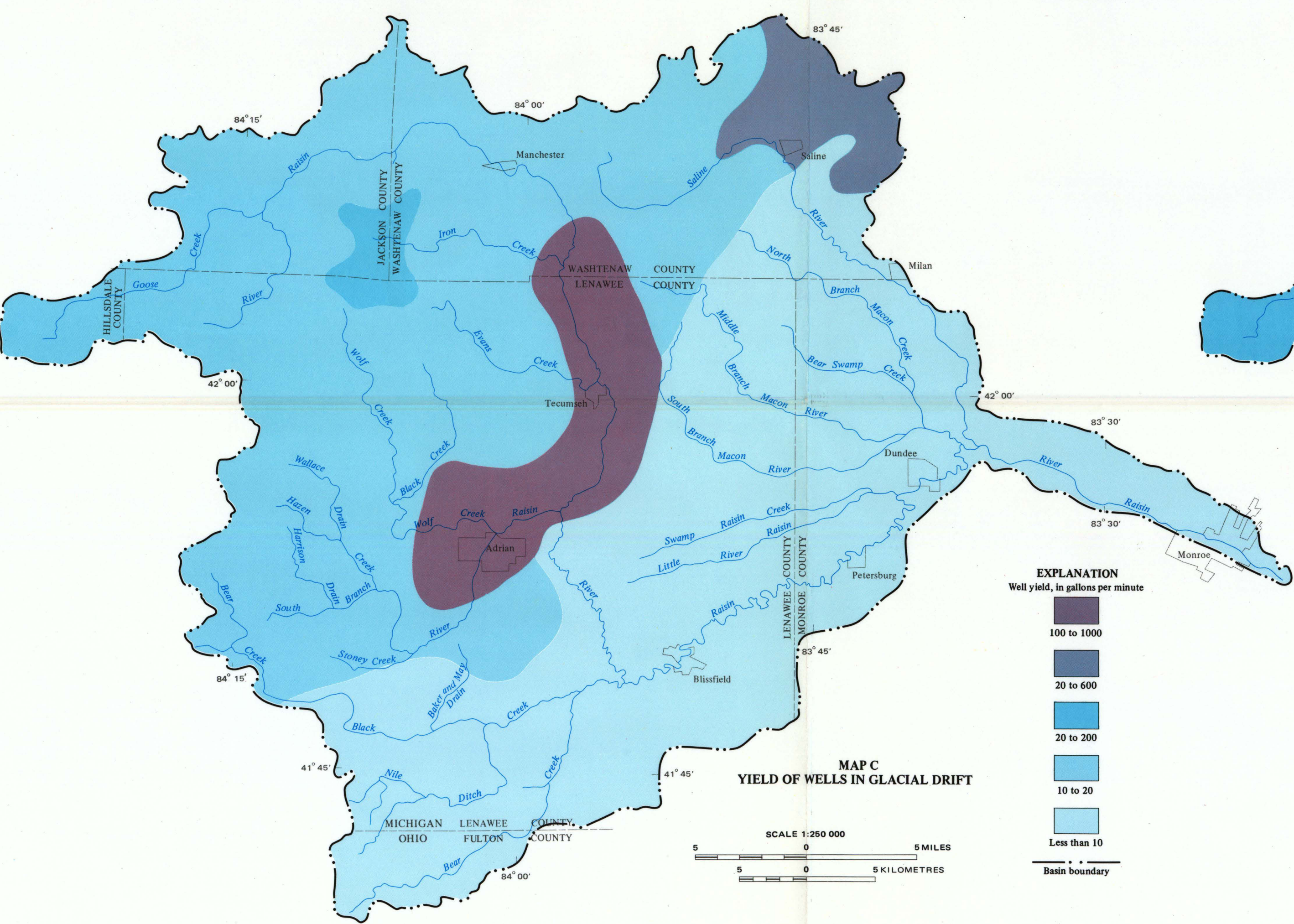
