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GROUNDWATER QUALITY ASSESSMENT

PROGRAM

AT

CABOT CORPORATION PLANT
TUSCOLA, ILLINOIS

January, 1984

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EPA Region 5 Records Ctr.
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GROUNDWATER QUALITY ASSESSMENT PROGRAM FOR HAZARDOUS WASTE IMPOUNDMENT AT CABOT CORPORATION PLANT NEAR TUSCOLA, ILLINOIS

INTRODUCTION

This Groundwater Quality Assessment Program for the hazardous waste impoundment at the Cabot Corporation's plant near Tuscola, Illinois has been prepared to satisfy the requirements of Section 725.193(d)(2), Subpart F: Groundwater Monitoring, Part 725: Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities, Subchapter c: Hazardous Waste Operating Requirements, Illinois Pollution Control Board Regulations. Previous to the Quality Assessment Program, Cabot Corporation has submitted to the IEPA in August 1982, the groundwater monitoring program as required by Section 725.190(a) and (b) of the same regulations. The initial monitoring program included four monitoring wells: one upgradient and three downgradient. Assessment of the results from these wells led the conclusions that (1) general groundwater flow direction was toward east-northeast, (2) a groundwater mound was formed beneath the impoundment, (3) groundwater flow was radial near the impoundment, and (4) the impoundment was leaking. The last finding prompted initiation of the Groundwater Quality Assessment Program at the site.

GROUNDWATER QUALITY ASSESSMENT PROGRAM

The groundwater quality assessment program has been prepared to determine as quickly as technically feasible the rate and extent of migration, and the concentrations of hazardous waste or hazardous waste constituents in the groundwater beneath the plant property, especially in the direction of groundwater flow. Such information will be useful both to estimate migration distance of hazardous waste constituents from the impoundment in the groundwater and to assess the quality of groundwater at the boundary of the Cabot Corporation plant.

Monitoring System

The groundwater monitoring system includes 13 monitoring wells (Figure 1). Of these, M[illegible] the background well and the rest are the downgradient wells. MW-1, MW-2, M[illegible]-3 and MW-4 were in the initial groundwater monitoring program at the plant. These wells were installed in December 1981. The log and construction details of these wells were submitted to the IEPA with the Groundwater Monitoring Program in August 1982. Four more wells, MW-5, MW-6, MW-7, and MW-8, were installed in December 1982. These wells were not a part of the initial program. The log of them is in the appendix. Another set of four wells will be installed at the site. Of these, MW-9 and MW-13 are to detect any downward vertical migration of the hazardous waste constituents. MW-10, MW-11, and MW-12 will be primarily utilized to determine the quality of water at the property boundary. The log of these wells will be submitted to the IEPA with the groundwater quality assessment that will be made after the completion of the wells.

Well Construction

Information on the first group of four wells was submitted to the IEPA with initial groundwater monitoring program. The second group of four wells were installed exactly the same way as the first four wells. A summary of information on these wells is included in Table 1. These wells, drilled to a depth of approximately thirty feet with a hollow stem auger, consists of 20 feet of 2-inch diameter, machine-slotted PVC well screen and 13 feet of riser pipe. Flush threaded screen and casing were used to avoid potential sample contamination by PVC cleaner and glue. After backfilling the screened interval with clean quartz sand, the well was backwashed by pumping municipal water down the well casing and out of the screen to remove silt and clay

from the sand [illegible] annulus was then filled to grade with cement/ bentonite gro[illegible] lockable steel cover was set in concrete around the PVC casing to provide well protection.

Wells To Be Installed

The five wells to be drilled will be constructed as above, however, their depths and screen intervals would be different.

Monitoring wells MW-9, MW-10, MW-11, MW-12 and MW-13 (Figure 1) will be installed according to the Schedule of Implementation in this program. MW-9, and MW-13 will be located near MW-6 and MW-10, respectively. They will be drilled to a depth of 50 ft. A 5-ft long, machine slotted PVC well screen will be placed at the 45 to 50 ft depth and 45 to 50 ft PVC riser pipe installed above the screen so that water would be sampled from only 45 to 50 ft depth. If water from MW-9 and/or MW-13 is found to be contaminated, a deeper well(s) will be installed to determine the extent of vertical migration.

MW-10, MW-11, and MW-12 will be located along the eastern property boundary of the plant and they will be drilled to a depth of 20 ft. A 10-ft long, machine slotted PVC well screen and 10 to 15 ft PVC riser pipe will be installed in these wells.

After filling the screened interval with clean quartz sand, the annulus will be filled to grade with cement/bentonite grout in all wells above.

