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Region V
230 South Dearborn Street
Chicago, Illinois 60604

July 1981

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Water Division

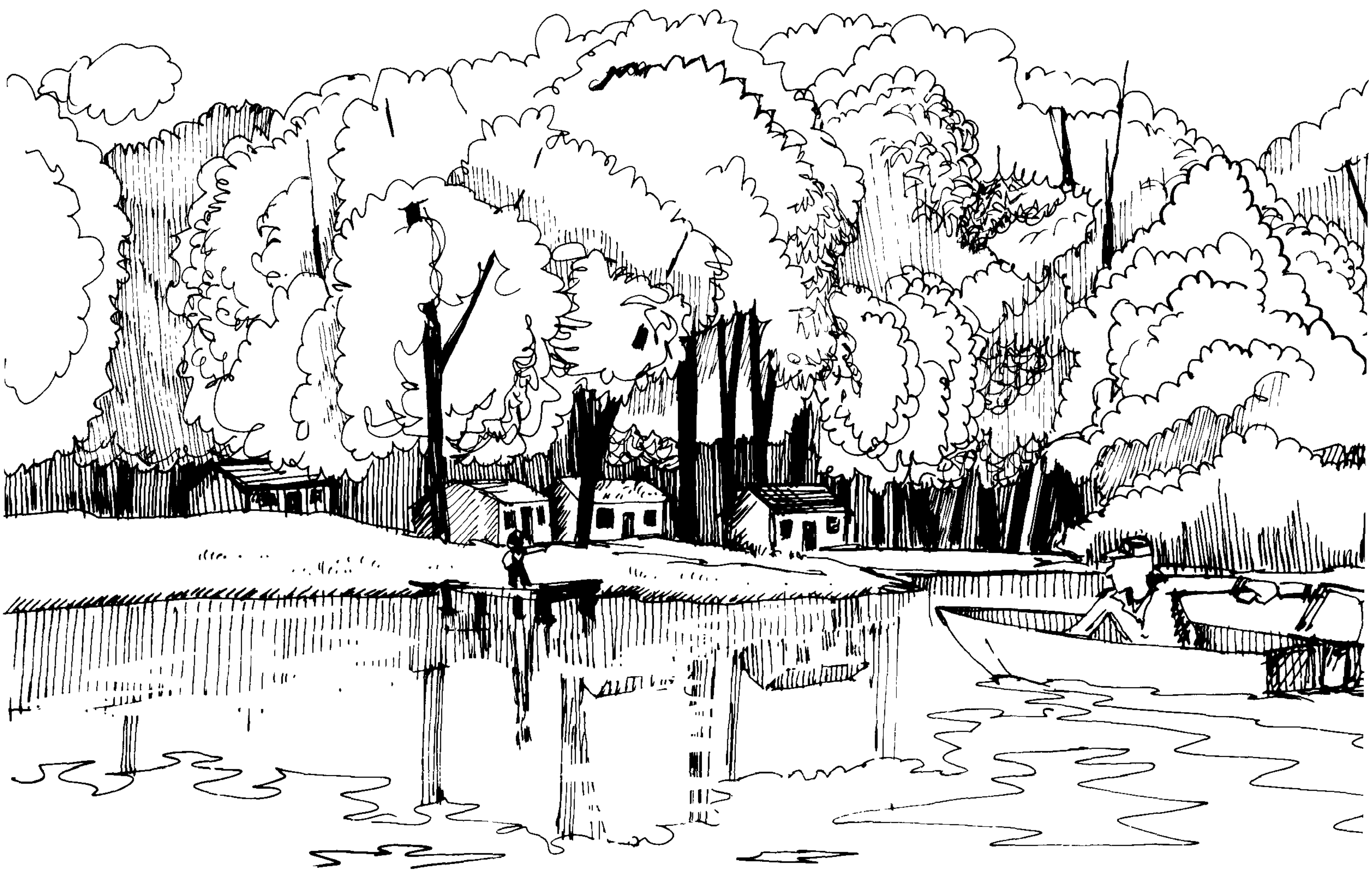
EPA

Environmental Impact Statement

Draft

Alternate Waste Treatment Systems For Rural Lake Projects

Case Study Number 6
Williams County Commissioners
Nettle Lake Area
Williams County, Ohio



DRAFT ENVIRONMENTAL IMPACT STATEMENT

ALTERNATIVE WASTEWATER TREATMENT SYSTEMS FOR RURAL LAKE PROJECTS
WILLIAMS COUNTY COMMISSIONERS

CASE STUDY NO. 6

NETTLE LAKE AREA, WILLIAMS COUNTY, OHIO

Prepared by the

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION V

CHICAGO, ILLINOIS

With the assistance of

WAPORA, Inc.

CHEVY CHASE, MARYLAND

Approved by:

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Acting Regional Administrator
July 1981

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DRAFT ENVIRONMENTAL IMPACT STATEMENT

Alternative Wastewater Treatment Systems for
Rural Lake Projects

Case Study Number 6: Williams County Commissioners
(Nettle Lake Area) Williams County, Ohio

Prepared by

US Environmental Protection Agency, Region V

Comments concerning this document are invited and should by received by September 28, 1981.

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Abstract

A Facilities Plan was prepared for the Nettle Lake Planning Area and concluded that extensive sewering would be required to correct malfunctioning on-site wastewater disposal systems and to protect water quality.

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 complete abandonment of on-site systems is unjustified. An alternative to the Facilities Plan Proposed Action has therefore been presented and is recommended by this Agency.

LIST OF PREPARERS

This Environmental Impact Statement was prepared with the assistance of WAPORA, Inc. under the guidance of Catherine G. Garra, US EPA Region V Project Officer. Additonal US EPA participants were Alfred Krause, Ted Rockwell, Gene Wojcik and Ronald Brown.

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NETTLE LAKE SUMMARY

CONCLUSIONS

The principal need for wastewater treatment improvements is to protect Nettle Lake and the health of the area's residents from sewage contamination during flood periods. During flooding, periodic back-up of sewage into houses occurs, effluent is found on the ground surface outside homes, and odors are a nuisance. Privies are often flooded as well.

Based on technical studies and a limited sanitary survey of existing sewage treatment facilities, most of the on-site wastewater treatment systems around Nettle Lake are operating satisfactorily, except during these flood periods. On-site systems do not appear to contribute a significant amount of nutrients to Nettle Lake. Of the total amount of phosphorus entering the lake, 13% or less comes from on-site systems. The rest comes from non-point sources such as agricultural drainage.

There are large differences in the 20-year project (present worth) cost and customer user charges among the on-site and centralized alternatives considered in this Draft Environmental Impact Statement (DEIS). Both costs increase in direct proportion to the extent of new centralized sewering. In the more expensive alternatives, high local user charges would result in displacement pressure for many segments of the population and pressure for conversion of seasonal residences to permanent use. Water quality improvements would be very slight in comparison to the high costs.

Future growth in the Nettle Lake study area depends on how many new lots can be built on, the density of future development and the relative attractiveness of other lakeside developments in areas surrounding Williams County. Existing floodplain zoning will restrict new growth in floodplain areas. Selecting a wastewater management alternative that relies on the continued use of on-site systems could also limit the number of new lots and the density of development, as compared to extensive sewering around the lake. While the purpose of Federal wastewater treatment funding is to solve existing population problems, the form of pollution control can affect local growth pattens. One effect of improving on-site systems, rather than sewering, may be to preserve the present character of the Study Area.

DEIS RECOMMENDATIONS

The recommended action in this Draft EIS is EIS Alternative 8 (see Figure IV-12). This alternative would provide:

- o Site-specific environmental and engineering analysis of existing on-site systems throughout the proposed Service Area in Step 2;

- o Repair and renovation of on-site wastewater treatment systems as needed;

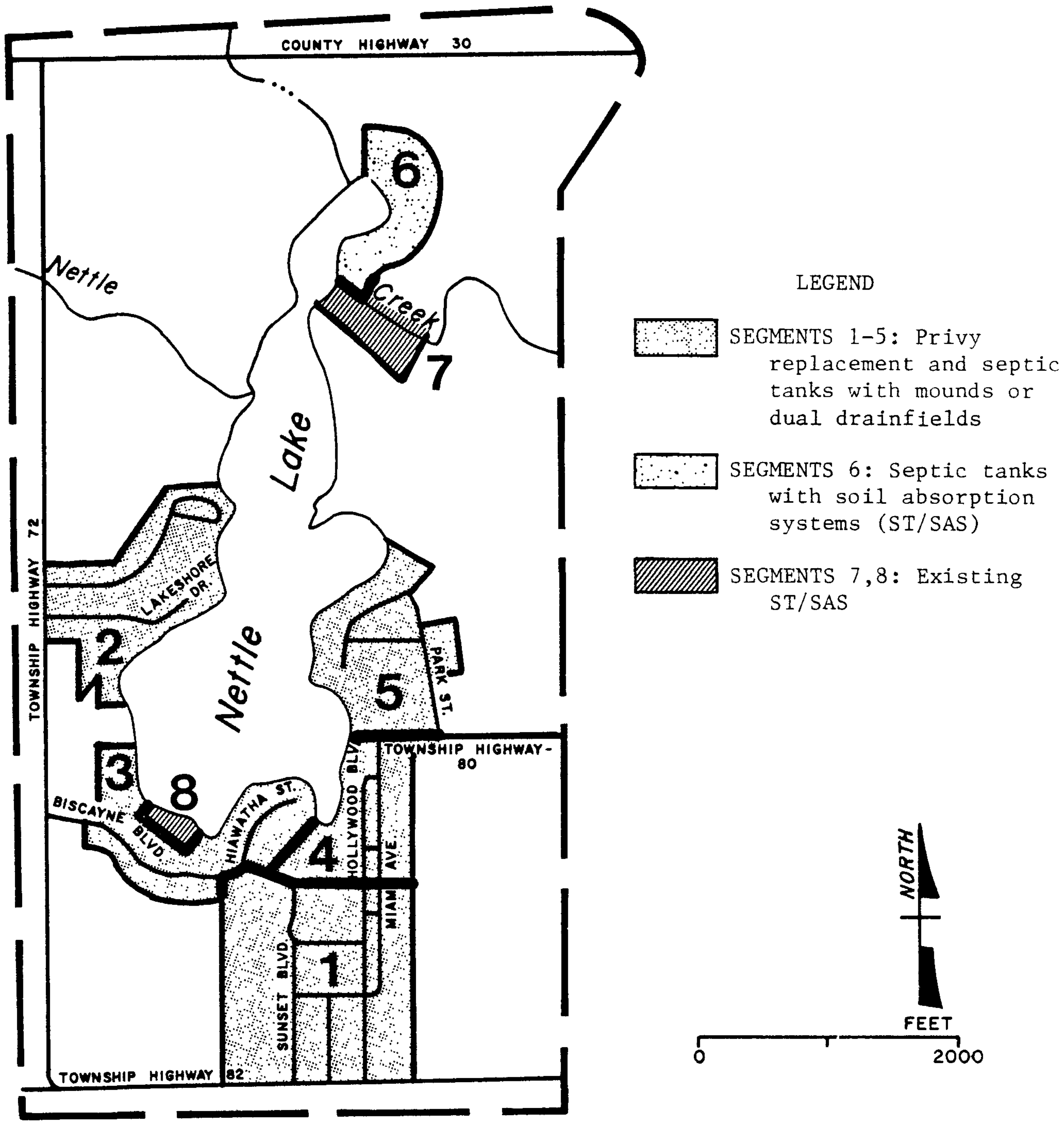

FIGURE IV-12 NETTLE LAKE: EIS ALTERNATIVE 8

- o Replacement or improvement of privies with alternative forms of on-site technology as needed;

- o Management of the on-site systems through a small waste flows district.

The recommended action will reduce the potential public health hazard during flood periods at Nettle Lake. At the same time, it will result in a modest improvement in overall water quality of Nettle Lake that would be comparable to the improvement realized under any of the wastewater alternatives. The present worth of Alternative 8, at a cost of $796,500, is 45 percent of the Facilities Plan Proposed Action's total present worth cost of $1,842,500. The local share of the capital cost of Alternative 8 is $83,568 or approximately 21 percent of the $396,271 local cost for the facilities Plan Proposed Action. The annual user charges are $110 and $335 per household, respectively. The recommended action would be cost-effective and would result in no significant adverse impacts upon the environment or residents of the Study Area. Eligible portions of the system may receive 85 percent Federal funding for design and construction.

If the recommended action were accepted by the applicant and by the State and local jurisdictions, it would be equivalent to a revised Facilities Plan Proposed Action. A small waste flows district would need to be established for the operation and management of the proposed on-site and cluster systems. To complete the Step 1 process, the Applicant would need to:

- o Certify that the project would be constructed and that an operation and maintenance program could be established to meet local, State, and Federal requirements, including those protecting present or potential underground potable sources of water

- o Obtain assurance (such as an easement or County Ordinance) of unlimited access to each individual system at all reasonable times for such purposes as inspection, monitoring, construction, maintenance, operation, rehabilitation, and replacement. (An option would satisfy this requirement if it would be exercised no later than the initiation of construction)

- o Establish a comprehensive program for regulation and inspection of individual systems before EPA approves the plans and specifications. Planning for this comprehensive program would be completed as part of the revised Facilities Plan. The program would include, as a minimum, periodic testing of water from existing potable water wells in the area.

LEGAL IMPLEMENTATION

Although it is presently possible to implement a management district for on-site systems under Ohio health laws, the laws are not entirely clear and an effort is presently being made to clarify the law to implement these districts. Details on these developments will be presented in the Final EIS. The district would be responsible for overseeing the construction, financing, and maintenance of on-site systems.

FUTURE WORK NECESSARY IN STEP 2

The preferred alternative requires a site-by-site analysis in order to design an appropriate wastewater treatment system for each home or business in the service area. This will occur as part of the Step 2 design work of wastewater treatment facilities for Nettle Lake. Individual sites and systems will be examined to determine if upgrading or replacement is necessary. Any new system would be planned in consultation with the homeowner. Eligible portions of this survey will receive 85 percent Federal funding.

At the beginning of Step 2 the grantee will choose one of the many small waste flow management options available and will set up a detailed implementation system for Nettle Lake. Both good design and effective management are needed to successfully implement the on-site wastewater treatment alternative.

PROJECT HISTORY

Nettle Lake is an unincorporated area of Williams County, which lies in the extreme northwest corner of Ohio. The Williams County Commissioners submitted a Facilities Plan for the Nettle Lake Planning Area to Ohio EPA in 1976. Two supplements were prepared in 1976 and 1977, in response to questions raised by Ohio EPA. The Facilities Plan proposed a centralized collection system with treatment in an aerated lagoon, chlorination for disinfection, and discharge to Nettle Creek downstream from Nettle Lake (see Figure I-4). Other alternatives were examined including no action, land application, other forms of lagoons, holding tanks, on-site treatment, and a package treatment plant. Sewering alternatives were also studied.

The Facilities Plan presents the following reasons for needing the project:

- Reports from the Williams County Health Department of malfunctioning on-lot wastewater treatment facilities;
- Complaints by residents of untreated sanitary wastes entering Nettle Lake;
- Inundation of on-site systems during spring floods and the washing of effluent from privies into Nettle Lake;
- Inadequacy of the size of platted lots for on-site treatment.

EIS ISSUES

USEPA's review of the Facilities Plan led to the issuance of a Notice of Intent to prepare an Environmental Impact Statement. The issues cited in that notice, dated 20 July 1977, are:

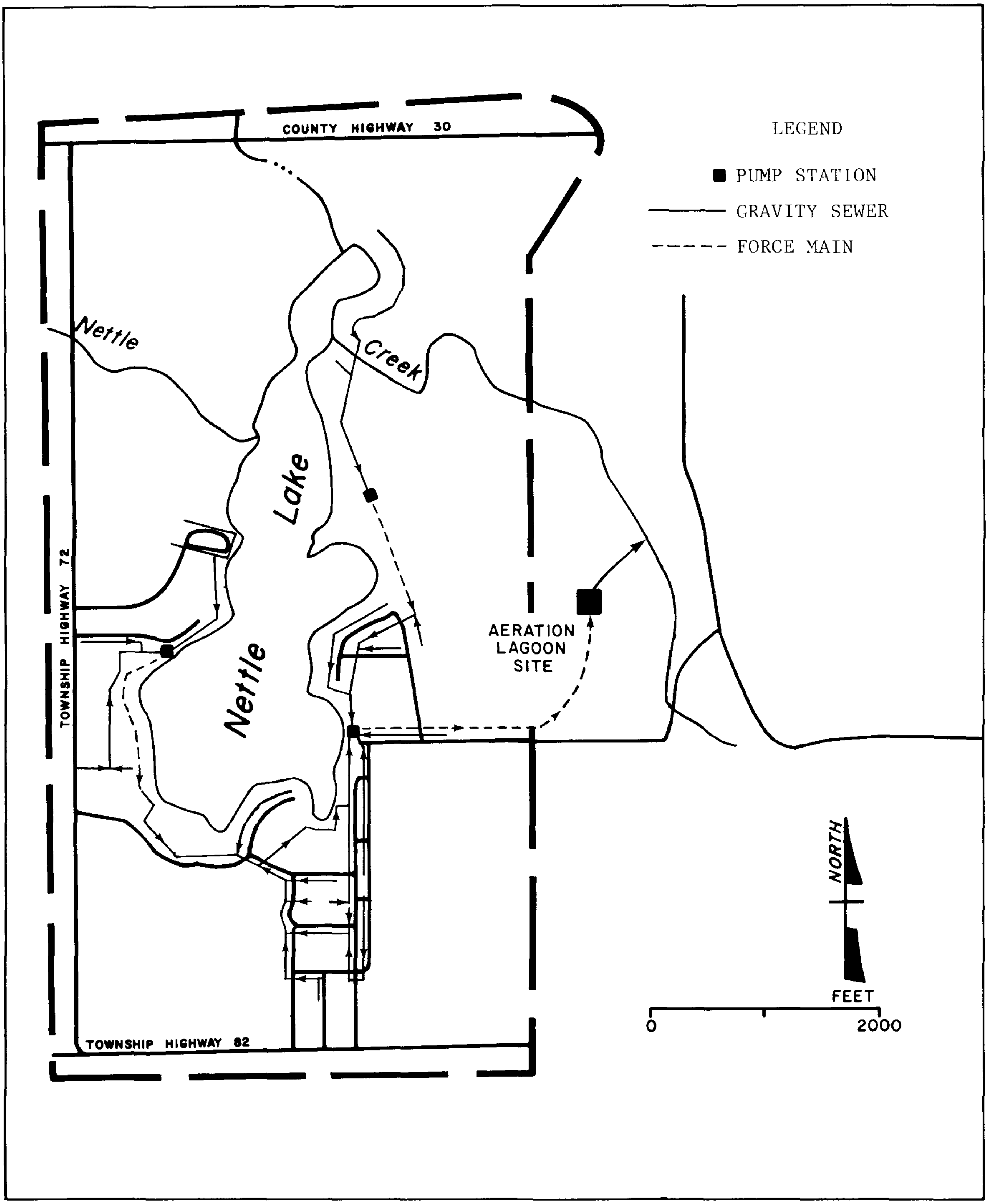

FIGURE I-4 NETTLE LAKE: FACILITIES PLAN PROPOSED ACTION

Cost-Effectiveness. The construction cost of the Facilities Plan Proposed Action was estimated to be $1.2 million in 1977. This amounts to $1,818 per person of total summer population and $960 per person of year 2000 summer population. Each home would be charged $16 per month for sewer service. The homeowner also would be responsible for additional costs associated with tap-in fees or sewer assessments, the house lateral line, and septic tank disconnection, as well as installation of indoor plumbing (in the case of some privy-equipped homes), and a running water supply. These costs could be a significant burden for retired persons or those of modest income. They could result in displacement of homeowners who are unable to pay for such expenses.

