Site Suitability Review of the Mayville Municipal Landfill

by
Phillip L. Greer
North Dakota Geological Survey
and
Jeffrey Olson
North Dakota State Water Commission

Prepared by the
North Dakota Geological Survey
and the
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ND Landfill Site Investigation No. 16

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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 Mayville municipal solid waste landfill is one of the landfills being evaluated.

Location of the Mayville Landfill

The Mayville solid waste landfill is located one half mile southeast of the City of Mayville in Township 146 North, Range 52 West, SE 1/4 of Section 5. The landfill site encompasses approximately 40 acres, most of which has been used.

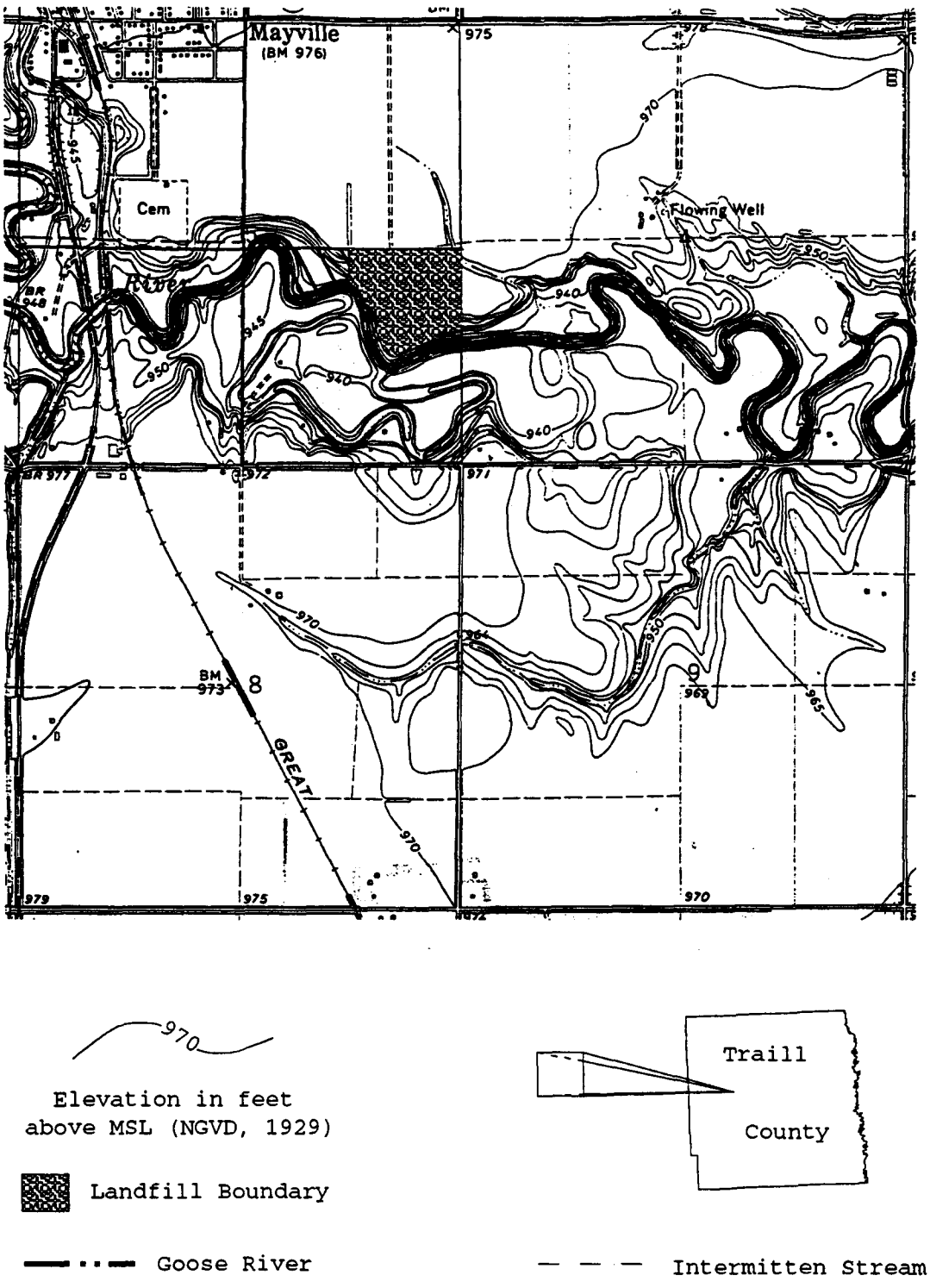

Figure 1. Location of the Mayville landfill in the SE 1/4 of section 5, T. 146N., R.52 W.

Previous Site Investigations

In 1981 two 50-foot soil borings were drilled at the Mayville landfill by Twin City Testing, Inc. The lithologic logs for these borings describe primarily clay and silty clay materials. A sandy clay till was observed in one of the borings from a depth of 42 feet to 50 feet.

Methods of Investigation

The Mayville 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. Well abandonment procedures were followed for non-permanent monitoring wells.

Test Drilling Procedure

The drilling method at the Mayville landfill was based on the site's geology and depth to ground water, as determined by the preliminary evaluation. A hollow-stem auger was used at the Mayville 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

Six test holes were drilled at the Mayville landfill and monitoring wells installed in each of the test holes. The number of wells installed was based on the geologic and topographic characteristics of the site. The wells were located near the active area of the landfill. 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 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 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.