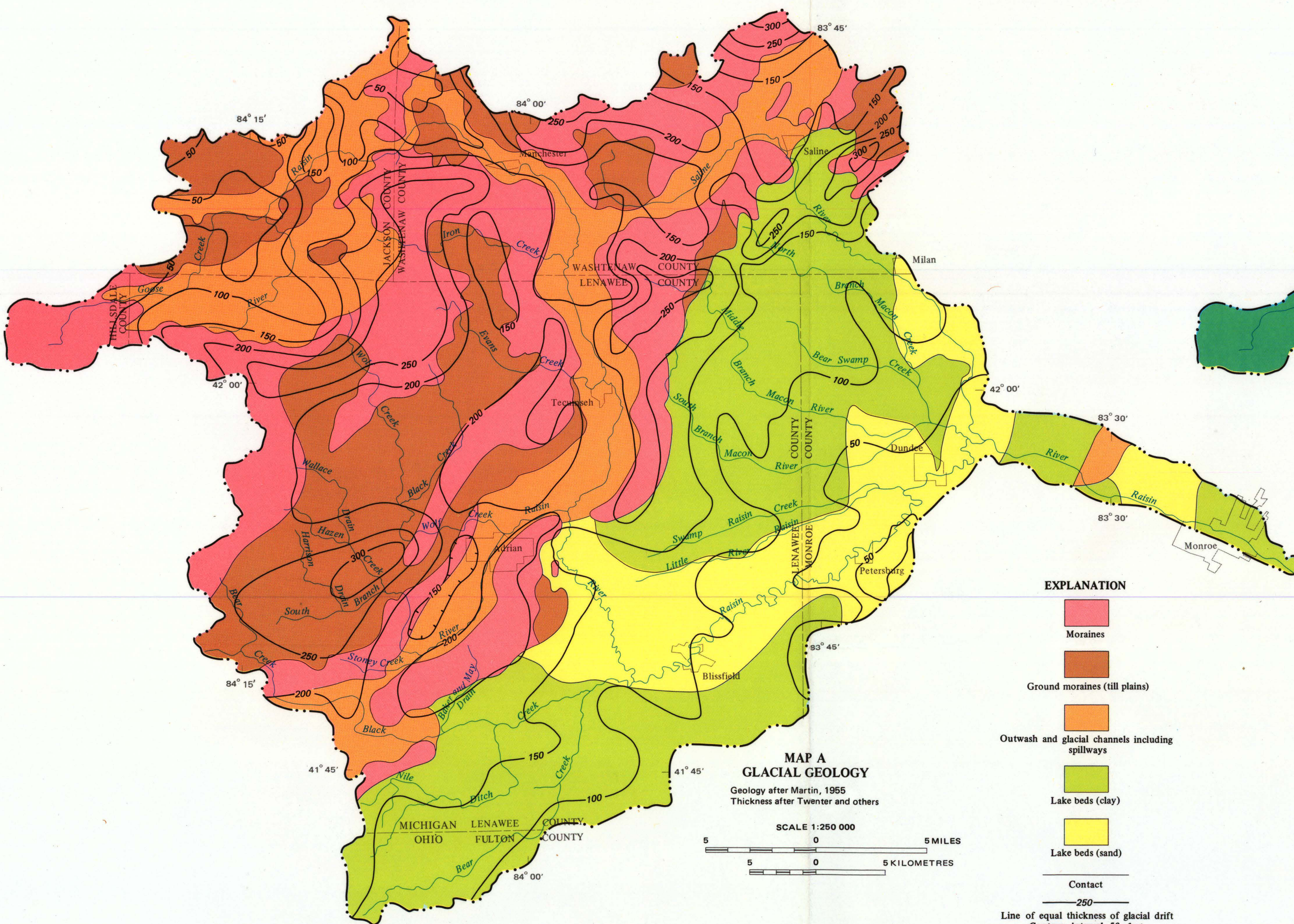
