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A COORDINATED SANITARY SEWER AND WATER SUPPLY SYSTEM PLAN FOR THE GREATER KENOSHA AREA

TECHNICAL ADVISORY AND INTERGOVERNMENTAL
COORDINATING COMMITTEE FOR UTILITY SYSTEM
PLANNING FOR THE GREATER KENOSHA AREA

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A COORDINATED SANITARY SEWER AND WATER SUPPLY SYSTEM PLAN FOR THE GREATER KENOSHA AREA

Prepared by
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for the

Southeastern Wisconsin Regional Planning Commission
Post Office Box 1607
Old Courthouse
916 North East Avenue
Waukesha, Wisconsin 53187-1607

October 1991

Ruekert | Mielke

Professional Engineers
& Registered Land Surveyors since 1946

February 15, 1993

Mr. Kurt Bauer, Executive Director
Southeastern Wisconsin Regional Planning Commission
916 North East Avenue
Post Office Box 1607
Waukesha, Wisconsin 53187-1607

RE: A Coordinated Sanitary Sewer
and Water Supply System Plan
for the Greater Kenosha Area

Dear Mr. Bauer:

We are pleased to submit the final report titled "A Coordinated Sanitary Sewer and Water Supply System Plan for the Greater Kenosha Area". This report is the culmination of three years of effort by the Committee, SEWRPC staff and Ruekert & Mielke.

We would like to express our sincere appreciation to every member of the Committee for the time and effort that they devoted toward the completion of this important planning effort. With implementation of this plan, development in the area can be carried out in an orderly fashion knowing that the sewer and water infrastructure is properly sized and located. The benefits of this regional view of the Greater Kenosha Area should be realized for years to come.

We also hope that a regional water and sewer authority is eventually established to implement the planning, construction and financing of the facilities in an economic and politically-efficient manner. The past cooperation by the members of the coordinating committee should be a good indication that sound public decisions can be made even though there are diverse interests among the affected municipalities.

Very truly yours,

RUEKERT & MIELKE, INC.

William J Mielke

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CHAPTER I
INTRODUCTION

The purpose of this study, report, and of the supporting inventories and analyses, is to prepare coordinated Sanitary Sewer and Water Supply System Plans for the Kenosha Area. More specifically, this report presents an analysis of the sanitary sewer and water needs of the Eastern half of Kenosha County from one mile West of ISH 94 to Lake Michigan. It proposes and evaluates alternative means of meeting those needs, and recommends a plan that will address the intergovernmental, administrative, legal and fiscal problems inherent in the development of the required utility systems.

This study is a result of a request by the Kenosha Water Utility in January of 1988 that the Southeastern Wisconsin Regional Planning Commission (SEWRPC) assist the Utility in the preparation of a prospectus for the Preparation of Coordinated Sanitary Sewer and Water Supply System Plans for the Kenosha Area. The Regional Planning Commission created a technical advisory and an intergovernmental coordinating committee to assist in the preparation of the prospectus. The committee consisted of local, county, state and private officials who were exceptionally knowledgeable about the study area and its utilities, development and private interests. The prospectus was approved by the Technical Advisory Committee in June, 1988.[1]

Following the interview process of a number of consulting engineering firms, the committee decided in December, 1988 to select the firm of Ruekert & Mielke, Inc. to perform this study.

The prospectus presents the following assumptions regarding the work elements of the project:

1. The primary purpose of the proposed planning program will be the development of a coordinated set of system plans to guide the extension of adequate sanitary sewerage and water supply services to existing and probable future urban development within the greater Kenosha area. The system plans are to identify the most cost-effective structure for the physical systems involved.

2. The sanitary sewerage and water supply system plans produced will be in sufficient depth to provide a sound basis for facility planning and design. To this end, the plan shall consider and recommend the general location, elevation, size, grade, and capacity of major trunk sewers, pumping stations, treatment plants, and other sewerage system appurtenances of area-wide significance; and the general location, size, and capacity of major water transmission mains, pumping stations, sources, and treatment and storage facilities. The plan shall, as necessary, contain recommendations for the abandonment or upgrading and expansion of existing facilities, the consolidation of such facilities, the possible exportation of potable water and wastewater from one watershed to another, and the possible construction of new or expanded treatment facilities. The system plans will explicitly and quantitatively identify the relationships between the two systems concerned and the related transfer of potable water and wastewater across the subcontinental divide traversing the study area, distinguishing between exportation and loss.

3. The plan will specifically address water quality considerations associated with both the water supply and sewage treatment facilities. The water supply, appearance, taste, and odor, as well as chemical and biological purity, will be considered. The sewage treatment plant effluent effects upon receiving waters will be considered. The interrelationship between these two systems with regard to water quality will also be considered.

4. The plan will specifically address the legal, fiscal, administrative, and intergovernmental problems inherent in the development of sanitary sewerage and water supply facilities in the study area and make sound recommendations for the resolution of those problems. To this end, the plans shall contain jurisdictional, as well as functional recommendations identifying the agencies to be responsible for the construction, operation and maintenance of each of the various components of the two systems and the intergovernmental arrangements required to implement the system plans. The plan shall also make recommendations concerning capital and operating and maintenance cost allocations and fee structures.

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1. SEWRPC, Prospectus for the Preparation of Coordinated Sanitary Sewer and Water Supply System Plans for the Kenosha Area, June 1988.

5. The planning effort will recognize the interrelationships existing between land use and utility system development. The system plans will be designed to serve and support the land use pattern recommended in the adopted regional land use plan which was refined and detailed in the adopted sanitary sewer service area plan for the study area, and is being refined by ongoing subregional planning efforts, including a current effort to provide a more detailed land use plan for the ISH 94 corridor through Kenosha, Racine, and southern Milwaukee Counties.

6. The study will utilize the latest planning and engineering techniques in developing the coordinated sanitary sewerage and water supply system plans for the area.

7. The planning program will require close and continuing cooperation among the various levels, units, and agencies of government concerned with, and involved in, land use and public utility system development in the study area.

8. Full use will be made of all existing and available surveys, study reports, and other data which may influence and affect the proposed work. Additional data collection activities will be considered only as necessary to develop data essential to the preparation of the plans.

The prospectus outlines a seven step planning process to be followed which is intended to culminate in the selection and adoption of an area-wide sanitary sewerage system plan and companion area-wide water supply system plan from among alternative plans, providing for the necessary utility services to the developing portions of the study area. The seven steps involved in this planning process are: 1) Study Design; 2) Formation of Objectives and Standards; 3) Inventory; 4) Analysis and Forecast; 5) Preparation, Test and Evaluation of Alternative Plans; 6) Plan Selection and Adoption; and 7) Plan Implementation.

This report follows the seven step process and in addition to this introductory chapter consists of the following six chapters which describe the findings of the inventory and analysis phases of the project and present the study recommendations: Chapter II, "Objectives and Standards"; Chapter III, "Inventory"; Chapter IV Analysis and Forecast; Chapter V, "Evaluation of Alternatives", Chapter VI, "Plan Selection and Adoption"; Chapter VII, "Plan Implementation"; and Chapter VIII "Findings, Conclusions and Recommendations".

CHAPTER II

OBJECTIVES AND STANDARDS

OVERALL OBJECTIVES FOR THE DEVELOPMENT OF SEWER AND WATER FACILITIES.

The overall objective of this report is to prepare a coordinated sanitary sewer and water supply plan for the eastern area of Kenosha County from one mile west of ISH 94 to Lake Michigan.

Although the study area encompasses approximately 98 square miles, not all of the area is projected to be served by municipal sewer and water facilities by the design year of 2010. A proposed year 2010 land use plan prepared by SEWRPC[1] indicates areas of anticipated urban growth within the study area that for the most part will be served by municipal services. These areas consist mainly of the area contiguous to existing service areas of the City of Kenosha, Village of Pleasant Prairie, Town of Somers, Town of Bristol and Town of Paris. It will also consist of areas along the ISH 94 corridor and areas adjacent to proposed trunk sewers. There will be pocket areas and some outlying rural areas that will not receive municipal service by the year 2010 which may have some random spot development on soils which are suitable for soil absorption systems. These rural developments are not likely to be of significance and are very difficult to accurately predict. Therefore, the service study will concentrate on major areas of urban growth predicted by the land use plan which will be served by municipal facilities.

As a minimum, the alternatives investigated for the service area will provide for sanitary trunk sewers and water mains with capacity to the year 2010. Some sewage pumping and forcemain alternatives may be investigated depending upon the terrain and cost effectiveness of extending services.

Intergovernmental, administrative, legal and fiscal concerns will be addressed for each of the alternatives investigated.

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1. SEWRPC Planning Report Number 25, A Regional land use plan and a Regional Transportation Plan for Southeastern Wisconsin: 2000, Volume one and two, May 1978. The land use data was updated for the year 2010 by SEWRPC.

DESIGN AND PLANNING STANDARDS FOR WATER FACILITIES

The design of and planning for water facilities is dependent upon projections of future demand by user classification, location, and volume requirements. The standards used in preparing demand projections for all user classifications will be developed in this section.

Water Demands

Water demands for a public water system are based on seven separate components. These are:

- Residential Requirements
- Commercial Requirements
- Industrial Requirements
- Public Facilities Fighting
- Unaccounted For Water Uses
- Unrecoverable Water used in treatment

To determine existing demands for these various components, records from the utility and the Public Service Commission are required. The following information is needed prior to developing current water demand schedules:

- Population Data for the past 10 years
- Pumpage by days and years for the past 10 years
- Metered sales to each category of user for the past 10 years
- The number of each size meter in service for each year
- Water used for treatment each day
- Pumpage rates and elevated storage levels at all times during the maximum demand days.

To determine the existing usage the above information is broken down into the seven components for each of the ten years. Once separated this way, the components can be studied individually to determine trends and verify growth or decline of demands. To determine future demands, population projections by quarter section are required for the entire study area. This would be for both a 20 year and a 40 year design period (years 2010 and 2030).

Residential

Existing residential demand is based on a review of the past 10 years records of the utility and the PSC Reports. The records are broken down into average day demand, average day pumpage, maximum day demand and maximum day pumpage. To determine demands, only the metered consumption is considered. Pumpages are comprised of all the water which is pumped by a utility. Graphical and tabular illustrations (see Table 2-1) are used as a basis for observing trends and aid in the projection of future demands and pumpages. Residential use demands are determined using the following parameters:

- Annual sales vs. year
- Combination of sales and population to obtain average Gallons per capita per day (GPCD) vs. year
- Number of meters vs. year
- Gallons per day per meter vs. year

Table 2-1
Example of Tabular Illustration of
Water Demands and Pumpages

Year	Average Day Pumpage (MGD)	Average Day Demand (MGD)	Percent Difference
1979	.876	.843	3.8
1980	.905	.871	3.8
1981	.819	.772	5.8
1982	.899	.846	5.9
1983	.913	.890	2.5
1984	.949	.911	4.0
1985	.965	.903	6.4
1986	.993	.965	2.8
1987	.879	.842	4.2
1988	.952	.927	2.6
Ave.	.915	.877	4.2

Source: Ruekert & Mielke, Inc.

Where information is readily available, the gallons per meter per year can be useful for checking water consumption predictions based on population. It may be possible to analyze consumption records for recent developments that are similar in nature to the type of developments planned for the future. Where the majority of existing developments are dissimilar to developments planned for the future, recent gallon per meter information from similar developments may be a better predictive tool.

Residential water consumption as reported to the PSC may or may not include persons living in multi-family dwelling units. A water utility may elect to include water consumed in multi-family buildings as commercial accounts. Since average GPCD figures are used to predict future water demands, it is desirable to segregate water consumed by 1 and 2 family dwelling units from that consumed by multi-family dwelling units. The utility or community may have records that will assist in segregating these two water consumption classifications.

Following the determination of existing demand trends and patterns, projections for future demands can be prepared. The initial data required are the population projections of the area for the entire study period. Population data are then used in conjunction with per capita consumption data to determine future residential use. Demand can then be calculated as:

Residential Population x Average GPCD = Average Total Demand

Commercial

Commercial consumption is based on past usage data broken down into gallons per customer per day. Where consumption data is available for multi-family dwelling units classified as commercial customers, the data should be segregated from the remaining commercial customer data. Meter size and usage records will be reviewed to determine if there are any large users which should be evaluated separately. Projections for future commercial usage will be based on land use plans and existing customer data. If projections of the number of anticipated new commercial establishments is not available, estimates will be developed based upon the average area occupied by existing establishments and the total area to be developed. Demand can then be calculated as:

Average Gallons per customer per day x No. of Customers = Average Commercial Consumption.

Industrial

It should be understood that predicting future industrial water consumption is difficult. One or a few large industrial customers can have a tremendous impact on the average daily water consumption.

Industrial demand is based on past usage data expressed as gallons per customer per day. Customers should be classified by meter size and type of industry, such as "Wet" or "Dry". Wet industries are those industries that use large amounts of water for process, cooling or other applications. Dry industries are those industries such as warehouses, trucking firms, banks, office buildings, and similar businesses. The largest users should be evaluated individually. For the majority of the industrial users, projections will be based on gallons per customer per day divided into "Wet" and "Dry" industries and multiplied by the number of customers in each category. If projections of the number of anticipated new industrial customers is not available, estimates will be developed based on average area occupied by each customer and the total area to be developed. These figures will be added to the individual demand projections for the large users in order to obtain the total average day industrial demand.

Public

Public demand is based on past usage data expressed as gallons per customer per day. Because public facilities range in size from fire stations to large colleges and universities, some individual customers may have to be evaluated separately. Usage for universities can be expressed as gallons per student per day and future demands determined by projected enrollment. All other existing buildings should have projected demands based upon past usage data. New buildings should be based upon past usage data for buildings of a similar size and work force.

Fire

Water which is used for fire fighting purposes is generally estimated by the utility on the PSC reports and is included as unaccounted-for water. If the utility keeps more exact records of usage, then trends can be developed and used to estimate future demand. In most cases, however, water used for fire fighting purposes should be considered a component of unaccounted for water.

Unaccounted For Water

Unaccounted for water is that water which is supplied by pumping facilities to the distribution system but not accounted for by metered billings. This may include water which is consumed but not metered due to meter inaccuracies; system leakage, water main flushing, sewer flushing, theft, storage tank overflows, and fire fighting. Records of unaccounted for water should be reviewed to determine past amounts and the effect repairs may have had on those amounts. Future projections should be based on past rates and trends.

Water Used In Treatment

Water used in treatment should be expressed as gallons per 1,000 gallons treated. Past rates should be used to project future rates which are based upon the previous six components of demand. In projecting future demands, proposed water-saving treatment methods and post treatment recovery should be taken into consideration.

The projected average day demand will be calculated as the sum of the following:

- o Residential average day demand
- o Commercial average day demand
- o Industrial average day demand
- o Public average day demand
- o Water used in treatment

Average day demand includes only those components which can be accounted for by metered billings and treatment plant records. Average day pumpage is the total amount of water which is pumped to the distribution system. Projected average day pumpage will be calculated by adding fire fighting usage and other unaccountable water losses/uses to the average day demand.

Drinking Water Quality Standards

Drinking water standards are established by the Wisconsin Administrative Code[2] in Chapter NR 109 entitled Safe Drinking Water and are administered by the Wisconsin Department of Natural Resources (WDNR). The standards are divided in two categories; primary, which are related to health; and secondary, which are related to aesthetics. The standards are further divided into the following categories; Microbiological, Inorganic, Organic, Radiological and Physical. The standards generally apply to samples collected at random locations in the distribution system which are representative of water delivered to the customer's tap. Also included in NR 109 are the sampling frequencies for the different parameters. Table 2-2 contains the standards set forth in NR 109 as of May 1989. It should be noted that NR 109 is currently being revised.

2. Wisconsin Administrative Code, Administrative Rules of State Agencies Published Pursuant to Chapter 227 Wisconsin Statues, Volumes 1-19.

Table 2-2
Current Drinking Water Standards: 1989

PRIMARY	
Inorganic Chemicals	Maximum Contaminant Level (Milligrams per Liter)
Arsenic	0.05
Barium	1.00
Cadmium	0.010
Chromium	0.05
Fluoride	2.2
Lead	0.05
Mercury	0.002
Nitrate (As N)	10.0
Selenium	0.01
Silver	0.05
Organic Chemicals	Maximum Contaminant Level (Milligrams per Liter)
(1) Chlorinated hydrocarbons:	
Endrin (1,2,3,4, 10-hexachloro- 6,7 epoxy- 1,4 4a5,6,7,8,8a-octahydro-1,4-endo, endo-5,8 -dimethano naphthalene).	0.0002
Lindane (1,2,3,4,5,6-hexachloro- cyclohexane, gamma isomer).	0.004
Methoxychlor (1,1,1-Trichloro- 0.1 2 2 - bis (p-methoxyphenyl) ethane).	0.1
Toxaphene ($C_{10}H_{10}Cl_8$-Technical chlorinated camphene, 67-69 percent chlorine).	0.005
(2) Chlorophenoxys:	
2,4 - D (2,4-Dichlorophenoxyacetic acid).	0.1
2,4,5 - TP Silvex (2,4,5-Trichloro- phenoxypropionic acid). 0.01	0.01
(3) Total trihalomethanes [the sum of the concentrations of bromodichloro- methane, dibromochloromethane, tribomomethane (bromoform), and trichloromethane (chloroform).	0.10
Microbiological	
As described in NR 109	
Radiological	
Radium - 226	5 pCi/L
Radium - 228	5 pCi/L
Gross Alpha	15 pCi/L
SECONDARY	
	Milligrams per Liter (micrograms per liter)- except as noted
Chloride	250
Color	15 Units
Copper	1.0 (1,000 ug/L)
Corrosivity	Noncorrosive
Foaming agents	
MBAS (Methylene-Blue Active Substances)	0.5
Hydrogen Sulfide	Not detectable
Iron	0.3
Manganese	0.05 (50 ug/L)
Odor	3 (Threshold No.)
Sulfate	250
Total Residue	500
Zinc	5 (5,000 ug/L)
Note: The following are the current standards as set forth in NR109. It should be noted that NR109 is being revised.	

Source: Wisconsin Administrative Code, NR 109

Water System Design Requirements

Design Objective

The objective in designing a potable water system is to provide a continuous supply of water to all customers. The water delivered to customers must meet certain standards of quality. The system must be able to supply the quantity of water demanded by individual customers and by all of the customers in aggregate. The system must be designed to provide acceptable water pressures at the customers tap. The system must have sufficient redundancy and reserve capacity to provide a continuous supply of water during the most probable emergencies such as fires and anticipated equipment outages.

Design Standards

Design standards are described below for the different components which make up a water supply system. Specific detailed standards are enumerated in Chapters NR 111 and PSC 185, of the Wisconsin Administrative Code, some of which are referenced below.

Peak Day to Average Day Ratio

Peak day to average day ratios are developed from past records and experience. Ten years of data is required to determine usage patterns, climatological impacts, variations due to changes in various customer class sizes and water rates. The average ratio over the last 10 years will be used for future peak day calculations. Peak day is defined as:

Average Day Usage x Peak to Average Ratio = Peak Day

Peak Hour Usage

Peak hour usage is defined as the maximum amount of water pumped in a one hour period. Peak hour usage is based on actual utility records, if they exist, or field measurements performed on or near the date of the peak day pumpage. If no data exists regarding peak hour usage, a ratio between peak day and peak hour usage of 1.75 shall be used.

Minimum and Maximum Pressures

Pressure requirements for water utilities are established by Chapters NR 111 and PSC 185 of the Wisconsin Administrative Code. NR 111.24 (2) requires a minimum pressure of 35 psi at all times in water mains except during fire flow conditions when the minimum allowable pressure is 20 psi (NR 111.24 (3)). Normal pressure variations in water mains should not be more than 13 psi (30 ft.) and no point in a distribution system should have normal pressures greater than 100 psi.

Fire Flow Requirements

The Wisconsin Administrative Code Chapter NR 111.72 (1) requires a minimum fire flow of 500 GPM at 20 psi residual pressure at all hydrants in the distribution system. In many cases, much larger fire flows are needed based upon building size, occupancy, construction and various other guidelines. These guidelines have been set by the Insurance Services Office (ISO)[3] and are used to determine the fire flow requirements for various areas within a utility as well as the fire suppression rating for a community as a whole. ISO recommendations shall be used to determine all fire flow requirements above 500 GPM at 20 psi residual pressure. Table 2-3 presents some of the rates used by the ISO.

Table 2-3
Water Systems Insurance Services Office Flow Rate Calculations for Fire Protection Purposes: 1989

Rate of Flow (GPM)	Duration (Hrs)	Total Gallons
500	2	60,000
750	2	90,000
1000	2	120,000
1250	2	150,000
1500	2	180,000
1750	2	210,000
2000	2	240,000
2250	2	270,000
2500	2	300,000
2750	2	330,000
3000	3	540,000
3250	3	585,000
3500	3	630,000

Source: Insurance Services Office

Supply and Storage Requirements

Future water demands, average day demands and maximum day demands are estimated based upon population and water usage data. The facilities required to supply and store adequate quantities of water to meet these demands are sized based upon conditions which are generally accepted as being necessary for adequate and dependable service. These conditions are summarized in the four parameters described as follows:

3. Insurance Services Office, Fire Suppression Rating Schedule, 1980.

Source Capacity

For a water system supplied by a single source, such as a surface water treatment facility, the nominal capacity of the facility should exceed the anticipated peak day pumpage. In addition, the reliability of the facility must be investigated to determine facility capacity under adverse conditions. Adverse conditions may include a frozen intake, equipment breakdown, power outage or a sharp drop in raw water quality.

For a water system supplied by multiple wells, the aggregate yield of the wells, less the largest capacity well, should exceed the peak day pumpage.

Peak Hour Storage

To be adequate, a water system should have enough usable elevated and ground storage volume to maintain required pressures in the system and to supply the maximum hour demand rate less the maximum day demand for a minimum duration of four hours with the largest pumping unit inoperable. Peak hour demand is assumed to be 1.75 times the maximum day demand.

Fire Flow

To be adequate, a water system should be able to supply the required fire flow for a specified duration concurrent with a maximum day pumpage event. This volume must be available from storage facilities and pumpstations with the largest pumping unit inoperable. The storage volume required to meet the peak hour storage parameter is not considered available to meet this requirement.

Emergency Supply

To be adequate, a water system should be able to supply an average day demand using only elevated storage and auxiliary power pumping.

Main Looping and Sizing

Transmissions mains are generally considered to be those mains 10 inches and larger which convey water between the supply, storage and distribution facilities. At a minimum, transmission mains should be placed one mile apart in a typical grid system. Standards for sizing and looping mains are as follows:

- o Should be sized no smaller than 12 inches. Consideration of future system expansion may require larger mains in some areas.
- o New mains constructed in industrial and commercial areas should be sized no smaller than 12 inches. Any other areas where large fire flows are needed should also have as a minimum, 12 inches mains.
- o All mains should be looped whenever possible. Exceptions to this rule include cul-de-sacs that are less than 300 feet in length.
- o Residential mains should be sized no smaller than 6 inches. In many cases, an 8 inch main will be required.
- o All main extensions should have the size and fire flow verified by a computer or manual hydraulic simulation such as the "Wood" program from the University of Kentucky or by use of a Hardy-Cross Analysis.

DESIGN AND PLANNING STANDARDS FOR SEWERAGE FACILITIES

The design of and planning for sewerage facilities is dependent upon land use, projections of future users, average and peak flow rates and upon the excess capacity of existing facilities. The standards used in preparing demand projections for all user classifications will be developed in this section.

Sewage Flows

Sewage Flows in a public sewage system are based on four separate components. These are:

- o Residential
- o Commercial
- o Industrial
- o Infiltration/Inflow

To determine the existing flows for each classification, records from the utilities are required. The following information is needed prior to developing total system flows.

- o Population data for the past 3 years served by each treatment facility
- o low records from each treatment facility for the past 3 years
- o Flow monitoring records for key points in the trunk sewer systems developed during previous studies
- o Flow monitoring records from pumping facilities for the past three years
- o Records of sewer surcharging or bypass activity for the past three years
- o Water usage records for Residential, Commercial and Industrial users as reported in water utility annual reports
- o Flow projections from previous reports

The past 3 or 4 years of records (1986 - 1989) will be examined to develop flows. This period represents several extremes in climatic conditions from the floods of 1986 to the drought of 1988. It also represents the current state of diurnal flows in the sewerage systems which have been dynamically changing. For example the two main sewerage systems in the area have undergone major changes since the early 1980's. The City of Kenosha eliminated its combined sewers and plugged all but one of its bypasses. In addition, Chrysler Corporation phased out a major auto manufacturing plant which dropped the average flow rate to the Kenosha Wastewater Treatment Facility by approximately 2.0 MGD. Furthermore, the Village of Pleasant Prairie Sewer Utility District "D" Wastewater Treatment Facility was constructed in 1966 and had major modifications in 1985.

Average daily flows and peak flows will be developed for the different user classes. Following the determination of existing flows, projections for future flows can be prepared. As required in the water usage analysis, population projections by quarter section are required for the entire study area. This would be for both a 20 year and a 40 year design period. (Years 2010 and 2030)

Residential

A future per capita average daily base flow rate will be developed and compared with the 100 GPCD factor recommended in the Wisconsin Administrative Code Chapter NR 110. Peaking factors will be used depending upon the total population which contributes to various points along the trunk sewer routes.

The Wisconsin Administrative Code Chapter NR 110.13 states that a peak to average flow ratio of 2.5:1 should be used for interceptor and main trunk sewers and a ratio of 4:1 should be used for sub-main and branch sewers.

This report will follow SEWRPC's peaking factor recommendations for trunk sewer sizing. In SEWRPC's Report 16 and Report 30, peaking factors were recommended for the design of trunk sewer systems. Those recommendations were as follows:

Population	Recommended Peak/Average Ratios
< 2,000	5:1
2,000 - 10,000	4:1
10,000 - 20,000	3:1
>20,000	2.5:1

Commercial and Industrial

For areas in which commercial zoning, industrial zoning and/or development intentions are known, a flow factor per acre (CFS/ACRE) which corresponds to the type of land use will be developed. This coefficient will be based upon factors used in previous planning reports and upon factors to be developed from existing flow records.

A typical peak hourly flow factor for industrial zoned land for trunk sewer design is 0.010 CFS per acre. This factor was developed from the Milwaukee Metropolitan Sewerage District (MMSD) Waste Water System Plan.[4] A flow of 2,650 gpd/acre based on a 250 day work year was assumed. An instantaneous peaking factor of 2.4 was computed using a 10 hour work day.

Trunk sewer flows from public and institutional land are usually calculated from the same coefficient as commercial land. With the exception that institutional land designated for schools is assigned a zero coefficient because the flow is included in the residential component. Parkland and flood plain or conservancy not planned for sewer development is also not assigned a flow coefficient.

Infiltration/Inflow

The existing sewer system has undergone extensive Infiltration/Inflow Analysis, Sewer System Evaluation Surveys and Sewer Rehabilitation in order to remove excessive infiltration/inflow (I/I). This study will assume that no more I/I removal will be accomplished and that maintenance programs will abate further deterioration of the sewer system.

An analysis will be made of the existing trunk system to determine excess capacity that can be used for future flows. A spot check will be made of existing bypass structures to determine activity. Treatment facility records will also be charted for the past 3 to 4 years to gauge the remaining I/I which will be considered non-excessive.

Flow projections will include a component of I/I based upon a rate per capita of new population. This rate will account for the infiltration and inflow that can inevitably be expected from an expanded system. The MMSD uses an average of 12 gpcd for future development.

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4. Planning Report 1 Milwaukee Metropolitan Sewage District, Waste Water System Plan, Volume 1A, June 1980, Chapter 6, Page 84.

Sewage Effluent Standards

Sewage effluent standards have been established for the existing wastewater treatment facilities in the service area by the WDNR. Effluent limitations, monitoring requirements and biomonitoring requirements are set forth in the permits based upon the provisions of Chapter NR 102 of The Wisconsin Administrative Code. These standards have been tailored to the type and characteristics of surface water to which the wastewater treatment facilities discharge.

Administrative Codes NR 105 and NR 106 regulating the control of toxic's was recently adopted and may impact the requirements of the water quality permit. The impacts of these rules will be considered during the study when reviewing the performance of the existing facilities and under any alternatives that would require expansion of existing facilities and/or any new discharge points. These existing standards and rules will be considered in the planning for any new or satellite facilities although no detailed testing is included in the scope of this study.

Sewerage System Design Requirements

This study will consider those trunk and interceptor sewers necessary to serve the study area through the design year. Trunk sewers are generally considered as those sewers 15 inches in diameter and larger. However, for this study, sewers as small as 12 inches in diameter may be considered to serve outlying fringe areas. The trunk sewer system for the most part will be a gravity system. Some pumping facilities may be considered depending upon the terrain and cost effectiveness analysis. Standards for the sewerage system are as follows:

Conveyance Facilities

Average flow for the various classes of users will be estimated from the water usage records. For commercial (includes institutional & public) and industrial users, actual water usage will be modified to reflect wastewater discharge by known credit meters. Estimated flows will be compared to flows generated using flow factors per acre and the existing land use configuration. After comparing the two methods one will be selected to estimate existing flows from commercial, industrial, public and institutional users. Water use records and wastewater treatment facility records will be used to ascertain existing I/I flows. The average flow will be calculated and compared to the 100 gpcd flow factor from NR 110. After comparing the two methods, a decision will be made on which procedure to use to predict future average flows.

Peak Hourly Flows will be determined based upon the previously described flow factors and equivalent population contribution.

Mains shall be laid a minimum depth of 10 feet with an average depth of 12 feet.

As a maximum, manholes shall be placed at 400 foot intervals on sewers less than 18 inches in diameter and at 500 foot intervals on sewers 18 inches in diameter and larger.

The systems analysis will assume no surcharging or bypassing is acceptable in the system except at the wastewater treatment facility.

Pump stations and lift stations will be designed per NR 110 requirements and will be equipped with emergency power backup facilities.

All pump and lift stations with design flows less than 500,000 gpd will be factory built stations. Larger pump stations will be concrete cast in place stations.

Tunneling will be considered as an alternate for sewers over 30 feet in depth.

All sewers and forcemains in street right-of-way will be backfilled with granular material. Slurry backfill will be used for all major highway crossings. All other backfill will be spoil.

Rock excavation and dewatering consideration will be based upon the existing soils map information and any knowledge of ground water and rock conditions.

Wastewater Treatment Facilities

Average flows will be based upon similar criteria as the conveyance facilities.

Peak flows will be obtained by reviewing wastewater treatment facility records. Peak I/I rates will be obtained by reviewing existing facility records with water use data. These flows will be compared to standard peaking factors.

Peak hydraulic loading factors will be based upon the following:

Population	Peaking Factor
<2000	5:1
2,000 - 10,000	4:1
10,000 - 20,000	3:1
20,000 - 300,000	2.5:1
>300,000	1.5:1

Total suspended solids (TSS) and biochemical oxygen demand (BOD) loadings will be obtained from wastewater treatment facility records and certified user data. These will be compared to typical values found in the Administrative Code. Following the data evaluation and comparison, the design criteria will be selected.

Phosphorous loadings will be determined from wastewater treatment facility and certified user data.

Sludge production will be obtained from existing wastewater treatment facility data. For the evaluation of alternative wastewater treatment systems, sludge production will be assumed typical for the specific system evaluated. Sludge dewatering and disposal will be considered in the alternative evaluations.

Oxygen consumption will be based upon facility operating data if available. If not, typical values will be used for the evaluation of the alternatives.

Regional wastewater treatment alternatives will include evaluation of existing treatment facility capacities, and will assume modifications sized in conformance with existing facility design criteria and existing treatment processes.

Satellite treatment facility alternatives will include several variations of the activated sludge process and combination of biological and physical processes as appropriate for the applicable effluent standards for that facility. Effluent discharge options to surface waters and to land will be evaluated. Sludge disposal options will include application of digested liquid and dewatered sludge on agricultural land and land filling. All design criteria will conform to NR 110.

Treatment facility structures will be assumed to be cast-in place concrete with a masonry/brick veneer building superstructure.

Wastewater treatment tankage and equipment sizing will be based upon peak daily loading.

COST-EFFECTIVE ANALYSIS

The alternative plan for both water and sewer projects will be evaluated on the basis of the benefits and costs involved. It is assumed that the least cost alternative that meets statutory requirements and the adopted regional development objectives will be economically the most desirable plan. This economic analysis should not be confused with the financial analysis which needs to be carried out to determine if public funds are available to implement the plan. Financial analysis procedures are described in Chapter V.

The cost-effective analysis compares the 50 year costs of conveyance, storage and treatment for each alternative. It includes total present worth calculations of capital expenditures (initial and future), operation and maintenance costs (O & M costs) and salvage values based on straight-line depreciation of structures and equipment. Sewers, forcemains, concrete structures, watermains and storage tanks are assumed to have a service life of 50 years. Steel structures and electrical components are assumed to have a service life of 30 years and pumps and equipment a service life of 20 years.

Unit cost tables for watermain, sewers and pump stations are included in Appendix A.

Costs are expressed in 1989 dollars. All construction is assumed to be completed within 12 months, therefore there is no interest costs during construction. Project costs include a 30 percent add-on to reflect non-construction contingencies such as engineering design, engineering during construction and associated legal and administrative costs. The interest rate used for the present worth analysis is 6 percent.

ENVIRONMENTAL ASSESSMENT

The environmental assessment of each alternate plan will be briefly addressed with regard to the following parameters:

- Surface waters
- Environmental corridors and wetlands
- Mammals, birds and plant life
- Fish and aquatic life
- Noise and air pollution
- Historic, archaeological and cultural sites
- Recreational areas
- Commitment of resources
- Excavated material
- Land use

CHAPTER III

INVENTORY

PLANNING AREA LOCATION

The planning area for this study consists of all that part of Kenosha County which extends from Lake Michigan to a distance one mile west of Interstate Highway 94. The area is shown in Figure 3-1. A number of governmental units exist in the planning area and are described as The City of Kenosha, the Town of Somers, the Town of Bristol, the Town of Paris and the recently formed Village of Pleasant Prairie. Table 3-1 provides a breakdown of the civil divisions which comprise the planning area.

Table 3-1
Existing Civil Divisions: 1989

	Estimated Acres	Estimated Square Miles	Percent of Study Area
Bristol Town (Part)	3,887.0	6.07	6.2
Kenosha City	12,225.1	19.10	19.5
Paris Town (Part)	3,887.0	6.07	6.2
Pleasant Prairie Village	20,939.5	32.72	33.4
Somers Town	21,754.5	34.00	34.7
Totals	62,693.1	97.96	100.0

Note: Areas are based on 1985 estimates prorated to reflect current areal data and updated as boundary changes occurred.

Source: SEWRPC, Ruekert & Mielke, Inc.

In addition to the governmental units described above, the County and State provide various services in the planning area. These include the County Seat, County and State Parks, and various educational institutions. Various other state and county owned areas also exist and will be discussed later in this chapter.

SERVICE AREAS

The planning area encompasses approximately 98 square miles of which approximately 25 are in the present service areas. For the purposes of this report, the service areas are described as that part of the planning area served by sewer, water or both. These areas as presented in the prospectus are outlined in Figure 3-2 and Figures 3-3. The 1988 service areas are described in Table 3-2.

The service areas consists of four separate water supply systems and their sub-systems, along with three public wastewater treatment facilities and the various collection systems which discharge to them. Each individual water service area and sewer service area is identified in Figure 3-3. Areas which share both water and sewer service are also shown. A detailed description of all sewer and water facilities is included later in this chapter.

PHYSICAL FEATURES

The planning area is divided by a variety of physical features including the subcontinental divide, rivers, lakes and major highways. County boundaries on the north, the state line on the south, Lake Michigan on the east and a line one mile west of ISH 94 serves as the outer boundary of the area.

The planning area is divided into three major watersheds described as the Pike River watershed; the Des Plaines River watershed; and the watershed which is directly tributary to Lake Michigan via a number of small creeks and drainage-ways. The boundaries of these watersheds and the location of the subcontinental divide is shown in Figure 3-4. The subcontinental divide serves to separate the Mississippi River drainage basin from the Great Lakes drainage basin. Total areas contained in each basin and watershed are provided in Table 3-3.

Table 3-3
Total Area Contained in Major Watersheds and Drainage Basins: 1989

	Area (Square Miles)	Percent of Study Area
Mississippi River Drainage Basin		
Des Plaines River Watershed	40.69	41.5
Great Lakes - St. Lawrence River Drainage Basin		
Pike River Watershed	30.13	30.8
Lake Michigan Watershed (From Small Tributaries)	27.14	27.7
Totals	97.96	100.0

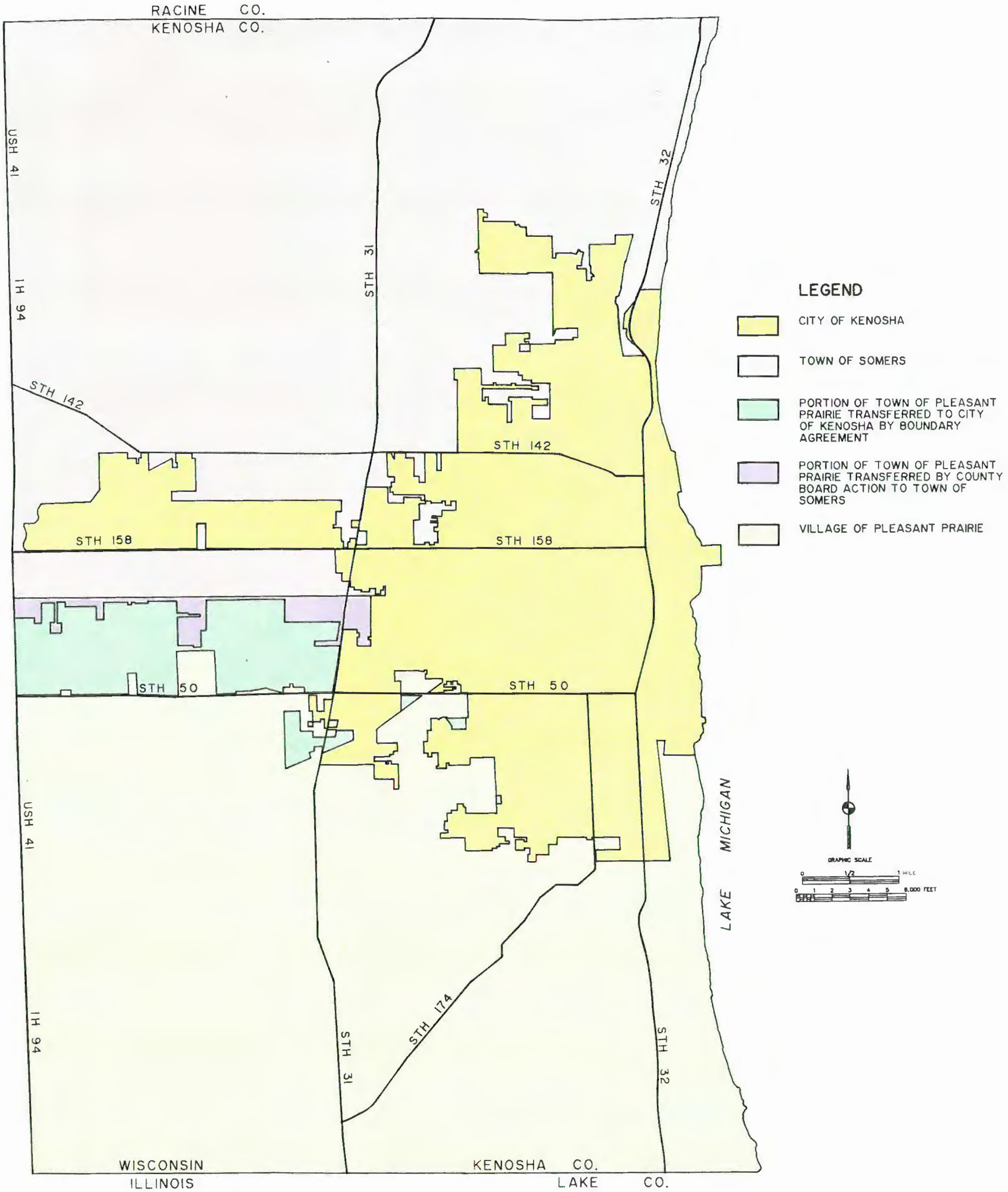
Note: Areas are based on estimates from the study prospectus and prorated to reflect current areal data.

Source: SEWRPC

Elevations in the planning area range from a high of approximately 750.0 NGVD to a low of approximately 578.8 NGVD. The highest point is located on the subcontinental divide while the lowest is the surface elevation of Lake Michigan.

Figure 3–1

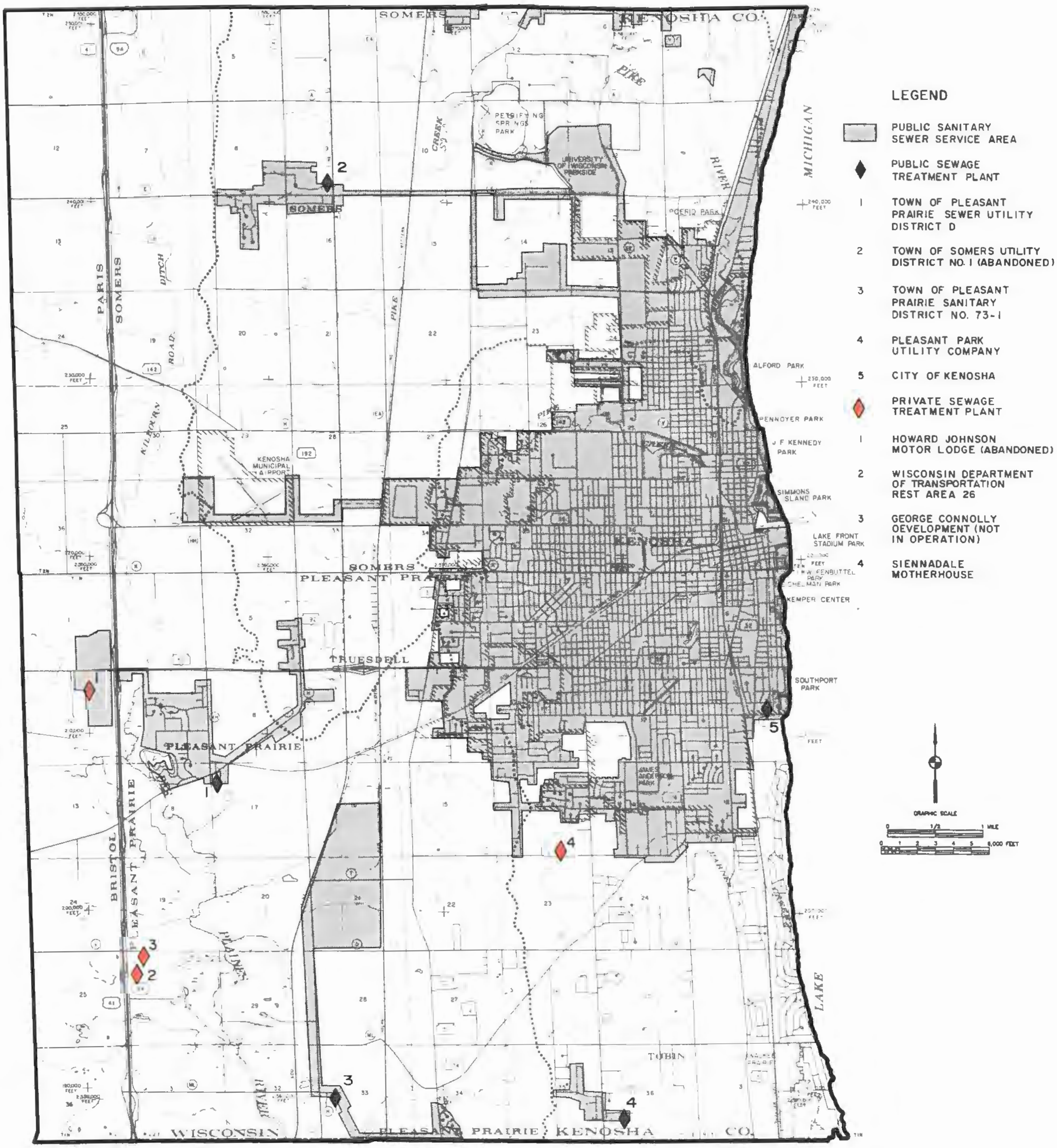
EXISTING CIVIL DIVISIONS: 1989



Source: SEWRPC

Figure 3-2

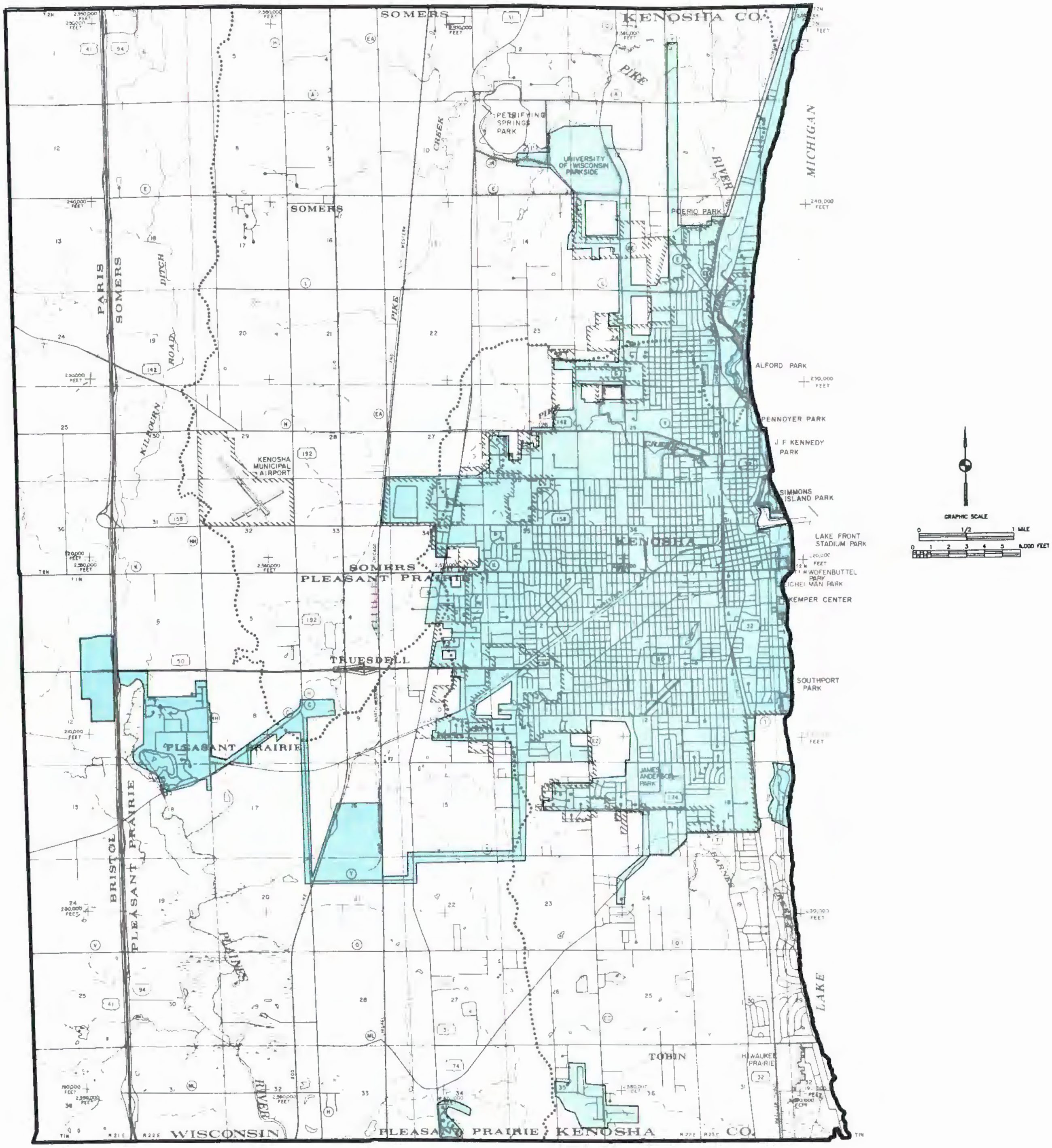
EXISTING SANITARY SEWERAGE FACILITIES AND SERVICE AREA IN THE GREATER KENOSHA UTILITY STUDY AREA: 1988



Source: SEWRPC

Figure 3–3

EXISTING PUBLIC WATER SUPPLY IN THE GREATER KENOSHA UTILITY STUDY AREA: 1988



Source: PSC, SEWRPC

Table 3-2

Description of Existing Wastewater and Water Service Areas: 1988

Name of Public Sewerage System	Estimated Area Served (Square Miles)	Estimated Population Served
Kenosha Water Utility and Village of Pleasant Prairie Sewer District No. 1	20.74	85,300
Village of Pleasant Prairie Sewer Utility District "D"	1.20	1,700
Village of Pleasant Prairie Sanitary District No. 73-1	0.98	600
Pleasant Park Sewer Utility	0.31	600
Town of Somers Utility District No. 1 (1)	0.86	1,100
Town of Somers Sanitary District No. 1	0.70	1,300
Town of Bristol Sewer Utility East (2)	0.31	---
Totals	25.10	90,600

(1) The Town of Somers Utility District No. 1 Treatment Facility was abandoned in 1986, the sewerage system was then connected to the City of Kenosha.

(2) As of 1988, The Town of Bristol System served only business and commercial establishments and discharges to the Pleasant Prairie Sewer Utility District "D".

(3) The Lakeview Corporate Park was provided with sewer service from Pleasant Prairie Sewer Utility 73-1 in 1989.

Name of Public Water Utility	Estimated Area Served (Square Miles)	Estimated Population Served
Kenosha Water Utility	18.40	83,300
Village of Pleasant Prairie Water Utility (1)	2.54	2,300
Town of Somers Sanitary District No. 1 (2)	0.70	1,300
Town of Bristol Water Utility (3)	0.50	---
Totals	22.14	86,900

(1) The Village of Pleasant Prairie Water Utility is comprised of the Pleasant Homes System, (as of 1988), the Zirbel System, the Ladish System, the Timber Ridge System, and those areas within the Village which are served by the Kenosha Water Utility.

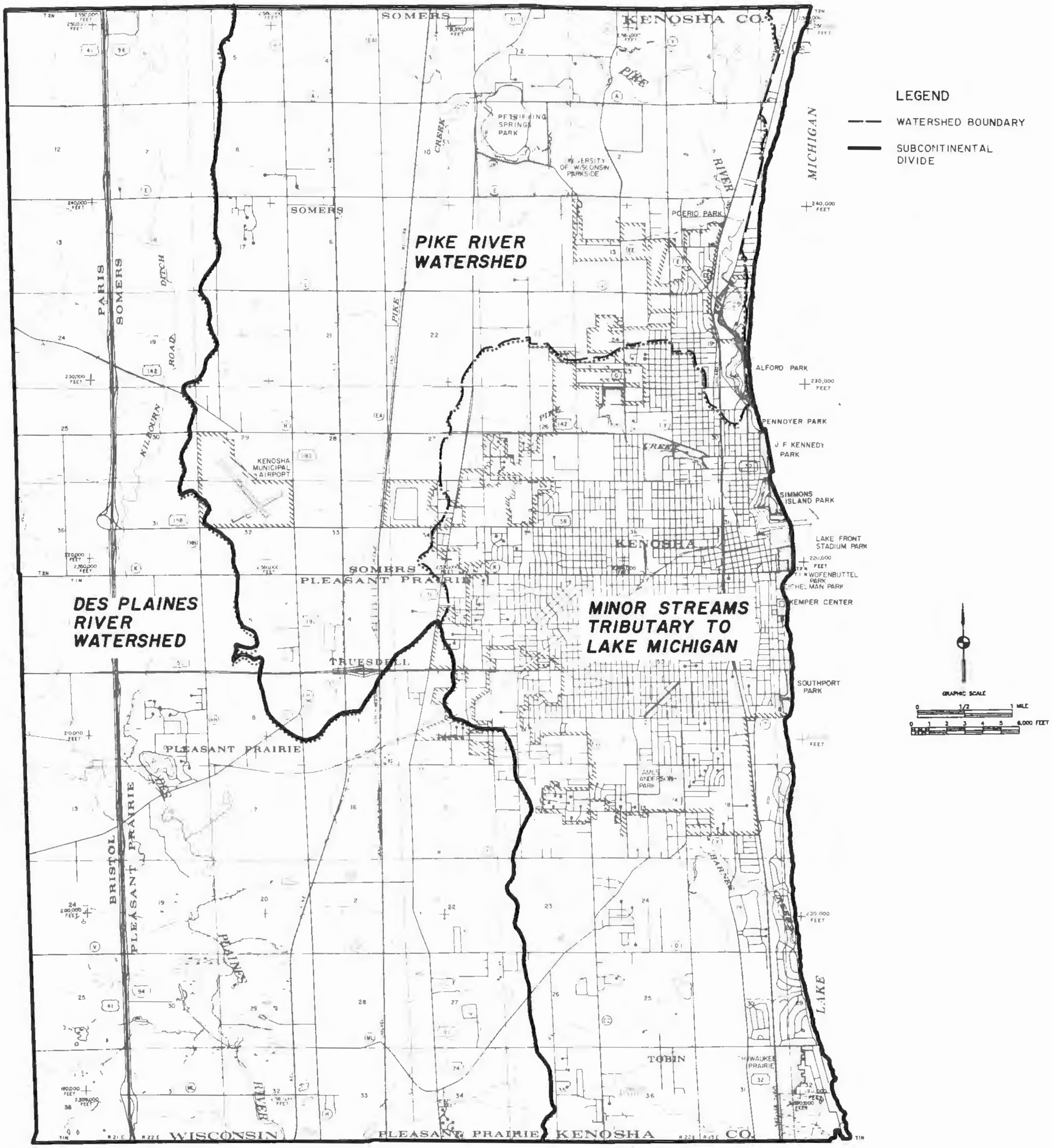
(2) The Town of Somers Sanitary District No. 1 receives water from the Kenosha Water Utility.

(3) As of 1988, The Town of Bristol System serves only business and commercial establishments.

Source: PSC, SEWRPC

Figure 3-4

WATERSHED BOUNDARIES IN THE GREATER KENOSHA UTILITY STUDY AREA: 1989



Source: SEWRPC

SOILS

The soils in the Kenosha Area are predominantly dense, organic soils of low permeability and are ill-suited for septic tank soil absorption systems.Soil capability data have been collected and collated by SEWRPC and are contained in Table 3-4. These data are based on the operational soil survey prepared by SEWRPC in cooperation with the U.S. Department of Agriculture, Soil Conservation Service.[1]

Table 3-4
Soil Suitability for Conventional
Onsite Sewage Disposal Systems under Curent
Administrative Rules: February 1991

Soil Limitation Category	Area in Acres	Sample Freq.	Percent of Study Area
Suitable	1,769.14	204	2.82
Undetermined	1,272.73	67	2.03
Unsuitable	58,002.24	5925	92.44
Other (1)	1,703.98	195	2.72
Total in Acres	62,748.10	6391	100.00

(1) Other includes those soil mapping units for which limitations for septic tank absorption fields have not been determined and surface water.

Source: U.S. Department of Agriculture, Soil Conservation Serivce, SEWRPC

These data indicate that approximately 92 percent of the soils in the study area are in the unsuitable category for septic tank absorption systems. Figure 3-5 provides locations of the suitable, unsuitable, and undetermined areas of soil limitation in the study area. The soils interpretation categories were developed as part of the year 2010 regional land use planning program to reflect the current regulatory practice under Chapter ILHR 83 of the Wisconsin Administrative Code.

While almost every major type of soil is represented in the planning area, three associations dominate: Varna-Ashkum-Elliot; Morley-Beecher-Ashkum; and Hebron-Montomery-Aztalan. The most common soils, Varna-Ashkum-Elliot, are formed in loess in the glacial till and clay loam on knobs and ridges which remain from the glacial moraines. These soils are not well suited for development due to poor mechanical properties and a high water table. They are, however, well suited to agricultural applications.

The second most abundant type soils are of the Morley-Beecher-Ashkum Association. These soils occur mainly in the central and south portions of the planning area and are well to poorly drained soils. They too are developed from glacial till and found on knobs and ridges. The Hebron-Montgomery-Aztalan Association is predominant in the south central portion of Pleasant Prairie and adjacent to river and stream beds. Both of the two previously mentioned groups as well as these soils have low permeability, low bearing capacity, poor shear strength, high shrinkage potential and a high water table. Other soils exist in the planning area but their use for engineering purposes is also severely limited.

1. SEWRPC Planning Report No. 8. Soils of Southeastern Wisconsin.

GEOLOGY AND GROUNDWATER

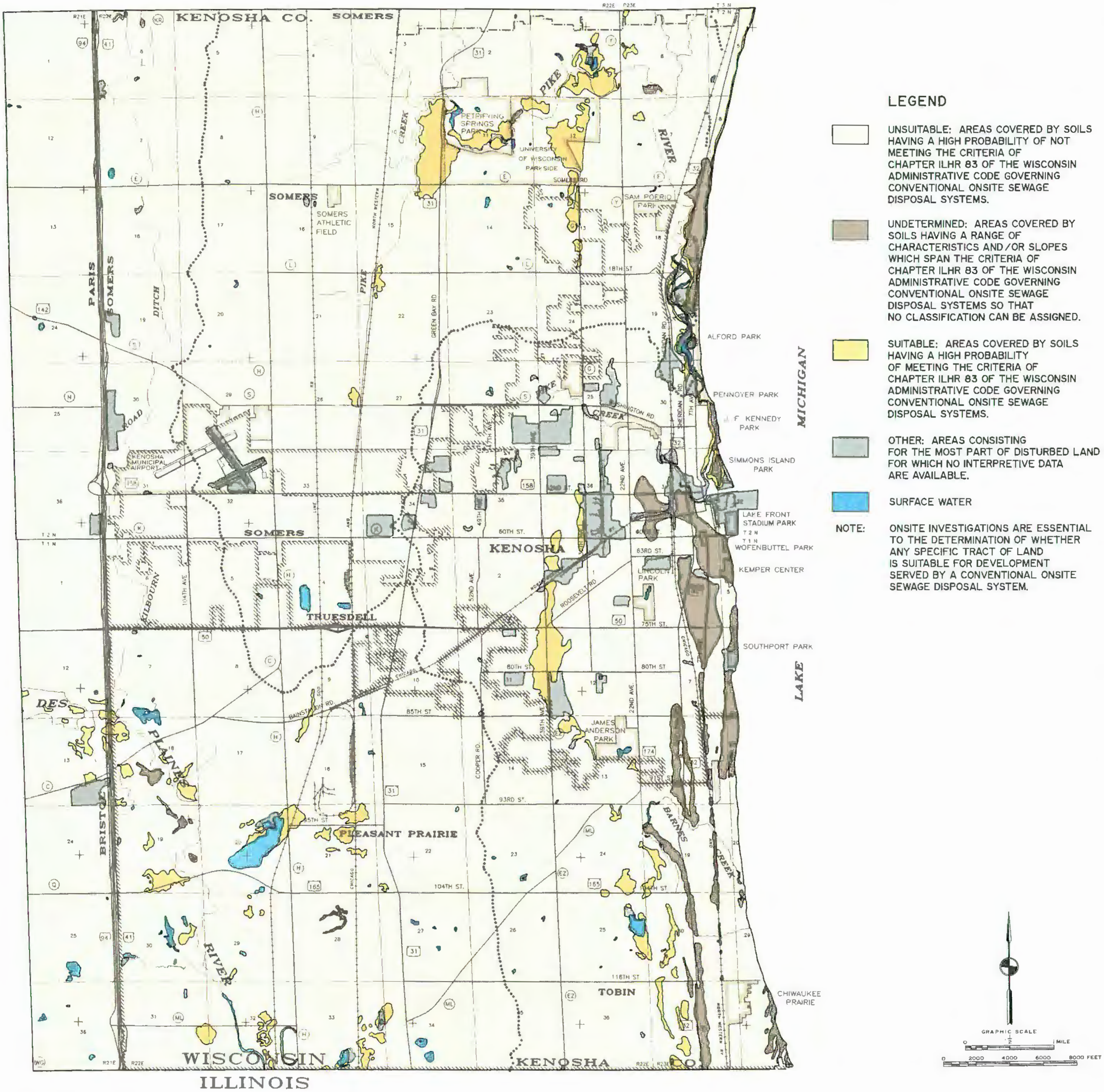
The natural environment of ground water is the aquifer, or the rocks and soils that constitute the water bearing strata. In order to determine aquifer strength and availability of groundwater, an inventory of the structure and stratigraphy of the geologic units within the planning area is necessary.

In Southeastern Wisconsin rock units range in age from precambrian to quaternary as shown in Figure 3-6 and Table 3-5. The consolidated rocks consist mainly of sandstone, dolomite, shale, some limestone, and all of the Paleozoic age layer. This group of consolidated rocks dips eastward from the northcentral part of the state and is known as the Wisconsin Arch. This arch is the main outcrop of precambrian rock which form the basement complex for southeastern Wisconsin.

Cambrian rock units are, in ascending order, the Mount Simon Sandstone, the Eau Claire Sandstone, the Galesville Sandstone, the Franconia Sandstone, and the Trempealeau Formation. Above the Cambrian level are the consolidated rocks of the ordovician, silurian and devonian ages and the unconsolidated quaternary system.

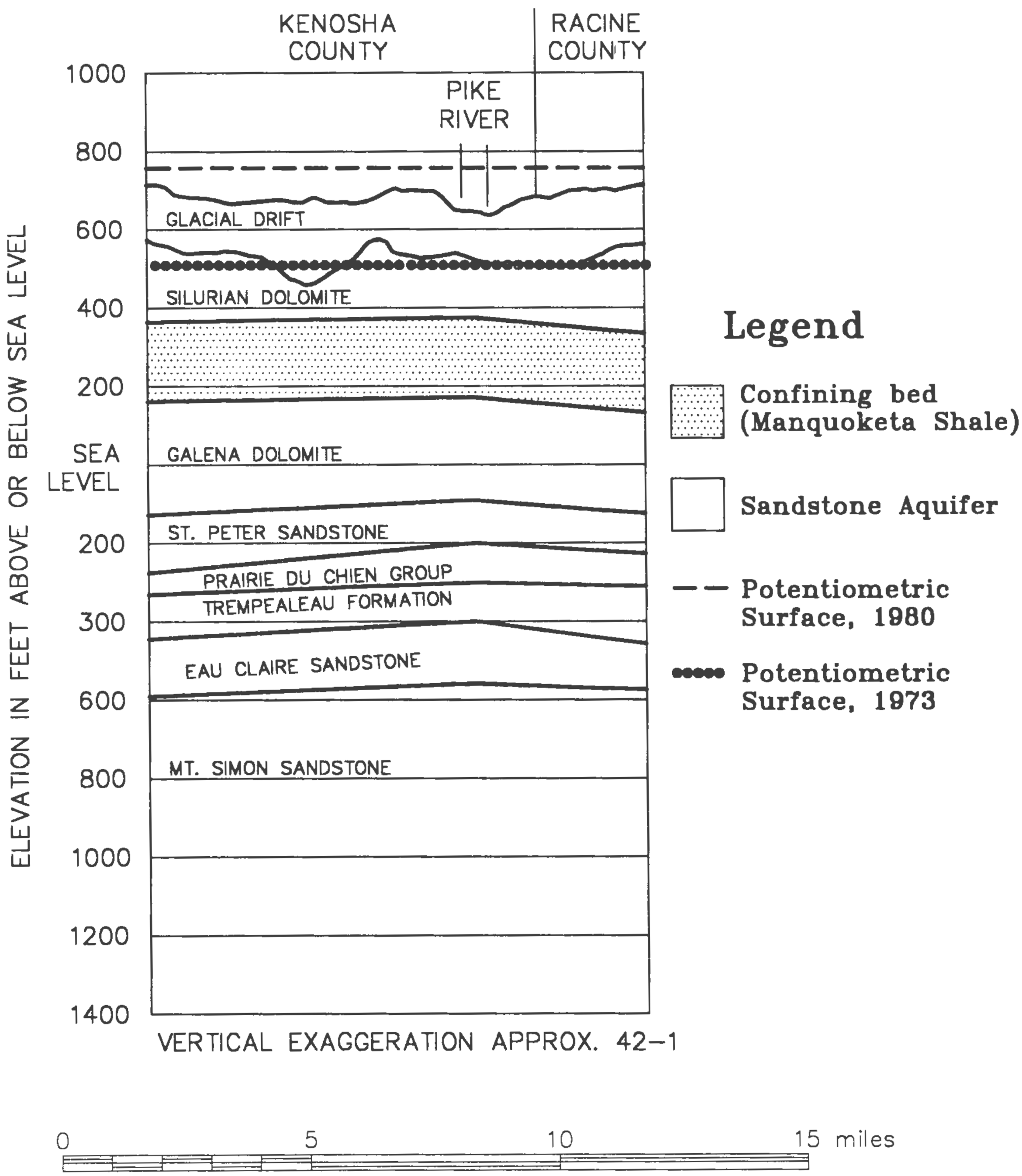
Groundwaters in the Kenosha area are contained in, from oldest to youngest, late Cambrian sandstones; the Prairie du Chien Group; the St. Peter Sandstone; the Platteville Galena unit of the Ordovician Age; the Niagara Dolomite of Silurian Age; and surface deposits containing glacial rock material of the Pleistocene Age. The two major aquifers for the study area are the lower sandstone aquifer and the shallow aquifer consisting of dolomite bedrock and the interconnecting glacial till. The two aquifers are separated by a virtually impermeable layer of shale and dolomite approximately 150 feet thick known as the Manquoketa Formation. The actual thickness of various formations and static water levels from wells in the study area is provided in Table 3-6. The potentiometric surface above the top of the sandstone aquifer in 1973 is presented in

Figure 3-5
SOIL SUITABILITY FOR SEPTIC TANK ABSORPTION SYSTEM



Source: SEWRPC.

Figure 3-6
GEOHYDROLOGIC SECTIONS
THROUGH KENSOSHA COUNTY



Source: U.S. Geological Survey

Table 3-5
Stratigraphic Units and Water Bearing Properties

System	Geologic Unit	Description	Saturated Thickness	Water Yield
Quaternary	Halocene and Pleistocene Deposits	Sand, silt, peat, clay, gravel, and boulders	0-300 Feet	Small to large: Large yields in buried valleys
Devonian	Undifferentiated	Shale and Dolomite	0-155	Small amounts to domestic wells
Silurian	Undifferentiated	Dolomite	0-560	Important aquifer. Yields depend on size and extent of crevices
Ordovician	Manquoketa Shale	Shale	0-270	Very low yield
	Galena Dolomite Decorah and Platteville formations	Dolomite	0-340	Small to moderate yield. Used in absence of Manquoketa
	St. Peter Sandstone	Sandstone	0-260	Moderate to large yields caves easily
	Prairie du Chien Group	Dolomite	0-150	Small yields
Cambrian	Trempealeau Formation	Dolomite	0-10	Small yields except where there are well developed solution channels
	Franconia and Galesville Sandstones	Sandstone	0-225	Moderate to large yields
	Eau Claire Sandstone	Sandstone, siltstone and shale	0-160	Small yields
	Mt. Simon Sandstone	Sandstone	0-1,500+	Moderate to large yields
Precambrian	Undifferentiated	Crystalline	Unknown	Very small yields locally

Source: University of Wisconsin Geological and Natural History Survey

Table 3-6
Static Water Levels and Formation Thickness for Various
Wells in the Study Area

Well Location	Drift	Devonian Undiffer	Silurian Undiffer	Neda/ Manquoketa	Other Ordovician	Cambrian	Static Level
Oak Hi Dev.	0-142'	---	142-295'	---	---	---	13'- 3"
Zirbel	0-118'	---	118-154'	---	---	---	18'
Timber Ridge	0-176'	---	176-430'	430-640'	640-1155'	1155-1955'	280'
Pleasant Prairie Industrial Park No. 1	0-170'	---	170-360'	360-570'	570-1060'	1060-1640'	225'
Pleasant Prairie Mobile Home Court	0-141'	---	141-269'	---	---	---	51'
Carol Beach Water Company	0-196'	---	196-370'	370-542'	542-855'	---	60'
Kenosha Mobile Home Park	0-102'	---	102-385'	385-562'	562-729'	---	95'

Source: DNR

Figure 3-7. Figure 3-8 provides the elevation of the shallow ground water table.

Groundwater levels in the area have been monitored at two sites containing DNR monitoring points for the past 10 years. The results of the monitoring show that the water table has remained relatively stable for the past decade. This data is presented in Table 3-7.

Table 3-7
Water Table Levels in the Study Area

Approximate Groundwater Level Below the Surface		
Year	Kenosha Landfill Groundwater Monitoring Well "A"	WEPCO Groundwater Monitoring Well No. 1
1980	5.0 Feet	2.5 Feet
1981	8.0 Feet	2.5 Feet
1982	8.0 Feet	3.5 Feet
1983	10.0 Feet	2.5 Feet
1984	10.0 Feet	3.5 Feet
1985	9.0 Feet	3.5 Feet
1986	8.0 Feet	3.5 Feet
1987	N/A	2.5 Feet
1988	8.0 Feet	3.5 Feet
1989	15.0 Feet	8.0 Feet

Source: DNR

GROUND WATER QUALITY

The quality of the groundwater in the study area is important in determining the usefulness of an aquifer as a source of water for domestic, industrial and commercial uses. Water which is not bacteriologically safe is not fit for human consumption. High concentrations of volatile organic chemicals, radioactive particles and certain inorganic chemicals may also preclude the use of groundwater as a source for domestic use. Hard water or water with objectionable physical qualities, such as high iron content, hardness or high solids content, may not be suitable for industrial or commercial applications.

Ground water quality at various wells in the area is monitored periodically by the Wisconsin Department of Natural Resources (WDNR) and recent records are contained in Table 3-8. Water from the shallow limestone aquifer has a history of providing good quality, relatively soft water for individual wells and some community wells. The sandstone aquifer in the area has a history, since 1978, of high radium counts. Radium histories of the Pleasant Prairie Ladish and Timber Ridge wells and the Bristol waterworks well are contained in Tables 3-9 to 3-11. Limited data is available on groundwater quality other than at municipal wells. There has been recent testing performed at the Wisconsin Department of Transportation (WDOT) Rest Area 26 and this data is included in Table 3-8.

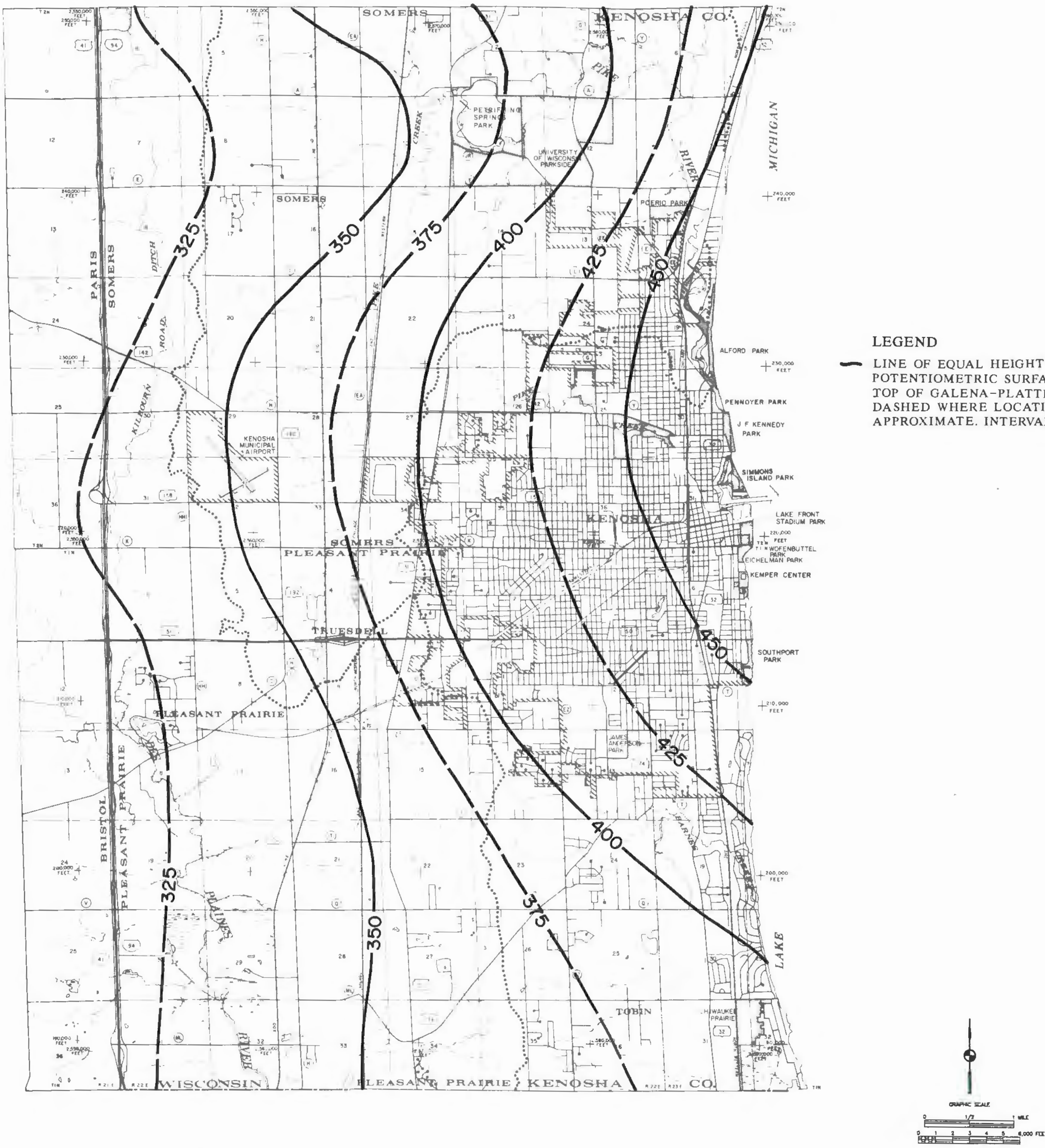
Ground water quality may be affected by sources of pollution such as landfills, wastewater treatment facilities, sludge dumping, spills, and leaking storage tanks. The DNR has kept a record of the location of reported areas of potential contamination in the study area. The location of potential contamination sites will be addressed with regard to potential water sources in the next chapter.

SURFACE WATER QUALITY

Surface waters, as a generalization, tend to be variable in quality, contain lower concentrations of minerals, are more colored,

Figure 3-7

HEIGHT OF POTENTIOMETRIC SURFACE ABOVE THE TOP OF THE SANDSTONE AQUIFER: 1973



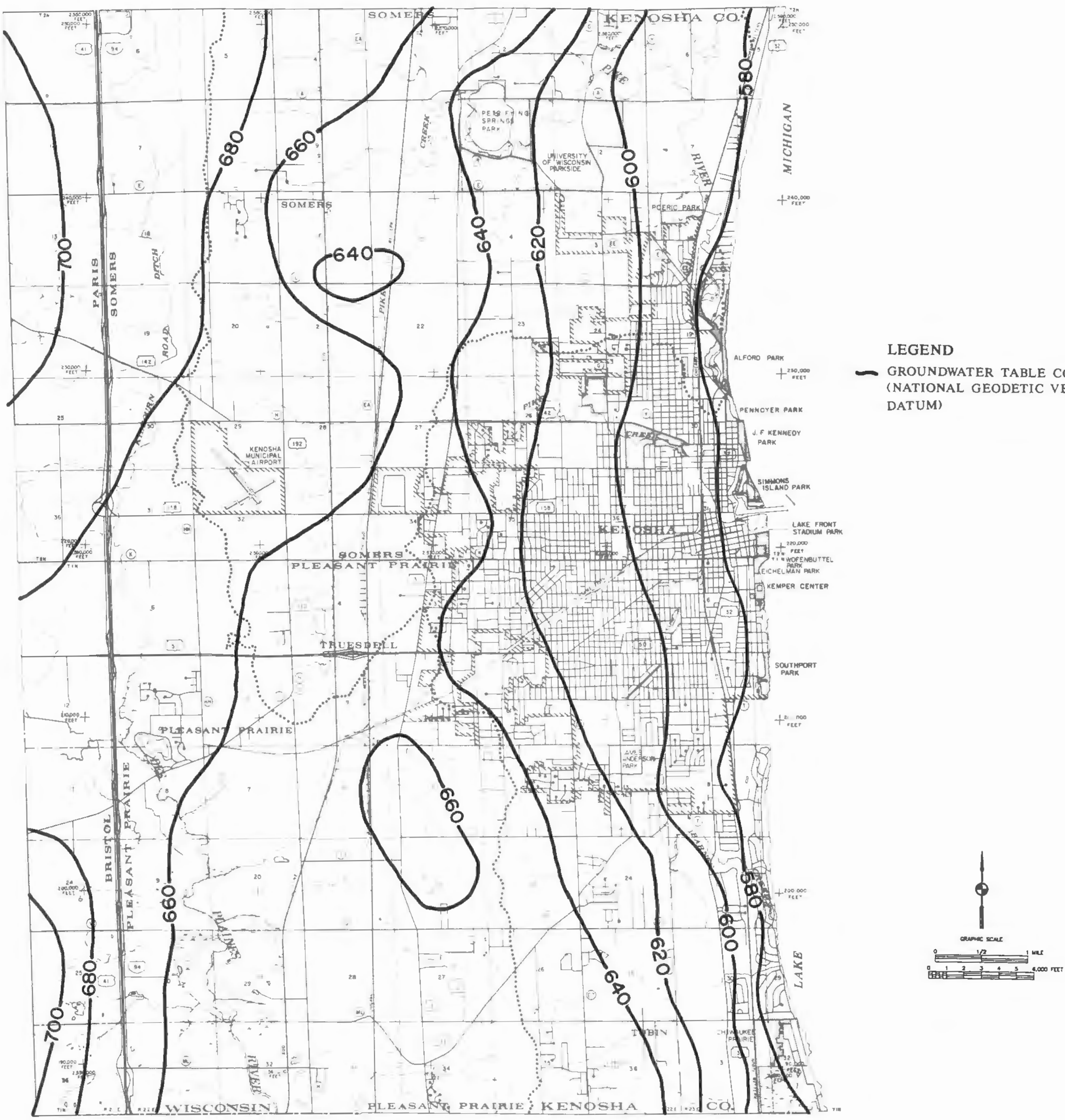
LEGEND

LINE OF EQUAL HEIGHT OF POTENTIOMETRIC SURFACE ABOVE TOP OF GALENA-PLATTEVILLE UNIT. DASHED WHERE LOCATION IS APPROXIMATE. INTERVAL IS 25 FEET.

Source: U.S. Geological Survey

Figure 3–8

ELEVATION OF GROUNDWATER TABLE IN KENOSHA COUNTY: 1978



LEGEND

GROUNDWATER TABLE CONTOUR (NATIONAL GEODETIC VERTICAL DATUM)

Source: U.S. Geological Survey

Table 3-8
DNR Inorganic Water Chemistry Sample Results - Groundwater

Parameter Name	Maximum Contaminant Level (MCL)/Units	Bristol Sanitary District No. 3	Wis. DOT Rest Area 26 Well	Pleasant Prairie Zirbel	Pleasant Prairie Ladish	Pleasant Park Utility	Kenosha Water Utility
Date	--	6-1-88	09-12-86	3-22-89	3-22-89	3-22-89	3-21-89
Sample Location	--	Well No. 3	Tap	Tap	Hose Bib	Hose Bib	Tap
Alkalinity Total ($CaCo_3$)	-/mg/l	98.00	140.00	N/T	256.00	205.00	N/T
Arsenic	50.0 mcg/l	<10.00	<1.00	<10.0	<10.00	<10.00	<10.00
Barium	1000.0 mcg/l	<40.00	N/T	<40.0	<40.00	58.00	<40.00
Cadmium	10.0 mcg/l	0.40	<1.0	<1.0	<0.2	<0.20	<0.20
Calcium	-- mg/l	86.00	42.00	22.00	N/T	37.00	N/T
Chloride	250.0 mg/l	5.90	15.00	13.00	N/T	2.70	14.00
Copper	1000.0 mcg/l	460.00	140.00	<20.00	170.00	<20.00	<5.00
Fluoride	2.2 mg/l	1.00	2.10	1.00	1.20	0.90	1.00
Hardness	-- mg/l	400.00	N/T	110	N/T	220	N/T
Iron	.3 mg/l	2.90*	.11	0.0	0.12	<0.05	<0.05
Lead	50.0 mcg/l	3.50	<1.00	<3.00	<3.00	<3.0	<3.0
Magnesium	-- mg/l	45.00	N/T	14.00	16.00	30.00	N/T
Manganese	50.0 mcg/l	180.00*	20.00	<40.00	<40.00	<40.00	<40.00
No3+No2 AsN	10.0 mg/l	<.50	<0.05	ND	ND	ND	0.20
Ph	-- --	8.10	7.40	8.10	8.40	8.29	7.70
Sodium	-- mg/l	85.00	67.00	95.00	19.00	45.00	7.00
Sulfate	250.0 mg/l	200.00	64.00	180.00	160.00	110.00	26.6
TD Solids	500 mg/l	1170.00	310.00	N/T	534.00	N/T	N/T
Zinc	5000.0 mcg/l	87.00	N/T	43.00	19.00	ND	10.00

Note: Maximum contaminant levels are based on Wisconsin Administrative Code Chapter NR 109.
N/T = Not Tested ND = Not Detected

have greater turbidity and to contain more taste and odor-producing substances than groundwater. They also are more susceptible to wastes, including accidental spills and illegal dumping.

Finished water quality and the type of treatment required are both dependent upon the quality of the source of supply. Treatment plants have been classified according to raw-water quality to assist those concerned with water treatment. Table 3-12 presents an example of the standards developed in Water Quality Criteria, a report of the California State Water Pollution Control Board. It should be pointed out that those waters classified as excellent by the Board would probably require complete treatment to satisfy consumer demands and individual states requirements for quality.

Table 3-13 contains the past 10 years raw water quality data from the Kenosha Water Utility. Quality is monitored on a daily basis at the treatment plant and the numbers presented are averages. The data indicates that the quality of the water has remained stable and should be considered a good source by the aforementioned standards.

The quality of the two major streams in the study area, The Des Plaines River and the Pike River, is provided in Table 3-14. While there are literally hundreds of parameters available for describing water quality, only a few are normally useful in the evaluation of wastewater quality and surface water quality. These

Table 3-9
Pleasant Prairie - Ladish (Ind. Park)
Municipal Radioactivity Sampling

Sample Information		Analysis Results (pCi/L)			
Sample Type	Dates(s) Collected	Gross Alpha	Ra-226	Ra-228	Combined Ra
Dist. Sys. Grab	11/30/78*	3.5			
Dist. Sys. Composite	7/25/79 - 7/1/80	40.2	8.3	13.5	21.8
Dist. Sys. Check	03/31/82	13.0	4.9	3.4	8.3
Dist. Sys. Check	12/14/82	15.3	4.2	5.7	9.9
Ladish Well	03/02/83	13.8	5.1	4.5	9.6
Dist. Sys. Check	06/17/83	10.8	5.1	4.1	9.2
Dist. Sys. Check	09/30/83	15.6	5.7	4.1	9.8
Dist. Sys. Check	12/12/83	11.0	6.4	1.9	8.3
Dist. Sys. Check	03/14/84	20.0	6.6	2.7	9.3
Dist. Sys. Check	9/25/84*	5.1	8.8	13.9	
Dist. Sys. Check	12/3/84	38.0	10.0	8.7	18.7
Dist. Sys. Check	12/3/84*	<3.0	<1.0	<1.0	---
Dist. Sys. Check	3/11/85*	<3.0	<1.0	<1.0	---
Dist. Sys. Check	6/27/85	15.3	5.1	4.9	10.0
Dist. Sys. Check	9/27/85	19.2	5.3	4.8	10.1
Dist. Sys. Check	12/10/85	21.7	5.2	4.7	9.9
Dist. Sys. Check	3/17/86	18.1	5.3	4.0	9.3
Dist. Sys. Check	6/16/86	18.4	5.4	4.2	9.6
Dist. Sys. Check	9/23/86	25.4	4.5	3.7	8.2
Dist. Sys. Check	12/8/86	18.5	4.8	2.4	7.2
Dist. Sys. Check	3/23/87	18.4	4.0	3.6	7.6
Dist. Sys. Check	6/18/87	14.9	3.8	3.4	7.2
Dist. Sys. Check	9/24/87	14.0	4.8	4.5	9.3
Dist. Sys. Check	12/1/87	15.5	4.4	3.1	7.5
Dist. Sys. Check	3/4/88	15.7	5.3	4.1	9.4
Dist. Sys. Check	6/21/88	15.7	5.5	5.9	11.4
Dist. Sys. Check	9/22/88	16.7	4.9	5.6	10.5
Dist. Sys. Check	12/88	Missed taking sample this qtr.			
Dist. Sys. Check	3/02/89*	<3.6	<1.0	<1.0	<2.0
Dist. Sys. Check	6/89	15.8	4.7	2.9	7.6
Dist. Sys. Check	8/23/89	15.8	5.4	4.2	9.6
Dist. Sys. Check	11/21/89	21.4	5.8	4.5	10.3

Note: The present drinking water standard for the combined isotopes of radium 226 and radium 228 as set forth in NR 109.50 for community water systems is 5.0 picocuries per liter (pCi/l). *Low values are from samples taken during periods when the Ladish System was connected to the Kenosha Water Utility or the sample was taken at a customer tap after the water had been softened, removing most of the radium.

Source: DNR

Table 3-10
Pleasant Prairie -Timber Ridge
Municipal Radioactivity Sampling

Sample Information		Analysis Results (pCi/L)			
Sample Type	Dates(s) Collected	Gross Alpha	Ra-226	Ra-228	Combined Ra
Dist. Sys. Grab	10/17/78	12.0	--	--	--
Dist. Sys. Composite	7/25/79-7/01/80	17.7	5.6	0.9	6.5
Dist. Sys. Check	03/31/82	27.5	11.5	6.2	17.7
Dist. Sys. Check	09/28/82	26.1	9.8	2.2	12.0
Dist. Sys. Check	12/14/82	32.3	9.2	0.7	9.9
Dist. Sys. Check	03/02/83	No Data Available			
Dist. Sys. Check	06/17/82	23.0	13.0	10.6	23.6
Dist. Sys. Check	09/30/83	43.3	10.9	7.3	18.2
Dist. Sys. Check	12/12/83	21.3	11.6	5.3	16.9
Dist. Sys. Check	03/14/84	28.9	11.7	8.2	19.9
Dist. Sys. Check	09/25/84	51.2	10.9	2.7	13.6
Dist. Sys. Check	12/03/84	38.0	10.0	8.7	18.7
Dist. Sys. Check	03/11/85	--	10.3	9.6	19.9
Dist. Sys. Check	06/27/85	--	9.9	9.7	19.6
Dist. Sys. Check	09/16/85	30.9	11.9	12.8	24.7
Dist. Sys. Check	12/10/85	49.0	10.9	12.5	23.4
Dist. Sys. Check	03/17/86	34.8	10.8	8.9	19.7
Dist. Sys. Check	06/10/86	30.5	11.5	10.4	21.9
Dist. Sys. Check	09/23/86	54.0	9.7	14.2	23.9
Dist. Sys. Check	12/08/86	34.9	9.5	6.4	15.9
Dist. Sys. Check	03/23/87	33.7	7.9	7.5	15.4
Dist. Sys. Check	06/09/87	37.8	10.1	10.0	20.1
Can't locate this one	09/24/87	34.3	6.4	6.8	13.2
Dist. Sys. Check	12/01/87	25.9	6.5	6.1	12.6
Dist. Sys. Check	03/04/88	24.9	8.2	5.1	13.3
Dist. Sys. Check	06/21/88	28.0	10.2	9.1	19.3
Dist. Sys. Check	09/22/88	24.0	7.9	10.6	18.5
Dist. Sys. Check	12/88	Missed taking sample this qtr.			
Dist. Sys. Check	03/10/89*	<4.9	<1.0	<1.0	<2.0
Dist. Sys. Check	08/23/89	22.6	7.4	6.0	14.0
Dist. Sys. Check	11/21/89	17.0	3.9	4.1	8.0

Note: The present drinking water standard for the combined isotopes of radium 226 and radium 228 as set forth in NR 109.50 for community water systems is 5.0 picocuries per liter (pCi/l). *Low values are from samples taken after the water had been softened, removing most of the radium.

Source: DNR

Table 3-11
Bristol Waterworks
Municipal Radioactivity Sampling

Sample Information		Analysis Results (Pci/L)			
Sample Type	Date(s) Collected	Gross Alpha	Ra-226	Ra-228	Combined Ra-
Dist. Sys. Comp.	03/22/82 - 12/14/82	12.9	3.1	2.7	5.8
Dist. Sys. Check	09/29/83	4.0	2.9	1.7	4.6
Dist. Sys. Check	12/12/83	6.1	2.8	1.6	4.4
Dist. Sys. Check	03/09/84	10.3	3.4	2.2	5.6
Dist. Sys. Check	06/07/84	8.3	2.8	4.4	7.2
Dist. Sys. Check	09/27/84	9.8	3.0	4.0	7.0
Dist. Sys. Check	12/03/84	13.1	2.8	2.2	5.0
Dist. Sys. Check	03/11/85	<3.0	1.2	<1.0	1.2
Dist. Sys. Comp.	10/28/86 - 9/21/87	5.3	<1.0	<1.0	---

Note: The present drinking water standard for the combined isotopes of radium 226 and radium 228 as set forth in NR 109.50 for community water systems is 5 picocuries per liter (pCi/l).

Source: DNR

Table 3-12
Ranges of Promulgated Standards for Raw-Water Sources
of Domestic Water Supply

Constituent	Excellent Source of Water Supply Requiring Disinfection only as Treatment	Good Source of Water Supply Requiring Usual Treatment Such as Filtration & Disinfection	Poor Source of Water Supply, Requiring Special or Auxiliary Treatment & Disinfection
BOD (5 day)-mg/l monthly average maximum day, or sample	0.75-1.5 1.0-3.0	1.5-2.5 3.0-4.0	>2.5 >4.0
Coliform MPN per 100 ml monthly average maximum day, or sample	50-100 Less than 5% over 100	50-5,000 Less than 20% over 5,000	>5,000 Less than 5% over 20,000
Dissolved oxygen average-mg/l saturation-per cent	4.0-7.5 75 or better	4.0-6.5 60 or better	4.0
pH average	6.0-8.5	5.0-9.0	3.8-10.5
Chlorides (max)-mg/l Florides - mg/l	50 or less <1.5	50-250 1.5-3.0	>250 >3.0
Phenolic compounds (max)-mg/l	none	.005	>.005
Color-units	0-20	20-150	>150
Turbidity-units	0-10	10-250	>250

Source: California State Water Pollution Control Board.

Table 3-14

Water Quality Conditions in the Des Plaines River Watershed
and the Pike River Watershed: 1968-1975

Des Plaines River Watershed

Parameter	Recommended Level/Standard	Numerical Value			Number of Analyses	Number of Time Recommended Standard/Level Was Not Met
		Maximum	Average	Minimum		
Chloride (mg/l)	0	85.00	55.00	30.00	22	0
Dissolved Oxygen (mg/l)	5.00	12.60	5.90	1.90	30	13[a]
Ammonia-N (mg/l)	2.50	0.26	0.09	0.03	8	0
Organic-N (mg/l)	0	2.42	1.52	0.99	8	0
Total-N (mg/l)	0	4.17	2.40	1.34	8	0
Specific Conductance (umhos/cm at 25ñC)	0	1,100.00	920.00	708.00	29	0
Nitrite-N (mg/l)	0	0.13	0.06	0.03	12	0
Nitrate-N (mg/l)	0.30	2.00	0.72	0.23	12	10
Soluble Orthophosphate-P (mg/l)	0	0.61	0.38	0.09	12	0
Total Phosphorus (mg/l)	0.10	0.62	0.41	0.15	8	8
Fecal Coliform (MFFCC/100/ml)	400.00	880.00	391.00	70.00	12	7
Temperature (ñF)	89.00	90.00	74.40	62.00	30	2
Hydrogen Ion Concentrations (standard units)	6.90	8.60	8.10	7.60	16	0

[a] The concentrations were below the water quality standard of 5.0 mg/l for dissolved oxygen.

Source: SEWRPC

Table 3-14

Water Quality Conditions in the Des Plaines River Watershed and the Pike River Watershed: 1968-1975

Pike River Watershed

Parameter	Recommended Level/Standard	Numerical Value Maximum	Numerical Value Average	Numerical Value Minimum	Number of Analyses	Number of Times Recommended Standard/Level was Not Met
Chloride (mg/l)	0	51.0	34.60	24.00	23	0
Dissolved Oxygen (mg/l)	5.00	14.2	6.90	3.20	31	5[a]
Ammonia-N (mg/l)	2.50	0.34	0.13	0.03	8	0
Organic-N (mg/l)	0	1.42	0.94	0.48	8	0
Total-N (mg/l)	0	4.50	2.31	1.15	8	0
Specific Conductance (umhos/cm at 25ñC)	0	956.00	616.00	445.00	29	0
Nitrite-N (mg/l)	0	0.13	0.05	0.02	13	0
Nitrate-N (mg/l)	0.30	2.85	1.43	0.37	13	13
Soluble Orthophosphate-P (mg/l)	0	0.55	0.30	0.06	12	0
Total Phosphorus (mg/l)	0.10	0.34	0.19	0.05	8	6
Fecal Coliform (MFFCC/100/ml)	2,100.00	720.00	391.00	20.00	12	6
Temperature (ñF)	89.00	81.50	71.40	50.00	31	0
Hydrogen Ion Concentrations (standard units)	6.90	8.90	8.30	7.50	23	0

[a]The concentrations were below the water quality standard of 5.0 mg/l for dissolved oxygen.

Source: SEWRPC

Table 3-13
Raw Water Characteristics
Kenosha Water Treatment Facility: 1979-1988

Year	Alkalinity Average	pH Average	Turbidity Raw Max	Turbidity Units Average	Temp Average	Raw Max	Raw Ave
1979	109	8.3	72.0	16.7	38	3	1.5
1980	112	8.1	36.0	16.0	37	2	1.0
1981	112	7.9	50.0	17.2	37	1	1.0
1982	112	8.2	20.8	6.7	45	2	1.0
1983	111	7.9	37.1	12.6	45	1	1.0
1984	113	8.0	31.0	9.6	45	1	1.0
1985	117	8.1	36.1	11.4	44	1	1.0
1986	115	8.1	42.0	11.1	46	1	1.0
1987	115	8.1	136.7	28.0	51	1	1.0
1988	115	8.2	24.0	N/A	47	1	1.0

Source: Annual Report of the Kenosha Water Utility.

parameters are temperature, dissolved solids, suspended solids, specific conductance, turbidity, PH, chloride, dissolved oxygen, biochemical oxygen demand (BOD), total and fecal coliform bacteria, phosphorus and nitrogen forms, heavy metals, pesticides and polychorinated biphenyls (PCB's). Wet and dry weather conditions affect the quality of the streams in that sources of pollution change as the weather changes. During dry conditions, streams are mainly affected by groundwater. During wet weather, the streams are influenced by surface runoff from storm sewers and streets, farms and other open lands.

CLIMATOLOGIC DATA

Temperature and precipitation patterns have an important impact on water consumption and thereby on sewer use. The effect temperature and precipitation have on lawn sprinkling, human consumption and industrial use can greatly influence the size, capacity, and type of sewer and water facilities required by a utility.

The Kenosha planning area, as with the rest of southeastern Wisconsin, has a continental climate which is affected to some degree by the Great Lakes. Spring is usually late and generally consists of periods of generous rain with alternating warm and cool periods. Due to the winter runoff and spring rains, waterways, marshes and low lying areas are often at or near flood stage. The summer months are warm and humid with some cool and very hot periods resulting from the movement of Canadian and Mexican air masses. Fall consists of days of Indian summer and cool nights. Winter comes in November with hard frosts, snowfall and frozen lakes and streams. Winters are generally long and cold with heavy snowfalls.

Temperatures vary with the seasons and can show large variation within any given season. Winter averages are in the mid-twenties, summer averages are in the low seventies and the yearly average is in the high forties. The effect Lake Michigan has on inland temperatures is most evident in the spring and early summer months when the prevailing winds are from the northeast off the water. The prevailing winter wind is from the west and decreases any moderating effect Lake Michigan has. Average seasonal temperatures are shown in Table 3-15.

Table 3-15
Maximum, Minimum and Average Temperatures at the Kenosha Weather Station: 1979-1988

Year	Max. Monthly Ave. Temp (°F)	Min. Monthly Ave. Temp (°F)	Annual Ave. Temp (°F)	Departure From Normal (°F)
1979	68.0	11.6	44.4	-2.4
1980	70.1	26.3	45.6	-1.2
1981	69.6	20.9	46.2	-0.6
1982	66.7	11.4	43.8	-3.0
1983	73.2	13.8	45.6	-1.2
1984	70.1	16.7	44.7	-2.1
1985	70.8	11.3	45.1	-1.7
1986	71.09	23.0	47.8	+1.0
1987	73.3	26.0	49.8	+3.0
1988	83.0	13.2	47.7	+0.9

Source: SEWRPC

Annual precipitation averages approximately 30 inches with extremes between 54 inches and 23 inches for the past 10 year period as shown in Table 3-16. Average snowfall is approximately 40 inches per year. The amount of evaporation directly to the atmosphere and transpiration through plants (evapotranspiration) is approximately 23 inches per year and occurs during the midsummer months.

Table 3-16
Total Precipitation, Departure and Greatest Monthly Rainfall at the Kenosha Weather Station: 1979-1988

Year	Total Precipitation (Inches)	Departure From Normal	Greatest Month	Month
1979	29.77	-2.47	6.14	Aug.
1980	53.42	+21.18	6.28	July
1981	33.85	+1.61	6.67	July
1982	35.37	+3.13	5.92	July
1983	33.68	+1.44	5.02	April
1984	34.55	+2.31	5.12	April
1985	41.06	+8.82	6.61	Nov.
1986	39.40	+7.16	10.47	Sept.
1987	45.34	+13.1	12.65	Aug.
1988	23.57	-8.67	4.22	Nov.
10-year Ave.	37.00	+4.67	N/A	N/A
Normal Ave.	32.24			

Note: N/A indicates average is not applicable to this parameter.

Source: SEWRPC

Individual rainfall events can have a great impact on sewer flow due to inflow and thereby influence required treatment plant size and operations. The Regional Planning Commission has developed Point Rainfall Intensity-Duration-Frequency Relationships based upon Milwaukee rainfall data. This data is presented in Figures 3-9 and 3-10.

For the most part, rainwater percolates through the soil to maintain a water table of approximately five feet or joins spring thaws and drains to the Des Plaines River or Lake Michigan via ditches and streams. Rainfall in the summer is often in the form of rapid and violent thunderstorms with spring and fall events having lower intensity and longer duration. Approximately one-half of the annual precipitation occurs between May and September. Sunshine is prevalent 55 percent of the daylight hours on an annual basis ranging from 40 percent in winter to 70 percent in July.

Minimum, maximum, and average monthly readings were also reviewed in conjunction with the study. During the 10 year period used for the analysis, the area experienced the worst drought in many years as well as periods of intense rainfall. Also experienced were extreme summertime temperatures during the severe drought.

POPULATION AND ECONOMIC ACTIVITY

Population estimates by quarter section for the entire Kenosha planning area have been developed by the Regional Planning Commission and are presented on a section by section basis in Table 3-17. The population numbers presented are based on the most recent inventory data from 1985. Table 3-18 provides the historic population of Kenosha County as a whole for the years 1900 to 1988. Following the rapid population growth for the period of 1950 to 1960, southeastern Wisconsin has experienced growth at a considerably slower rate. The estimated resident populations for the City of Kenosha, Town of Somers and Village/Town of Pleasant Prairie in 1988 are virtually the same as that counted in 1970, approximately 97,200. These population figures are presented in Table 3-18.

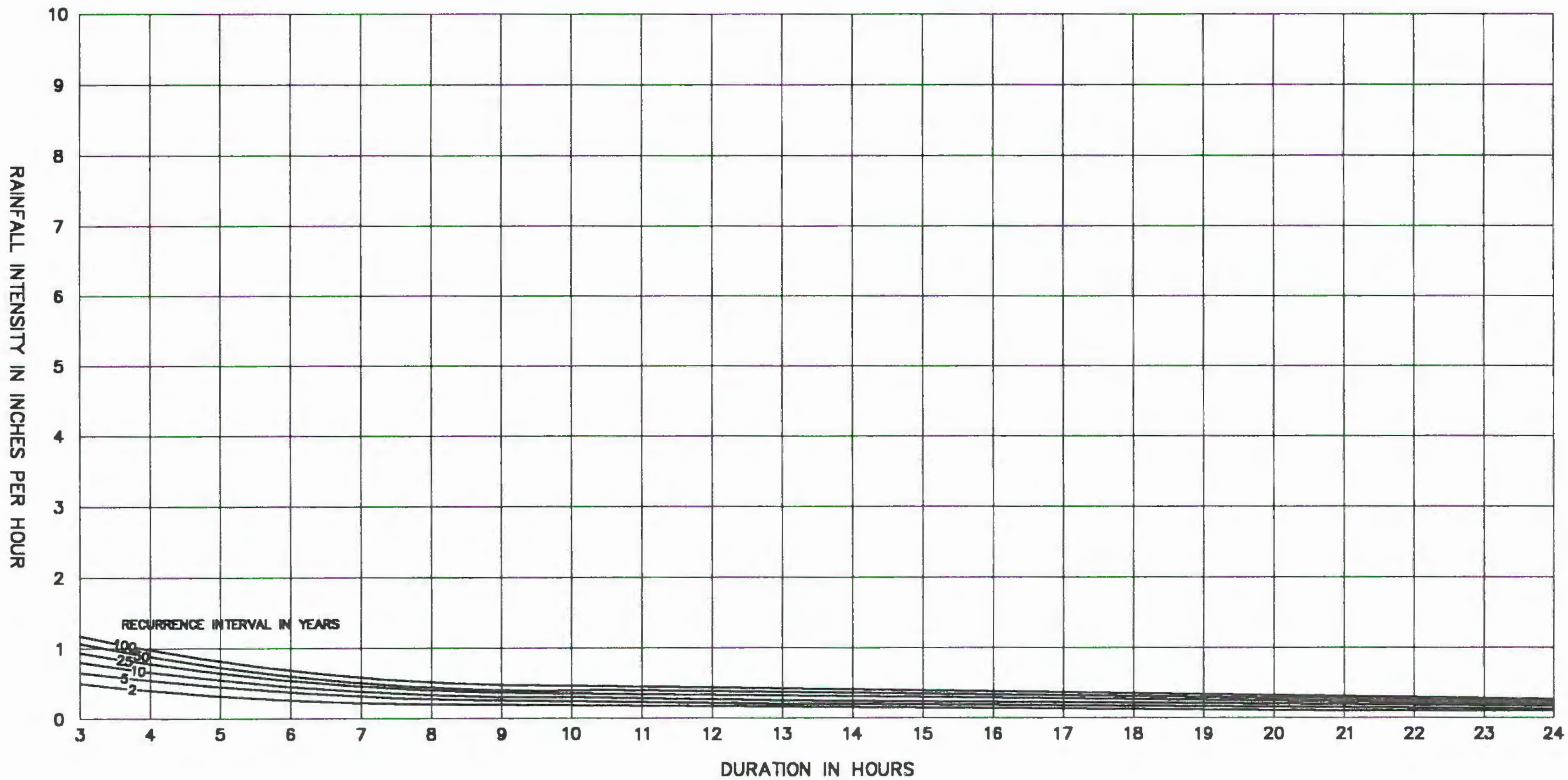
The number of housing units in the Kenosha planning area for the years 1960 to 1985 is shown in Table 3-19. Housing, as opposed to population, has continued to grow since 1970. These disparate rates of change between the number of housing units and population result in a decreasing number of persons per household. Table 3-19 shows the changing occupancy rates since 1960.

Economic activity in the Kenosha planning area has been consistent with that of southeastern Wisconsin as a whole. Factors such as household income, per capita income, labor force, and employment levels are indicators of the economic climate of the area. Household income figures for Kenosha County for the year 1979, the last year for which data of this type is available, are provided in Table 3-20. Per capita income estimates for the years 1979 and 1985 are also shown in Table 3-20. In comparison, per capita income increased by approximately 36.6 percent for Kenosha County as a whole while general price inflation was approximately 59 percent. Generally, this indicates that income on a per capita basis has not kept pace with general price inflation. Per capita incomes for Kenosha County range from a low of $7,756 in 1979 to a high of $10,594 in 1985.

The civilian labor force for the period 1960 through 1987 is shown in Table 3-21. Over that time period an increase of approximately 36 percent was noticed. Employment and unemployment rates and number of available jobs are also provided in Table 3-21.

Figure 3-9
POINT RAINFALL INTENSITY - DURATION - FREQUENCY RELATIONSHIPS FOR MILWAUKEE, WISCONSIN

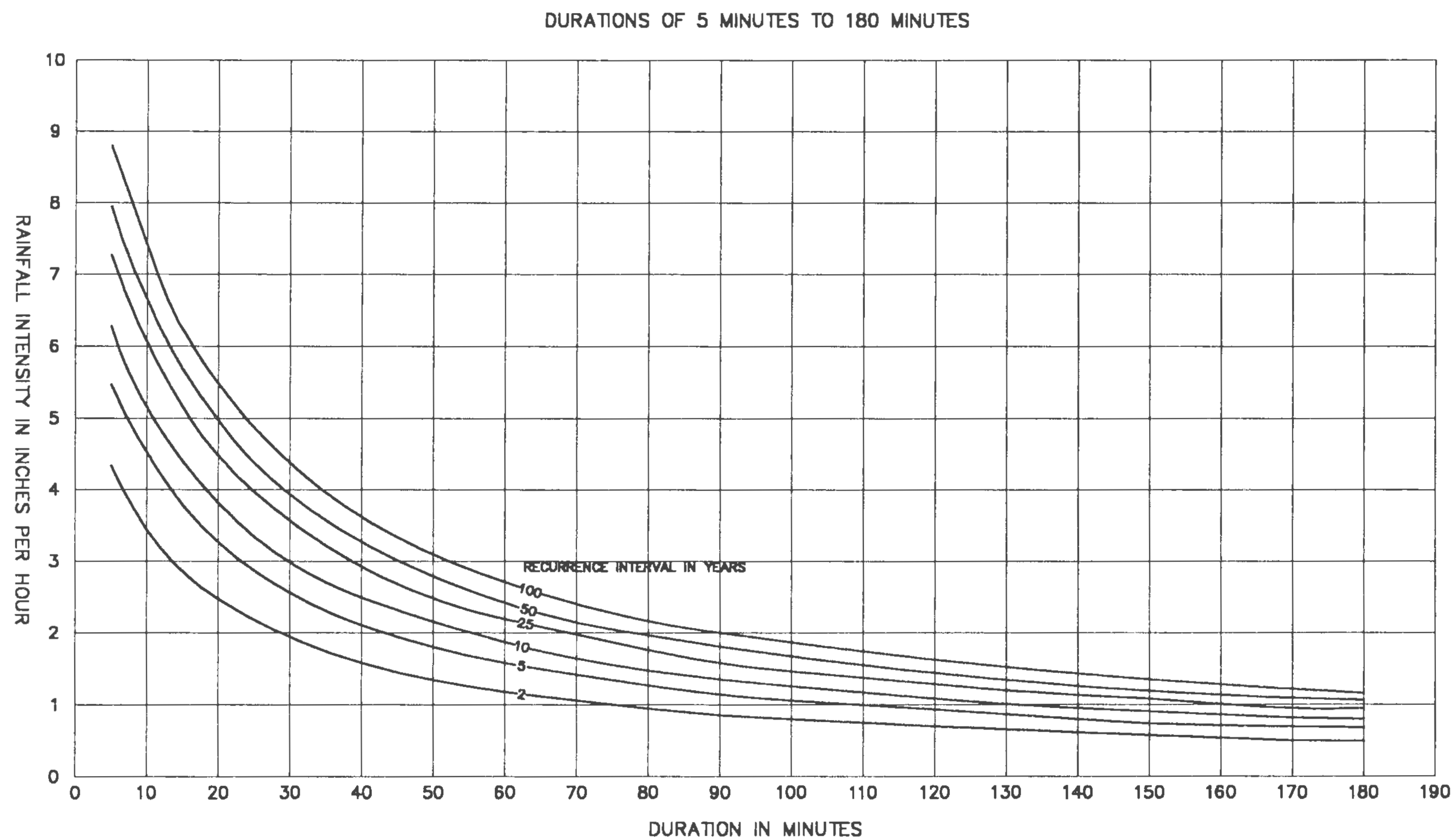
DURATIONS OF 3 HOURS TO 24 HOURS



Source: SEWRPC, 3/73
Revised, 3/88

THESE CURVES ARE BASED ON MILWAUKEE RAINFALL DATA FOR THE 84 YEAR PERIOD OF 1903 TO 1986.

Figure 3-10
POINT RAINFALL INTENSITY - DURATION - FREQUENCY RELATIONSHIPS FOR MILWAUKEE, WISCONSIN



Source: SEWRPC, 3/73
Revised, 3/88

THESE CURVES ARE BASED ON MILWAUKEE RAINFALL DATA FOR THE 84 YEAR PERIOD OF 1903 TO 1986.

Table 3-17
Study Area Population By Section 1985

Town	Range	Section	Pop.	Town	Range	Section	Pop.
1	21	01	81	2	21	01	31
1	21	12	58	2	21	12	40
1	21	13	60	2	21	13	46
1	21	24	47	2	21	24	103
1	21	25	57	2	21	25	94
1	21	36	93	2	21	36	40
1	22	01	7808	2	22	01	327
1	22	02	5715	2	22	02	288
1	22	03	1927	2	22	03	275
1	22	04	49	2	22	04	25
1	22	05	203	2	22	05	33
1	22	06	179	2	22	06	342
1	22	07	614	2	22	07	47
1	22	08	194	2	22	08	74
1	22	09	278	2	22	09	447
1	22	10	758	2	22	10	63
1	22	11	3096	2	22	11	4
1	22	12	5112	2	22	12	211
1	22	13	2292	2	22	13	923
1	22	14	2026	2	22	14	287
1	22	15	268	2	22	15	51
1	22	16	7	2	22	16	279
1	22	17	71	2	22	17	431
1	22	18	357	2	22	18	18
1	22	19	31	2	22	19	50
1	22	20	12	2	22	20	53
1	22	21	56	2	22	21	22
1	22	22	92	2	22	22	70
1	22	23	115	2	22	23	280
1	22	24	526	2	22	24	2532
1	22	25	274	2	22	25	2704
1	22	26	468	2	22	26	1145
1	22	27	463	2	22	27	123
1	22	28	28	2	22	28	56
1	22	29	12	2	22	29	337
1	22	30	45	2	22	30	111
1	22	31	72	2	22	31	18
1	22	32	12	2	22	32	10
1	22	33	50	2	22	33	56
1	22	34	362	2	22	34	1073
1	22	35	541	2	22	35	4492
1	22	36	336	2	22	36	5976
1	23	05	557	2	23	05	301
1	23	06	7948	2	23	06	104
1	23	07	4385	2	23	07	425
1	23	08	128	2	23	08	170
1	23	17	216	2	23	17	0
1	23	18	3010	2	23	18	3112
1	23	19	229	2	23	19	4304
1	23	20	83	2	23	29	0
1	23	29	107	2	23	30	5286
1	23	30	777	2	23	31	6705
1	23	31	125	2	23	32	102
1	23	32	66		Total		96,572

Source: SEWRPC

Table 3-18
Population Levels for Kenosha County, Kenosha City,
Towns of Somers and Pleasant Prairie: 1900-1988

Year	Town of Somers	Town of Pleasant Prairie	City of Kenosha	Kenosha County
1900	2044	1776	11,606	21,707
1910	1788	3217	21,371	32,929
1920	2084	2030	40,477	51,284
1930	3046	3457	50,262	63,277
1940	3641	3982	48,765	63,505
1950	5530	6207	54,368	75,238
1960	7139	10,287	67,899	100,615
1970	7270	12,019	78,805	117,917
1980	7724	12,703	77,685	123,137
1985	7529	12,009	76,284	121,158
1988	7836	12,221	77,095	123,127

Source: Wisconsin Department of Administration, U.S. Census and SEWRPC
Note: Those sections of the Towns of Paris and Bristol contained in the Study Area had 1985 populations of 354 and 396, respectively.

Table 3-19
Housing Units and Persons per Occupied Housing
Unit in Kenosha County: 1960-1985

	1960	1970	1980	1985
Number of Housing Units	33,643	39,110	47,506	48,696
Percent Change From Previous Time Period	--	16.3	21.5	2.5
Persons Per Occupied Housing Units	.36	3.26	2.80	2.68
Percent Change From Previous Time Period	--	-3.1	-16.4	-4.5

Source: SEWRPC

Table 3-20
Household Income in Kenosha County: 1979

	Number of Households Kenosha County	
Income Range	Number	Percent of Total
$0-$ 4,999	3,951	9.1
$ 5,000-$ 9,999	5,723	13.3
$10,000-$14,999	5,603	13.0
$15,000-$19,999	6,191	14.3
$20,000-$29,999	11,319	26.2
$30,000-$39,999	6,284	14.6
$40,000-$49,999	2,445	5.7
$50,000 and Over	1,649	3.8
Total	43,165	100.0

Per Capita Income			
	1979	1985	Percent Change
Kenosha County	$7,756	$10,594	36.6

Source: U.S. Bureau of the Census and SEWRPC.

Table 3-21
Civilian Labor Force, Employment, Unemployment and Available Jobs in Kenosha County

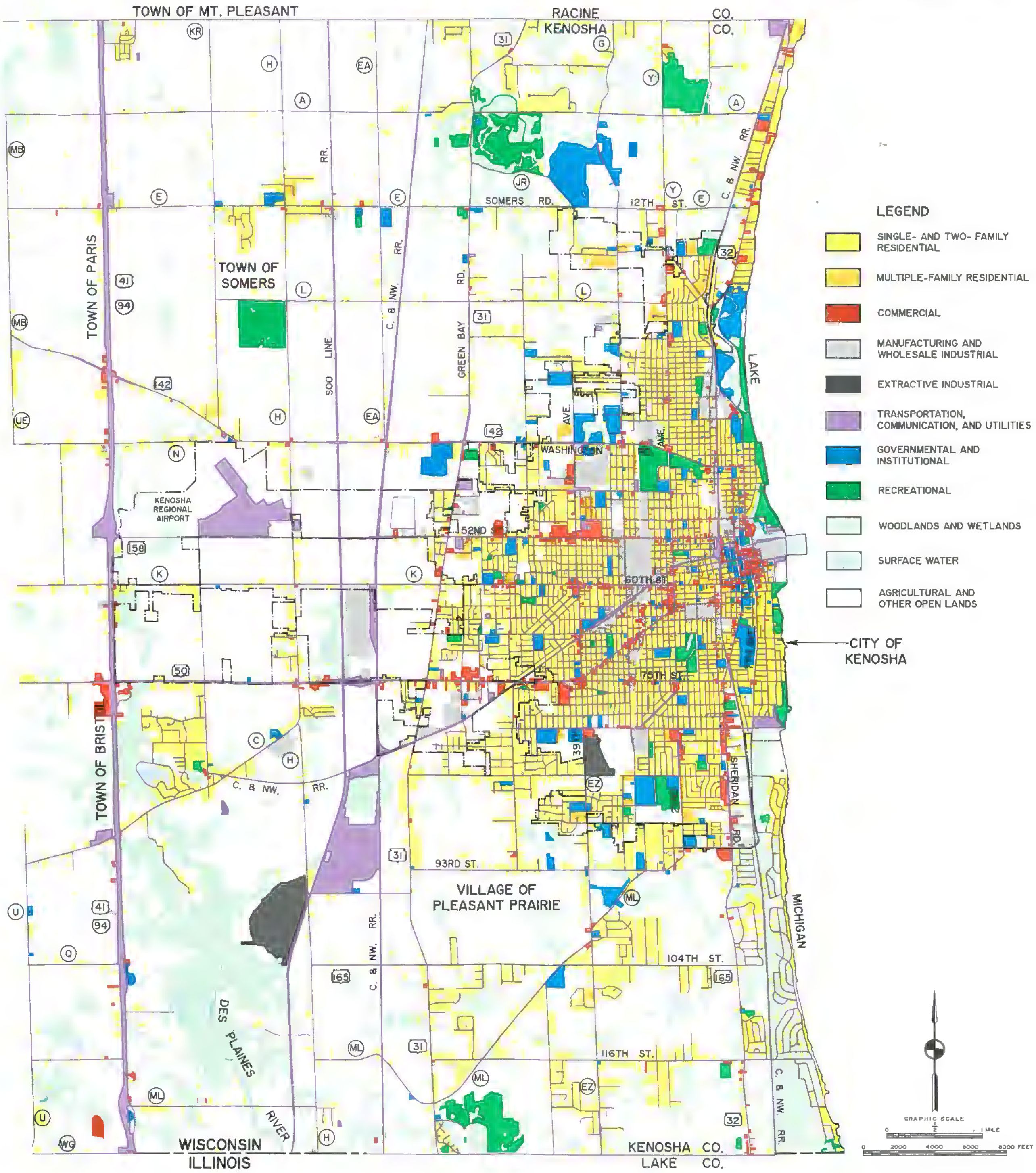
	1960	1970	1980	1985	1987
Civilian Labor Force	39,726	7,171	59,625	54,100	54,100
Employed	38,498	45,145	55,280	47,900	50,100
Unemployed	1,228	2,026	4,345	6,200	4,000
Percent Unemployed	3.1	4.3	7.3	11.5	7.4
Available Jobs					
		1972	1980	1985	
Number of Jobs		40,700	50,100	42,500	

Table 3-22
Existing Land Use in the Kenosha Utility Study Area: 1985

Land Use	Area In Acres	Area (Square Miles)	% of Total
Residential	8,877.6	13.87	14.5
Commercial	477.8	0.75	0.77
Industrial	805.4	1.26	1.29
Transportation, Communication & Utility	6,089.9	9.52	9.72
Government & Institutional	995.9	1.56	1.59
Recreational	1,170.5	1.83	1.87
Agricultural	37,484.0	58.56	59.78
Wetlands & Woodlands	6,059.8	9.47	9.67
Landfills	65.4	0.10	0.10
Water	378.2	0.59	0.60
Extrative	288.6	0.45	0.46
Total	62,693.1	97.96	100.00

Source: SEWRPC

Figure 3-11
EXISTING LAND USE IN THE KENOSHA UTILITY STUDY AREA: 1985



Source: SEWRPC.

LAND USE DATA

Existing land use for the Kenosha planning area is shown in Figure 3-11 and in Table 3-22. Land use plans have been prepared by SEWRPC for much of the study area. The most recent of these, the ISH 94 South Corridor Plan completed in 1989 by SEWRPC, identifies historic and existing land use for Kenosha County as a whole. In addition, SEWRPC has done extensive inventories and analyses and developed a land use plan which will be the basis for many of the projections presented in this report.

Historic patterns of land use and urban development are the basis for the preparation of land use plans and subsequently water supply and sewerage system requirements. Detailed inventories of existing land use in Kenosha County were conducted by SEWRPC in 1963 and 1985. A comparison of these two inventories resulted in the development of trends and patterns for use in projecting future land uses. These inventory results are summarized in Table 3-23.

Land use is generally analyzed under the following headings:

Urban	Rural
Residential	Prime Agricultural
Commercial	Agricultural & Open
Industrial Lands	Governmental
Water Institutional	Wetlands
Park & Recreational	Woodlands
Transportation & Utilities	
Extractive & Landfill	

A variety of regional plans have been prepared by SEWRPC and provide a framework for development within the planning area. Specifically, the reports which pertain to this study are: the Adopted Regional Land Use Plan; Regional Park and Open Space Plan; Regional Transportation System Plan; Regional Transportation System Plan for Lateral Streets and Highways; Regional Airport System Plan; and Regional Water Quality Management Plan for the Pike River Watershed. A brief synopsis of the recommendations contained in each of these reports follows.

Regional Land Use Plan

The regional land use plan currently adopted is documented in SEWRPC Planning Report No. 25, A Regional Land Use Plan and a Regional Transportation Plan for Southeastern Wisconsin - 2000, Volume One, Inventory Findings, April 1975; and Volume Two, Alternative and Recommended Plans, May 1978. The plan provided in Figure 3-11 is a composite of various land use plans and subregional studies.

These studies include A Development Plan for the ISH 94 South Freeway Corridor--2010; a Comprehensive Plan for the Kenosha Planning District; Regional Water Quality Management Plan--2000; a Plan for Sanitary Sewer Service areas for the City of Kenosha and Environs; and the Pike River Watershed Plan.

SEWRPC's basic recommendations resulting from the adopted land use plan are as follows:

1. Placement of Urban Land Use Development. The plan seeks to promote a more orderly and economic development pattern within the region by seeking to encourage the location of new urban development in areas adjacent to existing development; by seeking to encourage new urban development to occur at densities consistent with the provision of public sanitary sewer, water supply, and mass transit facilities and services; to encourage new urban development to occur only in areas covered by soils well suited to urban use and not subject to special hazards, such as flooding and erosion; and to encourage new urban development and redevelopment to occur in areas where essential urban facilities and services are already available, or into areas which such facilities and services can be easily and economically extended.

2. Protection and Preservation of Environmentally Sensitive Lands. The plan recommends that new urban development be discouraged from occurring in primary environmental corridors such as those corridors shown in Figure 3-12. Not only are the best remaining elements of the natural resource base found in those corridors, but the topography, soils, and flood hazards existing in those corridors make them poorly suited for intensive urban development of any kind. The secondary environmental corridors and isolated natural areas also shown in Figure 3-12 are recommended for consideration by local officials for preservation as needed for park, drainageway, and open space purposes.

3. Protection and Preservation of Prime Agricultural Lands. The plan recommends that the remaining prime agricultural lands, as identified in Figure 3-11, also be protected and preserved from urban encroachment. These lands contain soils that are very well suited for agricultural use and occur in farm sizes and farm blocks

Table 3-23

KENOSHA COUNTY PORTION OF THE IH 94 CORRIDOR STUDY AREA COMPARATIVE LAND USE: 1963-1985

Land Use Category	1963 Acres	1963 Percent of County	1963 Percent of Urban or Rural Subtotal	1985 Acres	1985 Percent of County	1985 Percent of Urban or Rural Subtotal	Changes: Change: 1963-1985 Acres	Changes: Change: 1963-1985 Percent
Urban								
Residential								
Single-Family	1,479	3.2	35.1	2,380	5.2	36.0	901	60.9
Two-Family	2	--a	-a	4	--a	0.1	2	100.0
Multiple-Family	--	--	--	23	--a	0.3	23	--
Subtotal	1,481	3.2	35.1	2407	5.2	36.4	926	62.5
Commercial	48	0.1	1.1	129	0.3	2.0	81	168.8
Industrial	85	0.2	2.0	306	0.7	4.6	221	260.0
Governmental and Institutional	99	0.2	2.3	133	0.3	2.0	34	34.3
Parks and Recreational	196	0.4	4.6	362	0.8	5.5	166	84.7
Transportation and Utilities								
Streets and Highways	1,622	3.5	38.5	1,805	3.9	27.3	183	11.3
Trucking and Busing Terminals	23	0.1	0.6	44	0.1	0.7	21	91.3
Railroads	414	0.9	9.8	430	0.9	6.5	16	3.9
Airports	147	0.3	3.5	247	0.5	3.7	100	68.0
Communication and Utilities	11	--a	0.3	309	0.7	4.7	298	2,709.1
Offstreet Parking	30	0.1	0.7	138	0.3	2.1	108	360.0
Subtotal	2,247	4.9	53.4	2,973	6.4	45.0	726	32.3
Extractive and Landfill	63	0.1	1.5	294	0.6	4.5	231	366.7
Urban Land Use Subtotal	4,219	9.1	100.0	6,604	14.3	100.0	2,385	56.5
Rural								
Prime Agricultural	27,982	60.7	66.8	25,002	54.2	63.3	-2,980	-10.6
Other Agriculatural and Open Lands	9,081	19.7	21.7	9,720	21.1	24.6	639	7.0
Water	98	0.2	0.2	219	0.5	0.6	121	123.5
Wetlands	3,164	6.9	7.6	3,093	6.7	7.8	-71	-2.2
Woodlands	1,559	3.4	3.7	1,465	3.2	3.7	-94	-6.0
Rural Land Use Subtotal	41,884	90.9	100.0	39,499	85.7	100.0	-2,385	-5.7
Total	46,103	100.0	--	46,103	100.0	--	--	0.0

[a]Less than 0.05 percent.

Source: SEWRPC Community Assistance Planning Report No. 200, A Land Use and Transportation System Development Plan for the IH 94 South Freeway Corridor.

large enough to help sustain an agricultural economy. Furthermore, given the commitment to urban development of substantial amounts of lands not identified for prime agricultural use, there is no need to consider committing prime agricultural lands to meet urban land use development needs.

Existing land use in the Kenosha planning area is approximately 28.6 percent urban which accounts for 28.03 square miles of land. SEWRPC reported in its publication Sanitary Sewer Service Areas for the City of Kenosha and Environs, 1985, that approximately 49 percent, or 47.7 square miles, of the study area would be developed for urban use by the year 2000. This represents 80 percent of the developable land lying in the proposed year 2000 sewer service area.

Other Plans

The other plans that have a bearing on this study contain the following basic recommendations:

Park and Open Space Plan

1. Park Site Acquisition and Development

   The only major park site recommended to be developed within the study area containing 150 acres or more is located along the Des Plaines River in the Village of Pleasant Prairie. Recommendations include purchase by Kenosha County, construction of a golf course and provision for picnicking and river access facilities.

2. Parkway Acquisition

   The only major additional parkway acquisition recommended to protect primary environmental corridors are adjacent to Pike Creek in Kenosha County. The plan recommends public parkway along the Pike Creek be acquired by county and local park agencies, especially in urbanizing areas.

Regional Transportation Plan

The currently adopted Regional Transportation System Plan, SEWRPC Planning Report No. 25, A Regional Land Use Plan and a Regional Transportation Plan for Southeastern Wisconsin: 2000, provides recommendations for development, operation and maintenance of streets and highways in the planning area. In particular, the plan addresses the general location, type, capacity and service levels for various street and highway facilities and addresses the agencies of government which should be responsible for construction, operation and maintenance of said facilities. Also included in this plan are recommendations pertaining to the provision of mass transit facilities.

Specifically, the currently adopted regional transportation plan contains the following recommendations:

1. New Arterial Facilities

   The new arterials proposed in the plan are shown on Figure 3-13. Recommended expansion includes: The Lake arterial extending from the Illinois State Line north, through the entire study area; the extension of CTH Q from CTH H west to ISH 94 which has been completed; extension of CTH "JR" south from CTH E to the Kenosha City limits; expansion of CTH G north from CTH Q to 85th Street; extension of 85th Street between Sheridan Road and 7th Avenue and between 30th Avenue and STH 31; extension of 51st Street south from CTH T to CTH Q; and expansion of 39th Avenue from 24th Street north to 12th Street.

2. Arterial Street Widening

   Numerous arterial street improvements are contained in the plan. Major widenings are described as; STH 31 throughout Kenosha County; STH 142 from the Kilbourn Ditch to STH 31 and from CTH G to STH 32; STH 158 from ISH 94 to STH 31; and STH 50 from STH 192 to CTH EZ and from CTH G to 7th Avenue.

3. Transit Service

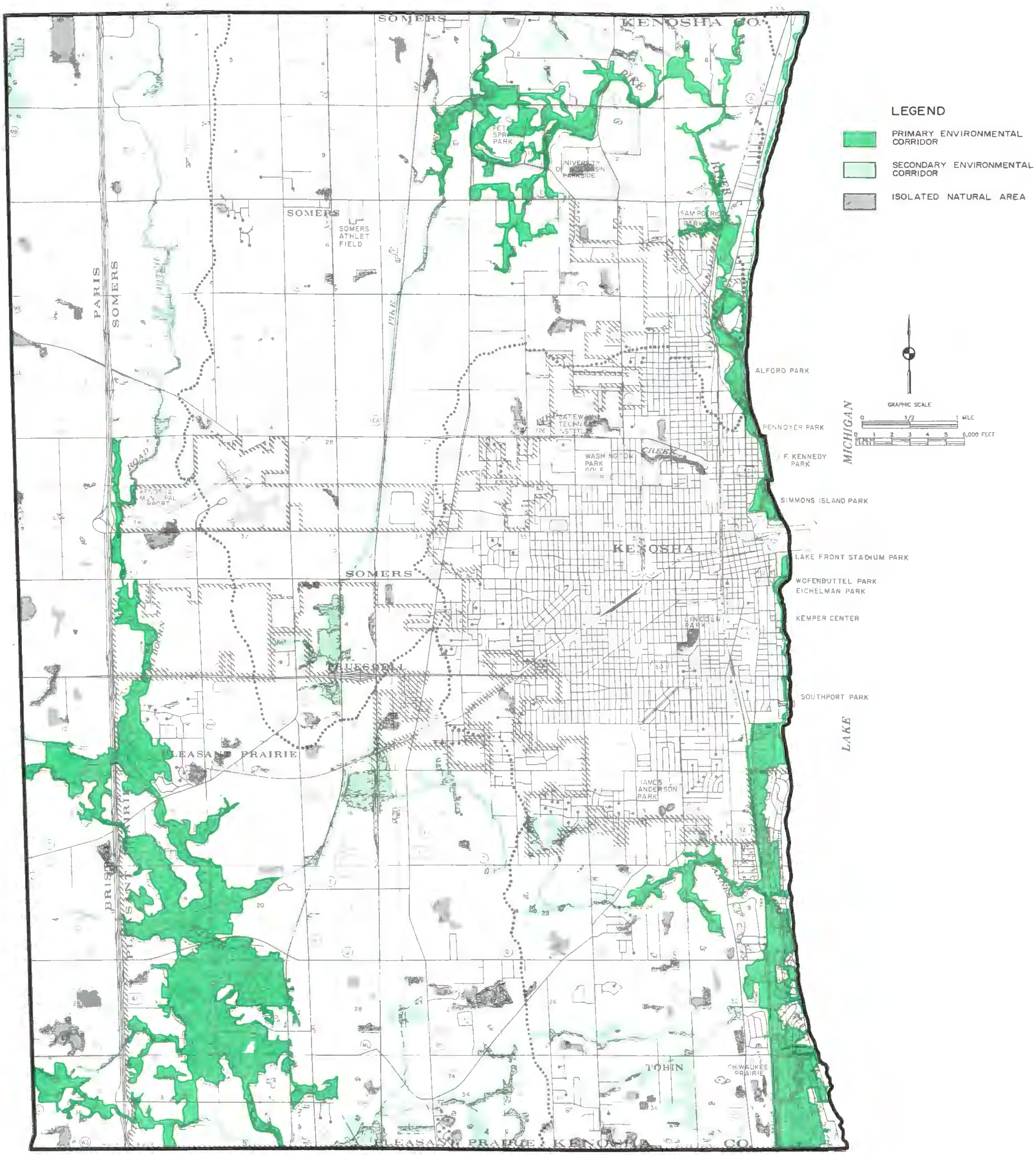
   Planned transit service areas are also shown in Figure 3-13 and include local service by transit systems and commuter services. The plan calls for a new Park-Ride lot along STH 158 east of ISH 94 and express bus rapid transit service over ISH 94 between Milwaukee, Racine and Kenosha.

4. Jurisdictional Changes

   A study currently underway was initiated at the request of Pleasant Prairie involving the WDOT, Kenosha County, WisPark, Inc., and SEWRPC has presented the following preliminary proposals:

1. The termination of the proposed Lake Arterial facility, as already noted, just south of the Racine-Kenosha County line via a connection with STH 31 just north

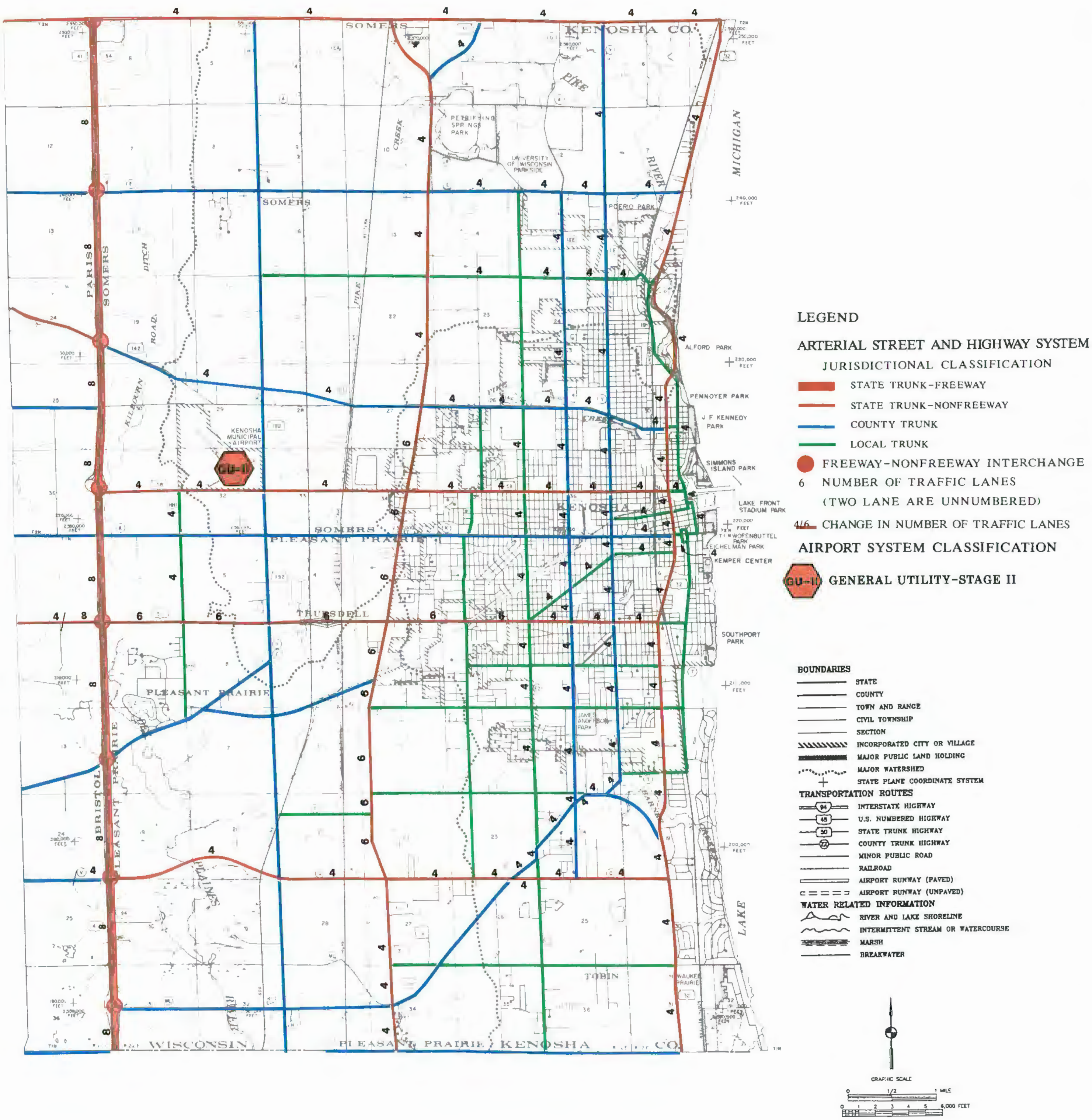
Figure 3-12
ENVIRONMENTALLY SIGNIFICANT LANDS: 1985



Source: SEWRPC

Figure 3–13

REGIONAL TRANSPORTATION PLAN: 1992



of Petrifying Springs County Park in the Town of Somers.

2. The reconstruction of STH 31 from STH 50 south to CTH T to provide for six, rather than four, travel lanes.

3. The ultimate provision of four, rather than two, travel lanes on CTH Q and its extension from STH 31 to ISH 94.

4. The realignment of CTH ML between STH 31 and CTH H, and the placement of that relocated segment of CTH ML and existing CTH ML from CTH H to ISH 94 on the planned county trunk highway system; presently the plan calls for CTH ML to be eliminated from the arterial street and highway system and revert to local jurisdiction.

5. The reconstruction of the CTH ML interchange on ISH 94.

6. The retention of STH 31 throughout Kenosha County on the state trunk highway system; presently the plan calls for CTH 31 to be placed on the county trunk highway system assuming the Lake Arterial would have been extended south to the Wisconsin-Illinois State Line.

7. The elimination from the county trunk highway system of CTH T from STH 31 to CTH H with its retention on the arterial street and highway system as a local facility.

Regional Airport System Plan

The currently adopted plan is documented in SEWRPC Planning Report No. 38, A Regional Airport System Plan for Southeastern Wisconsin: 2010, May 1987. Recommendations for the Kenosha Municipal Airport result in only minor improvements over and above the recent completion of a major new NE/SW primary runway and taxiway. Other improvements include lengthening, strengthening, and widening the NW/SE runway; the installation of a new instrument landing system at the SW end of the new NE/SW runway; and terminal and hanger improvements as required.

The recent improvements at the Kenosha Municipal Airport have resulted in it's reclassification as a General Utility - Stage II Airport. This change in classification means the airport can serve all single-engine aircraft, most twin-engine and turbo prop aircraft, and most business and corporate jets as well as propeller driven commuter aircraft.

Regional Water Quality Management Plan

SEWRPC Planning Report No. 30, A Regional Water Quality Management Plan for Southeastern Wisconsin: 2000, 1987, is the adopted plan and has been amended a number of times. The plan makes specific recommendations as they relate to point source pollution, planned sewer service areas, municipal sewage treatment facilities, and major trunk sewers. Results of the plan and the planned sewer service areas will be discussed in detail in the next section of this chapter.

Comprehensive Watershed Plan Pike River

The recommendations resulting from the Pike River watershed plan are as follows:

1. Channel cleaning and debrushing along Pike Creek from STH 31 at the study boundary to the confluence with the Somers Branch.

2. Major channel improvements, including channel widening, deepening and bridge replacement along Pike Creek from its confluence with the Somers Branch upstream to a point just north of STH 50. The proposed channel would be turf lined, and would be lowered by an average of approximately 6 feet and by a maximum of 13 feet. If carried out, these proposed improvements would eliminate overland flooding along the Pike Creek upstream from the Somers Branch confluence.

3. Major channel improvements, including channel widening and deepening along both the Airport Branch and the Airport Branch Tributary, provided that land development studies along these branches between STH 31 and the Kenosha Municipal Airport north of STH 158 find that such channel improvements are essential.

4. Major channel improvements consisting of channel widening, deepening, and realignment along the Upper Pike extending from CTH C downstream to the confluence with Pike Creek. The proposed channel would be turf lined and would be lowered by an average of approximately 3 feet and a maximum of approximately 6 feet. If carried out, these Upper Pike Creek channel improvements would virtually eliminate overland flooding along the Pike River.

Local Studies

A number of local plans and studies have been prepared by various entities and are summarized as follows:

1. Pleasant Prairie Housing and Development Study. This study was performed in 1985 by the Town of Pleasant Prairie Plan Commission and identified industrial, residential and commercial growth areas where growth should be encouraged over the next several decades. Industrial growth was recommended to be concentrated in the WisPark Corporate Center. Commercial development is to be concentrated at four major intersections: ISH 94 and STH 50, STH 192 and STH 50, CTH Q and ISH 94, and STH 31 and STH 174. Residential growth is recommended to be concentrated south of STH 50 and East of CTH HH near the Old Village area.

2. Pleasant Prairie Highway Access and Development Plan. This plan, prepared in 1986, was the result of a cooperative effort between the Town of Pleasant Prairie, the City and the County of Kenosha, and the WDOT. The purpose of this plan was to recommend the location of public and private access points and median locations and the location and layout of frontage roads along STH 50 between ISH 94 and 66th Avenue.

3. ISH 94 Interchange Plans. The WDOT has prepared a detailed plan to reconfigure the interchange ramps and frontage roads at STH 50.

EXISTING SANITARY SEWERAGE FACILITIES

Sanitary sewerage facilities for the Kenosha area consist of three public wastewater treatment facilities currently in use and two which have been or are in the process of being abandoned. Table 3-24 provides a listing of various capacities for these facilities. The facilities are described as; The Kenosha Water Utility; Village of Pleasant Prairie Utility District "D"; Village of Pleasant Prairie Sanitary District No. 73-1; Town of Somers Utility District No. 1; and the Pleasant Park Sewer Utility. Each of the sanitary sewer service areas will be discussed with respect to service area, trunk sewers, wastewater treatment facility and wastewater flows.

Kenosha Water Utility

The Kenosha Water Utility operates the largest of the public wastewater treatment facilities. The facility serves an estimated 22.3 square miles and a corresponding estimated population of 87,700. The service area for the Kenosha Water Utility was set forth in SEWRPC Community Assistance Planning Report No. 106 and was depicted in Figure 3-3 of this report. In 1988, the resident population of the City of Kenosha was 77,095. This represents approximately 93 percent of the total resident population of the Kenosha sewer service area as defined in SEWRPC Planning Report No. 30.

The collection system contains an estimated 255.39 miles of sewer mains of which approximately 30 percent are trunk sewers. For the purposes of this report, the trunk sewer system will be defined as those sewers 15 inches in diameter and larger. The maps included with this report show the location of those sewers 15 inches and larger as well as lift stations and forcemains.

There are currently 7 lift stations in the City of Kenosha collection system located as shown in Figure 3-14. Table 3-25 provides various characteristics of the lift stations and recent pumpage data.

Three areas lying outside the City limits discharge to the Kenosha wastewater treatment facility and are described as: Somers Utility District No. 1; Somers Sanitary District No. 1 and Village of Pleasant Prairie Sanitary Sewer District No. 1. The wastewater treatment facility in Kenosha is located on the south side of the City on 3rd Avenue near 78th Street. The facility was constructed in 1939 and had major modifications in 1967 and 1984. The facility provides a secondary level of treatment plus phosphorous removal and discharges to Lake Michigan. The average hydraulic design capacity of the facility is 28.40 MGD with a corresponding peak hydraulic design treatment capacity of 68.20 MGD. Selected characteristics of the Kenosha facility are provided in Table 3-26. Average and peak hydraulic loadings for the past four years are provided in Table 3-27. The peak instantaneous flow occurred on September 1, 1989 at which time approximately 95 MGD was pumped into the facility for treatment. The average hydraulic loading for the past ten years is 21.253 MGD. An estimated 22.3 square miles are served by the treatment facility with an estimated corresponding 1988 population of 87,700.

Raw wastewater enters the facility from 72 inch and 48 inch trunk sewers. The wastewater passes through two mechanically cleaned bar screens prior to pumpage to the gravity grit chambers by six sewage pumps. Of the six pumps, three are driven by gas engines which

Table 3-24
Existing Wastewater Treatment Facilities: 1988

						Design Capacity				
Name of Public Sewage Treatment Plant	Estimated Total Area Served (square miles)	Estimated Total Population Served	Date of Original Construction and Major Modification	Level of Treatment Provided	Disposal of Effluent	Population	1988 Average Hydraulic (mgd)	1988 Peak Hydraulic (mgd)	Average Organic (pounds BOD5/day)	Population Equivalent[a]
Kenosha Water Utility	22.30	87,700	1941, 1967, 1984	Secondary plus phosphorus removal	Lake Michigan	135,000	28.40	68.00	29,700	141,000
Village of Pleasant Prairie Sewer Utility District D	1.51	1,700	1966, 1985	Secondary	Tributary of Des Plaines River	3,300	0.499	1.120	460	2,200
Village of Pleasant Prairie Sanitary District 73-1	0.98	600	1975	Secondary	Des Plaines River	4,000	0.40	0.80	800	3,800
Pleasant Park Sewer Utility	0.31	600	1960	Secondary and tertiary	Lake Michigan via drainage ditch	600	0.06	N/A	126	600

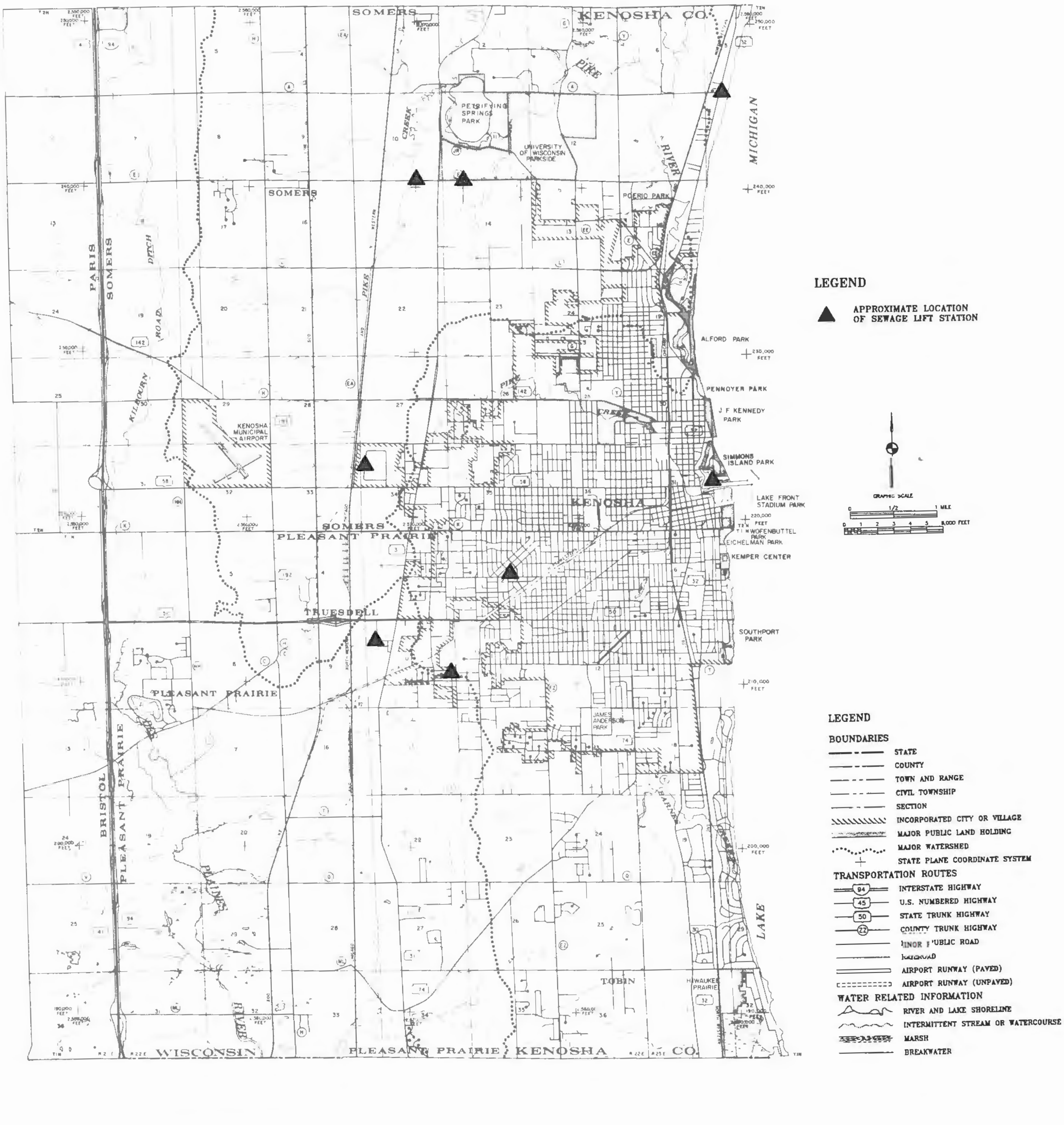
a. The population equivalent is based upon an estimated per capita contribution of 0.21 pounds of BOD_5/day.

Note: The Town of Somers Utility District No. 1 Facility was abandoned in 1986, with the sewerage system then connected to the City of Kenosha. The Pleasant Park Sewer Utility is scheduled to be abandoned and the sewage system connected to the City of Kenosha in 1990.

Source: SEWRPC, Kenosha Water Utility, and the Village of Pleasant Prairie.

Figure 3-14

LOCATION OF SEWAGE LIFT/PUMP STATIONS: 1989



Source: SEWRPC & Kenosha Water Utility

Table 3-25
Selected Characteristics of Sewage Lift/Pumpstations: 1989
Kenosha Water Utility

No.	Name	Location	Built	Force Main Size	Material Length/ Material	Discharge Point	Capacity (GPM)
1	Delta	Sheridan Road - 7th Ave.	1961	4"	700' cast iron	Parkway 35 St. - Sheridan Road	160
2	Carthage	Alford Drive West of College	1962	6"	1307' cast iron	19 Ave east of 15 St.	200
3	Yacht Club	4th Ave & 51st Pl.	1964	6" to 8"	2700' cast iron	5 Ave & 45 St.	500
4	Industrial Park	70 Ave. - North of 52 St.	1981	8"	1245' PVC	68 Ave - North of 51 St	400/800
5	78 St. - 70 Ave.	78 St. - 70 Ave.	1987"	6"'	915' PVC	78St. - Greenbay Road	300
6	Ganglers	80 St. - 57 Ave.	1979	6"	1085' PVC	80 St. - 60 Ave.	350
7	(Rain Lift) Taft Road	46 Ave. - Taft Rd.	1964	8"	70' cast iron	Storm Sewer 46 Ave. - Taft Road	1000
8	Somers Interim	12th St. - Pike Creek	1985	12"	6,400 cast iron	18th St. - W. Green Bay*	*
9	Somers Interim	12th St. - 52nd	1985	4"	1,675 cast iron	12th St. - Green Bay Rd.	*
10	Somers San. Dist. No. 1	Sheridan Rd. - 17th Place	*	12"	*	12th Ave. - Sheridan Rd.	2200

Note: Some City of Kenosha Flow currently goes into the Somers lift station. A new station is scheduled for construction at 15th avenue and 15th street in 1990.

* Data unavailable.

Source: Kenosha Water Utility

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Table 3-26
Selected Characteristics of the
Kenosha Wastewater Treatment Facility: 1988

Estimated Total Area Served (Sq. Miles)	22.30
Estimated Total Population Served	87,700
Date of Original Construction	1939
Date of Major Modifications	1967, 1984
Level of Treatment	Secondary plus phosphorous removal
Disposal of Effluent	Lake Michigan
Average Hydraulic Loading: 1988	19.829 MGD
Maximum Monthly Average Hydraulic Loading	26.241 MGD
Peak Hydraulic Loading	58.210 MGD
Average Annual Organic Loading (Pounds BOD_5/day)	18,191
DESIGN CAPACITY	
Population	135,000
Average Hydraulic Loading	28.40 MGD
Peak Hydraulic Loading	68.20 MGD
Peak Hydraulic Capacity (Primary)	85.000 MGD
Average Organic (Pounds BOD_5/day)	29,700
Equivalent Population	141,000
RESERVE CAPACITY	
Average Hydraulic Capacity	8.571 MGD
Average Organic Capacity (Pounds BOD_5)	11,509
Population Equivalent	51,737

Source: Kenosha Water Utility

Table 3-27
Comparison of Treatment Data for the Period 1986 - 1988
Kenosha Wastewater Treatment Facility

Year	Average Flow MGD	Peak Day Flow MGD	Average Influent MG/L	Average Primary Effluent MG/L	Average Primary Effi-ciency %	Average (1) Final Effluent MG/L	Average Overall Effi-ciency %
SUSPENDED SOLIDS							
1988	19.829	58.210	146	46	68	18	88
1987	21.978	53.397	152	54	64	10	93
1986	23.513	70.870	155	53	66	11	93
FIVE-DAY BOD							
1988	19.829	58.210	110	87	21	15	86
1987	21.978	53.397	106	67	37	12	89
1986	23.513	70.870	102	66	35	13	87
PHOSPHORUS							
1988	19.829	58.210	2.82	--	--	0.48	83
1987	21.978	53.397	2.67	--	--	0.25	91
1986	23.513	70.870	2.96	--	--	0.26	91

(1) Effluent limitations as set forth in the WPDES Permit are as follows:

BOD5	(Monthly)	30 mg/l
	(Weekly)	45 mg/l
Suspended Solids	(Monthly)	30 mg/l
	(Weekly)	45 mg/l
Total phosphorus	(Monthly)	1 mg/l

Source: Kenosha Water Utility

utilize digester gas to conserve energy. The pumps can also be driven by natural gas. The remaining four pumps are driven by variable speed electric motors. The heavier solids are removed by settling in the gravity grit chambers and are continuously removed from the chamber bottom. Wastewater then flows by gravity to the primary clarifiers.