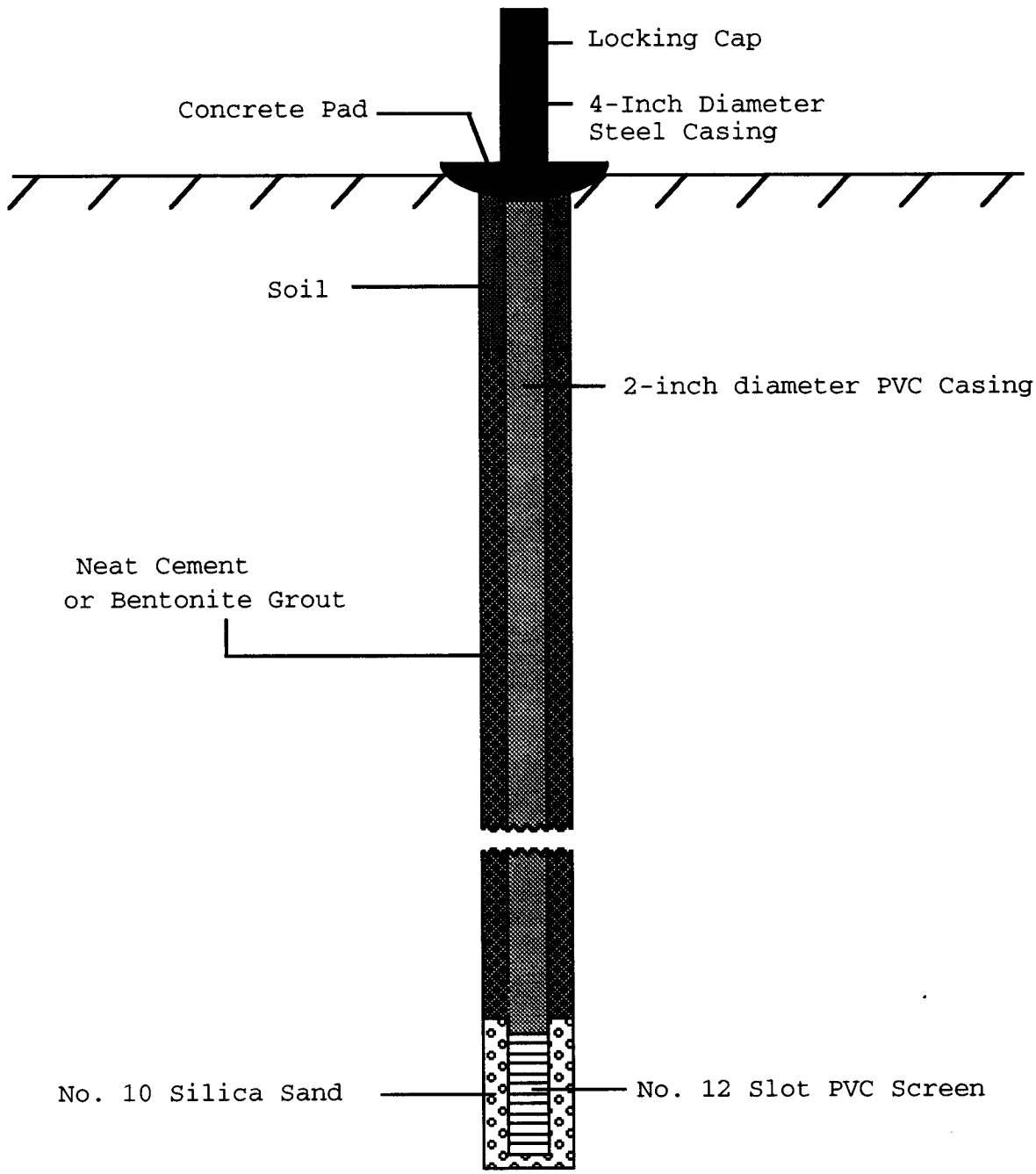

Figure 2. Construction design used for monitoring wells installed at the Mayville landfill.

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.

* No special preservative techniques were applied to nitrate samples and as a result reported nitrate concentrations may be lower than actual.

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.

Well-Abandonment Procedure

The test holes and monitoring wells that were not permanent were abandoned according to NDSDHCL and Board of Water Well Contractors regulations (North Dakota Department of Health, 1986). The soil around the well was dug to a depth of approximately three to four feet below land surface (Fig. 3) to prevent disturbance of the sealed wells. The screened interval of the well was plugged with bentonite chips to a height of approximately one foot above the top of the screen and the remaining well casing was filled with neat cement. The upper three to four feet was then filled with cuttings and the disturbed area was blended into the surrounding land surface. Test holes were plugged with high-solids bentonite grout and/or neat cement to a depth approximately five feet below land surface. The upper five feet of the test hole was filled with soil cuttings.

