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OPEN-FILE REPORT 80-UR – NO. 3: BROWN COUNTY

STATEWIDE LANDFILL STUDY:

BROWN COUNTY LANDFILL SITE CHARACTERISTICS

by

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INTRODUCTION

Purpose and Scope

The purpose of this report is to summarize the geologic data, hydrologic data, and other site characteristics of the Brown County Landfill. This information was compiled as a part of the Statewide Landfill Study.

In 1984, the state of South Dakota had 38 permitted solid waste landfills, both private and public, that accepted waste other than ordinary household waste. A study was undertaken in an effort to evaluate selected landfills in South Dakota and identify those that may be best suited for the disposal of these special wastes.

This study was conducted by the South Dakota Geological Survey and the Office of Air Quality and Solid Waste of the Department of Water and Natural Resources, now known as the Department of Environment and Natural Resources. The Office of Air Quality and Solid Waste contracted with the South Dakota Geological Survey for certain geological services. The South Dakota Geological Survey contribution to this study was three-fold. First, available geologic and hydrologic data from landfills in South Dakota were reviewed and evaluated. Second, monitoring well systems were designed and installed at four landfills which were selected by the Office of Air Quality and Solid Waste. Finally, the geology was evaluated in more detail at these four landfills.

Selection of Sites

Existing information concerning 38 permitted and 2 proposed landfill sites was reviewed by the Office of Air Quality and Solid Waste in order to prioritize the sites. The Office of Air Quality and Solid Waste used this preliminary screening to reduce the number of potential sites from 40 to 26 (table 1 and fig. 1).

TABLE 1. List of sites considered for further evaluation

1. Belle Fourche City
2. Brookings City - Proposed
3. Brown County
4. Brule County
5. Byre (Private)
6. Davison County
7. De Smet City
8. Gregory County
9. Haarstad (Private)
10. Huron City
11. John Clements (Private)
12. Kadoka City
13. Marshall County
14. Miedema City
15. Milbank City
16. Miller City
17. Pierre City - Proposed
18. Pierre City - Old Site
19. Ralph Dawson (Private)
20. Rapid City
21. Sioux Falls (Runge) City
22. Vermillion City
23. Walworth County
24. Watertown City
25. Winner City
26. Yankton County

Subsequently, the South Dakota Geological Survey evaluated these 26 sites and prepared a draft report describing each site. No field checking was done. Topics such as topography, drainage, climate, soils, geology, hydrology, water quality, adjacent land use, hazardous waste records, and operational practices were addressed. These reports included copies of available maps, lithologic logs and water quality analyses. Draft copies of these unpublished reports are on file at the Department of Environment and Natural Resources in Pierre and the South Dakota Geological Survey in Vermillion.

After the initial assessment of the 26 sites, the Office of Air Quality and Solid Waste established criteria for further prioritizing the sites. Four sites were selected for the installation of monitoring wells. The South Dakota Geological Survey conducted detailed investigations at the Brown County, Watertown City, Yankton County, and Rapid City landfills (fig. 1). A draft copy of the unpublished summary report is on file at the Department of Environment and Natural Resources in Pierre and the South Dakota Geological Survey in Vermillion.

The following information was available regarding the Brown County landfill in 1986. This report is a compilation of the preliminary report and the detailed investigation.

BROWN COUNTY LANDFILL

Location

The Brown County landfill is located 5 miles west of Aberdeen in Brown County. Its legal location is NE¼ sec. 14, T. 123 N., R. 65 W. (fig. 2).

Topography, Drainage, and Climate

The information on topography and drainage was taken from the Aberdeen West Quadrangle and the Lake Parmley Quadrangle (United States Geological Survey, 1960 and 1970). In actuality, the present landfill surface may be significantly different because of activities at the landfill.

The topography at the Brown County landfill consists primarily of shallow hummocky terrain. An intermittent stream adjacent to the south side of the landfill (Foot Creek) has formed a valley that slopes to the south-southeast. The elevation ranges from 1,357 to 1,383 feet for a maximum relief of 26 feet at the site (fig. 2).

Surface drainage in the area is controlled by low areas that drain into Foot Creek in the James River Basin. A small intermittent stream originates in the north central part of the landfill and drains south into Foot Creek (fig. 2). A draw cuts across the southwest corner of the site.

The average annual temperature in Brown County is 43 degrees Fahrenheit. Precipitation averages 19 inches per year. The average annual class A pan evaporation is 46 inches. Climatological data are from Spuhler and others (1971).

Method of Investigation

In general, the plan for the detailed investigation was to determine the lithologies present and to install 16 nested sets of monitoring wells at the landfill. Nested wells are individual wells installed

at various depths at roughly the same location. This plan was selected to allow for the determination of:

1. lithologic variations with depth,

2. the vertical distribution of hydraulic head, and

3. vertical distribution of water quality.

Modifications concerning the number, arrangement, depth, and design of wells were made based on local hydrogeology and financial considerations. No holes or wells were drilled or constructed in refuse. At localities exhibiting more than one lithology, the well depths were determined after the contact between the differing lithologies had been established (for example, between oxidized till and shale). Field work was conducted at the Brown County landfill during October 1985.

The drilling of test holes and installation of wells were accomplished using two types of drilling rigs. These included a Parmanco F-86-B rig with 4-inch outside diameter flight auger and a Mobile B-61XD rig with 4-inch inside diameter hollow-stem auger. The geology was described from flight-auger cuttings, selected 1.5-inch diameter core samples, and some 3-inch diameter core samples.

