Site Suitability Review of the Jahner Sanitation Landfill

by
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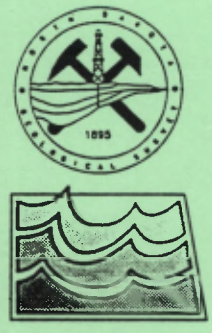

Prepared by the
North Dakota Geological Survey
and the
North Dakota State Water Commission

ND Landfill Site Investigation No. 12

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INTRODUCTION

Purpose

The North Dakota State Engineer and the North Dakota State Geologist were instructed by the 52nd State Legislative Assembly to conduct site-suitability reviews of the municipal landfills in the state of North Dakota. These reviews are to be completed by July 1, 1995 (North Dakota Century Code 23-29-07.7). The purpose of this program is to evaluate site suitability of each landfill for disposal of solid waste based on geologic and hydrologic characteristics. Reports will be provided to the North Dakota State Department of Health and Consolidated Laboratories (NDSDHCL) for use in site improvement, site remediation, or landfill closure. Additional studies may be necessary to meet the requirements of the NDSDHCL for continued operation of municipal solid waste landfills. The Jahner solid waste landfill is one of the landfills being evaluated.

Location of the Jahner Landfill

The Jahner solid waste landfill is located seven miles west of the City of Wishek in Township 132 North, Range 72 West, N 1/2 of SE 1/4 and S 1/2 of NE 1/4 of Section 8 (Fig. 1). The landfill site encompasses approximately 120 acres, of which 20 acres have been used.

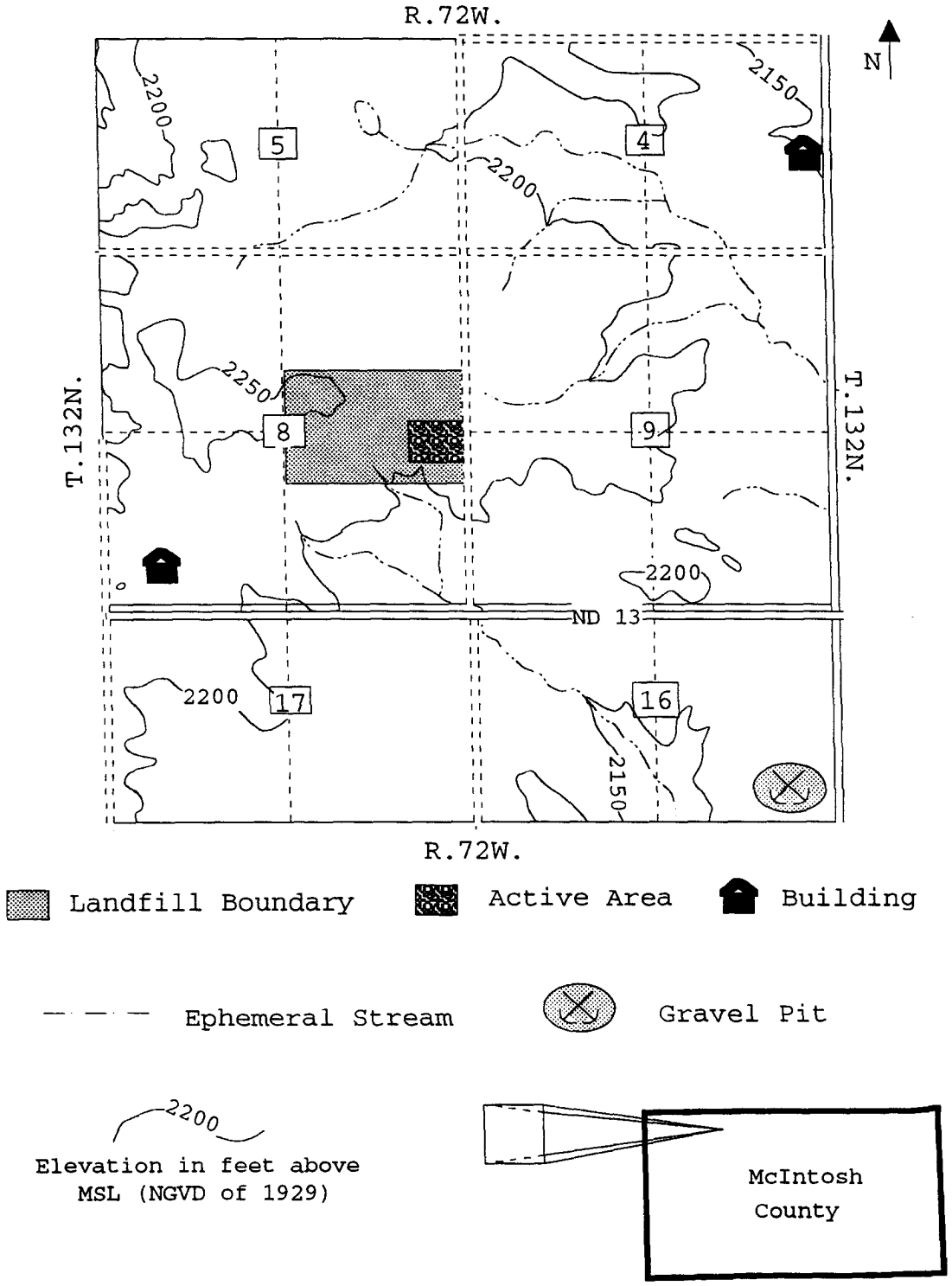

Figure 1. Location of the Jahner landfill in the N 1/2 of SE 1/4 and S 1/2 of NE 1/4 of section 8, T132N, R72W.

Previous Site Investigations

Water Supply, Inc. performed a hydrogeologic study of the site in 1988 (North Central Consultants, Ltd., 1988). Seven monitoring wells were installed at the site and six additional test holes were drilled. Lithologic logs of this study described a surficial layer of glacial deposits overlying the Fox Hills Formation. The Fox Hills Formation contains both clay and sand.

Two monitoring wells were dry at the time of this study. The water-level measurements could not be correlated because land surface elevations were not established at the well sites. Water-quality analyses were completed for major ions during this investigation. High concentrations of calcium, manganese, and bicarbonate were detected.

Methods of Investigation

The Jahner study was accomplished by means of: 1) test drilling; 2) construction and development of monitoring wells; 3) collecting and analyzing water samples; and 4) measuring water levels.

Test Drilling Procedure

The drilling method at the Jahner landfill was based on the site's geology and depth to ground water, as

determined by the preliminary evaluation. A solid-stem auger was used at the Jahner landfill because the sediments were poorly consolidated and because the depth to the water table was expected to be less than 70 feet. The lithologic descriptions were determined from the drill cuttings.

Monitoring Well Construction and Development

Seven test holes were drilled at the Jahner landfill, and monitoring wells were installed in all of the test holes. The number of wells installed at the Jahner landfill was based on the geologic and topographic characteristics of the site. The depth and intake interval of each well was selected to monitor the water level at the top of the uppermost aquifer.

Wells were constructed following a standard design (Fig. 2) intended to comply with the construction regulations of the NDSDHCL and the North Dakota Board of Water Well Contractors (North Dakota Department of Health, 1986). The wells were constructed using a 2-inch diameter, SDR21, polyvinyl chloride (PVC) well casing and a PVC screen, either 5 or 10 feet long, with a slot-opening size of 0.012 or 0.013 inches. The screen was fastened to the casing with stainless steel screws (no solvent weld cement was used). After the casing and screen were installed into the drill hole, the annulus around the screen was filled with No. 10 (grain-size