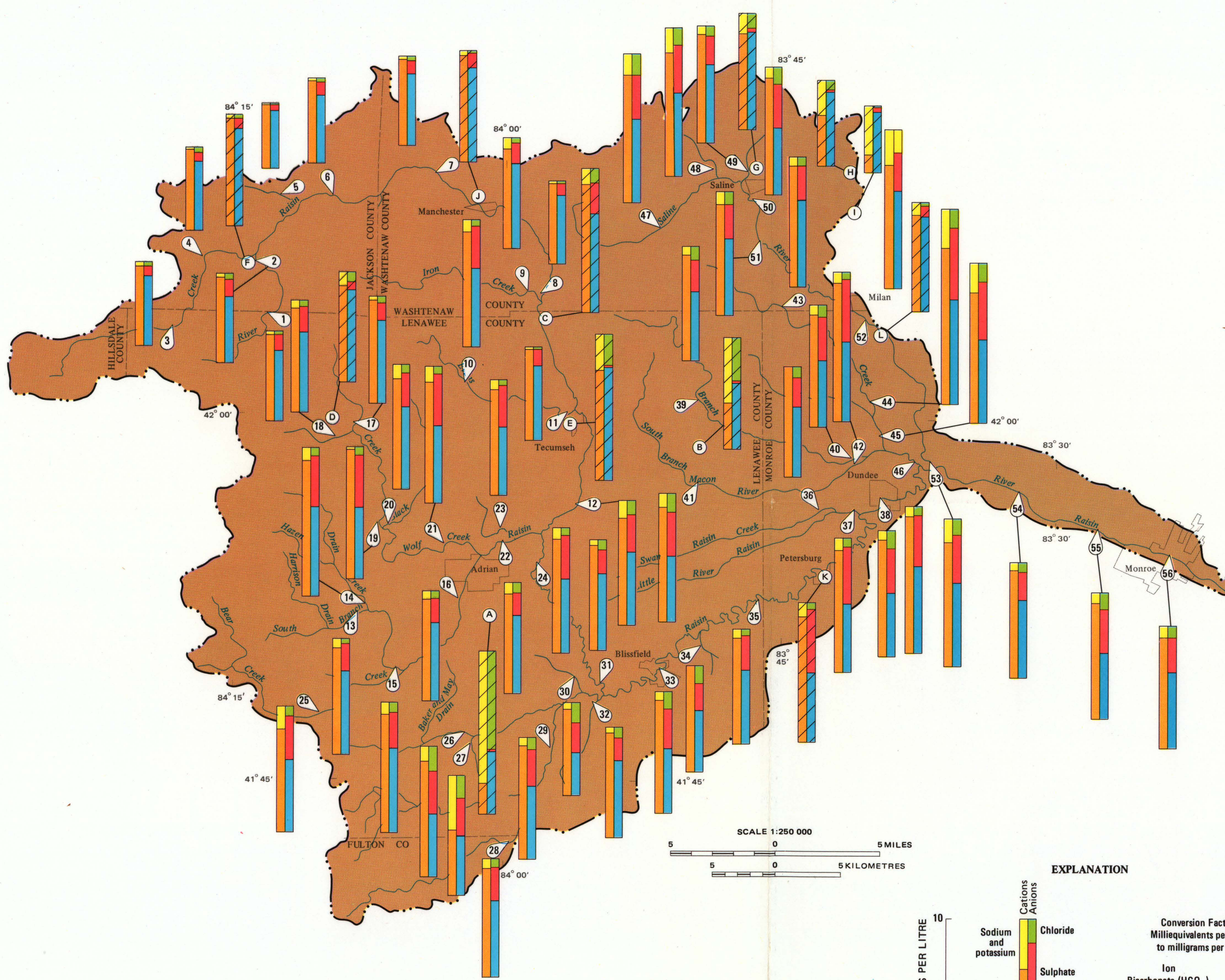


