March 16, 2015

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MAR 18 2015

SOUTH DAKOTA PUBLIC
UTILITIES COMMISSION

Public Utilities Commission
Capitol Building, 1st Floor
500 E. Capitol Avenue
Pierre, SD 57501-5070

HP 14-002 ~ In the Matter of the Application of Dakota Access, LLC for an Energy Facility Permit to Construct the Dakota Access Pipeline

Dear Commissioners:

I am not in favor of the Dakota Access Pipeline project. The project would potentially threaten the water supply on our farm if a spill would occur. In addition, it is proposed to run approximately ¼ mile to the west of Wall Lake. Wall Lake is part of the aquifer system to the city of Sioux Falls. It is the backup reservoir to our highest populated city. Can you imagine what would happen if oil contaminated the city of Sioux Falls' water supply? Think of everyone that would be affected: hospitals, schools, nursing homes, personal homes, businesses, etc. It would be a total disaster.

If a disaster like this would occur, the 2013 annual report from ETP states that they would not have enough "cash reserves" to cover "all future liabilities". Why would you want to approve this pipeline in the first place if the pipeline company would not have enough money to clean up a disaster?

I hope that you would put the people of South Dakota and the city of Sioux Falls' water supply priority over the Dakota Access Pipeline.

Sincerely,

Rod Hohn
[redacted]
Hartford, SD 57033

enclosure

Figure 3 ~ shows the Wall Lake Aquifer

Page 10 ~ states the Wall Lake Aquifer covers approximately 110 square miles

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SOUTH DAKOTA PUBLIC
UTILITIES COMMISSION

Open-File Report 60-UR

ASSESSMENT OF WATER RESOURCES AND CONCEPTUAL EVALUATION OF A REGIONAL WATER SUPPLY FOR SOUTHEASTERN SOUTH DAKOTA

by

Assad Barari
Derric L. Iles
Tim C. Cowman

Science Center
University of South Dakota
Vermillion, South Dakota

1989

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TABLE

INTRODUCTION

Increased water demand and the public's desire for better quality water have led to studies which evaluated potential improvements in the quantity or quality of drinking-water supplies in southeastern South Dakota. The demand for additional quantities of water is expected to continue. Because of the changing attitude of the public and government regarding the quality of drinking water, demands for protection and improvement of water quality will also continue.

In the past, remedies to satisfy these demands have generally been based on individual community requirements and financial resources. Because a large capital expenditure is involved in providing better quality water from a distant source, additional or new sources of water relatively near the water user have usually been developed.

The purpose of the present assessment is two-fold: (1) to identify the water requirements of some cities and rural-water systems in order to evaluate the adequacy of their present water supplies and (2) to address the concept of a regional water supply for southeastern South Dakota. Brief descriptions of some municipal and rural-water systems in southeastern South Dakota will serve as examples of current problems or problems that may be encountered in the future, by other municipalities or rural-water systems. Although a large area of South Dakota needs an evaluation of water-supply requirements and sources for the future, this report discusses only a few water-supply systems in the following seven counties: Hanson, McCook, Minnehaha, Turner, Lincoln, Clay, and Union (fig. 1). Part of this area is presently served by rural-water systems (fig. 2). The most feasible future water supply alternative for this seven-county area may be a single water-supply system. Further evaluation of the water-supply needs and sources of the rest of southeastern South Dakota (fig. 1) should be conducted to determine if an area larger than the seven counties mentioned above should be included in this water-supply system or if another water-supply system would be more appropriate.

The Census Bureau in 1987 estimated the population of the seven-county area at approximately 179,600 people. This is 25.3 percent of the population of the state of South Dakota. The population of this area will likely increase in the future, and as it does, the water demands of this area will also increase. The following sections of this report evaluate water supplies for selected water users in southeastern South Dakota.

EVALUATION OF PRESENT WATER SUPPLIES

Sioux Falls

Sioux Falls is the largest and the fastest growing city in the state. The present population of the city is estimated to be 101,000. The city's water use for 1988 was 6.3 billion gallons which represents an average pumping rate of 17.3 million gallons per day (MGD; Water Purification Plant personnel, city of Sioux Falls, personal communication, 1989). If conservation measures had not been imposed on water consumption during the summer months of 1988, water use would have been greater. The annual water use figure is lower than actual water pumped due to system loss. Peak daily water usage for 1988 was 33.0 MGD.