Nine primary clarifiers remove approximately 75 percent of the suspended solids and 20 to 30 percent of the BOD prior to discharging the wastewater to the aeration process. The clarifiers are divided into two bays with each having its own sludge collector mechanism. The primary sludge is pumped to anaerobic digesters and the scum is collected at the surface and combined with the grit that has been removed. The grit and scum are sent to a landfill. Ferric chloride is added to the primary clarifier effluent for removal of phosphorus.

The tankage for Secondary treatment consists of six activated sludge aeration basins and four secondary clarifiers. Basins are mixed and aerated by air from blowers which enters the basin via coarse bubble diffusers. The mixed liquor is then settled in the secondary clarifiers. Settled sludge is either returned to the aeration basins to maintain active biological mass or wasted to floatation thickeners by return activated sludge (RAS) and waste activated sludge (WAS) pumps, respectively. To provide mixing and to prevent the wastewater and mixed liquor from becoming septic, open channels ahead of the aeration basins and channels from the basins to the secondary clarifiers are continuously aerated.

The effluent from the secondary clarifiers flows to the chlorine contact tanks where it is chlorinated as it enters the tanks. These tanks provide enough time for pathogen reduction by the chlorine and discharge the effluent to Lake Michigan through a 48 inch pipe extending 1,200 feet into the lake. The waste sludge from the secondary clarifiers is thickened by use of two dissolved air flotation thickeners and then pumped to six anaerobic digesters.

The anaerobic digesters reduce the amount of waste solids handled and stabilize the sludge. The digesters are operated in series with sludge from the last digester pumped to plate and frame filter presses. Some of the gas generated is returned to the digesters to provide mixing and the remainder is either used in the raw wastewater pump gas engines or burned off.

The two filter presses dewater the digested sludge to approximately 40 percent solids prior to disposal. Presses are run as a batch operation and use pressure to remove some of the liquid from the solids. Prior to entering the filter press, sludge is conditioned with ferric chloride and lime to aid in the dewatering process. The dewatered sludge cake is then hauled to landfills. A schematic showing the operation of the facility is provided in Figure 3-15.

<u>Village of Pleasant Prairie Sewer Utility District "D" - (SUD "D")</u>

The Town of Pleasant Prairie Sewer Utility District "D" serves an estimated 1.51 square miles and a total population of approximately 1,700. Figure 3-2 depicts the area served by the utility district and it's relationship to the Kenosha Utility. The area is served by one wastewater treatment facility located on CTH C in the Village of Pleasant Prairie.

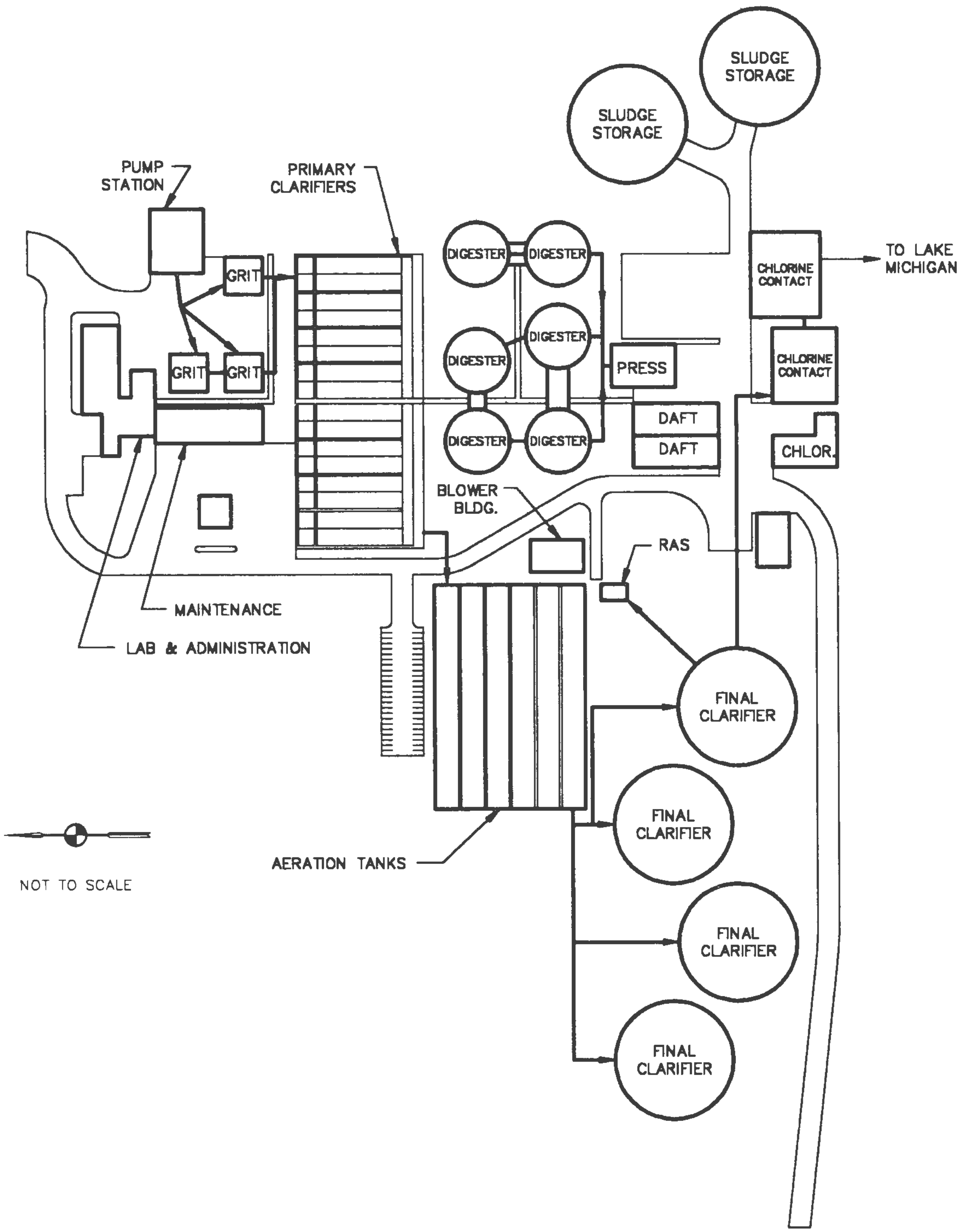
The wastewater collection system for Sewer Utility "D" consists of approximately 64,000 feet of gravity sanitary sewers ranging in size from 8 inches to 18 inches and approximately 11,990 feet of forcemain. Materials of construction are predominantly vitrified clay with the remaining sewers consisting of concrete, PVC plastic, and truss pipe. There are five lift stations and approximately 255 manholes in the system.

The Town of Bristol maintains a small collection system called the Town of Bristol Utility District No. 3 on the west side of ISH 94 near STH 50. The system contains approximately 9,000 feet of 12 inch sanitary sewer which discharges to a lift station east of ISH 94 on STH 50 and subsequently to the Sewer Utility District "D" treatment facility. The collection system serves a number of retail and wholesale businesses, restaurants and motels. Due to an inaccurate sewer meter, flow cannot be determined. It should be noted, however, that during periods of rain or thaw, run time at the lift station increases dramatically indicating a possible I/I problem.

A new treatment facility was constructed in 1985 on the site of the existing facility at Pleasant Prairie. A portion of the existing facility was modified for reuse but the majority of the structures were new. The average design flow for the facility is 0.499 MGD with a maximum influent flow of 1.120 MGD and a peak flow rate of 1,200 gpm. In 1988, the average hydraulic loading was .339 MGD with a peak day flow of 1.082 on April 6th. The peak instantaneous flow occurred on September 1, 1989 and is estimated at approximately 3.5 MGD. Flow rates for the treatment facility for the last 4 years are contained in Table 3-28.

Raw wastewater enters the facility and passes through a comminutor prior to grit removal. When the influent flow rate reaches 622 GPM, the comminutor bypasses to a manually cleaned bar screen. Following comminution, grit is

Figure 3-15
CITY OF KENOSHA WATER UTILITY
WATER POLLUTION CONTROL PLANT SCHEMATIC



Source: Kenosha Water Utility, 1988

Table 3-28
Comparison of Treatment Data: 1986 - 1989
Pleasant Prairie Sewer Utility District "D"

		Five Day BOD (1)			Suspended Solids (2)		
Year	Average Flow (MGD)	Influent MG/L	Effluent MG/L	Efficiency	Influent MG/L	Effluent MG/L	Efficiency
1989	.304	165	7.0	96%	162	4.3	97%
1988	.339	119	3.4	97%	170	2.0	99%
1987	.399(3)	98	2.5	97%	126	1.7	99%
1986	.300	117	3.0	97%	136	3.0	98%

(1) The Monthly Average WPDES permit limit for five day BOD is 20 mg/l.

(2) The Monthly Average WPDES permit limit for total suspended solids is 20 mg/l.

(3) 11-Month Average due to malfunction in influent totalizer

Source: DNR, Village of Pleasant Prairie.

removed from the wastewater by an aerated grit chamber utilizing a velocity control baffle. Grit is then dewatered using a mechanical grit screen tank and landfilled. Raw wastewater pumps lift the influent flow and sidestream flows to the oxidation ditch. Sidestreams are returned to the raw wastewater wet well.

Secondary treatment is accomplished in a two channel oxidation ditch system. The oxidation ditch utilizes the extended aeration process for treatment. Design flows for the oxidation ditch are presented in Table 3-29. A schematic of the plant is presented in Figure 3-16.

The effluent from the oxidation ditch then flows to the final clarifier. The final clarifier has a detention time of 8.5 hours at the average flow rate. Return activated sludge pumps are paced by the flowmeter to provide RAS flow from 50 percent to 200 percent of the average design flow. The effluent from the final clarifiers then flows to the chlorine contact tank. At the present time, chlorine disinfection is not required and the system is not in use. After leaving the chlorine contact tank, the effluent flows to a post aeration basin and is aerated using a fine bubble diffuser system prior to discharge to the effluent ditch. Waste sludge is pumped from the clarifier and oxidation ditch to a sludge holding tank until such time as it is removed by a private sludge hauling firm.

<u>Pleasant Prairie Sewer Utility District 73-1</u>

The Pleasant Prairie Sanitary District No. 73-1 wastewater treatment facility was constructed in 1975 and provides secondary treatment. It serves an estimated 600 persons and an area of 0.98 square miles. The 1988 average day flow at the facility was .069 MGD. Flow rates for the past 4 years are provided in Table 3-30. The collection system contains approximately 17,600 feet of gravity sanitary sewer, 2,000 feet of forcemain, and approximately 65 manholes.

Raw wastewater is delivered to the treatment facility, located just north of the Wisconsin - Illinois border in Section 33, Town 1 North, Range 22 East, by two 21 inch pipes which discharge to a lift station. The lift station then pumps the raw wastewater to a splitter box which is not in service. This box was provided to direct a portion of the flow to a second facility should it be required. The raw wastewater enters the stabilization basin through a manually cleaned bar screen. The wastewater then enters the aeration basin where it is mixed with activated sludge. The wastewater is then passed to the settling tank where solids settle out and the sludge is returned to the aeration basin or wasted to the aerobic digester tank.

Flow from the clarifier enters a chlorine contact tank which is provided for disinfection but is not

Table 3-29
Selected Characteristics of the
Pleasant Prairie Sewer Utility District "D"
Wastewater Treatment Facility: 1988

Estimated Total Area Service (Sq. Miles)	1.20
Estimated Total Population Served	1700
Date of Original Construction	1966
Date of Major Modifications	1985
Level of Treatment	Secondary
Disposal of Effluent	Des Plaines River (tributary)
Average Hydraulic Loading: 1988	.339 MGD
Maximum Monthly Average Hydraulic Loading: 1988	.490 MGD
Peak Hydraulic Loading: 1988	1.082 MGD
Average Annual Organic Loading: 1988 (Pounds BOD_5/day)	117
DESIGN CAPACITY	
Population	3,300
Average Hydraulic Loading	0.55 MGD
Peak Hydraulic Loading	1.16 MGD
Average Organic (Pounds BOD_s/day)	460
Equivalent Population	2,200
RESERVE CAPACITY	
Average Hydraulic Capacity	.211 MGD
Average Organic Capacity (BOD_s/day)	343
Population Equivalent	600

Source: Village of Pleasant Prairie

Table 3-30
Comparison of Treatment Data: 1986 - 1989
Pleasant Prairie Sewer Utility 73-1

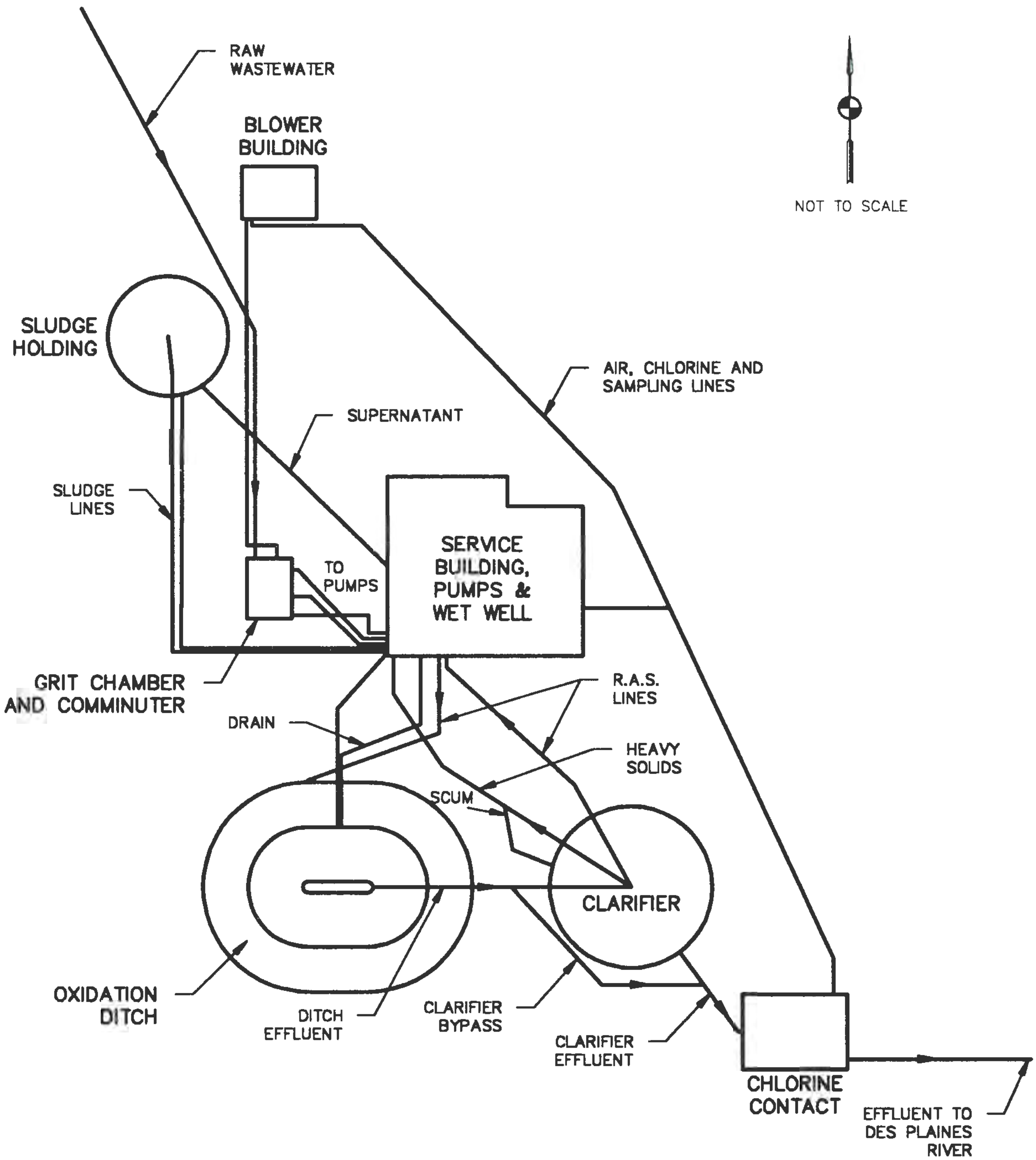
		Five Day BOD (1)			Average Suspended Solids (2)		
Year	Average Flow (MGD)	Influent MG/L	Effluent MG/L	Efficiency%	Influent MG/L	Effluent MG/L	Efficiency %
1989	.077	97	5	97%	57	5	91%
1988	.069	56	2	96%	50	5	90%
1987	.095	41	3	93%	42	6	86%
1986	.075	56	8	86%	74	9	88%

Source: DNR, Village of Pleasant Prairie.

(1) The monthly average WPDES limit for five day BOD is 15 mg/l.

(2) The monthly average WPDES limit for total suspended solids is 15 mg/l.

Figure 3-16
PLEASANT PRAIRIE SEWER UTILITY "D"
WASTEWATER TREATMENT PLANT SCHEMATIC



Source: Village of Pleasant Prairie, 1989

Table 3-31
Selected Characteristics of the
Pleasant Prairie Sanitary District 73-1
Wastewater Treatment Facility: 1988

Estimated Total Area Service (Sq. Miles)	0.98
Estimated Total Population Served	600
Date of Original Construction	1975
Date of Major Modifications	--
Level of Treatment	Secondary
Disposal of Effluent	Des Plaines River
Average Hydraulic Loading: 1988	.069 MGD
Maximum Monthly Average Hydraulic Loading	.117 MGD
Peak Hydraulic Loading: 1988	.326
Average Annual Organic Loading: 1988 (Pounds BOD_s/day)	56
DESIGN CAPACITY	
Population	4,000
Average Hydraulic Loading	0.40 MGD
Peak Hydraulic Loading	0.80 MGD
Average Organic (Pounds BOD_s/day)	240
Equivalent Population	3,800
RESERVE CAPACITY	
Average Hydraulic Capacity	.331 MGD
Average Organic Capacity (Pounds BOD_s/day)	184
Population Equivalent	3300

Source: Village of Pleasant Prairie

required at this time. Flow is then discharged through a ditch to the Des Plaines River. Sludge is hauled away by a private sludge hauling firm.

The facility is a package plant manufactured by Sanitaire. A schematic is provided in Figure 3-17 and various capacities of the facility are provided in Table 3-31.

Pleasant Park Utilities

The Pleasant Park wastewater treatment facility is scheduled to be abandoned in mid 1990 and the sewerage system will then be connected to the City of Kenosha System.

Somers Utility District No. 1

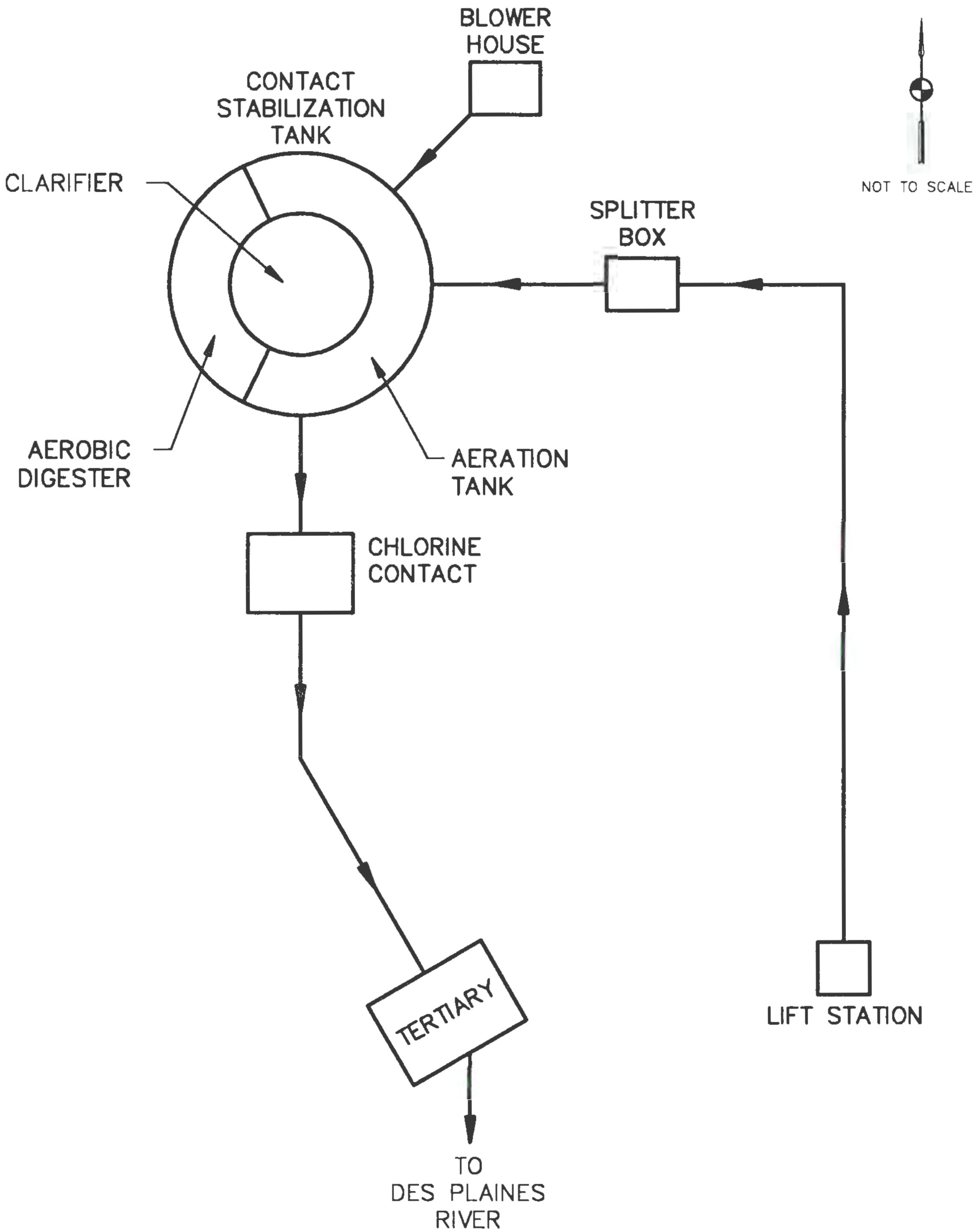
The Somers Utility District No. 1 wastewater treatment facility was abandoned in 1986 and the sewerage system was then connected to the City of Kenosha System.

Other Treatment Facilities

In addition to the aforementioned public sewage treatment facilities, there is a private facility which serves the WDOT Rest Area No. 36. The treatment facility is located at the WDOT Rest Area No. 26. The existing wastewater treatment facility was constructed in 1970 as part of a major expansion at the rest area. The facility is a septic tank/sand filter system which discharges to a holding lagoon and subsequently to a tributary of the Des Plaines River. The facility consists of two septic tanks, a dosing chamber, a distribution box, two sand filters, a chlorine contact chamber, and a 60 day holding pond with an outfall to the tributary. The design flow of the existing facility is 9,250 gpd.

In mid 1986, the WDNR determined the wastewater treatment facilities at Rest Area 26 were in violation of the facilities Wisconsin Pollutant Discharge Elimination System (WPDES) Permit. The WDNR notified the WDOT that it must upgrade the existing facility or provide other means of treatment for the wastewater. The current plan is for abandonment of the facility and connection to the Pleasant Prairie Sewer Utility District "D".

Figure 3-17
PLEASANT PRAIRIE SEWER UTILITY 73-1
WASTEWATER TREATMENT PLANT SCHEMATIC



Source: Ruekert & Mielke, 1989

Until recently abandoned, the Howard Johnson Motor Lodge owned and operated a 4th private wastewater treatment plant which was an extended aeration compact plant and polishing lagoon which discharged to the Des Plaines River. The abandoned plant served two gas stations and the Motor Lodge. Constructed in 1965, the plant had a capacity of .027 MGD and a BOD of 100 pounds per day (lb./day). Wastewater was conveyed to the plant via a package lift station consisting of two 100 GPM pumps which discharged through 3,900 feet of forcemain.

On-Site Disposal

The remainder of the residences, and some commercial and industrial establishments discharge to on-site soil absorption sewage disposal systems. As indicated in Community Assistance Planning, Report No. 106, Sanitary Sewer Service Areas for the City of Kenosha and Environs prepared by SEWRPC in 1985, there are approximately 11,362 persons in the study area who were served by on site soil absorption sewage disposal systems or by on-site sewage holding tanks in 1980.

The following is a history of private on site sewage systems on file at the office of Kenosha County Planning and Development.

1) Village of Pleasant Prairie
(information dating back to 1980)
163 holding tanks, 82 other systems

2) Town of Somers
(information dating back to [illegible])
87 holding tanks, 65 other systems

3) Town of Bristol, Sections 1, 12, 13, 24, 25 &26
(information dating back to 1970)
18 holding tanks, 9 in ground systems, 10 mound systems

4) Town of Paris, Sections, 1, 12, 13, 14, 24, 25, & 36
(information dating back to 1970)
9 holding tanks, 6 in ground systems, 10 mound systems.

EXISTING WATER SUPPLY FACILITIES

As previously mentioned, there are currently four separate water utilities operating in the planning area. Each utility has its own supply, storage, transmission, and distribution facilities with the exception of the Town of Somers Sanitary District No. 1 which purchases water from the Kenosha Water Utility on a wholesale basis. Table 3-32 provides a listing of various capacities of these facilities. Service areas for each utility was depicted earlier in this chapter in Figure 3-3. The water supply, storage and distribution facilities for each utility are discussed in detail on the following pages. A number of private water trusts and water coops also exist in the study area and are described as; Carol Beach Water Co., Eagle Chateau, Kenosha Mobile Home Court, Oakdale Estates, Country Charm Estates, and Elizabeth Manor Apartments. These areas generally have no storage, small capacity wells and serve very few customers. They are not governed by the Wisconsin Public Service Commission and therefore are not required to submit an annual report. The location of these private water utilities is provided on Figure 3-18.

Kenosha Water Utility

The Kenosha Water Utility was formed in 1895 from what was then the Park City Water Company and the North Side Water Company. The systems contained 13 miles of water main, a 4 MGD pumping station, a 24 inch Lake Michigan intake, 7 artesian wells and 102 fire hydrants. The water utility outgrew its capacity and a new treatment plant was constructed between 1916 to 1917. From time to time additions were made until the facility reached its present capacity of 40 MGD.

Water supply for the Kenosha treatment facility is provided through 42 inch and 48 inch pipes extending approximately 4,300 feet into Lake Michigan to a water depth of 30 feet. The water enters two completely separate rapid sand filter treatment plants through a 35 foot diameter low lift pumphouse called the roundhouse. The treatment plants are known as the east and the west plants. A description of the low lift pumps is provided in Table 3-33. A third intake line, 24 inches in diameter, is located on the north face of the harbor sheathing. The intake has a capacity of 15 MGD, however, the water is of poor quality and requires additional treatment. For this reason, this intake is only used during emergencies.

In 1979, Alvord, Burdick and Howson Engineers of Chicago performed yield tests on the 42 and 48 inch diameter intakes. Based on the results of these tests and minimum lake levels, the intakes have a minimum combined yield of 116 MGD. The Hazen-Williams hydraulic coefficient of the 42 inch cast iron intake was determined to be approximately 80. Considering this pipeline was constructed in 1917, this coefficient seems reasonable. The 48 inch concrete intake constructed in 1975 has a hydraulic coefficient of 135, which is considered very satisfactory. These coefficients and yields were based on 1979 data and have undoubtedly decreased in the last 10 years. Current estimates show that the safe yield of the 48 inch intake is 66 MGD and the safe yield of the 42 inch intake is 35 MGD for a total of 101 MGD.

Table 3-32
Existing Public Water Supply, Storage and Distribution Facilities: 1988

Name of Public Water Utility	Estimated Total Area Served (Sq. Mi.)	Estimated Population Serviced	Total Supply Capacity	Total Storage Capacity (Gallons)	Total Miles of Water Main
Kenosha Water Utility	18.40	83,300	40.0 MGD	15,050,000	282.80
Town of Somers Sanitary District No. 1	0.70	1,300	--(1)	--(1)	9.50
Town of Pleasant Prairie Water Utility	2.54	2,300	2.074 MGD	738,000	19.89
Town of Bristol Sanitary District No. 3	0.5	--(2)	0.432 MGD	250,000	1.57

(1) The Town of Somers Sanitary District No. 1 water system is supplied by the Kenosha Water Utility.
(2) The Town of Bristol Sanitary District No. 3 serves only commercial customers.

In the past, some problems with "Needle Ice" have been noticed at the intake crib for the 42 inch intake. Since the construction of the second intake, no icing problems have been noticed. Locations of all three intakes are shown in Figure 3-19.

Low Lift Pumping

The older, west plant is served by two low lift pumps capable of being driven either electrically or by gasoline engines. Rated capacities of the pumps are 10 and 12 MGD. These pumps are located at the pumphouse in the west plant and are considered to be standby units as lake water is normally pumped from the roundhouse at the east plant. The units are used when the roundhouse is out of service, being cleaned or bypassed.

The remaining low lift pumps are located at the roundhouse near the east plant. The four pumping units can serve the east plant, the west plant or both. The pumps have a combined capacity of 47.5 MGD. Their combined capacity with the largest unit out of service is 32.5 MGD. This pumping facility coupled with the standby pumps at the west plant have a total pumping capacity of 67.5 MGD or 52.5 MGD with the largest unit out of service. There is room provided at the roundhouse for two additional pumps.

Treatment

West Plant

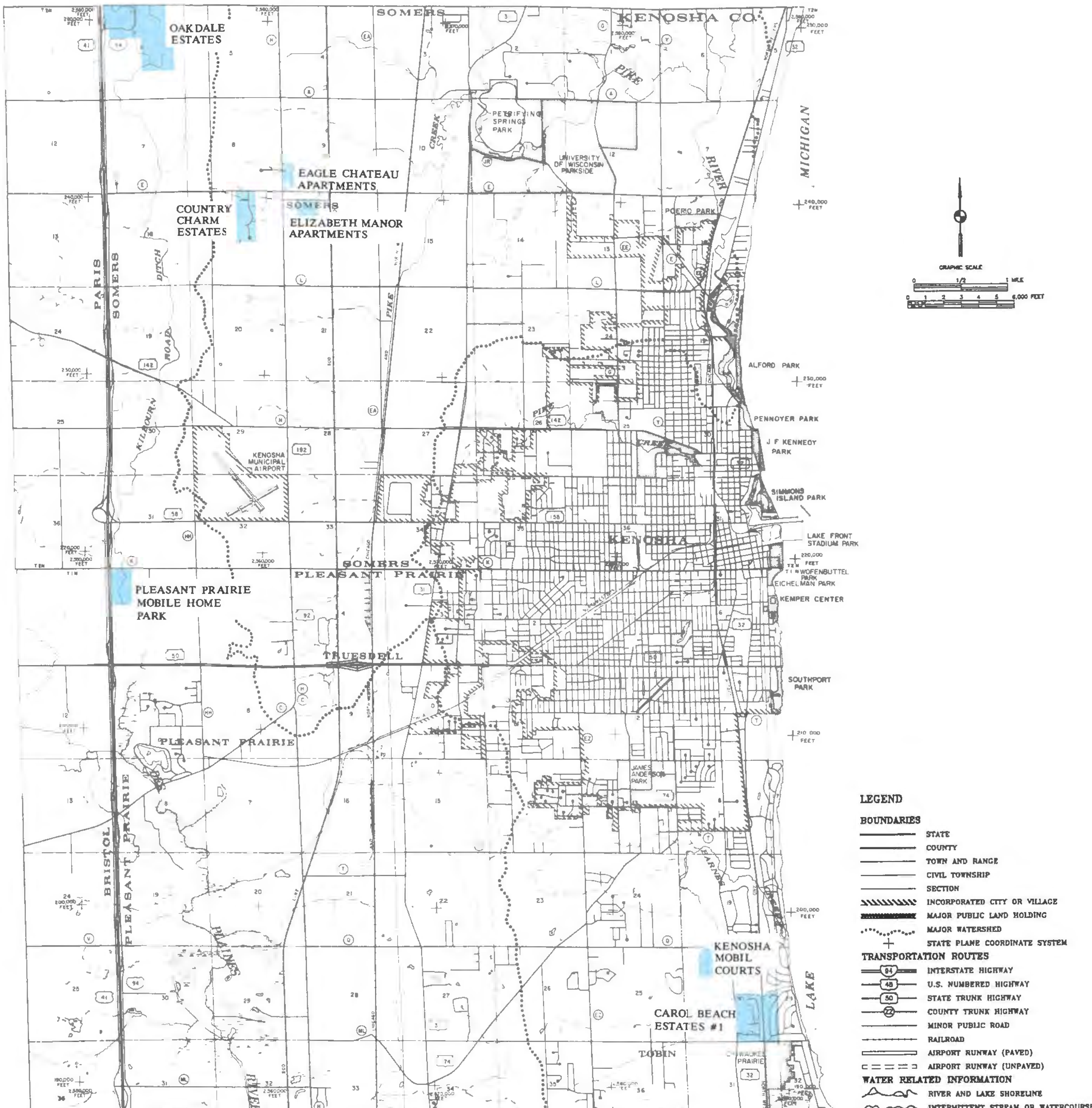
The west plant was constructed between 1916 to 1917 and had major upgrades in 1936 and 1952. The low lift pumps deliver water directly to the mixing basins located at the west plant. The water flows through the old microstrainer building where rapid mixing is performed by the paddles in the microstrainer and slow mixing by the baffles in the mixing basins. Prior to entering the mixing basins, water is treated with potassium permanganate to remove objectionable tastes and odors, chlorine for disinfection, and alum for coagulation. After flocculation, the water enters six rectangular settling basins. As the water flows through the basins, foreign matter which coagulated with the alum settles out.

Each settling basin is approximately 100 feet long. The four basins to the south operate in series with the remaining two operating independently. Using a design capacity of 20 MGD the estimated retention period for the six basins is 2.9 hours. The settling basins for the west plant are numbered 1 through 6 and are shown on Figure 3-19.

The settled water then flows onto 16 sand filter beds. Eight of these filters have a 1 MGD capacity and eight have a capacity or 1.5 MGD for a total capacity of 20 MGD. Water flows through the filters at a rate of 2 gallons per

Figure 3-18

LOCATION OF PRIVATE WATER UTILITIES: 1989



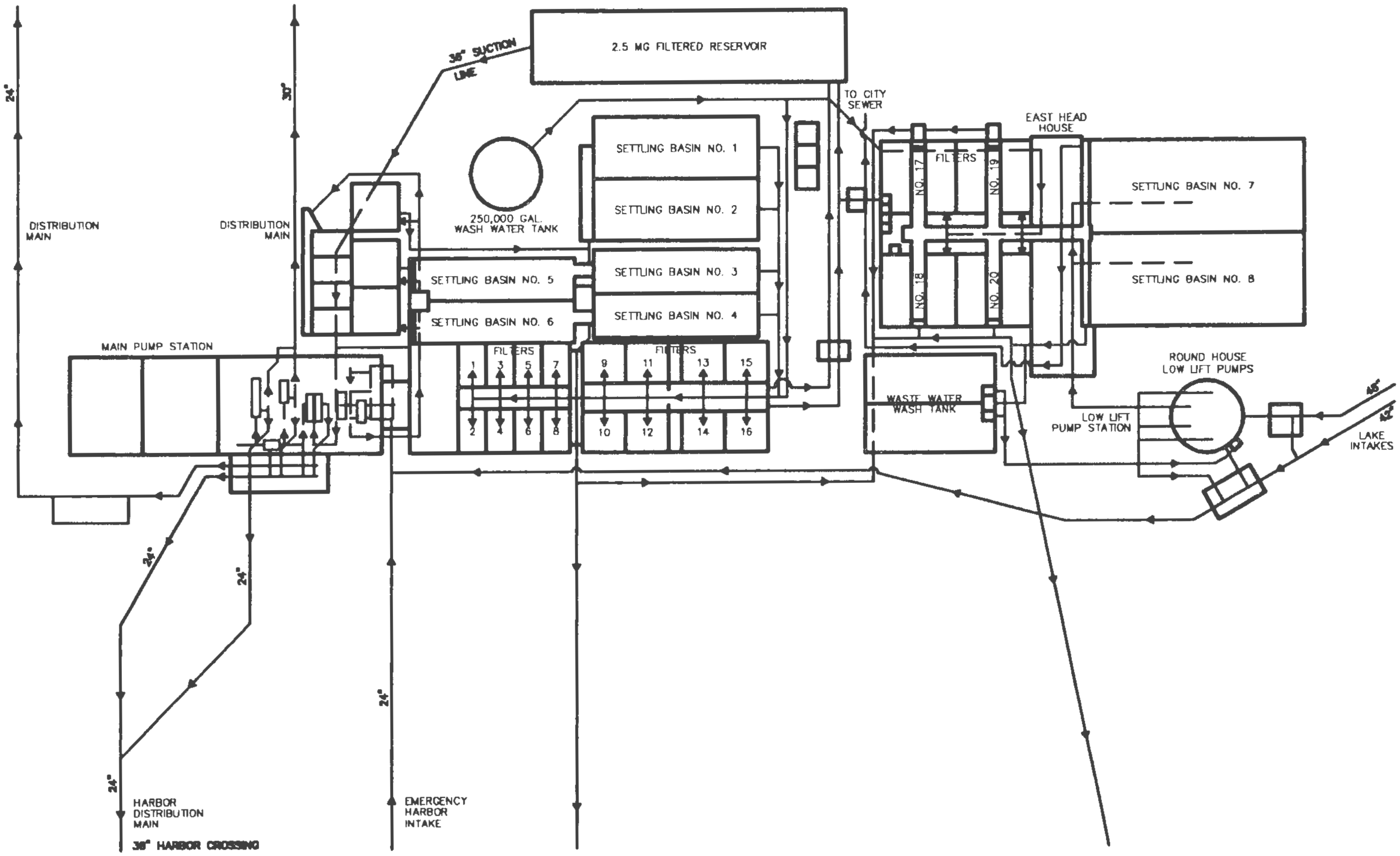
Source: Dept. of Natural Resources & Ruekert & Mielke

Table 3-33
Kenosha Water Treatment Facility
Low Lift Pumping Equipment: 1989

Pump Equipment	Pump No. 1	Pump No. 2	Pump No. 3	Pump No. 4	Stand By Pump No. 1	Stand By Pump No. 2
Year installed	1964	1964	1964	1964	1952	1956
Manufacturer	Worthington	Worthington	Worthington	Worthington	DeLaval	DeLaval
Type	Vert. Turbine	Vert. Turbine	Vert.Turbine	Vert.Turbine	Centrifugal	Centrifugal
Rated Capacity	15 MGD	15 MGD	10 MGD	7.5 MGD	10 MGD	12 MGD
Actual Capacity	15 MGD	15 MGD	10 MGD	7.5 MGD	10 MGD	12 MGD
Discharge Head	50 Ft.	50 Ft.	50 Ft.	50 Ft	50 Ft	50 Ft.
Power Equipment						
Year Installed	1964	1964	1964	1964	1952	1956
Manufacturer	G.E.	G.E.	G.E.	G.E.	G.E.	G.E.
Type	Electric	Electric	Electric	Electric	Electric	Electric
Rated Horsepower	200	200	125	100	60	100
Standby Equipment						
Year Installed	None	None	None	None	1952	1956
Manufacturer					Climax	Climax
Type					Gas	Gas

Source: Kenosha Water Utility

Figure 3-19
KENOSHA WATER UTILITY
WATER TREATMENT & PUMPING FACILITIES



Source: Kenosha Water Utility, 1989

square foot per minute at a capacity of 20 MGD. The filters remove any remaining fine particulate matter not previously settled out. Following filtration, the crystal clear water flows into a 770,000 gallon clear storage well below the filters and subsequently into a 2.5 MG underground storage reservoir. The filters are numbered 1 through 16 in Figure 3-19.

East Plant

The east plant was constructed in 1964 and is essentially the same today. Water enters the two settling basins, which operate in parallel, from the low lift pumps. After chemical addition and mixing, the water flows to the bottom tier of the three tiered basins. Here most of the solids are removed before the water passes to the second or third tier. By the time the water reaches the third tier, very little sludge is left to settle out. Total plant capacity is 20 MGD. The basins have an estimated retention period of approximately 4 hours and are numbered 7 and 8 in Figure 3-19.

Settled water then flows to four rapid sand filters. Each filter has a 5 MGD capacity and is rated at 2 gallons per square foot per minute. The filtered water is then discharged to clear water storage wells with a total capacity of 1.85 MG and to the 2.5 MG water storage reservoir at the west plant. An automatic vacuum controlled siphon controls the amount of flow between the clear wells and the reservoir. The siphon is required due to the difference in elevation between the clear wells and the reservoir. The filters are numbered 17 to 20 on Figure 3-19.

High Lift Pumps

All high lift pumping is performed at the west plant pumpstation. The five high lift pumps supply potable water from the treatment plant to the City of Kenosha and other nearby communities. The five pumps have a total rated capacity of 83 MGD and a reliable capacity of 53 MGD with the largest unit which is 30 MGD out of service. Table 3-34 provides a description of the high lift pumps. Rated capacities of the high lift pumps are 9 MGD, 15 MGD, 20 MGD and 30 MGD. Auxiliary power in the form of natural gas engines is available to the 20 MGD pump and one of the 9 MGD pumps. Plans are underway to provide 2 to 1000 Kilowatt (KW) diesel generators to power the entire plant by the end of 1990. Emergency power with the electrical feed to the plant out, natural gas to the plant out and one diesel generator down will provide for 30 MGD of treated water. With natural gas available, 40 MGD will be available from the plant. Water sales records and pumpage records are provided in Table 3-35.

Water Mains

Each system is comprised of two classifications of watermains, transmission and distribution. Transmission mains are generally considered to be those mains which are 10 inches and larger. Distribution mains receive water from the transmission mains and deliver it to the customer. These mains are generally 8 inches and smaller.

Each utility was its own water main network as shown on the maps included with this report. The type, size and length of mains for the Kenosha Water Utility is provided in Table 3-36. The Kenosha water system contains approximately 277 miles of watermain of which approximately 70 percent is contained in the primary zone, 28 is percent in the first Booster Zone and 2 percent is in the other boosted areas. Mains have been installed from 1892 to the present day and constructed of cast iron, ductile iron, copper, plastic and reinforced concrete.

Pleasant Prairie Water Utility

The Pleasant Prairie Water Utility consists of five separate water systems known as Ladish, Timber Ridge, Zirbel, Pleasant Homes and the Kenosha Wholesale Service Area. These systems will be discussed separately with regard to supply and storage facilities in the following section.

Ladish Water System

The Ladish Water System is located just east of ISH 94 south of STH 50. Supply for the system consists of one deep well located near the intersection of Wilmont Road and STH 192 near the Ladish Company. The well is known as Well No. 1 and was drilled in 1970 to a depth of 1,644 feet. An 18 inch casing extends from 2 feet above the pumphouse floor to a depth of 183 feet. Inside the 18 inch casing is a 14 inch casing extending to a depth of 587 feet. The remainder of the well is a 13-1/4 inch hole through rock, predominantly dolomite and sandstone.

During normal operations the well discharges to the distribution system and the adjacent water tower. The well presently has a yield of approximately 600 GPM or 1.152 MGD. The well pump is a Layne-Bowler vertical turbine style pump set at 510 feet in the well. Power for the well pump is supplied by a 200 horsepower Westinghouse Electric Motor, which runs at a nominal 1775 RPM, 460 volts, 3 phase, and 60 cycle. The pump and motor were installed in 1971 and the facility has no stand-by equipment in case of a power outage. No treatment is provided at the facility.

Table 3-34
Kenosha Water Treatment Facility
High Lift Pumping Equipment: 1989

Pumping Equipment	Pump No. 1	Pump No. 2	Pump No. 3	Pump No. 4	Stand By Pump No. 5
Year Installed	1952	1952	1988	1952	1965
Manufacturer	DeLaVal	DeLaVal	Fairganis-Morse	DeLaVal	DeLaVal
Type	Centrifugal	Centrifugal	Centrifugal	Centrifugal	Centrifugal
Rated Capacity	9 MGD	9 MGD	30 MGD	15 MGD	20 MGD
Actual Capacity	9 MGD	9 MGD	30 MGD	15 MGD	20 MGD
Discharge Head	200	200	230	200	200 FT.
Power Equipment					
Year Installed	1952	1952	1988	1952	1965
Manufacturer	G.E.	G.E.	G.E	G.E.	Westinghouse
Type	Synchronous Motor	Synchronous Motor	Electric	Synchronous Motor	Synchronous Motor
Rated Horsepower	400	400	500	700	800
Standby Equipment					
Year Installed	1987	None	None	None	1965
Manufacturer	Waukesha	--	--	--	Waukesha
Type	Natural Gas	--	--	--	Natural Gas

Source: Kenosha Water Utility

Table 3-35
Water Sales Records - Kenosha Water Utility: 1980-1989

Year	Estimated Residential Population Served	Total Gallons Pumped (MG)	Estimated Residential GPCD	(1) Consumption By Class (MG)				Total Metered Consumption	Other Usage	Percent Unaccounted For
				RES	COM	IND	Public			
1980	83,485	6,047.72	65.30	1,995.09	625.88	1,709.06	194.37	5,272.40	29.99	9.0
1981	83,941	5,654.17	72.60	2,223.77	884.14	2,192.13	197.82	5,296.89	17.27	3.1
1982	84,044	5,318.06	60.50	1,854.91	709.99	1,875.49	166.32	4,294.57	25.72	15.4
1983	84,358	5,677.39	66.20	2,039.10	805.03	2,035.71	186.63	5,066.48	32.09	6.0
1984	84,987	5,708.90	65.50	2,038.06	767.88	2,126.28	180.31	5,112.53	42.57	5.5
1985	85,417	5,771.18	64.80	2,018.85	753.03	1,931.35	177.94	5,112.50	33.85	7.5
1986	81,919	5,348.79	63.49	1,898.40	723.41	1,676.96	150.13	4,475.69	16.61	12.3
1987	82,038	5,748.41	67.60	2,024.24	820.27	1,934.52	161.08	5,072.90	56.63	6.5
1988	83,263	6,963.91	78.70	2,397.48	863.32	2,177.05	190.63	5,763.77	16.45	13.6
1989	83,763	(2)	69.10	2,101.07	909.64	1,892.46	166.18	5,069.35	(2)	(2)
Average	84,305	5,880.88	66.70	2,051.07	750.23	1,932.27	177.98	5,039.64	32.97	8.7

(1) Based on billing period April 1 to March 31.

(2) Information for January to December 1989. Total pumpage, other usage and accountability not available at the time of this report.

Source: Annual Report of the Kenosha Water Utility

Table 3-36
Existing Water Mains - Kenosha Water Utility: 1988

Material	Size	Length In Feet	Length In Miles	Percent of Total
Cast/Ductile Iron Pipe	36 Inch	353	0.07	*
	30 Inch	672	0.13	*
	24 Inch	45,543	8.63	3.1
	20 Inch	3,688	0.70	0.2
	18 Inch	2,576	0.49	0.2
	16 Inch	126,122	23.89	8.4
	14 Inch	8,607	1.63	0.6
	12 Inch	199,361	37.76	13.4
	10 Inch	13,672	2.59	0.9
	8 Inch	269,639	51.07	18.1
	6 Inch	769,443	145.73	51.5
Plastic Pipe	12 Inch	9,701	1.84	0.7
	8 Inch	6,689	1.27	0.4
	6 Inch	3,062	0.58	0.2
G.E. Pipe	4 Inch	31,733	6.01	2.1
Copper Pipe	3 Inch	150	0.03	*
	2 Inch	1,489	0.28	0.1
	1-1/2 Inch	272	0.05	*
	1 Inch	70	0.01	*
	Total	1,492,842	282.76	100.0

* Less than .1 Percent

Source: Kenosha Water Utility 1988 Annual Report

When drilled, the well was test pumped at a rate of 458 GPM for 23 hours with 167 feet of drawdown for a corresponding specific capacity of 2.74 gallons per minute per foot of drawdown. On July 20, 1989 the static level in the well was 348 feet, the pumping level was 460 feet and the drawdown was 112 feet. Assuming a yield of 600 GPM, the specific capacity of the well is 5.4 gallons per minute per foot of drawdown.

The Ladish System contains a 500,000 gallon elevated steel storage tower located next to the Well No. 1 Pumphouse. The Tower was constructed in 1970 and is approximately 155 feet in height. The tower is connected to the distribution system on Wilmont Road by a 12 inch water main. The USGS datum overflow elevation of the tower is 885.5 feet with a corresponding base elevation of 730.5 feet. The tank was last cleaned and painted in the summer of 1989.

Water mains in the Ladish System range in size from 6 inches to 12 inches. The Public Service Commission of Wisconsin in the Annual Utility Report does not require a break down of watermain by size and type for each individual system in a water utility. For this reason, the total amount of water main in the Pleasant Prairie utility is presented in Table 3-37 as opposed to such a breakdown. The utility has approximately 650 metered customers of which 625 are residential. Water sales records for the past 10 years are contained in Table 3-38.

Table 3-37
Existing Water Mains - Village of Pleasant Prairie
Water Utility: 1988

Type of Pipe	Diameter	No. of Feet	No. of Miles	% of Total
Ductile or Cast Iron	6	11,852	2.24	11.3
	8	21,498	4.07	20.5
	10	18	*	*
	12	38,007	7.20	36.2
	16	19,201	3.64	18.3
Galvanized Iron	1	2,650	.50	2.5
	1-1/4	2,050	.39	2.0
	1-1/2	600	.11	0.6
	2	3,050	.58	2.9
	3	2,600	.49	2.5
	6	40	*	*
Plastic	6	1,100	.21	1.0
	8	210	.04	0.2
	10	200	.04	0.2
	12	1,936	.37	1.8
	Total	105,012	19.89	100.0

* Less than .01 miles or .01 percent.

Source: Annual PSC Water Utility Report prepared by the Village of Pleasant Prairie

Timber Ridge Water System

The Timber Ridge water system is located just north of the Illinois-Wisconsin border east of STH 31. Supply for the system is obtained from a deep well located near the Big Oaks Golf Course east of Timber Ridge. This is known as Well No. 2 and was drilled in 1976 to a depth of 1962 feet. A 20 inch casing extends from the surface to a depth of 205 feet. Inside the 20 inch casing is a 16 inch casing extending to a depth of 620 feet. The reminder of the well is a 15 inch diameter hole through rock, predominantly dolomite and sandstone.

During normal operations the well discharges to the distribution system and the adjacent water tower. The well presently has a yield of approximately 380 GPM or .547 MGD at 550 feet Total Dynamic Head (TDH). The well pump is a Layne submersible pump set at 460 feet in the well. Power for the well pump is supplied by an electric motor (50 Hp, 460 volt, 60 cycle, 3 phase).

The pump and motor were installed in 1987. The facility has a stand-by right angle drive natural gas engine that was taken out of service when the old vertical turbine pump was removed and the new submersible pump installed.

Treatment at the facility includes the injection of sodium hypochlorite and the addition of polyphosphate. Sodium hypochlorite is added in a 15 percent solution for disinfection purposes while polyphosphates are added to hold iron satisfactorily in solution.

When drilled, the well was test pumped at a rate of 602 GPM for 24 hours with 96 feet of drawdown for a corresponding specific capacity of 6.3 gallons per minute per foot of drawdown. On July 20, 1989 the static level in the well was 338 feet, the pumping level was 423 feet and the drawdown was 85 feet. Assuming a yield of 380 GPM, the specific capacity of the well is 4.5 gallons per minute per foot of drawdown.

The Timber Ridge system contains a 200,000 gallon elevated steel storage tower located next to the Well No. 2 pumphouse. The tower was constructed in 1977 and is approximately 135 feet in height. The tower is connected to the distribution system on 123rd Place by an 8 inch water main. The USGS datum overflow elevation of the tower is 849.5 with a corresponding base elevation of 714.5. The tank was last cleaned and painted in the summer of 1989. Water mains in the Timber Ridge system are either 6 inch or 8 inch.

Pleasant Homes Water System

The Pleasant Homes Water System is located just north of the Wisconsin-Illinois state line east of 47th Avenue. Supply for the system consists of two shallow wells, one located at 122nd Street and 43rd Avenue known as Well No. 3 and one located on 122nd Street near 47th Avenue known as Well No. 4.

The Pleasant Park Utilities Co., Inc., owned and operated the Pleasant Homes Water System until recently when the Public Service Commission of Wisconsin require the Village of Pleasant Prairie to take over the operation of the system.

Well No. 3 has a submersible pump which pumps approximately 270 GPM to the system via a 4,000 gallon pressure tank. No data regarding well depth, size or construction could be located.

Well No. 4 has a submersible pump which pumps to the system via a 500 gallon pressure tank. The pump is used only as a back-up and pumps at a rate of 90 gpm. Again, no information could be found regarding well construction. The air lines in the wells are not functional so no data on static or pumping levels could be obtained.

Table 3-38
Water Sales Records
Village of Pleasant Prairie Water Utility: 1980 - 1988

Year	Total Gallons Pumped (MG)	Estimated Residential GPCD	Gallons of Water Sold (MG) RES	COM	IND	PUBLIC	Total	Other Usage	Gallons[a] of Water Purchased (MG)
1980	102.44	57.3	31.77	11.03	42.33	0.82	85.95	4.00	6.90
1981	98.92	74.6	34.52	59.20	63.42	0.28	104.14	2.75	8.87
1982	98.81	78.7	36.81	13.00	54.31	0.46	104.58	2.95	11.45
1983	108.73	77.7	39.64	14.39	46.41	0.48	100.92	4.20	17.17
1984	120.55	91.9	48.13	14.32	58.24	0.70	121.39	0.80	23.24
1985	127.31	108.6	57.38	22.55	69.70	0.71	150.34	4.98	36.07
1986	180.47	76.2	51.09	19.72	77.53	1.77	148.34	18.72	60.51
1987	146.36	60.4	36.94	21.22	78.77	2.13	139.06	4.80	15.79
1988	215.76	89.5	*	*	*	*	*	.98	75.51
Average	133.26	78.2	42.04	21.93	61.34	0.02	119.34	4.91	28.39

* Data not available. Averages are of available data.

a The Village of Pleasant Prairie purchases water from the City of Kenosha

Source: Public Service Commission of Wisconsin Annual Report as supplied by the Village of Pleasant Prairie

The water distribution system consists of a series of 6 inch mains, 17,880 feet or 3.4 miles in length. There is no elevated or ground storage within the system other than the two previously mentioned pressure tanks.

Zirbel Water System

The Zirbel Water System is located within the confines of the Ladish System in western Pleasant Prairie. The Zirbel Water System is the oldest system in Pleasant Prairie and consists of 2 shallow wells, a 30,000 gallon elevated tank and a series of 3 inch and smaller galvanized water mains.

Very few records exist as to the age or makeup of the system. The first well has a small vertical turbine pump located in a buried concrete vault. Well No. 2 has a submersible pump in a small, ground level structure near Well No. 1. The pumphouse contains a 500 gallon pressure tank that maintains pressures at approximately 45 psi in order to keep the corroded galvanized mains from breaking. The system has an emergency connection to the Ladish System which supplies the fire hydrants in the area. Pressures on the Ladish System are greater, however, and the corroded mains develop leaks when subjected to these higher pressures. The Ladish system is scheduled for abandonment in the near future.

Kenosha Wholesale Service Area

The Kenosha Water Utility provides wholesale water to Pleasant Prairie through five water meters located as shown in Figure 3-20. Also shown are meter locations proposed as of January, 1990. The total number of customers contained in these metered areas is estimated to be 263. Each of the five areas are independent of each other and require their own meters. Four areas are served by the Kenosha primary service area and one by the booster service area.

Somers Sanitary District No. 1

The Somers Sanitary District No. 1 water system is located in the northeastern corner of Kenosha County north of the City of Kenosha. Supply for the system is from the City of Kenosha water utility system at the southern end of the district where water is metered by the Kenosha Water Utility.

The system is on the primary pressure district of the Kenosha system and contains no pumps, reservoirs, standpipes or elevated storage. Water usage is included in the annual estimates of usage by the Kenosha Utility and also presented in Table 3-39. There are approximately 50,109 feet, or 9.5 miles, of water mains in the Somers Sanitary District No. 1 ranging in size from 2 inch to 8 inch. A listing of the mains in the district is contained in Table 3-40.

Table 3-40
Existing Water Mains
In Somers Sanitary District No. 1: 1988

Material	Size	Length In Feet	Length In Miles	Percent of Total
Cast/ Ductile Iron	8"	15,470	2.93	30.8
	6"	17,045	3.23	34.0
	3"	6,481	1.23	12.9
Plastic/ Polyvinyl	8"	7,517	1.43	15.1
	6"	2,496	0.47	4.9
Copper	2"	45	0.01	0.1
Outside District				
Ductile Iron	8"	216	0.05	0.5
Plastic	8"	839	0.16	1.7
	Total	50,109	9.50	100.0

Source: Public Service Commission Annual Utility Report.

Bristol Sanitary District East

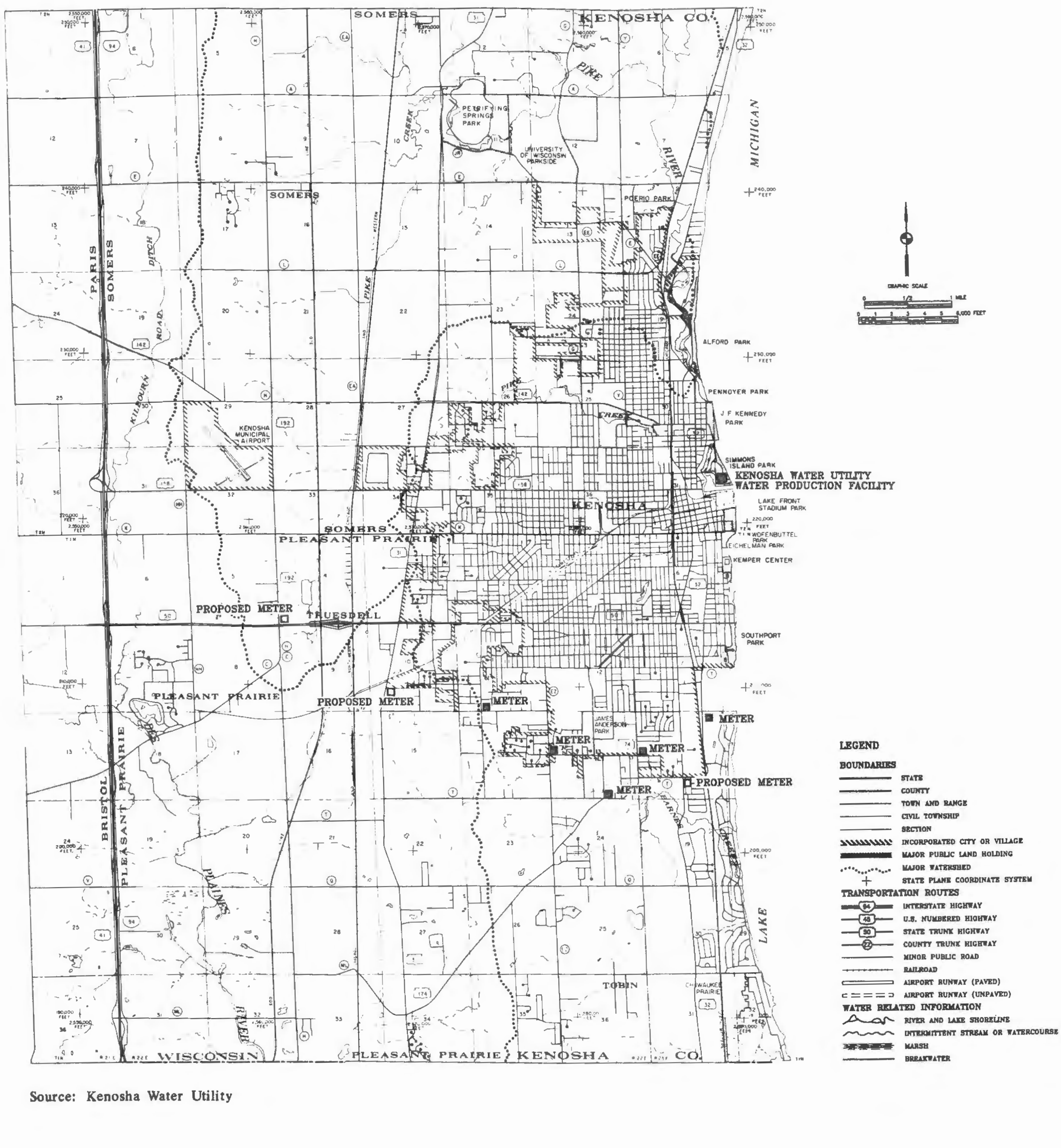
The portion of the Bristol water utility which lies in the study area is known as Bristol Sanitary District East. The Sanitary District is located just west of ISH 94 at STH 50. Supply for the water system is from a deep well located east of Bristol Parkway and west and south of 71st Street. The well is known as Bristol Well No. 3 and was drilled in April, 1988 to a depth of 310 feet. A 10 inch casing extends 10 feet into the limestone formation and a 10 inch drill hole makes up the remainder of the well. The well drillers report was not on file at the DNR at the time of this report.

During normal operations the well discharges to the distribution system and the adjacent elevated water tower. The well presently has a yield of approximately 300 GPM or .432 MGD. The well pump is a Layne-Bowler vertical turbine style pump. Power for the pump is supplied by a 40 Hp Newman Electric Motor rated at 1760 RPM, 460 volts, 3 phase, 60 cycle. The facility also has a stand-by Hercules natural gas engine equipped with a right angle drive unit for use in the event of a power outage or equipment failure. The well is now producing 300 GPM with a corresponding drawdown of approximately 32 feet for a specific capacity of 9.4 gallons per minute per foot of drawdown.

The Bristol Sanitary District East contains a 250,000 gallon elevated steel storage tower located south of 71st Street and west of Bristol Parkway East. The tower was constructed in 1988 and is approximately 152 feet in height. The tower is connected to the distribution system on Bristol Parkway East by a 12 inch

Figure 3-20

LOCATION OF KENOSHA WHOLESALE METERING POINTS FOR THE VILLAGE OF PLEASANT PRAIRIE: 1989



Source: Kenosha Water Utility

Table 3-39
Water Sales Records
Sanitary District No. 1, Town of Somers: 1979-1988

Year	Estimated Residential Population Served	Total Gallons Purchased[a]	Estimated Residential GPCD	Millions Gallons of Water Sold					Other Usage	Percent *Unaccounted for [b]
				RES	COM	IND	PUBLIC	TOTAL		
1979	1240	76.97	58.8	26.60	28.49	---	1.81	56.90	9.23	16.0
1980	1254	68.53	62.4	28.64	25.32	---	1.53	55.49	10.00	5.2
1981	1309	58.64	78.8	37.65	17.16	---	.86	55.67	2.96	*0.0
1982	1290	58.24	77.0	36.26	18.61	---	.83	55.70	2.55	*0.0
1983	1280	62.42	77.8	36.33	17.49	---	1.51	55.33	7.09	*0.0
1984	1274	67.04	83.1	38.76	23.21	---	.89	62.86	4.12	*0.0
1985	1268	81.35	78.3	36.24	21.08	---	.76	58.08	17.60	*7.0
1986	1262	73.34	64.4	29.66	30.05	---	.47	60.18	13.17	*0.0
1987	1235	82.52	80.2	36.16	22.56	---	---	58.72	23.70	*0.2
1988	1300	87.63	74.7	34.90	33.76	---	.08	68.74	18.89	*0.0
	Average	71.67	73.6	34.12	23.77	---	.97	60.55		

a Sanitary District No. 1 purchases all water from the Kenosha Water Utility.

b Unaccounted-for usage usually includes all unmetered pumpage. In recent years this has been in excess of 20 percent.

Source: Public Service Commission Annual Utility Report.

water main. The USGS datum overflow elevation of the tower is 885.5 feet with a corresponding base elevation of 733 feet. There is approximately 8,300 feet of water main in the Bristol system which is either 8 inch or 12 inch.

Water sales records for the Town of Bristol Water Utility as a whole are contained in Table 3-41. Records for the well at Sanitary District No. 3 are contained on Table 3-42.

Table 3-42
Monthly Pumpages - Town of Bristol Well No. 3

	Pumpage In Gallons	
Month	1988	1989
January	--	591,000
February	--	501,400
March	--	565,100
April	--	576,500
May	--	975,200
June	937,900	1,653,900
July	1,290,400	1,118,100
August	1,386,700	--
September	1,163,000	--
October	912,400	--
November	697,600	--
December	1,199,800	--
Total	7,587,800	5,981,200
Average Daily	37,195	28,213

Source: Bristol Sanitary District No. 3

RECENT SEWER SYSTEM BYPASSING, SURCHARGING AND BASEMENT FLOODING

Two rainfall events were recorded in the Kenosha area in 1989 which caused sanitary sewer surcharging, sewage backups into basements and several sewage bypasses.

The first storm occurred on June 21, 1989 and only impacted the Kenosha Utility System. This storm was a short duration/high intensity storm that dumped 1.27 inches in approximately 1.5 hours in downtown Kenosha and, according to reports, more than 2.0 inches in Western Kenosha County. The raw sewage pumping rate at the wastewater treatment facility increased from 20 MGD to 85 MGD within a two hour period. In addition, the main trunk sewer north of the plant surcharged and caused bypassing to Lake Michigan at 3rd Avenue and 68th Street. The local collection system also surcharged and bypassing occurred at Taft Road and 46th Avenue. There were reports of approximately 50 basement backups due to trunk and local collector surcharging. It is also suspected that there was overflow out of a manhole at the Washington Park Velodrome. The Department of Natural Resources was informed of the bypassing and classified the event as a "borderline" Category II bypass event which means that it is very close to an event that is likely to occur once every five years.

The second storm occurred on August 31, 1989 and September 1, 1989 and impacted the Kenosha Utility System and Pleasant Prairie Sewer Utility District "D". This storm produced a total of 2.86 inches of rain. The raw sewage pumping rate at the Kenosha wastewater treatment facility increased from 23 MGD to 95 MGD within a two hour period. In addition the main trunk sewer north of the plant surcharged and sewage overflowed out of manholes at several locations and was bypassed at 3rd Avenue and 68th Street. The local collection system surcharged at nine locations and caused sewage backups into approximately 70 basements and caused bypassing at Taft Road and 46th Avenue.

The September storm also caused surcharging in the Pleasant Prairie Sewer Utility District "D" trunk sewer system. The treatment plant reached peak capacity for three hours and was unable to keep up with the influent flow. Although the trunk sewer system backed up, there were no reported instances of basement backups or manhole overflowing.

The DNR has classified the September storm as a Category II storm. Comparison with the SEWRPC Intensity-Duration-Frequency curves indicates that is was between a 5 and 10 year recurrence interval event.

From these storm events the Kenosha Water Utility has determined several sewer areas are still in need of both short and long term solutions to avoid continued basement backups and bypassing. Listed in Table 3-43 are those areas identified as problem areas in the Kenosha Sanitary Sewer Surcharge Study[2]. Also contained in that report was a recommended plan to help eliminate the problem areas. These areas are shown on Figure 3-21.

2. Ruekert and Mielke, Inc., 1989.

Table 3-41
Water Sales Records
Town of Bristol Water Utility: 1979-1988

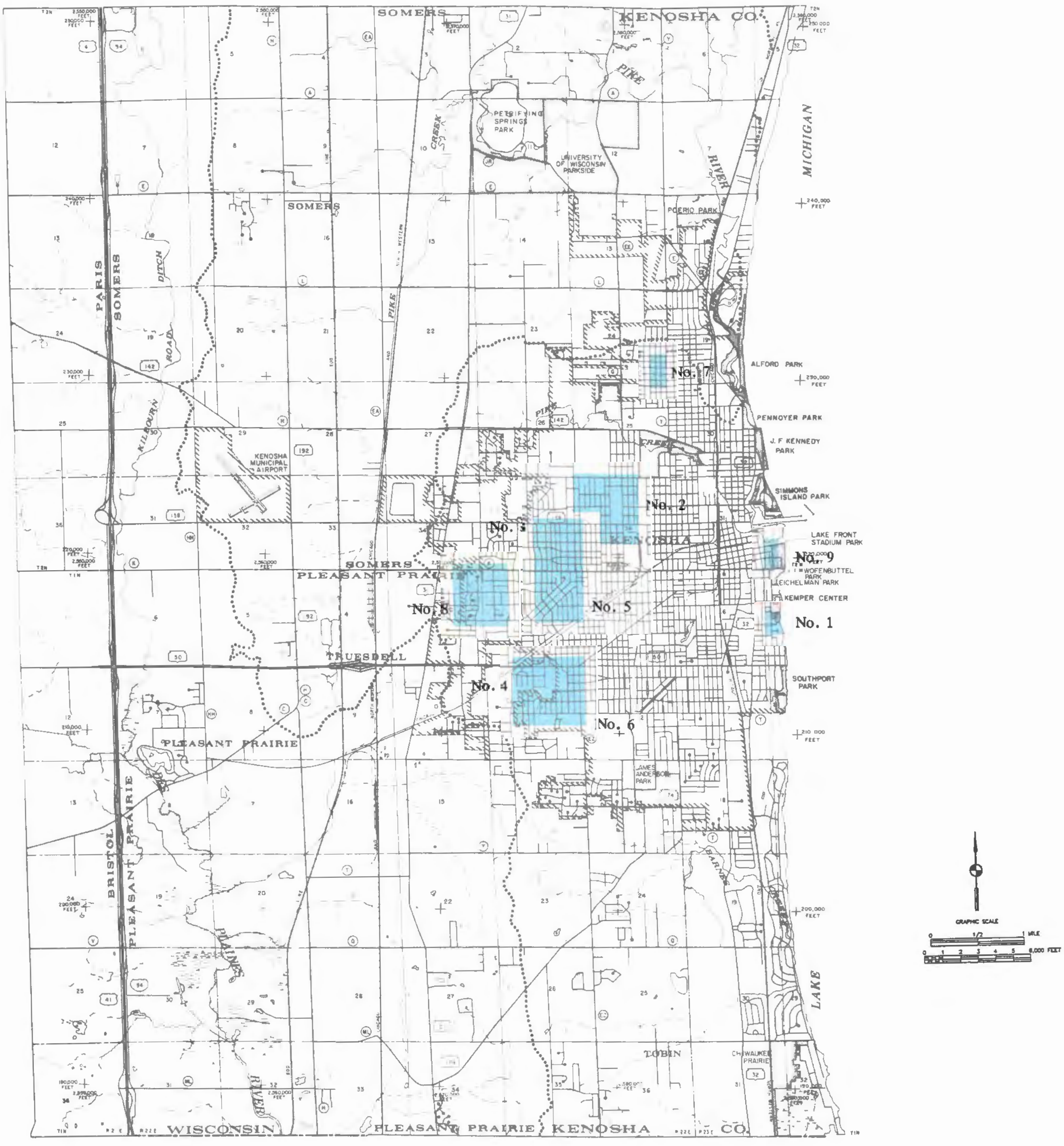
Year	Estimated Res. Pop. Served	Total Gallons Pumped (MG)	Residential GPCD	Million Gallons of Water Sold					Other Usage	Percent Unaccounted For
				RES	COM	IND	PUBLIC	TOTAL		
1979	328	32.74	93.6	11.21	4.86	7.83	2.37	26.27	.38	5.9
1980	353	29.81	81.8	10.54	4.08	9.40	2.56	26.58	1.13	7.3
1981	373	30.46	93.9	12.78	2.89	9.26	2.26	27.19	1.20	6.8
1982	377	35.64	97.2	13.38	3.59	8.57	3.64	29.18	1.20	15.6
1983	399	37.11	97.3	14.17	5.47	10.03	4.03	33.70	1.20	6.2
1984	397	38.28	86.1	12.48	4.51	11.43	4.06	32.48	1.80	11.0
*1985	402	39.02	109.1	16.00	4.44	15.13	4.47	40.04	1.80	*0.0
*1986	394	42.92	75.6	10.87	7.76	19.05	2.69	40.37	1.70	*2.0
*1987	423	37.11	80.6	12.45	7.19	15.02	2.46	37.12	1.11	*0.0
*1988	450	56.26	84.5	13.92	19.04	19.18	2.40	54.54	1.72	*0.0
Ave.	390	37.94	90.0	12.78	6.38	12.49	3.09	34.75	*	*

* Suspected meter error at pumping stations resulted in questionable results.

Source: Bristol Water Utility Annual PSC Reports

Figure 3–21

LOCATION OF SEWER SURCHARGING, BYPASSING AND BASEMENT FLOODING RESULTING FROM RAIN EVENTS OF 1989



Source: Ruekert & Mielke

Table 3-43
Description of Sewer Surcharging, Bypassing and Basement
Flooding Resulting from Rain Events of 1989

No. From Figure 3-21	Area of Collection System	Identified Problem
1.	Third Avenue Interceptor at 68th St. Bypass	Surcharged 60 inch sewer caused manhole covers to be lifted and basement flooding. Direct connection to storm sewer.
2.	50th St. to 52nd St. from 27th Ave. to Pershing Blvd.	Basement backups possible direct connections to sanitary sewer.
3.	44th Ave. to 43rd Ave. from 53rd St. to 57th St.	Basement backups possible direct connections to sanitary sewer.
4.	75th St. to 80th St. from 40th Ave. to 50th Ave.	Basement backups and surcharging.
5.	Wilson Road to 53rd St. from 44th Ave. to 40th Ave.	Basement backups.
6.	39th Ave. from 76th St. to 80th St.	Surcharging, direct connection and indirect connections.
7.	2900 Block of 24th Ave.	Basement flooding and substandard slope for sewer main.
8.	67th St. to 60th St. from 54th Ave. to STH 31	Basement flooding and sewer line blockages.
9.	57th St. to 60th St. from 3rd Ave. top lakefront	Basement backups and surcharging

Source: Ruekert & Mielke, Inc.

EXISTING SERVICE AGREEMENTS

Service agreements for sewer and water service currently exist between the City of Kenosha, the City of Kenosha Water Utility and the Town of Somers; the City of Kenosha, the Village of Pleasant Prairie and the Town of Somers; and the Town of Bristol Utility District East and the Village of Pleasant Prairie Sewer Utility District "D". These agreements are contained in Appendix B of this report and summarized below.

City of Kenosha, Kenosha Water Utility and Town of Somers

The existing agreement, dated March 20, 1985 provides for the City of Kenosha Treatment Facility to treat all sanitary sewage originating in the Town of Somers east of the sub-continental divide. The City would provide an interceptor sewer connection near the intersection of 18th Street and 41st Avenue to convey the sewage to the treatment facility. City and Town sewer service areas were also provided in the agreement.

The agreement further delineates the means by which the Parkside (northside) interceptor sewer shall be extended, installed and financed by the two parties. It should be noted that at the time of this report, this agreement was being renegotiated.

A second agreement, dated March 1, 1988 between the City of Kenosha Water Utility and the Town of Somers, is in effect regarding water service to a portion of the Town of Somers known as Fairfield Heights Subdivision. This agreement basically allows the City to extend water service to this portion of the Town on a retail basis. In turn, the City water utility is responsible for providing adequate service and maintenance of the facilities. It should be noted that additional water service agreements are expected in conjunction with current negotiations previously mentioned.

City of Kenosha and The Village of Pleasant Prairie

The agreement currently in effect is an amended agreement which supersedes a 1984 cooperative agreement for orderly development between the City of Kenosha and the Town of Pleasant Prairie dated December 9, 1988. The amended agreement was in effect upon incorporation of the Town as a Village. This agreement basically delineates those areas of the Village which will receive water service and sewer service and those areas of the City to receive water and sewer service from the Village. This agreement together with various boundary adjustment agreements were the predecessors to the incorporation of the Town of Pleasant Prairie.

Village of Pleasant Prairie and Town of Bristol

The agreement by which the sanitary sewage from the area of the Town of Bristol near ISH 94 and STH 50 is conveyed to and treated at the Village of Pleasant Prairie Sewer Utility "D" wastewater treatment facility was entered into on June 10, 1985. The agreement called for a maximum average daily flow of 0.135 MG with normal loadings to be received by the Village of Pleasant Prairie from the Town of Bristol.

CHAPTER IV

ANALYSIS AND FORECAST

The previous chapter presents the results of the inventory required to assemble the historic and existing data relative to the study and study area. The analysis and forecast phase is necessary to provide a basis for determining alternative plan feasibilities and adequacies to meet existing and future needs. In this chapter, population and economic activity level forecasts will be used to develop sewer and water flows and, in turn, determine water supply and sewerage facility requirements. In Chapter V future demands will then be compared to existing supply and treatment facilities to identify areas of deficiencies.

POPULATION, LAND USE & PLANNING

Population projections by quarter section have been prepared for the study area by the SEWRPC and are presented in Appendix B. The population projections are also presented graphically in Figure 4-1.

Table 4-1
Occupied Housing Units and Total Population in The Kenosha Planning District: 1985, 2010 Intermediate Centralized, 2010 Optimistic Decentralized and Ultimate Development

Category	1985	2010 Inter-mediate	2010 Opti-mistic	Ultimate
Occupied Housing Units	35,813	39,651	47,705	68,793
Total Popu-lation	96,572	97,176	127,958	185,855

Source: SEWRPC

The three scenarios for which projections were developed are described as:

1. 2010 Intermediate Centralized Development
2. 2010 Optimistic Decentralized Development
3. Ultimate Development

For the purpose of this report, the alternative plans presented in Chapter V will be evaluated using the year 2010 Intermediate Centralized Development Plan. In turn, the selected alternative will be evaluated under the two remaining scenarios.

The year 2010 Intermediate Centralized Development Plan follows the three basic guidelines of the regional land use plan which were presented in the previous chapter. The year 2010 Optimistic Decentralized Development Plan assumes a much higher population growth rate and greater rural development. The Ultimate Development Plan will be used as the year 2030 plan or a 40 year development period.

The resident population of the study area is anticipated to increase between 1985 and 2010 by approximately 604 persons or approximately 0.6 percent under the Intermediate Centralized Development Plan; by approximately 31,386 persons, or approximately 32.5 percent, under the Optimistic Decentralized Development Plan; and by approximately 89,283 persons, or approximately 92.5 percent under the Ultimate Development Plan.

The alternative plans used to determining the conditions described above; Intermediate, Optimistic and Ultimate, may be expected to result in year 2010 resident population levels in the study area of 97,176 persons under the Intermediate, 127,958 under the Optimistic and a year 2030 resident population level of 185,855 under the Ultimate Development Plan.

Economic Activity

Economic activity for the area has been projected by SEWRPC in terms of housing units, persons per household, employment levels and employment by general category.

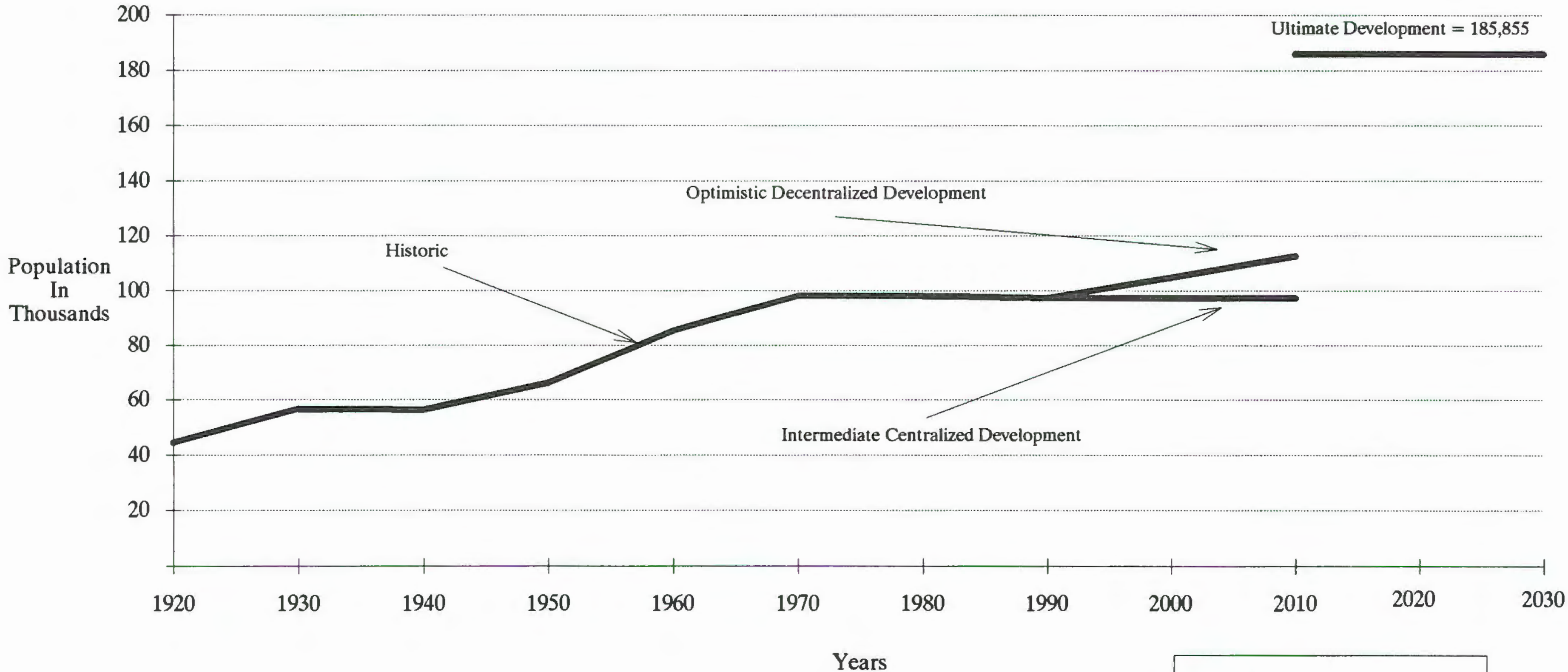
Households

The number of households in the study area is expected to increase over 1985 levels by approximately 3,838, or approximately 10.7 percent, to a total of 39,651 under the Intermediate Centralized; 11,892, or about 33.2 percent, to a total of 47,705 under the Optimistic Decentralized; and 32,930, or approximately 92.1 percent, to a total of 68,793 under the Ultimate Development Plan. Table 4-1 and Figure 4-2 present these projections.

Employment

Anticipated future employment levels coupled with anticipated future land use levels are important in the determination of future industrial, commercial and public water and sewer use. Study area employment is expected to increase over the 1985 level of 38,371 by approximately 15,522, or 40.5 percent, to a total of 53,893 under the Intermediate Centralized

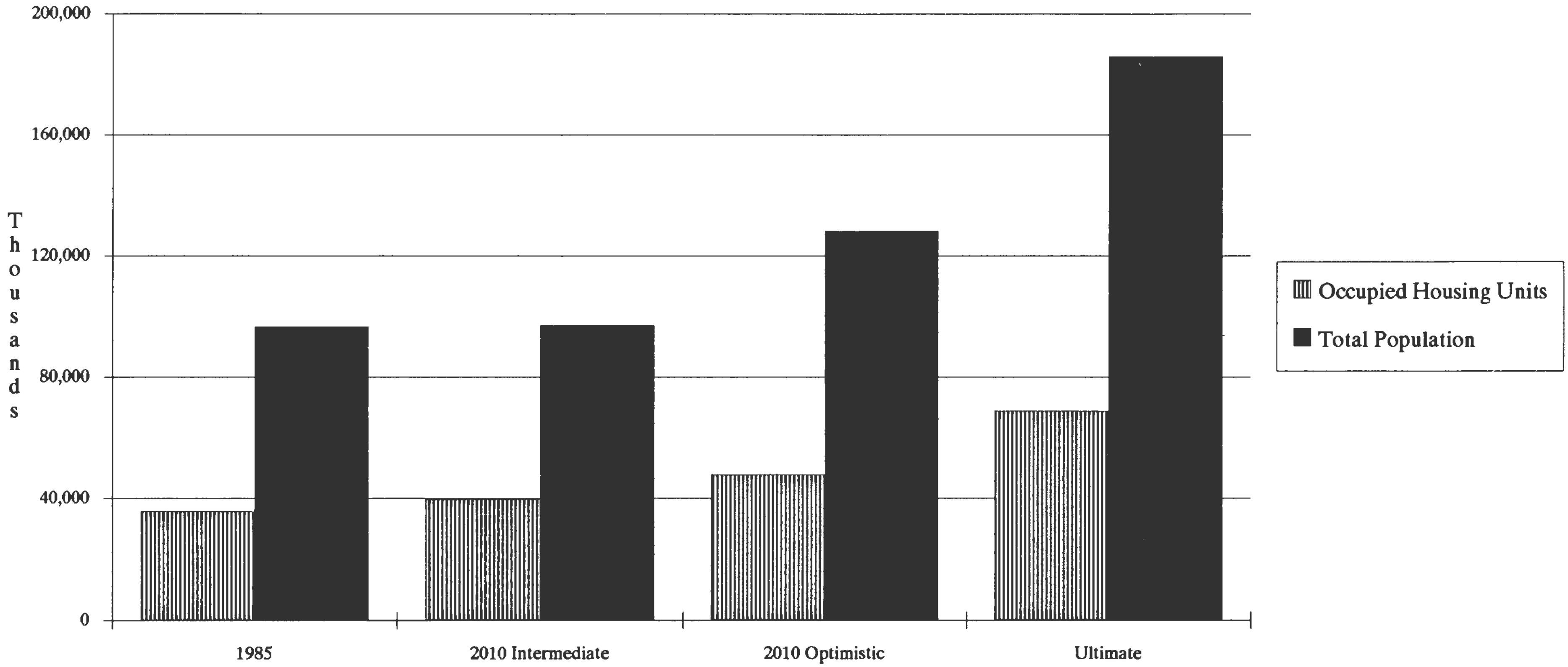
Figure 4-1
POPULATION: HISTORIC* AND PLANNED
GREATER KENOSHA UTILITY STUDY AREA



* Historic Population Does Not Include The Towns Of Paris Or Bristol

Source: SEWRPC

Figure 4-2
LEVELS OF FUTURE OCCUPIED HOUSING UNITS AND TOTAL POPULATION UNDER THE VARIOUS DEVELOPMENT PLANS GREATER KENOSHA UTILITY STUDY AREA



Source: SEWRPC

Plan; by approximately 33,042, or 86.1 percent, to a total of 71,413 under the Optimistic Decentralized Plan; and by 92,118 or 240.1 percent to a total of 130,489 under the Ultimate Development Plan. The remaining employment figures have been divided into two categories entitled government and other which includes agricultural, transportation, communications and utility employment. Projections of future employment by category is provided in Table 4-2 and in Figure 4-3.

Table 4-2
Total Employment by General Category in The Kenosha Planning District: 1985, 2010 Intermediate Centralized, 2010 Optimistic Decentralized and Ultimate Development

Category	1985	2010 Inter-mediate	2010 Optimistic	Ultimate
Agricultural	449	415	423	143
Industrial	12,054	17,546	23,631	40,952
Commer-cial	12,644	25,852	36,044	74,311
Transpor tation, Communi cation & Utility	1,414	1,549	1,839	2,605
Govern-mental	7,810	8,531	9,476	12,478
Totals	38,371	53,893	71,413	130,489

Source: SEWRPC

Land Use

Land use for the study area has been projected based on the three scenarios; Intermediate, Optimistic and Ultimate by SEWRPC and are provided in Table 4-3. The Intermediate and Optimistic plans for year 2010 are provided in Figures 4-4A and 4-4B, respectively. The Ultimate Development Plan is provided in Figure 4-C.

The year 2010 Intermediate Centralized Plan calls for a 12.5 percent increase in residential; a 38.0 percent increase in commercial; a 54.8 percent increase in industrial, a 16.4 percent increase in transportation communication, and utility; a 3.8 percent increase in government and institutional; and a 17.6 percent increase in recreational land use. A 7.9 percent decrease in agricultural land use will occur under this scenario.

The year 2010 Optimistic Decentralized Plan calls for a 41.9 percent increase in residential; a 71.7 percent increase in commercial; a 107.8 percent increase in industrial; a 37.6 percent increase in transportation, communication and utility; a 12.9 percent increase in government and institutional; and a 29.3 percent increase in recreational land use. A 20.5 percent decrease in agricultural and a 0.1 percent decrease in wetland/woodland land use will occur under this scenario.

The Ultimate Development Plan calls for a 107.9 percent increase in residential; a 207.5 percent increase in commercial; a 257.5 percent increase in residential; a 94.6 percent increase in transportation, communication and utility; a 33.8 percent increase in government and institutional; and a 47.1 percent increase in recreational land use. A 51.4 percent decrease in agricultural and a slight percent decrease in wetland/woodland land use will occur under this scenario.

Previous Planning

Previous plans relating to sewer and water service for the study area have been prepared by SEWRPC and the Kenosha Water Utility. SEWRPC, in its Community Assistance Planning Report No. 106[1] presented the refined year 2000 sanitary sewer service areas for the City of Kenosha and environs. These areas were agreed upon by local government officials in intergovernmental meetings and at public hearings. Since 1985, the sewer service area has been redefined until it reached its present configuration as shown in Figure 4-5.

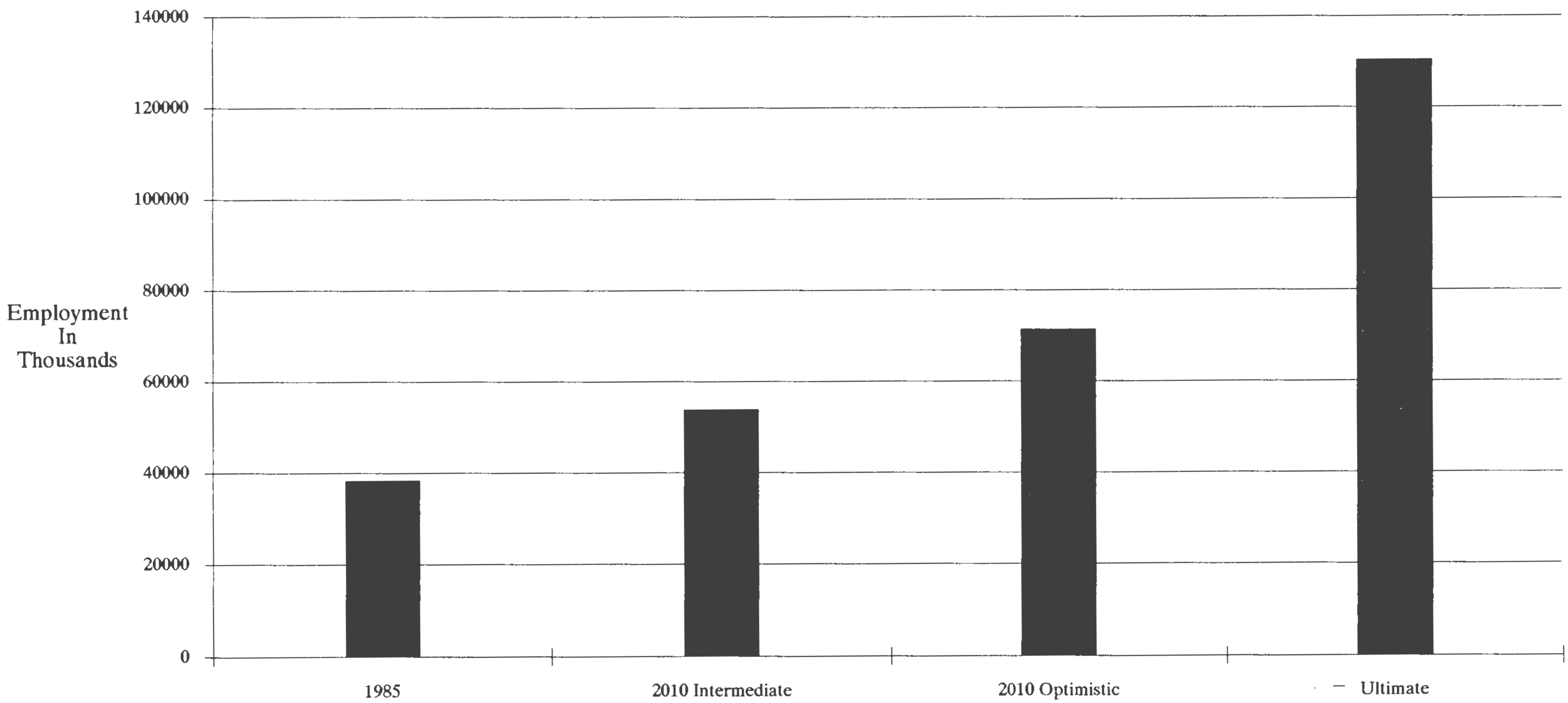
The Kenosha Water Utility also prepared a plan in 1987 for sewer and water service for year 2000 which is shown in Figure 4-6.

This plan, prepared in 1987 shows areas which the Kenosha Water Utility has planned to include in their service areas for both sewage collection and water distribution. The areas shown on Figure 4-6 loosely coincide with the area identified under the Ultimate Development Plan prepared by SEWRPC. This plan, however, is for the year 2000 sewer and water service areas.

The Village of Pleasant Prairie has employed consultants to prepare facility plans for Sewer Utility District "F" and Sewer Utility District "D". The Sewer Utility District "F" plan recommended the abandonment of the Pleasant Park treatment facility and connection of the service area to the City of Kenosha wastewater collection system. This recommendation was in keeping with recommendations from several previous planning reports including the adopted Area-wide Water Quality Management Plan; The Kenosha Area Facilities Plan; and Sanitary Sewer Service Areas for the City of Kenosha and Environs[1]. The Sewer Utility District "F" plant was abandoned in the spring of 1990 as

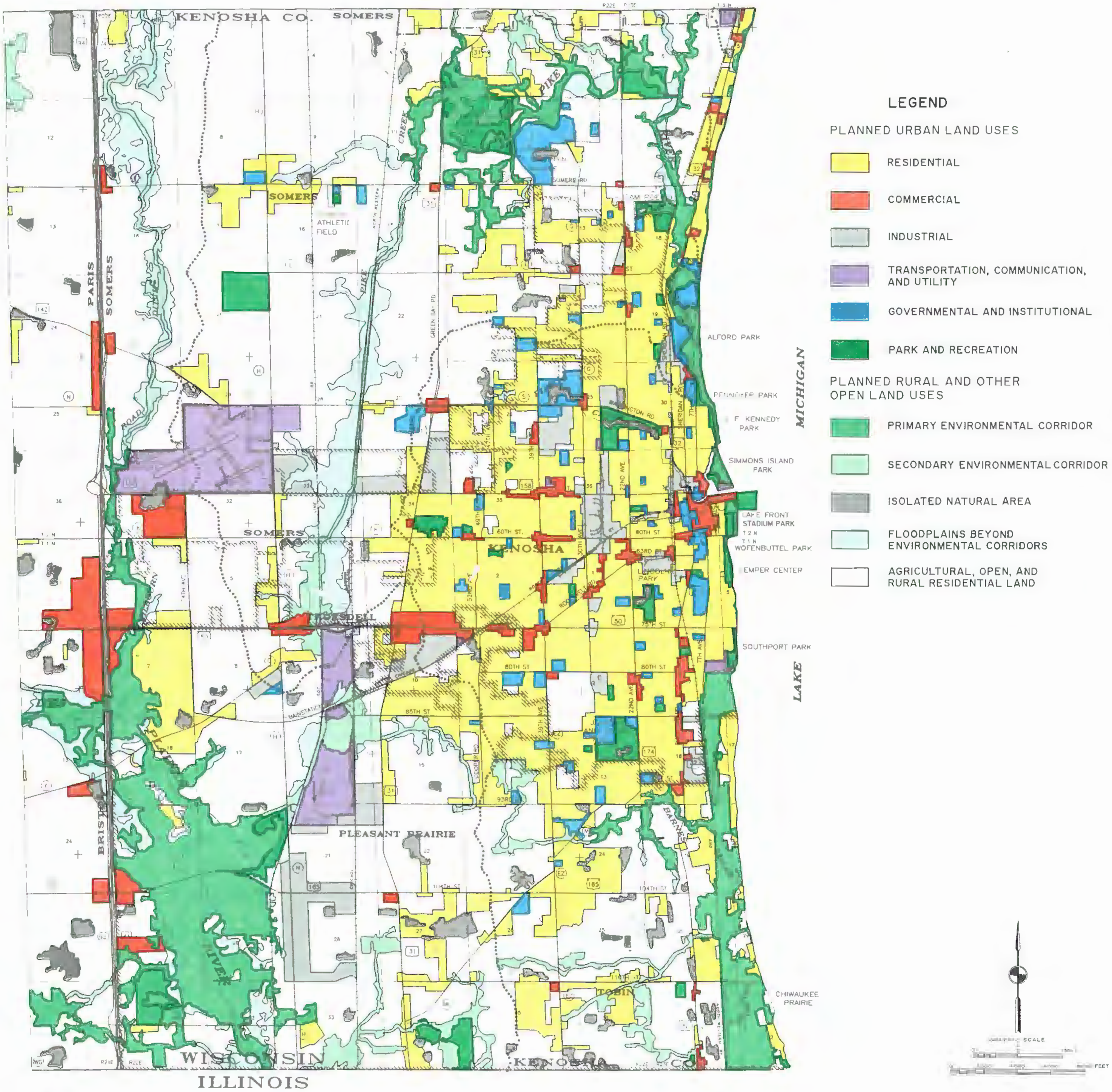
1. SEWRPC Community Assistance Planning Report No. 106, Sanitary Sewer Service Areas for the City of Kenosha and Environs.

Figure 4 - 3
LEVELS OF FUTURE EMPLOYMENT UNDER THE VARIOUS DEVELOPMENT PLANS



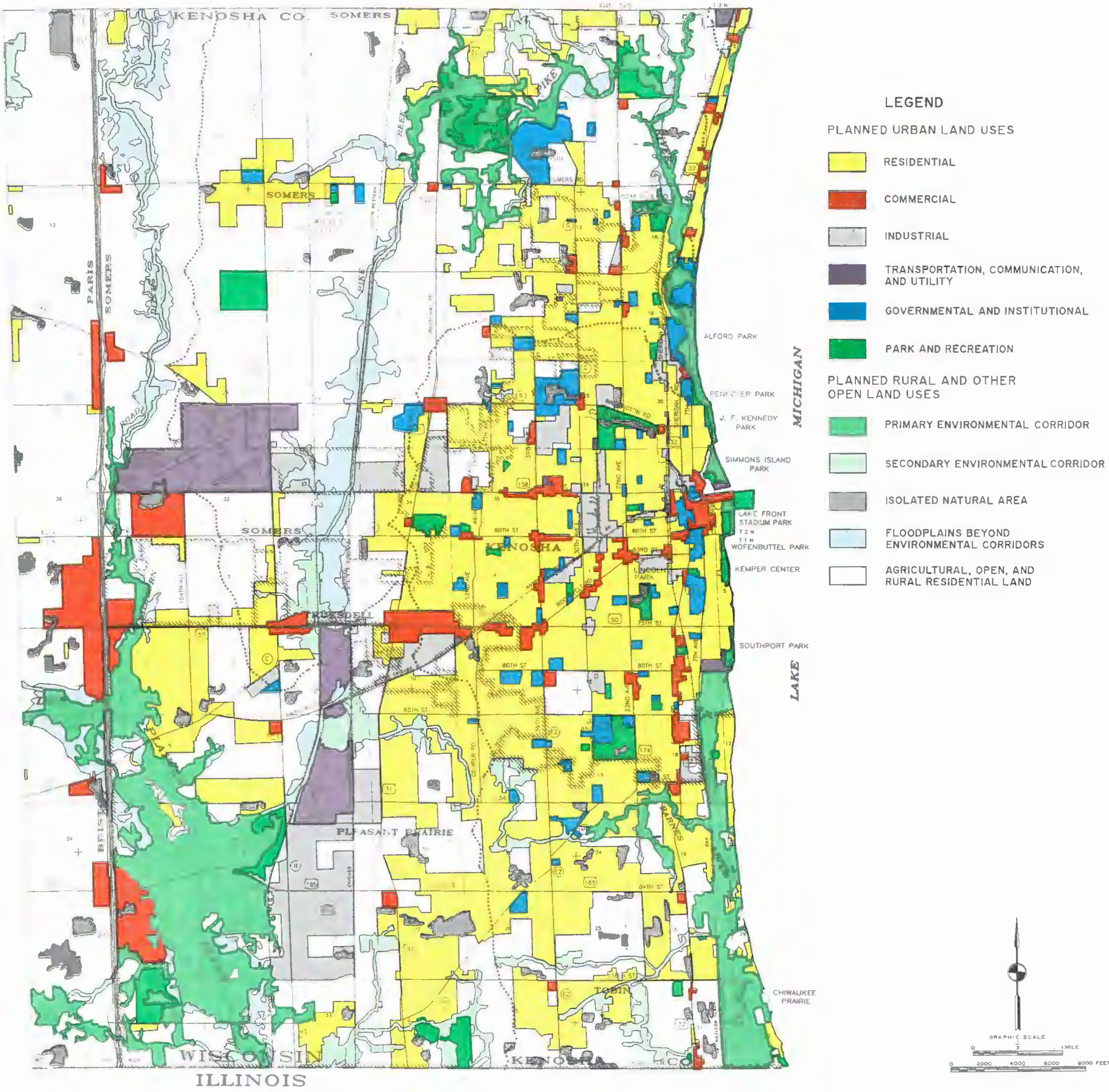
Source: SEWRPC

Figure 4-4A
PLANNED LAND USE BASED ON THE INTERMEDIATE DEVELOPMENT PLAN: 2010



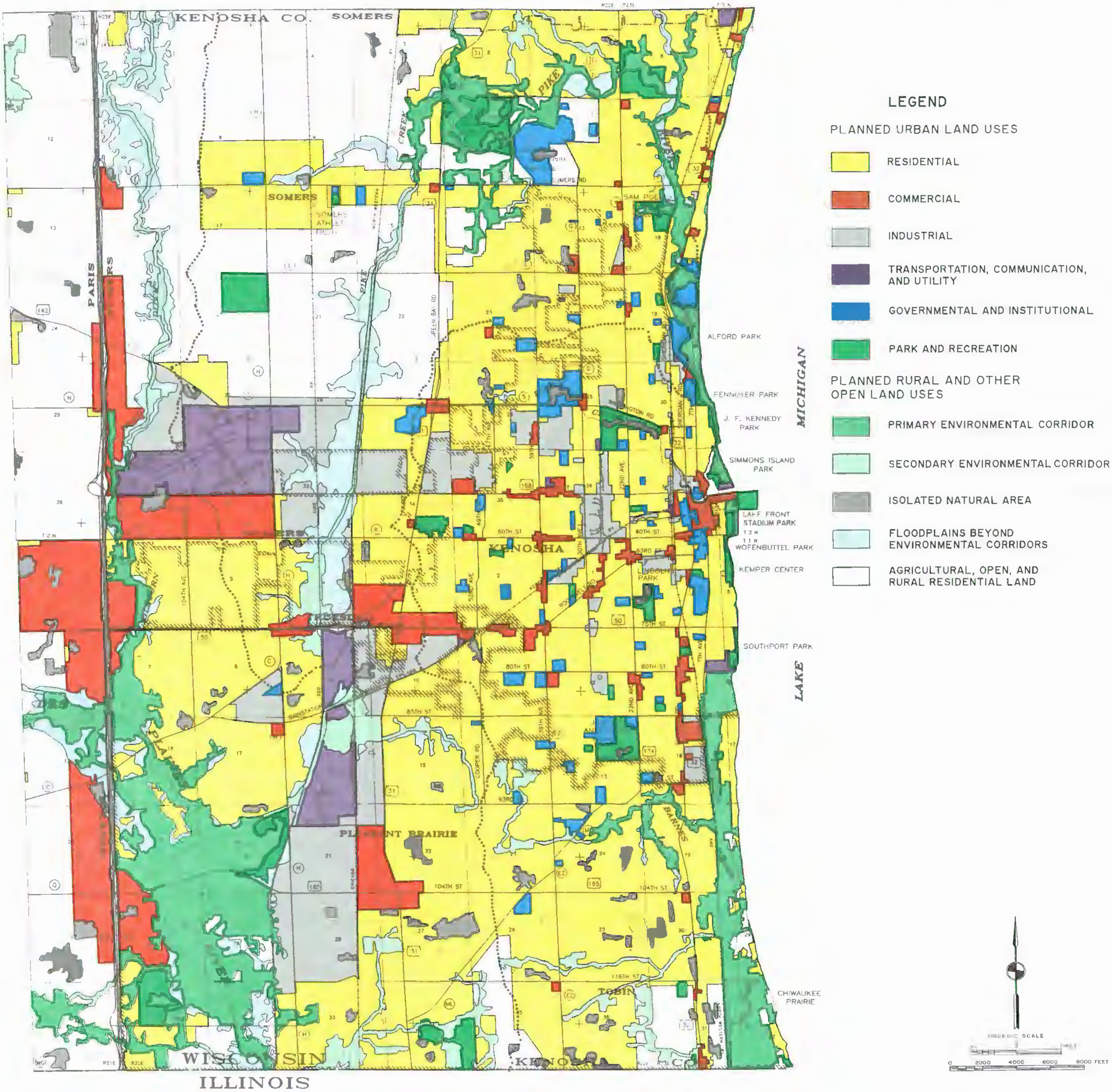
Source: SEWRPC.

Figure 4-4B
PLANNED LAND USE BASED ON THE OPTIMISTIC DEVELOPMENT PLAN: 2010



Source: SEWRPC.

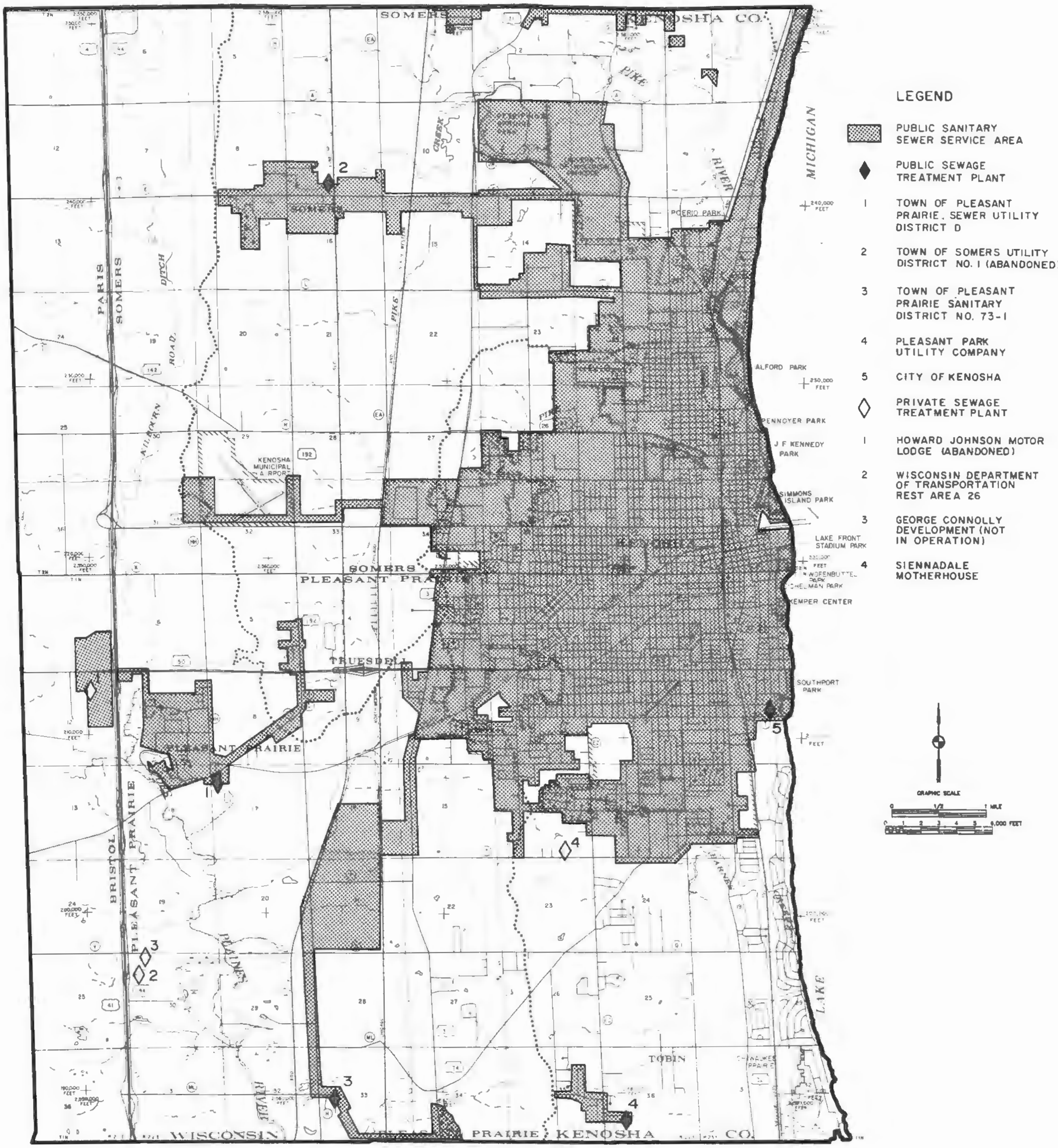
Figure 4-4C
PLANNED LAND USE BASED ON THE ULTIMATE DEVELOPMENT PLAN



Source: SEWRPC.

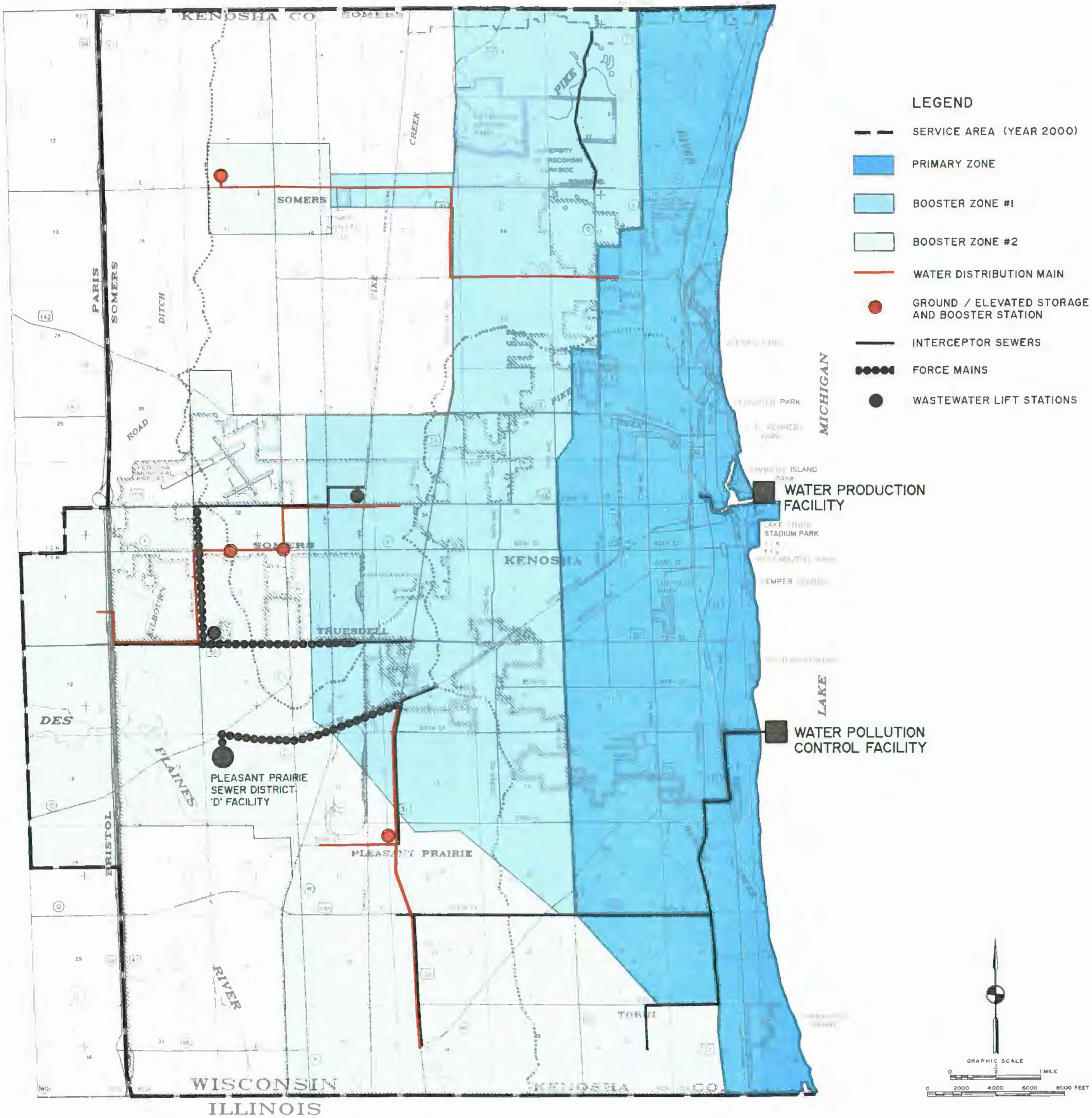
Figure 4-5

EXISTING SANITARY SEWERAGE FACILITIES AND SERVICE AREAS IN THE GREATER KENOSHA UTILITY STUDY AREA: 1989



Source: Ruekert and Mielke, Inc., and SEWRPC.

Figure 4-6
MASTER SEWER AND WATER SERVICE PLANNING AREA KENOSHA WATER UTILITY (YEAR 2000) FIVE-YEAR DEVELOPMENT PLAN FOR SEWER AND WATER



Source: Kenosha Water Utility.

Table 4-3

Generalized Land Uses in Acres Within The Greater Kenosha Planning District: 1985, 2010 Intermediate, 2010 Optimistic and Ultimate Development

Category	1985	2010 Intermediate	2010 Optimistic	Ultimate
Residential	8,878	9,991	12,597	18,466
Commercial	478	659	821	1,470
Industrial	805	1,247	1,673	2,878
Transportation, Communication & Utility	6,090	7,090	8,380	11,850
Government and Institutional	996	1,033	1,125	1,333
Recreational	1,170	1,377	1,513	1,721
Agicultural	37,484	34,504	29,801	18,207
Wetlands and Woodlands	6,060	6,060	6,051	6,036
Landfill, Dumps and Extractive	354	354	354	354
Water	378	378	378	378
Total	62,693	62,693	62,693	62,693

Source: SEWRPC

recommended. The sewage now flows to the City of Kenosha wastewater treatment facility.

The Village of Pleasant Prairie Sewer Utility District "D" was evaluated in a facilities plan prepared in 1982 for the then existing secondary treatment facility. The treatment facilities required upgrading to provide an adequate level of treatment for future requirements. In this study, the area in the Town of Bristol, adjacent to STH 50 and ISH 94 was included as part of the area tributary to Sewer Utility District "D". This area is a commercially developed area which contained some small on-site treatment facilities. The recommendation resulting from this study indicates that the flow from Bristol should be treated at the expanded sewer utility "D" facility.

Development of Future Flows

Flow estimates for both sewerage systems and water systems are dependent upon past flow rates, anticipated development, employment and population levels, climatologic impacts causing sewer system infiltration/inflow and water demand, and suitability of soils for onsite sewage disposal systems. In this section flows will be developed based upon analysis of these factors and engineering evaluations.

WASTEWATER FLOWS AND SYSTEMS

The wastewater flow rates in the existing and proposed sewerage systems are broken down into the four components defined in Chapter 2:

1. Residential
2. Commercial
3. Industrial
4. Infiltration/Inflow.

The first three components make up a category called base flow which is completely made up of wastewater and does not contain any infiltration or inflow. The existing base flow rate can be computed by a review of the existing water use records and dry weather sewage treatment records. The Kenosha Water Utility serves a major portion of the service area and historical records for the past 10 years were used to compute average estimated residential, commercial and industrial flow rates.

Water consumption records indicate that the existing average residential flow component is 67.4 gallons per capita per day.

Table 4-4
Wastewater Flow Development Factors

Flow Component	Flow Rate	* Peaking Factor	Peak Rate	I/I Exist Infiltration	Exist Inflow	** Future I/I
Residential	67.4 gpcd	4:1	270 gpcd			170 gpcd
		2.5:1	169 gpcd			170 gpcd
Commercial	6225 gpd/acre	2:1	12,450 gpd/acre			
			8.65 gpm/acre			
*** Industrial	1568 gpd/acre	2.4:1	3763 gpd/acre			
			2.61 gpm/acre			
I/I				657 gpd/MH	15,412 gpd/MH	
				0.31 gpm/acre	7.19 gpm/acre	1.2 gpm/ acre

Source: Ruekert & Mielke, Inc.

* Peaking factor is based upon tributary population per Chapter 2

** Per SEWRPC Report No. 16 (Table 1)
1.2 gpm/acre = 170 gpcd assuming medium density development

*** Industrial Flow Neglecting Large Users

Total existing commercial water consumption (1.930 MGD), based on historical records, was averaged over the number of acres (310) of commercial development. This 310 acres of commercial land does not include the acreage associated with selected large commercial users which were analyzed separately. The total commercial land use acreage is 478 acres including the larger sewage generators. The base average commercial flow rate was estimated at 6225 gallons per day per acre. This flow rate does not include Kenosha Memorial Hospital or Saint Catherine's Hospital which are large users and were analyzed separately.

Industrial flow rates were estimated based on the average industrial water consumption for the previous 10 years. For this period, the average daily industrial water use was 5.356 MGD. Industrial land use in 1985, the latest land use data available, was 535.26 acres. In 1985 the 10 largest users accounted for 93.3 percent of the water consumed and occupied 57 percent of the industrial acreage. These ten users were analyzed separately. The remaining industrial users used 0.359 MGD and occupied an estimated 229 acres, this results in an approximate average daily flow rate of 1568 gallons per day per acre.

These average daily flow rates were then peaked to simulate diurnal fluctuations. The residential component was peaked using the expected peak to average ratios of 4:1 or 2.5:1 based upon the population the within basins. The commercial component was peaked assuming a twelve hour work day or 2:1 peak. The industrial component was peaked assuming a ten hour work day or 2.4:1 peak.

Future base flow was computed using the same base flow factors, as derived above and multiplied by the future population, commercial and/or industrial acreage.

The forth component is infiltration/inflow. Infiltration is determined in an existing system by calculating the minimum flow that occurs between midnight and 5:00 AM. This flow is assumed to be infiltration and is adjusted to account for major industrial discharges. Again the Kenosha Water Utility wastewater treatment facility serves the majority of existing users and historic records were reviewed to determine infiltration rates. The treatment plant treats an average rate of 4 MGD of infiltration. For purposes of this study, it was assumed that infiltration was equally dispersed throughout the system and could be assigned equally to each sewer manhole in the system. A constant infiltration rate of 657 gallons per manhole per day or 0.31 gpm/acre was computed. Infiltration was not peaked but was assumed to occur at a constant rate throughout the day because it is dependent upon ground water conditions which do not fluctuate rapidly.

Inflow was found to be the major component of flow in both the Kenosha and Pleasant Prairie systems and accounted for an increase in peak flows of over 5 times average daily flows. During the September 1, 1989 storm event noted in Chapter 3 the Kenosha system is estimated to have conveyed, treated and/or bypassed a total peak rate of 110 MGD. The peak occurred in the early morning and after subtraction of infiltration and base flow a total peak inflow rate of 94 MGD was estimated, which equals 1145 gpcd. This storm was determined to have a recurrence interval of between 5 and 10 years and was used as the "Design Storm" for this study. The Pleasant Prairie Sewer Utility District "D" Plant also experienced a high inflow rate during the September 1, 1989 storm although there was no apparent bypassing. A peak flow of 2.5 MGD was estimated of which over 2 MGD was inflow. This corresponds to approximately 1220 gpcd. With the absence of system flow monitoring, it was assumed that inflow was equally dispersed throughout the system and could be assigned equally to each manhole in the system. Therefore, for the purposes of this study a peak value of 15,412 gallons per manhole per day or 10,350 gallons per day per acre (7.19 gpm/acre) was used.

To account for I/I in future systems a rate of 1.2 gpm/acre was applied to future developed land. This corresponds to the infiltration and storm water inflow allowances utilized in the Regional Sanitary Sewerage System Plan[1]. It also corresponds to a rate of 170 gpcd assuming medium density development. This is somewhat less than the inflow experienced in the existing systems. However, new systems should be constructed tighter than the old Kenosha sewers and the total peak flow will approach 400 gpcd once peaks are combined which is a reasonable design standard. Flow factors are summarized on Table 4-4 .

Capacity Analysis of Existing Systems

Computer Simulation

The sewer systems analyzed under this study are quite extensive which cause significant travel time for sewage to travel through them. As a result peak flows are attenuated as they route through the systems. This attenuation tends to dampen the peaks and effects sizing of conveyance and treatment systems. Because of this attenuation and interaction of the trunk sewers, a distributed flow routing computer model was developed to account for the continual variations of the flow rate, velocity and depth of flow. The model uses the Muskingum-Cunge Method which approximates the solution of modified diffusion wave equations.

The Muskingum-Cunge Method offers two advantages over the finite difference solution of the Saint-Venant Equations.

1. The solution is obtained through a linear algebraic equation rather than finite difference solutions which allows computation of the entire hydrograph at each cross section rather than requiring solutions along the entire length for each time step. This computational method requires much less computer time.

2. The solution will also show less attenuation which allows for a more flexible choice of time and distance step which translates into more numerical stability.

   Disadvantages of the Muskingum-Cunge method are that it cannot handle downstream disturbances that propagate upstream or large variations of the kinematic wave speed.

   The computer model that was developed routed the design flow hydrographs through representative existing trunk sewer reaches based on the Muskingum-Cunge Method described above. The peak flow resulting

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1. SEWRPC Planning Report No. 16, A Regional Sanitary Sewerage System Plan for Southeastern Wisconsin.

from this routing was then compared to the pipe full capacity of the existing trunk sewer determined by the Manning formula. In the cases where the peak design flow was greater than the existing capacity of the sewer under consideration, the model output the required sizes of a relief sewer laid at the same slope, a reconstructed sewer at the same slope and a reconstructed sewer at the slope of the ground surface.

To determine the extent of system surcharging and bypassing, the model takes the peak flows developed by the routing sub-program for each trunk sewer reach and computes the energy and hydraulic grade lines (HGL) based on the major and minor hydraulic losses. Trunk sewers flowing at less than capacity and with a free discharge are assumed to have a HGL equal to normal flow depth.

Conveyance Systems.

In order to determine the adequacy of the existing conveyance systems a skeletal system of trunk sewers larger than 12 inches in diameter was developed. This system represented the sewer size, invert elevation and ground elevations at points where hydraulic capacity would change such as changes in diameter and/or slope. The skeletal system used for this study is shown on Figure 4-7.

The existing service area was then divided into basins representing areas tributary to key points in the system. A peak 24 hour hydrograph was then developed for each existing basin representing the base flow components plus infiltration/inflow. The residential base flow component was developed by using a diurnal curve representing a peak flow at 8:00 as shown in Figure 4-8. To this was added the 12 hour commercial flow component, the 10 hour industrial flow component and the 24 hour infiltration component. A 24 hour inflow hydrograph was developed as shown in Figure 4-9. This hydrograph was also designed to peak at 8:00 so that all the peaks were aligned. These basin hydrographs were then input into the model at appropriate locations and the flows routed downstream. Figure 4-10 shows the basin configurations and basin identification code.

The results of routing the design hydrographs through the skeletal system were compared to the actual surcharging that occurred in the system in September of 1989. Good correlation was achieved with both the surcharging levels and the total flow delivered to the Kenosha wastewater treatment facility.

Appendix C shows the results of routing the existing condition hydrographs through the skeletal system. Included on these tables are the pipe full capacity, the peak flow rate, and in the cases of sewers over capacity, the required diameter for relief sewers or for a reconstructed sewer.

Appendix D shows the results of the surcharging analysis of the skeletal system. These tables indicate the pipe full capacities of the modelled sewers, the flow rate determined at this location in the system, the pipe diameter, the invert elevation of the trunk sewer, the manhole rim elevation and the predicted hydraulic grade line elevation.

Figure 4-11 shows those sewers that are inadequate under existing conditions. Two main trunk sewers are of particular significance. One is the trunk sewer (trunk sewer No. 12) following roughly the enclosed Pike Creek from the intersection of 50th Street and the Chicago and Northwestern Railroad right of way to 67th Street and 3rd Avenue and the other is the main north-south trunk sewer (trunk sewer No. 1) along 3rd Avenue from 67th Street to the sewage treatment plant.

Trunk sewer No. 1 is a 72 inch trunk sewer that is undersized and causes surcharging and resultant bypassing at 3rd Avenue and 67th Street as well as reported basement flooding. This sewer will have to be replaced with a 96 inch trunk sewer under the existing conditions scenario.

Trunk sewer No. 12 is a 60 inch trunk sewer which is undersized and causes surcharging. There have been reports of basement flooding as well as ground surface flooding in the areas tributary to this sewer. This sewer will have to be replaced with a 72 inch trunk sewer under the existing conditions scenario.

Several other areas of significant surcharging were indicated by the computer model. These trunk sewers are also indicated on **Figure 4-11**. The following is a list of trunk sewers that do not have adequate capacity under the existing conditions scenario:

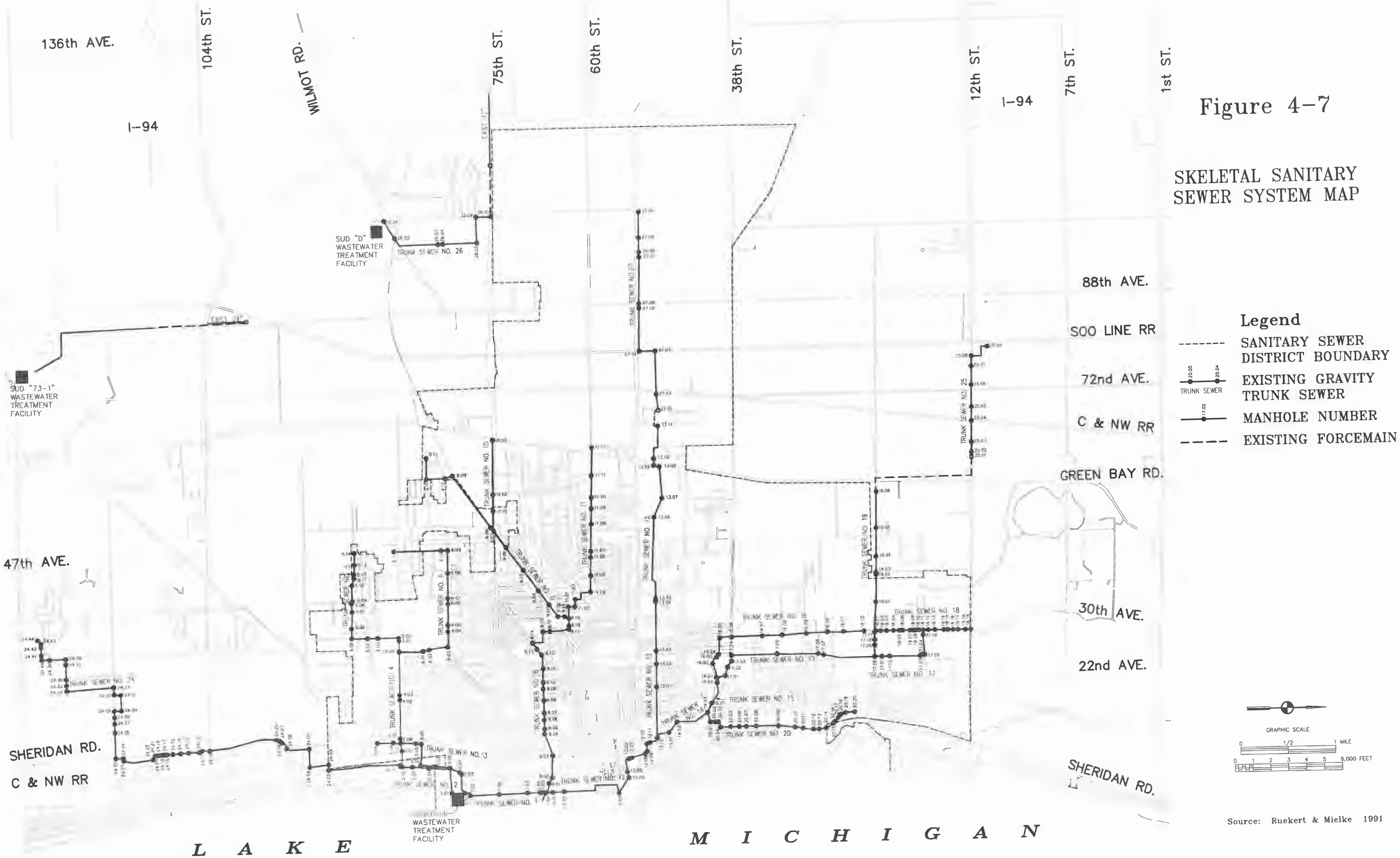
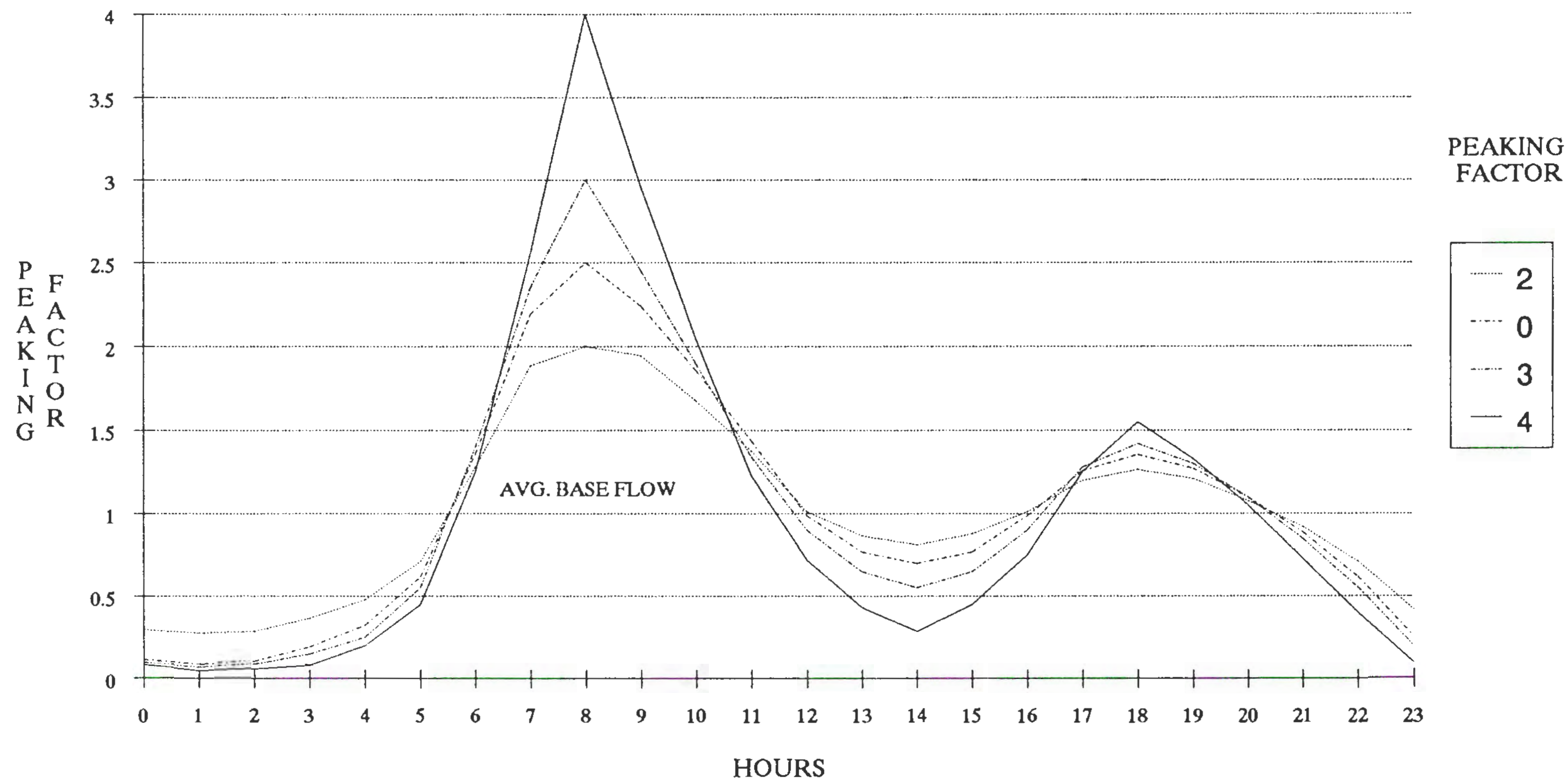


Figure 4-7

SKELETAL SANITARY SEWER SYSTEM MAP

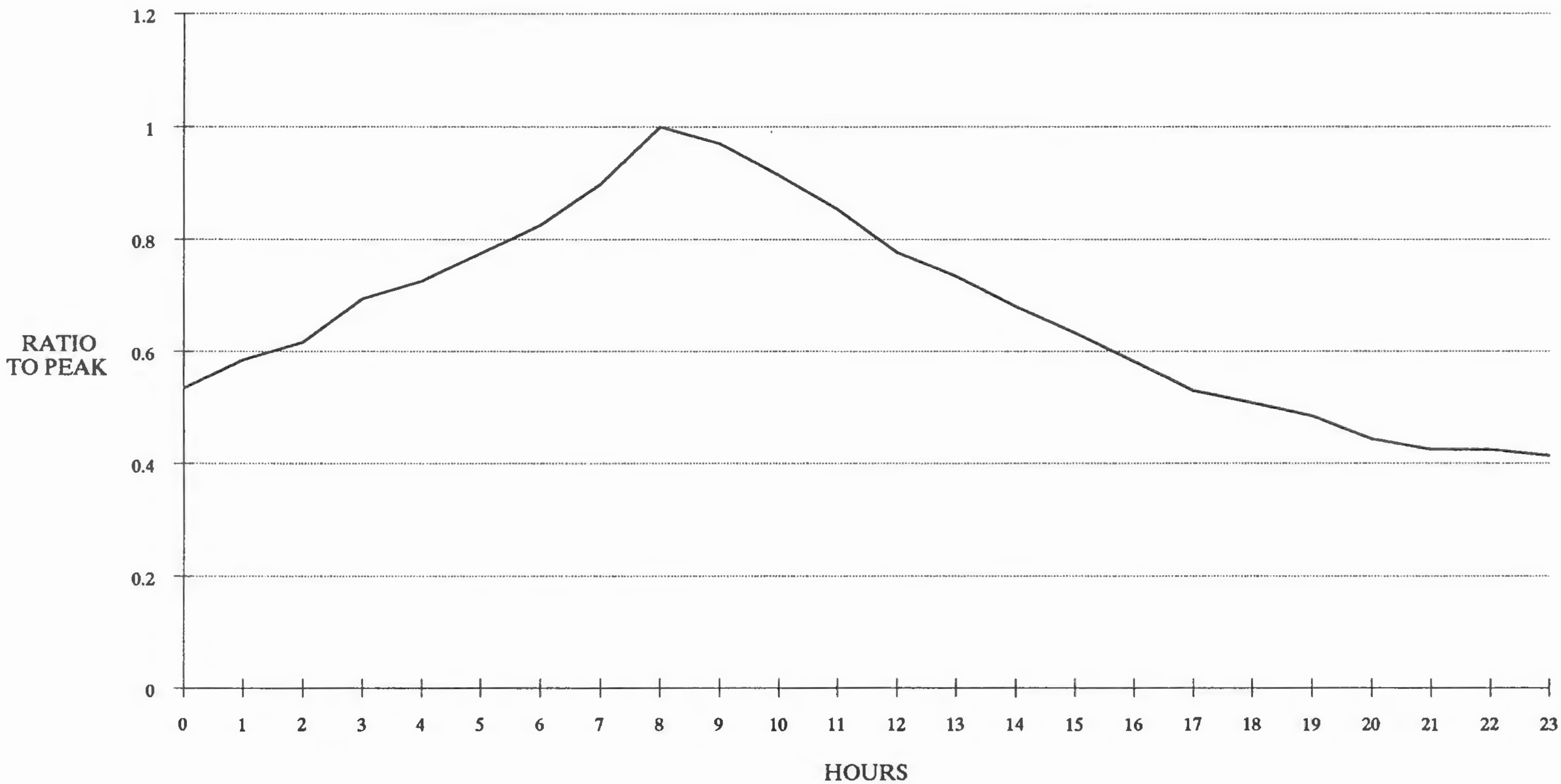
Source: Ruekert & Mielke 1991

Figure 4-8
RESIDENTIAL BASE FLOW HYDROGRAPHS
GREATER KENOSHA UTILITY STUDY AREA SEWERAGE SYSTEM



Source: Ruekert | Mielke

Figure 4-9
INFLOW HYDROGRAPH
GREATER KENOSHA UTILITY STUDY AREA SEWERAGE SYSTEM



Source: Ruekert|Mielke

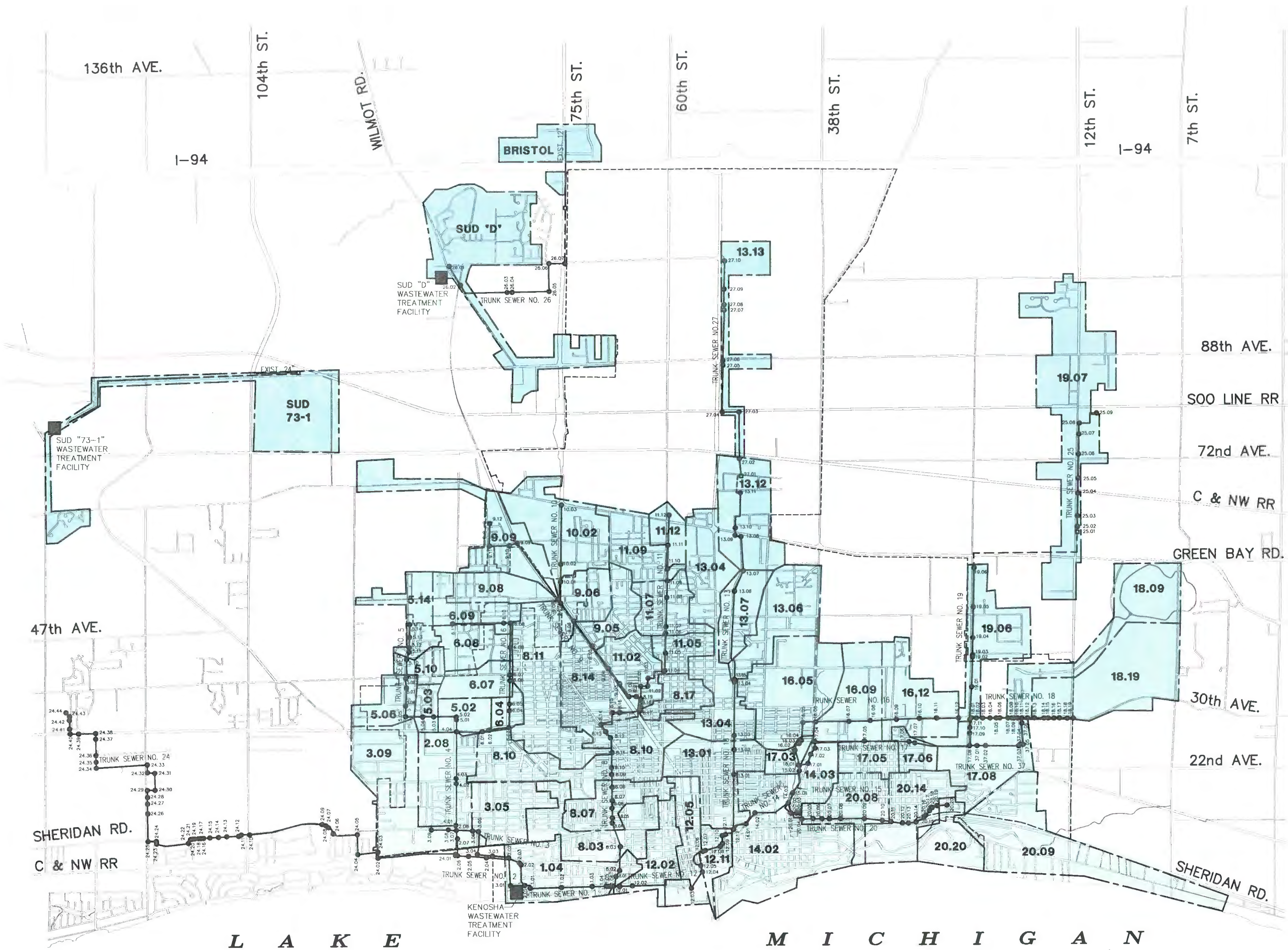


Figure 4-10

EXISTING SEWER BASINS

Legend

- SANITARY SEWER DISTRICT BOUNDARY
- EXISTING GRAVITY TRUNK SEWER (TRUNK SEWER)
- MANHOLE NUMBER
- EXISTING FORCEMAIN
- SEWER BASIN BOUNDARIES

GRAPHIC SCALE

0 1/2 1 MILE

0 1 2 3 4 5 6,000 FEET

Source: Ruekert & Mielke 1991

Figure 4-11

EXISTING UNDERSIZED SEWERS

Source: Ruekert & Mielke 1991

		Existing Diameter	Required Diameter
1.	Trunk Sewer 3 In: Sheridan Rd From: 87th St. To: 85th Street	18"	21"
2.	Trunk Sewer 16 In: 30th Ave. From: 34th St. to: 38th St.	21"	24"
3.	Trunk Sewer 18 In: 30th Ave. From: 15th St. To: 18th St.	15"	18"
4.	Trunk Sewer 20 In: 14th Ave. From: 25th St. To: 27th St.	18"	27"
5.	Trunk Sewer 20 In: 14th Ave. From: 35th St. To: 35th Place	36"	42"

Profiles of the entire trunk sewer system were developed showing the ground profile, sewer profile and resultant peak hydraulic grade line. For existing conditions these profiles are contained in Appendix E.

There were no apparent hydraulic problems with any existing pump/lift stations as a result of peak flows in 1989. Therefore it was assumed that no additional capacity is required for existing flow conditions.

It should be noted that the evaluation of the existing sewerage system in this chapter, and of the alternative plans in Chapter V, are based upon flow rates currently being experienced in the study area sewerage systems plus allowances for future growth. The Kenosha sewerage system currently includes contributions from approximately 73 storm sewer system catch basins which are connected to the sanitary sewer system. Since many of these catch basin connections will be eliminated in the near future by the Kenosha Water Utility, the peak flow rates in the system may be significantly impacted. Because the flow rates utilized in the evaluation of the existing system, as described in this chapter, and as well the alternative plans, as described in Chapter V, may be reduced due to the anticipated removal of the catch basin connections, the recommended plan as described in Chapter VI will be reevaluated using a reduced flow rate to reflect a reduction in clear water inflow from catch basin connections. In this respect, the flows will be revised based upon the locations of the catch basin connections expected to be removed as well as upon the total flow reduction.

Treatment Systems

The Kenosha wastewater treatment facility and the Pleasant Prairie Sewer Utility District "D" facility were unable to treat peak flows during the September 1, 1989 event. It is estimated that 6 MG of flow at a rate of 15 to 18 MGD was bypassed prior to entering the Kenosha plant. The peak hydraulic capacity of 85 MGD as well as the maximum daily average rated capacity of 68 MGD was reached and the trunk sewer system connecting to the wet well was surcharged by four feet because the raw sewage pumps could not keep pace. Average flows at the plant are adequately handled and treatment limits are being met. However, peak hydraulic flow capacity must be expanded to handle existing conditions. This would include:

- o Primary clarifier capacity
- o Aeration tank capacity
- o Final clarifier capacity

Depending upon the constraints of the existing site and the plant hydraulics, expansion may also include:

- o Raw sewage pumping capacity and bar-screen capacity
- o Additional disinfection facilities
- o Additional outfall

Expanding the hydraulic capacity of the plant would also involve the addition of organic capacity. Aeration equipment must be sized to accommodate the additional organic load. Discussions with plant personnel indicate that the solids handling facilities would treat the anticipated loading.

An alternate to expanding peak flow capacity would be the installation of a 10 MG storage reservoir at the head of the plant. This would require additional raw sewage pumping capacity. The peak flows would be pumped to the storage reservoir and released to the existing treatment processes after peak flows subsided. Costs of these two alternates will be developed in Chapter V.

Pleasant Prairie Sewer Utility District "D" wastewater treatment facility was also unable to keep up with peak flows in the September 1989 event. The peak hydraulic capacity of 1.16 MGD was exceeded as was the peak pumping capacity. It is estimated that the flow peaked at 2.5 MGD. This led to surcharging in the tributary trunk sewer. However, there were no reports of bypassing manhole overflow or basement backups. Apparently the trunk sewer system has the capability to provide storage without overflow or property damage during peak flow events. Therefore no treatment expansion is necessary under existing conditions.

Town of Pleasant Prairie Sanitary District No. 73-1 did not experience overloading during the September 1989 event. Therefore no treatment expansion is necessary under existing conditions.

WATER DEMANDS AND SYSTEMS

Water demands for a water utility are generally broken down by user classification. Due to the fact that the study area includes up to 8 individually monitored distribution systems and the probability of each having its own individual usage pattern, each system will be evaluated separately. Following the evaluations, the study area will be divided into homogeneous usage areas to provide for consistent projection of demands. Some individual areas where future land use is planned and future flow is projected will be analyzed separately.

The Portion of Kenosha Water Utility Serving The City of Kenosha and Adjacent Areas

The area served by the Kenosha water utility includes two small areas which purchase water wholesale and resell it. These areas are Somers Sanitary District No. 1 and that part of Pleasant Prairie served by Kenosha. Although total demand for these two areas comprises only around 3 percent of total the average day pumpage for the Kenosha Water Utility, it is still important to analyze the water use pattern in outlying areas of the service area. Generally, larger lots requiring more watering are in outlying areas and this may affect the required future supply for these areas.

The City of Kenosha service area usage rates by user classification for the years 1980 to 1989 are contained in Table 4-5. Average residential use expressed as gallons per capita per day for these years was 67.4. The graphs contained in Figure 4-12 show relationships between residential use and population, number of meters and use per meter. Trends have remained fairly steady and, as can be seen, as population decreased for the period 1985 to 1988 and residential sales increased, usage per meter and per person increased. The maximum residential usage during the last 10 years was during the drought of 1988. In 1989, usage in GPCD fell but remained above the 10 year average of 67.4 at a rate of 69.1 GPCD. No justification exists for either an increase or a decrease in the GPCD rate for year 2010 to 2030. The 10 year average of 67.4 GPCD will be used for projection purposes.

Table 4-5
Water Demand By User Classification in
Million Gallons per Day: 1980-89
Kenosha Water Utility

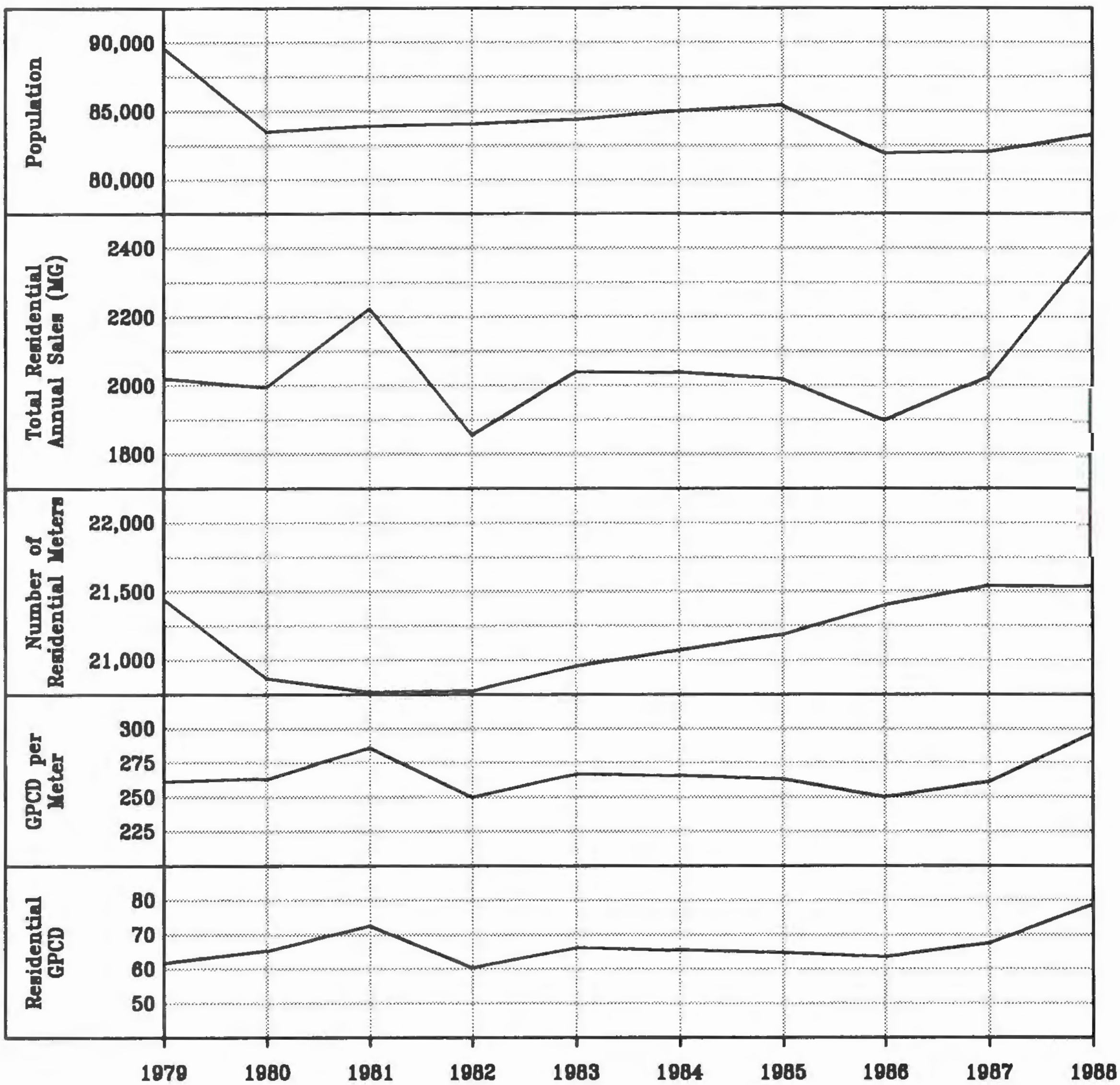
Year	Residential	Commercial	Industrial	Public
1980	5.451	1.710	4.670	.531
1981	6.093	2.422	6.006	.542
1982	5.082	1.945	5.138	.456
1983	5.587	2.206	5.577	.511
1984	5.568	2.098	5.810	.493
1985	5.531	2.063	5.291	.488
1986	5.201	1.982	4.594	.411
1987	5.546	2.247	5.300	.441
1988	6.550	2.359	5.948	.521
1989	5.756	2.492	5.185	.455

Source: Kenosha Water Utility

Commercial consumption is based upon consumption in gallons per day per acre developed. For the past 10 years, the average daily consumption by commercial customers as a whole has been 2.054 MGD. Year 1985, when the latest land use data was prepared, was the most typical year for water use when compared to the 10 year average. Based upon a commercial land use in the Kenosha service area of approximately 310 acres not including selected large users and an average daily commercial consumption of 1.930 MGD, the average daily consumption per commercial acre developed is 6,225 gallons. This does not include Kenosha Memorial Hospital and St. Catherine's Hospital which used an average of 73,000 GPD and 60,000 GPD respectively, and will be evaluated separately. Future commercial water demands will be based on projected acres developed times a rate of 6,225 gallons per acre. The two hospitals will be assigned average values from the last 10 years as provided in Table 4-6.