Wildlife Habitat and Wetlands Impact. The Nettle Lake area provides habitat for five State-listed endangered species, according to the Ohio Department of Natural Resources. These include two birds (King Rail and Upland Sandpiper), one snake (Northern Copperbelly), and two fishes (Iowa Darter and Lake Chubsucker). The Facilities Plan contains no specific discussion of the location of these habitats.

Several wetlands areas occur along the margins of Nettle Lake (see Figure II-11). Increased development may alter the character of the wetlands when filled for the construction of recreational homes. In addition, groundwater pumping by an expanded population was estimated to have the potential to lower groundwater levels. This could dewater wetlands and affect water levels in Nettle Lake, one of the few natural lakes in Ohio. The project's biological and hydrologic impacts also appear potentially significant.

Population and Sizing. The Facilities Plan estimated that about 110 permanent and 550 seasonal residents lived in the study area in 1975. The applicant's year 2000 projections foresee 250 permanent and 1000 seasonal residents. US Census Bureau population estimates show an essentially static permanent population in Northwest Township: 924 in 1960, 914 in 1970, and 934 in 1973. Commercial atlases for 1968 and 1977 show no summer population increases for the unincorporated area of Nettle Lake: 250 summer residents in both years, with an increase in the permanent population from 60 to 100. Oversizing wastewater treatment facilities based on inflated population projections could result in a cost burden for unneeded facilities.

Secondary Impacts and Induced Growth. The Facilities Plan and public hearing transcript state that the population projections assume increased growth rates caused by the availability of sewer service for new housing developments. This increased population will place additional demands on local community services. Increased development may impact the water quality of the lake and surrounding natural areas, as well.

Public participation during the EIS process has not brought out any additional EIS issues. See Section I.A.2 for a history of the construction grant application.

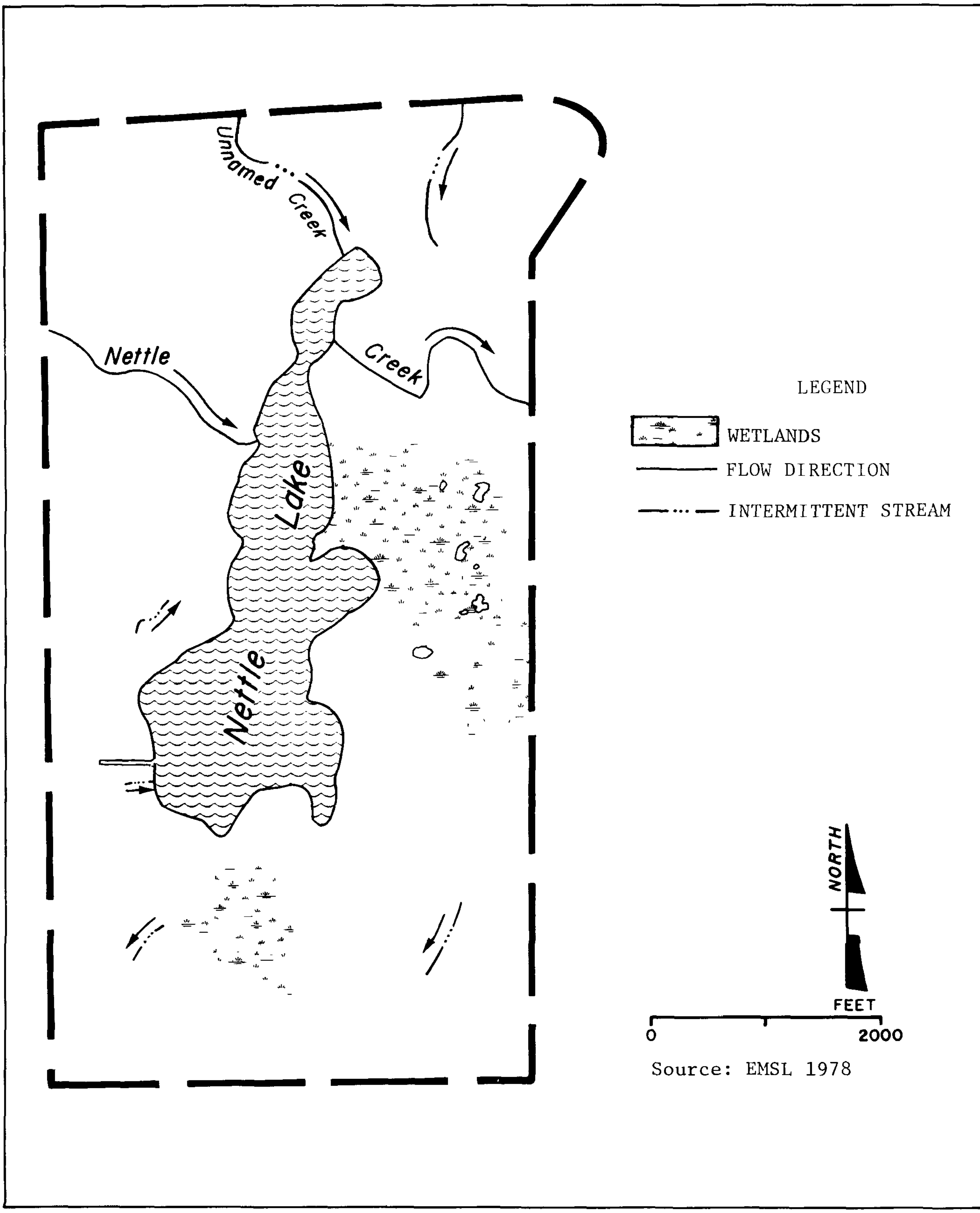

FIGURE II-11 NETTLE LAKE: WETLANDS

ENVIRONMENT

Soils. The soils in the Nettle Lake study area have formed predominantly in clay loam material from underlying limey loam glacial till. The soils in the immediate Nettle Lake area exhibit severe limitations for standard on-site wastewater absorption systems, based on criteria in the Ohio Sanitary Code. Suitable soils do exist for these absorption systems in parts of the northern and western sections of the study area (see Figure II-4). In spite of severe limitations defined by the Ohio Sanitary Code, the area's soils have apparently been effectively treating wastewater from on-site systems. Special design of individual on-site systems can be used to overcome the soil limitations of a site.

Surface Water Resources. Nettle Lake and Nettle Creek are the major surface water bodies in the study area. The 20 square mile watershed drains in a southeasterly direction to the Maumee River Basin, which discharges to Lake Erie. A nutrient budget based on available water quality data was developed for Nettle Lake. It shows that about 13 percent of the phosphorus entering Nettle Lake is from existing on-site systems, whereas 86 percent comes from non-point sources such as agricultural runoff. Water quality modeling demonstrated that the lake is medium eutrophic, which means that there is a relative abundance of oxygen to support aquatic animal life. Ultimately the lake will become filled with weeds and evolve into a wetland. None of the wastewater treatment alternatives will markedly change this projected transition. The exact time needed for this transition is unknown, perhaps tens to hundreds of years. What is known is that adding extra amounts of nutrients accelerates the process.

Substantial portions (60 percent) of the study area lie within the 100-year floodplain. This area of land has a 1% chance of being flooded in any year and is shown in Figure II-9. Residential areas and associated on-site treatment systems are subject to spring flooding around Nettle Lake.

Ground Water Resources. Sand and gravel glacier deposits constitute the major aquifer and drinking water supply for the planning area. Wells in the area are 30 to 180 feet deep and are overlain by a layer of impermeable clay. This clay layer prohibits wastewater from entering the drinking water supply.

Existing Population and Land Use. Of the total in-summer population of 1,873 estimated in this DEIS, approximately 93 percent are seasonal residents. The land use in the immediate lakeshore area is made up of 148 acres of residential and camp ground uses predominantly in the southern portion of the lake area. The population of the area is projected to be 1,904 by the year 2000, largely as a result of the conversion of seasonal units to permanent use. The limited projected growth in new housing is due to floodplain limitations and lack of buildable lakeshore lots, as well as competition from other lakeshore developments in surrounding areas.

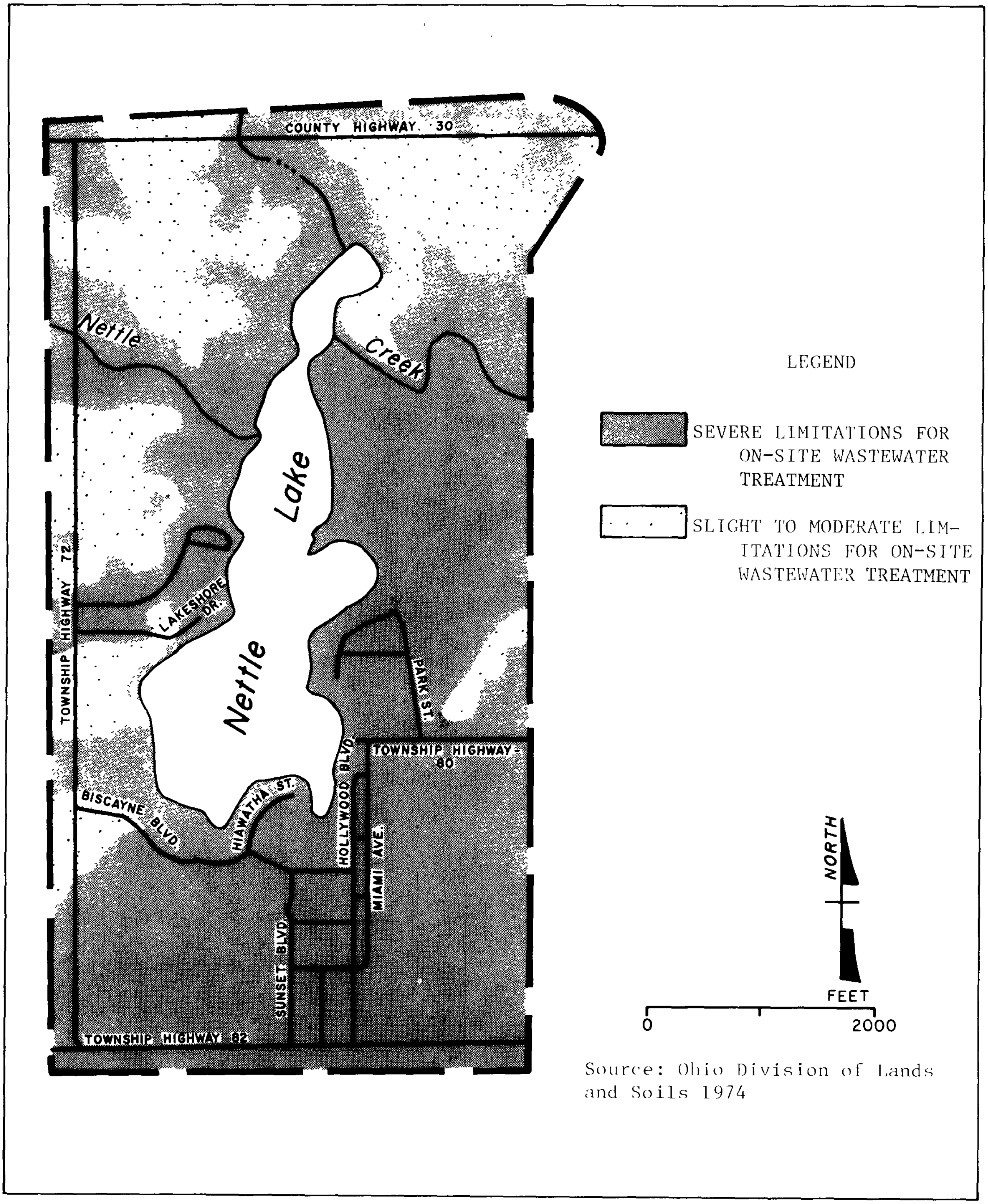

FIGURE II-4 NETTLE LAKE: SOIL SUITABILITY FOR STANDARD ON-SITE SYSTEMS

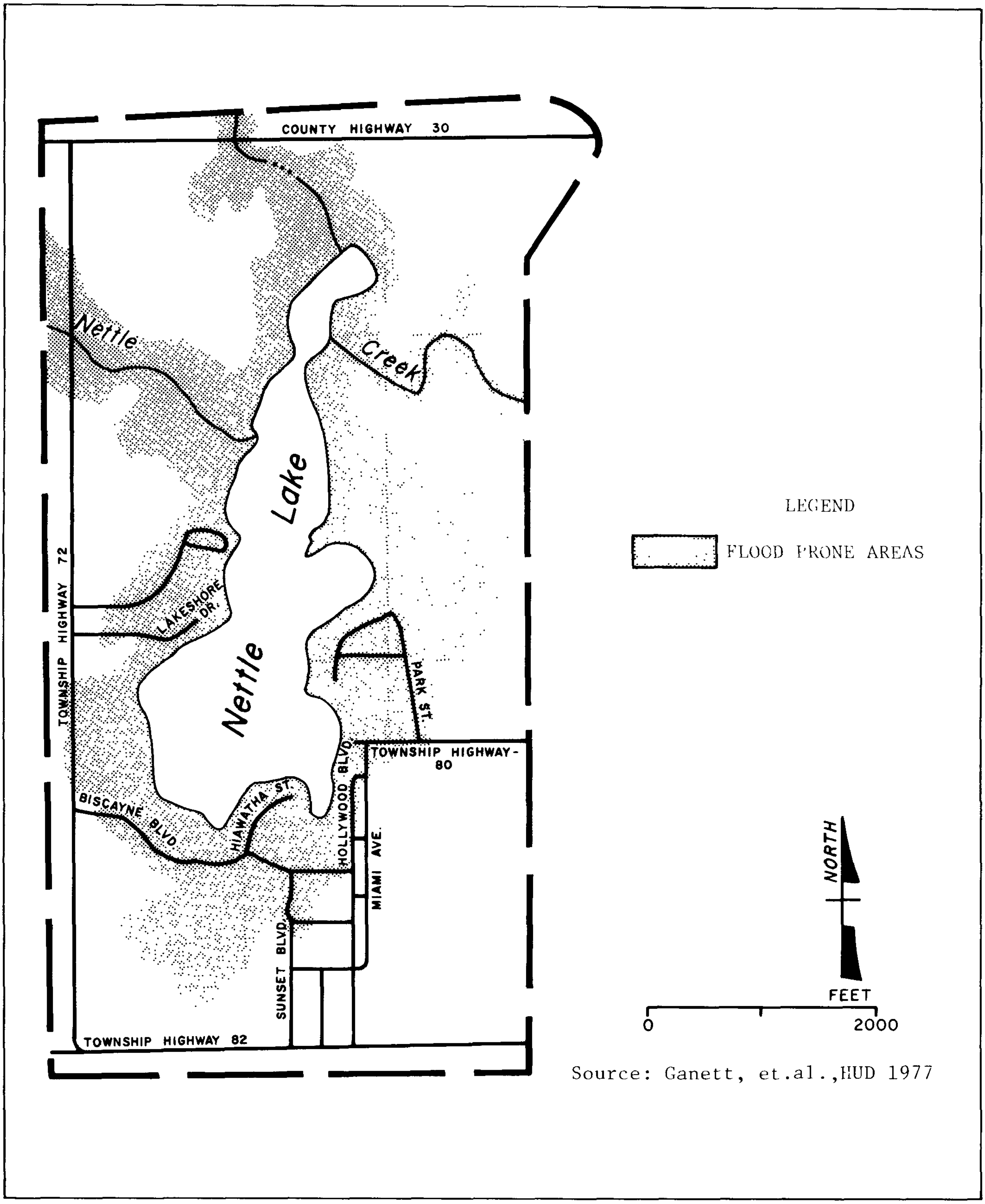

FIGURE II-9 NETTLE LAKE: FLOOD PRONE AREAS

Additional Studies. Because of the lack of data on the extent of malfunctioning on-site wastewater treatment systems, three additional studies were performed in connection with this EIS. The conclusions of these studies contradict some of the conventional sanitary codes relating to on-site systems.

1) A study was conducted during December 1978 to determine whether wastewater effluent from septic tank absorption fields were emerging along shoreline area. The results of this study indicated that no distinct groundwater plumes of wastewater were detected emerging along the shoreline of Nettle Lake and that septic leachate appears to be contained by the tight clayey soils. Discharges to surface waters occur, if at all, during spring floods or periods of high water table.

2) An aerial photographic survey was conducted during May and June of 1978 with color, color infrared, and thermal infrared imagery. This sensing technique is designed to detect sewage malfunctions of wastewater treatment systems. No malfunctioning systems within the study area were failing at the time of the survey.

3) A sanitary survey of existing on-site systems was conducted between late November and early December 1978 to determine the nature and extent of problems with on-site systems and the extent of systems not in compliance with the State sanitary code. Although the survey results indicated widespread violations of the sanitary code, only 15% of the residents surveyed indicated having problems with their systems. However, survey results suggest that problems with backups, ponding, and privy inundation are common in the area during spring flooding.

ALTERNATIVES

Because of the high cost estimate for the Facilities Plan Proposed Action, eight alternatives were evaluated in this EIS along with the Facilities Plan proposed alternative. These alternatives considered water conservation, alternative collection systems (low pressure sewers), treatment techniques (land application), multi-family septic systems (cluster systems), and alternative on-site technologies (waterless toilets, holding tanks, improved privies). The "No Action" alternative is also considered.

EIS Alternative 1. Most of the lakeshore would be served by gravity sewers, force mains, and an aerated lagoon similar to the Facilities Plan Proposed Action. Effluent would be discharged to Nettle Creek downstream from Nettle Lake. The western portion of the lake would be served by cluster systems, and the northern part of the lake would retain on-site systems instead of the sewers proposed in the Facilities Plan.

EIS Alternative 2. This alternative differs from EIS Alternative 1 only in the type of discharge after centralized collection. Treated effluent would be conducted to a nearby wetland for final treatment and disposal.

EIS Alternative 3. This alternative differs from the EIS Alternative 2 only by the type of centralized collection proposed. Low pressure sewers would be used wherever feasible to convey effluent to an aerated lagoon.

EIS Alternative 4. This alternative would incorporate both the wetland discharge from EIS Alternative 2 and the pressure sewers from EIS Alternative 3.

