# Site Suitability Review of the Lloyd Sanitation Landfill

by
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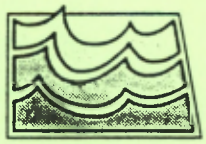

Prepared by the
North Dakota State Water Commission
and the
North Dakota Geological Survey

**ND Landfill Site Investigation No. 14**

# SITE SUITABILITY REVIEW OF THE LLOYD LANDFILL

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# INTRODUCTION

## Purpose

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

## Location of the Lloyd Landfill

The Lloyd solid waste landfill is located two miles west of the City of Fessenden in Township 148 North, Range 71 West, NW 1/4, NW 1/4 Section 13 (Fig. 1). The landfill site encompasses approximately 40 acres of which about 10 acres has been used.

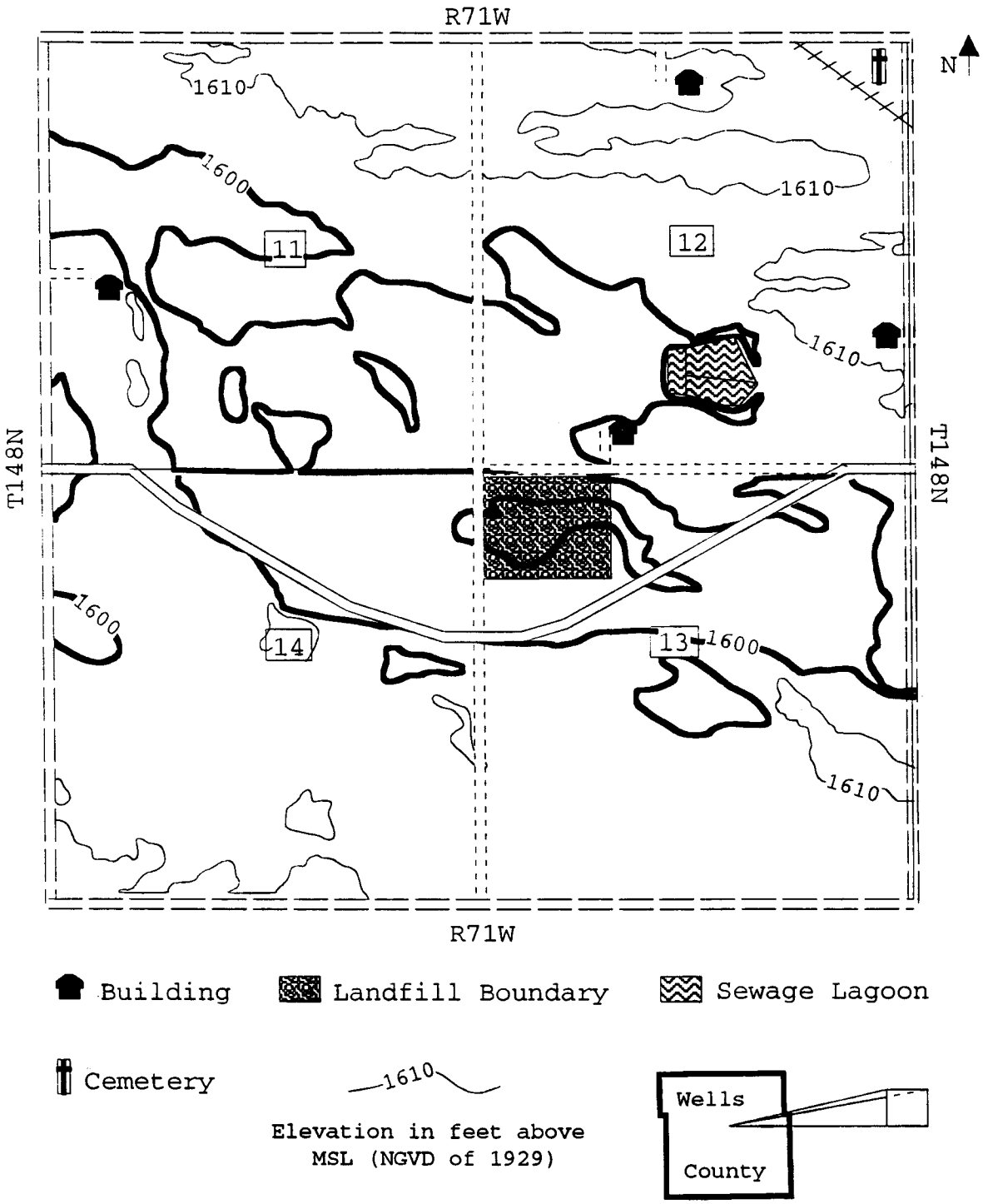


Figure 1. Location of the Lloyd landfill in the NW 1/4, NW 1/4 of section 13, T.148N., R.71W.

## Previous Site Investigations

Previous investigations include two test holes drilled to a depth of 35 feet by Schinelfenig Well Drilling in 1977. Lithologic logs of the test holes indicated clay till through the entire 35 feet. No other geological or hydrological investigations have been completed at the Lloyd landfill.

## Methods of Investigation

The Lloyd study was accomplished by means of drilling test holes with no water-quality analyses performed.