Industrial consumption is also based upon consumption in gallons per day per acre developed. For the past 10 years, the average daily consumption by industrial customers as a whole has been 5.356 MGD. In 1985 industrial land use in the Kenosha service area included 535.26 acres and the industries had a combined consumption rate of 5.406 MGD resulting in an average daily consumption per acre developed of 10,100 gallons. Furthermore the 10 largest

Figure 4-12
COMPARISON OF POPULATION, ANNUAL SALES, NUMBER OF METERS, GALLONS PER CAPITA PER DAY AND GALLONS PER CAPITA PER DAY PER METER FOR THE KENOSHA WATER UTILITY: 1979-1988



Source: Kenosha Water Utility

Table 4-6
Water Consumption by Large Users
in Million Gallons per Day: 1980-1989

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	Average	Projected Ave. Day Use (MGD)
AMC/Chrysler	3.233	3.076	3.497	3.951	4.103	3.445	2.768	3.479	3.907	2.364	3.382	1.000
Anaconda American Brass Co.	0.972	0.987	0.204	0.149	0.164	0.163	0.091	N/A	0.076	0.074	0.320	0.075
Ocean Spray	0.731	0.641	0.630	0.549	0.651	0.632	0.635	0.715	0.844	0.954	0.698	1.000
MacWhyte wire	0.468	0.349	0.299	0.307	0.243	0.229	0.281	0.365	0.465	0.426	0.343	0.343
Eaton Corp	0.138	0.099	0.097	0.095	0.073	0.075	0.080	0.115	0.110	0.106	0.099	0.100
Snap-on Tools	0.358	0.383	0.312	0.217	0.279	0.184	0.160	0.155	0.179	0.140	0.237	0.175
Somers Sanitary District 1	0.196	0.164	0.169	0.172	0.190	0.222	0.210	0.200	0.239	0.191	0.195	0.195
Arneson Foundry	0.100	0.081	0.066	0.079	0.103	0.089	0.081	0.098	0.116	0.135	0.095	0.120
Kenosha Mem. Hospital	0.095	0.134	0.123	0.076	0.069	0.073	0.069	0.072	0.086	0.079	0.088	0.088
Jockey International	0.088	0.069	0.034	0.037	0.034	0.025	0.037	0.037	0.031	N/A	0.043	0.043
Carthage College	0.087	0.075	0.062	0.072	0.086	0.075	0.067	0.064	0.054	0.058	0.070	0.070
UW-Parkside	0.082	0.075	0.067	0.096	0.081	0.079	0.057	0.058	0.088	0.070	0.075	0.075
Frost Co.	0.076	0.074	0.061	0.077	0.093	0.106	0.111	0.112	0.087	0.063	0.086	0.086
St. Catherine's	0.071	0.081	0.071	0.065	0.068	0.060	0.066	0.084	0.072	0.075		
E. J. Koos & Son	0.067	0.054	0.042	0.046	0.051	0.049	0.055	0.037	0.027	N/A	0.043	0.043
Petrifying Springs	0.032	0.033	0.042	0.046	0.059	0.059	0.026	0.051	0.100	N/A	0.050	0.050
Pleasant Prairie	0.019	0.024	0.031	0.048	0.063	0.097	0.124	0.106	0.189	0.625	0.133	*
TOTAL	6.813	6.399	5.807	6.082	6.410	5.662	4.918	6.420	6.670	6.005	6.028	3.534

* Pleasant Prairie projected flows depend upon the report findings.

Source: Kenosha Water Utility

industrial users accounted for 4.997 MGD or 93.3 percent of total industrial users. These 10 users are evaluated separately and occupied an estimated 306 acres or approximately 57 percent of total industrial acreages. The remaining .359 MGD of industrial water use was used by 74 customers for an average of 4,851 gallons per customer. The estimated area occupied by these 74 customer is 229 acres which results in an average daily usage of approximately 1,568 gallons per acre developed. This figure will be used for future industrial water use projections.

Public usage has historically been approximately 3.5 percent of total consumption in Kenosha. Figure 4-13 shows the last 10 years of public water consumption and the 10 year average. The three major public customers, Petrifying Springs, UW-Parkside and Carthage College, use approximately 44 percent of total public consumption and will be evaluated separately. The remaining public customers occupy an estimated 755 acres and use approximately 275,094 GPD or approximately 364 gallons per day per acre. Average day usage for Petrifying Springs, UW-Parkside and Carthage College for the past 10 years has been 50,000 GPD, 75,000 GPD and 70,000 GPD, respectively. The three large water users will be evaluated separately. The remaining public consumption will be added equally over the entire area at a rate of 3 percent of the total consumption.

Water used at the water treatment plant for things such as backwashing is an important consideration in projecting future requirements in that as demands increase, water used in treatment increases proportionately. Table 4-7 shows the amount of water used for treatment purposes over the period 1980 to 1988 and the percentage of total use. The average of 4.0 percent of total water pumped to the plant will be used for future projections.

The remainder of water pumped to the system and not accounted for by metered billings or treatment plant use is known as unaccounted for water. The City of Kenosha estimates the amount of water used in flushing water mains, by fountains, in parks and for fire fighting purposes. The remaining pumpage is not accounted for due to meter inaccuracies, leakage and other untraceable factors. Estimates of other usage and unaccounted for water are contained in Table 4-8. The average of 9.31 percent over the period 1980 to 1988 will be used to determine future demands for Kenosha.

Somers Sanitary District No. 1

Water use by Somers Sanitary District No. 1 was relatively stable for the period 1979 - 1988. Table 3-36 from the previous chapter has been illustrated graphically in Figure 4-14. Land use patterns for the area are not expected to change drastically under the three land use scenarios. The 10 year average of approximately 166,000 GPD will be used as a basis for future demands for the system as a whole.

Pleasant Prairie Water Utility

In order to standardize the factors used in projecting future water demands for those areas outside the City of Kenosha, Pleasant Prairie will be evaluated as a whole and then each individual supply system will be discussed briefly. Table 4-9 shows the breakdown of water demands for each of the five systems outlined in Chapter III.

The average residential gallons per capita per day usage was shown to be approximately 80 in Chapter III. Commercial and industrial use are estimated to be approximately 2550 and 1480 gallons per acre per day, respectively. This figure excludes the largest user which will be discussed below. The motel and restaurant developments in Pleasant Prairie and in adjacent areas use approximately 10,000 gallons per acre per day according to available data. Due to uncertainties regarding potential development of both commercial and industrial acreage, the Kenosha Water Utility figures of 6225 GPAD and 1568 GPAC will be used to project future demands.

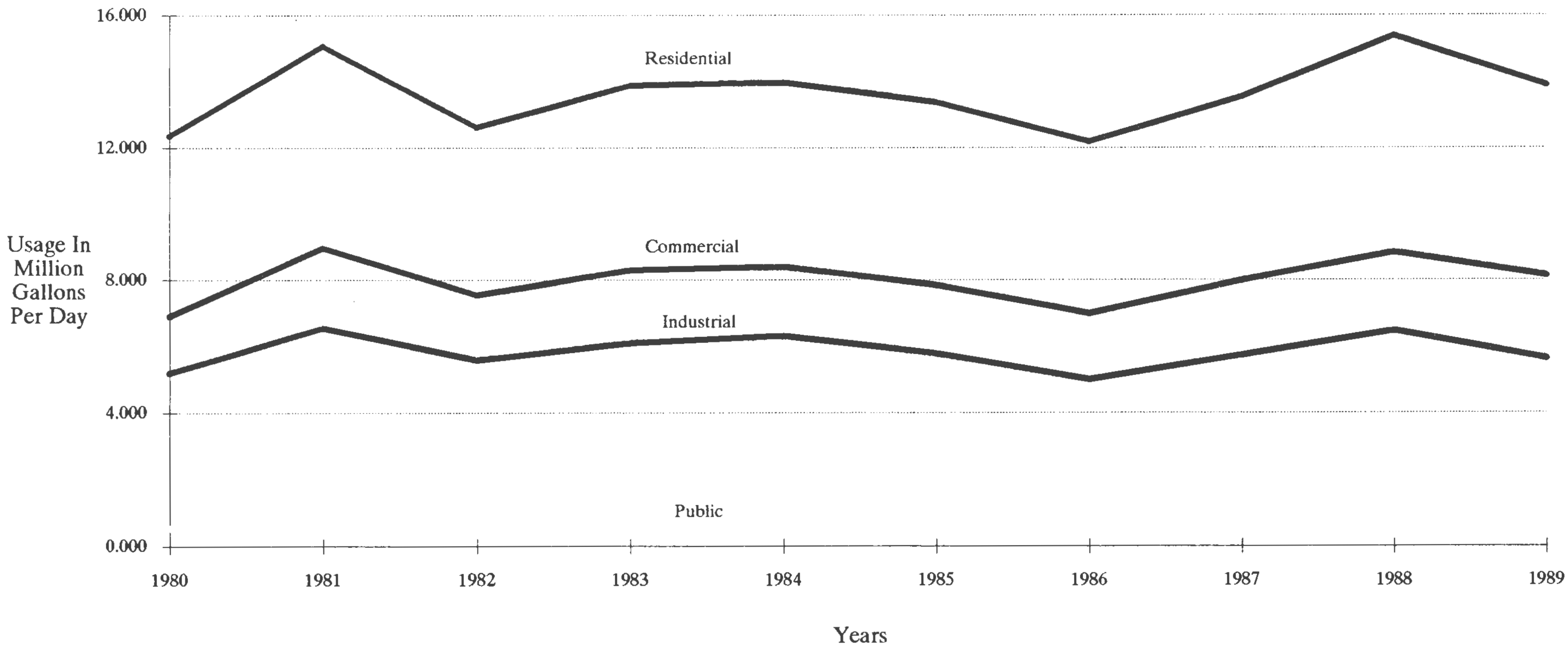
Area of Pleasant Prairie Served by The Kenosha Water Utility

The Kenosha Water Utility provides wholesale water service to the Village of Pleasant Prairie through five industrial metering points. There are 195 residential, five industrial, four commercial and three public customers in these areas. In addition, the Kenosha Water Utility provides emergency service to the Ladish Water System in the event the Ladish well is out of service and provides emergency service to the WEPCO Power Plant.

Ladish Water System

The Ladish System is the largest user in Pleasant Prairie using an average of 260,000 gallons per day. The largest user is the Ladish/Tri-Clover Company which is located adjacent to the Ladish well and elevated water storage tank and consumes an estimated 50 percent of the total use or 130,000 gallons per day. Five commercial customers, three additional industrial customers, four public customers and approximately 241 residential customers comprise the remainder of the demand. Ladish/Tri-Clover was evaluated separately in the computer model with residential, commercial and public customers evaluated as previously explained.

Figure 4 - 13
WATER DEMAND BY USER CLASSIFICATION
KENOSHA WATER UTILITY
1980 - 1989



Source: Kenosha Water Utility

Table 4-7
Water Used In Treatment: 1980 - 1988

Year	Total Gallons Pumped	Low Lift Water Use	High Lift Water Use	Total	Percent of Total
1980	6047.715	191.918	28.933	220.85	3.65
1981	5654.171	136.159	35.751	171.91	3.04
1982	5318.059	190.877	20.466	211.34	3.97
1983	5677.391	219.059	33.615	252.67	4.45
1984	5708.901	201.801	54.041	255.84	4.48
1985	5771.18	187.621	20.995	208.62	3.61
1986	5348.791	194.454	32.1	226.55	4.24
1987	5748.414	238.073	24.843	262.92	4.57
1988	6963.91	213.989	61.768	275.76	3.96
Average	5804.281	197.1056	34.72355	231.8292	4.00

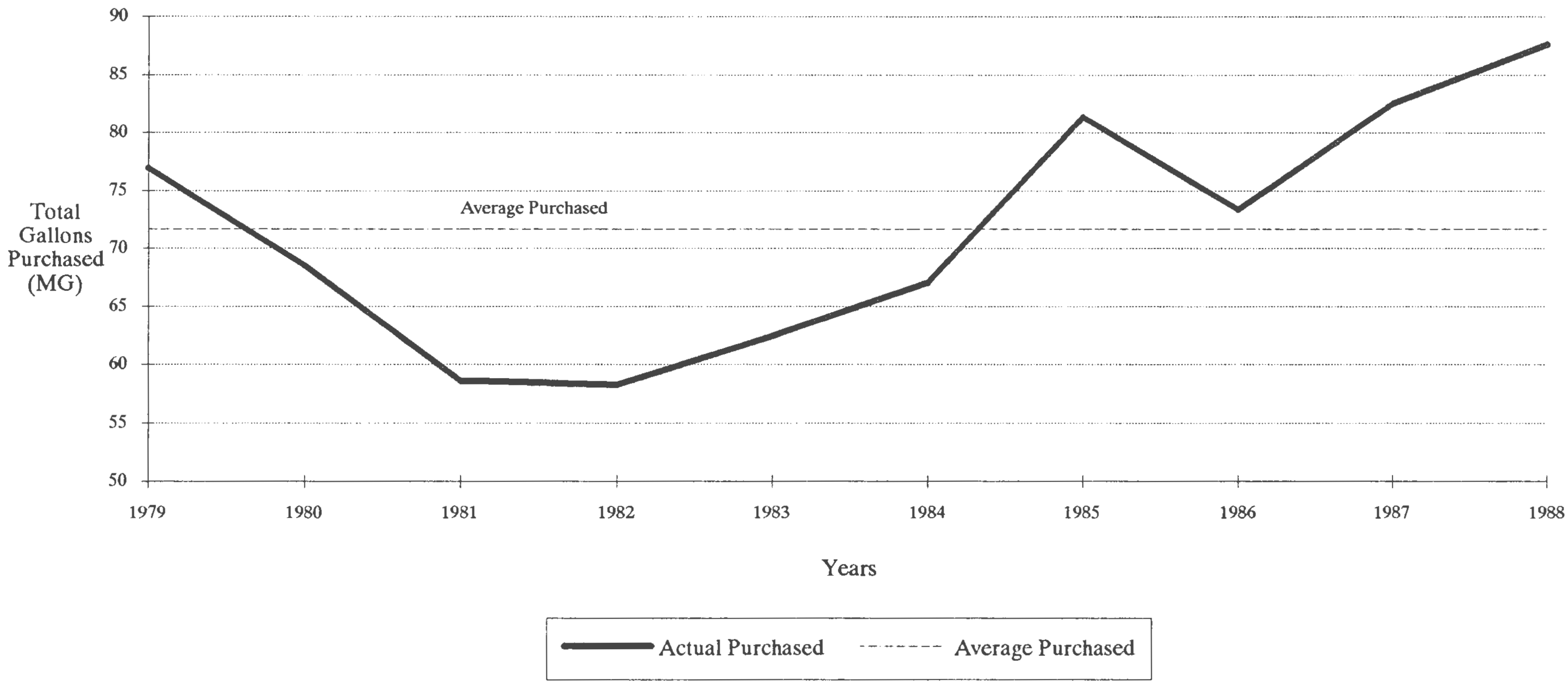
Source: Annual Report of the Kenosha Water Utility

Table 4-8
Other Usage And Unaccounted For Water
In The Kenosha Water System: 1980 - 1988

Year	Total Pumped to System (MG)	Other Usgae (MG)	Percent of Total	Unac-counted for Water (MG)	Percent of Total	Total Percent
1980	5826.864	29.993	0.51	524.4177	9.00	9.51
1981	5482.261	17.266	0.31	169.9500	3.10	3.41
1982	5106.716	25.722	0.50	786.4342	15.40	15.90
1983	5424.717	32.088	0.59	325.4830	6.00	6.59
1984	5453.059	42.57	0.78	299.9182	5.50	6.28
1985	5562.564	33.845	0.61	417.1923	7.50	8.11
1986	5122.237	16.606	0.32	630.0351	12.30	12.62
1987	5485.497	56.633	1.03	356.5573	6.50	7.53
1988	6688.153	16.453	0.25	909.5888	13.60	13.85
Average	5572.452	30.131	0.55	491.06	8.77	9.31

Source: Annual Report of the Kenosha Water Utility

Figure 4 - 14
WATER PURCHASED BY THE TOWN OF SOMERS SANITARY DISTRICT NO. 1 1979 - 1988



Source: Wisconsin Public Service Commission

Table 4-9
Water Use by The Village of Pleasant Prairie by System: 1985-1989

Year	Timber Ridge		Ladish		Pleasant Homes		Zirbel		Other	
	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max
1985	36.19	183.00	238.85	657.00	39.72	60.00	33.87	70.00	63.25	--
1986	27.87	179.00	231.52	633.00	38.98	81.00	30.19	43.00	165.79	--
1987	33.75	163.00	252.36	524.00	39.49	75.00	32.25	62.00	43.25	--
1988	36.46	123.00	291.33	963.00	45.71	156.00	34.57	70.00	388.81	--
1989	33.59	*98.00	278.04	*978.00	35.41	55.00	27.19	58.00	N/A	--
Ave.	33.57	149.20	260.22	751.00	39.86	85.40	31.61	60.60	N/A	--
Ratio Max/Day Ave/Day	4.44		2.89		2.14		1.92			

* Records show the maximum day usage was when the elevated towers were out of service for repainting. The well pumps ran constantly and excess water was discharged through a pressure valve.

N/A This information had not been tabulated by the Village of Pleasant Prairie at the time of this report.

Source: Village of Pleasant Prairie

Pleasant Homes Water Systems

The Pleasant Homes Water System is the second largest user in Pleasant Prairie using an average of 39,860 gallons per day. Assuming that the population of the area is approximately 500[1], the average daily water demand is 79.7 gallons per capita. This agrees favorably with the aforementioned 80 GPCD figure used for projection purposes. There are no industrial, commercial or public customers located in the area.

Timber Ridge Water System

The Timber Ridge water system is the third largest user in Pleasant Prairie using an average of 33,570 gallons per day. The system has 97 residential customers and 3 public customers. No commercial or industrial customers are served by this systems. For the purposes of this report, the residential 80 GPCD, commercial 6,225 gallon per acre and 1568 gallon per acre industrial figures will be used for future projections.

Zirbel Water System

The Zirbel water system is an old system located within the confines of the Ladish water system. The system is scheduled to be abandoned in 1991 and will be served as part of the Ladish water system. Very limited information exists on the capacity and usage in this system. The water supply demands for this system will be considered as part of the Ladish system in the evaluation of alternative plans.

Town of Bristol Sanitary District East

The Town of Bristol Sanitary District East serves both commercial and residential customers. The estimated commercial water use for the area is 3000 gallons per acre per day. This is based upon 1985 land use data and 1988 pumpages. Actual usage is expected to be higher based upon the character of the developments in the area (i.e. restaurants, motels etc.). For purposes of projection, the 6225 gallon per acre per day commercial figure used for Kenosha will be used in the Bristol area. Residential usage is expected to be the same as other outlying areas or 80 GPCD.

Capacity Analysis of Existing Water Systems

All existing public water supply, storage and distribution systems will be evaluated with respect to the Design Objectives and Standards

1. Town of Pleasant Prairie Sewer Utility District "F" Facilities Plan, Crispell-Snyder, Inc., 1987.

set forth in Chapter 2 of this report. Supply and storage facilities will be evaluated with respect to source capacity; peak hour storage; fire flow; and emergency supply. The existing distribution systems will be modeled on The "Wood" Program from the University of Kentucky and evaluated with respect to minimum and maximum pressures, hydraulic grade, fire flow requirements, velocities and head losses.

Kenosha Water Utility

The maximum volume of water available to the distribution system is based on the maximum volume which can be provided by the component with the smallest capacity at the treatment plant. Capacities for all components of the treatment facility are contained in Table 4-10.

As can be seen in Table 4-10, the limiting factor of the treatment facility is the capacity of the treatment plant itself. It is estimated that the capacity of the plant is approximately 40 MGD. The capacity of both the east and west side settling basins and filters is 20 MGD. The two plants will be evaluated individually.

West Plant

The west plant, commissioned in 1917, consists of rapid mixing, flocculation, six settling basins, and sixteen filters. Due to full load conditions during maximum day demands, four micro strainers with a 20 MGD capacity were added in 1961. The micro strainers have since been removed and the superstructure is now used as a mixing basin.

Water from Lake Michigan is delivered from the low lift pumps directly to the mixing basin/micro strainer building. At the maximum rate of 20 MGD, detention time in the rapid mix/floccuation process is 18 minutes. Detention periods as set forth in the "Ten States Standards" should be "... at least 30 minutes." In order to provide 30 minutes detention, the actual capacity of the west plant mixing basin/flocculator would be 12 MGD. Water is then distributed to 16 filters with a total capacity of 20 MGD at a rate of 2 gallons per square foot per minute. Of the 16 filters, 8 are rated at 1.0 MGD and 8 are rated at 1.5 MGD.

East Plant

The east plant, commissioned in 1964, consists of 2 settling basins and 4 rapid mixing, flocculation, rapid sand gravity filters. Water is pumped to the two parallel settling basins. The basins are designed to operate in 3 tiers. Mixing compartments contained on the second tier have a combined capacity of approximately 600,000 gallons which allows for 43 minutes of detention at 20 MGD. Water then flows to the bottom tier and rises along the second and third tier. Settled water is conveyed to four rapid sand filters with a total capacity of 2 gallons per square foot per minute. All of the filters are rated at 5 MGD.

Combined Capacity

The combined capacity of the mixing and settling basins is 40 MGD. If minimum detention times from the "Ten States Standards" are observed for the West Plant, combined capacity falls to a rate of 32 MGD. Discussion with utility personnel and inspection of the plant indicate that raw water quality and the design of the rapid and slow mixing processes allow for optimum flocculation and sedimentation with the decrease in detention time. The rate of 40 MGD is considered reasonable for the clarification process.

The filtration process is also rated at 40 MGD for the facility as a whole. Due to the fact that the filters are all capped with anthracite and are rated at 2.0 feet per square foot per minute, Alvord, Burdick and Howson determined in 1979 that the filters could handle a 25 percent increase in flow over the rated capacity. If we assume the largest filter is down for maintenance, the firm capacity of the plant would be 43.75 MGD. The total combined capacity of the treatment facility is then estimated at 40 MGD.

Reliable Pumping Capacity

The reliable pumping capacity of a facility is considered to be the capacity with the largest pump out of service. For the low lift pumps, the largest pump is rated at 15 MGD and the total capacity is 69.5 MGD with a resulting reliable capacity of 54.5 MGD. The total capacity of the high lift pumps is 73.0 MGD. The largest unit is a 30 MGD pump installed in 1989 and the resulting reliable pumping capacity is 43 MGD.

Lake Intakes

There are currently 3 lake intakes; a 48 inch with a 66 MGD capacity; a 42 inch with a 35 MGD capacity; and a 24 inch emergency intake with a 15 MGD capacity. The reliable capacity with the largest intake out of service is 50 MGD. This assumes the emergency intake, which draws water from the harbor, will be used. Because of the poor quality of the harbor water increased treatment is necessary. However, taste and odor problems can still be expected.

Using the aforementioned criteria, the total reliable capacity of the treatment facility is 40 MGD.

Engineering Evaluation of Supply and Storage Facilities

Existing water demands, average day and maximum day, have been determined based upon the standards developed in Chapter 2. The

Table 4-10
City of Kenosha Water Utility Water Treatment
Facility Capacities: 1988

COMPONENT	DESCRIPTION	CAPACITY
Lake Intake	42 - Inch Intake	35 MGD
Pipe Lines	48 - Inch Intake	66 MGD
	Combined Capacity	101 MGD
	Capacity with Largest Unit out of Service	35 MGD
	24 - Inch Intake (Emergency Use Only)	15 MGD
Low Lift Pumps	Pump 1	15 MGD
	Pump 2	15 MGD
	Pump 3	10 MGD
	Pump 4	7.5 MGD
	Pump 5 (Emergency Power Available)	10 MGD
	Pump 6 (Emergency Power Available)	12 MGD
	Capacity with Largest Unit Out of Service	54.5 MGD
Settling Basins	West Plant	20 MGD
	East Plant	20 MGD
Filters	West Plant	20 MGD
	East Plant	20
High Lift Pumps	Pump HSP - 5	30
	Pump HSP - 4	20
	Pump HSP - 3	15
	Pump HSP - 2	9
	Pump HSP - 1	9
	Total	73
	Reliable Capacity	43
Discharge Header & Mains	Maximum Delivered Through Header	44 MGD
	Maximum Estimated Header Capacity	50 MGD
	Capacity of: 24 Inch	18 MGD
	36 Inch	36 MGD
	30 Inch	24 MGD
	Largest Line Out of Service	42 MGD

Source: Ruekert & Mielke, Inc. and Kenosha Water Utility

Table 4-11
Water Use by Pressure Zone: 1980-1989

	Total Pumpage (MGD)		Primary Zone (MGD)		Boosted Zone (MGD)	
Year	Avg Day	Max Day	Avg Day	Max Day	Avg Day	Max Day
1980	15.999	23.359	14.513	21.189	2.486	2.170
1981	15.118	24.846	13.660	22.450	1.458	2.396
1982	14.047	20.362	12.198	17.682	1.849	2.680
1983	14.954	24.437	12.569	20.540	2.385	3.897
1984	15.047	22.827	11.924	18.089	3.123	4.738
1985	15.247	24.523	11.215	17.979	4.082	6.544
1986	14.121	19.021	8.908	11.999	5.213	7.022
1987	15.097	26.175	9.088	15.757	6.009	10.418
1988	18.442	32.437	10.596	18.637	7.846	13.800
Average	15.347	24.221	11.630	18.258	3.717	5.963

Source: Kenosha Water Utility

facilities required to supply and store adequate quantities of water are based upon the past 10 years of usage data for each system. The supply and storage facilities are sized based upon conditions which are generally accepted as being necessary for adequate and dependable service. These conditions are summarized in the four parameters described as follows:

Source Capacity

To be adequate, for a water system supplied by a single source, such as a surface water treatment facility, the nominal capacity of the facility should exceed the anticipated peak day pumpage. In addition, the reliability of the facility must be investigated to determine facility capacity under adverse conditions. Adverse conditions may include a frozen intake, equipment breakdown, power outage or a sharp drop in raw water quality.

For a water system supplied by multiple wells, the aggregate yield of the wells, less the largest capacity well, should exceed the peak day pumpage.

Peak Hour Storage

To be adequate, a water system should have enough usable elevated and ground storage volume (that is adequate to maintain required pressures in the system) to supply the maximum hour demand rate less the maximum day demand for a minimum duration of four hours, with the largest pumping unit inoperable. Peak hour demand is assumed to be 1.40 times the maximum day demand for the Kenosha Water Utility and 1.75 for all other areas.

Fire Flow

To be adequate, a water system should be able to supply the required fire flow for a specified duration concurrent with a maximum day pumpage event. This volume must be available from storage facilities and pump stations with the largest pumping unit inoperable. The storage volume required to meet the peak hour storage parameter is not considered available to meet this requirement.

Emergency Supply

To be adequate, a water system should be able to supply an average day demand using only elevated storage and auxiliary power pumping.

The following analyses, for the most part, are based upon average day and maximum day demands from 1988. The year 1988 flows were selected as existing flows due to the high usage rates during the drought. For the Bristol Waterworks Well No. 3, 1988-1989 pumpage data will be used as the system has only been in existence since the summer of 1988.

<u>Kenosha Water Utility</u>

The Kenosha Water Utility is divided into 2 major water pressure service areas, the primary zone and the booster zone. Usage by zone is provided in Table 4-11. Some small areas where pressure boosting or reduction is required also exist but will be included in the analyses of the large areas. First, the entire service area will be analyzed based upon supply requirements during 1988. Storage, fire flow and emergency supply requirements for the two pressure areas will be analyzed separately.

Parameter No. 1 - Source Capacity

This parameter was evaluated using the following assumptions:

1. The reliable capacity of the existing treatment facility, based on previous analysis, is 40 MGD.

2. Average day and maximum day flows are for the year 1988.

The required maximum day pumpages are as follows:

	Entire System	Primary Zone	Booster Area
Max Day Pumpage	32.437 MGD	18.637	13.800 MGD

Current available capacity is described as follows:

Entire System (from previous analysis)

Water Treatment Facility	40.000 MGD

Booster Zone No. 1

30th Avenue Booster Station

Pump No. 1	Does Not Pump to Booster Zone No. 1
Pump No. 2	3.000 MGD
Pump No. 3	3.000 MGD

60th Street Booster Station

Pump No. 1	3.000 MGD
Pump No. 2	1.730 MGD
Pump No. 3	3.000 MGD

80th Street Booster Station

Pump No. 1	1.760 MGD
Pump No. 2	3.000 MGD
Pump No. 3	5.000 MGD
Total	23.490 MGD
Less Largest Pump	18.490 MGD

Surplus capacity for entire system = 40.000-32.437 = 7.563 MG

Surplus capacity in booster zone from booster pu = 18.490-13.800 = 4.690 MG

Surplus capacity for primary zone = 2.873 MG

Parameter No. 2 - Peak Hour Storage

This parameter was evaluated assuming peak hour demand is 1.40 times the maximum day demand.

	Entire System	Primary Zone	Booster Zone
Peak Hour Demand	45.412 MGD	26.092	19.320 MGD
Required Volume	(45.412-32.437)x4	(26.508-18.618)	(19.320-13.800)
	24	24	24
	2.162 MG	1.242 MG	.920 MG

Entire System - Available Volume

Ground storage reservoir down 1 foot at plant =	4.096 MG
30th Avenue tank-80% =	3.440 MG
60th Street tank-80% =	2.200 MG
80th Street tank-80% =	3.200 MG
Usable elevated storage from two .750 MG tanks =	1.178 MG
Total =	14.114 MG
Minus Required Storage =	-2.162 MG
Surplus Peak Hour Storage =	11.952 MG

Because certain storage facilities can only be pumped to one pressure zone, the zones will be evaluated separately.

Primary Zone

The following usable storage is provided for the primary zone

Ground Storage reservoir =	4.096 MG
60th Street tank =	1.021 MG
80th Street tank =	1.135 MG
Total =	6.252 MG
Minus Required Storage =	-1.242 MG
Primary Zone Surplus Peak Hour Storage =	5.010 MG

Booster Zone

The following storage is provided for the booster zone.

30th Avenue tank - Storage available from

Booster Pumps in 4 hours =	1.000 MG
*Usable Elevated Storage from two	
.750 MG tanks =	.775
Surplus in 60th Street and 80th Street	
Tanks available from booster pumps =	2.082 MG

Based on maintaining 35 psi in the booster zone an approximately 19,000 gallons per foot of operating range.

Total =	3.857 MG
Minus Required Storage =	-.920 MG
Booster Zone Surplus Peak Hour Storage =	2.937 MG

Parameter No. 3 - Fire Flow

Scenario No. 1 - Entire System

The required fire flow equals 3,500 GPM for 3 hours concurrent with a maximum day demand of 32.437 MG

3,500 GPM x 180 minutes =	.630 MG
32.437 MGD x 3/24 hours =	4.055 MG
Total =	4.685 MG
Volume available from plant = 40 MGD x 3/24 =	5.000 MG
Volume available from storage Facilities not used in peak hour storage that can maintain 20 psi in the system =	11.952 MG
Total =	16.952 MG
Minus Required Fire Flow =	-4.685 MG
Surplus In Fire Flow =	12.267 MG

Scenario No. 2 - Primary Zone

The required fire flow equals 3,500 GPM for 3 hours concurrent with a maximum day demand of 18.637.

3,500 GPM x 180 minutes =	.630 MG
18.637 MGD x 3/24 hours =	2.330 MG
Total =	2.960 MG
Volume available from plant for primary - Zone (from Parameter No. 1) =	2.873 MG
2.873 MGD x 3/24 hours=	.359 MG
Volume available from storage. Facilities not used in peak hour storage but can maintain 20 psi in the system =	5.010 MG
Total =	8.242 MG
Minus Required Fire Flow =	-2.966 MG
Surplus Fire Flow =	5.276 MG

Scenario No. 3 - Booster Zone

The required fire flow equals 3,500 GPM for 3 hours concurrent with a maximum day demand of 13.800 MGD

3,500 GPM x 180 minutes =	.630 MG
13.800 MGD x 3/24 hours =	1.725 MG
Total =	2.355 MG
Available volume from booster stations for booster zone (Parameter No. 1	4.690 MG.
surplus) = 4.69 MGD x 3/24 hours =	586 MG
Volume available from storage that can maintain 20 psi in the system =	1.326 MG
Total =	1.912 MG
Minus Required Fire Flow =	-2.355 MG
Deficit in Fire Flow =	.443 MG

Parameter No. 4 - Emergency Supply

Scenario No. 1 - Entire System

Required Average Day Pumpage =	18.442 MG
Available Emergency Supply:	
Treatment Plant =	1.292 MG
Storage Facilities 30th Ave =	2.549 MG
60th Street =	2.195 MG
80th Street =	2.454 MG
Two .750 MG Elevated Tanks =	0.775 MG
Total =	9.265 MG
Required Volume =	18.442 MG
Surplus Emergency Supply =	0.823 MG

Scenario No. 2 - Primary Zone

Required Average Day Pumpage =	10.596 MG
Available Emergency Supply	
Treatment Plant =	11.292 MG
Storage Facilities 60th Street =	2.195 MG
80th Street =	2.454 MG
Total =	15.941 MG
Minus Required Volume =	-10.596 MG
Surplus Emergency Supply =	5.345 MG

Scenario No. 3 - Booster Zone

Required Average Day Pumpage =	7.846 MGD
Available Emergency Supply One Portable Generator Capable of running one 100 Hp Motor =	2.549 MG
(Pumped from Surplus Emergency Supply in Primary Zone)	
Storage Available to maintain 35 psi from two .750 MG Towers =	.775 MG
Total =	3.364 MG
Minus Required Volume =	-7.846 MG
Deficit in Emergency Supply =	4.482 MG

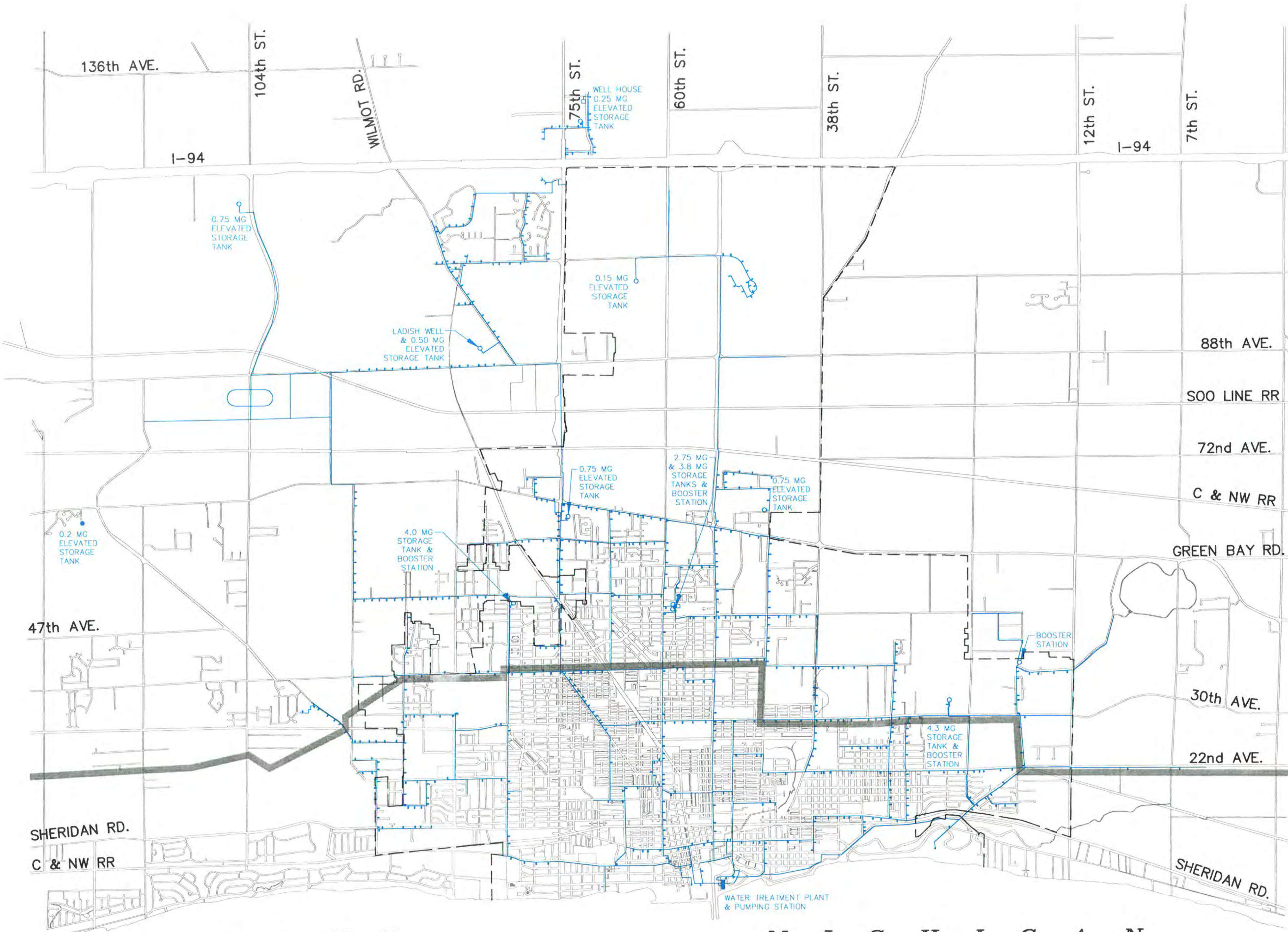


Figure 4-15

SKELETAL WATER SYSTEM MAP

Legend

- MUNICIPAL BOUNDARY
- EXISTING TRANSMISSION WATER MAIN
- APPROXIMATE PRESSURE BOUNDARIES

GRAPHIC SCALE
0 1/2 1 MILE
0 1 2 3 4 5 6,000 FEET

Source: Ruekert & Mielke 1990

Table 4-12
Results of Supply and Storage Facility Analysis for the Existing
Kenosha Water Utility: 1988

Parameter	Entire System	Primary Pressure Zone	Boosted Pressure Zone
Source Capacity	7.563 MG	4.690 MG	2.873 MG
Peak Hour Storage	11.952 MG	5.010 MG	2.937 MG
Fire Flow	12.267 MG	5.276 MG	-0.433 MG
Emergency Supply	0.823 MG	5.345 MG	-4.482 MG

Source: Ruekert & Mielke, Inc.

\+ = Surplus
\- = Deficiency

Note: Difference between the entire system results and the total of boosted and primary zone results are due to the complete separation of the zones and the ability of the 30th Avenue Tank to serve either zone. The entire system was evaluated to show the strength of the facilities and the possible utilization of surplus to more equitably serve the two pressure zones.

Table 4-13
Results of the Computer Simulations of the
Existing Kenosha Water Distribution System: 1985

Conditions for Simulation	Maximum Pressure	Minimum Pressure	Maximum Velocity (FPS)	Maximum Head Loss/1000 Ft.	Minimum Hydraulic Grade
(1) 1985 Average Day Flows	100.00	33.07	8.30	30.54	705.2
(2) 1985 Maximum Day Flows	108.07	33.18	9.66	41.63	705.6
(3) 1985 Maximum Day Flows with Fire Flow	108.50	2.99	14.14	81.97	675.47
(4) 1988 Maximum Day Flows with Fire Flows	128.12	1.09	15.41	88.10	672.61

Source: Ruekert & Mielke, Inc. from the University of Kentucky Pipe Program

Note: Maximum and minimum results are from the worst cases. For many of the simulations, multiple runs were performed.

The results of the analyses above are provided in tabular form in Table 4-12.

Computer Simulation

The Kenosha Water Utility distribution system was simulated using the University of Kentucky "Wood" Model. This program analyzes steady state flow and pressures in pipe distribution systems and is designed to accommodate any piping configuration and hydraulic components such as pumps, valves, pressure regulating valves, storage tanks and minor loss components (i.e. meters, bends, etc.). The pipe system is described numerically by assigning numbers to pipes, pipe junctions and valves for length, diameter, roughness, and pumping and storage components. These pipes 10 inches and larger were modeled as shown in Figure 4-15

To analyze the existing system, four sets of conditions were assumed and corresponding demands placed at the nodes in the computer model. These conditions are described as follows:

1) 1985 average day flows for commercial, industrial, and residential use. Diurnal flows were allocated over the 24 hour period based upon pumpage information from the utility.

2) 1985 maximum day flows developed by multiplying average day flows by a peaking factor of 1.6.

3) 1985 maximum day flows with a 3500 GPM fire flow requirement for 3 hours at a node identified by the ISO concurrent with a three hour peak hour demand. Peak hour for the Kenosha Water Utility is obtained by multiplying peak day demands by a factor of 1.4.

4) 1985 maximum day flows multiplied by a peaking factor of 3.0 which represents the maximum hour flow for 1988, the peak day on record. Included is a 3,500 GPM fire flow for a four hour period.

Results of the computer simulations are presented in Table 4-13 and summarized as follows:

1) The average day demand simulation for 1985 shows one area of the distribution system which has static pressures below 35 psi which is the minimum static pressure required under NR 111 of the Wisconsin Administrative Code. This area is at the southernmost end of the system, on Springbrook Road in the Village of Pleasant Prairie. The elevation at the end of the transmission main allows only for a static pressure of 30 psi. Minimum pressures elsewhere in the system are 40 psi or higher. It should be noted that this simulation was performed with all storage facilities water levels approximately 20 feet below overflow and the booster station on 80th Street near Sheridan Road not operating. Further simulation shows that with the booster station in operation, pressure on Springbrook Road is approximately 35 psi.

2) The maximum day demand simulation for 1985 was performed under the following assumptions:

   a) All average day demands were multiplied by a factor of 1.6. This represents the 1985 ratio of maximum day to average day.
   b) The 30 MGD and the 15 MGD pumps at the water treatment plant were in operation.
   c) One 3 MGD pump at each booster station was pumping into the booster service area.
   d) The 1.5 MGD pump at the 30th Avenue booster station was pumping to the primary zone.
   e) The 5 MGD booster pump on 80th Street was in operation.
   f) Storage levels at the start of simulation were as follows:

30th Avenue -	704 MSL
60th Street -	743 MSL
80th Street -	748 MSL
Ind. Park -	822 MSL
75th Street -	822 MSL

The system was able to handle all flows under the assumed conditions and maintain pressures in excess of 35 psi at all nodes. The distribution system should be considered adequate for 1985 maximum day demands.

3. The 1985 maximum day flow simulations with required fire flows at various points in the system were performed under the following assumptions.

   a. Maximum fire flows required did not exceed 3,500 GPM
   b. Seven representative areas of the system were subjected to fire flows based upon ISO data. This data is presented in Table 4-14.

Table 4-14
1989 ISO Fire Flow Data

			Pressure PSI		Flow at 20 PSI		
Test No.	Type Dist.*	Test Location	Static	Resid.	Needed**	Available	Difference
1	Comm	37th Ave & 65th St.	46	7	3000	1100	-1900
2	Comm	45th Ave & 68th St.	65	51	3000	4500	+1500
3	Comm	57th Ave & 75th St.	60	55	3000	11300	+8300
4	Comm	Pershing Blvd & 75th St	78	38	3000	2700	-300
5	Comm	38th Ave & 75th St.	46	30	3000	2700	-300
6	Comm	46th Ave & 80th St.	80	69	4000	7800	+3800
7	Comm	22nd Ave & 80th St.	63	54	1750	7300	+5550
8	Comm	30th Ave & 85th St.	59	42	3500	5700	+2200
9	Comm	22nd Ave & 88th St.	60	40	2250	4500	+2250
10	Comm	Sheridan & 86th St.	65	28	2500	3000	+500
11	Comm	24th Ave & 69th St.	45	23	4000	1300	-2700
12	Comm	18th Ave & 65th St.	54	40	3000	4900	+1900
13	Comm	3rd Ave & 63rd St.	67	17	4000	2100	-1900
14	Comm	16th Ave & 60th St.	52	38	4000	4700	+700
15	Comm	4th Ave & 58th St.	66	50	4000/ 3000	5000	+1000/ 2000
16	Comm	Sheridan & 56th St.	66	56	3000	3000	0
17	Comm	Sheridan & 50th St.	65	60	3500	7400	+2900
18	Comm	13th Ct & 45th St.	68	25	3500	2000	-1500
19	Comm	Sheridan & 35th St.	68	40	2500	4000	+1500
20	Comm	17th Ave & 30th St.	62	35	750	3900	+3150
21	Comm	16th Ave & Birch Rd.	65	30	3000	3400	+400
22	Comm	35th Ave & 14th Pl.	56	12	3000	1800	-1200
23	Comm	39th Ave & 27th St.	65	35	4000	4100	+100
24	Comm	Wash.& 32nd Ave	84	75	5000/ 2500	3800	-1200/ +1300

Table 4-14
1989 ISO Fire Flow Data

			Pressure PSI		Flow at 20 PSI		
Test No.	Type Dist.*	Test Location	Static	Resid.	Needed**	Available	Difference
25	Comm	Wash. &. 39th Ave	84	55	5000	4900	-100
26	Comm	35th Ave & 52nd St.	50	45	3500	3300	-200
27	Comm	41st Ave & 52nd St.	53	25	2000	2500	+500
28	Comm	52nd Ave & 52nd St.	59	55	3500	9500	+6000
29	Comm	Green Bay & 46th St.	42	30	3000	4600	+1600
30	Comm	68th Ave & 51st St.	50	48	1000	16700	+15,700
31	Comm	54th Ave & 60th St.	55	50	3500	11000	+7500

Source: ISO Commercial Risk Services, Inc.

Note: The above listed needed fire flows are for property insurance premium calculations only and are not intended to predict the maximum amount of water required for a large scale fire condition. The available flows only indicate the conditions that existed at the time and at the location where tests were witnessed.

* Comm = Commercial; Res = Residential

** Needed is the rate of flow for a specific duration for a full credit condition. Needed fire flows greater than 3,500 gpm are not considered in determining the classification of the City when using the Fire Suppression Rating Schedule.

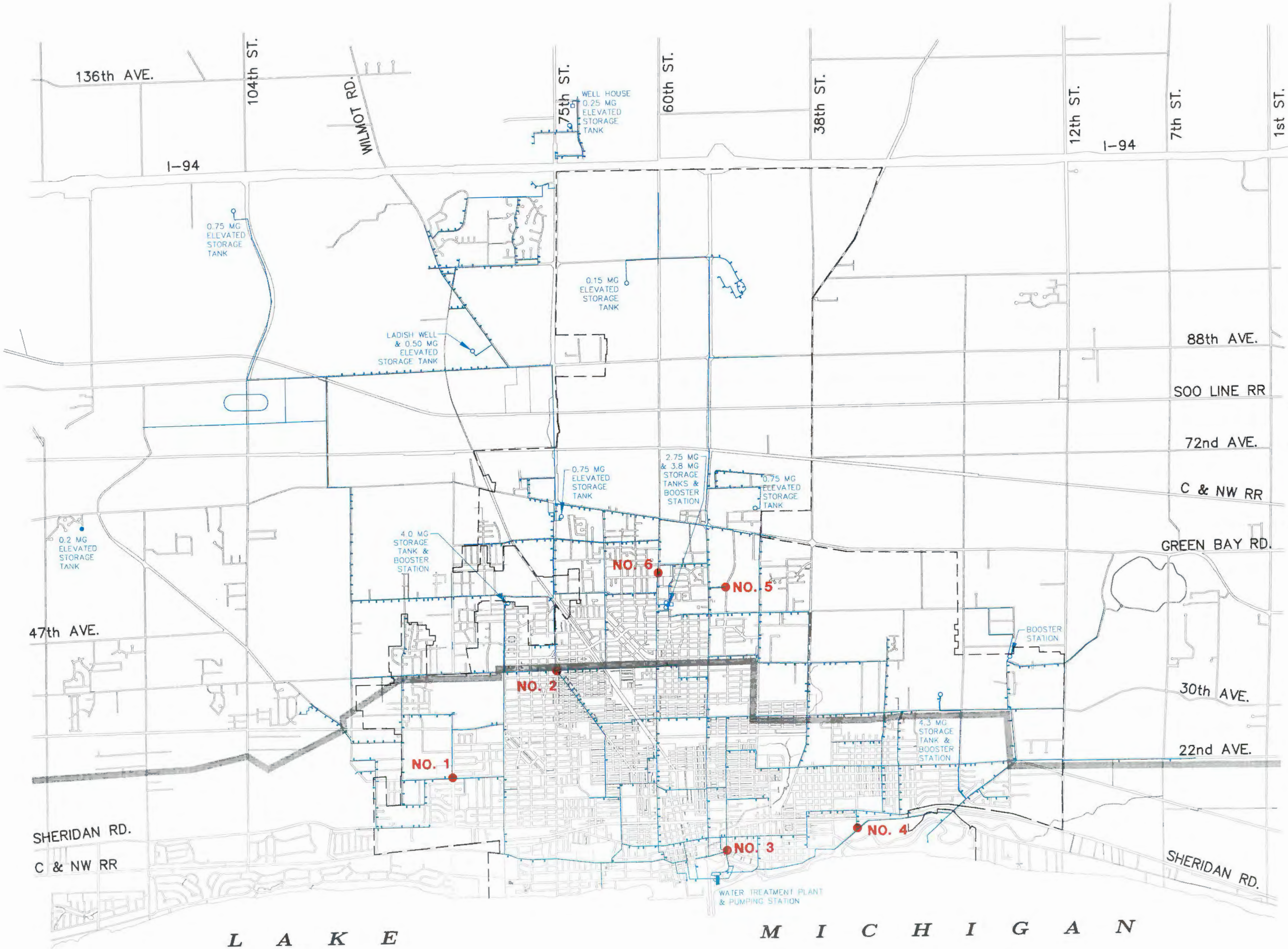


Figure 4-16

LOCATION OF FIRE FLOW SIMULATIONS FROM TABLE 4-15

Legend

- MUNICIPAL BOUNDARY
- EXISTING TRANSMISSION WATER MAIN
- LOCATION OF FIRE FLOW SIMULATIONS
- APPROXIMATE PRESSURE BOUNDARIES

GRAPHIC SCALE

0 1/2 1 MILE

0 1 2 3 4 5 6,000 FEET

Source: Ruekert & Mielke 1990

Table 4-15
Results of Fire Flow Simulations: 1985

Node No.	Location	ISO Required Flow	Flow Available R | M
7	85th St. & 22nd Ave	3500 GPM	< 6000 GPM
29	Roosevelt Rd. & 39th Ave. (38th Ave. & 75th St.)	3000 GPM	3650 GPM
56	Sheridan Rd. & 50th St.	3500 GPM	>10,000 GPM
81	Sheridan Rd. & 35th St.	3000 GPM	> 7,000 GPM
243	52nd Ave. & 52nd St.	3500 GPM	>13,000 GPM
219	60th St. & 54th Ave.	3500 GPM	>13,000 GPM

Source: Ruekert & Mielke, Inc.

Note: The Node where the demand was placed was the closest node to the intersection where the fire flow was required.

Table 4-16
1987 ISO Fire Flow Data for The Town of Somers

Test No.	Type Dist.*	Test Location	Static	Resid.	Needed**	Available
1	Comm	Sheridan Rd. 1st hydrant from City limits	65	52	1000	2000
2	Comm	Sheridan Rd. between 13 Pl. and 13 St.	60	27	1500	600
3	Comm	Sheridan Rd. at 9 Pl.	60	19	2000	300
4	Comm	Sheridan Rd. 4th hydrant South of 1st St.	60	15	2000	300
5	Comm	Sillcock at Country Club House	67	50	2000	1700
6	Comm	22 Ave. at 3 St.	59	30	1750	1000
7	Comm	U W Parkside South of Molanaro Hall	55	35	3000	1300

Source: ISO Commercial Risk Services, Inc.

Note: The above listed needed fire flows are for property insurance premium calculations only and are not intended to predict the maximum amount of water required for a large scale fire condition. The available flows only indicate the conditions that existed at the time and at the location where tests were witnessed.

* Comm = Commercial; Res = Residential

** Needed is the rate of flow for a specific duration for a full credit condition. Needed fire flows greater than 3,500 gpm are not considered in determining the classification of the City when using the Fire Suppression Rating Schedule.

Table 4-17
Results of The Village of Pleasant Prairie
Water Supply and Storage Analysis: 1988

Parameter	Ladish	Timber Ridge	Pleasant Homes
Source Capacity	-.963 MG	-.187 MG	-.040 MG
Peak Hour Storage	+.265 MG	+.117 MG	-.015 MG
Fire Flow	-.004 MG	-.132 MG	-.266 MG
Emergency Supply	+.134 MG	+.134 MG	-.046 MG

\+ = Surplus
\- = Deficit

Source: Ruekert & Mielke, Inc.

c. Pumps were added as required to increase flow while not exceeding a 100 psi pressure limitation in distribution mains.
d. Storage levels at the start of the simulations were down 20 feet.

The results of all the fire flow simulations show that the system can maintain the required fire flows at 20 psi for the 3 hour period concurrent with 1985 maximum hour flows. Areas subjected to fire flows are shown on Figure 4-16. Results of the fire flow simulations are provided in Table 4-15.

4. The 1988 maximum hour flow simulation with seven areas subjected to fire flows resulted in pressures above 20 psi. Results were similar to those from simulation for 1985.

Town of Somers Sanitary District No. 1

The Town of Somers Sanitary District No. 1 contains a series of water mains ranging in size from 3 inch to 8 inch. The entire system is fed through a single metering point. This is located at the southernmost end of the system near the Kenosha City limits. The lack of looping in the system apparently does not affect everyday static and residual pressures which are consistently between 50 and 75 psi.

Fire flow data from the ISO dated August 20, 1987 was obtained for the Town of Somers and is included in Table 4-16. Two of the tests performed on the northern end of the system show flows of only 300 GPM available at 20 psi. The Wisconsin Administrative Code in Chapter NR 111.72 (1) states that ... "The minimum flow requirement for water mains servicing fire hydrants is 500 gpm at 20 psi residual pressure." Computer simulation shows that the Hazen-William, coefficient of friction or "C" factor of these mains is approximately 60.

In order to provide the minimum 500 GPM fire flow to these areas, computer simulation indicates that a loop extending from the 8 inch main on the northern end of 22nd Avenue to CTH KR then east on CTH KR to the existing main serving the sanitary district should be constructed. This main extension will provide approximately 580 GPM of fire flow to the deficient areas. It is strongly suggested that the existing mains also be cleaned by "pigging" to increase the "C" factor and the total available flow.

Pleasant Prairie Water Utility

The same criteria will be used to evaluate the Pleasant Prairie water supply and storage facilities with the exception of the area of Pleasant Prairie served by Kenosha as these demands were included in the previous evaluation. The results of the evaluations are contained in Table 4-17. The four parameters were evaluated in the same manor shown in the evaluation of the Kenosha Water Utility, however, only the results are provided.

Ladish Water System

Due to the fact that the Ladish System is served by only one well, the source capacity parameter cannot be met. 1988 maximum day demand was 963,000 gallons or approximately 670 gallons per minute. The existing well pumps at a rate of approximately 600 GPM. To meet the requirements of the source capacity parameter, additional well capacity of 670 GPM will be necessary. If this capacity comes from one well, the capacity of the existing pump will have to be upgraded to a minimum 670 GPM.

The peak hour storage parameter is 160,500 gallons in a four hour period. Due to the fact that only one source of supply currently exists, this volume must be available from the elevated storage tank. Calculations show that the entire volume of the elevated tank can provide in excess of 35 psi so this parameter is easily met.

The fire flow parameter requires an available storage volume of approximately 344,000 gallons. Again, this is due to the fact that only one source of supply exists. Available volume from the elevated tank is 340,000 or a deficit of 4,000 gallons.

The emergency supply parameter requires storage and/or emergency power pumping capable of meeting average day demands. The storage volume of the elevated storage tank is sufficient to satisfy this requirement.

Timber Ridge Water System

The Timber Ridge Water System is also supplied by a single well which cannot satisfy the source capacity requirement. The system must be provided with an additional 130 GPM of well capacity to met this parameter.

Peak hour storage for Timber Ridge requires a usable storage volume of approximately 53,000 gallons. Estimates show that the entire storage volume can maintain the required 35 psi in the system so the peak hour storage parameter can be met.

The fire flow parameter requires an available volume of 280,000 gallons. The total capacity of the tower, 200,000 gallons, minus the peak hour storage requirement of 53,000 gallons results in an available capacity of only 147,000 gallons or a deficit of 132,000 gallons.

The emergency supply parameter requires approximately 36,000 gallons of usable storage or emergency power pumping. The elevated storage is sufficient to satisfy this requirement.

Pleasant Homes Water System

The Pleasant Homes water system is served by two wells with pumps capable of supplying 270 GPM and 90 GPM. Maximum day demands in 1988 was approximately 156,000 gallons. The required capacity of the smallest well is 108 GPM to provide the maximum day demand. This results in a source capacity deficit of approximately 40,000 gallons per day.

Peak hour storage for Pleasant Homes requires a volume of 19,500 gallons or 81 GPM. No storage other than the two small pressure tanks located at the s is provided for this system. The total deficit is approximately 15,000 gallons.

Fire flow requirements for the Pleasant Homes system requires an available volume of 277,000 gallons from wells and storage facilities for a 2 hour period. Estimates show only 11,000 gallons is currently available for this parameter resulting in a deficit of 266,000 gallons. Emergency supply is obtained from elevated storage or auxiliary power pumping. The Pleasant Homes system has neither, so the emergency supply deficit is equal to the average day pumpage of approximately 46,000 gallons.

Zirbel Water System

The Zirbel System is an old system with little or no recorded information as to capacities of the various system components. Discussions with the Village indicate that the system is scheduled to be abandoned in 1990 and will then be served by the Ladish System. Future requirements for this combined system will be addressed in subsequent chapters of this report.

CHAPTER V

EVALUATION OF ALTERNATIVES

INTRODUCTION

This chapter presents the descriptions and the evaluations of alternative sewerage and water systems to serve the planning area through the design year. The alternatives are sized using the year 2010 intermediate growth centralized land use projections provided by SEWRPC. A selected alternative will be re-evaluated in Chapter VI with the 2010 optimistic growth decentralized land use and the ultimate land use development scenario, with the former approximating the most optimistic 20-year growth projections and the later approximating the long-term facility needs and the 40-year growth condition as set forth in the Wisconsin Department of Natural Resources Facility Planning Requirements.

Sewerage Alternatives

The following alternatives for providing sewer service to the planning area will be evaluated in this section.

ALTERNATIVE I
"CENTRALIZED SERVICE"

Providing wastewater conveyance and treatment service to the entire planning area by the Kenosha sewerage system. Areas outside of the City of Kenosha in the Town of Somers and portions of the Village of Pleasant Prairie that are currently served by Kenosha will continue to be served by the present conveyance system to Kenosha. Other areas will be connected to the Kenosha system by one of the following sub-alternatives:

Sub-Alternative A

Providing sewer service to areas of the Town of Bristol, Village of Pleasant Prairie and the City of Kenosha, that are tributary to Sewer Utility District SUD "D", from the City of Kenosha along 75th Street.

Sub-Alternative B

Providing sewer service to areas of the Town of Bristol, Village of Pleasant Prairie and the City of Kenosha, that are tributary to SUD "D", from the City of Kenosha along 7th Avenue.

Sub-Alternative C

Providing sewer service to areas of the Town of Bristol, Village of Pleasant Prairie and the City of Kenosha that are tributary to SUD "D", and the City of Kenosha tributary to 75th Street, from the City of Kenosha along 7th Avenue.

Sub-Alternative D

Providing sewer service to the Oakdale Estates Subdivision from the City of Kenosha by connection to an existing trunk sewer in Somers Road. Providing sewer service to areas of the Town of Bristol, Village of Pleasant Prairie and the City of Kenosha that are tributary to SUD "D", and the City of Kenosha tributary to 75th Street, from the City of Kenosha along the Chicago and Northwestern Railroad right-of-way.

Sub-Alternative E

Providing sewer service to the Oakdale Estates Subdivision from the City of Racine through the Town of Mount Pleasant by connection to an existing trunk sewer in CTH KR. Providing sewer service to areas of the Town of Bristol, Village of Pleasant Prairie and the City of Kenosha that are tributary to SUD "D" and the City of Kenosha tributary to 75th Street, from the City of Kenosha along the Chicago and Northwestern Railroad right-of-way.

ALTERNATIVE II
"EXISTING FACILITY EXPANSION"

Expand the existing sanitary sewer systems and treatment facilities for SUD "D" and SUD "73-1" to provide service for the Village of Pleasant Prairie and the Town of Bristol.

ALTERNATIVE III
"NEW FACILITY CONSTRUCTION"

Expand the existing satellite wastewater treatment and conveyance facilities and supplement them with the construction of a new treatment facility for portions of the Town of Bristol.

ALTERNATIVE ANALYSIS CRITERIA

Conveyance Facility Criteria

The location of recommended conveyance facilities will be determined based on the following criteria:

1) Gravity sewers and forcemains should be placed in existing road right-of-ways or adjacent to existing railroad right-of-ways wherever possible.

2) Gravity sewers should follow the natural drainage patterns of the areas they serve as closely as possible.

3) New gravity sewers were sized to convey the design peak flow at approximately 80% of pipe full capacity.

4) Lift stations and forcemains will only be used where gravity sewers are not practical.

5) Previous utility planning will be used where ever possible.

Proposed sewage conveyance facilities will be sized based on peak flow requirements under the intermediate development plan. Peak flow will be determined as discussed in Chapter IV of this study and summarized in Table 4-4.

A friction factor (Mannings "n") of 0.013 will be used, as required by the Wisconsin Administration Code NR 110.13, for the sizing of all gravity sewers. Under peak flow conditions, forcemains are assumed to have an average velocity of approximately 5 ft/sec, unless excessive friction losses necessitate larger forcemain sizes.

Wastewater Treatment and Storage Facility Criteria

Wastewater Treatment Facility (WTF) expansion options will be analyzed at the Kenosha Water Utility WTF and the facilities at SUD "D" and 73-1 in the Village of Pleasant Prairie. A new facility will also be analyzed to serve a portion of the Town of Bristol at a location proposed in a previous planning report.

Treatment units for potential facility expansion will be designed to work in parallel with existing treatment facilities. Sizing criteria is listed in Chapter II.

Storage facilities to handle peak wet-weather flows will be analyzed at the head end of the Kenosha WTF. Satellite or remote storage sites will not be analyzed because without accurate system flow monitoring, it is impossible to determine accurate "upstream" storage volumes. Flow monitoring necessary to predict these volumes is beyond the scope of this study. However the cost comparisons between treatment and storage are common to all alternatives and will therefore not effect the decision between alternatives.

ALTERNATIVE I "CENTRALIZED SERVICE"

The first alternative involves the Kenosha Water Utility providing wastewater treatment facilities for the entire study area.

Several sub-alternatives have been developed. These sub-alternatives represent the different possible conveyance facilities required to serve the projected development of the entire planning area from the Kenosha Water Utility WTF. Future sewer basins are delineated on Figure 5-1. Due to the attenuation of peak flows caused by long flow distances, the individual sub-alternatives will require different conveyance facilities. Determination of the most cost effective means of providing "centralized" service will require analysis of the five (5) following individual sub-alternatives.

Sub-Alternative A

This sub-alternative involves providing wastewater treatment for the entire planning area from the Kenosha Water Utility WTF. The recommended conveyance facilities are as indicated on Figure 5-2. Peak flow rates at key points of the future and existing trunk sewer system are indicated on Figure 5-3.

Trunk Sewer No. 28

To provide sewer service for the area roughly delineated as basin No. 13.13 on Figure 5-1, will require the construction of trunk sewer No. 28.

Trunk sewer No. 28 would consist of approximately 3700 feet of 8 inch diameter gravity sewer along the existing Chicago and North Western Railroad right-of-way from 60th Street to the existing Kenosha trunk sewer system at 50th Street extended manhole No. 13.13 (see Figure 5-3). The peak flow conveyed by this sewer is estimated at 0.15 cfs (see Figure 5-3).

Existing trunk sewer No. 13 in 50th Street has a minimum of 10 cfs of unused capacity. The estimated additional flow to connect the upstream area of the Town of Somers is 2.09 cfs. Therefore no new construction will be required to the existing trunk sewer No. 13.

Trunk Sewers No. 10, 29, 30, 31

To provide sewer service to a portion of the Village of Pleasant Prairie and the Town of Bristol presently served by Sanitary Utility District "D" will require construction of Trunk sewer No. 29. The areas served by trunk sewer No. 29 are roughly delineated as basins 10.05 and 10.06 on Figure 5-1. Trunk sewer No. 29 consists of constructing a 4.0 MGD lift station at the location of the existing SUD "D" WTF and 11,000 feet of 16 inch diameter forcemain connecting the above described lift station with proposed trunk sewer No. 31 in 75th Street. The route for trunk sewer No. 29 would be north along the route of the existing trunk sewer No. 26 to 75th Street then east in the right-of-way of 75th Street to a connection with proposed trunk sewer No. 31 approximately 1/2 mile west of 88th Avenue (see Figure 5-2). This sewer was sized to convey a peak flow of 6.19 cfs (see Figure 5-3).

To convey the flow for the portion of the City of Kenosha roughly delineated on Figure 5-1 as basin No. 10.04 would require construction of trunk sewer No. 30. Trunk sewer No. 30 consists of constructing a 0.26 MGD lift station located on the north side of 75th Street at the east side of the Des Plaines River and 6,000 feet of 6 inch diameter forcemain. The 6 inch diameter forcemain would


Figure 5-1
FUTURE SEWER BASINS
Legend
SANITARY SEWER DISTRICT BOUNDARY
EXISTING GRAVITY TRUNK SEWER
MANHOLE NUMBER
EXISTING FORCEMAIN
SEWER BASIN BOUNDARIES
136th AVE.
104th ST.
WILMOT RD.
75th ST.
60th ST.
38th ST.
12th ST.
7th ST.
1st ST.
I-94
88th AVE.
SOO LINE RR
72nd AVE.
C & NW RR
GREEN BAY RD.
47th AVE.
30th AVE.
22nd AVE.
SHERIDAN RD.
SUD "D" WASTEWATER TREATMENT FACILITY
SUD "73-1" WASTEWATER TREATMENT FACILITY
KENOSHA WASTEWATER TREATMENT FACILITY
2.14
10.05
13.14
19.08
10.06
10.04
13.13
10.03
2.16
2.13
9.13
2.15
2.12
19.07
2.10
3.10
2.11
2.07
2.06
LAKE MICHIGAN
GRAPHIC SCALE
Source: Ruekert & Mielke 1991

Figure 5-2

ALTERNATE I
SUB-ALTERNATIVE A
RECOMMENDED
CONVEYANCE FACILITIES

Source: Ruekert & Mielke 1991

Figure 5-3

ALTERNATE I
SUB-ALTERNATIVE A
PEAK FLOW
AT KEY POINTS

Legend

- SANITARY SEWER DISTRICT BOUNDARY
- EXISTING GRAVITY TRUNK SEWER
- MANHOLE NUMBER
- EXISTING FORCEMAIN
- PROPOSED GRAVITY TRUNK SEWER
- PROPOSED FORCEMAIN

GRAPHIC SCALE 0 1/2 1 MILE; 0 1 2 3 4 5 6,000 FEET

Source: Ruekert & Mielke 1991

be constructed along 75th Street to convey flows from the above described lift station to a connection with the proposed trunk sewer No. 31 approximately 1/2 mile west of 88th Avenue. Trunk sewer No. 30 was sized to convey a peak flow of 0.41 cfs (see Figure 5-3).

To convey the flow from portions of the Village of Pleasant Prairie, the Town of Bristol and the City of Kenosha (basins Nos. 10.04, 10.05, 10.06) described above as well as provide sewer service to a portion of the City of Kenosha, roughly delineated on Figure 5-1 as basin No. 10.03, would require construction of trunk sewer No. 31. Trunk sewer No. 31 would consist of constructing approximately 3,800 feet of 18 inch diameter gravity sewer and approximately 2,450 feet of 30 inch diameter gravity sewer along 75th Street. The sewer would begin at a point approximately 1/2 mile west of 88th Avenue and continue east to a 5.2 MGD lift station. The lift station will be constructed near the Chicago and North Western Railroad crossing. The lift station would discharge to a 16 inch diameter forcemain which would be constructed along 75th Street from the above described lift station to a connection with the existing Kenosha trunk sewer system at STH 31 manhole No. 10.03 (see Figure 5-2). Trunk sewer No. 31 was sized to convey a peak flow of 8.02 cfs (see Figure 5-3).

Existing trunk sewer No. 10 has been determined to be inadequate to convey any additional flow. To provide service for the above described areas will require relaying existing trunk sewer No. 10 from STH 31 to the intersection of 75th Street and "KD" Tracks. The required relay is 1,900 feet of 18 inch diameter gravity sewer from STH 31 to 60th Avenue, 1080 feet of 21 inch diameter gravity sewer from 60th Avenue to 57th Avenue and 1950 feet of 27 inch gravity sewer from 57th Avenue to the connection with trunk sewer No. 9 at "KD" Tracks (see Figure 5-2). Trunk sewer No. 10 was sized to convey 12.68 cfs (see Figure 5-3).

<u>Trunk Sewers No. 32, 33, 34 and 35</u>

To provide sanitary sewer service to the area roughly delineated on Figure 5-1 as basin No. 2.14 would require construction of trunk sewer No. 32 (see Figure 5-2). This area is approximately evenly divided between the Village of Pleasant Prairie and the Town of Bristol. Trunk sewer No. 32 consists of a 0.69 MGD lift station located along CTH "Q" approximately 1/2 mile east of ISH 94 and 9,000 feet of 8 inch diameter forcemain from the above lift station, along CTH "Q" to an existing 24 inch diameter gravity sewer located at the intersection of 104th Street and 88th Avenue (see Figure 5-2). This trunk sewer was sized to convey an estimated peak flow of 1.07 cfs.

The area of Pleasant Prairie roughly delineated on Figure 5-1 as basin No. 2.13 would be served by trunk sewer No. 33. This sewer also conveys flow from basin 2.14. The conveyance facility would consist of a 2.58 MGD lift station located between the railroad right-of-way and 88th Avenue 1/2 mile north of 104th street. Approximately 10,800 feet of 12 inch diameter forcemain would be required to convey the flow from the proposed lift station to a connection with a proposed 15 inch diameter gravity sewer beginning at the intersection of 104th Street and 64th Avenue. The route of the forcemain would be in an easement from the above described lift station to the east along the north line of the SW 1/4 of Section 21, then south, in an easement along the east line of SW 1/4 of Section 21 to 104th Street, then east in 104th Street to the proposed 15 inch diameter gravity sewer at 64th Avenue(see Figure 5-2). Trunk sewer No. 33 was sized to convey a peak flow of 3.99 cfs (see Figure 5-3).

To provide sanitary sewer service to the portion of Pleasant Prairie delineated on Figure 5-1 as basins 2.15 and 2.16 would require construction of trunk sewer No. 34 (see Figure 5-2). These areas are presently served by Sanitary Utility District "73-1". Trunk sewer No. 34 consists of constructing a 0.56 MGD lift station at the location of the existing SUD "73-1" WTF. Flows from the lift station would be conveyed by 15,700 feet of 8 inch diameter forcemain to a connection with the proposed trunk sewer No. 35 at the intersection of 64th Avenue and 104th Street. The route of the 8 inch forcemain is northwesterly approximately 1500 feet in an existing easement from the site of the existing SUD "73-1" WTF to an easement, then east along the north line of the SW & SE 1/4 section of Section 34 to STH 31, then north along STH 31 to 104th Street, then east along 104th Street to the beginning of proposed trunk sewer No. 35 (see Figure 5-2). Trunk sewer No. 34 was sized to convey a peak flow of 0.86 cfs (see Figure 5-3).

To provide centralized service to the above described areas, basins 2.13, 2.14, 2.15, & 2.16, as well as the areas roughly delineated on Figure 5-1 as basin Nos. 2.11, 2.12 and 3.10 will require construction of trunk sewer No. 35. Trunk sewer No. 35 would consist of 2,200 feet of 15 inch diameter gravity sewer, 11,000 feet of 18 inch diameter gravity sewer and 2500 feet of 21 inch diameter gravity sewer. The route for trunk sewer No. 35 begins near the intersection of 64th Avenue and 104th Street then continues east along 104th Street to a connection with the existing trunk sewer system at Sheridan Road, manhole No. 24.10 of existing trunk sewer No. 24 (see Figure 5-2). The estimated peak flow used to size trunk sewer No. 35 varies from 5.29 cfs to 6.09 cfs (see Figure 5-3).

Analysis of trunk sewer No. 24 indicates that no improvement of this sewer is required to serve all tributary areas under the year 2010 Intermediate Development Plan.

Trunk Sewer No. 36

To provide sewer service for the area roughly delineated on Figure 5-1 as basin No. 13.14 will require construction of trunk sewer No. 36 (see Figure 5-2).

Trunk sewer No. 36 begins with constructing a 0.26 MGD lift station located near the intersection of ISH 94 and STH 142. Flow is conveyed along the south side of STH 142 from this lift station to the intersection of STH 142 and 96th Avenue via 16,000 feet of 6 inch diameter forcemain.

From this intersection to the intersection of STH 142 and 88th Avenue the flow is conveyed east along the south side of STH 142 by 6,000 feet of 8 inch diameter gravity sewer. From the intersection of STH 142 and 88th Avenue to a connection with existing trunk sewer No. 27, at 50th Street extended and the C.M. S.T.P. & P. railroad manhole No. 27.03, the flow is conveyed in an easement via 11,000 feet of 10 inch diameter gravity sewer (see Figure 5-2). The peak flow conveyed by this sewer is estimated to be 0.31 cfs (see Figure 5-3).

In Chapter IV of this study inadequate existing sewers were identified based on estimated existing flow rates. Based on the year 2010 Intermediate Development Plan these same sewers are inadequate for all alternatives. The need for these sewers will be re-evaluated in Chapter VI using re-distributed inflow rates based upon recent discoveries that there are a number of direct catch basin connections. The planned elimination of these sources could have a significant impact on the size, length and/or need of several of the proposed relays. The following is a preliminary description of existing trunk sewers requiring relays.

Trunk Sewer No. 20 (see Figure 5-2)

Existing trunk sewer No. 20 in 14th Avenue is inadequate to convey the estimated peak flows for the intermediate development plan. From manhole No. 20.14 at 23rd Street to manhole No. 20.11 at 27th Street the existing capacity for this sewer is estimated at 3 cfs. For this alternative, the estimated peak flow to this point in trunk sewer No. 20 is 9 cfs. To increase the capacity of this portion of sewer will require relay of the existing 18 inch diameter gravity sewer with a 24 inch diameter gravity sewer in 14th Avenue between manhole No. 20.14 and manhole No. 20.11.

Trunk Sewer No. 18

A portion of existing trunk sewer No. 18 in 30th Avenue is inadequate to convey the estimated future peak flows. The existing 15 inch diameter gravity sewer between 14th Street manhole No. 18.08 and 18th Street manhole No. 17.11 has a capacity of from 1.7 to 3.1 cfs. Under this sub-alternative peak flow in this portion of the trunk sewer is estimated at approximately 4 cfs (see Figure 5-3). To provide the required capacity for this portion of trunk sewer, the installation of an 18 inch diameter gravity sewer in 30th Avenue from 14th Street manhole No. 18.08 to the 18th Street manhole No. 17.11 will be required (see Figure 5-2).

Trunk Sewer No. 16

Existing trunk sewer No. 16 in 30th Avenue is inadequate to convey the estimated future peak flows. From 35th Street manhole No. 16.08 to 38th Street manhole 16.06 (see Figure 5-2) the existing 21 inch diameter gravity sewer has a capacity of from 1.7 cfs to 3.2 cfs. Under the intermediate development plan estimated peak flows are 3.8 cfs (see Figure 5-3). The existing 21 inch diameter gravity sewer between manhole No. 16.08 and manhole No. 16.06 must be relaid with a 24 inch diameter gravity sewer (see Figure 5-2).

Trunk Sewer No. 3

Existing trunk sewer No. 3 in Sheridan Road is inadequate to convey the estimated future peak flows between 87th Avenue manhole No. 3.09 and 85th Avenue manhole No. 3.08. The existing 18 inch gravity sewer between manhole No. 3.09 and 3.08 has a capacity of 3.5 to 4.2 cfs. Under the intermediate development plan the estimated peak flow is 4.8 cfs (see Figure 5-3). To provide capacity for the estimated future peak flow a relay of the existing 18 inch gravity sewer in Sheridan Road with a 21 inch diameter gravity sewer will be required (see Figure 5-2).

Trunk Sewer No. 12

Existing trunk sewer No. 12 is a portion of the main north-south trunk sewer for Kenosha. This sewer begins at the intersection of 50th Street with the Chicago and Northwestern Railroad right-of-way and connects to trunk sewer No. 1 at the intersection of 67th Street extended and 3rd Avenue. The existing sewer is a 60 inch diameter gravity sewer. The existing capacity of this trunk sewer ranges from 14 cfs to 165 cfs. The estimated future peak flow varies by location from 90 to 110 cfs (see Figure 5-3). To provide capacity for the estimated future peak flows, construction of 8770 feet of 72 inch diameter gravity sewer will be required (see Figure 5-2).

Trunk Sewer No. 1

Trunk sewer No. 1 is the main north-south trunk sewer for Kenosha. The sewer is an existing 72 inch diameter gravity sewer in 3rd Avenue from 67th Street (extended) to the Kenosha Water Utility WTF (see Figure 5-2). The estimated capacity of this sewer ranges between 77 cfs and 134 cfs. Under this sub-alternative the required capacity for this trunk sewer varies by location from 187 cfs to 192 cfs (see Figure 5-3). To provide the required capacity construction of 4430 feet of 96 inch diameter gravity sewer will be required (see Figure 5-2).

The total estimated construction cost of Sub-Alternative A for new and relayed trunk sewers is $18,747,650. The total 50 year present worth of these trunk sewers is $24,548,100. Detailed costs are listed in Table 5-1.

Treatment Facilities

Sub-Alternative A provides for "centralized" sanitary sewer service to the entire planning area. The centralized wastewater treatment facility will logically be located at the Kenosha Water Utility WTF site which already provides service to over 95 percent of the existing served population. In addition, major trunk lines have been constructed or have been planned for construction to deliver sewage flows to the current facility location. In addition, the Kenosha Water Utility has purchased 27 acres of land adjacent to and south of the current wastewater treatment facility for expansion purposes.

The current facility has excess capacity to handle additional average daily base flows but cannot handle maximum daily or peak instantaneous flows. The average hydraulic loading in 1988 was 19.8 MGD while the facility was designed to treat 28.4 MGD. Organic loading limits are not being exceeded per Table 3-24. Peak hydraulic loadings exceed the existing facilities hydraulic capacity of 68 MGD and the peak instantaneous pumping capacity of 90 MGD.

To solve the existing hydraulic problems and to provide for the year 2010 loadings, two alternatives were considered; the first being treatment facility expansion and the second being storage at the head end of the facility.

As noted in Chapter IV, an investigation of the existing facility shows that all the existing treatment components are at or over the design peak hydraulic limit with the exception of sludge handling. It is estimated that the existing max day and peak hour flows are 87 MGD and 137 MGD. The estimated 2010 future max day and peak hour flows are 92 MGD and 140 MGD compared to the original design flows of 68 MGD and 90 MGD respectively. This will require expansion of a number of components including the addition of a new, deeper sewage pumping station with a 140 MGD capacity, new grit removal, primary clarifiers, aeration, final clarifiers and chlorine contact chambers with a 72 MGD peak hydraulic capacity to bring the maximum hydraulic and treatment capacity up to 140 MGD. The continued use of rectangular primary clarifiers, peripheral feed secondary clarifiers and disinfection by use of the existing chlorine gas feed systems has been assumed because of the favorable recommendation given by the WTF operation staff. Use of fine bubble aeration equipment has also been assumed. It is anticipated that the existing facility aeration equipment will be converted to fine bubble diffusers. No costs were included for conversion of the existing facility aeration equipment, since this cost would be the same for all alternatives. A new effluent outfall pipe would be constructed into Lake Michigan to alleviate backups which currently occur under storm flow conditions with the existing outfall pipe. Since the existing average daily design flow of 28.4 MGD is greater than the proposed year 2010 average daily flow of 25.3 MGD, no additions to the sludge processing portion of the facility were included.

The new DNR requirement for 180 days of sludge storage capacity do not apply to this facility, because waste sludge is disposed of in a landfill, which operates all year long.

The issue of ammonia toxicity is just beginning to be explored at this facility. Preliminary tests have not indicated a problem, but additional toxicity testing of the effluent is anticipated. The construction of additional aeration basins under this alternative will increase the average hydraulic detention time by 100% which should enhance nitrification. In addition, the extra tankage should permit more flexibility in treating digester supernatant which is a significant source of ammonia in the wastewater. This report does not evaluate the additional aeration capacity that may be required to assure nitrification of all the WTF influent wastewater. Detailed facility planning for the Kenosha WTF should consider this issue in detail.

Specifically, this alternative includes the following additions to the Kenosha WTF:

- A new 140 MGD sewage pumping station
- New grit removal chambers of 72 MGD capacity
- Six new 40 feet wide by 200 feet long primary clarifiers
- Six new 30 feet wide by 270 feet long by 15 feet water depth aeration basins
- Three new 160 feet diameter peripheral feed final clarifiers
- Two new chlorine contact chambers of 748,000 gallons capacity to provide a minimum hydraulic detention time of 30 minutes at peak hourly design flow
- A new pump and blower building to house sludge pumps, blowers, grit handling equipment and electrical controls
- A new 1500 foot long 84 inch diameter outfall pipe

The current facility is hydraulically isolated from the land that is available for expansion because of a 99 inch diameter storm sewer which runs adjacent to the existing facility. Therefore, any facility expansion must be done parallel to rather than in series with existing treatment components. For this reason a new parallel treatment facility is planned under this alternative. The only exception

Table 5 -1

TRUNK SEWER COSTS

ALTERNATIVE I
SUB-ALTERNATIVE A

Location	Item	Quantity	Unit Price	Cost	Life	Replacement Costs 20 Years	30 Years	40 Years	Salvage	O & M
Trunk Sewer #1	96" Sanitary	4,430.000	$800	$3,544,000	50				$0	$1,678
Trunk Sewer #3	21" Sanitary	1,260.000	$165	$207,900	50				$0	$477
Trunk Sewer #12	72" Sanitary	8,770.000	$600	$5,262,000	50				$0	$3,322
Trunk Sewer #16	24" Sanitary	2,770.000	$100	$277,000	50				$0	$1,049
Trunk Sewer #18	18" Sanitary	2,250.000	$157	$353,250	50				$0	$852
Trunk Sewer #20	24" Sanitary	1,100.000	$100	$110,000	50				$0	$417
Trunk Sewer # 28	8" Sanitary	3,700.000	$50	$185,000	50				$0	$1,402
Trunk Sewer #29	4.0 MGD Lift Station	1.000	$696,000	$696,000	20 - 50	$45,000	$90,000	$45,000	($52,200)	$34,800
	16" Force Main	11,000.000	$46	$506,000	50				$0	$1,042
Trunk Sewer #30	.27 MGD Life Station	1.000	$88,000	$88,000	20 - 50	$10,000	$6,500	$10,000	($7,145)	$4,400
	6" Force Main	6,000.000	$30	$180,000	50				$0	$568
Trunk Sewer #31	18" Sanitary	2,200.000	$65	$143,000	50				$0	$833
	18" Sanitary	1,600.000	$65	$104,000	50				$0	$606
	5.2 MGD Lift Station	1.000	$1,016,000	$1,016,000	20 - 50	$50,000	$100,000	$50,000	($58,000)	$50,800
	16" Force Main	2,600.000	$46	$119,600	50				$0	$246
	30" Sanitary	2,450.000	$95	$232,750	50				$0	$928
	18" Sanitary	1,900.000	$85	$161,500	50				$0	$720
	21" Sanitary	1,080.000	$165	$178,200	50				$0	$409
	27" Sanitary	900.000	$225	$202,500	50				$0	$341
	27" Sanitary	1,050.000	$225	$236,250	50				$0	$398
Trunk Sewer #32	0.69 MGD Lift Station	1.000	$158,000	$158,000	20 - 50	$10,000	$158,000		($52,140)	$7,900
	8" Force Main	9,000.000	$34	$306,000	50				$0	$852
Trunk Sewer #33	2.58 MGD Lift Station	1.000	$264,000	$264,000	20 - 50	$15,000	$264,000		($87,120)	$13,200
	12" Force Main	10,800.000	$38	$410,400	50				$0	$1,023
Trunk Sewer #34	0.56 MGD Lift Station	1.000	$152,000	$152,000	20 - 50	$10,000	$152,000		($50,160)	$7,600
	8" Force Main	15,700.000	$34	$533,800	50				$0	$1,487
Trunk Sewer #35	15" Sanitary	2,200.000	$60	$132,000	50				$0	$833
	18" Sanitary	5,500.000	$65	$357,500	50				$0	$2,083
	18" Sanitary	5,500.000	$121	$665,500	50				$0	$2,083
	21" Sanitary	2,500.000	$145	$362,500	50				$0	$947
Trunk Sewer # 36	8" Sanitary	6,000.000	$90	$540,000	50				$0	$2,273
	10" Sanitary	11,000.000	$45	$495,000	50				$0	$4,167
	6" Force Main	16,000.000	$30	$480,000	50				$0	$1,516
	0.26 MGD Lift Station	1.000	$88,000	$88,000	20 - 50	$10,000	$6,500	$10,000	($7,145)	$4,400
Total				$18,747,650		$150,000	$777,000	$115,000	($313,910)	$155,652
Engineering & Contingencies (30%)				$5,624,295						
Total Costs				$24,371,945						
Present Worth Factors				1.0000		0.3118	0.1741	0.0972	0.0543	
Present Worth				$24,371,945		$46,771	$135,284	$11,181	($17,042)	
Total Present Worth Of Construction				$24,548,138						

Source: Ruekert & Mielke, Inc.

is the sludge handling which will be used by pumping sludge back to the existing sludge handling facilities.

The construction cost for this treatment alternative is estimated at $20,969,000 with a 50 year present worth of construction equal to $29,288,900. Annual operation and maintenance (O & M) is estimated to be $1,633,400 with a present worth of $25,745,700. The total present worth of this treatment alternative is $55,034,600. Detailed costs are listed in Table 5-2. Appendix F lists treatment facility operation and maintenance costs.

Storage Facilities

A storage option was also considered in lieu of facility expansion under this alternative. The existing average day capacity of the Kenosha WTF is 28.4 MGD, which is greater than the 2010 average design flow requirement of 25.3 MGD. However the existing WTF is forced to bypass wastewater when storm flows exceed the hydraulic capacity of the facility. The existing Kenosha WTF has the ability to treat a peak flow of approximately 68 MGD. Onsite storage of flows in excess of this flow rate would eliminate the need to add hydraulic capacity to the WTF. Storage of 22 million gallons would eliminate bypassing of the 10 year storm.

This alternative includes construction of a new deeper sewage pumping station of 140 mgd capacity. Flows in excess of 68 MGD would be pumped to one of five newly constructed 200 feet diameter by 19 feet water depth circular storage tanks, each of which can store 4,400,000 gallons of wastewater. A circular sludge collector mechanism installed in each tank would move settled sludge and debris to the tank centers from where it would be drained back to the pumpstation wet well with the wastewater following the storm flow event.

The construction cost for this alternative is approximately $11,635,000 with a fifty year present worth of construction of $12,644,000. Operation and maintenance of the storage facility only is estimated to be $25,000/year. The cost of operation and maintenance of the lift station is not included in this alternative because it is common to all alternatives, and would not be impacted by operation of the storage facility. Existing treatment facility annual O & M cost is $1,484,000. Detailed costs are listed in Table 5-3.

It should be noted that the above noted treatment facility upgrading and expansion requirements may require the use of additional lands beyond the current limits of the plant site. The Kenosha Water Utility currently owns 27 acres of land immediately south of the sewage plant site. A portion of that land is one potential site for new treatment facilities. Another option which could be considered if additional facility site area is required would be to fill into the lake to create additional site lands. It is noted that the land located south of the WTF has been identified as an open space preservation area in the land use management plan for the Chiwaukee Prairie.[1] The land is currently zoned as a conservancy area. In view of this, detailed environmental assessment analyses, as well as an evaluation of alternatives would be needed to support any rezoning request to utilize a portion of the lands designated for open space preservation for WTF purposes. Since detailed WTF site layouts and evaluations will not be conducted under this system plan, it is recommended that the necessary detailed environmental evaluations of alternative facility site expansion proposals be carried out as part of the detailed facility planning proposed to be carried out by the Kenosha Water Utility. Such environmental assessment would include consideration of complete use of the existing site and, if needed, the alternative of expanding the site to the south as well as the alternative of expanding the site on fill placed in the lake.

While storage of excess storm flows would eliminate wet weather bypassing, it does not address the potential problem of WTF effluent ammonia toxicity. Current data indicates that the WTF is meeting existing effluent ammonia toxicity standards. However the WTF was not designed to remove ammonia, and anticipated increases in wastewater flow to the facility may degrade its ammonia removal efficiency and result in toxicity violations during the planning period. Since this alternative does not alter the WTF performance except during storm events, additional studies of WTF performance, and the WTF's ability to nitrify wastewater to eliminate effluent ammonia should be made. However, these studies are beyond the scope of this study. In addition, this storage alternative will be evaluated in Chapter VI with year 2010 optimistic population and ultimate population projections. This may impact the choice of storage vs treatment or may result in a combination of storage and treatment units to cost effectively serve future flows. For these reasons the present worth analyses set forth in this chapter have incorporated the WTF expansion option. As stated above, storage will be considered in Chapter VI for the selected alternative.

WTF Abandonment

Under the "Centralized" alternate, Pleasant Prairie WTF's would be abandoned within the 20 year planning period.

Demolition of the Pleasant Prairie SUD 73-1 wastewater treatment facility would consist of complete removal and salvage of the steel package

1. SEWRPC Community Assistance Planning Report No. 86, A Land Use Management Plan for the Chiwaukee Prairie-Carol Beach Area of the Town of Pleasant Prairie.

Table 5 - 2

ALTERNATIVE I

KENOSHA WTF - 72 MGD ADDITION
COST SUMMARY

Item	Cost	Life	Replacement Costs 20 Years	Replacement Costs 30 Years	Replacement Costs 40 Years	Salvage
Lift Station	$3,043,000	20 -50	$1,003,000	$800,000	$1,003,000	($765,500)
Grit Collectors	$285,000	50				$0
Primary Clarifiers	$2,524,000	20 -50	$1,013,000	$114,000	$1,013,000	($544,120)
Aeration Basins	$2,720,000	20 -50	$890,000		$890,000	($445,000)
Final Clarifiers	$2,564,000	20 -50	$615,000	$42,000	$615,000	($321,360)
Chlorine Contact	$686,000	50				$0
Pump House	$1,004,000	20 -50	$461,000		$461,000	($230,500)
Outfall	$1,400,000	50				$0
Electrical	$2,300,000	30		$2,300,000		($759,000)
Mechanical	$2,950,000	50				$0
Miscellaneous Channels	$893,000	50				$0
Site Work	$600,000	50				$0
Total Costs	$20,969,000		$3,982,000	$3,256,000	$3,982,000	($3,065,480)
Engineering & Contingencies (30%)	$6,290,700					
Construction Total	$27,259,700					
Present Worth Factors	1.0000		0.3118	0.1741	0.0972	0.0543
	$27,259,700		$1,241,606	$566,903	$387,139	($166,420)

Total Present Worth Of Construction	$29,288,928
Average Annual O & M Costs *	$1,633,400

* O & M cost excludes administrative, billing and accounting costs. See Appendix F for detailed costs.

Source: Ruekert & Mielke, Inc.

Table 5-3

ALTERNATIVE I

KENOSHA WTF - 22 MILLION GALLON STORAGE RESERVIOR
COST SUMMARY

Item	Cost	Life	Replacement Costs 20 Years	30 Years	40 Years	Salvage
Lift Station	$3,043,000	20 -50	$1,003,000	$800,000	$1,003,000	($765,500)
Structure	$4,595,000	50				$0
Equipment	$1,312,000	20	$1,312,000		$1,312,000	($656,000)
Total Costs	$8,950,000		$2,315,000	$800,000	$2,315,000	($1,421,500)
Engineering & Contingencies (30%)	$2,685,000					
Construction Total	$11,635,000					
Present Worth Factors	1.0000		0.3118	0.1741	0.0972	0.0543
	$11,635,000		$721,828	$139,288	$225,069	($77,171)

Total Present Worth Of Construction	$12,644,015
Storage Facility Annual O & M Costs *	$25,000
Existing WTF Annual O & M Costs **	$1,484,000
Total Annual O & M Costs	$1,509,000

* O & M cost assumes $5,000 per year per tank for storage tanks.
** O & M excludes administrative, billing and accounting costs.

Source: Ruekert & Mielke, Inc.

plant structure down to the base slab and complete removal of the masonry construction blower building. Reinforced concrete structures would be broken off approximately 3 feet below final grade, holes would be punched in the bases for drainage, and the structures filled in with the rubble. The buried steel pump station would be filled in with sand unless a buyer could be found to make salvage practical. The steel package plant salvage value is assumed to equal the cost of removal of the structure.

Following demolition of all structures, the site would be graded smooth and seeded. Future uses for the site could include parklands, athletic fields, or light industry or commercial uses.

Table 5-4
Pleasant Prairie SUD "73-1"
Demolition Costs

1	Steel Package Plant assumes steel salvage value = cost of removal	$ 0
2	Salvage Value of Equipment	
a	Hoffman blowers 2 @ $500/Each	($1,000)
b	Misc. Equipment	($ 500)
3	Demolition	
a	Control Building	$4,500
b	Lift Station (fill in place)	$1,000
c	Other concrete structures	$5,000
4	Site Restoration	$5,000
	Total Demolition	$14,000

Demolition of the Pleasant Prairie SUD "D" wastewater treatment facility would be more difficult then the other Pleasant Prairie WTF. Salvageable items at the WTF would include pumps, mechanical aeration equipment, emergency power generator and aluminum handrails. In addition, the main control building and garage could be used for municipal use, or for light industry or commercial use. The existing sewage pumping station could be modified for use in pumping wastewater to the Kenosha collection system. Other reinforced concrete structures such as the aeration basin, final clarifier, sludge storage tank and chlorine contact chamber would be demolished down to several feet below final grade. Holes would be punched in floor slabs for drainage, the structures would be filled in with rubble and fill, and the area graded and restored. Future uses of the site, for construction, would be limited over the areas where the structures once stood. However, the site has ample open area to permit construction on undisturbed soil. Other possible uses for the site would include parklands, athletic fields, and municipal or light industrial or commercial development.

Table 5-5
Pleasant Prairie SUD "D"
Demolition Costs

1	Retain Control Building	($80,000)
2	Break structures down to 2' below final grade, fill and restore site	$130,000
3	Salvage Items:	
a	Pumps (RAS, sludge, etc.)	($ 5,000)
b	Aeration equip - 2 @ 5,000	($10,000)
c	Generator set	($ 5,000)
d	Handrails aluminum & stairs	($ 1,000)
e	Lab equipment, misc. items	($ 1,500)
	Total Salvage	($22,500)
	Net Abandonment Cost	$27,500

The costs of WTF abandonment would be offset by the value of reusable land which could be sold for a cost of between $3,000 and $5,000 per acre. Sale of the WTF land could generate between $30,000 and $50,000 per site. Because this revenue would offset the costs of abandonment, the costs were not carried through this present worth analysis.

Sub-Alternative A Total Costs

The fifty year total present worth cost of Sub-Alternative A is $82,036,100 including trunk sewers and with full wastewater treatment facility expansion. Detailed costs are listed in Table 5-6.

Table 5-6
Sub-Alternative A
Total Present Worth Cost Summary of Sewerage Facilities

WTF Alternate	
Present Worth of Construction	
o Trunk Sewers	24,548,138
o Kenosha WTF	29,288,928
Annual O & M	
o Trunk Sewers 155,652	
o Kenosha WTF 1,633,400	
1,789,052	
Present Worth of O & M	28,199,000
Total Present Worth	82,036,100

Source: Ruekert & Mielke, Inc.

SUB-ALTERNATIVE B

Sub-Alternative B also provides "centralized" sanitary sewer service to the entire study area. Sewer facilities for this sub-alternative were determined based on the 2010 Intermediate "Centralized" Land Use Plan. Peak flows at key points of the system can be found on Figure 5-5.

Sub-alternative B differs from Sub-Alternative A in that Basins 10.04, 10.05 & 10.06 would be conveyed to the site of the existing SUD "D" treatment facility. A lift station would be constructed at this location and all flow would be conveyed to the proposed trunk sewer No. 35 at the intersection of 64th Avenue and 104th Street (see Figure 5-4).

As a result of the change in the conveyance route for Sub-Alternative B, trunk sewers No. 10, 29, 30, 31 and 35 would require different size conveyance facilities than required under Sub-Alternative A. All other required conveyance facilities would remain the same as outlined under Sub-Alternative A. The following is a description of the required conveyance facilities for trunk sewers No. 10, 29, 30, 31 and 35 as well as an estimated cost for each sewer.

Trunk Sewer No. 30

This trunk sewer would convey flow from basin 10.04 to existing trunk sewer No. 26 via a 0.26 MGD lift station and approximately 5,500 feet of 6 inch diameter forcemain (see Figure 5-4). The route of this sewer would be along 75th Street, from the lift station site at the east side of the Des Plaines River, to a connection with the existing trunk sewer No. 26 at 104th Avenue. This sewer was sized to convey a peak flow of 0.41 cfs (see Figure 5-5).

Trunk Sewers No. 31 & 10

Trunk sewer No. 31 in 75th Street conveys flow from basin 10.03 to existing trunk sewer No. 10 at STH 31 manhole 10.03 (see Figure 5-4). Trunk sewer No. 31 would consist of approximately 2,200 feet of 8 inch diameter gravity sewer 4,050 feet of 12 inch diameter gravity sewer, 2600 feet of 8 inch diameter forcemain and a 0.92 MGD lift station. These sewers were sized based on a peak flow of 0.71 cfs to 1.42 cfs (see Figure 5-5). The route of the gravity sewer begins along the north side of 75th Street, approximately 1/2 mile west of 88th Avenue, and continues east along 75th Street to the Chicago and Northwestern Railroad right-of-way where the lift station would be located. An 8 inch diameter forcemain along the north side of 75th Street would connect the above lift station to manhole No. 10.03 at STH 31 (see Figure 5-4).

Existing trunk sewer No. 10 in 75th Street is inadequate to convey the additional flow from basin 10.03. As a result the existing 12 inch and 18 inch diameter sewers between manholes 10.03 and 10.01 would be replaced with a 15 inch diameter gravity sewer between STH 31 manhole No. 10.03 and 60th Street manhole 10.02 and a 21 inch diameter gravity sewer between 60th Street manhole No. 10.02 and "KD" tracks manhole No. 10.01. The estimated peak flow used to size these reaches of sewer are 3.75 cfs and 6.08 cfs respectively (see Figure 5-5).

Trunk Sewer No. 29

Trunk sewer No. 29 conveys flows from basins 10.04, 10.05 and 10.06. Trunk sewer 29 would consist of a 4.27 MGD lift station, at the location of the existing SUD "D" WTF, and approximately 24,800 feet of 16 inch diameter forcemain from the above lift station to a connection with the proposed trunk sewer No. 35 in 104th Street (see Figure 5-4). The route of the forcemain would be north from the above lift station to Wilmot Road; then northeast in Wilmot Road to Bain Station Road; then east in Bain Station Road to 88th Avenue; then south in 88th Avenue to 104th Street; then east in 104th Street to the intersection of 104th Street and 64th Avenue where trunk sewer No. 35 begins (see Figure 5-4). The peak flow used to size this sewer is 6.60 cfs (see Figure 5-5).

Trunk Sewer No. 35

Trunk sewer No. 35 conveys flow for basins 10.04, 10.05, 10.06, 2.10, 2.11, 2.12, 2.13, 2.14, 2.15 and 2.16 to the existing trunk sewer No. 24 (see Figure 5-4). The route for this sewer begins at the intersection of 64th Avenue and 104th Street and continues east along 104th Street to manhole No. 24.10 at the intersection of 104th Street and Sheridan Road. Trunk sewer No. 35 consists of 2,200 feet of 21 inch diameter gravity sewer; 11,000 feet of 24 inch diameter gravity sewer and 2,500 feet of 27" diameter gravity sewer. The peak flows used to size the pipes listed above range from 11.89 cfs to 12.98 cfs (see Table 5-7).

The total estimated construction cost of Sub-Alternative B for new and relayed trunk sewers is $18,387,800. The total 50 year present worth of these trunk sewers is $24,077,000. Detailed costs are listed in Table 5-7.

Storage and Treatment Facilities

The storage and treatment facility description and costs are the same as Sub-Alternative A.

Sub-Alternative B Total Costs

The fifty year total present worth cost of Sub-Alternative B is $80,974,200 including trunk sewers and with full wastewater treatment facility expansion. Detailed costs are listed in Table 5-8.

Figure 5-4

ALTERNATE I
SUB-ALTERNATIVE B
RECOMMENDED
CONVEYANCE FACILITIES

Figure 5-5

ALTERNATE I
SUB-ALTERNATIVE B
PEAK FLOW
AT KEY POINTS

Table 5-7

TRUNK SEWER COSTS

ALTERNATIVE I
SUB-ALTERNATIVE B

Location	Item	Quantity	Unit Price	Cost	Life	Replacement Costs 20 Years	30 Years	40 Years	Salvage	O & M
Trunk Sewer #1	96" Sanitary	4,430.000	$800	$3,544,000	50				$0	$1,678
Trunk Sewer #3	21" Sanitary	1,260.000	$165	$207,900	50				$0	$477
Trunk Sewer #12	72" Sanitary	8,770.000	$600	$5,262,000	50				$0	$3,322
Trunk Sewer #16	24" Sanitary	2,770.000	$100	$277,000	50				$0	$1,049
Trunk Sewer #18	18" Sanitary	2,250.000	$157	$353,250	50				$0	$852
Trunk Sewer #20	24" Sanitary	1,100.000	$100	$110,000	50				$0	$417
Trunk Sewer # 28	8" Sanitary	3,700.000	$50	$185,000	50				$0	$1,402
Trunk Sewer #29	4.27 MGD Lift Station	1.000	$778,000	$778,000	20 - 50	$45,000	$100,000	$45,000	($55,500)	$38,900
	16" Force Main	24,800.000	$46	$1,140,800	50				$0	$2,348
Trunk Sewer #30	.26 MGD Lift Station	1.000	$88,000	$88,000	20 - 50	$10,000	$6,500	$10,000	($7,145)	$4,400
	6" Force Main	5,500.000	$30	$165,000	50				$0	$521
Trunk Sewer #31	8" Sanitary	2,200.000	$50	$110,000	50				$0	$833
	12" Sanitary	4,050.000	$55	$222,750	50				$0	$1,534
	15" Sanitary	3,000.000	$80	$240,000	50				$0	$1,136
	21" Sanitary	900.000	$180	$162,000	50				$0	$341
	0.92 MGD Lift Station	1.000	$167,000	$167,000	20 - 50	$12,000	$167,000		($55,110)	$8,350
	8" Force Main	2,600.000	$34	$88,400	50				$0	$246
Trunk Sewer #32	0.69 MGD Lift Station	1.000	$158,000	$158,000	20 - 50	$10,000	$158,000		($52,140)	$7,900
	8" Force Main	9,000.000	$34	$306,000	50				$0	$852
Trunk Sewer #33	2.58 MGD Lift Station	1.000	$264,000	$264,000	20 - 50	$15,000	$264,000		($87,120)	$13,200
	12" Force Main	10,800.000	$38	$410,400	50				$0	$1,023
Trunk Sewer #34	0.56 MGD Lift Station	1.000	$152,000	$152,000	20 - 50	$10,000	$152,000		($50,160)	$7,600
	8" Force Main	15,700.000	$34	$533,800	50				$0	$1,487
Trunk Sewer #35	21" Sanitary	2,200.000	$70	$154,000	50				$0	$833
	24" Sanitary	5,500.000	$80	$440,000	50				$0	$2,083
	24" Sanitary	5,500.000	$146	$803,000	50				$0	$2,083
	27" Sanitary	2,500.000	$185	$462,500	50				$0	$947
Trunk Sewer # 36	8" Sanitary	6,000.000	$90	$540,000	50				$0	$2,273
	10" Sanitary	11,000.000	$45	$495,000	50				$0	$4,167
	6" Force Main	16,000.000	$30	$480,000	50				$0	$1,516
	0.26 MGD Lift Station	1.000	$88,000	$88,000	20 - 50	$10,000	$6,500	$10,000	($7,145)	$4,400
Total				$18;387,800		$112,000	$854,000	$65,000	($314,320)	$118,170
Engineering & Contingencies (30%)				$5,516,340						
Total Costs				$23,904,140						
Present Worth Factors				1.0000		0.3118	0.1741	0.0972	0.0543	
Present Worth				$23,904,140		$34,922	$148,690	$6,319	($17,064)	
Total Present Worth Of Construction				$24,077,008						

Source: Ruekert & Mielke, Inc.

Table 5-8
Sub-Alternative B
Total Present Worth Cost Summary of Sewerage Facilities

o Trunk Sewers		24,077,000
o Kenosha WTF		29,288,928
Annual O&M		
o Trunk Sewers	118,170	
o Kenosha WTF	1,633,400	
	1,751,600	
Present Worth of O&M		27,608,200
Total Present Worth		80,974,200

Source Ruekert & Mielke, Inc.

Sub-Alternative C

Sub-Alternative C also provides "centralized" sanitary sewer service to the entire planning area. This sub-alternative is different than Sub-Alternative A in that basins 10.05 and 10.06 are conveyed to different trunk sewers.

In Sub-Alternative A, the flow from basin 10.05 combines with the flow from basin 10.06 at a lift station near the existing SUD "D" WTF. The combined flows from basins 10.05 and 10.06 are pumped to trunk sewer No. 31 in 75th Street (see Figure 5-2). Under this sub-alternative, basin 10.05 is connected to trunk sewer No. 30 in 75th Street and basin 10.06 is connected to trunk sewer No. 35 in 104th Street (see Figure 5-6). As a result of conveying these two basins, No. 10.05 and No. 10.06, to different trunk sewers, the required capacities of trunk sewers No. 10, 29, 30, 31 and 35 will be different than the capacities required under Sub-Alternative A. The following is a description of the conveyance facilities and resulting costs required for trunk sewers No. 10, 29, 30, 31 and 35. All other trunk sewers and costs remain the same as required for Sub-Alternative A.

Trunk Sewer No. 30

To provide sanitary sewer service to basins No. 10.04 and 10.05, construction of trunk sewer No. 30 in 75th Street would be required (see Figure 5-6).

This sewer consists of 1300 feet of 15 inch diameter gravity sewer; 200 feet of 6 inch and 8 inch diameter inverted siphon; a 1.36 MGD lift station and 8,000 feet of 10 inch diameter forcemain.

The route of trunk sewer No. 30 begins at an existing lift station along the south side of 75th Street near 118th Avenue. The existing lift station would be abandoned and the flow would be conveyed by a 15 inch diameter gravity sewer and a 6 inch and 8 inch diameter inverted siphon east along 75th Street to a new 1.36 MGD lift station. This lift station would be located along the north side of 75th Street along the east side of the Des Plaines River. A 10 inch diameter forcemain conveys flow east along 75th Street to the connection with trunk sewer No. 31 approximately 1/2 mile west of 88th Avenue. The estimated peak flow used to size these facilities ranges from 0.41 cfs to 2.11 cfs depending on location (see Figure 5-7).

Trunk Sewer No. 31

To convey the estimated flows from basin Nos. 10.03, 10.04 and 10.05 to the existing City of Kenosha trunk sewer system will require construction of trunk sewer No. 31 in 75th Street (see Figure 5-6).

Trunk sewer No. 31 consists of 2,200 feet of 12 inch diameter gravity sewer; 1,600 feet of 15 inch diameter gravity sewer; 2450 feet of 21 inch diameter gravity sewer; a 2.28 MGD lift station and 2,600 feet of 12 inch diameter forcemain.

The route of trunk sewer No. 31 is east along 75th Street from 1/2 mile west of 88th Avenue to manhole No. 10.03 at STH 31. The peak flow used to size the above facilities ranges from 2.11 cfs to 3.52 cfs based on location (see Figure 5-7).

In addition, trunk sewer No. 10 in 75th Street from manhole No. 10.03 to manhole No. 10.01 is inadequate to convey the estimated future flows. The existing capacity of trunk sewer No. 10 between manholes No. 10.03 and 10.01 varies from 3.29 cfs to 4.50 cfs. The estimated future peak flow for trunk sewer No. 10 range from 5.86 cfs to 8.19 cfs (see Figure 5-7).

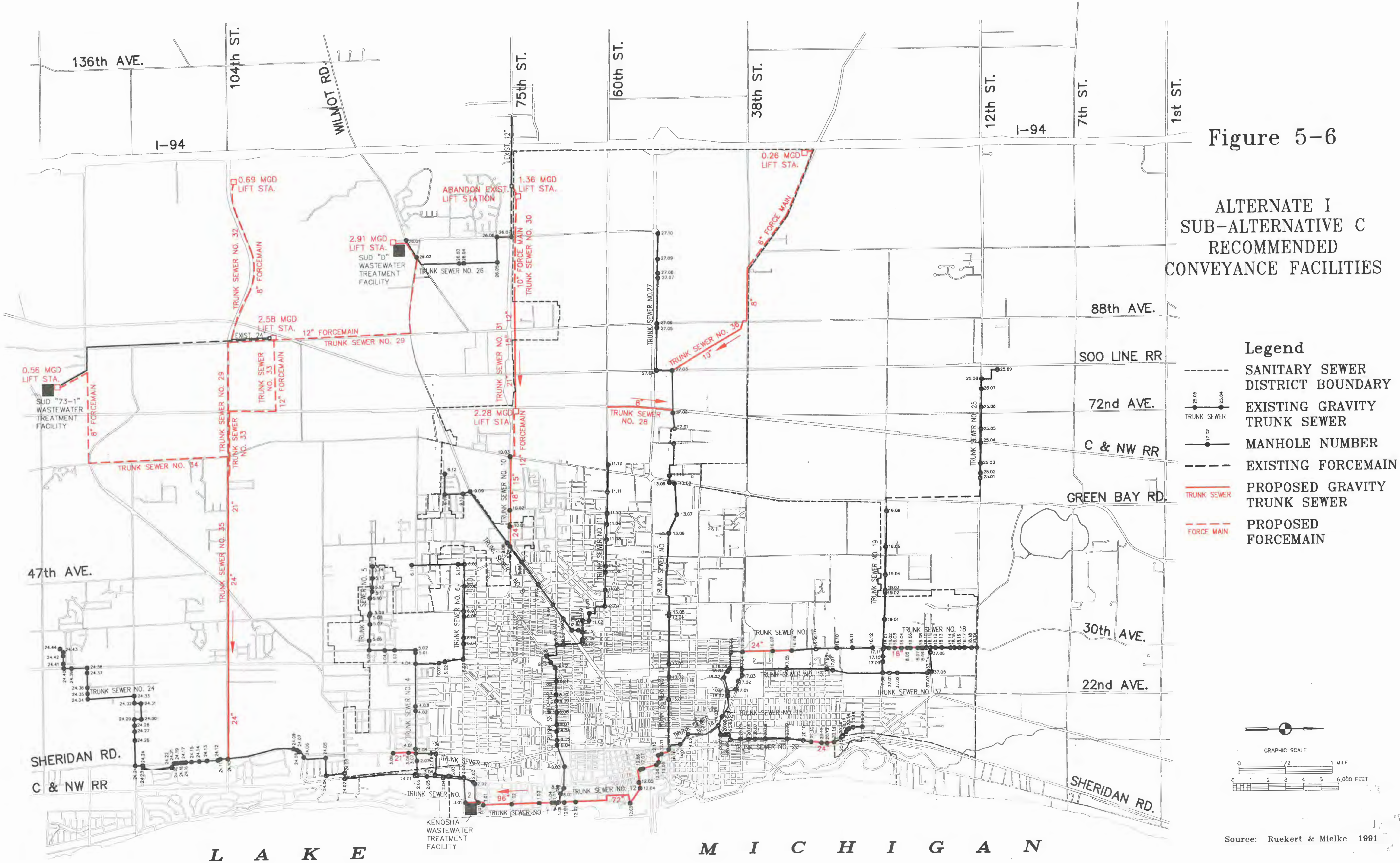
To provide adequate capacity in trunk sewer No. 10 would require relay of the existing 12 inch diameter gravity sewer between STH 31 manhole No. 10.03 and 60th Avenue manhole 10.02 with 1900 feet of 15 inch diameter and 900 feet of 18 inch diameter gravity sewer. Also, the existing 18 inch diameter gravity sewer between 60th Avenue manhole No. 10.02 and "KD" Tracks manhole No. 4.07 will have to be replaced with a 24 inch diameter gravity sewer (see Figure 5-6).

Trunk Sewer No. 29

To convey the flow from basin 10.06 would require construction of trunk sewer No. 29 (see Figure 5-6). This sewer consists of a 2.91 MGD lift station at the site of the existing SUD "D" WTF and 24,800 feet of 14 inch diameter forcemain. The route of the forcemain is from the above described lift station north to Wilmot Road, then northeast along Wilmot Road to Bain Station Road then east along Bain Station Road to 88th Avenue, then south along 88th Avenue to 104th Street, then east along 104th Street to 64th Avenue and a connection with trunk sewer No. 35 (see Figure 5-6). The estimated peak flow used to size the above facilities is 4.49 cfs (see Figure 5-7).

Figure 5-6

ALTERNATE I
SUB-ALTERNATIVE C
RECOMMENDED
CONVEYANCE FACILITIES



Source: Ruekert & Mielke 1991

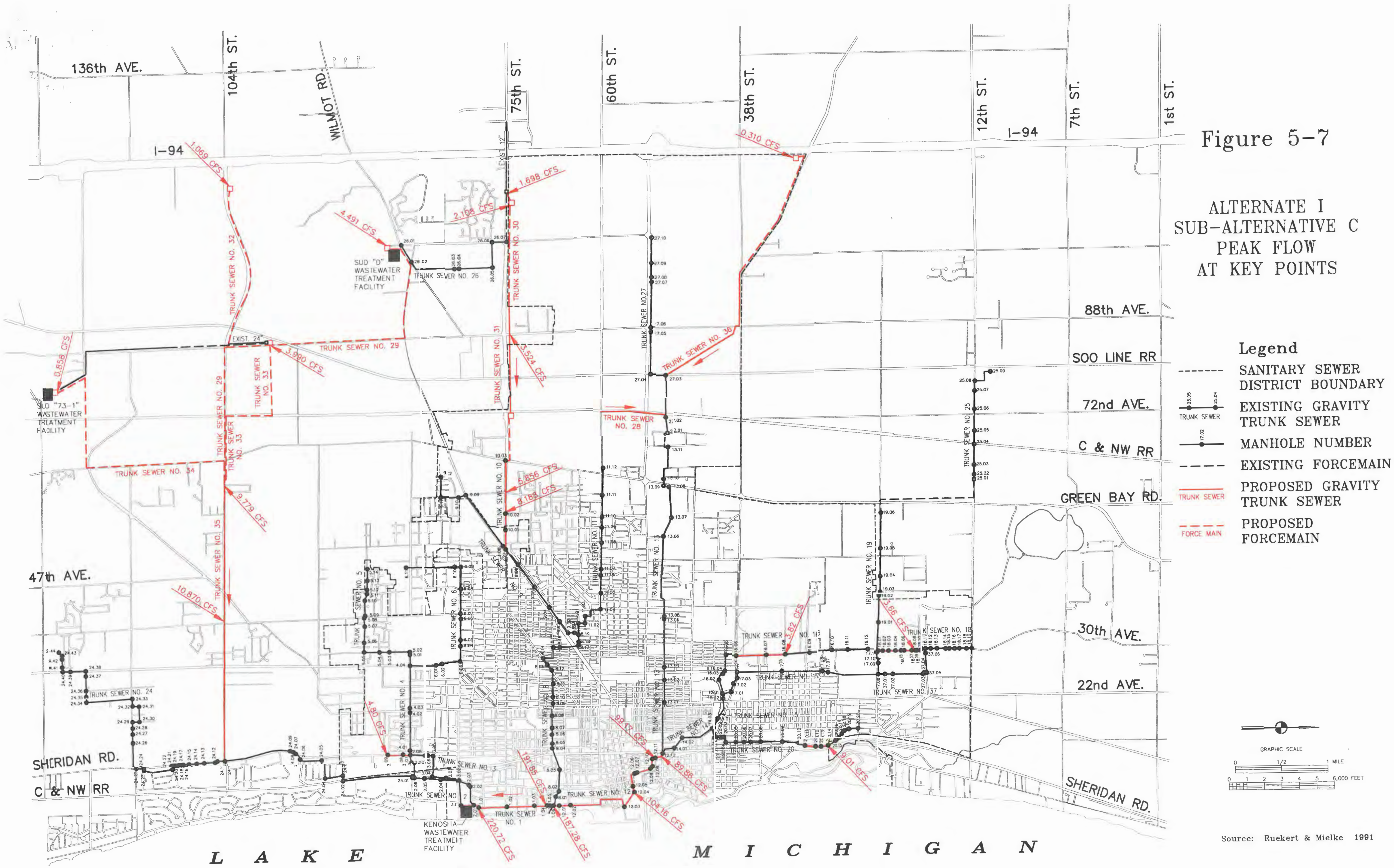


Figure 5-7

ALTERNATE I
SUB-ALTERNATIVE C
PEAK FLOW
AT KEY POINTS

Trunk Sewer No. 35

Under this sub-alternative trunk sewer No. 35 in 104th Street is sized to convey the peak flows for basins, 2.10, 2.11, 2.12, 2.13, 2.14, 2.15, 2.16, 3.10, and 10.06. The peak flow for this sewer ranges from 9.78 cfs to 10.87 cfs by location (see Figure 5-7). To convey these flows, construction of a 21 inch to 24 inch diameter gravity sewer. Trunk sewer No. 35 consists of 2,200 feet of 21 inch would be required and 13,500 feet of 24 inch diameter gravity sewer. The route of this sewer begins at the intersection of 64th Avenue and 104th Street and continues east along 104th Street to a connection with trunk sewer No. 24 at the intersection of 104th Street and Sheridan Road (see Figure 5-6).

The total estimated construction costs for Sub-Alternative C, for new and relayed sewers is $18,540,650. The total 50 year present worth of these trunk sewers is $24,342,857. Detailed costs are listed in Table 5-9.

Treatment and Storage Facilities

The storage and treatment facility description and costs are the same as Sub-Alternative A.

Sub-Alternate C Total Costs

The fifty year total present worth cost of Sub-Alternative C is $81,040,600 including trunk sewers and full wastewater treatment facility expansion. Detailed costs are listed in Table 5-10.

Table 5-10
Sub-Alternative C
Total Present Worth Cost Summary of Sewerage Facilities

Trunk Sewers		24,342,857
Kenosha WTF		29,288,928
Annual O&M		
o Trunk Sewers	105,516	
o Kenosha WTF	1,633,400	
	1,738,916	
Present Worth of O&M		27,408,800
Total Present Worth		81,040,600

Source: Ruekert & Mielke, Inc.

Sub-Alternative D

Sub-Alternative D will provide "centralized" sanitary sewer service to the entire study area from the Kenosha Water Utility WTF. This sub-alternative differs from Sub-Alternative A in the following ways. First, basins 10.03, 10.04, 10.05 and 10.06 would be connected to the existing City of Kenosha trunk sewer system via trunk sewer No. 9, along "KD" Tracks, rather than trunk sewer No. 10, along 75th Street. Secondly, the Oakdale Estates Subdivision, in the Town of Somers, would be provided sanitary sewer service via existing trunk sewer No. 25 in 12th Street (see Figure 5-8). Under Sub-Alternative A no sanitary sewer service is extended to the Oakdale Estates Subdivision. Routing flow from basins 10.03, 10.04, 10.05, and 10.06 to trunk sewer No. 9, along the "KD" Tracks rather than trunk sewer No. 10, in 75th Street would result in changes in trunk sewer No. 31. To provide sewer service to the Oakdale Estates Subdivision would require construction of trunk sewer No. 36 in 12th Street, 100th Avenue, 6th Street and along the ISH 94 Frontage Road (see Figure 5-8). The following is a description and estimated costs for the portions of this sub-alternative that differ from Sub-Alternative A. All other conveyance facilities remain the same under Sub-Alternative D as Sub-Alternative A.

Trunk Sewer No. 31

Trunk sewer No. 31 would convey flow from basins 10.03, 10.04, 10.05 and 10.06 to the existing City of Kenosha trunk sewer No. 9. Trunk sewer No. 31 consists of 3,800 feet of 18 inch diameter gravity sewer, a 5.2 MGD lift station and 7,500 feet of 14 inch diameter forcemain. The route of trunk sewer No. 31 is east along 75th Street beginning approximately 1/2 mile west of 88th Avenue to the lift station located at the Chicago and Northwestern Railroad right-of-way, then south along said right-of-way to the north line of the SE 1/4 of Section 9, T1N R22E, then east along the north line of said section and the north line of the SW 1/4 of Section 10 T1N, R22E to the Chicago and Northwestern railroad right-of-way; then northeast along the railroad right-of-way to a connection with trunk sewer No. 9 at 60th Avenue manhole 9.09 (see Figure 5-8). This sewer was sized based on estimated peak flows which vary by location from 6.60 cfs to 8.02 cfs (see Figure 5-9).

The existing capacity of trunk sewer No. 9 ranges from 31 cfs to 38 cfs. The estimated peak flows to this sewer including basins 10.03, 10.04, 10.05 and 10.06 are approximately 13 cfs. Therefore no additional capacity is required for trunk sewer No. 9.

Trunk Sewer No. 40

To provide "centralized" sanitary sewer service to the Oakdale Estates Subdivision would require construction of trunk sewer No. 40 (see Figure 5-6). This trunk sewer would consist of a 0.26 MGD lift station, located at the intersection of 4th Street and 113th Avenue, and 23,700 feet of 6 inch forcemain from the lift station to manhole No. 15.08 of existing trunk sewer No. 25 in 12th Street. The route of the forcemain is west, from the above described lift station, in 4th Street to an easement parallel to ISH 94, then south in said easement to 7th Street, then east along 7th Street to 88th Avenue, then south in 88th Avenue to 12th Street, then east in 12th Street to manhole 25.08 approximately 800 feet east of the Soo Line railroad crossing (see Figure 5-8). The estimated peak flow used to size this sewer is 0.26 cfs (see Figure 5-9). Approximately 7500 feet of forcemain would be eliminated from this alternative if a

Table 5-9

TRUNK SEWER COSTS

ALTERNATIVE I
SUB-ALTERNATIVE C

Location	Item	Quantity	Unit Price	Cost	Life	Replacement Costs 20 Years	30 Years	40 Years	Salvage	O & M
Trunk Sewer #1	96" Sanitary	4,430.000	$800	$3,544,000	50				$0	$1,678
Trunk Sewer #3	21" Sanitary	1,260.000	$165	$207,900	50				$0	$477
Trunk Sewer #12	72" Sanitary	8,770.000	$600	$5,262,000	50				$0	$3,322
Trunk Sewer #16	24" Sanitary	2,770.000	$100	$277,000	50				$0	$1,049
Trunk Sewer #18	18" Sanitary	2,250.000	$157	$353,250	50				$0	$852
Trunk Sewer #20	24" Sanitary	1,100.000	$100	$110,000	50				$0	$417
Trunk Sewer # 28	8" Sanitary	3,700.000	$50	$185,000	50				$0	$1,402
Trunk Sewer #29	2.91 MGD Lift Station	1.000	$365,000	$365,000	20 - 50	$25,000	$365,000		($120,450)	$18,250
	14" Force Main	24,800.000	$43	$1,066,400	50				$0	$2,348
Trunk Sewer #30	15" Sanitary	1,300.000	$60	$78,000	50				$0	$492
	6" & 8" Siphon	200.000	$150	$30,000	50				$0	$76
	1.36 MGD Lift Station	1.000	$185,000	$185,000	20 - 50	$13,000	$185,000		($61,050)	$9,250
	10" Force Main	8,000.000	$37	$296,000	50				$0	$758
Trunk Sewer #31	12" Sanitary	2,200.000	$55	$121,000	50				$0	$833
	15" Sanitary	1,600.000	$60	$96,000	50				$0	$606
	21" Sanitary	2,450.000	$70	$171,500	50				$0	$928
	2.28 MGD Lift Station	1.000	$206,000	$206,000	20 - 50	$15,000	$206,000		($67,980)	$10,300
	12" Force Main	2,600.000	$40	$104,000	50				$0	$246
	15" Sanitary	1,900.000	$80	$152,000	50				$0	$720
	18" Sanitary	1,080.000	$155	$167,400	50				$0	$409
	24" Sanitary	1,950.000	$200	$390,000	50				$0	$739
Trunk Sewer #32	0.69 MGD Lift Station	1.000	$158,000	$158,000	20 - 50	$10,000	$158,000		($52,140)	$7,900
	8" Force Main	9,000.000	$34	$306,000	50				$0	$852
Trunk Sewer #33	2.58 MGD Lift Station	1.000	$264,000	$264,000	20 - 50	$15,000	$264,000		($87,120)	$13,200
	12" Force Main	10,800.000	$38	$410,400	50				$0	$1,023
Trunk Sewer #34	0.56 MGD Lift Station	1.000	$152,000	$152,000	20 - 50	$10,000	$152,000		($50,160)	$7,600
	8" Force Main	15,700.000	$34	$533,800	50				$0	$1,487
Trunk Sewer #35	21" Sanitary	2,200.000	$70	$154,000	50				$0	$833
	24" Sanitary	5,500.000	$80	$440,000	50				$0	$2,083
	24" Sanitary	8,000.000	$144	$1,152,000	50				$0	$3,030
Trunk Sewer # 36	8" Sanitary	6,000.000	$90	$540,000	50				$0	$2,273
	10" Sanitary	11,000.000	$45	$495,000	50				$0	$4,167
	6" Force Main	16,000.000	$30	$480,000	50				$0	$1,516
	0.26 MGD Lift Station	1.000	$88,000	$88,000	20 - 50	$10,000	$6,500	$10,000	($7,145)	$4,400
Total				$18,540,650		$98,000	$1,336,500	$10,000	($446,045)	$105,516
Engineering & Contingencies (30%)				$5,562,195						
Total Costs				$24,102,845						
Present Worth Factors				1.0000		0.3118	0.1741	0.0972	0.0543	
Present Worth				$24,102,845		$30,557	$232,698	$972	($24,215)	
Total Present Worth Of Construction				$24,342,857						

Source: Ruekert & Mielke, Inc

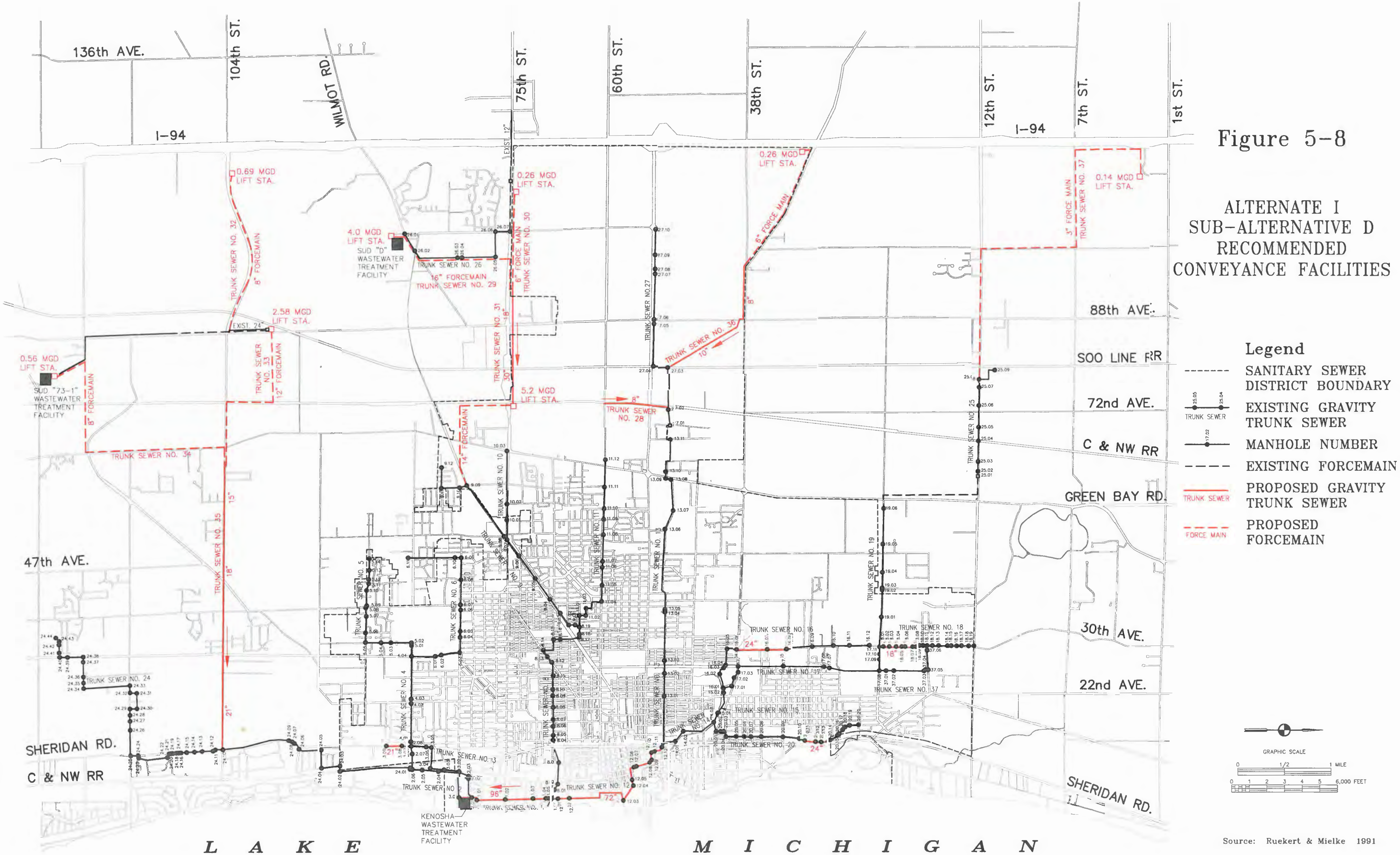


Figure 5-8
ALTERNATE I
SUB-ALTERNATIVE D
RECOMMENDED
CONVEYANCE FACILITIES
Legend
SANITARY SEWER DISTRICT BOUNDARY
EXISTING GRAVITY TRUNK SEWER
MANHOLE NUMBER
EXISTING FORCEMAIN
PROPOSED GRAVITY TRUNK SEWER
PROPOSED FORCEMAIN
GRAPHIC SCALE
Source: Ruekert & Mielke 1991
136th AVE.
104th ST.
WILMOT RD.
75th ST.
60th ST.
38th ST.
12th ST.
7th ST.
1st ST.
I-94
88th AVE.
SOO LINE RR
72nd AVE.
C & NW RR
GREEN BAY RD.
47th AVE.
30th AVE.
22nd AVE.
SHERIDAN RD.
0.69 MGD LIFT STA.
0.26 MGD LIFT STA.
4.0 MGD LIFT STA.
SUD "D" WASTEWATER TREATMENT FACILITY
2.58 MGD LIFT STA.
0.56 MGD LIFT STA.
SUD "73-1" WASTEWATER TREATMENT FACILITY
5.2 MGD LIFT STA.
0.14 MGD LIFT STA.
KENOSHA WASTEWATER TREATMENT FACILITY
L A K E M I C H I G A N

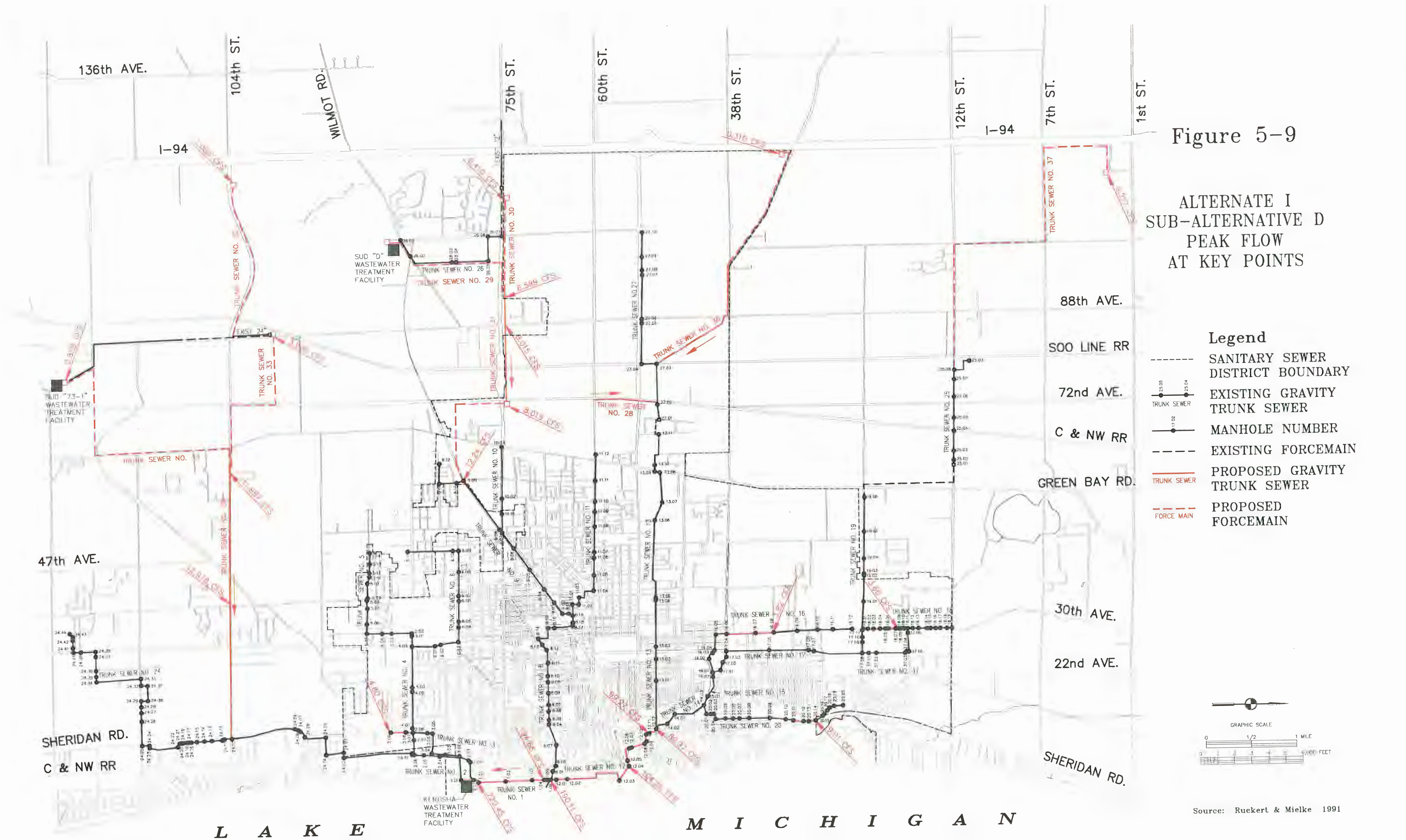


Figure 5-9
ALTERNATE I
SUB-ALTERNATIVE D
PEAK FLOW
AT KEY POINTS
Legend
SANITARY SEWER DISTRICT BOUNDARY
EXISTING GRAVITY TRUNK SEWER
MANHOLE NUMBER
EXISTING FORCEMAIN
PROPOSED GRAVITY TRUNK SEWER
PROPOSED FORCEMAIN
136th AVE.
104th ST.
WILMOT RD.
75th ST.
60th ST.
38th ST.
12th ST.
7th ST.
1st ST.
I-94
88th AVE.
SOO LINE RR
72nd AVE.
C & NW RR
GREEN BAY RD.
30th AVE.
22nd AVE.
47th AVE.
SHERIDAN RD.
SUD "D" WASTEWATER TREATMENT FACILITY
KENOSHA WASTEWATER TREATMENT FACILITY
L A K E M I C H I G A N
GRAPHIC SCALE
Source: Ruekert & Mielke 1991

connection can be made to a Town of Somers local sewer at 100th Avenue and CTH E. This option should be investigated as part of a detailed design process.

The total estimated construction costs of Sub-Alternative D for new and relayed sewers is $17,999,400. The total 50 year present worth of these trunk sewers is $23,575,300. Detailed costs are listed in Table 5-11.

Treatment and Storage Facilities

The storage and treatment facility description and costs are the same as Sub-Alternative A.

Sub-Alternative "D" Total Costs

The fifty year present worth cost of Sub-Alternative D is $81,029,500 including trunk sewers and wastewater treatment facility expansion. Detailed costs are listed in Table 5-12. These costs do not include trunk sewer No. 40 serving the Oakdale Estates Subdivision in order to fairly compare alternatives. The present worth cost of trunk sewer #37 is $1,156,400.

Table 5-12
Sub-Alternative D
Total Present Worth Cost Summary of Sewerage Facilities

o Trunk Sewers		23,575,300
o Kenosha WTF		29,288,900
o Trunk Sewers	153,510	
o Kenosha WTF	1,633,400	
	1,786,910	
Present Worth of O & M		28,165,300
Total Present Worth		81,029,500

Source: Ruekert & Mielke, Inc.

Sub-Alternative E

Sub-Alternative E is identical to Sub-Alternative D except that Oakdale Estates Subdivision, in the Town of Somers, is provided sanitary sewer service via an existing trunk sewer in CTH KR through the Town of Mount Pleasant to the City of Racine Wastewater Treatment Facility.

Trunk sewer No. 40 would require the identical pump station and length of forcemain as Sub Alternative D. However this sub-alternative was dropped after a cursory investigation revealed that the "KR" trunk sewer is considered full by the Town of Mount Pleasant engineer. A user agreement between the Town of Mount Pleasant and City of Kenosha permits connection of areas only within the original intended service area. The sewer which serves Oakdale Estates Subdivision is not in this service area.

Costs are identical to those listed under Sub Alternative D. The present worth cost is estimated at $81,029,500 not including trunk sewer No. 40 which has a present worth cost of $1,156,400.

Alternative II - "Existing Plant Expansion"

The second alternative also provides wastewater conveyance and treatment facilities for the entire planning area.

Under this alternative the areas delineated on Figure 5-1 as basin 10.05 and 10.06 would continue to be provided with wastewater treatment from the existing Pleasant Prairie Sanitary Utility District "D" WTF.

The areas delineated on Figure 5-1 as basins 2.15 & 2.16 would continue to be provided with wastewater treatment from the existing Pleasant Prairie Sanitary Utility District "73-1" WTF.

The remaining portions of the study area not tributary to either SUD "D" or SUD "73-1" would be conveyed to and treated by the Kenosha Water Utility WTF.

Conveyance Facilities

The recommended conveyanced facilities for this alternative are indicated on Figure 5-10. Peak Flow rates at key points of the future and existing trunk sewer system are indicated on Figure 5-11. Trunk Sewers No. 1, 3, 12, 16, 18, 20, 28, 30, 32, 33, 35, and 36 are identical to those listed in Alternative I A. Description and costs of unique trunk sewers to this alternative follow.

Trunk Sewers No. 10, 30, 31

To convey the flow for the portion of the City of Kenosha roughly delineated on Figure 5-1 as basin No. 10.04 will require construction of Trunk sewer No. 30. Trunk sewer No. 30 would consist of the construction of a 0.27 MGD lift station located on the north side of 75th Street at the east side of the Des Plaines River and 6,000 feet of 6 inch diameter forcemain. The 6 inch diameter forcemain would be constructed along 75th Street to convey flows from the above described lift station to a connection with proposed trunk sewer No. 31 approximately 1/2 mile west of 88th Avenue (see Figure 5-10). Trunk sewer No. 30 was sized to convey a peak flow of 0.41 cfs (see Figure 5-11).

To convey the flow from the area (basin 10.04) described above as well as provide sewer service to a portion of the City of Kenosha, roughly delineated on Figure 5-1 as basin 10.03, would require construction of trunk sewer No. 31. Trunk sewer No. 31 would consist of construction of approximately 2,200 feet of 8 inch diameter gravity sewer, and approximately 4,050 feet of 12 inch diameter gravity sewer along 75th Street. The sewer would begin at a point approximately 1/2 mile west of 88th Avenue and continue east to a 1.2 MGD lift station. The lift station would be

Table 5-11

TRUNK SEWER COSTS

ALTERNATIVE I
SUB-ALTERNATIVE D *

Location	Item	Quantity	Unit Price	Cost	Life	Replacement Costs 20 Years	Replacement Costs 30 Years	Replacement Costs 40 Years	Salvage	O & M
Trunk Sewer #1	96" Sanitary	4,430.000	$800	$3,544,000	50				$0	$1,678
Trunk Sewer #3	21" Sanitary	1,260.000	$165	$207,900	50				$0	$477
Trunk Sewer #12	72" Sanitary	8,770.000	$600	$5,262,000	50				$0	$3,322
Trunk Sewer #16	24" Sanitary	2,770.000	$100	$277,000	50				$0	$1,049
Trunk Sewer #18	18" Sanitary	2,250.000	$157	$353,250	50				$0	$852
Trunk Sewer #20	24" Sanitary	1,100.000	$100	$110,000	50				$0	$417
Trunk Sewer # 28	8" Sanitary	3,700.000	$50	$185,000	50				$0	$1,402
Trunk Sewer #29	4.0 MDG Lift Station	1.000	$696,000	$696,000	20 - 50	$45,000	$90,000	$45,000	($52,200)	$34,800
	16" Force Main	11,000.000	$46	$506,000	50				$0	$1,042
Trunk Sewer #30	.26 MDG Lift Station	1.000	$88,000	$88,000	20 - 50	$10,000	$6,500	$10,000	($7,145)	$4,400
	6" Force Main	8,000.000	$30	$240,000	50				$0	$758
Trunk Sewer #31	18" Sanitary	2,200.000	$65	$143,000	50				$0	$833
	18"Sanitary	1,600.000	$65	$104,000	50				$0	$606
	5.2 MGD Lift Station	1.000	$1,016,000	$1,016,000	20 - 50	$50,000	$100,000	$50,000	($58,000)	$50,800
	14" Force Main	7,500.000	$43	$322,500	50				$0	$710
Trunk Sewer #32	0.69 MGD Lift Station	1.000	$158,000	$158,000	20 - 50	$10,000	$158,000		($52,140)	$7,900
	8" Force Main	9,000.000	$34	$306,000	50				$0	$852
Trunk Sewer #33	2.58 MGD Lift Station	1.000	$264,000	$264,000	20 - 50	$15,000	$264,000		($87,120)	$13,200
	12" Force Main	10,800.000	$38	$410,400	50				$0	$1,023
Trunk Sewer #34	0.56 MGD Lift Station	1.000	$152,000	$152,000	20 - 50	$10,000	$152,000		($50,160)	$7,600
	8" Force Main	15,700.000	$34	$533,800	50				$0	$1,487
Trunk Sewer #35	15" Sanitary	2,200.000	$60	$132,000	50				$0	$833
	18" Sanitary	5,500.000	$65	$357,500	50				$0	$2,083
	18" Sanitary	5,500.000	$121	$665,500	50				$0	$2,083
	21" Sanitary	2,500.000	$145	$362,500	50				$0	$947
Trunk Sewer # 36	8" Sanitary	6,000.000	$90	$540,000	50				$0	$2,273
	10" Sanitary	11,000.000	$45	$495,000	50				$0	$4,167
	6" Force Main	16,000.000	$30	$480,000	50				$0	$1,516
	0.26 MGD Lift Station	1.000	$88,000	$88,000	20 - 50	$10,000	$6,500	$10,000	($7,145)	$4,400
Total				$17,999,350		$150,000	$777,000	$115,000	($313,910)	$153,510
Engineering & Contingencies (30%)				$5,399,805						
Total Costs				$23,399,155						
Present Worth Factors				1.0000		0.3118	0.1741	0.0972	0.0543	
Present Worth				$23,399,155		$46,771	$135,284	$11,181	($17,042)	
Total Present Worth Of Construction				$23,575,348						

* Trunk Sewer #40 Which Serves The Oakdale Estates Subdivision Is Not Included In This Cost Summary In Order To Fairly Compare Alternatives. The Costs For The Facility Are Listed Separately Below.

Location	Item	Quantity	Unit Price	Cost	Life	20 Years	30 Years	40 Years	Salvage	O & M
Trunk Sewer #40	0.26 MGD Lift Station	1.000	$88,000	$88,000	20 - 50	$10,000	$6,500	$10,000	($7,145)	$4,400
	6" Force Main	23,700.000	$30	$711,000	50				$0	$2,244

Source: Ruekert & Mielke, Inc.

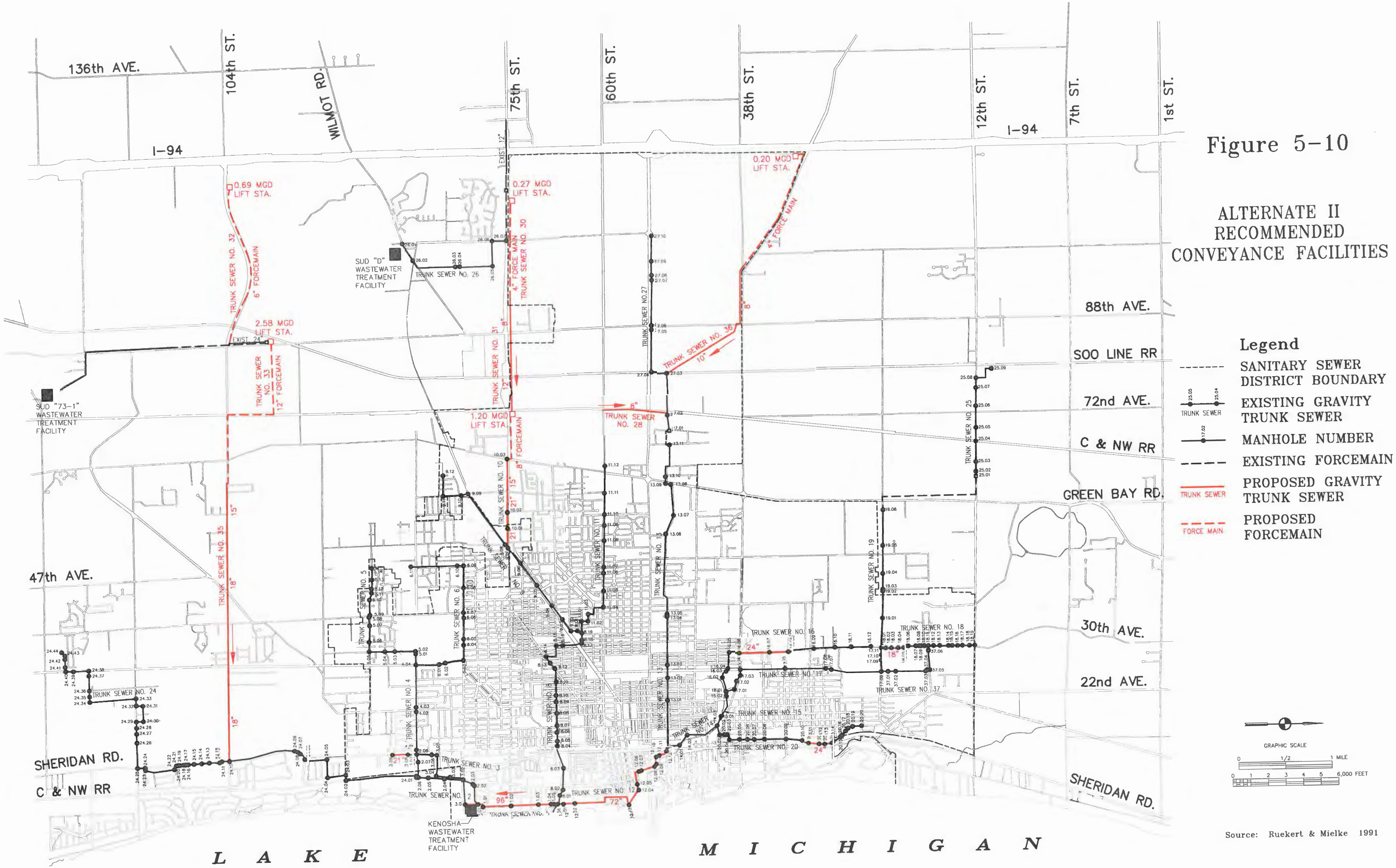


Figure 5-10
ALTERNATE II
RECOMMENDED
CONVEYANCE FACILITIES
Legend
SANITARY SEWER DISTRICT BOUNDARY
EXISTING GRAVITY TRUNK SEWER
MANHOLE NUMBER
EXISTING FORCEMAIN
PROPOSED GRAVITY TRUNK SEWER
PROPOSED FORCEMAIN
GRAPHIC SCALE
Source: Ruekert & Mielke 1991
136th AVE.
104th ST.
WILMOT RD.
75th ST.
60th ST.
38th ST.
12th ST.
7th ST.
1st ST.
I-94
88th AVE.
SOO LINE RR
72nd AVE.
C & NW RR
GREEN BAY RD.
47th AVE.
30th AVE.
22nd AVE.
SHERIDAN RD.
SUD "D" WASTEWATER TREATMENT FACILITY
SUD "73-1" WASTEWATER TREATMENT FACILITY
KENOSHA WASTEWATER TREATMENT FACILITY
0.69 MGD LIFT STA.
0.27 MGD LIFT STA.
0.20 MGD LIFT STA.
2.58 MGD LIFT STA.
1.20 MGD LIFT STA.
L A K E M I C H I G A N

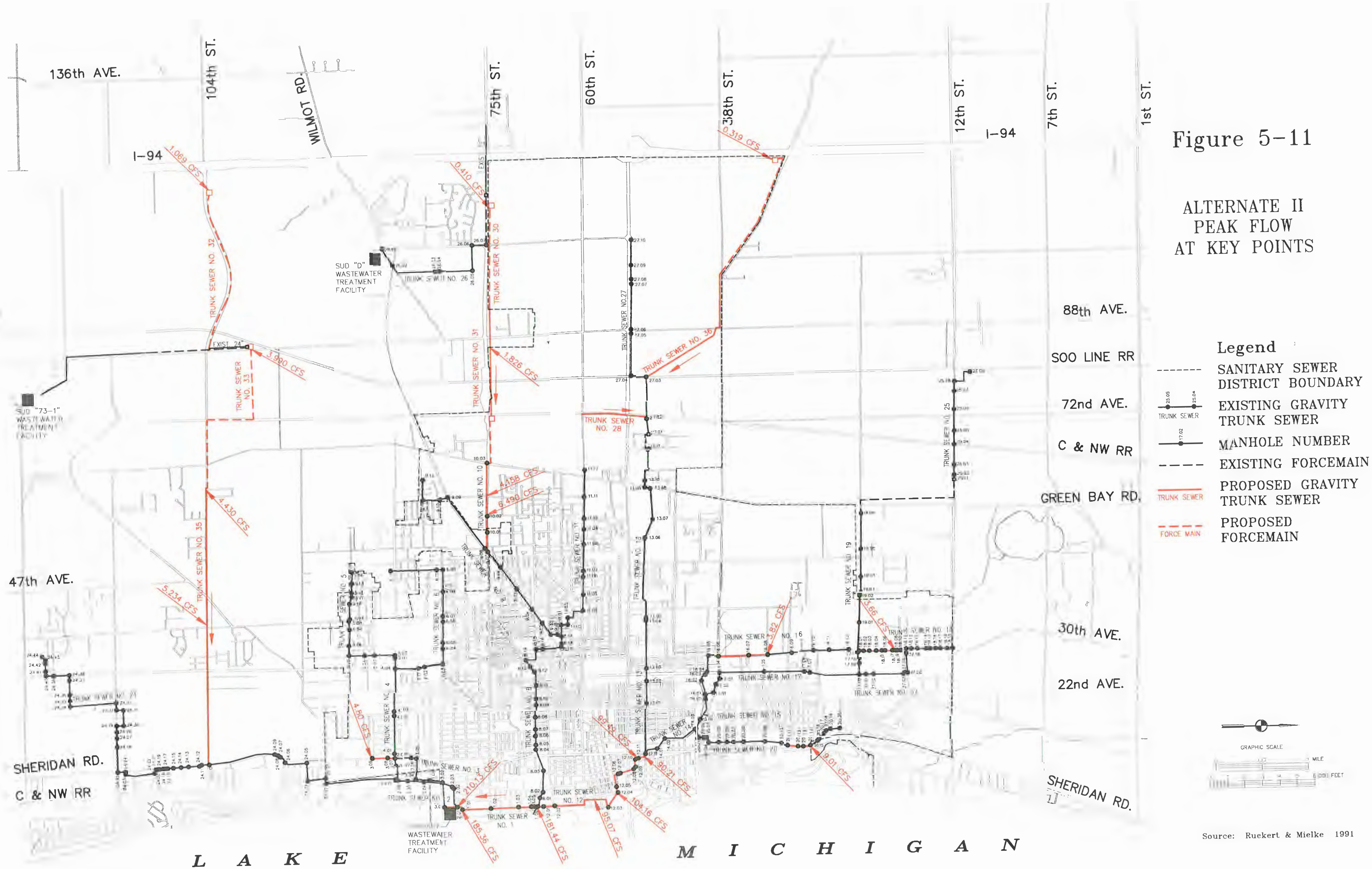


Figure 5-11
ALTERNATE II
PEAK FLOW
AT KEY POINTS
Legend
SANITARY SEWER DISTRICT BOUNDARY
EXISTING GRAVITY TRUNK SEWER
MANHOLE NUMBER
EXISTING FORCEMAIN
PROPOSED GRAVITY TRUNK SEWER
PROPOSED FORCEMAIN
136th AVE.
104th ST.
WILMOT RD.
75th ST.
60th ST.
38th ST.
12th ST.
7th ST.
1st ST.
I-94
88th AVE.
SOO LINE RR
72nd AVE.
C & NW RR
GREEN BAY RD.
30th AVE.
22nd AVE.
47th AVE.
SHERIDAN RD.
C & NW RR
SHERIDAN RD.
SUD "D" WASTEWATER TREATMENT FACILITY
WASTEWATER TREATMENT FACILITY
1.069 CFS
0.410 CFS
0.319 CFS
3.990 CFS
1.826 CFS
4.158 CFS
6.490 CFS
4.430 CFS
5.234 CFS
3.82 CFS
3.66 CFS
9.01 CFS
90.21 CFS
104.16 CFS
95.07 CFS
181.44 CFS
185.36 CFS
210.13 CFS
TRUNK SEWER NO. 32
TRUNK SEWER NO. 33
TRUNK SEWER NO. 35
TRUNK SEWER NO. 30
TRUNK SEWER NO. 31
TRUNK SEWER NO. 26
TRUNK SEWER NO. 27
TRUNK SEWER NO. 36
TRUNK SEWER NO. 28
TRUNK SEWER NO. 25
TRUNK SEWER NO. 19
TRUNK SEWER NO. 16
TRUNK SEWER NO. 12
TRUNK SEWER NO. 1
L A K E M I C H I G A N
Source: Ruekert & Mielke 1991

constructed near the Chicago and Northwestern Railroad crossing. The lift station would discharge to approximately 2600 feet of 8 inch diameter forcemain which would be constructed along 75th Street from the above described lift station to a connection with the existing Kenosha Trunk Sewer system at STH 31 manhole No. 10.03 (see Figure 5-2). Trunk sewer No. 31 was sized to convey a peak flow of 1.83 cfs (see Figure 5-3).

