CONTROL OF COMBINED SEWER OVERFLOWS IN MINNEAPOLIS-SAINT PAUL

(Review Draft)

prepared by

L. Scott Tucker

Metropolitan Water Intelligence Systems Project

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government of the area and how it effects adoption, implementation and operation of computer based control systems.

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Maurice L. Albertson and George L. Smith are co-principal investigators and L. Scott Tucker is project manager.

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The following technical reports were prepared during Phase I of the CSU-OWRR project, Metropolitan Water Intelligence Systems. Copies may be obtained for $3.00 from the National Technical Information Service, U. S. Department of Commerce, Springfield, VA 22151. (When ordering, use the report title and the identifying number noted for each report.)

Technical Report No. 1 - "Existing Automation, Control and Intelligence Systems of Metropolitan Water Facilities" by H. G. Poertner. (Identifying number to be obtained.)

Technical Report No. 2 - "Computer and Control Equipment" by Ken Medearis. (Identifying number to be obtained.)

Technical Report No. 3 - "Control of Combined Sewer Overflows in Minneapolis - St. Paul" by L. S. Tucker. (Identifying number to be obtained.)

Technical Report No. 4 - "Task 3 - Investigation of the Evaluation of Automation and Control Schemes for Combined Sewer Systems" by J. J. Anderson, R. L. Callery, and D. J. Anderson. (Identifying number to be obtained.)

Technical Report No. 5 - "Social and Political Feasibility of Automated Urban Sewer Systems" by D. W. Hill and L. S. Tucker. (Identifying number to be obtained.)

Technical Report No. 6 - "Urban Size and Its Relation to Need for Automation and Control" by Bruce Bradford and D. C. Taylor. (Identifying number to be obtained.)

Technical Report No. 7 - "Model of Real-Time Automation and Control Systems for Combined Sewers" by Warren Bell. (Identifying number to be obtained.)

Technical Report No. 8 - "Guidelines for the Consideration of Automation and Control Systems" by L. S. Tucker. (Identifying number to be obtained.)

Technical Report No. 9 - "Research and Development Needs in Automation and Control of Urban Water Systems" by H. G. Poertner. (Identifying number to be obtained.)

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INTRODUCTION

Phase I of the CSU project on metropolitan water intelligence systems is directed at studying control systems for combined sewers. However, it is becoming apparent that in order to effectively upgrade water quality of a region a total systems approach will have to be taken. Wastewater collection and transport facilities cannot be separated from treatment facilities because any changes made in the collection facilities will have an effect on the treatment works.

Control strategies and techniques are products of modern technology that can serve as tools to enable total system control for an urban water facility or facilities. Detroit, Seattle, and Minneapolis-St. Paul, with the support of demonstration grants from the Environmental Protection Agency, have installed control systems for maximizing the efficiency and in-system storage capabilities for their combined sewer facilities.(1) In these three projects regulators were redesigned and rebuilt; rainfall, water level, and water quality data are monitored and transmitted to computer based data logging and processing centers; and regulators, gates, and pumps are remotely controlled. These control projects were not designed as integral parts of complete metropolitan systems but were implemented to demonstrate and evaluate concepts and hardware.(2)

The Detroit, Seattle, and Minneapolis-St. Paul demonstration projects are first steps toward what could be eventually automatic systems where measured rainfall would be used on real-time bases to predict and automatically activate control devices to reduce or eliminate overflows. A final system, however, must coordinate the activities of the collection, transport, and treatment facilities and cannot be isolated to the control of combined sewer regulators.

Since the Minneapolis-St. Paul project was the first completed(3) it will be presented in this report in detail. In addition to describing the demonstration project, the report will address Minneapolis-St. Paul regional water quality objectives, institutional arrangements, local combined sewer systems, what motivated the project, and the potential of computer-based control systems.

The regional institutional setting will be discussed first, followed by the interceptor and treatment facility system, the demonstration project, local combined sewer collection systems, and motivation and potential of computer-based control systems in the Minneapolis-St. Paul region.

INSTITUTIONAL SETTING--REGIONAL GOVERNMENT

The control of combined sewers is of concern because of water quality considerations. However, for a combined sewer overflow project to have meaning it must be related to regional water quality objectives and goals which cannot be determined or achieved unless there are institutional arrangements available to plan and then influence or implement the plans. The regional form of government that exists in the Minneapolis-St. Paul area and how it relates to water quality management in general and combined sewers in particular is discussed in this section.

Background

The Minneapolis-St. Paul metropolitan area consists of seven counties comprising an area of 2,968 square miles and over 130 cities and villages and 76 townships, see Figure 1. The population of the metropolitan area is about 1,800,000 which is about 50% of the people in Minnesota. The Minnesota State Legislature in 1967 formed a regional authority (The Metropolitan Council of the Twin Cities, or Council) to prepare plans and, in varying degrees, to implement those plans. The Council, was an outgrowth of the Metropolitan Council and the Minneapolis-St. Paul Sanitary District (MSSD) which was formed in 1933.

Pollution of the Mississippi River, which flows between the Twin Cities of Minneapolis and St. Paul, has prompted several studies and the construction of treatment facilities and sewage collection systems since the 1920's. The conditions of the river were such in the 1920's that the Minnesota Legislature created the Metropolitan Drainage Commission in 1927 to study and investigate the pollution conditions and recommend corrective measures. Pollution of the river did not diminish with the initiation of studies, and the pollution of the river and studies of the pollution problem continued up through 1933 when the State Legislature enacted "An Act to Provide for the Creation of Sanitary Districts and the Disposal of Sewage and Other Wastes Therefrom," Chapter 341, Minnesota Session Laws of 1933. This act established the MSSD.

The MSSD included only the cities of Minneapolis and St. Paul, but the area tributary to the MSSD extended far beyond the limits of the two cities as a result of sewage service contracts and ordinances between

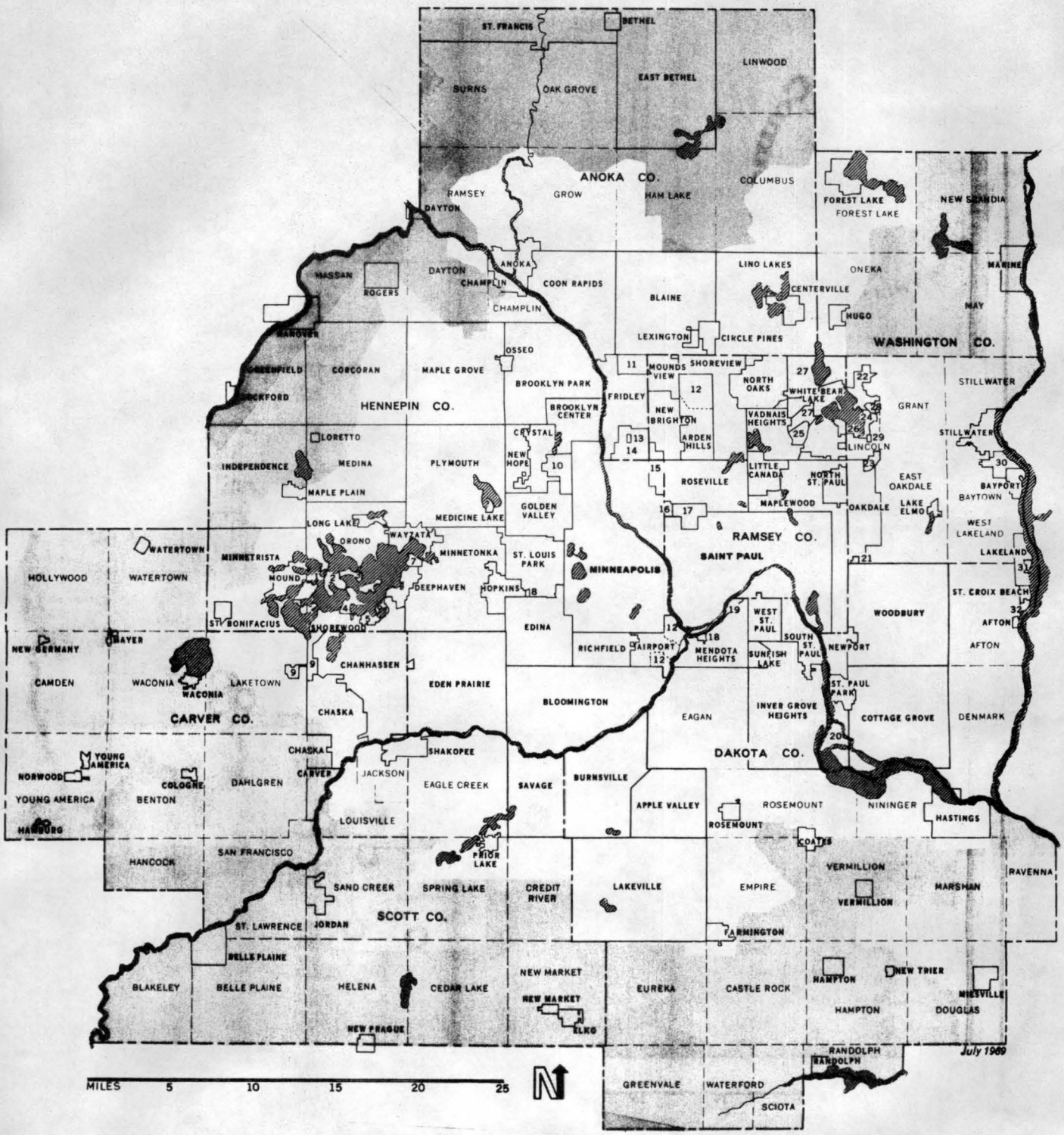

FIGURE 1

MINNEAPOLIS-ST. PAUL METROPOLITAN AREA
(From "Metropolitan Development Guide; Sanitary Sewers, Policies, System Plan, Programs," Adopted by the Metropolitan Council, January 22, 1970)

the central cities and adjacent suburban communities. The MSSD in 1960 served one-half the state's sewered population (1.7 million people) or over 90% of the metropolitan area's sewered population.

The MSSD planned, financed, constructed, and operated a main sewage treatment facility (Pig's Eye) and interceptor works. The sewage collection facilities within the cities, however, were and still are constructed, operated, and maintained by the individual cities. Costs of the MSSD were apportioned to the various cities and municipalities tributary to its intercepting and treatment facilities.

The MSSD was the only form of government that approached having any degree of regional interest or control until the Metropolitan Airport Commission was formed in 1945 because one small airport for each city did not meet the aviation needs of the metropolitan region. Other regional forms of government were established in 1957 when the Metropolitan Mosquito Control District and the Metropolitan Planning Commission (MPC) were formed.(3) The MPC had the authority to prepare advisory plans but had very limited power regarding enactment of plans. The hodgepodge of institutions were developing in reactive fashion throughout the metropolitan area, but a viable mechanism for addressing regional problems still did not exist. Because of the lack of a truly regional sewer authority, the North Suburban Sanitary Sewer District was established in 1961 to serve the communities north of Minneapolis and St. Paul on both sides of the Mississippi River.

Metropolitan Council

The Metropolitan Planning Commission did not provide the mechanism to plan and control the development in the metropolitan area and consequently the State Legislature created a Metropolitan Council in 1967 for the Counties of Anoka, Carver, Dakota, Hennepin, Ramsey, Scott, and Washington.(4) The purpose of the Council is to coordinate the planning and development of the metropolitan area. The Council is under the supervision and control of 15 members who must be residents of the metropolitan area. An executive director serves as the principal operating administrator for the Council.

The Council, as originally established by the Legislature in 1967, had the major function of coordination but did not have any operational controls. The Council was to achieve its goals through veto power over local government

plans and requests for Federal aid. The makeup of the Council in 1967 is shown in Figure 2. A copy of the Metropolitan Council Act is included in Appendix A.

The 15 members of the Council are all appointed by the governor with the consent of the senate. The chairman serves "at the pleasure" of the governor, but the other 14 are named "on a nonpartisan basis" after "consulting with all members of the legislature from the area composing the Council district for which the member is to be appointed." The conformity of the Council to the one man-one vote doctrine has significance in that it provides legal defense to the common argument against various government bodies on grounds that their unequal representation is unconstitutional.(24) Thus far the Council has received revenue from a levy imposed on all taxable property in the seven county area. This is an important factor regarding their ability to act as a truly independent and viable governmental body. The tax was 0.7 of a mill in 1969 and receipts have risen steadily from $657,500 in 1968 to a projected $1.5 million in 1972. Other sources of funding include Federal grants which are decreasing slightly.(24)

One of the responsibilities given to the Council was to prepare a comprehensive Metropolitan Development Guide based on physical, social and economic needs of the area. The Guide will eventually have about 20 functional chapters, six of which are complete (transportation, open space, housing, sewers, solid wastes, and "major diversified centers"). Each chapter contains three basic sections on: 1) policies to guide decision-making; 2) facilities location plan; and 3) program of development to guide the Council in achieving objectives of the Guide. Thus the Guide is not only a plan but also includes a plan of implementation.(24)

The Council receives its "clout" from three different types of review powers provided by the legislature. Each city, town or county in the area "shall submit to the Metropolitan Council for comment and recommendation thereon its long-term comprehensive plans or any matter which has a substantial effect on metropolitan area development." The local government must then wait 60 days while the Council notifies all other jurisdictions that may be effected. If any problems arise the Council may call a public hearing or attempt to mediate and resolve differences of opinion.(24)

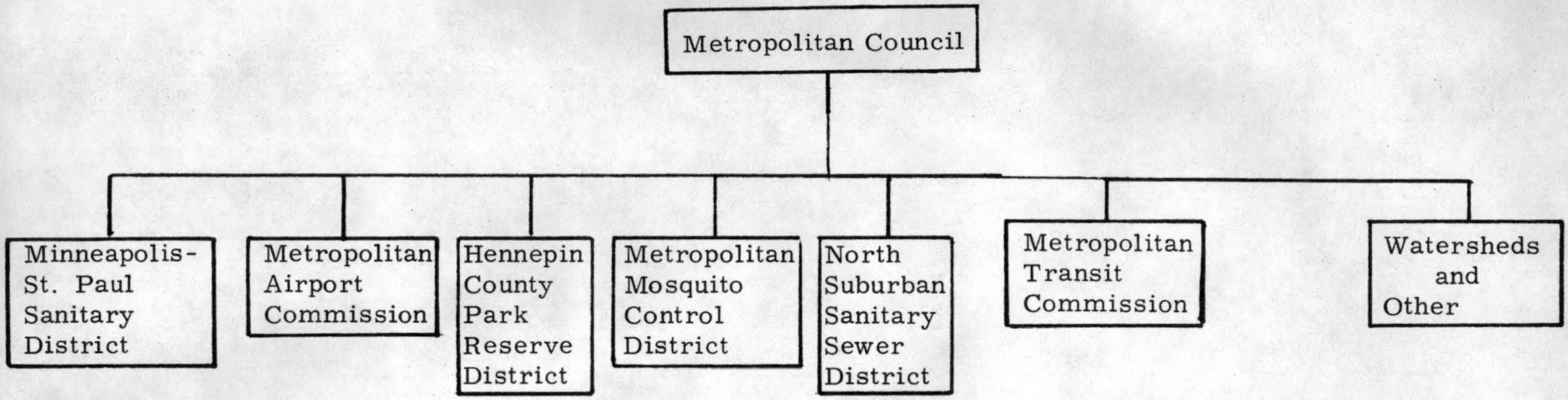

FIGURE 2

METROPOLITAN COUNCIL CREATED
BY 1967 LEGISLATIVE ENACTMENT

(From Einsweiler, Robert C., "Metropolitan Planning and Implementation," Journal of the Urban Planning and Development Division, ASCE, Vol. 96, No. UP2, Proc. Paper 7581, October 1970, pp. 113-121.)

If a local government unit requires a regional review prior to applying for a Federal loan or grant, the Council acts in this capacity and must give its comments and recommendations regarding the plan. The comments become a part of the application.(24)

A third review authority involves a veto power over all independent commissions, boards, agencies or districts. The Council reviews all long-term comprehensive plans of such independent agencies and may shift them indefinitely if it deems appropriate. The only recourse for the agency is the legislature.(24)

Sewer Board

The Council was principal sponsor of several acts (see Appendix B) passed by the 1969 Minnesota State Legislature that substantially increased the Council's authority regarding sanitary sewers, open space, and solid wastes. The act of most significance to sewage collection and treatment was the Metropolitan Sewer Act. This act placed the responsibility for long range sewerage planning in the hands of the Metropolitan Council, which through a Sewer Board has taken over acquisition, construction, operation, and maintenance of all joint use interceptors, other joint use facilities, and treatment works in the metropolitan area. The MSSD was the principal sewage treatment agency in the Minneapolis-St. Paul region since its beginning in 1933 until it became a part of the Sewer Board in 1968.

In general, the Council prepares overall plans and the Sewer Board implements them. The basic functions and powers of the Council and Sewer Board are as follows:(5)

Metropolitan Council

1. Prepare and adapt the metropolitan sewerage system plan with the assistance of the Sewer Board.
2. Establish guidelines for determining service areas and approve service area boundaries and changes.
3. Approve location and timing of plants, interceptors, and outfalls.
4. Establish Sewer Board policies for fiscal policy, bonding, and capital budgeting.
5. Prepare and adapt capital improvement programs with assistance and recommendations of the Sewer Board.
6. Adopt first year capital improvement program.

7. Review and approve Sewer Board budget.
8. Provide operating funds for Sewer Board.

Sewer Board

1. Assist in preparation of sewerage system plan.
2. Propose and recommend service area boundaries.
3. Prepare and recommend detailed engineering and design including construction schedule.
4. Assist in preparation of capital improvements program.
5. Prepare annual operating budget.
6. Establish costs to communities.
7. Construct interceptors and sewage treatment plants.
8. Operate and maintain physical facilities.

Sewer service areas were defined so that each sewer service area comprises a part of the metropolitan region primarily served or to be served by a particular interceptor or group of interceptors situated within the sewer service area. After the sewer service areas were established, the five most populous municipalities in each service area established advisory boards. The advisory board should meet with that service area's Sewer Board member concerning the operation and allocation of costs associated with the interceptors and treatment works in that area.

The Sewer Board or the Council have no direct involvement in the planning, design, construction, or operation of local municipalities' sewage collection systems. However, local government comprehensive plans for local collection systems are coordinated with the Council's master plan and must be reviewed and approved by the Sewer Board. All local sewage collection facilities are required to be constructed in accordance with approved plan.