QUALITY OF WATER



GEOLOGY AND GROUND WATER

The glacial deposits in the River Raisin basin are shown on map A, Glacial Geology. The deposits are classified according to the type of materials of which they are composed and the way they were deposited. Labeled deposits consist principally of clay and sand which were deposited in former glacial lakes. Till plains and moraines consist of various combinations of clay, silt, sand, and gravel. These materials were deposited directly by glacial ice and its melt waters.

The thickness of the glacial deposits is important in determining the potential of the deposits for development of a ground-water supply. Thicker deposits store larger quantities of water and the probability of encountering water-bearing materials is greater than from thin glacial deposits. Drift thickness as shown on map A, Glacial Geology, ranges from about 50 to 300 feet. The drift is thickest in the northeastern and southwestern parts of the basin, and thinnest in the eastern part.

Bedrock geology in the River Raisin basin (map B, Bedrock Geology) are of sedimentary rock consisting of shales, sandstones, and limestones. The formations range in age from Late Silurian (Base Islands Group) to Middle Mississippian (Marshall Formation). The layers of bedrock dip northwest and are a part of the southeastern rim of the Michigan structural basin.

Altitudes on the bedrock surface are shown by contours on the bedrock geology map. The highest altitudes, more than 1,000 feet above mean sea level, occur at the extreme western edge of the basin. The lowest altitudes, less than 550 feet above mean sea level, are in scattered depressions in the basin.

In the River Raisin basin water is stored in and moves through openings in the glacial deposits and the bedrock. In the glacial deposits, coarse sand and gravel generally are good sources of ground water. These materials occur principally in the western half of the basin. Silt, clay, fine sand, and till are generally poor sources of ground water. These deposits generally occur in the eastern half of the basin. Map C, Yield of Wells in Glacial Drift, illustrates the general availability of water from the glacial deposits. Glacial deposits along the River Raisin from Tecumseh to Adrian seem to be permeable and to have the best potential for large ground-water supplies. In this area, conditions also seem to be favorable for stream water to infiltrate the glacial deposits; thus a good supply of ground water is maintained at the expense of streamflow.

In the bedrock, sandstone and limestone generally are good sources of ground water, whereas shale is usually a poor source. Moderate yields of ground water from the bedrock can be obtained in the northwestern part of the basin, generally from the Marshall Formation. Elsewhere, bedrock (excluding shale) generally yields only enough water for domestic supplies. Map D, Yield of Wells in Bedrock, illustrates the general availability of water from the bedrock.

Changes in ground water in an aquifer can be determined by water levels in wells. Water levels in wells fluctuate due to changes in precipitation, evapotranspiration, and pumping. Typical fluctuations of water level are shown below by hydrographs of two wells at the State Hospital at Ypsilanti. Seasonal water levels in these wells generally reflect precipitation trends. Thus, water levels are highest in the spring and lowest in winter. Short-term fluctuations due to pumping are shown by sharp rises and falls in water level. For the period of record shown, the maximum annual fluctuation in water level for well 045 06E 09BB was 37 feet; the maximum fluctuation in level for well 045 06E 10BBCC was 16 feet. Under nonpumping conditions, these fluctuations would be about 3 and 5 feet, respectively.

To define streamflow conditions during periods of high and low base-flow, two sets of discharge measurements were made during periods when surface runoff due to antecedent precipitation was minimal. Results of the measurements are shown in the table to the right. The measurements indicate that streams draining the moraines and outwash areas in the western half of the basin discharge greater quantities of water per square mile than streams in the lake-bed area in the eastern half. Discharge, in cubic feet per second per square mile, can be used for estimating and comparing ground-water potential in the basin. High values are generally in areas that are more favorable for ground-water development. The May measurement on Wolf Creek, station number 1758.75, was

affected by regulation at an upstream dam. Also, the August measurement on Bear Creek, station number 1760.80, was probably affected by a localized rainstorm or other unknown cause. Some regulation may have affected other measurements also.