EIS Alternative 5. This alternative investigated land application by rapid infiltration as an alternative treatment method to wetland treatment or surface water discharge. As in EIS alternatives 1 to 4, the northern and western portions of the lake would be served by on-site or cluster treatment systems.

EIS Alternative 6. This alternative would provide service through two cluster systems for the western part of the lake. The rest of the lake would be served through on-site technology similar to EIS Alternative 7.

EIS Alternative 7. This alternative would employ on-site treatment for all residences. A small waste flows agency would be responsible for maintaining, repairing or replacing on-site systems as appropriate. Most malfunctioning or underdesigned septic tank/soil absorption systems would be upgraded to adequately sized septic tanks combined with either an elevated sand mound or a dual soil absorption system. Throughout the southern portion of the lake, all the privies would be replaced with indoor bathrooms. Dwellings would be provided with a water supply, a low flush toilet, and a holding tank for all wastewaters.

EIS Alternative 8. This alternative is identical to EIS Alternative 7 with the exception that all privies throughout the area would be upgraded or replaced with alternative toilets. The toilet technologies investigated include vault toilets, chemical toilets, water conserving flush toilets with holding tanks, and electrical composting toilets. Vault toilets would be pumped seasonally to prevent flood water contamination of the lake.

No Action Alternative. This alternative provides no EPA funding for wastewater treatment improvements. Any new construction, upgrading or expansion would be at the expense and initiative of individual property owners or Williams County.

KEY IMPACTS OF THE ALTERNATIVES

Surface Waters. None of the alternatives is anticipated to have a significant impact on the overall water quality or trophic status of Nettle Lake. Even if the current use of on-site systems were totally eliminated, the lake would probably remain eutrophic because of the large load of nutrients from upstream sources. The No Action alternative will continue to contribute nutrients to Nettle Lake, as well as present a potential health hazard during flood events.

Wildlife Habitat and Wetland Impacts. No significant short-term or long-term impacts on endangered species should result from the construction and operation of any of the alternatives. Minor construction impacts would occur in wetland areas under the Facilities Plan Proposed Action or EIS Alternatives 1, 2, 3, 4, and 5. No impact would result from construction of EIS Alternatives 6, 7, 8, or the No Action alternative.

Population and Land Use. The Nettle Lake area has demonstrated only limited development pressure for both seasonal and permanent residents. The Facilities Plan Proposed Action could result in an induced population increase above the modest increase projected for baseline conditions and the No Action alternative. This could result in only 10 additional acres of residential development. EIS Alternatives 1, 2, 3, 4, and 5 could induce 3.0 percent to 4.0 percent more population than projected, whereas Alternatives 6, 7, and 8 would not induce additional growth.

Floodplain Impacts. For any alternative, new growth will be restricted by floodplain zoning. The No Action alternative will continue the periodic nuisance and potential health impacts from existing flooded privies. Centralized collection and treatment under EIS Alternatives 1 through 6 would not result in any floodplain impact. Potential impacts from on-site treatment systems and privies under EIS Alternative 7 or 8 would be mitigated by seasonal pumping or temporary limitations on use. Construction within the floodplain must occur to serve existing homes under any of the EIS or Facilities Plan alternatives. None of these alternatives would increase the probability of flooding. All alternatives other than the No Action would provide the beneficial impact of reducing public health and water quality problems.

Archaeology. The National Register archaeological site within the planning area will not be affected by any alternative. Its presence indicates the possible need to look for other potential sites in the planning area, especially where larger areas of land will be disturbed. USEPA will ensure compliance with all historic preservation requirements.

Economic Impacts. Annual user charges are estimated to range from $376 a year for EIS Alternative 6 to $335 a year for the Facilities Plan Proposed Action and $110 per year for EIS Alternative 8. User charges are generally higher for the more centralized alternatives, the Facilities Plan Proposed Action and EIS Alternatives 1, 2, 3, 4, and 5, than they are for the decentralized alternatives, EIS Alternatives 7 and 8. EIS Alternative 6, while a decentralized approach, carries the highest user charge due to the costs of collection lines. The proportion of families that would face a financial burden ranges from a low of 20 to 25% (EIS Alternative 8) to a high of 40 to 45% (EIS Alternative 5). Displacement pressure is lowest under EIS Alternative 8 (10-15%) and highest under the Facilities Plan Proposed Action as well as EIS Alternatives 2, 4, 5, and 6 (20-25%).

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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	biochemical oxygen demand
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
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
RBC	rotating biological contactor
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	Michigan Department of Natural Resources
EIS	Environmental Impact Statement
EPA	United States Environmental Protection Agency
EPIC	Environmental Photographic Interpretation Center (of EPA)
FWS	Fish and Wildlife Service, United States Department of the Interior
GT-L-BHD	Grand Traverse-Leelanau-Benzie District Health Department
HUD	United States Department of Housing and Urban Development
NOAA	National Oceanic and Atmospheric Administration, United States Department of Commerce
NES	National Eutrophication Survey
NPDES	National Pollutant Discharge Elimination System
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

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CHAPTER I

INTRODUCTION

A. BACKGROUND

1. LOCATION

This Environmental Impact Statement (EIS) is being conducted on the "Facilities Plan--Nettle Lake Area, Williams County, Ohio, April 1976," with Addenda, which were submitted by the Williams County Commissioners for Federal funding under Section 201 of the Clean Water Act of 1977, P.L. 95-217. A preliminary environmental review of the facilities plan and addenda by the United States Environmental Protection Agency (US EPA) Region V indicated the possibility of significant environmental impacts and led to the Agency's decision that an EIS is warranted. The environmental issues raised in the US EPA's Notice of Intent to prepare an EIS are discussed in Section I.B. below.

The planning area identified in the Facilities Plan is located in Northwest Township, Williams County, Ohio (see Figures I-1 and I-2) approximately 10 miles northwest of the town of Montpelier. Centered around Nettle Lake, the Study Area is 1¼ square miles in area. Residential developments occupy 148 of the 870 acres of land in the Study Area. The Proposed Service Area of this EIS is composed of all of those residential developments and two campgrounds: Lazy Acres North, Lazy Acres South, Lakeview/Eureka Beach, Shady Shore, Roanza Beach, Crestwood, Camp DiClaire, and Shady Shore Camp (see Figure I-3). It is identical with the areas proposed for service during Phase I of the Facilities Plan, with the addition of Camp DiClaire and Shady Shore Camp.

2. HISTORY OF THE CONSTRUCTION GRANT APPLICATION

The following is a list of significant events associated with wastewater management in the Study Area and with the development of this Environmental Impact Statement.

Apr 1, 1974	Ohio Environmental Protection Agency (OEPA) issues National Pollutant Discharge Elimination System (NPDES) Permit No. G746*AD to the Williams County Commissioners for the proposed wastewater treatment facility for the Study Area.
Sept 16, 1974	Williams County Commissioners enter into agreement with Floyd G. Browne and Associates, Limited, Consulting Engineer-Planner, for the preparation of a facilities plan for wastewater disposal in the Study Area.
Nov 27, 1974	Ohio State Clearing House, Office of Budget and Management, approves the Williams County Commissioners' project information and recommends that they proceed with a Step 1 Grant application to the US Environmental Protection Agency (US EPA).

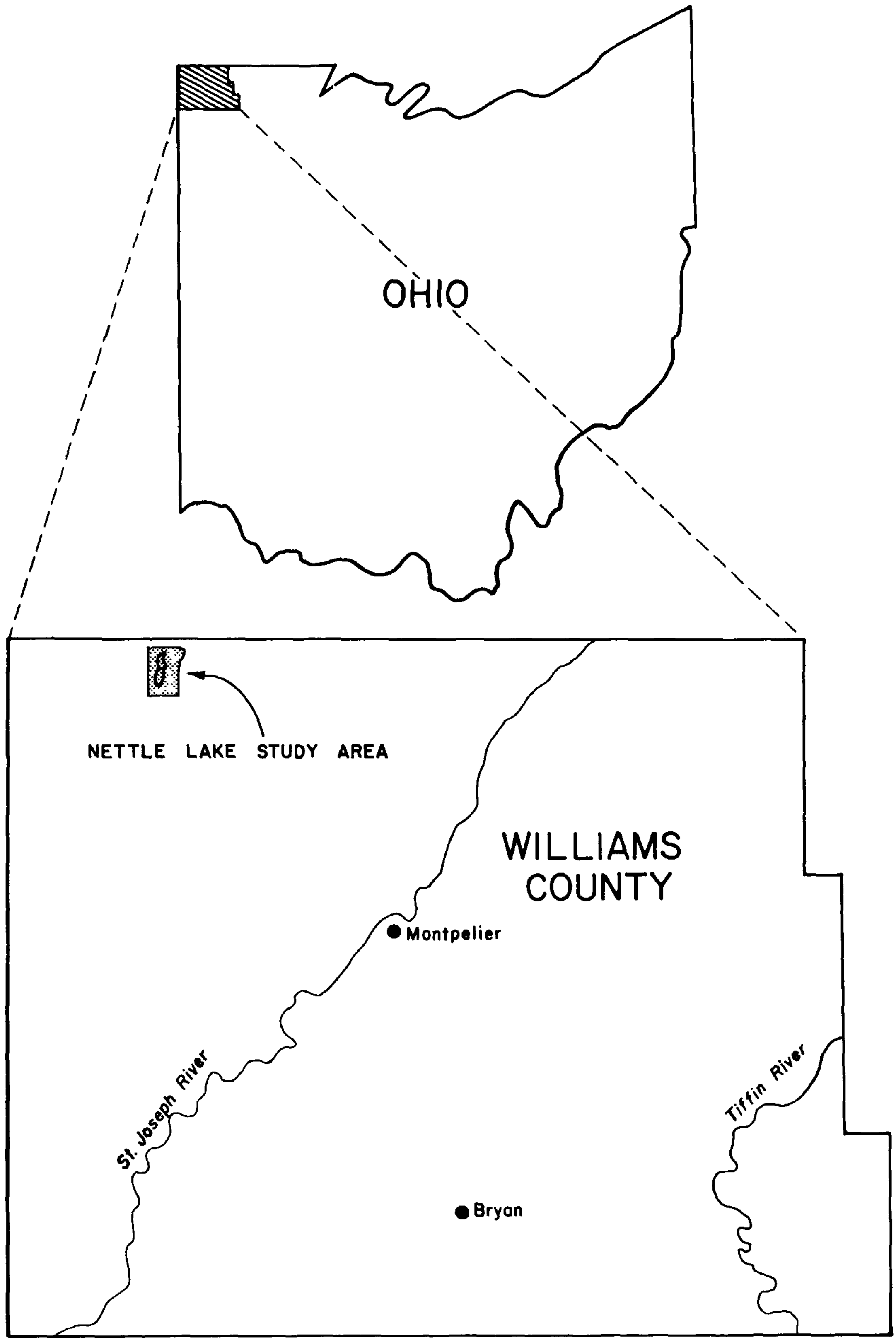


FIGURE I-1 LOCATION OF THE NETTLE LAKE STUDY AREA

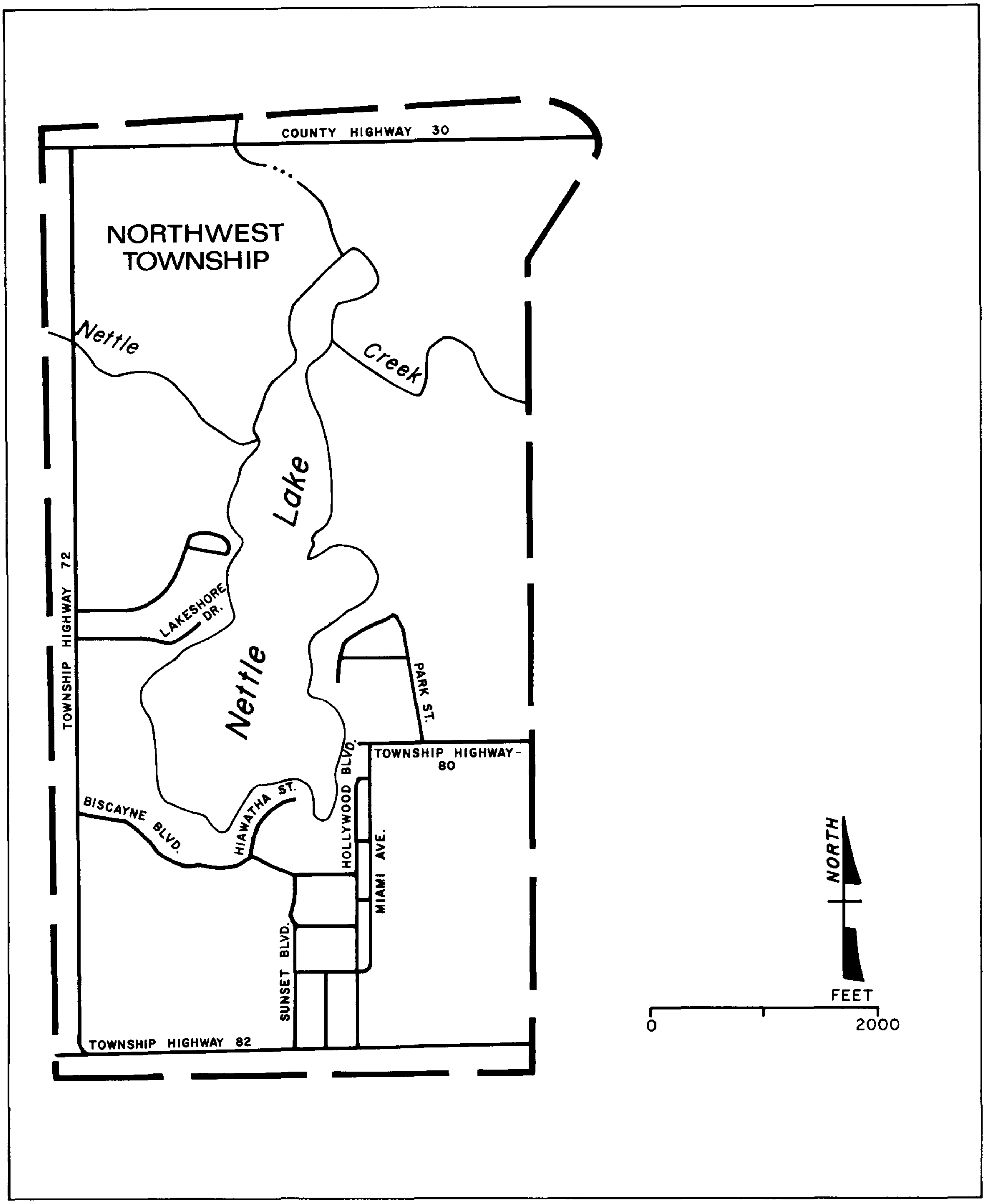


FIGURE I-2 NETTLE LAKE: STUDY AREA

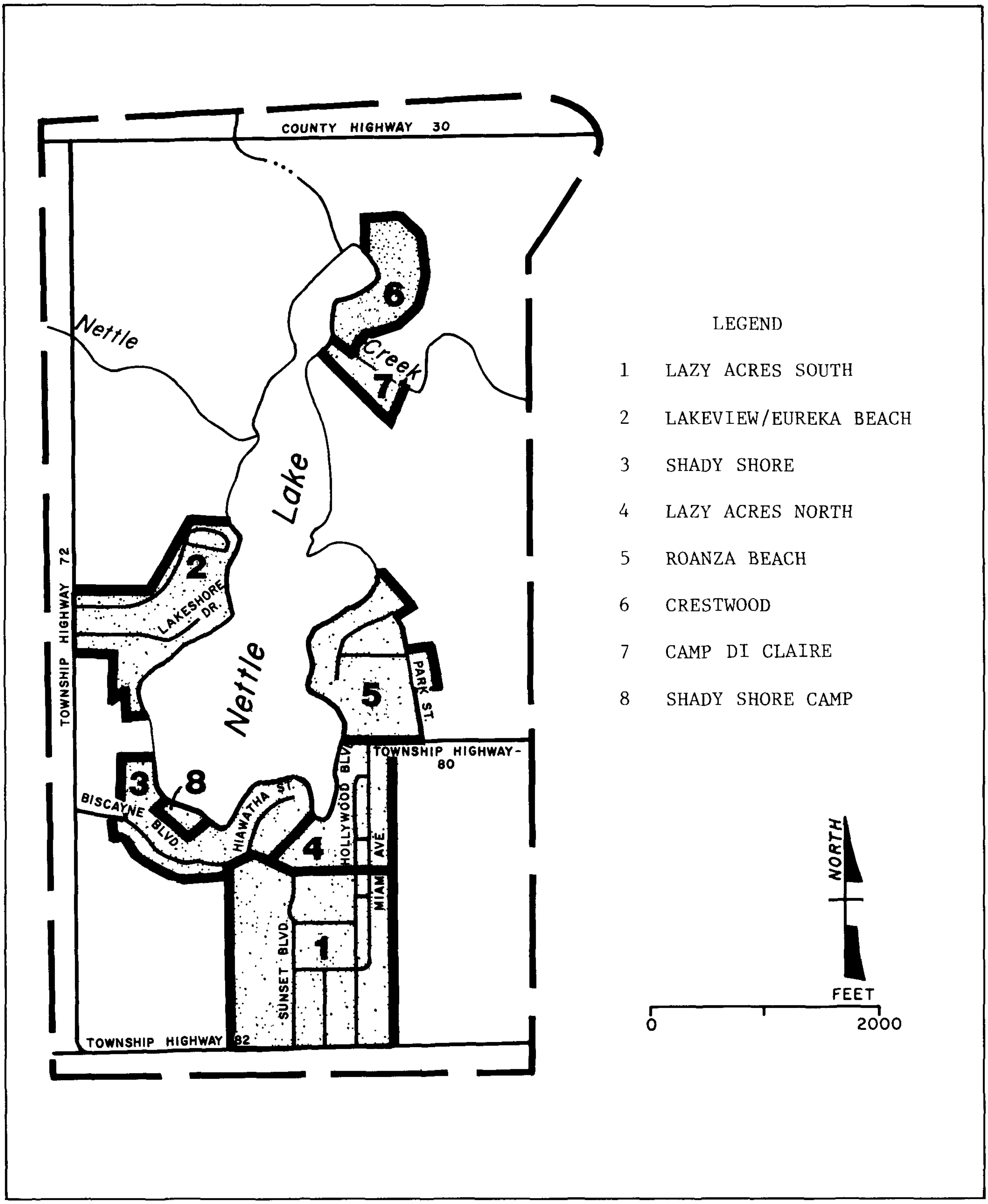


FIGURE I-3 NETTLE LAKE: SEGMENTED SUBDIVISIONS IN THE PROPOSED SERVICE AREA

May 22, 1975	Williams County Commissioners receive Step 1 Grant of $8,465 from US EPA.
June 16, 1975	Williams County Commissioners accept the Step 1 Grant.
Aug 23, 1975	Williams County Commissioners hold a Public Information Meeting on the proposed facilities plan.
Dec 4, 1975	Williams County Commissioners hold a Public Hearing on the proposed facilities plan.
Mar 24, 1976	Williams County Commissioners reply to the Hon. Thomas L. Ashley, Member of Congress, concerning issues raised by his constituents with respect to the development of the proposed facilities plan and the plans for holding public meetings and public hearings.
Apr 9, 1976	Ohio State Clearing House, Office of Budget and Management, approves the Williams County Commissioners' project notification information and recommends that they proceed with a Step 2 Grant application to the US EPA.
Apr 19, 1976	Floyd G. Browne and Associates, Limited, submits the Facilities Plan--Nettle Lake Area, Williams County, Ohio to the Williams County Commissioners.
Jul 23, 1976	Maumee Valley Resource Conservation, Development & Planning Organization recommends that Williams County Commissioners proceed with Step 2 Grant application to US EPA.
Oct 26, 1976	Floyd G. Browne and Associates, Limited, submits "Addendum No. 1 to Facilities Plan--Nettle Lake Area, Williams County, Ohio" to the Williams County Commissioners in response to OEPA's interoffice memo dated 2 August 1976 concerning planned sewer-crossings of the lake and wildlife habitats, existing privies, and related issues.
Mar 25, 1977	Floyd G. Browne and Associates, Limited, submits Addendum to Facilities Plan--Nettle Lake Area, Williams County, Ohio" to the OEPA in response to the agency's interoffice memo dated 18 January 1977 concerning on-site holding facilities, energy requirements of proposed alternatives, economic impacts, and short-term/long-term trade-offs.
Jul 20, 1977	US EPA Region V issues a Notice of Intent to prepare an EIS on the Facilities Plan.
Oct 1, 1977	WAPORA, Inc., commences work on the EIS.
Dec 12, 1977	Representatives of US EPA Region V and WAPORA, Inc., meet with Williams County Commissioners and the facility planners Floyd G. Browne and Associates, Limited.