Sampling, Preservation, and Chain of Custody

Elevation of Water Level

Before sampling, depth to water level from the top of casing (TOC) will be measured in each monitoring well. The elevation of the water level will be determined by subtracting this measurement from the elevation of TOC. In addition, the well depth will be measured to determine the standing water volume.

Sampling and Preservation

Water samples will be collected from all monitoring wells at the plant on a quarterly basis until otherwise indicated by the IPCB's regulations. Prior to collection, the monitoring wells will be evacuated by removing at least one well volume of water. A bailer, peristaltic pump, pitcher, airlift pump, or some other purging device will be used to evacuate well water. The water level in MW-9 and MW-13 will be kept at least 10 ft above the top of the screen during evacuation. After evacuation, the water level in the wells will be allowed to stabilize before samples are collected.

Unit well volume of water to be evacuated is determined with the following equation:

$$Vp = Vcu \times St$$

where,

Vp = Well volume of water to be purged, gal

Vcu = Casing unit volume, gal/ft

St = Standing water in well, ft

Water samples will be collected with a peristaltic pump. Before each use, the peristaltic pump and tubes will be allowed to pass through deionized [illegible] for rinsing. Then, at least 1000 ml of well water will be allowed [illegible] through the tubes and the pump before collection of a sample from each well.

The water samples collected will be filtered through a 0.45 micron filter.

The water samples will be collected, and preserved according to U.S.EPA procedures given in Table 2 (U.S.EPA, 1977). Until the samples delivered to the laboratory, they will be kept in an insulated cooler containing ice so that a temperature of 0° C to 10° C is maintained.

Chain of Custody

When the water samples are collected, they will be recorded in a log book. At least the following will be recorded: sample number, sampling date, well number, depth to water, collector's name. The log book will be signed and dated by the collector. A waterproof label will be put on each sample bottle and marked with the sample number and the analyses to be performed. Each bottle will be sealed immediately after sample collection and preservation. The sample bottles will then be placed inside a cooler and taped shut during transportation to laboratory.

When the coolers are received in the laboratory, the sample bottles will be inspected to make sure that they have not been tampered with. If there are problems, the laboratory personnel will inform immediately the Cabot Corporation plant and new samples will be collected. If there are no problems, the receiving person will mark his initial on the label of the sample bottles. After this, the samples will be subject to the laboratory's internal custody system. When the result of analyses are reported to the plant by the laboratory, it will be indicated that the samples were not tampered.

Method of Analyses

The groundwater samples collected will be analyzed according to U.S.EPA accepted methods which are listed in a U.S.EPA publication (U.S.EPA, 1979). Table 2 indicates parameters to be analyzed.

Method to Determine Whether Hazardous Waste Constituents have Entered groundwater.

Wells MW-1, MW-2, MW-5, MW-6, MW-7 and MW-8, will be sampled quarterly. All samples will be analyzed for the parameters listed in Section 725. 192(b)(1), (2), (3) and the hazardous waste constituents in the groundwater (Table 2). Four replicate measurements will be made of the hazardous waste constituents in the groundwater and the following indicator parameters: pH, specific conductance, TOX and TOC. The arithmetic mean, variance and standard deviation will be calculated on each sample for the indicator parameters for each well and compared to the initial background arithmetic mean of the same parameter in the upgradient well. The arithmetic mean will be calculated on each sample for the hazardous waste constituents and mean for each downgradient well will be compared to that of the upgradient well.

Method To Determine The Rate And Extent of Migration of Hazardous Waste Constituents in Groundwater.

Wells MW-3, MW-4, MW-9, MW-10, MW-11, and MW-12 will be sampled quarterly. All water samples will be analyzed for the parameters listed in Section 725.192(b)(1),(2),(3) and the hazardous waste constituents in the groundwater.

The well MW-9 and MW-13 will measure changes of water quality, in vertically do[illegible]direction, immediately adjacent to the impoundment and to the eas[illegible] property boundary. If the water samples from these wells show migration of hazardous waste constituents from the impoundment, a deeper monitoring well will be installed near MW-9 and MW-13 to determine vertical extent of migration.

Analyses from MW-10, MW-11, MW-12, and MW-13 will show lateral extent of migration and the quality of water leaving the plant property. The result of analyses from wells MW-3 and MW-4 may also be useful to show lateral extent of migration of hazardous waste constituents.

The rate of groundwater flow beneath the facility and at the facility boundary will be calculated by using the hydraulic conductivity estimated previously from the field slug tests. The hydraulic gradient will be measured from the elevation of the potentiometric surface in the monitoring wells.

The extent of migration of hazardous waste constituents determined by chemical analyses above will be compared to the extent of migration estimated using Darcy's Law for the rate of flow beneath the facility.