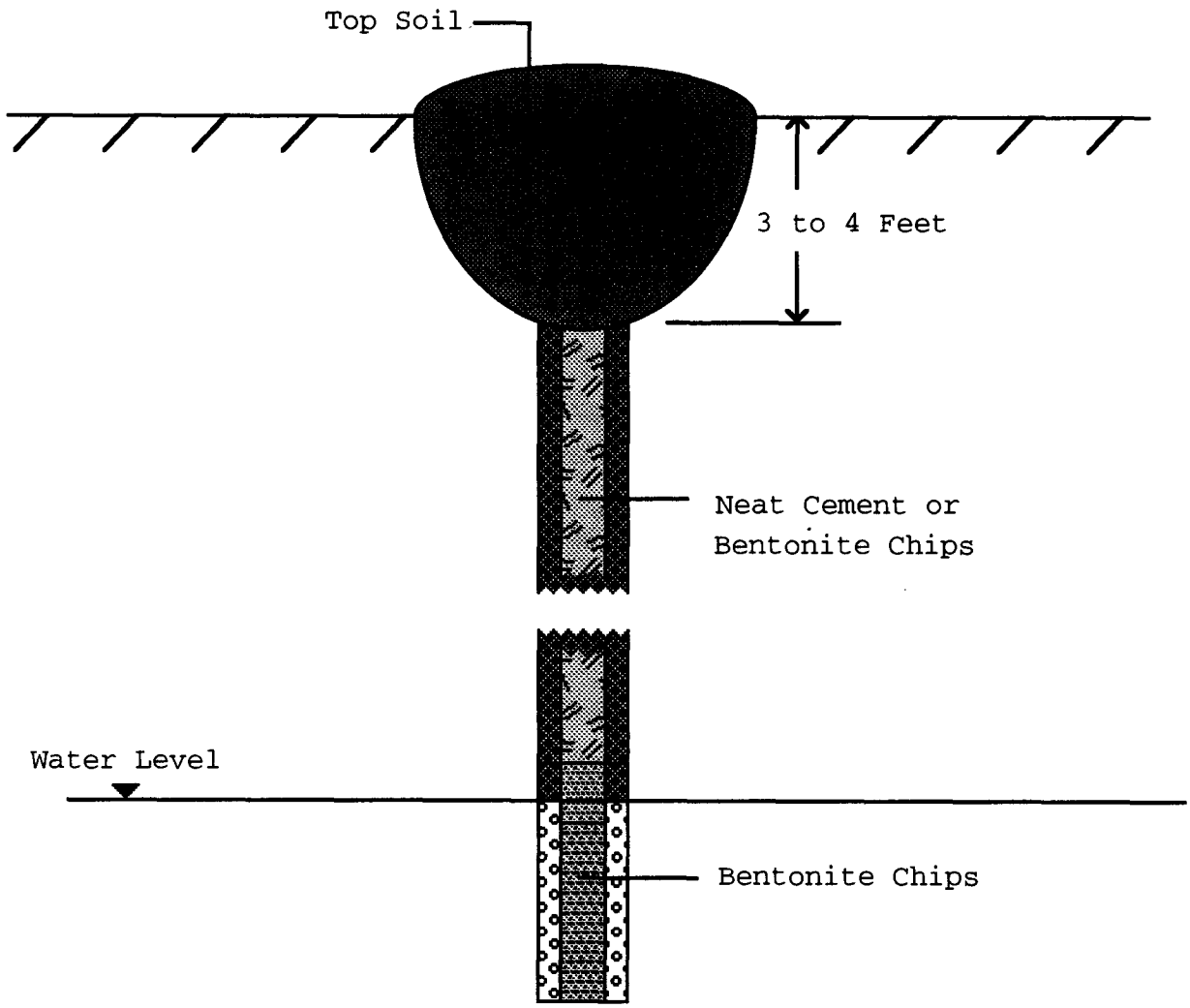

Figure 3. Monitoring well abandonment procedure.

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. 4). 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 (10-acre tract). Therefore, a well denoted by 146-052-05CAD would be located in the SE1/4, NE1/4, SW1/4, Section 5, Township 146 North, Range 52 West. Consecutive numbers are added following the three letters if more than one well is located in a 10-acre tract, e.g. 146-052-05CAD1 and 146-052-05CAD2.

GEOLOGY

The Mayville landfill is located on the glacial Lake Agassiz plain. On the south side of the landfill the Goose River has eroded a channel about 50 feet into the plain (Fig. 5). The original refuse cells were placed on the west side of the landfill property and were excavated partially within the wall of the channel. In 1981 operations were moved

