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United States
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Chicago, Illinois 60604

November, 1980

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Environmental Impact Statement Draft

Milwaukee Metropolitan Sewerage District

Water Pollution Abatement Program

Appendix VI
Local Alternatives
Appendix VII
Water Quality

DRAFT ENVIRONMENTAL IMPACT STATEMENT

MILWAUKEE METROPOLITAN SEWERAGE DISTRICT
WATER POLLUTION ABATEMENT PROGRAM

Prepared by the

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION V

CHICAGO, ILLINOIS

and

WISCONSIN DEPARTMENT OF NATURAL RESOURCES

MADISON, WISCONSIN

with the assistance of

ESEI - ECOLSCIENCES ENVIRONMENTAL GROUP

MILWAUKEE, WISCONSIN

November 1980

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MILWAUKEE METROPOLITAN SEWERAGE DISTRICT

WATER POLLUTION ABATEMENT PROGRAM

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NOVEMBER 1980

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INTRODUCTION

1.0 INTRODUCTION

This document is an appendix to the Environmental Impact Statement (EIS) for the Milwaukee Water Pollution Abatement Program (MWPAP). The main body of the EIS describes, generally, the reasons why Milwaukee needs a pollution abatement program, the purposes of the program, the development and evaluation of possible actions for the abatement of sewage-related pollution, and how those alternative actions would affect the natural and man-made environments.

The central planning document of the MWPAP is the Wastewater System Plan (WSP). The areawide planning process of the WSP was the first step in the total planning process of the MWPAP. This step identified general concepts for sewage treatment in the planning area. General locations for wastewater treatment plant (WWTPs), interceptors, and storage facilities were determined based on the location and condition of existing facilities, anticipated population growth, and land availability.

The WSP considered three approaches (local, subregional and regional) for providing sewer service to the MWPAP planning area. In the main body of the EIS the various treatment and conveyance alternatives for each approach or system-level were evaluated. It was concluded that no subregional alternatives were acceptable because of high costs and adverse environmental impacts. Local and regional alternatives were determined to be feasible.

The key difference between the local and regional system-levels would be the number of communities or agencies operating WWTPs in the planning area. Currently there are eight management agencies and eight private institutions operating WWTPs that discharge treated effluent to surface waters or to land. The eight management agencies are listed below:

- Caddy Vista Sanitary District
- Village of Germantown
- Milwaukee Metropolitan Sewerage District (MMSD)
- Village of Menomonee Falls
- City of Muskego
- City of New Berlin
- City of South Milwaukee
- Village of Thiensville

The eight private WWTPs are listed below with the community in which they are located:

- Wisconsin Electric Power Company, Oak Creek
- School Sisters of Notre Dame, Mequon
- Chalet-on-the-Lake Restaurant, Mequon

- Muskego Rendering Company, Muskego
- Highway 100 Drive-in Theater, Franklin
- St. Martins Road Truck Stop, Franklin
- Cleveland Heights Grade School, New Berlin
- New Berlin Memorial Hospital, New Berlin

Under the local system-level each of the above agencies and institutions would continue to operate and finance their own treatment facilities. The regional system-level would involve the abandonment of all of the WWTPs in the planning area except those operated by the MMSD. Conveyance systems would be built to connect the sewage flows from the abandoned WWTPs to the MMSD. The Jones Island and South Shore WWTPs would be operated by the MMSD under both the local and regional system-levels. The proposed actions at both of these plants are discussed in separate appendices.

1.1 Purpose

The purpose of this Local Alternatives Appendix is to discuss the seven management agencies and eight institutions currently not receiving sewer service from the MMSD and assess how both the local and regional system-levels affect each agency and business as well as the total planning area. This appendix includes descriptions of the existing WWTPs, the alternatives for continued local sewage treatment, and the alternatives for connection of the local service areas of the seven agencies and eight institutions to the MMSD.

The initial alternatives for each of the management agencies and private institutions were proposed by the MWPAP. The EIS study team reviewed this list of alternatives. Next, separate MWPAP and EIS analyses of environmental impacts, costs, and technical feasibility were done. These analyses were done primarily with MWPAP data, but were also independently verified with separate EIS data. The data and conclusions in this appendix are based on the conclusions of the EIS study team based on its review of the MWPAP planning process and additional independent analysis. A detailed description of the methodology used for the EIS analysis is presented in Chaper 2.

1.1.1. Assumptions

There were a number of assumptions made by the MWPAP and by the EIS study team with respect to the evaluation of alternatives for the eight management agencies and the eight private WWTPs which had a direct impact on the conclusions presented in this appendix. These assumptions are outlined below:

- The WSP planning area analysis was done by the MWPAP on a conceptual basis only. The alternatives evaluated by the MWPAP were developed based on typical state-of-the-art wastewater treatment processes and were not intended to represent all of the possible means of meeting specific levels of treatment.

- Because the WWTP and sewer connection alternatives were not identified in the Notices of Intent to prepare an Environmental Impact Statement, the EIS analysis presented in this appendix was also done on a conceptual level only. After a final local or regional approach for each agency is approved by EPA and DNR, a detailed facilities plan and environmental assessment will be prepared prior to the design and construction of any facilities.

- The MWPAP assumed that the marginal increased cost to the MMSD to treat additional wastewater flows from the local management agencies was insignificant. The implications of this assumption are discussed in this appendix.

- The EIS and this appendix evaluated water quality impacts with respect to existing DNR water quality goals. The MWPAP evaluated water quality impacts with respect to the future goals recommended by the regional 208 planning agency, the Southeastern Wisconsin Regional Planning Commission (SEWRPC). In general the recommended 208 water quality goals are more stringent than the existing DNR goals. Consequently, there are alternatives in which the MWPAP has concluded that water quality goals would not be met whereas the EIS has concluded that they would. These differences are noted in the discussion of the alternatives.

- The costs presented in this appendix are costs developed by the MMSD except for alternatives which were evaluated only in the EIS. All MMSD costs were reviewed by the EIS study team and were found to be consistent with published EPA cost data. However, there are instances when final cost estimates are much higher than preliminary costs. The impact of this situation is discussed in this appendix.

1.2 Background

The seven local sewage management agencies not served by the MMSD currently operate nine WWTPs. These plants are listed below:

- Caddy Vista WWTP
- Germantown WWTP
- Menomonee Falls Riverside WWTP

- Menomonee Falls Parkview WWTP
- Muskego Northeast WWTP
- Muskego Northwest WWTP
- New Berlin Regal Manors WWTP
- South Milwaukee WWTP
- Thiensville WWTP

The two Menomonee Falls treatment plants will soon be abandoned because of previously approved construction of interceptors that will connect the Menomonee Falls service area to the MMSD. For this reason Menomonee Falls sewer service will not be discussed further in this appendix.

There are other private wastewater treatment facilities in the planning area besides the eight listed earlier. However, the eight facilities being evaluated in this appendix discharge to waters of the State of Wisconsin and thus require Wisconsin Pollution Discharge Elimination System (WPDES) permits.

In June 1979 SEWRPC completed Planning Report No. 30, A Regional Water Quality Management Plan for Southeastern Wisconsin: 2000 (commonly referred to as the 208 Plan). The 208 Plan made a number of recommendations with respect to the continued operation of both the public and private WWTPs in the MMSD planning area. The Plan recommended the abandonment of all public WWTPs except the Jones Island and South Shore WWTPs operated by the MMSD and the City of South Milwaukee WWTP. It was recommended that all eight private WWTPs be abandoned.

The 208 Plan recognized the fact that the MWPAP would reevaluate many of the recommendations made in the 208 Plan, especially recommendations relating to the abandonment of local public and private WWTPs. Specifically, the 208 Plan called for further analysis of the WEPCO WWTP because the location of this plant could make abandonment much more costly than continued operation. Detailed analysis of the other public and private WWTPs in the planning area could also result in conclusions which differ from those presented in the 208 plan. The final MWPAP facility plan upon its adoption by the EPA and the DNR will serve as an amendment to the 208 plan.

1.3 Alternatives

Plant documents were reviewed by the MWPAP to determine each public and private plant's process train, design size, average and peak flows, and effluent characteristics. Onsite investigations were carried out for all of the public plants except South Milwaukee. These investigations were used to assess the general condition of each plant and to identify any structural problems. Community records and infiltration/inflow studies were also examined in order to evaluate the conveyance system to each WWTP.

The EIS study team reviewed the documents prepared by the MWPAP. A full list of references is included at the end of this appendix. The EIS study team also visited each public WWTP except South Milwaukee.

After the existing conditions of each WWTP had been assessed, an evaluation was made of the steps necessary to enable the facility to treat future wastewater flows to the levels specified by DNR as tentative effluent limits for the planning period (1985-2005). No bypassing of inadequately treated wastewater would be permitted. Seven alternatives were developed:

- No Action - The WWTP would continue operation with no major renovations. Existing operation and maintenance (O&M) procedures would be followed.

- Upgrade Operations and Maintenance (O&M) - The WWTP would continue to operate using existing processes, but O&M would be improved by training personnel or improving O&M procedures.

- Expand Existing Plant - By adding new equipment and processes, similar to those already in place, the capacity of the WWTP would be expanded. This alternative would assume the optimization of O&M procedures.

- Upgrade Treatment and Discharge to the Fox River Basin - Every public local WWTP was evaluated for the feasibility of discharging effluent to the Fox River Basin. Feasibility was based on the size of the WWTP and the distance to a suitable discharge location. If discharge was feasible, the new processes required to enable the plant to meet the effluent standards necessary for discharge to the Fox River basin were determined. For WWTPs now discharging to the Lake Michigan basin, this evaluation included the cost and environmental acceptability of constructing conveyance facilities to a new discharge site in the Fox River basin.

- Upgrade Treatment and Discharge to the Lake Michigan Basin - A similar evaluation was made to determine the feasibility of discharging WWTP effluent to the Lake Michigan Basin. For WWTPs where discharge was feasible, the new processes required to enable the plant to meet the effluent standards for discharge to the Lake Michigan basin were determined. For WWTPs now discharging effluent to waters in the Fox River basin, the evaluation included the cost and environmental acceptability of constructing conveyance facilities to a new Lake Michigan basin discharge site.

- Land Application of Effluent - For each WWTP, the cost, technical feasibility, and environmental impacts of developing land application treatment processes were determined. Four application alternatives were evaluated: high rate irrigation, normal rate irrigation, infiltration/percolation, and marsh application.

- Recycle and Reuse of Effluent - Consideration was also given to the possibility of treating wastewater to such levels that the effluent could be used by industry or recreational facilities.

Each WWTP was evaluated for all of these alternatives to determine the steps necessary to meet the future effluent standards established by the DNR. Also determined was the amount, availability and location of land necessary for WWTP expansion or for application of effluent; the cost of each alternative; and the environmental impacts of each alternative.

1.3.1 Surface Discharge Alternatives

For treatment plants discharging to surface waters, analyses were also conducted to ensure that the receiving waters would meet DNR water quality goals. Receiving water goals for all waters in the planning area are listed on Table 1-1. Secondary level treatment is always required and in some cases advanced secondary treatment (AST) would also be required for discharge to surface waters.

Secondary treatment is defined by EPA in Program Requirements Memorandum PRM No. 79-7 as a treatment level meeting effluent limits for 5-day biochemical oxygen demand (BOD_5) and suspended solids (SS) of 30/30 mg/l on a maximum monthly basis or 85 percent removal of these parameters, whichever is more stringent. Advanced secondary treatment refers to a treatment level meeting effluent limits for BOD_5/SS between 30/30 and 10/10 mg/l on a maximum monthly average, effluent limits which call for ammonia removal, or effluent limits which require both. Advanced waste treatment (AWT) is treatment meeting effluent limits for BOD_5/SS less than 10/10 mg/l on a maximum monthly average, effluent limits which provide for a total nitrogen removal of greater than 50 percent, or effluent limits which require both. The specific effluent limits are listed for each WWTP.

1.3.2 Land Application Alternatives

The four land application alternatives are very different in their application methods and effluent limits. Infiltration/percolation systems would employ a pond in highly permeable soil where biological and chemical action would occur.

TABLE 1-1

DNR Water Use Objectives

Surface Water	Contributing Local WWTP	Water Use Objectives At WWTP
Milwaukee River	Thiensville	Recreational use, Warm-water fishery and aquatic life
Menomonee River	Germantown	Recreational use, Warm-water fishery and aquatic life
Root River	Caddy Vista	Recreational use, Warm-water fishery and aquatic life
Tess Corners Creek	Muskego Northeast	Recreational use, Intermediate aquatic life
Deer Creek	New Berlin Regal Manors	Marginal use
Lake Michigan	South Milwaukee	Recreational use, Cold-water fishery and aquatic life Public water supply

Source: DNR and ESEI

The water would then infiltrate the groundwater aquifer. The size and loading rate to the infiltration/percolation pond would depend on the type and permeability of the soil. Effluent could be applied year round.

Two of the land application alternatives involve high rate and normal rate irrigation of crop land. Nutrients found in municipal wastewater have been found to be beneficial to crops. However, because pathogens may be present, wastewater irrigation is not allowed for crops that would be eaten raw. The presence of certain pollutants in the effluent would preclude the use of this system on crops whose edible parts easily accept toxic substances. The rate of irrigation would depend on the permeability of the soil and the level of saturation allowable for growth of the crop. These types of treatment would not be feasible during the nongrowing season. Storage facilities large enough to store effluent for seven months between growing seasons would be required.

Effluent treated by infiltration/percolation and both high and normal rate irrigation requires pretreatment by a secondary type treatment process. The effluent limits for this pretreatment, as set by subsection NR 214.07 (3) of the Wisconsin Administrative Code, require BOD_5 concentrations which do not exceed 50 mg/l in more than 20 percent of the monitored samples required during a calender quarter. Disinfection is also required for spray irrigation systems. Federal guidelines for land application systems are generally less stringent than those required by the State of Wisconsin. Effluent limits are normally based on the proximity of the land application sites to residents, schools or commercial areas. Isolated rural sites may require only primary treatment while sites near populated areas may require a secondary treatment. Because most of the potential land application sites in the planning area are near populated areas, the State limits were adopted for planning purposes.

Although chlorination is not required by the DNR for infiltration/percolation systems or irrigation systems which do not spray wastewater, the MMSD included chlorination facilities in all of its land application alternatives. The inclusion of these facilities unnecessarily in some of the alternatives did not appreciably affect the alternative analysis because generally these facilities amounted to less than 1 percent of the total alternative cost.

The fourth land application alternative evaluated was marsh application or enhancement. Marshes are diverse ecosystems providing habitat for a wide variety of flora and fauna. Because of their slow water movement, they serve as nutrient and sediment traps and provide storage for flood control. Marsh application has been used in Wisconsin for small treatment facilities. However, winter application is not considered feasible and storage facilities must be utilized. The Wisconsin DNR has required a treatment level of 20 mg/l BOD_5 and 20 mg/l suspended solids for other marsh application projects. Eight marshes near the planning area were determined to be suitable for application of effluent.

A fifth land application alternative (overland flow) was considered during alternative development. However, this process was found unsuitable for the planning area for three main reasons: excessive amounts of phosphorus would be carried by runoff into surface waters; the climate is too cold for adequate operations; and the process is unproven in the United States for sanitary sewage treatment.

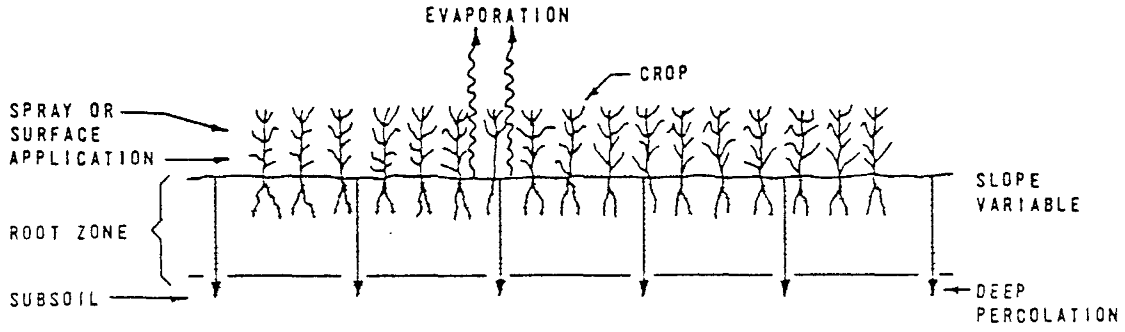
Most overland flow eventually enters surface waters with phosphorus concentrations of about 4 mg/l. The DNR limit of 1 mg/l which is applicable for most streams in the planning area would be exceeded. Overland flow cannot be used in cold weather because the vegetative growth needed for treatment would not exist. Secondly, an overland flow system requires from 50 to 120 days of start up time before adequate treatment can be achieved. Accordingly, the operating season of an overland flow system would be only about four months of the year.

A schematic of the various types of land application is shown in Figure 1-1. A comparison of the various types of land application can be found on Tables 1-2 and 1-3.

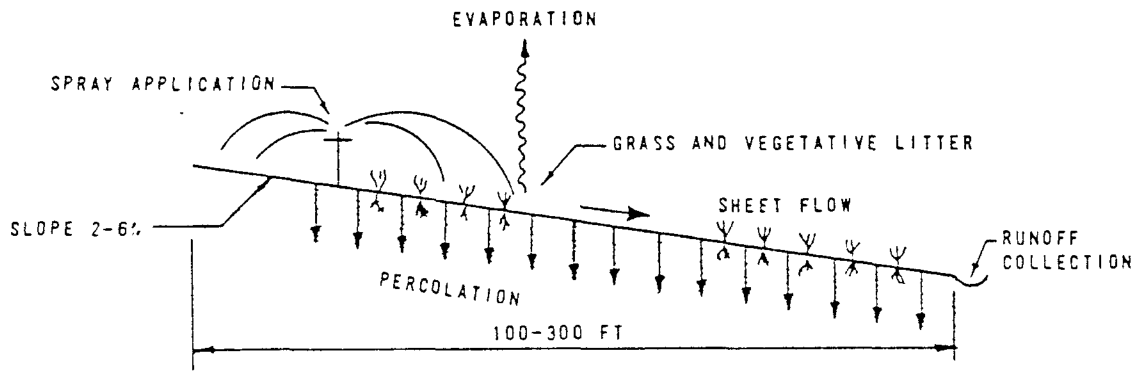
For screening purposes, land application sites were located by eliminating all areas designated as residential, flood-plain, wetland, scientific study areas, or otherwise sensitive. Proximity to surface waters was also considered. Soil testing and other site specific analyses would be conducted if a facility plan for such a project should become necessary.

1.3.3 Recycle and Reuse Alternatives

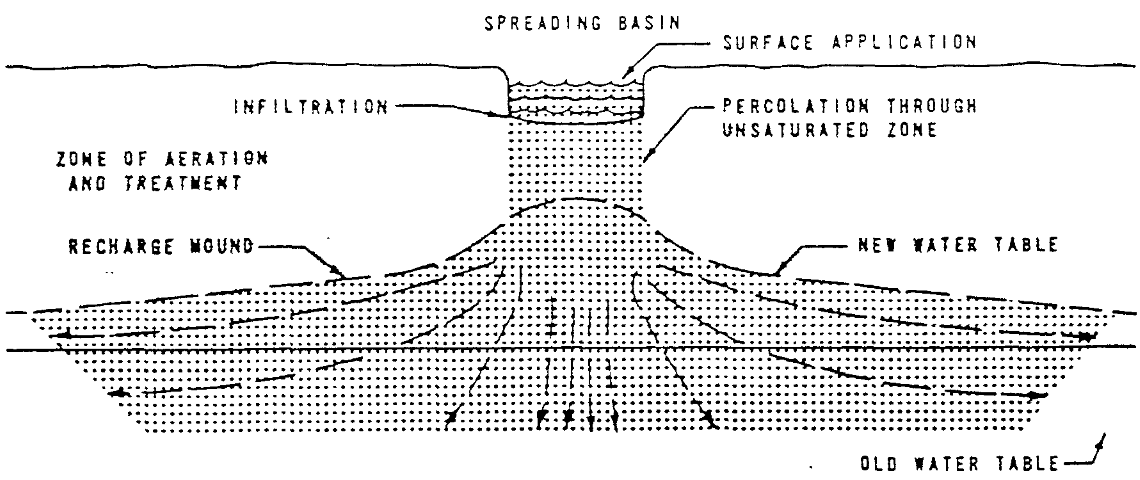
In general recycle and reuse was determined to be infeasible for all WWTPs. In all cases, higher levels of treatment and additional pumping costs made this alternative too costly.



(a) IRRIGATION



(b) OVERLAND FLOW



(c) INFILTRATION-PERCOLATION

FIGURE 1-1 DATE November 1980	LAND APPLICATION APPROACHES	SOURCE EPA PREPARED BY ESEI EcolSciences ENVIRONMENTAL GROUP

Table 1-2. Comparison of Irrigation, Overland Flow, and Infiltration-Percolation for Municipal Wastewater

Objective	Type of approach: Irrigation	Overland flow	Infiltration-percolation
Use as a treatment process with a recovery of renovated water	Impractical	50 to 60% recovery	Up to 90% recovery
Use for treatment beyond secondary:			
1. For BOD and suspended solids removal	90-99%	90-99%	90-99%
2. For nitrogen removal	Up to 90%[a]	70-90%	0-80%
3. For phosphorus removal	80-99%	50-60%	70-95%
Use to grow crops for sale	Excellent	Fair	Poor
Use as direct recycle to the land	Complete	Partial	Complete
Use to recharge groundwater	0-30%	0-10%	Up to 90%
Use in cold climates	Fair[b]	--[c]	Excellent

a. Dependent upon crop uptake.

b. Conflicting data--woods irrigation acceptable, cropland irrigation marginal.

c. Insufficient data.

Table 1-3. Comparative Characteristics of Irrigation, Overland Flow, and Infiltration-Percolation Systems[a]

Factor	Type of Approach: Irrigation	Overland flow	Infiltration-percolation
Liquid loading rate[b]	0.5 to 4 in./wk	2 to 5.5 in./wk	4 to 120 in./wk
Annual application	2 to 8 ft/yr	8 to 24 ft/yr	18 to 500 ft/yr
Land required for 1-mgd flow	140 to 560 acres plus buffer zones	46 to 140 acres plus buffer zones	2 to 62 acres plus buffer zones
Application techniques	Spray or surface	Usually spray	Usually surface
Soils	Moderately permeable soils with good productivity when irrigated	Slowly permeable soils such as clay loams and clay	Rapidly permeable soils, such as sands, loamy sands, and sandy loams
Probability of influencing groundwater quality	Moderate	Slight	Certain
Needed depth to groundwater	About 5 ft	Undetermined	About 15 ft
Wastewater lost to:	Predominantly evaporation or deep percolation	Surface discharge dominates over evaporation and percolation	Percolation to groundwater

a. Adapted from [62].

b. Irrigation rates of 4 in./wk are usually seasonal; yearly maximum loads of 8 ft/yr would average about 2 in./wk.

Source: EPA, 1973

CHAPTER 2

EIS SCREENING METHODOLOGY

2.0 EIS SCREENING METHODOLOGY

The MWPAP planning process was initiated specifically to address the sewage treatment problems of the MMSD and its member communities. Specifically, the MWPAP was designed to address sewage treatment problems at the Jones Island and South Shore WWTPs, bypasses in the MIS and local sewers as well as combined sewer overflows in the City of Milwaukee and the Village of Shorewood. Because the project would involve actions by EPA and DNR including funding a portion of the project and plan approval, it was necessary to prepare an EIS in accordance with the requirements of NEPA and WEPA.

Planning, however, was not limited to the existing MMSD service area. It included planning for the entire area designated as the the MMSD planning area. This area includes all or a portion of the seven communities and eight private WWTPs discussed in Chapter 1. For this reason, the MMSD also evaluated sewage treatment alternatives for these communities and private institutions as part of the MWPAP. This analysis was done only on a conceptual basis. No detailed refinement of alternatives was attempted.

Although the Notices of Intent to Prepare an EIS did not address specific actions for the communities currently not receiving service from the MMSD, the impacts of the proposed actions were evaluated in this EIS because the action would occur in the MMSD planning area. The EIS analysis was aimed at identifying major impacts. The analysis concentrated on the following criteria:

- Water quality
- Groundwater quality
- Energy and resource use
- Cost
- Engineering feasibility
- Legality

The EIS analysis involved both review and independent analysis activities. These activities included review of MWPAP screening and design criteria, site plans, and conclusions. The EIS study team reviewed the assumptions, the data base, and the final conclusions made by the MMSD to ensure that the data, procedures, and results were consistent with local, state, and federal regulations.

Independent analysis was used as both a separate check of MWPAP conclusions and as a means of developing new information for presentation in the EIS. As a means of checking MWPAP conclusions, alternative screening methodologies and separate data references were used. New information was developed for the EIS in areas such as energy and resources use.

Both the review and the independent analysis process are discussed further below.

2.1 Alternative Screening

The MWPAP developed the comprehensive list of actions for the seven management agencies and eight private institutions currently not served by the MMSD. This list included the alternatives for upgrading each local sewage treatment system as well as the actions necessary for each independent service area to connect to MMSD facilities. This list of alternatives served as the starting point for the alternative screening process. The results of the screening process are presented in the main body of the EIS and in Chapters 3 through 9 of this appendix.

The EIS screening and impact analysis was undertaken in two stages: primary screening and secondary screening. These two stages are outlined below.

2.1.1 Primary Screening

Primary screening was aimed at eliminating those preliminary alternatives that were too costly, likely to cause excessive environmental impact, or illegal. The MMSD developed general treatment plant locations, typical process trains, and tentative conveyance corridors. The MMSD then prepared preliminary costs for all the alternatives that were not eliminated because of overriding legal, technical, environmental or implementation constraints. EPA cost curves, existing project bid data, and construction cost estimates for recent wastewater treatment projects were used in this analysis. These costs had an accuracy range of +50 to -30%.

The EIS reviewed these data to ensure that the conclusions were reasonable. Site visits were used to verify impacts identified in the MMSD facility plan. EPA cost curves were used to make an independent check of the MMSD cost figures. The EIS next performed an independent screening of the preliminary alternatives.

2.1.2 Secondary Screening

The results of the EIS primary screening were very similar despite the independent analysis. In cases where the EIS and the MWPAP results differed, the alternative was included for further study by both groups.

The alternatives that survived the primary screening process were labeled as "feasible" alternatives. These feasible alternatives were next evaluated in further detail by the MMSD. Plant sites were specifically located, unit processes were sized and located on these plant sites, conveyance routes and pipe sizes were determined, and detailed costs were prepared based on EPA Cost-Effectiveness Analysis Guidelines. The costs for this analysis were based on specific cost data from bid tabulations of past projects, current manufacturers' equipment price quotations, published literature values such as the Means or Richardson cost estimating guides, and published EPA cost curves. The costs had an accuracy range of +30 to -15%.

The EIS study team again reviewed the MMSD data. Independent methodologies were developed in order to assess water quality impacts and energy and resource use. Treatment processes were reviewed for reliability. An independent cost analysis was undertaken based on published EPA cost data. The independent costing was also done using the EPA Cost-Effectiveness Analysis Guidelines.

In some situations new alternatives were identified and evaluated in the EIS. This analysis was usually done as a means of mitigating environmental impacts. These new alternatives are discussed in the following chapters.

2.2 Summary

The EIS evaluation of the local alternatives was done concurrently with the MMSD facility planning process. The analysis was based on MMSD data but was often verified through independent analysis. The results of the EIS analysis are summarized in the following chapters of this appendix.

CHAPTER 3

CADDY VISTA SANITARY DISTRICT

3.0 CADDY VISTA SANITARY DISTRICT

3.1 Introduction

The Caddy Vista Sanitary District is located along the Root River in the town of Caledonia in northern Racine County. The wastewater treatment plant and conveyance system were built in the mid 1950's. The present service area is approximately 100 acres with one commercial, one institutional and 266 single family connections. The served population is approximately 1,030 persons. Based upon DNR and EPA Environmental Assessment, a Finding of No Significant Impact (FNSI) was issued by EPA on September 18, 1980 for a pump station and force main to replace the Caddy Vista WWTP. The project would connect to the Oak Creek sewer system for conveyance to the MMSD for treatment. This decision removes Caddy Vista from further consideration in the EIS process. This chapter, then, will serve for informational purposes only.

The sewer system consists of 3 miles of 8-inch to 10-inch gravity sewers with no force mains, lift stations, or relief devices. The sanitary district has its own cleaning equipment and sewers are cleaned as needed with regular inspection of points considered potential problem areas. A 1977 I/I study conducted by the sanitary district found the sewers in fair to good condition. Some excess infiltration was identified.

The Caddy Vista WWTP is located to the north of the Caddy Vista subdivision on the Root River (see Figure 3-1). The plant is surrounded on the north and west by a heavily wooded sector of the Root River County Park land. To the east are agricultural fields. Houses are within 200 feet of the plant properly line and a school and recreational area are approximately 400 feet to the south. Plant facilities utilize only the northern half of the plant compound site. The WWTP creates some odor problems, but they are not considered severe. The plant produces very little noise. Because of the wooded location, the plant is not visible from the school or homes in the area.

The treatment plant processes consist of a comminution basin, a lift station, a primary clarifier, a low rate trickling filter, and a final clarifier. In 1977, a liquid chlorine dosing system was added following the final clarifier. Effluent is discharged to the Root River.

Within the plant there are three bypass points. The first is a manual bypass prior to the lift station. The second is an automatic bypass at the lift station to protect the pumps. The final bypass is manually operated and located just prior to the trickling filter. This bypass is designed to protect the filter from overloading.

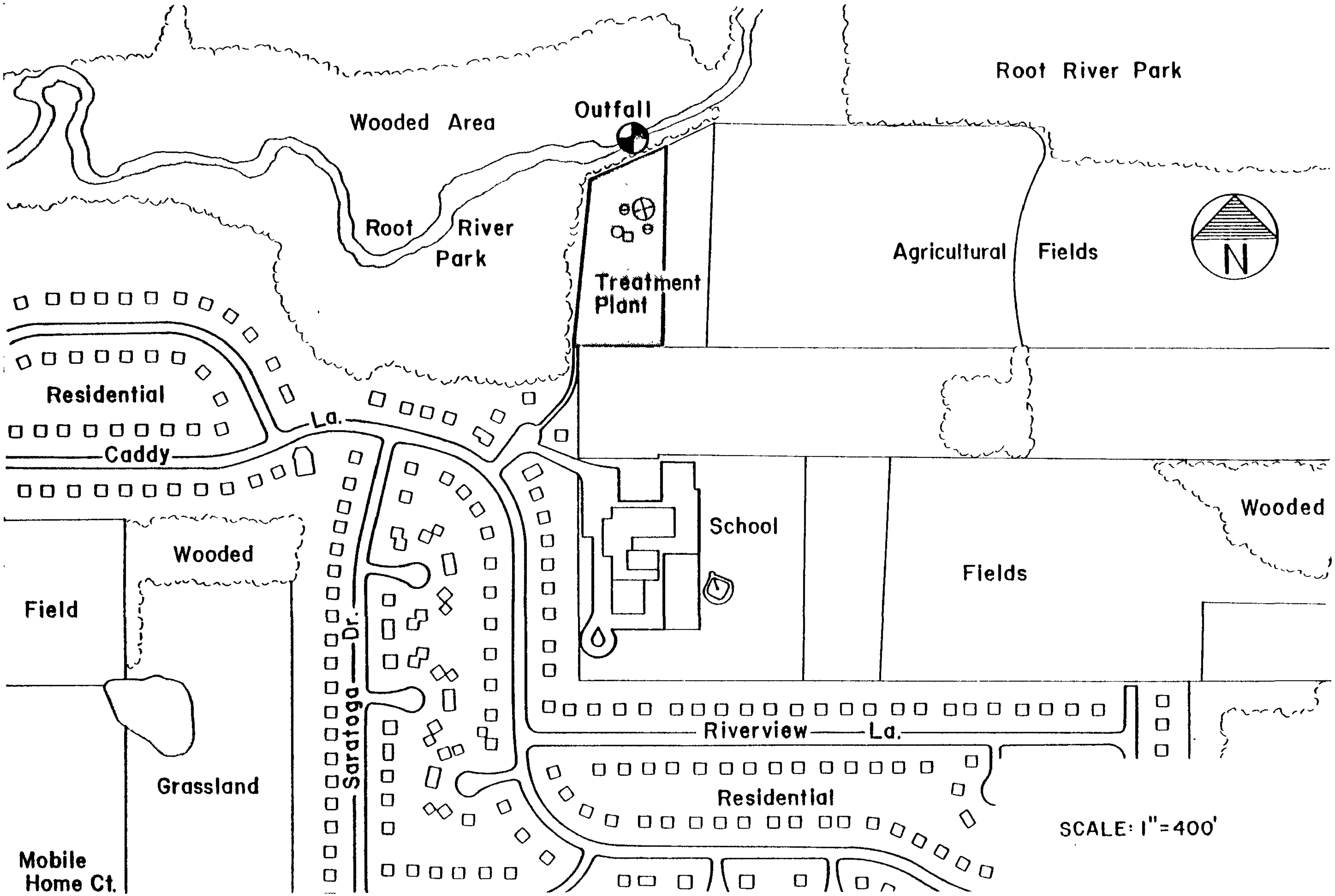


FIGURE 3-1

DATE NOV 1980

CADDY VISTA WWTP

SOURCE SEWRPC

PREPARED BY ESEI EcolSciences ENVIRONMENTAL GROUP

Solids at the plant are channeled to an anaerobic digestor and then to sludge drying beds. Dried sludge is made available for public use as a lawn and garden fertilizer and soil conditioner.

3.1.1 Effluent Limits

The WWTP is registered under the Wisconsin Pollution Discharge Elimination System and operations are governed by the requirements of its discharge permit (number WI-0030376-2). The permit was originally issued on December 12, 1974. The current permit expires in December, 1981.

The tentative future permit requirements are compatible with water quality goals in the Root River. The present and expected future effluent limits are listed below.

Parameter	Present	Future
BOD_5 (mg/l)	70 (mo. avg.)	30 (mo. avg.)
	100 (wk. avg.)	45 (wk. avg.)
Suspended Solids (mg/l)	70 (mo. avg.)	30 (mo. avg.)
	100 (wk. avg.)	45 (wk. avg.)
Fecal Coliform (#/100 ml)	--	400 (30-day avg.)
pH (standard units)		
(summer)	--	6-7.2 (wk. avg.)
(winter)	--	6-7.2 (wk. avg.)
NH_3-N (mg/l)		
(summer)	--	2 (wk. avg.)
(winter)	--	4 (wk. avg.)
Dissolved Oxygen (mg/l)	--	6 (min.)

3.1.2 Wastewater Flows

The existing Caddy Vista WWTP was designed for an average daily flow of 0.25 MGD. Existing wastewater flows in the Caddy Vista service area were determined during the MMSD I/I Study. Expected year 2005 wastewater flows were determined by the MMSD based on SEWRPC population forecasts, estimated I/I removals, and a proposed water conservation program which is expected to reduce average daily base flows by 10%.

The EPA requires the staging of all WWTP construction and expansion. Staging is used to minimize the possibilities of over-designing treatment plants if future population and flow projections are not achieved. The MMSD determined treatment plant staging periods based on the Flow Growth Factors outlined in the EPA Cost-Effectiveness Analysis Guidelines. According to these factors, if wastewater flows are expected to increase by more than 80% during the planning period, the staging period is 10 years. If flows are expected to increase by 30 to 80%, the staging period is 15 years. If the flows are expected to increase by less than 30%, the staging period is the entire planning period of 20 years.

Wastewater flows in the Caddy Vista service area are expected to increase by 54%. Accordingly, a 15-year staging period was adopted. This 15-year staging period means that the first portion of any Caddy Vista treatment plant construction would be based on year 2000 wastewater flows and loadings. At the year 2000, the plant would be expanded so that it could adequately treat the expected year 2005 wastewater flows.

The existing and future wastewater flows and loads and populations for the Caddy Vista service area are listed below.

	1978	2000	2005
Average Daily Base Flow (MGD)	0.072	0.090	0.111
Maximum Daily Flow (MGD)	--	0.342	0.503
Peak Flow Rate (MGD)	--	0.552	0.749
BOD_5 Loading (lb/day)	134	209	253
SS Loading (lb/day)	126	272	262
Population Served	1035	1393	1600

SS= Suspended Solids
1 MGD (Million Gallons/Day)= 3785 Cubic Meters/Day
1 Pound= 0.454 Kilogram

3.1.3 Existing Plant Conditions

The Caddy Vista WWTP is in generally poor condition. The comminutor basin is inoperative and heavily corroded. A metal grating has been placed across the channel between the basin and the adjacent lift station and acts as a bar screen. Most above ground concrete structures (primary clarifier, anaerobic digestor, and buildings) are cracked and in need of repair. The side walls of the trickling filter are a cyclone type fence and are protruding outward. The sludge drying beds are in fair to good condition but metal corner posts are badly corroded. The plant has no emergency power system. Most of the facility would have to be replaced prior to 2005.

3.2 Preliminary Alternatives

Alternatives considered during preliminary analysis for Caddy Vista were no action, upgrade O&M, expansion, upgrade treatment and discharge to the Fox River or Lake Michigan basins, land application, and connect to the MMSD.

- No Action

  If no action is taken to improve conditions at the Caddy Vista WWTP, the present plant equipment and structures would continue to deteriorate. The entire plant would need replacement before the end of the planning period. As discussed in Section 3.1.2, the service area population is expected to increase to approximately 1,600 persons by the year 2005, augmenting the average daily base flow to 0.111 MGD and the peak flow to 0.750 MGD.

  Because of these increased loadings to the plant and more stringent discharge requirements, it is doubtful that the plant would be able to function properly or consistently throughout the planning period. The declining state of the facilities would compound this problem.

- Upgrade O&M

  Upgrading the O&M of the present plant would have little effect on effluent quality because of the extensive deterioration of the existing plant processes. If the WWTP could be operated at its optimum level of efficiency, it would still not have the capacity to meet expected flows nor the necessary unit process to meet future effluent limits.

- Expand Existing Facilities

  The expected service life (the period of time a piece of equipment will operate effectively) of most of the plant's processes is less than the 20-year planning period. For this reason it would be necessary to replace as well as expand the existing unit processes. An expanded plant would meet the hydraulic requirements of the planning period. However, it is doubtful that an expanded plant could meet future effluent limits.

- Upgrade Treatment and Discharge to Lake Michigan Basin

  In order to meet future effluent limits for discharge to the Root River, the existing plant would have to be abandoned. A new AST plant would be built to meet the effluent limits for BOD_5, suspended solids, pH, and ammonia. Disinfection facilities would also be required. The plant would have the hydraulic capacity to treat all anticipated flows during the planning period. Preliminary costs for this alternative were $0.77 million for the treatment plant and $18,000 for annual O&M.

- Upgrade Treatment and Discharge to Fox River Basin

  In order for the Caddy Vista WWTP to discharge to the Fox River Basin, effluent would have to be treated to levels greater than required for discharge to the Root River and then pumped to the Wind Lake Canal south of Big Muskego Lake. The cost and environmental impacts of this alternative would be greater than the cost and impacts of continued discharge to the Root River.