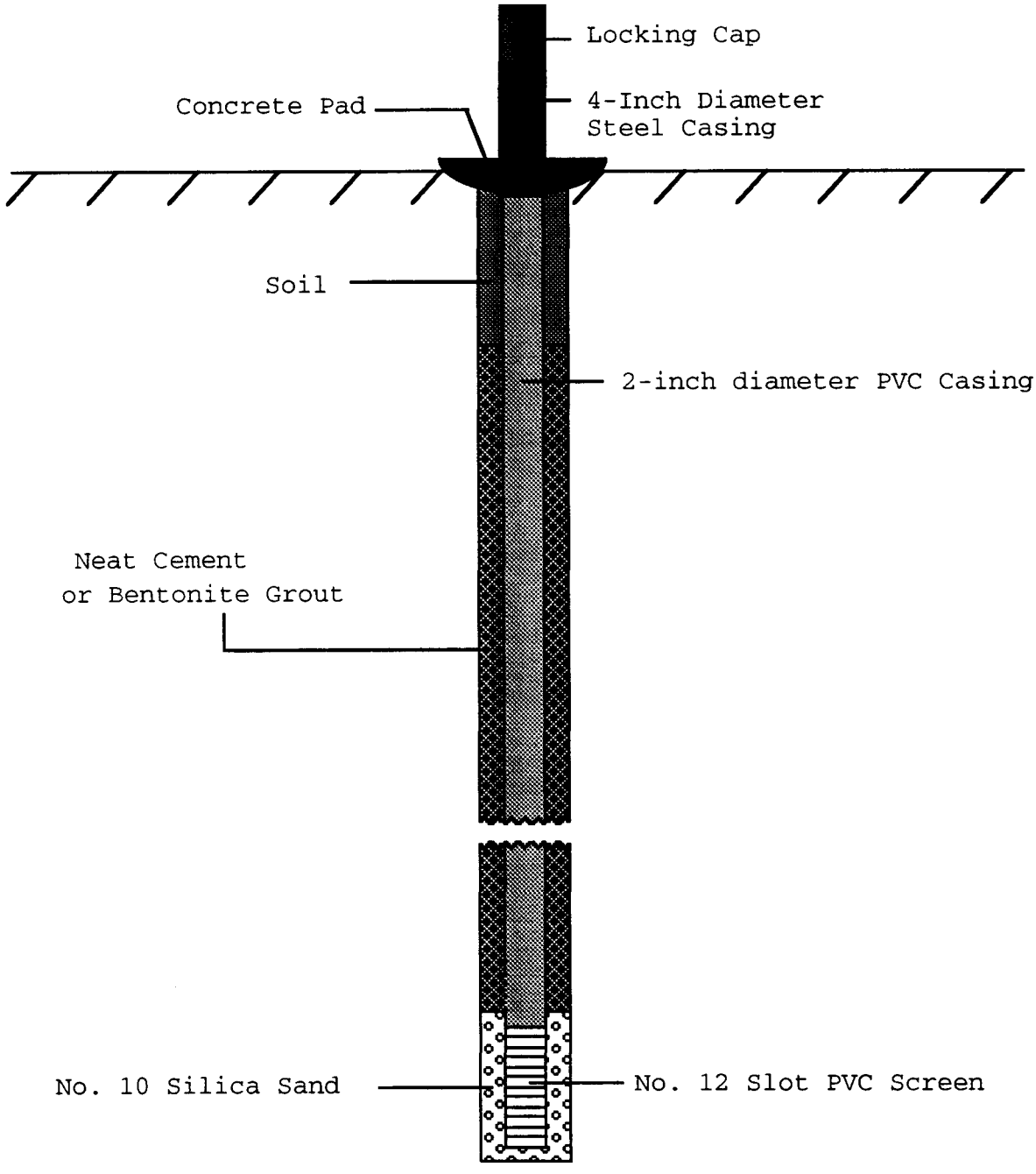

Figure 2. Construction design used for monitoring wells installed at the Jahner landfill.

diameter) silica sand to a height of two feet above the top of the screen. High-solids bentonite grout and/or neat cement was placed above the silica sand to seal the annulus to approximately five feet below land surface. The remaining annulus was filled with drill cuttings. The permanent wells were secured with a protective steel casing and a locking cover protected by a two-foot-square concrete pad.

All monitoring wells were developed using a stainless steel bladder pump or a teflon bailer. Any drilling fluid and fine materials present near the well were removed to insure movement of formation water through the screen.

The Mean Sea Level (MSL) elevation was established for each well by differential leveling to Third Order accuracy. The surveys established the MSL elevation at the top of the casing and the elevation of the land surface next to each well.

Collecting and Analyzing Water Samples

Water-quality analyses were used to determine if leachate is migrating from the landfill into the underlying ground-water system. Selected field parameters, major ions, and trace elements were measured for each water sample. These field parameters and analytes are listed in Appendix A with their Maximum Contaminant Levels (MCL). MCLs are enforcable drinking water standards and represent the maximum

permissible level of a contaminant as stipulated by the U.S. Environmental Protection Agency (EPA).

Water samples were collected using a bladder pump constructed of stainless steel with a teflon bladder. A teflon bailer was used in monitoring wells with limited transmitting capacity. Before sample collection, three to four well volumes were extracted to insure that unadulterated formation water was sampled. Four samples from each well were collected in high-density polyethylene plastic bottles as follows:

1) Raw (500 ml)
2) Filtered (500 ml)
3) Filtered and acidified (500 ml)
4) Filtered and double acidified (500 ml)

The following parameters were determined for each sample. Specific conductance, pH, bicarbonate, and carbonate were analyzed using the raw sample. Sulfate, chloride, nitrate, and dissolved solids were analyzed using the filtered sample. Calcium, magnesium, sodium, potassium, iron, and manganese were analyzed from the filtered, acidified sample. Cadmium, lead, arsenic, and mercury were analyzed using the filtered double-acidified samples.

One well was sampled for Volatile Organic Compounds (VOC) analysis. This sample was collected at a different time than the standard water quality sample. The procedure used for collecting the VOC sample is described in Appendix B. Each sample was collected with a plastic throw-away

bailer and kept chilled. These samples were analyzed within the permitted 14-day holding period. The standard water-quality analyses were performed at the North Dakota State Water Commission (NDSWC) Laboratory and VOC analyses were performed by the NDSDHCL.

Water-Level Measurements

Water-level measurements were taken at least three times at a minimum of two-week intervals. The measurements were taken using a chalked-steel tape or an electronic (Solnist 10078) water-level indicator. These measurements were used to determine the shape and configuration of the water table.

Location-Numbering System

The system for denoting the location of a test hole or observation well is based on the federal system of rectangular surveys of public land. The first and second numbers indicate Township north and Range west of the 5th Principle Meridian and baseline (Fig. 3). The third number indicates the section. The letters A, B, C, and D designate, respectively, the northeast, northwest, southwest, and southeast quarter section (160-acre tract), quarter-quarter section (40-acre tract), and quarter-quarter-quarter section

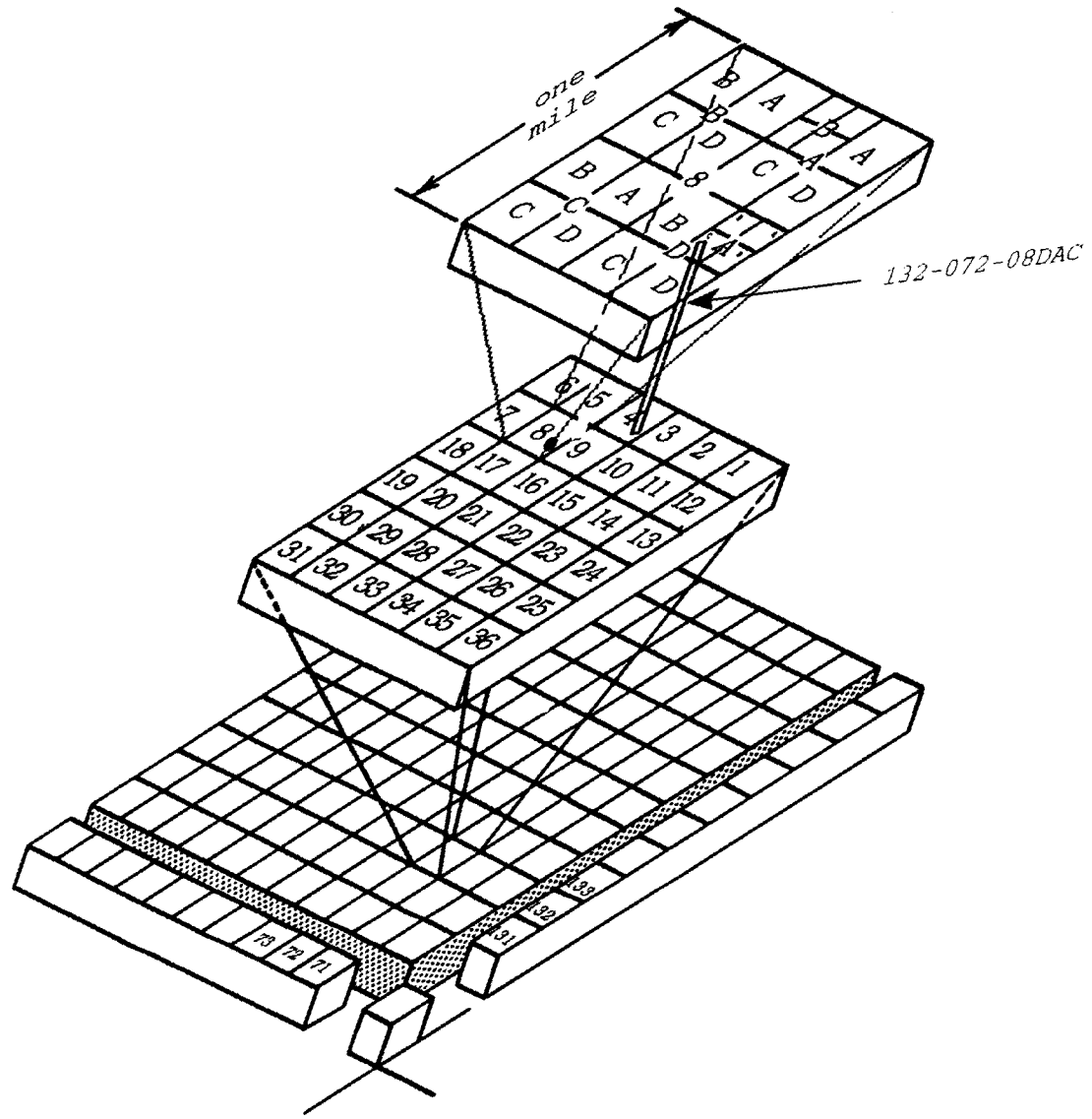

Figure 3. Location-numbering system for the Jahner landfill.

(10-acre tract). Therefore, a well denoted by 132-072-08DAD would be located in the SE1/4, NE1/4, SE1/4, Section 8, Township 132 North, Range 72 West. Consecutive numbers are added following the three letters if more than one well is located in a 10-acre tract, e.g. 132-072-08DAD1 and 132-072-08DAD2.

GEOLOGY

Regional Geology

The geology in the area surrounding the Jahner landfill is characterized by a stream-eroded bedrock topography partially covered by glacial sediments (Clayton, 1962). Glacial sediments in the region consist primarily of till with minor glaciofluvial and ice-contact deposits. The glacial sediments, which are generally thickest on land-surface topographic highs, are assigned to the Coleharbor Group.

The uppermost bedrock unit, the Cretaceous Fox Hills Formation, is approximately 200 feet thick and is composed of sand, sandstone, silt, and clay. The Fox Hills Formation was deposited in near-shore, barrier bar, and deltaic environments (Cvancara, 1976). The Fox Hills Formation is underlain by the Pierre Formation.

Local Geology

The Jahner landfill is located on the southeast slope of a ridge. The ridge trends north-northeast for several miles, forming a drainage divide between Beaver Creek and South Branch Beaver Creek. Elevations at the landfill range from 2,200 feet to 2,260 feet (Fig. 4).