Dec 12, 1977 — First EIS Public Information and Participation Meeting held by US EPA Region V at the Edon North West Elementary School, Cooney, Ohio.

Aug 23, 1978 — US EPA Region V issues EIS Newsletter citing the special studies in progress in the Study Area and the preliminary set of wastewater management alternatives.

June 1980 — Second EIS newsletter discussing the study process and alternatives under consideration.

Jul 28, 1980 — Second public information and participation meeting held at the Edon Northwest Elementary School, Cooney, Ohio.

3. FACILITIES PLAN

Discussion in this section is limited entirely to summarizing the main features of the "Facilities Plan -- Nettle Lake Area, Williams County, Ohio" (April 1976) prepared for the Williams County Commissioners by Floyd G. Browne and Associates, Limited. It should be noted that the conclusions reached in the Facilities Plan and summarized in this section are not those reached in this EIS.

a. Existing Wastewater Treatment Facilities

The Study Area has no central wastewater collection and treatment system. It is served entirely by individual systems, which include privies, septic tanks, home aeration systems, and leaching fields. Some individual treatment units are suspected of discharging directly into the lake.

b. Existing Problems

The Facilities Plan cites the following as demonstrating a need for action:

- Reports from the Williams County Health Department of malfunctioning on-lot wastewater treatment facilities
- Complaints by residents of untreated sanitary wastes entering the lake.

It also states:

"Many filter and leaching beds in the area have become filled; the effluent often ponds on top of the ground and then drains directly to the lake or to drainage ditches which lead to the lake. During late winter and spring when the lake surface is at a higher elevation than normal, this ponded effluent mixes directly with lake water. Because of the soil limitations, the platted lots are not large enough for proper on-lot septic tank treatment facilities."

Consequently, the OEPA issued NPDES Permit No. G746*AD (see Appendix A-VI) to the Williams County Commissioners, who agreed to prepare a plan in compliance with the permit.

c. Facilities Plan Alternatives and Proposed Action

The Facilities Plan considered three alternative types of sewer systems and seven treatment alternatives. These alternatives ranged from the use of holding tanks and on-site systems to centralized treatment facilities.

Design Parameters. The following is a summary of the main design parameters used in the Facilities Plan:

- Design Period. The twenty-year period 1980-2000.

- Population Projection. The Study Area's population was considered in two categories, winter and summer. The following design populations were used:

	1980	2000
Winter	130	250
Summer	750	1250

The projections were based on the current number of persons per residence (2.2) in the Study Area and the anticipated development potential of the platted areas, which would result in growth from the existing 300 residences to 560 during the 20-year design period.

- Waste Flows. Waste flows were based on average per capita flow of 50 gallons per capita per day (gpcd) for both winter and summer populations throughout the design period. The design maximum flows were based on OEPA criteria. Following is a summary of the Facilities Plan's design flows for the year 2000:

	Average Flow (mgd)	Maximum Flow (mgd)
Winter	0.025	0.077
Summer	0.125	0.420

Alternatives. Sewer system alternatives considered in the Facilities Plan were: (1) conventional gravity system with lift stations and force mains, (2) low pressure sewers with grinder pumps, and (3) vacuum sewers. Alternatives 1 and 3 were found to have similar total annual costs (capital plus operation and maintenance costs), which in both cases were less than that of Alternative 2. The conventional gravity system was, however, selected because of the probable yearly increases in O&M costs of the vacuum system and the limited experience with the use of such systems.

Treatment system alternatives considered were:

Alternative A -- Aerated Waste Stabilization Lagoon
Alternative B -- Controlled Discharge Photosynthetic Pond
Alternative C -- Extended Aeration Package Plant
Alternative D -- On-site Treatment Facilities
Alternative E -- Modified Oxidation Ditch
Alternative F -- On-site Holding Facilities
Alternative G -- Liquid Disposal on Land.

Based on economics, aesthetics, operation, and compatibility with wastewater flows, Alternative A, the aerated waste stabilization lagoon, was selected as the most cost-effective solution. On-site systems were rejected as being incapable of meeting the NPDES requirements. Holding facilities were rejected because of high annual costs, while land application was rejected on the grounds that suitable soils were not available.

Facilities Plan Proposed Action. The Facilities Plan Proposed Action consists of a centralized conventional gravity/force main collection system with an aerated waste stabilization lagoon located east of the lake. Effluent discharge is to Nettle Creek downstream of the lake.

The original layout for the collection system routed a force main across the lake from a point where Nettle Creek enters Nettle Lake on its western shore. In response to comments by OEPA, the Facilities Plan Proposed Action was modified by Addendum No. 1 to eliminate the lake crossing and to make other related changes in the collection system. The final layout of the Facilities Plan Proposed Action is shown in Figure I-4.

The total project cost (in 1976 dollars) was estimated at $1.673 million, of which the cost of sewers accounted for $1.253 million or 75%. The total annual cost was estimated at $167,000.

B. ISSUES OF THIS EIS

The US EPA's review of the Facilities Plan led to the Agency's issuing of a Notice of Intent on 20 July 1977 to prepare an Environmental Impact Statement. The issues set forth in that Notice are as follows:

1. Population and Sizing. About 110 permanent and 550 seasonal residents now live in the Study Area. The applicant's year 2000 projections foresee 250 permanent and 1000 seasonal residents. U.S. Census Bureau figures and P-25 population estimates show an essentially static permanent population in Northwest Township: 924 in 1960, 914 in 1970, and 934 in 1973. Commercial atlases for 1968 and 1977 show no summer population increases for the unincorporated area of Nettle Lake: 250 summer residents in both years with an increase in the permanent population from 60 to 100.

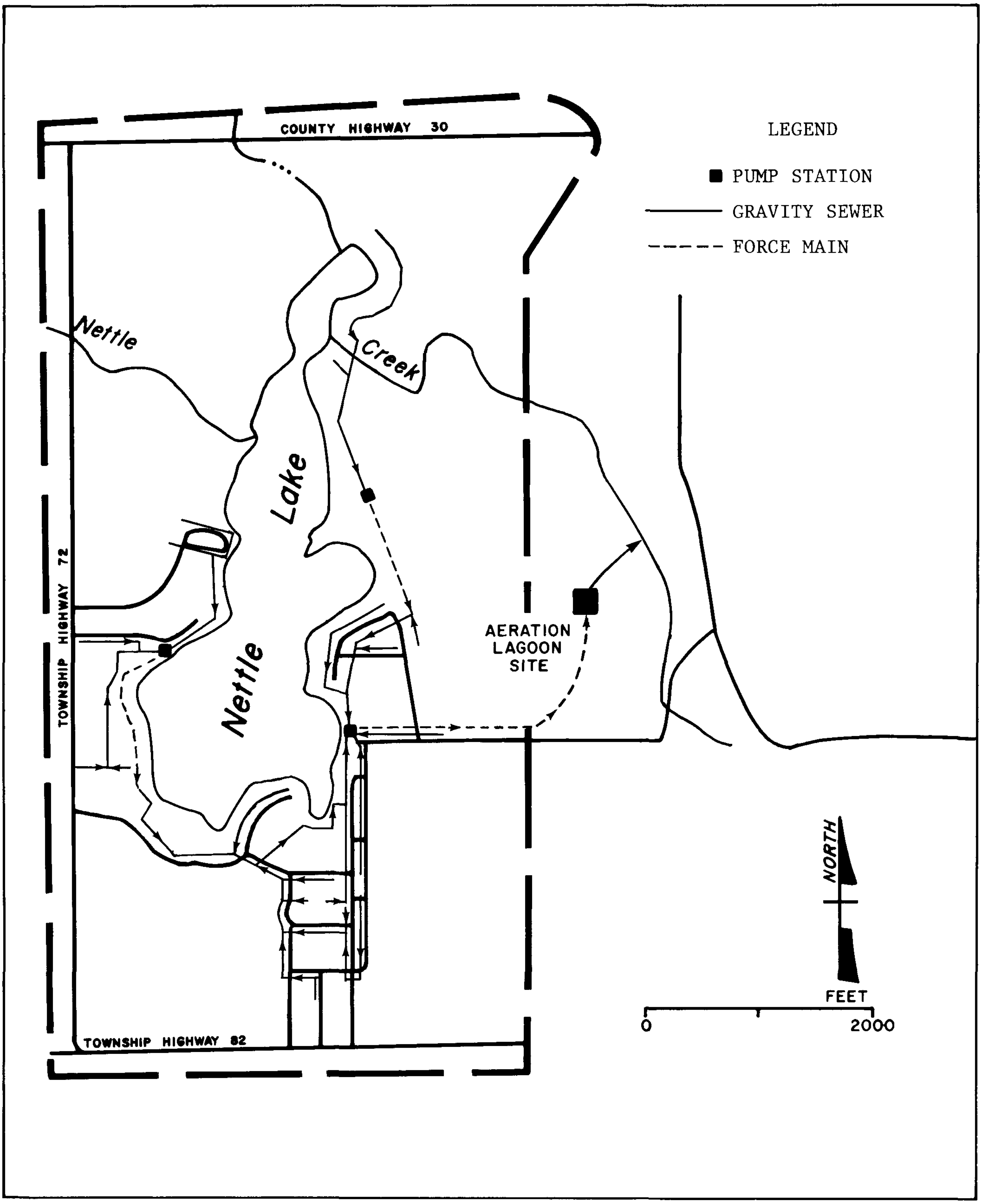


FIGURE I-4 NETTLE LAKE: FACILITIES PLAN PROPOSED ACTION

2. Secondary Impacts and Induced Growth. The Facilities Plan and public hearing transcript state that the population projections assume increased growth rates caused by the availability of sewer service for new housing developments. This increased population will place additional demands on local community services. Increased development may impact the quality of the lake and surrounding natural areas, as well.

3. Cost-Effectiveness and Socioeconomic Impact. Present Phase I capital costs are estimated at $1.6 million, a $1818 cost per capita of present summer population and $960 per capita of year 2000 summer population. Grant-eligible capital costs will be covered by 75 percent Federal funding. Each resident will be charged about $16.00 per month for sewer service. The user will also be responsible for any tap-in fee or sewer assessment, the costs of a house lateral line, septic tank disconnection, and (in the case of some privy-equipped homes) installation of indoor plumbing and a central water supply. Even if spread out over an extended period of time, these costs may be a significant burden for retired persons or those owning a modest summer home. This may result in displacement of existing residents, many of whom live in mobile homes. Low cost system alternatives must be thoroughly examined.

4. Wildlife Habitat and Wetlands Impact. The Facilities Plan states the Nettle Lake area provides habitat for five State-listed endangered species, according to the Ohio Department of Natural Resources. These include two birds (King Rail and Upland Sandpiper), one snake (Northern Copperbelly), and two fishes (Iowa Darter and Lake Chubsucker). The Facilities Plan contains no specific discussion of the location of these habitats. A grouping of several species that are considered rare within the State would constitute an area of special scientific interest.

   Several wetlands areas surround the lake. Increased development may alter the character of the wetlands, and additional groundwater pumping by an expanded population may lower wetlands levels and affect Nettle Lake itself, one of the few natural lakes in Ohio. The project's biological and hydrologic impacts appear environmentally significant.

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 Nettle Lake Study Area. They are typical of concerns raised by a large number of wastewater projects for rural and developing communities that have been submitted to US EPA for 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 across the country.

1. SOCIOECONOMICS

To assess the cost burden that many proposed wastewater collection projects would impose on small communities and the reasons for it, US EPA studied over 250 pending facilities plans from 49 states for communities under 50,000 population (Dearth, 1977). US 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 when the newly proposed facilities 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 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; or
- 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 lower project costs through 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 that community is clearly aware of the financial impacts of undertaking the high-cost project.

The collection system 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 collection systems. Figure I-5 indicates that costs per residence for gravity sewers increase exponentially as population density decreases. Primary factors contributing to this relationship are:

- Greater length of sewer pipe per dwelling in lower-density areas;
- More problems with grade, resulting in more lift stations or excessively deep sewers;
- Regulations or criteria setting eight inches as the smallest allowable sewer pipe diameter; and
- Inability of small communities to spread capital costs among larger, previously sewered populations.

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

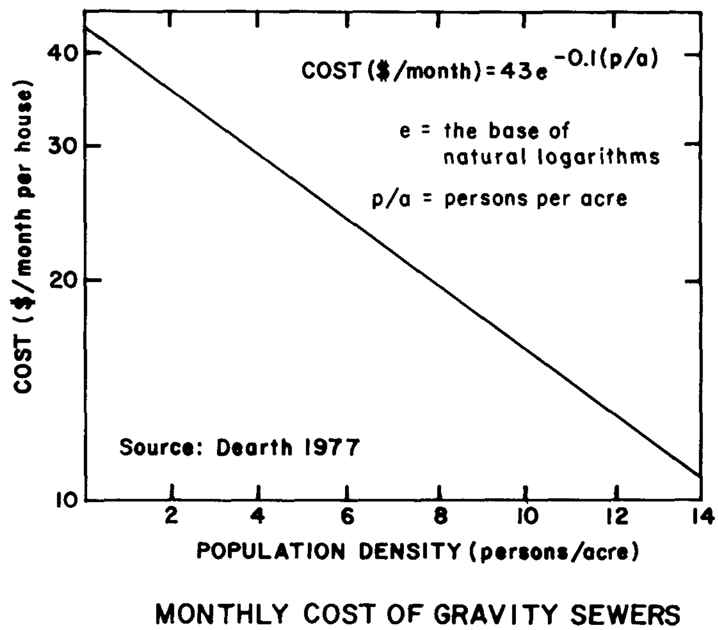


FIGURE I-5 MONTHLY COST OF GRAVITY SEWERS

- Oversophistication in design, with accompanying high chemical usage, large energy requirements, and costly maintenance and operator expense, when simpler methods would do.

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

- Abandonment of existing treatment works without economic justification.

2. SECONDARY IMPACTS

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

In broad terms, community potential for recreational, residential, industrial, commercial, or institutional development is determined by economic factors such as land availability, capital, and natural resources. However, fulfillment of this potential can be limited by the lack of facilities or services (called "infrastructural elements"), such as water supply, sewerage, and transportation. If a missing element of infrastructure is provided, it may induce development of one type or another depending upon prevailing local economic factors. Such development is termed "induced growth."

Induced growth is usually unplanned and may conflict with existing or planned development. The effects of such conflicts are termed "secondary impacts," as are the impacts of induced growth on existing water resources, land use, air quality, cultural resources, aesthetic features, and environmentally sensitive areas.

Secondary impacts of new wastewater facilities can be beneficial. 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 sometimes 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

One 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 on-site 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 to the lack of trust in them by local public health officials and consulting engineers.

Historically, State and local health officials were not empowered even to regulate installation of on-site systems until after World War II. They usually acted in only an advisory capacity. As the consequences of unregulated use of septic tank-soil absorption systems became apparent in the 1950's and 1960's, health officials were granted new authority. Presently most 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. They seldom have either a budget or the authority to inspect or monitor existing systems.

In the 1970's, the Congress recognized the need for continuing supervision and monitoring of on-site systems as demonstrated in the 1977 Clean Water Act. This encouragement of the maintenance of on-site systems includes, where eligible, 85% Federal funding for such things as a septage pumping truck. Now, US EPA regulations implementing the Act require that an applicant must meet the following requirements before a construction grant for on-site systems may be made:

- 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, where a substantial number of on-site systems exists, more extensive monitoring of aquifers;

- 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 flows 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. Section III.E discusses other implementation factors over which municipalities should have control.

4. RELATIONSHIP TO OTHER EISs PREPARED BY US EPA REGION V

US EPA Region V is preparing six other Environmental Impact Statements, similar in scope and in conditions to this one. The seven facilities planning areas generally share the following characteristics (Sutfin, 1977):

- Lakeshore development in rural areas;
- Relatively low population densities;
- Substantial proportions of seasonal residents generating sewage during perhaps a third of the year;
- High costs for their proposed plant sizes and populations served;
- Proposed actions including construction of sewers completely around lakes that are only partially developed.

The degree to which these characteristics are evident in the seven Study Areas varies, thus providing a range of conditions to be evaluated. The six other facilities planning areas for which individual EISs are being prepared are:

- Crystal Lake, Benzie County, Michigan
- Green Lake, Kandiyohi County, Minnesota
- Salem Township, Kenosha County, Wisconsin
- Crooked/Pickerel Lakes, Emmet County, Michigan
- Steuben Lakes, Steuben County, Indiana
- Otter Tail Lake, Otter Tail County, Minnesota.

In addition to the seven individual EISs, a generic EIS is being prepared, synthesizing findings and processes developed in the individual projects. On the basis of findings and planning methodologies developed during the individual EIS's, a systematic approach to planning rural wastewater facilities will be developed to serve as a planning guide for rural lake communities. Specific goals of the generic EIS will be to:

- Suggest working criteria for recognition of problematic sewering projects;
- Recommend specific, low-cost treatment alternatives to be examined;
- Recommend items of information to be included in future facilities plans for rural lake areas; and

- o Develop a comprehensive overview of the process of rural lakeshore development and the impacts of sewering on it.

