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OPEN-FILE REPORT 80-UR - NO. 24: WATERTOWN CITY

STATEWIDE LANDFILL STUDY:

WATERTOWN CITY LANDFILL SITE CHARACTERISTICS

by

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CONTENTS

FIGURES

Page

FIGURES – continued.

TABLE

APPENDICES

INTRODUCTION

Purpose and Scope

The purpose of this report is to summarize the geologic data, hydrologic data, and other site characteristics of the Watertown City 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 Watertown City landfill in 1986. This report is primarily a compilation of the preliminary report on the Watertown City landfill and the detailed investigation at the Watertown City landfill.

WATERTOWN CITY LANDFILL

Location

The Watertown City landfill is located 1½ miles south of Watertown in Codington County. Its legal location is W½ NW¼ sec. 21, T. 116 N., R. 52 W. (fig. 2).

Topography, Drainage, and Climate

The information on topography and drainage was taken from the Watertown SE Quadrangle (United States Geological Survey, 1969). In actuality, the present landfill surface may be significantly different because of activities at the landfill.

The topography at the Watertown City landfill is that of a dissected surface adjacent to a river valley. The surface slopes gently eastward for approximately 1 mile where it levels out to become part of the Big Sioux River floodplain (fig. 2). The elevation ranges from 1,760 to 1,802 feet for a maximum relief of 42 feet at the site.

Drainage is controlled by the Big Sioux River located 1½ miles east of the landfill. An intermittent stream drains the southern half of the landfill and a draw drains the northern half. Both drain eastward into two manmade ponds on the western edge of the Big Sioux River floodplain.

The average annual temperature in Codington County is 43 degrees Fahrenheit. Precipitation averages 20 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 Watertown City landfill during June 1986.

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

Surficial deposits at the Watertown City landfill have been mapped as ground moraine (fig. 5). Outwash and alluvium occur in the valley of the Big Sioux River approximately 1 mile, downslope and east of the site. The Pierre Shale underlies about 500 feet of glacial sediments in this area (Barari, 1971).

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 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."

Prior to the detailed South Dakota Geological Survey investigation, records for 22 shallow test holes or wells of varying depths located within 1 mile of the landfill were available (fig. 6). Eleven of the 22 test holes encountered topsoil ranging from 0 to 4 feet in thickness, followed by clay (till) to depths ranging from 22 to 53 feet, depending on the final depth of the drill hole. Test hole 7 was unusual in that thick topsoil from 0 to 18 feet was found, followed by clay from 18 to 56 feet and sand from 56 to 60 feet. Test hole R2-85-62 encountered 1 foot of topsoil overlying clay till to a depth of 110 feet. Below a depth of 110 feet, alternating layers of sand (or sand and gravel) and clay were encountered to a depth of 471 feet. The Altamont aquifer was identified from 413 to 471 feet and the test hole was completed at 580 feet in the Pierre Shale.

The other 11 test holes (out of 22) in sections 15, 22, 27, and 28 were drilled in the valley of the Big Sioux River. A thin cover of topsoil or clay overlies sand and gravel (12 to 32 feet thick) to a maximum depth based on test hole data of 38 feet in the valley. This outwash sand and gravel unit is typically saturated and comprises the Big Sioux aquifer (Stach and others, 1984).

During the South Dakota Geological Survey investigation in June 1986, 28 additional test holes were drilled at this site and all were completed as wells (fig. 7, app. A). Only till was observed in

these holes. The till was primarily unstratified, tan-brown, silty, sandy, and gravelly clay. It was oxidized to a depth of approximately 50 feet. Sand was observed only in test hole R20-86-26, from 24 to 26 feet below the surface and it is probably part of a small, discontinuous lens. No gravel intervals were encountered. Continuous core was collected from wells R20-86-25, R20-86-26, and R20-86-27 (fig. 7).

Hydrology

According to the Office of Air Quality and Solid Waste records, the material at the base of the landfill consists primarily of clay (till). This was confirmed by observations made during drilling. 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. No site specific permeability data are available.

Four monitoring wells were installed in this area in the Big Sioux aquifer prior to June 1986, and 28 wells were installed during the South Dakota Geological Survey investigation, but no hydrologic data are available in the Office of Air Quality and Solid Waste records. Well depths ranged between 19 and 50 feet. The locations of the wells are plotted on figures 6 and 7. Only data meeting South Dakota Geological Survey criteria were used in this study. Without the presence of adequately constructed monitoring wells (a minimum of three), the lateral hydraulic gradient and the direction of potential ground water movement cannot be estimated for the landfill area.

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.

The Big Sioux aquifer is the nearest ground water source and consists of Pleistocene and recent alluvial material filling the valley of the Big Sioux River. The landfill site is approximately 1 mile west of the western edge of the Big Sioux aquifer. Farms not located within the Big Sioux River valley obtain their water either from the local rural water system or have deep (greater than 200 feet) wells (Jay Gilbertson, South Dakota Geological Survey, personal communication, 1985). The Sioux Rural Water System has a well field in the Big Sioux aquifer, in the northwest corner of section 27, about 1 mile southeast of the landfill site. This water system provides water for a large portion of Codington and Hamlin Counties.

Water Quality

Three water quality analyses were collected from well CD-57B, a 33-foot deep observation well in the Big Sioux aquifer located within 1 mile of the site (fig. 8, app. B). The total dissolved solids concentration increased slightly from 618 milligrams per liter in 1964, to 718 milligrams per liter in 1970, to 752 milligrams per liter in 1975 in samples collected from this well.