Two types of wells were constructed. Screened wells were designed to be used primarily for measuring water levels (the shallowest water level). Cored-intake wells were designed to be used primarily for water sampling at a given depth. Both well installation methods are outlined below. In order to prevent organic contamination, no glue or lubricant was used on the polyvinyl chloride casing or in the drilling process.

1. Screened wells (fig. 3) were installed using the method outlined below:

   a. auger 4-inch or 10.75-inch diameter hole

   b. insert 2-inch diameter, schedule 80, polyvinyl chloride casing with slotted screen on bottom

   c. add filter pack to approximately 1 foot above the screen

   d. add granular bentonite and/or bentonite slurry to 1 to 2 feet below the ground surface

   e. cement the upper 1 to 2 feet of borehole to stabilize the casing approximately 6 inches above the ground surface

   f. protect with steel fence posts and/or fence

2. Cored-intake wells (fig. 4) were installed using the method outlined below:

   a. auger 4-inch or 10.75-inch diameter hole

   b. insert 2-inch diameter, schedule 80, polyvinyl chloride casing sealed on the bottom by using electrical tape to attach a thin plastic cap over the end of the casing

   c. press casing through the thin plastic cap to approximately 6 inches below bottom of the auger hole into undisturbed sediment, creating a seal with the outside of the casing and the surrounding sediment

d. insert 1.5-inch diameter shelby tube into casing, core an additional 6 to 12 inches beyond the end of the casing

e. add bentonite slurry between casing and borehole wall to 1 to 2 feet below the ground surface

f. cement the upper 1 to 2 feet of borehole to stabilize casing approximately 6 inches above the ground surface

g. protect with steel posts and/or fence

Several continuous cores were collected from the landfill. At the drill site, these cores were temporarily wrapped and stored in plastic bags. Subsequently, in October and November 1986, they were sealed in clear plastic wrap, placed in boxes, and permanently stored at the South Dakota Geological Survey core repository.

Geology

Lithologies present at the Brown County landfill include clay-rich till overlying shale. The till in this area is late Wisconsin in age and is part of a recessional moraine (Leap and others, 1986). The recessional moraine is composed of quasi-parallel hills of hummocky till which trend northwest-southeast near the landfill (fig. 5). At approximately 20 feet in depth, the till is underlain by Pierre Shale.

Prior to the South Dakota Geological Survey investigation in 1985, only one lithologic log was available within the landfill boundaries. Three lithologic logs were found within 1 mile of the landfill boundaries. Together, these four lithologic logs indicated that, in general, 1 to 3 feet of topsoil overlies 13 to 24 feet of oxidized till. The holes were completed in till or shale at depths of 24 to 39 feet below the land surface. The locations of these test holes are shown on figure 6 (app. A).

Only data meeting South Dakota Geological Survey criteria were used in this study. Lithologic logs were utilized if the legal locations were known to four quarter sections (2.5 acres) and if they were located within the landfill site or within 1 mile of the site boundaries. Also, the source of a log must have been known or the log was not utilized; for example, all logs of test holes drilled by the South Dakota Geological Survey identify the drilling company as "SDGS."

During October 1985, 72 test holes were drilled at this site and 68 were completed as wells (app. B). Test hole and well depths ranged between 8 and 50 feet. The locations of test holes and wells are plotted on figure 7. Generally, 1 to 2 feet of topsoil overlie till within the site. The till is approximately 20 feet thick and consists primarily of an unstratified, oxidized, tan-brown, silty-clay matrix. Two to 3 feet of unoxidized gray till (reworked shale) were occasionally observed beneath the oxidized till. The underlying undifferentiated Pierre Shale is Cretaceous in age. The shale is medium- to dark-gray in color. The uppermost 2 to 3 feet of the shale is weathered.

Minor sand lenses were observed in the till in four test holes at the landfill. Test hole A1-85-279, located in the southeast quarter of the landfill, contained sand from 15 to 16 feet. On the western boundary of the site, test hole A2-85-299 contained saturated sand from 17 to 28 feet. Test hole A1-85-288 contained saturated sand from 16 to 19 feet (the bottom of the hole). Test hole A1-85-289 contained very sandy, saturated till from 12 to 13 feet (the bottom of the hole).

Four additional test holes were drilled in the northwestern part of the landfill near A2-85-299 to check for lateral continuity of the saturated sand. Test hole A2-85-305 (fig. 7) encountered 1 foot from 15 to 16 feet in depth. Test hole A2-85-307 encountered 2 feet of sand from 14 to 16 feet in depth. Only sandy-clay till was observed in test holes A2-85-306 and A2-85-308. Although this sand lens appears to be continuous over approximately 600 feet along the fence line, it was not found to extend farther east into the landfill site. It was not within the scope of this project to define the extent of the sand outside the site boundaries.

Gravelly till layers, 6 inches to 2 feet thick, were observed in the till in two areas. Test hole A1-85-259, adjacent to the northeast corner of the landfill, contained gravelly till from 12 feet to the bottom of the augered hole (15 feet). From 15 to 15.5 feet a 6-inch gravel stringer was observed in the core in this test hole. Test holes A1-85-280, A1-85-281, A2-85-294, and A2-85-295 located in the southwest corner of the landfill encountered gravelly till from 6 to 8 feet below the land surface.

The western portion of the landfill contains more sand and gravel intervals than any other place in the landfill. Closely spaced drilling suggests that the sand and gravel bodies at a depth of approximately 15 feet may have some lateral continuity.

