VOLUME 1 OF THE MILWAUKEE RIVER WATERSHED STUDY PLANNING REPORT PUBLISHED

In 1965 the Southeastern Wisconsin Regional Planning Commission was requested by the Common Council of the City of Milwaukee and the Milwaukee County Board of Supervisors to assist them in solving flooding and water pollution problems in the Milwaukee River watershed through the conduct of a long-range, comprehensive watershed planning program. The Commission, pursuant to these requests, formed a Watershed Committee comprised of 28 local officials and interested citizens from throughout the watershed to assist the Commission in the assigned task. The Watershed Committee prepared a Prospectus outlining the necessary studies; and, subsequently, the five county boards concerned-Milwaukee, Ozaukee, Washington, Fond du Lac, and Sheboygan-approved the Prospectus and funded the recommended study.

The first volume of a two-volume planning report documenting the findings and recommendations of the comprehensive Milwaukee River watershed study has now been published by the Commission. This first volume, SEWRPC Planning Report No. 13, A Comprehensive Plan for the Milwaukee <u>River Watershed</u>, Volume 1, <u>Inventory Findings</u> and Forecasts, sets forth the basic concepts underlying the comprehensive watershed study and presents the factual findings of the extensive inventories conducted under the study. It also identifies and, to the extent possible, quantifies



the developmental and environmental problems in the watershed and sets forth forecasts of economic activity, population growth, and resultant demands upon the natural resource base.

The Milwaukee River watershed, with an area of 694 square miles, lies primarily in Milwaukee, Ozaukee, Washington, Sheboygan, and Fond du Lac Counties, with a very small portion lying in Dodge County. The watershed is the second largest natural surface water drainage unit in the Southeastern Wisconsin Region and comprises about 16 percent of the total area of the seven-county region. The watershed occupies portions or all of five cities, 18 villages, and 28 towns (see Map 1).

The second volume of the planning report, currently in the final stages of preparation by the Commission, will present the watershed development objectives and standards; alternative land use, natural resource protection, park and outdoor recreation, parkway and scenic drive, flood control, water pollution abatement, and water supply plan elements; a recommended comprehensive watershed development plan; and plan implementation recommendations. The final volume will be issued upon completion of several public informational meetings and a public hearing on the alternative plan elements, as well as on the recommended watershed plan. These informational meetings and the hearing will be held in June throughout the Milwaukee River watershed.

STUDY ORGANIZATION

The Milwaukee River watershed study has been conducted under the guidance of the Milwaukee River Watershed Committee. The Committee, which held its organizational meeting on September 14, 1965, has, as of the end of April 1971, met a total of 30 times in conducting the work assigned to it, including the preparation of the Prospectus for the study and the conduct of the study itself. The technical work has been carried out jointly by the Commission staff; cooperating governmental agencies,

FOND DU SHEBOYG OND co SHINGTON in sec. 1 1 1 0 8000 14000 <u>24000 320</u> IACVER 2 CHIGA -M OZAUKER MILWAUKEE EI. × 7 2 The Milwaukee River watershed is a natural surface water drainage basin about 694 square miles in extent, of which about 62 percent, or 430 square miles, are located within the jurisdiction of the seven-county Southeastern Wisconsin Planning Region. The remaining 38 percent, or about 264 square miles, are located in Dodge, Fond du Lac, and Sheboygan Counties. A sound approach to the growing environmental and developmental problems of the watershed requires that the entire watershed, including the headwater por-

tions beyond the geographic boundaries of the Region, be included



Source: SEWRPC.

in the comprehensive planning program.

including the U. S. Department of Agriculture, Soil Conservation Service; the U. S. Department of the Interior, Geological Survey; and the Wisconsin Department of Natural Resources; and by private consultants engaged by the Commission to perform specialized planning and engineering services, including the Harza Engineering Company of Chicago, Illinois, a firm specializing in hydrologic and hydraulic engineering, and Alster & Associates, Inc., of Madison, Wisconsin, a firm specializing in control survey and photogrammetric engineering.

Actual work on the study began in October 1967, after funding arrangements were completed. The study was funded cooperatively by the U. S. Department of Housing and Urban Development; the U. S. Environmental Protection Agency, Water Quality Office; the Wisconsin Department of Natural Resources; and the five county boards concerned. The Milwaukee River watershed study represents the first planning program to be conducted by the Commission which involved portions of counties lying outside the Region. Representatives of Fond du Lac and Sheboygan Counties have served on the Watershed Committee, and the Fond du Lac and Sheboygan County Boards of Supervisors have participated in the funding of the study.

