INTERNATIONAL JOINT COMMISSION

MENOMONEE RIVER
PILOT WATERSHED STUDY

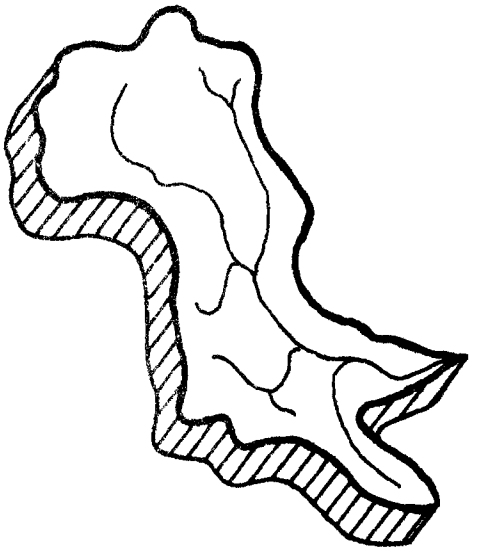
WORK PLAN

COOPERATING AGENCIES

WISCONSIN DEPARTMENT OF
NATURAL RESOURCES
JOHN G. KONRAD

UNIVERSITY OF WISCONSIN SYSTEM
WATER RESOURCES CENTER
GORDON CHESTERS

SOUTHEASTERN WISCONSIN REGIONAL
PLANNING COMMISSION
KURT W. BAUER



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ACTIVITIES REFERENCE GROUP

UNITED STATES ENVIRONMENTAL
PROTECTION AGENCY

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INTERNATIONAL JOINT COMMISSION
MENOMONEE RIVER PILOT WATERSHED
STUDY PLAN

I. INTRODUCTION

Concern for the effects of various land use activities on Great Lakes water quality has prompted the governments of the United States and Canada, under the Great Lakes Water Quality Agreement of April 15, 1972, to direct the International Joint Commission to conduct studies of the impact of land use activities on the water quality of the Great Lakes Basin and to recommend remedial measures for maintaining or improving Great Lakes water quality.

To effect this undertaking, the International Joint Commission, through the Great Lakes Water Quality Board, established the International Reference Group on Great Lakes Pollution from Land Use Activities (Pollution from Land Use Activities Reference Group - PLUARG). The Reference Group developed a study program which consisted of four major tasks. Task A is devoted to the collection and assessment of management and research information and in its later stages, to the critical analysis of implications of potential recommendations. Task B requires the preparation of a land use inventory, largely from existing data, and secondly, the analysis of trends in land use patterns and practices. Task C is the detailed survey of selected watersheds to determine the sources of pollutants, their relative significance and the assessment of the degree of transmission of pollutants to boundary waters. Task D is devoted to obtaining supplementary information on the impacts of materials to the boundary waters, their effect on water quality and their significance in these waters in the future and under alternative management schemes.

The Task C portion of the Detailed Study Plan includes intense investigations of six watersheds in Canada and the United States which are representative of the full range of urban and rural land uses found

in the Great Lakes Basin. A Technical Committee and Task C Subgroup have been established by the PLUARG and assigned primary responsibility for developing and conducting the pilot watershed studies. The Menomonee River watershed has been selected for the study of the effects of urban-residential land uses undergoing rapid change. Interfacing of Task C - Task D activities is to be accomplished by the Task C Technical Committee with inputs from the PLUARG, the pilot watershed studies and the Task D Subgroup and Technical Committee. Thus, the output of the Task C pilot watershed studies will be consistent with the objectives and activities of Task D. Likewise, the land use inventory developed by Task B will form the basis for extrapolation of information developed under the pilot watershed program to the total Great Lakes Basin. Coordinating responsibilities for this activity will lie with the Task C Technical Committee.

Although it is not an objective of the Menomonee River pilot watershed program to develop an analytical quality control program for the entire Task C activities, it should be reemphasized that maximum effectiveness of the Task C (and eventually Task D) program will only be achieved if the data collected is analytically compatible from one watershed to another. It is therefore urged that the Reference Group make the necessary arrangements to develop an analytical quality control program at the earliest opportunity.

The Wisconsin Department of Natural Resources (WDNR), the University of Wisconsin System through the Water Resources Center (UW-WRC) and the Southeastern Wisconsin Regional Planning Commission (SEWRPC) serve as the lead agencies or organizations responsible for participating with the Task C Technical Committee in the planning and conduct of the intensive study of water quality-land use relations in the Menomonee River watershed.

The principal functions of these agencies are:

a. Wisconsin Department of Natural Resources: The WDNR will be the lead agency and as such, will administer the total study. This will include coordination of activities associated with the Menomonee River Study and submission of reports to the U.S. Environmental Protection Agency and the PLUARG. The WDNR also will provide laboratory support for the monitoring program to be

conducted in the Menomonee River Basin.

b. University of Wisconsin System: The UW, through the Water Resources Center, will conduct special studies of selected land use activities and provide interpretation and assessment of monitoring data through development of land use-water quality models.

c. Southeastern Wisconsin Regional Planning Commission: The SEWRPC will provide background inventories on land use activities and project land use patterns from its current Menomonee River planning program and develop a computer file of all data and information applicable to the study.

In addition to these agencies, the U.S. Geological Survey will install and maintain gauging and sampling stations at twelve locations in the Basin.

The organizational structure of the Menomonee River Pilot Watershed Study is presented in Fig. 1.

The 136 square mile Menomonee River watershed is located in the southeastern corner of Wisconsin and discharges to Lake Michigan at the City of Milwaukee (Figs. 2 and 3). This highly urbanized watershed encompasses all or parts of four counties and 17 cities, villages and towns and currently contains a resident population of about 400,000 persons (2,940 persons/mile^2). Existing urban land uses range from an intensely developed commercial-industrial complex in the lower quarter of the watershed to low to medium density residential areas in the center half of the watershed, while the upper quarter is in the process of being converted from rural to urban land use, as reflected by scattered urban development. The irregular topography of the watershed results from the effects of glaciation. Heterogeneous glacial drift covers the entire watershed and the dominant soil types tend to be poorly drained. The long-term average discharge from the watershed is 66 cfs, but flood flows as high as 15,000 cfs have been recorded. The basin has a typical humid climate, with mild summers and cold winters. The annual average temperature is 50°F with mean daily temperatures ranging from 21°F in January to 71°F in July. Annual average precipitation is 31 inches (40 inches of snow).

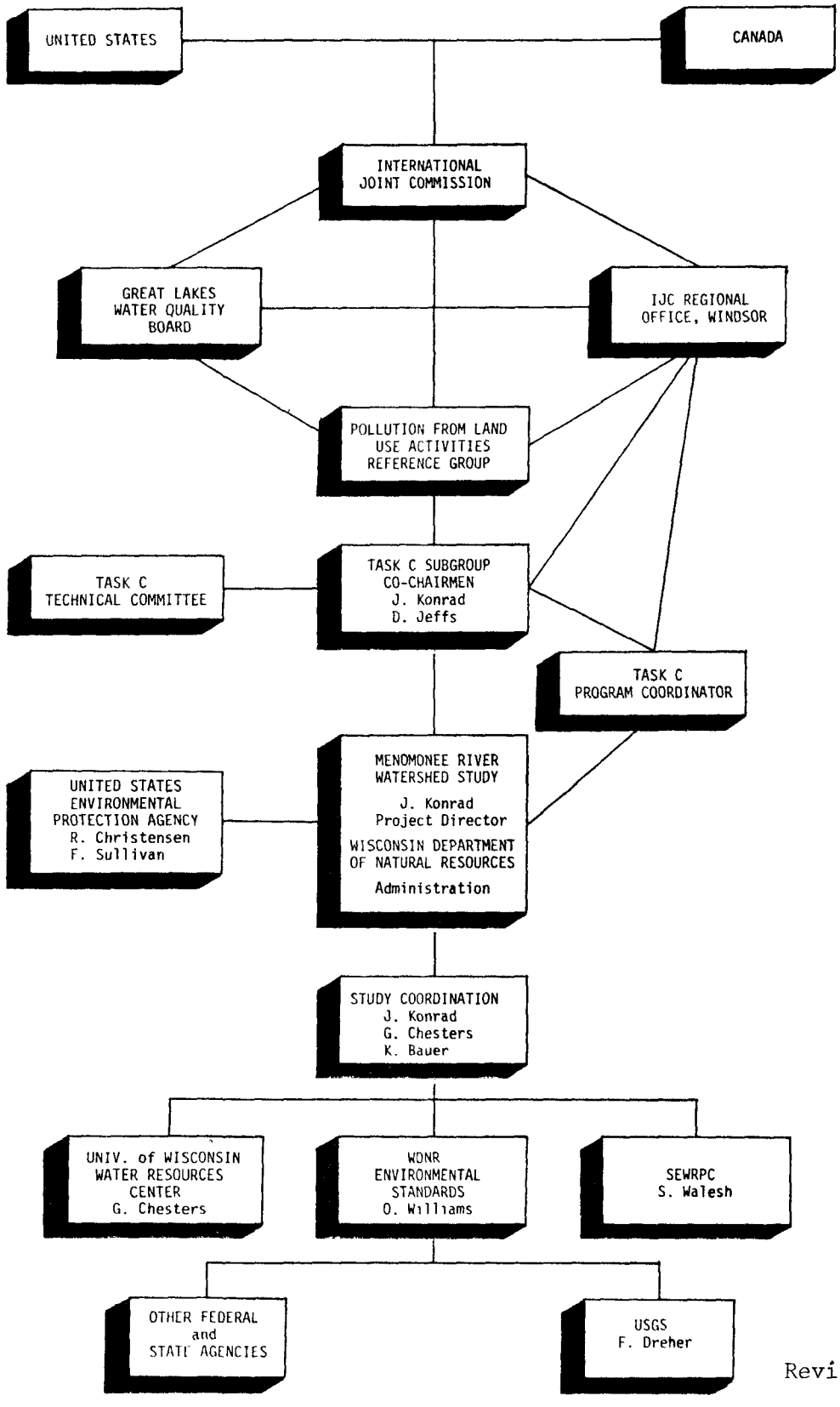

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Fig. 1. Organizational chart for the Menomonee River program.