Hydrology

The clay material at the base of the landfill consists primarily of till (Office of Air Quality and Solid Waste records). This was confirmed by observations made during drilling. Shale was also observed. The permeability of till is difficult to characterize due to the highly variable nature of its physical composition and texture (i.e., grain size), in both the vertical and horizontal directions. Fractures, if any, in the upper weathered portion of the till can also contribute to significant spatial changes in permeability. Till generally has much lower permeability than sand. Shale also has much lower permeability than sand. No site specific permeability data are available.

Prior to the 1985 South Dakota Geological Survey investigation, two monitoring wells with unknown legal locations were present within the landfill. Without the presence of adequately constructed monitoring wells (a minimum of three) in the proper locations and at the proper depths, the lateral hydraulic gradient and direction of potential ground water movement could not be estimated for the landfill area. The nearest ground water supply (aquifer) is unknown. According to Koch and Bradford (1976), the nearest sand and gravel aquifer that is more than 10 feet thick and above the bedrock surface is located 2 miles east of the site. However, according to Koch and others (1973), the intermittent stream valley south of the site (Foot Creek) also has a good probability of containing sand and gravel deposits.

Saturated material was found in four test holes during drilling. Test hole 2, from within the landfill, indicates saturated oxidized clay till at a depth of 6 feet. The other three drilling logs, within 1 mile of the site, indicated the presence of saturated clay at a depth of 5 to 7 feet (fig. 7, app. A). Although water table data are listed in the Office of Air Quality and Solid Waste records, these data cannot be used because no well locations are given.

Project plans called for the Office of Air Quality and Solid Waste to collect water level data from the wells that were installed for this project. No data are available in the Office of Air Quality and Solid Waste files for this project, but information may be available in records postdating 1986.

Water Quality

Although water quality data were available, the legal locations and/or well depths were not known for wells within the landfill or within 1 mile of the landfill boundaries. Only data meeting the South Dakota Geological Survey criteria were used in this study. Water quality analyses were utilized if the legal locations were known to four quarter sections (2.5 acres) and if they were located within the landfill or within 1 mile of the site boundaries. Only wells with recorded depths less than 100 feet and with corresponding lithologic logs have been considered. This limit of 100 feet was arbitrarily chosen. Any major changes in water quality would probably be detected within this 100-foot depth limit because of the relatively low permeability of the underlying shale. Also, the analytical laboratory that produced a water quality analysis must have been known or the analysis was not utilized.

Project plans called for the Office of Air Quality and Solid Waste to collect water quality data from the wells that were installed for this project. No data are available in the Office of Air Quality and Solid Waste files for this project, but information may be available in records postdating 1986.

Adjacent Land Features

Information in this section was taken from the Aberdeen West Quadrangle and Lake Parmley Quadrangle (United States Geological Survey, 1960 and 1970) and the General Highway Map - South Half - Brown County (South Dakota Department of Transportation, 1962).

* The nearest source of surface water to the site is an intermittent stream, which branches north off of Foot Creek. Foot Creek flows near the south boundary of the site.

* Two intermittent ponds are located approximately half a mile from the site, one to the northeast and the other to the southwest.

Operational and Siting Criteria – Summary from the Office of Air Quality and Solid Waste Records

The most common responses found on the Office of Air Quality and Solid Waste site inspection reports prior to 1986 are given in this section. Copies of the microfiche data are available from the Department of Environment and Natural Resources in Pierre.

1. Site: Brown County

2. Population served: 37,000

3. Method of disposal: Cut and fill (trench)

4. Estimated amount of waste received per unit time: 35,084 tons/year

5. Access to site:

   * Fenced: _X_ Yes ___ No Lockable gate: _X_ Yes ___ No
   * Litter fences present: _X_ Yes ___ No
   * All weather access road to site: _X_ Yes ___ No

6. List industry present: 3M, Safeguard Automatic Corporation

7. Land Use:

   * Preoperational land use: Agriculture
   * Proposed post-operational land use: None
   * Current land use within a quarter of a mile radial area: Agriculture

SUMMARY

* An intermittent stream valley is present at this site.

* The geology at this site generally consists of up to 2 feet of topsoil overlying approximately 20 feet of oxidized clayey till. Pierre Shale underlies the till.

* Seventy-three test hole logs were available at this site. Three additional test hole logs were available within 1 mile of the site.

* Sixty-eight monitoring wells were present at this site.

* No water level data were available near this site.

* No reliable water quality data were available near this site.

REFERENCES CITED

Koch, N.C., and Bradford, W., 1976, Geology and water resources of Brown County, South Dakota; Part II: Water resources: South Dakota Geological Survey Bulletin 25, 53 p.

Koch, N.C., Bradford, W., and Leap, D.I., 1973, Major aquifers and sand and gravel resources in Brown County, South Dakota: South Dakota Geological Survey Information Pamphlet 4, 8 p.

Leap, D.I., Koch, N.C., and Bradford, W., 1986, Geology and water resources of Brown County, South Dakota; Part I, Geology: South Dakota Geological Survey Bulletin 25, 48 p.

South Dakota Department of Transportation, 1962, General Highway Map - South Half - Brown County, South Dakota: South Dakota Department of Transportation in cooperation with the United States Department of Transportation, (revisions as of August 31, 1972).

Spuhler, W., Lytle, W.F., and Moe, D., 1971, Climate of South Dakota: Brookings, South Dakota, South Dakota State University Agricultural Experiment Station Bulletin 582, 30 p.