The chemical characteristics of surface water at base flow and ground water at selected locations are illustrated by means of bar diagrams on the Quality of Water Map. In general, surface water in the northwestern part of the basin has lower concentrations of dissolved constituents than does water in other areas. In the eastern part of the basin, the slightly higher concentrations of sulfate and chloride may reflect man's influence. The chemical characteristics of ground water and surface water are similar at most locations. Analyses of water from streams were collected and analyzed by the U.S. Geological Survey; ground-water samples were collected at various times and analyses were made by the Michigan Department of Health.

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Chemical analysis of water from wells in the glacial drift

Index letter	Location	Depth of well (feet)	Date of collection	Bicarbonate (HCO ₃) (mg/l)	Calcium (Ca) (mg/l)	Sulfate (SO ₄) (mg/l)	Chloride (Cl) (mg/l)	Total dissolved solids (TDS) (mg/l)	pH	Specific conductance (micro-mhos/cm)
A	NW 1/4, Sec. 13, T. 7 S., R. 3 E.	160	7-15-59	232	0	1	216	0.13	7.0	1,090
B	SW 1/4, Sec. 4, T. 7 S., R. 3 E.	60	10-18-60	245	0	0	98	0.144	7.0	737
C	NE 1/4, Sec. 5, T. 7 S., R. 3 E.	34	10-5-56	368	0	85	28	0.405	6.9	1,100
D	SW 1/4, Sec. 27, T. 7 S., R. 3 E.	154	3-3-58	346	0	15	14	0.285	6.9	737
E	NW 1/4, Sec. 31, T. 7 S., R. 3 E.	227	9-26-68	425	0	17	68	0.330	6.9	737
F	SW 1/4, Sec. 32, T. 7 S., R. 3 E.	131	11-21-61	365	0	30	6	0.280	6.9	737
G	SW 1/4, Sec. 34, T. 7 S., R. 3 E.	120	11-3-58	370	0	23	17	0.305	6.9	737
H	NW 1/4, Sec. 35, T. 7 S., R. 3 E.	217	2-20-63	270	0	0	26	0.132	5.7	463
I	NW 1/4, Sec. 36, T. 7 S., R. 3 E.	226	2-20-63	228	0	0	17	0.170	5.7	463
J	NW 1/4, Sec. 37, T. 7 S., R. 3 E.	87	3-1-58	330	0	15	7	0.270	5.7	463
K	SW 1/4, Sec. 3, T. 7 S., R. 3 E.	80	3-1-61	250	0	180	13	0.385	7.0	737
L	NW 1/4, Sec. 2, T. 7 S., R. 3 E.	84	10-22-56	358	0	33	10	0.295	6.9	737