### Test Hole Drilling Procedure

The drilling method at the Lloyd landfill was based on the site's geology and depth to ground water, as determined by the preliminary evaluation. A forward rotary rig was used at the Lloyd landfill because the sediments consisted of a very tight predominantly clay till and because the depth to the water table was expected to be greater than 70 feet. The lithologic descriptions were determined from the drill cuttings.

Five test holes were drilled at the Lloyd landfill, and no monitoring wells were installed in any of them. The test holes were drilled near the active area of the landfill.

## Test Hole Plugging Procedure

The test holes were plugged according to NDSDHCL and Board of Water Well Contractors regulations (North Dakota Department of Health, 1986). Test holes were plugged with high-solids bentonite grout and/or neat cement to a depth approximately five feet below land surface (Fig. 2). The upper five feet of the test hole was filled with soil cuttings.

## Location-Numbering System

The system for denoting the location of a test hole or observation well is based on the federal system of rectangular surveys of public land. The first and second numbers indicate Township north and Range west of the 5th Principle Meridian and baseline (Fig. 3). The third number indicates the section. The letters A, B, C, and D designate, respectively, the northeast, northwest, southwest, and southeast quarter section (160-acre tract), quarter-quarter section (40-acre tract), and quarter-quarter-quarter section (10-acre tract). Therefore, a well denoted by 148-071-13BBA would be located in the SE1/4, NW1/4, NW1/4, Section 13, Township 148 North, Range 71 West. Consecutive numbers are