Only data meeting 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 till. 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 Watertown SE Quadrangle (United States Geological Survey, 1969) and the General Highway Map - Codington County (South Dakota Department of Transportation, 1978).

* Four ponds are located near the landfill: two are half a mile to three-quarters of a mile east and two are three-quarters of a mile north.

* The Big Sioux River is approximately 1 mile east of the site.

* The site is located adjacent to the Big Sioux River valley.

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: Watertown City

2. Population served: 23,065

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

4. Estimated amount of waste received per unit time: 34,892 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: Poultry processing, rendering plant, Olin Industries, Minnesota Rubber Company, Chickasha Mobile Homes, Telelect, Inc., Midcom, Nutting

7. Land Use:

   * Preoperational land use: Agriculture
   * Proposed post-operational land use: Agriculture

* Current land use within a quarter of a mile radial area: Agriculture

SUMMARY

* This landfill is located near intermittent streams and the Big Sioux River.

* The geology at this site generally consists of a few feet of topsoil overlying approximately 50 feet of oxidized till above unoxidized till.

* Fifty test holes had been drilled within 1 mile of the landfill, both in the till and the Big Sioux aquifer.

* Thirty-two monitoring wells had been installed near this site.

* No water level data were available near this site.

* Analyses of three water samples, collected from the same well near this site, were available.

REFERENCES CITED

Barari, A., 1971, Hydrology of Lake Kempeska: South Dakota Geological Survey Report of Investigations 103, 84 p.

South Dakota Department of Transportation, 1978, General Highway Map Codington County, South Dakota: South Dakota Department of Transportation in cooperation with the United States. Department of Transportation, (revisions as of May 31, 1979).

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.

Stach, R.L., Allen, J., and Chadima, S.A., 1984, Draft final report Big Sioux aquifer study, Part I: South Dakota Geological Survey unpublished report.

Steece, F.V., 1958, Geology of the Watertown quadrangle: South Dakota Geological Survey Geologic Quadrangle Map, scale 1:62,500, text.

United States Geological Survey, 1969, Watertown SE quadrangle, South Dakota: 7.5 minute series (topographic), scale 1:24,000.

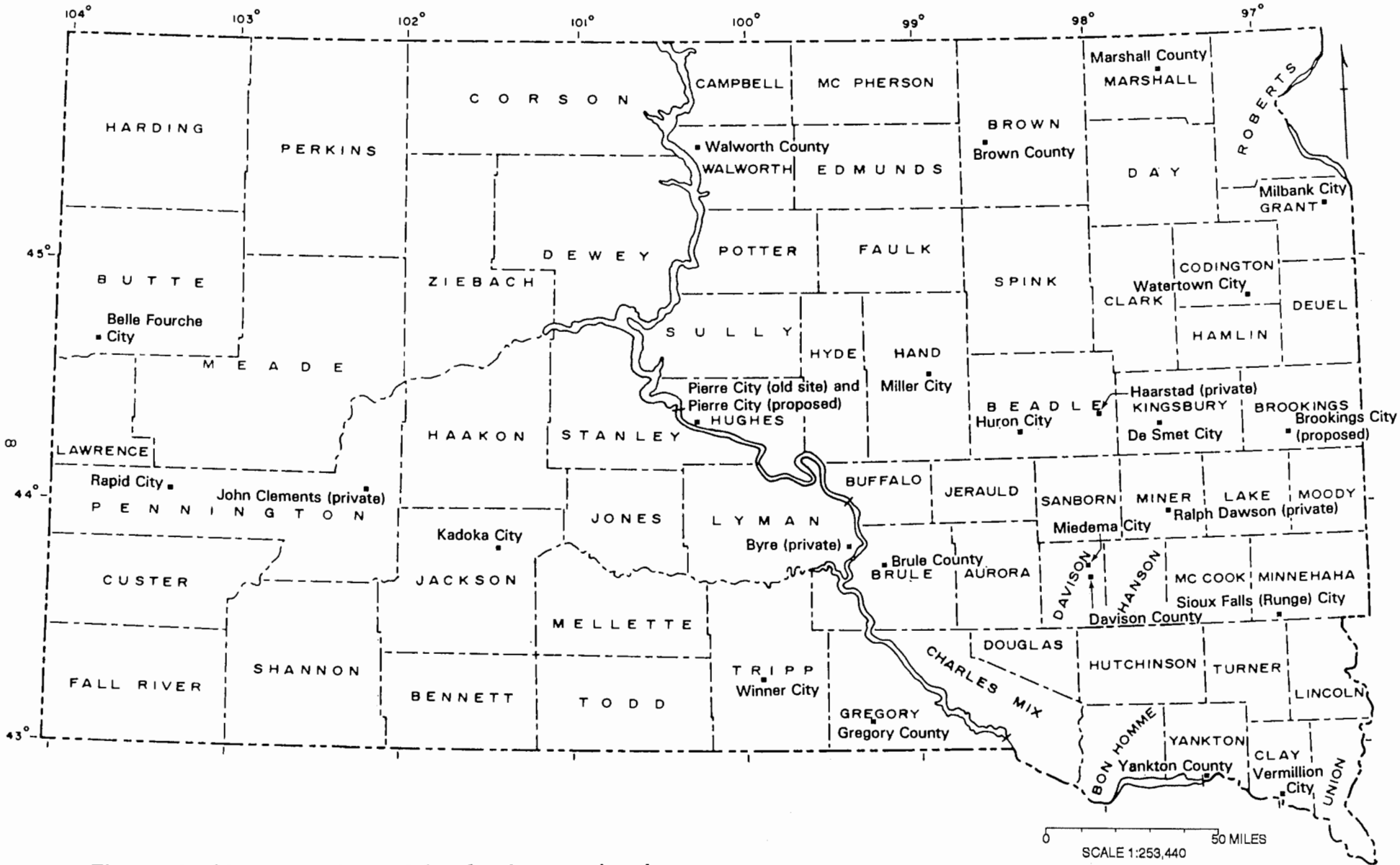


Figure 1. Sites considered for further evaluation.