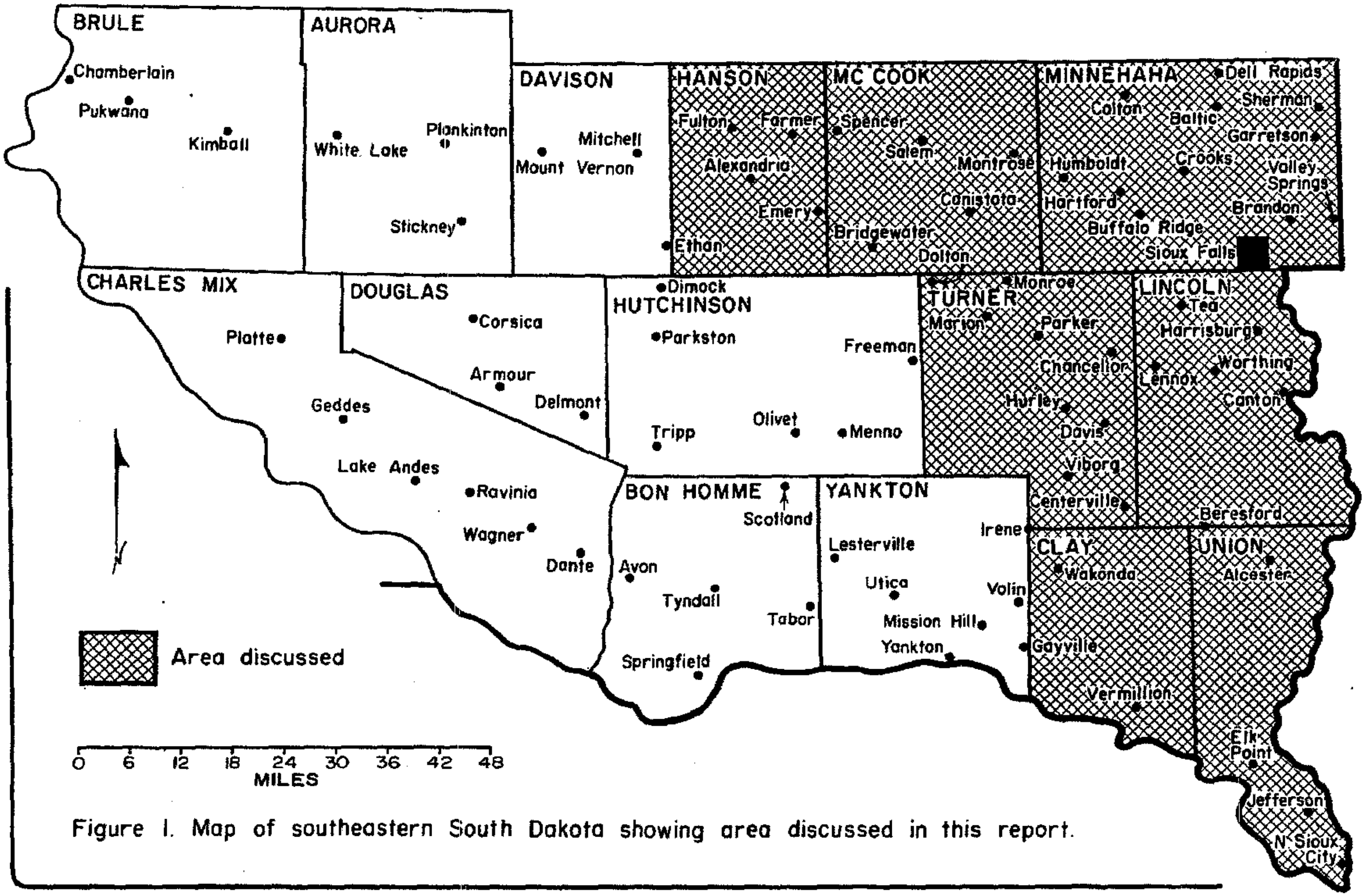

Figure 1. Map of southeastern South Dakota showing area discussed in this report.

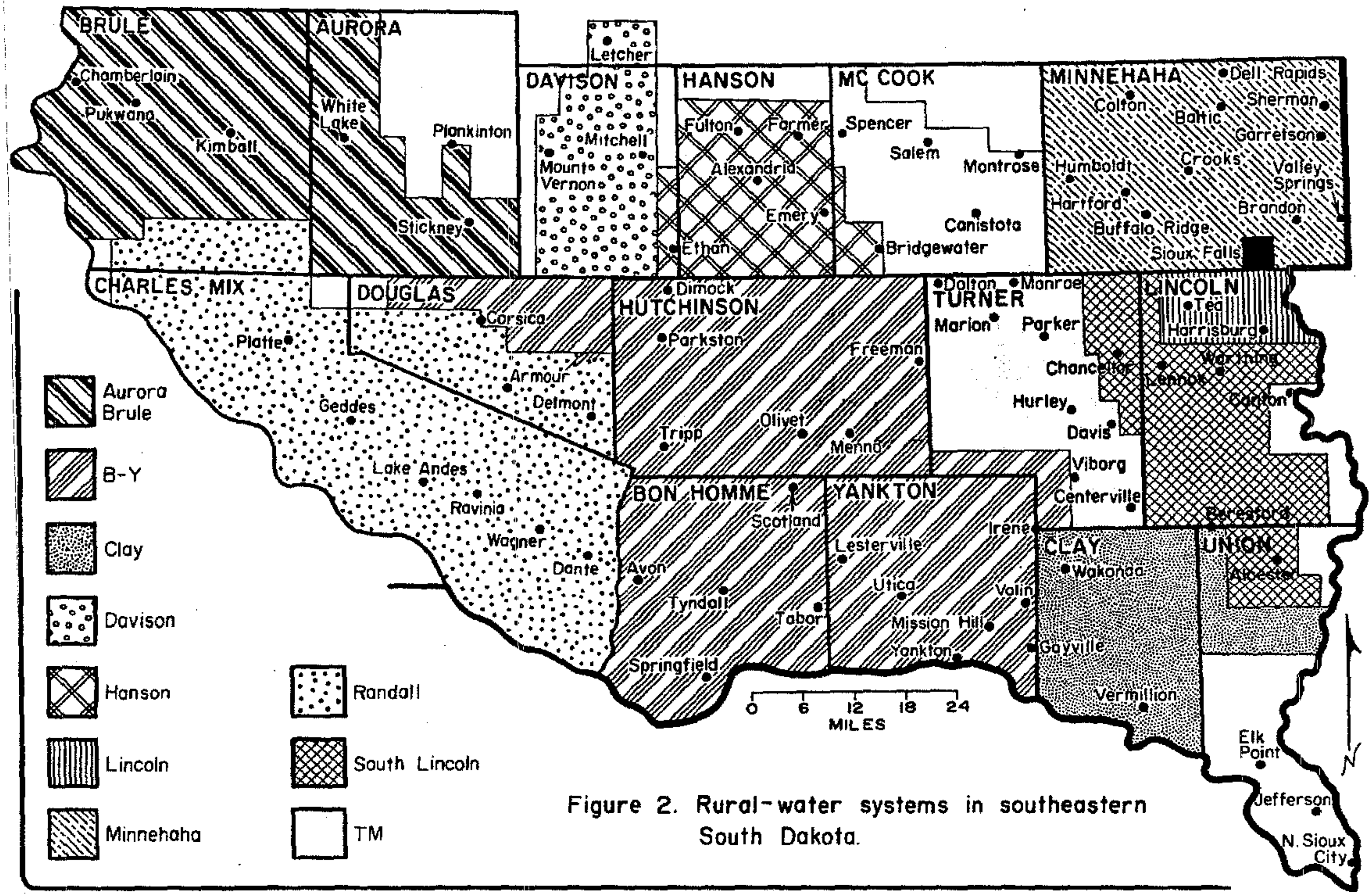

Figure 2. Rural-water systems in southeastern South Dakota.

The city of Sioux Falls has projected that the population of the city will be 137,000 by the year 2030. The projected quantity of water required in the year 2030 varies from an average daily demand of 26.8 MGD to a sustained maximum demand of 36.2 MGD during the three summer months and a peak daily demand of 53.6 MGD (Henningson, Durham, and Richardson, 1985). The city's water supply must also be capable of meeting the higher demand during drought years. During the 1976 drought, average demand was 15 percent higher than during normal precipitation years (Henningson, Durham, and Richardson, 1985).