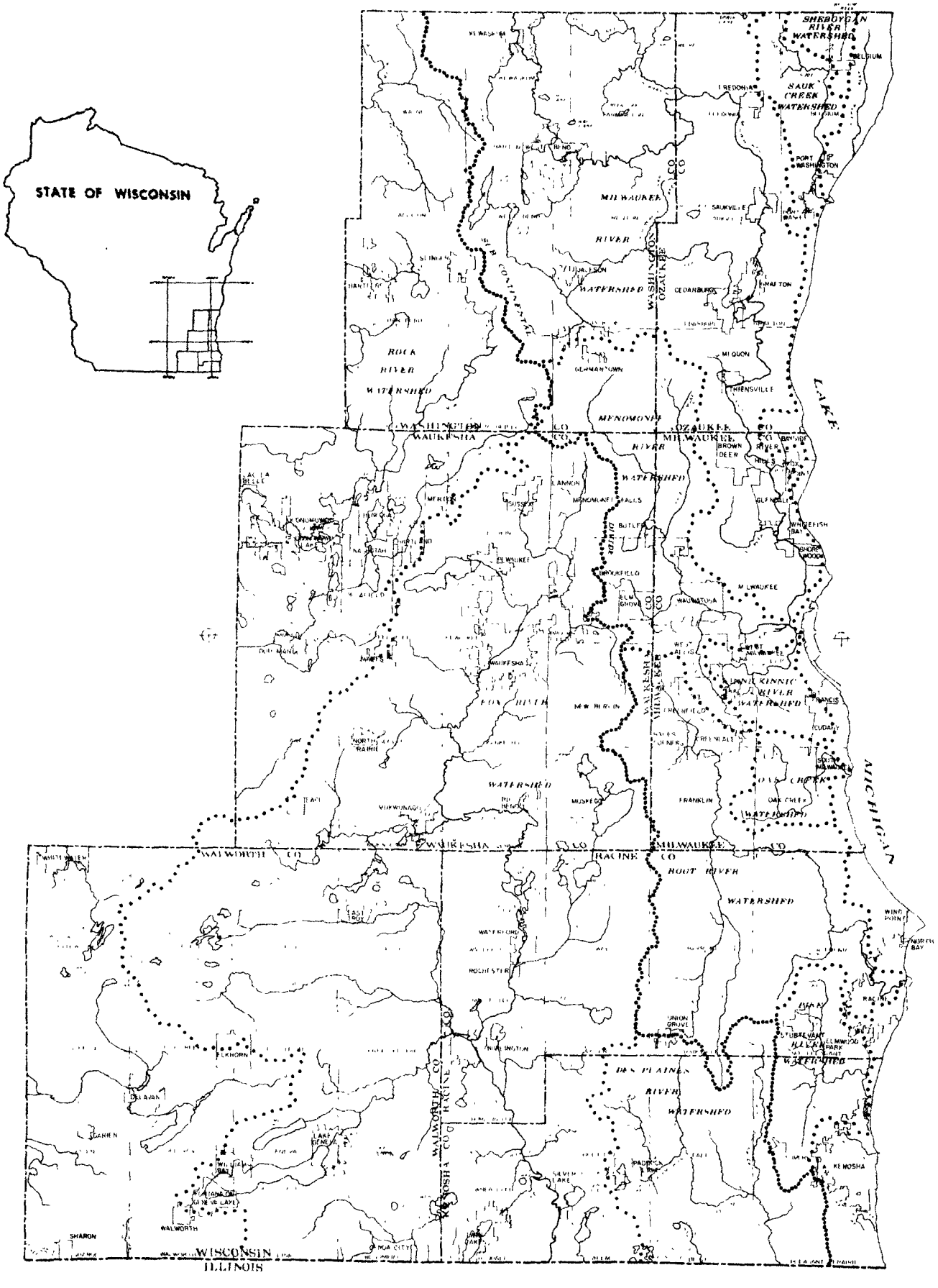


Figure 2. Location of Menomonee River Watershed.

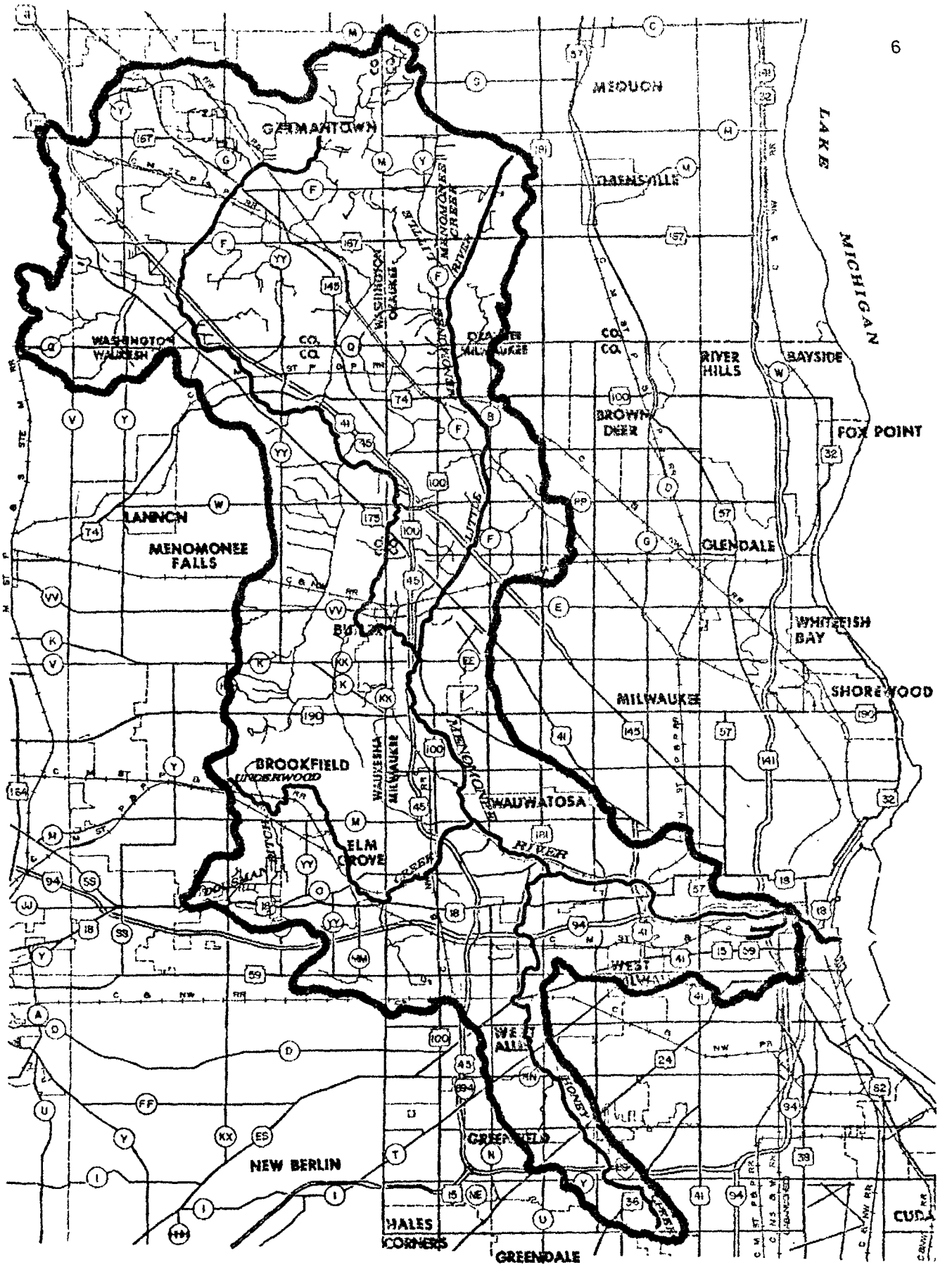


Figure 3. Menomonee River Watershed.

Several key factors entered into selection of the Menomonee River watershed. Not only is the watershed highly urbanized--approximately 75% of the land is in some type of urban use--but the watershed and contiguous lands contain a full range of urban uses including low to high density residential areas, extensive commercial and industrial tracts and a considerable amount of land devoted to transportation facilities. The high degree of diversity of urban land uses in this watershed is reflected by the existence of combined and separate sewer systems. A dynamic dimension is added by the rapid development occurring in the upper quarter of the basin where agricultural land is being converted to urban land uses. A unique facet of the Menomonee watershed stems from the proposed plan to remove all municipal point sources of pollution by 1976, at which time the effects of land use on water quality will arise almost entirely from non-point sources. Thus, of the six major watersheds chosen for intensive study in the PLUARG program, the Menomonee watershed will serve as the focus of investigations on the impact of urban land uses on water quality. Data obtained in the Menomonee watershed will be used to extrapolate the effects of urban land use on the water quality of the entire Great Lakes Basin.

II. OBJECTIVES

The overall objective of the Menomonee River watershed study is to investigate the effects of land drainage on the pollutional input to Lake Michigan and to develop a predictive capacity with respect to the sources, forms and amounts of pollutants reaching Lake Michigan.

The specific objectives of the Menomonee River watershed study are:

A. To determine the levels and quantities of major and trace constituents including, but not limited to, nutrients, pesticides and sediments reaching or moving in flow systems likely to affect the quality of Lake Michigan water.

B. To define the sources and evaluate the behavior of pollutants from an urban land use setting with particular emphasis on the impact of residential and industrial areas including utility facilities, transportational, recreational, agricultural and constructional activities associated with rapid urbanization.

C. To develop the predictive capability necessary to facilitate extension of the findings from the Menomonee River watershed study to other urban settings, leading to an eventual goal of integrating pollutional inputs from urban sources to the entire Great Lakes Basin.

Activities and decisions made in meeting the specific objectives of the Menomonee River watershed study will be carried out in such a manner as to effectively interface with objectives of Task D.

III. BACKGROUND WATER QUALITY INFORMATION RELATING TO THE MENOMONEE RIVER WATERSHED

The Menomonee River watershed contains a diversity of urban land uses confined within the relatively small area of 136 square miles, making feasible the detailed monitoring of basin-wide spatial and temporal changes in water quality and quantity. A number of water quality studies have been conducted in the Menomonee Basin since 1953 which serve to provide the necessary background information for planning and conduct of the proposed IJC land drainage study.

The Wisconsin Department of Natural Resources, as part of its statewide program, has conducted a number of surveys in the Milwaukee River Basin including investigations of the Menomonee River and its three principal tributaries, namely, Honey Creek, Underwood Creek and the Little Menomonee River. The purpose of the surveys was to identify the major point sources of pollution and to determine the effects of these discharges on the quality of receiving waterways. The earliest Milwaukee River Basin survey on record with the WDNR was conducted during 1951 (1), with subsequent surveys in 1952-53 (2), 1962 (3), 1966-67 (4), and 1968-69 (5). Because the primary concern of these surveys was to evaluate the capacity of streams to assimilate organic wastes, field and laboratory analyses undertaken included the measurement of 5-day biochemical oxygen demand (BOD_5) dissolved oxygen (DO) and biological surveys. These studies indicated that inadequate treatments of food processing and municipal sewage wastes was the major cause of organic pollution in the upper half of the watershed, whereas discharges from separate sanitary and combined sewer overflows were more significant pollutional sources in the lower half of the watershed. Other significant and specific pollution sources identified included the Moss American Co. on the Little Menomonee River and the State Fair Park on Honey Creek. Organic loadings from the Underwood Creek subwatershed were also significant but sources were not identified. Water quality problems which were observed within the watershed included high BOD_5 values and bacterial counts, critically low levels of DO, nuisance growths of aquatic plants, accumulation of sludge deposits and localized

succession of pollution-tolerant organisms.

During the period of January 1964 through February 1965, the Southeastern Wisconsin Regional Planning Commission (6)--with cooperation from state and federal agencies--conducted regional water quality stream studies for use in a seven-county planning program. The Menomonee River and its tributaries were monitored at twelve stations for 32 parameters. Present and predicted water quality were judged primarily on the basis of 4 parameters, namely, chloride content, dissolved solids, DO and coliform counts. The results of this investigation confirmed other findings regarding the effects of discharges from the sewage treatment plants at Germantown, Menomonee Falls and Butler. Oxygen depletion and high coliform counts were most evident at sites downstream from these treatment plants. High salt and dissolved solids concentrations were related to surface runoff from residential areas and to industrial waste discharges in the Underwood and Honey Creek subwatersheds. Chloride levels in these creeks averaged 210 and 370 mg/l (ppm), respectively, which compared with averages of 100 and 65 mg/l (ppm) for the Menomonee and Little Menomonee Rivers. Chlorides in residential runoff were attributed to overland seepage from private septic tank systems; however, street and highway de-icing activities likely contributed to the higher salt concentrations during the winter and spring periods. Throughout the course of the investigation oxygen deficits were more pronounced in the Menomonee and Little Menomonee Rivers than in Underwood and Honey Creeks. This was due, in part, to the seasonal loadings of organic materials from the marshy headwater regions of the Menomonee River.