HIGHLIGHTS OF INVENTORY, ANALYSIS, AND FORECAST FINDINGS

Some of the more salient findings contained in the first volume of the Milwaukee River watershed planning report are:

• The resident population of the watershed may be expected to increase to about 678,000 persons by 1990, an increase of 134,000 persons, or about 25 percent, over the estimated 1967 watershed population of about 544,000 persons. The portion of the watershed population within the Southeastern Wisconsin Region comprises about 30 percent of the total regional population. • Continuation of present land use development trends within the watershed may be expected to result in an increase in urban land uses from about 102 square miles at present to about 133 square miles by 1990, an increase of 30 percent. This demand for urban land would have to be satisfied primarily by the conversion of agricultural lands, woodlands, and wetlands, which collectively may be expected to decline by about 31 square miles, a decrease of about 6 percent. The generalized existing land use in the Milwaukee River watershed is shown on Map 2.

- About 64 percent of the developed area of the watershed is currently served by public sanitary sewerage facilities, while public water supply systems serve about 60 percent of the total developed area of the watershed. In recent years the construction of public sanitary sewer and water supply facilities has not fully kept pace with the rapid urbanization taking place within the watershed, necessitating the widespread use of individual on-site sewage disposal systems and private wells. About 56 percent of the total area of the watershed is covered by soils poorly suited for intensive urban development without public sanitary sewer service.
- Wetlands 50 acres or more in size cover an aggregate area of about 62 square miles, or about 9 percent of the total area of the watershed. Of this total wetland area, about 11 square miles, or 18 percent, are currently in public ownership. It is estimated that, at the time of settlement by Europeans, about 120 square miles, or about 17 percent of the watershed, were covered by wetlands. Thus, nearly one-half of the original wetlands within the watershed have been destroyed by man's activities.

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Source: SEWRPC.

WATERSHED STUDY-Continued

• Woodlands cover an aggregate area of about 111 square miles, or 16 percent of the total area of the watershed. Of this total woodland area, less than 24 percent is in public ownership, despite continued acquisition of Kettle Moraine State Forest lands. It is estimated that, at the time of settlement by Europeans, about 575 square miles, or about 83 percent of the watershed, were covered by woodlands. Thus, over 80 percent of the original woodland cover of the watershed has been destroyed.

• The watershed contains an estimated 67,662 acres, or about 105 square miles of wildlife habitat, exclusive of open water areas exceeding 10 acres in surface area. Of this total, 45 square miles, or about 43 percent, are rated as high-value habitat area. Competing land uses and improper development practices are continually lowering the quality, as well as the quantity, of the remaining wildlife habitat.

• Primary environmental corridors are generally elongated areas which encompass the best remaining elements of the natural resource base, including the lakes and streams and associated shorelands and floodlands, wetlands, woodlands, wildlife habitat areas, areas containing rough topography and significant geological formations, and the best remaining potential park and related open-space sites. Such primary environmental corridors encompass, within the Milwaukee River watershed, a total area of about 157 square miles, or 23 percent of the total area of the watershed (see Map 3). They contain, however, 52 lineal miles, or 88 percent, of the total lake shoreline on the 21 major lakes within the watershed; 282 miles, or 88 percent, of the major stream channel length within the watershed; and 68 percent of all remaining wetlands, 63 percent of all remaining woodlands, and 67 percent of the wildlife habitat area remaining within the watershed.



Source: Wisconsin Department of Natural Resources and SEWRPC.

• There are 186 park and related open-space sites existing within the Milwaukee River watershed, totaling 29,065 acres, or about 45.5 square miles in area. Approximately 68 percent of the sites and 86 percent of the total area are in public ownership. About 89 percent of the area held in public ownership is, however, held by the Wisconsin Department of Natural Resources, primarily in the form of the large woodland and wildlife conservancy areas comprising the Kettle Moraine State Forest; and only 38 percent of the publicly controlled lands are actually available to meet the growing demand for the 16 major water- and land-based recreational activities.