Sioux Falls Management Unit of the Big Sioux Aquifer

Sioux Falls' primary water supply is obtained from the Sioux Falls management unit of the Big Sioux aquifer. This supply is supplemented by surface water from the Big Sioux River. The Sioux Falls management unit of the Big Sioux aquifer (fig. 3) is a surficial-outwash aquifer and covers approximately 36 square miles along the Big Sioux River between Sioux Falls and Dell Rapids (Hedges and others, 1982). This aquifer is under unconfined hydraulic conditions and has an excellent hydraulic connection with the Big Sioux River (Koch, 1982). Pumping wells in the aquifer induce water from the river and, during periods of low flow in the river, cause cessation of flow. The dependence of the present ground-water supply on availability of flow in the Big Sioux River is illustrated on figure 4. The information presented in figure 4 was derived from Hedges and others (1985a,b), Koch (1983), and from personal communications with personnel representing the city of Sioux Falls and the Minnehaha Community Water Corporation. Examination of figure 4 shows that the average natural recharge to the Big Sioux aquifer is estimated to be 11.9 MGD (Hedges and others, 1985a) while average daily use is about 20.2 MGD. The difference between the average daily water use and the estimated daily natural recharge is balanced by induced recharge to the aquifer from the Big Sioux River. Water use from the aquifer can continue at this rate or even at a greater rate as long as the Big Sioux River continues to flow.

Presently, in addition to the city of Sioux Falls, the Minnehaha Community Water Corporation, several irrigation (about 10 permitted systems from surface and ground-water sources) and an unknown number of private wells pump water from the Big Sioux aquifer between Sioux Falls and Dell Rapids. The Minnehaha Community Water Corporation has nine wells in its well field south of Dell Rapids. Water appropriated for the corporation amounts to 4.5 MGD, with an additional 3.9 MGD in future water appropriations. The average annual water use by the corporation is about 1 MGD (Minnehaha Community Water Corporation, personal communication, 1988).

If additional production wells are installed in the Big Sioux aquifer between Sioux Falls and Dell Rapids, production from the aquifer could be increased. However, a hydrologic model of the Big Sioux aquifer (Koch, 1983) developed by the United States Geological Survey (USGS) showed that under zero-flow conditions in the Big Sioux River, a pumping rate of 25 MGD from wells developed along the entire portion of the aquifer between Sioux Falls and Dell Rapids could not be sustained for more than 248 days and that a pumping rate of 24 MGD could be sustained for 279 days (fig. 4). These sustainable pumping rates are less than the projected average daily pumping rate of 26.8 MGD for the year 2030. Other water users will pump additional water from this aquifer. Consideration of the aquifer's water-yielding potential relative to low-flow conditions in the river is justified because (1) the appropriated water including future use from the aquifer is in excess of 100 MGD (fig. 4), and (2) a record low-flow rate in the river at the Dell Rapids stream gaging station occurred for 270 consecutive days from June, 1976, to March, 1977. During this low-flow period, there were 54 consecutive days of zero flow (Koch, 1983).

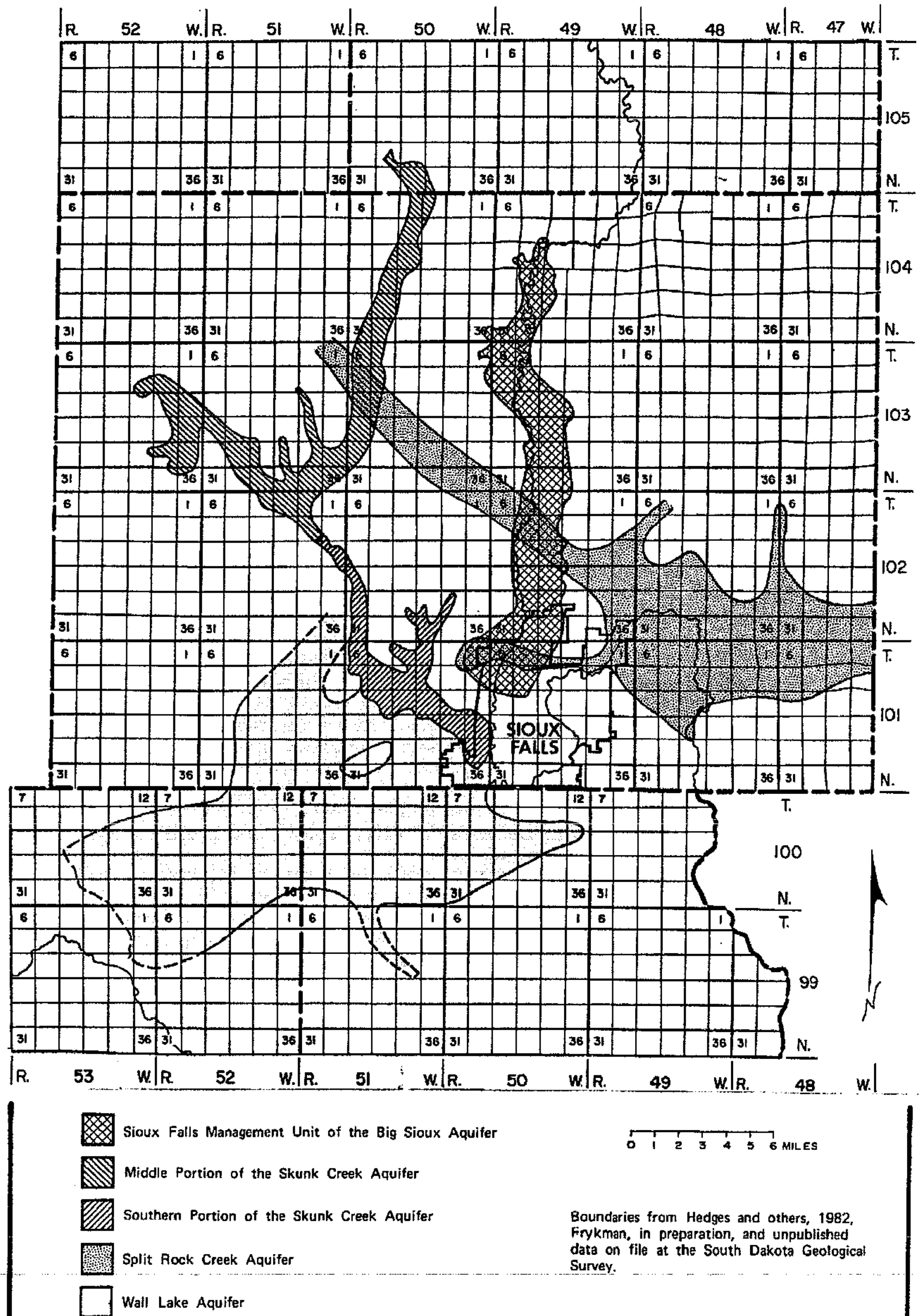

Figure 3. Areal extent of aquifers discussed in this report which are in the vicinity of Sioux Falls.

