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PROFILE SURVEYS OF RIVERS IN WISCONSIN

PREPARED UNDER THE DIRECTION OF

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Prepared in cooperation with
THE STATE OF WISCONSIN



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PROFILE SURVEYS OF RIVERS IN WISCONSIN.

Prepared under the direction of W. H. HERRON, Acting Chief Geographer.

INTRODUCTION.

In order to determine the location of undeveloped water powers the United States Geological Survey, alone and in cooperation with State organizations, has from time to time made surveys and profiles of some of the rivers of the United States that are adapted to the development of power by low or medium heads, ranging from 20 to 100 feet.

The surveys are made by means of plane table and stadia. The elevations given are derived from primary or precise levels determined by the United States Geological Survey. The maps are made in the field and show not only the outlines of the river banks, the islands, the positions of rapids, falls, shoals, and existing dams, and the crossings of all ferries and roads, but the contours of banks to an elevation high enough to indicate the possibility of using the stream. The elevations of all bench marks left are shown on the maps.

Those parts of the manuscript that deal with the geology of the drainage basins have been reviewed by W. O. Hotchkiss, State geologist of Wisconsin, who also prepared the description of the general features of drainage. The material on power plants constructed since the original surveys were made, as well as that relating to storage, has been supplied by W. G. Hoyt.

GENERAL FEATURES OF DRAINAGE OF WISCONSIN.

By W. O. HOTCHKISS, State Geologist.

About one-third of the area of the State of Wisconsin is drained by streams that flow north into Lake Superior and southeast and east into Lake Michigan, 3,020 square miles being tributary to Lake Superior and 14,570 square miles to Lake Michigan; the remaining two-thirds, comprising 38,500 square miles, is drained to the Mississippi through St. Croix, Chippewa, Wisconsin, and Rock rivers and minor streams.

The northern part of the State is a comparatively flat highland. Along the shore of Lake Superior there is a rather steep descent from a general altitude between 1,300 and 1,800 feet above the sea to the level of the lake—602 feet. This descent takes place in

a distance ranging from 15 to 30 miles. This northern highland slopes much more gently to the southwest, south, and southeast, so that elevations of 1,000 feet are reached on St. Croix River in Burnett County, on Chippewa River in northern Chippewa County, on Wisconsin River at Kilbourn, on Peshtigo River at High Falls, and on Menominee River at Niagara. The slopes on the southwest and east of the high central and northern area are steeper than those on the south.

A short distance below the 1,000-foot contour most of the large streams enter the area of flat-lying sandstones and limestones, where the stream gradients are much gentler and the valleys are deeply filled with loose sand and gravel.

Nearly all the northern highland is covered with thick glacial drift. It is a gently rolling country, in which there are few prominent elevations and thousands of lakes and swamps—features that combine to furnish excellent natural storage and help to regulate run-off.

The divides between the major drainage basins on the upper reaches of the streams are low—at some places so low as to be indeterminate over large areas. In the lower reaches of the streams tributary to the Mississippi there is little or no glacial drift, and the bordering lands lie 200 to 600 feet and at some places even higher above the streams. As a result of these conditions the main streams are moderately sluggish and relatively constant in volume, though many of the smaller tributaries are “flashy” and have steep gradients.

The streams tributary to Lake Michigan are more variable in character, owing to the heavy glacial drift. The Upper Fox pursues a sluggish course to Lake Winnebago, from which it descends rather steeply to Green Bay. The streams north of the Fox are very sluggish in their lower courses and much swifter in their upper courses. The streams that flow directly into Lake Michigan south of Sturgeon Bay are all relatively small and their gradients are very irregular; at some places they fall over limestone ledges, and at others they wind irregularly, with slight fall, through the glacial drift.

The gaging stations that have been maintained on the streams of Wisconsin are listed on pages 14–16 and their positions are shown on the map (Pl. I).

RIVER SURVEYS.

PESHTIGO RIVER BASIN.

Peshtigo River rises in the western part of Forest County, northeastern Wisconsin, flows southeastward across the southwestern part of Marinette County, and empties into Green Bay, an arm of Lake Michigan, at the extreme southeast corner of Marinette County, about 7 miles south of Marinette. The drainage area measured above the mouth comprises about 1,160 square miles.

