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MINN. POLLUTION CONTROL AGENCY

August 13, 1982

Mr. Donald J. Thimsen, P.E.
Manager, Environmental Engineering
Engineering Policy
General Mills, Inc.
P.O. Box 1113
Minneapolis, Minnesota 55440

Dear Mr. Thimsen:

This letter summarizes the status of our investigation of the groundwater-related impacts of the disposal site at the Henkel property and provides recommendations for the next phase of the investigation. A total of 14 shallow piezometers, 8 piezometers in the Platteville aquifer and 5 shallow sampling wells have been placed in the area surrounding the disposal site. Water levels measured in the shallow piezometers have been used to determine the direction of shallow groundwater movement in the vicinity of the disposal site. The Platteville borings and piezometers have been used to define the characteristics of the glacial drift and upper bedrock formations in the area and to measure groundwater levels in the Platteville aquifer. The Platteville is the uppermost bedrock aquifer beneath the site. The 4-inch diameter sampling wells have been used to collect samples of the surficial groundwater in the glacial drift. The locations of the monitoring wells and piezometers that have been placed to date are shown in Figure 1.

The elevation of the surface of the saturated zone in the glacial drift is shown in Figure 2. Streamlines showing the direction of groundwater movement in the upper saturated zone are also shown. The streamlines show a general southwesterly direction of groundwater movement across the disposal site area. Rates of groundwater movement appear to be fastest in the immediate vicinity of the disposal site and slower downgradient of the site as evidenced by the spacing between the contours. Since the permeability of the surficial soils has not yet been determined, rates of groundwater movement cannot be predicted at this time.

The generalized geologic column in the vicinity of the site is shown in Figure 3. The area is underlain by approximately 30 to 60 feet of alluvium that ranges from a fine to a medium sand. In some areas, the alluvium is underlain by a basal clay till unit that varies in thickness from 0 to 10 feet in the borings placed so far in the investigation. The thickness of the basal clay till unit is shown in Figure 4. This unit is thickest in the southwestern portion of the study area and is not present over the northern and

eastern halves of the area. The Decorah Shale is the subcropping bedrock under much of the study area, although it is thin and weathered in many areas and may be present only as islands. Available information shows that the Decorah is likely not present under the southern and southwestern portion of the study area. Contours of the thickness of the Decorah Shale are also shown in Figure 4. The Decorah Shale is underlain by the Platteville Limestone which is the uppermost aquifer in the site vicinity. Even though the Platteville can be considered an aquifer, it is not used extensively by wells in the area. Available information indicates that the upper portion of the Platteville is comprised of three units which are potentially water yielding, the Carimona, Magnolia, and Mifflin Members. The Platteville is underlain by the Glenwood which probably acts as an aquitard separating the Platteville from the underlying sandstone and dolomitic aquifers. The Glenwood is underlain by the St. Peter Sandstone and the remaining bedrock formations of the Twin City Basin.

The piezometric levels in the Platteville are shown in Figure 5. Comparing the piezometric levels measured in the Platteville piezometers with the surficial water table elevations measured in the accompanying shallow piezometers and wells indicates that the level of the shallow groundwater varies from 6 to 15 feet above the piezometric level of the Platteville. This indicates the potential for downward movement of groundwater from the glacial drift to the Platteville. The greater elevation differences in the area underlain by the Decorah Shale indicate that the Decorah may be acting to retard seepage from the surficial aquifer to the Platteville.

As shown in Figure 5, Platteville Piezometers BB, LL, and RR are located in the Carimona unit of the Platteville, Piezometers GG, OO, and QQ are located in the Magnolia unit, and Piezometers II and PP are located in both the Carimona and Magnolia units. Comparing the water level measurments taken from Piezometers RR and OO shows that the piezometric level in the Carimona is between 3½ and 4 feet higher than the piezometric level in the Magnolia unit at the location of these nested piezometers. These two units are separated by a thin stratum of bentonite in the lower Carimona and the massive, microgranular limestone of the upper Magnolia which seem to be retarding the movement of water from the Carimona to the Magnolia at least at the location of Piezometers RR and OO. Piezometric levels in the Carimona indicate that the likely direction of groundwater movement in this unit is to the west, southwest or south. Water level measurements in the Magnolia indicate the likelihood that the gradient is to the northwest or north with a somewhat steeper gradient than in the overlying Carimona. In summary, the data show that groundwater movement in the Platteville is likely complex, with different directions and rates in the two upper units.

Groundwater samples were collected from the shallow monitoring wells and the Platteville piezometers and analyzed for a series of volatile organic compounds. The results of these analyses are summarized in Tables 1 and 2. The samples from the shallow monitoring wells were split with the Minnesota Pollution Control Agency and the results from the two laboratories compared favorably. A sample collected from Monitoring Well 2 located immediately downgradient of the disposal site was also analyzed for priority pollutants

using GC/MS techniques. The results of this analysis are shown in Table 3. The results show that volatile organic compounds were the most common priority pollutants in the sample.

The analyses of the shallow groundwater samples showed that trichloroethylene was the volatile organic compound that is present in the highest concentration in the samples. Trichloroethylene concentrations in the groundwater samples are shown in Figure 6. As shown in Figure 6, highest concentrations in the surficial groundwater system were found immediately downgradient of the disposal site with concentrations gradually decreasing in the direction of downgradient groundwater movement.

