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Agency

Region V
230 South Dearborn
Chicago, Illinois 60604

June 1979

Water Division

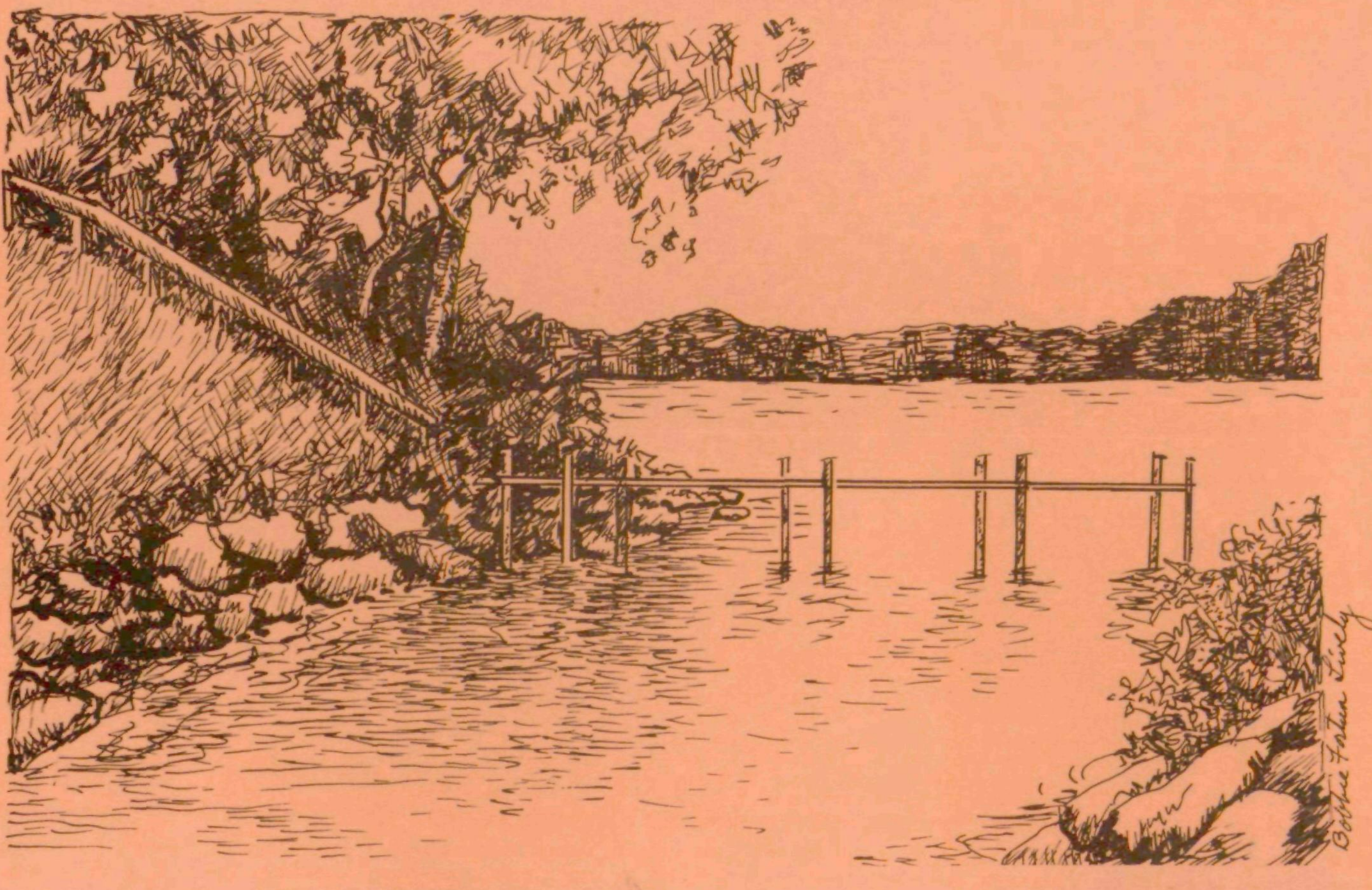
EPA

Environmental Impact Statement

Draft

Alternative Waste Treatment Systems for Rural Lake Projects

Case Study Number 2
Green Lake Sanitary Sewer and Water District
Kandiyohi County
Minnesota



DRAFT ENVIRONMENTAL IMPACT STATEMENT

WASTEWATER TREATMENT SYSTEMS

FOR RURAL LAKE PROJECTS

CASE STUDY No. 2: GREEN LAKE

SANITARY SEWER AND WATER DISTRICT

KANDIYOHI COUNTY, MINNESOTA

Prepared by the

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION 5

CHICAGO, ILLINOIS

and

WAPORA, INC.

WASHINGTON, D.C.

Approved by:

John McGuire
Regional Administrator

June 1979

DRAFT ENVIRONMENTAL IMPACT STATEMENT
GREEN LAKE STUDY AREA
KANDIYOHI COUNTY, MINNESOTA

Prepared by

US Environmental Protection Agency, Region V

Comments concerning this document are invited and should be received by

August 13, 1979 .

For further information, contact:

Mr. Gregory A. Vanderlaan, Project Monitor
230 South Dearborn Street
Chicago, Illinois 60609
312/353-2157

Abstract

A 201 Facilities Plan was prepared for the Green Lake Sanitary Sewer and Water District in 1976. The Facilities Plan concluded that extensive sewering would be required to correct malfunctioning on-site wastewater disposal systems and to protect the water quality of Green Lake.

Concern about the high proposed costs of the Facilities Plan Proposed Action prompted re-examination of the Study Area and led to preparation of this EIS. This EIS concludes that existing wastewater treatment plants in the area may upgraded, and that complete abandonment of on-site systems is unjustified. Alternatives to the Facilities Plan Proposed Action have therefore been developed and are recommended by this Agency.

LIST OF PREPARERS

This Environmental Impact Statement was prepared by WAPORA, Inc. under the guidance of Gregory Vanderlaan, EPA Region V Project Monitor. Key personnel for WAPORA included:

WAPORA, Inc.
6900 Wisconsin Avenue
Chevy Chase, MD 20015

Eric Hediger - Project Manager
David Twedell, Ph.D. - Assistant Project Manager
Gerald Peters - Project Director

In addition, several subcontractors and others assisted in preparation of this document. These, along with their areas of expertise, are listed below:

Aerial Survey
Environmental Photographic Interpretation Center
Vint Hill Farms Station
Warrenton, Virginia
Barry Evans

Engineering
Arthur Beard Engineers
6900 Wisconsin Avenue
Chevy Chase, Maryland
David Wohlscheid, P.E.
David Stewart

Financial
A. T. Kearney Associates
699 Prince Street
Alexandria, Virginia
Charles Saunders

Sanitary Survey
University of Michigan Biological Station
Pellston, Michigan
Mark Hummel

Septic Leachate Analysis
K-V Associates
Falmouth, Massachusetts
William Kerfoot, Ph.D.

Soils Interpretation
USDA, Soil Conservation Service
Willmar, Minnesota
Allan G. Giencke
St. Peter, Minnesota
Richard Paulson

SUMMARY

CONCLUSION

Most on-site systems around Green Lake and Nest Lake are operating satisfactorily. Approximately 30 septic tank effluent plumes entering Green Lake and 15 plumes entering Nest Lake have been identified, along with a few septic system surface malfunctions. Backup of sewage in these systems is relatively infrequent. On-site systems do not appear to be a significant contributor of nutrients to Green Lake -- only 8% of the total phosphorus input to this lake is estimated to come from effluent plumes. Effluent plumes only constitute an estimated 1% of the total phosphorus budget of Nest Lake.

In the Facilities Plan, septic systems were suspected of contributing to water quality and potential public health problems although there was little evidence to support this suspicion. Neither the Facilities Plan Proposed Action nor the EIS Alternatives are expected to either adversely or beneficially affect the water quality of the open bodies of Green Lake or Nest Lake. The lack of measurable improvement in the quality of these open waters suggests the significance of the non-point source loading associated with the Middle Fork of the Crow River. This loading constitutes an estimated 73% and 96% of the total phosphorus input to Green Lake and Nest Lake, respectively. Any improvement in the lake water quality associated with wastewater management schemes presented in this EIS is likely to be masked by tributary loads of the above magnitude.

Many of the on-site systems presently in use within the EIS Service Area are poorly maintained and many are inadequately designed. Routine maintenance for all on-site systems and upgrading of inadequately designed systems will substantially reduce the number of problems caused by them. Where problems cannot be solved by routine maintenance or upgrading alone, alternatives to the conventional septic tank -- subsurface absorption systems are feasible in the Study Area which will minimize or eliminate the problems.

Future growth in the Green Lake Service Area depends on the number of new lots that can be developed at the allowable density. Wastewater disposal alternatives relying on continued use of on-site systems around the lake would restrict both the number of new lots as well as their density. An effect of these limitations would be to preserve the present character of the community.

Total present worth for the centralized alternatives (Facilities Plan Proposed Action, EIS Alternatives 1, 2, and 3) are substantially higher than for the decentralized alternatives (EIS Alternatives 4, 5, 6, and Limited Action). As calculated in this EIS, the Facilities Plan Proposed Action is 57% more expensive than EIS Alternative 5 and 191% more expensive than Limited Action . Differences in water quality impacts of the alternatives are not proportionate to these large differences in costs. Because of the high costs and limited benefits to water quality with the centralized alternatives (Facilities Plan Proposed Action and EIS Alternatives 1, 2, and 3), they are not cost-effective and therefore cannot be funded by EPA.

DRAFT EIS RECOMMENDATIONS -- Because EIS Alternatives 4 and 5 (decentralized approaches with land application) and 6 (decentralized approach with upgrade/expansion of wastewater treatment plants at Spicer and New London) can all be considered cost-effective, and because they differ substantially from the Facilities Plan Proposed Action (centralized approach with stabilization ponds), the recommendation of this EIS is to return the grant application to the Green Lake Sanitary Sewer and Water District (GLSSWD) for additional Step 1 analysis. The scope of additional analysis will depend on the applicant's own decisions regarding the feasibility of the small waste flows approach for Green Lake and Nest Lake and the merits of land application for wastewaters from Spicer and New London.

Alternatives 4, 5, and 6 differ in the type and location of treatment and disposal facilities for Spicer's and New London's wastewaters. The GLSSWD will need to conduct additional Step 1 analyses, funded by EPA, of alternatives to serve Spicer and New London jointly or separately. EPA encourages the use of land application and will require evaluation of land application including detailed site analyses. If GLSSWD chooses Alternative 6, the Step 1 analyses must include the following:

- Applicant's own analysis of the feasibility and costs of treatment plant upgrading;

- Engineering, cost and environmental analysis of sludge management options; and

- Engineering, cost, and environmental analysis of effluent disinfection options.

EPA will participate in funding additional site specific analyses of existing on-site systems, their design, usage and environmental impacts. These additional analyses will address:

- Development of a site-specific environmental and engineering data base;

- Design of the management organization; and

- Start-up of the management district.

The applicant will need to complete additional Step 1 requirements by taking the following actions (40 CFR 35.918):

- Certify that construction of the project and operation and maintenance program will meet local, State and Federal requirements. As a first step, this certification involves a lot-by-lot investigation of existing septic tank systems and site suitability for wastewater treatment. If it can be demonstrated that existing systems do not degrade lake water quality or promote public health problems, despite the findings of the lot-by-lot investigation, then the GLSSWD may initiate variance procedures for these systems under the Minnesota Shoreland Management Act which has been adopted and amended by Kandiyohi County. The specific variance that would be negotiated between the GLSSWD and the County involves the Act's stipulation that there be a 4-foot vertical distance between the bottom of the septic tank drainfield and the highest known groundwater elevation.

- Obtain assurance of unlimited access to each individual system at all reasonable times for such purposes as inspections, monitoring, construction, maintenance, operations, rehabilitation and replacement.

- Plan for a comprehensive program of regulation and inspection for individual systems.

HISTORY

In November 1975, the Green Lake area Facilities Plan was submitted to EPA Region V by the Green Lake Sanitary Sewer and Water District acting as the applicant for funding under the EPA Construction Grants Program. The GLSSWD Service Area encompasses the City of Spicer, the Village of New London, and the residential area surrounding Green Lake. Portions of New London Township, Green Lake Township, Irving Township and Harrison Township are included in this Service Area. At the time, the City of Spicer and village had already been sewered and were operating their own sewerage facilities.

The Facilities Plan identified the following problems associated with the existing centralized wastewater collection and treatment facilities:

- The present Spicer and New London sanitary sewer systems are both subject to potentially excessive infiltration/inflow.

- The Spicer and New London treatment plants do not meet Minnesota Pollution Control Agency 1974 discharge requirements.

The following problems associated with existing on-site systems in the Study Area were also addressed by the facilities planners in 1976:

- An estimated 55% of the on-site wastewater disposal systems around Green Lake cannot comply with the 4 foot separation parameter specified in the Minnesota Shoreland Management Act;

- The same 55% of the individual disposal systems cannot be upgraded to comply with the Shoreland Management Act because of the small size of the platted lots around Green Lake;

- Individual disposal systems around Green Lake are contributing to the nutrient loading of this basin (approximately 23%

greater than the total discharge loading from Spicer and New London); and

- Many of the older individual on-site systems installed approximately 20 years ago may be cesspools.

The alternative involving centralized collection and treatment by waste stabilization lagoons was selected as the Facilities Plan Proposed Action because it proved to be the most cost-effective of the two final alternatives considered. The Proposed Action is cited to be in concurrence with the comprehensive water and sewer plan adopted by Kandiyohi County in 1973.

EIS ISSUES

1. COST EFFECTIVENESS

The total capital cost for the Facilities Plan Proposed Action was estimated in the Plan (August, 1976) to be $4.4 million. This represents an investment of approximately $875 per person and $3,709 per existing dwelling unit within the Facilities Plan Proposed Service Area.

It is questionable whether total elimination of septic tanks will have a strong positive impact on overall lake quality.

2. IMPACTS ON WATER QUALITY

Although indirect evidence was presented in the Facilities Plan indicating that there may be a water quality problem attributed to malfunctioning lakeshore septic systems, the relationship between deteriorating water quality and inadequately functioning septic systems was not documented. With the exception of two isolated cases involving high nitrate nitrogen levels (greater than 10 milligrams per litre (mg/l)) in domestic wells along the south shore of Green Lake, claims of possible hazards to the public health have been unsubstantiated.

3. ECONOMIC IMPACT

The average local share per residence of the total capital costs for the Facilities Plan Proposed Action is approximately $2,180. The Plan estimates the annual user charge per resident to be $194, which includes annual debt retirement of the amortized local share of the project cost and annual O&M costs. The user charge represents approximately 1.4% of the average annual income for year-round residents. Seasonal residents, particularly those in smaller, less expensive homes may come under considerable pressure to sell their property.

4. INDUCED GROWTH AND SECONDARY IMPACTS

Based upon their experience with previous wastewater management projects in rural lake areas, the Minnesota Pollution Control Agency has concluded that sewering of Green Lake may cause the following:

- Increased development of lakeside areas;
- Increased development of adjacent non-lakeside areas; and
- A shift from seasonal to permanent occupancy.

5. PUBLIC CONTROVERSY OVER WATER QUALITY

Residents of Harrison Township and Irving Township have expressed concern over the Facilities Plan - proposed stabilization pond (i.e., lagoon) system and its potentially adverse effects upon local groundwater quality. Farmers and other citizens who live in the vicinity of the proposed treatment site focus their concern on the potential for contamination of domestic water supply wells through lagoon seepage into sandy soils. This concern exists despite the fact that the Plan recommended installation of an impermeable bentonite liner during lagoon construction.

ENVIRONMENT

Soils

Opportunities for suitable treatment of domestic wastewater exist at selected sites throughout the Study Area. Major factors restricting the use of some soils for on-site waste disposal systems are permeability and a seasonal high water table. The extreme variability of these glacial soils, in some cases on a lot-by-lot basis along the Green Lake shoreline, is significant as it requires that detailed soils and groundwater investigations be performed prior to construction of soil-dependent treatment systems.

Surface Water Resources

Nest Lake, with an area of 945 acres, is classified as a eutrophic system. The irregular configuration of its shoreline, which restricts water circulation patterns, allows for build-up of nutrients and algae in its many embayments.

Green Lake is the focal point of the Study Area, occupying approximately 5400 acres; its primary tributary is the Middle Fork of the Crow River. Green Lake's water quality has remained stable over the past 7 years, and it is classified as a moderately fertile (mesotrophic) sytem.

There is no evidence that existing systems are contributing significant bacterial loads to Green Lake. Bacterial levels along nearshore areas were generally below the Minnesota State Health Department and MPCA standards for recreational waters. Values in excess of the standards were found in inlet and outlet streams and these levels could not be attributed to septic tank leachate. Kerfoot (1979) detected very low levels of fecal coliforms (generally less than 10 counts/100 ml) in surface water (Nest Lake and Green Lake) located at the discharge of septic leachate plumes.

Groundwater Resources

Groundwater serves as the source of drinking water for the entire EIS Service Area; it is plentiful and generally of good quality. Localized high nitrate concentrations were found in groundwater during a sample 97 wells on Green Lake in July 1977. Only two samples showed nitrate concentrations in excess of the public health drinking water standard of 10 mg/l. These wells were located on the northeast and eastern Green Lake shoreline.

Additional Studies

During the preparation of this EIS, EPA pursued three additional studies in order to evaluate the need for improved wastewater management facilities in the EIS Service Area. They are briefly described as follows:

1) An aerial survey was performed by EPA's Environmental Photographic Interpretation Center (EPIC) during August 1978. Results of the survey indicate that septic system surface malfunctions are not widespread in the EIS Service Area. Only 3 marginally failing systems were identified along the Green Lake shoreline. One currently failing and one marginally failing system were detected on the north shore of Nest Lake. Examination of these aerial photographs indicated that near-shore aquatic plant growth is spotty and inconclusive in terms of correlating it with septic tank malfunctions.

2) A sanitary survey was conducted by the University of Michigan during November 1978. The results indicate that 11% of the on-lot systems inspected had problems attributed to site limitations such as permeability and depth to seasonal high groundwater. Less than 1% of the systems inspected had repairable problems. The remainder of the systems surveyed showed no problems. There are relatively few septic tank systems which pose public health problems as a result of backups or ponding.

3) A study of septic effluent (leachate) movement into Green Lake and Nest Lake was conducted during March 1979.

The following observations were obtained from the shoreline profiles, analyses of groundwater and surface water samples, and evaluation of groundwater flow rates and patterns:

- A total of 64 locations exhibited effluent plume characteristics. Of these, 26 originated from surface water discharges and 38 from groundwater leachate.
- The most pronounced source of leachate was inflow from the Middle Fork of the Crow River into Nest Lake.
- A noticeable undocumented source of phosphorus loading was observed originating from the discharge stream of an unnamed lake near the sewered town of Spicer.

- The observed pattern of plumes on Green Lake correlated with projected groundwater inflow for the surficial deposits. Most plumes were found on the north and west shorelines with few observed for the south and east segments.

Existing Population and Land Use

Approximately 65% of the EIS Service Area population is seasonal; these residents are located primarily in the unsewered area surrounding Green Lake. The permanent resident population, located throughout the Service Area, is characterized by a relatively low income that is below the average income for the State of Minnesota. This can be attributed to the fact that a large portion of the population is comprised of elderly people, who are retired and living on fixed incomes. In 1970, persons 65 years or older accounted for 23% of all persons on poverty status in the Study Area.

Land use in the Service Area consists of two small urban centers (Spicer City and New London Village); permanent and seasonal family residences; agricultural areas; commercial areas; and open land consisting of woodlands and wetlands. The aesthetic appeal and recreational value of the area has resulted in substantial residential development around Green Lake.

ALTERNATIVES

Based upon the high cost of conventional wastewater collection and treatment technology and questions concerning the eligibility of the new sewers, 7 new alternatives were developed in this EIS. These alternatives evaluated alternative collection systems (pressure sewers), treatment techniques (land application), individual and multi-family septic systems (cluster systems), and water conservation.

EIS ALTERNATIVE 1

Same as the Facilities Plan Proposed Action (centralized collection; treatment by stabilization pond), except that pressure sewers would be substituted for gravity sewers.

EIS ALTERNATIVE 2

Same as EIS Alternative 1, except that a mechanical oxidation ditch plant would be substituted for stabilization ponds.

EIS ALTERNATIVE 3

New London Village, City of Spicer, western shore of Green Lake, residential/commercial area between New London Village and Nest Lake, and the eastern half of Nest Lake would discharge their wastewaters to a rapid infiltration plant located north of Nest Lake. Effluent is recovered and discharged to the Middle Fork of the Crow River. The remainder of the EIS Service Area would be served by a combination of cluster systems and on-site systems suitable to local conditions.

EIS ALTERNATIVE 4

Same as EIS Alternative 3 except that wastewater generated by residents on eastern half of Nest Lake would be treated by a combination of on-site systems and cluster systems instead of the rapid infiltration system.

EIS ALTERNATIVE 5

Same as EIS Alternative 4, except that a spray irrigation system would be substituted for the rapid infiltration system.

EIS ALTERNATIVE 6

Existing sewage treatment plants at Spicer and New London would be upgraded to tertiary treatment and expanded where necessary to accommodate design flow. Discharge of treated wastewaters does not change from existing locations. Remainder of EIS Service Area to be served by a combination of on-site systems and cluster systems.

Limited Action

Same as EIS Alternative 6 except that western shore of Green Lake and residential/commercial area between New London and Nest Lake to join the rest of the EIS Service Area on on-site systems. There would be no cluster systems under this alternative.

Project costs were most directly related to the extent of sewering. No cost advantage was obtained with the use of pressure sewers.

Implementation

Local jurisdictions have the legal and financial capability of implementing small waste flows districts. Although the concept of public management of septic systems has not been legally tested in Minnesota, present sanitary codes have been interpreted as authorizing such management by local governments. Some, but not many local jurisdictions have experience in the organization and operation of small waste flows districts. California and Illinois provide some specific examples.

Impacts of the Alternatives

Five major categories of impacts were relevant in the selection of an alternative. These categories included: surface water; groundwater; environmentally sensitive areas; population and land use; and socioeconomics.

Surface Water

None of the Alternatives is expected to have any significant impact on the present trophic status of Green Lake or Nest Lake. Both Nest

Lake and Green Lake will have only a slight improvement in overall water quality.

Phosphorus input to Woodcock Lake will decrease dramatically (more than 50%) under any proposed wastewater management scheme evaluated in this EIS.

Groundwater

No significant primary or secondary impacts on groundwater quality are anticipated either as a result of the short-term construction activities or long-term operation of any of the various alternatives. This is mainly because all of the water quantitites associated with the alternative are relatively miniscule in comparison with the estimated groundwater storage, recharge from all other sources, and available groundwater yield.

Primary Impacts

No significant short-term impacts on groundwater quality are anticipated to result from the construction activities of any of the alternatives. Conclusions with respect to long-term impacts are as follows:

- Impacts on bacterial quality are expected to be insignificant for all alternatives.
- Continued use of ST/SAS may result in minor impacts associated with shoreline algal growths.

It is possible that some nitrates from wastewater applied to land might reach surface waters via overland runoff, lateral interflow* in soils, or transport in percolating groundwaters. However, application rates for spray irrigation of effluents would be set to maximize crop uptake of nitrogen, minimizing its concentrations in groundwater. Because of the high application rates for rapid infiltration, recovery of renovated effluent by recover wells or drains may be necessary.

Environmentally Sensitive Areas

Development on steep slopes around Green Lake and Nest Lake is possible with any of the alternatives. This would result in erosion, sedimentation, and transfer of nutrients to the lakes. The Facilities Plan Proposed Action and EIS Alternatives 1 and 2 may have a somewhat greater impact in this respect than would the Limited Action or EIS Alternatives 3, 4, 5, or 6.

Population and Land Use Impacts

- A majority of residences directly contiguous to Green Lake and Nest Lake and not located within the boundaries of Spicer or New London are currently utilizing on-site waste disposal systems. An estimated 30 to 40 additional lakeshore acres are likely to be developed with provision of centralized sewerage facilities.

- Some increase in the density of residential development along the lake is also likely to result from centralized facilities.

- Population growth of 5 to 10% above levels possible without centralized facilities may accompany anticipated increases in residential acreage and intensity.

- Centralized facilities will place severe financial pressure upon lower- and middle-income families, resulting in the dislocation of many less affluent residents. In addition, these alternatives will accelerate the conversion of occupancy patterns from seasonal to year-round status. Disruption of the prevailing community environment will be a possible by-product of economic and financial pressures associated with centralization.

- Decentralized wastewater management facilities should only moderately influence the composition and character of the Green Lake area.

Economic Impacts

Annual user charges are higher for the centralized alternatives than the decentralized alternatives with respect to the currently unsewered portion of the Study Area. The centralized alternatives place a significant financial burden and displacement pressure on households in the unsewered areas. The Limited Action alternative and EIS Alternative 5 and 6 are the only ones not identified as a high-cost project for the unsewered area. None of the alternatives has been identified as a high-cost project with respect to New London and Spicer. Significant financial burden and displacement pressure are much lower in New London and Spicer as compared to the remainder of the EIS Service Area.

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SYMBOLS AND ABBREVIATIONS

*	An asterisk following a word indicates that the term is defined in the Glossary at the end of this report. Used at the first appearance of the term in this EIS.
<	less than
>	greater than
ρ	Rho
μ	Mu, micro
ν	Nu
σ	Sigma

TECHNICAL ABBREVIATIONS

AWT	advanced wastewater treatment
BOD_5	biochemical oxygen demand (5 day)
cm	centimeter
DO	dissolved oxygen
ft^2	square foot
fps	feet per second
$g/m^2/yr$	grams per square meter per year
GP	grinder pump
gpcd	gallons per capita per day
gpm	gallons per minute
I/I	infiltration/inflow
kg/yr	kilograms per year
kg/cap/yr	kilograms per capita per year
kg/mile	kilograms per mile
lb/cap/day	pounds per capita per day
mgd	million gallons per day

mg/l	milligrams per litre
ml	millilitre
mph	miles per hour
msl	mean sea level--implies above msl unless otherwise indicated
MPN	most probable number
N	nitrogen
NH_3-N	ammonia nitrogen
NO_3-N	nitrate nitrogen
NPS	non-point source
O&M	operation and maintenance
P	phosphorus, or "as phosphorus"
pH	measure of acidity or basicity; <7 is acidic; >7 is basic
PO_4	phosphate
ppm	parts per million
psi	pounds per square inch
SS	suspended solids
STEP	septic tank effluent pumping
STP	sewage treatment plant
ST/SAS	septic tank/soil absorption system
TKN	total Kjeldahl nitrogen
TP-P	total phosphorus as phosphorus
μg/l	micrograms per liter
EPAECO	name of a mathematical model

NON-TECHNICAL ABBREVIATIONS

DNR	Minnesota Department of Natural Resources
EIS	Environmenal Impact Statement

EPA	United States Environmental Protection Agency
EPIC	Environmental Photographic Interpretation Center (of EPA)
FWS	Fish and Wildlife Service, United Stated Department of the Interior
GLSSWD	Green Lake Sanitary Sewer and Water District
HUD	United States Department of Housing and Urban Development
MPCA	Minnesota Pollution Control Agency
NOAA	National Oceanic and Atmospheric Administration, United States Department of Commerce
NES	National Eutrophication Survey
NPDES	National Pollutant Discharge Elimination System
RCM	Rieke Carroll Muller Associates, Inc.
SCS	Soil Conservation Service, United States Department of Agriculture
STORET	STOrage and RETrieval (data base system of EPA)
USDA	United States Department of Agriculture
USGS	United States Geological Survey, Department of the Interior

CHAPTER I

INTRODUCTION, BACKGROUND AND ISSUES

A. PROJECT HISTORY AND DESCRIPTION

1. BACKGROUND

Partial Federal aid in funding of municipal wastewater facilities is authorized by Section 201 of the Federal Water Pollution Control Act Amendments of 1972 (FWPCA), Public Law 92-500. Funding of projects under Section 201 is subject to the provisions of the National Environmental Policy Act of 1969 (NEPA), Public Law 91-190. Section 102(2)(C) of NEPA requires the preparation of an environmental impact statement (EIS) on major Federal actions significantly affecting the quality of the human environment. Guidance for preparation of this EIS is provided by the Council on Environmental Quality's "Preparation of Environmental Impact Statements: Guidelines" August 1, 1973 (40 CFR Chapter V, Part 1500) and the Environmental Protection Agency's "Manual for Preparation of Environmental Impact Statements for Wastewater Treatment Works, Facilities Plans, and 208 Areawide Waste Treatment Management Plans" July 1974. Individual provisions of revised Council on Environmental Quality guidelines issued November 29, 1978 have been followed where practicable.

Federal funding of proposed wastewater collection and treatment facilities in the Green Lake Study Area of Kandiyohi County, Minnesota (see Figure I-1) has been requested and is the subject of this Environmental Impact Statement (EIS). Construction of the facilities was recommended in the "Preliminary Feasibility Report-Water Pollution Control Facilities Green Lake Kandiyohi County, Minnesota", which will be described later in this Chapter.

2. LOCATION

Located approximately 100 miles west of the Minneapolis-St. Paul metropolitan area, the Green Lake Study Area comprises about 24 square miles of rolling fields, farmlands, wetlands, and residential/commerical lake-side development (see Figure I-2). It includes parts of New London Township, Green Lake Township, Irving Township, and Harrison Township, as illustrated in Figure I-3. The Facilities Plan Proposed Service Area[1] is also illustrated in Figure I-3. The combined year-round population of the Study Area is estimated to be 2,400, with this figure swelling to approximately 6,900 during the vacation season.

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1 Also referred to in this EIS as the Green Lake Sanitary Sewer and Water District (GLSSWD) Service Area.

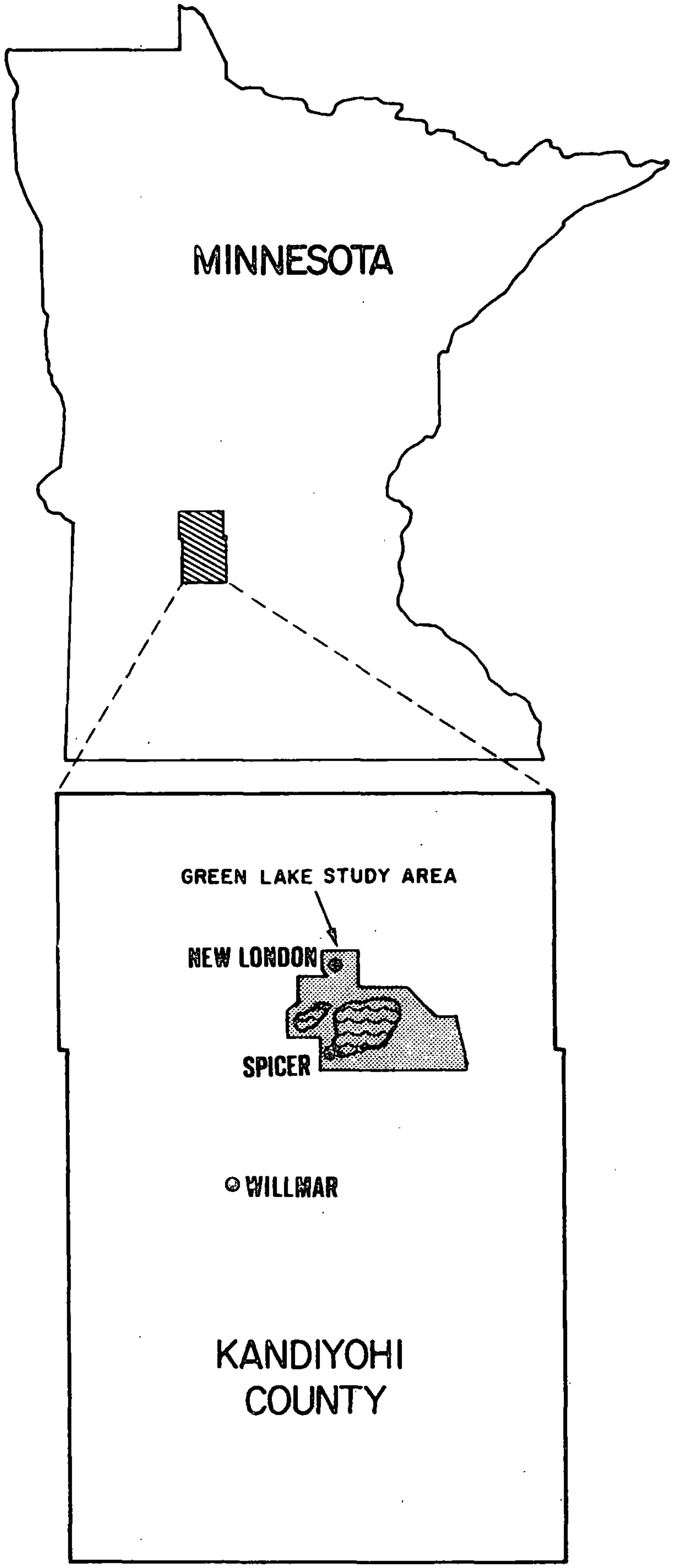


FIGURE I-1 LOCATION OF THE GREEN LAKE STUDY AREA

FIGURE I-2

PHOTOGRAPHS OF THE GREEN LAKE STUDY AREA

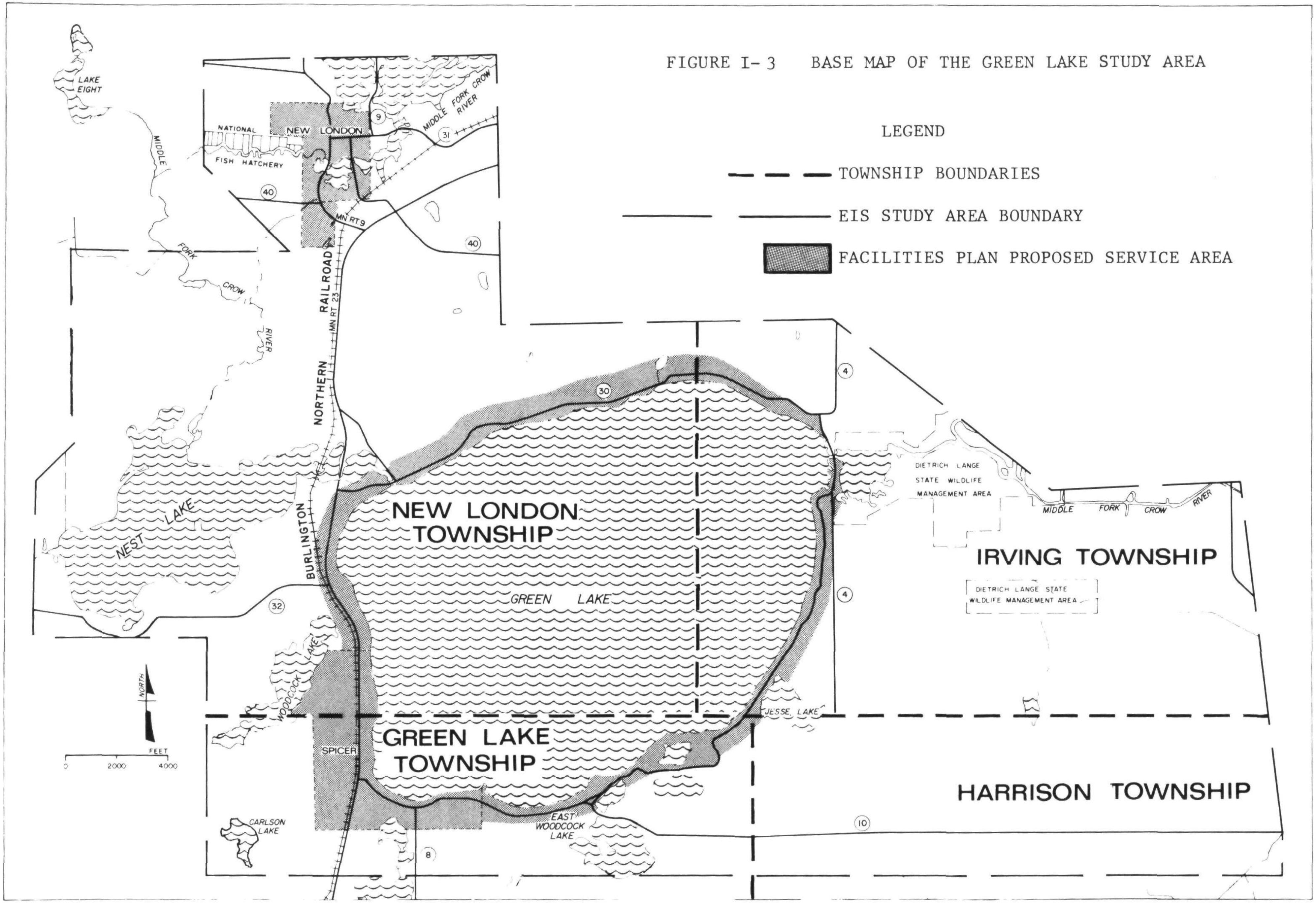


FIGURE I- 3 BASE MAP OF THE GREEN LAKE STUDY AREA

3. HISTORY OF THE CONSTRUCTION GRANT APPLICATION

A substantial amount of consideration was devoted to the wastewater management needs of the Study Area before the preparation of the Environmental Impact Statement. A chronology of the actions taken before and during this study is listed below.

1973	Petition of the Kandiyohi County Board of County Commissioners to establish the Green Lake Sanitary Sewer and Water District (GLSSWD), in accordance with Minnesota Statutes, Chapter 116A.
March 21, 1974	Agreement for Engineering Services between Rieke Carroll Muller Associates, Inc. and the County of Kandiyohi, Minnesota for a preliminary survey in accordance with Minnesota Statutes 116A.
November 1974	National Eutrophication Survey report on Green Lake.
December 16, 1974	Submittal of Preliminary Feasibility Report on Water Pollution Control Facilities for Green Lake and vicinity, Kandiyohi County, Minnesota to Kandiyohi County Commissioners.
February 21, 1975	National Pollution Discharge Elimination System (NPDES) permit issued for municipal wastewater treatment facility at Spicer, Minnesota.
April 3, 1975	NPDES permit issued for municipal wastewater treatment facility at New London, Minnesota.
April 24, 1975	Establishment of the GLSSWD by the Kandiyohi County Board of Commissioners.
August 28, 1975	Official Application for Construction Grants under the Federal Water Pollution Control Act by the GLSSWD
November 20, 1975	State "priority" certification of proposed project.
November 25, 1975	Application for construction grant received by United States Environmental Protection Agency (EPA).
March 2, 1976	Step I Grant offer made by EPA Region V.
August 16, 1976	Additional Facilities Plan Information for the GLSWSC submitted to Minnesota Pollution Control Agency (MPCA).
September 17, 1976	Concerned Property Owners of Green Lake request EPA to prepare an EIS.

September 18, 1976	Facilities Plan public hearing.
October 29, 1976	Submittal of preliminary feasibility report and supplemental information to MPCA.
September 28, 1976	MPCA requests Kandiyohi County to expand facilities plan.
December 17, 1976	Submittal to MPCA for evaluation of additional facilities plan alternatives.
July 19, 1977	Notice of Intent to prepare an EIS
October 1977	Preparation of EIS begins.
December 21, 1977	First public information meeting to discuss the EIS process and specific issues related to Green Lake.
May 17, 1978	Formation of the Green Lake Citizen's Advisory Committee.
October 1978	First Citizen's Advisory Committee meeting to discuss EIS project scope and issues.
December 20, 1978	Second Citizen's Advisory Committee meeting to discuss the preliminary EIS alternative report.

4. THE GREEN LAKE AREA FACILITIES PLAN

In November 1975, the Green Lake area Facilities Plan was submitted to EPA Region V by the Green Lake Sanitary Sewer and Water District acting as the applicant for funding under the EPA Construction Grants Program. The GLSSWD Service Area (as distinct from the Proposed EIS Service Area illustrated in Figure I-4) encompasses the City of Spicer, the Village of New London, and the residential area surrounding Green Lake. The following items together constitute the Facilities Plan for the proposed GLSSWD Service Area (Rieke Carroll Muller Associates, Inc., 1976):

- Preliminary Feasibilty Report on Water Pollution Control Facilities Green Lake Vicinity, Kandiyohi County, Minnesota, prepared by Noyes Engineering Service and Rieke Carroll Muller (RCM) Associates, Inc., dated December 16, 1974; and
- Supplemental information submitted to the GLSSWD dated August 16, 1976.

It must be emphasized here that although the Facilities Plan addressed the implementation of both a centralized wastewater collection and treatment system and a water supply system to serve Green Lake area residents, this EIS will only evaluate the construction and operation of wastewater management facilities. The EPA Construction Grants Program serves to partially fund wastewater collection and treatment systems, not water distribution systems.

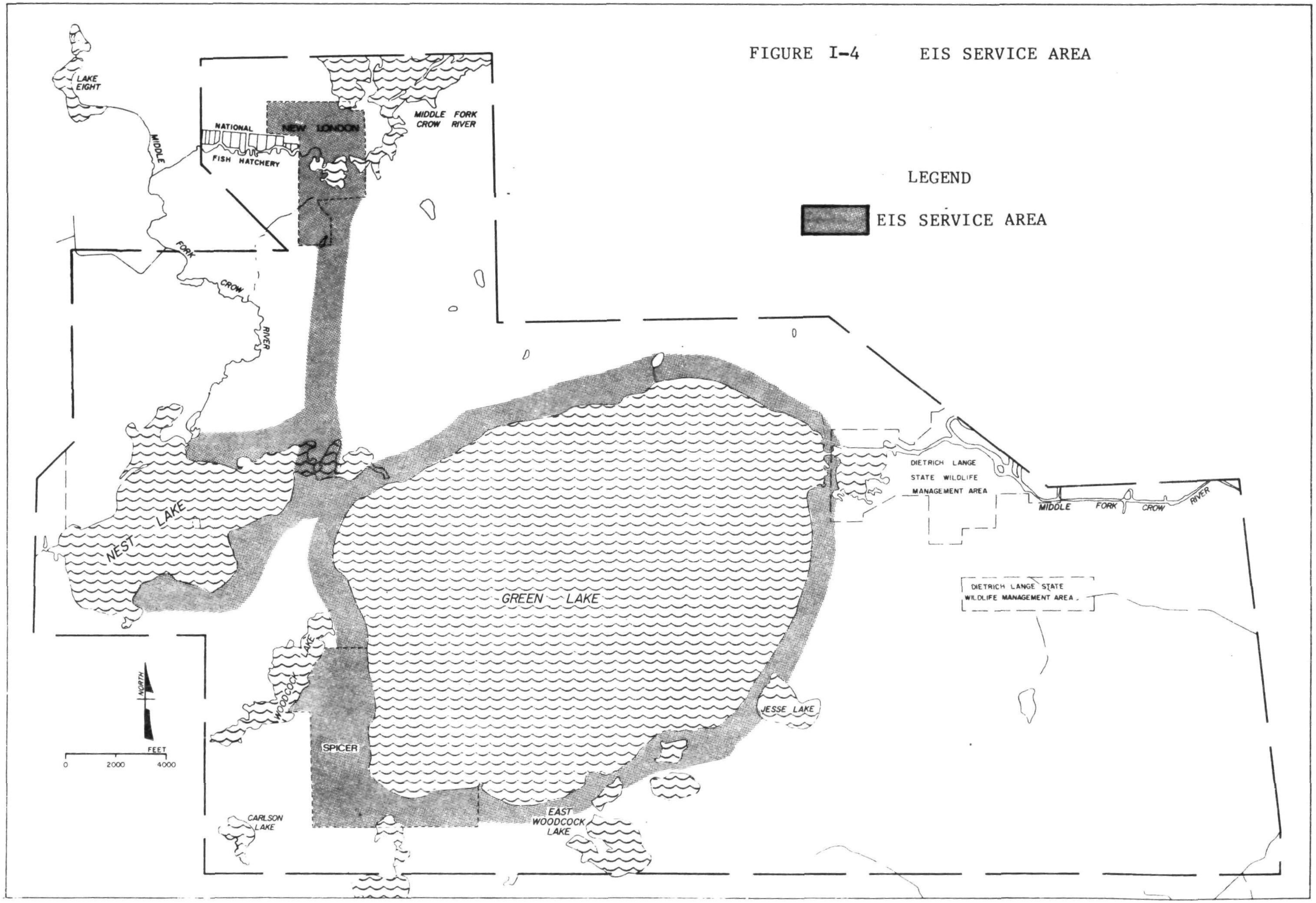


FIGURE I-4 EIS SERVICE AREA

The following section summarizes the Facilities Plan's descriptions of existing wastewater treatment facilities, water quality problems, the need for the project, alternative solutions, and the course of action proposed. It should be noted that conclusions reached in the Facilities Plan and reviewed here are not necessarily those reached in this EIS.

a. Existing Wastewater Treatment Facilities

There are two communities in the Green Lake Study Area that are each served by independent sanitary sewer and storm sewer systems: New London Village and the City of Spicer. The location of existing wastewater treatment facilities serving these communities and their respective discharge points are illustrated in Figure I-5. A brief description of these facilities is presented below.

New London Sewage Treatment Plant. The New London plant, constructed in 1954, provides primary treatment prior to discharge to the Middle Fork of the Crow River (see Figure I-6). The existing plant consists of a control building which houses a dry well on the lower level, and controls, office, and laboratory space on the upper level. The treatment plant contains, in addition to the control building, a primary clarifier or settling tank (see Figure I-6) and a separate anaerobic sludge digester (see Figure I-6). Sludge drying beds (see Figure I-6) are also located on the premises. The treatment plant was designed for an average daily flow of 129,000 gallons per day (gpd). No historical operating data are available. However, during preparation of the Preliminary Feasibility Report in August 1974, wastewater flows were found to average approximately 104,000 gpd during normal weather and 130,000 gpd during wet weather.

New London initiated planning in 1969 to upgrade its present wastewater treatment facility. The plans were completed in 1971. The MPCA, however, did not approve the plans as submitted because of a question regarding the handling of chemical sludge produced in the phosphorus removal process.

Spicer Sewage Treatment Plant. This plant, constructed in 1954, is a conventional primary plus secondary wastewater treatment plant with anaerobic sludge digestion. The plant consists of a control building which houses a primary clarifier on the upper level and a trickling filter on the lower level (see Figure I-7). The primary treatment unit is a "Spiragester" which is a treatment unit combining a primary settling tank with an anaerobic sludge digestion tank at two levels similar to an Imhoff tank. The trickling filter unit is a high rate, tile media unit with a rotating splash plate type distributor. A small final clarifier, a chlorine contact chamber, and some deteriorating sand sludge drying beds are located outside of the control buidling. The plant was designed for an average daily flow of 86,000 gpd. In August 1974, wastewater flows averaged approximately 112,000 gpd during normal weather and 116,000 gpd during wet weather. No historical wastewater flow data are available. The treatment plant discharges to Woodcock Lake (see Figure I-7).

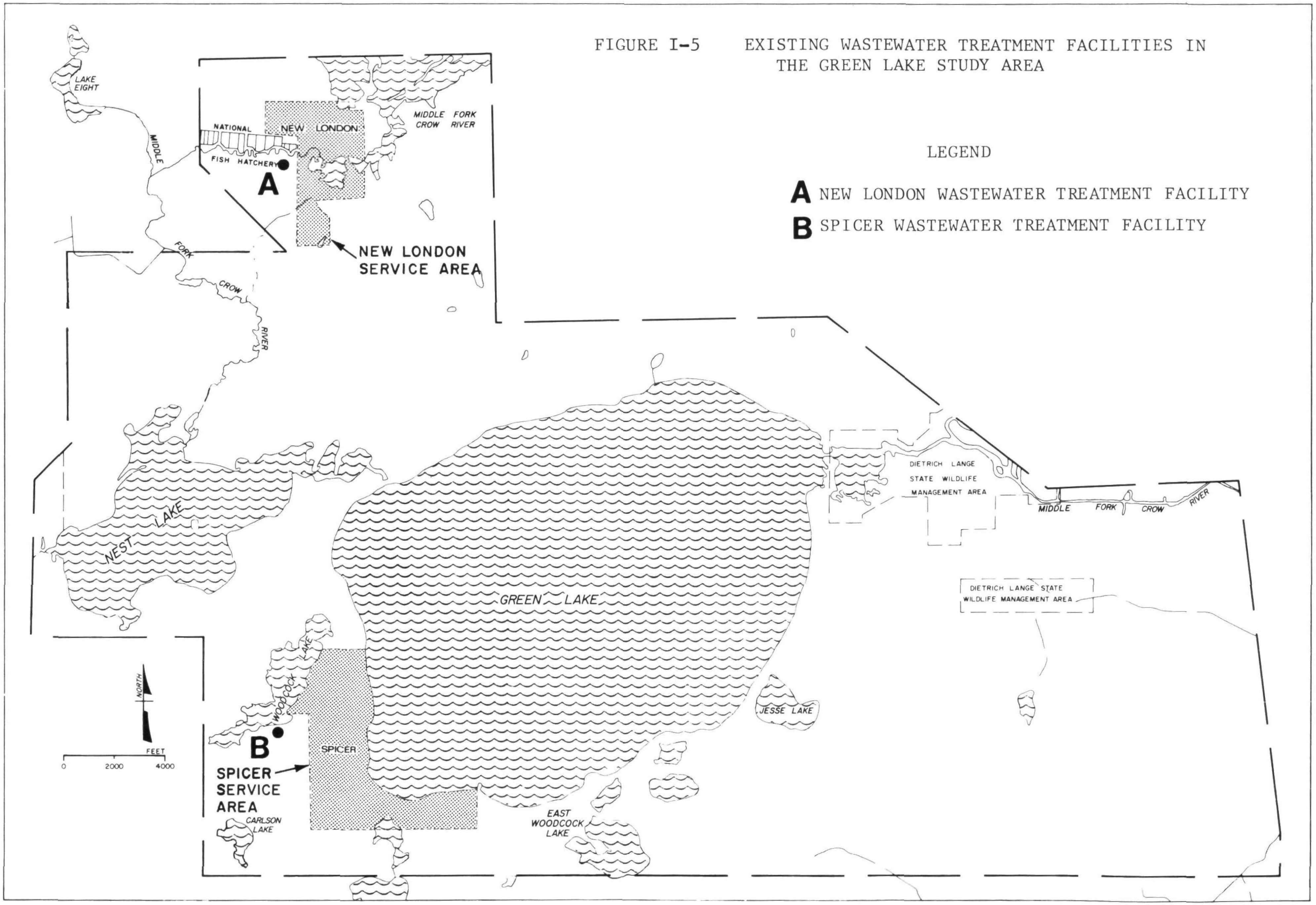


FIGURE I-5 EXISTING WASTEWATER TREATMENT FACILITIES IN THE GREEN LAKE STUDY AREA

FIGURE I-6

NEW LONDON SEWAGE TREATMENT PLANT

Primary Clarifier

New London Plant Discharge

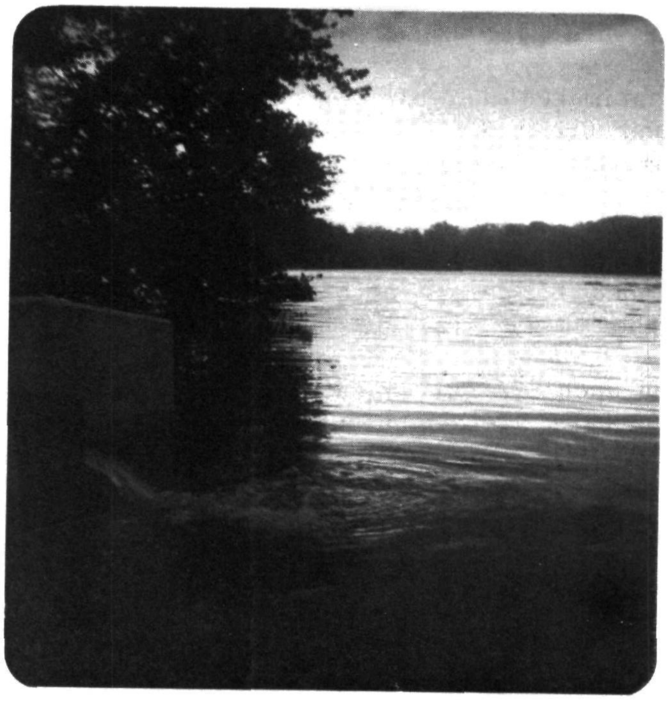
Anaerobic Sludge Digester

Sludge Drying Beds

FIGURE I-7

SPICER SEWAGE TREATMENT PLANT

Control Building



Discharge to Woodcock Lake

On-Site Systems. Wastewater generated in the remaining parts of the Green Lake Study Area are generally treated by septic tank-soil absorption systems (ST-SAS). The actual size and design of these soil-dependent on-site systems varies considerably according to when the system was installed and what sanitary codes were in effect at the time of installation. There are also some summer cottages which supplement in-house sanitary facilities with outhouses or chemical toilets.

b. Existing Problems with Water Quality and Wastewater Treatment Facilities

The Facilities Plan has identified the following problems associated with the existing centralized wastewater collection and treatment facilities:

- The present Spicer and New London sanitary sewer systems are both subject to potentially excessive infiltration/inflow. A Phase II infiltration/inflow survey is recommended for each community; and

- The Spicer and New London treatment plants do not meet Minnesota Pollution Control Agency 1974 discharge requirements. In order to meet these requirements additional, more efficient treatment capability is required in each community. Plant operation improvements at the existing Spicer-New London water pollution control facilities do not offer the possibility of raising plant performance to levels required by MPCA.

The following problems associated with existing on-site systems in the Study Area were also addressed by the facilities planners in 1976:

- An estimated 55% of the on-site wastewater disposal systems around Green Lake cannot comply with the 4 foot separation parameter[2] specified in the Minnesota Shoreland Management Act;

- The same 55% of the individual disposal systems cannot be upgraded to comply with the Shoreland Management Act because of the small size of the platted lots around Green Lake;

- Based upon EPA survey data, individual disposal systems around Green Lake are contributing to the nutrient loading of this basin. The Facilities Plan indicated that the amount of

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[2] The Act stipulates that there be a vertical distance of 4 feet between the bottom of the septic tank drainfield and the highest known groundwater elevation.

wastewater discharged to Green Lake from septic tank drainfields along its shoreline was approximately 23% greater than the total discharge loading from Spicer and New London (by letter, William Hendrickson, RCM, to James Roth, MPCA, December 17, 1976); and

- Many of the older individual on-site systems installed approximately 20 years ago may be cesspools*, which are prohibited under current sanitation codes.