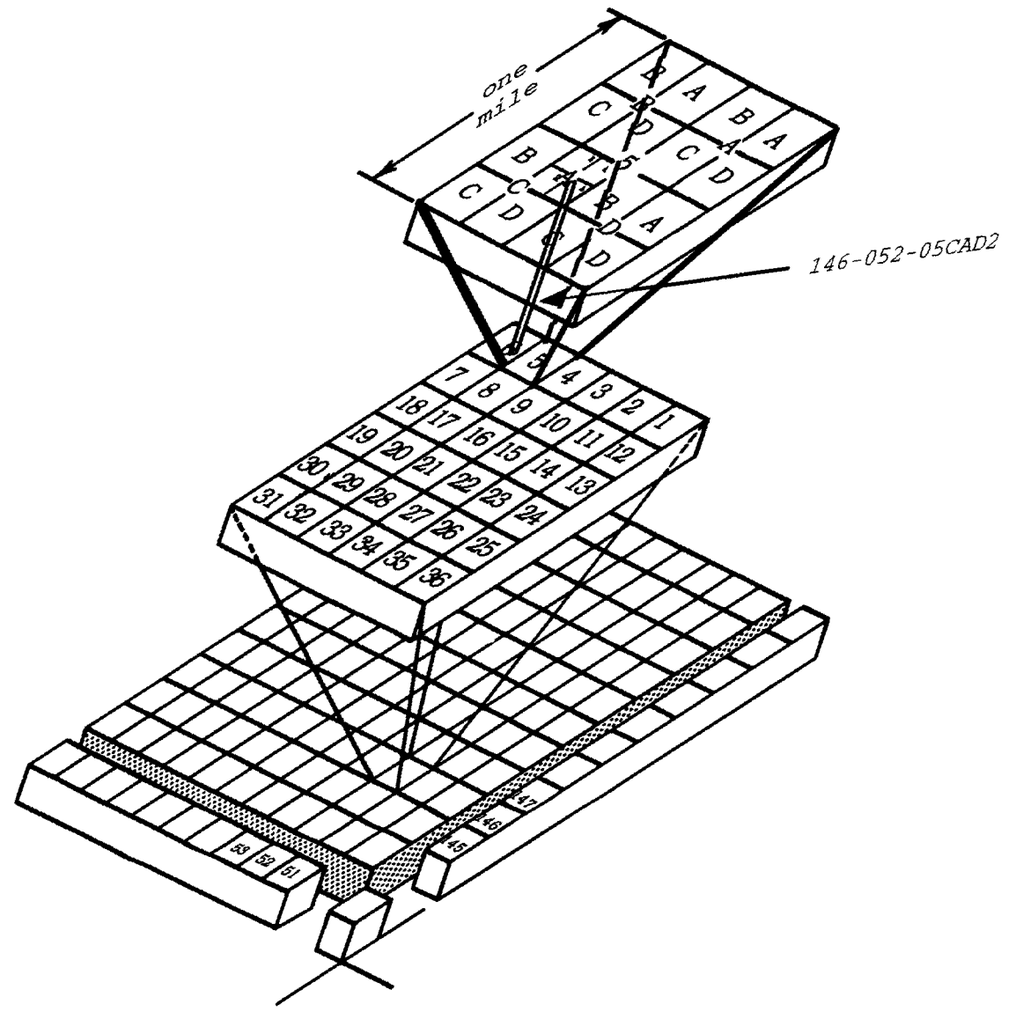

Figure 4. Location-numbering system for the Mayville landfill.

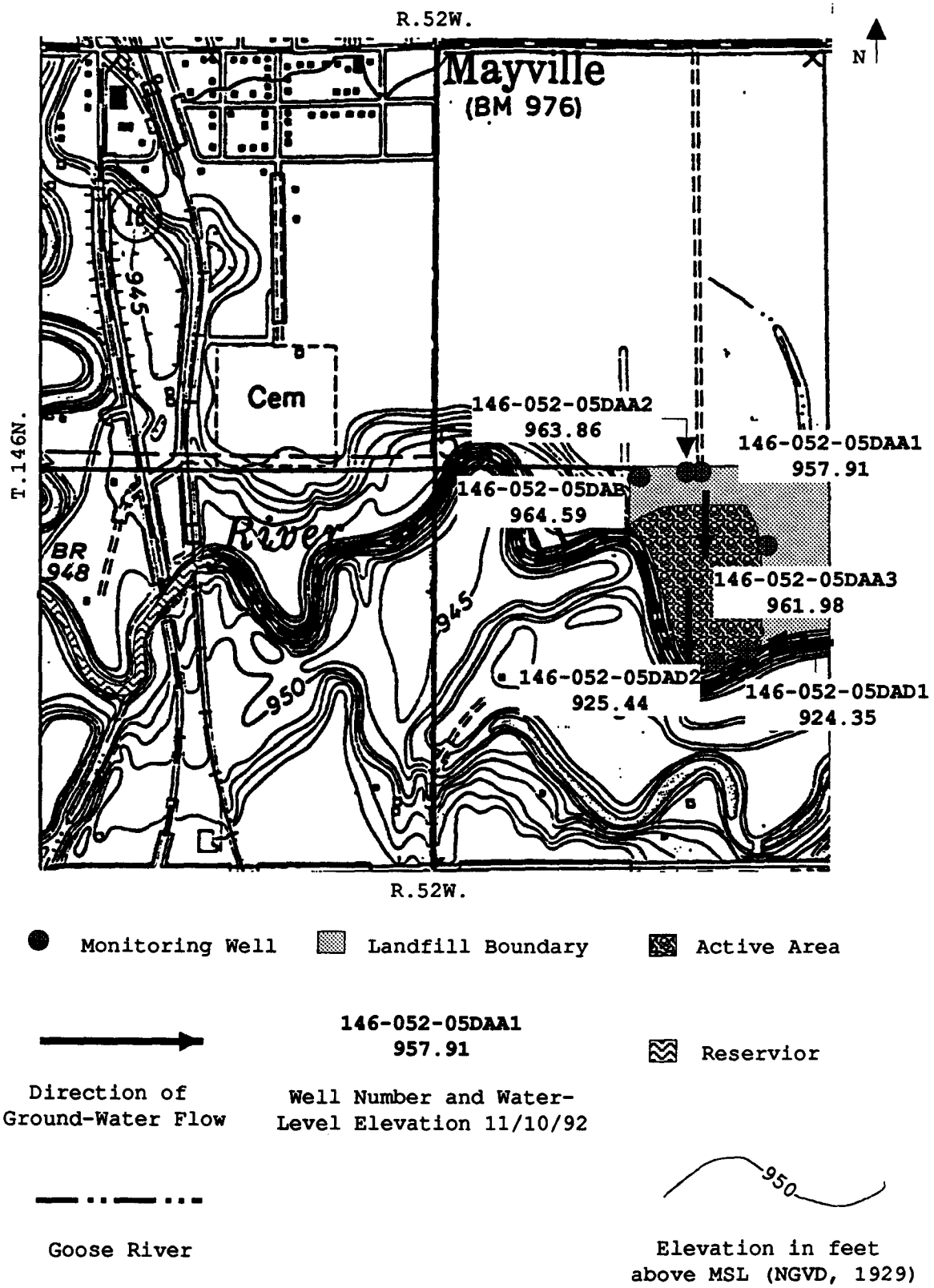

Figure 5. Location of monitoring wells and ground-water flow at the Mayville landfill.

farther east and since then the refuse cells have been placed on higher ground on the relatively flat surface north of the Goose River channel.