- Land Application of Effluent

  As an alternative to discharging to the Root River, four types of land application alternatives were considered for effluent disposal: high and normal rate irrigation, infiltration/percolation, and marsh application. There were no marshes or infiltration/percolation sites suitable for effluent application within a reasonable distance of the Caddy Vista area. For the remaining two alternatives the amount of land required (based on average effluent quality and flow), the distance to the nearest possible land application site and the cost were determined.

Alternative	Required Area (acres)	Distance to Site (miles)	Treatment Capital Cost ($ x 10^6)	Annual O&M ($)
High Rate Irrigation	44	2	2.75	30,000
Normal Rate Irrigation	110	2	2.00	40,000

- Connect to MMSD

  In the master plan for the MMSD written in the late 1950s, an interceptor was identified to connect the Caddy Vista subdivision to the MIS system. The MWPAP has concluded that there would be no demand for this interceptor until late in the planning period. Therefore, the planning and design efforts on this interceptor were discontinued.

  However, Caddy Vista wastewater could be conveyed to the MMSD by constructing approximately 6,000 feet of 8-inch sewer from the treatment plant to a 10-inch Oak Creek local sewer located 600 feet north of Elm Road in Nicholson Road. A pump station would be needed at the existing plant site. The cost for this alternative would be $0.48 million with an annual O&M of $6,300.

The costs of the preliminary alternatives capable of meeting the requirement of the planning period for the Caddy Vista Subdivision are summarized below.

Alternative	Treatment or Conveyance Capital Cost ($ x 10^6)	Annual O&M ($)
Upgrade Treatment Discharge to Root River	0.77	18,000
Land Application-Normal Rate Irrigation	2.00	40,000
Land Application-High Rate Irrigation	2.75	30,000
Connect to MMSD	0.48	6,300

Based on cost and environmental impacts, Upgrade Treatment and Discharge to the Root River was determined to be the most feasible alternative for continued local operation of the Caddy Vista WWTP. If the plant were to be abandoned the flows from Caddy Vista would be connected to the MMSD. Each of these feasible alternative were next evaluated in further detail.

3.3 Feasible Alternatives

3.3.1 Upgrade Treatment, Discharge to the Root River

As discussed above, only Upgrade Treatment and Discharge to the Root River would be feasible for continued operation of the Caddy Vista WWTP. It would be necessary to construct additional processes to meet future effluent limits. A package plant could be purchased to provide first stage aeration and intermediate clarification. Separate second stage nitrification basins, final clarifiers, chlorination and pH control facilities, and a postaeration basin would follow the package plant. The package plant would be preceded by manually cleaned bar screens. Construction would be staged for year 2000 conditions and year 2005 conditions.

The existing site would have adequate space for new process equipment. The increased capacity and improved treatment processes would improve water quality in the Root River. Noise, traffic disruption, and dust from the construction site could be expected, but these would be short-term impacts. Because of its proximity to the Caddy Vista subdivision, final design for the plant site and equipment should be developed to minimize noise and odor impacts on the community and to be aesthetically pleasing to residents and users of the Root River Park land.

Total present worth of this alternative including local sewer rehabilitation would be $2.64 million. The annual O&M would be $0.081 million.

3.3.2 Connect to the MMSD

If the Caddy Vista WWTP were abandoned, the sewage flows could be connected to the MMSD through the Oak Creek sewer system. EPA staging requirements for the construction of conveyance systems differ from the WWTP requirements. The conveyance system staging period has been set at 20 years. A longer staging period not to exceed 40 years may be used if it can be shown that this longer period would minimize construction impacts, would be consistent with projected land use goals, and would reduce overall primary and secondary environmental impacts. For the Caddy Vista service area a 20-year staging period was selected.

Positive environmental impacts of this alternative include the elimination of a point source of pollution to the Root River, a source of odors to the Caddy Vista community, and an increase in sewerage capacity available to the community. The route chosen for the connection should have no adverse environmental impacts if proper construction practices are employed. Extreme caution is advised to protect the natural environment where the conveyance line crosses the Root River. Total present worth of this alternative including local sewer rehabilitation would be $0.55 million. The annual O&M would be $0.018 million.

3.3.3 Summary

The costs of the feasible alternatives for serving the Caddy Vista Subdivision are summarized below.

Alternative	Annual O&M ($)	Total Present Worth ($ x 10^6)
Upgrade Treatment Discharge to Root River	76,100	2.64
Connect to MMSD	18,000	0.55[1]

[1]Does not include MMSD capital or O&M costs to treat Caddy Vista wastewater.

As was discussed in Section 1.1.1, Assumptions, there were instances when final cost estimates were much higher than the costs developed for the preliminary alternatives. This situation occurred during the analysis of the Caddy Vista alternatives.

The preliminary capital cost of the Upgrade Treatment and Discharge to the Root River alternative was $770,000. During the determination of the total present worth of this alternative, a more detailed capital cost of $1,895,400 was developed. This cost was over 145% greater than the preliminary cost estimate. O&M costs also increased 320% from $18,000 to $76,100 per year.

Large increases in capital and O&M costs could invalidate a screening process if the final costs of a preferred alternative are greater than the costs of a preliminary alternative that was screened out because of excessive cost. For the Caddy Vista analysis the final upgrade treatment alternative costs were very close to the preliminary costs for normal rate irrigation. If the alternative for connecting Caddy Vista to the MMSD had not received a FNSI from EPA and DNR, it might have been necessary to evaluate normal rate irrigation in more detail to ensure that its costs were indeed over twice the costs of the upgrade alternative as the preliminary costs had indicated.

3.4 Final Alternatives

The least cost alternative for serving the Caddy Vista Subdivision during the planning period would be to abandon the existing WWTP and connect to the MMSD. This alternative would eliminate a source of pollution to the Root River. As noted in Section 3.1 this alternative has been issued a FNSI and will be implemented. The location of this and the other connections to the MMSD are shown in Figure 11-1.

As noted in the cost summary, the cost for connection to the MMSD does not include the present worth of the MMSD capital expenditure or annual O&M attributable to the treatment of wastewater flows from the Caddy Vista Subdivision. In the MWPAP alternative analysis it was assumed that the additional flow to the MMSD treatment plants (Jones Island and South Shore) from Caddy Vista would be insignificant.

A comparison of projected 2005 flows from Caddy Vista and to the MMSD without any local flows is made below.

Location	2005 Average Daily Base Flow (MGD)	2005 Peak Flow (MGD)
Caddy Vista	0.111	0.749
MMSD	195.0	550.0

The Caddy Vista flows would represent a 0.06% increase to the MMSD base flow and a 0.1% increase to the MMSD peak flow. For the purposes of planning and designing conveyance and treatment facilities, these incremental flows are indeed insignificant. However, they do represent some portion of the overall MMSD system and consequently do contribute to the system's cost. This cost should be added to the cost of the conveyance facilities required to connect a local community to the MMSD in order to determine the true cost to the community. In this manner a fair comparison in cost between the final local and the final connection (regional) alternatives can be made.

This refined cost comparison was not made by the MMSD in the WSP. Because the Caddy Vista connection to the MMSD has received a FNSI, this cost comparison between the final local and connection alternatives will not be necessary. However, for the other local communities (Germantown, Muskego, New Berlin, South Milwaukee, and Thiensville), it will be necessary to determine the MMSD treatment costs prior to the selection of a preferred wastewater treatment alternative for these communities. These costs will be determined for inclusion in the Final EIS.

Although this comparison of final engineering present worth cost is not included in the Draft EIS, a fiscal analysis of both the final local and regional alternatives has been completed. This analysis shows the cost of each final alternative to a typical homeowner in each planning area community. This analysis is contained in the Fiscal/ Economic Appendix.

If a Local System Level alternative had been chosen, upgrading the existing facility would have been the least costly, and would have produced fewer environmental impacts than the other alternatives considered. DNR water quality standards would also have been met in the Root River. The location of this local WWTP and other local treatment systems are shown in Figure 11-2.

CHAPTER 4

VILLAGE OF GERMANTOWN

4.0 VILLAGE OF GERMANTOWN

4.1 Introduction

The Village of Germantown is located to the northwest of Milwaukee in Washington County. The Village covers ap-aproximately 35 square miles of which 1.9 are served by the Village-owned WWTP. The remainder of the community is served by private on-site systems.

Sewer construction began in 1956, although the majority (approximately 70%) of the existing system was added during a major expansion period after 1971. The present system consists of 28.3 miles of gravity sewer ranging in size form 8 inches to 48 inches in diameter. The system also has 3.8 miles of force main, and five operating pump stations. One bypass exists at the pump station at Carnegie Drive and Mequon Road and is used only in the event of power failures at the station. Sewer maintenance is performed as needed. Manholes are inspected and some sewers are flushed on a yearly basis. A 1975 I/I study by the MMSD showed that most of the infiltration and inflow problems in the system are located in the Old Village area (constructed in 1956). The study concluded that the efforts required to remove this flow would not be cost effective. In 1976 the Village passed an ordinance prohibiting the discharge of clear water from roofs, sumps, cooling equipment, and surface and subsurface sources into the sanitary sewer system.

The Germantown WWTP is located to the west of the Village of Germantown, at the end of Main Street. The plant is surrounded by a golf course except to the southeast where a large apartment complex is located. The facility stands on the southeast corner of the site and is totally visible from the road, apartment complex, and golf course. (See Figure 4-1).

The existing plant was constructed in 1970 to replace a plant on the present site which had been designed to serve a nearby subdivision. Processes at the facility consist of a comminutor basin, lift station, aerated contact chamber, final clarifier, Parshall flume for flow monitoring and a 3.4 acre polishing pond. Effluent is discharged to the Menomonee River. Chemicals are added to the lift station wet well for phosphorus control. Liquid chlorine is added at a manhole located between the Parshall flume and the polishing pond. The plant has one bypass located prior to the polishing pond to allow disinfected effluent to be discharged directly from the chlorination manhole to the river. Solids are pumped to an aerobic digester where they are retained for 13 to 21 days. The digested sludge is either pumped to a decanting tank and hauled by a commercial hauler, or hauled in tank

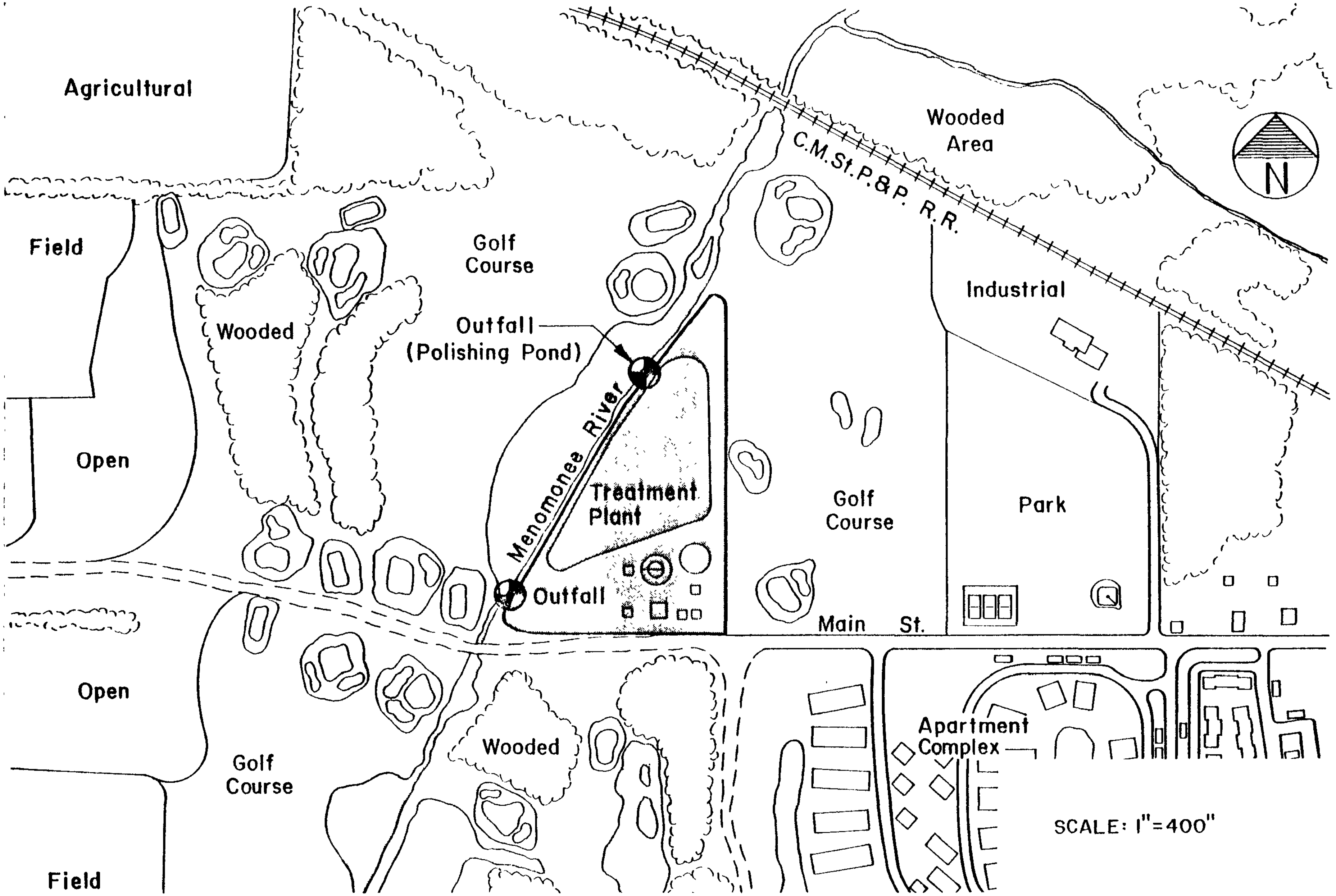


FIGURE 4-1
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GERMANTOWN WWTP

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trucks directly from the digester. Solids disposal is left to the discretion of the hauler but solids are usually land filled or applied to cropland.

4.1.1 Effluent Limits

Operations at the Germantown WWTP are presently regulated by the Wisconsin Pollution Discharge Elimination System under permit number WI-0020567-2, issued on November 30, 1977. The permit expires in June, 1982. Present limits for discharge to the Menomonee River and future limits for discharge to both the Menomonee and Fox Rivers are given below.

Parameter	Present	Future
BOD_5	20 (mo. avg.) 30 (wk. avg.)	10 (wk. avg.)
Suspended Solids (mg/l)	20 (mo. avg.) 30 (wk. avg.)	10 (wk. avg.)
Phosphorus (mg/l)	1.0 (mo. avg.)	1.0 (mo. avg.)
Fecal Coliform (#/100 ml)	200 (geo. mean)	400 (30 day avg.)
pH (standard units)		
(summer)	6.0 - 9.0	6.0 - 7.2
(winter)	6.0 - 9.0	6.0 - 7.4
NH_3-N (mg/l)		
(summer)	---	2 (wk. avg.)
(winter)	---	4 (wk. avg.)
Dissolved Oxygen (mg/l)	---	6 (minimum)

4.1.2 Wastewater Flows

The existing Germantown WWTP was designed for an average daily flow of 1.0 MGD with a peak design capacity of 2.0 MGD. Existing wastewater flows in the Germantown service area were determined based on the MMSD I/I Study. Expected year 2005 wastewater flows were determined by the MMSD based on SEWRPC population forecasts, estimated I/I removals, and the proposed water conservation program. Wastewater flows in Germantown are expected to increase by 353%. Accordingly, a 10-year treatment plant staging period was used.

The existing and future wastewater flows and loads and populations for Germantown are listed below.

	1978	1995	2005
Average Daily Base Flow (MGD)	0.72	1.86	2.54
Maximum Daily Flow (MGD)	--	4.94	6.37
Peak Flow Rate (MGD)	--	6.61	8.45
BOD_5 Loading (lb/day)	1280	4630	6450
SS Loading (lb/day)	1430	5270	7340
Population Served	5825	19501	27545

1 MGD = 3785 Cubic Meters/Day
1 Pound = 0.454 Kilogram

4.1.3 Existing Plant Conditions

The present structures are in good to excellent condition and all buildings should last throughout the planning period. The package plant is in good condition, but the plant has no cathodic protection for sub-surface equipment. Consequently, corrosion of metal below ground is a serious problem. Mechanical equipment at the plant is expected to be replaced as part of the normal maintenance schedule prior to 2005. The polishing pond is in good condition with no reported problems or leaks. Problems were experienced with phosphorous until April of 1976. At that time, pickle liquor was substituted for ferric chloride. Since that time, phosphorus concentrations have consistently been within acceptable limits. Average daily flow to the plant is 0.81 MGD.

Influent to the plant is consistently septic. Low flow velocities in the conveyance system are the suspected cause of this problem. The plant accepts 100,000 gallons per month from holding tanks but accepts no known septic tank waste.

Some odors have been noticed at the WWTP. Because of the proximity of the apartment complex, there is the potential nuisance associated with the odors. During periods when the polishing pond is not in operation, floating solids accumulate in the Southwest corner of the pond. This situation contributes to the odor problem.

4.2 Preliminary Alternatives

Preliminary alternatives considered for the Germantown WWTP included no action, upgrading O&M, expansion, upgrading treatment with continued discharge to the Menomonee River or a new discharge to the Fox River, land application, and connection to the MMSD.

- No Action

  It is doubtful that the plant would be adequate for the year 2005. The expected population growth from 5,800 to 27,500 persons would produce flows far in excess of design capacities of the WWTP. More stringent effluent standards would include requirements beyond the capability of the plant.

- Upgrading O&M

  Because of the large increase in service population, the present plant size would be inadequate despite improvements in operation and maintenance.

- Expand Existing Plant

  Expanding the existing plant would provide sufficient hydraulic capacity for the future growth, but the plant would not meet future effluent limits for discharge to the Menomonee River.

- Upgrade Treatment and Discharge to Lake Michigan Basin

  In order for the Germantown WWTP to continue discharging to the Menomonee River, the existing plant would have to be upgraded to provide AWT. This AWT plant would be required to meet the more strict effluent limits for BOD_5, suspended solids, pH, ammonia, and dissolved oxygen. Disinfection facilities would also be required. The overall plant hydraulic capacity would also need to be expanded to treat all anticipated flows during the planning period. Preliminary costs for this alternative were $11.67 million for the treatment plant and to provide new conveyance in the Village for expansion of the service area. Annual O&M would be $0.270 million.

- Upgrade Treatment and Discharge to Fox River Basin

  For the Germantown plant to discharge to the Fox River, the same level of treatment would have to be achieved as for the Menomonee River. In addition to improvements necessary to continue present discharge practices, new pumping and conveyance facilities would also be required. The cost of these additional facilities would make this alternative less desirable than improving the existing plant. The cost of this alternative would be $14.9 million for the treatment plant, new conveyance in

Germantown, and conveyance to the Fox River. Annual O&M would be $0.280 million.

° Land Application of Effluent

While the existing plant is capable of meeting effluent standards for land application of current flows, anticipated future flows would greatly exceed the plant's design hydraulic capacity. Consequently, the plant would have to be expanded. There is sufficient land at the existing plant site for this expansion. For the actual application of the treated effluent the nearest possible sites, land requirements, and costs for the four types of land application analyzed are listed below. The cost to expand the plant are included.

Alternatives	Required Area (acres)	Distance to Site (miles)	Treatment Capital Cost ($ x 10^6)	Annual O & M ($)
High Rate Irrigation	920	3	30.50	460,000
Normal Rate Irrigation	2,400	3	10.00	360,000
Infiltration/ Percolation	110	3	13.30	400,000
Marsh Application	1,020	8	23.70	590,000

The major reasons for the higher costs of the irrigation and marsh application alternatives is the requirement for winter effluent storage facilities.

° Connect to MMSD

The original design for the connection of the Village of Germantown to the MMSD was to construct a local sewer from the existing WWTP south to the Washington and Waukesha County Line and then east to the MMSD Menomonee Falls-Germantown Interceptor. The northern leg of Menomonee Falls-Germantown Interceptor would run north from Bradley Road along 124th Street to the County Line.

It was later determined that a considerable cost savings was possible if the northern leg of the Menomonee Falls-Germantown Interceptor was instead built in an east-west direction along the Ozaukee and

Milwaukee County Lines to 107th Street. There, the interceptor would be connected to an existing 57-inch MIS. The capital cost for the total connection would be $5.4 million. The annual O&M would be $0.085 million.

The costs of the preliminary alternatives capable of meeting the requirements of the planning period for the Village of Germantown are summarized below.

Alternative	Treatment or Conveyance Capital Cost ($ x 10^6)	Annual O&M ($)
Upgrade Treatment Discharge to Menomonee River	11.67	270,000
Upgrade Treatment Discharge to Fox River	14.90	280,000
Land Application - Normal Rate Irrigation	19.00	360,000
Land Application - High Rate Irrigation	30.50	460,000
Land Application - Infiltration/Percolation	13.30	400,000
Marsh Application	23.70	590,000
Connect to MMSD	5.40	85,000

Connection to the MMSD was by far the least expensive of all the alternatives and also provided the additional benefit of removing an effluent discharge from the Menomonee River. The most feasible of the local alternatives for Germantown would be to upgrade treatment and continue discharge to the Menomonee River. The next most attractive local alternative was land application by infiltration/percolation. This alternative would provide local control of waste treatment, would eliminate discharges to the Menomonee River, and would cost within 15 percent of the discharge to the Menomonee River alternative.

The remaining alternatives had costs at least 20 percent greater than the costs of the discharge to the Menomonee River alternative and offered no additional environmental benefits. Consequently, they were eliminated from further analysis.

4.3 Feasible Alternatives

As discussed above, the most feasible alternatives for the continued local operation of a Germantown WWTP would be to

4.3.2 Land Application - Infiltration/Percolation

As discussed under Preliminary Alternatives, secondary treatment for land application could be provided by expanding the existing plant. However, during the later, more detailed analysis of the feasible alternatives, the MMSD determined that it would be less costly to provide secondary treatment by aerated lagoons. In order to treat the expected wastewater flows in Germantown, aerated lagoons totalling 27.5 acres would be required. Seven infiltration/percolation ponds, each covering 11.6 acres, would be required for the application of the treated effluent. Because the staging of the aerated lagoons and the infiltration/percolation ponds would not be economical, both systems were designed for the estimated year 2005 flows and loads.

The existing treatment plant site is not large enough to accommodate the aerated lagoons. However, there is a site in northwestern Germantown with soils suitable for infiltration/percolation and large enough to accommodate both the aerated lagoons and the infiltration/percolation ponds. The existing WWTP would be abandoned and a force main would be constructed to the new treatment site. The planned conveyance system would begin at the existing plant site and run west to River Road, north to Freistadt Road, west to Maple Road, north to Highway 145, and northwest along Highway 145 to the application site. The conveyance system would consist of approximately 19,000 lineal feet of 20-inch force main and two 8.45 MGD pump stations. Figure 4-2 shows the proposed land application site and conveyance route.

The force main would be constructed by open cut methods at a typical depth of six feet. Most of the construction would be along existing roadways. The first mile of construction would be across a golf course and open fields. The route would cross the Menomonee River once and a tributary to the Menomonee River once. All impacts would be minimal and short-term in nature. Special care during construction would be required at the river crossings.

The abandonment of the existing plant would improve the aesthetics of the area. It would also eliminate a point source of pollution to the Menomonee River. In conjunction with the 208 Plan, this alternative would result in the achievement of DNR water quality standards in the river. The MMSD concluded that recommended 208 Plan water quality goals would not be met under this alternative. However, the frequency of nonconformance would be reduced.

The new land application WWTP would provide enough capacity to allow the abandonment of septic systems and permit the planned level of growth in Germantown. The potential secondary growth either upgrade the existing facilities and continue discharges to the Menomonee River or to land apply treated effluent by infiltration/percolation.

4.3.1 Upgrade Treatment, Discharge to the Menomonee River

There is adequate land at the existing plant site for the necessary plant expansion if the existing lagoon is filled. The upgraded plant would consist of mechanically and manually cleaned bar screens followed by an influent pump station and grit chambers. Following the grit chambers would be primary clarifiers, first stage aeration basins, intermediate clarifiers, second stage nitrification aeration basins for ammonia control, and final clarifiers. Final treatment would be provided by mixed media filters, a postaeration basin, and chlorination facilities. Solids would be anaerobically digested, mechanically dewatered, stored and applied to agricultural land or landfilled. The plant would be upgraded in two stages, for 1995 estimated flows and loads and for 2005 estimated flows and loads.

The construction required to upgrade the plant would cause short-term disturbance to the users of the golf course surrounding the plant and to the apartment complex southeast of the plant. Because Main Street provides the only means of access to the plant, construction traffic on this road would be increased. The upgraded plant would meet WPDES effluent limits, and DNR water standards would be met except for occasional ammonia violations at the plant outfall. Based on recommended 208 Plan water quality goals, the MMSD concluded that this alternative would increase the frequency of nonconformance with both the un-ionized ammonia and phosphorus standards. The increased treatment capacity would allow the abandonment of septic systems and would permit the planned level of growth in Germantown. The total present worth of this alternative including new conveyance in order to serve more areas of Germantown would be $17.03 million. The annual O&M would be $0.472 million.

The planned level of growth in Germantown cited in the Wastewater flows section above has been identified by the EIS as a potential problem. The EIS analysis of secondary growth impacts resulting from the MWPAP has shown that there is an overlap in the housing market between Germantown and the northwest side of Milwaukee. Based on this overlap, it is possible that the provision of sewerage capacity for increased growth in Germantown could attract some development that otherwise could occur on the northwest side of Milwaukee. This issue is further discussed in Chapter V of the EIS and in greater detail in the Secondary Growth Impacts Appendix.

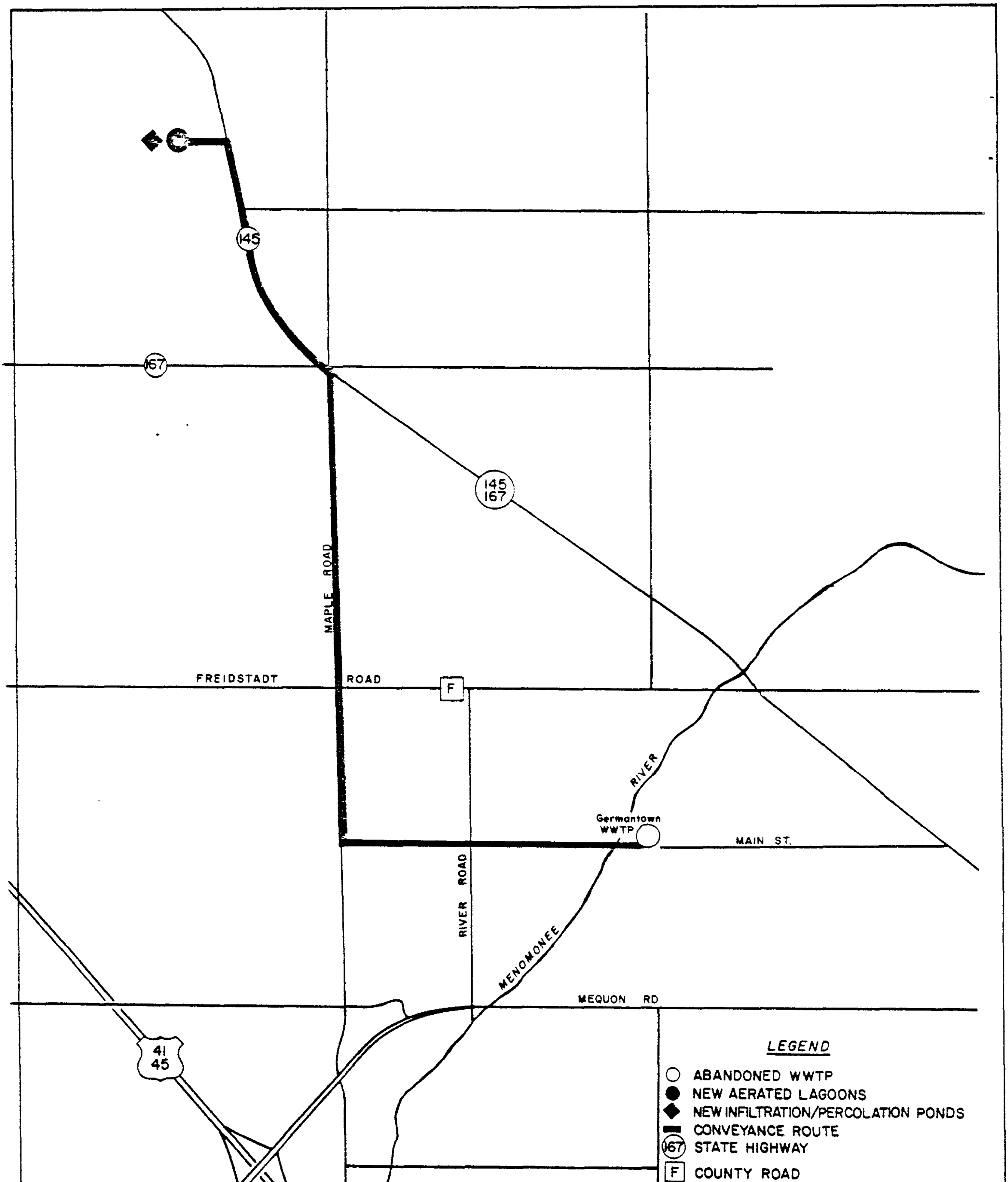

FIGURE 4-2

DATE November 1980

GERMANTOWN LAND APPLICATION SITE AND CONVEYANCE ROUTE

SOURCE ESEI

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impacts discussed earlier would also be possible under this alternative. The land application treatment system would require approximately 110 acres of agricultural land in the Village.

The plant could be a potential source of groundwater pollution. This problem could be minimized by proper construction and operation of the plant. The proposed application site was selected based on a general land use and soil type survey. If a land application plant were to be constructed, a detailed soil analysis would be undertaken at the proposed site to ensure that the soils were acceptable for the infiltration/percolation process. This analysis would further minimize the risk of groundwater pollution. Prior to construction, wells would be drilled for the purpose of assessing the groundwater conditions in the area. These wells would be used to monitor the system after it is in operation.

A major concern related to the land application of sewage is the development of groundwater pollution due to high nitrate concentrations. High nitrate concentrations in humans can cause methemoglobinemia, a blood poisoning that can be particularly fatal to children. If high nitrate concentrations were found and determined to be endangering the health of the public, the polluted groundwater could be pumped to the surface and discharged to a surface water. If the water could not meet surface effluent discharge limits, a new treatment scheme would have to be developed.

An infiltration/percolation land application system is considered to be alternative technology by EPA. Consequently, it would be eligible for 85 percent federal funding if it is part of the cost effective solution to an area's sewage treatment problems. Additionally, if an alternative technology treatment system fails within three years, repair or replacement is eligible for 100 percent federal funding.

The total present worth of the infiltration/percolation alternative including new conveyance to serve more areas of Germantown would be $13.17 million. The annual O&M would be $0.422 million.

4.3.3 Connect to the MMSD

Connection of the Germantown service area to the MMSD would have many of the benefits of the land application alternative without its possible adverse impacts. Benefits of connection to the MMSD would be improved aesthetics due to abandonment of the existing plant, achievement of DNR water quality standards in the Menomonee River, abandonment of septic systems, and availability of sewerage capacity to permit the planned level of growth in Germantown. Also there would be no need to remove agricultural land from production and no possibility of groundwater pollution. The adverse impacts of the connection alternative would be the same secondary growth impacts discussed for the other alternatives, plus the loss of local control of sewage treatment. As with the infiltration/percolation alternative, the MMSD concluded that recommended 208 Plan water quality goals would still not be met occasionally.

The tentative conveyance route for connection to MMSD would begin at the existing WWTP. It would extend south along an easement and South Division Road to County Line Road. It would then extend east along County Line Road to North 107th Street where it would connect to an existing 57-inch MIS. The total connection would consist of 12,300 feet of 12-inch force main, 6,000 feet of 24-inch force main, 5,000 feet of 24-inch gravity sewer, and 8,800 feet of 30-inch gravity sewer all constructed by open cut methods, and 1,600 feet of 30-inch tunnel. The impacts of this construction would be limited because most of the construction would be along existing roadways. There would be some disruption of traffic.

The total present worth of the connection to the MMSD including new conveyance to serve developing areas of Germantown would be $5.95 million. Annual O&M would be $0.085 million.

4.3.4 Summary

The refined costs of the feasible alternatives for serving Germantown during the planning period are summarized below.

Alternative	O&M ($)	Total Present Worth ($ x 10^6)
Upgrade Treatment Discharge to Menomonee River	472,000	17.03
Land Application - Infiltration/Percolation	442,000	13.17
Connect to MMSD	85,000	5.95[1]

[1]Does not include MMSD capital or O&M costs to treat Germantown wastewater. (See Section 3.4 for further discussion.)

A review of the preliminary and final costs of the Germantown alternatives shows a consistency between costs. The only preliminary alternative eliminated because of excessive cost, which had a cost less than a final alternative, was the alternative Upgrade Treatment and Discharge to the Fox River. This alternative, however, required treatment processes identical to those required for discharge to the Menomonee River. Its higher cost estimate during preliminary analysis was a result of conveyance costs to the Fox River. Accordingly, its cost could still be greater than the final Menomonee River discharge alternative cost as well as the final infiltration/percolation alternative cost.

4.4 Final Alternatives

Excluding the MMSD cost to treat Germantown wastewater, the least cost alternative for serving Germantown during the planning period would be connection to the MMSD via the 57-inch interceptor in North 107th Street. The route from the treatment plant to the connection point would not traverse any environmentally sensitive areas. Abandoning the treatment plant would eliminate a point source of pollution to the Menomonee River. Present noise and odor problems would also be eliminated and visual aesthetics would be improved in the area. The location of this connection is shown in Figure 11-1.

If a local system is the chosen alternative, a land application process employing infiltration and percolation would be the most attractive alternative. Proper design would be necessary at the land application site and along the conveyance system to avoid disturbing any environmentally sensitive sites. Groundwater contamination would be possible if the land application system was not designed and operated properly. The location of this system is shown in Figure 11-2.

Prior to the selection of the preferred wastewater treatment alternative for Germantown, a determination of the MMSD cost to treat Germantown's wastewater will be made. This cost will be added to the $5.95 million cost of the connection in order to determine the actual total present worth cost of this alternative. In the Final EIS, EPA, in accordance with NEPA, will describe its preferred alternative for wastewater treatment for Germantown. This alternative will be based upon findings set forth here and in other sections of this EIS, comments received from various review agencies, and comments received during the public comment period and at the public hearings.

CHAPTER 5

CITY OF MUSKEGO

5.0 CITY OF MUSKEGO

5.1 Introduction

The City of Muskego presently operates two WWTPs, the Muskego Northeast WWTP and the Muskego Northwest (Woods Road) WWTP. The Northeast plant serves a 2.1 square mile area of northeast Muskego with a 1978 population of 4,950. The Northwest plant serves a 2.4 square mile area of northwest Muskego with a 1978 population of 6,050.

Two sets of alternatives were developed for the Muskego service area. The first alternative involved the continued operation of both WWTPs. The second involved the abandonment of the Northwest plant and the upgrading of the Northeast plant to serve the entire Muskego service area in the planning area. The development of these alternatives is outlined below. The preferred two-plant and one-plant alternatives will be identified as the two most feasible local alternatives for the City of Muskego. Next, these two alternatives will be compared to the regional alternative of connecting Muskego to the MMSD. The impacts of each alternative will be identified.

5.2 Alternative A

For Alternative A, techniques for the continued operation of both the Northeast and Northwest WWTPs were considered. A description of each plant and the alternative evaluation process of each plant is outlined below.

5.2.1 Muskego Northeast WWTP

5.2.1.1 Introduction: The Muskego Northeast WWTP is located in northeastern Muskego southwest of the City of Milwaukee. The plant serves approximately 2.1 square miles with over 1,300 building connections. There are 28.6 miles of gravity sewers tributary to the treatment facility ranging in size from 8 inches to 60 inches in diameter. The system has four lift stations and no relief devices or force mains. This system is reported to be in good condition.

The Department of Public Works for the City of Muskego operates an inspection and maintenance program to note problems with any sewer elements. An I/I study performed by the MMSD identified excessive amounts of clear water in the system. The City has had a clear water ordinance since 1953 which requires all buildings to be equipped with sump pumps. The Muskego Northeast WWTP is located on McShane Road (See Figure 5-1).

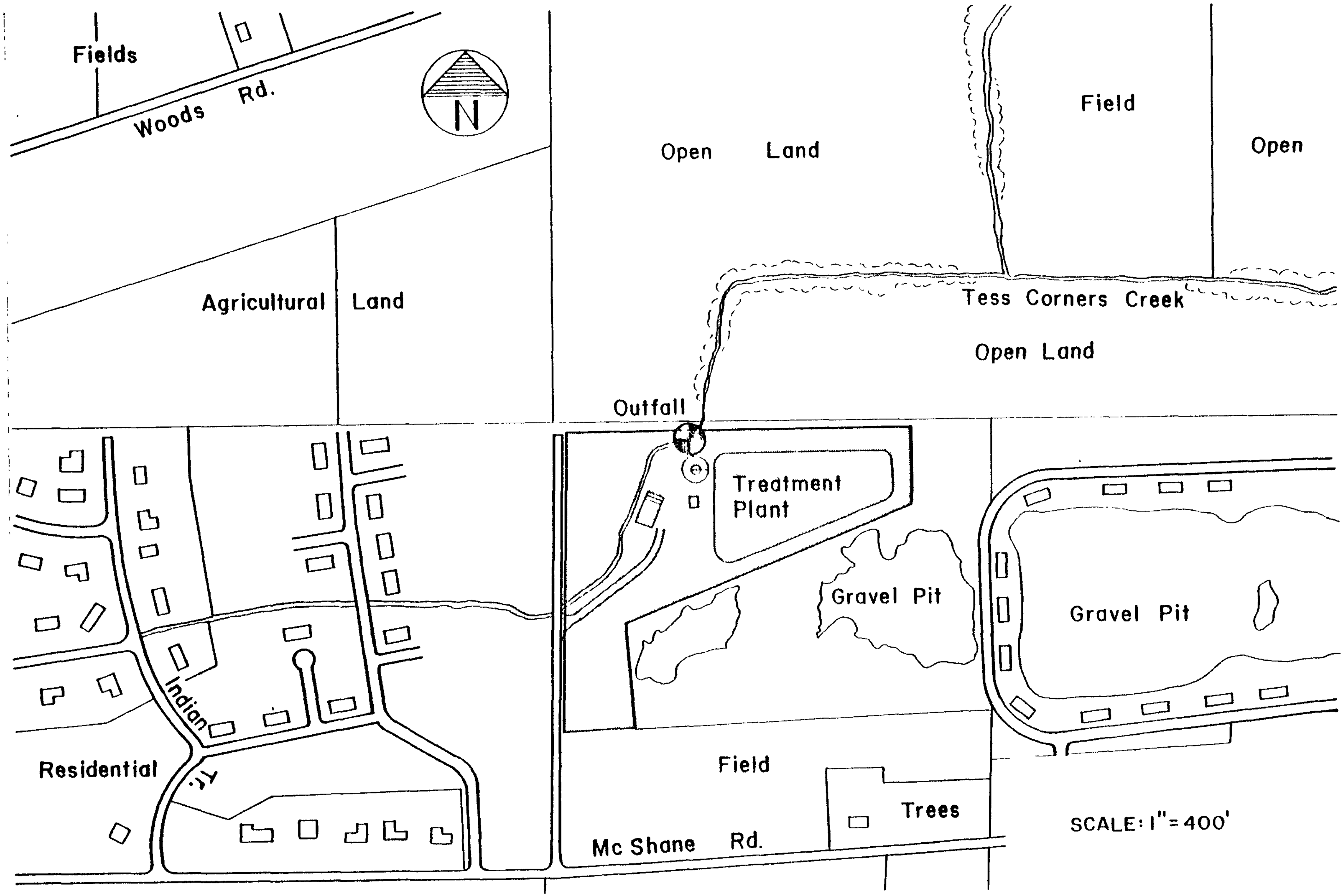


FIGURE 5-1

DATE NOV 1980

MUSKEGO NORTHEAST WWTP

SOURCE SEWRPC

PREPARED BY ESEI EcolSciences ENVIRONMENTAL GROUP

New residential units are being built on both the east and west sides of the plant with some houses built directly adjacent to the treatment plant's polishing pond. The close proximity of these new houses magnifies the severity of impacts from any noise or odor problems at the plant. Trees near the gravel pit screen much of the plant from view along McShane Road, but the plant is clearly visible from most of the new housing areas.

