape before sampling next well.

k) Determine the water column in the well by:
DTW (Column B) from the total well depth (Column A) and record the result on the field form (Column C).

- o for turbine pumps - subcontracting the DTW (Column B) from the total well depth (Column A). Record the result on the field form (Column C).

- o for bladder pumps - subcontracting the depth of the well packer (provided by supervision) from the result on the field form (Column C).

l) Using Attachment #5 determine the volume to be pumped from the well in order to evacuate 4 well volumes prior to sampling. If the well is not 4" diameter, or if the water column length is not in the table, calculate the volume using the formulas provided.

Record the volume to be pumped on the field form in the column provided.

m) Connect flow meter to discharge line.

n) Ensure pump switch is OFF and then connect pump cord to power source. Ensure system is grounded. Only one well should be pumped at any time. For bladder pumps, inflate packer and prepare system to pump.

o) Check all valves, gages, etc. The discharge line valve must be open.

p) Record the initial flow meter reading on the field form in the column provided.

q) Start generator for turbine pumps or pressurize bladder pump system.

r) Turn pump switch on and remove 4 well volumes of water. Note any obvious water characteristics in the field notebook. If a note is entered in the notebook, an "X" should be placed in the contaminant column of the field form. Examples of notable characteristics are: color, odor, rotten egg smell, floc (algae, bacteria, etc), oil, sand, other solids, bubbles.

s) Calibrate pH meter while well is pumping. After removing 4 well volumes, open sample nipple and run for 2 minutes; rinse the measuring probes and the sample vessel with this water to equilibrate. Measure air and water temperature using laboratory grade thermometer. Then measure the pH and conductivity according to the directions in attachment #3. Record these measurements on the field form. Perform any other field measurements (e.g., alkalinity) which were requested by supervision (or the project manager).

t) Fill sample vials and preserve as required according to Section E and Attachment #2. [NOTE: When sampling for volatile compounds, fill vials carefully without agitation or splashing to avoid loss of analyte. Leave no air space at the top. Handle sample vials only with clean plastic gloves, not ones used to handle pump equipment. Filter samples for metals through a 0.45 um filter using a non-metallic filter holder and hand air pump <u>before</u> adding acid.]

u) After collecting samples, turn pump switch off and record ending meter reading on field forms. Measure the water level, record this reading and the time on the well recovery data form. Calculate the volume pumped and record on field form. While completing steps v through y, continue to periodically measure the DTW and time and record on the field form (until well recovery).

v) Label sample vials with well number and date collected.

w) Check sample vials and place in cooler. Fill in Custody Transfer Record.

x) Rinse meter probes, sample cup and filter holder with distilled water. Turn off power and prepare for transit. [NOTE: For wells that will not provide 4 well volumes, i.e., the total column of water is evacuated while pumping, allow the well to fully recover (measure water level again). When recovery is complete, throttle pump by partially closing discharge valve and proceed with sampling. Samples should be collected immediately after well recovery. Also, record this on the field form and in the field notebook.]

[NOTE: For wells which are continuously pumped, purge sampling port for 2 minutes and proceed with sampling.]

y) Sample next well in cluster (repeating steps h-x)

z) Unplug electric pum/pumps from power source.

aa) Perform housekeeping around site, load samples and equipment, and proceed to next site.

bb) At the end of the day, return all samples to 704-U (or location designated by supervision or the project manager for shipment/distribution. Transfer samples to the shipping department and record. [NOTE: Three photocopies of the field data forms, custody transfer sheets and pertinent pages of the field book should be made. The originals will be maintained in the QA/Data/Equipment file (in 704-U or other designated location) and the copies will be distributed to (1) M-Area Supervision, (2) SRL and (3) sampler.[

5. Analyte Specific Requirements

5.1) Volatile Organic Compounds

Samples should be collected in 45 ml vial with a teflon lined silicone septum. Vial should be gently filled until water flows over the top and then tightly capped. Samples should

be stored cold (about 4° C) until analysis. Duplicate vials will be filled for each well sample.

5.2) **Full-Scan Priority Pollutants**

When a full scan of analyses for priority pollutants is required, the following bottles should be set out for each well sample:

2 vials - volatile organics
1 vial - GC scan
1 platic container - metals (filtered)
1 amber glass jar - phenols
1 amber glass jar - TOH
1 glass jar - coliform
1 plastic bottle - radionuclides
1 plastic bottle - sulfide
1 plastic bottle - SO_4, F^-, etc.
1 glass jar - non-volatile organics
1 glass jar - odor

Several constituents are required to be preserved with particular chemicals. Many of these chemicals are caustic and should be treated with caution. Plastic gloves (not those used for sampling) should be used. The container description and necessary preservatives for each analyte are listed in Attachment #2.

5.3) Other Chemical Parameters

Analysis of groundwater samples for a partial list of analytes discussed above or for other chemical parameters may be required. Appropriate containers/instruments/ instructions will be provided for each round of samples.

Examples of other typical analytes include alkalinity (field), sodium, calcium, magnesium, aluminum and potassium. These major constituents in groundwater are often required for various water chemistry purposes.

6. Shipping and Delivery of Samples

Many of the chemical analyses for groundwater constituents must be carried out within two weeks (Attachment #2). Therefore, supervision (or the project manager) should make arrangements for the immediate transfer of samples to the appropriate laboratories. Supervision is responsible for designating a shipping coordinator who will receive and distribute the samples and completed paperwork. Samples shipped to offsite laboratories should be packed with fresh ice packs and shipped by air in ice chests within 2 days. Shipping information should be recorded on the custody transfer record. Do not ship samples offsite on Fridays without prior arrangements.

REFERENCES

1) U. S. Environmental Protection Agency. Handbook for Analytical Quality Control in Water and Wastewater Laboratories. EPA-600/4-79-019 (1979).

2) U. S. Department of the Interior. National Handbook of Recommended Methods for Water-Data Acquisition. Office of Water Data Coordination/Geological Survey (1977).

3) U. S. Environmental Protection Agency. Environmental Protection Agency National Interim Primary Drinking Water Regulations. 40 CFR 141 (1982).

4) U. S. Environmental Protection Agency. Methods for Chemical Analysis of Water and Wastes. EPA-600/4-79-020 (1979).

5) Lee, G. F. and R. A. Jones. Guidelines for Sampling Groundwater. JWPCF SS: 92-96 (1983).

6) United States Environmental Protection Agency. NPDES Compliance Sampling Manual. Office of Water Enforcement (June 1977).

OSR 24-C253

ATTACHMENT #1

CHAIN OF CUSTODY RECORD
WATER SAMPLES
DUPONT/SRP

RETURN TO

SAMPLER'S SIGNATURE | INIT

ITEM NO.	WELL NUMBER OR SAMPLE ID	DATE MO DAY YR	DUPLICATE	TYPE	NO OF SAMPLES	FINAL DESTINATION OR LABORATORY	COMMENTS
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							
21							
22							
23							
24							

ITEMS	RELINQUISHED BY SIGNATURE	RELINQUISHED BY INIT	RECEIVED BY SIGNATURE	RECEIVED BY INIT	DATE

SHIPPING INFORMATION

COMMENTS

E-17

ATTACHMENT #2

REQUIRED CONTAINERS, PRESERVATION TECHNIQUES, HOLDING TIME AND LABORATORIES PERFORMING ANALYSES

SAMPLE PARAMETER[1]	CONTAINER/ LID/VOLUME[2]	PRESERVATIVE/ VOLUME/CONTAINER	HOLDING TIME	LABORATORY
volatile organics (VOC)	G/TS/45 ml	cold, 4°C-no air	14 days	*
non-volatile organics	G/T/≥ 100 ml	cold, 4°C	14 days	**
pesticides	G/T/≥ 100 ml	cold, 4°C	7 days	**
TOH	G/T/500 ml	cold, 4°C	14 days	**
phenol	G/T/500 ml	conc. H_3PO_4/ 2 ml/G $CuSO_4$/1g ± 0.1g/P	28 days	**
odor	G/-/1 liter	cold, 4°C	--------	**
gross and	P/P/1 liter	conc. HNO_3/5 ml/G	6 months	***
radium	P/P/2 liters	cold, 4°C	6 months	**
TDS	P/P/1 liter	cold, 4°C	7 days	***
NO_3	P/P/500 ml	conc. H_2SO_4/ 5 ml/G	28 days	***
sulfide	P/P/250 ml	2N ZnAc/0.5 ml/P	7 days	**
SO_4	P/P/2 liters	cold, 4°C	28 days	**
cyanide	P/P/1 liter	cold, 4°C NaOH/15 ml/P	14 days	**
metals	P/P/1 liter	conc. HNO_3/ 5 ml/G	6 months	**
total coliform	sterile P/P/ 100 ml	cold, 4°C	1 day	****

ATTACHMENT #2 (con't)

1) Each vial label will contain the well group ID, date, duplicate (if applicable), preservative, and parameter.