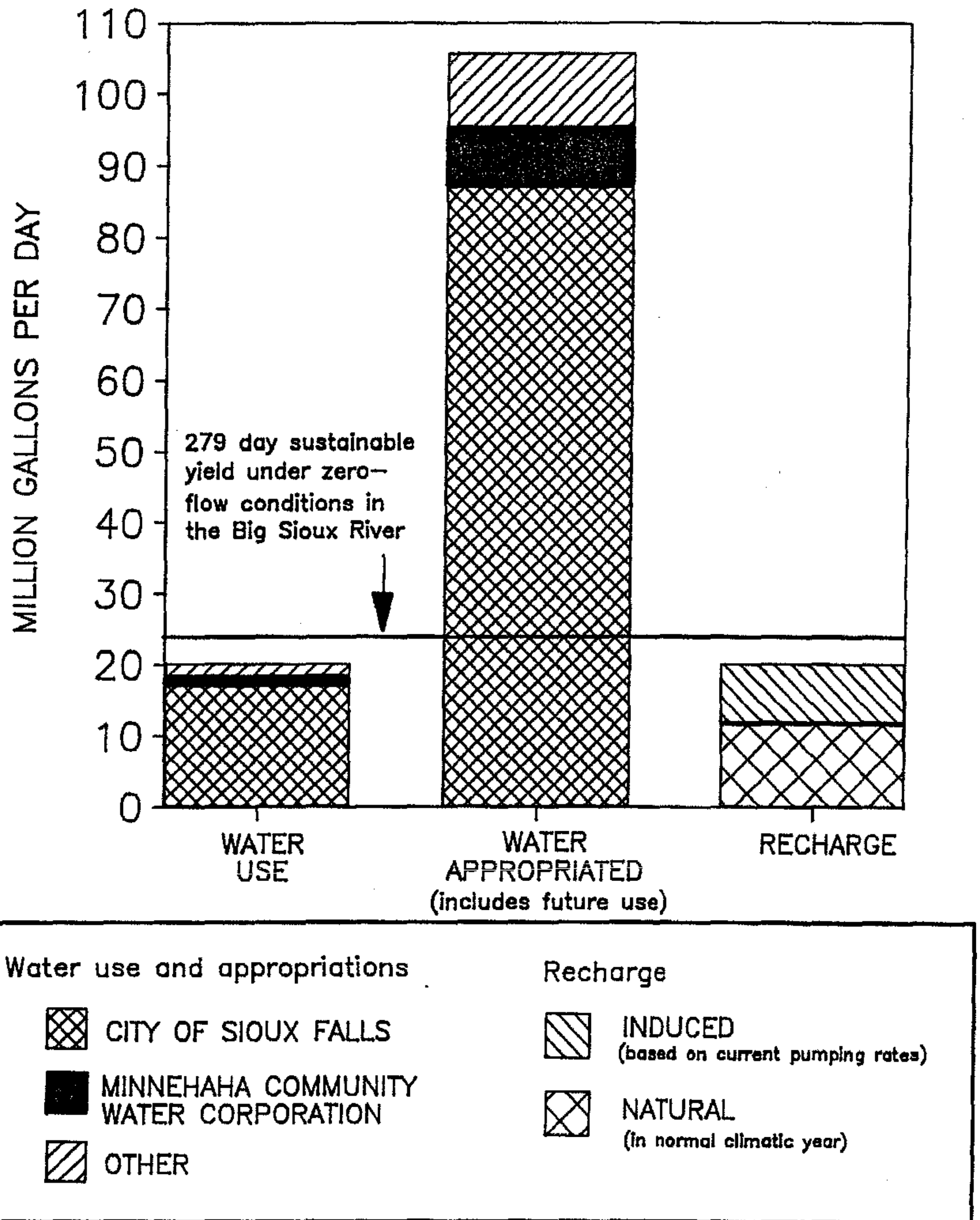

Figure 4. Water use from, appropriations from, and recharge to, the Sioux Falls management unit of the Big Sioux aquifer.

As the consumptive use of water from the Big Sioux aquifer upstream from Dell Rapids increases, the flow rate of the Big Sioux River will be less than it was in the past under similar climatic conditions. Also, from a hydrologic perspective, the Big Sioux River acts as a central drain for all potential sources of pollution from surface run-off in the upper Big Sioux basin, and all point- and nonpoint-source pollution introduced into the Big Sioux aquifer at, and upstream from Sioux Falls. Because of the good hydraulic connection between the river and the aquifer, some pumping wells in the Sioux Falls well field have been shown to induce water from the river. Thus, if significant degradation of water quality occurs in the river, it will have an impact on the quality of water pumped from the Sioux Falls municipal water supply wells. Without (1) pollution control practices in the vicinity of, and upstream from, the Sioux Falls well field and (2) control on additional consumptive water use upstream from Dell Rapids, a likely scenario for the future of the Sioux Falls management unit is less water and poorer-quality water than presently available. An example of the potential for water-quality degradation is illustrated by elevated nitrate concentrations occurring in private wells completed in the Big Sioux aquifer (South Dakota Department of Water and Natural Resources, undated). Also, significantly elevated nitrate concentrations which are attributed to nonpoint-source contamination in certain areas of the Big Sioux aquifer have been illustrated in a South Dakota Department of Water and Natural Resources report (Barari and others, 1988).

From the foregoing discussion, it is clear that, under the hydrologic and climatic conditions discussed above, water availability from the Sioux Falls management unit of the Big Sioux aquifer will not be adequate to meet the city's increasing water demand in the future and that supplemental or alternative water supplies need to be developed.

The water quality of the Sioux Falls municipal supply (untreated water) is generally good. Average concentrations for total-dissolved solids, hardness, sulfate, iron, and manganese are 773, 548, 245, 2.96, and 1.89 milligrams per liter (mg/L), respectively. The total dissolved solids value is an average of values presented in South Dakota Department of Water and Natural Resources (1986). Hardness, sulfate, iron, and manganese values are from the city of Sioux Falls, 1987. City water is treated for iron, manganese, and hardness. Treated-water hardness is approximately 300 mg/L (city of Sioux Falls, 1987).

Other Potential Water Supply Sources for Sioux Falls

SOUTHERN PORTION OF THE SKUNK CREEK AQUIFER

The southern portion of the Skunk Creek aquifer, officially known as the Southern Skunk Creek management unit of the Big Sioux aquifer is located west and northwest of the city of Sioux Falls in the valley of Skunk Creek (fig. 3). This aquifer is composed of surficial outwash and covers about 15 square miles (Hedges and others, 1982). A hydrologic model developed by the USGS predicts that the aquifer could sustain a 3.6 MGD production rate under normal climatic conditions (Neil Koch, U.S. Geological Survey, personal communication, 1988). This sustainable yield will be less under drought conditions. A total of 12.9 MGD have been appropriated from this portion of the aquifer, including a 10.0 MGD future use permit for the city of Sioux Falls. Thus, the appropriated water exceeds the estimated sustainable yield of 3.6 MGD predicted by the USGS model. However, not all of the appropriated water is currently being used. Figure 5 depicts the current water use and appropriations from the southern portion of the Skunk Creek aquifer. The information presented in figure 5 was derived from Hedges and others (1985b) and personal communication with Neil Koch, U.S. Geological Survey.