The Facilities Plan also indicated that Green Lake, Nest Lake, Woodcock Lake and the Middle Fork of the Crow River have become increasingly rich in nutrients (nitrogen and phosphorus) because treatment of municipal wastewater at plants in Belgrade (located 13 miles north of the Study Area), New London and Spicer is inadequate.

c. Proposed Solutions: Alternatives Addressed in the Facilities Plan

Given the reported constraints and problems associated with current wastewater management practices in the Study Area, a comprehensive set of preliminary alternative wastewater management schemes was considered in the facilities planning process for the communities of New London and Spicer as well as residents of Green Lake. These are:

- Centralized wastewater collection and treatment by lagoons and mechanical facilities;
- Decentralized treatment by individual on-site systems, cluster systems, and mound systems;
- Combinations of centralized and decentralized collection/treatment options;
- Land application;
- Direct reuse of treated wastewater;
- Discharge of the District's wastewater to the Willmar treatment facility (9 miles southwest of the Study Area);
- Upgrade or expand existing treatment plants at New London and Spicer; and
- Install holding tanks in lots where groundwater is too high for compliance with the provisions of the Shoreland Management Act.

Based upon cost-effectiveness analysis and feasibility of compliance with existing local codes, specifically the Shoreland Management Act, only two alternatives were advanced for evaluation of impact. Each provides wastewater collection and treatment for the entire GLSSWD.

Alternative 1. Centralized collection and treatment by waste stabilization lagoon (180-day storage capacity) with controlled discharge to the Middle Fork of the Crow River east of Green Lake.

Alternative 2. Centralized collection and treatment by mechanical oxidation ditch with continuous discharge to the Middle Fork of the Crow River east of Green Lake.

d. The Facilities Plan Proposed Action

The alternative involving centralized collection and treatment by waste stabilization lagoons was selected as the Facilities Plan Proposed Action because it proved to be the most cost-effective of the two final alternatives considered. The Proposed Action is cited to be in concurrence with the comprehensive water and sewer plan adopted by Kandiyohi County in 1973. This proposed alternative is discussed further in Chapter III.

The projected (1995) wastewater flows developed in the Facilities Plan for the Green Lake Sanitary Sewer and Water District are presented in Table I-1.

B. ISSUES OF THIS EIS

The purpose of this EIS is to respond to concerns raised regarding the Facilities Plan Proposed Action identified by review agencies (especially the EPA), local officials and the public. These concerns, involving the possibility of significant environmental impacts, include the following:

1. COST EFFECTIVENESS

The total capital cost for the Facilities Plan Proposed Action was estimated in the Plan (August, 1976) to be $4.4 million. This represents an investment of approximately $875 per person and $3,709 per existing dwelling unit within the Facilities Plan Proposed Service Area (see Figure I-3). The considerable disparity of incomes between rural and urban area residents means that the burden of these costs will fall most heavily on those people least able to afford them.

It is also questionable whether even total elimination of septic tanks will have a strong positive impact on overall lake quality. An assessment must be made of all the major nutrient* sources, such as precipitation, point source* discharges, non-point source* run-off, as well as septic tank effluents, before it can be demonstrated that the level of commitment of resources for proposed large-scale facilities is necessary.

2. IMPACTS ON WATER QUALITY

Although indirect evidence was presented in the Facilities Plan indicating that there may be a water quality problem attributed to

Table I-1

PROJECTED 1995 DESIGN FLOW, GREEN LAKE FACILITIES PLAN

SOURCE	1ST QUARTER DEC, JAN, FEB	2ND QUARTER MAR, APR, MAY	3RD QUARTER JUNE, JULY, AUG	4TH QUARTER SEPT, OCT, NOV	ANNUAL AVERAGE
Spicer					
Flow, gal/day	133,000	133,000	149,600	133,000	137,000
New London					
Flow, gal/day	156,000	156,000	144,000	156,000	153,000
Green Lake					
Flow, gal/day	60,000	61,000	216,000	62,000	100,000
Nest Lake					
Flow, gal/day	32,000	32,000	66,400	32,000	41,000
TOTAL					
Flow, gal/day	381,000	382,000	576,000	383,000	430,500

malfunctioning lakeshore septic systems, the relationship between deteriorating water quality and inadequately functioning septic systems was not documented. With the exception of two isolated cases involving high nitrate nitrogen levels (greater than 10 milligrams per litre (mg/l)) in domestic wells along the south shore of Green Lake (by letter, William Hendrickson, RCM, to James Roth, MPCA, December 17, 1976), claims of possible hazards to the public health have been unsubstantiated.

3. ECONOMIC IMPACT

The average local share per residence of the total capital costs for the Facilities Plan Proposed Action is approximately $2,180[3]. The Plan estimates the annual user charge per resident to be $194, which includes annual debt retirement of the amortized local share of the project cost and annual O&M costs. The user charge represents approximately 1.4% of the average annual income for year-round residents. Seasonal residents, particularly those in smaller, less expensive homes may come under considerable pressure to sell their property.

4. INDUCED GROWTH AND SECONDARY IMPACTS

Based upon their experience with previous wastewater management projects in rural lake areas, the Minnesota Pollution Control Agency has concluded that sewering of Green Lake may cause the following:

- Increased development of lakeside areas;
- Increased development of adjacent non-lakeside areas; and
- A shift from seasonal to permanent occupancy.

5. PUBLIC CONTROVERSY OVER WATER QUALITY

Residents of Harrison Township and Irving Township have expressed concern over the Facilities Plan - proposed stabilization pond (i.e, lagoon) system and its potentially adverse effects upon local groundwater quality. Farmers and other citizens who live in the vicinity of the proposed treatment site focus their concern on the potential for contamination of domestic water supply wells through lagoon seepage into sandy soils. This concern exists despite the fact that the Plan recommended installation of an impermeable bentonite liner during lagoon construction.

C. NATIONAL PERSPECTIVE ON THE RURAL SEWERING PROBLEM

The EIS issues discussed above are not unique to the proposed plan for wastewater management in the Green Lake Study Area. They are typical of the concerns raised by a large number of wastewater projects for rural and developing communities that have been submitted to EPA for

[3] This figure is based on RCM's estimate of local share of project capital costs (December 17, 1976) and the estimated number of residences in the Facilities Plan Proposed Service Area in 1976.

funding. The scope of the problem has grown in the last few years as controversy has mounted over the high costs and possible impacts of providing conventional sewerage facilities to small communities.

1. SOCIOECONOMICS

To assess the reasons and magnitude of the cost burden that many proposed wastewater collection projects would impose on small communities, EPA studied more than 250 facilities plans from 49 states for pending projects for communities under 50,000 population (Dearth 1977).

EPA found that, even with substantial State and Federal construction grants, the costs of conventional sewering are sometimes beyond the means of families in rural and semi-rural areas. This was particularly true for those communities where the new facilities proposed would result in annual user charges of more than $200 per household.

The Federal government has developed criteria to identify high-cost wastewater facilities projects (The White House Rural Development Initiatives 1978). Projects are considered to place a financial burden on rural community users when annual user charges (debt service plus operation and maintenance) would exceed:

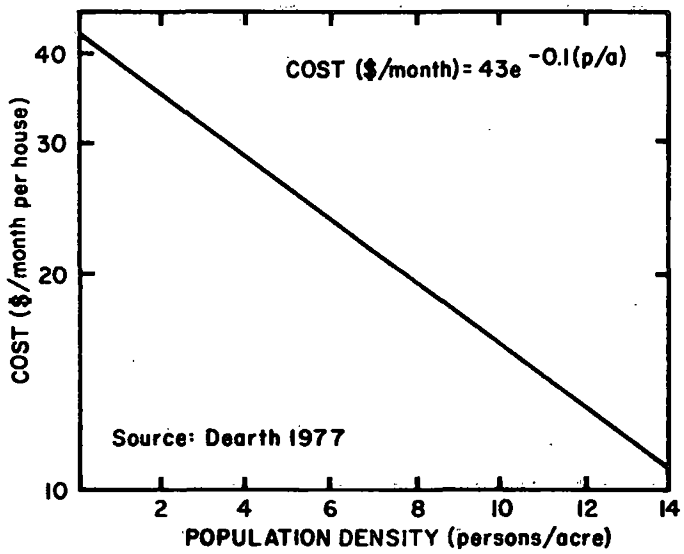
- 1.5% of median household incomes less than $6,000;
- 2.0% of median household incomes between $6,000 and $10,000; and
- 2.5% of median household incomes over $10,000.

Annual user charges exceeding these criteria would materially affect the households' standard of living. Federal agencies involved in funding wastewater facilities will work with the community to achieve lower project costs through a change in the project's scope or design. If the project's scope or design is not changed, the agencies will work with the community until they are assured that the community is aware of the financial impacts of undertaking the high-cost project.

It is the collection system that is chiefly responsible for the high costs of conventional sewerage facilities for small communities. Typically, 80% or more of the total capital cost for newly serviced rural areas is spent for the collection system. Figure I-8 indicates that the costs per residence for gravity sewers increase exponentially as population density decreases. Primary factors contributing to this cost/density relationship were found to be:

- greater length of sewer pipe per dwelling in lower-density areas;
- more problems with grade, resulting in more lift stations or excessively deep sewers;

FIGURE I-8



MONTHLY COST OF GRAVITY SEWERS

- regulations or criteria which set eight inches as the smallest allowable sewer pipe diameter; and

- inability of small communities to spread capital costs among larger populations sewered previously.

In addition to the comparatively high costs of sewers, facilities were sometimes found to be more expensive than necessary due to:

- Oversophistication in design, large energy requirements, and costly maintenance and operator expense;

- Use of expensive construction materials such as non-locally produced brick and block and terrazzo when a prefab steel and concrete building would do; and

- Abandonment of existing treatment works without economic justification.

2. SECONDARY IMPACTS

Installation of centralized collection and treatment systems in previously unsewered areas can have dramatic effects on development and, hence, on the economy, demography and environment of rural communities. These effects can be desirable, or they may substantially offset community objectives for water resource improvement, land use planning and environmental protection.

A community's potential for recreational, residential, industrial, commercial or institutional development is determined by economic factors such as the availability of land, capital, skilled manpower and natural resources. However, fulfillment of this potential can be limited by the unavailability of facilities or services such as water supply, sewerage, electric power distribution and transportation. If a missing community service element is supplied, development of one type or another may take place depending upon prevailing local economic factors. Such development is considered to be "induced growth" and is a secondary impact of the provision of the essential community service element.

Secondary impacts of new wastewater facilities may be highly desirable. For example, diversification of the local employment base may be possible only when sufficient wastewater collection and treatment capacity is provided for commercial or industrial development. On the other hand, new commercial or industrial development may not be compatible with existing recreational or agricultural interests. Residential development accompanying expansion of the employment base may take place on prime agricultural land, steep slopes or wetlands, or may otherwise infringe on valued natural features.

3. THE NEED FOR MANAGEMENT OF DECENTRALIZED ALTERNATIVE SYSTEMS

A promising alternative to expensive centralized sewer systems in rural areas is a decentralized wastewater management system. Both engineering and management are integral parts of such a system and "decentralized alternatives," as used in this EIS, incorporate both engineering and management elements.

Briefly, the engineering element consists of the use of existing and new on-site systems, rehabilitation or replacement of those systems where necessary, and construction of small-scale off-site systems where existing onsite systems are not acceptable.

The management element consists of continuing supervision for the systems' installation, maintenance and rehabilitation and of appropriate monitoring of the systems' environmental impacts.

While other factors such as soil characteristics, groundwater hydrology and lot configurations are highly important, adequate management may be critical to the success of decentralized alternatives in many communities. Similarly, lack of adequate management undoubtedly contributed to past failures of many on-site wastewater facilities and, therefore, the lack of trust in which they are held by local public health officials and consulting engineers.

Historically, State and local health officials were not empowered to regulate installation of on-site systems until after World War II. They usually acted in only an advisory capacity. As the adverse consequences of unregulated use of the septic tank-soil absorption systems became apparent in the 1950's and 1960's, they were granted new authority. Presently more health officials have authority for permitting and inspecting or denying new installations, and they can require renovation and replacement of on-site systems. However, their role in the operation and maintenance of on-site systems remains largely advisory. There is seldom either a budget or the authority to inspect or monitor a system.

In the Clean Water Act Amendments of 1977, Congress recognized the need for continuing supervision and monitoring of on-site systems. EPA regulations implementing this Act require that before a construction grant for on-site systems is awarded, the applicant must meet a number of requirements such as:

- Certify that it will be responsible for properly installing, operating and maintaining the funded systems;
- Establish a comprehensive program for regulation and inspection of on-site systems that will include periodic testing of existing potable water wells and more extensive monitoring of aquifers; and
- Obtain assurance of unlimited access to each individual system at all reasonable times for inspection, monitoring, construction, maintenance, operation, rehabilitation and replacement.

In some cases implementation of these requirements by municipalities may be hindered by lack of state enabling legislation for small waste flow management districts and by lack of adequately trained manpower. The municipality may have no control over the former and be at a disadvantage because of the latter. Other implementation factors, over which municipalities should have control, are discussed in Section III.D. of this EIS.

D. PURPOSE AND APPROACH OF THE EIS AND CRITERIA FOR EVALUATION OF ALTERNATIVES

1. PURPOSE

This EIS documents EPA's review and analysis of the application for EPA Step 2 funding of the Facilities Plan Proposed Action. Based upon this review, the Agency will take one of several actions:

- Approve the grant application, possibly with recommendations for design changes and/or measures to mitigate impacts of the Facilities Plan Proposed Action;

- Return the application with recommendations for additional Step 1 analysis;

- With the applicant's and State's concurrence, approve Step 2 funding for an alternative to the Facilities Plan Proposed Action, as presented in this EIS; or

- Reject the grant application.

The review and analysis focused on the issues identified in Section I.B. and was conducted with an awareness of the more general considerations of rural sewering problems discussed in Section I.C. Major emphasis has been placed on developing and evaluating alternative wastewater management approaches to be compared with the Facilities Plan Proposed Action.

2. APPROACH

The review and analysis reported in this EIS included a series of tasks, which were undertaken in approximately the following sequence:

a. Review of Available Data

Data presented in the Facilities Plan and other sources were reviewed for applicability in development and/or evaluations of the Facilities Plan Proposed Action and of the new alternatives developed for the EIS. Documents consulted are listed in the bibliography at the end of this volume.

b. Segment Analysis

As a basis for revised population projections and for development of alternatives, the EIS Proposed Service Area was partitioned into a number of segments. The number of dwellings in each segment was counted from black and white aerial photographs. Available information on soils, depth to groundwater, water quality problems, environmentally sensitive areas and land use capabilities was tabulated for each segment and the tabulations used to make preliminary estimates of the need for off-site wastewater disposal.

c. Review of Wastewater Design Flows

Available population projections were revised on the basis of the segment house counts. New EPA guidelines for estimating design wastewater flows were then used to revise the year 2000 wastewater flow projections.

d. Development of Alternatives

First, technologies that might potentially reduce project costs or minimize adverse impacts while still solving existing problems were examined. Four categories of alternative technologies -- flow reduction, low-cost sewers, decentralization, and land application -- were considered according to their functions in a wastewater management system. Next, several specific areawide alternatives were developed, combining the alternative technologies into complete wastewater management systems that would serve the Proposed Service Area. The technologies and the alternatives are described in Chapter III.

e. Estimation of Costs for Alternatives

In order to assure comparability of costs between the Facilities Plan Proposed Action and new alternatives, all alternatives were designed to serve a fixed design year population. Total present worth and local user charge estimates were based upon unit costs listed in a separate engineering report (Arthur Beard Engineers, Inc. 1978).

f. Evaluation of the Alternatives

The new alternatives were developed with a knowledge of the local environmental setting and with the understanding that they will be evaluated under criteria from several disciplines. The general criteria for evaluating the Facilities Plan Proposed Action and the new alternatives are listed in Section I.D.3 below.

g. Needs Documentation

The need for improved treatment of New London's and Spicer's wastewater is clear and is not an issue in this EIS. However, the effects of lakeshore septic systems on water quality and public health had not been clearly documented in the Facilities Plan. Because determination of eligibility for Federal funding of a substantial portion of the Facilities Plan Proposed Action will be based on the documentation of these effects, several supplemental studies were conducted:

- an aerial survey of visible septic tank system malfunctions using low-altitude color and infrared photography by EPA's Environmental Photographic Interpretation Center (EPIC);
- estimation of the existing Green Lake nutrient budget and empirical modeling of the lake's eutrophication status;
- a sanitary survey of lakeside residences to evaluate usage, design and condition of on-site systems;
- a "Septic Snooper" survey to locate and sample septic tank leachate plumes entering Green Lake and Nest Lake from nearby on-site systems;
- a hydrologic survey by K-V Associates to determine base hydrologic data for the Study Area; and
- evaluation and mapping by the Soil Conservation Service of soils within potential cluster and land application sites.

h. Public Participation

The Green Lake Citizen Advisory Committee was formed to aid EPA in the development process of alternative treatment and disposal systems for their community. The committee has convened on two occasions over the past eight months to discuss EIS scope and issues as well as preliminary EIS alternatives.

The results of these needs documentation studies were not available for consideration in the initial development of alternatives. The results of each study have required continuing modification of the alternatives as initially designed and have been the basis for necessary refinements in the determination of the eligibility for Federal funding of any new sewers around Green Lake.

3. MAJOR CRITERIA FOR EVALUATION OF ALTERNATIVES

While the high cost of sewering rural communities is a primary reason for examining alternative approaches to wastewater management, cost is not the only criterion. Trade-offs between cost and other major impacts will have to be made. The various criteria are defined below.

a. Cost

With some exceptions for innovative technologies, EPA construction grant regulations allow funding of only the most cost-effective alternatives. Cost-effectiveness has been measured here as the total present worth of an alternative, including capital costs for facilities needed now, capital costs for facilities required later in the 20-year planning period, and operation and maintenance costs for all wastewater facilities. Salvage value for facilities expected to be in service after 20 years has been deducted. Analyses of cost-effectiveness do not recognize differences between public and private expenditures.

The responsible municipality or sanitary district will recover operation, maintenance and local debt retirement costs through periodic sewage bills. The local economic impact of new wastewater facilities will be felt largely through associated residential user charges. Only publicly financed costs were included in residential user charges. Salvage was not factored into residential user charges.

According to the Facilities Plan, the local share of the total project cost per residence will be approximately $1,950. In addition, some homeowners may incur costs that they would directly have to pay to contractors. Installation of gravity house sewers on private land and renovation or replacement of privately owned on-lot systems for seasonally occupied dwellings are not eligible for Federal funding and are seldom financed by municipalities. These private costs are identified for each alternative.

b. Significant Environmental and Socioeconomic Impacts

The system selected for the Proposed Service Area will impact on environmental and socioeconomic resources within the Study Area. Following a comprehensive review of possible impacts of the Facilities Plan Proposed Action and the new alternatives, several types of impacts were determined to warrant in-depth evaluation and discussion in this EIS. These impacts are classified as follows:

- Surface Water Quality Impacts;
- Groundwater Impacts;
- Population and Land Use Impacts;
- Economic Impacts; and
- Infringement on Environmentally Sensitive Areas.

c. Reliability

Reliability criteria for the alternatives include both ability to remedy existing water quality problems and prospects of protecting water quality in the future. This first criterion was applied in the analysis of surface and groundwater impacts of the alternatives presented in Chapter IV. That analysis assumed that the collection, treatment and disposal units of each alternative would operate effectively as designed. The second criterion recognizes that all structural, mechanical and electrical facilities are subject to failure.

d. Flexibility

The capability of an alternative to accommodate increasing wastewater flows from future development in the Proposed Service Area is referred to as its flexibility. In order to demonstrate the relative levels of investment for different alternatives, all were designed and costed to provide service for the same population -- the design year population projected in Chapter II. However, factors such as the amount of land that could be developed using on-lot systems or the ability to increase the capacity of a treatment plant might have a significant effect on future development in the Study Area. The capability of the alternatives to accommodate increased wastewater flows is reviewed in Chapter III. The effects of the alternatives' flexibility on population growth are predicted in Chapter IV.

CHAPTER II

ENVIRONMENTAL SETTING

Evaluation of the courses of action open to EPA in the consideration of improved wastewater management for the Green Lake Study Area must begin with an analysis of the existing situation. This chapter offers an inventory of baseline conditions in the natural environment, divided into such categories as soils, groundwater, surface water and biology. Social and economic aspects of the man-made environment are discussed, along with the functioning of wastewater treatment facilities presently in operation.

Maximum use was made of available information in the analysis of the Study Area's environmental setting. It was necessary, however, to undertake additional field work in order to obtain more comprehensive data that would be utilized to document a need for improved wastewater management facilities and develop appropriate alternatives to the Facilities Plan Proposed Action. For example, this information was used to resolve such key issues as the need to sewer the entire shoreline of Green Lake and the need to include a portion of Nest Lake in the EIS Service Area. The new studies included: a sanitary survey; a sampling of leachate plumes from septic systems; an aerial survey of visible septic tank malfunctions; a soils survey; estimation of nutrient loads entering Green Lake; and modeling of the lake's trophic condition. In general, data given in the tables are not repeated in the text, and readers wishing more information should use the Appendices for more complete explanations and details.

A. PHYSICAL ENVIRONMENT

1. TOPOGRAPHY

Topographic relief within the Green Lake Study Area was formed by a mass of retreating glacial ice between ten and sixty thousand years ago. Elevations range from 1300 feet above mean sea level (msl) just north of Green Lake to 1160 feet above msl immediately east of Green Lake. The Study Area is drained primarily by the Middle Fork of the Crow River.

There are two distinct topographic areas found within the Study Area. Forested, rolling topography and steep slopes characterize the area north of Green Lake while the area east and southeast of the Lake becomes more level and is primarily agricultural. A large wetland is located east of Green Lake.

Most slopes within the Study Area are gentle (1 to 4%), but some areas contain slopes greater than 15% (Figure II-1). These latter locations are considered less suitable for land development.

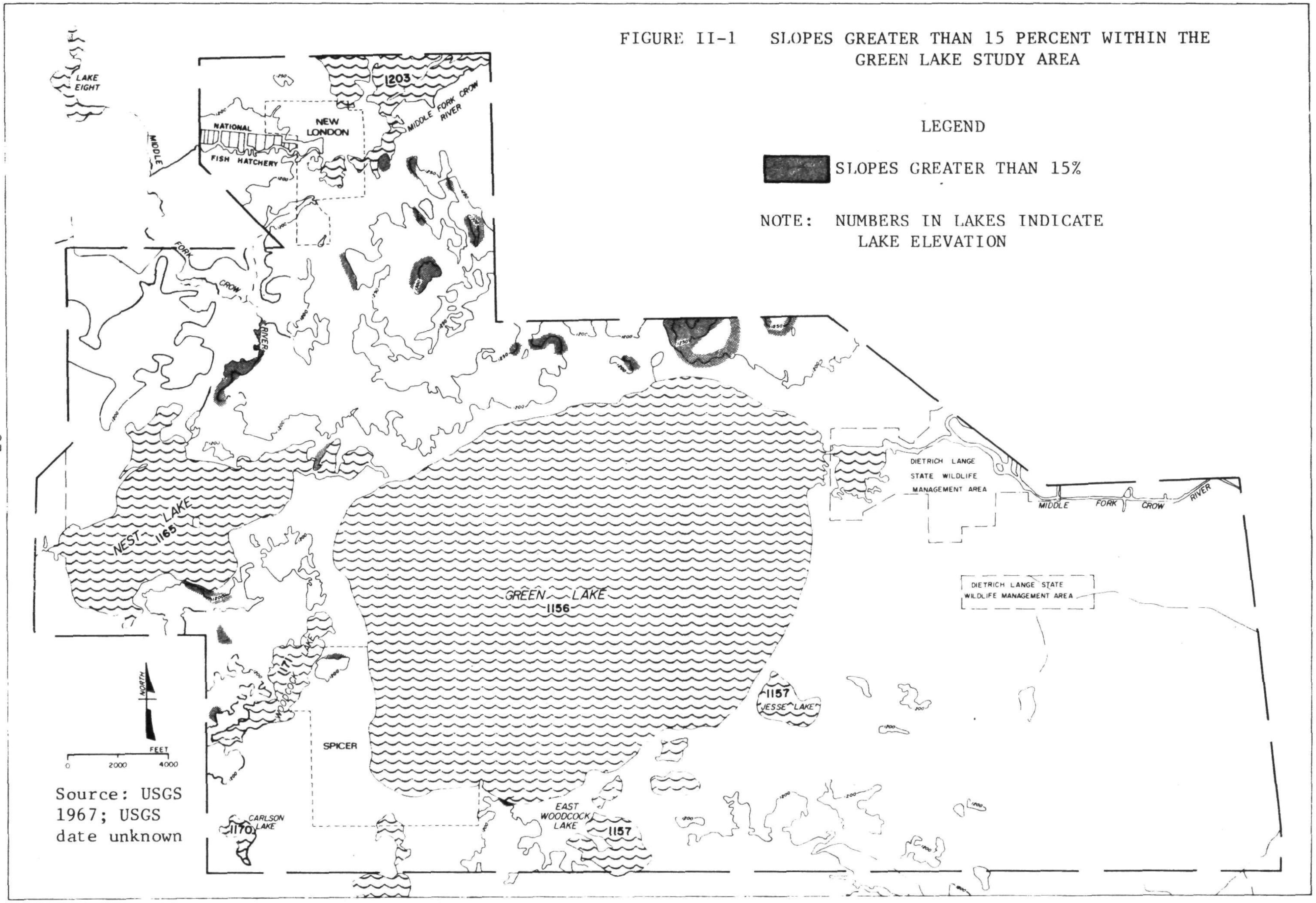


FIGURE II-1 SLOPES GREATER THAN 15 PERCENT WITHIN THE GREEN LAKE STUDY AREA

2. GEOLOGY

a. Bedrock Geology

Bedrock underlaying the Study Area is comprised of undifferentiated Precambrian igneous and metamorphic rock material. The predominant rock types are gneiss, granites or schists, overlain by a surficial layer of glacial drift. A general overview of the geologic sequence within the Study Area is shown in Figure II-2.

b. Surficial Geology

All surficial material within the Study Area was deposited by an ice advance ten and sixty thousand years ago. The extent and lithologic characteristics of surficial material within the Study Area are shown in Figure II-3 and described in Table II-1.

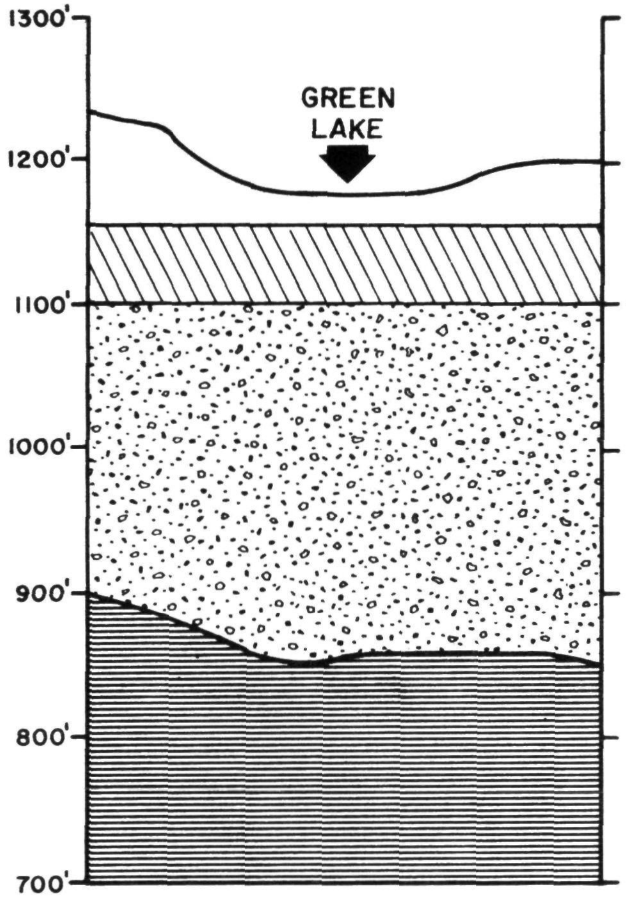
East of Green Lake along the Middle Fork of the Crow River are deposits of surficial outwash composed of fine to coarse grained sand and gravel with traces of silt and clay. However, the majority of the Study Area is made up of undifferentiated glacial till made up of poorly sorted calcareous* silt (Lindholm et al. 1974). Sand and gravel lenses of varying thicknesses may be found throughout the Study Area.

3. SOILS

In the Green Lake Study Area, soil suitability determines the extent to which alternatives to centralized wastewater treatment-surface water discharge systems may be developed. Following a soil survey, the US Department of Agriculture, Soil Conservation Service (SCS) normally provides soil suitability data, including permeability, depth to seasonally high groundwater, compaction, and expansion to engineers and planners for use as a decision making tool in the preliminary selection of wastewater management alternatives. Alternatives involving soil-dependent components are discussed in Chapter III. The SCS has scheduled completion of the Kandiyohi County Soil Survey for 1983, but limited soil suitability data is available for the Study Area. During this project, SCS personnel have augmented this limited data base by mapping an additional 700 acres in the Study Area. This additional data were used to identify potential land application and cluster system sites in the vicinity of Green Lake (discussed in Chapters III and IV). The extent of mapped SCS data, except those areas selected as potential cluster system sites (see Appendix A-1) is shown in Figure II-4.

Soils in the Green Lake Study Area were developed by weathering and erosion from the underlying glacial deposits. Vegetative processes have created a surface layer of rich, dark soils one to three feet thick. These soils are underlain by glacial till composed of sand and gravel several hundred feet thick.

The four primary soil groups represented within the Study Area and their limiting factors are listed below. The term "limiting factors" as used in these characterizations, refers to a possible deterrent to the operation of on-site sewage disposal systems (see Appendix A-2). These



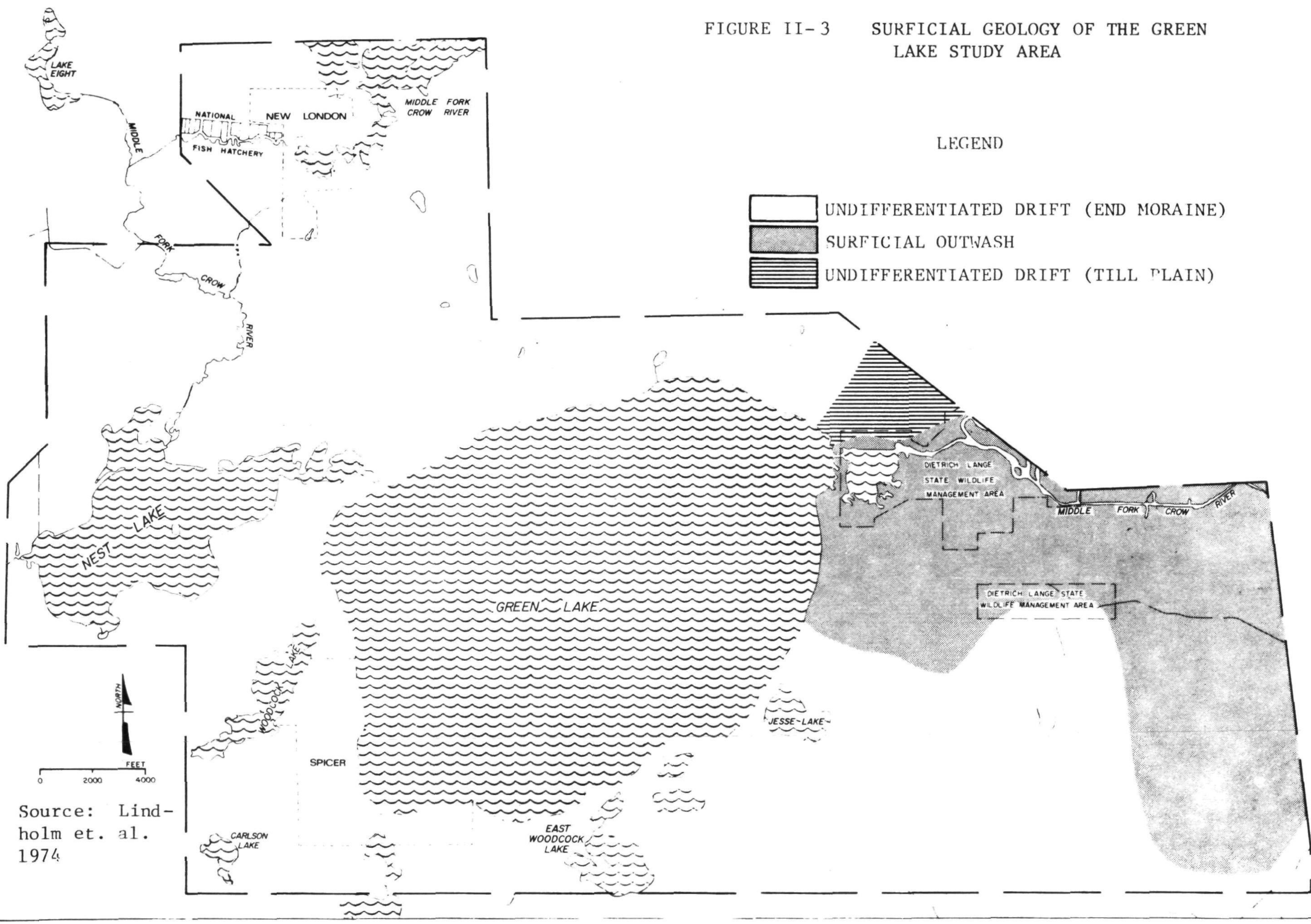
LEGEND

- OVERBURDEN
- SAND AND GRAVEL, BURIED; CONFINED
- UNDIFFERENTIATED DRIFT
- UNDIFFERENTIATED IGNEOUS AND METAMORPHIC ROCKS

Source: Lindholm et.al. 1974

FIGURE II-2 GENERAL GEOLOGIC SEQUENCE WITHIN THE GREEN LAKE STUDY AREA

FIGURE II-3 SURFICIAL GEOLOGY OF THE GREEN LAKE STUDY AREA



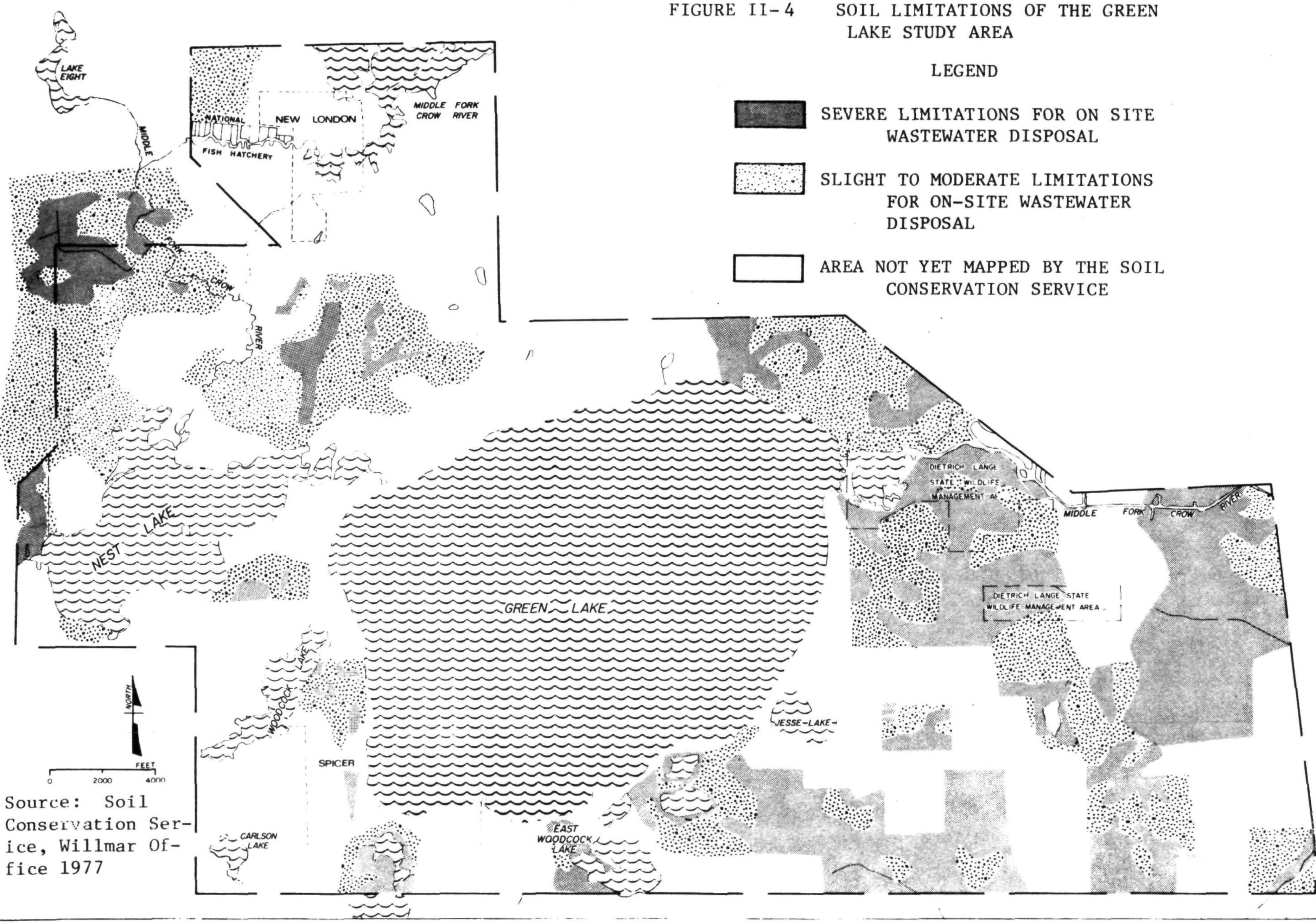
Source: Lindholm et. al. 1974

Table II-1

LOCATION AND LITHOLOGIC CHARACTERISTICS OF SURFICIAL DEPOSITS

	Thickness (ft.)	Location in Study Area	% of Study Area	Lithologic Characteristics
Alluvial	Variable	Streams and Rivers	<1%	Thin deposits of sand, gravel, silt, or clay.
Surficial Outwash	0 - 100 (20 - 50 commonly)	East of Green Lake	∿15%	Fine to coarse-grained sand and gravel; some silt and clay, stratified; commonly moderately to well sorted.
Undifferentiated Drift (till plain)	100 - 500 (200 - 500 commonly)	Northeastern corner of Study Area	∿ 3%	Primarily gray, calcareous, silty till; unstratified and unsorted, contains buried sand and gravel lenses of varying extend and thickness.
Undifferentiated Drift (end moraine)	100 - 500 (200 - 500 commonly)	All except North and East of Green Lake	∿82%	Primarily gray, calcareous, silty till; unstratified and unsorted; includes some ice - contact. Sand and gravel of largely unknown extent, contains buried sand gravel lenses of varying extent and thickness.

FIGURE II-4 SOIL LIMITATIONS OF THE GREEN LAKE STUDY AREA



Source: Soil Conservation Service, Willmar Office 1977 factors include (1) steepness of slope, (2) stoniness, (3) depth to bedrock, (4) depth to seasonally high groundwater, and (5) permeability. However, use of the term, limiting factors, does not eliminate the soil groups from consideration (see Appendix A-3). The four soil groups are:

- The Lester-Clarion-Salida group is comprised of steep well drained loam, intermixed with sandy soils. The limiting factor* within this group is steep slopes.

- The Salida-Esthervile-Clarion group is comprised of well to excessively well drained sand and gravel intermixed with loam. Rapid permeability, steep slopes and high groundwater are limiting factors in this group.

- The Esthervile-Biscay-Peat group is comprised of poorly drained loamy glacial outwash underlain by sand and gravel. Seasonal high water table is the limiting factor in this group.

- The Clarion-Storden-Peat group is comprised of well drained to poorly drained loamy soils with marshes. Permeability and seasonal high water table are limitations in this soil.

General locations of these soils are shown in Figure II-5; they are described in greater detail in Table II-2.

a. Soil Suitability for Wastewater Treatment

A generalized map of the Study Area displaying soil limitations for on-site wastewater disposal systems is shown in Figure II-4. The feasibility of utilizing land application methods for the disposal of wastewater within the Study Area depends upon the suitability of the soils present.

Within the Study Area, the major factors restricting the use of some soils for on-site waste disposal systems are permeability and a seasonal high water table. In acknowledgement of this problem, thirteen potential sites for cluster* systems were examined by the SCS at the request of EPA. Also examined and mapped by SCS was one potential spray irrigation* site, and one potential rapid infiltration* site.

The results of these field investigations and maps of the suitability of these sites for wastewater disposal are located in Appendix A-1.

b. Prime Agricultural Lands

The SCS has set forth general guidelines for a national program of inventorying prime and unique farmland (42 F.R., August 23, 1977). Any action (such as construction of interceptors, highways, buildings) that tends to impair the productive capacity of American agriculture is of concern to SCS because such action may reduce the land's capacity for producing food, fiber, feed, foliage and other crops. SCS in cooperation with other interested state and local agencies is inventorying these lands to determine the potential effects of construction and

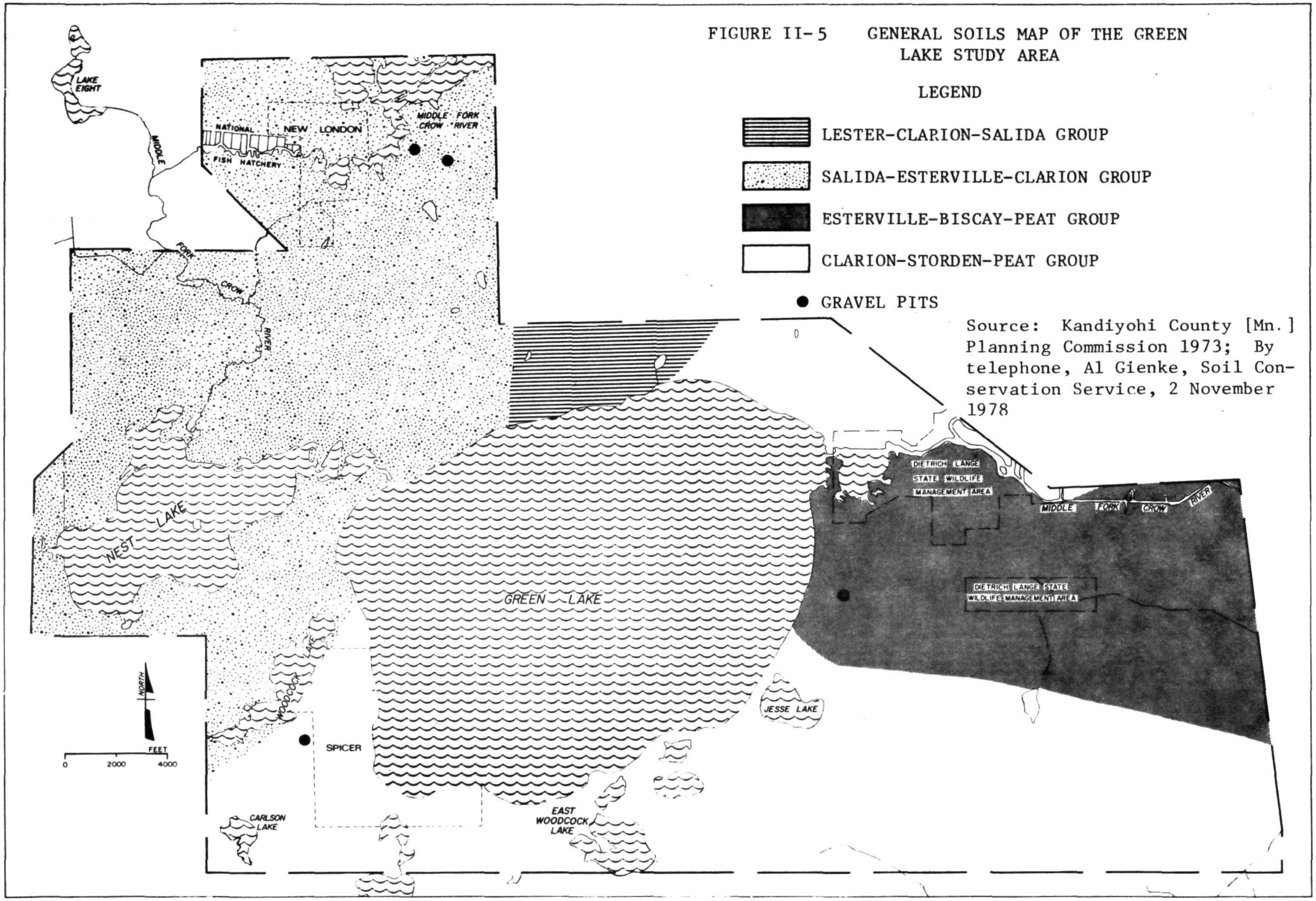


FIGURE II-5 GENERAL SOILS MAP OF THE GREEN LAKE STUDY AREA

Source: Kandiyohi County [Mn.] Planning Commission 1973; By telephone, Al Gienke, Soil Conservation Service, 2 November 1978

Table II-2

DESCRIPTION OF MAPPED SOILS IN THE GREEN LAKE STUDY AREA

Soil Type	Description	Depth (in)	Location Within the Study Area	Permeability (in/hr)	Depth to Seasonal High Water Table (ft)	Suitability for On-Site Waste Disposal	Soil Capability Class**
Alluvium	Poorly drained mixed alluvial soils	Variable	Along streams and drainageways especially north of Green Lake	Variable	2-4	Severe; flood hazard	IIw
Biscay	Poorly drained soils formed in loamy glacial outwash; underlain by sand and gravel	0-20 20-36 36-60	Scattered in northeast corner of the Study Area	0.6-2.0 0.6-2.0 0.6-2.0	1-3	Severe; high water table	II w if slope is <2%
Clarion	Well drained loamy soils; formed in calcarous glacial till under prairie vegetation	0-17 17-32 32-60	Scattered north of Green Lake, between Green and West Lakes Southeast of Green Lake	0.6-2.0 0.6-2.0 0.6-2.0	>6	Slight; <5% slope moderate; 5-14% severe; >14%	I & IIe if slope <5%
Dickenson	Well to somewhat excessively drained; moderately coarse	0-30 30-50 50-60	North and south of Nest Lakes	2.0-6.0 6.0-20.0 6.0->20.0	>10	Slight; <5% moderate; 9-14% severe; permeability	IIIe & IVe
Esterville	Well drained sandy and loamy soils	0-13 13-18 18-60	Widely distributed particularly west of Green Lake	2.0-6.0 2.0-6.0 6.0-20.0	>6	Slight; 0-8% moderate; 8-15% severe; >15%	
Glencoe	Deep, very poorly drained soils form in glacial till in depressions and swales in the uplands	0-35 35-48 48-60	Between Nest and Green Lakes	0.2-2.0 0.2-2.0 0.2-2.0	0-3	Severe; high water table	III w drained VW undrained

**Capability subclasses are soil groups within one class; they are designated by a small letter which follows the Roman Numeral II. (There are no subclasses in Class I because these soils have few limitations.) Examples are "e" = risk of erosion is main limitation; "w" = wet soil; "s" = droughty, shallow, or stony soil. Class I and IIe/w/s soils are the criteria upon which prime agricultural land is identified in Kandiyohi County.

Table II-2

DESCRIPTION OF MAPPED SOILS IN THE GREEN LAKE STUDY AREA (Continued)

Soil Type	Description	Depth (in)	Location Within the Study Area	Permeability (in/hr)	Depth to Seasonal High Water Table (ft)	Suitability for On-Site Waste Disposal	Soil Capability Class**
Hamel	Deep, poorly drained soils formed in loamy glacial till in swales, rims of depressions, drainageways and footslopes	0-22 22-41 41-60	Scattered between Nest and Green Lakes	0.2-2.0 0.2-0.6 0.6-2.0	1-3	Severe; high water table and slow percolation	II w drained IV w undrained
Houghton	Very poorly drained soils formed in thick herbaceous organic deposits	0-66	Scattered northwest of Nest Lake	Variable	0-1	Severe; wetness and ponding	III w
Lester	Undulating to steep, well drained soils formed in glacial till on convex upland slopes	0-9 8-36 36-60	Scattered throughout the Study Area	0.6-2.0 0.6-2.0 0.6-2.0	>5	Moderate; 2-12% Severe; >12% slope	IIe <6% slope IIIe 6-12% slope
Markey	Very poorly drained soils formed in deposits of organic material over sand	0-32 32-60	Along shores of Green Lake	6.0-10.0 6.0-20.0	0-1	Severe; high water table	IV w
Marsh	miscellaneous lands with shallow lakes, and sloughs; peaty muck or a loamy mineral soil	Variable	Northeastern corner of Study Area; south of Green Lake between Woodcock & George Lake	Variable	Above water table	Severe; ponded	---------------
Nicollet	Deep, moderately will to somewhat poorly drained soils formed under tall grass prairie in loamy glacial till	0-17 17-36 36-60	Widespread distribution southeast of Green Lake	0.6-2.0 0.6-2.0 0.6-2.0	3.0-5.0	Severe; high water table	I

Table II-2

DESCRIPTION OF MAPPED SOILS IN THE GREEN LAKE STUDY AREA (Continued)

Soil Type	Description	Depth (in)	Location Within the Study Area	Permeability (in/hr)	Depth to Seasonal High Water Table (ft)	Suitability for On-Site Waste Disposal	Soil Capability Class**
Okoboji	Very poorly drained soils in saucer-like depressions or sloughs in uplands; formed in local alluvium or waterworked glacial sediments under marsh grass or sedges	0-32 32-60	North of Nest and Green Lakes	0.06-0.2 0.06-0.2	0-3	Severe; slow permeability High water table	III w 0-2% slope
Palms	Very poorly drained soils in deposits of organic material over loamy mineral deposits	0-35 35-60	North of Green Lake	6.0-1.0 0.6-2.0	0-1	Severe; high water table; ponding	III w
Salida	Shallow excessively drained gravelly sandy loam	0-8 8-12 12-60	South of Nest between George Lake and Woodcock Lake, North of Green Lake	6.0-2.0 >20.0 >20.0	>6	Moderate; permeability, slopes Severe; permeability, slopes	----------------
Sandia	Excessively drained soils formed in coarse outwash materials under grass prairie on valley trains and glacial outwash plains	0-8 0-8 8-12 12-60	Distributed widely north of Nest Lake & west part of Green Lakes between George & Woodcock Lakes	6.0-20.0 6.0-20.0 >20.0 >20.0	>6	Slight; <8% slope moderate; 8-15% severe; >15%	IV-s to VII-s
Storden	Deep, somewhat excessively drained soils formed in glacial till	0-8 8-60	Widespread and scattered north of Green; between Green and Nest Lakes; south of Nest Lake; between Woodcock and George Lakes.	0.6-2.0 0.6-2.0	>6	Slight; <8% moderate; 8-15% severe; >15%	IIe 2-6% slope IIIe 6-12% slope

Table II-2

DESCRIPTION OF MAPPED SOILS IN THE GREEN LAKE STUDY AREA (Concluded)

Soil Type	Description	Depth (in)	Location Within the Study Area	Permeability (in/hr)	Depth to Seasonal High Water Table (ft)	Suitability for On-Site Waste Disposal	Soil Capability Class**
Talcot	Very poorly drained nearly level soils formed in fine outwash of Lacustrine sediments over sand and gravel on outwash plains	0-23 23-30 30-60	North of Nest and Green Lakes; also more widespread north & west of Nest Lake	0.6-20.0 0.6-20.0 6.3+	0-3	Severe; high water table & rapid	II w 0-10% slope
Wadena	Well drained loamy soils underlain by calcarous sand & gravel	0-13 13-20 30-60	Scattered in north-eastern corner	2.0-6.0 2.0-6.0 >20.0	>6	Slight; >6% moderate; 6-12% severe; <12%	II s 0-2% slope IIe 2-6% slope
Webster	Deep, poorly drained soils that formed in loamy glacial till high in lime carbonates	0-17 17-31 31-67	Scattered north & southeast of Green Lake	0.6-2.0 0.6-2.0 0.6-2.0	1-3	Severe; poorly drained & high water table	II w 0-2% slope

Source: USDA-SCS Soil Series Report

development. Because the Kandiyohi County soil survey by the SCS has not yet been completed, none of the land in the Green Lake Study Area has as yet been designated as prime or unique agricultural land. However, preliminary designation of prime agricultural land has been made for several soil series within the Study Area. These designations are listed in Table II-2.

4. ATMOSPHERE

a. Climate

Both the Canadian Arctic and the Gulf of Mexico affect the climate of the Green Lake Study Area. The region lies, in effect, in a funnel for the cold air of the far north as well as warm Gulf air, the major source of precipitation. Consequently, its climate is characterized by frequent precipitation and marked changes in temperature.

There are normally 5 to 10 winter days with temperatures falling as low as 20° to 30° below 0°F. Although summer temperatures rarely reach 100°F, they sometimes exceed 90°. The available climatological data for Willmar and New London is summarized in Appendix B.

More climatological data is available for St. Cloud, about 45 miles northeast of the Study Area (see Appendix B). There, average annual precipitation (water equivalent) is 26.8 inches, approximately 60% of which occurs during the growing season, between May and September. Snowfall averages 43.1 inches per year. Relative humidity averages approximately 82% in the morning and 60% at noon.

The average wind speed is approximately 8 mph (National Oceanic and Atmospheric Administration (NOAA) 1976). Wind is generally from the south in the summer and from northwest in the winter.

Damaging storms such as tornadoes and freezing rain are infrequent, and ice storms occur less than once a year on the average. The Study Area lies slightly north and east of the major storm paths. Nevertheless, localized damage from heavy rains, wind, or hail from thunderstorms is experienced each year (NOAA 1976).

b. Air Quality

The ambient air quality as measured in the City of Willmar is good. High-volume sampler readings for total suspended particulates show that in 1976 neither the primary (260.00 ug/m^3 at 25°C) nor the secondary (150.00 ug/m^3 at 25°C) 24-hour State ambient air quality standards were exceeded (Minnesota Pollution Control Agency (MPCA) 1977). No testing is performed for other air pollutants in the Study Area.

