Site Suitability Review of the Bismarck 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 North Dakota State Water Commission

ND Landfill Site Investigation No. 18

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Bismarck, North Dakota 1994

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

Location of the Bismarck Landfill

The Bismarck solid waste landfill is located about one mile east of the City of Bismarck in section 25, Township 139 North, Range 80 West, and section 30, Township 139 North, Range 79 West (Fig. 1). The western portion of the landfill, in section 25, was closed in 1986. The landfill site covers approximately 487 acres. A residential area, called

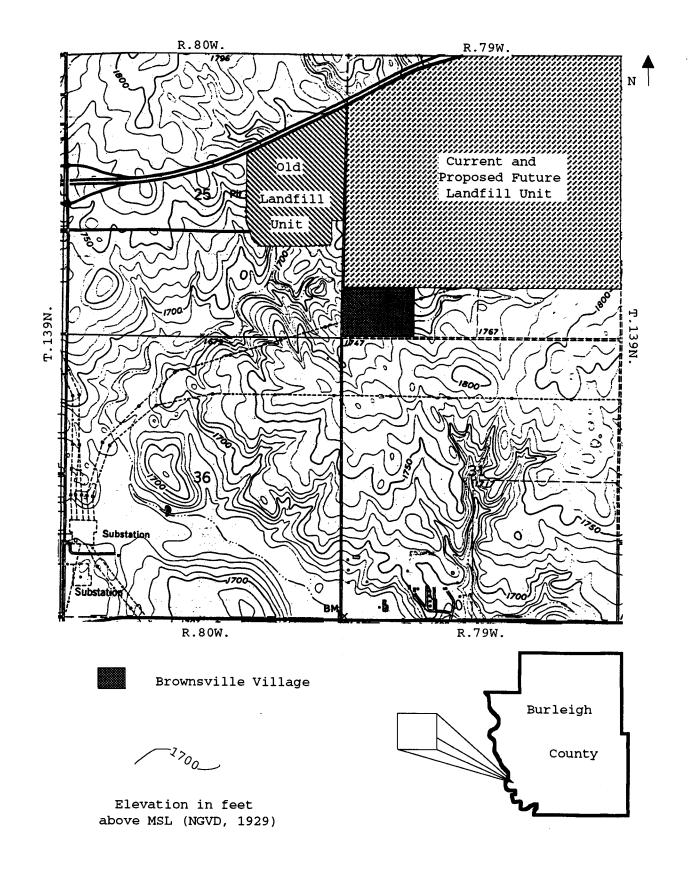


Figure 1. Location of the Bismarck landfill in the north half of section 30, T.1139 N., R.79 W.

Brownsville, is located south of the landfill in the SW 1/4, SW 1/4 of section 30.

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Previous Site Investigations

Braun Intertec completed a hydrogeologic study of the Bismarck landfill in 1989 and 1990. Twenty-nine soil borings, 17 monitoring wells, and 5 temporary piezometers were completed for the study. In 1992, Braun drilled 8 more soil borings and installed 6 additional monitoring wells. Reports of the investigation were submitted to the City of Bismarck in 1990, 1991, and 1992.

Braun identified four stratigraphic units at the landfill: unit A - fluvial sand and gravel; unit B fractured clay with silt; unit C - fine, silty sand; and unit D - clay with fine sand laminae. Unit A was found to occur only near intermittent streams, while the other units are widespread across the landfill.

Methods of Investigation

The Bismarck 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.

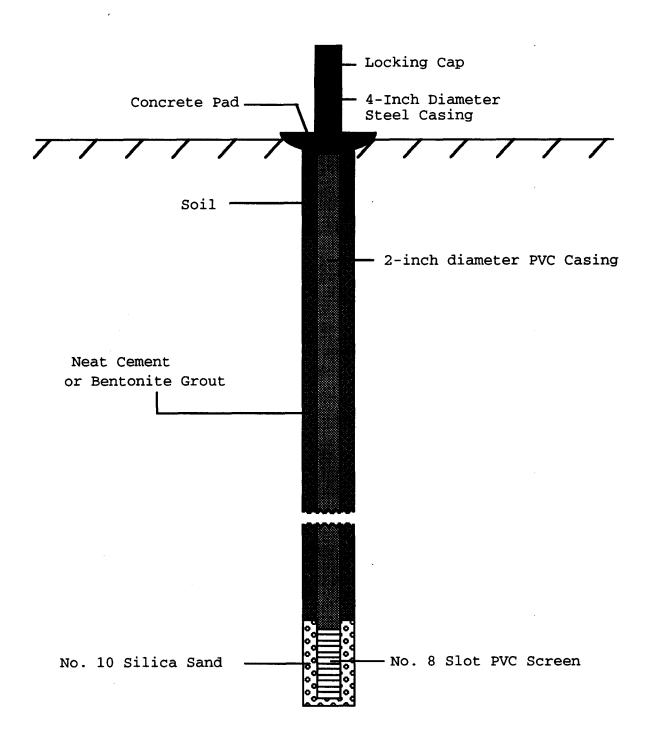
Test Drilling Procedure

The drilling procedure 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 Bismarck landfill because the sediments were poorly consolidated and the depth to groundwater was expected to be less than 70 feet. The lithologic descriptions were determined from the drilling returns.

Monitoring Well Construction and Development

Seven test holes were drilled at the Bismarck landfill and monitoring wells were installed in six of the test holes. Four of the monitoring wells were located on the north side of Brownsville. The other two were located in the north half of section 30 near the most recent waste disposal area. 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



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

steel screws (no solvent weld cement was used). After the casing and screen were inserted 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.

All monitoring wells were developed using a stainlesssteel bladder pump or a teflon bailer. Any drilling fluid and fine materials present in 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).

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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

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

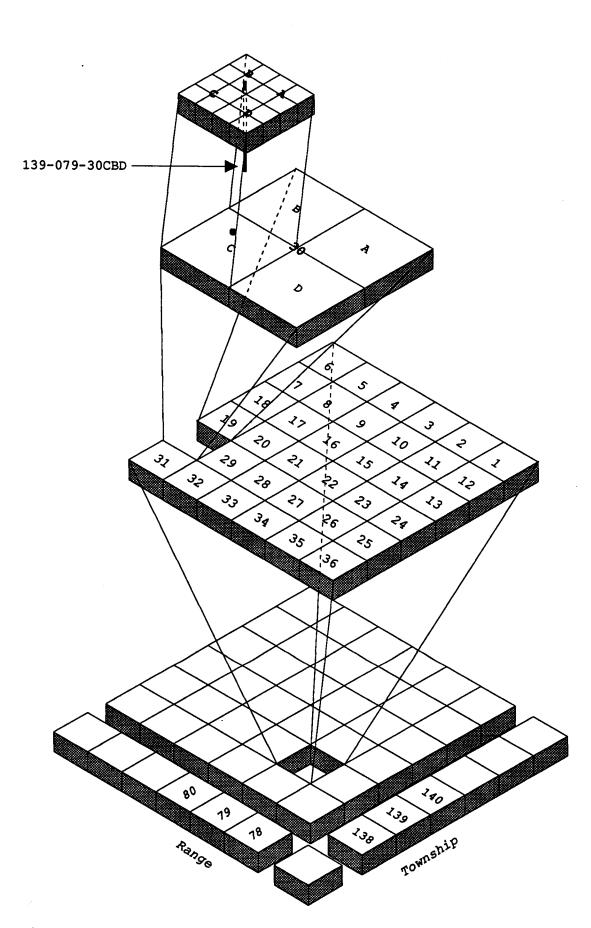
time than the standard water quality sample. The procedure used for collecting the VOC sample is described in Appendix B. The sample was collected with a plastic throw-away bailer, kept chilled and was analyzed within the permitted 14-day holding period. The standard water-quality analyses were performed at the North Dakota State Water Commission (NDSWC) Laboratory and VOC analysis was performed by the NDSDHCL.

Water-Level Measurements

Water-level measurements were taken at least four times at about a two-week interval. 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



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

section (40-acre tract), and quarter-quarter-quarter section (10-acre tract). Therefore, a well denoted by 139-079-30CBD would be located in the SE1/4, NW1/4, SW1/4, Section 30, Township 139 North, Range 79 West. Consecutive numbers are added following the three letters if more than one well is located in a 10-acre tract, e.g. 139-079-30CBD1 and 139-079-30CBD2.

GEOLOGY

Regional Geology

The Bismarck landfill is located in an area comprised of bedrock sediment overlain by a discontinuous layer of glacial till. Holocene alluvium occurs along present-day streams. The near-surface bedrock in the region is part of the Cannonball Formation (Paleocene). This marine sequence is composed of poorly consolidated sand, sandstone, silt, clay, and limestone (Kume and Hansen, 1965).

The Cannonball Formation is underlain by the Ludlow Formation (Paleocene) and the Hell Creek Formation (Cretaceous). The Ludlow Formation is composed of carbonaceous shale, lignite, and sandstone. The Hell Creek Formation is composed of shale, siltstone, and sandstone. The approximate thicknesses of the three formations in the Bismarck area are as follows: Cannonball - 300 feet, Ludlow -20 feet, Hell Creek - 250 feet (Kume and Hansen, 1965).

Two meltwater channels occur in the area. The Lower Apple Creek aquifer occupies a meltwater channel about two miles south of the landfill. The outwash deposits in this channel range from 10 feet to 100 feet thick and consist of sand and gravel with interbedded silt and clay (Randich and Hatchett, 1966). The outwash is overlain by Holocene alluvium.

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The Missouri River trench is about four miles southwest of the landfill. The combined thickness of alluvium and outwash in the trench is about 100 to 150 feet. The sediments are composed of sand and gravel with minor amounts of silt and clay (Kume and Hansen, 1965).

Local Geology

The Bismarck landfill is located in an area of moderate relief. An intermittent stream runs through the western part of the landfill in section 25 and the northwest corner of section 30 (Fig. 4). Surface elevations at the site range from 1700 feet to 1880 feet, with the higher elevations occurring in the east half of section 30.

Alluvium along the intermittent stream is composed of clay, silt, sand, and gravel. In monitoring well MW-L, located near the intermittent stream, layers of sand and gravel were reported between depths of 6 to 14 feet and again between depths of 49 to 54 feet (Braun, 1990).

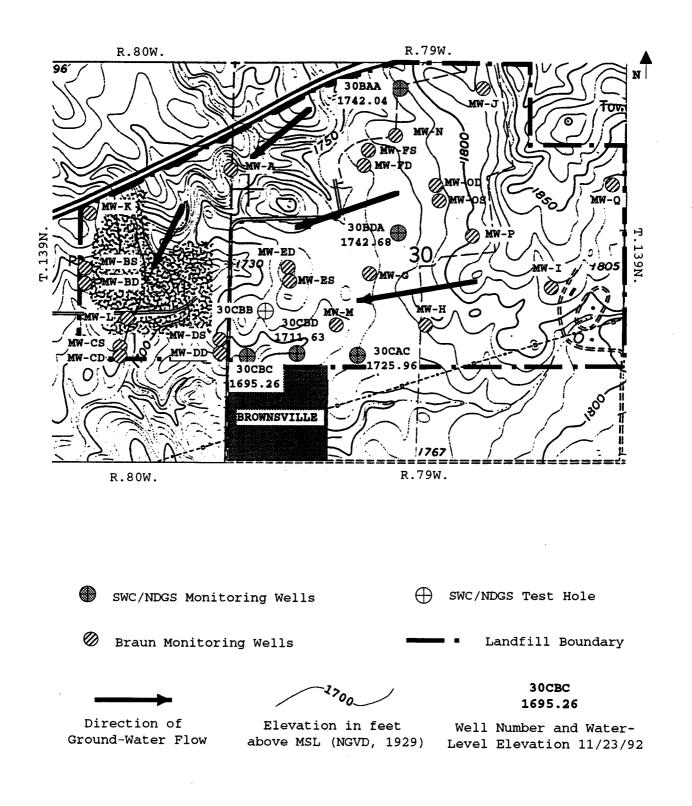
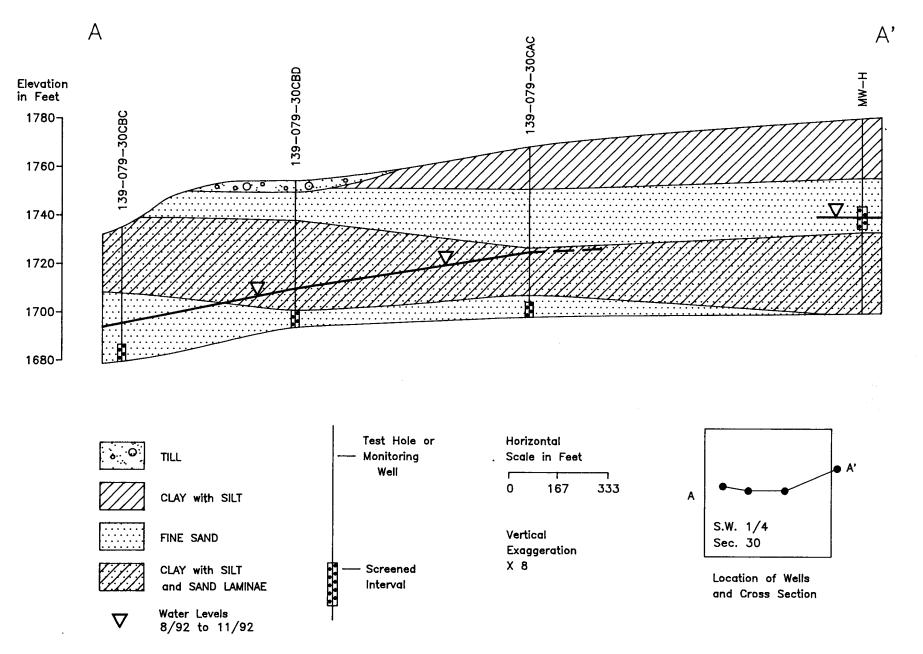


Figure 4. Location of monitoring wells and ground-water flow at the Bismarck landfill.



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Figure 5. Geohydrologic section A-A' in the Bismarck landfill.

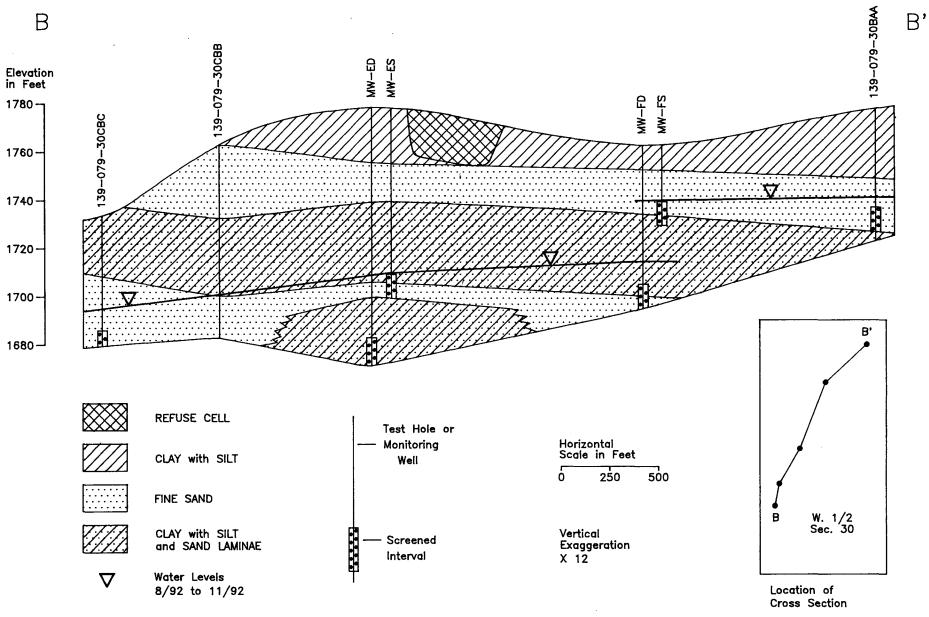


Figure 6. Geohydrologic section B-B' in the Bismarck landfill.

Away from the intermittent stream the landfill is situated within sediments of the Cannonball Formation, which are overlain by discontinuous bodies of glacial till. A veneer of glacial till was observed in the walls of a disposal trench (trench 91-2) and in several soil borings. However, the till has apparently been removed by erosion over much of the site.

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The stratigraphic units in the Cannonball Formation are illustrated in Figures 5 and 6. The upper unit, designated unit B by Braun (1992), is a silty clay. This unit contains vertical fractures which are commonly filled with gypsum crystals. The thickness of this unit varies according to topography across the site. The maximum thickness is about 80 feet on the hill on the east side of section 30 (Braun, 1992).

The silty clay is underlain by a fine sand (unit C of Braun), which averages about 20 feet in thickness. The sand consistently occurs in soil borings between elevations of 1720 feet and 1760 feet, and it outcrops along the flanks of the intermittent stream valley. Limestone concretions were observed near the top of the sand in two disposal trenches which were open in the summer of 1991 (98-2 and 91-2). The concretions are lenticular in shape and average about 2 feet thick and 10 feet long. The concretions were also encountered in several of Braun's test holes (MW-I, P-8, P-9, ST-5, and ST-6).

The sand is underlain by another silty clay (unit D of Braun). This unit typically contains thin layers and laminae of fine sand.

The deeper NDGS/SWC test holes encountered another sand unit between the 1680-foot and 1700-foot elevations. Braun test holes D, E, and F also penetrated sand layers at about the same elevation, but test holes A and K did not. The thickness and lateral extent of this lower sand cannot be determined because drill-hole data is sparse below 1700 feet.

The deepest borings drilled by Braun penetrated black shale and lignite, identified as Ludlow Formation, at an elevation of about 1648 feet.

Water-well logs south of the landfill in Brownsville encountered several sand units. Exact elevations for these wells are not available, making correlations difficult. A survey of wells in Brownsville conducted by the City of Bismarck found that the depths of well screens ranged from 42 feet to 175 feet, corresponding to elevations between approximately 1550 feet and 1725 feet (Braun, 1990). The shallowest of these wells are probably screened in the lower Cannonball sand shown in Figures 5 and 6 (Fig. 5 is located just north of Brownsville). The deeper wells in Brownsville are probably screened in sands of the Hell Creek Formation.

Prior to 1986 refuse was buried in section 25 on either side of the intermittent stream. Refuse trenches were placed in the lower part of the Cannonball Formation, and trenches near the intermittent stream may have been placed partially

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within alluvium. In 1986 operations were moved eastward to section 30, and the refuse was placed in the upper Cannonball sand and the overlying unit of silty clay. In 1992 the landfill plans were modified to prevent further burial of waste in the sand.

HYDROLOGY

Surface-Water Hydrology

Surface water in the area of the landfill consists of an intermittent stream that is located between the old and present sections of the landfill. This stream is usually dry except during spring runoff and periods of heavy precipitation. Dams located north of the landfill in the streambed may help control the amount of flow moving down the stream. This stream flows south into Apple Creek and then into the Missouri River.

Runoff from the landfill flows into this intermittent stream. This may cause contaminates to move from the landfill during heavy runoff periods. The streambed also may act as a local ground-water discharge area where the bedrock sand layers outcrop.

Regional Ground-Water Hydrology

The Dakota Formation ranges from 2,800 to 3,200 feet below land surface in Burleigh County (Randich, 1966). The Dakota Group aquifers are characterized by a sodium-sulfate type water. This aquifer system should not be affected by the landfill due to its depth and the intervening low conductivity shale of the Cannonball and Ludlow Formations.

The Hell Creek Formation is located about 140 feet below land surface near the landfill (Randich, 1966). The Hell Creek aquifer is characterized by a sodium-bicarbonate and sodium-bicarbonate-sulfate type water. Chloride is also found in varying concentrations throughout the Hell Creek aquifer.

The Cannonball Formation is the uppermost aquifer beneath the Bismarck landfill. Recharge to the Cannonball aquifer is by precipitation and lateral flow from adjacent glacial and bedrock aquifers. This aquifer is characterized by a sodium-sulfate-bicarbonate type water. This aquifer may be susceptible to contamination from the landfill due to its shallow depth and and relatively large hydraulic conductivity.

The Bismarck and Lower Apple Creek aquifers of glaciofluvial origin are located within five miles of the Bismarck landfill. The Bismarck aquifer is located southwest of the landfill and consists predominantly of mixed sand and gravel originating from a terrace or previous Missouri River

channel (Randich, 1966). Recharge to the Bismarck aquifer is predominantly from precipitation. Lateral flow from the Lower Apple Creek aquifer, bedrock aquifers, and the Missouri River also recharge the Bismarck aquifer. The Bismarck aquifer is characterized by a sodium-calcium-bicarbonate to a sodium-bicarbonate-sulfate type water. The Bismarck aquifer appears to be hydraulically connected to the Cannonball and Hell Creek aquifers.

The Lower Apple Creek aquifer is located south of the landfill and occurs from about 40 to 110 feet below land surface. The aquifer is comprised mainly of mixed sand and gravel with interbedded silts and clays (Randich, 1966). Recharge to the Lower Apple Creek aquifer is mainly by precipitation and seepage from Apple Creek, the McKenzie and Soo Channel aquifers, and from local bedrock aquifers. Discharge from the Lower Apple Creek aquifer is by pumpage and lateral flow into the Bismarck aquifer. The Lower Apple Creek aquifer is characterized by a sodium-bicarbonate type water. The Lower Apple Creek aquifer appears to be hydraulically connected to the Cannonball and Hell Creek aquifers that underlie the Bismarck landfill.

Local Ground-Water Hydrology

A conceptual model of the local ground-water hydrology is developed using data from 23 monitoring wells from previous investigations (Braun, 1991) and five supplementary

monitoring wells and one soil boring (Fig. 4). The five supplementary monitoring wells and test hole were drilled within the boundaries of the present landfill unit. All 28 monitoring wells are screened in the Cannonball Formation.