Division of Responsibility

The sewerage system for the entire metropolitan region is divided into the following two principal areas of responsibility:

1. Local collection systems
2. Metropolitan disposal system

The local collection systems are community responsibilities. Most local communities in the region have separate storm and sanitary collection facilities, although parts of Minneapolis and St. Paul have combined sewer systems. The Minneapolis and St. Paul sewer systems are discussed in greater detail later in this report.

The metropolitan disposal system consists of interceptors and treatment facilities that are the responsibility of the Sewer Board. An interceptor is defined as "any gravity sewer or pumping station and force main that conducts sewage originating in more than one community or that conducts all or most of the sewage originating in a single community from its logical collection point in that community to the treatment works. 'Treatment works' consist essentially of sewage treatment facilities, pumping stations, and outfalls."(5)

Comprehensive plans prepared by the Sewer Board treat the local communities as a "black box" to some extent. The Sewer Board is concerned about what is delivered by a community to a Sewer Board interceptor and generally not the local collection system. Although detailed design drawings and specifications must be approved by the Sewer Board before construction may proceed, the status of the local collection systems are of no direct concern to the Sewer Board. The Sewer Board may, however, exercise controls and set limits on certain strong industrial wastes.

THE SEWER BOARD'S INTERCEPTOR AND TREATMENT FACILITY SYSTEM

It was previously stated that the Council, through the Sewer Board, has the responsibility for all joint use interceptors and regulator and treatment facilities. The purpose of this section is to illustrate the extent of the Sewer Board's facilities and how they link together the many communities of the metropolitan region. Major portions of this section are based on references (6) and (7).

The metropolitan region has been divided into two basic areas for sewer purposes: the Metropolitan Sewer Service Region and the Peripheral Region, see Figure 1. Development trends indicate that the Metropolitan Sewer Service Region will require centralized sewage collection works while the Peripheral Region will be able to continue with on-lot or small individual community sewage collection and treatment facilities.

Sewer Service Areas

Six sewer service areas were established in the Metropolitan Sewer Service Region to provide for interceptor planning and construction and for apportionment of interceptor costs back to the communities benefiting from individual interceptor systems. The six service areas are Anoka, Bloomington-Eagen-Burnsville (BEB), Minneapolis-St. Paul, North Suburban, Southeast, and Southwest, see Figure 3.

Minneapolis-St. Paul Service Area

The only service area with combined sewers is the Minneapolis-St. Paul service area which represents essentially an extension of existing sewer systems tributary to the Pig's Eye treatment plant (formerly the MSSD system). This service area represents all or part of 52 communities including Minneapolis and St. Paul, the two largest and most populous cities in Minnesota, and contains the largest interceptor system.

Minneapolis and St. Paul are both undertaking, to a greater or lesser extent, storm water separation programs which will free interceptor capacity for sanitary sewer flows. A map showing the existing interceptors in the Minneapolis-St. Paul service area is given in Figure 4.

There are now over 100 locations where combined sewage can overflow into the Mississippi River within Minneapolis and St. Paul. The Sewer

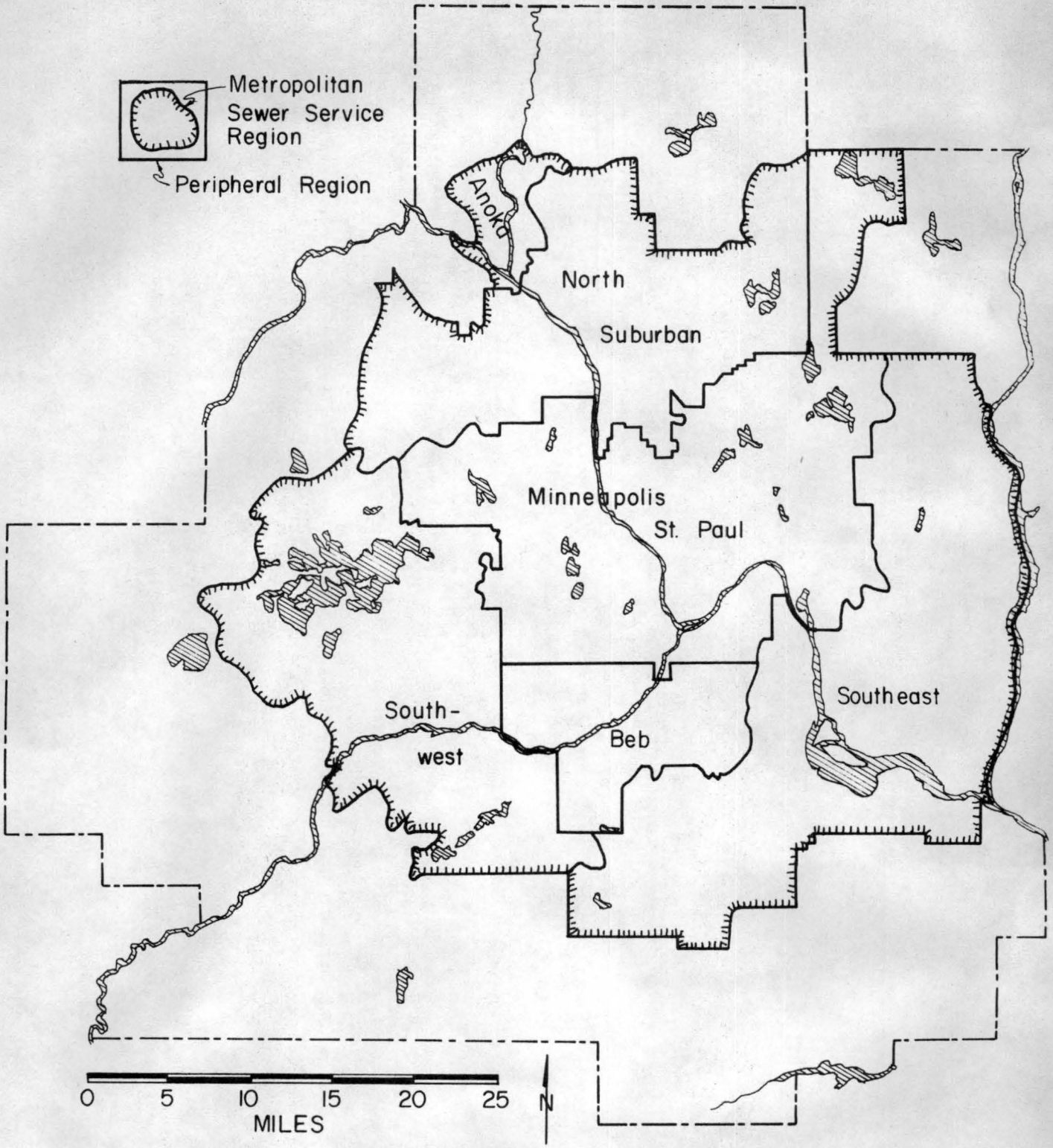

FIGURE 3

SIX SERVICE AREAS OF METROPOLITAN SEWER SERVICE REGION
(BASED ON METROPOLITAN COUNCIL MAPS)

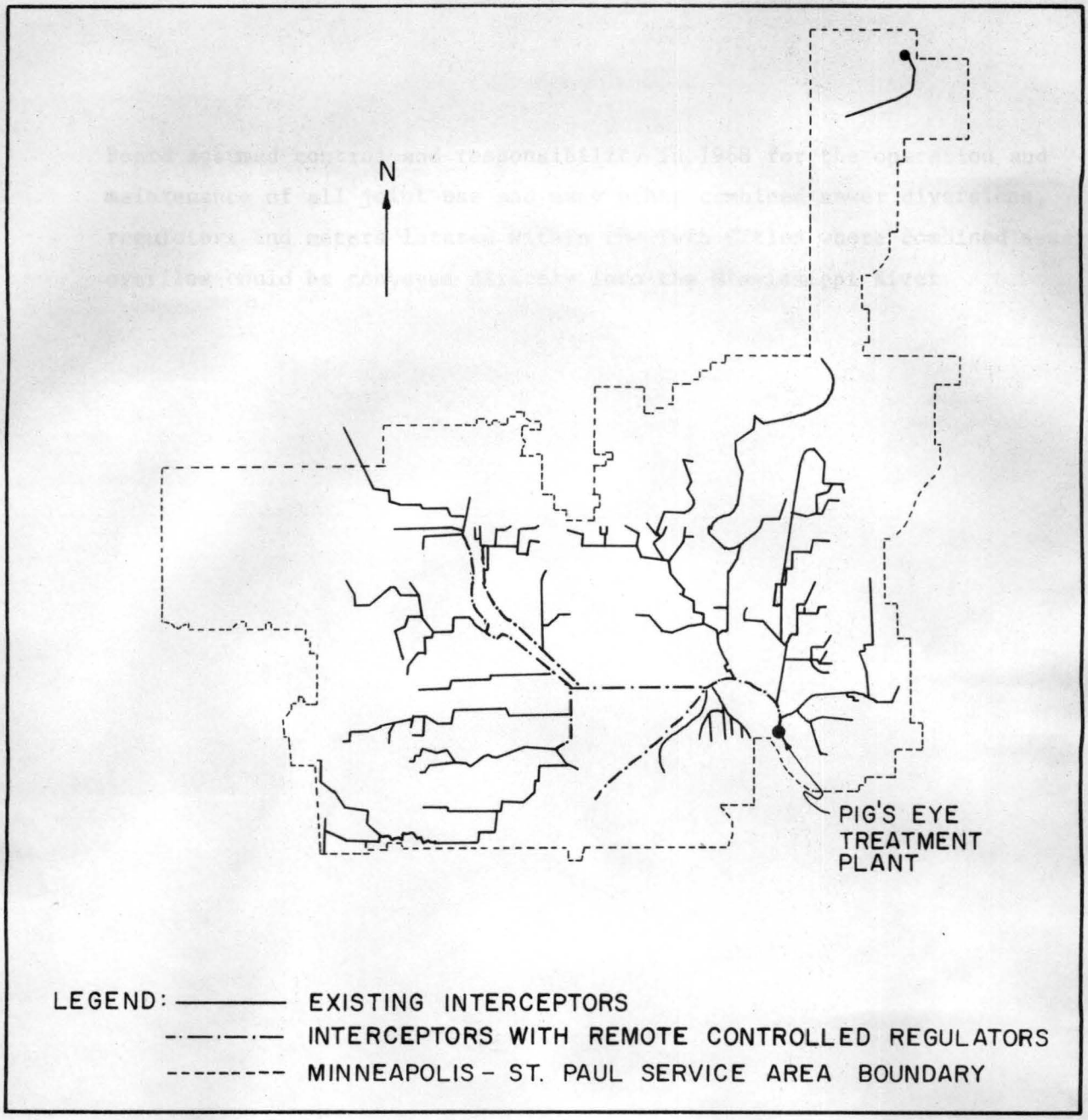

FIGURE 4
MINNEAPOLIS- ST. PAUL SERVICE AREA
AND EXISTING INTERCEPTORS-
METROPOLITAN SEWER BOARD

Board assumed control and responsibility in 1968 for the operation and maintenance of all joint use and many other combined sewer diversions, regulators and meters located within the Twin Cities where combined sewage overflow could be conveyed directly into the Mississippi River.

THE MINNEAPOLIS-ST. PAUL REMOTE REGULATOR CONTROL PROJECT

The largest source of pollution (measured in terms of BOD) entering the Mississippi River in the Minneapolis-St. Paul region is sewage treatment plant effluent.

A second largest source of pollution load is raw sewage that bypasses the treatment plant to the river. The treatment plant is usually bypassed for three reasons: 1) rapid drop of level in interceptor to flush deposited materials out of inverted siphons beneath railroad tracks. (This takes place routinely several times a year.); 2) annual shutdown of plant for repairs (occurs during high river conditions when there is a high dilution factor); and 3) excess flow due to runoff.[7]

The third major source of pollution to the river results from combined sewer overflows. There are over 100 locations, as shown in Figure 5, where combined sewer regulators and diversions were installed when the system of interceptors was originally built. The Minneapolis-St. Paul regulator control project is directed at reducing the pollution from this third source, combined sewer overflows. The Sewer Board began a project "Dispatching System for Control of Combined Sewer Losses" in 1966 with partial support of a demonstration grant (Grant No. 1--Minn 1) from the Environmental Protection Agency (EPA) formerly the Federal Water Pollution Control Administration.

Project Background

The Board of Trustees of the MSSD authorized in May 1956 an extensive five-year study of research and investigation of the Minneapolis-St. Paul metropolitan area's major sewerage works, including interceptors and treatment facilities. The Board retained Toltz, King, Duvall, Anderson and Associates, Inc., Consulting Engineers, St. Paul, to perform the comprehensive study. The following is extracted from the consultant's recommendations.[7]

> It is proposed that a comprehensive control system be initiated to provide an integrated system of regulator operations which will take advantage of the uncontrollable factors affecting the system.
>
> It is proposed that a system of supervisory control be installed at key points in the system to provide regulator operation based on interceptor utilization.

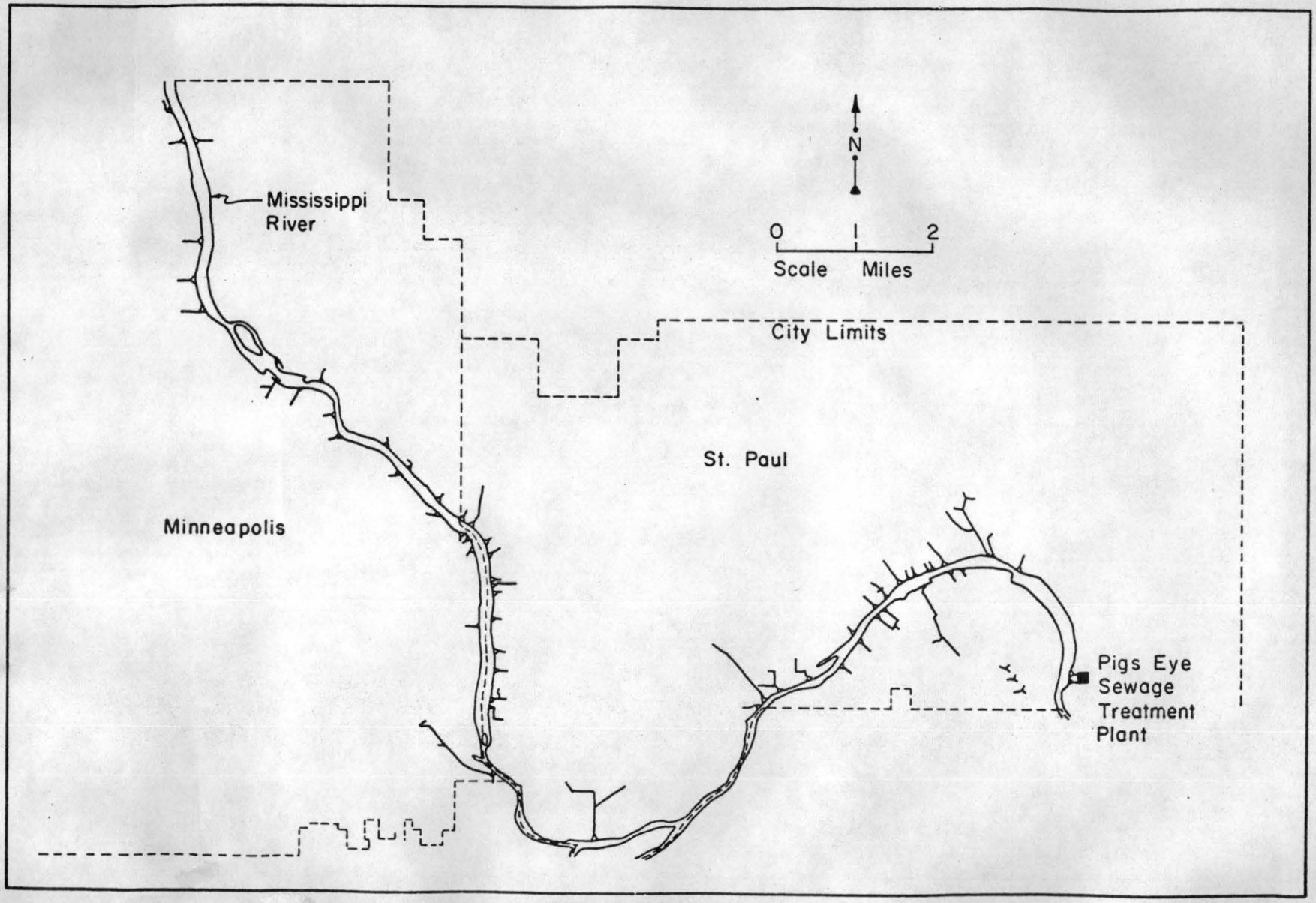

FIGURE 5
SEWAGE OVERFLOW AND DISCHARGE LOCATIONS
(Adapted from Reference 7 fig. 15-2)

The operation of regulators at present cannot be based on interceptor level and cannot be varied to meet actual conditions...

It is suggested that such a system would prove immediately useful in reducing loss of sanitary sewage at regulators and provide for day by day adjustments to meet changing conditions.

Along with the supervisory control system, it is proposed that modifications be made to non-automated regulators to provide better operation and simplify maintenance. It is proposed that a system of telemetering be installed to provide data on interceptor sewer and trunk sewer levels for operation of the supervisory control, determination of frequency, and quantity of overflow of sanitary sewage in actual operation and to provide data for design of future modifications...

The proposed system will allow full utilization of existing interceptor sewers. It will also insure a reduction of the quantity and frequency of sanitary sewage overflow to the river to a point less than at present and less than that intended by the original design.

The central control of regulators will allow the choice by an operator of points of bypassing raw sewage in the system based on river conditions at the time. Assuming that corrections are made at the treatment plant, particularly to grit removal equipment, additional peak rates of combined sewage could be treated when necessary and desirable because of river conditions. A number of small local storm flows, particularly during very dry weather, could be contained without increasing flow into the treatment plant above a desired limit, thereby reducing pollution of the river. In summary, the system will provide flexible control of storm water required by river conditions rather than requiring treatment or bypassing of combined flows based on an arbitrary pre-determined rate based on the worst conditions.

The proposed system could also provide automatic readout of data for analysis, either manually or with computer techniques, to further improve operation of the system and assist in predicting future quantities of dry weather flow which could be added to the existing system. In addition, should the separation programs set forth by the central cities not fully materialize, the control system would provide the best means of minimizing loss of sanitary sewage without major expenditures for further modification of regulators.