RESULTS OF BASE-FLOW INVESTIGATIONS																				
Index No. on map	Station No. on map	Station name	Location			Discharge		Chemical constituents, in milligrams per liter							Specific conductance (microhm/cm)	pH (units)	Temperature (°C)	Color (platinum-cobalt unit)		
			Sec.	Twp.	Range	Drainage area (sq mi)	Date (1970)	(cfs)	(cfs/m)	Bicarbonate (CO ₃)	Carbonate (CO ₃)	Sulfate (SO ₄)	Chloride (Cl)	Nitrate (NO ₃)					Hardness as CaCO ₃	
1	175570	River Raisin near Brooklyn	31	SE	45	2E	16.5	5-11 11.7	0.709	256	2	46	7.5	0.0	260	50	8.4	20.0	50	
2	175575	River Raisin near Brooklyn	19	NW	45	2E	32.3	8-10 18.9	585	235	4	52	11	0	260	60	8.7	20.0	40	
3	175580	Goose Creek at Cemetery City	4	SW	55	1E	24.9	5-12 14.8	594	259	0	29	8.0	0	240	30	8.3	24.5	10	
4	175585	Goose Creek at Brooklyn	24	NE	45	1E	39.1	8-10 8.88	357	257	0	17	9.5	0	220	30	8.4	24.5	35	
5	175590	Stony Creek near Napoleon	3	NW	45	2E	13.6	5-11 26.7	682	257	0	26	11	1.1	240	40	8.1	21.0	25	
6	175595	River Raisin near Napoleon	3	NE	45	2E	13.6	8-10 2.07	167	261	3	34	14	2.8	270	50	8.2	20.5	30	
7	175560	River Raisin at Norvell	33	SE	35	3E	132	8-10 2.53	194	240	0	13	6.0	8	220	20	8.2	24.0	60	
8	175565	River Raisin near Manchester	29	SE	45	4E	167	5-11 46.8	355	259	0	35	10	1	250	40	8.4	25.0	70	
9	175560	River Raisin near Clinton	39	SE	45	4E	167	5-12 90.6	542	266	0	35	10	1	250	40	8.4	25.0	20	
10	175650	Iron Creek near Clinton	29	SW	45	4E	28.8	5-12 20.1	698	233	0	32	7.0	0	240	40	8.7	16.0	25	
11	175665	Evans Creek near Clinton	22	NE	55	1E	10.0	5-12 2.71	181	295	10	57	11	8	300	40	8.7	15.0	40	
12	175660	Evans Creek near Clinton	22	SW	55	4E	34.2	5-11 5.72	167	282	2	120	16	10	350	110	8.3	8.4	170	30
13	175700	River Raisin near Tecumseh	21	NE	65	4E	267	5-11 97.9	649	277	0	49	4.0	13	280	50	8.1	18.5	30	
14	175750	Stony Creek near Clinton	31	NE	75	2E	23.9	5-11 6.28	181	272	0	110	31	1.6	330	100	8.0	16.5	110	
15	175800	Hazen River near Clinton	13	NW	75	2E	23.7	5-11 29.0	456	329	0	10	12	0	320	70	8.2	16.0	24	
16	175830	Stony Creek near Clinton	31	NE	75	2E	12.9	5-11 58.1	440	329	0	10	12	0	320	50	8.2	...	50	
17	175830	Stony Creek near Clinton	31	NE	75	2E	12.9	5-11 29.0	456	329	0	10	12	0	320	70	8.2	...	30	
18	175830	Stony Creek near Clinton	31	NE	75	2E	12.9	5-11 29.0	456	329	0	10	12	0	320	70	8.2	...	30	
19	175875	Square Creek near Ordway	35	NE	55	2E	18.7	8-10 25.2	290	316	0	67	24	1.6	340	80	8.2	8.2	210	
20	175900	Square Creek near Ordway	2	NW	65	2E	11.0	8-10 6.24	334	398	0	50	16	1.2	310	60	8.1	22.5	30	
21	175920	River Raisin near Rome Center	19	SW	65	4E	41.4	8-11 1.60	145	338	0	18	4.0	0	300	30	8.0	22.5	80	
