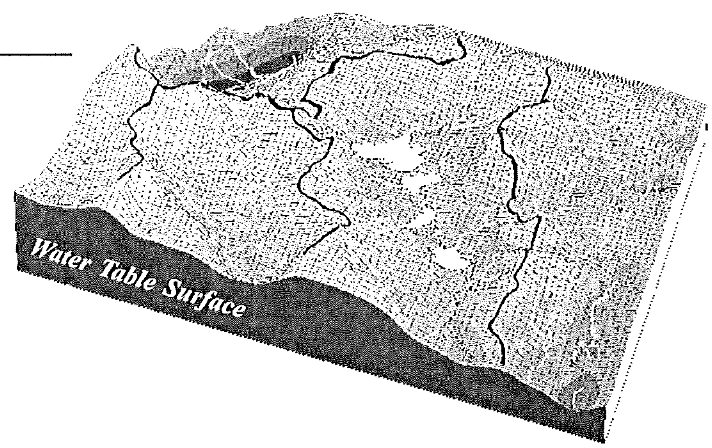
The 2004 Modeling and Management Program

Dane County Regional Hydrologic Study



Prepared by
staff to the
Dane County
Regional
Planning
Commission
in cooperation
with the
Wisconsin
Geological and
Natural History
Survey and the
United States
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I. Background

Groundwater is a critical resource in Dane County, Wisconsin. In order to identify existing and potential impacts of urban development, groundwater withdrawals and wastewater diversions, a multi-agency Dane County Regional Hydrologic Study was started in 1992 and completed in 1997. Since then, the Dane County Regional Planning Commission has coordinated an ongoing Regional Hydrologic Modeling and Management Program to use the information, analyses, and a sophisticated groundwater computer model developed from that study. The RPC coordinates this program with local units of government, the Wisconsin Geological and Natural History Survey (WGNHS) and U.S. Geological Survey (USGS). Nearly all of the municipal water suppliers in Dane County, including Dane County and the Madison Metropolitan Sewerage District, have participated in the program at various times.

This report summarizes the results of the 2004 work activities under this continuing program. Special thanks are expressed to the following sponsors for their interest and financial support in promoting the work this year:

Dane County
Madison Metropolitan Sewerage District
City of Madison
City of Middleton
City of Fitchburg
Village of Black Earth
Village of Cottage Grove
Village of Dane
Village of Deerfield
Village of Marshall
Town of Burke

This inter-agency management program allows local management agencies to annually update the groundwater database, to refine and improve the ground and surface water computer models, and to use the models for water resources management and impact evaluations. The information and tools developed from the Regional Hydrologic Study and ongoing Modeling and Management Program enable state and local agencies to make better and more informed decisions concerning the future availability and quality of our ground and drinking water supplies and to avoid or minimize adverse human health and environmental impacts. This work is particularly important in light of the new Groundwater Law (Wisconsin Act 310) that was passed by the Legislature this year.

As communities continue to grow and groundwater withdrawals increase, protection of groundwater will become even more important. Dane County efforts have been a model for similar work being conducted in other parts of the state. In Dane County, the groundwater model provides a modern hydrologic framework for groundwater movement and management in the county and has also stimulated a number of significant research projects by other researchers who have "telescoped" or refined the resolution of the model in specific areas of the county including Pheasant Branch, Nine Springs, and Token Creek watersheds.

In 2003, groundwater modeling and mapping responsibilities for Dane County were transferred from WGNHS and USGS to the RPC. Through this approach, the RPC is able to provide more timely and direct responses to community requests for modeling and mapping products. While the RPC does most of the routine modeling and mapping work for local units of government, the groundwater model and database continue to be housed and maintained by the WGNHS and USGS, who can also perform more complicated modeling work or special requests, as needed. With the dissolution of the RPC September 30, 2004, it is anticipated that Dane County will take a more prominent role in coordinating the regional program among these federal, state and local agencies.

As communities continue to grow and water use increases, intergovernmental coordination and cooperation will be especially critical in addressing future impacts to our ground and surface water resources, which do not recognize jurisdictional boundaries.

II. 2004 Work Activities

A. Update regional groundwater flow model and pumping database.

The regional groundwater flow model uses the USGS MODFLOW modeling code as implemented in the graphical user interface Groundwater Vistas, version 3.4. An important recent improvement has been the reorientation of the model grid to the Wisconsin WTM coordinate system. Placing the model in WTM coordinates makes it directly compatible with base maps, aerial photographs, and other geographic information system (GIS) coverages available at WGNHS, WDNR and the RPC. The Groundwater Vistas interface can directly import and export spatial data into WTM coordinates, and this ability makes model operation and the production of graphical output easier to use and much more efficient.

A significant part of this year's activities was updating the county database to include 2030 water use and pumping forecasts and modeling the effects of existing and future groundwater withdrawals. While the Dane County groundwater model and database continues to be housed and maintained by the WGNHS and USGS, staff of the RPC performed the modeling and mapping work requested by municipal sponsors.

The database of existing and planned wells simulated by the model was updated based on information collected by the RPC from local municipal water utilities as part of an annual survey. The model also includes private high-capacity wells[1]. The database contains pumping information for three different conditions:

- Year 2000 condition (measured pumping rates for the year 2000)
- Year 2030 condition (predicted pumping rates for the year 2030 distributed evenly among both existing and planned wells)
- Maximum Sustained Pumping rate condition (one-half the design capacity of each individual well).

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[1] The database does not include irrigation wells or other private high capacity wells where water is returned to the land surface in the vicinity of the well.

Appendix A presents the pumping rates used in the updated database, along with the model layers in which each well was simulated.

B. Baseline scenarios simulated

The updated model was used to simulate the following scenarios:

a. Pre-development condition (all wells turned off, total model pumping of 0 mgd).

b. Year 2000 current condition (all wells pumping at year 2000 rates, total model pumping of 53.175 mgd)

c. Year 2030 condition (all wells pumping at year 2030 rates, total model pumping of 70.327 mgd).

Each of these simulations produces a series of maps of hydraulic head, drawdown, and simulated baseflow into surface water features. Table 1 summarizes baseflow results for the three simulations.

The simulations show that the increase in pumping from 2000 to 2030 will have a significant effect on baseflow in the county. This is in addition to the significant reductions that have already occurred. Simulating an increase in pumping of from 53.175 to 70.327 mgd results in baseflow decreases of from 0.03 to 18.55 cfs at various gaging stations (see last column on table 2).

Figures 1 through 6 show water table (model layer 2) and potentiometric surface (model layer 4) maps for these three simulations. Figures 7 through 10 illustrate the simulated change in groundwater water levels caused by these pumping increases. Based on these results, significant drawdown will occur between 2000 and 2030 (figures 9 and 10). Additional water-level declines of up to 20 feet at the water table and up to 25 feet in the Mt Simon aquifer are expected. This is in addition to the significant declines that have already occurred: over 65 feet southwest of Madison and over 40 feet to the east (figures 7 and 8). The fact that there are two cones of depression indicates that the Yahara Lakes are a significant source of water to groundwater supplies, which raises potential groundwater quality concerns. It is interesting to note that groundwater levels actually rebound by as much as 20 feet in the Mt Simon aquifer and 5 feet in the water table (figures 9 and 10) as a result of proposed reductions in water withdrawals (3.53 mgd) by Oscar Mayer.

One of the best uses of the model is to show the sources of water (zones of contribution) for municipal wells. The model delineates zones of contribution by reverse tracking of mathematical particles initiated in a circle around each well of interest using the USGS MODPATH code implemented in Groundwater Vistas. Figures 11 and 12 show the 5-, 50-, and 100-year zones of contribution for all municipal wells pumping at 2030 rates and Maximum Sustained rates (one-half design capacity). Maps showing the zones of contribution for existing and planned wells under these two scenarios have been provided to the 2004 program sponsors at 1:24,000 scale.

Table 1. Summary of simulated base flows for Dane County for the 2004 model runs. All values in cubic feet per second (cfs).

Table 2 Simulated Stream Baseflows for Selected Sites in Dane County (cfs)

Rev. 9/04

Station	Predevelopment Baseflows[2]	Present Conditions (measured Q_{80})[3]	2030 Baseline Conditions[4]
Spring Creek near Lodi	16.87	16.70	16.48
Black Earth Creek above Cross Plains	1.70	0.60	0.19
Black Earth Creek @ USGS gage above Black Earth	21.18	19.44	18.50
Mt Vernon Creek @ USGS Gage	12.78	12.40	12.12
W Branch Sugar River @ STH 92 near Mt. Vernon	10.70	10.47	10.25
Pheasant Branch Creek @ USH 12 @ Middleton	2.20	0.85	0.29
Badger Mill Creek @ STH 69 south of Verona	5.37	3.50	2.79
Six Mile Creek @ Mill Rd near Waunakee	4.46	3.40	2.77
Yahara River @ Golf Course near Windsor	11.71	10.00	8.14
Token Creek @ USH 51	18.48	15.50	13.33
E. Branch Starkweather Creek @ Milwaukee St.	2.10	0.30	0
W Branch Starkweather Creek @ Milwaukee St.	5.44	0.60	0.57
Murphy (Wingra) Creek @ Beld St.	4.94	2.30	1.93
Nine Springs @ Hwy. 14	7.31	5.60	5.24
Badfish Creek @ Co. Hwy. A	6.59	5.17	4.47
Koshkonong Creek @ Bailey Rd. near Sun Prairie	0.95	0.24	0
Koshkonong Creek near Deerfield at STH 73	11.56	9.00	7.40
Koshkonong Creek @ Hoopen Rd. near Rockdale	21.90	18.39	16.43
Door Creek	4.64	3.20	2.50
Maunesha River south of USH 151	2.48	2.10	1.68
Yahara River outlet of L. Waubesa	127.28	70.00	54.21
Yahara River below Stoughton	223.42	161.06	142.51

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[2] Predevelopment baseflows were developed by eliminating all well pumping and applying the modeled changes in baseflow to present baseflow. This does not include the effects of land use and recharge loss up to the present.