The backbone of the MSSD system, or what is essentially now the Minneapolis-St. Paul service area of the Metropolitan Sewer Board, is an intercepting sewer system that was constructed during the period 1934 to 1938. This system consists of 50 miles of intercepting sewers including a 9 mile main interceptor, 28 miles of principal branch interceptors, and 15 miles of minor interceptors, see Figure 6. Much of the interceptor system did not fill to capacity during periods of storm, and combined sewage was allowed to overflow into the Mississippi River even though the sewers were not full.

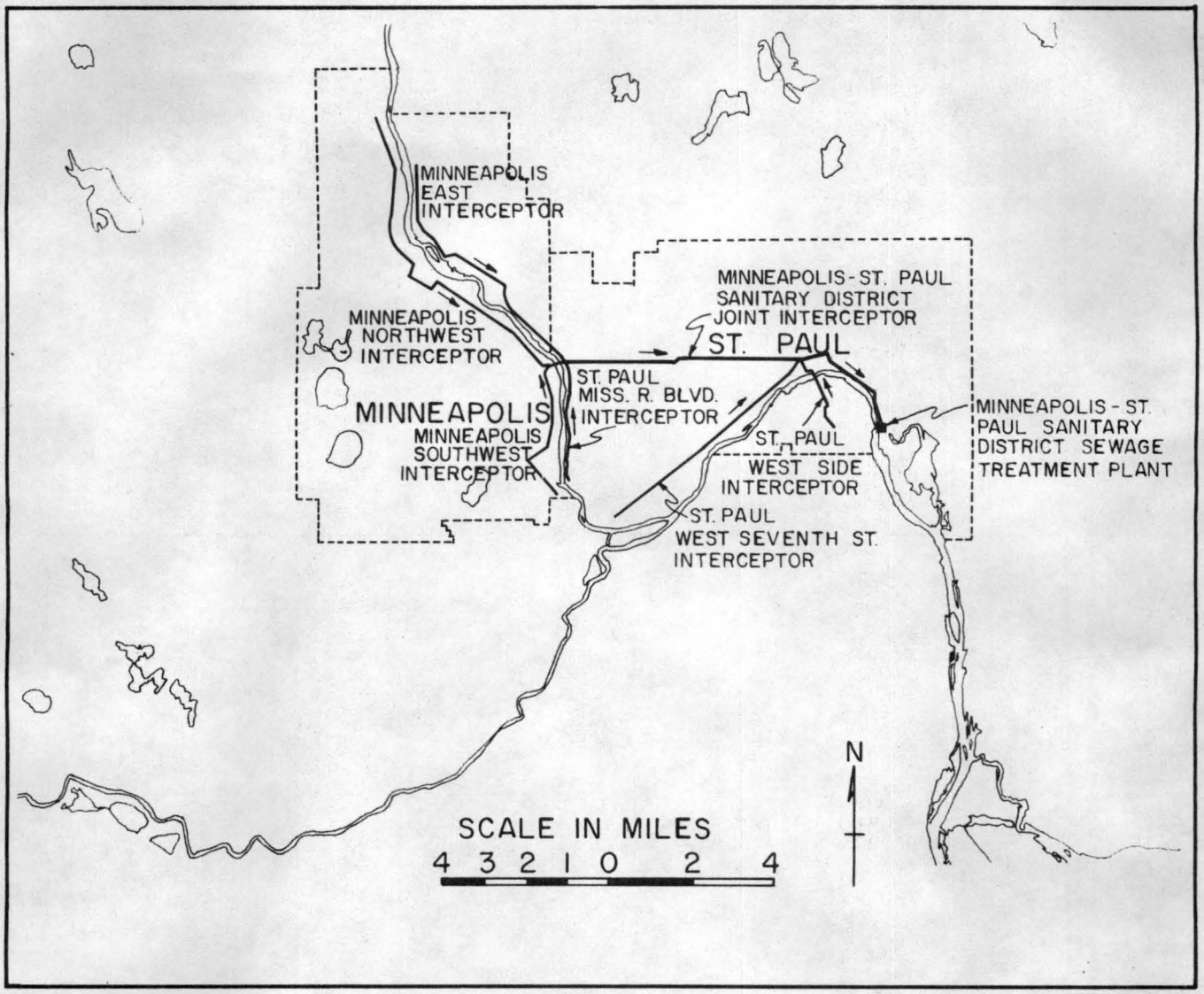

FIGURE 6

BACKBONE OF METROPOLITAN
SERVICE AREA INTERCEPTOR SYSTEM

Project Description

On May 25, 1966, the MSSD was awarded a matching grant of $870,750 from EPA to demonstrate a "Dispatching System for Control of Combined Sewer Losses." The project was described as a

> "dispatching system for control of combined sewer losses. The project includes preliminary studies to update historic data, a four phase construction project consisting of installation of a gauging system, a data logger, five river monitors, telemetering rain gauges, regulator modifications, and a post-construction program evaluation to include special studies by the University of Minnesota. Existing regulators were replaced with modern power operated gates at 18 key diversion locations. A supervisory system will be provided to telemeter gate positions, flows, and levels in sewers to be controlled by the new regulators. This information will be transmitted to a central point where a dispatching operator can observe conditions and regulate flow accordingly. Maximum utilization of interceptor sewer capacity would be assured and overflow to the river will be minimized."(1)

The project began in 1966 and was operational in April 1969, and during that time many reports, papers, and articles were written on various aspects of the project (see references 8 through 19). The intent of this section is to recapitulate and summarize the important features of the project.

Over 100 regulators and diversion structures are located in Minneapolis and St. Paul that divert sanitary and combined sewage flow from trunk sewers into the interceptor system. Of the over 100 regulator locations, 16 locations (8 in St. Paul and 8 in Minneapolis) were selected to be revised and become remotely controlled from a central location. Although only 16 regulators were involved, it was estimated that from 70 to 80 percent of the combined sewage overflow occurred at these 16 locations.

The modifications generally required included removal of existing equipment, concrete construction of new sewer structures, and constructing and providing regulator gates and adjustable diversion devices with necessary fluid power systems for their operation. A schematic drawing of a typical modified regulator is shown in Figure 7. The underground vault provides protection and easy and safe access to all electronic and motorized equipment which is connected to electric power and telephone circuits. Each of the gates can be controlled and two levels of sewage flow can be measured at each location. The adjustable diversion devices at all locations where required were inflatable dams made of a rubberized fabric called

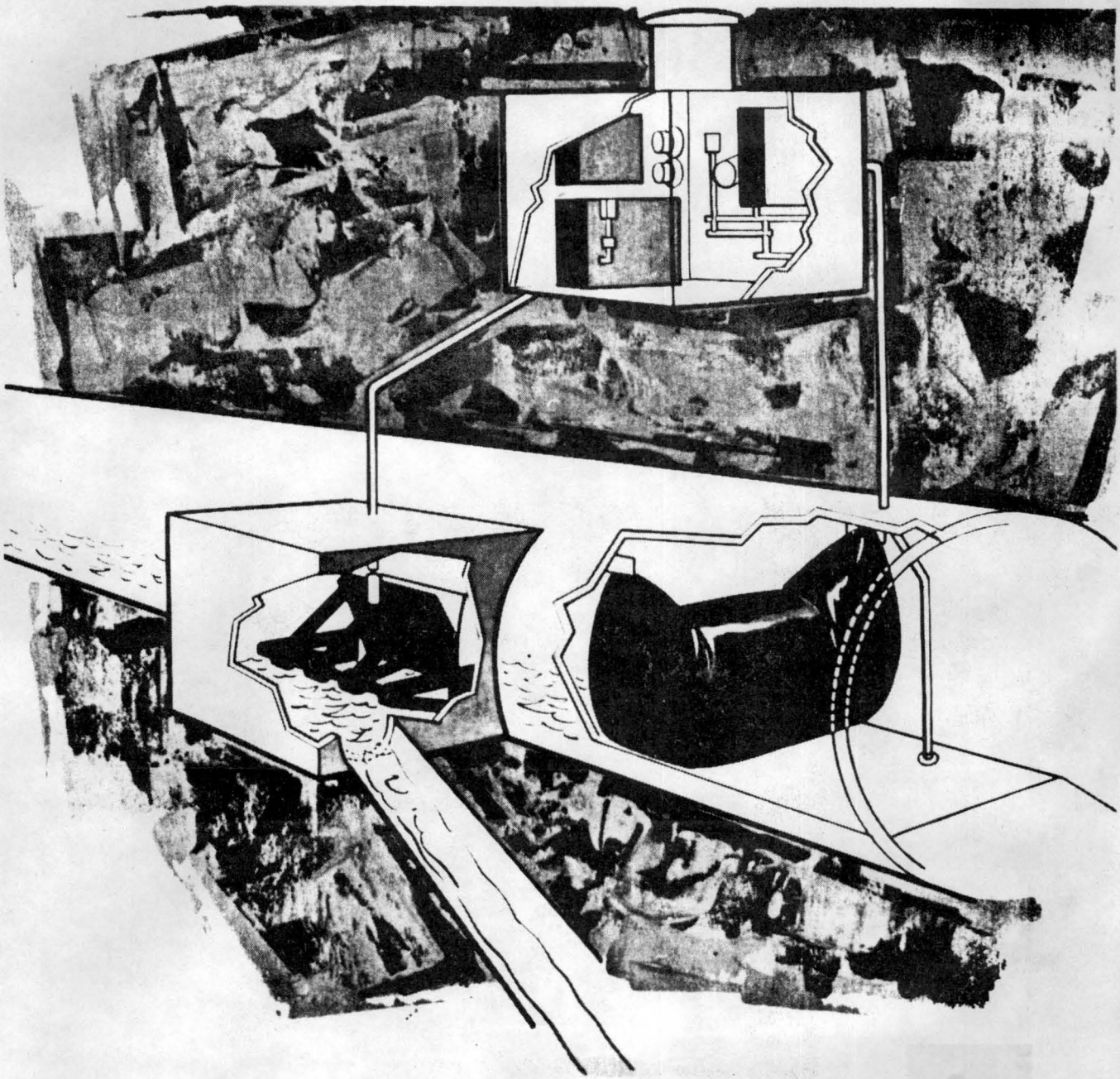

FIGURE 7

SCHEMATIC OF TYPICAL MODIFIED REGULATOR[8]

"Fabridams."* The modifications at each location were unique and each required special design considerations.

The locations of controlled diversion structures and recording rain gauges are shown in Figure 8.

Flow from three Minneapolis interceptors is automatically metered at permanent sewage metering stations which are used primarily for the purposes of determining cost apportionment for Sewer Board operations. At each of the three metering structures, overflow relief to the river was originally provided as well as bypass gates. New bypass gates were installed and now more flow can be conveyed from the Northwest Interceptor to the Joint Interceptor if capacity is available.

Telemetry and Process Control

The process control and telemetry system collects, processes, and logs data on sewage flow, gate status, rainfall and river quality. Basically the system consists of 44 pressure transducers, telemetry equipment for 38 remote stations, supervisory control equipment, and a computer with peripheral equipment.

The digital computer used is a PDP-9 manufactured by the Digital Equipment Corporation. The core memory size is 24,576 words and the central processor's core memory has a 1.0 micro second cycle time. The computer is a single address, 18-bit word length, parallel binary machine and is completely self-contained, not requiring special air conditioning or humidity control.

The peripheral equipment includes a 300 character-per-second paper tape punch, three 10 character-per-second console teleprinters, a high speed disk, two magnetic tape drives, a line printer, and a logging teletype.

The telemetry equipment provides a means to transfer information from remote location and to control regulators from a central location. The system utilizes leased telephone lines as the medium of communication. The frequency spectrum used ranges from 400 to 2,700 cycles per second. Installation charges for the seven leased lines which service 37 remote locations was $1,000 and the monthly charge for the circuits is $548 (July 1970).

The telemetering equipment transmits data from the remote stations to the metro treatment plant where analog to digital conversions and computer input takes place. The transmitted data consists of information from pressure-to-current transducers, rain gauges, gate position transducers, and

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*Registered trademark of the Firestone Company

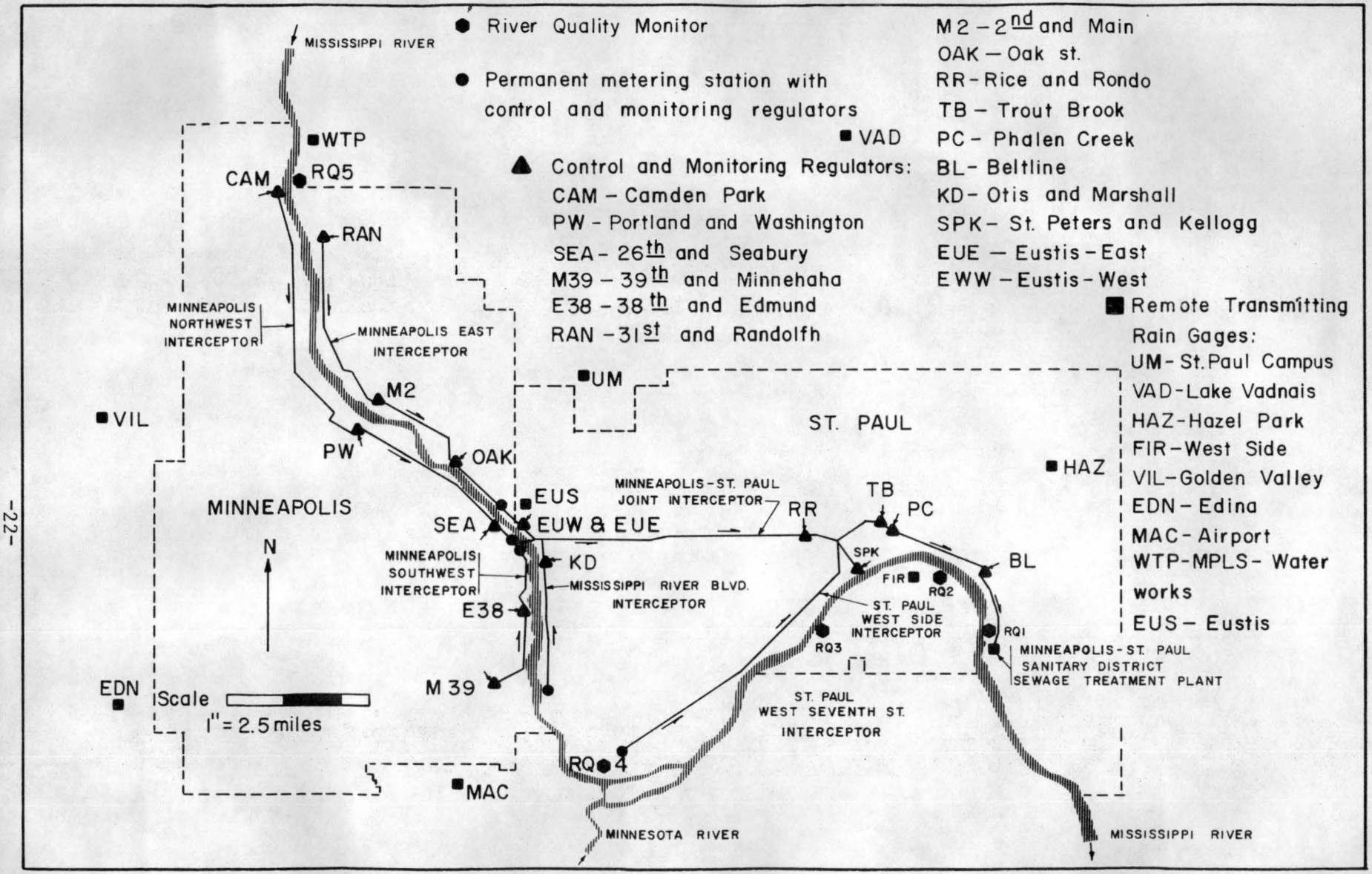


FIGURE 8

LOCATION OF RAIN GAGES AND CONTROL AND MONITORING REGULATORS [8] [17]

river quality monitors. There are a total of 139 unique addresses from which information can be obtained. The number of points of each description is shown in Table 1.

TABLE 1

NUMBER OF MEASUREMENTS AND CONTROL FUNCTIONS[8]

Function	No. of Locations	No. of Points
Level Measurement--Interceptor Sewers	12	12
Level Measurement--Trunk Sewers	15	18
Level Measurement--Outlets to Interceptors	12	12
Gate Positions and Controls	17	34
Rain Gauges	9	9
River Quality Monitors	5	30
Alarms and Spares	18	24
	(a)	139

(a) Total number of locations of telemetry equipment is 37 due to overlapping functions at certain stations.

Computer capability and equipment were also provided as a secondary priority function to permit monitoring and data logging for certain parameters in the sewage treatment plant. A station was provided in the Plant Operator's office where the data can be displayed and logged. The system for the treatment plant is hardwired with all the interfacing equipment. The hardware was tested and accepted, but thus far has received little use.

River Quality Monitoring

Five river quality monitors were used to intensively monitor the stretch of the river affected by combined sewer overflow. The general locations of the monitors included one upstream of the metropolitan area and all combined sewer overflow locations. One monitor was placed on the Mississippi River just upstream from the confluence with the Minnesota River and another downstream of the confluence where good mixing takes place. A fourth monitor was placed further downstream from the confluence and a fifth monitor was placed downstream of all the combined sewer outfalls and just upstream of treatment plant. The locations of the river quality monitors are shown on Figure 8.

The river quality monitors measure pH, conductivity, oxidation-reduction potential, temperature, chlorides, and dissolved oxygen. The units consist of sinks, plumbing, electric heating, ventilating fluorescent lighting systems, cabinets, work counter, and an automatic analyzer all housed in an 8 feet by 22 feet insulated trailer. The analyzer is capable of local read-out or telemetry output. Strip chart recorders have been provided to serve primarily as a backup in case of telemetry or telephone circuit problems.

The trailers were delivered and installed during the spring and summer of 1968. Monitoring continued through 1969 and into 1970, but the units are now (summer 1971) not being used in any continuous monitoring program.

Quality data acquired during and after storm events was closely examined to see what effect combined sewer overflows and storm sewer outlets have on the quality of the river. During and after most rainfall events, no changes were observed in any of the parameters measured. The 1969 data indicated that river quality was not effected by combined sewer overflows and storm sewer discharge.