Kandiyohi County is in a Minnesota Prevention of Significant Degradation (PSD) Class 2 zone. Moderate degradation of air quality is allowable, but a review is required for 19 major source categories (MPCA 1972).

c. Odors

There have been few complaints by residents of the Green Lake Study Area about objectionable odors associated with on-site septic systems, the Spicer wastewater treatment plant or the New London wastewater treatment plant.

d. Noise

The ambient noise level* within the Study Area is estimated at approximately 40 decibels* (Scale A) which is considered typical of a quiet outdoor community (US Department of Transportation 1978). Highways, motorboats, or aircraft flyovers generate louder sounds, but otherwise no excessive noise sources have been identified in the Study Area.

B. WATER RESOURCES

1. WATER QUALITY MANAGEMENT

Water resources management is a complex of many elements, in which the Federal government, the State and the locality all have an interest. To name just a few of these elements -- irrigation, municipal water supply, maintenance of navigable waters, and protection of the productivity of the soil -- illustrates the broad range of activities under this heading. Among the most important, however, is preservation or restoration of the quality of US waters. In the Federal Water Pollution Control Act (P.L. 92-500, 1972) and the Clean Water Act that amended it in 1977 (P.L. 95-217), Congress outlined a framework for comprehensive water quality management which applied to groundwater as well as to surface waters.

a. Clean Water Act

Water quality is the responsibility of the EPA in coordination with the appropriate State agency, in this case the Minnesota Pollution Control Agency (MPCA). However, with passage of the Clean Water Act, all Federal agencies were instructed to safeguard water quality standards in carrying out their respective missions. As the lead agency, EPA coordinates the national effort, sets standards, and reviews the work of other agencies, some of which are assigned responsibilities in line with their traditional missions. For example, the Army Corps of Engineers maintains its jurisdiction over dredging permits in commercially navigable waters and their adjacent wetlands and in coastal waters but now must also consider water quality. The Coast Guard has jurisdiction over oil spill cleanup. The Act officially draws certain other agency activities into the water pollution control effort: for example, it authorizes Federal cost-sharing in agricultural projects designed to improve water quality by controlling farm runoff. In the case of SCS, these new responsibilities may be in addition to, or as the case may be, may dovetail with SCS programs to reduce soil erosion, or to construct headwaters impoundments for flood control.

In delineating the responsibilities of the various levels of government for water quality, Congress recognized the rights of the States with regard to their waters. It authorized aid to the States in funding the development of plans for control of pollution, development of State water quality standards (which may be more restrictive than Federal standards), and research. When a State meets certain criteria, it is certified by EPA as the entity responsible for administration of the activity in question. The EPA may deny certification, and in all cases it retains power of enforcement of established standards, State or Federal. The State of Minnesota is one of the states which has been granted certification by EPA.

Among the goals and deadlines set in the Clean Water Act are these:

> "it is the national goal that the discharge of pollutants into the navigable waters be eliminated by 1985... an interim goal of water quality which provides for the protection and propagation of fish, shellfish, and wildlife and provides for recreation in and on the water (is to) be achieved by July 1, 1983".

This landmark legislation requires that publicly owned treatment works discharging effluent to surface waters must at least provide secondary treatment, i.e., biological oxidation of organic wastes. It directed that municipalities must provide the "best available technology" by 1983 and that in appraising their options localities must address both the control of all major sources of stream pollution (including combined sewer overflows and agricultural, street and other surface runoff) and the cost-effectiveness of various control measures. The use of innovative and alternative technologies must also be considered.

The key provisions in water quality planning stipulate that to receive aid a State must provide a continuing planning process. Part of Section 208 requires the states to inventory all the sources of pollution of surface and groundwaters, both point* and non-point*, and to establish priorities for the correction of substantial water quality problems within a given area. The 208 plans are intended to provide an areawide and, taken together, a statewide, framework for the more local decisions on treatment facilities.

The Section 303E Basin Plan (Upper Portion Upper Mississippi River Basin) that includes the Green Lake Study Area was completed in December 1975 by MPCA.

Section 201 of the Act (under which the Green Lake area application for funds was made) authorizes EPA to make grants to localities toward the improvement or construction of facilities for treatment of existing water quality problems. EPA may determine whether an environmental impact statement is required on a proposed project (see Section I.B). Where the state has been certified and assumes responsibility for water quality, EPA retains authority to approve or reject applications for construction grant funds for treatment facilities.

The local political jurisdiction has traditionally been responsible for meeting the wastewater treatment needs of the community. Local jurisdictions now have the benefit of Federal and State assistance in meeting water quality standards and goals.

b. Federal Agency Responsibilities for Study Area Waters

The following Federal agencies are responsible for insuring water quality in the Study Area:

- EPA:

  Administers the Clean Water Act;
  Sets Federal water quality standards;

- EPA Region V:

  Administers the grant program described above in Illinois, Indiana, Michigan, Minnesota, Ohio and Wisconsin;

  Provides partial funding for preparation of the Green Lake Facilities Plan. Region V's responsibilities in the construction grant program in general and specifically toward the application made in the Facilities Plan are discussed in Section I.B;

- US Army Corps of Engineers:

  Controls dredging and construction activities in commercially navigable streams, their 100-year floodplains and adjacent wetlands through a permit system;

- US Department of Agriculture:

  Under the Rural Clean Water Program will provide cost sharing for soil conservation practices designed to improve water quality. (The program will probably be assigned to SCS; it has not been funded by Congress at this time, however);

- Soil Conservation Service (SCS):

  Agency's mission is to control wind and water erosion, to sustain the soil resource base and to reduce deposition of soil and related pollutants into the water system;

  Conducts soil surveys. Established guidelines for inventorying prime or unique agricultural lands;

  Works with farmers and other land users on erosion and sedimentation problems;

  Gathers information at the county level as part of program of study and research to determine new methods of eliminating pollution from agricultural sources;

- Fish and Wildlife Services:

  Provides technical assistance in development of 208 plans.

c. State Responsibilities in the Green Lake Study Area

The following entities have responsibilities for water quality management in Minnesota:

- Minnesota Pollution Control Agency (MPCA):

  Implements water pollution control laws and establishes regulations. This agency has authority to issue permits to discharge pollutants into surface waters under the National Pollutant Discharge Elimination System (NPDES) and to set discharge levels. MPCA also establishes criteria and standards applicable to interstate and intrastate waters. The standards are being revised and are in draft form as of May, 1979. A water quality Management Basin Plan was prepared by MPCA in December 1975 (MPCA 1975). Although a complete regional plan, this document has little site specific data on the Study Area;

- Minnesota Department of Natural Resources (DNR):

  Identifies, categorizes and maintains existing natural resources, including surface water bodies. DNR reviews county actions and submits recommendations on industrial and agricultural permits;

- Department of Health:

  Reviews plans on public water and sewer improvements and regulates on-site sewage disposal systems.

d. Local Responsibilities for Water Quality Management

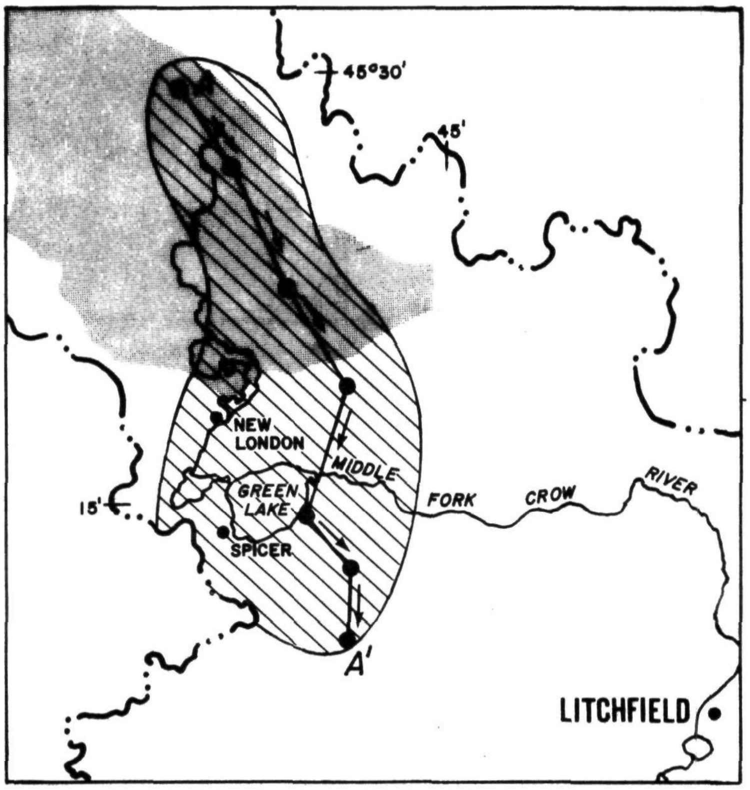
- Kandiyohi County:

  Administers the Shoreland Management Ordinance which established criteria for land use "along the shores of lakes, streams and rivers, and in natural environment areas".

2. GROUNDWATER HYDROLOGY

The buried outwash aquifer found in the undifferentiated glacial drift (see Figure II-6) constitutes the major groundwater aquifer in the Study Area. The aquifer of sand and gravel is under confined or artesian* conditions. The underlying igneous and metamorphic rocks do not constitute significant groundwater aquifers (Lindholm et al. 1974).

The outwash aquifer is on the order of 50 feet in thickness with an upper surface elevation of approximately 1150 feet above msl (see Figure II-6). Depth to the top of the aquifer ranges from about 20 feet to 70



LEGEND

SAND AND GRAVEL, SURFICIAL; UNCONFINED

SAND AND GRAVEL, BURIED; CONFINED

DIRECTION OF GROUNDWATER MOVEMENT

POTENTIOMETRIC SURFACE OF AQUIFER

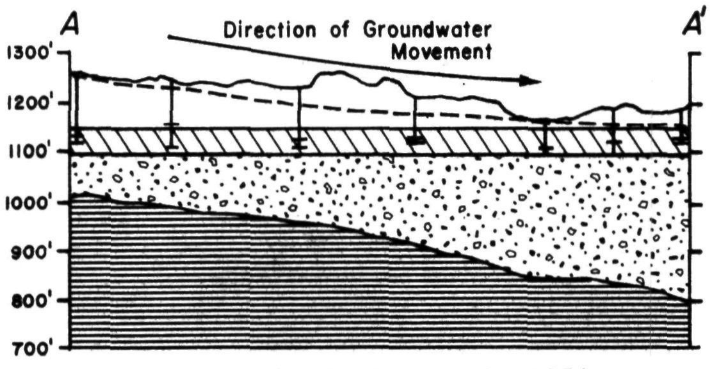
TOP OF BURIED OUTWASH ZONE

WELL

UNDIFFERENTIATED DRIFT

UNDIFFERENTIATED IGNEOUS AND METAMORPHIC ROCKS

CROW RIVER WATERSHED BOUNDARY



Source: Lindholm et.al. 1974

FIGURE II- 6 HYDROGEOLOGY OF THE GREEN LAKE STUDY AREA feet within the Study Area. The potentiometric or pressure surface of the water within the outwash aquifer as seen in the cross-section of Figure II-6 tends to slope southwards through the Study Area. This southward slope indicates the direction of flow through the aquifer.

Precipitation within the Study Area averages 27.6 inches annually. Of this amount, 24.2 inches is lost to the atmosphere through evapotranspiration and 3.3 inches are accounted for by runoff. The remaining 0.1 inch percolates downward to become groundwater mainly in the shallow glacial moraines. Discharge from these shallow moraines takes place principally in the North, South, and Middle Forks of the Crow River. Indications are that very little of the groundwater recharge reaches the buried outwash aquifer found in the Study Area.

The specific capacities of wells in the outwash aquifer may be as high as 50 gallons per minute per foot of drawdown. With available drawdown ranging from 10 to 80 feet, well yields of several thousand gallons per minute may be obtained. Lower well yields are found within the southern portion of the Study Area due to the potentiometric surface of the aquifer sloping downward in that direction.

3. GROUNDWATER QUALITY

Groundwater in the buried outwash aquifer of the Study Area is of the calcium magnesium bicarbonate type found throughout most of the Crow River watershed.

Total hardness* of water in the Study Area is approximately 300 to 350 mg/l. This is very high when compared to a normal of about 100 mg/l. The dissolved solids* content within the Study Area can range up to 400 mg/l, an amount considered moderate to high when compared to the recommended State limit of 500 mg/l. The iron content, with a median value of 0.59 mg/l generally exceeds the US Public Health Service drinking water standard of 0.3 mg/l (Lindholm et al. 1974). However, this high iron content occurs naturally and is not the result of pollution.

The results of a survey of 97 wells surrounding Green Lake near Spicer sponsored by the Green Lake Property Owners Association and undertaken by Noyes Engineering Service in July 1977, are shown in Appendix C-1. Parameters tested were orthophosphate, total coliforms, and nitrates reported as nitrate nitrogen (NO_3-N).

Nitrate nitrogen was observed in 28 of the 97 wells tested. Of these, only two exceeded the 10 mg/l permissible limit with levels of 12 mg/l and 48 mg/l. Twenty-eight wells were positive for total coliforms, and nineteen showed the presence of orthophosphates.

Of the total sample of wells, seven were positive for all three parameters, five for both nitrates and coliforms, five for both coliforms and orthophosphates, and two for both nitrates and orthophosphates. The data indicate that a number of wells have been contaminated but are insufficient to implicate human wastes as the source. Information on specific well construction and maintenance would be necessary to implicate human waste as the source of pollution. This information was not reported with the water sample analysis.

The outwash aquifer is confined by an impermeable upper layer which would indicate that contamination has been entering the specific wells directly as a result of poor well construction, rather than entering the aquifer by downward infiltration and percolation through the soil. An improperly constructed well permits surface runoff to percolate directly into the groundwater through annular space.* The irregular, spotty nature of the contamination among the tested wells is also supportive of this view.

4. GROUNDWATER USE

Groundwater sources provided nearly all of the potable water from the Study Area. Total water use in the Crow River Basin in 1969 exceeded 8 billion gallons (22 million gallons per day (mgd)) with municipal and rural domestic water use accounting for approximately one-half (Lindholm et al. 1974).

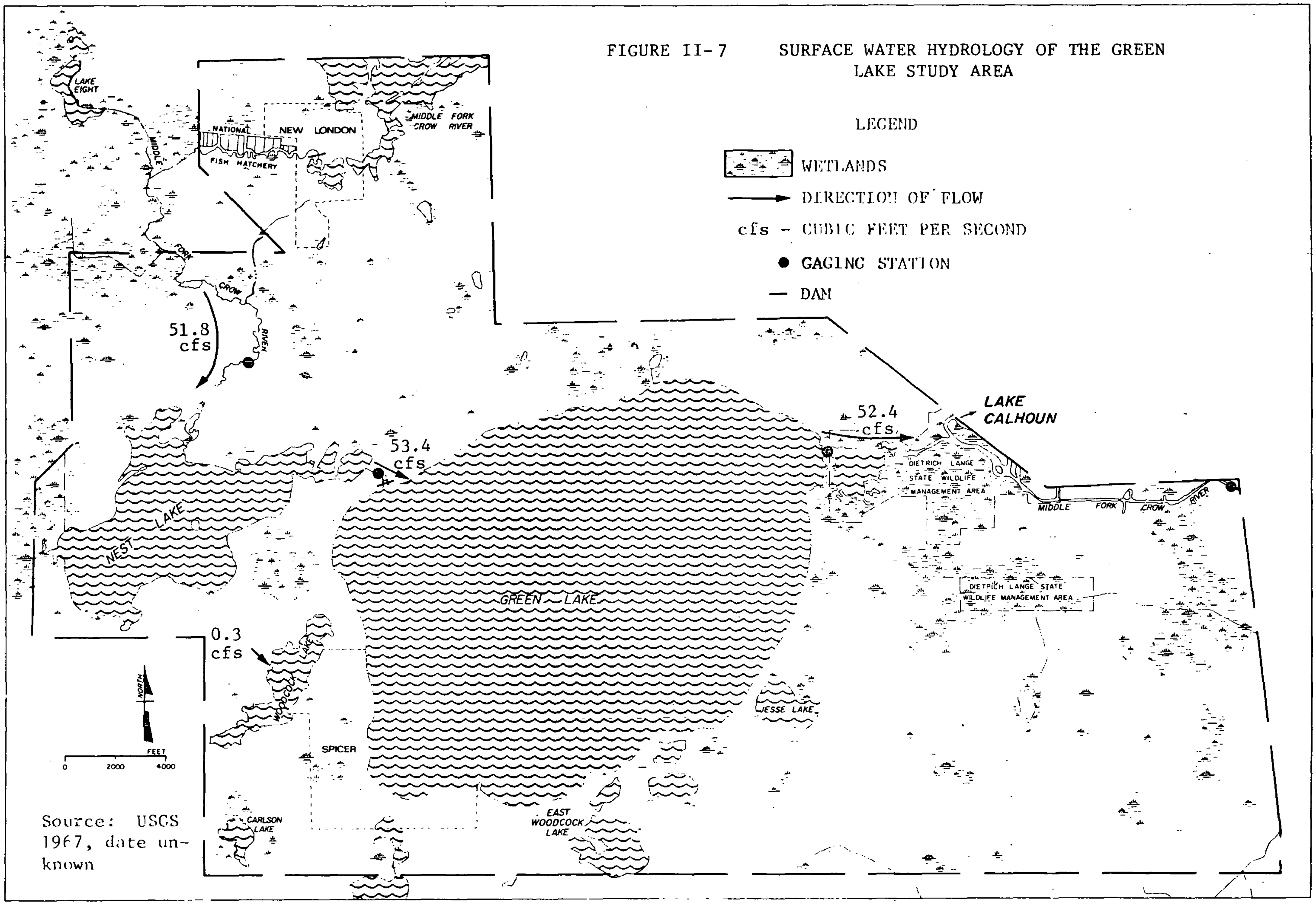
The communities of New London and Spicer each have two wells which serve as the sources of municipal water supply. In 1973, the average daily consumption was 87,000 and 143,000 gallons per day (gpd) for Spicer and New London, respectively (RCM, December 16, 1974). It is estimated that by the year 2000, average water use within the Study Area will be 0.59 mgd. Lindholm et al. (1974) has indicated that the buried outwash aquifer within the Study Area will generally yield adequate water quantities for municipal, industrial, rural domestic and irrigation uses.

5. SURFACE WATER HYDROLOGY

Green Lake, Nest Lake, and the Middle Fork of the Crow River are major surface water resources located in the Study Area (see Figure II-7). Woodcock Lake is one of many small lakes in the Study Area, located west of Green Lake. It is included as part of the surface water resources study in this EIS because it receives the effluent from the Spicer STP. Woodcock Lake is said to occasionally overflow into Green Lake (EPA 1974). The Middle Fork of the Crow River originates south of Belgrade, Minnesota and receives the surface water drainage of the entire Study Area. As it meanders southward past New London and the nearby New London sewage treatment plant, the river enters Nest Lake from the north which, in turn, overflows into the eastern end of Green Lake. The River eventually leaves the Study Area to the east, passing through the wetlands of the Dietrich State Wildlife Management Areas.

Physical characteristics pertaining to the hydrology of the surface waters serve to describe and differentiate the lakes and streams in the Study Area. Specific hydrologic and morphologic characteristics of the lake or stream not only form the surface water system in which chemical and other factors operate and interact but are themselves major factors in that interaction. Size of drainage basin, tributary flow, lake volume, hydraulic retention time and precipitation directly influence the quantity and quality of surface water resources. Table II-3 presents the physical characteristics of the lakes. Additional discussions on these parameters follow in the next few paragraphs.

FIGURE II-7 SURFACE WATER HYDROLOGY OF THE GREEN LAKE STUDY AREA



Source: USGS 1967, date unknown

Table II-3

PHYSICAL CHARACTERISTICS OF GREEN LAKE, NEST LAKE, AND WOODCOCK LAKE (EPA NES SURVEYS, 1974)

Parameter	Green Lake	Nest Lake	Woodcock Lake
Drainage Basin Area (Square miles)	129.6	121.7	1.07
Lake Surface Area (Acres)	5,406	945	125
Lake Mean Depth (Feet)	21	15	2.5
Maximum Depth (Feet)	110	40	8
Inflow (cfs)*	42.4	37.6	-
Outflow (cfs)*	42.4	37.6	-
Lake Volume (Acre/Feet)	113,526	14,175	312
Mean Hydraulic Retention Time (Years)	3.7	0.5	-

* Average flow from October 1972 to October 1973.

a. Size of Drainage Basins

The drainage basin sizes of Green Lake, Nest Lake, and Woodcock Lake are 129.6, 121.7, and 1.07 square miles respectively. The larger watersheds act as significant catchments of precipitation which is transferred as runoff to the lakes. Woodcock Lake occupies a larger portion of its total watershed (drainage basin) than do Green Lake and Nest Lake. That is, Green Lake's drainage basin-to-lake surface area ratio is 15:1, Nest Lake's is 82:1, while that of Woodcock Lake is 5:1.

b. Tributary Flow

The Middle Fork of the Crow River is the major tributary in the Study Area. The U.S. Geologic Survey (USGS) has maintained a continuous recording stream flow gauge on the Middle Fork of the Crow River approximately 2 miles east of Green Lake (see Figure II-7) since 1949.

For a period of 28 years from 1949-1977, the average flow was 50.6 cubic feet per second (cfs), or 1.43 cms. The maximum flow during this period was 408 cfs (11.5 cms). Mean annual runoff is estimated to be 3.84 inches/year (USGS 1977); this is a low rate which can be accounted for by high evaporation and transpiration loss from many lakes, potholes, and partially drained marshes in the region (Rieke Carroll Muller Associates, Inc. 1976).

Twelve measurements of stream flow were made during National Eutrophication Surveys (NES) from October 1972 to October 1973 at the outlet of Green Lake, in the channel connecting Green Lake and Nest Lake, and approximately 1 mile above Nest Lake (see Figure II-7). Mean flows at the upstream station and Green Lake outlet of the Middle Fork of the Crow River were determined to be 37.6 cfs (1.0 cms) and 42.4 cfs (1.20 cms), respectively during the study period.

Municipal wastewater discharges from the Belgrade and the New London treatment plants supplement the flow of the Middle Fork of the Crow River. In 1972, the National Eutrophication Survey estimated the combined wastewater discharge from these plants to be 0.26 mgd, or 0.40 cfs. This, however, represents only 0.7% of the average discharge of the Middle Fork of the Crow River. During periods of low flow, this proportion would substantially increase.

c. Lake Hydraulic Retention Time

Assuming complete mixing, the retention time of a lake is the time required for natural processes to replace the entire volume of its water. Nest Lake has a relatively short retention time of 0.5 years (NES 1974), while Green Lake has a longer retention time of 3.7 years (NES 1975). Since inflow and outflow measurements were not taken in Woodcock Lake, EPA did not estimate a hydraulic retention time.

d. Precipitation

The average precipitation in the Study Area during 1972-1973 was reported to be 28.1 inches (71.4 cm) by EPA's NES study. The value is slightly higher than the annual average over the recorded period (24.5 inches or 62.2 cm).

e. Hydraulic Budget

A generalized hydraulic budget for a lake includes the hydraulic inputs such as tributary inflow, precipitation and groundwater and the outputs such as tributary outflow, evaporation, and groundwater. The hydraulic budgets of Nest Lake, Green Lake and Woodcock Lake are summarized in Table II-4. Evaporation was determined by the difference between the total input and total output for each lake. Most of the information presented is derived from EPA's NES studies (1974, 1975).

6. SURFACE WATER USE AND CLASSIFICATION

Surface waters in the Study Area are popular for many aquatic activities, including swimming and fishing. They are also used to assimilate wastewater effluent. These waters are not used for domestic water supply.

The State of Minnesota has classified uses of its surface waters and assigned appropriate classification to each body of water. Water quality standards for the classifications and uses appear in Appendix C-2. For a lake or stream classified under two or more uses, the more restrictive standards apply.

The Middle Fork of the Crow River has been classified 2B, Fisheries and Recreation, to permit the propagation and maintenance of cool or warm water sport or commercial fishes and be suitable for aquatic recreation of all kinds, including bathing, for which the waters may be usable (MPCA, Water Pollution Code (WPC) 14, 1973).

7. SURFACE WATER QUALITY

This section presents the water quality conditions of Nest Lake, Green Lake, and Woodcock Lake in the following order: nutrient budget, open water quality, phosphorus loading-trophic condition relationships, and shoreline conditions. The discussion is intended to put the surface water quality into perspective by independently presenting the nutrient budget and lake water quality, and connecting these two aspects by using the simplified phosphorus loading-trophic condition relationships. Finally, the shoreline problems in terms of bacteria contamination is discussed. Most of the information presented is synthesized from studies conducted by the EPA National Eutrophication Survey in 1972 and 1973 and by the Minnesota Pollution Control Agency in 1976, 1977, and 1978.

a. Nutrient Budget

Nutrient budgets for Nest Lake, Green Lake, and Woodcock Lake are shown in Table II-5 in terms of phosphorus and nitrogen using data from the EPA 1972-1973 surveys. As indicated, the combination of tributary inflow and wastewater treatment plant discharges contributes a significant amount of nutrients into Nest Lake and Green Lake. In contrast,

Table II-4

WATER BUDGETS FOR NEST LAKE, GREEN LAKE, AND WOODCOCK LAKE (1972-73) IN 10^6 M^3/YR -- FROM EPA NES (1974)

	Nest Lake
1. Inputs	
Middle Fork Crow River	45.2
Immediate Drainage	2.2
Precipitation	2.8
Total	50.2
2. Outputs	
Outlet	48.2
Evaporation (by difference)	2.0
Total	50.2

	Green Lake
1. Inputs	
Outlet from Nest Lake	48.2
Immediate Drainage	4.4
Precipitation	15.6
Total	68.2
2. Outputs	
Outlet to Middle Fork Crow River	55.2
Evaporation (by difference)	13.0
Total	68.2

	Woodcock Lake
1. Inputs	
Immediate Drainage	0.27
Precipitation	0.38
Spicer Treatment Plant	0.14
Total	0.79
2. Outputs	
Evaporation	0.38
Overflow into Green Lake	0.41
Total	0.79

Table II-5

PHOSPHORUS AND NITROGEN BUDGETS FOR NEST LAKE, GREEN LAKE AND WOODCOCK LAKE (1972-73) IN KG/YR - FROM EPA NES (1974)

		Nest Lake	
1. Inputs		Phosphorus	Nitrogen
Middle Fork Crow River		4,197.8	82,930.2
Precipitation		73.0	4,744.2
Immediate Drainage		59.1	1,122.7
Septic tanks		40.0	1,589.0
	Total	4,369.9	90,386.1
2. Outputs			
Outlet to Green Lake		1,912.7	69,956.0
3. Retention		2,457.2	20,430.1

		Green Lake	
1. Inputs		Phosphorus	Nitrogen
Outlet from Nest Lake		1,912.7	69,956.0
Precipitation		437.9	27,151.1
Immediate Drainage		59.1	1,109.1
Septic Tanks		195.4	7,336.4
	Total	2,605.1	105,552.6
2. Outputs			
Outlet		975.2	46,834.1
3. Retention		1,629.9	58,718.5

		Woodcock Lake	
1. Inputs		Phosphorus	Nitrogen
Tributary Inflow		---	---
Precipitation		3.1	508.0
Immediate Drainage		36.3	526.8
Septic Tanks		1.4	66.7
Point Sources		523.4	4,005.6
	Total	564.2	5,107.2
2. Outputs		---	---
3. Retention		---	---

the septic tank systems only contribute a small portion of the nutrient into these two lakes. Because of the limited data base available for Woodcock Lake, the nutrient budget derived and presented is considered to be the best estimation with available data and standard loading methodologies used by the EPA. See Appendix C-10 for an illustration of the phosphorus loads, by major nutrient source, into Nest Lake, Green Lake, and Woodcock Lake, in terms of percentage.

The results in Table II-5 indicate over 50% retention of phosphorus for both Nest Lake and Green Lake. As to nitrogen, the retention percentage differs considerably between the two Lakes. Woodcock Lake is expected to retain most of the nutrients entering the Lake due to its landlocked nature.

b. Lake Water Quality

Data collected by EPA and MPCA have been analyzed for Nest Lake, Green Lake, and Woodcock Lake. The four key water quality parameters (total phosphorus, chlorophyll a, secchi depth, and hypolimnetic dissolved oxygen saturation level) are plotted over the period from 1972 to 1978 and presented in Appendix C-3. These graphs are used to assist us in understanding the open water conditions of the lakes.

The results of the analysis suggest no definite trend as to the water quality of these lakes during the last 7 years. That is, the variation of water quality over this period is no more than annual fluctuations, inherent with the system. The water quality conditions seem to have remained relatively steady during the last few years. According to the simple trophic classification system, Nest Lake and Woodcock Lake are eutrophic and Green Lake is mesotrophic.

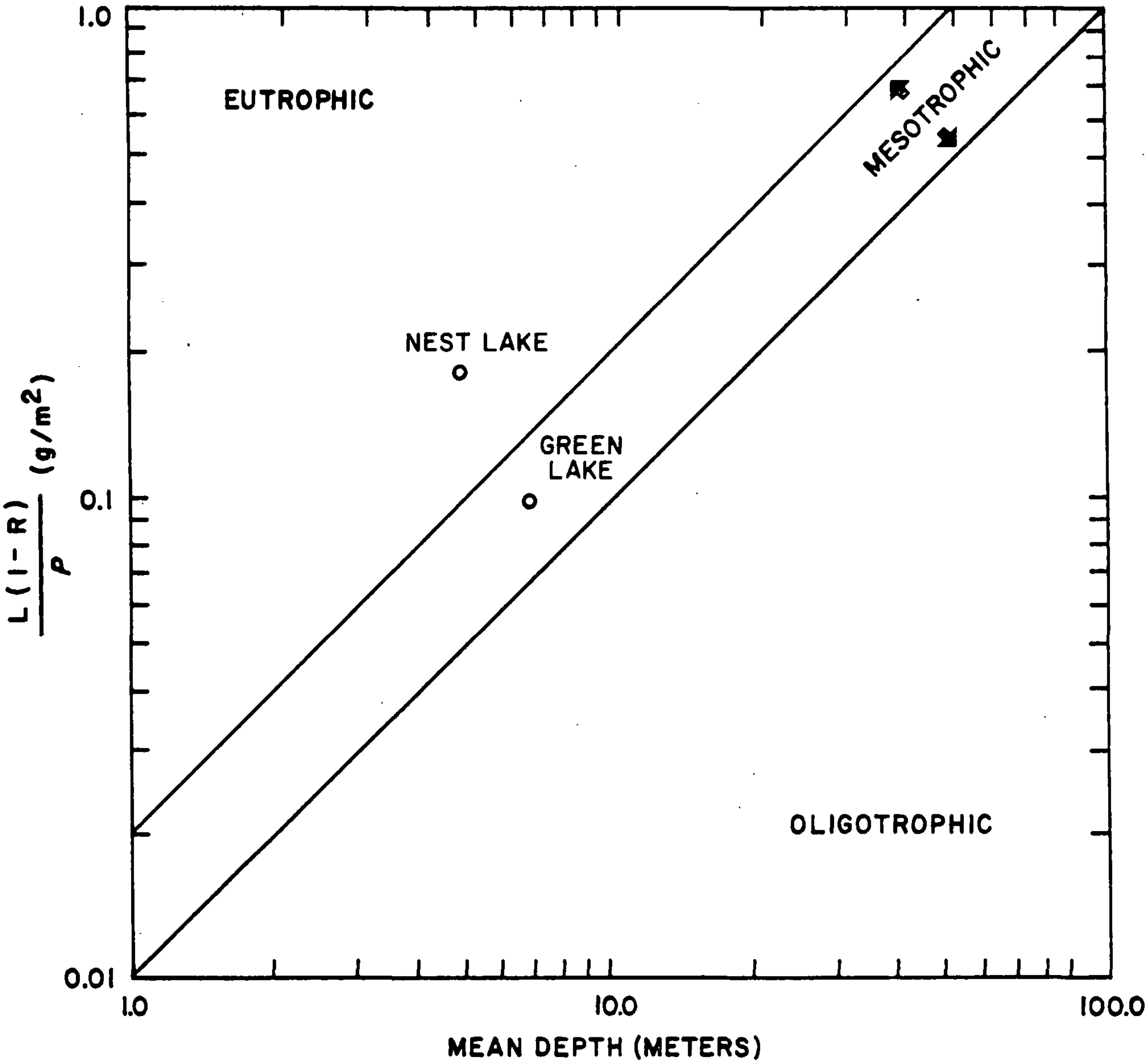
For a general description of lake water quality, see Appendix C-4.

c. Phosphorus Loading-Trophic Condition Relationships

This section examines relationships between phosphorus inputs (Section II.B.7.a) and the resulting water quality (Section II.B.7.b). Such relationships are needed to predict trophic responses which would result from phosphorus loading scenarios associated with various wastewater management alternatives. A detailed description of the procedures required to examine these relationships using Dillon's model (1975) is presented in Appendix C-5. Only the salient features of the results are included in this discussion. Figure II-8 shows the trophic conditions for Nest Lake and Green Lake based on the 1972-1973 data by EPA. Concurrent with the results in the previous section, Dillon's model describes Nest Lake as eutrophic and Green Lake mesotrophic.

d. Bacterial Contamination in Shoreline Areas

Investigations of fecal and total coliforms were made in Green Lake by Southwest State University (1972-1973, 1975-1977), Green Lake Property Owners Association (1970-1971), and MPCA (1968-1969). Along the nearshore areas of the Lake bacterial levels were generally below the Minnesota State Health Department and MPCA standards for swimming



L= AREAL PHOSPHORUS INPUT ($g/m^2/yr$)
R= PHOSPHORUS RETENTION COEFFICIENT
ρ= HYDRAULIC FLUSHING RATE (yr^{-1})

FIGURE II-8 TROPHIC CONDITIONS OF NEST LAKE AND GREEN LAKE (1972-1973) areas. Values in excess of the standards were commonly found in the Green Lake inlets and outlets, particularly at the Old Mill Outlet.

8. FLOOD PRONE AREAS

The Green Lake Study Area includes areas designated as flood hazard zones by the US Department of Housing and Urban Development (HUD) Flood Insurance Program. The zones delineate regions that have a 1% chance of flooding in any given year. These flood hazard zones include Nest Lake, Jessie Lake, Lake Calhoun, the Middle Fork of the Crow River and land on either side of it, and a large area of land located west of the City of New London. The flood hazard zones are delineated in Figure II-9.

C. EXISTING SYSTEMS

There are two existing wastewater treatment plants within the Green Lake Study Area. One plant serves the city of Spicer and the other serves New London. These two are discussed in detail in the Facilities Plan for the Green Lake vicinity. The rest of the development in the Study Area is served by on-site systems.

When the Facilities Plan was drafted, information about on-site systems was very limited. It was assumed, however, that many of the on-site system did not comply with the newly drafted standards for septic tanks which are detailed in the Kandiyohi County Zoning Ordinance (County Planning Commission 1972). This Ordinance is further discussed in this Section.

Septic tanks were suspected of contributing to public health and water quality problems although there was little evidence to support this suspicion. Three studies were recently undertaken by EPA to determine the extent and distribution of problems with on-site systems. The results of these studies, discussed in this section, are intended to identify potential water quality or public health problems. This identified information will be used to determine grant eligibility for collector sewers and to provide a basis for predicting the design, costs and impacts of continued use of on-site systems.

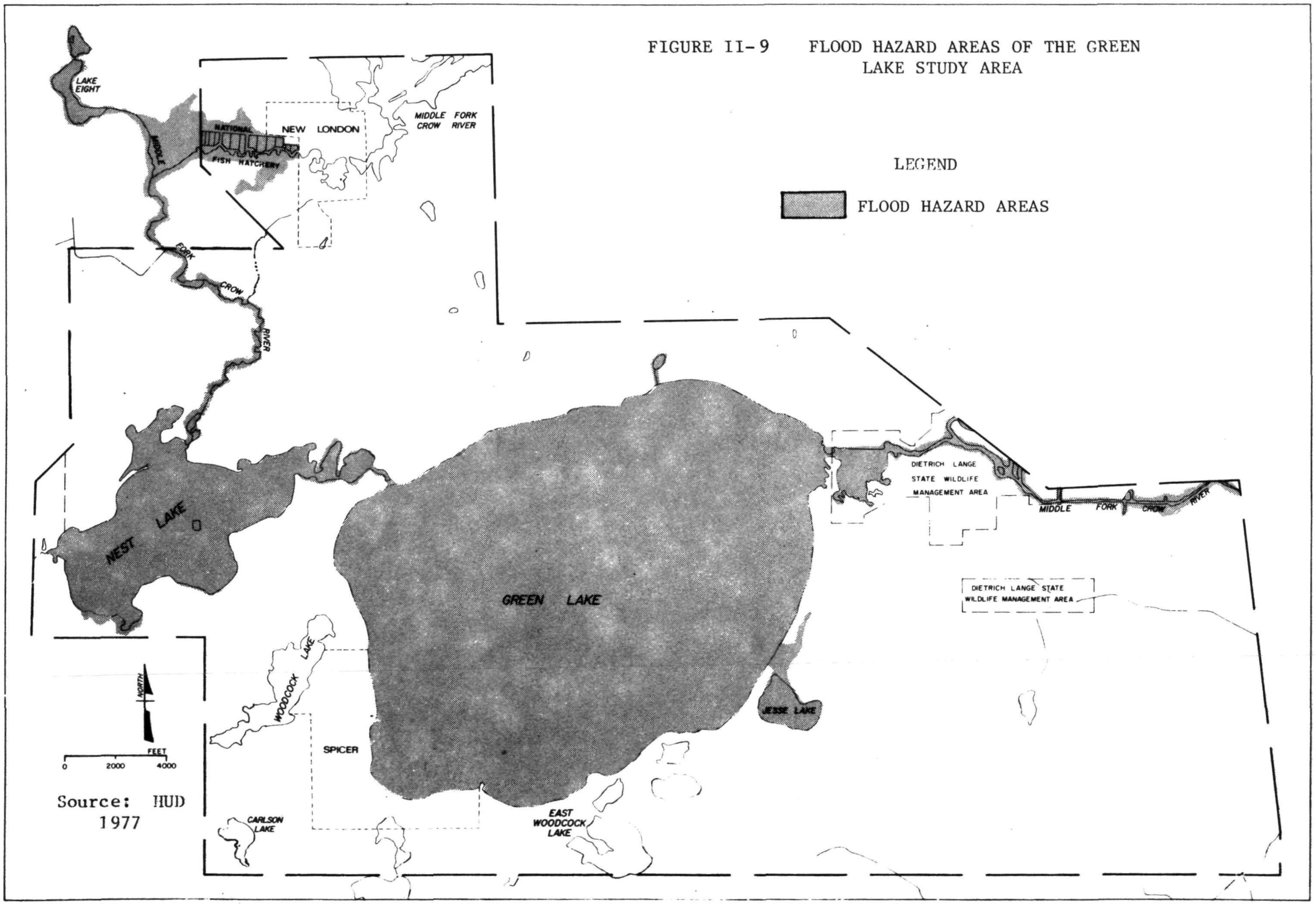
1. SUMMARY OF EXISTING DATA

Three studies were undertaken by EPA to evaluate existing lakeshore systems and problems resulting from these systems:

a. "Investigation of Septic Leachate Discharges into Green Lake, Minnesota" (Kerfoot, 1978).

A through-the-ice septic leachate survey was conducted along the shorelines of Green Lake and Nest Lake in Kandiyohi County, Minnesota during March, 1979. This study was undertaken to determine whether groundwater plumes from nearby septic tanks were emerging along the lakeshore causing elevated concentrations of nutrients. Septic tank leachate plumes were detected with an instrument referred to as a "Septic Snooper." The instrument is equipped with analyzers to detect

FIGURE II-9 FLOOD HAZARD AREAS OF THE GREEN LAKE STUDY AREA



Source: HUD 1977

both organic and inorganic chemicals from domestic wastewaters. Surface and groundwater sampling for nutrient and bacteria (surface water only) were coordinated with the septic leachate profile to clearly identify the source of the leachate.

The following observations were obtained from the shoreline profiles, analyses of groundwater and surface water samples, and evaluation of groundwater flow rates and patterns:

- A total of 64 locations exhibited effluent plume characteristics. Of these, 26 originated from surface water discharges and 38 from groundwater leachate. The locations of these effluent plumes is shown in Figure II-10.

- The most pronounced source of leachate was inflow from the Middle Fork of the Crow River into Nest Lake. The daily winter loading of phosphorus was estimated at 8.6 kg/day compared to <u>total</u> loading from all groundwater plumes around the lake of .15 kg/day.

- A noticeable undocumented source of phosphorus loading was observed originating from the discharge stream of an unnamed lake near the sewered town of Spicer.

- The observed pattern of plumes on Green Lake correlated with projected groundwater inflow for the surficial deposits. Most plumes were found on the north and west shorelines with few observed for the south and east segments.

The detailed results of this "Septic Snooper" study is presented in Appendix C-6.

b. "EPIC Survey" (EPA, 1978)

An aerial photographic survey was conducted by EPA's Environmental Photographic Interpretation Center in order to detect any surface malfunctions within the Study Area. The survey was made on August 20, 1978. Results of the survey, shown in Figure II-11 indicated that surface malfunctions were not widespread. Only three marginally failing systems were found along the Green Lake shoreline and two of these failures were located on the north shore. One currently failing and one marginally failing system were detected along the north shore of Nest Lake. A system that gave an indication of previously failing or exhibited potential for failing was considered a marginally failing system.

A brief description of EPIC's Green Lake septic system analysis is included in Appendix C-7.

c. Green Lake Construction Grants Sanitary Survey (1978)

An on-site sanitary survey of the Green Lake Proposed Service Area was conducted from November 6 through November 26, 1978. This survey consisted of a sample 74 (12%) of the residences around Green Lake which participated survey. This sample is sufficiently large to enable one to

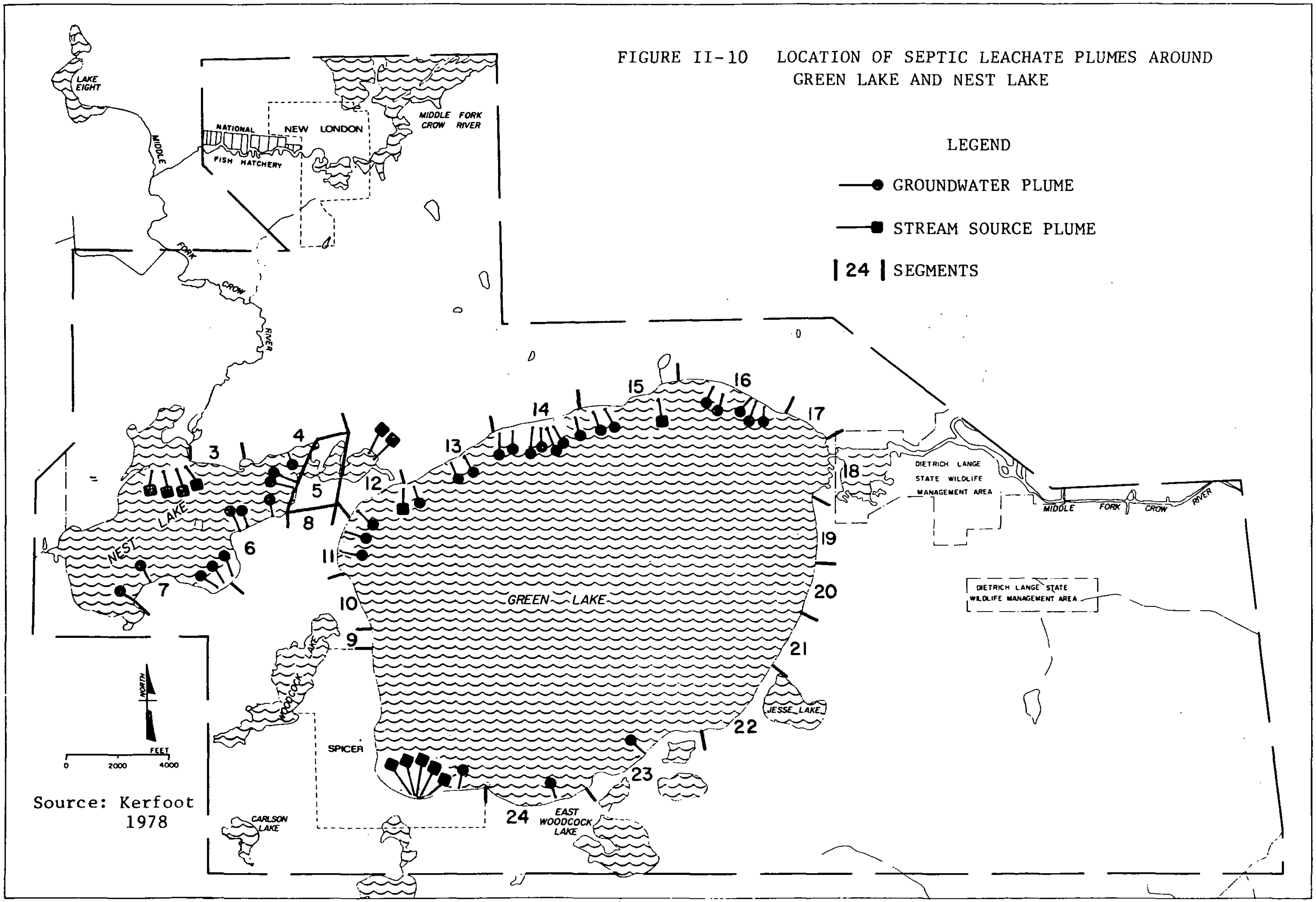


FIGURE II-10 LOCATION OF SEPTIC LEACHATE PLUMES AROUND GREEN LAKE AND NEST LAKE

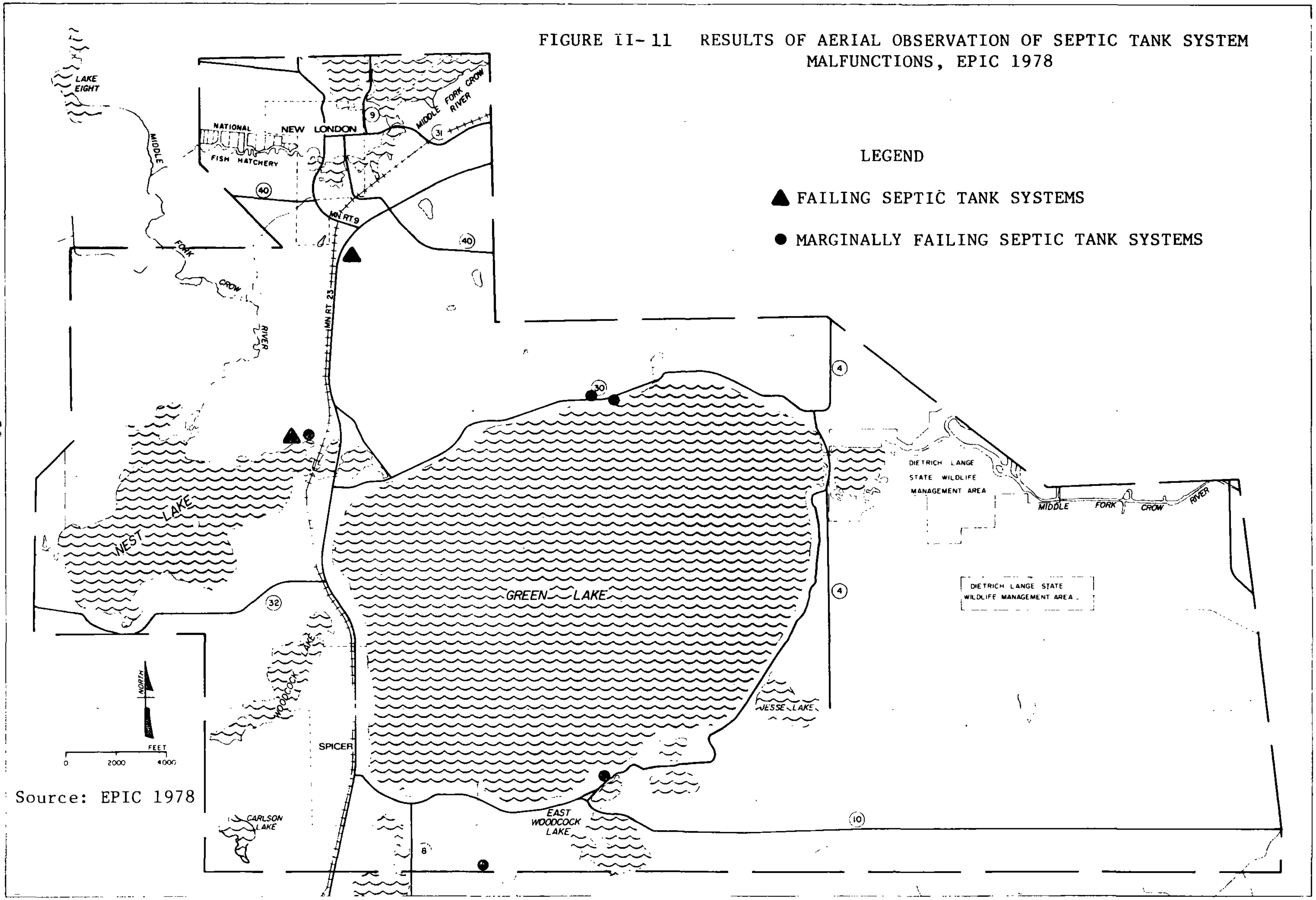


FIGURE II-11 RESULTS OF AERIAL OBSERVATION OF SEPTIC TANK SYSTEM MALFUNCTIONS, EPIC 1978 make some conclusions about the suitability of on-lot systems as perceived by the general public. It is to be noted that those interviewed during the survey were year-round residents; their septic tank drainfields had not been allowed to "rest" during the off-season, as would likely be the case with drainfields owned by seasonal residents.

The purpose of this study was to identify the extent of violations of the sanitary code and the extent, nature, and distribution of problems resulting from on-site systems. The study showed that despite widespread violations of standards for ST/SAS (septic tank-soil absorption systems) very few systems experienced recurring backups or ponding. The condition of the systems surveyed between November 6 and November 29 is described in Figure II-12.

2. TYPES OF SYSTEMS

The data gathered during the Sanitary Survey indicated that most on-lot systems within the EIS Proposed Service Area included one or two septic tanks accompanied by a single or double leachfield* (40%) or by a trench* (33%) (1978). In some instances, however, it was apparent that the residents were not quite sure of the type of system. Data in Table II-6 shows the types of on-site systems along the Green Lake shoreline. Both leachfields* and trenches* provide final treatment and disposal of septic tank effluent. A leachfield requires less lawn area than a trench but has much less sidewall area available for treatment of sewage.

Data gathered during the Sanitary Survey indicate that the use of alternative systems such as holding tanks, mounds and outhouses are not widespread throughout the Service Area. Some residents have made efforts to overcome severe site limitations by installing mounds, but this type of system numbers few. The county has recommended conversion to cluster systems, or multi-family filter fields in some instances where site limitations are severe but in each instance some of the residents were too reluctant to accept this type of system (by telephone, Steve Peterson, Kandiyohi County Tax Assessment Office, May 1979).

3. COMPLIANCE WITH SANITARY CODES

Enforcement of the Kandiyohi County Zoning Ordinance, passed in 1972, began in 1973. Prior to that time no standards were enforced. Under Subtitle 1-408, regulating the construction, repair and upgrading of individual sewage disposal systems (see Appendix C-8), newly constructed ST/SAS should meet the following standards:

- The system should consist of a watertight septic tank and a soil absorption system. Any alternative methods of sewage disposal are subject to rules and regulations of the MPCA (6 MCAR; 4.8040).

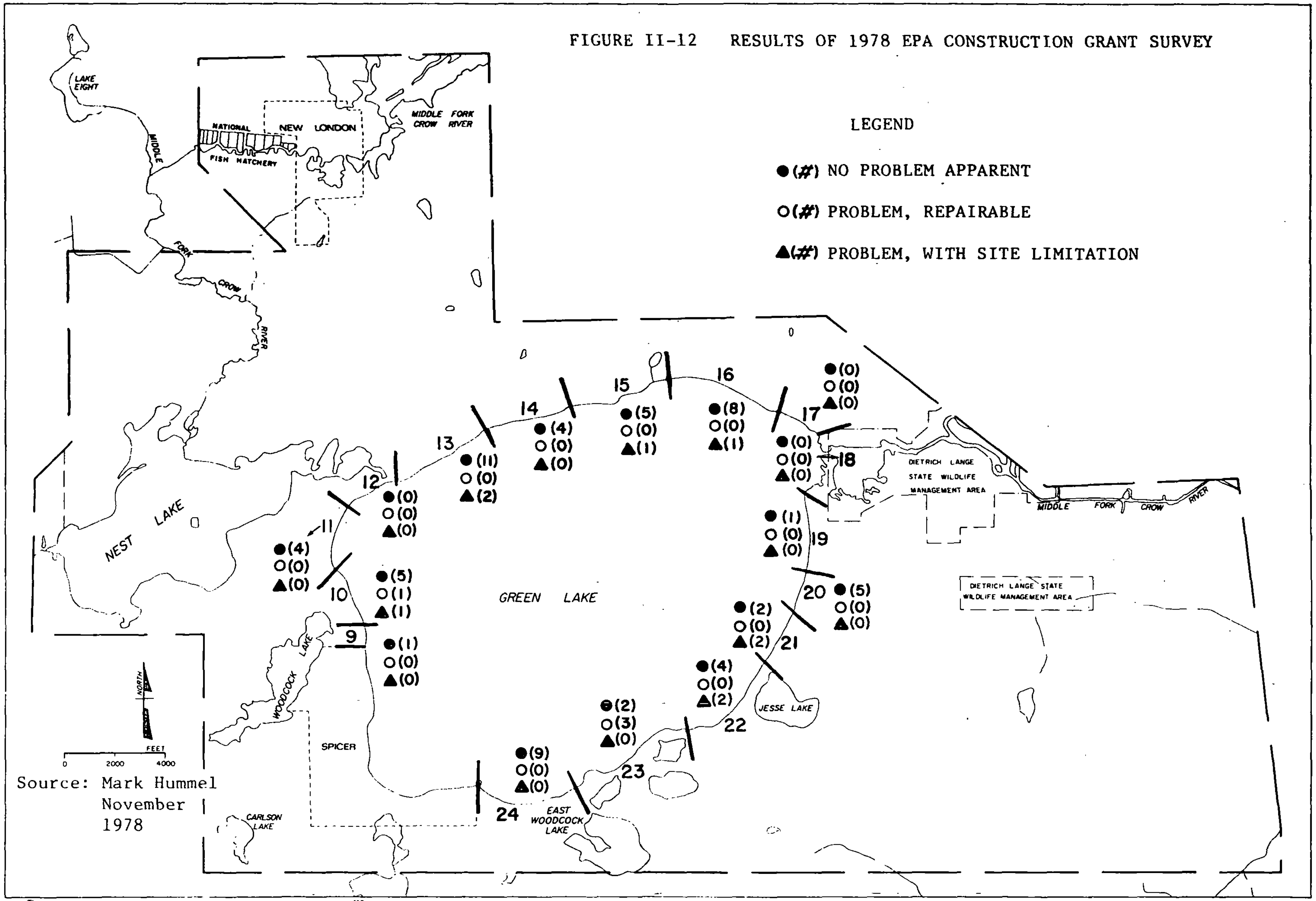


FIGURE II-12 RESULTS OF 1978 EPA CONSTRUCTION GRANT SURVEY

Table II-6

TYPES OF ON-SITE SYSTEMS FOUND ALONG GREEN LAKE SHORELINE
(BASED ON SANITARY SURVEY)*

Shoreline Area	Segments	Number Survey (%)	Septic Tank + Leachfield	Septic Tank + Trench	Septic Tank, Leach Tank, Leachfield	Septic Tank, Leach Tank, Trench	Outhouse	Septic Tank Only	Holding Tank	Don't Know
North Shore	12-17	33 (13%)	19	7	3	1	1	0	1	1
West Shore	9, 10, 11	11 (20%)	2	6	1	0	0	0	0	2
South Shore	22, 23, 24	20 (11%)	2	3	2	2	1	1	0	9
East Shore	18-21	10 (5%)	2	5	0	1	0	1	0	1
Total Shore		74 (12%)	25	21	6	4	2	2	1	11

Source: Green Lake Construction Grants Sanitary Survey. M. Hummell, 1978.