The glacial sediments have a maximum thickness of approximately 60 feet on the topographic high on the west side of the landfill. They thin toward the southeast and have been removed by erosion in the drainages near the southern boundary of the site. The glacial sediments consist of a clay till with layers and lenses of sand (Figs. 5 and 6, lithologic logs in Appendix C).

Most of the glacial sands are 1 to 3 feet thick, but two thicker glacial sands underlie part of the northeastern quarter of the site. These sands are shown on Fig. 6. The glacial sand in 132-072-08ADA is present in only one other test hole (WSI-12). The glacial sand in 132-072-08ADC correlates with a sand layer in WSI-9, 10, and 14. The thickest glacial sand is 18 feet in WSI-9. Neither of the sands are present in WSI-11, 13, or 15. On the remainder of the site, the glacial sands either are absent or are thinner than those in the northeast quarter.

The Fox Hills Formation at the landfill consists of alternating layers of clay, sand, and silt. The Fox Hills sands on the west side of the site do not appear to correlate

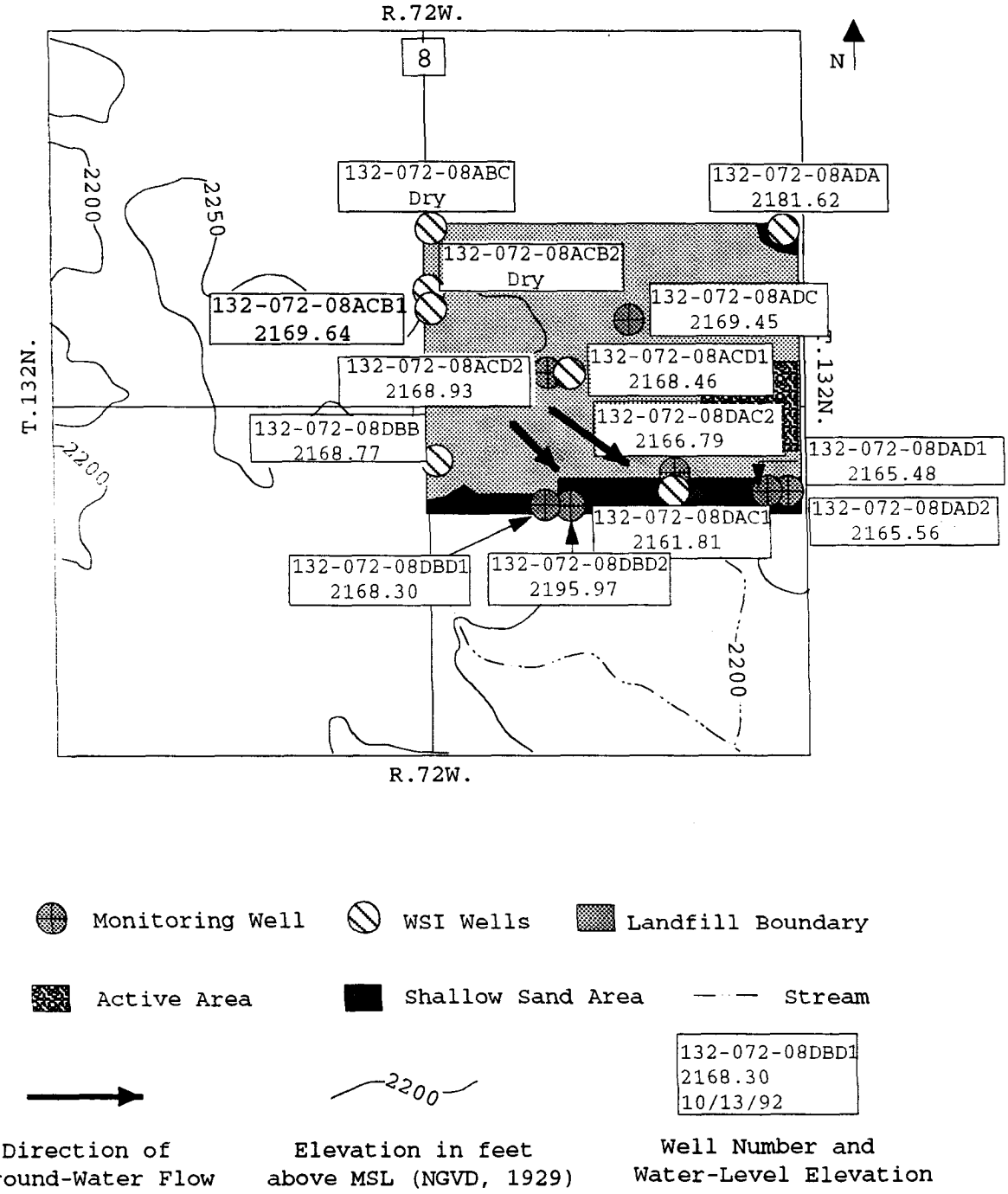

Figure 4. Location of monitoring wells and the direction of ground-water flow in the Fox Hills Formation.