A study supported by UW-WRC (7) between July 1968 and June 1970, allowed an evaluation of phosphorus loadings to Lake Michigan from the Menomonee River watershed. Phosphorus loadings, resulting from surface runoff from an agricultural subwatershed were correlated statistically with quantities of precipitation. However, phosphorus concentrations were not correlated statistically. Dissolved orthophosphate was found to comprise the greatest percentage of the total phosphorus and at times was indistinguishable from total phosphorus in the limited number of comparisons made. The sewage treatment plants in the villages of Germantown,

Menomonee Falls and Butler were major sources of phosphorus; effluent contained 20 to 40 mg/l of PO_4 (equivalent to 6.5 to 13.0 mg/l of P). Eutrophic conditions were evident during the summer months at several locations downstream from the treatment plant outfalls where concentrations of dissolved orthophosphate were frequently in the range of 3 to 6 mg/l of PO_4 (0.98 to 1.96 mg/l of P) and dense growth of aquatic plants was common. It was estimated that an average of 568 kg (1,250 lb) of PO_4 per day were discharged from the Menomonee River watershed to Lake Michigan; sewage treatment plants served as the source for approximately 40% of this phosphorus.

During the summer of 1972, investigators from Marquette University (8) conducted a survey of selected physical, chemical and biological parameters in the industrial sector of the lower Menomonee River. During a week of intensive sampling, fecal coliform and fecal streptococci counts averaged 1.7×10^6 and 2.1×10^3/100 ml, respectively. Nitrate contents, on average, were less than 5 mg/l (ppm) whereas chloride contents averaged 145 mg/l (ppm) with a range of 15 to 1,270 mg/l (ppm). Qualitative analysis of river bottom sediments indicated the presence of cresols and possible accumulations of trace and heavy metals. Furthermore, some residues of chlorinated hydrocarbons were noted in some sediment and fish samples; however, concentrations in the water samples were below the detection limit of the analytical techniques employed. Lead concentrations in river water samples at most sites were in the range of 15 to 25 μg/l (ppb), however, levels at one site were found to be as high as 121 and 139 μg/l (ppb) on two different dates. These high lead concentrations may have been caused by automobile emissions although no reasons could be offered for the lack of lead at nearby sites.

All but the Zanoni study (7) have dealt with the identification of point sources of pollution and further investigations are required to evaluate non-point sources of pollution in the watershed.

IV. MENOMONEE RIVER PILOT WATERSHED STUDY PLAN

Although it is fully understood that each of three sub-objectives are completely interrelated, the work plan is discussed and subdivided to parallel the sub-objectives. Thus, the plan is designed in three sections corresponding to sub-objectives A, B and C and each of the sections is divided into work units designated by a numbering system shown in the Menomonee River pilot watershed study plan (Fig. 4). The work units are identified by the two or more numbers which delineate a particular activity. Each of the work units is identified with one of the lead agencies, namely--WDNR, UW-WRC and SEWRPC--solely for the purpose of indicating that the particular agency will provide the leadership and major reporting responsibilities for that work unit. It should not be inferred that the activities have been segmented in such a fashion that coordination and cooperation implicit in the program design have been negated. A time sechedule for completion of the individual work units is shown in bar graph form in Fig. 5.

To give a more concise overview of the three work plan sections (sections A, B and C), Fig. 4 has been subdivided to present the work units involved in meeting a particular objective; these figures appear with the text.

Supplemental activities which must be pursued in conjunction with the sub-objectives are outlined separately and include: computer operations; information dissemination and report preparation.

A. WATER QUALITY: Monitoring of the Menomonee River Watershed System

The position of the particular work units within the overall work plan for section A is shown in Fig. 6.

Work Unit 100-225 (WDNR) Water Quality Parameters

The list of parameters adopted for the water quality studies includes the basic "core" list recommended by the Task C Technical Committee for

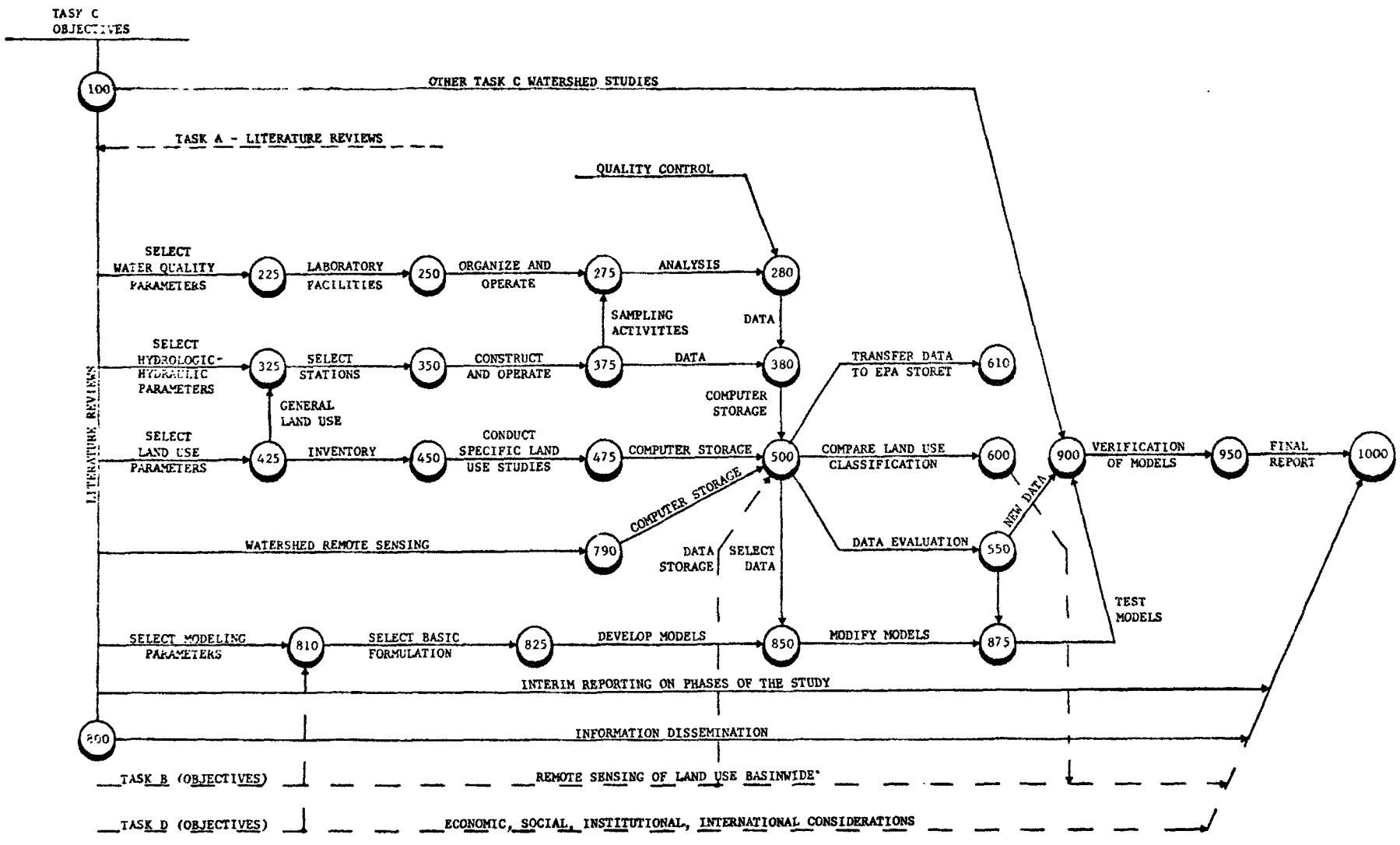
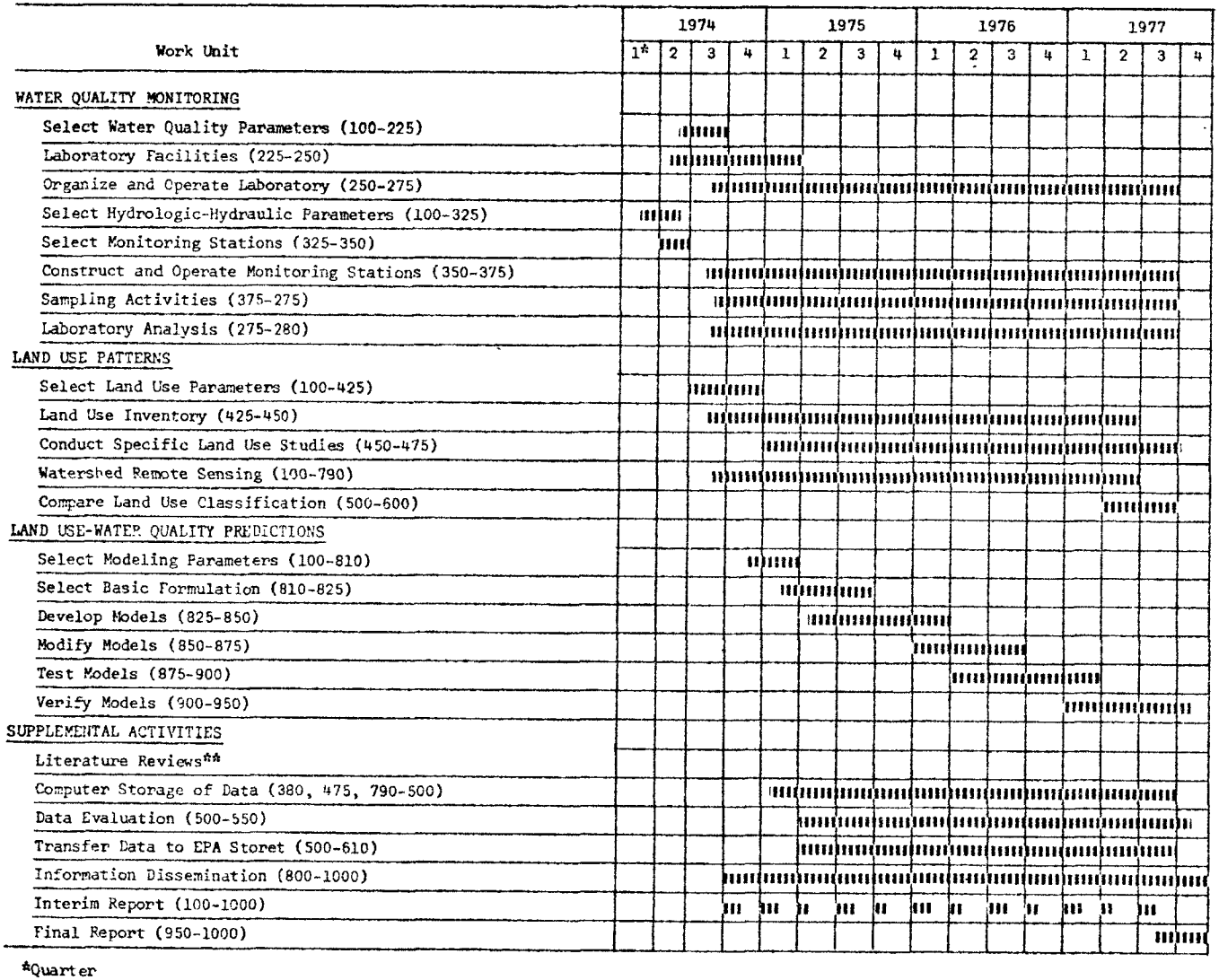


Fig. 4. Overall study plan.