- There are 131 potential park and related open-space sites remaining within the watershed, totaling 21,935 acres, or approximately 34 square miles in area. About one-half of these sites are considered to possess a very high recreational resource value.
- The participant demand for water-based recreational activities, such as swimming, fishing, and boating, may be expected to more than double by 1990, from 65,000 to 157,000 participants on an average seasonal Sunday. Land-based participant demand for major recreational activities within the watershed may be expected to almost double, from 145,000 to 255,000 participants per average seasonal Sunday. These forecasts, when related to the existing supply of recreational lands within the watershed, indicate that an additional 10,800 acres of land will have to be devoted to recreational use within the watershed by 1990, an increase of about 87 percent over present levels.

There are approximately 330 lineal miles of perennial streams and watercourses within the watershed and a total of 71 lakes, 21 of which have a surface water area of 50 acres or more. These 21 major lakes provide a combined surface water area of 5.4 square miles, or about 0.8 percent of the total watershed

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area, and a total of 59 miles of shoreline. The 50 smaller lakes provide a combined surface water area of about 1.1 square miles, or about 0.2 percent of the total watershed area and a total of about 41 miles of shoreline.

- Of the 21 major lakes within the watershed, 15 sustain a moderate fishery and must support the major proportion of the heavy fishing demand exerted upon the fishery resources of the watershed. Moderate stream fisheries are limited within the watershed to five major streams—the Milwaukee River and its three branches—the East, North, and West Branches—and Cedar Creek. The major streams supporting moderate fisheries have a combined length of 197 miles, or about 60 percent of the total perennial stream channel mileage within the watershed. In addition, there are five minor streams that are officially designated trout streams in the watershed, having a combined length of about 15 miles, including Lake Fifteen Creek in Fond du Lac County and Gooseville Creek, Melius Creek, Nickols Creek, and Watercress Creek in Sheboygan County.
- Several of the 21 major lakes within the watershed—including Ellen, Little Cedar, Mauthe, Random, Smith, and Wallace Lakes are in an advanced state of eutrophication, as indicated by the high phosphorus and low dissolved oxygen content of the water and excessive growths of algae and aquatic weeds. High coliform levels or high concentrations of ions indicative of pollution are found in several of the 21 major lakes of the watershed, including Ellen, Little Cedar, and Random Lakes, and may indicate a public health hazard resulting from sewage discharges from urban-type residential development around these lakes. Over 90 percent of the phosphorus and 40 percent of the nitrogen presently entering the major lakes of the watershed are estimated to be derived from human activities, including drainage from septic tanks and runoff from agricultural lands.

WATERSHED STUDY-Continued

- Surface water from Lake Michigan is presently the principal source of municipal and industrial water supply within the Mil-waukee River watershed. Water use within the basin in 1967 totaled about 67 million gallons per day, of which about 80 percent was obtained from Lake Michigan to supply the lower reaches of the watershed within Milwaukee County. The remaining 11.8 million gallons per day were obtained primarily from groundwater sources to supply users in the Villages of Bayside and River Hills in the lower watershed and all of the watershed above the Milwaukee County line. Total water use may be expected to increase by about 51 percent within the watershed by 1990, reaching an approximate total pumping rate of 103 million gallons per day, or 37.6 billion gallons per year.
- There are 48 man-made water control structures within the Milwaukee River watershed, not including bridges and culverts, which serve to regulate or modify the natural flow regimen of the stream system to some degree (see Map 4). Eleven of these dams are located at natural lake outlets and were constructed to regulate and control the lake levels, while 37 are located on the stream network proper and were originally constructed primarily to impound water for either power generation or transportation purposes. The water surface area of the 48 pools controlled by all of the existing dams within the watershed totals about 3,200 acres, of which about 40 percent is provided by Big and Little Cedar Lakes.
- A profusion of natural surface water storage areas exists within the Milwaukee River watershed and serves to decrease peak discharges and increase the duration of runoff. The peak discharge of a 100-year recurrence interval flood on the Milwaukee River at the Estabrook Park gaging station in Milwaukee is estimated at about 16,000 cubic feet per second (cfs), or about 23.3 cfs per square mile of tributary watershed area. Comparable flows of the Fox River in the Southeastern Wisconsin Region are 9,400 cfs,



Source: Harza Engineering Company.