[3] Measured streamflow was used to calculate the Q_{80} or 80 percent flow durations (provided by USGS, where available). This represents the percent of time the indicated value was equaled or exceeded and provides a close approximation of average dry-weather baseflow conditions. Surface discharges such as those by municipal wastewater treatment plants have been removed (where applicable) to estimate the portion of measured baseflows contributed directly by groundwater flow.

[4] 2020 baseflows were developed by applying 2000-2030 modeled changes in baseflow to present baseflow (Q_{80}).

C. Conversion of well DN-105 to nested monitoring wells

During 2004 the WGNHS investigated, designed, and purchased materials for conversion of municipal well DN-105 to a permanent groundwater monitoring well with nested piezometers. This well is located in Lakeside Park on the corner of Maher and Lakeside Streets in the City of Monona, about one third mile from the northeast end of Lake Monona. It was originally drilled in 1953 and was designated as Town of Blooming Grove well no. 6. The well later became Madison well no. 24. This well was drilled to a total depth of about 380 ft, encountered about 35 ft of glacial material, followed by 95 ft of Franconian sandstone, 50 ft of Dresbach sandstone and finished in about 200 ft of Eau Claire Formation. The Eau Claire Formation is sandstone with the exception of about 5 ft of red dolomitic shale from about 250-260 ft. The Franconian and Dresbach names have been replaced in recent years with the names Tunnel City and Wonowoc. About 85 ft of 10-inch casing seals out the 35 ft of glacial material and the top 50 ft of Tunnel City sandstone. The original open hole diameter telescopes from 16 inches down to 12 inches at about 108 ft and finally down to about 8 inches at 252 ft and remains at 8 inches to the bottom of the hole. Accordingly, this well is open across the Eau Claire aquitard, and connects the upper and lower bedrock aquifers.

DN-105 was used for municipal supply for about 20 years but was taken out of active production to be used as an emergency backup supply in the early 1970's. In 1973, the well was selected to become part of a statewide groundwater observation well network maintained by the U.S. Geological Survey (USGS) in cooperation with the Wisconsin Geological and Natural History Survey (WGNHS). Water-level measurements have been collected at varying time intervals through early 2003. In late 2003 the Madison Water Utility decided that this well was no longer needed for water supply and it was scheduled to be abandoned and filled with concrete.

The recent Dane County Hydrologic Study indentified the shaley part of the Eau Claire Formation as an important regional aquitard in Dane County. The study also showed that good water level measurements in the aquifers above and below the shale were lacking in the Madison metropolitan area. The proposed abandonment of DN-105 offered an opportunity to convert the supply well to a deep monitoring well at minimal cost. Dn-105 is open to the sandstone units above and below the shaley part of the Eau Claire. To fully determine the thickness of this shale, a (geophysical) gamma log was run. This log contains a gamma "kick" at the interval 250-262 ft - the typical gamma "signature" of the shaley part of the Eau Claire Formation in the Dane County area. Therefore, it was determined that an inflatable straddle packer should be temporarily placed across from the shaley part of the Eau Claire at a depth of about 260 ft to determine the hydraulic-head differences, if any, in the sandstone units on either side of the shale. The WGNHS and USGS installed temporary packers and measured a downward hydraulic head drop of approximately 35 feet across the shale at this site. One interpretation for this head drop is that the majority of pumpage from municipal wells near DN-105 is derived from the sandstone units below the shaley part of the Eau Claire.

The data collected during this packer experiment resulted in a decision to reconstruct Dn-105 into a permanent nest of two observation wells (piezometers). One piezometer will be completed just below the Eau Claire aquitard, and a second will be completed just above the Eau Claire. Each piezometer will consist of a 2-inch diameter standpipe terminating in a 5-ft long well screen. The annual space around the standpipes above and below the screens will be backfilled with bentonite and cement to DNR codes. This work will served the dual purpose of abandoning the large-diameter production well while leaving two excellent monitoing points for future data collection. The geographic location, near the center of the deep cone of depression in Dane County, will allow improved monitoring of groundwater levels in the bedrock aquifers in this critical area of the county. Water levels will continue to be monitored continuously for the future so as to provide a view of hydraulic heads in the sandstone aquifer in the Madison area and provide a valuable calibration target for future groundwater flow models of the Madison/Dane County area.

The piezometer materials have been purchased, and installation is expected during October, 2004.

D. USGS Reservoir Routing Model Report

Also, previously, Dane County was awarded a DNR Lake Management Planning Grant to develop a calibrated Yahara Lakes Reservoir Routing Model using the surface water model developed from the Dane County Regional Hydrologic Study. The model was initially used to evaluate and develop rules for operating the Yahara Lakes as multi-purpose reservoirs in order to restore pre-diversion low-flow conditions. However, low flow conditions were not the only concern. Flooding is also a significant problem. In order to help address these issues, the reservoir routing model was modified and expanded by Bill Krug and Peter Hughes from the U.S. Geological Survey. The model is now capable of simulating lake levels and flows through the full range of flooding and drought conditions using 71 years of historic lake level and flow data.

The reservoir routing model is expected to provide an important management tool for evaluating and optimizing various alternative, multi-purpose management objectives for the Yahara Lakes system. Copies of the USGS report have been provided to municipal public works directors and inter-agency resource management representatives involved with managing the Yahara Lake chain system. Additional copies are also available on request. This complements another effort by Dane County, MG&E, MMSD, and others to develop a Yahara River watershed runoff model. The model will be used to help anticipate and address the problems associated with flooding and drought conditions.

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III. References

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2004 Dane County Groundwater Model Simulations

Appendix, Figures and Maps

Appendix A. Wells and pumping rates used in the 2004 regional model.

Model Designation Code	Community	Well no.	Capacity gpm	Top model layer	Bottom model layer	Q2000, mgd	Q2030, Mgd	Max. Sustained Q, mgd
BV1	Belleville	1	275	2	2	0.065	0.0896	0.1980
BV2	Belleville	2	500	2	2	0.097	0.0896	0.3600
BVP3	Belleville	3*	650	4	4	0	0.0896	0.4680
BE1	Black Earth	1	430	4	4	0.055	0.0673	0.3096
BE2	Black Earth	2	380	2	4	0.055	0.0673	0.2736
BM1	Blue Mounds	1	370	2	4	0.046	0.0480	0.2664
BM-99P3	Blue Mounds	3*	425	4	4	0	0.0480	0.3060
BR1	Brooklyn	1	270	2	4	0.020	0.0534	0.1944
BR2	Brooklyn	2	470	2	4	0.039	0.0534	0.3384
BK1	Burke	1	750	2	4	0.043	0.2845	0.5400
BK2	Burke	2	250	4	4	0.010	0.2845	0.1800
CM2	Cambridge	2	400	2	4	0.102	0.0740	0.2880
CM3	Cambridge	3	450	2	4	0	0.0740	0.3240
CG1	Cottage Grove	1	0	2	4	0.037	0	0
CG2	Cottage Grove	2	750	2	4	0.060	0.2070	0.5400
CG3	Cottage Grove	3	1000	2	4	0.216	0.2070	0.7200
CG-99P4	Cottage Grove	4*	1000	4	4	0	0.2070	0.7200
CG-99P5	Cottage Grove	5*	1000	4	4	0	0.2070	0.7200
CP1	Cross Plains	1	425	2	2	0.089	0.1626	0.3060
CP2	Cross Plains	2	650	2	2	0.217	0.1626	0.4680
CP-99P3	Cross Plains	3*	650	4	4	0	0.1626	0.4680
DN1	Dane	1	200	2	2	0.016	0.0520	0.1440
DN2	Dane	2	300	2	4	0.039	0.0520	0.2160
DE1	Deerfield	1	330	2	4	0.011	0.1270	0.2376
DE3	Deerfield	3	375	2	4	0.153	0.1270	0.2700
DF2	DeForest	2	350	2	4	0.102	0.3313[5]	0.2520
DF3	DeForest	3	850	2	4	0.239	0.3313[5]	0.6120
DF4	DeForest	4	1200	2	4	0.395	0.3313[5]	0.8640
DF-04P7	DeForest	5*	1500	4	4	0	0.3313[5]	1.0800
DF-04P6	DeForest	6*	1500	4	4	0	0.3313[5]	1.0800
DF-04P5	DeForest	7*	1500	4	4	0	0.3313[5]	1.0800
EDG-2	Edgerton	2	625	2	4	0.153	0.1045	0.4500
EDG-3	Edgerton	3	975	2	4	0.168	0.1045	0.7020
EDG-4	Edgerton	4	825	2	4	0.120	0.1045	0.5940
EDG-00P5	Edgerton	5*	950	4	4	0	0.1045	0.6840
EDG-00P6	Edgerton	6*	950	4	4	0	0.1045	0.6840
FI4	Fitchburg	4	1200	4	4	0.696	0.4683	0.8640
FI5	Fitchburg	5	1250	4	4	0.658	0.4683	0.9000
FI7/8	Fitchburg	7/8*	1200	2	4	0.031	0.4683	0.8640
FI9	Fitchburg	9	850	4	4	0.337	0.4683	0.6120
FI10	Fitchburg	10	1250	4	4	0.089	0.4683	0.9000
FI-99P11	Fitchburg	11*	1200	4	4	0	0.4683	0.8640