Computer Capability and Model of System

A management model was developed by the University of Minnesota St. Anthony Falls Hydraulics Laboratory for the MSSD project.[8][11][12][13][14] The model is a deterministic runoff model capable of continuous real-time operation. The model was designed to operate on the PDP-9 computer. Input to the model consists of rainfall readings and estimated gate and fabridam settings. Output can vary from messages to an operator to complete rainfall and loss rate analysis, diversion analysis, and predicted hydrographs at points in the sewer system.

A major purpose of the model is to assist an operator in making decisions that will lead to optimum utilization of interceptor capacity. Also, a model is a necessity if the control system is ever to become automatic. The model is designed so that an operator can interact with the model while it is in real-time operation. The effect of various gate and fabridam settings on the expected storage utilization of the interceptor due to real-time rainfall occurrences can be determined with the model. The model can also be used to study historical, theoretical, or design rainstorms.

The model is organized basically into three phases. The first phase transforms rainfall into runoff arriving at an inlet to the interceptor sewer. Fifteen watersheds tributary to the interceptor system are presently used in the model. The second phase called the diversion phase determines how much flow will enter the interceptor and how much will be diverted to the river for given gate and fabridam settings. The third, or routing phase, predicts the movement of flow that enters the interceptor. Thus the model can be used to predict what portions of the interceptor will have available capacity and can aid an operator in determining optimum gate and fabridam settings. The model is presented in detail in reference 8, which includes an operator's manual.

System Monitoring and Data Collection and Reduction

The combined sewer overflow control system is used basically in five ways:

1. Scan and print readings of the river quality monitors, regulator control and monitoring stations, interceptor monitoring stations and rain gauges.
2. Control regulator gate and fabridam positions.
3. Perform analyses of data described in number 1 above.
4. Operate model that can aid operator during rainstorm events.
5. Perform any other functions for management that would not affect its performance during rainstorm events.

Data Acquisition Programs

Normal scanning of the system employs four routines for determining: 1) status of the river quality monitors (RIVMON); 2) regulator control and monitoring stations (REGCTL); 3) interceptor monitoring stations (INCPTR); and 4) rain gauges (RAINRP). Data acquisition and scanning is under the control of RTIME. Initiation of scanning for RIVMON, REGCTL, RAINRP, and INCPTR is by RTIME.

The river quality monitor report, which is available immediately after scanning, includes a reading of the six quality parameters (DO, CL, ORP, pH, and temperature) at each of the five locations, and the date and time of the readings.

The regulator control report describes depths of flow and gate and fabridam positions at each of the control locations. The following information is printed for each location: 1) depth of flow in the trunk sewer

just upstream of the regulator gate; 2) depth of flow in the dry weather outlet pipe which carries diverted flow from the regulator gate to interceptor; 3) the position of the regulator gate expressed in percent open; and 4) position of the storm gate (located in outfall to river) expressed in terms of inflation pressure for fabridams or precent open for gates.

The basic purpose of the interceptor monitoring stations is to record the level of flow in the interceptors at the locations shown in Figure 9. At each of the locations noted in Figure 9 the depth of flow in inches is recorded on a printout. In addition, the positions of the bypass gates at the ends of the three main Minneapolis interceptors and flow rates in MGD and levels at two old metering locations associated with the treatment plant are recorded on this scan.

The rain gauge report records the inches of water in the rain gauge bucket for the current scan, data from the prior scan, the rainfall rate during the intervening period in inches per hour and the total accumulation for that day.

The scan frequency can be varied by an operator. The normal scan rate is hourly, but it is changed during rainfall events.

Regulator Control Check Program

Gates and fabridams can be controlled remotely, both by an operator and automatically through a control program. The program can be manually initiated or initiated periodically by the computer. The program directs the computer to interface with the gates and fabridams one at a time. The gate position or fabridam pressure is checked and then the position or inflation pressure is brought into agreement with a predetermined set point.

Routine Data Collection

During non-rainfall periods the computer automatically scans the system and records the data. The gate control program is normally run at three-hour intervals to maintain all regulator gates at 100% open and all fabridams inflated. Each day at about 8:00 a.m., the four data files (quality, interdeptor levels, rainfall, and regulator condition) are removed and stored. The next scan begins a new daily file. The daily files are routinely reviewed to spot data problems, either with operating equipment or monitoring equipment.

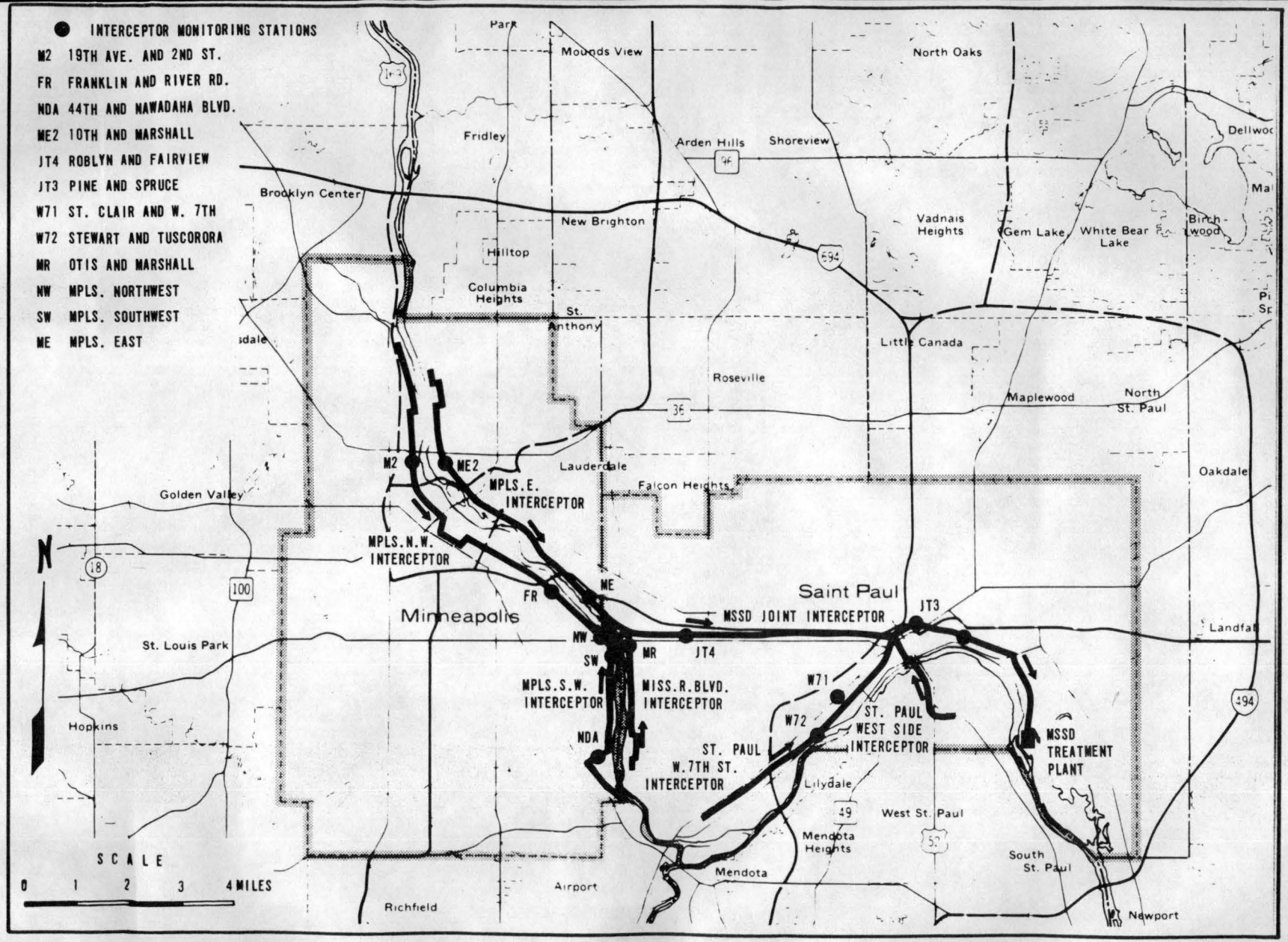


FIGURE 9
INTERCEPTOR MONITORING STATIONS(8)

Routine Data Reduction

Data is routinely reduced using three data processing programs. One program, called DANALS for Data Analysis, reads the entire data file and prints the address, number of times address is scanned, maximum and minimum values of parameters and time the maximum and minimum occurred, mean value, standard deviation, number of times address did not conform, and number of values falling outside of set range.

A second data processing program, called GRAPHP, is a data plotting routine. This program plots any selected data parameter versus time. Both the time scale and data scale are selected by the operator adding flexibility. Normally, data only for rainy days is plotted.

Another plotting program, called OGIVE, was developed to portray utilization of interceptors. The plotted curve shows the percent of time that the depth of flow in an interceptor equals or exceeds given magnitudes.

Control System Operation

Actual operation of the dispatching system is accomplished by an operator who is familiar with the interceptor sewer system. The normal setting for fabridams, see Figure 7, is fully inflated. Therefore, when a small rainfall event occurs, all flow is diverted to the interceptor and on to the treatment works. The main concerns of the operator are to prevent the following: 1) surcharging in trunk sewers; and 2) excessive pressure from building up on the inflated fabridams. In each case, action the operator takes is to deflate the fabridam and permit combined sewage to flow to the river. The only alternative open to the operator is the selection of the best location for a flow release. The fabridams deflate automatically if excess pressure builds up due to sudden rises in the storm water hydrograph after intense thunderstorms. Controlled deflation is preferred, however.

The operator also has the option of utilizing the mathematical model to assist him in his decisions. The model incorporates RTIME which initiates data scanning. To use the model, the operator has to "load" the program. Upon request, the model will calculate hydrographs anticipated at each regulator based on real-time rainfall data, perform a diversion analysis, estimate the flow entering the interceptor and the river, and route the flows through the interceptor checking for excess flow at each inlet and at other key places. With this information, the operator is alerted to which

trunk sewer will be carrying the most flow and when the storm flow will be arriving. He can then check actual flow levels and will be prepared to deflate the appropriate fabridams to prevent trunk sewer surcharging. The model can update its predictions as new rainfall data is accumulated.

If the system is operated without the use of the model, the operator can anticipate developments by observing real-time rainfall data on trend recorders. Based on operating experience, he will have a "feel" for which trunk sewers will most likely have large flow hydrographs. He can then carefully monitor the conditions in the appropriate regulators and be prepared to deflate the fabridams. Fabridams are normally deflated when the level of flow in the trunk sewer reaches the sewer crown.

As of April 1971, the interceptor regulator control staff consisted of three operation and monitoring personnel, and a regulator crew who performed system maintenance.

Data for all storm events is routinely collected, reduced, and reviewed. One of the three operation and monitoring personnel must be on duty to monitor a rainstorm event. If an event is predicted to occur during off duty hours, one of the men will attempt to be on duty during the event.

The operational mode for all outlet gates to interceptors is 100% open and for all fabridams it is fully inflated. This mode will divert all potential overflows for most storms to the interceptor.

Operation of the system, as of summer 1971, consisted only of deflating fabridams if pressures became too high. No attempts are being made to utilize the control systems potential to "optimize" storage in the interceptors, and the mathematical model is <u>not</u> being used.

MINNEAPOLIS AND ST. PAUL COMBINED SEWERAGE SYSTEMS

In any study or proposed manipulation or alteration of the interceptor sewer system the collection systems feeding into the interceptor sewers should also be considered. Sewage flows entering the interceptor system originate primarily from the cities of Minneapolis and St. Paul. Each of these cities in turn have agreements with surrounding suburbs to transport sanitary sewage through each city.

The demonstration project is directed at operational control of the interceptor sewers to reduce combined sewage overflow. Available capacity of the interceptor for storage of combined sewage flows depends on the quantity of dry weather flow in the interceptor at the time of the occurrence of the storm. The sources of dry weather flow and combined sewage flow both originate within Minneapolis and St. Paul systems (or tributary systems). The Sewer Board has no control over the separate and combined sewer collection systems of the Twin Cities. Thus it has no direct control over the inputs to the system which it is trying to control.

In order to ever "operate" or control the Sewer Board's interceptor and treatment system, both cities would have to be intimately involved.

Minneapolis Sewer System

Sewers were first constructed in Minneapolis in 1870, which were all combined. The major reason for first constructing sewers was related to frequent outbreaks of typhoid fever and other water borne diseases. Sewerage systems were needed to protect the water supply and three basic measures had to be taken: 1) transport the sewage to an outlet downstream of the fresh water intake; 2) eliminate cross connections between safe and unsafe water supplies; and 3) construct a treatment facility.[20,21]

Combined sewers continued to be constructed in Minneapolis until 1926. Since that time, most sewer construction has been of the separate type. Sewage was discharged directly into the Mississippi River until 1938 when the Minneapolis sewer outlets were connected to a newly constructed interceptor system which conveyed the sewage to the Twin City Sewage Plant at Pig's Eye. Controls or regulators were built on the old combined sewer outlets to permit dry weather flow to enter the interceptor while diverting combined sewage to the river during storms via the old outlets.

Minneapolis has been pursuing a steady policy of providing separate storm sewers since 1933. The basic procedure has been to construct a new storm sewer thereby providing additional capacity for sanitary sewage in the old combined sewer. Since 1933 about $40,000,000 has been expended for sewer separation.(22)

As of 1970 the Minneapolis sewer system consisted of 832 miles of sanitary and combined sewers, 34 miles of sanitary interceptor tunnels, 332 miles of storm drains, 8.1 miles of storm drain tunnels and about 35,000 catch basins. About 20 percent of the sewered area is served by combined sewers. The plan is to essentially completely separate the system in the next six years requiring an annual expenditure of about $5,000,000.(22)

The sewer system is maintained by the Sewer Maintenance Division of the Public Works Department. The Maintenance Division consists of a maintenance engineer, two general foremen, and approximately 45 men. There is also a Construction Division in the Public Works Department consisting of 7 or 8 full time construction crews under a foreman with 40 to 55 men total, sewer construction engineer with surveying assistants, and a general foreman of sewer construction.

The City Sewer construction crews consist of miners, pipe layers, grade setters, equipment operators, and laborers. The construction force carries out most of the sewer separation work with the remainder being contracted and jointly paid for by the Minnesota Department of Highways or other agencies and the City of Minneapolis.

The Metropolitan Sewer Board has responsibility for maintenance and operation of most combined sewer diversions and regulators along the Mississippi River in Minneapolis. The Sewer Board was also granted the right to install replacements for existing regulators and diversions and to make new installations. As of 1971 there were 25 locations in Minneapolis where combined sewage may overflow into the river. Eight regulators or diversions and three interceptor metering stations are controlled as a part of the Sewer Board demonstration project. The regulator locations in Minneapolis are shown in Figure 10.

St. Paul Sewer System

Sewers were first installed in St. Paul in 1873 and by 1895 the system totaled 151 miles. The sewer system had increased to 605 miles

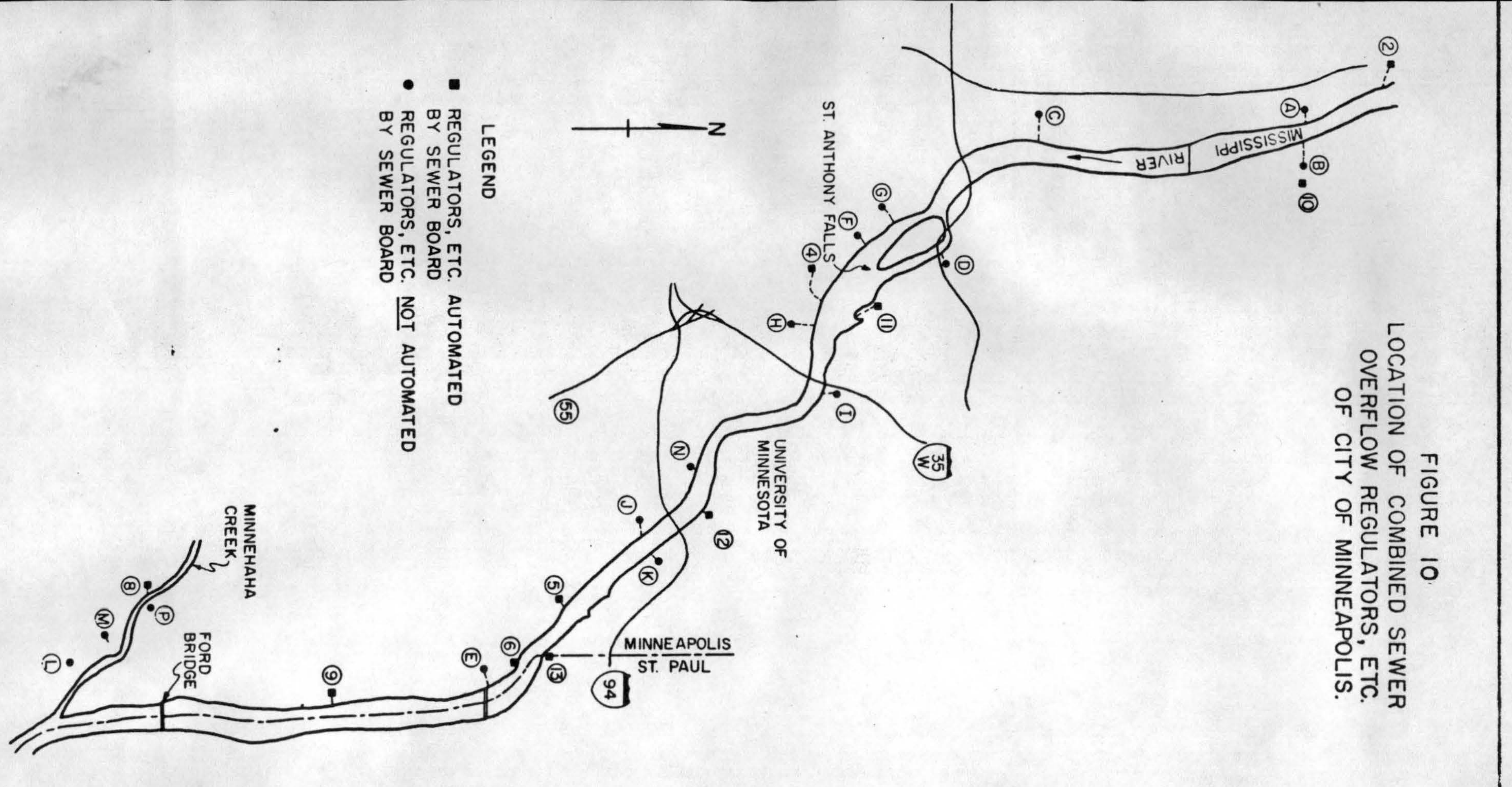


FIGURE 10
LOCATION OF COMBINED SEWER OVERFLOW REGULATORS, ETC. OF CITY OF MINNEAPOLIS.