2) The laboratory or sampler should prepare bottles, caps and preservatives (except coliform - this sterile container is purchased from stores). P = polyethylene, G = glass, T = teflon liner, TS = teflon lined silicone septum.

3) * = 320-M or offplant laboratory (non-radioactive samples)
** = Offplant laboratory
*** = 735-A or offplant laboratory
**** = 772-D or offplant laboratory

ATTACHMENT 3
INSTRUMENT CALIBRATION PROCEDURES

A. ALL METERS

The electronics of all meters used in the field should be kept in a plastic bag with dessicant. Experience in the southeastern region shows that this is a necessary step to avoid problems with humidity.

B. CONDUCTIVITY METER

1) Daily Calibration - Place a small amount of previously prepared 0.01 N KCl solution in a beaker (solution is prepared by dissolving 745.6 mg of anhydrous KCl in deionized water). Measure the temperature of this solution with a laboratory grade thermometer. Record in bound field notebook. Place conductivity probe in solution, turn temperature compensation knob to the measured temperature, and turn selector knob to the 0-1999 scale. Adjust the reading to 1413 umhos/cm using the cell constant knob. Record the meter was successfully calibrated to 1413 umhos/cm in the field notebook. Rinse electrode with deionized water and dry with a laboratory wipe.

2) At Each Site - No recalibration is required. Measure the temperature of the sample solution. Place the conductivity probe in the sample, turn the temperature compensation knob to the measured temperature, and place the selector knob in either the 0-199.9, 0-1999, or 0-19999 position. Use the lowest (most accurate) position which results in an "on-scale" reading. If a reading is "off-scale", the display will read '1' in the far left digit position.
NOTE: Three zeros must be added to the values read on the 0 - 19,999 scale (eg., 12.88 = 12880 umhos/cm).

3) Weekly Maintenance & Troubleshooting - Each week, the cover of the probe should be removed, and the PVC body and steel rings should be cleaned using alcohol and a cotton swab. After cleaning, the probe should be thoroughly rinsed and dried carefully with a laboratory wipe. Check the dessicant and replace if necessary. Replace 9 volt battery when the 'low battery' signal is displayed.

The electrode is made of PVC and has a limited resistance to temperature extremes. In particular, it should be noted that the 4 steel rings, which combine to form 2 electrode pairs, are imbedded in PVC. Prolonged exposure to high heat can open the joint permitting fluid underneath and breaking the contact. A damaged electrode can be identified as follows: in air (with switch in the 0-199.9 position, the display should read '0.0' (readings of '0.1' to '0.2' are still acceptable). Higher readings (eg., '10') are a clear sign of a ruined electrode. Other erratic behavior should be corrected based on the manual or by calling Cole-Parmer for technical assisstance at 1-800-323-4340. (model number 1481-50)

ATTACHMENT 4

TO | FROM | DATE | PAGE OF

WATER SAMPLE COLLECTION FIELD DATA FORM

WELL NUMBER	DATE (MO DAY YR)	DUPLICATE*	TIME	WELL DEPTH (FT) A	DEPTH OF WATER (FT) B	WATER COLUMN (FT) A-B	VOLUME TO BE PUMPED COL x 2.0	METER READING BEGINNING	METER READING END	VOLUME PUMPED (GAL)	pH	SPECIFIC CONDUCTANCE (umho/cm)	WATER TEMP °C	AIR TEMP °C	CONTAM	NO SAMPLES	SAMPLERS INITIALS	TURBIDITY	DISSOLVED OXYGEN	ALKALINITY (DROPS/20ml)

ATTACHMENT 4 (cont)

TO	FROM	WATER SAMPLE COLLECTION FIELD DATA FORM	DATE	PAGE __ OF __

TO	FROM	OSR 711 211A WATER SAMPLE COLLECTION FIELD DATA FORM PAGE 2	DATE	PAGE __ OF __

WELL NUMBER	DATE MO	DATE DAY	DATE YR	DUPLICATE #	BEGINNING TIME	BEGINNING METER READING	BEGINNING DEPTH OF WATER (FT)	END TIME	END METER READING	END DEPTH OF WATER (FT)	TIME	DEPTH OF WATER (FT)	TIME	DEPTH OF WATER (FT)	TIME	DEPTH OF WATER (FT)	TIME	DEPTH OF WATER (FT)

ATTACHMENT 4 (cont)

DIRECTIONS FOR FILLING OUT THE WATER SAMPLE COLLECTION FIELD DATA FORM (OSR 24-C241A)

WELL NUMBER

Columns 1-8 are the well name as in the Well File Index or preassigned name of surface water collection site. Columns 1-3 are an alpha field, left justified. Columns 4-6 are a numeric field, right justified. Columns 7-8 are an alpha-numeric field, left justified. (example: MSB 11A)

DATE

Sample collection date. (example: 090783)

DUPLICATE #

Normally a blank field. This can be an alpha or numeric character used to distinguish samples collected at a site during a single day. (example a & b)

TIME

Military time. (examples: 7:45 AM is 0745, 1:50 PM is 1350)

WELL DEPTH

The total depth of the well from the top of the casing. This number is obtained from the driller's log of the well.

DEPTH OF WATER

The distance from the top of the casing to the water surface in the well prior to pumping recorded as decimal feet.

WATER COLUMN

See instructions in procedures.

VOLUME TO BE PUMPED

See instructions in procedures.

ATTACHMENT 4 (cont)

METER READING BEGINNING

The [illegible]ding before pumping the well.

METER READING END

The water meter reading after pumping the well.

VOLUME PUMPED

METER READING END minus METER READING BEGINNING. If the well was sampled with no pumping, enter zero (0). Enter -1 if well is being continuously pumped.

X/PUMPED DRY

Enter X if the well was pumped dry.

pH

Enter pH measurement of water taken after pumping is completed.

SPECIFIC CONDUCTANCE

Specific conductance measurement.

WATER TEMP °C

Water temperature measured at sampling point.

AIR TEMP °C

Air temperature measured at time of sampling.

NO. SAMPLES

Number of samples collected.

SAMPLER'S INITIALS

WELL WATER SAMPLING PROCEDURE FOR NONRADIOACTIVE PARAMETERS

PURPOSE:

To provide instructions for sampling well water for analyses of nonradioactive parameters.

INTRODUCTION:

Groundwater is collected routinely for hazardous waste analyses from monitoring wells installed in the vicinity of liquid and dry waste disposal sites. Some disposal sites are no longer operative.

Special well water samples are also taken from both permanent and temporary wells e.g., plume development.

PROCEDURE:

A. GENERAL INFORMATION

1. Scheduling

The routine groundwater monitoring program for hazardous waste analyses is carried out following the direction of Energy Conservation and Environmental Control (ECEC) and the regulating agency, South Carolina Department of Health and Environmental Control (DHEC).

Usually in December, ECEC sends Health Protection a memorandum detailing the required analyses (e.g., annual, quarterly, site specific) for groundwater wells being monitored for hazardous waste.

Groundwater wells monitored for hazardous waste are listed on the Health Protection Environmental Collections posted schedule. In addition, following receipt of the memorandum from Special Programs, the groundwater program field supervisor prepares an inter-office memorandum listing the first quarter sampling dates.

Example: Inter-Office Memorandum

To: Environmental Collections Supervisor, plus distribution
From: Groundwater Program Supervisor
Title: (Year) First Quarter Sampling of Groundwater Monitoring Wells Being Analyzed for Hazardous Waste

Wells	Proposed Sampling Date	Remarks
709-G #1	Jan. 4 & 5	
200-H S.B. #65-#71	Jan. 4 & 5	
200-F S.B. #76-#79	Jan. 4 & 5	#76 dry
300-M S.B. #1A-#8A	Jan. 11 & 12	

A,1...

The wells listed in the example are priority wells (and others will be added as we continue) and are always sampled first in the quarter; however, nonpriority wells are also listed in the inter-office memorandum.

This inter-office memorandum with scheduled sampling dates is repeated each quarter.

2. Chain of Custody

2.1 Transfer of Custody and Shipment:

When transferring the possession of the samples, the transferee signs and records the date and time on the Chain-of-Custody Record. Custody transfers account for each individual sample, although samples may be transferred as a group.