The hazardous waste constituents to be analyzed in the quarterly water samples will be determined from the analysis of water samples that have been taken from MW-1, MW-2, MW-6 and a fluid sample from the impoundment. These samples are being analyzed for the priority pollutants because the majority of the laboratories are set up to analyze the priority pollutants rather than the hazardous waste constituents. Furthermore, the only toxic

waste stored in the impoundment would have been "chlorinated solvents" of R.R. Donnelly [illegible] Company. The priority pollutants include constituents of [illegible]ganic solvents. When the above analyses are completed, the IEPA will be provided with the list of hazardous waste constituents.

Method To Determine The Concentration of Hazardous Waste Constituents In The Groundwater.

Each quarter, four replicate measurements will be made on each water sample taken from each well for the hazardous waste constituents and the indicator parameters of groundwater contamination. The results will be expressed as mg/l. The arithmetic mean of the four replicate measurements for these constituents will constitute their concentrations in the groundwater.

Evaluation Procedures

The proc[illegible] outlined in Sections 725.192(c)(2) and 725.193(b),(c) of the IPCB regulations, will be used to evaluate the indicator parameters of groundwater contamination because their background concentrations were established previously. These procedures require that an initial background concentration must be calculated for each indicator parameters for the upgradient wells. To do this, at least four replicate measurement must be made on each sample, and the initial background arithmetic mean and variance must be determined by pooling the replicate measurements for the respective parameter concentrations obtained quarterly during the first year.

Following the establishment of the initial background concentration for each indicator parameter, the arithmetic mean and variance must be calculated on quarterly samples based on at least four replicate measurements on each sample for each well. In order to determine any significant change over background concentration, these results must be compared with the initial background arithmetic means of the upgradient well by using the Student's t-test at the 0.01 level of significance.

In the case of hazardous waste constituents, the above method will not be used due to lack of the initial background concentrations established. The arithmetic mean for each hazardous waste constituents will be calculated based on four replicate measurements on each sample from each well. To determine any significant change, the mean of each constituent in each downgradient well will be compared with the mean and range of the respective constituents

in the upgradient well.

However, a ne[illegible]hmetic mean and range for the upgradient well will be calcu[illegible] for each quarter, after the first one, by pooling the replicate measurements for the respective constituent concentrations measured in the previous quarters. Revision of the mean and range for the upgradient well will continue during the first four quarters (one year) of this program. After the first year, the Student's t-test as described above will be used to determine any statistically significant change for the hazardous waste constituents in the groundwater.

Schedule Of Implementation

The following schedule will be followed to implement the groundwater quality assessment program:

1. Five additional monitoring wells will be installed within 6 weeks of the submittal date of this program.
2. All 13 wells will be sampled within one week after the installation of the wells.
3. The samples will be analyzed within two months after the sample collection.
4. Assessment of the groundwater quality will be prepared in one month following the completion of the analyses.
5. A copy of the assessment will be submitted to the Director within 15 days after the completion of the assessment.

Prepared by:

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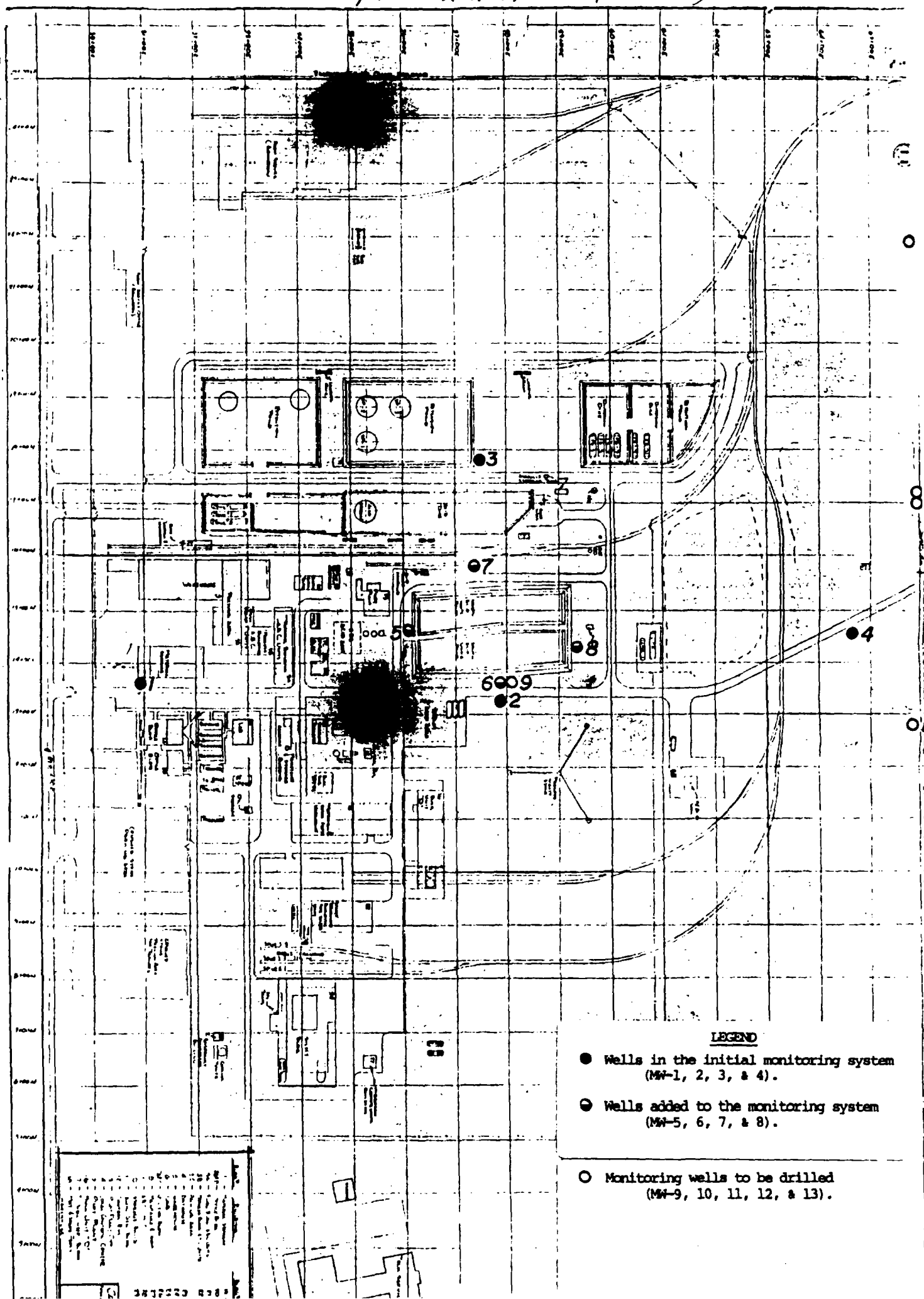


Table 2. Depth, elevation and construction data associated with the monitoring and observation wells.

Well No.	Date installed	Elevation of TOC * ft	Well depth ft	Screen interval ft	[illegible] casing and [illegible]n type and [illegible]ter (inches)
MW-1	12-7-81	696.44	31.3	11.4-31.3	PVC, 2 O.D.
MW-2	12-7-81	693.68	31.4	11.4-31.4	PVC, 2 O.D.
MW-3	12-8-81	689.90	29.8	10.0-29.8	PVC, 2 O.D.
MW-4	12-8-81	693.87	30.5	10.6-30.5	PVC, 2 O.D.
MW-5	12-16-82	692.95	29.8	10.5-29.8	PVC, 2 O.D.
MW-6	12-15-82	692.96	30.2	10.9-30.2	PVC, 2 O.D.
MW-7	12-15-82	692.94	30.2	10.9-30.2	PVC, 2 O.D.
MW-8	12-14-82	692.95	30.0	10.9-30.0	PVC, 2 O.D.

* TOC (top of the casing is approximately 3.0 ft above the ground).

Table 2. Parameters to be analyzed, sample containers, and preservation procedures

PARAMETER	CONTAINER	PRESERVATIVE	HOLDING TIME
DRINKING WATER			
Arsenic	P,G **	HNO^3 to pH< 2	6 months
Barium	P,G	HNO^3 to pH< 2	6 months
Cadmium	P,G	HNO^3 to pH< 2	6 months
Chromium	P,G	HNO^3 to pH< 2	6 months
Fluoride	P,G	Cool, 4° C	7 days
Lead	P,G	HNO^3 to pH< 2	6 months
Mercury	P,G	HNO^3 to pH< 2	13-38 days
Nitrate (N)	P,G	Cool, 4° C	24 hours
Selenium	P,G	HNO^3 to pH< 2	6 months
Silver	P,G	HNO^3 to pH< 2	6 months
Endrin	Amber Glass	Cool, 4° C	3 days
Lindane	Amber Glass	Cool, 4° C	3 days
Methoxychlor	Amber Glass	Cool, 4° C	3 days
Toxaphene	Amber Glass	Cool, 4° C	3 days
2, 4-D	Amber Glass	Cool, 4° C	3 days
2, 4, 5-TP silvex	Amber Glass	Cool, 4° C	3 days
Radium	P	HNO^3 to pH< 2	6 months
Gross Alpha	P	HNO^3 to pH< 2	6 months
Gross Beta	P	HNO^3 to pH< 2	6 months
Turbidity	P	Cool, 4° C	7 days
Coliform Bacteria	P	Cool, 4° C	6 hours
WATER QUALITY			
Chloride	P,G	Cool, 4° C	7 days
Iron	P,G	HNO^3 to pH< 2	6 months
Manganese	P,G	HNO^3 to pH< 2	6 months
Phenols	G	H^2SO4 to pH<2	24 hours
Sodium	P,G	HNO^3 to pH< 2	6 months
Sulfate	P,G	Cool, 4° C	7 days
* CONTAMINATION INDICATORS			
pH	P,G	Det.on site Cool, 4° C	6 hours
Specific Conductance	P,G	Cool, 4° C	24 hours
Total Organic Carbon(TOX)	Amber Glass	H^2SO_4 to pH< 2 Cool, 4° C	24 hours
Total Organic Halogen (TOX)	Amber Glass	Cool, 4° C	7 days
* HAZARDOUS WASTE CONSTITUENTS	G	Cool, 4° C	