* In some instances, the type of system was based on the resident's best guess.

- The set-back distance from a domestic water supply or general development lakes must be a minimum of 50 feet.

- Distance between the soil absorption system and the depth to groundwater or bedrock shall be a minimum of 4 feet.

- The size of the septic tank and the soil absorption system must meet the criteria outlined in Appendix C-7.

The County has indicated that enforcement of the Ordinance is generally more stringent for sites located along the lakeshore than in other parts of the county where lots are generally larger. However, a percolation test is not required prior to septic tank system installation in any part of the Study Area (by telephone, Steve Peterson, Tax Assessment Office, May 1979). Many of the on-site system located on unsuitable sites serve seasonal residences. Several residents are interested in converting from seasonal to permanent status but hesitate to upgrade or replace their on-site systems with a more suitable one, until the issues raised in this EIS are resolved.

Many existing systems do not comply with the Kandiyohi County Ordinance because the development and enforcement of standards for on-site systems is recent and because there are limitations on the enforcement of the standards relating to site limitations. The data gathered during the sanitary survey provides the best indication of the types of violations of the standards and the location of non-complying systems. Table II-7 summarizes available information on violations of standards for on-site systems. Major violations include:

<u>Well Setback Distance</u>. A setback distance of 50 feet from the well is intended to provide an adequate setback distance so that bacteria and nutrients are sufficiently removed (or diluted in the case of nitrates) as the wastewater percolates through the soils matrix. Table II-7 indicates that 21% of the sites surveyed violated the standard for well setback distance. Most (50%) of the violations were found along the east shore, although a significant number of sites along the north (32%) and south (26%) shores were also in violation of the setback distance standard.

<u>Lake Setback Distance</u>. Only the north shore of Green Lake had a significant number of soil absorption units which were located too close to the Lake (30%). Generally, homes along Green Lake and their accompanying ST/SAS are setback a good distance from the shoreline. The setback distance of 50 feet from the lake is intended to minimize leaching of nutrients from on-site systems into surface waters.

<u>Undersized Septic Tanks</u>. Septic tanks which are too small for the number of residents using them can lead to several problems including backups into the house and poor solids removal in the septic tank. Poor solids removal may lead to clogging of the soil absorption unit.

Records on the size of the septic tanks were not maintained prior to enforcement of the ordinance; the size of the septic tank in 53% of the homes surveyed could not be identified. Where information was

Table II-7

SUMMARY OF DATA ON ON-SITE SYSTEMS
(BASED ON SANITARY SURVEY)

	Number Surveyed (% Total)	Number of Systems >10 yr. (% Total)	Average Age	System Setback <50 ft. from Well	System Setback <50 ft. from Lake	House Setback Range - ft. (Mean)	Septic Tanks Undersized
North Shore	33 (13%)	20 (65%)	15	10 (32%)	9 (30%)	31-450 (172)	21 Don't Know 50%+
West Shore	11 (20%)	4 (36%)	11	1 (9%)	0	40-100 (85)	4 Don't Know 14%
South Shore	20 (11%)	11 (58%)	12	5 (26%)	0	48-225 (84)	10 Don't Know 50%
East Shore	10 (5%)	7 (78%)	15	5 (50%)	1 (11%)	50-300 (137)	4 Don't Know 50%
Total	74 (12%)	42 (56%)	13	21 (29%)	10 (8%)		39

Source: Green Lake Constructions Grants Sanitary Survey. M. Hummel, 1978.

+based on limited no. of residents who knew this information available, the survey data indicated that 50% of the sites on the south, north, and east shores had undersized septic tanks. Only 14% of the septic tanks found along the western shore were undersized. This shoreline has the fewest number of ST/SAS which are older than 10 years and consequently a larger number comply with the standards for septic tank size.

Site Limitations. Because no percolation test is required for a permit and because depth to groundwater is shallow throughout much of the Proposed Service Area, it is suspected that many on-site systems violate the standards with respect to site limitations. MPCA standards for individual sewage treatment systems (WPC-40) require that the size of the drainfield be determined by the soils percolation rate. Although the SCS soils survey has not been completed for the Study Area, available survey data indicate that the soils are quite variable. Generally, suitable sandy and sandy loam soils are found along Green Lake, but impervious clay areas are not uncommon. Some excessively permeable soils along the west shore, and some impervious soils around Nest Lake have been noted as having site limitations (by telephone, Steve Peterson, May 1978).

4. PROBLEMS WITH EXISTING SYSTEMS

Numerous violations of the standards for ST/SAS conditions throughout some parts of the Study Area have led to the question of whether existing systems along the lakeshore are causing public health or water quality problems. The distinction should be made between water quality and public health problems on the one hand and nuisance or community improvement problems on the other hand. On-site systems known to contribute to violations of water quality standards or changes in trophic status pose water quality problems. Public health problems may result from ponding of effluent on the soil surface or contamination of groundwater supply in excess of drinking water standards. Where lakes are used for contact recreation, violation of the fecal coliform standard also constitutes a public health hazard. Community improvement problems include odors, restrictions on water use and restrictions on building expansion.

5. PUBLIC HEALTH PROBLEMS

a. Backups/Ponding

Despite numerous alleged violations of the County's standards for on-site systems, and an alleged shallow depth to groundwater found throughout much of the Proposed Service Area, the number of systems which pose public health problems as a result of backups or ponding is relatively few. The County has indicated that where problems do occur they are usually the result of residents converting from seasonal to permanent status. When this happens, the individual soil absorption systems may not be large enough to accommodate the extra flow. Conversion from seasonal to permanent status has been most frequent along the eastern shore.

The County indicated that the number of failures around Nest Lake is also low; although impermeable soils are found in some areas, the lots are adequately sized and many of the systems have been upgraded (by telephone, Steve Peterson, May 1978).

Based on data gathered during the Sanitary Survey only 13% (9 systems) had ever experienced problems with backups or pondings. Appendix C-9 summarizes data on these systems. At least three of these problem systems were in need of maintenance which is expected to correct the problem. Only five ST/SAS or 7% of those surveyed had backups or ponding on more than one occasion each year. It is not clear that these problems are the result of site limitations. All of these systems were more than 10 years old, at least one septic tank was undersized and three had a poor maintenance record. However, all five systems were suspected of being in an area where the groundwater level was high (less than 8 feet). The location of these few systems with recurring problems was limited to the north and east shores of the lake.

The EPIC aerial photographic survey was flown in August of 1978 to identify surface malfunctions. As Figure II-11 shows, only three marginally failing ST/SAS were detected along the Green Lake shoreline. The two marginally failing systems observed along the north shore may be in an area with a high groundwater level. Since many of the systems are poorly maintained, however, these surface malfunctions cannot be attributed to site limitations without further investigation. One failing and one marginally failing system were observed along the north shore of Nest Lake. Some impervious soils are known to exist in this area.

b. Groundwater Contamination

As discussed in Section II.B.2 only localized high nitrate concentrations in groundwater have been found in the Study Area. Out of 97 water well samples tested in July 1977, only two samples showed nitrate concentrations in excess of the public health drinking water standard of 10 mg/l. Their samples were from wells located in the northeast and east lakeshore areas (see Appendix C-1 for well data).

c. Water Quality Problems

Based on data available through the National Eutrophication Survey and the results of the "Septic Snooper" analysis (see II.B.I) septic tanks are not significantly contributing to water quality degradation. It is estimated that septic tanks contribute only 6% of the total phosphorus load to Green Lake and that the lake is mesotrophic in status. Kerfoot (1979) observed that only a small number of septic leachate plumes were being discharged into Green Lake during a March 1979 survey. These plumes were associated mainly with sites along the north shore; the phosphorus loadings at a location adjacent to the plumes were insignificant compared to the load contributed by the Middle Fork of the Crow River.

There is no evidence that existing systems are contributing significant bacterial loads. Bacterial levels along nearshore areas were generally below the Minnesota State Health Department and MPCA standards for recreational waters (Green Lake Property Association 1970-1971; MPCA 1968-1968; and SW State University 1975-1977). Values in excess of the standards were found in inlet and outlet streams and these levels could not be attributed to septic tank leachate. Kerfoot (1979) detected very low levels of fecal coliform (generally less than 10 counts/100 ml) in surface water located at the discharge of a septic leachate plumes.

d. Other Problems

Some residents served by on-site systems have reported localized algal growth along the Green Lake shoreline. While localized algal growth may be considered a nuisance since it interferes with recreational activity and is aesthetically displeasing, it is not necessarily indicative of a water quality problem.

The sanitary survey investigated the extent of Cladophora growth along the Green Lake shoreline. Since the natural nutrient level in Green Lake is low, growth of the filamentous algae, Cladophora is dependent on localized nutrient sources. Table II-8 summarizes the results of the Cladophora study. The dead Cladophora found washed up on the north and west shore may not have grown adjacent to those sources. Green Lake had been lowered prior to the time of the survey and there were signs of dead Cladophora along the shoreline where no live Cladophora was found in water.

Dense patches of Cladophora were observed only along the north shore and at the point of outflow of the Canal on the east shore.

D. BIOTIC RESOURCES

Of the 16,700 acres in the Green Lake Study Area, 40% is water, 19% is forested, 30% is under cultivation, and 4% is developed for residential and industrial purposes, (including the New London National Fish Hatchery). The 7% remaining is in open space: wetlands, hay meadows, fallow land in private ownership, Minnesota wildlife refuges or Federal waterfowl areas. Scattered throughout the Study Area, the forests and open lands provide habitat for a variety of wildlife, including amphibians, reptiles, birds, and mammals.

The State of Minnesota regards wildlife as a resource and regulates the shooting of upland birds and game mammals, as well the taking of fur-bearing animals in season. A major concern about the Green Lake project is the maintenance or improvement of the quality of lake and stream waters in a manner that will conserve valuable wildlife habitat.

1. AQUATIC BIOLOGY

a. Aquatic Vegetation

The production of plant material ultimately determines the number and kinds of animals that can be supported in a lake or stream. Furthermore, the number of species of aquatic plants and their relative numbers indicate in a qualitative manner the degree of nutrient pollution of the water. In the poor quality water of midwestern eutrophic lakes, the relatively few species of aquatic vascular plants* are dominated by

Table II-8

RESULTS OF SANITARY SURVEY
(# of Homesites with Cladophora)

Shoreline	Homes Surveyed	Slight to Moderate Cladophora	Heavy Cladophora	Heavy Dead*
North	33	5**	2	6
West	11	5	0	5
South	20	9	0	0
East	10	4	0***	0
Total	74	21	2	11

* This algae was not necessarily associated with the home adjacent to where algae was found.

** Only 16 sites were free of ice cover.

*** Heavy Cladophora growth was found near canal.

water milfoil. Blue-green algae or late summer algal "blooms" may produce green-colored water in eutrophic lakes and foul-smelling piles of decaying vegetation on the shorelines (Lind and Cottam 1969).

A limited survey of the aquatic plants of Green Lake and Nest Lake conducted in 1971 by DNR found a mix of semi-aquatic* (shoreline) and rooted aquatic plants* but no water milfoil. The algal blooms reported to be heavy at times in the Nest Lake did not appear to significantly reduce light penetration during critical times of year for the rooted plants.

The DNR surveyors estimated that only 1% of the surface of Green Lake was covered with emergent plants (bulrushes, cattails, manna and other grasses) probably because of its great average depth and the absence of embayments. Green Lake's exposed shoreline is regularly scoured by waves and ice, both detrimental to the production of rooted aquatic vegetation. In Green Lake, rooted aquatic plants were found to a depth of 35 feet, indicating very clear water. Rooted vegetation grew from depths of 30 feet in Nest Lake, 7% of whose surface was estimated to be covered with emergent plants.

b. Fishes

Green Lake and Nest Lake are important for recreation and serve as habitats and spawning areas for fish and wildlife. These lakes have been classified by the Minnesota DNR as follows (by telephone, Elvin Tews, October 1978):

Lake	Ecological Classification	Management Classification
Green	Bass, panfish, walleye	Same Species
Nest	Bass, panfish, walleye (northern pike)	Same Species

The fact that the management classification is the same as the ecological classification indicates that the composition of the fishery is consistent with management goals based on the physical parameters of the lakes.

Woodcock Lake supports populations of only bullheads and minnows. The fauna is determined in part by frequent "winterkills", or fish die-offs, caused by severe reductions in the level of dissolved oxygen. Winterkills are most common in shallow lakes where a long period of snow cover can reduce or prevent significant photosynthesis by aquatic plants. In Woodcock Lake, this problem is aggravated by the high oxygen demand resulting from the breakdown of organic wastes discharged from the Spicer wastewater treatment facility.

The most recent survey of lake fishes was conducted by Minnesota DNR in 1971 (by telephone, Elvin Tews, October 1978). A list of the number of species and their relative densities for Green Lake and Nest Lake appears in Appendix E-1. Although the densities varied, the similar composition indicates a healthy diversity of sport and rough fishes in these lakes. Results of the survey are summarized in the following table which also shows changes since 1954.

Lake	1971 Status	Change since 1954 survey	Important as spawning grounds for
Green	Walleyes, perch, rockbass, green sunfish, bull-heads, pumpkin-seed above State average; others average.	Increase in number of bluegills; de-crease in cisco.	Walleyes, smallmouth bass, panfish, cisco
Nest	Walleyes, perch & bluegills above.	White crappie decline in number.	Northern pike and panfish.

DNR from its surveys concluded that population fluctuations are common natural occurrences and that the Lakes are supporting large and diverse fish populations. (The New London Fish Hatchery produces only Salmon fry and fingerlings for release in Lake Superior).

c. Waterfowl, Shore and Wading Birds

The Study Area provides varied nesting and feeding habitat for waterfowl and other water birds. It contains five Federal waterfowl protection areas plus the Dietrich Lange State Wildlife Management Area. Such marsh birds as great blue heron, black-crowned night heron, little green heron and American egret feed on fish, crustaceans,* insects and small vertebrate animals living in shallow water or adjacent wetlands. Waterfowl, including mallards, American mergansers, and Canada geese breed and feed on area lakes. Although most birds are summer residents only, some, such as the small numbers of Canada geese which use the unfrozen section of the Middle Fork of the Crow River and feed in corn-fields, remain in the Study Area throughout the winter months. Kandiyohi County, located near the Mississippi Flyway, and with about 40 State and Federal wildlife and waterfowl areas, attracts migratory birds (including waterfowl) especially in the autumn.

2. TERRESTRIAL BIOLOGY

a. Forest

The major forests in the Study Area are mixed hardwood types, including many elm and cottonwood trees (Kandiyohi County Economic Development Plan 1977). Forested areas are confined primarily to river and stream banks, lakeshores and steep hills; the largest are located north of Green Lake and Nest Lake. With the soils of the Study Area continuing to be productive for agricultural crops, neither reforestation nor growth of the timber or pulp industry is likely in the foreseeable future there.

b. Wildlife

Vertebrate wildlife is found throughout the Study Area wherever there is habitat for feeding or nesting. Wildlife is likely to concentrate in the state wildlife management areas and Federal waterfowl protection areas, but undeveloped private lands are probably locally important as well. Hunters seek ring-necked pheasants in the high quality habitat provided by small wetlands found on many farms south and east of Green Lake, and the ruffed grouse and American woodcock in the forests. Migratory waterfowl are major game birds.

The forests, especially those north of Green Lake, provide important habitat for the most valuable big game animal, the white-tailed deer, which although it feeds mostly in open lands and crop lands, usually spends periods of inactivity in forests. Other hunted species that may rely heavily or solely on forest habitat are both fox and gray squirrels, raccoons, and to a lesser extent, red foxes (by telephone, Charles Gernes, 24 October 1978). Mammalian species in the Study Area valuable for sport or as food for valuable mammals are listed in Appendix E-2. Of these, a small mammal, the 2-ounce meadow vole may be the most numerous; it is a staple food item in the diets of most larger carnivorous mammals as well as of hawks, owls, and many large snakes. Meadow voles are numerous in grasslands or cattail marshes, often sharing the latter with their close relative, the muskrat. According to Charles Gernes, Manager of the New London Fish Hatchery, both the American bald eagle, classified as endangered by the Federal Government, and the great horned owl hunt in the Study Area; the owls nest there as well.

3. WETLANDS

Wetlands deserve particular consideration because of their role in purifying water, their value to wildlife, their potential susceptibility to the adverse effects of construction, and their diminishing frequency of occurrence within the Study Area.

The State of Minnesota recognizes that wetlands are valuable for preserving and maintaining groundwater levels, as habitat for wildlife, and as spawning grounds for certain important fishes, including northern pike. Even lands not available for public use or not connected with any navigable waterway are considered to be a resource of the State; the alteration of a wetland larger than 50 acres requires an application by the landowner and a subsequent hearing. In the event that permission to drain the wetland is denied, the State must be prepared to purchase the lands under either the State or Federal waterbank system.

Part of the State's concern about the preservation of wetlands is the realization that although they can be destroyed, directly or indirectly, within a short time, wetlands cannot be reconstructed or restored like terrestrial or water environments. Wetlands are formed over hundreds or thousands of years by deposition of sediments and organic debris during natural processes, creating acid, water-logged soils and a range of other features that cannot be restored after harsh disturbance. For instance, the lowering of the water table by as little as two or three feet can cause the organic matter in the peaty soils to be lost through oxidation within a short span of months or years (depending partly on whether the soils are burned). The raising of the water table 5 years later will not restore the conditions that formerly existed, and in this sense wetlands cannot be restored.

The lack of shallow embayments and coves along Green Lake's symmetrical shoreline retards the development of large wetlands areas there.

Ditching to improve the drainage for agricultural purposes has led to the loss of much wetland area within the Green Lake Study Area, decreasing wildlife habitat. Nevertheless, on almost every farm, patches of land remain, some several acres in extent, which are too poorly drained to be plowed and planted. (Such moist patches of wetland may be vegetated by cattails, sedges, willows and alders. Crops are generally planted right up to the edge of intermittent streams, drainage ditches or hay meadows.) In addition to those near agricultural areas, there are several extensive wetlands near other lakes and streams, covered by herbaceous growth and dominated by cattails. Many of these wetland areas have been incorporated into State-run wildlife management areas and Federally managed waterfowl areas. The total wetland acreage is estimated to be approximately 7% of the Study Area (see Figure II-7).

Wetlands are vital to the maintenance of wildlife populations. Alteration of some proportion of wetlands would alter both fish and wildlife populations and almost certainly reduce the recreational potential of the Study Area.

4. THREATENED OR ENDANGERED SPECIES

Kandiyohi County does not lie within the primary or peripheral range of the gray wolf, nor is it within either the breeding or winter habitat of the American bald eagle. Both animals have Threatened status and are protected by the Endangered Species Act of 1973 (P.L. 93-205). Furthermore, none of the two species of butterflies or five species of plants that have been proposed for special status by the US Fish and Wildlife Service is known in Kandiyohi County. According to a letter of 20 April 1979 of D.H. Rasmussen, Acting Regional Director, US Fish and Wildlife Service, no species of plant or animal that is additionally protected by Minnesota law is known to exist in the Study Area.

E. POPULATION AND SOCIOECONOMICS

1. POPULATION

a. Introduction

Population information for the Green Lake Study Area is derived from published data and primary field data collected during the preparation of this EIS. Published information from the US Bureau of the Census and other sources is available for Kandiyohi County and the minor civil divisions (villages, cities, and townships) within the County.

The Study Area consists of New London Village, Spicer City, and portions of the New London Township, Green Lake Township, Harrison Township, and Irving Township. It is not possible to accurately disaggregate existing published data below the township level for the purpose of describing the population characteristics of the portions of the townships included in the Study Area. Thus, published socioeconomic data is presented for the entirety of each of the minor civil divisions wholly or partially within the Study Area.

Primary field data was gathered for the Proposed EIS Service Area (see Figure I-3). For the purpose of this study, the Proposed Service Area was divided into 25 segments. A map of the segments is contained in Figure II-13. Population related data collected through primary field study include the number of permanent and seasonal dwellings. The dwelling counts served as the basis for estimates of permanent and seasonal population within the Proposed Service Area.

b. Existing Population

The Proposed Service Area had an estimated 1976 permanent population of 2,400 and a seasonal population of 4,500. The 1976 population estimates were based on field surveys. Thus, the Proposed Service Area had a total summer population of 6,900 with seasonal and permanent residents accounting for 65% and 35% of the total, respectively. New London Village and Spicer City had the largest number and proportion of permanent residents, while Green Lake Township, New London Township, and Irving Township all had large seasonal populations (see Table II-9 for a detailed breakdown of 1976 permanent and seasonal population by minor civil divisions). No data specific to the Proposed Service Area are available on either the permanent or seasonal population prior to 1976.

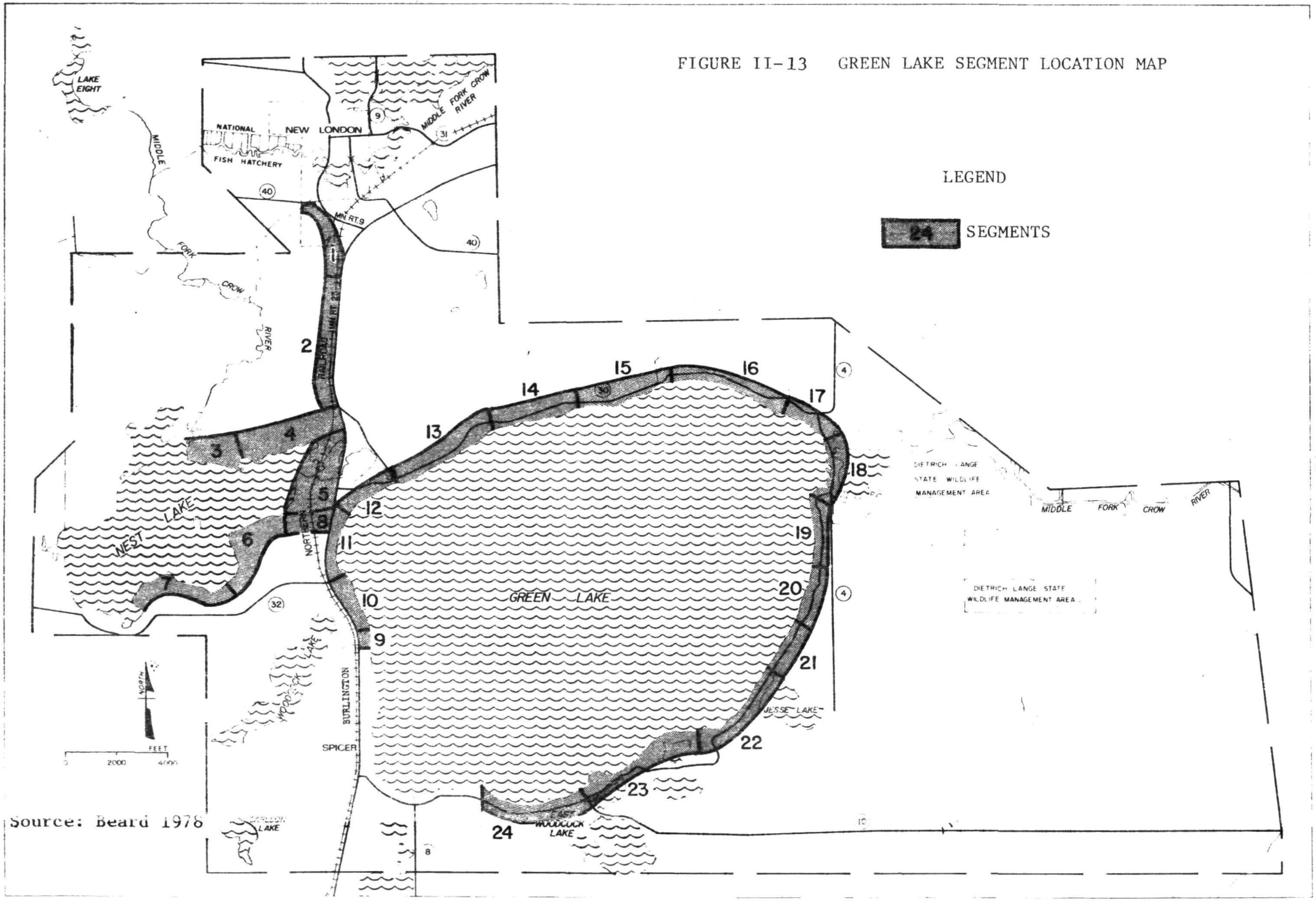
c. Population Projections

Permanent and seasonal baseline Proposed Service Area populations were projected for the year 2000. Permanent population projections were based on projections developed by the Minnesota State Demographer (1978) and the Kandiyohi County Planning Commission (1977) for the minor civil divisions containing the Proposed Service Area. These projections were applied to the 1976 Service Area estimates and adjusted to reflect the proportion of future population growths in minor civil divisions expected to occur within the Proposed Service Area.

Seasonal population for the year 2000 was projected on the basis of 1976 estimated seasonal population. Projections of seasonal population for the year 2000 were estimated for each segment of the Proposed Service Area. The future ratio of seasonal to permanent population was revised downward to reflect the assumption that the ratio is declining. Built into this assumption is the understanding that the conversion of seasonal residences to permanent residences will outnumber new seasonal residential construction. A drop of 20% in seasonal population (from 4,500 to 3,600) is projected to occur by the year 2000.

A total summer population was calculated based on seasonal and permanent population. Permanent, seasonal and total summer populations

FIGURE II-13 GREEN LAKE SEGMENT LOCATION MAP



Source: Beard 1978

TABLE II-9

	POPULATION						DWELLING UNITS					
	1976			2000			1976			2000		
	Total Summer	Permanent	Seasonal	Total Summer	Permanent	Seasonal	Total Summer	Permanent	Seasonal	Total Summer	Permanent	Seasonal
Green Lake Township	958	73	885	1,024	316	708	168	21	147	205	87	118
Irving Township	1,453	138	1,315	1,696	646	1,050	265	46	219	383	208	175
New London Township	2,685	721	1,964	3,513	1,941	1,572	539	212	327	825	563	262
New London Village	734	734	0	734	734	0	220	220	0	220	220	0
Spicer City	1,071	735	336	1,440	1,170	270	310	254	56	447	402	45
TOTAL SERVICE AREA	6,901	2,401	4,500	8,407	4,807	3,600	1,502	753	749	2,081	1,480	600

are listed in Table II-9. A detailed explanation of the methodology of calculating these population projections is provided in Appendix F-1.

In the year 2000, the total summer population of the Proposed Service Area is projected to be 8,407, an increase of 18% over the 1976 population estimate. The largest absolute increase is projected to occur in New London Township which is expected to gain 828 residents by the year 2000. The permanent to seasonal population ratio is expected to increase. This trend has been incorporated into the population projection to reflect the tendency for second homes to be converted to full time use.

2. CHARACTERISTICS OF THE POPULATION

a. Income

The data presented in this section are for the State of Minnesota, Kandiyohi County, New London Township, Green Lake Township, Harrison Township, Irving Township, New London Village, and the City of Spicer. Characteristics were selected because of their importance in analyzing the financial effects that the various wastewater management alternatives could have on individual households. The data presented below represent income figures for permanent residents. No data is available for population income of seasonal residents.

In 1970, the mean average family income in the Green Lake Study Area was $9,285 (see Appendix F-2). Although the Study Area's mean family income was slightly greater than the county mean, it was substantially less than the national and state figures of $10,999 and $11,048. Significant variation in mean incomes of the individual communities within the Study Area were evident, ranging from a low of $6,026 in Irving Township to a high of $14,385 in Harrison Township. Thus, it appears that while aggregate figures for the Study Area were indicative of a moderate income area, pockets of low income households were present.

Compared to Minnesota, both Kandiyohi County and the Green Lake Study Area were characterized by a large proportion of lower income families (see Appendix F-2). Approximately 50% of the families in Minnesota had an income in 1970 of less than $10,000, while similar statistics for the county and the Study Area were 61.3% and 64.6%, respectively.

The relatively low incomes experienced in the Study Area could have been the result of a number of factors such as:

- The agricultural and tourism orientation of the local economy providing relatively low skill/low wage employment opportunities; and

- A large portion of the population was comprised of elderly people, who were retired and living on fixed incomes.

b. Poverty Levels

In 1970 there was a slightly higher incidence of poverty among families in the Study Area and Kandiyohi County than in the State of Minnesota (see Appendix F-2). The family poverty rate for the Green Lake Study Area was 10.8% for this period and for the state was 8.2%. The proportion of families with incomes below the poverty level varied considerably among communities in the Study Area from a high of 22.8% in Irving Township to a low 4.4% in Spicer Village.

A large proportion of persons with incomes below the poverty level are elderly or retired and living on fixed incomes. In 1970, persons 65 years or older accounted for 23% of all persons of poverty status in the Study Area (see Appendix F-2). New London Township had an especially high number (44%) of people who were 65 years or older and classified as living in poverty.

c. Employment

In 1970, Kandiyohi County and the State of Minnesota were characterized by similar employment characteristics with the exception of two sectors: agriculture and manufacturing. Kandiyohi County and the region were relatively more dependent on agriculture for employment than the state as a whole. More current information on this trend will not be available until the 1980 Census. The county's manufacturing employment was considerably lower than either the region or the State. Although agricultural activity has been declining since 1960, the service and trade industries have become the primary sources of employment (see Table II-10).

Tourism played a significant role in the local economy in 1972. A comparison of tourism-related services in Minnesota and Kandiyohi County shows the importance of these activities to the county (see Table II-11). Hotels, automotive and amusement services accounted for a larger proportion of services in the county than in the State. Retail trade statistics reinforce the observation of the importance of tourism to the local economy (see Table II-12). Over 20% of all retail trade in Kandiyohi County in 1972 was related to building material and farm equipment compared to 7% for Minnesota. This divergence could be attributed to retail sale for farm equipment since the local economy was largely oriented toward agriculture.

Financial Characteristics. Financial characteristics of the local governments in Green Lake Study Area are presented in Table II-13. The information includes taxable valuation of real property, total revenue receipts, total current expenses, total capital outlay, and total indebtedness. Such information is helpful in evaluating various financing alternatives available to local governments.

In Minnesota, counties serve as agents for subordinate government units, acting as the collector and distributor of taxes and grants. Revenues are generated from three major sources:

Table II-10

KANDIYOHI COUNTY PERCENT SHARE OF
EMPLOYMENT BY INDUSTRY 1960 and 1970

	State		Region 6E		Kandiyohi	
	1960	1970	1960	1970	1960	1970
Agriculture	14.9	7.7	37.4	21.9	29.8	17.4
Construction	5.7	5.7	5.9	6.2	7.2	6.6
Manufacturing	20.1	21.0	10.6	19.4	8.5	11.1
Transportation	5.1	4.1	3.2	2.8	6.4	4.6
Wholesale and Retail Trade	20.1	22.0	18.5	20.7	18.3	24.6
Finance	4.2	4.6	2.4	2.6	3.1	2.7
Public Administration	3.9	3.8	2.5	2.7	2.8	3.1
Service(1)	22.0	27.6	17.7	21.7	21.9	27.7
Utilities and Communication	2.4	2.5	1.7	1.9	1.8	2.1
Mining	1.5	1.0	0.1	0.1	0.2	0.1

(1) Includes business and repair services, personal service workers, entertainment and recreation, professional and related services workers.

Sources: Minnesota Socio-Economic Population Characteristic-Employment, Volume 2.

Minnesota Analysis and Planning System (MAPS).

Table II - 11

SELECTED SERVICES - 1972

	Minnesota		Kandiyohi County(1)	
	Receipts ($1,000)	Percent of Industry Receipts	Receipts ($1,000)	Percent of Industry Receipts
Hotels	$ 188,879	10.8	$ 332	14.9
Automotive Services	185,916	10.7	369	16.6
Amusement	192,008	11.0	326	14.7
Total Services	1,734,051	-	2,223	-

(1) Excludes Willmar

Source: U.S. Department of Commerce, Bureau of Census, Census of Selected Services 1972.

Table II-12

RETAIL TRADE - 1972

	Minnesota		Kandiyohi County(1)	
	Sales ($1,000)	Percent of all Trade	Sales ($1,000)	Percent of all Trade
Building Materials and Farm Equipment	$ 601,195	7.1	$ 4,233	23.0
General Merchandise	1, 240,686	14.8	(D)	--
Food Stores	1,583,252	18.9	2,449	13.3
Automotive Dealers	1,503,205	17.9	4,130	22.4
Gasoline Service Station	710,548	8.5	2,722	14.8
Apparel Stores	369,731	4.4	(D)	--
Furniture Stores	378,425	4.5	404	2.2
Eating and Drinking Places	659,344	7.8	1,245	6.7
Drug Stores	246,132	2.9	(D)	--
Miscellaneous Retail Stores	1,059,879	12.7	2,180	11,8
Total	$8,352,397		$18,370	

(1) Excludes Willmar.
(D) Withheld to avoid disclosure.
Source: U.S. Department of Commerce, Bureau of Census, Census of Retail Trade-1972.

Table II-13

FINANCIAL CHARACTERISTICS OF THE LOCAL GOVERNMENTS IN THE GREEN LAKE STUDY AREA

	Kandiyohi County (1)	Green Lake Township (2)	Harrison Township (2)	Irving Township (2)	New London Township (2)	New London Village (2)	Spicer Village (3)
Taxable Valuation	$79,584,606	$3,360,248	$2,567,957	$2,174,262	$3,851,864	$1,110,839	$1,567,827
Total Revenue Receipts	6,846,234	27,671	24,968	28,461	41,877	108,821	139,862
Total Current Expense	6,271,202	25,180	19,430	15,900	30,565	103,147	97,589
Total Capital Outlay	67,894	6,714	--	20,933	--	--	--
Total Indebtedness	3,464,780	--	--	--	--	--	218,000

Sources: (1) Report of the State Auditor of Minnesota. Revenues, Expenditures and Debt of Local Governments in Minnesota. August 1977.

(2) Report of the State Auditor of Minnesota. Revenues, Expenditures and Debt of the Towns in Minnesota. January 1978.

(3) Report of the State Auditor of Minnesota. Revenues, Expenditures and Debt of the Cities in Minnesota. November 1977.

- General property tax;
- Federal revenue sharing; and
- State aid to local governments, usually $25-$30 per capita.

From these revenues, expenditures for general government and capital outlays are made. Counties, townships, and cities all can take on debt in the form of general obligation bonds. The debt limit on such bonds is set at 6-2/3% of the taxable valuation of the government unit. General obligation bonds require voter approval in Minnesota. In contrast, revenue bonds have no set debt limit and do not require a public referendum.

According to Table II-13 only the entities of Kandiyohi County and Spicer Village have outstanding debt. At the end of fiscal year 1975 Kandiyohi County had a total indebtedness of $3,464,780. Of this debt $1,155,000 were general obligation bonds; $2,109,780 were special assessment bonds; and $200,000 were other types of bonds. The general obligation debt amounts to $1,155,000, which was relatively low compared to a debt limit of $5,252,684. The Village of Spicer's debt was comprised of $18,000 in general obligation bonds and $200,000 in special assessment bonds. Spicer had a debt limit of $104,417 on general obligation bonds.

3. HOUSING CHARACTERISTICS

The total dwelling unit count for the Proposed EIS Service Area in 1976 was 1,502 units. Of these, 753 units or 50%, were occupied on a year-round basis. In 1970, seasonal units accounted for 11.9% of the housing stock in Kandiyohi County (see Table II-14).

Age characteristics of the permanent housing stock provide an indication of construction trends in the area. The distribution of housing ages for the Study Area closely corresponds to age distribution for the State and county. However, a wide variation in ages exists between the communities within the Study Area. Irving Township has a relatively old stock, with 81.7% of units built before 1939. Both New London Township and Green Lake Township experienced substantial increases in residential construction between 1965 and 1970, while very little construction activity was evident in the villages of New London and Spicer.

The median value of owner-occupied units and the median gross rent for rental units in the Study Area were considerably lower than the national and state medians (see Table II-15). The low values could be attributed to such factors as:

- The rural location of the Study Area;

- The structural conditions and amenities of individual units; and

- Second homes and vacation homes are often of lower value than year-round units.

Table II-14

HOUSING CHARACTERISTICS 1970

	Minnesota		Kandiyohi County		Study Area		Green Lake Township		Harrison Township		Irving Township		New London Township		New London Village		Spicer Village	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Total Dwelling Units	1,276,082		11,109		2,428		450		386		373		662		285		292	
Permanent	1,219,591	95.6	9,791	88.1	1,601	65.9	364	58.7	198	51.3	175	46.9	450	68.0	281	98.6	233	85.7
Seasonal	56,491	4.4	1,318	11.9	827	34.1	186	41.3	188	48.7	196	53.1	212	32.0	4	1.4	39	14.3
Of Permanent	1,153,946	94.6	9,272	94.7	1,505	94.0	259	98.1	193	97.5	161	92.0	398	88.4	271	96.4	223	95.3
Occupied	65,645	5.4	519	5.3	96	6.0	5	1.9	5	2.5	14	8.0	52	11.6	10	3.6	10	4.3
Vacant																		
Of Occupied																		
Owner Occupied	824,634	71.5	7,065	76.2	1,255	83.4	229	88.4	143	74.1	151	93.8	331	63.2	219	80.8	182	81.6
Renter Occupied	329,312	28.5	2,207	23.8	250	16.6	30	11.6	50	25.9	10	6.2	67	16.6	52	19.2	41	10.4
Age of Permanent Housing Stock																		
Built after 1965	155,478	17.8	1,007	10.3	197	12.3	47	17.8	15	7.6	19	10.9	94	20.9	11	3.9	11	4.7
Built between 1939-1964	461,590	37.8	3,198	32.7	485	30.3	78	29.5	46	23.2	13	7.4	179	39.8	81	28.8	88	37.8
Built before 1939	602,523	49.4	5,504	57.0	919	57.4	139	52.7	137	69.2	143	81.7	177	39.3	189	67.3	134	57.5

Sources: U.S. Census of Housing, Summary Date and Fifth Count Summary Tapes, 1970.

Table II-15

HOUSING VALUE - 1970

	Median Value Of Owner Occupied Unit	Median Gross Rent
United States	$17,130	$110
Minnesota	$18,054	$117
Kandiyohi County	$14,779	$ 94

Source: U.S. Bureau of the Census, County and City Data Book - 1972.

Little information concerning the characteristics of seasonal dwelling units in the Study Area is available.[1] The 1970 census provides detailed information on housing age, tenure patterns, vacancy rates, and other housing characteristics for permanent residences only. Seasonal units by nature of their use as second homes or vacation retreats are likely to differ from year-round homes in terms of size, value, condition and amenities.

4. LAND USE

a. Existing Land Use

Significant land uses in the Study Area include (see Figure II-14):

- Small urban communities of New London Village and the City of Spicer with a mix of commercial, residential and institutional uses;

- Single family residential/recreational development adjacent to the shoreline of Green Lake and Nest Lake;

- Agricultural lands; and

- Open land consisting mostly of woodlands, wetlands and lakes.

Major transportation routes serving the area include Minnesota Routes 9 and 23 which run east-west and US 71 which provides north-south circulation. The Burlington Northern Railroad runs north-south through the Study Area but does not provide direct service to the area.

The lakes, streams, woods, and hills in the area provide aesthetic value which, combined with the recreational value of Nest Lake and Green Lake has resulted in considerable residential development of land bordering these lakes. A majority of these homes are occupied on a seasonal basis only.

Other than scattered, tourist-serving commercial functions throughout the townships, most commercial activities are located in village centers or the approaches thereto. Industrial land uses constitute a minor percentage of land use activity within the Study Area. The major industrial activities are gravel pit operations located primarily in the Green Lake Township-New London Township portions of the Study Area.

b. Future Land Use

A Comprehensive Zoning Ordinance for Kandiyohi County was prepared in 1977, and contained a zoning map. This map was reviewed to obtain an appraisal of future land use patterns. This zoning map is the only

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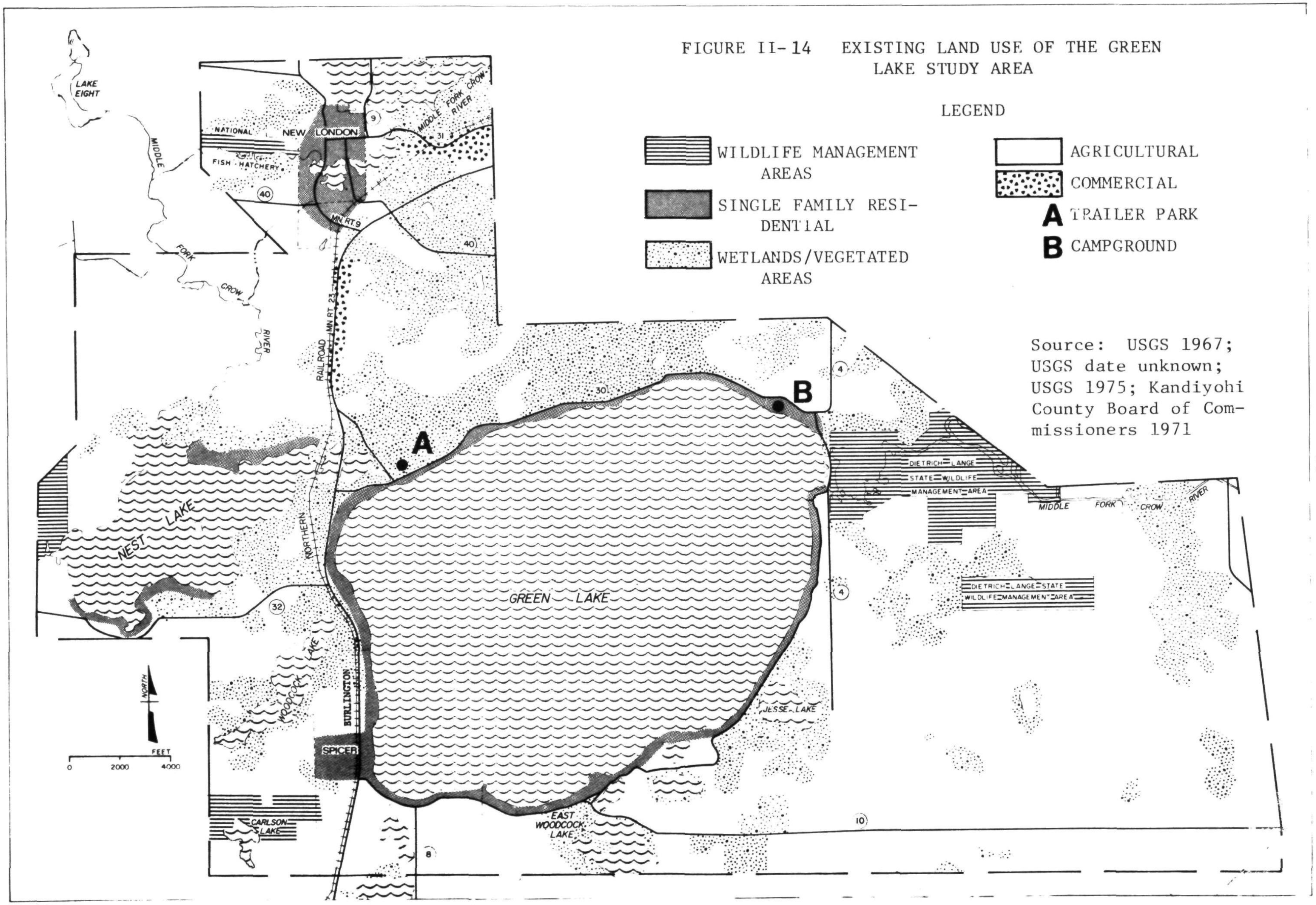
1 Although specific information is available for permanent units, it is not reasonable to assume that permanent and seasonal units exhibit similar characteristics.

FIGURE II-14 EXISTING LAND USE OF THE GREEN LAKE STUDY AREA



available information relating to future land use patterns for the Study Area. A majority of future land uses in the Study Area will be residential and agricultural (see Figure II-15). As can be seen from Figure II-15, future residential land uses were projected to be concentrated around Green Lake, Nest Lake, Woodcock Lake, New London Village and Spicer Village.

c. Growth Management

Kandiyohi County's Shoreland Management Ordinance established the major land development controls affecting acreage adjacent to Green Lake and Nest Lake. The Minnesota Shoreland Management Act requires counties throughout the State to adopt regulations which attempt to reconcile future lakeshore development pressures with the environmental sensitivities and development capabilities of a lakeshore.

The Kandiyohi County Shoreland Management Ordinance has been integrated with the county zoning ordinance (see Figure II-15). Shoreland acreage around Green Lake and Nest Lake has (with minor exceptions) been zoned R-1 Residential: Shoreland Management District. The shoreland management district is intended to accommodate residential development "along the shores of lakes, streams and rivers, and in natural environment areas," while "retain(ing) the physical features of the shoreland and natural areas."

Permitted uses in the shoreland management district include the following:

- General agricultural pasture and minimum tillage cropland uses (drainage of wetland areas without Planning Commission approval is prohibited);
- Single-family non-farm detached dwellings, included individual mobile homes, of either a seasonal or permanent nature;
- Parks and other public recreation facilities owned or operated by county or other governmental agencies;
- Public and private camping and outing areas operated on a non-profit basis; and
- Historic sites and markers, commemorative public areas.

Conditional uses permitted in the shoreland management district, subject to public comment and Planning Commission and County Board review and approval, are:

- Golf clubhouses, country clubs, or public swimming pools;
- Public sewage treatment facilities, and similar essential public utility and service structures;
- Recreation-oriented commercial establishments;

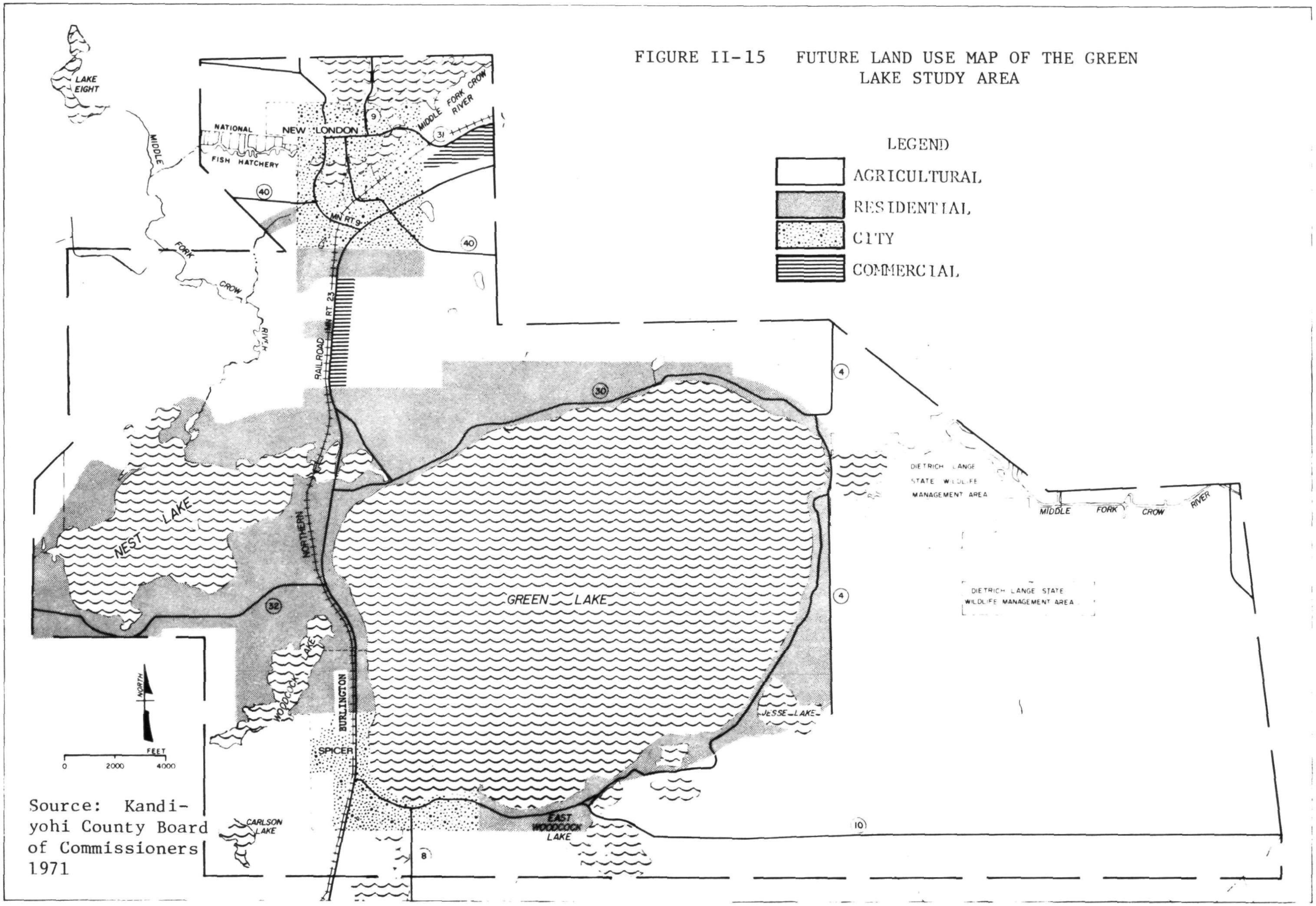


FIGURE II-15 FUTURE LAND USE MAP OF THE GREEN LAKE STUDY AREA

Source: Kandiyohi County Board of Commissioners 1971

- Churches;

- Recreational vehicle camping (subject to Minnesota health regulations; and

- Planned residential subdivision developments (subject to special requirements).

Special provisions for planned residential subdivisions relax established density restrictions for the purpose of encouraging cluster development, multiple dwellings and modular unit developments. Minimum required land area is 20 acres. Public or community water and sewer systems are required. Maximum permitted residential densities are doubled, provided that 25% of the land (lakeshore area) is reserved for public use and 75% of the lakeshore is left in a natural state. County Planning Commission and County Board review and approval of planned residential subdivision plot and site plan, together with issuance of a conditional use permit, are required under terms of the provision.

Additional provisions influencing the development of shoreland acreage include:

- Restriction of cutting or other disturbance of natural forest ecology within a 100 foot wide strip paralleling the shoreline;

- Prohibition of construction in areas requiring grading or filling where such activity may impair water quality through erosion and sedimentation;

- Allowance for clustered residential development, subject to plan approval by the Commission of Natural Resources and the County Commissioners, with higher net residential densities conditional upon provision of central sewage facilities and preservation of open space through restrictive deed covenants or public dedication; and

- Establishment of procedures for designation of special districts in areas of acute environmental sensitivity requiring more stringent protective measures than those otherwise available.

Minimum lot size, frontage, and setback from the lakeshore for single-family residential development in the shoreland management district vary with a lake's classification (see Table II-16).

Green Lake and Nest Lake have both been classified as general development lakes. A maximum density of two dwelling units per acre is possible for residential development in these shoreland management districts. Densities of up to four dwellings per acre are possible for approved planned residential subdivisions or cluster developments.

The zone outside contiguous lake areas are restricted to general agricultural activities including cash crops and animal husbandry. This is done to regulate the encroachment of non-farm activities on agricultural lands.

Table II-16

SINGLE-FAMILY RESIDENTIAL DEVELOPMENT
RESTRICTIONS IMPOSED BY KANDIYOHI COUNTY

Lake Classification	Minimum Lot Size	Minimum Lot Frontage	Minimum Setback from Lakeshore
Natural Environment Lake (NE)	80,000 sq.ft.	200 ft.	200 ft.
Recreational Development Lake (RD)	40,000 sq.ft.	150 ft.	100 ft.
General Development Lake (GD)	20,000 sq.ft.	100 ft.	75 ft.

Source: Kandiyohi County Shoreland Management Ordinance

5. CULTURAL RESOURCES

a. Archaeological Resources

The Minnesota State Historical Society has indicated the presence of a number of important archaeological sites within the Study Area. It is reported that the area immediately to the east of Green Lake was occupied by a Sioux Indian Village led by Little Crow, a hereditary chieftain and last of his dynasty. Remnants of a corn storage hole are still to be seen at this campsite. Lakotah Sioux bands established a great camp on the north shore of Green Lake. This camp existed for well over 100 years. The burial mounds for the camp were located just south of the Green Lake outlet. This is one of the larger Indian mound complexes in the State of Minnesota.

b. Historic Resources

The State Historic Preservation Officer (SHPO) has identified sites and buildings of historic significance in the Study Area. However, none is listed on the National Register of Historic Sites. The Green Lake Village was homesteaded beginning in 1869, with a number of settlements as well as a post office, and grist mill. One of the first missionary sites in the state was located contiguous to the Indian camp on the north shore of Green Lake.

