

1970

WISCONSIN DEPARTMENT OF NATURAL RESOURCES

BASE-FLOW STUDY OF
DUCK CREEK BASIN
BROWN AND OUTAGAMIE
COUNTIES, WISCONSIN

by

Robert W. Devaul

U. S. Geological Survey

Prepared by
United States Geological Survey
in cooperation with the
Wisconsin Department of Natural Resources

Madison, Wisconsin

OR

Duck Creek

Copy #3



United States Department of the Interior

GEOLOGICAL SURVEY
Water Resources Division
1815 University Avenue
Madison, Wisconsin - 53706
June 22, 1970

Mr. John O'Donnell
Wisconsin Department of Natural Resources
P. O. Box 450
Madison, Wisconsin - 53701

Dear Mr. O'Donnell:

Attached is the information collected as a result of the base-flow study of the Duck Creek basin, Brown and Outagamie Counties, Wisconsin, in August 1969. It includes one adjacent small basin tributary to Lake Michigan. This study was conducted by the U.S. Geological Survey in cooperation with the Wisconsin Department of Natural Resources.

Figure 2 is a map showing the locations of all stream measuring sites. Table 1 contains the streamflow information collected during the periods indicated; table 2 lists dissolved oxygen measurements. The additional tables were compiled from information already available from the files of the U.S. Geological Survey.

The streamflow at four continuous-record gaging sites in and near the Green Bay area (figure 1) indicated the discharge in the area to be at about the 50 to 55 percent duration point (table 2) during the first set of August measurements and at about the 70 to 80 percent duration point during the second set of August measurements. That is, about 55 and 80 percent of the time respectively, the discharge of these streams would exceed that which occurred on these dates. A representative summer base flow is considered to be on the order of 80 percent duration.

Very truly yours,


C. L. R. Holt, Jr.
District Chief

CLH/paz

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Streams in the Duck Creek basin gain ground water throughout most of their reaches, however, ground-water pumping of the Green Bay - DePere area may reduce the water being gained by the streams from ground water. The August 11, 12 measurements were made during base-flow period when flow duration was about 50 to 55 percent (table 2). The August 27 measurements were made during a lower base-flow period when flow duration was about 70 to 80 percent. About 80 percent duration is more representative of low-flow conditions during the summer.

On August 11, 12, the sub-basins contributed ground water ranging from 0 to .108 cfs per sq mi. On August 11, 12, there was no measurable discharge at four sites and on August 28 there was no measurable discharge at six sites. Backwater at site 8 prevented a reliable measurement. The sub-basins contributing very small discharges are in the upper reaches of the stream near where the stream may become intermittent during dry periods. The high (.108 cfs per sq mi) discharge of Beaver Dam Creek (site 9) may be related to discharge from industries in western Green Bay.

Water temperatures during August 11, 12, and 28 ranged from 22.2°C (72°F) to 30.0°C (86°F). No temperature correlations were made because water temperatures were taken at different times during the day.

Specific conductance of water, measured in micromhos at 25°C, indicates the amount of dissolved minerals in the water. The specific conductance measured for the Duck Creek basin area ranged from 500 to 775 micromhos.

Dissolved oxygen measurements were made at least once at each site during the study. The values obtained indicated that at nearly every site the water was supersaturated. It would, however, be more useful to obtain a 24-hour dissolved oxygen profile at several points within the basin.

Table No. 1.--Low-flow and related water quality measurements in the Duck Creek basin, Brown and Outagamie Counties, Wisconsin.