*Quarter

**Periodic review and updating of literature by project personnel and inputs from Task A

Fig. 5. Time schedule of activities.

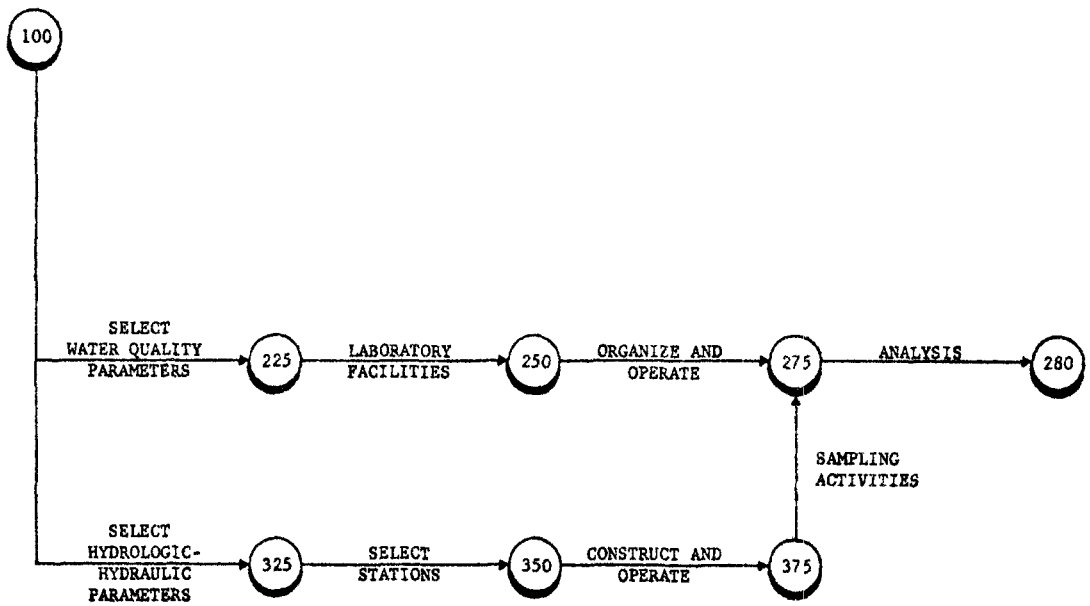


Fig. 6. Study plan for objective A.

use in all pilot watershed studies. Additional parameters have been selected to fit the needs of the Menomonee River pilot watershed study. Table 1 summarizes the specific water quality and sediment parameters selected for laboratory analysis. The group listings shown in Table 1 correspond to the field study time schedules described in subsequent work units, namely, 375-275 and 275-280.

Work Unit 100-325 (SEWRPC) Hydrologic-Hydraulic Parameters

Basic hydrologic information to be selected for the study will include parameters pertinent to the atmospheric phase of the hydrologic cycle such as precipitation, temperature, solar radiation, potential evaporation, wind, and relative humidity data; parameters related to the surface water phase of the cycle such as streamflow, river stage, soils and land slope data; and information descriptive of the ground water phase of the hydrologic cycle such as the vertical and horizontal extent of the aquifers underlying the watershed and the quantity of water contained within and moving through them. Some of the basic hydrologic data will be subjected to statistical analyses to develop flow duration curves and high and low flow discharge-frequency relationships.

Basic hydraulic data to be selected will include surface water information such as channel profiles, floodland cross sections, roughness coefficients and hydraulic structure plans and such ground water data as hydraulic conductivity values and potentiometric surface maps for the shallow and deep aquifers underlying the watershed.

Much of the hydrologic-hydraulic data will be provided by the SEWRPC as a product of its water resources planning programs. This data will be supplemented with hydrologic data collected during the monitoring phase of the pilot watershed study. This supplemental data will include continuous streamflow and precipitation measurements.

Work Unit 325-350 (WDNR) Selection of Monitoring Stations

A monitoring network has been developed for the Menomonee River watershed. This network consists of twelve automatic water quality

Table 1 - Selected water quality parameters

Parameters determined on water samples	Parameters determined on water & sediment samples	Parameters determined on sediment samples
Group A	Group C (Inorganic)	Group E
Organic nitrogen	Copper	Total nitrogen
Ammonium-nitrogen	Lead	Ammonium nitrogen
Nitrate-nitrogen	Zinc	Total phosphorus
Nitrite-nitrogen	Chromium	Orthophosphate
Total-phosphorus	Arsenic	Cation exchange capacity
Dissolved ortho-phosphate	Selenium	Amorphous minerals
Alkalinity	Nickel	Particle size distribution
Hardness	Cadmium	Total carbonates
Chloride	Mercury	pH
Total carbon	Group C (Organic)	Organic matter
Dissolved carbon	Phenolics	Suspended sediment
Total suspended solids	Cyanide	Group F
Turbidity	PCBs'	Clay
Group B	Phthalate	Silt
Total coliform counts	DDT	Sand
Fecal coliform counts	DDD	Mineralogy
Fecal streptococci counts	DDE	
	Heptachlor	
	Aldrin	
	Lindane	
	Heptachlor epoxide	
	Dieldrin	
	Methoxychlor	
	Group D	
	*Sulfate	
	*Silica	
	Iron	
	Aluminum	
	Calcium	
	Magnesium	
	Manganese	
	Sodium	
	Potassium	

*Parameter will not be measured on sediment samples.

and sediment samplers with eleven associated automatic gauging stations (flow will not be measured at station 413004). In addition, three grab sample stations have been established in the harbor area. Continuous probe-type monitors (for temperature, dissolved oxygen, pH and conductivity) will be installed at five of the automatic sites. The locations will be determined at a later date.

The selection of sampling sites was based primarily upon the distribution of the diverse urban and urbanizing land uses in the Menomonee River watershed. The stations are located either downstream from mixed land use activities, such as the transition from rural to urban areas, or are located to characterize the runoff from areas of homogeneous land uses.

Figure 7 shows the location of the monitoring stations and Table 2 is a listing of the stations with STORET Primary Station Numbers, locations and types, together with a brief description of the activities to be monitored at each station.

Work Unit 350-375 (WDNR-USGS) Installation of River Network Sampling Stations

Construction of facilities for housing the monitoring equipment was begun in August 1974. This activity has been subcontracted to the U.S. Geological Survey and will include installation and maintenance of eleven streamflow recording and twelve automatic water sampling devices. Additionally, five of these stations will be equipped with electronic sensor type monitors for measurement of dissolved oxygen, pH, conductivity and temperature. Water sample collection will be regulated on a proportional flow basis while the flow recording and electronic sensor units will operate continuously. Present plans require the complete installation of monitoring instrumentation by early December with a brief time allowance for a short equipment testing period. The total system is expected to be fully operational by January 1, 1975.

Work Units 225-250, 250-275, 275-280 (WDNR) Laboratory Analysis

Laboratory support for the river network monitoring activities will

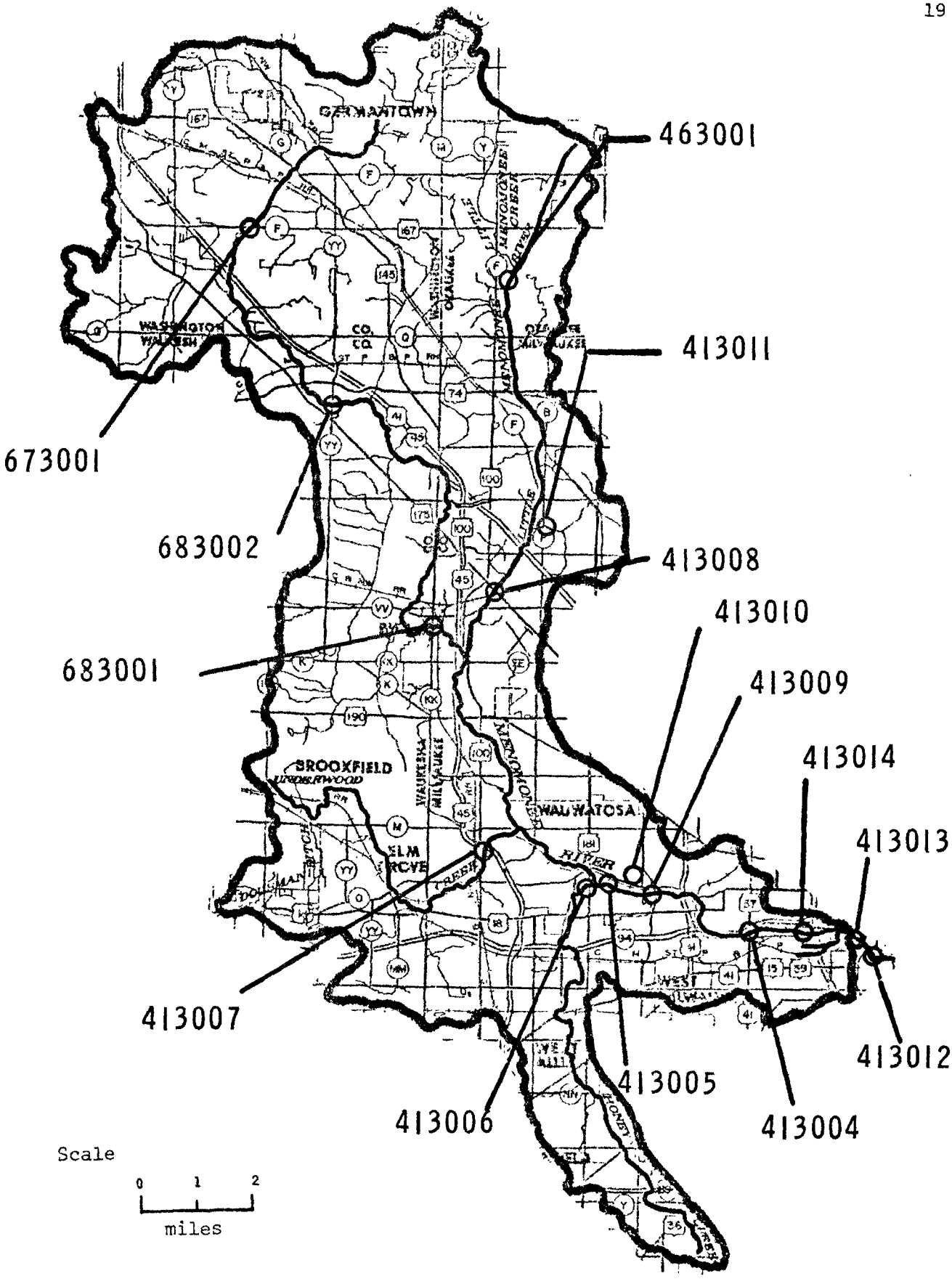


Figure 7. Location of monitoring stations.