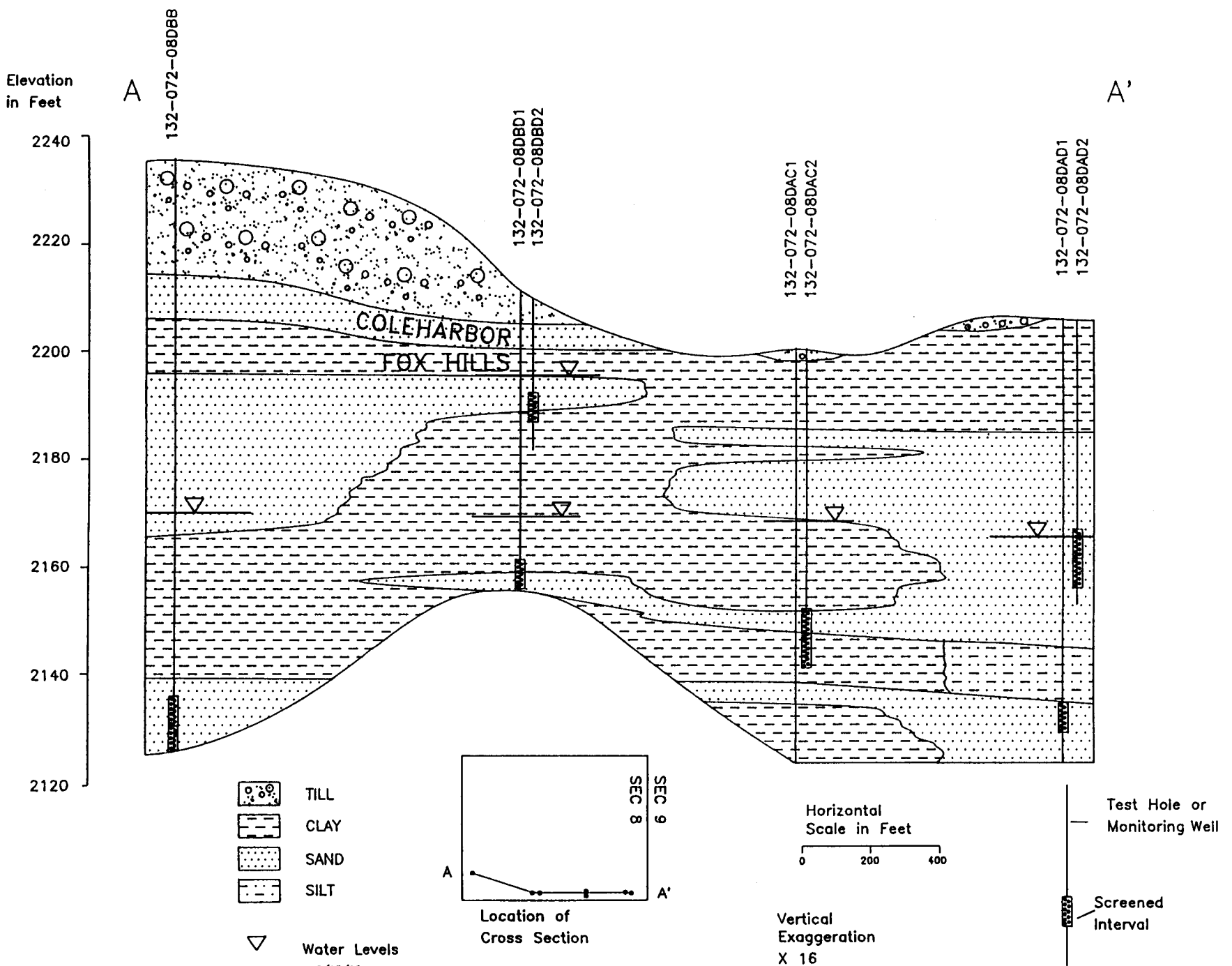

Figure 5. Geohydrologic section A–A' in the Jahner landfill

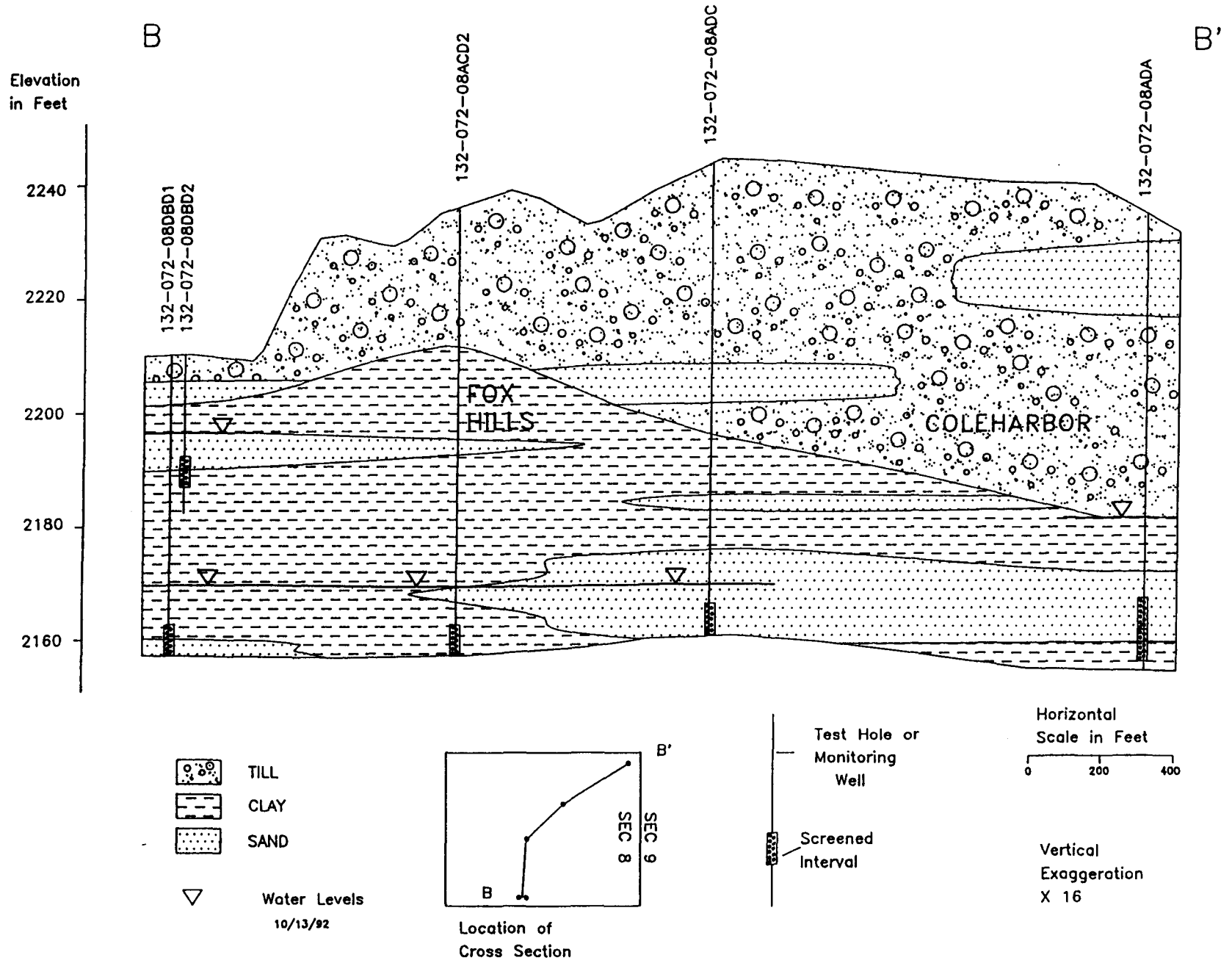

Figure 6. Geohydrologic section B–B' in the Jahner landfill

with those on the east side, although some of them may be interconnected at depth. The thickest Fox Hills sand is found in the southeast corner of the site (132-072-08DAD1, Fig. 5). Near the southern boundary of the site the uppermost Fox Hills sand is relatively close to the surface.

Figure 4 shows the areas of the landfill which are underlain by sand at shallow depths. The small area in the northeast corner of the landfill is underlain by a glacial sand at a depth of 5 feet. The area near the southern boundary is underlain by a Fox Hills sand at a depth of 11 to 22 feet.

HYDROLOGY

Surface-Water Hydrology

There are no surface-water impoundments located within a one-mile radius of the Jahner landfill. Two ephemeral streams, located to the east and south of the landfill (Fig. 1), appear to flow only during large precipitation and/or snowmelt events.

The landfill is located on the south and east slope of a hill. Surface water runoff should not create a ponding problem. There is no surface water diversion around the active cell.

Regional Ground-Water Hydrology

Major aquifers in the area of the Jahner landfill consist of bedrock and glacial aquifers. The bedrock aquifers in the region are located in the Fox Hills and Dakota Formations. The Fox Hills aquifer ranges in depth from 0 to 300 feet below land surface (Klausing, 1981). The Fox Hills aquifer is composed of a clayey sandstone that ranges in thickness from 1 to 82 feet (Klausing, 1981). Recharge to the Fox Hills aquifer is by precipitation or surface runoff and by lateral movement from glacial deposits. The water in the Fox Hills aquifer is a mixed cation type with bicarbonate and sulfate being the dominant anions (Klausing, 1981). There are a number of domestic/stock wells developed in the Fox Hills aquifer.

The Dakota aquifer is another bedrock aquifer located between 2,100 to 2,500 feet below land surface. The Dakota aquifer is composed of very fine to coarse-grained sandstone (Klausing, 1981). The thickness of the sandstone ranges from 115 to 160 feet. Recharge to the Dakota aquifer is from upward movement from underlying aquifers. The Dakota aquifer will flow when elevations are less than 2,100 feet MSL (Klausing, 1981). The Dakota aquifer is characterized by a sodium-sulfate and calcium-sulfate type water. Three wells are known to be developed in the Dakota aquifer within the county. These are municiple wells for the cities of Venturia and Zeeland and a well for livestock.

There are no major glacial aquifers within a two-mile radius of the Jahner landfill. The Wishek aquifer is located about seven-miles east. This aquifer is recharged by precipitation and snowmelt and lateral movement from the Fox Hills aquifer. The Wishek aquifer is characterized by a calcium-bicarbonate type water. The city of Wishek and area farms obtain water from this aquifer. This aquifer should not be affected by leachate migration from the landfill.

The South Branch Beaver Creek aquifer is located about five-miles south of the landfill. This aquifer is composed of very-fine sand to very-coarse-sandy gravel. The thickness of this aquifer is about 58 feet with 27 feet being saturated (Klausing, 1981). This aquifer is recharged by precipitation or surface runoff, by lateral movement from the Fox Hills Formation, and by flow from small tributary aquifers (Klausing, 1981). The South Branch Beaver Creek aquifer is characterized by a mixed cation-bicarbonate water type. A number of domestic wells are completed in this aquifer.

Undifferentiated sand and gravel aquifers are found throughout the region. These aquifers are not extensive and small quantities of water are usually found with slow recharge potential. These aquifers are generally characterized by a mixed cation-bicarbonate-sulfate water type. Few wells are developed in these aquifers because they yield small quantities of water.

Local Ground-Water Hydrology

Seven test holes were drilled at the Jahner landfill and monitoring wells were installed at each site. In addition, seven monitoring wells from an earlier study by WSI drilling were used in evaluating this site. The well screens were placed near the top of the Fox Hills aquifer beneath the landfill. Five water-level measurements were taken over a thirteen-week period (Appendix D). Wells 132-072-08ACD2 and 132-072-08DAC2 are screened in the clay and the other twelve wells are screened in sand within the Fox Hills Formation. Water-level measurements in the Fox Hills Formation indicated that the water occurs under both confined and unconfined conditions. The direction of ground-water flow in the Fox Hills Formation is south-southeast (Fig. 4).

Due to the thin layer of till overlying a thick layer of sand at the northeast corner and the southern boundary of the landfill, the underlying Fox Hills aquifer may be susceptible to leachate migration. Therefore, these areas should be avoided for refuse disposal.

Water Quality

Chemical analyses of water samples are shown in Appendix E. Anomalously high pH values were measured at wells 132-072-08ACD2 (pH=11.1), 132-072-08ADC1 (pH=9.11), and 132-072-

08DBD2 (pH=9.4). The source of these pH levels may be due to well construction or to natural variations in the Fox Hills Formation because the wells are located up-gradient of the landfill and should not be affected by leachate migration.

The trace element analyses indicated high concentrations of molybdenum (112 µg/L) in well 132-072-08ADC and selenium (10 µg/L) in well 132-072-08DAD2. The source of the molybdenum does not appear to be related to leachate migration because the well is located up-gradient of the landfill. The source of the selenium may be from leachate migration from the landfill. However, selenium concentrations of this magnitude are also found in ground waters not affected by anthropogenic activities.

The results of the VOC analysis, from well 132-072-08DAC1, are shown in Appendix F. The analysis detected the compound tetrahydrofuran (239 µg/L). Tetrahydrofuran is a man-made compound used in glues and liquid cement for fabricating packages and polyvinyl-chloride materials. This well was completed for te North Central Consultant study in 1988. The source of tetrahydrofuran could be from glue which may have been used during well construction. The detection of tetrahydrofuran may also indicate leachate migration from the landfill.

CONCLUSIONS

The Jahner landfill is located on the south and east slopes of a hill. Two ephemeral streams, located to the east and south of the landfill, appear to flow only during precipitation or snow melt events.

Glacial sediments at the landfill consist of till with interbedded sands. The glacial sands are thin except in the northeast quarter of the site, where two sand lenses are present. The Fox Hills Formation underlying the glacial deposits consists of clay, sand, and silt. The depth to the uppermost Fox Hills sand ranges from 11 feet in the southeast corner to about 70 feet on the topographic highs.

Regional water supplies are derived from the Fox Hills Formation, the Dakota Formation, and glacial aquifers. The nearest significant glacial aquifer is located five miles from the landfill. Within the landfill site the water table is located within the Fox Hills sand and water occurs under both confined and unconfined conditions. The direction of ground-water flow is south-southeast in the Fox Hills Formation.

The major ion concentrations are typical for the Fox Hills Formation in this area. High pH levels, detected in three of the monitoring wells, may be due to the well construction or natural variations in the Fox Hills Formation. The high concentration of molybdenum in well 132-

072-08ADC may be a natural occurrence. The high concentration of selenium in well 132-072-08DAD2 could be a natural occurrence or it could be due to leachate migration from the landfill. Tetrahydrofuran was detected in the VOC analysis from well 132-072-08DAC1. The source of the tetrahydrofuran could not be determined.