6. RECREATION

a. Potential

One of the prime attractions of the Green Lake Area is its recreational potential. Major activities include boating, fishing, camping, and swimming. Table II-17 indicates in relative terms how much use each lake has received and the potential for overuse.

b. County Parks

County Park 4. This park is located on the southwest shore of Green Lake in the community of Spicer. This park is used only during the day as a public beach and picnic area. It is 8 acres in size and contains picnic tables, bathhouse, beach, off-street parking, fireplaces and a well.

County Park 5. This park is situated on County Road 30 on the northeast shore of Green Lake. It is a heavily wooded area with campsites, picnic area and paved roads.

c. Wildlife Areas

Several wildlife management areas managed by the Minnesota Department of Conservation exist within the Study Area. These are listed in Table II-18 and delineated in Figure II-13. In addition, three Federal waterfowl protection areas exist near Green Lake.

Table II-17

RECREATIONAL POTENTIAL OF LAKES
WITHIN THE STUDY AREA

Name	Acres	Shore Miles	Crowding Potential	Relative Water Crowding
Green	5,820	11.2	Negligible	High
East Woodcock	150	2.7	High	High
Woodcock	170	3.7	High	Medium
Nest	1,020	8.1	Low	High

Source: Kandiyohi County Planning Commission, 1971.

Table II-18

MAJOR WILDLIFE MANAGEMENT AREAS
WITHIN THE STUDY AREA

Name of Unit	Acres Owned	Acres Projected	Miles From Town
Dietrich Lange	1,045	-	3 E-NE Spicer
Ringo Nest	452	448	2 NW Spicer
Total	1,497	448	

Source: Kandiyohi County Planning Commission, 1971.

Table II-19

PUBLIC ACCESS TO LAKES IN THE
GREEN LAKE STUDY AREA

Municipality	Lake	Shore Miles	Facility Description	Approximate Shoreline Frontage
Townships of New London, Iriving, Green Lake, Village of Spicer	Green Lake	11.2	County Park No. 5 - swimming, boating, rafting, camping	800 ft.
Same as above	Green Lake	Same as above	County Park No. 4 - swimming, boating, rafting, diving	600 ft.
New London Township	Nest Lake	8.1	Wayside Rest	1500 ft.
Same as above	Nest Lake	Same as above	Public access point	100 ft.

Source: Telephone interview with T. Peterson, 6E Regional Development Commission, Willmar, Minnesota, 3/15/78.

d. Public Access

Public access to Green Lake and Nest Lake is relatively limited (see Table II-19). Although there is a total of approximately 23 miles of lake shoreline in the Study Area, less than 3% of the lakeshore is available for public access.

CHAPTER III

DEVELOPMENT OF ALTERNATIVES

A. INTRODUCTION

1. GENERAL APPROACH

New alternative systems for wastewater collection and treatment in the Proposed EIS Green Lake Service Area (see Figure I-4) are developed in this chapter. In Chapter IV, the alternatives are described and compared, in terms of cost-effectiveness, with the Proposed Action in the Facilities Plan Report: Proposed Green Lake Sanitary Sewer and Water District (Rieke Carroll Muller Associates 1976). Chapter V assesses the environmental and socioeconomic impacts of all these systems.

The development of new alternatives in the EIS focuses on those aspects and implications of the proposed wastewater management plan for the Service Area which either have been identified as major issues or concerns, or were not adequately addressed in the Facilities Plan. The high cost of the Facilities Plan Proposed Action and the potential impact on area residents make the cost-effectiveness of proposed facilities a major concern. Since the collection system accounts for approximately 80% of the Proposed Action, the extent of servicing necessary, along with alternative wastewater treatment systems and the use of newer technologies for wastewater collection are investigated in detail. The development of alternative treatment facilities has been undertaken by matching available technologies, both conventional and alternative or innovative, to the site conditions, such as soil characteristics and housing density in the Proposed EIS Service Area.

Chapter I of this EIS emphasized that an important issue is the overall need for the project proposed in the Facilities Plan. Documenting a clear need for new wastewater facilities requires evidence that the existing on-lot systems are directly related to water quality and public health problems. Such a need is shown when one or more of the following conditions exist:

- Standing pools of septic tank effluent or raw domestic sewage in yards or public areas where direct contact with residents is likely.
- Sewage in basements from inoperable or sluggish sewage disposal systems.
- Contaminated private wells clearly associated with sewage disposal systems.

The Proposed EIS Service Area exhibits some indirect evidence of the unsuitability of site conditions for on-site soil disposal systems. The evidence includes high groundwater, slowly permeable soils, small lot sizes, proximity to lakeshores and substandard setback distances between wells and private wastewater facilities. Available information on these factors was used early in the preparation of this EIS to develop the decentralized alternatives designated EIS Alternatives 3, 4 5, and 6.

Indirect evidence is insufficient to justify Federal funding, however. Federal water pollution control legislation and regulations require documentation of actual water quality or public health problems. Section II.C. summarizes the extensive efforts mounted during the preparation of this EIS to document and quantify the need for improved facilities around Green Lake.

The dollar cost of the Facilities Plan Proposed Action and its impact on area residents make cost effectiveness an issue equally as important as documentation. Since the collection system accounts for the major share of the construction costs in the Facilities Plan Proposed Action, the extent that sewers are needed and the use of other technologies for wastewater collection have been investigated in detail here, as have alternative wastewater treatment systems. The technologies assessed are listed below:

WASTEWATER MANAGEMENT COMPONENTS AND OPTIONS

Functional Component	Options
Flow and Waste Load Reduction	- household water conservation measures - ban on phosphorus - rehabilitation of existing sewers to reduce infiltration and inflow
Collection of Wastewaters	- limited service area - pressure sewers - vacuum sewers - gravity sewers
Wastewater Treatment Processes	- conventional centralized treatment plus chemical treatment to reduce phosphorus concentrations - land application - on-site treatment - cluster systems
Effluent Disposal	- subsurface disposal - land application - discharge to surface waters

Sludge Handling	-	anaerobic digestion
	-	dewatering
Sludge Disposal	-	land application
	-	landfilling
	-	composting
	-	contract hauling

Next, appropriate options were selected and combined into the alternative systems that are described in Chapter IV. The last section of Chapter III considers implementation, administration and financing of the alternatives.

2. COMPARABILITY OF ALTERNATIVES: DESIGN POPULATION

The various alternatives for wastewater management in the EIS Service Area must provide equivalent levels of service if their designs and costs are to be properly compared. A design population of 8407 has been assumed (see Section II.E.1) in the following evaluation of alternatives. The design population is that population projected to reside in the EIS Service Area in the year 2000. The methodology used to develop this estimate is presented in Appendix E-1.

The same year 2000 design population has been used as the basis for all the EIS alternatives and the Facilities Plan Proposed Action in the interest of equitable comparison; it must be recognized, however, that each alternative carries its own constraints and that the wastewater management system chosen may itself be a significant determinent of the EIS Service Area's actual population in the year 2000.

3. COMPARABILITY OF ALTERNATIVES: FLOW AND WASTE LOAD PROJECTIONS

Design flows for centralized treatment facilities and for the cluster systems are based on a design domestic sewage flow of 60 gallons per capita per day (gpcd) in residential areas for both permanent and seasonal residents. Infiltration and inflow* (I/I) into gravity sewers was added to the calculated sewage flow in appropriate alternatives. These data are summarized in Table III-1.

The design flow used in the Facilities Plan for the Proposed Action ranged from 15-190 gpcd, including I/I. To compare costs properly in this EIS, flows developed for the EIS alternatives were used to re-calculate flows for the Proposed Action.

The domestic sewage generation rate depends upon the mix of residential, commercial, and institutional sources in the area. Studies on residential water usage (Witt, Siegrist, and Boyle 1974; Bailey et al. 1969; Cohen and Wallman 1976) reported individual household water consumptions varying widely between 20 and 100 gpcd. However, averaged values reported in those studies generally ranged between 40-56 gpcd. On a community-wide basis, non-residential domestic (commercial, small

Table III-1

GREEN LAKE EIS SERVICE AREA
DESIGN POPULATION AND FLOW (YEAR 2000)

	TOTAL POPULATION	WINTER POPULATION	TOTAL FLOW (MGD)	WINTER FLOW (MGD)
New London Area	1282	1116	.077	.067
Nest Lake Area (eastern half Nest Lake)	1542	686	.092	.041
Spicer Area (Spicer Village, west shore Green Lake)	1913	1504	.114	.091
Green Lake Area (remainder Green Lake)	3670	1787	.221	.108
INFILTRATION			.504 .038	.307 .038
TOTAL	8407	5073	.542	.345

industrial, and institutional) water use increases per capita flows. The extents of such increases are influenced by:

- the importance of the community as a local or regional trading center;
- the concentration of such water-intensive institutions as schools and hospitals; and
- the level of small industrial development.

For communities with populations of less than 5,000, EPA regulations allow design flows in the range of 60 to 70 gpcd where existing per capita flow data is not available. In larger communities, and in communities within Standard Metropolitan Statistical Areas, the maximum allowable flow ranges up to 85 gpcd.

Water consumption by seasonal users varies much more than consumption by permanent residents. The actual rates of consumption depend upon such factors as type of accommodations in the area and type of recreation areas available. EPA regulations (EPA 1978) suggest that seasonal population can be converted to equivalent permanent population by using the following multipliers:

Day-use visitor	0.1 to 0.2
Seasonal visitor	0.5 to 0.8

A multiplier of 1.0 was applied to the projected seasonal population to account for both day-use and seasonal visitors. Considering the possible error in projecting future seasonal populations, the preponderance of present seasonal visitors using well-equipped private dwellings and the lack of data on day-use visitors, this multiplier was thought conservative i.e., it probably overestimates flows to some degree.

The design flow figure of 60 gpcd does not reflect reductions in flow from a program of water conservation. Residential water conservation devices, discussed in Section III.B.1.a, could reduce flows by 16 gpcd. Later in this chapter, to demonstrate probable impacts of such reduction in flow, the Facilities Plan Proposed Action has been redesigned and recosted.

B. COMPONENTS AND OPTIONS

1. FLOW AND WASTE REDUCTION

a. Residential Flow Reduction Devices

A variety of devices which reduce water consumption and sewage flow are available. A list of some of the devices is presented in Appendix F-1 with data on their water saving potential and costs. Most of these devices will require no change in the user's hygienic habits and are as maintenance-free as standard fixtures. Others, such as compost toilets, may require changes in hygiene practices and/or increased maintenance. The use of any of these devices may be justified under certain conditions, for instance when no other device can provide adequate sanitation or when excessive flows cause malfunctions of conventional on-site septic systems. In most cases, however, the justifications for flow reduction devices are economic.

Table III-2 presents a list of proven flow reduction devices and homeowner's savings resulting from their use locally. Data on the devices listed in Appendix F-2 and local cost assumptions listed beneath the table were used to develop these estimates. The homeowner's savings include savings for water supply, water heating and wastewater treatment. With a combination of shower flow control insert device, dual cycle toilet and lavatory faucet flow control device the annual savings would be approximately $80 per year.

If all residences in the Proposed EIS Service Area were to install these flow reduction devices, they could not all save the $1.40/1000 gallons in wastewater treatment costs (see assumption in Table III-2). This is due to the fact that a substatial portion of this charge goes to pay off capital, operation and maintenance costs which will remain constant even if flow is reduced. For everyone to benefit fully from flow reduction then wastewater collection, treatment and disposal facilities would have to be designed with flow capacities that reflect the lower sewage flows. Use of the three types of devices cited above would reduce per capita sewage flows by approximately 16 gpcd. To calculate the cost-effectiveness of community-wide flow reduction, the Facilities Plan Proposed Action (see Section IV.B.2) was redesigned and recosted using a design flow based on 44 gpcd instead of 60 gpcd.

The estimated savings in project capital cost (1980) would be $1,245,000 and the operation and maintenance cost savings would be approximately $8,000 per year. To achieve this savings, approximately $9,000 worth of flow reduction devices would be necessary. The total present worth* of savings over the 20-year design period would be $1,126,000 or 13% of the Facilities Plan Proposed Action.

These economic analyses of homeowner's saving and total present worth reduction assumed all dwellings would be sewered. However, for dwellings which continue to use on-site systems the economic benefits of flow reduction devices cannot be readily estimated. State regulatory agencies generally do not allow a reduction in the design of conventional on-site systems based upon proposals to use flow reduction devices. However, it is likely that reduced flows will prolong the life of soil adsorption systems there by saving money in the long run.

With some decentralized technologies, substantial reductions in flow may be required regardless of costs. Holding tanks, soil adsorption systems which cannot be enlarged, evaporation or evapotranspiration systems and sand mounds are examples of technologies which would operate with less risk of malfunction if sewage flows could be reduced to the minimum. Sewage flows on the order of 15 to 30 gpcd can be achieved by installation of combinations of the following devices:

Table III-2

ESTIMATED SAVINGS WITH FLOW REDUCTION DEVICES

	First Year Savings (or Cost)	Annual Savings After First Year
Shower flow control insert device	$41.29	$43.29
Dual cycle toilet[a]	7.96	27.96
Toilet damming device	10.72	13.97
Shallow trap toilet[a]	8.97	13.97
Dual flush adapter for toilets	7.64	11.64
Spray tap faucet	(65.33)	11.87
Improved ballcock assembly for toilets	4.35	7.35
Faucet flow control device	5.14	8.14
Faucet aerator	0.89	3.39

[a] First year expenditure assumed to be difference in capital cost between flow-saving toilet and a standard toilet costing $75.

Assumptions

Household: Four persons occupying dwelling 328 days per year. One bathroom in dwelling.

Water Cost: Private well water supply. Cost of water = $0.02/1000 gallons for electricity to pump against a 100 foot hydraulic head.

Water Heating Cost: Electric water heater. Water temperature increase = 100°F. Electricity costs $0.03/kilowatt-hour. Cost of water heating = $7.50/100 gallons.

Wastewater Cost: Assumed that water supply is metered and sewage bill is based on water supply at a constant rate of $1.40/1000 gallons. Rate is based on a 1980 Study Area sewage flow of 0.5 mgd and local costs of $254,000 in 1980 for the Facilities Plan Proposed Action as estimated in this EIS.

- Reduce lavatory water usage by installing spray tap faucets.

- Replace standard toilets with dual cycle or other low volume toilets.

- Reduce shower water use by installing thermostatic mixing valves and flow control shower heads. Use of showers rather than baths should be encouraged whenever possible.

- Replace older clothes washing machines with those equipped with water-level controls or with front-loading machines.

- Eliminate water-carried toilet wastes by use of in-house composting toilets.

- Recycle bath and laundry wastewaters for toilet flushing. Filtering and disinfection of bath and laundry wastes for this purpose has been shown to be feasible and aesthetically acceptable in pilot studies (Cohen and Wallman 1974; McLaughlin 1968). This is an alternative to in-house composting toilets that could achieve the same level of wastewater flow reduction.

- Recycle bath and laundry wastewaters for lawn sprinkling in summer. The feasibility of this method would have to be evaluated on a trial basis in the Study Area because its general applicability is not certain.

- Commercially available pressurized toilets and air-assisted shower heads using a common air compressor of small horsepower would reduce sewage volume from these two largest household sources up to 90%.

b. Minnesota Ban on Phosphorus

Phosphorus is frequently the nutrient controlling algae growth in surface waters and is therefore an important influence on lake or stream eutrophication. Enrichment of the waters with nutrients encourages the growth of algae and other microscopic plant life; decay of the plants increases biochemical oxygen demand, decreasing dissolved oxygen in the water. Addition of nutrients encourages higher forms of plant life, thereby hastening the aging process by which a lake evolves into a bog or marsh. Normally, eutrophication is a natural process proceeding slowly over thousands of years. Human activity however, can greatly accelerate it. Phosphorus and other nutrients, contributed to surface waters by human wastes, laundry detergents and agricultural runoff, often result in over-fertilization, over-productivity of plant matter, and "choking" of a body of water within a few years. Appendix C-4 discuss the process and data pertinent for the Green Lake Study Area.

In 1977 the Minnesota legislature limited the amount of phosphorus in laundry and cleaning supplies sold in the state to 0.5%. Presently, there is no enforcement of this law because an injunction has been issued as a result of a lawsuit.

The Minnesota Pollution Control Agency estimates that for the Minneapolis-St. Paul area (where a local phosphorus ban is in effect) a 35% reduction in phosphorus loading in raw wastewater effluent has resulted. The Twin Cities have experienced a 1.1 pound per capita per year reduction in phosphorus loading from 1971 to 1974 (by telephone, Craig Affeldt, MPCA, April, 1978).

Treatment plants and on-site disposal facilities in the Study Area could experience a similar reduction in phosphorus concentration. However, such characteristics of the Green Lake area as the number of residential laundry facilities may differ from those in the communities where data were collected. Clearly, the extent of phosphorus reduction can only be determined by a survey of the characteristics of the Study Area. One approach to the reduction of phosphorus is to require that household detergents be free of phosphates.

Reduction of phosphorus by control of detergents will not achieve the effluent discharge limits of 1 mg/1 (see Appendix G-1 for Effluent Limits) for discharges to area lakes or their tributaries. Consequently, facilities for phosphorus removal is required in treatment plants which discharge to any of the surface water bodies in the Study Area except for the Middle Fork of the Crow River below Green Lake. A phosphorus ban would result in an unquantifiable reduction in phsophorus entering surface waters with septic tank leachate.

c. Rehabilitation of Existing Sewers To Reduce Infiltration and Inflow

Infiltration/Inflow Analyses conducted in New London and Spicer for the Facilities Plan revealed that infiltration was substantial in both sewer systems and that combined sewers in New London receive significant inflow. Sewer system evaluation surveys (SSES), were recommended in the Facilities Plan and were performed in May 1978. The costs and projected flow reduction for the rehabilitation effort are incorporated in all EIS Alternatives except No Action.

2. COLLECTION

The collection system proposed in the Facilities Plan is estimated to cost $6.4 million -- 80% of the total cost of the Proposed Action -- and is the single most expensive portion of the sewerage facilities. Since not all parts of collection systems are eligible for Federal and State funding, the costs of the collection system can affect the local community more than other components of the project. There is, therefore, considerable incentive at local, state and national levels to choose less expensive alternatives to conventional sewer systems.

Alternative means of wastewater collection are:

- pressure sewers (including grinder pumps or STEP systems);
- vacuum sewers; and
- small diameter gravity sewers (Troyan and Norris 1974).

An alternative collection system may economically sewer areas with site conditions that increase the cost of conventional sewerage, such as shallow depth to bedrock, high groundwater table, or hilly terrain. Housing density also affects the relative costs of conventional and alternative wastewater collection techniques.

The alternative most extensively studied is collection by a pressure sewer system. The principles behind the pressure system and the gravity flow system are opposite to each other. The water system consists of a single point of pressurization and a number of user outlets. Conversely, the pressure sewer system has inlet points of pressurization and a single outlet. Pressurized wastewater is generally discharged to the treatment facility or to a gravity sewer.

The two major types of pressure sewer systems are the grinder pump (GP) system and the septic tank effluent pumping (STEP) system. The differences between the two systems are in the on-site equipment and layout. The GP system employs individual grinder pumps to convey raw wastewater to the sewer. In the STEP system septic tank effluent from individual households is pumped to the pressure main.

The advantages of pressure sewer systems are:

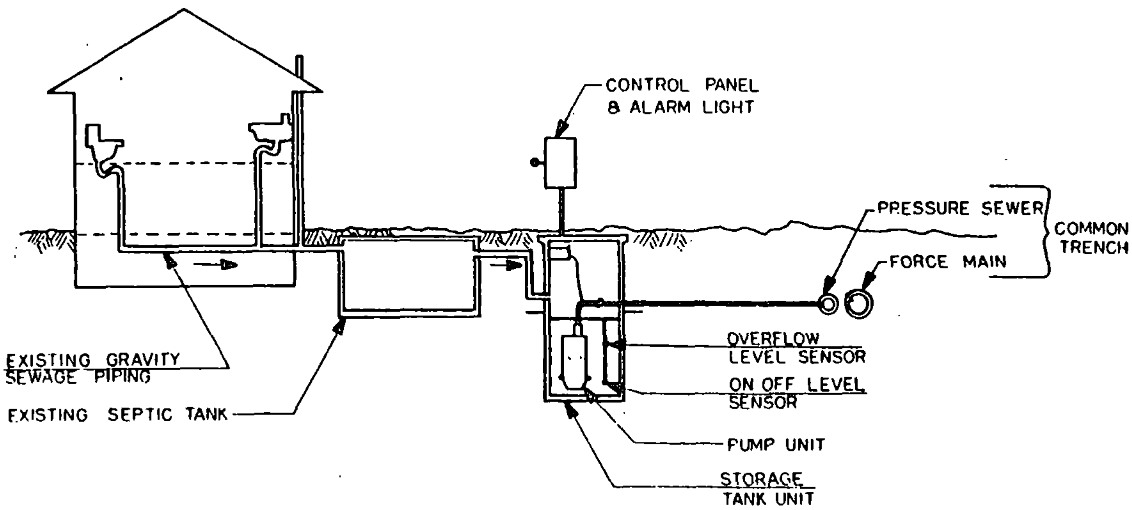
- elimination of infiltration/inflow;
- reduction of construction cost; and
- use in varied site and climatic conditions.

The disadvantages include relatively high operation and maintenance cost, and the requirement for individual home STEP systems or grinder pumps.

Vacuum sewers provide similar advantages. Their major components are vacuum mains, collection tanks and vacuum pumps, and individual home valve connection systems. A recent review of vacuum sewer technology, however, noted significant differences among design of four major types of current systems (Cooper and Rezek 1975).

As a third alternative to conventional gravity sewers, small diameter (4-inch) pipe can be used if septic tank effluent, rather than raw waste, is collected. Such pipe may result in lower costs of materials, but the systems retain some of the disadvantages of larger sewers. The need for deep excavations and pump stations is unaffected.

This document analyzed the reliability, site requirements, and costs of the alternative sewer systems considered for the Green Lake area. The STEP-type low-pressure sewer system was found the most advantageous of the three alternatives. A preliminary STEP system serving residents around Green Lake was, therefore, developed to determine the differences in project costs if it were substituted for the gravity system specified by the Facilities Plan. The arrangement of the STEP system house pump and sewer line connection is illustrated in Figure III-1.



TYPICAL PUMP INSTALLATION FOR PRESSURE SEWER

Figure III-1

3. WASTEWATER TREATMENT

Wastewater treatment options include three categories: centralized treatment prior to discharge into surface water; centralized treatment prior to disposal on land; and decentralized treatment.

"Centralized treatment" refers to treatment at a central site of wastewater collected by a single system and transported to a central location. Centralized treatment systems may serve all or a part of the service area. Centrally treated effluent may be discharged to surface waters or applied to the land; the method and site of disposal affect the treatment process requirements.

"Decentralized treatment" defines those systems processing a relatively small amount of wastewater. Decentralized treatment can be provided on-site or off-site. Typically, effluent disposal occurs in close proximity to the source of sewage elimiating the need for costly transmission of sewage to distant disposal sites.

A major purpose of this EIS is to assess the technical feasibility, relative costs, environmental impacts, and implementation problems associated with these three approaches to wastewater treatment in the proposed Green Lake EIS Service Area.

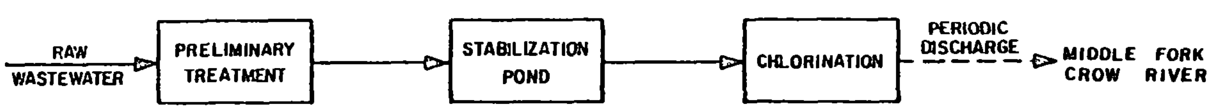
a. Centralized Treatment -- Discharge to Surface Waters

The Middle Fork of the Crow River, east of Green Lake, was selected by the Facilities Plan as the point of disposal for treated wastewater. The Facilities Plan evaluated two options for centralized treatment: wastewater stabilization lagoons, which would permit controlled discharge of treated wastewater; and a mechanical oxidation ditch which would allow for continual discharge.

Four methods of centralized treatment involving effluent discharge to surface water were developed for the new alternatives in this EIS, including a waste stabilization lagoon, a mechanical oxidation ditch, an extended aeration treatment plant and an activated sludge plant. A rapid infiltration system, which involves the discharge of recovered wastewater to the Middle Fork of the Crow River, is discussed in Section III.3.b. All methods of treatment, which are briefly described below, were designed to comply with MPCA's current effluent standards listed in Appendix G-1.

The first centralized treatment scheme for the new alternatives consists of a 0.59 mgd stabilization lagoon facility with controlled effluent discharge to the Middle Fork of the Crow River. The facility involves a dual or parallel system of ponds operating in series which allow for the shutting down of one side during the low flow winter months. The ponds will require an area of 75 acres located at a site east of Green Lake.

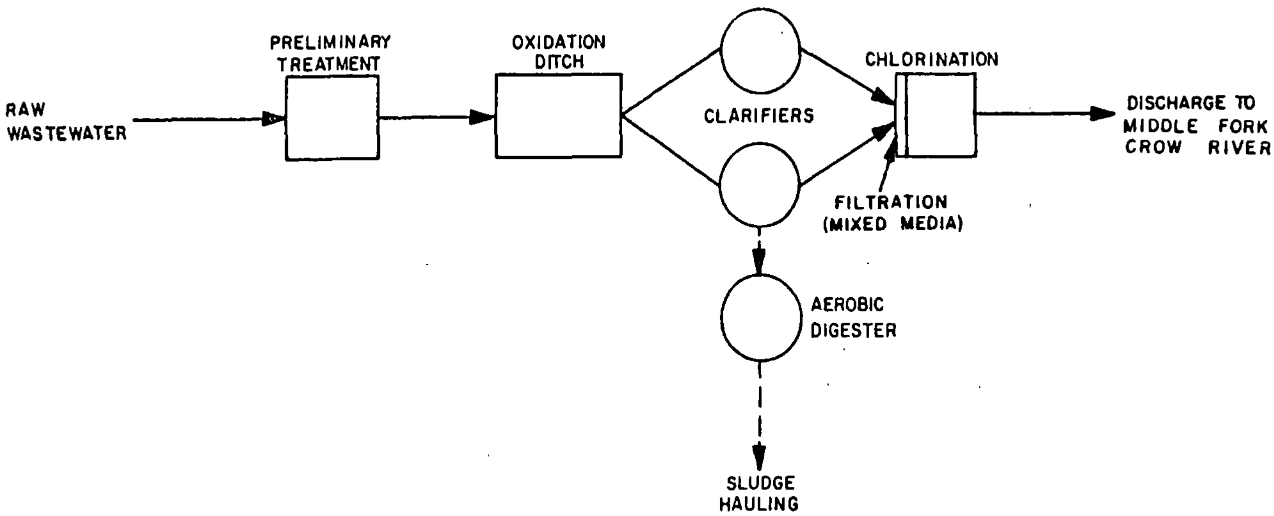
The treatment process is identical to that proposed in the Facilities Plan. A flow diagram of this plant is presented in Figure III-2. The "preliminary treatment" component shown in the diagram simply involves the removal of coarse solids.



STABILIZATION POND
CONTROLLED DISCHARGE

Figure III-2

The second centralized treatment method considered for the EIS Service Area includes a 0.59 mgd mechanical oxidation ditch plant with continuous discharge to the Middle Fork of the Crow River east of Green Lake. The treatment process is identical to that proposed in the Facilities Plan. Tertiary filtration is included in this process to provide sufficient removal of organic substances (BOD_5 and suspended solids) in compliance with MPCA effluent quality standards. A flow diagram of this plant is illustrated in Figure III-3. Again, preliminary treatment involves the removal of coarse solids.



OXIDATION DITCH WITH FILTRATION

Figure III-3

The third method of centralized treatment evaluated in the development of new alternatives in this EIS involved the upgrading of the Village of New London's wastewater treatment plant. The existing plant has sufficient capacity to meet the design flow but only provides primary treatment. The upgraded plant (0.10 mgd) will provide tertiary treatment of wastewater and consists of a conventional activated sludge process, chemical addition for phosphorus removal and filtration (see Figure III-4).

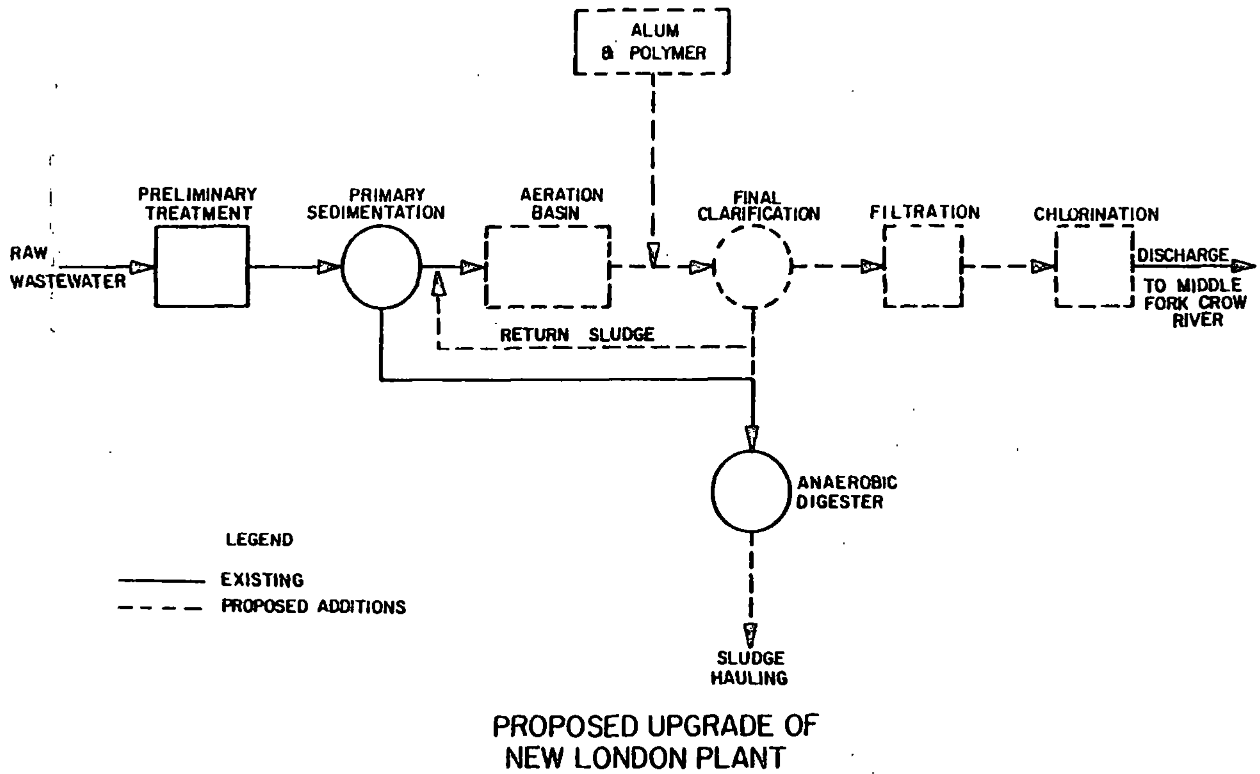
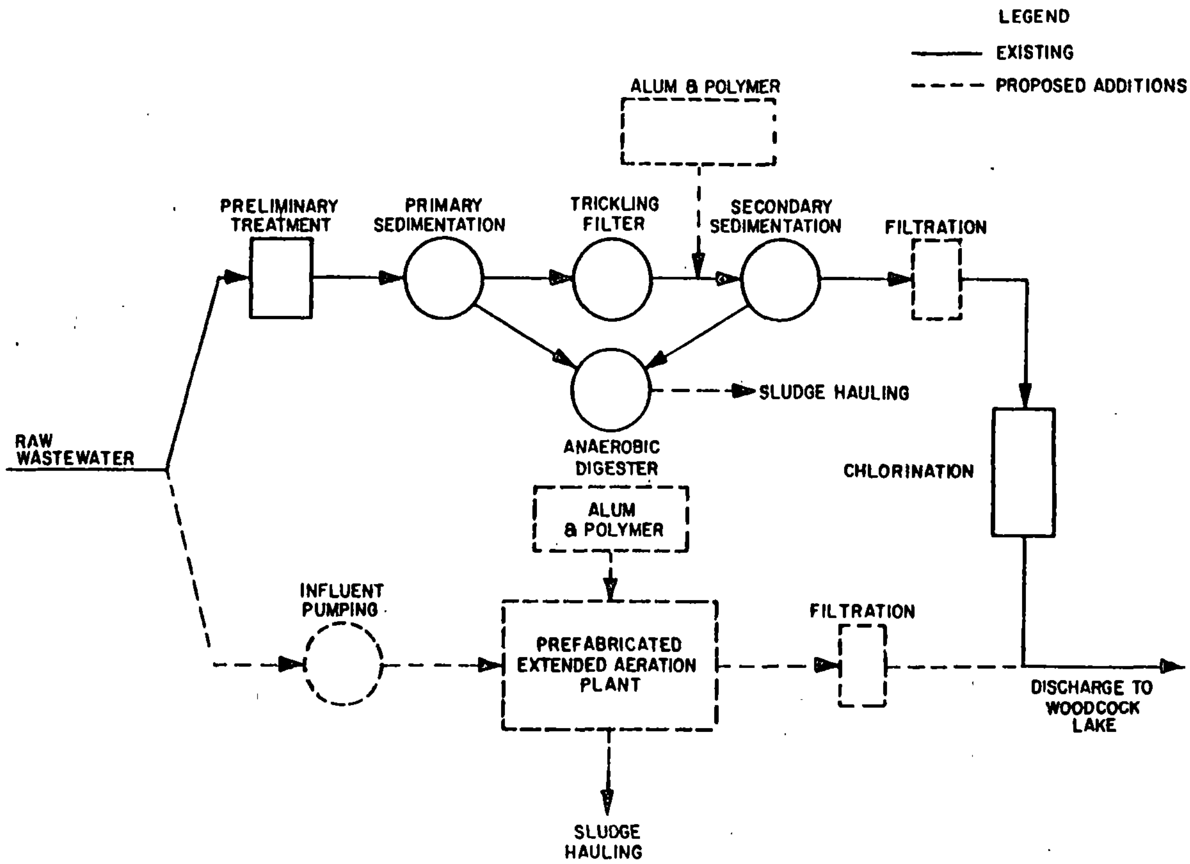


Figure III-4

The fourth method of centralized treatment that was developed as a component of one of the new alternatives involved the upgrading of Spicer's secondary treatment plant. The existing plant does not have sufficient capacity to meet the design flow. Enlargement of the Spicer plant to design flow capacity required the preliminary design of a parallel plant. The capacity of the parallet plant (0.054 mgd) is equal to the difference between the capacity of the existing plant (0.086 mgd) design flow (0.14 mgd). The parallel plant was designed as a prefabricated extended aeration plant with filtration and phosphorus removal (see Figure III-5).



PROPOSED UPGRADE AND ENLARGEMENT
OF SPICER PLANT

Figure III-5

b. Centralized Treatment -- Land Disposal

Land treatment of municipal wastewater involves the use of plants and the soil to remove many wastewater constituents. A wide variety of processes can be used to achieve many different objectives of treatment, water reuse, nutrient recycling, and crop production. The three principal types of land application systems are:

1. Slow rate (irrigation)
2. Rapid infiltration (infiltration-percolation)
3. Overland flow (EPA 1977).

The effluent quality required for land application in terms of organic content (BOD and suspended solids) is not as critical as with stream discharge options. Pretreatment of wastewaters is necessary, however, to prevent nuisance conditions, insure a higher level of constituent removal through the soil, reduce soil clogging, and insure reliable operation of the distribution system. Generally, the equivalent of secondary treatment of wastewaters is required prior to land application. (Great Lakes Upper Mississippi River Board of State Sanitary Engineers 1971).

Storage of wastewater is necessary with land application systems for nonoperating periods and periods of reduced application rates resulting from climatic constraints. In Minnesota land application systems must have storage facilities for holding wastewaters over the winter months.

A recent memorandum from EPA may alter the requirements for pretreatment prior to land application. To encourage both land treatment and land disposal of wastewater, EPA has indicated that:

> "A universal minimum of secondary treatment for direct surface discharge...will not be accepted because it is inconsistent with the basic concepts of land treatment.
>
> ...the costs of the additional pre-application increment needed to meet more stringent pre-application treatment requirements [than necessary] imposed at the State or local level would be ineligible for Agency funding and thus would be paid for from State or local funds." (EPA 1978)

The EPA policy has important ramifications for land treatment alternatives. By allowing Federal funding of land used for storage and underwriting the risk of failure for certain land-related projects the policy promotes their consideration.

The Facilities Plan (August 16, 1976) did not develop a land application system for the proposed Service Area. In this EIS, both the spray irrigation and rapid infiltration methods of land application were evaluated as treatment options for the EIS Service Area. These are described below.

<u>Spray irrigation</u>. The 0.24 mgd spray irrigation facility evaluated in one of the new alternatives for this EIS consists of preliminary treatment (bar screen, comminator, primary settling basin), a stabilization pond, and a chlorination process to disinfect the effluent prior to its application on cropland. The treatment plant component would provide secondary treatment prior to spray irrigation as recommended by the MPCA (MPCA 1972). An application rate of 2 inches per week was determined after calculating the nitrogen loading rate and found that there would be no need for under-drainage at this rate. Higher loading rates may produce poor crop growth. Alfalfa was the chosen cover crop over corn since alfalfa allows a higher application rate with its growing season limited solely by climatic factors. The pond system

shall have a storage period of 210 days. A flow diagram of this plant is illustrated in Figure III-6.

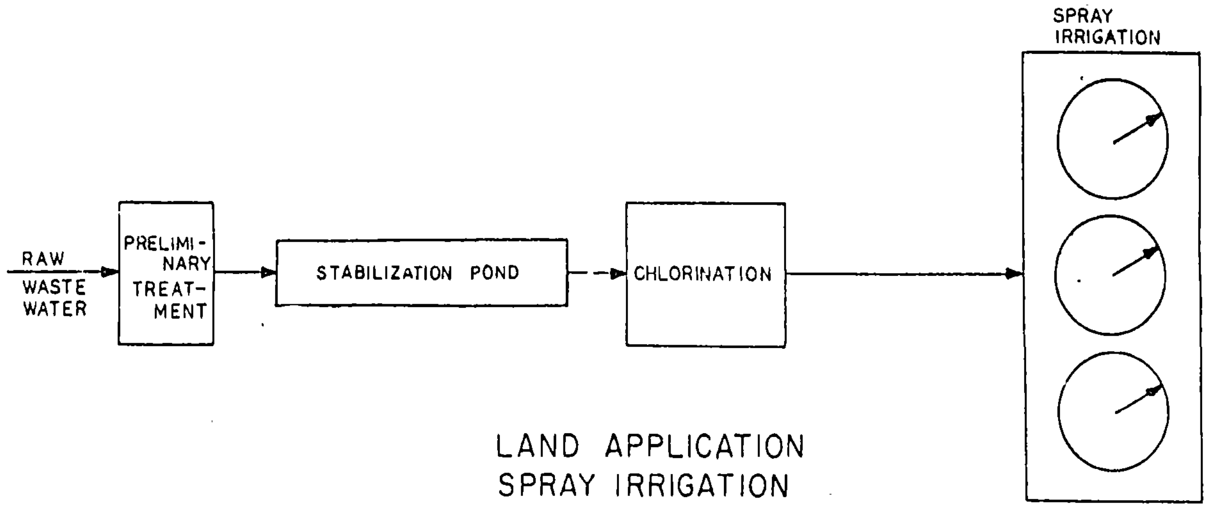
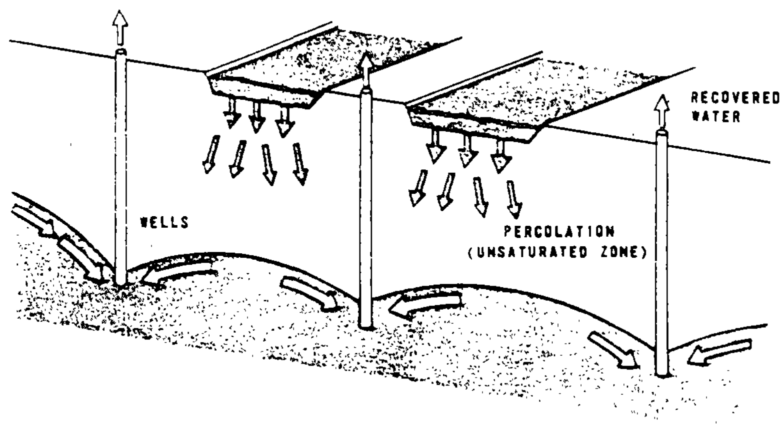


Figure III-6

Rapid Infiltration. The rapid infiltration method of land treatment is evaluated in two of the new wastewater management alternatives (0.34 mgd and 0.24 mgd). Rapid infiltration of wastewater was selected for further investigation as a component option, because it usually requires less area for operation as compared to spray irrigation. Furthermore, as a result of reduced land requirements the site can usually be located closer to wastewater transportation lines, thus, reducing capital, operation and maintenance costs of interceptors and/or force mains.

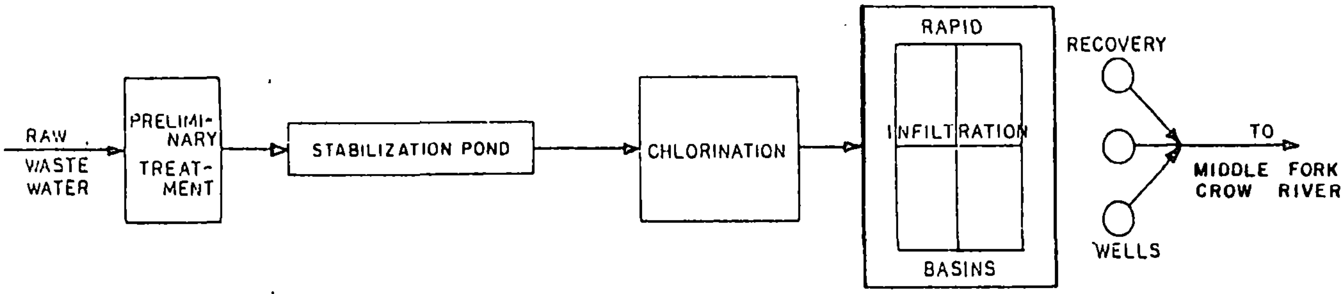
After land application the renovated wastewater will be drawn from recovery wells (see Figure III-7) and discharged into the Middle Fork of



RECOVERY OF RENOVATED WATER BY WELLS

Figure III-7

the Crow River above Nest Lake. Consideration in selection of the method of land application and a potential site are discussed in the section on disposal options. A flow diagram of this plant is illustrated in Figure III-8.



LAND APPLICATION
RAPID INFILTRATION
Figure III-8

c. Decentralized Treatment and Disposal

A number of technologies are available which can provide decentralized treatment either on-site or at sites near the point of sewage generation. Disposal of treatment wastewaters can be to the air, soil or surface waters and normally occurs near the treatment site. Some of the available technologies are:

- Alternative toilets:

  Composting toilets

  Toilets using filtered and disinfected bath and laundry wastewater

  Waterless toilets using oils to carry and store wastes

  Incineration toilets

- On-lot treatment and disposal:

  Septic tank and soil absorption systems (ST/SAS)

  Septic tank and dual, alternating soil disposal system

  Aerobic treatment and soil disposal system

  Septic tank or aerobic treatment and sand filter with effluent discharge to surface waters

  Septic tank and evapotranspiration system

Septic tank and mechanical evaporation system

Septic tank and sand mound system

Rejuvenation of soil disposal fields with hydrogen peroxide (H_2O_2) treatments

- Off-lot Treatment and Disposal:

  Holding tanks

  Cluster systems (multiple houses served by a common soil disposal system)

  Community septic tank or aerobic treatment and sand filter with effluent discharge to surface water

  Small scale lagoon with seasonal effluent discharge to surface waters

  Small scale lagoon with effluent discharge at rapid infiltration land application site

  Small scale lagoon with seasonal effluent discharge at slow rate land application site

  Small scale, preconstructed activated sludge (package) treatment plants with effluent discharge to surface waters.

Because all of the developed portions of the Study Area are tributary to lakes, decentralized technologies which discharge to surface waters are not further considered here. All of the remaining technologies, used alone or in combination with each other or with flow reduction devices, could be useful in individual situations within the Study Area. It is expected that, technologies selected for each dwelling will be appropriate to the problem being remedied (or lack of problem) to the soil and groundwater site characteristics, and to the expected use of the systems.

Lacking necessary information to select appropriate technologies on a site-by-site basis, this EIS assumes that the best known and most reliable decentralized technologies will be used. Continued use of on-site septic tanks and soil absorption systems is the technology of choice where acceptable public health and environmental impacts are attainable with them. Where on-site systems (including alternatives to ST/SAS) are not economically, environmentally or otherwise feasible, cluster systems are assumed to be used. The assumption that only these two technologies will be used is made here to form the basis for cost and feasibility estimates and is not meant to preclude other technologies for any site(s). Estimates of their frequency of repair and construction are conservative to reflect the possibility that other, more appropriate technologies may be more expensive.

Continued use of septic tank-soil absorption systems for most dwellings in the Proposed EIS Service Area would perpetuate violations of Minnesota's Shoreline Management Act as discussed in Section II.C.3. However, the substantial amount of field investigation undertaken for this EIS has indicated that most existing systems are operating with acceptable environmental and public health impacts. More detailed site investigations may indicate that renovation or replacement of some existing on-site systems is necessary. To estimate the investment this might require, it is assumed that 50% of on-site systems will be replaced with new septic tanks and soil absorption systems.

Detailed site evaluations may show for some dwellings that continued use of on-site systems is not feasible or that repairs for a number of dwellings is more expensive than joint disposal. Cluster systems are subsurface absorption systems similar in operation and design to on-site soil absorption systems but are large enough to accommodate flows from a number of (approximately 20) dwellings. Because of the need to collect and transport wastes, cluster systems include limited collection facilities using pressure sewers, small diameter sewers and/or pumps and force mains. Generally, existing septic tanks would continue to be used for settling and stabilization of wastewater.

An analysis of soil conditions at 13 sites around Green Lake was conducted in October 1978 by the Soil Conservation Service, St. Peters, Minnesota. With the exception of one site south of the lake, 50 to 100% of each site had only slight or moderate limitations for subsurface disposal of septic tank effluent. The size and distribution of apparently suitable sites is such that any portion of Green Lake shoreline could be served by cluster systems if necessary. Before use of sites for this purpose, additional analysis of soils and groundwater would be necessary. The locations of sites investigated by the SCS as well as cluster system sites considered in preparation of the Facilities Plan are illustrated in Figure III-9. The results of the October 1978 SCS investigations are presented in Appendix A-1.

The exact number and locations of dwellings requiring off-site disposal of wastewater would be determined after detailed evaluation of existing systems are estimated to be abandoned.

The cost for cluster systems were developed based on the design of a "typical" cluster system serving approximately 20 residences along the shoreline of Green Lake and Nest Lake. The costs include a 50% replacement of septic tanks. The total cost for cluster systems to serve 25% of existing residences was then based on the cost per residence from the typical cluster system design. Design assumptions for this cluster system design appear in Appendix H-1. Design criteria for the cluster systems recommended by the State of Minnesota was considered in the development of the typical cluster system design. Presently, there are a number of successfully operating cluster systems in Otter Tail County, Minnesota (by letter, Larry Krohn, Department of Land and Resource Management, Otter Tail County, October 18, 1978.

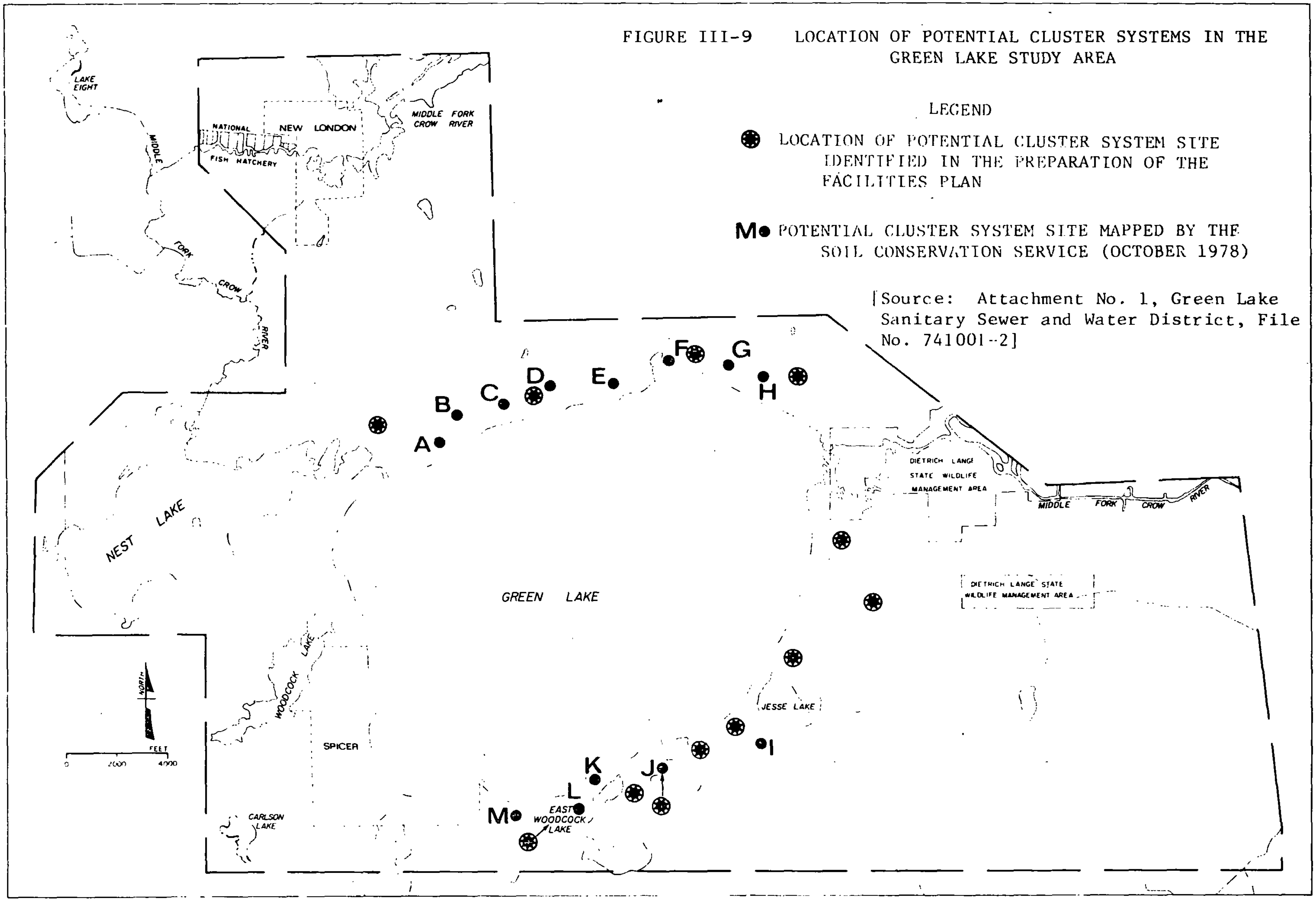


FIGURE III-9 LOCATION OF POTENTIAL CLUSTER SYSTEMS IN THE GREEN LAKE STUDY AREA

[Source: Attachment No. 1, Green Lake Sanitary Sewer and Water District, File No. 741001-2]

4. EFFLUENT DISPOSAL

Three approaches exist for disposal of treated wastewater. Reuse, perhaps the most desirable of the three, implies recycling of the effluent by industry, agriculture or groundwater recharge. Land application takes advantage of the absorptive and renovative capacities of soil to improve effluent quality and reduce the quantity of wastewater requiring disposal. Discharge to surface water generally implies the use of streams or impoundments for ultimate disposal of treated effluent.

a. Reuse

Industry Reuse. There is no industrial development in the Study Area, consequently industrial reuse does not seem to be a feasible means of effluent disposal.

Agricultural Irrigation. The use of treated wastewaters for irrigation is addressed in Section III.B.4.6.

Groundwater Recharge. Groundwater supplies all of the potable water in the EIS Service Area. The availability of ample quantities of water from sand and gravel deposits is a significant resource of the area. There is no evidence that these resources are being depleted to the extent that supplemental recharge is necessary. Wastewater reuse by groundwater recharge has therefore not been evaluated.

b. Discharge to Surface Waters

This EIS evaluates surface water discharge of treated wastewater at several locations in the Green Lake Study Area, as listed below:

Treatment Method	Potential Location of Surface Water Discharge
Waste stabilization pond	Middle Fork of the Crow River below Lake Calhoun
Mechanical oxidation ditch	Middle Fork of the Crow River below Lake Calhoun
Rapid infiltration, with renovated wastewater collected	Middle Fork of the Crow River above Nest Lake
Conventional activated sludge	Middle Fork of the Crow River above Nest Lake
Extended aeration	Woodcock Lake

Effluent quality limitations promulgated by the MPCA and EPA will govern the feasibility of implementing any of the wastewater treatment components listed above. Concern over low dissolved oxygen due to organic loading (BOD_5 and Total Suspended Solids [TSS]) of streams has prompted the MPCA to stipulate effluent limitations of 5 mg/l BOD_5 and 5 mg/l TSS (see Appendix G-1). Concern over the cultural eutrophication* of lakes in Minnesota has prompted MPCA to stipulate that total phosphorus levels in effluent be restricted to 1.0 mg/l. The State is currently reviewing effluent limitation requirements and expect some revision of the standards in approximately one year. The effluent quality limitation regarding total phosphorus for discharge to lakes, however, will remain at 1 mg/l (by telephone, Lanny Piessig, MPCA, 20 October 1978).

c. Land Application

Land application methods of wastewater treatment that are evaluated for potential use in the Study Area have been briefly described in Section III.D.3.b. These methods, spray irrigation and rapid infiltration, are illustrated in Figure III-10. The locations of land application sites evaluated in this EIS are shown in Figure III-11.

Soil suitability for renovation of wastewater at these locations has been determined by SCS on the basis of on-site field investigations conducted in 1978. Maps illustrating soil suitability of these sites are included as in Appendix A-1. Both sites have soils with moderate permeability for the most part, and have moderate limitations for wastewater disposal.

