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OPEN-FILE REPORT 78-UR

**EVALUATION OF THE SKUNK CREEK AQUIFER IN THE VICINITY
OF MADISON, SOUTH DAKOTA**

by

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INTRODUCTION

During the summer of 1993, an investigation was conducted by the South Dakota Geological Survey for the city of Madison to evaluate the Skunk Creek aquifer for additional municipal well development. The results are presented in this report. The investigation was financed by the South Dakota Geological Survey and the city of Madison.

Field work for this study was conducted in two phases. The first phase started on June 17, 1993, and continued through September of 1993. Field work for phase one included the drilling of 12 test holes, of which 7 were completed as observation wells, and the collection of 6 water samples for analysis. The second phase of the study took place in May of 1995. During this phase, three additional observation wells were completed and three water samples were collected for analysis. After each phase of this investigation was completed, an oral presentation was made to the city of Madison.

The aquifer investigated for this project is identified as the Northern Skunk Creek management unit of the Big Sioux aquifer in the computerized databases of the Department of Environment and Natural Resources. However, the aquifer is commonly called the Skunk Creek aquifer and will be referred to as such in this report.

RESULTS OF INVESTIGATION

Phase One Work

Phase one of the study concentrated on an area west of the city of Madison extending toward Lake Herman and along Silver Creek. The locations of the test holes and observation wells drilled for this portion of the project are shown on figure 1. Lithologic logs of the test holes and wells are on file at the South Dakota Geological Survey in Vermillion, South Dakota. The saturated thickness of the Skunk Creek aquifer in this area is variable and was found to range from 0 to 27 feet as shown in figure 2. Water levels used for determining the saturated thickness were measured in September of 1993. The water in this portion of the aquifer is variable in quality and had average concentrations of sulfate and total dissolved solids of 788 and 1,493 milligrams per liter, respectively (table 1).

Phase Two Work

After the phase one work was completed, it was found that the saturated thickness of the Skunk Creek aquifer west of the city of Madison was not sufficient for municipal well development. The city then requested that additional work be completed in the southeast part of the city in the SE $\frac{1}{4}$ sec. 8, T. 106 N., R. 52 W. Previous work in this area had shown promise for a greater saturated thickness in the Skunk Creek aquifer.

The phase two work included the drilling and sampling of three additional observation wells (R20-95-01, -02, and -03). The locations of these observation wells and one other well drilled for a previous project are shown on figure 3. Also shown on figure 3 is the saturated thickness of the Skunk Creek aquifer in this area. Lithologic logs of these observations wells are on file at the South Dakota Geological Survey in Vermillion, South Dakota. The saturated thickness ranged from about 20 to 30

feet. Water levels used to determine saturated thickness for this area were measured in May of 1995. It should be noted that because of high precipitation in 1995, and thus high ground water levels, the thickness of saturated sand and gravel would be less during an average precipitation year. The water in this portion of the aquifer had average concentrations of sulfate and total dissolved solids of 493 and 1,110 milligrams per liter, respectively (table 1).