| Stream | Site No. | Drainage area above site (sq mi) | August 11, 12, 1969 | | | | | | | August 27, 1969 | | | | | | |
|--------------------------------|----------|----------------------------------|---------------------|--------------------|--------------------|--------------------------|------------------|-------|----------|--------------------|--------------------|--------------------|--------------------------|------------------|-------|----------|
| | | | Discharge | | Mean vel. (ft/sec) | Spec. cond. (micro-mhos) | Temperature (°F) | | Time CDT | Discharge | | Mean vel. (ft/sec) | Spec. cond. (micro-mhos) | Temperature (°F) | | Time CDT |
| | | | cfs | cfs/m ² | | | Air | Water | | cfs | cfs/m ² | | | Air | Water | |
| Duck Creek | 1 | 32.0 | No measurable flow | | 640 | 79 | 77 | 1045 | | No measurable flow | | | | | | |
| Tributary | 2 | 7.81 | No measurable flow | | 775 | 76 | 72 | 1100 | | No measurable flow | | | | | | |
| Duck Creek | 3 | 47.3 | .10* | .002 | - | 615 | 77 | 73 | 1020 | | No measurable flow | | | | | |
| Tributary | 4 | 16.8 | No measurable flow | | 580 | 76 | 76 | 0955 | | No measurable flow | | | | | | |
| Duck Creek (sta. 04-0720.5) | 5 | 92.2 | .42 | .004 | .28 | 550 | 76 | 75 | 0935 | .113 | .001 | .48 | 580 | 72 | 69 | 1135 |
| Duck Creek | 6 | 105 | .94 | .009 | .50 | 580 | 84 | 84 | 1030 | No measurable flow | | | | | | |
| Trout Creek | 7 | 18.4 | .43 | .023 | .50 | 590 | 76 | 80 | 1700 | .24 | .013 | .34 | 560 | 86 | 75 | 1220 |
| Duck Creek | 8 | 128 | No measurable flow | | 700 | 83 | 74 | 0825 | | No measurable flow | | | | | | |
| Beaver Dam Creek | 9 | 6.55 | .71 | .108 | .12 | 580 | 87 | 73 | 1045 | .54 | .082 | .59 | 540 | 84 | 78 | 1425 |
| Tributary | 10 | 11.4 | .47 | .041 | .41 | 580 | 87 | 74 | 1130 | .13 | .011 | .45 | 500 | 84 | 78 | 1350 |
| Miscellaneous measurement | | | | | | | | | | October 3, 1968 | | | | | | |
| Duck Creek (sta. 04-0720.5) | 5 | 92.2 | 1.25 | .014 | 1.00 | 750 | - | 55 | 1800 | October 3, 1968 | | | | | | |

* - estimated

Table 2.--Discharge and flow duration of four long-term continuous record gaging stations and two long-term partial record sites in the Green Bay area on indicated dates. Includes 7-day Q_2 and 7-day Q_{10} values*.

| Stream | Drainage area (sq mi) | Date | Discharge | | Flow duration % of time flow equaled or exceeded | 7-day Q_2 (cfs) ^a | 7-day Q_{10} (cfs) ^b |
|--|-----------------------|---------|-------------------|-----------|--|--------------------------------|-----------------------------------|
| | | | cfs (ave. daily) | cfs/sq mi | | | |
| Wolf River at Keshena Falls | 812 | 8/11/69 | 584 | .72 | 57.0 | 380 | 300 |
| | | 8/12/69 | 597 | .74 | 54.9 | | |
| | | 8/13/69 | 595 | .73 | 55.2 | | |
| | | 8/26/69 | 472 | .58 | 78.3 | | |
| | | 8/27/69 | 472 | .58 | 78.3 | | |
| | | 8/24/69 | 473 | .58 | 78.1 | | |
| Embarrass River near Embarrass | 395 | 8/11/69 | 194 | .49 | 44.8 | 75 | 45 |
| | | 8/12/69 | 180 | .46 | 48.7 | | |
| | | 8/13/69 | 168 | .43 | 53.6 | | |
| | | 8/26/69 | 126 | .32 | 70.8 | | |
| | | 8/27/69 | 126 | .32 | 70.8 | | |
| | | 8/28/69 | 125 | .32 | 71.4 | | |
| Wolf River at new London | 2,240 | 8/11/69 | 1,180 | .53 | 51.8 | 655 | 450 |
| | | 8/12/69 | 1,140 | .51 | 54.3 | | |
| | | 8/13/69 | 1,140 | .51 | 54.3 | | |
| | | 8/26/69 | 824 | .37 | 78.0 | | |
| | | 8/27/69 | 824 | .37 | 78.0 | | |
| | | 8/28/69 | 824 | .37 | 78.0 | | |
| Oconto River near Gillette | 678 | 8/11/69 | 406 | .60 | 54.0 | 230 | 175 |
| | | 8/12/69 | 411 | .61 | 53.1 | | |
| | | 8/13/69 | 397 | .59 | 55.8 | | |
| | | 8/26/69 | 300 ^e | .44 | 78.2 | | |
| | | 8/27/69 | 290 ^e | .43 | 80.7 | | |
| | | 8/28/69 | 285 ^e | .42 | 82.4 | | |
| North Branch Embarrass River near Bowler | 37.1 | 8/11/69 | 25.3 ^m | .68 | - | 9.2 ^c | 5.6 ^c |
| | | 8/27/69 | 23.1 ^m | .62 | - | | |
| Apple Creek near Kaukauna | 14.6 | 8/12/69 | 0 ^m | 0 | - | 0 | 0 |
| | | 8/26/69 | 0 ^m | 0 | - | | |