* note – wells with an asterisk (*) are planned, and do not yet physically exist

[5] Includes 0.1042 mgd associated with the American Breeders Service (ABS) development

MD3	Madison	3	1800	2	4	0.694	1.9473[6]	1.2960
MD6	Madison	6	2400	4	4	0.568	1.4413	1.7280
MD7	Madison	7	2100	4	4	1.080	1.9473[6]	1.5120
MD8	Madison	8	1800	4	4	0.679	1.9473[6]	1.2960
MD9	Madison	9	1700	2	4	1.183	1.4413	1.2240
MD10	Madison	10	2200	2	4	1.764	1.4413	1.5840
MD11	Madison	11	2000	2	4	1.502	1.9473[6]	1.4400
MD12	Madison	12	2400	2	4	1.052	1.4413	1.7280
MD13	Madison	13	2200	2	4	2.250	1.4413	1.5840
MD14	Madison	14	2400	2	4	2.453	1.4413	1.7280
MD15	Madison	15	2200	2	4	2.737	1.9473[6]	1.5840
MD16	Madison	16	2400	2	4	0.798	1.4413	1.7280
MD17	Madison	17	1800	2	4	1.478	1.4413	1.2960
MD18	Madison	18	2200	4	4	2.116	1.4413	1.5840
MD19	Madison	19	2100	4	4	0.691	1.4413	1.5120
MD20	Madison	20	2100	2	4	1.473	1.4413	1.5120
MD23	Madison	23	1200	2	4	0.369	1.4413	0.8640
MD24	Madison	24	1800	4	4	1.239	1.4413	1.2960
MD25	Madison	25	2200	2	4	2.475	1.4413	1.5840
MD26	Madison	26	2200	2	4	3.060	1.4413	1.5840
MD27	Madison	27	2200	2	4	1.917	1.4413	1.5840
MD28	Madison	28	2000	4	4	0	1.4413	1.4400
MD29	Madison	29	2100	4	4	0	1.4413	1.5120
MD30	Madison	30	2100	4	4	0	1.4413	1.5120
MD-99P6	Madison	6*	2100	4	4	0	1.4413	1.5120
MD-99P29	Madison	29*	2100	4	4	0	1.4413	1.5120
MD-99P30	Madison	30*	2100	4	4	0	1.4413	1.5120
MD-04P31	Madison	31*	2100	4	4	0	1.4413	1.5120
MD-04P32	Madison	32*	2200	4	4	0	1.4413	1.5840
MSH1	Marshall	1	500	2	4	0.104	0.1445	0.3600
MSH2	Marshall	2	500	2	4	0.148	0.1445	0.3600
MSH-99P3	Marshall	3*	500	4	4	0	0.1445	0.3600
MZ2	Mazomanie	2	500	4	4	0.076	0.0925	0.3600
MZ3	Mazomanie	3	600	1	1	0.071	0.0925	0.4320
MF1	McFarland	1	600	2	4	0.103	0.2392	0.4320
MF3	McFarland	3	1020	2	4	0.221	0.2392	0.7344
MF4	McFarland	4	1150	2	4	0.259	0.2392	0.8280
MF-00P5	McFarland	5*	1100	4	4	0	0.2392	0.7920
MI2	Middleton	2	350	2	2	0.300	0.4253	0.2520
MI3	Middleton	3	1060	2	4	0.300	0.4253	0.7632
MI4	Middleton	4	1200	2	4	0.361	0.4253	0.8640
MI5	Middleton	5	1325	2	4	0.604	0.4253	0.9540
MI6	Middleton	6	1550	2	4	0.712	0.4253	1.1160
MI7	Middleton	7	1500	2	4	0	0.4253	1.0800
MI-04P8	Middleton	8*	1500	4	4	0	0.4253	1.0800
MO1	Monona	1	800	2	4	0.159	0.2446	0.5760
MO2	Monona	2	1400	2	4	0.343	0.2446	1.0080
MO3	Monona	3	1200	2	4	0.397	0.2446	0.8640

* note – wells with an asterisk (*) are planned, and do not yet physically exist

[6] Includes 0.506 mgd associated with Oscar Mayer

MR1	Morrisonville	1	350	2	2	0	0.0170	0.2520
MR2	Morrisonville	2	500	2	4	0.026	0.0170	0.3600
MT3	Mt Horeb	3	500	2	4	0.178	0.2452	0.3600
MT4	Mt Horeb	4	500	2	4	0.183	0.2452	0.3600
MT5	Mt Horeb	5	1000	2	4	0.175	0.2452	0.7200
MT-99P6	Mt Horeb	6*	1000	4	4	0	0.2452	0.7200
OR3	Oregon	3	900	2	4	0.098	0.4242	0.6480
OR4	Oregon	4	850	2	4	0.287	0.4242	0.6120
OR5	Oregon	5	850	4	4	0.303	0.4242	0.6120
ST3	Stoughton	3	525	2	4	0.181	0.4041	0.3780
ST4	Stoughton	4	1140	2	4	0.316	0.4041	0.8208
ST5	Stoughton	5	1025	4	4	0.241	0.4041	0.7380
ST6	Stoughton	6	1010	4	4	0.337	0.4041	0.7272
ST7	Stoughton	7	1100	4	4	0.166	0.4041	0.7920
SP3	Sun Prairie	3	1200	2	4	0.417	0.4425	0.8640
SP4	Sun Prairie	4	1200	2	4	0.157	0.4425	0.8640
SP5	Sun Prairie	5	1200	2	4	0.698	0.4425	0.8640
SP6	Sun Prairie	6	1200	2	4	0.387	0.4425	0.8640
SP7	Sun Prairie	7	1400	2	4	0.630	0.4425	1.0080
SP-02P32	Sun Prairie	13*	1200	4	0	0	0.4425	0.8640
SP-99P11	Sun Prairie	11*	1200	4	4	0	0.4425	0.8640
SP-99P12	Sun Prairie	12*	1200	4	4	0	0.4425	0.8640
SP-99P8	Sun Prairie	8*	1200	4	4	0	0.4425	0.8640
VE1	Verona	1	500	2	4	0.086	0.4484	0.3600
VE2	Verona	2	1000	2	4	0.192	0.4484	0.7200
VE3	Verona	3	1500	2	4	0.211	0.4484	1.0800
VE4	Verona	4	1500	2	4	0.351	0.4484	1.0800
WA1	Waunakee	1	650	2	4	0.328	0.4438	0.4680
WA2	Waunakee	2	950	2	4	0.227	0.4438	0.6840
WA3	Waunakee	3	1000	2	4	0.227	0.4438	0.7200
WA4	Waunakee	4	1000	4	4	0.103	0.4438	0.7200
WP1	Westport	1	600	2	4	0.048	0.0800	0.4320
WP2	Westport	2	700	4	4	0.027	0.0800	0.5040
WI1	Windsor	1	500	2	4	0.088	0.1257	0.3600
WI2	Windsor	2	500	2	4	0.106	0.1257	0.3600
WI-04P3	Windsor	3*	500	4	4	0	0.1257	0.3600
Private high-capacity wells								
XPW-Anderson	Anderson			2	2	0.012	0.012	0.012
XPW-BF471-Da	Dane Co Home			4	4	0.050	0.050	0.050
XPW-Foremost	Foremost Farms			4	4	0.127	0.127	0.127
XPW-Interpan	Interpane Corp			2	2	0.315	0.315	0.315
XPW-Lycon	Lycon Corp			2	2	0.020	0.020	0.020
XPW-Mendota	Mendota	1		4	4	0.039	0	0
XPW-Mendota	Mendota	2		4	4	0.146	0.146	0.146
XPW-MG&E	MG&E			4	4	0.091	0.091	0.091
XPW-OM2 #43614	Oscar Mayer	2		4	4	0.991	0.1175	0.1175
XPW-OM4 #43613	Oscar Mayer	4		4	4	1.585	0.1175	0.1175
XPW-OM5 #43635	Oscar Mayer	5		4	4	0.681	0.1175	0.1175
XPW-OM6 #02246	Oscar Mayer	6		4	4	1.065	0.1175	0.1175
XPW-RockGen	RockGen Power Plant			4	4	0.014	0.014	0.014
XPW-UW Physi	UW Physical Plant			4	4	0.068	0.068	0.068

Figure 1. Simulated predevelopment water table. Contours in feet above mean sea level (msl).

