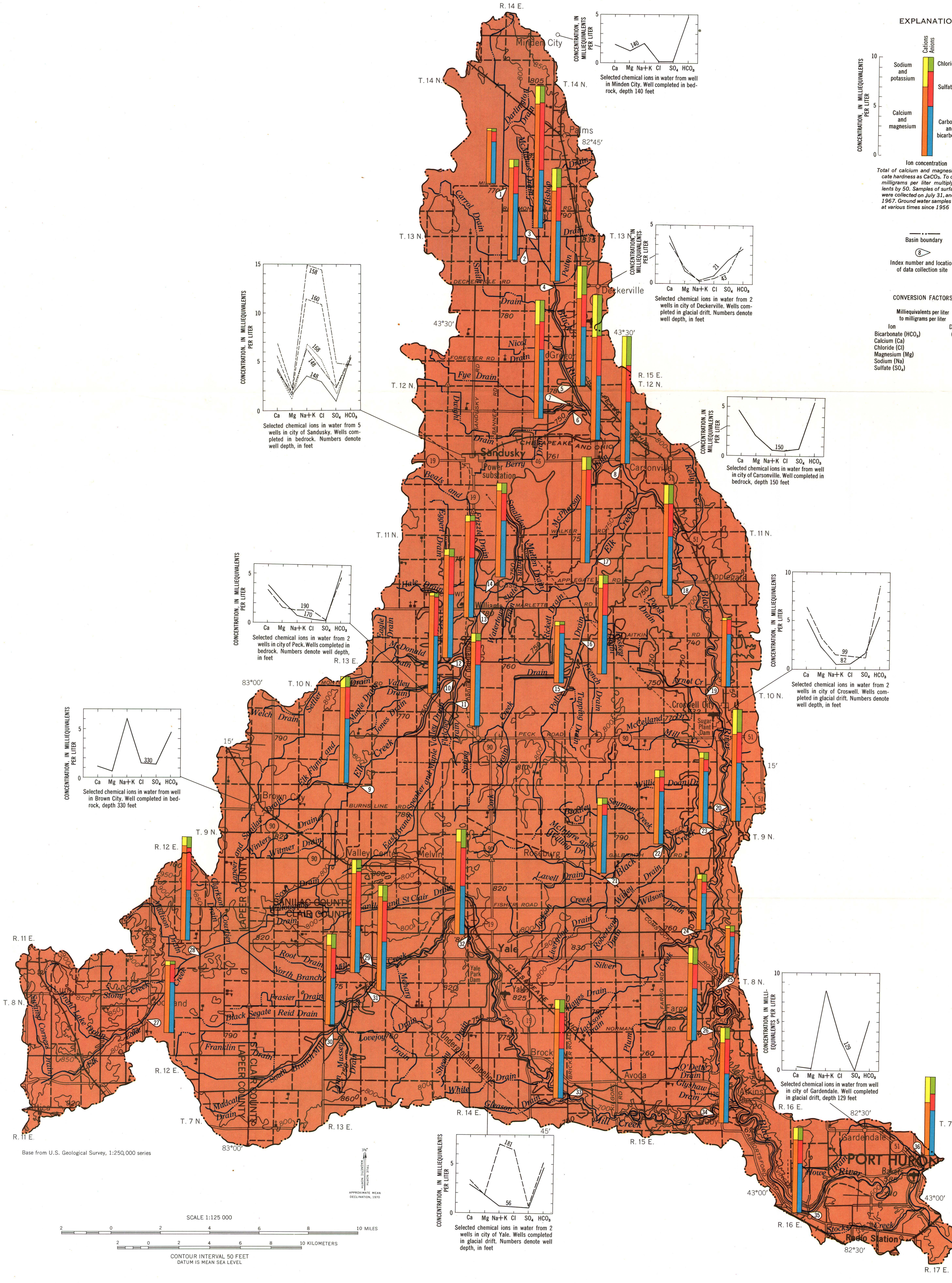
QUALITY OF WATER



EXPLANATION

Cations: Sodium and potassium; Calcium and magnesium

Anions: Chloride; Sulfate; Carbonate and bicarbonate

Ion concentration

Total of calcium and magnesium indicate hardness as $CaCO_3$. To convert to milligrams per liter multiply equivalents by 50. Samples of surface water were collected on July 31, and Aug. 1, 1967. Ground water samples collected at various times since 1956

Basin boundary

Index number and location of data collection site

CONVERSION FACTORS

Milliequivalents per liter to milligrams per liter

Ion	Divide by
Bicarbonate (HCO_3)	0.01639
Calcium (Ca)	.04990
Chloride (Cl)	.02821
Magnesium (Mg)	.08226
Sodium (Na)	.04350
Sulfate (SO_4)	.02082

WATERS OF THE BASIN ARE CHEMICALLY SUITABLE FOR MOST USES

Water from streams is of the calcium magnesium bicarbonate type and is very hard. The hardness is characteristic of most stream waters in lower Michigan. Stream water is generally high in sulfates and, locally, high in chlorides. Water from shallow wells in the glacial drift is of the calcium magnesium bicarbonate type. Water from deep wells in the glacial drift is of the calcium magnesium bicarbonate, sodium bicarbonate or sodium chloride types. Water from bedrock wells may be of the calcium magnesium bicarbonate, sodium bicarbonate, sodium chloride, or mixtures of these types. The analyses of the samples from the Sandusky wells illustrate the various types and mixtures of water obtained from the bedrock. The calcium magnesium bicarbonate and sodium chloride types represent the end points, and the other types are various combinations or stages in transition between these types.