This site is suitable for municipal solid waste disposal except for the shallow sand areas outlined on Fig 4. The small area in the northeast corner of the landfill is underlain by a near-surface lens of glacial sand. The area at the southern boundary of the landfill is underlain by Fox Hills sand at a relatively shallow depth. This area should be avoided to protect the Fox Hills aquifer down-gradient from the site.

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APPENDIX A

WATER QUALITY STANDARDS
AND
MAXIMUM CONTAMINANT LEVELS

Water Quality Standards and Maximum Contaminant Levels

Field Parameters	MCL (mg/L)
appearance	color/odor
pH	6-8 (optimum)
specific conductance	-----
temperature	-----
water level	-----
Geochemical Parameters	
iron	>0.3
calcium	25-50
magnesium	25-50
manganese	>0.05
potassium	------
total alkalinity	------
bicarbonate	150-200
carbonate	150-200
chloride	250
fluoride	0.7-1.2
nitrate+nitrite (N)	10
sulfate	300-1000
sodium	20-170
total dissolved solids (TDS)	>1000
cation/anion balance	------
hardness	>121 (hard to very hard)
Heavy Metals (µg/L)	
arsenic	50
cadmium	10
lead	50
molybdenum	100
mercury	2
selenium	10
strontium	*

* EPA has not set a MCL for strontium. The median concentration for most U.S. water supplies is 110 µg/L (Hem, 1989).

APPENDIX B

SAMPLING PROCEDURE FOR VOLATILE ORGANIC COMPOUNDS

SAMPLING PROCEDURE FOR 40ML AMBER BOTTLES

Sample Collection for Volatile Organic Compounds

by
North Dakota Department of Health
and Consolidated Laboratories

1. Three samples must be collected in the 40ml bottles that are provided by the lab. One is the sample and the others are duplicates.

2. A blank will be sent along. Do Not open this blank and turn it in with the other three samples.

3. Adjust the flow so that no air bubbles pass through the sample as the bottle is being filled. No air should be trapped in the sample when the bottle is sealed. Make sure that you do not wash the ascorbic acid out of the bottle when taking the sample.

4. The meniscus of the water is the curved upper surface of the liquid. The meniscus should be convex (as shown) so that when the cover to the bottle is put on, no air bubbles will be allowed in the sample.

convex meniscus

5. Add the small vial of concentrated HCL to the bottle.

6. Scew the cover on with the white Teflon side down. Shake vigorously, turn the bottle upside down, and tap gently to check if air bubbles are in the sample.

7. If air bubbles are present, take the cover off the bottle and add more water. Continue this process until there are no air bubbles in the sample.

8. The sample must be iced after collection and delivered to the laboratory as soon as possible.

9. The 40 ml bottles contain ascorbic acid as a preservative and care must be taken not to wash it out of the bottles. The concentrated acid must be added after collection as an additional preservative.

APPENDIX C

LITHOLOGIC LOGS OF WELLS AND TEST HOLES

132-072-082ACD2

NDSWC

Date Completed:	8/3/92	Well Type:	P2
Depth Drilled (ft):	78	Source of Data:	
Screened Interval (ft):	73-78	Principal Aquifer :	Undefined
Casing size (in) & Type:		L.S. Elevation (ft)	2253.29
Owner: Jahner			

Lithologic Log

Unit	Description	Depth (ft)
TOPSOIL		0-1
SILT	Trace of pebbles, gray-brown 5Y3/2.	1-4
CLAY	Silty with a trace of sand and pebbles, pale brown 5YR5/2	4-7
CLAY	Silty, pale brown 10YR5/2.	7-10
CLAY	Sandy and pebbly, dark yellow-brown 10YR4/2.	10-16
CLAY	Silty with a trace of sand and pebbles, moderate yellow-brown 10YR5/4.	16-20
CLAY	Sandy with a trace of small pebbles, dark yellow-brown 10YR4/2.	20-24
CLAY	Silty with atrace of sand, partly carbonaceous, medium gray N5 to olive black 5Y2/1, Fox Hills Formation.	24-35
CLAY	Sandy with lignite fragments, light olive gray 5Y5/2.	35-37
CLAY	Silty with a trace of sand, olive black 5Y2/1.	37-40
SAND	Fine grain, silty, pale yellow-brown 10YR6/2.	40-42
CLAY	Silty, olive gray 5Y4/1.	42-51
CLAY	Olive gray, 5Y4/1.	51-67
SAND	Fine grain, silty, light olive gray 5Y6/1.	67-69
CLAY	Trace of sand, olive gray 5Y4/1.	69-78

132-072-08ABC
NDSWC

Date Completed:	6/28/88	Well Type:	P2
Depth Drilled (ft):	33	Source of Data:	
Screened Interval (ft):	27-30	Principal Aquifer :	Undefined
Casing size (in) & Type:		L.S. Elevation (ft)	2234.23

Owner: Jahner

Lithologic Log

Unit	Description	Depth (ft)
TOPSOIL	Silty, black.	0-1
SAND	Fine grain, yellow-gray.	1-4
CLAY	Silty, yellow-brown.	4-17
GRAVEL	Fine to coarse grain, about 20% sand.	17-19
CLAY	Silty, yellow-brown.	19-21
SAND	Fine to coarse grain.	21-24
CLAY	Silty, yellow-brown.	24-27
SAND	Fine to coarse grain, yellow-brown.	27-28.5
CLAY	Silty, brown-gray, bedrock.	28.5-33

132-072-08ACB1

NDSWC

Date Completed:	6/17/88	Well Type:	P2
Depth Drilled (ft):	100	Source of Data:	
Screened Interval (ft):	90-100	Principal Aquifer :	Undefined
Casing size (in) & Type:		L.S. Elevation (ft)	2247.92

Owner: Jahner

Lithologic Log

Unit	Description	Depth (ft)
TOPSOIL	Silty, black.	0-1
CLAY	Silty to sandy, yellow-brown, till.	1-9
SAND	Fine grain, yellow-brown.	9-13
CLAY	Silty, yellow-brown.	13-29
CLAY	Yellow-brown.	29-32
SAND	Fine grain, yellow-brown.	32-34
CLAY	Yellow-brown.	34-36
GRAVEL	Fine to coarse grain.	36-37
CLAY	Yellow-brown.	37-40
SAND	Fine to coarse grain, yellow-brown.	40-48
CLAY	Olive to medium gray, bedrock.	48-57
SAND	Fine grain, yellow-brown.	57-74
CLAY	Yellow-brown.	74-80
SAND	Fine grain, yellow-brown.	80-100

132-072-08ACB2

NDSWC

Date Completed:	6/27/88	Well Type:	P2
Depth Drilled (ft):	51	Source of Data:	
Screened Interval (ft):	43.5-49.5	Principal Aquifer :	Undefined
Casing size (in) & Type:		L.S. Elevation (ft)	2247.41

Owner: Jahner

Lithologic Log

Unit	Description	Depth (ft)
TOPSOIL	Silty, black.	0-1
CLAY	Silty, yellow-brown, till.	1-4
CLAY	Sandy, yellow-brown, with interbedded sand layers, till.	4-8
CLAY	Silty, yellow-brown.	8-30
SAND	Fine grain, yellow-brown.	30-31
CLAY	Silty to sandy, yellow-brown.	31-40
SAND	Fine to coarse grain, yellow-brown.	40-48
CLAY	Medium to olive gray, bedrock.	48-51

132-072-08ACD1

NDSWC

Date Completed:	6/21/88	Well Type:	P2
Depth Drilled (ft):	71	Source of Data:	
Screened Interval (ft):	66-69	Principal Aquifer :	Undefined
Casing size (in) & Type:		L.S. Elevation (ft)	2235.04

Owner: Jahner

Lithologic Log

Unit	Description	Depth (ft)
TOPSOIL	Silty, black.	0-1
CLAY	Silty to sandy, yellow-brown.	1-5
CLAY	Silty, yellow-brown.	5-16
SAND	Fine to medium grain, yellow-brown.	16-17
CLAY	Silty, yellow-brown.	17-20
SAND	Fine to medium grain, yellow-brown.	20-23
CLAY	Medium to brown-gray, bedrock.	23-40
SAND	Fine grain, yellow-brown.	40-42
CLAY	Medium gray.	42-66
SAND	Fine grain, blue-gray, moist.	66-69
CLAY	Medium gray.	69-71

132-072-08ADA

NDSWC

Date Completed:	6/23/88	Well Type:	P2
Depth Drilled (ft):	80	Source of Data:	
Screened Interval (ft):	69-78	Principal Aquifer :	Undefined
Casing size (in) & Type:		L.S. Elevation (ft)	2233.84

Owner: Jahner

Lithologic Log

Unit	Description	Depth (ft)
TOPSOIL	Silty, black	0-1
CLAY	Silty, yellow-brown.	1-5
SAND	Fine to coarse grain, about 20% gravel.	5-17
CLAY	Silty, yellow-brown.	17-52
CLAY	Brown-gray, bedrock.	52-62
SAND	Fine grain, yellow-brown.	62-76
CLAY	Medium gray.	76-80

132-072-08ADC

NDSWC

Date Completed:	7/27/92	Well Type:	P2
Depth Drilled (ft):	82	Source of Data:	
Screened Interval (ft):	77-82	Principal Aquifer :	Undefined
Casing size (in) & Type:		L.S. Elevation (ft)	2243.27