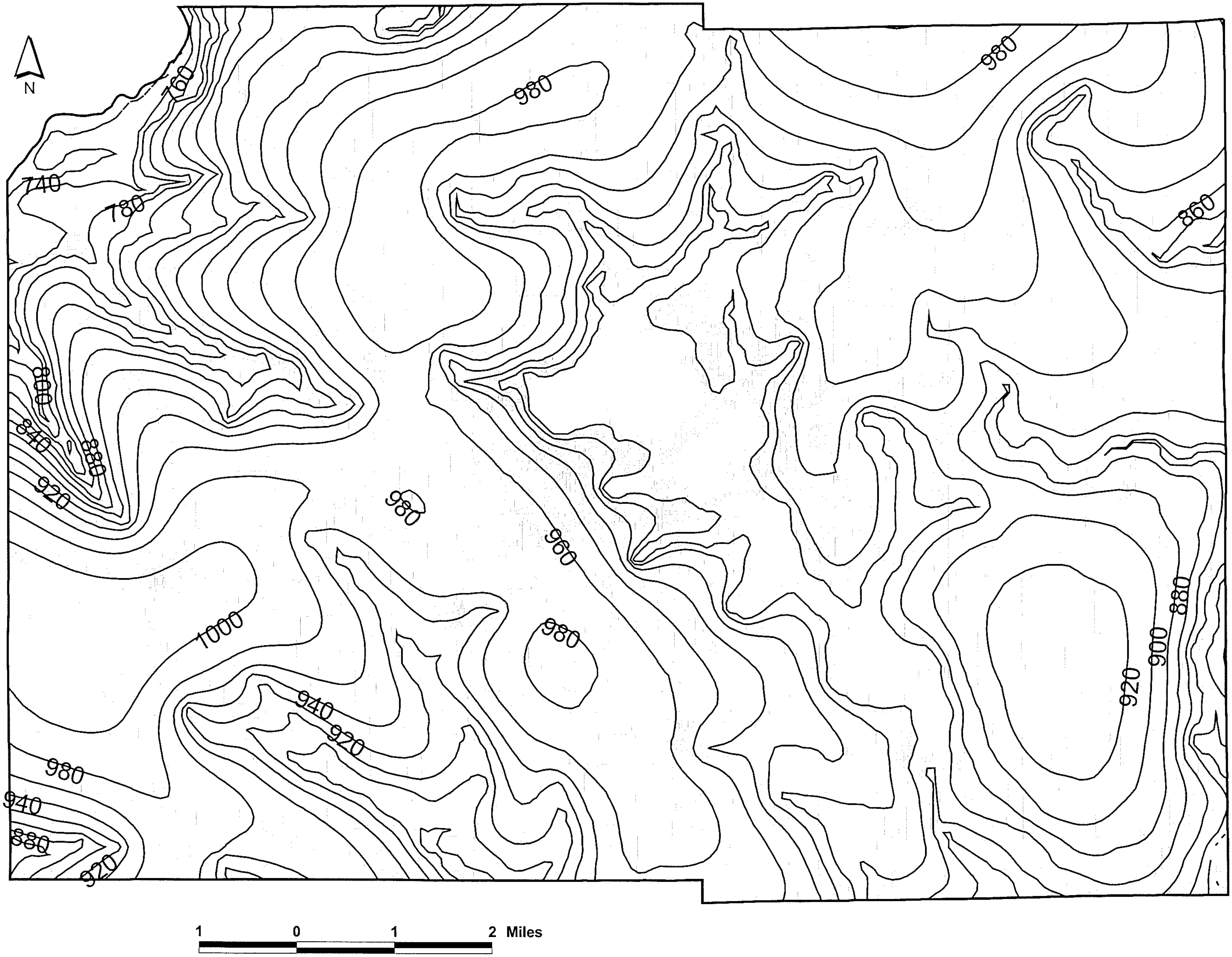


Figure 2. Simulated predevelopment heads in the Mt. Simon aquifer. Contours in feet above mean sea level (msl).

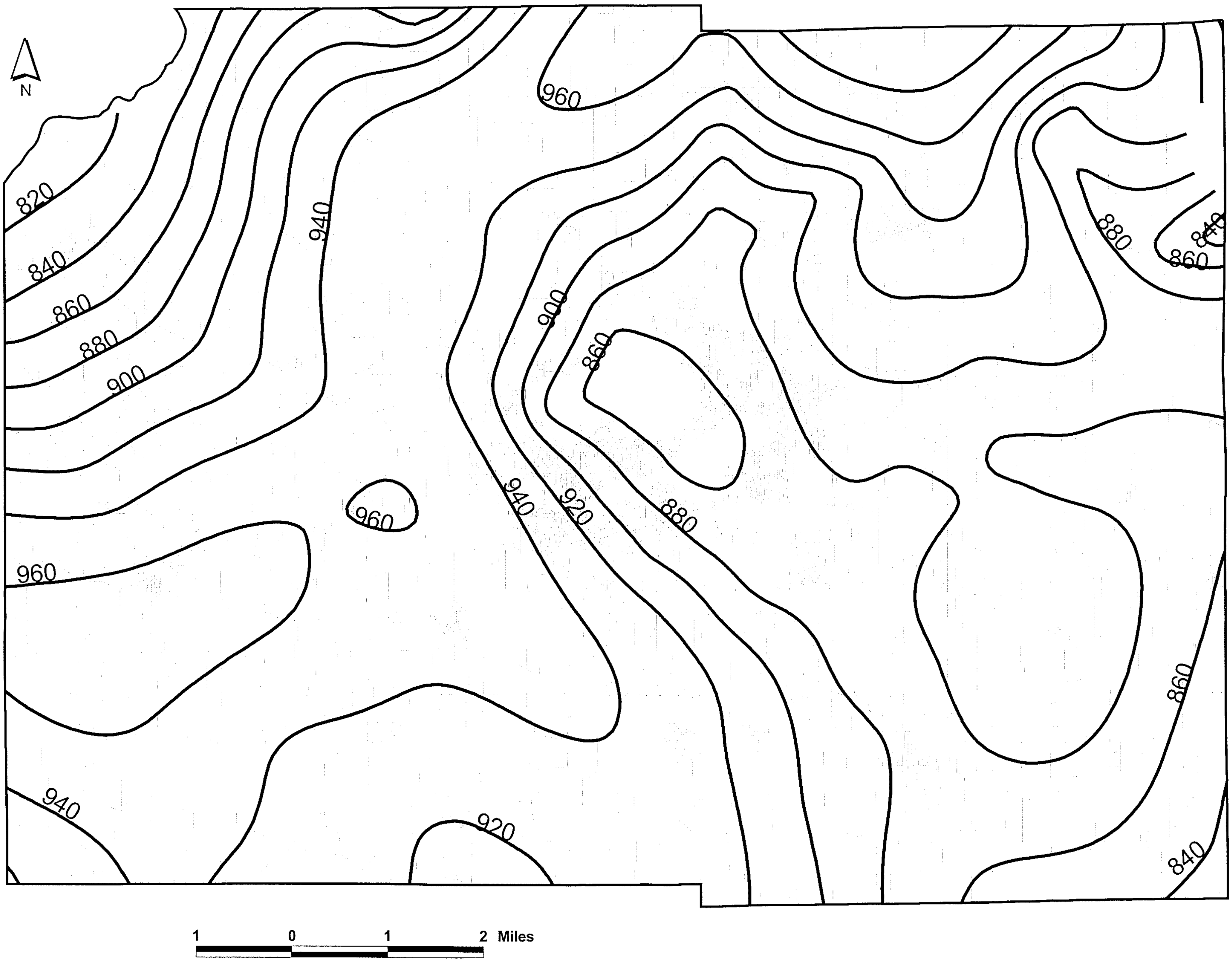


Figure 3. Simulated 2000 water table. Contours in feet above mean sea level (msl).