The surficial geologic materials in the area consist of alluvial and lacustrine deposits. Alluvial deposits associated with the Goose River include both channel and overbank deposits. Lacustrine deposits either underlie the alluvium or form the surficial deposits where alluvium is absent. The lacustrine deposits in the Mayville area are composed mainly of clay and silt and average about 50 feet in thickness, according to published drill-hole data (Jensen, 1967).

In the subsurface an interval of till and outwash averaging about 150 feet in thick lies below the lacustrine deposits. Bedrock of the Colorado and Dakota Groups occurs beneath the till.

Four of the six test holes for this study were drilled on flat ground north of the Goose River channel. These test holes encountered alternating beds of lacustrine clay and silt (Fig. 6, lithologic logs in Appendix C). The deepest hole, 146-052-05DAA1, also penetrated a gravel bed from 43 feet to the bottom of the hole at 50 feet.

The remaining two test holes were drilled on a terrace above the Goose River. Test hole 146-052-05DAD1 drilled through 28 feet of clay, silt, and sandy silt followed by 2 feet of till. Test hole 146-052-05DAD2 was similar down to 28 feet, but this hole bottomed in fine-grained to coarse-

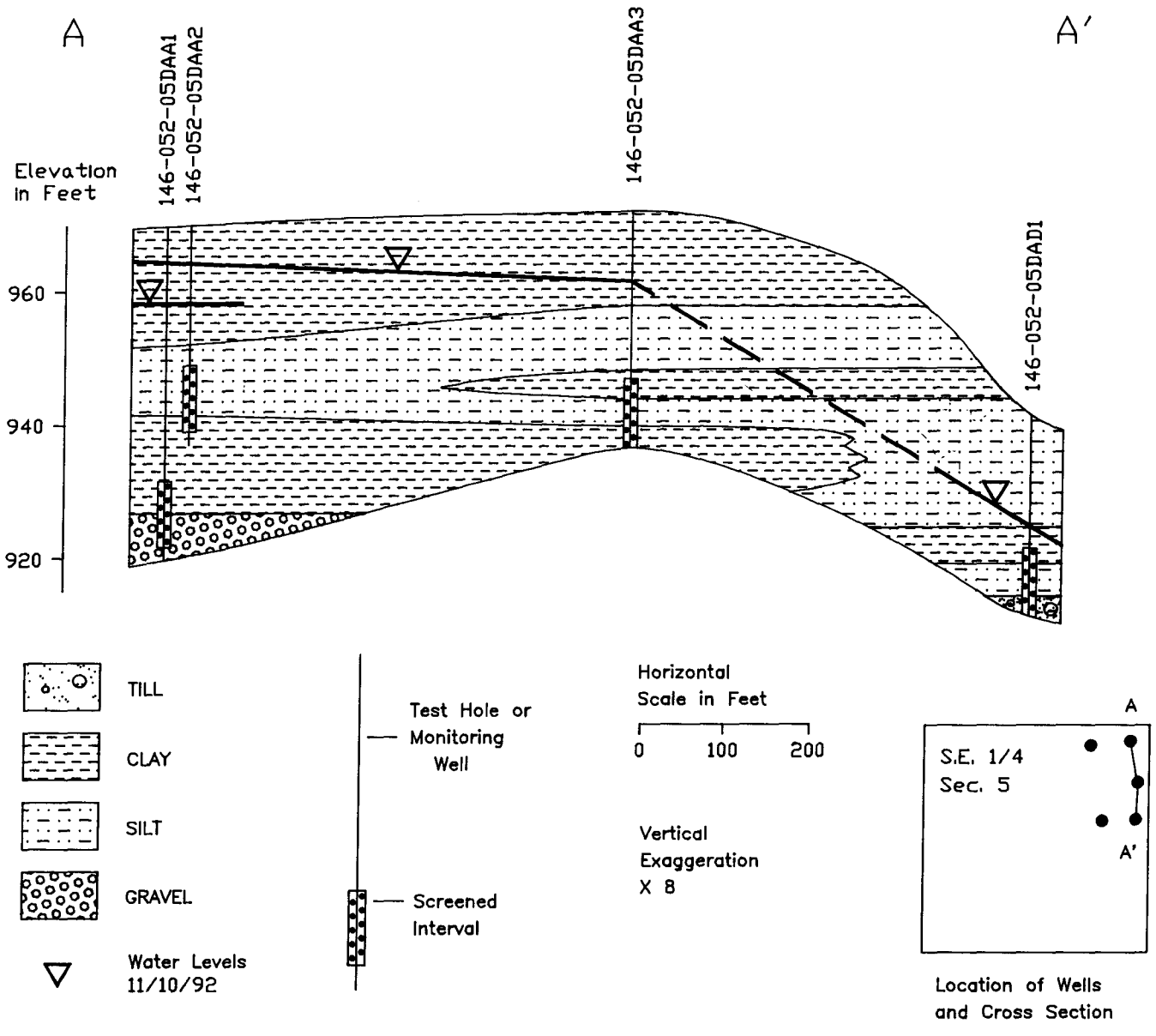

Figure 6. Geohydrologic section A–A' in the Mayville landfill.

grained sand. The sand at the base of this test hole and the gravel at the base of test hole 146-052-05DAA1 appear to be outwash deposits.

HYDROLOGY

Surface-Water Hydrology

The Goose River forms the western and southern boundaries of the Mayville landfill (Fig. 5). The Goose River flows southeast and discharges into the Red River. The proximity of the Goose River to the landfill may cause it to be susceptible to leachate migration from the landfill.

There are no surface water diversions or impoundments at the landfill. Surface water runoff from the landfill is toward the Goose River.