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

1. PURPOSE

US EPA both reviews and approves funding for wastewater treatment facilities under Section 201 of the Clean Water Act. Federal funding covers 75% of the eligible costs for the planning, design, and construction of eligible facilities. In special instances 85% Federal funding is provided for innovative or alternative systems (see Section V.E.2a).

This EIS documents US 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:

- o Approve the Facilities Plan and Step 2 grant application, possibly with recommendations for design changes and/or measures to mitigate impacts of the Facilities Plan Proposed Action;

- o With the applicant's and State's concurrence, approve Step 2 funding for a cost-effective alternative to the Facilities Plan Proposed Action;

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

- o Reject the grant application.

The review and analysis focused on the issues identified in Section I.B., and were 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, undertaken in approximately the following sequence:

a. Review of Available Data

Facilities Plan data and other sources were reviewed for applicability in development and/or evaluation of the Proposed Action and of the new EIS alternatives. The EIS reference list includes these sources.

b. Documentation of Need for Action

The need for action had not been clearly established in the Facilities Plan. Since the completion of the Facilities Plan, the requirements for needs documentation have been made more stringent. New technologies, such as septic snooper surveys, have also become available. The effects of the existing systems on surface waters, groundwater, and public health had not been clearly documented. 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 septic tank system malfunctions using low-altitude color and infrared photography by US EPA's Environmental Monitoring and Support Laboratory (EMSL);

- An environmental analysis and resource inventory of the Study Area using low-altitude color and infrared photography by EMSL;

- An estimation of the existing nutrient budget and empirical modeling of the eutrophication status of Nettle Lake;

- A "Septic Snooper"* survey to locate and sample septic tank leachate plumes entering Nettle Lake from nearby on-site systems; and

- A sanitary survey to evaluate usage, design, and condition of on-site systems.

The results of these needs documentation studies have been used in the development of alternatives and form the basis for necessary refinements in the determination of the eligibility of sewers for Federal funding.

c. Segment Analysis

As a basis for revised population projections and for development of alternatives, the Proposed Service Area was divided 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 of 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.

d. Review of Wastewater Design Flows

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

e. 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 (collection, treatment, etc.). Next, several specific areawide alternatives were developed, combining the alternative technologies into complete wastewater management systems that would serve the Proposed Service Area. Chapter III describes the technologies reviewed. Chapter IV presents the areawide alternatives.

f. Estimation of Costs of Alternatives

To assure cost comparability between the Facilities Plan Proposed Action and the EIS 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).

g. Evaluation of Alternatives

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

3. MAJOR CRITERIA FOR EVALUATION OF ALTERNATIVES

While the high cost of sewering rural communities is a primary reason to examine alternative approaches to wastewater management, cost is not the only criterion. Evaluation of trade-offs between cost and significant impacts is also essential. The various criteria are discussed below.

a. Cost

With some exceptions for innovative technologies, US EPA construction grants regulations allow funding of only the most cost-effective alternative. In accordance with those regulations, cost-effectiveness has been measured here by the net present worth of capital costs for facilities needed immediately, capital costs for facilities required during the 20-year planning period, operation and maintenance costs for all wastewater facilities, and the salvage value of facilities expected to be in service at the end of the planning period. These costs are balanced with significant adverse non-monetary effects such as environmental or social drawbacks. If these drawbacks are overriding, the least expensive waste treatment alternative may be rejected.

The interest rate used for discounting future costs to present worth is that established by the Water Resources Council at 6 5/8% for 1978. The differentiation between public and private costs is not a consideration of the cost-effectiveness analysis, as required by the US EPA construction grants regulations.

A sewer district recovers operation, maintenance, and local debt retirement costs through periodic sewage bills or residential user charges. Some homeowners might also incur costs that they would have to pay directly to contractors. Installation of gravity sewers on private land and indoor plumbing in houses now served by privies are not eligible for Federal funding and are seldom financed by municipalities.

The local economic impacts of new wastewater facilities would be felt largely through user charges and whatever private costs might be incurred. To provide an index to the homeowner's cost for various alternatives, their local public costs (debt service plus O&M) are determined for the first year of operation and added to the amortized (6-7/8%, 30 years) costs for all private expenditures in the community. This "1980 Average Annual User Charge" provides a single homeowner's costs to be used in determining economic impacts for each system 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, the major issues of this EIS (see Section I.B.). These include: Surface water quality impacts, groundwater impacts, population and land use impacts, including infringement on environmentally sensitive areas, and economic impacts.

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. The first criterion was applied in the analysis of surface and groundwater impacts of the alternatives presented in Chapter V. 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. Types of possible failure and appropriate remedies and preventive measures were reviewed for selected components of the alternatives.

d. Flexibility

The ability of an alternative to accommodate increasing wastewater flows from future development is referred to here as its flexibility. 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, such factors as the amount of land developable using on-lot systems or ability to increase the capacity of a treatment plant might significantly affect future Study Area development. Chapter III discusses the capability of the alternatives to accommodate increased wastewater flows. Chapter V predicts the effects of the alternatives' flexibility on population growth.

CHAPTER II

ENVIRONMENTAL SETTING

A. INTRODUCTION

Nettle Lake, one of the few natural lakes in the State of Ohio, was formed by action of the last retreating continental glacier that extended into North America. High concentrations of organic material give Nettle Lake a very murky appearance. The abundance of cattails, bulrushes, reeds, sedges, and grasses around the lakeshore is seen as an indication of natural plant succession in the eutrophication process (EMSL, 1978). Agriculture is the predominant form of land use in the drainage basin. The main crops are corn, soybeans, and wheat, which are grown in fields that are artificially drained by subsurface tile systems.

Permanent or year-round inhabitants of the Study Area are considerably outnumbered by seasonal inhabitants at the lake. Typical permanent residents are families on modest incomes living in dwellings ranging from mobile homes to two-story wooden buildings. The seasonal residents generally maintain summer-type cottages. For domestic waste disposal the community relies mainly on septic-tank soil absorption systems (ST/SAS) and on-site pit privies. The clayey soils found throughout most of the Study Area are not well suited for standard effluent drain fields because of poor permeability and seasonal flooding.

Indian burial mounds of the prehistoric Hopewell tribe that inhabited Ohio approximately 2000 years ago are located northwest of the lake. The Williams County Historical Society owns and maintains the site--the Study Area's only known site of archaeological significance--as a public park.

B. PHYSICAL SETTING

1. PHYSIOGRAPHY

The topography of the Study Area is characterized by gently rolling hills with changes in elevation never exceeding 100 feet (see Figure II-1). The highest elevations, 1000 feet above mean sea level (msl), are found in the south and southwest of the area, while the lowest, of approximately 900 feet msl, surround the lake. The land surface is generally flat in the immediate vicinity of the lake, becoming hilly with distance from the lake. Slopes steeper than 15% are found in very few areas, mainly northeast and southwest of the lake, as indicated in Figure II-1.

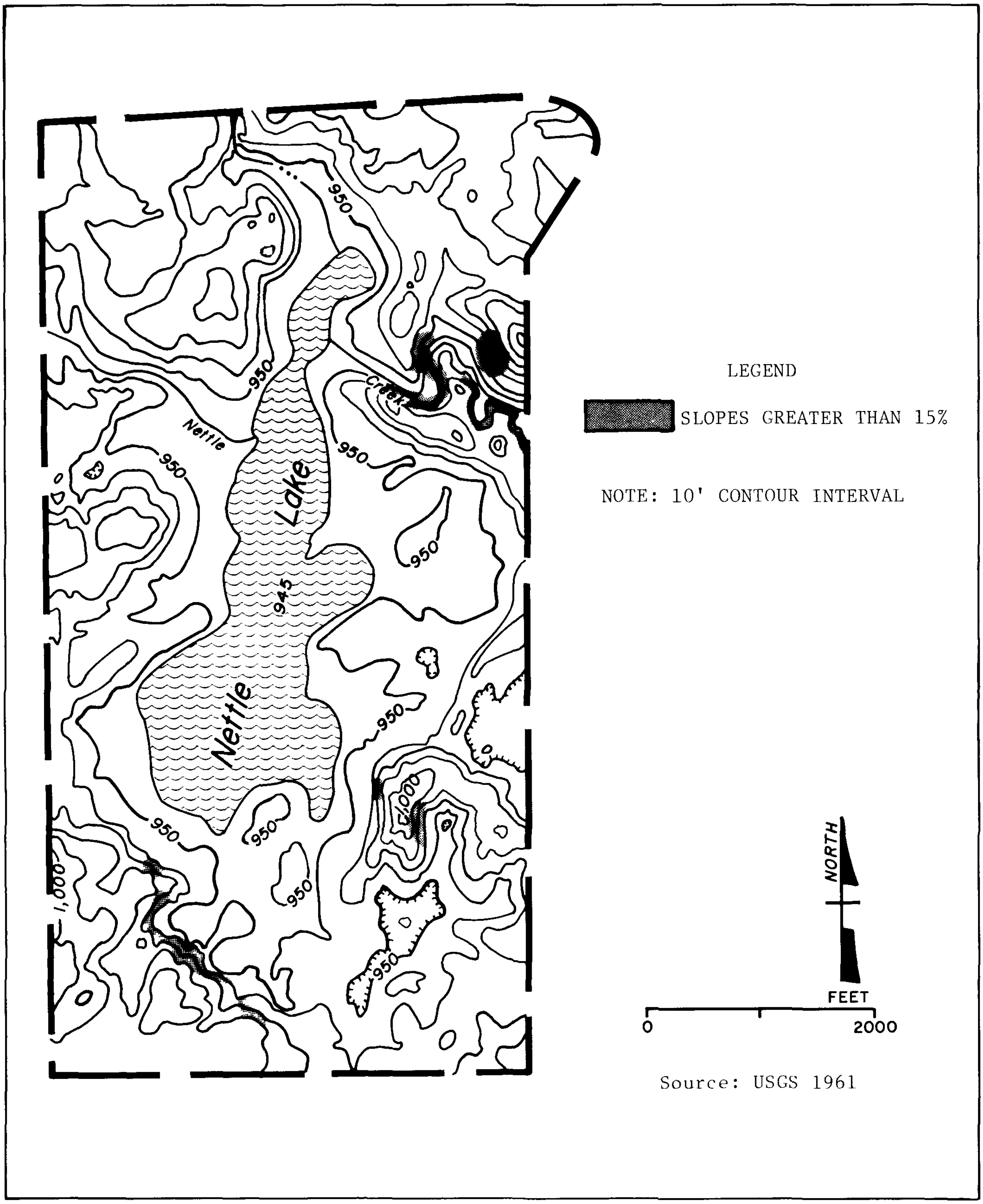


FIGURE II-1 NETTLE LAKE: TOPOGRAPHY

2. GEOLOGY

a. Surficial Geology

The Nettle Lake Study Area is blanketed by unconsolidated glacial material, deposited during the Pleistocene period, 10 to 60 thousand years ago. These end moraine deposits were left by the last recession of the continental glacier that once covered North America. Clayey glacial till predominates throughout the area.

The specific thickness of glacial material within the Study Area is not known. However, average sediment thickness overlying bedrock within Williams County is approximately 75 to 250 feet (USDA-SCS, 1978). Glacial deposits within the Study Area are illustrated in Figure II-2. The legend provides a key to the location of the deposits, specific composition, and associated geologic formations.

b. Bedrock Geology

The Williams County Study Area is principally underlain by the Coldwater Shale Member (also referred to as the Cuyahoga Member) of the Mississippian Formation. Average thickness of the formation is about 300 to 400 feet (USDA-SCS, 1978). The general bedrock stratigraphy of southwest Michigan, northwest Ohio (Williams County), and northeast Indiana is shown in Figure II-3.

3. SOILS

a. General

The soils in the Nettle Lake Study Area have been formed predominantly in clay loam material underlain with limey loam glacial till. Two major associations have been identified in the Study Area (Stone and Powell, 1975):

1. Blount, Loam Substratum Phase-Glynwood, Loam Substratum Phase soils, found in the southeastern half of the area, are poorly drained and occupy level or gently sloping land. Wetness resulting from seasonal high water table and clayey subsoils is a severe limitation of this soil for many engineering purposes.

2. Glynwood, Loam Substratum Phase-Spinks-Haney soils are found in the northwestern half of the area. These soils are moderately well drained and occur in gently sloping to moderately steep areas. The well drained Spinks soils are underlain by sand and gravel; the Haney soils are formed in deep sandy and loamy deposits.

b. Suitability for Septic Tank Soil Absorption Fields

Three main factors determine soil suitability for standard on-site absorption systems, according to the criteria of the National Cooperative Soil Survey, which have been adopted by the Ohio Sanitary Code. These are:

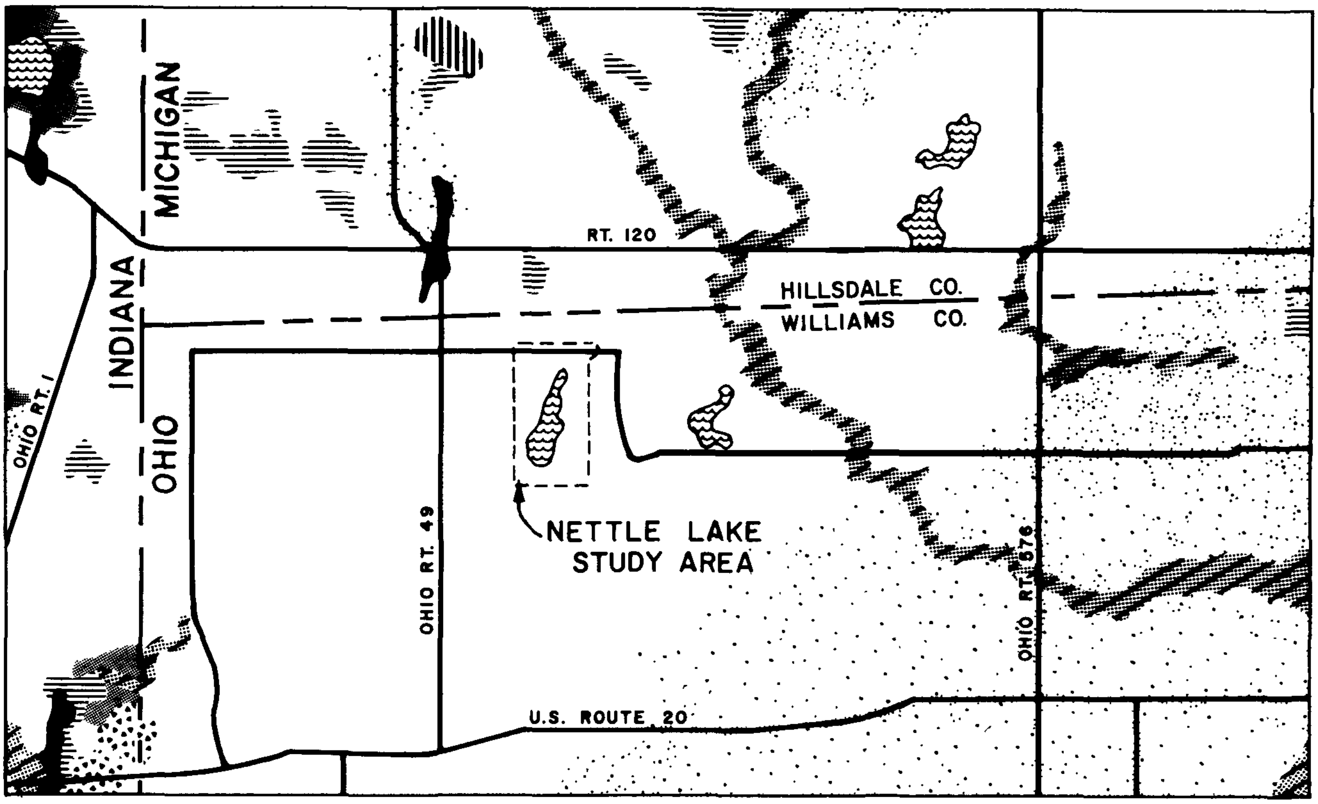


FIGURE II- 2 NETTLE LAKE: SURFICIAL GEOLOGY

LEGEND

RECENT

- SILT, SAND & GRAVEL (Mostly alluvium, but includes some colluvial and paludal deposits.)
- MUCK, PEAT & MARL (Paludal and lucustrine deposits.)

WISCONSINAN AND RECENT

- SAND & SOME SILT (Dune deposits.)

WISCONSINAN

- GRAVEL, SAND & SILT (Outwash valley train deposits.)
- GRAVEL, SAND & SILT (Outwash plain deposits.)
- GRAVEL, SAND & SOME SILT (Ice contact stratified drift in kames and kame moraines.)
- TILL (Includes some ice contact stratified drift, mainly ground moraine deposits.)
- TILL (Includes some ice contact stratified drift, mainly end moraine deposits.)

Source: Johnson and Keller 1972

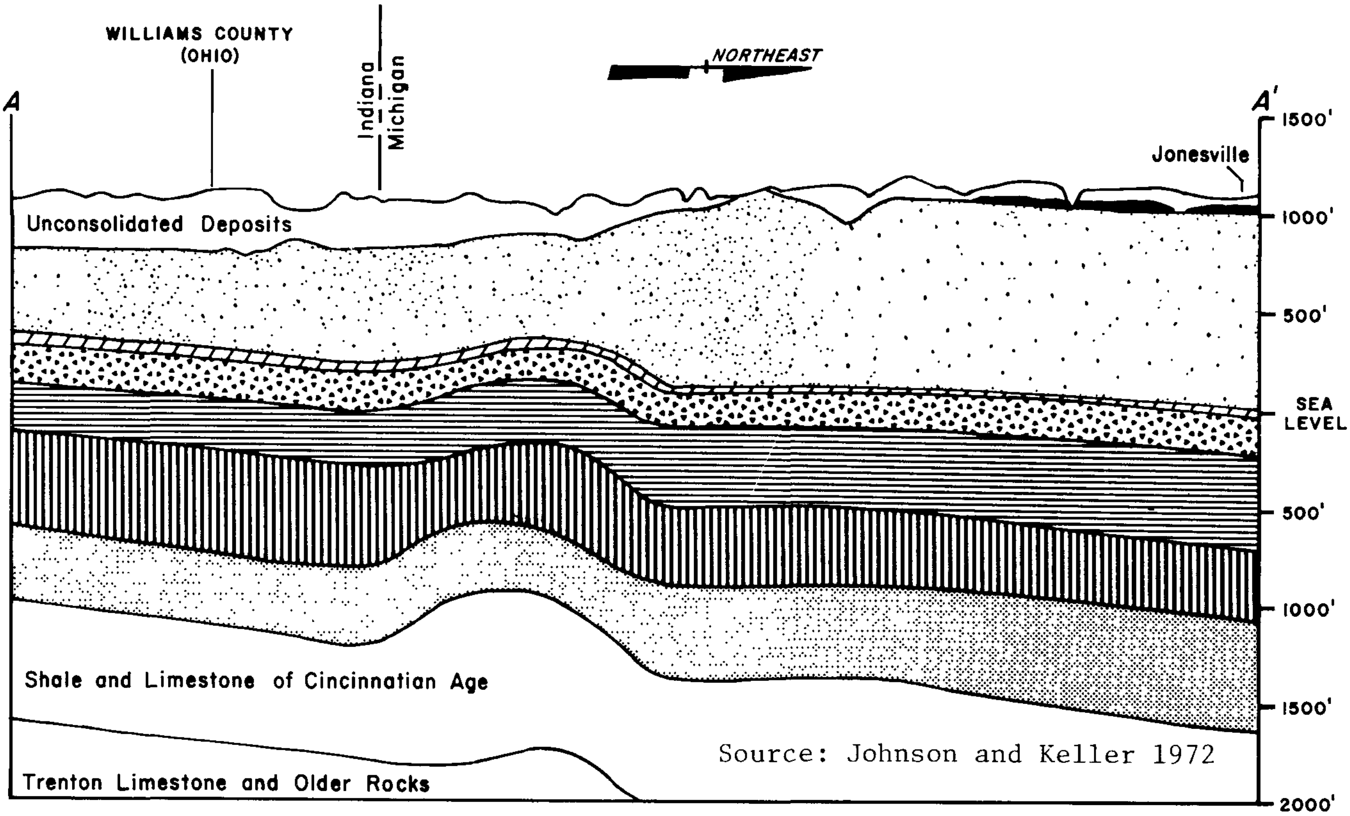


FIGURE II-3 NETTLE LAKE: BEDROCK GEOLOGY

LEGEND

MISSISSIPPIAN

- MARSHALL SANDSTONE (Varicolored micaceous sandstone)
- COLDWATER SHALE (Mostly gray shale Cuyahoga Formation in Ohio)

DEVONIAN & MISSISSIPPIAN

- SUNBURY AND ELLSWORTH SHALES (Green shale with black shale in upper and lower parts. Includes Berea Sandstone and Bedford Shale in Ohio.)