The Groundwater Program supervisor is responsible for seeing that samples are properly preserved, labeled, packaged, and dispatched to the several laboratories for analysis. This responsibility includes filling out, dating, and signing the appropriate portion of the Chain-of-Custody Record. Preservation techniques employed will be those prescribed by EPA (see Attachment #1).

The sample container is then placed in a cooler along with "blue ice" to maintain the sample at approximately 4°C. Samples must be packed so as not to break. All packages sent to the laboratories should be accompanied by the Chain-of-Custody Record and other pertinent forms. A copy of these forms should be retained by the Groundwater Program supervisor.

Samples are delivered to SRP Laboratories and shipped to the offplant laboratory on the second day of sampling (Thursday) each week via an air priority service. If air priority service is not available, a non-stop flight should be selected for sample transport. If no non-stop flight is available, every attempt is made to schedule the transfer via the same airline throughout the flight. This latter provision helps minimize delays and other problems encountered with transfers between airlines. Transportation receipts are retained as part of the permanent chain of custody documentation.

2.2 Laboratory Custody Procedures:

Chain of custody procedures are also necessary in the laboratory from the time of sample receipt to the time the sample is discarded. The following procedures are followed in the laboratory:

Samples are received in the laboratory and logged in by the Laboratory Supervisor. The Laboratory Supervisor verifies that the items on the custody transfer agree with what is received and that all containers are in good condition. If there is any discrepancy or if any samples are received broken in shipment, the sampler is notified. The Laboratory Supervisor signs the custody sheet. A file copy is maintained.

A,2.2...

In the offplant laboratory, each sample fraction is assigned a unique laboratory number by affixing a gummed tape label with a five-digit number. The sample number, sample identification, date, description, and parameters requested along with the project number, date, and person who received the sample are recorded on the laboratory work request form . Copies of the laboratory work request are distributed to the various laboratory section managers who are responsible for assigning and scheduling the particular analyses to be performed. The Data Manager also is responsible for recording the sample identification, sample date, and required parameters in a permanent bound logbook.

Once samples are received and logged, they are stored at 4°C. The sample custodian maintains the custody forms and technicians are to sign for samples when they remove them for analysis. Samples are maintained until the data are completed, reviewed and reported, and disposal instructions are provided by the Project Manager.

Sample Collection Bottles -

Routine: From Stores, 735-A Water Quality (WQ) Lab, and offplant laboratory to HP Environmental Collections (EC).

Special: From 320-M Lab, 773-A Lab, or Laboratories listed above to Sample Group.

Samples -

Routine: From EC to 772-D Lab, 735-A WQ Lab, and offplant laboratory on form EM-7.

Special: From EC or other Sample Group to 320-M Lab, 773-A Lab, or Laboratories listed above on form EM-8.

Field Measurements -

Routine: From EC to HP Data Evaluation (DE) on forms EM-1 (priority wells) and EM-2 (nonpriority wells) and then to Energy Conservation and Environmental Control (ECEC).

Special: From EC or other Sample Group to DE and then to ECEC.

Laboratory Results[1] -

Routine: From 735-A WQ Lab (Env. Chemistry) to DE on forms EM-3 (priority wells) and EM-4 (nonpriority wells), and then to ECEC.

Routine: From 772-D Lab to DE on forms EM-5 (priority wells) and EM-6 (nonpriority wells), and then to ECEC.

Routine: From offplant laboratory to EC on offplant laboratory reporting form for review and then data, with any pertinent comments, is given to DE for transmittal to ECEC.

Special: From participating Laboratories to EC or other special groups, and then ECEC and Custodian.

1 The summary of laboratory methods for analyzing for hazardous waste by onplant of offplant laboratories is shown in Attachment #2.

A,2.2...

Data Evaluation -
Routine: From ECEC to offplant laboratory for (Ref Data Management Services, Scope of Work by ECEC, dated 1/17/83) to offplant laboratory:
- Statistical test of raw data[1]
- Comparison to Drinking Water Standard (DWS) or Arbitrary Standard
- Graphic display of data failing statistical test and outside DWS.

3. Quarterly and Annual Groundwater Monitoring Parameters and Laboratories Performing Analyses

3.1 Routine Program

[NOTE: Quarterly analyses are indicated by an *. An annual (comprehensive) analysis includes all parameters listed, including the quarterly.]

3.1.1 Offplant Lab

Sulfate
Fluoride
Dissolved Organic Carbon*
Phenols
Foaming agents
Corrosivity
Odor
Selenium
Silver
Copper
Iron
Manganese
Zinc
Radium, Total
Sulfide
Cyanide
Arsenic
Barium
Cadmium
Chromium
Lead
Nickel
Beryllium
Mercury
-2,4-D
2,3,5-TP Silvex
Lindane
Endrin
Methoxychlor
Toxaphene
Organic Constituents as determined by GC scan.
Total Organic Carbon*
Sodium
Total Organic Halogen*
Two Principal Metals (site specific)*

3.1.2 735-A WQ Lab

Total dissolved solids*
Chloride*
Gross alpha
Gross beta
Turbidity
Temp (C°)*
Color
Specific conductivity*

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[1] QA samples would not be entered in statistical analyses.

A,3...

[NOTE: Quarterly analyses are indicated by an *. An annual (comprehensive) analysis includes all parameters listed, including the quarterly.]

3.1.3 772-D Lab
Coliform, total

3.1.4 735-A Env. Collections (Field Measurements)
Temp (C°)*
pH*
Specific conductivity*
Water level*

3.2 Special Samples

3.2.1 Offplant, 735-A, and 772-D
All parameters listed in section 3.1

3.2.2 320-M Lab and 773-A Lab
Organic constituents as determined by GC scan.

B. SAFETY

1. General

1) Personnel will wear safety glasses and rubber gloves when performing all phases of the sampling and handling procedure.

2) Housekeeping must be maintained at all sample sites. Health Protection supervision should be notified when weeds and grass are growing on the well site.

3) Any unsafe conditions and hazards should be reported to supervision immediately.

4) When pumping, all equipment must be properly grounded.

5) Acids must be transported in special containers.

6) When performing field operations, an acid wash station must be available.

2. Requirements for Sampling in Regulated Areas

1) Personnel entering Regulated Areas must familiarize themselves and comply with all safety rules and protective clothing procedures.

2) A Thyac must be carried and used in order to monitor each sample site, sample, and sampling equipment. When entering a Regulated Area, the Thyac must be on at the entrance and during the entire sampling period.

B,2...

3) Health Protection Area Survey must be notified prior to sampling wells inside the burial ground.

4) When moving from one well site to another inside the burial ground fence, the technician will remove shoe covers at a time when entering vehicle and put on shoe covers prior to dismounting from vehicle.
[NOTE: Shoe covers and any other Regulated Area protective equipment will be disposed of in approved receptacles.]

5) Vehicle tires must be checked prior to leaving a Regulated Area. The vehicle must not leave the area until Health Protection (Area Survey) gives permission.

C. EQUIPMENT REQUIRED

1. General

- Stainless steel puller
- Rope
- Generator (used when pumping)
- Measuring tape, steel 200 ft
- Tape, one roll, filament
- Logbook
- Pens (2), water resistant ink
- Thyac
- Spare clean pullers, locks
- Bottles[1]
- Coolers: 6-8, received from offplant laboratory and containing sample bottles, 2 containing frozen blue ice packs.
- Hydrolab water quality monitor, 4041[2]
- Preservative[1]

2. Protective

- Basic: rubber gloves, leather gloves, safety glasses
- Portable eye wash station
- Regulated Area: Follow posted requirements.

---

[1]See Attachment #1.

[2]The Hydrolab is used for measuring conductivity, temperature, and pH. It must be calibrated weekly before using and all calibration data and results must be posted in the hazardous waste logbook (wells being sampled that week). See DPSOL 271-1-415 for Hydrolab calibration.

D. BUCKET SAMPLING

1) Select coolers containing bottles for wells to be sampled.
[NOTE: Each well set of bottles (i.e., bottles for one well) will arrive onplant from an offplant laboratory in the same cooler and are returned to the offplant laboratory the same way. The blanks for volatile organics or organic constituents accompany the set of empty bottles from offplant laboratory to SRP and the full bottles back to offplant laboratory in the same cooler. Obtain frozen ice packs from the freezer and place in separate coolers and close the lids.]

2) Obtain equipment listed in division C and proceed to load in vehicle.