Owner: Jahner

Lithologic Log

Unit	Description	Depth (ft)
TOPSOIL		0-1
CLAY	Sandy with a trace of pebbles, moderate yellow-brown 10YR5/4.	1-9
CLAY	Trace of sand and pebbles, moderate yellow-brown 10YR5/4.	9-13
CLAY	Trace of sand and small pebbles, moderate yellow-brown 10YR5/4, (drills heavier at 29 feet).	13-35
SAND	Fine to medium grain with a trace of fine gravel, moderate yellow-brown 10YR 5/4.	35-38
SAND	Fine to medium grain with a trace of gravel, damp, moderate yellow-brown 10YR5/4.	38-41
CLAY	Trace of sand and small pebbles, moderate yellow-brown 10YR5/4.	41-46
CLAY	Sandy, dark yellow-brown 10YR4/2, damp, Fox Hills Formation.	46-53
CLAY	Trace of sand, dark yellow-brown 10YR4/2.	53-58
SANDSTONE	Fine grain, moderate cementation, calcite, yellow-gray 5Y7/2.	58-60
CLAY	Sandy, dark yellow-brown 10YR4/2.	60-66
SAND	Medium to coarse grain, silty, dark yellow-brown 10YR4/2.	66-72
SAND	Fine grain, clayey, dark yellow-brown 10YR4/2.	72-82

132-072-08DAC1

NDSWC

Date Completed:	6/17/88	Well Type:	P2
Depth Drilled (ft):	94	Source of Data:	
Screened Interval (ft):	84-93	Principal Aquifer :	Undefined
Casing size (in) & Type:		L.S. Elevation (ft)	2201.05

Owner: Jahner

Lithologic Log

Unit	Description	Depth (ft)
TOPSOIL	Silty, black	0-1
CLAY	Silty, yellow-brown.	1-7
CLAY	Yellow-brown to yellow-gray, bedrock, bedrock.	7-14
SAND	Fine grain, yellow-brown.	14-16
CLAY	Yellow-brown	16-17
SAND	Fine grain, yellow-brown.	17-20
CLAY	Yellow-brown.	20-22
SAND	Fine grain, yellow-brown.	22-32
CLAY	Brown-gray.	32-42
CLAY	Medium gray.	42-49
SAND	Fine grain, blue-gray, moist.	49-52
CLAY	Medium gray.	52-62
SAND	Fine grain, blue-gray, moist.	62-66
CLAY	Silty, medium gray.	66-84
SAND	Fine grain, blue-gray.	84-92
CLAY	Silty, medium gray.	92-94

132-072-08DAC2
NDSWC

Date Completed:	8/4/92	Well Type:	P2
Depth Drilled (ft):	58	Source of Data:	
Screened Interval (ft):	48-58	Principal Aquifer :	Undefined
Casing size (in) & Type:		L.S. Elevation (ft)	2201.29
Owner: Jahner			

Lithologic Log

Unit	Description	Depth (ft)
TOPSOIL		0-1
CLAY	Sandy with a trace of pebbles, light olive gray 5Y5/2.	1-5
SAND	Fine grain, clayey, light olive gray 5Y5/2, Fox Hills Formation.	5-7
CLAY	Trace of sand, light olive gray 5Y5/2.	7-10
CLAY	Trace sand, dark yellow-brown 10YR4/2.	10-14
CLAY	Sandy, light olive gray 5Y5/2.	14-20
SAND	Fine grain, silty, moderate yellow-brown 10YR5/4.	20-22
SAND	Fine grain, clayey, light olive gray 5Y5/2.	22-32
CLAY	Silty with a trace of sand, olive gray 5Y4/1.	32-35
CLAY	Silty, dark yellow-brown 10YR4/2.	35-38
CLAY	Olive gray 5Y4/1 to pale green 10G6/2.	38-44
CLAY	Olive gray 5Y4/1.	44-58

132-072-08DAD1

NDSWC

Date Completed:	8/5/92	Well Type:	P2
Depth Drilled (ft):	83	Source of Data:	
Screened Interval (ft):	73-78	Principal Aquifer :	Undefined
Casing size (in) & Type:		L.S. Elevation (ft)	2207.37

Owner: Jahner

Lithologic Log

Unit	Description	Depth (ft)
TOPSOIL		0-1
CLAY	Silty, sandy, pale yellow-brown 10YR6/2, Fox Hills Formation.	1-11
CLAY	Silty with a trace of sand, moderate yellow-brown 10YR5/4	11-17
SAND	Fine to medium grain, silty with a trace of clay, pale yellow-brown 10YR6/2.	17-48
SAND	Fine grain, silty with a trace of clay, pale yellow-brown 10YR6/2.	48-54
SAND	Fine to very fine grain, silty with a trace of clay, pale yellow-brown 10YR6/2.	54-62
SILT	Sandy, clayey, pale yellow-brown 10YR6/2.	62-72
SAND	Fine grain, silty, pale yellow-brown 10YR6/2.	72-83

132-072-08DAD2

NDSWC

Date Completed:	8/12/92	Well Type:	P2
Depth Drilled (ft):	53	Source of Data:	
Screened Interval (ft):	40-50	Principal Aquifer :	Undefined
Casing size (in) & Type:		L.S. Elevation (ft)	2207.48

Owner: Jahner

Lithologic Log

Unit	Description	Depth (ft)
TOPSOIL		0-1
CLAY	Silty, sandy, moderate yellow-brown 10YR5/4 (Foxhill Formation).	1-11
SAND	Fine grain, silty, moderate yellow-brown 10YR5/4.	11-13
CLAY	Silty, pale brown 5YR5/2.	13-17
SAND	Fine to medium grain, silty with a trace of clay, pale yellow-brown 10YR6/2.	17-48
SAND	Fine grain, silty with a trace of clay, pale yellow-brown 10YR6/2.	48-54

132-072-08DBB

NDSWC

Date Completed:	6/22/88	Well Type:	P2
Depth Drilled (ft):	109	Source of Data:	
Screened Interval (ft):	102-109	Principal Aquifer :	Undefined
Casing size (in) & Type:		L.S. Elevation (ft)	2236.2

Owner: Jahner

Lithologic Log

Unit	Description	Depth (ft)
TOPSOIL	Silty, black.	0-1
SAND	Fine grain, yellow-brown.	1-3
CLAY	Silty, yellow-brown, till.	3-17
CLAY	Yellow-brown.	17-22
SAND	Fine to medium grain, yellow-brown.	22-29
CLAY	Yellow-brown, bedrock.	29-40
SAND	Fine grain, yellow-brown.	40-69
CLAY	Yellow-brown.	69-84
CLAY	Silty to sandy, blue gray to yellow-brown.	84-94
CLAY	Silty, medium gray.	94-97
SAND	Fine grain, blue-gray, water.	97-108
CLAY	Medium gray.	108-109

132-072-08DBD1
NDSWC

Date Completed:	8/4/92	Well Type:	P2
Depth Drilled (ft):	53	Source of Data:	
Screened Interval (ft):	48-53	Principal Aquifer :	Undefined
Casing size (in) & Type:		L.S. Elevation (ft)	2209.53

Owner: Jahner

Lithologic Log

Unit	Description	Depth (ft)
TOPSOIL		0-1
SILT	Clayey with a trace of small pebbles, moderate yellow-brown 10YR5/4.	1-5
SAND	Fine grain, light olive gray 5Y5/2, Fox Hills Formation.	5-9
CLAY	Sandy, olive gray 5Y4/1.	9-13
SAND	Fine grain, silty, light olive gray 5Y5/2, damp.	13-21
CLAY	Moderate yellow-brown 10YR5/4 with dark yellow-orange 10YR6/6 mottles.	21-23
CLAY	Sandy, light olive gray 5Y5/2.	23-26
CLAY	Carbonaceous, olive black 5Y2/1.	26-30
CLAY	Sandy, olive gray 5Y4/1.	30-32
CLAY	Olive gray 5Y4/1.	32-35
CLAY	Brown-gray 5Y4/1.	35-39
CLAY	Pale green 10G6/2.	39-43
CLAY	Trace of sand, brown-gray 5YR4/1.	43-50
SAND	Fine grain, olive gray 5Y4/1.	50-53

132-072-08DBD2

NDSWC

Date Completed:	8/4/92	Well Type:	P2
Depth Drilled (ft):	28	Source of Data:	
Screened Interval (ft):	18-23	Principal Aquifer :	Undefined
Casing size (in) & Type:		L.S. Elevation (ft)	2210.1

Owner: Jahner

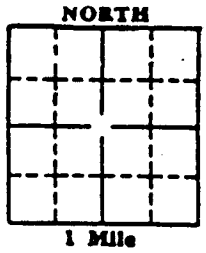
Lithologic Log

Unit	Description	Depth (ft)
TOPSOIL		0-1
SILT	Clayey with a trace of small pebbles, moderate yellow-brown 10YR5/4.	1-5
SAND	Fine grain, light olive gray 5Y5/2, Fox Hills Formation.	5-9
CLAY	Sandy, olive gray 5Y4/1.	9-13
SAND	Fine grain, silty, light olive gray 5Y5/2, damp.	13-21
CLAY	Moderate yellow-brown 10YR5/4 with dark yellow-orange 10YR6/6 mottles.	21-23
CLAY	Sandy, light olive gray 5Y5/2.	23-26
CLAY	Carbonaceous, olive black 5Y2/1.	26-28

DRILLER'S LOG

WATER SUPPLY, INC.