WATERSHED STUDY—Continued

or 10.8 cfs per square mile of tributary drainage area, and on the Root' River, 9,900 cfs, or 53 cfs per square mile. Thus, although the Milwaukee River watershed system is not as naturally a well-regulated system as the Fox River system, a considerable potential still exists for maintaining a well-regulated streamflow regimen through maintenance of existing lakes and wetlands in the watershed. Of particular importance is the preservation of such major wetland areas of the watershed as the wetlands along the East Branch of the Milwaukee River, the Lake Fifteen area wetlands, the wetlands tributary to the Kettle Moraine Lake outlet, the Jackson Marsh on Cedar Creek, and the Cedarburg Bog tributary to Cedar Creek. These wetlands. together with the 71 lakes in the Milwaukee River watershed and the temporary floodplain overflow area storage along the streams of the watershed, tend to provide a high degree of natural flood control within the basin.

Significant floods in the Milwaukee River watershed have occurred in March-April of 1960, March of 1959, March of 1929, August of 1924, and March of 1918 (see Figure 1). The March-April 1960 flood had an estimated recurrence interval of about 10 years; that is, a flood of this magnitude has about a 10 percent chance of occurrence within the watershed in any year. The August 1924 flood was a result of a high-intensity thunderstorm centered approximately over the City of West Bend and was a flood having an approximately 77-year recurrence interval, or a flood of nearly the same magnitude as a 100-year recurrence interval flood. If the March-April 1960 flood on the Milwaukee River were to recur under present land use development conditions. it could be expected to cause monetary damages totaling about \$335,000, about 78 percent of which would be incurred by private property owners. If the August 1924 flood on the Milwaukee River were to recur under present land use development conditions, it could be expected to cause monetary damages totaling

Figure I

SEASONAL DISTRIBUTION OF ANNUAL PEAK DISCHARGE OCCURRENCES MILWAUKEE RIVER AT MILWAUKEE 1915-1968



Source: Harza Engineering Company.

The extended width of the normal floodplain of the Milwaukee River in certain reaches is illustrated by this photo taken of the 1960 flood just south of Highland Road in the City of Mequon. The channel of the Milwaukee River is in the foreground, clogged with ice. The homes along the River are completely surrounded by floodwaters, with several homes in this reach experiencing firstfloor inundation. Unwise, improper floodland development such as this inevitably results in pleas for public officials to "do something about it."

Photo courtesy of The Milwaukee Journal





The "Sunny Point Lane peninsula" area in the City of Glendale has received frequent and extensive historic flood damage. In the 1960 flood shown in this photo, two homes in this area each reported damages of about \$3,000. The hardship, inconvenience, and mental anguish suffered by residents of areas along the Milwaukee River, such as this, to say nothing of economic loss, could have been avoided had sound land use controls prohibiting residential development.

Photo Courtesy of The Milwaukee Sentinel

Street intersections and walkways located in natural floodplains are subject to frequent, sometimes yearly, inundation. This photo of an urbanizing area in the City of Mequon along the Milwaukee River was taken in March 1963, a year in which flooding was not particularly severe. Such flooding not only constitutes a hazard to public safety but also a hazard to public health.

Photo Courtesy of The Milwaukee Journal



about \$1.8 million. The reaches of historic and potential heaviest flood damages along the Milwaukee River are in the City of Glendale (see Maps 5 and 6), where total flood damages from a 100year recurrence interval flood could be expected to exceed a total of \$584,000, and in the City of Mequon and Village of Thiensville, where such damages could be expected to exceed \$688,000. If urban development continues unregulated within the riverine areas, additional floodplain land would be developed; and the average annual flood-damage risk may be expected to increase from the current level of about \$119,000 per year to about \$160,000 per year by 1990, while damages resulting from a single 100-year recurrence interval flood may be expected to increase from the present level of \$1.8 million to \$2.2 million.

Existing water quality conditions do not, considering the stream system of the watershed as a whole, meet the standards for the state-established water use objectives. Twelve major municipal sewage treatment plants, all of which are located upstream from the Milwaukee County line and all of which provide secondary waste treatment, discharge wastes to surface waters of the watershed. About 54 percent of the pollution loading on the stream system at the Milwaukee County line, as measured in nutrient content, is contributed by these 12 municipal sewage treatment plants. An additional 33 percent is contributed by agricultural runoff, while 13 percent is contributed by miscellaneous sources, including urban runoff and industrial waste sources. In direct contrast, only 18 percent of the nutrient loading below the county line and above the North Avenue Dam is contributed by the 12 sewage treatment plants, whereas 60 percent is contributed by sewer overflows, 11 percent by agricultural runoff, and 11 percent by miscellaneous sources, including urban runoff and industrial waste sources. Of the total average daily organic waste loading on the Milwaukee River system of about 18,200 pounds of biochemical oxygen demand (BOD), about





The Glendale reach of the Milwaukee River has experienced frequent and extensive flooding. A portion of this reach as it existed in 1936 is shown on the historic map reproduced above. The extent of inundation of the 1924 flood has been superimposed on the 1936 land use conditions shown on the map. This same area as it exists today is shown on Map 6. It is evident that the known flood hazard provided no deterrent to continued urban development in the floodplains of the River.