The basin is fairly regular in outline and measures about 80 miles in length and 14 miles in average width. The river itself is about 150 miles long. Among its larger tributaries are Rat, Thunder, and Little rivers, which enter on the west or right bank, and Eagle Nest and Noque Bay rivers, which enter on the east or left bank. In the upper two-thirds of its course the river flows through an area of ancient crystalline rocks; in the lower third it crosses successively beds of sandstone and limestone. The largest falls and rapids are in the crystalline area.

In this region, as in other parts of Wisconsin, practically all the original timber has been cut off and has been replaced by second growth and brush. A considerable area is being brought under cultivation. These changes in forest conditions have probably not appreciably altered the flow of the streams, but a marked effect on the run-off may be caused by the draining of the numerous swamps and lakes at the sources of the river.

The mean annual rainfall is about 32 inches. The winters are severe, the river being icebound for about three months of each year.

The opportunities for storage have not been investigated, but the numerous lakes and swamps in the basin must afford excellent sites for reservoirs.

The stream is still used to some extent for logging, but the run of logs is small. A good share of the timber is being used for making pulp.

The river rises in the highest land in northern Wisconsin. At North Grandon Railroad crossing, near its sources, the river is 1,620 feet above sea level, at the mouth its elevation is 580 feet, so that it falls 1,040 feet in about 140 miles, or about 7 feet to the mile. This high average gradient gives rise to more and larger rapids than occur in any other river in Wisconsin, and, together with the high and rocky banks, insures numerous water powers.

Plates II to V show the results of a survey made in 1906 from Peshtigo, near the mouth, to Strong Falls and Copper Rapids. Since these surveys were made a dam owned by the Wisconsin Public Service Co. and operated for generating electric power has been built on the river in secs. 1 and 2, T. 32 N., R. 18 E. The head on the dam is about 37 feet and on the wheels 85 feet.

CHIPPEWA RIVER BASIN.

The Chippewa River drainage system has its sources in more than a hundred lakes, large and small, and many connecting swamps, lying in northwestern Wisconsin near the Michigan boundary, only 20 miles from Lake Superior. The main line of drainage runs very nearly along the central line of the basin, but the name Chippewa River is not applied to the continuation of the main stream. The river divides 112 miles from the mouth. One branch, the prolonga-

tion of the line of drainage, called the Flambeau, rises in the lakes near the Michigan line at an elevation of a little over 1,600 feet above sea level; the other branch, the Chippewa, is formed in the central part of Sawyer County by the union of East and West branches, both of which rise in the southwestern part of Ashland County. The course of the river is general southwestward to its junction with the Mississippi at the foot of Lake Pepin. The Flambeau drains about 1,980 square miles; the Chippewa above its junction with the Flambeau drains only about 1,780 square miles.

The larger tributaries of the Chippewa from the west, beginning at the sources are West Branch and Red Cedar rivers; those from the east are East Branch, Thornapple, Flambeau, Jump, Yellow, and Eau Claire rivers.

The total length of the Chippewa is 267 miles. The total drainage area is about 9,540 square miles, of which more than 5,000 square miles include the least settled part of northern Wisconsin.

The drainage basin is regular in outline and measures about 180 miles by 60 miles. The part of it that lies above Chippewa Falls is covered with glacial drift, and the underlying crystalline rocks appear only in the river bed. In the southern part of the basin the rivers have eroded deeply into the drift, but in the northern part they have not cut much below the surface. The country is level or rolling.

With few exceptions all the many and important water powers on Chippewa River are in the region of crystalline rocks, but on account of the deep glacial drift the powers on the upper streams occur as boulder rapids.

The lakes in this drainage basin lie in two widely separated groups—one in its extreme northeastern part, at the headwaters of the Flambeau, the other in its northwestern part, at the headwaters of Chippewa and Red Cedar rivers. In the remainder of the basin there are very few lakes. The wooded regions, however, include large areas of swamps. The elevation at the sources of Chippewa River is about 1,500 feet above sea level; at Chippewa Falls it is 806 feet, and at the mouth of the river it is about 665 feet. At the sources of Flambeau River the elevation is about 1,650 feet; at Ladysmith it is 1,115 feet.