3) Proceed to the sample site with equipment. Wear glasses and rubber gloves for your personal protection. Personal contact with the bailer can introduce both chemical and biological contaminants in the sample.
[NOTE: If well is located inside a Regulated Area, wear prescribed protective clothing and monitor area with Thyac. If a reading greater than 24,000 c/m is obtained, leave the area and notify Health Protection supervision.]

4) Unlock and remove well cap and stainless steel sample bucket suspended from cap.
[NOTE: Be watchful of wasp nests and alert for strong odors emitting from hazardous waste wells. If odor persists, request area survey to monitor.]

5) Using etched steel tape, measure depth of water below top of pipe and record in logbook (reference procedure 271-1-406).

6) Rinse sample bucket with distilled water and attach rope with snap latch to the 4-ft chain extension on the bucket.

7) Ensure that sample bucket and rope do not touch the ground. Hang bucket on metal rod provided.

8) With hands over the well (not to the side), lower sample bucket slowly into well until it is below the water surface.
[NOTE: Wear rubber gloves over leather gloves.]

9) Raise bucket of water from well by pulling straight up with a smooth motion.

10) If the rope has touched the water, remove it from service.
[NOTE: Look for discoloration of the rope.]

11) Pour the first bucket of water into a 6-gallon jug marked "Waste Water", to ensure removal of the surface film on the water column.

12) Repeat steps 7) and 8).

13) Using water from this bucket, thoroughly rinse the Hydrolab probes and its matching sample container and then pour the remainder of the water into the Hydrolab sample container.

D...

14) Immediately insert the Hydrolab probes into the Hydrolab sample cup of sample water (Ref procedure 271-1-415). Measure and record in logbook (see Attachment #3):
   - Temperature, °C
   - pH
   - Conductivity, µmhos/cm

15) Pour the water from the Hydrolab sample cup into the 6-gallon jug marked "Waste Water".

16) Rinse the sample cup and the Hydrolab probes thoroughly with distilled water. Add distilled water to cup and screw cup to Hydrolab to keep probes moist and ready to use at the next well.

17) For the well being sampled, remove all sample bottles from the cooler. Check labels and layout bottles with preservative as required, in the order shown in Attachment #1.
    [NOTE: All sample containers are premarked with parameter and preservative required. Add the site, well number, and date (i.e., 300-M S.B., well #1, 3/10/83).]

18) Repeat steps 7) and 8) until all bottles are filled.
    [NOTE: The reference procedure for coliform sampling is DPSOL 271-1-418.]
    a) Wear protective clothing as required.
    b) As each bottle is filled, immediately add preservative as required and cap bottle.
       [NOTE: Volatile organic samples should be poured in a manner to reduce exposure to air (no bubbles in vial) and immediately placed in a secondary container.]

19) Ensure as each sample is collected that all pertinent information (color, sediment, odor, etc.) is recorded in the logbook (see Attachment #3).

20) Secure sampling bucket to snap ring in cap, replace well cap, lock well, perform housekeeping around well, load samples and equipment, and move to the next well.

21) Repeat steps 3) through 20) for each well being sampled.

22) After each bottle is filled, preservative added to sample bottle, the bottle is capped and labeled, check the sample for leaks and for complete information on label. Place bottles in coolers containing frozen, sealed ice packs. At the end of the first day of sampling, the 13 samples taken from each well should be handled as follows:
    a) The nine samples going to offplant laboratory should remain in the offplant laboratory cooler containing blanks.
    b) Deliver one sample (for coliform) to the 772-D Laboratory and place in refrigerator. Sample analysis request accompanies samples to 772-D.
       [NOTE: This sample can be held on ice in cooler overnight, but must be delivered and analysis started within 24 hours from time of sampling. Maintain on ice after delivery.]

D,22)...

c) Three samples scheduled for delivery to 735-A Laboratory can remain in the EC cooler until samples are delivered to 735-A Laboratory.
d) Alert Shipping, phone 3483, that a shipment of samples will be ready for shipment offsite the following day. Provide time when samples will be delivered, the date to be shipped, method of shipment, and shipping request number.
[NOTE: One shipping request number is used for the calendar year.]

23) Complete second day of week's sampling schedule by repeating steps 1) through 20) including delivering of coliform samples to the 772-D Laboratory. Obtain signed receipt for samples.

24) Complete chain of custody forms for samples going to 735-A and offplant laboratories.

25) Deliver samples to 735-A Water Quality Laboratory and have Laboratory custodian sign chain of custody form for receipt of samples. Each sample set (3 samples) should remain in individual coolers and stored apart in the refrigerator.

26) Check each offplant laboratory sample set (9 samples) carefully to ensure they are properly packed and iced (ice packs).
[NOTE: Each set will be shipped in an individual cooler.]

27) Place lid on each cooler and secure by wrapping reinforced tape around cooler and lid at both ends.

28) Deliver coolers with samples to Shipping by 3:00 p.m. on day of shipment (second day of sampling schedule for the week):
a) Obtain flight number and time of arrival at final destination airport.
b) Immediately notify Laboratory of above information.

29) Have offplant laboratory:
a) Notify SRP by telephone immediately after receipt of samples and their condition.
b) Return chain of custody receipt to SRP.

E. PUMP SAMPLING

1) Select coolers containing bottles for wells to be sampled.
[NOTE: See note at step D,1).]

2) Obtain all other equipment listed in division C and proceed to load in vehicle.

3) Hook generator to vehicle (Ref procedure 271-1-212).

E...

4) Proceed to the sample site with equipment. Wear glasses and rubber gloves for your personal protection at each well site. Gloves also protect the sample since personal contact with equipment can introduce both chemical and biological contaminants in the samples.
[NOTE: See Note at step D,3).]

5) Position generator near well to be sampled, but on side opposite to discharge side of pump (follow Ref procedure 271-1-119).

6) Remove lock and cover from pump.
[NOTE: Be watchful of wasp nests and alert for strong odors emitting from hazardous waste wells. If odor persists, request Area Survey to monitor.]

7) Using etched steel tape, measure depth of water from top of well casing and record in logbook (reference procedure 271-1-406).

8) Subtract depth of water from depth of well (inside bottom of screen) which is posted for each well in the logbook (see Attachment #3). This will give the length of the water column in feet. Record in logbook.

9) Turn to table posted in logbook (see Attachment #3). Look in left margin for feet measured in well (i.e. 10) and then move across the page to the column under the fraction of a foot measured (i.e. 0.5). Record in the logbook the volume of water (10.98 gals) to be removed for a column of water 10.5 ft long.
[NOTE: The volume for any given length of pipe was multiplied by 4 in order to show the volume of water to be removed from the well. The reason is the requirement that four volumes be removed from a well prior to sampling.]

10) Ensure pump switch is OFF and system is grounded; then connect pump cord to power source.

11) Check all valves, gages, etc. The discharge line valve must be open.

12) Place 6-gallon jugs marked "Waste Water" under the pump nozzle. Have spares nearby.

13) Start power source.

14) After again checking valves (ensure discharge line is closed, but open quickly when pump starts) turn pump switch to ON and remove four volumes of the water column.
   a) If the well goes dry while pumping, allow for full recovery (measure water level again).
   [NOTE: Sometimes a well will not provide four volumes.]
   b) When recovery is complete, throttle pump by partially closing discharge valve and proceed with sampling.

E,14)...

c) If experience shows a great deal of time must elapse before full recovery, proceed to the next well and empty the "Waste Water" pumped in step E,14),a) into an approved receptacle.
[NOTE: If not sampled within 24 hours the well must be pumped again.]

d) If the well history indicates the well being pumped will not provide the volume of water required for removal of four volumes of the water column, remove all sample bottles from the cooler before the pump is turned ON.

(1) Check the labels and layout bottles and preservatives, as required, in the order shown in Attachment #1.
[NOTE: All sample containers are premarked with parameter being sampled and preservative required.]

(2) Add site number, well number, and date as shown in example below:

Example:	Site:	300-M Seepage Basin
	Well #:	1
	Date:	3/10/84

15) As pumping continues:

a) Keep check on volume being removed.
b) Replace filled jug marked "Waste Water" with an empty jug.
c) Repeatedly fill the Hydrolab sample cup with pumped water.
[NOTE: This acclimates sample cup temperature to well water temperature.]
d) Insert calibrated Hydrolab (reference procedure 271-1-415) probes in cup each time it is filled.
e) Observe changes, if any, in conductivity, temperature, and pH. With the removal of four volumes of the water column, these parameters should stabilize.
f) After removal of four volumes of water, measure conductivity, temperature, and pH. Record in logbook.
g) Pour sample cup water into "Waste Water" jug.
h) Rinse the Hydrolab sample cup and the Hydrolab probe thoroughly with distilled water. Place probes in cup containing distilled water to keep moist during transit.
[NOTE: "Wipes" or any other material must not be used on cup or probes.]