Source: Adapted from The Milwaukee River Basin, Wisconsin State Planning Board Bulletin No. 10, June 1940.



Despite major historic floods in 1918, 1924, 1939, 1959, and 1960, urban development has continued to occur on the natural floodplains of the Milwaukee River in the City of Glendale. Many of the homes shown on this 1969 map prepared by the Regional Planning Commission were constructed since 1960, the year in which the last major flood on the river occurred. If the 10- and 100-year recurrence interval floods were to occur today, it is estimated that 32 and 200 homes, respectively, in the area shown, would be subject to inundation. Because of rapid turnover in home ownership, many of the homeowners in this area contacted during the SEWRPC flood damage survey were unaware of the flood hazards to which their homes were subject.

Source: SEWRPC.



Combined sewer overflows, which discharge directly to the Milwaukee River at sixty-two locations in the watershed, have a frequent, severe, adverse impact on the water quality of the Milwaukee River. This large combined sewer outfall, located on the Milwaukee River beneath the Locust Street bridge in the City of Milwaukee, is 78 inches in diameter and can discharge raw sewage to the River at rates in excess of 100,000 gallons per minute. This outfall is one of the smaller outfalls along the banks of the Milwaukee River. Other outfalls range in size from 12 inches in diameter up to a twin conduit having two barrels each, 9 feet by 4-1/2 feet in size. It is estimated that the combined sewers overflow and discharge a mixture of storm water and raw sanitary sewage to the waterways in the Milwaukee area an average of 52 times a year. One of the major objectives of the watershed study is to explore alternative means of abating this source of water pollution and recommend a method for solving this problem not only in the 5,800 acre combined sewer service area of the Milwaukee River watershed but throughout the entire 17,200 acre combined sewer service area in Milwaukee County.

SEWRPC Photo



Overflows contributed from separate sanitary sewers to streams in the lower Milwaukee River watershed are estimated to average about 7.5 million gallons per day, or about 2.73 billion gallons annually. These overflows create very intense, short-term shock effects in the receiving streams. Much of this raw sewage comes to the streams through large storm sewers, such as the twin double-box storm conduits shown in the photo at left, located near N. 35th Street and Lincoln Creek in the City of Milwaukee. The middle photo, taken from the top edge of one of the conduits, shows the visual contrast in the waters entering the Creek, indicating the probable discharge of raw sewage to the storm water. Raw sanitary sewage can enter these storm sewers at a number of relief points upstream. The photo at right, taken near the storm sewer outlet at left, shows the extent of concern by local public health officials over the polluted condition of Lincoln Creek.

SEWRPC Photos

17,000 pounds, or 93 percent, are contributed by the sewer overflows located on the river system between the county line and the North Avenue Dam. Of the 17,000 pounds, it is estimated that about 85 percent is contributed by the 85 separate sanitary sewer overflows in the watershed and about 15 percent is contributed by the 10 combined sewer overflows in the watershed. It is estimated that more than 6,000,000 pounds of BOD enter the Milwaukee River above the North Avenue Dam annually as a direct result of sewer overflows. Thus, the major water pollution problems in the Milwaukee River watershed are associated with the wastes from sewage treatment plants and sewer overflows. Map7 shows the combined sewer service area in Milwaukee County.

In brief summary, the research operations conducted under the Milwaukee River watershed study picture a dynamic and rapidly changing watershed, extending from the headwaters of the Milwaukee River in Fond du Lac County to its mouth in Downtown Milwaukee. The inventories and analyses further reveal that the population of the watershed may be expected to increase by about 25 percent over the next 20 years, accompanied by an increase in the amount of land devoted to urban use by 30 percent over the same time period. The research further revealed that over one-half of the original woodland and wetland cover has been destroyed; that there are inadequate facilities for outdoor recreation and, in particular, for water-based recreation; that damaging floods occur in the watershed; and that the lakes and streams of the watershed are badly polluted.