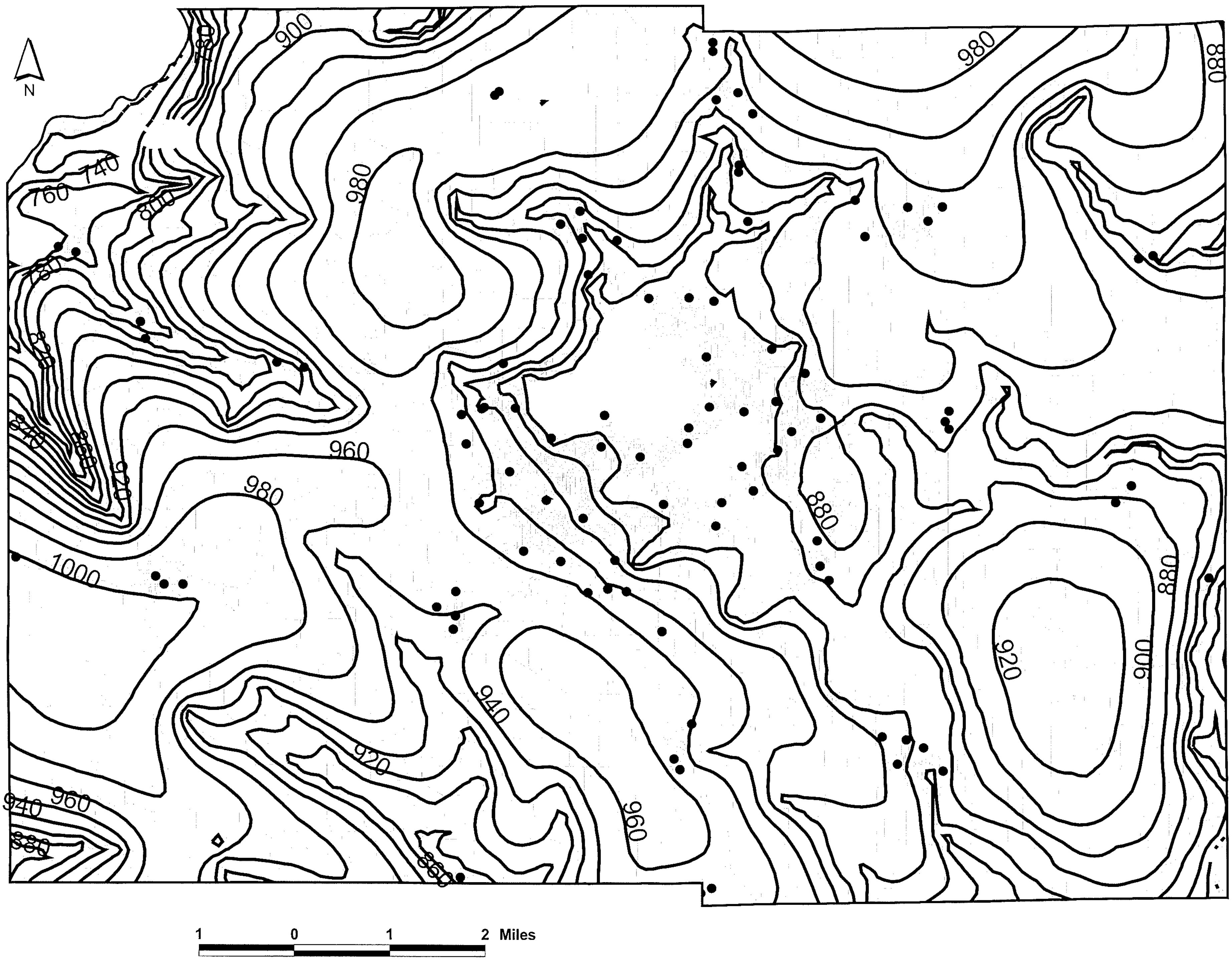


Figure 4. Simulated 2000 heads in Mt. Simon aquifer. Contours in feet above mean sea level (msl).

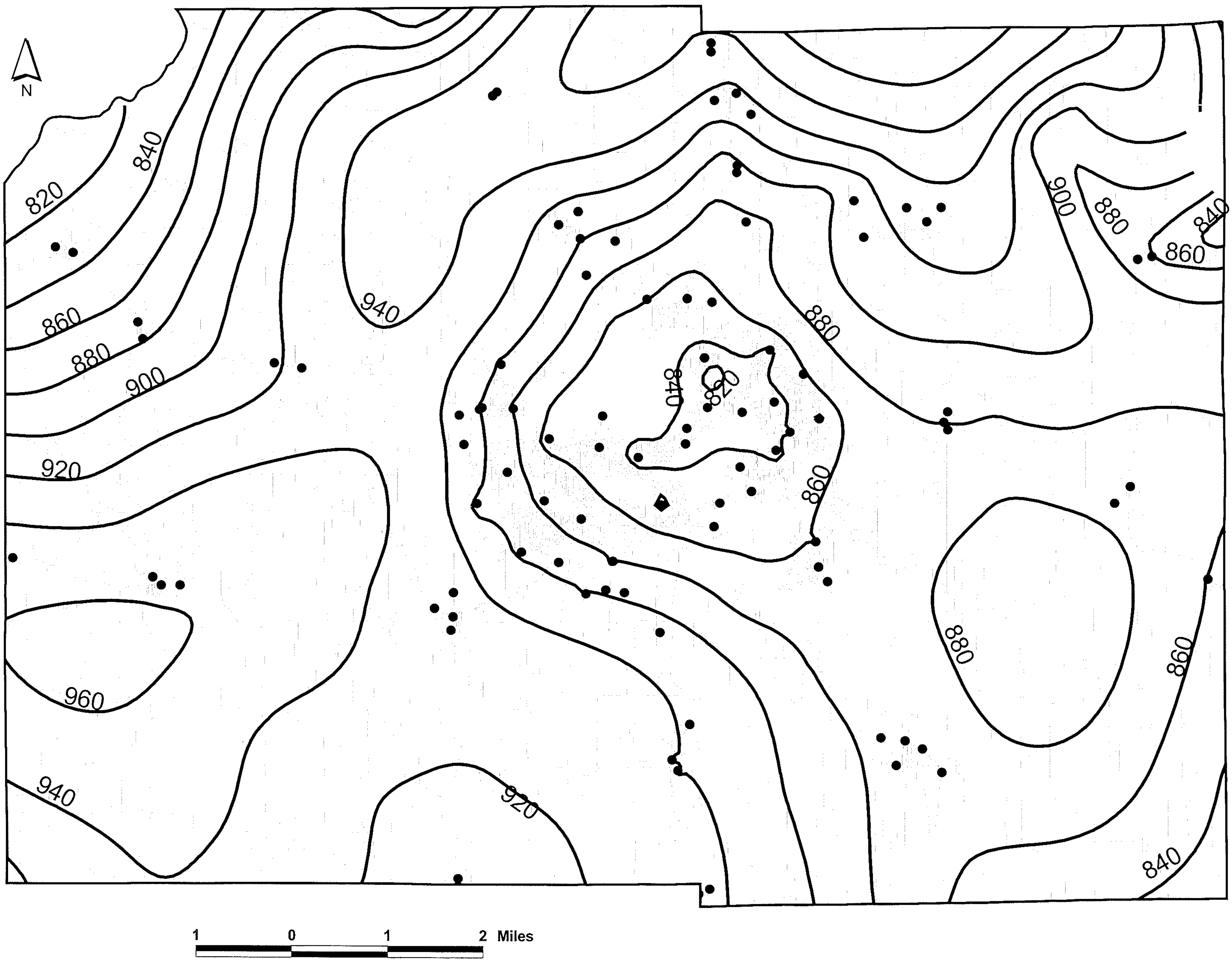


Figure 5. Simulated 2030 water table. Contours in feet above mean sea level (msl).

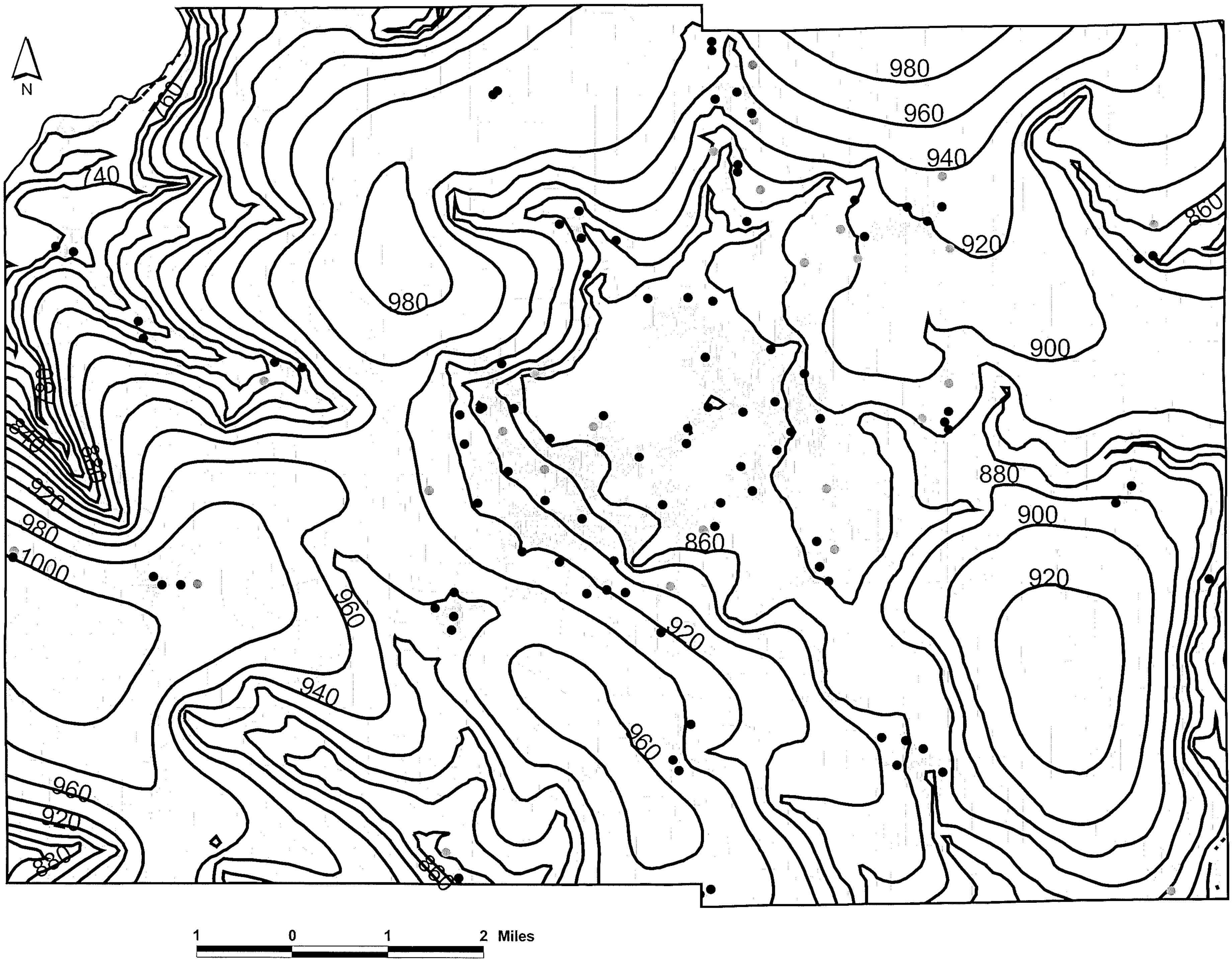


Figure 6. Simulated 2030 heads in Mt. Simon aquifer. Contours in feet above mean sea level (msl).