Table 2 - Selection of monitoring stations for the Menomonee River pilot watershed study

Station No.	Location	Type*	Monitoring activities
413012	Milwaukee Harbor at N. Broadway (Hwy. 32) bridge	4	Estuary waters of Lake Michigan and the Menomonee and Milwaukee Rivers
413013	Menomonee River at 2nd St. (N. Plankinton) bridge	4	Last station on Menomonee River before confluence with the Milwaukee. Monitors entire watershed and local shipping activities
413014	Menomonee River at N. 13th St. bridge	4	Industrial activities including railroad yards and shipping
413004	Menomonee River above 27th St. at Falk Corporation	2	Industrial activities including railroad yards. Combined and separate sewer systems
413009	Menomonee River at Hawley Rd.	3	Located at combined sewer system outfall
413005	Menomonee River at 70th St. bridge	1	Runoff from urban development, light industry and expressway development
413006	Honey Creek 150 yards above confluence with Menomonee River along Honey Creek Parkway Dr.	1	Monitor net effect of Honey Creek, a densely populated residential area
413010	Schoonmaker Creek at Vliet St.	3	Monitor net effect of Schoonmaker Creek stormwater runoff from an older residential area
413007	Underwood Creek above Hwy. 45 off North Ave.	1	Monitor net effect of Underwood Creek runoff from a residential and light industrial developing area

*Station types are 1. automatic sampling and continuous flow, 2. automatic sampling only, 3. storm water station - automatic sampling and continuous flow dependent on flow conditions, and 4. grab sample.

Table 2 (continued)

Station No.	Location	Type*	Monitoring activities
683001	Menomonee River at 124th St. (Hwy. M)	1	Monitor the quality of the Upper Menomonee River above the Town of Butler sewage treatment plant and the confluence with the Menomonee River
413008	Little Menomonee River at Appleton Ave. (Hwy. 175)	1	Monitor effect of the rural to urban land use transition above the confluence with the Menomonee River
413011	Noyes Creek at 91st St.	3	Monitor net effect of Noyes Creek stormwater runoff from a new residential area
683002	Menomonee River at Pilgrim Rd. (Hwy. YY)	1	Monitor the transition from a rural to urban land use
463001	Little Menomonee River at Donges Bay Rd.	1	Monitor the transition from a rural to urban land use
673001	Menomonee River at River Lane Rd. (Hwy. F)	1	Monitor rural land usage (agriculture) with a new residential lake and golf course development

*Station types are 1. automatic sampling and continuous flow, 2. automatic sampling only, 3. storm water station - automatic sampling and continuous flow dependent on flow conditions, and 4. grab sample.

be conducted by a cooperative agreement with the Laboratory Services Section of the WDNR. This agreement was initiated in July 1974, concurrent with the establishment of preliminary sampling stations in the Milwaukee harbor area. This arrangement with WDNR has been made for the duration of the pilot watershed investigation. Laboratory analytical techniques will follow the standardized procedures recommended by the U.S. EPA Analytical Methods Manual and by techniques selected by the Task C Technical Committee. The adoption of standard techniques for the entire Task C program will ensure data comparability and provide the greatest opportunity for integration of data on a Great Lakes Basin-wide scale.

Work Unit 375-275 (WDNR) Sampling Activities

Collection of samples from the nine automatically operated stations (Types 1 and 2 described in Table 2) on the Menomonee River and its major tributaries will be made on a weekly basis beginning January 1, 1975. Storm water runoff areas (Type 3, Table 2) will be equipped with automatic sample collection and continuous gauging capability, however, the frequency of sample collection will be determined by flow conditions, i.e., runoff events, snow melt, etc. During periods of high runoff (spring and fall runoff and selected rainfall events) the sampling frequency at the nine river and tributary stations will be increased to an average of four times per week. In general, the increased sampling frequency will cover a period of 10 to 12 weeks during each year. Three grab sample stations have been established in the Milwaukee harbor area and will be sampled weekly. Depth profiles for dissolved oxygen, pH and temperature along with samples at various depths will be obtained at these stations. Collection of these grab samples was initiated in the summer of 1974. All samples obtained will be analyzed for the Group A parameters (Table 1). Parameters in Groups B, C and D (Table 1) will be determined on a less frequent basis. The frequency of these analyses will be determined by the results of the preliminary data evaluations. In addition to the parameters listed in Table 1, temperature, pH, dissolved oxygen and

conductivity will be determined in the field at each sampling time for the stations not utilizing continuous probe-type monitors.

Bottom sediments will be obtained from selected locations and screened initially for each of the parameters contained in Groups C, D, E and F (Table 1). Subsequent sediment characterization will be determined on a quarterly basis and will focus primarily on the mobile chemical constituents in the sediment near the sediment-water interface. Benthic organisms also will be characterized from these quarterly samples.

Biannual, 24-hour composite surveys will commence in the spring of 1975 at the Germantown and Menomonee Falls waste water treatment plants. These are the only treatment plants within the watershed which are discharging significant quantities of treated effluent on a continuous basis. Initial laboratory analyses will cover a full range of parameters to characterize the discharged effluent. Analyses will include, but will not be limited to, nutrients, pesticides and other organics and heavy metals. The Village of Butler is now under contract to the Milwaukee Metropolitan Sewerage Commission for treatment of wastes up to 400,000 gals/day. The excess effluent is chlorinated prior to discharge to the Menomonee River. Since this discharge is not a continuous flow, regular surveys will not be conducted.

The atmosphere may be a source of several of the constituents being transported in the Menomonee River system. The transfer of materials from the atmosphere to the watershed will be monitored in order to develop a mass balance. A basic air quality monitoring system already exists in and near the watershed. The in-watershed portion of that system, which consists of four continuous air quality monitoring sites and two sites at which only particulates are measured, will be supplemented with additional particulate measuring and precipitation recording devices. The air quality monitoring system will permit determination of the rates at which constituents are being added to the water and land surfaces from the atmosphere, either as particulate fallout or rainout. The additional sites will be selected so that they, in conjunction with the existing air quality monitoring sites, will be uniformly distributed over the watershed.

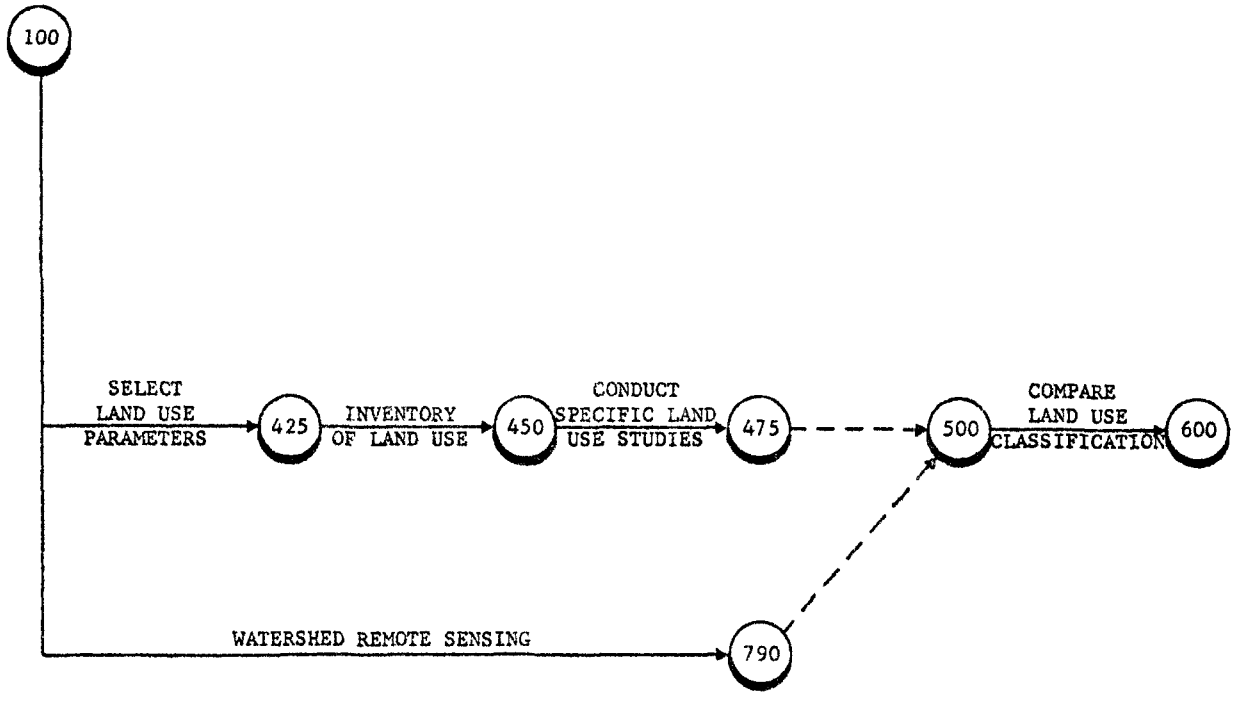


Fig. 8. Study plan for objective B.

B. LAND USE PATTERNS IN THE MENOMONEE RIVER WATERSHED: Sources and Behavior of Pollutants

The position of the particular work units within the overall work plan for section B is shown in Fig. 8.

Work Unit 100-425 (SEWRPC) Selection of Land Use Parameters

The results of literature reviews coupled with the modeling experience of the pilot watershed study participants will result in the identification of a list of land use parameters for which quantitative data are to be obtained for the entire Menomonee River watershed. With respect to its use, this data will be subject to two restrictions. First, it must be of sufficient detail to meet the needs of the land use-water quality model to be developed for the Menomonee River watershed; and secondly, the land use data must be upward compatible with the general land use categories being inventoried by the Task B Subgroup.

The basic land use classification system to be used is that employed by the SEWRPC. This system utilizes nine general land use categories, consisting of seven urban categories--1. residential, 2. retail and service, 3. wholesale and storage, 4. manufacturing, 5. transportation, communication and utilities, 6. government and institutional, and 7. park and recreation; and two rural categories--1. agriculture and related, and 2. other open space lands, swamps and water areas. Each of these nine general categories is subdivided into two to 10 detailed land uses resulting in a total of 41 detailed land use categories.

While this classification system employing 41 land use categories will meet the needs of the land use-water quality model for the entire Menomonee River watershed, the classification system may not be adequate for special short term research studies to be conducted during the course of the project such as investigations of the characteristics and impact of runoff from roadways or certain bulk storage areas on water quality. In the case of these unique situations, supplemental land use classifications may be required.

Work Unit 425-450 (SEWRPC) Inventory of Land Use

Aerial photographs of the Menomonee River watershed at a scale of 1" = 400' as obtained by the SEWRPC in 1963, 1967 and 1970, and planned for spring of 1975 constitute the primary data source for the inventory and collation of land use data. By means of photo interpretation, supplemented with on-site checks, 41 land use categories have been identified on the 1963, 1967 and 1970 aerial photographs and will be identified on the 1975 aerial photographs. The identified land uses have been or will be delineated on overlays to the aerial photographs. These overlays will be subdivided into small cells, and the coordinates and dominant land use of each cell will be determined prior to entering the land use data into a digital computer file.

Work Unit 450-475 (UW-WRC) Specific Land Use Studies

Intensive studies of specific land use activities in the Menomonee River watershed will be conducted. The overall objective of these studies is to determine the sources, quality, quantity and behavior of major pollutants associated with land drainage originating from various segments of the watershed. The general approach of the study will be to divide the watershed into sub-basins. In each sub-basin specific land use activities will be identified and the physical characteristics of each inventoried by SEWRPC. Selection of typical land use areas will be made such that the pollutants arising from these areas will be representative of similar areas within the basin. Further, the selection of areas will be made to maximize the isolation of major pollutional loads arising from the specific land use. Each selected site will be provided with automatic sampling and gauging stations. The WDNR has identified 12 sampling stations and installation of permanent automatic sampling and gauging equipment is underway. If use of the permanent (WDNR) stations can provide the necessary information, mobile stations will not be required.