DISCUSSION AND CONCLUSIONS

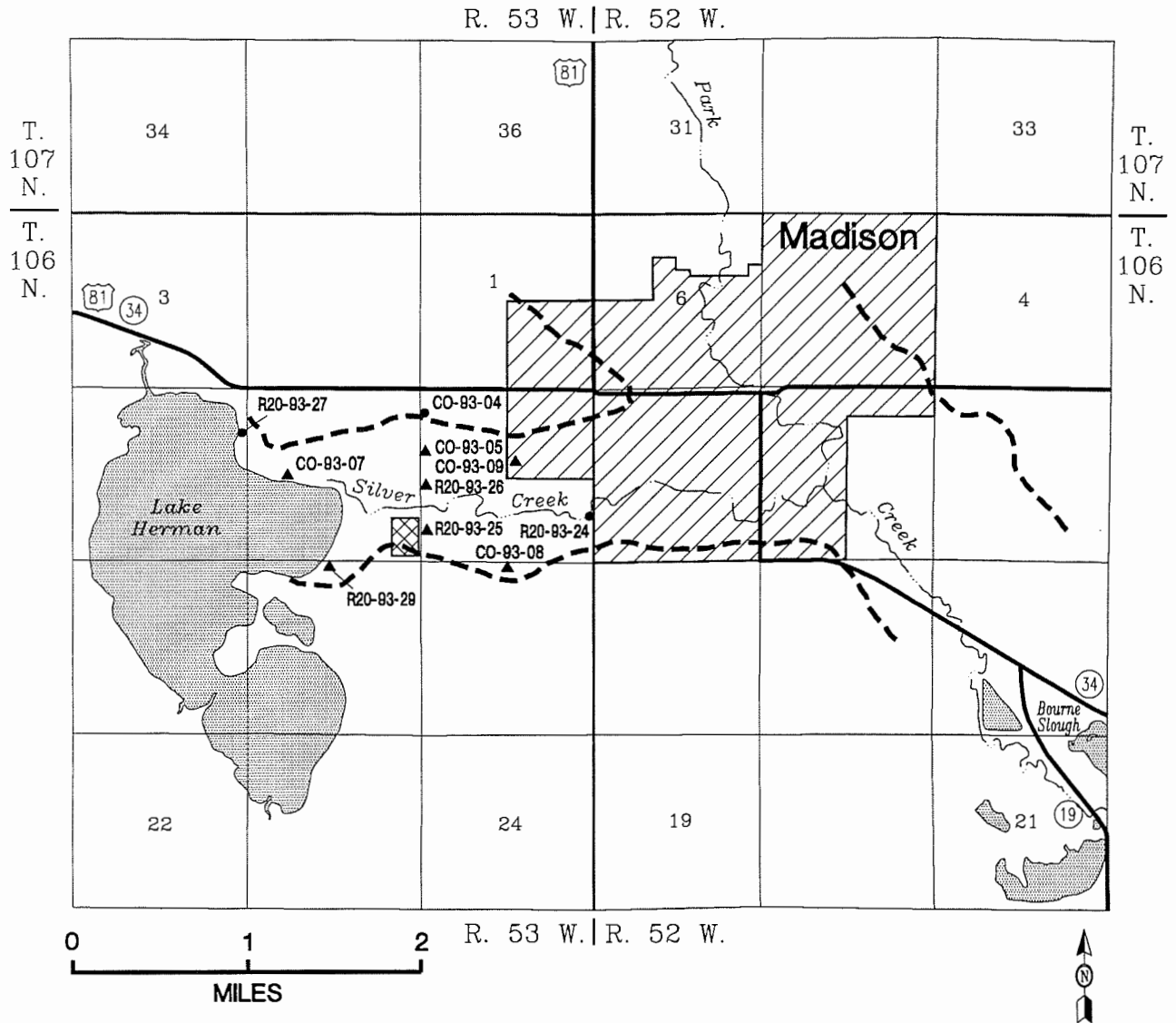
The Skunk Creek aquifer west of the city of Madison does not have sufficient saturated thickness to support the placement of a new municipal well. The water in this portion of the aquifer is variable in quality and generally has concentrations above secondary maximum contaminant levels for sulfate and total dissolved solids set forth by the U.S. Environmental Protection Agency.

That portion of the Skunk Creek aquifer that was investigated in SE¼ sec. 8, T. 106 N., R. 52 W. had a saturated thickness that ranged from about 20 to 30 feet in May of 1995. The water in the aquifer in this area also has concentrations above secondary maximum contaminant levels (recommended limits) for sulfate and total dissolved solids. The data show some promise for the development of a new water supply for the city of Madison in this area.

It was recommended that the city of Madison contract with a private well driller to conduct test drilling to verify the saturated thickness and water quality in the SE¼ sec. 8, T. 106 N., R. 52 W. and vicinity. It was also recommended that an aquifer test be conducted to identify the potential yield from the Skunk Creek aquifer in this area.

REFERENCES

- Hammond, P.D., and Green, S.A., 1991, *Ground-water study for the city of Madison, South Dakota*: South Dakota Geological Survey Open File Report No. 49-UR.
- U.S. Environmental Protection Agency, 1994, *Drinking water regulations and health advisories*: November 1994.



- R20-93-27 Test hole drilled for the current project. Letter and numbers are the test hole identifier.