If existing trends are allowed to continue within the watershed, much of the new urban development over the next 20 years will not be related sensibly to the underlying and sustaining natural resource base of the watershed, particularly to its soils, its lakes and streams and associated floodlands and shorelands, its woodlands and wetlands, and its wildlife habitat areas, nor to long-established public utility systems and service areas. The deterioration and, in some cases, the complete destruction of the best remaining elements of the natural resource base within the watershed can, in the absence of a sound, comprehensive watershed plan and implementation of the plan, be expected to con-



Until the mid-1920's, all development in the Milwaukee area was designed to be served by combined sanitary storm sewers, which sewers discharged directly to watercourses. Most of this area, totaling about 17,200 acres, is still served by the combined systems today. Intercepting sewers have been built in this area to intercept the normal dry-weather flow of sanitary wastes in the combined sewers, as well as a portion of the storm flows, and convey these flows to the Jones Island sewage treatment plant. Excess flows during storm periods, consisting of raw sanitary sewage and storm water, are discharged to watercourses an average of 52 times per year. A total of 62 combined sewer outfalls, serving a 5,800 acre combined sewer service area in the Milwaukee River.

Source: Milwaukee-Metropolitan Sewerage Commissions and City Engineer, City of Milwaukee.

WATERSHED STUDY—Continued

tinue, as can the unnecessary encroachment of urban development onto the historic floodplains of the watershed. Furthermore, deficiencies already evident in land and water area for outdoor recreation use can be expected to become more severe, as can the serious and widespread problems of flooding and water pollution.

REPORT AVAILABILITY

SEWRPC Planning Report No. 13, <u>A Comprehensive Plan for the Mil-waukee River Watershed</u>, Volume 1, <u>Inventory Findings and Forecasts</u>, set forth in 514 pages of text and illustrations, is now available from the Commission offices at a price of \$10.00 inside the Southeastern Wisconsin Region and \$15.00 outside the Region. Pursuant to Commission policy, all local units of government and all public libraries within the Milwaukee River watershed will receive copies of this report in the very near future.

QUESTION BOX

WILL ALL OF THE DATA COLLECTED AND DEVELOPED UNDER THE MILWAUKEE RIVER WATERSHED STUDY BE PUBLISHED IN THE FINAL PLANNING REPORT?

No. Even though the final planning report for the Milwaukee River watershed will consist of two volumes, totaling about 1,200 pages, not all of the massive amount of information developed under the study can be included in that report. In addition to a summary of the basic data which identifies and, to the extent possible, quantifies the land use, natural resource, park and open-space, flood-damage, and water quality problems of the watershed—data necessary for plan preparation—the published planning report will contain the following detailed planning and engineering data useful to the local units of government and private developers in the making of day-to-day development decisions:

• Profiles of 216 miles of major perennial stream channels in the watershed showing the stream bed elevation and the peak stages for the 10- and 100-year recurrence interval flood flows.

QUESTION BOX—Continued

- Tables showing peak discharges and stages corresponding to the 10-, 50-, and 100-year recurrence interval floods for 205 existing highway and railroad bridges and culverts along the aforementioned 216 miles of stream channel.
- Small-scale (1" = 2000', 10' and 20' contour interval) topographic maps of all of the riverine areas of the 216 miles of perennial stream channels in the watershed for which the flood-flow simulation model was developed showing the 10- and 100-year recurrence interval flood inundation limits.

In addition to the foregoing, however, a great deal of unpublished planning and engineering data pertaining to the watershed will be available only on request from the Commission files. These data include the following:

- Large-scale topographic maps (1" = 200', 4'-2' contour interval) upon which the 10- and 100-year recurrence interval flood hazard lines have been delineated. Such large-scale topographic maps are available for those areas of the watershed shown on Map 8
- Dossiers on 523 second order bench marks established throughout the Milwaukee River watershed, including bench marks on or near 279 dams, bridges, and culverts in the watershed and supplementary bench marks and reference bench marks established as a part of the second order vertical control survey (spirit level circuits) carried out under the watershed study.
- Dossiers on 142 U. S. Public Land Survey section and quartersection corners relocated, monumented, and tied into the State Plane Coordinate System by second order horizontal control surveys carried out under the watershed study. The corners were relocated throughout the areas for which large-scale topographic maps were prepared, as shown on Map 8.
- Descriptive data, including cross sections, for all bridges, culverts, dams, and other water control facility structures on the 216 miles of the perennial stream system included in the floodflow simulation model.