Highest concentrations in the Platteville were found in the sample from Piezometer BB located northeast of the disposal site. This piezometer is finished in the Carimona unit. Concentrations of trichloroethylene in samples from the other Carimona piezometers (LL and RR) were 1½ orders of magnitude lower than at Piezometer BB. If the trichloroethylene is migrating from the disposal site to the Platteville, the measured distribution of trichloroethylene concentrations is not consistent with the measured direction of groundwater movement in the Carimona. This inconsistency is significant and will be further investigated in the next phase of this study. Concentrations of trichloroethylene in the underlying Magnolia were consistently less than the concentrations in the Carimona.

A number of industrial bedrock wells in the vicinity of the disposal site have been sampled. The locations of the bedrock wells that were selected for sampling are shown in Figure 7 and the characteristics of these wells are summarized in Table 4. The results of the analysis of volatile organic compounds in these samples are shown in Table 5. The results indicate that, with one exception, none of the samples consistently showed detectable concentrations of volatile organic compounds. The exception was Well 200384, located approximately 4,000 feet west of the disposal site which showed trace concentrations (6 ug/L) of trichloroethylene.

The next step in the investigation will involve the further definition of piezometric levels in the Platteville aquifer upgradient of the disposal site. Based on the results of the investigation to date, it is possible that the trichloroethylene measured in Piezometer BB northeast of the site is coming from another source. To further define piezometric levels in the Platteville aquifer northeast of the disposal site, a series of additional Platteville piezometers will be placed north and east of the site in both the Carimona and Magnolia units of the Platteville. The locations of these additional piezometers are shown in Figure 8. Piezometers SS, TT, UU, VV, and WW will be placed first and water levels will be measured to determine the directions of groundwater movement. As necessary, Piezometers XX and YY will be placed to provide additional information on Platteville water levels northeast of the site. Based on the apparent directions of groundwater movement in the Carimona and Magnolia aquifers, one or more 4-inch diameter monitoring wells will be placed upgradient of Piezometer BB in the Carimona to provide information on the quality of groundwater upgradient of the Platteville piezometer showing the highest concentration of trichloroethylene measured in the Platteville to date.

We have developed the specifications for the new Platteville piezometers and have discussed them with the Minnesota Department of Health. We are planning to place the additional Platteville piezometers during August and hope to have water level measurements and a recommendation for the location of one or more Platteville monitoring wells by September 1. If you have any questions, please contact me.