REGULATORS, ETC. AUTOMATED BY SEWER BOARD

NO	LOCATION	SIZE OF OUTFALL
(2)	CAMDEN PARK AREA (41ST - 42ND AV. N.)	72" CIR. RE. CONC.
(4)	PORTLAND AV. S. & WASHINGTON AV. S.	7'6" x 7'6" HORSESHOE
(5)	E. 26TH ST. & SEABURY AV. S.	96" BR. CIR. TUNNEL
(6)	N.W. & S.W. METER AT RIVER CROSSING (E. 29TH ST.)	8' CIRCULAR TUNNEL
(8)	MINNEHAHA PKWY. & 39TH AV. S.	10'6" x 10'3" HORSESHOE
(9)	E. 38TH ST. & EDMUND BLVD.	120" CIR. RE. CONC.
(10)	31ST AV N.E. - RANDOLPH ST. N.E.	8'6" CIRCULAR
(11)	MAIN ST. S.E. & 2ND AV. S.E. (OUTLET TAILRACE 3RD AV.)	7'0" x 7'0" HORSESHOE
(12)	OAK ST. SE. & E. RIVER RD.	96" TUNNEL
(13)	EMERALD ST. & E. RIVER RD.	(UNKNOWN)

REGULATORS, ETC. NOT AUTOMATED BY SEWER BOARD

NO	LOCATION	SIZE OF OUTFALL
(A)	DOWLING AV. N. & 1ST ST. N.	OVERFLOW WEIR 52"
(B)	31ST AV. N.E. & MARSHALL ST. N.E.	8'6" CIR. RE. CONC.
(C)	W. BROADWAY AT 2ND ST. N.	OVERFLOW WEIR 42" BR. EGG
(D)	3RD AV. N.E. & MAIN ST.	TUNNEL 12' x 6'3"
(E)	E. LAKE ST. & W. RIVER RD.	TUNNEL 3'6" x 6'
(F)	2ND AV. S. & 1ST ST.	TUNNEL 57"
(G)	1ST AV. N. & 1ST ST.	DRAIN TUNNEL 6"
(H)	11TH AV. S. & 2ND ST.	TUNNEL 3' x 6'
(I)	10TH AV. S.E. & 2ND ST.	TUNNEL 8' CIRCULAR
(J)	E. FRANKLIN AV. & SEABURY AV.	TUNNEL 36"
(K)	FRANKLIN AV. S.E. & E. RIVER RD.	TUNNEL 36"
(L)	E 52ND ST. & 47TH AV. S.	OVERFLOW WEIR 75" EGG
(M)	E. 50TH ST. & HIAWATHA AV.	OVERFLOW WEIR 60" EGG, 15", 22
(N)	27TH ST. & 6TH ST. S.	84"
(P)	NAWADAHA BLVD. & HIAWATHA AV.	42"

NOTE: DRY WEATHER FLOW CHECKED APPROX. 2" BELOW WEIRS AT LOCATIONS "A" TO "P"

by 1932 and in 1960 the system comprised 687 miles of combined sewers, 54 miles of separate sanitary sewers, 26 miles of separate storm water sewers, and 5 miles of relief sewers totaling 722 miles.(7) In general, St. Paul sewers have been built by contractors rather than by in-house crews as with Minneapolis.

St. Paul consists of approximately 35,500 acres and the sewer system serves about 22,100 acres or 62 percent of the total (1959 figures). About 80 percent of the sewered area of St. Paul is served by combined sewers. There are presently (1971) 21 separate storm sewer outfalls and 50 combined sewer overflows to the Mississippi River, see Figure 11. The principal components of the St. Paul sewer system consist of 35 miles of trunk sewers which discharge dry weather flow to the Sewer Board's interceptor and treatment system. Sizes of the trunk sewers range up to 12 feet in diameter.

The sewered areas of St. Paul as of 1959 are shown in Figure 12.

In contrast to Minneapolis, St. Paul is pursuing a basic policy of not separating sewers except in cases where the existing combined sewers need relief. In these instances, a new storm sewer will be constructed and the old combined sewer will serve as a separate sanitary sewer.

St. Paul has initiated a comprehensive study of their sewer system at the urging of the Minnesota Pollution Control Agency (MPCA) (see section on Motivation and Potential for Control of Combined Sewer Overflows in Minneapolis-St. Paul Region). The purpose of Phase I of the study was

> "to itemize and appraise very generally conceptual alternatives for achieving the equivalent of combined sewer separation for the area served by the city's combined sewer system to meet MPCA requirements."(23)

The key phrase is "achieving equivalent combined sewer separation." The philosophy of "equivalent" separation permitted the consideration and evaluation of several alternative solutions including:(23)

1. Total separation
2. Partial separation
3. Increase capacity of interceptor and treatment facilities
4. Storage of combined flows
5. Disinfection of combined flows
6. Regulation of the combined sewer system.
7. Partial separation and partial treatment

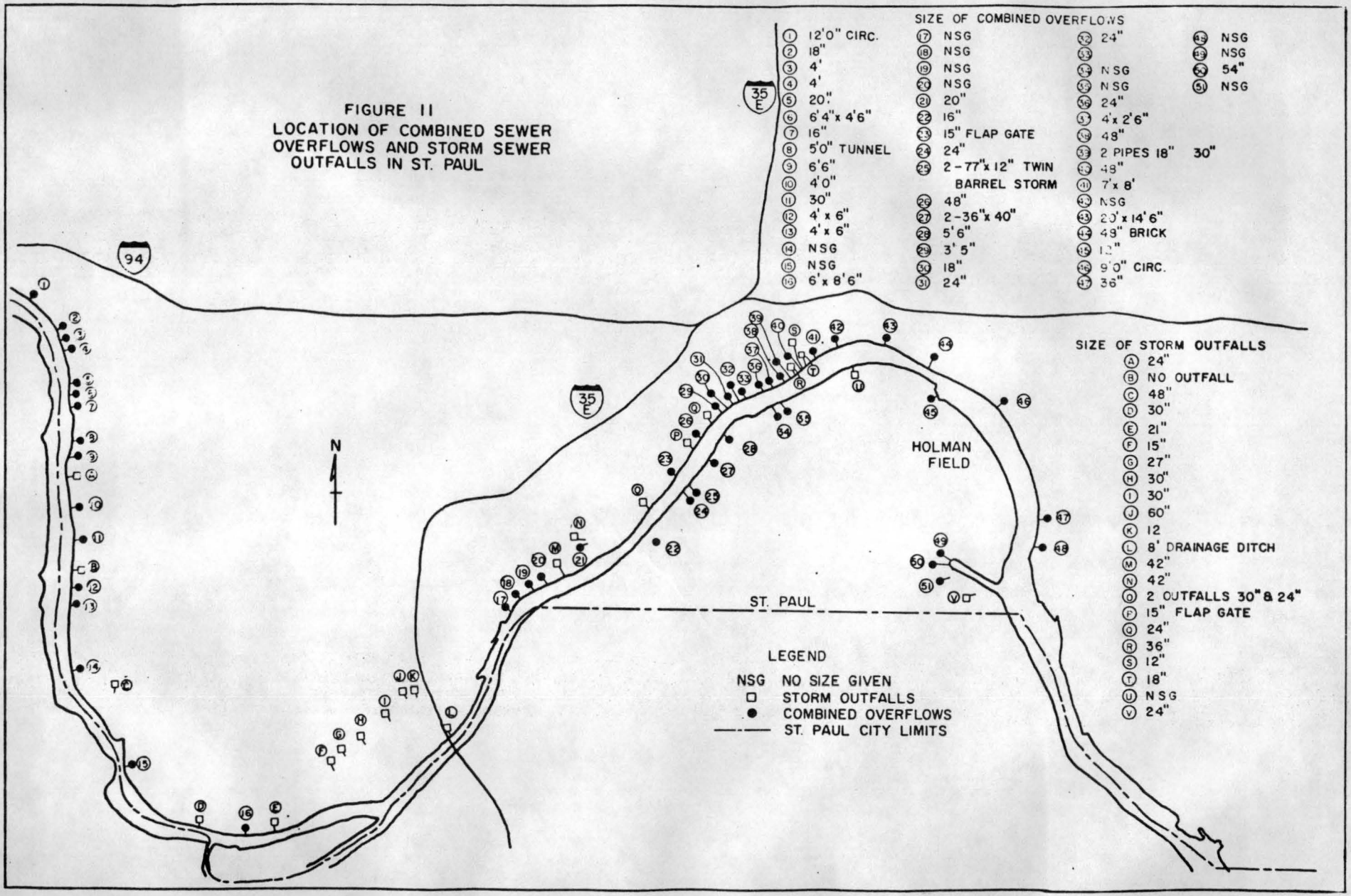
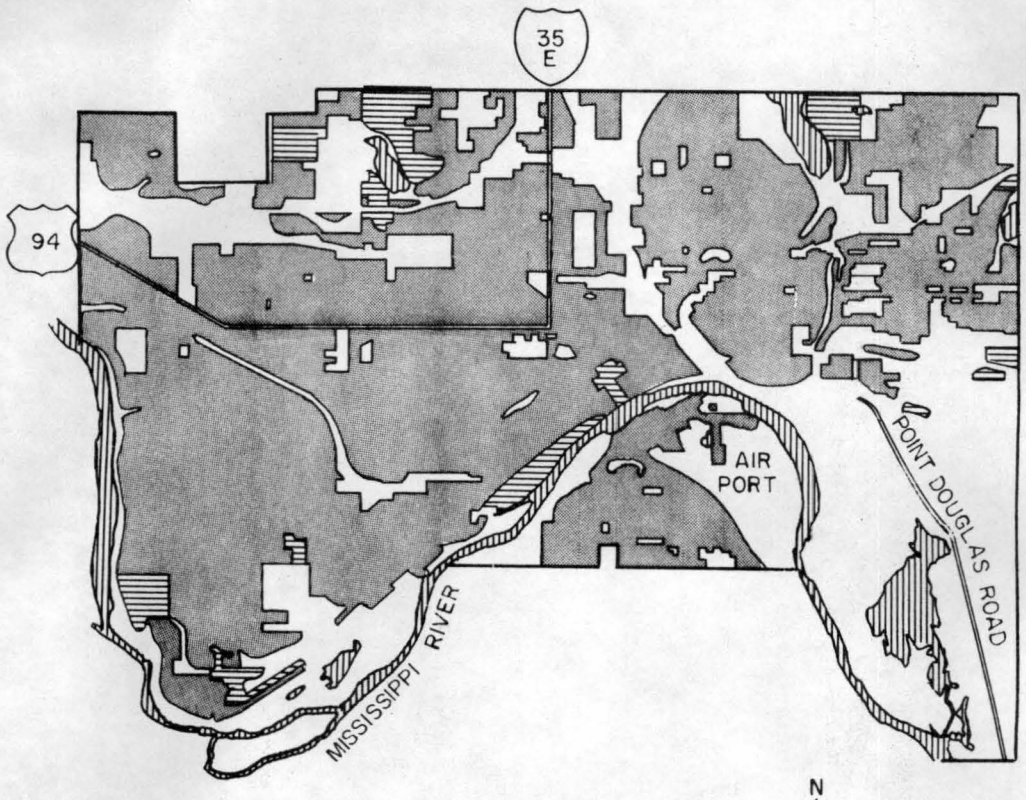


FIGURE 11
LOCATION OF COMBINED SEWER OVERFLOWS AND STORM SEWER OUTFALLS IN ST. PAUL
SIZE OF COMBINED OVERFLOWS
1 12'0" CIRC.
2 18"
3 4'
4 4'
5 20"
6 6'4"x 4'6"
7 16"
8 5'0" TUNNEL
9 6'6"
10 4'0"
11 30"
12 4' x 6"
13 4' x 6"
14 NSG
15 NSG
16 6'x 8'6"
17 NSG
18 NSG
19 NSG
20 NSG
21 20"
22 16"
23 15" FLAP GATE
24 24"
25 2-77"x 12" TWIN BARREL STORM
26 48"
27 2-36"x 40"
28 5'6"
29 3' 5"
30 18"
31 24"
32 24"
33
34 NSG
35 NSG
36 24"
37 4'x 2'6"
38 48"
39 2 PIPES 18" 30"
40 48"
41 7'x 8'
42 NSG
43 20'x 14'6"
44 48" BRICK
45 12"
46 9'0" CIRC.
47 36"
48 NSG
49 NSG
50 54"
51 NSG
SIZE OF STORM OUTFALLS
A 24"
B NO OUTFALL
C 48"
D 30"
E 21"
F 15"
G 27"
H 30"
I 30"
J 60"
K 12
L 8' DRAINAGE DITCH
M 42"
N 42"
O 2 OUTFALLS 30" & 24"
P 15" FLAP GATE
Q 24"
R 36"
S 12"
T 18"
U NSG
V 24"
94
35 E
N
HOLMAN FIELD
ST. PAUL
LEGEND
NSG NO SIZE GIVEN
STORM OUTFALLS
COMBINED OVERFLOWS
ST. PAUL CITY LIMITS



Key:

Body of Water

Area Served by Combined Sewers

Area Served by Separate Sewers

Note: Areas not marked do not have sewers.

FIGURE 12
SAINT PAUL SEWERED AREA

The preliminary plan presented in Phase I involves several solutions including separation of storm waters (except from roofs) by the construction of supplementary storm sewers, and in other areas the construction of interceptor sewers for combined overflows with disinfection of such overflows in chlorine contact basins. Under the preliminary plan about 40 percent of the 1970 sewered area would eventually consist of separate sewers.

The basic policy of St. Paul is to eventually treat all combined sewer overflows although there is serious doubt as to the effect of such treatment on the river. There is very little evidence available to indicate that combined sewer overflows contribute measurable "pollution" to the Mississippi River. Be that as it may, the Sewer Board demonstration project is being seriously evaluated during Phase II of the St. Paul sewer study to determine its compatibility with an overall plan developed for the city of St. Paul. The basic objective of the demonstration project was to show that the interceptor could be more efficiently utilized to retain and subsequently treat combined sewage that normally would have been discharged to the river. This is in keeping with St. Paul's objective and their general feeling is that the demonstration project did prove the control concept feasible and that it should have been done even if Federal support had not been available.

There is a non-technical problem, however, regarding the treatment of combined sewer overflows. The Sewer Board is required by Legislative enactment to treat all sanitary wastes, but there are no guidelines for combined sewage in the enactment. The Sewer Board's first priority is to treat all sanitary flows and their present position (summer 1971) is not to treat combined sewage in their treatment facility because of the lack of capacity. However, whether St. Paul can legally operate a treatment facility is questionable. Combined sewage contains sanitary wastes and it can be interpreted that combined flows should be treated by the Sewer Board under the enactment to treat. This question will have to be resolved before St. Paul can complete plans for "equivalent separation."

There are many storm outfalls and combined sewer overflows that discharge into the Mississippi River that are owned and maintained by the City of St. Paul. The Sewer Board, by Legislative enactment, has jurisdiction for only those regulators and outfalls on trunk sewers transporting flow from more than one community. There are possibilities

for extending the Sewer Board's overflow control demonstration project to some of St. Paul's regulators as previously mentioned. When asked if St. Paul thought it would be realistic for the Sewer Board to be making operational decisions regarding their regulators, St. Paul indicated that this would be acceptable. In fact, precedent has been set on some regulators now owned by St. Paul that are a part of the Sewer Board's demonstration project, such as Phalen Creek regulator.

The information presented thus far gives the pieces but not an integrated picture of the Twin Cities situation. The next two sections attempt to analyze and give meaning to this material.

MOTIVATION AND POTENTIAL FOR COMPUTER BASED CONTROL SYSTEM IN MINNEAPOLIS-ST. PAUL REGION

The Minneapolis-St. Paul metropolitan region, as most others, consists of many municipal jurisdictions. Of the more than 200 cities, villages, and townships, Minneapolis and St. Paul are the only ones with combined sewers, although they comprise the large majority of the metropolitan population. A third governmental jurisdiction concerned with combined sewage is the Sewer Board. What is it that might motivate these three entities to employ a control system to reduce or eliminate combined sewage overflow?

Sewer Board

The Sewer Board's demonstration project "Dispatching System for Control of Combined Sewer Losses" is the only actual evidence of a control system for combined sewage overflows in the region. The Metropolitan Development Guide pertaining to Sanitary Sewers[6] indicates that existing interceptors will eventually be used to capacity due to inputs from newly constructed suburbs. The present control project is based on utilizing excess interceptor capacity to store combined sewage overflows. The Development Guide also stresses the storm water separation programs of the two prinicpal cities and does not mention "equivalent separation". It appears that long range plans of the Sewer Board do not include utilization of the interceptor control system as the concept now exists.

The proposal for the demonstration project was originally prepared and submitted to EPA by the MSSD. It was previously noted that a system for supervisory control of regulators was first recommended in 1960 as a result of a five year study by consultants retained by MSSD. Key personnel in the MSSD who recognized the potential of a control system subsequently convinced the District to apply for demonstration grant funds. The MSSD applied for and received funds totalling $870,750 to implement the demonstration project which had a total cost of over $1,700,000. Although the MSSD invested a considerable amount of their money in the project, it is doubtful it would have been done without Federal support.

The Sewer Board was not in existence when the demonstration project was funded. If it had been, perhaps the demonstration project would have never been implemented, at least in its present form.

A principal objective of the demonstration project was to show that remote supervisory control of regulators would indeed work. In this regard the project was successful. The regulator control project, however, was conceived and implemented in somewhat of a vacuum from a systems point of view. The treatment plant capacity was not adequate to treat the additional load of large amounts of combined sewage stored in the interceptor. Although combined sewage overflows have been reduced by the regulator control project, the additional flow is usually made to bypass the treatment plant. The original MSSD plant was designed to treat the hydraulic capacities of 610 mgd the entering interceptor sewer. The bypassing is due to plant operating decisions and a law removal resulting from high flows.[25] The sewage collection network, interceptor facilities, and treatment plant must be operated as a system to be effective from an overall point of view.

The primary objective of the Sewer Board is to treat adequately all sanitary sewage. Since the capacity of the treatment plant is already stressed, the treatment of combined sewage is given second priority. As new communities are added to the Sewer Board's system, plant capacity will probably continue to be used entirely for treatment of sanitary wastes.