This drainage basin contains rich forests of both hard and soft woods. Though lumbering has been carried on actively for many years, considerable pine timber still remains, chiefly at the upper headwaters, but it is fast disappearing. The upper half of the basin may be considered forested.

The mean annual rainfall is about 30 inches. The winters are severe. The snowfall is heavy and lasts a long time, and ice forms on the streams to a thickness of about 2 feet and remains three to four months.

This drainage area affords an unusually large number of excellent sites for reservoirs. The United States Engineer Corps in 1880 located and surveyed 12 reservoir sites, whose total capacity was about 25 billion cubic feet. The highest dam necessary will measure about 26 feet. The operation of these reservoirs, it was estimated, would increase the ordinary low-water flow of the river by 3,245 second-feet for 90 days, thus about doubling the present available water power of the river. The main obstacle to building such reservoirs by the Government is the fact that, owing to the settling of this region, the land that would be flooded has become very valuable. Private enterprise has developed some of the smaller of these reservoirs.

The results of profile surveys on the Chippewa from its mouth to Flambeau, Wis., and of Flambeau River from its mouth to Turtle River, Wis., are shown in Plates VI-XVI.

The Chippewa and its tributaries afford several valuable developed water powers and numerous undeveloped power sites. The Dells dam, near Eau Claire, was constructed in 1877. The head, as determined by the Wisconsin Geological Survey,¹ was 21 feet. The head on the wheels at the present time (1916) is about 27 feet at ordinary stage. Apparently the dam is about 7 feet higher than when originally constructed.

The Wisconsin-Minnesota Light & Power Co. is building a dam in sec. 3, T. 28 N., R. 8 W., and sec. 34, T. 29 N., R. 8 W., which, when completed, will back water to the foot of Jim Falls, at the north line of lots 4 and 5, sec. 30, T. 30 N., R. 7 W. This dam, which is known as the Wissota dam, will have a head of about 57 feet.

In 1910 the river was dammed at Jim Falls, in secs. 19, 20, and 29, T. 30 N., R. 7 W. No gates were put in this dam, and neither the power house nor the canal has yet been built. The present head at the dam is 6 or 7 feet. When the plant is completed the head on the wheels will be about 55 feet.

A dam designed to furnish power for a paper mill was built in 1913 at Brunet Falls, in sec. 18, T. 31 N., R. 6 W. The head at ordinary water is about 38 feet.

Several of the exceptionally good power sites afforded by the Flambeau were developed prior to the surveys on which Plates XI-XVI are based. Two other dams have been constructed since the surveys were made—the Port Arthur dam, in lots 2 and 7, sec. 18, T. 34 N., R. 6 W., constructed in 1906, furnishing 17 feet head and supplying power used in manufacturing pulp; and the Thornapple dam, in lots 1 and 2, sec. 22, T. 34 N., R. 7 W., constructed in 1910. The head on the Thornapple dam is 11 feet at all times, and the power is used for making pulp.

¹ Smith, L. S., The water powers of Wisconsin: Wisconsin Geol. and Nat. Hist. Survey Bull. 20, Economic ser., No. 13, p. 97, 1908.

On account of the numerous lakes in the drainage basin of the Chippewa and the possibility of using them for storage, this river system is destined to become a great center of power, but the development of the power sites is retarded because the region is not thickly settled and railroad facilities are lacking in many parts of it.

The upper headwaters of the river and its tributaries are used for running logs, but in areas where there are railroads the logs are moved by rail, as the rivers can not compete with the railroads in log running.

BLACK RIVER BASIN.

The drainage basin of Black River lies west of the central part of the State of Wisconsin. The river rises in the northeastern part of Taylor County, flows in a generally southwesterly direction, and joins the Mississippi at La Crosse. The drainage basin is long and narrow and the tributaries are small. The largest are Poplar River and East Fork of Black River, both of which enter from the east. The total length of the river is about 145 miles; the total drainage area is about 2,300 square miles.