16) Fill each bottle from the sample nipple in the order in which the bottles were laid out.
[NOTE: The sample nipple is on the main discharge line from the pump. A slight back pressure caused by partially closing the main valve will increase the flow from the nipple.]

17) Immediately after bottle is filled, cap, place in secondary container, and return to cooler containing trip blank.
[NOTE: When sampling for volatile organics, the water sampled should have minimum contact with air and should not splash into the receiving container.]

E...

18) Add preservatives as required.
[NOTE: Wear protective clothing as required.]

19) Cap bottle firmly. Ensure there is no leak for each bottle.

20) Check label for complete information (should have been filled in earlier) and place each sample in cooler.
[NOTE: All samples from the same well (called a set) go in the same cooler for transport.]

21) When sampling is complete, turn pump switch to OFF. Unplug pump from power source and replace cover on pump.

22) Ensure that all pertinent information (color, sediment, odor, etc.) pertaining to the well and the sample is recorded in the logbook (see Attachment #3).

23) Perform housekeeping around well, load samples and equipment, and move to the next well.

24) Repeat steps 1) through 23) for each well being sampled this day.

25) At the end of the first day of sampling, the 13 samples taken from each well should be handled as follows:
a) The nine samples going to offplant laboratory should remain in the offplant laboratory cooler with the blanks.
b) Deliver one sample (for coliform) to the 772-D Laboratory and place in refrigerator. Submit sample analysis request with sample.
[NOTE: This sample can be held on ice in cooler overnight, but must be delivered and analysis started within 24 hours from time of sampling. Maintain on ice after delivery.]
c) Three samples scheduled for delivery to 735-A Laboratory can remain in EC cooler until samples are delivered to 735-A Laboratory.
d) Alert Shipping, phone #3483, that a shipment of samples will be ready for shipment offsite the following day. Provide time when samples will be delivered, the date to be shipped, method of shipment, and shipping request number.
[NOTE: One shipping request number is used for the calendar year.]

26) Complete second day of week's sampling schedule by repeating steps 1) through 24) including delivering of coliform samples to the 772-D Laboratory. Obtain signed receipt for samples.

27) Complete chain of custody forms for samples going to 735-A and offplant laboratories.

28) Deliver samples to 735-A Water Quality Laboratory and have Laboratory Custodian sign chain of custody form for receipt of samples. Each sample set (3 samples) should remain in individual EC coolers and stored apart in the refrigerator.

E...

29) Check each offplant laboratory sample set (9 samples) carefully to ensure they are properly packed and iced (ice packs).
[NOTE: Each set will be shipped in an individual offplant laboratory cooler.]

30) Place lid on each cooler and secure by wrapping reinforced tape around cooler and lid at both ends.

31) Deliver coolers with samples to Shipping by 3:00 p.m. on day of shipment (second day of sampling schedule for the week):
   a) Obtain flight number and time of arrival at final destination airport.
   b) Immediately notify Laboratory of above information.

32) Have offplant laboratory:
   a) Notify SRP by telephone immediately after receipt of samples and their condition.
   b) Return chain of custody receipt to SRP.

ATTACHMENT #1

REQUIRED CONTAINERS, PRESERVATION TECHNIQUES, HOLDING TIMES, AND LABORATORIES PERFORMING ANALYSES

SAMPLE PARAMETER FOR EACH WELL[1]	TYPE SAMPLE CONTAINER & VOLUME	PRESERVATIVE TYPE CONTAINER AND VOLUME[2]	HOLDING TIME	LABORATORY[3]
Total Coliform	Sterile P[4], 100 ml	Cool, 4°C	1 Day	772-D
TDS, NO	P, 1ℓ	Cool,	7 Days	735-A
Gross β and α	P, 1ℓ	Conc HNO_3, 5 ml, G[4]	6 Months	"
NO_3	P, 500 ml	Conc H_2SO_4, 1 ml, G 1 ml, G	28 Days	"
Metals	1ℓ	Cool, 4°; 5 ml Conc HNO_3	6 Months	Offplant Lab
Pesticides	G, 2ℓ	Cool, 4°C	7 Days	"
Radium	P, 2ℓ	Cool, 4°C	6 Months	"
Sulfide	P, 250 ml	100 ml[5] 2N ZnAc,P	7 Days	"
SO_4F	P, 2ℓ	Cool, 4°C	28 Days	"
Odor	G, 1ℓ	Cool, 4°C	--	"
Cyanide	P, 1ℓ	Cool, 4°C; 15 ml NaOH	14 Days	"
Phenol	G, 500 ml	2 ml Conc H_3PO_4, G 1 g $\pm$0.1 $CuSO_4$, P	28 Days	"
Organic Scan	G, 100 ml	Cool, 4°C	14 Days	"
TOH	G, 500 ml	Cool, 4°C	14 Days	"

[1]Each bottle will contain the well group identification number, preservative, and the parameter.

[2]735-A Water Quality Laboratory prepares preservatives; new bottles and vial caps are used witn polyseal liners.

[3]The laboratory receiving the sample also provides the bottles except for coliform; this sterile container is purchased from Stores.

[4]P = Polyethylene and G = Glass.

[5]100 ml will preserve about 200 samples.

ATTACHMENT #2

SUMMARY OF METHODS FOR ANALYSES - HAZARDOUS WASTE

PARAMETER	REFERENCE[a]	METHOD DESCRIPTION
Cyanide	EPA Method 335.2	Colorimeteric without distillation
Sulfate	EPA Method 375.2	Automated methylthymol blue colorimetric
Dissolved Organic Carbon	EPA Method 415.1	Filter sample through 0.45 micron filter, analyze by combustion
Total Organic Carbon	EPA Method 415.1	Combustion Method
Total Organic Halogens	EPA Method 450.1	
Fluoride	EPA Method 340.1	Colorimetric, SPADNS with Bellack Distillation
Phenol	EPA Method 420.2	Automated 4-AAP colorimetric with Distillation
Surfactants	EPA Method 425.1	Colorimetric MBAS
Corrosivity	Method 5.3	Corrosivity towards steel
Odor	EPA Method 140.1	Threshold odor
Sulfide	EPA Method 376.1	Iodine titration
METALS:		
Arsenic	EPA Method 206.2	AA, Graphite Furnace
Barium	EPA Method 208.1	AA, Direct Aspiration
Beryllium	EPA Method 210.2	AA, Graphite Furnace
Cadmium	EPA Method 213.2	AA, Graphite Furnace
Chromium	EPA Method 218.2	AA, Graphite Furnace
Copper	EPA Method 220.2	AA, Graphite Furnace
Iron	EPA Method 236.1	AA, Direct Aspiration
Lead	EPA Method 239.2	AA, Graphite Furnace
Manganese	EPA Method 243.1	AA, Direct Aspiration
Mercury	EPA Method 245.1	Manual cold vapor with no digestion
Nickel	EPA Method 249.2	Manual cold vapor with no digestion
Selenium	EPA Method 270.2	AA, Graphite Furnace
Silver	EPA Method 272.2	AA, Graphite Furnace
Sodium	EPA Method 273.1	AA, Direct Aspiration
Zinc	EPA Method 289.1	AA, Direct Aspiration
Total Radium	Standard Methods, Method 705	Radium by precipitation
Pesticides	EPA Method 608	Organochlorine Pesticides in Industrial Effluents, GC/EC
Herbicides	EPA, Federal Register Vol 38, No. 75, Part II	Chlorinated Phenoxy Acid Herbicides in Industrial Effluents, GC/EC
GC Sean	EPA, Federal Register Vol 44, No. 231	Analysis of Trihalomethanes in Drinking Water by Liquid/Liquid Extraction

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ATTACHMENT #2, Contd

PARAMETER	REFERENCE[a]	METHOD DESCRIPTION
Color	Not in print yet	Visual comparative method
Special conductivity	Not in print yet	Beckman bridge
	DPSOL 271-1-415	Hydrolab (analyzed in field)
Turbidity	DPSOL 271-318	Need revised Hach method
Total dissolved solids	DPSOL 271-310	Filterable residue (revised)
pH	Not in print yet	Corning procedure
	DPSOL 271-1-415	Hydrolab (analyzed in field)
Chloride	DPSOL 271-306	End point titration
Temperature	DPSOL 271-1-415	Hydrolab (analyzed in field)
Nitrate	DPSOL 271-313	Technicon automated
Nitrite	DPSOL 271-261	Technicon automated
Gross alpha-beta activity	DPSOL 271-261	
Coliform	DPSOL 85-4W89.1	

[NOTE: All references are on file and available for inspection in 735-9A. These include three sets of the offplant laboratory procedures titled "Procedures for Analysis of Groundwater Monitoring Samples for Du Pont - SRP."]