Existing trunk sewer No. 10 has been determined to be inadequate to convey any additional flow. To provide service for the above described areas would require relaying existing trunk sewer No. 10 from STH 31 to the intersection of 75th Street and the "KD" Tracks. The required relay would consist of 3,000 feet of 15 inch diameter gravity sewer from STH 31 to 57th Avenue and 900 feet of 21 inch gravity sewer from 57th Avenue to the connection with Trunk sewer No. 9 at The "KD" Tracks (see Figure 5-2). Trunk sewer No. 10 was sized to convey 6.49 cfs (see Figure 5-3).

The total estimated construction cost for Alternative II new and relayed trunk sewers is \$15,444,200. The total 50 year present worth of these trunk sewers is \$20,193,000. Detailed costs are listed in Table 5-13.

Treatment and Storage Facility

The Pleasant Prairie SUD "D" WTF would be expanded to accommodate an average daily flow of 0.97 MGD, and a peak hourly flow of 3.44 MGD. These flows are approximately double the existing facility capacity. The existing influent pump station would be upgraded with new larger sewage pumps, piping and controls. A new aeration tank and final clarifier would be constructed essentially identical to the existing structures.

Since chlorination of the WTF effluent is no longer required, no additional chlorine contact chamber capacity would be constructed. The existing office, laboratory and other support facilities would not be significantly changed.

Preliminary comments by the DNR have indicated that to the effluent limit for the expanded WTF would be significantly more stringent than the current limit. This would require construction of tertiary filtration equipment following the final clarifiers. Therefore the cost of construction and operating effluent filtration equipment will be included in this analysis. WTF effluent toxicity has also become a concern of the DNR. There is no data yet available to evaluate if the new effluent limits for toxic compounds will affect the WTF. This analysis will assume that an additional costs will be incurred by the WTF to comply with current toxicity limit.Sludge storage is presently limited to one tank which would provide only 18 days storage at the proposed flows. New rules promulgated by the DNR require six months sludge storage when land application of the sludge is practiced. The Pleasant Prairie WTF currently contracts for its sludge hauling and disposal with a firm that has its own sludge storage lagoon. It will be assumed, in this report, that the contract hauler will maintain the facilities necessary to meet the new storage criteria. As a result, construction of a new sludge storage facilities will not be included in this facility.

The existing Pleasant Prairie SUD "D" WTF was placed in service in 1985. As a result, the primary structural components of the facility will theoretically require replacement five years prior to the end of the fifty year planning period. However, for purposes of this report, it will be assumed that all 50 year life-structures will not require replacement during the planning period. The cost of the mechanical and electrical component replacement will be included in the present worth analysis.

The construction cost for this WTF expansion is approximately \$2,401,100 with a fifty year present worth of construction of \$2,709,600. Annual operation and maintenance is estimated to be \$275,000. Detailed costs are listed in Table 5-14.

A peak flow storage alternative to the treatment facility expansion was also considered. However, that alternative was dropped because treatment facility expansion was required to handle an increase in average daily base flow which cannot be adequately handled with the addition of storage facilities.

The Pleasant Prairie SUD 73-1 WTF would not be expanded within the study period. The existing facility has adequate reserve capacity to serve its existing and proposed service area. This is possible because the current facility was designed to serve the WisPark development which is now committed to connect to the Kenosha sewerage system. However the existing facility, which is 15 years old and has many components with a 20 year life, will have to be replaced within the design period. Therefore only replacement and O & M costs will be carried through the present worth analysis. These costs amount to a 50 year present worth of \$1,318,700. Detailed costs are listed in Table 5-14.

The Kenosha WTF construction and operation and maintenance costs were determined assuming a peak hour flow of 68.7 MGD, which amounts to the 72 MGD facility sized for Alternative I and reduced by the average and maximum daily flows of the Pleasant Prairie SUD "D" and "73-1" treatment facilities. The construction costs for this expansion is approximately \$20,610,000. Annual average operation and maintenance is estimated to be \$1,610,700. Detailed costs are listed in Table 5-15.

A peak flow storage facility alternative was also considered for the Kenosha WTF. Without the

Table 5-13

TRUNK SEWER COSTS
ALTERNATIVE II

Location	Item	Quantity	Unit Price	Cost	Life	Replacement Costs 20	30	40	Salvage	O & M
Trunk Sewer #1	96" Sanitary	4,430.000	$800	$3,544,000	50				$0	$1,678
Trunk Sewer #3	21" Sanitary	1,260.000	$165	$207,900	50				$0	$477
Trunk Sewer #12	72" Sanitary	8,770.000	$600	$5,262,000	50				$0	$3,322
Trunk Sewer #16	24" Sanitary	2,770.000	$100	$277,000	50				$0	$1,049
Trunk Sewer #18	18" Sanitary	2,250.000	$157	$353,250	50				$0	$852
Trunk Sewer #20	24" Sanitary	1,100.000	$100	$110,000	50				$0	$417
Trunk Sewer # 28	8" Sanitary	3,700.000	$50	$185,000	50				$0	$1,402
Trunk Sewer #30	.26 MGD Life Station	1.000	$88,000	$88,000	20 - 50	$10,000	$6,500	$10,000	($7,145)	$4,400
	6" Force Main	6,000.000	$30	$180,000	50				$0	$758
Trunk Sewer #31	8" Sanitary	2,200.000	$50	$110,000	50				$0	$833
	12" Sanitary	4,050.000	$55	$222,750	50				$0	$1,534
	15" Sanitary	3,000.000	$80	$240,000	50				$0	$1,136
	21" Sanitary	900.000	$180	$162,000	50				$0	$341
	1.20 MGD Lift Station	1.000	$180,000	$180,000	20 - 50	$13,000	$180,000		($59,400)	$9,000
	8" Force Main	2,600.000	$34	$88,400	50				$0	$246
Trunk Sewer #32	0.69 MGD Lift Station	1.000	$158,000	$158,000	20 - 50	$10,000	$158,000		($52,140)	$7,900
	8" Force Main	9,000.000	$34	$306,000	50				$0	$852
Trunk Sewer #33	2.58 MGD Lift Station	1.000	$264,000	$264,000	20 - 50	$15,000	$264,000		($87,120)	$13,200
	12" Force Main	10,800.000	$38	$410,400	50				$0	$1,023
Trunk Sewer #35	15" Sanitary	2,200.000	$60	$132,000	50				$0	$833
	18" Sanitary	5,500.000	$65	$357,500	50				$0	$2,083
	18" Sanitary	5,500.000	$121	$665,500	50				$0	$2,083
	18" Sanitary	2,500.000	$135	$337,500	50				$0	$947
Trunk Sewer # 36	8" Sanitary	6,000.000	$90	$540,000	50				$0	$2,273
	10" Sanitary	11,000.000	$45	$495,000	50				$0	$4,167
	6" Force Main	16,000.000	$30	$480,000	50				$0	$1,516
	0.26 MGD Lift Station	1.000	$88,000	$88,000	20 - 50	$10,000	$6,500	$10,000	($7,145)	$4,400
Total				$15,444,200		$58,000	$615,000	$20,000	($212,950)	$68,722
Engineering & Contingencies (30%)				$4,633,260						
Total Costs				$20,077,460						
Present Worth Factors				1.0000		0.3118	0.1741	0.0972	0.0543	
Present Worth				$20,077,460		$18,085	$107,078	$1,944	($11,561)	
Total Present Worth Of Construction				$20,193,006						

Source: Ruekert & Mielke, Inc.

Table 5-14

PLEASANT PRAIRIE SUD "D" WTF
COST SUMMARY

Item	Cost	Life	Replacement Costs 20 Years	30 Years	40 Years	Salvage
Lift Station	$100,000	20 - 50	$30,000	$30,000	$30,000	($24,900)
Aeration Basins	$309,000	20 - 50	$127,000		$127,000	($63,500)
Final Clarifiers	$219,000	20 - 50	$95,000	$49,000	$95,000	($63,670)
Tertiary Filtration	$864,000	20 - 50	$106,000	$95,000	$106,000	($84,700)
Electrical	$85,000	30		$85,000		($28,050)
Mechanical	$270,000	50				$0
Existing Plant Equipment	$0	20	$287,000		$287,000	($143,500)
Existing Plant Equipment	$0	30		$139,000		($45,870)
Total Costs	$1,847,000		$645,000	$398,000	$645,000	($454,190)
Engineering & Contingencies (30%)	$554,100					
Construction Total	$2,401,100					
Present Worth Factors	1.0000		0.3118	0.1741	0.0972	0.0543
	$2,401,100		$201,114	$69,296	$62,708	($24,657)

Total Present Worth Of Construction	$2,709,561
Estimated Annual O & M Costs	$275,200

PLEASANT PRAIRIE SUD "73-1" WTF
COST SUMMARY

Item	Life	Replacement Costs 5 Years	15 Years	25 Years	35 Years	45 Years	Salvage
Lift Station	30	$11,000	$170,000		$11,000	$170,000	($151,100)
Package Plant	30	$150,000	$432,000		$150,000	$432,000	($384,000)
Blowers	20	$20,000		$20,000		$20,000	($17,800)
Pumps	20	$15,000		$15,000		$15,000	($13,300)
		$196,000	$602,000	$35,000	$161,000	$637,000	($566,200)
Present Worth Factor		0.7473	0.4173	0.2330	0.1301	0.0727	0.0543
		$146,463	$251,194	$8,155	$20,947	$46,278	($30,738)

Total Present Worth Of Construction	$442,298
Estimated Annual O & M Costs	$55,600

Source: Ruekert & Mielke, Inc

Table 5 - 15
ALTERNATIVE II
KENOSHA WTF - 68.7 MGD ADDITION
COST SUMMARY

Item	Cost	Life	Replacement Costs 20 Years	30 Years	40 Years	Salvage
Lift Station	$3,043,000	20 -50	$1,003,000	$800,000	$1,003,000	($765,500)
Grit Collectors	$285,000	50				$0
Primary Clarifiers	$2,431,000	20 -50	$982,000	$109,000	$982,000	($526,970)
Aeration Basins	$2,581,000	20 -50	$846,000		$846,000	($423,000)
Final Clarifiers	$2,459,000	20 -50	$600,000	$42,000	$600,000	($313,860)
Chlorine Contact	$664,000	50				$0
Pump House	$1,004,000	20 -50	$461,000		$461,000	($230,500)
Outfall	$1,400,000	50				$0
Electrical	$2,300,000	30		$2,300,000		($759,000)
Mechanical	$2,950,000	50				$0
Miscellaneous Channels	$893,000	50				$0
Site Work	$600,000	50				$0
Total Costs	$20,610,000		$3,892,000	$3,251,000	$3,892,000	($3,018,830)
Engineering & Contingencies (30%)	$6,183,000					
Construction Total	$26,793,000					
Present Worth Factors	1.0000		0.3118	0.1741	0.0972	0.0543
	$26,793,000		$1,213,544	$566,032	$378,389	($163,887)
Total Present Worth Of Construction			$28,787,077			
Average Annual O & M Costs *			$1,610,700			

* O & M cost excludes administrative, billing and accounting costs. See Appendix F for detailed costs.

Table 5 - 16
ALTERNATIVE II
KENOSHA WTF - 21 MILLION GALLON STORAGE RESERVIOR
COST SUMMARY

Item	Cost	Life	Replacement Costs 20 Years	30 Years	40 Years	Salvage
Lift Station	$3,043,000	20 -50	$1,003,000	$800,000	$1,003,000	($765,500)
Structure	$4,430,000	50				$0
Equipment	$1,275,000	20	$1,275,000		$1,275,000	($637,500)
Total Costs	$8,748,000		$2,278,000	$800,000	$2,278,000	($1,403,000)
Engineering & Contingencies (30%)	$2,624,400					
Construction Total	$11,372,400					
Present Worth Factors	1.0000		0.3118	0.1741	0.0972	0.0543
	$11,372,400		$710,291	$139,288	$221,472	($76,167)
Total Present Worth Of Construction			$12,367,285			
Storage Facility Annual O & M Costs *			$25,000			
Existing WTF Annual O & M Costs **			$1,461,700			
Total Annual O & M Costs			$1,486,700			

* O & M cost assumes $5,000 per year per tank for storage tanks.
** O & M excludes administrative, billing and accounting costs.

Source: Ruekert & Mielke, Inc.

flows contributed from the two Pleasant Prairie Treatment Facilities, the Kenosha WTF storage facility size could be reduced to 21 million gallons. The estimated cost of construction of this facility is $11,372,000, and the annual average operation and maintenance cost for storage and treatment is estimated to be $1,486,700. Detailed costs are listed in Table 5-16. As noted in Alternative IB, storage will be re-evaluated for the selected alternative in Chapter VI.

Review of this data also showed that is not cost effective to continue to operate and maintain SUD "73-1" WTF if the SUD "D" WTF is abandoned and its respective service area connected to the Kenosha sewerage system per Alternative IB. The total present worth cost of replacement and operation and maintenance cost of SUD "73-1" is $1,318,700 per **Appendix G**. The present worth cost to connect SUD "73-1" to the Kenosha sewerage system via trunk sewer No. 34 is $1,067,100. Costs for treatment of the 0.1 MGD average daily flow at the Kenosha WTF amount to $6456 annually or a present worth cost of $101,800. Total present worth costs to abandon SUB "73-1" WTF and connection to the Kenosha sewerage system are estimated at $1,168,900. This is $149,800 or 11 percent less expensive than continuing its operation.

Alternative II Total Costs

The fifty year present worth cost of Alternative II is $83,817,000 including trunk sewers and wastewater treatment facility expansion at the Kenosha WTF and Pleasant Prairie SUD "D" WTF and replacement costs at Pleasant Prairie SUD "73-1" WTF. Detailed costs are listed in **Table 5-17**.

Table 5-17
Alternative II
Total Present Worth Cost Summary of Sewerage Facilities

Present Worth of Construction		
o Trunk Sewers		$20,193,000
o Kenosha WTF		28,787,000
o SUD "D" WTF		2,709,500
o SUD "73-1" WTF		442,300
Annual O & M		
o Trunk Sewers	68,722	
o Kenosha WTF	1,610,700	
o SUD "D" WTF	275,200	
o SUD "73-1" WTF	55,600	
	$2,010,222	
Present Worth of O & M		$31,685,100
Total Present Worth		$83,817,000

Source: Ruekert & Mielke, Inc.

Alternative III "New Plant Construction"

Alternative III evaluates providing sewer service to approximately 500 acres of land located west of ISH 94 and adjacent to CTH C and CTH Q 104th Street in the Town of Bristol with a new satellite wastewater treatment facility.

This alternative would be similar to Alternative II except that the SUD 73-1 wastewater treatment facility would not include the Town of Bristol service area proposed to be served by the new Bristol satellite wastewater treatment facility.

Cost information had been developed considering this alternative in conjunction with a proposal by the Town of Bristol to provide public sewer service to the area in the vicinity of ISH 94 and CTH Q. Specific information is provided in a report prepared by the Town's engineer, entitled "Town of Bristol Highway Q and ISH 94 Wastewater Management Analysis" dated December 1988, and in a SEWRPC draft staff memorandum dated April 18, 1989. That staff memorandum considered three sewerage system alternatives for the area with each alternative having a sub-alternative relating to the timing of construction. The equivalent annual costs of the alternatives as set forth in Table 5-18 of the SEWRPC staff memorandum are as follows:

This alternative was dropped after review of the above cost data and the fact that the DNR has adopted a policy of non-proliferation and anti-degradation of wastewater treatment facilities that would make this alternative unfeasible.

SEWERAGE ALTERNATIVE SUMMARY

Total present worth costs for the various sewerage alternatives investigated are summarized in Table 5-19. The least cost alternative is Alternative I B for the "Centralized" Plan which has a total present worth cost of $80,974,200. This is approximately $2,842,800 less than Alternative II which represents the "Decentralized" Plan which has a total present worth cost of $83,817,000.

Because the two plan costs differ by only three percent, a comparison was made of the elements that are unique or different to serving the Pleasant Prairie Sewer Utility Districts "D" and "73-1" and also the existing Town of Bristol service area by conveyance and treatment in the Kenosha sewerage system or by the expansion of Pleasant Prairie treatment facilities. The present worth cost to convey and treat the Pleasant Prairie and Bristol sewage by the Kenosha sewerage system is $5,605,300. The present worth cost to expand and/or maintain the existing Pleasant Prairie treatment facilities is $8,386,100. These calculations show that it is approximately 33 percent less expensive to construct, operate and maintain the "Centralized" alternative to convey all flows to the Kenosha sewerage system than it is to expand and maintain the Pleasant Prairie

Table 5-18

Alternative		Equivalent Annual Cost [1]
Alternative With No Deferred Construction		
1A.	Connection of the Bristol CTH Q (104th Street) service area to the Kenosha sewerage system	$383,000
2A.	Connection of the Bristol CTH Q (104th Street) service area to the Town of Bristol Utility District No. 1	$532,000
3A.	Construction of a new public WTF to service the Bristol ISH 94 service area	$609,000
Alternatives With Deferred Construction		
1B.	Connection of the Bristol CTH Q (104th Street) service area to the Kenosha sewerage system	$312,000
2B.	Connection of the Bristol CTH Q (104th Street) service area to the Town of Bristol Utility District No. 1	$414,000
3B.	Construction of a new public WTF to serve the Bristol ISH 94 service area	$494,000

1 Economic analysis was conducted using a 50-year analysis period and a 6 percent interest rate.

Table 5-19
Present Worth Cost Summary of Sewerage Alternatives

Alternative	Item	Construction Cost	Present Worth Construction	Annual O&M	Total Present Worth
IA	Trunk Sewers & Kenosha WTF	39,716,700	53,837,100	1,789,100	82,036,100
IB	Trunk Sewers & Kenosha WTF	39,356,800	53,365,900	1,751,600	80,974,200
IC	Trunk Sewers & Kenosha WTF	39,509,600	53,631,800	1,738,900	81,040,600
ID	Trunk Sewers & Kenosha WTF	38,968,400	52,864,200	1,786,900	81,029,500
II	Trunk Sewers & Kenosha, SUD "D", "73-1" WTF	37,901,200	52,131,900	2,010,200	83,817,000

Source: Ruekert & Mielke, Inc.

treatment facilities. Detailed costs are listed in **Appendix** G.

A similar comparison was made for the decentralized alternative assuming that SUD "D" WTF would remain in place and be expanded to treat flows through the planning period and that SUD "73-1" WTF would be abandoned and flows from its service area conveyed to the Kenosha sewerage system. The present worth cost to expand the SUD "D" WTF and to abandon SUD "73-1" WTF and convey and treat its sewage with the Kenosha sewerage system is $7,067,500. The present worth cost to abandon both facilities and convey the sewage to Kenosha for treatment is $4,441,900. These calculations show that is approximately 37 percent less expensive to construct, operate and maintain the "Centralized" alternative to convey all flows to the Kenosha sewerage survey than it is to expand and maintain Pleasant Prairie SUD "D" WTF. Detailed costs are listed in Appendix H.

For this reason Alternative IB plus the Oakdale Estates Subdivision trunk sewer No. 37 per Alternative 1D will be evaluated together with the cost-effective water alternative as the selected alternative in Chapter VI.

The "Centralized" alternative would eliminate the need for diversion of flows from the Lake Michigan basin because any water supplied from east of the sub-continental divide would be returned via the sewer system. In addition, centralization of wastewater treatment at the Kenosha WTF would allow abandonment of two small wastewater treatment facilities in Pleasant Prairie. This would eliminate the use of energy and resources necessary to essentially double the size of Pleasant Prairie SUD "D" WTF, and the need to continue operation of the SUD "73-1" WTF which is operating at less than 20 percent of its design capacity. Elimination of these two treatment facilities would eliminate the discharge of treated wastewater effluent into the Des Plaines River. Consolidation of treatment facilities would also eliminate the duplication of labor and resources necessary to maintain three separate wastewater treatment facilities which perform the same basic functions as one centralized facility. Consolidation of treatment facilities would be in compliance with the non-proliferation policy of the SEWRPC areawide 208 Plan

SEWERAGE SYSTEM PLAN MODIFICATIONS

Following the report inventory and modeling phase of the existing trunk sewer system in the City of Kenosha, several new trunk sewers impacting trunk sewers 10, 18 and 31 were identified as having been placed into service. These new trunk sewers follow, in concept, the trunk sewers recommended for construction under all sub-alternatives of the "Centralized" sewer scenario of Alternative 1. Because these trunk sewers do exist, the costs must be considered as sunk costs for Alternative 1 which will reduce the cost for Sub-Alternatives A through E.

In this Chapter, costs of all alternatives and sub-alternatives were analyzed. The results of this analysis indicate that the "Centralized" alternative is the most cost effective means of providing sanitary sewer service to the entire study area. Exclusion of the newly identified trunk sewers will further reduce the costs of providing "Centralized" sewer service to the entire study area. With the additional reductions in cost to provide centralized sanitary sewer service the cost disparity between "Centralized" and "Decentralized" alternates will grow larger.

Therefore, given the cost effectiveness of providing "Centralized" sanitary sewer service versus "Decentralized" sanitary sewer service already established in this chapter and the additional cost reductions for "Centralized" sewer service as a result of the additional trunk sewers not previously analyzed, no additional cost analysis is required.

However, all analyses for Chapter VI and VII, will include these additional trunk sewers in determining required conveyance facilities under all land use scenarios for the recommended Alternative, Alternative I ("Centralized Sanitary Sewer Service") and Sub-Alternative B.

The following is a description of the new trunk sewers not previously analyzed and the effect of each on the system.

1) A 12 inch diameter relief sewer was constructed on 14th Place between 26th Avenue and 30th Avenue which relieved Trunk sewer No. 18 and 30th Avenue under all alternatives.

2. A 36 inch and 24 inch diameter trunk sewer was constructed from the "KD" Tracks trunk sewer (trunk sewer No. 9) west along 80th Street extended to STH 31 and along STH 31 from 80th Street to 75th Street. This sewer eliminated the need for relief of trunk sewer No. 10 in 75th Street from STH 31 to 51st Street.

3. Portions of proposed trunk sewer No. 31 have been constructed in 75th Street from STH 31 to 3900 feet west of STH 192. This trunk sewer consists of 30 inch, 24 inch and 21 inch diameter gravity sewer and a pump station and forcemain.

WATER ALTERNATIVES

The following alternatives for providing water service to the planning area will be evaluated in this section.

ALTERNATIVE I "CENTRALIZED SERVICE"

Alternative I evaluates providing water service to the entire service area from the Kenosha Water Utility.

Sub-Alternative A

Evaluates providing service to the Oakdale Estates Subdivision from Sturtevant while serving the remainder of the service area from Kenosha.

Sub-Alternative B

Evaluates maintaining the existing Bristol East Water System while serving the remainder of the service area from Kenosha.

Each alternative will be evaluated using the 2010 Intermediate Development Plan. The Sub-Alternatives will be addressed only with regard to resulting changes in costs or other substantial impacts. Following these evaluations, the diversion issue will be addressed in Chapter VII with respect to the recommended plan.

Since completion of the inventory phase of this report, on going system planning by the Kenosha Water Utility and the Village of Pleasant Prairie has resulted in the approval and/or construction of additional water supply, storage and transmission facilities. These new facilities are shown in Figure 5-12 and described as follows:

1. A 3.8 MG storage reservoir, constructed in 1990, located at the 60th Street booster station. This brings the total storage capacity at this location to 6.55 MG and the total storage volume for the primary zone to 19.970 MG.

2. A new pressure zone for the western portion of Pleasant Prairie was established. The pressure zone will be able to serve a maximum elevation of 740 NGVD before boosting is required and a minimum elevation of 615 NGVD before pressure reduction is required. These elevations are based upon an overflow elevation of 845.5 NGVD, a 20 foot operating range for elevated storage facilities, and 5 feet of total head loss between storage facilities and the point of demand.

3. A new elevated storage facility located near the intersection of 114th Avenue and 104th Street (CTH Q). The facility will be in the new pressure zone and will have a total volume of 750,000 gallons and a usable volume at 35 psi of 416,000 gallons with an overflow elevation of 845.5 NGVD.

4. A new booster station and reservoir located at the southeast corner of 93rd Street (CTH T) and Green Bay Road (STH 31). The sizes used for the booster pumps and reservoir are based upon preliminary engineering studies provided by the Village of Pleasant Prairie. Actual facility sizes may change during detailed design. Preliminary investigations provide for two 100 Hp, 2000 GPM pumps and one 250 Hp, 5000 GPM pump at the booster station and one 5 MG reservoir. The reservoir would be approximately 35 feet in height with a corresponding overflow elevation of 745.

5. New transmission mains have been planned and/or constructed by the Kenosha Water Utility, Village of Pleasant Prairie and Town of Somers. These are shown on Figure 5-12.

6. The Kenosha Water Utility recently contracted for the construction of an emergency power generation system capable of providing power to the entire water treatment facility.

The facilities described above are included in the following alternative analysis. Additionally, facilities not currently designed or not under construction will be included in the cost analyses.

In addition to the facilities mentioned above, the Kenosha Water Utility has begun planning of facilities to serve the second boosted pressure zone. Howard, Needles, Tammen and Bergendoff recently completed an initial study of the facilities required to serve the ..."western segment of booster zone No. 2."[2] This initial planning has resulted in the recommendation of a site on 60th Street (CTH K) west of CTH H (STH 192) for the booster station and a number of water reservoirs. The study used the ultimate land use scenario adjusted to reflect additional construction in the area to size the facilities. Actual facility sizes recommended in this report will be based upon the analysis techniques and criteria presented in the previous chapters.

Alternative I - Kenosha Water Utility Servicing the Entire Region-Analysis Criteria

The first alternative involves the Kenosha Water Utility providing the entire planning area with potable water supply. Figure 5-12 shows the recommended piping configuration for this alternative. The location of the water mains was chosen with the following criteria as a model:

1) Mains should be placed in the right-of-way whenever possible.

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2. Letter to Mr. O. Fred Nelson, March 2, 1990.

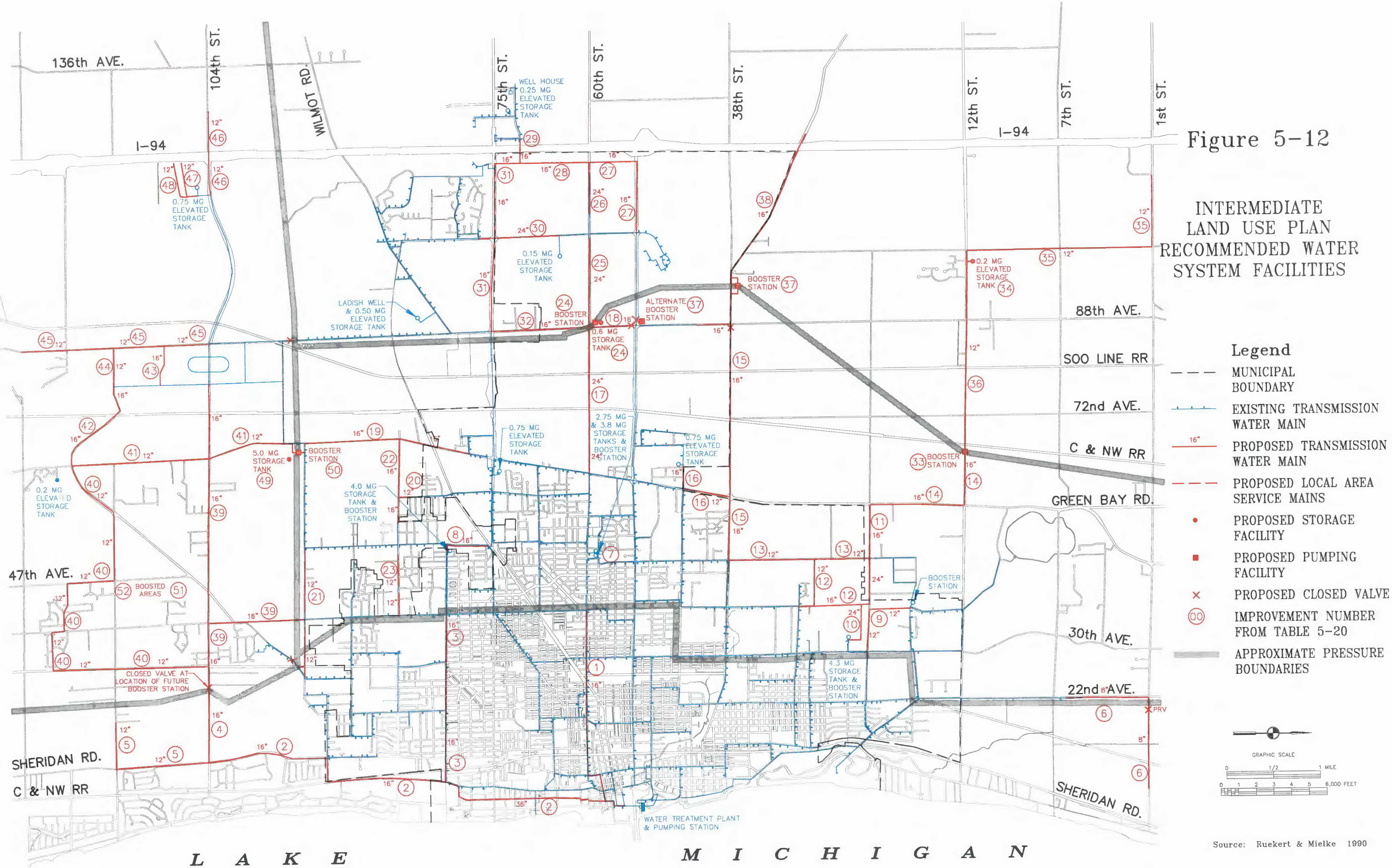


Figure 5-12

INTERMEDIATE LAND USE PLAN RECOMMENDED WATER SYSTEM FACILITIES

Source: Ruekert & Mielke 1990

2) Existing stubs should be used as the point the extension begins when ever possible.

3) Previous utility planning for main location should be adhered to whenever possible.

4) A one mile grid system for the transmission network should be used.

Water mains were then sized using a computer simulation of the demands required under the Intermediate Development Plan. Under maximum hour demands, no velocities exceed 8 Ft./Sec. and no head loss exceeds 5 Ft./1000 feet of pipe. In addition, a fire flow rate of 3,500 GPM was simulated at strategic locations in the system to verify the main sizes. A coefficient of friction (C-Factor) of 110 was assumed for all main extensions. This value is based upon using cement lined ductile iron pipe, a 50-year design life and regular system maintenance.

The supply and storage facilities required to satisfy the 2010 Intermediate Development Plan demands are based upon analysis using the projected average day and maximum day demands. In the analyses of required facilities under the alternative plans, the following average and maximum day demands will be used.

Study area average day demand =	18.947 MGD[3]
Study area maximum day demand =	33.157 MGD

For each alternative, these demands will be broken down for the various service areas which will then be analyzed separately.

Alternative I - Kenosha Serving the Entire Study Area

This alternative will analyze the needs of the system as a whole and the needs of each individual pressure zone. The following are the average and maximum day demands broken down by pressure zone:

Entire system average day demand =	18.946 MGD
Entire system maximum day demand =	33.157 MGD
Primary pressure zone average day demand =	10.639 MGD
Primary pressure zone maximum day demand =	18.618 MGD
Boosted pressure zone average day demand =	5.414 MGD
Boosted pressure zone maximum day demand =	9.476 MGD
Second boosted pressure zone average day demand =	1.174 MGD
Second boosted pressure zone maximum day demand =	2.054 MGD
Somers second boosted pressure zone average day demand =	0.201 MGD
Somers second boosted pressure zone maximum day demand =	0.351 MGD
Pleasant Prairie pressure zone average day demand =	1.519 MGD
Pleasant Prairie pressure zone maximum day demand =	2.657 MGD

Source Capacity

For the system as a whole, the required source capacity is the maximum day demand which must be reliably available from the source of supply. For the boosted areas, the required volume must be available from booster pumps with the largest unit out of service. Results of the analysis are as follows:

Entire system required capacity =	33.157 MGD
Existing capacity =	40.000 MGD
Surplus in source capacity =	6.843 MGD
Primary zone required capacity =	18.618 MGD
Existing capacity =	40.000 MGD
Surplus in source capacity =	21.382 MGD
Boosted pressure zone required capacity =	9.476 MGD
Existing capacity =	13.730 MGD
Surplus source capacity =	4.254 MGD
Second boosted pressure zone required capacity =	2.324 MGD
Existing capacity[4] =	0.000 MGD

3. Demands include the Oakdale Estates Subdivision. It is doubtful this area will be served due to the cost to construct water mains.

4. There are presently two inground booster stations serving the second boosted pressure zone. Upon construction of the booster station/reservoir at 60th street (CTH K) and 88th Avenue (STH 192). These stations will be abandoned. For the purpose of this and additional analyses, existing capacity will be expressed as "zero" to allow for proper sizing of the new facility.

Deficit source capacity =	2.324 MGD
Somers second boosted pressure zone required source capacity =	0.351 MGD
Existing capacity =	0.000 MGD
Deficit source capacity =	0.351 MGD
Pleasant Prairie pressure zone required capacity =	2.657 MGD
Existing capacity[5] =	5.760 MGD
Surplus source capacity =	3.103 MGD

Under Alternative I, the first boosted zone must be capable of providing the source capacity for not only the first boosted zone but also the second boosted zone, the Somers second boosted zone and the Pleasant Prairie boosted zone. Calculations are as follows:

Boosted pressure zone maximum day demand =	9.476 MGD
Second boosted pressure zone maximum day demand =	2.324 MGD
Somers second boosted pressure zone maximum day demand =	0.351 MGD
Pleasant Prairie pressure zone maximum day demand =	2.657 MGD
Total =	14.808 MGD
Existing capacity =	13.730 MGD
Deficit source capacity =	1.078 MGD

Peak Hour Storage

Peak hour storage requirements are the equivalent of the maximum day demand times 1.4 for Kenosha and 1.75 for outlying areas for a period of four hours. It is assumed that the maximum day demand has been met by supply sources. The remaining volume must be available from usable elevated and ground storage. Usable storage volumes are provided in Appendix I.

Entire system required peak hourstorage capacity =	2.788 MG
Existing capacity=	14.231 MG
Surplus peak hour storage capacity =	11.443 MG
Primary pressure zone required peak hour storage capacity=	1.315 MG
Existing capacity =	6.475 MG
Surplus peak hour storage capacity =	5.160 MG
Boosted pressure zone required peak hour storage capacity =	0.840 MG
Existing capacity =	4.355 MG
Surplus peak hour storage capacity =	3.515 MG
2nd boosted pressure zone required peak hour storage capacity =	0.257 MG
Existing capacity =	0.637 MG
Surplus peak hour storage capacity =	0.380 MG
Somers second boosted pressure zone required peak hour storage capacity =	0.044 MG
Existing capacity =	0.000 MG
Deficit peak hour storage capacity =	0.044 MG
Pleasant Prairie pressure zone required peak hour storage capacity =	0.332 MG
Existing capacity =	4.667 MG
Surplus peak hour storage capacity =	4.335 MG

Fire Flow

The required fire flow capacity is equivalent to 3,500 GPM for a three hour duration concurrent with the maximum day demand. For the entirely residential area contained in the Somers second boosted zone, a fire flow rate of 1000 GPM for a two hour period concurrent with the maximum day demand will be used. This rate is based upon ISO guidelines for fire protection. This volume must be supplied with reliable pumping capacity and storage volume not used in peak hour storage.

Entire system required fire flow capacity =	4.775 MG
Existing capacity =	13.122 MG
Surplus fire flow capacity =	8.347 MG
Primary pressure zone required fire flow capacity =	2.957 MG
Existing capacity =	9.886 MG
Surplus fire flow capacity =	6.929 MG
Boosted pressure zone required fire flow capacity =	1.815 MG
Existing capacity =	2.708 MG
Surplus fire flow capacity =	0.893 MG
Second boosted pressure zone required fire flow capacity =	0.887 MG
Existing capacity =	0.380 MG
Deficit fire flow capacity =	0.507 MG

The Somers service area lies within the first and second boosted zones. The area located in the first boosted zone can be adequately served by the existing facilities in Kenosha. A new "Dead-end" system will have to be constructed for those areas in the second boosted zones. Projected demands for this area are .201 MG average day and .351 MG maximum day. These flow rates are not reflected in the second boosted zone demand projections.

5. Existing capacity for the Pleasant Prairie system is based upon the proposed booster station pump sizes.

Somers second boosted pressure	
zone required fire flow capacity =	0.135 MG
Existing capacity =	0.000 MG
Deficit fire flow capacity =	0.135 MG
Pleasant Prairie pressure zone	
required fire flow capacity =	0.966 MG
Existing capacity =	3.439 MG
Surplus fire flow capacity =	2.473 MG

Emergency Supply

The required emergency supply is equivalent to the average day pumpage and must be available from elevated storage and auxiliary power pumping.

Entire system required emergency	
supply =	18.946 MG
Existing capacity =	40.000 MG
Surplus emergency supply =	21.054 MG
Primary pressure zone required	
emergency supply =	10.639 MG
Existing capacity =	40.000 MG
Surplus emergency supply =	29.361 MG
Boosted pressure zone required	
emergency supply =	5.414 MG
Existing capacity =	2.077 MG
Deficit emergency supply =	3.337 MG
Second boosted pressure zone	
required emergency supply =	1.174 MG
Existing capacity =	.637 MG
Deficit emergency supply =	.537 MG
Somers second boosted pressure zone	
required emergency supply =	0.201 MG
Existing capacity =	0.000 MG
Deficit emergency supply =	0.201 MG
Pleasant Prairie pressure zone	
required emergency supply =	1.519 MG
Existing capacity =	4.667 MG
Surplus emergency supply =	3.148 MG

Interpretation of Supply & Storage Analysis - Alternative I

The location of proposed supply and storage facilities for Alternative I are shown in **Figure 5-12**. Locations of supply facilities were determined on the basis of elevation in the area, water main size, location of existing facilities, and results of the computer model with the facilities in place. Locations of storage facilities were determined on the basis of elevation and results of the computer model with the facilities in place. For Pleasant Prairie, locations and sizes were based upon existing plans. Due to the demand projections used to size the Pleasant Prairie facilities, the facilities are more than adequate under this land use scenario. Also shown in **Figure 5-12** are the sizes and locations of transmission mains required to provide adequate supplies to the areas shown.

Primary Zone Facilities

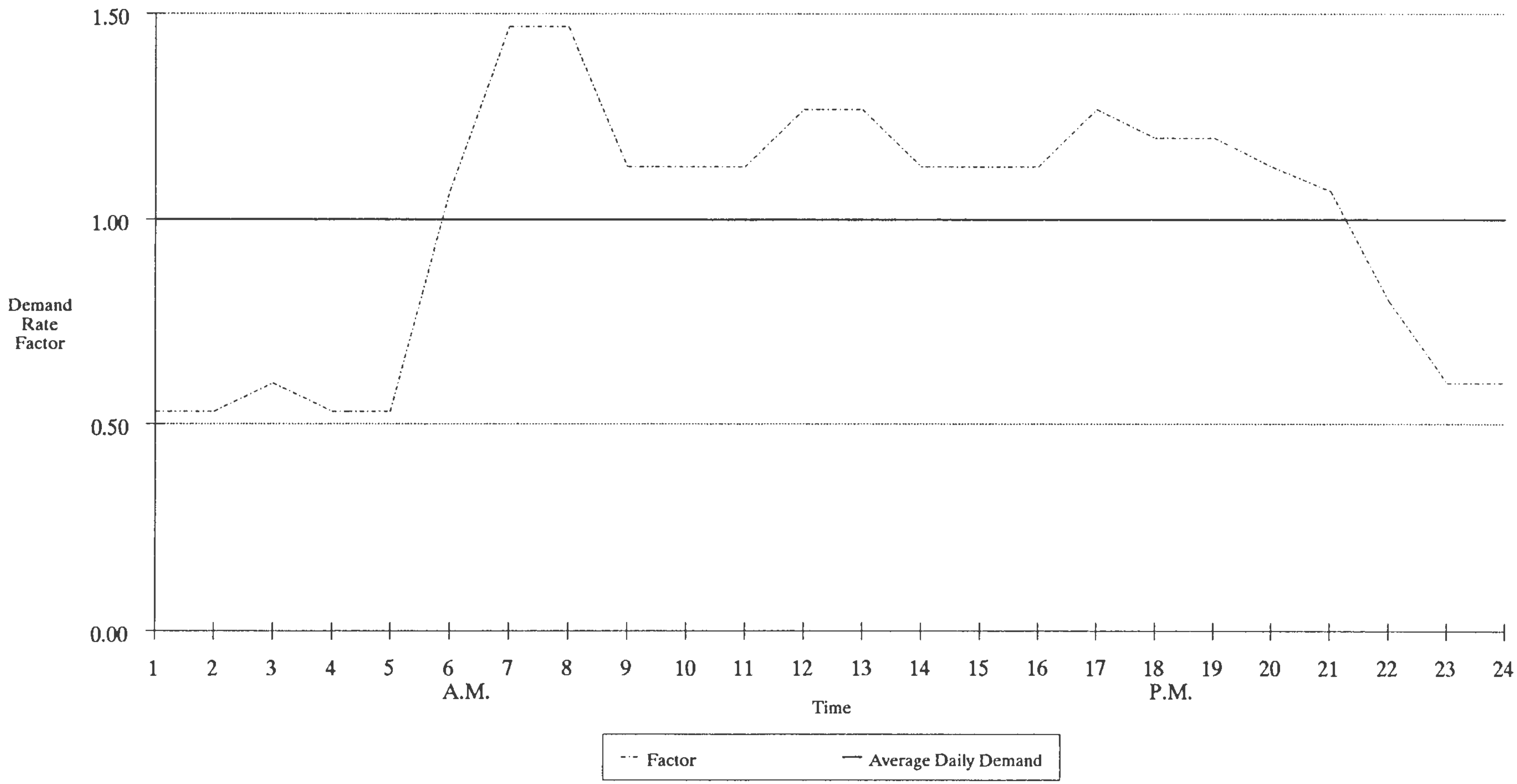
In Alternative I, no increase in treatment facility capacity will be required to meet the maximum day demand of 33.157 MGD under the Intermediate Development Plan. The only recommended addition to the plant is a 4 million gallon clear water storage reservoir at the treatment plant site. This 4 million gallon reservoir will cost an estimated $2,400,000. It should be noted that the discharge header at the water treatment facility will not be capable of supplying the 58.5 MGD required under the maximum hour flow rate. While storage facilities can assist in providing this amount, the diurnal curve presented in Figure 5-13 shows that there are 6 hours with flows greater than 50 MGD and the computer model shows that the storage facilities cannot provide additional flow for these periods. Existing storage facilities are adequate to provide service to areas north and south of the existing primary zone service area if the header capacity is increased. A detailed study of the header capacity is not in the scope of this project. It is recommended that the Kenosha Water Utility pursue this matter as soon as possible. The following improvements to the existing system are required to provide adequate transmission from the water treatment facility to the storage and booster stations located in the first booster zone. These improvements are required under all alternate plans.

1) Construction of approximately 11,500 feet of 16 inch main from the intersection of 58th Street and 6th Avenue west to Sheridan road; south on Sheridan Road to 60th Street and west on 60th Street to the 24 inch main at 39th Avenue.

2) To serve the areas south of 91st Street in the Village of Pleasant Prairie and to provide additional transmission to the boosted zones; a 36 inch main beginning at the 36 inch harbor crossing from the treatment facility and then running south down 5th Avenue to 79th Street, at which point it will run west to 7th Avenue then south to 80th Street. Approximately 12,000 feet of 36 inch main would be required. At the intersection of 7th Avenue and 80th Street, a 16 inch main would continue south on 7th Avenue to 91st Street, west on 91st to Sheridan Road and south on Sheridan Road to 104th Street. Approximately 15,200 feet of 16 inch main would be required

3) Approximately 6,000 feet of 16 inch main running parallel to the existing 16 inch, west on 80th Street from the 36 inch main on 7th Avenue to the existing 24 inch main near 28th Avenue. This main is required to provide

Figure 5-13
WATER DEMAND 24 HOUR DIURNAL CURVE: 1988
GREATER KENOSHA UTILITY STUDY AREA



Source: Ruekert|Mielke, Inc.

additional transmission between the treatment facility and the 80th Street storage tank and will eliminate the need for the booster station at 80th Street and 7th Avenue.

4) Approximately 4,500 feet of 16 inch main on 104th Street running west from Sheridan Road to 28th Avenue. This main would provide transmission to a possible future booster station to provide supply to the Pleasant Prairie service area.

5) Approximately 8,100 feet of 12 inch main running south on Sheridan Road from 104th Avenue to 116th Street then west on 116th Street to 22nd Avenue.

6) To serve the Town of Somers Sanitary District No. 1, approximately 7,600 feet of 8 inch main extending north from the 8 inch dead end on 22nd Avenue near Patio Homes to CTH KR and then east on CTH KR to the existing 8 inch main near Sheridan Road. A pressure reducing valve would be required to isolate the booster zone from the primary zone. In the event of a fire situation, the valve would open fully allowing for additional required fire protection.

First Booster Zone Facilities

Results of the supply and storage analysis for the first booster zone show a deficit in emergency supply. All other parameters were adequately met. In order to provide the 2.865 MG deficit, either additional elevated storage or additional emergency power must be provided or a combination of the two.

The ground level storage volume at 30th Avenue, 60th Street and 80th Street is adequate to satisfy the mathematical peak hour storage parameter, however transmission between the booster stations at these sites and the elevated storage is not adequate to handle peak flow conditions. By increasing main sizes to allow pumps to operate at or near capacity and the elevated tanks to float more evenly, these peak demands can be satisfied. For these reasons, the following improvements to the first booster zone are recommended under alternative plans:

7) To provide the additional .807 MGD of source capacity to serve all areas west of the primary pressure zone it is recommended a new 50 Hp pump be added to the 60th Street booster station. To provide the additional emergency supply it is recommended an emergency power generator be installed at the 60th Street booster station. It is recommended the generator be sized to power any of the booster pumps as well as the controls and lighting at the station. Modifications to the electrical controls would be required. The estimated required size of the generator is 200 to 230 KW.

8) Construction of approximately 3,000 feet of 16 inch main running parallel to the existing 16 inch main from the 80th Street booster station north on 51st Avenue to 75th Street.

Pressure Zone Modification

The existing intermediate pressure zone created by the pressure reducing valve located near the 30th Avenue storage tank and booster station, should be modified to eliminate the booster station at 15th Street and 41st Avenue. In this area, pressure is first reduced to serve lower elevation areas, then boosted to serve higher elevation areas near 45th Avenue. The following water main construction will provide adequate pressures in this area and eliminate the need for the booster station.

9) Construction of approximately 4,500 feet of 12 inch main running west on 18th Street from 30th Avenue to 39th Avenue extended then north to the 16 inch stub on 39th Avenue. This main would serve as a second feed to the intermediate zone and those areas around Petrifying Springs and UW-Parkside and increase fire flows to the area.

10) Construction of 5,800 feet of 24 inch main from the 30th Avenue booster station west to 39th Avenue, north to 18th Street, then west to 47th Avenue. This main would be in the first booster service area and would be the primary feed to the Town of Somers. It would also connect the area near 45th Avenue and 15th Street to the first booster service area thereby eliminating the need for the booster station at 15th street and 41st Avenue.

11) Construction of approximately 5,800 feet of 16 inch main running west from 39th Avenue on 18th Street to Green Bay Road (STH 31).

12) Construction of approximately 2,800 feet of 16 inch main running south from the 24 inch main connected to the 30th Avenue booster station on 39th Avenue to 27th Street. Also construct 2,800 feet of 12 inch main on 24th Street between 39th Avenue and 47th Avenue.

13) Construction on 47th Avenue of 8,000 feet of 12 inch main running south from the 24 inch main on 18th Street to 38th Street (Washington Road). This would provide a second connection to Somers from Kenosha and would also provide flow in the event either the 24 inch main or 30th Avenue booster station is out of service.

14) Construction of approximately 12,400 feet of 16 inch water main running north on Green Bay Road (STH 31) from the 24 inch main at

18th Street to 12th Street then west to the Chicago, Milwaukee and St. Paul Railroad. This main would serve the areas of the Town of Somers in the first booster area.

The following additions are required to provide adequate service to the remainder of the first booster area:

15) Construction of approximately 16,000 feet of 16 inch main on 38th Street (STH 142) from 39th Avenue west to 88th Avenue (STH 192). This main would provide transmission and fire protection to the residential development near 100th Avenue and the commercial developments at ISH 94 via a booster station discussed in number 33 below.

16) Construction of approximately 1,500 feet of 16 inch main running east from the Industrial Park elevated tank on 45th Street to Green Bay Road (STH 31); then 2,500 feet of 12 inch main north on Green Bay Road (STH 31) to 38th Street (STH 142). This main would provide increased transmission from the elevated tank to areas north of 38th Street (STH 142).

17) Construction of approximately 8,600 feet of 24 inch main on 60th Street (CTH K) from Green Bay Road (STH 31) west to approximately 1000 feet west of 88th Avenue (STH 192). This main would provide transmission to the main booster station for the second boosted zone.

18) Construction of approximately 2,600 feet of 16 inch main on 88th Avenue (STH 192) between 52nd Street (STH 158) and 60th Street (CTH K).

19) Construction of approximately 5,200 feet of 16 inch main on Green Bay Road (STH 31) from the existing 16 inch main in Kenosha, south to the existing main near the WisPark development.

20) Construction of approximately 1,500 feet of 12 inch main on 60th Avenue between 82nd Street and 85th Street.

21) Construction of approximately 5,400 feet of 12 inch main on 93rd Street between 51st Avenue and 30th Avenue extended (bike path). The 12 inch main on STH 174 near 29th Avenue would then be valved closed as part of the pressure boundary between the Pleasant Prairie pressure zone and first boosted zone.

22) Construction of approximately 4,800 feet of 16 inch main running west on 85th Street from approximately 58th Avenue to Green Bay Road (STH 31).

23) Construction of approximately 3,400 feet of 12 inch main on 85th Street between 39th Avenue and an existing stub east of 51st Avenue.

<u>Second Boosted Zone</u>

The second boosted zone would serve those areas above elevation 700 NGVD (National Geodetic Vertical Datum) in the western portion of the study area. There are currently three elevated storage facilities located in this service area; a 150,000 gallon tank approximately 2000 feet east of 104th Avenue and 2500 feet south of 60th Street; a 500,000 gallon tank south of Wilmont Road near the Tri-clover/Ladish Plant in Pleasant Prairie; and a 250,000 gallon elevated tank off Bristol Parkway east, north of STH 50 in Bristol. All three tanks have overflow elevations of 885 NGVD.

The Bristol and Pleasant Prairie Ladish tanks are supplied by wells and the City of Kenosha tank is supplied by two small booster stations, one at the intersection of 88th Avenue (CTH H) and 52nd Street (STH 158) and one at the intersection of 88th Avenue (CTH H) and 75th Street (STH 50). These stations are temporary and may be abandoned upon construction of a new station outlined below. Other possible uses for the stations are discussed later in this section. Upon connection to the Kenosha system, the wells for the Ladish system and the wells and 40,000 gallon storage tank for the Zirbel system will be removed from the public water supply system. The well at the Bristol East system was constructed in 1987 and may be kept in service until maintenance costs preclude its use, which is estimated to be in the year 2007.

The following new construction is recommended for the second boosted zone:

24) Construction of a booster station at the intersection of STH 192 and CTH K (60th Street). The source capacity parameter for the second boosted pressure zone indicated a 2.324 MGD deficit. This volume must be provided by this booster station with the largest unit out of service. It is recommended that the station contain two pumps, both capable of supplying 3 MGD and an emergency power generator. Both pumps would be approximately 150 Hp. At the booster station site, a 0.6 MG reservoir would be required to provide storage to meet the peak hour storage and emergency supply requirements. The storage facility should be a below ground concrete reservoir. The emergency power generator would be approximately 200 kw.

25) Construction of approximately 4,800 feet of 24 inch water main on 60th Street (CTH K) from the STH 192 booster station to the existing 24 inch water main at CTH HH.

26) Construction of approximately 1,000 feet of 24 inch main on 60th Street (CTH K) from the existing 24 inch main west of 104th Avenue (CTH HH) west to ISH 94.

27) Construction of a 16 inch, 7,100 foot loop beginning at 60th Street (CTH K) and ISH 94 running north to 52nd Street (STH 158) then east to the existing mains at 104th Avenue (CTH HH).

28) Construction of approximately 4,000 feet of 16 inch main along ISH 94 from 60th Street (CTH K) south to the 16 inch main north of 75th Street (STH 50) on 120th Avenue.

29 Construction of approximately 1,200 feet of 16 inch main, 400 feet of which will be in 30 inch casing under ISH 94, at 71st Street to join the existing main at 122nd Avenue in the Bristol East System with the 16 inch main on 120th Avenue. This main would provide transmission to the Bristol East elevated storage tank and eliminate the need for the Bristol East well as previously discussed.

30) Construction of approximately 3,600 feet of 24 inch main from the 150,000 gallon elevated tank connection on 104th Avenue (CTH HH) south to 75th Street (STH 50).

31) Construction of approximately 10,100 feet of 16 inch main on 75th Street (STH 50) from the pressure area boundary at STH 192 west to 118th Avenue where it would connect to the existing 16 inch main. This main would also connect to the 24 inch main at 104th Avenue (CTH HH).

32) Construction of approximately 5,900 feet of 16 inch main on 88th Avenue (STH 192) from the STH 192 booster station south to the existing 16 inch main at 75th Street (STH 50).

<u>Somers Second Boosted Pressure Zone</u>

This zone will serve only the areas of Somers which will be developed under this land use scenario. The following construction is recommended to provide adequate supply, storage and transmission facilities.

33) Construction of a booster station on 12th Street near the Chicago, Milwaukee and St. Paul Railroad to serve the Town of Somers. The booster station should have two 500 GPM pumps with total dynamic head ratings capable of filling an elevated tank with an overflow elevation of 885 NGVD. The booster station should also have an emergency generator capable of running both pumps. Depending upon exact elevations at the booster station, the pumps would require approximately 25 Hp motors.

34) Construction of a 200,000 gallon elevated storage tank near 100th Avenue and 12th Street. The tank would have an overflow elevation of 885 NGVD and be approximately 140 feet in height.

35) Construction of approximately 14,500 feet of 12 inch main to serve the Oakdale Estates Subdivision. The main would run from the elevated tank in Somers west on 12th Street to 100th Avenue then north on 100th Avenue to CTH KR, then west on CTH KR to 113th Avenue.

36) Construction of approximately 7,000 feet of 12 inch main from the booster station to the elevated tank. This would serve as the main feed between the two.

In addition, a small boosted area shared by Somers and Kenosha will be created. Required facilities are as follows:

37) Construction of a small booster station near the intersection of STH 142 (38th Street) and STH 192. This booster station would serve the commercial area around ISH 94 and STH 142 and the residential development along STH 142. As options, the booster station currently serving the airport could either be moved or modified to provide service to this area and the areas along STH 142. Detailed design will verify this option.

    Pressure boosting is required to serve those areas above elevation 850. Pumps should be sized for the maximum elevation where development will occur. Cost estimates are based upon providing an in ground booster station and 10 Hp, 15 Hp and 25 Hp motors and pumps.

38) Construction of approximately 12,000 feet of 16 inch main on STH 142 from the booster station to a point approximately 1000 feet west of ISH 94. (Note: some additional 12 inch main may be required to provide fire protection in the commercial areas around ISH 94, but that will have to be determined at the time of construction.

<u>Pleasant Prairie Pressure Zone</u>

As previously discussed, a new pressure zone in Pleasant Prairie is being created. The following main is scheduled for construction in the fall of 1990 and will not be included in the cost estimates. Construction of approximately 5,300 feet of 16 inch main on 39th Avenue (CTH EZ) from 93rd Street (CTH T) south to 104th Street (CTH Q). A closed valve will be required just south of 93rd Street to separate pressure zones.

The following improvements are required to adequately serve the Pleasant Prairie Zone:

39) Construction of approximately 17,000 feet of 16 inch main on 104th Street (CTH Q) from the pressure zone boundary near 28th Avenue to 80th Avenue.

40) Construction of approximately 26,200 feet of 12 inch main beginning at the intersection of 30th Avenue extended and 104th Street and running south along 30th Avenue extended to 124th Street; west on 124th Street to 39th Avenue (CTH EZ); north to 122nd Street, west on 122nd Street to 47th Avenue; north on 47th Avenue to 116th Street (Tobin Road), west on 116th Street (Tobin Road) to Springbrook Road (STH 174); southwest on Springbrook Road (STH 174) to Green Bay Road (STH 31); then south on Green Bay Road to 123rd Place to connect to the 8 inch main running to the Timber Ridge elevated tank.

41) Construction of approximately 12,000 feet of 12 inch main on Green Bay Road (STH 31) from 95th Street (CTH T) south to Springbrook Road (STH 174). This main will connect to the 16 inch main on 104th Street and the mains at Springbrook Road.

42) Construction of approximately 5,500 feet of 16 inch main on Springbrook Road from Green Bay Road (STH 31) to the intersection of 116th Street (CTH ML) and 80th Avenue.

43) Construction of approximately 3,000 feet of 16 inch main from 80th Avenue west on 116th Street in the Lakeview Corporate Park to 84th Avenue; north on 84th Avenue to 109th Street; then west on 109th Street to the western edge of the park.

44) Construction of approximately 2,500 feet of 12 inch main on 116th Street west from 80th Avenue to the western edge of the Lakeview Corporate Park.

45) Construction of approximately 10,000 feet of 12 inch main on the western edge of the Lakeview Corporate Park from 104th Street (CTH Q) south to State Line Road. The main will connect to the mains in 27 and 28 above.

46) Construction is approximately 3,000 feet of 12 inch main from the existing 12 inch stub west of 114th Avenue on 104th Street (CTH Q) west under ISH 94. This main will have to be installed in a 30 inch casing under ISH 94.

47) Construction of approximately 1,500 feet of 12 inch main from the 750,000 gallon tower connection on 114th Avenue south to 108th Street then west to ISH 94.

48) Construction of approximately 2,000 feet of 12 inch main on 116th Avenue south from 108th Street to 110th Street then west on 110th Street to ISH 94.

As previously mentioned, the following facilities have been proposed for the area but not designed. They will be included in the cost estimates.

49) A 5.000 MG prestressed above ground concrete reservoir will be located at the intersection of Green Bay Road (STH 31) and 93rd Street (CTH T).

50) Construction of a booster pump station which will pump from the reservoir to the Pleasant Prairie Pressure Zone. The booster station will have three pumps, two 100 Hp pumps capable of supplying 2000 GPM (3.00 MGD) and one 350 Hp fire pump capable of supplying 5000 GPM (7.00 MGD). The station will also require an emergency generator capable of starting either the fire pump or both 100 Hp pumps.

    An additional 4,600 feet of discharge main from the booster station will also be required. Plans call for a 16 inch main on Green Bay Road (STH 31) running south from the booster station parallel to the existing 16 inch. The main will then turn west on 95th Street (CTH T) and run parallel to the existing 12 inch main to 80th Avenue.

Additional Boosting In Pleasant Prairie

Under the 2010 Intermediate Development Plan there are two areas which will require additional pressure boosting. Areas above elevation 839 NGVD will require boosting to provide the minimum required domestic pressure of 35 psi at all times. These areas are shown in Figure 5-12. The cut-off elevation for boosting was determined as follows:

Overflow elevation of elevated tanks =	845.50 NGVD
Minus 20 foot operating range of tanks =	825.50 NGVD
Minus 35 Psi times 2.31 feet/pound = 80.85ft =	744.65 NGVD

The maximum elevation to be served is approximately 763 NGVD. At this elevation the normal pressure system will be able to provide a fire flow of 750 GPM and not drop to the minimum 20 Psi pressure restriction.

The following improvements are recommended:

51) In Area No. 1, which is located in Town 1 North, Range 22 East, Sections 22 and 27, approximately 110 homes will require boosting. In accordance with Chapter NR 111.75 of the Wisconsin Administrative Code, a submersible pumping station containing two pumps, 7-1/2 Hp each, and rated at a 330 GPM is recommended. Also required is a check valve manhole to allow adequate flow in fire situations.

52) In Area No. 2, which is located in Town 1 North, Range 22 East, Section 35, approximately 20 homes will require boosting. In accordance with Chapter NR 111.75 of the Wisconsin Administrative code, a submersible pumping station containing two pumps, 3 Hp each and rated at 110 GPM, is recommended. Also required is a check valve manhole to allow adequate flow in fire situations.

The total estimated construction cost of Alternative I is $22,130,400. The total 50 year O & M present worth of the facilities is $33,064,400. Detailed costs are listed in Table 5-20. O & M costs are assumed to be $1,200 per mile of water main and 5% of construction costs for supply and storage facilities.

Alternative I - Sub-Alternative A

This sub-alternative involves serving the Oakdale Estates Subdivision with water service from the Village of Sturtevant which is the closest water system in Racine County. An estimated 19,200 feet of 12 inch main would be required to serve the area. This would increase the construction cost $249,000 over the area being served from the Town of Somers.

The total estimated construction cost of Alternative I-A for facilities construction is $22,379,500. The total 50 year present worth of the facilities is $33,405,100. Detailed costs are listed in Table 5-21.

Alternative I - Sub-Alternative B

Sub-Alternative B involves the Bristol Water Utility East remaining a separate entity. This would eliminate $160,500 of main construction under ISH 94. It would, however, add the cost of constructing a 400 GPM well and pumphouse.

The total estimated construction cost of Alternative I-B for facilities construction is $22,136,400. The total 50 year present worth of the facilities is $33,209,900. Detailed costs are listed in Table 5-22.

Additional Alternatives

Additional alternatives were reviewed and rejected based upon a cursory analysis of capital and O & M costs, long term needs and discussions with local area representatives.

Alternative II Decentralized Service

The decentralized water service alternative would involve the maintenance of existing well and pumpstation facilities in Pleasant Prairie. High radium concentrations in the two major systems, Ladish and Timber Ridge would require either costly treatment, blending with City of Kenosha water or construction of new limestone wells.

Crispell-Snyder in their 1987 Report on Radium Control Methods recommended the connection of the Ladish and Timber Ridge systems to the Kenosha System. While this report recommended blending of water at a minimum 1 to 1 ratio for the Ladish System and a minimum 4.5 to 1 ratio for the Timber Ridge System, the Village of Pleasant Prairie has indicated a desire to abandon the well facilities and use the Kenosha Water Utility as a sole source of supply. The Pleasant Homes water system currently has no storage and poor well capacity. The Village has also indicated a desire to connect this system to the City of Kenosha water utility. For these reasons, the decentralized service alternative was eliminated from consideration.

Construction of New Facilities

New facilities could be constructed to serve two areas; an area in the Town of Paris near STH 142 and ISH 94; and an area in the Town of Bristol near CTH Q and ISH 94. Both areas will have mains capable of serving them within a few thousand feet. The cost to construct additional wells, storage, pumpstations and water main far exceeds the cost of connection to the Kenosha Water Utility supplied system.

Water Alternative Summary

Total present worth costs for the various water alternatives are presented in Tables 5-20 through 5-22. The least costly alternative is Alternative I with the Kenosha water system serving the entire study area. The total present worth cost for this Alternative is $33,064,400. Sub-alternative A and Sub-alternative B have total present worth costs of $33,405,100 and $33,209,900 respectively. Because the plan costs differ by less than 10 percent, a comparison was made of the elements that are unique or different to serving Bristol from Kenosha or by the existing system and to serving Oakdale Estates from Kenosha or Sturtevant. Calculations show that it is approximately 24 percent less expensive to serve Oakdale Estates from Kenosha. The cost of serving Bristol from Kenosha is 2 percent less expensive than having Bristol remain a separate utility. The surface water provided by the Kenosha Utility is of higher quality and the four elevated tanks and two booster stations serving the area from Kenosha provide increased reliability. In addition, the limestone formation in the area around the existing Bristol east well may not be

Table 5 -20

WATER SUPPLY, STORAGE AND TRANSMISSION FACILITY COSTS

ALTERNATIVE I

Improvement	Item	Quantity	Unit Price	Cost	Life	Replacement Costs				Salvage
						10 Years	20 Years	30 Years	40 Years	
1	16" Water Main	11,500	$55	$632,500	50					$0
2	36" Water Main	12,000	$108	$1,296,000	50					$0
	16" Water Main	15,200	$55	$836,000	50					$0
3	16" Water Main	6,000	$55	$330,000	50					$0
4	16" Water Main	4,500	$55	$247,500	50					$0
5	12" Water Main	8,100	$53	$429,300	50					$0
6	8" Water Main	7,600	$43	$326,800	50					$0
	8" Pressure Control Valve	1	$3,200	$3,200	20		$3,200		$3,200	($1,600)
	Manhole	1	$1,500	$1,500	50					$0
	Mechanical & Bypass	1	$15,000	$15,000	20		$15,000		$15,000	($7,500)
7	50Hp Pump, Mechanical	1	$25,000	$25,000	20		$25,000		$25,000	($12,500)
	200 KW Generator, Reduced Voltage Starter, Controls	1	$30,000	$30,000	30			$30,000		($9,900)
	Fuel Tank	1	$7,000	$7,000	30			$7,000		($2,310)
	Building Addition	1	$65,000	$65,000	50					$0
8	16" Water Main	3,000	$55	$165,000	50					$0
9	12" Water Main	4,500	$53	$238,500	50					$0
10	24" Water Main	5,800	$73	$423,400	50					$0
11	16" Water Main	5,800	$55	$319,000	50					$0
12	16" Water Main	2,800	$55	$154,000	50					$0
	12" Water Main	2,800	$53	$148,400	50					$0
13	12" Water Main	8,000	$53	$424,000	50					$0
14	16" Water Main	12,400	$55	$682,000	50					$0
15	16" Water Main	16,000	$55	$880,000	50					$0
16	12" Water Main	2,500	$53	$132,500	50					$0
	16" Water Main	1,500	$55	$82,500	50					$0
17	24" Water Main	8,600	$73	$627,800	50					$0
18	16" Water Main	2,600	$55	$143,000	50					$0
19	16" Water Main	5,200	$55	$286,000	50					$0
20	12" Water Main	1,500	$53	$79,500	50					$0
21	12" Water Main	5,400	$53	$286,200	50					$0
22	16" Water Main	4,800	$55	$264,000	50					$0
23	12" Water Main	3,400	$53	$180,200	50					$0
24	Pump Station Building	1	$125,000	$125,000	50					$0
	Pumps (150 Hp)	2	$12,000	$24,000	20		$24,000		$24,000	($12,000)
	Mechanical	1	$60,000	$60,000	20		$60,000		$60,000	($30,000)
	Electrical	1	$80,000	$80,000	30			$80,000		($26,400)
	Controls	1	$20,000	$20,000	30			$20,000		($6,600)
	200 KW Generator, Reduced Voltage Starter, Controls, Fuel Tan	1	$37,000	$37,000	30			$37,000		($12,210)
	Sitework	1	$30,000	$30,000	50					$0
	600,000 Gallon Reservior	1	$420,000	$420,000	50					$0

Table 5 -20

WATER SUPPLY, STORAGE AND TRANSMISSION FACILITY COSTS

ALTERNATIVE I

						Replacement Costs				
Improvement	Item	Quantity	Unit Price	Cost	Life	10 Years	20 Years	30 Years	40 Years	Salvage
25	24" Water Main	4,800	$73	$350,400	50					$0
26	24" Water Main	1,000	$73	$73,000	50					$0
27	16" Water Main	7,100	$55	$390,500	50					$0
28	16" Water Main	4,000	$55	$220,000	50					$0
29	16" Water Main	800	$55	$44,000	50					$0
	16" Water Main in 30" Casing	400	$250	$100,000	50					$0
30	24" Water Main	3,600	$73	$262,800	50					$0
31	16" Water Main	10,100	$55	$555,500	50					$0
32	16" Water Main	5,900	$55	$324,500	50					$0
33	Pump Station Building	1	$60,000	$60,000	50					$0
	Pumps (25 Hp)	2	$3,000	$6,000	20		$6,000		$6,000	($3,000)
	Mechanical	1	$30,000	$30,000	20		$30,000		$30,000	($15,000)
	Electrical & Controls, Generator	1	$50,000	$50,000	30			$50,000		($16,500)
34	200,000 Gallon Elevated Tank									
	140' Tall, Foundation	1	$310,000	$310,000	50					$0
	Painting	1	$50,000	$50,000	10	$50,000	$50,000	$50,000	$50,000	$0
	Electrical & Controls	1	$7,500	$7,500	30			$7,500		($2,475)
35	12" Water Main	14,500	$53	$768,500	50					$0
36	12" Water Main	7,000	$53	$371,000	50					$0
37	Buried Booster Station With 10 Hp,									
	15 Hp & 25 Hp Motors Installed	1	$80,000	$80,000	20		$80,000		$80,000	($40,000)
	Electrical	1	$5,000	$5,000	30			$5,000		($1,650)
38	16" Water Main	12,000	$55	$660,000	50					$0
39	16" Water Main	17,000	$55	$935,000	50					$0
40	12" Water Main	26,200	$53	$1,388,600	50					$0
41	12" Water Main	12,000	$53	$636,000	50					$0
42	16" Water Main	5,500	$55	$302,500	50					$0
43	16" Water Main	3,000	$55	$165,000	50					$0
44	12" Water Main	2,500	$53	$132,500	50					$0
45	12" Water Main	10,000	$53	$530,000	50					$0
46	12" Water Main	2,600	$53	$137,800	50					$0
	12" Water Main in 30" Casing	400	$250	$100,000	50					$0
47	12" Water Main	1,500	$53	$79,500	50					$0
48	12" Water Main	2,000	$53	$106,000	50					$0
49	5 MG Prestressed Above									
	Ground Concrete Reservior	1	$1,560,000	$1,560,000	50					$0

Table 5 -20

WATER SUPPLY, STORAGE AND TRANSMISSION FACILITY COSTS

ALTERNATIVE I

Improvement	Item	Quantity	Unit Price	Cost	Life	Replacement Costs 10 Years	20 Years	30 Years	40 Years	Salvage
50	Pump Station Building	1	$150,000	$150,000	50					$0
	Fire Pump (250 Hp)	1	$20,000	$20,000	20		$20,000		$20,000	($10,000)
	Service Pump (100 Hp)	2	$7,000	$14,000	20		$14,000		$14,000	($7,000)
	Mechanical	1	$60,000	$60,000	20		$60,000		$60,000	($30,000)
	Controls	1	$20,000	$20,000	30			$20,000		($6,600)
	Electric	1	$80,000	$80,000	30			$80,000		($26,400)
	Generator, Controls, Fuel Tank	1	$44,000	$44,000	30			$44,000		($14,520)
	Site Work	1	$30,000	$30,000	50					$0
	16" Discharge Main	4,600	$55	$253,000	50					$0
51	Submersible Booster Station	1	$57,000	$57,000	20		$57,000		$57,000	($28,500)
52	Submersible Booster Station	1	$54,000	$54,000	20		$54,000		$54,000	($27,000)
				$22,130,400		$50,000	$498,200	$430,500	$498,200	($349,665)
Engineering & Contingencies (30%)				$6,639,120						
Total Costs				$28,769,520						
Present Worth Factors				1.0000		0.5584	0.3118	0.1741	0.0972	0.0543
Present Worth				$28,769,520		$27,920	$155,341	$74,954	$48,436	($18,983)
Total Present Worth Of Construction				$29,057,189						
Annual O & M Costs *			$254,237							
50 Year Present Worth Factor			15.7619							
Present Worth Of Annual O & M Costs				$4,007,252						
Total Present Worth				$33,064,441						

* O & M costs are assumed to be 5% of construction costs for pumping and storage faciltics and $1,200 per mile of transmission main.

Source: Ruekert & Mielke, Inc.

Table 5 -21

WATER MAIN COSTS

ALTERNATIVE I
SUB ALTERNATIVE A

Improvement	Item	Quantity	Unit Price	Cost	Life	Replacement Costs 10 Years	20 Years	30 Years	40 Years	Salvage
Total Costs Of Items 1-34, 36-52 Alternative I (Table 5 - 20)				$21,361,900		$50,000	$498,200	$430,500	$498,200	($349,665)
35	12" Water Main	19,200	$53	$1,017,600	50					$0
Total				$22,379,500						
Engineering & Contingencies (30%)				$6,713,850						
Total Costs				$29,093,350						
Present Worth Factors				1.0000		0.5584	0.3118	0.1741	0.0972	0.0543
Present Worth				$29,093,350		$27,920	$155,341	$74,954	$48,436	($18,983)
Total Present Worth Of Construction				$29,381,019						
Annual O & M Costs			$255,305							
50 Year Present Worth Factor			15.7619							
Present Worth Of Annual O & M Costs				$4,024,089						
Total Present Worth				$33,405,108						

Source: Ruekert & Mielke, Inc.

Table 5 -22

WATER MAIN COSTS

ALTERNATIVE I
SUB ALTERNATIVE B

Improvement	Item	Quantity	Unit Price	Cost	Life	Replacement Costs 10 Years	20 Years	30 Years	40 Years	Salvage
Total Costs Of Alternative I (Table 5 - 20)				$22,130,400		$50,000	$498,200	$430,500	$498,200	($349,665)
Remove Item #29 Costs (Table 5 - 20)										
	16" Water Main	800	$55	$44,000	50					$0
	16" Water Main in 30" Casing	400	$250	$100,000	50					$0
Remove Item #24 Costs (Table 5 - 20)										
	Pump Station Building	1	$125,000	$125,000	50					$0
	Pumps (150 Hp)	2	$12,000	$24,000	20		$24,000		$24,000	($12,000)
	Mechanical	1	$60,000	$60,000	20		$60,000		$60,000	($30,000)
	Electrical	1	$80,000	$80,000	30			$80,000		($26,400)
	Controls	1	$20,000	$20,000	30			$20,000		($6,600)
	200 KW Generator, Reduced Voltage Starter, Controls, Fuel Tan	1	$37,000	$37,000	30			$37,000		($12,210)
	Sitework	1	$30,000	$30,000	50					$0
	600,000 Gallon Reservior	1	$420,000	$420,000	50					$0
Add New Item #24 Costs										
	Pump Station Building	1	$125,000	$125,000	50					$0
	Pumps (150 Hp)	2	$12,000	$24,000	20		$24,000		$24,000	($12,000)
	Mechanical	1	$60,000	$60,000	20		$60,000		$60,000	($30,000)
	Electrical	1	$80,000	$80,000	30			$80,000		($26,400)
	Controls	1	$20,000	$20,000	30			$20,000		($6,600)
	200 KW Generator, Reduced Voltage Starter, Controls, Fuel Tan	1	$37,000	$37,000	30			$37,000		($12,210)
	Sitework	1	$30,000	$30,000	50					$0
	535,000 Gallon Reservior	1	$380,000	$380,000	50					$0
Add	400 GPM Well									
	Approximately 300' Deep	1	$50,000	$50,000	50					$0
	Pumpstation	1	$60,000	$60,000	50					$0
	Pumping & Mechanical	1	$50,000	$50,000	20		$50,000		$50,000	($25,000)
	Electrical & Controls	1	$30,000	$30,000	30			$30,000		($9,900)
Totals				$22,136,400		$50,000	$548,200	$460,500	$548,200	($384,565)
Engineering & Contingencies (30%)				$6,640,920						
Total Costs				$28,777,320						
Present Worth Factors				1.0000		0.5584	0.3118	0.1741	0.0972	0.0543
Present Worth				$28,777,320		$27,920	$170,931	$80,178	$53,297	($20,877)
Total Present Worth Of Construction				$29,088,769						
Annual O & M Costs			$261,465							
50 Year Present Worth Factor			15.7619							
Present Worth Of Annual O & M Costs				$4,121,168						
Total Present Worth				$33,209,936						

Source: Ruekert & Mielke, Inc.

able to provide the required 400 GPM and additional wells may be required.

For these reasons, Alternative I will be evaluated together with Sewerage Alternative IB as the selected alternative in Chapter VI.

Summary of Alternatives

The cost effective sewerage alternative is "Centralized" Alternative IB. The cost effective water alternative is "Centralized" Alternative I. These "Centralized" alternatives will be refined in Chapter VI as the selected alternative.

CHAPTER VI

PLAN SELECTION AND ADOPTION

INTRODUCTION

This Chapter refines the selected "Centralized" plan presented in Chapter V. That plan calls for the planning area to be served, in concept, by sewerage Alternative 1B and by a "Centralized" water system. The plan will be tested with three land use scenario's: The year 2010 intermediate growth centralized land use plan, the year 2010 optimistic growth decentralized growth land use plan and the ultimate land use development plan (i.e.. 40 year growth condition). The final system plan recommendations will be based on consideration of all three future scenarios.

In addition, the plan will be modified to incorporate recent system improvements made by the Kenosha Water Utility and the Village of Pleasant Prairie. These improvements include several trunk sewer extensions, sewer reinforcements and some water main, supply and storage facilities. The plan will be further modified to include the proposed removal of a number of storm sewer catch basins that are currently directly connected to the Kenosha sewer system. Also, included in the analysis will be a calibration of flows based upon actual sewage flow measurements at four locations in the system which were taken in the summer of 1990.

RECOMMENDED SEWERAGE ALTERNATIVE

Sewerage Alternative 1B is the recommended alternative. This alternative provides for "Centralized" service with sewage conveyed to and treated at the Kenosha WTF. The two WTF's in the Village of Pleasant Prairie (SUD "D" and "73-1") will be phased out and abandoned by the year 2010. Trunk sewers will be extended from the Kenosha sewerage system to service the planning area as necessary and the Kenosha WTF will be expanded to treat the planning area sewage.

Major components for the three different land use development scenarios were sized and estimated costs were developed. A description of the components for each scenario follows.

Modifications To The Recommended Alternative

Following completion of the existing system inventory, system modeling and alternative selection phase of this study, several new trunk sewers and system modifications were identified as already in service or proposed for construction in the immediate future. These new sewers and modifications directly impact the recommended improvements for trunk sewers No. 10,18,31 and 35. In concept the new sewers and system modifications are similar to the recommended improvements for trunk sewers No. 10,18,31 and 35 detailed in Chapter V and indicated on Figure 5-4. Because these trunk sewers in fact do exist, the costs associated with the construction of trunk sewers No. 10,18,31 and 35 are no longer applicable.

The identification of these new trunk sewers and system modifications has significantly reduced the required conveyance facilities to provide "Centralized" sanitary sewer service to the entire study area. As a result, all analyses for this chapter will include these additional trunk sewers and system modifications in determining the required conveyance facilities for future land use scenarios.

The following is a description of the new trunk sewers and system modifications not previously analyzed and their effect on the system:

1) Trunk sewer No. 37 is a 12 inch diameter gravity relief sewer that was constructed in 14th Place between 26th Avenue and 30th Avenue. Construction of this sewer eliminated the need to relieve trunk sewer No. 18.

2) Trunk sewer No. 7 which is a 36 inch and 24 inch diameter gravity sewer was constructed from the "KD" tracks (trunk sewer No. 9) west along 80th Street (extended) to Green Bay Road and north along Green Bay Road to 75th Street. This sewer eliminated the need to relieve trunk sewer No. 10 (75th Street from Green Bay Road to 51st Avenue).

3) Trunk sewer No. 31 was constructed along 75th Street from Green Bay Road to approximately 3900 feet west of 88th Avenue. This system consists of 30 inch, 24 inch and 21 inch diameter gravity sewers and a lift station and forcemain that connects with trunk sewer No. 7 at the intersection of Green Bay Road and 75th Street. This sewer eliminated the need to construct the proposed trunk sewer No. 31.

4) Trunk sewer No. 35 is designed and is under construction by the Village of

Pleasant Prairie in 1991. This system is a 30 inch diameter and 36 inch diameter gravity sewer in 104th Street from Sheridan Road to approximately 300 feet west of 64th Avenue. This sewer eliminates the need to construct the proposed trunk sewer No. 35.

Inflow Reduction After Catch Basin Removal

During the course of this study a number of catch basins with direct connections to the sanitary sewer system were discovered. The Kenosha Water Utility intends to remove these catch basins in the immediate future. To more precisely estimate facility sizes required for the future land use scenario's, it was decided to remove the excess inflow that could reasonably be anticipated to occur as a result of these catch basins.

Catch basin capacity is a function of many variables. Some of these variables are:

1. Rainfall intensity

2. Rainfall duration

3. The rainfall losses due to:

    a. infiltration
    b. interception
    c. surface storage

5. The catch basin location whether in a ponded condition or on a continuous slope.

6. The depth of flow at the basin which is a function of:

    a. longitudinal slope
    b. transverse slope
    c. the channel geometry in which the basin is located
    d. the channel roughness

7. The catch basin grate capacity.

To precisely determine the inflow from catch basins all of the above data must be available. However, only limited data was available to determine the amount of inflow generated by these catch basins.

Therefore, to reasonably determine the inflow from these catch basins the following assumptions have been made.

1. The only rainfall data available for the design storm of August 31 and September 1, 1989 is the total depth of rain from a gauge at the Kenosha WTF. To determine hourly rainfall intensity the hourly rainfall recorded by the National Weather Service gauge was used and individual hourly intensities were multiplied by a factor so that the resulting rainfall hyetograph had a total depth of rainfall equal to the depth recorded at the Kenosha WTF.

2. The Kenosha Department of Public Works provided data for many basins indicating tributary area, location, design recurrence interval, and peak runoff rates. This data was used to calculate runoff coefficients "C" using the Rational Formula.

3. Topographic maps were used to determine whether basins were on a continuous slope or in a "sump" condition.

4. For catch basins on continuous slopes the following data was used.

    a. longitudinal slope from topographic maps
    b. transverse slope = 0.02'/foot
    c. right angle channel section
    d. Manning's "n"=0.013

5. Catch basin capacity was based on a standard catch basin grate size.

6. Catch basins in ponded conditions were assumed to collect all flow directed to them.

The Rational Formula was used to determine the peak runoff to each basin using the peak intensity from the rainfall hyetograph and site specific tributary areas and runoff coefficients. The peak inflow rate for each basin was determined from the Neenah Inlet Grate Capacities Manual.

The peak hourly inflow rate attributable to the known catch basins connected to the sanitary sewer system has been estimated at 14 MGD. Of this total 10 MGD will be removed as a result of the Cities ongoing removal program. This will reduce the total estimated peak inflow in the sewerage system from 94 MGD to 84 MGD. The inflow rate on an average will drop from 15,415 gpd/manhole to 13,798 gpd/manhole.

Calibration Of The System Model

Recently the Kenosha Water Utility installed 4 velocity meters at various points in the existing sewer system. An attempt was made to calibrate the system model to flows recorded by these meters. However, at the time the large rainfalls occurred, the velocity meters did not record any data. In addition one of the meters appears to be in a location experiencing serious backwater effects making the data recorded not suitable for calibration.

The events that have been recorded have been from rainfalls of approximately 35% or less of the total rainfall observed in the design storm of August 31, and September 1, 1989. As a result useful calibration of the model has not been possible.

PLANNING REPORT FLOW ACCURACY

Peak flows in the Kenosha sewerage system have been estimated from treatment plant records and limited system flow monitoring. Flow gauged at the WTF is not an accurate representation of peak flow in the system because the pumping capacity is below the actual required capacity which results in system backwater and bypassing upstream. In addition, some major interceptors are undersized and peaks are therefore stored, delayed and/or bypassed. An attempt was made to estimate the bypassed flows through manual observation. However, no flow bypass monitor was in place during the course of this study. Four continuous monitors were installed upstream in the system in 1990 but were not operational during any significant storm event which hindered calibration of flows for the study.

Additionally a number of catchbasins are proposed to be removed in 1990 and 1991 which will significantly reduce inflow to the system. System level planning estimates of the effect of this removal have been made. However, monitoring data from the system after removal of these catch basins should be used in final design to refine the system level flow estimates.

In summary, because of the limited data available for use in estimating existing and plan condition sewerage system flows, flow estimates used in this report, although suitable for facility planning, should be refined prior to detailed design. Monitoring and further calibration is recommended.

YEAR 2010 INTERMEDIATE GROWTH SCENARIO

Sewage Conveyance Facilities

The year 2010 intermediate "centralized" growth land use plan includes the areas as shown on Figure 6-1 and components as shown on Figure 6-2 and described as follows:

Trunk Sewer No. 1

Trunk sewer No. 1 is the main north-south trunk sewer for Kenosha. The sewer is an existing 72 inch diameter gravity sewer in 3rd Avenue from 67th Street (extended) to the Kenosha Water Utility WTF (see Figure 6-2). The estimated capacity of this sewer ranges between 77 cfs and 134 cfs. Under this land use plan the required capacity for this trunk sewer varies by location from 159 cfs to 163 cfs (see Figure 6-3). To provide the required capacity, construction of 4430 feet of 96 inch diameter gravity sewer will be required (see Figure 6-2).

Trunk Sewer No. 3

Existing trunk sewer No. 3 in Sheridan Road is inadequate to convey the estimated future peak flows between manhole 3.09 (87th Street) and manhole 3.07 (85th Street). The existing 18 inch gravity sewer between manhole No. 3.09 and 3.07 has a capacity of 3.5 to 4.2 cfs. Under this land use plan the estimated peak flow is 4.4 cfs (see Figure 6-3). To provide capacity for the estimated future peak flow, a relay of the existing 18 inch gravity sewer in Sheridan Road with 1260 feet of 21 inch diameter gravity sewer will be required (see Figure 6-2).

Trunk Sewer No. 8

Trunk sewer No. 8 is one of the main east-west trunk sewers for Kenosha. This sewer is a 60 inch to 99 inch diameter gravity sewer. The sewer begins at the intersection of 34th Avenue and 63rd Street and connects with trunk sewer No. 1 at the intersection of 67th Street (extended) and 3rd Avenue (see Figure 6-2). The estimated capacity for this trunk sewer ranges between 30 cfs and 1013 cfs. Under the intermediate centralized land use scenario the required capacity for this sewer ranges from 50 cfs to 92 cfs by location (See Figure 6-3).

The sewer reaches between manholes 8.03 (Sheridan Road and 66th Street) and 8.01 (5th Avenue and 66th Street extended) and have an existing capacity of 30 cfs to 47 cfs. Required capacity for these same reaches is approximately 92 cfs. System modelling has indicated a maximum Hydraulic Grade Line (HGL) of approximately 589.6 at manhole No. 8.03 and approximately 589.5 at manhole 8.02.

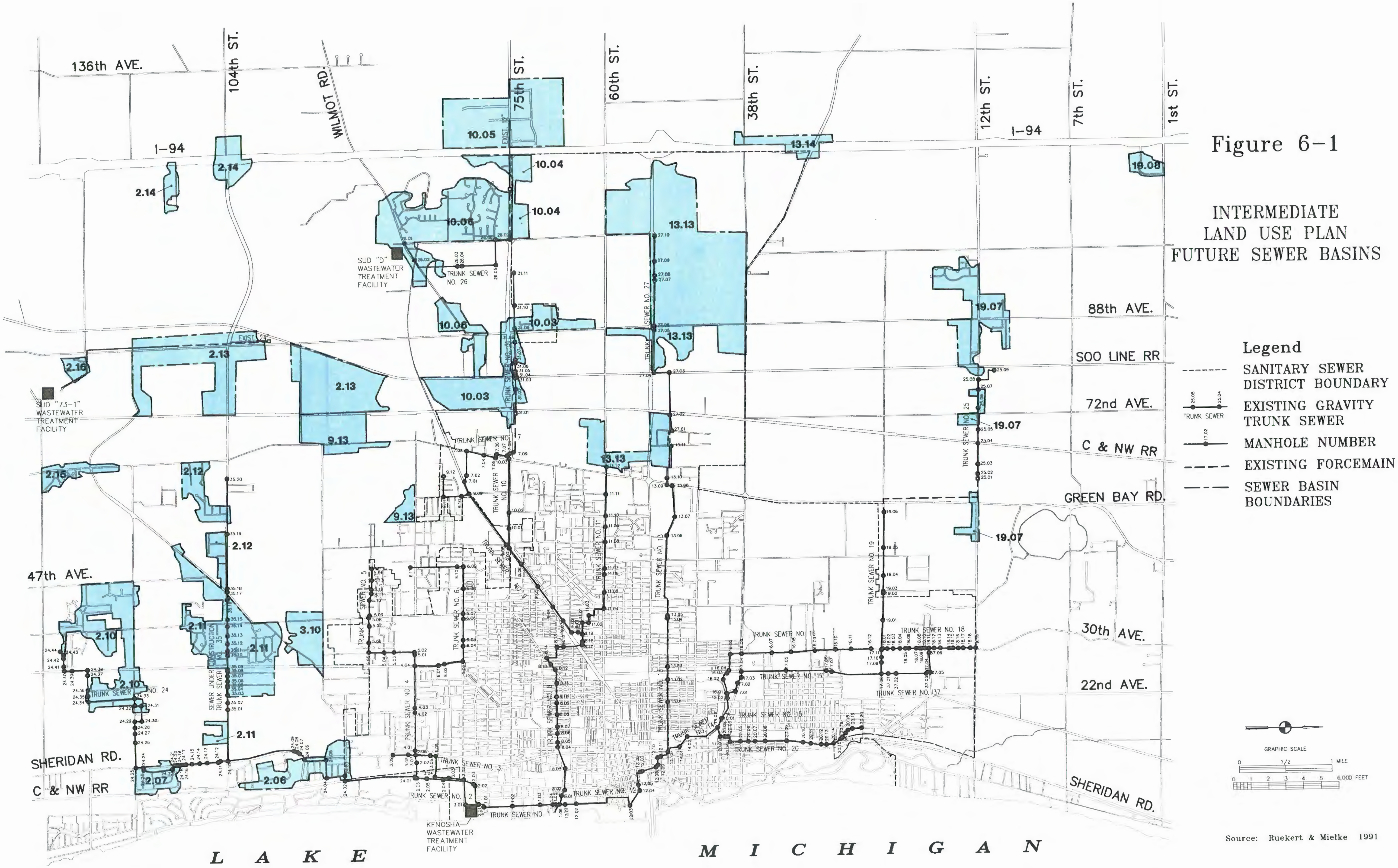


Figure 6-1

INTERMEDIATE LAND USE PLAN FUTURE SEWER BASINS

Source: Ruekert & Mielke 1991

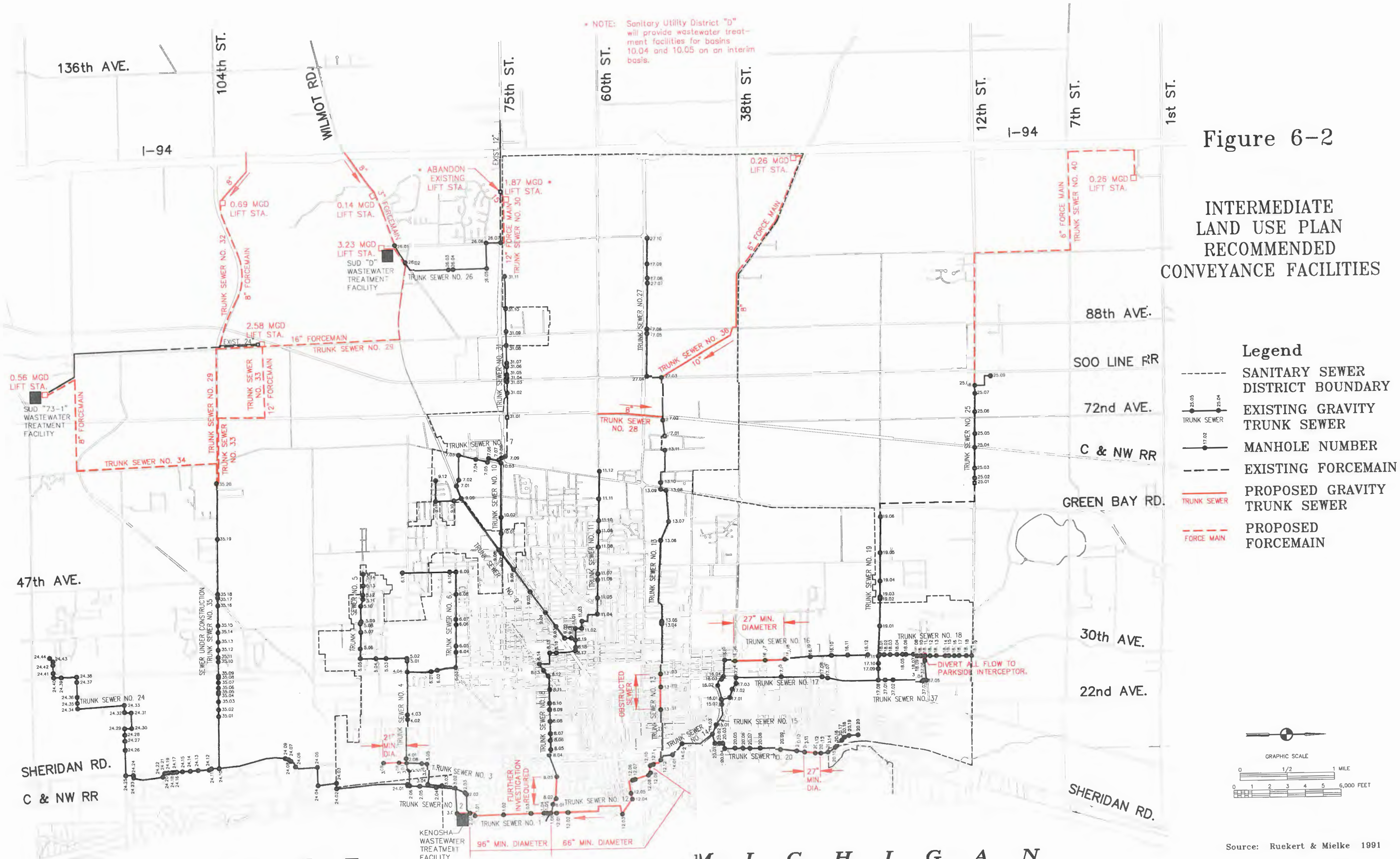


Figure 6-2
INTERMEDIATE LAND USE PLAN RECOMMENDED CONVEYANCE FACILITIES
Legend
SANITARY SEWER DISTRICT BOUNDARY
EXISTING GRAVITY TRUNK SEWER
MANHOLE NUMBER
EXISTING FORCEMAIN
PROPOSED GRAVITY TRUNK SEWER
PROPOSED FORCEMAIN
NOTE: Sanitary Utility District "D" will provide wastewater treatment facilities for basins 10.04 and 10.05 on an interim basis.
136th AVE.
104th ST.
WILMOT RD.
75th ST.
60th ST.
38th ST.
12th ST.
7th ST.
1st ST.
I-94
88th AVE.
SOO LINE RR
72nd AVE.
C & NW RR
GREEN BAY RD.
30th AVE.
22nd AVE.
47th AVE.
SHERIDAN RD.
ABANDON EXISTING LIFT STA.
1.87 MGD LIFT STA.
0.69 MGD LIFT STA.
0.14 MGD LIFT STA.
3.23 MGD LIFT STA.
SUD "D" WASTEWATER TREATMENT FACILITY
2.58 MGD LIFT STA.
16" FORCEMAIN
0.56 MGD LIFT STA.
SUD "73-1" WASTEWATER TREATMENT FACILITY
0.26 MGD LIFT STA.
TRUNK SEWER NO. 34
TRUNK SEWER NO. 29
TRUNK SEWER NO. 26
TRUNK SEWER NO. 28
TRUNK SEWER NO. 36
TRUNK SEWER NO. 16
TRUNK SEWER NO. 17
TRUNK SEWER NO. 18
TRUNK SEWER NO. 15
TRUNK SEWER NO. 20
TRUNK SEWER NO. 24
TRUNK SEWER NO. 3
TRUNK SEWER NO. 12
TRUNK SEWER NO. 1
TRUNK SEWER NO. 37
27" MIN. DIAMETER
21" MIN. DIA.
27" MIN. DIA.
DIVERT ALL FLOW TO PARKSIDE INTERCEPTOR.
FURTHER INVESTIGATION REQUIRED
OBSTRUCTED SEWER
96" MIN. DIAMETER
66" MIN. DIAMETER
KENOSHA WASTEWATER TREATMENT FACILITY
GRAPHIC SCALE
0 1/2 1 MILE
0 1 2 3 4 5 6,000 FEET
LAKE MICHIGAN
Source: Ruekert & Mielke 1991

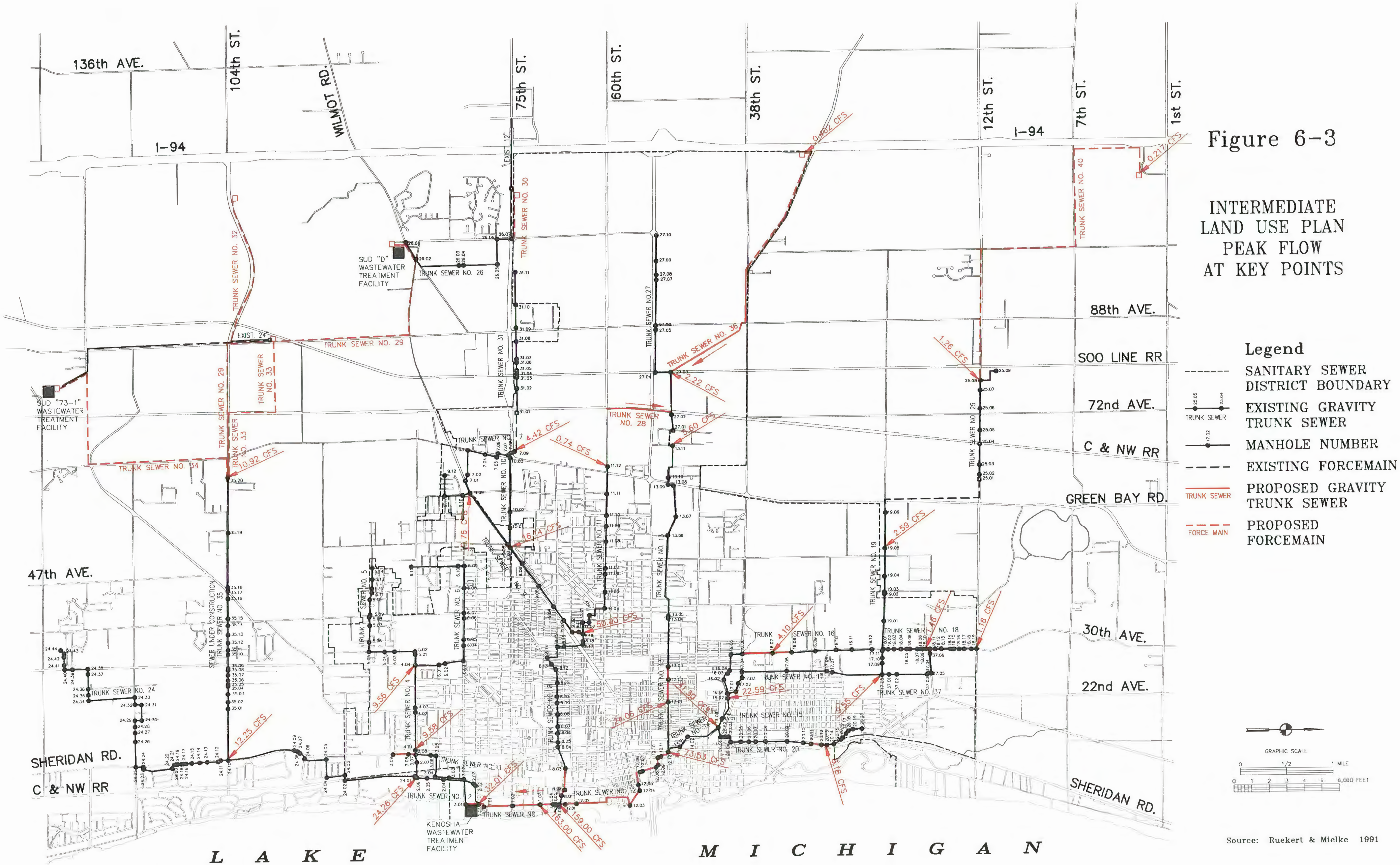


Figure 6-3

INTERMEDIATE LAND USE PLAN PEAK FLOW AT KEY POINTS

The manhole rim elevation at manhole No. 8.03 is 601.70 and at manhole No 8.02 is 595.30. Therefore, at manhole No. 8.03 the HGL is 12.1 feet ö below ground surface and at manhole No. 8.02 it is 5.8 feet ö below ground surface.

This portion of trunk sewer No. 8 is a part of the old combined sewer system of the City of Kenosha. Further investigation by the Kenosha Water Utility should be undertaken to determine whether the level of the HGL in this sewer reach can be tolerated without resulting basement back ups. To date there have been no reports of basement backups which can be attributed to this portion of sewer.

Trunk Sewer No. 12

Existing trunk sewer No. 12 is a portion of the main north-south trunk sewer for Kenosha. This sewer begins at the intersection of 50th Street with the Chicago and Northwestern Railroad right-of-way and connects to trunk sewer No. 1 at the intersection of 67th Street (extended) and 3rd Avenue. The existing sewer is a 60 inch diameter gravity sewer. The existing capacity of this trunk sewer ranges from 14 cfs to 165 cfs. The estimated peak flow, for this land use plan, varies by location from 90 to 110 cfs (see Figure 6-3). To provide capacity for the estimated future peak flows, construction of 8770 feet of 66 inch diameter gravity sewer will be required (see Figure 6-2).

Trunk Sewer No. 13

Trunk sewer No. 13 is one of the main east-west trunk sewers of Kenosha. This sewer conveys flow along 50th Street and 50th Street extended from 68th Avenue to trunk sewer No. 12 at the Chicago and Northwestern Railroad right-of-way. Trunk sewer No. 13 is a gravity sewer ranging in size from a 27 inch diameter to a 60 inch diameter pipe. The estimated capacity ranges by location from 15 cfs to 226 cfs. The estimated peak flow to this sewer ranges from 6 cfs to 24 cfs.

Recently, the Kenosha Water Utility installed a velocity meter at 26th Avenue and 50th Street. Data recently made available from this meter allows the calculation of the actual Manning's roughness coefficient for this portion of trunk sewer No. 13. The calculated roughness coefficient for trunk sewer No. 13 between 28th Avenue and 26th Avenue is 0.216, which indicates that there is some type of obstruction or constriction in this sewer downstream of the meter location.

There have been reports of basement backups on trunk sewer No. 13 and its' tributaries. The existing sewer has adequate capacity for the projected peak flows for this land use plan provided the obstruction problem downstream of 26th Avenue can be resolved. Therefore, the Kenosha Water Utility should attempt to determine the cause of the loss of flow capacity in this trunk sewer. If this obstruction or constriction can be removed, no additional capacity will be required.

Trunk Sewer No. 16

A portion of trunk sewer No. 16 is inadequate to convey the peak flows under the intermediate land use scenario.

The portion of this sewer between manhole No. 16.08, at the intersection of 34th Street and 30th Avenue, and manhole 16.06, at the intersection of 30th Avenue and 40th Street, is inadequate to convey the estimated peak flow of 4.11 cfs. The existing sewer has a capacity of 1.73 cfs (see Figure 6-2 & 6-3).

To provide the required capacity for this land use scenario, a portion of the sewer to be relayed with 2770 feet of 27 inch diameter pipe.

Trunk Sewer No. 18

A portion of trunk sewer No. 18, in 30th Avenue, is inadequate to convey the estimated peak flows from this land use scenario. Downstream of 15th Street the capacity of this sewer ranges from 1.7 cfs to 4.2 cfs. The estimated peak flow to this portion of trunk sewer No. 18 is 2.6 cfs. To alleviate the demand on trunk sewer No. 18, it is recommended that all flow north of 14th Street be diverted to the Parkside interceptor via trunk sewer No. 37 in 14th Place. Because trunk sewer No. 37 already exists, the only modification required is bulkheading trunk sewer No. 18, just downstream of the connection with trunk sewer No. 37. The cost of this bulkhead is considered insignificant in the cost analysis of the three individual land use scenarios analyzed in this chapter and is therefore omitted.

Trunk Sewer No. 20

Existing trunk sewer No. 20 in 14th Avenue is inadequate to convey the estimated peak flows for the intermediate land use scenario. From manhole No. 20.13 at 24th Street to manhole No. 20.11 at 27th Street the existing capacity for this sewer is estimated at 3 cfs (see Figure 6-3). Under this scenario, the estimated peak flow to this point in trunk sewer No. 20 is 8 cfs. To increase the capacity of this portion of sewer will require a relay of the existing 18 inch diameter gravity sewer with 900 feet of 27 inch diameter gravity sewer in 14th Avenue between manhole No. 20.13 and manhole No. 20.11 (see Figure 6-2).

Trunk Sewer No. 28

To provide sewer service for the area roughly delineated on Figure 6-1 as basin No. 13.13 will require construction of trunk sewer No. 28.

Trunk sewer No. 28 would consist of approximately 3700 feet of 8 inch diameter gravity sewer along the existing Chicago and Northwestern Railroad right-of-way from 60th Street to the existing Kenosha trunk sewer system at manhole No. 13.13 (see Figure 6-2). The peak flow conveyed by this sewer is estimated at 0.15 cfs (see Figure 6-3).

Trunk Sewer No. 29 & 30

To provide sewer service to the portion of Pleasant Prairie presently served by SUD "D" will require construction of trunk sewer No. 29. The area served by trunk sewer No. 29 is roughly delineated on Figure 6-1 as basin 10.06.

Trunk sewer No. 29 consists of constructing a 3.2 MGD lift station at the location of the existing SUD "D" WTF and 24,800 feet of 16 inch diameter force main connecting the above described lift station with proposed trunk sewer No. 35 in 104th Street approximately 300 feet west of 64th Avenue. The route for trunk sewer No. 29 would be north along the route of the existing trunk sewer No. 26 to Bain Station Road; then east along Bain Station Road to 88th Avenue; then south on 88th Avenue to 104th Street; then east on 104th Street to trunk sewer No. 35 approximately 300 feet west of 64th Avenue (see Figure 6-2). This sewer was sized to convey a peak flow of 5.00 cfs (see Figure 6-3).

To serve a portion of the Town of Bristol west of ISH 94 and tributary to Bain Station Road will require construction of 3300 feet of 8 inch gravity sewer in Bain Station Road from the west side of ISH 94 to a 0.14 MGD lift station near the Des Plaines River. In addition 3800 feet of 3 inch diameter forcemain will connect this lift station with the lift station at the site of the SUD "D" WTF.

To convey the flow for the portion of the City of Kenosha roughly delineated as basin No. 10.04 and the portion of the Town of Bristol roughly delineated as basin 10.05 (see Figure 6-1) will require abandonment of the existing lift station along the west side of the Des Plaines River and construction of 500 feet of 15 inch diameter gravity sewer in 75th Street. This sewer will convey the flow to a new 1.87 MGD lift station along the east side of the Des Plaines River. From the new lift station, 4100 feet of 12 inch diameter forcemain will be constructed along 75th Street to a connection with the existing trunk sewer No. 31, which is approximately 3900 feet west of 88th Avenue.

The existing lift station presently serving basin 10.05 is able to be upgraded to 2.06 MGD. Existing trunk sewer No. 26 which receives flow from the existing lift station has an available capacity of approximately 2.63 MGD. Therefore, on an interim basis the most cost effective means of serving basins 10.04 and 10.05 would be to make use of the existing lift station and convey all flows to SUD "D". In the future when flows increase due to additional development and capacity of the existing downstream conveyance system and/or the treatment capacity of SUD "D" WTF is exceeded, trunk sewer No. 30 should be constructed and the flow redirected to the Kenosha Water Utility WTF via existing trunk sewer No. 31 in 75th Street.

Trunk Sewers No. 32, 33, 34

To provide sanitary sewer service to the area roughly delineated on Figure 6-1 as basin 2.14 would require construction of trunk sewer No. 32 (see Figure 6-2). This area is approximately evenly divided between the Village of Pleasant Prairie and the Town of Bristol. Trunk sewer No. 32 consists of a 0.69 MGD lift station located along CTH "Q" approximately 1/2 mile east of ISH 94 and 9,000 feet of 8 inch diameter force main along CTH "Q" to an existing 24 inch diameter gravity sewer located at the intersection of 104th Street and 88th Avenue (see Figure 6-2). To provide sanitary sewer service to the portion of the Town of Bristol west of ISH 94 will require construction of 2400 feet of 8" diameter gravity sewer from the above described lift station northwest to a point 1600 feet north of 104th Street along the east side of ISH 94 then 500 feet west under ISH 94. This trunk sewer was sized to convey an estimated peak flow of 1.07 cfs.

The area of Pleasant Prairie roughly delineated on Figure 6-1 as basin 2.13 would be served by trunk sewer No. 33 (see Figure 6-2). This sewer also conveys flow from basin No. 2.14. The conveyance facility required consists of a 2.58 MGD lift station located between the railroad right-of-way and 88th Avenue 1/2 mile north of 104th Street. Approximately 10,800 feet of 12 inch diameter forcemain would be required to convey the flow from the proposed lift station to a connection with trunk sewer No. 35 in 104th Street approximately 300' west of 64th Avenue. The route of the forcemain would be in an easement from the above described lift station to the east along the north line of the SW 1/4 of Section 21, then south, in an easement along the east line of SW 1/4 of Section 21 to 104th Street, then east in 104th Street to trunk sewer No. 35 approximately 300' west of 64th Avenue (see Figure 6-2). Trunk sewer No. 33 was sized to convey a peak flow of 3.99 cfs. (see Figure 6-3)

To provide sanitary sewer service to the portion of Pleasant Prairie delineated on Figure 6-1 as basins 2.15 and 2.16 will require construction of trunk sewer No. 34 (see Figure 6-2). These areas are presently served by Sanitary Utility District "73-1". Trunk sewer No. 34 consists of constructing a 0.56 MGD lift station at the location of the existing SUD "73-1" WTF. Flows from the lift station would be conveyed by 15,700 feet of 8 inch diameter force main to a connection with the proposed trunk sewer No. 35 at the intersection of 64th Avenue and 104th Street. The route of the 8 inch forcemain is northwesterly approximately 1500 feet in an existing easement from the site of the existing SUD "73-1" WTF to an easement; then east along the north line of the SW and SE 1/4 section line of Section 34 to STH 31; then north along STH 31 to 104th Street; then east along 104th Street to the beginning of proposed trunk sewer No. 35 (see Figure 6-2). Trunk sewer No. 34 was sized to convey a peak flow of 0.86 cfs (see Figure 6-3).

Trunk Sewer No. 36

To provide sewer service for the area roughly delineated on Figure 6-1 as basin No. 13.14 will require construction of trunk sewer No. 36 (see Figure 6-2).

Trunk sewer No. 36 begins with construction of a 0.26 MGD lift station located near the intersection of ISH 94 and STH 142. Flow is conveyed along the south side of STH 142 from this lift station to the intersection of STH 142 and 96th Avenue via 16,000 feet of 6 inch diameter forcemain. From this intersection to the intersection of STH 142 and 88th Avenue, the flow is conveyed east along the south side of STH 142 by 6,000 feet of 8 inch diameter gravity sewer. From the intersection of STH 142 and 88th Avenue to a connection with the existing trunk sewer No. 27, at manhole No. 27.03 (50th Street extended and the Soo Line Railroad), the flow is conveyed in an easement via 11,000 feet of 10 inch diameter gravity sewer (see Figure 6-2). The peak flow conveyed by this sewer is estimated to be 0.31 cfs (see Figure 6-3).

Trunk Sewer No. 40

To provide "centralized" sanitary sewer service to the Oakdale Estates Subdivision would require construction of trunk sewer No. 40 (see Figure 6-1). This trunk sewer would consist of a 0.26 MGD lift station, located at the intersection of 4th Street and 113th Avenue, and 23,700 feet of 6 inch force main from the lift station to manhole No. 25.08 of existing trunk sewer No. 25 in 12th Street at the Soo Line Railroad right-of-way. The route of the force main is west, from the above described lift station, in 4th Street to an easement parallel to ISH 94; then south in the easement to 7th Street; then east along 7th Street to 88th Avenue; then south in 88th Avenue to 12th Street; then east in 12th Street to manhole No. 25.08 approximately 800 feet east of the Soo Line Railroad crossing (See Figure 6-2). The estimated peak flow used to size this sewer is 1.13 cfs. Approximately 7500 feet of forcemain would be eliminated from this alternative if a connection can be made to a Town of Somer's local sewer at 100th Avenue and CTH E. This option should be investigated as part of a detailed design process.

The total estimated construction cost of the intermediate land use scenario for new and relayed sewers is $20,129,300 with an annual O&M cost of $102,065. Detailed costs are listed in Table 6-1.

Treatment Facilities

The centralized wastewater treatment facility for the intermediate "Centralized" land use plan will logically be located at the Kenosha Water Utility WTF site which already provides service to over 95 percent of the existing served population. In addition, major trunk lines have been constructed or have been planned for construction to deliver sewage flows to the current facility location. The Kenosha Water Utility has also purchased 27 acres of land adjacent to and south of the current wastewater treatment facility for expansion purposes. As discussed in Chapter V, the location for the additional sewage treatment facilities will be evaluated as part of the detailed facility planning and will consider the environmental impacts of developing on all or part of the 27-acre parcel south of the Kenosha sewage treatment plant, in addition to other alternatives for citing these facilities.

The current facility has excess capacity to handle additional average daily base flows but cannot handle maximum daily or peak instantaneous flows. The average hydraulic loading in 1988 was 19.8 MGD while the facility was designed to treat 28.4 MGD. Organic loading limits are not being exceeded per Table 3-24. Peak hydraulic loadings exceed the existing facilities hydraulic capacity of 68 MGD and the peak instantaneous pumping capacity of approximately 90 MGD.

Table 6 - 1

TRUNK SEWER COSTS

INTERMEDIATE LAND USE SCENARIO

Location	Item	Quantity	Unit Price	Cost	Life	Replacement Costs 20 Years	30 Years	40 Years	Salvage	O & M
Trunk Sewer #1	96" Sanitary	4,430.000	$800	$3,544,000	50				$0	$1,678
Trunk Sewer #3	21" Sanitary	1,260.000	$165	$207,900	50				$0	$477
Trunk Sewer #12	66" Sanitary	8,770.000	$560	$4,911,200	50				$0	$3,322
Trunk Sewer #16	27" Sanitary	2,770.000	$110	$304,700	50				$0	$1,049
Trunk Sewer #20	27" Sanitary	900.000	$110	$99,000	50				$0	$341
Trunk Sewer # 28	8" Sanitary	3,700.000	$50	$185,000	50				$0	$1,402
Trunk Sewer #29	3.23 MGD Lift Station	1.000	$470,000	$470,000	20 - 50	$51,000	$470,000		($155,100)	$23,500
	16" Force Main	24,800.000	$46	$1,140,800	50				$0	$2,348
	8" Sanitary	2,800.000	$50	$140,000	50				$0	$1,061
	8" Sanitary	500.000	$300	$150,000	50				$0	$189
	0.14 MGD Lift Station	1.000	$60,000	$60,000	20 - 50	$6,800	$4,400	$6,800	($4,852)	$3,000
	3" Force Main	3,800.000	$22	$83,600	50				$0	$360
Trunk Sewer #30	1.87 MGD Lift Station	1.000	$212,000	$212,000	20 - 50	$13,000	$212,000		($69,960)	$10,600
	12" Force Main	4,100.000	$42	$172,200	50				$0	$388
	15" Sanitary	500.000	$130	$65,000	50				$0	$189
Trunk Sewer #32	0.69 MGD Lift Station	1.000	$158,000	$158,000	20 - 50	$10,000	$158,000		($52,140)	$7,900
	8" Force Main	9,000.000	$34	$306,000	50				$0	$852
	8" Sanitary	2,400.000	$50	$120,000	50				$0	$909
	8" Sanitary	500.000	$300	$150,000	50				$0	$189
Trunk Sewer #33	2.58 MGD Lift Station	1.000	$264,000	$264,000	20 - 50	$15,000	$264,000		($87,120)	$13,200
	12" Force Main	10,800.000	$38	$410,400	50				$0	$1,023
Trunk Sewer #34	0.56 MGD Lift Station	1.000	$152,000	$152,000	20 - 50	$10,000	$152,000		($50,160)	$7,600
	8" Force Main	15,700.000	$34	$533,800	50				$0	$1,487
Trunk Sewer # 36	8" Sanitary	3,000.000	$90	$270,000	50				$0	$2,273
	10" Sanitary	5,500.000	$45	$247,500	50				$0	$4,167
	6" Force Main	8,000.000	$30	$240,000	50				$0	$1,516
	0.26 MGD Lift Station	1.000	$88,000	$88,000	20 - 50	$10,000	$6,500	$10,000	($7,145)	$4,400
Trunk Sewer #40	.26 MGD Lift Station	1.000	$88,000	$88,000	20 - 50	$10,000	$6,500	$10,000	($7,145)	$4,400
	6" Force Main	23,700.000	$30	$711,000	50				$0	$2,244
Total				$15,484,100		$125,800	$1,273,400	$26,800	($433,622)	$102,065
Engineering & Contingencies (30%)				$4,645,230						
Total Cost of Construction				$20,129,330						
Present Worth Factors				1.0000		0.3118	0.1741	0.0972	0.0543	
Present Worth of Construction				$20,129,330		$39,225	$221,712	$2,606	($23,541)	
Total Present Worth Of Construction & Replacement				$20,369,332						
Annual O & M Costs		$102,065								
50 Year Present Worth Factor		15.7619								
Present Worth of Annual O&M Costs				$1,608,735						
Total Present Worth				$21,978,067						

Source: Ruekert & Mielke, Inc.

To solve the existing hydraulic problems and to provide for the year 2010 loadings, two alternatives were considered; treatment facility expansion and treatment facility expansion and storage at the head end of the facility.

Treatment Facility Expansion

The Kenosha WTF would be expanded to increase its peak hydraulic capacity from the existing 68 MGD to 125.5 MGD, which would be the peak hourly flow to the WTF. The new facilities would operate in parallel to the existing WTF. A new, deeper sewage pumping station would be constructed with a peak pumping capacity of 35.5 MGD. This lift station would operate in parallel with the existing 90 MGD sewage lift station to deliver the required 125.5 MGD peak pumping capacity. Subsequent new wastewater treatment units would be designed for a peak hydraulic capacity of 57.5 MGD. A new grit collector would be constructed as would ten new rectangular primary clarifiers sized for 1500 gpd/ft^2 at peak design flows. Six new aeration basins would be constructed to give 2 hours hydraulic detention time at peak hourly flows. The aeration tanks would be equipped with fine bubble diffusers to maximize oxygen transfer efficiency. Three 145 foot diameter peripheral feed final clarifiers would be constructed, sized for 1200 gpd/ft^2 at peak flows. Two new chlorine contact basins would be sized to provide 30 minutes detention time at peak flows. These chlorine contact tanks would be baffled to provide a 40:1 length to width ratio to prevent short circuiting. A new pump and blower building would be constructed to house the various sludge, return activated sludge, and grit pumps, as well as the new aeration blowers. A new 60 inch diameter outfall would be required which would extend out into Lake Michigan. Since the average design flows under this scenario are less than the 28 MGD average day capacity of the existing WTF, no new sludge handling, sludge disposal or chemical feed systems (for phosphorous removal, chlorination or dechlorination) would be required. The construction cost of this alternative is $24,835,200 and the annual O & M costs are $1,668,000. A summary of the construction and O & M costs can be found on Table 6-2.

Treatment and Storage Facilities

A storage option was also considered in lieu of facility expansion for the intermediate centralized land use plan. The Kenosha WTF would be expanded only to the 82 MGD peak day flows expected. The remaining peak hourly flows of up to 125.5 MGD would be temporarily pumped to, and stored in circular storage tanks at the WTF site until the sewage flows in to the WTF diminish to less than 82 MGD. At that time, the stored wastewater would be drained back to the sewage wet well for treatment. Since the existing WTF has a peak hydraulic capacity of 68 MGD, only an additional 14 MGD capacity would need to be added to the WTF. However, the new sewage pump station would be sized for 35.5 MGD so that the combined pumpage of the existing and new pump stations would equal the 125.5 MGD peak hourly flows. In addition to the new 35.5 MGD sewage pump station and 57.5 MGD grit collection facilities, the following WTF units would be constructed for 14 MGD: three primary clarifiers, two aeration basins, two final clarifiers, two chlorine contact basins, a pump house and a new 30 inch diameter outfall. Three circular storage tanks, 200 foot diameter by 15 foot side water depth would be constructed. Each tank would be equipped with a circular sludge collection device. The four tanks would provide a total storage volume of 10.2 million gallons. The construction cost of this alternative is $14,836,510, and the annual operation and maintenance costs are $1,491,700. A summary of the construction and the O & M costs can be found on Table 6-3.

Year 2010 Intermediate Growth Scenario Total Costs

The fifty year total present worth cost of this scenario is $75,210,232 or $61,444,099. The former includes the trunk sewers and full WTF expansion and the latter includes the trunk sewers and WTF expansion and storage. Detailed costs are listed in Table 6-4.

YEAR 2010 OPTIMISTIC LAND USE SCENARIO

The optimistic land use scenario includes the areas roughly delineated on Figure 6-4 and contains the sewage conveyance components as shown on Figure 6-5.

Many of the system improvements required for the optimistic land use scenario and the intermediate land use scenario are the same. Therefore, this section will only highlight conveyance and treatment facilities that differ from the intermediate land use scenario.

Trunk Sewer No. 29

Under the intermediate land use plan trunk sewer No. 29 conveyed an estimated peak flow of 5.00 cfs. Under the optimistic land use plan the estimated peak flow is 7.64 cfs. As a result the recommended lift station at the site of the former SUD "D" treatment plant is a 4.94 MGD lift station. The forcemain conveying the flow will be a 20 inch forcemain. All facility locations are the same for this land use

Table 6 - 2

TREATMENT FACILITIES

KENOSHA WTF - INTERMEDIATE DEVELOPMENT
EXPAND WTF TO HANDLE 125.5 MGD PEAK FLOW
COST SUMMARY

Item	Cost	Life	Replacement Costs 20 Years	Replacement Costs 30 Years	Replacement Costs 40 Years	Salvage
Lift Station	$2,355,000	20 -50	$674,000	$761,000	$674,000	($588,130)
Grit Collectors	$201,000	20 -50	$146,000		$146,000	($73,000)
Primary Clarifiers	$2,957,000	20 -50	$1,569,000	$130,000	$1,569,000	($827,400)
Aeration Basins	$2,380,000	20 -50	$789,000		$789,000	($394,500)
Final Clarifiers	$2,130,000	20 -50	$696,000	$37,000	$696,000	($360,210)
Chlorine Contact	$828,000	50				$0
Pump House	$964,000	20 -50	$421,000		$421,000	($210,500)
Outfall	$1,250,000	50				$0
Electrical	$2,055,000	30		$2,055,000		($678,150)
Mechanical	$2,636,000	50				$0
Miscellaneous Channels	$893,000	50				$0
Site Work	$455,000	50				$0
Total Costs	$19,104,000		$4,295,000	$2,983,000	$4,295,000	($3,131,890)
Engineering & Contingencies (30%)	$5,731,200					
Construction Total	$24,835,200					
Present Worth Factors	1.0000		0.3118	0.1741	0.0972	0.0543
	$24,835,200		$1,339,201	$519,371	$417,569	($170,025)
Present Worth Of Construction & Replacement			$26,941,316			
Average Annual O & M Costs *	$1,668,000					
50 Year Present Worth Factor	15.7619					
Present Worth of O & M			$26,290,849			
Total Present Worth			$53,232,165			

* O & M cost excludes administrative, billing and accounting costs. See Appendix I for detailed costs.

Source: Ruekert & Mielke, Inc.

Table 6 - 3

TREATMENT & STORAGE FACILITIES

KENOSHA WTF - INTERMEDIATE DEVELOPMENT
EXPAND WTF TO HANDLE 82 MGD PEAK FLOW
PROVIDE 10.2 MG STORAGE
COST SUMMARY

Item	Cost	Life	Replacement Costs 20 Years	30 Years	40 Years	Salvage
Lift Station	$2,355,000	20 -50	$674,000	$761,000	$674,000	($588,130)
Grit Collectors	$201,000	20 -50	$146,000		$146,000	($73,000)
Primary Clarifiers	$492,000	20 -50	$197,000	$23,000	$197,000	($106,090)
Aeration Basins	$530,000	20 -50	$173,000		$173,000	($86,500)
Final Clarifiers	$551,000	20 -50	$165,000	$10,000	$165,000	($85,800)
Chlorine Contact	$133,000	50				$0
Pump House	$481,000	20 -50	$176,000		$176,000	($88,000)
Outfall	$850,000	50				$0
Electrical	$868,000	30		$868,000		($286,440)
Mechanical	$1,200,000	50				$0
Miscellaneous Channels	$400,000	50				$0
Site Work	$300,000	50				$0
Storage	$3,051,700	20 -50	$715,500		$715,500	($357,750)
Total Costs	$11,412,700		$2,246,500	$1,662,000	$2,246,500	($1,671,710)
Engineering & Contingencies (30%)	$3,423,810					
Construction Total	$14,836,510					
Present Worth Factors	1.0000		0.3118	0.1741	0.0972	0.0543
	$14,836,510		$700,469	$289,371	$218,410	($90,754)
Present Worth Of Construction & Replacement			$15,954,006			
Average Annual O & M Costs *	$1,491,700					
50 Year Present Worth Factor	15.7619					
Present Worth of O & M			$23,512,026			
Total Present Worth			$39,466,032			

* O & M cost excludes administrative, billing and accounting costs. See Appendix I for detailed costs.

Source: Ruekert & Mielke, Inc.

Table 6 - 4

INTERMEDIATE LAND USE SCENARIO
TOTAL PRESENT WORTH COST SUMMARY
OF SEWERAGE FACILITIES

WITHOUT STORAGE

Present Worth of Construction & Replacement	
Trunk Sewers	$20,369,332
Kenosha WTF	$26,941,316
Present Worth of O&M	
Trunk Sewers	$1,608,735
Kenosha WTF	$26,290,849
Total Present Worth	$75,210,232

WITH STORAGE

Present Worth of Construction & Replacement	
Trunk Sewers	$20,369,332
Kenosha WTF	$15,954,006
Present Worth of O&M	
Trunk Sewers	$1,608,735
Kenosha WTF	$23,512,026
Total Present Worth	$61,444,099

Source: Ruekert & Mielke, Inc.

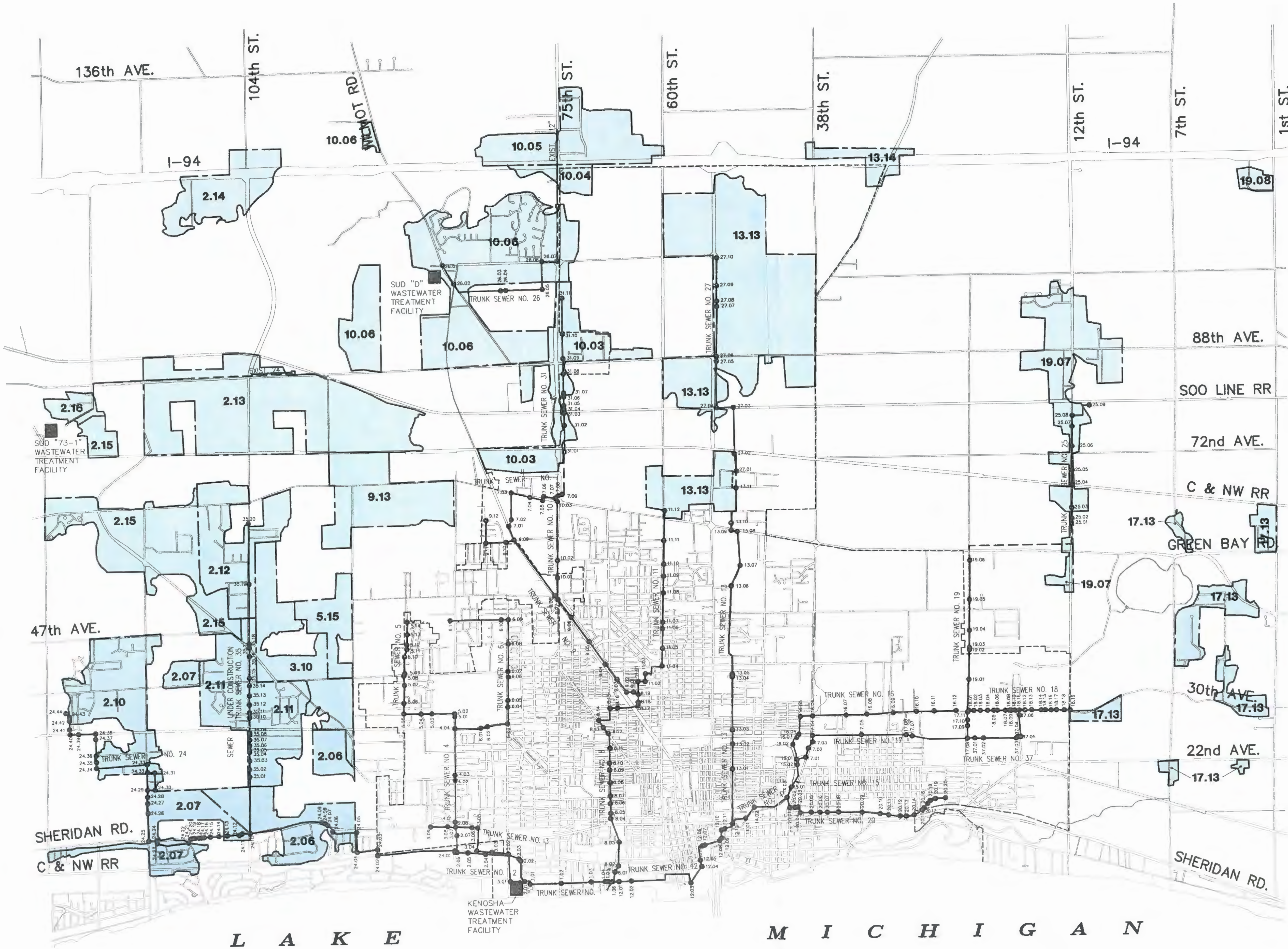


Figure 6-4

OPTIMISTIC
LAND USE PLAN
FUTURE SEWER BASINS

Legend

- SANITARY SEWER DISTRICT BOUNDARY
- EXISTING GRAVITY TRUNK SEWER
- MANHOLE NUMBER
- EXISTING FORCEMAIN

GRAPHIC SCALE

0 1/2 1 MILE

0 1 2 3 4 5 5,000 FEET

Source: Ruekert & Mielke 1991

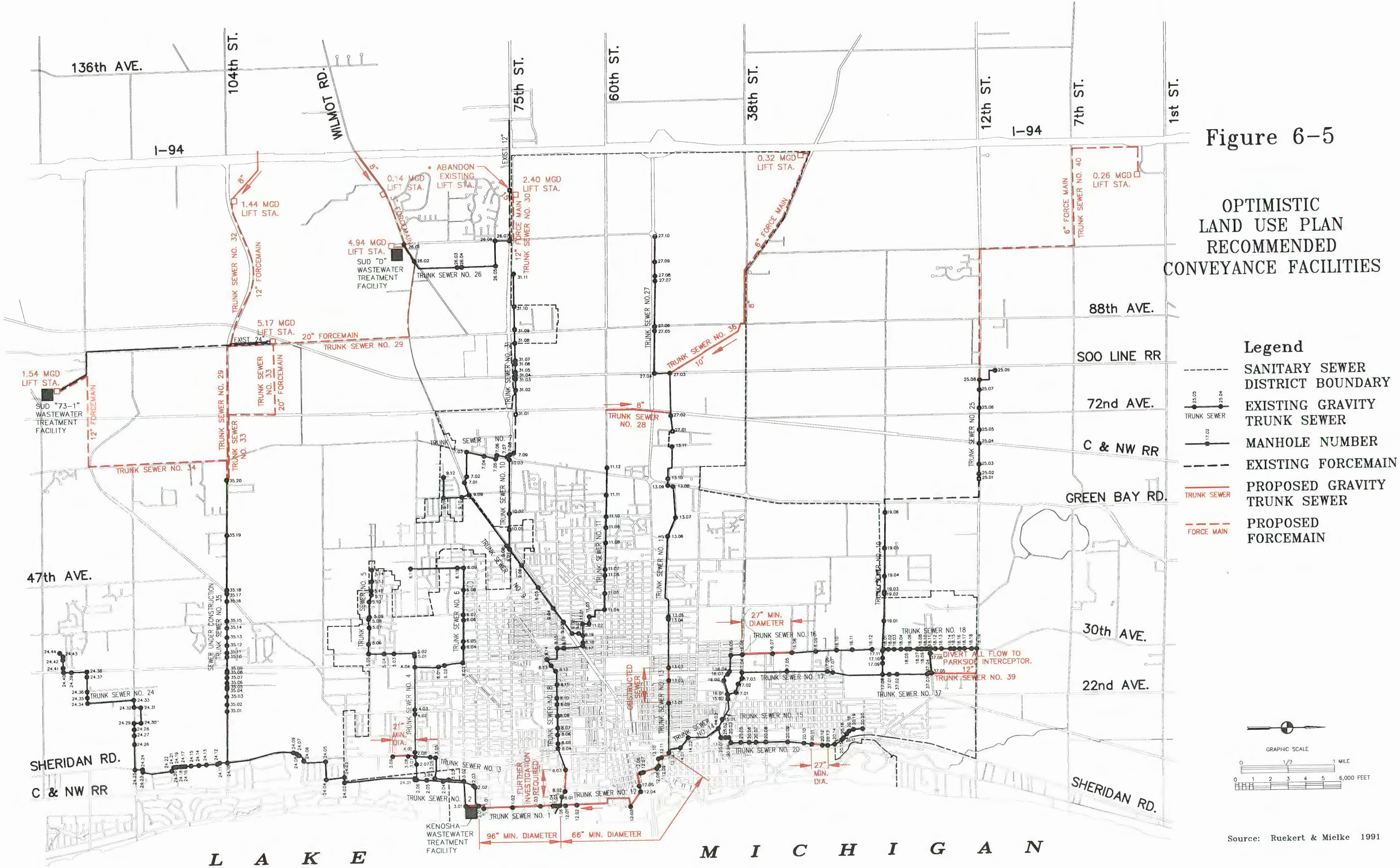


Figure 6-5

OPTIMISTIC LAND USE PLAN RECOMMENDED CONVEYANCE FACILITIES scenario as for the intermediate land use scenario (see Figures 6-5 & 6-6).

Trunk Sewer No. 30

Under this land use scenario the facility locations will be the same as under the intermediate land use scenario. However, the peak flows have increased from 1.87 cfs to 3.71 cfs which necessitates increasing the capacities of the recommended facilities. The recommended lift station is a 2.40 MGD lift station and the forcemain connecting the lift station to trunk sewer No. 31 will be a 12 inch diameter main (see Figures 6-5 & 6-6).

Trunk Sewer No. 32

Under this land use scenario all facilities remain in the same locations as under the intermediate land use scenario. However, the required capacities have increased from 1.07 cfs to 2.23 cfs. As a result the recommend lift station has capacity for 1.44 MGD and the forcemain size has been increased to a 12 inch diameter main (see Figures 6-5 & 6-6).

Trunk Sewer No. 33

Under this land use scenario all facilities remain at the same locations as under the intermediate land use scenario. However, the required capacities have increased from 4.00 cfs to 8.00 cfs. The recommended lift station is a 5.17 MGD lift station and the forcemain connecting this lift station to trunk sewer No. 35 is a 20 inch diameter main (see Figures 6-5 & 6-6).

Trunk Sewer No. 34

The required capacity for trunk sewer No. 34 has increased from 0.87 cfs to 2.38 cfs under this land use scenario. As a result the required lift station is a 1.54 MGD lift station and the required forcemain diameter is 12 inches. All facilities remain in the same location under this scenario as under the intermediate land use scenario (see Figures 6-5 & 6-6).

Trunk Sewer No. 36

The required capacity for this trunk sewer has increased from 0.40 cfs to 0.50 cfs under the optimistic land use scenario. As a result the lift station capacity required has increased to 0.32 MGD. No change is required in the 6 inch forcemain and all gravity portions of this sewer remain the same as recommended under the intermediate land use scenario. All facilities remain in the same location under this scenario as under the intermediate land use scenario (see Figures 6-5 & 6-6).

Trunk Sewer No. 39

To provide sewer service for the area roughly delineated on Figure 6-4 as basin 17.13 will require construction of trunk sewers No. 39.

Trunk sewer No. 39 will consist of 12 inch diameter sewer extending 2600 feet due north from the Parkside Interceptor (trunk sewer No. 37) at 14th Place and 26th Avenue (extended) to 12th Street. This trunk sewer was sized to convey a peak flow of 1.00 cfs (see Figures 6-5 & 6-6).

The total estimated construction cost of the optimistic land use scenario for new and relayed sewers is $23,144,600 with an annual O&M cost of $172,721. Detailed costs are listed in Table 6-5.

Treatment Facilities

The Kenosha WTF would be expanded to increase its peak hydraulic capacity from the existing 68 MGD to a peak hourly flow of 142 MGD. All new WTF sewage treatment units would be sized to handle 78 MGD peak flows, except the new sewage pump station, which would be sized for 52 MGD. All treatment units would be sized on the same design basis as those in the intermediate land use scenario. Since the average day design flows are essentially equal to the existing WTF design flows, no additions to the sludge handling, sludge disposal or chemical feed systems would be needed. The construction cost of this alternative is $27,375,400 and the O & M costs are $2,075,500. A summary of the construction and the O & M costs can be found on Table 6-6.

Storage Facilities

The WTF would be expanded to handle the peak daily flow of 90.7 MGD, and the excess peak hourly flows of up to 142.0 MGD would be pumped to circular storage tanks located on site. Under this scenario the new lift station would be sized for 52 MGD, and the remaining WTF sewage processing units sized for 22.7 MGD. All treatment units would be sized on the same basis as those in the intermediate land use scenario. Four 180 foot diameter by 16 foot side water depth circular tanks would be constructed. These tanks would provide 12.2 million gallons of storage volume. A new 42 inch diameter outfall pipe would also be required. The construction cost of this alternative is $19,748,300 and the annual O & M is $1,869,700. A summary of the construction costs and the O & M costs can be found on Table 6-7.

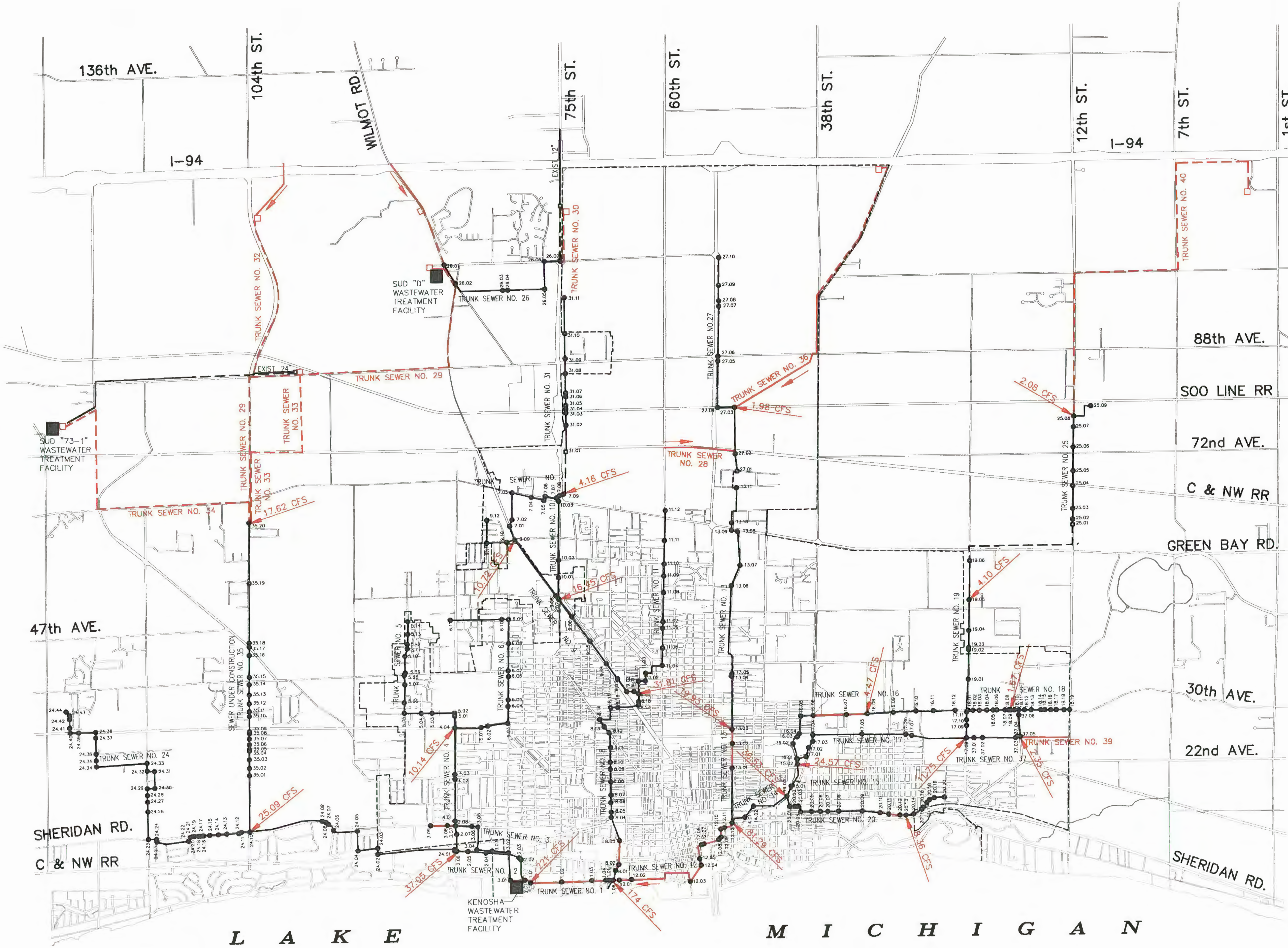


Figure 6-6

OPTIMISTIC LAND USE PLAN PEAK FLOW AT KEY POINTS

Legend

- SANITARY SEWER DISTRICT BOUNDARY
- EXISTING GRAVITY TRUNK SEWER
- MANHOLE NUMBER
- EXISTING FORCEMAIN
- PROPOSED GRAVITY TRUNK SEWER
- PROPOSED FORCEMAIN

GRAPHIC SCALE: 0, 1/2, 1 MILE; 0, 1, 2, 3, 4, 5, 6,000 FEET

Source: Ruekert & Mielke 1991

Table 6 - 5

TRUNK SEWER COSTS

OPTIMISTIC LAND USE SCENARIO

Location	Item	Quantity	Unit Price	Cost	Life	Replacement Costs 20 Years	30 Years	40 Years	Salvage	O & M
Trunk Sewer #1	96" Sanitary	4,430.000	$800	$3,544,000	50				$0	$1,678
Trunk Sewer #3	21" Sanitary	1,260.000	$165	$207,900	50				$0	$477
Trunk Sewer #12	66" Sanitary	8,770.000	$560	$4,911,200	50				$0	$3,322
Trunk Sewer #16	27" Sanitary	2,770.000	$110	$304,700	50				$0	$1,049
Trunk Sewer #20	27" Sanitary	900.000	$110	$99,000	50				$0	$341
Trunk Sewer # 28	8" Sanitary	3,700.000	$50	$185,000	50				$0	$1,402
Trunk Sewer #29	4.94 MGD Lift Station	1.000	$1,000,000	$1,000,000	20 - 50	$50,000	$100,000	$50,000	($58,000)	$50,000
	20" Force Main	24,800.000	$56	$1,388,800	50				$0	$2,348
	8" Sanitary	2,800.000	$50	$140,000	50				$0	$1,061
	8" Sanitary	500.000	$300	$150,000	50				$0	$189
	0.14 MGD Lift Station	1.000	$60,000	$60,000	20 - 50	$6,800	$4,400	$6,800	($4,852)	$3,000
	3" Force Main	3,800.000	$22	$83,600	50				$0	$360
Trunk Sewer #30	2.40 MGD Lift Station	1.000	$240,000	$240,000	20 - 50	$15,000	$240,000		($79,200)	$12,000
	12" Force Main	4,100.000	$42	$172,200	50				$0	$388
	15" Sanitary	500.000	$130	$65,000	50				$0	$189
Trunk Sewer #32	1.44 MGD Lift Station	1.000	$190,000	$190,000	20 - 50	$13,000	$190,000		($62,700)	$9,500
	12" Force Main	9,000.000	$42	$378,000	50				$0	$852
	8" Sanitary	2,400.000	$50	$120,000	50				$0	$909
	8" Sanitary	500.000	$300	$150,000	50				$0	$189
Trunk Sewer #33	5.17 MGD Lift Station	1.000	$1,000,000	$1,000,000	20 - 50	$50,000	$100,000		($33,000)	$50,000
	20" Force Main	10,800.000	$56	$604,800	50				$0	$1,023
Trunk Sewer #34	1.54 MGD Lift Station	1.000	$195,000	$195,000	20 - 50	$13,000	$195,000		($64,350)	$9,750
	12" Force Main	15,700.000	$42	$659,400	50				$0	$1,487
Trunk Sewer # 36	8" Sanitary	3,000.000	$90	$270,000	50				$0	$2,273
	10" Sanitary	5,500.000	$45	$247,500	50				$0	$4,167
	6" Force Main	8,000.000	$30	$240,000	50				$0	$1,516
	0.32 MGD Lift Station	1.000	$112,450	$112,450	20 - 50	$10,000	$6,500	$10,000	($7,145)	$5,625
Trunk Sewer #39	12" Sanitary	2,600.000	$110	$286,000	50				$0	$985
Trunk Sewer #40	.26 MGD Lift Station	1.000	$88,000	$88,000	20 - 50	$11,000	$6,500	$10,000	($7,145)	$4,400
	6" Force Main	23,700.000	$30	$711,000	50				$0	$2,240
Total				$17,803,550		$168,800	$842,400	$76,800	($316,392)	$172,721
Engineering & Contingencies (30%)				$5,341,065						
Total Cost of Construction				$23,144,615						
Present Worth Factors				1.0000		0.3118	0.1741	0.0972	0.0543	
Present Worth of Construction				$23,144,615		$52,633	$146,670	$7,467	($17,176)	
Total Present Worth Of Construction & Replacement				$23,334,208						
Annual O&M Costs		$172,721								
50 Year Present Worth Factor		15.7619								
Present Worth of Annual O&M Costs				$2,722,408						
Total Present Worth				$26,056,617						

Source: Ruekert & Mielke, Inc.

Table 6 - 6

TREATMENT FACILITIES

KENOSHA WTF - OPTIMISTIC DEVELOPMENT
EXPAND WTF TO HANDLE 142 MGD PEAK FLOW
COST SUMMARY

Item	Cost	Life	Replacement Costs 20 Years	Replacement Costs 30 Years	Replacement Costs 40 Years	Salvage
Lift Station	$2,832,000	20 -50	$869,000	$889,000	$869,000	($727,870)
Grit Collectors	$285,000	20 -50	$176,000		$176,000	($88,000)
Primary Clarifiers	$2,580,000	20 -50	$1,027,000	$117,000	$1,027,000	($552,110)
Aeration Basins	$2,795,000	20 -50	$915,000		$915,000	($457,500)
Final Clarifiers	$2,626,000	20 -50	$623,000	$43,000	$623,000	($325,690)
Chlorine Contact	$705,000	50				$0
Pump House	$1,008,000	20 -50	$465,000		$465,000	($232,500)
Outfall	$1,400,000	50				$0
Electrical	$2,332,000	30		$2,332,000		($769,560)
Mechanical	$2,990,000	50				$0
Miscellaneous Channels	$905,000	50				$0
Site Work	$600,000	50				$0
Total Costs	$21,058,000		$4,075,000	$3,381,000	$4,075,000	($3,153,230)
Engineering & Contingencies (30%)	$6,317,400					
Construction Total	$27,375,400					
Present Worth Factors	1.0000		0.3118	0.1741	0.0972	0.0543
	$27,375,400		$1,270,604	$588,666	$396,180	($171,184)
Present Worth of Construction & Replacement			$29,459,667			
Average Annual O & M Costs *	$2,075,500					
50 Year Present Worth Factor	15.7619					
Present Worth of O&M			$32,713,823			
Total Present Worth			$62,173,491			

* O & M cost excludes administrative, billing and accounting costs. See Appendix I for detailed costs.