The City of Mayville obtains its water supply from a dammed reservoir on the Goose River. This dam is located about 1.25 miles up-gradient of the landfill and should not be affected by leachate migration from the landfill.

Regional Ground-Water Hydrology

The major aquifer in the area of the Mayville landfill is located in the Dakota Group. The Dakota aquifer ranges in depth from 250 to 400 feet below land surface. About 70% of the wells located in the Dakota aquifer were flowing (Jensen, et al, 1971). The discharge ranged from about 10 to 50

gallons per minute. A flowing well is located approximately one-half mile east of the landfill (Fig. 1). The Dakota aquifer is characterized by a sodium-sulfate type water. The Dakota aquifer should not be susceptible to leachate migration from the landfill because of its depth, the low hydraulic conductivity of the lacustrine clay, till, and shale bedrock. In addition, because the Goose River is a regional discharge area, ground-water flow at the landfill site probably is toward the river and not downward to the deeper bedrock aquifers.

No major glacial aquifers are located within a five mile radius of the Mayville landfill. Undifferentiated glacial aquifers are located throughout the area of western Traill County. These aquifers are generally small in size and discharge small amounts of water. It is not known if there are any undifferentiated glacial aquifers within a two-mile radius of the landfill. The chemistry of the undifferentiated glacial aquifers is highly variable.

Local Ground-Water Hydrology

Six test holes were drilled at the Mayville landfill and monitoring wells were installed at each site. The well screens were placed at the top of the uppermost aquifer. Four water-level measurements were taken over a seven-week period (Appendix D). Wells 146-052-05DAA1, 146-052-05DAA2, and 146-052-05DAB are located along the northern boundary of

the landfill and are up-gradient of the landfill. Well 146-052-05DAA1 is screened in a layer of gravel and wells 146-052-05DAA2 and 146-052-05DAB are screened in a silty clay layer. Wells 146-052-05DAA1 and 146-052-05DAA2 indicate downward ground-water movement through the silty clay and into the gravel layer. Wells 146-052-05DAD1 and 146-052-05DAD2 are located down-gradient of the landfill between the landfill and Goose River. The direction of ground-water flow in the shallow flow system is to the south toward the Goose River (Fig. 5).

Water Quality

Chemical analyses of water samples are shown in Appendix E. All wells are characterized by a calcium-sulfate type water with concentrations of manganese, calcium, and magnesium above SMCL. Elevated calcium and magnesium concentrations are the primary cause of water hardness. These concentrations are common throughout glaciated areas of North Dakota. The major ion analysis did not indicate leachate migration from the landfill.

Selenium concentrations in wells 146-052-05DAA1 (7 µg/L), 146-052-05DAB (6 µg/L), and 146-052-05DAD1 (7 µg/L) were detected near the MCL of 10µg/L. Wells 146-052-05DAA1 and 146-052-05DAB are located up-gradient of the landfill indicating that the source of the selenium is not related to leachate migration from the landfill. Chloride

concentrations were found to be variable within the area therefore, chloride is not considered indicative of leachate migration from the landfill. The trace element analyses did not indicate leachate migration from the landfill.

Results of the VOC analysis, from well 146-052-05DAD2, are shown in Appendix F. The results detected the compound tetrahydrofuran (162 µg/L). Tetrahydrofuran is a man-made compound used in glues and liquid cement for fabricating packages and polyvinyl-chloride materials. No glue was used in the construction of this well. The presence of tetrahydrofuran may indicate leachate migration from the landfill.

CONCLUSIONS

The Mayville landfill is bounded on the west and south by the Goose River. The original refuse cells were placed on the west side of the landfill property and were excavated partially within the wall of the channel. In 1981 operations were moved farther east and the refuse cells were placed from the edge of the channel northward.

The surficial materials at the landfill consist of alluvium near the Goose River channel and lacustrine sediments away from the channel. The lacustrine sediments are composed of clay and silt and average about 50 feet in thickness. The lacustrine sediments are underlain by an interval of till with occassional sand and gravel layers

averaging about 150 feet in thickness. Bedrock of the Colorado and Dakota Groups occurs beneath the till.

The main aquifers in the region consist of undifferentiated glacial aquifers and the Dakota aquifer. There are no major glacial aquifers within five miles of the landfill. The Dakota aquifer ranges in depth from 250 to 400 feet below the surface.

Four of the monitoring wells in this study were screened in lacustrine silt or silty clay. The other two wells were screened in sand or gravel underlying the lacustrine sediments. The direction of ground-water flow in the shallow flow system is south toward the Goose River.

All monitoring wells are characterized by a calcium-sulfate type water with concentrations of manganese, calcium, and magnesium which exceed the SMCL. High concentrations of these ions are not unusual for glaciated areas of North Dakota. Samples from three of the wells had relatively high concentrations of selenium. Two of the wells are up-gradient from the landfill, indicating that the source of selenium is not related to leachate migration from the landfill. The VOC analysis, from well 146-052-05DAD2, detected the man-made compound tetrahydrofuran.

The Dakota aquifer should not be affected by the landfill because of its depth and the presence of a low hydraulic conductivity lacustrine clay, till, and shale bedrock. The Goose River could be susceptible to leachate migration because of the proximity of the refuse cells to the

river channel. Major ion and trace element analyses provided no evidence of leachate migration from the landfill. The detection of tetrahydrofuran from the VOC analysis may indicate contamination from the landfill

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APPENDIX A

WATER QUALITY STANDARDS
AND
CONTAMINANT LEVELS

Water Quality Standards and Contaminant Levels

Field Parameters

appearance	color/odor
pH	6-9 (optimum)
specific conductance	-----
temperature	-----

Constituent	MCL (µg/L)
Arsenic	50
Cadmium	10
Lead	50
Molybdenum	100
Mercury	2
Selenium	10
Strontium	*

*EPA has not set an MCL for strontium. The median concentration for most U.S. water supplies is 100 µg/L (Hem, 1989).