Sincerely,

Allan Gebhard

AG/tn
Enclosures
c: Mike Ayers
Dennis Vaughn

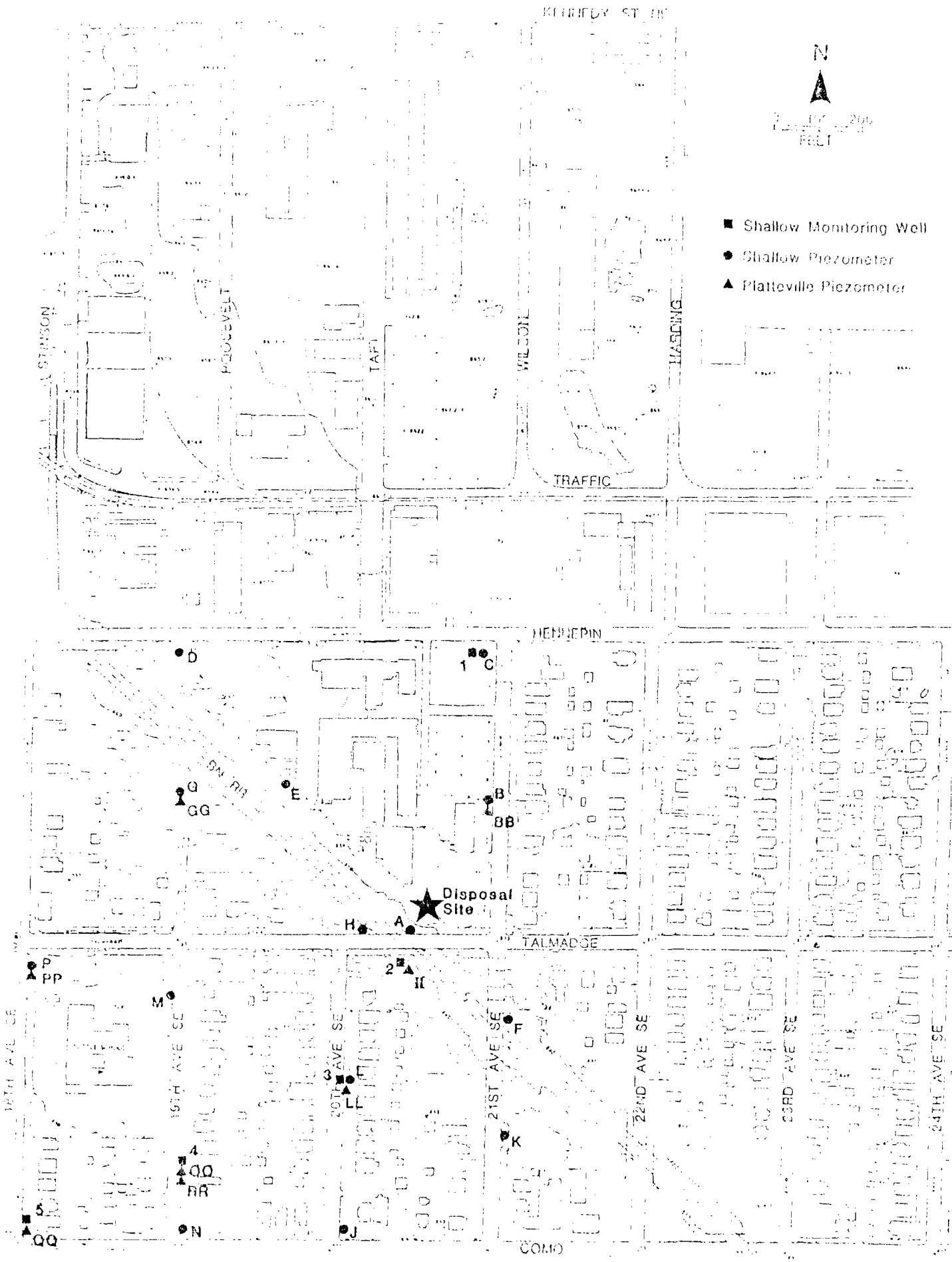


Figure 1

WELLS AND PIEZOMETERS

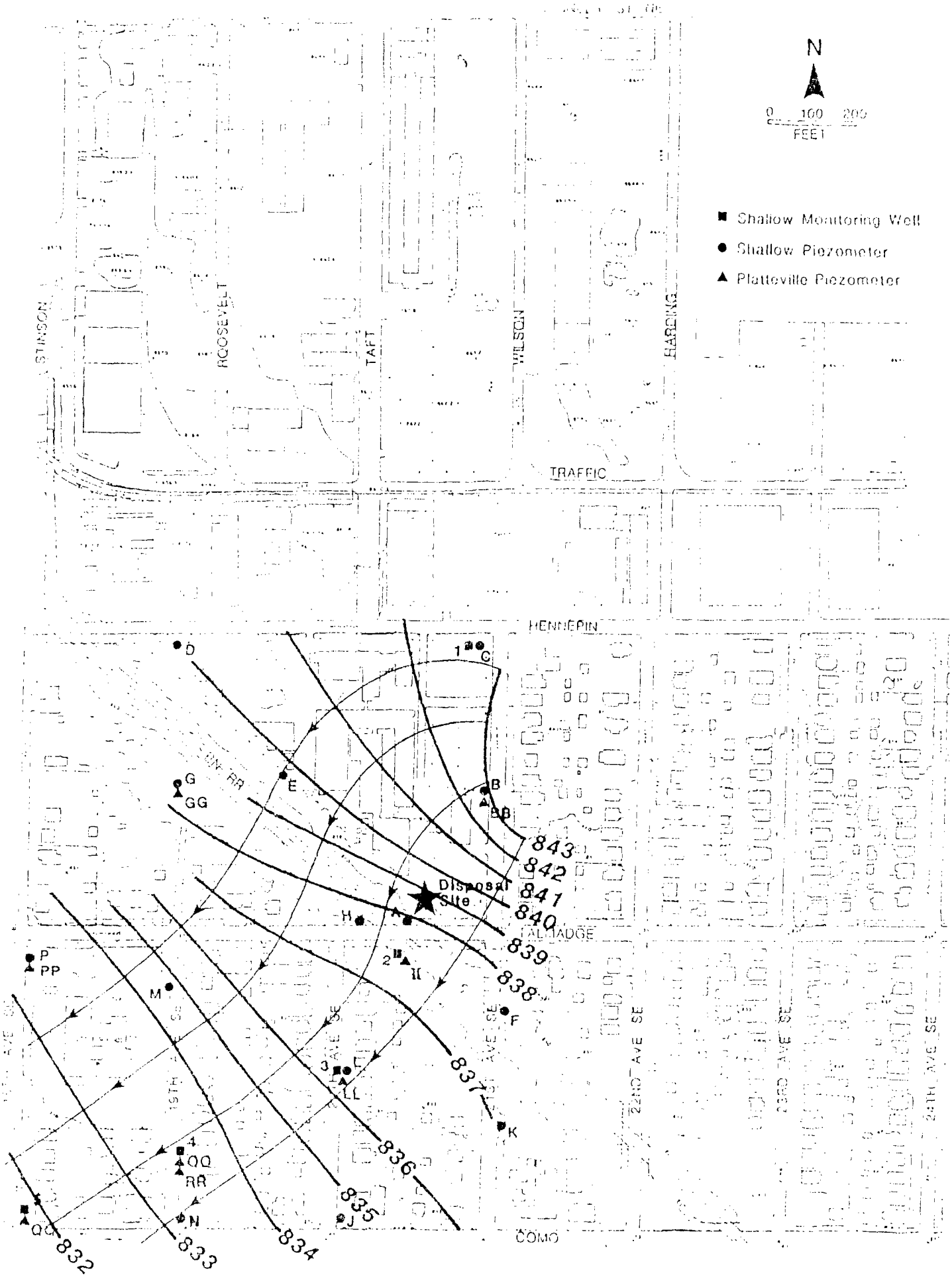
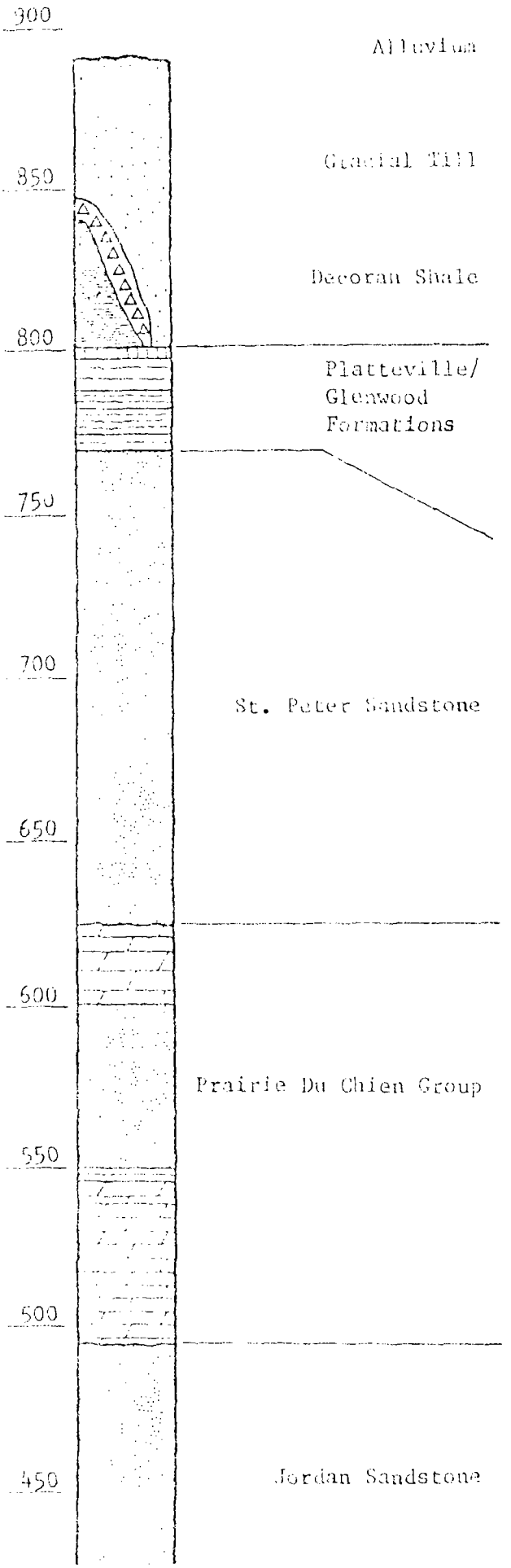