The rapid infiltration site, located north of Nest Lake, is characterized by gently rolling knolls and side slopes. The sandy and loamy soils are well drained and deep to groundwater. The depth to the seasonal high water table is estimated to be 10 to 20 feet based upon an inspection of a nearby abandoned quarry several hundred yards away from the rapid infiltration site. This site is reported to be representative of the soil conditions that exist beneath the rapid infiltration site. (Interview, Al Giencke, Soil Scientist, SCS, Kandiyohi, County, October 24, 1978). There are no streams that traverse the potential land application area. The sandy-loamy soils at the spray irrigation site are also well drained.

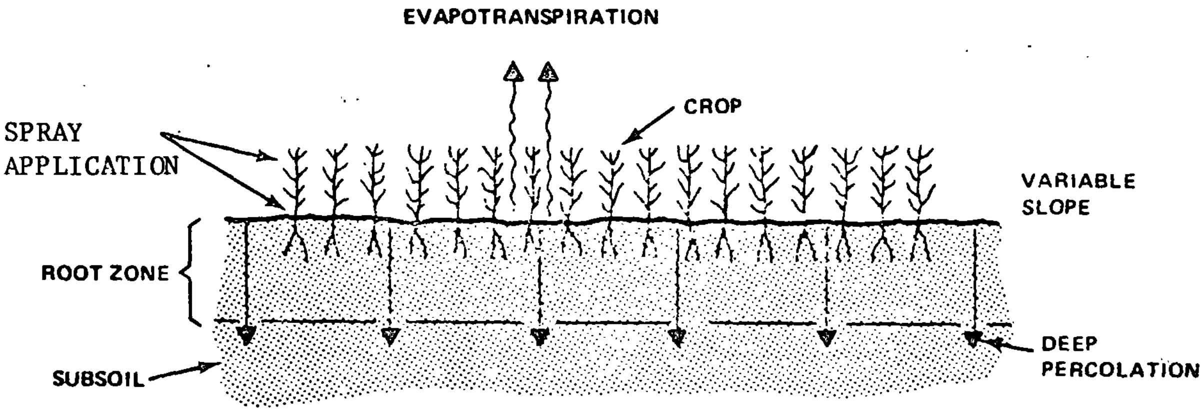
It is emphasized here that any serious consideration given to implementing an EIS alternative involving either rapid infiltration or spray irrigation must be preceded by a detailed field investigation of the existing soil and groundwater conditions. The detailed soils mapping of these two sites performed by SCS personnel during the course of this project is useful only as a planning tool for the development of wastewater management alternatives.

5. SLUDGE HANDLING AND DISPOSAL

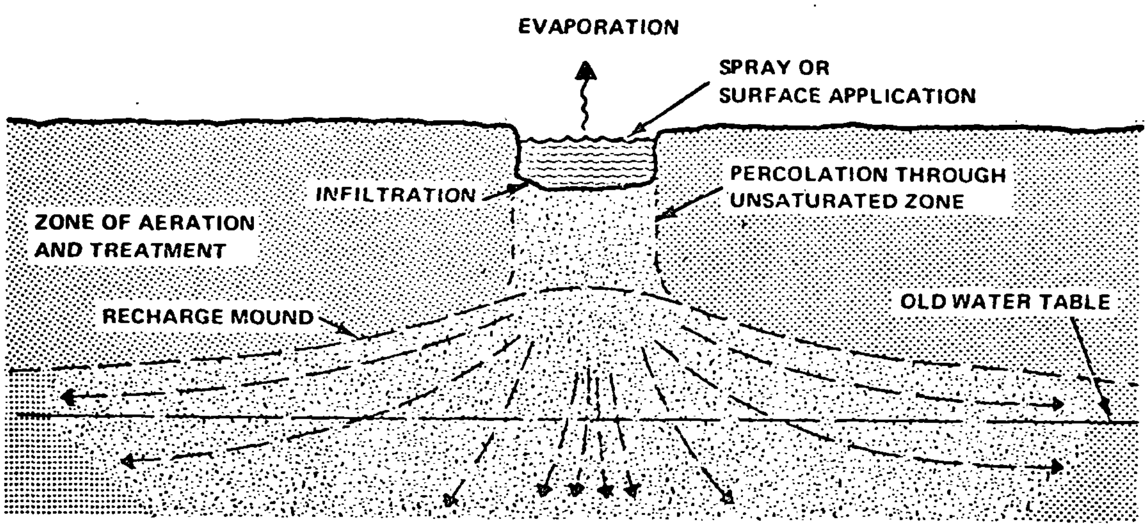
Two types of sludge would be generated by the wastewater treatment options considered above: chemical/biological sludges from secondary and terriary treatment processes; and solids pumped from septic tanks. The residues from treatment by lagoons and land application are grit and screenings. Since the oxidation ditch was not selected, sludge from

FIGURE III- 10

LAND APPLICATION METHODS EVALUATED
FOR THE GREEN LAKE STUDY AREA

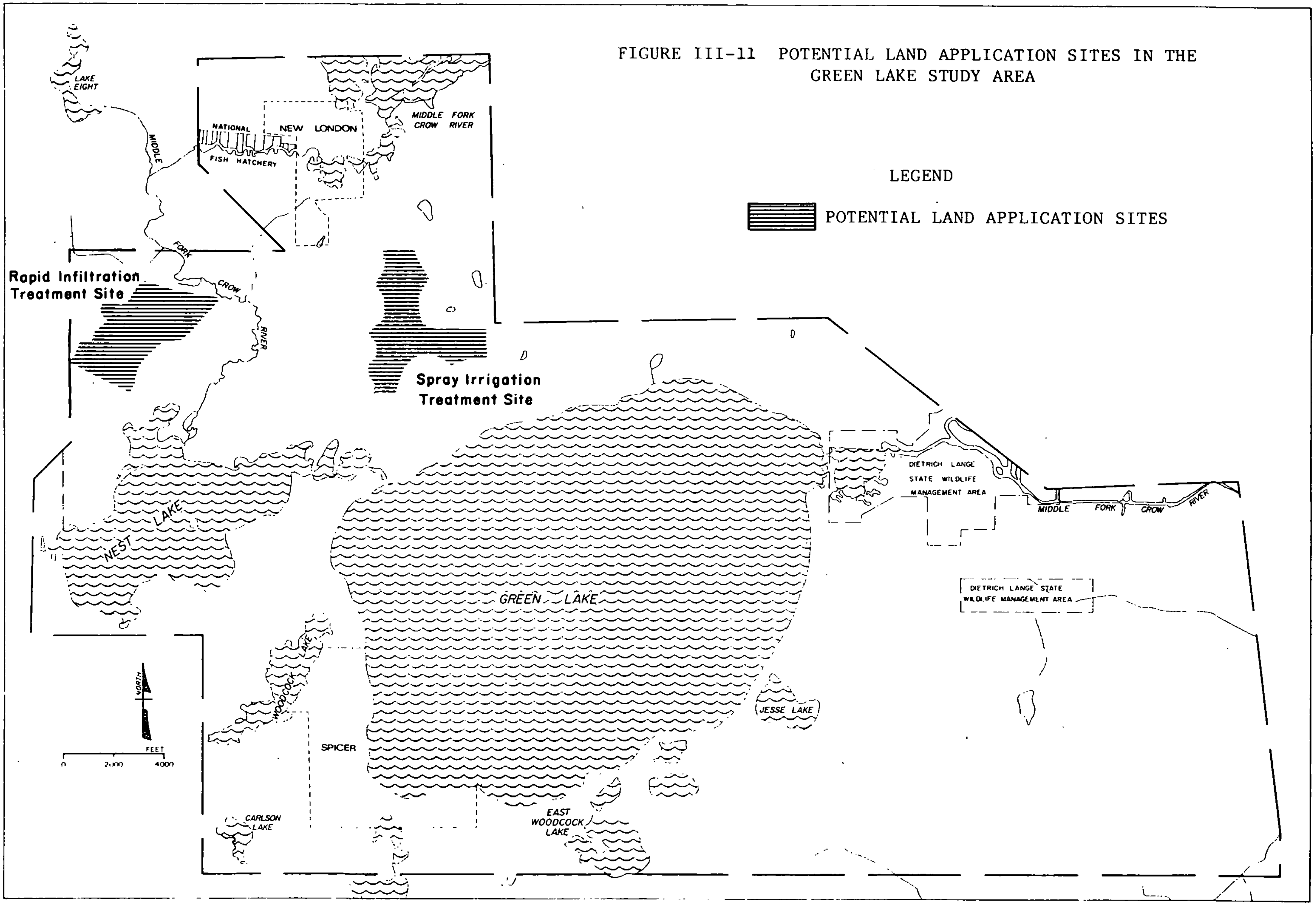


(A) SPRAY IRRIGATION



(B) RAPID INFILTRATION

FIGURE III-11 POTENTIAL LAND APPLICATION SITES IN THE GREEN LAKE STUDY AREA



this source was not considered further by the Facilities Plan. Disposal of sludge from stabilization ponds was not addressed in detail by the Facilities Plan.

This EIS has estimated the costs of these alternatives by assuming that a contract hauler would be responsible for hauling and disposal of sludge. A cost of $81 per million gallons of sewage was used, based upon $30/1000 gallons of sludge and 2700 gallons of sludge per million gallons of sewage. These costs have been incorporated into the cost-effectiveness analysis presented in Chapter IV.

Alternatives using residential septic tanks for on-lot systems, cluster systems, or STEP sewer systems must provide for periodic removal and disposal of the accumulated solids. For the purpose of design and costing these alternatives, it is assumed that pumping would occur every 3 years and would cost $45 per pumping. Local septage haulers are licensed to operate in Kandiyohi County. Farm lands are typical septage disposal sites.

C. RELIABILITY OF COMPONENTS

1. SEWERS

Gravity Sewers. When possible, sewer systems allow wastewater to flow downhill by force of gravity. This type of system, known as gravity sewer, is highly reliable. Designed properly, such systems require little maintenance. They consume no energy and have no mechanical components to malfunction.

Problems associated with gravity sewers include clogged pipes, leading to sewer backups; infiltration/inflow, increasing the volume of flow beyond the design level; and broken or misaligned pipes. Major contributors to these problems are improperly jointed pipes and the intrusion of tree roots into the sewer, which tend to be more prevalent in older systems.

Where ground slope is opposite to the direction of sewage flow, it may be necessary to pump the sewage through sections of pipe called force mains. The pumps add a mechanical component which increases operation and maintenance (O&M) requirements and decreases the system reliability. To assure uninterrupted operation of the system, two pumps are generally installed, providing a backup in case one malfunctions. Each is usually able to handle at least twice the peak flow. A standby generator is usually provided to ensure operation of the pumps in case of a power failure.

Because the flow through force mains is intermittent, solids may be deposited during periods of no flow. In addition, when the pumps shut off, the sudden cessation of flow may cause the hydraulic conditions known as "water hammer" in the force main, a phenomenon marked by sudden sharp surges in water pressure that may result in burst pipes. However, both deposition of solids and water hammer may be controlled through proper design procedures. The reliability of properly designed force mains is comparable to that of gravity sewers.

Pressure Sewers. Pressure sewers transmit wastewater uphill when ground topography does not allow gravity flow. Because the system is always under pressure, pumping is required to force the wastewater into the sewer

Grinder Pumps. Grinder pumps are used primarily to grind and pump raw domestic sewage from an individual house to the collection system and occasionally for small lift stations. They are either of the semi-positive displacement or the centrifugal type, depending upon the mode of operation. The reliability of both types is high.

One problem may arise during a power failure. Standby power for a grinder pump would not usually be available at an individual house and the residence would be without sewage removal. This is a lesser problem than might be supposed, for a power failure would curtail many operations that generate wastewater.

There were problems in the operation of the first generation of grinder pumps when pressure to pump wastewater or power to grind solids was insufficient. Modifications have been made in their design and construction, and the second generation of these pumps is appreciably more reliable. Periodic maintenance is required to clean or replace parts of the grinder pump.

Septic Tank Effluent Pumps* (STEP). It is sometimes desirable to pump wastewater from an existing septic tank rather than directly from the house, using STEP rather than a grinder pump. In this way difficulties associated with suspended solids are largely avoided. STEP pumps are relatively simple modifications of conventional sump pumps.

The reliability of STEP made by experienced manufacturers is good. Newer entries into the field have not yet accumulated the operating experience necessary to demonstrate conclusively the reliability of their products. In the event of failure of a STEP system, an overflow line may be provided, which permits passage of the septic tank effluent to the old drainfield for emergency disposal.

Pipes. Pressure sewer pipes are subject to the same problems as force mains, discussed above. As with force mains, proper design can prevent clogging and breaking of pipes, the most common cause of sewer problems. Because pressure sewer piping has no mechanical components, the reliability is high.

2. CENTRALIZED TREATMENT

Conventional. The reliability of conventional wastewater treatment has been tested by time. Most unit processes have been used for many years, and there is consequently much information on their design and operation in nearly all climates. In general, the larger the treatment facility, the more reliable its operation, because the large volumes of flow require multiple units per treatment process. For instance, a large facility will have several primary clarifiers, and if one malfunctions, the remaining units can handle the entire load. Therefore, difficulties that arise as a result of failure of a single unit process, or of severe weather conditions such as heavy rain or very cold temperatures, are less likely to affect operations. Conventional wastewater treatment plants can be designed to handle most problems.

Advanced Treatment. Advanced treatment serves primarily to remove toxic substances and nutrients that would stimulate biological activity. The technology is relatively new; experience in design and operation of advanced treatment processes is therefore limited. However, when designed properly, the reliability of these processes is high.

Land Application. Application of treated sewage effluent to the land is still infrequent in the United States, but its use is growing steadily. Local climatic conditions such as heavy rains or very low temperatures may make the technique unsuitable in a particular area.

Potential problems with land application include: groundwater contamination; dispersal of microbial mass by airborne transport; odors; surface water contamination; accumulation of metals in the vegetation; and possible toxic effects upon local animals. These problems can be minimized with proper design, but there is not yet the extensive practical experience required to develop advanced design technology.

3. ON-SITE TREATMENT

Septic Tanks. The design and operation of modern septic tanks have benefited from long experience. Properly designed and maintained, septic systems will provide satisfactory service with minimum maintenance. Care must be taken not to put materials in the system that may clog it. The principal maintenance requirement is periodic pumping of the tank, usually every two or three years.

Problems of septic systems include heavy rain saturating the ground, clogged drainfields caused by full septic tanks, clogged or frozen pipes, and broken pipes. Current environmental laws restricting sites according to soil suitability, depth to groundwater and bedrock, and other factors are limiting the cases where septic systems can be used.

Sand Mounds. Elevated sand mounds four or five feet above original ground level are an alternative treatment system where siting restrictions do not allow the use of standard drainfields. Because they do not always provide satisfactory service and are considerably more expensive than conventional drainfields, they have not been universally accepted.

4. CLUSTER SYSTEMS

Cluster systems are localized wastewater disposal mechanisms servicing several (approximately 20) residences. The reliability is similar to that of a septic system, except that a malfunction affects not just one, but a number of residences. Because a cluster system requires more piping to connect individual houses to the treatment tank than does a series of individual systems, there is a greater chance for pipes to break or clog, or for I/I to occur during heavy rain. If pumping is required, the reliability of the system declines because of the mechanical nature of the pumps and their dependence upon electricity for power.

The experience with cluster systems in Otter Tail County, Minnesota is described in Appendix F-3.

D. IMPLEMENTATION

The process by which a wastewater management plan is to be implemented depends upon whether the selected alternative relies primarily upon centralized or decentralized components. Since most sanitary districts have in the past been designed around centralized collection and treatment of wastewater, there is a great deal of information about the implementation of such systems. Decentralized collection and treatment is, however, relatively new and there is little management experience on which to draw.

Regardless of whether the selected alternative is primarily centralized or decentralized, four aspects of the implementation program must be addressed:

- There must be legal authority for a managing agency to exist and financial authority for it to operate.
- The agency must manage construction, ownership and operation of the sanitary district.
- A choice must be made between the several types of long-term financing that are generally required in paying for capital expenditures associated with the project.
- A system of user charges to retire capital debts, to cover expenditures for operation and maintenance, and to provide a reserve for contingencies must be established.

In the following sections, these requirements are examined first with respect to centralized sanitary districts, then with respect to decentralized districts.

1. CENTRALIZED DISTRICTS

a. Authority

The Green Lake Area Facilities Plan identified the proposed Green Lake Sanitary District as the legal authority for implementing the Plan's Proposed Action. Under Chapter 176A of the Minnesota statutes, the District would have the authority to implement this system and to contract with the villages and townships for services.

b. Managing Agency

The role of the managing agency has been well defined for centralized sanitary districts. In general, the agency constructs, maintains and operates the sewerage facilities. Although in fact different contractual relationships exist between the agencies and their service areas, for the purposes of this document ownership of the facilities may be assumed to reside with the agency. For gravity sewers, such ownership has traditionally extended to the private property. For STEP or grinder pump stations connected to pressure sewers several options exist:

- The station may be designed to agency specifications, with the responsibility for purchase, maintenance and ownership residing with the homeowner.
- The station may be specified and purchased by the agency, with the homeowner repurchasing and maintaining it.
- The station may be specified and owned by the agency, but purchased by the homeowner.
- The station may be specified, purchased and owned by the agency. Regardless, however, of the option selected, all residences are treated equally.

c. Financing

Capital expenses associated with a project may be financed by several techniques. Briefly, they are:

- pay-as-you-go methods;
- special benefit assessments;
- reserve funds; and
- debt financing.

The Facilities Plan indicated that much of the Proposed Action would not be funded by Federal and State grants, and recommended that loans be sought from the Farmers Home Administration. The Plan did indicate that Spicer and New London should seek such construction grants.

d. User Charges

User charges are set at a level that will provide for repayment of long-term debt and cover operating and maintenance expenses. In addition, prudent management agencies frequently add an extra charge to provide a contingency fund for extraordinary expenses and replacement of equipment.

The implementation program proposed by the Facilities Plan is an example of a scheme calling for a County to recover the costs of wastewater management from the local municipalities. The municipalities would, in turn, charge the users of the system. Because of the potential economic impacts, the charges must be carefully allocated among various classes of users. Recognized classes of users include:

- Permanent residents/Seasonal residents
- Residential/Commercial/Industrial users
- Presently sewered users/Newly sewered users
- Low- and fixed-income residents/Active income producers

Each class of user imposes different requirements on the design and cost of each alternative, receives different benefits, and has different financial capabilities.

2. SMALL WASTE FLOW DISTRICTS

Regulation of on-lot sewage systems has evolved to the point where most new facilities are designed, permitted and inspected by local health departments or other agencies. After installation, local government has no further responsibility for these systems until malfunctions become evident. In such cases the local government may inspect and issue permits for repair of the systems. The sole basis for government regulation in this field has been its obligation to protect public health.

Rarely have governmental obligations been interpreted more broadly to include monitoring and control of other effects of on-lot system use or misuse. The general absence of information concerning septic system impacts on ground and surface water quality has been coupled with a lack of knowledge of the operation of on-site systems.

Methods of identifying and dealing with the adverse effects of on-lot systems without building expensive sewers are being developed. Technical methods include both the wastewater treatment and disposal alternatives discussed in Section III.B and improved monitoring of water quality. Managerial methods have already been developed and are being applied in various communities as discussed in Appendix I-1.

As with any centralized district, the issues of legal and fiscal authority, agency management, project financing, and user charges must all be resolved by small waste flow districts.

a. Authority

Minnesota presently has no legislation which explicitly authorizes governmental entities to manage wastewater facilities other than those connected to conventional collection systems. However, Minnesota Statutes Sections 444.085, 444.065 and 444.075, and Chapter 116A have been interpreted as providing cities, villages, counties, and special purpose water and sewer districts, respectively, with sufficient powers to manage decentralized facilities (Otis and Stewart 1976).

California and Illinois, to resolve interagency conflicts or to authorize access to private properties for inspection and maintenance of wastewater facilities, have passed legislation specifically intended to facilitate management of decentralized facilities. These laws are summarized in Appendix I-2.

b. Management

The purpose of a small waste flow district is to balance the costs of management with the needs of public health and environmental quality. Management of such a district implies formation of a management agency and formulation of policies for the agency. The concept of such an agency is relatively new. Appendix I-3 discusses this concept in detail.

The range of functions a management agency may provide for adequate control and use of decentralized technologies is presented in Table III-3. Because the level of funding for these functions could become an economic burden, their costs and benefits should be considered in the development of the management agency. Major decisions which have to be made in the development of this agency relate to the following questions:

- Should engineering and operations functions be provided by the agency or by private organizations under contract?
- Would off-site facilities require acquisition of property and right-of-way?
- Would public or private ownership of on-site wastewater facilities be more likely to provide cost savings and improved control of facilities operation?
- Are there environmental, land use, or economic characteristics of the area that would be sensitive to operation and construction of decentralized technologies? If so, would special planning, education and permitting steps be appropriate?

Five steps are recommended to implement an efficient, effective program for the management of wastewater in unsewered areas:

- Develop a site-specific environmental and engineering data base;
- Design the management organization;
- Agency start-up;
- Construction and rehabilitation of facilities; and
- Operation of facilities.

<u>Site Specific Environmental and Engineering Data Base</u>. The data base should include groundwater monitoring, a house-to-house investigation (sanitary survey), soils and engineering studies, and a survey of

Table III-3

SMALL WASTE FLOW MANAGEMENT FUNCTIONS BY OPERATIONAL COMPONENT AND BY BASIC AND SUPPLEMENTAL USAGE

Component	Basic Usage	Supplemental Usage
Administrative	User charge system Staffing Enforcement	Grants administration Service contracts supervision Occupancy/operating permits Interagency coordination Property and right-of-way acquisition Performance bonding requirements
Engineering	Adopt design standards* Review and approval of plans* Evaluate Existing systems/ design rehabilitation measures Installation inspection* On-site soils investigations* Acceptance for public management of privately installed facilities	Design and install facilities for public ownership Contractor training Special designs for alternative technologies Pilot studies of alternative technologies Implementing flow reduction techniques
Operations	Routine inspection and maintenance Septage collection and disposal Groundwater monitoring	Emergency inspection and maintenance Surface water monitoring
Planning		Land use planning Public education Designate areas sensitive to soil-dependent systems Establish environmental, land use and economic criteria for issuance or non-issuance of permits

* Usage normally provided by local governments at present.

available technologies likely to function adequately in the area. This baseline information will provide the framework for the systems and technologies appropriate to the district.

A program for monitoring groundwater should include sampling of existing wells and possibly additional testing of the aquifer. Such monitoring should be instituted early enough to provide data useful in selecting and designing wastewater disposal systems.

The sanitary survey should include interviews with residents and inspections of existing systems. A trained surveyor should record information on lot size and location; age and use of dwelling; location, age, and type of sewage disposal system; adequacy of the maintenance of the existing system; water-using fixtures; and problems with the existing system.

Detailed site analyses may be required to evaluate operation of the effluent disposal fields and to determine the impacts of effluent disposal upon local groundwater. These studies may include probing the disposal area; boring soil samples; and the installation of shallow groundwater observation shafts. Sampling of the water table downhill from leach fields aids in evaluating the potential for transport of nutrients and pathogens through the soil. Soil classifications near selected leach fields may improve correlations between soils and leach field failures. An examination of the reasons for the inadequate functioning of existing wastewater systems may avoid such problems with the rehabilitation or construction of new systems.

<u>Design the Management Organization</u>. Both the Facilities Plan and the EIS have recommended the Green Lake Sanitary Sewer and Water District as the agency best suited to managing wastewater facilities in both unsewered and sewered areas of the Study Area. The role of organizations such as the Department of Health should be examined with respect to avoiding interagency conflicts and duplication of effort and staffing.

Determination of the basic and supplementary management functions to be provided will be influenced by the technologies appropriate to the Study Area. In this respect, the questions raised earlier regarding formulation of management policies must be resolved.

The product of these analyses should be an organizational design in which staffing requirements, functions, interagency agreements, user charge systems and procedural guidelines are defined.

<u>Agency Start-Up</u>. Once the structure and responsibilities of the management agency have been defined, public review is advisable. Additional personnel required for construction and/or operation should be provided. If necessary, contractual arrangements with private organizations should be developed. Acquisition of property should also be initiated.

<u>Construction and Rehabilitation of Facilities</u>. Site data collected for the environmental and engineering data base should support selection

and design of appropriate technologies for individual residences. Once construction and rehabilitation begin, site conditions may be revealed that suggest technology or design changes. Since decentralized technologies generally must be designed to operate within site limitations instead of overcoming them, flexibility should be provided. Personnel authorized to revise designs in the field would provide this flexibility.

Operation of Facilities. The administrative planning, engineering, and operations functions listed in Table III-4 are primarily applicable to this phase. The role of the management agency would have been determined in the organizational phase. Experience gained during agency start-up and facilities construction may indicate that some lower or higher level of effort will be necessary to insure long term reliability of the decentralized facilities.

c. Financing

The financing of a small waste flows district is similar to that of a centralized district. Such financing was discussed in Section III.D.1.c.

d. User Charges

Although renovation and replacement costs for on-site systems owned by permanent residents are eligible for Federal funding, such costs incurred by seasonal residents are not. The major difference in the financing of the two systems arises from the question of seasonals' ownership of on-site systems. With respect to the Study Area, where a significant proportion of the users would be seasonal, the absence of Federal funding would transfer a large fraction of the project costs to the local users. This would be reflected in either 1) capital outlays by the users for construction, 2) increased user charges covering increased local costs or 3) both.

User charges and classes have been discussed in Section III.E.1.d. The significance of decentralized districts lies in the creation of an additional class of users. Since residents of such districts may be differentiated in terms of centrally sewered areas and decentralized areas, user charges may differ. As a result many different management functions are conjoined. For example, permanent users on septic systems may be charged less than those on central sewers. Seasonal users on pressure sewers may have high annual costs associated with amortization of capital expenses; permanent users of pressure sewers may be charged less than seasonal users, because Federal funding reduced their share of the capital costs. Alternatively, the management agency may choose to divide all costs equally among all users. For the analyses in this EIS, public ownership of permanent and seasonal on-site systems has been assumed.

Problems such as these have not been adequately addressed by the historical sources of management information. Development of user charges by small waste flows districts will undoubtedly be complicated by the absence of such historical records. EPA is preparing an analysis of equitable means for recovering costs from users in small waste flow districts and combined sewer/small waste flow districts.

CHAPTER IV

EIS ALTERNATIVES

A. INTRODUCTION

The preceding chapter described options for the functional components of wastewater management systems for the communities in the Study Area. This chapter examines alternative wastewater management plans, or alternative courses of action for the Study Area. A No Action Alternative and a Limited Action Alternative are also examined.

The Proposed Action developed in the Facilities Plan (described earlier) provides for centralized collection and treatment of wastewater generated in the area shown in Figure I-3. In response to concerns about the need for and expense of the Proposed Action, the development of EIS alternatives emphasized decentralized and alternative or innovative technologies: alternative collection systems, decentralized treatment and land disposal of wastewaters. The EIS alternatives provide for management of wastewaters in a slightly larger Service Area than that proposed in the Facilities Plan. The eastern half of the Nest Lake shoreline was added to the Facilities Plan Proposed Service Area in order to examine the water quality impacts each alternative would have on this eutrophic lake (see Section II.B.7.c.). The data gathered during the 1979 "Septic Snooper" survey indicated a need for improved wastewater management facilities on this portion of Nest Lake (see Figure II-10). Five of the EIS alternatives, including the Limited Action Alternative use decentralized treatment to partly avoid the costs of sewers.

Because the cost of collection in the Proposed Action is high, the cost effectiveness of pressure sewers, vacuum sewers, and small-diameter gravity sewers was compared. These sewers were, therefore, incorporated into the design of two completely centralized systems, one calling for a stabilization pond (EIS Alternative 1), the other for an oxidation ditch (EIS Alternative 2). However, pressure sewers did not prove to be a cost-effective method for collection of wastewater in the Green Lake Service Area.

Where site conditions such as soils and topography are favorable, land disposal of wastewater offers advantages over conventional biological treatment systems that discharge to surface waters: the land is used as a natural treatment facility system; reduced operation and maintenance may result from relatively simple operations; and savings in capital and operating costs are possible.

Analysis of decentralized treatment technologies and site conditions revealed that there are feasible alternatives to sewering the entire Green Lake, and part of the Nest Lake shorelines. It would be possible to combine multi-family filter fields (cluster systems) with rehabilitated and new on-site treatment systems to meet the wastewater treatment needs in portions of the Study Area.

The assumptions used in design and costing of the alternatives are presented in Appendix H-1. The major features of the Proposed Action, the EIS Alternatives, and the Limited Action Alternative are listed in Table IV-1.

B. ALTERNATIVES

The action proposed by the Facilities Plan has been compared with the "do-nothing" (no action) alternative, and seven new approaches developed in this EIS. The alternatives discussed below are summarized in Table IV-1, and Table IV-2 lists the cost-effectiveness of each. Detailed cost data for each alternative are provided in Appendix H-2. To facilitate the development of wastewater management alternatives, the Proposed EIS Service Area was divided into 24 segments; the location of these is shown in Figure II-13.

1. NO ACTION

The EIS process must evaluate the consequences of not taking action. This "no action" alternative implies that EPA would not provide funds to support new construction, upgrading, or expansion of existing wastewater collection and treatment systems. Presumably, no new facilities would be built; wastewater would still be treated in existing plants and on-site systems.

If this course of action were taken, additional flows to the treatment plants at Spicer and New London would be prohibited because the plants are already overloaded and have difficulty meeting MPCA effluent discharge standards. Existing on-site systems in the EIS Service Area would continue to be used in their present conditions. In the absence of a small waste flows management agency, the Kandiyohi County Tax Assessors Office would continue to issue permits to build and repair on-lot systems.

The No Action Alternative is unlikely to be selected. It implies that the treatment plants at New London and Spicer would continue to violate NPDES and MPCA discharge conditions. Consequently, new facilities to adequately treat wastewaters would be needed in the near future.

2. FACILITIES PLAN PROPOSED ACTION

The Facilities Plan recommended treatment of all wastewaters generated in the Proposed Service Area in a stabilization pond treating 0.63 mgd. The plant, located east of Green Lake, would retain wastewater for 210 days and periodically discharge effluent to the Middle Fork of the Crow River (see Chapter I for a brief description of the Proposed Action). The design of the proposed facilities is outlined in detail in Chapter VII of the Green Lake Area Facilities Plan (Rieke

Table IV-1

REGIONAL ALTERNATIVES FOR THE EIS SERVICE AREA - SUMMARY OF MAJOR COMPONENTS

Alternative	Centralized Treatment	Centralized Service Area	Additional BOD_5 and Total Suspended Solids (TSS) Removal	Effluent Disposal	On Lot and Cluster Systems	Alternative Collection Method
Facilities Plan Proposed Action	Stabilization Lagoons (0.63 MGD)	All proposed Service Area	Not required due to the detention time (210 days)	Discharge to the Middle Fork of the Crow River	No	Conventional (gravity) collection
EIS Alternative #1	Stabilization Lagoons (0.59 MGD)	All proposed Service Area	Not required due to the detention time (210 days)	Discharge to the Middle Fork of the Crow River	No	Combination (STEP) pressure sewers and force mains
EIS Alternative #2	Oxidation Ditch (0.59 MGD)	All proposed Service Area	Mixed-Media Filters (sand beds)	Discharge to the Middle Fork of the Crow River	No	Combination (STEP) pressure
EIS Alternative #3	Stabilization Lagoons followed by rapid infiltration (0.38 MGD)	All proposed Service Area except North, East and South Shores of Green Lake	Not required because of the effluent disposal technique	Land application by rapid infiltration-recovery wells will withdraw 75% of the effluent and discharge to the Middle Fork of the Crow River	North, East, South Shores of Green Lake	Conventional (gravity) collection
EIS Alternative #4	Same as EIS Alternative #3 (0.28 MGD)	New London Village, Spicer City, and connecting segments	Not required because of the effluent disposal technique	Same as EIS Alternative #3	North, East, South Shores of Green Lake, east half of Nest Lake	Conventional (gravity) collection
EIS Alternative #5	Stabilization Lagoons followed by spray irrigation (0.28 MGD)	New London Village, Spicer City, and connecting segments	Not required because of the effluent disposal technique	Land Application by spray irrigation. Revenue crop is alfalfa.	North, East, South Shores of Green Lake, east half of Nest Lake	Conventional (gravity) collection
EIS Alternative #6	Upgrade the existing New London plant to meet permit requirements (0.12 MGD). Upgrade and expand the existing Spicer plant to meet permit requirements (0.15 MGD)	New London Village, Spicer City, and connecting segments	Mixed-Media Filters (sand beds)	New London: Middle Fork of the Crow River Spicer: Woodcock Lake	North, East, South Shores of Green Lake, east half of Nest Lake	Conventional (gravity) collection
Limited Action	Upgrade the existing New London plant to meet permit requirements (0.09 MGD). Upgrade and expand the existing Spicer plant to meet permit requirements (0.12 MGD)	New London Village and Spicer City only	Same as EIS Alternative #6	Same as Eis Alternative #6	On-lot: entire Green Lake Shoreline, except Spicer City Cluster: No	Conventional (gravity) collection

Table IV-2

COST-EFFECTIVE ANALYSIS OF ALTERNATIVES

	FACILITIES PLAN PROPOSED ACTION	EIS 1	EIS 2	EIS 3 (25% CLUSTER)	EIS 4 (25% CLUSTER)	EIS 5 (25% CLUSTER)	EIS 6 (25% CLUSTER)	LIMITED ACTION
Present Project Construction Costs (x$1,000)	8,156.1	8,826.1	8,639.1	4,827.1	3,957.1	4,217.1	2,830.1	1,483.7
Future Project Construction Costs (x$1,000/yr)	38.0	28.5	28.5	38.9	39.9	39.9	39.9	24.9
Total Present Worth (x$1,000)	8,411.3	9,394.2	9,475.5	6.113.7	5,092.6	5,365.5	4,507.5	2,887.2
Average Annual Equivalent Cost ($)	770.5	860.5	868.0	560.0	466.5	491.5	412.9	264.5

Carroll Muller Associates 1974) and the process is illustrated in Figure IV-1. As discussed in Chapter III, the Facilities Plan Proposed Action has been upgraded in this EIS in order that its cost-effectiveness be compared to that of the EIS Alternatives.

The Proposed Service Area and location of the proposed stabilization pond are illustrated in Figure IV-2.

3. EIS ALTERNATIVE 1

EIS Alternative 1, with a design flow of 0.59 mgd, is identical to the Proposed Action involving treatment by stabilization ponds. The intent of New Alternative 1 was to consider different collection methods. Low pressure sewers and low pressure sewers in combination with conventional gravity sewers were considered. None of the segments studied was advantageous for alternate methods of collection. In all cases the conventional collection system proved to be the most cost effective method. The area to be served by the system, the treatment plant location and the transmission line routings are shown in Figure IV-2.

4. EIS ALTERNATIVE 2

EIS Alternative 2 is a modification of one of the alternatives examined in the Facilities Plan (August 1976), with pressure sewers again used in conjunction with gravity services to collect sewage prior to treatment at an oxidation ditch plant. Discharge of treated wastewater (0.59 mgd) as in EIS Alternative 1, would be to the Middle Fork of the Crow River. This alternative is illustrated in Figure IV-4.

5. EIS ALTERNATIVE 3

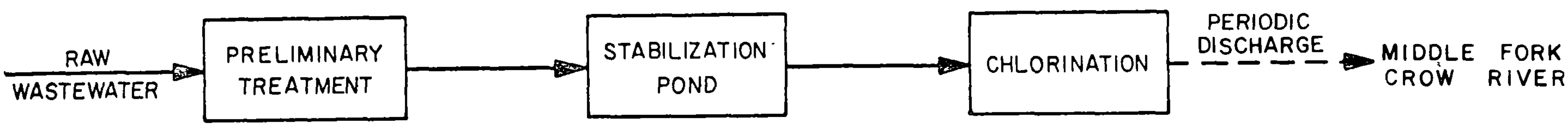
EIS Alternative 3 is partly decentralized; portions of the Green Lake EIS Service Area would employ on-site and cluster systems while the remaining flow would be treated by land application (rapid infiltration). This alternative is illustrated in Figure IV-5. Approximately 0.38 mgd (from the western part of the area) would be collected and conveyed to a central treatment facility.

Wastewater would be pretreated in a stabilization pond, chlorinated, and disposed of by rapid infiltration. Renovated wastewater would be drawn from recovery wells and discharged to the Middle Fork of the Crow River.

The remaining portions of the Green Lake shoreline would be served by a combination of cluster systems and on-site systems suitable to local soil conditions. The preliminary design, comparison, and assessment of decentralized systems (in this Alternative as well as EIS Alternatives 4, 5, and 6) were based upon the following assumptions:

Cluster Systems. Cluster systems would be used for those parts of the EIS Service Area where rehabilitation and continued use of on-site systems would result in unacceptable public health or environmental

Figure IV-1



STABILIZATION POND
CONTROLLED DISCHARGE

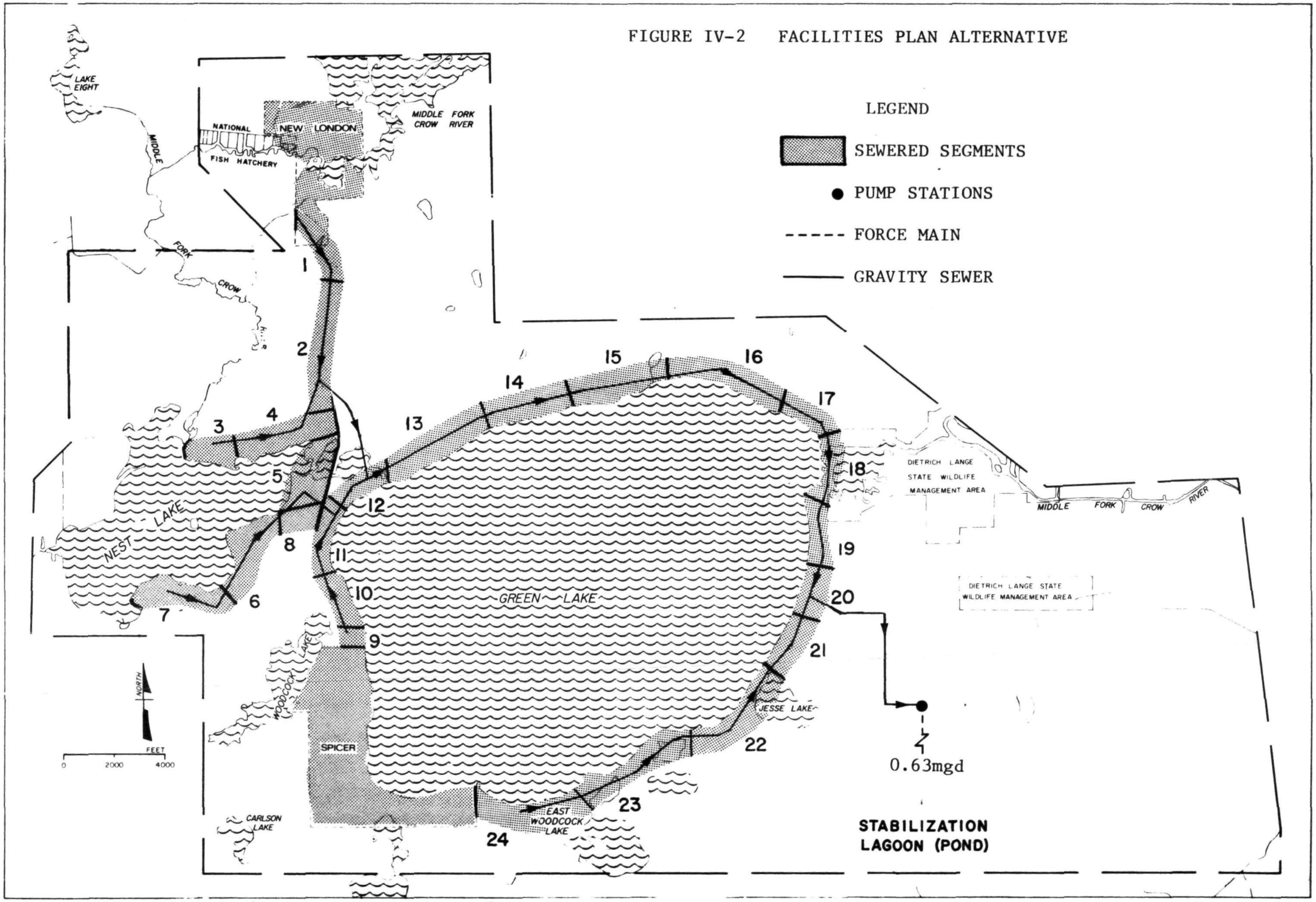


FIGURE IV-2 FACILITIES PLAN ALTERNATIVE

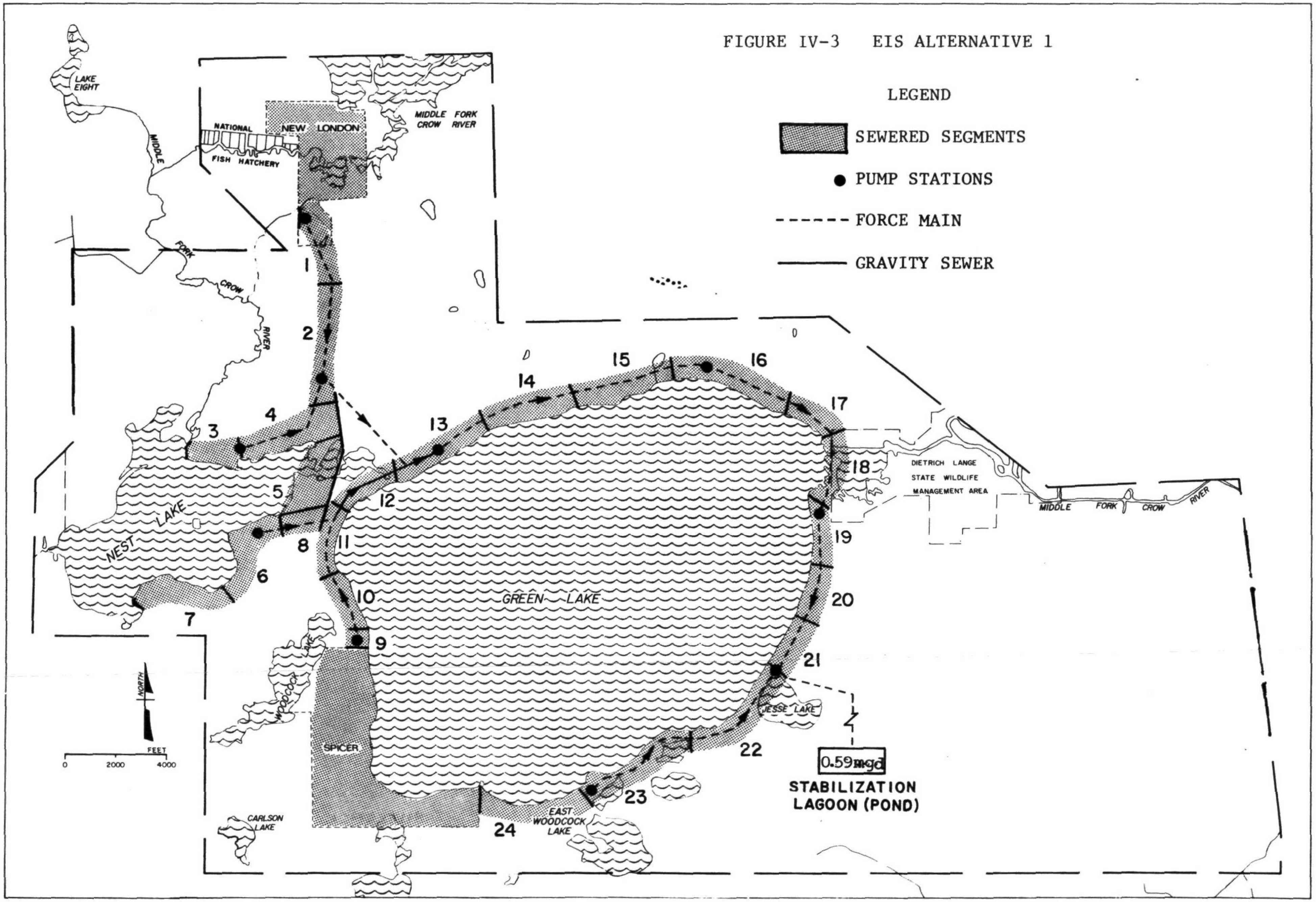


FIGURE IV-3 EIS ALTERNATIVE 1

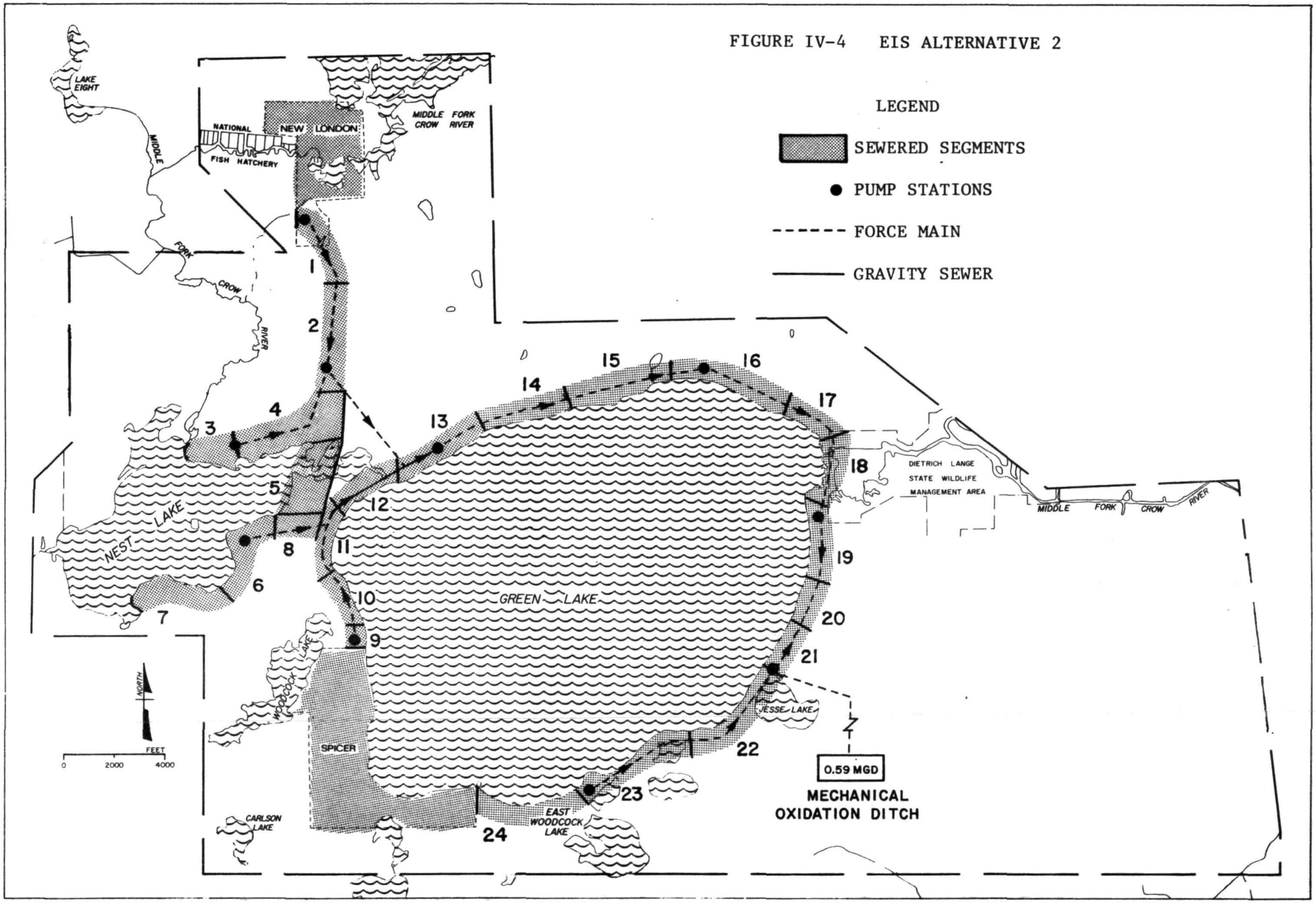


FIGURE IV-4 EIS ALTERNATIVE 2

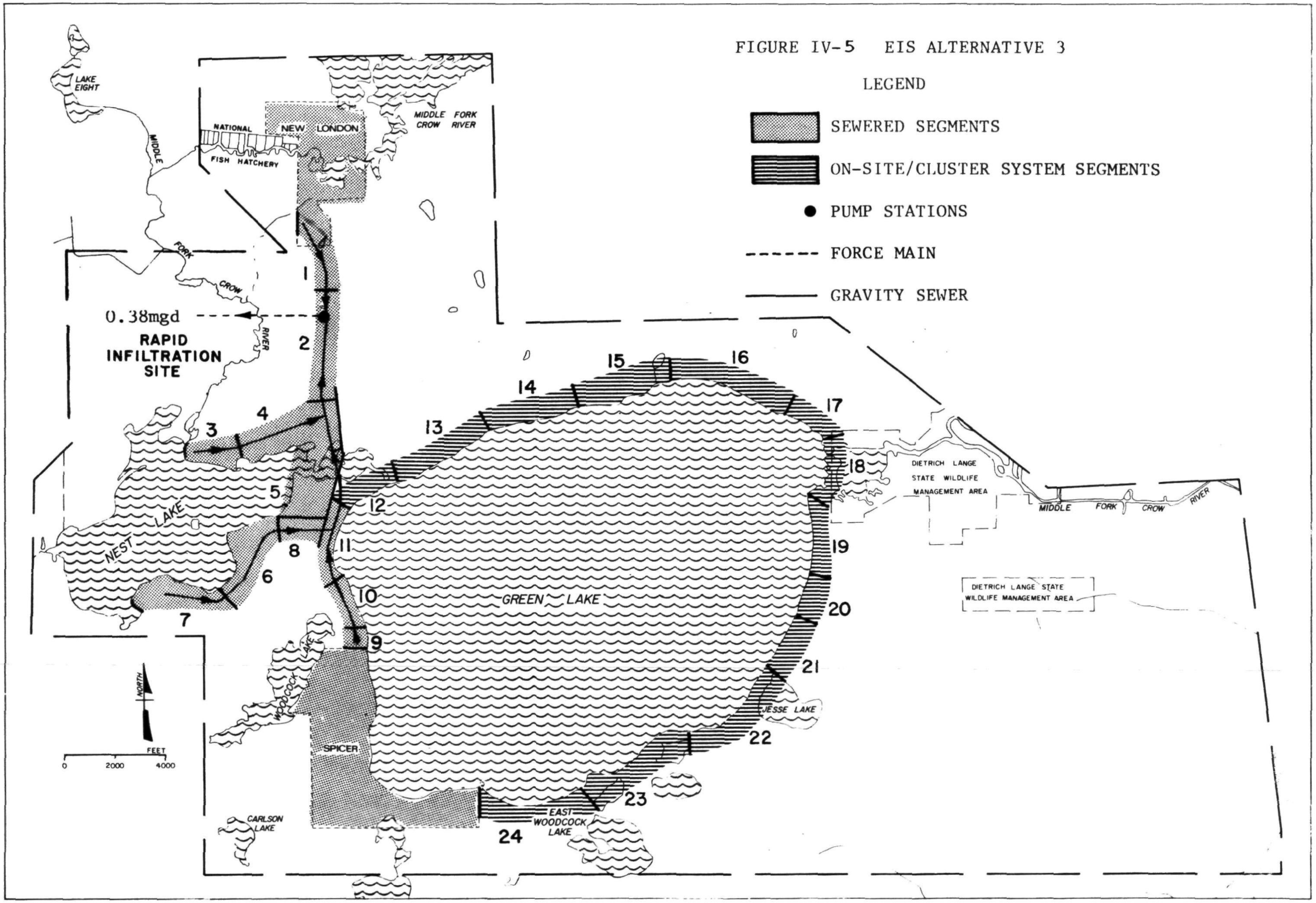


FIGURE IV-5 EIS ALTERNATIVE 3
LEGEND
SEWERED SEGMENTS
ON-SITE/CLUSTER SYSTEM SEGMENTS
PUMP STATIONS
FORCE MAIN
GRAVITY SEWER
LAKE EIGHT
MIDDLE FORK CROW RIVER
NATIONAL FISH HATCHERY
NEW LONDON
MIDDLE FORK CROW RIVER
0.38mgd
RAPID INFILTRATION SITE
NEST LAKE
GREEN LAKE
WOODCOCK LAKE
SPICER
CARLSON LAKE
EAST WOODCOCK LAKE
JESSE LAKE
DIETRICH LANGE STATE WILDLIFE MANAGEMENT AREA
MIDDLE FORK CROW RIVER
DIETRICH LANGE STATE WILDLIFE MANAGEMENT AREA
NORTH
FEET
0 2000 4000
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24

impacts. It was assumed that 25% of those residences utilizing decentralized systems would be tied into cluster systems; suitable soils exist at the sites for which these systems are proposed. The costs developed were based on a "typical" cluster system that would serve 23 residences.

On-lot Systems. Residences not served by sewers or cluster systems would use on-lot systems. This alternative would include a program of replacement or rehabilitation of on-lot systems where necessary to alleviate existing malfunctions.

The specific requirements for upgrading existing on-lot systems were estimated by analysis of the data presented in the Green Lake sanitary survey, the "Septic Snooper" investigation, and other environmental data. Based upon these, 50% of the on-lot systems were assumed to require replacement of both septic tank and drainfield. Site evaluations and selection of appropriate replacement or rehabilitation technologies are likely to result in variation from this assumption in both the number of systems affected and the mix of technologies. The assumption of 50% replacement results in cost estimates expected to be conservatively high.

6. EIS ALTERNATIVE 4

EIS Alternative 4 is identical to Alternative 3 except that the areas surrounding Nest Lake would be added to the areas that were proposed for on-site treatment in Alternative 3. Consequently, flow from the sewered area would be reduced by 0.10 mgd to 0.28 mgd. Flows from the City of Spicer, the Village of New London, and segments 1, 2, 9, 10 and 11 would be collected and treated by land application using rapid infiltration.

The locations of wastewater facilities and service areas for Alternative 4 are shown in Figure IV-6.