	SMCL (mg/L)
Chloride	250
Iron	>0.3
Nitrate	50
Sodium	20-170
Sulfate	300-1000
Total Dissolved Solids	>1000

	Recommended Concentration Limits (mg/L)
Bicarbonate	150-200
Calcium	25-50
Carbonate	150-200
Magnesium	25-50
Harness	>121 (hard to very hard)

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

146-052-05DAA1

NDSWC

Date Completed:	9/29/92	Well Type:	Observation
Depth Drilled (ft):	50	Source of Data:	
Screened Interval (ft):	38-48	Principal Aquifer :	Undefined
Casing size (in) & Type:	P2	L.S. Elevation (ft)	969.50

Site: Mayville

Lithologic Log

Unit	Description	Depth (ft)
TOPSOIL		0-1
CLAY	Grayish brown 5YR3/2 (Lake Sediment).	1-5
CLAY	Silty, pale yellowish brown 10YR6/2 to light gray N7.	5-8
CLAY	Silty, moderate yellowish brown 10YR5/4 with light gray mottles.	8-18
CLAY	Silty, moderate yellowish brown 10YR5/4.	18-28
CLAY	Trace of silt, moderate yellowish brown 10YR5/4.	28-33
CLAY	Medium gray N5.	33-43
GRAVEL	Up to 1 cm, with interbedded sand and clay, olive gray 5Y4/1.	43-50

146-052-05DAA2

NDSWC

Date Completed:	9/29/92	Well Type:	Observation
Depth Drilled (ft):	31	Source of Data:	
Screened Interval (ft):	25-35	Principal Aquifer :	Undefined
Casing size (in) & Type:	P2	L.S. Elevation (ft)	969.44

Site: Mayville

Lithologic Log

Unit	Description	Depth (ft)
TOPSOIL		0-1
CLAY	Clay, grayish brown 5YR 3/2 (Lake Sediment)	1-5
CLAY	Silty, pale yellowish brown 10YR6/2 to light gray N7.	5-8
CLAY	Silty, moderate yellowish brown 10YR5/4 with light gray mottles.	8-17
CLAY	Silty, moderate yellowish brown 10YR5/4 with few moderate reddish brown 10R4/6 mottles.	17-23
CLAY	Silty, moderate yellowish brown 10YR5/4.	23-31
CLAY	Medium gray N5.	31-35

146-052-05DAA3

NDSWC

Date Completed:	9/30/92	Well Type:	Observation
Depth Drilled (ft):	35	Source of Data:	
Screened Interval (ft):	25-35	Principal Aquifer :	Undefined
Casing size (in) & Type:	P2	L.S. Elevation (ft)	971.88

Site: Mayville

Lithologic Log

Unit	Description	Depth (ft)
TOPSOIL		0-2
CLAY	Pale brown 5YR5/2 (Lake Sediment).	2-6
CLAY	Silty with a trace of very fine sand, moderate yellowish brown 10YR5/4, with zones of light gray N7.	6-14
SILT	Clayey, moderate yellowish brown 10YR5/4.	14-24
CLAY	Silty, moderate yellowish brown 10YR5/4.	24-28
SILT	Clayey, moderate yellowish brown 10YR5/4.	28-32
CLAY	Silty, medium gray N5.	32-35

146-052-05DAB

NDSWC

Date Completed:	9/30/92	Well Type:	Observation
Depth Drilled (ft):	25	Source of Data:	
Screened Interval (ft):	15-25	Principal Aquifer :	Undefined
Casing size (in) & Type:	P2	L.S. Elevation (ft)	968.18

Site: Mayville

Lithologic Log

Unit	Description	Depth (ft)
TOPSOIL		0-2
CLAY	Slightly silty, pale brown 5YR5/2 (Lake Sediment).	2-6
CLAY	Silty, moderate yellowish brown 10YR5/4 with light gray N7 and moderate reddish brown10R4/6 mottles.	6-12
CLAY	Silty, wet, moderate yellowish brown 10YR5/4.	12-15
SILT	Clayey, wet, moderate yellowish brown 10YR5/4.	15-21
CLAY	Stiff, moderate yellowish brown 10YR5/4.	21-25

146-052-05DAD1

NDSWC

Date Completed:	9/30/92	Well Type:	Observation
Depth Drilled (ft):	30	Source of Data:	
Screened Interval (ft):	20-30	Principal Aquifer :	Undefined
Casing size (in) & Type:	P2	L.S. Elevation (ft)	941.26

Site: Mayville

Lithologic Log

Unit	Description	Depth (ft)
TOPSOIL		0-2
SILT	Clayey, dark yellowish brown 10YR5/4 (Lake and Stream Sediment).	2-9
SILT	Clayey with a trace of very fine sand, dark yellowish brown 10YR4/2.	9-17
CLAY	Silty, moderate yellowish brown 10YR5/4.	17-23
SILT	Clayey with very fine sand, moderate yellowish brown 10YR5/4.	23-26
CLAY	With very fine sand, medium gray N5.	26-28
CLAY	With a trace of sand and gravel, medium gray N5, till.	28-30

146-052-05DAD2

NDSWC

Date Completed:	9/30/92	Well Type:	Observation
Depth Drilled (ft):	35	Source of Data:	
Screened Interval (ft):	25-35	Principal Aquifer :	Undefined
Casing size (in) & Type:	P2	L.S. Elevation (ft)	943.82