Figure 2

ELEVATION OF GROUNDWATER TABLE (MSL)



Alluvium

Sand, gravelly sand and silty sand, sometimes overlain by bogs and marshes which have been drained and filled. Overlying soil is variable in composition often clayey or silty. Deposits are terrace deposits from Glacial River Warren. Thickness ranges from 23 to 57 feet.

Glacial Till

Gray and red tills associated with Des Moines and Superior lobes. Unsorted material with variable texture containing clay sizes and boulders. Sometimes underlain by thin layer of alluvium. Contains sand lenses. Absent in many places, up to 20' thick.

Decorah Shale

Greenish-gray to olive-gray claystone, fissile, fossiliferous, contains several limestone layers. Patchy in this area. Thicknesses range up to 50'.

Platteville/ Glenwood Formations

Carimona member - micrite, fossiliferous, often fractured and weathered, 3.5-4.5' thick.
Magnolia member - fossiliferous micrite, calcitic shale, with rippled bedding, corroded zones, some fractures. 8.5-9' thick.
Hidden Falls - micrite, shaly, fossiliferous, 6-7' thick.
Mifflin member. thin beds of limestone, interbedded shale 12-13' thick.
Pecatonica member - dolomite, hard, 1-1.5' thick.
Glenwood Shale - green shale, sandy at the base, 3-5' thick.

St. Peter Sandstone

Light yellow or white, medium grained, massive appearing sandstone composed of rounded and subrounded grains. Thin beds of green shale are present. Ranges in thickness from 150-170'.