The basin is about 120 miles long and has an average width of 20 miles. All that part of the river that lies north of Black River Falls is in crystalline rocks. Through a part of this stretch the river has worn deeply into the rock, and the banks rise 40 to 60 feet above the river. In places the rock is covered with glacial drift. Below Black River Falls the river flows in a sandstone region; its valley is wide and the banks are usually low. The surface of the basin is level or rolling. The soil in the upper part of the basin is clay loam. This region was at one time covered with pine. In the lower part of the basin the soil is sandy.

The elevation at the source of the river is about 1,400 feet; at Neillsville, 990 feet; and at the mouth of the river, 628 feet.

The timber on this drainage basin has been nearly all cut and the river is no longer used for running logs. The country is well settled.

The mean annual rainfall is about 32 inches. The winters are severe. The snowfall is heavy, and ice forms to a thickness of 1 to 2 feet and lasts about three months.

Storage possibilities have not been investigated. There are but few lakes in the drainage basin, and some of these may make suitable reservoirs, but the basin is so well settled that the building of storage reservoirs would be prohibited by the cost of the land that would be flooded.

The conditions of stream flow are not favorable for the development of water power, but power sites at which there is considerable head, favorably located for the building of dams, are numerous, and some of them will probably be developed. Most of the sites are above Black River Falls.

The results of surveys made to determine the possibility of using Black River for developing power are presented in Plates XVII-XIX.

The dam of the Greenwood Municipal Light Co., built about 1905, in sec. 34, T. 27 N., R. 2 W., does not appear on the profile. At ordinary stages the head of the dam is about 11 feet.

A dam built at Neillsville in 1870 and still in existence is not shown on the profile. The dam is in secs. 10 and 11, T. 24 N., R. 2 W., maintains a head of approximately $7\frac{1}{2}$ feet, and the power is used by a gristmill.

The Dells dam, shown on the profile in sec. 18, T. 23 N., R. 2 W., was damaged in October, 1911, when about 400 feet of the core wall, extending from the west end of the main concrete dam into the west bank, was entirely carried away; this section has not yet been replaced.

The Hatfield dam, in sec. 3, T. 22 N., R. 3 W., was constructed in 1912, after failing in 1911. The head at the dam is about 38 feet and the total head at the plant about 92 feet. The plant is owned and operated by the Wisconsin Railway, Light & Power Co.

WISCONSIN RIVER BASIN.

The drainage basin of Wisconsin River, except a few square miles, is in Wisconsin. The river rises in Lac Vieux Desert, directly on the boundary between Michigan and Wisconsin, whence it flows southward about 300 miles to the city of Portage, near the center of Portage County. From this point it flows westward 118 miles to Prairie du Chien, Wis., about 40 miles from the southern boundary of the State, where it enters the Mississippi. The total length of the river is about 429 miles. The river receives from the west or right Tomahawk, Rib, Big Eau Pleine, Eau Pleine, Yellow, Lemonweir, Baraboo, Pine, and Kickapoo rivers; from the east Pelican, Prairie, Eau Claire, and Plover rivers.

The basin is about 225 miles long, about 50 miles in average width, and includes 11,800 square miles. The river flows for the most part in the eastern half of its basin; below Portage it flows within 10 miles of its southern edge. At Portage the divide between Wisconsin River and Fox River is so low that during high water some of the excess flows into the Fox.

Like all the large rivers of the State, the Wisconsin heads in the drift-covered region. The part of the Wisconsin basin above Nekoosa, including more than half the area drained, is underlain by crystalline rocks, which, by presenting a barrier to erosion, cause numerous rapids that afford excellent sites for water power. Below Nekoosa the crystalline rocks give way to the softer sandstone. This lower part of the valley is deeply filled with sand and gravel, which have made the bed of the river a succession of shifting sand bars almost to

its mouth. Where the sandstone is near the surface in the surrounding country the soil is very light and in places even sterile. North of Nekoosa this sandy belt rapidly narrows, and at Merrill, Wis., about 90 miles above, it almost disappears, being replaced by clayey loams and loamy clays. North of Tomahawk the clays are again replaced by sandy soils containing gravel and by boulders and glacial drift.