It is concluded that supervisory control as <u>now</u> conceived does not appear to fit into the Sewer Board's future plans. An important result of the demonstration project, however, was to show that a control system was indeed feasible. As the Sewer Board develops and implements their master plan for providing additional interceptor and treatment facilities for the entire metropolitan region, the complexity of the system will very likely make the use of a computer centered control system very desirable. Breaking the ice via the demonstration project becomes very important. Possibly, provisions can be made in the future for shifting sewage flows from one plant to another to balance loads; or perhaps in some sections of the region (such as watersheds draining into small lakes) storm water will have to be treated; alternatives such as these might be possible only with the aid of a computer based control system.

Future flexibility is an important aspect of operating a system through a control center. A completely separated system for instance allows no flexibility for changing conditions. Once separation has occurred

all other alternatives are closed off. "Operating" a system on the other hand leaves room for changing operating parameters as conditions change. Today the interceptors can be used for overflow storage. As sanitary flows increase perhaps upstream stormwater detention coupled with slow release to treatment can be used to eliminate or effectively reduce overflows.

Another advantage of control is that it can be accomplished rather quickly and usually for less capital outlay when compared to separation. A control scheme can be completed in a matter of 5 years while separation may take 25 to 50 years.

It is safe to say that the water quality collection and treatment system will become more complex in the future, and as it does a real need for a computer based control system will most likely emerge.

Minneapolis

Since Minneapolis is pursuing a basic policy of sewer separation, their need for a control system is difficult to justify except on a short term basis. The demonstration project reduced combined sewage overflows in Minneapolis, but as a larger percentage of the city becomes separated, the need for regulator control will diminish. It is doubtful that Minneapolis would have supported the demonstration project without Federal support. It appears the supervisory control as now conceived does not fit into the plans of Minneapolis.

However, if the Sewer Board ever elects to use a computer based control system to "operate" their interceptor and collection system to make more efficient use of their facilities, it would be necessary for Minneapolis to be a part of the control system. It is doubtful, though, that Minneapolis would ever initiate a computer based control system on their own.

St. Paul

The situation in St. Paul is different than in Minneapolis. At an enforcement conference held in St. Paul in March 1967 the following recommendations regarding combined sewers were provided:[23]

> "...Combined storm and sanitary sewers be prohibited in all newly developed areas and be eliminated in existing areas wherever opportunity to do so is afforded by redevelopment, or as otherwise reasonably feasible. Present combined sewers should be continually monitored and operated so as to convey the maximum possible amount of combined flows to and through the waste treatment plant.

In addition, studies to develop effective control of wastes from this source and to eliminate combined sewers should be continued or initiated by the localities involved.....Methods to be used to control wastes from combined sewers and a time schedule for their accomplishment should be reported to the Conference within two years after issuance of the Conference Summary."(23)

As a result of the Enforcement Conference, the MPCA issued a Directive in August 1967 to St. Paul that said in part:

1. The City of St. Paul....is not in compliance with the standards in that it....does also discharge major quantities of raw sewage from numerous combined sanitary and/or storm sewer outfalls to the Mississippi River in the reach abutting the City, which sewage effluents when discharged generally include suspended solids in excess of 50 mg/l., or settleable solids in excess of 5 ml/l., or 5-day biochemical oxygen demand in excess of 50 mg/l, or coliform organisms in excess of 1,000 MPN/100 ml, or other matters or characteristics in excess of those specified in the standards.

2. For the purpose of eliminating such noncompliance, it is recommended that the City:

   a. Undertake detailed engineering studies on eliminating the existing combined sewers within the City and/or developing effective methods for controlling the discharge of sewage to the Mississippi River from this source in conformance with the standards, with progress reports being provided regularly every quarter and the completed study report, with an improvement proposal by the City, being submitted to the Agency for consideration by not later than March 17, 1969.

   b. Henceforth construct no more combined sewers, and wherever reasonably possible eliminate such existing sewers, or otherwise control or treat the sewage from this source so as to be in compliance with the standards by not later than July 17, 1977.

   c. Continuously monitor the outfalls and report thereon monthly, and operate the existing combined sewer system so as to convey in the interim the maximum possible amount of combined sewage and storm water into the Minneapolis-St. Paul Sanitary District (hereinafter called the District) interceptor sanitary sewer and through its sewage treatment works, wherever this is not already being done, or will not otherwise be done by or in cooperation with the District under its special study program; subject, however, to reasonable limitations which may be imposed by the District for the purpose of protecting its disposal system, operations or studies from damage or undue interference."

St. Paul initiated a study of their sewer system in April 1968 in compliance with the August 1967 MPCA directive. The results of the Phase I

study and the direction of a Phase II study were discussed previously in the section on Minneapolis and St. Paul Combined Sewerage Systems.

In summary, St. Paul is looking at all alternative methods to achieve effective control of discharge of sewage into the Mississippi River. One of the alternatives is complete separation, but this would be very costly, to the extent of probably being prohibitive. The alternative given most serious consideration in the Phase I study consists of several solutions, including separation of storm water (except from roofs) by the construction of supplementary storm sewers, and in other areas the construction of supplementary storm sewers, and in other areas the construction of interceptor sewers for combined overflows with disinfection of such overflows in chlorine contact basins. Under the preliminary plan about 40 percent of the 1960 sewered area would eventually be separated.

St. Paul is considering options that may involve "operating" their system. They will thoroughly examine, in Phase II of their study, the demonstration project to determine its compatability with an overall plan developed for St. Paul. Even if the control concept now being demonstrated is not compatible with an overall plan, it appears that St. Paul is much more amenable to coming up with solutions that may involve a computer based control system.

They have a definite interest in the demonstration project and probably would have supported it even in the absence of Federal support.

CONCLUSIONS

The demonstration project "Dispatching System for Control of Combined Sewer Losses" was a definite success in that it demonstrated the feasibility of control of combined sewer overflows. Overflow regulators are being remotely operated and flow conditions and other parameters throughout the interceptor system are being monitored.

The demonstration project, however, is not being used up to its potential. No attempts are being made to optimize storage of combined sewage overflows in the interceptor system and the prediction model developed to assist an operator in making decisions is not being used.

One of the problems appears to be priorities. The major source of pollution load into the Mississippi River is from treatment plant effluent, the second is from treatment bypass flows, and the third is from combined sewage overflows. The greatest initial concern of the Sewer Board is understandably on more efficient treatment. After storms, the hydraulic load on the Pig's Eye treatment plant exceeds plant capacity and the overflows stored in the interceptor have to be discharged to the river without treatment. The Sewer Board is currently upgrading the Pig's Eye treatment plant, both in terms of capacity and efficiency. The treatment plant, however, probably will still not be in a position to treat all combined sewage overflows after present improvements are made.

Another problem is that the Council and Sewer Board do not really have effective control of the various collection systems, most notably Minneapolis and St. Paul. In order to effectively plan, implement and operate the combined sewer system, operating control must be obtained over the laterals and trunk sewers. The Detroit Metro Water Department (DMWD) for example has the responsibility for constructing, operating and maintaining the sewer collection, drainage and water distribution system within the city limits of Detroit in addition to wastewater interception and treatment for 55 communities. Therefore, they can effectively utilize the lateral and trunk sewers for stormwater detention. The Sewer Board does not have this alternative at this time.

The Sewer Board is continuing to maintain the regulator control system which does provide a potential for controlling and treating much of the overflow volume. However, treatment is an integral part of "controlling

and treating" and until treatment of the overflows can be added, the pollution load from overflows into the Mississippi River is not going to be effectively reduced.

Priorities are again emphasized; the Sewer Board is justifiably tackling the major problem first, i.e., the pollution load from treatment plant effluent. Another factor is that the Sewer Board has developed their sewer plans on the assumption that Minneapolis and St. Paul will effectively separate or achieve equivalent separation of their combined sewers.(6) Thus, any solution of the combined sewage overflow problem provided by the Sewer Board would be temporary until equivalent separation is achieved by the Twin Cities.

The overflow problem has essentially been made the responsibility of Minneapolis and St. Paul. If the cities are to provide the eventual solution to the overflow problem, the incentive for the Sewer Board to commit large amounts of funds for interim treatment of combined sewage is not very great. Minneapolis is now engaged in a continuing program of sewer separation and St. Paul has commissioned a detailed study of alternatives for obtaining equivalent separation.

The sewer plan for the metropolitan area, as developed by the Metropolitan Council and presented in the Metropolitan Development Guide for Sanitary Sewers,(6) calls for "construction and operation of a number of sewage treatment plants discharging treated effluent to several reaches of the major rivers of the Metropolitan Area." The Development Guide goes on to say that "These plants could be either independently operated or operated under central control. However, independent operation increases the possibility for substandard treatment. A centrally controlled operation can more efficiently and economically maintain plant standards for the benefit of the entire Metropolitan Area." The Development Guide stresses the need for a water quality intelligence system by stating that "Maintenance of high water quality standards cannot be assured unless there is a stringent operating program with constant surveillance of river conditions and means to provide quick and appropriate ameliorative action."

In support of the above, the Council has adopted the following policies:

"Coordinate the planning, design, construction, and operation of all treatment works so that they constitute a single sewage disposal system.

Provide an automatic river and effluent monitoring system to ensure that effluent and river standards are met or bettered.

Provide safeguards to prevent raw or inadequately treated sewage and industrial waste discharge into any river or stream in the metropolitan area.

Ensure adequate supervision of treatment plants and automatic monitoring equipment by qualified personnel."

How are these policies going to be implemented? Constant surveillance and the capability for quick and correct responsive action will most likely necessitate a computer based information and control system of some sort. The degree to which "automatic computer control" is employed is not the central issue at this time. It is, however, imperative to recognize the need for some type of computer based "intelligence system" to assist in the central operation and control of the interceptor and treatment facilities of the metropolitan area.

The demonstration project, as implemented, probably will not fit into the overall future plans of the Council and Sewer Board. However, the concept of control that the demonstration project represents and the experience obtained from designing, installing, and operating a computer based system could prove to be invaluable to the Council and Sewer Board.

The Sewer Board must also measure sewage flows and determine quantities received from many sources for the purpose of distributing costs. This is an activity that lends itself to remote readout and computerized data processing.

The activities and demands upon the Council will become much more complicated in the future, and as they do the need for management to employ computer based intelligence systems will become more obvious and easier to justify.

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APPENDIX A

METROPOLITAN COUNCIL ACT

METROPOLITAN COUNCIL
Capitol Square Building, Cedar at 10th, St. Paul, Minnesota 55101
227-9421

Metropolitan Council Act

MINNESOTA SESSION LAWS 1967, CHAPTER 896
(Codified as Chapter 473B)

AN ACT

CREATING A METROPOLITAN COUNCIL FOR THE COUNTIES OF ANOKA, CARVER, DAKOTA, HENNEPIN, RAMSEY, SCOTT AND WASHINGTON; PROVIDING FOR THE OPERATION THEREOF.

BE IT ENACTED BY THE LEGISLATURE OF THE STATE OF MINNESOTA:

Section 1. PURPOSE. In order to coordinate the planning and development of the metropolitan area comprising the counties of Anoka, Carver, Dakota, Hennepin, Ramsey, Scott and Washington, it is in the public interest to create an administrative agency for that purpose.

Sec. 2. METROPOLITAN COUNCIL. Subdivision 1. CREATION. A metropolitan council with jurisdiction in the metropolitan area consisting of the counties of Anoka, Carver, Dakota, Hennepin, Ramsey, Scott and Washington, is created. It shall be under the supervision and control of 15 members, all of whom shall be residents of the metropolitan area.

Subd. 2 TERMS. The first members of the metropolitan council appointed by the governor shall be appointed as follows: the chairman as provided in subdivision 4; four for terms ending the first Monday in January 1969; five for terms ending the first Monday in January 1971; and five for terms ending the first Monday in January 1973. Thereafter the term of each member shall be for a term of six years and until his successor is appointed and qualified.

Subd. 3 MEMBERSHIP. Fourteen members of the metropolitan council shall be appointed by the governor on a nonpartisan basis, after consulting with all members of the legislature from the area composing the council district for which the member is to be appointed, by and with the advice and consent of the senate. Each such council member shall reside in the council district which he represents. Council districts consist of combinations of legislative and representative districts established by Extra Session Laws 1966, Chapter 1, as prescribed herein. Each council district shall be represented by one member of the council. Council districts are hereby created as follows:

(1) The first council district consists of legislative district 12, that part of representative district 6A within Dakota county, and representative district 14A, and that part of representative district 14B within Scott county.

(2) The second council district consists of legislative districts 8 and 50.

(3) The third council district consists of legislative districts 49 and 57, and representative district 32B.

(4) The fourth council district consists of legislative district 33 and representative districts 13A and 21A.

(5) The fifth council district consists of legislative districts 30 and 31 and representative district 32A.

(6) The sixth council district consists of legislative districts 29 and 37.

(7) The seventh council district consists of legislative districts 27 and 28.

(8) The eighth council district consists of legislative districts 34 and 35.

(9) The ninth council district consists of legislative districts 36 and 38.

(10) The tenth council district consists of legislative districts 39 and 40.

(11) The eleventh council district consists of legislative districts 41 and 42.

(12) The twelfth council district consists of legislative districts 43 and 44.

(13) The thirteenth council district consists of legislative districts 45 and 46.

(14) The fourteenth council district consists of legislative districts 47 and 48.

Subd. 4. CHAIRMAN. (a) APPOINTMENT. The chairman of the metropolitan council shall be appointed by the governor as the 15th voting member thereof by and with the advice and consent of the senate to serve at his pleasure. He shall be a person experienced in the field of minicipal and urban affairs with administrative training and executive ability.

(b) DUTIES. The chairman of the metropolitan council shall preside at [illegible] officers and employees thereof, subject to the approval of the metropolitan council, and be responsible for carrying out all policy decisions of the metropolitan council. His salary and expense allowances shall be fixed by the metropolitan council.

Subd. 5. METROPOLITAN COUNCIL; DUTIES AND COMPENSATION. The metropolitan council shall elect such officers as it deems necessary for the conduct of its affairs other than the chairman. A secretary and treasurer need not be members of the metropolitan council. Meeting times and places shall

be fixed by the metropolitan council and special meetings may be called by a majority of the members of the metropolitan council or by the chairman thereof. Each metropolitan council member other than the chairman shall be paid a per diem compensation of $35 for each meeting and for such other services as are specifically authorized by the metropolitan council, and shall be reimbursed for his reasonable expenses.

In the performance of its duties the metropolitan council may promulgate rules governing its operation, establish committees, divisions, departments and bureaus and staff the same as necessary to carry out its duties and when specifically authorized by law make appointments to other governmental agencies and districts. All officers and employees of the metropolitan council shall serve at the pleasure of the appointing authority in the unclassified service of the state civil service. Rules promulgated by the metropolitan council shall be in accordance with the administrative procedure provisions contained in Minnesota Statutes, Chapter 15.

Subd. 6. Upon the recommendation of the chairman the metropolitan council may appoint an executive director to serve at his pleasure as the principal operating administrator for the metropolitan council. He may be chosen from among the citizens of the nation at large, and shall be selected on the basis of his training and experience in the field of municipal and urban affairs.

Sec. 3. ADVISORY COMMITTEES. The metropolitan council may establish and appoint persons to advisory committees to assist the metropolitan council in the performance of its duties. Members of the advisory committees shall serve without compensation but shall be reimbursed for their reasonable expenses as determined by the metropolitan council.

Sec. 4. REPORTS. On or before January 15th, of each odd numbered year the metropolitan council shall report to the legislature. The report shall include:

(1) A statement of the metropolitan council's receipts and expenditures by category since the preceding report;

(2) A detailed budget for the year in which the report is filed and the following year including an outline of its program for such period;

(3) An explanation of any comprehensive plan adopted in whole or in part for the metropolitan area;

(4) Summaries of any studies and the recommendations resulting therefrom made by the metropolitan council, and a listing of all applications for federal moneys made by governmental units within the metropolitan area submitted to the metropolitan council;

(5) A listing of plans of local governmental units submitted to the metropolitan council; and

(6) Recommendations of the metropolitan council for metropolitan area legislation, including the organization and functions of the metropolitan council.

Sec. 5. METROPOLITAN PLANNING. Subdivision 1. All the powers, duties, obligations and property now vested in or imposed upon the commission established under Minnesota Statutes, Chapter 473, for the metropolitan area, are hereby transferred to, imposed upon, and vested in the metropolitan council as the successor of such commission. At the time of such transfer the commission established under such laws is abolished.

Subd. 2. All employees of the commission shall be employees of the metropolitan council without interruption of salaries and employee benefits.

Sec. 6 GENERAL POWERS OF THE METROPOLITAN COUNCIL. subdivision 1. The metropolitan council shall have and exercise all powers which may be necessary or convenient to enable it to perform and carry out the duties and responsibilities now existing or which may hereafter be imposed upon it by law. Such powers include the specific powers enumerated in this section.

Subd. 2. OFFICERS AND EMPLOYEES. The metropolitan council may prescribe all terms and conditions for the employment of its officers, employees, and agents including but not limited to the fixing of compensation, their classification, benefits,and the filing of performance and fidelity bonds and such policies of insurance as it may deem advisable, the premium for which, however, shall be paid for by the district. Officers and employees of the metropolitan council, however, are public employees. The compensation and other conditions of employment of such officers and employees shall not be governed by any rule applicable to state employees in the classified service nor to any of the provisions of Minnesota Statutes, Chapter 15A, unless the council so provides. Those employed by the metropolitan council are members of the state employees retirement association. Those employed by a predecessor of the metropolitan council and transferred to it may at their option become members of the public retirement association to which they belonged as employees of the predecessor of the metropolan council. The metropolitan council shall make the employer's contributions to pension funds of its employees.

Subd. 3. CONSULTING CONTRACTS. The metropolitan council may contract for the services of consultants who perform engineering, legal, or services of a professional nature. Such contracts shall not be subject to the requirements of any law relating to public bidding.

Subd. 4 GIFTS AND APPROPRIATIONS. The metropolitan council may accept gifts, apply for and use grants or loans of money or other property from

the United States, the state, or any person for any metropolitan council purpose and may enter into agreements required in connection therewith and may hold, use, and dispose of such moneys or property in accordance with the terms of the gift, grant, loan, or agreement relating thereto. All moneys of the metropolitan council received pursuant to this subdivision or any other provision of law shall be deposited in the state treasury and the amount thereof is appropriated annually to the metropolitan council for the purposes of carrying out its duties and responsibilities.