Bar diagrams on the map show the chemical quality of the stream during the base-flow investigation of July 31, and Aug. 1, 1967. The investigation was made during a period of dry weather so the water in the stream is chiefly ground-water flow. Analyses of water samples collected during the base-flow investigation of May 15, and 16, 1967 showed water of similar chemical quality (see table "Results of Base-Flow Investigations"). In general, concentrations of dissolved solids in stream water are higher during periods of base flow than during periods of high flow when most of the water has reached the stream as overland flow. The bar diagrams, therefore, show the probable upper range of concentrations for the basin.

Ground water is generally softer than surface water and usually requires less treatment for domestic use. Concentrations of chlorides generally increase with depth of wells in the glacial drift, and, principally in the southern part of the basin, the deeper wells may yield water with chlorides in excess of that recommended for drinking water. There are not enough analyses to define the type or quality of water which might be expected from wells completed in the bedrock. The water ranges from soft to very hard. It is generally of good chemical quality; however, some highly mineralized or salty water may be expected.

Analyses of surface waters were made in the field by the U.S. Geological Survey from samples collected on July 31, and Aug. 1, 1967. Analyses of water from wells were made by the Michigan Department of Health.

RESULTS OF BASE FLOW INVESTIGATIONS

BASE FLOW INVESTIGATIONS PROVIDE A BASIS FOR DETERMINING THE OCCURRENCE, DISTRIBUTION, AND MAGNITUDE OF DRY-WEATHER STREAMFLOW

The measurements were made during a period when surface runoff due to antecedent precipitation was minimal, and the discharge is almost entirely ground-water flow. The two sets of measurements represent conditions during high and low base-flows and serve as an indication of the water-supply potential, with particular reference to sustained flow. Discharge results are shown in cubic feet per second (cfs) and cubic feet per second per square mile (cfsm) to facilitate comparisons of runoff in different parts of the basin. Comparison of the measurements show that North Branch Mill Creek has higher base-flows than most other parts of the basin reflecting the capacity of the surface deposits, largely outwash and sandy lake beds, to transmit water to streams. Sandy lake beds in the headwaters of Black River, particularly in the areas served by Berry and Fye Drains, also maintain relatively high base-flows. Streams draining the areas of clayey soils have the lowest base-flow yields.

Tabulated with the discharge are results of water-quality analyses obtained at each site. Specific conductance (a function of the total dissolved solids) in micromhos, pH, temperature, and selected ion concentrations are included.