In general the country is level or undulating. At a few places the surface is broken by decided ridges, as, for example, the Baraboo ranges of quartzite and the bluffs along the lower river. The northern part of the basin is covered with innumerable lakes and swamps, which tend to make the flow of the stream uniform and steady.

According to the United States Engineer Corps, the elevation of Lac Vieux Desert, the source of the river, is about 1,650 feet, the elevation at the mouth is about 604 feet, so that the total fall is about 1,050 feet. About 634 feet of this fall occur in the 150 miles between Rhinelander and Nekoosa, an average of over 4 feet to the mile. This descent is concentrated at many places, producing a large number of valuable water powers.

The dense growth of pine which covered the upper part of the basin of Wisconsin River has nearly all been cut off, and a thick growth of brush and second-growth timber has taken its place; large areas have been brought under cultivation. In some places this second growth has been burned over, leaving almost impenetrable thickets of brush and dead timber.

The mean annual rainfall on the headwaters of the river is about 31 inches; at the lower part of the basin the rainfall is about 34 inches.

The winters, except in the very lowest part of the basin, are severe. The snowfall is rather heavy, and stays on the ground for long periods, and the streams are covered with ice 1 to 2 feet thick for three to four months. These conditions tend to make winter the period of minimum flow.

The basin affords numerous opportunities for storage. The United States Engineer Corps located and surveyed eight reservoir sites at the headwaters of Wisconsin River to aid navigation of the Mississippi River. The capacity of these reservoirs is about 20,000,000,000 cubic feet, and it was estimated that a flow of 3,000 cubic feet per second could be maintained for three months. Such a flow would nearly double the low-water flow of the river and its resulting water power. Several of these reservoirs have been constructed by private parties for water-power development. The Wisconsin Valley Improvement Co. has been authorized by law to construct, acquire, and maintain a system of reservoirs on the tributaries of Wisconsin River north of the south line of township 34, about 6 miles below Tomahawk, for the purpose of producing a uniform flow of water. The law provides that when this company shall have completed

reservoirs of a capacity of 2,000,000,000 cubic feet it may collect and receive reasonable tolls from the owner of every improved and operated water power on the river below such reservoirs.

The following tables show the reservoirs maintained by the Wisconsin Valley Improvement Co. in 1915, and the developed powers on Wisconsin and Tomahawk rivers above Nekoosa, Wis.

Reservoirs maintained by the Wisconsin Valley Improvement Co. in 1915.^a

Name.	Location of reservoir.	Location of dam.	Area of reservoir.	Drainage area.	Capacity (millions of cubic feet).	
					Summer.	Winter.
<i>Tomahawk River.</i>						
Rice Storage.....	Tps. 35-36 N., Rs. 5-7 E..	Secs. 4 and 9, T. 35 N., R. 6 E.	6.85	558.25	1,788	1,788
Squirrel.....	T. 39 N., R. 5 E.....	Sec. 30, T. 39 N., R. 5 E..	3.00	17.07	152	152
Minoqua.....	Tps. 38-40 N., Rs. 6-7 E..	Sec. 10, T. 39 N., R. 6 E..	11.31	81.60	291	651
<i>Wisconsin River.</i>						
South Pelican.....	T. 35 N., Rs. 10-11 E....	Sec. 11, T. 35 N., R. 10 E..	5.49	22.50	0	305
North Pelican.....	Tps. 36-38 N., Rs. 9-11 E..	Sec. 4, T. 36 N., R. 10 E..	2.33	93.00	83	205
Big St. Germain....	Tps. 40-41 N., Rs. 7-8 E..	Sec. 30, T. 40 N., R. 8 E..	2.51	68.76	243	243
Little St. Germain..	T. 40 N., Rs. 8-9 E.....	Sec. 35, T. 40 N., R. 8 E..	1.57	19.34	142	142
Sugar Camp.....	Tps. 38-39 N., Rs. 8-10 E..	Sec. 17, T. 39 N., R. 9 E..	3.34	59.00	380	380
Seven Mile.....	T. 39 N., Rs. 11-12 E....	Sec. 11, T. 39 N., R. 11 E..	.87	14.00	117	117
Upper Nine Mile....	T. 40 N., Rs. 11-12 E....	Sec. 36, T. 40 N., R. 11 E..	.24	3.00	14	14
Lower Nine Mile....	Tps. 39-40 N., R. 11 E....	Sec. 4, T. 39 N., R. 11 E..	1.14	28.00	93	93
Burnt Rollways....	Tps. 37-40 N., Rs. 11-12 E..	Sec. 5, T. 39 N., R. 11 E..	10.91	133.00	386	609
Long on Deerskin....	Tps. 41-42 N., R. 12 E....	Sec. 7, T. 41 N., R. 12 E..	3.96	28.80	316	384
Little Deerskin....	Tps. 40-41 N., Rs. 10-11 E..	Sec. 33, T. 41 N., R. 11 E..	.49	4.90	22	22
Buckatahpon.....	T. 41 N., R. 9 E.....	Sec. 24, T. 41 N., R. 9 E..	1.88	14.10	142	142
Twin.....	Tps. 41-42 N., R. 11 E....	Sec. 19, T. 41 N., R. 11 E..	5.41	25.70	330	380
Vieux Desert.....	T. 42 N., R. 11 E.....	Sec. 17, T. 42 N., R. 11 E..	7.47	27.50	600	600
			68.77	1,198.52	5,099	6,227