Source: Ruekert & Mielke, Inc.

Table 6 - 7

TREATMENT & STORAGE FACILITIES

KENOSHA WTF - OPTIMISTIC DEVELOPMENT
EXPAND WTF TO HANDLE 90.7 MGD PEAK FLOW
PROVIDE 12.2 MG STORAGE
COST SUMMARY

Item	Cost	Life	Replacement Costs			Salvage
			20 Years	30 Years	40 Years	
Lift Station	$2,832,000	20 -50	$869,000	$889,000	$869,000	($727,870)
Grit Collectors	$285,000	20 -50	$176,000		$176,000	($88,000)
Primary Clarifiers	$795,000	20 -50	$319,000	$36,000	$319,000	($171,380)
Aeration Basins	$859,000	20 -50	$281,000		$281,000	($140,500)
Final Clarifiers	$808,000	20 -50	$194,000	$13,000	$194,000	($101,290)
Chlorine Contact	$216,000	50				$0
Pump House	$526,000	20 -50	$221,000		$221,000	($110,500)
Outfall	$1,020,000	50				$0
Electrical	$1,088,000	30		$1,088,000		($359,040)
Mechanical	$1,395,000	50				$0
Miscellaneous Channels	$501,000	50				$0
Site Work	$337,000	50				$0
Storage	$4,529,000	20 -50	$860,000		$860,000	($430,000)
Total Costs	$15,191,000		$2,920,000	$2,026,000	$2,920,000	($2,128,580)
Engineering & Contingencies (30%)	$4,557,300					
Construction Total	$19,748,300					
Present Worth Factors	1.0000		0.3118	0.1741	0.0972	0.0543
	$19,748,300		$910,470	$352,747	$283,889	($115,557)
Present Worth of Construction & Replacement			$21,179,849			
Average Annual O & M Costs *	$1,869,700					
50 Year Present Worth Factor	15.7619					
Present Worth of O&M			$29,470,024			
Total Present Worth			$50,649,873			

* O & M cost excludes administrative, billing and accounting costs. See Appendix I for detailed costs.

Source: Ruekert & Mielke, Inc.

Year 2010 Optimistic Growth Scenario Total Costs

The fifty year total present worth cost of this scenario is $88,230,100 including trunk sewers and with full WTF expansion or $76,706,500 including trunk sewers and with WTF expansion and storage. Detailed costs are listed in Table 6-8.

ULTIMATE LAND USE SCENARIO

Conveyance Facilities

The ultimate land use scenario includes the areas roughly delineated on Figure 6-7. The recommended conveyance facilities to serve the study area via the Kenosha Wastewater Treatment Facility are as shown on Figure 6-8. Estimated peak flows at key points of the conveyance facilities are as indicated on Figure 6-9.

In most cases the recommended conveyance facilities for the ultimate land use scenario remain in the same locations as described under the intermediate land use scenario. In many cases improvements to the existing trunk sewer system remain the same under this scenario as under the intermediate land use option. The following is a summary highlighting the differences between the recommended facilities for the ultimate and intermediate land use options.

Trunk Sewer No. 1

Trunk sewer No. 1 is a portion of the main north-south interceptor sewer for Kenosha. Under the intermediate land use plan estimated peak flows to this trunk sewer range from 159 cfs to 162 cfs. Under this land use scenario the peak flows range from 197 cfs to 202 cfs. To provide the additional capacity required by these flows, trunk sewer No. 1 would have to be relayed as a 102 inch diameter sewer (see Figures 6-8 & 6-9). This sewer remains in the location described under the intermediate option.

Trunk Sewer No. 7

Trunk sewer No. 7 begins at 75th Street and Green Bay Road then goes south on Green Bay Road to 80th Street extended; then east along 80th Street extended to the "KD" Tracks; then northeast along the "KD" Tracks to existing trunk sewer No. 9 at the intersection of 60th Avenue and the "KD" Tracks (see Figure 6-8).

Trunk sewer No. 7 consists of 24 inch and 36 inch diameter gravity sewer. The available capacity for this sewer ranges from 9.94 cfs to 22.88 cfs. Under this land use scenario peak flows to this sewer are estimated at 17.67 cfs. This sewer is inadequate to convey the estimated peak flows between manhole No. 7.09 (Green Bay Road and 75th Street) and manhole No. 7.07 (approximately 300' south of 75th Street). To provide adequate capacity for the estimated flow, the sewer between manholes 7.09 and 7.07 must be relayed with 300 feet of 30 inch diameter gravity sewer.

Trunk Sewer No. 12

Trunk sewer No. 12 is a portion of the main north-south interceptor for Kenosha. Under the intermediate land use scenario estimated peak flows to this sewer range from 74 cfs to 87 cfs. Under this scenario the estimated peak flows range from 98 cfs to 111 cfs. To provide the additional capacity required by this land use scenario, trunk sewer No. 12 is recommended to be relayed with 8770 feet of 72 inch diameter sewer (see Figure 6-8 & 6-9). This sewer remains in the location described in the intermediate land use scenario.

Trunk Sewer No. 20

Under the intermediate land use scenario the portion of trunk sewer No. 20 between manholes 20.13 and 20.11 (24th Street and 27th Street) is recommended to be relayed with a 27 inch diameter pipe (see Figure 6-8). In the intermediate scenario, peak flows to this area are estimated at 8.20 cfs. Under this land use scenario peak flows are estimated at 9.60 cfs (see Figure 6-9). To provide the additional required capacity 200 feet of 21 inch diameter pipe is required from manhole No. 20.14 (22nd Street) to manhole No. 20.13 (23rd Street) and 1100 feet of 27 inch diameter pipe is required from manhole 20.13 (23rd Street) to manhole 20.10 (approximately 28th Street extended).

The location of this trunk sewer remains the same as described for the intermediate land use plan.

Trunk Sewer No. 24

Trunk sewer No. 24 conveys flow from the areas roughly delineated on Figure 6-7 as basins 10.06, 2.06, 2.07, 2.10, 2.11, 2.12, 2.13, 2.14, 2.15, 2.16, and 3.10. In general this sewer conveys all of the flow from the Village of Pleasant Prairie to the Kenosha Wastewater Treatment Facility. Under this land use scenario many of the component sections of trunk sewer No. 24 are inadequate.

The route of the existing sewer begins at 125th Street and 35th Avenue; then continues due east to 30th Avenue; then north on 30th Avenue to 122nd Street extended; then east on future 122nd Street to 26th Avenue; then north on 26th Avenue to 116th Street; then generally east on 116th Street to Sheridan Road; then north generally along Sheridan Road to a

Table 6 - 8

OPTIMISTIC LAND USE SCENARIO
TOTAL PRESENT WORTH COST SUMMARY
OF SEWERAGE FACILITIES

WITHOUT STORAGE

Present Worth of Construction & Replacement	
Trunk Sewers	$23,334,208
Kenosha WTF	$29,459,667
Present Worth of O&M	
Trunk Sewers	$2,722,408
Kenosha WTF	$32,713,823
Total Present Worth	$88,230,107

WITH STORAGE

Present Worth of Construction & Replacement	
Trunk Sewers	$23,334,208
Kenosha WTF	$21,179,849
Present Worth of O&M	
Trunk Sewers	$2,722,408
Kenosha WTF	$29,470,024
Total Present Worth	$76,706,490

Source: Ruekert & Mielke, Inc.

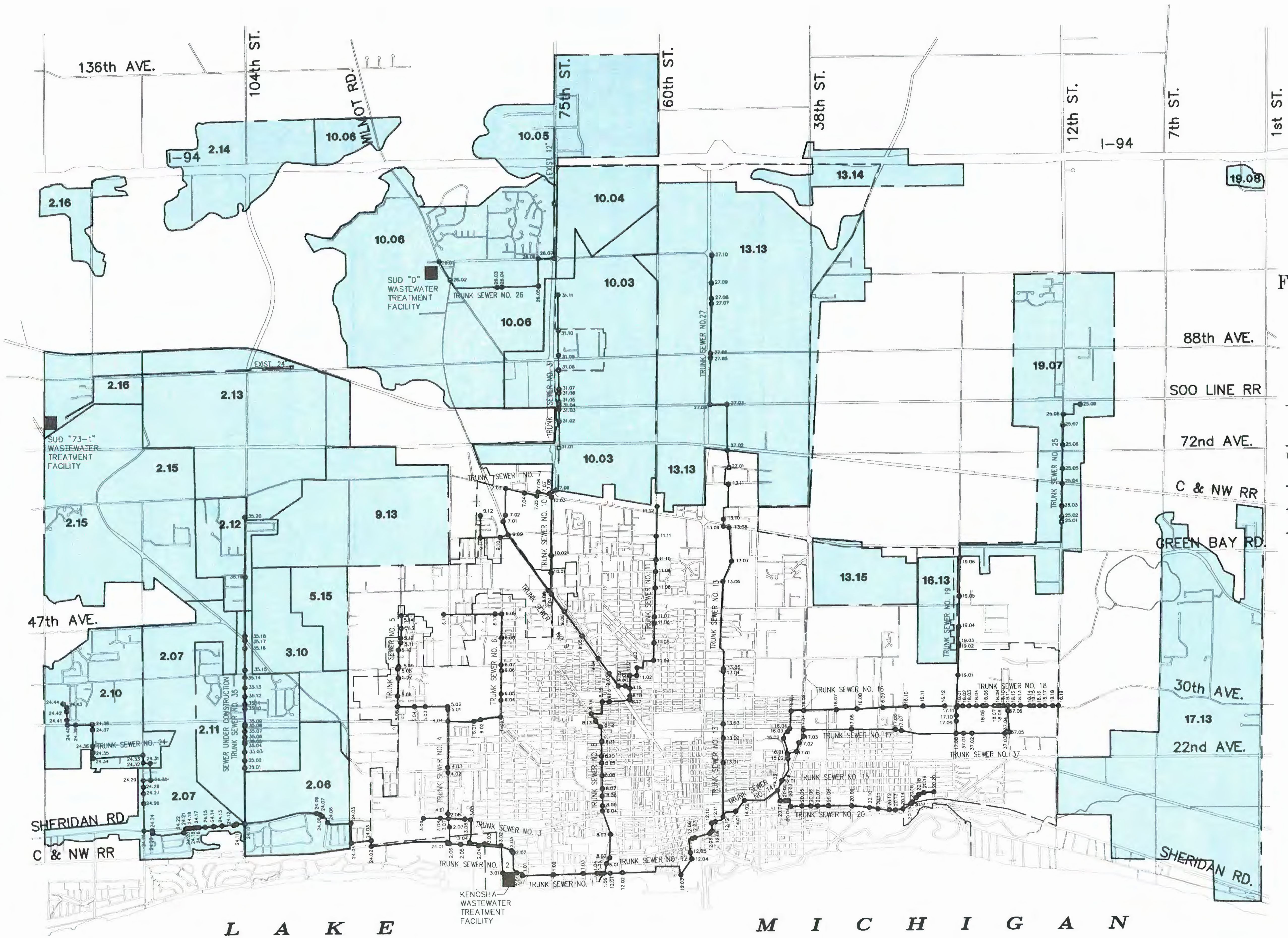


Figure 6-7

ULTIMATE LAND USE PLAN FUTURE SEWER BASINS

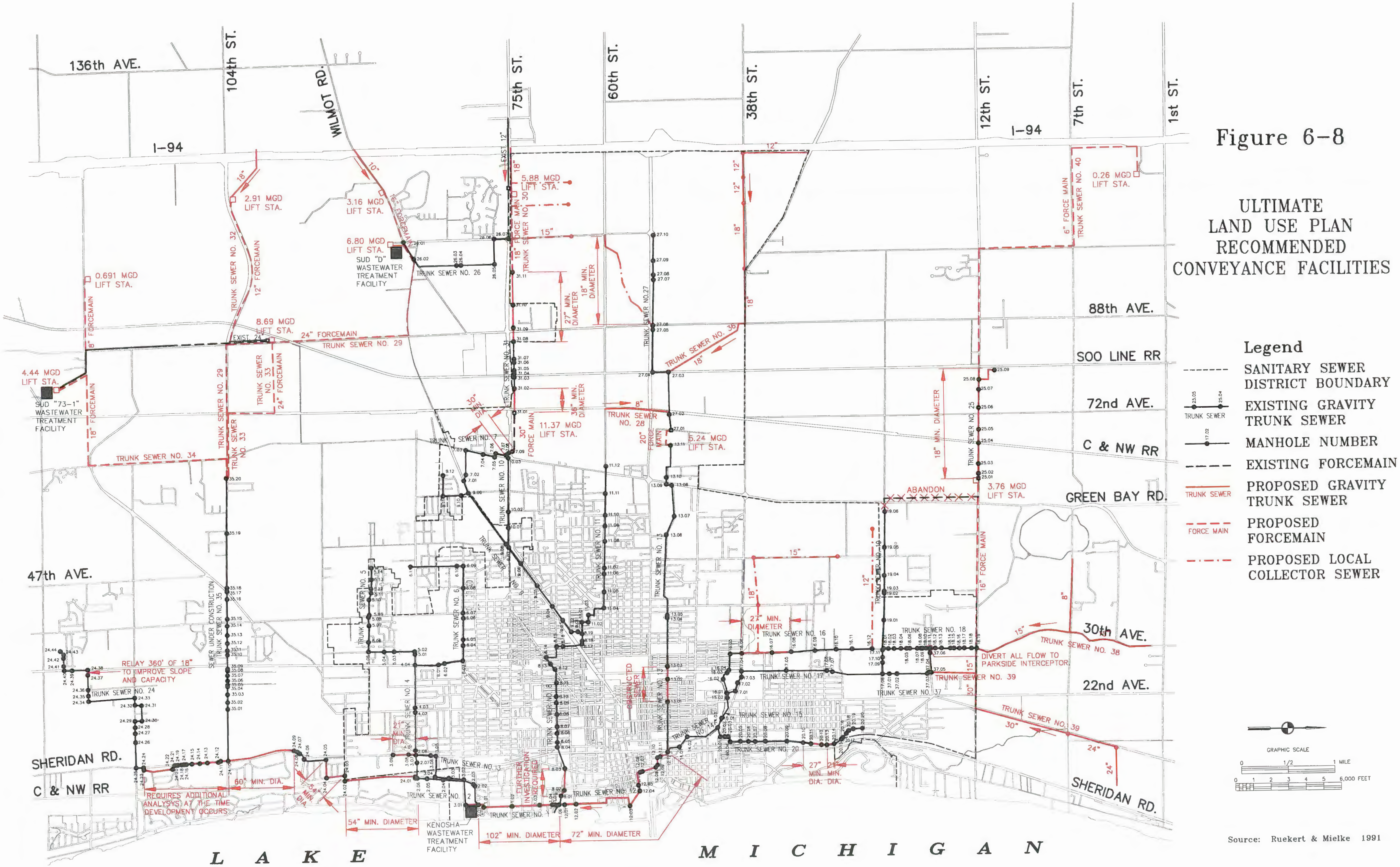
Legend

- SANITARY SEWER DISTRICT BOUNDARY
- EXISTING GRAVITY TRUNK SEWER
- MANHOLE NUMBER
- EXISTING FORCEMAIN
- SEWER BASIN BOUNDARIES

Source: Ruekert & Mielke 1991

Figure 6-8

ULTIMATE
LAND USE PLAN
RECOMMENDED
CONVEYANCE FACILITIES



Source: Ruekert & Mielke 1991

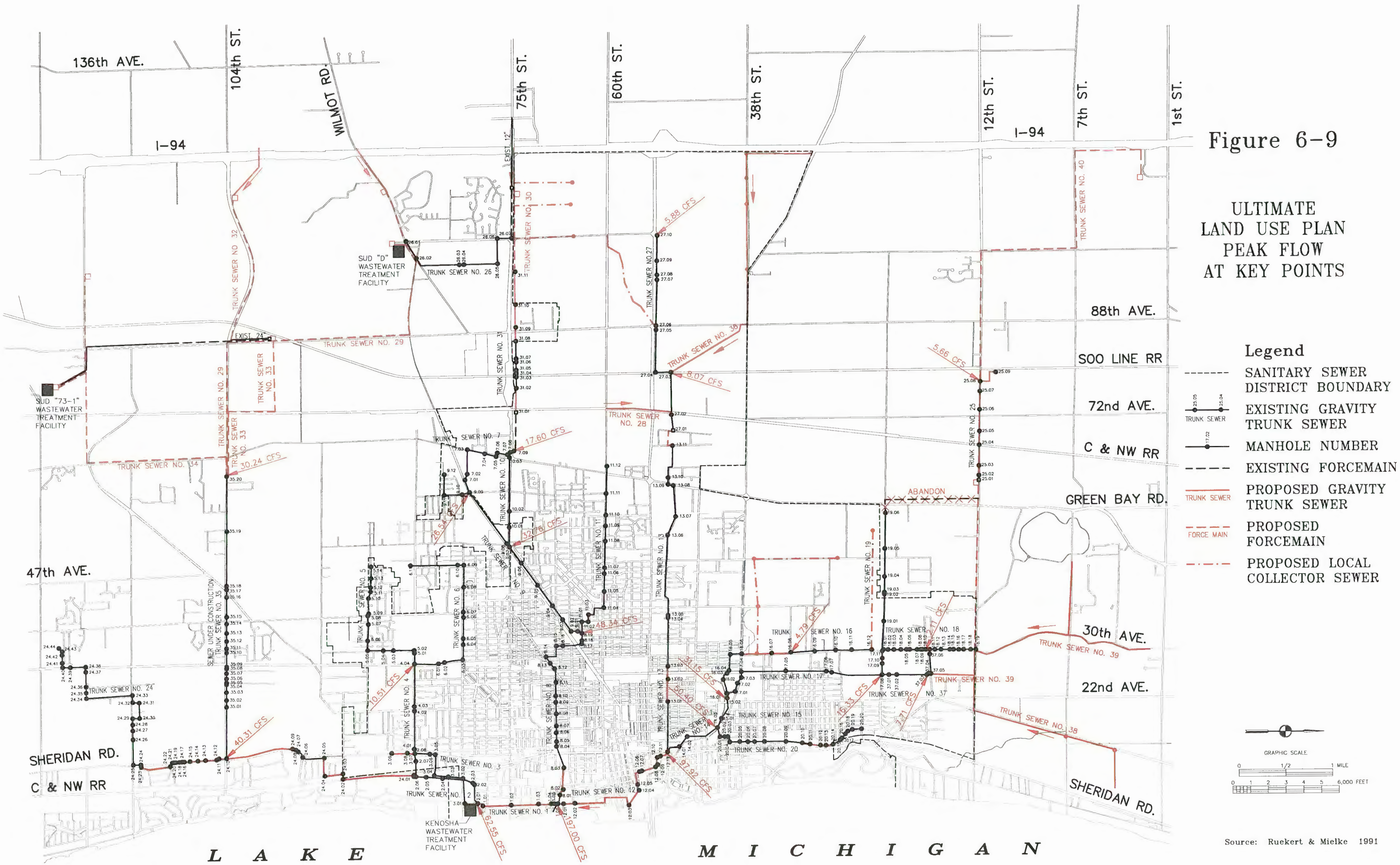


Figure 6-9

ULTIMATE LAND USE PLAN PEAK FLOW AT KEY POINTS crossing under Barnes Creek; then north along 11th Avenue to 92nd Place; then east in 92nd Place to 8th Avenue; then north in 8th Avenue to 91st Street; then east on 91st Street to 7th Avenue; then north on 7th Avenue to a connection with trunk sewer No. 2 at manhole No. 2 near the intersection of 7th Avenue and 85th Street (see Figure 6-8).

The existing sewer ranges in size from 18 inches in diameter at the southerly end to 48 inches in diameter at the northerly end. The capacity for this sewer ranges from approximately 2 cfs to 71 cfs. The estimated peak flows to this sewer under the ultimate land use scenario range from 4 cfs to 41 cfs (see Figure 6-9).

The following portions of trunk sewer No. 24 have been identified as inadequate to convey the estimated peak flows under the ultimate land use scenario:

1) Manhole 24.38 (122nd extended and 30th Avenue) to Manhole 24.37 (330' east of 30th Avenue) (see Figure 6-8). The capacity for this reach of sewer is 1.84 cfs. The estimated peak flow under this land use scenario is 4.17 cfs (see Figure 6-9). To improve the capacity of this reach, relaying 360 feet of 18 inch diameter pipe from manhole No. 24.38 to the east and constructing a new manhole at that location will be required.

   Additional analysis of the HGL for this reach indicates the height of the surcharge will be approximately 12 feet below ground at manhole No. 24.38. Therefore, it is possible that the surcharge in this area may be tolerable. If existing basement elevations and future basement elevations are high enough to prevent basement backups, no relay will be required.

2) Manhole No. 24.21 (Sheridan Road and 111th Street) to manhole No. 24.10 (Sheridan Road and 104th Street (see Figure 6-8). The capacity of this portion of trunk sewer No. 24 ranges from 3.35 cfs to 16.77 cfs. Under this land use scenario peak flows to this portion of sewer are estimated at 7.73 cfs (see Figure 6-9). Analysis of individual sewer reaches indicate that several are under capacity. However, because of the undeveloped nature of basin No. 2.07 (see Figure 6-7), it is impossible to determine the precise capacity required on a reach by reach basis. Therefore, it is recommended that as the land in basin No. 2.07 develops, the Village of Pleasant Prairie analyze the sewer capacities in this portion of trunk sewer No. 24 to determine if any improvements are required.

3) Manhole No. 24.10 (Sheridan Road and 104th Street) to manhole No. 24.09 (4100 ö feet north of 104th Street) (see Figure 6-8). The capacity of this portion of trunk sewer No. 24 is 28.51 cfs. The estimated peak flow to this sewer reach is 40.31 cfs (see Figure 6-9). To provide the required capacity for this land use scenario will require that the sewer between manholes No. 24.10 and 24.09 be relayed with a 60 inch diameter pipe.

4) Manhole No. 24.05 (111th Avenue to 92nd Place) (see Figure 6-7). The capacity of this portion of trunk sewer No. 24 is approximately 32.1 cfs. The estimated peak flow to this reach is 41.9 cfs (see Figure 6-8). To provide the required capacity under this land use scenario will require that these two reaches of sewer be relayed with a 54 inch diameter pipe.

5) Manhole No. 24.02 (7th Avenue and 91st Street) to manhole No. 24.01 (7th Avenue and 85th Street) (see Figure 6-7). The capacity of this portion of trunk sewer No. 24 is 37.6 cfs. The estimated peak flow to this reach of sewer under the ultimate land use scenario is 41.3 cfs (see Figure 6-8). To provide the required capacity this reach of trunk sewer No. 24 must be relayed with a 54 inch diameter pipe.

<u>Trunk Sewer No. 25</u>

Trunk sewer No. 12 provides sewage conveyance facilities for the portions of the study area roughly delineated on Figure 6-7 as basins 19.07 and 19.08.

Trunk sewer No. 25 is an existing 15 inch diameter gravity sewer with a lift station and forcemain. The route of this sewer is along 12th Street from the Soo Line Railroad right-of-way to a lift station along 12th Street approximately 1500 feet west of Green Bay Road with the forcemain along Green Bay Road to a connection with trunk sewer No. 19 near the intersection of Green Bay Road and 18th Street (see Figure 6-8).

The existing 15 and 16 inch diameter gravity sewer has a capacity of from 2.41 cfs to 6.2 cfs. The existing lift station has a capacity of 1.35 MGD. Under the ultimate land use scenario the estimated peak flow to this sewer is 5.66 cfs or 3.76 MGD. Trunk sewer No. 19 (the receiving sewer for trunk sewer No. 25) is inadequate to convey the flow to trunk sewer No. 25.

To provide adequate capacity for trunk sewer No. 25, the portion between manhole No. 25.09 (Soo Line Railroad R/W) and manhole No. 25.03 (2200 feet west of Green Bay Road) will have to be relayed with 6200 feet of 18 inch diameter pipe. The lift station will have to be upgraded to a capacity of 3.76 MGD.

To provide an outlet with adequate capacity for the peak flows from trunk sewer No. 25, 10,950 feet of 16 inch diameter forcemain will be required in 12th Street from the lift station to a connection with trunk sewer No. 39 at the intersection of 12th Street and 30th Avenue (see Figure 6-8).

Additional detailed facility planning should be done for this area to determine the most cost effective means of serving the Town of Somers.

Trunk Sewer No. 27

Trunk sewer No. 27 provides service to the areas roughly delineated on Figure 6-7 as basin No. 13.13 and basin 13.14.

Trunk sewer No. 27 is an existing 10 inch and 24 inch diameter gravity sewer in 52nd Street. This sewer begins at 105th Avenue and terminates in a lift station at 70th Avenue and 50th Street extended. The existing sewer has capacity of from 1.5 cfs to 14.3 cfs. The estimated peak flows to this sewer range from 6 cfs to 8 cfs.

The portion of this sewer between manhole 27.10 (105th Avenue) and manhole No. 27.06 (Soo Line Railroad) is inadequate to convey the estimated peak flow. To provide adequate capacity this portion of sewer will have to be relayed with 5090 feet of 18 inch diameter pipe.

The existing lift station at 70th Avenue has a capacity of 1.73 MGD which is unable to be upgraded to 3.46 MGD. Under this land use scenario a 5.24 MGD lift station is required at this location. Approximately 900 feet of 20 inch diameter forcemain will be required to connect this lift station and trunk sewer No. 13 at 68th Avenue and 50th Street extended.

Trunk Sewer No. 29

This trunk sewer remains in the same location as under the intermediate land use scenario (see Figure 6-8). However, the required capacity has grown from 4.96 cfs under the intermediate land use plan to 10.53 cfs under the ultimate land use plan. As a result the lift station required at the site of the existing SUD "D" WTF is a 6.80 MGD lift station under this scenario and the forcemain connecting the lift station with trunk sewer No. 36 is a 24 inch diameter forcemain.

Trunk Sewer No. 30

This trunk sewer remains in the same location as described under the intermediate land use scenario (see Figure 6-7). However, the estimated peak flows to this lift station have increased from 1.87 MGD to 5.88 MGD.

As a result, the required lift station is a 5.88 MGD station and the forcemain has increased to a 18 inch diameter forcemain. In addition the existing 12 inch diameter main connecting Bristol to this lift station will have to be relayed with an 18 inch diameter gravity sewer (see Figure 6-8 & 6-9).

Trunk Sewer No. 31

Trunk sewer No. 31 is an existing gravity sewer in 75th Street from 3700 feet west of 88th Avenue to a lift station near the Chicago and North Western Railroad right-of-way (see Figure 6-8). This sewer ranges in size from 21 inches to 30 inches in diameter. The capacity of the existing sewer ranges from 7.3 cfs to 14.3 cfs. The existing lift station has capacity for 5.04 MGD. The estimated peak flows to this sewer range from 13 cfs to 17.6 cfs (see Figure 6-7).

To provide the required capacity, trunk sewer No. 31 will have to be relayed from manhole No. 31.11 (3700 feet west of 88th Avenue) to manhole No. 31.08 (500 feet east of 88th Avenue) with a 27 inch diameter gravity sewer and from manhole No. 31.02 (12.00 feet west of the railroad right-of-way) to the lift station with a 36 inch diameter gravity sewer. In addition, a new 11.37 MGD lift station and 2300 feet of 30 inch diameter forcemain will be required (see Figure 6-8 & 6-9).

Trunk Sewer No. 32

Trunk sewer No. 32 remains in the same location as described for the intermediate land use scenario (see Figure 6-8). Under the ultimate land use scenario the peak flow to this sewer has increased to 4.50 cfs. As a result the required lift station capacity is 2.91 MGD and the required forcemain is a 12 inch diameter pipe. In addition, to serve a portion of the Town of Bristol on the west side of ISH 94 will require that 2400 feet of 18 inch diameter gravity sewer be extended northwest from the lift station to the east side of ISH 94 approximately 1600 feet north of 104th Street. From this point, the 18 inch gravity sewer will be extended 500 feet to the west side of ISH 94. The 18 inch sewer is sized to convey a peak flow of 3.11 cfs (see Figure 6-8 & 6-9).

Trunk Sewer No. 33

Trunk sewer No. 33 remains in the same location and serves the same basins as described for the intermediate land use scenario (see Figure 6-8). However, under this land use scenario the required capacity for this lift station and forcemain has increased to 8.69 MGD or 13.45 cfs. Therefore, the required lift station capacity is 8.69 MGD and the required forcemain size is 24 inches in diameter (see Figure 6-8 & 6-9).

Trunk Sewer No. 34

Trunk sewer No. 34 remains in the same location and serves the same areas as under the intermediate land use plan. However, under this scenario the capacity required has increased to 4.44 MGD or 6.87 cfs. Therefore, the required lift station capacity is 4.44 MGD and the required forcemain size is 18 inches in diameter.

Additionally, to serve a portion of basin 2.16 located west of this lift station (see Figure 6-7), a new 0.69 MGD lift station will be required along 122nd Street approximately 2500 feet west of the Soo Line Railroad. Approximately 6800 feet of 8 inch diameter forcemain will connect the two lift stations (see Figure 6-8 & 6-9).

Trunk Sewer No. 35

Trunk sewer No. 35 is the main east-west trunk sewer for the Village of Pleasant Prairie. This sewer is proposed for construction in 1991 and is treated as an existing sewer in this Chapter.

This sewer conveys flow for the areas roughly delineated on Figure 6-7 as 2.11, 2.12, 2.13, 2.14, 2.15, 2.16, 3.10 and 10.06. The sewer runs east-west in 104th Street from 64th Avenue to Sheridan Road. Trunk sewer No. 35 ranges in size from 30 inches in diameter to 36 inches in diameter. The capacity for this sewer varies by reach from 29.8 cfs to 144.9 cfs. The estimated peak flows to this sewer range form 30.2 cfs to 34.1 cfs.

From manhole No. 35.01 (2700 feet west of Sheridan Road) to manhole No. 24.10 (Sheridan Road) the capacity is 29.83 cfs. The peak flow to this reach is 33.57 cfs.

It is estimated that to pass this additional flow will require a minimum hydraulic head of 1.5 feet above the top of the pipe at manhole No. 35.01. Because the flow line of this reach of sewer is a minimum of 24 feet below the ground surface, it may be possible to tolerate the surcharge in this area. This reach is not included in the cost estimates for this alternative.

Trunk Sewer No. 36

To provide sewer service for the area roughly delineated as basin No. 13.14 (see Figure 6-7) will require construction of trunk sewer No. 36.

Trunk sewer No. 36 consists of 6250 feet of 12 inch diameter and 12,900 feet of 18 inch diameter gravity sewer. The sewer begins at the intersection of STH 142 and ISH 94. From this point the sewer flows south along the east side of ISH 94 to 38th Street; then east in 38th Street to 88th Avenue; then southeast from 88th Avenue to a connection with trunk sewer No. 27, and manhole 27.03 (Soo Line Railroad) 1000 feet north of 52nd Street (see Figure 6-8). This sewer was sized to convey a flow of 2.23 cfs (see Figure 6-9).

Trunk Sewers No. 38 & 39

To provide sewer service for the area roughly delineated on Figure 6-7 as basin No. 17.13 will require construction of trunk sewers No. 38 and 39.

Trunk sewer No. 39 known as the Parkside Interceptor consists of 2600 feet of 36 inch diameter gravity sewer from manhole No. 37.05 (14th Place and 26th Avenue) due north to 12th Street; then east with 2000 feet of 30 inch diameter gravity sewer in 12th Street to a former railroad right-of-way presently used as a bike trail; then northeast with 5325 feet of 30 inch diameter gravity sewer to 7th Street; then northeast along the bike trail with a 24 inch diameter gravity sewer approximately 1/2 mile; then due east approximately 2500 feet (see Figure 6-8). This sewer is sized to convey peak flows that range from 1.93 cfs at the north end to 13.81 cfs at manhole No. 37.05 (see Figure 6-9).

Trunk sewer No. 38 consists of a 15 inch diameter gravity sewer that connects with the above described trunk sewer No. 38 at 12th Street and 26th Avenue extended. The 15 inch sewer extends approximately 1500 feet west to 30th Avenue, then northerly approximately 9850 feet in 30th Avenue to the north end of the study area. In addition an 8 inch diameter gravity sewer will be required in 7th Street from approximately 4250 feet west of 30th Avenue to 30th Avenue (see Figure 6-8). Peak flow ranges from 1.23 cfs for the 8 inch diameter gravity sewer to 3.30 cfs for the 15 inch diameter gravity sewer (see Figure 6-9).

The total estimated construction costs of the ultimate land use scenario for new and relayed sewers is $49,357,800 with an annual O&M cost of $486,229. Detailed costs are listed in Table 6-9.

Table 6 - 9
TRUNK SEWER COSTS
ULTIMATE LAND USE SCENARIO

Location	Item	Quantity	Unit Price	Cost	Life	Replacement Costs 20 Years	30 Years	40 Years	Salvage	O & M
Trunk Sewer #1	102" Sanitary	4,430.000	$850	$3,765,500	50				$0	$1,678
Trunk Sewer #3	21" Sanitary	1,260.000	$165	$207,900	50				$0	$477
Trunk Sewer #7	30" Sanitary	300.000	$95	$28,500	50				$0	$114
Trunk Sewer #12	72" Sanitary	8,770.000	$600	$5,262,000	50				$0	$3,322
Trunk Sewer #16	27" Sanitary	2,770.000	$110	$304,700	50				$0	$1,049
Trunk Sewer #20	27" Sanitary	1,100.000	$110	$121,000	50				$0	$417
	21" Sanitary	200.000	$100	$20,000	50				$0	$76
Trunk Sewer #24	18" Sanitary	360.000	$65	$23,400	50				$0	$136
	54" Sanitary	2,155.000	$275	$592,625	50				$0	$816
	54" Sanitary	3,934.000	$165	$649,110	50				$0	$1,490
	60" Sanitary	4,061.000	$310	$1,258,910	50				$0	$1,538
Trunk Sewer #25	18" Sanitary	6,200.000	$135	$837,000	50				$0	$2,348
	3.76 MDG Lift Station	1.000	$623,000	$623,000	20 - 50	$40,000	$85,000	$40,000	($48,050)	$31,150
	16" Forcemain	10,950.000	$46	$503,700	50				$0	$1,037
Trunk Sewer # 27	18" Sanitary	6,650.000	$100	$665,000	50				$0	$2,519
	5.24 MGD Lift Station	1.000	$1,000,000	$1,000,000	20 - 50	$50,000	$100,000	$50,000	($58,000)	$50,000
	20" Force Main	900.000	$56	$50,400	50				$0	$85
Trunk Sewer # 28	8" Sanitary	3,700.000	$50	$185,000	50				$0	$1,402
Trunk Sewer #29	6.80 MGD Lift Station	1.000	$1,200,000	$1,200,000	20 - 50	$64,000	$136,000	$64,000	($76,880)	$60,000
	24" Force Main	24,800.000	$62	$1,537,600	50				$0	$2,348
	3.16 MGD Lift Station	1.000	$380,000	$380,000	20 - 50	$20,000	$380,000		($125,400)	$19,000
	16" Force Main	3,800.000	$46	$174,800	50				$0	$360
	10" Sanitary	2,800.000	$60	$168,000	50				$0	$1,061
	10" Sanitary	500.000	$300	$150,000	50				$0	$189
Trunk Sewer #30	5.88 MGD Lift Station	1.000	$1,100,000	$1,100,000	20 - 50	$55,000	$110,000	$55,000	($63,800)	$55,000
	18" Force Main	4,100.000	$56	$229,600	50				$0	$388
	18" Sanitary	1,200.000	$200	$240,000	50				$0	$455
Trunk Sewer #31	27" Sanitary	4,500.000	$185	$832,500	50				$0	$1,705
	36" Sanitary	1,240.000	$270	$334,800	50				$0	$470
	11.37 MGD Lift Station	1.000	$1,600,000	$1,600,000	20 - 50	$110,000	$28,000	$110,000	($64,240)	$80,000
	30" Force Main	2,300.000	$80	$184,000	50				$0	$218
Trunk Sewer #32	2.91 MGD Lift Station	1.000	$365,000	$365,000	20 - 50	$19,000	$37,000		($12,210)	$18,250
	12" Force Main	9,000.000	$42	$378,000	50				$0	$852
	18" Sanitary	2,900.000	$165	$478,500	50				$0	$1,098
Trunk Sewer #33	8.69 MGD Lift Station	1.000	$1,340,000	$1,340,000	20 - 50	$84,000	$197,000	$84,000	($107,010)	$67,000
	24" Force Main	10,800.000	$62	$669,600	50				$0	$1,023
Trunk Sewer #34	4.44 MGD Lift Station	1.000	$830,000	$830,000	20 - 50	$45,000	$95,000	$45,000	($53,850)	$41,500
	18" Force Main	15,700.000	$56	$879,200	50				$0	$1,487
	0.69 MGD Lift Station	1.000	$160,000	$160,000	20 - 50	$11,000	$6,000	$11,000	($7,480)	$8,000
	8" Force Main	6,800.000	$36	$244,800	50				$0	$644
Trunk Sewer # 36	12" Sanitary	6,250.000	$130	$812,500	50				$0	$2,367
	18" Sanitary	12,900.000	$140	$1,806,000	50				$0	$4,886
Trunk Sewer #38	8" Sanitary	4,250.000	$110	$467,500	50				$0	$1,610
	15" Sanitary	4,550.000	$150	$682,500	50				$0	$1,723
	15" Sanitary	6,800.000	$150	$1,020,000	50				$0	$2,576
Trunk Sewer #39	24" Sanitary	2,500.000	$140	$350,000	50				$0	$947
	24" Sanitary	2,675.000	$180	$481,500	50				$0	$1,013
	30" Sanitary	7,325.000	$195	$1,428,375	50				$0	$2,775
	36" Sanitary	2,600.000	$210	$546,000	50				$0	$985
Trunk Sewer #40	0.26 MGD Lift Station	1.000	$88,000	$88,000	20 - 50	$10,000	$5,000	$10,000	($6,650)	$4,400
	6" Forcemain	23,700.000	$30	$711,000	50				$0	$2,244
Total				$37,967,520		$508,000	$1,179,000	$469,000	($623,570)	$486,229
Engineering & Contingencies (30%)				$11,390,256						
Total Cost of Construction				$49,357,776						
Present Worth Factors				1.0000		0.3118	0.1741	0.0972	0.0543	
Present Worth				$49,357,776		$158,397	$205,276	$45,597	($33,853)	
Present Worth of Construction & Replacement				$49,733,193						
Annual O&M Costs		$486,229								
50 Year Present Worth Factor		15.7619								
Present Worth of O&M Costs				$7,663,893						
Total Present Worth				$57,397,087						

Source: Ruekert & Mielke, Inc.

Treatment Facilities

Under this scenario the Kenosha WTF would be expanded to treat an average daily flow of 46.2 MGD, with a peak hourly capacity of 177 MGD. A new sewage pumping station would be constructed with a capacity of 87 MGD; all subsequent treatment units would be sized for 109 MGD peak hourly flow. A new 84 inch gravity outfall pipe would also be constructed. The existing anaerobic digesters currently provide approximately 30 days sludge detention time, typical of standard rate digestion. At the ultimate daily flow of 46 MGD, the sludge detention time would be reduced to approximately 12 days. Since this is within typical design parameters for a high rate digestion process, it will be assumed that no new anaerobic digesters would have to be constructed. The existing filter press building currently houses two plate and frame filter presses with provisions for a third press. By the addition of a third filter press and a change to a two shift operation, the sludge dewatering facilities should be adequate for the ultimate sludge production rates expected. The construction cost of this alternative is $37,793,210, and the annual O & M cost is $3,022,200 (see Table 6-10).

Storage Facilities

This scenario is similar to the intermediate land use plan in that the WTF would be expanded to handle the peak daily flow of 113.7 MGD, with the excess of up to 177.0 MGD pumped to storage tanks located onsite. After a storm event the stored wastewater would be drained back to the wetwell for treatment. The new sewage pump station would be sized for 87 MGD while the remaining WTF units would be sized for 45.7 MGD. A new 60 inch diameter outfall pipe and four - 200 foot diameter by 16 foot side water depth storage tanks would be constructed. The storage tanks would provide a total of 15 million gallons of storage volume. Sludge handling and disposal facilities would be identical to the facilities planned under the optimistic land use plan scenario.

The construction cost of this alternative is $29,845,100 and the annual O & M cost is $2,764,100. A summary of construction and O & M costs can be found in Table 6-11.

Ultimate Growth Scenario Total Costs

The fifty year total present worth cost of the scenario is $146,133,100 including trunk sewers and with full WTF expansion or $133,472,200 including trunk sewers and with WTF expansion and storage. Detailed costs are listed in Table 6-12.

SEWERAGE ALTERNATIVE SUMMARY

The average day (MGD), peak day (MGD) and peak hour (MGD) flow rates are listed in Table 6-13 for each land use growth scenario. Trunk sewer present worth costs are summarized in Table 6-14 and WTF present worth costs are summarized in Table 6-15. The trunk sewer and WTF costs are combined and summarized in Table 6-16.

Table 6-13

Kenosha WTF - Design Flows

Growth Scenario	Average Day (MGD)	Peak Day ((MGD)	Peak Hour (MGD)
Intermediate	20.3	82.0	125.5
Optimistic	28.6	90.7	142.0
Ultimate	46.2	113.7	177.0

Table 6-14
Trunk Sewer Alternatives
Present Worth Summary

Alternative	Construction Cost	Construction Present Worth	Annual O&M	O&M Present Worth	Total Present Worth
Intermediate	$20,129,330	$20,369,332	$102,065	$1,608,735	$21,978,067
Optimistic	23,144,615	23,334,208	172,721	2,722,408	26,056,617
Ultimate	49,357,776	49,733,193	486,229	7,663,893	57,397,087

Table 6 - 10

TREATMENT FACILITIES

KENOSHA WTF - ULTIMATE DEVELOPMENT
EXPAND WTF TO 177 MGD CAPACITY
COST SUMMARY

Item	Cost	Life	Replacement Costs 20 Years	Replacement Costs 30 Years	Replacement Costs 40 Years	Salvage
Lift Station	$4,081,000	20 -50	$1,541,000	$1,150,000	$1,541,000	($1,150,000)
Grit Collectors	$285,000	20 -50	$176,000		$176,000	($88,000)
Primary Clarifiers	$3,702,300	20 -50	$1,518,300	$171,500	$1,518,300	($815,745)
Aeration Basins	$4,097,400	20 -50	$1,340,300		$1,340,300	($670,150)
Final Clarifiers	$4,066,000	20 -50	$1,026,000	$88,000	$1,026,000	($542,040)
Chlorine Contact	$920,000	50				$0
Pump House	$1,360,000	20 -50	$780,000		$780,000	($390,000)
Outfall	$1,400,000	50				$0
Electrical	$3,245,000	30		$3,245,000		($1,070,850)
Mechanical	$3,630,000	50				$0
Miscellaneous Channels	$1,250,000	50				$0
Site Work	$660,000	50				$0
Filter Presses	$375,000	20	$375,000		$375,000	($187,500)
Total Costs	$29,071,700		$6,756,600	$4,654,500	$6,756,600	($4,914,285)
Engineering & Contingencies (30%)	$8,721,510					
Construction Total	$37,793,210					
Present Worth Factors	1.0000		0.3118	0.1741	0.0972	0.0543
	$37,793,210		$2,106,740	$810,396	$656,891	($266,788)
Present Worth of Construction & Replacement			$41,100,448			
Average Annual O & M Costs *	$3,022,200					
50 Year Present Worth Factor	15.7619					
Present Worth of O&M			$47,635,614			
Total Present Worth			$88,736,063			

* O & M cost excludes administrative, billing and accounting costs. See Appendix I for detailed costs.

Source: Ruekert & Mielke, Inc.

Table 6 - 11

TREATMENT & STORAGE FACILITIES

KENOSHA WTF - ULTIMATE DEVELOPMENT
EXPAND WTF TO HANDLE 113.7 MGD PEAK FLOW
PROVIDE 15 MG STORAGE
COST SUMMARY

Item	Cost	Life	Replacement Costs 20 Years	30 Years	40 Years	Salvage
Lift Station	$4,081,000	20 -50	$1,541,000	$1,150,000	$1,541,000	($1,150,000)
Grit Collectors	$285,000	20 -50	$176,000		$176,000	($88,000)
Primary Clarifiers	$2,133,800	20 -50	$1,025,100	$103,700	$1,025,100	($546,771)
Aeration Basins	$1,863,100	20 -50	$617,400		$617,400	($308,700)
Final Clarifiers	$1,707,000	20 -50	$600,000	$54,000	$600,000	($317,820)
Chlorine Contact	$662,000	50				$0
Pump House	$929,000	20 -50	$386,000		$386,000	($193,000)
Outfall	$1,250,000	50				$0
Electrical	$1,865,000	30		$1,865,000		($615,450)
Mechanical	$2,391,000	50				$0
Miscellaneous Channels	$893,000	50				$0
Site Work	$454,000	50				$0
Filter Presses	$375,000	20	$375,000		$375,000	($187,500)
Storage	$4,068,900	20 -50	$954,000		$954,000	($477,000)
Total Costs	$22,957,800		$5,674,500	$3,172,700	$5,674,500	($3,884,241)
Engineering & Contingencies (30%)	$6,887,340					
Construction Total	$29,845,140					
Present Worth Factors	1.0000		0.3118	0.1741	0.0972	0.0543
	$29,845,140		$1,769,336	$552,399	$551,687	($210,869)
Present Worth of Construction & Replacement			$32,507,693			
Average Annual O & M Costs *	$2,764,100					
50 Year Present Worth Factor	15.7619					
Present Worth of O&M			$43,567,468			
Total Present Worth			$76,075,161			

* O & M cost excludes administrative, billing and accounting costs. See Appendix I for detailed costs.

Source: Ruekert & Mielke, Inc.

Table 6 - 12

ULTIMATE LAND USE SCENARIO
TOTAL PRESENT WORTH COST SUMMARY
OF SEWERAGE FACILITIES

WITHOUT STORAGE

Present Worth of Construction & Replacement	
Trunk Sewers	$49,733,193
Kenosha WTF	$41,100,448
Present Worth of O&M	
Trunk Sewers	$7,663,893
Kenosha WTF	$47,635,614
Total Present Worth	$146,133,149

WITH STORAGE

Present Worth of Construction & Replacement	
Trunk Sewers	$49,733,193
Kenosha WTF	$32,507,693
Present Worth of O&M	
Trunk Sewers	$7,663,893
Kenosha WTF	$43,567,468
Total Present Worth	$133,472,248

Source: Ruekert & Mielke, Inc.

Table 6 - 15

KENOSHA WTF PRESENT WORTH SUMMARY

ALTERNATIVE	CONSTRUCTION COST	CONSTRUCTION PRESENT WORTH	ANNUAL O & M	O & M PRESENT WORTH	TOTAL PRESENT WORTH
TREATMENT FACILITIES INTERMEDIATE	$24,835,200	$26,941,316	$1,668,000	$26,290,849	53,232,165
TREATMENT FACILITIES WITH STORAGE INTERMEDIATE	14,836,510	15,954,006	1,491,700	23,512,026	39,466,032
TREATMENT FACILITIES OPTIMISTIC	27,375,400	29,459,667	2,075,500	32,713,823	62,173,491
TREATMENT FACILITIES WITH STORAGE OPTIMISTIC	19,748,300	21,179,849	1,869,700	29,470,024	50,649,873
TREATMENT FACILITIES ULTIMATE	37,793,210	41,100,448	3,022,200	47,635,614	88,736,063
TREATMENT FACILITIES WITH STORAGE ULTIMATE	29,845,140	32,507,693	2,764,100	43,567,468	76,075,161

Source: Ruekert & Mielke, Inc.

Table 6 - 16

SEWERAGE ALTERNATIVES
PRESENT WORTH SUMMARY

Land Use Plan	Trunk Sewers		WTF - W/O Storage		WTF - W/ Storage		Present Worth Least Cost Alternate Totals
	Construction	O & M	Construction	O & M	Construction	O & M	
Intermediate	$20,369,332	$1,608,735	$26,941,316	$26,290,849	$15,954,006	$23,512,026	$61,444,099
Optimistic	$23,334,208	$2,722,408	$29,459,667	$32,713,823	$21,179,849	$29,470,024	$76,706,490
Ultimate	$49,733,193	$7,663,893	$41,100,448	$47,635,614	$32,507,693	$43,567,468	$133,472,248

Source: Ruekert & Mielke, Inc.

In summary, the least cost alternate for each scenario was a combination of trunk sewer and WTF expansion with storage provided at the head end of the plant.

Using present worth costs, the optimistic trunk sewer scenario was approximately 18 percent more expensive than the intermediate trunk sewer scenario and the ultimate trunk sewer scenario was approximately 150 percent more expensive than the intermediate trunk sewer scenario.

Using present worth costs the optimistic WTF expansion scenario with storage was approximately 28 percent more expensive than the intermediate WTF expansion scenario with storage. The ultimate WTF expansion scenario with storage was approximately 93 percent more expensive than the intermediate WTF expansion scenario with storage.

Because the present worth costs for the optimistic scenario are not significantly higher than the intermediate scenario and because the optimistic scenario facilities will provide for a reasonable growth prediction above the intermediate scenario, it is recommended that the optimistic scenario facilities be constructed. However, trunk sewers that are common between optimistic and ultimate scenarios should be compared individually to choose a cost effective size because the sewers have a service life of more than 50 years and often times a pipe size increase can be made for a minimal cost difference. Table 6-17 lists those trunk sewers that are common and similar in size between the optimistic and ultimate growth scenarios. These sewers are recommended to be sized for ultimate growth. The total increase in construction cost is 12 percent to construct these facilities for the ultimate rather than the optimistic growth scenario. However pipe sizes should be verified during detailed facility planning to ensure that a cleansing velocity is maintained during the first few years of service. Figure 6-10 shows the final recommended sewage conveyance facilities which correspond to the optimistic scenario with the exception of the ultimate scenario facilities listed in Table 6-17.

RECOMMENDED WATER ALTERNATIVE

In Chapter V a recommendation to adopt the centralized service plan resulted from the alternative analysis. The centralized service plan will now be updated and modified using the 2010 Optimistic Decentralized Development Plan and the Ultimate Development Plan.

The improvements recommended in Chapter V under the Intermediate Centralized Development Plan are presented below and shown in Figure 6-11. In the Optimistic and Ultimate Development Plan analyses, only those improvements which differ from those recommended under the Intermediate Development Plan will be addressed.

2010 INTERMEDIATE CENTRALIZED WATER SYSTEM PLAN

Primary Zone Facilities

Under the Intermediate Plan no increase in water treatment facility capacity will be required to meet the maximum day demand of 33.157 MGD. The only recommended addition to the plant is a 4 million gallon of clear water storage reservoir at the treatment plant site. This 4 million gallon reservoir will cost an estimated $2,400,000. It should be noted that the discharge header at the water treatment facility will not be capable of supplying the 58.5 MGD required under the maximum hour flow rate. While storage facilities can assist in providing this amount, the diurnal curve presented in Figure 5-13 shows that there are 6 hours with flows greater than 50 MGD. The computer model shows that the storage facilities cannot provide additional flow for these periods. Existing storage facilities are adequate to provide service to areas north and south of the existing primary zone service area if the header capacity is increased. A detailed study of the header capacity is not in the scope of this project. It is recommended that the Kenosha Water Utility pursue this matter as soon as possible. The following improvements to the existing system are required to provide adequate transmission from the water treatment facility to the storage and booster stations located in the first booster zone.

1) Construction of approximately 11,500 feet of 16 inch main from the intersection of 58th Street and 6th Avenue west to Sheridan road; south on Sheridan Road to 60th Street and west on 60th Street to the 24 inch main at 39th Avenue.

2) To serve the areas south of 91st Street in the Village of Pleasant Prairie and to provide additional transmission to the boosted zones; a 36 inch main beginning at the 36 inch Harbor crossing from the treatment facility and then running south down 5th Avenue to 79th Street, at which point it will run west to 7th Avenue then south to 80th Street. Approximately 12,000 feet of 36 inch main would be required. At the intersection of 7th Avenue and 80th Street, a 16 inch main would continue south on 7th Avenue to

Table 6 - 17

CONSTRUCTION COST COMPARISON
TRUNK SEWERS

Trunk Sewer	Length	Intermediate Scenario			Optimistic Scenario			Ultimate Scenario		
		Flow (CFS)	Size	Cost	Flow (CFS)	Size	Cost	Flow (CFS)	Size	Cost
1	4,430 Feet	163.0	96" Sanitary	$3,544,000	168.0	96" Sanitary	$3,544,000	202.0	102" Sanitary	$3,765,500
3	1,260 Feet	9.0	21" Sanitary	$207,900	9.0	21" Sanitary	$207,900	9.0	21" Sanitary	$207,900
12	8,770 Feet	87.0	66" Sanitary	$4,911,200	89.0	66" Sanitary	$4,911,200	112.0	72" Sanitary	$5,262,000
16	2,770 Feet	10.0	27" Sanitary	$304,700	10.0	27" Sanitary	$304,700	11.0	27" Sanitary	$304,700
20	900 Feet	18.0	27" Sanitary	$99,000	11.0	27" Sanitary	$99,000	20.0	27" & 21" Sanitary	$141,000
29	24,800 Feet	5.0	16" Forcemain	$1,140,800	8.0	20" Forcemain	$1,388,800	11.0	24" Forcemain	$1,537,600
	3,300 Feet		8" Sanitary	$290,000		8" Sanitary	$290,000		10" Sanitary	$318,000
30	4,100 Feet	3.0	12" Forcemain	$172,200	4.0	12" Forcemain	$172,200	9.0	18" Forcemain	$229,600
	500 Feet		15" Sanitary	$65,000		15" Sanitary	$65,000		18" Sanitary	$240,000
32	2,900 Feet	1.0	8" Sanitary	$270,000	2.0	8" Sanitary	$270,000	5.0	18" Sanitary	$478,500
	9,000 Feet		8" Forcemain	$306,000		12" Forcemain	$378,000 (1)		16" Forcemain	$414,000
33	10,800 Feet	4.0	12" Forcemain	$410,400	8.0	20" Forcemain	$604,800	13.0	24" Forcemain	$669,600
34	15,700 Feet	1.0	8" Forcemain	$533,800	2.0	12" Forcemain	$659,400 (1)	7.0	18" Forcemain	$879,200
39	2,600 Feet				1.0	12" Sanitary	$286,000	14.0	36" Sanitary	$546,000
40	23,700 Feet	0.4	6" Forcemain	$711,000	0.4	6" Forcemain	$711,000	0.4	6" Forcemain	$711,000
				$12,966,000			$13,892,000			$15,704,600

Note:
(1) Optimistic sizing recommended in order to maintain cleansing velocities.

Source: Ruekert & Mielke, Inc.

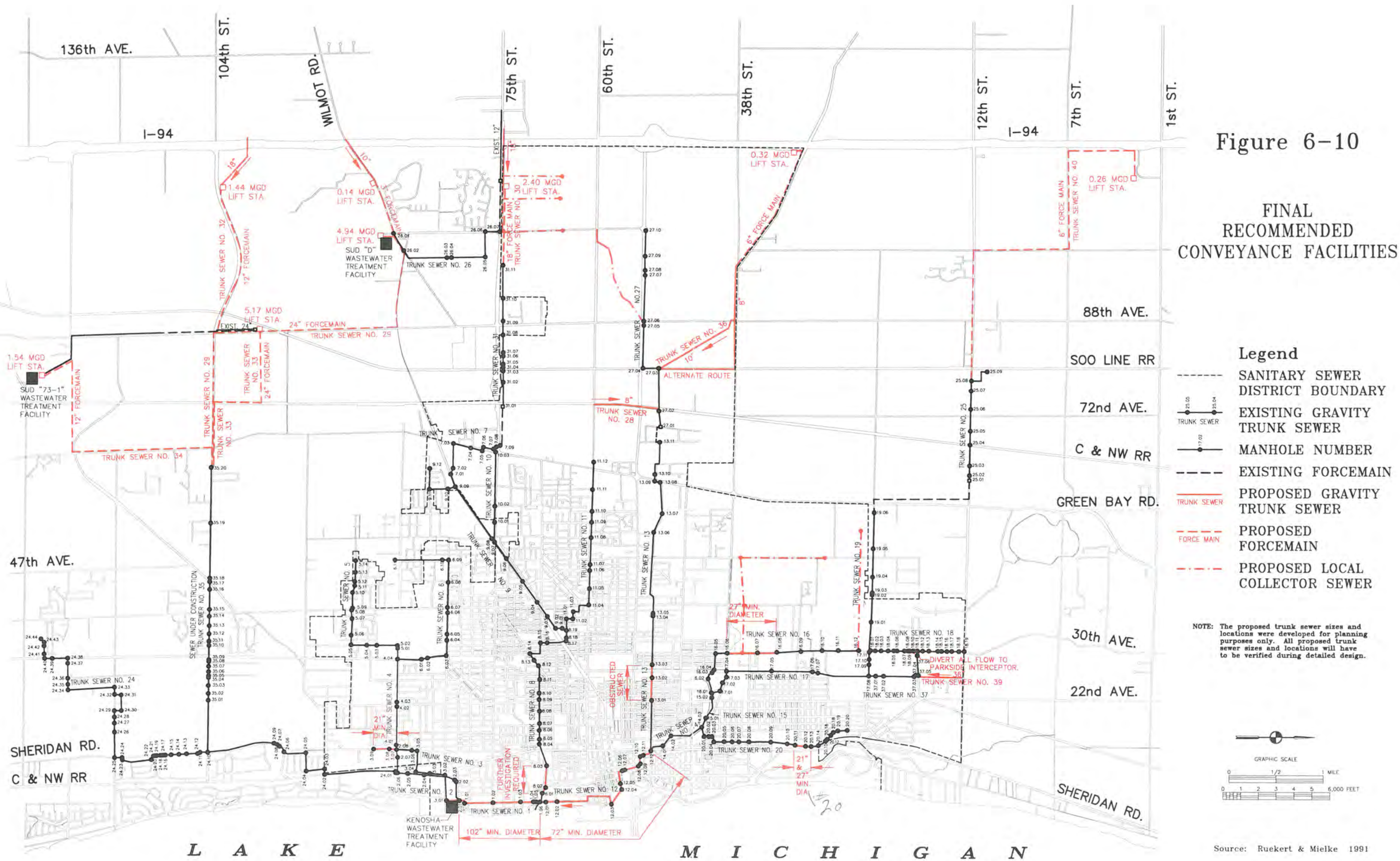


Figure 6-10

FINAL RECOMMENDED CONVEYANCE FACILITIES

Source: Ruekert & Mielke 1991

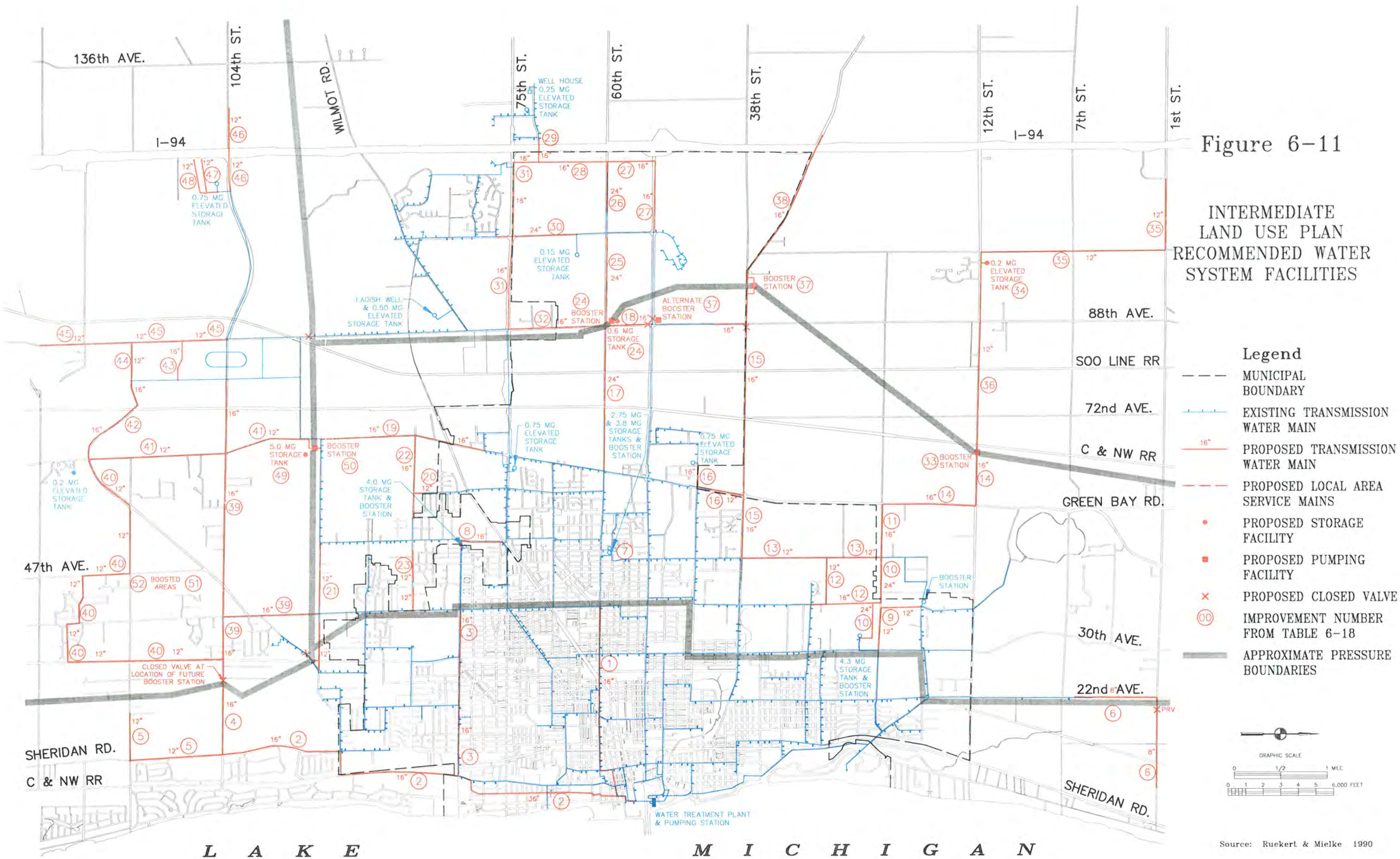


Figure 6-11

INTERMEDIATE LAND USE PLAN RECOMMENDED WATER SYSTEM FACILITIES

91st Street, west on 91st to Sheridan Road and south on Sheridan Road to 104th Street. Approximately 15,200 feet of 16 inch main would be required

3) Approximately 6,000 feet of 16 inch main running parallel to the existing 16 inch, west on 80th Street from the 36 inch main on 7th Avenue to the existing 24 inch main near 28th Avenue. This main is required to provide additional transmission between the treatment facility and the 80th Street storage tank and will eliminate the need for the booster station at 80th Street and 7th Avenue.

4) Approximately 4,500 feet of 16 inch main on 104th Street running west from Sheridan Road to 28th Avenue. This main would provide transmission to a possible future booster station to provide supply to the Pleasant Prairie service area.

5) Approximately 8,100 feet of 12 inch main running south on Sheridan Road from 104th Avenue to 116th Street then west on 116th Street to 22nd Avenue.

6) To serve the Town of Somers Sanitary District No. 1, approximately 7,600 feet of 8 inch main extending north from the 8 inch dead end on 22nd Avenue near Patio Homes to CTH KR and then east on CTH KR to the existing 8 inch main near Sheridan Road. A pressure reducing valve would be required to isolate the booster zone from the primary zone. In the event of a fire situation, the valve would open fully allowing for additional required fire protection.

<u>First Booster Zone Facilities</u>

Results of the supply and storage analysis for the first booster zone show a deficit in emergency supply. All other parameters were adequately met. In order to provide the 2.865 MG deficit, either additional elevated storage or additional emergency power must be provided or a combination of the two.

The ground level storage volume at 30th Avenue, 60th Street and 80th Street is adequate to satisfy the mathematical peak hour storage parameter, however transmission between the booster stations at these sites and the elevated storage is not adequate to handle peak flow conditions. By increasing main sizes to allow pumps to operate at or near capacity and the elevated tanks to float more evenly, these peak demands can be satisfied. For these reasons, the following improvements to the first booster zone are recommended under alternative plans:

7) To provide the additional .807 MGD of source capacity to serve all areas west of the primary pressure zone it is recommended a new 50 Hp pump be added to the 60th Street booster station. To provide the additional emergency supply it is recommended an emergency power generator be installed at the 60th Street booster station. It is recommended the generator be sized to power any of the booster pumps as well as the controls and lighting at the station. Modifications to the electrical controls would be required. The estimated required size of the generator is 200 to 230 KW.

8) Construction of approximately 3,000 feet of 16 inch main running parallel to the existing 16 inch main from the 80th Street booster station north on 51st Avenue to 75th Street.

<u>Pressure Zone Modification</u>

The existing intermediate pressure zone created by the pressure reducing valve located near the 30th Avenue storage tank and booster station, should be modified to eliminate the booster station at 15th Street and 41st Avenue. In this area, pressure is first reduced to serve lower elevation areas, then boosted to serve higher elevation areas near 45th Avenue. The following water main construction will provide adequate pressures in this area and eliminate the need for the booster station.

9) Construction of approximately 4,500 feet of 12 inch main running west on 18th Street from 30th Avenue to 39th Avenue extended then north to the 16 inch stub on 39th Avenue. This main would serve as a second feed to the intermediate zone and those areas around Petrifying Springs and UW-Parkside and increase fire flows to the area.

10) Construction of 5,800 feet of 24 inch main from the 30th Avenue booster station west to 39th Avenue, north to 18th Street, then west to 47th Avenue. This main would be in the first booster service area and would be the primary feed to the Town of Somers. It would also connect the area near 45th Avenue and 15th Street to the first booster service area thereby eliminating the need for the booster station at 15th street and 41st Avenue.

11) Construction of approximately 3,100 feet of 16 inch main running west from 47th Avenue on 18th Street to Green Bay Road (STH 31).

12) Construction of approximately 2,800 feet of 16 inch main running south from the 24 inch main connected to the 30th Avenue booster station on 39th Avenue to 27th Street. Also construct 2,800 feet of 12 inch main on 24th Street between 39th Avenue and 47th Avenue.

13) Construction on 47th Avenue of 8,000 feet of 12 inch main running south from the 24 inch main on 18th Street to 38th Street (Washington Road). This would provide a second connection to Somers from Kenosha and would also provide flow in the event either the 24 inch main or 30th Avenue booster station is out of service.

14) Construction of approximately 12,400 feet of 16 inch water main running north on Green Bay Road (STH 31) from the 24 inch main at 18th Street to 12th Street then west to the Chicago, Milwaukee and St. Paul Railroad. This main would serve the areas of the Town of Somers in the first booster area.

The following additions are required to provide adequate service to the remainder of the first booster area:

15) Construction of approximately 16,000 feet of 16 inch main on 38th Street (STH 142) from 39th Avenue west to 88th Avenue (STH 192). This main would provide transmission and fire protection to the residential development near 100th Avenue and the commercial developments at ISH 94 via a booster station discussed in number 33 below.

16) Construction of approximately 1,500 feet of 16 inch main running east from the Industrial Park elevated tank on 45th Street to Green Bay Road (STH 31); then 2,500 feet of 12 inch main north on Green Bay Road (STH 31) to 38th Street (STH 142). This main would provide increased transmission from the elevated tank to areas north of 38th Street (STH 142).

17) Construction of approximately 8,600 feet of 24 inch main on 60th Street (CTH K) from Green Bay Road (STH 31) west to approximately 1000 feet west of 88th Avenue (STH 192). This main would provide transmission to the main booster station for the second boosted zone.

18) Construction of approximately 2,600 feet of 16 inch main on 88th Avenue (STH 192) between 52nd Street (STH 158) and 60th Street (CTH K).

19) Construction of approximately 5,200 feet of 16 inch main on Green Bay Road (STH 31) from the existing 16 inch main in Kenosha, south to the existing main near the WisPark development.

20) Construction of approximately 1,500 feet of 12 inch main on 60th Avenue between 82nd Street and 85th Street.

21) Construction of approximately 5,400 feet of 12 inch main on 93rd Street between 51st Avenue and 30th Avenue extended (bike path). The 12 inch main on STH 174 near 29th Avenue would then be valved closed as part of the pressure boundary between the Pleasant Prairie pressure zone and first boosted zone.

22) Construction of approximately 4,800 feet of 16 inch main running west on 85th Street from approximately 58th Avenue to Green Bay Road (STH 31).

23) Construction of approximately 3,400 feet of 12 inch main on 85th Street between 39th Avenue and an existing stub east of 51st Avenue.

<u>Second Boosted Zone</u>
The second boosted zone would serve those areas above elevation 700 NGVD (National Geodetic Vertical Datum) in the western portion of the study area. There are currently three elevated storage facilities located in this service area; a 150,000 gallon tank approximately 2000 feet east of 104th Avenue and 2500 feet south of 60th Street; a 500,000 gallon tank south of Wilmont Road near the Tri-clover/Ladish Plant in Pleasant Prairie; and a 250,000 gallon elevated tank off Bristol Parkway east, north of STH 50 in Bristol. All three tanks have overflow elevations of 885 NGVD.

The Bristol and Pleasant Prairie Ladish tanks are supplied by wells and the City of Kenosha tank is supplied by two small booster stations, one at the intersection of 88th Avenue (CTH H) and 52nd Street (STH 158) and one at the intersection of 88th Avenue (CTH H) and 75th Street (STH 50). These stations are temporary and may be abandoned upon construction of the new station outlined below. Other possible uses for the stations are discussed later in this section. Upon connection to the Kenosha system, the wells for the Ladish system and the wells and 40,000 gallon storage tank for the Zirbel system will be removed from the public water supply system. The well at the Bristol East system was constructed in 1987 and may be kept in service until maintenance costs preclude its use, which is estimated to be in the year 2007.

The following new construction is recommended for the second boosted zone:

24) Construction of a booster station at the intersection of STH 192 and CTH K (60th Street). The source capacity parameter for the second boosted pressure zone indicated a 2.324 MGD deficit. This volume must be provided by this booster station with the largest unit out of service. It is recommended that the station contain two pumps, both capable of supplying 3 MGD and an emergency power generator. Both pumps would be approximately 150 Hp. At the booster station site, a 0.6 MG reservoir would be required to provide storage to meet the peak hour storage and emergency supply requirements. The storage facility should be a below ground concrete reservoir. The emergency power generator would be approximately 200 kw.

25) Construction of approximately 4,800 feet of 24 inch water main on 60th Street (CTH K) from the STH 192 booster station to the existing 24 inch water main at CTH HH.

26) Construction of approximately 1,000 feet of 24 inch main on 60th Street (CTH K) from the existing 24 inch main west of 104th Avenue (CTH HH) west to ISH 94.

27) Construction of a 16 inch, 7,100 foot loop beginning at 60th Street (CTH K) and ISH 94 running north to 52nd Street (STH 158) then east to the existing mains at 104th Avenue (CTH HH).

28) Construction of approximately 4,000 feet of 16 inch main along ISH 94 from 60th Street (CTH K) south to the 16 inch main north of 75th Street (STH 50) on 120th Avenue.

29) Construction of approximately 1,200 feet of 16 inch main, 400 feet of which will be in 30 inch casing under ISH 94, at 71st Street to join the existing main at 122nd Avenue in the Bristol East System with the 16 inch main on 120th Avenue. This main would provide transmission to the Bristol East elevated storage tank and eliminate the need for the Bristol East well as previously discussed.

30) Construction of approximately 3,600 feet of 24 inch main from the 150,000 gallon elevated tank connection on 104th Avenue (CTH HH) south to 75th Street (STH 50).

31) Construction of approximately 10,100 feet of 16 inch main on 75th Street (STH 50) from the pressure area boundary at STH 192 west to 118th Avenue where it would connect to the existing 16 inch main. This main would also connect to the 24 inch main at 104th Avenue (CTH HH).

32) Construction of approximately 5,900 feet of 16 inch main on 88th Avenue (STH 192) from the STH 192 booster station south to the existing 16 inch main at 75th Street (STH 50).

Somers Second Boosted Pressure Zone

This zone will serve only the areas of Somers which will be developed under this land use scenario. The following construction is recommended to provide adequate supply, storage and transmission facilities.

33) Construction of a booster station on 12th Street near the Chicago, Milwaukee and St. Paul Railroad to serve the Town of Somers. The booster station should have two 500 GPM pumps with total dynamic head ratings capable of filling an elevated tank with an overflow elevation of 885 NGVD. The booster station should also have an emergency generator capable of running both pumps. Depending upon exact elevations at the booster station, the pumps would require approximately 25 Hp motors.

34) Construction of a 200,000 gallon elevated storage tank near 100th Avenue and 12th Street. The tank would have an overflow elevation of 885 NGVD and be approximately 140 feet in height.

35) Construction of approximately 14,500 feet of 12 inch main to serve the Oakdale Estates Subdivision. The main would run from the elevated tank in Somers west on 12th Street to 100th Avenue then north on 100th Avenue to CTH KR, then west on CTH KR to 113th Avenue.

36) Construction of approximately 7,000 feet of 12 inch main from the booster station to the elevated tank. This would serve as the main feed between the two.

In addition, a small boosted area shared by Somers and Kenosha will be created. Required facilities are as follows:

37) Construction of a small booster station near the intersection of STH 142 (38th Street) and STH 192. This booster station would serve the commercial area around ISH 94 and STH 142 and the residential

development along STH 142. As options, the booster station currently serving the airport, could either be moved or modified to provide service to this area and the areas along STH 192. Detailed design will verify this option.

Pressure boosting is required to serve those areas above elevation 850. Pumps should be sized for the maximum elevation where development will occur. Cost estimates are based upon providing an in ground booster station and 10 Hp, 15 Hp and 25 Hp motors and pumps.

38) Construction of approximately 12,000 feet of 16 inch main on STH 142 from the booster station to a point approximately 1000 feet west of ISH 94. (Note: some additional 12 inch main may be required to provide fire protection in the commercial areas around ISH 94, but that will have to be determined at the time of construction.

<u>Pleasant Prairie Pressure Zone</u>

As previously discussed, a new pressure zone in Pleasant Prairie is being created. The following main is scheduled for construction in the fall of 1990 and will not be included in the cost estimates. Construction of approximately 5,300 feet of 16 inch main on 39th Avenue (CTH EZ) from 93rd Street (CTH T) south to 104th Street (CTH Q). A closed valve will be required just south of 93rd Street to separate pressure zones.

The following improvements are required to adequately serve the Pleasant Prairie Zone:

39) Construction of approximately 17,000 feet of 16 inch main on 104th Street (CTH Q) from the pressure zone boundary near 28th Avenue to 80th Avenue.

40) Construction of approximately 26,200 feet of 12 inch main beginning at the intersection of 30th Avenue extended and 104th Street and running south along 30th Avenue extended to 124th Street; west on 124th Street to 39th Avenue (CTH EZ); north to 122nd Street; west on 122nd Street to 47th Avenue; north on 47th Avenue to 116th Street (Tobin Road); west on 116th Street (Tobin Road) to Springbrook Road (STH 174); southwest on Springbrook Road (STH 174) to Green Bay Road (STH 31); then south on Green Bay Road to 123rd Place to connect to the 8 inch main running to the Timber Ridge elevated tank.

41) Construction of approximately 12,000 feet of 12 inch main on Green Bay Road (STH 31) from 95th Street (CTH T) south to Springbrook Road (STH 174). This main will connect to the 16 inch main on 104th Street and the mains at Springbrook Road.

42) Construction of approximately 5,500 feet of 16 inch main on Springbrook Road from Green Bay Road (STH 31) to the intersection of 116th Street (CTH ML) and 80th Avenue.

43) Construction of approximately 3,000 feet of 16 inch main from 80th Avenue west on 116th Street in the Lakeview Corporate Park to 84th Avenue; north on 84th Avenue to 109th Street; then west on 109th Street to the western edge of the Park.

44) Construction of approximately 2,500 feet of 12 inch main on 116th Street west from 80th Avenue to the western edge of the Lakeview Corporate Park.

45) Construction of approximately 10,000 feet of 12 inch main on the western edge of the Lakeview Corporate Park from 104th Street (CTH Q) south to State Line Road. The main will connect to the mains in 27 and 28 above.

46) Construction of approximately 3,000 feet of 12 inch main from the existing 12 inch stub west of 114th Avenue on 104th Street (CTH Q) west under ISH 94. This main will have to be installed in a 30 inch casing under ISH 94..

47) Construction of approximately 1,500 feet of 12 inch main from the 750,000 gallon tower connection on 114th Avenue south to 108th Street then west to ISH 94.

48) Construction of approximately 2,000 feet of 12 inch main on 116th Avenue south from 108th Street to 110th Street; then west on 110th Street to ISH 94.

As previously mentioned, the following facilities have been proposed for the area. They will be included in the cost estimates.

49) A 5.00 MG prestressed above ground concrete reservoir will be located at the intersection of Green Bay Road (STH 31) and 93rd Street (CTH T).

50) Construction of a booster pump station which will pump from the reservoir to the

Pleasant Prairie Pressure Zone. The booster station will have three pumps, two 100 Hp pumps capable of supplying 2000 GPM (3.00 MGD) and one 350 Hp fire pump capable of supplying 5000 GPM (7.00 MGD). The station will also require an emergency generator capable of starting either the fire pump or both 100 Hp pumps.

An additional 4,600 feet of discharge main from the booster station will also be required. Plans call for a 16 inch main on Green Bay Road (STH 31) running south from the booster station parallel to the existing 16 inch. The main will then turn west on 95th Street (CTH T) and run parallel to the existing 12 inch main to 80th Avenue.

Additional Boosting In Pleasant Prairie

Under the 2010 Intermediate Development Plan there are two areas which will require additional pressure boosting. Areas above elevation 839 NGVD will require boosting to provide the minimum required domestic pressure of 35 psi at all times. These areas are shown in Figure 6-11. The cut-off elevation for boosting was determined as follows:

Overflow elevation of elevated tanks=	845.5 NGVD
Minus 20 foot operating range of tanks=	25.5 NGVD
Minus 35 Psi times 2.31 feet/pound = 80.85ft=	44.65 NGVD
Minus 5 feet of head loss in water mains=	739.65 NGVD

The maximum elevation to be served is approximately 763 NGVD. At this elevation the normal pressure system will be able to provide a fire flow of 750 GPM and not drop to the minimum 20 Psi pressure restriction.

The following improvements are recommended:

51) In Area No. 1, which is located in Town 1 North, Range 22 East, Sections 22 and 27, approximately 110 homes will require boosting. In accordance with Chapter NR 111.75 of The Wisconsin Administrative Code, a submersible pumping station containing two pumps, 7-1/2 Hp each and rated at a 330 GPM, is recommended. Also required is a check valve manhole to allow adequate flow in fire situations.

52) In Area No. 2, which is located in Town 1 North, Range 22 East, Section 35, approximately 20 homes will require boosting. In accordance with Chapter NR 111.75 of the Wisconsin Administrative code, a submersible pumping station containing two pumps, 3 Hp each and rated at 110 GPM, is recommended. Also required is a check valve manhole to allow adequate flow in fire situations.

The total estimated facilities construction cost of Intermediate Development Plan is $28,769,500. The total present worth of the facilities is $33,064,441. Cost estimates are provided in Table 6-18.

2010 OPTIMISTIC DECENTRALIZED WATER SYSTEM PLAN

This plan was developed using the same criteria as in Chapter V with existing planning adhered to for future facilities and additional facilities sized to satisfy the demand projections. Required facilities are shown in Figure 6-12.

Supply and Storage Analysis

The following are the average and maximum day demands for the year 2010 optimistic decentralized development plan broken down by pressure zone:

Entire system average day demand =	23.560 MG
Entire system maximum day demand =	41.230 MG
Primary pressure zone average day demand =	11.004 MG
Primary pressure zone maximum day demand =	19.257 MG
Boosted pressure zone maximum day demand =	6.697 MG
Boosted pressure zone maximum day demand =	11.720 MG
Second boosted pressure zone average day demand =	1.923 MG
Second boosted pressure zone maximum day demand =	3.365 MG
Somers second boosted pressure zone average day demand =	0.293 MG
Somers second boosted pressure zone maximum day demand =	0.513 MG
Pleasant Prairie pressure zone average day demand =	3.643 MG
Pleasant Prairie pressure zone maximum day demand =	6.375 MG

Results of the supply and storage analysis are as follows:

Table 6 -18

WATER SUPPLY, STORAGE AND TRANSMISSION FACILITY COSTS INTERMEDIATE CENTRALIZED DEVELOPMENT PLAN

Improvement	Item	Quantity	Unit Price	Cost	Life	Replacement Costs 10 Years	20 Years	30 Years	40 Years	Salvage
1	16" Water Main	11,500	$55	$632,500	50					$0
2	36" Water Main	12,000	$108	$1,296,000	50					$0
	16" Water Main	15,200	$55	$836,000	50					$0
3	16" Water Main	6,000	$55	$330,000	50					$0
4	16" Water Main	4,500	$55	$247,500	50					$0
5	12" Water Main	8,100	$53	$429,300	50					$0
6	8" Water Main	7,600	$43	$326,800	50					$0
	8" Pressure Control Valve	1	$3,200	$3,200	20		$3,200		$3,200	($1,600)
	Manhole	1	$1,500	$1,500	50					$0
	Mechanical & Bypass	1	$15,000	$15,000	20		$15,000		$15,000	($7,500)
7	50Hp Pump, Mechanical	1	$25,000	$25,000	20		$25,000		$25,000	($12,500)
	200 KW Generator, Reduced Voltage Starter, Controls	1	$30,000	$30,000	30			$30,000		($9,900)
	Fuel Tank	1	$7,000	$7,000	30			$7,000		($2,310)
	Building Addition	1	$65,000	$65,000	50					$0
8	16" Water Main	3,000	$55	$165,000	50					$0
9	12" Water Main	4,500	$53	$238,500	50					$0
10	24" Water Main	5,800	$73	$423,400	50					$0
11	16" Water Main	5,800	$55	$319,000	50					$0
12	16" Water Main	2,800	$55	$154,000	50					$0
	12" Water Main	2,800	$53	$148,400	50					$0
13	12" Water Main	8,000	$53	$424,000	50					$0
14	16" Water Main	12,400	$55	$682,000	50					$0
15	16" Water Main	16,000	$55	$880,000	50					$0
16	12" Water Main	2,500	$53	$132,500	50					$0
	16" Water Main	1,500	$55	$82,500	50					$0
17	24" Water Main	8,600	$73	$627,800	50					$0
18	16" Water Main	2,600	$55	$143,000	50					$0
19	16" Water Main	5,200	$55	$286,000	50					$0
20	12" Water Main	1,500	$53	$79,500	50					$0
21	12" Water Main	5,400	$53	$286,200	50					$0
22	16" Water Main	4,800	$55	$264,000	50					$0
23	12" Water Main	3,400	$53	$180,200	50					$0
24	Pump Station Building	1	$125,000	$125,000	50					$0
	Pumps (150 Hp)	2	$12,000	$24,000	20		$24,000		$24,000	($12,000)
	Mechanical	1	$60,000	$60,000	20		$60,000		$60,000	($30,000)
	Electrical	1	$80,000	$80,000	30			$80,000		($26,400)
	Controls	1	$20,000	$20,000	30			$20,000		($6,600)
	200 KW Generator, Reduced Voltage Starter, Controls, Fuel Tan	1	$37,000	$37,000	30			$37,000		($12,210)
	Sitework	1	$30,000	$30,000	50					$0

Table 6 -18

WATER SUPPLY, STORAGE AND TRANSMISSION FACILITY COSTS
INTERMEDIATE CENTRALIZED DEVELOPMENT PLAN

Improvement	Item	Quantity	Unit Price	Cost	Life	Replacement Costs				Salvage
						10 Years	20 Years	30 Years	40 Years	
	600,000 Gallon Reservior	1	$420,000	$420,000	50					$0
25	24" Water Main	4,800	$73	$350,400	50					$0
26	24" Water Main	1,000	$73	$73,000	50					$0
27	16" Water Main	7,100	$55	$390,500	50					$0
28	16" Water Main	4,000	$55	$220,000	50					$0
29	16" Water Main	800	$55	$44,000	50					$0
	16" Water Main in 30" Casing	400	$250	$100,000	50					$0
30	24" Water Main	3,600	$73	$262,800	50					$0
31	16" Water Main	10,100	$55	$555,500	50					$0
32	16" Water Main	5,900	$55	$324,500	50					$0
33	Pump Station Building	1	$60,000	$60,000	50					$0
	Pumps (25 Hp)	2	$3,000	$6,000	20		$6,000		$6,000	($3,000)
	Mechanical	1	$30,000	$30,000	20		$30,000		$30,000	($15,000)
	Electrical & Controls, Generator	1	$50,000	$50,000	30			$50,000		($16,500)
34	200,000 Gallon Elevated Tank									
	140' Tall, Foundation	1	$310,000	$310,000	50					$0
	Painting	1	$50,000	$50,000	10	$50,000	$50,000	$50,000	$50,000	$0
	Electrical & Controls	1	$7,500	$7,500	30			$7,500		($2,475)
35	12" Water Main	14,500	$53	$768,500	50					$0
36	12" Water Main	7,000	$53	$371,000	50					$0
37	Buried Booster Station With 10 Hp,									
	15 Hp & 25 Hp Motors Installed	1	$80,000	$80,000	20		$80,000		$80,000	($40,000)
	Electrical	1	$5,000	$5,000	30			$5,000		($1,650)
38	16" Water Main	12,000	$55	$660,000	50					$0
39	16" Water Main	17,000	$55	$935,000	50					$0
40	12" Water Main	26,200	$53	$1,388,600	50					$0
41	12" Water Main	12,000	$53	$636,000	50					$0
42	16" Water Main	5,500	$55	$302,500	50					$0
43	16" Water Main	3,000	$55	$165,000	50					$0
44	12" Water Main	2,500	$53	$132,500	50					$0
45	12" Water Main	10,000	$53	$530,000	50					$0
46	12" Water Main	2,600	$53	$137,800	50					$0
	12" Water Main in 30" Casing	400	$250	$100,000	50					$0
47	12" Water Main	1,500	$53	$79,500	50					$0
48	12" Water Main	2,000	$53	$106,000	50					$0
49	5 MG Prestressed Above									
	Ground Concrete Reservior	1	$1,560,000	$1,560,000	50					$0

Table 6 -18

WATER SUPPLY, STORAGE AND TRANSMISSION FACILITY COSTS

INTERMEDIATE CENTRALIZED DEVELOPMENT PLAN

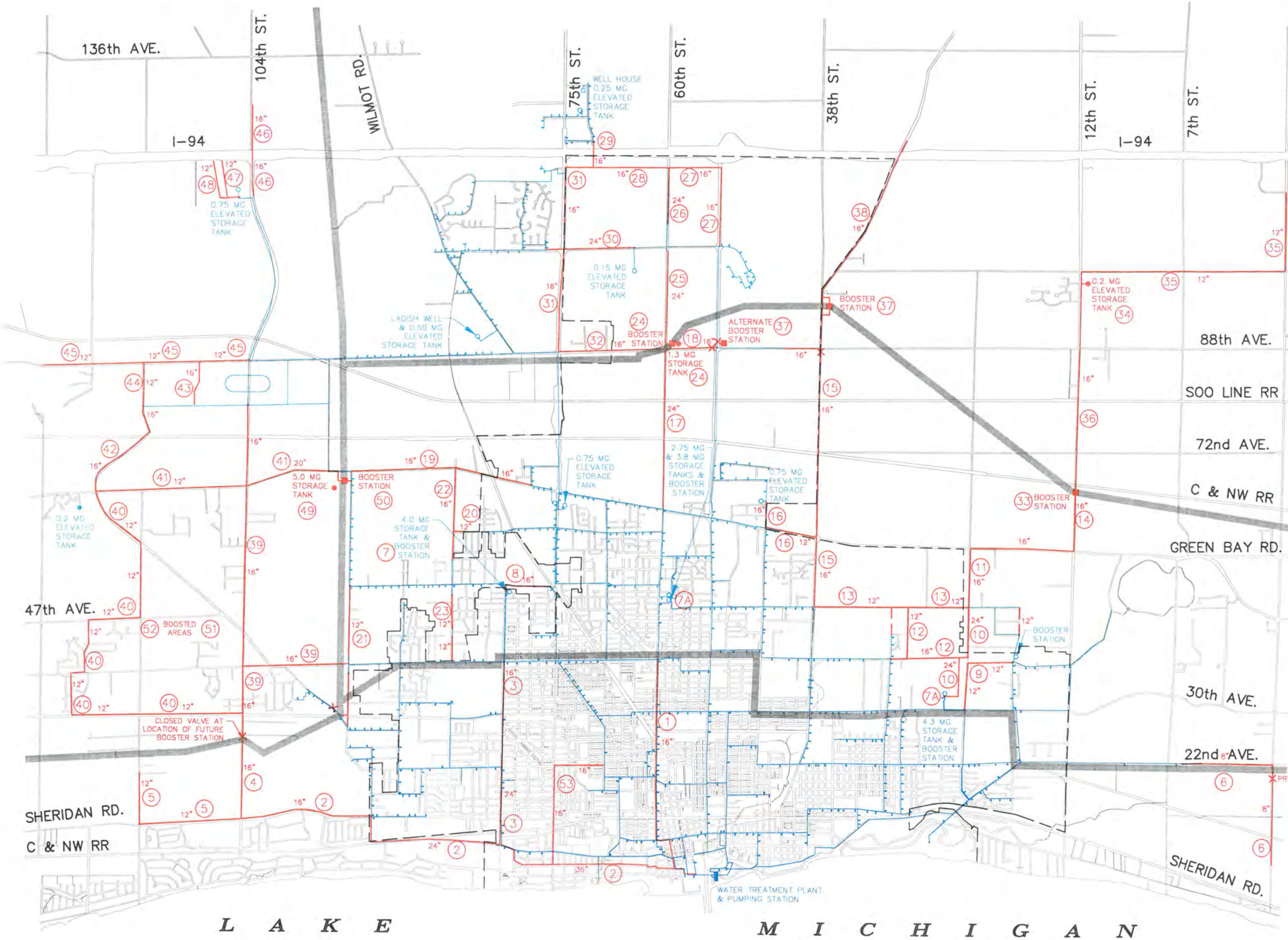
Improvement	Item	Quantity	Unit Price	Cost	Life	Replacement Costs 10 Years	20 Years	30 Years	40 Years	Salvage
50	Pump Station Building	1	$150,000	$150,000	50					$0
	Fire Pump (250 Hp)	1	$20,000	$20,000	20		$20,000		$20,000	($10,000)
	Service Pump (100 Hp)	2	$7,000	$14,000	20		$14,000		$14,000	($7,000)
	Mechanical	1	$60,000	$60,000	20		$60,000		$60,000	($30,000)
	Controls	1	$20,000	$20,000	30			$20,000		($6,600)
	Electric	1	$80,000	$80,000	30			$80,000		($26,400)
	Generator, Controls, Fuel Tank	1	$44,000	$44,000	30			$44,000		($14,520)
	Site Work	1	$30,000	$30,000	50					$0
	16" Discharge Main	4,600	$55	$253,000	50					$0
51	Submersible Booster Station	1	$57,000	$57,000	20		$57,000		$57,000	($28,500)
52	Submersible Booster Station	1	$54,000	$54,000	20		$54,000		$54,000	($27,000)
				$22,130,400		$50,000	$498,200	$430,500	$498,200	($349,665)
Engineering & Contingencies (30%)				$6,639,120						
Total Costs				$28,769,520						
Present Worth Factors				1.0000		0.5584	0.3118	0.1741	0.0972	0.0543
Present Worth				$28,769,520		$27,920	$155,341	$74,954	$48,436	($18,983)
Total Present Worth Of Construction				$29,057,189						
Annual O & M Costs *			$254,237							
50 Year Present Worth Factor			15.7619							
Present Worth Of Annual O & M Costs				$4,007,252						
Total Present Worth				$33,064,441						

* O & M costs are assumed to be 5% of construction costs for pumping and storage facilties and $1,200 per mile of transmission main.

Source: Ruekert & Mielke, Inc.

Figure 6-12

OPTIMISTIC
LAND USE PLAN
RECOMMENDED WATER
SYSTEM FACILITIES



Legend

MUNICIPAL BOUNDARY
EXISTING TRANSMISSION WATER MAIN
PROPOSED TRANSMISSION WATER MAIN
PROPOSED LOCAL AREA SERVICE MAINS
PROPOSED STORAGE FACILITY
PROPOSED PUMPING FACILITY
PROPOSED CLOSED VALVE
IMPROVEMENT NUMBER FROM TABLE 6-19
APPROXIMATE PRESSURE BOUNDARIES

GRAPHIC SCALE
0 1/2 1 MILE
0 1 2 3 4 5 6,000 FEET

Source: Ruekert & Mielke 1990

Source Capacity

For the system as a whole, the required source capacity is the maximum day demand which must be reliably available from the source of supply. For the boosted areas, the required volume must be available from booster pumps with the largest unit out of service. Results of the analysis are as follows:

Entire system required capacity =	41.230 MGD
Existing capacity =	40.000 MGD
Deficit in source capacity =	1.230 MGD
Primary zone required capacity =	19.257 MGD
Existing capacity =	N/A MGD
Surplus in source capacity =	N/A MGD[1]
Boosted pressure zone required capacity =	11.720 MGD
Existing capacity =	13.730 MGD
Surplus source capacity =	2.010 MGD
Second boosted pressure zone requiredcapacity =	3.365 MGD
Existing capacity[2] =	0.000 MGD
Deficit source capacity =	3.365 MGD
Somers second boosted pressure zone required source capacity =	0.513 MGD
Existing capacity =	0.000 MGD
Deficit source capacity =	0.513 MGD
Pleasant Prairie pressure zone required capacity =	6.375 MGD
Existing capacity[3] =	5.760 MGD
Surplus source capacity =	0.615 MGD

1. Existing capacity of 40.000 MGD will have to be expanded to serve the entire system. It is assumed it will be adequate to serve the primary zone.

2. There are presently two inground booster stations serving the second boosted pressure zone. Upon construction of the booster station/reservoir at 60th Street (CTH K) and 88th Avenue (STH 192), these stations will be abandoned. For the purpose of this analysis, existing capacity will be expressed as "zero" to allow for proper sizing of the new facility.

   The Somers service area lies within the first and second boosted zones. The area located in the first boosted zone can be adequately served by the existing facilities in Kenosha. A new "Dead-end" system will have to be constructed for those areas in the second boosted zones. Projected demands for this area are .201 MG average day and .351 MG maximum day. These flow rates are not reflected in the second boosted zone demand projections.

The first boosted zone must be capable of providing the source capacity for all pressure zones except the primary calculations are as follows:

Boosted pressure zone maximum day demand =	11.720 MGD
Second boosted pressure zone maximum day demand =	3.365 MGD
Somers second boosted pressure zone maximum day demand =	.513 MGD
Pleasant Prairie pressure zone maximum day demand =	6.375 MGD
Total =	21.973 MGD
Existing capacity =	13.730 MGD
Deficit source capacity =	8.243 MGD

Peak Hour Storage

Peak hour storage requirements are the equivalent of the maximum day demand times 1.4 for Kenosha and 1.75 for outlying areas for a period of four hours. It is assumed that the maximum day demand has been met by supply sources. The remaining volume must be available from elevated and ground storage.

Entire system required peak hour storage capacity =	3.562 MG
Existing capacity =	14.231 MG
Surplus peak hour storage capacity =	10.669 MG
Primary pressure zone required peak hour storage capacity =	1.396 MG
Existing capacity =	6.475 MG
Surplus peak hour storage capacity =	5.079 MG
Boosted pressure zone required peak hour storage capacity =	0.884 MG
Existing capacity =4.355 MG	
Surplus peak hour storage capacity =	.471 MG
2nd boosted pressure zone required peak our storage capacity =	0.421 MG
Existing capacity =	0.637 MG
Surplus peak hour storage capacity =	0.216 MG
Somers second boosted pressure zone equired peak hour storage capacity =	0.064 MG
Existing capacity =	0.000 MG
Deficit peak hour storage capacity =	0.064 MG

3. Existing capacity for the Pleasant Prairie system is based upon the proposed booster station pump sizes.

Pleasant Prairie pressure zone	
required peak hour storage capacity =	0.797 MG
Existing capacity =	4.667 MG
Surplus peak hour storage capacity =	3.870 MG

Fire Flow

The required fire flow capacity is equivalent to 3,500 GPM for a three hour duration concurrent with maximum day demand. For the entirely residential area contained in the Somers second boosted zone, a fire flow rate of 1000 GPM for a two hour period concurrent with maximum day demand will be used. This rate is based upon ISO guidelines for fire protection. This volume must be supplied with reliable pumping capacity and storage volume not used in peak hour storage.

Entire system required fire flow	
capacity =	5.784 MG
Existing capacity =	13.122 MG
Surplus fire flow capacity =	7.338 MG
Primary pressure zone required fire	
flow capacity =	3.037 MG
Existing capacity =	9.886 MG
Surplus fire flow capacity =	6.849 MG
Boosted pressure zone required fire	
flow capacity =	2.095 MG
Existing capacity =	2.708 MG
Surplus fire flow capacity =	0.613 MG
Second boosted pressure zone	
requiredfire flow capacity =	1.051 MG
Existing capacity =	0.216 MG
Deficit fire flow capacity =	0.835 MG
Somers second boosted pressure	
zone required fire flow capacity =	0.163 MG
Existing capacity =	0.000 MG
Deficit fire flow capacity =	0.163 MG
Pleasant Prairie pressure zone	
required fire flow capacity =	1.427 MG
Existing capacity =	3.387 MG
Deficit fire flow capacity =	0.040 MG

Emergency Supply

The required emergency supply is equivalent to the average day pumpage and must be available from elevated storage and auxiliary power pumping.

Entire system required emergency	
supply =	23.560 MG
Existing capacity =	40.000 MG
Surplus emergency supply =	16.440 MG
Primary pressure zone required	
emergency supply =	11.004 MG
Existing capacity =	18.905 MG
Surplus emergency supply =	7.901 MG
Boosted pressure zone required	
emergency supply =	6.697 MG
Existing capacity =	2.077 MG
Deficit emergency supply =	4.620 MG
Second boosted pressure zone	
required emergency supply =	1.923 MG
Existing capacity =	0.637 MG
Deficit emergency supply =	1.286 MG
Somers second boosted pressure zone	
required emergency supply =	0.293 MG
Existing capacity =	0.000 MG
Deficit emergency supply =	0.293 MG
Pleasant Prairie pressure zone	
required emergency supply =	3.643 MG
Existing capacity =	4.667 MG
Surplus emergency supply =	1.024 MG

Treatment Plant Expansion

The current capacity of the water treatment facility is not adequate to supply the 2010 Optimistic Development Plan maximum day water demands. While only 1.220 MGD of increased capacity is required to satisfy maximum day demands, the increased volume will require either an increase in plant capacity or an increase in existing filter capacity at the east plant from 2.0 gallons per minute per square foot (GPM/Ft^2) to 2.2 gallons per minute per square foot.

The first option is an increase in treatment plant capacity. Generally, a 1.220 MG expansion is not practical. The Kenosha Water Utility has experienced expansions of 8 MG, 6 MG and most recently 20 MG. Discussions with representatives of the utility have indicated that the existing plant is designed for expansions in 10 MG and 20 MG larger increments. For this reason, a 10 MG expansion would be the recommended size. The estimated cost of a 10 MG treatment plant expansion is $9,850,000.

The second option is to increase the filtering rate of the existing treatment plant. Discussions with the DNR have indicated that in previous cases of this type, increases of up to 3.0 GPM/Ft^2 of filter capacity have been allowed. In this case, the required increase is only 10 percent of existing capacity or up to 2.2 GPM/Ft^2. DNR approval for this type of increase is granted on a case by case basis. It is recommended that an increase be pursued as the maximum day demand approaches 40 MGD. The increase in treatment plant capacity by increasing filter capacities will have a minimal impact upon costs. Only operation and maintenance costs will increase due to increased chemical costs and power charges. Estimates of O & M charges for the plant are contained in Appendix J. The increase in maximum day and maximum hour demands will require an increase in clear water storage of approximately 6 MG. The estimated cost of a 6 MG storage reservoir is $3,600,000.

Additional Improvements

The following improvements reflect only those which have changed from improvements recommended under the Intermediate Development Plan. The improvement numbering remains the same. Additional improvements under this plan will be added at the end of this section.

Primary Zone Facilities

1) No Change

2) The 16 inch main on 7th Avenue between 80th Street and 91st Street is changed to a 24 inch main. Approximately 6,800 feet of the 15,200 feet of 16 inch main originally recommended would change to 24 inch.

3) The parallel main recommended for 80th Street changes from all 16 inch to 24 inch between 7th Avenue and 22nd Avenue. An estimated 3,500 feet of 24 inch and 2,500 feet of 16 inch will be required.

4-6) No Change

The following are improvements required under the optimistic development plan which differ from the intermediate development plan for the first boosted zone.

7) The recommended generator size (230 kw) is sufficient to start and run any pump at any booster station. Due to the increase in demand in the Pleasant Prairie Pressure Zone, it is recommended that the auxiliary power generator be placed at the 80th Street booster station under this alternative.

7A) The required additional source capacity, 8.243 MGD, should be divided so that with an entire booster station out of service, the other two stations can supply the required volume. To do this, a 225 Hp, 6.000 MGD pump is required at the 30th Avenue booster station and a 150 Hp, 4.500 MGD pump is required at the 60th Street booster station.

8-23) No Change

Second Boosted Zone

The following are improvements required under the optimistic development plan which differ from the intermediate development plan for the second boosted zone.

24) Construction of a booster station at the intersection of 88th Street (STH 192) and 60th Street (CTH K). The source capacity parameter indicated a 3.365 MGD deficit in capacity. This volume must be provided by the facility with the largest pumping unit out of service. It is recommended that the station contain two pumps, both capable of supplying 4 MGD and an emergency power generator capable of starting and running either pump. Both pumps would be approximately 200 Hp. At the booster station site a 1.3 MG reservoir would be required to provide the needed storage to meet the fire flow, peak hour storage and emergency supply requirements. The storage facility should be an above ground prestressed concrete reservoir approximately 40 feet in height. The emergency power generator would be approximately 230 kw.

25-33) No Change

Somers Second Boosted Pressure Zone

The facilities recommended for the Somers second boosted pressure zone under the intermediate development plan are also adequate under the optimistic development plan.

34-39) No Change

Pleasant Prairie Pressure Zone

40) No Change

41) Construction of approximately 4,300 feet of 20 inch main on Green Bay Road (STH 31) from 95th Street (CTH T) south to 104th Street (CTH Q). The main will then continue south on Green Bay Road (STH 31) to Springbrook Road (STH 174) as a 12 inch main for approximately 7,700 feet.

42-45) No Change

46) Construction of approximately 3,000 feet of 16 inch main from the existing 12 inch stub west of 114th Avenue on 104th Street (CTH Q) west under ISH 94. This main will have to be installed in a 30-inch casing under ISH 94.

47-50) No Change

Additional Boosting in Pleasant Prairie

51) It is estimated that up to 560 homes in area No. 1 may require additional boosting. Due to uncertainties regarding the development in the area, cost estimates for two stations each capable of providing 520 GPM, will be used. Each submersible station will contain two pumps at a minimum 12 Hp each and a check valve manhole to allow adequate flow in fire situations.

52) No Change

Additional Improvements Required for the Optimistic Plan

53) Construction of approximately 7,700 feet of 16 inch main beginning at the intersection of 75th Street and 5th Avenue at the 36 inch main and running west to 22nd Avenue then north to connect to the 12 inch main at 67th Street.

The total estimated construction costs for improvements required under the Optimistic Development Plan is $30,731,100. The total present worth of the facilities is $35,770,200. Detailed costs are listed in Table 6-19.

ULTIMATE DEVELOPMENT WATER SYSTEM

The following facilities are required to provide adequate service under the Ultimate Development Plan. Recommended facility sizes are based upon the supply and storage analysis and results of the computer simulation using ultimate demands. Changes in facility sizes from the initial analysis using the Intermediate Development Plan will be discussed first followed by a discussion of additional facilities. Required facilities are shown in Figure 6-13.

Supply and Storage Analysis

The following are the average and maximum day demands for the ultimate development plan broken down by pressure zone: ultimate.

Entire system average day demand	37.074 MGD
Entire system maximum day demand	64.881 MGD
Primary pressure zone ave. day demand	12.076 MGD
Primary pressure zone max.day demand	21.134 MGD
Boosted pressure zone max. day demand	10.520 MGD
Boosted pressure zone max. day demand	18.410 MGD
Second boosted pressure zone average day demand	7.220 MGD
Second boosted pressure zone max. day demand	12.636 MGD
Somers second boosted pressure zone average day demand	1.041 MGD
Somers second boosted pressure zone maximum day demand	1.822 MGD
Pleasant Prairie pressure zone average day demand	7.258 MGD
Pleasant Prairie pressure zone maximum day demand	12.701 MGD

Results of the supply and storage analysis are as follows:

Source Capacity

For the system as a whole, the required source capacity is the maximum day demand which must be reliably available from the source of supply. For the boosted areas, the required volume must be available from booster pumps with the largest unit out of service. Results of the analysis are as follows:

Entire system required capacity	64.881 MGD
Existing capacity	40.000 MGD
Deficit in source capacity	24.881 MGD
Primary zone required capacity	21.134 MGD
Existing capacity	N/A MGD
Surplus in source capacity	N/A MGD[4]
Boosted pressure zone required capacity	18.410 MGD
Existing capacity	13.730 MGD
Deficit source capacity	4.680 MGD
Second boosted pressure zone required capacity	12.636 MGD
Existing capacity[5]	0.000 MGD

4. The existing capacity of 40.000 MGD will have to be expanded to serve the entire system. It is assumed it will be adequate to serve the primary zone.

5. There are presently two inground booster stations serving the second boosted pressure zone. Upon construction of the booster station/reservoir at 60th Street (CTH K) and 88th Avenue (STH 192), these stations will be abandoned. For the purpose of this analysis, existing capacity will be expressed as "zero" to allow for proper sizing of the new facility.

The Somers service area lies within the first and second boosted zones. The area located in the first boosted zone can be adequately served by the existing facilities in Kenosha. Due to the extensive development under the ultimate projections, the Somers system will be connected to the second boosted zone. Somers demands are provided for comparison purposes and facility sizing.

Table 6 -19

WATER SUPPLY, STORAGE AND TRANSMISSION FACILITY COSTS
OPTIMISTIC DECENTRALIZED DEVELOPMENT PLAN

Improvement	Item	Quantity	Unit Price	Cost	Life	Replacement Costs 10 Years	Replacement Costs 20 Years	Replacement Costs 30 Years	Replacement Costs 40 Years	Salvage
1	16" Water Main	11,500	$55	$632,500	50					$0
2	36" Water Main	12,000	$108	$1,296,000	50					$0
	16" Water Main	8,400	$55	$462,000	50					$0
	24" Water Main	6,800	$73	$496,400	50					$0
3	16" Water Main	2,500	$55	$137,500	50					$0
	24" Water Main	3,500	$73	$255,500	50					$0
4	16" Water Main	4,500	$55	$247,500	50					$0
5	12" Water Main	8,100	$53	$429,300	50					$0
6	8" Water Main	7,600	$43	$326,800	50					$0
	8" Pressure Control Valve	1	$3,200	$3,200	20		$3,200		$3,200	($1,600)
	Manhole	1	$1,500	$1,500	50					$0
	Mechanical & Bypass	1	$15,000	$15,000	20		$15,000		$15,000	($7,500)
7	50Hp Pump, Mechanical	1	$25,000	$25,000	20		$25,000		$25,000	($12,500)
	200 KW Generator, Reduced Voltage Starter, Controls	1	$30,000	$30,000	30			$30,000		($9,900)
	Fuel Tank	1	$7,000	$7,000	30			$7,000		($2,310)
	Building Addition	1	$65,000	$65,000	50					$0
7A	30th Avenue:									
	225 Hp Pump	1	$18,000	$18,000	20		$18,000		$18,000	($9,000)
	Building Addition	1	$60,000	$60,000	50					$0
	Mechanical	1	$50,000	$50,000	20		$50,000		$50,000	($25,000)
	80th Street:									
	150 Hp Pump	1	$12,000	$12,000	20		$12,000		$12,000	($6,000)
	Building Addition	1	$60,000	$60,000	50					$0
	Mechanical	1	$12,000	$12,000	20		$12,000		$12,000	($6,000)
8	16" Water Main	3,000	$55	$165,000	50					$0
9	12" Water Main	4,500	$53	$238,500	50					$0
10	24" Water Main	5,800	$73	$423,400	50					$0
11	16" Water Main	5,800	$55	$319,000	50					$0
12	16" Water Main	2,800	$55	$154,000	50					$0
	12" Water Main	2,800	$53	$148,400	50					$0
13	12" Water Main	8,000	$53	$424,000	50					$0
14	16" Water Main	12,400	$55	$682,000	50					$0
15	16" Water Main	16,000	$55	$880,000	50					$0
16	12" Water Main	2,500	$53	$132,500	50					$0
	16" Water Main	1,500	$55	$82,500	50					$0
17	24" Water Main	8,600	$73	$627,800	50					$0
18	16" Water Main	2,600	$55	$143,000	50					$0
19	16" Water Main	5,200	$55	$286,000	50					$0
20	12" Water Main	1,500	$53	$79,500	50					$0
21	12" Water Main	5,400	$53	$286,200	50					$0
22	16" Water Main	4,800	$55	$264,000	50					$0

Table 6 -19

WATER SUPPLY, STORAGE AND TRANSMISSION FACILITY COSTS

OPTIMISTIC DECENTRALIZED DEVELOPMENT PLAN

Improvement	Item	Quantity	Unit Price	Cost	Life	Replacement Costs 10 Years	20 Years	30 Years	40 Years	Salvage
23	12" Water Main	3,400	$53	$180,200	50					$0
24	Pump Station Building	1	$125,000	$125,000	50					$0
	Pumps (200 Hp)	2	$16,000	$32,000	20		$32,000		$32,000	($16,000)
	Mechanical	1	$60,000	$60,000	20		$60,000		$60,000	($30,000)
	Electrical	1	$80,000	$80,000	30			$80,000		($26,400)
	Controls	1	$20,000	$20,000	30			$20,000		($6,600)
	230 KW Generator, Reduced Starter, Controls, Fuel Tank	1	$44,000	$44,000	30			$44,000		($14,520)
	Sitework	1	$30,000	$30,000	50					$0
	1,300,000 Gallon Reservior	1	$950,000	$950,000	50					$0
25	24" Water Main	4,800	$73	$350,400	50					$0
26	24" Water Main	1,000	$73	$73,000	50					$0
27	16" Water Main	7,100	$55	$390,500	50					$0
28	16" Water Main	4,000	$55	$220,000	50					$0
29	16" Water Main	800	$55	$44,000	50					$0
	16" Water Main in 30" Casing	400	$250	$100,000	50					$0
30	24" Water Main	3,600	$73	$262,800	50					$0
31	16" Water Main	10,100	$55	$555,500	50					$0
32	16" Water Main	5,900	$55	$324,500	50					$0
33	Pump Station Building	1	$60,000	$60,000	50					$0
	Pumps (25 Hp)	2	$3,000	$6,000	20		$6,000		$6,000	($3,000)
	Mechanical	1	$30,000	$30,000	20		$30,000		$30,000	($15,000)
	Electrical & Controls, Generato	1	$50,000	$50,000	30			$50,000		($16,500)
34	200,000 Gallon Elevated Tank 140' Tall, Foundation	1	$310,000	$310,000	50					$0
	Painting	1	$50,000	$50,000	10	$50,000	$50,000	$50,000	$50,000	$0
	Electrical & Controls	1	$7,500	$7,500	30			$7,500		($2,475)
35	12" Water Main	14,500	$53	$768,500	50					$0
36	12" Water Main	7,000	$53	$371,000	50					$0
37	uried Booster Station W/ 10 Hp, 15 Hp & 25 Hp Motors	1	$80,000	$80,000	20		$80,000		$80,000	($40,000)
	Electrical	1	$5,000	$5,000	30			$5,000		($1,650)
38	16" Water Main	12,000	$55	$660,000	50					$0
39	16" Water Main	17,000	$55	$935,000	50					$0
40	12" Water Main	26,200	$53	$1,388,600	50					$0
41	12" Water Main	7,700	$53	$408,100	50					$0
	20" Water Main	4,300	$69	$296,700	50					$0
42	16" Water Main	5,500	$55	$302,500	50					$0
43	16" Water Main	3,000	$55	$165,000	50					$0
44	12" Water Main	2,500	$53	$132,500	50					$0
45	12" Water Main	10,000	$53	$530,000	50					$0

Table 6 -19

WATER SUPPLY, STORAGE AND TRANSMISSION FACILITY COSTS
OPTIMISTIC DECENTRALIZED DEVELOPMENT PLAN

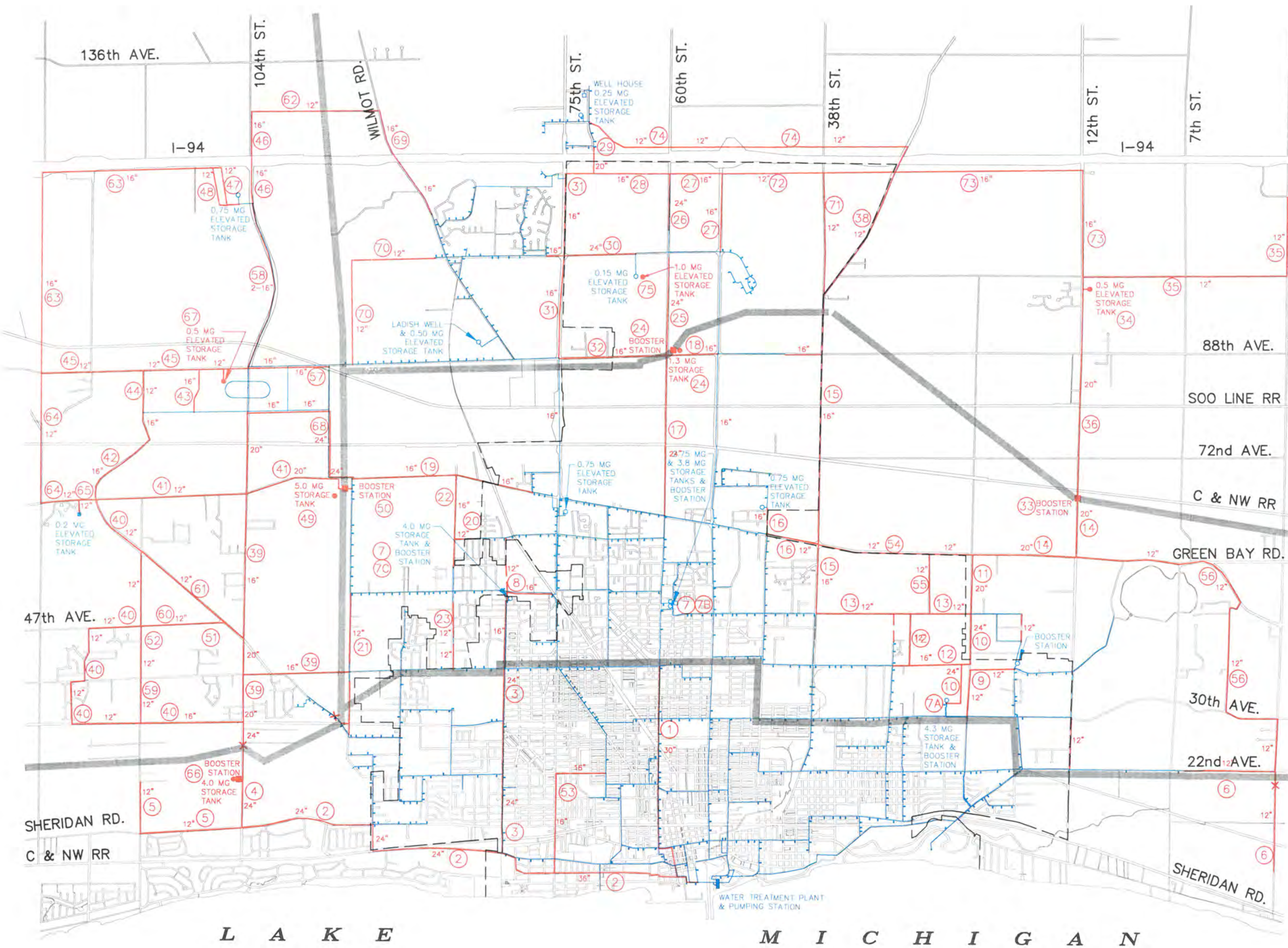
Improvement	Item	Quantity	Unit Price	Cost	Life	Replacement Costs 10 Years	20 Years	30 Years	40 Years	Salvage
46	16" Water Main	2,600	$55	$143,000	50					$0
	16" Water Main in 30" Casing	400	$250	$100,000	50					$0
47	12" Water Main	1,500	$53	$79,500	50					$0
48	12" Water Main	2,000	$53	$106,000	50					$0
49	5 MG Prestressed Above Ground Concrete Reservior	1	$1,560,000	$1,560,000	50					$0
50	Pump Station Building	1	$150,000	$150,000	50					$0
	Fire Pump (250 Hp)	1	$20,000	$20,000	20		$20,000		$20,000	($10,000)
	Service Pump (100 Hp)	2	$7,000	$14,000	20		$14,000		$14,000	($7,000)
	Mechanical	1	$60,000	$60,000	20		$60,000		$60,000	($30,000)
	Controls	1	$20,000	$20,000	30			$20,000		($6,600)
	Electric	1	$80,000	$80,000	30			$80,000		($26,400)
	Generator, Controls, Fuel Tank	1	$44,000	$44,000	30			$44,000		($14,520)
	Site Work	1	$30,000	$30,000	50					$0
	16" Discharge Main	4,600	$55	$253,000	50					$0
51	Submersible Booster Station	2	$63,000	$126,000	20		$126,000		$126,000	($63,000)
52	Submersible Booster Station	1	$54,000	$54,000	20		$54,000		$54,000	($27,000)
53	16" Watermain	7,700	$55	$423,500	50					$0
				$23,639,300		$50,000	$667,200	$437,500	$667,200	($436,475)
Engineering & Contingencies (30%)				$7,091,790						
Total Costs				$30,731,090						
Present Worth Factors				1.0000		0.5584	0.3118	0.1741	0.0972	0.0543
Present Worth				$30,731,090		$27,920	$208,036	$76,173	$64,867	($23,696)
Total Present Worth Of Construction				$31,084,390						
Annual O & M Costs *			$297,287							
50 Year Present Worth Factor			15.7619							
Present Worth Of Annual O & M Costs				$4,685,801						
Total Present Worth				$35,770,191						

* O & M costs are assumed to be 5% of construction costs for pumping and storage facilties and $1,200 per mile of transmission main.

Source: Ruekert & Mielke, Inc.

Figure 6-13

ULTIMATE LAND USE PLAN RECOMMENDED WATER SYSTEM FACILITIES



Source: Ruekert & Mielke 1990

Deficit source capacity =	12.636 MGD
Somers second boosted pressure zone equired source capacity =	1.822 MGD
Existing capacity =	0.000 MGD
Deficit source capacity =	1.822 MGD
Pleasant Prairie pressure zone required capacity =	12.701 MGD
Existing capacity[6] =	5.760 MGD
Deficit source capacity =	6.941 MGD

The first boosted zone must be capable of providing the source capacity for all pressure zones except the primary. Calculations are as follows:

Boosted pressure zone maximum day demand =	18.410 MGD
Second boosted pressure zone maximum day demand including Somers =	12.636 MGD
Pleasant Prairie pressure zone maximum day demand =	12.701 MGD
Total =	43.747 MGD
Existing capacity =	13.730 MGD
Minus capacity of New Pleasant Prairie booster station with the primary zone as a source =	7.000 MGD
Deficit Source Capacity =	23.017 MGD

Peak Hour Storage

Peak hour storage requirements are the equivalent of the maximum day demand times 1.4 for Kenosha and 1.75 for outlying areas over a period of four hours. It is assumed that the maximum day demand has been met by supply sources. The remaining volume must be available from elevated and ground storage.

Entire system required peak hour storage capacity =	6.414 MG
Existing capacity =	14.231 MG
Surplus peak hour storage capacity =	7.817 MG
Primary pressure zone required peak hour storage capacity =	1.589 MG
Hour storage capacity =	6.475 MG
Surplus peak hour storage capacity =	4.886 MG
Boosted pressure zone required peak hour storage capacity =	1.657 MG
Existing capacity =	4.355 MG
Surplus peak hour storage capacity =	2.698 MG
2nd boosted pressure zone required peak hour storage capacity =	1.580 MG
Existing capacity =	0.637 MG
Deficit peak hour storage capacity =	0.943 MG
Somers second boosted pressure zone required peak hour storage capacity =	0.228 MG
Existing capacity =	0.000 MG
Deficit peak hour storage capacity =	0.228 MG
Pleasant Prairie pressure zone required peak hour storage capacity =	1.588 MG
Existing capacity =	4.667 MG
Surplus peak hour storage capacity =	3.079 MG

Fire Flow

The required fire flow capacity is equivalent to the 3,500 GPM for a three hour duration concurrent with the maximum day demand. This volume must be supplied with reliable pumping capacity and storage volume not used in peak hour storage.

Entire system required fire flow capacity =	8.740 MG
Existing capacity =	13.122 MG
Surplus fire flow capacity =	4.382 MG
Primary pressure zone required fire flow capacity =	3.272 MG
Existing capacity =	9.886 MG
Surplus fire flow capacity =	6.614 MG
Boosted pressure zone required fire flow capacity =	2.931 MG
Existing capacity =	2.708 MG
Deficit fire flow capacity =	0.223 MG
Second boosted pressure zone required fire flow capacity =	2.210 MG
Existing capacity =	0.000 MG
Deficit fire flow capacity =	2.210 MG
Somers second boosted pressure zone required fire flow capacity =	0.858 MG
Existing capacity =	0.000 MG
Deficit fire flow capacity =	0.858 MG
Pleasant Prairie pressure zone required fire flow capacity =	2.218 MG
Existing capacity =	1.387 MG
Deficit fire flow capacity =	0.831 MG

Emergency Supply

The required emergency supply is equivalent to the average day pumpage and must be available from elevated storage facilities and auxiliary power pumping.

6. Existing capacity for the Pleasant Prairie system is based upon the proposed booster station pump sizes.

Entire system required emergency supply =	32.074 MG
Existing capacity =	40.000 MG
Surplus emergency supply =	2.926 MG
Primary pressure zone required emergency supply =	12.076 MG
Existing capacity =	46.475 MG
Surplus emergency supply =	6.829 MG
Boosted pressure zone required emergency supply =	10.520 MG
Existing capacity =	2.077 MG
Deficit emergency supply =	8.443 MG
Second boosted pressure zone required emergency supply =	7.220 MG
Existing capacity =	0.637 MG
Deficit emergency supply =	6.583 MG
Somers second boosted pressure zone required emergency supply =	1.041 MG
Existing capacity =	0.000 MG
Deficit emergency supply =	1.041 MG
Pleasant Prairie pressure zone required emergency supply =	7.258 MG
Existing capacity =	4.667 MG
Deficit emergency supply =	2.591 MG

Treatment Plant Expansion

A maximum day demand of 64.881 MGD is projected for the ultimate development plan treatment facilities. This volume would require an increase in the existing plant capacity of 25 MGD. There is limited space available for an expansion of this size while utilizing the existing facilities. Discussions with the Kenosha Water Utility personnel indicated that the preferred mode of expansion would be demolition of the older West Plant including the microstrainer building, the mixing basins, filters, administration buildings and the 2.5 MG reservoir. In its place a new 46 MGD plant, including the following components, would then be constructed.

- A new 48 inch Lake intake extending approximately 5,000 feet into Lake Michigan to a depth of approximately 35 feet. The intake will be required in the event an existing intake is down for repair or maintenance.
- New flocculation and sedimentation basins capable of a rate of 46 MGD.
- 2 new filters each rated at 5 MGD at a rate of 2 GPM/ft.^{2}
- Additional filter capacity totalling 36 MGD at a rate of 2 GPM/ft.^{2}
- Clear water storage under each filter of approximately .500 MG.
- An additional clear water storage reservoir with a total capacity of 12.000 MG.
- New low lift pumping facilities at the Roundhouse capable of providing an additional 20 MGD.
- New high lift pumping facilities capable of providing an additional 25 MGD.
- New chlorination, alum feed, carbon feed and chemical storage and delivery facilities for the entire plant. Detailed facility planning may also call for ozonation facilities.
- New administration, operation and control facilities.

To provide adequate service during construction, the following schedule is recommended;

1) Construct a "Mirror Image" plant with a 10 MGD capacity just north of the existing east plant. This plant was planned as part of the design of the original east plant.

2) Demolish the existing 2.5 MG reservoir and construct a 6 MG reservoir. The location of this reservoir is shown in Figure 6-14.

3) Construct a 48 inch lake intake located to the north of the existing intakes. This structure should extend approximately 5,000 feet into Lake Michigan and contain an intake crib located in approximately 35 feet of water.

4) Construct a new administration, operations and control facility located as shown in Figure 6-14.

5) Demolish the west plant components and construct a new 36 MGD plant of the configuration shown in Figure 6-14. Some expansion of the existing high lift pumping facilities will also be required to provide room for the new pumps. This plant should be of similar design as the existing plant. Also construct a second 6 MG reservoir.

   The reasons for expanding the plant in the described manor are threefold. First, the available land limits the amount of construction. According to water utility personnel, it would be difficult or impossible to obtain additional land in the area. The only other option is to reclaim part of Lake Michigan. Previous projects of this type have proven extremely costly.

   Second, the west treatment plant was first constructed in 1916. Replacement costs

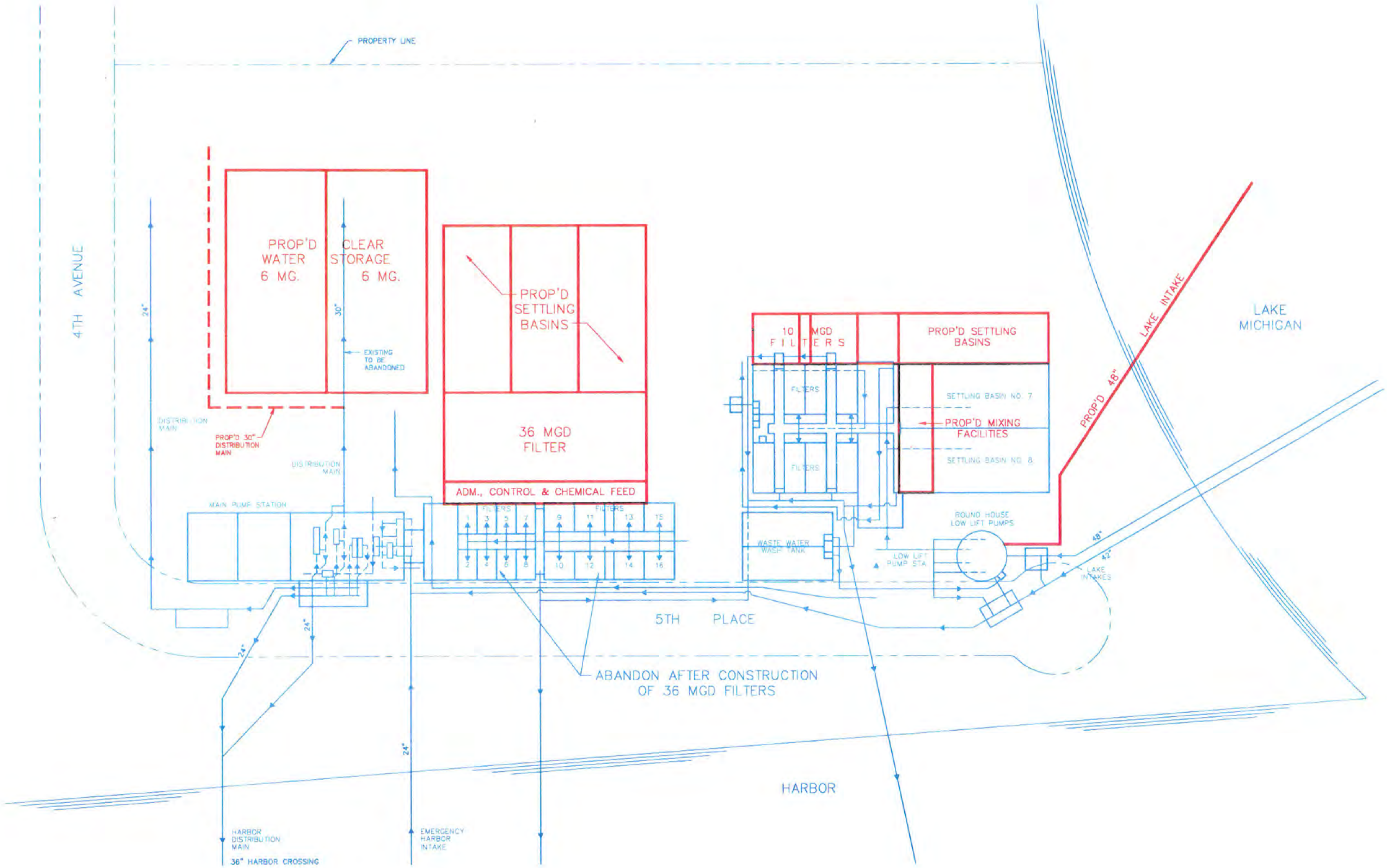


Figure 6-14

ULTIMATE LAND USE PLAN WATER TREATMENT PLANT EXPANSION

Legend

EXISTING STRUCTURES

PROPOSED IMPROVEMENTS

Source: Ruekert & Mielke 1990

for structures are based on a 50 year life expectancy, mechanical on a 20 year life expectancy and electrical and controls on a 30 year life expectancy. Estimates show that major renovations to this facility can be expected in the next 40 year period. This conclusion agrees with water system studies performed for the Kenosha Water Utility in the past.

Third, a working plant capable of providing a sufficient volume should be in place prior to demolition. The old west plant capacity of 40 MGD will be unusable during demolition, therefore, the 46 MGD expansion should be in place prior to demolition of the old plant. Administration, operation, control and chemical feed facilities will also be required prior to the 46 MGD expansion.

Cost estimates for the 46 MGD addition are broken down by components on Table 6-20. Estimates were based upon discussions with the treatment plant designers Alvord, Burdick and Howson Engineers and recent costs of construction for similar surface water treatment facilities. O & M costs for the ultimate average day pumping rate are $2,085,487 per year.

Primary Zone Facilities

1) Construction of approximately 11,500 feet of 30 inch main from the intersection of 58th Street and 6th Avenue west to Sheridan Road; south on Sheridan Road to 60th Street and west on 60th Street to the 24 inch main at 39th Avenue. This main should replace existing mains along the suggested route and connect to the 36 inch main recommended in improvement No. 2 below.

2) To serve the areas south of 91st Street in the Village of Pleasant Prairie and to provide adequate transmission to the boosted pressure zones, construction of a 36 inch main beginning at the 36 inch harbor crossing from the treatment facility and then running south down 5th Avenue to 79th Street, at which point it will run west to 7th Avenue then south to 80th Street. Approximately 12,000 feet of 36 inch main would be required. At the intersection of 7th Avenue and 80th Street, a 24 inch main would continue south on 7th Avenue to 91st Street, west on 91st Street to Sheridan Road and south on Sheridan Road to 104th Street. Approximately 15,200 feet of 24 inch main would be required.

3) Construction of approximately 6,000 feet of 24 inch main running parallel to the existing 16 inch on 80th street between the 36 inch main on 7th Avenue and the existing 24 inch near 28th Avenue. At this point, a 16 inch main running parallel to the 24 inch main between 28th Avenue and the 80th Street storage tank. Approximately 9,000 feet of 16 inch main will be required.

4) Construction of approximately 4,500 feet of 24 inch main on 104th running west from Sheridan Road to 28th Avenue. This main would provide transmission to a storage facility described in number 66 below.

5) No Change

6) To serve the Town of Somers Sanitary District No. 1, approximately 7,600 feet of 12 inch main extending north from the 12 inch on 22nd Avenue near Patio Homes to CTH KR and then east on CTH KR to the existing 8 inch main near Sheridan Road. A pressure reducing valve would be required to isolate the booster zone from the primary zone. In the event of a fire situation, the valve would open fully allowing for additional required fire protection not currently available.

First Booster Zone Facilities

Results of the supply and storage analysis for the first booster zone and zones it supplies show a deficit of 23.017 MG with the largest station out of service. The fire flow parameter shows a deficit of 0.223 MG or a rate of 1.784 MGD. This volume must be supplied by storage or supply facilities.

The emergency supply parameter showed a deficit of 8.443 MGD. This must be available from elevated storage or emergency power pumping. To allow the transmission of water between pumping and storage facilities, additional mains or increases in main sizes are also required. The following improvements are required to satisfy these requirements:

7) To provide the required emergency supply to the first boosted service area and to provide adequate supply to storage facilities for outlying pressure zones, it is recommended that emergency power generators be provided at both the 60th Street and 80th Street booster stations. The generators should be capable of starting and running two of the 3.000 MG pumps at each station. Each generator would be approximately 350 KW and be able to run the lighting and controls at the

Table 6 - 20
45 MGD WATER TREATMENT PLANT ADDITION
COST SUMMARY

Item	Quantity	Unit Price	Cost	Life	Replacement Costs 20 Years	30 Years	40 Years	Salvage
Lake Intake	1	$3,758,000	$3,758,000	50				$0
Flocculation and Sedimentation Basins	1	$7,385,000	$7,385,000	20 - 50	$2,954,000	$1,477,000	$2,954,000	($1,964,410)
Filters and Appurtanaces, Backwash Water Storage, Water Reclamation	1	$7,446,000	$7,446,000	20 - 50	$2,978,400	$1,489,200	$2,978,400	($1,980,636)
Electrical	1	$3,458,000	$3,458,000	30		$3,458,000		($1,141,140)
Controls and Telemetry	1	$1,414,000	$1,414,000	30		$1,414,000		($466,620)
Chemical Tanks, Feed, Pumping and Miscellaneous Small Structures	1	$3,953,000	$3,953,000	20 - 50	$790,600	$1,185,900	$790,600	($786,647)
12,000,000 Gallon Water Storage Reservior	1	$6,000,000	$6,000,000	50				$0
Administration and Operations Building and Site Work	1	$1,965,000	$1,965,000	50				$0
			$35,379,000		$6,723,000	$9,024,100	$6,723,000	($6,339,453)
Engineering & Contingencies (30%)			$10,613,700					
Total Costs			$45,992,700					
Present Worth Factors			1.0000		0.3118	0.1741	0.0000	0.0543
Present Worth			$45,992,700		$2,096,263	$1,571,187	$653,625	($344,159)
Total Present Worth Of Construction			$49,969,617					
Annual O & M Costs *		$2,085,487						
50 Year Present Worth Factor		15.7619						
Present Worth Of Annual O & M Costs			$32,871,155					
			$82,840,772					

* O & M cost excludes administrative, billing and accounting costs. See Appendix J for detailed cost.

Source: Ruekert & Mielke, Inc.

station. Modifications to the controls and electrical will also be required.

7a) To provide the projected maximum day demand for all areas supplied by the first boosted zone facilities, with one station out of service, the following new pumping facilities are required:

a) At the 30th Avenue booster station, three new pumps with 5.000 MGD, 175 Hp, 4.000 MGD, 150 Hp, and 3.000 MGD, 125 Hp motors should be provided.
b) At the 60th Street booster station the existing 1.730 MGD pump should be replaced with a 4.000 MGD, 125 Hp, pump and two new 5.000 MGD, 150 Hp pumps.
c) At the 80th Street Booster Station a 5.000 MGD, 150 Hp and a 4.000 MGD, 125 Hp pumps should be provided.

All stations will need building additions, mechanical, electrical and control updates.

8-10) No Changes

11) Construction of approximately 5,800 feet of 20 inch main running west from 47th Avenue on 18th Street to Green Bay Road (STH 31).

12-13) No Change

14) Construction of approximately 12,400 feet of 20 inch water main running north on Green Bay Road (STH 31) from the 16 inch at 18th Street to 12th street, then west to the Chicago, Milwaukee and St. Paul Railroad.

15-16) No Change

17) Construction of approximately 8,600 feet of 24 inch main on 60th Street (CTH K) from Green Bay Road (STH 31) west to approximately 1000 feet west of 88th Avenue (STH 192). This main would provide transmission to the main booster station for the second boosted zone.

18-23) No Change

Second Boosted Zone

The following new construction is recommended for the second boosted zone:

24) Construction of a booster station at the intersection of 88th Avenue (STH 192) and 60th Street (CTH K). The source capacity parameter for the second boosted pressure zone showed a 12.636 MGD deficit. This flow rate is based upon abandoning the two existing inground stations which have a combined capacity of 6.480 MGD but are not designed for long term service. This 12.636 MGD rate must be supplied by the station with the largest unit out of service. It is recommended the station contain four pumps; a 7.000 MGD pump approximately 325 Hp; two 5.000 MGD pumps approximately 225 Hp; and one 3 MGD pump approximately 125 Hp. An emergency power generator capable of starting and running any pump at the station as well as lighting and controls will also be required. The estimated size of the generator is 350 KW.

At the booster station site, a total storage volume of 6.000 MG will be required. It is recommended that storage facilities be constructed in stages as required. For the purposes of this analysis, it is assumed two 3.000 MG facilities will be constructed.

25-27) No Change

28) Construction of approximately 4,000 feet of 16 inch main, along ISH 94 from 60th Street (CTH K) south to the 16 inch main north of 75th Street (STH 50) on 120th Avenue.

29) Construction of approximately 1,200 feet of 20 inch main, 400 feet of which will be in a 36 inch casing under ISH 94, at 71st Street to join the existing main at 122nd Avenue in the Bristol east system with the 16 inch mains at 120th Avenue.

30-32) No Change

Somers Second Boosted Pressure Zone

The ultimate development plan will allow the Somer's second boosted zone and the Kenosha/Pleasant Prairie/ Bristol second boosted pressure zone to be hydraulically connected. The actual connection will be discussed later in this section. The following improvements to the intermediate plan are recommended:

33) Construction of a booster station on 12th Street near the Chicago, Milwaukee and St. Paul Railroad. The booster station will provide water supply to the Town of Somers service area and to commercial and residential developments south of 12th Street near ISH 94 in Paris and Somers. It will also provide back-up

supply in the event of a failure at the second boosted zone station in Kenosha. The booster station should have one pump capable of supplying 3.000 MG and one pump capable of supplying 2.000 MG. The motors would be approximately 175 Hp and 100 Hp, respectively. The booster station should also have an emergency generator capable of starting and running either pump. The approximate size of the generator would be 200 KW.

34) Construction of a 500,000 gallon elevated storage tank near 100th Avenue and 12th Street, an overflow elevation of 885 NGVD and approximately 140 feet in height.

35) No Change

36) Construction of approximately 7,000 feet of 20 inch main from the booster station to the elevated tank. This would serve as the main feed between the two.

37) This improvement will not be required due to additional system looping discussed later in the chapter. Some individual areas above elevation 850 may require additional boosting but the extent of the improvements will have to be determined at the time of development.

38) Construction of approximately 12,000 feet of 12 inch main on STH 142 from 88th Avenue (pressure boundary) to a point approximately 1000 feet west of ISH 94.

Pleasant Prairie Pressure Zone

The following main is scheduled for construction in the fall of 1990 and will not be included in the cost estimates. Construction of approximately 5,300 feet of 16 inch main on 39th Avenue (CTH EZ) from 93rd Street (CTH T) south to 104th Street (CTH Q). A closed valve will be required just south of 93rd Street to separate pressure zones.

The following improvements are required to adequately serve the Pleasant Prairie pressure zone:

39) Construction of approximately 1,500 feet of 24 inch main on 104th Street (CTH Q) from the booster station near 28th Avenue to the bike path. From this point a 20 inch main will continue on 104th Street to Springbrook Road (STH 174) and then a 16 inch main will continue to Green Bay Road (STH 31). The estimated quantities are 5,000 feet of 20 inch and 6,500 feet of 16 inch.

39a) Construction of approximately 4,000 feet of 20 inch main on 104th Street (CTH Q) between Green Bay Road (STH 31) and 80th Street.

40) Construction of approximately 5,300 feet of 16 inch main on 30th Avenue extended (bike path) between 104th Street and 116th Street. From this point, 20,900 feet of 12-inch main will run along 30th Avenue extended to 124th Street, west on 124th Street to 39th Avenue (CTH EZ), north to 122nd Street, west on 122nd Street to 47th Avenue, north on 47th Avenue to 116th Street (Tobin Road), west on 116th Street (Tobin Road) to Springbrook Road (STH 174), southwest on Springbrook Road (STH 174) to Green Bay Road (STH 31), then south on Green Bay Road to 123rd Place to connect to the 8 inch main running to the Timber Ridge elevated tank.

41) Construction of approximately 4,300 feet of 20 inch main on Green Bay Road (STH 31) from 95th Street (CTH T) south to 104th Street (CTH Q). From this point, a 12 inch main will continue south on Green Bay Road (STH 31) for 7,700 feet to Springbrook Road (STH 174).

42-45) No Change

46) Construction of approximately 3000 feet of 16 inch main from the existing 12 inch stub west of 114th Avenue on 104th Street (CTH Q) west under ISH 94. This main will have to be installed in a 30 inch casing under ISH 94.

47-50) No Change

Additional Boosting in Pleasant Prairie

51) It is estimated that up to 750 homes in area No. 1 may require additional boosting. Due to uncertainties regarding the development in the area, cost estimates for three stations, each capable of providing 520 GPM, will be used. Each submersible station will contain two pumps, 12 Hp each and a check valve manhole to allow adequate flow in fire situations.

52) In area No. 2, which is located in Town 1 North, Range 22 East, Section 35, approximately 50 homes will require boosting. In accordance with Chapter NR 111.75 of the Wisconsin Administrative Code, a submersible pumping station containing two pumps 4 Hp each, rated at 110 GPM is recommended. Also required

is a check valve manhole to allow adequate flow in fire situations.

Additional Improvements Required for the Ultimate Plan

The following is a listing of the facilities required under the ultimate development plan not identified in the previous numbered analysis:

Primary Zone

53) Construction of approximately 7,700 feet of 16 inch main beginning at the intersection of 75th Street and 5th Avenue at the 36 inch main and running west to 22nd Avenue then north to connect to the 12 inch main at 67th Street.

First Boosted Zone

54) Construction of approximately 7,900 feet of 12 inch main on Green Bay Avenue (STH 31) from 38th Street (STH 142) north to 18th Street.

55) Construction of approximately 3,200 feet of 12 inch main on 22nd Street between 47th Avenue and Green Bay Avenue (STH 31).

56) Construction of approximately 21,500 feet of 12 inch main from the intersection of Green Bay Road and 12th Street, north on Green Bay Road to 4th Street, east on 4th Street to 30th Avenue, north on 30th to 1st Street and west on 1st Street to 22nd Avenue. This main will be serving residential areas of the first boosted zone.

Pleasant Prairie Pressure Zone

57) Construction of two 16 inch mains in the Wispark area on 88th Avenue and 80th Street between 95th Street and 100th Street. These mains are required in addition to the existing mains. Each main will be approximately 2,000 feet in length.

58) Construction of a approximately 12,000 feet of 16 inch main running parallel to the existing 16 inch on CTH Q between 88th Avenue and the 750,000 gallon elevated tank.

59) Construction of approximately 5,000 feet of 12 inch main on 116th Street between the bike path (30th Avenue extended) and 47th Avenue.

60) Construction of approximately 4,000 feet of 12 inch main on 47th Avenue between 116th Street and Springbrook Road.

61) Construction of approximately 7,000 feet of 12 inch main on Springbrook Road between 104th Street and 116th Street.

62) Construction of approximately 6,500 feet of 12 inch main on 128th Avenue extended north from 104th Street in the Town of Bristol. This is the minimum amount of main required to serve the area. Depending upon development patterns additional looping may be sized differently.

63) Construction of approximately 20,000 feet of 16 inch main on State Line Road from 88th Avenue west to ISH 94, then north to the 16 inch, 750,000 gallon tower connection. This main will not only provide service to the commercial and residential areas State Line Road and ISH 94 but also provide additional transmission to the elevated tank.

64) Construction of approximately 10,000 feet of 12 inch main on State Line Road between 88th Avenue and Green Bay Road (STH 31) then north to the Timber Ridge connection.

65) Construction of 2,050 feet of 12 inch main to replace the 8 inch main connecting the Timber Ridge Tower to Green Bay Road (STH 31).

66) Construction of a booster station and reservoir near the intersection of 28th Avenue and 104th Street (CTH Q). The booster station should contain three pumps, one 350 Hp, 7.000 MGD pump, one 250 Hp, 5.000 MGD pump and one 150 Hp, 2.000 MGD pump. This station is required to satisfy the source capacity parameter.

To meet peak hour demands and fire flow demands, the facility should also have a 4.000 MG above ground prestressed concrete reservoir approximately 45 feet in height. Emergency power supply in the form of a 350 KW generator will also be required.

67) To provide required storage for the industrial park demands, a 500,000 gallon elevated tank approximately 135 feet in height is required. The tank should be located south of 104th Street (CTH Q) on ground with an elevation of ö710 NGVD. Approximately 700 feet of 16 inch main will be required to connect the tower to the main at 104th Street.

68) To provide adequate capacity from the booster station at 93rd Street and Green Bay Road to the Industrial Park area approximately 4,700 feet of 24 inch main will be required from the station discharge, south to 95th Street then west to 80th Avenue.

<u>Second Booster Pressure Zone</u>

69) Construction of approximately 7,000 feet of 16 inch main along Wilmont Road (CTH C) from 111th Place to 128th Avenue. This will serve the commercial areas around ISH 94 and serve as an emergency connection between pressure zones.

70) Construction of approximately 9,000 feet of 12 inch main running south on 104th Avenue extended from Wilmont Road for 5,400 feet then turning west to connect to the 12 inch main on 88th Avenue (STH 192). The exact route of this main may be changed depending upon the nature of development in the area.

71) Construction of approximately 6,500 feet of 12 inch main on 38th Street between STH 142 and ISH 94.

72) Construction of approximately 5,000 feet of 12 inch main along ISH 94 between 38th Street and 52nd Street (STH 158).

73) Construction of approximately 15,000 feet of 16 inch main from the Somer's elevated tank west to ISH 94 then south to STH 142. This will provide a hydraulic connection between Somers and the second boosted zone.

74) Construction of approximately 14,000 feet of 12 inch main from the intersection of ISH 94 and STH 142, under ISH 94 and then south along ISH 94 to the Bristol Parkway east main. This will provide service to commercial establishments on the western edge of ISH 94 and serve as a second connection to the Bristol east system. Additional mains will be required to provide service to the commercial areas in the Bristol east area but the extent and location will have to be determined at the time of development.

75) Construction of a 1.0 MG elevated storage tank east of 104th Avenue (CTH HH) on the site of the existing 150,000 gallon tank. The tank should be a multi-pedestal style tank approximately 150 feet in height with an overflow elevation of 885 NGVD. The tank is required to provide peak hour storage and emergency supply.

The total estimated construction costs for improvements required under the Ultimate Development Plan is $51,255,700. The total present worth of the facilities is $61,542,400. Detailed costs are listed in Table 6-21.

WATER ALTERNATIVE SUMMARY

The average day (MGD) and maximum day (MGD) flow rates for each pressure zone are listed in Table 6-22. The water storage and transmission main costs and the water treatment facility costs are combined and summarized in Table 6-23.

In summary, using present worth costs, the optimistic water facility scenario was approximately 8 percent more expensive than the intermediate water facility scenario. The ultimate water facility scenario was approximately 80 percent more expensive than the intermediate water facility scenario.

Using present worth costs, optimistic water treatment facility expansion is approximately 28 percent more expensive than the intermediate water treatment facility expansion. The ultimate water treatment facility expansion is approximately 431 percent more expensive than the intermediate water treatment facility expansion scenario.

Because the present worth costs for the optimistic scenario are not significantly higher than the intermediate scenario and because the optimistic scenario facilities will provide for a reasonable growth projection above the intermediate scenario, it is recommended that the optimistic scenario facilities be constructed. However, water facilities that are common between the optimistic and ultimate scenario's should be compared individually to choose a cost effective size because the water mains have a service life in excess of 50 years and often times a pipe size increase can be made for a minimal cost difference. Table 6-24 lists those water mains and other facilities that are common between the intermediate, optimistic and ultimate growth scenarios. These facilities are recommended to be sized for ultimate growth. The total increase in construction cost is 8 percent in order to construct these facilities for the ultimate rather than the optimistic growth. Figure 6-15 shows the recommended water system plan corresponding to Table 6-24.