Prairie Du Chien Group

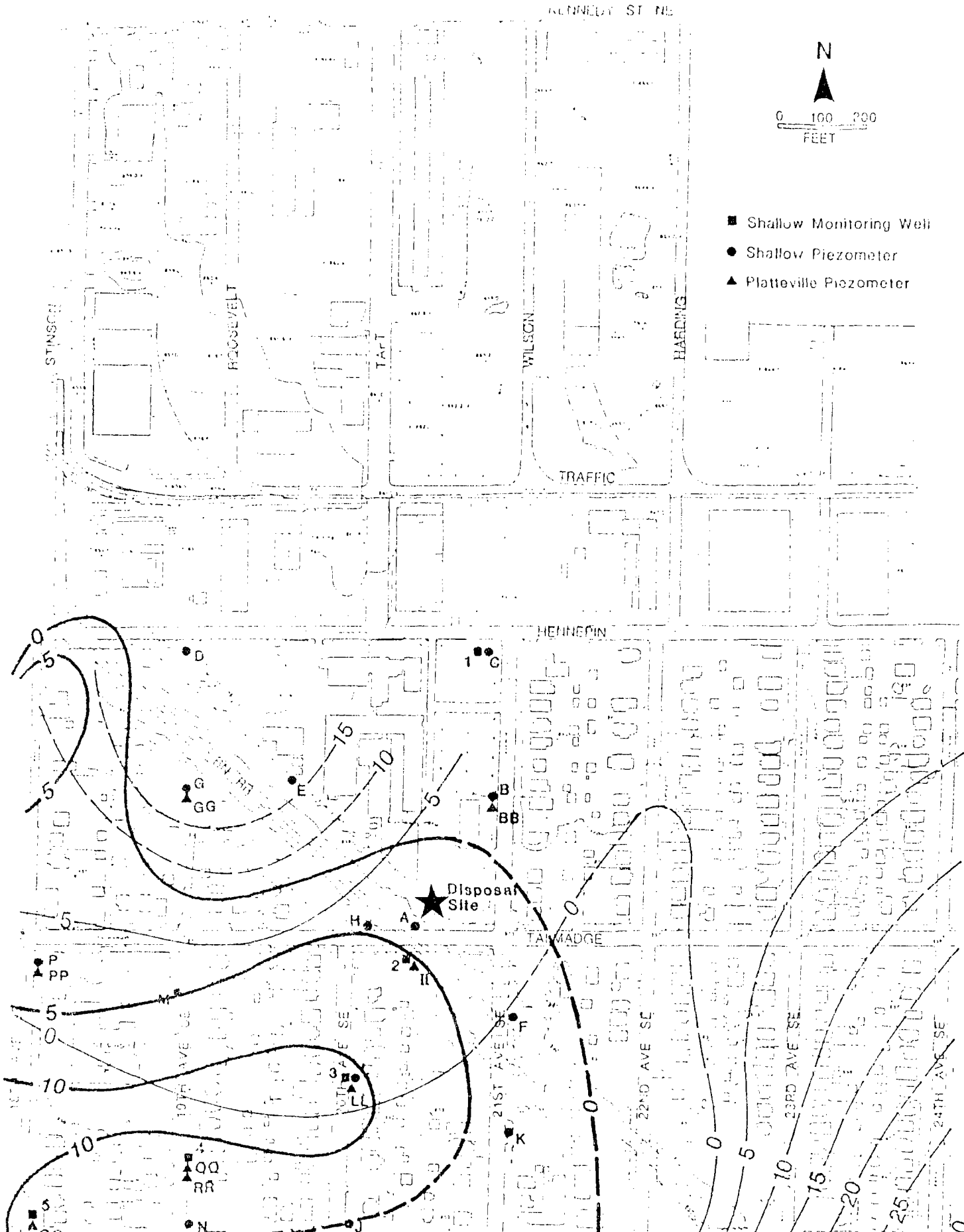
Thickness of entire formation is 120'-150'.
Oneota Dolomite - thin to thick bedded, light brownish gray or buff, fine- to medium-grained dolomite, silt sized dolomite matrix.
New Richmond Sandstone - fine- to medium-grained quartzose sandstone and quartzitic dolomite, minor amounts of shale and pure dolomite.
Willow River Dolomite - thin to thick bedded dolomite, sandy dolomite with some interbedded quartzose sandstone.

Jordan Sandstone

Argillaceous and dolomitic quartz sandstone with pebble-size clasts of dolomitic sandstone and thin beds of dolomite, white or yellow, coarse to medium-grained orthoquartzites to yellow, silty, fine grained quartzose sandstone. 85-100' thick. Underlain by the St. Lawrence Formation which is 120'-200' thick and contains a variety of silty or sandy dolomitic rocks.