* Four replicate measurements will be made on each sample from each well

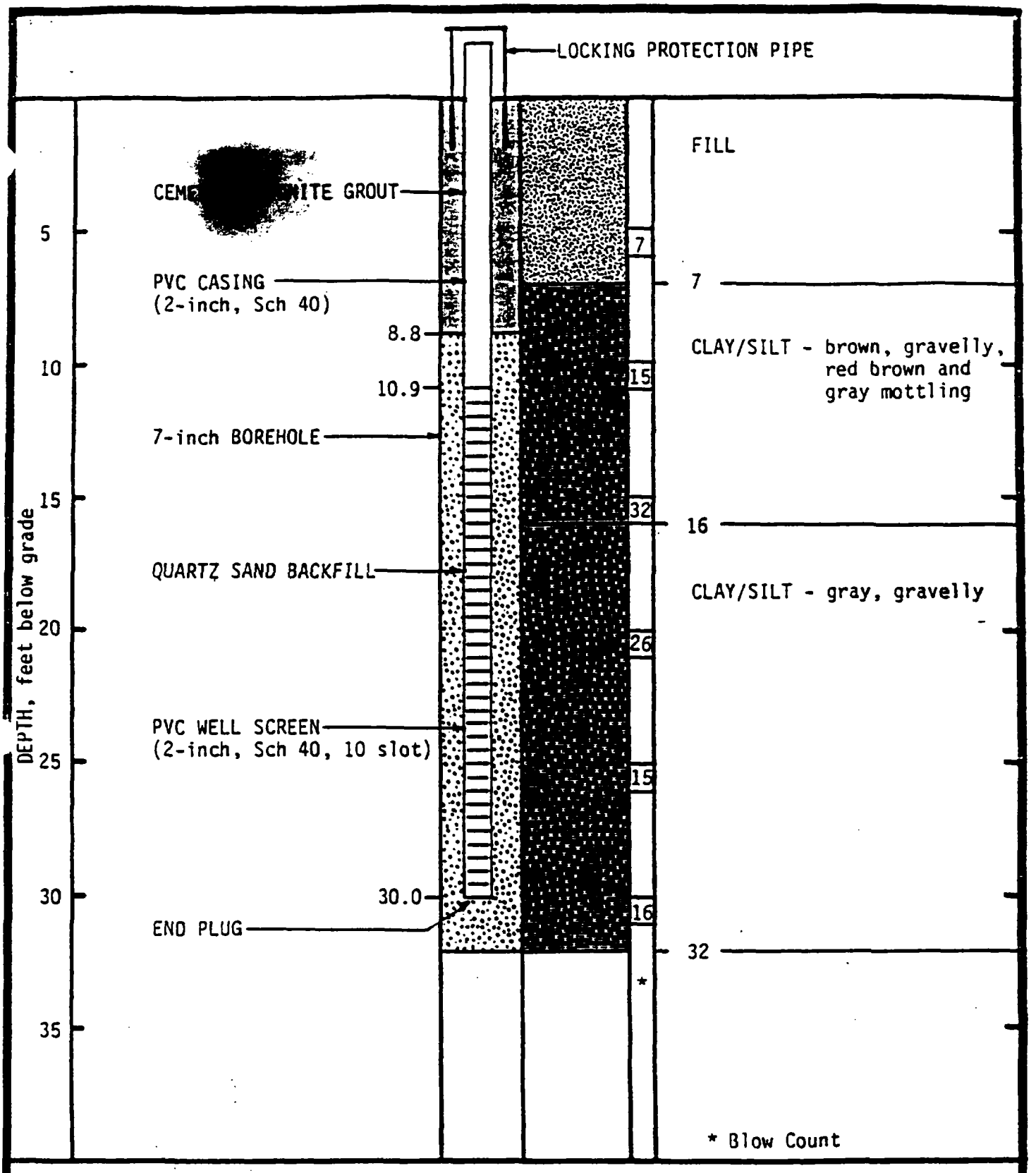
** P,G Plastic or Glass

LIST OF REFERENCES

1. U.S.EPA. 1977. Procedures manual for groundwater monitoring at solid waste disposal facilities. EPA/530/SW-611, 269p.

2. U.S.EPA. 1979. Methods for Chemical analysis of water and wastes. EPA/600/4-79-020, 298p.