Four water-level measurements were taken over a fiveweek period from the five supplemental wells (Appendix D). Water-level data from an ongoing monitoring program by Braun Intertec (Appendix E) was also used in this site evaluation. Water levels indicate ground-water flow to the west-southwest below the present landfill unit and to the south-southwest below the intermittent stream. The direction of ground-water flow under the old landfill unit is to the south-southeast toward the intermittent stream.

Braun (1991) indicates an unconfined sand aquifer about 25 feet below land surface that appears to underlie much of the present landfill unit. The water level in this aquifer is controlled by the intermittent stream channel along the west boundary of the present landfill site. This unconfined aquifer was not found in the supplemental wells installed along the southern boundary of the landfill.

A confined/unconfined sand aquifer occurs about 60 feet below land surface in the landfill study area. This sand aquifer occurs under unconfined conditions at the southwest corner of the landfill and confined under the eastern part of the landfill. This aquifer also appears to underlie much of the landfill. Locally, the direction of ground-water in this aquifer is west toward the intermittent stream channel.The

difference in water-level elevations between the upper and lower sand aquifers suggest that the two aquifers are not directly connected hydraulically in the landfill study area.

Water Quality

Chemical analyses of water samples are shown in Appendix F and G. Braun (1991) found the general ground-water chemistry under the present landfill unit to be a sodiumsulfate type water except in monitoring well MW-I where it was found to be a calcium-bicarbonate type water. Groundwater analyses taken after the 1991 report indicate no change in ground-water chemistry (Appendix G).

Ground-water analyses from supplemental wells 139-079-30BAA, 30BDA, and 30CBC indicate a sodium-sulfate type water. Monitoring well 30CAC indicated the ground-water is characterized by a mixed sodium-bicarbonate-sulfate type water and monitoring well 30CBD indicated a mixed calciumsodium-bicarbonate type water.

Supplemental monitoring wells 30BAA and 30BDA are screened in the upper-unconfined sand aquifer whereas monitoring wells 30CBC, 30CBD, and 30CAC are screened in the lower-confined/unconfined sand aquifer. The ground-water chemistry of the upper sand aquifer determined from the supplemental monitoring wells is consistant with the results of Braun (1991).

Braun monitoring wells MW-K, MW-BS, MW-BD, MW-CS, and MW-CD are located in the old landfill unit (Fig. 4). Chemical analyses from well MW-CS indicated a chloride concentration of 140 mg/L. This concentration is lower than the SMCL of 250 mg/L, but higher than the concentrations from the surrounding wells. Data from Braun (1991) indicates that this concentration has been increasing over the past three years. This trend may indicate leachate migration from the old landfill unit.

Anomalously high pH values were measured in wells 139-079-30CBC (pH=11.04), 139-079-30CBD (9.03), and 139-079-30BDA (8.97). The normal pH range for ground water in the Cannonball Formation should be between 7.0 and 8.5. Wells 30CBC and 30CBD are located down-gradient from the landfill along the southern property line and well 30BDA is located in the middle of the landfill. The source of the elevated pH may be due to leachate migration from the landfill or influences related to well construction. Braun Intertec sampled well 30BDA (MW-R) in November, 1992 and June, 1993 and measured the pH at 8.5 and 10.5 respectively. This well should be periodically monitored to determine the cause of the pH fluctuation. Monitoring wells 30CBC and 30CBD located along the southern boundary also should be monitored periodically to determine the cause of the elevated pH.

An arsenic concentration of 32 μ g/L was detected in well 139-079-30BDA. This concentration is lower than the MCL of 50 μ g/L, but higher than the surrounding monitoring-well

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data. This well is located in the middle of the landfill. The elevated arsenic concentration may be due to leachate migration from the landfill. Well 139-079-30CAC indicated 337 μ g/L of molybdenum, which is over three times higher than the MCL of 100 μ g/L. This well is located down-gradient at the southwest corner of the property line. The elevated molybdenum concentration may also be due to leachate migration from the landfill.

VOC analysis from well 139-079-30BDA is shown in Appendix H. There were no VOC detections from this well.

CONCLUSIONS

The Bismarck landfill is located in an area of bedrock overlain by a thin, discontinuous layer of glacial till. A small amount of alluvium occurs along an intermittent stream within the landfill site. The Cannonball Formation is the uppermost bedrock formation and is underlain by the Ludlow and Hell Creek Formations.

Four stratigraphic units have been identified in the Cannonball Formation at the landfill. The upper unit consists of a fractured, silty clay of variable thickness. This unit is thickest in the east half of section 30. The underlying sand is about 20 feet thick and is laterally continuous except in the area of the intermittent stream where it has been removed by erosion. The sand is underlain by another unit of silty clay. The fourth

unit in the Cannonball is a sand that occurs below about 1710 feet.

Area water supplies are derived from bedrock and glaciofluvial aquifers. The main bedrock aquifers consist of sands in the Cannonball, Hell Creek, and Dakota Formations. The nearest glaciofluvial aquifers are the Lower Apple Creek aquifer, located two miles south of the landfill, and the Bismarck aquifer, located four miles southwest of the landfill.

Within the landfill the upper Cannonball sand is partially saturated, whereas the lower Cannonball sand contains water under both confined and unconfined conditions. The direction of groundwater flow in these aquifers is west-southwest toward the intermittent stream. Near the intermittent stream the flow direction changes to south-southwest.

South of the landfill in Brownsville, a number of residences obtain domestic water from wells. Some of the wells are screened in the lower Cannonball sand, while others are screened in sands of the Hell Creek Formation. Contamination of these water supplies is possible because the wells are located down-gradient from the landfill.

Water quality analyses indicated an elevated concentration of chloride in monitoring well MW-CS. Although the concentration is below the SMCL, it may be caused by leachate migration from the old landfill unit.

Anomalously high pH measurements were detected in three of the supplemental monitoring wells. Later analyses from well 30BDA indicated that the pH measurements have fluctuated

over the past year from 8.5 to 10.5. The cause of the pH fluctuation has not been determined.

An elevated arsenic concentration of 32 μ g/L was detected in monitoring well 30BDA. Although the concentration is below the SMCL, it may be caused by leachate migration from the landfill. Monitoring well 30CAC detected a molybdenum concentration of 337 μ g/L, which is three times higher than the MCL. The elevated molybdenum concentration may also be caused by leachate migration from the present landfill unit. No VOC's were detected from any of the monitoring wells.

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APPENDIX A

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WATER QUALITY STANDARDS AND CONTAMINANT LEVELS

Water Quality Standards and Contaminant Levels

Field Parameters

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

<u>Constituent</u>	MCL (ug/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 $\mu\text{g/L}$ (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
Hardness	>121 (hard to
	very hard)

APPENDIX B

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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

•			19-30baa Idswc				
Date Complete		9/11/92	Well Type:	P2			
Depth Drilled Screened Inte		56 38-48	Source of Data: Principal Aquifer :	Undefined			
Casing size (in) & Type:		L.S. Elevation (ft)	1778.66			
Owner: Bismar	ck						
		Litho	ologic Log				
Unit	Descripti			Depth (ft)			
TOPSOIL				0-1			
CLAY		y with dark ye l Formation).	llowish orange streak	s 1-6			
CLAY	Medium gra	y N5.		6-11			
CLAY	Sandy, dar	k yellowish br	own 10YR4/2.	11-14			
CLAY		a trace of sa hin sandstone	nd, moderate yellowis at 18 feet.	h brown 14-19			
CLAY	Silty with 10YR5/4.	a trace of sa	nd, moderate yellowis	h brown 19-24			
CLAY	Dark yello	wish brown 10)	/R4/2	24-27			
CLAY	Silty, san	ady, dark yello	owish brown 10YR4/2.	27-29			
SAND	Fine grain	ned, silty, dan	rk yellowish brown 10¥	R4/2. 29-31			
SAND	Fine grain	ned, moderate y	ellowish brown 10YR5/	′4. 31-41			
SAND	Fine grain	ned, damp, mode	erate yellowish brown	10YR5/4. 41-46			
SAND	Fine grained, olive gray 5Y4/1.						
SAND	Fine grain 5Y4/1.	ned, silty wit	h a trace of clay, oli	ive gray 49-52			
CLAY	Silty with	h a trace of s	and, dark gray N3.	52-56			

*		139-07	9-30BDA	
		N	DSWC	
Date Completed Depth Drilled		9/14/92 41	Well Type: Source of Data:	P2
Screened Inter			Principal Aquifer :	Undefined
Casing size (i Owner: Bismarc	in) & Type:		L.S. Elevation (ft)	1769.6
		- · · · ·		
Unit	Descripti		logic Log	Depth (ft)
TOPSOIL				0-1
CLAY	Calcite mot 10YR4/2 (ti		, dark yellowish brown	1-5
CLAY		a trace of sar prown 10YR4/2 (nd and pebbles, dark (till).	5-8
SAND		ad, silty, mode aball Formation	erate yellowish brown 1(n).	DYR 8-13
SAND	Fine graine	ed, moderate ye	ellowish brown 10YR5/4.	13-26
SAND	Fine graine	d, damp, olive	a gray 5Y4/1.	26-32
SAND	Fine graine gray N4.	d, with interb	bedded clay, medium dar)	c 32-38
CLAY	Sandy, medi	um dark gray N	14.	38-41

		139-	079-30CAC NDSWC	
Date Complete Depth Drilled		9/10/92 70	Well Type: Source of Data:	P2
Screened Inte	rval (ft):	65-70	Principal Aquifer :	Undefined 1767.52
Casing size (: Owner: Bismar		2 1n	L.S. Elevation (ft)	1/6/.52
			hologic Log	
Unit	Descripti	on		Depth (ft)
TOPSOIL		:		0-2
SILT		and and clay, annonball For	, moderate yellowish brown mation).	vn 2-6
SILT	Sandy, mode	erate yellow:	ish brown 10YR5/4.	6-10
CLAY	Silty with brown 10YR	a trace of 1 4/2.	fine sand, dark yellowis)	h 10-16
SAND	Fine grain brown 10YR		silt, moderate yellowis	h 16-20
SILT	Sandy with brown 10YR		clay, moderate yellowish	20-23
SAND	Fine grain brown 10YR		silt, moderate yellowis	h 23-33
SAND		ed, trace of brown 10YR5/	silt, damp, moderate 4.	33-41
SILT	Clayey wit	h fine sand,	olive gray 5Y4/1.	41-45
CLAY	Silty with	a trace of	fine sand, olive gray 5Y	4/1. 45-49
CLAY	Silty, dar	k greenish g	ray 5GY4/1.	49-57
CLAY	Silty, med	lium dark gra	y N4.	57-60
SAND	Fine grain dark gray	-	th a trace of clay, medi	um 60-64
SILT	Sandy with	a trace of	clay, medium dark gray N	14. 64-70

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•		139-079 NI	-30CBB		
Date Completed Depth Drilled L.S. Elevation	(ft):	9/9/92 78 1760.07	Purpose: Source of Data: Owner: Bismarck	Test	Hole
		Litho	logic Log		
Unit	Descriptio				Depth (ft)
TOPSOIL	Cored to 70 (unable to		8 feet described by c	uttings:	0-1
SAND	yellowish b	•	a trace of clay, mode ith spots of calcite	rate	1-5
SAND		d, silty with rown 10YR5/4.	a trace of clay, mode	irate	5-8
SANDSTONE	Fine graine	d, well cement	ed, light gray N6		8-10
SAND	Fine graine 10YR5/4.	d, silty, mode	rate yellowish brown		10-17
SAND	Fine graine	d, moderate ye	llowish brown 10YR5/4	1.	17-25
SAND		d, moderate ye vish orange 10Y	llowish brown 10YR5/4 R6/6 mottles.	with	25-27
CLAY	sand, abund	ant gypsum cry	rrows filled with sil stals, dark yellowish s on fractures.		27-33
CLAY			d, gypsum crystals, c with orange stain on	lark	33-44
CLAY		lt, gypsum cry h orange on fr	stals, dark yellowish actures.	n brown	44-48
CLAY	grayish bla	ack N2			48-53
CLAY	Trace of si	llt and sand, g	rayish black N2.		53-58
CLAY	Silty , sar	ndy, grayish bl	ack N2.		58-60
SAND			e gray 5Y4/1 with a s sets of grayish black		60-70

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139-079-30CBC NDSWC								
Date Complete Depth Drilled Screened Inte Casing size (Owner: Bismar	(ft): erval (ft): (in) & Type:	9/11/92 55 48-53	Well Type: Source of Data: Principal Aquifer : L.S. Elevation (ft)	P2 Undefined 1733.8				
		Litho	ologic Log					
Unit	Descripti	on		Depth (ft)				
TOPSOIL				0-4				
CLAY	Silty, dar Formation)		own 10YR4/2 (Cannonball	4-7				
CLAY		•	yellowish brown 10YR4/2 ge 10YR6/6 mottles.	2 7-16				
CLAY	Silty, sti	ff, dark yello	wish orange 10YR6/6.	16-26				
CLAY	Trace fine	sand, dark ye	llowish brown 10YR4/2	26-30				
SAND	Fine grain	ed, clayey, da	rk yellowish orange 10Y	R6/6. 30-38				
SAND	Fine grain	ed, clay, oliv	e gray 5¥3/2.	38-50				
SAND	Fine grain	ed, dark green	ish gray 5GY4/1, satura	ced. 50-55				

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•			9-30CBD DSWC	
Date Completed		9/10/92	Well Type:	P2
Depth Drilled		62	Source of Data:	
Screened Inte			Principal Aquifer :	Undefined
Casing size (: Owner: Bismar		2 in	L.S. Elevation (ft)	1755.21
		Litho	logic Log	
Unit	Descripti			Depth (ft)
TOPSOIL				0-2
CLAY	Intermixed oxidized (†		ry fine sand, rock at 3	feet, 2-5
SAND		ed, moderate y l Formation).	ellowish brown 10YR5/4	5-17
SAND	Clayey, da	rk yellowish b	rown 10YR4/2, moist.	17-21
CLAY	Sandy, dar	k yellowish br	own 10YR4/2.	21-27
CLAY	Silty with	very fine san	d, olive gray 5Y4/1.	27-57
SAND	Fine grain	ed, clay, gree	nish black 5GY2/1.	57-60
SAND	Fine grain green 10G4		a trace of clay, grayi	sh 60-62

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APPENDIX D

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BRAUN LITHOLOGIES

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٦	PROJI		DG-006		BORING	G:		Α		
Ĺ				OLOGIC INVESTIGATION	LOCAT	ION:			-	
]				Sanitary Landfill	See m	ap: N	. 425	5,839.0; I	E. 1,9	47,644.6
		اط 		North Dakota	DATE:	10/3	0/89		LE:	1" = 4'
	C. Elev.	Depth 0.0	ASTM D2487 Symbol	Description of Materials (ASTM D2488)		BPF	WL	Tests	Or	Notes
]	1717.8	1.5		SANDY SILT, very fine- to coarse-g with roots, olive brown to light gray, FAT CLAY, with very fine-grained	moist.					
]	1716.3	3.0	СН	SAND, dark olive brown to light gray (Shale)						
]	d descriptiv		Ch	FAT CLAY, with very fine-grained SAND and a trace of Gravel, dark ol brown to light gray, wet. (Shale)						
1	<u>1711.3</u>	8.0	СН	FAT CLAY, with layers of fine-grai	ned	-11				
]]]]]	standard Plates for evaluation 1001	3 18.0		SILTY SAND, dark gray, moist to w (Shale)	et.					
1	S 1696	.3 23.		FAT CLAY, with fine-grained SAN dark gray, moist. (Shale)	D, very					
]	1690	.8 28	CH	FAT CLAY, with layers of fine-gra SILTY SAND, very dark gray, wate (Shale)						-
]				END OF BORING Water level down 14.5 feet with 28. hollow-stem auger in the ground.	.5 feet of			Monito at 27.5		well installed
	NDG-	006		BRAUN				· · · · · · · · · · · · · · · · · · ·		A page 1 of

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1	PROJ	ECT: N	DG-000	6		BORING	G:		В			
3		H	YDROC	GE	OLOGIC INVESTIGATION	LOCAT	ION:				,	
1					anitary Landfill	See map: N. 424198.5; E. 1,946,12						
		B	Ismarck	ί, Γ	North Dakota	DATE:	10/24/89		SCAI	JE:	$1^{n} = 4^{2}$	
ן וּ	Elev. 1732.8	Depth 0.0	ASTM D2487 Symbo	7	Description of Materials (ASTM D2488)	•	BPF	WL	Tests	or	Notes	
Tineleau.			ĊL		SANDY LEAN CLAY, very fine- to coarse-grained, yellow to brown, dry.							
1 +	i	2.0			(Fill) Landfill waste material.	<u> </u>						
	8 5 6 1											
l l												
eveluation												
-												
d Plate	1											
andard												
and St	1											
Report												
See Re												
	1700.0	20.0										
	1702.8	30.0	СН		FAT CLAY, with very fine-grained S	AND,	20					
	1700.8 NDG-006	32.0			olive brown, moist. (Shale) BRAUN		Ĩ				3 page 1 c	

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7	PROJE	ECT: NI	DG-006		BORINC	<u>.</u>		В	(cont.)	
				OLOGIC INVESTIGATION	LOCATI	ION:		;			
				anitary Landfill North Dakota	See m	ap: N	1. 424	4198.5; E	198.5; E. 1,946,121.9		
·					DATE:	10/2	4/89			$1^{"} = 4^{"}$	
	Elev.	Depth	ASTM D2487 Symbol	Description of Materials (ASTM D2488)		BPF	WL	Tests	or	Note:	
			CH	FAT CLAY, with very fine-grained, solive brown, moist.	SAND,					; <u></u> ;	
η.	te Te Te			(Shale)							
	atice										
	1694.8	38.0									
Г	1		CH	FAT CLAY, with very fine-grained S very dark gray, wet.	SAND,						
1				(Shale)							
٦	ation										
الي.	3 1689.8	43.0									
]			CH	FAT CLAY, with layers of very fine							
۲.				SILTY SAND, very dark gray, water (Shale)	bearing.			· ·			
7	Plate										
Ţ	1										
	andard										
1	nd st										
٦.											
]	Report										
٦	8										
]	3										
]	1674.	.8 58.0									
1	1074.	.0	СН	FAT CLAY, with very fine-grained very dark gray, wet.	SAND,						
4				(Shale)							
1	1668 NDG-	.8 64.	0								
	NDG-	006		BRAUN				•		B page 2	

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1	ſ	PROJI	JECT: NDG-006 HYDROGEOLOGIC INVESTIGATION				G:		В	(0	cont.)
- -						LOCAT	ION:	_		_	
					Sanitary Landfill	See m	ap: N	J. 42	4198.5; E	. 1,9	46,121.9
7			B		North Dakota	DATE:	10/2	4/89	SCAI	LE:	1" = 4'
	(.15	Elev.	Depth	ASTM D2487 Symbol	Description of Materials (ASTM D2488)		BPF	WL	Tests	or	Notes
]	terminologu.			СН	FAT CLAY, with very fine-grained S very dark gray, wet. (Shale)	AND,					
]	tiue t	1664.8	68.0								
]	descriptio			SP SM	POORLY GRADED SAND with SILT fine-grained, brownish gray, wet. (Sandstone)	2					
]	pre no										
]	evaluati	1657.8	75.0								
	<u>Jates for e</u>			SP SM	POORLY GRADED SAND with SILT fine-grained, very dark gray, waterbea (Sandstone)						
	t and Standard F										
		1648.3	84.5	СН	TAT OLAN SCHULT A						
	(See R	1646.3	86.5		FAT CLAY, with lignite fragments an layer of lignite, very dark brownish gr moist. (Shale)						
7					END OF BORING						
1					Water level down 49 feet 1 day after completion of boring.						
1					Monitoring well B South (deep) installe 85.5 feet.	ed at					
1					Monitoring well B North (shallow) inst adjacent borehole at 55 feet.	alled in					
45	N	DG-006			BRAUN		1	<u> </u>		p	nare 9 of 9

กรายหนูซึ่ง การสารกรรมการสารการการสารสารสารสารสารสีสีสีสสีสสารสารสารสารสารการการการการการการการการการการการการก

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]	PROJ	OJECT: NDG-006 HYDROGEOLOGIC INVESTIGATION				G:		С		
T				Sanitary Landfill	LOCAT See m		I. 423.	,385.8: E	. 1.9	46,271.2
		Bi	ismarck,	North Dakota	DATE: 10/4/89			SCAL	1" = 4'	
]	• Elev. ☐ 1689.5	Depth 0.0		Description of Materials (ASTM D2488)		BPF	ĪĪ	Tests	or	Notes
]	rminolo		CH	FAT CLAY, with roots, olive brown, rather stiff.	damp,	89				<u></u>
]	1686.5	3.0	СН	FAT CLAY with a trace of Crownlad						
	descriptio			FAT CLAY, with a trace of Gravel, d olive brown, moist to wet, rather soft rather stiff.	to	8 9 8				
Ĵ						8				
]	altation 1679 2	11.0				8 4				
]	<u>1678.5</u>	11.0	СН	FAT CLAY, with very fine-grained S and a trace of Gravel, brown, waterbe rather soft to rather stiff.		7				
	Plates			rather sort to rather stirf.		∏ ∙				
	<u>1673.5</u>	16.0		END OF BORING	<u> </u>					
	and Sta			Water level down 4.5 feet with 16 fee hollow-stem auger in the ground.	t of					
۲ د	Report			Monitoring well installed at 16 feet.						
]										
1										
1										
-	NDG-00)6		BRAUN			<u> </u>			

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- N. N. H.