Table 3 is a listing of specific land use activities and related pollutants that require intensive investigation. This list is not exhaustive and it is likely that other special land use activities may be

Table 3 - Specific land use activities to be investigated and their related pollutants

Specific Land Use Activity	Specific Land Use Practice	Pollutant to be Investigated
	TRANSPORTATION	
Highways and roads	Road construction including an overpass	Sediments, nutrients, organics
Highways and roads	Road maintenance including weed control and deicing	Sediments, nutrients, pesticides and other organics, salts
Railroads	Railway maintenance including weed control and tie replacement	Sediments, nutrients, pesticides
Airport	Airport expansion and maintenance	Sediments, nutrients, salts
	UTILITIES (Electrical, Telephone, Pipeline)	
Utility lines	Utility construction	Sediments, nutrients, organics
Utility lines	Utility maintenance including weed control	Sediments, nutrients, pesticides
	RESIDENTIAL AREAS	
New and developing areas	Residential construction	Sediments, nutrients
New and developing areas	Residential maintenance including lawns and garden care, street cleaning, and deicing	Sediments, nutrients, pesticides, coliform bacteria
Established areas - High population density	Residential maintenance including lawns and garden care, street cleaning, and deicing	Sediments, nutrients, pesticides, coliform bacteria
Established areas - Low population density	Residential maintenance including lawns and garden care, street cleaning, and deicing	Sediments, nutrients, pesticides, coliform bacteria
	COMMERCIAL AND INDUSTRIAL AREAS	
New and developing areas	Construction and development of commercial and industrial complexes	Sediments, nutrients, organics
New and developing areas	Maintenance and operation within grounds and parking areas	Sediments, nutrients, pesticides and other organics
Established areas	Maintenance and operation within grounds and parking areas - commercial	Sediments, nutrients, pesticides and other organics
Established areas	Maintenance and operation within grounds and parking areas - light industry	Sediments, nutrients, pesticides and other organics
Established areas	Maintenance and operation within grounds and parking areas - heavy industry	Sediments, nutrients, pesticides and other organics
	RECREATIONAL AREAS	
Park	Maintenance and operation within a park	Sediments, nutrients, pesticides and other organics, coliform bacteria
Golf course	Maintenance and operation within a golf course	Sediments, nutrients, pesticides and other organics
	LAND DISPOSAL AREA	
Landfill	Solid waste disposal	Nutrients, organics, toxic elements

identified as the study progresses.

Work Units 100-790 and 500-600 (UW-WRC) Remote Sensing

The remote sensing task will primarily involve the detection and location of thermal outfalls along the Menomonee River and the analysis of land cover in selected sub-basins.

Thermal outfalls will be located using aircraft thermal scanner analysis. This will be a cooperative effort between the University of Wisconsin Environmental Monitoring and Data Acquisition Group and the WDNR. The locations of these point source pollutants will be related to the monitoring stations at the time of the mission. Hence, this capability may locate known and previously unknown point sources of pollution and will be helpful also in model development.

Another useful application of the aircraft-collected thermal imagery and photography will be in the delineation of hydrologically active areas, such as partial source areas. It will be important to locate these areas to enable better quantifications of interflow and overland flow.

High altitude aircraft photography will be digitized and computer processed to develop land cover maps within three sub-basins. The sub-basins were chosen to include an urban, a residential and an agricultural area. This technique will be evaluated by relating the remotely sensed output to the ground truth information available in the data files of the SEWRPC.

The remotely sensed parameters will be placed into computer storage according to a readily useable format, such as the unit cell arrangement. The land use parameters will be in a form complementary to other stored parameters and will be coordinated with the computer facilities of the participants.

C. LAND USE-WATER QUALITY PREDICTION: Modeling of the Menomonee River Watershed System

The position of the particular work units within the overall work plan for section C is shown in Fig. 9.

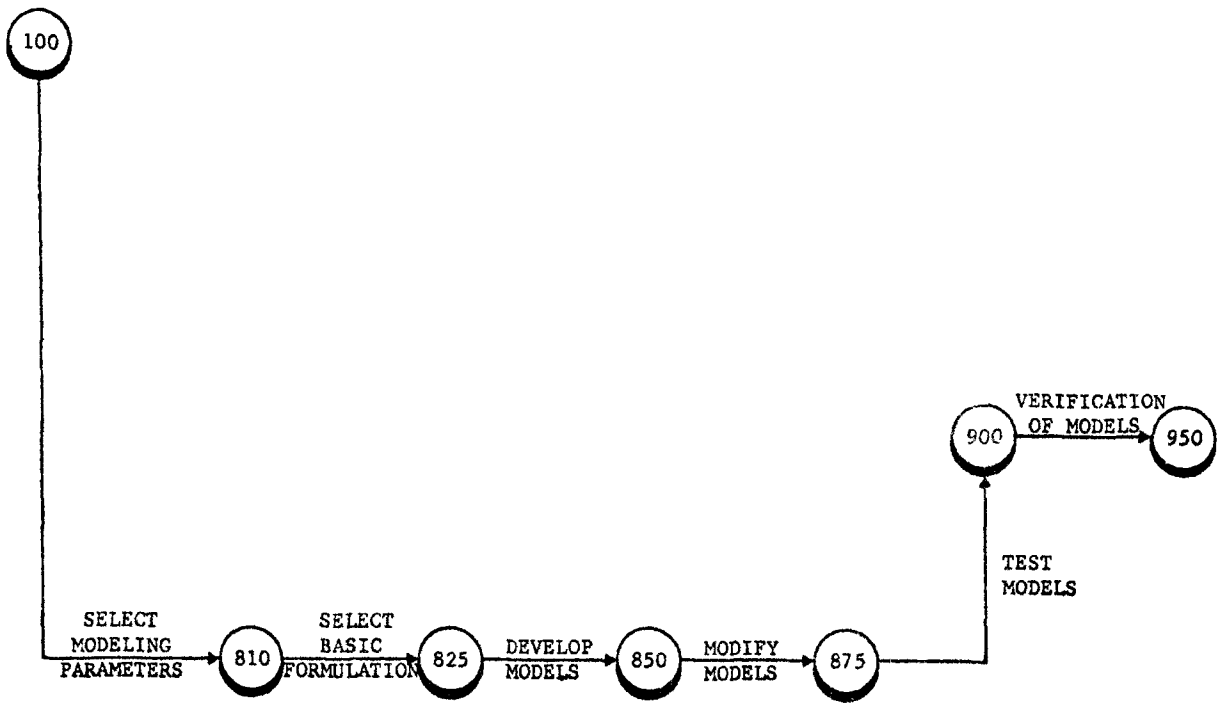


Fig. 9. Study plan for objective C.

Work Unit 100-810 (UW-WRC) Selection of Modeling Parameters

The applications of systems analysis techniques to the Menomonee River pilot watershed study will be used to support the goals of the International effort and will not become an end in itself. Thus, it will be necessary to develop an overall system with complementary elements which evaluate, simulate and account for interactions between essential parameters. As an initial step it is useful to format the study plan according to the critical-path method. From this analysis it is seen that the the objectives of the Menomonee Study are constrained and broadened within the limits imposed by the other activities of the Pollution from Land Use Activities Reference Group, namely, Task B, other watershed studies in Task C and the future requirements of Task D.

With an appreciation of the overall PLUARG activities it will be necessary to describe in some detail the essential parameters that must be included in the modeling and analysis activities. Flexibility will be maintained in the modeling effort to provide an iterative process in the developing stages. The parameters to be included in the models will be selected from those identified in the chain of activities 100-225, 100-325, 100-425 and 100-790, as well as parameters which will provide a linkage between the land use and water quality elements. Special consideration will be placed on identifying those parameters that have the strongest cause and effect relationship among the numerous parameters identified for possible consideration.

Work Unit 810-825 (UW-WRC) Selection of Basic Modeling System

It is unlikely that the objectives of this multi-dimensional study can be serviced effectively by a single model and it is highly possible that an array of models will be necessary to accomplish various tasks. Therefore, it will be essential to provide for a "system of models" that will avoid duplication and encourage interaction.

The formulation of models may take three fundamental forms (Fig. 9). One approach would be to develop mathematical models to describe as closely as possible the physical processes of nature. Because of the

limitation of these models to describe accurately the physical system and the lack of mathematical techniques capable of finding a solution to the described system, it is often necessary to simulate the system, as either steady state or stochastic processes, and run sensitivity analyses on the parameters of the models. These models are referred to as deterministic models.

A second general approach is to develop simple parametric models for stationary and non-stationary time series. This method requires empirical reduction of a given time series to uncorrelated residuals. The approach leads to autocorrelation time series models containing only a few parameters which may be used to forecast future events. As such, correlation analysis is used to fit a random process model to a given time series.

A third group of models may be described as decision or optimization models. These models apply mathematical optimization techniques of operations research to watershed management alternatives. To use many of the optimization techniques available it is necessary to simplify the problem under analysis because of the mathematical limitation of the available method. However, simulation models may be used to effectively guide the modification of the problem description so that the results will have application in the real world.

In recent years, several models have been developed for use in watersheds. Thus, it will be necessary to review the recent literature and make an overall assessment of the application of systems analysis techniques to problems associated with water quality management and land use activities. Members of the study teams from the WDNR, SEWRPC, UW-WRC and other experts from the university sector will participate in the assessment with UW-WRC providing leadership. As a result of the joint evaluation a specifically organized modeling format will be selected.

Work Unit 825-850 (UW-WRC) Development of Models

The decisions made in work unit 310-825--basic modeling formation--will dictate the activities to be undertaken in developing models and the

degree of intensity to which each activity will be pursued.

At this point one may speculate that a series of deterministic models will be applied to describe the watershed. Because of the difficulty in describing the cause and effect relationships between land use activities in the watershed and the resulting water quality in the receiving waters, it may be useful to develop three separate models to represent different sub-units within a watershed network, namely, overland flow (including subsurface, non-point sources), stream flow and river flow (including main-stream and larger tributaries). Subdividing the river network in this manner provides for the spatial and temporal differences which exist between the flow patterns of these sub-units, and the increments of time at which they will be monitored. The overland-subsurface flow model will be used to describe the water quality parameters that are affected by specific land use activities from a limited area (< 10 acres) and the active response time will be within units of an hour. At the other extreme the river model will describe the drainage from 1,000 acres to that of the entire watershed in terms of daily intervals.

An analytical approach to the land use-water quality model may be to use water as a carrier of foreign material--causing a change in water quality. By modeling the movement of water through the system, the basis for transporting the foreign material is established. As such, the transport and transformation of materials and their chemical forms within the system can be "piggy-backed" onto a hydrologic simulation to achieve a basin-wide, interactive model. Wherever appropriate, every effort would be made to adopt or modify existing models developed for IBP, EPA, OWRT, etc.

Apart from the deterministic models it may be useful to develop statistical models to check the reliability of the descriptive models and to provide additional capabilities to better predict future conditions. For example, it may be desirable to investigate the usefulness of an auto-regressive time-series model to analyze the quantity and quality of the river water being discharged to Lake Michigan.