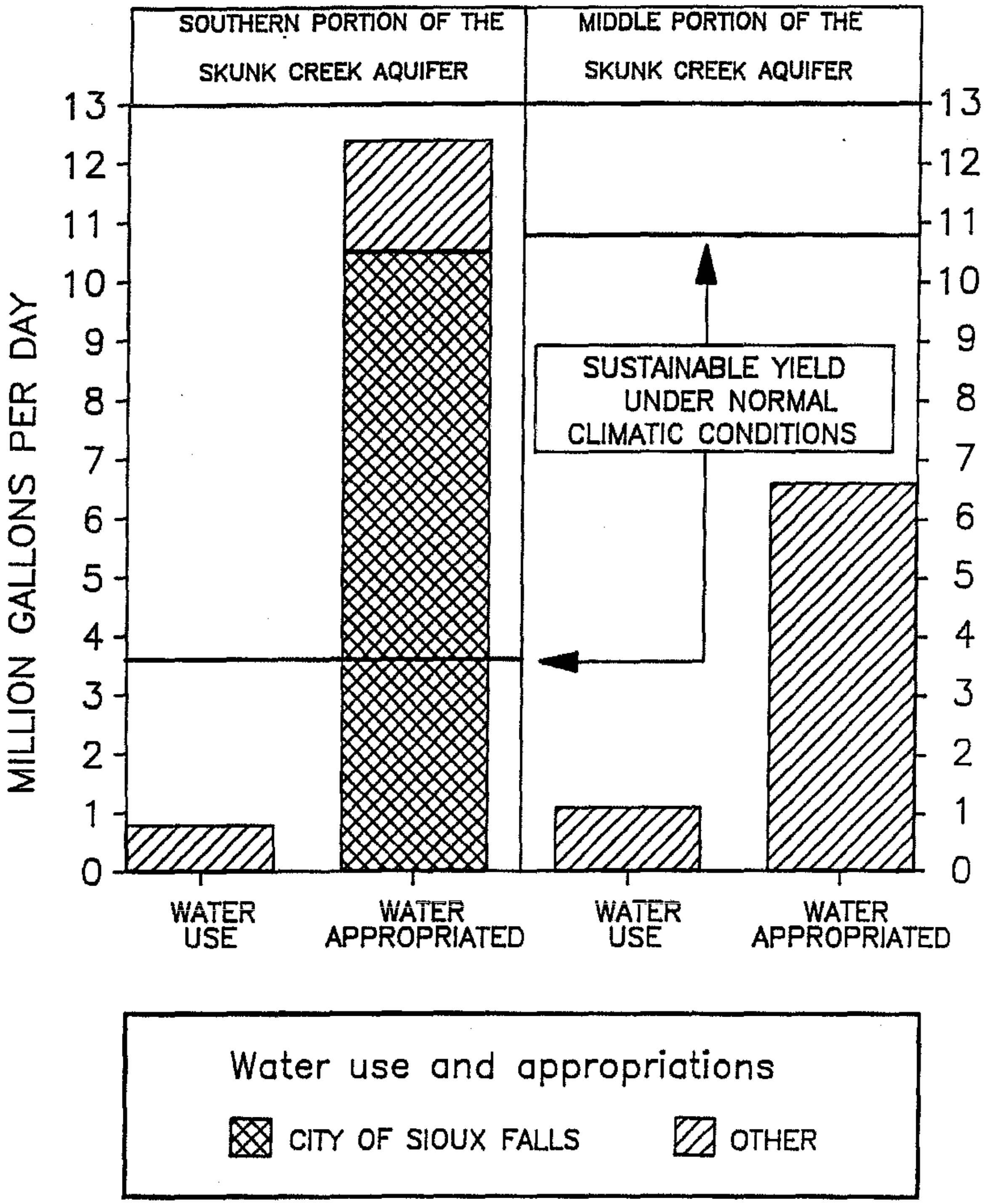

Figure 5. Water use and appropriations from the southern and middle portions of the Skunk Creek aquifer.

The average concentrations of total-dissolved solids, hardness, sulfate, iron, and manganese in the southern portion of the Skunk Creek aquifer are 736, 518, 280, 0.34, and 0.64 mg/L, respectively. In certain areas, the water quality is comparable to the Sioux Falls management unit of the Big Sioux aquifer. Near the lower end of the southern portion of the Skunk Creek aquifer on the south and west sides of Skunk Creek, the water quality is worse due to a hydraulic connection with the Wall Lake aquifer. The city of Sioux Falls is planning to utilize the southern portion of the Skunk Creek aquifer in the near future.

MIDDLE PORTION OF THE SKUNK CREEK AQUIFER

The middle portion of the Skunk Creek aquifer, officially known as the Middle Skunk Creek management unit of the Big Sioux aquifer, is located along Skunk Creek to the northwest of the city of Sioux Falls, approximately 10 to 22 miles from the city limits (fig. 3). This surficial-outwash aquifer covers about 29 square miles. A hydrologic model developed by the USGS predicts that the aquifer could sustain a 10.8 MGD production rate under normal climatic conditions. Records indicate that 6.6 MGD have been appropriated from this portion of the aquifer. The city of Sioux Falls does not have any water rights in this portion of the aquifer. Figure 5 depicts the current water use and appropriations from the middle portion of the Skunk Creek aquifer.

The average concentrations of total-dissolved solids, hardness, sulfate, and iron in the middle portion of the Skunk Creek aquifer are 646, 440, 132, and 0.42 mg/L, respectively (Meyer and Bardwell, 1983). In certain areas, the water quality of this aquifer is similar to the water quality of the Sioux Falls management unit of the Big Sioux aquifer.

SPLIT ROCK CREEK AQUIFER

The Split Rock Creek aquifer is composed of buried quartz sand, which is believed to be derived from weathering of the Sioux Quartzite. The aquifer covers about 100 square miles in Minnehaha County, with the most extensive part located east of Sioux Falls (fig. 3). In general, the aquifer is buried under tens of feet of clay, siltstone, and shale. The source and rate of recharge to this aquifer are unknown. However, buried aquifers generally receive less recharge than surficial aquifers.