MW-CD **PROJECT: BORING:** CFEX-91-0006 LOCATION: **BISMARCK SOLID WASTE** See Plate 3. MANAGEMENT FACILITY **BISMARCK, NORTH DAKOTA** SCALE: DATE: 6/1/92 1'' = 4'Tests Notes or Elev. 1689.0 Depth ASTM **Description of Materials** BPF WL (ASTM D 2488) 0.0 Symbol SC CLAY clay is the dominant constituent for /./ the entire soil boring. There are zones that will contain abundant fine sand or silt; these generally alternate with no apparent regularity. (See Report and Standard Plates for evaluation and descriptive

BRAUN INTERTEC

[PROJ	ECT:			BORING	G:	Μ	W-CD) (cont.)
		B	MANAG	0006 (Solid Waste Ement Facility (, North Dakota	LOCAT See F	ION: Plate 3	- }.			
				······································	DATE:	6/1	/92	SCA	LE:	1" = 4'
(.480	Elev.	Depth	ASTM Symbol	Description of Materials (ASTM D 2488)		BPF	WL	Tests	or	Notes
<u>ver parent and standard Plates for evaluation and descriptive terminology.</u>				abundant sand with the clay from abo 43.3' predominantly clay with some silt and for remainder of boring						

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INTERTEC

	PROJI				BORING	G :	Μ	W	-CD	(c	ont.)	
		CI BI	MAN	RCI AG	0006 K SOLID WASTE EMENT FACILITY K, NORTH DAKOTA	LOCAT See F	ION: Plate 3	·····				
						DATE:	6/1	/92		SCAI	.E:	1" = 4'
084.)	Elev.	Depth	AST Symt	M pol	Description of Materials (ASTM D 2488)		BPF	WL	Т 	ests	or	Notes
(See Report and Standard Plates for evaluation and descriptive terminology.)					END OF BORING							

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ſ	PROJECT: NDG-006 HYDROGEOLOGIC INVESTIGATION					BORING: D							
			•		LOCATI	ION:							
	i			Sanitary Landfill	See map: N. 423,339.9; E. 1,947,559.2								
		Bi	smarck,	North Dakota	DATE:	10/2	2/89	SCAL	LE:	1" = 4'			
gu.)	Elev. 1733.3	Depth 0.0	ASTM D2487 Symbol	Description of Materials (ASTM D2488)		BPF	WL	Tests	or	Notes			
terminologu.			ML	SANDY SILT, fine-grained, olive bro to damp, stiff to very stiff.	wn, dry	8 14							
- 1	1729.3	4.0				16							
descriptive			СН	FAT CLAY, with fine-grained SAND yellowish brown, damp, stiff to very s (Shale)		13							
						8 17							
evaluation and						19							
				•		8 13							
Indard Plates for						8 16							
and Stand	1716.3	17.0	SP SM	POORLY GRADED SAND with SILT fine-grained, yellowish brown, damp	, to	8							
(See Report al				moist, medium dense to dense. (Sandstone)		8 18							
(See		·											
						38	1						
		e e e e e e e e e e e e e e e e e e e			e* .	48				- - - - - - - - - - - - - - - - - - -			
	1701.3 NDG-006	32.0		BRAUN		v			D	page 1 of 4			

						ENTAL LABS.
PROJ		DG-006		BORING	;	D (cont.)
	H	IYDROG	EOLOGIC INVESTIGATION	LOCATIO	ON:	``'
			Sanitary Landfill	See may	p: N. 423,	339.9; E. 1,947,559.2
	· B	ismarck,	, North Dakota	DATE:	10/2/89	SCALE: 1" = 4'
Elev.	Depth	ASTM D2487 Symbol	Description of Materials		BPF WL	Tests or Note
		SP SM	POORLY GRADED SAND with SILT fine-grained, yellowish brown, damp moist, medium dense to dense. (Sandstone)		52	
1692.3	41.0	SC SM	SILTY CLAYEY SAND, fine-grained, dark gray, moist, dense. (Sandstone)	1	49	
683.3	50.0	SP SM	POORLY GRADED SAND with SILT, fine-grained, dark gray, wet to waterb dense to very dense. (Sandstone)		37	
					63	
60.2			· ·		74	
69.3 G-006	64.0	<u>1:11</u>				

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	PKO]]	JECT: NDG-006 HYDROGEOLOGIC INVESTIGATION						<u> </u>	(C	ont.)
			•		LOCAT	10N:				
				Sanitary Landfill	See m	ap: N	N. 42.	3,339.9; 1	E. 1,94	17,559.2
		B	ISMATCK,	North Dakota	DATE:	10/	2/89	SCAI	_E:	1" = 4'
			ASTM					Tests	or	Notes
C	Elev.	Depth	D2487 Symbol	Description of Materials (ASTM D2488)		BPF	WL			
Boj			SYMBOI	POORLY GRADED SAND with SILT	•	6	┥─┤			
descriptive terminology.)			SM	fine-grained, dark gray, wet to waterb		84				
rmi.		1		dense to very dense.		ñ				
ų.				(Sandstone)						
5										
ot i										
iri						Ľ				
		1				8 78				
						ñ				
Ĕ										
5										
ļ.										
evaluation and	1658.8	74.5			<u> </u>					
2			CH	FAT CLAY, with very fine-grained SA	AND,	8 100				
for				lignite, very dark gray, moist, hard.	•	Π				
Ĩ				(Shale)						
ļ	·					70				(
킙										
P										
ndard Plates						8 78				
d St					1					
빈										
						8 77				
(See Report	1647.8	85.5		FAT CLAY, with very fine-grained SA		ğ ''				
Se			CH	and layers of lignite and plant fibers, g						
1				brownish black, moist, hard.	-					
				(Shale)						
	, ,									
						8 84				
						84				
	ļ									ĺ
						1				
										Į
				ć		62				
	1637.3	96.0				8				
1	DG-006			BRAUN					5	page 3 of 4

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PROJECT: N	DG-006		BORINC	<u>}:</u>		D (e	cont.)		
•	•	COLOGIC INVESTIGATION	LOCATI	ION:					
		Sanitary Landfill	See map: N. 423,339.9; E. 1,947,559.2						
Bi	smarck,	North Dakota	DATE:	10/2	2/89	SCALE:	1" = 4'		
Elev. Depth	ASTM D2487 Symbol	Description of Materials (ASTM D2488)		BPF		Tests or	Notes		
	CH	FAT CLAY, with lignite fragments, we dark gray, moist, hard. (Shale)		60 63 76 90					
612.8 120.5		END OF BORING	5	88		*Monitoring w North was sub			
		Water level down 39.5 feet with 120.5 hollow-stem auger in the ground. Monitoring well D North (deep) installe 120 feet.* Monitoring well D South (shallow) insta	ed at		a F F I I i	abandoned due presence of a l plug within the North replacen installed in adj porehole at 76	to the centonite riser. nent well acent		
		adjacent borehole at 47.5 feet.			,				

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1	PROJ	ECT: N H	DG-0 YDRC	06)GE	OLOGIC INVESTIGATION	BORING		
]					anitary Landfill North Dakota	See map:		
1		اط 	AST			DATE:	10/	
1	Elev. 1777.5	Depth 0.0	D24	87	Description of Materials (ASTM D2488) SILT, with roots, yellowish brown, dry	/.	BPF	
_1 _1	1776.0 1774.5	1.5 3.0	СН		(Topsoil) FAT CLAY, with roots and layers of S SAND, yellowish brown, dry.	SILTY		
	(See Report and Standard Plates for evaluation and descriptive	20.0	CH SP SM		SAND, yellowish brown, dry. (Shale) FAT CLAY, with very fine-grained S and layers of gypsum, dark yellowish damp. (Shale) POORLY GRADED SAND with SILT fine-grained, light brown, damp, with fossils. (Sandstone)	brown,		
	1745.5 NDG-006	32.0	, 		BRAUN		<u> </u>	

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PROJECT: N	DG-006		BORING	G:		E	(cont.)
	•	EOLOGIC INVESTIGATION	LOCAT	ION:			•
		Sanitary Landfill	See m	ap: N	1. 424	1,589.3; E. 1	,948,373.3
В	ismarck,	North Dakota	DATE:	10/3	31/89	SCALE:	1" = 4'
Elev. Depth	Symbol	Description of Materials (ASTM D2488)		BPF	WL	Tests o	r Note:
1741 5 26 0	SP SM	POORLY GRADED SAND with SILT fine-grained, light brown, damp, with fossils. (Sandstone)					
<u>1741.5 36.0</u> 1739.5 38.0	SP SM	POORLY GRADED SAND with SILT fine-grained, brown, damp, with trace (Sandstone)					
1739.3 30.0	CH	FAT CLAY, with very fine-grained S. and layers of gypsum, brownish gray, fractures.					
		(Shale)					
1724.5 53.0	СН	FAT CLAY, with very fine-grained SA					
		and layers of gypsum, very dark gray, fractures. (Shale)	moist,				
						r ^a	

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PROJI		DG-006	OLOCIC INVESTICATION	BORING	<u>.</u>		E	cont.)
	Н	IDKUGE	OLOGIC INVESTIGATION	LOCAT	ION:			
			Sanitary Landfill	See m	ap: N	1. 424	4,589.3; E. 1,	948,373.3
	B	ismarck, i	North Dakota	DATE:	10/3	31/89	SCALE:	1" = 4'
		ASTM	<u> </u>	A	1	T	Tests or	Notes
Elev.	Depth		Description of Materials		BPF	WL		
D		Symbol CH	(ASTM D2488) FAT CLAY, with very fine-grained S	AND		╉╌╌┨	<u> </u>	
			very dark gray, moist.	,				
.T E			(Shale)					
۹. ۲								
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Dt i								
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ם ס								
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1704.5	73.0							
et i		SP	POORLY GRADED SAND with SILT					
		SM	fine-grained, very dark gray, wet to					
2			waterbearing.					
far			(Sandstone)					
1699.5	78.0		FAT CLAN with some first spin of S					
3		CH	FAT CLAY, with very fine-grained S. very dark gray, damp.	AND,				
			(Shale)					
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Repart				1			4	
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1681 4	060							
1681.5 NDG-006	96.0		BRAUN	•	<u> </u>			E page 3 of 4

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PROJECT: NDG-006						G:		E	(0	ont.)	
		H	YDROGE	OLOGIC INVESTIGATION	LOCAT						
		Bi	smarck S	anitary Landfill	See map: N. 424,589.3; E. 1,948,373.3						
		Bi	smarck, I	North Dakota						·	
			ASTM		DATE:	10/3	1/89	SCAI Tests		$\frac{1"=4'}{Notes}$	
	Elev.	Depth	D2487	Description of Materials		BPF	WL	1 6313	or	Inoles	
			Symbol CH	(ASTM D2488) FAT CLAY, with very fine-grained S.	AND	<u> </u>	┝╌┤		<u></u>	"	
				very dark gray, damp.							
				(Shale)							
	1670.5	107.0									
計	0.0.0	107.0		END OF BORING		11					
<u>; </u>		•									
				Water level down 73 feet with 107 fee hollow-stem auger in the ground.	t of						
				Monitoring well E South (deep) install 107 feet.	ed at						
╎				Monitoring well E North (shallow) ins adjacent borehole at 78 feet.	talled in						
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ļ	IDG-006	<u> </u>		BRAUN		11				E name 4 of	



PROJECT: N		OLOGIC INVESTIGATION	BORING: F							
-		Sanitary Landfill	LOCAT							
			See m	ap: N. 4	25,991.9; E. 1,948,980.3					
£	lismarck,	North Dakota	DATE:	10/20/8	39 SCALE: 1" = 4'					
Elev. Depth 1762.4 0.0		Description of Materials (ASTM D2488)		BPF WI	Tests or Note					
1759.4 3.0	ML	SANDY SILT, fine-grained, brown,	damp.							
1/33.4 3.0	СН	FAT CLAY, very fine-grained, brow (Shale)	vn, damp.							
1754.4 8.(
	SP SM	POORLY GRADED SAND with SIL fine-grained, dark yellowish brown, with trace fossils. (Sandstone)								
<u>1741.4 21.</u>	0 SP SM	POORLY GRADED SAND with SII fine-grained, brownish gray, wet, w fossils. (Sandstone)								
1734.4 28	.0 CH	FAT CLAY, with very fine-grained very dark gray, moist. (Shale)	SAND,							
1730.4 32 NDG-006	.0	BRAUN			Fpage					

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ſ	PROJE	ECT: N	DG-006	BORING: F (cont.)							
				OLOGIC INVESTIGATION	LOCAT	ION:					
				anitary Landfill	See ma	ap: N	. 425	,99	1.9; E	E. 1,94	18,980.3
		Bi	smarck, 1	North Dakota	DATE: 10/20/			SCALE: 1" =			1" = 4'
, , ,	Elev.	Depth	ASTM D2487 Symbol	Description of Materials		BPF	WL	Te	ests	or	Notes
			Symbol CH	(ASTM D2488) FAT CLAY, with very fine-grained SA	AND.		$\left \right $				
candard Plates for statustion and descriptive terminology.)				very dark gray, moist.							
				(Shale)							
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	(00 4			• •							
L N	698.4 DG-006	64.0		BRAUN						F	page 2 of 3

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PROJECT: N		EOLOGIC INVESTIGATION	BORING		F	(cont.)
			LOCAT	ION:		
		Sanitary Landfill	See m	ap: N. 425,	991.9; E. 1,	948,980.3
B	ismarck,	North Dakota	DATE:	10/20/89	SCALE:	1" = 4'
Elev. Depth	ASTM D2487 Symbol	Description of Materials	.	BPF WL	Tests or	Note
	SP SM	POORLY GRADED SAND with SILT fine-grained, very dark gray, waterbe (Sandstone)				
<u>695.4</u> 67.0		END OF BORING				
		Water level down 50 feet with 67 feet hollow-stem auger in the ground.	of			
		Monitoring well installed at 67 feet.				
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	PROJ		DG-006		BORING: G						
		H	YDROG	EOLOGIC INVESTIGATION	LOCAT	ION:					
				Sanitary Landfill	See map: N. 424,593.0; E. 1,949,256.1						
		В	ismarck,	North Dakota	DATE:	10/30/8	9	SCAL	E:	1" = 4'	
(Elev. 1764.1	Depth 0.0	ASTM D2487 Symbol	Description of Materials (ASTM D2488)		BPF WI		Гests	or	Notes	
terminolo	1762.6		ML	SANDY SILT, very fine- to coarse-gr with roots, brown, dry.	ained,					<u> </u>	
descriptive	1	8.0	СН	(Topsoil) FAT CLAY, with very fine-grained S yellowish brown, dry. (Shale)	AND,						
	1752.6		СН	FAT CLAY, with very fine-grained S. olive brown, damp. (Shale)	AND,						
) a	1752.6	11.5									
ates for	1/51.1	13.0	SP SM SP SM	POORLY GRADED SAND with SILT fine-grained, brown, damp, with trace (Sandstone)							
Standard Plates	1746.1	18.0		POORLY GRADED SAND with SILT fine-grained, tan, damp, with trace for (Sandstone)							
iee Report and			SP SM	POORLY GRADED SAND with SILT fine-grained, brown, moist, with trace (Sandstone)					·		
S)	1741.1	23.0	SP SM	POORLY GRADED SAND with SILT, fine-grained, very dark gray, waterbea with trace fossils. (Sandstone)							
	1722 1			и." К				·			
ļ	1732.1 NDG-006	32.0		BRAUN					G	page 1 of 2	

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ROJECT: N	DG-006		BORINO			G		cont.)		
Н	YDROGE	EOLOGIC INVESTIGATION	LOCAT			<u> </u>				
Bi	ismarck S	Sanitary Landfill	See map: N. 424,593.0; E. 1,949,256.							
Bi	ismarck,	North Dakota	DATE:	10/3	0/89	SCAI	LE:	1" = 4'		
lev. Depth	ASTM D2487 Symbol	Description of Materials (ASTM D2488)		BPF	WL	Tests	or	Note		
30.6 33.5	CH	FAT CLAY, with very fine-grained S very dark gray, moist. (Shale) END OF BORING Water level down 24 feet with 33 feet hollow-stem auger in the ground. Monitoring well installed at 33.5 feet.	/							

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PROJ		DG-006		BORING: H							
	H	YDROGE	OLOGIC INVESTIGATION	LOCATION:							
			Sanitary Landfill	See m	ap: N	. 423	3,703.7; E	2. 1,9	50,254.3		
	B	ismarck,	North Dakota	DATE:	10/2	2/89	SCAI	LE:	1" = 4'		
Elev.	Depth 0.0	ASTM D2487 Symbol	Description of Materials (ASTM D2488)		BPF	WL	Tests	or	Notes		
Elev. 1782.5		ML	SILT, with roots, dark brown, damp. (Topsoil)								
1779.5	3.0	СЦ	•								
1774.5	8.0	CH	FAT CLAY, with very fine-grained SI SAND and a trace of gypsum, dark bro damp. (Shale)								
		CH	FAT CLAY, with very fine-grained SA and layers of gypsum, grayish brown, (Shale)					-			
1758.0	24.5	SP SM	POORLY GRADED SAND with SILT, fine-grained, light brown, damp, with fossils. (Sandstone)				•				
1750.5 NDG-006	32.0		BRAUN				i	н	page 1 of 3		

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PROJE	ECT: N	DG-006	FOLOCIC INVESTICATION	BORING	G:		Н	(cont.)
			EOLOGIC INVESTIGATION	LOCAT	ION:				
			Sanitary Landfill	See m	50,254.3				
	B	ismarck,	North Dakota	DATE:	10/22	2/89	SCAI	LE:	1" = 4'
Elev.	Depth	ASTM D2487 Symbol	Description of Materials		BPF	WL	Tests	or	Notes
		SP SM	POORLY GRADED SAND with SILT fine-grained, light brown, damp, with fossils. (Sandstone)						
1744.5	38.0								
		SP SM	POORLY GRADED SAND with SILT fine-grained, grayish brown, wet, with fossils. (Sandstone)						
739.5	43.0			•					
-		SP SM	POORLY GRADED SAND with SILT fine-grained, very dark gray, waterbes with trace fossils. (Sandstone)				-		
734.0	48.5		р Г Г Г						
		СН	FAT CLAY, with layers of very fine- SAND, dark gray, moist. (Shale)	grained			•		
719.5	63.0								
718.5 DG-006	64.0	СН	FAT CLAY, with very fine-grained S. BRAUN	AND,					page 2 d

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PROJECT: ND			BORING	 }:		H	(c	ont.)		
HY	DROGE	OLOGIC INVESTIGATION	LOCAT	ON:	·		<u>`</u>	<u> </u>		
		anitary Landfill	See map: N. 423,703.7; E. 1,950,254							
Bisi	marck, [North Dakota	DATE:	10/2	2/89	SCAL	.E:	1" = 4'		
1 1 1	ASTM D2487 Symbol	Description of Materials (ASTM D2488)		BPF	WL	Tests	or	Notes		
1709.5 73.0 1699.5 83.0	CH	(ASTM D2488) dark gray, moist. (Shale) FAT CLAY, with very fine-grained S dark gray, moist. (Shale) FAT CLAY, with layers of very fine- SAND, dark gray, moist. (Shale) END OF BORING Water level down 42 feet immediately withdrawal of auger.	grained							
a a a a a a a a a a a a a a a a a a a		Boring then backfilled. Monitoring well installed at 47.5 feet adjacent borehole.	in							
NDG-006	······	BRAUN		<u> </u>		L		H page 3 of		

H page 3 of 3

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				OFBORING		E		AU IAB	s.	
.1	PR	JECT: N	DG-006		BORING			1		
1				OLOGIC INVESTIGATION	LOCAT			-		
				Sanitary Landfill	See m	ap: N	. 424	,505.0; E	. 1,9	51,910.9
		E	ismarck,	North Dakota	DATE:	10/2	1/89	SCAI	.E:	1" = 4'
]	C Ele ∃ 1814		ASTM D2487 Symbol	Description of Materials (ASTM D2488)		BPF	WL	Tests	or	Notes
1	01813		MI	SANDY SILT, very fine- to coarse-gra	ained,					
L.			СН	dark brown, dry. (Topsoil)	ʃ					
			CD	FAT CLAY, fine- to coarse-grained,						
•	<u>.5 1810</u>	.6 4.0	SM /	trace of Gravel, yellowish brown, dry.	/					
]	descript		CH	SILTY SAND, very fine- to coarse-gravellowish brown, dry.	ained,					
]	E 1806	.6 8.0		FAT CLAY, with very fine- to coarse-grained SAND, yellowish brown						
	(See Report and Standard Plates for evaluation		CH	FAT CLAY, with layers of gypsum, b moist. (Shale) FAT CLAY, with very fine-grained Si SAND and a trace of gypsum, olive br moist. (Shale)	ILTY					
-	1786	.6 28.0	CH	FAT CLAY, with very fine-grained S.	AND					
Ŧ				and a trace of gypsum, brownish gray light gray, moist. (Shale)						ι.
ľ	1782 NDG	.6 32.0		BRAUN	.					1 page 1 of

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PROJECT: NDG-006 BORING:						1	(c	ont.)_	
	Н	YDROGE	OLOGIC INVESTIGATION	LOCAT					
			anitary Landfill	See m	. 424	,505.0; I	E. 1,95	51,910.9	
	Bi	ismarck, 1	North Dakota	DATE:	10/2	1/89	SCAI	LE:	$1^{"} = 4^{"}$
Elev.	Depth	ASTM D2487 Symbol	Description of Materials (ASTM D2488)		BPF	WL	Tests	or	Notes
1771.6	43.0	CH	FAT CLAY, with very fine-grained S. brownish gray and light gray, moist. (Shale)	AND,					
1765.6		СН	FAT CLAY, with very fine-grained Sa grayish brown, moist. (Shale)	AND,				·	
1761.6		CH	FAT CLAY, with very fine-grained Savery dark gray, moist. (Shale)	AND,					
		CH	FAT CLAY, with very fine-grained Savery dark gray, moist. (Shale)	AND,					
1753.6	61.0	СН	FAT CLAY, with very fine-grained Sa dark brownish gray, moist. (Shale)	AND,					
1750.6 NDG-006	64.0		BRAUN	×	[]			I	page 2 of 3