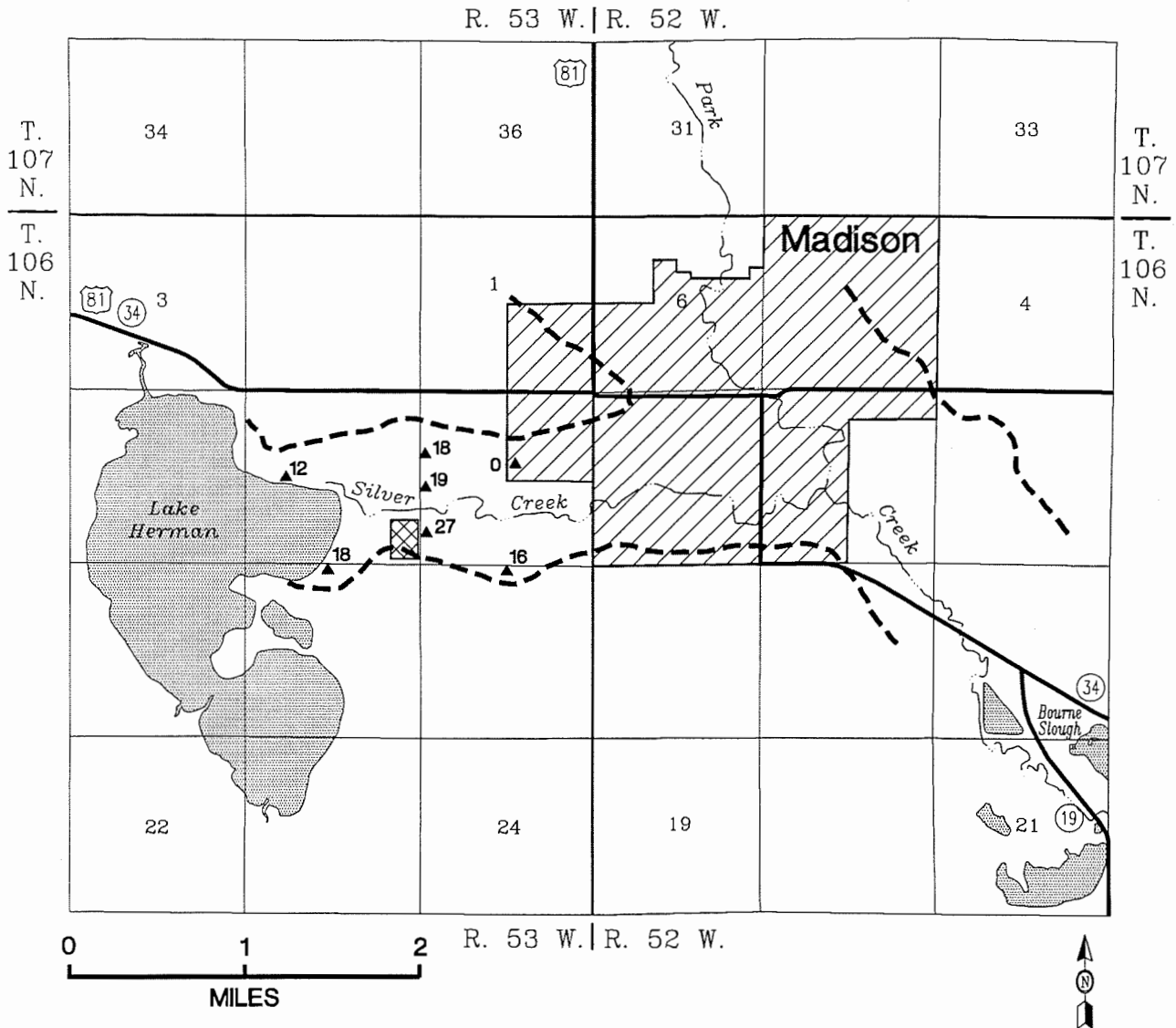
- CO-93-08 Observation well drilled and sampled for the current project. Letters and numbers are the well identifier.

- Approximate boundary of the Skunk Creek aquifer for the area directly east of Lake Herman.

- Area filled with dredge cuttings from Lake Herman.