Water-quality data for the Split Rock Creek aquifer are limited. The few analyses available indicate that the water quality varies with location, but is generally comparable with the water quality of the Big Sioux aquifer. The average concentrations for total-dissolved solids, hardness, sulfate, iron, and manganese are 737, 539, 270, 0.69, and 0.32 mg/L, respectively. Two water samples have also been analyzed for radium. The radium 226/228 activity was 1.4 picocuries per liter (pCi/L) in one sample and 0.3 pCi/L in the other. The drinking water standard for radium 226/228 is 5 pCi/L. A project is currently being conducted by the South Dakota Geological Survey and the USGS to evaluate the feasibility of the Split Rock Creek aquifer as a supplemental water supply for the city of Sioux Falls.

WALL LAKE AQUIFER

The Wall Lake aquifer is composed of a buried outwash which occurs primarily in Lincoln and Turner

Counties (fig. 3) and covers approximately 110 square miles (Hedges and others, 1982). However, a portion of it extends northward into Minnehaha County and is in contact with the southern portion of the Skunk Creek aquifer near the confluence of Skunk Creek and the Big Sioux River (Lindgren, in preparation; Frykman, in preparation). The Wall Lake aquifer is under confined hydraulic conditions except near the area where it is in contact with the Skunk Creek aquifer (Lindgren, in preparation; Frykman, in preparation). The source and rate of recharge to this aquifer are undocumented. The water-yielding capabilities of this aquifer have not been determined but lithologic data indicate that development of some large-capacity wells may be possible.

Available data indicate that the quality of water in the Wall Lake aquifer is much worse than that presently being used by the city of Sioux Falls. Average concentrations for total-dissolved solids, hardness, sulfate, iron, and manganese are 1,455, 933, 753, 2.27, and 1.72 mg/L, respectively.

SLIP-UP CREEK RESERVOIR

Construction of a new surface water reservoir has been proposed to the east of Sioux Falls in the valley of Slip-up Creek (Benjamin, Kasl and Associates and others, 1977). This reservoir would receive water from the drainage basin of Slip-up Creek and flows diverted from the Big Sioux River. The quality of water in the reservoir should, in theory, be relatively good, like the Big Sioux River, but would be subject to agricultural runoff from the drainage basins of the Big Sioux River and Slip-up Creek. As designed, the reservoir project could provide the city of Sioux Falls with a supplemental water supply of 20.9 MGD (Benjamin, Kasl and Associates and others, 1977). Available storage in the proposed reservoir, based on climatic conditions from 1970 to 1983, ranged from 3,500 acre-feet (1,141 million gallons) to 26,000 acre-feet (8,473 million gallons) (Benjamin, Kasl and Associates and others, 1977). However, the feasibility of the reservoir project is dependent on flow diversions from the Big Sioux River. Thus, if the flow in the river is insufficient, as it may be during prolonged dry periods, the reservoir will not be able to provide the quantity of water for which it was designed.

REUSE OF WASTEWATER EFFLUENT

Reusing treated wastewater effluent from the city wastewater treatment plant has been considered in the past (Henningson, Durham, and Richardson, 1985). However, the effluent from the plant usually exceeds 1,000 mg/L for total-dissolved solids and 10 mg/L for nitrate as nitrogen. Thus, additional treatment of the effluent may be required, depending on whether it is used as a potable or nonpotable water source.

Hanson and TM Rural Water Systems

The Hanson Rural Water System serves most of Hanson County and some locations beyond the county boundary (fig. 2). The TM Rural Water System serves most of Turner and McCook Counties (fig. 2). Both of these rural-water systems pump water from the Dolton aquifer. The well fields for the rural-water systems are separated by approximately 5 miles and are located near the town of Dolton. Additionally, the aquifer supplies water to many private wells including those in the town of Dolton.

The known areal extent of the Dolton aquifer is approximately 82 square miles in portions of south-central McCook County, northeastern Hutchinson County, and northwestern Turner County. This outwash aquifer is buried under approximately 140 feet of till, primarily a clay with some silt, sand, gravel, and boulders.

There are 2.97 MGD of water appropriated from this aquifer. The appropriated water is for the Hanson Rural Water System (0.39 MGD) and the TM Rural Water System (2.58 MGD). Water use in 1988 from this aquifer amounted to 0.38 MGD by the Hanson Rural Water System, 0.51 MGD by the TM Rural Water System, and some smaller unknown amount by private wells.

While there is a large quantity of water in the aquifer, water-level measurements in observation wells installed in the area show that water levels are declining in the Dolton aquifer (the water levels discussed here represent the potentiometric surface of the aquifer). As an example, an observation well about 2 miles from the Hanson Rural Water System well field shows a water-level decline of approximately 35 feet from August 28, 1979, through June 1, 1989. Other observation wells in the area also show water-level declines of varying magnitude. Present data indicate that water levels are declining in all observation wells in the aquifer.

The pumping rates of the Hanson Rural Water System wells have been reduced due primarily to the declining water levels. Continuing water-level declines will further reduce the pumping capacity of the wells.

Because of a continuous decline of water levels in the monitored portion of the aquifer, the rate of recharge appears to be less than the amount of withdrawal. Potential recharge to the aquifer through the overlying till is very small; less than 0.1 inches per year (Holly, in preparation). Other sources of recharge to the aquifer have not been identified or quantified.

The quality of water in the Dolton aquifer is highly variable and is dependent on the location within the aquifer. An area of relatively good quality water is bounded by an area of much poorer quality. The area of relatively good quality is arbitrarily defined here as the area containing water with less than 1,000 mg/L of total-dissolved solids. Total dissolved solids concentrations in the center of this area are less than 600 mg/L. The average concentrations of total-dissolved solids, hardness, sulfate, iron, and manganese in the area of good quality are 610, 125, 31, 0.57, and 0.07 mg/L, respectively. The areal extent of the good quality is about 15 square miles, which amounts to only 19 percent of the known areal extent of the aquifer.

The well fields for the rural-water systems are within the area of good-quality water. However, the water quality deteriorates rapidly within a short distance of the rural water system well fields. An example of this is that in a distance of about one mile from the TM Rural Water System well field, the concentration of total-dissolved solids increases from approximately 560 to approximately 2,400 mg/L and the hardness from approximately 90 to approximately 1,000 mg/L.

A gradual degradation of water quality in the rural water system wells is expected as pumping of water by the rural-water systems induces surrounding poorer quality water into the area of good quality. A water sample collected from the Hanson Rural Water System in August, 1979, had concentrations of sulfate and hardness of 7 and 94 mg/L, respectively. A water sample collected from the same well in November, 1988, had concentrations of sulfate and hardness of 134 and 124 mg/L, respectively. Increasing water demand will require the rural-water systems to pump more water. The additional pumping from this aquifer will increase water-level declines and accelerate water-quality degradation over what they would be if pumping rates remained the same.