United States Geological Survey, 1960, Aberdeen West quadrangle, South Dakota: 7.5 minute series (topographic), scale 1:24,000, (photorevised in 1978).

_____1970, Lake Parmley quadrangle, South Dakota: 7.5 minute series (topographic), scale 1:24,000.

Figure 1. Sites considered for further evaluation.

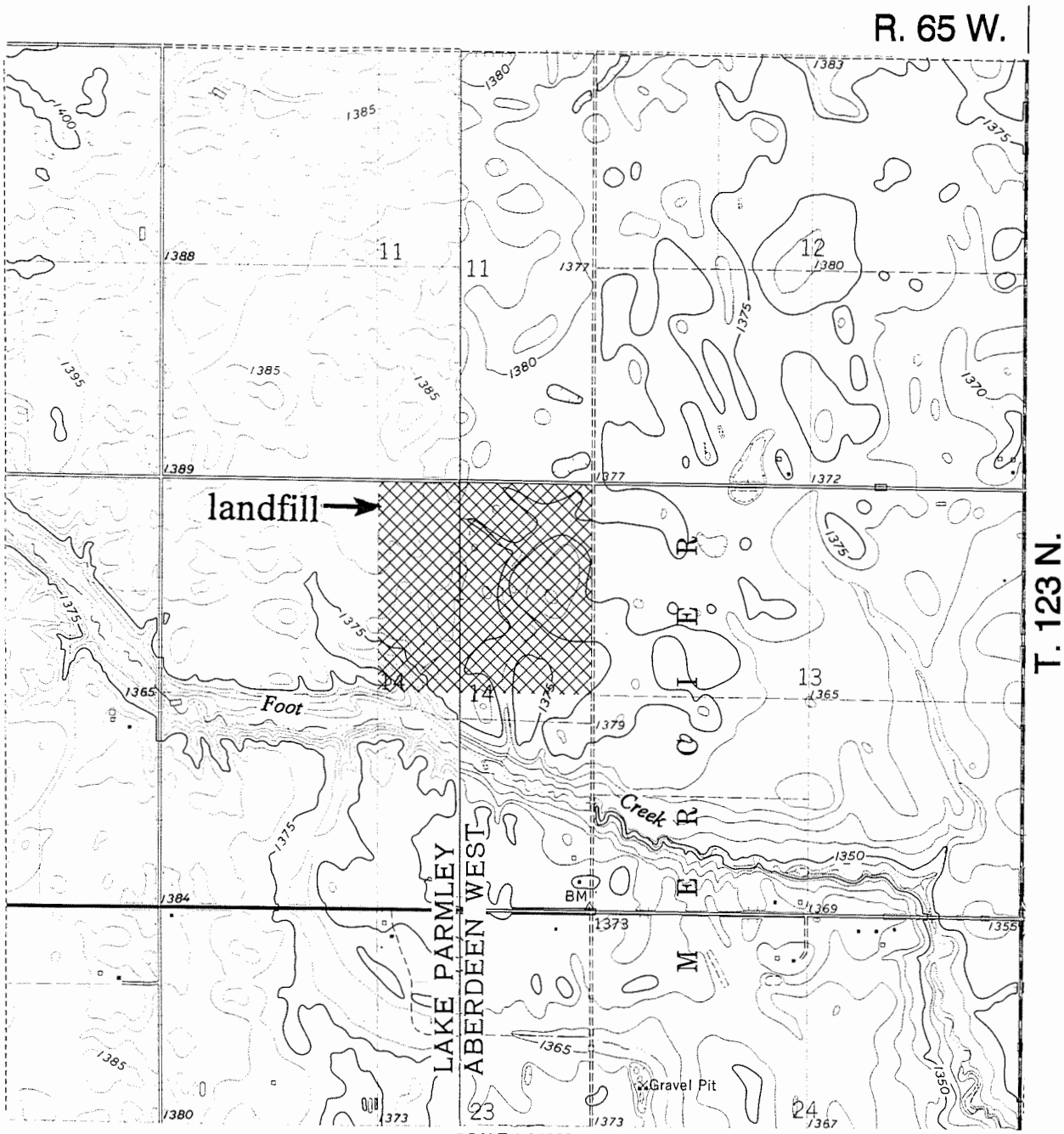


Figure 2. Location of the Brown County landfill.