^a From information furnished by Wisconsin Valley Improvement Co.

Power plants on Wisconsin and Tomahawk rivers above Nekoosa, Wis.^a

Name of power.	Location.	Head developed.	Area of pond in acres.
<i>Wisconsin River.</i>			
Nekoosa—Edwards Paper Co.:		<i>Feet.</i>	
Nekoosa dam.....	T. 21 N., R. 5 E.....	19	150
Port Edwards dam....	T. 22 N., R. 5 E.....	18	50
Centralia Pulp & Water Power Co. dam.	T. 22 N., R. 5 E.....	13	150
Consolidated Water Power & Paper Co.:			
Grand Rapids dam....	T. 22 N., R. 6 E.....	28	320
Biron dam.....	T. 23 N., R. 6 E.....	16	160
Whiting—Plover Paper Co. dam.....	T. 23 N., R. 8 E.....	6.5	49
Wisconsin River Paper & Pulp Co. dam.	T. 23 N., R. 8 E.....	18	76
Jackson Milling Co. dam.....	T. 23 N., R. 8 E.....	8	
Wausau Sulphate Fibre Co. dam.....	Sec. 29, T. 27 N., R. 7 E..	17	674
Marathon Paper Mills Co. dam.....	Sec. 24, T. 28 N., R. 7 E..	20	1,774
Wausau Street Railway Co. dam.....	Sec. 35, T. 29 N., R. 7 E..	22	304
Wausau Paper Mills Co. dam.....	Sec. 3, T. 29 N., R. 7 E..	16	596
Merrill—Merrill Electric Light & Railway Co.	Sec. 13, T. 31 N., R. 6 E..	14	
Grandfather Falls—Grandfather Falls Co.	Sec. 30, T. 33 N., R. 6 E..	33	
Tomahawk—Tomahawk Pulp & Paper Co.	Sec. 10, T. 34 N., R. 6 E..	16	2,733
Kings—Tomahawk Power Co.....	Sec. 25, T. 35 N., R. 6 E..	23	1,810
Hat Rapids—Rhineland Paper Co.....	Sec. 27, T. 36 N., R. 8 E..	20	650
Rhineland—Rhineland Paper Co.....	Sec. 6, T. 36 N., R. 9 E..	32	3,576
Otter Rapids—Eagle River Electric Co.....	Sec. 36, T. 40 N., R. 9 E..	12	3,250
<i>Tomahawk River.</i>			
Tomahawk—Tomahawk Light, Telephone & Improvement Co.	Sec. 28, T. 35 N., R. 6 F.....	13.5	709

^a From information furnished by Wisconsin Valley Improvement Co.

The opportunities for water-power development in this basin are numerous. Some of the larger sites have been developed, but many valuable sites on the main river and on the tributaries are still unused.

The stream was used extensively for logging, but the greater part of the large timber has been cut off and lumbering is decreasing, although considerable pulp wood is being run in the upper reaches of the river. The dams at the water-power sites do not interfere seriously with the small run of logs.