The Muskego Northeast WWTP was constructed in 1971 with phosphorus controls added in 1974. The plant consists of a lift station, comminutor, chemical phosphorus removal equipment, aeration basin, clarifier, polishing pond, and chlorine contact chamber. Effluent is discharged to the Root River via a tributary of Tess Corners Creek. Detention time in the polishing pond aerobic digesters. The digested sludge is either hauled directly to land application sites or is spread on sludge drying beds. Dried sludge is then applied to land.

5.2.1.1.1 Effluent Limits: The Muskego Norhteast WWTP is registered under the Wisconsin Pollution Discharge Elimination System and operations are regulated by the requirements of its discharge permit, number WI-0021164. This permit was issued on July 29, 1974 and expired March 31, 1979. The permit has not been renewed because the plant has consistently had problems meeting its effluent limits. Presently, the City and the DNR are involved in a number of actions aimed at eliminating the sewage treatment problems in the City.

The effluent limits in the expired WPDES permit are outlined below. Also listed are the effluent limits that the DNR has set for future effluent discharges from the Northeast WWTP to the Lake Michigan basin (Tess Corners Creek) and to the Fox River basin (Big Muskego Lake).

5.2.1.1.2 Wastewater Flows: The existing Muskego Northeast WWTP was designed for an average daily flow of 0.50 MGD with a peak design capacity of 1.30 MGD. The existing wastewater flows to the Muskego Northeast WWTP were determined based on the MMSD I/I study. Expected year 2005 flows and loads were determined by the MMSD based on SEWRPC population forecasts, estimated I/I removals, and the proposed water conservation program. Wastewater flows are expected to increase by 269% by 2005. Accordingly, a 10-year staging period was used.

The existing and future wastewater flows and loads and populations for the Muskego Northeast service area are listed below.

Effluent Limits

Parameters	Present	Future: Tess Corners Creek	Future: Big Muskego Lake
BOD_5 (mg/l)	30 (mo.avg.) 45 (wk.avg.)	15 (mo.avg.) 30 (daily max.)	10 (wk.avg.)
Suspended Solids (mg/l)	30 (mo.avg.) 45 (wk.avg.)	20 (mo.avg.) 30 (daily max.)	10 (wk.avg.)
Fecal Coliforms (#/100 ml)	200 (mo.avg.) 400 (wk.avg.)	400 (30 day avg.)	400 (30 day avg.)
Phosphorus (mg/l)	1.0 (mo.avg.)	1.0 (mo. avg.)	1.0 (wk.avg.)
NH_3-N (mg/l)			
(May to Oct.)	--	3.0 (wk.avg.)	2.0 (wk.avg.)
(Nov. to Apr.)	--	6.0 (wk.avg.)	2.0 (wk.avg.)
pH (standard units)	6.0-9.0	6.0-9.0	6.0-9.0
Residual Chlorine (mg/l)	--	0.5 (max.)	--
Dissolved Oxygen (mg/l)	--	4.0 (min.)	--

Wastewater Flows

	1978	1995	2005
Average Daily Base Flow (MGD)	0.39	0.76	1.05
Maximum Daily Flow (MGD)	--	3.01	3.34
Peak Flow Rate (MGD)	--	4.61	4.98
BOD_5 Loading (lb/day)	650	2,030	2,950
SS Loading (lb/day)	520	2,100	3,160
Population Served	4,950	7,790	9,460

1 MGD = 3,785 Cubic Meters/Day
1 Pound = 0.454 Kilogram

5.2.1.1.3 Existing Plant Conditions: Inspection of the plant found it to be in generally good condition. The lift station has a dry well made of welded plate metal, and the package treatment plant (the aeration and clarification basins) are also of welded plate metal. These structures have induced current cathodic protection to prevent corrosion. There are no known leaks in these structures and they should remain useful through 2005. The polishing pond is clay lined. This lining is reported to have isolated leaks and is not expected to remain in use through the planning period.

5.2.1.2 Preliminary Alternatives: Alternatives considered for the Muskego Northeast WWTP during preliminary alternative analysis included no action, upgrade O&M, expansion, upgrade and discharge to the Lake Michigan basin or to the Fox River basin, and land application of effluent.

- No Action

  The plant does not consistently meet its discharge permit requirements for phosphorus. Population in the service area is expected to increase by 78 percent. The additional population would increase average flows to the plant to 1.05 MGD. This increase in flow would overtax the treatment system and increased discharge violations could be expected.

- Upgrade O&M

  Upgrading the O&M of the present plant would have little effect on the plant's ability to meet future effluent limits. The capacity of the existing plant would be exceeded. In addition, the plant would not have the necessary unit processes to meet the effluent limits for continued discharge to Tess Corners Creek.

- Expand Existing Facilities

  An expanded, well operated Northeast WWTP would be able to meet the future limits for many of the parameters for discharge to Tess Corners Creek. However, an expanded plant would not be able to meet the limits for ammonia or dissolved oxygen and would have trouble meeting the more stringent BOD_5 and suspended solids limits. Accordingly, the expansion alternative would not be acceptable.

- Upgrade Treatment and Discharge to Lake Michigan Basin

  In order to meet the future effluent limits for discharge to the tributary to Tess Corners Creek, the existing plant would have to be expanded and new processes to remove ammonia and provide postaeration would have to be added. The capital cost for this alternative would be $3.40 million for the treatment plant. The annual O&M would be 0.11 million.

- Upgrade Treatment and Discharge to Fox River Basin

  Effluent limits for discharge to Big Muskego Lake are more stringent than those for discharge to the Tess Corners Creek tributary except for chlorine residual and dissolved oxygen. However, to meet these limits no change in treatment processes would be required and, in fact, a postaeration basin could be eliminated. However, a longer outfall conveyance system to Big Muskego Lake would be required. This route would require approximately 4,500 feet of gravity sewer south to the lake. The initial capital cost of this alternative was $3.20 million for the treatment plant and conveyance. The annual O&M would be $0.11 Million.

- Land Application of Effluent

  As an alternative to discharging to surface waters, high and normal rate irrigation, infiltration/percolation, and marsh application alternatives were evaluated. The amount of land required, the distance to the nearest suitable site, and the cost of each alternative is listed below.

Alternative	Required Area (acres)	Distance to Site (miles)	Treatment Capital Cost ($ x 10^6)	Annual O & M ($)
Normal Rate Irrigation	1,000	3.6	9.70	150,000
High Rate Irrigation	380	3.6	14.20	190,000
Infiltration/ Percolation	50	9.5	8.00	180,000
Marsh Application	420	14.0	--	--

  The cost of the marsh application alternative was not determined because the additional cost for the longer conveyance and additional pretreatment would make the alternative infeasible.

The cost of the preliminary alternatives capable of meeting the requirements of the Muskego Northeast WWTP service area during the planning period are summarized below.

Alternative	Treatment and Conveyance Capital Cost ($ x 10^6)	Annual O&M ($)
Upgrade Treatment Discharge to Tess Corners Creek Tributary	3.40	110,000
Upgrade Treatment Discharge to Big Muskego Lake	3.77	110,000
Land Application - Normal Rate Irrigation	9.70	150,000
Land Application - High Rate Irrigation	14.20	190,000
Land Application - Infiltration/ Percolation	8.00	180,000

Based on these costs only upgrading and discharging to Tess Corners Creek and Big Muskego Lake would be considered feasible alternatives. Both alternatives were further analyzed during detailed analysis.

5.2.1.3 Feasible Alternatives

5.2.1.3.1 Upgrade Treatment, Discharge to Tess Corners Creek: In order to upgrade treatment and discharge to Tess Corners Creek, it would be necessary to expand and upgrade the existing plant. The existing plant site would not be large enough for the proposed expansion unless the existing lagoon was filled. This expansion would also be very near a new housing development just east of the existing plant. In order to minimize these impacts, the proposed plant would have to be moved south of McShane Road on city-owned land. The existing treatment plant and polishing pond would be abandoned.

The new plant discharging to Tess Corners Creek would consist of an aerated grit chamber followed by primary clarifiers, first stage aeration basins, intermediate clarifiers, second stage aeration basins for ammonia removal, final clarifiers, filters, and postaeration and chlorination facilities. Solids would be anaerobically digested, mechanically dewatered and land applied or land filled.

The construction of the plant would cause short-term impacts due to noise and dust. Because the plant would be located in a relatively isolated area, these impacts would not be severe. The plant could make the development of residential housing north of McShane Road less desirable. The new plant would meet WPDES effluent limits.

In conjunction with the 208 Plan, water quality standards would be met in this reach of Tess Corners Creek except for occasional un-ionized ammonia violations which could occur during Q_{7-10} flow conditions (the lowest flow rate to occur during 7 consecutive days in a 10 year period) depending on the temperature and pH conditions of the creek. The increased phosphorus loads from the plant would contribute to the long-term eutrophication of Whitnall Park Pond and the Root River. The MMSD concluded that this alternative would result in nonconformance with the recommended 208 Plan un-ionized ammonia and phosphorus water quality goals for Tess Corners Creek. The total present worth of this alternative including local sewer rehabilitation would be $11.0 million. The annual O&M would be $0.205 million.

5.2.1.3.2 Upgrade Treatment, Discharge to Big Muskego Lake: The proposed AST plant for discharge to Big Muskego Lake would be identical to the plant for discharge to Tess Corners Creek except postaeration would not be necessary. The effluent outfall to Big Muskego Lake would consist of 4,500 feet of 24-inch gravity sewer. The outfall would run south to Durham Road and then southwest across the marshy area surrounding the lake. This construction would disrupt wildlife habitat and could affect fish spawning which occurs in the near-shore area of the lake. The construction impacts at the plant site would be identical to those of the Tess Corners Creek alternative. The plant would meet the WPDES effluent limits for discharge to Big Muskego Lake but the increased loads of phosphorus and nitrogen would sustain the continued eutrophication of the lake. Tess Corners Creek would become intermittent if no other treatment plants were to discharge to it. The creek would meet DNR water quality standards at well as recommended 208 Plan goals. The total present worth of the treatment plant, conveyance and local sewer rehabilitation would be $11.13 million. The annual O&M would be $0.287 million.

5.2.1.3.3 Summary: The costs of the feasible Muskego Northeast WWTP alternatives are summarized below:

Alternative	O&M ($)	Total Present Worth ($ x 10^6)
Upgrade Treatment Discharge to Tess Corners Creek Tributary	285,400	11.00
Upgrade Treatment Discharge to Big Muskego Lake	286,500	11.13

The costs for these two alternatives are essentially equal. However, environmentally neither alternative is desirable because of their impacts on water quality. The MWPAP did not analyze a land application alternative in their detailed analysis.

The EIS study team has; however, developed the costs of such an alternative based on the MWPAP costs for a land application infiltration/percolation plant to serve all of Muskego. (This plant is discussed later under Alternative B.) Based on this analysis, the total present worth of the plant plus local rehabilitation and conveyance to the land application site would be approximately $9.50 million. The annual O&M would be approximately $0.300 million.

This cost is lower than either of the surface discharge alternatives. The aerated lagoons and the infiltration/percolation ponds would be located in the Town of Vernon southeast of the intersection of State Highway 15 and County Road F. The lagoon system would cover approximately 12.1 acres and there would be seven ponds each covering approximately 4.8 acres. There is sufficient land at the site for the ponds, the lagoons and a 500 foot buffer from all roads and residences.

The conveyance route to the application site would be 8.6 miles in length. It would begin at the existing plant site and run west through an easement along Easy Street, through another easement and along Roger Drive to Mystic Drive. The pipe would then proceed north on Mystic Drive to Woods Road, southwest along Woods Road to State Highway 24 (Janesville Road), southwest on Janesville Road to Edgewood Avenue, west on Edgewood Avenue to County Road F, and north on County Road F to the application site. The route would contain four river crossings. Figure 5-2 shows the proposed land application site and conveyance route.

The infiltration/percolation alternative for the Northeast WWTP would permit the abandonment of a treatment plant in a growing residential area. DNR water quality standards would be achieved in Tess Corners Creek and no additional pollutant load would be added to Big Muskego Lake. Construction impacts along the conveyance route would be short-term and mostly along existing roadways. The most inconvenience and disruption would occur in the housing area west of the existing plant. It would be necessary to acquire from 50 to 100 acres of agricultural land in the Town of Vernon. There would be the same potential for groundwater pollution as was discussed in detail for the Germantown infiltration/percolation alternative (Section 4.3.2).

5.2.2 Muskego Northwest WWTP

5.2.2.1 Introduction: The Muskego Northwest plant is located in central Muskego on the northwest side of Big Muskego Lake. The plant services 2.4 square miles with approximately 1,900 building connections.

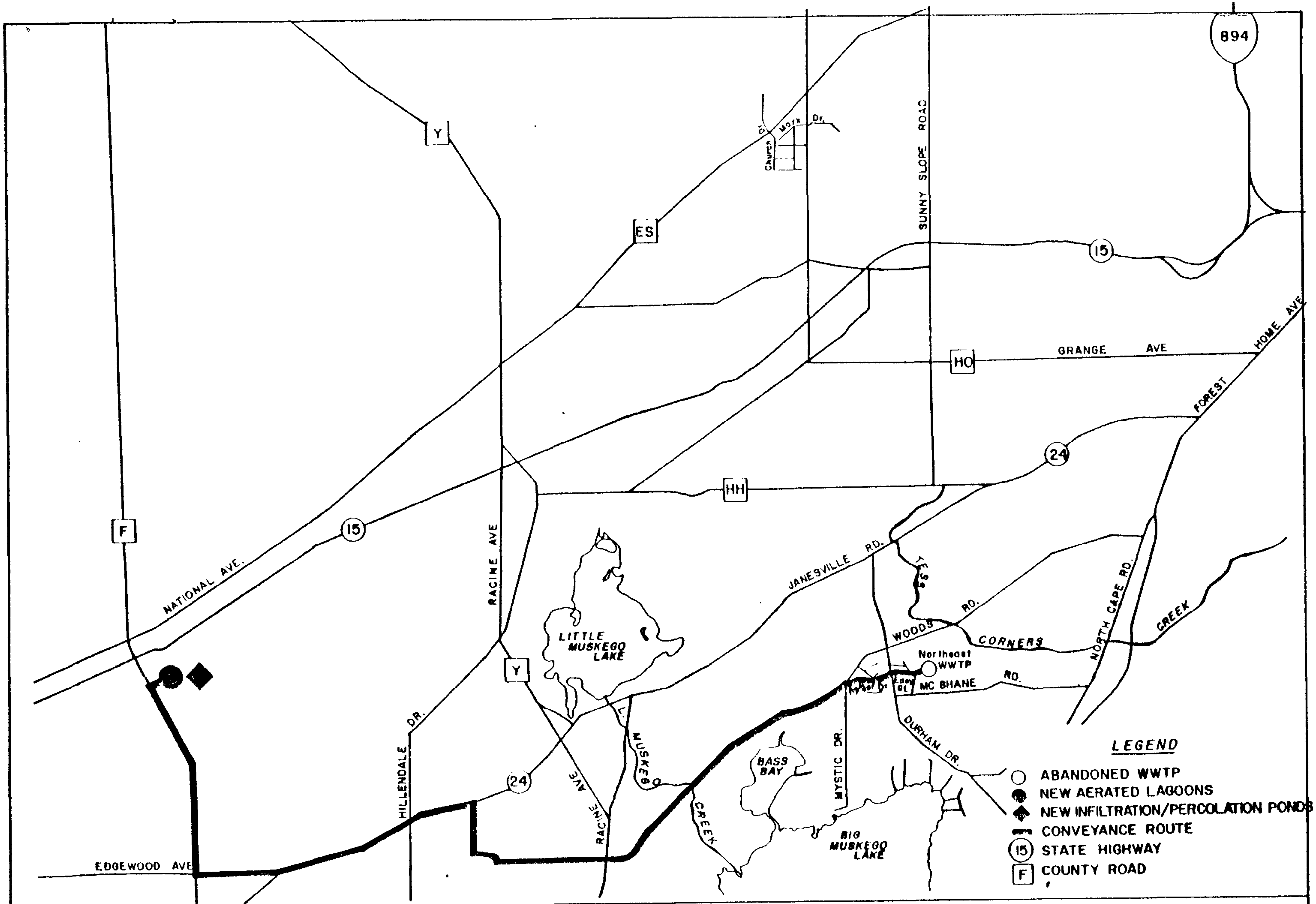


FIGURE 5-2

DATE November 1980

MUSKEGO NORTHEAST ALTERNATIVE A LAND APPLICATION SITE AND CONVEYANCE ROUTE

SOURCE ESEI

PREPARED BY ESEI EcolSciences ENVIRONMENTAL GROUP

The sewer system consists of 32.3 miles of gravity sewer ranging from 8 inches to 42 inches in diameter with 5 lift stations. There are no regular relief devices in the system but an auxiliary pump is available if flows exceed the capacity of the Woods Road lift station. The system is reported to be in good condition. The Department of Public Works of the City of Muskego operates an inspection and cleaning program on a block by block basis, noting any major problems with the system. An I/I study performed by the MMSD identified excessive amounts of clear water in the system during wet weather. The City of Muskego has had a clear water ordinance since 1953 which requires sump pumps in all buildings.

The Muskego Northwest treatment plant is located south of Woods Road approximately 1 mile east of the intersection of Woods Road and Racine Avenue (Figure 5-3). The plant is surrounded completely by open or agricultural land. Some residential units are located along Wood Road but the nearest house is over 600 feet from the plant site. Big Muskego Lake lies approximately one-half mile southeast of the plant.

Noise and odors are not a problem at the plant. Because of its isolated location potential impacts are considered slight. Trees screen much of the plant from view and the facility is almost unnoticeable from the road.

The Muskego Northwest WWTP was originally constructed in 1966 as a series of quiescent stabilization ponds. In 1971, subsurface aeration was added. Phosphorus removal was added in 1977. The present plant consists of a lift station, an 8.7 acre aerated lagoon, a 4.2 acre aerated lagoon, a 4.8 acre aerated lagoon, and a chlorine contact chamber. Effluent is discharged to Little Muskego Creek, a tributary to Big Muskego Lake. The lagoons were designed with excess capacity to accumulate solids.

5.2.2.1.1 Effluent Limits: The Muskego Northwest WWTP is registered under the Wisconsin Pollution Discharge Elimination System and operations are regulated by the limits of its discharge permit, number WI-0021750. This permit was issued July 29, 1974 and expired March 31, 1979. The permit has not been renewed because of problems meeting permit requirements for suspended solids and phosphorus. These problems are most severe during warm weather when algae grow in the lagoons. As with the Northeast WWTP, the City and the DNR are involved in a number of actions aimed at ending the sewage treatment problems at the Northwest WWTP.

The effluent limits in the expired permit are outlined below. Also listed are the effluent limits set by the DNR for possible future discharges to the Lake Michigan basin (Tess Corners Creek) and the Fox River basin (Big Muskego Lake).

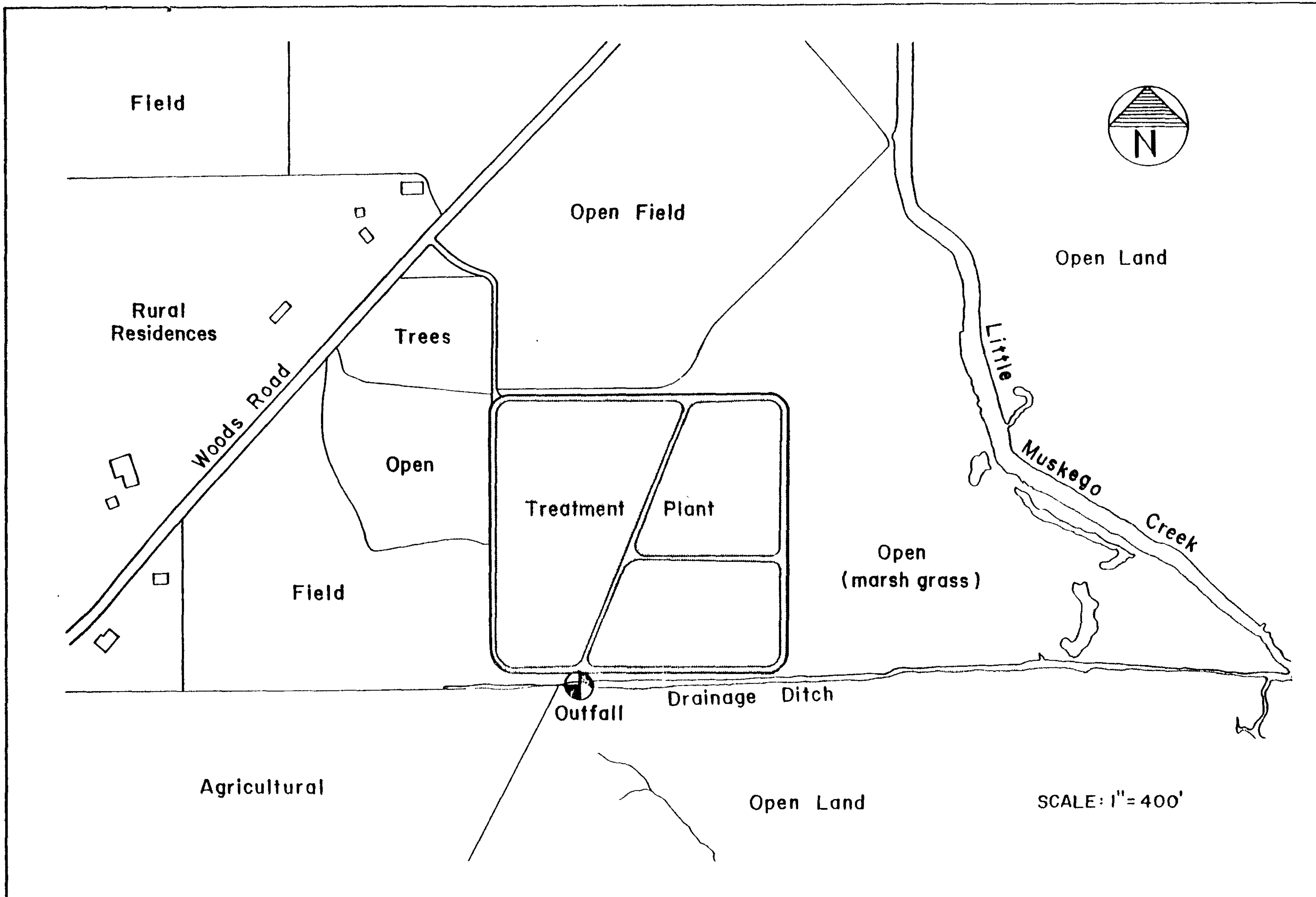


FIGURE 5-3

DATE NOV 1980

MUSKEGO NORTHWEST WWTP

SOURCE SEWRPC

PREPARED BY ESEI EcolSciences ENVIRONMENTAL GROUP

Parameters	Present	Tess Corners Creek	Big Muskego Lake
BOD_5 (mg/l)	30 (mo.avg.)	15 (mo.avg.) 30 (daily max.)	10 (wk.avg.)
Suspended solids (mg/l)	30 (mo.avg.)	20 (mo.avg.) 30 (daily max.)	10 (wk.avg.)
Fecal Coliforms			
(#/100 ml)	200 (mo.avg.)	400 (30 day avg.)	400 (30 day avg.)
Phosphorus (mg/l)	1.0 (mo.avg.)	1.0 (mo.avg.)	1.0 (wk.avg.)
NH_3-N (mg/l)			
(May to Oct)	--	3.0 (wk.avg.)	2.0 (wk.avg.)
(Nov to Apr)	--	6.0 (wk.avg.)	2.0 (wk.avg.)
PH (standard units)	6.0 - 9.0	6.0 - 9.0	6.0 - 9.0
Residual Chlorine			
(mg/l)	--	0.5 (max.)	--
Dissolved Oxygen			
(mg/l)	--	4.0 (min.)	--

5.2.2.1.2 Wastewater Flows: The average daily design flow and peak design flow of the existing Northwest WWTP are 0.7 MGD and 1.08 MGD respectively. Existing wastewater flows and loads were determined by the MMSD based on their I/I study. Estimated year 2005 flows and loads were based on SEWRPC population forecasts, estimated I/I removals, and the proposed water conservation program. Wastewater flows in the Northwest WWTP sewer area are expected to increase by 204% by 2005. Therefore, a 10-year staging period was used.

The existing and future wastewater flows and loads and populations for the Northwest WWTP service area are listed below.

	1978	1995	2005
Average Daily Base Flow (MGD)	0.45	0.74	0.92
Maximum Daily Flow (MGD)	--	2.67	2.90
Peak Flow Rate (MGD)	--	4.04	3.83
BOD_5 Loading (lb/day)	370	1,220	1,730
SS Loading (lb/day)	460	1,430	2,010
Population Served	6,050	10,111	12,500

1 MGD = 3,785 Cubic Meters/Day
1 Pound = 0.454 Kilogram

5.2.2.1.3 Existing Plant Conditions: The WWTP is generally in good condition. Occasional problems are experienced with clogging of the aeration equipment. This clogging places excessive back pressure on the blower equipment which increases blower maintenance requirements and reduces service life. The lagoons are in good condition with no known leaks. The lift station is in good condition, but it is 12 years old. The plant has no auxiliary power supply. All structures should remain useful through the year 2005. Mechanical equipment would require replacement prior to the end of the planning period as part of normal maintenance.

5.2.2.2 Preliminary Alternatives: Alternatives considered for the Muskego Northwest WWTP included no action, upgrade O&M, expansion, upgrade and discharge to the Lake Michigan basin or the Fox River basin, and land application of effluent.

- No action

  The existing facilities do not consistently meet discharge permit requirements for suspended solids and phosphorus. The service population is expected to increase to 12,500 persons, augmenting average daily flows to 0.92 MGD, with peak flows at 5.83 MGD. This increase in flow would lead to further effluent violations and would hydraulically overload the plant. The WWTP is presently operating without a valid WPDES permit. Improvements would be needed before a permit could be reissued or the plant would have to be abandoned.

- Upgrade O&M

Upgrading the O&M of the present plant would have little effect on the plant's ability to meet future effluent limits. The capacity of the existing plant would be exceeded. In addition, the plant would not have the necessary unit processes to meet the effluent limits for continued discharge to Big Muskego Lake.

- Expand Existing Facilities

An expanded, well operated Northwest WWTP would be able to meet some of the parameters required of its future effluent limits for discharge to Big Muskego Lake. However, an expanded plant would not be able to meet limits for ammonia, BOD_5, suspended solids and probably phosphorus.

- Upgrade Treatment and Discharge to Fox River Basin

It was not deemed technically feasible to upgrade the existing lagoons in order to meet the more stringent future limits for discharge to Big Muskego Lake. Accordingly, for this alternative the existing lagoons would be abandoned and replaced with a two-stage activated sludge plant with ammonia and phosphorous removal capabilities followed by filtration and chlorination. The initial capital cost for this alternative would be $3.90 million. The annual O&M would be $0.10 million.

- Upgrade Treatment and Discharge to Lake Michigan Basin

In order to discharge to Tess Corners Creek, a new treatment plant similar to the plant proposed for discharge to Big Muskego Lake would be required. However, postaeration facilities would have to be added to the plant to meet minimum dissolved oxygen levels. In addition, 18,000 feet of force main would be required to convey the treated wastewater to Tess Corners Creek. The initial capital cost of this alternative including new treatment and conveyance facilities would be $5.35 million. The annual O&M would be $0.10 million.

- Land Application of Effluent

As an alternative to discharging to Big Muskego Lake or Tess Corners Creek, four land application alternatives were evaluated: normal and high rate irrigation, infiltration/percolation, and marsh application. The land required, the distance to the nearest possible site, and the cost of each alternative are summarized below.

Alternative	Required Area (acres)	Distance to Site (miles)	Treatment Capital Cost ($ x 10^6)	Annual O & M ($)
Normal Rate Irrigation	910	2	7.00	190,000
High Rate Irrigation	330	2	10.40	230,000
Infiltration/ Percolation	44	5	5.30	220,000
Marsh Application	370	10.7	10.70	300,000

The costs of the preliminary alternatives capable of meeting the treatment requirements for the Northwest WWTP during the planning period are summarized below.

Alternative	Treatment Capital Cost ($ x 10^6)	Annual O&M ($)
Upgrade Treatment Discharge to Big Muskego Lake	3.90	100,000
Upgrade Treatment Discharge to Tess Corners Creek	5.35	100,000
Land Application - Normal Rate Irrigation	7.00	190,000
Land Application - High Rate Irrigation	10.40	230,000
Land Application - Infiltration/Percolation	5.30	220,000
Marsh Application	10.70	300,000

The least cost alternative would be to upgrade the existing plant and continue discharging effluent to Big Muskego Lake. However, there are potentially major adverse water quality impacts if effluent discharges to Big Muskego Lake continue. Also the City does not favor continued discharge. Discharge to Tess Corners Creek or to an infiltration/percolation system are the next least costly alternatives and they would eliminate the Big Muskego Lake discharge. Consequently, they and the Big Muskego Lake discharge alternative were evaluated in further detail.

5.2.2.3 Feasible Alternatives

5.2.2.3.1 Upgrade Treatment: The treatment plants for discharge to Big Muskego Lake and Tess Corners Creek would be very similar. Both treatment plants would require an aerated grit chamber, first stage aeration basis, intermediate clarifiers, second stage nitrification basins for ammonia removal, final clarifiers, filters, and chlorination facilities. In order to meet minimum dissolved oxygen levels, postaeration would also be required for discharge to Tess Corners Creek. Both plants would aerobically digest solids and apply them to agriculutral land or dispose of them in certified landfills.

Both plants would result in the abandonment of the existing lagoons. The southwest corner of the lagoons would be converted to an aerated sludge storage lagoon. New process expansion would require five acres of land to the west of the existing lagoons in an area currently zoned suburban residential. There are currently very few houses near the existing lagoons. However, the expanded plant would be built in the direction of some existing housing.

Although both plants would meet their future WPDES effluent limits, the impacts of each plant on their respective receiving water would be very different. The plant discharging to Big Muskego Lake would cause an increase in the phosphorus and nitrogen loads to the lake. These increased loads would foster the accelerated eutrophication of the lake.

If the upgraded Northwest plant were to discharge to Tess Corners Creek, all DNR water quality standards would be met except for occasional un-ionized ammonia violations. These violations could occur during Q_{7-10} flow conditions depending on the temperature and pH conditions of the creek. There would be an increase in phosphorous loads to the creek. Since Tess Corners Creek is tributary to Whitnall Park Pond, this added phosphorous load would contribute to the long-term eutrophication of the pond. The MMSD concluded that both phosphorus and un-ionized ammonia 208 Plan water quality goals for Tess Corners Creek would not be met.

The present worth of the new treatment plant to discharge to Big Muskego Lake including local sewer rehabilitation would be $10.29 million. The annual O&M would be $0.282 million.

As discussed in the analysis of preliminary alternatives, discharge to Tess Corners Creek would require 18,000 feet of force main. The force main would run from the new plant northeast on Woods Road to Mystic Road, south on Mystic Road to Roger Drive, east on Roger Drive across an easement to Easy Street, and east on Easy Street across another easement to the tributary to Tess

Corners Creek. This force main would cause some traffic disruption on Woods Road and some construction noise and dust impacts to the houses along Mystic Drive, Roger Drive and Easy Street. This conveyance route is shown in Figure 5-4.

The total present worth of the new Northwest plant discharging to Tess Corners Creek including new outfall conveyance and local sewer rehabilitation would be $13.1 million. The annual O&M would be $0.309 million.

5.2.2.3.2 Land Application - Infiltration/Percolation: The proposed infiltration/percolation land application system for the Northwest plant would consist of aerated lagoons at the existing plant site and infiltration/percolation ponds at a site in the Town of Vernon. In order to upgrade and enlarge the existing lagoons, approximately 62,000 cubic yards of fill would be brought in to construct new dikes. The lagoons would not be dug any deeper than they are now because of the high groundwater in the area. The upgraded lagoons would be lined on the interior slopes to prevent exfiltration and erosion due to wave action.

The infiltration/percolation pond site in Vernon would require approximately 74 acres of agricultural land southwest of the intersection of State Highway 15 and County Road F. The conveyance system to the ponds would require approximately 30,200 feet of 16-inch force main and one pump station. The conveyance route would run from the lagoon site west and north along Woods Road to State Highway 24 (Janesville Road), southwest along Janesville Road to Edgewood Avenue, west along Edgewood Avenue to County Road F, north on County Road F to Cheri Avenue, west on Cheri Avenue, and finally north to the pond site in Section 11 of the Town of Vernon. The entire route would be along existing roadways. There would be one stream crossing. The proposed conveyance route and infiltration/percolation pond site are shown in Figure 5-5. The impacts of the land application system would be identical to those identified in the discussion of the Germantown infiltration/percolation system (Section 4.3.2) including the potential for groundwater pollution. The system would be considered an alternative technology and would be eligible for 85% federal funding if the system were part of the cost-effective areawide pollution abatement program.

The benefits to water quality of this alternative would be the elimination of the existing plant's phosphorus and nitrogen loads to Big Muskego Lake. This reduction in nutrient loads would slow the lake's eutrophication. In conjunction with the 208 Plan, DNR water quality standards would be achieved in Tess Corners Creek. The MMSD has concluded that recommended 208 Plan water quality goals would also be achieved. The present worth of this alternative including conveyance and local sewer rehabilitation would be $10.25 million. The annual O&M would be $0.220 million.

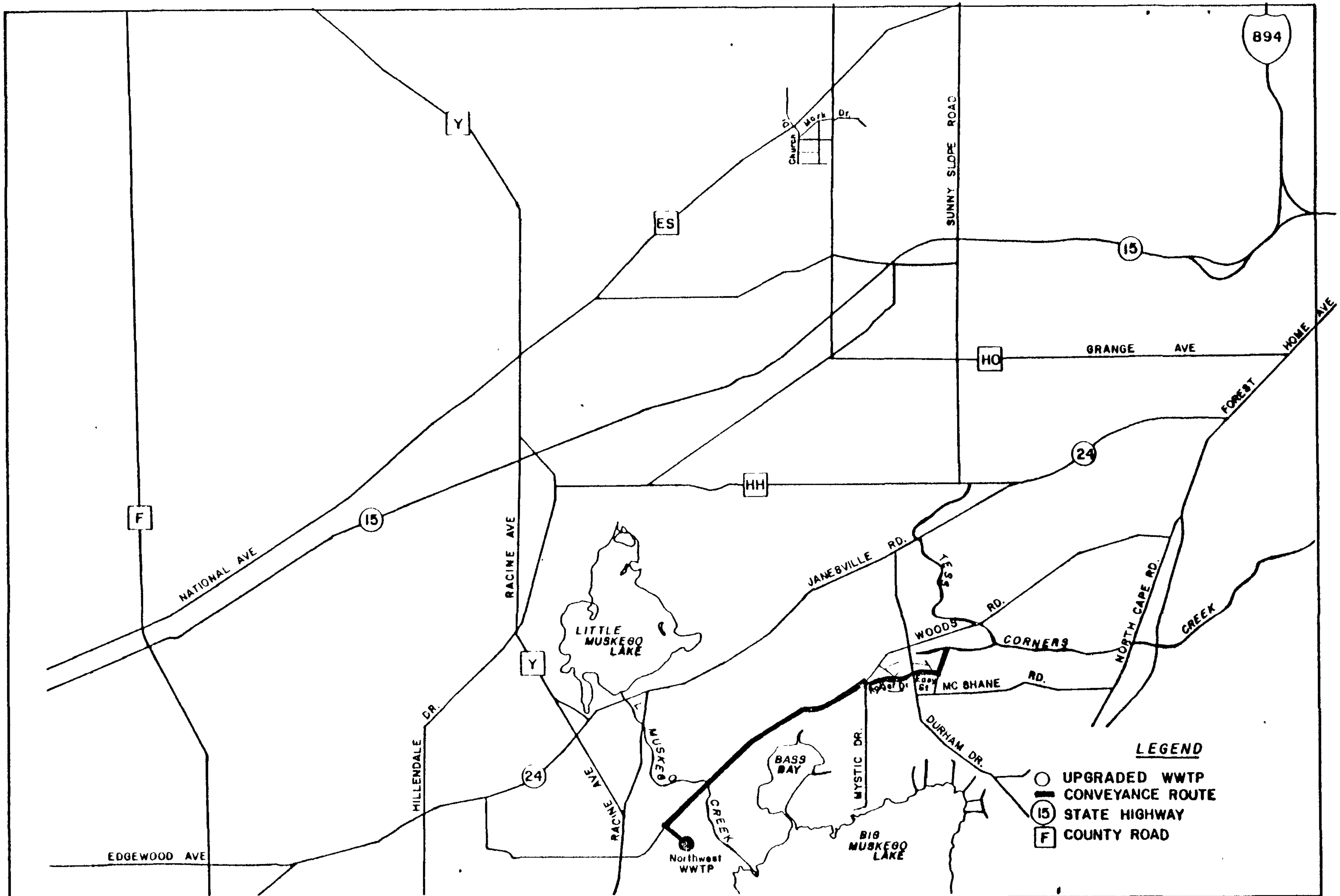


FIGURE 5-4

DATE November 1980

MUSKEGO NORTHWEST ALTERNATIVE A TESS CORNERS
CREEK OUTFALL CONVEYANCE ROUTE

SOURCE ESEI

PREPARED BY ESEI EcolSciences ENVIRONMENTAL GROUP

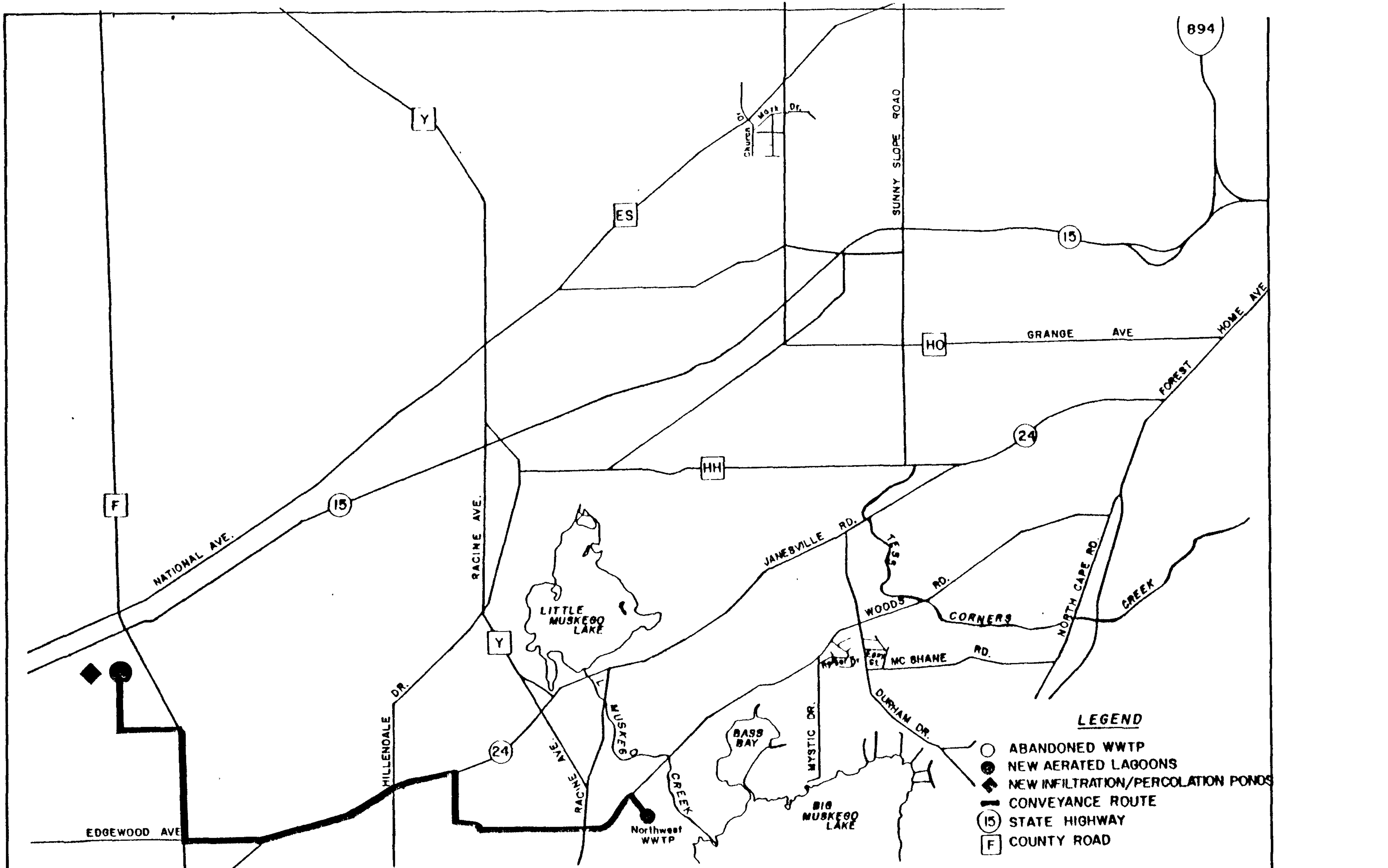


FIGURE 5-5 DATE November 1980	MUSKEGO NORTHWEST ALTERNATIVE A LAND APPLICATION SITE AND CONVEYANCE ROUTE	SOURCE ESEI PREPARED BY ESEI EcolSciences ENVIRONMENTAL GROUP

5.2.2.3.3 Summary: The costs of the feasible alternatives for serving the Muskego Northwest service area are summarized below.