[a]EPA Methods - Methods for the Chemical Analysis of Water and Waste EPA, March 1979.

Standard Methods - Standard Methods for the Examination of Water and Waste Water, 15th Edition, APHA-AWWA-WPCF, 1980.

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ATTACHMENT #3

LOGBOOK HEADINGS

SITE AND WELL # ________________

COORDINATES: N _______ E _______

EVALUATION (TOP OF CASING) ___________

LENGTH (ft) FROM TOP OF CASING TO BOTTOM OF SCREEN ___________

DATE	TIME	MEASUREMENTS						SAMPLES - 735A W.Q.			
		TEMP °C	PH	COND. us/cm	DEPTH Ft	WATER COLUMN(Ft)	GALS OF WATER REMOVED	COLIF. (ice) 400-D	1-LITER (ice)	1-LITER HNO_3	500 ml H_2SO_4

METALS 1-LITER HNO_3	PESTICIDES .5 GAL GLASS (ICE)	RADIUM .5 GAL (ICE)	SULFIDE 8oz.POLY ZnAc	SO_4F .5 GAL (ICE)	ODOR 1-LITER GLASS (ice)	CYNANIDE 1-LITER NAOH	PHENOL 8oz GLASS H_3PO_4 $CuSO_4$	ORG. SCAN 100 ml GLASS (ICE)	TOH	REMARKS	INITIALS

TABLE -

PUMPING WELLS

FOUR VOLUMES (GAL.) OF H_2O in 4" CASING WELLS

Water Column (Ft.)	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
0	0	0	1	1	1	1	2	2	2	2
1	3	3	3	3	4	4	4	4	5	5
2	5	6	6	6	6	6	7	7	7	8
3	8	8	8	9	9	9	9	10	10	10
4	11	11	11	11	12	12	12	12	13	13
5	13	13	14	14	14	14	15	15	15	15
6	16	16	16	17	17	17	17	18	18	18
7	18	19	19	19	19	20	20	20	20	21
8	21	21	22	22	22	22	23	23	23	23
9	24	24	24	24	25	25	25	26	26	26
10	26	27	27	27	27	27	28	28	28	29
11	29	29	29	30	30	30	31	31	31	31
12	32	32	32	32	33	33	33	33	34	34
13	34	35	35	35	35	36	36	36	36	37
14	34	37	37	38	38	38	38	39	39	39
15	39	40	40	40	40	41	41	41	42	42
16	42	42	43	43	43	43	44	44	44	44
17	45	45	45	45	46	46	46	47	47	47
18	47	48	48	48	48	49	49	49	49	50
19	50	50	50	51	51	51	52	52	52	52
20	53	53	53	53	54	54	54	54	55	55
21	55	56	56	56	56	57	57	57	57	57
22	58	58	58	59	59	59	59	60	60	60
23	60	61	61	61	61	62	62	62	63	63
24	63	64	64	64	64	64	65	65	65	65
25	66	66	66	67	67	67	67	68	68	68
26	68	69	69	69	69	70	70	70	70	71
27	71	71	72	72	72	72	73	73	73	73
28	74	74	74	74	75	75	75	75	76	76
29	76	77	77	77	77	77	78	78	78	79
30	79	79	79	80	80	80	80	81	81	81
31	82	82	82	82	83	83	83	83	83	84
32	84	84	84	85	85	85	86	86	86	86
33	87	87	87	88	88	88	88	89	89	89
34	89	90	90	90	90	90	91	91	92	92
35	92	92	93	93	93	93	94	94	94	94

APPENDIX F. WATER LEVEL ELEVATIONS IN MONITORING WELLS

This appendix includes the water-level elevations that were used to construct Figures 5-3, 5-4, 5-5, and 5-6 as well as others that were measured before collecting water samples for analysis.

Appendix F-1 includes the water-level measurements that were used to construct most of Figure 5-3, Water Table Elevation Map for Spring 1984. Most of these measurements were all made at the end of July to obtain a synoptic set of water-level elevations. Wells other than water-table wells were also measured during this time period and they are included in Appendix F-1. In order to extend the water table map to the Silverton Road waste site area, it was necessary to use water-level measurements taken while collecting samples for chemical analysis and these water levels are given in Appendix F-2. These measurements were made in May and June 1984. For construction of Figure 5-4, Potentiometric Map of the Elevation Interval where the Top of the Screen is Between 146 and 187 ft, i.e., ~50 ft Below the Green Clay, for April-June 1984, the measurements taken in July 1984 did not provide sufficient areal coverage. So the water-level measurements obtained while collecting samples for chemical analyses given in Appendix F-2 were used. This resulted in a broadened time span but provided better areal coverage.

The same situation applied to the construction of Figure 5-5, Potentiometric Map of the Elevation Interval where the Top of the Screen is Between 100 and 144 ft, i.e., in Basal Tertiary Sediments for April-June 1984, and the same solution was applied, i.e., the measurements are given in Appendix F-2. For Figure 5-6, Potentiometric Map of the Elevation Interval where the Top of the Screen is Between 14 and 76 ft, i.e., Upper "Tuscaloosa" Formation, for May 1984, the water-level measurements made while collecting samples for chemical analyses, Appendix F-2, were used but the time period was restricted to May 1984 without sacrificing any areal coverage.

APPENDIX F-1

WELL	DATE	DEPTH	ELEVWAT
AC 1A	30JUL84	-39.54	222.56
AC 1B	30JUL84	-39.33	222.67
AC 2A	26JUL84	.	.
AC 2B	26JUL84	.	.
AC 3A	26JUL84	-84.83	217.47
AC 3B	26JUL84	-83.66	218.84
ASB 7	27JUL84	-112.66	240.72
ASB 8	27JUL84	-110.00	238.95
ASB 9	27JUL84	-63.25	245.70
MSB 9A	27JUL84	-136.66	221.04
MSB 9B	27JUL84	-114.50	243.40
MSB 9C	27JUL84	-115.42	243.68
MSB 10A	26JUL84	-135.42	219.58
MSB 10B	26JUL84	-132.91	221.79
MSB 10C	26JUL84	-114.08	241.92
MSB 10D	26JUL84	-114.00	241.50
MSB 11A	27JUL84	-143.25	221.65
MSB 11B	27JUL84	-138.83	225.97
MSB 11C	27JUL84	-132.25	232.65
MSB 11D	27JUL84	-122.50	242.70
MSB 11E	27JUL84	-122.00	243.20
MSB 11F	27JUL84	-121.66	242.94
MSB 12A	24JUL84	-130.75	217.05
MSB 12B	24JUL84	-117.50	230.90
MSB 12C	24JUL84	-113.08	234.82
MSB 12D	24JUL84	-107.50	240.60
MSB 12TA	24JUL84	-157.75	190.75
MSB 12TB	24JUL84	-158.25	190.65
MSB 13A	24JUL84	-129.33	215.87
MSB 13B	24JUL84	-114.25	231.35
MSB 13C	24JUL84	-103.08	242.62
MSB 14A	27JUL84	-121.42	226.88
MSB 14B	27JUL84	-119.75	228.95
MSB 14C	27JUL84	-104.00	244.70
MSB 15A	27JUL84	-134.50	232.70
MSB 15C	27JUL84	-120.33	246.27
MSB 16A	27JUL84	-132.46	234.24
MSB 16C	27JUL84	-123.50	243.10
MSB 17A	24JUL84	-133.33	224.67
MSB 17B	24JUL84	-121.83	236.07
MSB 17C	24JUL84	-120.00	238.10
MSB 18A	25JUL84	-121.66	218.54
MSB 18B	25JUL84	-110.56	229.74
MSB 18C	25JUL84	-103.91	236.69
MSB 19A	27JUL84	-81.00	218.50
MSB 19B	27JUL84	-77.17	222.73
MSB 19C	27JUL84	-53.58	246.62
MSB 20A	26JUL84	-126.75	227.25
MSB 20C	26JUL84	-116.00	237.30
MSB 21A	26JUL84	-123.75	229.65
MSB 21C	26JUL84	-113.08	240.32
MSB 22	27JUL84	-115.83	246.47
MSB 23	30JUL84	-127.04	244.73
MSB 23B	[illegible]	-135.71	235.89
MSB 24	30JUL84	-138.73	241.42
MSB 24A	30JUL84	-143.37	238.21
MSB 25	27JUL84	-124.66	242.27
MSB 25A	27JUL84	-138.25	228.17
MSB 26	26JUL84	-117.50	244.05
MSB 26A	26JUL84	-125.58	235.35
MSB 27	27JUL84	-129.08	246.40
MSB 27A	27JUL84	-134.50	240.65
MSB 28	26JUL84	-112.42	241.99
MSB 28A	26JUL84	-120.66	233.57
MSB 30A	26JUL84	-157.50	197.06
MSB 30C	26JUL84	-112.91	241.13
MSB 31A	27JUL84	-151.66	195.54
MSB 31B	27JUL84	-120.48	227.02
MSB 31C	27JUL84	-101.00	246.30
MSB 32	27JUL84	-27.83	227.43
MSB 33	27JUL84	-35.33	221.30
MSB 34A	27JUL84	-159.58	223.59
MSB 34B	27JUL84	-145.25	237.83
MSB 34C	27JUL84	-143.54	239.65
MSB 34TA	27JUL84	-183.66	198.83
MSB 34TB	27JUL84	-181.37	201.40

APPENDIX F. WATER-LEVEL ELEVATIONS IN OBSERVATION WELLS IN THE A AND M AREA VICINITY.