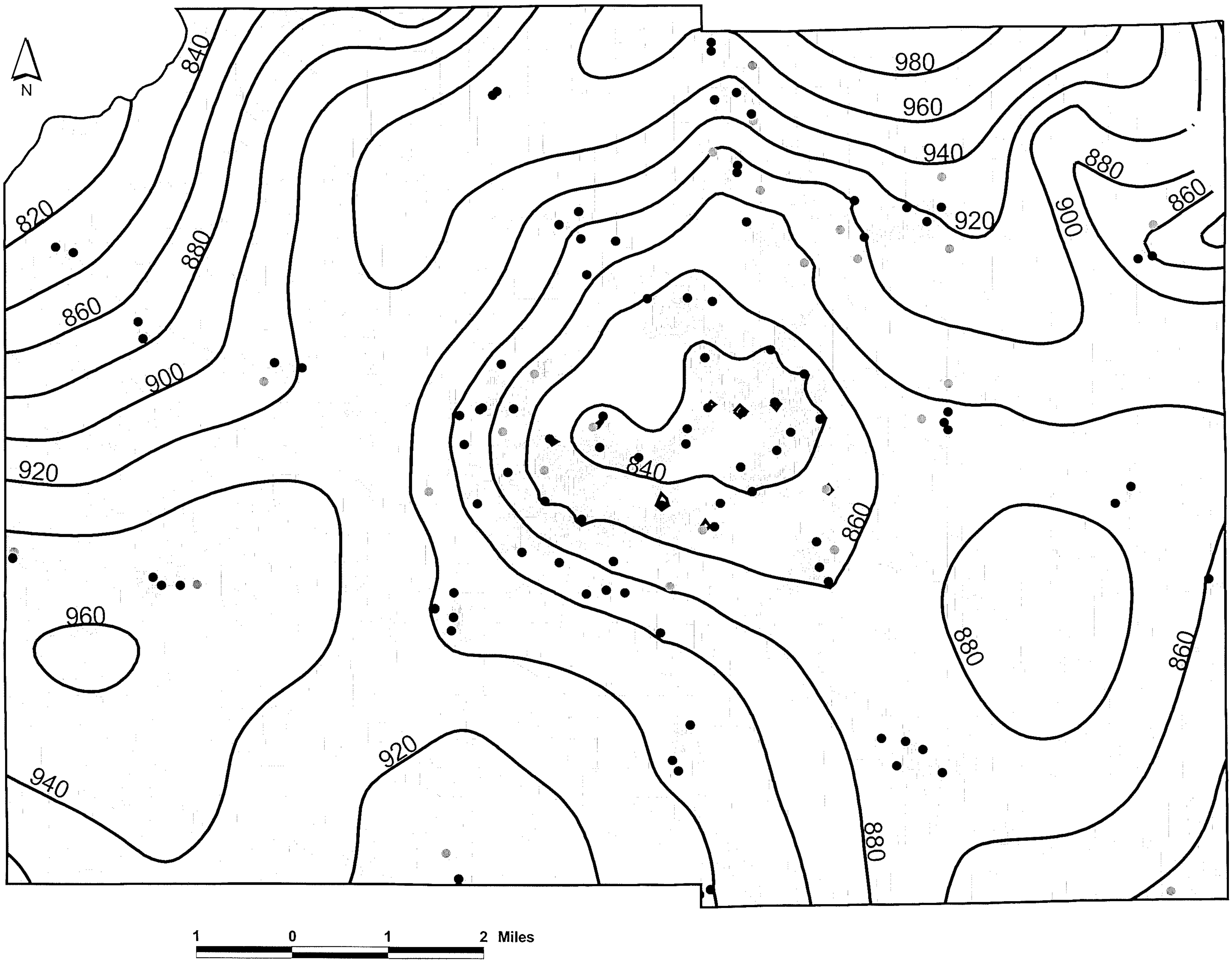


Figure 7. Simulated drawdown at water table, 1900-2000. Contours represent water level declines in feet.

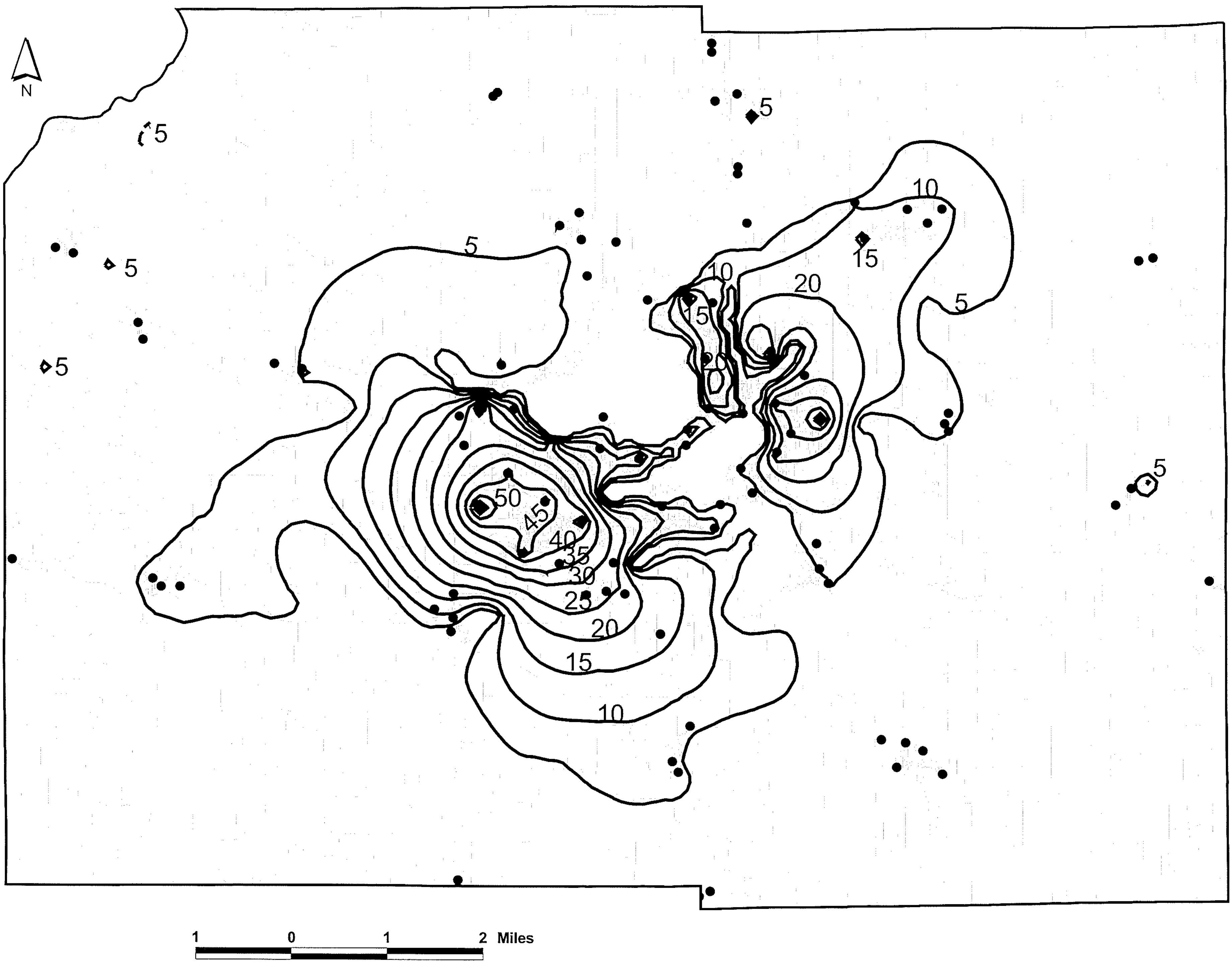


Figure 8. Simulated drawdown in Mt Simon aquifer, 1900-2000. Contours represent water level declines in feet.