Work Unit 850-875 (UW-WRC) Modify Models

The major activity to be achieved by this work element will be to develop the software necessary to effectively utilize the geographic, land use and water data stored in the computer system in operating the developed models. To make the operation of the models economically efficient it may be necessary to adopt changes in the connecting links between the individual models.

After the computer software is operational, it will be necessary to check the individual models to determine whether they are receiving the correct information from the data file, and if the elements of the program are functioning properly. Preliminary water quality monitoring information will be used to check the models and to make changes in the models.

The Univac 1110 computer at UW will be the principal computer used for the modeling activities, with secondary support from the Xerox Sigma Six computer at Marquette University and the IBM 370-125 computer at SEWRPC. The UW-WRC staff will provide the coordination for the entire modeling effort.

Work Unit 875-900 (UW-WRC) Testing of Models

After the models have been modified to operate within the data system, it will be necessary to test the developed models against the data that have been collected and evaluated from the watershed. During this work element it will be necessary to establish the sensitivity of the models to key parameters, and identify the change in parametric control based on variation in geographical location, time, and season. Should the deterministic series modeling be selected, where a separate model exists for overland-, stream- and river-flow, it will be necessary to describe the response surfaces interfacing these models. As in the previous activity, the testing of the models will be principally conducted on the Univac 1110 computer.

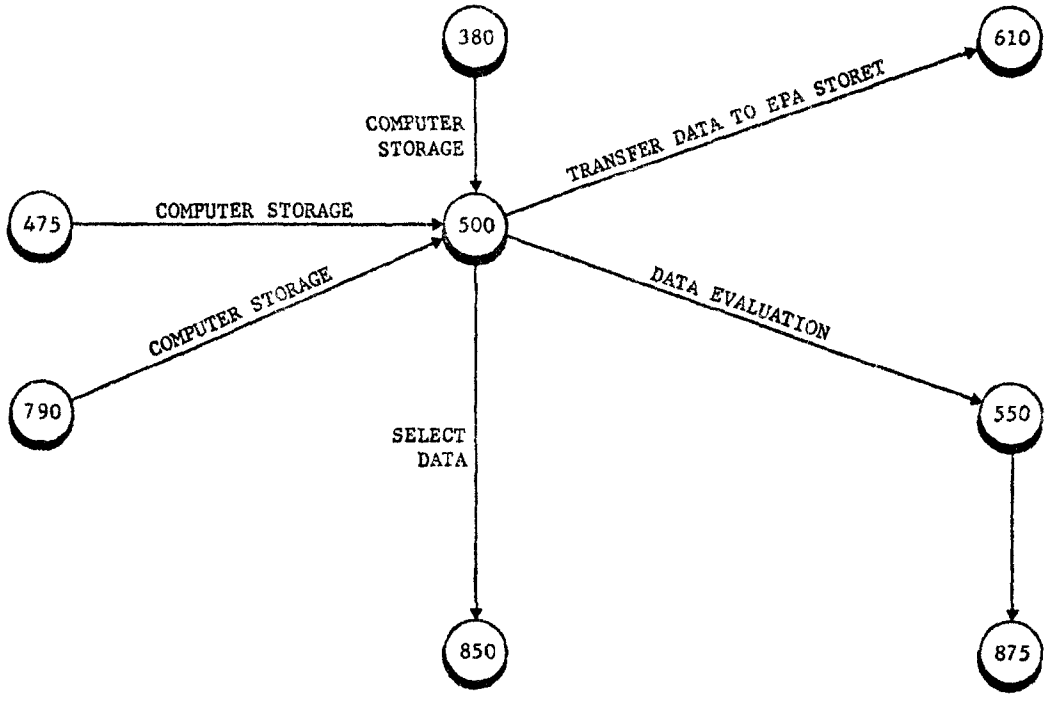


Fig. 10. Study plan for data evaluation and storage.

Work Unit 900-950 (UW-WRC, WDNR, SEWRPC) Model Verification

The modeling activities of the Menomonee River watershed will be developed in coordination with the other IJC pilot watershed studies. Once the models have been tested for the individual watersheds, it will be necessary to validate the models using data from similar watersheds in the system. Validation of these mdoels will be required before they can be made available to project the water quality conditions of the rivers entering the entire Great Lakes system.

SUPPLEMENTAL ACTIVITIES: Activities in Support of the Study Objectives

The position of the particular work units within the overall work plan for data evaluation and storage is shown in Fig. 10.

Work Unit 500-550 (UW-WRC) Data Evaluation

Data gathered by the three lead organizations will be evaluated on a continuous basis throughout the study period. Coordinated data evaluation and interpretation is imperative for establishing guidelines for determining the relevance of data to the objectives of the study and adequacy of data for the development, modification and testing of the land use-water quality model. Further, it will provide for the refinement and/or modification of schemes for gathering data which include experimental design, sampling techniques and frequency, and analytical techniques. Evaluations of data in the early phases of the study (FY '75) will isolate parameters that are not relevant to the study and will indicate the introduction of new parameters needed to meet the overall objectives of the study.

In order to obtain valid inferences from which conclusions will be drawn to answer the objectives of the study, statistical analyses will be employed. Basic data developed in the study will be compiled and tabulated according to designed statistical formats and results will be subjected to appropriate statistical analysis. Statistical analysis will determine the best estimates of parameters and stability of analytical values. Statistical analysis will also provide a means for determining

the significance, relationships and trends of selected water quality parameters as influenced by land use activities in a rapidly urbanizing watershed.

Work Unit 500-850 and 550-875 (UW-WRC) Data Storage, Processing and Dissemination

One of the major problems encountered in large multi-disciplinary programs is data collection, analysis and dissemination. Firm decisions regarding data processing must be made before the initiation of the program to ensure usefulness of the data to participants and outside interests.

The UW-WRC, in cooperation with the WDNR and SEWRPC, will coordinate data processing. The main thrust of this activity will be to ensure data compatibility between participants. This activity will be accomplished by:

Clearly defining data file format needs for participants and computers.

Establishing programs for reformating data tapes for those instances when a participant cannot provide the data in the required format.

Establishing guidelines for presentation of data (printout).

Consultation with a systems analyst to expedite data flow between participants.

The flow of processed and unprocessed information is critical to the success of the study plan. The participants, in the initial phase of the study, have agreed upon certain computer activities to facilitate information transfer as outlined below:

UW-WRC Univac 1110

The UW-WRC will provide computer support for the storage and processing of field and laboratory data (special land-use studies), model calculations, remote sensing data and the dissemination of information. Raw and evaluated data (work elements 500-850 and 550-875) will be provided in a format suitable for model development and modification.

WDNR Univac 1110 (UW)

WDNR through use of the UW computer will provide computer support for the storage and processing of field and laboratory data from the twelve (WDNR) sample site locations.

SEWRPC IBM 370-125

SEWRPC will provide information on the Menomonee River watershed and its environs. It will also lend assistance in model formation and development.

It is anticipated that by clearly defining participants data needs and establishing lines of communication between participants, program delays can be eliminated or lessened.

Work Unit 500-610 (WDNR) STORET

In conformance with the requirements of the project, all data collected throughout the study period will be submitted to the U.S. EPA STORET system. Final procedures will be based upon the East Lansing Study Group recommendations and will be in accordance with EPA guidelines. All water quality monitoring data will be placed on tape in STORET's Decimal Input (DIP) format. It is proposed that all data be stored under a unique agency number and protection key so as to limit access of stored information until the data have been analyzed and reported.

Work Unit 800-1000 (UW-WRC) Information Dissemination

An important aspect of the PLUARG program must center on providing public awareness of the activities and recommendations of the programs constituting the pilot watershed studies. This awareness can best be achieved through an effective information program geared to providing a variety of audiences with materials packaged in a manner most suitable to their comprehension and needs. The initial step in the process requires identification of the different audiences which might include the general public, decision making officials, technical personnel and other special interest groups. The UW-WRC has a long-standing information dissemination program which can be brought to bear on the Menomonee River pilot watershed study. This effort will be coordinated with the information dissemination effort emanating from the IJC Office in Windsor, Ontario.

For example, activities during the first year could include preparation

of newspaper articles, two television 1 minute spots, 7-10 meetings, and 3 to 4 summary reports. This level of activity is planned for the first two years and will taper off in the last year as the information program related to Task D is expanded. Articles highlighting specific aspects of the study will be submitted to local newspapers and other serial publications on a regular basis. The University's reporting staff will write and distribute these stories. University staff and facilities will also be utilized to produce television spots and films. Meetings with local groups and agencies will be conducted by the project personnel at various locations in the watershed. These meetings will be the best means of conveying the significance of the study to the general public and to special interest groups as they will allow direct interaction with project personnel. Brief reports or one-page announcements will be written at several technical levels to publicize selected aspects of the study. Mailing lists maintained by the UW-WRC, WDNR and SEWRPC will aid in reaching the desired audiences.

It is anticipated that together the approaches taken announcing and clarifying the objectives, highlights and conclusions of the study will reach the maximum number of interested citizens in the watershed and provide an opportunity for all interested individuals to understand and support the recommendations of PLUARG.

Furthermore, public awareness of Task C activities will facilitate an understanding and acceptance of the management strategies instigated through the Task D program.

Work Unit 100-1000 (WDNR, UW-WRC, SEWRPC) Report Preparation

Interim reports will be prepared according to the contractual schedule to describe the progress during the reporting period. These reports will summarize the basic data collected and present preliminary and final results developed by the study team. Included in the progress reports will be a narrative description of the work elements that were active during the period, and maps, tables and graphs will be utilized to illustrate the basic data and information. In addition to the presentation of basic information there will be an increasing need to provide an overview of

the results following the evaluation and interpretation of the collected data.

Final results of the study will not be available until the termination of all phases of the study. However, milestones will be established during the study period when independent elements of the research plan are finalized and reported upon.

A special report series will be developed to effectively report on specialized monitoring and research activities, which can be practically separated from other elements of the study. These reports may be developed into technical papers to be submitted for publication in professional and scientific journals or as agency reports.

Progress reporting will be used as a research management tool to focus the efforts of the project staff and supervisory personnel on the objectives of the total study. Thus, the interim reports will provide each member of the multidisciplinary program with a general overview of the entire study. As such,these reports also will inform non-project personnel of study developments.

V. REFERENCES

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2. Wisconsin Department of Natural Resources, "Report of Investigations of Pollution of Surface Waters in Milwaukee County and that Portion of the Root River System Draining from Waukesha County through Milwaukee County Conducted during 1952 and 1953," March, 1954.

3. Wisconsin Department of Natural Resources, "Report on a Field Investigation of Surface Water Quality in Southeastern Wisconsin in the Summer of 1962," (no date).

4. Wisconsin Department of Natural Resources, "Report on an Investigation of the Pollution in the Milwaukee River Basin Made during 1966 and 1967," January, 1968.

5. Wisconsin Department of Natural Resources, "Report on an Investigation of the Pollution of the Milwaukee River, Its Tributaries, and Oak Creek Made during 1968 and 1969," May, 1969.

6. Southeastern Wisconsin Regional Planning Commission, "Water Quality and Flow of Streams in Southeastern Wisconsin," Technical Report No. 4, November, 1966.

7. Zanoni, A., "Eutrophic Evaluation of a Small Multi-Land Use Watershed," U.W. Water Resources Center Technical Report, June, 1970.