Figure 3

GENERALIZED GEOLOGIC COLUMN
Waste Disposal Site/Henkel Property



Thickness of Basal Till

Thickness of Decorah Shale

Figure 4

THICKNESS OF DECORAH SHALE AND BASAL TILL

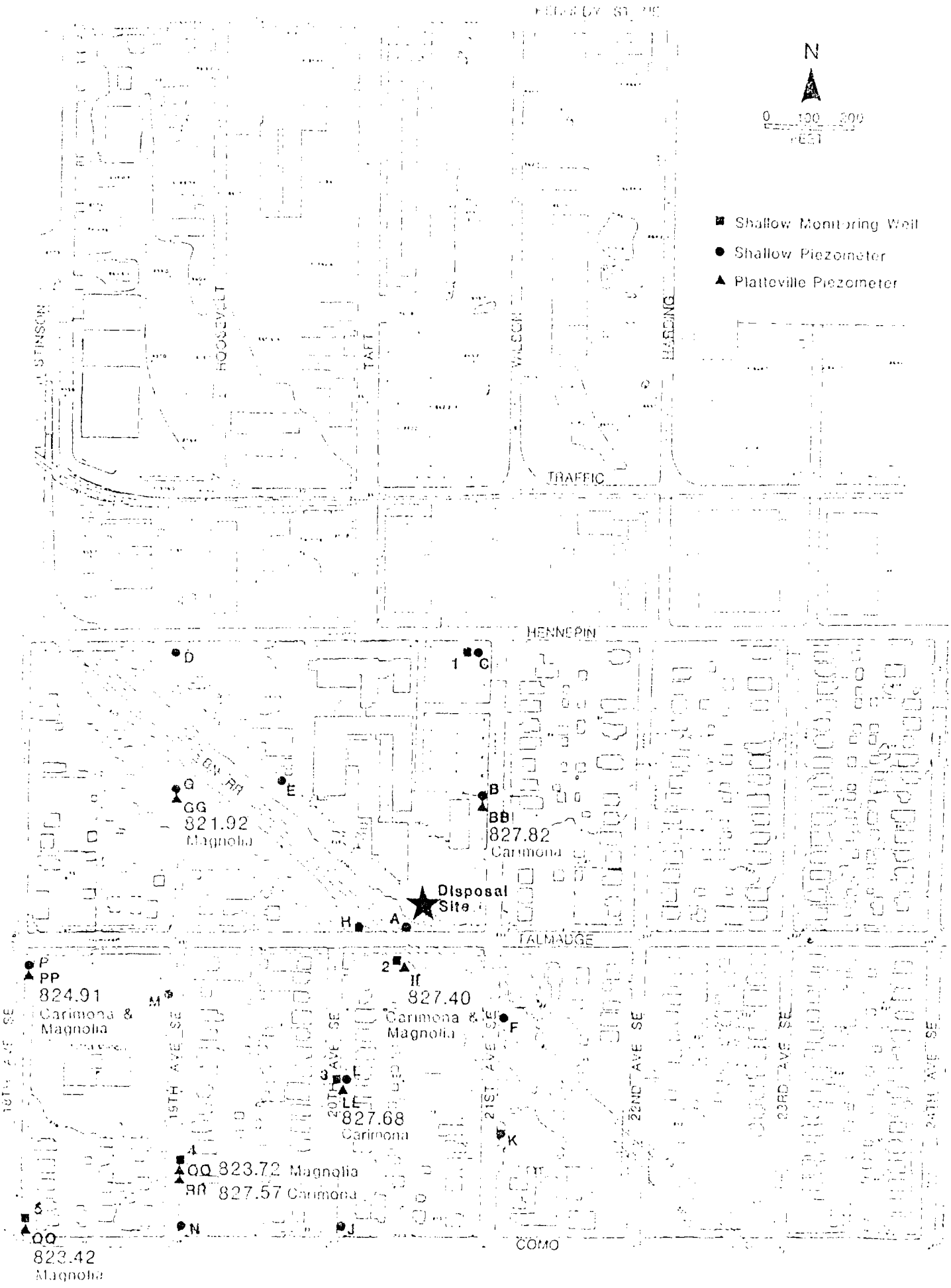


Figure 5

PIEZOMETRIC LEVELS IN PLATTEVILLE FORMATION

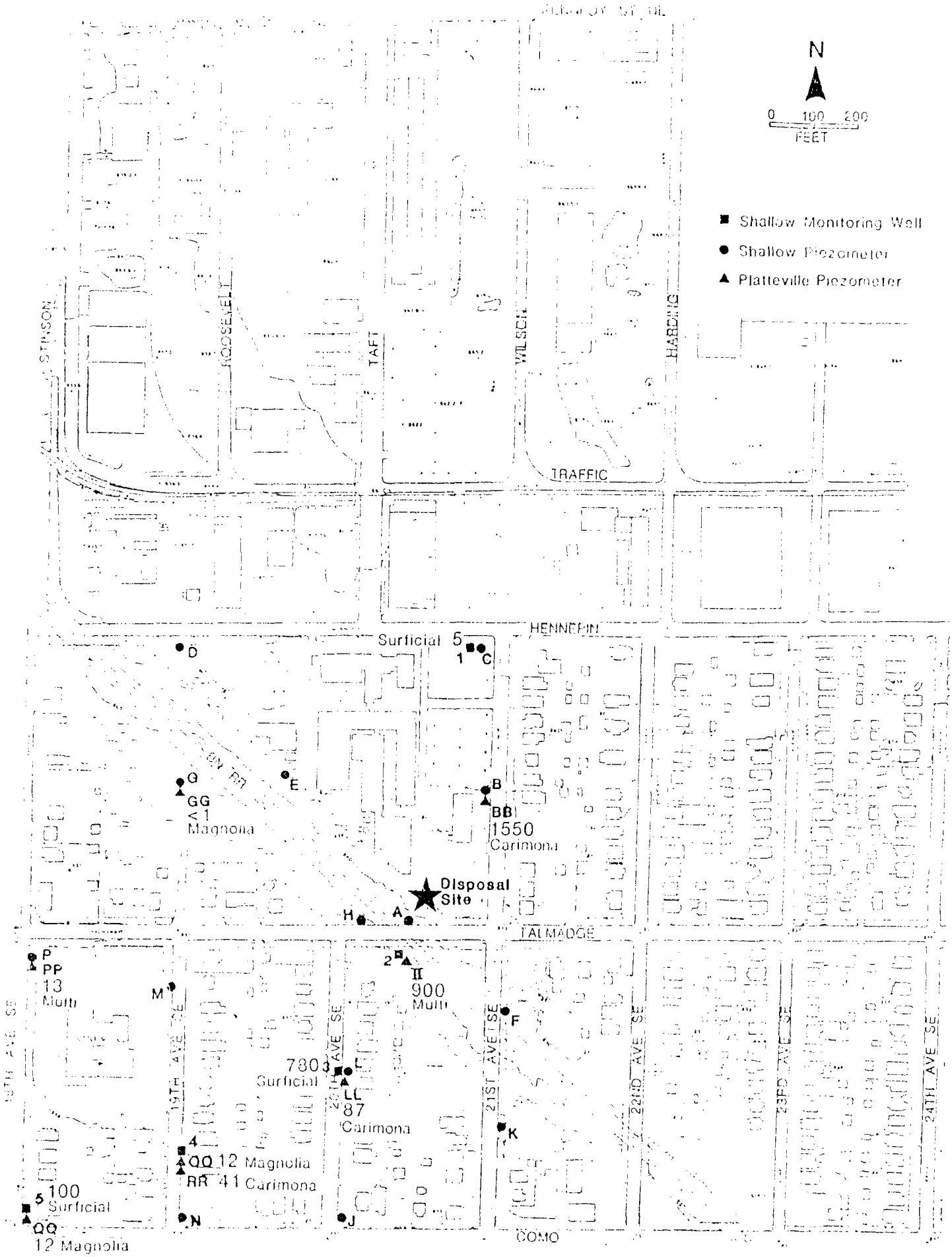


Figure 6

TRICHLOROETHYLENE CONCENTRATIONS
(µg/l)

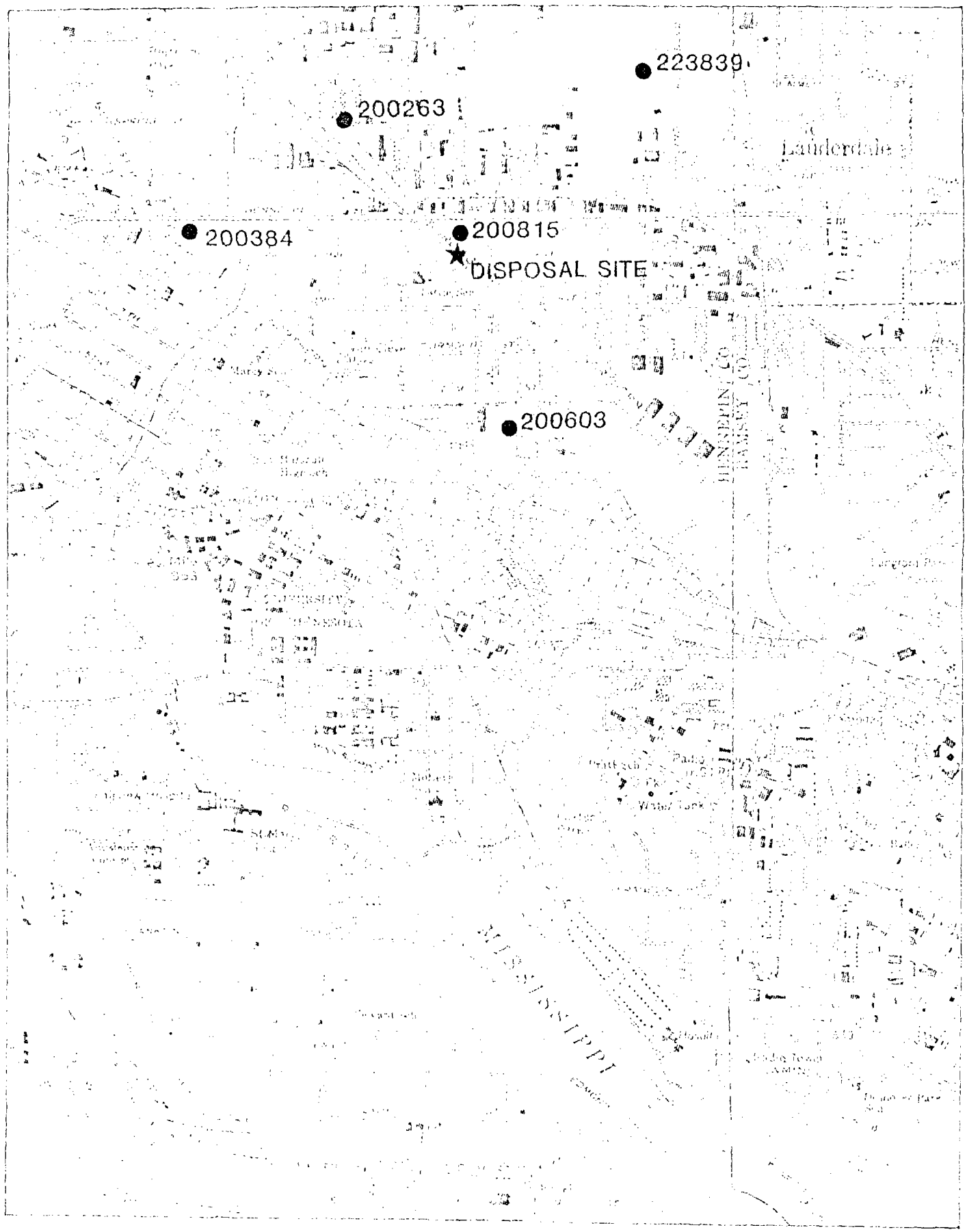


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Figure 7

LOCATIONS OF PRIVATE BEDROCK WELLS SAMPLED

MARCH, 1982

Figure 8
LOCATIONS OF RECOMMENDED
PLATTEVILLE PIEZOMETERS

TABLE 1

SHALLOW DRIFT MONITORING WELLS[1]

WATER QUALITY

Concentrations in μg/L

	Shallow Well				
	1	2	3	4	5
Benzene	*	47	130	*[3]	*[3]
Chloroform	*	36[2]	340[2]	7.1	*
1,1-Dichloroethane	*	11	14	*	*
1,2-Dichloroethane	*	14	78[2]	*	*
1,1,2,2-Tetrachloroethane	*	22	19	*	*
Toluene	*	*	*	*[3]	*[3]
1,1,1-Trichloroethane	5.0	30	43[2]	*	1.2
Trichloroethylene	*	830[2]	780[2]	4.2	100[2]
Xylene	*	34	10	*[3]	*[3]

*Concentration was less than detection limit.