APPENDIX - Log of monitoring (observation) wells nos. 5, 6, 7, & 8

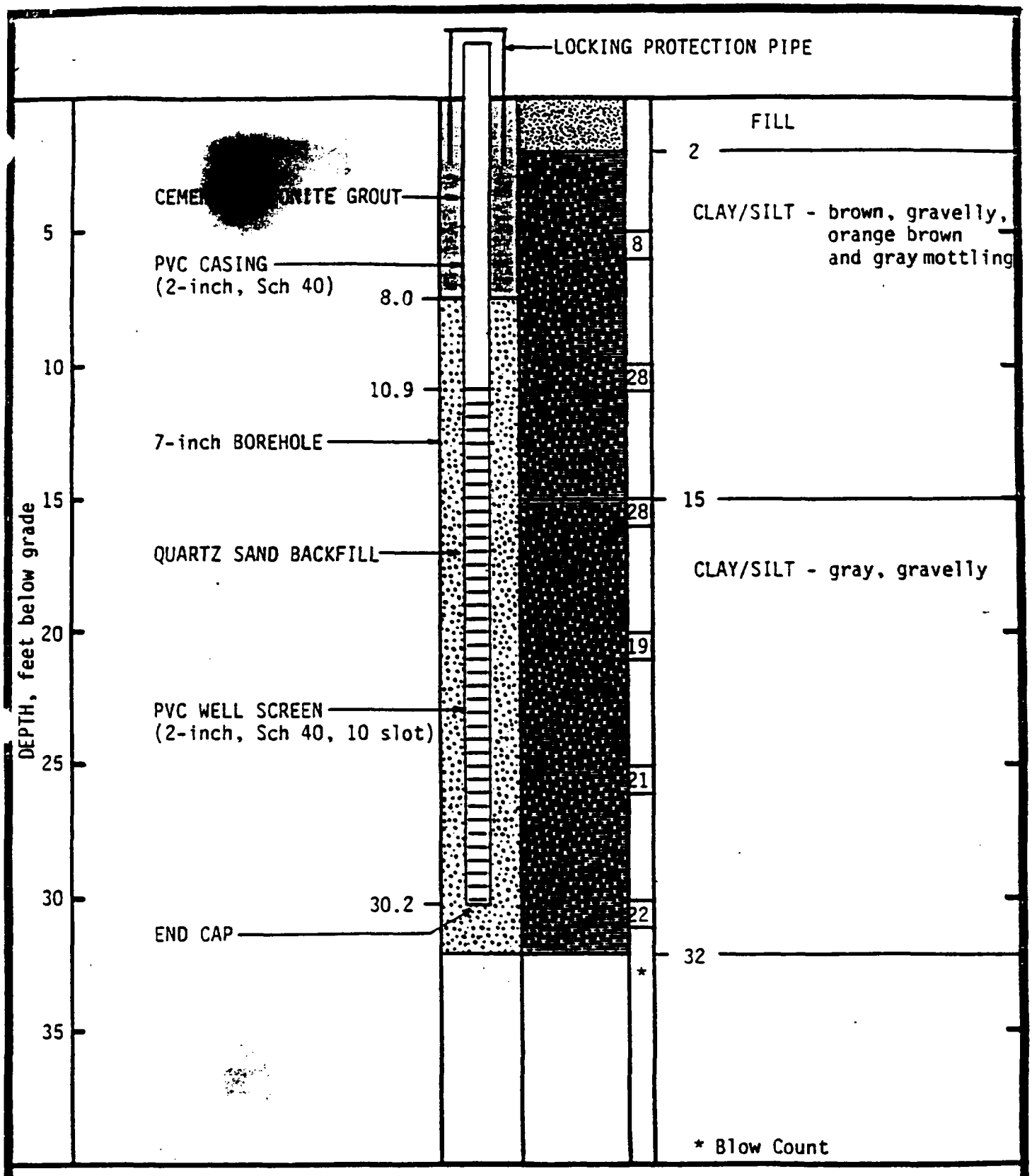


YARE AND ASSOCIATES, INC. **WELL RECORD**

DRILLER: SKS & Assoc. **RIG:** CME 55 HSA
COMPLETION DATE: 12-14-83
CASING JOINTS: Flush Threaded
TOC ELEVATION: 123.49 ft MSL
TOC HEIGHT: 3.0 ft AGS **DTW:** 6.96 ft BTOC