DEVONIAN

- ANTRIM SHALE (Black shale with gray shale and limestone in lower part. Ohio Shale and upper part of Traverse Group in Ohio.)
- TRAVERSE AND DETROIT RIVER FORMATIONS (Mostly limestone and dolomite. Major part of Traverse Group and Dundee Limestone and Detroit River Group in Ohio.)

SILURIAN

- SALINA FORMATION (Limestone and dolomite. Salina Group in Ohio.)
- WABASH FORMATION (Dolomite, cherty limestone, and some shale.)

- o A minimum soil percolation rate of at least 1 inch per hour has been established.

- o The seasonal water table must not be shallower than 6 feet, and the area must not be subject to seasonal wetness, ponding of water, or periodic flooding during any part of the year.

- o Steep slope gradient is limited to 15%.

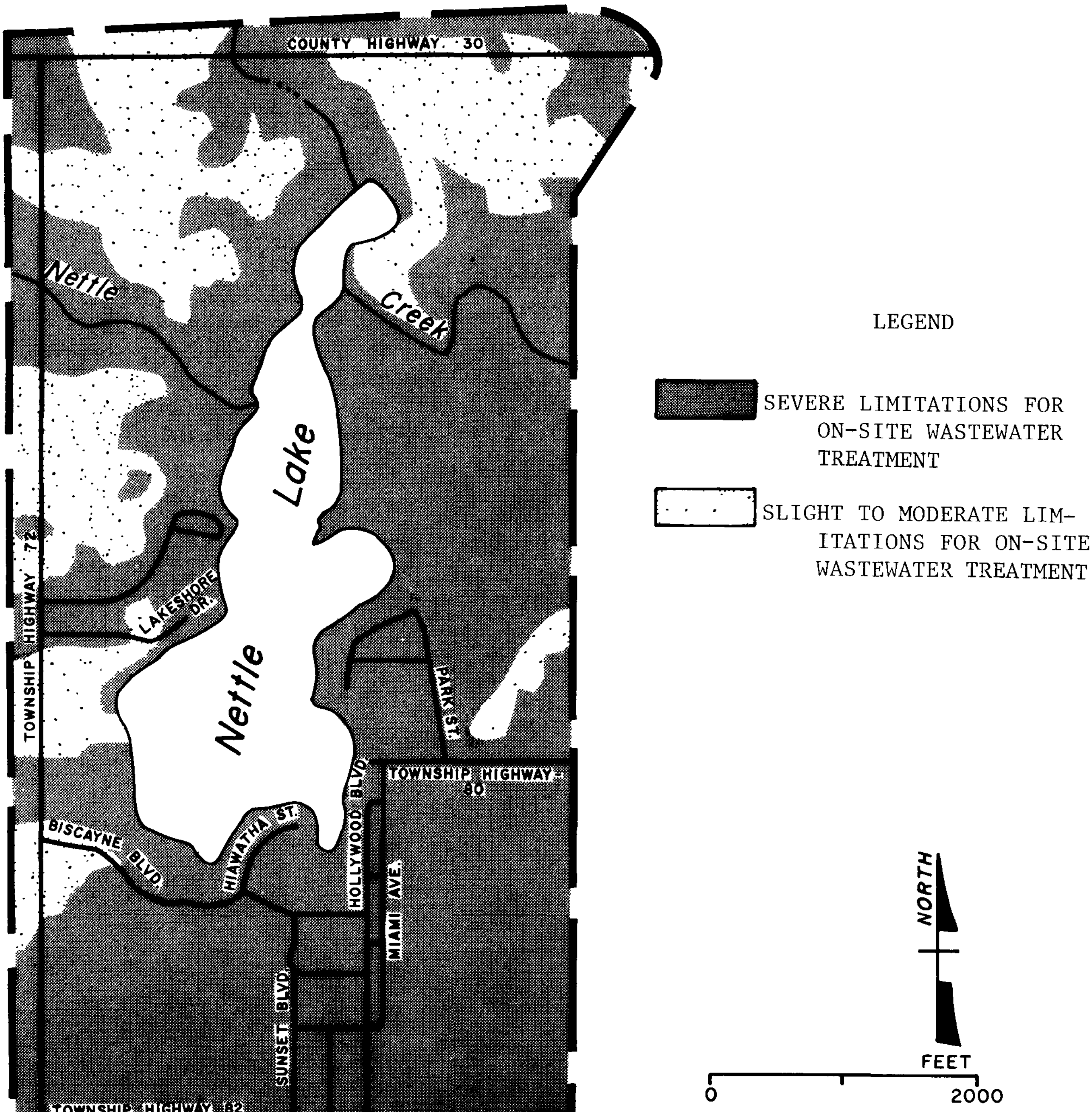
Percolation rates within the Study Area are mainly influenced by the clay (and silt) content of the loamy soils and in most of the area are very low. Clayey soil materials do not transmit water very readily because they are very fine and flat and lack sizeable, continuous pores through which water may flow. Clays mixed with the otherwise permeable sands and gravels tend to fill the relatively large pores of the latter granular materials and thus restrict flow through them. Therefore, the more clayey the loam, the lower is its percolation rate. Percolation rates through clay soils are usually so low that these soils are termed impermeable.

High water table and severe wetness are grouped together here because they are interrelated in the Study Area. Available information indicates that the depths to the artesian* groundwater aquifer (i.e., the aquifer is confined by a thick clay layer) generally exceeded 30 feet throughout the Study Area (see Section C.2.a). The observed high water tables are in effect (1) soil water* levels in clayey soils with such low permeabilities that water is trapped in them, or (2) perched* water tables in thin permeable soils overlying impermeable clays and clayey materials. Where either of these occurs in low areas and depressions, soils exhibit severe wetness, ponding of water, and periodic flooding that make them unsuitable for on-site disposal systems.

The steepness of land slopes is a criterion because steep slopes increase the depths required for sewers and adversely affect the direction and rate of surface drainage, the control of erosion and sedimentation, and the method of draining fixtures or appliances located in basements. Sections of the Study Area with slopes greater than 15% may be seen in Figure II-1 to be very limited.

Figure II-4, which reflects all the above factors, shows areas whose soils exhibit severe limitations for standard soil-dependent on-site systems and which, therefore, should be used for that purpose only after detailed site evaluation or documented satisfactory performance of previously installed systems. The remaining areas, which exhibit slight to moderate limitations, generally satisfy the above criteria for soil suitability and may be used for soil absorption systems with normal site evaluation procedures.

As the soil suitability map shows, with few exceptions, the soils immediately surrounding the lake and to its east and south exhibit severe limitations for standard wastewater absorption systems. These soils are mainly the Blount loam, Digby loam, Pewamo loam, Glynwood loam, and Carlisle muck. They are deep, very poorly drained, nearly level and medium- to fine-textured with very high seasonal water table



Source: Ohio Division of Lands and Soils 1974

FIGURE II-4 NETTLE LAKE: SOIL SUITABILITY FOR STANDARD ON-SITE SYSTEMS

(½ to 1½ feet below the surface) and very low to low permeability (0.06 to 0.6 inches per minute). These soils in many cases also exhibit a high shrink-swell potential, which is another undesirable characteristic. It is seen that all development in the Study Area to the south of the lake and most of it west of the lake are located on these soils.

In the northern and western portions of the Study Area, and extending westward out of the area, Spinks sand, Haney-Rawson sandy loams, and Boyer loamy sands and gravelly loamy sands can be found in relative abundance. These soils are moderately well drained, with a permeability of more than 6 inches per hour and a depth to the seasonal high water table of 6 feet or more. The sandy loams range in permeability from 0.6 to 2.0 inches per hour and depth to seasonal high water ranges from 1½ to more than 6 feet. Soils with these characteristics, particularly the Spinks sand, the Boyer loamy sands and gravelly loam sands are generally suitable for on-site systems. The temporary high water tables of the sandy loams may be compensated for through design features such as elevated sand mound treatment systems.

In summary, suitable soils for wastewater treatment by soil absorption systems are located in the northern and western sections of the Study Area. With the main exception of the northeastern lakeshore, all existing development within the Study Area is located on soils rated as unsuitable for standard on-site wastewater treatment systems.

c. Suitability for Land Application

The physical and hydraulic properties of soils required for effective land treatment of wastewaters by overland flow (OF), slow rate (SR) or spray irrigation, and rapid infiltration (RI) are summarized in Table II-1 (EPA, 1977). The alternatives presented in this EIS include the use of land application by rapid infiltration. The sites selected in all cases contain soils of the Spinks series.

The Soil Conservation Service's (SCS) interpretation of the Spinks series soils indicate that:

- Depth of soil profile to water table exceeds 6 feet;
- The soils are yellowish brown fine sand, banded with dark brown loamy fine sand overlying fine sand; and
- The limiting infiltration rate in the soil profile ranges from 6.0 to 20.0 inches/hour.

A comparison of these properties with those listed in Table II-1 indicates that the soils of the Spinks series are suitable for land application by rapid infiltration. However, prior to design and implementation, detailed field investigations of the selected site will be necessary to confirm its suitability for use in this process.

Table II-1

INTERPRETATION OF SOIL PHYSICAL AND HYDRAULIC PROPERTIES TO BE CONSIDERED IN THE DEVELOPMENT OF LAND APPLICATION SYSTEMS[a]

DEPTH OF SOIL PROFILE (ft.)	
≤ 1-2	Suitable for OF[b]
> 2-5	Suitable for SR and OF
5-10	Suitable for all processes
TEXTURE AND STRUCTURE	
Fine texture, poor structure	Suitable for OF
Fine texture, well-structured	Suitable for SR and possibly OF
Coarse texture, well-structured	Suitable for SR and RI
INFILTRATION RATE (in./hr.)	
0.2-6	Suitable for SR
> 2.0	Suitable for RI
< 0.2	Suitable for OF
SUBSURFACE PERMEABILITY	
Exceeds or equals infiltration rate	Infiltration rate limiting
Less than infiltration rate	May limit application rate

[a]Including overland flow (OF), slow rate or spray irrigation (SR), and rapid infiltration (RI) systems.

[b]Suitable soil depth must be available for shaping of overland flow slopes. Slow rate process using a grass crop may also be suitable.

1 ft. = 0.305 m
1 in. = 2.54 cm

Source: USEPA (1977), Process Design Manual for Land Treatment of Municipal Wastewater.

d. Prime Agricultural Lands

The Soil Conservation Service of the United States Department of Agriculture (SCS) has set forth general guidelines for a national program of inventorying "Prime and Unique" Farmland (SCS 1977). Prime and Unique Farmland has been designated as those lands which can produce present and future food and fiber supplies with the least use of energy, capital and labor, and with minimal environmental impact. Ohio's inventory to date has resulted in a tentative "List of Prime Farmland Map Units" (by letter, C. Cunningham, District Conservationist, August 4, 1979). Criteria used in designating a soil as prime include permeability and erodability (by telephone, Cecil Fleischer, SCS, September 10, 1979). Certain soil series generally considered prime may be excluded from this distinction if they are frequently flooded or if they are not artificially drained and frequently farmed. Consequently, final designation of prime agricultural lands must be accomplished on a site-specific basis. Table II-2 lists the prime agricultural soil series found in the Study Area (SCS 1979) and shows those soils which may be excluded from the distinction of prime farmland because of flooding or poor drainage. Figure II-5 delineates prime agricultural lands in the Study Area based on that list. The figure illustrates that much of the soil would require artificial drainage to be considered as prime agricultural land.

4. ATMOSPHERE

a. Climate

The climate of the Study Area is of the humid continental type characterized by warm summers and cold winters. Lake Erie and the other Great Lakes have an important effect upon the area's weather and climate. The prevailing winds tend to moderate the temperature, resulting in warmer winter temperatures and cooler summer temperatures than further inland. Precipitation is moderate, averaging 34.5 inches per year. The area is outside the principal tornado zone of the United States. Climatological data (temperature and precipitation) are collected in Toledo, Lucas County, in Montpelier, Williams County, and in Hoytville, Wood County, Ohio (National Oceanographic and Atmospheric Administration, 1975 and 1976).

b. Noise

Other than highway or road noises and motorboat noises, the Study Area has no known intensive noise sources.

c. Odors

Organic material containing sulfur and/or nitrogen, in the absence of oxygen, undergoes incomplete oxidation, resulting in the emissions of by-products which may be malodorous. The degree of tolerance to mal-

Table II-2

PRIME AGRICULTURAL SOILS FOUND WITHIN THE STUDY AREA

Symbol	Description	Limitation
Bn	Blount loam, 0-2% slope Blount loam, 2-6% slope Blount loam, 2-6% slope, moderately eroded	
BoB BoC	Boyer loamy sand, 1-6% slope Boyer loamy sand, 6-12% slope	
Bv	Bono silty clay loam	
Ca	Carlise muck	must be drained and farmed most years to be considered prime
De	Del Rey, 0-2% slope Del Rey, 2-6% slope	
Dm Dg	Digby loam, 0-3% slope Digby sandy loam, 0-3% slope	
Ed	Edwards muck	must be drained and farmed most years to be considered prime
Fs	Fulton loam, 0-2% slope Fulton loam, 2-6% slope	
Hd	Haney loam, 1-6% slope	
He	Haney-Rawson sandy loam, 1-6% slope	
Hk	Haskins sandy loam, 0-2% slope	
Hn	Haskins loam, 0-3% slope	
Kl	Kibbie very fine sandy loam, 0-2% slope Kibbie very fine sandy loam, 2-6% slope	
Mh	Millgrove loam	
Mp	Glynwood loam, 2-6% slope Glynwood loam, 2-6% slope, moderately eroded	
Ot	Ottokee fine sand, 0-6% slope	
Rl	Rawson sandy loam, 2-6% slope Rawson sandy loam, 6-12% slope	
Sc	Bono silty clay loam	
Sd	Seward loamy fine sand, 2-6% slope	

Table II-2 (cont.)

Symbol	Description	Limitation
Sg	Shinrock silt loam, 2-6% slope	
Sp	Spinks fine sand, 2-6% slope Spinks fine sand, 6-12% slope	
So	Sloan silty clay loam	not prime if frequently flooded
Wc	Wallkill silt loam	must be drained or farmed most years to be considered prime
Wr	Martisco muck	must be drained and farmed most years to be considered prime

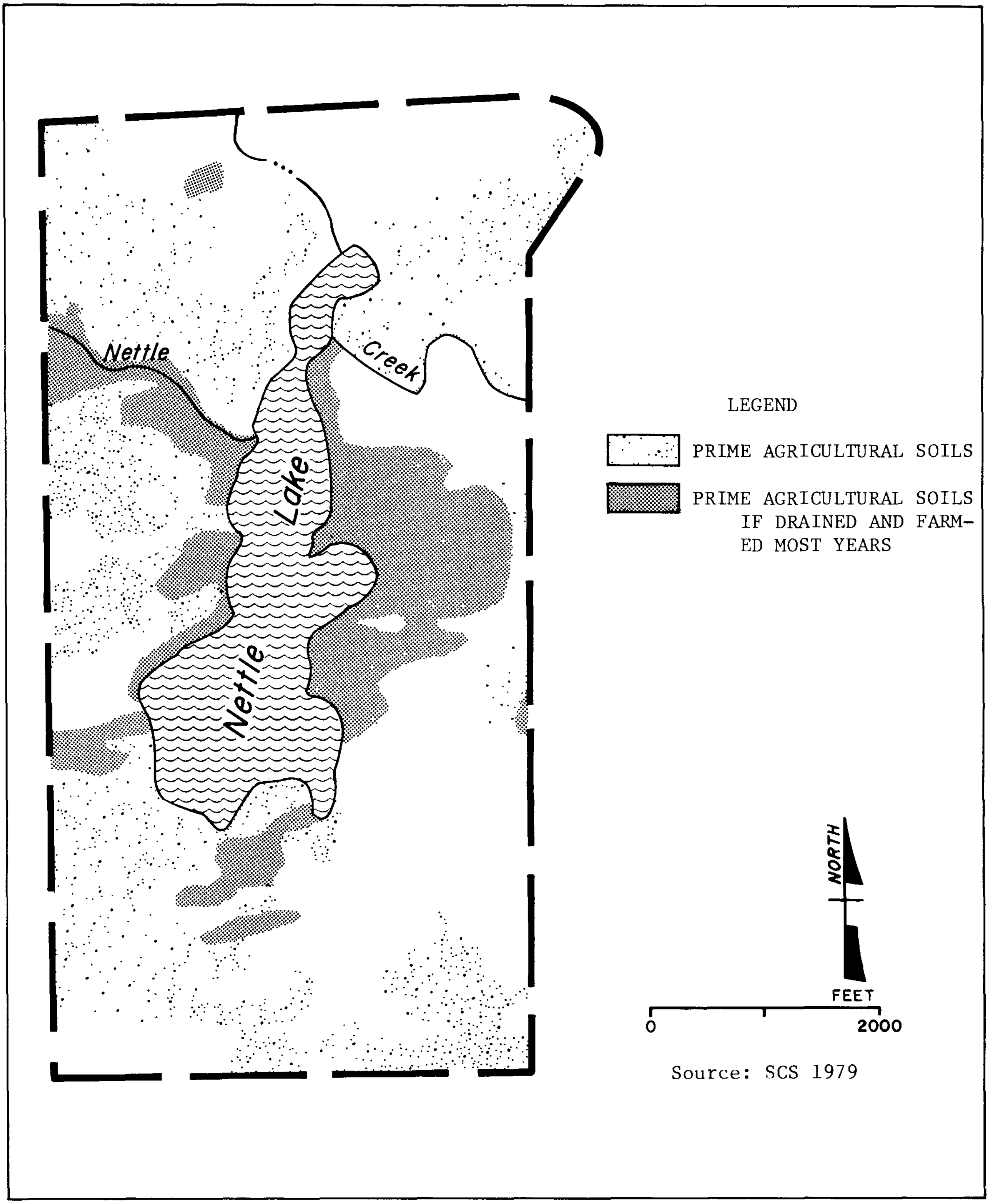


FIGURE II-5 NETTLE LAKE: PRIME AGRICULTURAL LAND odorous gases is subjective and depends on the person exposed to the odor and on the concentration and intensity of the odor. Odors that can be identified as coming from domestic waste are particularly objectionable to most people. For this reason, wastewater treatment works must be carefully located, designed, and operated.