2501 Twin City Drive
Mandan, ND 58554
(701) 663-0877



SE ¼ NE ¼ Sec. 8

Twp 132 Rg. 72 W

Hole Elev. 2245 Hole No. 9

Project: Landfill

Firm Jahner Sanitation

County McIntosh State ND

1550' E & 650' N of Sec. Cen

Sample	Feet	From	To	Description
		0	1	Topsoil, silty to sandy, dark brown, w/gravel & rocks
		1	4	Clay, silty to sandy, medium brown, w/gravel & rocks, fil
		4	4.5	Rocks
		4.5	25	Clay, silty to sandy, medium gray, w/gravel & rocks, till
		25	28	Sand, fine to silty, yellowish brown
		28	42.5	Sand, fine to coarse, yellowish brown, w/gravel
		42.5	43	Rocks and gravel
		43	45	Clay, silty to sandy, yellowish brown
				Plugged w/400# coarse bentonite

Footage Drilled w/~~XX~~ Auger 45'

Footage Drilled w/Water

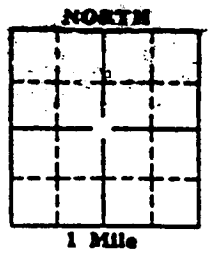
Date: 5/12/89 Driller Reed

Helpers: Hummel

DRILLER'S LOG

WATER SUPPLY, INC.

2501 Twin City Drive
Mandan, ND 58554
(701) 663-0877



SE ¼ NE ¼ Sec. 8

Twp 132 Rg. 72 W

Hole Elev. 2231 Hole No. 10

Project: Landfill

Firm Jahner Sanitation

County McIntosh State ND

2300' E & 650' N of Sec. Cente

ample	Feet	From	To	Description
		0	1	Topsoil, silty to sandy, dark brown, w/gravel & rocks
		1	3	Clay, silty to sandy, medium brown, w/gravel, till
		3	9	Clay, silty to sandy, medium brown, abt 25% sand w/gravel and rocks, till
		9	13	Clay, silty to sandy, medium brown, abt 5% sand w/gravel and rocks, till
		13	16.5	Sand, fine to silty, medium brown, w/gravel
		16.5	18	Clay, silty to sandy, medium brown, abt 25% sand, till
		18	27.5	Sand, fine to coarse, medium brown, w/gravel
		27.5	28	Gravel and rock
		28	30	Clay, silty to sandy, medium gray
				Plugged w/350# coarse bentonite

Footage Drilled w/Air auger 30.45'

Footage Drilled w/Water

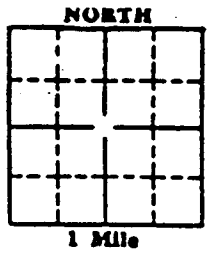
Date: 5/12/89 Driller Reed

Helpers: Hummel

DRILLER'S LOG

WATER SUPPLY, INC.

2501 Twin City Drive
Mandan, ND 58554
(701) 663-0877



SE ¼ NE ¼ Sec. 8 Twp 132N Rg. 72 W

Hole Elev. 2218 Hole No. 11

Project: Landfill

Firm Jahner Sanitation

County McIntosh State ND

1900' E of Sec. Center

Sample	Feet	From	To	Description
		0	2	Topsoil, silty, black
		2	20	Clay, silty, yellowish brown, till
				Plugged w/150# coarse bentonite

Footage Drilled w/Air 20

Footage Drilled w/Water

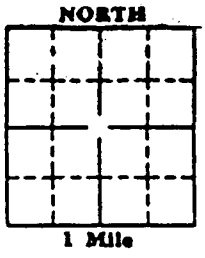
Date: 8/22/89 Driller Knutson

Helpers: Leingang

DRILLER'S LOG

WATER SUPPLY, INC.

2501 Twin City Drive
Mandan, ND 58554
(701) 663-0877



SE ¼ NE ¼ Sec. 8 Twp 132N Rg. 72W

Hole Elev. 2240 Hole No. 12

Project: Landfill

Firm Jahner Sanitation

County McIntosh State ND

2100' E & 400' N of Sec. Center

mple	Feet	From	To	Description
		0	1	Topsoil, silty, black
		1	13	Sand, fine to medium, yellowish brown
		13	15	Gravel, rocks, & sand, yellowish brown
		15	40	Clay, silty, yellowish brown, w/a few rocks, till
				Plugged w/300# coarse bentonite

Footage Drilled w/Air 40

Footage Drilled w/Water

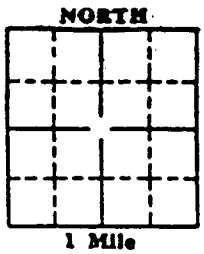
Date: 8/22/89 Driller Knutson

Helpers: Leingang

DRILLER'S LOG

WATER SUPPLY, INC.

2501 Twin City Drive
Mandan, ND 58554
(701) 663-0877



SE ¼ NE ¼ Sec. 8

Twp 132N Rg. 72 W 1800' E & 500' N of Sec. Center

Hole Elev. 2244 Hole No. 13

Project: Landfill

Firm Jahner Sanitation

County McIntosh State ND

Sample	Feet	From	To	Description
		0	1	Topsoil, silty, black
		1	26	Clay, silty, yellowish brown, till
		26	26.5	Gravel, fine to coarse
		26.5	45	Clay, silty, yellowish brown, till
				Plugged w/200# coarse bentonite

Footage Drilled w/Air

Footage Drilled w/Water 45

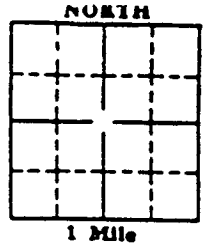
Date: 8/22/89 Driller Knutson

Helpers: Leingang

DRILLER'S LOG

WATER SUPPLY, INC.

2501 Twin City Drive
Mandan, ND 58554
(701) 663-0877



SW ¼ NE ¼ Sec. 8

Twp 132N Rg. 72 W 1150' E & 450' N of Sec. center

Hole Elev. 2235 Hole No. 14

Project: Landfill

Firm Jahner Sanitation

County McIntosh State ND

ample	Feet	From	To	Description
		0	1	Topsoil, silty, black
		1	21	Clay, silty, yellowish brown, till
		21	24	Clay, silty to sandy, yellowish orange
		24	28	Clay, silty, yellowish brown, till
		28	40	Sand, silty to clayey, grayish brown to light gray, abt
				50% sand, bedrock
				Plugged w/150# coarse bentonite

Footage Drilled w/Air

Footage Drilled w/Water 40

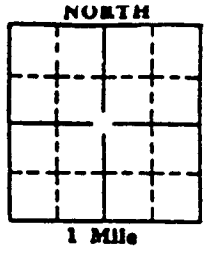
Date: 8/22/89 Driller Knutson

Helpers: Leingang

DRILLER'S LOG

WATER SUPPLY, INC.

2501 Twin City Drive
Mandan, ND 58554
(701) 663-0877



SW ¼ NE ¼ Sec. 8 Twp 132N Rg. 72 W

Hole Elev. 2250 Hole No. 15

Project: Landfill

Firm Jahner Sanitation

County McIntosh State ND

800' E & 550' N of Sec. center

Sample	Feet	From	To	Description
		0	1	Topsoil, silty, black
		1	21	Clay, silty, yellowish brown, till
		21	24	Clay, silty to sandy, yellowish brown
		24	34	Clay, silty, yellowish brown, till
		34	38	Clay, silty to sandy, yellowish brown
		38	50	Clay, silty, medium gray, bedrock
				Plugged w/150# coarse bentonite

Footage Drilled w/Air

Footage Drilled w/Water 50

Date: 8/22/89 Driller Knutson

Helpers: Leingang

APPENDIX D

WATER-LEVEL TABLES

Jahner Water Levels
8/20/92 to 11/20/92

132-072-08ABC LS Elev (msl,ft)=2234.23
Undefined Aquifer SI (ft.)=27-30

Date	Depth to Water (ft)	WL Elev (msl, ft)	Date	Depth to Water (ft)	WL Elev (msl, ft)
08/25/92	29.11	2205.12			

132-072-08ACB1 LS Elev (msl,ft)=2247.92
Undefined Aquifer SI (ft.)=90-100

Date	Depth to Water (ft)	WL Elev (msl, ft)	Date	Depth to Water (ft)	WL Elev (msl, ft)
08/20/92	78.40	2169.52	11/09/92	78.32	2169.60
08/26/92	78.80	2169.12	11/20/92	78.53	2169.39
10/13/92	78.28	2169.64			

132-072-08ACB2 LS Elev (msl,ft)=2247.41
Undefined Aquifer SI (ft.)=43.5-49.5

Date	Depth to Water (ft)	WL Elev (msl, ft)	Date	Depth to Water (ft)	WL Elev (msl, ft)
08/20/92	48.48	2198.93			

132-072-08ACD1 LS Elev (msl,ft)=2235.04
Undefined Aquifer SI (ft.)=66-69

Date	Depth to Water (ft)	WL Elev (msl, ft)	Date	Depth to Water (ft)	WL Elev (msl, ft)
08/20/92	66.71	2168.33	11/09/92	66.49	2168.55
08/26/92	66.91	2168.13	11/20/92	66.67	2168.37
10/13/92	66.58	2168.46			

132-072-08ACD2 LS Elev (msl,ft)=2235.29
Undefined Aquifer SI (ft.)=73-78

Date	Depth to Water (ft)	WL Elev (msl, ft)	Date	Depth to Water (ft)	WL Elev (msl, ft)
08/13/92	66.84	2168.45	11/09/92	66.35	2168.94
08/26/92	66.86	2168.43	11/20/92	66.62	2168.67
10/13/92	66.36	2168.93			

132-072-08ADA LS Elev (msl,ft)=2233.84
Undefined Aquifer SI (ft.)=69-78

Date	Depth to Water (ft)	WL Elev (msl, ft)	Date	Depth to Water (ft)	WL Elev (msl, ft)
08/25/92	52.94	2180.90	11/09/92	52.21	2181.63
08/26/92	52.95	2180.89	11/20/92	52.45	2181.39
10/13/92	52.22	2181.62			

132-072-08ADC LS Elev (msl,ft)=2243.27

Undefined Aquifer SI (ft.)=77-82

Date	Depth to Water (ft)	WL Elev (msl, ft)	Date	Depth to Water (ft)	WL Elev (msl, ft)
08/25/92	74.38	2168.89	11/09/92	73.87	2169.40
08/26/92	75.60	2167.67	11/20/92	74.11	2169.16
10/13/92	73.82	2169.45			