* ^a 7-day Q_2 - The lowest mean discharge for 7 consecutive days that occurs on the average of once in 2 years or has a 50 percent chance of occurring in any year.

^b 7-day Q_{10} - The lowest mean discharge for 7 consecutive days that occurs on the average of once in 10 years or has a 10 percent chance of occurring in any year.

^c - Values obtained by correlation with nearby long-term gaging stations.

^m - Measured discharge. ^e - Estimated.

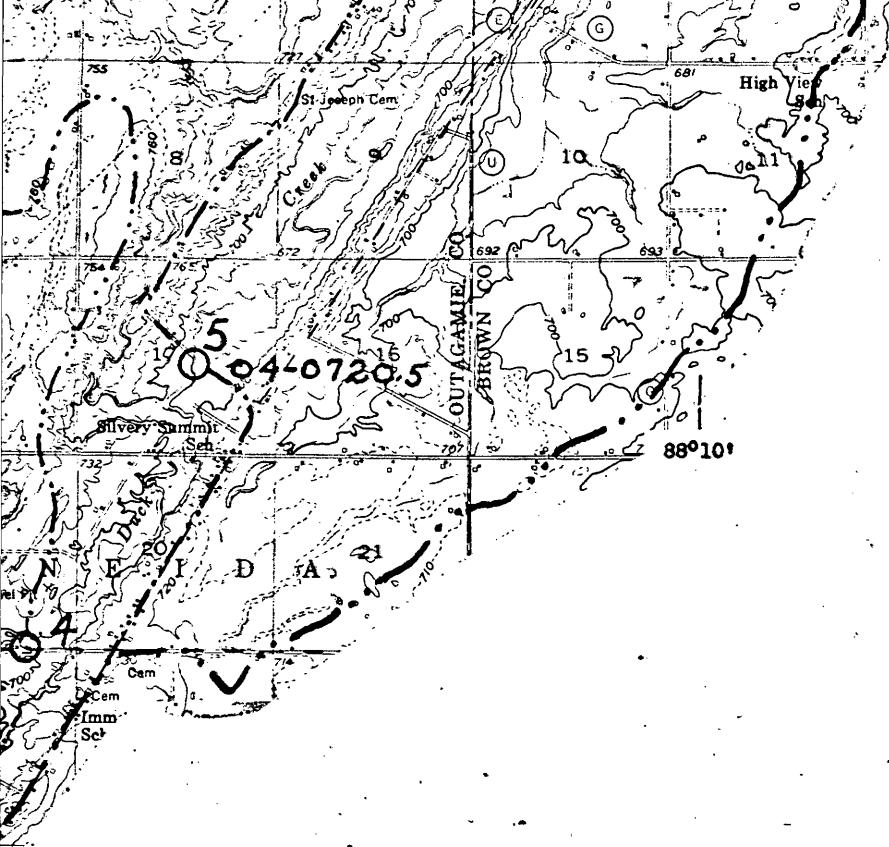
Table No. 3.--Dissolved oxygen measurements made during period of low-flow investigations in the Duck Creek basin, Wisconsin.