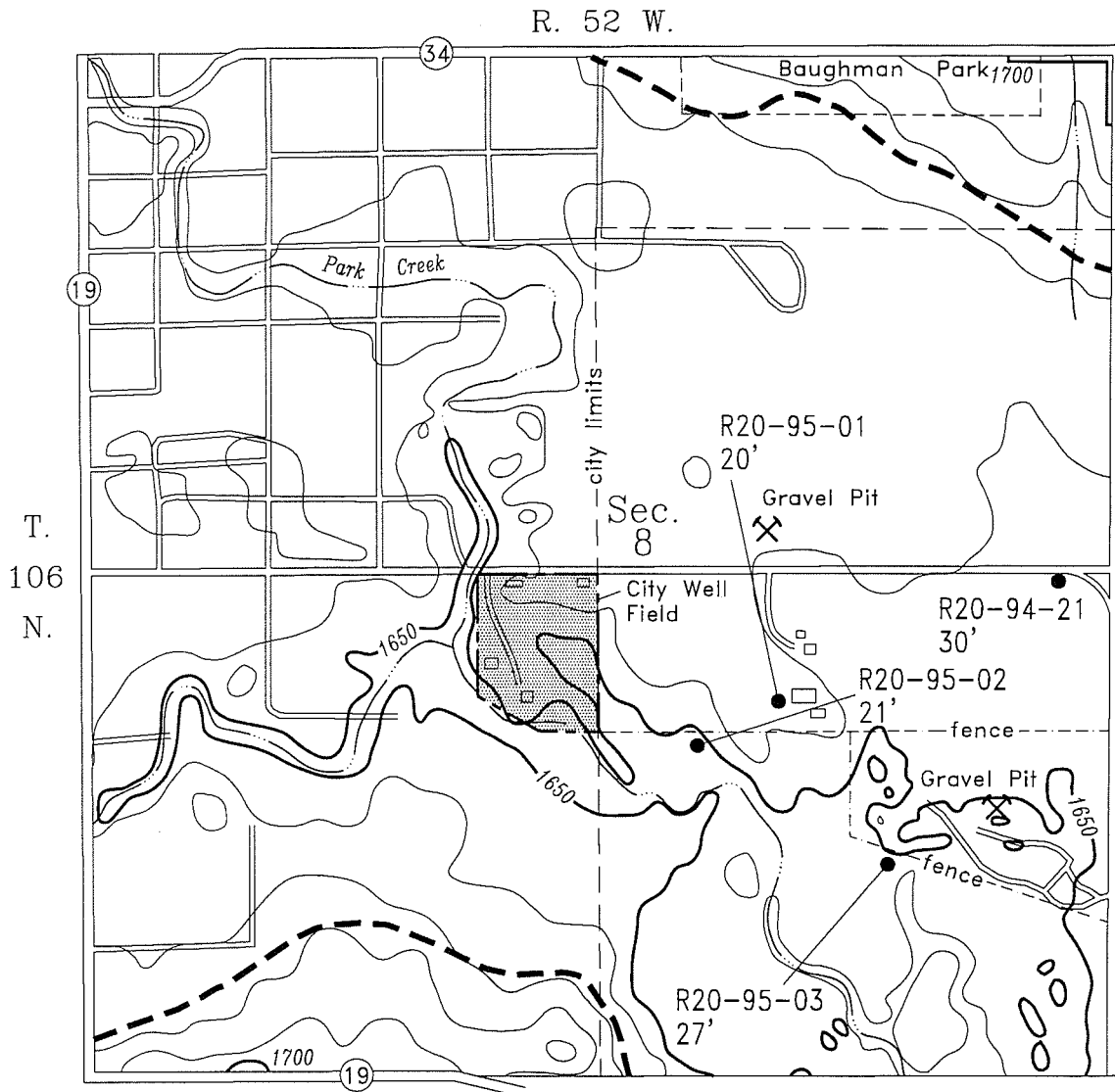
- Intermittent stream.

Figure 1. Locations of test holes and observation wells for phase one of the investigation.



- ▲ 18 Observation well. The number is saturated thickness in feet.
- - - Approximate boundary of the Skunk Creek aquifer for the area directly east of Lake Herman.
- ▣ Area filled with dredge cuttings from Lake Herman.
- ~ Intermittent stream.

Figure 2. Saturated thickness of the Skunk Creek aquifer - phase one work.



R20-94-21
30' ●

Observation well. The upper letter and numbers are the well identifier. The lower number is the saturated thickness in feet.



Approximate boundary of the Skunk Creek aquifer.

Map base digitized from the Madison and Lake Madison South Dakota 7.5 minute series topographic maps. Scale 1:24,000. Contour interval 10 feet.

Figure 3. Well locations and saturated thickness of the Skunk Creek aquifer for phase two of the investigation.