Table 6 - 21

WATER SUPPLY, STORAGE AND TRANSMISSION FACILITY COSTS

ULTIMATE DEVELOPMENT PLAN

Improvement	Item	Quantity	Unit Price	Cost	Life	Replacement Costs 10 Years	20 Years	30 Years	40 Years	Salvage
1	30" Water Main	11,500	$93	$1,069,500	50					$0
2	36" Water Main	12,000	$108	$1,296,000	50					$0
	24" Water Main	15,200	$73	$1,109,600	50					$0
3	16" Water Main	9,000	$55	$495,000	50					$0
	24" Water Main	6,000	$73	$438,000	50					$0
4	24" Water Main	4,500	$73	$328,500	50					$0
5	12" Water Main	8,100	$53	$429,300	50					$0
6	12" Water Main	7,600	$53	$402,800	50					$0
	12" Pressure Control Valve	1	$4,000	$4,000	20		$4,000		$4,000	($2,000)
	Manhole	1	$1,500	$1,500	50					$0
	Mechanical & Bypass	1	$18,000	$18,000	20		$18,000		$18,000	($9,000)
7	Natural Gas Engine W/Drive for 3 MGD Pump	4	$30,000	$120,000	30			$120,000		($39,600)
	Mechanical & Installation	4	$15,000	$60,000	20		$60,000		$60,000	($30,000)
	Electrical & Controls	4	$8,000	$32,000	30			$32,000		($10,560)
	Building Additions	2	$15,000	$30,000	50					$0
7A	125 Hp Pump	1	$9,000	$9,000	20		$9,000		$9,000	($4,500)
	150 Hp Pump	1	$12,000	$12,000	20		$12,000		$12,000	($6,000)
	175 Hp Pump	1	$14,000	$14,000	20		$14,000		$14,000	($7,000)
	Installation & Mechanical	1	$50,000	$50,000	20		$50,000		$50,000	($25,000)
	Electrical & Controls	1	$40,000	$40,000	30			$40,000		($13,200)
	Building Addition	1	$45,000	$45,000	50					$0
7B	125 Hp Pump	1	$9,000	$9,000	20		$9,000		$9,000	($4,500)
	150 Hp Pump	2	$12,000	$24,000	20		$24,000		$24,000	($12,000)
	Installation & Mechanical	1	$50,000	$50,000	20		$50,000		$50,000	($25,000)
	Electrical & Controls	1	$40,000	$40,000	30			$40,000		($13,200)
	Building Addition	1	$45,000	$45,000	50					$0
7C	125 Hp Pump	1	$9,000	$9,000	20		$9,000		$9,000	($4,500)
	150 Hp Pump	1	$12,000	$12,000	20		$12,000		$12,000	($6,000)
	Installation & Mechanical	1	$30,000	$30,000	20		$30,000		$30,000	($15,000)
	Electrical & Controls	1	$30,000	$30,000	30			$30,000		($9,900)
	Building Addition	1	$30,000	$30,000	50					$0
8	16" Water Main	3,000	$55	$165,000	50					$0
9	12" Water Main	4,500	$53	$238,500	50					$0
10	24" Water Main	5,800	$73	$423,400	50					$0
11	20" Water Main	5,800	$67	$388,600	50					$0
12	16" Water Main	2,800	$55	$154,000	50					$0
	12" Water Main	2,800	$53	$148,400	50					$0
13	12" Water Main	8,000	$53	$424,000	50					$0
14	20" Water Main	12,400	$67	$830,800	50					$0
15	16" Water Main	16,000	$55	$880,000	50					$0
16	12" Water Main	2,500	$53	$132,500	50					$0
	16" Water Main	1,500	$55	$82,500	50					$0
17	24" Water Main	8,600	$73	$627,800	50					$0

Table 6 - 21

WATER SUPPLY, STORAGE AND TRANSMISSION FACILITY COSTS

ULTIMATE DEVELOPMENT PLAN

						Replacement Costs				
Improvement	Item	Quantity	Unit Price	Cost	Life	10 Years	20 Years	30 Years	40 Years	Salvage
18	16" Water Main	2,600	$55	$143,000	50					$0
19	16" Water Main	5,200	$55	$286,000	50					$0
20	12" Water Main	1,500	$53	$79,500	50					$0
21	12" Water Main	5,400	$53	$286,200	50					$0
22	16" Water Main	4,800	$55	$264,000	50					$0
23	12" Water Main	3,400	$53	$180,200	50					$0
24	Pump Station Building	1	$175,000	$175,000	50					$0
	325 Hp Pump	1	$35,000	$35,000	20		$35,000		$35,000	($17,500)
	225 Hp Pump	2	$26,000	$52,000	20		$52,000		$52,000	($26,000)
	125 Hp Pump	1	$9,000	$9,000	20		$9,000		$9,000	($4,500)
	350 KW Generator, Starter With Controls, Fuel Tank	1	$44,000	$44,000	30			$44,000		($14,520)
	Mechanical	1	$70,000	$70,000	20		$70,000		$70,000	($35,000)
	Electrical	1	$100,000	$100,000	30			$100,000		($33,000)
	Controls	1	$40,000	$40,000	30			$40,000		($13,200)
	Sitework	1	$30,000	$30,000	50					$0
	6,000,000 Gallon Reservior	1	$1,900,000	$1,900,000	50					$0
25	24" Water Main	4,800	$73	$350,400	50					$0
26	24" Water Main	1,000	$73	$73,000	50					$0
27	16" Water Main	7,100	$55	$390,500	50					$0
28	16" Water Main	4,000	$55	$220,000	50					$0
29	20" Water Main	800	$67	$53,600	50					$0
	20" Water Main in 36" Casing	400	$350	$140,000	50					$0
30	24" Water Main	3,600	$73	$262,800	50					$0
31	16" Water Main	10,100	$55	$555,500	50					$0
32	16" Water Main	5,900	$55	$324,500	50					$0
33	Pump Station Building	1	$125,000	$125,000	50					$0
	100 Hp Pump	1	$7,000	$7,000	20		$7,000		$7,000	($3,500)
	175 Hp Pump	1	$14,000	$14,000	20		$14,000		$14,000	($7,000)
	Mechanical	1	$50,000	$50,000	20		$50,000		$50,000	($25,000)
	Electrical	1	$40,000	$40,000	30			$40,000		($13,200)
	Controls	1	$10,000	$10,000	30			$10,000		($3,300)
	Generator	1	$37,000	$37,000	30			$37,000		($12,210)
34	500,000 Gallon Elevated Tank 140' Tall, Foundation	1	$610,000	$610,000	50					$0
	Painting	1	$65,000	$65,000	10	$65,000	$65,000	$65,000	$65,000	$0
	Electrical & Controls	1	$7,500	$7,500	30			$7,500		($2,475)
35	12" Water Main	14,500	$53	$768,500	50					$0
36	20" Water Main	7,000	$67	$469,000	50					$0
37	Not Required	0	$0	$0	0					$0
38	12" Water Main	12,000	$53	$636,000	50					$0

Table 6 - 21
WATER SUPPLY, STORAGE AND TRANSMISSION FACILITY COSTS
ULTIMATE DEVELOPMENT PLAN

Improvement	Item	Quantity	Unit Price	Cost	Life	Replacement Costs				Salvage
						10 Years	20 Years	30 Years	40 Years	
39	24" Water Main	1,500	$73	$109,500	50					$0
	16" Water Main	6,500	$55	$357,500	50					$0
	20" Water Main	5,000	$67	$335,000	50					$0
39A	20" Water Main	4,000	$67	$268,000	50					$0
40	12" Water Main	20,900	$53	$1,107,700	50					$0
	16" Water Main	5,300	$55	$291,500	50					$0
41	12" Water Main	7,700	$53	$408,100	50					$0
	20" Water Main	4,300	$69	$296,700	50					$0
42	16" Water Main	5,500	$55	$302,500	50					$0
43	16" Water Main	3,000	$55	$165,000	50					$0
44	12" Water Main	2,500	$53	$132,500	50					$0
45	12" Water Main	10,000	$53	$530,000	50					$0
46	16" Water Main	2,600	$55	$143,000	50					$0
	16" Water Main in 30" Casing	400	$250	$100,000	50					$0
47	12" Water Main	1,500	$53	$79,500	50					$0
48	12" Water Main	2,000	$53	$106,000	50					$0
49	5 MG Prestressed Above Ground Concrete Reservior	1	$1,560,000	$1,560,000	50					$0
50	Pump Station Building	1	$150,000	$150,000	50					$0
	Fire Pump (250 Hp)	1	$20,000	$20,000	20		$20,000		$20,000	($10,000)
	Service Pump (100 Hp)	2	$7,000	$14,000	20		$14,000		$14,000	($7,000)
	Mechanical	1	$60,000	$60,000	20		$60,000		$60,000	($30,000)
	Controls	1	$20,000	$20,000	30			$20,000		($6,600)
	Electric	1	$80,000	$80,000	30			$80,000		($26,400)
	Generator, Controls, Fuel Tank	1	$44,000	$44,000	30			$44,000		($14,520)
	Site Work	1	$30,000	$30,000	50					$0
51	Submersible Booster Station	3	$63,000	$189,000	20		$189,000		$189,000	($94,500)
52	Submersible Booster Station	1	$54,000	$54,000	20		$54,000		$54,000	($27,000)
53	16" Water Main	7,700	$55	$423,500	50					$0
54	12" Water Main	7,900	$53	$418,700	50					$0
55	12" Water Main	3,200	$53	$169,600	50					$0
56	12" Water Main	21,500	$53	$1,139,500	50					$0
57	16" Water Main	4,000	$55	$220,000	50					$0
58	16" Water Main	12,000	$55	$660,000	50					$0
59	12" Water Main	5,000	$53	$265,000	50					$0
60	12" Water Main	4,000	$53	$212,000	50					$0
61	12" Water Main	7,000	$53	$371,000	50					$0
62	12" Water Main	6,500	$53	$344,500	50					$0

Table 6 - 21

WATER SUPPLY, STORAGE AND TRANSMISSION FACILITY COSTS

ULTIMATE DEVELOPMENT PLAN

Improvement	Item	Quantity	Unit Price	Cost	Life	Replacement Costs 10 Years	20 Years	30 Years	40 Years	Salvage
63	16" Water Main	20,000	$55	$1,100,000	50					$0
64	12" Water Main	10,000	$53	$530,000	50					$0
65	12" Water Main	2,050	$53	$108,650	50					$0
66	Booster Station Building	1	$175,000	$175,000	50					$0
	350 Hp Pump	1	$40,000	$40,000	20		$40,000		$40,000	($20,000)
	250 Hp Pump	1	$20,000	$20,000	20		$20,000		$20,000	($10,000)
	150 Hp Pump	1	$12,000	$12,000	20		$12,000		$12,000	($6,000)
	350 KW Generator	1	$44,000	$44,000	30			$44,000		($14,520)
	Mechanical	1	$70,000	$70,000	20		$70,000		$70,000	($35,000)
	Electrical	1	$100,000	$100,000	30			$100,000		($33,000)
	Controls	1	$40,000	$40,000	30			$40,000		($13,200)
	Site Work	1	$30,000	$30,000	50					$0
	4,000,000 Gallon Reservior	1	$1,300,000	$1,300,000	50					$0
67	500,000 Gallon Elevated Tank	1	$610,000	$610,000	50					$0
	Painting	1	$65,000	$65,000	10	$65,000	$65,000	$65,000	$65,000	($53,950)
	Electrical & Controls	1	$7,500	$7,500	30			$7,500		($2,475)
68	24" Water Main	4,700	$73	$343,100	50					$0
69	16" Water Main	7,000	$55	$385,000	50					$0
70	12" Water Main	9,000	$53	$477,000	50					$0
71	12" Water Main	6,500	$53	$344,500	50					$0
72	12" Water Main	5,000	$53	$265,000	50					$0
73	16" Water Main	15,000	$55	$825,000	50					$0
74	12" Water Main	14,000	$53	$742,000	50					$0
75	1,000,000 Gallon Elevated Tank	1	$825,000	$825,000	50					$0
	Painitng	1	$100,000	$100,000	10	$100,000	$100,000	$100,000	$100,000	($83,000)
	Electrical & Controls	1	$9,500	$9,500	30			$9,500		($3,135)
				$39,427,450		$230,000	$1,247,000	$1,115,500	$1,247,000	($937,665)
Engineering & Contingencies (30%)				$11,828,235						
Total Costs				$51,255,685						
Present Worth Factors				1.0000		0.5584	0.3118	0.1741	0.0972	0.0543
Present Worth				$51,255,685		$128,431	$388,820	$194,220	$121,236	($50,904)
Total Present Worth Of Construction				$52,037,488						
Annual O & M Costs *			$603,030							
50 Year Present Worth Factor			15.7619							
Present Worth Of Annual O & M Costs				$9,504,868						
Total Present Worth				$61,542,356						

* O & M costs are assumed to be 5% of construction costs for pumping and storage facilties and $1,200 per mile of transmission main.

Source: Ruekert & Mielke, Inc.

Table 6 - 22

KENOSHA AREA WATER SYSTEM DESIGN FLOWS

	Intermediate		Optimistic		Ultimate	
	Average Day (MGD)	Maximum Day (MGD)	Average Day (MGD)	Maximum Day (MGD)	Average Day (MGD)	Maximum Day (MGD)
Entire System	18.946	33.175	23.560	41.230	37.074	64.881
Primary Zone	10.639	18.618	11.004	19.257	12.076	21.134
First Boosted Zone	54.140	9.476	6.697	11.720	10.520	18.410
Second Boosted Zone	1.174	2.054	1.923	3.365	7.220	12.636
Somers Second Boosted Zone	0.201	0.351	0.293	0.513	1.041	1.822
Pleasant Prairie Pressure Zone	1.519	2.657	3.643	6.375	7.258	12.701

Table 6 - 23

WATER ALTERNATIVES
PRESENT WORTH SUMMARY

Land Use Plan	Water Transmission, Pumping And Storage Facilities		Water Treatment Facility		Present Worth Least Cost Alternate Totals
	Construction	O & M	Construction	O & M	
Intermediate	$29,057,189	$4,007,252	$2,400,000	$16,798,245	$52,262,686
Optimistic	$31,084,390	$4,685,801	$3,600,000	$20,889,199	$60,259,390
Ultimate	$52,037,488	$9,504,868	$49,969,617	$32,871,155	$144,383,128

Source: Ruekert & Mielke, Inc.

Table 6 - 24

CONSTRUCTION COST COMPARISON
WATERMAINS AND SELECTED FACILITIES

	Intermediate Plan			Optimistic Plan			Ultimate Plan		
Improvement	Item	Quantity	Cost	Item	Qty	Cost	Item	Qty	Cost
1	16" Water Main	11,500	$632,500	16" Water Main	11,500	$632,500	30" Water Main	11,500	$1,069,500
2	36" Water Main	12,000	$1,296,000	36" Water Main	12,000	$1,296,000	36" Water Main	12,000	$1,296,000
	16" Water Main	15,200	$836,000	16" Water Main	8,400	$462,000	24" Water Main	15,200	$1,109,600
				24" Water Main	6,800	$496,400			
4	16" Water Main	4,500	$247,500	16" Water Main	4,500	$247,500	24" Water Main	4,500	$328,500
5	12" Water Main	8,100	$429,300	12" Water Main	8,100	$429,300	12" Water Main	8,100	$429,300
6	8" Water Main	7,600	$326,800	8" Water Main	7,600	$326,800	12" Water Main	7,600	$402,800
	8" Pressure Control Valve	1	$3,200	8" Pressure Control Valve	1	$3,200	12" Pressure Control Valv	1	$4,000
	Manhole	1	$1,500	Manhole	1	$1,500	Manhole	1	$1,500
	Mechanical & Bypass	1	$15,000	Mechanical & Bypass	1	$15,000	Mechanical & Bypass	1	$18,000
8	16" Water Main	3,000	$165,000	16" Water Main	3,000	$165,000	16" Water Main	3,000	$165,000
9	12" Water Main	4,500	$238,500	12" Water Main	4,500	$238,500	12" Water Main	4,500	$238,500
10	24" Water Main	5,800	$423,400	24" Water Main	5,800	$423,400	24" Water Main	5,800	$423,400
11	16" Water Main	5,800	$319,000	16" Water Main	5,800	$319,000	20" Water Main	5,800	$388,600
12	16" Water Main	2,800	$154,000	16" Water Main	2,800	$154,000	16" Water Main	2,800	$154,000
	12" Water Main	2,800	$148,400	12" Water Main	2,800	$148,400	12" Water Main	2,800	$148,400
13	12" Water Main	8,000	$424,000	12" Water Main	8,000	$424,000	12" Water Main	8,000	$424,000
14	16" Water Main	12,400	$682,000	16" Water Main	12,400	$682,000	20" Water Main	12,400	$830,800
15	16" Water Main	16,000	$880,000	16" Water Main	16,000	$880,000	16" Water Main	16,000	$880,000
16	12" Water Main	2,500	$132,500	12" Water Main	2,500	$132,500	12" Water Main	2,500	$132,500
	16" Water Main	1,500	$82,500	16" Water Main	1,500	$82,500	16" Water Main	1,500	$82,500
17	24" Water Main	8,600	$627,800	24" Water Main	8,600	$627,800	24" Water Main	8,600	$627,800
18	16" Water Main	2,600	$143,000	16" Water Main	2,600	$143,000	16" Water Main	2,600	$143,000
19	16" Water Main	5,200	$286,000	16" Water Main	5,200	$286,000	16" Water Main	5,200	$286,000
20	12" Water Main	1,500	$79,500	12" Water Main	1,500	$79,500	12" Water Main	1,500	$79,500
21	12" Water Main	5,400	$286,200	12" Water Main	5,400	$286,200	12" Water Main	5,400	$286,200
22	16" Water Main	4,800	$264,000	16" Water Main	4,800	$264,000	16" Water Main	4,800	$264,000
23	12" Water Main	3,400	$180,200	12" Water Main	3,400	$180,200	12" Water Main	3,400	$180,200
25	24" Water Main	4,800	$350,400	24" Water Main	4,800	$350,400	24" Water Main	4,800	$350,400
26	24" Water Main	1,000	$73,000	24" Water Main	1,000	$73,000	24" Water Main	1,000	$73,000
27	16" Water Main	7,100	$390,500	16" Water Main	7,100	$390,500	16" Water Main	7,100	$390,500

Table 6 - 24

CONSTRUCTION COST COMPARISON
WATERMAINS AND SELECTED FACILITIES

	Intermediate Plan			Optimistic Plan			Ultimate Plan		
Improvement	Item	Quantity	Cost	Item	Qty	Cost	Item	Qty	Cost
28	16" Water Main	4,000	$220,000	16" Water Main	4,000	$220,000	16" Water Main	4,000	$220,000
29	16" Water Main	800	$44,000	16" Water Main	800	$44,000	20" Water Main	800	$53,600
	16" Main in 30" Casing	400	$100,000	16" Main in 30" Casing	400	$100,000	20" Main in 36" Casing	400	$140,000
30	24" Water Main	3,600	$262,800	24" Water Main	3,600	$262,800	24" Water Main	3,600	$262,800
31	16" Water Main	10,100	$555,500	16" Water Main	10,100	$555,500	16" Water Main	10,100	$555,500
32	16" Water Main	5,900	$324,500	16" Water Main	5,900	$324,500	16" Water Main	5,900	$324,500
34	00,000 Gal Elevated Tank			200,000 Gal Elevated Tank			500,000 Gal Elevated Tank		
	140' Tall, Foundation	1	$310,000	140' Tall, Foundation	1	$310,000	140' Tall, Foundation	1	$610,000
	Painting	1	$50,000	Painting	1	$50,000	Painting	1	$65,000
	Electrical & Controls	1	$7,500	Electrical & Controls	1	$7,500	Electrical & Controls	1	$7,500
35	12" Water Main	14,500	$768,500	12" Water Main	14,500	$768,500	12" Water Main	14,500	$768,500
36	12" Water Main	7,000	$371,000	12" Water Main	7,000	$371,000	20" Water Main	7,000	$469,000
37	Booster Station w/ 10 Hp,			Booster Station w/ 10 Hp,			Booster Station w/ 10 Hp,		
	15 Hp & 25 Hp Motors	1	$80,000	15 Hp & 25 Hp Motors	1	$80,000	15 Hp & 25 Hp Motors	1	$80,000
	Electrical	1	$5,000	Electrical	1	$5,000	Electrical	1	$5,000
38	16" Water Main	12,000	$660,000	16" Water Main	12,000	$660,000	12" Water Main	12,000	$636,000
39	16" Water Main	17,000	$935,000	16" Water Main	17,000	$935,000	24" Water Main	1,500	$109,500
							16" Water Main	6,500	$357,500
							20" Water Main	5,000	$335,000
39A	Not Required	0	$0	Not Required	0	$0	20" Water Main	4,000	$268,000
40	12" Water Main	26,200	$1,388,600	12" Water Main	26,200	$1,388,600	12" Water Main	20,900	$1,107,700
							16" Water Main	5,300	$291,500
41	12" Water Main	12,000	$636,000	12" Water Main	7,700	$408,100	12" Water Main	7,700	$408,100
				20" Water Main	4,300	$296,700	20" Water Main	4,300	$296,700
42	16" Water Main	5,500	$302,500	16" Water Main	5,500	$302,500	16" Water Main	5,500	$302,500
43	16" Water Main	3,000	$165,000	16" Water Main	3,000	$165,000	16" Water Main	3,000	$165,000
44	12" Water Main	2,500	$132,500	12" Water Main	2,500	$132,500	12" Water Main	2,500	$132,500
45	12" Water Main	10,000	$530,000	12" Water Main	10,000	$530,000	12" Water Main	10,000	$530,000
46	12" Water Main	2,600	$137,800	16" Water Main	2,600	$143,000	16" Water Main	2,600	$143,000
	12" Main in 30" Casing	400	$100,000	16" Main in 30" Casing	400	$100,000	16" Main in 30" Casing	400	$100,000
47	12" Water Main	1,500	$79,500	12" Water Main	1,500	$79,500	12" Water Main	1,500	$79,500
48	12" Water Main	2,000	$106,000	12" Water Main	2,000	$106,000	12" Water Main	2,000	$106,000

Table 6 - 24

CONSTRUCTION COST COMPARISON
WATERMAINS AND SELECTED FACILITIES

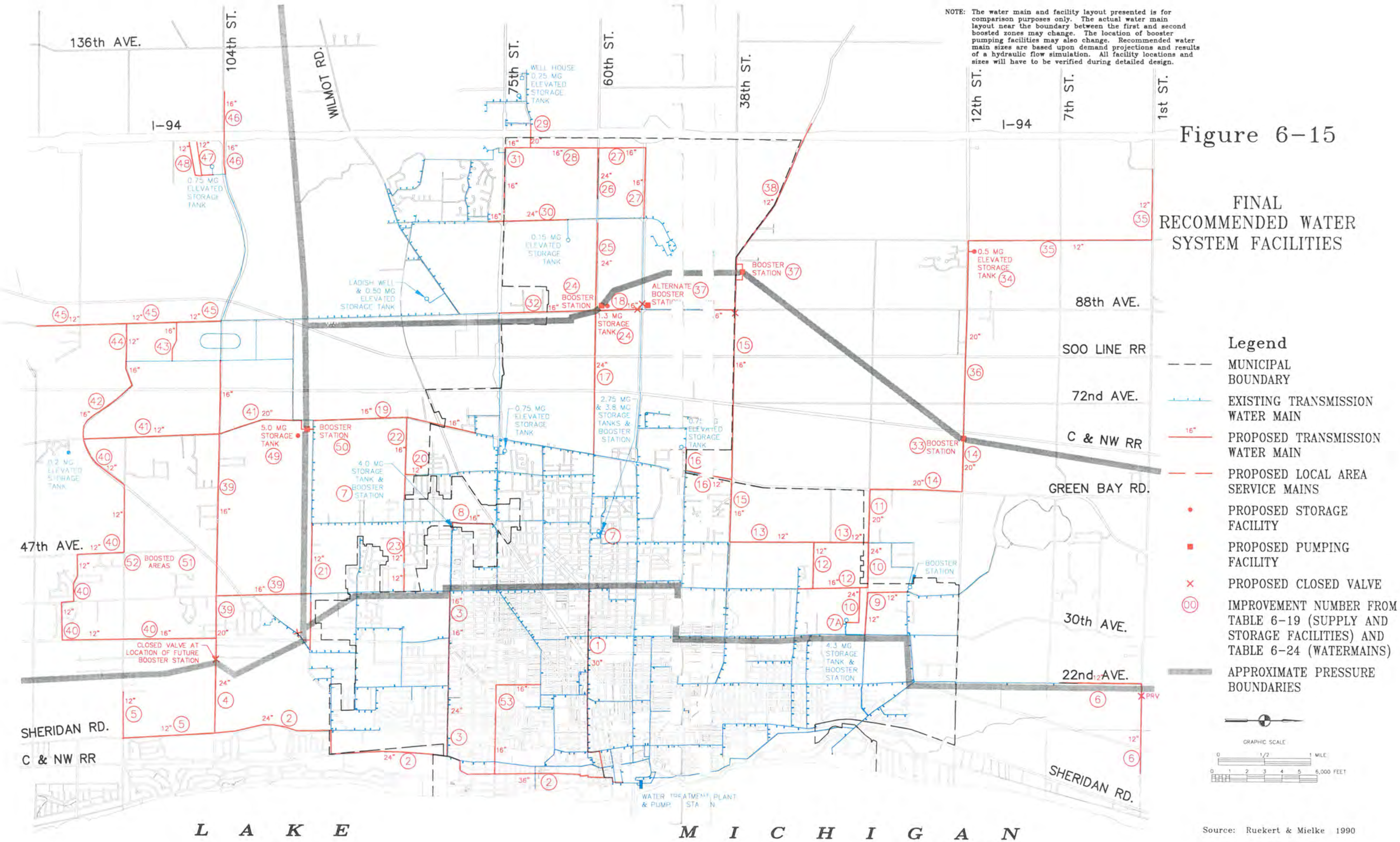
	Intermediate Plan			Optimistic Plan			Ultimate Plan		
Improvement	Item	Quantity	Cost	Item	Qty	Cost	Item	Qty	Cost
49	5 MG Prestressed Above Ground Concrete Reservi	1	$1,560,000	5 MG Prestressed Above Ground Concrete Reservi	1	$1,560,000	5 MG Prestressed Above Ground Concrete Reservi	1	$1,560,000
50	Pump Station Building	1	$150,000	Pump Station Building	1	$150,000	Pump Station Building	1	$150,000
	Fire Pump (250 Hp)	1	$20,000	Fire Pump (250 Hp)	1	$20,000	Fire Pump (250 Hp)	1	$20,000
	Service Pump (100 Hp)	2	$14,000	Service Pump (100 Hp)	2	$14,000	Service Pump (100 Hp)	2	$14,000
	Mechanical	1	$60,000	Mechanical	1	$60,000	Mechanical	1	$60,000
	Controls	1	$20,000	Controls	1	$20,000	Controls	1	$20,000
	Electric	1	$80,000	Electric	1	$80,000	Electric	1	$80,000
	Gen., Controls, Fuel Tan	1	$44,000	Gen., Controls, Fuel Tan	1	$44,000	Gen., Controls, Fuel Tan	1	$44,000
	Site Work	1	$30,000	Site Work	1	$30,000	Site Work	1	$30,000
	16" Discharge Main	4,600	$253,000	16" Discharge Main	4,600	$253,000			
52	Sub Booster Station	1	$54,000	Sub Booster Station	1	$54,000	Sub Booster Station	1	$54,000
53				16" Watermain	7,700	$423,500	16" Water Main	7,700	$423,500
			$20,674,400			$21,294,300			$22,592,900

Source: Ruekert & Mielke, Inc.

NOTE: The water main and facility layout presented is for comparison purposes only. The actual water main layout near the boundary between the first and second boosted zones may change. The location of booster pumping facilities may also change. Recommended water main sizes are based upon demand projections and results of a hydraulic flow simulation. All facility locations and sizes will have to be verified during detailed design.

Figure 6-15

FINAL RECOMMENDED WATER SYSTEM FACILITIES



Source: Ruekert & Mielke 1990

CHAPTER VII
PLAN IMPLEMENTATION

INTRODUCTION

This chapter will refine the recommended sewerage system and water distribution system plans as presented in Chapter VI, analyze various funding options and the fiscal impact of implementing the recommended plans, review the organizational structure necessary for implementation, and discuss plan adoption and implementation.

WATER DIVERSION

The issue of water diversion across the sub-continental divide from the Lake Michigan Basin to the Mississippi River Basin is governed by Wisconsin Statutes (Sections 30.18, 30.21 and 144.026) and by Section 1109 of the Federal Water Resources Development Act of 1986. Basically, there are many restrictions and limitations regarding water diversion and rights of riparian owners that must be considered. The traditional common law riparian doctrine forbade the transfer of water between watersheds, such transfer being regarded as a nonriparian use of water. Nevertheless, interbasin diversions have taken place in the Great Lake areas although not without a great deal of regulation.

One of the major concerns of the study was that any recommended plan would comply with the water diversion requirements. If an area on the west side of the sub-continental divide was to be served by a wastewater treatment facility discharging to the Mississippi River Basin, additional regulations and approvals would need to be followed to allow the community to be served with water from Lake Michigan. If all of the areas to be provided water from Lake Michigan from the Kenosha Water Utility were also to be served by the Kenosha wastewater treatment facility, a diversion problem would not exist.

In 1989, the Village of Pleasant Prairie did obtain permission to divert up to 3.2 MGD from Lake Michigan, to use it and to discharge it into the Mississippi River Basin. This diversion was made in order to "address a significant public health concern associated with the radium contamination of the Town of Pleasant Prairie's Water supply". This approval was based upon the understanding that diversion would be eliminated by the year 2010.

The integrated final recommended sewer and water facilities in this plan do not provide for any water diversion beyond the year 2010. The Village of Pleasant Prairie wastewater treatment facilities (SUD "D" and 73-1) are scheduled to be phased out before the year 2010. The study area by that time will be served by both regional wastewater and water treatment facilities that will in effect take water from Lake Michigan and discharge it back to Lake Michigan as treated wastewater. Thus, the administrative and financial options discussed in this chapter do not involve this issue.

METHODS OF FINANCING

There are a variety of methods available which could be utilized to finance the construction of the recommended regional water and sewerage system alternative presented in Chapter VI. The following is a general discussion of the types of assistance available, sources of potential revenue to minimize municipal expenditures, and debt instruments. Each community will have to evaluate the financing alternatives available to fit their own financial obligations.

<u>Financial Assistance</u>

<u>Sanitary Sewer Facilities</u>

Financial assistance for the construction of the WTF and the trunk sewers should be available through the Clean Water Fund Loan Program administered by the Department of Natural Resources. The Clean Water Fund Loan Program provides loans at or below market interest rates for eligible projects. The available interest rate is determined by 1) the portion of the project which is eligible for a loan below the market interest rate and 2) the portion of the project which is eligible to receive a market interest rate loan. The program provides for a three tier interest rate structured on the following criteria:

Tier	Project Type	Loan Rate
Tier 1	Compliance maintenance projects; new or changed treatment standards	55% of market rate
Tier 2	Unsewered projects; urban storm water projects; and nonpoint source projects	70% of market rate
Tier 3	Violator projects; future growth and industrial capacity	Market rate

The costs relating to the capacity of the proposed trunk sewers required for non-industrial users in unsewered areas for the first 10 years would be eligible for a Tier 2 subsidized loan. The capacity of the proposed trunk sewers required for growth beyond 10 years and capacity for industrial flows would only be eligible for a market interest rate loan. The loan interest rate for the entire project would be calculated on a proportional basis using the two loan interest rates.

Each trunk sewer should be examined in greater detail to determine the eligible tier level when an application for assistance is completed. For the purposes of this report it was assumed that 90% of the trunk sewer project costs would be eligible for a Tier 2 subsidized loan. The remaining 10% of project costs would receive a Tier 3 loan. The current market rate is estimated at 7.25%. Using this interest rate, 90% of the trunk sewer project could receive a loan at 5.08% and the remaining 10% of the project would receive a market rate loan at 7.25%. This produces a blended interest rate for the entire project of approximately 5.30%.

As discussed in Chapters V and VI, the expansion of the WTF is primarily driven by the need to provide peak flow capacity. The current WTF facility is adequate to handle average daily flows and loading. Each element of the proposed WTF expansion would have to be examined in greater detail at the time of application for financial assistance to determine eligibility levels. For the purposes of this report it is assumed that 90% of the WTF construction cost would be eligible for a Tier 1 subsidized loan and the remaining 10% would be eligible for a Tier 3 loan. The current market rate is estimated at 7.25%. Using this interest rate, 90% of the WTF project could receive a loan at 4.00% and the remaining 10% of the project would receive a market rate loan of 7.25%. This produces a blended interest rate for the entire WTF project of approximately 4.33%.

Water Facilities

Financial assistance for construction of facilities required by a utility to be in compliance of a "maximum contaminant level" as determined by Chapter NR109 of the Wisconsin Administrative Code is available from the Municipal Clean Drinking Water Grant Program, administered by the Department of Natural Resources. The program provides grants to "...assist municipal water system owners, that are in violation of a maximum contaminant level standard (MCL), to achieve compliance through the provision of grant funding."

The available funds, currently $9.8 million, are allocated based upon a priority ranking system with the following eligibility requirements:

1) Project costs must be to correct a MCL standard violation that occurred on or after 4/1/90, and

2) The total eligible cost to correct the violation divided by the current population served by the water system must be greater than $150.

The amount an individual community receives after it has been deemed eligible is determined in the following manner:

"The grant share authorized is 90% of the difference between the total eligible cost minus a deductible amount. The "deductible" amount, which is required by statute, is determined by multiplying $25 times the current population of the water system. Because of this statutory "deductible", the effective grant percent varies between 75% and almost 90%, depending on the amount of total eligible cost."[1]

As discussed in Chapter IV and V, the Village of Pleasant Prairie has radium levels in excess of the MCL. The proposed water system improvements are designed to provide water which is in compliance with this MCL. Each element of the proposed system would have to be examined in greater detail at the time of application for financial assistance to determine eligibility levels. Additional funds in the form of grants are anticipated to be available each year.

Special Assessments

Under the provisions of Wisconsin Statutes 66.60 and 66.62, any city, town, or village may by resolution levy and collect special assessments upon property within a determined area that has received special benefit due to the construction of municipal improvements. Two widely used methods of levying such assessments are the front foot method and the area wide method.

Front Foot Assessments

A commonly used method of reducing the overall cost of a capital improvement project is

1. Program Summary, Municipal Clean Drinking Water Grant Program, Wisconsin Department of Natural Resources, April 15, 1991.

the use of front foot assessments which recovers the cost of the direct benefit the property receives. For each assessable property which a sanitary sewer or water main abuts, a set charge per assessable front foot is levied against the property. The charges are typically equivalent to the what the cost would be for installing an 8" sanitary sewer or 6" water main, which is normally required to serve an average residential customer. The rate per assessable front foot has generally been in the range of $30 to $40 per foot for sanitary sewer and $15 to $20 per foot for water main. As a point of comparison, the City of Kenosha is currently charging $26.50 per foot for 8" sanitary sewer and $20.00 per foot for 8" to 12" water main. The property owners who receive such an assessment are usually given the option of paying the assessment in full within a short timeframe or utilizing an installment plan which ranges from 5 to 10 years in length.

Each community within the study area will need to evaluate the option of front foot assessments to lower the construction costs to be financed with municipal and utility revenues. For the purposes of this report, front foot assessments were not utilized to reduce the construction costs to be financed, therefore any use of front foot assessments will lower the user charges contained in this report.

Area Wide Assessments

Area wide assessments are often used in conjunction with front foot assessments to recover the costs associated with municipal improvements whereby the benefit received by a property is not as apparent or direct as under the front foot method. Examples of infrastructure improvements which provide an indirect benefit to a property are such items as sewage lift stations, trunk sewer oversizing, wastewater treatment facilities, water towers, wells, and water reservoirs. In levying area wide assessments, the construction costs less front foot assessments costs are assessed to all benefitted properties using an equivalent unit such as acreage or residential equivalent unit. Each property owner who would receive such an assessment would be given the same type of financing options as discussed with the front foot assessment.

Each community within the study area will need to evaluate the option of area wide assessments to lower the construction costs to be financed with municipal and utility revenues. For the purposes of this report, area wide assessments were not utilized to reduce the construction costs to be financed.

Contributions In Aid of Construction

The typical case of contribution in aid of construction is requiring a private developer to pay for any water or sewer infrastructure improvements that are necessary to service his development. Depending upon the type of improvement and the potential it has for serving a greater area, a community may elect to participate in financing any oversizing costs or extraordinary costs. Other cases of contributions in aid of construction would involve private industries paying for special wastewater treatment facilities or watermain oversizing needed which benefit the private industry.

Each community within the study area will need to evaluate the potential of contributions in aid of construction from private developers or industry which may lower the construction costs to be financed with municipal and utility revenues. For the purposes of this report, consideration of contributions in aid of construction was not utilized to reduce the construction costs to be financed.

Impact Fees

As an alternative to area wide assessments which would apply to all property within a defined area, impact fees have evolved as a means for financing water and sewer improvements necessary to meet the demands of new growth. Following the concept that "growth should pay for growth", impact fees are designed to reflect the relationship between costs and benefits and also provide a clear price signal to those entities that have created the demand for new facilities. The fees that are collected from new customers would be applied to any retirement of debt that needs to be issued to finance new construction, or could be dedicated to the future debt service payments which will alleviate any cost increases an existing customer may experience due to new construction.

While the use of impact fees has evolved nationwide over the past decade, statutory law enabling the use of such fees has not evolved at the same pace. In Wisconsin, it appears that sufficient statutory law exists to establish impact fees for sewer construction. Since the Public Service Commission has jurisdiction over water utility financing, discussions and consent may be necessary from that agency prior to implementing any impact fee relating to water improvement construction.

Impact fees and their determination will be examined in greater detail in subsequent sections of this chapter.

Financing Instruments

General Obligation Bonds

General obligation bonds are by far the most common municipal debt instrument due to the municipality's ability to levy property taxes to support the principal and interest payments of the bond. As general obligation bonds are secured by the full faith and credit of the issuing municipality, this credit provides the strongest security pledge in the marketplace thus lowering the interest rate on the bonds and issuance costs. Each municipal entity has a bonding limit of 5% of its current equalized value which can cause a municipality to use other financing mechanisms.

Revenue Bonds

Revenue bonds are issued with a pledge of future rates or charges being available to support the bond. The principal and interest payments for revenue bonds are payable solely from the revenue generated from a specific project or utility rate. Revenue bonds have the advantage of protecting a municipality's "debt limit". Revenue bonds have the disadvantage of being sold at slightly higher interest rates than general obligation bonds due to the weaker security pledge, which increases the credit risk. To offset this risk to investors most revenue bonds will require reserve funds to be established to provide a sufficient cushion to meet debt payments.

For the purposes of this report, it was assumed that all sewer facility construction would be eligible for some level of Wisconsin Clean Water Fund loan financing. The municipalities would be required to issue a revenue bond pledge against the loans.

For the purposes of this report, it was assumed that for all water facility construction financing, the municipalities would issue 20 year revenue bonds at an interest rate of 7.5%.

INSTITUTIONAL STRUCTURE

There are several institutional options which could be used to implement the recommended regional water and sewerage system alternative. The four options which could be considered are as follows:

1) Form a regional sewer and water authority which would operate independently to furnish water and wastewater conveyance and treatment facilities for the entire service area. This regional authority would be involved in all aspects of providing sewer and water service to the region. It would assume ownership of all of the municipalities sewer and water systems and be responsible for all day to day operations. The advantage of this type of structure would be the establishment of an independent body which would not be as politically influenced by any one of the individual governmental units. An additional benefit would be the ability to plan, coordinate, construct and finance major improvements to the system throughout the service area. An additional benefit of a regional authority is the economic advantage provided by uniform sewer and water rates throughout the area which would aid in attracting new industry and development. A disadvantage of this institutional arrangement is the complexity of the division of assets from the individual municipalities to the regional agency. This includes the assumption of existing debt by the new agency and the purchase or credit for existing debt free equity from the various communities. The establishment of a regional authority and the resolution of compensating for the debt free equity the municipalities have in their existing facilities would require further study.

2) A variation of the regional authority option would be the formation of an agency which only owned and operated the regional infrastructure. This regional infrastructure would include all treatment, storage, and pumping facilities and also all trunk sewers and water transmission mains. The local municipalities would retain ownership and control of local infrastructure . The modified regional authority formed under this option would provide wholesale service to the communities.

   The majority of the advantages and disadvantages would be identical to those described under the regional option albeit on a smaller scale. Under this alternative the individual municipalities would retain local control over the construction and operation and maintenance of its local sewers and water mains. The actual retail billing of each customer would be performed by each municipality.

3) Continue serving the existing contracting communities of Pleasant Prairie and the Town of Somers using Wisconsin Statutes Section 66.30 contracts. In addition, similar contracts for sewer and water service for portions of the Town of Bristol and portions of the Town of Paris would be negotiated. The present contracts require the party contracting with the Kenosha Water Utility to pay for any interceptor or water main which solely benefits that party. If a sewer or water main jointly benefits

more than one community, a prorata share of each entities use is utilized to divide the capital costs if these costs are not included in the rate base. If either the wastewater treatment facility or the water treatment facility are enlarged, each contributing contracting party would advance their proportionate share of the capital costs to the Kenosha Water Utility prior to the construction payments becoming due.

The advantages of this system for providing service is that it is currently being used by the two largest extraterritorial customers of the Kenosha system. The disadvantage of this system lies in the degree of complexity involved in the division of costs for project elements which benefit more than one community.

4) The Kenosha Water Utility would furnish service to the four extraterritorial entities via Section 66.30 contracts and would build and finance all of the facilities within the City boundaries. The Utility would recover the capital costs associated with these facilities via impact fees to be charged to all new customers. The impact fees would be used to pay the principal and interest due on the bonds issued to build the new facilities. Any shortfall in revenues caused by a growth rate lower than predicted would require that the shortfall be made up through the user charge rate structure.

   The main advantage of this institutional arrangement is the ability to simplify the capital cost allocation formulas for any joint use facilities. The disadvantage of this type of arrangement would be the possible debt limitations which the Kenosha Water Utility may experience if many of the projects take place simultaneously.

For the purposes of depicting the fiscal impact of the recommended regional plan, the costs to each governmental entity will be computed using the four institutional structures. A discussion of the institutional structures is as follows:

REGIONAL SEWERAGE AND WATER AUTHORITY OPTION

A regional sewerage and water authority would own, operate, and maintain all treatment facilities, all trunk sewers and transmission mains, and all local collection and distribution facilities. The regional authority would be responsible for all daily operations and would provide retail service to the customers in the service area.

Sewerage Facilities

The closest statutory provisions for a regional authority deal with metropolitan sewerage districts. The provisions of Wisconsin Statues 66.20 and 66.22 allow for the creation of a metropolitan sewerage district by order of the Department of Natural Resources if proceedings are initiated by a municipality and any of the following conditions are met:

1) The territory of at least one entire municipality and all or part of one or more municipalities can be determined to be conducive to fiscal and physical management of a unified sewerage system.

2) The formation of a district will promote sewerage management policies and will be consistent with adopted plans of municipal, regional, and state agencies.

3) The formation of the district will promote the public health and welfare and effect efficiency and economy in sewerage management.

In order for the creation of a metropolitan district to take effect, each municipality owning and operating a sewerage collection and disposal system so slated to be included within the district's territory must issue by resolution its consent to inclusion is such a district. A district formed under the provisions of 66.20 would be governed by a 5 member commission with the commissioners being appointed by the county executive unless it is resolved by all affected municipalities to hold elections.

An additional step in the formation of a metropolitan sewerage district is that with the creation order, the district must establish an infrastructure base for transporting, treating and disposing of sewage. Municipalities with existing facilities could convey to or permit the use of such facilities by the district, with or without compensation. Under the provisions of Wi. Stats. 66.24, the commission of a sewerage district may order the district to assume ownership of existing utility works and facilities within the district as are necessary to carry out the purposes of conveying, treating, and disposal of sewage. The district may be required to reimburse the value of those facilities to the municipality which had owned those facilities, in addition to paying to the municipality funds sufficient to pay the principal and interest of any outstanding obligations issued for the construction of those facilities.

The reimbursement of debt free equity in the existing infrastructures which would become part of the regional system could be accomplished two ways. Under the first approach, the regional authority could make direct payments to an individual municipality, which would require the authority to issue additional bonding. The individual municipality could then utilize the payment as a "sinking fund" to stabilize the retail rate passed on to the customer. The second approach would be to devise a system of credits which would be applied to the rates charged to an individual municipality.

As developed in Chapter VI under the Optimistic Land Use Scenario, the estimated construction cost of upgrading and expanding the Kenosha WTF is approximately $19.7 million. The estimated construction cost of installing all of the recommended trunk sewer system is approximately $25.2 million. The total estimated cost for constructing the sewer facilities under the Optimistic Land Use Scenario is approximately $44.9 million. Under a scenario whereby a regional authority is created to provide sewerage service to the study area, that agency would be responsible for financing and constructing the new facilities. If the authority was also required to acquire existing sewerage facilities to implement regional sewage service, the total cost would be greater. The following table presents the financial data provided by the municipalities and details the level of assets and debt free equity the regional authority could acquire and the amount of existing debt it may have to assume. The table allocates this financial information between local and regional elements and shall be used again under the Modified Regional Option discussion.

Table 7-1
Prepared Financial Data
on Existing Sewerage Facilities
As of December 31, 1990

	Local	Regional	Total
Kenosha			
Net asset value	$8,400,000	$15,717,663	$24,117,663
Long term debt	--	15,266,376	15,266,376
Debt free equity	8,400,000	451,287	8,851,287
Pleasant Prairie			
Net asset value	$(960,202)	$3,210,626	$2,250,424
Long term debt	4,730,000	8,074,385	12,804,385
Debt free equity	(5,690,202)	(4,863,759)	(10,553,961)
Somers			
Net asset value	$312,989	$346,304	$659,293
Long term debt	1,239,560	50,440	1,290,000
Debt free equity	(926,571)	295,864	(630,707)
Bristol			
Net asset value	$424,000	---	$424,000
Long term debt	715,000	---	715,000
Debt free equity	(291,000)	---	(291,000)
Combined			
Net asset value	$8,176,787	$19,274,593	$27,451,380
Long term debt	6,684,560	23,391,201	30,075,761
Debt free equity	1,492,227	(4,116,608)	(2,624,381)

For the purposes of analyzing the regional and modified regional options it was assumed that the regional authority would make direct payments to those municipalities which have positive debt free equity and would receive payments from those municipalities which have negative debt free equity. As Table 7-1 indicates, the regional authority would need to make a direct payment of $8.8 million to Kenosha in order to acquire $24.1 million in total assets and would assume $15.3 million in total existing debt. In the case of Pleasant Prairie, in order for the regional authority to acquire $2.3 million in total assets and assume

$12.8 in total existing debt, Pleasant Prairie would have to make a payment of $10.5 million to the regional authority.

The total net effect of the municipalities relinquishing local control and ownership of their sewerage facilities and forming a regional authority would be for the authority to acquire $27.5 million in assets and assume $30.1 million in existing debt.

Cost Allocation

As discussed in Chapter VI, the Optimistic Land Use Scenario establishes the recommended sewerage system. The Kenosha WTF would be expanded to handle a peak daily flow of 90.7 MGD and storage facilities would be constructed at the plant site to accommodate peak hourly flows up to 142.0 MGD. As presented in Table 6-7, the estimated construction cost is $19,748,300. The annual operation and maintenance cost for the new facilities is estimated to be $1,869,700 per year.

Trunk sewer elements, as listed in Table 7-2, would be constructed to handle the flows generated by the optimistic growth scenario. For those trunk sewers that were common to both the optimistic and ultimate growth scenarios, it is recommended that the trunk sewers be sized to accommodate the flows generated under the ultimate growth scenario due to minimal construction cost differences. Table 7-2 details the trunk sewer elements and costs that would be needed to construct the recommended facilities. The estimated construction cost of these trunk sewers is $25,168,455. The annual operation and maintenance costs for the new sewers are estimated to be $169,161 per year. Combining the WTF and trunk sewer costs results in a total construction cost of $44,916,755. Annual operation and maintenance costs for the new facilities would be $2,038,861.

Under the regional authority option, the agency would construct and finance the recommended infrastructure improvements. The revenue necessary to recover those costs would be allocated to the entire service area based on flows received at the wastewater treatment facility. Table 7-3 tabulates the flow estimates over the near term and the 2010 projections.

Table 7-3
Sewer Facility
Billable Flow Allocations

Municipality	Existing Flow to Kenosha WTF (MGD)	Future Basins Projected Flow (MGD)	Total Basins Projected Flow (MGD)	% of Total
Kenosha (1)	13.637	0.719	14.355	69.49%
Pleasant Prairie (2)	1.147	3.710	4.858	23.51%
Somers (3)	0.221	0.423	0.644	3.12%
Bristol (4)	0.000	0.743	0.743	3.60%
Paris	0.000	0.058	0.058	0.28%
Totals	15.005	5.653	20.658	100.00%

Sources:

1) Kenosha Water Utility PSC Report dated December 31, 1989.
2) Data prepared by Village of Pleasant Prairie March 1991. Pleasant Prairie also transmits 0.254 MGD to the SUD D WTF.
3) Data prepared by Town of Somers December 1990. The future basin flows reflect the border agreement between the Town of Somers and the City of Kenosha.
4) Data prepared by Village of Pleasant Prairie and Town of Bristol shows average daily flow of 0.112 MGD to Pleasant Prairie SUD D WTF.

Fiscal Impact - Regional Authority Option

Trunk Sewers

For the purposes of preparing the fiscal impact that the construction of the proposed trunk sewers would have on an average residential household in the study area the following assumptions were used:

1) As detailed in Table 7-4, the construction of the trunk sewers can be divided into two time frames; 1990 to 1995, and 2000 to 2010 with the majority of the work likely to occur in the earlier period. The one

Table 7-2

TRUNK SEWER COSTS
RECOMMENDED ALTERNATIVE
OPTIMISTIC LAND USE SCENARIO
OPTIMAL PIPE SIZING

Location	Item	Quantity	Unit Price	Cost	Life	Replacement Costs			Salvage	O & M
						20 Years	30 Years	40 Years		
Trunk Sewer #1	102" Sanitary (1)	4430 Ft	$850	$3,765,500	50				$0	$1,678
Trunk Sewer #3	21" Sanitary (1)	1260 Ft	$165	$207,900	50				$0	$477
Trunk Sewer #12	72" Sanitary (1)	8770 Ft	$600	$5,262,000	50				$0	$3,322
Trunk Sewer #16	27" Sanitary (1)	2770 Ft	$110	$304,700	50				$0	$1,049
Trunk Sewer #20	27" Sanitary (1)	1100 Ft	$110	$121,000	50				$0	$417
	21" Sanitary (1)	200 Ft	$100	$20,000	50				$0	$76
Trunk Sewer # 28	8" Sanitary	3700 Ft	$50	$185,000	50				$0	$1,402
Trunk Sewer #29	4.94 MGD Lift Station	1	$1,000,000	$1,000,000	20 - 50	$50,000	$100,000	$50,000	($58,000)	$50,000
	24" Force Main (1)	24800 Ft	$62	$1,537,600	50				$0	$2,348
	0.14 MGD Lift Station	1	$60,000	$60,000	20 - 50	$6,800	$4,400	$6,800	($4,852)	$3,000
	3" Force Main	3800 Ft	$22	$83,600	50				$0	$360
	10" Sanitary (1)	2800 Ft	$60	$168,000	50				$0	$1,061
	10" Sanitary (1)	500 Ft	$300	$150,000	50				$0	$189
Trunk Sewer #30	2.40 MGD Lift Station	1	$240,000	$240,000	20 - 50	$15,000	$240,000		($79,200)	$12,000
	18" Force Main (1)	4100 Ft	$56	$229,600	50				$0	$388
	18" Sanitary (1)	1200 Ft	$200	$240,000	50				$0	$455
Trunk Sewer #32	1.44 MGD Lift Station	1	$190,000	$190,000	20 - 50	$13,000	$190,000		($62,700)	$9,500
	12" Force Main	9000 Ft	$42	$378,000	50				$0	$852
	18" Sanitary (1)	2900 Ft	$165	$478,500	50				$0	$1,098
Trunk Sewer #33	5.17 MGD Lift Station	1	$1,000,000	$1,000,000	20 - 50	$50,000	$100,000		($33,000)	$50,000
	24" Force Main (1)	10800 Ft	$62	$669,600	50				$0	$1,023
Trunk Sewer #34	1.54 MGD Lift Station	1	$195,000	$195,000	20 - 50	$13,000	$195,000		($64,350)	$9,750
	12" Force Main	15700 Ft	$42	$659,400	50				$0	$1,487
Trunk Sewer # 36	8" Sanitary	3000 Ft	$90	$270,000	50				$0	$1,136
	10" Sanitary	5500 Ft	$45	$247,500	50					$2,083
	6" Force Main	8000 Ft	$30	$240,000	50					$758
	0.32 MGD Lift Station	1	$112,450	$112,450	20 - 50	$10,000	$6,500	$10,000	($7,145)	$5,623
Trunk Sewer #39	36" Sanitary (1)	2600 Ft	$210	$546,000	50				$0	$985
Trunk Sewer #40	0.26 MGD Lift Station	1	$88,000	$88,000	20 - 50	$10,000	$6,500	$10,000	($7,145)	$4,400
	6" Forcemain (1)	23700 Ft	$30	$711,000	50				$0	$2,244
Total				$19,360,350		$167,800	$842,400	$76,800	($316,392)	$169,161
Engineering & Contingencies (30%)				$5,808,105						
Total Cost of Construction				$25,168,455						
Present Worth Factors				1.0000		0.3118	0.1741	0.0972	0.0543	
Present Worth of Construction				$25,168,455		$52,321	$146,670	$7,467	($17,176)	
Present Worth Of Construction & Replacement				$25,357,736						
Annual O&M Costs		$169,161								
50 Year Present Worth Factor		15.7619								
Present Worth of Annual O&M Costs				$2,666,295						
Total Present Worth				$28,024,031						

Source: Ruekert & Mielke, Inc.

Table 7-4

Trunk Sewer
Construction Timeline

Trunk Sewer	Construction Cost	Location	1990 to 1995	1995 to 2000	2000 to 2010
1	$3,765,500	Kenosha			
3	$207,900	Kenosha			
12	$5,262,000	Kenosha			
16	$304,700	Kenosha			
20	$141,000	Kenosha			
28	$185,000	Kenosha			
29	$2,999,200	Pleasant Prairie			
30	$709,600	Kenosha			
32	$1,046,500	Pleasant Prairie			
33	$1,669,600	Pleasant Prairie			
34	$854,400	Pleasant Prairie			
36	$869,950	Kenosha			
39	$546,000	Kenosha			
40	$799,000	Somers			
Total	$19,360,350		$15,169,350	$854,400	$3,336,600
Engineering & Cont. @ 30%	$5,808,105		$4,550,805	$256,320	$1,000,980
Total Cost	$25,168,455		$19,720,155	$1,110,720	$4,337,580
Annual Operation & Maintenance	$169,161		$98,932	$11,237	$58,992

Notes:
1) Portions of Trunk Sewers 29, costing $461,600, to service Town of Bristol to be constructed during 1990-1995 period. Portion of Trunk Sewer 29, costing $2,537,600, to connect SUD 'D' to Kenosha to be constructed 2000-2010.

Source: Ruekert & Mielke, Inc.

project that is between these two time frames is Trunk Sewer 34 which will service Utility District 73-1 in Pleasant Prairie and will be considered to fall into the latter time frame for fiscal impact consideration.

2) The construction of the trunk sewers will require the issuance of two Clean Water Fund subsidized bond issues at an interest rate of 5.30% with a 20 year term. The issues would be for $19.7 million to cover the first phase of construction and the other for $5.5 million to cover the second phase. The annual principal and interest payments for these issues would be approximately $1,621,000 and $453,000 respectively.

3) The regional authority would have the option of meeting this capital obligation through user charges, impact fees, assessments, property taxes, or other sources. For the purposes of this report, it is assumed that sewer user charges would serve as the mode for capital cost recovery. As a minimum, the regional authority would be required by the DNR to recover operation, maintenance and replacement costs through the use of sewer user charges.

Wastewater Treatment Facility

For the purposes of preparing the fiscal impact that the construction of the proposed WTF expansion would have on an average residential household in the study area, the following assumptions were used:

1) The construction and expansion of the Kenosha WTF would occur during the 1990-1995 time period.

2) The construction of the WTF expansion will require the issuance of a Clean Water Fund subsidized bond issue for $19.8 million at an interest rate of 4.33% with a 20 year term. The annual principal and interest payments would be approximately $1,499,800.

3) The regional authority would have the option of meeting this capital obligation through user charges, assessments, impact fees, property taxes, or other sources. For the purposes of this report, it is assumed that sewer user charges would serve as the mode for capital cost recovery. As a minimum, the regional authority would be required by the DNR to recover operation, maintenance and replacement costs through the use of sewer user charges.

Existing Facilities and Charges

Under the regional authority option, the regional authority, in addition to financing, constructing, and operating the recommended facilities, would also own and operate the Kenosha Wastewater Treatment Plant, the Pleasant Prairie SUD D and 73-1 WTF's, all trunk sewers, all local collection systems and all major sewage pump stations and force mains. Operation, maintenance, and replacement costs for those existing facilities would be included in the regional rate structure. The regional authority would assume any outstanding debt associated with the facilities being taken over. It was assumed that the regional authority would refinance all of the existing debt it has assumed at an interest rate of 7% over a 20 year term. This debt refinancing assumption ensures a simpler and consistent analysis in formulating the fiscal impact of this option and the other institutional options to be explored.

As was discussed previously, the municipalities will either be issuing local debt to make up the difference in debt free equity the regional authority has acquired or in the case of Kenosha would be receiving payment. It was assumed that the municipalities would recover or dispense this "equity adjustment" through sewer user charges applied to the charge generated by the regional authority. An example of this would be the requirement by Pleasant Prairie to pay the regional authority $10.5 million which represented their negative debt free equity. Assuming that Pleasant Prairie borrowed this amount at 7% over 20 years, they would have to recover $926,000 annually as a charge in addition to the regional authority charge.

Based on the above assumptions and the flows presented in Table 7-3, Table 7-5 presents the annual fiscal impact to an average residential household using 65,000 gallons of water per year over the planning period. It should be noted that the Local Cost presented in the table represents the "equity adjustment" for the community reallocated back as a sewer user charge. The computations for these charges and the other charges are included in Appendix K.

Table 7-5
Regional Authority Option
Annual Fiscal Impact on
Average Residential Household
Total Sewer Facility Costs

	Local Cost		Regional Cost		Total Cost	
Community	1995	2010	1995	2010	1995	2010
Kenosha	($10)	($10)	$136	$106	$126	$96
Pleasant Prairie	$118	$34	$136	$106	$254	$140
Bristol	$41	$6	$136	$106	$177	$112
Somers	$45	$15	$136	$106	$181	$121
Paris	---	---	$136	$106	$136	$106

Water Facilities

Wisconsin Statutes 198.22 allows for the creation of a municipal water district with a governing commission to service more than one governmental entity. The formation of such a district to provide municipal water service to the study area would likely require changes in the current statutes. The creation of a municipal water district under Wisconsin Statutes 198.22 is contingent upon the application of Wisconsin Statutes 198.02 which states "Any two or more municipalities, whether contiguous or otherwise in the same or different counties, may organize and incorporate as a municipal power [water] district, but no municipality shall be divided in the formation of such a district...".[2]. This language appears to conditionally limit the creation of a municipal water district to include only the City of Kenosha and the Village of Pleasant Prairie. The Towns of Bristol and Paris may have to be excluded given their respective western boundaries are outside of the study area, and the Town of Somers may have to be excluded due to the K-R Utility District which is located on the northern boundary of the Town and receives service from facilities in Racine County. While this statute provides for the basis of establishing a water district between municipalities, no such districts have ever been established in the State of Wisconsin under this statute.

Enabling legislation may be required to provide for the structure and creation of a regional water and sewer authority. This legislation would parallel Wisconsin Statutes Section 66.073, "Municipal Electric Power Company Act", which allows for two or more municipal electric utilities to combine.

Under Wisconsin Statutes 198 a municipal water district has the power to own, acquire, and construct a water utility, and while the language on acquiring existing utilities to serve as the basis for the district is not specific, the assumption can be made that any enabling legislation would have to include language to provide for reimbursement by the created district or authority for existing facility acquisition. The reimbursement of debt free equity in the existing infrastructures which would become part of the regional system could be accomplished two ways. Under the first approach, the regional authority could make direct payments to an individual municipality, which would require the authority to issue additional bonding. The individual municipality could then utilize the payment as a "sinking fund" to stabilize the retail rate passed on to the customer. The second approach would be to devise a system of credits which would be applied to the rates charged to an individual municipality. An example of the type of credits to be applied could be the waiving of the depreciation and rate of return components of the user charge rate to the municipality which contributed debt free equity.

As developed in Chapter VI under the Optimistic Land Use Scenario, the existing Kenosha water treatment plant would have to be upgraded at an estimated cost of $4.7 million. The estimated construction cost of installing all of the recommended water transmission mains is approximately $33.1 million. The total estimated cost for constructing the recommended water facility improvements is approximately $37.8 million. In addition to this cost, the regional authority would also incur additional costs for acquiring the existing water facilities. The following table presents the financial data provided by the municipalities and details the level of assets and debt free equity the regional authority would acquire and the amount of existing debt it may have to assume. The table allocates this financial information between local and regional elements and shall be used again under the Modified Regional Option discussion.

2 State of Wisconsin, Wisconsin State Statutes Chapter 198.02, emphasis added.

Table 7-6
Prepared Financial Data
on Existing Water Systems
As of December 31, 1990

	Local	Regional	Total
Kenosha			
Net asset value	$1,057,416	$12,708,726	$13,776,142
Long term debt	---	3,417,994	3,417,994
Debt free equity	1,057,146	9,290,732	10,348,148
Pleasant Prairie			
Net asset value	$1,606,904	$439,958	$2,046,862
Long term debt	3,786,100	472,505	4,258,605
Debt free equity	(2,179,196)	(32,547)	(2,211,743)
Somers			
Net asset value	$772,347	---	$722,347
Long term debt	---	---	---
Debt free equity	772,347	---	722,347
Bristol			
Net asset value	$898,377	---	$898,377
Long term debt	1,300,000	---	1,300,000
Debt free equity	(401,623)	---	(401,623)
Combined			
Net asset value	$4,335,044	$13,148,684	$17,483,728
Long term debt	5,086,100	3,890,499	8,976,599
Debt free equity	(751,056)	9,258,185	8,507,129

For the purposes of analyzing the regional and modified regional options it was assumed that the regional authority would make direct payments to those municipalities which have positive debt free equity and would receive payments from those municipalities which have negative debt free equity. As Table 7-6 indicates, the regional authority would need to make a direct payment of $10.3 million to Kenosha in order to acquire $13.8 million in total assets and assume $3.4 million in total existing debt. In the case of Pleasant Prairie, in order for the regional authority to acquire $2.0 million in total assets and assume $4.3 in total existing debt, Pleasant Prairie would have to make a payment of $2.2 million to the regional authority.

The total net effect of the municipalities relinquishing local control and ownership of their water systems and forming a regional authority would be for the authority to acquire $17.5 million in assets and assume $9.0 million in existing debt.

Cost Allocation

As discussed in Chapter VI, the "centralized" water system based on the optimistic growth scenario is the recommended water system plan. The water treatment facility will have to be expanded to provide additional clear water storage of 6.0 MG. As presented in Table 6-23 the estimated construction cost is $3,600,000 with a total cost of $4,680,000 including engineering and contingencies. The annual operation and maintenance cost for the new construction is estimated to be $438,011 per year.

Water transmission, pumping and storage elements, as listed in Table 7-7 would be constructed to handle the demands generated by the optimistic growth scenario. For those facilities that were common to both the optimistic and ultimate growth scenarios, it is recommended that the transmission mains be sized to accommodate the demands generated under the ultimate growth scenario due to minimal cost differences.

Table 7-7 details the elements and costs that would be needed to construct the recommended facilities. The estimated construction costs of these facilities is $33,106,580. The annual operation and maintenance cost is estimated to be $316,750 per year.

Combining the water treatment facility and supply, storage, and transmission facility costs results in a total construction cost of $37,786,580. The annual operation and maintenance cost would be $754,761.

As was the case with the regional sewer authority, under the regional water authority option, the authority would construct and finance the recommended infrastructure improvements. The regional authority would also assume the outstanding debt associated with any of the facilities being taken over. The revenue necessary to recover the existing and future debt would be allocated to the entire

Table 7-7

WATER SUPPLY, STORAGE AND TRANSMISSION FACILITY COSTS

RECOMMENDED DEVELOPMENT PLAN

Improvement	Item	Quantity	Unit Price	Cost	Life	Replacement Costs 10 Years	Replacement Costs 20 Years	Replacement Costs 30 Years	Replacement Costs 40 Years	Salvage	O & M
1	30" Water Main	11,500	$93	$1,069,500	50						$2,614
2	36" Water Main	12,000	$108	$1,296,000	50						$2,727
	24" Water Main	15,200	$73	$1,109,600	50						$3,455
3	16" Water Main	2,500	$55	$137,500	50						$568
	24" Water Main	3,500	$73	$255,500	50						$795
4	24" Water Main	4,500	$73	$328,500	50						$1,023
5	12" Water Main	8,100	$53	$429,300	50						$1,841
6	12" Water Main	7,600	$53	$402,800	50						$1,727
	12" Pressure Control Valv	1	$4,000	$4,000	20		$4,000		$4,000	($2,000)	$200
	Manhole	1	$1,500	$1,500	50						$75
	Mechanical & Bypass	1	$18,000	$18,000	20		$18,000		$18,000	($9,000)	$900
7	50Hp Pump, Mechanical	1	$25,000	$25,000	20		$25,000		$25,000	($12,500)	$1,250
	200 KW Gen, Reduced										
	Voltage Starter, Controls	1	$30,000	$30,000	30			$30,000		($9,900)	$1,500
	Fuel Tank	1	$7,000	$7,000	30			$7,000		($2,310)	$350
	Building Addition	1	$65,000	$65,000	50						$3,250
7A	30th Avenue:										
	225 Hp Pump	1	$18,000	$18,000	20		$18,000		$18,000	($9,000)	$900
	Building Addition	1	$60,000	$60,000	50						$3,000
	Mechanical	1	$50,000	$50,000	20		$50,000		$50,000	($25,000)	$2,500
	80th Street:										
	150 Hp Pump	1	$12,000	$12,000	20		$12,000		$12,000	($6,000)	$600
	Building Addition	1	$60,000	$60,000	50						$3,000
	Mechanical	1	$12,000	$12,000	20		$12,000		$12,000	($6,000)	$600
8	16" Water Main	3,000	$55	$165,000	50						$682
9	12" Water Main	4,500	$53	$238,500	50						$1,023
10	24" Water Main	5,800	$73	$423,400	50						$1,318
11	20" Water Main	5,800	$67	$388,600	50						$1,318
12	16" Water Main	2,800	$55	$154,000	50						$636
	12" Water Main	2,800	$53	$148,400	50						$636
13	16" Water Main	8,000	$55	$440,000	50						$1,818
14	20" Water Main	12,400	$67	$830,800	50						$2,818
15	16" Water Main	16,000	$55	$880,000	50						$3,636
16	12" Water Main	4,000	$53	$212,000	50						$909
17	24" Water Main	8,600	$73	$627,800	50						$1,955
18	16" Water Main	2,600	$55	$143,000	50						$591
19	16" Water Main	5,200	$55	$286,000	50						$1,182
20	12" Water Main	1,500	$53	$79,500	50						$341
21	12" Water Main	5,400	$53	$286,200	50						$1,227
22	16" Water Main	4,800	$55	$264,000	50						$1,091
23	12" Water Main	3,400	$53	$180,200	50						$773

Table 7-7

WATER SUPPLY, STORAGE AND TRANSMISSION FACILITY COSTS

RECOMMENDED DEVELOPMENT PLAN

Improvement	Item	Quantity	Unit Price	Cost	Life	Replacement Costs 10 Years	20 Years	30 Years	40 Years	Salvage	O & M
24	Pump Station Building	1	$175,000	$175,000	50						$8,750
	Pumps (200 Hp)	2	$16,000	$32,000	20		$32,000		$32,000	($16,000)	$1,600
	Mechanical	1	$60,000	$60,000	20		$60,000		$60,000	($30,000)	$3,000
	Electrical	1	$80,000	$80,000	30			$80,000		($26,400)	$4,000
	Controls	1	$20,000	$20,000	30			$20,000		($6,600)	$1,000
	230 KW Gen, Reduced Starter, Controls, Fuel Ta	1	$44,000	$44,000	30			$44,000		($14,520)	$2,200
	Sitework	1	$30,000	$30,000	50						$1,500
	1,300,000 Gal Reservior	1	$950,000	$950,000	50						$47,500
25	24" Water Main	4,800	$73	$350,400	50						$1,091
26	24" Water Main	3,400	$73	$248,200	50						$773
27	16" Water Main	7,100	$55	$390,500	50						$1,614
28	16" Water Main	4,000	$55	$220,000	50						$909
29	20" Water Main	800	$67	$53,600	50						$182
	20" Main in 30" Casing	400	$350	$140,000	50						$91
30	24" Water Main	3,600	$73	$262,800	50						$818
31	16" Water Main	10,100	$55	$555,500	50						$2,295
32	16" Water Main	8,000	$55	$440,000	50						$1,818
33	Pump Station Building	1	$60,000	$60,000	50						$3,000
	Pumps (25 Hp)	2	$3,000	$6,000	20		$6,000		$6,000	($3,000)	$300
	Mechanical	1	$30,000	$30,000	20		$30,000		$30,000	($15,000)	$1,500
	Elec & Controls, Gen	1	$50,000	$50,000	30			$50,000		($16,500)	$2,500
34	500,000 Gal Elevated Tank 140' Tall, Foundation	1	$610,000	$610,000	50						$30,500
	Painting	1	$65,000	$65,000	10	$65,000	$65,000	$65,000	$65,000		$3,250
	Electrical & Controls	1	$7,500	$7,500	30			$7,500		($2,475)	$375
35	12" Water Main	14,500	$53	$768,500	50						$3,295
36	20" Water Main	7,000	$67	$469,000	50						$1,591
37	Booster Station w/ 10 Hp, 15 Hp & 25 Hp Motors	1	$80,000	$80,000	20		$80,000		$80,000	($40,000)	$4,000
	Electrical	1	$5,000	$5,000	30			$5,000		($1,650)	$250
38	12" Water Main	12,000	$53	$636,000	50						$2,727
39	24" Water Main	1,500	$73	$109,500	50						$341
	16" Water Main	6,500	$55	$357,500	50						$1,477
	20" Water Main	9,000	$67	$603,000	50						$2,045
40	12" Water Main	20,900	$53	$1,107,700	50						$4,750
	16" Water Main	5,300	$55	$291,500	50						$1,205
41	12" Water Main	7,700	$53	$408,100	50						$1,750
	20" Water Main	4,300	$69	$296,700	50						$977
42	16" Water Main	5,500	$55	$302,500	50						$1,250
43	16" Water Main	3,000	$55	$165,000	50						$682
44	12" Water Main	2,500	$53	$132,500	50						$568
45	12" Water Main	10,000	$53	$530,000	50						$2,273
46	16" Water Main	3,000	$55	$165,000	50						$682

Table 7-7

WATER SUPPLY, STORAGE AND TRANSMISSION FACILITY COSTS

RECOMMENDED DEVELOPMENT PLAN

						Replacement Costs					
Improvement	Item	Quantity	Unit Price	Cost	Life	10 Years	20 Years	30 Years	40 Years	Salvage	O & M
47	12" Water Main	1,500	$53	$79,500	50						$341
48	12" Water Main	2,000	$53	$106,000	50						$455
49	5 MG Prestressed Above Ground Conc. Reservior	1	$1,560,000	$1,560,000	50						$78,000
50	Pump Station Building	1	$150,000	$150,000	50						$7,500
	Fire Pump (250 Hp)	1	$20,000	$20,000	20		$20,000		$20,000	($10,000)	$1,000
	Service Pump (100 Hp)	2	$7,000	$14,000	20		$14,000		$14,000	($7,000)	$700
	Mechanical	1	$60,000	$60,000	20		$60,000		$60,000	($30,000)	$3,000
	Controls	1	$20,000	$20,000	30			$20,000		($6,600)	$1,000
	Electric	1	$80,000	$80,000	30			$80,000		($26,400)	$4,000
	Gen, Controls, Fuel Tank	1	$44,000	$44,000	30			$44,000		($14,520)	$2,200
	Site Work	1	$30,000	$30,000	50						$1,500
	16" Discharge Main	4,600	$55	$253,000	50						$1,045
51	Sub Booster Station	2	$63,000	$126,000	20		$126,000		$126,000	($63,000)	$6,300
52	Sub Booster Station	1	$54,000	$54,000	20		$54,000		$54,000	($27,000)	$2,700
53	16" Water Main	7,700	$55	$423,500	50						$1,750
				$25,466,600		$65,000	$686,000	$452,500	$686,000	($438,375)	$316,750
Engineering & Contingencies (30%)				$7,639,980							
Total Cost of Construction				$33,106,580							
Present Worth Factors				1.0000		0.5584	0.3118	0.1741	0.0972	0.0543	
Present Worth of Construction				$33,106,580		$36,296	$213,898	$78,785	$66,694	($23,799)	
Present Worth Of Construction & Replacement				$33,478,454							
Annual O & M Costs *			$316,750								
50 Year Present Worth Factor			15.7619								
Present Worth Of Annual O & M Costs				$4,992,569							
Total Present Worth				$38,471,024							

* O & M costs are assumed to be 5% of construction costs for pumping and storage facilties and $1,200 per mile of transmission main.

Source: Ruekert & Mielke, Inc.

service area based on supplied flows. Table 7-8 presents the existing and estimated water demands used for the analysis.

Fiscal Impact - Regional Authority Option

Following discussions with local officials, a general timetable was developed for the construction of the various water facility components. Table 7-9 presents the projected timetable and will be utilized further in developing the fiscal impacts of construction.

For the purposes of computing the fiscal impact that the construction of the proposed water facilities, including the treatment plant expansion, would have on an average residential household in the study area, the following assumptions were used:

1) As detailed in Table 7-9, the construction of the required water improvements can be divided into three time frames; 1990 to 1995; 1995 to 2000; and 2000 to 2010 with the majority of the work likely to occur in the earlier period. For fiscal impact consideration, the four items contained in the 1995 to 2000 time frame will be included in the 2000 to 2010 time frame.

2) The construction of the water facilities will be financed by revenue bonds at an interest rate of 7.5% with a 20 year term.

3) For the purposes of this report, it is assumed that water rates would serve as the mode for cost recovery. Water rates are determined by using the base-extra capacity method in which costs of service are separated into base costs, extra capacity costs (maximum day and maximum hour demand capacity) and customer costs.

Table 7-8
Billable Water Demand Allocations
Kenosha Water Treatment Plant*

Municipality	Existing Demand on Kenosha Water Plant	Future Projected Demand	% of Future Demand	Projected Total Demand	% of Total
Kenosha	12.346 MG	0.635 MG	8.84%	12.981 MG	63.36%
Pleasant Prairie	.542 MG	4.955 MG	69.00%	5.497 MG	26.83%
Somers	.418 MG	0.790 MG	11.00%	1.208 MG	5.90%
Bristol	0.000 MG	0.743 MG	10.35%	0.743 MG	3.63%
Paris	0.000 MG	0.058 MG	0.81%	0.058 MG	0.28%
Totals	13.306 MG	7.181 MG	100.00%	20.487 MG	100.00%

*Cost of the water storage facility is estimated at $4,680,000.

Existing Facilities and Charges

Under the regional authority option, the authority, in addition to financing, constructing, and operating the recommended facilities, would also own and operate the Kenosha Water Treatment facility, all storage reservoirs and elevated tanks, all pumping facilities, and all transmission and distribution mains within the service area. Operation, maintenance, depreciation, and debt costs for those existing facilities would be included in the regional rate structure. It was assumed that the regional authority would refinance all of the existing debt it has assumed at an interest rate of 7% over a 20 year term.

As was discussed previously, the municipalities will either be issuing local debt or receiving a direct payment to satisfy the debt free equity balances. It was assumed that the municipalities would recover or dispense this "equity adjustment" through water charges applied to the retail charge computed by the regional authority. An example of this would be the requirement by Pleasant Prairie to pay the regional authority $2.2 million which represented their negative debt free equity. Assuming that Pleasant Prairie borrowed this amount at 7% over 20 years, they would have to recover $194,000 annually as a charge in addition to the regional authority charge.

Based on the above assumptions and the flows presented in Table 7-8, Table 7-10 presents the annual fiscal impact to an average residential household using 65,000 gallons of water per year over the planning period. It should be noted that the local cost presented in the table represents the "equity adjustment" for the community reallocated back as a water user charge.

Table 7-9
Water Improvements
Construction Timeline

Improvement	Construction Cost	Location	1990 to 1995	1995 to 2000	2000 to 2010
1	$1,069,500	Kenosha	■		
2	$1,296,000	Kenosha	■		
	$1,109,600	Pleasant Prairie			■
3	$393,000	Kenosha	■		
4	$328,500	Pleasant Prairie			■
5	$429,300	Pleasant Prairie			■
6	$426,300	Somers	■		
7	$127,000	Kenosha	■		
7A	$212,000	Kenosha	■		
8	$165,000	Pleasant Prairie	■		
9	$238,500	Kenosha	■		
10	$423,400	Kenosha	■		
11	$388,600	Somers	■		
12	$302,400	Kenosha	■		
13	$440,000	Kenosha	■		
14	$830,800	Somers	■		
15	$880,000	Kenosha	■		
16	$212,000	Kenosha	■		
17	$627,800	Kenosha	■		
18	$143,000	Kenosha	■		
19	$286,000	Pleasant Prairie	■		
20	$79,500	Pleasant Prairie	■		
21	$286,200	Pleasant Prairie	■		
22	$264,000	Pleasant Prairie	■		
23	$180,200	Pleasant Prairie	■		
24	$1,391,000	Kenosha	■		
25	$350,400	Kenosha	■		
26	$248,200	Kenosha	■		
27	$390,500	Kenosha	■		
28	$220,000	Kenosha	■		
29	$193,600	Kenosha	■		

Table 7-9
Water Improvements
Construction Timeline

Improvement	Construction Cost	Location	1990 to 1995	1995 to 2000	2000 to 2010
30	$262,800	Kenosha	■		
31	$555,500	Kenosha	■		
32	$440,000	Kenosha	■		
33	$146,000	Somers		■	
34	$682,500	Somers			■
35	$768,500	Somers			■
36	$469,000	Somers		■	
37	$85,000	Kenosha	■		
38	$636,000	Kenosha	■		
39	$1,070,000	Pleasant Prairie	■		■
40	$1,399,200	Pleasant Prairie	■		■
41	$704,800	Pleasant Prairie	■	■	■
42	$302,500	Pleasant Prairie	■		
43	$165,000	Pleasant Prairie	■		
44	$132,500	Pleasant Prairie	■		
45	$530,000	Pleasant Prairie	■		■
46	$165,000	Pleasant Prairie	■		
47	$79,500	Pleasant Prairie	■		
48	$106,000	Pleasant Prairie	■		
49	$1,560,000	Pleasant Prairie	■		
50	$671,000	Pleasant Prairie	■		
51	$126,000	Pleasant Prairie	■		
52	$54,000	Pleasant Prairie		■	
53	$423,500	Pleasant Prairie	■		
Treatment Plant	$3,600,000	Kenosha			■
Total	$29,066,600		$19,764,400	$965,700	$8,336,500
Engineering & Cont. @ 30%	$8,719,980		$5,929,320	$289,710	$2,500,950
Total Cost	$37,786,580		$25,693,720	$1,255,410	$10,837,450
Annual Operation & Maintenance	$754,761		$254,602	$12,568	$487,591

Source: Ruekert & Mielke, Inc.

Table 7-10
Regional Authority Option
Annual Fiscal Impact on
Average Residential Household
Total Water Facility Costs

	Local Cost		Regional Cost		Total Cost	
Community	1995	2010	1995	2010	1995	2010
Kenosha	($13)	($12)	$122	$95	$109	$83
Pleasant Prairie	$42	$6	$122	$95	$164	$101
Bristol	$70	$8	$122	$95	$192	$103
Somers	($29)	($10)	$122	$95	$93	$85
Paris	---	---	$122	$95	$122	$95

MODIFIED REGIONAL SEWERAGE AND WATER AUTHORITY OPTION

A modified regional sewerage and water authority would own operate and maintain the wastewater treatment facilities in both Pleasant Prairie and Kenosha, including the trunk sewers and major lift stations and forcemains, as well as major conveyance facilities in the Town of Somers. The Kenosha water treatment facility, major water mains, storage facilities, and booster facilities would all be owned and operated by the regional authority. The regional authority would bill the individual municipalities for wholesale service based on master meters installed in the system. Retail service could be provided via Wisconsin Statutes 66.30 agreements for any municipality served by the regional authority. Since the Kenosha Water Utility presently operates the sewer and water systems for the City on a retail basis it is assumed that Kenosha would request that the regional authority provide the retail service. Each of the other municipal customers would need to evaluate the question of wholesale service versus retail service.

The primary difference between the regional and modified regional options is that the created authority would not acquire and operate the local utility infrastructure. Each municipality would continue to own and operate its local sewer collection system and water distribution system. All of the other conditions previously discussed under the regional authority option would pertain to this option with the exception of the amount of assets acquired and debt assumed by the regional authority.

Table 7-1 and Table 7-6 presents the level of total assets and debt the authority would acquire under the regional option. Under the modified regional option, the authority would acquire only those assets and assume the debt that was identified as regional in the tables. As Table 7-1 indicates, the regional authority under the modified option would need to make a direct payment of $450,000 to Kenosha in order to acquire $15.7 million in assets and assume $15.3 million in debt.

The net effect of the municipalities relinquishing control and ownership of their regional infrastructure elements would be for the authority to acquire $19.3 million in sewerage facility assets and assume $23.4 million in sewerage related debt. On the water facility side, the authority would acquire $13.1 million in water facility assets and assume $3.8 million in water related debt.

Fiscal Impact - Modified Regional Authority Option

Sewer Facilities

For the purposes of preparing the fiscal impact that the construction of the proposed sewer improvements previously identified in Table 7-2, including the Kenosha WTF expansion, the same assumptions and criteria used under the regional authority option will be repeated for the modified regional option. The modified regional authority would own, operate, and construct all of the necessary improvements in addition to owning and operating the existing regional facilities. The municipalities would continue to own and operate the local collection system facilities. The municipalities would receive a wholesale bill for service from the regional authority and would add to this bill costs for local operations. An element of the local charge would be costs for the "equity adjustment" which had been discussed under the regional option.

Based on these assumptions, Table 7-11 presents the annual fiscal impact to an average residential household using 65,000 gallons of water per year over the planning period.

Table 7-11
Modified Regional Authority Option
Annual Fiscal Impact on
Average Residential Household
Total Sewerage Facilities Costs

	Local Cost		Regional Cost		Total Cost	
Community	1995	2010	1995	2010	1995	2010
Kenosha	$14	$14	$106	$84	$120	$98
Pleasant Prairie	$184	$53	$106	$84	$290	$137
Bristol	$148	$22	$106	$84	$254	$106
Somers	$112	$39	$106	$84	$218	$123
Paris (1)	---	---	$106	$84	$106	$84

(1) Paris would incur local costs in the future when a local system is constructed.

Water Facilities

For the purposes of preparing the fiscal impact that the construction of the proposed water improvements identified in Table 7-7, including the expansion of the Kenosha water treatment plant would have on the users, the same assumptions and criteria used under the regional authority option will be repeated. The modified regional authority would own, operate, and construct all of the necessary improvements in addition to owning and operating the existing regional facilities. The municipalities would continue to own and operate the local collection system facilities. The municipalities would receive a wholesale bill for service from the regional authority and would add to this bill costs for local operations. An element of the local charge would be costs for the "equity adjustment" which had been discussed under the regional option.

Based on these assumptions, Table 7-12 presents the annual fiscal impact to an average residential household using 65,000 gallons of water per year over the planning period.

Table 7-12
Modified Regional Authority Option
Annual Fiscal Impact on
Average Residential Household
Total Water Facilities Costs

	Local Cost		Regional Cost		Total Cost	
Community	1995	2010	1995	2010	1995	2010
Kenosha	$28	$26	$79	$67	$107	$93
Pleasant Prairie	$163	$54	$79	$67	$242	$121
Bristol	$277	$33	$79	$67	$356	$100
Somers	$38	$14	$79	$67	$117	$81
Paris (1)	---	---	$79	$67	$79	$67

(1) Paris would incur local costs in the future when a local system is constructed.

EXISTING CONTRACT OPTION

Sewer Facilities

The Town of Somers and Village of Pleasant Prairie have in place a contractual agreement with the Kenosha Water Utility for the allocation of sanitary sewer and wastewater treatment related capital costs. The essence of these agreements is that for trunk sewer facilities constructed to exclusively benefit a municipality that municipality would be responsible for the cost regardless of the jurisdictional location of the facility. For the construction of trunk sewers that provide mutual benefit, a cost sharing arrangement would be derived based on design flow.

The additional costs for any oversizing of sewer mains, trunk sewers, or other infrastructure constructed in a municipality would be recovered from the benefiting municipality to the extent that the additional costs are not covered in the sewer rate base.

Under the Existing Contract Option, costs for constructing the recommended sewer facilities would be allocated to the municipalities in accordance with the existing intermunicipal agreements.

Trunk Sewers

In accordance with the existing contractual agreements for the allocation of trunk sewer costs, Table 7-13 presents the municipal cost allocations. This is based on the basin flows that each trunk sewer will convey to the Kenosha Wastewater Treatment Facility and the costs of constructing each trunk sewer.

As this table indicates, the construction of these trunk sewers including engineering and contingencies has an estimated cost of $25,168,455. Based on year 2010 projected basin flows, the City of Kenosha would account for 42.30% or $10,646,527 of these costs; the Village of Pleasant Prairie would account for 31.99% or $8,051,965 of these costs; the Town of Bristol would account for 6.11% or $1,537,915 of these costs; the Town of Somers would account for 16.99% or $4,275,144 of these costs; and the Town of Paris would account for the remaining 2.61% or $656,904 of these costs.

Following discussions with local officials, a general time table was developed for the construction of the various trunk sewer components. Table 7-4 presents the projected time table and will be utilized further in developing the fiscal impact of the trunk sewer construction.

Wastewater Treatment Facility

The same rationale for the distribution of construction costs for the trunk sewers can be applied to allocating construction costs of the WTF. Based on the billable flows conveyed to the WTF projected for year 2010, the costs can be allocated to each contributing municipality as detailed in Table 7-3.

The construction of the Wastewater Treatment Facility including engineering and contingencies has an estimated cost of $19,748,300. Based on year 2010 projected basin flows, the City of Kenosha would account for 69.49% or $13,723,094 of these costs; the Village of Pleasant Prairie would account for 23.51% or $4,642,825 of these costs; the Town of Bristol would account for 3.60% or $710,939 of these costs; the Town of Somers would account for 3.12% or $616,147 of these costs; and the Town of Paris would account for the remaining 0.28% or $55,295 of these costs.

Fiscal Impact Existing Contract

Trunk Sewers

For the purposes of preparing the fiscal impact that the construction of the proposed trunk sewers would have on an average residential household in the study area, the assumptions presented under the Regional Authority Option were used with the following change:

1) In accordance with current contractual language for capital cost recovery for constructing trunk sewers, each municipality would contribute its share of the annual debt service based on the percentages developed in Table 7-13. For recovery of annual operation and maintenance costs, each municipality would contribute its share of this cost based on the percentage of billable flow it contributes to the system.

Wastewater Treatment Facility

For the purposes of preparing the fiscal impact that the construction of the proposed WTF expansion would have on an average residential household in the study area the assumptions presented under the Regional Authority Option were used with the following change:

1) The annual debt service payment would be allocated to the communities based on the percentages previously developed in Table 7-3. Annual operation and maintenance expenses would be allocated on the basis of billable flow percentages. For the purposes of this report, it is assumed that sewer user charges would serve as the mode for cost recovery.

Existing Sewerage Infrastructure

In addition to the charges developed for constructing the recommended facilities, each municipality would continue to charge for local infrastructure costs. The local charges would need to be added to the new facility charges to present a total residential charge. Local charges were computed using the financial data submitted by the municipalities. These charges are structured to recover only operation and maintenance costs and debt service costs assuming the existing local debt is financed at 7% over 20 years. The computed local charges do not include any allowances for reserves, depreciation or any capital projects thus the computed charged may vary from current sewer charges. Table 7-14 presents the total average annual residential charges.

Table 7-13
Trunk Sewer Construction
Allocation of Costs
Based on Basin Flows

Trunk Sewer	Construction Cost	Kenosha	Pleasant Prairie	Bristol	Somers	Paris
1	$3,765,500	$3,106,399	$200,674		$437,850	$20,577
3	$207,900	$103,950	$103,950			
12	$5,262,000	$4,153,423			$1,058,818	$49,759
16	$304,700	$304,700				
20	$141,000	$129,071			$11,929	
28	$185,000	$185,000				
29	$2,999,200		$2,879,232	$119,968		
30	$709,600	$207,094	$50,251	$452,255		
32	$1,046,500		$697,702	$348,798		
33	$1,669,600		$1,407,610	$261,990		
34	$854,400		$854,400			
36	$869,950				$434,975	$434,975
39	$546,000				$546,000	
40	$799,000				$799,000	
Subtotal	$19,360,350	$8,189,636	$6,193,819	$1,183,011	$3,288,572	$505,311
Engineering & Cont. @ 30%	$5,808,105	$2,456,891	$1,858,146	$354,903	$986,572	$151,593
Total Cost	$25,168,455	$10,646,527	$8,051,965	$1,537,915	$4,275,144	$656,904
% of Cost		42.30%	31.99%	6.11%	16.99%	2.61%
O&M Costs	$169,161	$71,557	$54,118	$10,337	$28,734	$4,415

Source: Ruekert & Mielke, Inc.

Table 7-14
Existing Contract Option
Annual Fiscal Impact on
Average Residential Household
Total Sewerage Facilities Costs

	Local		New Facilities		Total Charge	
Community	1995	2010	1995	2010	1995	2010
Kenosha	$55	$46	$43	$41	$101	$84
Pleasant Prairie	$311	$107	$130	$55	$441	$162
Bristol	$226	$73	$243	$62	$469	$135
Somers	$283	$135	$176	$75	$459	$210
Paris		$29		$209		$238

Under the Existing Contract Option, the estimated 1995 customer base using the constructed sewer facilities would include the City of Kenosha, the Town of Somers, and portions of the Village of Pleasant Prairie. Though the Town of Bristol would be serviced by the Village of Pleasant Prairie "SUD D" treatment plant and would not need to convey any flow through the proposed trunk sewer constructed during this period, the Town would still be required to participate in capital contributions towards its portion of the trunk sewers and the WTF designed for its future flows. The annual capital contribution by the Town of Bristol are estimated to be $152,900 per year until the Town begins to utilize the constructed facilities, at which time sewer user charges would recover the capital needs. The 1995 charges presented in the table reflects the cost of having Bristol's flow treated at the SUD D plant and raising the necessary capital for the trunk sewers. The 2010 charges presented in the table reflects the abandonment of the SUD D plant and Bristol's flows being sent to the new Kenosha plant.

The Town of Paris will experience a similar situation under the Existing Contract Option whereby the Town will be required to contribute capital towards facilities designed for them though a customer base hasn't been established. The estimated annual capital contribution towards the trunk sewers and WTF is $46,500 per year.

Water Facilities Existing Contract

Currently, the majority of the municipalities within the study area have in place a contractual structure for the allocation of water system related capital costs. The essence of these agreements is that for water supply, storage, and transmission facilities constructed to exclusively benefit a municipality, that municipality will be responsible for the cost regardless of the jurisdictional location of the facility. For the construction of water supply, storage and transmission facilities that provide a mutual benefit, a cost sharing arrangement would be instituted.

The division of costs for construction of water facilities based upon benefit is extremely difficult. A water transmission facility may carry a small amount of water under normal demands and a much larger amount under peak demands. An equitable way of sharing costs has not been determined by the Kenosha Water Utility and the adjacent communities. The current practice is for the municipalities to construct and pay for facilities within their municipal boundaries. Costs are then recovered through water rates.

The following assumptions will be used to determine cost allocations under the existing contract option.

1) Transmission mains will be constructed and paid for by the municipality they are located in. The division of cost for these facilities based upon benefit is not possible without detailed and lengthy analysis and negotiation. In areas where a transmission main runs adjacent to a municipal boundary and may serve both municipalities, costs will be shared evenly. In areas where a transmission main crosses municipal boundaries, costs will be divided on a prorata basis.

2) Storage facilities costs will be divided based upon peak hour demands for the areas that will eventually benefit from the construction of these facilities. This is done because the required size of storage facilities is a function of the projected peak hour demand in the areas to be served.

3) Water supply and pumping facility costs will be divided based upon peak day demands for the areas that will eventually benefit from the construction of these facilities. The required size of supply

facilities is most nearly a function of the projected peak day demands for areas that will eventually be served. This means that if water needs booster pumping twice before it reaches a customer, a portion of both stations cost will be incurred by that customer. In situations such as the booster station to serve high elevation areas near ISH 94 and STH 142, the only benefitting municipality is Paris which then should pay for the construction costs of the booster station even though it is located in a different municipality.

Based on year 2010 projected demands and the aforementioned assumptions, the City of Kenosha would account for 34.08% or $11,283,545 of these costs; the Village of Pleasant Prairie would account for 43.89% or $14,530,750 of these costs; the Town of Bristol would account for 2.58% or $854,880 of these costs; the Town of Somers would account for 18.65% or $6,172,985 of these costs; and the Town of Paris would account for 0.80% or $264,420 of these costs.

Water Treatment Facility

The water treatment facility is currently capable of meeting peak day demands. Based upon projected year 2010 flows, a slight increase in clear water storage will be required. The cost of the required improvements can be allocated based upon the incremental demands and percentages detailed in Table 7-8.

As this table indicates, the construction of the clear water storage reservoir including engineering and contingencies has an estimated cost of $4,680,000. Based on year 2010 projected incremental water demands, the City of Kenosha would account for 8.84% or $413,720 of these costs; the Village of Pleasant Prairie would account for 69.00% or $3,229,200 of these costs; the Town of Somers would account for 11.00% or $514,800 of these costs; the Town of Bristol would account for 10.35% or $484,380 of theses costs; and the Town of Paris would account for 0.81% or $37,900 of these costs.

Combining the cost allocations for the supply, storage, and transmission facilities with the water treatment facility costs results in a total cost of $37,786,580 which can be allocated as follows; the City of Kenosha - $11,697,265 or 30.96%; the Village of Pleasant Prairie - $17,759,950 or 47.00%; the Town of Bristol - $1,339,260 or 3.54%; the Town of Somers - $6,687,785 or 17.70%; and the Town of Paris - $302,320 or 0.80%. Table 7-15 summarizes the costs allocated to each municipality

Fiscal Impact - Water Facilities

For the purposes of preparing the fiscal impact that the construction of the proposed water facilities, including treatment plant expansion, would have on an average residential household in the study area the same assumptions used under the Regional Authority Option were followed.

Based on these assumptions, financing and constructing the recommended water facilities under the Existing Contract Option would result in the annual charges listed in Table 7-16 for an average household using 65,000 gallons of water per year. It must be noted that the Town of Bristol could see a wide range of charges within the Town depending upon which facilities are used for service. It is assumed that the Town of Bristol's share of the net local capital costs expended within the Village of Pleasant Prairie would be based on Bristol's pro rata share of the design capacities of those facilities.

Table 7-16
Existing Contract Option
Annual Fiscal Impact on
Average Residential Household
Total Water Facility Costs

	Existing		New		Total	
Community	1995	2010	1995	2010	1995	2010
Kenosha	$76	$46	$16	$16	$92	$62
Pleasant Prairie	$343	$102	$325	$75	$668	$177
Bristol	$374	$100	$155	$36	$529	$136
Somers	$136	$79	$248	$122	$384	$201
Paris (1)	---	$66				

(1) Existing 2010 charge represents estimated wholesale charge from Kenosha Water Utility

Table 7-15

WATER SUPPLY, STORAGE AND TRANSMISSION FACILITY COSTS ALLOCATION OF COSTS BASED UPON DEMAND

Improvement	Construction Cost	Kenosha	Pleasant Prairie	Bristol	Somers	Paris
1	$1,069,500	$1,069,500				
2	$2,405,600	$1,296,000	$1,109,600			
3	$393,000	$393,000				
4	$328,500		$328,500			
5	$429,300		$429,300			
6	$426,300				$426,300	
7	$339,000	$30,000	$234,000	$35,000	$37,300	$2,700
8	$165,000	$11,000	$154,000			
9	$238,500	$238,500				
10	$423,400	$248,200			$175,200	
11	$388,600				$388,600	
12	$302,400	$302,400				
13	$440,000	$440,000				
14	$830,800				$830,800	
15	$880,000	$440,000			$440,000	
16	$212,000	$106,000			$106,000	
17	$627,800	$627,800				
18	$143,000	$143,000				
19	$286,000		$286,000			
20	$79,500		$79,500			
21	$286,200		$286,200			
22	$264,000		$264,000			
23	$180,200		$180,200			
24	$1,391,000	$409,000	$420,000	$525,800		$36,200
25	$350,400	$350,400				
26	$248,200	$248,200				
27	$390,500	$390,500				
28	$220,000	$220,000				
29	$193,600	$96,800		$96,800		
30	$262,800	$197,100	$65,700			
31	$555,500	$555,500				
32	$440,000	$165,000	$275,000			
33	$146,000				$146,000	
34	$682,500				$682,500	
35	$768,500				$768,500	

Table 7-15

WATER SUPPLY, STORAGE AND TRANSMISSION FACILITY COSTS ALLOCATION OF COSTS BASED UPON DEMAND

Improvement	Construction Cost	Kenosha	Pleasant Prairie	Bristol	Somers	Paris
36	$469,000				$469,000	
37	$85,000					$85,000
38	$636,000	$278,250			$278,250	$79,500
39	$1,070,000		$1,070,000			
40	$1,399,200		$1,399,200			
41	$704,800		$704,800			
42	$302,500		$302,500			
43	$165,000		$165,000			
44	$132,500		$132,500			
45	$530,000		$530,000			
46	$165,000		$165,000			
47	$79,500		$79,500			
48	$106,000		$106,000			
49	$1,560,000		$1,560,000			
50	$671,000		$671,000			
51	$126,000		$126,000			
52	$54,000		$54,000			
53	$423,500	$423,500				
Subtotal	$25,466,600	$8,679,650	$11,177,500	$657,600	$4,748,450	$203,400
Engineering & Con. (30%)	$7,639,980	$2,603,895	$3,353,250	$197,280	$1,424,535	$61,020
Subtotal	$33,106,580	$11,283,545	$14,530,750	$854,880	$6,172,985	$264,420
Treatment Plant w/30%	$4,680,000	$413,720	$3,229,200	$484,380	$514,800	$37,900
Total	$37,786,580	$11,697,265	$17,759,950	$1,339,260	$6,687,785	$302,320

Source: Ruekert & Mielke, Inc.

MODIFIED CONTRACT OPTION

Sewerage Facilities

This option differs from the contract option previously discussed in that under this approach the problem of allocating capital costs for joint use facilities is eliminated by having a community wherein the facilities are located construct and finance those facilities. As an example, a trunk sewer that is located entirely within the City of Kenosha would be constructed and financed by the Kenosha

Table 7-18
Trunk Sewer
Capital Cost Allocation Comparison

Community	Contract	Modified	Difference
Kenosha	$10,646,527	$15,589,145	$4,942,618
Pleasant Prairie	8,051,965	8,540,610	488,645
Somers	4,275,144	1,038,700	(3,236,444)
Bristol	1,537,915	0	(1,537,915)
Paris	656,904	0	(656,904)
Total	$25,168,455	$25,168,455	$0

Table 7-19
WTF Expansion
Capital Cost Allocation Comparison

Community	Contract	Modified	Difference
Kenosha	$13,723,094	$19,748,300	$6,025,206
Pleasant Prairie	4,642,825	0	(4,642,825)
Somers	616,147	0	(616,147)
Bristol	710,939	0	(710,939)
Paris	55,295	0	(55,295)
Total	$19,748,300	$19,748,300	$0

Water Utility even though that trunk sewer may convey sewage originating from a number of different communities. The community that built and financed the trunk sewer would then recover the capital costs for those facilities through user charges, impact fees, or other sources.

Cost Allocation

As has been discussed, the majority of the municipalities in the study area have contractual agreements in place for dealing with the capital cost allocation of constructing sewer facilities. A disadvantage with the current contractual arrangements is determining the level of participation by municipal entities for constructing joint use facilities.

Under this revised option, the sewer facilities located within a particular municipality would be constructed and financed by that municipality. Table 7-17 details the cost allocation of the necessary trunk sewer elements to the communities in which they are located. As can be noted, the Kenosha Water Utility would be responsible for approximately $15.6 million in construction costs which represents nearly a $5.0 million increase over the previous option. The Village of Pleasant Prairie would be responsible for approximately $8.5 million in construction costs which represents an approximate increase of $500,000 over the previous option. The Towns of Bristol, Somers, and Paris would see decreases in direct capital cost sharing as the result of this allocation. In addition to the trunk sewer costs allocated in Table 7-17, the Kenosha Water Utility would also be initially responsible for the entire $19,748,300 estimated for the expansion of the Kenosha WTF.

The following tables, Table 7-18 and 7-19, present the capital cost allocations for construction of the trunk sewers and the WTF expansion under the two options:

The question of how the Kenosha Water Utility and the Village of Pleasant Prairie can recover the capital costs associated with providing excess capacity in the trunk sewers, and, in case of the Kenosha Water Utility, excess capacity in the WTF, located within their respective jurisdiction will be addressed in the fiscal impact analysis.

Fiscal Impact Modified Contract

Trunk Sewers

For the purpose of preparing the fiscal impact that the construction of the proposed trunk sewers would have on an average residential household in the study area under the modified contract option, the previously defined assumptions were used with the following modification:

1) The construction of the trunk sewers will require the issuance of two Clean Water Fund subsidized bond issues at an interest rate of 5.30% with a 20 year term. The issues would be for $19.7 million to cover the first phase of construction and the second for $5.5 million to cover the second phase. The annual principal and interest payments for these issues would be $1,621,000 and $453,000 respectively. The Kenosha Water Utility would be responsible for approximately 79.0% or $15.56 million of the $19.7 million bond issue. The Village of Pleasant Prairie would be responsible for the remaining 21% or $4.14 million.

Table 7-17

Trunk Sewer Construction
Allocation of Costs
Based on Location

Trunk Sewer	Construction Cost	Kenosha	Pleasant Prairie	Bristol	Somers	Paris
1	$3,765,500	$3,765,500				
3	$207,900	$207,900				
12	$5,262,000	$5,262,000				
16	$304,700	$304,700				
20	$141,000	$141,000				
28	$185,000	$185,000				
29	$2,999,200		$2,999,200			
30	$709,600	$709,600				
32	$1,046,500		$1,046,500			
33	$1,669,600		$1,669,600			
34	$854,400		$854,400			
36	$869,950	$869,950				
39	$546,000	$546,000				
40	$799,000				$799,000	
Subtotal	$19,360,350	$11,991,650	$6,569,700	$0	$799,000	$0
Engineering & Cont. @ 30%	$5,808,105	$3,597,495	$1,970,910	$0	$239,700	$0
Total Cost	$25,168,455	$15,589,145	$8,540,610	$0	$1,038,700	$0
% of Cost		61.94%	33.93%	0.00%	4.13%	0.00%
O&M Costs	$169,161	$31,848	$130,669	$0	$6,644	$0

Source: Ruekert & Mielke, Inc.

The second phase of trunk sewer construction would be financed by a $5.5. million bond issue of which Pleasant Prairie would be responsible for approximately 81% or $4.455 million and the Town of Somers would be responsible for the remaining 19% or $1.045 million.

WTF Construction

For the purposes of preparing the fiscal impact that the construction of the proposed WTF expansion would have on an average residential household in the study area under the modified contract option, the previously defined assumptions were used with the following modification.

1) The annual debt service payment would be the responsibility of the Kenosha Water Utility in addition to the annual operation and maintenance expenses. Recovery of these annual expenses would be based on total billable flow received at the WTF and Kenosha would bill each community for is proportionate share. Each community would have the option of meeting these obligations through user charges, assessments, impact fees, property taxes, or other sources. For the purposes of this report, it is assumed that sewer user charges would serve as the mode for cost recovery.

Existing Sewerage Facilities

In addition to the charges developed for constructing the recommended facilities, each municipality would continue to charge for existing local infrastructure costs. The local charges would need to be added to the new facility charges to present a total residential charge overview. As had been done with the previous alternatives, the local charges were computed using the supplied financial data. Table 7-20 presents the total average residential charges.

Table 7-20
Modified Contract Option
Annual Fiscal Impact on
Average Residential Household
Total Sewerage Facilities Costs

	Local		New Facilities		Total Charges	
Community	1995	2010	1995	2010	1995	2010
Kenosha	$55	$43	$55	$41	$110	$84
Pleasant Prairie	$366	$148	$52	$30	$418	$178
Bristol	$226	$114	---	---	$226	$114
Somers	$232	$116	---	$24	$232	$140
Paris (1)	---	$69	---	---	---	$69

(1) Local 2010 Charge represents charge from Kenosha Sewer Utility.

Excess Capacity Cost Recovery

Under the modified contract option whereby a community constructs and finances the sewer infrastructure within its jurisdiction, the community may incur additional expenses for providing capacity for other communities and for future growth within its own community. As Table 7-18 and 7-19 presented, the Kenosha Water Utility and the Village of Pleasant Prairie would be expending funds for providing excess capacity in the trunk sewers and WTF.

Historically, communities have utilized a variety of assessments or connection charges levied upon users to recover excess capacity costs. For the purposes of this report, a sewer impact fee that the Kenosha Water Utility and the Village of Pleasant Prairie could implement for cost recovery will be examined. Using Table 7-3 and Table 7-18 as the basis for excess cost recovery, a trunk sewer impact fee for the Kenosha Water Utility can be computed in the following manner:

Estimated 2010 base flow	20,658,000 gpd
- Kenosha base flow (1990)	13,637,000 gpd
Future base flow increment	7,021,000 gpd

At 178 gpd per residential equivalent (REC), this future base flow increment equates to - 39,444 RECs

Additional capital incurred by the City of Kenosha under the modified contract option -	$4,942,618
Cost per REC	$125.00

Thus the Kenosha Water Utility could charge a one-time sewer impact fee of $125 per residential equivalent for each customer that is not presently connected to the Kenosha sewerage system and for each future non-City customer that connects to the sewerage system. A system could be developed for monitoring and tracking the collection of these fees. The system would require the impact fees to paid when either existing sewered areas connect to the Kenosha system or at the time of building permit issuance for new construction. The revenue from these fees would be placed in a designated fund to be used for capital purposes, either funding debt service or new construction. Depending upon the interest rate that the Utility would finance trunk sewer construction at, the sewer impact fee would escalate at the same annual rate as the borrowing rate or slightly above it. If the Utility was able to finance the trunk sewer construction with Clean Water Fund subsidized loans at 5.30%, the sewer impact fee would escalate by 5.30% to 6.00% per year to cover interest costs and administrative costs.

The identical type of sewer impact fee computations can be performed for the Kenosha Water Utility in financing the construction and expansion of the proposed WTF facilities. Using the computed number of future RECs from above (39,044) and the additional capital the Utility would incur from Table 7-19 ($6,025,206), the resulting impact fee for the WTF would be approximately $154. This impact fee would also escalate on an annual basis in accordance with the financing provisions outlined under the trunk sewer impact fee development.

The development of a sewer impact fee that the Village of Pleasant Prairie could implement to recover the capital costs incurred for building facilities to convey sewage from Pleasant Prairie and portions of the Town of Bristol can be developed in a similar manner and would amount to $790/REC.

Water Facilities - Modified Contract

The modified contract option differs from the contract option previously discussed in that under this approach the problem of allocating capital costs for joint use facilities and special use facilities is eliminated by having a community where the facilities are located construct and finance those facilities. The community that built and financed the facilities would then recover the capital costs through water rates, system development charges, or impact fees.

As was previously developed, the water system elements presented in Table 7-7 would be constructed in addition to expanding the water treatment facility. The estimated construction costs, interest and operation and maintenance costs are the same as under the existing contract option. Cost allocation under this scenario will be explained below.

Cost Allocation

As has been discussed, the majority of the municipalities in the study area have contractural agreements in place for dealing with capital cost allocation of constructing water facilities. A disadvantage with the current contractural arrangements is determining the level of participation by municipal entities for construction of joint use facilities.

Under this modified contract option, the water facilities located within a particular municipality would be constructed and financed by that municipality. Table 7-21 details the cost allocation of the water improvements to the communities in which they are located. As can be noted in Table 7-22, the Kenosha Water Utility would be responsible for $18,014,880 in construction costs which represents approximately a $6,300,000 increase over the existing contract option. The Village of Pleasant Prairie, the Town of Bristol, the Town of Somers, and the Town of Paris would experience decreases in capital cost sharing as the result of this allocation.

Table 7-22
Water Improvements
Capital Cost Allocation Comparison

Community	Contract	Modified	Difference
Kenosha	$11,697,265	$18,014,880	$6,317,615
Pleasant Prairie	17,759,950	13,802,490	(3,957,460)
Somers	6,687,785	5,969,210	(718,575)
Bristol	1,339,260	0	(1,339,260)
Paris	302,320	0	(302,320)
Total	$37,786,580	$37,786,580	$0

The question of how the Kenosha Water Utility can recover the capital costs associated with providing facilities to service the other four communities will be addressed in the fiscal impact analysis.

Fiscal Impact Modified Contract

For the purposes of preparing the fiscal impact that the construction of the proposed water facilities, including the treatment plant expansion, would have on an average residential household in the study area under the modified contract option the previously defined assumptions were used. Table 7-23 presents the annual charges for constructing and financing the recommended water facilities including existing local charges.

Table 7-21
Water Improvements
Allocation of Costs
Based on Location

Improvement	Construction Cost	Kenosha	Pleasant Prairie	Bristol	Somers	Paris
1	$1,069,500	$1,069,500				
2	$2,405,600	$1,296,000	$1,109,600			
3	$393,000	$393,000				
4	$328,500		$328,500			
5	$429,300		$429,300			
6	$426,300				$426,300	
7	$127,000	$127,000				
7A	$212,000	$212,000				
8	$165,000		$165,000			
9	$238,500	$238,500				
10	$423,400	$423,400				
11	$388,600				$388,600	
12	$302,400	$302,400				
13	$440,000	$440,000				
14	$830,800				$830,800	
15	$880,000				$880,000	
16	$212,000	$212,000				
17	$627,800	$627,800				
18	$143,000	$143,000				
19	$286,000		$286,000			
20	$79,500		$79,500			
21	$286,200		$286,200			
22	$264,000		$264,000			
23	$180,200		$180,200			
24	$1,391,000	$1,391,000				
25	$350,400	$350,400				
26	$248,200	$248,200				
27	$390,500	$390,500				
28	$220,000	$220,000				
29	$193,600	$193,600				
30	$262,800	$262,800				
31	$555,500	$555,500				
32	$440,000	$440,000				
33	$146,000				$146,000	
34	$682,500				$682,500	
35	$768,500				$768,500	
36	$469,000				$469,000	
37	$85,000	$85,000				
38	$636,000	$636,000				
39	$1,070,000		$1,070,000			
40	$1,399,200		$1,399,200			
41	$704,800		$704,800			
42	$302,500		$302,500			
43	$165,000		$165,000			
44	$132,500		$132,500			
45	$530,000		$530,000			
46	$165,000		$165,000			
47	$79,500		$79,500			
48	$106,000		$106,000			
49	$1,560,000		$1,560,000			
50	$671,000		$671,000			
51	$126,000		$126,000			
52	$54,000		$54,000			
53	$423,500		$423,500			
Treatment Plant	$3,600,000	$3,600,000				
Total	$29,066,600	$13,857,600	$10,617,300	$0	$4,591,700	$0
Engineering & Cont. @ 30%	$8,719,980	$4,157,280	$3,185,190	$0	$1,377,510	$0
Total Cost	$37,786,580	$18,014,880	$13,802,490	$0	$5,969,210	$0
Annual O&M	$754,761	$556,670	$141,105	$0	$56,986	$0

Source: Ruekert & Mielke, Inc.

Table 7-23
Modified Contract Option
Annual Fiscal Impact on
Average Residential Household
Total Water Facility Costs

	Local		New Facilities		Total Charges	
Community	1995	2010	1995	2010	1995	2010
Kenosha	$76	$44	$24	$23	$100	$67
Pleasant Prairie	$349	$108	$242	$60	$591	$168
Bristol	$383	$105	---	---	$383	$105
Somers	$145	$86	160	$109	$205	$195
Paris (1)	---	$72	---			$72

(1) Local 2010 Charge represents charge from Kenosha Sewer Utility.

System Development Charges

Under the modified contract option whereby a community constructs and finances water infrastructure within its own jurisdiction, the community may incur additional expenses for providing capacity for other communities and for future growth within its own communities.

Table 7-22 presented the excess funds which would be expended by the Kenosha Water Utility to construct facilities that will benefit the Village of Pleasant Prairie, the Town of Bristol, the Town of Somers, and the Town of Paris.

Historically, communities statewide have been restricted to using only water rates to recovering excess capital costs incurred for providing facilities for new customers. The current nationwide trend, however, has been to incorporate system development charges or impact fees to assist in capital cost recovery. The purpose of such a charge is to prevent or reduce the inequity to existing customers that results where these customers must pay the increases in water rates that are needed to pay for added facilities costs for new customers. For purposes of this report a system development charge will be developed that the Kenosha Water Utility could employ to assist in capital cost recovery. Prior to implementing such a charge it will be necessary for discussions to be held with the Wisconsin Public Service Commission and obtain their subsequent approval. Using Table 7-22 as the basis for determining excess costs, the system development charges can be calculated in the following manner.

Kenosha System Development Charge

Estimated 2010 Base Demand	20,487,000 GPD
Kenosha Base Demand (1990)	12,346,000 GPD
Future Base Flow Increment	8,141,000 GPD

At 178 gpd per residential equivalent (REC), this future base flow increment equates to	45,736 REC's
Additional capital incurred by the City of Kenosha =	$6,317,623
Cost Per REC =	$138.00

Thus, the Kenosha Water Utility could charge a water system development charge of $138.00 per residential equivalent for each future city and non-city customer that is connected to the water system. Depending upon the interest rate that the City would use to finance water system improvements, the water system development charge would escalate at the same annual rate or slightly above it to recover administrative costs. If the Utility was able to secure revenue bonds at 7.50% for instance, a 7.75% to 8.00% increase in the charge may be used. By using the impact fee and development charge for both the sewer and water facilities the Kenosha Water Utility will be reimbursed for all of the costs incurred to build the future capacity including the financing and carrying costs.

OPTION SELECTION

In review of the fiscal impact analysis presented in this chapter, it appears that the creation of a Regional Authority would provide the most equitable approach for implementing the recommended plan. Given the complexity of creating such an agency and the length of time required, it is recommended that the modified contract option be utilized during the interim, due to ease of administration and lessening of impact on undeveloped areas.

Chapter VIII will further define this recommendation.

The fiscal impact on an average residential household under the Regional Authority Option could be lessened through the use of impact fees and credits for debt free equity. Both of these subjects were explored within this chapter yet further detailed analysis would be required for implementing the creation of a Regional Authority. Briefly, the implementation and collection of impact fees from future customers would provide an additional revenue source for the Regional Authority that could be utilized to stabilize or lessen user rates and charges. For those communities which currently have a high margin of debt free equity in infrastructure which would become part of the Regional Authority, the use of asset credits or direct payments for those assets could be utilized to mitigate rates and charges.

The relative advantages and disadvantages of the options are presented in Table 7-24.

Table 7-24
Comparison of Options

Alternative	Advantages	Disadvantages
Regional Authority	- Coordinated effort to plan and implement recommended improvements - Independent nonpolitical agency - Uniform sewer and water rates would aid in attracting regional development - Ability of regional agency to issue debt would relieve existing debt burden on communities - Minimizes fiscal impact of constructing recommended improvements - Eliminates need of local governments to maintain and improve local system infrastructure	- Absence of statutory authority to create joint agency and/or regional water agency - Length of time and amount of effort required to establish a regional authority - Difficulty in administering credit of existing asset base to communities - Loss of control over local system infrastructure and connection to local systems
Modified Regional Authority	- Coordinated effort to plan and implement recommended improvements - Independent nonpolitical agency - Ability of regional agency to issue debt would relieve existing debt burden on communities - Minimizes fiscal impact of constructing recommended improvements - Local communities maintain greater control over local system infrastructure and connection to local systems	- Absence of statutory authority to create joint agency and/or regional water agency - Length of time and amount of effort required to establish a regional authority - Difficulty in administering credit of existing asset base to communities - Requires local communities to continue maintaining and improving local infrastructure
Existing Contract	- Contractual structure in place for majority of communities in service area - Existing contract structure easily modified for remaining communities	- Difficult to properly allocate costs to the communities - Places higher economic costs on developing communities than regional authority option - Could be subject to political pressures
Modified Contract	- Minimizes economic impact of existing contract - Ease to which existing contractual structure can be altered - Future users pay their fair share of facilities cost	- Places higher economic costs on developing communities than regional authority option - Imposition of greater debt burden on Kenosha Water Utility

CHAPTER VIII

FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

The purpose of this report is to prepare coordinated sanitary sewer and water supply system plans for the Kenosha area. The study area consists of eastern Kenosha County from a line one mile west of ISH 94 to Lake Michigan. It encompasses all of the City of Kenosha, Village of Pleasant Prairie, Town of Somers and portions of the Town of Bristol and Town of Paris. The study was guided by a Technical Advisory and Intergovernmental Coordinating Committee comprised of local, county and state elected and appointed officials.

SUMMARY

The growth currently being experienced in the study area coupled with growth projections necessitate the preparation of a coordinated plan for sewer and water service for the entire area. The soils in the study area are predominantly dense, organic soils of low permeability and are ill suited for on-site sewage disposal systems. There are several existing municipal sewerage systems operating within the area. However, it was found to be cost effective to convey the sewage from all existing and future development to an expanded Kenosha wastewater treatment facility and for other existing treatment facilities to be phased out prior to the year 2010.

The study found that both existing and future water demands could not be met by the communities presently relying on groundwater supplies. In addition the water found in the sandstone aquifer does not meet current standards for radium content. It was found to be cost effective to supply the study area with water from the Kenosha water treatment facility.

Various options for establishing an institutional structure to construct and operate the cost effective facilities were evaluated. The present intermunicipal agreements between Kenosha and the Village of Pleasant Prairie and the Town of Somers have been successful to date and have provided for an acceptable level of service. However, the extent and magnitude of the recommended facilities make continuation of the existing agreements overly cumbersome and difficult to administer. Based on the amount of financing needed and the addition of several more municipal entities to the regional system, all indications point to consideration of the formation of a regional authority. Whether or not the formation of a regional authority would result in the acquisition of all existing sewerage and water facilities or only existing regional related facilities needs to be studied further. The formation of a regional authority would, at a minimum, acquire all of the existing treatment facilities and transmission and distribution systems. Provisions would also be made for the regional authority to assume and refinance all existing debt relating to the assets acquired and create a equitable methodology for resolving the problems relating to each municipalities contribution of debt free equity.

The Wisconsin Statutes do not currently contain sufficient provisions to create a regional water and sewer authority envisioned for the municipalities. Therefore an advisory committee is needed similar to the existing Intergovernmental Coordinating Committee which managed the preparation of this study. The charge to the committee would be to determine what legislation and proposed governing structure is required to create an acceptable regional authority which all affected parties can subscribe to. Since the process to establish concensus and actually carry out a change in the governance of the utility will take a significant amount of time, an interim plan for transitioning into a regional authority type system will be necessary.

FINDINGS

<u>Sewer Facilities</u>

City of Kenosha

1) The Kenosha sewerage system owned and operated by the Kenosha Water Utility serves the City of Kenosha and portions of the Village of Pleasant Prairie and Town of Somers.

2) Several trunk sewers experience surcharging which cause basement backups and limited bypassing during significant precipitation events.

3) A number of storm water catchbasins were identified as directly connected to the sanitary sewer system which have since been disconnected or are in the process of being disconnected.

4) The wastewater treatment facility cannot handle peak hour flows during significant precipitation events.

Village of Pleasant Prairie

1) The Village operates two wastewater treatment facilities which serve portions of the Village and Town of Bristol.

2) The Village recently completed construction of several trunk sewers which are connected to the Kenosha sewerage system and are designed to serve a large portion of its jurisdiction.

3) SUD "D" wastewater treatment facility which serves portions of the Village of Pleasant Prairie and the Town of Bristol is at or near peak hour flow capacity.

4) SUD "73-1" wastewater treatment facility which serves a portion of the Village is well below its design capacity.

5) Per agreement, by the year 2010, the Village will no longer be able to divert potable water from Lake Michigan and discharge it to the Mississippi River basin, via the wastewater treatment facilities.

Town of Somers

1) Portions of the Town of Somers are tributary to the Kenosha sewerage system

Town of Bristol

1) Portions of the Town of Bristol within the study area are tributary to SUD "D" in the Village of Pleasant Prairie.

Town of Paris

1) Users in the study area are serviced by private on-site sewage disposal systems.

<u>Water Facilities</u>

City of Kenosha

1) The Kenosha Water Utility serves the City of Kenosha and a limited number of retail customers in the Town of Somers and Village of Pleasant Prairie in addition to providing wholesale service to the Village of Pleasant Prairie and Town of Somers Sanitary District #1.

2) The water treatment facility does not have adequate clearwater storage capacity for the 2010 demand.

3) Booster pump facilities do not have adequate capacity for the 2010 demand.

4) The "Booster Area" does not have adequate emergency power generating facilities.

5) Segments of the transmission main system are not adequate to serve the 2010 service area.

Village of Pleasant Prairie

1) The Village operates groundwater wells as a source of supply as well as receiving wholesale water from Kenosha.

2) The existing groundwater facilities are not adequate to meet the 2010 demands.

3) The quality of the existing groundwater supply does not meet current standards for radium content. The Village on an interim basis until 2010 has obtained permission to draw up to 3.2 MGD of water from Lake Michigan and then after use to divert it to the Mississippi River basin as treated wastewater.

4) Existing water storage facilities are not adequate to meet year 2010 demands.

5) The existing water systems are segmented and not looped together. These systems do not have adequate back-up or emergency demand facilities.

Town of Somers

1) Users are served by private wells except for small fringe areas served by Kenosha.

Town of Bristol

1) A portion of the Town within the study area uses groundwater as a source of supply.

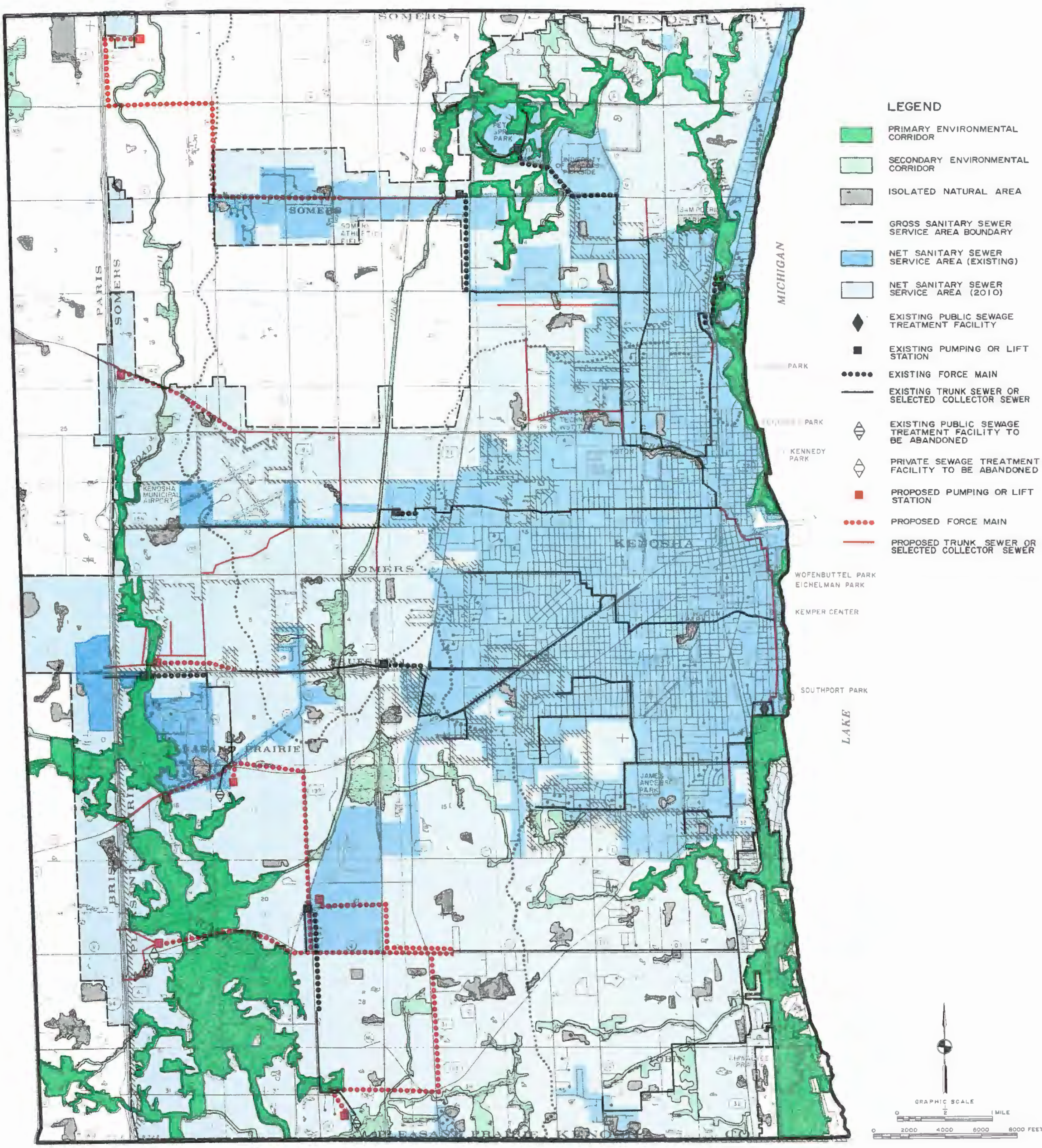
Town of Paris

1) A portion of the Town within the study area uses groundwater as a source of supply.

CONCLUSIONS

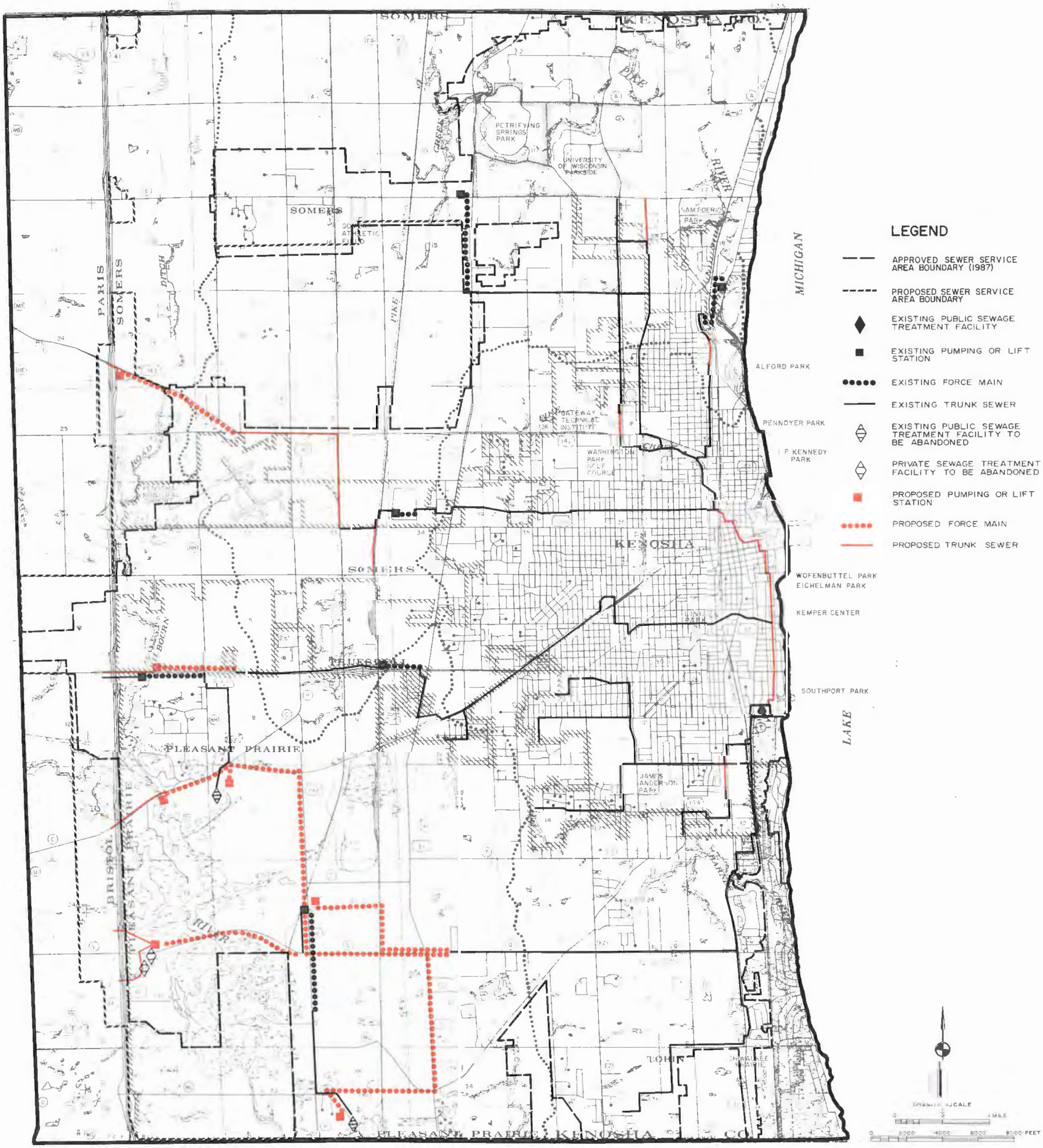
Chapters V and VI evaluated various alternatives for providing coordinated sewer and water service to the study area. The most cost effective alternative for both sewer and water service was the centralized plan designed for the optimistic growth scenario. For water mains and trunk sewers common to both the optimistic growth alternative and the ultimate growth alternative it was concluded that it would be cost effective to construct the sewer or water main to the ultimate size because of the 50 to 100 year life of the mains. Tables 7-2 and 7-7 detail the recommended sewer and water main. Figures 8-1, 8-2 and 8-3 depict the 2010 area to be served by the recommended facilities and the location of the recommended facilities. Figure 8-1 represents existing major trunk sewers and other selected sewers and recommended future sewerage facilities needed to serve the study area. Figure 8-2 represents the minimum existing and

FIGURE 8-1
RECOMMENDED SEWERAGE FACILITIES FOR GREATER KENOSHA UTILITY STUDY AREA: (2010)



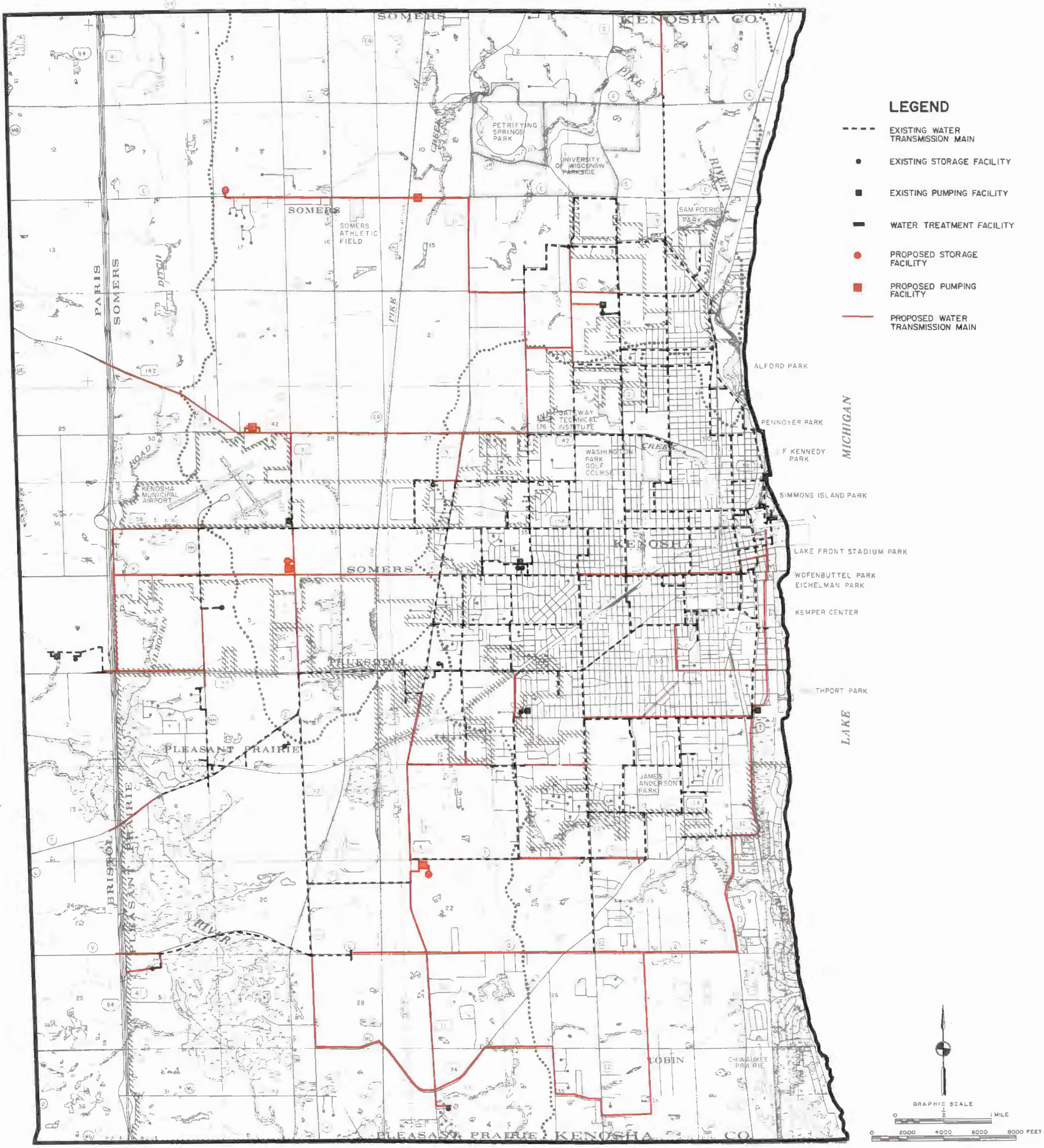
Source: Ruekert and Mielke, Inc., and SEWRPC (base year 1990).

FIGURE 8-2
SEWERAGE FACILITIES CONSIDERED FOR
THE REGIONAL ALTERNATIVE : (2010)



Source: Ruekert and Mielke, Inc.

FIGURE 8-3
WATER FACILITIES CONSIDERED FOR
THE REGIONAL ALTERNATIVE : (2010)



Source: Ruekert and Mielke, Inc.

recommended future sewerage facilities which the regional authority would own, operate and maintain. Figure 8-3 represents the minimum existing and recommended future water facilities which the regional authority would own, operate and maintain. If the ownership of any of the facilities is not assumed by the regional authority the fiscal impact to the users would change accordingly depending on the amount of outstanding debt related to the facilities.

The cost effective wastewater treatment facility would be sized for a peak hourly flow capacity of 142 MGD and a maximum day capacity of 90.7 MGD. Peak flow storage capacity of 12.2 MG would be constructed at the treatment facility site. Storage units would only be utilized during periods of peak hourly flow events. No additions to the sludge handling, sludge disposal or chemical feed systems are required during the planning period. Upgrading, replacement or periodic repair costs should be anticipated as part of the yearly budgeting process.

The cost effective water system consisted of increasing the filter capacity by 10% to 41.23 MGD. A 6 MG storage reservoir would be constructed at the water treatment facility site. In addition, 54 individual project improvements are recommended as detailed on Figure 8-3 and Table 7-5.

The integrated final recommended sewer and water facilities in this plan do not provide for any water diversion beyond 2010. The Village of Pleasant Prairie wastewater treatment facilities (SUD "D" and 73-1) are scheduled to be phased out prior to 2010.

Of the four methods evaluated for charging the municipalities for the recommended facilities, the existing contract provided the highest charges to all the communities receiving service from the Kenosha water utility. The most balanced rates for all users of the regional system resulted from the consolidation of the facilities into a regional authority. Because it will take a significant amount of time to set up a regional authority, in the interim, the modified contract option provides an equitable method for the regional facilities to be built and still have those benefitting from the construction contributing their fair share via impact fees. Upon formation of a regional sewer and water authority it is anticipated that the impact fees from new users would be continued to be collected by the new regional authority. The fiscal impacts on a typical residential household including local charges under the four options are as provided in Table 8-1.

RECOMMENDATIONS

Regional Water & Sewer Authority

1) It is recommended that to implement the planning, construction and financing of the recommended facilities in an economic and politically efficient manner, a regional water and sewer authority should be established. Given the administrative and legal requirements for establishing such an authority, the municipalities which will be receiving service from the proposed facilities should establish an advisory committee to evaluate and implement the regional authority. The Southeastern Wisconsin Regional Planning Commission should assist in establishing this advisory committee. This committee should be composed of a representative from each municipality, a representative from Kenosha County, and possibly several citizen members.

2) The advisory committee should address the following questions.

   a) Should the authority be governed by elected or appointed people?
   b) How many members should be included in the governing body?
   c) What type of bonding authority should the regional authority have?
   d) Should the regional authority have taxing power and should that power have restrictions?
   e) What facilities should be taken over by the regional authority and over what time frame?
   f) Should the formation of a regional authority include the acquisition of all existing infrastructure and operations, or should the regional authority limit itself to acquiring only existing "regional" infrastructure?
   g) How should the communities who contribute debt free equity to the regional authority be compensated?
   h) What procedure should be used for assuming the existing debt on facilities taken over by the regional authority.

3) It is recommended that the Regional Authority should install, own, operate and maintain the recommended facilities detailed in Chapter 7 including the existing treatment facilities, pumping stations and water storage facilities. The ownership and control of the local sewer and water mains should be evaluated by the advisory committee.

4) If the regional authority does not include owning and operating local system infrastructure, the regional authority should have provisions for providing retail

Table 8-1
Annual Fiscal Impact for an Average Residential Household

REGIONAL AUTHORITY OPTION

Community	1995 Sewer	1995 Water	2010 Sewer	2010 Water
Kenosha	$126.00	$109.00	$96.00	$83.00
Pleasant Prairie	254.00	164.00	140.00	101.00
Bristol	117.00	192.00	112.00	103.00
Somers	181.00	93.00	121.00	85.00
Paris	---	---	106.00	95.00

MODIFIED REGIONAL AUTHORITY OPTION

Community	1995 Sewer	1995 Water	2010 Sewer	2010 Water
Kenosha	$120.00	$107.00	$98.00	$93.00
Pleasant Prairie	290.00	242.00	137.00	121.00
Bristol	254.00	356.00	106.00	100.00
Somers	218.00	117.00	123.00	81.00
Paris	---	---	84.00	67.00

EXISTING CONTRACT OPTION

Community	1995 Sewer	1995 Water	2010 Sewer	2010 Water
Kenosha	$101.00	$92.00	$84.00	$62.00
Pleasant Prairie	441.00	668.00	162.00	177.00
Bristol	469.00	529.00	135.00	136.00
Somers	459.00	384.00	210.00	201.00
Paris	---	---	238.00	66.00

MODIFIED CONTRACT OPTION

Community	1995 Sewer	1995 Water	2010 Sewer	2010 Water
Kenosha	$110.00	$100.00	$84.00	$67.00
Pleasant Prairie	418.00	591.00	178.00	168.00
Bristol	226.00	383.00	114.00	105.00
Somers	232.00	205.00	140.00	195.00
Paris	---	---	69.00	72.00

services on a Wisconsin Statutes 66.30 type contract to all municipal customers. The municipalities should not be required to accept retail service and should be allowed to remain wholesale customers and be billed based on master meters.

Sewer Facilities

5) Based upon the cost effectiveness analysis, the approved plan as presented in Chapter 7 should be constructed. This plan sizes treatment facilities and major system components for the optimistic scenario flows and selected trunk sewers for the ultimate growth scenario flows. The recommended time frames for construction of system components are contained in Chapter VII.

6) During the interim, prior to formation of a regional sewer and water authority, the modified contract option as presented in Chapter VII appears to be the most equitable capital cost recovery method and should be utilized as the method for recovering the capital costs associated with constructing the recommended facilities. The use of impact fees removes the burden of financing facilities for future users by the existing customers and more equitably distributes the costs.

7) The City of Kenosha and the Kenosha Water Utility should review the financial implications of the modified contract option with their legal and financial consultants. If approved, Kenosha should undertake a cost of service study to establish both the sewer and water impact fees. In addition the Village of Pleasant Prairie should undertake a similar study.

8) The City of Kenosha should begin negotiations with the Village of Pleasant Prairie and the Town of Somers to revise the current contractual agreement to reflect the change to the modified contract cost recovery option and to implement the use of sewer impact fees. The City of Kenosha should begin negotiations with the Town of Bristol and the Town of Paris to implement interim Wisconsin Statutes 66.30 intermunicipal agreements similar to the current agreements in place as amended with the Village of Pleasant Prairie and the Town of Somers. These agreements would be structured in accordance with the modified contract cost recovery option.

9) The Village of Pleasant Prairie should adopt a sewer planning and construction program that anticipates the abandonment of the Sewer Utility District "D" and 73-1 wastewater treatment plants when they reach their capacity and by no later than 2010 to remain in compliance with the 1989 water diversion order.

10) If the Village of Pleasant Prairie experiences capacity problems at the Utility District "D" facility, trunk sewer No. 30 sewer should be constructed to reroute the flows from the Bristol Utility District No. 3 to the City of Kenosha system.

11) The Kenosha Water Utility should institute a computer controlled system of flow monitoring for all major extraterritorial connections to the sewer system. In addition the City should evaluate placing additional flow monitors at key locations within the City sewer system in order to provide more accurate design data for future expansions of the system.

12) The adopted sanitary sewer service plan of 1987 for the greater Kenosha area should be amended to include the cross-hatched areas as shown on Figure 8-1. The gross sanitary sewer service area boundary will then match the 2010 Optimistic Decentralized Development scenario.

Water Facilities

13) Based on the cost effective analysis, the approved plan as presented in Chapter VI should be constructed. This plan sizes treatment facilities and some storage and pumping facilities for the optimistic scenario water demands and selected storage and pumping facilities and transmission mains for the ultimate scenario. The recommended time frames for construction of system components are contained in Chapter VII.

14) The modified contract option as presented in Chapter VII should be utilized as the interim method for recovering the capital costs associated with constructing the recommended facilities.

15) Prior to implementing the use of impact fees to assist in capital cost recovery, the City of Kenosha should meet with the Wisconsin PSC and present the methodology and rationale for establishing an impact fee. If the PSC cannot accommodate the use of impact fees, the City of Kenosha may consider seeking legislative changes to allow the use of such fees for financing water utility improvements.

16) In keeping with recommendation 3, the subsequent Wisconsin Statutes 66.30 contract negotiations should revise the current contract language pertaining to water facility cost allocations to conform with the modified contract cost recovery option as presented in Chapter VII.