OBSERVATION WELL OW-8

CABOT CORPORATION
TUSCOLA, ILLINOIS

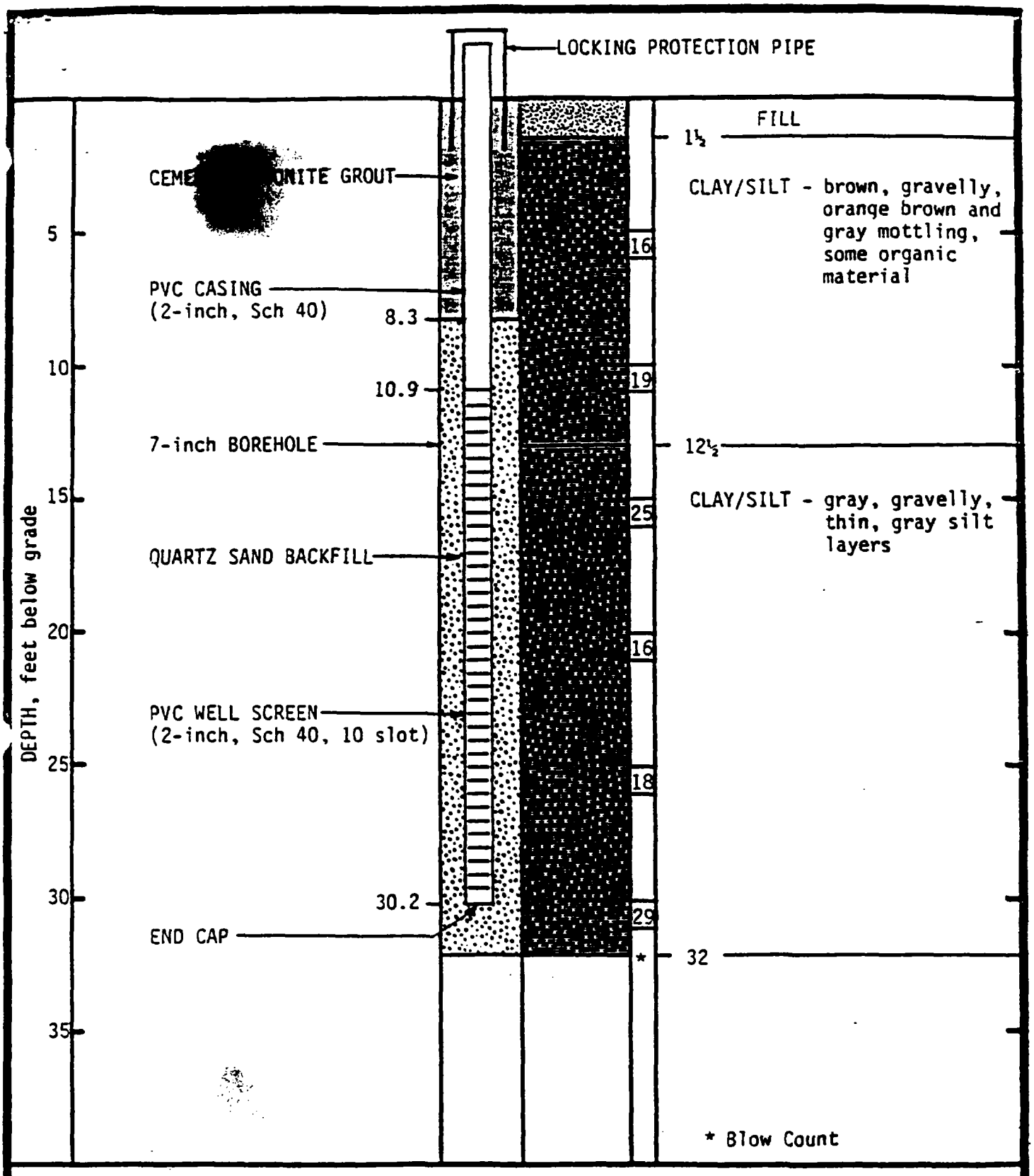


YARE AND ASSOCIATES, INC. **WELL RECORD**

DRILLER: SKS & Assoc. **RIG:** CME 55 HSA
COMPLETION DATE: 12-15-83
CASING JOINTS: Flush Threaded
TOC ELEVATION: 122.95 ft MSL
TOC HEIGHT: 3.0 ft AGS **DTW:** 7.22 ft BTOC (1-4-83)