WELL		SAMPLE DATE	WATER ELEVATION
ABG	1	061284	227.37
AC	1A	050283	217.10
AC	1A	071283	219.04
AC	1A	060784	221.63
AC	1B	042683	217.20
AC	1B	071283	219.16
AC	1B	060784	222.69
AC	2A	042383	226.30
AC	2A	071183	227.25
AC	2A	050184	230.79
AC	2A	061384	229.52
AC	2A	091984	230.76
AC	2B	051083	233.50
AC	2B	071183	235.00
AC	2B	050184	239.19
AC	2B	091984	237.33
AC	3A	042983	214.30
AC	3A	071283	215.11
AC	3A	032484	219.90
AC	3A	060784	218.57
AC	3B	042983	215.20
AC	3B	071283	215.82
AC	3B	032484	220.71
AC	3B	032484	220.71
AC	3B	060784	219.39
AOB	1	061184	245.82
AOB	2	061184	245.55
ASB	4	061284	241.71
ASB	7	051484	241.93
ASB	8	053084	242.45
LA	4	051884	207.00
MPT	1	070783	236.77
MPT	1	082283	223.06
MPT	1	082683	222.04
MPT	1	092383	223.16
MPT	1	092683	223.16
MPT	1	092983	223.45
MPT	1	101483	222.84
MPT	1	101883	225.66
MPT	1	102083	223.16
MPT	1	102583	222.66
MPT	1	103183	224.16
MPT	1	113083	221.76
MPT	1	120583	221.91
MSB	1A	050384	242.33
MSB	2A	050384	242.48
MSB	3A	032184	242.35
MSB	3A	032184	242.35
MSB	3A	050384	242.28
MSB	4A	050384	242.15
MSB	5A	051084	230.70
MSB	5A	091284	240.07
MSB	6A	051084	224.43
MSB	7A	051084	225.72
MSB	7A	091284	238.48
MSB	8A	051084	225.70
MSB	8A	091284	241.16
MSB	9A	042483	218.60
MSB	9A	070783	218.90
MSB	9A	041384	222.55
MSB	9A	090684	221.84
MSB	9B	062983	241.69
MSB	9B	041784	244.72
MSB	9B	090684	244.38
MSB	9C	051683	241.90
MSB	9C	062983	241.87
MSB	9C	041684	244.97
MSB	9C	090684	244.55
MSB	10A	042483	216.50
MSB	10A	041784	220.96
MSB	10A	091084	220.90
MSB	10B	062783	220.12
MSB	10B	070783	220.17
MSB	10B	041884	223.32
MSB	10B	091084	223.42
MSB	10C	042483	240.20
MSB	10C	070783	240.09
MSB	10C	041884	243.00
MSB	10C	091084	242.86
MSB	10D	041884	242.72
MSB	11A	042483	219.10
MSB	11A	062783	219.59
MSB	11A	082283	220.30
MSB	11A	082683	220.30
MSB	11A	091683	220.36
MSB	11A	092083	220.45
MSB	11A	092383	220.54
MSB	11A	092683	220.54
MSB	11A	092983	220.55
MSB	11A	120583	221.10
MSB	11A	032184	221.26
MSB	11A	041284	223.28
MSB	11A	090584	222.38
MSB	11B	062883	231.09
MSB	11B	082283	229.94
MSB	11B	082683	229.87
MSB	11B	091683	231.30
MSB	11B	092083	230.43
MSB	11B	092383	230.10
MSB	11B	092683	230.10
MSB	11B	092983	230.08
MSB	11B	113083	230.00
MSB	11B	032184	230.53
MSB	11B	041284	232.22
MSB	11B	090584	231.62

APPENDIX F. WATER-LEVEL ELEVATIONS IN OBSERVATION WELLS IN THE A AND M AREA VICINITY.

WELL	SAMPLE DATE	WATER ELEVATION
MSB 11C	062883	232.32
MSB 11C	082283	231.95
MSB 11C	082683	231.80
MSB 11C	091683	233.82
MSB 11C	092083	232.59
MSB 11C	092383	232.22
MSB 11C	092683	232.22
MSB 11C	092983	232.23
MSB 11C	112883	232.40
MSB 11C	041284	233.72
MSB 11C	090584	233.77
MSB 11D	062783	241.97
MSB 11D	082283	241.95
MSB 11D	082683	242.02
MSB 11D	091683	242.49
MSB 11D	092083	242.46
MSB 11D	092383	241.96
MSB 11D	092683	241.96
MSB 11D	092983	242.25
MSB 11D	112883	242.44
MSB 11D	041284	243.90
MSB 11D	090684	243.69
MSB 11E	082283	242.71
MSB 11E	082683	242.63
MSB 11F	070783	241.88
MSB 11F	082283	242.32
MSB 11F	082683	242.39
MSB 11F	091683	242.58
MSB 11F	092083	242.70
MSB 11F	092383	242.68
MSB 11F	092683	242.68
MSB 11F	092983	242.68
MSB 11F	120583	241.98
MSB 11F	032184	242.89
MSB 11F	032184	242.89
MSB 11F	041284	244.20
MSB 11F	090684	244.10
MSB 12A	062783	214.83
MSB 12A	032284	216.75
MSB 12A	041984	218.37
MSB 12A	091184	218.40
MSB 12B	042783	224.60
MSB 12B	070783	221.17
MSB 12B	032284	229.60
MSB 12B	041984	229.85
MSB 12B	091184	229.76
MSB 12C	042783	232.90
MSB 12C	032284	234.35
MSB 12C	041884	233.25
MSB 12C	091184	233.23
MSB 12D	070783	239.03
MSB 12D	032284	239.90
MSB 12D	041884	242.70

WELL	SAMPLE DATE	WATER ELEVATION
MSB 12D	091184	242.66
MSB 12TA	102483	189.50
MSB 12TA	102583	190.50
MSB 12TA	102683	189.50
MSB 12TA	051784	193.55
MSB 12TA	052284	193.60
MSB 12TA	052584	193.16
MSB 12TA	091084	194.20
MSB 12TB	102483	190.90
MSB 12TB	102583	190.90
MSB 12TB	102683	190.90
MSB 12TB	051784	193.99
MSB 12TB	052184	194.05
MSB 12TB	052384	193.90
MSB 12TB	091084	196.78
MSB 13A	042883	213.50
MSB 13A	071283	214.42
MSB 13A	042084	217.15
MSB 13A	091184	217.15
MSB 13B	070583	229.29
MSB 13B	042084	232.20
MSB 13B	091284	232.16
MSB 13C	042883	241.60
MSB 13C	071283	241.20
MSB 13C	042084	244.41
MSB 13C	091284	244.46
MSB 14A	042783	225.10
MSB 14A	071183	226.10
MSB 14A	041384	228.35
MSB 14A	061484	228.01
MSB 14A	090484	227.69
MSB 14B	062983	227.39
MSB 14B	041384	230.34
MSB 14B	090484	229.65
MSB 14C	042783	244.20
MSB 14C	071183	243.24
MSB 14C	041384	245.72
MSB 14C	090584	245.26
MSB 15A	042883	231.10
MSB 15A	062783	231.19
MSB 15A	041684	234.22
MSB 15A	090784	233.41
MSB 16A	042383	232.70
MSB 16A	062783	232.85
MSB 16A	041784	235.58
MSB 16A	090784	235.21
MSB 16C	042483	241.10
MSB 16C	062883	241.48
MSB 16C	041784	243.80
MSB 16C	090784	243.96
MSB 17A	042883	222.20
MSB 17A	071183	224.18
MSB 17A	042384	226.60

APPENDIX F. WATER-LEVEL ELEVATIONS IN OBSERVATION WELLS IN THE A AND M AREA VICINITY.