Alternative	Annual O&M ($)	Total Present Worth ($ x 10^6)
Upgrade Treatment Discharge to Big Muskego Lake	309,200	13.10
Upgrade Treatment Discharge to Tess Corners Creek	282,100	10.29
Land Application - Infiltration/ Percolation	220,300	10.25

The least cost alternative for serving the Muskego Northwest service area would be to construct an infiltration/percolation land application system. This system would also have the greatest environmental benefits in terms of water quality improvement. However, it would require the greatest amount of new land for construction.

5.3 Alternative B

Under Alternative B a single WWTP would serve the entire developed portion of Muskego in the planning area. This alternative was developed at the request of the City as a means of abandoning the very unpopular Northwest WWTP.

5.3.1 Northeast (B)

5.3.1.1 Introduction: The City-owned land south of McShane Road was chosen as a suitable site for the Northeast (B) WWTP. Because the City did not want to continue discharging to Big Muskego Lake, discharge to the Lake Michigan basin was the only surface discharge considered.

5.3.1.1.1 Effluent Limits: The effluent limits for discharge to Tess Corners Creek are outlined below.

Parameter	Future Limit
BOD_5 (mg/l)	15 (mon. avg.)
	30 (daily avg.)
Suspended Solids (mg/l)	20 (mon. avg.)
	30 (daily avg.)
Fecal Coliform (#/100 ml)	400 (30 day avg.)
pH (standard units)	6.0 - 9.0
NH_3-N (mg/l) (May-Oct)	3 (wk. avg.)
(Nov-Apr)	6 (wk. avg.)
Dissolved Oxygen (mg/l)	4 (min.)
Residual Chlorine (mg/l)	0.5 (max.)
Phosphorus (mg/l)	1 (mon. avg.)

Discharges in the Fox River basin other than Big Muskego Lake would be possible. The two closest discharge locations would be the Wind Lake Canal and Deer Creek, both approximately five miles from the proposed plant site. There would be little, if any, advantage in discharging to these surface waters because the effluent limits would be very similar to those required for discharge to Tess Corners Creek. The outfall conveyance costs would also be considerable.

5.3.1.1.2 Wastewater Flows: The service area of the Northeast (B) WWTP would be the combined service area of the Northeast WWTP and Northwest WWTP service areas. Accordingly, both the existing and future wastewater flows and loading and populations were computed in the same manner as the Alternative A values. These MMSD estimated values are listed below.

	1978	1995	2005
Average Daily Base Flow (MGD)	0.84	1.50	1.98
Maximum Daily Flow (MGD)	--	5.80	6.07
Peak Flow Rate (MGD)	--	7.44	7.85
BOD_5 Loading (lb/day)	1,020	3,260	4,680
SS Loading (lb/day)	980	3,540	5,700
Population Served	11,000	17,900	21,960

1 MGD = 3,785 Cubic Meters/Day
1 Pound = 0.454 Kilograms

The 136% increase in base flows between the current situation and 2005 resulted in the selection of a 10-year staging period.

5.3.1.2 Preliminary Alternatives: The alternatives which were considered during preliminary analyses were treatment and discharge to the Lake Michigan basin and land application.

- Treatment and Discharge to Lake Michigan Basin

  In order to meet the expected effluent limits for discharge to Tess Corners Creek, a new WWTP with a two stage activated sludge process, filtration, disinfection, and post-aeration would be built. The existing Northwest WWTP lagoons would be abandoned and connected to the new Northeast WWTP via a combination force main gravity sewer. This connection would proceed northeast along Woods Road and then east to the existing Northeast plant site. The total Muskego wastewater flows would then be treated at the new plant. The initial capital cost of this alternative including the new plant and conveyance would be $11.55 million. The annual O&M would be $0.260 million.

- Land application of Effluent

  All four land application alternatives were considered for a new Northeast WWTP. During preliminary analysis, it was assumed pretreatment would occur at the new Northeast plant site using an activated sludge secondary level of wastewater treatment. For marsh application fine screens would be added to the process and postaeration would be provided at the application site. The land required, distance to the nearest possible site and cost of each alternative is outlined below.

Alternatives	Required Area (acres)	Distance to Site (miles)	Treatment Capital Cost ($ x 10^6)	Annual O & M ($)
Normal Rate Irrigation	1,900	6.5	20.75	280,000
High Rate Irrigation	720	6.5	32.45	370,000
Infiltration/ Percolation	84	9.5	15.15	340,000
Marsh Application	8,810	13.8	24.16	520,000

Comparing the costs of the land application alternative with the cost of discharging to Tess Corners Creek shows that discharging to Tess Corners Creek would be the least costly. However, the water quality impacts of a relatively large discharge (1.98 MGD average daily base flow) on Tess Corners Creek could be significant. Accordingly, the least cost land application alternative, infiltration/percolation, was also considered during detailed analysis.

Muskego. The aerated lagoons and the infiltration/percolation ponds would be located at the Town of Vernon site discussed in Alternative A.

The lagoon system would cover approximately 22 acres. There would be seven ponds each about 9.1 acres in size. The total system including buffer land would require approximately 115 acres of agricultural land.

The conveyance route to the land application site would be 8.6 miles in length. The route would contain four river crossings. The conveyance pipe would be a 20-inch force main constructed at a typical six foot depth. Four pump stations would be required. This route would be identical to the route described for the Northeast WWTP infiltration/percolation system shown in Figure 5-2.

The infiltration/percolation alternative to serve all of the developed portions of Muskego would permit the abandonment of both the Northeast and Northwest WWTPs. Abandonment of the Northeast WWTP would make further residential development in that area of Muskego more attractive. DNR water quality standards would be achieved in Tess Corners Creek and no additional pollutant load would be added to Big Muskego Lake. Construction impacts along the conveyance route would be short-term in nature and mostly along existing roadways. The most inconvenience and disruption would occur in the housing area west of the existing Northeast plant. The MMSD concluded that the 208 Plan recommended water quality goals would also be achieved.

5.3.1.3.3 Land Application - Infiltration/Percolation (EIS): The EIS study team during its review of the MWPAP detailed analysis, proposed that the existing lagoons at the Northwest WWTP be rehabilitated to provide pretreatment for all Muskego wastewater flows prior to land application by infiltration/percolation in Vernon. The aim of this proposal was to possibly lower costs by utilizing an existing lagoon system and by reducing the amount of land to be purchased in Vernon. The impacts on water quality in Big Muskego Lake or Tess Corners Creek would not change. The conveyance route would also not change. However, because it would be easier to pump treated wastewater, only two pump stations would be required.

The analysis of the rehabilitation requirements for the Northwest lagoons identified a number of impacts. Firstly, because it would not be possible to enlarge the existing lagoons by digging them deeper, a substantial amount of fill would have to be acquired in order to build higher lagoon levees. The cost for this additional fill and the need to maintain treatment during rehabilitation would exceed the cost of constructing new lagoons by approximately $800,000. Secondly, the lagoon rehabilitation could require work in the wetlands and floodplain that surrounds the existing lagoons. The benefits of rehabilitating the Northwest lagoons would be a 17 acre reduction in the amount of agricultural land required in Vernon.

The total present worth of this alternative was determined by the EIS study team to be approximately $15.49 million.

5.2.2.3.4 Summary: The cost of the feasible alternatives for serving all of Muskego on a local level are summarized below.

Alternative	Annual O&M ($)	Total Present Worth ($ x 10^6)
Upgrade Treatment Discharge to Tess Corners Creek	448,100	16.72
Land Application-Infiltration/ Percolation (Vernon)	435,200	14.57
Land Application-Infiltration/ Percolation (Northwest) (EIS Alternative)	435,200	15.49

The least cost alternative for serving all of Muskego with one wastewater treatment facility would be to construct an infiltration/percolation system in Vernon and abandon the two existing WWTPs. This system would have the greatest environmental benefits in terms of water quality improvement. However, it would require the acquisition of new land and could result in groundwater pollution.

5.4 Final Muskego Alternatives

There are three final alternatives for serving the developed areas of Muskego during the planning period. The first is a combination of the final Northeast and Northwest WWTP alternatives developed for Alternative A. Both of these alternatives involve infiltration/percolation systems and would result in the elimination of WWTP discharges to Tess Corners Creek and Big Muskego Lake. The total present worth of this alternative would be $19.75 million. The total annual O&M would be approximately $0.520 million.

The second alternative is a single infiltration/percolation WWTP located in the Town of Vernon and serving all of Muskego. This alternative would also eliminate effluent discharges to Big Muskego Lake and Tess Corners Creek. The total present worth of this alternative would be $14.57 million.

The environmental impacts of both the one-plant and two-plant alternatives are nearly identical. They both involve conveyance networks along the same route and land application in the same areas of Vernon. They both would improve water quality. However, the one-plant alternative would be much less expensive and would not require the continued operation of a WWTP in the sensitive wetlands surrounding Big Muskego Lake. The cost savings of the single plant would be expected because of economy-of-scale factors. Also the cost to rehabilitate the Northwest lagoons and continue operation of the plant during this work was found to be more expensive than the construction of a new lagoon system. For these reasons the one-plant infiltration/percolation alternative would be the preferred local alternative for Muskego.

The third alternative for Muskego would be the regional approach of connecting to the MMSD. This approach would require the construction of a connection from the Northwest WWTP to the Northeast WWTP. This connection would be identical to the connection discussed under Alternative B. The remainder of the connection to the MMSD would consist of a 20-inch force main and one lift station. The force main would begin at the Northeast plant site and would run due east along an easement to Forest Home Avenue, northeast along Forest Home Avenue to a point directly east to College Avenue. There it would proceed directly east to College Avenue where it would connect to an 84-inch MIS.

The proposed construction corridor contains a variety of land uses including residential, commercial, open space, and community facilities. This construction would cause noise and dust impacts typical of open cut sewer construction. The force main would cross Tess Corners Creek one time and its tributary near the Northeast plant one time. Sedimentation of the creek could occur if proper erosion control construction methods are not employed. Any impacts to Tess Corners creek could also affect Whitnall Park Pond. The connection would have long-term benefits to Tess Corners Creek by eliminating wastewater treatment plant discharges. All DNR water quality standards for Tess Corners Creek would be met. Pollutant loads to Big Muskego Lake would also be reduced due to the abandonment of the Northwest WWTP. The MMSD concluded that the recommended 208 Plan water quality goals for Tess Corners Creek would also be achieved.

The force main would be constructed at a depth of 6 to 10 feet. Groundwater is present along the construction route at depths of less than 10 feet during periods of high groundwater. Other areas have groundwater at 10 to 30 foot depths and, in a smaller area, groundwater may be found at depths greater than 30 feet.

There is one known archaeological site along the construction route. It is located north of the intersection of St. Martins Road and Cape Road just South of Tess Corners Creek.

The cost of the connection alternative includes conveyance from the Northwest plant to the College Avenue MIS plus the cost of the rehabilitation of local Muskego sanitary sewers. The total present worth of the connection alternative would be $5.65 million. The annual O&M would be $0.044 million.

The cost of the final alternatives for serving the City of Muskego are summarized below.

Alternative	Annual O&M ($)	Total Present Worth ($ x 10^6)
Northeast and Northwest WWTPs Infiltration/Percolation (Alternative A)	520,300	19.75
Northeast WWTP Infiltration/Percolation (Alternative B)	435,200	14.57
Connect to MMSD	43,700	5.65[1]

[1]Does not include MMSD capital or O&M costs to treat Muskego wastewater. (See Section 3.4 for further discussion.)

A review of the preliminary and final costs for both the Northeast WWTP and Northwest WWTP alternatives as developed under Muskego Alternative A shows that many of the alternatives eliminated due to excessive cost had costs less than some of the final alternatives. During its review of the costs of Northeast WWTP alternatives, the EIS study team determined that the infiltration/percolation alternative was actually less costly than the upgrading of the plant for surface discharge. The infiltration/percolation alternative had been eliminated due to its apparent high cost during preliminary analysis. The normal rate irrigation alternative preliminary cost was also less than the final surface discharge alternative costs. A similar situation exists for the Northwest WWTP. All of the preliminary costs were less than all or some of the final alternatives costs.

This situation did not occur for the new Northeast WWTP under Alternative B. None of the final alternatives has costs greater than the preliminary alternatives which were eliminated based on cost.

As a result of the inconsistencies in costs under Alternative A, it is possible that a combination of the preliminary alternatives at the Northeast and Northwest WWTPs which were originally eliminated due to excessive costs could produce a total cost lower than the final Muskego Alternative B infiltration/percolation cost. To check this possibility, a cost comparison was made between the total capital and annual O&M costs of the Alternative A normal rate irrigation alternatives at the Northeast and Northwest WWTPs and the total capital and annual O&M costs of the Alternative B infiltration/percolation system. The costs are shown below.

Alternative A	Total Capital ($ x 10^6)	Annual O&M ($ x 10^6)
Northeast WWTP Normal Rate Irrigation	9.70	0.150
Northwest WWTP Normal Rate Irrigation	7.00	0.190
Total	16.70	0.340
Alternative B		
Northeast WWTP Infiltration/Percolation	10.14	0.435

A comparison of these costs shows that the Alternative B infiltration/percolation system would still be the least costly local alternative for treating wastewater in the City of Muskego.

Each of the final alternatives would have the same impacts on water quality because they would eliminate WWTP discharges to Tess Corners Creek and Big Muskego Lake. The land application alternatives would require the purchase of land in the Town of Vernon and could cause groundwater pollution if not operated properly. However, as alternative technology, they would be eligible for increased federal funding if they were part of the most cost effective sewage treatment plan. The location of the connection to the MMSD is shown in Figure 11-1. The location of the Alternative B infiltration/percolation system is shown in Figure 11-2.

Prior to the selection of the preferred wastewater treatment alternative for Muskego, a determination of the MMSD cost to treat Muskego's wastewater will be made. This cost will be added to the $5.65 million cost of the connection in order to determine the actual total present worth cost of this alternative. In the final EIS, EPA, in accordance with NEPA, will describe the preferred alternative for wastewater treatment for Muskego.

This alternative will be based upon findings set forth here and in other sections of this EIS, comments received from various review agencies, and comments received during the public comment period and at the public hearings.

CHAPTER 6

CITY OF NEW BERLIN

6.0 CITY OF NEW BERLIN

6.1 Introduction

At present the eastern portion of New Berlin in the planning area receives wastewater treatment by three means: the MMSD, the Regal Manors Subdivision WWTP, and on-site septic systems. Figure 6-1 shows these service areas.

Two alternatives for local sewer service during the planning period were proposed for New Berlin. The first alternative would expand the Regal Manors WWTP to serve all areas of the New Berlin service area not presently served by the MMSD. The areas currently served by the MMSD would continue to be served throughout the planning period. The second alternative for New Berlin would be the construction of a new WWTP to serve the entire New Berlin service area in the planning area. The northern portion of the Roberts Golf Park and vacant area west of Lower Kelly Lake were identified as possible new treatment plant sites. Both of these local alternatives will be discussed and compared prior to an overall comparison of the impacts of all of New Berlin connecting to the MMSD.

6.2 Alternative A

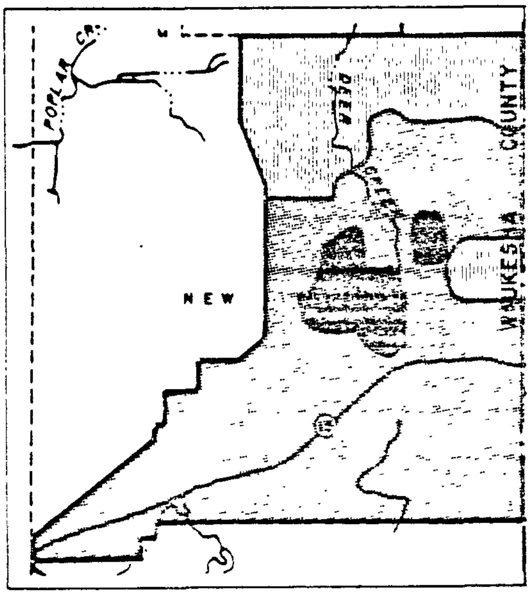
6.2.1 Regal Manors WWTP

6.2.1.1 Introduction: The first local alternative would involve continued use of the Regal Manors WWTP. The Regal Manors WWTP was originally constructed in 1969 to service the Regal Manors and Glen Park subdivisions. The WWTP is located at the end of Harcove Drive east of the intersection of Regal Drive. The Regal Manors subdivision, a medium density residential area, is located adjacent to the plant site on the west and directly across Harcove Drive on the south (See Figure 6-2). Immediately east of the plant is Deer Creek beyond which lie agricultural fields to the east and north of the plant. Directly to the north of the treatment facility lies an abandoned polishing pond. Because of the close proximity of the houses to the site, noise and odors have been a source of constant, potentially severe, impacts. There are no open spaces or trees to buffer the subdivision from the plant.

The present service area is approximately one square mile, with 282 single family, 29 commercial, and one multi-family sewer connections. The conveyance system to the plant consists of 4.2 miles of gravity sewer 8 to 18 inches in diameter and two lift stations. There are no known bypasses in the system. Sewers are cleaned and inspected annually by the City of New Berlin with repairs performed as needed. An I/I analysis of the sewer system conducted by the MMSD showed that the system

CHAPTER 6

CITY OF NEW BERLIN



LEGEND

- - - - - - - - NEW BERLIN CORPORATE LIMITS

———— NEW BERLIN AREA IN THE PLANNING AREA

REGAL MANORS WWTP SERVICE AREA

MMSD SERVICE AREA

ON-SITE SYSTEMS

FIGURE 6-1	NEW BERLIN SERVICE AREAS	SOURCE MMSD
DATE NOV 1980		PREPARED BY ESEI EcolSciences ENVIRONMENTAL GROUP

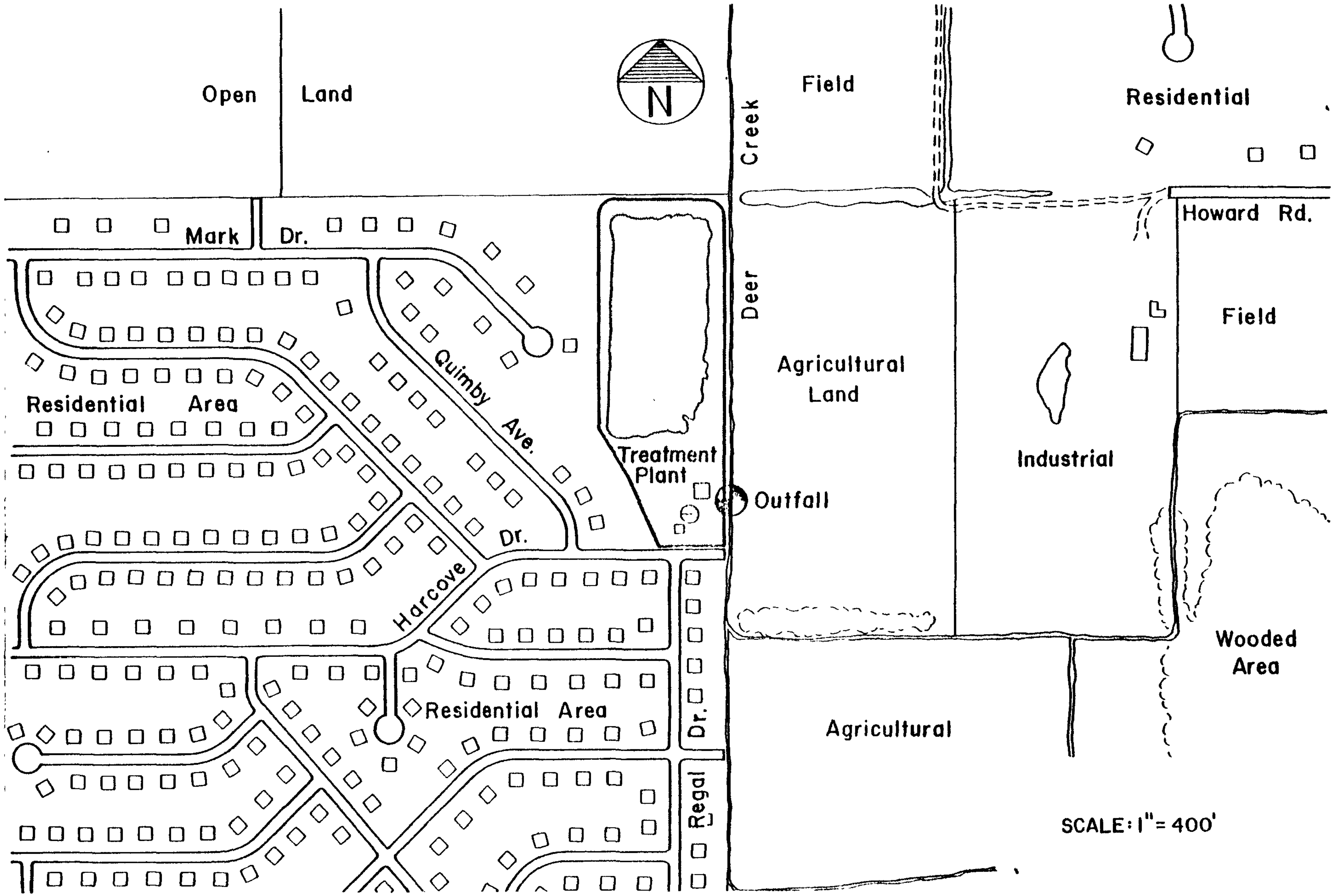


FIGURE 6-2

DATE NOV 1980

REGAL MANORS WWTP

SOURCE SEWRPC

PREPARED BY ESEI EcolSciences ENVIRONMENTAL GROUP

is in good condition and I/I flows are so minimal that removal was not considered cost effective.

Plant processes consist of a comminution basin, chemical addition for phosphorus control followed by flash mixing, aeration basins, final clarifiers, a single media sand filter, a lift station, and a chlorination chamber. Effluent is discharged to Deer Creek, a tributary of the Fox River. Solids are pumped to aerobic digesters. The digested sludge is then spread on drying beds. Once dried, the sludge is used by the New Berlin Parks and Recreation Department as a soil conditioner at City parks and in new subdivision areas. A 1978 expansion program added aeration and clarifier capacity, the sand filter, and phosphorus removal systems.

6.2.1.1.1 Effluent Limits: The Regal Manors treatment plant is registered under the Wisconsin Pollution Discharge Elimination System and regulated under the limits described in its permit, number WI-0028347-2. This permit was issued November 30, 1977, and will expire June 30, 1982. Current effluent limits as well as future limits for discharge to Deer Creek or a new discharge to the Root River are listed below.

Parameter	Present	Future
BOD_5 (mg/l)	20 (mo.avg.) 30 (wk. avg.)	20 (mo. avg.) 30 (wk. avg.)
Suspended Solids (mg/l)	20 (mo. avg.) 30 (wk. avg.)	20 (mo. avg.) 30 (wk. avg.)
Phosphorus (mg/l)	--	1.0 (mo. avg.)
Fecal Coliform (#/100 ml)		400 (30 cons. days)
pH (standard units)	6.0 - 9.0	6.0 - 9.0
Dissolved Oxygen (mg/l)	4.0 (min.)	4.0 (min.)
Residual Chlorine (mg/l)	--	0.5 (max.)

6.2.1.1.2 Wastewater Flows: The existing Regal Manor WWTP was designed for an average daily flow of 0.65 MGD with a peak design capacity of 1.625 MGD. The existing wastewater flows to the Regal Manors WWTP were determined based on the MMSD I/I study. Expected year 2005 flows and loads were estimated by the MMSD based on SEWRPC population forecasts, estimated I/I removals, and the proposed water conservation program. Wastewater flows are expected to increase by 956% by 2005. Accordingly, a 10-year staging period was used.

The existing and future wastewater flows and loads and populations for the Regal Manors WWTP service area are listed below.

	1978	1995	2005
Average Daily Base Flow (MGD)	0.18	1.25	1.90
Maximum Daily Flow (MGD)	--	3.36	4.72
Peak Flow Rate (MGD)	--	4.47	6.22
BOD_5 Loading (lb/day)	210	2,080	4,770
SS Loading (lb/day)	90	3,370	5,300
Population Served	3,230	16,884	24,916

1 MGD = 3,785 Cubic Meter/Day
1 Pound = 0.454 Kilogram

6.2.1.1.3 Existing Plant Conditions: Presently the plant is in very good condition. The structures built in 1978 would remain useful through the planning period. The original package plant would need to be replaced prior to 2005. Mechanical equipment would require replacement on normal maintenance schedules. The sand filter is presently not in operation because of clogging problems. The current problem appears to be excess solids flowing over the weirs in the final clarifiers. The plant operators have reported very low suspended solids in the effluent. Poor sampling technique is felt to be the cause.

6.2.1.2 Preliminary Alternatives: The alternatives considered for the Regal Manors WWTP included no action, upgrade O&M, expansion, upgrading the existing plant with continued discharge to the Fox River basin, discharge to the Lake Michigan basin, and land application of effluent.

° No Action

  As shown in Section 6.2.1.2, the existing WWTP would be inadequate to treat anticipated year 2005 flows. Additional capacity would be required. The peak flows are expected to be four times the peak hydraulic capacity of the existing treatment system.

° Upgrade O&M

  Upgrading the O&M of the existing plant would have little benefit because the plant would still not be large enough to handle anticipated year 2005 flows.

- Expand Existing Facilities

  Expanding the existing facilities would provide the necessary treatment processes and capacity to meet all future effluent requirements except dissolved oxygen. Consequently, by itself, expansion alone would not satisfy the requirements of the planning period.

- Upgrade Treatment and Discharge to Fox River Basin

  In order to continue discharges to Deer Creek the existing plant would be expanded and a postaeration basin would be added to the plant. Land for expansion would be available by filling in the abandoned polishing pond. Capital cost for this alternative including new conveyance to serve a larger area of New Berlin would be $8.00 million. The annual O&M would be $0.240 million.

- Upgrade Treatment and Discharge to Lake Michigan Basin

  The nearest receiving water to the Regal Manors plant in the Lake Michigan basin is the Root River. As discussed earlier the effluent standards for discharge to this river are identical to the Fox River standards. However, additional pumping and conveyance would be required to convey the effluent to the Root River. The cost associated with this additional conveyance would make this alternative less attractive than continuing to discharge to Deer Creek. The capital cost of this alternative including new conveyance to serve a larger area of New Berlin would be $9.00 million. Annual O&M would be $0.240 million.

- Land Application of Effluent

  The existing treatment plant has the necessary unit processes to provide acceptable levels of pretreatment for land application. However, to adequately treat the anticipated increase in future flows, additional capacity would have to be added to the lift station, blowers, and chlorine contact chamber. The package plants would also be replaced.

  Land requirements, the distance to the nearest acceptable site, and estimated costs for the four types of land application considered are indicated below.

Alternatives	Required Area (acres)	Distance to Site (miles)	Treatment Capital Cost ($ x 10^6)	Annual O & M ($)
High Rate Irrigation	620	7.4	26.90	390,000
Normal Rate Irrigation	1,800	7.4	19.80	300,000
Infiltration/ Percolation	80	4.0	12.20	340,000
Marsh Application	760	12.0	--	

No costs were prepared for the Marsh Application alternative because of the distance to the nearest suitable marsh.

The costs for the preliminary alternatives capable of meeting the requirements of the planning period for the City of New Berlin are summarized below.

Alternative	Treatment or Conveyance Capital Cost ($ x 10^6)	Annual O&M ($)
Upgrade Treatment Discharge to Deer Creek	8.00	240,000
Upgrade Treatment Discharge to Root River	9.00	240,000
Land Application - Normal Rate Irrigation	19.80	300,000
Land Application - High Rate Irrigation	26.90	390,000
Land Application - Infiltration/ Percolation	12.20	340,000

The most feasible of the local alternatives for New Berlin's continued operation of the Regal Manor WWTP would be to upgrade treatment and discharge to Deer Creek. The EIS analysis of water quality impacts to Deer Creek indicated that no existing DNR water quality standards would be exceeded. Deer Creek is currently classified as a marginal surface water by the DNR. Accordingly, it has no water quality criteria for ammonia concentrations.

The MMSD water quality analysis was based on 208 Plan recommended water quality goals which include ammonia limits for Deer Creek.

Consequently, during the MMSD detailed analysis of an alternative for upgrading treatment, a nitrification process was added to the treatment system. Because water quality impacts on Deer Creek could still be a problem even with further upgraded treatment, the MMSD also evaluated the least cost land application alternative, infiltration/percolation in further detail. The MMSD did not evaluate any other alternatives further. However, the EIS study team did evaluate an alternative for upgrading the Regal Manors WWTP without adding nitrification processes. This analysis is discussed in detail below.

6.2.1.3 Feasible Alternatives

6.2.1.3.1 Upgrade Treatment, Discharge to Deer Creek: Because of the potential water quality impacts to Deer Creek, further analysis of two local treatment alternatives for the Regal Manors WWTP was undertaken. In order to reduce the possibility of ammonia violations in Deer Creek, the MMSD added a two stage nitrification process to the treatment plant. The new plant would consist of bar screens followed by a grit chamber, primary clarifiers, first stage aeration basins, intermediate clarifiers, second stage aeration basins for ammonia removal, final clarifiers, filters, and chlorination and postaeration facilities. Solids would be anaerobically digested, mechanically dewatered and applied to agricultural land or landfilled.

The construction impacts of the plant expansion would be severe due to the proximity of housing and the necessity of using subdivision roads for all truck traffic. Noise and dust due to construction would be severe for those homes near the plant. The expanded plant could be expected to cause long-term increased noise and odor problems.

The upgraded plant would meet WPDES effluent limits and would also have additional ammonia control. However, recommended 208 Plan water quality standards for ammonia could still not be met according to the MMSD. The increased treatment capacity would allow the abandonment of septic systems and would permit the planned level of growth in New Berlin. The total present worth of this alternative including the new conveyance would be $20.83 million. The annual O&M would be $0.433 million.

If the plant were upgraded without adding the nitrification processes, the intermediate clarifiers and second stage aeration basins could be eliminated. All of the construction impacts of the proposed nitrification plant would also occur for this plant. WPDES effluent limits would be met and DNR water quality standards would be met in Deer Creek. The total present worth of this alternative including the new conveyance would be $19.54 million. The annual O&M would be $0.398 million.

6.2.1.3.2 Land Application - Infiltration/Percolation: As discussed under the Germantown land application alternatives, secondary treatment for land application would be less costly if aerated lagoons are used for pretreatment. In order to adequately treat the expected wastewater flows from the Regal Manors service area, an aerated lagoon system covering 22 acres would be necessary. The treated effluent would be applied to seven infiltration/percolation ponds each covering 9.1 acres. There would not be adequate land at or near the present plant site for either the lagoons or the application ponds. However, there would be sufficient land in the Town of Vernon at a site southeast of the intersection of State Highway 15 and County Road F.

The existing WWTP would be abandoned and a force main would be constructed to the new treatment site. The conveyance system would run from the existing WWTP west along Mark Drive, then north on Church Drive, then southwest along County Road ES (National Avenue), and finally south on County Road F to the application site. The force main would consist of 44,400 lineal feet of 16-inch pipe and three 6.22 MGD pump stations. Figure 6-3 shows the location of the proposed conveyance route and application site.

The force main would be constructed entirely along existing roadways using open cut construction at a typical depth of six feet. A portion of the construction would be through the Regal Manors Subdivision and would cause short-term noise, dust,and traffic congestion impacts.

The abandonment of the existing plant would significantly improve the aesthetics of the area. It would also eliminate the discharge of effluent to Deer Creek. The elimination of this discharge would cause Deer Creek to become an intermittent stream that would be dry most of the year.

The new land application WWTP would provide enough capacity to allow the abandonment of septic systems and permit the planned level of growth in New Berlin. It would be necessary to acquire approximately 80 acres of land in the Town of Vernon. The potential for groundwater pollution and the benefits of using an alternative technology are the same as described for the Germantown land application alternative (see Section 4.32.)

The total present worth of the infiltration/percolation alternative including new conveyance to serve additional areas of New Berlin would be $19.27 million. The annual O&M would be $0.407 million.

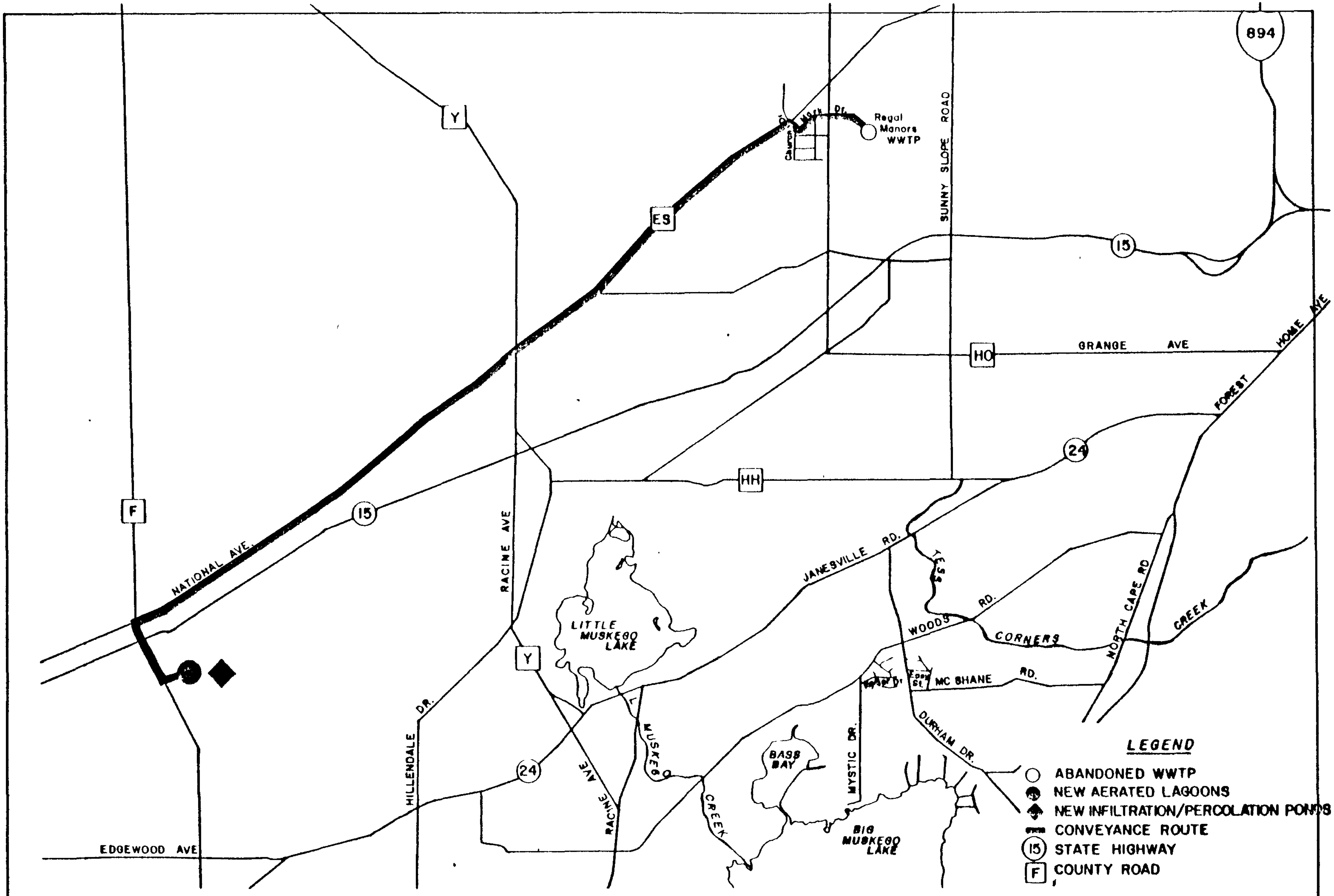


FIGURE 6-3 DATE November 1980	NEW BERLIN ALTERNATIVE A REGAL MANORS LAND APPLICATION SITE AND CONVEYANCE ROUTE	SOURCE ESEI PREPARED BY ESEI EcolSciences ENVIRONMENTAL GROUP

6.2.1.3.3 Summary: The refined costs of the feasible alternatives for serving the Regal Manors service area of New Berlin are summarized below.