22	175940	River Raisin near Rome Center	19	SW	65	4E	41.4	8-11 1.77	158	338	0	21	7.1	1.6	310	60	8.0	22.5	170	
23	175950	River Raisin near Rome Center	19	SW	65	4E	41.4	8-11 2.61	232	309	0	18	1.6	1.3	310	60	8.0	22.5	105	
24	175950	River Raisin near Rome Center	19	SW	65	4E	41.4	8-11 3.93	235	337	4	150	18	0	330	90	8.3	16.5	110	
25	175950	River Raisin near Rome Center	27	SW	65	4E	69.7	8-11 1.98	278	353	50	10	1.5	0	300	90	8.2	16.0	50	
26	175960	River Raisin near Rome Center	27	SW	65	4E	69.7	8-11 2.84	356	301	0	100	18	6	330	90	8.2	8.1	160	
27	175960	River Raisin near Rome Center	27	SW	65	4E	69.7	8-11 1.84	267	301	0	15	1.5	0	325	100	8.2	16.5	45	
28	175960	River Raisin near Rome Center	25	SE	65	4E	165	5-12 5.84	354	393	0	110	34	12	340	80	7.9	15.5	50	
29	175980	Beaver Creek near Ordway	25	NE	65	4E	147	5-11 4.14	282	285	1	150	16	3	360	130	8.3	16.5	10	
30	175980	Beaver Creek near Ordway	25	NE	65	4E	147	5-11 8.07	399	285	0	150	16	3	360	130	8.3	16.5	10	
31	176000	River Raisin near Ordway	5	NW	75	4E	463	5-12 208	449	290	0	65	22	3	300	60	8.1	17.0	30	
32	176020	Beaver Creek near Ordway	4	SE	85	2E	17.1	5-11 144	334	295	0	120	12	6	290	60	8.0	22.0	25	
33	176040	Black Creek at Seneca	10	SE	85	4E	42.8	8-10 6.23	365	256	0	83	11	0	300	80	8.0	23.5	90	
34	176060	Black Creek at Seneca	10	SE	85	4E	42.8	8-10 3.00	220	256	0	120	17	0	320	60	8.0	23.5	90	
35	176060	Near Ordway near Jasper	14	SW	85	2E	5.0	5-11 1.33	267	267	0	120	17	0	320	60	8.0	23.5	90	
36	176080	Near Ordway near Jasper	12	NE	95	2E	22.3	5-10 8.00	906	276	1	220	22	...	...	160	555	8.4	24.0
37	176080	Near Ordway near Jasper	12	NE	95	2E	22.3	5-10 8.00	906	276	1	220	22	...	...	160	555	8.4	24.0
38	176100	Near Ordway near Jasper	17	SE	85	4E	35.1	8-10 10.3	417	212	0	83	26	8.0	360	80	8.0	23.5	40	
39	176110	Near Ordway near Jasper	34	SW	75	4E	10.7	8-10 1.77	500	256	2	100	57	0	330	130	8.3	22.0	40	
40	176110	Near Ordway near Jasper	34	SW	75	4E	10.7	8-10 1.77	500	256	2	100	57	0	330	130	8.3	22.0	40	
41	176120	Near Ordway near Jasper	2	NW	85	4E	141	5-12 21.9	229	271	0	110	22	5.3	340	120	8.0	17.0	30	
42	176130	Near Ordway near Jasper	3	SE	85	4E	10.6	8-10 26.3	458	256	0	83	1.6	0	310	90	8.2	23.0	60	
43	176140	Hazen River near Ordway	3	SE	85	4E	10.6	8-10 8.08	292	159	0	87	34	1.6	260	30	8.5	8.2	305	
44	176140	Hazen River near Ordway	30	SE	75	5E	643	5-12 ...	...	283	0	68	20	4.5	320	90	8.0	7.9	180
45	176150	River Raisin near Ordway	28	NE	75	5E	9.69	5-12 6.78	411	240	1	26	7.5	0	240	30	8.3	24.5	10	
46	176160	River Raisin near Ordway	28	NE	75	5E	9.69	5-12 6.78	411	240	1	26	7.5	0	240	30	8.3	24.5	10	
47	176160	River Raisin near Ordway	12	NE	75	5E	686	5-12 285	245	285	0	69	21	2.2	320	80	8.1	7.9	190	