132-072-08DAC1 LS Elev (msl,ft)=2201.05

Undefined Aquifer SI (ft.)=84-93

Date	Depth to Water (ft)	WL Elev (msl, ft)	Date	Depth to Water (ft)	WL Elev (msl, ft)
08/20/92	36.45	2164.60	11/09/92	39.88	2161.17
08/27/92	38.76	2162.29	11/20/92	39.14	2161.91
10/22/92	39.24	2161.81			

132-072-08DAC2 LS Elev (msl,ft)=2201.29

Undefined Aquifer SI (ft.)=48-58

Date	Depth to Water (ft)	WL Elev (msl, ft)	Date	Depth to Water (ft)	WL Elev (msl, ft)
08/13/92	34.68	2166.61	11/09/92	34.33	2166.96
08/27/92	34.69	2166.60	11/20/92	34.40	2166.89
10/13/92	34.50	2166.79			

132-072-08DAD1 LS Elev (msl,ft)=2207.37

Undefined Aquifer SI (ft.)=73-78

Date	Depth to Water (ft)	WL Elev (msl, ft)	Date	Depth to Water (ft)	WL Elev (msl, ft)
08/13/92	42.17	2165.20	11/09/92	42.01	2165.36
08/27/92	42.11	2165.26	11/20/92	42.12	2165.25
10/13/92	41.89	2165.48			

132-072-08DAD2 LS Elev (msl,ft)=2207.48

Undefined Aquifer SI (ft.)=40-50

Date	Depth to Water (ft)	WL Elev (msl, ft)	Date	Depth to Water (ft)	WL Elev (msl, ft)
08/13/92	42.05	2165.43	11/09/92	41.91	2165.57
08/27/92	41.98	2165.50	11/20/92	42.04	2165.44
10/13/92	41.92	2165.56			

132-072-08DBB LS Elev (msl,ft)=2236.2

Undefined Aquifer SI (ft.)=102-109

Date	Depth to Water (ft)	WL Elev (msl, ft)	Date	Depth to Water (ft)	WL Elev (msl, ft)
08/25/92	67.50	2168.70	11/09/92	67.78	2168.42
08/26/92	67.56	2168.64	11/20/92	66.46	2169.74
10/13/92	67.43	2168.77			

132-072-08DBD1 LS Elev (msl,ft)=2209.63

Undefined Aquifer SI (ft.)=48-53

Date	Depth to Water (ft)	WL Elev (msl, ft)	Date	Depth to Water (ft)	WL Elev (msl, ft)
08/14/92	41.64	2167.89	11/09/92	41.25	2168.28
08/27/92	41.59	2167.94	11/20/92	41.37	2168.16
10/13/92	41.23	2168.30			

132-072-08DBD2 LS Elev (msl,ft)=2210.1

Undefined Aquifer SI (ft.)=18-23

Date	Depth to Water (ft)	WL Elev (msl, ft)	Date	Depth to Water (ft)	WL Elev (msl, ft)
08/14/92	14.16	2195.94	11/09/92	14.17	2195.93
08/27/92	14.13	2195.97	11/20/92	14.37	2195.73
10/13/92	14.13	2195.97			

APPENDIX E

MAJOR ION AND TRACE-ELEMENT CONCENTRATIONS

Jahner Landfill Water Quality
Major Ions

Location	Screened Interval (ft)	Date Sampled	(milligrams per liter) SiO_2	Fe	Mn	Ca	Mg	Na	K	HCO_3	CO_3	SO_4	Cl	F	NO_3	B	TDS	Hardness $CaCO_3$	as NCH	% Na	SAR	Spec Cond (µmho)	Temp (°C)	pH
132-072-08ACB1	90-100	08/26/92	32	0.01	0.2	49	24	16	8.2	298	0	20	17	0.5	0	0.13	314	220	0	13	0.5	456	9	7.93
132-072-08ACD1	66-69	08/26/92	18	0.17	0.49	130	58	44	12	635	0	81	13	0.1	0.3	0.14	670	560	43	14	0.8	1073	11	8.13
132-072-08ACD2	73-78	08/26/92	12	0.3	0.04	46	1.5	47	15	2	45	130	22	0.5	1.9	0.05	322	120	45	1	1.9	575	9	11.1
132-072-08ADA	69-78	08/26/92	27	0.01	0.02	55	25	17	7.5	334	0	9.9	12	0.5	2.7	0.1	322	240	0	13	0.5	494	8	7.3
132-072-08ADC	77-82	08/26/92	16	0.09	0.04	120	24	85	22	163	0	480	17	0.7	10	0.09	855	400	260	30	1.8	1171	11	9.11
132-072-08DAC1	84-93	08/27/92	22	0.06	0.27	52	22	47	9.1	362	0	39	3.8	0.1	3.2	0.15	377	220	0	31	1.4	594	11	6.86
132-072-08DAC2	48-58	08/27/92	19	0.06	0.15	46	17	42	14	244	0	91	9.5	0.2	3.5	0.1	363	190	0	31	1.3	526	14	7.66
132-072-08DAD1	73-78	08/27/92	23	0.09	0.45	58	26	35	8.1	350	0	48	6.9	0.7	0	0.17	378	250	0	22	1	576	11	7.51
132-072-08DAD2	40-50	08/27/92	25	0.01	0.07	46	22	16	4	198	0	44	25	0.8	5.5	0.1	286	210	43	14	0.5	453	15	8.19
132-072-08DBB	102-109	08/26/92	27	0.12	0.15	40	17	28	7.5	251	0	28	4.9	0.5	0.1	0.15	277	170	0	25	0.9	426	9	8.02
132-072-08DBD1	48-53	08/27/92	15	0.06	0.05	36	16	34	5.6	145	0	110	15	0.5	2.9	0.08	306	160	37	31	1.2	448	9	8.41
132-072-08DBD2	18-23	08/26/92	21	0.21	0.04	30	8.5	25	12	135	19	19	4.9	0.2	17	0.01	224	110	0	30	1	323	10	9.4

Jahner Landfill Water Quality
Trace Element Analyses

Location	Date Sampled	Selenium	Lead	Cadmium	Mercury	Arsenic	Molybdenum	Strontium
		(micrograms per liter)						
132-072-08ACB1	08/26/92	1	0	0	0	0	1	360
132-072-08ACD1	08/26/92	0	0	0	0	3	14	770
132-072-08ACD2	08/26/92	1	0	0	0	1	80	310
132-072-08ADA	08/26/92	4	0	0	0	1	27	410
132-072-08ADC	08/26/92	0	0	0	0	0	112	610
132-072-08DAC1	08/27/92	0	0	0	0	1	0	440
132-072-08DAC2	9/30/92	1	0	0	0	0	35	400
132-072-08DAD1	10/01/92	0	0	0	0	1	8	460
132-072-08DAD2	10/01/92	10	0	0	0	0	5	290
132-072-08DBB	08/26/92	0	0	0	0	0	0	310
132-072-08DBD1	9/30/92	0	0	0	0	4	10	290
132-072-08DBD2	08/26/92	0	0	0	0	0	1	220

APPENDIX F

VOLATILE ORGANIC COMPOUNDS FOR WELL 132-072-08DAC1

Volatile Organic Compounds
and
Minimum Concentrations

Concentrations are based only on detection limits. Anything over the detection limit indicates possible contamination.

Constituent	Chemical Analysis µg/L
Benzene	<2
Vinyl Chloride	<1
Carbon Tetrachloride	<2
1,2-Dichlorethane	<2
Trichloroethylene	<2
1,1-Dichloroethylene	<2
1,1,1-Trichloroethane	<2
para-Dichlorobenzene	<2
Acetone	<50
2-Butanone (MEK)	<50
2-Hexanone	<50
4-Methyl-2-pentanone	<50
Chloroform	<5
Bromodichloromethane	<5
Chlorodibromomethane	<5
Bromoform	<5
trans1,2-Dichloroethylene	<2
Chlorobenzene	<2
m-Dichlorobenzene	<5
Dichloromethane	<5
cis-1,2-Dichloroethylene	<2
o-Dichlorobenzene	<2
Dibromomethane	<5
1,1-Dichloropropene	<5
Tetrachlorethylene	<2
Toluene	<2
Xylene(s)	<2
1,1-Dichloroethane	<5
1,2-Dichloropropane	<2
1,1,2,2-Tetrachloroethane	<5
Ethyl Benzene	<2
1,3-Dichloropropane	<5
Styrene	<2
Chloromethane	<5
Bromomethane	<5
1,2,3-Trichloropropane	<5
1,1,1,2-Tetrachloroethane	<5
Chloroethane	<5
1,1,2-Trichloroethane	<5

* Constituent Detection

VOC Constituents cont.

2,2-Dichloropropane	<5
o-Chloroluene	<5
p-Chlorotoluene	<5
Bromobenzene	<5
1,3-Dichloropropene	<5
1,2,4-Trimethylbenzene	<5
1,2,4-Trichlorobenzene	<5
1,2,3-Trichlorobenzene	<5
n-Propylbenzene	<5
n-Butylbenzene	<5
Naphthalene	<5
Hexachlorobutadiene	<5
1,3,5-Trimethylbenzene	<5
p-Isopropyltoluene	<5
Isopropylbenzene	<5
Tert-butylbenzene	<5
Sec-butylbenzene	<5
Fluorotrichloromethane	<5
Dichlorodifluoromethane	<5
Bromochloromethane	<5
Allylchloride	<5
2,3-Dichloro-1-propane	<5
Tetrahydrofuran	239*
Pentachloroethane	<5
Trichlorotrofluoroethane	<5
Carbondisufide	<5
Ether	<5

* Constituent Detection