7. EIS ALTERNATIVE 5

New Alternative 5 is identical to Alternative 4 except that spray irrigation would be substituted for rapid infiltration. An application rate of 2 inches/week was used based on the nitrogen loading rate. The crop chosen was alfalfa because a high rate of application and because the plant is a perennial. Storage of wastewater for 15 weeks was used in design of the facilities (EPA, 1977).

The locations of cluster systems, on-site disposal areas, and the land application site (0.28 mgd) are shown in Figure IV-7.

8. EIS ALTERNATIVE 6

This alternative would include decentralized treatment for portions of the EIS Service Area. The area would be divided into two centralized districts; one for the City of Spicer and segments 9, 10, and 11, and the other for the Village of New London and segments 1 and 2. All other areas of Green Lake and Nest Lake would utilize a combination of cluster systems.

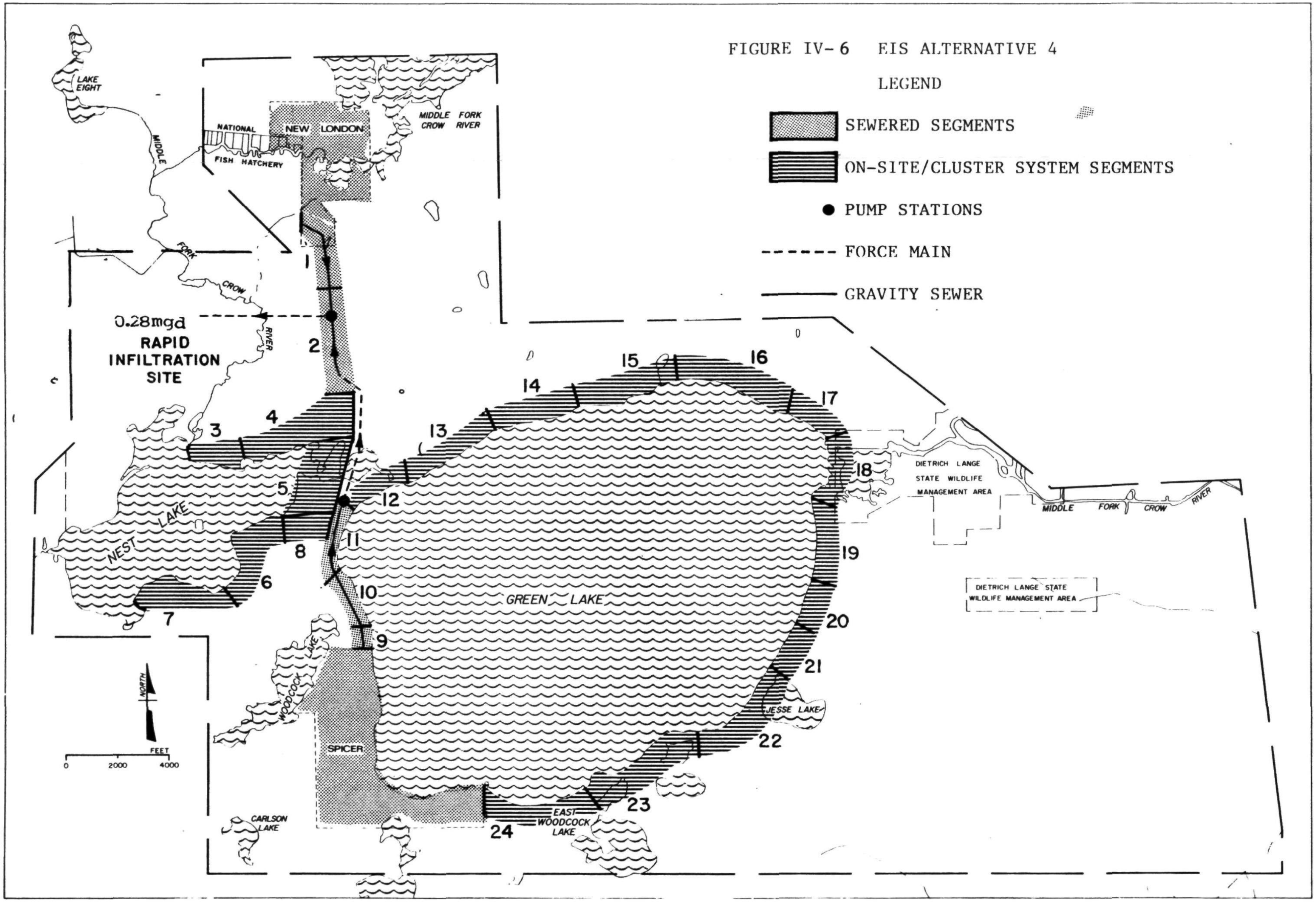


FIGURE IV-6 EIS ALTERNATIVE 4

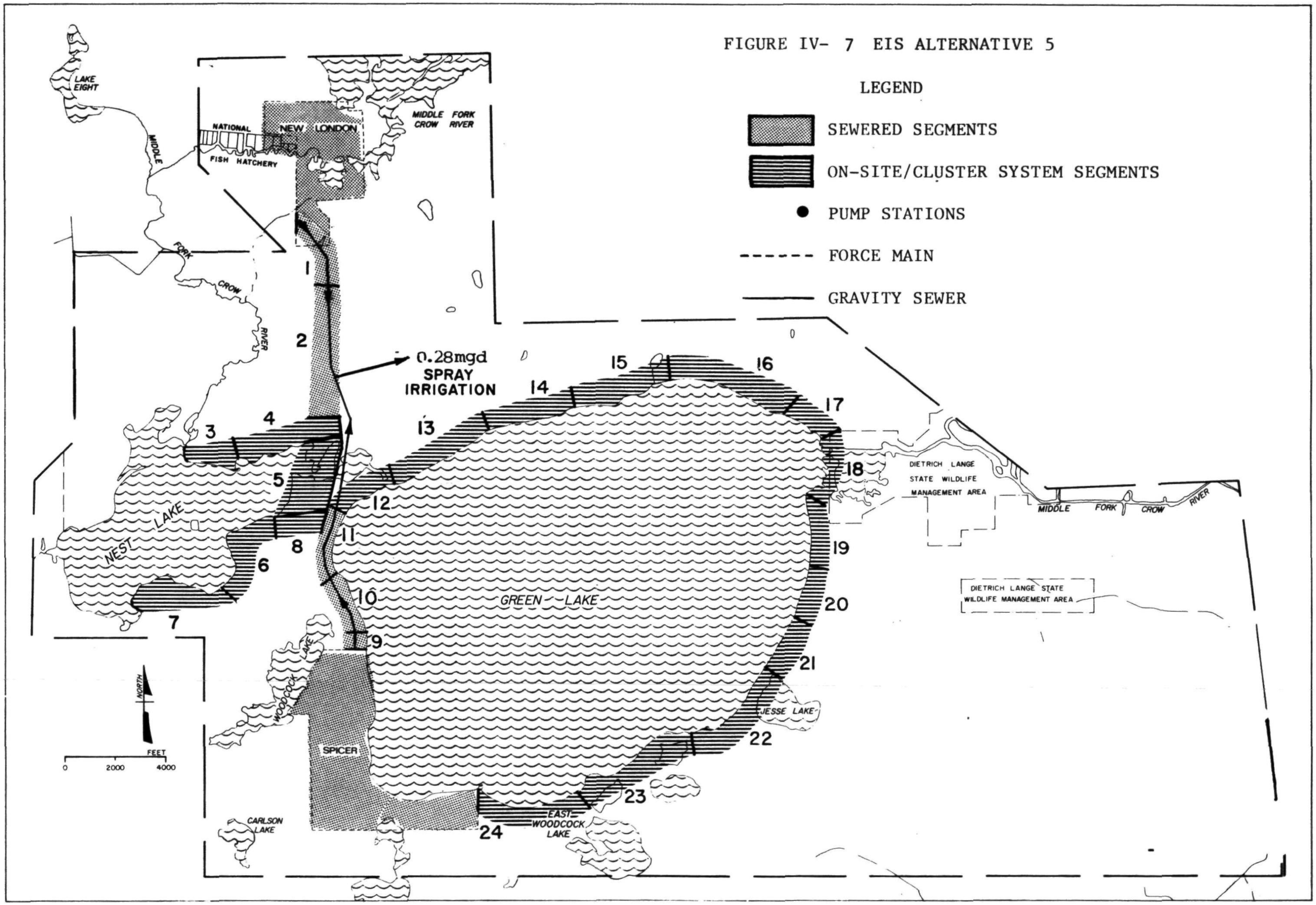


FIGURE IV- 7 EIS ALTERNATIVE 5

The New London and Spicer treatment plants would be upgraded to tertiary* (advanced) treatment and their capacity expanded to handle the design flows. The New London plant has sufficient hydraulic capacity to meet design flow (0.12 mgd) but provides only primary treatment. Aeration, alum addition, final clarification, mixed-media filtration and chlorination would be added in upgrading the plant.

The Spicer plant does not have sufficient hydraulic capacity to handle the design flows (0.086 mgd) and would be expanded by constructing a parallel plant. Upgrading from secondary to advanced treatment would require provision of the following processes: alum and polymer addition, a prefabricated extended aeration plant and mixed-media filters.

A map of this alternative is presented in Figure IV-8.

9. LIMITED ACTION

A "limited action" wastewater management alternative for the design period has been developed and evaluated in this EIS. Under this scheme, there would be no expansion of presently sewered communities in the Study Area (i.e., New London and Spicer). The existing sewage treatment plants at New London and Spicer would both be upgraded to tertiary* (advanced) treatment with capacity expanded as necessary to handle the design flows. The capacity of these facilities is increased only to handle wastewater generated by growth in the existing sewered areas. The design flow of the New London plant is estimated to be 0.098 mgd; effluent discharge would be to the Middle Fork of the Crow River above Nest Lake. The estimated year 2000 flow of the Spicer plant is 0.12 mgd, with effluent discharged to Woodcock Lake.

Existing and future residences in the EIS Service Area outside of New London and Spicer would be served by on-lot systems. As with EIS Atlernatives 3, 4, 5, and 6, it is assumed that 50% of the on-lot systems would require replacement of both septic tank and drainfield over the design period. No cluster systems are proposed for service in this alternative.

Implicit in this alternative is the assumption that the designated wastewater management agency would not be authorized to acquire easements and rights-of-way or otherwise secure land, given that no land application systems or cluster systems are proposed.

The configuration of the Limited Action Alternative is very similar to that for EIS Alternative 6: The former has no cluster systems around Green Lake and Nest Lake, and segments 1, 2, 9, 10, and 11 are served by on-site systems, no sewers.

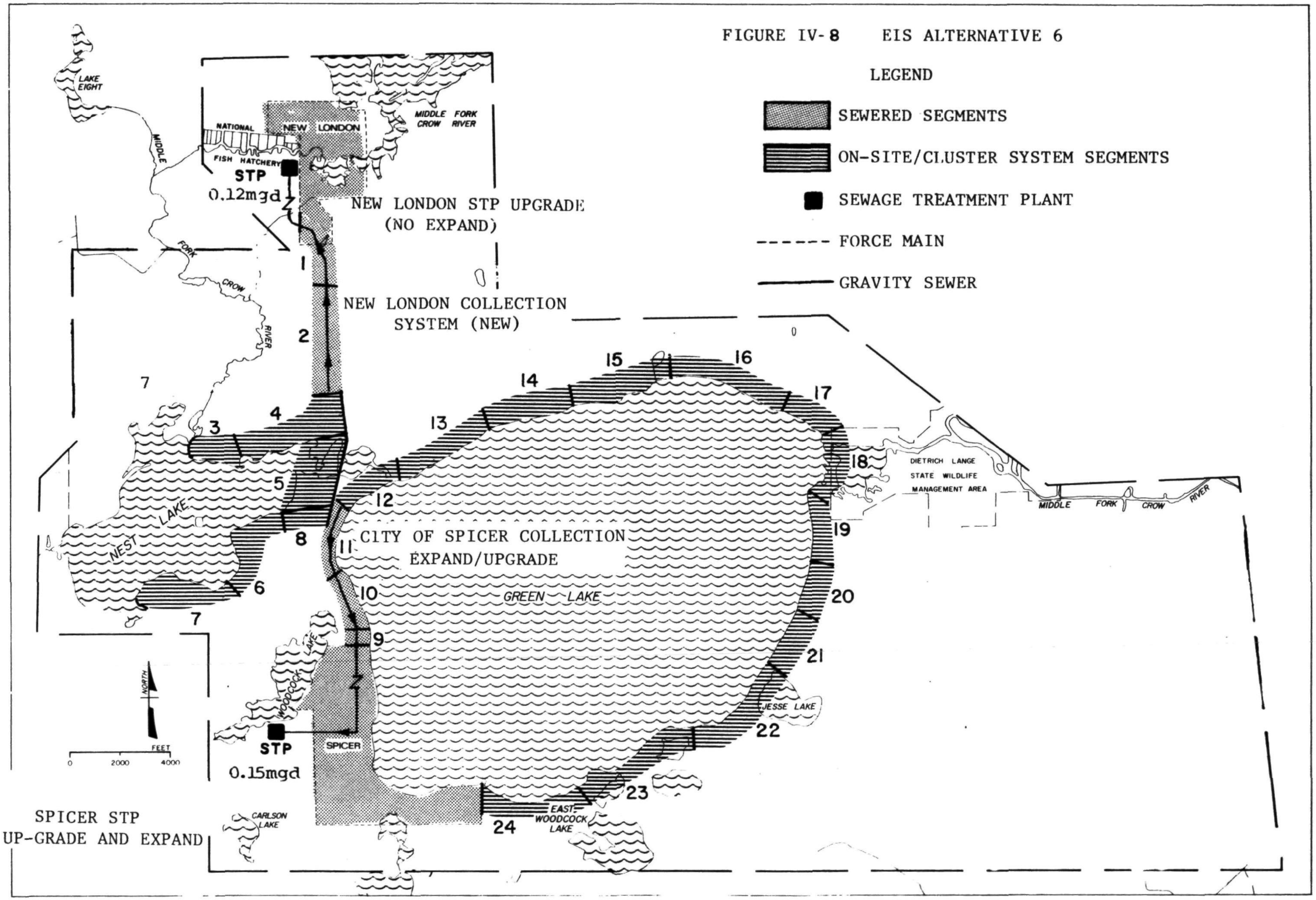


FIGURE IV-8 EIS ALTERNATIVE 6
LEGEND
SEWERED SEGMENTS
ON-SITE/CLUSTER SYSTEM SEGMENTS
SEWAGE TREATMENT PLANT
FORCE MAIN
GRAVITY SEWER
LAKE EIGHT
MIDDLE FORK CROW RIVER
NATIONAL FISH HATCHERY
NEW LONDON
STP
0.12mgd
NEW LONDON STP UPGRADE
(NO EXPAND)
NEW LONDON COLLECTION
SYSTEM (NEW)
CITY OF SPICER COLLECTION
EXPAND/UPGRADE
NEST LAKE
GREEN LAKE
WOODCOCK LAKE
JESSE LAKE
EAST WOODCOCK LAKE
CARLSON LAKE
DIETRICH LANGE STATE WILDLIFE MANAGEMENT AREA
SPICER
STP
0.15mgd
SPICER STP
UP-GRADE AND EXPAND
NORTH
FEET
0 2000 4000
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24

C. FLEXIBILITY OF ALTERNATIVES

The flexibility of the Proposed Action and the EIS Alternatives to accommodate future growth in the service Area along with their operational flexibility over the design period is evaluated in this section.

1. FACILITIES PLAN PROPOSED ACTION

This alternative provides good flexibility for growth since, as long as land is available, stabilization ponds can be expanded to accommodate increased flows relatively easily. Flexibility for future growth is, however, reduced somewhat because the entire proposed Service Area is to be sewered. More flexibility for future expansion is usually available for alternatives that require a smaller initial commitment of resources.

2. EIS ALTERNATIVE 1

Except for the use of pressure sewers for wastewater collection, this alternative is identical to the Facilities Plan Proposed Action. Such pressure sewers provide more flexibility for design than do gravity sewers since pressure sewers do not require suitable ground contours for economical construction. The flexibility for expansion is the same as for the Facilities Plan Proposed Action.

3. EIS ALTERNATIVE 2

With the exception of the treatment process, this alternative is identical to EIS Alternative 1. The treatment scheme in EIS Alternative 2 provides greater flexibility of operation than does the stabilization pond. The flexibility of expanding an oxidation ditch is dependent upon the availability of land. Much less land, however, is required for an oxidation ditch than for a stabilization pond.

4. EIS ALTERNATIVE 3

Unlike the alternatives that propose discharges of effluent to the Middle Fork of the Crow River, EIS Alternative 3 proposes that effluent be disposed of by rapid infiltration. The addition of preliminary treatment and rapid infiltration to the stabilization pond treatment process reduces operational flexibility over the plain stabilization pond process. From the standpoint of expansion, rapid infiltration is less flexible than spray irrigation because siting restrictions are more severe. However, rapid infiltration requires much less land area than spray irrigation. Also, the operational flexibility of rapid infiltration is good since it has a wide range of possible application rates, and can be used year round, even in cold weather. EIS Alternative 3 is somewhat more flexible than previous alternatives because only part of the proposed Service Area would be sewered. This limits the initial commitment of resources and increases the flexibility for future planning and design.

5. EIS ALTERNATIVE 4

Operational flexibility is the same as for EIS Alternative 3. The flexibility for future expansion is slightly greater than for EIS Alternative 3 because the amount of sewered area is slightly less.

6. EIS ALTERNATIVE 5

This alternative is similar to EIS Alternative 4 except that spray irrigation, rather than rapid infiltration, would be used for effluent disposal. Spray irrigation is subject to fewer siting restrictions, therefore has increased flexibility for expansion, but requires much more land than rapid infiltration. The range of application rates is more limited for spray irrigation than for rapid infiltration. Additionally, spray irrigation may not be feasible in very cold weather.

7. EIS ALTERNATIVE 6

Upgrading and expanding an existing facility provides less flexibility than does constructing a new one. When planning and designing a new treatment plant, factors such as location, treatment process, and plant configuration can be optimized. When expanding or upgrading an existing facility, the components that are already in use constrain the design and reduce flexibility. Upgrading and expanding the existing Spicer and New London wastewater treatment plants appears to be a relatively simple operation. Since the improvements will involve only process additions with little or no interactions between new and existing components, the main limitation of flexibility will be the availability of surrounding land for expansion.

8. LIMITED ACTION

The Limited Action Alternative represents the maximum decentralized approach of all wastewater management schemes evaluated in this EIS. With no provision of improved collection and treatment facilities for present and future residents outside currently sewered areas, it also represents the least flexible of all alternatives in terms of accommodating future growth in the EIS Service Area.

D. COSTS OF ALTERNATIVES

Project costs were grouped by capital expenses, operating and maintenance expenses, and salvage values of the equipment and land required for each alternative. A contingency fund amounting to approximately 25% of capital costs was included to provide for such expenses as engineering and legal fees, acquisition of rights-of-way, and administration. The methodology and assumptions used in the analyses are described in Appendix H-1. Detailed costs for each alternative are also presented in Appendix H-2.

The present and future project costs for the upgraded Facilities Plan Proposed Action, EIS Alternatives and Limited Action are summarized in Table IV-2. The analyses of total present worth and annual equivalent costs of each alternative are also presented in this table. (Debt service on financing and local share is not included.) Discussion of Federal/State cost sharing and remaining local costs is included in Section V.E.

CHAPTER V

IMPACTS

A. IMPACTS ON SURFACE WATER QUALITY

1. PRIMARY IMPACTS

a. Analysis of Eutrophication Potential

This section discusses the effect of nutrient loading associated with different wastewater management alternatives upon the trophic status of open waters in Nest Lake, Green Lake, and Woodcock Lake. To evaluate the impact of each alternative, nutrient loading levels for phosphorus were calculated. The empirical model developed by Dillon was used to project future trophic conditions associated with different phosphorus loading scenarios based on the EIS wastewater management alternatives.

The major sources of phosphorus for Nest Lake, Green Lake, and Woodcock Lake were identified earlier in the following order of significance:

- tributaries (Middle Fork of the Crow River to Nest Lake and from Nest Lake to Green Lake);
- wastewater treatment plants (Belgrade and New London to Middle Fork Crow River and Spicer to Woodcock Lake);
- septic tank systems; and
- immediate drainage around the lake.

The relative contributions of phosphorus to Nest Lake, Green Lake, and Woodcock Lake made by these sources under present conditions are illustrated in Figure V-1. Other sources known to contribute to nutrient loading such as groundwater, detritus, waterfowl, and release from sediments are less significant in the Study Area in terms of the time scales considered.

Future Phosphorus Loading Scenarios. In this analysis, future phosphorus loading levels have been projected for the year 2000. The immediate problem in deriving these loads is the phosphorus loading in the Middle Fork of the Crow River upstream from Belgrade. This load varies with the flow in the river from year to year. A normalized load proportional to the average flow in the river over the record period was used. Furthermore, this normalized load was assumed to remain the same until the year 2000, because future land use changes were uncertain. Phosphorus output from Nest Lake represents a significant contribution to Green Lake. In this analysis, the retention coefficient for phosphorus in Nest Lake observed during 1972-73 (56%) was used. The septic tank leachate, and wastewater treatment plant discharge loads were calculated according to each wastewater management alternative

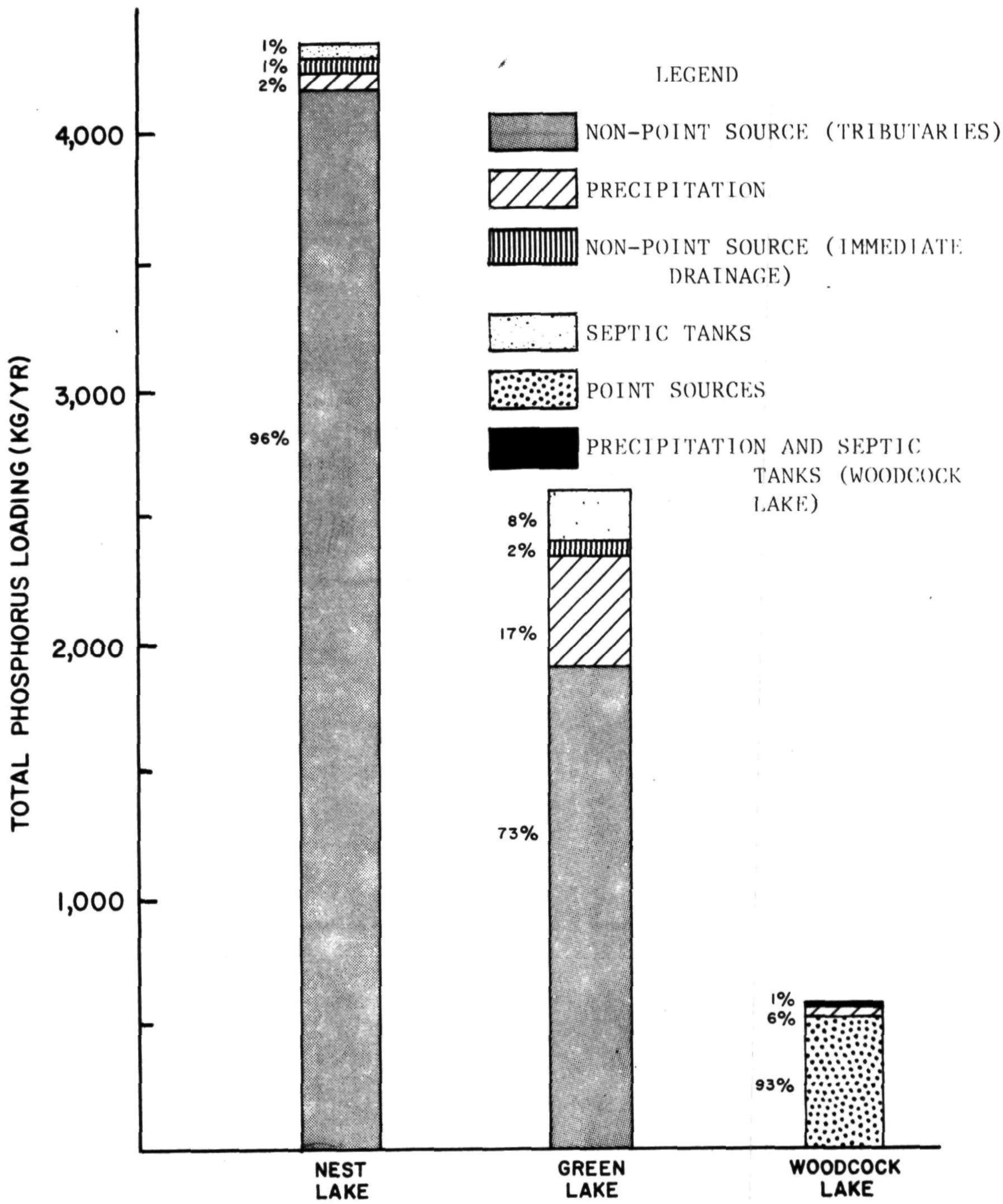


Figure V-1

COMPARISON OF PHOSPHORUS LOADINGS BY SOURCE CONTRIBUTIONS FOR THE GREEN LAKE STUDY AREA developed. The immediate drainage contribution is usually relatively insignificant in this case and was assumed to be constant until year 2000 for practical purposes. The total phosphorus inputs associated with various alternatives for Nest Lake and Green Lake are presented in Table V-1. The 1972-73 loading levels are included for comparison.

Future Trophic Conditions. Figure V-2 summarizes the results from the modeling analysis with respect to various wastewater management alternatives. Nest Lake is predicted to remain eutrophic for all the alternatives with slight improvement in water quality. Green Lake will also maintain its trophic status in the mesotrophic category. This small improvement in the quality of open waters suggests the significance of the non-point source loading associated with the Middle Fork of the Crow River which is uncontrollable at the present time. In addition, cautions have to be exercised when interpreting the results because of the yearly variation of phosphorus inputs existent in the River. That is, this variation may be so significant that it masks the reduction of phosphorus inputs incurred for Green Lake by some alternatives.

The modeling analysis described above cannot be used to assess the trophic status of Woodcock Lake, due to the landlocked nature of this water body. In any event, phosphorus input to Woodcock Lake will decrease dramatically (more than 50%) under any proposed wastewater management scheme evaluated in this EIS. This reduction would result from either the discontinuation of the present Spicer wastewater treatment plant discharge or from the proposed upgrading of the plant to provide effluent phosphorus concentrations of 1.0 mg/l.

b. Bacterial Contamination

Lakes in the Study Area have met State standards for fecal and total coliform bacteria. Where human wastes have been implicated as a contributor to coliform counts in the lakes, it is expected that all of the wastewater management alternatives should effectively abate such a problem.

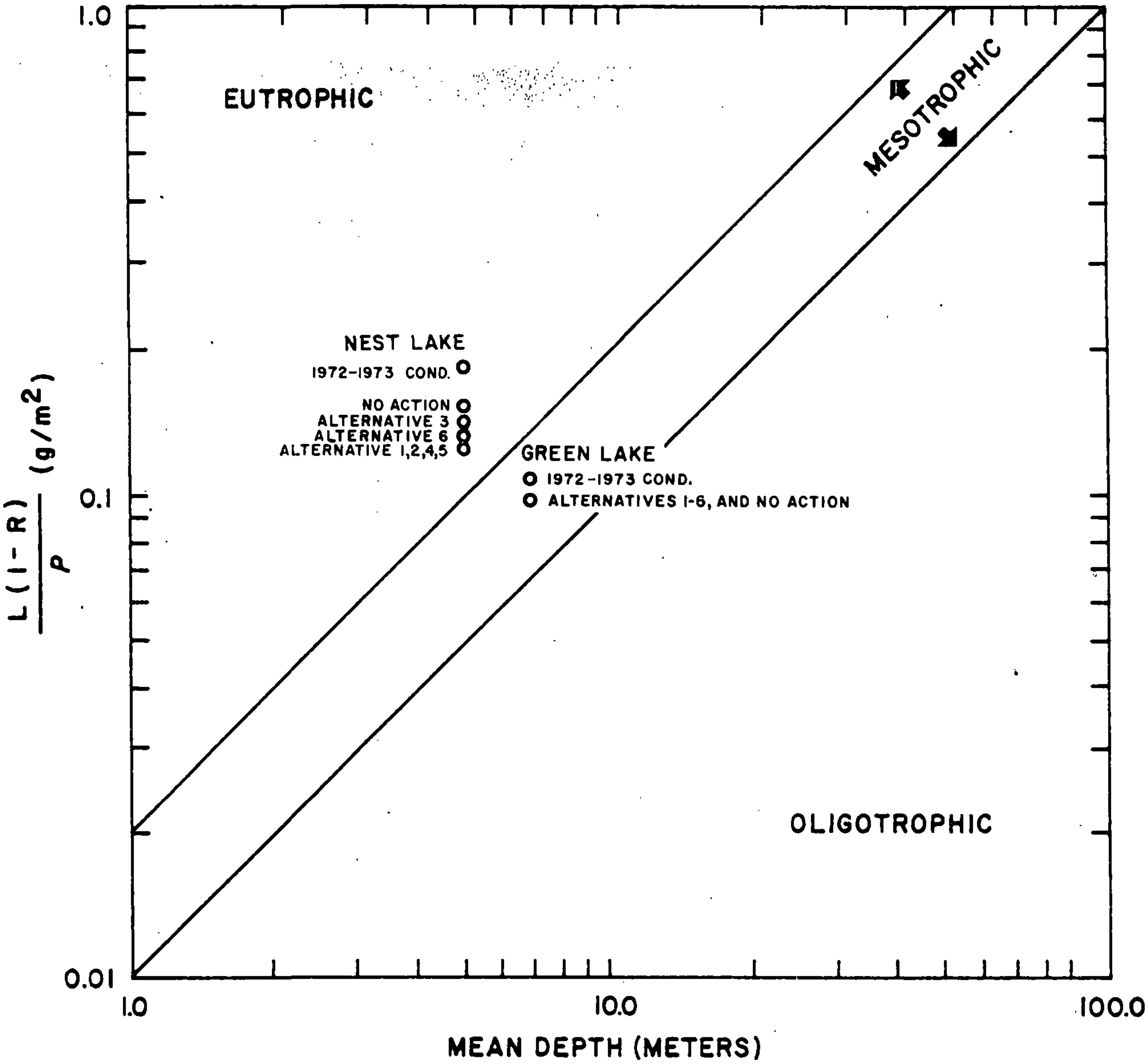
Land application of wastewater is an effective way of eliminating or immobilizing sewage-borne pathogens particularly if some pretreatment (stabilization pond) precedes the application (Johnson et al. 1977). Bacterial pathogens undergo rapid die-off in the soil matrix. Studies have shown the summer survival rate of fecal coliform organisms to be 0.001% after a period of 35 days (Miller 1973).

With the centralized alternatives, pumping station malfunctions could result in substantial bacterial contamination of the lakes. Rigorous inspection and maintenance of pumping stations, back-up electrical power supplies, standby pumps and an overflow alarm would minimize the possibility of this happening. Similar measures should be taken with pumping stations for cluster systems.

Table V-1

TOTAL PHOSPHORUS INPUTS (KG/YR) TO NEST LAKE AND GREEN LAKE

Alternative	Nest Lake	Green Lake
1972-73 Conditions	4,329.9	2,605.1
No Action	3,029.2	1,969.1
1 & 2 (Proposed Action)	2,355.8	1,679.6
3	2,707.8	1,827.7
4	2,386.4	1,686.3
5	2,355.8	1,672.9
6	2,474.0	1,724.9



L= AREAL PHOSPHORUS INPUT ($g/m^2/yr$)
R= PHOSPHORUS RETENTION COEFFICIENT
P= HYDRAULIC FLUSHING RATE (yr^{-1})

FIGURE V-2 TROPHIC STATUS OF NEST LAKE AND GREEN LAKE IN TERMS OF VARIOUS WASTEWATER MANAGEMENT ALTERNATIVES

c. Non-Point Source Loads

Primary impacts on surface water quality related to the construction of ST/SAS and the replacement of old systems is likely to result in increased soil erosion. Similarly, installation of sewers, especially those that pass under the many small drainage ways leading to the lakes, will increase erosion.

Compliance with state and local soil erosion control requirements could substantially reduce the erosion problem and the subsequent impact on water quality.

2. SECONDARY IMPACTS

Increasing housing development along lake shores may increase nutrient and sediment loads into the lake as a result of the following:

- increased runoff from construction of impervious surfaces such as rooftops and parking areas;
- lawn and garden fertilization creating unnaturally high nutrient levels in the runoff; and
- soil disruption by human activities (i.e., housing construction, leveling of forested area, etc.).

Soil organic debris and dissolved materials mobilized and transported to temporary runoff channels during storms are settled, filtered and absorbed on the land or in pools if the runoff channels are long or if adequate storage areas, such as wetlands, occur. Increasing housing density normally accelerate storm runoff thereby increasing not only the amount of runoff but also its ability to erode soil and to transport contaminants.

B. IMPACTS ON GROUNDWATER

Groundwater impacts fall into two categories, those affecting the available quantity of the resource, and those affecting its quality.

1. GROUNDWATER QUANTITY IMPACTS

The conversion from sewage disposal practices based on individual soil absorption systems to central collection and treatment systems without land application of effluent can result in a loss of groundwater recharge. The significance of this loss depends upon its relationship to the recharge from all other sources, including downward infiltration and percolation from precipitation and surface water bodies and inflow from adjacent aquifers. The precise quantification of this significance requires an accurate delineation of the aquifer(s) plus knowledge of its hydrology (precipitation, runoff, evapotranspiration, discharge, etc.)

and hydraulic characteristics (transmissivity*, storage coefficients*, etc.). There is not enough data to attempt such quantification for Green Lake.

Because the confining layer above the buried outwash aquifer in the Study Area is impermeable, essentially no significant recharge of this aquifer takes place by means of infiltration within the boundary of the aquifer which includes the entire Study Area. The aquifer is recharged mainly by underflow from the surficial glacial deposits northwest of the Study Area, but the extent of recharge is unknown (Lindholm et al. 1974). Because the source of recharge is outside of the Study Area, none of the alternatives will affect this aquifer. Furthermore, the estimated domestic water use by the Facilities Plan Proposed Action of 0.63 mgd in the year 2000 is very small and unlikely to significantly affect quantities of water within the buried outwash aquifer or surficial groundwater which Lindholm et al., indicated will support additional development for domestic and irrigation supplies (1974).

2. GROUNDWATER QUALITY IMPACTS

Human wastewater disposal can affect the quality of groundwater through three main types of pollutants. The first type includes suspended solids, bacteria and other forms of organic matter which are normally removed by downward movement through approximately 5 feet of soil above the water table of aquifers. These contaminants are very unlikely to reach the buried outwash aquifer because the impermeable confining layer provides an adequate barrier depth to this aquifer is generally more than 20 feet.

Groundwaters overlying the buried outwash aquifer are more susceptible to the influence of wastewaters applied to the soil either by land application or through soil absorption systems. The surficial aquifer is apparently unconfined and the water table is near the ground surface in many places near lakes. Organic or bacterial contamination of this surficial aquifer by spray irrigation or rapid infiltration of wastewaters can be avoided by using only sites where the water table will remain deeper than 6 feet below ground surface and where soils are fine enough to filter wastewater efficiently. The most likely source of contamination to this aquifer is soil absorption systems in low-lying areas. It was partially on the basis of such contamination that the applicant applied for grants to build sewers. While there is little doubt that these contaminants enter the surficial aquifer in some places, their effects appear from available data to be very localized. Well data submitted by the applicant shows the presence of total coliform bacteria in some wells but there is no support to the implication that their source was soil absorption systems. A more likely cause of the well contamination is the design and condition of the wells themselves. Nevertheless, if continued use of soil absorption systems is recommended, a substantial program of well inspection and sampling should be undertaken to include location of suspect wells; inspection of their casing, seal and grouting; identification of all potential sources of contamination near the wells; sampling of properly designed wells for fecal coliform bacteria, and nitrates at a minimum; and measurement of groundwater flow direction and rate in representative areas around the lake shores.

In the Study Area, the impermeable confining layer above the buried outwash aquifer should also serve as an effective barrier against the entry of nitrates into the aquifer by infiltration. The surficial aquifer is not so protected and is likely receiving nitrates from soil absorption systems as well as from agricultural sources and lawn fertilization. With the exception of two wells sampled by the applicant, groundwater have nitrate concentrations below the drinking water standard of 10 mg/l as nitrogen. As housing densities increase in areas dependent on soil absorption systems, nitrate levels will increase especially if development involves multiple rows of dwellings. A sampling program to determine the levels and sources of nitrates and other contaminants in wells is required if alternatives using soil absorption systems are funded.

It is possible that some nitrates from wastewater applied to land might reach surface waters via overland runoff, lateral interflow* in soils, or transport in percolating groundwaters. However, application rates for spray irrigation of effluents would be set to maximize crop uptake of nitrogen, minimizing its concentrations in groundwater. Because of the high application rates for rapid infiltration, recovery of rennovated effluent by recover wells or drains may be necessary.

3. MITIGATIVE MEASURES

Groundwater quality should be carefully monitored for all alternatives involving the use of ST/SAS's, cluster systems and land application systems to check that water quality is not being significantly degraded and to signal the existence of malfunctions, inadequate treatment or the need for corrective action.

The potential for groundwater contamination from the sewage lagoons required in the Facilities Plan Proposed Action and EIS Alternatives 1, 3, 4 and 5 will be low if the lagoons are adequately designed. Existing engineering and hydrogeologic procedures would prohibit the construction of these systems directly in the aquifer, and would require an adequate distance between the lagoon bottom and the groundwater. Also, an impervious layer of soil material such as bentonite clay would be used as a line for the lagoons' sides and bottom to insure leakage of untreated wastewater does not occur. As a final protection measure, groundwater quality monitoring wells would be used to identify any changes in groundwater quality that may be a result of leakage from a sewage lagoon. This would insure that corrective action could be taken before any serious contamination develops.

C. POPULATION AND LAND USE IMPACTS

Population and land use impacts associated with various system alternatives are evaluated in this section (see Table V-2). These impacts are summarized below:

Table V- 2

COMPARISON OF POPULATION AND LAND USE IMPACTS
ASSOCIATED WITH MAJOR SYSTEM ALTERNATIVES

		Centralized Wastewater Management Facilities	Decentralized Wastewater Management Facilities
GROWTH INDUCEMENT	Differential Population Growth	+ 5-10%	Base Case
	Increase in Residential Acreage	+30-40 Acres	Base Case
	Development Pattern and Intensity	Increase in lakeshore densities and in extent of shoreline development.	Continued scattered residential development, limited by on-site limitations in lakeshore areas.
COMMUNITY ENVIRONMENT	Community Composition	Accelerated conversion from seasonal to year-round occupancy status; loss of lower-income population base due to displacement pressure.	Existing composition influenced by demographic pressures unrelated to facility provision.
	Community Character	Increase in lakeshore densities and in extent of shoreline development.	Continued scattered residential development, limited by on-site limitations in lakeshore areas.

- A majority of residences directly contiguous to Green Lake and Nest Lake and not located within the boundaries of Spicer or New London are currently utilizing on-site waste disposal systems. An estimated 30 to 40 additional lakeshore acres are likely to be developed with provision of centralized sewerage facilities.

- Some increase in the density of residential development along the lake is also likely to result from centralized facilities.

- Population growth of 5 to 10% above levels possible without centralized facilities may accompany anticipated increases in residential acreage and intensity.

- Centralized facilities will place severe financial pressure upon lower- and middle-income families, resulting in the dislocation of many less affluent residents. In addition, these alternatives will accelerate the conversion of occupancy patterns from seasonal to year-round status. Disruption of the prevailing community environment will be a possible by-product of economic and financial pressures associated with centralization.

- Decentralized wastewater management facilites should only moderately influence the composition and character of the Green Lake area.

1. INTRODUCTION

The capacity of an area to support development varies with the degree to which wastewater facilities are site-related. On-lot wastewater treatment facilities are site-dependent because they are limited to sites with suitable soils. Sewers allow development to be much more independent of site characteristics because the soil permeability, slope and drainage are not such strong constraining factors. Thus, sewers increase the inventory of developable land. Sewers also increase the possible density of development. The amount of additional growth actually occurring in the area if sewers are provided is dependent not only upon increases in development potential but also upon demand for additional residential development in the area. This demand reflects the residential amenity of the area in comparison to other areas and the reduction in the cost of residential land when the supply of developable land is increased.

Population and land use impacts are estimated in this Section for completely centralized (Proposed Action and EIS Alternatives 1 and 2) and completely dencentralized (No Action) alternatives. Impacts are also estimated for EIS Alternatives 3, 4, 5 and 6, which incorporate partial sewering and cluster systems. These alternatives, while described as decentralized, are actually hybrid or intermediate systems in terms of population and land use impacts.

2. POPULATION

If centralized facilities were provided, minor differences in population would occur over levels expected for decentralized facilities. With centralized facilities, population in the Service Area would be anticipated to increase between 5 to 10% above the levels expected for decentralized wastewater management alternatives. Centralized facilities would concentrate growth within the nearshore segments of the Green Lake EIS Service Area. With site-dependent, decentralized facilities, nearshore areas would be developed at a lower density or may not be developed at all, resulting in more development in areas remote from the lakeshore.

3. LAND USE

Implementation of centralized facilities should not significantly affect future land use except in certain lakeshore segments. Segment-by-segment analysis of the Green Lake shore yielded an estimated 30 to 40 lakeshore acres likely to be developed only with provision of centralized facilities.

4. CHANGES IN COMMUNITY COMPOSITION AND CHARACTER

The composition and character of the Green Lake community would be only slightly influenced by the provision of centralized facilities. Additional costs of wastewater treatment would displace some lower income permanent and seasonal residents. These residents would be replaced by higher income persons able to afford the additional wastewater treatment costs. Higher costs would also accelerate the current trend of seasonal to year-round residence because fewer people could afford to maintain second homes.

The rural character of the area would be diminished only slightly by the increased amount of land that would be devoted to residential and associated uses with centralized facilities. Moderate change in the character of the area could also occur with EIS Alternatives 3, 4, 5 and 6 as population growth and land development would take place in areas serviced by sewers and the numerous cluster systems.

Adoption of a Limited Action or a No Action Alternative would encourage preservation of the area's prevailing community character and composition. There would be very little economic displacement pressure in the Green Lake area and land use patterns would be unlikely to change.

D. DEVELOPMENT ON ENVIRONMENTALLY SENSITIVE AREAS

The following areas have been identified as being environmentally sensitive to building or construction in the Study Area:

- Floodplain and shoreline area;
- Wetlands;
- Natural areas;
- Archaeological and historical sites;
- Steep slopes; and
- Prime agricultural land.

As stated in Section II.E.4, implementation of EIS Alternatives 1 or 2 or the Facilities Plan Proposed Action would probably result in conversion of approximately 30 to 40 acres from agricultural to residential use. If no wastewater treatment facilities are provided, no substantial conversion of agricultural lands is likely.

1. FLOODPLAINS AND SHORELINE AREAS

The 100-year floodplain in the Study Area includes a narrow ribbon of land along the Middle Fork of the Crow River and surrounds the numerous lakes located in the Study Area. The largest individual areas of floodplain in the Study Area have been incorporated into the New London Fish Hatchery and the Dietrich Lange Wildlife Management Area and are consequently under State and Federal protection.

Kandiyohi County has a floodplain management ordinance intended to provide suitable areas for orderly and aesthetic development which would retain the natural features of the shoreline and adjacent areas. This ordinance, which recognizes that control of shoreline development will assist in the maintenance of good water quality and the prevention of erosion, is critical to the development of the 22 miles of shoreline around Green Lake and Nest Lake. Placement and construction of sanitary and wastewater disposal facilities are governed by the ordinance (Kandiyohi County Overall Economic Development Plan 1977). It also requires that the basement floor of any structure to be used for human habitation be more than 4 feet above the 100-year flood elevation.

Primary physical impacts on the shorelines would occur with all alternatives; such impacts are likely to be more severe with the centralized treatment systems i.e., EIS Alternatives 1 and 2, Facilities Plan Proposed Action which require construction of sewer lines.

2. WETLANDS

Figure II-7 indicates that wetlands are widespread throughout the Study Area. More than 1800 acres of wetlands are under Federal and State management as part of waterfowl protection and wildlife management areas. Potential impacts of construction on privately owned wetlands also need to be assessed in view of the importance of wetlands to both groundwater levels and wildlife and because the agricultural practice of ditching and draining lands has already reduced certain wetlands to small areas.

If a centralized alternative is chosen, primary construction-related impacts on certain wetlands will be unavoidable. The water table might be lowered, erosion and siltation increased, streamflow altered and habitat modified. Impacts might be minimized by excavating during low flow or during the six cold months of the year, and by immediate restoration of the area. However, wetland areas may be permanently damaged if the water table even drops one or two feet. Some wetlands may become dried up by a process that may not be reversible.

Wetlands might be permanently altered by EIS Alternatives 1, 3, 4 and 5. Scattered throughout the areas of the selected land treatment sites, wetlands could be avoided during construction. In selecting a site, the importance of any wetland to the watershed, its storage capacity, its habitat type, and the effects of construction on wildlife should be considered.

There are currently no regulations regarding discharge of municipal wastewater into wetlands other than the requirement to obtain a Minnesota Pollution Control Permit (MPCP). Nevertheless, compliance with effluent limitations for surface water would be required (by telephone, Dale Wikre, MPCA, April 1978).

3. NATURAL AREAS

The existing natural areas within the Study Area have been delineated in Figure II-13 and include State wildlife management and Federal waterfowl protection areas.

In addition, current easements give the Federal government the right to manage additional acreage of waterfowl habitat in the Study Area if they so decide (Economic Development Plan 1977). The large size and low population density of these wetlands means that the direct impacts on these wetlands resulting from wastewater management alternatives should be minimal. However, secondary impacts resulting from human activities could pose future problems for these areas. The degree to which development rates will differ among the alternatives cannot be determined.

4. ARCHAEOLOGICAL AND HISTORICAL SITES

Numerous archaeological sites are believed to be located within the Proposed Service Area. Several historic sites are located in the Study Area. Construction of pipelines around Green Lake and Nest Lake could have potentially significant impacts on these sites with EIS Alternative 1 and 2 and the Facilities Plan Proposed Action. Those alternatives which provide increasingly centralized sewerage service would have greater long-term secondary impacts due to induced growth and development near the lakes.

Upon the selection of a final alternative, detailed designs and specifications will have to be sent to the State Historic Preservation Officer. At that time, detailed site investigations will be performed by an archaeologist/historian to resolve potential conflicts with any archaeological or historic site which could be disturbed by construction activities.

5. STEEP SLOPES

a. Primary Impacts

The difficulties of installing on-lot systems on steep slopes appear to be a factor historically limiting home construction of lakeshore and other level of rolling sites. Nonetheless, suitably designed on-site systems may be constructed on steep slopes, as can sewers. Adherence to the Sediment and Erosion Control Act of 1972 should minimize the impacts of erosion from construction.

b. Secondary Impacts

The availability of off-lot treatment systems provided for cluster systems, along with the apparent demand for residential development may result in construction activity on steep-sloped areas. Accelerated soil erosion particularly on any steep bluffs surrounding the lakes can result in additional non-point source runoff in the form of sediment.

c. Mitigative Measures

The municipalities should adopt performance standards with specific slope-density provisions. Developers would then have to meet the performance standards burden of proof that the sloped areas are not a hazard to development. Zoning ordinances should limit growth in steep sloped areas.

If cluster systems or septic tanks are placed in areas with steep slopes a series of drop boxes should be used. With this method, no hillside seepage should occur unless the sewage flow exceeds the design capacity.

6. PRIME AGRICULTURAL LAND

Some agricultural land within the Study Area will be used for the implementation of all potential actions. For areas requiring extensive sewering (EIS Alternatives 1 and 2 and the Proposed Action), it is estimated that 30 to 40 acres of land would be used for the construction of sewer lines and wastewater treatment facilities. The EIS Alternatives that rely on decentralized cluster systems (3, 4, 5 and 6) may require significant acreage for construction, but these clusters are concentrated to the north of Green Lake, where sandy-gravelly (nonprime) agricultural land would be used. No treatment facilities are proposed for the area of greatest concentration of prime agricultural land, to the south of Green Lake.

E. ECONOMIC IMPACTS

1. INTRODUCTION

The economic impacts of the alternative wastewater systems proposed for the Proposed Green Lake Service Area are evaluated in this section. These impacts include: the financial pressure placed on residents to move away from the Service Area; financial pressure to convert seasonal residences to year-round residences; and the net benefits of water quality on the economy of the Green Lake area EIS Service Area.

2. USER CHARGES

User charges represent the costs billed periodically to the wastewater system customers. Total annual user charges have been developed for seven alternative wastewater systems. The user charge consists of three parts: debt service (repayment of principal and interest), operation and maintenance costs, and a reserve fund equalling 20% of the capital costs. Annual user charges are presented in Table V-3 and are expressed in terms of 1) the entire Service Area, 2) the currently sewered communities of Spicer City and New London Village, and 3) the currently unsewered portions of the proposed Green Lake EIS Service Area.

a. Eligibility

Eligibility refers to that portion of wastewater facilities costs determined by EPA to be eligible for a Federal wastewater facilities construction grant. Capital costs of wastewater facilities are funded under Section 201 of the 1972 Federal Water Pollution Control Act Amendments. Section 201 enables EPA to fund 85% of the total eligible capital costs of innovative and alternative systems. Innovative and alternative systems considered in the EIS Alternative include land treatment, pressure sewers, cluster systems, and septic tank rehabilitation and replacement.

The percentage of capital costs that is eligible for Federal and State funding greatly affects the cost that local users must bear. The capital costs of treatment, on-site systems, and cluster systems were assumed to be fully eligible for grant funding. However, collector system capital costs were subject to Program Requirements Memorandum (PRM 78-9). This PRM established three main conditions that must be met before collector sewer costs may be declared eligible:

- Systems in use for disposal of wastes from the existing population are creating a public health problem, contaminating groundwater or violating point source discharge requirements;

- Two-thirds of the design population (year 2000) served by a sewer must have been in residence on October 18, 1972; and

- Sewers must be shown to be cost-effective when compared to decentralized or on-site alternatives.

Table V-3

FINANCIAL BURDEN AND DISPLACEMENT PRESSURE

Alternative	Entire System	Spicer/New London Village	Currently Unsewered Area
Facilities Plan Proposed Action			
• Displacement Pressure	1-5%	1-5%	1-5%
• Financial Burden	10-20	10-20	10-20
• Can Afford	80-90	80-90	80-90
EIS Alternative 1			
• Displacement Pressure	5-10%	1-5%	5-10%
• Financial Burden	20-30	10-20	20-30
• Can Afford	70-80	80-90	70-80
EIS Alternative 2			
• Displacement Pressure	1-5%	1-5%	5-10%
• Financial Burden	10-20	10-20	20-30
• Can Afford	80-90	80-90	70-80
EIS Alternative 3			
• Displacement Pressure	1-5%	1-5%	1-5%
• Financial Burden	10-20	10-20	20-30
• Can Afford	80-90	80-90	70-80
EIS Alternative 4			
• Displacement Pressure	1-5%	1-5%	1-5%
• Financial Burden	10-20	10-20	10-20
• Can Afford	80-90	80-90	80-90
EIS Alternative 5			
• Displacement Pressure	1-5%	1-5%	1-5%
• Financial Burden	10-20	10-20	10-20
• Can Afford	80-90	80-90	80-90
EIS Alternative 6			
• Displacement Pressure	1-5%	1-5%	<1%
• Financial Burden	10-20	10-20	10-20
• Can Afford	80-90	80-90	80-90
Limited Action			
• Displacement Pressure	<1%	1-5%	<1%
• Financial Burden	5-10	10-20	1-5
• Can Afford	90-95	80-90	95-99

A determination of the eligibility of wastewater management facilities in the Green Lake Study Area for Federal funding has been made by the Facilities Planning Branch of EPA, Region V (June 1979). This determination stipulates that capital costs involved in 95% of the publicly-owned on-site systems along Green Lake[1] will be eligible for 85% Federal funding. Ninety-five (95) percent of the cluster system capital costs proposed in the decentralized alternatives are to be eligible for 85% Federal funding. The State of Minnesota's funding of these systems will be 60% of the non-Federal eligible capital costs.

Furthermore, gravity collector sewer (not interceptor) capital costs will be 80% eligible for 75% Federal funding. Pressure sewer capital costs will be 80% eligible for 85% Federal funding. State funding of these systems will be 80% of the non-Federal share of eligible costs. Neither hook-ups for gravity and pressure systems or operation and maintenance (O&M) costs are eligible for funding under the EPA Construction Grants Program.

b. Calculation of User Charges

User charges are presented in Table V-4. The user charges have been calculated for two different conditions: 1) the costs of the system were divided equally among all of the system's users throughout the currently sewered (Spicer City and New London Village) and the unsewered areas, and 2) the costs were prorated between the currently sewered and unsewered portions of the Proposed Service Area. The Facilities Plan allocated local costs to future residents of the Plan's Proposed Service Area. The authors of the Facilities Plan assumed the allocation would be based on each resident's proportionate share of collection and treatment costs. The allocation method of spreading

Table V-4

ANNUAL USER CHARGES

Alternative	Cost Distributed Evenly Over Entire System	Spicer City/ New London Village	Currently Unsewered Areas
Facilities Plan Proposed Action	160	160	170
EIS Alternative 1	190	110	240
EIS Alternative 2	210	150	240
EIS Alternative 3	150	100	180
EIS Alternative 4	130	140	120
EIS Alternative 5	120	150	110
EIS Alternative 6	130	150	120
Limited Action	80	120	60

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1 All on-lot systems along the lake are assumed to be publicly-owned.

costs throughout the entire system is presented for the purpose of illustration. To be equitable, the costs for areas to be served by existing sewers have been segregated from those associated with the unsewered areas. This prevents the situation where the sewered areas of Spicer City and New London Village subsidize the construction and operation of sewerage in the currently unsewered areas.

The calculation of the user charges was based on local capital costs being paid through the use of a 30 year bond at 6-7/8% interest. Some communities may be eligible for a 40 year loan at 5% interest from the Farmers Home Administration to reduce the financial burden of local capital costs. The Facilities Plan used an interest rate of 7% over a 20 year period in the computation of the various alternatives cost.