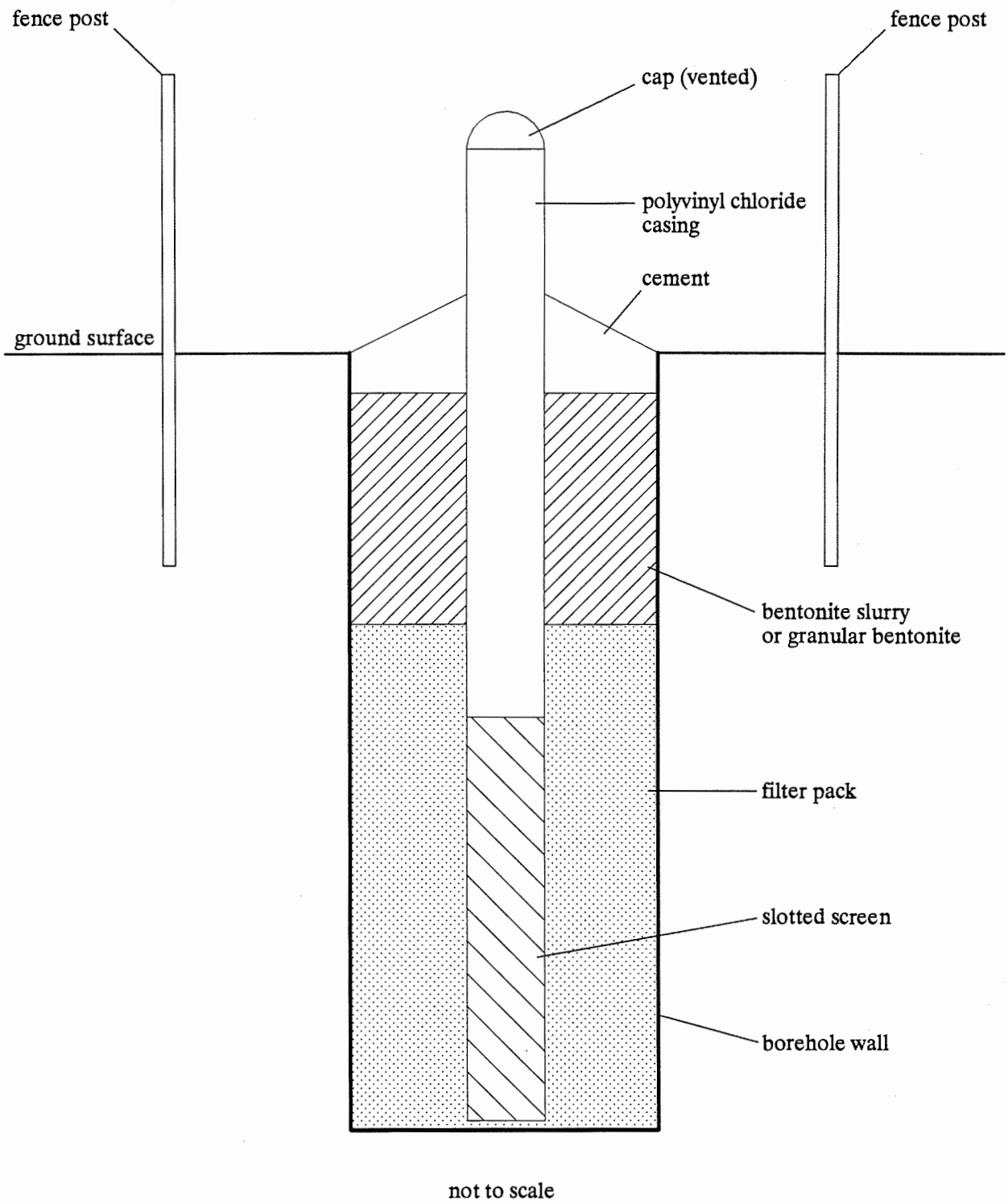


Figure 3. Generalized construction of a screened well.