| Stream | Site No. | Date | Dissolved Oxygen | | | |
|------------------|----------|--------------------------------|------------------|--------------|--|-----------------|
| | | | Time CDT | Temp. °C | mg/l | Percent Sat. |
| Duck Creek | 3 | Aug. 15, 1969 | 1720 | 27.7 | 11.6 ^a | 153 |
| Duck Creek | 4 | Aug. 15, 1969 | 1700 | 25.2 | 10.2 ^a | 129 |
| Duck Creek | 5 | Aug. 15, 1969 | 1625 | 23.7 | 11.0 ^a | 134 |
| Duck Creek | 6 | Aug. 15, 1969 | 1540 | 27.6 | 12.5 ^a | 164 |
| Trout Creek | 7 | Aug. 15, 1969 | 1535 | 25.0 | 11.2 ^a | 140 |
| Duck Creek | 8* | Aug. 15, 1969 | 1425 | 27.5 | 9.8 ^a | 129 |
| Beaver Dam Creek | 9 | Aug. 15, 1969 Aug. 27, 1969 | 1450 1435 | 27.5 25.6 | 11.2 ^a 10.0 ^b | 147 127 |
| Tributary | 10 | Aug. 15, 1969 | 1550 | 25.3 | 6.6 ^a | 84 |

* - D. O. measurement taken about 2 miles upstream.

^a - D. O. determination by D. O. meter.

^b - D. O. determination by field kit.



EXPLANATION

o₁

Measuring site and site number
for this study

DA-5.2

Drainage area of sub-basin in square miles above measuring site

11
15

Discharge from basin in cfs per sq mi (cubic feet per second per square mile). Upper figure is August 11,12 measurement, lower figure is August 27 measurement.

Outline of Duck Creek drainage basin

Outline of sub-basins

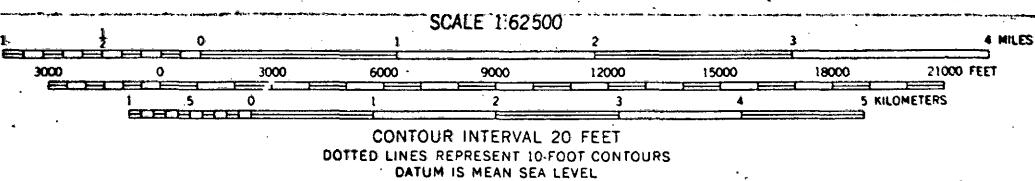
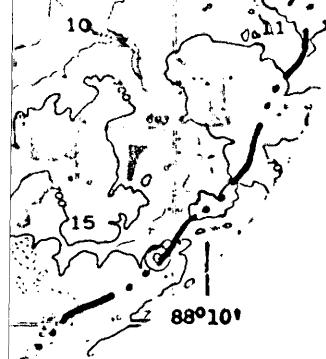


Figure 2.--Map of the Duck Creek basin, Brown and Outagamie Counties, Wisconsin, showing locations of stream gaging sites.



Measuring site and site number
for this study

DA-5.2

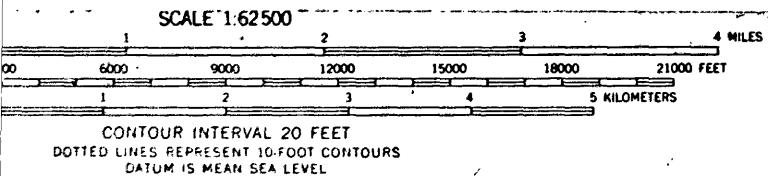
Drainage area of sub-basin in
square miles above measuring site

.11
.15

Discharge from basin in cfs per
sq mi (cubic feet per second
per square mile). Upper figure
is August 11,12 measurement,
lower figure is August 27
measurement

Outline of Duck Creek drainage
basin

Outline of sub-basins



Duck Creek basin, Brown and Outagamie Counties,
showing locations of stream gaging sites.