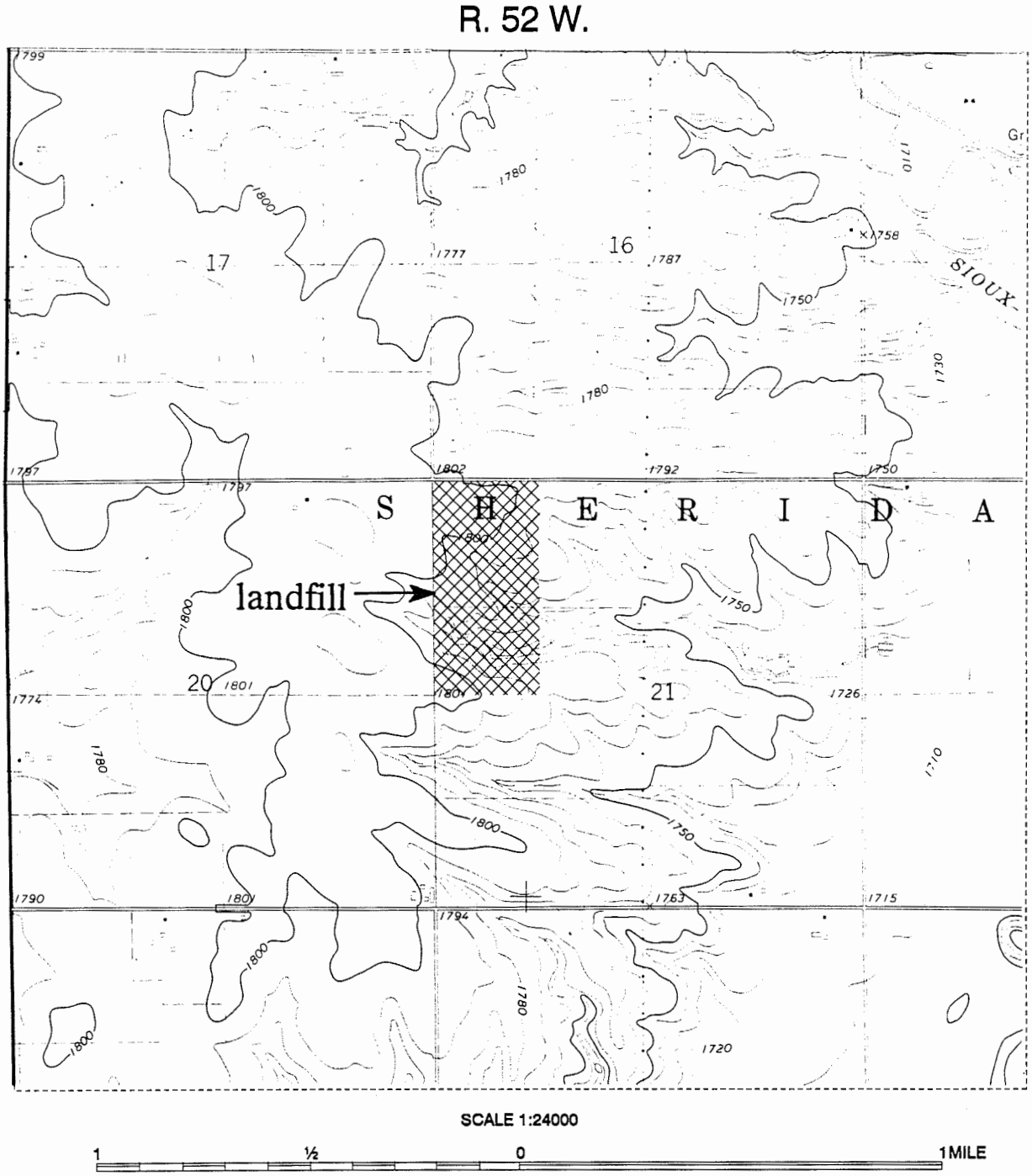


Figure 2. Location of the Watertown City landfill.