Alternative	O&M ($)	Total Present Worth ($ x 10^6)
Upgrade Treatment Discharge to Deer Creek (Ammonia Removal)	432,900	20.85
Upgrade Treatment Discharge to Deer Creek (No Ammonia Removal)	398,000	19.54
Land Application-Infiltration/Percolation	406,900	19.26

These final costs are consistent with the preliminary costs developed for the Regal Manors WWTP.

6.2.1.4 Final Alternative: The least cost of the feasible alternatives for the future Regal Manors service area would be the construction of a new infiltration/percolation WWTP. It would allow the abandonment of the existing plant located in a subdivision and would eliminate a point source to Deer Creek. However, it would be necessary to acquire land in the Town of Vernon.

6.3 Alternative B

6.3.1 Introduction

The evaluation of a new treatment plant to serve all of New Berlin was undertaken at the request of the City. Two potential sites were selected: 1) the Roberts Golf Course near the Root River; and 2) a vacant parcel of land west of Lower Kelly Lake.

6.3.1.1 Effluent Limits: Effluent limits would be identical for discharges to the Root River, Tess Corners Creek, Deer Creek, or Big Muskego Lake. The anticipated future effluent limits are listed below.

Parameter	Future Limit
BOD_5 (mg/l)	10 (wk. avg.)
Suspended Solids (mg/l)	10 (wk. avg.)
Phosphorous (mg/l)	1.0 (mo. avg.)
Fecal Coliform (#/100 ml)	400 (30 day avg.)
pH (standard units)	
(summer)	6.0 - 7.2
(winter)	6.0 - 7.4
NH_3-N (mg/l)	
(summer)	2 (wk. avg.)
(winter)	4 (wk. avg.)
Dissolved Oxygen (mg/l)	6 (min.)

6.3.1.2 Wastewater Flows: The service area of both the proposed Northeast and Southeast WWTPs would include all of the planned sewered area of New Berlin in the planning area. The existing and future wastewater flows and loadings and populations were computed in the same manner as the Alternative A values. These MMSD estimated values are listed below.

	1978	1985	2005
Average Daily Base Flow (MGD)	1.83	4.14	5.39
Maximum Daily Flow (MGD)	--	11.51	12.68
Peak Flow Rate (MGD)	--	15.53	16.47
BOD_5 Loading (lb/day)	5,270	12,600	16,050
SS Loading (lb/day)	6,620	15,000	18,940
Population Served	14,470	38,100	52,000

1 MGD = 3,705 Cubic Meters/Day
1 Pound = 0.454 Kilograms

The 195% increase in base flows between the existing situation and 2005 resulted in the selection of a 10-year staging period.

6.3.2 Preliminary Alternatives

6.3.2.1 Northeast Plant: The Northeast plant could be built at the Roberts Golf Course along the Root River. There is sufficient land at the proposed site to build the plant and provide a 500-foot buffer between the plant and local residences. In order to abandon the Regal Manors plant and connect presently unsewered portions of New Berlin to the Northeast plant, two new interceptors would be necessary. The first would run from the Regal Manors plant southeast through a presently unsewered but fully developed residential area of New Berlin to Grange Road, then east along Grange Road to 124th Street. The second interceptor would run along 124th Street from Grange Road to the proposed plant site.

The alternatives considered for the Northeast plant included treatment and discharge to the Lake Michigan basin, treatment and discharge to the Fox River basin, and land application of effluent.

- Treatment and Discharge to the Lake Michigan Basin

  In order for the Northeast plant to discharge effluent to the Root River, an advanced secondary treatment (AWT) plant capable of meeting the effluent limits listed above would have to be constructed. The capital cost for this alternative including the cost for the two new interceptors would be $35.45 million. The annual O&M would be $1.02 million.

- Treatment and Discharge to the Fox River Basin

  Because effluent limits to Deer Creek are identical to those of the Root River, the same type of AWT plant would be required. Additional conveyance would be required to convey the treated effluent to Deer Creek. The capital cost for this alternative including the cost of all new conveyance would be $39.75 million. The annual O&M would be $1.04 million.

- Land Application of Effluent

  Suitable land for high rate and normal rate irrigation and infiltration/percolation land application systems was found in the Town of Vernon about 10 miles from the Northeast plant site. The closest suitable marsh application site was the Vernon Marsh located about 15 miles southeast of the Northeast site.

  Land requirements, the distance to the potential application sites, and the estimated costs for each of the land application alternatives are outlined below. The costs include both conveyance to the plant and to the land application sites.

Alternatives	Required Area (acres)	Distance to Site (miles)	Treatment Capital Cost ($ x 10^6)	Annual O & M ($)
High Rate Irrigation	1,900	10	77.35	960,000
Normal Rate Irrigation	5,100	10	58.55	760,000
Infiltration/ Percolation	230	10	39.55	820,000
Marsh Application	2,190	15	59.85	1,020,000

6.3.2.2 Southeast Plant: As an alternative to the Northeast plant, another proposed plant to serve all New Berlin in the planning area would be located in southeastern New Berlin west of Lower Kelly Lake. This area is presently undeveloped and has suitable land for the proposed Southeast plant.

An interceptor system similar to the one described for the Northeast plant would be required. In order to abandon the Regal Manors plant, an interceptor would be built southeasterly to Grange Avenue. Another interceptor would be built along 124th Street from Greenfield Avenue south to Grange Avenue, west on Grange Avenue to where it would intersect the Regal Manors interceptor and further west and south to the Southeast plant site.

The alternatives considered for the Southeast plant included treatment and discharge to the Lake Michigan basin, treatment and discharge to the Fox River basin, and land application of effluent.

° Treatment and Discharge to the Lake Michigan Basin

  The effluent limits for discharge to Tess Corners Creek are identical to those for discharge to the Root River and Deer Creek. Consequently, an AST plant would be necessary at the Southeast site. The capital cost for this alternative including the cost for the two new interceptor would be $38.55 million. The annual O&M would be $1.06 million.

° Treatment and Discharge to the Fox River Basin

  Effluent would be discharged to an unnamed tributary of Big Muskego Lake. The effluent requirements were identical to those for discharge to Tess Corners Creek. Additional conveyance would be required to convey the treated effluent to the tributary. The capital cost of this alternative including the new conveyance would be $41.85 million. The annual O&M would be $1.08 million.

° Land Application of Effluent

The same land application sites proposed for the Northeast plant could also be used for the Southeast plant. Land requirements, distances to the potential application sites, and the estimated costs of each land application alternative are outlined below. The costs include all conveyance to the plant and to the land application sites.

Alternatives	Required Area (acres)	Distance to Site (miles)	Treatment Capital Cost ($ x 10^6)	Annual O & M ($)
High Rate Irrigation	1,900	8.6	81.15	990,000
Normal Rate Irrigation	5,100	8.6	62.35	790,000
Infiltration/ Percolation	230	8.6	43.45	860,000
Marsh Application	2,190	12.4	63.15	1,040,000

6.3.2.3 Summary: All of the costs of the Northeast and Southeast plants preliminary alternatives are summarized in Table 6-1.

All of the normal and high rate irrigation and marsh application alternatives were infeasible because of their high costs. Of the remaining alternatives, the two treatment and discharge alternatives and the infiltration/percolation alternative for the Northeast plant were less costly. However, the Northeast site was very unattractive in terms of land use compatibility. It infringes on the Roberts Golf Course and is near Greenfield Park and existing residences.

Consequently, in spite of the slightly higher preliminary costs, it was decided to further analyze only the feasible Southeast plant alternatives. These alternatives are treatment and discharge to Tess Corners Creek or the unnamed tributary of Big Muskego Lake and land application by infiltration/percolation. The cost of the Southeast plant alternatives were 5 to 9 percent higher than the feasible Northeast plant alternatives.

6.3.3 Feasible Alternatives

6.3.3.1 Upgrade Treatment, Discharge to Tess Corners Creek: To meet the anticipated effluent requirements for discharge to Tess Corners Creek an AST type plant would be necessary. This new plant would consist of bar screens followed by a grit chamber,

TABLE 6-1.

SUMMARY OF PRELIMINARY COSTS FOR NEW BERLIN
NORTHEAST AND SOUTHEAST WASTEWATER TREATMENT PLANTS

Alternatives	Treatment & Conveyance Capital Cost ($ x 10^6)	Annual O & M ($ x 10^6)
Northeast Plant		
Treatment and Discharge to Root River	35.45	1.02
Treatment and Discharge to Deer Creek	39.75	1.04
Land Application - Normal Rate Irrigation	58.55	0.76
Land Application - High Rate Irrigation	77.35	0.96
Land Application - Infiltration/Percolation	39.55	0.82
Marsh Application	59.85	1.02
Southeast Plant		
Treatment and Discharge to Tess Corners Creek	38.55	1.06
Treatment and Discharge to Big Muskego Lake	41.85	1.08
Land Application - Normal Rate Irrigation	62.35	0.79
Land Application - High Rate Irrigation	81.15	0.99
Land Application - Infiltration/Percolation	43.45	0.86
Marsh Application	63.15	1.04

Source: MMSD, 1980c

primary clarifiers, first stage aeration basins, intermediate clarifiers, second stage aeration basins for ammonia removal, final clarifiers, filters, and chlorination and postaeration facilities. Solids would be anaerobically digested, mechanically dewatered and applied to agricultural land or landfilled.

The plant would be constructed in a presently undeveloped area of New Berlin. Accordingly, noise and dust impacts would be reduced. However, the two proposed interceptors would cause major disruption. The first interceptor would begin at the abandoned Regal Manors plant and run approximately 14,000 feet south and east along Deer Creek to Sunny Slope Road, south on Sunny Slope Road for approximately 600 feet and lastly southeasterly along a drainage ditch through a subdivision to Grange Avenue. The interceptor would consist of a 30-to 36-inch gravity sewer constructed by open cut methods.

The second interceptor would run south on 124th Street from Needham Avenue to Grange Avenue. It would then turn west on Grange Avenue, intersect the Regal Manors connector and finally turn south to the treatmentplant site. This interceptor would consist of 11,400 feet of gravity open cut sewer and 20,300 feet of open cut constructed force main. Four pump stations would be required.

The Regal Manors connector would be disruptive to the residential area between Grange Avenue and Beloit Road. The interceptor along 124th Street would also be disruptive to traffic and homes along the route because the road is very narrow.

A long-term impact of the treatment plant would be the loss of 11.5 acres of land currently zoned for residential development. The Surrounding land could become less attractive for development because of its proximity to the proposed plant. The new plant would meet WPDES effluent limits. Tess Corners Creek would meet DNR water quality standards and would have a permanent flow. However, the discharge to Tess Corners Creek would increase the phosphorus loads to the creek and to Whitnall Park Pond thereby adding to the long-term eutrophication of the pond. The MMSD concluded that this WWTP would result in nonattainment of the phosphorus water quality goals of the 208 Plan for the Root River, Tess Corners Creek, and Whitnall Park Pond. The recommended un-ionized ammonia water quality goals for Tess Corners Creek would also not be met. A new Southeast plant would allow the abandonment of septic systems and would permit the planned level of growth in New Berlin. The total present worth of this alternative including the new conveyance would be $38.53 million. The annual O&M would be $0.825 million.

6.3.3.2 Upgrade Treatment, Discharge to Deer Creek: The original Fox River basin alternative would have had the Southeast plant discharging effluent to an unnamed tributary of Big Muskego Lake. Subsequent detailed environmental analysis determined that any discharges to Big Muskego Lake would be unacceptable. Consequently, the discharge location was moved to Deer Creek.

The Southeast plant alternative for discharge to Deer Creek would be identical to the alternative for discharge to Tess Corners Creek except for the discharge location and the resulting water quality impacts. The new conveyance along 124th Street and from the Regal Manors would be the same. And since the effluent limits for discharge to Deer Creek and Tess Corners Creek are identical, the plant processes would also be the same.

Deer Creek is naturally an intermittent stream. It currently receives effluent from the Regal Manors WWTP which results in a minimum flow of approximately 0.3 ft^3/sec. If the New Berlin Southeast plant were to begin discharging effluent to Deer Creek, the minimum flow would be increased to 8.3 ft^3/sec. DNR water quality standards would be met. However, the MMSD concluded that 208 Plan un-ionized ammonia and phosphorus goals would not be met. The plant effluent would be conveyed to Deer Creek via a 30-inch force main along Sunny Slope Road. The total present worth of this alternative including new conveyance would be $40.01 million. The annual O&M would be $0.879 million.

6.3.3.3 Land Application - Infiltration/Percolation: Secondary treatment for the Southeast plant infiltration/percolation pond system would be provided by aerated lagoons. An aerated lagoon system would require 221 acres of land including 500 feet of buffer from existing housing. The proposed Southeast plant site would have sufficient land for the lagoons. The treated effluent would be applied to 21 infiltration/percolation ponds each covering 8.2 acres of land in the Town of Vernon. The application site would be located at a site southeast of the intersection of State Highway 15 and County Road F.

The conveyance system to the application site would run south along Sunny Slope Road to County Road HH (College Avenue), west on County Road HH to County Road Y (Racine Avenue), north on County Road Y to County Road ES (National Avenue), west on County Road ES to County Road F, and finally south on County Road F to the application site. The conveyance system would consist of 50,000 lineal feet of 30-inch force main and one 12.68 MGD pump station. The entire force main would be constructed by open cut methods along existing roadways. It would be necessary to cross five streams and construct along 1500 feet of swampy area. The aerated lagoon site and the conveyance route are shown in Figure 6-4.

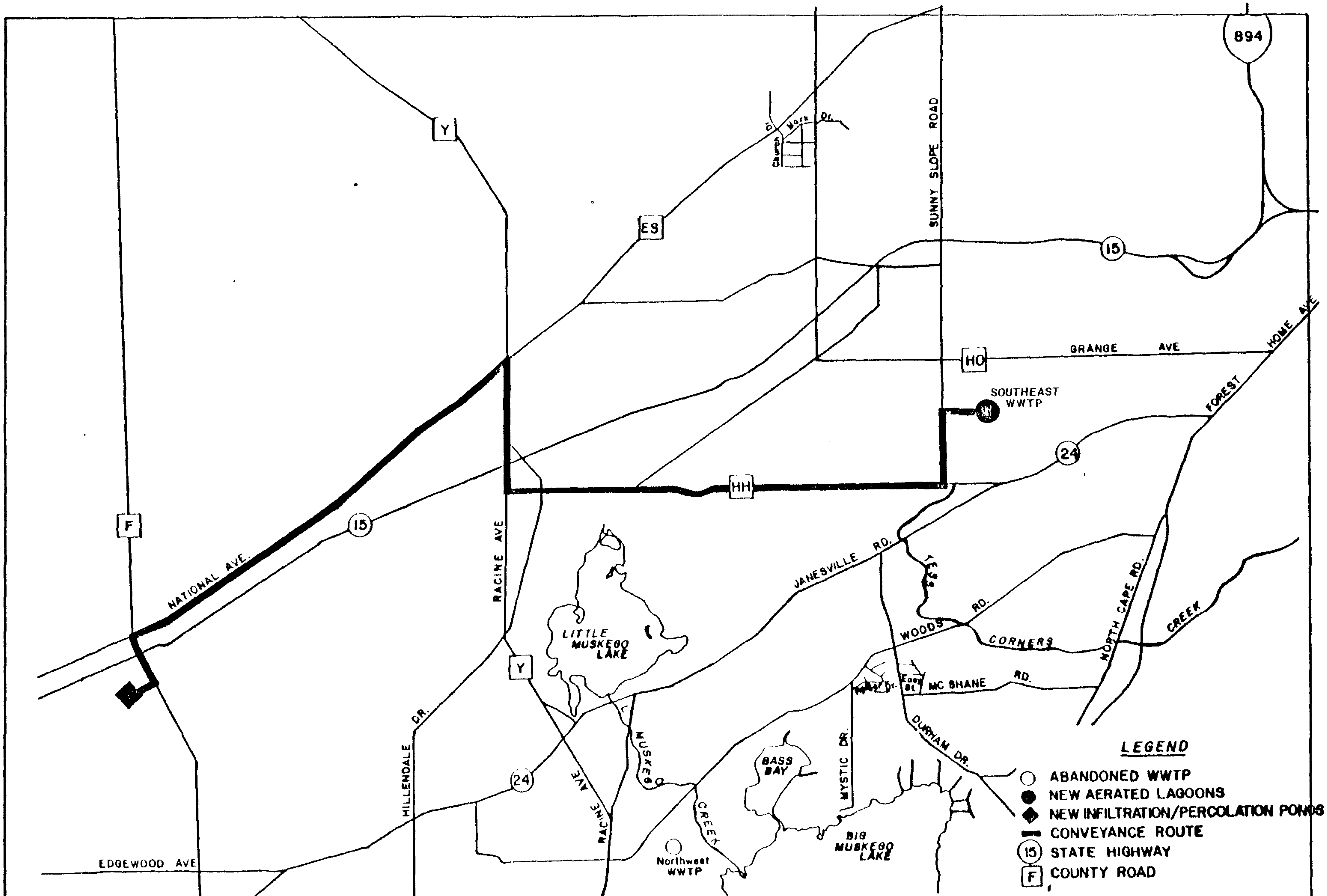


FIGURE 6-4 DATE November 1980	NEW BERLIN ALTERNATIVE B SOUTHEAST LAND APPLICATION SITE AND CONVEYANCE ROUTE	SOURCE ESEI PREPARED BY ESEI EcolSciences ENVIRONMENTAL GROUP

The construction of a southeast land application plant coupled with the abandonment of the Regal Manors WWTP would cause Deer Creek to become an intermittent stream that would be dry most of the year. Tess Corners Creek would also be intermittent if Muskego ended its discharges. The new land application WWTP would provide enough capacity for New Berlin to abandon septic systems and meet planned levels of growth. The potential for groundwater pollution and the benefits of using an alternative technology are the same as described for the Germantown infiltration/percolation alternative (Section 4.3.2).

The total present worth of the infiltration/percolation alternative including new conveyance to serve New Berlin would be $39.43 million. The annual O&M would be $0.754 million.

6.3.3.4 Summary: The refined costs of the feasible alternatives for serving the service area of New Berlin at a Southeast WWTP are summarized below.

Alternative	O&M (S)	Total Present Worth ($ x 10^6)
Treatment and Discharge to Tess Corners Creek	824,500	38.53
Treatment and Discharge to Deer Creek	878,900	40.01
Land Application-Infiltration/ Percolation	753,600	39.43

These final costs are consistent with the preliminary costs developed for the New Berlin Southeast WWTP.

6.3.4 Final Alternative

The least cost alternative for a New Berlin Southeast WWTP would be an AST plant discharging to Tess Corners Creek. However, this plant would have several disadvantages when compared to the land application alternative. Firstly, discharging to Tess Corners Creek would result in the continued nutrient enrichment of Whitnall Park Pond. Secondly, the O&M cost of the AST plant is greater than the land application WWTP. And thirdly, because land application is an alternative technology, it is considered more cost effective than a conventional alternative if its cost is less than 115 percent of the least cost conventional alternative.

The disadvantages of the infiltration/percolation alternative were its high land requirements both in New Berlin and the town of Vernon. Also, the potential for groundwater pollution could be a problem. Based on a comparison of all the impacts, infiltration/percolation was judged to have the most beneficial features. Consequently, for planning purposes, a Southeast infiltration/percolation WWTP was compared to the final Regal Manors alternative and the alternative for connection to the MMSD. Because the costs for each of the three feasible southeast WWTP alternatives were so close in cost (less than a four percent difference), the selection of any one of them for comparison to the Regal Manors alternative or the connection to the MMSD alternative would have a negligible impact on the selection of a final New Berlin wastewater treatment system.

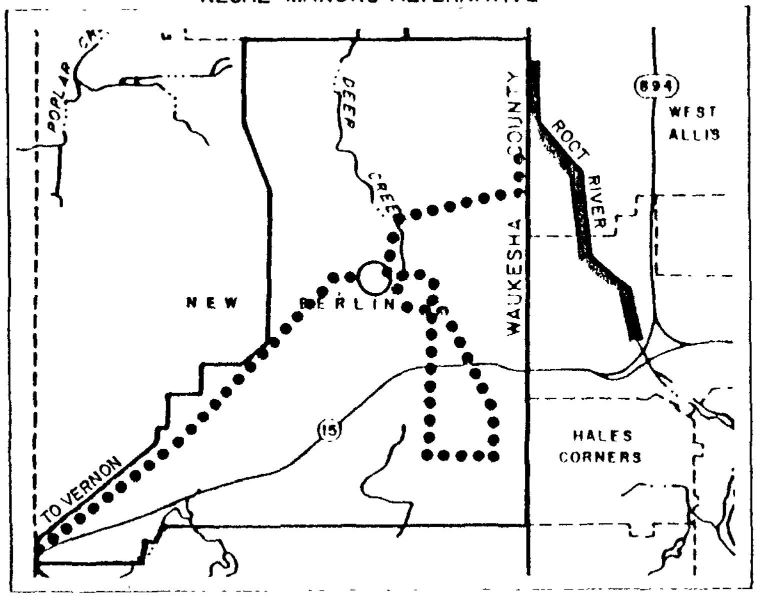
6.4 Final New Berlin Alternatives

The selected most feasible Regal Manors alternative was to construct a new infiltration/percolation WWTP with a total present worth of $19.26 million. A new Southeast infiltration/percolation WWTP to serve all of New Berlin had a total present worth of $39.43 million. The Regal Manors alternative would require part of New Berlin to continue MMSD sewer service. The proposed Root River interceptor would serve West Allis, Greenfield and a portion of the MMSD service area in New Berlin. In order for all of New Berlin to be served by the MMSD, a second interceptor, the Hales Corners interceptor, would also have to be constructed. A sewer from the Regal Manors WWTP would connect to the Hales Corners Interceptor.

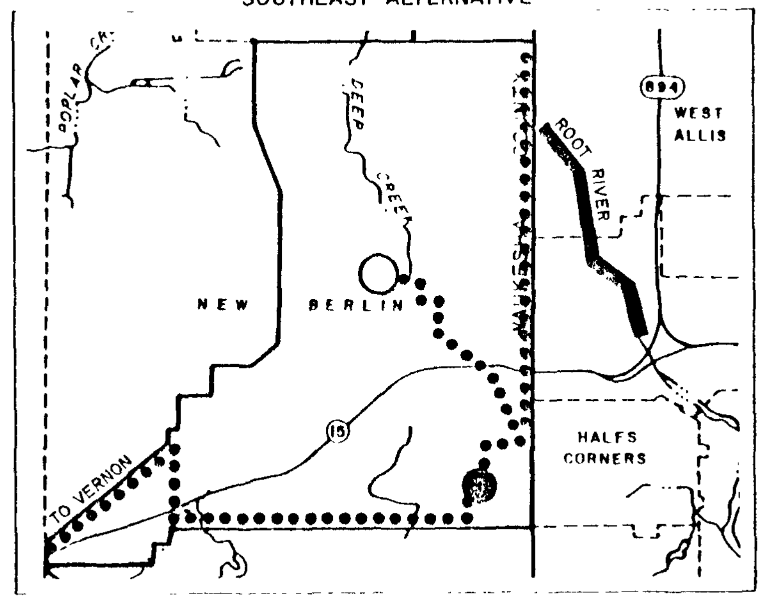
A schematic of each of these three actions is shown in Figure 6-5. A list of components and their costs for each action is shown in Table 6-2.

A direct comparison of the costs of each alternative is not appropriate because of the different possible service areas of the Root River Interceptor. For the Regal Manors WWTP alternative, only the present MMSD service area in northern New Berlin with an estimated year 2005 population of 17,749 would be tributary to the Root River Interceptor. The Interceptor would also serve an additional 12,505 people in West Allis and Greenfield. For the connect to the MMSD alternative, the New Berlin population tributary to the Root River Interceptor would be 24,349. The interceptor would serve the same 12,505 people in West Allis and Greenfield. For the Southeast WWTP alternative, the Root River interceptor would serve only West Allis and Greenfield.

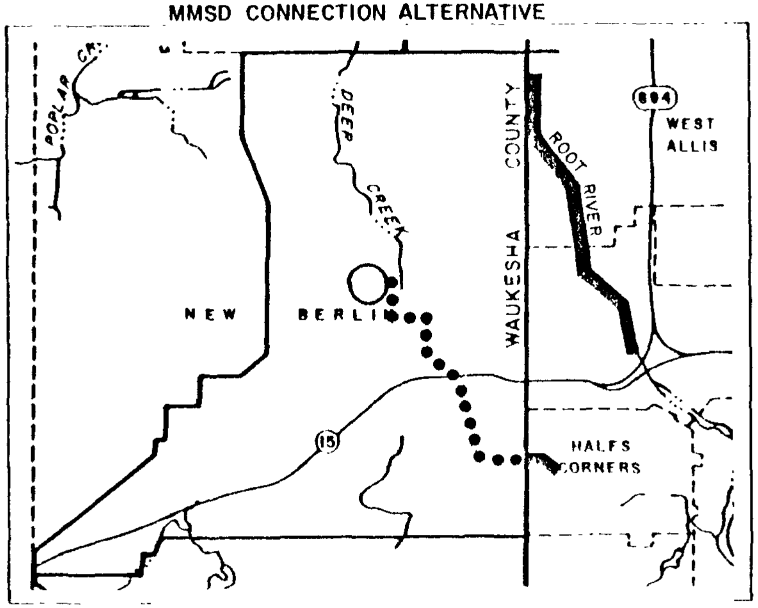
REGAL MANORS ALTERNATIVE

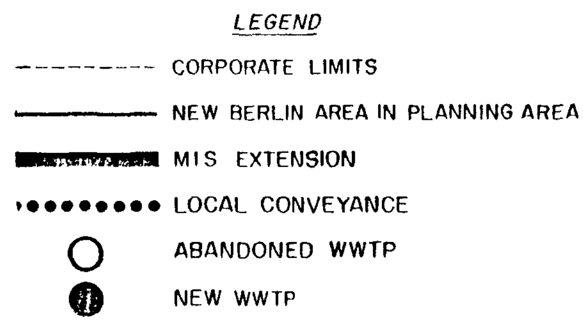


SOUTHEAST ALTERNATIVE



MMSD CONNECTION ALTERNATIVE





MMSD

SOURCE

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FIGURE
6-5

DATE
NOV 1980

FINAL NEW BERLIN ACTIONS

TABLE 6-2.

FEASIBLE NEW BERLIN SEWAGE TREATMENT ALTERNATIVES

Regal Manors WWTP

Action	Present Worth ($ x 10^6)
Land Application WWTP New Berlin Sewer Two Local Force Mains	18.16
Root River Interceptor	13.17
Local Sewer Rehabilitation	1.10
Total	32.43

Southeast WWTP

Action	Present Worth ($ x 10^6)
Land Application WWTP New Berlin Sewer 124th Street Sewer	38.33
Local Sewer Rehabilitation	1.10
Total	39.43

Connect to MMSD

Action	Present Worth ($ x 10^6)
New Berlin Connection	2.80
Root River Interceptor	13.17
Hales Corners Interceptor	2.08
Local Sewer Rehabilitation	1.10
Total	19.15

Source: MMSD, 1980c

The Root River Interceptor would be designed for existing flows because flows are expected to decrease during the planning period. This flow reduction would be due to the removal of excessive clear water, and the implementation of water conservation and user charge programs. Therefore, the cost of the interceptor would be most appropriately apportioned to the three communities it would serve based on the 1978 peak flows. The community flows are listed below.

ROOT RIVER 1978 PEAK FLOWS

Community	Peak Flow (MGD)	% of Total Peak
New Berlin	13.84	45%
West Allis/ Greenfield	17.18	55%
	31.02	100%

Based on these figures, the New Berlin share of the Root River Interceptor cost, regardless of the future population served under the Regal Manors WWTP alternative or the connect to MMSD alternative, would be 45 percent of the total present worth or $6.23 million. The total present worth of the construction and O&M costs to serve New Berlin for each feasible alternative are summarized below.

Alternative	Total Present Worth ($ x 10^6)
Regal Manors WWTP	25.49[1]
Southeast WWTP	39.43
Connect to MMSD	12.21[1]

[1]Does not include MMSD capital or O&M costs to treat New Berlin wastewater.

Based on these values the least cost alternative for serving the City of New Berlin would be to connect to the MMSD. This conclusion again is predicated on the assumption that there would be no incremental cost to the MMSD to provide New Berlin with sewer service through the planning period. Connection to the MMSD would result in the abandonment of the Regal Manors WWTP and the elimination of effluent discharges to Deer Creek. The construction of the Root River and Hales Corners Interceptors and the Regal Manors Connection would cause short-term construction impacts.

Assuming no MMSD treatment costs, the Regal Manors WWTP alternative would be the least cost local alternative for New Berlin. It would have the same beneficial impacts as the Southeast WWTP alternative of abandoning the existing Regal Manors WWTP and eliminating its discharge to Deer Creek. However, New Berlin would still be served by two sewage treatment agencies. Accordingly, the Southeast WWTP would be the preferred local alternative.

Regardless of which alternative for sewer service in New Berlin is chosen, there is a possibility that New Berlin would develop at a faster rate than called for in SEWRPC's 208 Plan. This accelerated growth would likely occur in southeastern New Berlin. This area is a prime area for development because it is physically attractive, is accessible by major highways, has local employment opportunities, and has a great deal of vacant, developable land.

This increased development could occur at the expense of other southwestern suburbs such as Franklin and Greenfield where sewered vacant land for development already exists. Further discussion of this issue may be found in the Secondary Growth Impacts Appendix.

The locations of the connection conveyance routes are shown in Figure 11-1. The Southeast WWTP infiltration/percolation system is shown in Figure 11-2.

Prior to the selection of the preferred wastewater treatment alternative for New Berlin, a determination of the MMSD costs to treat New Berlin's wastewater for both the Regal Manors and the MMSD connections alternatives will be made. These costs will be added to the $25.49 million cost of the Regal Manors alternative and to the $12.21 million cost of the MMSD connection alternative. These new costs will then be compared to the Southeast WWTP alternative costs.

In the final EIS, EPA, in accordance with NEPA, will describe the preferred alternative for wastewater treatment for Thiensville. This alternative will be based upon findings set forth here and in other sections of this EIS, comments received from various review agencies, and comments received during the public comment period and at the public hearings.

CHAPTER 7

CITY OF SOUTH MILWAUKEE

7.0 CITY OF SOUTH MILWAUKEE

7.1 Introduction

The City of South Milwaukee is located in Milwaukee County, south of the City of Milwaukee. South Milwaukee is the only community within Milwaukee County that has not joined the MMSD.

The South Milwaukee sewer system serves 4.9 square miles. Population within the service area is approximately 23,400 persons. The system has four known bypasses.

The South Milwaukee WWTP is located between South 5th Avenue and Lake Michigan on the east side of the City of South Milwaukee (See Figure 7-1). Housing units are located directly across South 5th Avenue from the treatment plant site. An apartment complex is located to the south of the plant, but is buffered by a stand of trees.

The plant facilities are located in the eastern portion of the plant site. The highest topographic elevation on the site is in the western portion, hiding much of the plant from view. The plant has occasional odor problems but these are not considered severe.

The treatment plant was originally constructed in 1937 with major modifications in 1952, 1962 and 1972. The plant consists of grit removal chambers, a comminutor, primary clarifiers, aeration basins, final clarifiers, and chlorine contact chambers. Effluent is discharged directly to Lake Michigan. Solids are pumped from the clarifiers to anaerobic digestors. Ninety percent (90%) of the anaerobic digested sludge is oxidized by use of the Zimpro wet oxidation process. The by-product is then landfilled. The remaining ten percent (10%) of the sludge is spread on sludge drying beds and distributed to local residents as fertilizer.

7.1.1 Effluent Limits

Operations at the South Milwaukee WWTP are regulated by WPDES discharge permit number WI-0028819. The permit was originally issued on December 12, 1974 and will expire on June 30, 1982. Current WPDES effluent limits for the plant are outlined below.

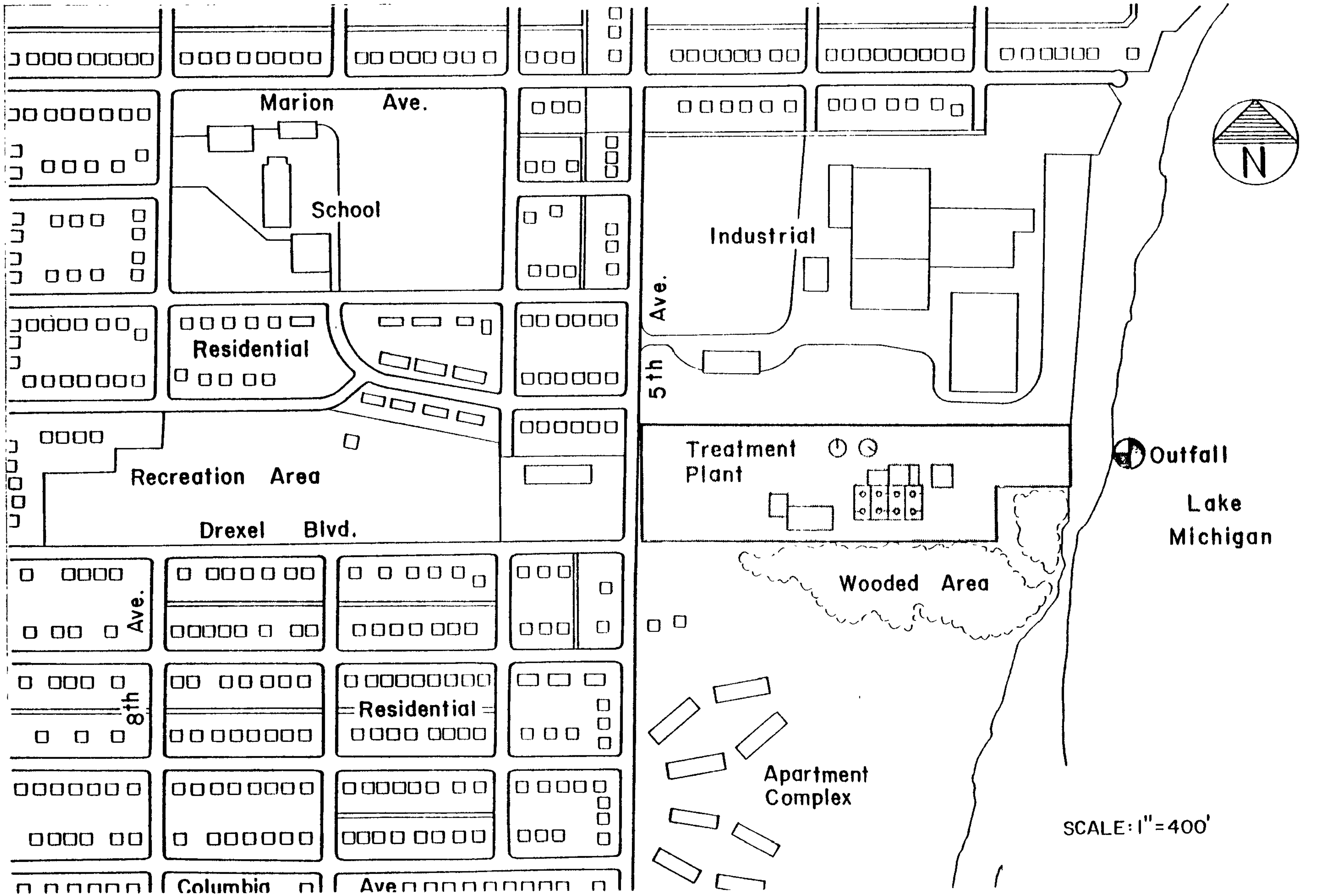

FIGURE 7-1

DATE NOV 1980

SOUTH MILWAUKEE WWTP

SOURCE SEWRPC

PREPARED BY ESEI EcolSciences ENVIRONMENTAL GROUP

Parameter	Present Limits
BOD_5 (mg/l)	30 (mo. avg.) 45 (wk. avg.)
Suspended Solids (mg/l)	30 (mo. avg.) 45 (wk. avg.)
Fecal Coliform (#/100 ml)	200 (mo. avg.) 400 (wk. avg.)
pH (standard units)	6.0-9.0
Phosphorus (mg/l)	1.0 (mo. avg.)

These limits are not expected to change before the end of the planning period. The South Milwaukee WWTP consistently meets all effluent parameters except phosphorus which is occasionally in excess of 1.0 mg/l.

7.1.2 Wastewater Flows

The existing South Milwaukee WWTP has an average daily flow design capacity of 6.0 MGD and a peak design capacity of 12.0 MGD. The existing wastewater flows to the South Milwaukee WWTP were determined based on the MMSD I/I Study. Year 2005 estimated flows were determined by the MMSD based on SEWRPC population forecasts, estimated I/I removals, and the proposed water conservation program.

The existing and future wastewater flows and loads and populations for the South Milwaukee service are are compiled below.

	1978	2005
Average Daily Base Flow (MGD)	3	3
Maximum Daily Flow (MGD)	--	12
Peak Flow Rate (MGD)	--	16
BOD_5 Loading (lb/day)	3620	4720
SS Loading (lb/day)	3520	4770
Population Served	23390	22615

1 MGD= 3785 Cubic Meters/Day
1 Pound= 0.454 Kilograms

Since no increase in wastewater flow is expected during the planning period, a 20 year staging period was used.

7.1.3 Existing Plant Conditions

It is reported that the entire plant is in very good condition and well maintained.

Preliminary Alternatives

The alternatives considered for South Milwaukee WWTP included no action, upgrade O&M, expansion, and connect the MMSD. Because the existing plant has the capacity and treatment processes to meet the expected planning period wastewater flow, no expansion or upgrading was necessary for continued discharge to Lake Michigan. In order to discharge to the Fox River Basin, the existing plant would have to meet more stringent effluent limits and the effluent would have to be pumped at least nine miles to the nearest Fox River basin discharge point which is at Big Muskego Lake. The cost and impacts of this alternative were considered excessive. Another impact would be the interbasin transfer of 3 MGD. This amount of water originally drawn from Lake Michigan could be considered excessive and in violation of interbasin water transfer lwas.

Land application alternatives were also considered infeasible because of cost and impacts. Treatment costs would be virtually identical to the cost for discharge to Lake Michigan because land application requires a secondary type pretreatment, meaning the existing plant would probably continue operation. However, the plant effluent would have to be pumped a long distance to any land or marsh application site. The cost of acquiring this land and operating the facilities would exceed the cost of discharging to Lake Michigan.

- No Action

  The population of South Milwaukee is expected to decrease slightly over the planning period, thus decreasing the flow to the treatment plant. The WWTP is hydraulically adequate and has no major problems meeting existing effluent standards. However, the City is presently in the planning process for upgrading its solids handling system.

- Upgrade O&M

  Upgrading O&M would improve the effluency of the plant and reduce phosphorus limits violations but would not solve the solids handling problems. The solids handling system would have to be upgraded to handle expected increases in solids as a result of increased industrial contributions. No cost was available for this upgrading at the time of preliminary analysis.

- Connect to MMSD

  The community of South Milwaukee has chosen not to join the MMSD and is strongly opposed to such action. To connect to the MMSD, a sewer would be constructed starting at the existing WWTP and running south along South 5th Street to the South Shore Interceptor at Puetz Road. Approximately 6,000 feet of sewer would be required. The cost for this alternative would be a $2.25 million capital cost for the connection with a $0.012 million annual O&M.