Red tint indicates areas in which only landmark buildings are shown



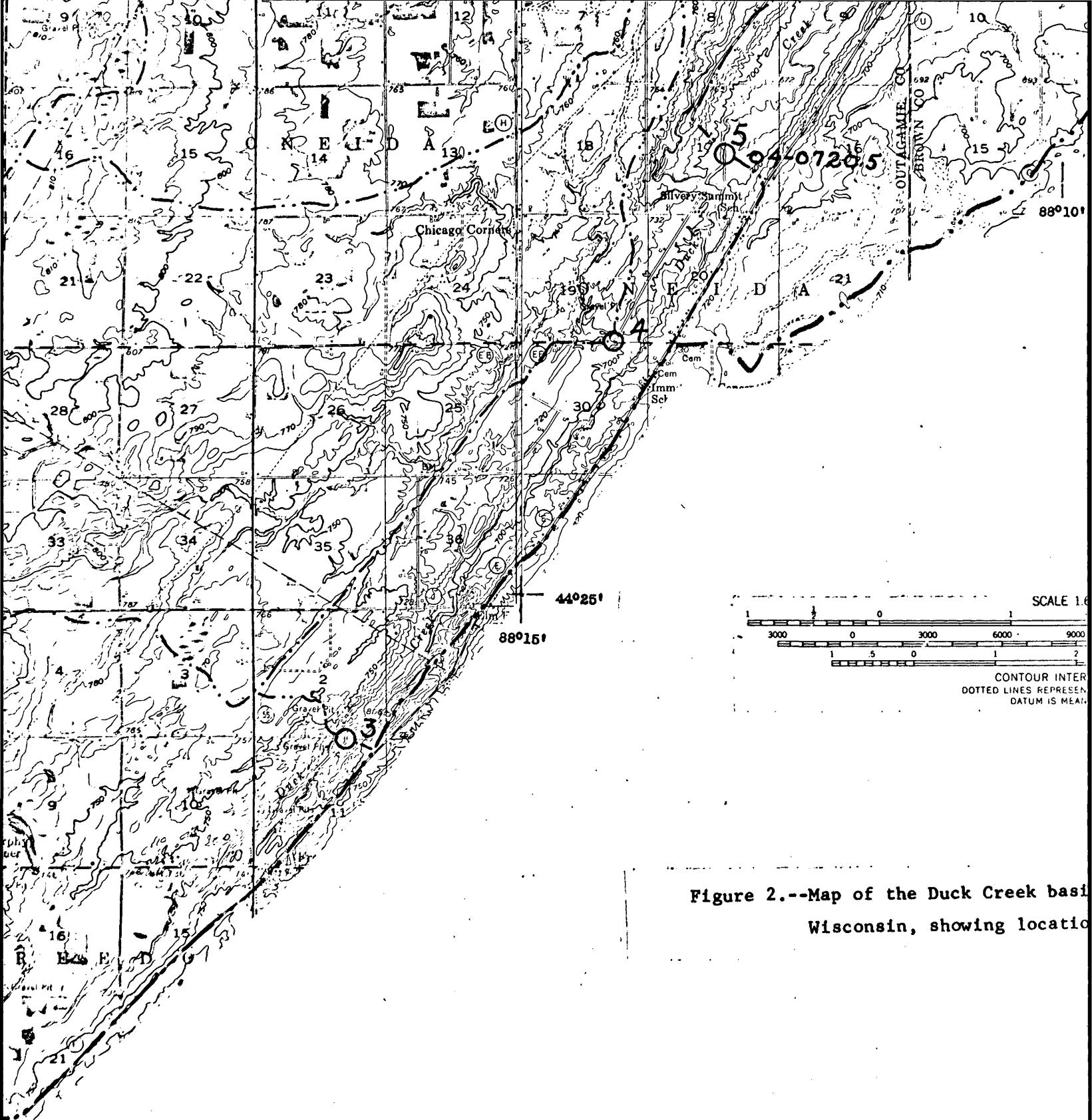


Figure 2.--Map of the Duck Creek