Subd. 5. DEVELOPMENT GUIDE. The metropolitan council shall prepare and adopt, after appropriate study and such public hearings as may be necessary, a comprehensive development guide for the metropolitan area. It shall consist of a compilation of policy statements, goals, standards, programs, and maps prescribing guides for an orderly and economic development, public and private, of the metropolitan area. The comprehensive development guide shall recognize and encompass physical, social, or economic needs of the metropolitan area and those future developments which will have an impact on the entire area including but not limited to such matters as land use, parks, and open space land needs, the necessity for and location or airports, highways, transit facilities, public hospitals, libraries, schools, and other public buildings.

Subd. 6. COUNCIL REVIEW; INDEPENDENT COMMISSIONS, BOARDS, AND AGENCIES. (1) The metropolitan council shall review all long term comprehensive plans of each independent commission, board, or agency prepared for its operation and development within the metropolitan area but only if such plan is determined by the council to have an area-wide effect, a multi-community effect, or to have a substantial effect on metropolitan development. Each plan shall be submitted to the council before any action is taken to place the plan or any part thereof, into effect.

(2) No action shall be taken to place any plan or any part thereof, into effect until 60 days have elapsed after the date of its submission to the council, or until the council finds and notifies the submitting commission, board, or agency that the plan is consistent with its comprehensive guide for the metropolitan area and the orderly and economic development of the metropolitan area, whichever first occurs. If, within 60 days after the date of submission, the council finds that a plan, or any part thereof, is inconsistent with its comprehensive guide for the metropolitan area or detrimental to the orderly and economic development of the metropolitan area, or any part thereof, it may direct that the operation of the plan, or such part thereof, be indefinitely suspended; provided that the council shall not direct the suspension of any plan or part thereof of any sanitary sewer district operating within the metropolitan area which pertains to the location and construction of a regional sewer plant or plants or the expansion or improvement of the present Minneapolis-St. Paul sanitary

district treatment plant. An affected commission, board, or agency may appeal the decision of the metropolitan council suspending a plan, or part thereof, to the entire membership of the metropolitan council for public hearing. If the metropolitan council and the affected commission, board, or agency are unable to agree as to an adjustment of the plan, so that it may receive the council's approval, then a record of the disagreeing positions of the metropolitan council and the affected commission, board, or agency shall be made and the metropolitan council shall prepare a recommendation in connection therewith for consideration and disposition by the next regular session of the legislature.

Subd. 7. COUNCIL REVIEW; MUNICIPALITIES. Each city, village, borough, and town, all or part of which lies within the metropolitan area, shall submit to the metropolitan council for comment and recommendation thereon its long term comprehensive plans or any matter which has a substantial effect on metropolitan area development, including but not limited to plans for land use. The council shall maintain such plans in its files available for inspection by members of the public. No action shall be taken to place any such plan or part thereof into effect until 60 days have elapsed after its submission to the council. Promptly after submission, the council shall notify each city, village, borough, town, county, or special district which may be affected by the plans submitted, of the general nature of the plan, the date of submission, and the identity of the submitting unit. Political subdivisions contiguous to the submitting unit shall be notified in all cases. Within ten days after receipt of such notice any governmental unit so notified may request the council to conduct a hearing at which the submitting unit and any other governmental unit or subdivision may present its views. The council may attempt to mediate and resolve differences of opinion which exist amont the participants in the hearing with respect to the plans submitted.

Subd. 8. REVIEW OF FEDERAL PROGRAMS. The metropolitan council shall review all applications of governmental units, independent commissions, boards or agencies operating in the metropolitan area for a loan or grant from the United States of America or any agency thereof if review by a regional agency is required by federal law or the federal agency. Each governmental unit, independent commission, board, or agency, before submitting such an application to the United States government or any agency thereof shall first transmit the application to the metropolitan council for its comments and recommendations with respect to whether or not the project proposed in consistent with the comprehensive development guide for the metropolitan area. The comments and recommendations made by the metropolitan council shall then become a part of the application and if submitted to the United States of America or an agency thereof, such comments and recommendations shall also be submitted.

Subd. 9. DATA COLLECTION. The metropolitan council in cooperation with other departments and agencies of the state and the regents of the University

of Minnesota may develop a center for data collection and storage to be used by it and other governmental users and may accept gifts as otherwise authorized in this section for the purposes of furnishing information on such subjects as population, land use, governmental finances, and the like.

Subd. 10. URBAN RESEARCH. Where studies have not been otherwise authorized by law the metropolitan council may study the feasibility of programs relating but not limited to water supply, refuse disposal, surface water drainage, communication, transportation, and other subjects of concern to the peoples of the metropolitan area, may institute demonstration projects in connection therewith, and may accept gifts for such purposes as otherwise authorized in this section.

Subd. 11. CIVIL DEFENSE. The metropolitan council may coordinate civil defense, community shelter planning within the metropolitan area, accept gifts for such purposes as otherwise authorized in this section and contract with local governmental agencies and consultants in connection therewith.

Subd. 12. LOCAL GOVERNMENTAL PARTICIPATION. The metropolitan council may (1) participate as a party in any proceedings originating before the Minnesota municipal commission under Minnesota Statutes, Chapter 414, if the proceedings involve the change in a boundary of a governmental unit in the metropolitan area, (2) conduct studies of the feasibility of annexing, enlarging, or consolidating units in the metropolitan area, (3) furnish space and other necessary assistance to a metropolitan expeditor assigned to the metropolitan area or any part thereof under the Federal Demonstration City Act of 1966, on condition that such expeditor files monthly reports with the metropolitan council concerning his activities. The metropolitan council shall approve the use of moneys made available for land acquisition to local units of government from the land and conservation fund, the open space program of HUD, the natural resources account in the state treasury, if the use thereof conforms with the system of priorities established by law as a part of a comprehensive plan for the development of parks; otherwise it shall disapprove of the use thereof.

Subd. 13 PARTICIPATION IN SPECIAL DISTRICT ACTIVITY. The metropolitan council shall appoint from its membership a member to serve with the metropolitan airports commission, a member to serve with the mosquito control commission, a member to serve on the Minneapolis-St. Paul sanitary district or any successor thereof, and may appoint a member to serve on any metropolitan area commission or board authorized by law. Each member of the metropolitan council so appointed on each of such commissions shall serve without a vote.

Sec. 7 SPECIAL STUDIES AND REPORTS. Subdivision 1. The metropolitan council shall engage in a continuous program of research and study concerning the matters enumerated in this section.

Subd. 2. The control and prevention of air pollution.

Subd. 3. The acquisition and financing of suitable major parks and open spaces within and adjacent to the metropolitan area.

Subd. 4. The control and prevention of water pollution in the metropolitan area in conformity with applicable federal and state laws.

Subd. 5. The development of long range planning in the metropolitan area but not for the metropolitan area.

Subd. 6. The acquisition of necessary facilities for the disposal of solid waste material for the metropolitan area and the means of financing such facilities.

Subd. 7. The examination of the tax structure in the metropolitan area and consideration of ways to equalize the tax resources therein.

Subd. 8. Assessment practices in the metropolitan area.

Subd. 9. The acquisition of necessary storm water drainage facilities for the metropolitan area and the means of financing such facilities.

Subd. 10. The necessity for the consolidation of common services of local governmental units and the kind of consolidation most suitable in the public interest.

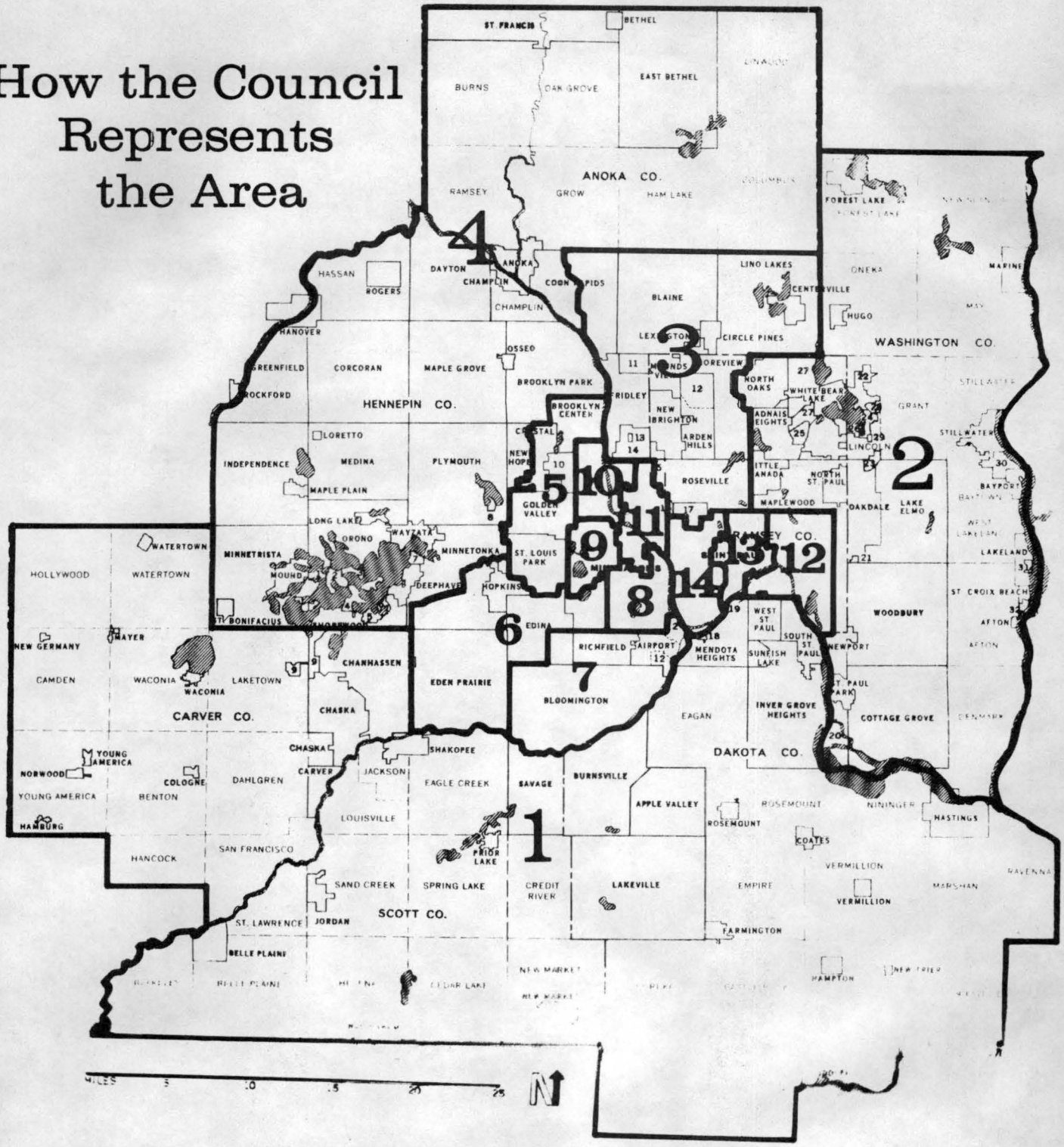
Subd. 11. Advance land acquisition for development purposes in the metropolitan area and the role of the public in connection therewith.

Subd. 12. All studies shall include recommendations as to the governmental organization, governmental subdivision, or governmental district best suited to discharge the powers recommended.

Sec. 8. TAX LEVY. The metropolitan council may levy a tax upon all taxable property in the counties named in section 2 to provide funds for the purposes of this act. The tax shall not exceed one-half mill on each dollar of assessed valutation of all such taxable property, and shall be levied and collected in the manner provided by Minnesota Statutes, Section 473.08.

Sec. 9. The metropolitan council created by this act shall commence operations when the governor has appointed the members thereof in conformity with section 2 and has proclaimed the organization of the metropolitan council in writing filed in the office of the secretary of state.

How the Council Represents the Area



The councilmen and their districts are as follows:
Chairman — James L. Hetland, Minneapolis.

1. **Marvin F. Borgelt, West St. Paul.**
2. **Milton L. Knoll, Jr., White Bear Lake.**
3. **Joseph A. Craig, Coon Rapids.**
4. **Donald Dayton, Wayzata.**
5. **George T. Pennock, Golden Valley.**
6. **Dennis Dunne, Edina.**
7. **Clayton L. LeFevere, Richfield.**
8. **Glenn G. C. Olson, Minneapolis.**
9. **E. Peter Gillette, Jr., Minneapolis.**
10. **James L. Dorr, Minneapolis.**
11. **George W. Martens, Minneapolis.**
12. **The Rev. Norbert Johnson, St. Paul.**
13. **Mrs. James L. Taylor, St. Paul.**
14. **Joseph A. Maun, St. Paul.**

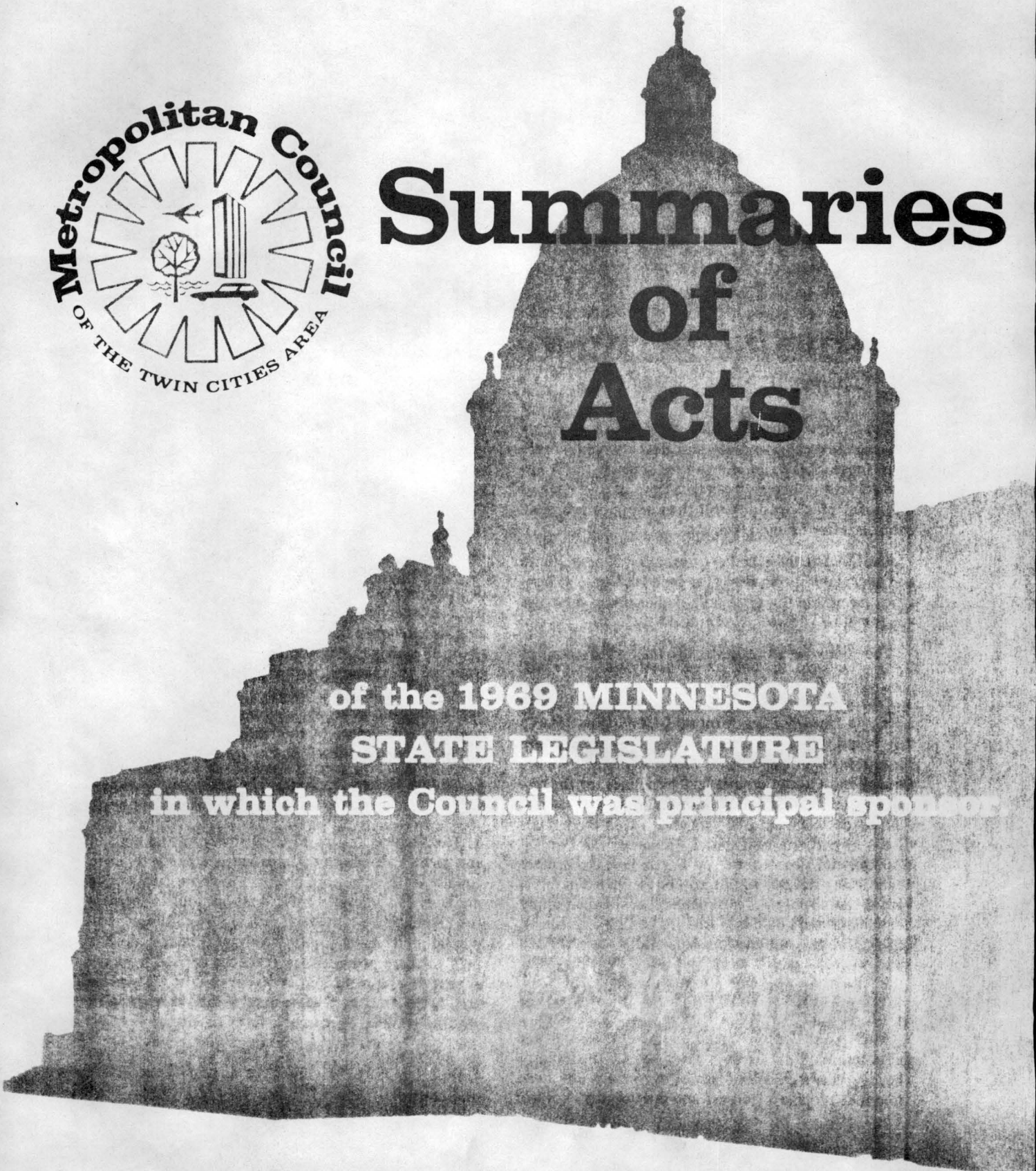
APPENDIX B

SUMMARIES OF ACTS OF THE 1969 MINNESOTA STATE LEGISLATURE SPONSORED BY THE COUNCIL

Metropolitan Council
OF THE TWIN CITIES AREA

Summaries of Acts

of the 1969 MINNESOTA
STATE LEGISLATURE
in which the Council was principal sponsor



Contents

AIRPORT ZONING

Chapter 1111, 1969 Session Laws

The act gives the Council authority to set criteria and guidelines for land-use and development within three miles of the site selected for the new major airport to protect people from noise and protect natural resources. Municipalities will then adopt appropriate controls, after Council review.

The Council will also determine aircraft noise zones and acceptable noise levels for each land-use. No contrary use within the three mile ring or under the noise zones will be allowed.

The following summarizes the major provisions of the act.

1. **"Airport Development Area"** – Within 120 days after the Metropolitan Airports Commission (MAC) selects and the Metropolitan Council approves the site for a new major airport in the Metropolitan Area, the Council must adopt criteria and guidelines for the regulation and use of property within an area called the "airport development area," an area within three miles of the airport site boundaries. However, the Council could extend this distance up to five miles to protect a particular natural resource. The government units within the airport development area will then apply the criteria and guidelines to their zoning ordinances, building codes, subdivision regulations, and official maps.

The act also will temporarily "freeze" land zoning in the airport development area when the Council approves a site. Unzoned land is zoned for agricultural purposes. Within 120 days after the Council adopts the criteria and guidelines, each government unit must submit its proposed land-use and development control measures to the Council for approval. After a hearing, the Council may make any changes that are necessary for consistency. The government unit must then put these control measures into effect within 60 days. No contrary uses will be allowed.

During the time after the MAC calls a hearing for the selection of a site but prior to selection and approval of a site, any applicable or proposed land-use and development control measure must be submitted to the Council for review and comment.