Stream	Index No. on map	Location				Drainage area (sq mi)	Date (1967)	Discharge		Quality of water			Chemical constituents (milligrams per liter)			
		section	¼	township	range			(cfs)	(cfsm)	specific conductance	pH	temperature (°C)	Chloride	Sulfate	Carbonate and bicarbonate	Hardness as $CaCO_3$
Black River	1	3	SW	13N	14E	21.7	5–16 8–1	8.38 1.54	0.386 .071	470 470	7.6 7.7	14 24	12 10	84 50	183 264	244 272
Carrol Drain	2	23	SW	13N	14E	10.7	5–16 8–1	6.58 .98	.615 .092	640 820	7.7 8.1	11 20	15 27	140 134	254 418	342 474
Bishop Creek	3	14	SE	13N	14E	9.91	5–16 8–1	1.82 .55	.184 .055	940 1200	8.1 7.9	11 22	26 62	212 332	331 364	490 638
Black River	4	25	SW	13N	14E	56.4	5–16 8–1	23.7 4.46	.420 .079	740 950	7.9 7.8	13 20	30 67	148 168	251 376	368 462
Black River	5	18	SW	12N	15E	77.6	5–16 8–1	26.5 6.69	.341 .086	780 1025	8.1 7.9	14 19	37 105	164 160	258 371	378 451
Berry Drain	6	24	SE	12N	14E	17.2	5–16 8–1	3.88 3.21	.226 .187	1230 1350	8.6 7.8	17 18	130 150	96 197	323 406	486 530
Fye Drain	7	19	SW	12N	15E	10.1	— 8–1	— 1.60	— .158	— 1005	— 7.8	— 18	— 79	— 137	— 437	— 486
Black River	8	4	NW	11N	15E	126	5–16 8–1	37.8 14.9	.300 .118	920 1130	8.0 8.0	10 20	61 109	180 180	300 387	416 494
Elk Creek	9	11	NW	9N	13E	23.9	5–16 8–1	2.15 .22	.090 .009	1000 900	8.5 8.0	17 22	58 34	220 160	314 400	442 487
Elk Creek	10	16	SE	10N	14E	39.4	5–16 8–1	5.52 2.20	.140 .056	950 860	8.5 7.8	15 18	31 16	236 190	317 361	489 500
E. B. Speaker and Maple Valley Drain	11	21	SE	10N	14E	19.9	5–16 8–1	2.55 1.15	.128 .058	900 800	8.2 7.8	16 18	22 27	204 120	329 384	482 432
McDonald Drain	12	16	NW	10N	14E	23.2	5–16 8–1	3.99 1.31	.172 .056	940 945	8.0 7.7	14 18	29 28	228 190	313 398	506 530
Elk Creek	13	3	NE	10N	14E	95.2	5–16 8–1	15.3 5.28	.161 .055	910 870	8.2 7.8	12 18	30 22	208 182	314 375	474 494
Frizzle Drain	14	33	NE	11N	14E	16.9	5–16 8–1	2.39 1.40	.141 .083	900 850	7.9 7.8	10 17	38 39	168 133	324 353	450 442
Potts Drain	15	17	SW	10N	15E	13.5	5–16 8–1	2.07 .09	.153 .007	810 540	8.0 8.2	10 18	19 13	152 43	346 310	436 295
Potts Drain	16	8	NE	10N	15E	34	5–16 8–1	10.4 2.42	.306 .071	940 850	8.3 7.8	14 18	8 32	200 159	317 368	460 443
Elk Creek	17	29	NW	11N	15E	177	5–16 8–1	29.9 12.2	.169 .069	950 905	8.1 8.2	14 22	37 48	212 172	322 364	464 476
Black River	18	35	NE	11N	15E	333	5–16 8–1	82.0 36.0	.246 .108	900 960	8.1 8.1	13 22	44 70	180 160	290 368	418 465
Arnot Creek	19	19	NE	10N	16E	13.0	5–16 8–1	2.87 1.36	.221 .105	740 600	8.2 8.2	12 22	10 10	152 72	320 328	410 341
Black River	20	8	SE	9N	16E	376	5–16 8–1	95.2 44.9	.253 .119	850 1000	8.2 7.9	13 22	46 85	156 150	284 368	406 449
Black Creek	21	28	SE	9N	15E	9.60	5–16 8–1	2.01 1.02	.209 .106	790 680	8.0 8.0	9 17	18 25	128 54	337 361	414 349
Black Creek	22	24	NW	9N	15E	28.2	5–16 8–1	3.96 1.54	.140 .055	740 655	8.2 8.0	12 19	20 27	136 68	300 332	382 341
Black Creek	23	17	SW	9N	16E	50.4	5–16 8–1	— 3.37	— .067	670 620	8.1 8.2	13 21	21 26	100 59	273 327	336 333
Silver Creek	24	7	NW	8N	16E	26.8	5–16 8–1	1.59 .19	.059 .007	525 530	8.2 7.9	10 19	20 29	72 58	232 232	256 264
Plum Creek	25	19	NE	8N	16E	11.2	5–16 8–1	1.33 .41	.119 .037	490 450	8.2 8.0	9 17	23 24	68 23	197 228	232 231
Black River	26	32	NW	8N	16E	480	5–16 8–1	— 59.2	— .123	— 850	— 8.4	— 22	— 64	— 121	— 322	— 397
Elk Lake Creek	27	29	SE	8N	12E	23.2	5–16 8–1	11.0 3.64	.474 .157	650 645	8.2 8.1	13 17	14 14	100 89	288 317	342 347
N. B. Mill Creek	28	10	SE	8N	12E	46.4	5–16 8–1	18.1 6.30	.390 .136	790 950	8.1 7.8	14 18	22 41	160 210	281 317	416 488
N. B. Mill Creek	29	13	NW	8N	13E	70.5	5–16 7–31	26.2 8.21	.372 .116	850 950	8.2 8.3	13 29	26 44	208 270	278 296	458 512
S. B. Mill Creek	30	34	NW	8N	13E	24.6	5–16 7–31	4.89 1.13	.199 .046	940 800	7.8 7.5	16 22	50 54	240 147	226 292	466 408
S. B. Mill Creek	31	23	NE	8N	13E	48.1	5–16 8–1	11.8 1.51	.245 .031	1000 945	7.8 7.6	15 23	44 59	272 202	247 307	508 486
Mill Creek	32	10	NW	8N	14E	146	5–16 7–31	47.9 13.0	.328 .089	900 990	8.2 7.9	12 24	34 67	208 190	270 306	452 479
Mill Creek	33	8	NW	7N	15E	169	5–16 8–1	50.0 14.2	.296 .084	850 900	8.3 8.1	13 21	35 49	204 177	269 310	438 456
Mill Creek	34	17	NW	7N	16E	185	5–16 8–1	63.9 21.6	.345 .117	820 805	8.3 8.3	12 23	33 42	184 174	266 307	422 414
Black River	35	2	NW	6N	16E	684	5–16 8–1	216 90.2	.316 .132	810 760	8.4 8.4	12 24	41 48	152 115	278 306	372 373
Howe Drain	36	27	NW	7N	17E	9.50	5–15 8–1	3.04 .20	.320 .021	610 760	8.4 7.9	16 23	38 63	72 80	256 284	272 270

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By
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1970

Explanatory pamphlet accompanies map