The centralized alternatives i.e., Facilities Plan Proposed Action, EIS Alternatives 1 and 2 are the most costly to the unsewered area users (and all users if costs are spread out over the entire system). Total annual user charges for each household range from $160 to $210 for the entire system, $170 to $240 for the unsewered areas, and $110 to $160 for the communities Spicer and New London.

EIS Alternatives 3, 4, 5, and 6 combine centralized and decentralized components and are less costly than the centralized alternatives for the total system and the currently unsewered areas. The costs of these alternatives for Spicer and New London Village are not significantly different from the costs of the centralized alternatives. Annual user charges range from $120 to $150 for the entire system, $100 to $150 for Spicer and New London, and $110 to $180 for the currently unsewered areas.

The Limited Action Alternative offers the lowest user charge over the entire system and incurrently unsewered areas, while EIS Alternative 3 offers the lowest user charge in Spicer and New London.

The decentralized alternatives involve the least amount of sewering and the lowest annual user charges for the entire system and residents in the currently unsewered areas.

In addition to user charges, households in the newly sewered areas would have to pay the capital costs (approximately $25 to $1,950 for each connection) of a house sewer on their property to connect to gravity and pressure collector sewers. Seasonal homeowners also may have to pay the full price for the replacement or rehabilitation of their on-site systems (septic tanks and soil absorption systems) if they do not cede these systems to the local wastewater management agency. Assuming, however, a high proportion of public on-site system ownership, EIS Alternatives 3, 4, 5 and 6 would offer a substantial reduction in private costs. Overall, private costs would vary from household to household due to the differences in the distance to the collection sewer and the condition of on-site systems.

3. LOCAL COST BURDEN

a. Significant Financial Burden

High-cost wastewater facilities may place an excessive financial burden on users of the system. Excessive burdens may cause families to alter their spending patterns substantially by diverting money from their normal expenditure categories. The Federal government has developed criteria to identify high-cost wastewater projects (The White House Rural Development Initiatives 1978). A project is identified as high-cost when the annual user charges are:

- 1.5% of median household incomes less than $6,000;
- 2.0% of median household incomes between $6,000 and $10,000; or
- 2.5% of median household incomes greater than $10,000.

The 1978 median household income for the proposed Green Lake Study Area has been estimated to be $18,000 for permanent residents. No data are available for seasonal resident income characteristics. According to the Federal criteria, annual user charges should not exceed 2.5% ($450) of the $18,000 median household income figure. Any alternative having annual user charges exceeding $450 is identified as a high-cost alternative and is likely to place a financial burden on users of the system. None of alternatives are classified as a high-cost alternative under the Federal criteria.

Significant financial burden is measured by comparing annual user charges with the distribution of household incomes. Families not facing a significant financial burden are the only families able to afford the annual wastewater user charges. The percentage of households estimated to face a significant financial burden under each of the alternatives is listed in Table V-2.

b. Displacement Pressure

Displacement pressure is the determination of the percentage of families likely to move away from the EIS Service Area as a result of costly user charges. Displacement is measured by determining the number of households having annual user charges exceeding 5% of their annual income. Displacement pressure for each of the alternatives is listed in Table V-2.

Displacement pressure for the entire system ranges from 1-10% with the greatest displacement pressure occurring under EIS Alternative 1. Residents of Spicer City and New London Village would face displacement pressures of 1-5% under each of the alternatives. Displacement pressure is greatest under EIS Alternatives 1 and 2 for the currently unsewered area.

c. Conversion Pressure

Costs of providing wastewater facilities are likely to accentuate the trend of converting seasonal residences to permanent residences already underway in the area. Capital requirements impose a higher cost burden on seasonal residences than on permanent residences on the basis of relative use. Seasonal residences are used only three or four months during the year are charged capital costs throughout the year. This may place a financial burden on seasonal residents who are supporting full year residences in addition to seasonal residences. The higher cost burden of centralized alternatives will exert more conversion pressure than the lower cost decentralized alternatives. The averaging of operation and maintenance costs among permanent and seasonal residents in addition to capital costs will intensify conversion pressures.

4. MITIGATIVE MEASURES

The significant financial burden and displacement pressure on users in the currently unsewered areas may be mitigated by the selection of EIS Alternatives 4, 5 or 6. The local wastewater management authority may seek to obtain a loan or grant from the Farmers Home Administration. Such a loan would decrease annual user charges by spreading out the payment of the local share over a longer period of time with a lower interest rate. The impacts of financial burden on seasonal users may be mitigated by not charging the seasonal residents for operation and maintenance during the months that seasonal residences are vacant.

COMPARISON OF ENVIRONMENTAL IMPACTS ASSOCIATED WITH MAJOR SYSTEM ALTERNATIVES

IMPACT CATEGORY	RESOURCE	IMPACT TYPE & DEGREE	IMPACT DESCRIPTION
Surface Water Quality	Nutrient loading	Primary: long-term	All Alternatives: Nutrient loads from septic tank drainfields and municipal wastewater treatment plant discharges are reduced with Limited Action, Proposed Action and EIS Alternatives 1-6, but tributaries continue to be a major source of phosphorus and nitrogen. Estimated total phosphorus load (with phosphorus ban) decreases (relative to existing conditions) as follows: Green = 27-33%; Nest = 24-27%; Woodcock = 77-92%.
	Eutrophication potential	Primary: long-term	All Alternatives: Green Lake - eutrophication potential decreased most sharply with complete sewering of Service Area (P.A. and EIS Alternatives 1 and 2). EIS Alternative 5 (spray irrigation), and EIS Alternative 3 & 4 (rapid infiltration): Sharpest decrease in loading → eutrophication potential is still within the range imposed by existing conditions. Nest Lake and Woodcock Lake - eutrophication potential decreases but lake remains eutrophic (nutrient rich).
Groundwater	Groundwater quantity	Primary: long-term	All Alternatives: Failure to return wastewater flows to groundwater system results in negligible loss of groundwater recharge to outwash aquifer(s).
		Secondary: long-term	All Alternatives: Loss of aquifer surface recharge area as a result of possible development of impervious surface cover is minimal.
	Groundwater quality	Primary: long-term	No Action: With the continued reliance on septic systems, there is the possibility of localized high groundwater nitrate concentrations. Phosphorus from septic systems will continue to leach in amounts sufficient to support localized algae growth. EIS Alternatives 1, 2, Proposed Action: Sewering the entire lakeshore area eliminates any possibility of septic systems as a source of nitrates for localized groundwater contamination and phosphorus as a nutrient source for localized algae growth. EIS Alternatives 3, 4, 5, and 6: A combination of renovation of septic systems and cluster system construction around lakeside areas will significantly reduce nitrate and phosphorus levels leaching into groundwater systems.
Environmentally Sensitive Areas	Floodplain	Secondary: long-term	All Alternatives: Impacts on flood hazard areas are expected to be minimal.
	Shoreline	Primary: short-term	EIS Alternatives 1, 2, 3, and Proposed Action: Construction impacts are unavoidable and directly related to total length of sewer lines.
		long-term	Impacts are judged to be minimal.
		Secondary: long-term	Development away from the lake (tiers) may be directly related to number of miles of sewer lines.
		Primary: short- and long-term	EIS Alternatives 4, 5, 6, and Limited Action: Construction impacts will be unavoidable. Duration of impacts depends on season and method of construction and extent of restoration.
		Secondary: long-term	Development will be variable in Study Areas depending on proximity to sewer line or suitability for on-lot soil disposal system.

IMPACT CATEGORY	RESOURCE	IMPACT TYPE & DEGREE	IMPACT DESCRIPTION
Environmentally Sensitive Areas (Continued)	Wetland	Primary: short- and long-term	EIS Alternatives 1, 2, 3, and Proposed Action: Construction impacts will be unavoidable. Extent of impact will be directly related to extent of sewerage. Duration of impact will relate to the timing of construction and the swiftness of restoration. EIS Alternatives 4, 5, 6, and Limited Action: Except for unavoidable effects of construction, impacts will be minimal.
		Secondary: long-term	All Alternatives: Some development may occur near or in wetlands, although less so in the centralized treatment plans.
	Archaeological/ Historical Sites	Primary and Secondary: short- and long-term	All Alternatives: Potential impacts due to construction and induced growth can be minimized with proper identification of valued sites.
	Steep Slopes	Primary: short-term	All Alternatives: Temporary increases in erosion and sedimentation can be minimized with proper construction methods. Impacts would be more significant for EIS Alternatives 1, 2, and the Proposed Action.
		long-term	EIS Alternatives 3, 4, 5, 6, and Limited Action: Impacts associated with decentralized alternatives will be minimal because only systems designed for steep slopes will be used.
		Secondary: long-term	Limited Action: Development will continue to be minimal, and impacts will be slight with the use of proper design. EIS Alternatives 1, 2, and Proposed Action: Increased development may result with extensive sewerage. EIS Alternatives 3, 4, 5, and 6: Less induced growth will result compared to EIS Alternative 1, 2, and Proposed Action.
	Prime Agricultural Lands	Primary: short-term	Limited Action: No significant impact is expected to occur. EIS Alternatives 1-6 and Proposed Action: About 30-40 acres will be used for combinations of sewer lines, ditches, lagoons, and/or treatment facilities.
		Secondary: long-term	Limited Action: Large lot requirements may result in some loss of prime agricultural lands. EIS Alternatives 3, 4, 5, and 6: Some prime agricultural lands may be lost to induced growth near cluster systems. EIS Alternatives 1, 2, and Proposed Action: Because induced growth will occur primarily near the lakes, less prime agricultural land will be lost.
Population	Rate of growth	Secondary: long-term	Proposed Action, EIS Alternatives 1 and 2: Population growth in projected to increase between 5 and 10% above that possible without centralized facilities. EIS Alternatives 3, 4, 5, and 6; Limited Action: Growth opportunities will be moderate. No Action: Growth opportunities are limited.

IMPACT CATEGORY	RESOURCE	IMPACT TYPE & DEGREE	IMPACT DESCRIPTION
Land Use	Developable acreage	Secondary: long-term	Proposed Action, EIS Alternatives 1 and 2: Provision of site-independent facilities increased the inventory of developable acreage. Less than 30 to 40 lakeshore acres were found which were likely to be developed. EIS Alternatives 3, 4, 5, and 6; Limited Action: Development opportunities are considered to be limited for these alternatives. No Action: Development is considered limited.
	Development patterns and density	Secondary: long-term	Proposed Action, EIS Alternatives 1 and 2: Some increase in the density of residential development along the lake is likely. EIS Alternatives 3, 4, 5, and 6: Development density will remain at approximately the same rate.
Local Economy	Financial Burden Displacement Pressure	Primary: long-term	Proposed Action, EIS Alternatives 1 and 2: Displacement pressure (5-30%) and financial burden (30-60%) are highest for the residents of currently unsewered areas. Spicer and New London Village residents would face displacement pressures ranging from 1-10% and a financial burden ranging from 10-40%. EIS Alternatives 3, 4, 5, and 6: Displacement pressure would range from <1-5% and financial burden from 5-30% for residents of the currently unsewered areas. The residents of Spicer and New London Village would face displacement pressure ranging from 1-5% and a financial burden ranging from 10-20%.
	Conversion Pressure		All Alternatives: Conversion pressure in the currently unsewered area would be highest under the centralized alternatives (Facilities Plan Proposed Action, EIS Alternatives 1 and 2) and minimal under the decentralized alternatives (EIS Alternatives 3, 4, 5, and 6). Conversion pressure would be moderate for the residents of Spicer and New London Village. Conversion pressure would be highest under the Facilities Plan Proposed Action and lowest under EIS Alternative 3.

CHAPTER VI

CONCLUSIONS AND RECOMMENDATIONS

A. INTRODUCTION

As discussed in Section I.D.1, EPA has several possible courses of action in addition to the Facilities Plan Proposed Action. The Agency may:

- Approve the original grant application, possibly with recommendations for design changes and/or measures to mitigate impacts of the Facilities Plan Proposed Action;

- Return the application with recommendations for additional Step I analysis;

- With the applicant's and State's concurrence, approve Step II funding for an alternative to the Facilities Plan Proposed Action;

- Reject the grant application.

The choice of one of the above options depends upon how the Alternatives in the EIS compare to the Facilities Plan Proposed Action.

B. SUMMARY OF EVALUATION

Four primary criteria were used in selecting the EIS Reommendation costs, impact, reliability, and flexibility. Within each category several factors were compared. Cost factors for example, included present worth, user charges for central sewered areas, small waste flow district user charges, and total 1980 private costs. Impacts which EPA considers to be decisive in selection of an alternative are identified and considered. The reliability of alternatives is measured against centralized collection and treatment as the standard.

A matrix offers a simple way to visualize the relationship between alternatives and the criteria used to evaluate them. By tabulating for each alternative the factors that influence the range of choice, one can quickly compare the effect of each alternative upon that factor. A matrix relating alternatives to environmental impacts is presented in Section V.F. Table VI-1 presents a matrix summarizing the relationship between the alternatives and their costs, environmental impacts, reliability, and flexibility.

Table VI-1 also ranks the alternatives according to their total present worth. This ranking has two purposes:

- Costs are easily quantifiable, perhaps the least subjective measure of value.

Table VI-1

ALTERNATIVE SELECTION MATRIX

	COSTS				ENVIRONMENTAL IMPACTS					SOCIOECONOMIC IMPACTS					
										FINANCIAL BURDEN %		DISPLACEMENT PRESSURE %			
	PRESENT WORTH (x1,000)	SPICER/ NEW LONDON USER CHARGE	SMALL WASTE FLOW DISTRICT USER COSTS	ONE TIME HOUSE-HOLD CHARGE	SURFACE WATER QUALITY IMPACTS	GROUNDWATER QUALITY IMPACTS	ENVIRON-MENTALLY SENSITIVE AREAS	POPULATION IMPACTS	LAND USE	SPICER/ NEW LONDON	SMALL WASTE-FLOW DISTRICT	SPICER/ NEW LONDON	SMALL WASTE-FLOW DISTRICT	FLEXIBILITY	RELIABILITY
Facilities Plan Proposed Action	8,411.3	160	170	1,950	• Nutrient loads from septic tank drain-fields and municipal wastewater treatment plant dis-charges are reduced. • Tributary continues to be a major source of nutrients • Estimated phosphorus load de-creases 27-33% for Green Lake and 24-27% for Nest Lake • Eutrophica-tion poten-tial sharply decreases • Nest and Woodcock Lakes remain eutrophic.	• Elimination of septic systems as a source of any ground-water pollu-tion	• Construction impacts are unavoidable and direct-ly related to the num-ber of sewer miles • Long-term impacts are minimal • Possible in-creased development away from the lake may encroach in sensitive areas.	Population increase of 5-10% greater than expected	• Increase in density of residential development around lakeshore areas is likely • Less than 30 to 40 lakeshore acres are likely to be develop-ed	20-30%	30-40%	5-10%	5-10%	Reduced flexibility in terms of design changes; but there is flexability for added treatment capacity	High, centralized collection and treatment has been tested and proven. Pumps may be subject to periodic failure.
EIS Alternative #1	9,394.2	110	240	25	Same as Proposed Action	Same as Proposed Action	Same as Proposed Action	Same as Proposed Action	Same as Proposed Action	10-20%	50-60%	1-5%	20-30%	Same as Proposed Action	Higher than Proposed Action because of fewer pumps subject to failure.
EIS Alternative #2	9,475.5	150	240	25	Same as Proposed Action	Same as Proposed Action	Same as Proposed Action	Same as Proposed Action	Same as Proposed Action	10-20%	40-50%	1-5%	10-20%	Same as Proposed Action	Same as Proposed Action

Table VI-1

ALTERNATIVE SELECTION MATRIX (Continued)

	COSTS				ENVIRONMENTAL IMPACTS			SOCIOECONOMIC IMPACTS							
										FINANCIAL BURDEN %		DISPLACEMENT PRESSURE %			
	PRESENT WORTH (x1,000)	SPICER/ NEW LONDON USER CHARGE	SMALL WASTE FLOW DISTRICT USER COSTS	ONE TIME HOUSE-HOLD CHARGE	SURFACE WATER QUALITY IMPACTS	GROUNDWATER QUALITY IMPACTS	ENVIRON-MENTALLY SENSITIVE AREAS	POPULATION IMPACTS	LAND USE	SPICER/ NEW LONDON	SMALL WASTE-FLOW DISTRICT	SPICER/ NEW LONDON	SMALL WASTE-FLOW DISTRICT	FLEXIBILITY	RELIABILITY
EIS Alternative #3	6,113.7	100	180	470	• Same as Proposed Action except nutrient loading from septic tank will be reduced but not eliminated	• Significant reduction of nitrate and phosphorus levels leaching into groundwater systems, but not eliminated	Same as Proposed Action	Growth opportunities will be moderate	• Development opportunities for this type of alternative is considered limited	10-20%	20-30%	1-5%	1-5%	Increased flexibility for future land planning because of the decentralized nature of the alternative; good flexability for adding treatment capacity	Limited: Proper maintenance of on-site and cluster systems should improve reliability of these systems. Any systems located in areas of marginal soils, shallow geology or shallow water will be subject to failure.
EIS Alternative #4	5,092.6	140	120	190	Same as EIS Alternative #3	Same as EIS Alternative #3	Same as Proposed Action	Same as EIS Alternative #3	Same as EIS Alternative #3	10-20%	5-10%	1-5%	<1%	Same as EIS Alternative #3	Same as EIS Alternative #3
EIS Alternative #5	5,365.5	150	110	190	Same as EIS Alternative #3	Same as EIS Alternative #3	Same as Proposed Action	Same as EIS Alternative #3	Same as EIS Alternative #3	10-20%	5-10%	1-5%	<1%	Same as EIS Alternative #3	Same as EIS Alternative #3
EIS Alternative #6	4,507.5	150	120	190	Same as EIS Alternative #3	Same as EIS Alternative #3	Same as Proposed Action	Same as EIS Alternative #3	Same as EIS Alternative #3	10-20%	10-20%	1-5%	<1%	Same as EIS Alternative #3	Same as EIS Alternative #3
Limited Action Alternative	2,887.2	120	60	-	Same as EIS Alternative #3	Same as EIS Alternative #3	Same as Proposed Action	Same as EIS Alternative #3	Same as Eis Alternative #3	10-20%	1-5%	1-5%	<1%	Same as EIS Alternative #3	Same as EIS Alternative #3

- EPA Construction Grants regulations require selection of the most cost-effective alternative, that is, the alternative meeting project goals with the least total present worth with acceptable environmental and socioeconomic impacts.

Selection of the cost-effective alternative requires identification of trade-offs between costs and other criteria. The evaluation factors included with total present worth in Table VI-1 are those EPA has determined to be most important in identifying trade-offs for this project.

C. CONCLUSIONS

In regard to the existing on-site systems around Green Lake and Nest Lake, information gathered during the preparation of this EIS has indicated the following: 1) Approximately 25 effluent plumes were found entering Green Lake and 12 entering Nest Lake. 2) Five septic system surface malfunctions* were confirmed by field verification of aerial photography. 3) Sanitary surveys have revealed that periodic sewage backups in some households have occurred. 4) Effluent plumes from septic systems do not contribute significant quantities of nutrients to Green Lake or Nest Lake. While detailed site-by-site analysis may reveal more problems, field studies conducted so far indicate that the percentage of systems causing problems are small.

Most of the on-site systems presently in use within the EIS Service Area are poorly maintained and many are inadequately designed. Routine maintenance for all on-site systems and upgrading of inadequately designed systems will substantially reduce the number of problems caused by them.

Where problems cannot be solved by routine maintenance or upgrading alone, alternatives to the conventional septic tank -- subsurface adsorption systems are feasible in the Study Area which will minimize or eliminate the problems.

Future growth in the Green Lake watershed depends on how many new lots can be developed and the allowable density. Wastewater disposal alternatives relying on continued use of on-site systems as compared to extensive sewering around the lake would restrict both the number of new lots as well as their density. An effect of these limitations would be to preserve the present character of the community.

Total present worth for the centralized alternatives (Facilities Plan Proposed Action, EIS Alternatives 1, 2, and 3) are substantially higher than for the decentralized alternatives (EIS Alternatives 4, 5, 6, and Limited Action). As calculated in this EIS, the Facilities Plan Proposed Action is 57% more expensive than EIS Alternative 5 and 91% more expensive than Limited Action. Differences in water quality impacts of the alternatives are not proportionate to these large differences in costs.

Because of the high costs and limited benefits to water quality with the centralized alternatives (Facilities Plan Proposed Action and EIS Alternatives 1, 2 and 3), they are not cost-effective and are not recommended.

The No Action Alternative was unacceptable for three reasons:

- Existing treatment plants at New London and Spicer do not comply with effluent requirements and contribute substantially to high productivity in Nest Lake and Woodcock Lake.

- There are some problems with on-site systems in the remainder of the Proposed EIS Service Area which should be addressed through monitoring, improved maintenance of the existing and future systems, residential water conservation, and renovation or replacement of existing systems.

- Improved surveillance and regulation of on-site systems in the Green Lake watershed to insure maintenance of the lake's unique scenic and recreational values is recommended.

The remaining alternatives, EIS Alternatives 4, 5 and 6, include the use of alternative on-site and small scale off-site systems around Green Lake and Nest Lake. They differ in their methods for treating and disposing of New London's and Spicer's wastewaters: Alternative 4 uses joint pretreatment and rapid infiltration; Alternative 5 uses joint pretreatment and spray irrigation; and Alternative 6 employs separate tertiary treatment facilities for both communities.

Costs and environmental impacts are similar for these three alternatives. Lack of detailed data on site characteristics creates some uncertainty in the determination of reliability for the land application alternatives. In addition the possible unavailability of land application sites may prove a potential problem for implementation.

D. DRAFT EIS RECOMMENDATIONS

Because EIS Alternatives 4 and 5 (decentralized approaches with land application) and 6 (decentralized approach with upgrade/expansion of wastewater treatment plants at Spicer and New London) can all be considered cost-effective, and because they differ substanitally from the Facilities Plan Proposed Action (centralized approach with stabilization ponds), the recommendation of this EIS is to return the grant application to the Green Lake Sanitary Sewer and Water District (GLSSWD) for additional Step 1 analysis. The scope of additional analysis will depend on the applicant's own decisions regarding the feasibility of the small waste flows approach for Green Lake and Nest Lake and the merits of land application for wastewaters from Spicer and New London.

Alternatives 4, 5, and 6 differ in the type and location of treatment and disposal facilities for Spicer's and New London's wastewaters. The GLSSWD will need to conduct additional Step 1 analyses, funded by EPA, of alternatives to serve Spicer and New London jointly or separately. EPA encourages the use of land application and will require evaluation of land application including detailed site analyses. If GLSSWD chooses Alternative 6, the Step 1 analyses must include the following:

- Applicant's own analysis of the feasibility and costs of treatment plant upgrading;

- Engineering, cost and environmental analysis of sludge management options; and

- Engineering, cost, and environmental analysis of effluent disinfection options.

EPA will participate in funding additional site specific analyses of existing on-site systems, their design, usage and environmental impacts. These additional analyses will address:

- Development of a site-specific environmental and engineering data base;

- Design of the management organization; and

- Start-up of the management district.

The applicant will need to complete additional Step 1 requirements by taking the following actions (40 CFR 35.918):

- Certify that construction of the project and operation and maintenance program will meet local, State and Federal requirements. As a first step, this certification involves a lot-by-lot investigation of existing septic tank systems and site suitability for wastewater treatment. If it can be demonstrated that existing systems do not degrade lake water quality or promote public health problems, despite the findings of the lot-by-lot investigation, then the GLSSWD may initiate variance procedures for these systems under the Minnesota Shoreland Management Act which has been adopted and amended by Kandiyohi County. The specific variance that would be negotiated between the GLSSWD and the County involves the Act's stipulation that there be a 4-foot vertical distance between the bottom of the septic tank drainfield and the highest known groundwater elevation.

- Obtain assurance of unlimited access to each individual system at all reasonable times for such purposes as inspections, monitoring, construction, maintenance, operations, rehabilitation and replacement.

- Plan for a comprehensive program of regulation and inspection for individual systems.

E. IMPLEMENTATION

Management of centralized and decentralized wastewater facilities is discussed in Section III.D. and Appendix I-3. Two topics which the District will have to address in regard to small waste flow management are discussed below.

1. COMPLIANCE WITH STATE AND LOCAL STANDARDS IN THE SMALL WASTE FLOWS DISTRICT

As discussed in Section II.C. many existing on-site systems do not conform to current design standards for site, design or distance from wells or surface waters. For some systems, such as those with undersized septic tanks, non-conformance can be remedied relatively easily and inexpensively. In other cases the remedy may be disruptive and expensive and should be undertaken only where the need is clearly identified. Data on the effects of existing systems indicate that many existing non-conforming systems, and future repairs that still may not conform to design standards, may operate satisfactorily. Where compliance with design standards is either 1) unfeasible or too expensive or 2) site monitoring of ground and surface waters shows that acceptable impacts are attainable, then a variance procedure to allow renovation and continued use of non-conforming system is recommended. Decisions to grant variances should be based on site-specific data or on a substantial history of similar sites in the area.

Local and state decisions on variance procedures would likely be influenced by the degree of authority vested in the small waste flows district. If the district has the authority and sufficient financial means to correct errors, plus the trained personnel to minimize errors in granting variances, variance procedures may be more liberal than where financial and professional resources are limited. Higher local costs, caused by unnecessary repairs or abandonment of systems would be expected to result from very conservative or no variance guidelines. Conversely, ill-conceived or improperly implemented variance procedures would cause frequent water quality problems and demands for more expensive off-site technologies.

2. OWNERSHIP OF ON-SITE SYSTEMS SERVING SEASONAL RESIDENCES

Construction Grants regulations allow Federal funding for renovation and replacement of publicly owned on-site systems serving permanent or seasonally occupied residences and of privately owned on-site systems serving permanent residences. Privately owned systems serving seasonally occupied residences are not eligible for Federally funded renovation and replacement.

Depending on the extent and costs of renovation and replacement necessary for seasonal residences, the municipalities or a small waste flows district may elect to accept ownership of the on-site systems. Rehabilitation of these systems would then be eligible for Federal assistance, and local costs for seasonal residents would be dramatically reduced. Any decision to accept ownership on a community-wide basis should await the conclusions of the site-specific environmental and engineering analyses and preliminary determination of the functions of the management agency. Ownership of seasonally used systems may create responsibilities that the agency is not equipped to discharge.

CHAPTER VII

THE RELATIONSHIP BETWEEN SHORT-TERM USE AND LONG-TERM PRODUCTIVITY

A. SHORT-TERM USE OF THE STUDY AREA

The Green Lake Study Area has been, and will continue to be used as a residential/recreational area. The site was initially disturbed when construction of houses began approximately 20 years ago.

Disturbance of the site by routine residential/recreational activities will continue. Implementation of either the action proposed by the Facilities Plan or recommended in this EIS is not expected to alter these disturbances.

B. IMPACTS UPON LONG-TERM PRODUCTIVITY

1. COMMITMENT OF NON-RENEWABLE RESOURCES

If the Facilities Plan Proposed Action were implemented, an increased potential for development may result in some loss of terrestrial habitat. Such would be expected to a lesser extent by implementation of the EIS Recommendations.

Non-renewable resources associated with either action would include concrete for construction. Consumption of electric power by pumps may also increase. Manpower would also be committed to the construction, operation and management of new or rehabilitated facilities.

2. LIMITATIONS OF BENEFICIAL USE OF THE ENVIRONMENT

Aquatic recreation is one of the major benefits enjoyed by people, residents and visitors alike, in the Green Lake Study Area. Public access to this 5400 acre recreational resource has become increasingly restricted over the past 20 years, with approximately 85% of the Green Lake shoreline currently supporting year-round and seasonal cottage development. It is judged that the implementation of any centralized wastewater management plan, such as the Proposed Action or EIS Alternatives 1 and 2, would significantly increase the current level of recreational activity through induced near-shore development. This activity may become aesthetically displeasing to current residents, many of whom come to Green Lake during the vacation season to leave urban crowds. The implementation of decentralized EIS alternatives (3, 4, 5, 6, and Limited Action) would have a less significant effect on the recreational benefits of the Green Lake area, because induced growth would be less dense and more scattered than that afforded by centralized wastewater management.

CHAPTER VIII

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

The resources that would be committed during implementation of any of the EIS Recommendations include those associated with construction and maintenance of wastewater systems. These were discussed in Section VI.B.1.

In addition, growth expected in the Study Area would require a commitment of resources to the construction of new dwellings and commercial establishments, construction or improvement of roads and facilities associated with water sports. Besides construction materials, such as lumber, steel, concrete and glass, electricity and manpower would also be committed to new development.

Human resources would include construction personnel and, perhaps infrastructural personnel to service the added community needs.

CHAPTER IX

PROBABLE ADVERSE IMPACTS WHICH CANNOT BE AVOIDED

If the action proposed by the Facilities Plan were implemented, some destruction of terrestrial habitat would result from construction of new dwellings. Such would be true, but to a lesser extent, if any EIS Recommendations were implemented.

Construction of sewage lagoons or new sewer lines would disturb the soil, resulting in sediment runoff. This runoff would cause a temporary increase in siltation in both streams and offshore areas. This type of runoff can also be caused by the extensive excavation required during upgrade or rennovation of on-site septic systems and off-site cluster systems.

GLOSSARY

ACTIVATED SLUDGE PROCESS. A method of secondary wastewater treatment in which a suspended microbiological culture is maintained inside an aerated treatment basin. The microbial organisms oxidize the complex organic matter in the wastewater to carbon dioxide, water, and energy.

ADVANCED WASTE TREATMENT. Wastewater treatment beyond the secondary or biological stage that includes removal of nutrients such as phosphorus and nitrogen and a high percentage of suspended solids. Advanced waste treatment, also known as tertiary treatment, is the "polishing stage" of wastewater treatment and produces a high quality of effluent.

AEROBIC. Refers to life or processes that occur only in the presence of oxygen.

ALGAL BLOOM. A proliferation of algae on the surface of lakes, streams or ponds. Algal blooms are stimulated by phosphate enrichment.

ALKALINE. Having the qualities of a base, with a pH of more than 7.

ALLUVIAL. Pertaining to material that has been carried by a stream.

ALTERNATIVE TECHNOLOGY. A technology whose use has been widely supported by experience, but is not a variant of conventional biological or physical/chemical treatment.

AMBIENT AIR. The unconfined portion of the atmosphere; the outside air.

ANAEROBIC. Refers to life or processes that occur in the absence of oxygen.

ANNULAR SPACE. The open space between particles of soil material.

AQUATIC PLANTS. Plants that grow in water, either floating on the surface, or rooted emergent or submergent.

AQUIFER. A geologic stratum or unit that contains water and will allow it to pass through. The water may reside in and travel through innumerable spaces between rock grains in a sand or gravel aquifer, small or cavernous openings formed by solution in a limestone aquifer, or fissures, cracks, and rubble in such harder rocks as shale.

ARTESIAN AQUIFER. A water-filled layer that is sufficiently compressed between less permeable layers to cause the water to rise above the top of the aquifer. If the water pressure is great, water will flow freely from artesian wells.

ARTESIAN WELL. A well in which flow is sustained by the hydrostatic pressure of the aquifer. See Artesian Aquifer.

BACTERIA. Any of a large group of microscopic organisms living in soil, water or organic matter, important to man because of their chemical effects as in nitrogen fixation, putrefaction, or fermentation, or as pathogens.

BAR SCREEN. In wastewater treatment, a screen that removes large floating and suspended solids.

BASE FLOW. The rate of movement of water in a stream channel which occurs typically during rainless periods when stream flow is maintained largely or entirely by discharges of groundwater.

BASIC USAGE. In regard to functions of small waste flow districts, those which would be required to comply with EPA Construction Grants regulations governing individual on-site wastewater systems.

BEDROCK. The solid rock beneath the soil and subsoil.

BIOCHEMICAL OXYGEN DEMAND (BOD). A measure of the amount of oxygen consumed in the biological processes that decompose organic matter in water. Large amounts of organic waste use up large amounts of dissolved oxygen; thus, the greater the degree of pollution, the greater the BOD.

BIOMASS. The weight of living matter in a specified unit of environment. Or, an expression of the total mass or weight of a given population of plants or animals.

BIOTA. The plants and animals of an area.

BOD_5. See "Biochemical Oxygen Demand." Standard measurement is made for 5 days at 20°C.

BOG. Wet, spongy land; usually poorly drained, and rich in plant residue, ultimately producing highly acid peat.

CALCASEOUS. Resembling, containing of composed of calcium carbonate.

CAPITAL COSTS. All costs associated with installation (as opposed to operation) of a project.

CAPITAL EXPENDITURES. See Capital Costs.

CHLORINATION. The application of chlorine to drinking water, sewage or industrial waste for disinfection or oxidation of undesirable compounds.

COARSE FISH. See Rough Fish.

COLIFORM BACTERIA. Members of a large group of bacteria that flourish in the feces and/or intestines of warm-blooded animals, including man. Fecal coliform bacterial, particularly Escherichia coli (E. coli), enter water mostly in fecal matter, such as sewage or feed-lot runoff. Coliform bacteria apparently do not cause serious human diseases, but these organisms are abundant in polluted waters and they are fairly easy to detect. The abundance of coliform bacteria in water, therefore, is used as an index to the probability of the occurrence of such diease-producing bodies (pathogens) as Salmonella, Shigella, and enteric viruses. These pathogens are relatively difficult to detect.

COLIFORM ORGANISM. Any of a number of organisms common to the intestinal tract of man and animals whose presence in wastewater is an indicator of pollution and of potentially dangerous bacterial contamination.

COMMINUTOR. A machine that breaks up wastewater solids.

CONNECTION FEE. Fee charged by municipality to hook up house connection to lateral sewer.

CLUSTER SYSTEM. A soil dependent waste disposal system that uses a common septic drainfield for up to 25 individual residences.

CRUSTACEANS. Zonal growths of algae, masses, lickens, or liverwarts having variable coverage and thickness of only a few centimeters.

CUBIC FEET PER SECOND (cfs). A measure of the amount of water passing a given point.

CULTURAL EUTROPHICATION. Acceleration by man of the natural aging process of bodies of water.

DECIDUOUS. The term describing a plant that periodically loses all of its leaves, usually in the autumn. Most broadleaf trees in North America, and a few conifers, such as larch and cypress, are deciduous.

DECOMPOSITION. Reduction of the net energy level and change in chemical composition of organic matter by action of aerobic or anaerobic microorganisms. The breakdown of complex material into simpler substances by chemical or biological means.

DETENTION TIME. Average time required to flow through a basin. Also called retention time.

DETRITUS. (1) The heavier debris moved by natural watercourses, usually in bed loam form. (2) The sand, grit, and other coarse material removed by differential sedimentation in a relatively short period of detention.

DISINFECTION. Effective killing by chemical or physical processes of all organisms capable of causing infectious disease. Chlorination is the disinfection method commonly employed in sewage treatment processes.

DISSOLVED OXYGEN (DO). The oxygen gas (O_2) dissolved in water or sewage. Adequate oxygen is necessary for maintenance of fish and other aquatic organisms. Low dissolved oxygen concentrations generally are due to presence of excessive organic solids having high BOD in inadequately treated wastewater.

DRAINAGE BASIN. (1) An area from which surface runoff is carried away by a single drainage system. Also called catchment area, watershed, drainage area. (2) The largest natural drainage area subdivision of a continent. The United States has been divided at one time or another, for various administrative purposes, into some 12 to 18 drainage basins.

DRAINAGEWAYS. Man-made passageways, usually lined with grass or rock, that carry runoff of surface water.

EFFLUENT. Wastewater or other liquid, partially or completely treated, or in its natural state, flowing out of a reservoir, basin, treatment plant, or industrial treatment plant, or part thereof.

EFFLUENT LIMITED. Any stream segment for which it is known that water quality will meet applicable water quality standards after the application of effluent limitations.

ELEVATED MOUND. A mound, generally constructed of sand, to which settled wastewater is applied. Usually used in areas where conventional on-site treatment is inadequate.

ENDANGERED SPECIES (FEDERAL CLASSIFICATION). Any species of animal or plant declared to be in known danger of extinction throughout all or a significant part of its range. Protected under Public Law 93-205 as amended.

ENDANGERED SPECIES (STATE CLASSIFICATION). Minnesota's list includes those species on the Federal list that are resident for any part of their life cycle in Minnesota. It also includes indigenous species the State believes are uncommon and in need of study.

ENDECO. Type 2100 Septic Leachate Dector. See "Septic Snooper".

ENVIRONMENT. The conditions external to a particular object, but generally limited to those conditions which have a direct and measurable effect on the object. Usually considered to be the conditions which surround and influence a particular living organism, population, or community. The physical environment includes light, heat, moisture, and other principally abiotic components. The components of the biotic environment are other living organisms and their products.

ENVIRONMENTAL IMPACT STATEMENT. A document required by the National Environmental Policy Act (PL 91-190, 1969) that is used in the decision-making process to evaluate the effects (impacts) of a proposed action on the human, biological, and physical environment.

EPILIMINION. The upper layer of more or less uniformly warm, circulating, and fairly turbulent water in lakes during the spring heating season.

EROSION. The process by which an object is eroded, or worn away, by the action of wind, water, glacial ice, or combinations of these agents. Sometimes used to refer to results of chemical actions or temperature changes. Erosion may be accelerated by human activities.

EUTROPHIC. Waters with a relatively large concentration of nutrients and hence a large production of organic matter, often shallow, with periods of oxygen deficiency.

EUTROPHIC LAKES. Shallow lakes, weed-choked at the edges and very rich in nutrients. The water is characterized by large amounts of algae, low water transparency, low dissolved oxygen and high BOD.

EUTROPHICATION. The normally slow aging process by which a lake evolves into a bog or marsh, ultimately assumes a completely terrestrial state and disappears. During eutrophication the lake becomes so rich in nutritive compounds, especially nitrogen and phosphorus, that algae and plant life become superabundant, thereby "choking" the lake and causing it eventually to dry up. Eutrophication may be accelerated by human activities.

EVAPOTRANSPIRATION. A process by which water is evaporated and/or transpired from water, soil, and plant surfaces.

FECAL COLIFORM BACTERIA. The group of organisms common to the intestinal tracts of man and of animals. The presence of fecal coliform bacteria in water is an indicator of pollution and of potentially dangerous bacterial contamination.

FLOE. A sheet of floating ice.

FORCE MAIN. Pipe designed to carry wastewater under pressure.

GLACIAL DEPOSIT. A mass of rock, soil, and earth material deposited by a melting glacier. Such material was originally picked up and carried along its path by the glacier, and usually varies in texture from very fine rock flour to large boulders. Named according to their location and shape.

GLACIAL DRIFT. Material which has been deposited by a glacier or in connection with glacial processes. It consists of rock flour, sand, pebbles, cobbles, and boulders. It may occur in a heterogeneous mass or be more or less well-sorted, according to its manner of deposition.

GRAVITY SYSTEM. A system of conduits (open or closed) in which no liquid pumping is required.

GROUNDWATER. Water that is below the water table.

GROUNDWATER RUNOFF. Groundwater that is discharged into a stream channel as spring or seepage water.

HABITAT. The specific place or the general kind of site in which a plant or animal normally lives during all or part of its life cycle.

HOLDING TANK. Enclosed tank, usually of fiberglass or concrete, for the storage of wastewater prior to removal or disposal at another location.

HYDROPONIC. Refers to growth of plants in a nutrient solution, perhaps with the mechanical support of an inert medium such as sand.

HYPOLIMNION. Deep, cold and relatively undisturbed water separated from the surface layer in lakes.

IGNEOUS. Rock formed by the solidification of magma (hot molten material).

INDIAN MOUND SYSTEM. See Elevated Mound.

INFILTRATION. The flow of a fluid into a substance through pores or small openings. Commonly used in hydrology to denote the flow of water into soil material.

INFILTRATION/INFLOW. Total quantity of water entering a sewer system. Infiltration means entry through such sources as defective pipes, pipe joints, connections, or manhole walls. Inflow signifies discharge into the sewer system through service connections from such sources as area or foundation drainage, springs and swamps, storm waters, street wash waters, or sewers.

INTERCEPTOR SEWERS. Sewers used to collect the flows from main and trunk sewers and carry them to a central point for treatment and discharge. In a combined sewer system, where street runoff from rains is allowed to enter the system along the sewage, interceptor sewers allow some of the sewage to flow untreated directly into the receiving stream, to prevent the treatment plant from being overloaded.

INNOVATIVE TECHNOLOGY. A technology whose use has not been widely documented by experience and is not a variant of conventional biological or physical/chemical treatment.

LAGOON. In wastewater treatment, a shallow pond, usually man-made, in which sunlight, algal and bacterial action and oxygen interact to restore the wastewater to a reasonable state of purity.

LAND TREATMENT. A method of treatment in which the soil, air, vegetation, bacteria, and fungi are employed to remove pollutants from wastewater. In its most simple form, the method includes three steps: (1) pretreatment to screen out large solids; (2) secondary treatment and chlorination; and (3) spraying over cropland, pasture, or natural vegetation to allow plants and soil microorganisms to remove additional pollutants. Much of the sprayed water evaporates, and the remainder may be allowed to percolate to the water table, discharged through drain tiles, or reclaimed by wells.

LEACHATE. Solution formed when water percolates through solid wastes, soil or other materials and extracts soluble or suspendable substances from the material.

LEACHFIELD. Soil component of a septic system which removes particulate matter and nutrients.

LIMITING FACTOR. A factor whose absence, or excessive concentration, exerts some restraining influence upon a population.

LOAM. The textural class name for soil having a moderate amount of sand, silt, and clay. Loam soils contain 7 to 27% of clay, 28 to 50% of silt, and less than 52% of sand.

LOESS. Soil of wind-blown origin, predominantly silt and fine sand.

MACROPHYTE. A large (not microscopic) plant, usually in an aquatic habitat.

MELT WATER. Water which is formed from the melting of snow, rime, or ice.

MESOTROPHIC. Waters with a moderate supply of nutrients and no significant production of organic matter.

MESOTROPHIC LAKE. Lakes of intermediate characteristics between oligotrophic and eutrophic. They contain a moderate supply of nutrients and plant life.

METHEMOGLOBINEMIA. The presence of methemoglobin in the blood. Methemoglobin is the oxidized form of hemoglobin and it is unable to combine reversibly with oxygen.

MICROSTRAINER. A device for screening suspended solids that are not removed by sedimentation.

MILLIGRAM PER LITER (mg/l). A concentration of 1/1000 gram of a substance in 1 liter of water. Because 1 liter of pure water weighs 1,000 grams, the concentration also can be stated as 1 ppm (part per million, by weight). Used to measure and report the concentrations of most substances which commonly occur in natural and polluted waters.

MORPHOLOGICAL. Pertaining to Morphology.

MORPHOLOGY. The form or structure of a plant or animal, or of a feature of the earth, such as a stream, a lake, or the land in general. Also, the science that is concerned with the study of form and structure of living organisms. Geomorphology deals with the form and structure of the earth.

NON-POINT SOURCE. A general source of pollution not originating from a single controllable source. Surface water runoff is an example of a non-point source that is not easily controlled.

NUTRIENT BUDGET. The amount of nutrients entering and leaving a body of water on an annual basis.

NUTRIENTS. Elements or compounds essential as raw materials for organisms growth and development, e.g. carbon, oxygen, nitrogen, and phosphorus.

OLIGOTROPHIC. Waters with a small supply of nutrients and hence an insignificant production of organic matter.

OLIGOTROPHIC LAKES. Deep lakes that have a low supply of nutrients and thus contain little organic matter. Such lakes are characterized by high water transparency and high dissolved oxygen.

ORDINANCE. A municipal or county regulation.

OUTWASH. Drift carried by melt water from a glacier and deposited beyond the marginal moraine.

OUTWASH PLAIN. A plain formed by material deposited by melt water from a glacier flowing over a more or less flat surface of large area. Deposits of this origin are usually distinguishable from ordinary river deposits by the fact that they often grade into moraines and their constituents bear evidence of glacial origin. Also called frontal apron.

PARAMETER. Any of a set of physical properties whose values determine characteristics or behavior.

PERCOLATION. The downward movement of water through pore spaces or larger voids in soil or rock.

PERMEABILITY. The property or capactiy of porous rock, sediment, or soil to transmit a fluid, usually water or air; it is a measure of the relative ease of flow under unequal pressures. Terms used to describe the permeability of soil are: slow, less than 0.2 inch per hour; moderately slow, 0.2 to 0.63 inch; moderate, 0.63 to 2.0 inches; moderately rapid. 2.0 to 6.3 inches; and rapid, more than 6.3 inches per hour. A very slow class and a very rapid class also may be recognized.

PETROGLYPH. An ancient or prehistoric carving or inscription on a rock.

PHOSPHORUS LIMITED. Of all the primary nutrients necessary to support algal growth, phosphorus is in the shortest supply and therefore can limit additional algal growth.

PHYTOPLANKTON. Floating plants, microsopic in size, that both supply small animals with food and give polluted water its green color and bad taste.

POINT SOURCE. A stationary source of a large individual emission. This is a general definition; point source is legally and precisely defined in Federal regulations.

POVERTY LEVEL. An index providing a range of poverty income cutoffs adjusted by such factors as family size, sex of family head, number of children under 18 years of age, and farm or non-farm residence.

PREHISTORIC. A term which describes the period of human development that occurred before the advent of written records. More generally, any period in geologic time before written history.

PRESENT WORTH. The sum of money that must be set aside at the beginning of the planning period in order to amortize the costs of a project over the planning period.

PRESSURE SEWER SYSTEM. A wastewater collection system in which household wastes are collected in the building drain and conveyed therein to the pretreatment and/or pressurization facility. The system consists of two major elements, the on-site or pressurization facility, and the primary conductor pressurized sewer main.

PRIMARY PRODUCTION. Growth of green plants resulting from solar energy being fixed as sugar during photosynthesis.

PRIMARY TREATMENT. The first stage in wastewater treatment in which substantially all floating or settleable solids are mechanically removed by screening and sedimentation.

RAPID INFILTRATION. A form of land treatment where wastewater is placed into spreading basins and applied to the land to undergo percolation into the soil.

RARE SPECIES. A species not Endangered or Threatened but uncommon and deserving of further study and monitoring. Peripheral species, not listed as threatened, may be included in this category along with those species that were once "threatened" or "endangered" but now have increasing or protected, stable populations.

RECHARGE. The process by which water is added to an aquifer. Used also to indicate the water that is added. Natural recharge occurs when water from rainfall or a stream enters the ground and percolates to the water table. Artificial recharge by spreading water on absorptive ground over an aquifer or by injecting water through wells is used to store water and to protect groundwater against the intrusion of sea water.

ROOTED AQUATIC PLANTS. Aquatic or water borne plants which take root below water.

ROUGH FISH. Those fish species considered to be of low sport value when taken on tackle, or of poor eating quality; e.g. gar, suckers. Rough fish are more tolerant of widely changing environmental conditions than are game fish. Also called coarse fish.

RUNOFF. The portion of rainfall, melted snow or irrigation water that flows across the ground surface and eventually is returned to streams. Runoff can pick up pollutants from the air or the land and carry them to the receiving waters.

SANITARY SEWERS. Sewers that transport only sanitary wastewater. Storm water runoff is carried in a separate system. See sewer.

SANITARY SURVEY. A method used to determine possible sources of water quality and public health problems and to locate inadequately functioning wastewater systems by making site-specific investigations of existing lots and systems.

SCENIC EASEMENT. A partial transfer of land rights to preserve the aesthetic attractiveness of the land by restricting activities such as the removal of trees, placement of billboards, or development incompatible with the scenic qualities of the land. Just compensation is given to owners for rights lost. The right of legal trespass is generally not included as part of this easement.

SECCHI DISK. A round plate, 30 cm (1 foot) in diameter, that is used to measure the transparency of water. The disk is lowered into the water until it no longer can be seen from the surface. The depth at which the disk becomes invisible is a measure of transparency.

SECONDARY TREATMENT. Wastewater treatment in which bacteria consume the organic parts of the wastes. This biochemical action is accomplished by use of trickling filters or the activated sludge process. Effective secondary treatment may remove approximately 90% of both BOD_5 and suspended solids.

SEEPAGE CELLS. Unlined wastewater lagoons designed so that all or part of wastewater percolates into the underlying soil.

SEMI-AQUATIC. Plants that can exist on both land and in water.

SEPTIC SNOOPER. Trademark for the ENDECO (Environmental Devices Corporation) Type 2100 Septic Leachate Detector. This instrument consists of an underwater probe, a water intake system, an analyzer control unit and a graphic recorder. Water drawn through the instrument is continuously analyzed for specific fluorescence and conductivity. When calibrated against typical effluents, the instrument can detect and profile effluent-like substances and thereby locate septic tank leachate or other sources of domestic sewage entering lakes and streams.

SEPTIC TANK. An underground tank used for the collection of domestic wastes. Bacteria in the wastes decompose the organic matter, and the sludge settles to the bottom. The effluent flows through drains into the ground. Sludge is pumped out at regular intervals.

SEPTIC TANK EFFLUENT PUMP (STEP). Pump designed to transfer settled wastewater from a septic tank to a sewer.

SEPTIC TANK SOIL ABSORPTION SYSTEM (ST/SAS). A system of wastewater disposal in which large solids are retained in a tank; fine solids and liquids are dispersed into the surrounding soil by a system of pipes.

SEWER, COMBINED. A sewer, or system of sewers, that is used to collect and conduct both sanitary sewage and storm-water runoff. During rainless periods, most or all of the flow in a combined sewer is composed of sanitary sewage. During a storm, runoff increases the rate of flow and may overload the sewage treatment plant to which the sewer connects. At such times, it is common to divert some of the flow, without treatment, into the receiving water.

SEWER, INTERCEPTOR. See Interceptor Sewer.

SEWER, LATERAL. A sewer designed and installed to collect sewage from a limited number of individual properties and conduct it to a trunk sewer. Also known as a street sewer or collecting sewer.

SEWER, SANITARY. See Sanitary Sewer.

SEWER, STORM. A conduit that collects and transports storm-water runoff. In many sewerage systems, storm sewers are separate from those carrying sanitary or industrial wastewater.

SEWER, TRUNK. A sewer designed and installed to collect sewage from a number of lateral sewers and conduct it to an interceptor sewer or, in some cases, to a sewage treatment plant.

SHOALING. The bottom effect that influences the height of waves moving from deep to shallow water.

SINKING FUND. A fund established by periodic installments to provide for the retirement of the principal of term bonds.

SLOPE. The incline of the surface of the land. It is usually expressed as a percent (%) of slope that equals the number of feet of fall per 100 feet in horizontal distance.

SOIL ASSOCIATION. General term used to describe taxonomic units of soils, relative proportions, and pattern of occurrence.

SOIL LIMITING FACTOR. Any physical characteristic which impedes the proper renovation of wastewater in soils.

SOIL TEXTURAL CLASS. The classification of soil material according to the proportions of sand, silt, and clay. The principal textural classes in soil, in increasing order of the amount of silt and clay, are as follows: sand, loamy sand, sandy loam, loam, silt loam, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay, and clay. These class names are modified to indicate the size of the sand fraction or the presence of gravel, sandy loam, gravelly loam, stony clay, and cobbly loam, and are used on detailed soil maps. These terms apply only to individual soil horizons or to the surface layer of a soil type.

STATE EQUALIZED VALUATION (SEV). A measure employed within a State to adjust actual assessed valuation upward to approximate true market value. Thus it is possible to relate debt burden to the full value of taxable property in each community within that State.

SPRAY IRRIGATION. Desposing of semi-treated wastewater by spraying upon the land at slow application rates.

STRATIFICATION. The condition of a lake, ocean, or other body of water when the water column is divided into a relatively cold bottom layer and a relatively warm surface layer, with a thin boundary layer (thermocline) between them. Stratification generally occurs during the summer and during periods of ice cover in the winter. Overturns, of periods of mixing, occur in the spring and autumn. This condition is most common in middle latitudes and is related to weather conditions, basin morphology, and altitude.

STUB FEE. See Connection Fee.

SUCCESSION. The ecological process by which terrestrial and aquatic environments age.

SUPPLEMENTAL USAGE. In regard to functions of small waste flow districts, those which are not required to comply with EPA Construction Grants regulations governing individual, on-site wastewater systems. May be necessary to achieve administrative or environmental objectives.

SUSPENDED SOLIDS (SS). Small solid particles that contribute to turbidity. The examination of suspended solids and the BOD test constitute the two main determinations for water quality performed at wastewater treatment facilities.

TERTIARTY TREATMENT. See Advanced Waste Treatment.

THREATENED SPECIES (FEDERAL CLASSIFICATION). Any species of animal or plant that is likely to become an endangered species within the foreseeable future throughout all or a significant part of its range. Protected under Public Law 93-205, as amended.

TILL. Deposits of glacial drift laid down in place as the glacier melts. These deposits are neither sorted nor stratified and consist of a heterogeneous mass of rock flow, sand, pebbles, cobbles, and boulders.

TOPOGRAPHY. The configuration of a surface area including its relief, or relative evaluations, and the position of its natural and man-made features.

TRICKLING FILTER PROCESS. A method of secondary wastewater treatment in which the biological growth is attached to a fixed medium, over which wastewater is sprayed. The filter organisms biochemically oxidize the complex organic matter in the wastewater to carbon dioxide, water, and energy.

TROPHIC LEVEL. Any of the feeding levels through which the passage of energy through an ecosystem proceeds. In simplest form, trophic levels are: primary producers (green plants) herbivores, omnivores, predators, scavengers, and decomposers.

WATER QUALITY. The relative condition of a body of water as judged by a comparison between contemporary values and certain more or less objective standard values for biological, chemical, and/or physical parameters. The standard values usually are based on a specific series of intended uses, and may vary as the intended uses vary.

WATER TABLE. The upper level of groundwater that is not confined by an upper impermeable layer and is under atmospheric pressure. The upper surface of the substrate that is wholly saturated with groundwater.

WATERSHED. The area drained by a stream.

WELL LOG. A chronological record of the soil and rock formations encountered in the operation of sinking a well, with either their thickness or the elevation of the top and bottom of each formation given. It also usually includes statements about the lithologic composition and water-bearing characteristics of each formation, static and pumping water levels, and well yield.

ZONING. The regulation by governmental action (invested by the State to cities, townships, or counties) of the use of the land, the height of buildings, and/or the proportion of the land surface that can be covered by structures.

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