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PROJE	CT: NI	DG-006	COLOGIC INVESTIGATION	BORING: I (cont.)						
→ _				LOCAT	ION:					
			Sanitary Landfill	See m	See map: N. 424,			,505.0; E. 1,951,910.9		
	Bi	smarck,	North Dakota	DATE:	10/2	1/89	SCAL	.E:	1" = 4'	
· Elev.	Depth	ASTM D2487 Symbol	Description of Materials (ASTM D2488)	L	BPF	WL	Tests	or	Notes	
1748.6	66.0	SP SM	POORLY GRADED SAND with SIL fine-grained, dark gray, waterbearing (Sandstone)							
	68.0		LIMESTONE, dark gray, massive.							
Jar son and description	00.0	SP SM	POORLY GRADED SAND with SIL fine-grained, dark gray, wet to wate (Sandstone)	T, very rbearing.						
	78.0		END OF BORING Water level down 63.5 feet 1 day aft completion of boring. Monitoring well installed at 75 feet.	er						
(See Report				· · ·				•.		
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NDG-00	6		BRAUN						I page 3	

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PROJ	ECT: N	DG- 006		BORING: J							
	H	YDROGI	EOLOGIC INVESTIGATION	LOCATION:							
	B	ismarck S	Sanitary Landfill			176 0	7) 7. 10 1	061 764 9			
		ismarck	North Dakota	See map: N. 426,872.7; E. 1,951,254.8							
		ismaick,		DATE:	1" = 4'						
	Denth	ASTM D2487	Description of Materials		DDE		Tests o	or Notes			
Elev.	Depth 0.0	Symbol	Description of Materials (ASTM D2488)		BPF	WL					
1825.3		ML	SILT, with fine- to coarse-grained SA	ND,				· · · · · ·			
		СН	with roots, dark brown, dry. (Topsoil)	h							
				/							
5			FAT CLAY, with very fine- to coarse-grained SAND, with roots and a	trace							
Elev. 1826.3 1825.3			of Gravel, olive brown and light gray,	dry.							
			(Shale)								
1818.3	8.0										
	0.0	SP	POORLY GRADED SAND with SILT.	,				• •			
		SM	fine-grained, yellowish brown, dry. (Sandstone)								
1015 2	11.0		(Sandstone)								
1815.3	11.0	СН	FAT CLAY with more fine and S								
			FAT CLAY, with very fine-grained Sa and a trace of gypsum, yellowish brow								
			damp.	-							
			(Shale)								
1808.3	18.0	СН	FAT CLAY, with very fine-grained SA	AND							
Ī			and layers of gypsum, dark olive brow								
			damp, fractures. (Shale)					1			
1											
1798.3	28.0	СН	FAT CLAV with your firs series of								
			FAT CLAY, with very fine-grained SA and layers of gypsum, dark brownish g								
			moist, fractures.								
			(Shale)			,					
1794.3 NDG-006	32.0										
	~		BRAUN					J page 1 of 3			

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PROJI	ECT: NI HY	DG-006 YDROGE	OLOGIC INVESTIGATION	BORING			J	(c	ont.)
	Bi	smarck S	anitary Landfill			. 426	,872.7; E	. 1.95	1.254.8
	Bi	smarck, l	North Dakota	DATE:		8/89			$\frac{1}{1^{"}} = 4^{"}$
Elev.	Depth	ASTM D2487 Symbol	Description of Materials (ASTM D2488)		BPF		Tests	or	Note:
		CH	FAT CLAY, with very fine-grained S and layers of gypsum, dark brownish moist, fractures. (Shale)						
<u>1783.3</u>	43.0	СН	FAT CLAY, with very fine-grained S and a trace of gypsum, very dark gra fractures. (Shale)						
1768.:	3 58.0	СН	FAT CLAY, with very fine-grained	SILTY	_				
			SAND, dark gray, moist. (Shale)					•	
1762. NDG-0	3 64.0		BRAUN						J page

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Elev. Depth D2487 Symbol Description of Materials (ASTM D2488) BPF WL Tests or Note CH FAT CLAY, very fine-grained SILTY SAND, dark gray, moist. (Shale) FAT CLAY, very fine-grained SILTY SAND, dark gray, moist. Image: Character State		PROJE	ECT: N	DG-006		BORING	G:		J	(c	ont.)
Bismarck, North Dakota Bismarck, North Dakota DATE: 10/18/89 SCALE: 1" = 4 DATE: 10/18/89 SCALE: 1" = 4 Tests or Note Symbol (ASTM D2488) SPF WL Tests or Note CH FAT CLAY, very fine-grained SILTY SAND, dark gray, moist. (Shale) POORLY GRADED SAND with SILT, fine-grained, dark gray, waterbearing. (Sandstone) 1736.3 90.0 END OF BORING Water level down 81.5 feet with 90 feet of hollow-stem auger in the ground. Monitoring well installed at 90 feet.						LOCAT	ION:				•
DATE: 10/18/89 ISCALE: 1" = 4" Elev. Depth D2487 Symbol Description of Materials (ASTM D2488) BPF CH FAT CLAY, very fine-grained SILTY SAND, dark gray, moist. (Shale) PF WL Tests or Note 1743.3 83.0 SP POORLY GRADED SAND with SILT, fine-grained, dark gray, waterbearing. (Sandstone) POORLY GRADED SAND with SILT, fine-grained, dark gray, waterbearing. 1736.3 90.0 END OF BORING Water level down \$1.5 feet with 90 feet of hollow-stem auger in the ground. Monitoring well installed at 90 feet. Note						See m	ap: N	. 426	5,872.7; 1	E. 1,9	51,254.8
Elev. Depth D2487 Description of Materials PFF Symbol (ASTM D2488) PFF CH FAT CLAY, very fine-grained SILTY SAND, dark gray, moist. (Shale) 1743.3 83.0 SM POORLY GRADED SAND with SILT, fine-grained, dark gray, waterbearing. (Sandstone) 1745.3 90.0 END OF BORING Water level down 81.5 feet with 90 feet of hollow-stem auger in the ground. Monitoring well installed at 90 feet.			B	ismarck,	North Dakota	DATE:	10/1	8/89	SCA	LE:	1" = 4'
1743.3 83.0 1743.3 83.0 SM POORLY GRADED SAND with SILT, fine-grained, dark gray, waterbearing. (Sandstone) 1736.3 90.0 END OF BORING Water level down 81.5 feet with 90 feet of hollow-stem auger in the ground. Monitoring well installed at 90 feet.	1.)	Elev.	Depth	D2487			BPF	WL	Tests	or	Notes
1743.3 83.0 1743.3 83.0 SM POORLY GRADED SAND with SILT, fine-grained, dark gray, waterbearing. (Sandstone) 1736.3 90.0 END OF BORING Water level down 81.5 feet with 90 feet of hollow-stem auger in the ground. Monitoring well installed at 90 feet.	010				FAT CLAY, very fine-grained SILTY	SAND,					
Image: SP SM POORLY GRADED SAND with SILT, fine-grained, dark gray, waterbearing. (Sandstone) 1736.3 90.0 IT36.3 90.0 END OF BORING Water level down 81.5 feet with 90 feet of hollow-stem auger in the ground. Monitoring well installed at 90 feet.	Standard Plates for evaluation and	1743.3	83.0								
		1736.3	90.0		fine-grained, dark gray, waterbearing. (Sandstone) END OF BORING Water level down 81.5 feet with 90 fee hollow-stem auger in the ground.					· · · ·	
		NDG-006			BRAUN		11		•		page 3 of 3



	PROJE	CT: NI	DG-006		BORING	}:		K		<u></u>
				EOLOGIC INVESTIGATION	LOCAT	ION:				
		Bi	smarck S	Sanitary Landfill	See ma	ap: N	. 425	,306.7; I	E. 1,9	46,080.8
		Bi	smarck,	North Dakota	DATE:	10/	5/89	SCAI	LE:	1" = 4'
	Elev. 1749.6	Depth 0.0		Description of Materials (ASTM D2488)		BPF	WL	Tests	or	Notes
	1746.6 1742.6	3.0	СН	FAT CLAY, with very fine-grained S and a trace of Gravel, dark olive brow damp. (Shale) FAT CLAY, with very fine-grained S olive brown and light gray, moist, stif (Shale) FAT CLAY, with very fine-grained S	vn, SAND, ff. SAND,	× 13				
5	inderd Plates for evaluation			dark grayish brown, moist, rather stif very stiff. (Shale)	f to	8 12 8 16 8 19				
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]	1717. NDG-0	6 32.0 06		BRAUN				<u> </u>		K page 1 of
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PROJECT: N	DG-006	· ·	BORING	G :		K		cont.)
H	YDROGE	EOLOGIC INVESTIGATION	LOCAT	ION:		··· ·· ·· ·· ··		
		Sanitary Landfill	See m	ap: N	. 425	5,306.7; E	. 1,9	46,080.8
В	ismarck,	North Dakota	DATE:	10/	5/89	SCAL	.E:	1'' = 4'
Elev. Depth	ASTM D2487 Symbol	Description of Materials (ASTM D2488)		BPF	WL	Tests	or	Notes
Elev. Depth	CH	FAT CLAY, with very fine-grained S dark grayish brown, moist, rather stiff very stiff. (Shale) FAT CLAY, with very fine-grained S very dark gray, moist to wet, very stif (Shale)	AND, f.	23 22 22 25 26 23 23				



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٦	PROJE		DG-006		BORING	 3:		ł	<	(c	cont.)	
1				OLOGIC INVESTIGATION	LOCAT	ION:						
]				anitary Landfill	See m	ap:]	N. 425	5,30)6.7; E	. 1,9	46,080.8	
-			,	North Dakota	DATE:	10	/5/89		SCAL	.E:	1" = 4'	r
	Elev.	Depth	ASTM D2487 Symbol	Description of Materials (ASTM D2488)		BPI	WL	Г 	[ests	or	Notes	_
]			CH	FAT CLAY, with very fine-grained S very dark gray, moist to wet, very sti		2						-
1				hard. (Shale)		Ĩ						
	descripti.					20	5					
]						×						
]	lumtior	6										
	a 2					× 3	D					
]	lates 1							-				
]	Preserve P					2	7					
-]	and Star											
د ا	Report a											
1	1663.6	5 86.0					2					Ì
]	S)			END OF BORING								Ì
r				Water level down 62 feet immediatel withdrawal of auger.	y after							
7				Monitoring well installed at 85 feet.								
]										•		
1												
ł												
]												
-	NDG-0	06		BRAUN		<u> </u>	L	_			K page 3	of 3

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	PROJ	ECT: N	DG-00)6	· · · · · · · · · · · · · · · · · · ·	BORING	3 :	Ν	IW-M		
		В	ismarc	k S	OLOGIC INVESTIGATION Sanitary Landfill North Dakota				3,635.0; 1	Ξ.	
						DATE:	9/1	3/90	SCAI	.E:	$1^n = 4^s$
(, nвo	Elev. 1756.1	Depth 0.0	Symb		Description of Materials (ASTM D2488)		BPF	WL	Tests	or	Notes
Plate	- - - - - - - - - - - - - - - - - - -					ry, with led, s.	BPF	WL			INDIES
	1731.1 1730.1	25.0 26.0	CH	0	FAT CLAY with very fine-grained SA very dark gray, moist.	.ND,					
	-	-			(Shale) END OF BORING.	/					
	-	-			Boring down to 26 feet. Monitoring w installed at 25 feet.	ell					
ĺ					· · · · · · · · · · · · · · · · · · ·						
1	VDG-006	,			BRAUN - 1/24/91				N	AW-M	page 1 of

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[PROJECT: CFEX-91-0006						BORINO	G :		N	1V	V-N			
					006 SOLID WASTE	ſ	LOCAT	IC	N:						,
		TR 1			EMENT FACILITY A, NORTH DAKOTA		See H	-18	ile 5	•					
		ים	SMAT	\CN	, NORTH DAROTA	┝	DATE:		E / 1 6			SCAL	Е.	1" =	
				_			DATE:	Т	5/15	9/92		Fests	DI OI		otes
and descriptive terminology.)	Elev. 1773.1	Depth 0.0	ASTI Symb		Description of Materials (ASTM D 2488)			E	3PF	WL					
inol	-		CL		CLAY with silt and trace of sand, dan gray (5Y3/2), abundant gypsum	rk	olive								
erm	-	-			crystallizations.										
/e †	- 1	-		\square											
pti.	-	-		\square											
cri	-														
des	-	-													
pq	-	-													
E C	-	-		\square											
atio	-	-	4												
evaluation	 -		4												
	1	-	{												
for	-	-	1												
ates	-	-	1	\mathbb{V}											
P la	-	-	1												
		-	1	\mathbb{V}											
Standard	- 1756.1	17.0		\mathbb{V}											
1 1 1	5		SP		SAND light olive gray, fine grained,	li	ttle	٦							
]		silt, dry.										
]												
Pannt			1												
000/			_												
Ű	<u>ال</u>		_												
	F		-		iron staining evident										
	\vdash	-	4												
	\vdash		-					ĺ			ļ				
	\vdash		-												
	-		-		damp to moist								•		
	┢		-												
	┣─	-	-{												
	-		-												
	1741.0	31.	2			_									_

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BRAUN

	PROJ					BORING: MW-N (con					
		B	MAN	RCH IAG	0006 K Solid Waste Ement Facility K, North Dakota	LOCAT See P	ION: Plate 3	3.			
		1			· · · · · · · · · · · · · · · · · · ·	DATE:	5/19	9/92	SCAI	LE:	1" = 4'
(.180	Elev.	Depth	AST Syml		Description of Materials (ASTM D 2488)		BPF	WL	Tests	or	Notes
ive terminology.)	- - 	 36.0	SP		SAND fine to medium grained, dark g gray (5BG4/1), waterbearing.	reenish					
and descript	-		SC		SANDY CLAY clay with some sand fi above, dark greenish gray, sand appear burrows (bioturbation).						
eva i ua	<u>1731.6</u> - - 1729.1	41.5 - - 44.0	SC		SANDY CLAY same as above, but app contain more clay and less fine sand, dark gray (5Y3/1), water not as abund above.	very					
(See Report and Standard Plates f					END OF BORING						

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INTERTEC

ſ	PROJE					BORINC	 G:	N	٨W	-0		
			FEX-9 SMAR		006 SOLID WASTE	LOCAT	ION:	· <u>·</u>				•
			MANA	AGI	EMENT FACILITY , NORTH DAKOTA	See P	late 3	•				
		DI	SMAN	(Ch	, NORTH DAROTA	DATE:	5/2	(/0.7		SCAL	Е.	1" = 4'
						DATE:	5/20	5/92	-	ests	or	Notes
(.460	Elev. 1776.5 - - - 1770.5	Depth 0.0	ASTI Symb		Description of Materials (ASTM D 2488)		BPF	WL				
<u>e</u>	_	_	CL	A	CLAY very dark grayisg brown (10YF some silt, some iron staining present.	(3/2),						
Ē	-	_		\land								
e +	-	_		\square								
t i v	_	-		\land								
r i p				\square								
lesc	1770.5	6.0	CL	A	gradational contact	(41					
and c	-	-		\square	CLAY light olive brown (2.5Y5/3), so							
		-		\square	dry, abundant iron staining, crumbly, horizontal bedding planes present.							
it io	-	-		\square								
evaluation	<u> </u>			\square								
		-		\square								
for	╞	-]			
	,	- 14.0		\square								
P at	1762.5	14.0	SP	~~	SAND fine grained with silt, light oli		1					
		-			brown (2.5Y5/6), grades to pale olive (5Y6/3), damp.							
Standard	F	-	1									
Sta		-										
and												
Report												
d days												
Ś		.										
	F		4									
		_	-		moist, iron staining present							
	 -		4		moist, non stammig present							
	\vdash		-									
	\vdash		4									
	-		4									
	┣─		4									
	╞		-									
		<u> </u>	1	1								_

BRAUN INTERTEC

PROJ				<u></u>	BORINC	;	ľ	ММ	-0	(c	ont.)
	B	MAN	RCI	0006 (SOLID WASTE EMENT FACILITY (, NORTH DAKOTA	LOCATI See P	ON: late 3	3.				
	•				DATE:	5/2	6/92		SCAL	.E:	1" = 4'
Elev.	Depth	AST Sym		Description of Materials (ASTM D 2488)		BPF	WL		ests	or	Notes
Elev.	33.0	SP		sharp contact .M=SP SAND fine grained, dark greenish gray (5BG4/1), moist to wet.	y						
T 1/41.5	35.0 	SC		SANDY CLAY sand from above mixed clay, bioturbation possible, dark green (5GY4/1 to 5G4/1). waterbearing same clay, very dark gray (5Y3/1)							
				END OF BORING					·		

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INTERTEC

PROJECT:				BORINO	3:				
	BI	MANAG	006 Solid Waste Ement Facility S, North Dakota	LOCAT See P	ION: Plate 3	•			
				DATE:	5/2	7/92	SCA	LE:	1'' = 4'
Elev. Dej	pth 0.0	ASTM Symbol	Description of Materials (ASTM D 2488)		BPF	WL	Tests	or	Notes
Creation and Standard Plates for evaluation and descriptive terminology.			CLAY with silt, dark grayish brown (2.5Y4/2), abundant gypsum crystalls along fracture planes, dry. abundant iron staining, less gypsum, of damp grades to olive gray (5Y4/2) some horizontal bedding of altenating clay laminae some very fine sand laminae present	đry to					

BRAUN

	PROJI			<u> </u>	· · · · · · · · · · · · · · · · · · ·	BORING	 G:	N	/W-P	(0	cont.)
		B	MAN	RCI	0006 (SOLID WASTE EMENT FACILITY (, NORTH DAKOTA	LOCAT				· · · ·	
			-			DATE:	5/2	7/92	SCAI	LE:	1" = 4'
094.)	Elev.	Depth	AST Symt		Description of Materials (ASTM D 2488)		BPF	WL	Tests	or	Notes
	- - - - - - - - - - - - - - - - - - -		SP		 SAND fine grained, friable, not cemenyellowish brown (10YR5/8) to light oli (5Y6/2), dry, some silt, waterbearing at 50' SAND waterbearing, fine grained, darl greenish gray (5BG4/1), some silt. SANDY CLAY sand-filled burrows (indication of bioturbation), very dark (5Y3/1). END OF BORING 	ive gray k					



INTERTEC

ſ	PROJE	CT:	BORING: MW-Q									
		BI	MANAG	0006 (SOLID WASTE EMENT FACILITY (, NORTH DAKOTA		LOCAT See F	ION: Plate	3.				
					T	DATE:	5/2	8/92		SCAL	.E:	$1^{"} = 4'$
(. <u>19</u> 0	Elev. 1824.7	Depth 0.0	Symbol	Description of Materials (ASTM D 2488)			BPF			Fests	or	Notes
.co. provid standard Plates for evaluation and descriptive terminology.				CLAY with silt, brown (10YR5/3) gy crystalls and iron staining present, dr same as above, but grades to dark g brown (2.5Y4/2), dry to damp	у.							



	PROJ				BORING	G:	N	/W-Q	(cont.)
		B	MANAG	0006 K SOLID WASTE Ement facility K, North Dakota	LOCAT See F	ION: Plate 3	3.			·
					DATE:	5/2	8/92	SCAI	.E:	$1^{"} = 4'$
(.180	Elev.	Depth	ASTM Symbol	Description of Materials (ASTM D 2488)		BPF	WL	Tests	or	Notes
Standard Plates for evaluation and descriptive terminology.)				very dark gray (5Y3/1), otherwise san above less gypsum and iron staining	ne as					· · · ·
(See Report and S1	 -			very dark gray to black clay (5Y3/1 to 5Y2.5/1), gypsum and iron staining ab waterbearing from 59 to 61', more silt previous no longer waterbearing, dry very dark gray clay (5Y3/1)	osent					



INTERTEC

PRO	JECT:			BORINO	<u>.</u>	N	NW-G	2 (0	(cont.)		
	В	MANAG	0006 (Solid Waste Ement Facility (, North Dakota	LOCAT See P	ION: late 3	3.					
				DATE:	5/2	8/92	SC/	ALE:	$1^{"} = 4^{"}$		
Flev.	Depth	ASTM Symbol	Description of Materials (ASTM D 2488)		BPF	WL	Tests	or	Notes		
(See Report and Standard Plates for evaluation and descriptive terminology.)	5.7 89.	Image: Second se second second se	very hard or dense material, therefore sampling switched from continuos to split-spoon SAND dark greenish gray (5BG4/1), stiff					· ·			

BRAUN INTERTEC

Γ	PROJE	ECT:				BORING	G:	∕W-Q	-Q (cont.)			
		B]	MAN		0006 K Solid Waste Ement Facility K, North Dakota	LOCAT See H	ION: Plate 3	3.				
L						DATE:	5/2	8/92		.E:	1" = 4'	
094.)	Elev.	Depth	M	Description of Materials (ASTM D 2488)		BPF	WL	Tests	or	Notes		
desc	-		SC		CLAY with sand-filled bioturbation. END OF BORING							

APPENDIX E

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WATER-LEVEL TABLES

.