Site: Mayville

Lithologic Log

Unit	Description	Depth (ft)
TOPSOIL		0-2
SILT	Clayey, dark yellow brown 10YR4/2 (Lake and Stream Sediment).	2-8
CLAY	Trace of silt and very fine sand, dark yellowish brown 10YR4/2.	8-16
SILT	With very fine sand, dark yellowish brown 10YR4/2.	16-25
CLAY	Sandy with a trace of gravel, dark yellowish brown 10YR4/2, till.	25-28
SAND	Very fine to coarse grain with clay and a trace of gravel, olive gray 5Y4/1.	28-35

APPENDIX D

WATER-LEVEL TABLES

Mayville Water Levels
10/20/92 to 12/03/92

146-052-05DAA1 LS Elev (msl,ft)=969.5
Undefined Aquifer SI (ft.)=38-48

Date	Depth to Water (ft)	WL Elev (msl, ft)	Date	Depth to Water (ft)	WL Elev (msl, ft)
10/20/92	11.67	957.83	11/19/92	11.57	957.93
11/10/92	11.59	957.91	12/03/92	11.29	958.21

146-052-05DAA2 LS Elev (msl,ft)=969.44
Undefined Aquifer SI (ft.)=25-35

Date	Depth to Water (ft)	WL Elev (msl, ft)	Date	Depth to Water (ft)	WL Elev (msl, ft)
10/20/92	5.06	964.38	11/19/92	5.50	963.94
11/10/92	5.58	963.86	12/03/92	5.38	964.06

146-052-05DAA3 LS Elev (msl,ft)=971.88
Undefined Aquifer SI (ft.)=25-35

Date	Depth to Water (ft)	WL Elev (msl, ft)	Date	Depth to Water (ft)	WL Elev (msl, ft)
10/21/92	9.83	962.05	11/19/92	9.94	961.94
11/10/92	9.90	961.98	12/03/92	9.98	961.90

146-052-05DAB LS Elev (msl,ft)=968.18
Undefined Aquifer SI (ft.)=15-25

Date	Depth to Water (ft)	WL Elev (msl, ft)	Date	Depth to Water (ft)	WL Elev (msl, ft)
10/21/92	3.43	964.75	11/19/92	3.54	964.64
11/10/92	3.59	964.59	12/03/92	3.44	964.74

146-052-05DAD1 LS Elev (msl,ft)=941.26
Undefined Aquifer SI (ft.)=20-30

Date	Depth to Water (ft)	WL Elev (msl, ft)	Date	Depth to Water (ft)	WL Elev (msl, ft)
10/21/92	16.65	924.61	11/19/92	16.98	924.28
11/10/92	16.91	924.35	12/03/92	17.12	924.14

146-052-05DAD2 LS Elev (msl,ft)=943.82
Undefined Aquifer SI (ft.)=25-35

Date	Depth to Water (ft)	WL Elev (msl, ft)	Date	Depth to Water (ft)	WL Elev (msl, ft)
10/21/92	18.10	925.72	11/19/92	18.02	925.80
11/10/92	18.38	925.44	12/03/92	17.68	926.14

APPENDIX E

MAJOR ION AND TRACE-ELEMENT CONCENTRATIONS

Mayville Landfill Water Quality
Major Ions

Location	Screened Interval (ft)	Date Sampled	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
			← (milligrams per liter) →																					
146-052-05DAA1	38-48	10/21/92	19	0.06	1.4	260	92	73	25	365	0	790	82	0.3	2.1	0.29	1530	1000	730	13	1	1943	6	7.35
146-052-05DAA2	25-35	10/20/92	20	0.06	0.25	250	98	47	11	197	0	900	43	0.2	4.7	0.14	1470	1000	920	9	0.6	1810	7	8.06
146-052-05DAA3	25-35	10/21/92	13	0.04	1.5	290	130	100	19	147	0	1300	51	0.4	0.7	0.08	1980	1300	1100	15	1.2	2330	12	8.65
146-052-05DAB	15-25	10/21/92	21	0.05	0.8	320	260	100	12	279	0	1700	38	0.6	1.1	0.11	2590	1900	1600	10	1	2920	8	8.03
146-052-05DAD1	20-30	10/21/92	23	0.09	1.2	540	330	75	4	763	0	2000	100	0.2	1.9	0.14	3450	2700	2100	6	0.6	3710	10	7.21
146-052-05DAD2	25-35	10/21/92	21	0.69	1.6	180	51	65	12	264	0	500	68	0.4	0	0.14	1030	660	440	17	1.1	1399	10	8.06

Trace Element Analyses

Location	Date Sampled	Selenium	Lead	Cadmium	Mercury	Arsenic	Molybdenum	Strontium
		(micrograms per liter)						
146-052-05DAA1	10/21/92	7	0	0	0	19	16	1300
146-052-05DAA2	110/21/92	4	0	0	0.1	3	10	1100
146-052-05DAA3	10/21/92	5	0	0	0	3	13	1700
146-052-05DAB	10/21/92	6	0	0	0.1	3	16	1600
146-052-05DAD1	10/21/92	7	0	0	0.1	4	44	1800
146-052-05DAD2	10/21/92	4	0	0	0	3	24	870

APPENDIX F

VOLATILE ORGANIC COMPOUNDS
FOR WELL 146-052-05DAD2.

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	162*
Pentachloroethane	<5
Trichlorotrofluoroethane	<5
Carbondisufide	<5
Ether	<5

* Constituent Detection