basin, Wisconsin, showing location

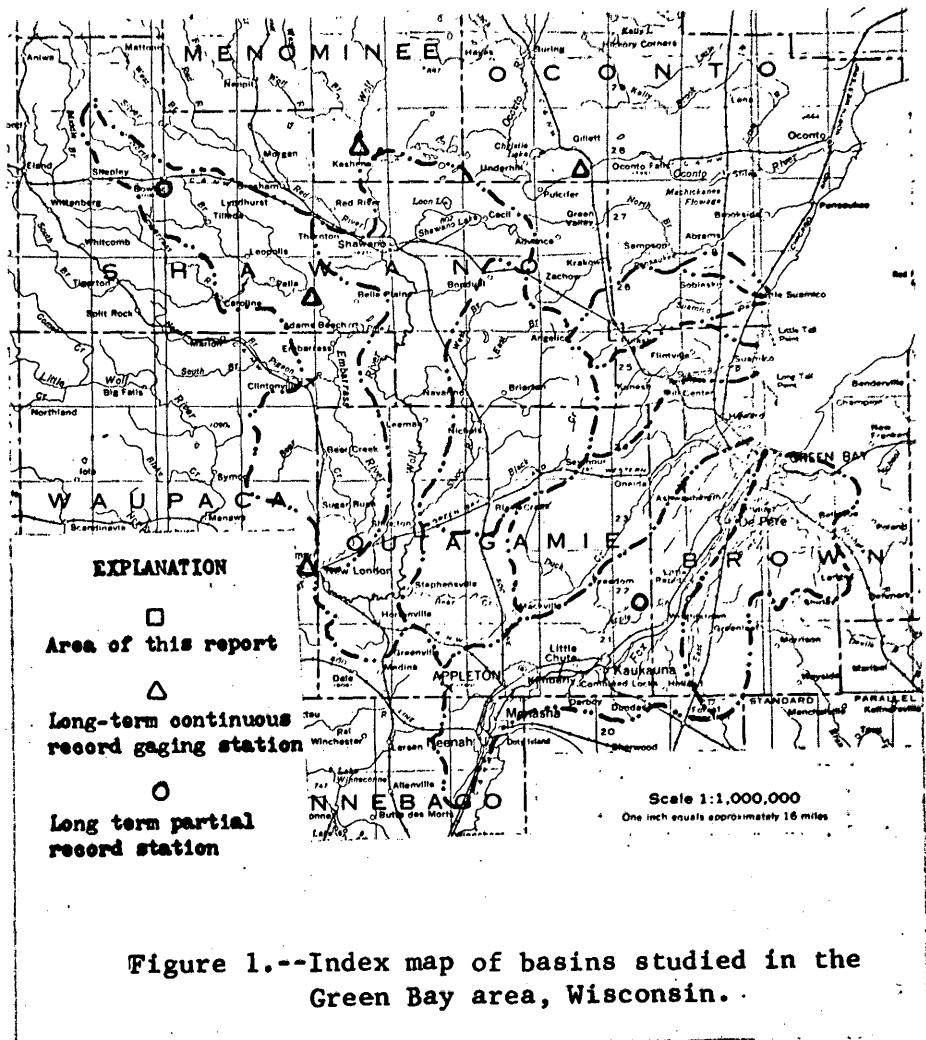


Figure 1.--Index map of basins studied in the Green Bay area, Wisconsin.