APPENDICES

Appendix A

Table A-1

Sewer Construction Costs
New Construction with Granular Backfill
Depth to Invert

Pipe Diameter	Depth of Sewer 10-15	16-20	21-25	25-30	30-35
8"	$ 50/LF	$ 90/LF			
12"	55	110	$140/LF	$170/LF	$210/LF
15"	60	130	145	175	215
18"	65	135	150	180	220
21"	70	145	160	190	230
24"	80	160	180	210	245
27"	90	185	205	230	265
30"	95	195	215	245	285
36"	105	210	230	270	315
42"	115	225	245	290	345
48"	135	250	265	320	380
54"	165	275	275	325	390
60"	195	310	310	345	420

- Costs do not include:
    - Pavement - Add $20.00/LF to include pavement.
    - Engineering
    - Legal and administration
    - Rock excavation
    - Contingencies

- Costs are for July 1989 and include:
    - Labor and equipment
    - Pipe
    - Bedding
    - Shoring
    - Backfill
    - Contractors overhead and profit
    - Manholes
    - Site restoration
    - Dewatering operations

<u>Tunnel Construction Costs</u>

48"	$450/LF
60"	$525/LF
72"	$600/LF

Appendix A

Table A-2

Sewer Construction Costs
New Construction with Spoil Backfill
Depth to Invert

Pipe Diameter Inches	8-12	Depth of Sewer 13-15	16-20	21-25
8"	$ 40/LF	$ 45/LF		
12"	45	50	$100/LF	$130/LF
15"	50	55	115	135
18"	55	60	120	140
21"	60	65	125	145
24"	65	75	140	155
27"	70	80	150	170
30"	80	90	160	180
36"	95	105	180	200
42"	105	115	195	215
48"	115	120	220	235
54"	140	160	240	240
60"	160	180	265	265

- Costs do not include:
    - Pavement - Add $20.00/LF to include pavement.
    - Engineering
    - Legal and administration
    - Rock excavation
    - Contingencies

- Costs are for July 1989 and include:
    - Labor and equipment
    - Pipe
    - Bedding
    - Shoring
    - Backfill
    - Contractors overhead and profit
    - Manholes
    - Site restoration
    - Dewatering operations

Appendix A

Table A-3

Open-Cut Watermain and Forcemain Construction Costs

Item	Ductile Iron* Cost Gravel/Spoil		Plastic* Cost Gravel/Spoil	
6-inch	$32.00/LF	$29.00/LF	$30.00/LF	$27.00/LF
8-inch	36.00	32.00	34.00	30.00
10-inch	39.00	35.00	37.00	33.00
12-inch	42.00	37.00	40.00	35.00
16-inch	46.00	41.00	46.00	41.00
20-inch	56.00	51.00	56.00	51.00
24-inch	62.00	57.00	62.00	57.00
30-inch	80.00	72.00	80.00	72.00
36-inch	95.00	85.00	95.00	85.00

Item	Valve Box	Vault
6-inch	$ 350.00/LF	---
8-inch	450.00	---
10-inch	600.00	---
12-inch	750.00	$1200.00/EA
16-inch	1000.00	1500.00
20-inch	1600.00	1500.00
24-inch	2100.00	1500.00
30-inch	2700.00	2000.00
36-inch	3500.00	2300.00

	Cost
Fire Hydrant 2 - 2-1/2" Nozzles	$2100.00/EA
Fire Hydrant 2 - 2-1/2" Nozzles 1 - 4-1/2" Nozzle	2500.00
Fire Hydrant 1 Pumper Nozzle	2100.00
Cost includes Valve & 12'of 6" Main	
Air Relief Valve in Valve Box	$ 300.00/EA
Air Relief Valve in Vault	1300.00

*Costs do not include:

- Pavement. Add $10 per lineal foot for pavement.
- Engineering
- Legal and administration
- Rock excavation
- Contingencies

Appendix A

Table A-4

Kenosha Area Sewer and Water Study
Pump Station Construction Costs

Peak Pumping Capacity Q (MGD)	Type	Construction Cost*
0.15	Submersible Pump	$ 60,000 **
0.5	Buried Steel	$ 150,000
1.0	Buried Steel	$ 170,000
2.5	Buried Steel	$ 240,000
5.0	Cast in Place Concrete	$1,000,000
7.5	Cast in Place Concrete	$1,200,000
10.0	Cast in Place Concrete	$1,500,000

* Costs Include:
- Normal dewatering systems
- Earth support systems
- Emergency power generator with the exception of the 0.15 MGD Station.
- Depth for 0.15-1.0 MGD Station = 20'
  Depth for 2.5-10 MGD Station = 25'

Costs Do Not Include:
- Engineering
- Legal and administration
- Rock excavations
- Contingencies

** Add $17,000 for Portable Emergency Generator if Desired.

Appendix B

Kenosha Area Sewer And Water Study
Population Projections By Quarter Section:
2010-Intermediate, 2010-Optimistic,
And Ultimate Development

Town	Range	Section	1/4 Section	1985 Population	2010 Intermediate	2010 Optimistic	Ultimate
1	21	01	1	27	24	27	27
1	21	01	2	27	24	27	27
1	21	01	3	27	24	27	27
1	21	01	4	0	0	0	0
1	21	12	1	38	34	37	37
1	21	12	2	13	12	13	13
1	21	12	3	0	0	0	0
1	21	12	4	7	6	7	7
1	21	13	1	0	0	0	0
1	21	13	2	3	3	3	3
1	21	13	3	34	30	33	33
1	21	13	4	23	20	23	23
1	21	24	1	7	6	7	7
1	21	24	2	0	0	0	0
1	21	24	3	30	27	29	29
1	21	24	4	10	9	10	10
1	21	25	1	17	15	17	17
1	21	25	2	11	10	11	11
1	21	25	3	6	5	6	6
1	21	25	4	23	20	23	23
1	21	36	1	6	5	6	6
1	21	36	2	11	10	11	11
1	21	36	3	26	23	26	26
1	21	36	4	50	44	49	49
1	22	01	1	2111	1875	2078	2078
1	22	01	2	1618	1437	1592	1592
1	22	01	3	2143	1903	2107	2107
1	22	01	4	1936	1719	1907	1907
1	22	02	1	1634	1451	1616	1616
1	22	02	2	1552	1420	1609	1609
1	22	02	3	1115	1036	1180	1180
1	22	02	4	1414	1255	1415	1415
1	22	03	1	1214	1173	1297	1452
1	22	03	2	64	214	237	984
1	22	03	3	66	150	166	166
1	22	03	4	583	1333	1471	1471
1	22	04	1	3	3	3	252
1	22	04	2	8	7	8	579
1	22	04	3	35	31	34	422
1	22	04	4	3	3	3	3
1	22	05	1	72	64	71	1114
1	22	05	2	8	7	8	1152
1	22	05	3	6	5	195	1064
1	22	05	4	117	104	479	842
1	22	06	1	62	55	61	892
1	22	06	2	103	92	101	356
1	22	06	3	7	6	7	7
1	22	06	4	7	174	193	913
1	22	07	1	194	640	762	762
1	22	07	2	106	190	222	251
1	22	07	3	16	39	50	50
1	22	07	4	298	335	418	418
1	22	08	1	40	36	494	882
1	22	08	3	116	103	500	716
1	22	08	4	32	28	31	295
1	22	09	1	10	9	10	10
1	22	09	2	258	292	292	548
1	22	09	2	10	10	10	572
1	22	09	4	0	0	0	0

Appendix B

Kenosha Area Sewer And Water Study
Population Projections By Quarter Section:
2010-Intermediate, 2010-Optimistic,
And Ultimate Development

Town	Range	Section	1/4 Section	1985 Population	2010 Intermediate	2010 Optimistic	Ultimate
1	22	10	1	81	204	227	473
1	22	10	2	94	98	111	144
1	22	10	3	149	409	434	434
1	22	10	4	434	946	894	1002
1	22	11	1	1063	1018	1147	1147
1	22	11	2	668	739	855	855
1	22	11	3	941	865	1036	1036
1	22	11	4	424	520	597	619
1	22	12	1	1816	1613	1792	1792
1	22	12	2	1746	1590	1769	1769
1	22	12	3	60	53	59	598
1	22	12	4	1490	1391	1511	1511
1	22	13	1	21	21	21	21
1	22	13	2	1308	1343	1648	1661
1	22	13	3	306	408	619	646
1	22	13	4	657	656	817	817
1	22	14	1	1239	1257	1407	1435
1	22	14	2	353	446	667	694
1	22	14	3	190	285	561	561
1	22	14	4	244	438	457	705
1	22	15	1	30	107	461	613
1	22	15	2	155	138	554	554
1	22	15	3	62	55	484	484
1	22	15	4	21	19	144	880
1	22	16	1	0	0	0	0
1	22	16	2	7	6	7	434
1	22	16	3	0	0	0	0
1	22	16	4	0	0	0	0
1	22	17	1	9	8	464	677
1	22	17	2	53	47	53	787
1	22	17	3	0	0	455	924
1	22	17	4	9	8	464	983
1	22	18	1	232	468	598	754
1	22	18	2	75	96	107	248
1	22	18	3	41	36	41	177
1	22	18	4	9	8	9	426
1	22	19	1	25	22	25	250
1	22	19	2	6	5	6	69
1	22	19	3	0	0	0	0
1	22	19	4	0	0	0	0
1	22	20	1	6	5	6	6
1	22	20	2	0	0	0	0
1	22	20	3	0	0	0	0
1	22	20	4	6	5	6	6
1	22	21	1	6	6	6	6
1	22	21	2	39	35	38	38
1	22	21	3	3	3	3	3
1	22	21	4	8	7	8	8
1	22	22	1	15	13	293	1035
1	22	22	2	17	15	295	632
1	22	22	3	8	7	286	430
1	22	22	4	52	46	335	946
1	22	23	1	41	36	502	761
1	22	23	2	21	18	577	937
1	22	23	3	3	3	559	954
1	22	23	4	50	44	404	701
1	22	24	1	8	7	380	638
1	22	24	2	52	402	440	554
1	22	24	3	288	456	508	553

Appendix B

Kenosha Area Sewer And Water Study
Population Projections By Quarter Section:
2010-Intermediate, 2010-Optimistic,
And Ultimate Development

Town	Range	Section	1/4 Section	1985 Population	2010 Intermediate	2010 Optimistic	Ultimate
1	22	24	4	178	172	472	618
1	22	25	1	33	29	40	736
1	22	25	2	164	172	472	684
1	22	25	3	25	22	25	942
1	22	25	4	52	46	54	842
1	22	26	1	178	170	467	718
1	22	26	2	196	176	582	582
1	22	26	3	48	43	47	370
1	22	26	4	46	41	323	748
1	22	27	1	139	124	375	491
1	22	27	2	161	145	439	439
1	22	27	3	44	39	369	837
1	22	27	4	119	144	566	699
1	22	28	1	10	9	10	277
1	22	28	2	4	4	4	4
1	22	28	3	10	9	10	10
1	22	28	4	4	4	4	376
1	22	29	1	0	0	0	0
1	22	29	2	0	0	0	0
1	22	29	3	3	3	3	3
1	22	29	4	9	8	9	9
1	22	30	1	0	0	0	0
1	22	30	2	26	23	26	26
1	22	30	3	13	12	13	241
1	22	30	4	6	5	6	6
1	22	31	1	22	20	22	22
1	22	31	2	19	17	19	485
1	22	31	3	17	15	23	641
1	22	31	4	14	12	14	284
1	22	32	1	0	0	0	0
1	22	32	2	6	5	6	6
1	22	32	3	6	5	6	6
1	22	32	4	0	0	0	0
1	22	33	1	13	12	174	889
1	22	33	2	6	5	130	783
1	22	33	3	24	77	489	774
1	22	33	4	7	6	7	875
1	22	34	1	35	31	480	746
1	22	34	2	52	46	312	630
1	22	34	3	271	319	575	753
1	22	34	4	4	4	4	180
1	22	35	1	261	516	639	741
1	22	35	2	6	5	6	237
1	22	35	3	4	4	4	364
1	22	35	4	270	290	326	803
1	22	36	1	168	153	179	217
1	22	36	2	96	89	380	555
1	22	36	3	48	43	333	688
1	22	36	4	24	21	24	567
1	23	05	2	148	132	148	148
1	23	05	3	409	363	419	419
1	23	06	1	2151	2059	2262	2262
1	23	06	2	2274	2105	2364	2364
1	23	06	3	1910	1697	1881	1881
1	23	06	4	1613	1432	1597	1597
1	23	07	1	943	883	987	987
1	23	07	2	1849	1642	1827	1827
1	23	07	3	1271	1188	1358	1358
1	23	07	4	322	286	319	489

Appendix B

Kenosha Area Sewer And Water Study
Population Projections By Quarter Section:
2010-Intermediate, 2010-Optimistic,
And Ultimate Development

Town	Range	Section	1/4 Section	1985 Population	2010 Intermediate	2010 Optimistic	Ultimate
1	23	08	2	128	114	126	126
1	23	08	3	0	0	0	0
1	23	17	2	156	139	167	167
1	23	17	3	60	53	67	67
1	23	18	1	204	181	236	236
1	23	18	2	2008	1888	2088	2114
1	23	18	3	694	725	816	828
1	23	18	4	104	155	174	244
1	23	19	1	106	157	190	263
1	23	19	2	27	24	399	672
1	23	19	3	0	0	459	759
1	23	19	4	96	148	163	429
1	23	20	2	43	38	48	48
1	23	20	3	40	36	45	45
1	23	29	2	24	21	27	27
1	23	29	3	83	74	84	84
1	23	30	1	42	37	41	166
1	23	30	2	329	291	647	884
1	23	30	3	36	32	494	752
1	23	30	4	370	372	419	455
1	23	31	1	27	24	27	282
1	23	31	2	3	3	3	120
1	23	31	3	9	8	9	9
1	23	31	4	86	76	84	235
1	23	32	2	29	26	34	34
1	23	32	3	34	30	36	36
1	23	32	4	3	3	3	3
2	21	01	1	7	6	7	7
2	21	01	2	10	9	10	10
2	21	01	3	7	6	7	7
2	21	01	4	7	6	7	7
2	21	12	1	10	9	10	10
2	21	12	2	10	9	10	10
2	21	12	3	7	6	7	7
2	21	12	4	13	12	13	13
2	21	13	1	20	18	23	23
2	21	13	2	13	12	13	13
2	21	13	3	0	0	0	0
2	21	13	4	13	12	13	13
2	21	24	1	3	3	3	3
2	21	24	2	13	12	13	13
2	21	24	3	42	37	47	47
2	21	24	4	45	40	44	44
2	21	25	1	28	25	27	27
2	21	25	2	19	17	19	19
2	21	25	3	3	3	3	3
2	21	25	4	44	39	43	43
2	21	36	1	16	14	16	16
2	21	36	2	3	3	3	3
2	21	36	3	9	8	9	9
2	21	36	4	12	11	12	12
2	22	01	1	121	123	269	773
2	22	01	2	76	83	164	882
2	22	01	3	104	109	120	650
2	22	01	4	26	23	26	465
2	22	02	1	79	86	205	630
2	22	02	2	60	53	73	306
2	22	02	3	48	43	72	180
2	22	02	4	101	101	119	412

Appendix B

Kenosha Area Sewer And Water Study
Population Projections By Quarter Section:
2010-Intermediate, 2010-Optimistic,
And Ultimate Development

Town	Range	Section	1/4 Section	1985 Population	2010 Intermediate	2010 Optimistic	Ultimate
2	22	03	1	205	182	282	322
2	22	03	2	6	6	6	6
2	22	03	3	15	14	15	15
2	22	03	4	49	47	53	215
2	22	04	1	12	11	12	12
2	22	04	2	0	0	0	0
2	22	04	3	0	0	0	0
2	22	04	4	13	12	13	13
2	22	05	1	12	11	12	12
2	22	05	2	9	8	9	9
2	22	05	3	6	5	6	6
2	22	05	4	6	5	6	6
2	22	06	1	9	8	9	9
2	22	06	2	315	319	320	320
2	22	06	4	9	8	9	9
2	22	07	1	7	6	7	7
2	22	07	2	0	0	0	0
2	22	07	3	36	32	38	38
2	22	07	4	4	4	4	4
2	22	08	1	10	9	10	10
2	22	08	2	11	10	11	11
2	22	08	3	7	6	7	641
2	22	08	4	46	52	211	712
2	22	09	1	4	4	4	4
2	22	09	2	0	0	0	0
2	22	09	3	394	367	590	890
2	22	09	4	49	44	123	427
2	22	10	1	33	29	32	115
2	22	10	2	7	6	7	7
2	22	10	3	6	5	81	345
2	22	10	4	17	15	17	367
2	22	11	1	0	100	120	120
2	22	11	2	0	0	0	0
2	22	11	3	0	0	0	0
2	22	11	4	4	4	4	4
2	22	12	1	10	9	10	488
2	22	12	2	0	0	0	0
2	22	12	3	188	167	185	185
2	22	12	4	13	115	127	805
2	22	13	1	241	235	573	672
2	22	13	2	123	192	466	625
2	22	13	3	553	690	856	990
2	22	13	4	6	280	671	785
2	22	14	1	59	52	76	643
2	22	14	2	86	76	98	398
2	22	14	3	53	47	52	345
2	22	14	4	89	237	262	768
2	22	15	1	13	12	13	491
2	22	15	2	8	7	83	242
2	22	15	3	7	6	7	7
2	22	15	4	23	20	23	319
2	22	16	1	20	18	95	545
2	22	16	2	218	254	435	842
2	22	16	3	9	8	9	9
2	22	16	4	32	28	31	31
2	22	17	1	311	335	530	890
2	22	17	2	105	93	108	543
2	22	17	3	4	4	4	4
2	22	17	4	11	10	11	11

Appendix B

Kenosha Area Sewer And Water Study
Population Projections By Quarter Section:
2010-Intermediate, 2010-Optimistic,
And Ultimate Development

Town	Range	Section	1/4 Section	1985 Population	2010 Intermediate	2010 Optimistic	Ultimate
2	22	18	1	3	3	3	3
2	22	18	2	9	8	9	9
2	22	18	3	6	5	6	6
2	22	18	4	0	0	0	0
2	22	19	1	3	3	3	3
2	22	19	2	0	0	0	0
2	22	19	3	23	20	23	23
2	22	19	4	24	21	24	24
2	22	20	1	0	0	0	0
2	22	20	2	15	13	15	15
2	22	20	3	31	28	30	30
2	22	20	4	7	6	7	7
2	22	21	1	3	3	3	3
2	22	21	2	12	11	12	12
2	22	21	3	4	4	4	4
2	22	21	4	3	3	3	3
2	22	22	1	10	9	10	53
2	22	22	2	11	10	11	11
2	22	22	3	11	10	11	11
2	22	22	4	38	34	37	197
2	22	23	1	86	76	89	955
2	22	23	2	80	86	95	689
2	22	23	3	3	3	3	1125
2	22	23	4	111	312	413	496
2	22	24	1	642	893	1164	1238
2	22	24	2	65	189	493	585
2	22	24	3	391	521	821	821
2	22	24	4	1434	1403	1558	1586
2	22	25	1	824	877	974	1018
2	22	25	2	376	443	551	763
2	22	25	3	695	676	805	805
2	22	25	4	809	718	822	822
2	22	26	1	460	607	632	659
2	22	26	2	14	12	14	910
2	22	26	3	296	563	800	840
2	22	26	4	375	333	415	415
2	22	27	1	8	7	8	524
2	22	27	2	47	42	46	184
2	22	27	3	44	39	43	890
2	22	27	4	24	21	272	343
2	22	28	1	15	13	15	15
2	22	28	2	14	12	14	14
2	22	28	3	20	18	20	20
2	22	28	4	7	6	7	7
2	22	29	1	7	6	7	7
2	22	29	2	222	197	220	589
2	22	29	3	10	9	10	10
2	22	29	4	98	87	96	96
2	22	30	1	57	51	56	133
2	22	30	2	12	11	12	12
2	22	30	3	16	14	16	16
2	22	30	4	26	23	26	26
2	22	31	1	0	0	0	0
2	22	31	2	3	3	3	3
2	22	31	3	12	11	12	51
2	22	31	4	3	3	3	3
2	22	32	1	0	0	0	0
2	22	32	2	0	0	0	0
2	22	32	3	0	0	0	0

Appendix B

Kenosha Area Sewer And Water Study
Population Projections By Quarter Section:
2010-Intermediate, 2010-Optimistic,
And Ultimate Development

Town	Range	Section	1/4 Section	1985 Population	2010 Intermediate	2010 Optimistic	Ultimate
2	22	32	4	10	9	10	10
2	22	33	1	3	3	3	3
2	22	33	2	0	0	0	0
2	22	33	3	41	36	40	40
2	22	33	4	12	11	12	261
2	22	34	1	186	165	228	228
2	22	34	2	8	7	8	8
2	22	34	3	81	211	568	827
2	22	34	4	798	767	891	891
2	22	35	1	1253	1171	1377	1377
2	22	35	2	116	103	114	114
2	22	35	3	1366	1255	1415	1415
2	22	35	4	1757	1579	1758	1758
2	22	36	1	1581	1404	1569	1569
2	22	36	2	1504	1413	1571	1592
2	22	36	3	1863	1654	1843	1843
2	22	36	4	1028	919	1014	1014
2	23	05	1	106	106	106	106
2	23	05	2	84	76	82	455
2	23	05	3	111	99	136	334
2	23	06	1	23	20	23	736
2	23	06	2	42	58	131	670
2	23	06	3	8	8	8	8
2	23	06	4	31	28	30	943
2	23	30	1	586	602	706	706
2	23	30	2	1372	1218	1367	1367
2	23	30	3	1389	1233	1378	1378
2	23	30	4	1939	1722	1920	1920
2	23	31	1	1017	969	1010	1010
2	23	31	2	2242	1991	2208	2208
2	23	31	3	2342	2197	2439	2439
2	23	31	4	1104	1397	1519	1519
2	23	32	2	0	0	0	0
2	23	32	3	102	276	294	294
Totals				88546	89863	119356	173856

Source: SEWRPC

Appendix C

Kenosha Area Sewer and Water Study
Pipe Routing Summary
(Existing Land Use)

PIPE NO.	CAP. (CFS)	PEAK Q. (CFS)	TIME (hrs)	NORMAL DEPTH (feet)	REQUIRED DIAMETER @ GRND SLOPE	@ PIPE SLOPE	WITH PARAL. PIPE
20.20	4	2	8	0.63	0	0	0
20.19	3	2	8	0.76	0	0	0
20.18	3	2	8	0.76	0	0	0
20.17	3	2	8	0.87	0	0	0
20.16	5	2	8	0.63	0	0	0
20.15	4	2	8	0.65	0	0	0
20.14	8	9	8	0.00	N/A	19	8
20.13	3	9	8	0.00	21	27	23
20.12	3	9	8	0.00	24	27	23
20.11	9	9	8	1.61	0	0	0
20.10	13	9	8	1.25	0	0	0
20.09	32	9	8	1.10	0	0	0
20.08	21	28	8	0.00	N/A	40	23
20.07	28	28	8	2.39	0	0	0
20.06	32	28	8	2.13	0	0	0
20.05	31	28	8	2.18	0	0	0
20.04	60	28	8	1.67	0	0	0
20.03	74	28	8	1.48	0	0	0
20.02	66	28	8	1.57	0	0	0
20.01	116	27	8	1.16	0	0	0
19.06	4	4	8	0.00	13	13	6
19.05	4	4	8	0.76	0	0	0
19.04	4	4	9	0.00	N/A	16	7
19.03	7	5	9	0.81	0	0	0
19.02	4	5	9	0.00	13	17	11
19.01	9	5	9	0.68	0	0	0
18.19	3	2	8	0.90	0	0	0
18.18	3	2	8	0.93	0	0	0
18.17	3	2	8	0.85	0	0	0
18.16	3	2	8	0.91	0	0	0
18.15	3	2	8	0.94	0	0	0
18.14	3	2	8	0.93	0	0	0
18.13	2	2	8	0.00	11	16	9
18.12	3	2	8	0.82	0	0	0
18.11	2	2	8	1.08	13	15	4
18.10	2	2	9	0.00	N/A	18	12
18.09	4	4	8	0.89	0	0	0
18.08	3	4	8	0.00	N/A	16	9
18.07	2	4	8	0.00	N/A	18	13
18.06	3	4	8	0.00	N/A	17	10

Appendix C

Kenosha Area Sewer and Water Study
Pipe Routing Summary
(Existing Land Use)

PIPE NO.	CAP. (CFS)	PEAK Q. (CFS)	TIME (hrs)	NORMAL DEPTH (feet)	REQUIRED DIAMETER @ GRND SLOPE	@ PIPE SLOPE	WITH PARAL. PIPE
18.05	2	4	8	0.00	N/A	18	12
18.04	2	4	9	0.00	15	18	13
18.03	3	4	9	0.00	N/A	16	7
18.02	2	4	9	0.00	N/A	20	16
18.01	2	4	9	0.00	11	18	12
17.11	7	9	9	0.00	15	16	9
17.10	6	9	9	0.00	15	18	12
17.09	338	9	9	0.56	0	0	0
17.08	62	11	9	1.44	0	0	0
17.07	145	11	9	0.94	0	0	0
17.06	90	13	9	1.27	0	0	0
17.05	82	16	9	1.47	0	0	0
17.04	99	16	9	1.34	0	0	0
17.03	83	16	9	1.49	0	0	0
17..02	61	16	9	1.76	0	0	0
17.01	94	16	9	1.40	0	0	0
16.12	4	2	8	0.84	0	0	0
16.11	3	2	9	1.07	0	0	0
16.10	6	2	9	0.73	0	0	0
16.09	6	4	9	1.03	0	0	0
16.08	2	4	9	0.00	17	28	22
16.07	3	4	9	0.00	17	22	10
16.06	14	4	9	0.62	0	0	0
16.05	12	10	9	1.33	0	0	0
16.04	18	10	9	1.05	0	0	0
16.03	16	10	9	1.11	0	0	0
16.02	10	10	9	1.50	0	0	0
16.01	34	10	9	0.90	0	0	0
15.02	75	26	9	2.01	0	0	0
15.01	94	26	9	1.78	0	0	0
14.03	97	56	9	3.51	0	0	0
14.02	74	66	9	4.75	0	0	0
14.01	115	66	9	3.51	0	0	0
13.11	18	3	8	0.77	0	0	0
13.10	15	3	8	0.86	0	0	0
13.09	26	3	8	0.65	0	0	0
13.08	56	3	9	0.44	0	0	0

Appendix C

Kenosha Area Sewer and Water Study
Pipe Routing Summary
(Existing Land Use)

PIPE NO.	CAP. (CFS)	PEAK Q. (CFS)	TIME (hrs)	NORMAL DEPTH (feet)	REQUIRED DIAMETER @ GRND SLOPE	@ PIPE SLOPE	WITH PARAL. PIPE
13.07	30	4	8	0.59	0	0	0
13.06	35	8	9	0.79	0	0	0
13.05	23	8	9	1.00	0	0	0
13.04	41	16	8	1.07	0	0	0
13.03	35	16	8	1.42	0	0	0
13.02	31	16	8	2.04	0	0	0
13.01	226	26	8	1.14	0	0	0
12.12	14	91	9	0.00	N/A	120	112
12.11	166	100	9	2.80	0	0	0
12.10	40	100	9	0.00	55	84	70
12.09	137	100	9	3.18	0	0	0
12.08	10	100	9	0.00	39	141	135
12.07	18	100	9	0.00	N/A	113	105
12.06	32	100	9	0.00	N/A	92	80
12.05	26	105	9	0.00	38	101	91
12.04	91	106	9	0.00	44	64	31
12.03	90	106	9	0.00	N/A	64	31
12.02	64	111	9	0.00	52	74	54
12.01	78	111	9	0.00	53	69	44
11.12	4	1	8	0.30	0	0	0
11.11	4	1	8	0.35	0	0	0
11.10	4	1	8	0.35	0	0	0
11.09	6	3	8	0.82	0	0	0
11.08	14	3	8	0.51	0	0	0
11.07	8	8	8	1.13	0	0	0
11.06	8	8	8	1.13	0	0	0
11.05	12	10	8	1.23	0	0	0
11.04	52	10	9	1.16	0	0	0
11.03	106	10	9	0.82	0	0	0
11.02	200	13	8	0.88	0	0	0
11.01	191	14	9	0.90	0	0	0
10.02	4	3	8	0.96	0	0	0
10.02	4	3	8	0.96	0	0	0
10.01	10	3	9	0.69	0	0	0
9.12	4	4	8	1.30	14	19	8
9.11	3	5	8	0.00	N/A	20	12
9.10	4	5	8	0.00	N/A	19	10
9.09	31	4	9	0.73	0	0	0

Appendix C

Kenosha Area Sewer and Water Study
Pipe Routing Summary
(Existing Land Use)

PIPE NO.	CAP. (CFS)	PEAK Q. (CFS)	TIME (hrs)	NORMAL DEPTH (feet)	REQUIRED DIAMETER @ GRND SLOPE	@ PIPE SLOPE	WITH PARAL. PIPE
9.08	66	6	9	0.59	0	0	0
9.07	51	9	9	0.85	0	0	0
9.06	53	11	9	0.95	0	0	0
9.05	52	15	9	1.09	0	0	0
9.04	51	15	9	1.10	0	0	0
9.03	54	15	9	1.07	0	0	0
9.02	38	15	9	1.30	0	0	0
9.01	50	15	9	1.12	0	0	0
8.19	175	28	9	1.36	0	0	0
8.18	264	28	9	1.22	0	0	0
8.17	214	32	9	1.44	0	0	0
8.16	187	32	9	1.54	0	0	0
8.15	230	32	9	1.39	0	0	0
8.14	345	40	9	1.60	0	0	0
8.13	268	40	9	1.83	0	0	0
8.12	198	40	9	1.67	0	0	0
8.11	112	50	9	2.56	0	0	0
8.10	403	63	9	1.74	0	0	0
8.09	257	63	9	2.19	0	0	0
8.08	350	63	9	1.86	0	0	0
8.07	470	67	9	2.11	0	0	0
8.06	297	67	9	2.67	0	0	0
8.05	485	67	9	2.08	0	0	0
8.04	650	67	9	1.79	0	0	0
8.03	30	73	9	0.00	41	139	114
8.02	47	73	9	0.00	37	117	81
8.01	1013	73	9	1.51	0	0	0
6.11	2	2	9	0.61	0	0	0
6.10	4	2	9	0.43	0	0	0
6.09	7	2	9	0.49	0	0	0
6.08	7	3	9	0.72	0	0	0
6.07	26	3	9	0.49	0	0	0
6.06	20	3	9	0.55	0	0	0
6.05	11	3	9	0.74	0	0	0
6.04	13	4	9	0.76	0	0	0
6.03	10	4	9	0.87	0	0	0
6.02	6	4	9	1.20	0	0	0
6.01	18	4	9	0.80	0	0	0

Appendix C

Kenosha Area Sewer and Water Study
Pipe Routing Summary
(Existing Land Use)

					REQUIRED DIAMETER		
PIPE NO.	CAP. (CFS)	PEAK Q. (CFS)	TIME (hrs)	NORMAL DEPTH (feet)	@ GRND SLOPE	@ PIPE SLOPE	WITH PARAL. PIPE
5.14	3	1	8	0.41	0	0	0
5.13	9	1	8	0.26	0	0	0
5.12	13	1	8	0.21	0	0	0
5.09	19	2	9	0.31	0	0	0
5.09	19	2	9	0.31	0	0	0
5.09	19	2	9	0.31	0	0	0
5.08	8	2	9	0.57	0	0	0
5.07	7	2	9	0.59	0	0	0
5.06	8	3	9	0.70	0	0	0
5.05	8	3	9	0.73	0	0	0
5.04	8	3	9	0.73	0	0	0
5.03	7	4	9	0.98	0	0	0
5.02	13	5	9	1.06	0	0	0
5.01	44	5	9	0.56	0	0	0
4.04	16	9	9	1.32	0	0	0
4.03	10	9	9	1.74	0	0	0
4.02	16	9	9	1.33	0	0	0
4.01	36	9	9	0.83	0	0	0
3.09	3	5	8	0.00	17	20	11
3.08	4	5	8	0.00	15	18	7
3.07	10	5	8	1.18	0	0	0
3.06	20	4	8	0.80	0	0	0
3.05	21	9	8	1.14	0	0	0
3.04	19	9	8	1.21	0	0	0
3.03	28	9	8	0.98	0	0	0
3.02	26	9	9	1.02	0	0	0
3.01	35	9	9	1.04	0	0	0
2.08	48	13	9	1.07	0	0	0
2.07	25	13	9	1.56	0	0	0
2.06	67	13	9	1.20	0	0	0
2.05	65	13	9	1.23	0	0	0
2.04	112	13	9	0.93	0	0	0
2.03	45	13	9	1.48	0	0	0
2.02	65	13	9	1.23	0	0	0
2.01	86	22	9	1.05	0	0	0
1.06	134	185	9	0.00	N/A	81	50
1.05	134	185	9	0.00	N/A	81	50

Appendix C

Kenosha Area Sewer and Water Study
Pipe Routing Summary
(Existing Land Use)

PIPE NO.	CAP. (CFS)	PEAK Q. (CFS)	TIME (hrs)	NORMAL DEPTH (feet)	REQUIRED DIAMETER @ GRND SLOPE	@ PIPE SLOPE	WITH PARAL. PIPE
1.04	77	189	9	0.00	89	101	83
1.03	91	189	9	0.00	89	95	74
1.02	81	212	9	0.00	N/A	103	86

Appendix D

Hydraulic Grade Lines And Peak Flows For Kenosha Analysis

MH#	Size (in)	Slope	Capacity (cfs)	Peak Flow (cfs)	Inv.	Rim	Max HGL.	Parts Full*
0.00	0	0.0000	0.00	0.00	0.00	0.00	0.000	0.000
1.02	72	0.0004	81.22	198.59	571.20	589.00	580.957	2.445
1.03	72	0.0005	91.28	198.59	571.92	590.00	585.285	2.176
1.04	72	0.0003	76.81	198.59	572.17	590.50	587.875	2.585
1.05	72	0.0010	133.93	198.59	572.42	590.00	589.344	1.483
1.06	72	0.0010	133.93	198.59	572.62	590.00	590.703	1.483
2.01	36	0.0164	85.54	22.43	578.36	593.00	579.407	0.262
2.02	48	0.0020	64.68	13.30	580.59	604.90	581.822	0.206
2.03	48	0.0010	45.41	13.30	580.66	605.00	582.144	0.293
2.04	48	0.0061	112.13	13.31	588.46	606.00	589.390	0.119
2.05	48	0.0020	64.79	13.30	591.41	606.00	592.639	0.205
2.06	48	0.0022	67.38	13.27	592.51	610.00	593.714	0.197
2.07	36	0.0014	24.83	13.26	594.66	614.00	596.220	0.534
2.08	36	0.0053	48.48	13.26	597.83	614.00	598.903	0.273
3.01	36	0.0027	34.96	9.13	580.42	594.00	582.232	0.261
3.02	30	0.0040	26.07	9.09	587.24	598.00	588.256	0.349
3.03	30	0.0046	27.83	9.05	591.06	606.00	592.044	0.325
3.04	30	0.0022	19.29	9.09	592.83	606.00	594.040	0.471
3.05	30	0.0027	21.37	9.13	596.52	614.00	597.678	0.427
3.06	30	0.0025	20.32	4.50	597.33	614.00	598.591	0.221
3.07	30	0.0006	9.95	4.51	597.83	614.00	599.184	0.453
3.08	18	0.0016	4.20	4.51	599.47	616.00	601.094	1.074
3.09	18	0.0011	3.49	4.51	600.42	618.00	602.803	1.293
4.01	30	0.0077	36.07	8.67	598.89	619.40	599.724	0.240
4.02	30	0.0014	15.58	8.67	602.84	624.70	604.173	0.556
4.03	30	0.0007	10.47	8.68	602.99	624.00	604.727	0.829
4.04	30	0.0015	15.85	8.69	606.38	625.70	608.224	0.548
5.01	30	0.0113	43.54	4.73	613.14	624.00	613.696	0.109
5.02	30	0.0009	12.53	4.72	613.42	624.80	614.483	0.377
5.03	21	0.0021	7.27	4.42	619.09	631.00	620.073	0.608
5.04	21	0.0025	7.91	2.87	620.55	634.70	621.278	0.363
5.05	21	0.0025	7.89	2.86	622.83	639.10	623.557	0.363
5.06	21	0.0028	8.34	2.85	624.30	647.50	625.004	0.342
5.07	21	0.0021	7.31	1.81	626.64	644.30	627.232	0.247
5.08	21	0.0025	7.85	1.80	627.45	647.60	628.020	0.229
5.09	18	0.0322	18.86	1.80	630.60	647.60	630.913	0.095
5.10	18	0.0002	1.36	1.80	630.76	649.00	632.382	1.319

* 1.000 corresponds to a full pipe or 100% capacity

Appendix D

Hydraulic Grade Lines And Peak Flows For Kenosha Analysis

MH#	Size (in)	Slope	Capacity (cfs)	Peak Flow (cfs)	Inv.	Rim	Max HGL.	Parts Full*
5.11	18	0.0256	16.82	0.81	640.50	663.00	640.723	0.048
5.12	15	0.0393	12.80	0.81	652.28	665.00	652.492	0.063
5.13	15	0.0180	8.66	0.81	661.26	672.00	661.517	0.093
5.14	15	0.0028	3.40	0.81	662.92	683.00	663.334	0.237
6.01	30	0.0018	17.61	3.96	608.98	624.50	610.134	0.225
6.02	24	0.0007	5.87	3.94	609.87	623.50	611.070	0.672
6.03	24	0.0020	10.09	3.94	611.56	622.60	612.507	0.390
6.04	24	0.0032	12.73	3.93	615.40	623.60	616.160	0.308
6.05	24	0.0026	11.47	3.35	616.30	624.30	617.039	0.292
6.06	24	0.0078	20.04	3.34	625.72	637.50	626.270	0.167
6.07	24	0.0128	25.56	3.33	629.55	647.60	630.037	0.130
6.08	21	0.0022	7.36	2.66	632.84	649.00	633.565	0.362
6.09	18	0.0044	6.94	1.62	643.83	658.10	644.322	0.233
6.10	12	0.0139	4.20	1.61	646.41	659.00	646.839	0.383
6.11	12	0.0042	2.31	1.61	657.32	671.30	657.928	0.697
8.01	99	0.0105	1012.60	73.48	581.15	590.30	584.983	0.073
8.02	99	0.0000	46.55	73.49	581.16	595.30	589.437	1.579
8.03	99	0.0000	29.87	73.37	581.17	601.70	589.538	2.457
8.04	99	0.0043	650.08	73.05	586.99	607.30	589.647	0.112
8.05	99	0.0024	485.05	67.23	587.59	611.00	589.794	0.139
8.06	99	0.0009	297.01	67.24	588.04	615.00	590.710	0.226
8.07	99	0.0023	469.64	67.28	588.67	614.80	590.845	0.143
8.08	78	0.0045	350.02	62.75	591.79	620.60	593.650	0.179
8.09	78	0.0024	256.85	62.77	592.51	624.50	594.698	0.244
8.10	78	0.0059	402.71	62.80	594.28	623.20	596.016	0.156
8.11	66	0.0011	112.09	49.71	594.67	622.70	597.235	0.443
8.12	66	0.0035	198.10	39.92	598.15	623.90	599.824	0.202
8.13	84	0.0018	268.00	39.87	599.91	623.80	601.736	0.149
8.14	84	0.0029	345.28	39.85	601.02	621.50	602.620	0.115
8.15	66	0.0047	229.55	32.07	606.02	623.30	607.407	0.140
8.16	66	0.0031	187.30	32.00	607.42	625.70	608.960	0.171
8.17	66	0.0041	214.24	31.96	611.49	629.60	612.925	0.149
8.18	66	0.0062	264.42	28.38	612.11	629.60	613.325	0.107
8.19	60	0.0045	175.36	28.38	614.15	633.60	615.512	0.162
9.01	36	0.0056	49.91	14.84	620.34	635.00	621.460	0.297
9.02	36	0.0033	38.09	14.82	622.46	632.70	623.758	0.389
9.03	36	0.0065	53.77	14.77	627.01	635.00	628.083	0.275

* 1.000 corresponds to a full pipe or 100% capacity

Appendix D

Hydraulic Grade Lines And Peak Flows For Kenosha Analysis

MH#	Size (in)	Slope	Capacity (cfs)	Peak Flow (cfs)	Inv.	Rim	Max HGL.	Parts Full*
9.04	36	0.0059	51.05	14.73	631.99	648.00	633.090	0.289
9.05	36	0.0060	51.50	14.67	640.04	657.50	641.131	0.285
9.06	36	0.0063	52.93	11.47	651.06	666.00	652.005	0.217
9.07	36	0.0058	50.76	8.98	662.54	690.00	663.392	0.177
9.08	36	0.0099	66.48	5.59	674.83	689.20	675.418	0.084
9.09	36	0.0022	31.30	4.37	682.69	699.00	683.423	0.140
9.10	18	0.0013	3.74	4.54	684.08	698.00	686.057	1.213
9.11	18	0.0010	3.39	4.55	685.15	691.40	688.136	1.345
9.12	18	0.0015	4.00	4.46	686.85	699.00	690.475	1.115
10.01	21	0.0040	10.06	3.32	671.77	693.20	672.460	0.330
10.02	18	0.0018	4.50	3.32	673.42	695.00	674.381	0.737
10.03	12	0.0085	3.29	3.33	699.59	710.20	701.325	1.013
11.01	60	0.0054	190.67	13.50	618.17	641.70	619.072	0.071
11.02	60	0.0059	199.63	13.49	620.52	639.90	621.405	0.068
11.03	48	0.0054	105.84	9.73	624.32	636.70	625.138	0.092
11.04	48	0.0013	52.45	9.73	625.72	645.00	626.882	0.185
11.05	21	0.0054	11.65	9.75	638.41	653.00	639.636	0.836
11.06	18	0.0063	8.31	7.55	644.98	661.00	648.138	0.909
11.07	18	0.0194	14.62	7.58	651.37	666.50	652.136	0.518
11.08	18	0.0175	13.92	3.47	678.22	698.00	678.733	0.249
11.09	18	0.0033	6.03	3.49	681.02	703.80	681.839	0.578
11.10	15	0.0048	4.48	0.75	692.31	708.00	692.657	0.168
11.11	15	0.0048	4.46	0.76	698.52	715.00	698.870	0.170
11.12	12	0.0112	3.77	0.76	713.38	729.30	713.684	0.202
12.01	60	0.0009	77.82	107.42	573.67	591.00	585.954	1.380
12.02	60	0.0006	63.80	107.39	574.06	593.50	587.617	1.683
12.03	60	0.0012	90.26	102.59	578.42	588.00	588.000	1.137
12.04	60	0.0012	90.58	101.80	579.69	597.00	590.196	1.124
12.05	60	0.0001	26.03	101.17	579.72	602.90	591.149	3.886
12.06	60	0.0001	31.66	95.93	579.85	595.10	592.829	3.031
12.07	60	0.0001	18.43	95.85	579.86	595.10	593.916	5.202
12.08	60	0.0000	10.22	95.87	579.87	604.00	595.240	9.380
12.09	60	0.0027	136.58	95.99	580.42	597.00	596.031	0.703
12.10	60	0.0002	40.19	96.01	580.52	598.00	597.121	2.389
12.11	60	0.0041	165.86	96.20	581.25	600.00	597.812	0.580
12.12	60	0.0000	14.34	86.98	581.26	600.00	598.614	6.064
13.01	60	0.0075	225.85	107.42	601.82	621.80	603.764	0.476

* 1.000 corresponds to a full pipe or 100% capacity

Appendix D

Hydraulic Grade Lines And Peak Flows For Kenosha Analysis

MH#	Size (in)	Slope	Capacity (cfs)	Peak Flow (cfs)	Inv.	Rim	Max HGL.	Parts Full*
13.02	48	0.0005	30.86	15.83	604.42	620.60	606.455	0.513
13.03	36	0.0027	34.96	15.88	606.62	618.80	608.270	0.454
13.04	30	0.0099	40.78	15.83	635.02	649.00	636.094	0.388
13.05	30	0.0032	23.20	7.77	635.34	649.00	637.035	0.335
13.06	30	0.0074	35.25	7.76	670.42	689.90	671.213	0.220
13.07	27	0.0095	30.15	4.46	682.32	710.00	682.906	0.148
13.08	36	0.0070	55.96	2.63	695.59	724.90	696.033	0.047
13.09	36	0.0015	25.54	2.65	696.03	726.00	696.683	0.104
13.10	36	0.0005	14.91	2.65	696.28	730.00	697.139	0.178
13.11	36	0.0008	18.30	2.66	697.56	705.00	698.329	0.146
14.01	78	0.0005	115.27	61.57	581.58	602.30	599.012	0.534
14.02	78	0.0002	74.13	61.52	581.72	610.00	599.189	0.830
14.03	78	0.0003	97.21	51.67	582.38	592.00	592.000	0.532
15.01	60	0.0013	94.30	21.64	582.97	592.00	592.000	0.229
15.02	60	0.0008	75.07	21.63	584.05	596.00	592.112	0.288
16.01	30	0.0070	34.39	9.52	586.37	596.00	592.332	0.277
16.02	24	0.0021	10.43	9.52	588.72	596.00	593.978	0.913
16.03	24	0.0050	16.00	9.50	590.47	600.00	594.795	0.594
16.04	24	0.0060	17.57	9.50	595.06	618.00	596.690	0.541
16.05	24	0.0029	12.18	9.50	597.87	616.80	600.886	0.781
16.06	21	0.0073	13.56	3.64	607.77	616.30	608.390	0.269
16.07	21	0.0004	3.19	3.65	608.42	619.00	610.374	1.142
16.08	21	0.0001	1.73	3.67	608.56	621.00	611.044	2.115
16.09	21	0.0012	5.55	3.65	610.01	623.00	611.713	0.657
16.10	21	0.0014	5.96	2.21	611.71	625.00	613.135	0.371
16.11	21	0.0004	3.13	2.20	612.14	626.00	613.689	0.701
16.12	18	0.0012	3.65	2.21	613.75	629.50	615.146	0.607
17.01	60	0.0013	94.42	12.11	584.97	607.00	592.162	0.128
17.02	60	0.0005	60.52	12.11	585.24	607.00	592.184	0.200
17.03	60	0.0010	83.44	12.12	585.63	610.00	592.201	0.145
17.04	60	0.0014	99.08	11.63	586.18	600.90	592.216	0.117
17.05	60	0.0010	82.36	11.64	588.80	621.00	592.281	0.141
17.06	60	0.0012	90.05	8.81	591.43	621.50	593.310	0.098
17.07	60	0.0031	145.34	7.19	592.52	623.00	593.542	0.049
17.08	60	0.0006	61.90	7.19	594.13	623.00	595.270	0.116
17.09	60	0.0168	337.97	4.92	610.97	630.00	611.391	0.015
17.10	15	0.0084	5.92	4.92	613.49	635.00	614.359	0.831

* 1.000 corresponds to a full pipe or 100% capacity

Appendix D

Hydraulic Grade Lines And Peak Flows For Kenosha Analysis

MH#	Size (in)	Slope	Capacity (cfs)	Peak Flow (cfs)	Inv.	Rim	Max HGL.	Parts Full*
17.11	15	0.0115	6.93	4.91	615.79	639.40	617.002	0.709
18.01	15	0.0012	2.24	3.59	615.91	641.00	617.957	1.602
18.02	15	0.0007	1.67	3.58	616.11	635.00	619.039	2.148
18.03	15	0.0023	3.12	3.57	616.88	634.00	620.208	1.146
18.04	15	0.0011	2.15	3.56	617.29	635.00	621.490	1.656
18.05	15	0.0012	2.24	3.56	617.71	634.00	622.710	1.591
18.06	15	0.0017	2.64	3.57	618.16	634.00	623.691	1.353
18.07	15	0.0011	2.16	3.57	618.53	634.00	624.856	1.650
18.08	15	0.0019	2.85	3.57	618.92	633.00	625.625	1.251
18.09	15	0.0042	4.16	3.57	619.75	632.00	626.392	0.857
18.10	15	0.0006	1.57	2.40	619.85	631.00	626.768	1.529
18.11	15	0.0013	2.31	2.40	620.08	631.50	627.087	1.038
18.12	15	0.0024	3.16	2.40	620.75	632.00	627.546	0.761
18.13	15	0.0009	1.89	2.41	621.04	634.00	628.090	1.277
18.14	15	0.0017	2.68	2.42	622.07	636.00	629.003	0.903
18.15	15	0.0017	2.66	2.43	622.46	637.00	629.400	0.913
18.16	15	0.0018	2.78	2.43	622.94	639.00	629.841	0.875
18.17	15	0.0022	3.02	2.43	623.42	637.00	630.225	0.805
18.18	15	0.0017	2.70	2.43	623.89	636.00	630.679	0.900
18.19	15	0.0018	2.77	2.42	624.48	636.00	631.201	0.873
19.01	15	0.0209	9.34	1.33	671.90	683.00	672.219	0.142
19.02	15	0.0035	3.81	1.33	675.90	697.00	676.408	0.348
19.03	15	0.0118	7.01	1.32	676.10	697.00	676.468	0.189
19.04	15	0.0031	3.57	1.32	678.09	690.70	678.615	0.370
19.05	12	0.0150	4.36	1.32	702.41	712.60	702.785	0.302
19.06	12	0.0098	3.53	1.32	725.70	736.10	726.125	0.373
20.01	42	0.0133	116.07	27.48	589.70	614.50	592.528	0.237
20.02	42	0.0044	66.41	27.51	590.92	615.00	593.500	0.414
20.03	42	0.0055	74.31	27.53	592.12	615.80	594.491	0.370
20.04	42	0.0035	59.52	27.54	593.17	613.90	596.574	0.463
20.05	36	0.0022	31.47	27.55	595.05	614.50	599.120	0.876
20.06	36	0.0023	32.33	27.60	596.06	613.50	600.295	0.854
20.07	36	0.0018	28.37	27.61	596.82	612.00	601.299	0.973
20.08	36	0.0010	21.31	27.62	597.30	611.00	602.389	1.296
20.09	36	0.0023	31.99	9.09	600.13	613.50	602.860	0.284
20.10	24	0.0032	12.83	9.13	604.12	613.50	606.292	0.712
20.11	24	0.0017	9.30	9.14	604.88	613.50	607.359	0.984

* 1.000 corresponds to a full pipe or 100% capacity

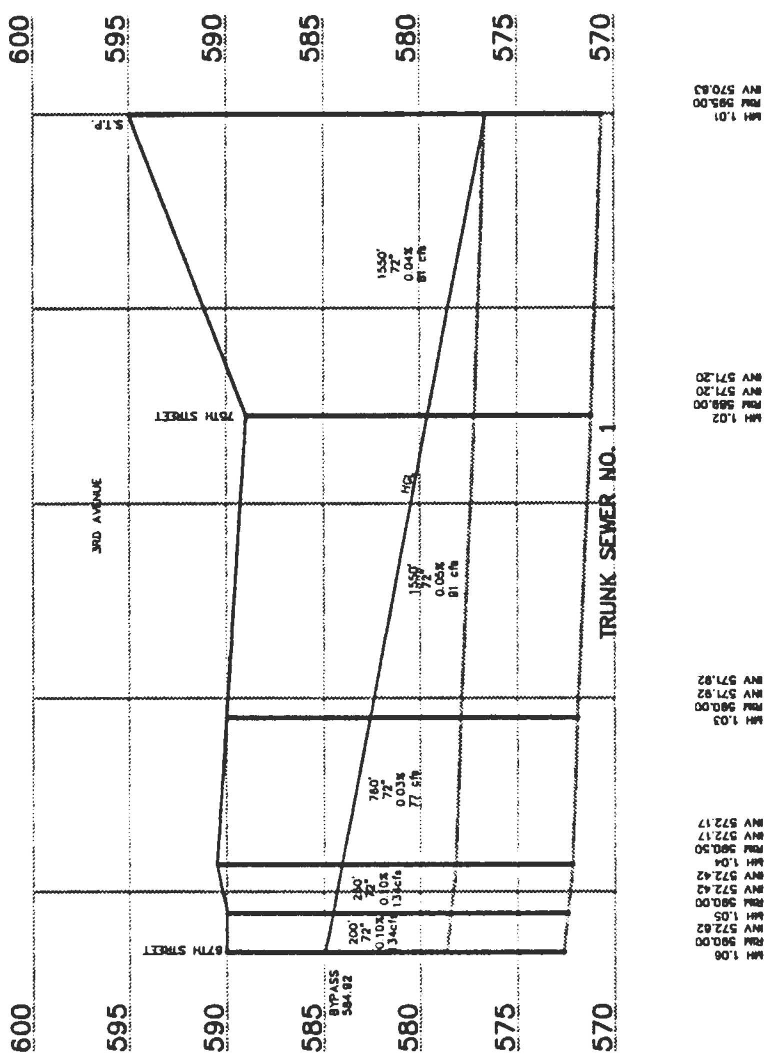
Appendix D

Hydraulic Grade Lines And Peak Flows For Kenosha Analysis

MH#	Size (in)	Slope	Capacity (cfs)	Peak Flow (cfs)	Inv.	Rim	Max HGL.	Parts Full*
20.12	18	0.0009	3.18	9.15	605.93	614.50	612.204	2.876
20.13	18	0.0009	3.21	9.12	606.21	615.50	614.967	2.843
20.14	18	0.0061	8.24	9.09	607.44	615.00	615.000	1.104
20.15	18	0.0017	4.31	1.68	608.65	618.50	615.681	0.391
20.16	18	0.0018	4.51	1.68	608.89	617.50	615.734	0.373
20.17	18	0.0006	2.64	1.68	609.08	618.50	615.831	0.637
20.18	18	0.0010	3.25	1.68	609.30	618.50	615.909	0.517
20.19	18	0.0010	3.26	1.68	609.56	618.50	615.998	0.514
20.20	18	0.0018	4.47	1.67	610.52	618.50	616.151	0.373

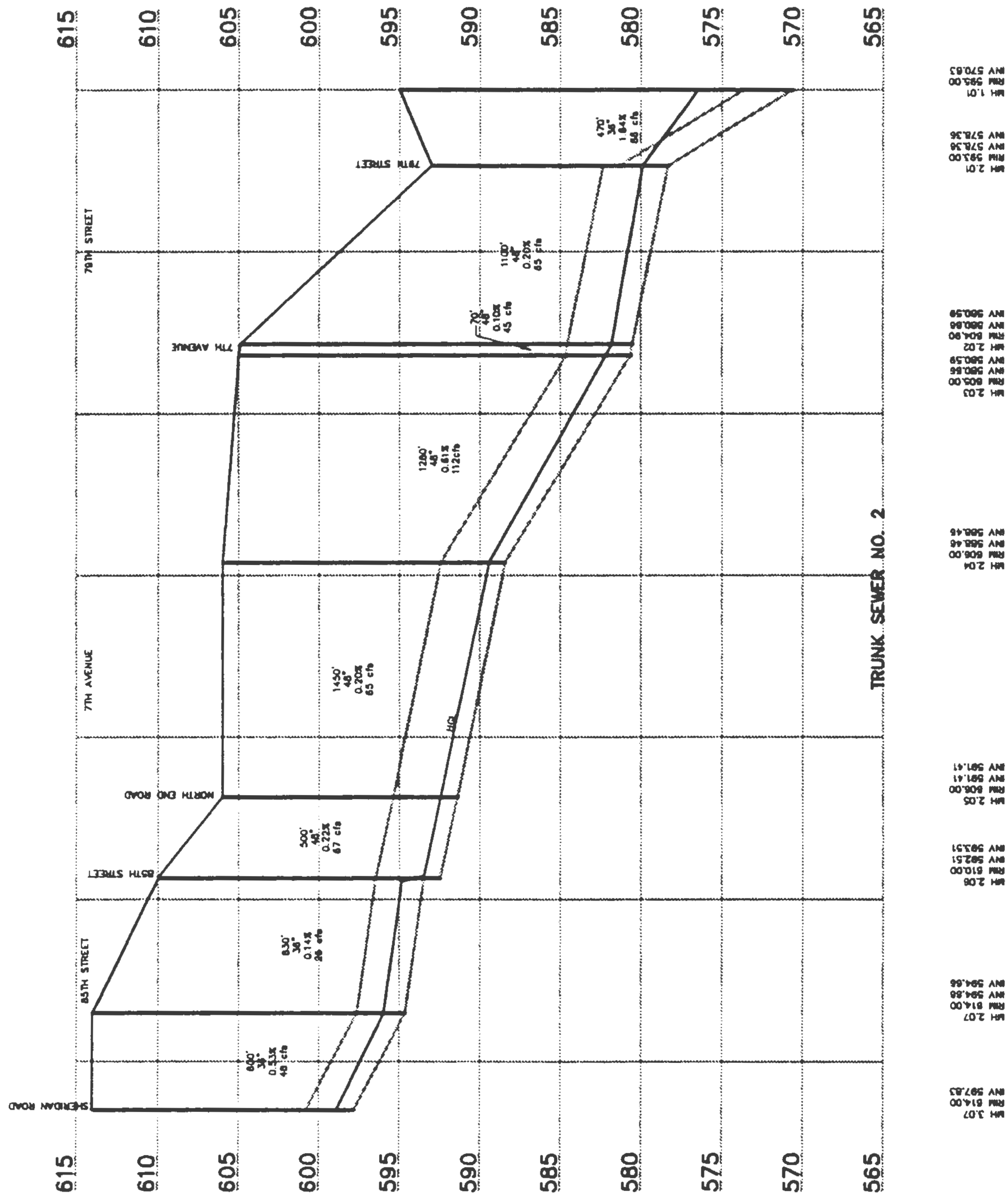
* 1.000 corresponds to a full pipe or 100% capacity

Appendix E



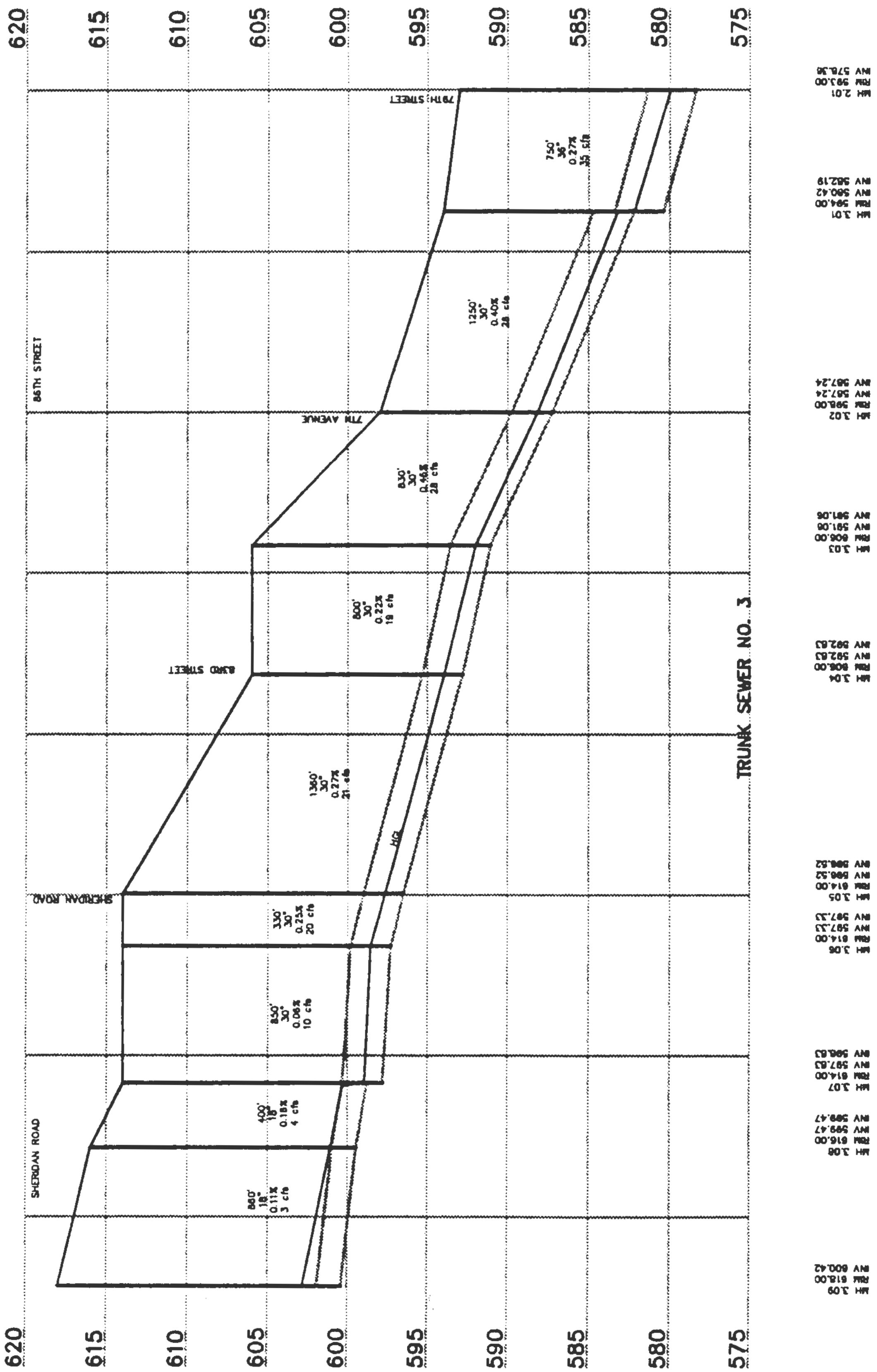
TRUNK SEWER NO. 1
600
595
590
585
580
575
570
S.T.P.
75TH STREET
3RD AVENUE
67TH STREET
HGL
BYPASS 584.82
1550'
72"
0.04%
81 cfs
1550'
72"
0.05%
81 cfs
780'
72"
0.03%
77 cfs
MH 1.01
RIM 595.00
INV 570.83
MH 1.02
RIM 588.00
INV 571.20
INV 571.20
MH 1.03
RIM 590.00
INV 571.82
INV 571.82
MH 1.04
RIM 590.50
INV 572.17
INV 572.17
MH 1.05
RIM 590.00
INV 572.42
INV 572.42
MH 1.06
RIM 590.00
INV 572.62

Appendix E

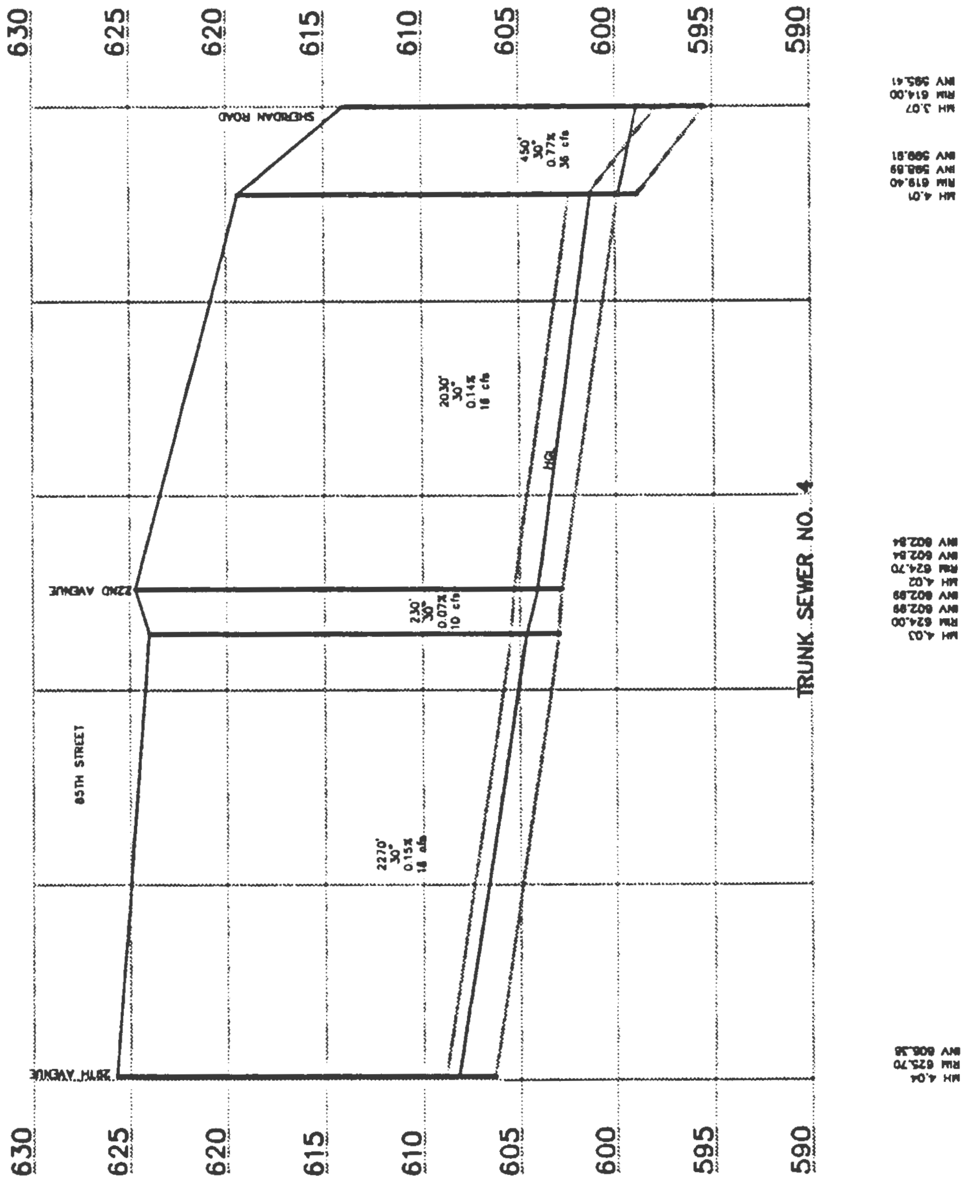


TRUNK SEWER NO. 2
SHERIDAN ROAD
85TH STREET
85TH STREET
NORTH END ROAD
7TH AVENUE
7TH AVENUE
78TH STREET
78TH STREET
HGL
615
610
605
600
595
590
585
580
575
570
565

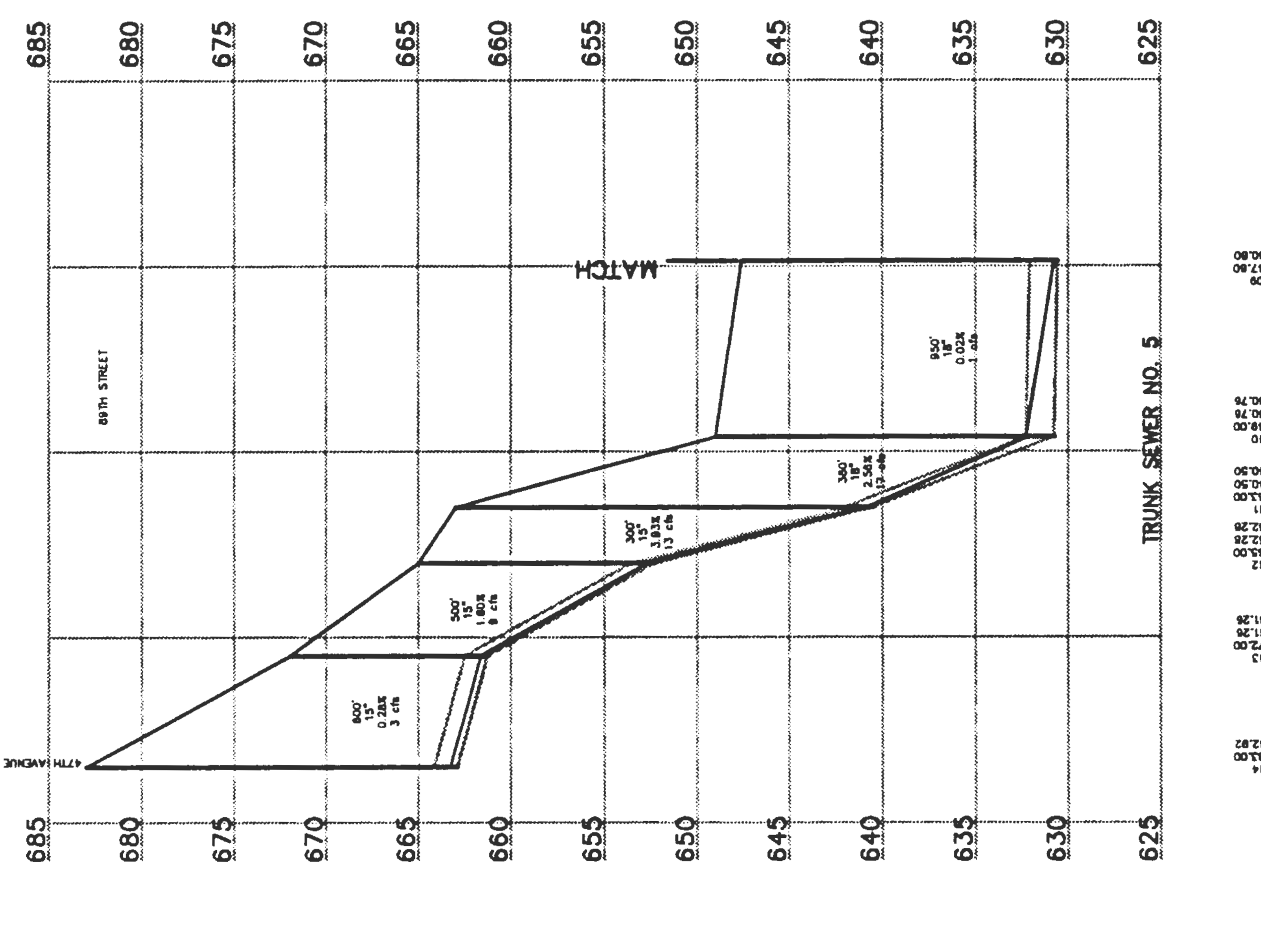
Appendix E



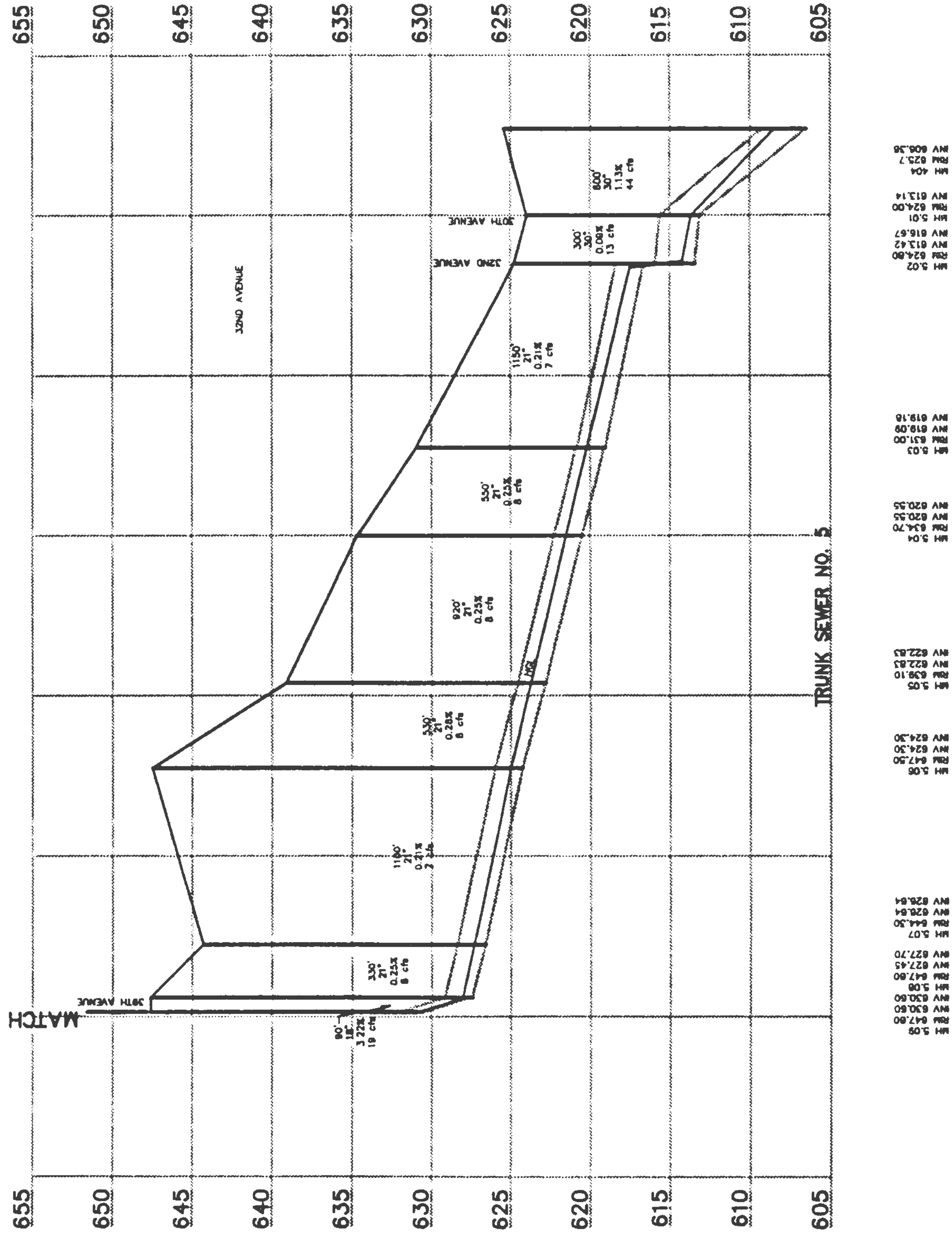
TRUNK SEWER NO. 3
79TH STREET
86TH STREET
7TH AVENUE
83RD STREET
SHERIDAN ROAD
HG
620
615
610
605
600
595
590
585
580
575


TRUNK SEWER NO. 4
SHERIDAN ROAD
82ND AVENUE
85TH STREET
HGL
630
625
620
615
610
605
600
595
590

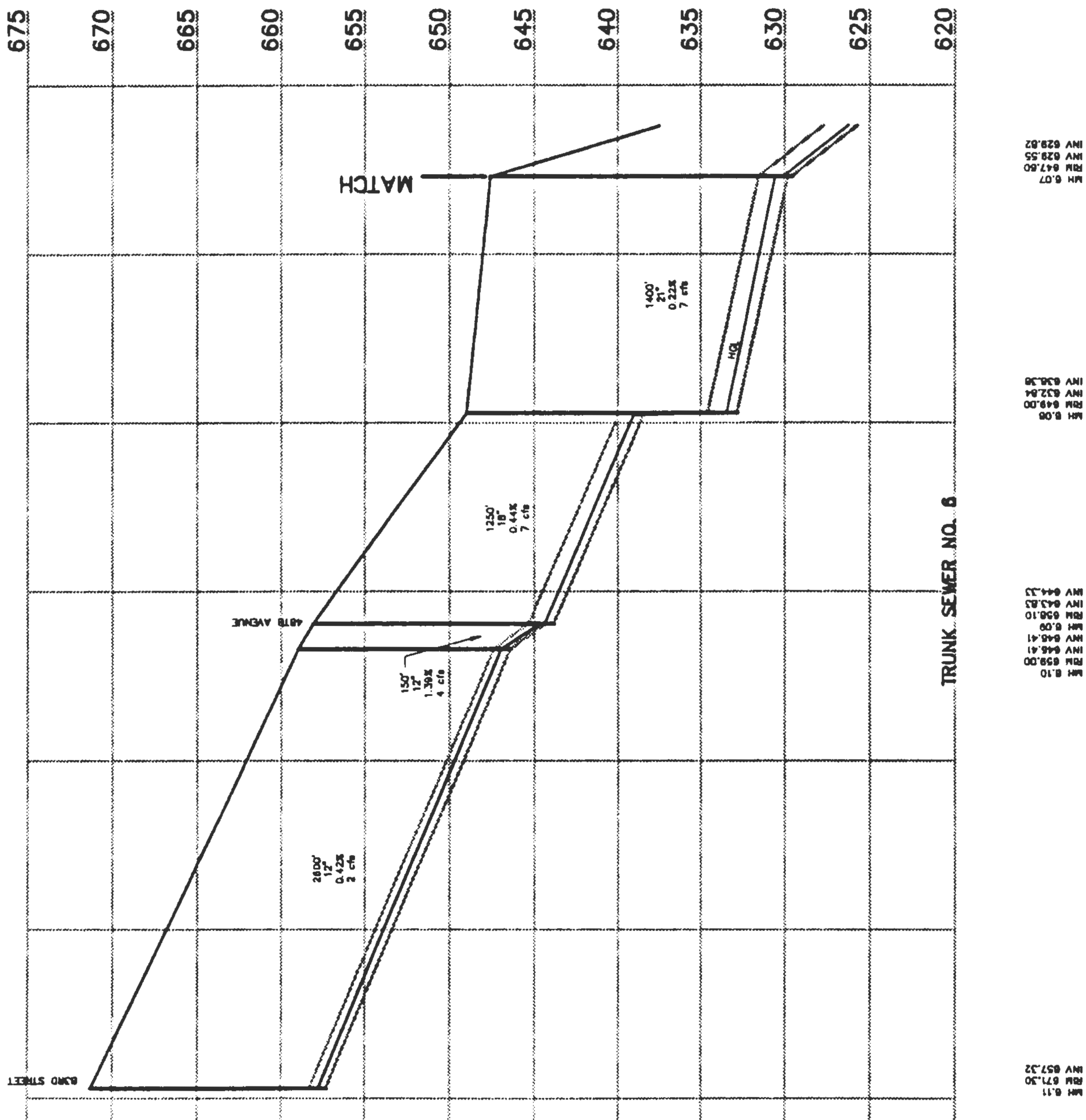
Appendix E



TRUNK SEWER NO. 5
MATCH
89TH STREET
47TH AVENUE
685
680
675
670
665
660
655
650
645
640
635
630
625

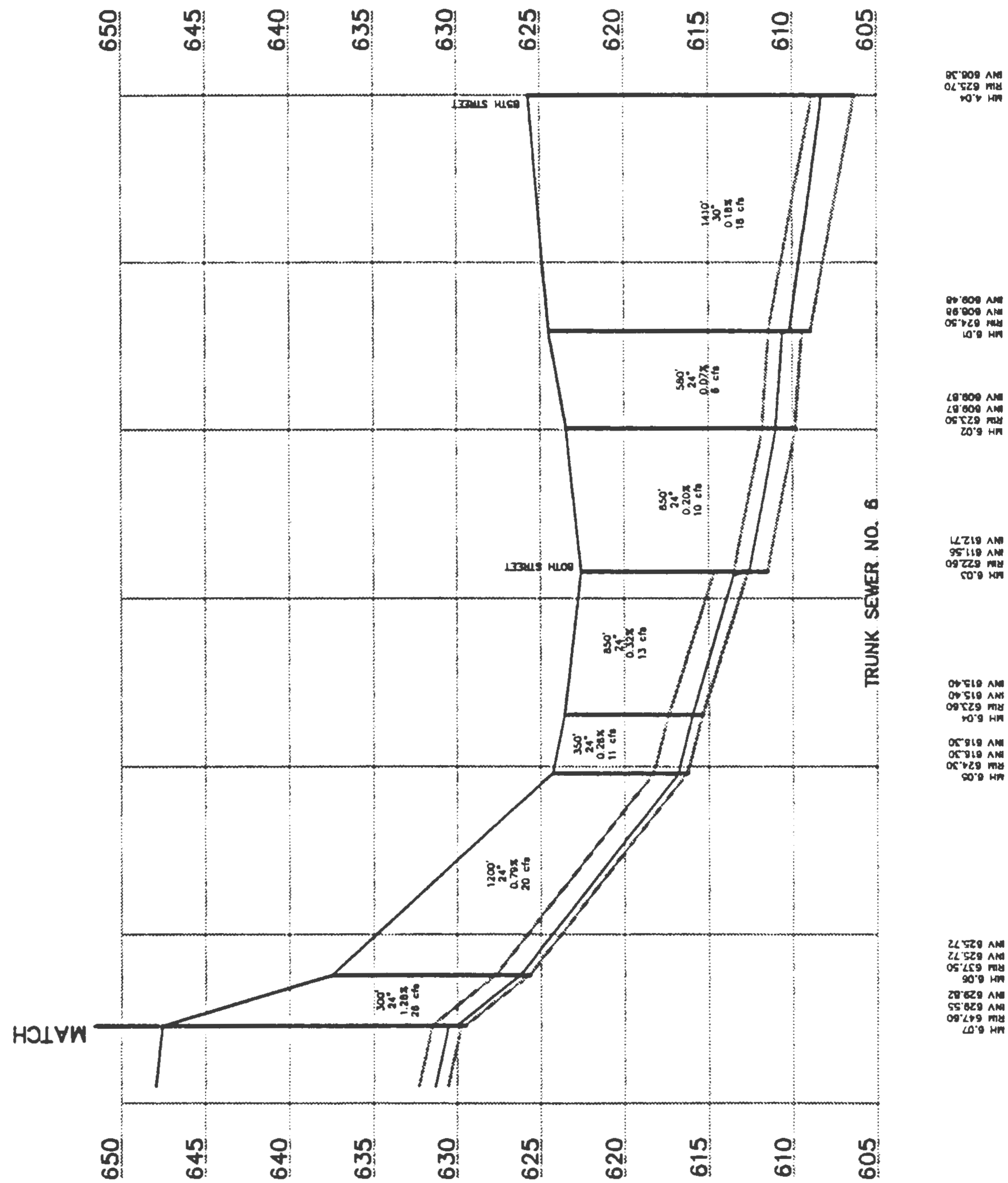

655
650
645
640
635
630
625
620
615
610
605
TRUNK SEWER NO. 5
MATCH
32ND AVENUE
30TH AVENUE

Appendix E

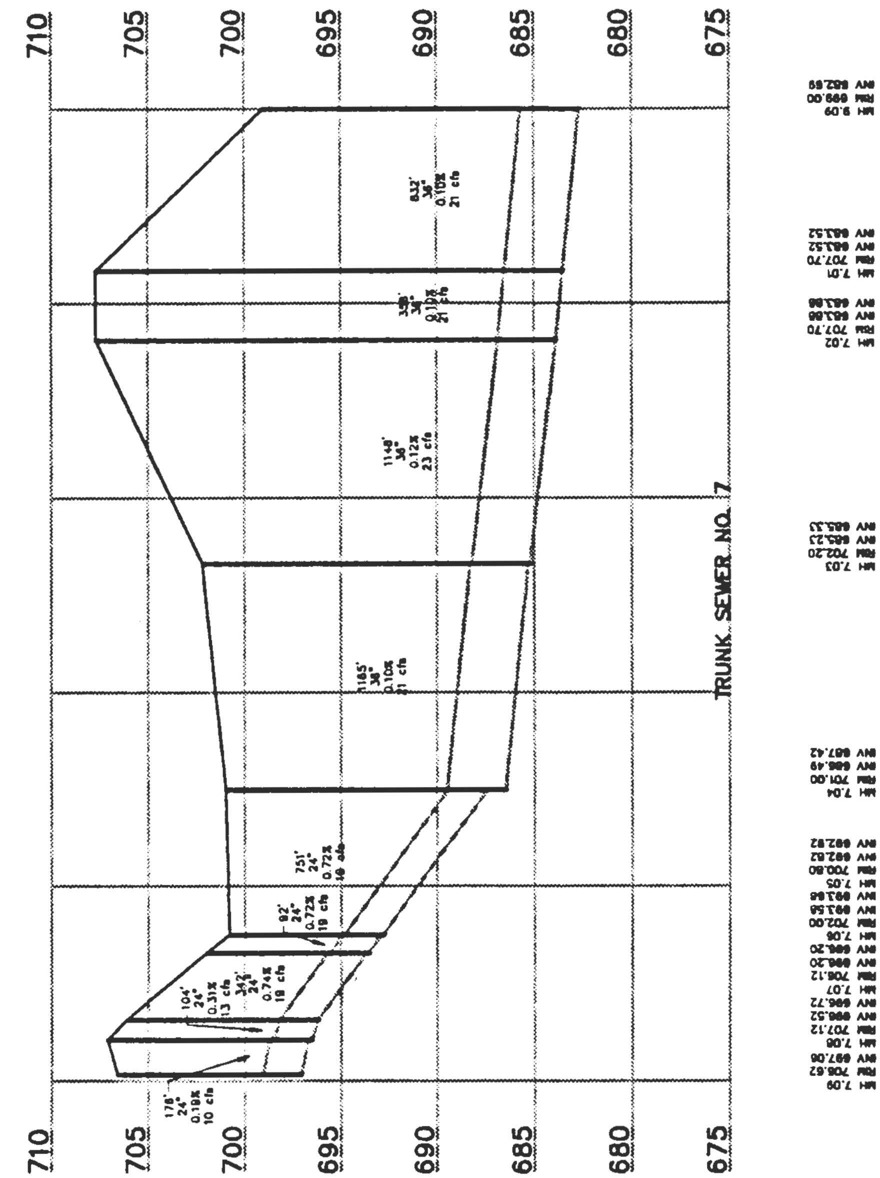


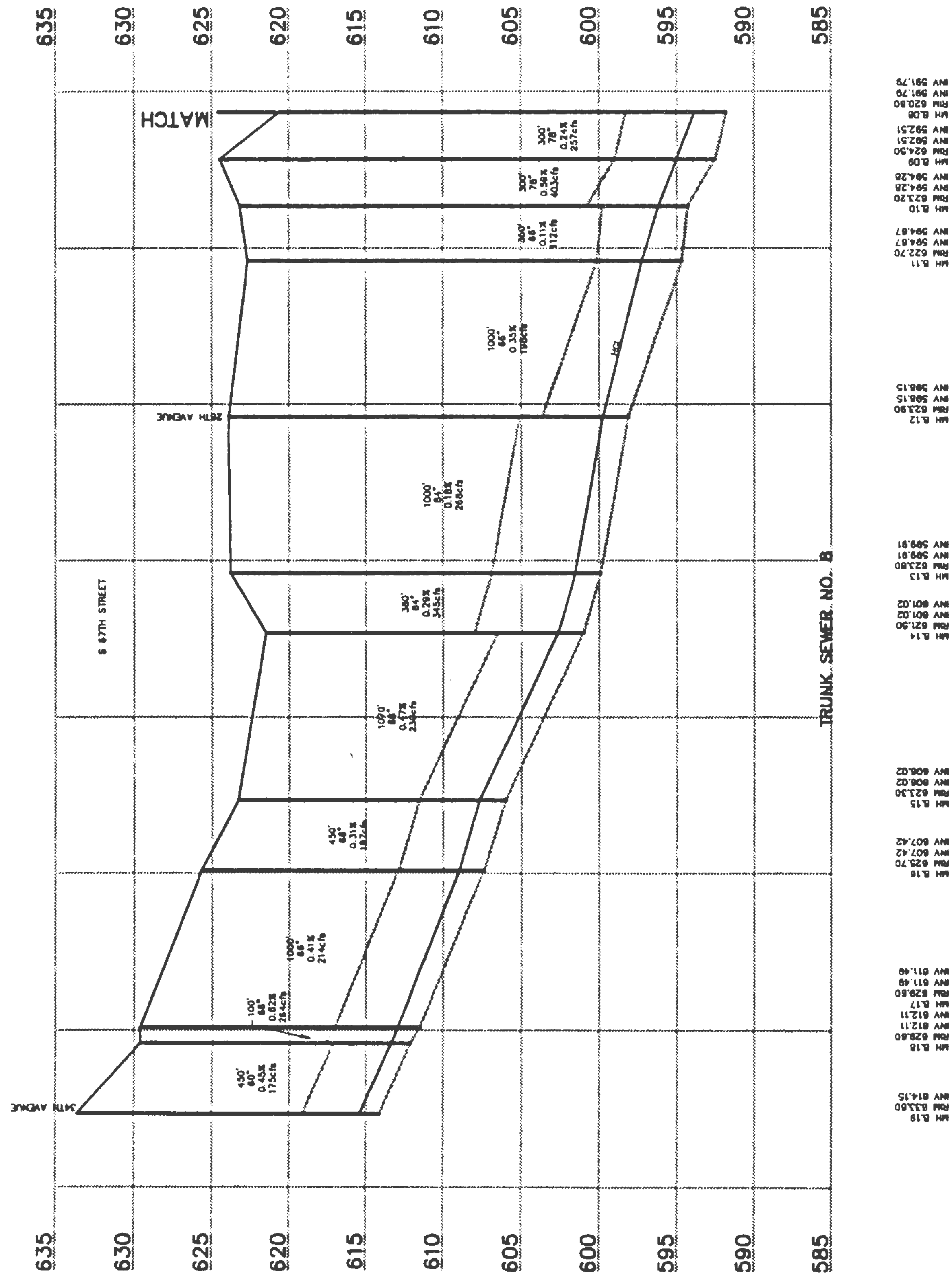
TRUNK SEWER NO. 6
MATCH
63RD STREET
48TH AVENUE
HGL
2600' 12" 0.42% 2 cfs
150' 12" 1.30% 4 cfs
1250' 18" 0.44% 7 cfs
1400' 21" 0.22% 7 cfs
MH 6.11 RIM 671.30 INV 657.32
MH 6.10 RIM 658.00 INV 646.41 INV 646.41
MH 6.09 RIM 658.10 INV 643.83 INV 644.33
MH 6.08 RIM 649.00 INV 632.84 INV 638.38
MH 6.07 RIM 647.60 INV 629.55 INV 629.82
675 670 665 660 655 650 645 640 635 630 625 620

Appendix E

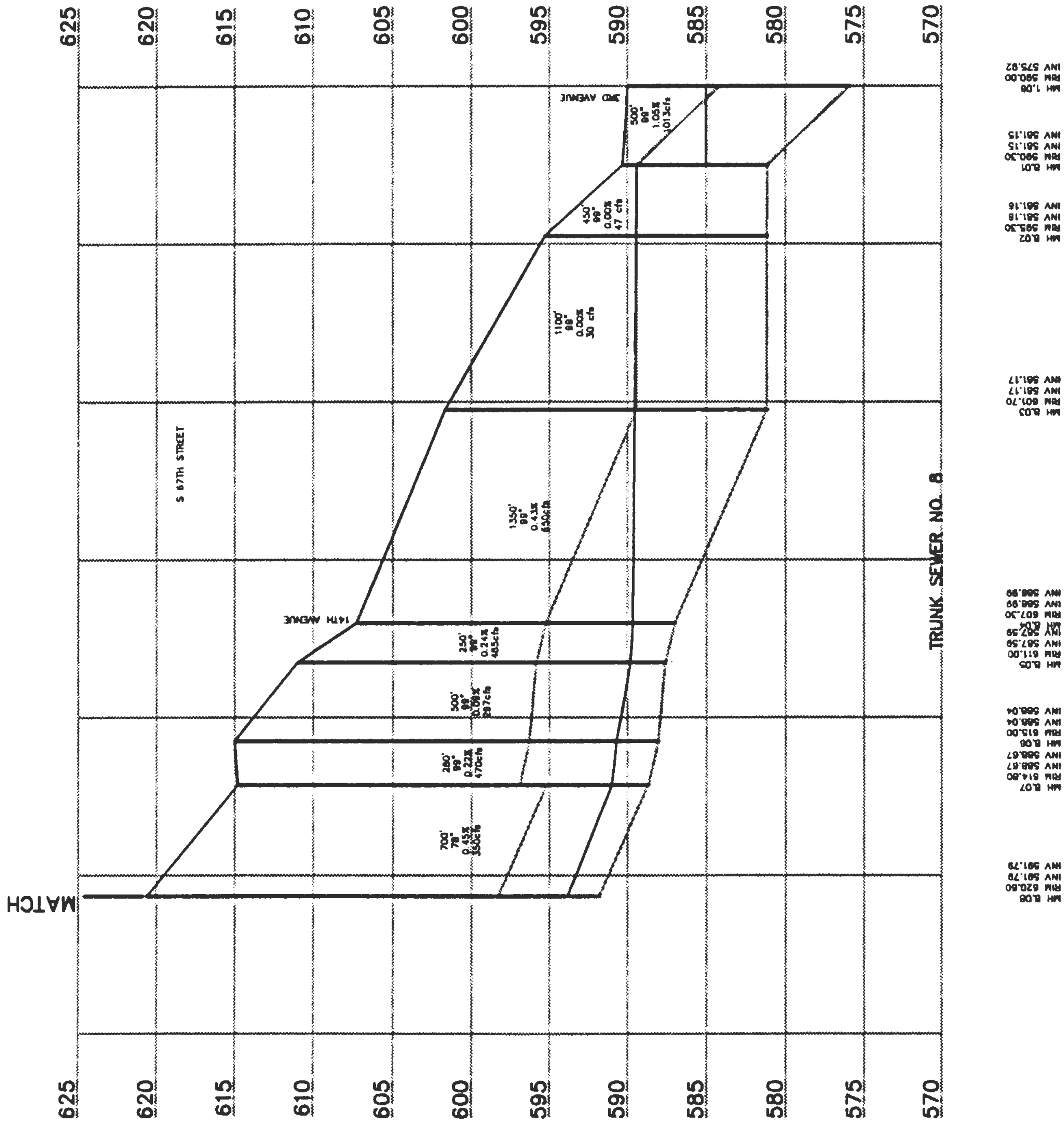

TRUNK SEWER NO. 6
650
645
640
635
630
625
620
615
610
605
MATCH
85TH STREET
80TH STREET
MH 4.04
RIM 625.70
INV 606.38
MH 6.01
RIM 624.50
INV 606.98
INV 609.48
MH 6.02
RIM 623.50
INV 609.87
INV 609.87
MH 6.03
RIM 622.60
INV 611.56
INV 612.71
MH 6.04
RIM 623.60
INV 615.40
INV 615.40
MH 6.05
RIM 624.30
INV 616.30
INV 616.30
MH 6.06
RIM 637.50
INV 625.72
INV 625.72
MH 6.07
RIM 647.60
INV 629.55
INV 629.82
1410' 30" 0.18% 18 cfs
580' 24" 0.07% 6 cfs
650' 24" 0.20% 10 cfs
850' 24" 0.32% 13 cfs
350' 24" 0.26% 11 cfs
1200' 24" 0.79% 20 cfs
300' 24" 1.28% 28 cfs

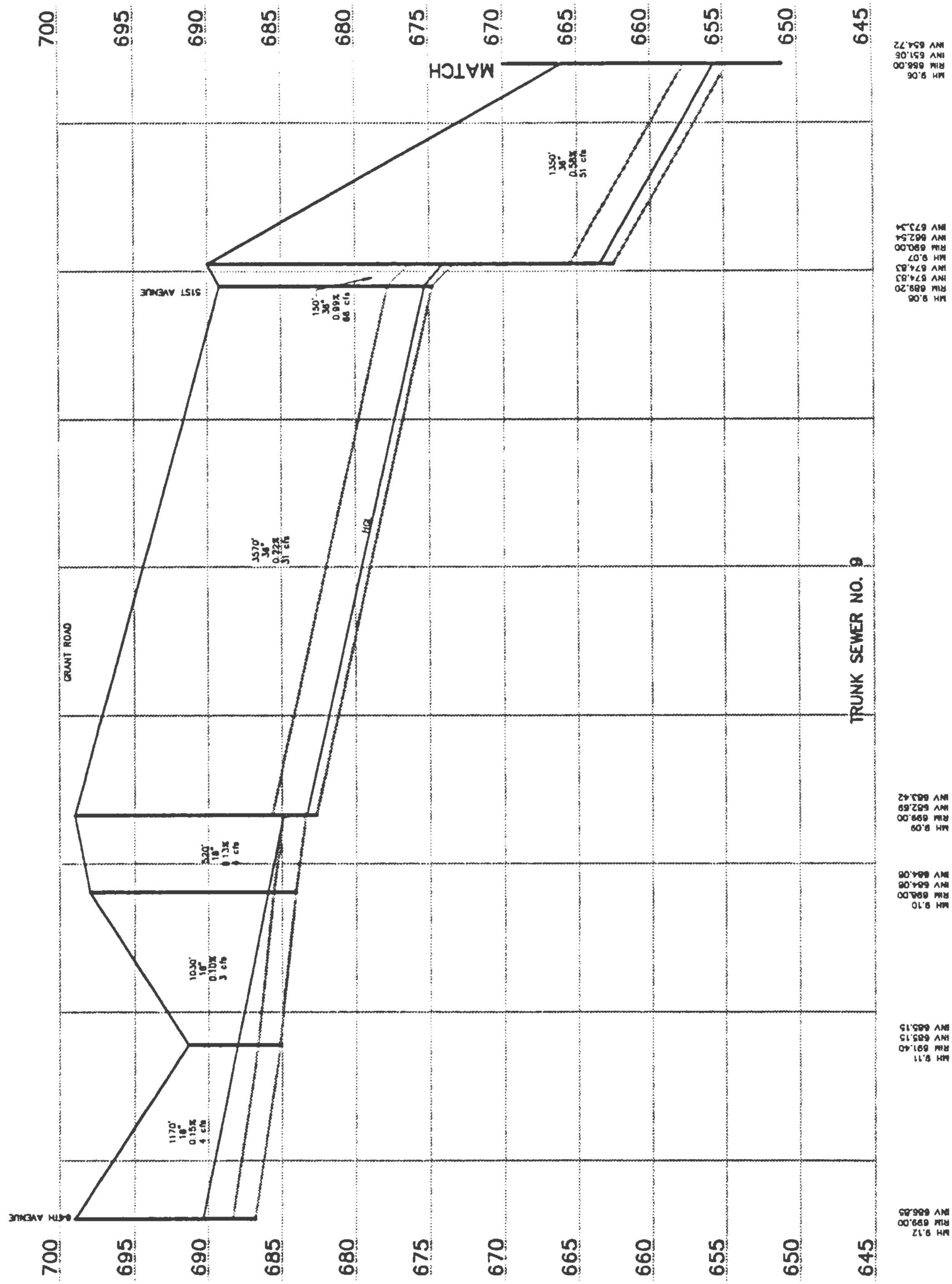
Appendix E



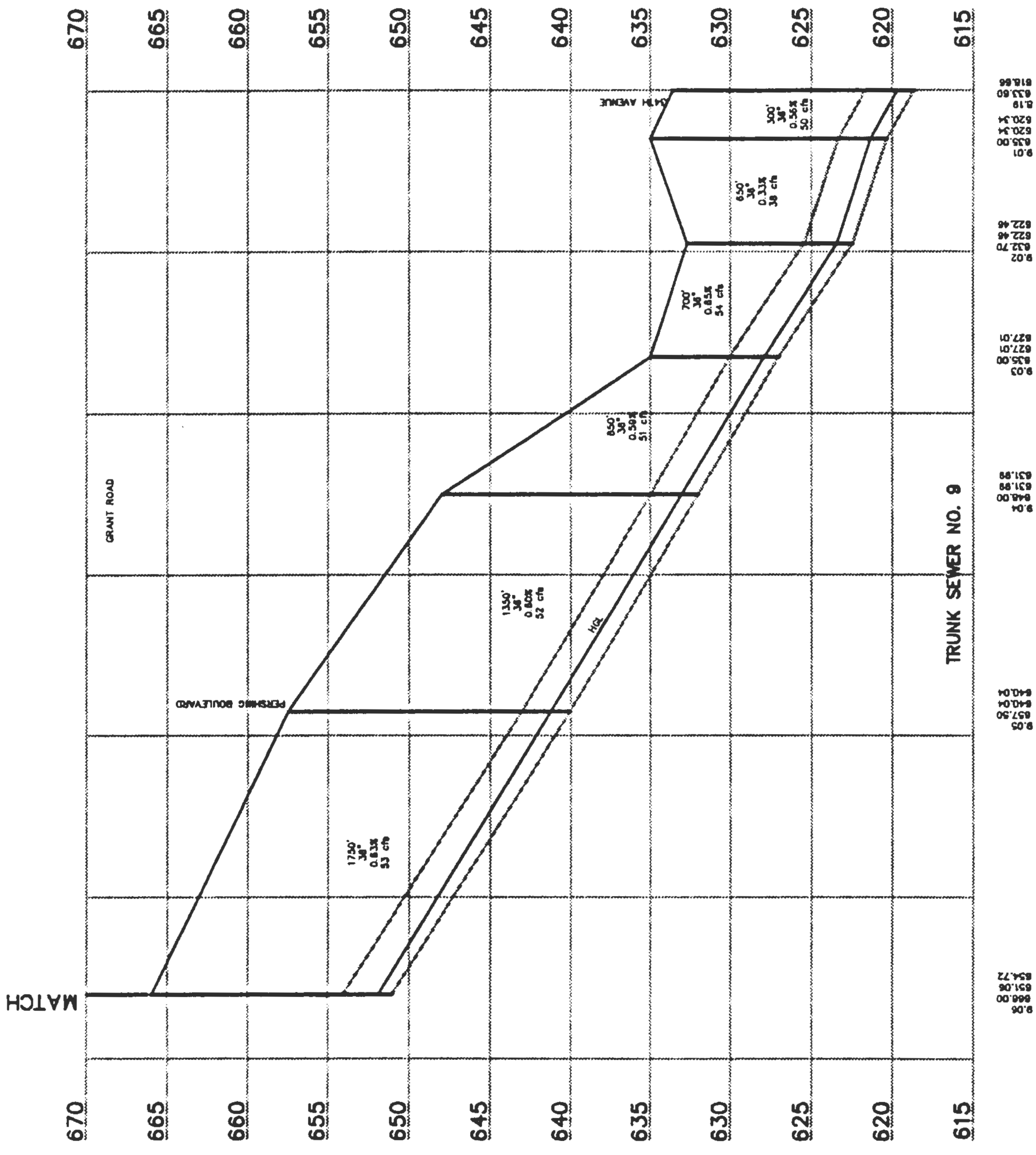


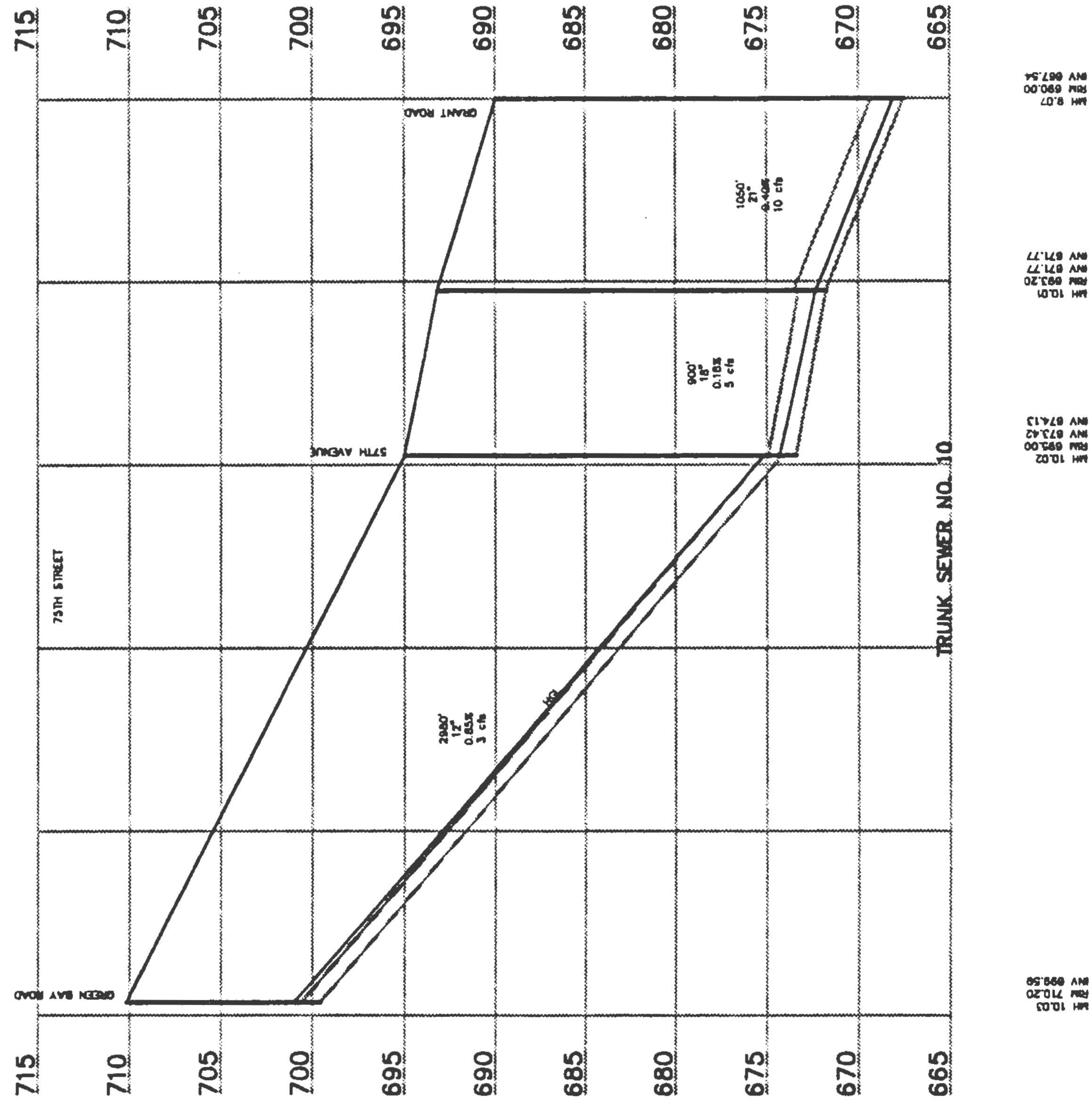
635
630
625
620
615
610
605
600
595
590
585
MATCH
S 67TH STREET
TRUNK SEWER NO. B


TRUNK SEWER NO. 8
MATCH
S 67TH STREET
14TH AVENUE
3RD AVENUE
625
620
615
610
605
600
595
590
585
580
575
570

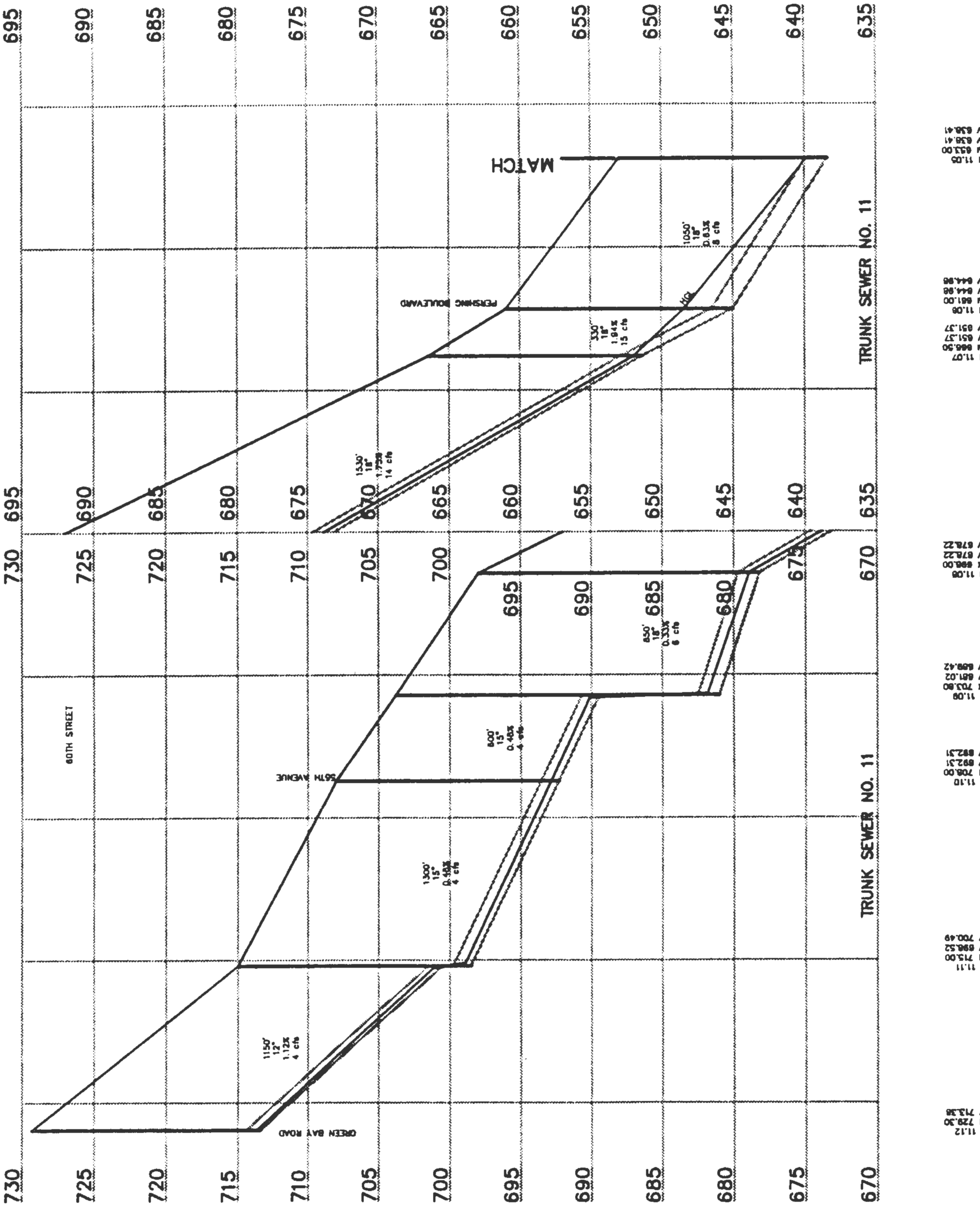


TRUNK SEWER NO. 9
MATCH
51ST AVENUE
GRANT ROAD
700
695
690
685
680
675
670
665
660
655
650
645

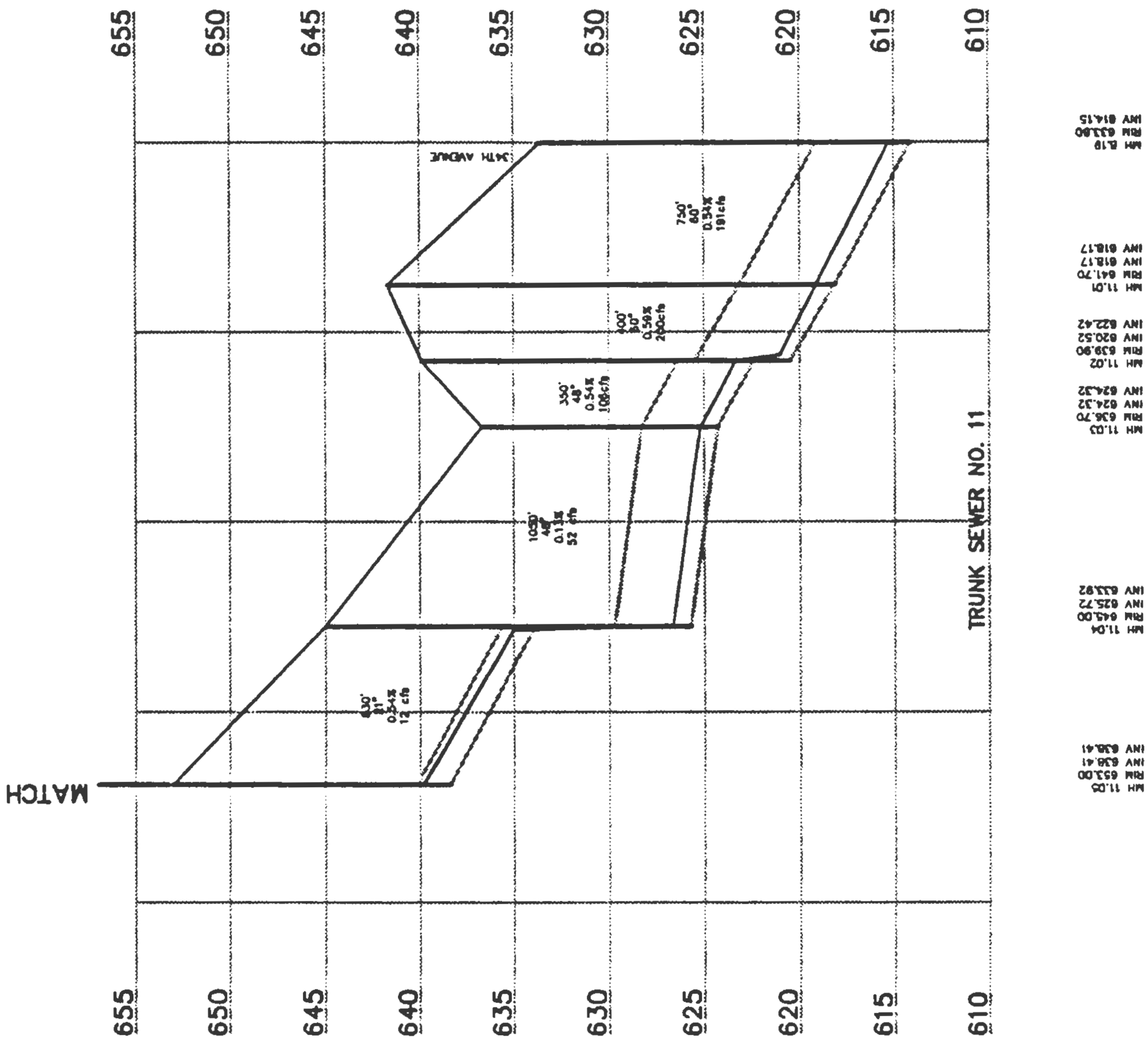

TRUNK SEWER NO. 9
MATCH
GRANT ROAD
PERSHING BOULEVARD
HGL
670
665
660
655
650
645
640
635
630
625
620
615


TRUNK SEWER NO. 10
715
710
705
700
695
690
685
680
675
670
665
GREEN BAY ROAD
75TH STREET
57TH AVENUE
GRANT ROAD
2980' 12" 0.85% 3 cfs
900' 18" 0.18% 5 cfs
1050' 21" 0.40% 10 cfs
MH 10.03 RIM 710.20 INV 699.58
MH 10.02 RIM 695.00 INV 673.42 INV 674.13
MH 10.01 RIM 693.20 INV 671.77 INV 671.77
MH 8.07 RIM 690.00 INV 667.54

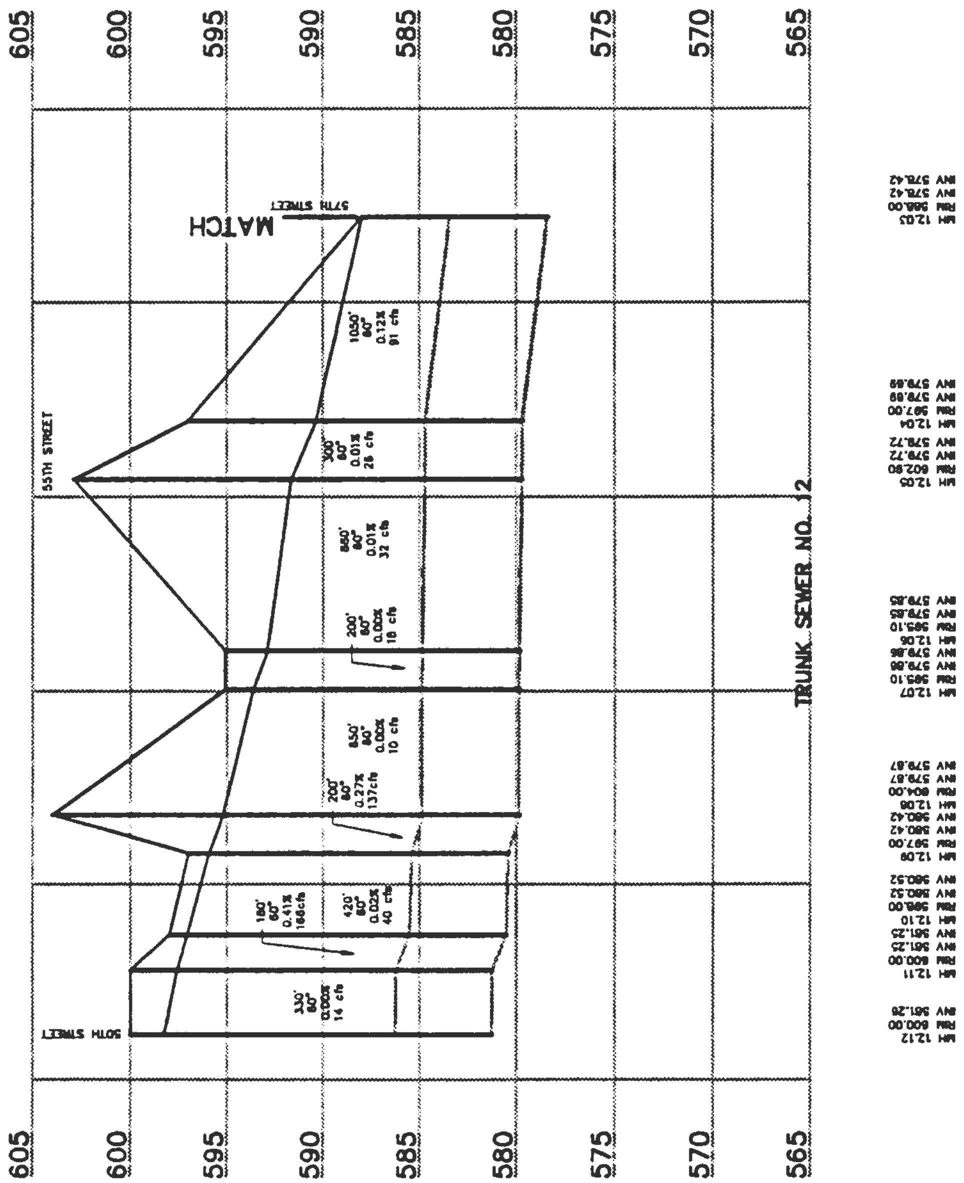
Appendix E

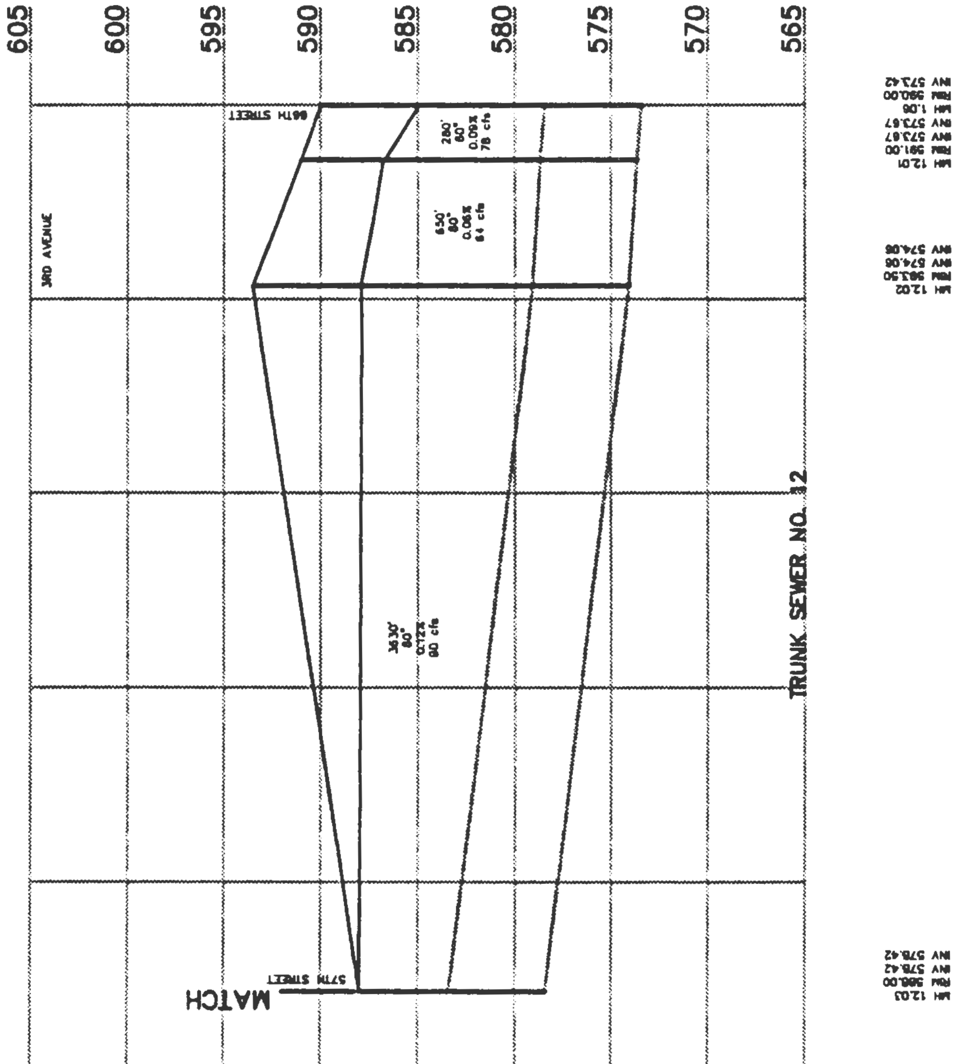


TRUNK SEWER NO. 11
TRUNK SEWER NO. 11
MATCH
PERSHING BOULEVARD
60TH STREET
56TH AVENUE
GREEN BAY ROAD

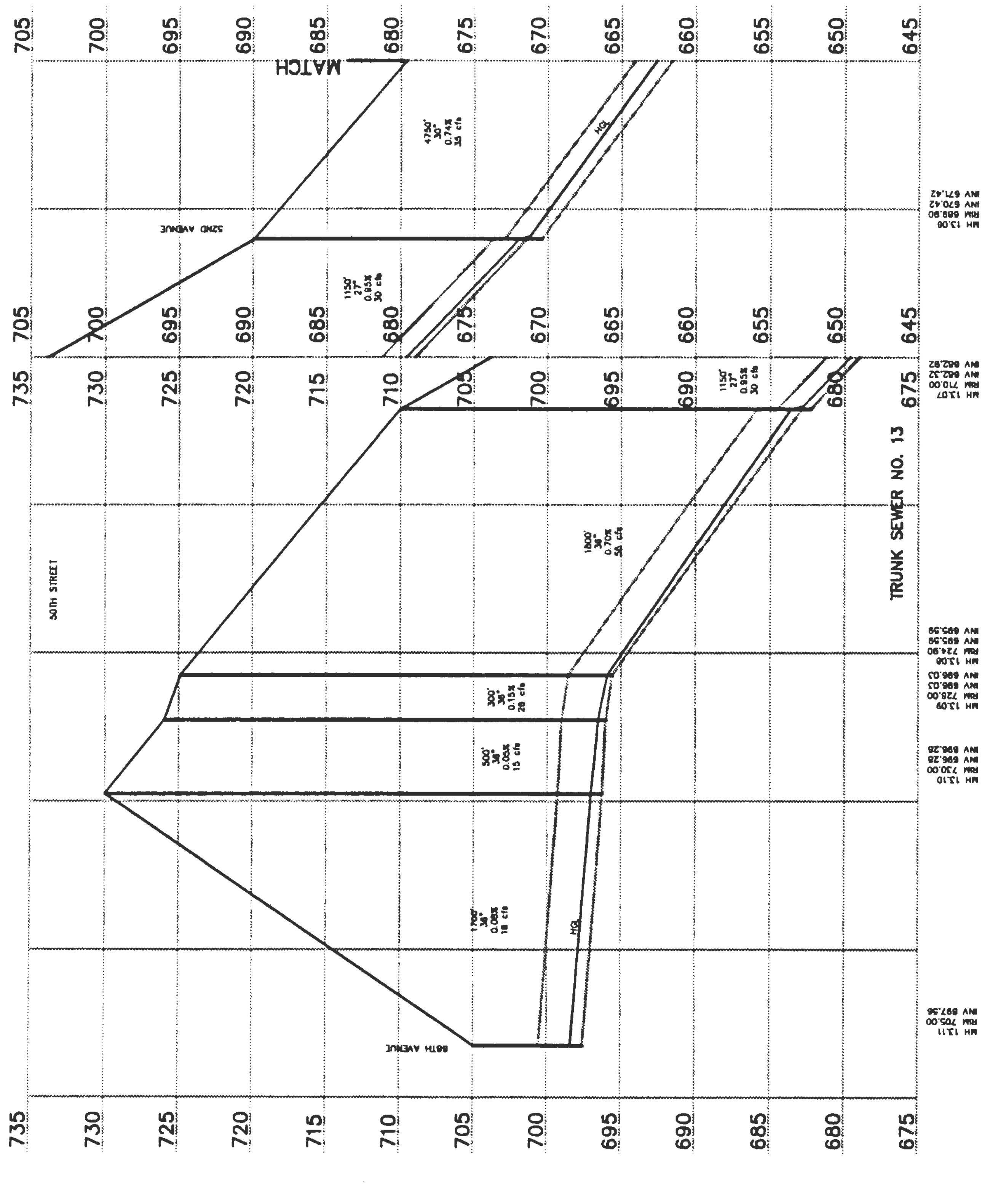

TRUNK SEWER NO. 11
MATCH
34TH AVENUE
655
650
645
640
635
630
625
620
615
610

Appendix E

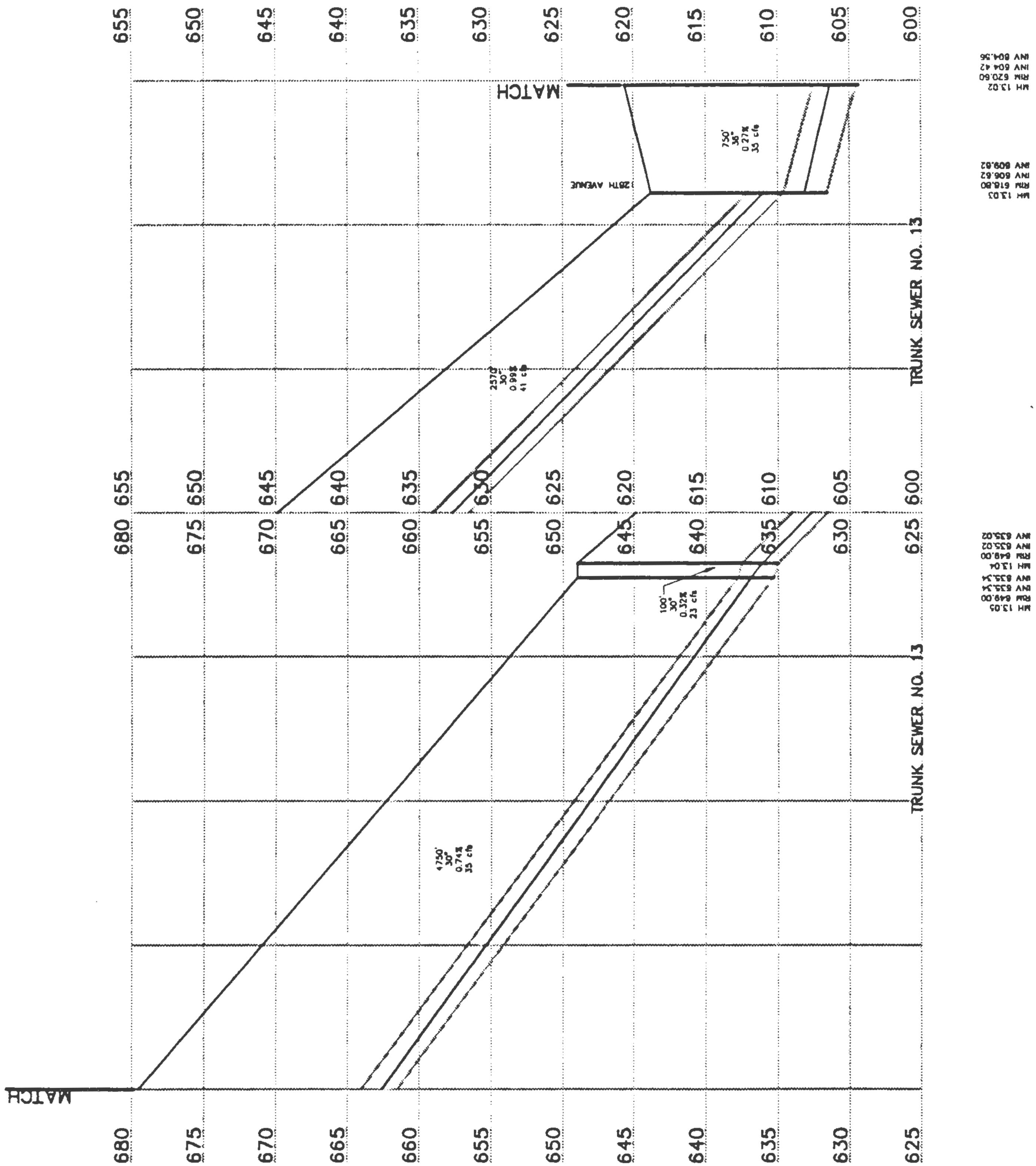

TRUNK SEWER NO. 12
MATCH
55TH STREET
57TH STREET
50TH STREET
605
600
595
590
585
580
575
570
565

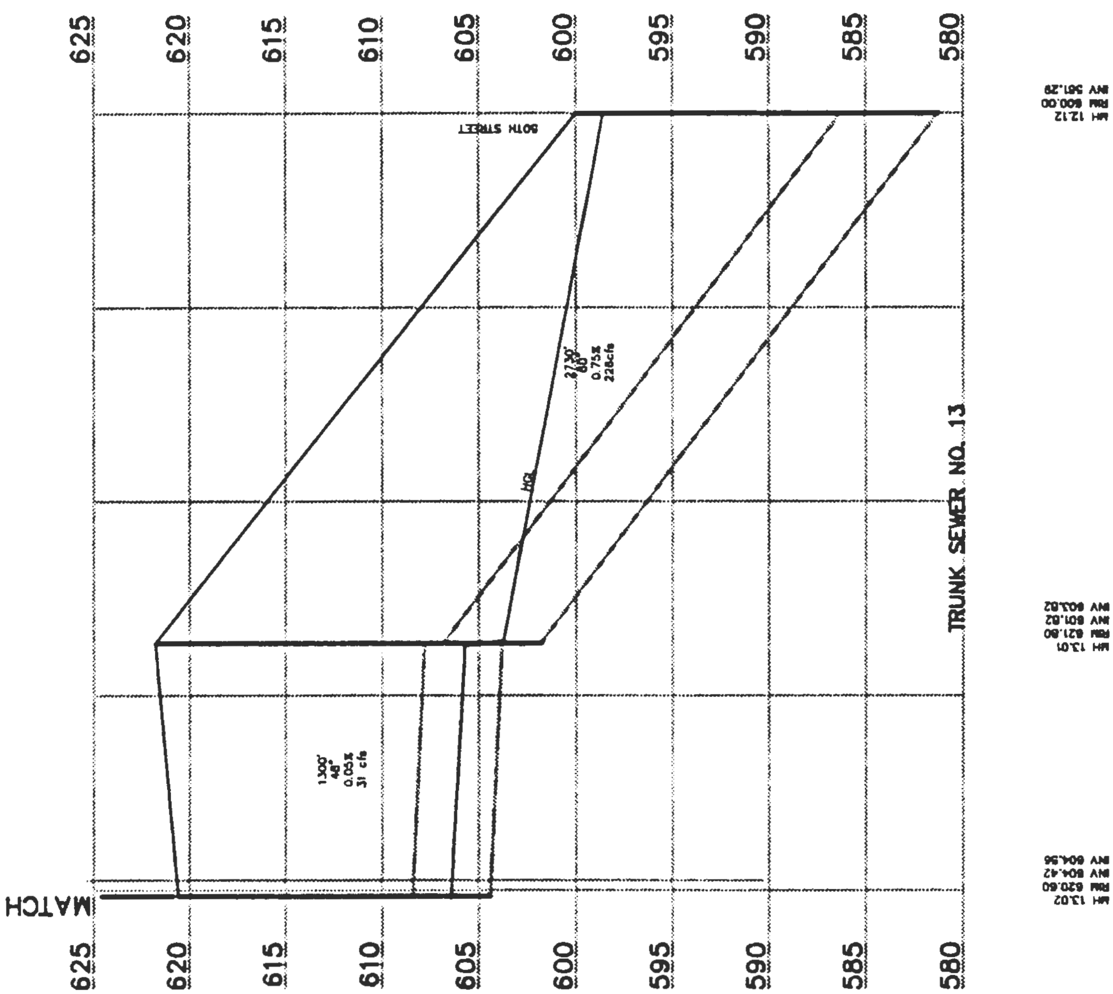

TRUNK SEWER NO. 12
MATCH
3RD AVENUE
605
600
595
590
585
580
575
570
565

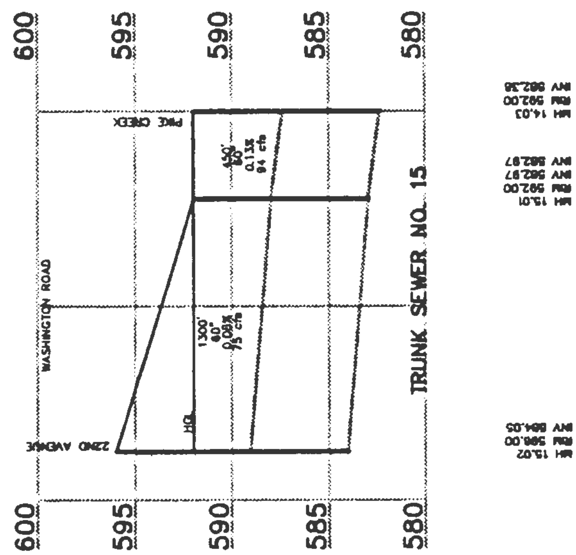
Appendix E

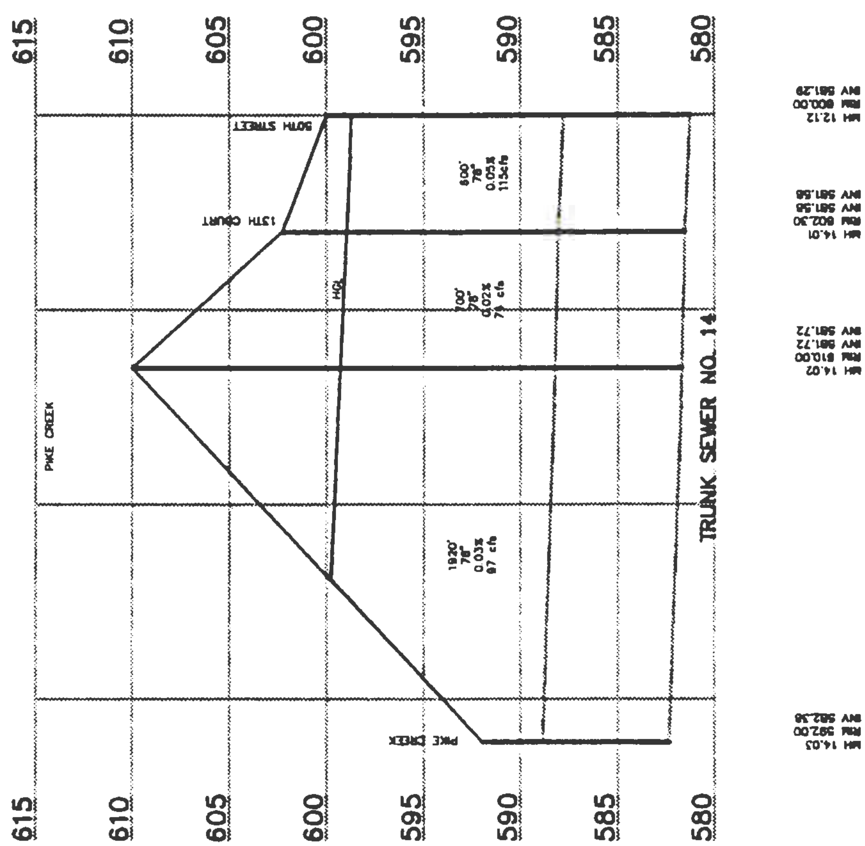


Appendix E

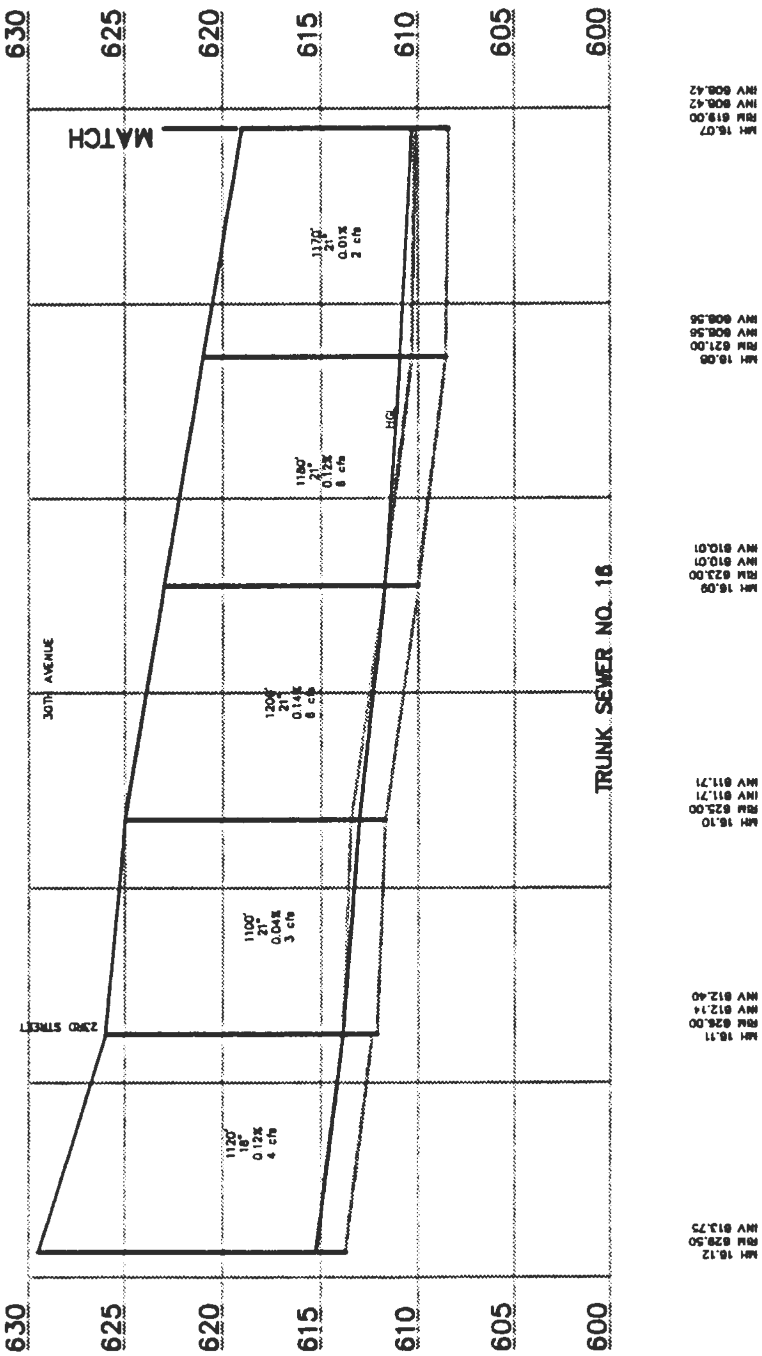


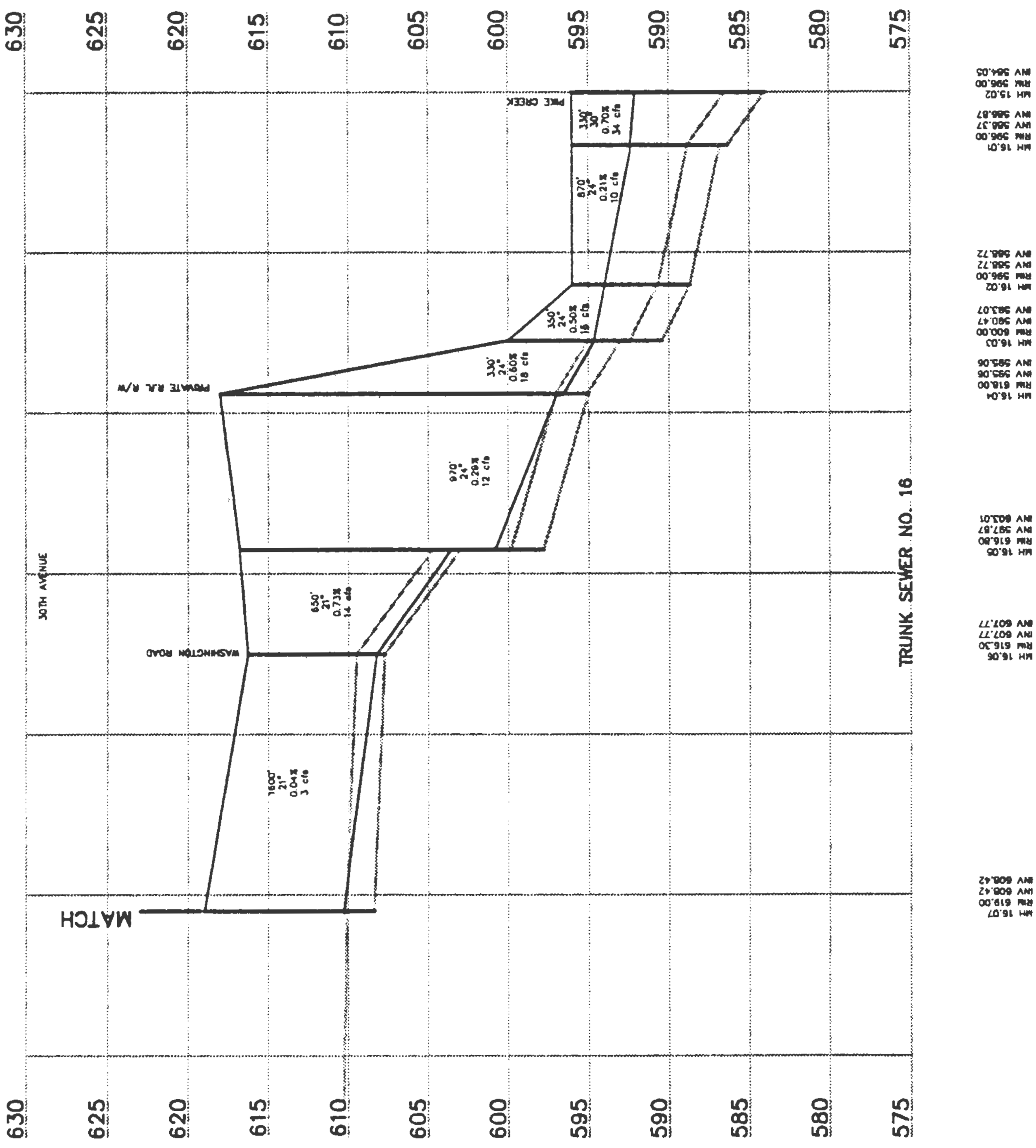

TRUNK SEWER NO. 13
MATCH
HGL
80TH STREET
2730'
60"
0.75%
228cfs
1300'
48"
0.05%
31 cfs
625
620
615
610
605
600
595
590
585
580


TRUNK SEWER NO. 15
600
595
590
585
580
PIKE CREEK
WASHINGTON ROAD
22ND AVENUE
HGL
1300'
60"
0.08%
75 cfs
0.13%
94 cfs


TRUNK SEWER NO. 14
615
610
605
600
595
590
585
580
50TH STREET
15TH COURT
PIKE CREEK
HGL
600'
78"
0.05%
115cfs
700'
78"
0.02%
79 cfs
1920'
78"
0.03%
97 cfs

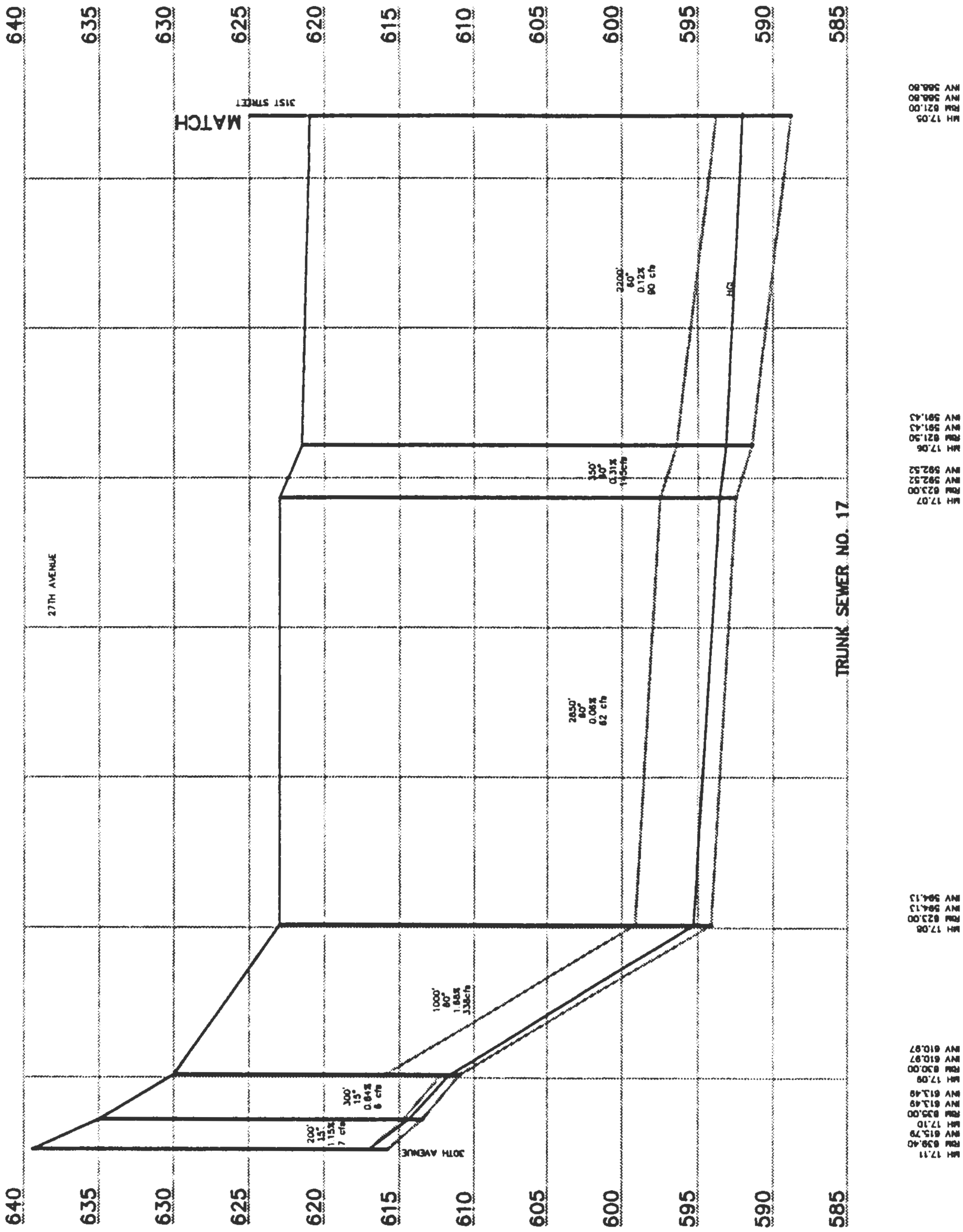
Appendix E



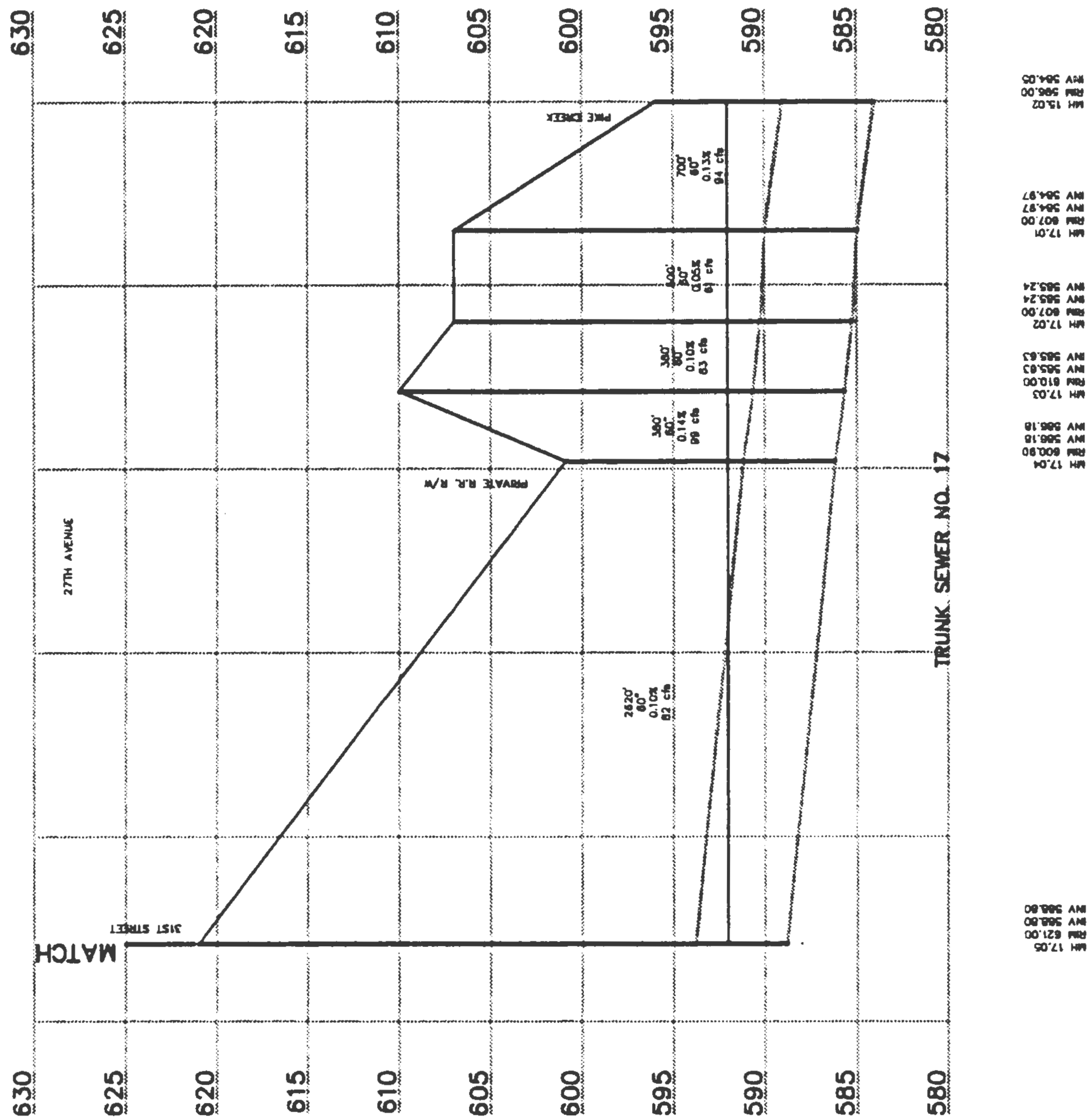


TRUNK SEWER NO. 16
MATCH
PIKE CREEK
PRIVATE R.R. R/W
WASHINGTON ROAD
30TH AVENUE
630
625
620
615
610
605
600
595
590
585
580
575

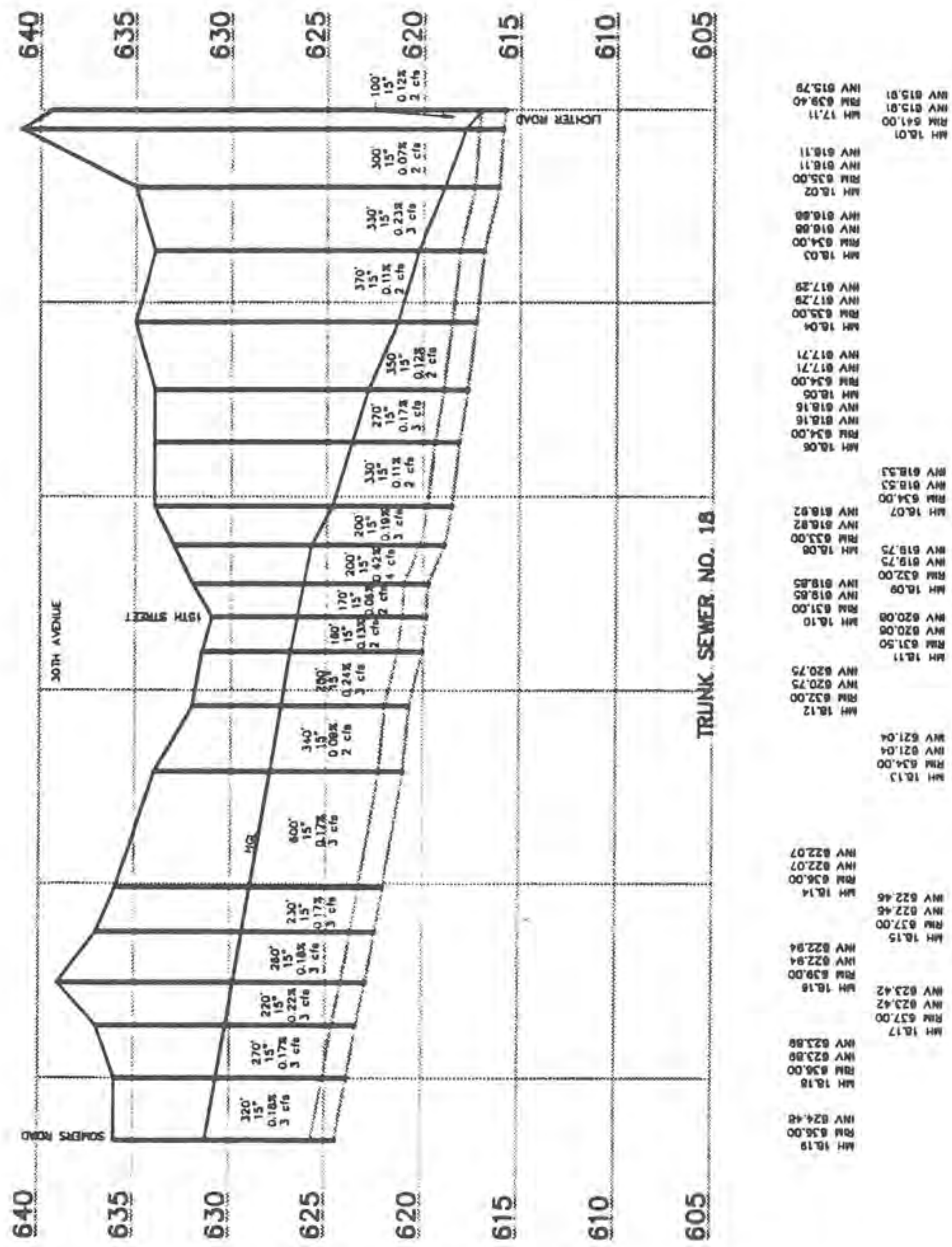
Appendix E

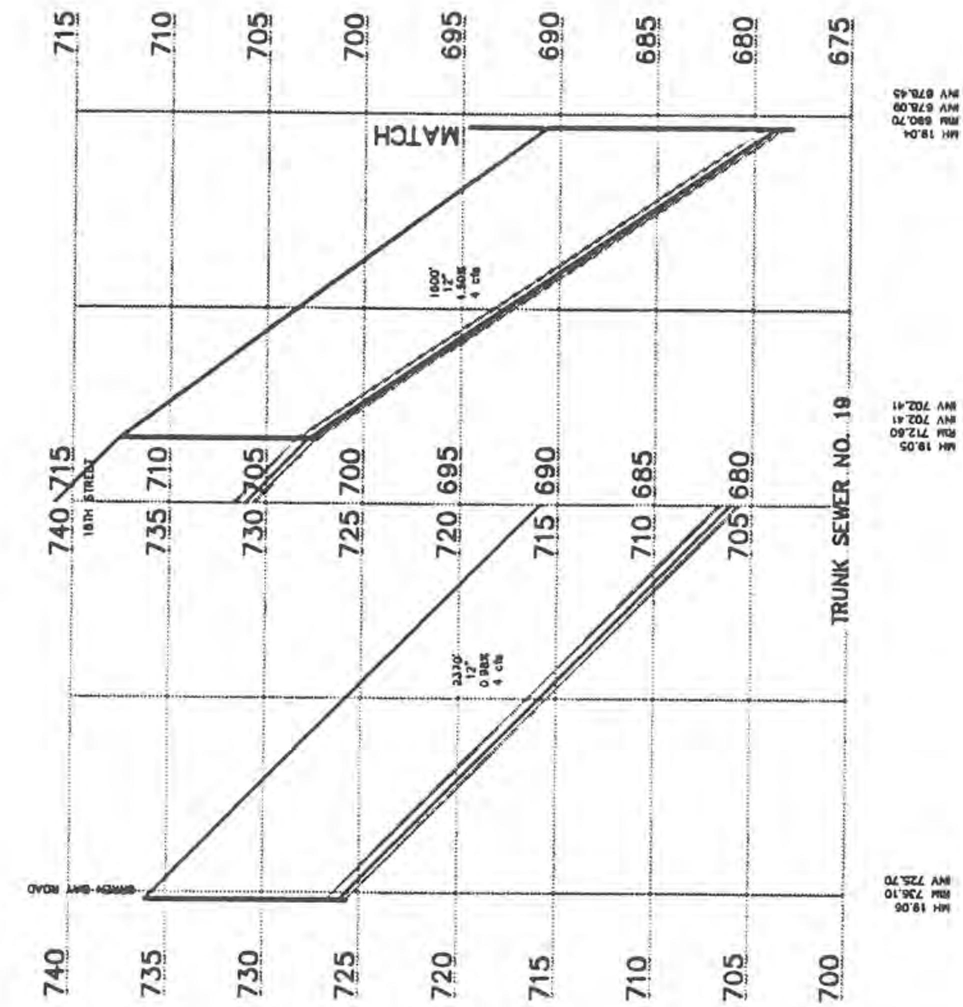

TRUNK SEWER NO. 17
MATCH
31ST STREET
27TH AVENUE
30TH AVENUE
HG
2200'
60"
0.12%
90 cfs
2850'
60"
0.06%
62 cfs
1000'
60"
1.68%
338 cfs
300'
15"
0.84%
6 cfs
200'
15"
1.15%
7 cfs
640
635
630
625
620
615
610
605
600
595
590
585