(1" = 200') flood hazard maps of selected stream reaches which are expected to be subject to particularly rapid urbanization in the near future. Watershed-wide floodplain identification, particularly that delineated on large-scale topographic maps, in conjunction with corresponding stream bed-flood stage profiles and peak discharges, provides hydrologic and hydraulic data necessary for the orderly development of the watershed.

Source: SEWRPC.

- Photographs of all bridges, dams, and other water control facility structures along the 216 miles of perennial stream system studied.
- Inspection reports on all dams and lake outlet control structures in the watershed.
- Historic flood-damage data by public and private sector and by minor civil division.
- Detailed soil survey maps for that portion of the Milwaukee River watershed lying outside the Southeastern Wisconsin Region in Dodge, Fond du Lac, and Sheboygan Counties.
- Water quality sampling data at lakes and on streams throughout the watershed.
- Recreational lake use reports for the 21 major lakes in the watershed. These reports contain a descriptive analysis of the physical characteristics of the lake, including drainage basin and shore characteristics, fish and game resources, and lake use characteristics; a discussion of the existing local land use controls as applied to the lake area; a discussion of the recreation and resource-related problems of the lake; and recommended steps for resource protection and enhancement. These reports, with text and supporting tables and maps, are from 20 to 25 pages in length and in themselves constitute a series of planning reports for important subareas of the watershed.
- Information on park use developed through personal interview surveys conducted at Mauthe Lake State Recreation Area and Terry Andrae State Park, including data on the origin and destination of the recreational trips involved, on the primary and secondary types of recreational activity participation, and estimated monetary expenditures.

QUESTION BOX-Continued

- Inventory data, including a description of the specific recreational activities available, pertaining to all public and private recreational facilities in the watershed.
- Inventory data, including available recreation-related resources and potential recreation uses, pertaining to all potential park and open-space sites in the watershed.
- Survey data collected regarding the water-related recreational activity of persons living permanently or seasonally in dwellings adjacent to the major lakes in the Milwaukee River watershed, including information on lot size, utility services, occupancy, and recreational activity participation of the lakeshore occupants.
- An aquatic plant survey report of the major lakes in the Milwaukee River watershed reporting the abundance and species composition of aquatic vegetation in the watershed.
- Delineation on 1"=400' scale aerial photographs and accompanying detailed descriptions of the 12 major environmental corridors in the Milwaukee River watershed, including an identification and discussion of the natural resource base elements contained in each of these corridors, such as lakes, streams, floodplains, wetlands, woodlands, wildlife habitat, significant topographic features, significant geological formations, wet or poorly drained soils, existing outdoor recreation sites, potential outdoor recreation sites, historic sites, and significant scenic areas or vistas.

It is important to note that all of the detailed data compiled in the inventories and analyses conducted under the Milwaukee River watershed study are available for use by interested local officials and citizens. All materials may be inspected at the Commission offices; certain materials, such as the recreation lake use reports, are published separately and can be purchased at nominal cost; and, where possible, other materials can be made available at only nominal cost for reproduction. QUOTABLE QUOTE.....

"Ecology is that branch of biological science dealing with the mutual relations between organisms and their environment. The first law of ecology is that everything is connected to everything else, in an interdependent interfacing of organisms and environmental elements. In addition to interdependence, ecology recognizes the principles of limitation (constraints) and complexity (interrelationships) --the basic principles of the systems approach. The ecologist refers to any given segment of nature as an ecosystem: the community of living things and the physical environment of the That is, he studies natural segment. biophysical systems functioning as integrated wholes. In the sense that ecology posits that all growth is limited, that mankind is dependent for well-being and even survival on its global and lesser ecosystems, and that the complexity of systems should be confronted as a whole--contrary to long-held beliefs in limitless growth and ultimate conquest of nature, and the usual analytical approach of isolating and simplifying -- ecology is subversive."

William Bowen "Our New Awareness of the Great Web" in "Books and Ideas" Fortune, February, 1970 WAUKESHA, WIS.

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Kurt W. Bauer Executive Director RETURN REQUESTED

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