48	176170	Swampy Raisin near Dunade	21	SE	65	3E	31.6	5-10 3.47	120	276	0	38	22	3.0	350	150	8.0	8.0	23.0	
49	176180	Little River near Dunade	23	SW	65	4E	42.9	5-10 7.34	...	294	4	83	41	0	270	110	8.0	8.5	25.0	
50	176200	Saline R. at Dunade	22	SW	65	4E	41.9	8-11 1.22	029	183	3	58	48	1	420	150	8.1	8.4	150	
51	176200	Saline R. at Dunade	22	SW	65	4E	41.9	8-11 31.6	151	258	0	120	14	0	370	60	8.2	16.0	20	
52	176220	M. B. near Macon R. near Dunade	28	NE	55	5E	19.8	8-11 21.0	276	271	0	50	25	2.6	290	70	...	8.2	...	
53	176230	M. B. near Macon R. near Dunade	28	NE	55	5E	19.8	8-10 1.11	056	260	0	37	87	22	1	380	70	8.0	8.3	27.0
54	176230	M. B. near Macon R. near Dunade	28	NE	55	5E	19.8	8-10 1.11	056	260	0	37	87	22	1	380	70	8.0	8.3	27.0
55	176240	M. B. near Macon R. near Dunade	15	NW	65	4E	10.5	8-10 1.29	029	271	2	83	29	0	380	90	8.5	27.5	0	
56	176240	M. B. near Macon R. near Dunade	15	NW	65	4E	10.5	8-10 1.11	056	271	2	83	29	0	380	90	8.5	27.5	0	
57	176260	M. B. near Macon R. near Dunade	11	NW	65	4E	45.5	5-11 4.95	109	228	0	130	33	15	340	90	8.0	8.1	19.5	
58	176260	M. B. near Macon R. near Dunade	5	NW	55	5E	14.5	5-11 1.32	091	260	0	87	20	2.2	300	90	8.0	8.1	20.5	
59	176310	N. Macon C. near Anawaka	35	NE	55	5E	23.0	5-11 2.26	098	256	0	91	28	3	320	110	8.2	8.0	18.5	
60	176320	N. Macon C. near Anawaka	36	SE	55	5E	45.1	5-11 ...	...	256	0	120	21	6.9	440	170	8.7	8.1	19.0
61	176330	Macon River near Anawaka	8	NW	65	3E	144	5-11 1.13	092	245	0	190	39	4.2	350	150	8.0	8.2	19.0	
62	176330	Macon River near Anawaka	17	NW	45	3E	144	5-11 1.48	260	294	0	180	14	1.2	420	180	8.2	8.2	17.0	
63	176330	Macon River near Anawaka	17	NW	45	3E	144	5-11 2.54	192	319	0	120	14	6	370	120	8.0	8.0	19.0	
64	176370	Saline R. Trib. near Saline R.	34	SE	35	3E	13.2	8-10 9.00	068	302	6	120	14	1.6	350	150	8.7	8.5	22.0	
65	176370	Saline R. Trib. near Saline R.	36	NW	35	3E	13.2	8-10 2.48	196	393	0	100	54	5	390	150	8.0	20.0	20	
66	176390	No. 2 at Saline R. near Saline R.	1	SE	45	4E	77.6	8-10 9.62	120	300	0	170	31	1.9	400	150	8.0	8.4	23.0	
67	176400	Saline River near Saline R.	13	SE	45	4E	26.6	8-10 1.96	270	299	0	100	30	3.0	380	170	8.5	8.2	22.0	
68	176420	Saline River near Saline R.	1	SW	55	4E	113	8-10 1.67	148	355	0	110	49	3.8	370	80	8.0	8.1	25.0	
69	176430	Saline River near Saline R.	5	NE	65	3E	127	8-11 18.9	149	323	3	73	40	2.0	380	120	8.0	8.0	18.0	
70	176500	Willow Run near Monroe	350	SE	65	3E	1042	5-12 3.70	355	268	4	81	22	3.7	330	100	8.4	8.4	18.0	
71	176515	Willow Run near Monroe	Land Grant	SE	65	3E	1011	5-12 1.27	126	248	0	120	32	11	350	150	8.0	8.1	17.5	
72	176540	River Raisin at Land Grant	SE	65	3E	1062	5-12 3.08	290	285	1	100	24	3.2	340	190	8.3	18.0	30		