Objectionable odors from existing on-site systems were reported during a sanitary survey conducted in November-December 1978 (see Section II.F.4). Complaints indicated that the odor problems were particularly severe during spring floods, sometimes forcing residents to leave until the odors subsided.

d. Air Quality

The Air Quality Section of the OEPA conducts sampling and analysis procedures for air pollutants in the State of Ohio, but they do not maintain any stations in Williams County. The closest sampling stations are in Defiance, Defiance County, and Napoleon, in Henry County. They are both approximately 30 miles southeast of the Study Area, and the air pollution readings in these areas are probably not representative of Nettle Lake (by telephone, John Martz, Air Quality Section, OEPA, December 1, 1977). Nettle Lake is not close to any metropolitan area, and Mr. Martz does not believe that Ohio air quality standards are being violated.

C. WATER RESOURCES

1. SURFACE WATER

a. Surface Water Hydrology

Nettle Lake and Nettle Creek are the major surface water bodies in the Study Area. Nettle Creek originates in Hillsdale County, Michigan. It flows in a southeasterly direction, enters Nettle Lake just north of Eureka Beach, discharges just south of Crestwood, and finally flows into the St. Joseph's River near Montpelier, Ohio. Intermittently, a small, unnamed stream also discharges into Nettle Lake along the north shore (EPA-EMSL, 1978). The Nettle Lake watershed is part of the much larger drainage area of the Maumee River, which discharges into Lake Erie.

The balance of water in lakes is expressed by changes in water quantity and quality, determined by the inputs from all sources less the rates of loss. Each input and output varies seasonally and is governed by the characteristics of the drainage basin, the lake basin, and the climate. Table II-3 summarizes the major physical characteristics of Nettle Lake and its drainage basin, which are discussed in the next few paragraphs.

Size of the Drainage Basin. The total runoff received by Nettle Lake is determined by the topography and size of the drainage basin. The Nettle Lake drainage basin, shown in Figure II-6, is approximately 20.1 square miles. In comparison to the size of Nettle Lake, its watershed is very large; the ratio of drainage basin to lake surface area is 137:1 (USGS Topographic Map, 1973).

Table II-3

PHYSICAL CHARACTERISTICS OF NETTLE LAKE*

Parameter		
Lake Surface Area	94.0 acres	38.1 hectares
Drainage Basin Area**	20.07 mi^2	51.98 km^2
Lake Mean Depth	20 feet	6.1 meters
Maximum Depth	28 feet	8.5 meters
Lake Volume	1880 acre-feet	2.32×10^6 m^3
Mean Hydraulic Retention Time	0.32 yr.	0.32 yr.

* ODNR - 1974
** Estimated from USGS Topographic map for Clear Lake and Nettle Lake Quadrangles. 1973.

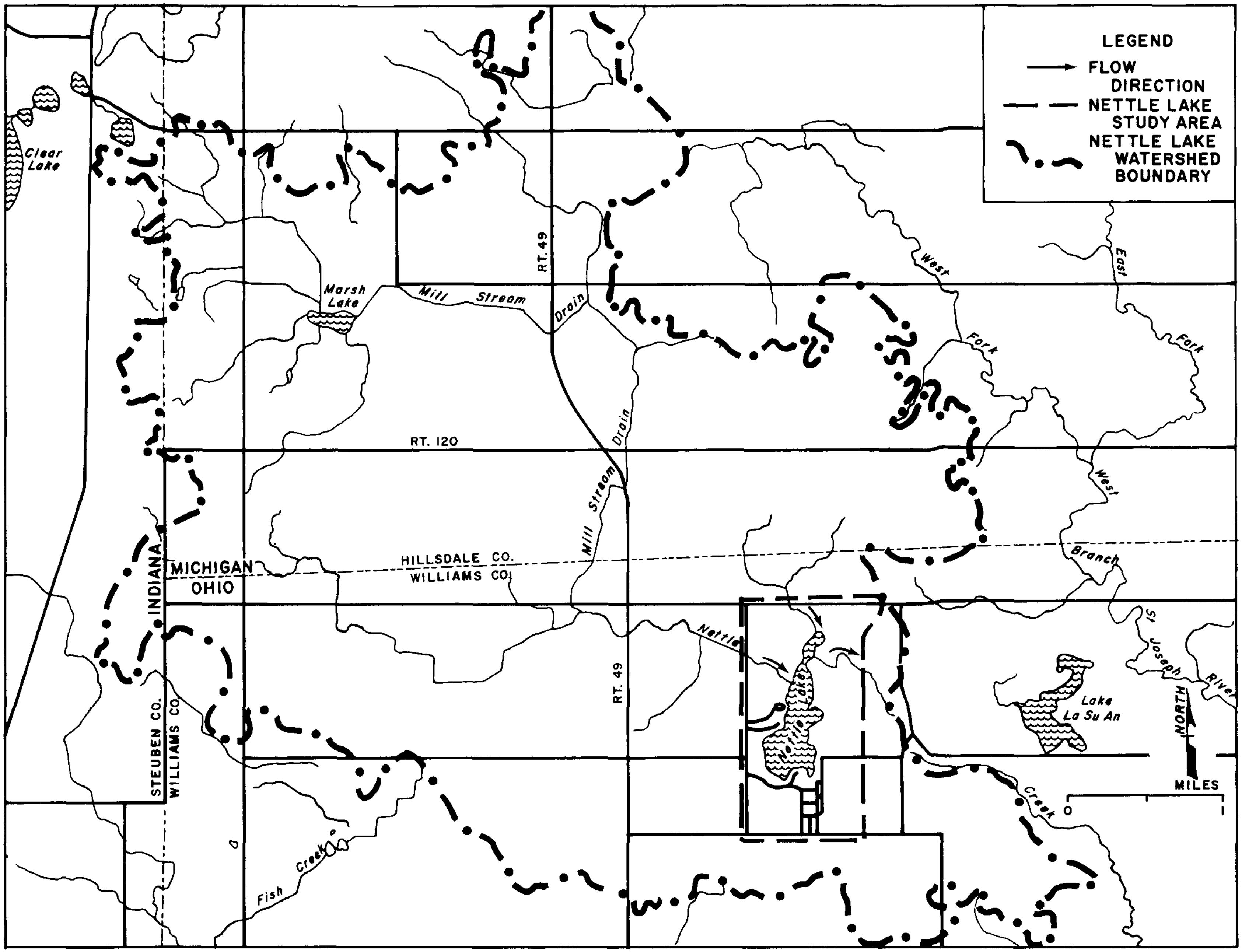


FIGURE II-6 NETTLE LAKE: SURFACE WATER HYDROLOGY

Tributary Flow. Nettle Creek is the only significant tributary in the Nettle Lake Basin. Neither the US Geological Survey, which has primary responsibility for monitoring stream flow, nor any other agency, has maintained continuous stream flow gauges along Nettle Creek and consequently no flow records are available. One important characteristic of the tributary flow is that during spring runoff, Nettle Creek, at the outlet of Nettle Lake, is unable to accommodate the additional flow, and flooding results (EPA-EMSL, 1978).

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 water. The hydraulic retention time is an important factor in determining nutrient concentrations in the water column of the lake. The hydraulic retention time for Nettle Lake is estimated to be 3.8 months.

Climatological Factors. Climatological factors vary seasonally and induce variations in stream runoff and in the capacity of a stream to assimilate pollutants. The amount of runoff over the watershed is equivalent to the annual precipitation minus evaporative losses and the amount of groundwater recharge. Annual precipitation averages 34.5 inches in the Nettle Lake drainage basin, evaporative losses are approximately 25 inches, and runoff 9.5 inches (ODNR, 1962).

b. Surface Water Quality

Water quality conditions for Nettle Lake and Nettle Creek are discussed in this section. Only very limited data were available. Consequently, in evaluating the water quality, it was necessary to employ "theoretical estimates" based on assumptions discussed below along with the actual data.

Surface Water Quality. During May and August 1978, Nettle Lake was sampled as part of the National Eutrophication Survey (USGS, 1978). This survey was an investigation on a nationwide basis of potential acceleration of eutrophication of fresh water lakes and streams. Table II-4 summarizes the analytical results for those water quality parameters most affected by domestic wastewater. Appendix A-2 includes analytical results for other parameters measured during the survey.

Due to seasonal variations in tributary flow and nutrient loads, an evaluation of water quality requires a minimum of one year's sampling data. Seasonal variations in water quality are further discussed in Appendix A-3. Conclusions regarding water quality drawn from the less extensive sampling program carried out for Nettle Lake may be modified by more extensive sampling. Total phosphorus concentrations averaged 0.04 mg/l, and orthophosphorus was not detected. Concentrations of nitrogen compounds were reported as follows: total nitrogen, 1.55 mg/l; total organic nitrogen, 0.74 mg/l and 0.95 mg/l; total Kjeldahl nitrogen, 0.95 mg/l; and nitrite plus nitrate nitrogen, 0.61 mg/l. The Secchi Disc was visible to a depth of 3.8 feet during August sampling. Although these conditions are generally indicative of eutrophic conditions, more complete sampling is needed to verify this.

Table II-4

SURFACE WATER QUALITY ANALYSIS FOR NETTLE LAKE AND NETTLE CREEK*

Parameter	Nettle Lake 5/22/78	Nettle Lake 8/14/78	Nettle Creek 8/14/78
Total Nitrogen	1.5 mg/1	1.6 mg/1	1.6 mg/1
Ammonia Nitrogen**	0.16 mg/1	0.05 mg/1	-
Nitrate as Nitrogen	0.61 mg/1	-	-
Total Organic Nitrogen	0.74 mg/1	0.95 mg/1	-
Total KJD Nitrogen	0.90 mg/1	1.0 mg/1	1.1 mg/1
Total Phosphorus	0.04 mg/1	0.04 mg/1	0.05 mg/1
Ortho Phosphorus	0.00 mg/1	0.00 mg/1	-
Total Organic Carbon	4.9;8.5 mg/1	1.1;6.9 mg/1	7.7 mg/1
Secchi Disc Measurement	-	3.8 ft	-
Dissolved Oxygen	-	8.4 mg/1 (surface)	-
	-	2.6 mg/1 (10 feet)	-
	-	0.4 mg/1 (15 feet)	-
Chlorophyll a (2 feet)	19.5 μg/1	19.5 μg/1	-

* Values are averaged for two samples unless otherwise noted.
** Both ionized and un-ionized.
Source: ODNR 1978

Nettle Creek was sampled during August only. Similar concentrations of total phosphorus (0.05 mg/l) and total nitrogen (1.6 mg/l) were found.

Nutrient Budgets. Nutrient loads to Nettle Lake are shown in Table II-5 for major nutrient sources, including tributaries and runoff, precipitation, and septic tanks (or other on-site systems).

Table II-5
THEORETICAL NUTRIENT INPUT OF NETTLE LAKE
(BASED ON 1973-1975 DATA)

	Nitrogen			Phosphorus		
	$gm/m^2/yr$	Kg/yr	%	$gm/m^2/yr$	Kg/yr	%
Precipitation	1.16	428.0	2.0	0.018	6.7	0.9
Non-point sources	57.60	22,073.0	91.0	1.63	692.0	86.3
Septic Tanks	4.31	1,653.9	7.0	0.24	103.4	12.8
Total	63.07	24,154.9	100.0	1.89	802.1	100.0

These nutrient sources should be measured directly in order to accurately determine their contribution to the total nutrient load. However, because data on water quality and land use characteristics for the Nettle Lake watershed are so limited, direct calculations of nutrient loads cannot be made. Instead, a theoretical nutrient load was calculated on the basis of assumptions used in the National Eutrophication Survey and the assumptions regarding conditions at Nettle Lake.

The theoretical load suggests that non-point sources contribute the largest percentage of the total load, although on-site systems are also a significant source of phosphorus.

The following assumptions and methodology were used in deriving the theoretical load:

- Non-Point Sources: Non-point source nutrient loads were derived using a simple model developed by Omernik (1976). The relationship between land use and total phosphorus and total nitrogen export rates was developed from tributary data collected from other watersheds in the same geographic region as Nettle Lake where non-point sources were the major contributor. The US EPA National Eutrophication Survey (NES) has adopted Omernik's model as their standard methodology for estimating nutrient export from ungauged tributaries and immediate drainage areas of lakes. Omernik's model is described in detail in Appendix A-4. Table II-6 shows the relative proportion of land use categories in the watershed, used as a basis for calculating the non-point source load.

Table II-6
DISTRIBUTION OF LAND USE CATEGORIES IN
NETTLE LAKE WATERSHED

Land Type	Acres	Percent
Forest/Wetland	1,922	14.96
Residential	350	2.72
Agricultural	10,461	81.45
Lake	112	0.87
Total	12,845	100.00

- Precipitation: The US EPA National Eutrophication Survey methodology (US EPA, 1975) was used to determine nutrient loads from precipitation. This method assumes average nutrient loads of 1.08 $gm/m^2/yr$ nitrogen and 0.017 $gm/m^2/yr$ phosphorus, and does not account for regional differences in annual precipitation.

- On-Site Waste Disposal Systems: Because of the recurring spring floods at Nettle Lake, it was assumed that the wastes in the drainfields (of permanent residences) and pit privies of residences, that are flooded, are thoroughly mixed with the Lake at this time. During this period, phosphorus loads of 3.5 lb/cap/yr and nitrogen loads of 9.4 lb/cap/yr, or 100% of the total nutrient load, were assumed to reach the surface waters in flooded areas. Throughout the remainder of the year, the assumption developed by NES, that only 7% of the phosphorus was leached to surface water, was used. If this more conservative estimate of 7% phosphorus loading from septic tanks were used for determining the total annual load, the phosphorus load from on-site systems would be estimated to be only 44.7 kg/yr, or about 6% of the total input to the lake. However, the load of 103.4 kg/yr shown in Table II-5 is considered more representative of conditions at Nettle Lake.

Phosphorus Loading/Trophic Conditions Relationship. This section examines the relationship between phosphorus inputs and the resulting water quality and lake trophic status. Phosphorus has been found to be the limiting nutrient for algal growth in most temperate waters, thereby controlling their trophic status. Predictions of trophic status based on phosphorus loading were derived from an empirical model developed by Dillon (1975). A detailed discussion of this model can be found in Appendix A-5. Essentially the model predicts in-lake concentrations of phosphorus and lake trophic status by relating mean depth to a factor that includes annual phosphorus loading, a phosphorus retention coefficient, and the hydraulic flushing rate. The Dillon relationship was found to be applicable to 23 lakes in the eastern United States that were sampled during the National Eutrophication Survey. Figure II-7 shows the trophic condition of Nettle Lake based on the Dillon model, using the "theoretical phosphorus" load presented earlier in this section. Dillon's model describes Nettle Lake as being eutrophic, a conclusion which concurs with water quality sampling results.

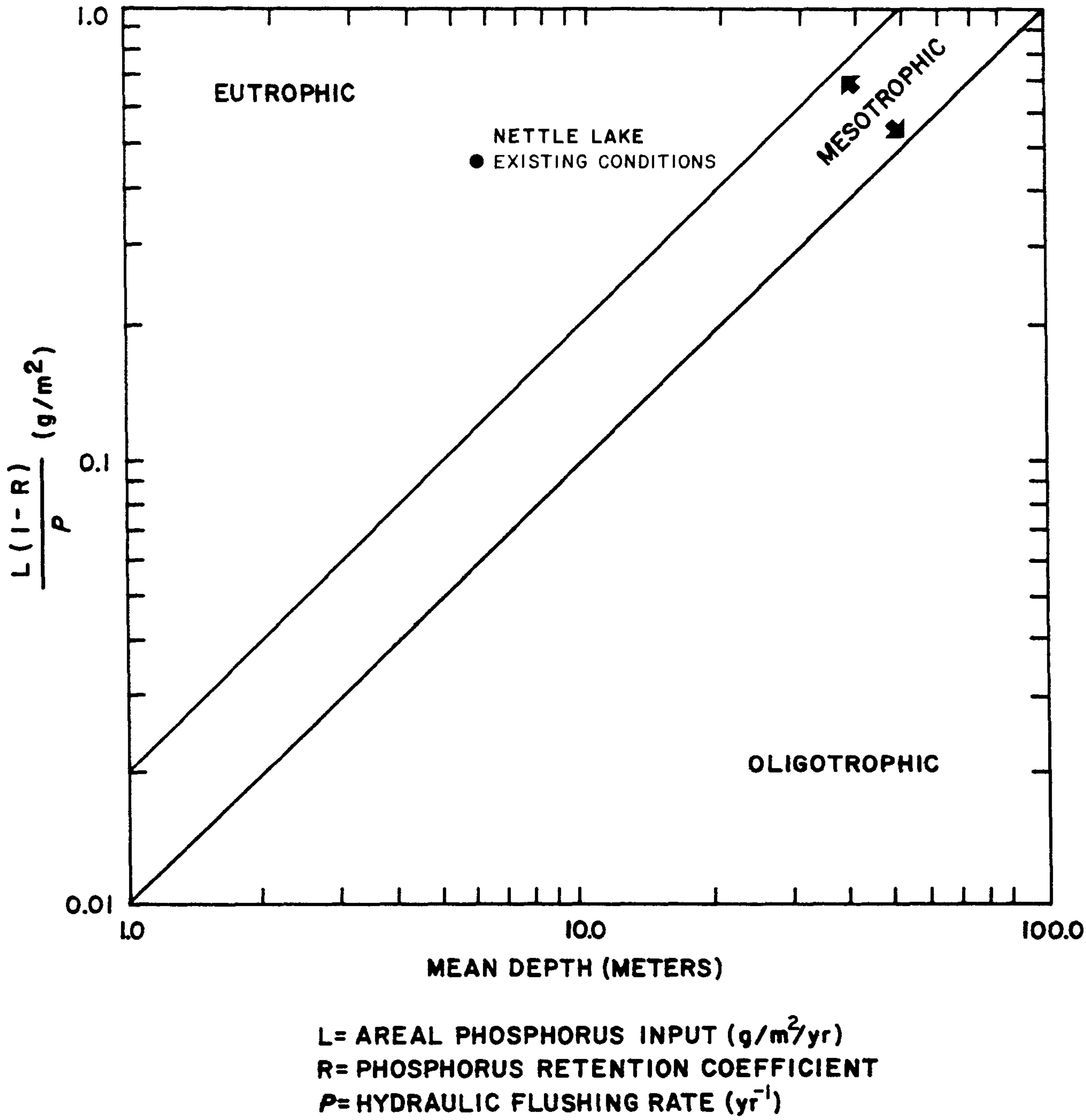


FIGURE II-7 TROPHIC STATUS OF NETTLE LAKE

Bacteria. Nettle Lake's primary use is for recreation. The water quality standards promulgated by the OEPA declare that, for bathing waters and waters designated for primary and secondary contact recreation, fecal coliform and fecal strep counts shall not exceed 200 per 100 ml, and 1000 per 100 ml, as a geometric mean, respectively (based on not less than five samples per month).