The costs of the preliminary alternatives capable of meeting the requirements of the planning period for South Milwaukee are summarized below.

Alternative	Treatment and Conveyance Capital Cost ($ x 10^6)	Annual O&M ($)
Upgrade O&M Discharge to Lake Michigan	a)	a)
Connect to MMSD	2.25	12,000

a) No preliminary cost prepared.

Both of the alternatives were evaluated in more detail below.

7.3 Feasible Alternatives

7.3.1 Upgrade O&M. Discharge to Lake Michigan

The most feasible alternative for continued local operation of a South Milwaukee WWTP would be to continue operation of the existing treatment, improve O&M procedures to eliminate phosphorus violations, and upgrade solids handling. Because the current solids upgrading program is still underway, a solids handling program similar to that for the South Shore WWTP was assumed. Solids would be thickened by dissolved air flotation, anaerobically digested, mechanically dewatered, and stored prior to land application or landfilling. The total present worth of this alternative including operation of the WWTP over the planning period would be $7.01 million. The annual O&M would be $0.41 million.

The continued operation of the South Milwaukee WWTP would result in the continued discharge of effluent to Lake Michigan. If the South Milwaukee WWTP were abandoned, its flows would be conveyed to the South Shore WWTP. Since the two plants have the same effluent limits, the amount and quality of effluent entering Lake Michigan would be the same. There would be some local degradation of water quality near the South Milwaukee outfall, but this would influence only a small area.

7.3.2 Connect to MMSD

If South Milwaukee were abandoned, the proposed sewer connection to the South Shore WWTP would not encounter any environmentally sensitive areas. Proper construction technique would minimize traffic congestion, noise, dust and other detrimental impacts. Abandonment of the plant would provide a site along the Lake Michigan shoreline that could be developed into a prime recreational area. The total present worth of this alternative including the construction and operation of the force main would be $3.21 million. The annual O&M would be $0.032 million.

7.3.3 Summary

The costs of the feasible alternatives for serving the City of South Milwaukee are summarized below.

Alternative	O&M (s)	Total Present Worth ($ x 10^6)
Upgrade O&M Discharge to Lake Michigan	410,000	7.01
Connect to MMSD	31,600	3.21[1]

[1]Does not include MMSD capital or O&M costs to treat South Milwaukee wastewater. (See Section 3.4 for further discussion).

These final costs are consistent with the preliminary costs developed in Section 7.2

7.4 Final Alternative

While connection to the MMSD is the least cost alternative for South Milwaukee, socioeconomic conditions make upgrading the existing facility a more attractive alternative. While abandoning the treatment plant would cost less, the fiscal burden to the average household in South Milwaukee would increase by 630%. Furthermore, the City of Milwaukee has continuously fought to remain independent of the MMSD and the City of Milwaukee. Further discussion of the fiscal impacts of the South Milwaukee alternatives can be found in EIS Chapter V, Environmental Consequences.

Prior to the selection of the preferred wastewater treatment alternative for South Milwaukee, a determination of the MMSD cost to treat South Milwaukee's wastewater will be made. This cost will be added to the $3.21 million cost of the connection in order to determine the actual total present worth cost of this alternative. In the final EIS, EPA, in accordance with

NEPA, will describe its preferred alternative for wastewater treatment for South Milwaukee. This alternative will be based upon findings set forth here and in other sections of this EIS, comments received from various review agencies, and comments received during the public comment period and at the public hearings.

CHAPTER 8

VILLAGE OF THIENSVILLE

8.0 VILLAGE OF THIENSVILLE

8.1 Introduction

Thiensville is a small community located in Ozaukee County, north of Milwaukee. The Thiensville wastewater treatment plant has a service area of one square mile which includes 790 single family, 300 multi-family, and some light commercial connections.

The sewer system consists of 14.8 miles of gravity sewer ranging from 6-inch to 18-inch in diameter, 0.4 miles of force main, one pump station, and three relief devices. The Village contracts for all maintenance work as needed.

There have been two I/I studies prepared on the system. The first one was conducted in 1971 by the Village. It found that I/I contributed between 1.3 and 2.5 MGD during wet weather. The recommendation of this study was to institute a clear water ordinance and a program to inspect portions of the sewer system by television. In 1976, the MMSD also conducted an I/I study which concurred with the data gathered in the 1971 study. As a result of these studies the Village has televised nearly 40,000 lineal feet of sewer (51% of the entire system). These studies found numerous leaks and major structural failures. Home connections and infiltration from high groundwater were also identified as major sources of clear water in the system. The Village clear water ordinance (revised in 1975) requires sump pumps to be installed in all residences to eliminate discharges from basement and foundation drains to the sewer system.

The Thiensville WWTP is located west of the Village's commercial district on Freistadt Road. The plant is located at the north end of the Village's public works yard (see Figure 8-1). North and west of the WWTP is low lying wooded land which is susceptible to local flooding. To the south of the plant is a residential area. To the east of the plant is the Village's main commercial district. The business district is buffered from the plant by a railroad corridor. The residential area to the south is screened from the plant by the remainder of the public works yard. Odors and noise could have a moderately severe impact on the commercial district because of its location, but to date no serious problems have been experienced.

The Thiensville WWTP was constructed in 1951 and remodeled in 1963. The plant processes consist of a comminutor, an aerated grit chamber, primary clarifiers, aeration basins, final clarifiers, and a chlorine contact chamber. Disinfected effluent is

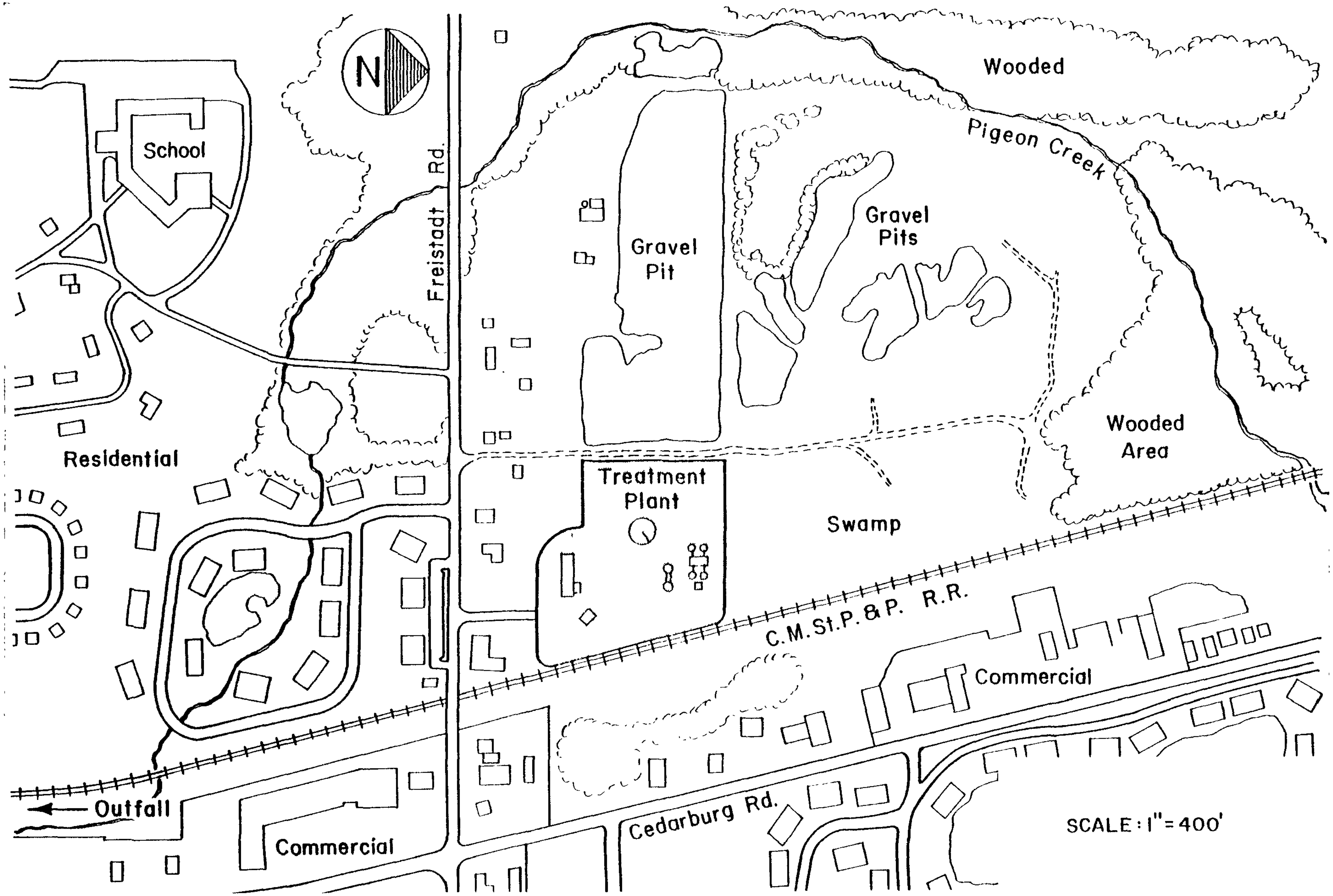

FIGURE 8-1

DATE NOV 1980

THIENSVILLE WWTP

SOURCE SEWRPC

PREPARED BY ESEI EcolSciences ENVIRONMENTAL GROUP

discharged to the Milwaukee River at the confluence with Pigeon Creek. Waste solids are pumped from the clarifiers to a system of primary and secondary anaerobic digesters. Digested sludge is either spread on drying beds or hauled by a commercial hauler and spread on agriculture fields in Germantown. In the treatment process, chemicals are added prior to the aeration basins for phosphorus control and prior to the final clarifiers to improve solids settling and aid in the removal of phosphorus.

8.1.1 Effluent Limits

The Thiensville WWTP is registered under the Wisconsin Pollution Discharge Elimination System and its operations are regulated by the limits of its permit number WI-0020320-2. The current permit was issued December 31, 1977 and will expire October 31, 1981. The present limits defined in the permit for discharge to the Milwaukee River are listed below and are not expected to change during the planning period.

Parameters	Present and Future Limits
BOD_5 (mg/l)	30 (mo. avg.) 45 (wk. avg.)
Suspended Solids (mg/l)	30 (mo. avg.) 45 (wk. avg.)
Fecal Coliform (#/100 ml)	200 (mo. avg.) 400 (wk. avg.)
pH (standard units)	6.0 - 9.0
Phosphorus (mg/l)	1.0 (mo. avg.)

8.1.2 Wastewater Flows

The existing Thiensville WWTP has an average daily flow design capacity of 0.24 MGD and a peak design capacity of 0.36 MGD. The existing wastewater flows to the Thiensville WWTP were determined based on the MMSD I/I Study. Year 2005 estimated flows were determined by the MMSD based on SEWRPC population forecasts, estimated I/I removals, and the proposed water conservation program.

The existing and future wastewater flows and loads and populations for the Thiensville service area are compiled below.

	1978	2005
Average Daily Base Flow (MGD)	0.46	0.47
Maximum Daily Flow (MGD)	--	2.18
Peak Flow Rate (MGD)	--	3.05
BOD_5 Loading (lb/day)	590	740
SS Loading (lb/day)	840	1010
Population Served	3520	4200

1 MGD=3785 Cubic Meters/Day
1 Pound= 0.454 Kilograms

Since less than a 30% increase in wastewater flow is expected during the planning period, a 20-year staging period was used.

8.1.3 Existing Plant Conditions

General conditions at the treatment facility are fair. The average daily flow to the plant is 0.59 MGD, which is in excess of its peak hydraulic capacity. The digesters are made of concrete and vent walls are badly deteriorated. The sludge drying beds are in poor condition and occasionally flood due to high groundwater. Presently the plant has occasional problems with BOD_5, suspended solids, and phosphorus levels in its effluent.

8.2 Preliminary Alternatives

Alternatives considered for the Thiensville WWTP were no action, upgrade O&M, expansion, land application of effluent and connection to the MMSD.

- No Action

  As stated above, the plant is presently hydraulically overloaded. Over the planning period, the service population is expected to increase by 8% which would add to the overloading problem. Improved solids handling facilities are also needed. The plant is presently having problems keeping within its discharge permit. Therefore action must be taken at this plant in order to meet the expected effluent limits for the planning period.

- Upgrade O&M

  Upgrading the O&M would have little benefit because the plant would not be large enough to handle future flows or meet future effluent limits.

- Expansion

  By expanding the existing unit processes and upgrading the solids handling facilities, the existing treatment plant could meet all future effluent requirements. Capital cost for this alternative would be $1.40 million. The annual O±M would be $0.060 million.

- Land Application of Effluent

  The existing treatment plant processes would be capable of meeting land application pretreatment limits. However, the plant would have to be expanded. For marsh application additional treatment would be required. The expanded plant processes would be followed by microscreens and postaeration at the marsh application site.

  Land requirements, the distance to the nearest site, and the estimated costs for the four application alternatives are shown below.

Alternatives	Required Area (acres)	Distance to Site (miles)	Treatment Capital Cost ($ x 10^6)	Annual O & M ($)
High Rate Irrigation	170	2.3	7.00	110,000
Normal Rate Irrigation	460	2.3	4.90	90,000
Infiltration/ Percolation	22	7.2	4.40	100,000
Marsh Application	190	6.2	7.20	280,000

  The two irrigation sites were located in Mequon and the infiltration/percolation site was located in northeastern Germantown. The most suitable marsh was the Germantown Marsh also located in northeastern Germantown

- Connect to MMSD

  Connection to the MMSD would require approximately 18,000 feet of gravity sewer. The route of the connector sewer would start at the existing treatment plant site and run east along Friestadt Road (County Road M) to Cedarburg Road (State Route 57). The sewer would continue south along Cedarburg Road to County Line Road where it would connect to an existing 48-inch Milwaukee Intercepting Sewer (MIS). The portion of this connector from the Thiensville village line to the county line is already planned for construction in order to provide sewer service to western Mequon. In order for this connector to also serve Thiensville it would have to be increased from a 36-inch to a 42-inch pipe. The capital cost for this size increase and for the remainder of the connection in Thiensville would be $2.04 million. The annual O&M would be $0.002 million.

The costs of the preliminary alternatives capable of meeting the requirements of the planning period for the Village of Thiensville are summarized below.

Alternative	Treatment and Conveyance Capital Cost ($ x 10^6)	Annual O&M ($)
Expansion and Discharge to Milwaukee River	1.40	60,000
Land Application - Normal Rate Irrigation	4.90	90,000
Land Application - High Rate Irrigation	7.00	110,000
Land Application - Infiltration/ Percolation	4.40	100,000
Marsh Application	7.20	280,000
Connect to MMSD	2.04	1,600

The most feasible of the local alternatives for the continued operation of a Thiensville WWTP would be to expand the existing plant and continue discharging to the Milwaukee River. The other local land and marsh application alternatives would all require at least the same level of treatment and would have significantly greater conveyance and land requirements, with resulting costs 200 to 400 percent higher. Because all DNR water quality standards would be met in the Milwaukee River if the plant were expanded, only that local alternative was further analyzed. The MMSD also concluded that the 208 Plan recommended water quality goals would also be met in the Milwaukee River.

The second least costly alternative would be connection of Thiensville to the MMSD. This alternative would permit abandonment of the existing WWTP and the elimination of a point discharge to the Milwaukee River. Both this connection and plant expansion were further analyzed.

8.3 Feasible Alternatives

8.3.1 Expansion and Discharge to the Milwaukee River

The most feasible alternative for local operation of a Thiensville WWTP would be to expand the existing plant. The expanded plant would consist of grit removal, primary clarification, aeration, final clarification, phosphorus removal, chlorination and discharge to the Milwaukee River at Pigeon Creek. Solids would be anaerobically digested, dried on sludge drying beds and landfilled or applied to agricultural land.

The expansion of the plant would cause some short-term noise and dust impacts to the surrounding area. These impacts would be minimal due to the relatively isolated location of the plant. Increased truck traffic on Freistadt Road would cause some disturbance to the commercial and residential areas south of the road. Because the existing plant is surrounded by low lying land often subject to local high groundwater and flooding, plant expansion may require the regrading of some land. Expansion to the north was identified as the most feasible location. This expansion would require the acquisition of 0.9 acres of industrially zoned land within the Village.

Provided that the expanded plant would meet its WPDES permit limits, the plant discharge would meet water quality standards for the Milwaukee River. The increased treatment capacity would eliminate bypassing and would permit the planned level of growth in Thiensville. The total present worth of this alternative would be $5.17 million. The annual O&M would be $0.128 million.

8.3.2 Connect to the MMSD

Under this alternative, there would be few additional environmental benefits over the local alternative of expanding the existing WWTP. Bypasses would be eliminated and the Milwaukee River would meet DNR water quality standards. The Village would have sufficient sewage treatment capacity to meet its planned level of growth. Connection to the MMSD would mean a loss of local control of sewage treatment.

The total present worth of Thiensville's share of the Mequon/Thiensville connection plus local sewer rehabilitation would be $1.56 million. The annual O&M would be $0.002 million.

8.3.3 Summary

The refined costs of the feasible alternatives for serving Thiensville during the planning period are summarized below.

Alternative	O&M ($)	Total Present Worth ($ x 10^6)
Expansion and Discharge to Milwaukee River	128,600	5.17
Connect to MMSD	1,600	1.56[1]

[1]Does not include MMSD capital or O&M costs to treat Thiensville wastewater. (See Section 3.4 for further discussion.)

The total capital cost of the WWTP expansion alternative developed during the analysis of the feasible alternatives was $3.76 million. Although this value is larger than the preliminary capital cost estimate for this alternative, it is still less than all of the preliminary cost estimates of the other local treatment alternatives which were eliminated due to excessive costs.

8.4 Final Alternatives

Excluding the MMSD cost to treat Thiensville wastewater, connection to the MMSD would be the least cost alternative for serving the Village. This connection would result in the abandonment of the existing plant, the elimination of a discharge to the Milwaukee River, and the loss of sewage treatment control for the Village. Impacts due to construction of the connector would be short-term and only along existing right-of-ways. The proposed conveyance route is shown in Figure 11-1.

There would be little long-term difference in impacts if the local alternative were chosen. However, the cost of an expanded plant would be much greater than the connection costs. The location of the expanded WWTP is shown in Figure 11-2.

Prior to the selection of the preferred wastewater treatment alternative for Thiensville, a determination of the MMSD cost to treat Thiensville's wastewater will be made. This cost will be added to the $1.56 million cost of the connection in order to determine the actual total present worth cost of this alternative. In the final EIS, EPA, in accordance with NEPA, will describe the preferred alternative for wastewater treatment for Thiensville. This alternative will be based upon findings set forth here and in other sections of this EIS, comments received from various review agencies, and comments received during the public comment period and at the public hearings.

CHAPTER 9

PRIVATE WASTEWATER TREATMENT PLANTS

9.0 PRIVATE WASTEWATER TREATMENT PLANTS

9.1 Introduction

There are eight private WWTPs in the planning area with effluent discharges regulated by the DNR through WPDES permits. These WWTPs were constructed primarily because municipal sewer service was not available. The eight private plants to be evaluated are listed below with the community in which they are located.

- Wisconsin Electric Power Company, Oak Creek
- School Sisters of Notre Dame, Mequon
- Chalet-on-the-Lake Restaurant, Mequon
- Muskego Rendering Company, Muskego
- Highway 100 Drive-in Theater, Franklin
- St. Martins Road Truck Stop, Franklin
- Cleveland Heights Grade School, New Berlin
- New Berlin Memorial Hospital, New Berlin

The 208 Plan for southeastern Wisconsin has recommended that all eight private WWTPs under the jurisdiction of the DNR be abandoned. The study further recommended that the DNR develop a schedule for this abandonment based on the extension of public centralized sanitary sewerage systems. Because of the location of the Wisconsin Electric Power Company WWTP, the 208 Plan recommended further study to determine if abandoning the plant was the most cost effective alternative.

The following is a summary of the alternative analysis performed by the MMSD. The MMSD evaluated a number of alternatives for each of the eight facilities and selected a preferred alternative.

9.2 Wisconsin Electric Power Company

9.2.1 Introduction

The Wisconsin Electric Power Company operates a small treatment plant at its power generating facilities in Oak Creek. The facilitiy has 450 employees with a maximum of 300 working at any given time.

The WEPCO WWTP was constructed in 1962. It has a design capacity of 0.04 MGD average and a peak capacity of 0.1 MGD. Average flow to the plant is 0.06 MGD. Processes at the plant consist of a comminutor, an aeration basin, a final clarifier, and a chlorine contact chamber. Effluent is discharged to Lake Michigan via an abandoned tile field where it is mixed with yard drainage. Solids are stored in an abandoned septic tank. The sludge is hauled away by private contractor as needed and used for land application. The plant has the capability to bypass the aeration basin. Bypassed flows can re-enter the system at the final clarifier or be discharged directly to the Lake.

9.2.1.1 Effluent Limits: The power plant has twelve outfalls used to discharge cooling and process water as well as yard drainage and treatment plant effluent. All outfalls are regulated by a single WPDES permit, number WI-0000914-2. The permit was issued December 31, 1974 and modified September 2, 1977. The current permit will expire December 31, 1981. The effluent limits in the current permit are identical to the tentative limits for future discharges to Lake Michigan. These limits are summarized below.

Parameter	Present and Future Limits
BOD_5 (mg/l)	30 (mo. avg.) 45 (wk. avg.)
Suspended Solids (mg/l)	30 (mo. avg.) 45 (wk. avg.)
Fecal Coliform (#/100 ml)	200 (mo. avg.) 400 (wk. avg.)
pH (standard units)	6.0 - 9.0
Residual Chlorine (mg/l)	0.5 (max.)

9.2.1.2 Existing Plant Conditions: Conditions at the WWTP found to be good to excellent. No major structures would need replacement during the planning period, but some mechanical equipment would need to be replaced as part of normal maintenance procedures.

9.2.2. Alternatives

Alternatives considered for the Wisconsin Electric Power Company WWTP included no action and connect to the local sewer system. Land application was not considered because the company does not own any suitable land near the plant.

- No Action

  The WEPCO WWTP is presently operating within its discharge permit limits and no expansion is expected at the power plant. All structures are expected to last the planning period with normal maintenance. The continued operation of the existing WWTP would result in an annual O&M cost of $14,200.

- Connection to the Local Sewer System

  If the plant is connected to the local sewer system, a lift station, a manhole, and approximately 5,000 feet of force main would be required. The total initial capital cost of this alternative would be $201,500. The annual O&M would be $24,100.

Final Alternative

Continued operation of the existing facility would be the least costly alternative for the Wisconsin Electric Power Company. At present, the plant causes no adverse or potentially severe environmental impacts to Lake Michigan. Because no expansion is expected, no adverse impacts would occur in the future. If this MMSD recommendation is approved by DNR and EPA, the 208 Plan will be amended.

9.3 School Sisters of Notre Dame Academy

9.3.1 Introduction

The academy of the School Sisters of Notre Dame is located on the Lake Michigan shore in Mequon (Ozaukee County). The academy constructed the WWTP in 1958 to provide sewer service for a convent and school population of 400. Presently, the service population is 200 persons.

The design capacity of the plant is 40,000 gallon per day. The plant consists of a bar screening and comminution facility, an aeration basin, and a final clarifier. Effluent is discharged to Lake Michigan. The plant has a sludge holding tank which is not used because solids are not wasted from the system. A chlorine contact chamber following the final clarifier was added in 1979.

9.3.1.1 Effluent Limits: Operations at the WWTP are regulated by WPDES permit number WI-0029882-2. The permit was issued November 30, 1977 and will expire June 30, 1982. The effluent limits in the current permit are identical to the tentative limits for future discharges to Lake Michigan. These limits are summarized below.

Parameter	Present and Future Limits
BOD_5 (mg/l)	30 (mo. avg.) 45 (wk. avg.)
Suspended Solids (mg/l)	30 (mo. avg.) 45 (wk. avg.)
Fecal Coliform (#/100 ml)	200 (mo. avg.) 400 (wk. avg.)
pH (standard units)	6.0 - 9.0

9.3.1.2 Existing Plant Conditions: MWPAP inspection of the facility found the plant in good to excellent condition. The plant has no emergency power facilities and flows are not monitored.

9.3.2 Alternatives

Alternatives evaluated for the School Sisters of Notre Dame WWTP were no action, upgrade O&M, and connect to the local sewer system. Land application was not considered because suitable land was not owned at the academy and the cost to purchase suitable land was considered excessive.

- No Action

  Enrollment at the school is not expected to increase. The plant consistantly meets its permit requirements and is expected to continue to do so through the planning years. However, the plant does not have an emergency power source, flow monitoring equipment or a solids handling system. This additional equipment would be necessary in order to insure adequate treatment during the planning period.

- Upgrade O&M

  The plant has adequate hydraulic capacity and with normal maintenance should continue to operate well throughout the planning period. Auxiliary power facilities and flow monitoring equipment would be added. Solids handling could be provided by using the existing solids handling tank and having excess solids removed by a contractor. The solids could be land applied, landfilled or discharged at an approved location in a public sanitary sewer system. The total initial capital cost of this alternative would be $14,200. The annual O&M would be $15,400.

- Connect to Local Sewer System

  Connection to the local Mequon sewer system would require 4,000 feet of 4-inch force main, a lift station, and a manhole. The total initial capital cost of this alternative would be $149,900. The annual O&M would be $12,700. In addition, the academy could also be expected to pay a connection charge plus an annual user charge.

Final Alternative

The least costly alternative for the School Sisters of Notre Dame would be to continue operation of the existing WWTP with minimal upgrading of facilities. The flows from the plant are very small and they would continue to have an imperceivable impact on Lake Michigan water quality. If local sewers are extended to areas closer to the academy in the future, it may become less costly for the academy to connect to the public sewer system. At that time, connection fees and user charges would have to be determined.

9.4 Chalet-on-the-Lake Restaurant

9.4.1 Introduction

The Chalet-on-the-Lake Restaurant is located on Lake Michigan in the City of Mequon. The restaurant owns and operates its own wastewater treatment facility to serve the sanitary needs of the establishment. The plant was constructed in 1956 and consists of a primary clarifier and an anaerobic sludge digester. Effluent from the clarifier is treated with a chlorine bleach solution and discharged to the lake. The plant has a design capacity of 25,000 gallons per day. Flows are intermittent, peaking at early afternoon and again in the early evening. Solids are digested in the anaerobic digester and pumped out by a commercial hauler on an as needed basis.

9.4.1.1 Effluent Limits: Operations at the plant are regulated by WPDES permit number WI-0030058-2. The permit was originally issued November 22, 1974 and modified December 29, 1977. It will expire June 30, 1982. The effluent limits in the current permit are similar to the tentative limits for future discharge to Lake Michigan. The present and future limits are summarized below.

Parameter	Present	Future
BOD_5 (mg/l)	30 (mo. avg.) 45 (wk. avg.)	30 (mo. avg.) 45 (wk. avg.)
Suspended Solids (mg/l)	30 (mo. avg.) 45 (wk. avg.)	30 (mo. avg.) 45 (wk. avg.)
Fecal Coliform (#/100 ml)	-- --	200 (mo. avg.) 400 (wk. avg.)
pH (standard units)	6.0 - 9.0	6.0 - 9.0

No discharge records have been submitted to the DNR to date.

9.4.1.2 Existing Plant Conditions: On-site investigation was not permitted. It is reported that the plant is in very poor condition due to lack of maintenance. The bleach solution is not considered effective for treatment of primary effluent.

9.4.2 Alternatives

Alternatives considered for the Chalet-on-the-Lake Restaurant WWTP included no action, upgrade existing facilities, and connect to the local sewer system. Because the restaurant does not own suitable land for application and the cost to procure such land would be excessive, this alternative was not considered.

- No Action

  If no action is taken at this plant, deterioration of this facility would continue. While there is no monitoring data available, it is doubtful that this plant is now operating within its discharge limits.

- Upgrade Existing Plant

  Present facilities are not expected to remain useful through the planning period. In order to achieve the future effluent limits, the plant would have to be modified. The clarifier would be replaced, secondary treatment facilities would be added, and disinfection would be upgraded to normal chlorine contact, instead of addition of a bleach solution. Because flows to the plant are intermittent, strict process control would be required to maintain proper operations. The initial capital cost of this alternative would be $190,000 with an annual O&M cost of $19,000.

- Connect to MMSD

  The restaurant could be connected to a local City of Mequon sewer in Lake Shore Drive. The connection would require 4,300 feet of force main and a small lift station. The initial capital cost of this alternative would be $100,000. The annual O&M would be $19,000.

9.4.3 Final Alternative

The least cost alternative for Chalet-on-the-Lake Restaurant would be connection to the local sewer system. The abandonment of this treatment would slightly reduce pollutant loads to Lake Michigan.

9.5 Muskego Rendering Company

9.5.1 Introduction

The Muskego Rendering Company is located in western Muskego in an area not currently served by sanitary sewers. The company processes animal carcasses into greases which are used in the manufacturing of cosmetics, animal food, and medicines. The wastewater treatment plant was designed to process sanitary waste of employees as well as process wastes. The company processes between 170,000 and 200,000 pounds of raw materials during a 10 hour operating day.

The Muskego Rendering Company WWTP was constructed in 1973. Major expansion took place in 1978 to relieve severe odor problems. Treatment processes include a primary clarifier equipped with settling and scum skimming facilities, an aerated pond, and a final clarifier. Effluent is discharged to a 1.18 acre soil absorption field. Solids produced in the clarifier are hauled to a licensed sanitary land fill.

9.5.1.1 Effluent Limits: The treatment plant operations are regulated by WPDES permit number WI-0052272. The current permit was issued in January, 1980, and will expire June 30, 1983. Effluent limits required by this permit for land application are listed below.

Parameter	Present
BOD_5 (mg/l)	50 (80% of required samples during a quarter)

The tentative effluent limits for future land application of effluent would be identical to the existing limit.

9.5.1.2 Existing Plant Conditions: The WWTP is reported to be in good to excellent condition. All parts of the treatment system are either new or were totally renovated in the 1978 expansion. The absorption pond was also regraded and repaired at that time, but it is not large enough to accommodate planned future flows.

9.5.2 Alternatives

Alternatives considered for the Muskego Rendering Company WWTP included no action, continued land application, discharge to the Fox River basin, and connect to the local sewer system.

- No Action

  The treatment facilities at the plant have recently been upgraded. The Company is expecting to increase production from 200,000 to 500,000 pounds of raw material per day. The hydraulic capacity at the treatment plant should be adequate to handle the expected 83,000 gallons per day flow. However, the absorption pond has a capacity of only 24,000 gallons per day. Under no action it is not likely that the plant could meet its future effluent limits.

- Continued Land Application of Effluent

  In order for the rendering company to continue land applying its treated wastewater, three acres of land would be required for the expansion of the absorption ponds. There is a 9.7 acre site on the northwest corner of the company's property approximately one-half mile from the current WWTP with soils suitable for the infiltration/percolation process. Approximately 3,200 feet of 4-inch force main and one pump station would be necessary. In addition to the increased pond capacity, the treatment plant would also have to be upgraded to meet the future effluent limits. Two possible schemes were identified: 1) additional package plant treatment following the existing system; and 2) chemical addition to enhance coagulation in the existing system. The cost of the two systems are summarized below.

Alternative	Total Initial Capital Cost ($)	Annual O&M ($)
Land Application - Package Plant	761,900	74,900
Chemical Addition	705,200	79,900

- Discharge to Fox River

  Effluent from the treatment plant would be discharged directly to the Fox River or to Big Muskego Lake. Expected effluent standards for either of these receiving waters would be much more stringent than those required for discharge to the absorption ponds. The treatment plant would have to be equipped with advanced treatment processes, nitrification, and phosphorous removal equipment. It is over a mile to the nearest receiving stream in this basin. The additional treatment and conveyance equipment required to implement this alternative would make it more costly than land application. No cost estimates were prepared for this alternative.

- Connect to the Local System

  Influent loads to the existing treatment facility average 4500 mg/l BOD_5 and 2,900 mg/l suspended solids. These high concentrations could not be discharged directly to the local sewers without pretreatment. The existing treatment plant could be used for this purpose without modification. Approximately 6,900 feet of sewer would be constructed to connect the flows to a local City of Muskego sewer in Janesville Road. The sewer would consist of a 4-inch force main and a lift station. The total capital cost of this alternative would be $334,400. The annual O&M would be $46,000. The company would also incur connection and user charge costs.

9.5.3 Final Alternative

The least capital cost alternative for the Muskego Rendering Company would be connection to the local Muskego sewer system. The proposed route for the connection to the local sewer would not traverse any environmentally sensitive areas. Elimination of the absorption pond would decrease chances of groundwater contamination. However, if connection fees and user charges are high and a land application system acceptable to the DNR can be implemented, the company may choose to continue to operate its own treatment plant.

9.6 Highway 100 Drive-in Theatre

9.6.1 Introduction

The Highway 100 Drive-in Theater is located in southwest Franklin, in an area not served by public sewers. The plant is owned and operated by the drive-in proprietors to serve the drive-in and its patrons. The plant is operated on a seasonal basis; the theater is closed during the winter months. Presently, the theater is closed and up for sale.

The plant was constructed in 1965. It consists of a septic tank, a dosing tank, and a subsurface sand filter. Effluent is discharged to an absorption pond. Solids are stored in the septic tank and hauled to a land application site as needed.

9.6.1.1 Effluent Limits: A WPDES permit was issued to the treatment plant on December 31, 1975. Permit number WI-0060364 expired on June 30, 1979. Neither the owner of the theater nor the DNR has made any attempt to renew this permit and it is doubtful that this permit would be reissued. The permit required only that the maximum load to the plant be less than 6,000 gallons per day. There is no sampling data available.

9.6.1.2 Existing Plant Conditions: The facility is reported to be in poor condition. The septic tank, sand filter, and absorption pond are not expected to remain useful through the planning period. There is very little, if any, maintenance performed at the treatment plant. According to the U.S. Department of Agriculture and the DNR, the existing absorption pond is located on unsuitable soil. Any future land application would have to meet the land application effluent limits discussed in Chapter 1.

9.6.2 Alternatives

Alternatives considered for the WWTP at the Highway 100 Drive-in Theater were no action, upgrade existing facility, land application, and connect to the local sewer system.

- No Action

  The existing facilities at the treatment plant are in poor condition and it is doubtful that the plant would be able to meet the future land application effluent requirements. Most of the existing equipment would not remain useful through the planning period.

- Upgrade Existing Facilities

  The plant is in such poor condition that much of its equipment would need replacement during the planning period. Furthermore, the existing absorption pond is unsuitable for continued land application of effluent. Therefore, no costs estimates were prepared for this alternative.

- Land Application

  In addition to the present absorption pond system, infiltration/percolation, normal and high rate irrigation, and marsh application were also considered. No suitable sites were located within a reasonable distance of the drive-in for the infiltration/percolation and marsh application alternatives. A site suitable for both forms of irrigation exists to the east of the theater. However, the odors generated by an irrigation system could be a nuisance to the residents of the Security Acres subdivision located just northeast of the drive-in as well as to the patrons of the drive-in. For this reason no costs were prepared for this alternative.

- Connect to Local Sewer System

  The drive-in theater is included in sewerage plans for the Security Acres subdivision, which is planning to build new sanitary sewers to replace failing septic systems. Connection to the local sewers in the subdivision would require 1,500 feet of gravity sewer. The initial capital cost to connect to the local system would be approximately $55,000. Annual O&M costs would be approximately $4,000. Connection fees and annual users charges would be an additional cost.

9.6.3 Final Alternatives

If the theater re-opens, the most feasible alternative would be connection to the local sewer system. Abandoning the plant would eliminate a potentially hazardous source of groundwater pollution.

9.7 St. Martins Road Truck Stop

9.7.1 Introduction

The St. Martins Road Truck Stop is located in southwest Franklin in an area not served by public sanitary sewers.

The wastewater treatment plant is owned by the truck stop and provides sanitary service for its patrons and operators.

The plant is an activated sludge package unit constructed in 1964. Processes consist of a comminutor, a bar screen, an aeration basin, a final clarifier, and a chlorine contact chamber. Effluent is discharged to a drainage ditch which is tributary to the Root River. Solids are stored in a sludge holding tank and hauled by a commercial hauler as needed.

9.7.1.1 Effluent Limits: No WPDES permit has ever been issued to this treatment facility. Litigation is underway by the DNR against the owners of the truck stop for illegal pollutant discharge. No monitoring data is available.

If the treatment plant were upgraded, it would have to meet the following effluent limits in order to continue discharge to the drainage ditch.

Parameters		Future Limits
BOD_5 (mg/l)		15 (mo. avg.)
		30 (daily max.)
Suspended Solids (mg/l)		20 (mo. avg.)
		30 (daily max.)
Fecal Coliform (#/100ml)		400 (30 cons. days)
NH_3-N(mg/l)	(May-Oct)	3 (wk. avg.)
	(Nov-Apr)	6 (wk. avg.)
Dissolved Oxygen (mg/l)		4 (min.)
Residual Chlorine (mg/l)		0.5 (max.)

9.7.1.2 Existing Plant Conditions: The treatment facility is reported to be inoperative because of poor maintenance. Inadequately treated sewage is being discharged to an open drainage ditch. Because of the poor condition, it is doubtful that the plant could economically be put back into operation.

9.7.2 Alternatives

Alternatives considered for the St. Martins Road Truck Stop WWTP included no action, upgrade the existing facility, and connect to the local system. Land application was not considered because there are no suitable sites nearby for this purpose.

- No Action

  Presently the plant is inoperative and has no WPDES permit. Operators of the truck stop are being sued by the DNR to ensure compliance with existing water quality standards.

- Upgrade Existing Facilities

  This plant is in such poor condition that it could not economically be put back into operation. It was assumed that the entire plant would be replaced with a two stage aeration nitrification process followed by filtration, chlorination, and postaeration. The initial capital cost of this plant would be $200,000. The annual O&M would be $19,000. Because of the complexity of the proposed treatment processes, a full-time state certified sewage treatment plant operator would be required.

- Connect to Local Sewer System

  The truck stop is included for service in the Franklin master development plan, but sewers in this area have not yet been constructed. A temporary holding tank would be possible for the truck stop until sewers can be installed in this area. At that time the truck stop would need only construct a lateral to the local sewer. The cost to connect to the local system would be negligible. There would also be a connection fee and an annual user charge. These fees would be considerably less than the cost of constructing a new treatment plant.

9.7.3 Final Alternative

The least cost alternative for the truck stop would be connection to the local sewer system. Until this alternative can be implemented, a holding tank could be used for storage of sanitary waste. The waste could be removed by a contractor and discharged to an approved location in a public sanitary sewer system. The abandonment of the present treatment facility would reduce the pollutant load to the Root River and eliminate a potential health hazard.

9.8 Cleveland Heights Grade School

9.8.1 Introduction

Cleveland Heights Grade School is located in an area of New Berlin not presently served by public sewerage facilities. The New Berlin School District owns and operates a wastewater treatment facility at the school to serve the needs of the students and staff. Enrollment is presently 750 students. The school does not operate a kitchen. Flows are generally from showers and domestic waste.

The plant was constructed in 1968 and has an average design capacity of 15,000 gallons per day. Processes consist of a septic tank, dosing tanks, subsurface sand filter, and polishing pond. Effluent is discharged to a drainage canal tributary to Poplar Creek in the Fox River drainage basin. Solids are stored and hauled away as needed to a local land application site. Average flow to the plant is 5,000 gallons per day.