Maps showing the results of surveys made in 1906 on Wisconsin River from Kilbourn to Tomahawk, Wis., form Plates XX-XXX, and the results of surveys on Eau Claire River from the mouth to Dells of the Eau Claire form Plates XXXI-XXXII.

No dams have been built on Eau Claire River since the profiles were made.

The Grandfather Falls dam in sec. 30, T. 33 N., R. 6 E., was built in 1907. The head is approximately 33 feet, and power is transmitted to Merrill, where it is used in the manufacture of paper.

The Rothschild dam on Wisconsin River, in the NE. $\frac{1}{4}$ sec. 36, T. 28 N., R. 7 W., was built by the Marathon Paper Mills Co. in 1909.

In 1909 the Southern Wisconsin Power Co. built the Kilbourn dam, in sec. 4, T. 13 N., R. 6 E. The head is approximately 17 feet and the power is transmitted to Portage and Milwaukee.

In 1915 the Wisconsin Power Co. built the Prairie du Sac dam, in sec. 25, T. 10 N., R. 6 E.; head, approximately 29 feet. The power generated is transmitted to Milwaukee, Madison, Prairie du Sac, Sauk City, and smaller towns.

GAGING STATIONS.

[NOTE.—Dash following a date indicates that station was being maintained by the U. S. Geological Survey in cooperation with the Railroad Commission of Wisconsin Sept. 30, 1915. Period after date indicates discontinuance.]

ST. LAWRENCE RIVER BASIN.

Streams tributary to Lake Superior:

- Aminicon River near Aminicon Falls, Wis., 1914—
- Brule River near Brule, Wis., 1914—
- Bad River near Odanah, Wis., 1914—

Streams tributary to Lake Michigan:

- Brule River (head of Menominee River) near Florence, Wis., 1914—
- Menominee River at Iron Mountain, Mich., 1902–1914.
- Menominee River at Lower Quinnesec Falls, Wis., 1898–99.
- Menominee River at Koss, Mich., 1902–1909.
- Menominee River at Rapids Power Plant below Koss, 1913—
- Pine River near Florence, Wis., 1914—
- Pike River at Amberg, Wis., 1914—
- Peshtigo River at High Falls, Wis., 1913—
- Peshtigo River near Crivitz, Wis., 1906–1909.
- Peshtigo River at Crivitz, Wis., 1906.
- Oconto River near Gillett, Wis., 1906–1909; 1914—
- Oconto River at Stiles, Wis., 1906.

Streams tributary to Lake Michigan—Continued.

- Fox River at Omro, Wis., 1902-3.
- Fox River at Oshkosh, Wis., 1902.
- Fox River at Wrightstown, Wis., 1902-1904.
- Wolf River at Keshena, Wis., 1907-1909; 1911-
- Wolf River at White House Bridge, near Shawano, Wis., 1906-7.
- Wolf River at Darrows Bridge, near Shawano, Wis., 1906.
- Wolf River at New London, Wis., 1913-
- Wolf River at Northport, Wis., 1905.
- Wolf River at Winneconne, Wis., 1902-3.
- West Branch of Wolf River at Neopit, Wis., 1911-
- Little Wolf River near Royalton, Wis., 1914-
- Little Wolf River near Northport, Wis., 1907-1910.
- Fond du Lac River, West Branch (head of Fond du Lac River) at Fond du Lac, Wis., 1903.
- East Branch of Fond du Lac River at Fond du Lac, Wis., 1903.
- Milwaukee River at Milwaukee, Wis., 1914-

UPPER MISSISSIPPI RIVER BASIN.