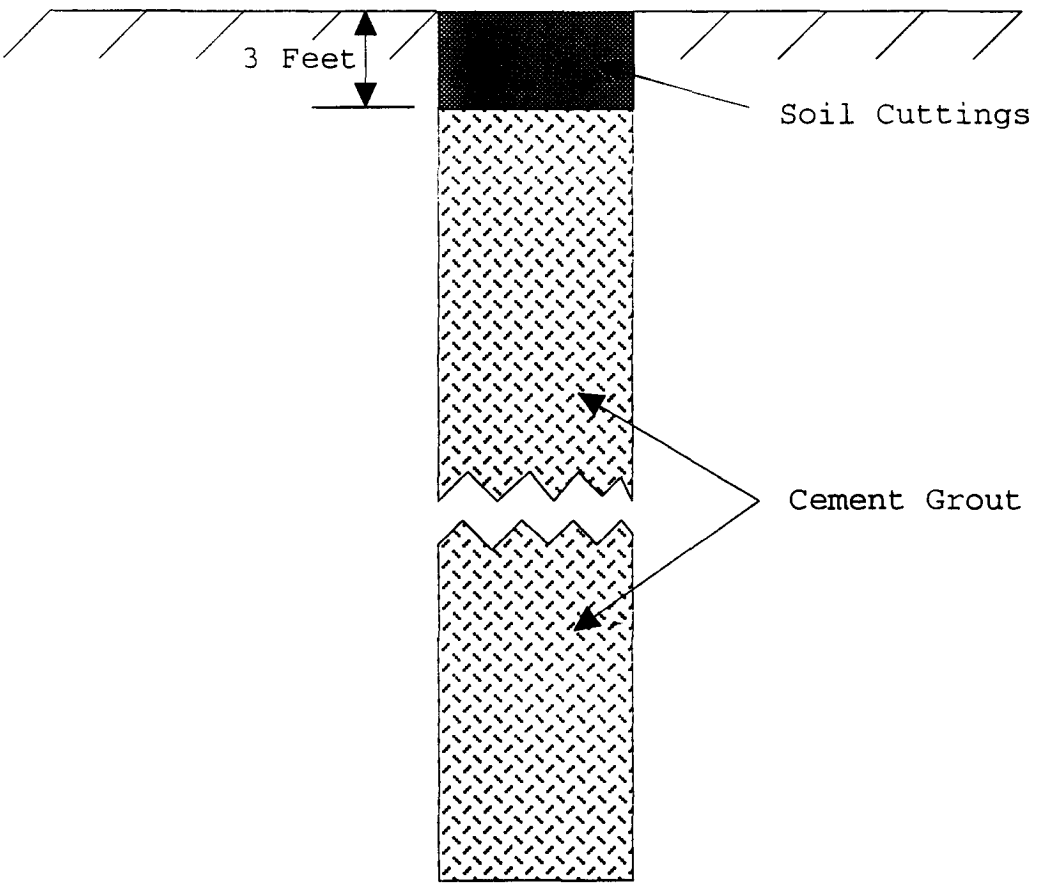


Figure 2. Test hole plugging procedure.