[1]Unless otherwise noted, reported concentration is the average of two or more analyse

[2]Value reported is from single analysis. Analysis of second sample exceeded linear response range at initial instrument setting.

[3]Single analysis only.

TABLE 2

PLATTEVILLE PIEZOMETERS

WATER QUALITY [1]

(Concentrations in μg/L)

	BB	GG	II	LL	OO	PP	QQ	RR
Benzene	*	*	*	*	*	*	*	*
Chloroform	8.1	*	*	*	*	1.8	*	*
1,1-Dichloroethane	13	*	6.7	*	*	*	*	*
1,2-Dichloroethane	*	*	1.5	*	*	*	*	*
1,1,2,2-Tetrachloroethane	37	*	5.8	*	*	*	*	*
Toluene	*	*	*	*	6.5	*	*	24
1,1,1-Trichloroethane	20	*	3.7	*	*	*	*	*
Trichloroethylene	1,600	1.9	900	87	12	11	12	41
Xylenes	*	*	*	*	*	*	*	32

[1] Reported concentration is the average concentration from multiple analyses.

* Concentration was less than detection limit.

TABLE 3

GC/MS ANALYSIS
SHALLOW MONITORING WELL 2

	GC/MS	GC	Blank
Indicator Parameters			
Benzene	(9)	47	(0.6)
Chloroform	22	36	<10
1,1-Dichloroethane	(9.7)	11	<10
1,2-Dichloroethane	16	14	<10
1,1,2,2-Tetrachloroethane	<10	22	<10
Toluene	<10	1	<10
1,1,1-Trichloroethane	<10	30	<10
Trichloroethylene	1400	830	<10
Xylenes	<10	34	<10
Other Parameters Detected			
Volatile Organics			
Carbon Tetrachloride	(4)	--	(1.4)
1,1-Dichloroethylene	(1.5)	--	<10
1,2-Dichloroethylene, trans	17	--	(0.3)
Methylene Chloride	(2.2)	--	(4.4)
Tetrachloroethene	17	--	(0.4)
Base/Neutral Organics			
Bis(ethylhexyl)phthalate	(1.75)	--	--
Di-n-butylphthalate	(7.0)	--	--
Nitrobenzene	(2.6)	--	--

*the concentration was less than detection limit

--not analyzed

( )compound was identified as present at a concentration less than the EPA detection limit for the method used

TABLE 4

CHARACTERISTICS OF PRIVATE WELLS INCLUDED
IN SAMPLING PROGRAM

Well Number	Well Depth	Casing Depth	Aquifer Used
200815	404'	215'	Prairie du Chien/Jordan
200263	425'	290'	Prairie du Chien/Jordan
200384	340'	261'	Prairie du Chien
223839	No Record	331'	At Least Prairie du Chien -- Maybe Others
200603	1110'	No Record	Hinckley -- Maybe Others

TABLE 5

PRIVATE BEDROCK WELL DATA
(concentrations in µg/L)

	Well #200815 (B-1)					Well #200603 (B-2)		Well #200384 (B-3)		
	A	B	C	D	E	A	B	A	B	C
Benzene	*	--	--	--	--	*	--	*	--	--
Chloroform	*	*	9.1[1]	*	*	*	*	*	*	1.5
1,1-Dichloroethane	*	*	*	*	*	*	*	*	*	*
1,2-Dichloroethane	*	*	*	*	*	*	*	*	*	*
1,1,2,2-Tetrachloroethane	*	*	*	*	*	*	*	*	*	*
1,1,1-Trichloroethane		*	*	*	*	*	*	*	*	*
Trichloroethylene	*	1.3	*	*	*	*	*	6.0	5.8	6.3
Toluene	*	--	--	--	--	*	--	*	--	--
Xylenes	*	--	--	--	--	*	--	*	--	--

	Well #200263 (B-4)				Well #223839 (B-5)				Minneapolis City Water (C-1)		
	A	B	C	D	A	B	C	D	A	B	C
Benzene	*	--	--	--	*	--	--	--	*	*	*
Chloroform	*	*	6.4[1]	*	*	*	12[1]	*	9.1	22[1]	9.0
1,1-Dichloroethane	*	*	*	*	*	*	*	*	*	*	*
1,2-Dichloroethane	*	*	*	*	*	*	*	*	*	*	*
1,1,2,2-Tetrachloroethane	*	*	*	*	*	*	*	*	*	*	*
1,1,1-Trichloroethane	*	*	*	*	*	*	*	*	*	*	*
Trichloroethylene	*	*	*	*	*	*	*	*	*	*	*
Toluene	*	--	--	--	*	--	--	--	*	--	--
Xylenes	*	--	--	--	*	--	--	--	*	--	--

[1] Detector cleaning biased the chloroform data high.

* Concentration was less than detection limit.

-- Not analyzed.