Alternate water sources for the two rural-water systems exist in the area but all are inferior in quality when compared to the present water source. The potential alternate water sources are all outwash aquifers. Two of them are surface aquifers; one associated with the Vermillion River near the town of Parker (Parker-Centerville aquifer) and the other with the West Fork of the Vermillion River within a few miles of the present rural water system well fields. The other two are buried aquifers which occur in the immediate vicinity of the present rural water system well fields. Water-quality data from these alternate water sources show that concentrations range from 776 to 2,578 mg/L for total-dissolved solids, from 431 to 1,440 mg/L for hardness, and from 341 to 1,480 mg/L for sulfate. This is in contrast to average values for the good-quality area of the Dolton aquifer of 610 mg/L for total-dissolved solids, 125 mg/L for hardness, and 31 mg/L for sulfate.

Vermillion

The city of Vermillion is located in southern Clay county near the Missouri River and has a population of 9,270 according to 1986 Census Bureau figures. The city obtains its water supply from five wells completed in the Elk Point management unit of the Missouri aquifer, which is composed of outwash. Aquifer thickness ranges from 75 to 125 feet in the vicinity of the well field (Christensen and Stephens, 1967). This aquifer occurs in the Missouri River flood plain where it is overlain by alluvium. Recharge to the aquifer is from infiltration of precipitation and inflow from adjoining aquifers. The aquifer is also hydraulically connected to the Vermillion and Missouri Rivers (Christensen and Stephens, 1967).

In 1987, the city of Vermillion pumped an average of 1.09 MGD of water from the aquifer and the average water usage by the city for the years 1984, 1985, 1986, and 1987 was 1.05 MGD (Water Department Files, city of Vermillion). The water-yielding capabilities of the aquifer are more than sufficient for the city's current and future needs.

The quality of the untreated Vermillion municipal water supply is characterized by total-dissolved solids, sulfate, hardness, iron, and manganese concentrations of 1,172, 452, 693, 2.03, and 1.76 mg/L, respectively (Banner Associates, Inc., 1988). Due to the elevated hardness, iron, and manganese concentrations in the aquifer, the city treats the water for these parameters. Thus, although water quantity is not a problem for the Vermillion municipal water supply, water-quality considerations necessitate the treatment of water at a considerable cost.

Other Water Supply Problems

In addition to the three case studies already discussed, there are numerous other water-distribution systems in the area which also have problems related to water quality, quantity or both. Some of these distribution systems belong to the municipalities of Alcester, Beresford, Canton, Elk Point, Fairview, Lennox, and Worthing and to the Clay, Lincoln County, and South Lincoln rural-water systems. Hardness and total dissolved solids concentrations in the water will be used as an example of a water-quality problem which is common to most water-distribution systems in the area discussed in this evaluation.

The water supplies for the municipalities of Beresford, Elk Point, and Lennox, and the Clay Rural Water System have hardness concentrations which range from a low of 427 mg/L at Beresford to a high of 1,375 mg/L at Lennox. Total dissolved solids concentrations for these water systems range from a low of 552 mg/L at Beresford to a high of about 2,134 mg/L at Lennox (water-quality figures in this paragraph are from South Dakota Department of Water and Natural Resources, 1986). Another example of a water-quality problem is radium 226/228 in excess of the drinking-water standard in the water supply for the city of Garretson. These water-distribution systems could realize significant cost savings in water treatment and system maintenance if an alternate water source of good-quality water were available.

The municipalities of Canton and Worthing and the South Lincoln Rural Water System have relatively good quality water derived from an area of the Dakota Formation in Lincoln County. Average concentrations of total-dissolved solids, hardness, and sulfate for this area are 634, 270, and 227 mg/L, respectively (Iles, 1984). Average concentrations for iron and manganese for this area are 0.52 and 0.09 mg/L, respectively. However, the surrounding water in the Dakota Formation is much poorer in quality with total-dissolved solids and hardness concentrations as high as 3,050 and 2,600 mg/L, respectively. Furthermore, there is no known source of good quality recharge water. An inevitable result of use of this good-quality water is that the surrounding water of poor quality will be induced into the area of good quality. The probable rate of encroachment of poor quality on the area of good quality has not been determined, although it is believed to be slow.

The city of Lennox, the Lincoln County Rural Water System, and the Lyon-Sioux Rural Water System just across the state border in Iowa are all seriously considering the Dakota Formation as a water source. All three of these entities have either completed, or are in the process of, actual field exploration of the potential of this aquifer. Additionally, the South Lincoln Rural Water System is examining the possibility of further expansion within this aquifer. Although the life expectancy of the good-quality water in the Dakota Formation has not been accurately predicted, its longevity will be reduced as more development occurs.

The Lincoln County Rural Water System has a problem which is unique and consists of both quality and quantity. Its production wells, which are completed in the Big Sioux aquifer in northeast Lincoln County, were found to have selenium concentrations in excess of the South Dakota State Drinking Water Standard of 10 micrograms per liter (ug/L). There is presently an agreement between the rural-water system and the city of Sioux Falls wherein the rural-water system buys most of its water from the city and blends it with water from its own production wells. The result is water which meets the drinking water standard for selenium. However, given the water-quantity problems discussed earlier for Sioux Falls, it is very likely that the rural-water system may also have to find an alternate or supplemental source of water because it presently relies on the city of Sioux Falls for most of its water supply.

High nitrate concentrations in excess of 10 mg/L in a shallow-water source caused the city of Fairview to drill a well into a different and deeper aquifer. High nitrate concentrations and the presence of pesticides found in the well field of Alcester was cause for that city to join a rural-water system.

Although this section of the report has identified some cities and rural-water systems with water-related problems, there has been no attempt to identify and document all known water problems, or to define all areas likely to experience water-supply problems in the future.

DISCUSSION

The available data show that many communities and rural-water systems in southeastern South Dakota will require additional or alternate water supplies. This is due to the limited capabilities of the present supplies to meet future increasing quantity and quality demands. There are two different approaches to meet the future requirements:

1. consider the requirement of each community or rural-water system separately and find a solution based on individual requirements and financial capabilities, or

2. consider the water supply in southeastern South Dakota as a regional problem and determine if it is feasible to find a comprehensive solution based on the requirements and financial capabilities of all the communities and rural-water systems in the area.

The first approach has been practiced in the past and some temporary solutions have been found. The long-term problem with this solution is that it leaves individual entities competing for good quality water resources that are becoming more scarce. Generally, this scenario can lead to costly legal proceedings, delays in water development, and the possibility of some water users having no practical alternatives for improving their water supplies. The second approach, a regional-water supply, will be discussed (Missouri River Pipeline Alternative section of this report) after a brief summary of water-supply problems in eastern South Dakota. In general, the water-supply problems could be divided into quantity and quality categories, while recognizing that in certain areas they are related.