Topographic base maps

Mapped, edited, and published by the Geological Survey in cooperation with State of Wisconsin agencies

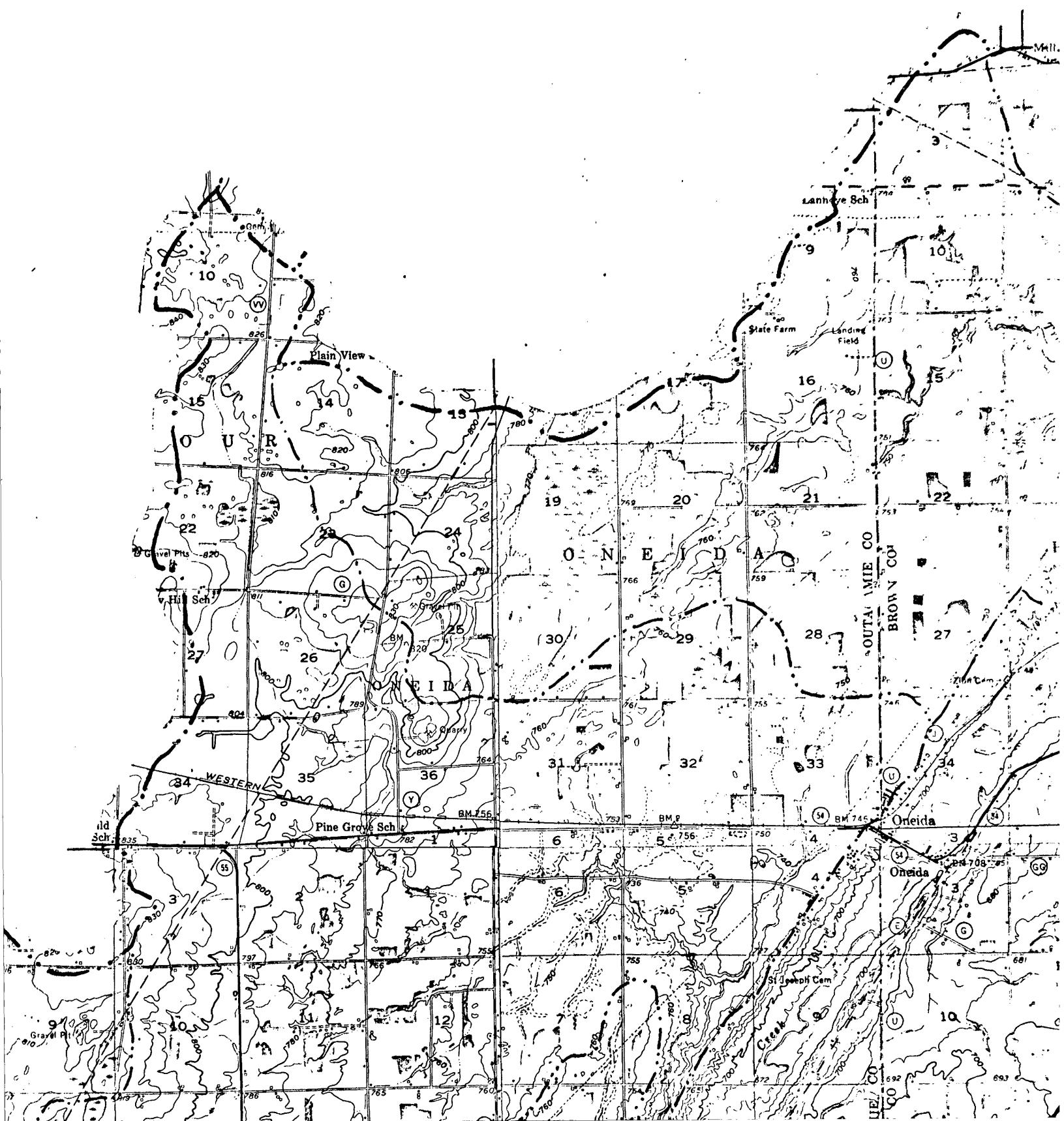
Control by USGS and USC&GS

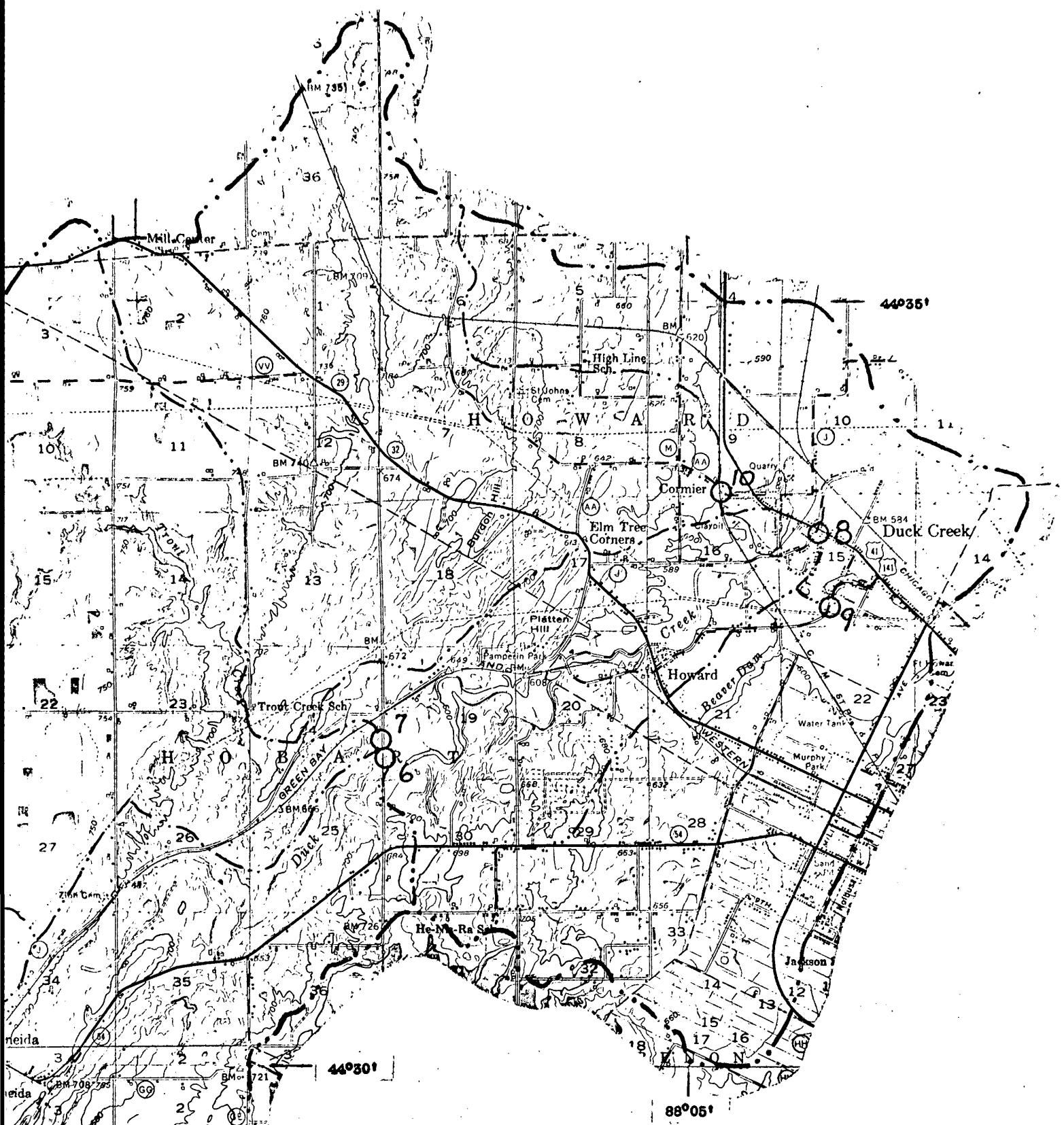
Polyconic projection, 1927 North American datum
10,000-foot grid based on Wisconsin coordinate system, south zone
1000-meter Universal Transverse Mercator grid ticks,
zone 16, shown in blue

Red tint indicates areas in which only landmark buildings are shown



In cooperation with the WISCONSIN DEPARTMENT OF NATURAL RESOURCES





EXPLANATION

1

Measuring site and site number
for this study



CONTOUR INTERVAL 20 FEET
DASHED LINES REPRESENT HALF-INTERVAL CONTOURS
DATUM IS MEAN SEA LEVEL