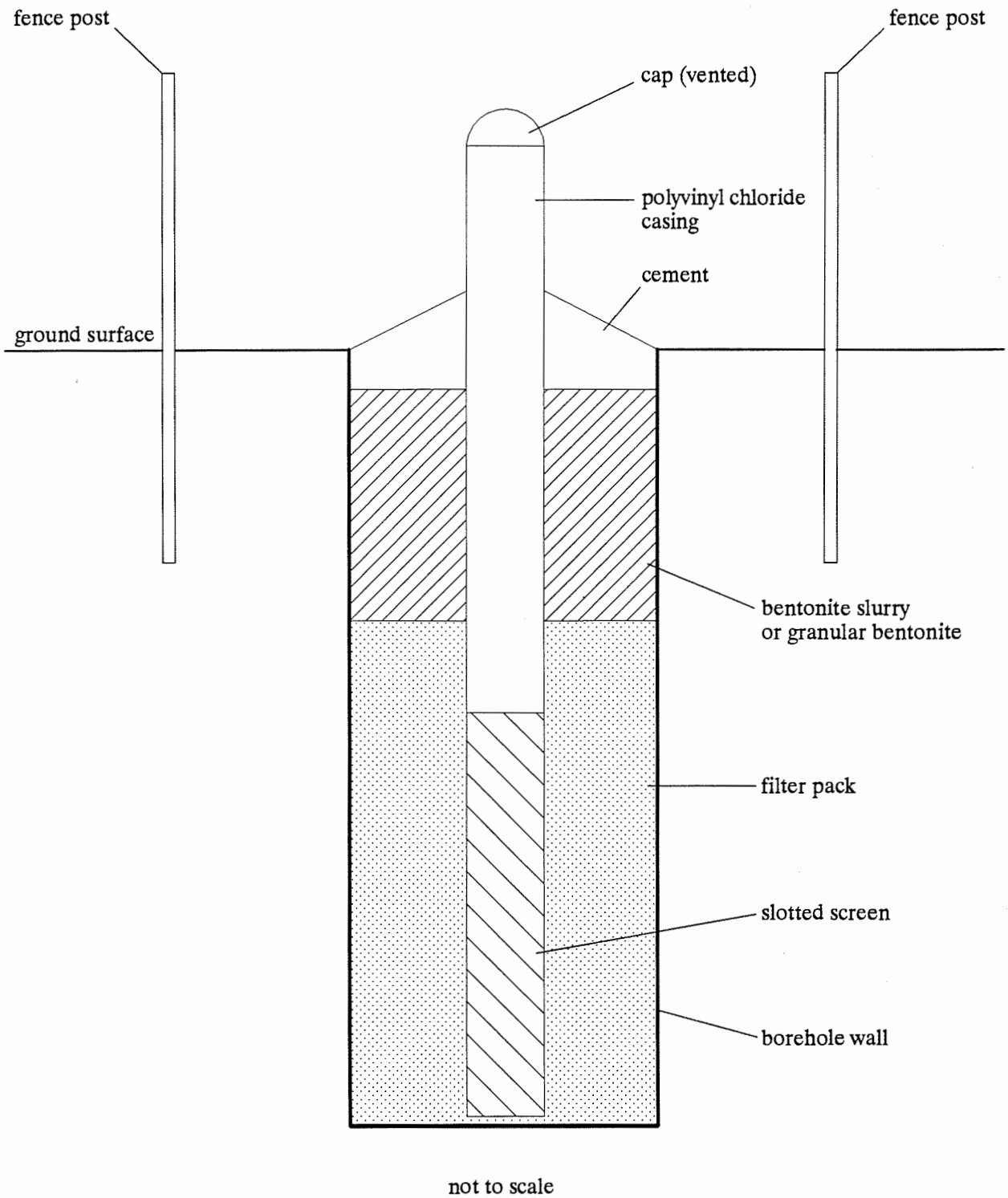


Figure 3. Generalized construction of a screened well.