Water-Quantity Problems

Quantity of water is not the major problem in most of the study area at the present time. However, some quantity problems are becoming apparent. In the case of Sioux Falls, the portion of the Big Sioux aquifer presently used by the city will not meet the future water requirement of the city. Also, if a significant portion of the water appropriated to the city from the lower portion of the Skunk Creek aquifer unit is utilized as a supplement to their present supply, the sustainable yield of this aquifer will be exceeded. This could initiate a conflict between private and municipal users of this water.

The following example is not exclusively a quantity problem, however, the quantity of good-quality water is an issue. In the case of the Dolton aquifer, which provides water to the Hanson and TM Rural Water Systems, private wells in the city of Dolton, and other private wells, increasing water demand is accelerating the decline of water levels (potentiometric surface) in the aquifer. This problem is compounded by the encroachment of poorer-quality water into the area in which the rural water systems wells are located. Declining water levels and the gradual degradation of water quality will limit the future reliability of this aquifer as a water-supply source.

Water-Quality Problems

Naturally Occurring Problems

Water-quality problems are the result of naturally occurring and man-induced chemicals. Naturally occurring chemicals are present in any water supply. Where these chemicals exceed the recommended drinking water standards, they are generally removed by water treatment as necessary. Some chemicals are easily removed, while others are more difficult to remove.

Water supplies of eastern South Dakota generally have high concentrations of dissolved chemicals. Total-dissolved solids (excluding hardness) and sulfate concentrations cannot be economically reduced in the water. Therefore, aquifers such as the Wall Lake aquifer near Sioux Falls and some other water-supply alternatives in the area of the Hanson and TM Rural Water Systems are not considered as a desirable source for public water supplies.

The parameters that are easier to reduce by treatment include iron, manganese, and hardness. The Sioux Falls management unit of the Big Sioux aquifer has a hardness of approximately 550 mg/L. The city of Sioux Falls reduces the hardness of the water to about 300 mg/L. The city of Vermillion reduces the hardness of the water in the Missouri aquifer from 685 mg/L to 240 mg/L and also reduce levels of iron and manganese. The Clay Rural Water System would like to lower the hardness of their present water supply, which is approximately 640 mg/L.

In the case of the Dakota Formation, a few municipalities, private wells, and a rural-water system are pumping water from the area of good-quality water and additional development from this water source is in the planning stage. Because this aquifer does not appear to be receiving recharge comparable to the quality being pumped, the long-range potential of this aquifer for yielding high-quality water should be determined.

Man-made Problems

Man-induced chemicals in ground water are the result of both point and nonpoint sources of contamination. Surficial water table aquifers discussed in this evaluation are vulnerable to both kinds of contamination. Examples of point-source contamination are the numerous petroleum leaks into shallow ground water that have been documented in part of the area discussed in this evaluation.

Documentation of contamination of shallow aquifers from nonpoint sources of pollution is a more complex problem. Presently, little data are available for the Big Sioux aquifer near the Sioux Falls well field and do not indicate a nonpoint source of contamination in that area. However, data from other locations in the Big Sioux aquifer indicate the presence of nonpoint sources of nitrate contamination.

Recent publications from adjacent states show high nitrate concentrations and the presence of pesticides in ground water as a result of agricultural activities (Thompson and others, 1986; Hallberg, 1985). Because of similarities between the Big Sioux aquifer and the shallow aquifers described in the referenced publications, these problems are also expected to exist in shallow aquifers in South Dakota. Limitations on the application of agricultural chemicals over surficial aquifers, such as the Big Sioux aquifer, may be necessary to prevent or limit such contamination. Other activities over shallow aquifers such as industrial and commercial development also may provide potential sources for ground-water contamination. Restricting these activities may also be necessary to prevent degradation of the shallow aquifers.

Missouri River Pipeline Alternative

Construction of a regional water supply system from the Missouri River would be a solution to most of the water quality and quantity problems discussed in this report. The average flow rate of the Missouri River at Yankton for the past 57 years has been 17,232 MGD (17.2 billion gallons per day). The quantity of water required for a regional water supply in southeastern South Dakota would only be a small fraction of the flow in the river.

Discussion in the previous sections of this report pointed out problems that many water-supply systems are facing concerning water quality. The water quality of the Missouri River is very good. Near Vermillion, concentrations of total-dissolved solids and sulfate in the river are 557 and 237 mg/L, respectively (Banner Associates, Inc., 1988). Concentrations of hardness, iron, and manganese in the river are 250, 0.01, and 0.03 mg/L, respectively (Banner Associates, Inc., 1988). The concentrations of total-dissolved solids and hardness in the untreated Missouri River water are equal to or less than the concentrations in treated water distributed by many of the water-supply systems in southeastern South Dakota (table 1). Water could be pumped directly from the Missouri River by construction of a surface intake, or indirectly by construction of shallow wells or infiltration galleries near enough to the river to induce river water. The quality of water pumped from the shallow well field or infiltration gallery would be similar to that in the Missouri River, with the exception of iron and manganese concentrations which may be higher than in water taken directly from the river.

RECOMMENDATIONS

It is recommended that a thorough investigation be conducted to determine the future water requirements of the communities and the rural-water systems in southeastern South Dakota. The cost of obtaining and treating the water from local sources, where it is available, should be determined and compared with the cost of a Missouri-River pipeline. Among other things, the following benefits of a pipeline should be evaluated and included in the cost comparison of a local water supply:

1. benefits obtained from improved water quality,

2. benefits of preventing conflicts that will undoubtedly develop between different groups to utilize the same limited water resources in certain areas, and

3. benefits of making the local water supply sources available for agricultural and other uses.

Finally, if it is determined that it is economically feasible and in the best interest of all concerned to obtain the future water supply for southeastern South Dakota from the Missouri River, it should be implemented without delay before current water supplies become inadequate and before presently available water in the river is committed to other uses.

TABLE 1. Comparison of water quality in the Missouri River with selected water supplies in southeastern South Dakota

Water-Supply System	Total-Dissolved Solids		Sulfate		Hardness	
	Raw	Treated	Raw	Treated	Raw	Treated
Missouri River near Vermillion [1]	557	---	237	---	250	---
Sioux Falls [2]	773	480	245	245	548	302
Vermillion [1]	1,172	730	452	430	693	248
Clay Rural Water System [3]	1,077	---	380	---	638	---
Lennox [3]	2,134	2,032	1,138	1,095	1,363	1,360

All values are in milligrams per liter.

[1] Data from Banner Associates, Inc. (1988).

[2] Data for total-dissolved solids from South Dakota Department of Water and Natural Resources (1986) and data for sulfate and hardness is from city of Sioux Falls (1987).

[3] Data from South Dakota Department of Water and Natural Resources (1986).

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