OBSERVATION WELL OW-7

CABOT CORPORATION
TUSCOLA, ILLINOIS

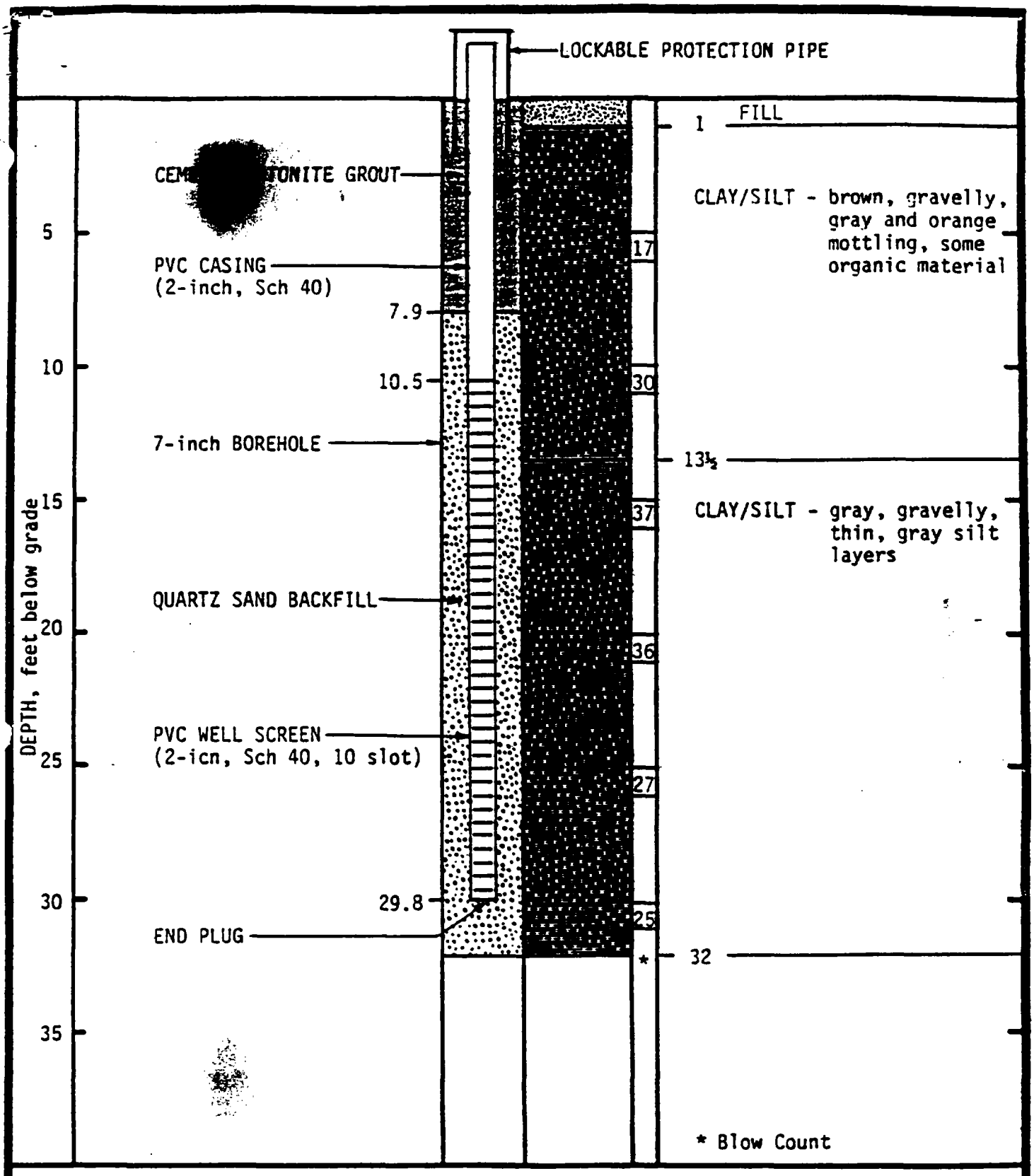


YARE AND ASSOCIATES, INC. **WELL RECORD**

DRILLER: SKS & Assoc. **RIG:** CME 55 HSA
COMPLETION DATE: 12-15-83
CASING JOINTS: Flush Threaded
TOC ELEVATION: 124.00 ft MSL
TOC HEIGHT: 3.0 ft AGS **DTW:** 5.16 ft BTOC (1-4-83)

OBSERVATION WELL OW-6

CABOT CORPORATION
TUSCOLA, ILLINOIS



YARE AND ASSOCIATES, INC. **WELL RECORD**

DRILLER: SKS & Assoc. **RIG:** CME 55 HSA
COMPLETION DATE: 12-16-82
CASING JOINTS: Flush Threaded
TOC ELEVATION: 126.49 ft MSL
TOC HEIGHT: 3.1 ft AGS **DTW:** 7.78 ft BTOC (1-4-83)

OBSERVATION WELL OW-5

CABOT CORPORATION
TUSCOLA, ILLINOIS