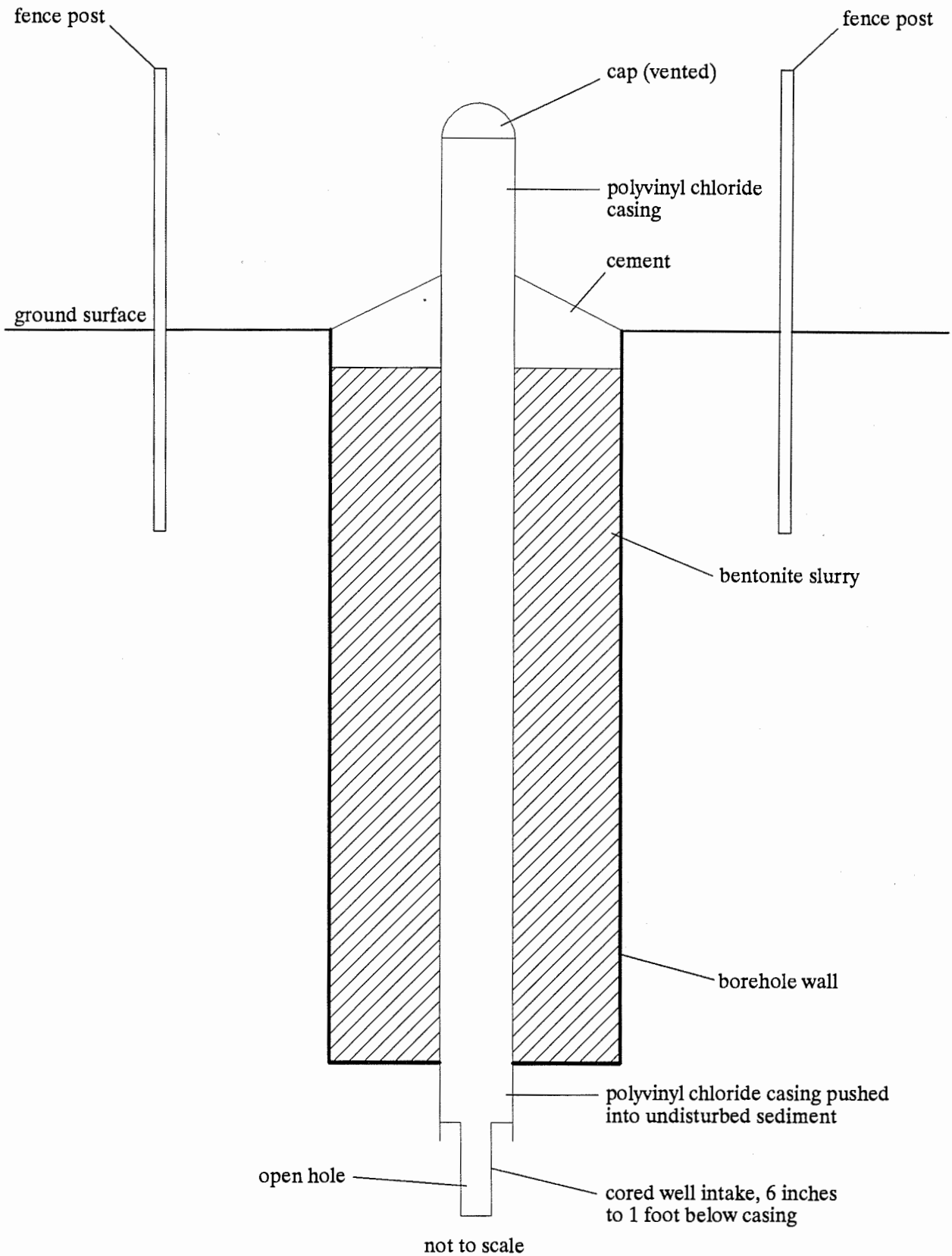
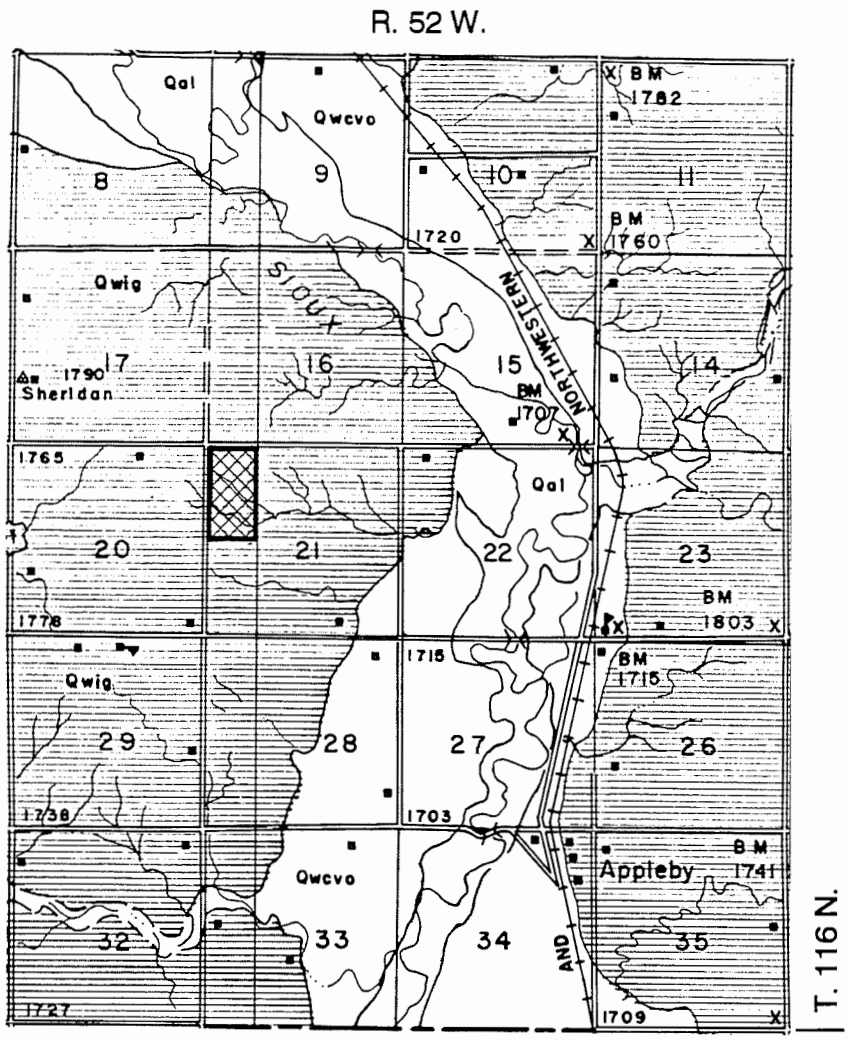


Figure 4. Generalized construction of a cored-intake well.



Qal..... Alluvium

Qwcvo..... Middle(?) Cary valley train outwash

Qwig..... Iowan(?) ground moraine

⊠ Landfill

Adapted from Steece (1958)

Figure 5. Geology near the Watertown City landfill.