Table 1. Chemical analyses of water samples

Legal location	Well name	Date collected	Well depth ²	Conductivity ³	Parameter ¹ with concentration in milligrams per liter													
					HCO ₃	Ca	Cl	F	Fe	K	Mg	Mn	Na	NO ₂ -N	NO ₃ -N	Hardness as CaCO ₃		
Standards					250 ⁴	2.4 ⁵	0.3 ⁴				0.05 ⁴				10 ⁵	250 ⁴	500 ⁴	
SKUNK CREEK AQUIFER (west of Madison)																		
SE SE SW NW sec. 11, T. 106 N., R. 53 W.	CO-93-07	9-13-93	17	1690	327	162	66	0.14	<0.05	20	92	0.21	85	<0.04	630	1310	783	
SW NW SW NW sec. 12, T. 106 N., R. 53 W.	CO-93-05	9-13-93	18	1690	324	198	66	0.54	<0.05	7.2	101	0.14	63	0.06	684	1380	910	
SW NW NW SW sec. 12, T. 106 N., R. 53 W.	R20-93-26	9-13-93	28	1180	313	119	13	0.17	<0.05	12	65	1.98	48	<0.04	410	880	565	
NW NW SW SW sec. 12, T. 106 N., R. 53 W.	R20-93-25	9-13-93	40	2880	444	444	14	0.12	3.32	17	184	2.33	57	0.05	1660	2770	1870	
NW NW NW NE sec. 13, T. 106 N., R. 53 W.	CO-93-08	9-13-93	21	1730	241	174	18	0.56	<0.05	2.5	113	<0.05	76	29.8	770	1460	900	
NE NE NE NW sec. 14, T. 106 N., R. 53 W.	R20-93-29	9-13-93	34	1450	367	167	18	0.08	<0.05	15	79	5.19	58	<0.04	573	1160	742	
AVERAGES					1770	336	211	33	0.27	0.57	12.3	106	1.97	65	9.97	788	1493	962
SKUNK CREEK AQUIFER (southeast of Madison)																		
NE SW NW SE sec. 8, T. 106 N., R. 52 W.	R20-95-02	5-30-95	30	1368	291	179	35	0.30	0.63	9.3	53	2.58	51	<0.04	478	1040	665	
NE SE NW SE sec. 8, T. 106 N., R. 52 W.	R20-95-01	5-30-95	40	1445	316	202	43	0.21	0.89	9.6	57	2.25	46	<0.04	471	1090	739	
NE NW SE SE sec. 8, T. 106 N., R. 52 W.	R20-95-03	5-30-95	34	1516	294	264	44	0.16	1.89	10	42	2.59	31	<0.04	530	1200	832	
AVERAGES					1443	300	215	41	0.22	1.14	9.6	51	2.47	43	<0.04	493	1110	745

Table 1 - continued.

Legal location	Well name	Date collected	Well depth ²	Conductivity ³	Parameter ¹ with concentration in milligrams per liter												
					HCO ₃	Ca	Cl	F	Fe	K	Mg	Mn	Na	NO ₂ -N	NO ₃ -N +	SO ₄	TDS
Standards					250 ⁴	2.4 ⁵	0.3 ⁴					0.05 ⁴			10 ⁵	250 ⁴	500 ⁴

AVERAGE OF MADISON CITY WELLS SKUNK CREEK AQUIFER⁶

NE SW sec 8, T. 106 N., R. 52 W.	2072	---	266	318	0.17	<0.05	---	76	2.74	157	<0.10	647	1528	973
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AVERAGE OF MADISON CITY WELLS HOWARD AQUIFER⁶

NE SW sec 8, T. 106 N., R. 52 W.	1820	---	269	16.6	0.65	<0.05	---	107	38	110	<0.10	1015	1520	1110
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COMPOSITE TREATED WATER SUPPLY FOR THE CITY OF MADISON⁶

	1581	---	118	124	1.68	0.23	---	70	<0.02	105	<0.10	578	1156	582
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¹ HCO₃ - bicarbonate; Ca - calcium; Cl - chloride; F - fluoride; Fe - iron; K - potassium; Mg - magnesium; Mn - manganese; Na - sodium; NO₃-N + NO₂-N - nitrate plus nitrite as nitrogen; SO₄ - sulfate; TDS - total dissolved solids; Hardness as CaCO₃ - hardness as calcium carbonate.

² Well depth is presented in feet below top of casing.

³ Numbers are presented in micromhos.

⁴ U.S. Environmental Protection Agency (1994). Secondary maximum contaminant levels. Recommended limit.

⁵ U.S. Environmental Protection Agency (1994). Maximum contaminant levels. Enforceable limit.

⁶ Source of information from Hammond and Green (1991)