2. **Aircraft Noise Zones** – Within 120 days after selection and approval of a site, the Council must (a) determine probable aircraft noise levels in various parts of the Metropolitan Area; (b) map aircraft noise zones; and (c) determine acceptable levels of perceived noise decibels for each land-use. The government units in the noise zones must then prepare and adopt land-use and development control measures consistent with the acceptable levels. These measures must be submitted to the Council for review and approval and then enacted. No contrary uses will be allowed.

3. **Condemnation by MAC** – If a court determines that application of the land-use and development controls within the airport development area constitutes a taking, the MAC is authorized to purchase the property or any like property by condemnation if necessary. Condemnation power insures that the objectives of the legislation are accomplished. The acquisition of such land must be exercised if the Commission has or will have the necessary funds and if the Council determines that it is necessary to protect the airport from encroachment, or protect the residents of the area, or encourage the most appropriate use of property in the airport development area, or protect and conserve the natural resources of the Metropolitan Area. After property acquisition, the MAC would prepare a plan for its use in accordance with the land-use controls and dispose of the land in the same manner as a housing and redevelopment agency.

4. **Airport Hazard Zoning** – The act does not supersede or limit existing airport hazard zoning powers.

5. **Tax Sharing** – The affected governmental units in any airport development area are not likely to share equally in the resulting tax base under normal taxing methods. To alleviate this situation, and to increase the likelihood of orderly development, the governmental units must jointly study and decide upon a plan to share property tax revenues derived from the airport development area. If 80 per cent of the government units in the area agree upon a plan, then the plan shall be put into effect.

6. **Jurisdiction** – The MAC's jurisdiction is extended from 25 miles to 35 miles for airport site selection and control.

HIGHWAY (LOCAL CONSENT)

Chapter 312, 1969 Session Laws

The act changes highway planning procedures to make early local involvement in highway planning for affected communities mandatory, and creates a procedure whereby participants must make written comments on plans that are binding at a later stage.

Existing law has required municipal approval before highways could be built or altered within community boundaries. Interstate routes were removed from local consent requirements in 1959.

The procedure in the act calls for hearings on highway department plans at the corridor, design, and contract drawing stages, at which time the plan, if disapproved by the Council or a governmental unit, is either reworked and resubmitted or appealed to a Highway Appeal Board made up of three individuals, one mutually agreed upon by the communities involved and one appointed by the governor. These individuals would select a third member. The decision of the Appeal Board would be binding.

The act has statewide jurisdiction. When the plans are submitted for part of the Metropolitan Area, the Council and the Metropolitan Transit Commission become participants in the proceedings.

PROCEDURE

1. **Corridor Study** – The Highway Commissioner will submit to affected governmental bodies a study showing the need for the proposed project, alternatives and reasons for selecting the recommended route, route information (general alignments and profile, approximate access points, level of service, and costs), relationship of the project to existing and planned regional and local development, and social and community value factors.

Within 120 days after a hearing each governmental unit will indicate in writing its approval or disapproval to the Commissioner. If it disapproves, specific reasons will be stated and alternatives suggested. The Commissioner would accept the suggested alternative or explain his rejection and justify his proposal before proceeding. Neither the community nor the Commissioner make a binding commitment at the early stage, but formal response makes it difficult for either to change approaches later. There is no appeal procedure at the corridor stage.

2. **Layout or Design Plan** – The Highway Commissioner will submit to each affected governmental unit a report containing a recommended layout plan with an evaluation of the alternatives, approximate right-of-way limits, tentative schedules for right-or-way acquisition, profile, alignment of roads, access and interchange configurations, frontage roads, and tentative schedules for construction, utilities, landscaping, illumination, and estimated costs of each layout.

Within 90-to-120 days the Commissioner will conduct a public hearing on the proposed project. Within 180 days after the hearing, the Commissioner shall adopt a layout plan. Within 120 days after receipt of the adopted layout plan, each governing body will notify the Commissioner in writing of its approval or disapproval of the adopted layout plan, and proposed alternatives. The municipalities may request the Metropolitan Council to aid them in determining whether the alternatives are likely to meet minimum federal standards. If the governing body notified the Commissioner of its approval or does not indicate its disapproval within 180 days, the layout plan, as adopted by the Commissioner, would become final. The Commissioner may then proceed to prepare final construction plans and specifications and acquire the necessary right-of-way. If the governing body disapproves the layout plan, it will indicate along with its written disapproval the parts of the layout to which it objects, the reasons for its objections, and proposed alternatives. If the parties cannot agree on a layout, the Commissioner may request a hearing by the Highway Appeal Board. If the Commissioner fails to act within one year after submission of the adopted layout plan, any objecting municipality may invoke the appointment of the Appeal Board.

3. **Contract Drawings and Specifications** – at least 120 days prior to letting contracts the Commissioner will submit to affected governing bodies the final plans and as much of the specifications as are available together with indications of any changes from the earlier approved layout and the reasons for these changes. The contract drawings then undergo the same procedures as the initial submission of an adopted layout except that action is limited to changes from the earlier approved layout. However, in this case, municipality may request the Appeal Board within 60 days.

4. **Appeal Procedure** – When a deadlock occurs, a three-member Highway Appeal Board shall be appointed. One of the members shall be selected by the governor, one by the governing body of the municipality or municipalities involved, and the two appointed members select a third member. If the municipalities cannot agree on a member, or the two appeal board members cannot agree on a third member, then the Chief Justice of the Supreme Court shall make the appointment. After considering all the evidence in the record, the Appeal Board shall approve the Commissioner's layout plan or one of the municipal alternatives.

METROPOLITAN PARK BOARD

Chapter 1124, 1969 Session Laws

The park board act calls for the Council to prepare a long-range plan for protection of large areas of open space and recreation facilities as well as smaller open spaces along water bodies and trails by acquisition or other means. A seven-member Council-appointed park board will acquire the property in accordance with the Council plan.

I. Board Selection

The park board will consist of seven members selected from Council districts on the basis of their knowledge and interest in the metropolitan park and open space program. They will serve four-year staggered terms. The Council chairman will appoint the first board chairman from among the seven for a two-year term. Board members will select subsequent chairman.

II. Responsibilities

A. Metropolitan Council

The Council will prepare a long-range plan directed towards the protection of open space through a program of easements and less then fee title, acquisition and development of large areas of open space, recreational facilities, and open space along bodies and trails.

The Council will also review yearly the operative and capital budget of the board, and can suspend them in accordance with MSA 473B.06 Sub. 6.

The Council must cooperate with local government units in their zoning and acquisition programs for parks and open space.

B. Park Board

The board will assist the Council in preparation of the long-range plan and acquire real and personal property and arrange to buy property on installments, and acquire easements. It may establish fees and rentals for any of its facilities and services. It may appoint a director and maintain a staff to assist it.

The board shall, when feasible, contract with local governmental units for the acquisition, development and maintenance of properties acquired in the name of the park board. It may also contract with local governments for policing park property and may enact regulations to protect park property.

The board shall cooperate with local government units in their zoning and land acquisition programs for parks and open space.

C. Local Government

Local governments would continue present park and open space planning and development and would advise on preparation of the long-range Council plan.

III. Financing

A separate act (Chapter 879, 1969 Session Law) provides 2 million dollars over the next two years from a one cent-per-pack cigarette tax for regional parks and open space in the Metropolitan Area.

METROPOLITAN SEWER

Chapter 449, 1969 Session Laws

The metropolitan sewer act places responsibility for long-range sewerage planning in the hands of the Metropolitan Council, which, through a sewer board, will take over, acquire, construct, operate, and maintain all interceptors and treatment works necessary to collect, treat, and dispose of sewage in the Metropolitan Area in a manner that will protect public health and natural resources, specifically water, from pollution.

The act prescribes the responsibilities of the Council and a sewer board, and defines their interrelationship and responsibilities in preparing and implementing an Area-wide comprehensive plan, within which communities will prepare local plans. It also sets up a cost allocation method that includes volume, equity in the present system, excess built in capacity, and metropolitan benefits in its determination of each communities' share of the cost of the system.

I. BOARD SELECTION

Under the act, the Metropolitan Council appoints a sewer board consisting of not less than seven members each representing two contiguous Council districts. They cannot hold another public office, and will be appointed for staggered four-year terms. Not more than half the board members may be appointed from residents of any one sewer service area. The board members will be compensated on the same per diem basis as members of the Metropolitan Council. If the chairman of the sewer board is to be compensated on other than a per diem basis, the Council will determine the rate of compensation. The Council chairman would appoint the first chairman and, thereafter, the board would select its own chairman. The term of the board chairman would be for two years.

II. RESPONSIBILITIES

In general, the Council prepares the over-all plan and the sewer board implements it. The functions and powers of the Council and the sewer board will be as follows:

A. Metropolitan Council

1. Prepare and adopt the metropolitan sewerage system plan with the assistance of the sewer board.
2. Establish guidelines for determining service areas and approve service area boundaries and changes.
3. Approve location and timing of plants, interceptors, and outfalls.
4. Establish board policies for fiscal policy, bonding, and capital budgeting.
5. Prepare and adopt capital improvement program with assistance and recommendations of the sewer board.
6. Adopt first-year capital improvements program.
7. Review and approve board budget.
8. Provide operating funds for sewer board.

B. Sewer Board

1. Assist in preparation of sewerage system plan.
2. Propose and recommend service area boundaries.
3. Prepare and recommend detailed engineering and design including construction schedule.
4. Assist in preparation of capital improvements program.
5. Prepare annual operating budget.
6. Establish cost to communities.
7. Construct interceptors and sewage treatment plants.
8. Operate and maintain physical facilities.

C. Advisory Board

After the sewer service areas have been set-up, the five most populous municipalities in each service area may establish an advisory board that shall meet with that service area's sewer board member concerning the operation and allocation of costs associated with the interceptors and treatment works in that area.

D. Local Governments

Local governments prepare comprehensive plans for the local collection system that are coordinated with the Council's plan and approved by the sewer board, and construct all such facilities in accordance with the approved plan.

Local governments also determine the method used to charge and collect for costs allocated to the community by the sewer board.

III. FINANCING

The total sewer system for the Metropolitan Area has two parts: a local collection system, which remains a community responsibility; and the metropolitan disposal system, made up of interceptors and treatment works that are the responsibility of the sewer board. An "interceptor" means any gravity sewer or pumping station and force main that conducts sewage originating in more than one community or that conducts all or most of the sewage originating in a single community from its logical collection point in that community to the treatment works. "Treatment works" consist essentially of sewage treatment facilities, pumping stations, and outfalls.

The Council is given bonding power, and the full faith and credit of the whole Metropolitan Area will be used to obtain a low interest rate on bonds. The Council will assume all bonded indebtedness of the existing metropolitan sewer system. Lodging the responsibility for establishing fiscal policy with the Council will also assure equity in financing the sanitary sewer system.

Cost apportionment and payment will be based upon the following:

A. Basis of Cost Apportionment

1. Costs will paid by communities depending on the volume and strength of the adjusted average annual flow of sewage treated in the metropolitan sewer system.

2. User costs will be apportioned on the basis of volume and strength of sewage contributed by communities. Future user costs will be apportioned on estimated volumes based on the excess capacity reserved in the system for each community. Strong effluent that results in significant additional treatment costs, as determined by the sewer board, will be calculated and charged back to the community contributing it. Conversely, if a community contributes a weak effluent, its charge will reflect a lower treatment costs.

B. Rates

1. All the sewage treatment plants within the metropolitan service area will form a single system.

2. Treatment costs will be allocated across the whole metropolitan service area rather than by separate service areas.

3. The metropolitan interceptors within service areas will be paid by the community within each service area based on user and future user costs.

C. Acquisition of the Existing System

1. Between January 1, 1970 and January 1, 1971, the Council and the Sewer Board will take

over the existing sanitary districts, joint power arrangements and existing municipal sewer plants and selected interceptors within the area to be given sewer service. The treatment plants based on an 40-year life and the designated metropolitan interceptors based on a 80-year life will have a dollar value assigned based on a replacement-less-depreciation formula.

2. This dollar credit will be assigned to those municipalities owning the equity and will be credited to them over not more than a 30-year period with interest.

3. The board will own all existing and new sewer facilities.

D. Deferred Payments

The Council may defer payment of all or part of current costs of the estimated unused capacity allocated to a community if it is determined that a substantial part of that local government unit has not been connected to the metropolitan disposal system and that the costs are disproportionate to the available economic resources of the unit at that time. The local government unit will repay these amounts with interest on a schedule to be determined by the Council. Deferred costs in the meantime will be paid by the local government units using the metropolitan system as follows:

1. 1/2 based on the assessed valuation.
2. 1/2 based on estimated population.

E. Allocation of metropolitan interceptor costs.

When the Council determines that an interceptor is of substantial benefit to the Metropolitan Area as a whole, the amount of costs associated with it shall be deducted and spread in the same manner as the deferred costs above.

Chapter 1114, 1969 Session Laws*

1. After appointment of a sewer board by the Metropolitan Council, the state shall advance to the Council for the use of the sewer board in amounts and times determined by the Council, the sum of $500,000 from the state general revenue fund.

2. This money shall be used by the sewer board to carry out its duties to provide for the collection, treatment, and disposal of sewage in the Metropolitan Area. The board shall collect in its 1969 or 1970 budget the money advanced and repay it to the State Auditor with six per cent per annum by January 1, 1971.

*This act also includes the authorization to increase the Metropolitan Council tax levy from one half to seven tenths of one mill commencing in 1969.

SOLID WASTE DISPOSAL

Chapter 847, 1969 Session Laws

The solid waste act provides for joint intergovernmental action to make certain that the Metropolitan Area is able to dispose of its solid waste in a planned, economical, and efficient manner consistent with the protection of public health, safety, and welfare. The Metropolitan Council will develop a system plan containing the general location of solid waste disposal sites, site criteria, and operational standards. The counties will acquire, finance, develop, and operate sites or license private operators to do so. The Pollution Control Agency (PCA) will develop air and water pollution standards and issue licenses.

A summary of the functions of each level-of-government in establishing, operating, and regulating the solid waste disposal system follows.

I. Minnesota Pollution Control Agency

A. The Pollution Control Agency shall adopt and seek enforcement of regulations for the location and operation of solid waste disposal sites and facilities in the Metropolitan Area and issue permits, if the operation of the site is consistent with the regulations. However, the agency may not issue a permit for a site or facility in the Metropolitan Area that is not in accordance with the Council's comprehensive plan.

B. PCA must provide the Council a copy of each permit application with supporting information so that the Council can determine if the application is consistent with the Council's comprehensive plan.

II. Metropolitan Council

A. The Council must prepare and adopt, after an appropriate hearing, a comprehensive plan for the disposal of solid waste in the Metropolitan Area. The act further state that "when adopted, such plan shall be followed in the Metropolitan Area." The plan shall include a statement of goals and policies for solid waste disposal; site criteria; the general location and capacities of needed disposal sites and facilities; projections of disposal capacities required; operating regulations; a description of disposal techniques that may be used; and the type or types of solid waste to be disposed of at each site or facility.

B. The Council may revise the comprehensive plan as it deems necessary following the same public hearing and notice procedure in each case.

C. The Council must review the reports submitted by each county and approve these reports if they are

in accordance with the comprehensive plan and review and comment on the proposed disposition of any site or property that has been acquired by a county for solid waste disposal purposes.

D. The Council must review each application for a solid waste disposal permit to determine whether the permit is in accord with the comprehensive plan, and submit this determination to the PCA.

III. Metropolitan Area Counties

A. After the Council adopts its comprehensive plan each county shall prepare and submit to the Council for its approval a report that contains a detailed description of plans to acquire, develop, and operate sites including tables, costs, revenues, and use when completed.

B. When the Council has approved the county report, the county shall implement the report.

C. Counties may acquire by purchase, lease, gift, or condemnation sites or facilities that are in accord with PCA regulations, the Council's comprehensive plan, and the county report as approved by the Council.

D. Each county may authorize bonds to provide funds to acquire disposal sites or facilities. These bonds may be backed by the full faith, credit, and taxing powers of the county, and repaid from the proceeds of any designated tax levies, or user charges derived from each site or facility.

E. Each county may operate and maintain solid waste disposal sites and facilities or contract with any person for the operation and maintenance of any solid waste disposal site which the county owns.

F. Each county may establish and collect reasonable nondiscriminatory rates and charges for the use of the site or facility and contract with any person for the operation and maintenance of any solid waste disposal site that it owns.

G. Each county may sell or lease any property rights acquired for solid waste disposal purposes. However, no property rights may be disposed of until the county has submitted to the Metropolitan Council for its review and comment the terms on and the use for which the property will be sold.

H. Each county must submit to the Council a schedule of the rates and charges in effect or proposed for the use of any solid waste disposal site owned or operated by or on the county's behalf.

I. No public or private solid waste disposal facility will commence operation after July 1, 1969 unless a permit for that operation has been issued by the PCA or unless PCA has given approval for temporary operation prior to the issuance of a permit. Similarly, no governmental unit or person can continue operation of an existing site after January 1, 1970 unless they have either a permit or a temporary operational approval from the PCA.

STATE ZOO

Chapter 868, 1969 Session Laws

The act creates a state board to plan, acquire, construct, and operate a Minnesota zoological garden located in the seven-county Metropolitan Area. A second act provides funds for planning and engineering purposes.

The Council must approve the board's comprehensive plan. The board may grant funds to other zoological gardens in the state.

I. BOARD SELECTION

The state zoological board will consist of 11 members appointed by the governor for six-year staggered terms. The board will appoint a chairman annually from within its membership. Members will be paid a $35 per diem and expenses.

II. RESPONSIBILITIES

A. Zoo Board

The board shall appoint its director and staff, and acquire, construct, and operate the Minnesota Zoological Garden. It may grant funds to other public zoological gardens now in existence for capital improvements or animal acquisition.

The board may also appoint an advisory committee, acquire the lands necessary for the zoo by eminent domain if necessary, and establish a schedule of admission charges.

The board must report its activities yearly to the State Department of Economic Development. Prior to site selection, the board must prepare a comprehensive plan for site selection and development that must be approved by the Council before the plan can be implemented.

B. Metropolitan Council

The Council must approve the site location and development plan before it can be implemented in accordance with MSA 473B.06 Sub. 6.

III. FINANCING

A separate act (Chapter 879, 1969 Session Laws) authorizes $500,000 for the next two years for planning and engineering purposes. The funds will come from a one cent-per-pack cigarette tax increase.

Metropolitan Council
OF THE TWIN CITIES AREA

Capitol Square Building,
Cedar Street at 10th Street,
Saint Paul, Minnesota 55101

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