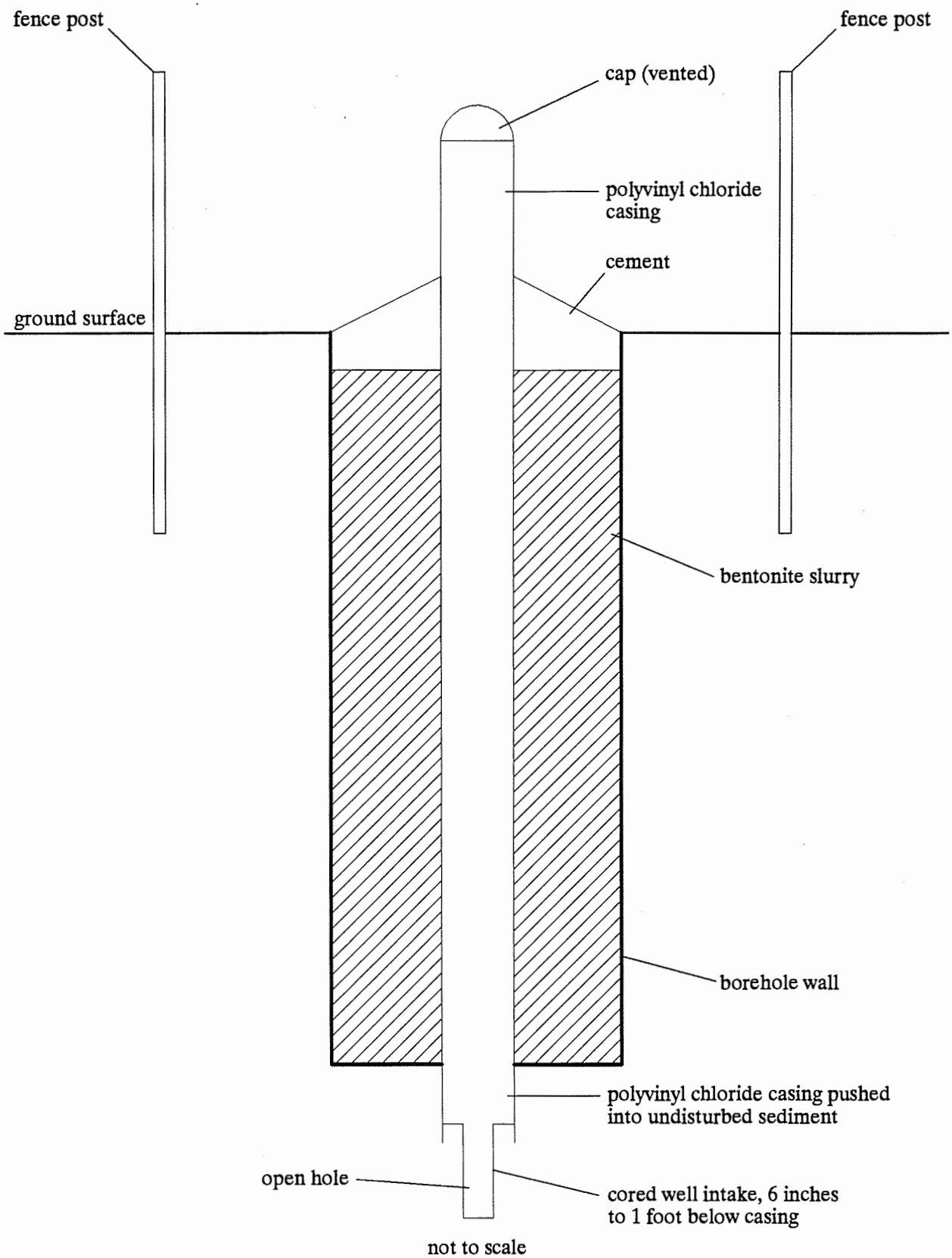
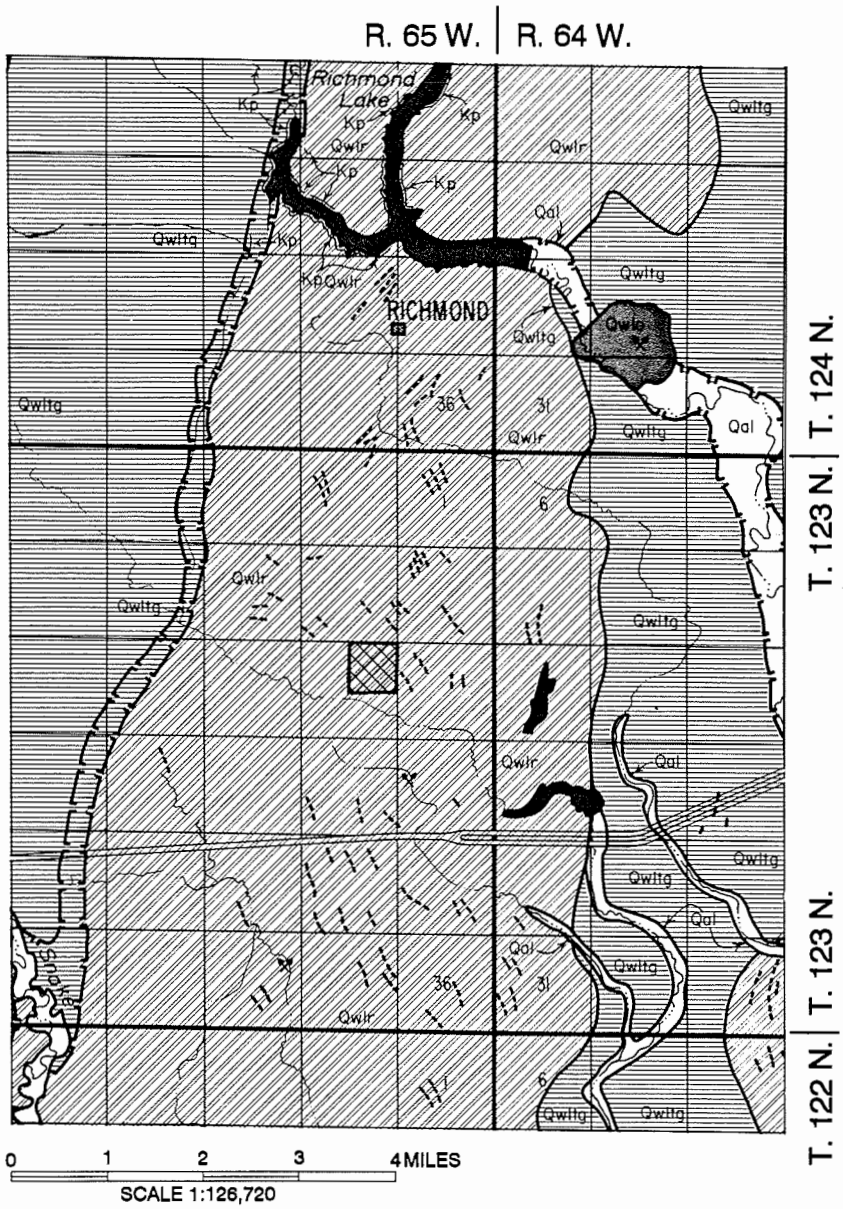


Figure 4. Generalized construction of a cored-intake well.



Qwlr..... Recessional moraine

Qwltg..... Till, ground moraine

Qal..... Alluvium

Qwlo..... Outwash sand and gravel

Kp..... Pierre Shale

⊠ Landfill

Adapted from Leap and others (1986)

Figure 5. Geology near the Brown County landfill.