Bismarck Water Levels 11/06/92 to 12/21/92

OBDA Aquifer		LS Elev (msl,ft)=1769.6 SI (ft.)=36-41									
Depth to Water (ft)	WL Elev (msl, ft)	Date	Depth to Water (ft)	WL Elev (msl, ft)							
26.61	1742.99	12/07/92	26.90	1742.70							
27.02	1742.58	12/21/92	26.76	1742.84							
	Aquifer Depth to Water (ft) 26.61	Aquifer Depth to WL Elev Water (ft) (msl, ft) 26.61 1742.99 27.02 1742.58	Aquifer Depth to WL Elev Water (ft) (msl, ft) Date 26.61 1742.99 12/07/92 27.02 1742.58 12/21/92	Aquifer SI (ft.) Depth to WL Elev Depth to Water (ft) (msl, ft) Date Water (ft) 26.61 1742.99 12/07/92 26.90 27.02 1742.58 12/21/92 26.76							

139-079-30CAC

.

139-079-3 <u>Undefined</u>			LS Elev (msl,ft)=1767.52 SI (ft.)=65-70								
Date	Depth to Water (ft)	WL Elev (msl, ft)	Date	Depth to Water (ft)	WL Elev (msl, ft)						
11/13/92 11/16/92 11/23/92	30.96 51.21 41.56	1736.56 1716.31 1725.96	12/07/92 12/21/92	32.86 31.14	1734.66 1736.38						

139-079-3 <u>Undefined</u>			LS	Elev (msl,ft)• SI (ft.);	
Date	Depth to Water (ft)	WL Elev (msl, ft)	Date	Depth to Water (ft)	WL Elev (msl, ft)
11/13/92 11/23/92	38.76 38.54	1695.04 1695.26	12/07/92 12/21/92	38.66 38.55	1695.14 1695.25

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139-079-3 <u>Undefined</u>			LS E	.755.21 =57-62		
Date	Depth to Water (ft)	WL Elev (msl, ft)	Date	Depth to Water (ft)	WL Elev (msl, ft)	
11/13/92 11/23/92	44.53 43.58	1710.68 1711.63	12/07/92 12/21/92	43.69 43.62	1711.52 1711.59	

139-079-30BAA

LS Elev (msl,ft)=1778.66

.

<u>Undefined</u>	Aquifer		<u>SI (ft.)=38-4</u> 8							
Date	Depth to Water (ft)	WL Elev (msl, ft)	Date	Depth to Water (ft)	WL Elev (msl, ft)					
10/30/92 11/23/92	36.52 36.62	1742.14 1742.04	12/07/92 12/21/92	36.62 36.66	1742.04 1742.00					

APPENDIX F

,

MAJOR ION AND TRACE-ELEMENT CONCENTRATIONS

Bismarck Landfill Water Quality Major Ion Analyses

Screened				l←(milligrams per liter)																				
Location	Interval (ft)	Date Sampled	sio ₂	Fe	Mn	Ca	Mg	Na	ĸ	нсоз	co3	504	c1	F	, NO ₃	в	TDS	Hardness CaCO ₃	as NCH	t Na	SAR	Cond (µmho)	Temp (∞C)	
139-079-30BAA	38-48	10/30/92	15	0.04	1.5	85	40	1100	8	1430	0	1700	8	0.4	5.4	2.3	3670	380	0	86	25	4700	6	7.89
139-079-30BDA	36-41	11/13/92	16	0.19	0.02	14	2	480	4.2	421	47	690	16	1.1	6.9	1.5	1490	43	0	96	32	2140	' 0.8	8.97
139-079-30CAC	65-70	11/16/92	9.1	0.13	0.06	21	13	180	4.2	236	0	280	18	0.7	5.4	0.63	648	110	0	78	7.5	985	7	8.22
139-079-30CBC	48-53	11/13/92	1.5	0.01	0.01	63	18	90	13	51	17	360	5	0.2	0	0.09	593	230	160	44	2.6	975	4	11.0 4
139-079-30CBD	57-62	11/13/92	20	0.01	0.13	60	38	60	6.2	328	0	130	5.1	0.3	5	0.28	487	310	37	29	1.5	742	4	9.03

Trace Element Analyses

.

Location	Date . Sampled	Selenium	Lead	Cadmium (mi	Mercury crograms per	Arsenic liter)	Molybdenum	Strontium	•
139-079-30 BAA	10/30/92	0	1	0	0	0	4	1200	
139-079-30BDA	10/30/92	1	2	0	0	32	35	320	
139-079-30CAC	10/30/92	1	0	0	0	6	337	440	
139-079-30CBC	10/30/92	0	0	0	-	0	16	890	
139-079-30CBD	10/30/92	0	0	0	0	1	6	640	

APPENDIX G

BRAUN INTERTEC MAJOR ION AND TRACE-ELEMENT CONCENTRATIONS

City of Bismarck

Page 3

.

PROJECT: CFEX-91-0006 COLLECTED: Braun Intertec RECEIVED: 25-JUN-92

PARAMETER	Braun Intertec ID: Client ID: Matrix: Collect Date:	92-1365 MW-J Liquid 22-JUN		92-136 MW-I Liquid 22-JU]	-	92-136 MW-Q Liquid 23-JUN		92-136 MW-P Liquid 23-JUI		
2,3-Dichloro-1-propene 2-Chloroethyl Vinyl Ether Dichloroacetonitrile Pentachloroethane Acrylonitrile		<10 <10 <20 <10 <10	ug/L ug/L ug/L ug/L ug/L	<10 <10 <20 <10 <10	ug/L ug/L ug/L ug/L ug/L	<10 <10 <20 <10 <10	ug/L ug/L ug/L ug/L ug/L	<10 <10 <20 <10 <10	ug/L ug/L ug/L ug/L ug/L	
Carbon Disulfide trans-1,4-Dichloro-2-butene Methyl Butyl Ketone Methyl Iodide Vinyl Acetate		<10 <10 <10 <10 <10	ug/L ug/L ug/L ug/L ug/L	<10 <10 <10 <10 <10	ug/L ug/L ug/L ug/L ug/L	<10 <10 <10 <10 <10	ug/L ug/L ug/L ug/L ug/L	<10 <10 <10 <10 <10	ug/L ug/L ug/L ug/L ug/L	
Dichlorodifluoromethane Chloromethane Vinyl Chloride Bromomethane Chloroethane		<5.0 <5.0 <1.0 <5.0 <1.0	ug/L ug/L ug/L ug/L ug/L	<5.0 <5.0 <1.0 <5.0 <1.0	ug/L ug/L ug/L ug/L ug/L	<5.0 <5.0 <1.0 <5.0 <1.0	ug/L ug/L ug/L ug/L ug/L	<5.0 <5.0 <1.0 <5.0 <1.0	ug/L ug/L ug/L ug/L ug/L	
Trichlorofluoromethane 1,1-Dichloroethylene Methylene Chloride trans-1,2-Dichloroethylene 1,1-Dichloroethane		<1.0 <1.0 <5.0 <0.2 <1.0	ug/L ug/L ug/L ug/L ug/L	<1.0 <1.0 <5.0 <0.2 <1.0	ug/L ug/L ug/L ug/L ug/L	<1.0 <1.0 <5.0 <0.2 <1.0	ug/L ug/L ug/L ug/L ug/L	<1.0 <1.0 <5.0 <0.2 <1.0	ug/L ug/L ug/L ug/L ug/L	
cis-1,2-Dichloroethylene Chloroform 1,1,1-Trichloroethane Carbon Tetrachloride 1,2-Dichloroethane		<0.2 <1.5 <2.0 <1.7 <0.3	ug/L ug/L ug/L ug/L ug/L	<0.2 <1.5 <2.0 <1.7 <0.3	ug/L ug/L ug/L ug/L ug/L	<0.2 <1.5 <2.0 <1.7 <0.3	ug/L ug/L ug/L ug/L ug/L	<0.2 <1.5 <2.0 <1.7 <0.3	ug/L ug/L ug/L ug/L ug/L	
Benzene 1,1,2-Trichloroethylene Bromodichloromethane Dibromomethane cis-1,3-Dichloro-1-Propene		<1.0 <0.5 <0.3 <5.0 <0.5	ug/L ug/L ug/L ug/L ug/L	<1.0 <0.5 <0.3 <5.0 <0.5	ug/L ug/L ug/L ug/L ug/L	<1.0 <0.5 <0.3 <5.0 <0.5	ug/L ug/L ug/L ug/L ug/L	<1.0 <0.5 <0.3 <5.0 <0.5	ug/L ug/L ug/L ug/L ug/L	
Toluene trans-1,3-Dichloro-1-propene 1,1,2-Trichloroethane 1,3-Dichloropropane Tetrachloroethylene		<1.0 <0.5 <1.2 <1.0 <1.0	ug/L ug/L ug/L ug/L ug/L	<1.0 <0.5 <1.2 <1.0 <1.0	ug/L ug/L ug/L ug/L ug/L	<1.0 <0.5 <1.2 <1.0 <1.0	ug/L ug/L ug/L ug/L ug/L	<1.0 <0.5 <1.2 <1.0 <1.0	ug/L ug/L ug/L ug/L ug/L	
Chlorodibromomethane Chlorobenzene 1,1,1,2-Tetrachloroethane Ethyl Benzene m,p-Xylene		<2.5 <1.0 <0.5 <1.0 <1.0	ug/L ug/L ug/L ug/L ug/L	<2.5 <1.0 <0.5 <1.0 <1.0	ug/L ug/L ug/L ug/L ug/L	<2.5 <1.0 <0.5 <1.0 <1.0	ug/L ug/L ug/L ug/L ug/L	<2.5 <1.0 <0.5 <1.0 <1.0	ug/L ug/L ug/L ug/L ug/L	
o-Xylene Bromoform Cumene 1,1,2,2-Tetrachloroethane 1,2,3-Trichloropropane		<1.0 <0.5 <1.0 <1.2 <1.0	ug/L ug/L ug/L ug/L ug/L	<1.0 <0.5 <1.0 <1.2 <1.0	ug/L ug/L ug/L ug/L ug/L	<1.0 <0.5 <1.0 <1.2 <1.0	ug/L ug/L ug/L ug/L ug/L	<1.0 <0.5 <1.0 <1.2 <1.0	ug/L ug/L ug/L ug/L ug/L	
Bromochloromethane 1,2-Dibromo-3-Chloropropan 1,2-Dibromoethane Styrene	e	<1.0 <10 <0.2 <1.0	ug/L ug/L ug/L ug/L	<1.0 <10 <0.2 <1.0	ug/L ug/L ug/L ug/L	<1.0 <10 <0.2 <1.0	ug/L ug/L ug/L ug/L	<1.0 <10 <0.2 <1.0	ug/L ug/L ug/L ug/L	

< = less than: compound not detected at or above indicated detection limit</p>
- = Analysis not required

Quality control data reviewed: _____

IRO

BRAUN INTERTEC REPORT NO: 921365

City of Bismarck

PROJECT: CFEX-91-0006 COLLECTED: Braun Intertec RECEIVED: 25-JUN-92

PARAMETER	Braun Intertec ID: Client ID: Matrix: Collect Date:	92-1365 MW-J Liquid 22-JUN-		92-136: MW-I Liquid 22-JUN		92-1365 MW-Q Liquid 23-JUN		92-1365 MW-P Liquid 23-JUN	
1,3-Dichlorobenzene		<1.5	ug/L	<1.5	ug/L	<1.5	ug/L	<1.5	ug/L
1,4-Dichlorobenzene		<0.2	ug/L	<0.2	ug/L	<0.2	ug/L	<0.2	ug/L
1,2-Dichlorobenzene		<0.2	ug/L	<0.2	ug/L	<0.2	ug/L	<0.2	ug/L
Dichlorofluoromethane		<5.0	ug/L	<5.0	ug/L	<5.0	ug/L	<5.0	ug/L
Ethyl Ether		<1.0	ug/L	<1.0	ug/L	<1.0	ug/L	<1.0	ug/L
Trichlorotrifluoroethane	pylene)	<5.0	ug/L	<5.0	ug/L	<5.0	ug/L	<5.0	ug/L
Acetone		<50	ug/L	<50	ug/L	<50	ug/L	<50	ug/L
Allyl Chloride (3-Chloropro		<1.0	ug/L	<1.0	ug/L	<1.0	ug/L	<1.0	ug/L
Methyl Ethyl Ketone		<5.0	ug/L	<5.0	ug/L	<5.0	ug/L	<5.0	ug/L
Tetrahydrofuran		<5.0	ug/L	<5.0	ug/L	<5.0	ug/L	<5.0	ug/L
Methyl Isobutyl Ketone		<5.0	ug/L	<5.0	ug/L	<5.0	ug/L	<5.0	ug/L
Alkalinity, Total Bicarbonate Alkalinity Carbonate Alkalinity Appearance Cation/Anion Balance		860 530 330 a +5.3	mg/L mg/L mg/L %	460 460 <4 b -2.6	mg/L mg/L mg/L %	1100 1100 <4 c +0.4	mg/L mg/L mg/L %	820 820 <4 d +1.1	mg/L mg/L mg/L %
Chloride Chemical Oxygen Demand Fluoride Hardness as CaCO3, Total pH Specific Conductance		14 36 0.55 54 9.5 3900 u	mg/L mg/L mg/L mgEq/L Units mhos/cm	6.8	mg/L mg/L mg/L mgEq/L Units umhos/cm	6.5 36 . 0.51 290 7.8 4800 u	mg/L mg/L mg/L mgEq/L Units mhos/cm	6.8	mg/L mg/L mg/L mgEq/L Units unhos/cm
Total Dissolved Solids		3000	mg/L	830	mg/L	3800	mg/L	2400	mg/L
Temperature *		9.0	Deg. C	9.0	Deg. C	9.0	Deg. C	9.0	Deg. C
Total Organic Carbon		9.0	mg/L	2.0	mg/L	3.4	mg/L	2.2	mg/L
Total Suspended Solids		95	mg/L	690	mg/L	91	mg/L	610	mg/L
Arsenic, Total		12	ug/L	2	ug/L	6	ug/L	<2	ug/L
Beryllium, Total		<0.2	ug/L	0.2	ug/L	0.2	ug/L	<0.2	ug/L
Cadmium, Total		<0.2	ug/L	1.1	ug/L	<0.2	ug/L	<0.2	ug/L
Cobalt, Total		59	ug/L	8.0	ug/L	96	ug/L	21	ug/L
Chromium, Total		7.7	ug/L	6.6	ug/L	18	ug/L	8.8	ug/L
Lead, Total	·	<2	ug/L	6	ug/L	14	ug/L	<2	ug/L
Thallium, Total		77	ug/L	4.0	ug/L	100	ug/L	17	ug/L
Vanadium, Total		3.0	ug/L	26	ug/L	18	ug/L	27	ug/L
Barium, Total		0.05	mg/L	0.58	mg/L	0.09	mg/L	0.07	mg/L
Silver, Total		0.01	mg/L	<0.01	mg/L	0.02	mg/L	<0.01	mg/L
Calcium, Total		17	mg/L	120	mg/L	47	mg/L	200	mg/L
Copper, Total		<0.01	mg/L	0.02	mg/L	0.01	mg/L	0.01	mg/L
Iron, Total		0.70	mg/L	32	mg/L	5.8	mg/L	6.7	mg/L
Magnesium, Total		2.8	mg/L	80	mg/L	41	mg/L	170	mg/L
Manganese, Total		0.05	mg/L	2.3	mg/L	0.30	mg/L	0.87	mg/L

a = Light precipitate, lightly cloudy, brownish.
b = Brown precipitate, brownish, very cloudy.
c = Precipitate, lightly cloudy, gray-brown.
d = Precipitate, lightly cloudy, gray-brown.
* = Temperature as received by laboratory.

< = less than: compound not detected at or above indicated detection limit - = Analysis not required

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Quality control data reviewed: _

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BRAUN INTERTEC REPORT NO: 921365

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City of Bismarck

06-AUG-92

PROJECT: CFEX-91-0006 COLLECTED: Braun Intertec RECEIVED: 25-JUN-92

PARAMETER	Braun Intertec ID: Client ID: Matrix: Collect Date:	92-1365 MW-J Liquid 22-JUN-		92-136 MW-I Liquid 22-JUN		92-1365 MW-Q Liquid 23-JUN-		92-136 MW-P Liquid 23-JUN	
Nickel, Total Potassium, Total Sodium, Total Zinc, Total Antimony, Total		<0.02 8.7 930 0.02 <6	mg/L mg/L mg/L ug/L ug/L	<0.02 8.8 62 0.07 <6	mg/L mg/L mg/L ug/L	<0.02 8.2 1300 0.03 <6	mg/L mg/L mg/L mg/L ug/L	<0.02 9.1 390 0.04 <6	mg/L . mg/L . mg/L mg/L ug/L
Selenium, Total		<5.0	ug/L	<5.0	ug/L	<5.0	ug/L	<5.0	ug/L
Mercury, Total		<0.4	ug/L	<0.4	ug/L	<0.4	ug/L	<0.4	ug/L
Ammonia as N		2.8	mg/L	1.0	mg/L	2.0	mg/L	0.61	mg/L
Nitrate + Nitrite, as N		<0.02	mg/L	<0.02	mg/L	1.5	mg/L	<0.02	mg/L
Sulfate		1400	mg/L	270	mg/L	2000	mg/L	1200	mg/L
Total Phosphorus, as P		0.27	mg/L	0.55	mg/L	0.22	mg/L	0.18	mg/L

< = less than: compound not detected at or above indicated detection limit - = Analysis not required

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Quality control data reviewed:

City of Bismarck

PROJECT: CFEX-91-0006 COLLECTED: Braun Intertee RECEIVED: 25-JUN-92

PARAMETER	Braun Intertec ID: Client ID: Matrix: Collect Date:	92-1365 MW-FS Liquid 23-JUN	5	92-136 MW-F Liquid 23-JUN	D	92-1365 MW-A Liquid 23-JUN		92-136 MW-G Liquid 24-JUN		
2,3-Dichloro-1-propene 2-Chloroethyl Vinyl Ether Dichloroacetonitrile Pentachloroethane Acrylonitrile		<10 <10 <20 <10 <10	ug/L ug/L ug/L ug/L ug/L	<10 <10 <20 <10 <10	ug/L ug/L ug/L ug/L ug/L	<10 <10 <20 <10 <10	ug/L ug/L ug/L ug/L ug/L	<10 <10 <20 <10 <10	ug/L ug/L ug/L ug/L ug/L	-
Carbon Disulfide trans-1,4-Dichloro-2-butene Methyl Butyl Ketone Methyl Iodide Vinyl Acetate		<10 <10 <10 <10 <10	ug/L ug/L ug/L ug/L ug/L	<10 <10 <10 <10 <10	ug/L ug/L ug/L ug/L ug/L	<10 <10 <10 <10 <10	ug/L ug/L ug/L ug/L ug/L	<10 <10 <10 <10 <10	ug/L ug/L ug/L ug/L ug/L	
Dichlorodifluoromethane Chloromethane Vinyl Chloride Bromomethane Chloroethane		<5.0 <5.0 <1.0 <5.0 <1.0	ug/L ug/L ug/L ug/L ug/L	<5.0 <5.0 <1.0 <5.0 <1.0	ug/L ug/L ug/L ug/L ug/L	<5.0 <5.0 <5.0 <5.0 <1.0	ug/L ug/L ug/L ug/L ug/L	<5.0 <5.0 <1.0 <5.0 <1.0	ug/L ug/L ug/L ug/L ug/L	
Trichlorofluoromethane 1,1-Dichloroethylene Methylene Chloride trans-1,2-Dichloroethylene 1,1-Dichloroethane		<1.0 <1.0 <5.0 <0.2 <1.0	ug/L ug/L ug/L ug/L ug/L	<1.0 <1.0 <5.0 <0.2 <1.0	ug/L ug/L ug/L ug/L ug/L	<1.0 <1.0 <5.0 <0.2 <1.0	ug/L ug/L ug/L ug/L ug/L	<1.0 <1.0 <5.0 <0.2 <1.0	ug/L ug/L ug/L ug/L ug/L	
cis-1,2-Dichloroethylene Chloroform 1,1,1-Trichloroethane Carbon Tetrachloride 1,2-Dichloroethane		<0.2 <1.5 <2.0 <1.7 <0.3	ug/L ug/L ug/L ug/L ug/L	<0.2 <1.5 <2.0 <1.7 <0.3	ug/L ug/L ug/L ug/L ug/L	<0.2 <1.5 <2.0 <1.7 <0.3	ug/L ug/L ug/L ug/L ug/L	<0.2 <1.5 <2.0 <1.7 <0.3	ug/L ug/L ug/L ug/L ug/L	
Benzene 1,1,2-Trichloroethylene Bromodichloromethane Dibromomethane cis-1,3-Dichloro-1-Propene		<1.0 <0.5 <0.3 <5.0 <0.5	ug/L ug/L ug/L ug/L ug/L	<1.0 <0.5 <0.3 <5.0 <0.5	ug/L ug/L ug/L ug/L ug/L	<1.0 <0.5 <0.3 <5.0 <0.5	ug/L ug/L ug/L ug/L ug/L	<1.0 <0.5 <0.3 <5.0 <0.5	ug/L ug/L ug/L ug/L ug/L	
Toluene trans-1,3-Dichloro-1-propene 1,1,2-Trichloroethane 1,3-Dichloropropane Tetrachloroethylene		<1.0 <0.5 <1.2 <1.0 <1.0	ug/L ug/L ug/L ug/L ug/L	<1.0 <0.5 <1.2 <1.0 <1.0	ug/L ug/L ug/L ug/L ug/L	<1.0 <0.5 <1.2 <1.0 <1.0	ug/L ug/L ug/L ug/L ug/L	<1.0 <0.5 <1.2 <1.0 <1.0	ug/L ug/L ug/L ug/L ug/L	
Chlorodibromomethane Chlorobenzene 1,1,1,2-Tetrachloroethane Ethyl Benzene m,p-Xylene		<2.5 <1.0 <0.5 <1.0 <1.0	ug/L ug/L ug/L ug/L ug/L	<2.5 <1.0 <0.5 <1.0 <1.0	ug/L ug/L ug/L ug/L ug/L	<2.5 <1.0 <0.5 <1.0 <1.0	ug/L ug/L ug/L ug/L ug/L	<2.5 <1.0 <0.5 <1.0 <1.0	ug/L ug/L ug/L ug/L ug/L	
o-Xylene Bromoform Cumene 1,1,2,2-Tetrachloroethane 1,2,3-Trichloropropane	. •	<1.0 <0.5 <1.0 <1.2 <1.0	ug/L ug/L ug/L ug/L ug/L	<1.0 <0.5 <1.0 <1.2 <1.0	ug/L ug/L ug/L ug/L ug/L	<1.0 <0.5 <1.0 <1.2 <1.0	ug/L ug/L ug/L ug/L ug/L	<1.0 <0.5 <1.0 <1.2 <1.0	ug/L ug/L ug/L ug/L ug/L	
Bromochloromethane 1,2-Dibromo-3-Chloropropan 1,2-Dibromoethane Styrene	e	<1.0 <10 <0.2 <1.0	ug/L ug/L ug/L ug/L	<1.0 <10 <0.2 <1.0	ug/L ug/L ug/L ug/L	<1.0 <10 <0.2 <1.0	ug/L ug/L ug/L ug/L	<1.0 <10 <0.2 <1.0	ug/L ug/L ug/L ug/L	