9.8.1.1 Effluent Limits: Operations at the plant are regulated by WPDES permit number WI-0029980-2. The permit was issued November 22, 1974 and will expire June 30, 1982. The effluent limits in the current permit are similar to the tentative limits for future discharge to the drainage canal. The present and future limits are summarized below.

Parameter	Present	Future
BOD_5 (mg/l)	20 (mo. avg.) 30 (wk. avg.)	20 (mo. avg.) 30 (wk. avg.)
Suspended Solids (mg/l)	20 (mo. avg.) 30 (wk. avg.)	20 (mo. avg.) 30 (wk. avg.)
Fecal Coliform (#/100 ml)	--	400 (30 cons. days)
pH (standard units)	6.0 - 9.0	6.0 - 9.0
Residual Chlorine (mg/l)	--	0.5 (max.)
Dissolved Oxygen (mg/l)	4.0 (min.)	4.0 (min.)

9.8.1.2 Existing Plant Conditions: The plant is in fair to good condition. The sand filter would require new sand within the next 10 years. The plant has available land for expansion.

9.8.2 Alternatives

Alternatives considered for the treatment plant at Cleveland Heights Grade School included no action, upgrade the existing plant, discharge to the Lake Michigan basin, and connect to the local sewer system. No land application sites were readily available for use by the school system, so this alternative was not considered.

- No Action

  The plant would not meet future effluent standards. Effluent quality tends to decline in the summer months due to algae growth in the polishing ponds.

- Upgrade Existing Facility

  In order to meet future effluent standards the entire existing treatment work would be abandoned and replaced with a small activated sludge package treatment plant. Following the package treatment plant, postaeration and disinfection facilities and a tertiary filter system would have to be added. The polishing pond could be used but provisions should be made to bypass the pond when algae becomes a problem. The initial capital cost for the new treatment processes would be approximately $150,000. The annual O&M would be approximately $19,000.

- Discharge to Lake Michigan Basin

  In order to discharge to the Lake Michigan basin, the same WWTP upgrading would be required as for continued discharge to the Fox River basin. In addition, approximately 12,000 feet of force main would be required to convey effluent to the Lake Michigan basin. The total initial capital cost of this alternative would be approximately $460,000. The annual O&M would be approximately $21,000.

- Connect to Local Sewer System

  The Cleveland Heights Grade School is located 2,000 feet from the nearest City of New Berlin local sanitary sewer. Approximately 2,000 feet of force main and a lift station would be necessary to convey the school's wastewater to the local sewer. The total initial capital cost of this alternative would be $55,000. The annual O&M would be about $19,000. Connection fees and annual user charges would be an additional cost.

9.8.3 Final Alternative

The least cost alternative for Cleveland Heights Grade School would be connection to the local sewer system. Abandonment of this plant would reduce pollutant loads to Poplar Creek. Odors associated with the treatment plant and the polishing pond would be eliminated. The route proposed for conveyance would not traverse any environmentally sensitive areas. No severe construction impacts would be expected.

9.9 New Berlin Memorial Hospital

9.9.1 Introduction

New Berlin Memorial Hospital is located in an area of the City without sanitary sewers. The hospital owns and operates its own treatment facility to treat the sanitary wastes it produces.

The WWTP was constructed in 1966. The treatment plant consists of a screening structure, an aeration basin, a clarifier, a chlorine contact chamber, and a polishing pond. Effluent is discharged to a drainage ditch which flows to the Root River. Solids are stored in a sludge holding tank which is pumped out as needed by a private hauler. The solids are then spread on a land application site. The plant has a design capacity of 19,000 gallons per day.

9.9.1.1 Effluent Limits: Operations at the plant are regulated by WPDES permit number WI-0030244-2. The permit was originally issued December 12, 1974, and will expire June 30, 1982. Effluent limits required by this permit and the limits for future discharges to the drainage ditch or to a Fox River basin stream are listed below.

Parameter	Present	Future
BOD_5 (mg/l)	20 (mo. avg.) 30 (wk. avg.)	20 (mo. avg.) 30 (wk. avg.)
Suspended Solids (mg/l)	20 (mo. avg.) 30 (wk. avg.)	20 (mo. avg.) 30 (wk. avg.)
Fecal Coliform (#/100 ml)	--	400 (30 cons. days)
pH (standard units)	6.0 - 9.0	6.0 - 9.0
Residual Chlorine (mg/l)	--	0.5 (max.)
Dissolved Oxygen (mg/l)	4.0 (min.)	4.0 (min.)

9.9.1.2 Existing Plant Conditions: The treatment plant is in fair condition. WPDES permit violations have occurred for BOD_5, suspended solids, and pH. These problems appear to be due to excessive flows. Average flow at the plant is 26,000 gallons per day. The package treatment plant (aeration basin and clarifier) is constructed of 1/4 inch metal plate, as is the sludge holding tank. None of these structures are supplied with cathodic protection against corrosion. Algae grow in the polishing pond during the warmer seasons. Very little process control is exercised at the plant. There are no provisions for auxiliary power.

9.9.2 Alternatives

The alternatives considered for New Berlin Memorial Hospital WWTP were no action, upgrade existing facilities, discharge to the Fox River basin, and connect to the local City of New Berlin sewer system. No land application sites were located within suitable distance of the hospital for this option to be considered.

- No Action

  The WWTP would have the capability to adequately treat present flows to secondary treatment levels with proper operation and maintenance procedures. However, future effluent limits are more stringent than secondary limits. Frequent effluent violations could be expected, making this alternative unacceptable.

- Upgrade Existing Plant

  In order to meet the anticipated future effluent limits, new equipment would have to be added for postaeration, and pH control. Based on present conditions at the plant, it is doubtful that the existing plant would remain operable through the planning period. Much of the facility would have to be replaced. Flow monitoring and auxiliary power equipment would also be needed. The initial capital cost for process replacement and upgrading would be $210,000. The annual O&M would be $19,000.

- Discharge to Fox River Basin

  Discharge to the Fox River basin would require the same effluent quality as discharge to the Root River. In addition to the improvements required to continue discharge to the Root River, changing the discharge location to the Fox River basin would require facilities to convey effluent from the treatment plant site to the new receiving body. A 4-inch force main 5,000 feet in length would be constructed to Poplar Creek. The initial capital cost for the upgraded plant and the new outfall would be $390,000. The annual O&M would be $21,000.

- Connect to Local System

  A local sewer has been proposed by the City of New Berlin along National Avenue. Upon completion of this sewer, a gravity lateral could easily be constructed to it from the present treatment plant site. The cost to connect to the local system would be negligible. Connection fees and annual user charges would be an additional cost.

9.9.3 Final Alternative

The least cost alternative for the New Berlin Memorial Hospital would be connection to the local sewer system. Elimination of this facility would reduce the pollutant loads to the Root River. Because the hospital is a sensitive site, any construction that occurs in the area should minimize noise and dust generation.

CHAPTER 10

ENERGY AND RESOURCE IMPACTS

10.0 ENERGY AND RESOURCE IMPACTS

10.1 Introduction

An important aspect of the EIS analysis was the determination of the energy and resource impacts of the various alternatives. Resources utilization is a very important part of wastewater treatment plant (WWTP) operation for two reasons. The first is the growing shortage of a number of resources. Severe shortages of a particular resource can jeopardize the operation of a sewage treatment facility. The second area of concern is cost. The resources consumed in the operation of a treatment facility must be paid for entirely with local funds. Costly O&M can be a major fiscal burden on a community.

10.2 EIS Analysis

The energy and resources requirements of each of the six local management agencies were computed for the operation of the preferred local WWTP and for the preferred alternative for connection to the MMSD. For the WWTPs each unit process was evaluated to determine its energy and resource requirements. The overall needs of each plant varied greatly according to size and unit processes. Wastewater treatment plants discharging to surface waters required the greatest amount of chemical addition, mostly for the purpose of phosphorous removal and solids conditioning. The only major energy requirement for the land application WWTPs was electricity for the operation of aerators in the aerated lagoons and force main pump stations. As discussed earlier, the MMSD included chlorine disinfection facilities in its analysis of all alternatives although the DNR does not require chlorination of wastewater applied to infiltration/percolation ponds. Chlorination was chosen for disinfection for both the surface discharge and land application WWTPs because it has a lower cost than other disinfectants, and it is a proven technique.

Resources required for conveyance facilities were limited to electricity for pumping.

Resources were computed for each treatment and conveyance component for the year 2005. The year 2005 was selected for comparison because it represented the peak year for resources consumption. The quantities of electrical power, natural gas, diesel fuel, and chemicals required for the local WWTPs were developed from EPA publication MCD-32, "Energy Conservation in Municipal Wastewater Treatment" (1978). Conveyance system and solids handling resource requirements were developed from data presented in the MWPAP WSP.

10.3 Results

The total resources requirements of the preferred local WWTP alternatives and the preferred alternative for connection to the MMSD are summarized in Table 10-1. As can be seen from the table, more resources would be used for the operation of the local WWTPs than would be required to operate the conveyance facilities for connection to the MMSD. Both the New Berlin and Thiensville connections would be gravity sewers and accordingly would not require any resources for operation. The other connections would require only electricity for the operation of pump stations.

For local WWTP operation, use of chemicals other than chlorine would be limited to the Thiensville and South Milwaukee WWTPs. Both would use polymer as a sludge conditioner. The Thiensville plant would use alum and South Milwaukee would use ferric chloride for phosphorous removal.

Both the Thiensville and South Milwaukee WWTPs would use anaerobic digesters for solids stabilization. The digester gas produced during the anaerobic solids stabilization process could be used as a supplementary energy source for these plants. Diesel fuel would be required for the trucks carrying the digested solids to land application or landfill sites.

The total resources requirements of the preferred local WWTPs or the connections to the MMSD are a small percentage of the total local system-level or regional system-level alternatives. Table 10-2 summarizes the total resource requirements of proposed MWPAP actions in the planning area for the year 2005. As can be seen from the table, the Jones Island and South Shore WWTPs would consume the greatest amount of resources in the planning area for both system-levels. The Inline Storage alternative is the assumed CSO system. It was also assumed that all of the private WWTPs would be abandoned except for the WEPCO and School Sisters of Notre Dame WWTPs.

The values in Table 10-2 show that the total resource requirements of the local system-level would be greater than the requirements for the regional system-level. Some of this difference is a result of the assumption that Jones Island and South Shore O&M would not be affected by the relatively low flows from the Caddy Vista, Muskego, New Berlin, Germantown, Thiensville, and South Milwaukee service areas or the flows from the private WWTPs. However, most of the difference is a result of the lower resource requirements of conveyance systems versus small local WWTPs.

TABLE 10-1
LOCAL ALTERNATIVE YEAR 2005 RESOURCES REQUIREMENTS

Management Agency	Alternative	Alum T/Yr	Polymer T/Yr	Ferric Chloride T/Yr	Chlorine T/Yr	Diesel Fuel Gal x 10^3/Yr	Electricity Kwh x 10^6/Yr	Excess Digester Gas SCF x 10^6/Yr
Caddy Vista	Upgrade WWTP				1.4	0.10	0.20	
	Connect to MMSD						0.01	
Germantown	Infiltration/ Percolation				30.9[1]		4.91	
	Connect to MMSD						0.83	
Muskego	Infiltration/ Percolation NE(B)				24.1[1]		5.55	
	Connect to MMSD						0.31	
New Berlin	Infiltration/ Percolation SE(B)				65.6[1]		12.23	
	Connect to MMSD							
South Milwaukee	Upgrade O&M		4.4	338	36.5	2.59	1.78	15.83
	Connect to MMSD						0.40	
Thiensville	Upgrade WWTP	143	0.36		5.7	0.36	0.32	2.55
	Connect to MMSD							
Total	Local WWTPs	143	4.76	338	164.2	2.95	25.09	18.38
	Connection to MMSD						1.55	

[1]Chlorine disinfection not required by DNR

1 T (Ton) = 0.9072 Metric Ton
1 Gallon = 0.003785 Cubic Meters
1 kwh (kilowatt hour) = 3,600,000 Joules
1 SCF (Standard Cubic Foot, a volume of gas at $0^{o}C$ and 1 atmosphere) = 0.02832 Standard Cubic Meters

Source: ESEI

TABLE 10-2
SYSTEM LEVEL RESOURCES
2005

Local System Level	Alum T/yr	Polymer T/yr	Ferric Chloride T/yr	Pickel Liquor T/yr as Fe	Act. Carbon lb/yr	Lime T/yr	Fly Ash T/yr	Chlorine T/yr	Sulfer Dioxide T/yr	Diesel Fuel galx10^3/yr	Fuel Oil galx10^3/yr	Natural Gas Therms x10^3/yr	Elec. Kwhx10^6 per year	Excess Digester Gas SCFx10^6/yr
Caddy Vista								1.4		0.10			0.20	
Muskego NE								24.1					5.55	
New Berlin SE								65.6					12.23	
Germantown								30.9					4.91	
Thievesville	143	0.358						5.7		0.36			0.32	2.55
Sisters of Notre Dame								0.5		0.30			0.04	
WEPCO								1.2		1.27			0.07	
South Milwaukee		4.4	338					36.5		2.57			1.78	15.83
Jones Island		290	2400	1697	2860	9500	6700	1055	352	211.5			70.06	375.3
South Shore		510		3030	2860			700	350	353.0	5.70	475	18.34	54.1
Conveyance Systems (includes MMSD collection system)													4.76	
CSO System													0.67	
TOTALS	143	800	2738	4727	5720	9500	6700	1900	702	570.0	5.70	475	118.9	447.8
Regional System Level														
Sisters of Notre Dame								0.50		0.30			0.04	
WEPCO								1.20		1.27			0.07	
Jones Island		290	2400	1697	2860	9500	6700	1055	352	211.5			70.06	375.3
South Shore		510		3030	2860			700	350	353.0	5.7	475	18.34	54.1
Conveyance Systems (includes MMSD collection system)													4.59	
CSO System													0.67	
TOTALS	0	800	2400	4727	5720	9500	6700	1757	702	566.0	5.7	475	93.77	429.4

Source: ESEI

CHAPTER 11

SUMMARY

11.0 SUMMARY

11.1 Introduction

An analysis of the sewage treatment alternatives for the Cities of New Berlin, Muskego and South Milwaukee; the Villages of Germantown and Thiensville; the Caddy Vista Subdivision; and eight private WWTPs was undertaken by the MMSD as part of the development of the MWPAP Wastewater System Plan. The EIS study team reviewed the MMSD analysis and independently checked major issues such as water quality, energy and resource use, and cost.

11.2 Summary

Table 11-1 summarizes the major impacts of the feasible local and regional sewage treatment alternatives identified by the EIS study team in this appendix. Figures 11-1 and 11-2 show the locations of each of the final local wastewater treatment alternatives and the regional alternatives for connection to the MMSD.

TABLE 11-1

SUMMARY OF FINAL LOCAL AND CONNECTION ALTERNATIVES IMPACTS
Local Alternatives Impacts

Plant/Community	Final Alternative	Impacts
Caddy Vista	Upgrade Treatment Discharge to Root River	● Short-term construction impacts. ● Existing plant would be abandoned. ● New plant would be built on existing property along an area currently zoned as a recreational park. ● Plant would meet WPDES effluent limits. ● Water quality in the Root River would not change greatly and would remain within DNR goals during low-flow periods. ● Bypassing of untreated or poorly treated sewage would be eliminated. ● Present Worth = $\$2.64 \times 10^6$.
Germantown	Land Application by Infiltration/Percolation	● Short-term construction impacts. ● Groundwater pollution potential exists. ● DNR water quality goals would be met in the Menomonee River. ● 110 acres of agricultural land would be lost in the Village. ● Abandonment of existing plant in residential area. ● Alternative technology. ● Present Worth = $\$13.17 \times 10^6$.
Muskego (Alternative B)	Land Application Infiltration/Percolation (Aerated Lagoons at Vernon)	● Short-term construction impacts. ● Groundwater pollution potential exists. ● Existing Northeast Plant would be abandoned, eliminating discharges to Tess Corners Creek. If New Berlin Southeast does not discharge to Tess Corners Creek, the creek will become intermittent. ● Existing Northwest Plant would be abandoned and its phosphorus and nitrogen loads to Big Muskego Lake would be eliminated.

TABLE 11-1 (Cont.)

Local Alternatives Impacts

Plant/Community	Final Alternative	Impacts
Muskego (Cont.)		● A 22 acre aerated lagoon and 7 9.1 acre infiltration/percolation ponds would be located on 115 acres of agricultural land in Vernon. ● Alternative technology. ● Present Worth = $\$14.57 \times 10^6$.
New Berlin Regal Manors (Alternative A)	Land Application by Infiltration/Percolation	● Short-term construction impacts. ● Groundwater pollution potential exists. ● Deer Creek would become intermittent and dry most of the year. ● 80 acres of agricultural land would be lost. It would have to be secured from the Town of Vernon. ● Abandonment of existing plant. ● New Berlin would be served by both the land application plant and the MMSD. ● Failing septic systems would be abandoned. ● Present Worth = $\$25.49 \times 10^6$.
New Berlin Southeast (Alternative B)	Land Application Infiltration/Percolation	● Short-term construction impacts. ● Groundwater pollution potential exists. ● Deer Creek would become intermittent and dry most of the year. ● Tess Corners Creek would become intermittent if Muskego ended its discharges. ● Approximately 221 acres of residentially zoned land would be needed in New Berlin. ● A 12.1 acre storage pond and 21-8.2 acre infiltration/percolation ponds would be located on 230 acres of agricultural land in Vernon. ● Regal Manor Plant would be abandoned. ● Failing septic systems would be abandoned. ● Alternative technology. ● New Berlin would own and operate its own plant. ● Present Worth = $\$39.43 \times 10^6$.

TABLE 11-1 (Cont.)

Local Alternatives Impacts

Plant/Community	Final Alternative	Impacts
Thiensville	Expand In Kind Discharge to Milwaukee River	● Short-term construction impacts. ● Plant would be expanded into open land to North. ● Plant would meet WPDES effluent limits. ● The Milwaukee River would continue to meet DNR water quality goals. ● Present Worth = $\$5.17 \times 10^6$.
South Milwaukee	Upgrade Treatment Discharge to Lake Michigan	● Only solids handling will be upgraded. ● Plant will meet WPDES effluent limits. ● Phosphorus loads to Lake Michigan would continue, contributing to the long-term eutrophication of the lake. ● Present Worth = $\$7.01 \times 10^6$.

Connection Alternatives Impacts

Plant/Community	Final Alternative	Impacts
Caddy Vista	Connect to MMSD	· Short-term construction impacts including a crossing of the Root River. · Existing plant would be abandoned. · Discharge to Root River would be eliminated. · Water quality in the Root River would meet DNR goals. · Loss of local control of sewage treatment. · Present worth = $\$0.55 \times 10^6$.

TABLE 11-1 (Cont.)

Connection Alternatives Impacts

Plant/Community	Final Alternative	Impacts
Germantown	Connect to MMSD	· Short-term construction impacts. · Existing plant would be abandoned. · Discharge to Menomonee River would be eliminated. · Water quality in the Menomonee River would meet DNR goals. · Loss of local control of sewage treatment. · Present Worth = $\$5.95x10^6$.
Muskego	Connect to MMSD	· Short-term construction impacts. · Existing Northeast Plant would be abandoned, eliminating discharges to Tess Corners Creek. The creek would meet DNR water quality goals and would become intermittent. · Existing Northwest Plant would be abandoned and its phosphorus and nitrogen loads to Big Muskego Lake would be eliminated. · Loss of local control of sewage treatment. · Present Worth = $\$5.65 \times 10^6$.
New Berlin	Connect to MMSD	· Short-term construction impacts. · Regal Manors Plant would be abandoned. · Deer Creek would meet DNR water quality goals. The Creek would be intermittent and dry most of the year. · Failing septic systems would be abandoned. · Loss of local control of sewage treatment. · Present Worth = $\$12.21 \times 10^6$.

TABLE 11-1 (Cont.)

Connection Alternatives Impacts

Plant/Community	Feasible Alternative	Impacts
Thiensville	Connect to MMSD	· Short-term construction impacts. · Existing plant would be abandoned. · Discharge to Milwaukee River would be eliminated. · DNR water quality goals would still be met in the Milwaukee River. · Loss of local control of sewage treatment. · Present Worth = $\$1.56 \times 10^6$.
South Milwaukee	Connect to MMSD	· Short-term construction impacts. · Existing plant would be abandoned. · Point source to Lake Michigan would be eliminated. South Milwaukee wastewater would be treated at the South Shore WWTP. · 630% increase South Milwaukee Fiscal burden. · Loss of local control of sewage treatment. · Present Worth = $\$3.21 \times 10^6$.

Source: ESEI

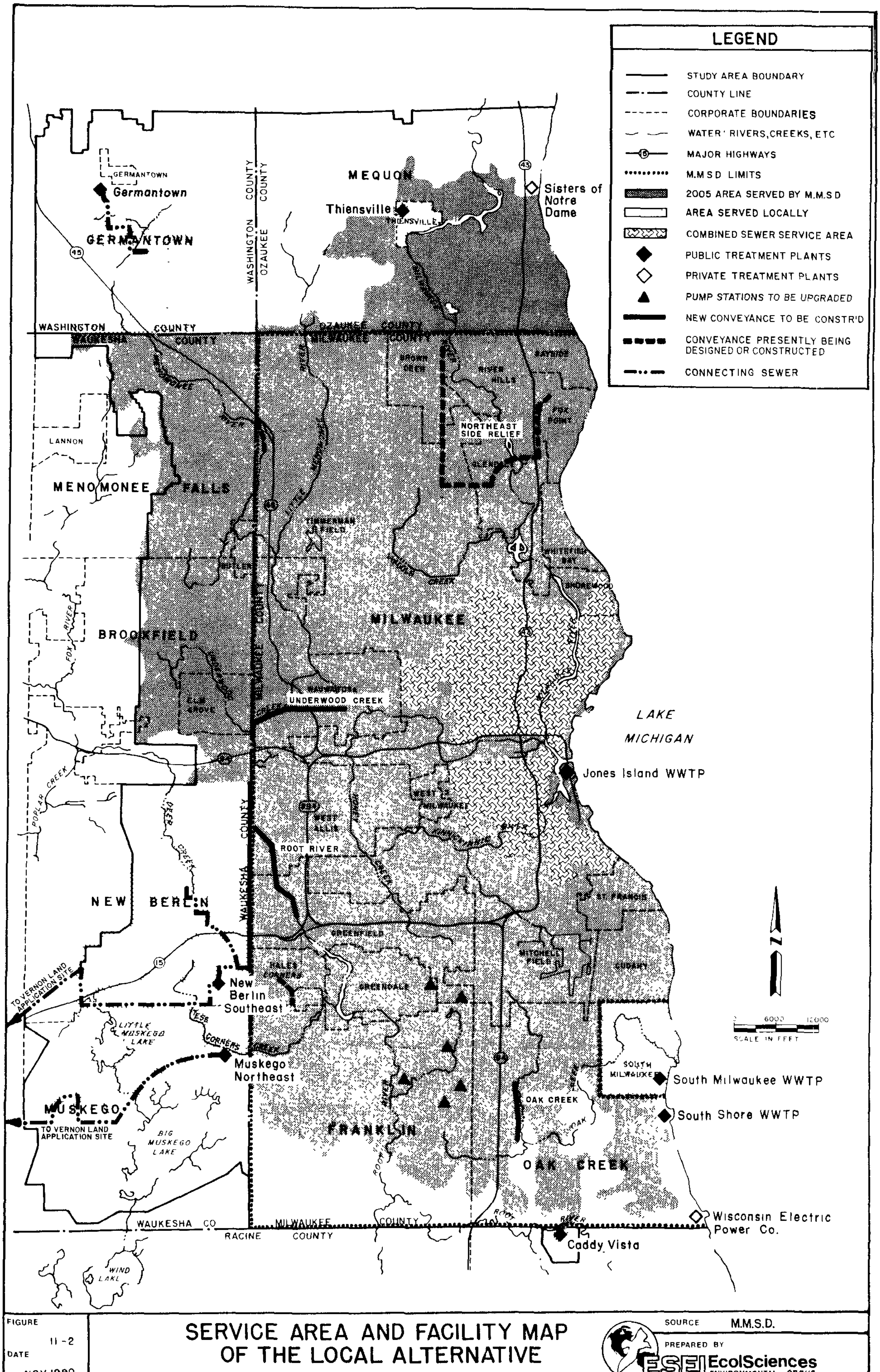

FIGURE II-2

DATE NOV 1980

SERVICE AREA AND FACILITY MAP OF THE LOCAL ALTERNATIVE

SOURCE M.M.S.D.

PREPARED BY ESEI EcolSciences ENVIRONMENTAL GROUP

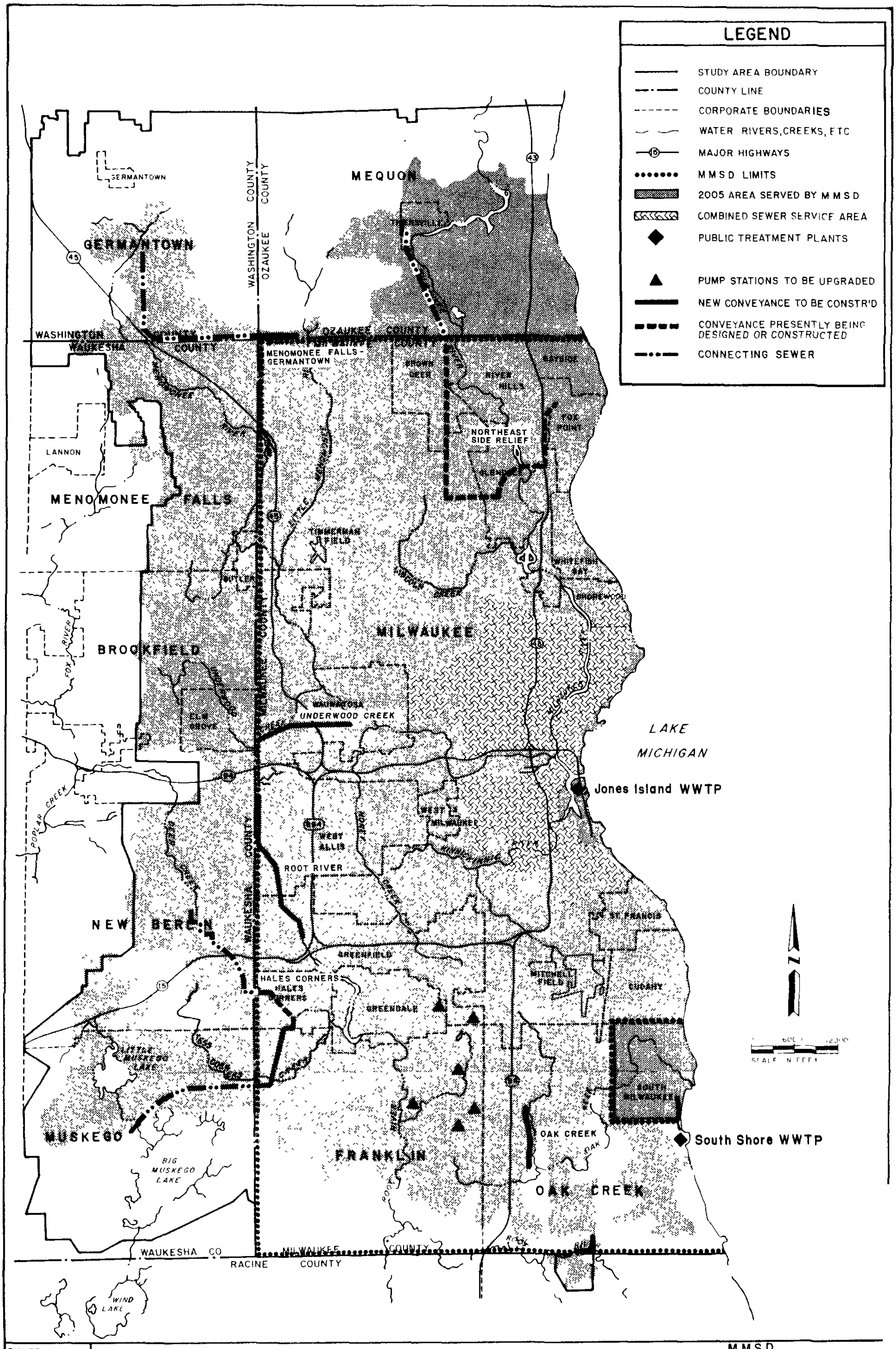

FIGURE II-I

DATE NOV 1980

SERVICE AREA AND FACILITY MAP OF THE REGIONAL ALTERNATIVE

SOURCE MMSD

PREPARED BY ESEI EcolSciences ENVIRONMENTAL GROUP

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MILWAUKEE METROPOLITAN SEWERAGE DISTRICT

WATER POLLUTION ABATEMENT PROGRAM

ENVIRONMENTAL IMPACT STATEMENT

APPENDIX VII

WATER QUALITY

NOVEMBER 1980

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INTRODUCTION

The goal of the Milwaukee Water Pollution Abatement Program is to eliminate unacceptable sources of water pollution and bring the water quality of affected streams closer to the Department of Natural Resources (DNR) objectives. However, water quality--the chemical, physical, and biological state of water bodies--is determined by many factors, of which sewage pollution is only one. Storm runoff, resuspended sediment, and the atmoshere are often major contributors. Once the pollutants are in the water they are subject to dispersion, sedimentation, chemical and biological transformation, and outgassing. A stream or lake is a dynamic, complex system in which many different processes must be considered when predicting the fate of pollutants.

The prediction of water quality impacts necessitates that the alternatives under consideration and the processes occurring within the rivers and lakes must be defined and many simplifying assumptions must be made. It is hoped that the simplifications and assumptions will not deviate too far from the real situation; therefore, the most important part of this Appendix is the discussion of assumptions and procedures, on which the applicability of all results inevitably hinge. The purpose of these sections is not to ignore complications; rather, it is to put all of the processes in perspective. This will serve to create a conception of how water quality is affected so that the complications can be considered, and their relative importance judged.

This Appendix covers the impacts of wastewater treatment plant (WWTP) effluent on lakes and streams. Other types of water quality impacts which are expected to occur and are covered elsewhere in this EIS include: construction-related impacts, impacts due to induced urbanization, combined sewer overflows, and sanitary sewer bypassing. (Where any of these affect the assessment of WWTP impacts, they are taken into account here.) The presentations of the impacts are grouped by water body.

PROCEDURE

The procedure for assessing water quality impacts is to:

1) characterize the present water quality, both upstream and downstream of existing WWTPs:

2) estimate the future quantities of pollutants added by alternative WWTPs;

3) estimate the future quantities of pollutants added by other sources;

4) compute the resultant concentrations of pollutants in the water body (if mixing can be assumed); and

5) modify the loads or concentrations by any factors that significantly affect them in the water body.

Of the 169 substances that the EPA has identified as water pollutants, 11 are common in sewage effluent and are listed in Table 1. In addition to these substances, there are 3 parameters (dissolved oxygen concentration, pH, and temperature) that are part of water quality and also affect the other pollutants' impacts. Additional pollutants, such as PCBs and pesticides, which may be of importance with respect to water quality, were not generally discussed because of a lack of evidence suggesting that discharges of such pollutants from existing or proposed WWTPs are creating or could create a problem.

The quantities (loads) of pollutants added to lakes and streams from treatment plants is readily calculated:

$$L_e = C_e Q_e$$

where L_e is the effluent load, C_e is the effluent concentration, and Q_e is the flow rate of effluent. All pollutants follow this equation; however, some pollutants, like BOD, degrade, while some, like chlorine and ammonia, evaporate or are chemically transformed, and others, like fecal coliform bacteria, die off in receiving waters. Therefore, when estimating changes in water quality resulting from the addition of sewage effluent, it is necessary to consider these "non-conservative" pollutants in a different manner than the "conservative" ones.

The change in water quality due to a conservative pollutant load is assessed by applying the mass-balance principle: the quantity of the substance remains constant at all dilutions. Thus, if the addition of effluent into a stream dilutes the effluent to 50% of its strength, then the concentration of a conservative pollutant will be the half of the upstream concentraton plus half of the effluent concentration, to maintain constant quantities. In formula form,

$$C = \frac{(C_s Q_s) + (C_e Q_e)}{Q_s + Q_e}$$

TABLE 1

POLLUTANTS IN SEWAGE EFFLUENT

Pollutant	Type
Biochemical Oxygen Demand	Non-conservative
Particulate Solids	Conservative
Dissolved Solids	Conservative
Total Phosphorus	Conservative
Total Nitrogen	Conservative
Ammonia	Non-Conservative
Chlorine	Non-Conservative
Fecal Coliform Bacteria	Non-Conservative
Cadmium	Conservative
Chromium	Conservative
Lead	Conservative

"Conservative" means that the pollutant can be diluted but not degraded; "non-conservative" means that the pollutant can be degraded or lost.

Source: ESEI

where C is the mixed concentration, C_s and C_e are the concentrations in the stream and effluent, respectively, and Q_s and Q_e are the respective flow rates of stream effluent. As the affected stream flows farther downstream, there may be more water added, diluting the pollutant even more, but the mass-balance relationship would still be applicable.

The non-conservative pollutants do not generally follow the mass-balance principle. BOD quantities diminish as they become oxidized (that is, combine with oxygen) and chlorine quantities diminish as they become reduced in open waters, but they can be considered to mix thoroughly before they are depleted. Fecal coliform bacteria do not mix thoroughly; they remain in clumps of high density. Coliforms are assessed in terms of loads only.

Nitrogen is a pollutant that has several related forms. Ammonia is the form that is common in sewage; at low pH it is mostly ionized and relatively harmless to aquatic organisms, while at high pH it is mostly un-ionized and very poisonous. Ammonia is oxidized under aerobic conditions to form nitrogen gas, nitrite, and nitrate, all of which are harmless to aquatic organisms except in large concentrations. Although total nitrogen is conservative, ammonia acts as a non-conservative pollutant because it gradually converts to nitrate in streams and lakes.

Dissolved oxygen, pH, and temperature are qualities of water that can be affected by sewage effluent. The concentration of dissolved oxygen in water is a function of temperature, the amount of agitation in the water, the rate of oxygen uptake by sediments and animals, the rates of oxygen production and uptake by algae and other plants, the load of oxidizable carbonaceous organic matter (measured as total organic carbon and indicated by BOD), and the load of other oxidizable matter (ammonia, sulfide, ferrous iron). Except for temperature, all of these factors affect a stream's oxygen concentration in complicated ways and are not easily predicted. However, for large rivers without appreciable sediment oxygen demand or algae, predictions of small changes in dissolved oxygen concentrations can be approximated by the Streeter-Phelps equation (Metcalf & Eddy 1979). This formula should not be applied to any of the receiving waters in this analysis because all are strongly affected by algae and sediment, many are too small to be properly described by the equation, and the formula does not apply to lakes. The pathways of oxygen depletion and replenishment are traceable, however, and this is done for all alternatives.

The acidity of water, measured by pH, is affected by the addition of effluent. The pH affects the toxicity of ammonia, the solubility of phosphorus, iron, and many other compounds, and extreme pH is itself harmful to plants and animals. The waters of the Milwaukee area resist changes in pH because of their high buffering capacity (alkalinity), but sewage effluent is just as well buffered, so that below pH 8.5, the mass-balance principle is reasonably close. Acidity is calculated as follows:

$$pH = -\log \frac{(10^{-pH_s} Q_s) + (10^{-pH_e} Q_e)}{Q_s \qquad\qquad Q_e}$$

for pH_s (stream) and pH_e (effluent) less than 8.5.

As a stream flows beyond the effluent discharge point, its pH will gradually return to its upstream value. The processes that cause a stream to have its particular pH (groundwater inputs, losses of carbon dioxide to the atmosphere and to plants, inputs of carbon dioxide from decomposition of organic matter) will drive the pH back to its upstream value. The rate at which pH returns to its upstream value is unknown but it is probably much less rapid than the mixing of stream and effluent.

Water temperature is also modified by the temperature of sewage effluent, which varies seasonally between about 54°F(12°C) and 64°F(20°C). Large WWTPs have a smaller temperature range; between about 59°F(15°C) and 65°F(18°C). The mixed temperature is calculated by the mass-balance equation.

In predicting the future water quality of streams upstream of wastewater discharge, the changes in other treatment plants upstream of that point were taken into account. If the upstream plants were themselves subject to alternative actions in this project, all feasible combinations were assessed. Conservative pollutants were added or subtracted from upstream water by the mass-balance formula; non-conservative pollutants were considered dissipated shortly after discharge.

Lakes are different from streams in several respects and are handled differently in this EIS. Effluent does not quickly mix thoroughly with lake water; it forms a plume of pollutants which undergoes settling, chemical transformation, biological uptake, and dilution at the same time. Conservative pollutants tend to end up in sediments unless the lake's water residence time (the time it takes for a volume of water equal to the lake's capacity to flow into a lake) is very short, in which case the lake is well flushed and acts more like a river. The pollutants in sediment are released to the water at a rate which may be related to their concentrations in the sediments. Since the water quality of lakes may be affected by the past accumulation of pollutants, it is more appropriate to consider loads than to make unreliable mixture calculations. The dynamics of the effluent plume are of importance and are discussed where relevant.

In Big Muskego Lake, pollution from nonpoint sources was compared to that from point sources. These nonpoint loads were estimated by multiplying the amount of land of each land use category in the watershed (SEWRPC 1975) by the appropriate load coefficient (IJC 1978).

ASSUMPTIONS

A. Streams are most susceptible to degradation when they are flowing at the lowest rate over seven consecutive days in a ten-year period ($Q_{7,10}$) (Holmstrom 1979).

B. There is no pollution of streams from nonpoint sources during low flow conditions. Nonpoint pollution is assumed to be carried into rivers by rain and melted snow runoff.

C. During low flow, upstream water quality is assumed to be in the future as it is at present. If there are other sewage treatment plants upstream, the upstream water quality is modified to include all alternatives changes to the upstream plants.

D. On an annual basis, nonpoint pollution is assumed to be abated according to SEWRPC (1979) recommendations: 25% in the watersheds of the Milwaukee, Menomonee, Kinnickinnic, and Fox Rivers, 50% in the Root River and Oak Creek watersheds, and 75% in most of the Big Muskego Lake watershed.

E. The concentrations of pollutants in effluent will be the maximum allowed by the WPDES permits anticipated to be in force in the future (MWPAP 1980a). If a pollutant concentration is not specified, it will be set at a reasonable average value for plants with similar treatment processes (MMSD 1978, MWPAP 1978).

F. Effluent and stream are assumed to mix completely at the point of discharge. No such assumption is made for lakes.

ACCURACY

The overall level of accuracy of the numerical predictions in this Appendix is one order of magnitude. Smaller differences between predictions should be considered insignificant.

There are two reasons for this qualification. First, there is considerable uncertainty in some of the baseline data, especially for the small streams and Big Muskego Lake. Too few samples were taken, and different investigators used different sampling and testing techniques. Although baseline data were assembled as carefully as possible, the uncertainty remains.

Second, the assumptions simplify and limit the analysis. Predictions are actually extrapolations of present conditions, and any unforeseen changes in conditions will negate them. Also, the streams and lakes are more complicated than they are portrayed, and the large-scale predictions here do not apply on a smaller scale.