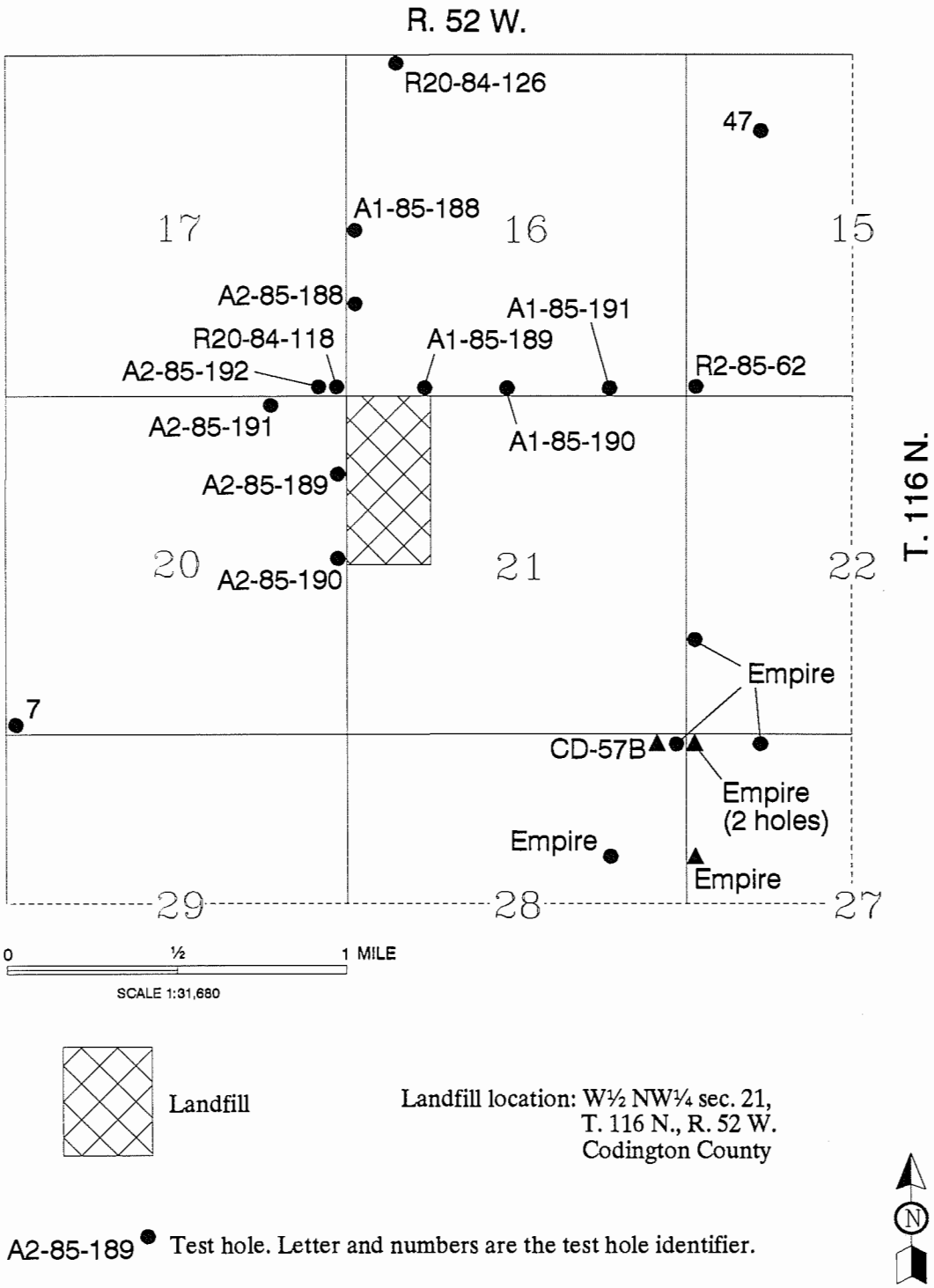
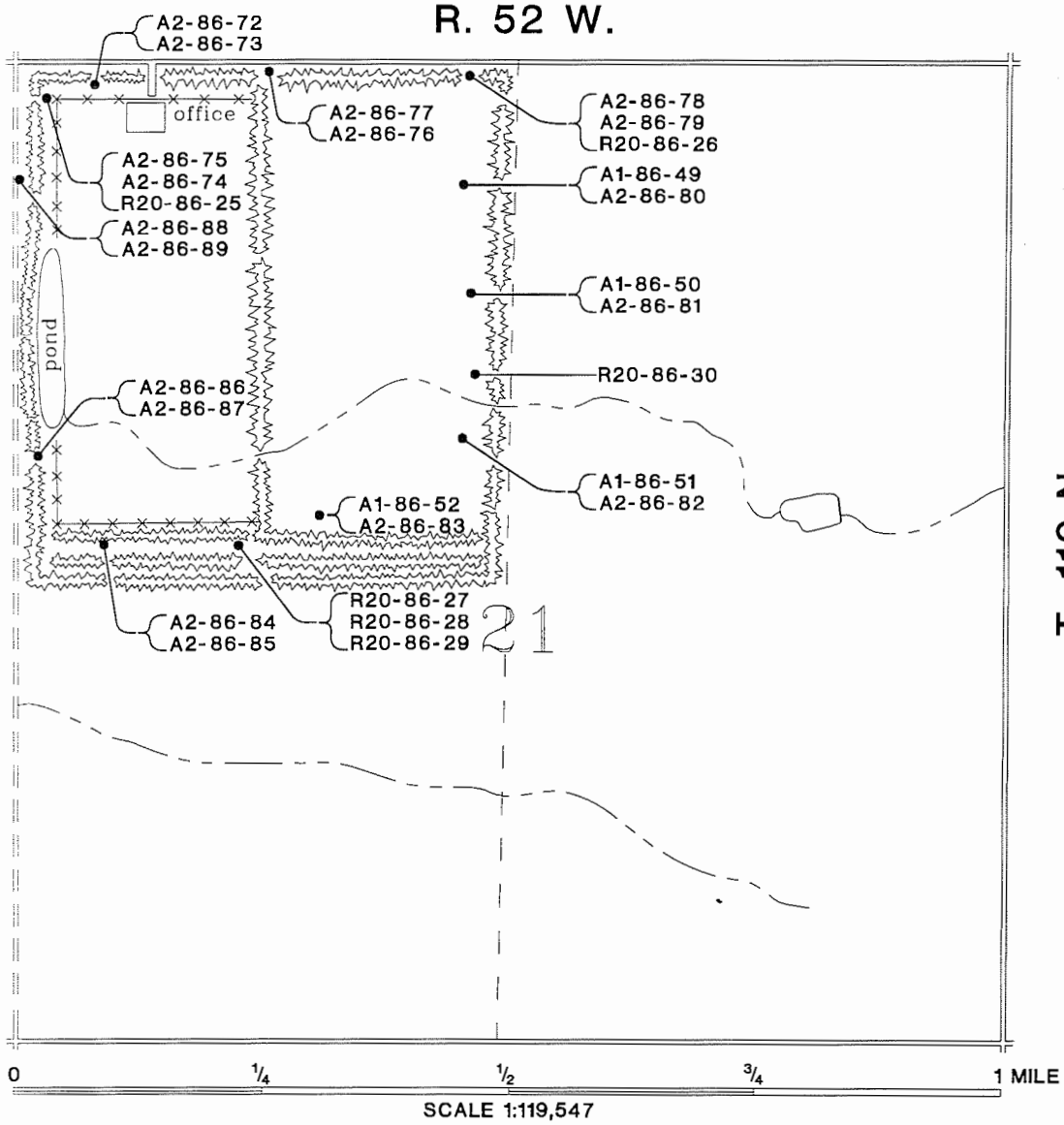