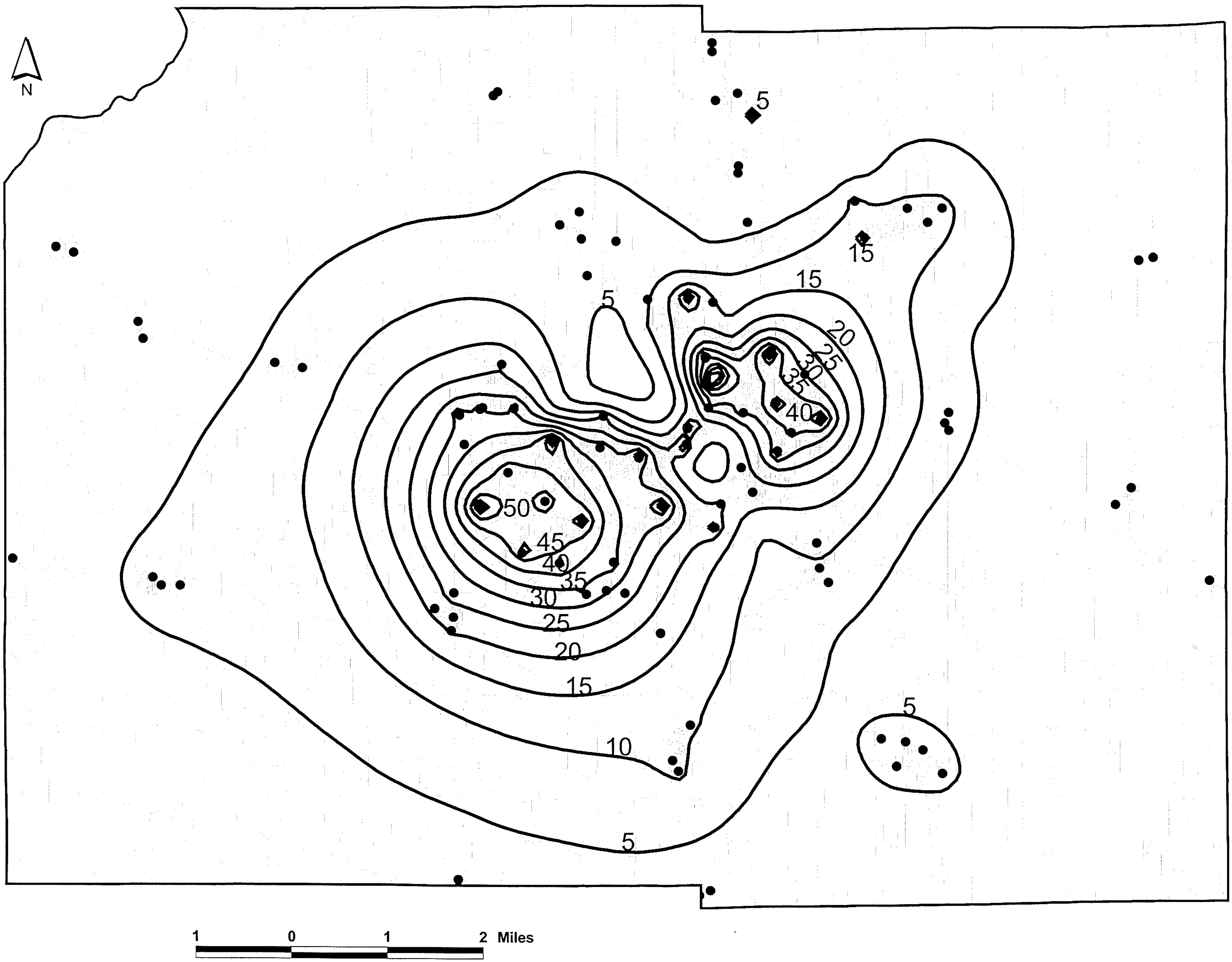


Figure 9. Simulated drawdown at the water table, 2000-2030. Contours represent water level declines in feet.