WELL	SAMPLE DATE	WATER ELEVATION
MSB 17A	091384	226.56
MSB 17B	042983	234.10
MSB 17B	071183	235.42
MSB 17B	042484	238.78
MSB 17B	091384	238.70
MSB 18A	062883	216.55
MSB 18A	070183	217.62
MSB 18A	042384	220.35
MSB 18A	091384	220.07
MSB 18B	042883	226.80
MSB 18B	071283	227.13
MSB 18B	042384	230.95
MSB 18B	091384	230.85
MSB 18C	042883	232.90
MSB 18C	071283	234.10
MSB 18C	042384	236.00
MSB 18C	091384	235.85
MSB 19A	043083	217.00
MSB 19A	060884	219.17
MSB 19B	060884	222.39
MSB 19C	043083	243.80
MSB 19C	071183	244.55
MSB 19C	061384	245.82
MSB 20A	042383	224.00
MSB 20A	070683	224.86
MSB 20A	042484	228.45
MSB 20A	091784	228.40
MSB 20C	042383	234.00
MSB 20C	070683	234.68
MSB 20C	042484	238.30
MSB 20C	091784	238.19
MSB 21A	042383	226.80
MSB 21A	071183	227.60
MSB 21A	042584	230.85
MSB 21A	091784	230.75
MSB 21C	042383	237.10
MSB 21C	042484	240.95
MSB 21C	091784	240.90
MSB 22	062783	241.32
MSB 22	032184	240.12
MSB 22	032184	240.12
MSB 22	041384	244.23
MSB 22	090584	243.97
MSB 23	050983	243.57
MSB 23	070683	243.77
MSB 23	051184	245.37
MSB 23A	050983	198.62
MSB 23A	070683	198.36
MSB 23A	051184	202.60
MSB 23A	052484	199.44
MSB 23A	052984	201.70
MSB 23A	060584	202.05
MSB 23A	071084	202.03
MSB 23A	082484	200.01
MSB 23A	082884	199.93
MSB 23B	050983	234.30
MSB 23B	070683	234.62
MSB 23B	051184	237.08
MSB 24	042983	238.45
MSB 24	070783	240.01
MSB 24	032384	239.32
MSB 24	051584	240.30
MSB 24A	042983	237.08
MSB 24A	070783	237.29
MSB 24A	032384	231.90
MSB 24A	032384	231.90
MSB 24A	051584	237.06
MSB 25	051683	240.53
MSB 25	071283	242.32
MSB 25	051584	241.15
MSB 25A	051683	226.32
MSB 25A	071283	228.31
MSB 25A	051584	227.36
MSB 26	051083	242.45
MSB 26	071183	243.01
MSB 26	042684	242.42
MSB 26	091784	242.38
MSB 26A	051083	233.23
MSB 26A	071183	233.97
MSB 26A	042684	236.35
MSB 26A	091884	236.39
MSB 27	051683	244.18
MSB 27	071183	242.93
MSB 27	032484	249.64
MSB 27	042684	246.48
MSB 27	091984	246.37
MSB 27A	051083	239.15
MSB 27A	071183	242.60
MSB 27A	042684	241.80
MSB 27A	061384	240.23
MSB 27A	092084	240.21
MSB 28	051283	239.21
MSB 28	071183	239.96
MSB 28	032584	253.48
MSB 28	043084	241.69
MSB 28	091884	241.67
MSB 28A	051283	231.03
MSB 28A	043084	234.78
MSB 28A	091884	234.76
MSB 30A	051283	194.56
MSB 30A	070583	196.91
MSB 30A	032484	201.15
MSB 30A	043084	200.56
MSB 30A	052184	198.20
MSB 30A	083184	198.96
MSB 30C	051283	237.74

APPENDIX F. WATER-LEVEL ELEVATIONS IN OBSERVATION WELLS IN THE A AND M AREA VICINITY.

WELL	SAMPLE DATE	WATER ELEVATION
MSB 30C	070583	238.44
MSB 30C	043084	241.54
MSB 30C	091984	242.51
MSB 31A	100683	194.24
MSB 31A	101083	194.40
MSB 31A	050984	198.91
MSB 31A	052284	198.59
MSB 31A	052584	195.60
MSB 31B	062983	225.74
MSB 31B	050984	229.06
MSB 31C	062883	244.59
MSB 31C	050984	247.40
MSB 32	062883	225.76
MSB 32	061484	228.62
MSB 33	050283	220.33
MSB 33	062883	220.28
MSB 33	050984	223.63
MSB 34A	090883	215.50
MSB 34A	042584	225.47
MSB 34A	072684	223.33
MSB 34B	090883	237.18
MSB 34B	042584	239.35
MSB 34B	072684	238.18
MSB 34B	080684	238.40
MSB 34B	082184	238.50
MSB 34C	090883	238.99
MSB 34C	042584	241.04
MSB 34C	072684	240.05
MSB 34TA	091283	197.49
MSB 34TA	091583	197.47
MSB 34TA	091983	197.74
MSB 34TA	102683	197.99
MSB 34TA	051684	199.22
MSB 34TA	051884	199.49
MSB 34TA	071984	195.89
MSB 34TA	071984	195.89
MSB 34TA	082184	201.04
MSB 34TB	090883	199.27
MSB 34TB	051684	204.18
MSB 34TB	051884	204.26
MSB 34TB	071884	201.46
MSB 34TB	071884	201.46
MSB 34TB	082184	203.73
RWM 2	011284	209.26
RWM 2	011484	208.88
RWM 2	011584	228.81
RWM 2	012584	210.69
RWM 2	012684	211.28
RWM 2	012784	212.28
RWM 2	012884	212.83
RWM 2	012984	213.03
RWM 2	013084	212.57
RWM 2	013184	212.98
RWM 2	020184	213.03
RWM 2	020284	213.40
RWM 2	020384	213.62
RWM 2	020484	214.89
RWM 2	021584	201.68
RWM 2	021784	205.74
RWM 2	022484	208.08
RWM 2	022884	207.78
RWM 2	030284	207.48
RWM 2	030984	222.18
RWM 2	031384	222.78
RWM 2	032084	210.68
RWM 2	032384	212.24
RWM 2	032384	212.24
RWM 2	033084	207.48
RWM 3	020284	231.37
RWM 3	020384	231.81
RWM 3	020484	232.25
RWM 3	020584	226.93
RWM 3	020684	226.89
RWM 3	020784	226.45
RWM 3	020884	226.33
RWM 3	020984	226.38
RWM 3	021084	226.48
RWM 3	021184	226.67
RWM 3	021284	226.75
RWM 3	021384	226.92
RWM 3	021584	231.97
RWM 3	021784	230.07
RWM 3	022184	230.30
RWM 3	022484	231.43
RWM 3	022884	231.43
RWM 3	030284	230.13
RWM 3	030984	230.23
RWM 3	031384	230.63
RWM 3	032084	228.43
RWM 3	032384	228.19
RWM 3	032384	228.19
RWM 3	033084	228.83
SRW 1C	050484	219.98
SRW 1C	092684	220.08
SRW 2A	050284	212.09
SRW 2A	072584	214.38
SRW 2A	092084	212.17
SRW 2B	050284	213.13
SRW 2B	092084	213.14
SRW 2C	092684	229.85
SRW 3C	050284	219.15
SRW 4C	050484	220.97
SRW 4C	092784	220.83
SRW 5C	050484	217.57
SRW 5C	092784	217.53
SRW 9A	060184	206.41

APPENDIX F. WATER-LEVEL ELEVATIONS IN OBSERVATION WELLS IN THE A AND M AREA VICINITY.

WELL	SAMPLE DATE	WATER ELEVATION
SRW 9B	060484	208.61
SRW 12A	060484	202.27
SRW 12B	060484	198.02
SRW 12C	060684	206.02
SRW 13A	053184	207.74
SRW 13B	053184	209.84
SRW 13C	060184	214.78
SRW 14A	050784	211.56
SRW 14B	050484	213.10
SRW 14C	050484	219.82
SRW 15A	050784	217.46
SRW 15B	050784	217.23
SRW 15C	050184	217.76
SRW 16A	050884	222.85
SRW 16B	050784	222.77