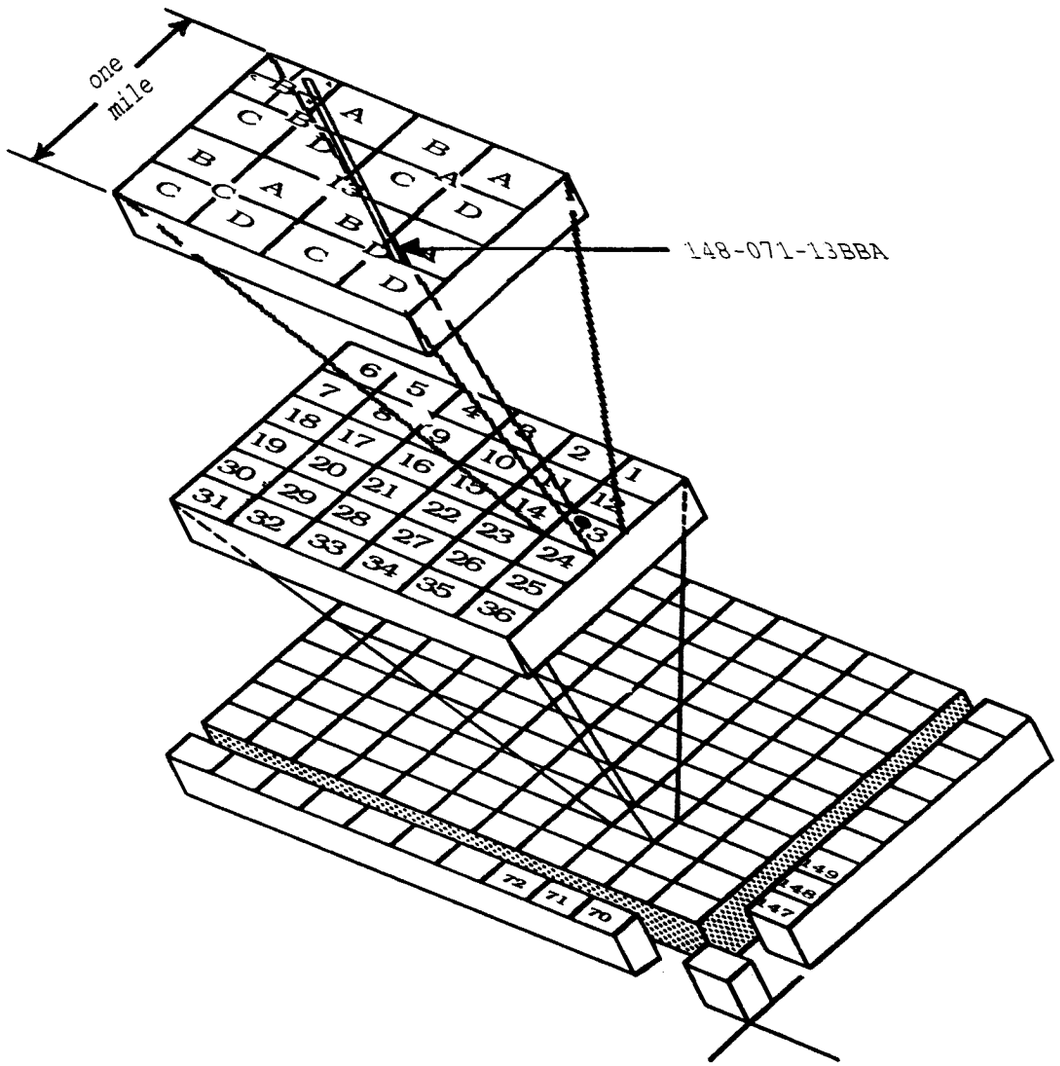


Figure 3. Location-numbering system for the Lloyd landfill.

added following the three letters if more than one well is located in a 10-acre tract, e.g. 148-071-13BBA1 and 148-071-13BBA2.

## GEOLOGY

The Lloyd landfill is located in an area of low relief, with marshy areas to the the south, west, and north. The geologic materials in the region include glacial till, glacial outwash deposits, and ice-contact deposits. A small outwash plain south of the landfill contains sand and gravel beds with intervening areas of till (Bluemle, et al, 1967). The area identified as outwash plain is about 1/4 mile from the landfill. The total thickness of the Pleistocene deposits ranges from 100 to 200 feet. The uppermost bedrock unit in the area, the Cretaceous Pierre Formation, is composed of shale, clay, and bentonite.

Six test holes drilled on the landfill property (Fig. 4) encountered mainly clay and sandy-clay till (Fig. 5, lithologic logs in Appendix A). A thin layer of sand and gravel was observed near the surface in three of the test holes. Additional thin gravel beds were encountered at depths below 60 feet in several of the test holes. Bedrock was penetrated at depths of 135 to 158 feet within the landfill site.