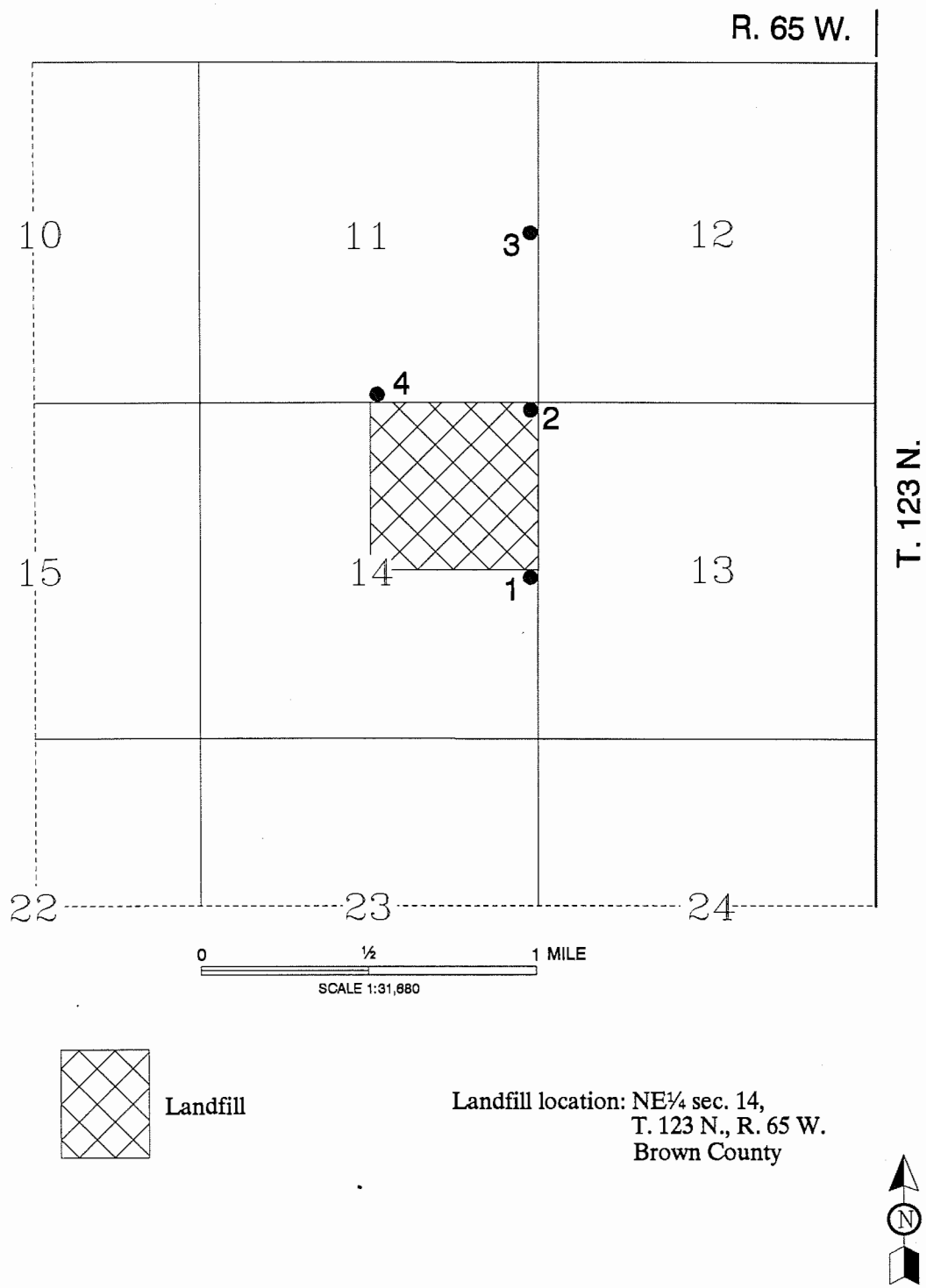
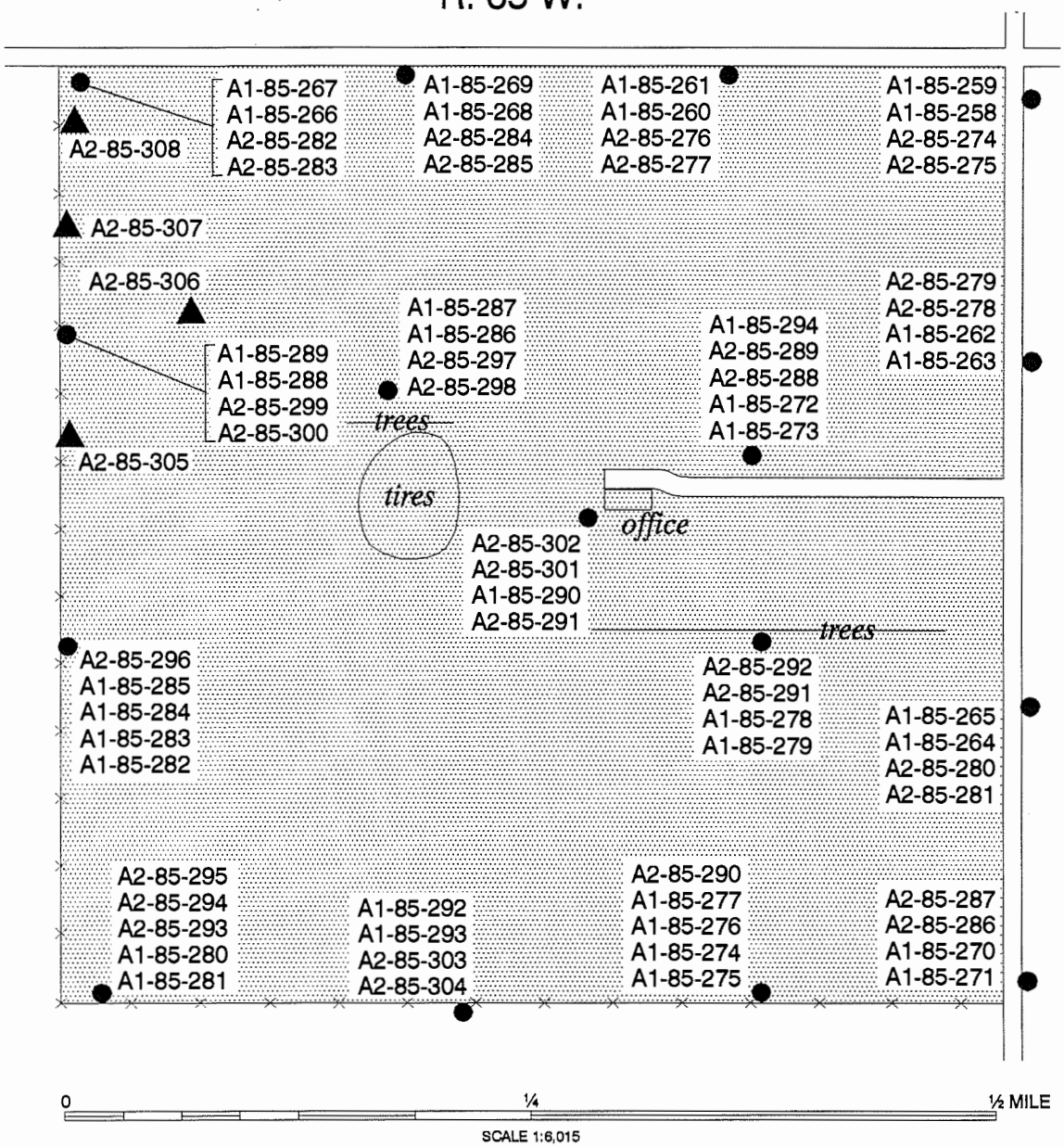