< = less than: compound not detected at or above indicated detection limit</p>
- = Analysis not required

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Quality control data reviewed: _

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06-AUG-92

City of Bismarck Braun Intertec Environmental 913 S. 18th Street Bismarck, ND 58502

BRAUN INTERTEC REPORT NO: 921365

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PROJECT: CFEX-91-0006 COLLECTED: Braun Intertec RECEIVED: 25-JUN-92

PARAMETER	Braun Intertec ID: Client ID: Matrix: Collect Date:	92-1365 MW-FS Liquid 23-JUN		92-130 MW-F Liquid 23-JU	FD I	92-1365 MW-A Liquid 23-JUN		92-130 MW-0 Liquid 24-JU	3 · · · ·
1,3-Dichlorobenzene 1,4-Dichlorobenzene 1,2-Dichlorobenzene Dichlorofluoromethane Ethyl Ether		<1.5 <0.2 <0.2 <5.0 <1.0	ug/L ug/L ug/L ug/L ug/L	<1.5 <0.2 <0.2 <5.0 <1.0	ug/L	<1.5 <0.2 <0.2 <5.0 <1.0	ug/L ug/L ug/L ug/L ug/L	<1.5 <0.2 <0.2 <5.0 <1.0	ug/L ug/L
Trichlorotrifluoroethane Acetone Allyl Chloride (3-Chloropropyl Methyl Ethyl Ketone	lene)	<5.0 <50 <1.0 <5.0	ug/L ug/L ug/L ug/L	<5.0 <50 <1.0 <5.0	ug/L ug/L	<5.0 <50 <1.0 <5.0	ug/L ug/L ug/L ug/L	<5.0 <50 <1.0 <5.0	ug/L ug/L
Tetrahydrofuran Methyl Isobutyl Ketone		<5.0 <5.0	ug/L ug/L	<5.0 <5.0	ug/L ug/L	<5.0 <5.0	ug/L ug/L	<5.0 <5.0	ug/L ug/L
Alkalinity, Total Bicarbonate Alkalinity Carbonate Alkalinity Appearance Cation/Anion Balance		570 570 <4 e +1.1	mg/L mg/L mg/L %	780 710 72 f -2.5	mg/L mg/L mg/L %	860 860 <4 g -0.08	mg/L mg/L mg/L %	290 290 <4 h +1.3	mg/L mg/L mg/L %
Chloride Chemical Oxygen Demand Fluoride Hardness as CaCO3, Total pH		97 <25 0.23 350 7.5	mg/L mg/L mg/L mgEq/L Units	6.1 <25 0.88 100 8.6	mg/L mg/L mgEq/L Units	26 <25 0.93 240 8.0	mg/L mg/L mg/L mgEq/L Units	13 39 0.46 220 7.6	mg/L mg/L mg/L mgEq/L Units
Specific Conductance Total Dissolved Solids Temperature * Total Organic Carbon Total Suspended Solids		2600 un 1900 9.0 5.1 70	mhos/cm mg/L Deg. C mg/L mg/L	3800 2900 8.0 5.2 8	umhos/cm mg/L Deg. C mg/L mg/L	4700 un 3800 10 5.9 50	mhos/cm mg/L Deg. C mg/L mg/L	1600 1200 10 3.0 400	umhos/cm mg/L Deg. C mg/L mg/L
Arsenic, Total Beryllium, Total Cadmium, Total Cobalt, Total Chromium, Total		<2 <0.2 <0.2 31 6.3	ug/L ug/L ug/L ug/L ug/L	11 <0.2 <0.2 77 9.8	ug/L ug/L ug/L ug/L ug/L	<2 <0.2 100 17	ug/L ug/L ug/L ug/L ug/L	<2 <0.2 <0.2 16 10	ug/L ug/L
Lead, Total Thallium, Total Vanadium, Total Barium, Total Silver, Total	,	3 40 8.0 0.05 <0.01	ug/L ug/L ug/L mg/L mg/L	9 75 <2.0 0.04 0.01	ug/L ug/L ug/L mg/L mg/L	12 110 11 0.04 0.01	ug/L ug/L ug/L mg/L mg/L	3 20 18 0.14 <0.01	ug/L ug/L ug/L mg/L l mg/L
Calcium, Total Copper, Total Iron, Total Magnesium, Total Manganese, Total		63 0.01 2.0 48 0.07	mg/L mg/L mg/L mg/L mg/L	27 <0.01 0.70 8.7 0.15	mg/L mg/L mg/L mg/L mg/L	58 <0.01 2.1 24 0.07	mg/L mg/L mg/L mg/L mg/L	48 0.02 11 25 0.33	mg/L mg/L mg/L mg/L mg/L

e = Precipitate, lightly cloudy, light gray.
f = No precipitate, lightly cloudy, light tan.
g = Light precipitate, lightly cloudy, light gray.
h = Brown precipitate, lightly cloudy, gray.
* = Temperature as received by laboratory.

< = less than: compound not detected at or above indicated detection limit - = Analysis not required

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Quality control data reviewed:

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BRAUN INTERTEC REPORT NO: 921365

City of Bismarck

PROJECT: CFEX-91-0006 COLLECTED: Braun Intertec RECEIVED: 25-JUN-92

PARAMETER	Braun Intertec ID: Client ID: Matrix: Collect Date:	92-1365 MW-FS Liquid 23-JUN		92-1365 MW-FI Liquid 23-JUN)	92-1365 MW-A Liquid 23-JUN		92-136: MW-G Liquid 24-JUN	
Nickel, Total Potassium, Total Sodium, Total Zinc, Total Antimony, Total		<0.02 6.1 570 0.02 <6	mg/L mg/L mg/L ug/L	<0.02 4.2 1100 0.02 49	mg/L mg/L mg/L ug/L ug/L	<0.02 5.7 1300 0.02 <6	mg/L mg/L mg/L mg/L ug/L	<0.02 6.7 330 0.05 <6	mg/L mg/L mg/L mg/L ug/L
Selenium, Total		<5.0	ug/L	<5.0	ug/L	<5.0	ug/L	<5.0	ug/L
Mercury, Total		<0.4	ug/L	<0.4	ug/L	<0.4	ug/L	<0.4	ug/L
Ammonia as N		0.03	mg/L	2.2	mg/L	1.9	mg/L	0.03	mg/L
Nitrate + Nitrite, as N		16	mg/L	<0.02	mg/L	<0.02	mg/L	3.5	mg/L
Sulfate		840	mg/L	1500	mg/L	2100	mg/L	630	mg/L
Total Phosphorus, as P		0.06	mg/L	0.15	mg/L	0.20	mg/L	0.29	mg/L

< = less than: compound not detected at or above indicated detection limit - = Analysis not required

Quality control data reviewed:

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BRAUN INTERTEC REPORT NO: 921365

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City of Bismarck

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PROJECT: CFEX-91-0006 COLLECTED: Braun Intertee RECEIVED: 25-JUN-92

PARAMETER	Braun Intertec ID: Client ID: Matrix: Collect Date:	92-136 MW-M Liquid 24-JUN		92-130 MW-H Liquid 24-JU	I	92-136: Duplica Liquid			
2,3-Dichloro-1-propene		<10	ug/L	<10	ug/L	<10	ug/L		
2-Chloroethyl Vinyl Ether		<10	ug/L	<10	ug/L	<10	ug/L		
Dichloroacetonitrile		<20	ug/L	<20	ug/L	<20	ug/L		
Pentachloroethane		<10	ug/L	<10	ug/L	<10	ug/L		
Acrylonitrile		<10	ug/L	<10	ug/L	<10	ug/L		
Carbon Disulfide		<10	ug/L	<10	ug/L	<10	ug/L		
trans-1,4-Dichloro-2-butene		<10	ug/L	<10	ug/L	<10	ug/L		
Methyl Butyl Ketone		<10	ug/L	<10	ug/L	<10	ug/L		
Methyl Iodide		<10	ug/L	<10	ug/L	<10	ug/L		
Vinyl Acetate		<10	ug/L	<10	ug/L	<10	ug/L		
Dichlorodifluoromethane		<5.0	ug/L	<5.0	ug/L	< 5.0	ug/L		
Chloromethane		< 5.0	ug/L	<5.0	ug/L	< 5.0	ug/L		
Vinyl Chloride		<1.0	ug/L	<1.0	ug/L	<1.0	ug/L		
Bromomethane		< 5.0	ug/L	< 5.0	ug/L	< 5.0	ug/L		
Chloroethane		<1.0	ug/L	<1.0	ug/L	<1.0	ug/L		
Trichlorofluoromethane 1,1-Dichloroethylene		<1.0 <1.0	ug/L ug/L	<1.0 <1.0	ug/L	<1.0	ug/L		
Methylene Chloride		<5.0	ug/L ug/L	<5.0	ug/L ug/L	<1.0 <5.0	ug/L ug/L		
trans-1,2-Dichloroethylene		< 0.2	ug/L	< 0.2	ug/L	< 0.2	ug/L		
1,1-Dichloroethane		<1.0	ug/L	<1.0	ug/L	<1.0	ug/L		
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cis-1,2-Dichloroethylene Chloroform		<0.2 <1.5	ug/L	< 0.2	ug/L	< 0.2	ug/L		
1,1,1-Trichloroethane		<2.0	ug/L ug/L	<1.5 <2.0	ug/L ug/L	<1.5 <2.0	ug/L ug/L		
Carbon Tetrachloride		<1.7	ug/L ug/L	<1.7	ug/L	<1.7	ug/L ug/L		
1,2-Dichloroethane		< 0.3	ug/L	< 0.3	ug/L	< 0.3	ug/L		
Deserve			-				-		
Benzene 1,1,2-Trichloroethylene		<1.0	ug/L	<1.0	ug/L	<1.0	ug/L		
Bromodichloromethane		<0.5 <0.3	ug/L ug/L	<0.5 <0.3	ug/L ug/L	<0.5 <0.3	ug/L		
Dibromomethane		< 5.0	ug/L ug/L	<5.0	ug/L	< 5.0	ug/L ug/L		
cis-1,3-Dichloro-1-Propene		< 0.5	ug/L	< 0.5	ug/L	< 0.5	ug/L		
			-		_		-		
Toluene trans-1,3-Dichloro-1-propene		<1.0 <0.5	ug/L ug/L	<1.0	ug/L	<1.0	ug/L		
1,1,2-Trichloroethane		<1.2	ug/L ug/L	<0.5 <1.2	ug/L ug/L	<0.5 <1.2	ug/L ug/L		
1,3-Dichloropropane		<1.0	ug/L	<1.0	ug/L	<1.0	ug/L		
Tetrachloroethylene		<1.0	ug/L	<1.0	ug/L	<1.0	ug/L		
Chlorodibromomethane		40 E		10.5	7	10.5			
Chlorobenzene		<2.5 <1.0	ug/L	<2.5 <1.0	ug/L	<2.5	ug/L		
1,1,1,2-Tetrachloroethane		< 0.5	ug/L ug/L	< 0.5	ug/L ug/L	<1.0 <0.5	ug/L ug/L		
Ethyl Benzene		<1.0	ug/L	<1.0		<1.0	ug/L		
m,p-Xylene		<1.0	ug/L	<1.0	ug/L	<1.0	ug/L		
-Yulene			-		-				
o-Xylene Bromoform		<1.0 <0.5	ug/L ug/L	<1.0	ug/L	<1.0	ug/L		
Cumene		<1.0	ug/L ug/L	<0.5 <1.0		<0.5 <1.0	ug/L ug/I		
1,1,2,2-Tetrachloroethane		<1.2	ug/L ug/L	<1.2		<1.2	ug/L ug/L		
1,2,3-Trichloropropane		<1.0	ug/L	<1.0	ug/L	<1.0	ug/L		
Bromochloromethane		~1.0	<u>ие</u> П	~1 0		~10	-		
1,2-Dibromo-3-Chloropropan	•	<1.0 <10	ug/L ug/L	<1.0 <10	ug/L ug/L	<1.0 <10	ug/L vo/I		
1,2-Dibromoethane		<0.2	ug/L ug/L	< 0.2		< 0.2	ug/L ug/L		
Styrene		<1.0	ug/L	<1.0		<1.0	ug/L		
			-		-		-		

< = less than: compound not detected at or above indicated detection limit</p>
- = Analysis not required

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Quality control data reviewed: _____

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City of Bismarck

BRAUN INTERTEC REPORT NO: 921365

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PROJECT: CFEX-91-0006 COLLECTED: Braun Intertec RECEIVED: 25-JUN-92

PARAMETER	Braun Intertec ID: Client ID: Matrix: Collect Date:	92-1365 MW-M Liquid 24-JUN		92-136 MW-H Liquid 24-JUN		92-1365 Duplicat Liquid		
1,3-Dichlorobenzene		<1.5	ug/L	<1.5	ug/L	<1.5	ug/L	
1,4-Dichlorobenzene 1,2-Dichlorobenzene		<0.2 <0.2	ug/L	<0.2 <0.2	ug/L	< 0.2	ug/L	
Dichlorofluoromethane		< 5.0	ug/L ug/L	< 5.0	ug/L ug/L	<0.2 <5.0	ug/L ug/L	
Ethyl Ether		<1.0	ug/L	<1.0	ug/L	<1.0	ug/L	
Trichlorotrifluoroethane		<5.0	ug/L	< 5.0	ug/L	<5.0	ug/L	
Acetone	_	<50	ug/L	<50	ug/L	< 50	ug/L	
Allyl Chloride (3-Chloropropy	ylene)	<1.0	ug/L	<1.0	ug/L	<1.0	ug/L	
Methyl Ethyl Ketone		<5.0	ug/L	<5.0	ug/L	<5.0	ug/L	
Tetrahydrofuran		<5.0	ug/L	< 5.0	ug/L	< 5.0	ug/L.	
Methyl Isobutyl Ketone		<5.0	ug/L	<5.0	ug/L	<5.0	ug/L	
Alkalinity, Total		160	mg/L	190	mg/L	460	mg/L	
Bicarbonate Alkalinity		160	mg/L	190	mg/L	460	mg/L	
Carbonate Alkalinity		<4	mg/L	<4	mg/L	<4	mg/L	
Appearance		i		j		k	-	
Cation/Anion Balance		-18	%	-13	%	-11	%	
Chloride		4.8	mg/L	2.4	mg/L	1.8	mg/L	
Chemical Oxygen Demand		44	mg/L	58	mg/L	98	mg/L	
Fluoride		0.34	mg/L	0.26	mg/L	0.18	mg/L	
Hardness as CaCO3, Total pH		190	mgEq/L	120	mgEq/L	640	mgEq/L	
· · · · ·		7.6	Units	7.5	Units	6.8	Units	
Specific Conductance			hos/cm		nhos/cm	1100 ur		
Total Dissolved Solids		230	mg/L	290	mg/L	760	mg/L	
Temperature *		9.0	Deg. C	9.0	Deg. C	10	Deg. C	
Total Organic Carbon		1.4	mg/L	1.4	mg/L	1.4	mg/L	
Total Suspended Solids		710	mg/L	370	mg/L	890	mg/L	
Arsenic, Total		4	ug/L	2	ug/L	2	ug/L	
Beryllium, Total		< 0.2	ug/L	0.4	ug/L	< 0.2	ug/L	
Cadmium, Total		< 0.2	ug/L	< 0.2	ug/L	0.8	ug/L	
Cobalt, Total Chromium, Total		7.0 4.5	ug/L	10 5.0	ug/L	8.0 5.2	ug/L ug/T	
		4.J	ug/L	5.0	ug/L	J.2	ug/L	
Lead, Total		4	ug/L	2	ug/L	4	ug/L	
Thallium, Total		2.0	ug/L	2.0	ug/L	4.0	ug/L	
Vanadium, Total Barium, Total		13	ug/L	9.0	ug/L	23	ug/L	
Silver, Total		0.28 <0.01	mg/L mg/L	0.22 <0.01	mg/L mg/L	0.47 <0.01	mg/L mg/L	
Calcium, Total		40	mg/L	24	mg/L	120	mg/L	
Copper, Total		0.02	mg/L mg/L	0.02	mg/L mg/L	0.02	mg/L mg/L	
Iron, Total		21	mg/L	18	mg/L	28	mg/L	
Magnesium, Total		23	mg/L	14	mg/L	83	mg/L	
Manganese, Total		0.44	ng/L	0.31	mg/L	2.2	mg/L	
				*				

i = Brown precipitate, cloudy, light brown.
j = Brown precipitate, cloudy, light brown.
k = Brown precipitate, very cloudy, brownish.
* = Temperature as received by laboratory.

< = less than: compound not detected at or above indicated detection limit - = Analysis not required

Quality control data reviewed:

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City of Bismarck

PROJECT: CFEX-91-0006 COLLECTED: Braun Intertec RECEIVED: 25-JUN-92

PARAMETER	Braun Intertec ID: Client ID: Matrix: Collect Date:	92–1365 MW-M Liquid 24–JUN		92-136 MW-H Liquid 24-JUN		2-1365-1 Duplicat Liquid	
Nickel, Total		<0.02	mg/L	<0.02	mg/L	<0.02	mg/L
Potassium, Total		7.3	mg/L	6.0	mg/L	8.7	mg/L
Sodium, Total		37	mg/L	84	mg/L	67	mg/L
Zinc, Total		0.07	mg/L	0.07	ug/L	0.06	mg/L
Antimony, Total		<6	ug/L	<6	ug/L	<6	ug/L
Selenium, Total		<5.0	ug/L	<5.0	ug/L	<5.0	ug/L
Mercury, Total		<0.4	ug/L	<0.4	ug/L	<0.4	ug/L
Ammonia as N	·	0.05	mg/L	0.17	mg/L	1.0	mg/L
Nitrate + Nitrite, as N		0.06	mg/L	0.05	mg/L	<0.02	mg/L
Sulfate		26	mg/L	40	mg/L	170	mg/L
Total Phosphorus, as P		0.32	mg/L	0.37	mg/L	0.54	mg/L

< = less than: compound not detected at or above indicated detection limit - = Analysis not required

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Quality control data reviewed:

BRAUN INTERTEC REPORT NO: 921404

Page 2

City of Bismarck						COLLECT	CT: CFE ED: Brau ED: 29-J	EX-91-000 in Intertec IUN-92	6	•
PARAMETER	Braun Intertec ID: Client ID: Matrix:	92-1404 MW-DI Liquid)	92-140 MS-DS Liquid	5	92-1404 MW-CE Liquid)	92-140 MW-C Liquid		
	Collect Date:	24-JUN	-92	24-JUN	N-92	24-JUN	-92	24-JUN	1-92	
2,3-Dichloro-1-propene		<10	ug/L	<10	ug/L	<10	ug/L	<10		
2-Chloroethyl Vinyl Ether		<10	ug/L	<10	ug/L	<10	ug/L	<10	ug/L ug/L	
Dichloroacetonitrile Pentachloroethane		<20 <10	ug/L	<20	ug/L	<20	ug/L	<20	ug/L	
Acrylonitrile		<10	ug/L ug/L	<10 <10	ug/L ug/L	<10 <10	ug/L ug/L	<10 <10	ug/L ug/L	
Carbon Disulfide		<10	ug/L	<10	ug/L	<10	ug/L	<10		
Methyl Butyl Ketone		<10	ug/L	<10	ug/L	<10	ug/L	<10	ug/L ug/L	
trans-1,4-Dichloro-2-butene		<10	ug/L	<10	ug/L	<10	ug/L	<10	ug/L	
Methyl Iodide Vinyl Acetate		<10	ug/L	<10	ug/L	<10	ug/L	<10	ug/L	
·		<10	ug/L	<10	ug/L	<10	ug/L	<10	ug/L	
Dichlorodifluoromethane Chloromethane		<5.0	ug/L	<5.0	ug/L	<5.0	ug/L	<5.0	ug/L	
Vinyl Chloride		<5.0 <1.0	ug/L ug/L	<5.0 <1.0	ug/L ug/L	< 5.0	ug/L	<5.0	ug/L	
Bromomethane		<5.0	ug/L ug/L	< 5.0	ug/L ug/L	<1.0 <5.0	ug/L ug/L	<1.0 <5.0	ug/L ug/L	
Chloroethane		<1.0	ug/L	<1.0	ug/L	<1.0	ug/L	<1.0	ug/L ug/L	
Trichlorofluoromethane		<1.0	ug/L	<1.0	ug/L	<1.0	ug/L	<1.0	ug/L	
1,1-Dichloroethylene		<1.0	ug/L	<1.0	ug/L	<1.0	ug/L	<1.0	ug/L	
Methylene Chloride trans-1,2-Dichloroethylene		<5.0	ug/L	<5.0	ug/L	<5.0	ug/L	<5.0	ug/L	
1,1-Dichloroethane		<0.2 <1.0	ug/L ug/L	<0.2 <1.0	ug/L ug/L	<0.2 <1.0	ug/L ug/L	<0.2 <1.0	ug/L ug/L	
cis-1,2-Dichloroethylene		<0.2	ug/L	<0.2		-02	-		-	
Chloroform		<1.5	ug/L	<1.5	ug/L ug/L	<0.2 <1.5	ug/L ug/L	<0.2 <1.5	ug/L ug/L	
1,1,1-Trichloroethane		<2.0	ug/L	<2.0	ug/L	<2.0	ug/L	<2.0	ug/L	
Carbon Tetrachloride		<1.7	ug/L	<1.7	ug/L	<1.7	ug/L	<1.7	ug/L	
1,2-Dichloroethane		<0.3	ug/L	<0.3	ug/L	<0.3	ug/L	<0.3	ug/L	
Benzene		<1.0	ug/L	<1.0	ug/L	<1.0	ug/L	<1.0	ug/L	
1,1,2-Trichloroethylene Bromodichloromethane		< 0.5	ug/L	<0.5	ug/L	<0.5	ug/L	< 0.5	ug/L	
Dibromomethane		<0.3 <5.0	ug/L ug/L	<0.3 <5.0	ug/L	<0.3 <5.0	ug/L	< 0.3	ug/L	
cis-1,3-Dichloro-1-Propene		<0.5	ug/L	<0.5	ug/L ug/L	< 0.5	ug/L ug/L	<5.0 <0 <i>.</i> 5	ug/L ug/L	
Toluene		<1.0	ug/L	<1.0	ug/L	<1.0	ug/L	<1.0	- 	
trans-1,3-Dichloro-1-propene	\$	< 0.5	ug/L	< 0.5	ug/L	< 0.5	ug/L	< 0.5	ug/L ug/L	
1,1,2-Trichloroethane		<1.2	ug/L	<1.2	ug/L	<1.2	ug/L	<1.2	ug/L	
1,3-Dichloropropane Tetrachloroethylene		<1.0	ug/L	<1.0		<1.0	ug/L	<1.0	ug/L	
-		<1.0	ug/L	<1.0	ug/L	<1.0	ug/L	<1.0	ug/L	
Chlorodibromomethane		<2.5	ug/L	<2.5	ug/L	<2.5	ug/L	<2.5	ug/L	
Chlorobenzene 1,1,1,2-Tetrachloroethane		<1.0	ug/L	<1.0		<1.0	ug/L	<1.0	ug/L	
Ethyl Benzene		<0.5 <1.0	ug/L ug/L	<0.5 <1.0	-	< 0.5	ug/L	< 0.5	ug/L	
m,p-Xylene		<1.0	ug/L	<1.0		<1.0 <1.0	ug/L ug/L	<1.0 <1.0	ug/L ug/L	
o-Xylene		<1.0	ug/L	<1.0	ug/L	<1.0	ug/L	<1.0	ug/L	
Bromoform		<0.5	ug/L	< 0.5		<0.5	ug/L ug/L	<0.5	ug/L ug/L	
Cumene		<1.0	ug/L	<1.0	ug/L	<1.0	ug/L	<1.0	ug/L	
1,1,2,2-Tetrachloroethane 1,2,3-Trichloropropare		<1.2 <1.0	ug/L ug/L	<1.2 <1.0		<1.2 <1.0	ug/L ug/L	<1.2 <1.0	ug/L	
••					-				ug/L	
Bromochloromethane 1,2-Dibromo-3-chloropropan	•	<1.0	ug/L	<1.0	ug/L	<1.0	ug/L	<1.0	ug/L	
1,2-Dibromoethane	10	<0.2 <1.0	ug/L ug/L	<0.2 <1.0		< 0.2	ug/L	< 0.2	ug/L	
Styrene	•	<10	ug/L ug/L	<10	ug/L ug/L	<1.0 <10	ug/L ug/L	<1.0 <10	ug/L ug/L	
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< = less than: compound not detected at or above indicated detection limit - = Analysis not required

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Quality control data reviewed:

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BRAUN INTERTEC REPORT NO: 921404

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City of Bismarck

City of Bismarck		4	PROJECT: CFE COLLECTED: Bran RECEIVED: 29-	in Intertec
Braun Intertec ID: Client ID: Matrix: PARAMETER Collect Date:	92-1404-01 MW-DD Liquid 24-JUN-92	92-1404-02 MS-DS Liquid 24-JUN-92	92-1404-03 MW-CD Liquid 24-JUN-92	92-1404-04 MW-CS Liquid 24-JUN-92
·····				
1,3-Dichlorobenzene 1,4-Dichlorobenzene 1,2-Dichlorobenzene Dichlorofluoromethane Ethyl Ether	<1.5 ug/L <0.2 ug/L <0.2 ug/L <5.0 ug/L <1.0 ug/L	<0.2 ug/L <0.2 ug/L <5.0 ug/L	<1.5 ug/L <0.2 ug/L <0.2 ug/L <5.0 ug/L <1.0 ug/L	<1.5 ug/L <0.2 ug/L <0.2 ug/L <5.0 ug/L <1.0 ug/L
Trichlorotrifluoroethane Acetone Allyl Chloride (3-Chloropropylene) Methyl Tertiary Butyl Ether Methyl Ethyl Ketone	<5.0 ug/L <50 ug/L <1.0 ug/L <1.0 ug/L <5.0 ug/L	<50 ug/L <1.0 ug/L <1.0 ug/L	<5.0 ug/L <50 ug/L <1.0 ug/L <1.0 ug/L <5.0 ug/L	<5.0 ug/L <50 ug/L <1.0 ug/L <1.0 ug/L <5.0 ug/L
Tetrahydrofuran Methyl Isobutyl Ketone	<5.0 ug/L <5.0 ug/L		<5.0 ug/L <5.0 ug/L	<5.0 ug/L <5.0 ug/L
Alkalinity, Total Bicarbonate Alkalinity Carbonate Alkalinity Appearance Cation/Anion Balance	620 mg/L 620 mg/L <4.0 mg/L a 4.4 %	, 390 mg/L	730 mg/L 730 mg/L <4.0 mg/L c 2.5 %	1100 mg/L 1100 mg/L <4.0 mg/L d -1.3 %
Chloride Chemical Oxygen Demand Fluoride Hardness as CaCO3, Total pH	9.0 mg/I <25 mg/I 0.61 mg/I 260 mgE 7.5 Units	, <25 mg/L , 0.16 mg/L q/L 450 mgEq/L	12 mg/L <25 mg/L 0.94 mg/L 220 mgEq/L 7.8 Units	140 mg/L 44 mg/L 0.26 mg/L . 2200 mgEq/L 7.0 Units
Specific Conductance Total Dissolved Solids Temperature * Total Organic Carbon Total Suspended Solids	2600 umhos/c 1900 mg/L 13 Deg. 1.7 mg/L 8 mg/L	C 13 mg/L C 13 Deg. C 1.7 mg/L	2400 umhos/cm 1800 mg/L 13 Deg. C 6.7 mg/L 200 mg/L	6600 umhos/cm 6500 mg/L 12 Deg. C 15 mg/L 550 mg/L
Antimony, Total Arsenic, Total Barium, Total Beryllium, Total Cadmium, Total	<0.0 mg/L <2.0 ug/L 0.03 mg/L <0.2 ug/L <0.2 ug/L	3.0 ug/L	<6.0 mg/L 8.0 ug/L 0.12 mg/L 0.4 ug/L <0.2 ug/L	<6.0 mg/L 7.0 ug/L 0.26 mg/L 0.8 ug/L 0.3 ug/L
Calcium, Total Chromium, Total Cobalt, Total Copper, Total Iron, Total	55 mg/L 5.2 ug/L 39 ug/L <0.01 mg/L 0.5 mg/L	3.7 ug/L 10 ug/L 0.03 mg/L	50 mg/L 6.4 ug/L 31 ug/L 0.02 mg/L 8.0 mg/L	360 mg/L 22 ug/L 99 ug/L 0.05 mg/L 25 mg/L
Lead, Total Magnesium, Total Manganese, Total Mercury, Total Nickel, Total	4 ug/L 30 mg/L 0.29 mg/L <0.4 ug/L <0.02 mg/L	0.84 mg/L <0.4 ug/L	6 ug/L 23 mg/L 0.40 mg/L <0.4 ug/L <0.02 mg/L	8 ug/L 310 mg/L 1.0 mg/L <0.4 ug/L 0.03 mg/L

a = No precipitate, clear, light gray, slight odor.
b = Heavy dark brown precipitate, light tan and brown in color, very cloudy, slight odor.
c = Light precipitate, cloudy, brown, slight odor.
d = Light precipitate, cloudy, brown, slight odor.
* Temperature was taken upon receipt in the laboratory.

< = less than: compound not detected at or above indicated detection limit - = Analysis not required

Quality control data reviewed:

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City of Bismarck				5.)6 5			
PARAMETER	Braun Intertec ID: Client ID: Matrix: Collect Date:	92-1404 MW-DE Liquid 24-JUN-)	92-1404 MS-DS Liquid 24-JUN		92-1404 MW-CD Liquid 24-JUN)	92-140 MW-C Liquid 24-JUN	S
Potassium, Total Selenium, Total Silver, Total Sodium, Total Thallium, Total		5.6 <5.0 <0.01 580 40	mg/L ug/L mg/L ug/L ug/L	7.9 <5.0 <0.01 120 6.0	mg/L ug/L mg/L ug/L ug/L	6.8 <5.0 <0.01 560 34	mg/L ug/L mg/L mg/L ug/L	5.7 <5.0 0.02 1300 68	mg/L ug/L mg/L mg/L ug/L
Vanadium, Total Zinc, Total		6.0 <0.02	ug/L mg/L	22 0.14	ug/L mg/L	13 0.05	ug/L mg/L	64 0.09	ug/L mg/L
Ammonia as N Nitrate + Nitrite, as N Sulfate Total Phosphorus, as P		1.4 <0.02 1000 0.03	mg/L mg/L mg/L	0.17 <0.02 350 0.17	mg/L mg/L mg/L mg/L	1.6 0.04 740 1.1	mg/L mg/L mg/L mg/L	0.06 0.11 3400 0.66	mg/L mg/L mg/L mg/L

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< = less than: compound not detected at or above indicated detection limit - = Analysis not required

IRO Quality control data reviewed:

Page 4

BRAUN INTERTEC REPORT NO: 921404

City of Bismarck

	RECEIVED: 29-JUN-92									
PARAMETER	Braun Intertec ID: Client ID: Matrix: Collect Date:	92-1404 MS-OS Liquid 25-JUN		92-140 MW-N Liquid 25-JUN		92-1404 MW-EI Liquid 25-JUN)	92-140 MW-E Liquid 25-JUN	S	
2,3-Dichloro-1-propene 2-Chloroethyl Vinyl Ether Dichloroacetonitrile Pentachloroethane Acrylonitrile		<10 <10 <20 <10 <10	ug/L ug/L ug/L ug/L ug/L	<10 <10 <20 <10 <10	ug/L ug/L ug/L ug/L ug/L	<10 <10 <20 <10 <10	ug/L ug/L ug/L ug/L ug/L	<10 <10 <20 <10 <10	ug/L ug/L ug/L ug/L ug/L	
Carbon Disulfide Methyl Butyl Ketone trans-1,4-Dichloro-2-butene Methyl Iodide Vinyl Acetate		<10 <10 <10 <10 <10	ug/L ug/L ug/L ug/L ug/L	<10 <10 <10 <10 <10	ug/L ug/L ug/L ug/L ug/L	<10 <10 <10 <10 <10	ug/L ug/L ug/L ug/L ug/L	<10 <10 <10 <10 <10	ug/L ug/L ug/L ug/L ug/L	
Dichlorodifluoromethane Chloromethane Vinyl Chloride Bromomethane Chloroethane		<5.0 <5.0 <1.0 <5.0 <1.0	ug/L ug/L ug/L ug/L ug/L	<5.0 <5.0 <1.0 <5.0 <1.0	ug/L ug/L ug/L ug/L ug/L	<5.0 <5.0 <1.0 <5.0 <1.0	ug/L ug/L ug/L ug/L ug/L	<5.0 <5.0 <1.0 <5.0 <1.0	ug/L ug/L ug/L ug/L ug/L	
Trichlorofluoromethane 1,1-Dichloroethylene Methylene Chloride trans-1,2-Dichloroethylene 1,1-Dichloroethane		<1.0 <1.0 <5.0 <0.2 <1.0	ug/L ug/L ug/L ug/L ug/L	<1.0 <1.0 <5.0 <0.2 <1.0	ug/L ug/L ug/L ug/L ug/L	<1.0 <1.0 <5.0 <0.2 <1.0	ug/L ug/L ug/L ug/L ug/L	<1.0 <1.0 <5.0 <0.2 <1.0	ug/L ug/L ug/L ug/L ug/L	
cis-1,2-Dichloroethylene Chloroform 1,1,1-Trichloroethane Carbon Tetrachloride 1,2-Dichloroethane		<0.2 <1.5 <2.0 <1.7 <0.3	ug/L ug/L ug/L ug/L ug/L	<0.2 <1.5 <2.0 <1.7 <0.3	ug/L ug/L ug/L ug/L ug/L	<0.2 <1.5 <2.0 <1.7 <0.3	ug/L ug/L ug/L ug/L ug/L	<0.2 <1.5 <2.0 <1.7 <0.3	ug/L ug/L ug/L ug/L ug/L	
Benzene 1,1,2-Trichloroethylene Bromodichloromethane Dibromomethane cis-1,3-Dichloro-1-Propene		<1.0 <0.5 <0.3 <5.0 <0.5	ug/L ug/L ug/L ug/L ug/L	<1.0 <0.5 <0.3 <5.0 <0.5	ug/L ug/L ug/L ug/L ug/L	<1.0 <0.5 <0.3 <5.0 <0.5	ug/L ug/L ug/L ug/L ug/L	<1.0 <0.5 <0.3 <5.0 <0.5	ug/L ug/L ug/L ug/L ug/L	
Toluene trans-1,3-Dichloro-1-propene 1,1,2-Trichloroethane 1,3-Dichloropropane Tetrachloroethylene		<1.0 <0.5 <1.2 <1.0 <1.0	ug/L ug/L ug/L ug/L ug/L	<1.0 <0.5 <1.2 <1.0 <1.0	ug/L ug/L ug/L ug/L ug/L	<1.0 <0.5 <1.2 <1.0 <1.0	ug/L ug/L ug/L ug/L ug/L	<1.0 <0.5 <1.2 <1.0 <1.0	ug/L ug/L ug/L ug/L ug/L	
Chlorodibromomethane Chlorobenzene 1,1,1,2-Tetrachloroethane Ethyl Benzene m,p-Xylene	۰. ۲.	<2.5 <1.0 <0.5 <1.0 <1.0	ug/L ug/L ug/L ug/L ug/L	<2.5 <1.0 <0.5 <1.0 <1.0	ug/L ug/L ug/L ug/L ug/L	<2.5 <1.0 <0.5 <1.0 <1.0	ug/L ug/L ug/L ug/L ug/L	<2.5 <1.0 <0.5 <1.0 <1.0	ug/L ug/L ug/L ug/L ug/L	
o-Xylene Bromoform Cumene 1,1,2,2-Tetrachloroethane 1,2,3-Trichloropropane		<1.0 <0.5 <1.0 <1.2 <1.0	ug/L ug/L ug/L ug/L ug/L	<1.0 <0.5 <1.0 <1.2 <1.0	ug/L ug/L ug/L	<1.0 <0.5 <1.0 <1.2 <1.0	ug/L ug/L ug/L ug/L ug/L	<1.0 <0.5 <1.0 <1.2 <1.0	ug/L ug/L ug/L	
Bromochloromethane 1,2-Dibromo-3-chloropropan 1,2-Dibromoethane Styrene	8	<1.0 <0.2 <1.0 <10	ug/L ug/L ug/L ug/L	<1.0 <0.2 <1.0 <10	ug/L ug/L ug/L ug/L	<1.0 <0.2 <1.0 <10	ug/L ug/L ug/L ug/L	<1.0 <0.2 <1.0 <10	ug/L	

< = less than: compound not detected at or above indicated detection limit - = Analysis not required

Quality control data reviewed:

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BRAUN INTERTEC REPORT NO: 921404

City of Bismarck					C	OLLECTI	T: CFEX ED: Braun ED: 29-JU	Intertec	5
PARAMETER	Braun Intertee ID: Client ID: Matrix: Collect Date:	92-1404- MS-OS Liquid		92-1404 MW-N Liquid	-	92-1404 MW-ED Liquid		92-1404 MW-ES Liquid	
	Confect Date:	25-JUN-9	92	25-JUN	-92	25-JUN-	92	25-JUN	-92
1,3-Dichlorobenzene 1,4-Dichlorobenzene 1,2-Dichlorobenzene Dichlorofluoromethane	-	<1.5 <0.2 <0.2	ug/L ug/L ug/L	<1.5 <0.2 <0.2	ug/L ug/L ug/L	<1.5 <0.2 <0.2	ug/L ug/L ug/L	<1.5 <0.2 <0.2	ug/L ug/L ug/L
Ethyl Ether		<5.0 <1.0	ug/L ug/L	<5.0 <1.0	ug/L ug/L	<5.0 <1.0	ug/L ug/L	<5.0 <1.0	ug/L ug/L
Trichlorotrifluoroethane Acetone		<5.0 <50	ug/L ug/L	<5.0 <50	ug/L ug/L	<5.0 <50	ug/L ug/L	<5.0 <50	ug/L ug/L
Allyl Chloride (3-Chloroprop	ylene)	<1.0	ug/L	<1.0	ug/L	<1.0	ug/L	<1.0	ug/L.
Methyl Tertiary Butyl Ether Methyl Ethyl Ketone		<1.0 <5.0	ug/L ug/L	<1.0 <5.0	ug/L ug/L	<1.0 <5.0	ug/L ug/L	<1.0 <5.0	ug/L ug/L
Tetrahydrofuran Methyl Isobutyl Ketone		<5.0 <5.0	ug/L ug/L	<5.0 <5.0	ug/L ug/L	<5.0 <5.0	ug/L ug/L	<5.0 <5.0	ug/L ug/L
Alkalinity, Total Bicarbonate Alkalinity		770 770	mg/L mg/L	1000 1000	mg/L mg/L	850 810	mg/L mg/L	870 870	mg/L mg/L
Carbonate Alkalinity		<4.0	mg/L	<4.0	mg/L	40	mg/L	<4.0	mg/L
Appearance Cation/Anion Balance		е 3.6	%	f 1.2	%	g 0.35	%	h -1.8	%
Chloride Chemical Oxygen Demand Fluoride Hardness as CaCO3, Total pH		3.9 <25 0.21 280 7.3	mg/L mg/L mgEq/L Units	5.6 <25 0.30 240 7.3	mg/L mg/L mg/L mgEq/L Units	41 <25 1.2 280 8.4	mg/L mg/L mgEq/L Units	15 <25 0.21 1100 6.9	mg/L mg/L mg/L mgEq/L Units
Specific Conductance Total Dissolved Solids Temperature *		3600 ur 2800 13	mhos/cm mg/L Deg. C	3500 2700 13	mg/L Deg. C	3200 u 2400 13	mhos/cm mg/L	6800 u 6000 13	mhos/cm mg/L
Total Organic Carbon Total Suspended Solids		1.8 120	mg/L mg/L	2.1 110	mg/L mg/L	5.4 270	Deg. C mg/L mg/L	3.4 290	Deg. C mg/L mg/L
Antimony, Total Arsenic, Total Barium, Total Beryllium, Total Cadmium, Total		<6.0 3 0.07 <0.2 <0.2	mg/L ug/L tt mg/L ug/L ug/L	<6.0 7 0.09 <0.2 <0.2	mg/L ug/L mg/L ug/L ug/L	<6.0 12 0.21 0.9 <0.2	mg/L ug/L mg/L ug/L ug/L	<6.0 <2 0.09 0.6 0.2	mg/L ug/L mg/L ug/L ug/L
Calcium, Total Chromium, Total Cobalt, Total Copper, Total Iron, Total		68 7.8 63 0.02 2.9	mg/L ug/L ug/L mg/L mg/L	58 37 48 0.01 3.6	mg/L ug/L ug/L mg/L mg/L	92 32 39 0.03 15	mg/L ug/L ug/L mg/L mg/L	220 38 100 0.02 8.0	mg/L ug/L ug/L mg/L mg/L
Lead, Total Magnesium, Total Manganese, Total Mercury, Total Nickel, Total		5 27 0.25 <0.4 <0.02	ug/L mg/L mg/L ug/L mg/L	5 23 0.9 <0.4 <0.02	ug/L mg/L mg/L ug/L mg/L	5 13 0.45 <0.4 0.02	ug/L mg/L mg/L ug/L mg/L	<2 130 0.5 <0.4 <0.02	ug/L mg/L mg/L ug/L mg/L

e = Very light precipitate, slightly cloudy, gray-brown, slight odor.
f = Very light precipitate, slightly cloudy, gray-brown, slight odor.
g = Light precipitate, cloudy, yellow-gray, slight odor.
h = Precipitate, cloudy, yellow-brown, slight odor.
t = See discussion.