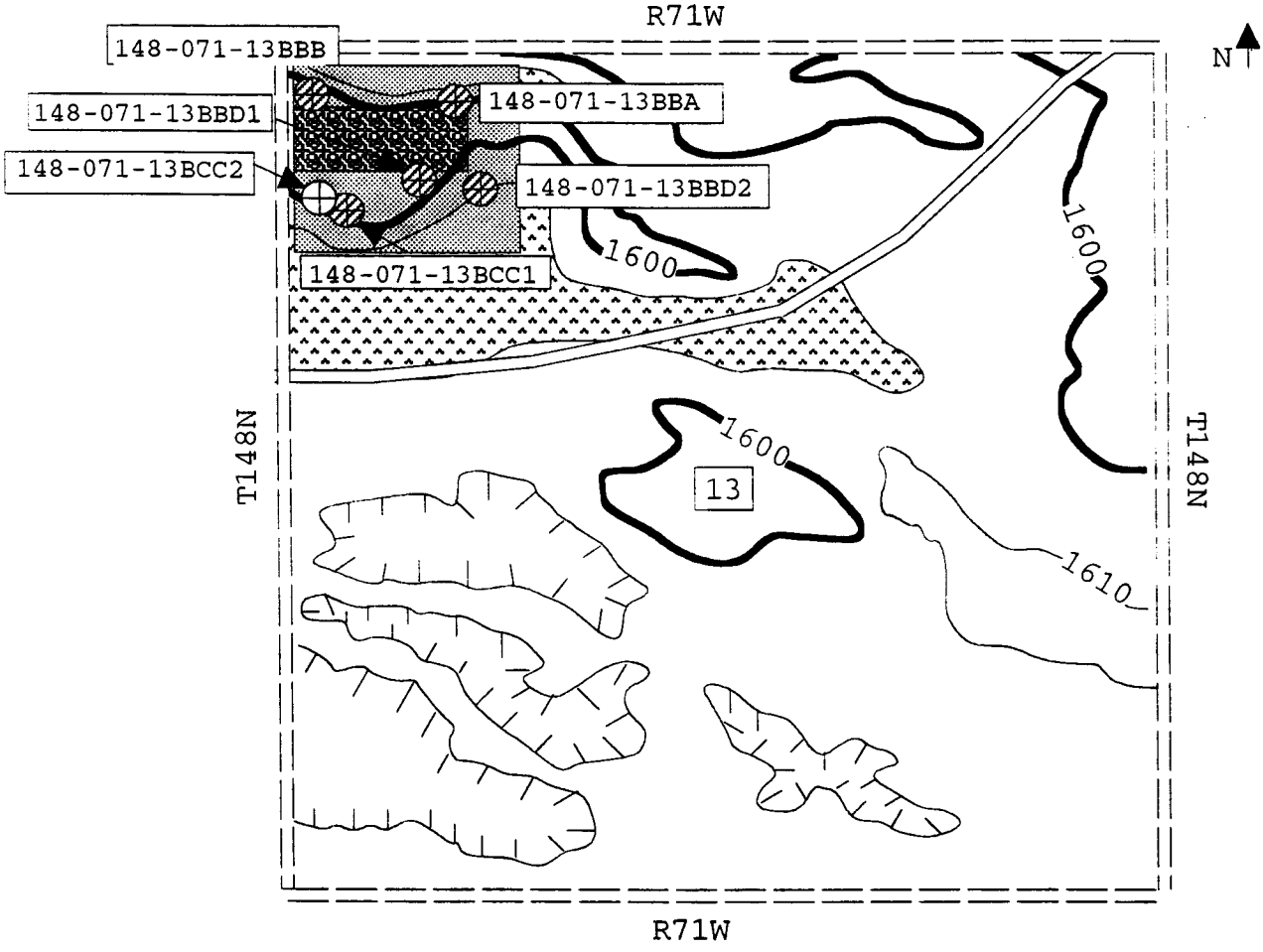


Figure 4. Location of test holes at the Lloyd landfill.