8. Marquette University, "Lower Menomonee River--Selected Biological, Chemical, and Physical Parameters," 1972.

VI. BUDGET

The budget is divided into three tables to delineate the total budget being administered by the Wisconsin Department of Natural Resources (Table 4), and the subcontracts to the University of Wisconsin (Table 5) and the Southeastern Wisconsin Regional Planning Commission (Table 6). The budget details are presented for each year of the program.

Table 4. Total Project Budget--Wisconsin Department of Natural Resources

	FY 74 4-1-74 to 6-30-74		FY 75 7-1-74 to 6-30-75		FY 76 7-1-75 to 6-30-76		FY 77 7-1-76 to 6-30-77		FY 78 7-1-77 to 12-31-77		Total Project 4-1-74 to 12-31-77	
	Total	EPA	Total	EPA	Total	EPA	Total	EPA	Total	EPA	Total	EPA
A. Personnel:												
1. Project Aid - NRS 1 (M. A. Byrans)												
Salary	750	750	9,350	9,350	10,000	10,000	10,700	10,700	5,725	5,725	36,525	36,525
F. B.	150	150	1,870	1,870	2,000	2,000	2,140	2,140	1,153	1,153	7,313	7,313
2. Field Coordinator - NRS 1 (D. L. Misterek)												
Salary	750	750	9,350	9,350	10,000	10,000	10,700	10,700	5,725	5,725	36,525	36,525
F. B.	150	150	1,870	1,870	2,000	2,000	2,140	2,140	1,153	1,153	7,313	7,313
3. Data Coordinator - MIT 2 (D. R. Scott)												
Salary			8,828	8,828	9,313	9,313	9,825	9,825	5,182	5,182	33,148	33,148
F. B.			1,760	1,760	1,860	1,860	1,970	1,970	1,044	1,044	6,634	6,634
4. DNR Matching J. G. Konrad 50% J. R. McKersie 10% F. H. Schraufnagel 5%												
Salary	1,000		11,000		14,000		15,000		8,000		55,629	
F. B.	240		2,640		3,360		3,600		1,920		11,760	
B. Travel	250	250	1,750	1,750	1,750	1,750	1,750	1,750	1,000	1,000	6,500	6,500
C. Capital Equipment	28,000	28,000	5,000	5,000	1,000	1,000	1,000	1,000	-	-	35,000	35,000
D. Supplies and Services	15,000	15,000	20,000	20,000	1,250	1,250	1,250	1,250	1,850	1,850	39,350	39,350
E. Vehicle Operation	250	250	1,000	1,000	1,000	1,000	1,000	1,000	500	500	3,750	3,750
F. DNR Sampling Programs	2,000	-	3,000	-	3,100	-	2,500	-	2,000	-	12,600	-
G. Laboratory Space Rental	2,000	-	6,000	-	6,000	-	6,000	-	3,000	-	23,000	-
H. Overhead	4,129	3,984	6,324	4,740	6,231	3,732	7,340	4,661	3,617	2,189	27,641	19,306
Subtotal	54,669	49,284	89,742	65,518	72,864	43,905	76,915	47,136	41,869	25,521	336,059	231,364
I. Subcontracts Administered by WDNR												
1. Installation of Monitoring Stations-12 locations U.S.G.S.	100,000	100,000	-	-	-	-	-	-	-	-	100,000	100,000
2. Gaging Station Maintenance-U.S.G.S.	-	-	70,000	70,000	70,500	70,500	71,025	71,025	-	-	211,525	211,525
3. Laboratory Support-WDNR	-	-	115,000	115,000	115,000	115,000	115,000	115,000	25,000	25,000	370,000	370,000
4. Univ. of Wisconsin	-	-	290,277	236,057	295,486	239,376	279,353	221,303	143,093	113,110	1,008,209	809,846
5. Southeast Wis. Reg. Planning Commission	-	-	89,900	89,900	91,200	91,200	44,000	44,000	23,120	23,120	248,220	248,220
6. Special Groundwater Survey	-	-	30,000	30,000	20,000	20,000	-	-	-	-	50,000	50,000
7. Misc. Services SCS, NOAA, additional comp. time etc.	-	-	40,000	40,000	40,000	40,000	40,000	40,000	-	-	120,000	120,000
Total Project Cost	154,669	149,284	724,919	646,475	705,050	619,981	626,293	538,464	233,082	186,751	2,444,013	2,140,955

Table 5. University of Wisconsin Subcontract

		FY 75 7-1-74 to 6-30-75		FY 76 7-1-75 to 6-30-76		FY 77 7-1-76 to 6-30-77		FY 78 7-1-77 to 12-31-77		Total Project 4-1-74 to 12-31-77	
		Total	EPA	Total	EPA	Total	EPA	Total	EPA	Total	EPA
A. Personnel -											
2 Project Associates	Salary	26,250	26,250	27,560	27,560	28,900	28,900	15,200	15,200	97,910	97,910
	F. B.	3,998	3,998	4,190	4,190	4,400	4,400	2,310	2,310	14,898	14,898
	Overhead	14,700	14,700	15,430	15,430	16,200	16,200	8,550	8,550	54,880	54,880
8 Research Assistants 50% Time	Salary	36,800	36,800	38,800	38,800	40,800	40,800	21,420	21,420	137,820	137,820
	F. B.	1,656	1,656	1,746	1,746	1,836	1,836	965	965	6,203	6,203
	Overhead	20,610	20,610	21,730	21,730	22,850	22,850	12,000	12,000	77,190	77,190
1 Secretary	Salary	6,930	6,930	7,035	7,035	7,385	7,385	3,880	3,880	25,230	25,230
	F. B.	1,610	1,610	1,635	1,635	1,716	1,716	902	902	5,863	5,863
	Overhead	3,881	3,881	3,930	3,930	4,136	4,136	2,173	2,173	14,120	14,120
3 Technicians	Salary	28,350	28,350	29,760	29,760	31,255	31,255	16,409	16,409	105,774	105,774
	F. B.	4,312	4,312	4,528	4,528	4,754	4,754	2,495	2,495	16,089	16,089
	Overhead	15,876	15,876	16,670	16,670	17,503	17,503	9,190	9,190	59,239	59,239
Hourly Help 160 Hours/Month	Salary	6,144	6,144	6,450	6,450	6,775	6,775	3,600	3,600	22,969	22,969
	Overhead	3,440	3,440	3,612	3,612	3,793	3,793	2,016	2,016	12,861	12,861
U.W. Matching	Salary	28,000	-	29,000	-	30,000	-	15,500	-	102,500	-
	F. B.	6,720	-	6,960	-	7,200	-	3,720	-	24,600	-
	Overhead	19,500	-	20,150	-	20,850	-	10,763	-	71,263	-
Subtotal		228,777	174,557	239,186	183,076	250,353	192,303	131,093	101,110	849,409	651,046
B. Supplies		15,500	15,500	15,800	15,800	12,500	12,500	4,000	4,000	47,800	47,800
C. Capital Items (Special Sampling & Analyses)		32,500	32,500	25,000	25,000	5,000	5,000	1,000	1,000	63,500	63,500
D. Travel		2,500	2,500	2,500	2,500	2,500	2,500	1,000	1,000	8,500	8,500
E. Publications and Reporting		1,000	1,000	1,000	1,000	1,000	1,000	2,000	2,000	5,000	5,000
F. Computer Time		3,000	3,000	4,000	4,000	4,000	4,000	4,000	4,000	15,000	15,000
G. Data and Info. Retrieval		2,000	2,000	3,000	3,000	2,000	2,000	-	-	7,000	7,000
H. Communications (Local Public Meetings, Newspaper, TV Coverage)		5,000	5,000	5,000	5,000	2,000	2,000	-	-	12,000	12,000
Total To U.W.		290,277	236,057	295,486	239,376	279,353	221,303	143,093	113,110	1,008,209	809,846

Table 6. Southeastern Wisconsin Regional Planning Commission Subcontract

	FY 75 7-1-74 to 6-30-75		FY 76 7-1-75 to 6-30-76		FY 77 7-1-76 to 6-30-77		FY 78 7-1-77 to 12-31-77		Total Project 4-1-74 to 12-31-77	
	Total	EPA	Total	EPA	Total	EPA	Total	EPA	Total	EPA
A. Project Management										
1. Personnel -										
Senior Staff ¼ time	4,500	4,500	4,750	4,750	5,000	5,000	2,625	2,625	16,875	16,875
Fringe Benefit	900	900	950	950	1,000	1,000	525	525	3,375	3,375
Secretary ½ time	4,000	4,000	4,250	4,250	4,500	4,500	2,375	2,375	15,125	15,125
Fringe Benefit	800	800	850	850	900	900	475	475	3,025	3,025
2. Travel	2,100	2,100	2,100	2,100	2,100	2,100	1,150	1,150	7,450	7,450
3. Equipment	500	500	-	-	-	-	-	-	500	500
4. Overhead	2,550	2,550	2,700	2,700	2,850	2,850	1,505	1,505	9,605	9,605
Subtotal	15,350	15,350	15,600	15,600	16,350	16,350	8,655	8,655	55,955	55,955
B. Assembly, Interpretation and Transmittal of SEWRPC data										
1. Personnel -										
Junior Staff ½ time	6,000	6,000	6,350	6,350	6,700	6,700	3,525	3,525	22,575	22,575
Fringe Benefit	1,200	1,200	1,270	1,270	1,340	1,340	705	705	4,515	4,515
Aid Full time	8,000	8,000	8,500	8,500	9,000	9,000	4,750	4,750	30,250	30,250
Fringe Benefit	1,600	1,600	1,700	1,700	1,800	1,800	950	950	6,050	6,050
2. Travel	600	600	600	600	600	600	300	300	2,100	2,100
3. Equipment	500	500	-	-	-	-	-	-	500	500
4. Supplies	600	600	600	600	600	600	300	300	2,100	2,100
5. Computer Time	2,900	2,900	2,900	2,900	2,900	2,900	1,450	1,450	10,150	10,150
6. Overhead	4,200	4,200	4,455	4,455	4,710	4,710	2,485	2,485	15,850	15,850
Subtotal	25,600	25,600	26,375	26,375	27,650	27,650	14,465	14,465	94,090	94,090
C. Development of Computer File										
1. Personnel -										
Senior Staff ½ time	9,000	9,000	9,500	9,500					18,500	18,500
Fringe Benefit	1,800	1,800	1,900	1,900					3,700	3,700
Junior Staff ½ time	6,000	6,000	6,350	6,350					12,350	12,350
Fringe Benefit	1,200	1,200	1,270	1,270					2,470	2,470
Aid Full time	8,000	8,000	8,000	8,000					16,000	16,000
Fringe Benefit	1,600	1,600	1,600	1,600					3,200	3,200
2. Travel	1,350	1,350	1,350	1,350					2,700	2,700
3. Equipment	1,000	1,000	-	-					1,000	1,000
4. Supplies	600	600	600	600					1,200	1,200
5. Computer Time	11,500	11,500	11,500	11,500					23,000	23,000
6. Overhead	6,900	6,900	7,155	7,155					14,055	14,055
Subtotal	48,950	48,950	49,225	49,225					98,175	98,175
Totals	89,900	89,900	91,200	91,200	44,000	44,000	23,120	23,120	248,220	248,220

U.S. Environmental Protection Agency
GLNPO Library Collection (PL-12J)
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