Appendix E

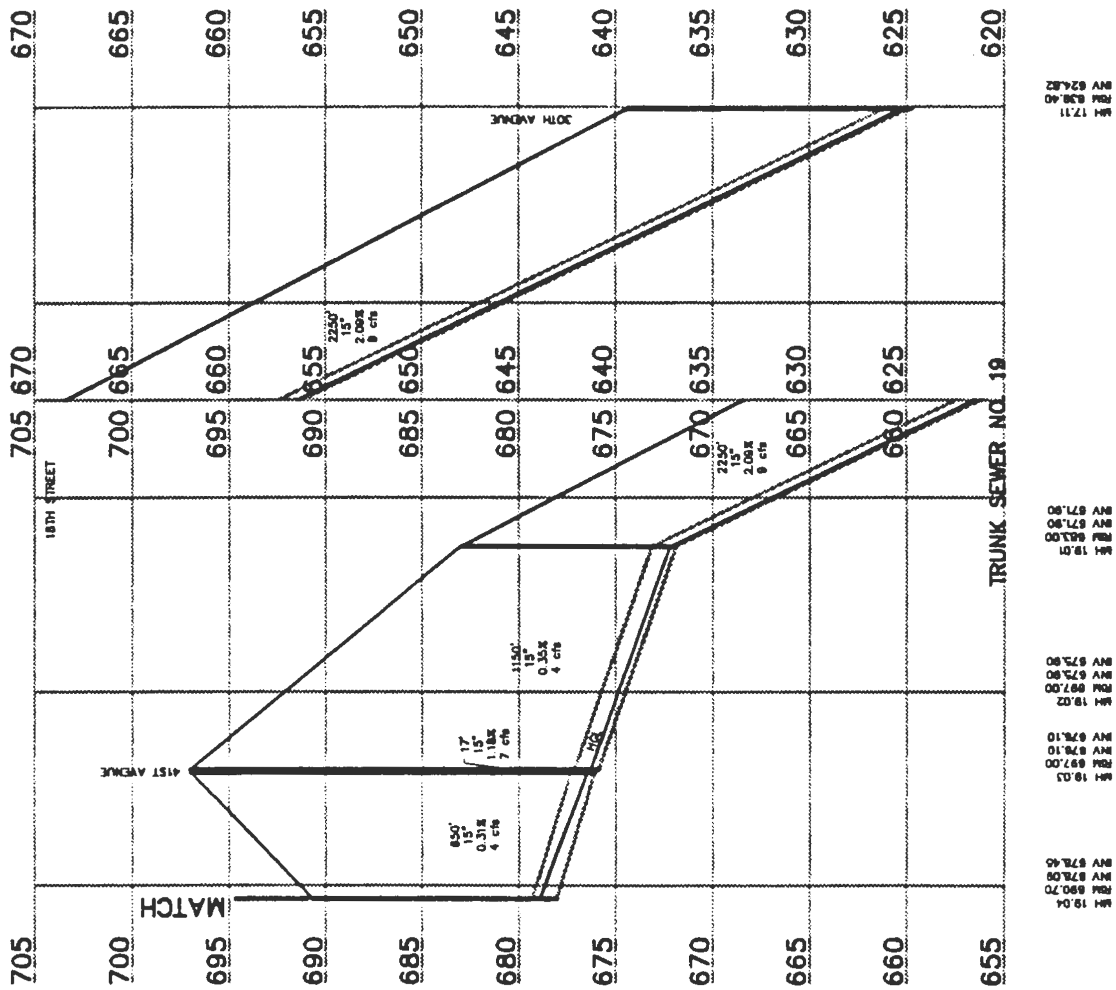

TRUNK SEWER NO. 17
MATCH
31ST STREET
27TH AVENUE
PRIVATE R.R. R/W

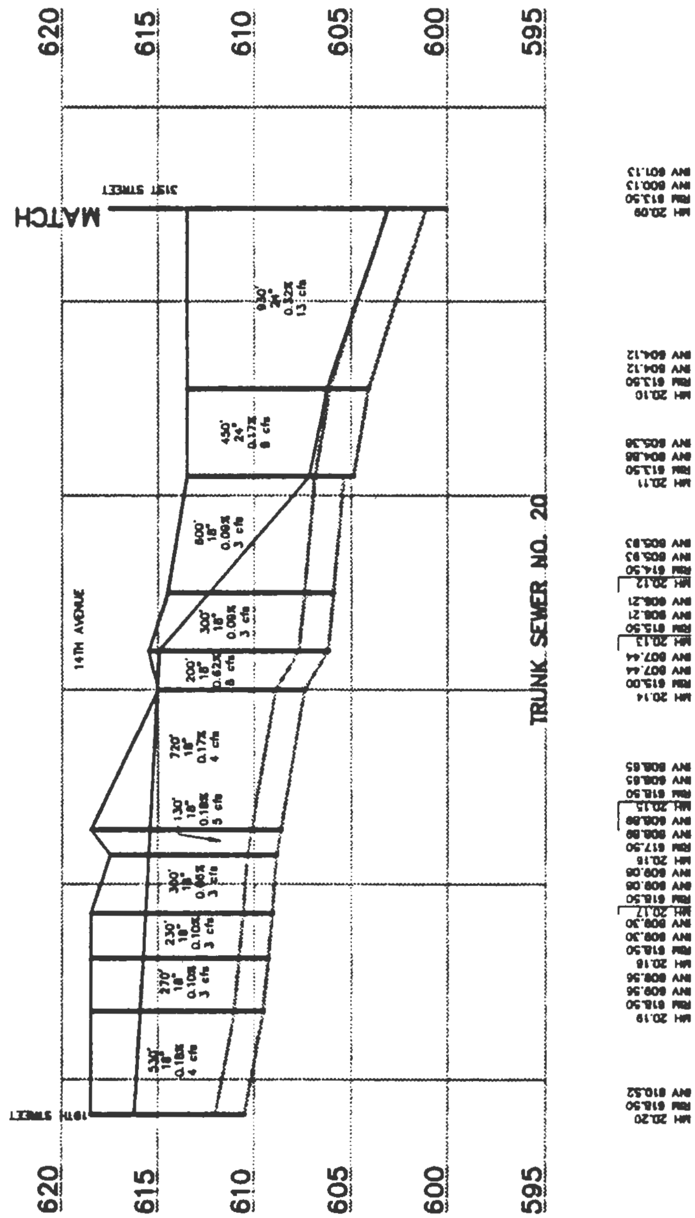
Appendix E


TRUNK SEWER NO. 18
SOMERS ROAD
30TH AVENUE
15TH STREET
LICHTER ROAD
HGL


TRUNK SEWER NO. 19
MATCH
18TH STREET

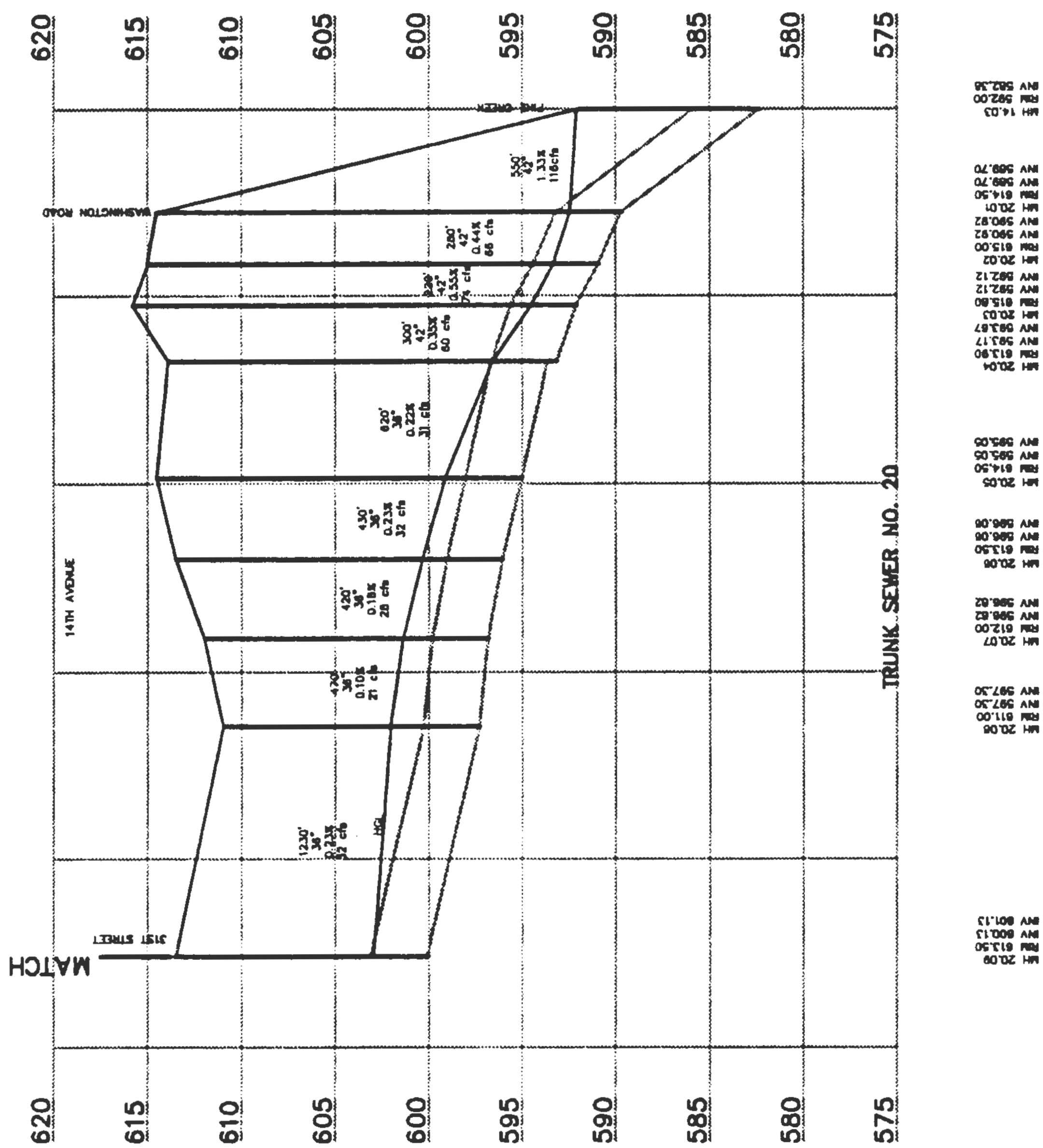
Appendix E





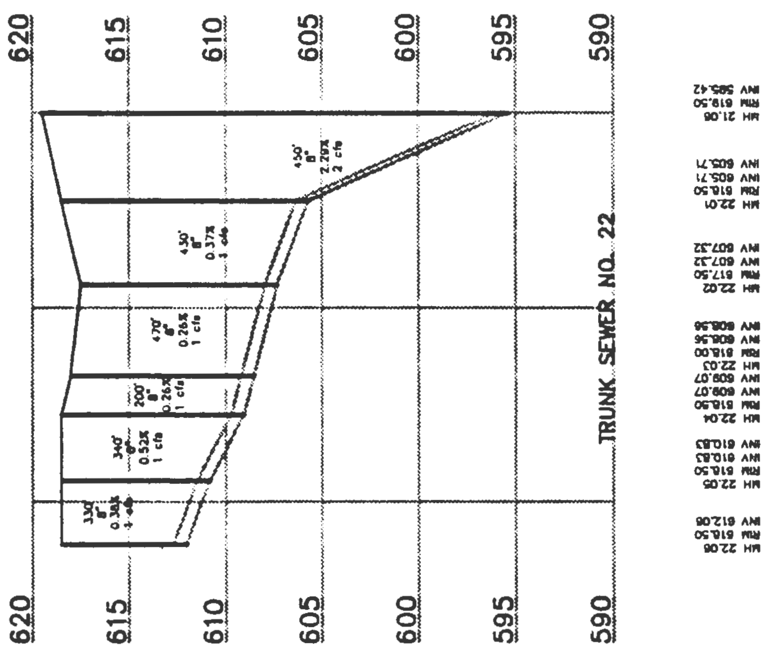
TRUNK SEWER NO. 20
MATCH
31ST STREET
14TH AVENUE
19TH STREET
620
615
610
605
600
595

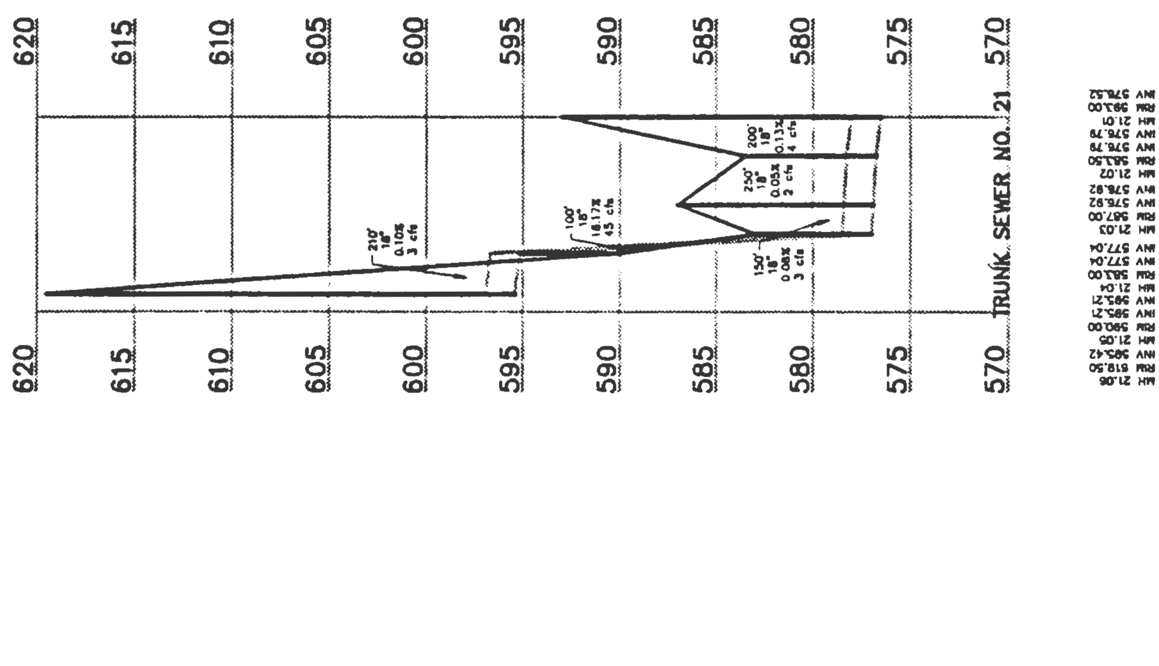
Appendix E



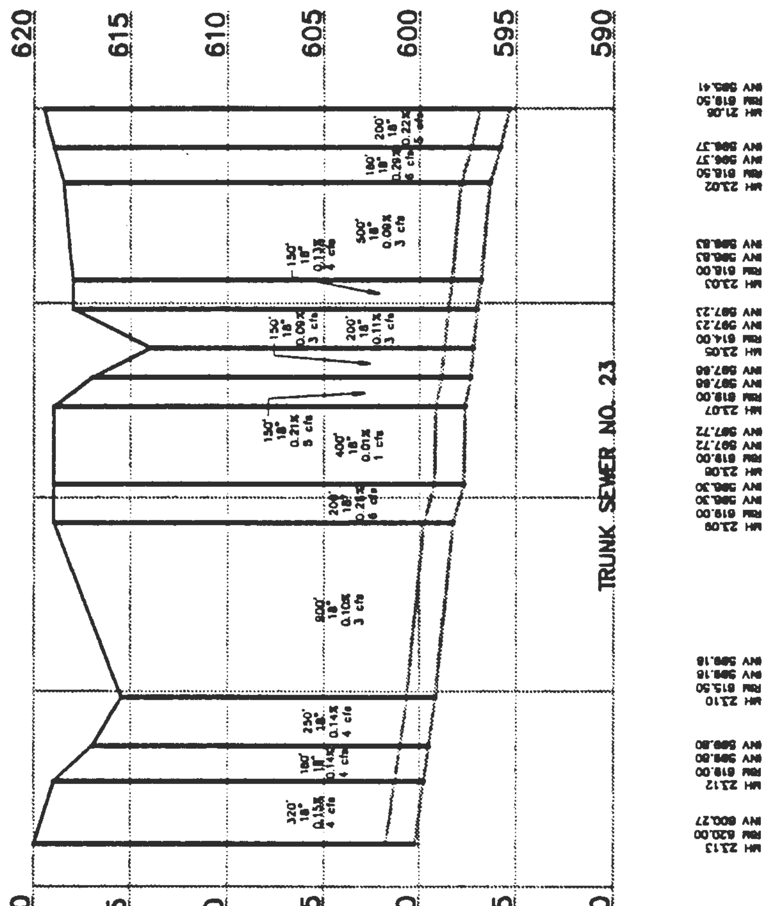
620
615
610
605
600
595
590
585
580
575
TRUNK SEWER NO. 20
MATCH
14TH AVENUE
WASHINGTON ROAD
31ST STREET
HGL

Appendix E

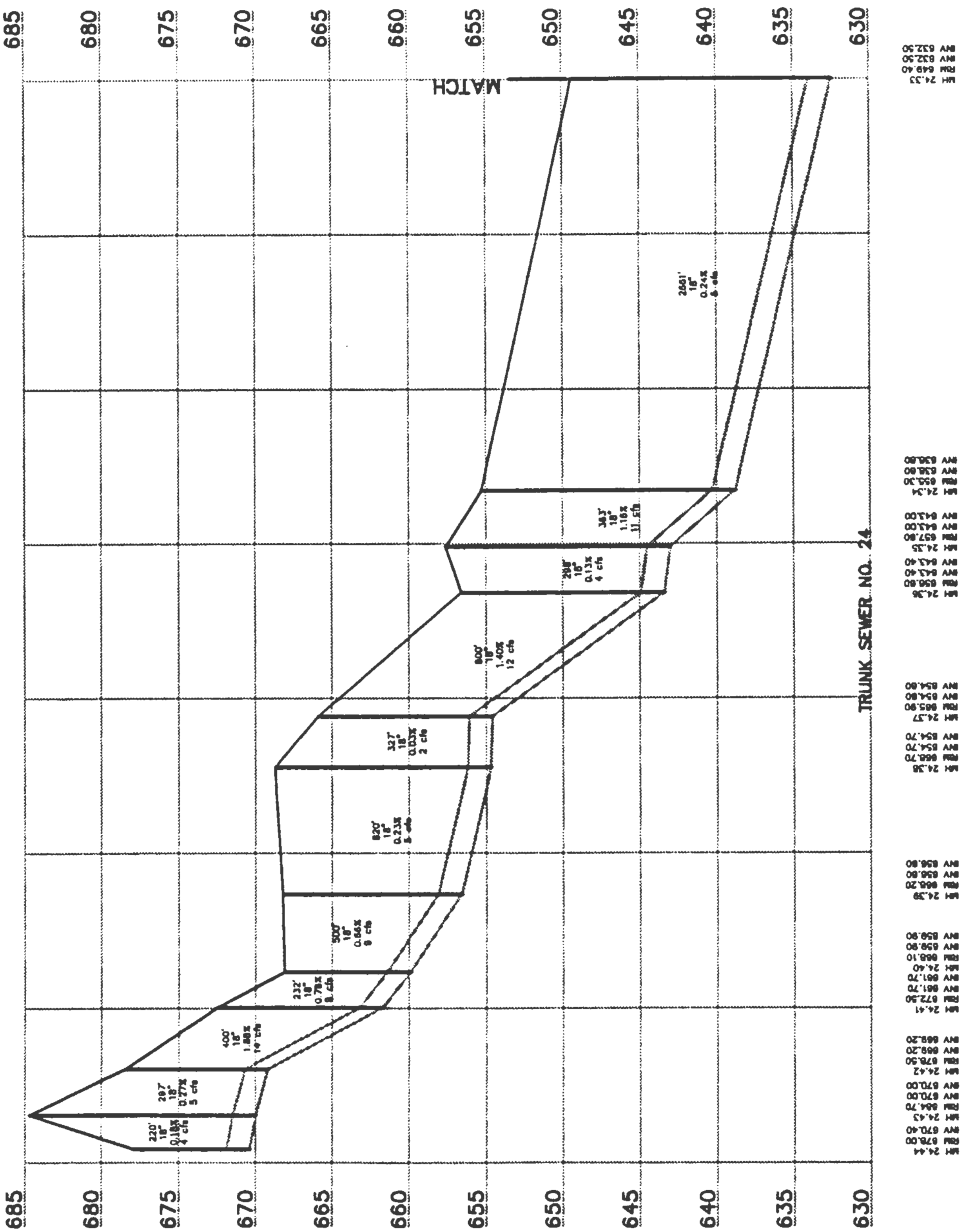


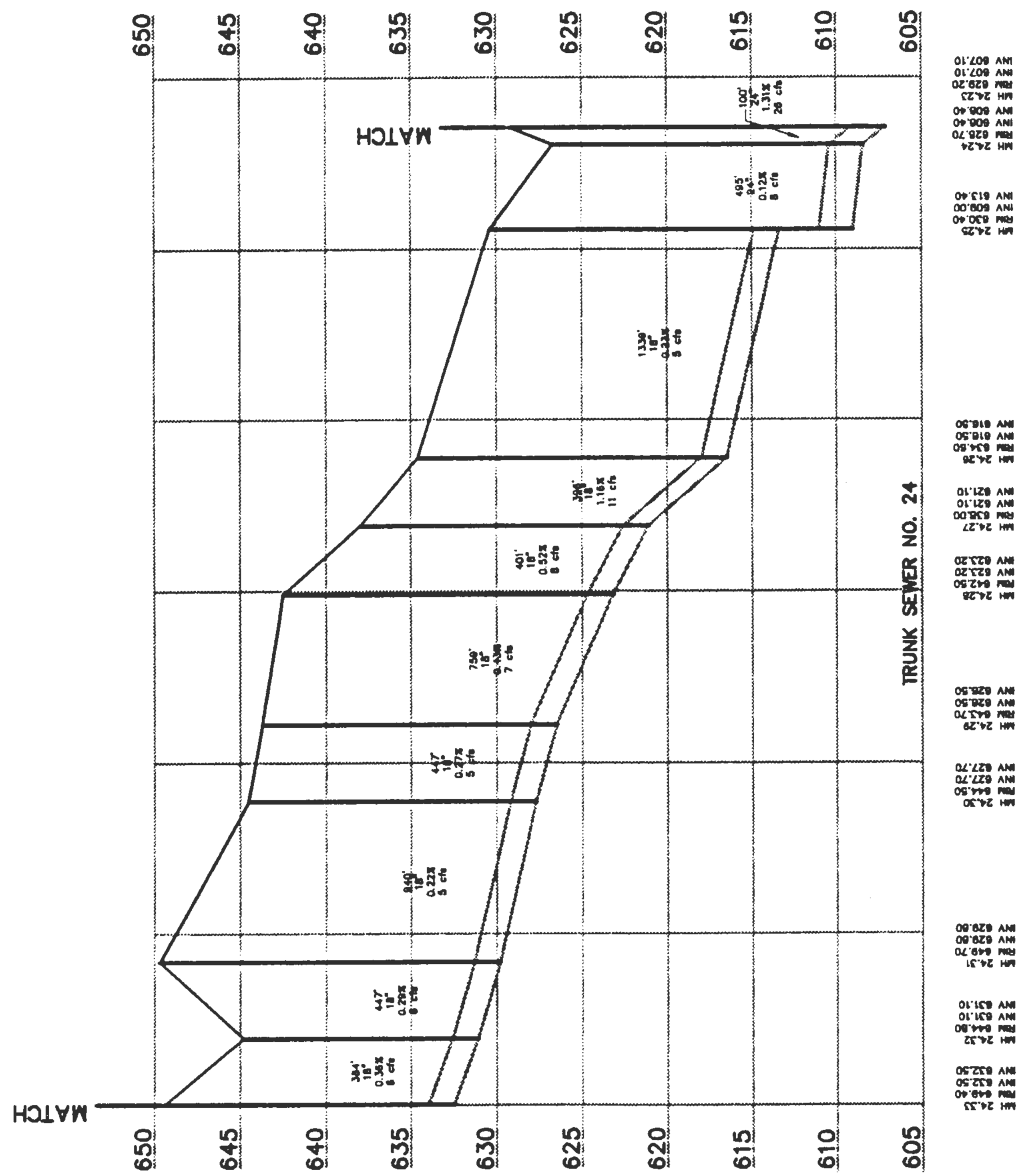


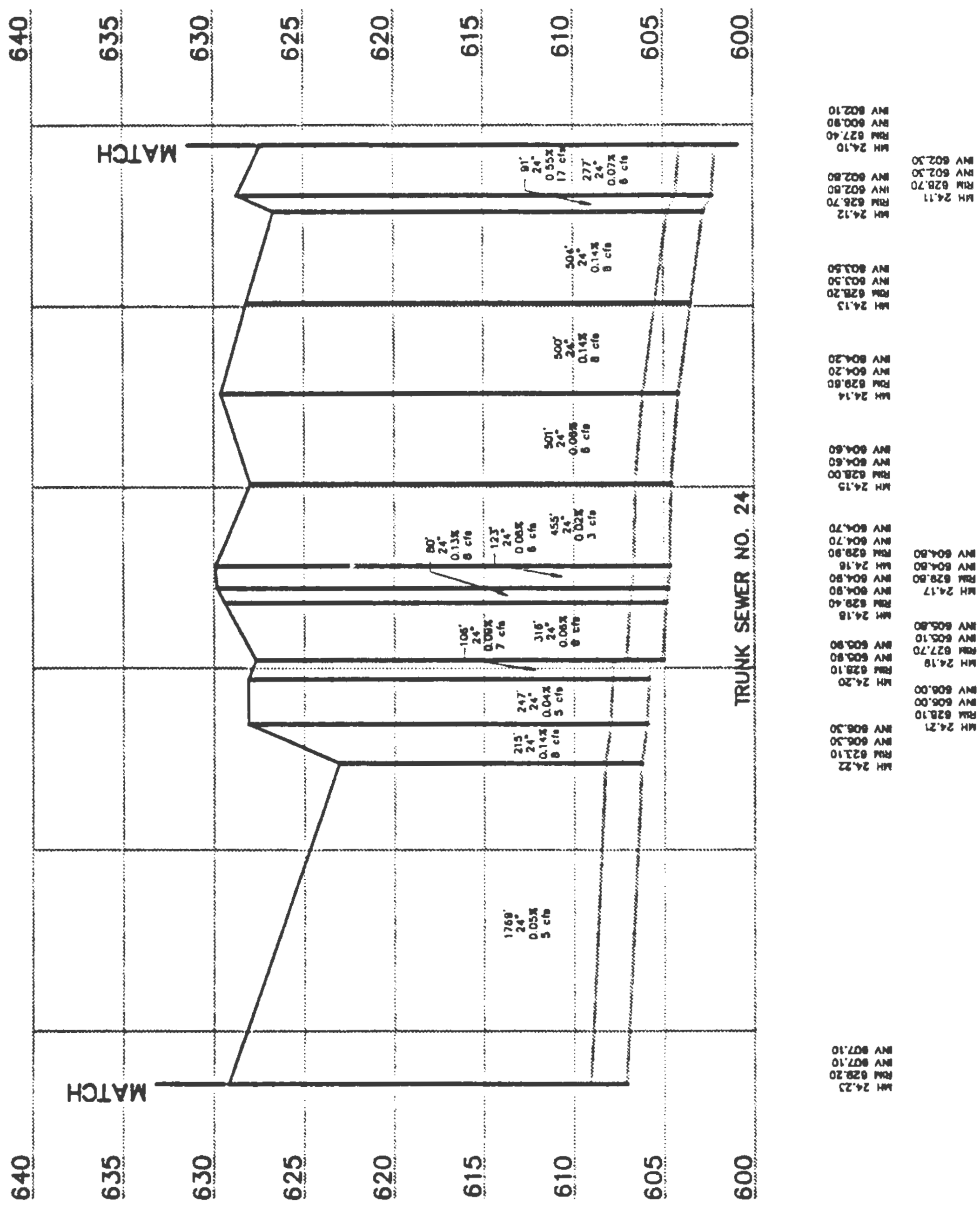
Appendix E

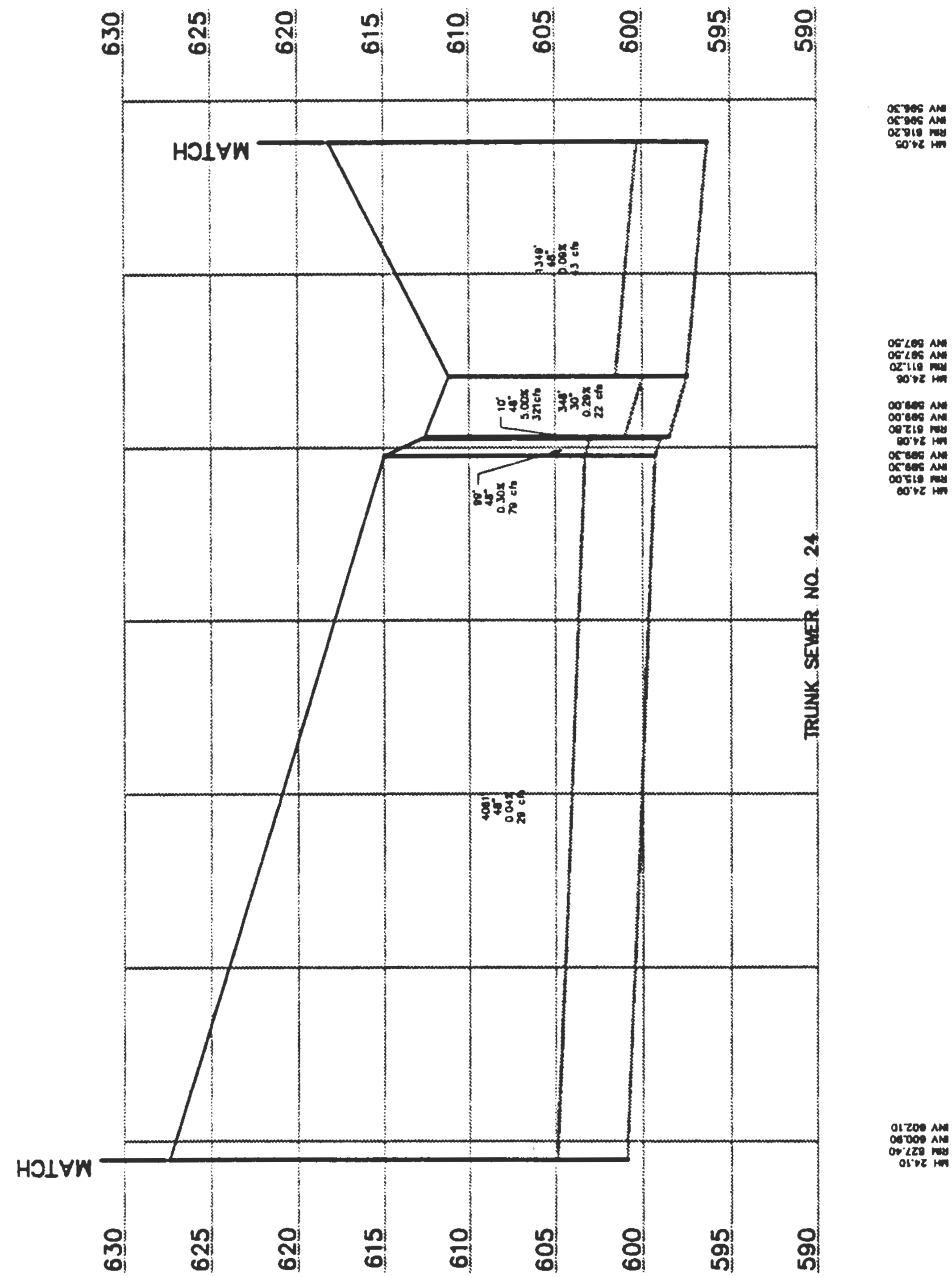


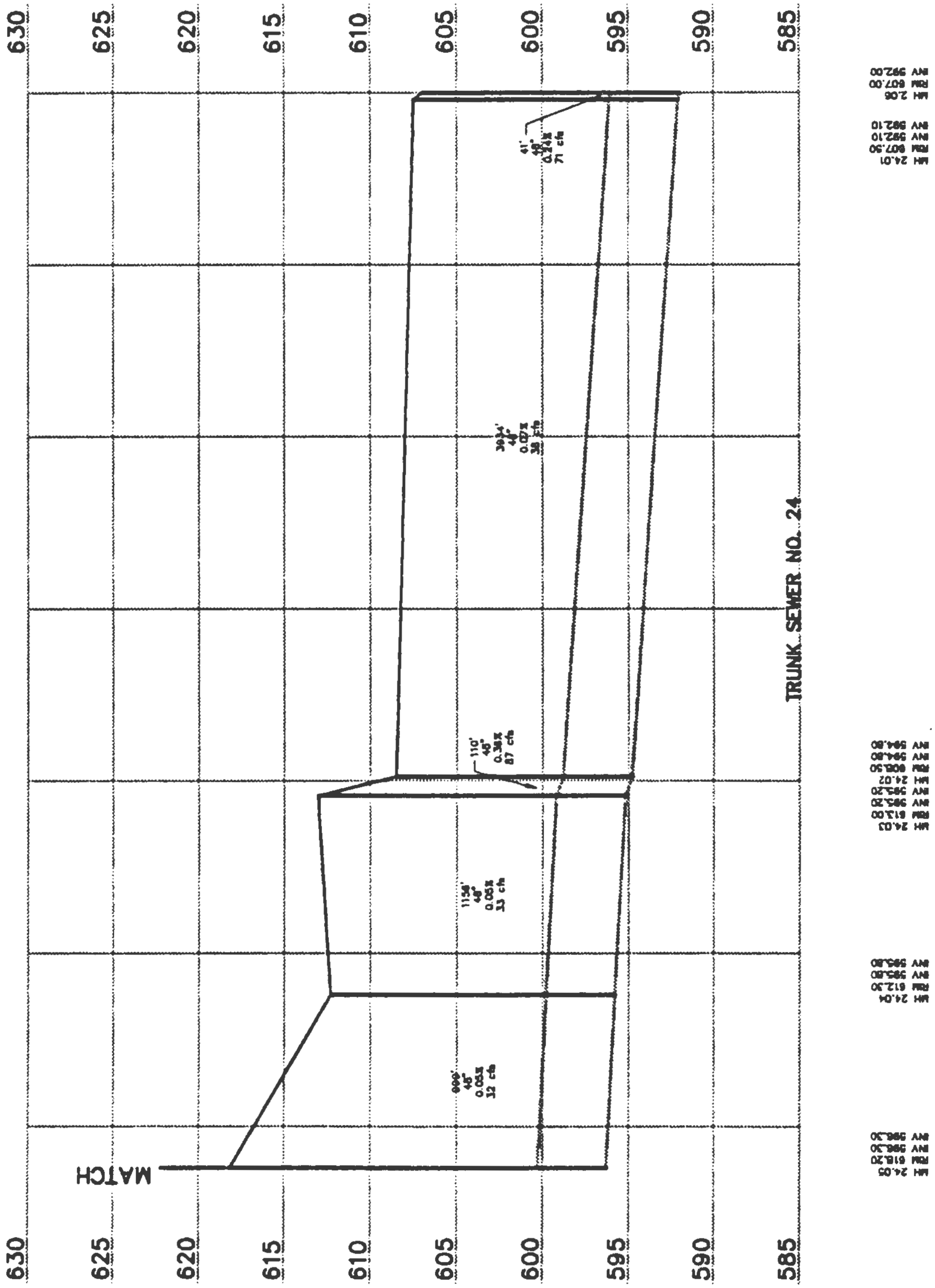
Appendix E



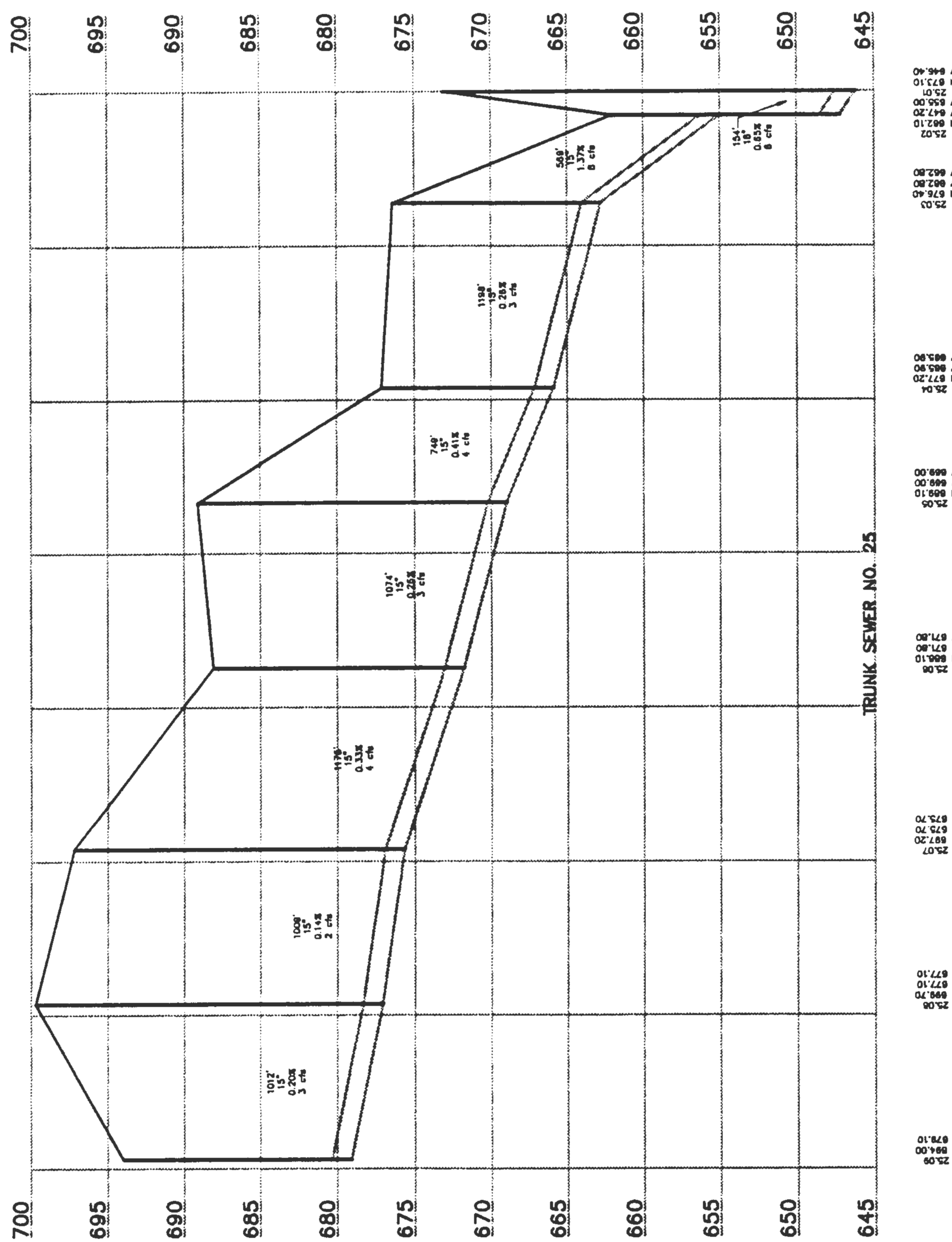

TRUNK SEWER NO. 24
MATCH
MATCH
650
645
640
635
630
625
620
615
610
605

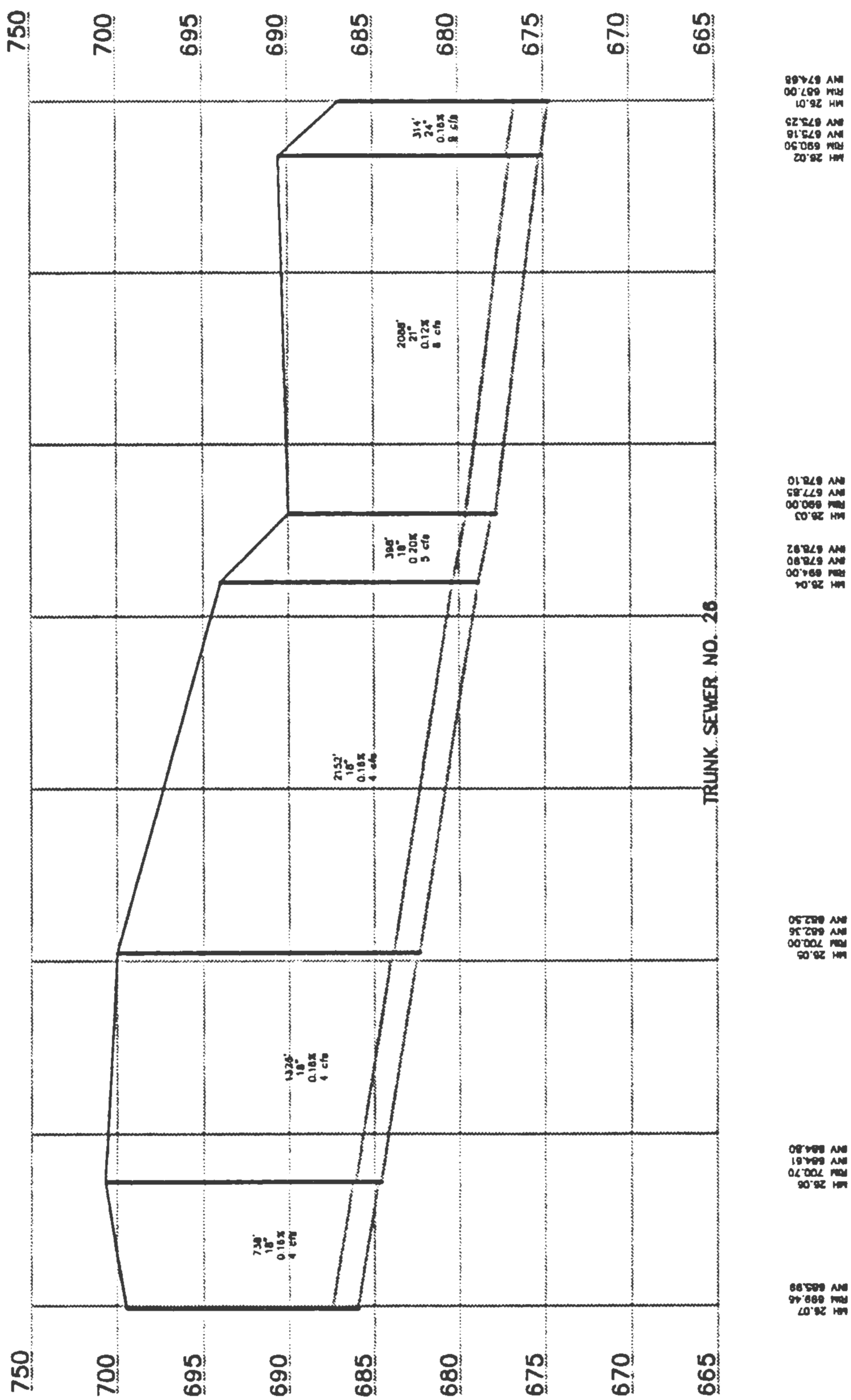

TRUNK SEWER NO. 24
MATCH
MATCH


TRUNK SEWER NO. 24
MATCH
MATCH
630
625
620
615
610
605
600
595
590

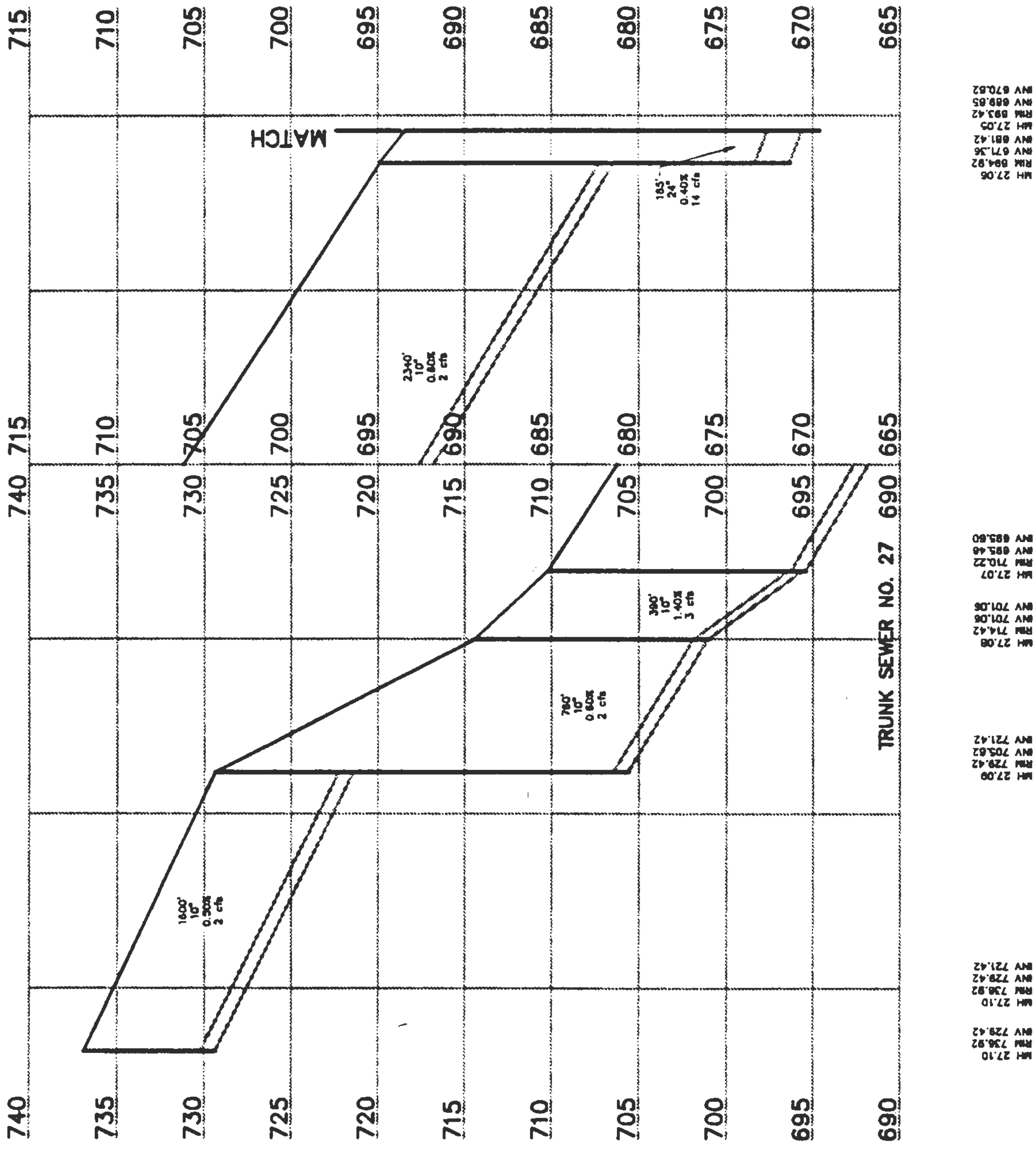

TRUNK SEWER NO. 24
MATCH
630
625
620
615
610
605
600
595
590
585

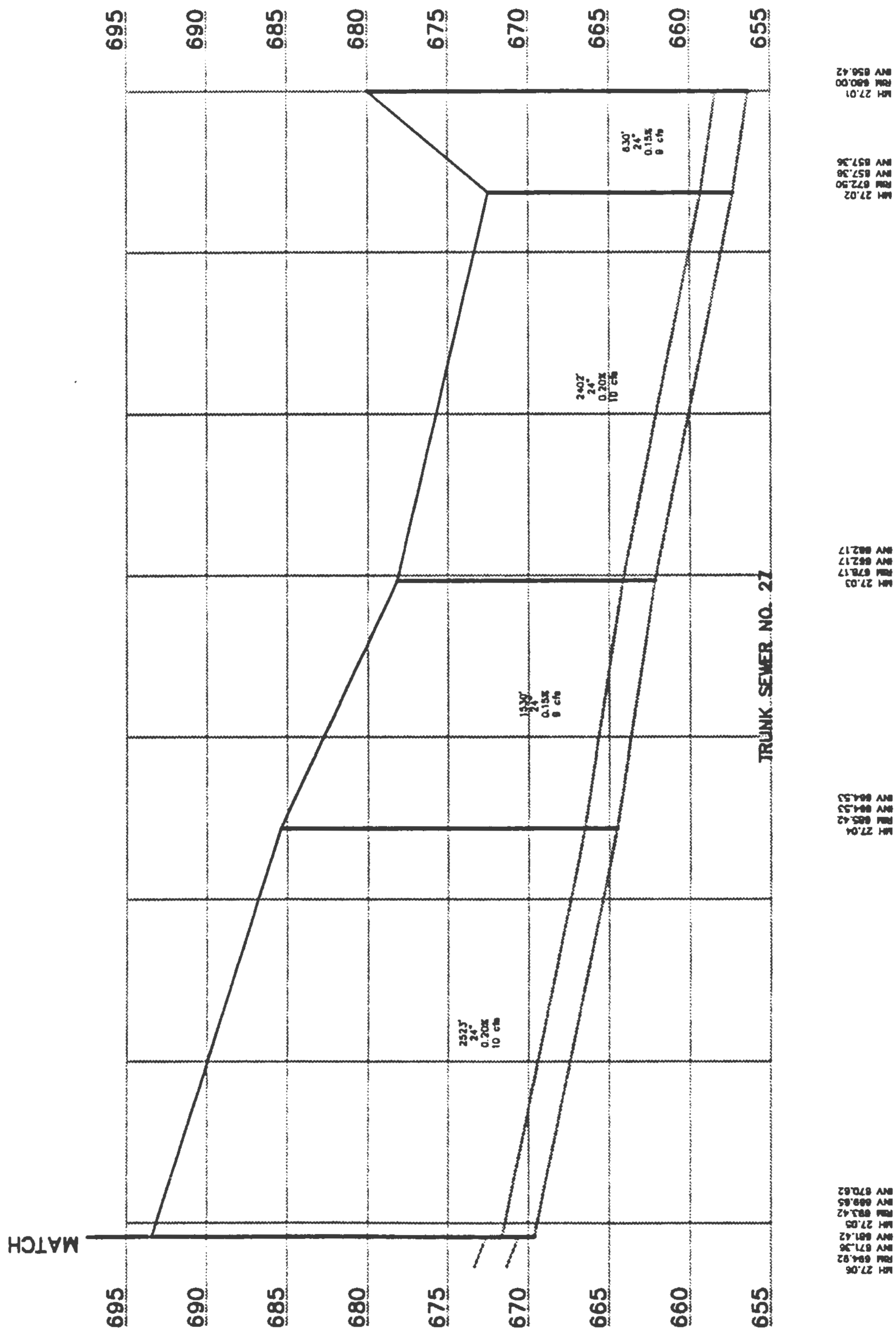
Appendix E

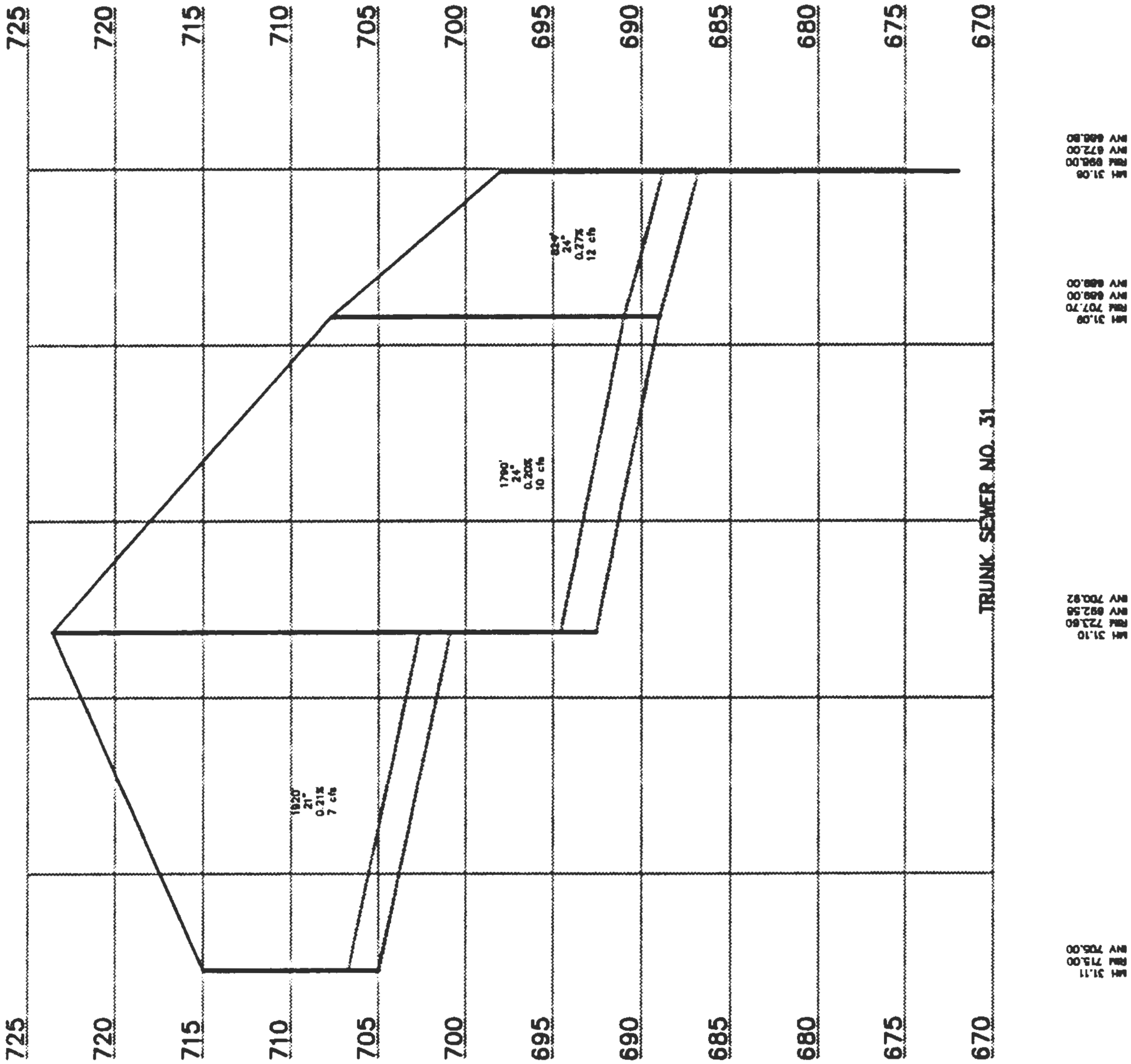



TRUNK SEWER NO. 26
750
700
695
690
685
680
675
670
665

Appendix E

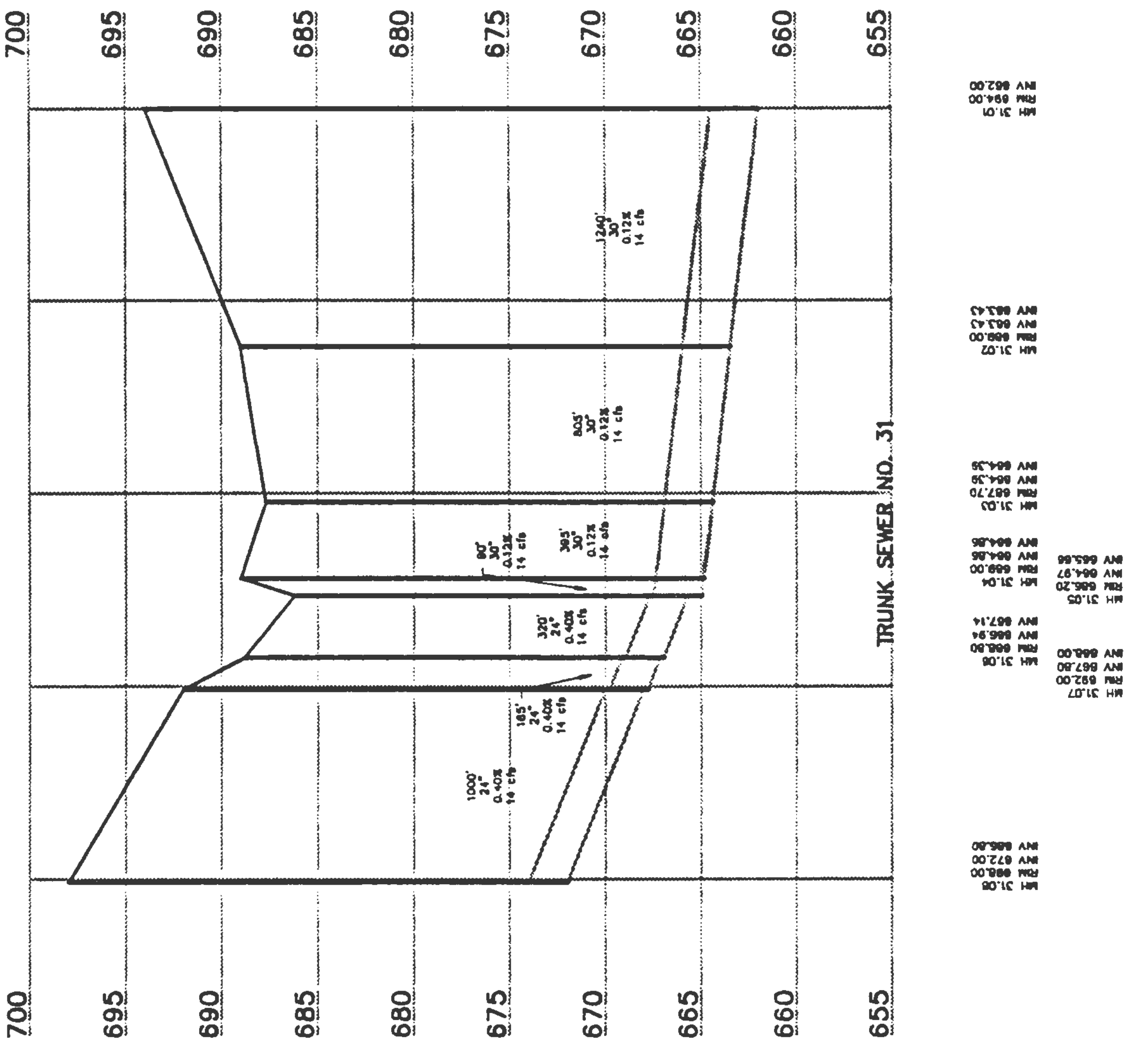

TRUNK SEWER NO. 27
MATCH
1600' 10" 0.30% 2 cfs
780' 10" 0.60% 2 cfs
390' 10" 1.40% 3 cfs
2340' 10" 0.60% 2 cfs
185' 24" 0.40% 14 cfs


695
690
685
680
675
670
665
660
655
TRUNK SEWER NO. 27
MATCH

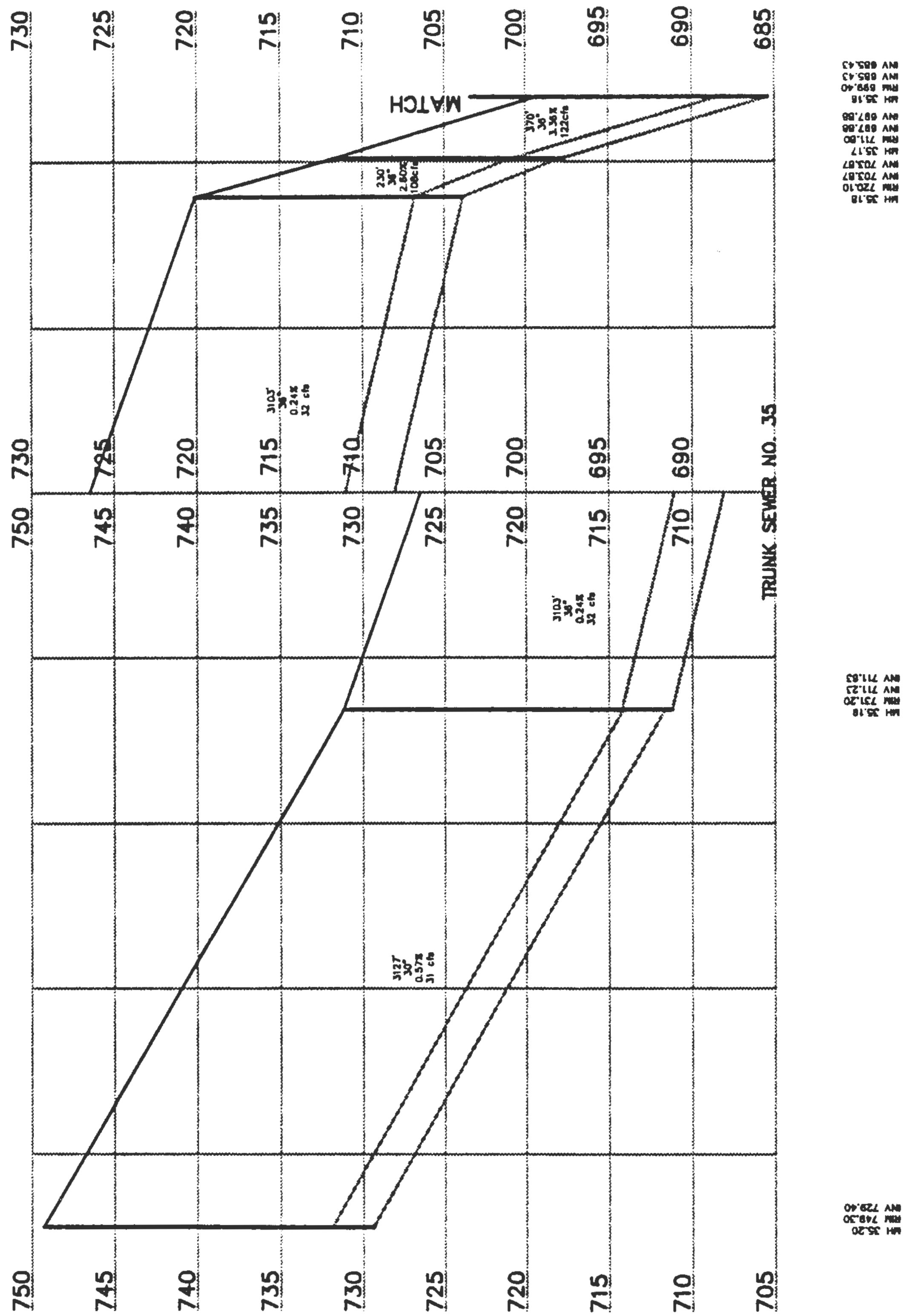


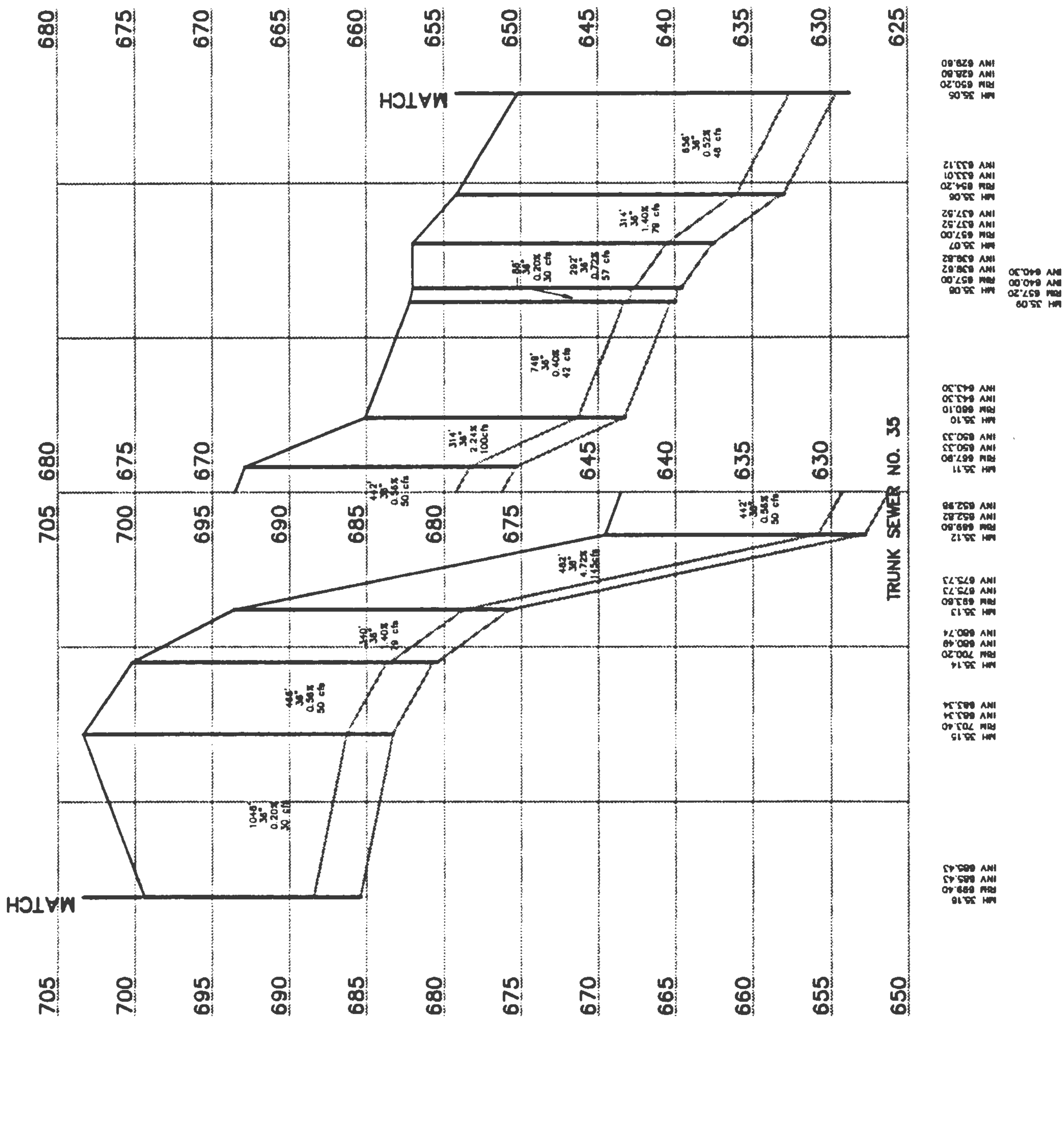
TRUNK SEWER NO. 31
725
720
715
710
705
700
695
690
685
680
675
670

Appendix E

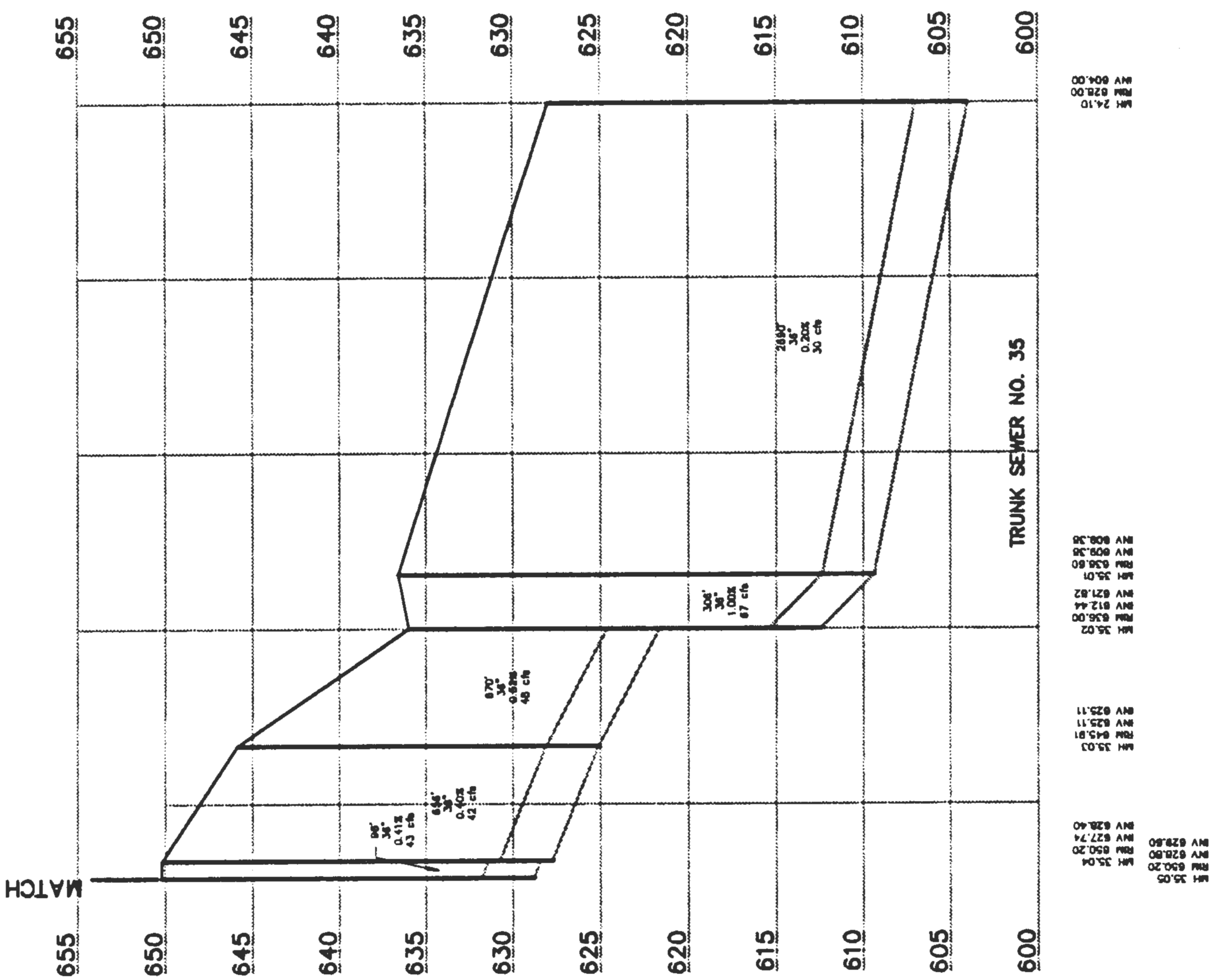

TRUNK SEWER NO. 31
700
695
690
685
680
675
670
665
660
655
1240'
30"
0.12%
14 cfs
805'
30"
0.12%
14 cfs
90'
30"
0.12%
14 cfs
395'
30"
0.12%
14 cfs
320'
24"
0.40%
14 cfs
165'
24"
0.40%
14 cfs
1000'
24"
0.40%
14 cfs

Appendix E



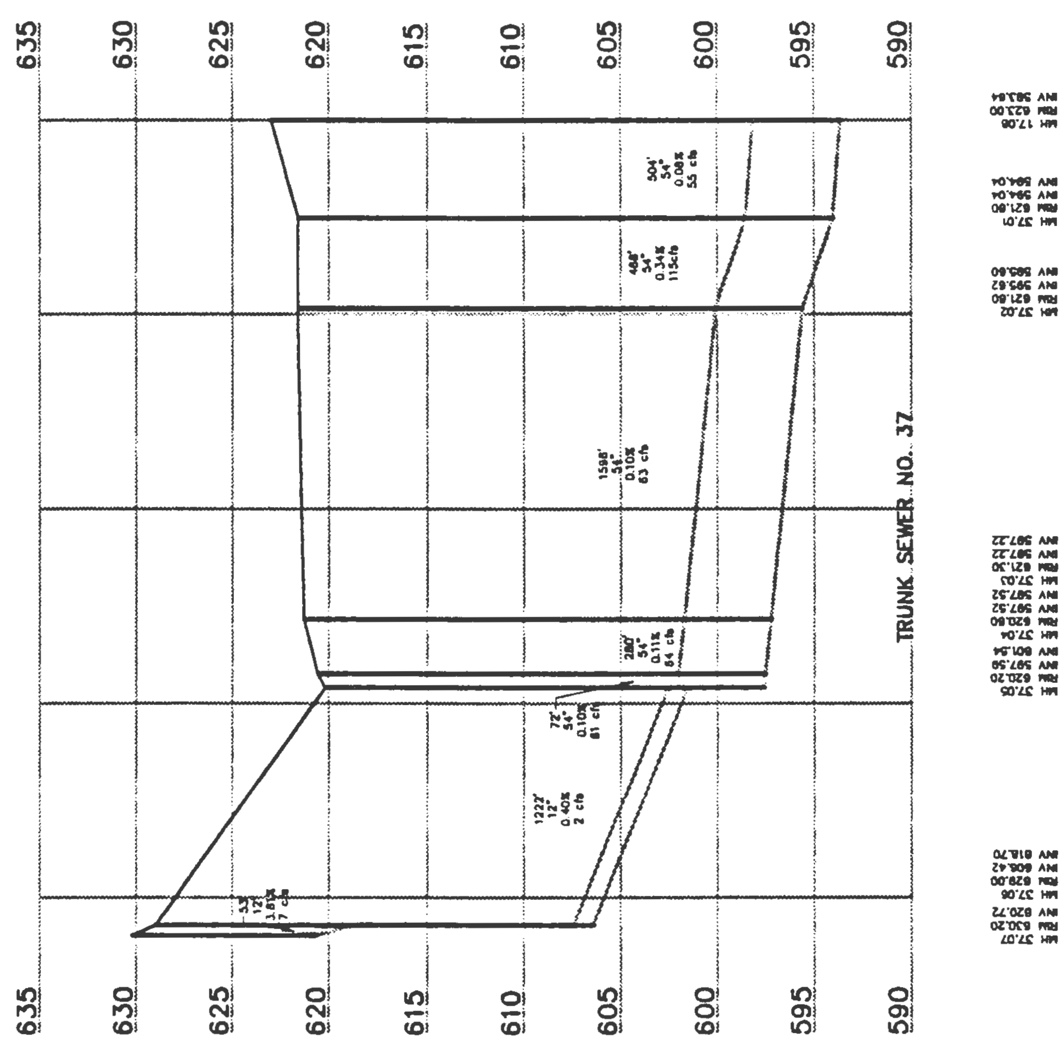

TRUNK SEWER NO. 35
MATCH
MATCH

Appendix E



TRUNK SEWER NO. 35
MATCH
655
650
645
640
635
630
625
620
615
610
605
600

Appendix E



Appendix F
Kenosha Area Sewer and Water Study

Kenosha WTF O&M Costs

Alt. 1 Kenosha at present 18.7 MGD flow (no expansion)

O&M: 18.7 MGD x $40,300/MGD	=	$753,610	
Maintenance: Sewage	=	298,700	
Maintenance: Sludge	=	298,700	
		$1,351,010	yr.

Alt. 2 Kenosha at proposed 2010 flow with no plant expansion (reservoir O&M with that item)

O&M: 25.3 MGD x $40,300/MGD	=	$1,019,600	
Maintenance: Sewage	=	298,700	
Maintenance: Sludge	=	298,700	
		$1,617,000	yr.
Reservoir O&M	=	25,000	
		$1,642,000	yr.

Alt. 3 Kenosha at proposed 2010 flow with the expanded sewage facilities but existing sludge facilities.

O&M: 25.3 MGD x $40,300/MGD	=	$1,019,600	
Maintenance: Sewage: 298,700 x 2	=	597,400	
Maintenance: Sludge	=	298,700	
		$1,915,700	

* Administrative, billing and accounting costs are not included since they would be the same for all alternatives.

INCREMENTAL COSTS
"CENTRALIZED" ALTERNATIVE
TRUNK SEWERS

Location	Item	Quantity	Incremental Unit Price	Cost	Life	Replacement Costs 20	30	40	Salvage	O & M
Trunk Sewer #29	4.27 MGDLift Station	1	$778,000	$778,000	20 - 50	$45,000	$100,000	$45,000	($55,500)	$38,900
	16" Force Main	24,800	$46	$1,140,800	50				$0	$2,348
Trunk Sewer #31	Lift Station	1	$13,000	$13,000	20 - 50	$1,000	$13,000		($4,290)	$650
Trunk Sewer #34	.56 MGD Lift Station	1	$152,000	$152,000	20 - 50	$10,000	$152,000		($50,160)	$7,600
	8" Force Main	15,700	$34	$533,800	50				$0	$1,487
Trunk Sewer #35	15/21 San	2,200	$10	$22,000	50				$0	
	18/24 San	5,500	$15	$82,500	50				$0	
	18/24 San	5,500	$25	$137,500	50				$0	
	18/24 San	2,500	$50	$125,000	50				$0	
Total				$2,984,600		$56,000	$265,000	$45,000	($109,950)	$50,985
Engineering & Contingencies (30%)				$895,380						
Total Costs				$3,879,980						
Present Worth Factors				1.0000		0.3118	0.1741	0.0972	0.0543	
Present Worth				$3,879,980		$17,461	$46,139	$4,375	($5,969)	
Total Present Worth Of Construction				$3,941,986						
Annual O & M Costs			$50,985							
50 Year Present Worth Factor			15.7619							
Present Worth Of Annual O & M Costs				$803,618						
Total Present Worth				$4,745,605						

WASTEWATER TREATMENT FACILITIES

Present Worth Of Construction			
Kenosha WTF Alternative I B			$29,288,928
Kenosha WTF Alternative II			$28,787,077
			$501,851
Present Worth Of Incremental O & M			
Kenosha WTF Alternative I B	$1,633,400		
Kenosha WTF Alternative II	$1,610,700		
	$22,700	15.7619	$357,794
			$859,645

TOTAL COSTS

Present Worth Of Trunk Sewers	$4,745,605
Present Worth Of Kenosha WTF	$859,645
	$5,605,250

Source: Ruekert \| Mielke, Inc.

Appendix H

INCREMENTAL COSTS
"CENTRALIZED" ALTERNATIVE
TRUNK SEWERS

Location	Item	Quantity	Incremental Unit Price	Cost	Life	Replacement Costs 20	30	40	Salvage	O & M
Trunk Sewer #29	4.27 MGDLift Station	1	$778,000	$778,000	20 - 50	$45,000	$100,000	$45,000	($55,500)	$38,900
	16" Force Main	24,800	$46	$1,140,800	50				$0	$2,348
Trunk Sewer #31	Lift Station	1	$13,000	$13,000	20 - 50	$1,000	$13,000		($4,290)	$650
Trunk Sewer #35	15/21 San	2,200	$10	$22,000	50				$0	
	18/24 San	5,500	$15	$82,500	50				$0	
	18/24 San	5,500	$25	$137,500	50				$0	
	18/24 San	2,500	$50	$125,000	50				$0	
Total				$2,298,800		$46,000	$113,000	$45,000	($59,790)	$41,898
Engineering & Contingencies (30%)				$689,640						
Total Costs				$2,988,440						
Present Worth Factors				1.0000		0.3118	0.1741	0.0972	0.0543	
Present Worth				$2,988,440		$14,343	$19,674	$4,375	($3,246)	
Total Present Worth Of Construction				$3,023,587						
Annual O & M Costs			$41,898							
50 Year Present Worth Factor			15.7619							
Present Worth Of Annual O & M Costs				$660,390						
Total Present Worth				$3,683,977						

WASTEWATER TREATMENT FACILITIES

Present Worth Of Construction			
Kenosha WTF Alternative I B			$29,288,928
Kenosha WTF Alternative II			$28,787,077
			$501,851
Present Worth Of Incremental O & M			
Kenosha WTF Alternative I B	$1,633,400		
Kenosha WTF Alternative II (w/o SUD "73-1")	$1,617,156		
	$16,244	15.7619	$256,036
			$757,887

TOTAL COSTS

Present Worth Of Trunk Sewers	$3,683,977
Present Worth Of Kenosha WTF	$757,887
	$4,441,864

Source: Ruekert | Mielke, Inc.

Appendix I

KENOSHA WTF O & M COSTS

TREATMENT FACILITIES INTERMEDIATE	WTF expanded to 125.5 MGD peak flow	
	O & M Sewage : 20.3 MGD x $40,300/MGD =	$818,000
	Maintenance - Sewage : 125.5/68 x 298,700 =	$551,300
	Maintenance - Sludge : 298,700 =	$298,700
		$1,668,000 / yr.
TREATMENT FACILITIES WITH STORAGE INTERMEDIATE	WTF expanded to 82 MGD peak flow, 10.2 MG storage added	
	O & M Sewage : 20.3 MGD x $40,300/MGD =	$818,000
	Maintenance - Sewage : 82/68 x 298,700 =	$360,000
	Maintenance - Sludge : 298,700 =	$298,700
	Maintenance - Storage : 3 tanks @ $5,000 each =	$15,000
		$1,491,700 / yr.
TREATMENT FACILITIES OPTIMISTIC	WTF expanded to 142 MGD peak flow	
	O & M Sewage : 28.6 MGD x $40,300/MGD =	$1,153,000
	Maintenance - Sewage : 142/68 x 298,700 =	$623,800
	Maintenance - Sludge : 298,700 =	$298,700
		$2,075,500 / yr.
TREATMENT FACILITIES WITH STORAGE OPTIMISTIC	WTF expanded to 90.7 MGD peak flow, 12.2 MG storage added	
	O & M Sewage : 28.6 MGD x $40,300/MGD =	$1,153,000
	Maintenance - Sewage : 90.7/68 x 298,700 =	$398,000
	Maintenance - Sludge : 298,700 =	$298,700
	Maintenance - Storage : 4 tanks @ $5,000 each =	$20,000
		$1,869,700 / yr.
TREATMENT FACILITIES ULTIMATE	WTF expanded to 177 MGD peak flow	
	O & M Sewage : 46.2 MGD x $40,300/MGD =	$1,861,900
	Maintenance - Sewage : 177/68 x 298,700 =	$777,500
	Maintenance - Sludge : 382,800 =	$382,800
		$3,022,200 / yr.
TREATMENT FACILITIES WITH STORAGE ULTIMATE	WTF expanded to 113.7 MGD peak flow, 15 MG storage added	
	O & M Sewage : 46.2 MGD x $40,300/MGD =	$1,861,900
	Maintenance - Sewage : 113.7/68 x 298,700 =	$499,400
	Maintenance - Sludge : 382,800 =	$382,800
	Maintenance - Storage : 4 tanks @ $5,000 each =	$20,000
		$2,764,100 / yr.

Source: Ruekert | Mielke, Inc.

Appendix J

* OPERATION AND MAINTENANCE COST : 1985 - 1989
WATER TREATMENT FACILITY

Year	Total Gallons Pumped Average Day	Total O & M Cost Per Year	Cost Per Million Gallons Average Day
1985	15,239,901	$807,568	$52,990
1986	13,995,183	$853,327	$60,973
1987	15,028,759	$895,006	$59,553
1988	19,079,205	$961,069	$50,373
1989	15,524,019	$890,665	$57,373
Average	15,773,413	$881,527	$56,252
2010 - I	18,946,000	$1,065,750	$56,252
2010 - O	23,560,000	$1,325,297	$56,252
Ultimate	37,074,000	$2,085,487	$56,252

* O & M cost excludes administrative, billing and accounting costs.

Source: Ruekert | Mielke, Inc.

Appendix K

Table K-1
Total Combined Municipalities
Sewer and Water Utility Financial Information

Sewer Utility	Local	Regional	Total
Fixed Assets	27,623,323	52,476,851	80,100,174
Depreciation	1,949,986	9,741,371	11,691,357
Contributions	17,496,550	23,460,887	40,957,437
Net asset value	8,176,787	19,274,593	27,451,380
Long term debt	6,684,560	23,391,201	30,075,761
Debt free equity	1,492,227	-4,116,608	-2,624,381
O&M	1,853,928	2,389,137	4,243,065

Water Utility	Local	Regional	Total
Fixed Assets	22,840,898	22,199,032	45,039,930
Depreciation	4,952,366	5,559,944	10,512,310
Contributions	13,553,488	3,490,404	17,043,892
Net asset value	4,335,044	13,148,684	17,483,728
Long term debt	5,086,100	3,890,499	8,976,599
Debt free equity	-751,056	9,258,185	8,507,129
O&M	2,074,942	1,167,695	3,242,637

Appendix K

Table K-2
City of Kenosha
Sewer and Water Utility Financial Information

Sewer Utility	Local	Regional	Total
Fixed Assets	8,400,000	41,521,949	49,921,949
Depreciation		8,875,907	8,875,907
Contributions		16,928,379	16,928,379
Net asset value	8,400,000	15,717,663	24,117,663
Long term debt		15,266,376	15,266,376
Debt free equity	8,400,000	451,287	8,851,287
O&M	1,165,111	1,987,015	3,152,126

Water Utility	Local	Regional	Total
Fixed Assets	15,988,347	18,588,613	34,576,960
Depreciation	4,091,581	5,292,920	9,384,501
Contributions	10,839,350	586,967	11,426,317
Net asset value	1,057,416	12,708,726	13,766,142
Long term debt		3,417,994	3,417,994
Debt free equity	1,057,416	9,290,732	10,348,148
O&M	1,677,578	1,008,368	2,685,946

Appendix K

Table K-3
Village of Pleasant Prairie
Sewer and Water Utility Financial Information

Sewer Utility	Local	Regional	Total
Fixed Assets	15,018,265	9,864,902	24,883,167
Depreciation	1,325,874	810,964	2,136,838
Contributions	14,652,593	5,843,312	20,495,905
Net asset value	-960,202	3,210,626	2,250,424
Long term debt	4,730,000	8,074,385	12,804,385
Debt free equity	-5,690,202	-4,863,759	-10,553,961
O&M	603,182	402,122	1,005,304

Water Utility	Local	Regional	Total
Fixed Assets	4,620,618	3,610,419	8,231,037
Depreciation	660,399	267,024	927,423
Contributions	2,353,315	2,903,437	5,256,752
Net asset value	1,606,904	439,958	2,046,862
Long term debt	3,786,100	472,505	4,258,605
Debt free equity	-2,179,196	-32,547	-2,211,743
O&M	371,764	159,327	531,091

Appendix K

Table K-4
Town of Somers
Sewer and Water Utility Financial Information

Sewer Utility	Local	Regional	Total
Fixed Assets	3,141,058	1,090,000	4,231,058
Depreciation	383,112	54,500	437,612
Contributions	2,444,957	689,196	3,134,153
Net asset value	312,989	346,304	659,293
Long term debt	1,239,560	50,440	1,290,000
Debt free equity	-926,571	295,864	-630,707
O&M	55,635	0	55,635

Water Utility	Local	Regional	Total
Fixed Assets	858,933	0	858,933
Depreciation	86,586	0	86,586
Contributions	0	0	0
Net asset value	772,347	0	772,347
Long term debt	0	0	0
Debt free equity	772,347	0	772,347
O&M	0	0	0

Appendix K

Table K-5
Town of Bristol
Sewer and Water Utility Financial Information

Sewer Utility	Local	Regional	Total
Fixed Assets	1,064,000		1,064,000
Depreciation	241,000		241,000
Contributions	399,000		399,000
Net asset value	424,000		424,000
Long term debt	715,000		715,000
Debt free equity	-291,000	0	-291,000
O&M	30,000		30,000

Water Utility	Local	Regional	Total
Fixed Assets	1,373,000		1,373,000
Depreciation	113,800		113,800
Contributions	360,823		360,823
Net asset value	898,377	0	898,377
Long term debt	1,300,000		1,300,000
Debt free equity	-401,623	0	-401,623
O&M	25,600		25,600

Table K-6
Regional Alternative
Sewer User Charges

REGIONAL COSTS

	1995	2010	
New WTF Debt	1,499,808	1,499,808	
New WTF O&M	1,869,700	1,869,700	
New Trunks Debt	1,621,000	2,074,000	From Table 7-4
New Trunks O&M	98,932	169,161	
Consolidated debt	2,421,697	2,421,697	
Consolidated O&M	4,243,065	4,243,065	From Table 7-1
Totals	11,754,202	12,277,431	
Flow (MGD)	15.371	20.658	From Table 7-3
Rate / 1000 gal	$2.10	$1.63	
Cost per 65,000 gal	$136.18	$105.84	
Use:	$136.00	$106.00	

EQUITY ADJUSTMENTS

Kenosha

Would receive 8,850,000 which if placed in a sinking fund for 20 years @ 7% would yield $781,000 annual credit

	1995	2010
Credit	781,000	781,000
Flow (MGD)	13.637	14.356
Rate / 1000 gal	$0.16	$0.15
Cost per 65,000 gal	$10.20	$9.69
Use:	$10.00	$10.00

Table K-6
Regional Alternative
Sewer User Charges

Pleasant Prairie

Would need to bond $10.5 mil to cover
negative equity for 20 years @ 7%
yields $926,000 additional cost

	1995	2010
Credit	926,000	926,000
Flow (MGD)	1.401	4.857
Rate / 1000 gal	$1.81	$0.52
Cost per 65,000 gal	$117.70	$33.95
Use:	$118.00	$34.00

Somers

Would need to bond $631,000 mil to cover
negative equity for 20 years @ 7%
yields $55,700 additional cost

	1995	2010
Credit	55,700	55,700
Flow (MGD)	0.221	0.644
Rate / 1000 gal	$0.69	$0.24
Cost per 65,000 gal	$44.88	$15.40
Use:	$45.00	$15.00

Bristol

Would need to bond $291,000 mil to cover
negative equity for 20 years @ 7%
yields $25,700 additional cost

	1995	2010
Credit	25,700	25,700
Flow (MGD)	0.112	0.743
Rate / 1000 gal	$0.63	$0.09
Cost per 65,000 gal	$40.86	$6.16
Use:	$41.00	$6.00

Appendix K

Table K-6
Regional Alternative
Sewer User Charges

Regional User Charges

Community	Local Cost 1995	Local Cost 2010	Regional Cost 1995	Regional Cost 2010	Total Cost 1995	Total Cost 2010
Kenosha	$0	$0	$136	$106	$136	$106
Pleasant Prairie	$0	$0	$136	$106	$136	$106
Bristol	$0	$0	$136	$106	$136	$106
Somers	$0	$0	$136	$106	$136	$106
Paris	$0	$0	$136	$106	$136	$106

Debt Free Equity Adjustments

Community	Local Cost 1995	Local Cost 2010
Kenosha	($10)	($10)
Pleasant Prairie	$118	$34
Bristol	$41	$6
Somers	$45	$15
Paris	$0	$0

Adjusted Sewer User Charges

Community	Local Cost 1995	Local Cost 2010	Regional Cost 1995	Regional Cost 2010	Total Cost 1995	Total Cost 2010
Kenosha	($10)	($10)	$136	$106	$126	$96
Pleasant Prairie	$118	$34	$136	$106	$254	$140
Bristol	$41	$6	$136	$106	$177	$112
Somers	$45	$15	$136	$106	$181	$121
Paris	$0	$0	$136	$106	$136	$106

Table K-7
Regional Alternative - Retained Local Collection
Sewer User Charges

REGIONAL COSTS

	1995	2010	
New WTF Debt	1,499,808	1,499,808	
New WTF O&M	1,869,700	1,869,700	
New Trunks Debt	1,621,000	2,074,000	From Table 7-4
New Trunks O&M	98,932	169,161	
Consolidated debt	1,700,360	1,700,360	Debt from 7-1
Consolidated O&M	2,389,137	2,389,137	From Table 7-1
Totals	9,178,937	9,702,166	
Flow (MGD)	15.371	20.658	From Table 7-3
Rate / 1000 gal	$1.64	$1.29	
Cost per 65,000 gal	$106.34	$83.64	
Use:	$106.00	$84.00	

LOCAL COSTS

Kenosha	1995	2010	
O&M	1,165,111	1,165,111	From Table K-2
Local debt	0	0	
	1,165,111	1,165,111	
Flow (MGD)	13.637	14.356	
Rate / 1000 gal	$0.23	$0.22	
Cost per 65,000 gal	$15.21	$14.45	
Use:	$15.00	$14.00	

Pleasant Prairie	1995	2010	
O&M	603,182	603,182	From Table K-3
Local debt	417,270	417,270	
	1,020,452	1,020,452	
Flow (MGD)	1.401	4.857	
Rate / 1000 gal	$2.00	$0.58	
Cost per 65,000 gal	$129.71	$37.41	
Use:	$130.00	$37.00	

Table K-7
Regional Alternative - Retained Local Collection
Sewer User Charges

Somers	1995	2010	
O&M	55,635	55,635	From Table K-4
Local debt	109,351	109,351	From Table K-4
	164,986	164,986	
Flow (MGD)	0.221	0.644	
Rate / 1000 gal	$2.05	$0.70	
Cost per 65,000 gal	$132.95	$45.62	
Use:	$133.00	$46.00	

Bristol	1995	2010	
O&M	30,000	30,000	From Table K-5
Local debt	63,076	63,076	From Table K-5
	93,076	93,076	
Flow (MGD)	0.112	0.743	
Rate / 1000 gal	$2.28	$0.34	
Cost per 65,000 gal	$147.99	$22.31	
Use:	$148.00	$22.00	

Equity Adjustments

Kenosha

Would receive 450,000 which if placed in a sinking fund for 20 years @ 7% would yield $39,800 annual credit

	1995	2010
Credit	39,800	39,800
Flow (MGD)	13.637	14.356
Rate / 1000 gal	0.01	0.01
Cost per 65,000 gal	0.52	0.49
Use:	$1.00	$0.00

Table K-7
Regional Alternative - Retained Local Collection
Sewer User Charges

Pleasant Prairie

Would need to bond \$4.8 mil to cover negative equity for 20 years @ 7% yields \$424,00 additional cost

	1995	2010
Credit	424,000	424,000
Flow (MGD)	1.401	4.857
Rate / 1000 gal	\$0.83	\$0.24
Cost per 65,000 gal	\$53.89	\$15.55
Use:	\$1.00	\$0.00

Somers

Would receive \$296,000 which if placed in a sinking fund for 20 years @ 7% would yield \$26,000 annual credit

	1995	2010
Credit	26,000	26,000
Flow (MGD)	0.221	0.644
Rate / 1000 gal	\$0.32	\$0.11
Cost per 65,000 gal	\$20.95	\$7.19
Use:	\$21.00	\$7.00

Table K-7
Regional Alternative - Retained Local Collection
Sewer User Charges

Regional User Charges

Community	Local Cost 1995	Local Cost 2010	Regional Cost 1995	Regional Cost 2010	Total Cost 1995	Total Cost 2010
Kenosha	$15	$14	$106	$84	$121	$98
Pleasant Prairie	$130	$37	$106	$84	$236	$121
Bristol	$148	$22	$106	$84	$254	$106
Somers	$133	$46	$106	$84	$239	$130
Paris	$0	$0	$106	$84	$106	$84

Debt Free Equity Adjustments

Community	Local Cost 1995	Local Cost 2010
Kenosha	($1)	$0
Pleasant Prairie	$54	$16
Bristol	$0	$0
Somers	($21)	($7)
Paris	$0	$0

Adjusted Sewer User Charges

Community	Local Cost 1995	Local Cost 2010	Regional Cost 1995	Regional Cost 2010	Total Cost 1995	Total Cost 2010
Kenosha	$14	$14	$106	$84	$120	$98
Pleasant Prairie	$184	$53	$106	$84	$290	$137
Bristol	$148	$22	$106	$84	$254	$106
Somers	$112	$39	$106	$84	$218	$123
Paris	$0	$0	$106	$84	$106	$84

Table K-8
Sewer User Charges
Existing Contract Option
City of Kenosha

	1995	2010	
Local O&M	$1,165,111	$1,165,111	- From Table K-2
Local debt	0	0	
Trunk sewer debt	685,683	877,302	
Trunk sewer O&M	89,912	71,557	
WTF O&M	1,699,234	1,299,291	
WTF debt	1,042,246	1,042,246	
	$4,682,186	$4,455,507	
Local flow (MGD)	13.637	14.356	
Local rate per Kgal	$0.94	$0.85	
Regional O&M	1,987,015	1,987,015	- From Table K-2
Regional debt	1,346,764	1,346,764	- K-2 debt @ 7% 20 years
	$3,333,779	$3,333,779	
Region flow (MGD)	15.005	20.658	
Region rate per Kgal	$0.61	$0.44	- Apply rate to Pleasant Prairie, Somers, Bristol & Paris
Total rate per Kgal	$1.55	$1.29	
Cost per 65,000 gal	$100.71	$84.01	
Use:	$101.00	$84.00	

Table K-9
Sewer User Charges
Existing Contract Option
Village of Pleasant Prairie

	1995	2010	
Local O&M	$603,182	$603,182	- From Table K-3
Local debt	417,270	417,270	- K-3 debt @ 7% 20 years
Trunk sewer debt	518,558	663,473	
Trunk sewer O&M	7,565	54,118	
WTF O&M	142,976	439,658	
WTF debt	352,678	352,678	
Regional O&M	402,122	402,122	- From Table K-3
Regional debt	712,304	712,304	- K-3 debt @ 7% 20 years
	$3,156,654	$3,644,804	
Local flow (MGD)	1.401	4.857	
Local rate per Kgal	$6.17	$2.06	
+ Kenosha regional	$0.61	$0.44	
Total rate per Kgal	$6.78	$2.50	
Cost per 65,000 gal	$440.81	$162.38	
Use:	$441.00	$162.00	
Rate to Bristol per Kgal (Assume regional O&M & 30% regional debt as cost to Bristol)	$1.20	$0.35	

Appendix K

Table K-10
Sewer User Charges
Existing Contract Option
Town of Somers

	1995	2010	
Local O&M	$55,635	$55,635	- From Table K-4
Local debt	109,351	109,351	- K-4 debt @ 7% 20 years
Trunk sewer debt	275,408	352,373	
Trunk sewer O&M	1,455	28,734	
WTF O&M	27,490	58,253	
WTF debt	46,728	46,728	
Regional O&M	0	0	
Regional debt	4,450	4,450	- K-4 debt @ 7% 20 years
	$520,517	$655,524	
Local flow	0.221	0.644	
Local rate	$6.45	$2.79	
+ Kenosha regional	$0.61	$0.44	
Total rate per Kgal	$7.06	$3.23	
Cost per 65,000 gal	$459.00	$210.01	
Use:	$459.00	$210.00	

Table K-11
Sewer User Charges
Existing Contract Option
Town of Bristol

	1995	2010	
Local O&M	$30,000	$30,000	- From Table K-5
Local debt	63,076	63,076	- K-5 debt @ 7% 20 years
Trunk sewer debt	99,043	126,721	
Trunk sewer O&M	0	10,337	
WTF O&M	0	67,148	
WTF debt	53,944	53,944	
Regional O&M	0	0	
Regional debt	0	0	
	$246,063	$351,226	
Local flow	0.112	0.743	
Local rate	$6.02	$1.30	
+ Pleasant Prairie	$1.20	$0.35	
+ Kenosha regional		$0.44	
Total rate per Kgal	$7.22	$2.08	
Cost per 65,000 gal	$469.52	$135.50	
Use:	$470.00	$136.00	

Table K-12
Sewer User Charges
Existing Contract Option
Town of Paris

	1995	2010
Local O&M	$0	$0
Local debt	0	0
Trunk sewer debt	42,308	54,131
Trunk sewer O&M	0	4,415
WTF O&M	0	5,250
WTF debt	4,211	4,211
Regional O&M	0	0
Regional debt	0	0
	$46,519	$68,007
Local flow	0.000	0.058
Local rate		$3.21
+ Kenosha regional	$0.00	$0.44
Total rate per Kgal	$0.00	$3.65
Cost per 65,000 gal	$0.00	$237.55
Use:	$0.00	$238.00

Table K-13
Sewer User Charges
Modified Contract Option
City of Kenosha

	1995	2010	
Local O&M	$1,165,111	$1,165,111	- From Table K-2
Local debt	0	0	
	$1,165,111	$1,165,111	
Local flow (MGD)	13.637	14.356	
Local rate per Kgal	$0.23	$0.22	
Trunk sewer debt	$1,280,590	$1,280,590	
Trunk sewer O&M	31,848	31,848	
WTF O&M	1,869,700	1,869,700	
WTF debt	1,499,800	1,499,800	
Regional O&M	1,987,015	1,987,015	- From Table K-2
Regional debt	1,346,764	1,346,764	- K-2 debt @ 7% 20 years
	$8,015,717	$8,015,717	
Region flow (MGD)	15.005	20.658	
Region rate per Kgal	$1.46	$1.06	- Apply rate to Pleasant Prairie, Somers, Bristol & Paris
Total rate per Kgal	$1.70	$1.29	
Cost per 65,000 gal	$110.35	$83.55	
Use:	$110.00	$84.00	

Table K-14
Sewer User Charges
Modified Contract Option
Village of Pleasant Prairie

	1995	2010	
Local O&M	$603,182	$603,182	- From Table K-3
Local debt	417,270	417,270	- K-3 debt @ 7% 20 years
Trunk sewer debt	340,410	685,070	
Trunk sewer O&M	67,083	130,668	
WTF O&M			
WTF debt			
Regional O&M	402,122	402,122	- From Table K-3
Regional debt	712,304	712,304	- K-3 debt @ 7% 20 years
	$2,542,370	$2,950,615	
Local flow (MGD)	1.401	4.857	
Local rate	$4.97	$1.66	
+ Kenosha regional	$1.46	$1.06	
	$6.44	$2.73	
Cost per 65,000 gal	$418.29	$177.28	
Use:	$418.00	$177.00	
Rate to Bristol / Kgal (Assume regional O&M & 30% regional debt as cost to Bristol)	$1.20	$0.35	

Table K-15
Sewer User Charges
Modified Contract Option
Town of Somers

	1995	2010	
Local O&M	$55,635	$55,635	- From Table K-4
Local debt	109,351	109,351	- K-4 debt @ 7% 20 years
Trunk sewer debt		81,300	
Trunk sewer O&M		6,644	
WTF O&M			
WTF debt			
Regional O&M	0	0	
Regional debt	4,450	4,450	- K-4 debt @ 7% 20 years
	$169,436	$257,380	
Local flow (MGD)	0.221	0.644	
Local rate	$2.10	$1.09	
+ Kenosha regional	$1.46	$1.06	
	$3.56	$2.16	
Cost per 65,000 gal	$231.66	$140.27	
Use:	$232.00	$140.00	

Table K-16
Sewer User Charges
Modified Contract Option
Town of Bristol

	1995	2010	
Local O&M	$30,000	$30,000	- From Table K-5
Local debt	63,076	63,076	- K-5 debt @ 7% 20 years
Trunk sewer debt			
Trunk sewer O&M	0		
WTF O&M	0		
WTF debt			
Regional O&M	0	0	
Regional debt	0	0	
	$93,076	$93,076	
Local flow (MGD)	0.112	0.743	
Local rate	$2.28	$0.34	
+ Pleasant Prairie	$1.20	$0.35	
+ Kenosha regional		$1.06	
	$3.48	$1.75	
Cost per 65,000 gal	$226.27	$113.99	
Use:	$226.00	$114.00	

Table K-17
Sewer User Charges
Modified Contract Option
Town of Paris

	1995	2010
Local O&M	$0	$0
Local debt	0	0
Trunk sewer debt		
Trunk sewer O&M	0	
WTF O&M	0	
WTF debt		
Regional O&M	0	0
Regional debt	0	0
	$0	$0
Local flow (MGD)	0.000	0.058
Local rate		$0.00
+ Kenosha regional	$0.00	$1.06
	$0.00	$1.06
Cost per 65,000 gal	$0.00	$69.10
Use:	$0.00	$69.00

Table K-18
Water Rates
Regional Authority Option - Existing Demands
Existing Demands - 1995

Retail Class	Annual Vol (1000 gal)	Average Day (1000 gal)	Max Day Capacity Factor	Max Day (1000 gal)	Extra Capacity (1000 gal)	Max Hour Capacity Factor	Max Hour (1000 gal)	Extra Capacity (1000 gal)
Residential	0	0	160%	0	0	445%	0	0
Commercial	0	0	125%	0	0	360%	0	0
Industrial	0	0	50%	0	0	150%	0	0
Public	0	0	125%	0	0	360%	0	0
	0	0		0	0		0	0
Wholesale	4,856,690	13,306	170%	22,620	9,314	450%	59,877	50,563
Total	4,856,690	13,306		22,620	9,314		59,877	50,563

Costs Allocated

	Total	40.00% Base	2.00% Max Day	58.00% Max Hour
Operation & Maint	$3,497,239	$1,398,896	$69,945	$2,028,399
Depreciation	919,541	367,816	18,391	533,334
Taxes	1,697,614	679,046	33,952	984,616
Return	3,022,441	1,208,976	60,449	1,753,016
	$9,136,835	$3,654,734	$182,737	$5,299,365

Unit Cost		Base	Max Day	Max Hour
Number		4,856,690	9,314	50,563
Units		(1000 gal)	(1000 gal)	(1000 gal)
Operation & Maint	$3,497,239	$0.288	$7.509	$40.116
Depreciation	919,541	0.076	1.974	10.548
Taxes	1,697,614	0.140	3.645	19.473
Return	3,022,441	0.249	6.490	34.670
	$9,136,835	$0.753	$19.619	$104.808

Cost Distribution to Customer Classes

	Base	Max Day	Max Hour	Total	Rate
Unit costs of service	$0.753	$19.619	$104.808		
Total	4,856,690	9,314	50,563		
	$3,654,734	$182,737	$5,299,365	$9,136,835	$1.88
			Cost per 65,000 gallons		$122.28

Table K-19
Water Rates
Regional Authority Option - Existing Demands
Future Demands - 2010

Retail Class	Annual Vol (1000 gal)	Average Day (1000 gal)	Max Day Capacity Factor	Max Day (1000 gal)	Extra Capacity (1000 gal)	Max Hour Capacity Factor	Max Hour (1000 gal)	Extra Capacity (1000 gal)
Residential	0	0	160%	0	0	445%	0	0
Commercial	0	0	125%	0	0	360%	0	0
Industrial	0	0	50%	0	0	150%	0	0
Public	0	0	125%	0	0	360%	0	0
	0	0		0	0		0	0
Wholesale	7,477,755	20,487	170%	34,828	14,341	450%	92,192	77,851
Total	7,477,755	20,487		34,828	14,341		92,192	77,851

Costs Allocated

	Total	Base	Max Day	Max Hour
		40.00%	2.00%	58.00%
Operation & Maint	$3,997,398	$1,598,959	$79,948	$2,318,491
Depreciation	1,076,748	430,699	21,535	624,514
Taxes	1,987,843	795,137	39,757	1,152,949
Return	3,868,941	1,547,576	77,379	2,243,986
	$10,930,930	$4,372,372	$218,619	$6,339,940

Unit Cost		Base	Max Day	Max Hour
Number		7,477,755	14,341	77,851
Units		(1000 gal)	(1000 gal)	(1000 gal)
Operation & Maint	$3,997,398	$0.214	$5.575	$29.781
Depreciation	1,076,748	0.058	1.502	8.022
Taxes	1,987,843	0.106	2.772	14.810
Return	3,868,941	0.207	5.396	28.824
	$10,930,930	$0.585	$15.244	$81.437

Cost Distribution to Customer Classes

	Base	Max Day	Max Hour	Total	Rate
Unit costs of service	$0.585	$15.244	$81.437		
Wholesale	7,477,755	14,341	77,851		
	$4,372,372	$218,619	$6,339,940	10,930,930	$1.46
				Cost per 65,000 gallons	$95.02

Table K-20
Water Rates
Modified Regional Option
Regional Rate - 1995

Retail Class	Annual Vol (1000 gal)	Average Day (1000 gal)	Max Day Capacity Factor	Max Day (1000 gal)	Extra Capacity (1000 gal)	Max Hour Capacity Factor	Max Hour (1000 gal)	Extra Capacity (1000 gal)
Residential	0	0	160%	0	0	445%	0	0
Commercial	0	0	125%	0	0	360%	0	0
Industrial	0	0	50%	0	0	150%	0	0
Public	0	0	125%	0	0	360%	0	0
	0	0		0	0		0	0
Wholesale	4,856,690	13,306	170%	22,620	9,314	450%	59,877	50,563
Total	4,856,690	13,306		22,620	9,314		59,877	50,563

Costs Allocated

	Total	Base	Max Day	Max Hour
		40.00%	2.00%	58.00%
Operation & Maint	$1,422,297	$568,919	$28,446	$824,932
Depreciation	622,609	249,044	12,452	361,113
Taxes	1,149,433	459,773	22,989	666,671
Return	2,718,988	1,087,595	54,380	1,577,013
	$5,913,327	$2,365,331	$118,267	$3,429,730

Unit Cost		Base	Max Day	Max Hour
Number		4,856,690	9,314	50,563
Units		(1000 gal)	(1000 gal)	(1000 gal)
Operation & Maint	$1,422,297	$0.117	$3.054	$16.315
Depreciation	622,609	0.051	1.337	7.142
Taxes	1,149,433	0.095	2.468	13.185
Return	2,718,988	0.224	5.838	31.189
	$5,913,327	$0.487	$12.697	$67.831

Cost Distribution to Customer Classes

	Base	Max Day	Max Hour	Total	Rate
Unit costs of service	$0.487	$12.697	$67.831		
Wholesale	4,856,690	9,314	50,563		
	$2,365,331	$118,267	$3,429,730	$5,913,327	$1.218
				Cost per 65,000 gallons	$79.14

Appendix K

Table K-21
Water Rates
Modified Regional Option
Regional Rate - 2010

Retail Class	Annual Vol (1000 gal)	Average Day (1000 gal)	Max Day Capacity Factor	Max Day (1000 gal)	Extra Capacity (1000 gal)	Max Hour Capacity Factor	Max Hour (1000 gal)	Extra Capacity (1000 gal)
Residential	0	0	160%	0	0	445%	0	0
Commercial	0	0	125%	0	0	360%	0	0
Industrial	0	0	50%	0	0	150%	0	0
Public	0	0	125%	0	0	360%	0	0
	0	0		0	0		0	0
Wholesale	7,477,755	20,487	170%	34,828	14,341	450%	92,192	77,851
Total	7,477,755	20,487		34,828	14,341		92,192	77,851

Costs Allocated

	Total	40.00% Base	2.00% Max Day	58.00% Max Hour
Operation & Maint	$1,922,456	$768,982	$38,449	$1,115,024
Depreciation	779,817	311,927	15,596	452,294
Taxes	1,439,661	575,865	28,793	835,004
Return	3,565,488	1,426,195	71,310	2,067,983
	$7,707,422	$3,082,969	$154,148	$4,470,305

Unit Cost		Base	Max Day	Max Hour
Number		7,477,755	14,341	77,851
Units		(1000 gal)	(1000 gal)	(1000 gal)
Operation & Maint	$1,922,456	$0.103	$2.681	$14.323
Depreciation	779,817	0.042	1.088	5.810
Taxes	1,439,661	0.077	2.008	10.726
Return	3,565,488	0.191	4.972	26.563
	$7,707,422	$0.412	$10.749	$57.422

Cost Distribution to Customer Classes

	Base	Max Day	Max Hour	Total	Rate
Unit costs of service	$0.412	$10.749	$57.422		
Wholesale	7,477,755	14,341	77,851		
	$3,082,969	$154,148	$4,470,305	$7,707,422	$1.031
			Cost per 65,000 gallons		$67.00

Table K-22
Water Rates
Modified Regional Option
Kenosha Local Costs - 1995

Retail Class	Annual Vol (1000 gal)	Average Day (1000 gal)	Max Day Capacity Factor	Max Day (1000 gal)	Extra Capacity (1000 gal)	Max Hour Capacity Factor	Max Hour (1000 gal)	Extra Capacity (1000 gal)
Residential	1,890,221	5,179	160%	8,286	3,107	445%	23,045	17,866
Commercial	770,402	2,111	125%	2,638	528	360%	7,598	7,071
Industrial	1,677,610	4,596	50%	2,298	-2,298	150%	6,894	9,192
Public	168,002	460	125%	575	115	360%	1,657	1,542
	4,506,235	12,346		13,798	1,452		39,195	35,672
Wholesale		0	170%	0	0	450%	0	0
Total	4,506,235	12,346		13,798	1,452		39,195	35,672

Costs Allocated

	Total	Base	Max Day	Max Hour
		40.00%	2.00%	58.00%
Operation & Maint	$1,677,578	$671,031	$33,552	$972,995
Depreciation	207,849	83,139	4,157	120,552
Taxes	383,720	153,488	7,674	222,558
Return	74,019	29,608	1,480	42,931
	$2,343,166	$937,266	$46,863	$1,359,036

Unit Cost		Base	Max Day	Max Hour
Number		4,506,235	1,452	35,672
Units		(1000 gal)	(1000 gal)	(1000 gal)
Operation & Maint	$1,677,578	$0.149	$23.109	$27.276
Depreciation	207,849	0.018	2.863	3.379
Taxes	383,720	0.034	5.286	6.239
Return	74,019	0.007	1.020	1.204
	$2,343,166	$0.208	$32.278	$38.099

Cost Distribution to Customer Classes

	Base	Max Day	Max Hour	Total	Rate
Unit costs of service	$0.208	$32.278	$38.099		
Residential					
Units	1,890,221	3,107	17,866		
Allocated Cost	$393,153	$100,295	$680,687	$1,174,135	$0.62
			Cost per 65,000 gallons		$40.38

Table K-23
Water Rates
Modified Regional Option
Kenosha Local Costs - 2010

Retail Class	Annual Vol (1000 gal)	Average Day (1000 gal)	Max Day Capacity Factor	Max Day (1000 gal)	Extra Capacity (1000 gal)	Max Hour Capacity Factor	Max Hour (1000 gal)	Extra Capacity (1000 gal)
Residential	2,035,900	5,578	160%	8,924	3,347	445%	24,821	19,243
Commercial	1,010,400	2,768	125%	3,460	692	360%	9,966	9,274
Industrial	1,535,600	4,207	50%	2,104	-2,104	150%	6,311	8,414
Public	156,200	428	125%	535	107	360%	1,541	1,434
	4,738,100	12,981		15,023	2,042		42,638	38,365
Wholesale		0	170%	0	0	450%	0	0
Total	4,738,100	12,981		15,023	2,042		42,638	38,365

Costs Allocated

	Total	Base	Max Day	Max Hour
		40.00%	2.00%	58.00%
Operation & Maint	$1,677,578	$671,031	$33,552	$972,995
Depreciation	207,849	83,139	4,157	120,552
Taxes	383,720	153,488	7,674	222,558
Return	74,019	29,608	1,480	42,931
	$2,343,166	$937,266	$46,863	$1,359,036

Unit Cost

		Base	Max Day	Max Hour
Number		4,738,100	2,042	38,365
Units		(1000 gal)	(1000 gal)	(1000 gal)
Operation & Maint	$1,677,578	$0.142	$16.429	$25.362
Depreciation	207,849	0.018	2.036	3.142
Taxes	383,720	0.032	3.758	5.801
Return	74,019	0.006	0.725	1.119
	$2,343,166	$0.198	$22.948	$35.424

Cost Distribution to Customer Classes

	Base	Max Day	Max Hour	Total	Rate
Unit costs of service	$0.198	$22.948	$35.424		
Residential					
Units	2,035,900	3,347	19,243		
Allocated Cost	$402,731	$76,799	$681,680	$1,161,210	$0.57
			Cost per 65,000 gallons		$37.07

Table K-24
Water Rates
Modified Regional Option
Pleasant Prairie Local Costs - 1995

Retail Class	Annual Vol (1000 gal)	Average Day (1000 gal)	Max Day Capacity Factor	Max Day (1000 gal)	Extra Capacity (1000 gal)	Max Hour Capacity Factor	Max Hour (1000 gal)	Extra Capacity (1000 gal)
Residential	163,984	449	160%	719	270	445%	1,999	1,550
Commercial	33,986	93	125%	116	23	360%	335	312
Industrial	98,247	269	50%	135	-135	150%	404	538
Public	2,160	6	125%	7	1	360%	21	20
	298,377	817		977	160		2,760	2,420
Wholesale		0	170%	0	0	450%	0	0
Total	298,377	817		977	160		2,760	2,420

Costs Allocated

	Total	40.00% Base	2.00% Max Day	58.00% Max Hour
Operation & Maint	$371,764	$148,706	$7,435	$215,623
Depreciation	60,068	24,027	1,201	34,839
Taxes	110,895	44,358	2,218	64,319
Return	112,483	44,993	2,250	65,240
	$655,210	$262,084	$13,104	$380,022

Unit Cost		Base	Max Day	Max Hour
Number		298,377	160	2,420
Units		(1000 gal)	(1000 gal)	(1000 gal)
Operation & Maint	$371,764	$0.498	$46.547	$89.098
Depreciation	60,068	0.081	7.521	14.396
Taxes	110,895	0.149	13.885	26.577
Return	112,483	0.151	14.084	26.958
	$655,210	$0.878	$82.037	$157.029

Cost Distribution to Customer Classes

	Base	Max Day	Max Hour	Total	Rate
Unit costs of service	$0.878	$82.037	$157.029		
Residential					
Units	163,984	270	1,550		
Allocated Cost	$144,038	$22,114	$243,393	$409,545	$2.497
				Cost per 65,000 gallons	$162.34

Table K-25
Water Rates
Modified Regional Option
Pleasant Prairie Local Costs - 2010

Retail Class	Annual Vol (1000 gal)	Average Day (1000 gal)	Max Day Capacity Factor	Max Day (1000 gal)	Extra Capacity (1000 gal)	Max Hour Capacity Factor	Max Hour (1000 gal)	Extra Capacity (1000 gal)
Residential	907,332	2,486	160%	3,977	1,492	445%	11,062	8,576
Commercial	463,514	1,270	125%	1,587	317	360%	4,572	4,254
Industrial	621,368	1,702	50%	851	-851	150%	2,554	3,405
Public	14,344	39	125%	49	10	360%	141	132
	2,006,558	5,497		6,465	968		18,329	16,367
Wholesale		0	170%	0	0	450%	0	0
Total	2,006,558	5,497		6,465	968		18,329	16,367

Costs Allocated

	Total	40.00% Base	2.00% Max Day	58.00% Max Hour
Operation & Maint	$371,764	$148,706	$7,435	$215,623
Depreciation	60,068	24,027	1,201	34,839
Taxes	110,895	44,358	2,218	64,319
Return	112,483	44,993	2,250	65,240
	$655,210	$262,084	$13,104	$380,022

Unit Cost		Base	Max Day	Max Hour
Number		2,006,558	968	16,367
Units		(1000 gal)	(1000 gal)	(1000 gal)
Operation & Maint	$371,764	$0.074	$7.684	$13.174
Depreciation	60,068	0.012	1.242	2.129
Taxes	110,895	0.022	2.292	3.930
Return	112,483	0.022	2.325	3.986
	$655,210	$0.131	$13.543	$23.219

Cost Distribution to Customer Classes

	Base	Max Day	Max Hour	Total	Rate
Unit costs of service	$0.131	$13.543	$23.219		
Residential					
Units	907,332	1,492	8,576		
Allocated Cost	$118,510	$20,199	$199,131	$337,840	$0.372
			Cost per 65,000 gallons		$24.20

Table K-26
Water Rates
Modified Regional Option
Somers Local Costs - 1995

Retail Class	Annual Vol (1000 gal)	Average Day (1000 gal)	Max Day Capacity Factor	Max Day (1000 gal)	Extra Capacity (1000 gal)	Max Hour Capacity Factor	Max Hour (1000 gal)	Extra Capacity (1000 gal)
Residential	14,355	39	160%	63	24	445%	175	136
Commercial	24,381	67	125%	83	17	360%	240	224
Industrial	0	0	50%	0	0	150%	0	0
Public	113,635	311	125%	389	78	360%	1,121	1,043
	152,371	417		536	118		1,536	1,402
Wholesale		0	170%	0	0	450%	0	0
Total	152,371	417		536	118		1,536	1,402

Costs Allocated

	Total	40.00% Base	2.00% Max Day	58.00% Max Hour
Operation & Maint	$0	$0	$0	$0
Depreciation	11,166	4,466	223	6,476
Taxes	20,614	8,246	412	11,956
Return	54,064	21,626	1,081	31,357
	$85,845	$34,338	$1,717	$49,790

Unit Cost		Base	Max Day	Max Hour
Number		152,371	118	1,402
Units		(1000 gal)	(1000 gal)	(1000 gal)
Operation & Maint	$0	$0.000	$0.000	$0.000
Depreciation	11,166	0.029	1.890	4.618
Taxes	20,614	0.054	3.490	8.526
Return	54,064	0.142	9.153	22.360
	$85,845	$0.225	$14.534	$35.503

Cost Distribution to Customer Classes

	Base	Max Day	Max Hour	Total	Rate
Unit costs of service	$0.225	$14.534	$35.503		
Residential					
Units	14,355	24	136		
Allocated Cost	$3,235	$343	$4,817	$8,395	$0.58
				Cost per 65,000 gallons	$38.01

Table K-27
Water Rates
Modified Regional Option
Somers Local Costs - 2010

Retail Class	Annual Vol (1000 gal)	Average Day (1000 gal)	Max Day Capacity Factor	Max Day (1000 gal)	Extra Capacity (1000 gal)	Max Hour Capacity Factor	Max Hour (1000 gal)	Extra Capacity (1000 gal)
Residential	282,846	775	160%	1,240	465	445%	3,448	2,673
Commercial	63,608	174	125%	218	44	360%	627	584
Industrial	81,892	224	50%	112	-112	150%	337	449
Public	12,850	35	125%	44	9	360%	127	118
	441,196	1,209		1,614	405		4,539	3,824
Wholesale		0	170%	0	0	450%	0	0
Total	441,196	1,209		1,614	405		4,539	3,824

Costs Allocated

	Total	40.00% Base	2.00% Max Day	58.00% Max Hour
Operation & Maint	$0	$0	$0	$0
Depreciation	11,166	4,466	223	6,476
Taxes	20,614	8,246	412	11,956
Return	54,064	21,626	1,081	31,357
	$85,845	$34,338	$1,717	$49,790

Unit Cost		Base	Max Day	Max Hour
Number		441,196	405	3,824
Units		(1000 gal)	(1000 gal)	(1000 gal)
Operation & Maint	$0	$0.000	$0.000	$0.000
Depreciation	11,166	0.010	0.551	1.694
Taxes	20,614	0.019	1.018	3.127
Return	54,064	0.049	2.669	8.200
	$85,845	$0.078	$4.238	$13.021

Cost Distribution to Customer Classes

	Base	Max Day	Max Hour	Total	Rate
Unit costs of service	$0.078	$4.238	$13.021		
Residential					
Units	282,846	465	2,673		
Allocated Cost	$22,014	$1,970	$34,810	$58,794	$0.21
				Cost per 65,000 gallons	$13.51

Table K-28
Water Rates
Modified Regional Option
Bristol Local Costs - 1995

Retail Class	Annual Vol (1000 gal)	Average Day (1000 gal)	Max Day Capacity Factor	Max Day (1000 gal)	Extra Capacity (1000 gal)	Max Hour Capacity Factor	Max Hour (1000 gal)	Extra Capacity (1000 gal)
Residential		0	160%	0	0	445%	0	0
Commercial	32,700	90	125%	112	22	360%	323	300
Industrial	0	0	50%	0	0	150%	0	0
Public		0	125%	0	0	360%	0	0
	32,700	90		112	22		323	300
Wholesale		0	170%	0	0	450%	0	0
Total	32,700	90		112	22		323	300

Costs Allocated

		40.00%	2.00%	58.00%
	Total	Base	Max Day	Max Hour
Operation & Maint	$25,600	$10,240	$512	$14,848
Depreciation	17,849	7,140	357	10,352
Taxes	32,952	13,181	659	19,112
Return	62,886	25,155	1,258	36,474
	$139,287	$55,715	$2,786	$80,787

Unit Cost		Base	Max Day	Max Hour
Number		32,700	22	300
Units		(1000 gal)	(1000 gal)	(1000 gal)
Operation & Maint	$25,600	$0.313	$22.860	$49.473
Depreciation	17,849	0.218	15.939	34.494
Taxes	32,952	0.403	29.425	63.681
Return	62,886	0.769	56.155	121.530
	$139,287	$1.704	$124.379	$269.178

Cost Distribution to Customer Classes

	Base	Max Day	Max Hour	Total	Rate
Unit costs of service	$1.704	$124.379	$269.178		
Commercial					
Units	32,700	22	300		
Allocated Cost	$55,715	$2,786	$80,787	$139,287	$4.26
			Cost per 65,000 gallons		$276.87

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Table K-29
Water Rates
Modified Regional Option
Bristol Local Costs - 2010

Retail Class	Annual Vol (1000 gal)	Average Day (1000 gal)	Max Day Capacity Factor	Max Day (1000 gal)	Extra Capacity (1000 gal)	Max Hour Capacity Factor	Max Hour (1000 gal)	Extra Capacity (1000 gal)
Residential		0	160%	0	0	445%	0	0
Commercial	271,195	743	125%	929	186	360%	2,675	2,489
Industrial	0	0	50%	0	0	150%	0	0
Public		0	125%	0	0	360%	0	0
	271,195	743		929	186		2,675	2,489
Wholesale		0	170%	0	0	450%	0	0
Total	271,195	743		929	186		2,675	2,489

Costs Allocated

	Total	40.00% Base	2.00% Max Day	58.00% Max Hour
Operation & Maint	$25,600	$10,240	$512	$14,848
Depreciation	17,849	7,140	357	10,352
Taxes	32,952	13,181	659	19,112
Return	62,886	25,155	1,258	36,474
	$139,287	$55,715	$2,786	$80,787

Unit Cost		Base	Max Day	Max Hour
Number		271,195	186	2,489
Units		(1000 gal)	(1000 gal)	(1000 gal)
Operation & Maint	$25,600	$0.038	$2.756	$5.965
Depreciation	17,849	0.026	1.922	4.159
Taxes	32,952	0.049	3.548	7.678
Return	62,886	0.093	6.771	14.654
	$139,287	$0.205	$14.997	$32.457

Cost Distribution to Customer Classes

	Base	Max Day	Max Hour	Total	Rate
Unit costs of service	$0.205	$14.997	$32.457		
Commercial					
Units	271,195	186	2,489		
Allocated Cost	$55,715	$2,786	$80,787	$139,287	$0.51
				Cost per 65,000 gallons	$33.38

Table K-30
Water Rates
Existing Contract Option
Kenosha Local Rates -1995

Retail Class	Annual Vol (1000 gal)	Average Day (1000 gal)	Max Day Capacity Factor	Max Day (1000 gal)	Extra Capacity (1000 gal)	Max Hour Capacity Factor	Max Hour (1000 gal)	Extra Capacity (1000 gal)
Residential	1,890,221	5,179	160%	8,286	3,107	445%	23,045	17,866
Commercial	770,402	2,111	125%	2,638	528	360%	7,598	7,071
Industrial	1,677,610	4,596	50%	2,298	-2,298	150%	6,894	9,192
Public	168,002	460	125%	575	115	360%	1,657	1,542
	4,506,235	12,346		13,798	1,452		39,195	35,672
Wholesale	350,455	960	170%	1,632	672	450%	4,321	3,649
Total	4,856,690	13,306		15,430	2,124		43,516	39,320

Costs Allocated

	Total	Base	Max Day	Max Hour
		40.00%	2.00%	58.00%
Operation & Maint	$2,774,751	$1,109,900	$55,495	$1,609,356
Depreciation	566,006	226,402	11,320	328,284
Taxes	1,044,934	417,974	20,899	606,062
Return	1,590,968	636,387	31,819	922,761
	$5,976,659	$2,390,664	$119,533	$3,466,462

Unit Cost		Base	Max Day	Max Hour
Number		4,856,690	2,124	39,320
Units		(1000 gal)	(1000 gal)	(1000 gal)
Operation & Maint	$2,774,751	$0.229	$26.128	$40.930
Depreciation	566,006	0.047	5.330	8.349
Taxes	1,044,934	0.086	9.839	15.414
Return	1,590,968	0.131	14.981	23.468
	$5,976,659	$0.492	$56.278	$88.160

Cost Distribution to Customer Classes

	Base	Max Day	Max Hour	Total	Rate
Unit costs of service	$0.492	$56.278	$88.160		
Residential					
Units	1,890,221	3,107	17,866		
Allocated Cost	$930,445	$174,869	$1,575,106	$2,680,420	$1.42
Wholesale			Cost per 65,000 gal		$92.17
Units	350,455	672	3,649		
Allocated Cost	$172,508	$37,825	$321,658	$531,991	$1.52
			Cost per 65,000 gal		$98.67

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Table K-31
Water Rates
Existing Contract Option
Kenosha Local Rates - 2010

Retail Class	Annual Vol (1000 gal)	Average Day (1000 gal)	Max Day Capacity Factor	Max Day (1000 gal)	Extra Capacity (1000 gal)	Max Hour Capacity Factor	Max Hour (1000 gal)	Extra Capacity (1000 gal)
Residential	2,035,900	5,578	160%	8,924	3,347	445%	24,821	19,243
Commercial	1,010,400	2,768	125%	3,460	692	360%	9,966	9,274
Industrial	1,535,600	4,207	50%	2,104	-2,104	150%	6,311	8,414
Public	156,200	428	125%	535	107	360%	1,541	1,434
	4,738,100	12,981		15,023	2,042		42,638	38,365
Wholesale	2,739,655	7,506	170%	12,760	5,254	450%	33,777	28,522
Total	7,477,755	20,487		27,783	7,296		76,415	66,887

Costs Allocated

	Total	Base	Max Day	Max Hour
		40.00%	2.00%	58.00%
Operation & Maint	$3,209,643	$1,283,857	$64,193	$1,861,593
Depreciation	604,226	241,691	12,085	350,451
Taxes	1,115,495	446,198	22,310	646,987
Return	1,796,769	718,708	35,935	1,042,126
	$6,726,133	$2,690,453	$134,523	$3,901,157

Unit Cost		Base	Max Day	Max Hour
Number		7,477,755	7,296	66,887
Units		(1000 gal)	(1000 gal)	(1000 gal)
Operation & Maint	$3,209,643	$0.172	$8.798	$27.832
Depreciation	604,226	0.032	1.656	5.239
Taxes	1,115,495	0.060	3.058	9.673
Return	1,796,769	0.096	4.925	15.580
	$6,726,133	$0.360	$18.437	$58.324

Cost Distribution to Customer Classes

	Base	Max Day	Max Hour	Total	Rate
Unit costs of service	$0.360	$18.437	$58.324		
Residential					
Units	2,035,900	3,347	19,243		
Allocated Cost	$732,505	$61,703	$1,122,361	$1,916,569	$0.94
				Cost per 65,000 gal	$61.19
Wholesale					
Units	2,739,655	5,254	28,522		
Allocated Cost	$985,712	$96,871	$1,663,553	$2,746,136	$1.00
				Cost per 65,000 gal	$65.15

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Table K-32
Water Rates
Existing Contract Option
Pleasant Prairie Local Rates - 1995

Retail Class	Annual Vol (1000 gal)	Average Day (1000 gal)	Max Day Capacity Factor	Max Day (1000 gal)	Extra Capacity (1000 gal)	Max Hour Capacity Factor	Max Hour (1000 gal)	Extra Capacity (1000 gal)
Residential	163,984	449	160%	719	270	445%	1,999	1,550
Commercial	33,986	93	125%	116	23	360%	335	312
Industrial	98,247	269	50%	135	-135	150%	404	538
Public	2,160	6	125%	7	1	360%	21	20
	298,377	817		977	160		2,760	2,420
Wholesale		0	170%	0	0	450%	0	0
Total	298,377	817		977	160		2,760	2,420

Costs Allocated

	Total	Base	Max Day	Max Hour
		40.00%	2.00%	58.00%
Operation & Maint	$642,836	$257,134	$12,857	$372,845
Depreciation	253,604	101,442	5,072	147,090
Taxes	468,192	187,277	9,364	271,552
Return	932,668	373,067	18,653	540,948
	$2,297,301	$918,920	$45,946	$1,332,434

Unit Cost		Base	Max Day	Max Hour
Number		298,377	160	2,420
Units		(1000 gal)	(1000 gal)	(1000 gal)
Operation & Maint	$642,836	$0.862	$80.488	$154.063
Depreciation	253,604	0.340	31.753	60.779
Taxes	468,192	0.628	58.621	112.208
Return	932,668	1.250	116.777	223.525
	$2,297,301	$3.080	$287.638	$550.575

Cost Distribution to Customer Classes

	Base	Max Day	Max Hour	Total	Rate
Unit costs of service	$3.080	$287.638	$550.575		
Residential					
Units	163,984	270	1,550		
Allocated Cost	$505,026	$77,537	$853,384	$1,435,947	$8.76
			Cost per 65,000 gallons		$569.18

Table K-33
Water Rates
Existing Contract Option
Pleasant Prairie Local Rates - 2010

Retail Class	Annual Vol (1000 gal)	Average Day (1000 gal)	Max Day Capacity Factor	Max Day (1000 gal)	Extra Capacity (1000 gal)	Max Hour Capacity Factor	Max Hour (1000 gal)	Extra Capacity (1000 gal)
Residential	907,332	2,486	160%	3,977	1,492	445%	11,062	8,576
Commercial	463,514	1,270	125%	1,587	317	360%	4,572	4,254
Industrial	621,368	1,702	50%	851	-851	150%	2,554	3,405
Public	14,344	39	125%	49	10	360%	141	132
	2,006,558	5,497		6,465	968		18,329	16,367
Wholesale		0	170%	0	0	450%	0	0
Total	2,006,558	5,497		6,465	968		18,329	16,367

Costs Allocated

	Total	Base	Max Day	Max Hour
		40.00%	2.00%	58.00%
Operation & Maint	$670,113	$268,045	$13,402	$388,665
Depreciation	337,879	135,152	6,758	195,970
Taxes	623,777	249,511	12,476	361,791
Return	1,386,458	554,583	27,729	804,146
	$3,018,227	$1,207,291	$60,365	$1,750,572

Unit Cost		Base	Max Day	Max Hour
Number		2,006,558	968	16,367
Units		(1000 gal)	(1000 gal)	(1000 gal)
Operation & Maint	$670,113	$0.134	$13.851	$23.747
Depreciation	337,879	0.067	6.984	11.974
Taxes	623,777	0.124	12.893	22.105
Return	1,386,458	0.276	28.657	49.133
	$3,018,227	$0.602	$62.385	$106.959

Cost Distribution to Customer Classes

	Base	Max Day	Max Hour	Total	Rate
Unit costs of service	$0.602	$62.385	$106.959		
Residential					
Units	907,332	1,492	8,576		
Allocated Cost	$545,917	$93,047	$917,298	$1,556,262	$1.72
				Cost per 65,000 gal	$111.49

Table K-34
Water Rates
Existing Contract Option
Somers Local Rates - 1995

Retail Class	Annual Vol (1000 gal)	Average Day (1000 gal)	Max Day Capacity Factor	Max Day (1000 gal)	Extra Capacity (1000 gal)	Max Hour Capacity Factor	Max Hour (1000 gal)	Extra Capacity (1000 gal)
Residential	14,355	39	160%	63	24	445%	175	136
Commercial	24,381	67	125%	83	17	360%	240	224
Industrial	0	0	50%	0	0	150%	0	0
Public	113,635	311	125%	389	78	360%	1,121	1,043
	152,371	417		536	118		1,536	1,402
Wholesale		0	170%	0	0	450%	0	0
Total	152,371	417		536	118		1,536	1,402

Costs Allocated

	Total	Base	Max Day	Max Hour
		40.00%	2.00%	58.00%
Operation & Maint	$47,483	$18,993	$950	$27,540
Depreciation	73,461	29,384	1,469	42,607
Taxes	135,619	54,248	2,712	78,659
Return	389,496	155,798	7,790	225,908
	$646,059	$258,424	$12,921	$374,714

Unit Cost		Base	Max Day	Max Hour
Number		152,371	118	1,402
Units		(1000 gal)	(1000 gal)	(1000 gal)
Operation & Maint	$47,483	$0.125	$8.039	$19.638
Depreciation	73,461	0.193	12.437	30.381
Taxes	135,619	0.356	22.961	56.089
Return	389,496	1.022	65.944	161.086
	$646,059	$1.696	$109.382	$267.194

Cost Distribution to Customer Classes

	Base	Max Day	Max Hour	Total	Rate
Unit costs of service	$1.696	$109.382	$267.194		
Residential					
Units	14,355	24	136		
Allocated Cost	$24,347	$2,581	$36,255	$63,183	$4.40
			Cost per 65,000 gallons		$286.09

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Table K-35
Water Rates
Existing Contract Option
Somers Local Rates - 2010

Retail Class	Annual Vol (1000 gal)	Average Day (1000 gal)	Max Day Capacity Factor	Max Day (1000 gal)	Extra Capacity (1000 gal)	Max Hour Capacity Factor	Max Hour (1000 gal)	Extra Capacity (1000 gal)
Residential	282,846	775	160%	1,240	465	445%	3,448	2,673
Commercial	63,608	174	125%	218	44	360%	627	584
Industrial	81,892	224	50%	112	-112	150%	337	449
Public	12,850	35	125%	44	9	360%	127	118
	441,196	1,209		1,614	405		4,539	3,824
Wholesale		0	170%	0	0	450%	0	0
Total	441,196	1,209		1,614	405		4,539	3,824

Costs Allocated

	Total	Base	Max Day	Max Hour
		40.00%	2.00%	58.00%
Operation & Maint	$59,074	$23,630	$1,181	$34,263
Depreciation	98,125	39,250	1,963	56,913
Taxes	181,155	72,462	3,623	105,070
Return	522,307	208,923	10,446	302,938
	$860,661	$344,264	$17,213	$499,183

Unit Cost		Base	Max Day	Max Hour
Number		441,196	405	3,824
Units		(1000 gal)	(1000 gal)	(1000 gal)
Operation & Maint	$59,074	$0.054	$2.916	$8.960
Depreciation	98,125	0.089	4.844	14.883
Taxes	181,155	0.164	8.943	27.477
Return	522,307	0.474	25.784	79.221
	$860,661	$0.780	$42.487	$130.542

Cost Distribution to Customer Classes

	Base	Max Day	Max Hour	Total	Rate
Unit costs of service	$0.780	$42.487	$130.542		
Residential					
Units	282,846	465	2,673		
Allocated Cost	$220,704	$19,754	$349,000	$589,458	$2.08
				Cost per 65,000 gal	$135.46

Table K-36
Water Rates
Existing Contract Option
Bristol Local Rates - 1995

Retail Class	Annual Vol (1000 gal)	Average Day (1000 gal)	Max Day Capacity Factor	Max Day (1000 gal)	Extra Capacity (1000 gal)	Max Hour Capacity Factor	Max Hour (1000 gal)	Extra Capacity (1000 gal)
Residential		0	160%	0	0	445%	0	0
Commercial	32,700	90	125%	112	22	360%	323	300
Industrial	0	0	50%	0	0	150%	0	0
Public		0	125%	0	0	360%	0	0
	32,700	90		112	22		323	300
Wholesale		0	170%	0	0	450%	0	0
Total	32,700	90		112	22		323	300

Costs Allocated

	Total	Base	Max Day	Max Hour
		40.00%	2.00%	58.00%
Operation & Maint	$32,169	$12,867	$643	$18,658
Depreciation	26,467	10,587	529	15,351
Taxes	48,862	19,545	977	28,340
Return	109,289	43,716	2,186	63,388
	$216,786	$86,714	$4,336	$125,736

Unit Cost		Base	Max Day	Max Hour
Number		32,700	22	300
Units		(1000 gal)	(1000 gal)	(1000 gal)
Operation & Maint	$32,169	$0.394	$28.726	$62.167
Depreciation	26,467	0.324	23.634	51.148
Taxes	48,862	0.598	43.632	94.427
Return	109,289	1.337	97.592	211.206
	$216,786	$2.652	$193.583	$418.948

Cost Distribution to Customer Classes

	Base	Max Day	Max Hour	Total	Rate
Unit costs of service	$2.652	$193.583	$418.948		
Commercial					
Units	32,700	22	300		
Allocated Cost	$86,714	$4,336	$125,736	$216,786	$6.63
				Cost per 65,000 gal	$430.92

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Table K-37
Water Rates
Existing Contract Option
Bristol Local Rates - 2010

Retail Class	Annual Vol (1000 gal)	Average Day (1000 gal)	Max Day Capacity Factor	Max Day (1000 gal)	Extra Capacity (1000 gal)	Max Hour Capacity Factor	Max Hour (1000 gal)	Extra Capacity (1000 gal)
Residential		0	160%	0	0	445%	0	0
Commercial	271,195	743	125%	929	186	360%	2,675	2,489
Industrial	0	0	50%	0	0	150%	0	0
Public		0	125%	0	0	360%	0	0
	271,195	743		929	186		2,675	2,489
Wholesale		0	170%	0	0	450%	0	0
Total	271,195	743		929	186		2,675	2,489

Costs Allocated

	Total	Base	Max Day	Max Hour
		40.00%	2.00%	58.00%
Operation & Maint	$33,772	$13,509	$675	$19,588
Depreciation	35,250	14,100	705	20,445
Taxes	65,077	26,031	1,302	37,744
Return	156,583	62,633	3,132	90,818
	$290,682	$116,273	$5,814	$168,596

Unit Cost		Base	Max Day	Max Hour
Number		271,195	186	2,489
Units		(1000 gal)	(1000 gal)	(1000 gal)
Operation & Maint	$33,772	$0.050	$3.636	$7.870
Depreciation	35,250	0.052	3.795	8.214
Taxes	65,077	0.096	7.007	15.164
Return	156,583	0.231	16.860	36.487
	$290,682	$0.429	$31.298	$67.735

Cost Distribution to Customer Classes

	Base	Max Day	Max Hour	Total	Rate
Unit costs of service	$0.429	$31.298	$67.735		
Commercial					
Units	271,195	186	2,489		
Allocated Cost	$116,273	$5,814	$168,596	$290,682	$1.07
				Cost per 65,000 gal	$69.67

Table K-38
Water Rates
Modified Contract Option
Kenosha Local Rates - 1995

Retail Class	Annual Vol (1000 gal)	Average Day (1000 gal)	Max Day Capacity Factor	Max Day (1000 gal)	Extra Capacity (1000 gal)	Max Hour Capacity Factor	Max Hour (1000 gal)	Extra Capacity (1000 gal)
Residential	1,890,221	5,179	160%	8,286	3,107	445%	23,045	17,866
Commercial	770,402	2,111	125%	2,638	528	360%	7,598	7,071
Industrial	1,677,610	4,596	50%	2,298	-2,298	150%	6,894	9,192
Public	168,002	460	125%	575	115	360%	1,657	1,542
	4,506,235	12,346		13,798	1,452		39,195	35,672
Wholesale	350,455	960	170%	1,632	672	450%	4,321	3,649
Total	4,856,690	13,306		15,430	2,124		43,516	39,320

Costs Allocated

	Total	Base	Max Day	Max Hour
		40.00%	2.00%	58.00%
Operation & Maint	$2,804,600	$1,121,840	$56,092	$1,626,668
Depreciation	622,854	249,142	12,457	361,255
Taxes	1,149,884	459,954	22,998	666,933
Return	1,897,072	758,829	37,941	1,100,301
	$6,474,410	$2,589,764	$129,488	$3,755,158

Unit Cost		Base	Max Day	Max Hour
Number		4,856,690	2,124	39,320
Units		(1000 gal)	(1000 gal)	(1000 gal)
Operation & Maint	$2,804,600	$0.231	$26.409	$41.370
Depreciation	622,854	0.051	5.865	9.188
Taxes	1,149,884	0.095	10.828	16.962
Return	1,897,072	0.156	17.863	27.983
	$6,474,410	$0.533	$60.965	$95.502

Cost Distribution to Customer Classes

	Base	Max Day	Max Hour	Total	Rate
Unit costs of service	$0.533	$60.965	$95.502		
Residential					
Units	1,890,221	3,107	17,866		
Allocated Cost	$1,007,935	$189,432	$1,706,285	$2,903,652	$1.54
			Cost per 65,000 gallons		$99.85
Wholesale					
Units	350,455	672	3,649		
Allocated Cost	$186,875	$40,975	$348,446	$576,297	$1.64
			Cost per 65,000 gallons		$106.89

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Table K-39
Water Rates
Modified Contract Option
Kenosha Local Rates - 2010

Retail Class	Annual Vol (1000 gal)	Average Day (1000 gal)	Max Day Capacity Factor	Max Day (1000 gal)	Extra Capacity (1000 gal)	Max Hour Capacity Factor	Max Hour (1000 gal)	Extra Capacity (1000 gal)
Residential	2,035,900	5,578	160%	8,924	3,347	445%	24,821	19,243
Commercial	1,010,400	2,768	125%	3,460	692	360%	9,966	9,274
Industrial	1,535,600	4,207	50%	2,104	-2,104	150%	6,311	8,414
Public	156,200	428	125%	535	107	360%	1,541	1,434
	4,738,100	12,981		15,023	2,042		42,638	38,365
Wholesale	2,739,655	7,506	170%	12,760	5,254	450%	33,777	28,522
Total	7,477,755	20,487		27,783	7,296		76,415	66,887

Costs Allocated

	Total	Base 40.00%	Max Day 2.00%	Max Hour 58.00%
Operation & Maint	$3,242,611	$1,297,044	$64,852	$1,880,714
Depreciation	683,694	273,478	13,674	396,542
Taxes	1,262,204	504,882	25,244	732,078
Return	2,224,672	889,869	44,493	1,290,309
	$7,413,181	$2,965,272	$148,264	$4,299,645

Unit Cost		Base	Max Day	Max Hour
Number		7,477,755	7,296	66,887
Units		(1000 gal)	(1000 gal)	(1000 gal)
Operation & Maint	$3,242,611	$0.173	$8.888	$28.118
Depreciation	683,694	0.037	1.874	5.929
Taxes	1,262,204	0.068	3.460	10.945
Return	2,224,672	0.119	6.098	19.291
	$7,413,181	$0.397	$20.320	$64.282

Cost Distribution to Customer Classes

	Base	Max Day	Max Hour	Total	Rate
Unit costs of service	$0.397	$20.320	$64.282		
Residential					
Units	2,035,900	3,347	19,243		
Allocated Cost	$807,328	$68,006	$1,237,006	$2,112,339	$1.04
Wholesale			Cost per 65,000 gallons		$67.44
Units	2,739,655	5,254	28,522		
Allocated Cost	$1,086,399	$106,766	$1,833,478	$3,026,643	$1.10
			Cost per 65,000 gallons		$71.81

Table K-40
Water Rates
Modified Contract Option
Pleasant Prairie Local Rates - 1995

Retail Class	Annual Vol (1000 gal)	Average Day (1000 gal)	Max Day Capacity Factor	Max Day (1000 gal)	Extra Capacity (1000 gal)	Max Hour Capacity Factor	Max Hour (1000 gal)	Extra Capacity (1000 gal)
Residential	163,984	449	160%	719	270	445%	1,999	1,550
Commercial	33,986	93	125%	116	23	360%	335	312
Industrial	98,247	269	50%	135	-135	150%	404	538
Public	2,160	6	125%	7	1	360%	21	20
	298,377	817		977	160		2,760	2,420
Wholesale		0	170%	0	0	450%	0	0
Total	298,377	817		977	160		2,760	2,420

Costs Allocated

	Total	40.00% Base	2.00% Max Day	58.00% Max Hour
Operation & Maint	$656,359	$262,544	$13,127	$380,688
Depreciation	224,984	89,994	4,500	130,491
Taxes	415,355	166,142	8,307	240,906
Return	778,560	311,424	15,571	451,565
	$2,075,259	$830,103	$41,505	$1,203,650

Unit Cost		Base	Max Day	Max Hour
Number		298,377	160	2,420
Units		(1000 gal)	(1000 gal)	(1000 gal)
Operation & Maint	$656,359	$0.880	$82.181	$157.304
Depreciation	224,984	0.302	28.170	53.920
Taxes	415,355	0.557	52.005	99.545
Return	778,560	1.044	97.481	186.591
	$2,075,259	$2.782	$259.837	$497.360

Cost Distribution to Customer Classes

	Base	Max Day	Max Hour	Total	Rate
Unit costs of service	$2.782	$259.837	$497.360		
Residential					
Units	163,984	270	1,550		
Allocated Cost	$456,214	$70,042	$770,901	$1,297,158	$7.91
			Cost per 65,000 gallons		$514.17

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Table K-41
Water Rates
Modified Contract Option
Pleasant Prairie Local Rates - 2010

Retail Class	Annual Vol (1000 gal)	Average Day (1000 gal)	Max Day Capacity Factor	Max Day (1000 gal)	Extra Capacity (1000 gal)	Max Hour Capacity Factor	Max Hour (1000 gal)	Extra Capacity (1000 gal)
Residential	907,332	2,486	160%	3,977	1,492	445%	11,062	8,576
Commercial	463,514	1,270	125%	1,587	317	360%	4,572	4,254
Industrial	621,368	1,702	50%	851	-851	150%	2,554	3,405
Public	14,344	39	125%	49	10	360%	141	132
	2,006,558	5,497		6,465	968		18,329	16,367
Wholesale		0	170%	0	0	450%	0	0
Total	2,006,558	5,497		6,465	968		18,329	16,367

Costs Allocated

	Total	40.00% Base	2.00% Max Day	58.00% Max Hour
Operation & Maint	$672,195	$268,878	$13,444	$389,873
Depreciation	286,436	114,574	5,729	166,133
Taxes	528,805	211,522	10,576	306,707
Return	1,109,455	443,782	22,189	643,484
	$2,596,890	$1,038,756	$51,938	$1,506,196

Unit Cost		Base	Max Day	Max Hour
Number		2,006,558	968	16,367
Units		(1000 gal)	(1000 gal)	(1000 gal)
Operation & Maint	$672,195	$0.134	$13.894	$23.821
Depreciation	286,436	0.057	5.920	10.151
Taxes	528,805	0.105	10.930	18.740
Return	1,109,455	0.221	22.932	39.317
	$2,596,890	$0.518	$53.676	$92.028

Cost Distribution to Customer Classes

	Base	Max Day	Max Hour	Total	Rate
Unit costs of service	$0.518	$53.676	$92.028		
Residential					
Units	907,332	1,492	8,576		
Allocated Cost	$469,708	$80,058	$789,246	$1,339,012	$1.48
			Cost per 65,000 gallons		$95.92

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Table K-42
Water Rates
Modified Contract Option
Somers Local Rates - 1995

Retail Class	Annual Vol (1000 gal)	Average Day (1000 gal)	Max Day Capacity Factor	Max Day (1000 gal)	Extra Capacity (1000 gal)	Max Hour Capacity Factor	Max Hour (1000 gal)	Extra Capacity (1000 gal)
Residential	14,355	39	160%	63	24	445%	175	136
Commercial	24,381	67	125%	83	17	360%	240	224
Industrial	0	0	50%	0	0	150%	0	0
Public	113,635	311	125%	389	78	360%	1,121	1,043
	152,371	417		536	118		1,536	1,402
Wholesale		0	170%	0	0	450%	0	0
Total	152,371	417		536	118		1,536	1,402

Costs Allocated

	Total	40.00% Base	2.00% Max Day	58.00% Max Hour
Operation & Maint	$10,675	$4,270	$214	$6,192
Depreciation	53,850	21,540	1,077	31,233
Taxes	99,416	39,766	1,988	57,661
Return	283,903	113,561	5,678	164,664
	$447,845	$179,138	$8,957	$259,750

Unit Cost		Base	Max Day	Max Hour
Number		152,371	118	1,402
Units		(1000 gal)	(1000 gal)	(1000 gal)
Operation & Maint	$10,675	$0.028	$1.807	$4.415
Depreciation	53,850	0.141	9.117	22.271
Taxes	99,416	0.261	16.832	41.116
Return	283,903	0.745	48.066	117.415
	$447,845	$1.176	$75.823	$185.217

Cost Distribution to Customer Classes

	Base	Max Day	Max Hour	Total	Rate
Unit costs of service	$1.176	$75.823	$185.217		
Residential					
Units	14,355	24	136		
Allocated Cost	$16,877	$1,789	$25,132	$43,798	$3.05
			Cost per 65,000 gallons		$198.31

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Table K-43
Water Rates
Modified Contract Option
Somers Local Rates - 2010

Retail Class	Annual Vol (1000 gal)	Average Day (1000 gal)	Max Day Capacity Factor	Max Day (1000 gal)	Extra Capacity (1000 gal)	Max Hour Capacity Factor	Max Hour (1000 gal)	Extra Capacity (1000 gal)
Residential	282,846	775	160%	1,240	465	445%	3,448	2,673
Commercial	63,608	174	125%	218	44	360%	627	584
Industrial	81,892	224	50%	112	-112	150%	337	449
Public	12,850	35	125%	44	9	360%	127	118
	441,196	1,209		1,614	405		4,539	3,824
Wholesale		0	170%	0	0	450%	0	0
Total	441,196	1,209		1,614	405		4,539	3,824

Costs Allocated

	Total	40.00% Base	2.00% Max Day	58.00% Max Hour	
Operation & Maint	56,986	22,794	1,140	33,052	
Depreciation	88,766	35,506	1,775	51,484	
Taxes	163,875	65,550	3,278	95,048	
Return	471,909	188,764	9,438	273,707	
	781,536	312,615	15,631	453,291	781,536

Unit Cost

		Base	Max Day	Max Hour
Number		441,196	405	3,824
Units		(1000 gal)	(1000 gal)	(1000 gal)
Operation & Maint	56,986	0.052	2.813	8.643
Depreciation	88,766	0.080	4.382	13.464
Taxes	163,875	0.149	8.090	24.856
Return	471,909	0.428	23.296	71.577
	781,536	0.709	38.581	118.540

Cost Distribution to Customer Classes

	Base	Max Day	Max Hour	Total	Rate
Unit costs of service	0.709	38.581	118.540		
Residential					
Units	282,846	465	2,673		
Allocated Cost	$200,414	$17,938	$316,915	$535,266	$1.89
			Cost per 65,000 gallons		$123.01

Table K-44
Water Rates
Modified Contract Option
Bristol Local Rates - 1995

Retail Class	Annual Vol (1000 gal)	Average Day (1000 gal)	Max Day Capacity Factor	Max Day (1000 gal)	Extra Capacity (1000 gal)	Max Hour Capacity Factor	Max Hour (1000 gal)	Extra Capacity (1000 gal)
Residential		0	160%	0	0	445%	0	0
Commercial	32,700	90	125%	112	22	360%	323	300
Industrial	0	0	50%	0	0	150%	0	0
Public		0	125%	0	0	360%	0	0
	32,700	90		112	22		323	300
Wholesale		0	170%	0	0	450%	0	0
Total	32,700	90		112	22		323	300

Costs Allocated

	Total	40.00% Base	2.00% Max Day	58.00% Max Hour
Operation & Maint	$25,600	$10,240	$512	$14,848
Depreciation	17,849	7,140	357	10,352
Taxes	32,952	13,181	659	19,112
Return	62,886	25,155	1,258	36,474
	$139,287	$55,715	$2,786	$80,787

Unit Cost		Base	Max Day	Max Hour
Number		32,700	22	300
Units		(1000 gal)	(1000 gal)	(1000 gal)
Operation & Maint	$25,600	$0.313	$22.860	$49.473
Depreciation	17,849	0.218	15.939	34.494
Taxes	32,952	0.403	29.425	63.681
Return	62,886	0.769	56.155	121.530
	$139,287	$1.704	$124.379	$269.178

Cost Distribution to Customer Classes

	Base	Max Day	Max Hour	Total	Rate
Unit costs of service	$1.704	$124.379	$269.178		
Commercial					
Units	32,700	22	300		
Allocated Cost	$55,715	$2,786	$80,787	$139,287	$4.26
			Cost per 65,000 gallons		$276.87

Table K-45
Water Rates
Modified Contract Option
Bristol Local Rates - 2010

Retail Class	Annual Vol (1000 gal)	Average Day (1000 gal)	Max Day Capacity Factor	Max Day (1000 gal)	Extra Capacity (1000 gal)	Max Hour Capacity Factor	Max Hour (1000 gal)	Extra Capacity (1000 gal)
Residential		0	160%	0	0	445%	0	0
Commercial	271,195	743	125%	929	186	360%	2,675	2,489
Industrial	0	0	50%	0	0	150%	0	0
Public		0	125%	0	0	360%	0	0
	271,195	743		929	186		2,675	2,489
Wholesale		0	170%	0	0	450%	0	0
Total	271,195	743		929	186		2,675	2,489

Costs Allocated

	Total	40.00% Base	2.00% Max Day	58.00% Max Hour
Operation & Maint	$25,600	$10,240	$512	$14,848
Depreciation	17,849	7,140	357	10,352
Taxes	32,952	13,181	659	19,112
Return	62,886	25,155	1,258	36,474
	$139,287	$55,715	$2,786	$80,787

Unit Cost		Base	Max Day	Max Hour
Number		271,195	186	2,489
Units		(1000 gal)	(1000 gal)	(1000 gal)
Operation & Maint	$25,600	$0.038	$2.756	$5.965
Depreciation	17,849	0.026	1.922	4.159
Taxes	32,952	0.049	3.548	7.678
Return	62,886	0.093	6.771	14.654
	$139,287	$0.205	$14.997	$32.457

Cost Distribution to Customer Classes

	Base	Max Day	Max Hour	Total	Rate
Unit costs of service	$0.205	$14.997	$32.457		
Commercial					
Units	271,195	186	2,489		
Allocated Cost	$55,715	$2,786	$80,787	$139,287	$0.51
			Cost per 65,000 gallons		$33.38