- St. Croix River at Swiss, Wis., 1914-
- St. Croix River near St. Croix Falls, Wis., 1902-1905; 1910-
- Namakagon River at Trego, Wis., 1914-
- Yellow River at Webster, Wis., 1914.
- Apple River near Somerset, Wis., 1911-
- Chippewa River above East Fork, near Winter, Wis., 1911-
- Chippewa River below East Fork, near Winter, Wis., 1912-
- Chippewa River near Bruce, Wis., 1913-
- Chippewa River at Chippewa Falls, Wis., 1888-
- Chippewa River near Eau Claire, Wis., 1902-1909.
- Flambeau River near Butternut, Wis., 1914-
- Flambeau River near Ladysmith, Wis., 1914-
- Flambeau River at Ladysmith, Wis., 1903-1906.
- Jump River at Sheldon, Wis., 1915-
- Eau Claire River near Augusta, Wis., 1914-
- Eau Claire River near Eau Claire, Wis., 1913-14.
- Red Cedar River near Colfax, Wis., 1914-
- Red Cedar River at Cedar Falls, Wis., 1909-
- Red Cedar River at Menominee, Wis., 1907-8; 1913-
- Trempealeau River at Dodge, Wis., 1913-
- Black River at Neillsville, Wis., 1905-1909; 1913-
- Black River at Melrose, Wis., 1902-3.
- La Crosse River near West Salem, Wis., 1913-
- Wisconsin River near Rhinelander, Wis., 1905-
- Wisconsin River at Merrill, Wis., 1902-
- Wisconsin River near Nekoosa, Wis., 1914-
- Wisconsin River near Necedah, Wis., 1902-1914.
- Wisconsin River at Muscoda, Wis., 1902-3; 1913-
- Tomahawk River near Bradley, Wis., 1914-
- Prairie River near Merrill, Wis., 1914-
- Little Rib River near Wausau, Wis., 1914-
- Eau Claire River at Kelley, Wis., 1914-
- Big Eau Pleine River near Stratford, Wis., 1914-
- Plover River near Stevens Point, Wis., 1914-
- Baraboo River near Baraboo, Wis., 1913-
- Kickapoo River at Gays Mills, Wis., 1913-

Rock River at Watertown, Wis., 1914.

Rock River at Afton, Wis., 1914—

Catfish River at Madison, Wis., 1902-3.

Lake Mendota at Madison, Wis., 1902-3.

Pecatonica River at Dill, Wis., 1914—

Sugar River near Brodhead, Wis., 1914—

PUBLICATIONS.

Information concerning stream flow at the stations indicated by the preceding table has been published in the reports of the Geological Survey listed below:

Water-Supply Papers 65, 66, 75, 83, 85, 97, 98, 99, 128, 129, 130, 170, 171, 206, 207, 244, 245, 264, 265, 284, 285, 304, 305, 324, 325, 354, 355, 384, 385, 404,¹ 405.¹

Water-supply papers and other publications of the United States Geological Survey containing data in regard to the water resources of the United States may be obtained or consulted as indicated below:

1. Copies may be obtained free of charge by applying to the Director of the Geological Survey, Washington, D. C. The edition printed for free distribution is, however, small and is soon exhausted.

2. Copies may be purchased at nominal cost from the Superintendent of Documents, Government Printing Office, Washington, D. C., who will, on application, furnish lists giving prices.

3. Sets of the reports may be consulted in the libraries of the principal cities in the United States.

4. Complete sets are available for consultation in the local offices of the water-resources branch of the Geological Survey, as follows:

Boston, Mass., Customhouse.

Albany, N. Y., Room 18, Federal Building.

Atlanta, Ga., Post Office Building.

Madison, Wis., care Railroad Commission of Wisconsin.

St. Paul, Minn., Old Capitol Building.

Helena, Mont., Montana National Bank Building.

Denver, Colo., 403 New Post Office Building.

Salt Lake City, Utah, 421 Federal Building.

Boise, Idaho, 615 Idaho Building.

Tacoma, Wash., 406 Federal Building.

Portland, Oreg., 416 Couch Building.

San Francisco, Cal., 328 Customhouse.

Los Angeles, Cal., 619 Federal Building.

Austin, Tex., Old Post Office Building.

Phoenix, Ariz., 417 Fleming Building.

Honolulu, Hawaii, Kapiolani Building.

A list of the Geological Survey's publications may be obtained by applying to the Director of the United States Geological Survey, Washington, D. C., who will also send, on request, an index map of Wisconsin, showing areas mapped and giving other information in regard to publications of special interest to residents of the State.

¹ In preparation June 1, 1916.