This Appendix may be used to compare the probable effects of various alternatives on the water quality of lakes and streams, and to gain a general understanding of the nature and magnitude of these effects.

MILWAUKEE RIVER

The Milwaukee River receives sewage effluent from one treatment plant in the planning area, at Thiensville. There are 13 small treatment plants upstream (SEWRPC 1970), but because they are from 10 to 70 stream miles upstream of Thiensville and comprise less than 20% of the low flow, it is doubtful that small changes in their effluent quality would affect the water quality at Thiensville.

The Thiensville WWTP could either be expanded, from its present average daily base flow of 0.46 MGD (0.01 m^3/sec) to a future 0.47 MGD (0.02 m^3/sec), or abandoned. If expanded, it would maintain its secondary process with phosphorus removal.

Table 2 shows the predicted concentrations of water quality parameters of the Milwaukee River just after it is mixed with Thiensville WWTP effluent under present and expanded plant flow conditions, and without Thiensville effluent. The plant would increase the low flow of the river by 3%.

Dissolved oxygen levels fluctuate greatly over a 24-hour period due to the large amount of algae in the water (USGS 1978); the algae produce oxygen during the day and consume it at night. However, even the lower concentration is generally adequate for fish and is normally above the DNR minimum standard (USGS 1978).

MENOMONEE RIVER

With the imminent abandonment of the two sewage treatment plants in Menomonee Falls, the only plant discharging to the Menomonee River is the Germantown WWTP. This plant may either be expanded and upgraded to tertiary treatment, or abandoned. (Land application has the same effects on the river as abandonment.)

The changes in the Menomonee River's water quality are estimated in Table 3. The water of the river would be mostly effluent during low flow if the WWTP is expanded from 0.72 MGD (0.03 m^3/sec) to 2.54 MGD (0.11 m^3/sec). If the plant is abandoned, there would be little flow in the river at those times.

TABLE 2

WATER QUALITY OF THE MILWAUKEE RIVER AT THIENSVILLE

	Present	Expand WWTP	Abandon WWTP
Low Flow ($Q_{7,10}$)	42 ft^3/sec	42 ft^3/sec	41 ft^3/sec
BOD	7 mg/l	8 mg/l	7 mg/l
Particulate Solids	20 mg/l	20 mg/l	20 mg/l
Phosphorus	0.3 mg/l	0.3 mg/l	0.3 mg/l
Nitrogen	2.3 mg/l	2.5 mg/l	2.2 mg/l
Ammonia	0.2 mg/l	0.3 mg/l	0.1 mg/l
Un - ionized Ammonia @21°C	0.016 mg/l	0.022 mg/l	0.009 mg/l
pH	8.3	8.3	8.3
Chlorine	0.005 mg/l	0.01 mg/l	nil
Fecal Coliforms	4 billion/day	4 billion/day	--

1 ft^3/sec = 28.3 liters/sec

Source: ESEI

TABLE 3

WATER QUALITY OF THE MENOMONEE RIVER AT GERMANTOWN

	Present	Expand WWTP	Abandon WWTP
Low Flow ($Q_{7,10}$)	1.1 ft^3/sec	3.9 ft^3/sec	0.01 ft^3/sec
BOD	8 mg/l	10 mg/l	5 mg/l
Particulate Solids	10 mg/l	10 mg/l	8 mg/l
Phosphorus	0.7 mg/l	1 mg/l	1 mg/l
Nitrogen	20 mg/l	20 mg/l	5 mg/l
Ammonia	8 mg/l	2 mg/l	0.1 mg/l
Un - ionized Ammonia @21°C	0.1 mg/l	0.01 mg/l	0.003 mg/l
pH	7.5	7.2	7.9
Chlorine	0.5 mg/l	0.5 mg/l	nil
Fecal Coliforms	5 billion/day	38 billion/day	--

1 ft^3/sec = 28.3 liters/sec

Source: ESEI

The river is impounded at the Germantown WWTP outfall; therefore, it tends to accumulate plant nutrients and organic matter. This promotes dense algae growths and raises the pH which causes more of the ammonia to become un-ionized and toxic. A simple measure to remedy the situation would be to relocate the outfall to downstream of the pond. This measure would probably reduce ammonia problems in the pond, but not algae growths, because the accumulated nutrients would remain for a long time.

The impoundment probably has large daily oxygen concentration fluctuations around a fairly low mean. The large algae population would add oxygen during the day and remove it at night. The organic matter in sediments would remove oxygen from the water at all times. Neither upgrading nor removing the WWTP would change this situation. One of the major differences between the alternatives would be the amount of water flowing in the river below the impoundment.

The DNR water quality standards could likely be met on the free-flowing portions of the river under the local alternative if the plants maintain compliance with strict water quality related effluent limitations. The impounded areas would probably not meet the DNR standard for oxygen content regardless of the alternative chosen; continued discharge into the pond could cause the ammonia standard to be exceeded as well. Relocation of the outfall to a point below the pond would lessen the ammonia problem.

TESS CORNERS CREEK

A multiplicity of alternatives complicates the analysis of the future water quality of Tess Corners Creek, a small tributary of the Root River. Briefly, there is presently one treatment plant (Muskego Northeast) discharging effluent to the creek. This plant could be upgraded or abandoned. The Muskego Northwest, New Berlin Southeast, or a combined Muskego WWTP could add sewage effluent to Tess Corners Creek, or they could send the wastewater elsewhere. After eliminating some incompatible combinations, there are five combinations that could occur, as shown in Table 4. Again, land application alternatives would have the same effects on water quality that abandonment would.

Without the effluent from the Muskego Northeast WWTP, Tess Corners Creek would have little flow in dry weather. The DNR has in fact classified it an intermittent stream. However, four of the five alternatives add water (up to 11.3 ft^3/sec [0.32 m^3/sec]) to the creek and allow it to flow permanently. The water that would be added from the Muskego plants is somewhat richer in solids, phosphorus, nitrogen, fecal coliforms and organic matter than the upstream water. The proposed New Berlin Southeast WWTP's effluent would be similar to the creek's existing water quality.

TABLE 4

WATER QUALITY OF TESS CORNERS CREEK AT MUSKEGO

	Present	Expand Muskego Northeast	Muskego Northeast +Muskego Northwest	Muskego WWTPs +New Berlin Southeast	New Berlin Southeast Only	No WWTP Discharges
Low Flow ($Q_{7,10}$)	0.6 ft^3/sec	1.6 ft^3/sec	3.0 ft^3/sec	11.3 ft^3/sec	8.3 ft^3/sec	0.01ft^3/sec
BOD	12 mg/l	15 mg/l	15 mg/l	< 12 mg/l	< 10 mg/l	3 mg/l
Particulate Solids	14 mg/l	20 mg/l	20 mg/l	13 mg/l	10 mg/l	10 mg/l
Phosphorus	1 mg/l	1 mg/l	1 mg/l	1 mg/l	1 mg/l	1 mg/l
Nitrogen	20 mg/l	20 mg/l	20 mg/l	20 mg/l	20 mg/l	1 mg/l
Ammonia	8 mg/l	3 mg/l	3 mg/l	2.3 mg/l	2 mg/l	0.1 mg/l
Non-ionized Ammonia @21°C	0.1 mg/l	0.04 mg/l	0.04 mg/l	0.02 mg/l	0.01 mg/l	0.003 mg/l
pH	7.5	7.5	7.5	7.3	7.2	7.8
Chlorine	0.5 mg/l	0.5 mg/l	0.5 mg/l	0.5 mg/l	nil	nil
Fecal Coliforms	3 billion/day	16 billion/day	30 billion/day	110 billion/day	82 billion/day	--

1 ft^3/sec = 28.3 liters/sec

a) The chlorine added from this plant will dissipate quickly and not be present by the time the water parcel reaches Muskego.

Source: ESEI

If only Muskego WWTPs discharge effluent to Tess Corners Creek, the concentration of un-ionized ammonia-nitrogen would normally be high and could occasionally exceed the DNR's limit of 0.04 mg/l. This would probably be a rare occurence if the New Berlin Southeast WWTP also added effluent to the creek. Any alternative would lower the amount of ammonia in the creek from present conditions.

Dissolved oxygen levels have been moderately high in the creek; most measurements are in the range of 6-8 mg/l (DNR 1976). There is little algae since much of the creek is shaded by trees along the banks. The major causes of oxygen depletion appear to be sediment uptake and oxygen demand in treatment plant effluent, but these seem to be far outweighed by natural re-aeration. Decreasing the flow rate could create slow-flowing reaches that could accumulate sediment and have slower rates of re-aeration, resulting in lower oxygen concentrations in these reaches.

There is an impoundment about 2.5 miles (4 kilometers) downstream from the Muskego Northeast WWTP, in Whitnall Park. This pond becomes green with algae each summer, partly because of the nutrients (phosphorus and nitrogen), that are added to Tess Corners Creek by the treatment plant. The algae cause large variations in oxygen concentrations and probably deplete dissolved oxygen in the winter and spring, when decomposition and oxygen-consuming processes are at their maximum. Eliminating sewage effluent from the creek would slow the rate of accumulation of nutrients in Whitnall Park Pond, but problems would persist for many years.

ROOT RIVER

The water quality of the Root River upstream of Caddy Vista is not fixed; it depends upon which sewage treatment plants are adding effluent to its tributary, Tess Corners Creek. There are five combinations of WWTP discharges, ranging from zero to 11.3 ft^3/sec (0.32 m^3/sec), as shown in the previous section. Although there are ten miles of stream between Tess Corners Creek and Caddy Vista, and stream quality will change as it flows (due to settling, biological uptake, chemical reactions, and atmospheric losses), all of the parameters except BOD, chlorine, ammonia, and coliform are treated as if their quantities did not change over distance. The results are shown in Table 5. These figures are a slight overestimate of the levels of most parameters except pH, which is slightly under estimated.

The sewage treatment plant at Caddy Vista could either be rebuilt (and its capacity enlarged from 0.07 MGD [0.003 m^3/sec] to 0.11 MGD [0.005 m^3/sec]), or abandoned, with connection to the MIS. The rebuilt secondary plant would remove nitrogen, control pH, and aerate its effluent.

TABLE 5

WATER QUALITY OF THE ROOT RIVER AT CADDY VISTA

	Present	Caddy Vista WWTP only	Caddy Vista +Muskego NE	Caddy Vista +Muskego NE +Muskego NW	Caddy Vista + Muskego +New Berlin	Caddy Vista +New Berlin	No wastewater discharges
Low Flow ($Q_{7,10}$)	2.4 ft^3/sec	1.9 ft^3/sec	3.5 ft^3/sec	4.9 ft^3/sec	13.2 ft^3/sec	10.2 ft^3/sec	1.7 ft^3/sec
BOD	7 mg/l	7 mg/l	6 mg/l	6 mg/l	5 mg/l	5 mg/l	5 mg/l
Particulate Solids	14 mg/l	12 mg/l	20 mg/l	20 mg/l	13 mg/l	10 mg/l	10 mg/l
Phosphorus	1 mg/l	0.8 mg/l	1 mg/l	1 mg/l	1 mg/l	1 mg/l	0.4 mg/l
Nitrogen	20 mg/l	2 mg/l	20 mg/l	20 mg/l	20 mg/l	20 mg/l	1 mg/l
Ammonia	1 mg/l	0.4 mg/l	0.3 mg/l	0.3 mg/l	0.2 mg/l	0.2 mg/l	0.2 mg/l
Non-ionized Ammonia @ 21°C	0.03 mg/l	0.008 mg/l	0.006 mg/l	0.008 mg/l	0.005 mg/l	0.005 mg/l	0.005 mg/l
pH	7.8	7.7	7.7	7.8	7.8	7.8	7.8
Chlorine	0.03 mg/l	0.04 mg/l	0.02 mg/l	0.02 mg/l	0.006 mg/l	0.008 mg/l	nil
Fecal Coliforms	0.5 billion/day	3 billion/day	3 billion/day	3 billion/day	3 billion/day	3 billion/day	--

1 ft^3/sec = 28.3 liters/second

Source: ESEI

Table 5 shows that the dominant influence on the Root River's water quality would be the Tess Corners Creek treatment plants; the Caddy Vista plant does not contribute significantly to the water quality. This result stems partly from the simplifying assumptions that 100% of the loads of conservative pollutants (e.g. phosphorus) are carried from Tess Corners Creek to Caddy Vista and that non-conservative pollutants (e.g. BOD) do not reach Caddy Vista at all. The actual situation is most likely somewhere between these two extremes some phosphorus is lost and some BOD persists. Even with these errors in prediction, the quality of the Root River would remain within State standards during low-flow periods, and the main difference between alternatives would be the amount of water in the river during low flow.

A number of factors in the stream contribute to occasional low dissolved oxygen levels: abundant algae, substantial deposits of degradable sediments from agricultural runoff, and a slow, unperturbed flow that does not efficiently aerate the water.

DEER CREEK

Deer Creek, a small tributary of the Fox River, is extensively channelized. It carries little or no water except for rain, snow melt, and sewage effluent. It presently receives effluent from the New Berlin Regal Manors plant, and in the future would receive either no effluent, 1.9 MGD (0.083 m^3/sec) of New Berlin Regal Manors WWTP effluent, or 5.4 MGD (0.24 m^3/sec) of New Berlin Southeast WWTP effluent. Table 6 shows the expected effect on the creek's water quality.

Little is known about the present water quality of the creek. Since the effluent is nearly 100% of the creek's low flow, it is assumed that the water quality at low flow is the same as the effluent quality.

The creek is filled with cattails; algae coating the submerged stems probably add some oxygen and take up some phosphorus and ammonia. The small size of the creek facilitates re-aeration, but oxygen may be slightly depleted in pools where sediments may accumulate and the current velocity is reduced.

DNR water quality goals would not be met if the Regal Manors plant is expanded. The expected level of un-ionized ammonia-nitrogen would normally be higher than the acceptable level of 0.04 mg/l. This problem would not occur with the New Berlin Southeast WWTP alternative. This alternative would noticeably change the character of Deer Creek from an intermittent stream with a channel full of cattails to a permanent stream, probably with cattails only along the banks. DNR goals for both intermittent and permanent streams could normally be met with this alternative, provided that the plant maintained compliance with the effluent limits designed to achieve the applicable DNR water quality standards.

Table 6

Water Quality of Deer Creek at New Berlin

	Present	Upgrade Regal Manors WWTP	New Berlin Southeast WWTP	Abandon WWTP
Low Flow ($Q_{7,10}$)	0.3 ft^3/sec	2.9 ft^3/sec	8.3 ft^3/sec	< 0.01 ft^3/sec
BOD	21 mg/l	20 mg/l	10 mg/l	-
Particulate Solids	0 mg/l	20 mg/l	10 mg/l	-
Phosphorus	1 mg/l	1 mg/l	1 mg/l	-
Nitrogen	20 mg/l	20 mg/l	20 mg/l	-
Ammonia	8 mg/l	8 mg/l	2 mg/l[a)]	-
Non-ionized Ammonia @ 21°C	0.11 mg/l	0.11 mg/l	0.01 mg/l	-
pH	7.5	7.5	7.2	-
Chlorine	0.5 mg/l	0.5 mg/l	0.5 mg/l	-
Fecal Coliforms	1 billion/day	29 billion/day	82 billion/day	-

1 ft^3/sec = 28.3 liters/sec

a) This is the lowest limit set for ammonia concentration by the DNR.

Source: ESEI

BIG MUSKEGO LAKE

Big Muskego Lake is a large, shallow lake that is rapidly being encroached upon by marsh. The lake has an area of 2,177 acres (5,380 hectares) and an average depth of 2.5 feet (0.8 meters). Its level is maintained by a spillway at its outlet, at the south end of the lake. Only one permanent creek--Little Muskego Creek--feeds Big Muskego Lake; the creek also drains Little Muskego Lake and has an average flow of 3 ft^3/sec (0.085 m^3/sec). Big Muskego Lake also receives runoff from 19 square miles (22,000 hectares) of predominatly flat rural watershed.

The Muskego Northwest sewage treatment plant sends its effluent to Big Muskego Lake at the rate of 0.5 MGD (0.02 m^3/sec). Future options for lake discharge are: (1) upgrade the Muskego Northwest plant to AWT and expand to 0.9 MGD (0.04 m^3/sec); (2) upgrade both the Northwest and Northeast plants to AWT and discharge both to the lake at 2.0 MGD (0.09 m^3/sec); or (3) cease discharging to the lake, either by converting to land application, discharging to Tess Corners Creek, or connecting to the MIS system. In Table 7, the loads of pollutants from all sources are shown for each alternative.

Nonpoint pollution was estimated by applying a load factor (IJC 1978) to the area of each type of land use in the Big Muskego Lake watershed (SEWRPC 1979): rural, urban, urban developing. The loads from Little Muskego Creek were estimated from data collected by the MWPAP. Since the lake is very shallow, it is well mixed and oxygenated at all depths (except during ice cover). The residence time for water is approximately 5 months.

Nonpoint pollution, especially from developing urban land, is the largest source of sediment, phosphorus, and nitrogen. However, the sewage treatment plant supplies almost as much phosphorus and is a major source of nitrogen. This condition will continue whether the Northwest plant or the two Muskego plants discharge to Big Muskego Lake, although the overall load could be as small as one-fourth the present load due to proposed controls on nonpoint sources of pollution (SEWRPC 1979).

Halting the discharge of effluent to Big Muskego Lake will result in a substantial reduction in the amounts of phosphorus and nitrogen added to the lake each year. This action would not reverse the eutrophication of the lake, since it will not remove nutrients already present. It will, however, make future lake rehabilitation programs more likely to succeed.

OUTER HARBOR

Milwaukee's downtown lakefront is protected by a breakwater that surrounds 1,450 acres (3600 hectares) of Lake Michigan. This

TABLE 7

POLLUTANT LOADS TO BIG MUSKEGO LAKE

	Present	Expand Muskego NW	Muskego NE and NW	Abandon WWTP
Water (x 10^6 gallons/yr)	920	1040	1420	708
BOD from WWTPs	39,000 lbs/yr	35,000 lbs/yr	75,000 lbs/yr	0 lbs/yr
Particulate Solids:				
from streams	30,000 lbs/yr	30,000 lbs/yr	30,000 lbs/yr	30,000 lbs/yr
from runoff	5,500,000 lbs/yr	1,400,000 lbs/yr	1,400,000 lbs/yr	1,4000,000 lbs/yr
from WWTPs	60,000 lbs/yr	35,000 lbs/yr	75,000 lbs/yr	0 lbs/yr
% from WWTPs	1%	2%	5%	0%
Phosphorus:				
from streams	590 lbs/yr	590 lbs/yr	590 lbs/yr	590 lbs/yr
from runoff	7500 lbs/yr	1900 lbs/yr	1900 lbs/yr	1900 lbs/yr
from WWTPs	5500 lbs/yr	2800 lbs/yr	6000 lbs/yr	0 lbs/yr
% from WWTPs	40%	53%	71%	0%
Nitrogen:				
from streams	5900 lbs/yr	5900 lbs/yr	5900 lbs/yr	5900 lbs/yr
from runoff	140,000 lbs/yr	35,000 lbs/yr	35,000 lbs/yr	35,000 lbs/yr
from WWTPs	34,000 lbs/yr	7000 lbs/yr	15,000 lbs/yr	0 lbs/yr
% from WWTPs	19%	14%	27%	0%
Fecal Coliforms:				
from WWTPs	4 billion/day	14 billion/day	29 billion/day	

1 lb/yr = 0.45 kilograms/yr

Source: ESEI

area is known as the Outer Harbor to distinguish it from the Inner Harbor, the portions of the Milwaukee, Menomonee, and Kinnickinnic Rivers that are dredged deep enough for shipping. The Outer Harbor's southern basin is periodically dredged to a depth of 27 feet (8 meters).

The breakwater restricts the mixing of Lake water with Outer Harbor water. The Milwaukee, Menomonee and Kinnickinnic Rivers and the effluent from the Jones Island WWTP are constant sources of input water to the Outer Harbor, with an annual average flow of 175 billion gallons. Inputs are smaller in the summer and winter and larger in the spring and fall. Mixing of lake water depends on the strength of the near-shore currents, which in return depends on the strength and direction of the wind. Uniform mixing in the Outer Harbor is unlikely and cannot be assumed but the central portion of the Harbor probably mixes more thoroughly than either the northern or southern parts because the three rivers and the largest breakwater opening are located there.

The Outer Harbor is being polluted from three major sources: the three rivers, combined sewer overflows, and the Jones Island WWTP effluent. In addition, organic sediments in the Inner and Outer Harbors--the results of decades of pollution, runoff from land, and CSOs--degrade water quality every time they are re-suspended (Meinholz et at. 1978). The effects of CSOs on the Inner Harbor are dealt with in Appendix V of this EIS. The pollution of the Outer Harbor from three extreme CSO alternatives (no action, complete sewer separation and complete storage and treatment at Jones Island WWTP) are considered here; other alternatives will have intermediate impacts, depending on how much CSO is allowed and how much storm water is allowed to enter the rivers untreated.

Average conditions and pollutant concentrations in the Milwaukee River were obtained from the USGS station at Estabrook Park, and in the Menomonee River at the USGS station at Wauwatosa. The Kinnickinnic River's pollutant concentrations were assumed to be the same as in the Menomonee River.

The relative proportions of Lake Michigan water, water from the three rivers, and Jones Island WWTP effluent are estimated by using conductivity as a tracer. Conductivity is a measure of the concentration of ionic salts in solution; it is conservative, additive, and is not subject to biological or chemical transformation. Data from Bothwell (1975) indicate that the central portion of the Outer Harbor is approximately 75% lake water and 25% input water from the three rivers and the treatment plant. The percentages vary seasonally, from 40% input water in the spring to 12% input water in the late summer.

Estimates were made of the expected concentrations of pollutants in the Outer Harbor, assuming 25% input water and no losses. This analysis is limited to the ideal condition of uniform inputs, no biological uptake, settling or sediment inputs, and only the relatively well-mixed central portion of the Outer Harbor is considered. Nonetheless, the projected present conditions (Tables 8a and 8c) agree well with observations (Bothwell 1975). Further refinement of these estimates will be made as part of a study to be conducted by the University of Wisconsin-Milwaukee for the MMSD. The preliminary results will be available in early 1981.

Tables 8a through 8c present the loads and concentrations of pollutants in the Outer Harbor as a result of the proposed expansion of Jones Island in the context of three CSO alternatives. Table 8d gives the present and future pollutant loads from the Jones Island WWTP. Particulate solids, BOD, and phosphorus are given as maximum permissable loads; others are average annual loads. The loads and concentrations are based upon all sources of input. These include the Milwaukee, Menomonee and Kinnickinnic rivers, the Jones Island WWTP combined sewer overflows and the inputs from Lake Michigan.

The Jones Island WWTP would add 7% of the input water volume, but would contribute from 47% to 56% of the phosphorus load, from 75% to 94% of the ammonia-nitrogen load, and from 39% to near 44% of the cadmium load. The input of organic solids from Jones Island would continue to be large, perpetuating the accumulation of polluted sediment in the Outer Harbor. The estimated levels of un-ionized ammonia in the Harbor, although somewhat overestimated by the procedure used, would probably exceed the criterion set by the DNR, and this would certainly be the case close to the outfall. These impacts represent continuations or increases in the loads of pollutants from the Jones Island WWTP to the Outer Harbor.

Relocation of the outfall to a point in Lake Michigan beyond the breakwater would greatly reduce the loads of all pollutants (except fecal coliforms) to the Outer Harbor and allow the Harbor to meet DNR standards for levels of un-ionized ammonia. It would not greatly change the pollutant loads to Lake Michigan; it would only allow the pollutants to be mixed with more lake water more quickly, and it would stop the Outer Harbor from acting as a settling basin for pollutants in Jones Island effluent. CSOs are by far the largest sources of fecal bacteria. Other toxic substances are introduced in small quantities by the Jones Island WWTP: chlorine, chloramine, and chlorinated hydrocarbons, and heavy metals; these would affect the area near the outfall no matter where it is located. The decrease in input flow to the Outer Harbor due to the relocation of the outfall would be inconsequential to water levels or mixing rates.

Dissolved oxygen levels are high in most parts of the Outer Harbor (MWPAP 1980b). The large amount of algae (Bothwell 1975) elevates the oxygen level even higher during the day. The Jones Island WWTP's effluent would be post-aerated, thus alleviating the potential depletion of oxygen at the outfall.

TABLE 8a

WATER QUALITY AND LOADS TO THE OUTER HARBOR
SOLIDS, PHOSPHORUS, AND METALS

Parameter		Expand Jones Island WWTP			Expand Jones Island WWTP and Relocate Outfall		
	Existing	No Action	Complete Sewer Separation	Total Storage	No Action	Complete Sewer Separation	Modified Total Storage
Water ($x10^9$ gallons/ year)	701	701	701	701	659	661	655
Particulate Solids: Total Load[1] ($x10^6$ lbs/yr)	54	46	49	46	16	16	16
Concentration[2] (mg/l)	2.8	2.8	2.8	2.8	2.8	2.8	2.8
Phosphorus: Total Load[1] (lbs/yr)	552,000	464,000	451,000	414,000	205,000	193,000	153,000
Concentration[2]	0.08 mg/l	0.07 mg/l	0.07 mg/l	0.06 mg/l	0.04 mg/l	0.04 mg/l	0.03 mg/l
Lead: Total Load[1] (lbs/yr)	69,300	61,900	66,300	60,500	30,900	33,200	24,400
Concentration[2]	0.010 mg/l	0.009 mg/l	0.009 mg/l	0.007 mg/l	0.006 mg/l	0.006 mg/l	0.004 mg/l
Cadmium: Total Load[1] (lbs/yr)	8070	7200	6890	6620	4020	3900	3600
Concentration[2]	0.0013 mg/l	0.0011 mg/l	0.0011 mg/l	0.0011 mg/l	0.0008 mg/l	0.0007 mg/l	0.0006 mg/l

[1]Total load includes load to water and sediment
[2]Concentration includes 75% Lake Michigan inflow and sedimentation of 95% of the upstream particulates entering the Outer Harbor.

Source: ESEI

TABLE 8b

WATER QUALITY AND LOADS TO THE OUTER HARBOR
NON-CONSERVATIVE POLLUTANTS

		Expand Jones Island WWTP			Expand Jones Island and Relocate Outfall		
	Present	No Action	Complete Sewer Separation	Modified Total Storage	No Action	Complete Sewer Separation	Modified Total Storage
Water (x 10^9 gallons/yr)	701	701	701	701	659	661	655
BOD Load	40 million lbs/yr	34 million lbs/yr	33 million lbs/yr	32 million lbs/yr	17.4 million lbs/yr	16.7 million lbs/yr	15.4 million lbs/yr
Chlorine Concentration at Outfall	2 mg/l	0.5 mg/l	0.5 mg/l	0.5 mg/l	-	-	-
Fecal Coliform Load	159×10^{15}/yr	157×10^{15}/yr	2.0×10^{15}/yr	1.5×10^{15}/yr	157×10^{15}/yr	2.0×10^{15}/yr	1.4×10^{15}/yr

Source: ESEI

TABLE 8c

WATER QUALITY AND LOADS TO THE OUTER HARBOR:

THE NITROGEN GROUP

		Expand Jones Island WWTP			Expand Jones Island and Move Outfall		
	Present	No Action	Complete Sewer Separation	Modified Total Storage	No Action	Complete Sewer Separation	Modified Total Storage
Water (x10^9 gallons/yr)	701	701	701	701	659	661	655
Total Nitrogen:							
Load	7 million lbs/yr	11 million lbs/yr	11 million lbs/yr	11 million lbs/yr	2.4 million lbs/yr	1.6 million lbs/yr	1.5 million lbs/yr
*Concentration	1.7 mg/l	2.5 mg/l	2.5 mg/l	2.5 mg/l	1.1 mg/l	0.9 mg/l	0.9 mg/l
Ammonia Concentration:							
at Outfall	8 mg/l	18 mg/l	18 mg/l	18 mg/l	-	-	-
*in Harbor	0.5 mg/l	1.0 mg/l	1.0 mg/l	1.0 mg/l	0.1 mg/l	0.1 mg/l	0.1 mg/l
Non-ionized Ammonia Concentration @15°C:							
at Outfall	0.07 mg/l	0.15 mg/l	0.15 mg/l	0.15 mg/l	-	-	-
*in Harbor	0.01 mg/l	0.03 mg/l	0.03 mg/l	0.03 mg/l	0.003 mg/l	0.003 mg/l	0.003 mg/l
pH:							
at Outfall	7.5	7.5	7.5	7.5	-	-	-
*in Harbor	8.0	8.0	8.0	8.0	8.0	8.0	8.0

*Concentrations use 75% lake water and 25% input water as indicated by conductivity data.

Source: ESEI

TABLE 8d
ANNUAL POLLUTANT LOADS
FROM THE JONES ISLAND WWTP

	Existing	Future[a]
Water ($\times 10^9$ gallons/yr)	49.0	45.6
Suspended Solids ($\times 10^6$ pounds/yr)	11.4	11.8
Biochemical Oxygen Demand - Ultimate ($\times 10^6$ pounds/yr)	18.0	16.0
Phosphorus ($\times 10^3$ pounds/yr)	261	231
Ammonia ($\times 10^6$ pounds/yr)	2.13	6.8
Cadmium ($\times 10^3$ pounds/yr)	3.27	2.90
Lead ($\times 10^3$ pounds/yr)	28.6	31.9
Fecal Coliform Bacteria (counts per year)	3.70×10^{14}	3.45×10^{14}

1 pound = 0.45 kilograms
1 gallon = 3.78 liters

[a]This assumes the Modified Total Storage Alternative for CSO abatement. It represents the maximum loads to be discharged from the treatment plant under any of the CSO abatement alternatives.

Source: ESEI.

The location of a new outfall for the Jones Island WWTP is a subject requiring further study. It is likely that suitable locations exist that would not contaminate Milwaukee's water supply intake or bathing beaches. There are two guiding principles: the effluent should be well diffused and the regime of the near-shore currents should be considered. These principles lead to locations at least a few hundred meters beyond the breakwater, east or southeast from Jones Island. The plume of effluent would only rarely be detectable beyond two hundred meters from the outfall, based on the experience at the South Shore WWTP (MMSD 1979).

LAKE MICHIGAN

Lake Michigan is the ultimate recipient of conservative pollutants from the Milwaukee area. Except for locally polluted harbor areas, the lake is considered to have excellent water quality (EPA 1978) and a thorough circulation system, so pollution is rapidly diluted with clean lake water. Although diluted, the pollutants do not vanish. The Lake retains water for about 100 years, and sediments are essentially permanent. Gradually, the pollutants accumulate, causing greater algae density (eutrophication) and harmful levels of poisonous substances in fish (as has already happened with PCBs). The long-term pollution of Lake Michigan has been studied by the International Joint Commission, and recommended maximum pollutant loads to the lake have been published (IJC 1978).

Four sewage treatment plants would discharge effluent directly to Lake Michigan: The South Shore WWTP, the South Milwaukee WWTP, private plants at the Sisters of Notre Dame Academy and the Wisconsin Electric Power Company's Oak Creek Plant. The Jones Island WWTP would also discharge its effluent directly if a new outfall beyond the Harbor breakwater is constructed. All other plants, except those that would discharge effluent to Deer Creek or Big Muskego Lake, would be indirectly adding pollutants to Lake Michigan. The existing plants add an amount of phosphorus to Lake Michigan basin each year equal to 3% of the total load (IJC 1978). Ninety-five percent of these loads are from the Jones Island and South Shore plants. Tables 9a through 9d present the expected concentrations and loads from all WWTPs that would discharge direct to Lake Michigan.

The proposed expansions of these two plants may result in increases in phosphorus loads and in nitrogen loads as shown in Tables 8 and 9. Loads in every category would increase. However, if the Jones Island and South Shore plants will be operated to generate effluent well within the WPDES permit limits, as is being done now, the increases in pollutant loads would be smaller.

TABLE 9a
WATER QUALITY AND LOADS TO LAKE MICHIGAN:
SOLIDS, PHOSPHORUS, AND METALS

	Ambient	South Shore WWTP Present	South Shore WWTP Future	South Milwaukee WWTP	Sisters of Notre Dame	Wisconsin Electric	Jones Island WWTP Relocated Outfall[a]
Effluent Flow (x 10^6 gallons/yr)	--	31,000	42,000	986	5.84	21.9	45,600
Particulate Solids:							
*Concentration	10 mg/l	17 mg/l	30 mg/l	30 mg/l	30 mg/l	30 mg/l	31 mg/l
Load	--	4.2 million lbs/yr	10 million lbs/yr	0.3 million lbs/yr	1800 lbs/yr	4600 lbs/yr	11.8 million lbs/yr
Phosphorus:							
*Concentration	0.007 mg/l	0.7 mg/l	1 mg/l	1 mg/l	5 mg/l	5 mg/l	0.6 mg/l
Load	--	170,000 lbs/yr	350,000 lbs/yr	11,000 lbs/yr	300 lbs/yr	760 lbs/yr	231,000 lbs/yr
Cadmium:							
*Concentration	0.0006 mg/l	0.007 mg/l	0.007 mg/l	0.007 mg/l	nil	nil	0.008 mg/l
Load	--	1700 lbs/yr	2400 lbs/yr	80 lbs/yr	nil	nil	2900 lbs/yr
Lead:							
*Concentration	0.004 mg/l	0.06 mg/l	0.06 mg/l	0.06 mg/l	nil	nil	0.09 mg/l
Load	--	15,000 lbs/yr	21,000 lbs/yr	680 lbs/yr	nil	nil	31,900 lbs/yr

1 lb/yr = 0.45 kilograms/yr

*Concentration at outfall except "Ambient," where it is the average concentration at Lake Michigan's western shore (Torrey 1976).

[a]This assumes the Modified Total Storage Alternative for CSO abatement. It represents the maximum loads to be discharged from the treatment plant under any of the CSO abatement alternatives.

Source: ESEI

TABLE 9b

WATER QUALITY AND LOADS TO LAKE MICHIGAN
NON-CONSERVATIVE POLLUTANTS

	Ambient	South Shore WWTP Present	South Shore WWTP Future	South Milwaukee WWTP	Sisters of Notre Dame	Wisconsin Electric	Jones Island WWTP Relocated Cutfall
:ffluent Flow (x 10^6 gallons/yr.)	-	31,000	42,000	986	5.84	21.9	42,100[a]
3OD Load	-	3 million lbs/yr	10 million lbs/yr	0.3 million lbs/yr	1800 lbs/yr	4600 lbs/yr	16 million lbs/yr
:hlorine Concentration at Outfall	-	1.4 mg/l	0.5 mg/l	0.5 mg/l	0.5 mg/l	0.5 mg/l	0.5 mg/l
'ecal Coliform Load	-	0.03×10^{15}/yr	0.3×10^{15}/yr	0.01×10^{15}/yr	0.00005×10^{15}/yr	0.0001×10^{15}/yr	0.3×10^{15}/yr

[a]This assumes the Modified Total Storage Alternative for CSO abatement. It represents the maximum loads to be discharged from the treatment plant under any of the CSO abatement alternatives.

Source: ESEI

TABLE 9C

WATER QUALITY AND LOADS TO LAKE MICHIGAN
THE NITROGEN GROUP

	Ambient	South Shore WWTP Present	South Shore WWTP Future	South Milwaukee WWTP	Sisters of Notre Dame	Wisconsin Electric	Jones Island WWTP Relocated Outfall
Effluent Flow ($\times 10^6$ gallons/yr.)	-	31,000	42,000	986	5.84	21.9	45,600[a]
Total Nitrogen:							
*Concentration	0.7 mg/l	28 mg/l	28 mg/l	20 mg/l	20 mg/l	20 mg/l	28 mg/l
Load	-	6 million lbs/yr	10 million lbs/yr	200,000 lbs/yr	1200 lbs/yr	3100 lbs/yr	9 million lbs/yr
Ammonia:							
*Concentration	0.1 mg/l	18 mg/l	18 mg/l	8 mg/l	8 mg/l	8 mg/l	18 mg/l
Un- ionized Ammonia							
*Concentration at 15°C	0.002 mg/l	0.15 mg/l	0.15 mg/l	0.07 mg/l	0.07 mg/l	0.07 mg/l	0.15 mg/l
*pH	8.2	7.5	7.5	7.5	7.5	7.5	7.5

*Concentrations at outfall except "Ambient," where it is the average concentration at Lake Michigan's western shore (Torrey 1976).

[a]This assumes the Modified Total Storage Alternative for CSO abatement. It represents the maximum loads to be discharged from the treatment plant under any of the CSO abatement alternatives.

Source: ESEI

TABLE 9d

ANNUAL POLLUTANT LOADS FROM THE SOUTH SHORE WWTP

	Existing		
	Effluent	Relief Bypass Discharge[a]	Future
Water ($x10^6$ gallons/ Yr.)	30,000	300	42,000
Suspended Solids	7.5 million lbs/yr[b]	290,000 lbs/yr	10 million lbs/yr
BOD	7.5 million lbs/yr[b]	250,000 lbs/yr	10 million lbs/yr
Phosphorus	250,000 lbs/yr[b]	13,000 lbs/yr	350,000 lbs/yr
Ammonia	4.5 million lbs/yr	20,000 lbs/yr	6 million lbs/yr
Cadmium	1700 lbs/yr	25 lbs/yr	2500 lbs/yr
Lead	15,000 lbs/yr	320 lbs/yr	21,000 lbs/yr
Fecal Coliform Bacteria	0.2×10^{15}/yr[b]	0.007×10^{15}/yr	0.3×10^{15}/yr

1 lb = 0.45 kilogram
1 gal = 3.78 liters

[a] Relief Bypass Discharges consist of material in the MIS which is discharged to the surface waters prior to being treated in the WWTP.

[b] Assumes maximum WPDES concentrations. Actual values may be lower.

Source: ESEI

There is no reason to expect decreases in pollutant loads from the treatment plants below those currently occurring.

South Shore WWTP would continue to use its present outfall: four outlets located on the bottom of Lake Michigan, 1800 feet (550 meters) northeast of the plant. Effluent, being warmer than lake water, rises to the surface where it spreads into a plume a few inches deep (MMSD 1979). The plume is carried at most a thousand meters by winds and currents before it is diluted to background conditions. Water quality monitoring (MMSD 1979) shows that sewage constituents are detectable 300 meters from the outfall less than 10% of the time.

Plumes from the South Milwaukee WWTP and the two private plants would be expected to be much smaller and affect a smaller area. The Outer Harbor generates plumes of pollutant-laden water from its four openings, but these plumes would be of a different nature than sewage effluent plumes. There is little temperature difference between lake water and harbor water, so instead of floating in a thin surface layer, subject to dilution outward and downward the water moves out at all layers, subject only to outward dilution and because of the larger volume is less easily dissipated in the lake. Furthermore, the harbor flow from the north or south openings in the breakwater may flow along the shore, spoiling beaches.

Sewage effluent contains more impurities than lake water. It contains 100 times more phosphorus, 150 times more ammonia, and 10 times more cadmium per unit volume. The area near the South Shore outfall (and the new Jones Island outfall, if it is built) would have higher concentrations of un-ionized ammonia than is recommended by the DNR for the protection of fish. However, only a portion of the plume would be likely to have high levels of ammonia, since oxidation, outgassing, and biological uptake will reduce the quantity of dissolved ammonia as dilution reduces the concentration. There would be no local accumulation of ammonia in Lake Michigan.

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