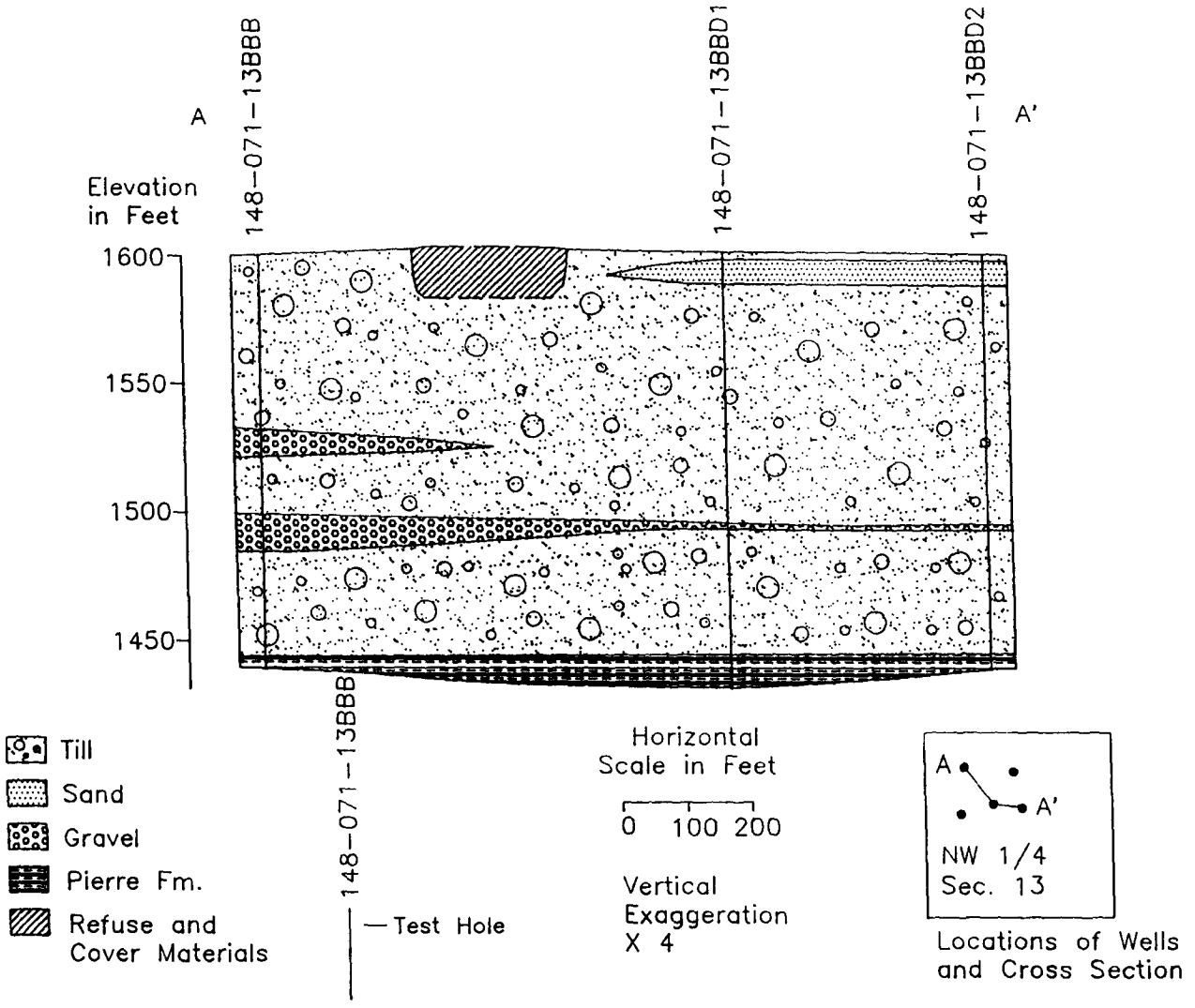


Figure 5. Geohydrologic Section A – A' in the Lloyd landfill

# HYDROLOGY

## Surface-Water Hydrology

The Lloyd landfill is located about 3-1/2 miles south of the James River. The James River should not be affected by leachate migration from the landfill. The City of Fessenden sewage lagoons are located about 1/2 mile northeast of the landfill. No other surface water is located within a two-mile radius of the landfill.

## Ground-Water Hydrology

Five 160-foot borings and one 80-foot boring were drilled around the landfill property (Figure 4). Based on the depth to ground water and the thickness of till, no monitoring wells were installed at the Lloyd landfill. Consequently, no water samples were collected for water quality analysis.

A two-foot thick layer of sand or gravel is located near the land surface. Ground water may be moving laterally through this layer and contributing to perched wetlands that surround the active landfill. The wetlands may be susceptible to surface-water runoff from the landfill. Available data does not indicate a direct hydraulic connection to other glacial or bedrock aquifers in the vicinity of the landfill.

An 80-foot test hole (Test Hole 148-071-13BBC1) was drilled and left open for an 18-hour period to determine recharge from the formation. There was no water movement out of the till into the test hole during this time period. Based on the results of this test, no monitoring wells were installed within the glacial drift at this study site.

Ground-water supply wells, in a two-mile radius, are screened at depths greater than 280 feet. These supply wells should not be affected by leachate migration due to the large thickness and low hydraulic conductivity associated with clay till which is the dominant lithology in the landfill area.

## CONCLUSIONS

The Lloyd landfill is located in an area of low relief where the geologic materials include glacial till, glacial outwash deposits, and ice-contact deposits. A thin layer of sand and gravel was observed near the surface with additional thin gravel beds at depths below 60 feet.

No surface water impoundments in the area of the landfill that should be affected by leachate migration from the landfill. Wetlands surrounding the landfill may be recieving recharge from the thin shallow sand and gravel layer. These wetlands may be susceptible to leachate contamination from lateral ground-water flow in the shallow sand and gravel layer and/or surface-water runoff from the

landfill. Deeper sand and gravel lenses were dry at the time of drilling. Production wells in the area are screened at depths greater than 280 feet and should not be affected by leachate migration because these bedrock aquifers are overlain by a relatively thick, low-permeability clay till.