* Temperature was taken upon receipt in the laboratory.

< = less than: compound not detected at or above indicated detection limit - = Analysis not required

Quality control data reviewed:

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City of Bismarck		PROJECT: CFEX-91-0006 COLLECTED: Braun Intence RECEIVED: 29-JUN-92									
PARAMETER	Braun Intertec ID: Client ID: Matrix: Collect Date:	92-1404-05 MS-OS Liquid 25-JUN-92		92-1404-06 MW-N Liquid 25-JUN-92		MW-ED Liquid	92-1404-07 MW-ED Liquid 25-JUN-92		4-08 S I-92		
Potassium, Total Selenium, Total Silver, Total Sociium, Total Thallium, Total		6.8 <5.0 0.01 880 70	mg/L ug/L mg/L mg/L ug/L kk	6.9 <5.0 0.01 890 60	mg/L ug/L mg/L ug/L ug/L	5.5 <5.0 0.01 840 55	mg/L ug/L mg/L mg/L ug/L	11 <5.0 0.02 1600 120	mg/L ug/L mg/L mg/L ug/L		
Vanadium, Total Zinc, Total		8.0 0.04	ug/L mg/L	19 0.05	ug/L mg/L	36 0.1	ug/L mg/L	37 0.06	ug/L mg/L		
Ammonia as N Nitrate + Nitrite, as N Sulfate Total Phosphorus, as P		0.24 <0.02 1500 0.32	mg/L mg/L mg/L mg/L	0.64 <0.02 1200 0.12	mg/L mg/L mg/L mg/L	1.0 <0.02 1100 0.50	mg/L mg/L mg/L mg/L.	1.4 0.20 3400 0.27	mg/L mg/L mg/L mg/L		

17. J. 198

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kk = See discussion.

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< = less than: compound not detected at or above indicated detection limit - = Analysis not required

Quality control data reviewed:



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BRAUN INTERTEC REPORT NO: 921434

City of Bismarck

PROJECT: CFEX-91-0006 COLLECTED: Braun Intertec RECEIVED: 01-JUL-92

PARAMETER	Braun Intertec ID: Client ID: Matrix: Collect Date:	92-1434 MW-K Liquid 29-JUN		92-143 MW-B Liquid 29-JUN	S	92-1434 MW-BE Liquid 29-JUN		92-143 MW-O Liquid 29-JUN	D	
Dichlorodifluoromethane		<5.0	ug/L	<5.0	ug/L	<5.0	ug/L	<5.0	ug/L	
Chloromethane		<5.0	ug/L	<5.0	ug/L	<5.0	ug/L	<5.0	ug/L	
Vinyl Chloride		<1.0	ug/L	<1.0	ug/L	<1.0	ug/L	<1.0	ug/L	
Bromomethane		< 5.0	ug/L	< 5.0	ug/L	<5.0	ug/L	<5.0	ug/L	
Chloroethane		<1.0	ug/L	<1.0	ug/L	<1.0	ug/L	<1.0	ug/L	
Trichlorofluoromethane		<1.0	ug/L	<1.0	ug/L	<1.0	ug/L	<1.0	ug/L	
1,1-Dichloroethylene		<1.0	ug/L	<1.0	ug/L	<1.0	ug/L	<1.0	ug/L	
Methylene Chloride		<5.0	ug/L	< 5.0	ug/L	<5.0	ug/L	< 5.0	ug/L	
trans-1,2-Dichloroethylene		<0.2	ug/L	< 0.2	ug/L	<0.2	ug/L	< 0.2	ug/L	
1,1-Dichloroethane		<1.0	ug/L	<1.0	ug/L	<1.0	ug/L	<1.0	ug/L	
cis-1,2-Dichloroethylene		<0.2	ug/L	<0.2	ug/L	< 0.2	ug/L	< 0.2	ug/L	
Chloroform		<1.5	ug/L	<1.5	ug/L	<1.5	ug/L	<1.5	ug/L	
Bromochloromethane		<1.0	ug/L	<1.0	ug/L	<1.0	ug/L	<1.0	ug/L	
1,1,1-Trichloroethane		<2.0	ug/L	<2.0	ug/L	<2.0	ug/L	<2.0	ug/L	
Carbon Tetrachloride		<1.7	ug/L	<1.7	ug/L	<1.7	ug/L	<1.7	ug/L	
1,2-Dichloroethane		< 0.3	ug/L	< 0.3	ug/L	< 0.3	ug/L	< 0.3	ug/L	
Benzene		<1.0	ug/L	<1.0	ug/L	<1.0	ug/L	<1.0	นฐ/โ	
1,1,2-Trichloroethylene		< 0.5	ug/L	< 0.5	ug/L	< 0.5	ug/L	< 0.5	ug/L	
Bromodichloromethane		< 0.3	ug/L	< 0.3	ug/L	< 0.3	ug/L	< 0.3	ug/L	
Dibromomethane		<5.0	ug/L	<5.0	ug/L	<5.0	ug/L	<5.0	ug/L	
cis-1,3-Dichloro-1-Propene		<0.5	ug/L	< 0.5	ug/L	<0.5	ug/L	< 0.5	ug/L	
Toluene		<1.0	ug/L	<1.0	ug/L	<1.0	ug/L	<1.0	ug/L	
trans-1,3-Dichloro-1-propene		< 0.5	ug/L	< 0.5	ug/L	< 0.5	ug/L	< 0.5	ug/L	
1,1,2-Trichloroethane		<1.2	ug/L	<1.2	ug/L	<1.2	ug/L	<1.2	ug/L	
1,3-Dichloropropane		<1.0	ug/L	<1.0	ug/L	<1.0	ug/L	<1.0	ug/L	
Tetrachloroethylene		<1.0	ug/L	<1.0	ug/L	<1.0	ug/L	<1.0	ug/L	
Chlorodibromomethane		<2.5	ug/L	<2.5	ug/L	<2.5	ug/L	<2.5	ug/L	
1,2-Dibromoethane		< 0.2	ug/L	< 0.2	ug/L	< 0.2	ug/L	< 0.2	ug/L	
Chlorobenzene		<1.0	ug/L	<1.0	ug/L	<1.0	ug/L	<1.0	ug/L	
1,1,1,2-Tetrachloroethane		<0.5	ug/L	<0.5	ug/L	< 0.5	ug/L	< 0.5	ug/L	
Ethyl Benzene		<1.0	ug/L	<1.0	ug/L	<1.0	ug/L	<1.0	ug/L	
m,p-Xylene		<1.0	ug/L	<1.0	ug/L	<1.0	ug/L	<1.0	ug/L	
o-Xylene		<1.0	ug/L	<1.0	ug/L	<1.0	ug/L	<1.0	ug/L	
Styrene		<1.0	ug/L	<1.0	ug/L	<1.0	ug/L	<1.0	ug/L	
Bromoform		<0.5	ug/L	<0.5	ug/L	< 0.5	ug/L	< 0.5	ug/L	
Isopropylbenzene (Cumene)		<1.0	ug/L	<1.0	ug/L	<1.0	ug/L	<1.0	ug/L	
1,1,2,2-Tetrachloroethane		<1.2	ug/L	<1.2	ug/L	<1.2	ug/L	<1.2	ug/L	
1,2,3-Trichloropropane		<1.0	ug/L	<1.0	ug/L	<1.0	ug/L	<1.0	ug/L	
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< = less than: compound not detected at or above indicated detection limit - = Analysis not required

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Quality control data reviewed:

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BRAUN INTERTEC REPORT NO: 921434

17-AUG-92

City of Bismarck

PROJECT: CFEX-91-0006 COLLECTED: Braun Intertee RECEIVED: 01-JUL-92

PARAMETER	Braun Intertec ID: Client ID: Matrix: Collect Date:	92-143 MW-k Liquid 29-JU		92-14 MW-1 Liquid 29-JU	BS 1	92-143 MW-B Liquid 29-JU1	D	92-14 MW-C Liquic 29-JU	DD	
1,3-Dichlorobenzene		<1.5	ug/L	<1.5	ug/L	<1.5	ug/L	<1.5	<u></u>	
1,4-Dichlorobenzene		< 0.2	ug/L	<0.2		<0.2	ug/L ug/L	<0.2		
1,2,4-Trimethylbenzene		<1.0	ug/L	<1.0		<1.0	ug/L	<1.0	- o	
1,2-Dichlorobenzene		< 0.2	ug/L	<0.2		< 0.2	ug/L	< 0.2		
1,2-Dibromo-3-Chloropropa	ne	<10	ug/L	<10	ug/L	<10	ug/L	<10	ug/L	
Dichlorofluoromethane		< 5.0	ug/L	<5.0	ug/L	< 5.0	ug/L	< 5.0	ug/L	
Ethyl Ether		<1.0	ug/L	<1.0		<1.0	ug/L	<1.0	· • • -	
Trichlorotrifluoroethane		< 5.0	ug/L	< 5.0		< 5.0	ug/L	< 5.0		
Acetone		< 50	ug/L	<50	ug/L	< 50	ug/L	< 50	ug/L	
Allyl Chloride (3-Chloroproj	pylene)	<1.0	ug/L	<1.0		<1.0	ug/L	<1.0		
Methyl Ethyl Ketone		< 5.0	ug/L	<5.0	ug/L	<5.0	ug/L	<5.0	ug/L	
Tetrahydrofuran		<5.0	ug/L	< 5.0		< 5.0	ug/L	< 5.0		
Methyl Isobutyl Ketone		< 5.0	ug/L	< 5.0		< 5.0	ug/L	< 5.0		
Acrylonitrile		<10	ug/L	<10	ug/L	<10	ug/L	<10	ug/L	
Carbon Disulfide		<10	ug/L	<10	ug/L	<10	ug/L	<10	ug/L	
rans-1,4-Dichloro-2-Butene		<10	ug/L	<10	ug/L	<10	ug/L	<10	ug/L	
Methyl Butyl Ketone		<10	ug/L	<10	ug/L	<10	ug/L	<10	ug/L	
Methyl Iodide		<10	ug/L	<10	ug/L	<10	ug/L	<10	ug/L	
Vinyl Acetate		<10	ug/L	<10	ug/L	<10	ug/L	<10	ug/L	
Alkalinity, Total		620	mg/L	500	mg/L	810	mg/L	940	mg/L	
Bicarbonate Alkalinity		620	mg/L	500	mg/L	810	mg/L	910	mg/L	
Carbonate Alkalinity		<4	mg/L	<4	mg/L	<4	mg/L	32	mg/L	
Appearance		2	-	Ъ	-	c	•	b	-	
Cation/Anion Balance		-10	%	-15	%	-3.7	%	-22	%	
Chloride		6.1	mg/L	2.7	mg/L	13	mg/L	5.7	mg/L	
Chemical Oxygen Demand		62	mg/L	79	mg/L	32	mg/L	<25	mg/L	
Fluoride		0.38	mg/L	0.26	mg/L	1.2	mg/L	0.34	mg/L	
Ammonia as N		1.1	mg/L	0.46	mg/L	0.73	mg/L	1.4	mg/L	
Nitrate + Nitrite, as N		0.050	mg/L	0.03	mg/L	< 0.02		0.03	mg/L	
pH		7.4	Units	7.4	Units	8.2	Units	8.6	Units	
Specific Conductance		3200	umhos/cm	1200	umhos/cm	2900	umhos/cm	3600	umhos/cm	
Sulfate		1700	mg/L	170	mg/L	770	mg/L	1200	mg/L	

a = Heavy precipitate, heavy turbidity, yellow-gray, odorless.
 b = Heavy precipitate, heavy turbidity, brown-gray, odorless.
 c = Medium precipitate, medium turbidity, yellow, odorless.

< = less than: compound not detected at or above indicated detection limit - = Analysis not required

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Quality control data reviewed:

City of Bismarck

BRAUN INTERTEC REPORT NO: 921434

Page 5

PROJECT: CFEX-91-0006 COLLECTED: Braun Intertec RECEIVED: 01-JUL-92

PARAMETER	Braun Intertec ID: Client ID: Matrix: Collect Date:	92-1434 MW-K Liquid 29-JUN-		92-1434 MW-BS Liquid 29-JUN	5	92-1434- MW-BD Liquid 29-JUN-		92-1434 MW-OJ Liquid 29-JUN	D
Total Dissolved Solids Total Suspended Solids Total Phosphorus Temperature * Total Organic Carbon	-	3100 830 9.7 13 6.7	mg/L mg/L Deg. C mg/L	1000 1400 0.85 14 2.7	mg/L mg/L mg/L Deg. C mg/L	2200 71 0.17 13 3.9	mg/L mg/L mg/L Deg. C mg/L	2700 620 4.8 12 2.3	mg/L mg/L mg/L Deg. C mg/L
Chromium, Total		18	ug/L	11	ug/L	4.7	ug/L	4.4	ug/L
Silver, Total		<0.01	mg/L	<0.01	mg/L	<0.01	mg/L	0.01	mg/L
Arsenic, Total		19	ug/L	12	ug/L	2.0	ug/L	36	ug/L
Beryllium, Total		2.4	ug/L	1.2	ug/L	<0.2	ug/L	18	ug/L
Cadmium, Total		<0.4	ug/L	0.5	ug/L	<0.2	ug/L	1.6	ug/L
Cobalt, Total		23	ug/L	12	ug/L	42	ug/L	170	ug/L
Lead, Total		17	ug/L	13	ug/L	5.0	ug/L,	39	ug/L
Thallium, Total		18	ug/L	<4.0	ug/L	45	ug/L,	51	ug/L
Vanadium, Total		110	ug/L	34	ug/L	8.0	ug/L	760	ug/L
Mercury, Total		<0.4	ug/L	<0.4	ug/L	<0.4	ug/L	<0.4	ug/L
Barium, Total		0.64	mg/L	0.9	mg/L	0.09	mg/L	5.6	mg/L
Calcium, Total		610	mg/L	110	mg/L	47	mg/L	170	mg/L
Copper, Total		0.09	mg/L	0.07	mg/L	0.03	mg/L	0.34	mg/L
Iron, Total		71	mg/L	61	mg/L	3.1	mg/L	450	mg/L
Magnesium, Total		120	mg/L	89	mg/L	22	mg/L	160	mg/L
Manganese, Total		2.0	mg/L	1.4	mg/L	0.2	mg/L	6.5	mg/L
Nickel, Total		0.08	mg/L	0.07	mg/L	<0.02	mg/L	0.43	mg/L
Potassium, Total		23	mg/L	15	mg/L	5.6	mg/L	65	mg/L
Sodium, Total		250	mg/L	120	mg/L	710	mg/L	1100	mg/L
Zinc, Total		0.24	mg/L	0.22	mg/L	0.10	mg/L	1.2	mg/L
Antimony, Total		<6.0	mg/L	<6.0	mg/L	<6.0	mg/L	<6.0	mg/L
Selenium, Total		<5.0	ug/L	<5.0	ug/L	<5.0	ug/L	<5.0	ug/L

* = Temperature on receipt in laboratory.

< = less than: compound not detected at or above indicated detection limit - = Analysis not required

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Quality control data reviewed:

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City of Bismarck

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PROJECT: CFEX-91-0006 COLLECTED: Braun Intertee RECEIVED: 01-JUL-92

PARAMETER	Braun Intertec ID: Client ID: Matrix: Collect Date:	92-1434-0 MW-L Liquid 29-JUN-9	
Dichlorodifluoromethane	_	<5.0	ug/L
Chloromethane			ug/L
Vinyl Chloride Bromomethane			ug/L ug/
Chloroethane			ug/L ug/L
Trichlorofluoromethane		<1.0	ug/L
1,1-Dichloroethylene			ug/L
Methylene Chloride			ug/L
trans-1,2-Dichloroethylene		<0.2	ug/L
1,1-Dichloroethane		<1.0	ug/L
cis-1,2-Dichloroethylene			ug/L
Chloroform		<1.5	ug/L
Bromochloromethane		<1.0	ug/L
1,1,1-Trichloroethane		<2.0	ug/L
Carbon Tetrachloride		<1.7	ug/L
1,2-Dichloroethane		< 0.3	ug/L
Benzene		<1.0	ug/L
1,1,2-Trichloroethylene Bromodichloromethane		<0.5 <0.3	ug/L ug/L
Dibromomethane		<5.0	ug/L
cis-1,3-Dichloro-1-Propene		<0.5	ug/L
Toluene		<1.0	ug/L
trans-1,3-Dichloro-1-propend	8	< 0.5	ug/L
1,1,2-Trichloroethane		<1.2	ug/L
1,3-Dichloropropane		<1.0	ug/L
Tetrachloroethylene		<1.0	ug/L
Chlorodibromomethane		<2.5	ug/L
1,2-Dibromoethane		< 0.2	ug/L
Chlorobenzene		<1.0	ug/L
1,1,1,2-Tetrachloroethane		<0.5	ug/L.
Ethyl Benzene		<1.0	ug/L
m,p-Xylene		<1.0	ug/L
o-Xylene		<1.0	ug/L
Styrene		<1.0	ug/L
Bromoform		<0.5	ug/L
Isopropylbenzene (Cumene)		<1.0	ug/L
1,1,2,2-Tetrachloroethane		<1.2	ug/L
1,2,3-Trichloropropane		<1.0	ug/L

< = less than: compound not detected at or above indicated detection limit - = Analysis not required

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Quality control data reviewed: ______ CO____

City of Bismarck

PROJECT: CFEX-91-0006 COLLECTED: Braun Intertee RECEIVED: 01-JUL-92

Brau PARAMETER	n Intertec ID: Client ID: Matrix: Collect Date:	92-1434 MW-L Liquid 29-JUN-	
1,3-Dichlorobenzene	-	<1.5	ug/L
1,4-Dichlorobenzene		<0.2	ug/L
1,2,4-Trimethylbenzene		<1.0	ug/L
1,2-Dichlorobenzene		<0.2	ug/L.
1,2-Dibromo-3-Chloropropane		<10	ug/L
Dichlorofluoromethane		<5.0	ug/L
Ethyl Ether		<1.0	ug/L
Trichlorotrifluoroethane		<5.0	ug/L
Acetone		<50	ug/L
Allyl Chloride (3-Chloropropylene)	I	<1.0	ug/L
Methyl Ethyl Ketone		< 5.0	ug/L
Tetrahydrofuran		<5.0	ug/L
Methyl Isobutyl Ketone		<5.0	ug/L
Acrylonitrile		<10	ug/L
Carbon Disulfide		<10	ug/L
trans-1,4-Dichloro-2-Butene		<10	ug/L
Methyl Butyl Ketone		<10	ug/L
Methyl Iodide		<10	ug/L
Vinyl Acetate		<10	ug/L
Alkalinity, Total		1300	mg/L
Bicarbonate Alkalinity		1300	mg/L
Carbonate Alkalinity		<4	mg/L
Appearance		ď	
Cation/Anion Balance		-4.1	%
Chloride		84	mg/L
Chemical Oxygen Demand		57	mg/L
Fluoride		0.49	mg/L
Ammonia as N		0.15	.mg/L
Nitrate + Nitrite, as N		< 0.02	mg/L
pH		7.2	Units
Specific Conductance		7700	umhos/cm
Sulfate		3200	mg/L

d = Heavy precipitate, heavy turbidity, yellow-brown, odorless.

< = less than: compound not detected at or above indicated detection limit - = Analysis not required

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Quality control data reviewed:

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17-AUG-92

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City of Bismarck

PROJECT: CFEX-91-0006 COLLECTED: Braun Intertee RECEIVED: 01-JUL-92

PARAMETER	Braun Intertee ID: Client ID: Matrix: Collect Date:	92-1434 MW-L Liquid 29-JUN-	
Total Dissolved Solids		330	mg/L
Total Suspended Solids		810	mg/L
Total Phosphorus		0.68	mg/L
Temperature *		13	Deg. C
Total Organic Carbon		15	mg/L
Chromium, Total	•	10	ug/L
Silver, Total		0.02	mg/L
Arsenic, Total		20	ug/L
Beryllium, Total		0.4	ug/L
Cadmium, Total		<0.4	ug/L
Cobalt, Total		110	ug/L
Lead, Total		15	ug/L
Thallium, Total		100 kk	; ug/L
Vanadium, Total		27	ug/L
Mercury, Total		<0.4	ug/L
Barium, Total		0.42	mg/L
Calcium, Total		360	mg/L
Copper, Total		0.04	mg/L
Iron, Total		30	mg/L
Magnesium, Total		320	mg/L
Manganese, Total		1.6	mg/L
Nickel, Total Potassium, Total Sodium, Total Zinc, Total Antimony Selenium, Total		0.04 11 1600 0.11 <6.0 <5.0	mg/L mg/L mg/L ug/L ug/L

kk = See discussion.

* = Temperature on receipt in laboratory.

< = less than: compound not detected at or above indicated detection limit - = Analysis not required

Quality control data reviewed: ______

APPENDIX H

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VOLATILE ORGANIC COMPOUNDS FOR WELL 139-079-30CBD

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
1/1/2 IIIOIIUIUECHANE	

* Constituent Detection

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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
· · ·	<5
p-Isopropyltoluene	
Isopropylbenzene	<5
Tert-butylbenzene	<5
Sec-butylbenzene	<5
Fluorotrichloromethane	<5
Dichlorodifluoromethane	<5
Bromochloromethane	<5
Allylchloride	<5
2,3-Dichloro-1-propane	<5
Tetrahydrofuran	<50
Pentachloroethane	<5
Trichlorotrofluoroethane	<5
Carbondisufide	<5
Ether	<5

* Constituent Detection