Figure 6. Locations of test holes drilled and wells installed within 1 mile of the Watertown City landfill.



A1-86-52
A2-86-83 — Nested well set. Letters and numbers are the individual well name identifiers in that set.

Landfill location: W½ NW¼ sec. 21, T. 116 N., R. 52 W.

Trees

Fence

Intermittent stream

Power line

N

Figure 7. Locations of wells drilled and installed in June 1986 at the Watertown City landfill.

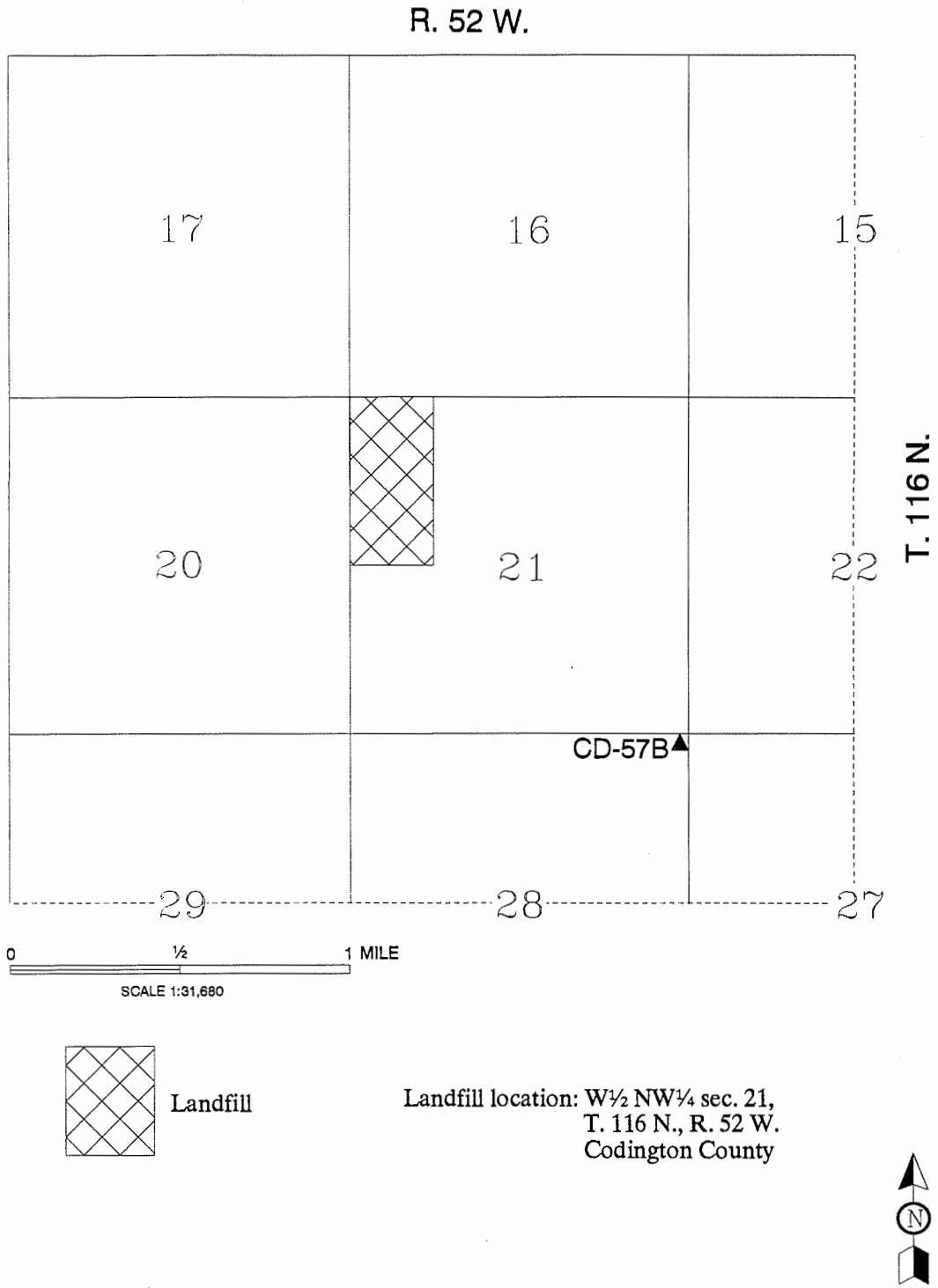


Figure 8. Location of water quality samples collected within 1 mile of the Watertown City landfill.

APPENDIX A

Legal locations of Watertown City landfill area logs of test holes and monitoring wells

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.

NE NW SW NW sec. 15, T. 116 N., R. 52 W.
SW SW SW SW sec. 15, T. 116 N., R. 52 W.
NE NW NW NW sec. 16, T. 116 N., R. 52 W.
NW NW NW SW sec. 16, T. 116 N., R. 52 W.
NW NW SW SW sec. 16, T. 116 N., R. 52 W.

SE SE SW SW sec. 16, T. 116 N., R. 52 W.
SE SE SE SW sec. 16, T. 116 N., R. 52 W.
SW SW SE SE sec. 16, T. 116 N., R. 52 W.
SE SE SE SE sec. 17, T. 116 N., R. 52 W.
SE SE SE SE sec. 17, T. 116 N., R. 52 W.

NW NW NE NE sec. 20, T. 116 N., R. 52 W.
SE SE NE NE sec. 20, T. 116 N., R. 52 W.
SE SE SE NE sec. 20, T. 116 N., R. 52 W.
SW SW SW SW sec. 20, T. 116 N., R. 52 W.
NE NE NE NW sec. 21, T. 116 N., R. 52 W.

NE NE NE NW sec. 21, T. 116 N., R. 52 W.
NE NE NE NW sec. 21, T. 116 N., R. 52 W.
SE NE NE NW sec. 21, T. 116 N., R. 52 W.
SE NE NE NW sec. 21, T. 116 N., R. 52 W.
SE SE NE NW sec. 21, T. 116 N., R. 52 W.

SE SE NE NW sec. 21, T. 116 N., R. 52 W.
NE NE NW NW sec. 21, T. 116 N., R. 52 W.
NE NE NW NW sec. 21, T. 116 N., R. 52 W.