# REFERENCES

Bluemle, J.P., Faigle, G.A., Kresl, R.J., and Reid, J.R., 1967, Geology and ground water resources of Wells County, part I, geology: North Dakota Geological Survey, Bulletin 51, North Dakota State Water Commission, County Ground Water Studies 12, 39 p.

North Dakota Department of Health, 1986, Water well construction and well pump installation: Article 33-18 of the North Dakota Administrative Code.

# APPENDIX A

## LITHOLOGIC LOGS OF WELLS AND TEST HOLES

**148-071-13BBA**

NDSWC

| | | | |
|---|---|---|---|
| Date Completed: | 8/5/92 | Purpose: | Test Hole |
| Depth Drilled (ft): | 160 | Source of Data: | |
| L.S. Elevation (ft) | 1599.53 | Owner: J. Lloyd | |

Lithologic Log

| Unit | Description | Depth (ft) |
|---|---|---|
| TOPSOIL | | 0-2 |
| GRAVEL | FINE TO MEDIUM GRAIN, OXIDIZED, DARK YELLOW-ORANGE, 10YR6/6 TILL. | 2-4 |
| CLAY | FINE SANDY, DARK YELLOW-ORANGE, 10YR6/6 OXIDIZED. | 4-14 |
| CLAY | MEDIUM GRAY, N5, STIFF, ROCK AT 45'. | 14-156 |
| CLAY | SILTY, LIGHT GRAY, N7,. | 156-160 |

**148-071-13BBB**

NDSWC

| | | | |
|---|---|---|---|
| Date Completed: | 8/5/92 | Purpose: | Test Hole |
| Depth Drilled (ft): | 160 | Source of Data: | |
| L.S. Elevation (ft) | 1598.86 | Owner: J. Lloyd | |

Lithologic Log

| Unit | Description | Depth (ft) |
|---|---|---|
| TOPSOIL | | 0-2 |
| CLAY | FILL MATERIAL, CLAY, ROCKS. | 2-5 |
| CLAY | FINE SAND, YELLOW-ORANGE, 10YR6/6, ROCK AT 15'. | 5-17 |
| CLAY | MEDIUM GRAY, N5, STIFF, ROCK AT 21'. | 17-68 |
| GRAVEL | MEDIUM GRAIN. | 68-78 |
| CLAY | MEDIUM GRAY, N5. | 78-88 |
| CLAY | SANDY, DARK GRAY, N3, GRAVEL INTER-MIXED. | 88-91 |
| CLAY | MEDIUM GRAY, N5. | 91-101 |
| GRAVEL | MEDIUM GRAIN, SHALE. | 101-116 |
| CLAY | FINE SANDY, OLIVE GRAY,5Y4/1. | 116-124 |
| CLAY | MEDIUM GRAY, N5, STIFF, TILL. | 124-157 |
| CLAY | SILTY, LIGHT GRAY, N7. | 157-160 |

**148-071-13BBC1***

NDSWC

| | | | |
|---|---|---|---|
| Date Completed: | 7/6/92 | Purpose: | Test Hole |
| Depth Drilled (ft): | 80 | Source of Data: | |
| L.S. Elevation (ft) | 1601.23 | Owner: J. Lloyd | |

Lithologic Log

| Unit | Description | Depth (ft) |
|---|---|---|
| TOPSOIL | | 0-2 |
| CLAY | DUSKY YELLOW-GREEN, 5GY5/2. | 2-8 |
| CLAY | MODERATE OLIVE BROWN 5Y4/4 | 8-13 |
| CLAY | TILL, MODERATE BROWN, 5YR4/4. | 13-18 |
| CLAY | MEDIUM GRAY, N5, ROCK AT 55' WHICH MOVED TO THE SIDE | 18-80 |

*Drilled with NDGS auger rig
Note: Hole was left open over night and was dry the next day.