Figure 6. Locations of test holes drilled prior to 1985 within of the Brown County landfill.



A1-85-261● Nested well set. Letters and numbers are the individual well name identifiers in that set.

A2-85-305▲ Test hole. Letter and numbers are the test hole identifier.

Landfill. Landfill location: NE¼ sec. 14, T. 123 N., R. 65 W., Brown County.

Fence

Figure 7. Locations of test holes drilled and wells installed in 1985 at the Brown County landfill.

APPENDIX A

Legal locations of Brown County landfill area logs of test holes drilled prior to 1985

Listed below are the legal locations of those test holes cited in this report. Please contact the South Dakota Geological Survey if a copy of a lithologic log is needed.

NE NE NE SE sec. 11, T. 123 N., R. 65 W.
SW SW SW SE sec. 11, T. 123 N., R. 65 W.
NE NE NE NE sec. 14, T. 123 N., R. 65 W.
NE NE NE SE sec. 14, T. 123 N., R. 65 W.

APPENDIX B

Legal locations of Brown County landfill logs of test holes drilled and wells installed in 1985

Listed below are the legal locations of those test holes and wells cited in this report. Please contact the South Dakota Geological Survey if a copy of a lithologic log is needed. If a legal location is duplicated, that means more than one test hole or well has been drilled or installed at that location.

NW NW NW NW sec. 13, T. 123 N., R. 65 W.
NW NW NW NW sec. 13, T. 123 N., R. 65 W.
NW NW NW NW sec. 13, T. 123 N., R. 65 W.
NW NW NW NW sec. 13, T. 123 N., R. 65 W.
NW SW NW NW sec. 13, T. 123 N., R. 65 W.

NW SW NW NW sec. 13, T. 123 N., R. 65 W.
NW SW NW NW sec. 13, T. 123 N., R. 65 W.
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SW SW SW NW sec. 13, T. 123 N., R. 65 W.
NE NW NE NE sec. 14, T. 123 N., R. 65 W.
NE NW NE NE sec. 14, T. 123 N., R. 65 W.
NE NW NE NE sec. 14, T. 123 N., R. 65 W.
NE NW NE NE sec. 14, T. 123 N., R. 65 W.

SE SW NE NE sec. 14, T. 123 N., R. 65 W.
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NW NE NW NE sec. 14, T. 123 N., R. 65 W.
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SW NW NW NE sec. 14, T. 123 N., R. 65 W.

APPENDIX B -- continued.

NW SW NW NE sec. 14, T. 123 N., R. 65 W.
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NW NW SE NE sec. 14, T. 123 N., R. 65 W.
NW NW SE NE sec. 14, T. 123 N., R. 65 W.
NW NW SE NE sec. 14, T. 123 N., R. 65 W.
NW NW SE NE sec. 14, T. 123 N., R. 65 W.
SE NW SE NE sec. 14, T. 123 N., R. 65 W.

SE NW SE NE sec. 14, T. 123 N., R. 65 W.
SE NW SE NE sec. 14, T. 123 N., R. 65 W.
SE NW SE NE sec. 14, T. 123 N., R. 65 W.
SE SW SE NE sec. 14, T. 123 N., R. 65 W.
SE SW SE NE sec. 14, T. 123 N., R. 65 W.

SE SW SE NE sec. 14, T. 123 N., R. 65 W.
SE SW SE NE sec. 14, T. 123 N., R. 65 W.
SE SW SE NE sec. 14, T. 123 N., R. 65 W.
NE NE NW SE sec. 14, T. 123 N., R. 65 W.
NE NE NW SE sec. 14, T. 123 N., R. 65 W.

NE NE NW SE sec. 14, T. 123 N., R. 65 W.
NE NE NW SE sec. 14, T. 123 N., R. 65 W.