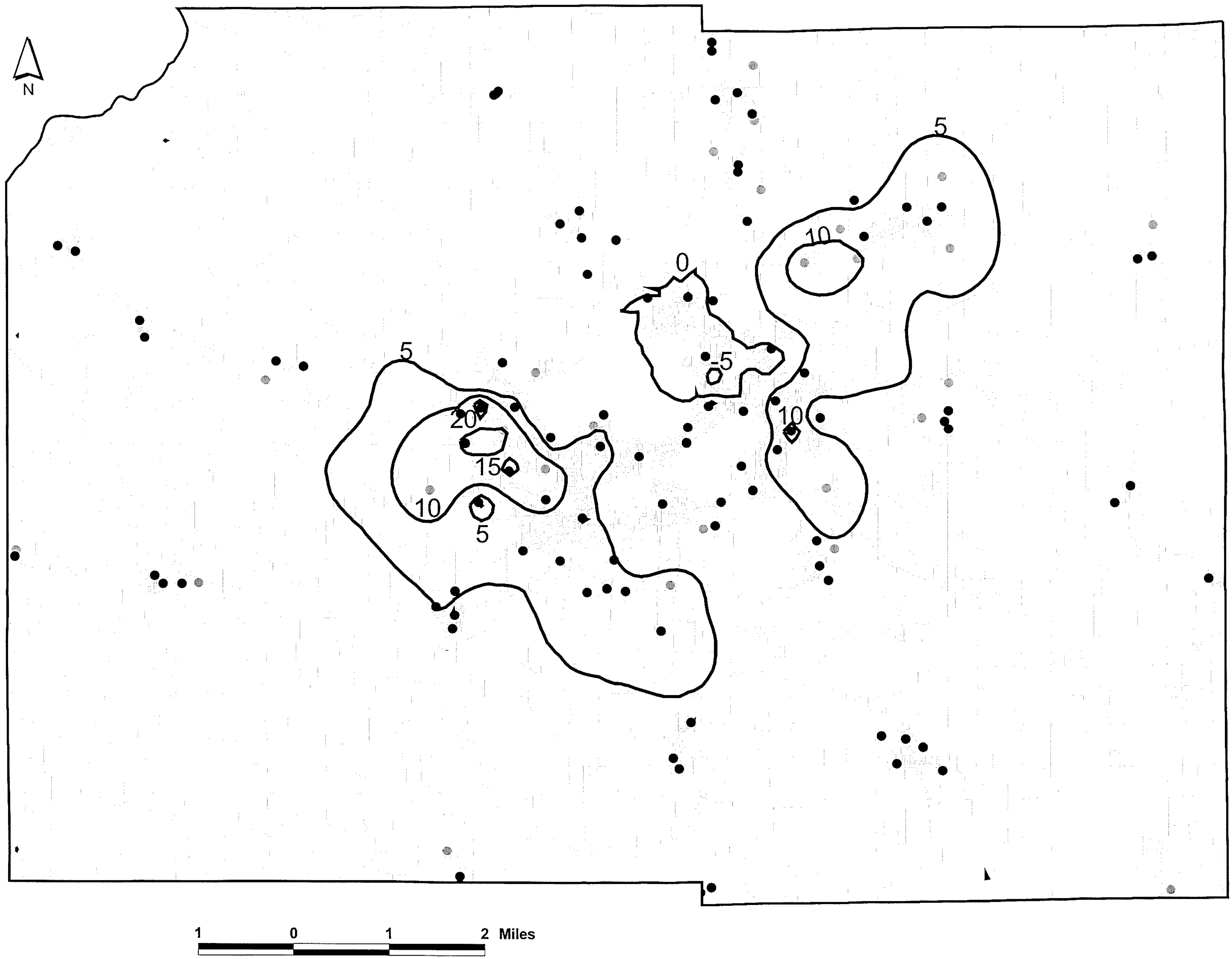
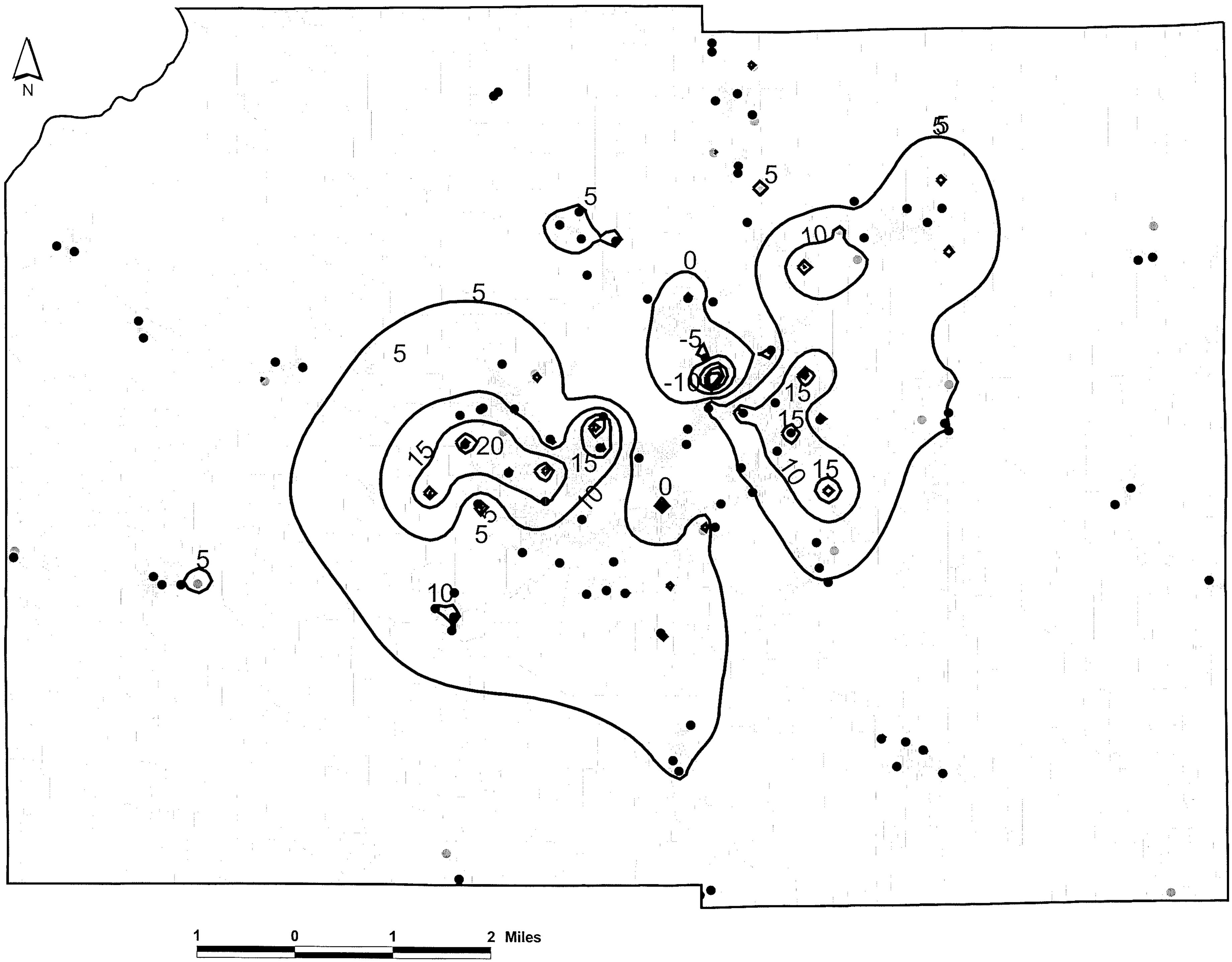
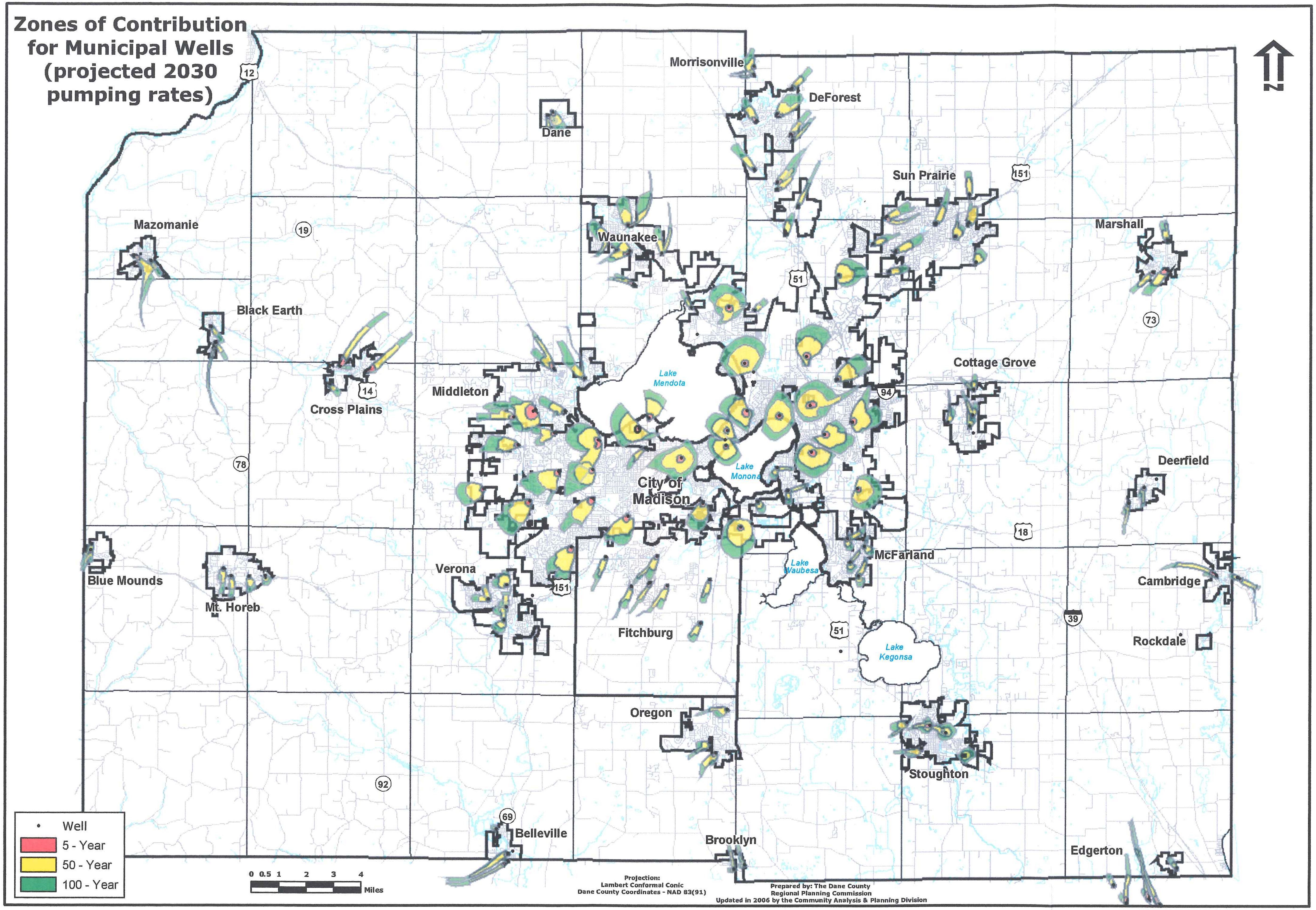
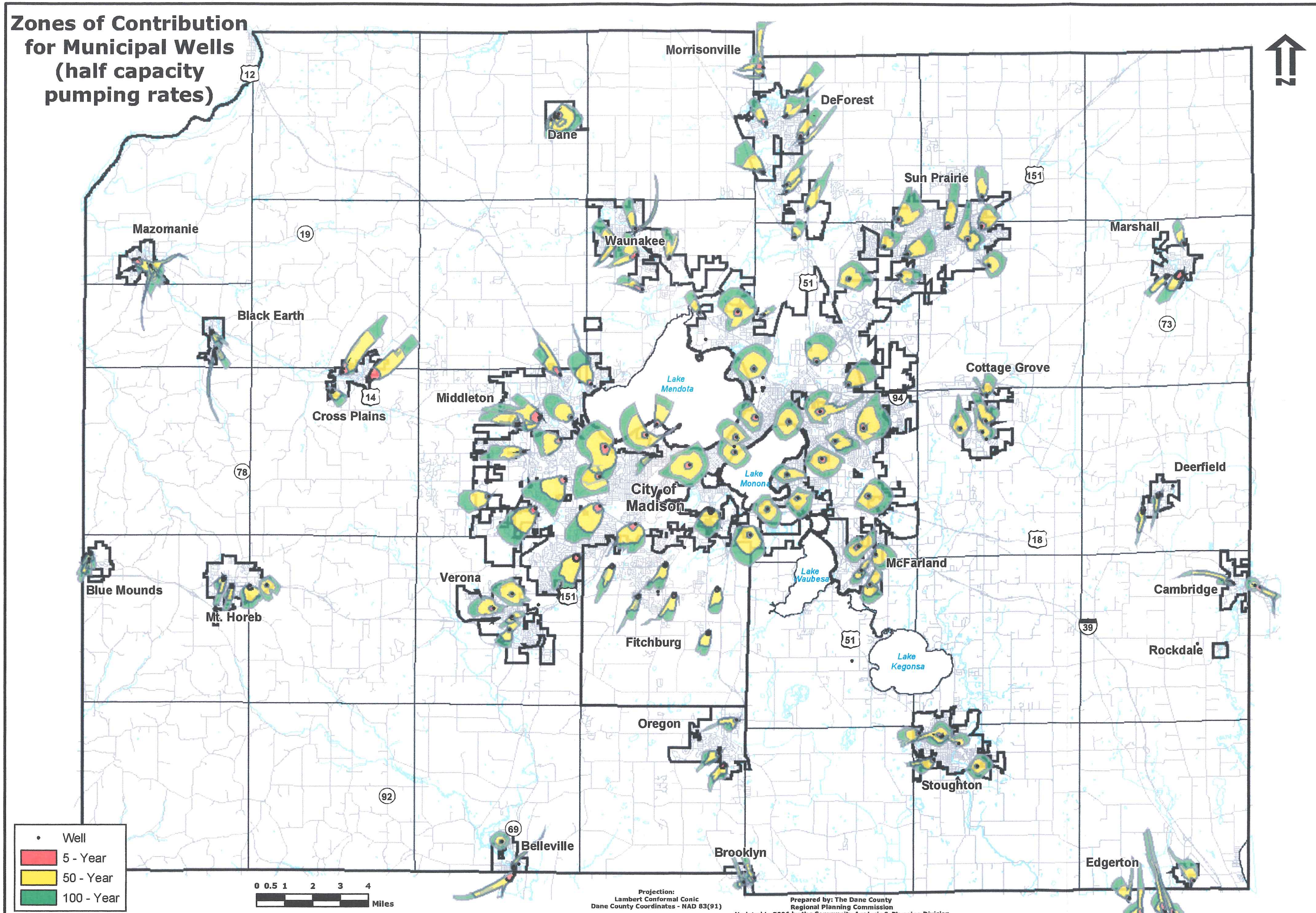


Figure 10. Simulated drawdown in Mt Simon aquifer, 2000-2030. Contours represent water-level declines in feet.



Zones of Contribution for Municipal Wells (projected 2030 pumping rates)





Zones of Contribution for Municipal Wells (half capacity pumping rates)
Morrisonville
DeForest
Dane
Sun Prairie
Marshall
Mazomanie
Waunakee
Black Earth
Cross Plains
Middleton
Lake Mendota
Cottage Grove
Deerfield
Lake Monona
City of Madison
Blue Mounds
Mt. Horeb
Verona
McFarland
Lake Waubesa
Cambridge
Fitchburg
Lake Kegonsa
Rockdale
Oregon
Stoughton
Belleville
Brooklyn
Edgerton
12
19
78
14
151
51
94
73
18
39
92
69
Well
5 - Year
50 - Year
100 - Year
0 0.5 1 2 3 4
Miles
Projection:
Lambert Conformal Conic
Dane County Coordinates - NAD 83(91)
Prepared by: The Dane County
Regional Planning Commission
Updated in 2006 by the Community Analysis & Planning Division