**148-071-13BBC2**

NDSWC

| | | | |
|---|---|---|---|
| Date Completed: | 8/4/92 | Purpose: | Test Hole |
| Depth Drilled (ft): | 160 | Source of Data: | |
| L.S. Elevation (ft) | 1601.23 | Owner: J. Lloyd | |

Lithologic Log

| Unit | Description | Depth (ft) |
|---|---|---|
| TOPSOIL | | 0-7 |
| CLAY | SANDY, MODERATE YELLOW-BROWN, 10YR5/4, TILL. | 7-8 |
| CLAY | SILTY, YELLOW-BROWN, STIFF, ROCK AT 13'. | 8-17 |
| CLAY | MEDIUM GRAY, N5, STIFF, ROCKS AT 33', 51', 116', | 17-135 |
| CLAY | SILTY, LIGHT GRAY, N7, LIGNITE CHIPS. | 135-143 |
| CLAY | BENTONITIC, VERY LIGHT GRAY, N8. | 143-144 |
| CLAY | SANDY, STIFF, GRAYISH BLUE-GREEN, 5BG5/2. | 144-152 |
| CLAY | STIFF, DARK GRAY, N3. | 152-160 |

**148-071-13BBD1**

NDSWC

| | | | |
|---|---|---|---|
| Date Completed: | 8/4/92 | Purpose: | Test Hole |
| Depth Drilled (ft): | 170 | Source of Data: | |
| L.S. Elevation (ft) | 1602.10 | Owner: J. Lloyd | |

Lithologic Log

| Unit | Description | Depth (ft) |
|---|---|---|
| TOPSOIL | | 0-2 |
| CLAY | SILTY, MODERATE YELLOW-BROWN, 10YR5/4, TILL. | 2-5 |
| GRAVEL | MEDIUM GRAIN, MODERATE YELLOW-BROWN, 10YR5/4. | 5-7 |
| SAND | FINE-GRAINED, CLAYEY, MODERATE YELLOW-BROWN, 10YR5/4, ROCK AT 13'. | 7-14 |
| CLAY | SANDY, STIFF, MODERATE YELLOW-BROWN, 10YR5/4. | 14-17 |
| CLAY | MEDIUM GRAY, N5, STIFF, ROCKS AT 40', 64', 98'. | 17-109 |
| GRAVEL | FINE TO MEDIUM GRAIN TO SANDY. | 109-109.5 |
| CLAY | MEDIUM GRAY, N5, STIFF. | 109.5-158 |
| CLAY | SILTY, STIFF, OLIVE-GRAY, 5Y4/1. | 158-160 |
| CLAY | SILTY, OLIVE-GRAY, 5Y4/1, STIFF, LIGNITE CHIPS. | 160-164 |
| CLAY | BENTONITIC, VERY LIGHT GRAY, N8, WITH GRAYISH BLUE-GREEN, 5BG5/2 SANDY CLAY, DRY. | 164-166 |
| CLAY | SANDY, GRAYISH BLUE-GREEN, 5BG4/2, DRY. | 166-170 |

**148-071-13BBD2**

NDSWC

| | | | |
|---|---|---|---|
| Date Completed: | 8/5/92 | Purpose: | Test Hole |
| Depth Drilled (ft): | 160 | Source of Data: | |
| L.S. Elevation (ft) | 1599.31 | Owner: J. Lloyd | |

Lithologic Log

| Unit | Description | Depth (ft) |
|---|---|---|
| TOPSOIL | | 0-2 |
| GRAVEL | MEDIUM GRAIN, TILL. | 2-3 |
| SAND | FINE-GRAINED, SILTY, DARK YELLOW-ORANGE, 10YR6/6. | 3-11 |
| ROCK | | 11-12 |
| CLAY | LIGHT GRAY, N7, STIFF. | 12-16 |
| CLAY | MEDIUM GRAY, N5, ROCK AT 29'-31' | 16-105.5 |
| GRAVEL | FINE GRAIN. | 105.5-106 |
| CLAY | MEDIUM GRAY, N5, STIFF. | 106-153 |
| CLAY | SILTY, OLIVE-GRAY, 5Y4/1. | 153-157 |
| SILTSTONE | CEMENTED, OLIVE GRAY, 5Y4/1. | 157-157.5 |
| CLAY | SANDY, GRAYISH BLUE-GREEN, 5BG5/2. | 157.5-160 |