NE NW NW NW sec. 21, T. 116 N., R. 52 W.
NE NW NW NW sec. 21, T. 116 N., R. 52 W.

NW NW NW NW sec. 21, T. 116 N., R. 52 W.
NW NW NW NW sec. 21, T. 116 N., R. 52 W.
NW NW NW NW sec. 21, T. 116 N., R. 52 W.
SW NW NW NW sec. 21, T. 116 N., R. 52 W.
SW NW NW NW sec. 21, T. 116 N., R. 52 W.

APPENDIX A – continued.

NW SW SW NW sec. 21, T. 116 N., R. 52 W.
NW SW SW NW sec. 21, T. 116 N., R. 52 W.
SE SW SW NW sec. 21, T. 116 N., R. 52 W.
SE SW SW NW sec. 21, T. 116 N., R. 52 W.
SE SE SW NW sec. 21, T. 116 N., R. 52 W.

SE SE SW NW sec. 21, T. 116 N., R. 52 W.
SE SE SW NW sec. 21, T. 116 N., R. 52 W.
NE NE SE NW sec. 21, T. 116 N., R. 52 W.
SE NE SE NW sec. 21, T. 116 N., R. 52 W.
SE NE SE NW sec. 21, T. 116 N., R. 52 W.

SE SW SE NW sec. 21, T. 116 N., R. 52 W.
SE SW SE NW sec. 21, T. 116 N., R. 52 W.
SW SW NW SW sec. 22, T. 116 N., R. 52 W.
NE NE NW NW sec. 27, T. 116 N., R. 52 W.
NW NW NW NW sec. 27, T. 116 N., R. 52 W.

NW NW NW NW sec. 27, T. 116 N., R. 52 W.
NW SW SW NW sec. 27, T. 116 N., R. 52 W.
NE NE NE NE sec. 28, T. 116 N., R. 52 W.
NE NE NE NE sec. 28, T. 116 N., R. 52 W.
NW SE SE NE sec. 28, T. 116 N., R. 52 W.

APPENDIX B

Legal locations of Watertown City landfill area water quality analyses

Listed below is the legal location of the three samples collected from one well cited in this report. Please contact the Department of Environment and Natural Resources in Pierre if a copy of a water quality analysis (from their microfiche records) is needed.

SAMPLE NO.	LOCATION
P-7494	NE NE NE NE sec. 28, T. 116 N., R. 52 W.
70-99	NE NE NE NE sec. 28, T. 116 N., R. 52 W.
75-381	NE NE NE NE sec. 28, T. 116 N., R. 52 W.