OEPA sampled Nettle Lake on 12 July and 2 August 1976, for fecal coliforms and fecal streptococcal bacteria. The locations of the sampling points are shown in Figure II-8. Results of the bacteria survey are listed in Table II-7. No conclusive violation of water quality standards is apparent, as the results in Table II-7 were obtained from single samples at each station instead of the required standard of five samples per month.

Fecal streptococcal bacteria found in samples indicate the presence of fecal pollution by warm-blooded animals. The relative concentrations of fecal coliforms and fecal streptococci indicate the degree and likely source of fecal contamination--human or animal--in the immediate area around Nettle Lake. High ratios of fecal coliform bacteria to fecal streptococci (greater than 4 to 1) indicate the presence of human-generated fecal contamination, and low ratios (less than 0.7 to 1) indicate fecal contamination generated primarily by farm animals (USEPA, 1978e).

The fecal coliform to fecal streptococci ratios in Table II-7 show that almost all samples were dominated by fecal bacteria of animal origin. One possible exception was a sample taken from a backwater area behind a house located on the south shore of Nettle Lake. The data suggest contamination by human sewage at this location.

c. Surface Water Use and Classification

Fishing, boating, and swimming are the major recreational uses of Nettle Lake. Ohio water quality standards were revised by the OEPA in 1977, but have not been approved by US EPA. Under these standards, all surface waters within the state of Ohio are designated for use as warm-water fisheries, agricultural and industrial water supply, and primary contact recreation, unless otherwise noted (OEPA, 1977). Nettle Creek has not been exempted from these designated uses and must therefore meet applicable standards for these uses. The standards are listed in Appendix A-6. The Maumee River and its tributaries, in those reaches that include Nettle Creek, is "effluent limited." That is to say, if all discharged wastes were to be treated in accordance with the OEPA standards, these waters would soon attain acceptable water quality.

2. GROUNDWATER RESOURCES

a. Groundwater Hydrology

Sand and gravel units within the 75 to 250-feet-thick unconsolidated glacial drift constitute the major sources of groundwater within the Study Area. The aquifers are most likely of the discontinuous types characteristic of glacial deposits. The available quantity of ground-

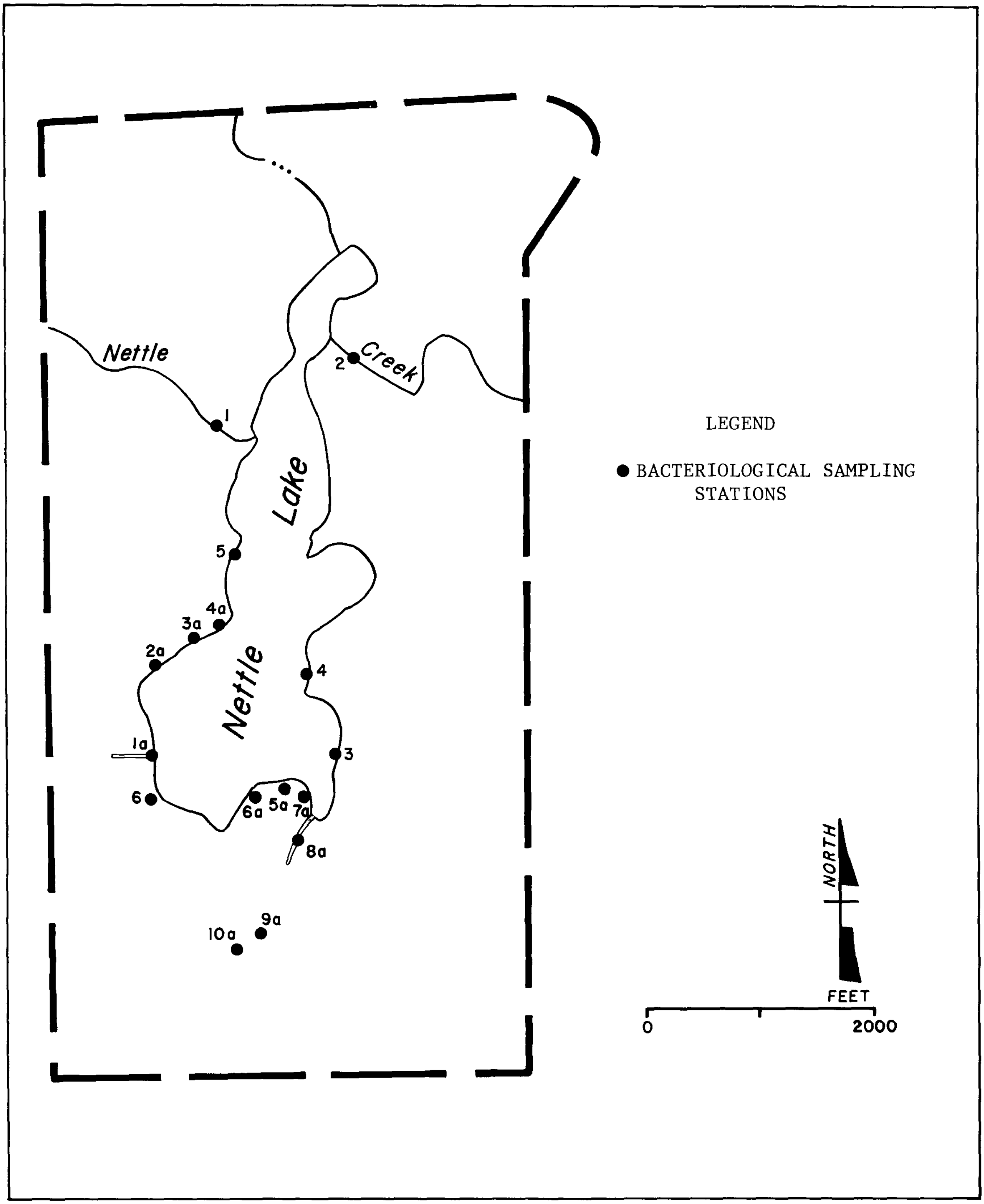


FIGURE II-8 NETTLE LAKE: BACTERIOLOGICAL SAMPLING STATIONS

Table II-7

RESULTS OF BACTERIOLOGICAL SAMPLING BY OHIO EPA, NETTLE LAKE, OHIO
JULY - AUGUST 1976

Sample Station	Description of Location	Fecal Coliform Bacteria (#/100 ml)(FC)	Fecal Streptococci (#/100 ml)(FC)	FC/FS
1	On County Rd. 4-75; west tributary	350	1,320	0.265
2	On County Rd. 5-75; east tributary	80	430	0.19
3	Off southeast shore of Nettle Lake	<1	30	<0.03
4	Off east shore of Nettle Lake	12	30	0.4
5	Off northwest shore of Nettle Lake	9	16	0.56
6	∿100 ft. off southwest shore of Nettle Lake	2	62	0.032
1a	End of canal west of Nettle Lake	<1	10	<0.10
2a	North of lake	7,500	<10,000	≥0.75
3a	Western shore of Nettle Lake	10	40	0.25
4a	Discharge pipe from settling system, western shore of Nettle Lake	<1	10	<0.10
5a	On-shore by large home, south end of Nettle Lake	10	60	0.16
6a	Beach area (swimming), south end of Nettle Lake	10	90	0.11
7a	South end of Nettle Lake	40	370	0.108
8a	Backwater area behind home (across from Nettle Lake, south side)	330	50	6.6
9a	Pipe draining swamp area near entrance road to cottages, S. end, Nettle Lake	70	260	0.269
10a	Ditch draining into south end of Nettle Lake	180	1,590	0.113

water depends upon the extent and permeability of the sand and gravel lenses interbedded with the less permeable glacial material. Very few wells have penetrated to the bedrock shales, which are normally very poor aquifers.

Fourteen driller's well logs supplied by the OEPA and the US Geological Survey were examined for wells located around the southern half of Nettle Lake. These well logs indicate that aquifers in the Study Area are of the artesian (confined) type, are composed primarily of sand and gravel, range in depth below the surface from 30 to 180 feet, and are overlain or confined by clay. Six of the fourteen wells were the flowing artesian types when constructed. Most of the sand and gravel aquifers of Williams County are under relatively high artesian pressure derived from two end moraines that traverse the area (Kaser and Harstine, 1965).

Precipitation averages 34.5 inches annually, with 25 inches being accounted for by evapotranspiration. Average annual runoff for the area is 9.5 inches (ODNR, 1962). Recharge of the aquifers by precipitation takes place through the unconfined sections. The extent of this recharge in the Study Area is unknown but is likely to be insignificant because of the thick impermeable clays confining the aquifer. Water level fluctuations in response to the annual recharge and discharge cycle have been less than 0.05 foot (Kaser and Harstine, 1965). This is an indication that current water use and disposal practices were causing essentially no changes in water levels and thus in the availability of water.

Because of the tight clayey soils surrounding Nettle Lake and the thick clay layer confining the aquifer in the Study Area, it is unlikely that any groundwater flows into the lake. This has been confirmed by the "Septic Snooper Survey" (see Section II.F.1.a).

b. Groundwater Quality

Groundwater throughout the St. Joseph River Basin is of the calcium magnesium bicarbonate type, very hard and of high iron content exceeding the US Public Health Service (1962) recommended limit. Otherwise, the water is of good chemical quality for most uses. Typical of the very high iron content and hardness are the recorded values near Cooney, Ohio on the west side of Nettle Lake, where the iron content is 1.3 mg/l and the hardness 306 mg/l at a depth of 122 feet (USGS, 1952).

c. Groundwater Use

Groundwater sources--private wells--provide essentially all of the water supplies of the Study Area, which are used mainly for domestic purposes. Present groundwater use within the Study Area is on the order of 0.06 mgd. It is expected to increase to an average of 0.07 mgd by the year 2000 as a result of the projected population growth. These withdrawal rates and the change of .01 mgd are miniscule and would result in essentially no changes in water levels of the aquifer or the lake.

3. WATER QUALITY MANAGEMENT

In the Federal Water Pollution Control Act (PL 92-500, 1972) and the Clean Water Act that amended it in 1977 (PL 92-517), Congress outlined a framework for comprehensive water quality management that applied to groundwater as well as to surface waters. Water quality is the responsibility of the United States Environmental Protection Agency (US EPA) in coordination with the Ohio Environmental Protection Agency (OEPA). However, the Clean Water Act instructed all Federal agencies to safeguard water quality standards in carrying out their respective missions. As the lead agency, US EPA coordinates the national effort, sets standards, and reviews the work of other agencies, some of which, for example, the Army Corps of Engineers, are assigned responsibilities in line with their traditional missions.

In delineating the responsibilities of the various levels of government for water quality management, Congress recognized the rights of the States with regard to their waters. It authorized funding for development of State plans for control of pollution, for State water quality standards (which may be more restrictive than Federal standards), and for research. US EPA retains power of enforcement of established standards, State or Federal. Parts of the State of Ohio's water quality standards have not been approved by US EPA, which is proposing Federal regulations to supersede the disapproved portions (44 FR 39371-39508, 6 July 1979). The State of Ohio has, however, been certified to administer the National Pollutant Discharge Elimination System (NPDES) (see Section Appendix A-1).

The key provisions on 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.

Section 201 of the Act (under which the Williams County Commissioners applied for funds for Nettle Lake) authorizes US EPA to make grants of up to 85% to localities toward the improvement or construction of facilities for treatment of existing water quality problems. US EPA retains authority to approve or reject applications for construction funds for treatment facilities. Federal, State and local responsibilities for water quality management in the Study Area are discussed in Appendix A-7.

4. FLOOD HAZARD AREAS

The US Department of Housing and Urban Development Flood Insurance Program has designated flood hazard zones within the Study Area (Ganett, et al., 1977). These zones identify areas for which there is a 1% chance of flooding in any year (commonly called the 100-year flood). Wide areas bordering Nettle Lake and Nettle Creek, covering approximately 60% of the Study Area, are included in the designated flood hazard zones (see Figure II-9).

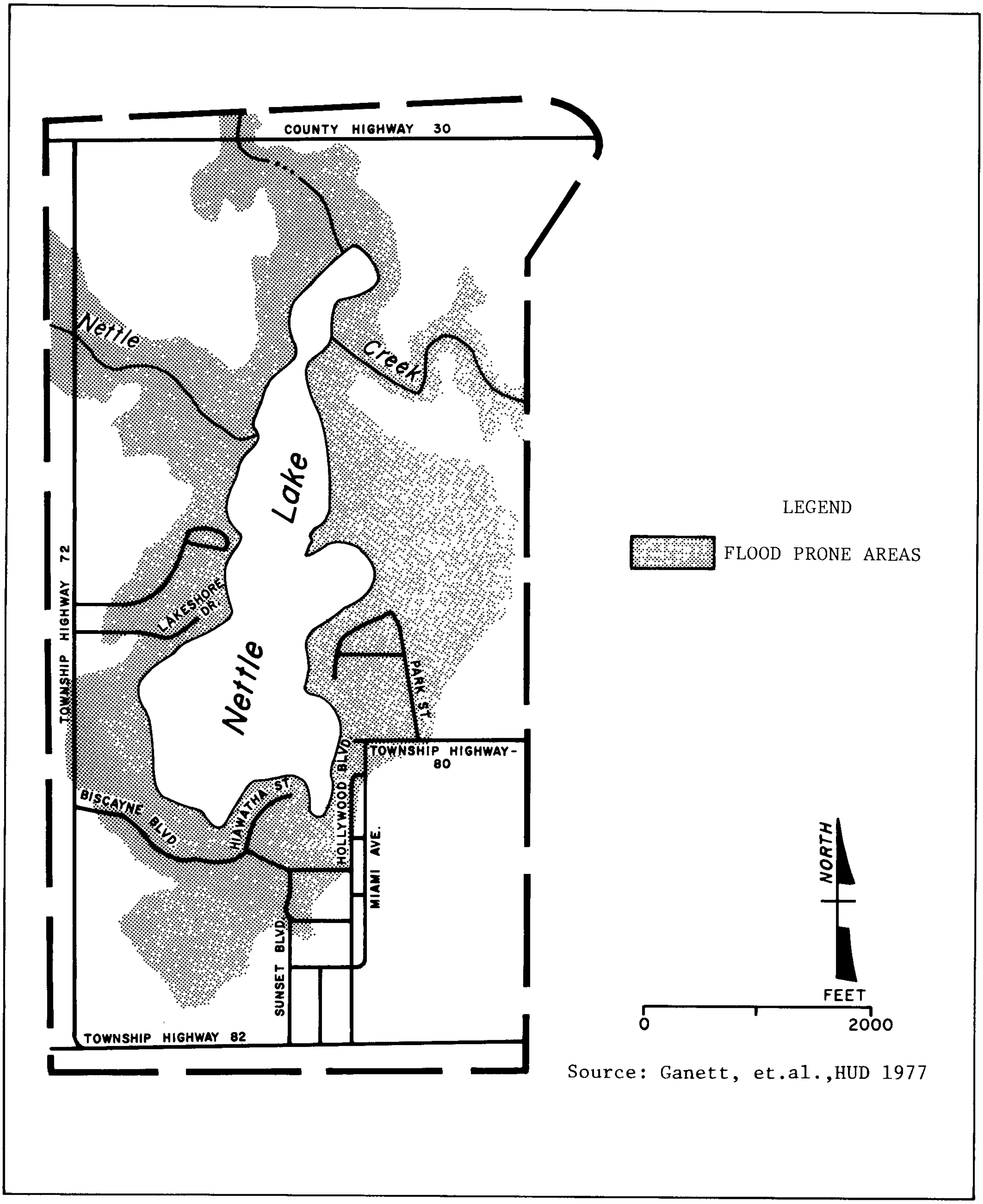


FIGURE II-9 NETTLE LAKE: FLOOD PRONE AREAS

Extended rains and spring thaws have caused the lake level to rise as much as five or six feet in past years (Charles Cunningham, Soil and Water Conservation Service, January 9, 1978). This has caused flooding in the developed and wetland areas at the south end and east side of Nettle Lake, including inundation of septic tank/soil absorption systems and privies in the area. Two factors contribute to the flooding problem in these areas. Flat Carlisle Muck soils surround most parts of the lake, which increases the flooding hazard because of slow percolation and reduced permeability properties. Additionally, several streams flow into Nettle Lake, which acts as a natural reservoir with Nettle Creek as the only outflow. Dredging of Nettle Creek from the lake outlet to the St. Joseph River has been proposed as a solution to the flooding problem but was rejected by the County Commissioners in October 1979 following a public hearing (by telephone, John Hartman, Williams County Engineering Office, 2 November 1979).

The Williams County Commissioners, pursuant to the Ohio Revised Code Section 307.37 and in compliance with Section 1910 of the National Flood Insurance Act of 1968, enacted a Floodplain Ordinance on 28 March 1978. The ordinance vested the responsibility for its implementation and enforcement in the Williams County Regional Planning Commission, through its Planning Director. The ordinance requires the obtaining of a permit from the Planning Director for all construction, enlargement, alteration, repair, improvement, moving, or demolishing of buildings or structures within the 100-year flood hazard zone as defined by the Flood Hazard Boundary Map issued by the Federal Insurance Administration. The Planning Director is required to review subdivision proposals to ensure that

a. "All such proposals are consistent with the need to minimize flood damage within the flood prone area.

b. All public utilities and facilities, such as sewer and gas, are designed to minimize or eliminate flood damage.

c. Adequate drainage is provided to reduce exposure to flood hazards."

"The Planning Director must require within flood prone areas new and replacement water supply systems to be designated to minimize or eliminate infiltration of flood waters into the systems."

The Planning Director must require within the flood prone area:

a. "New and replacement sanitary sewage systems to be designed to minimize or eliminate infiltration of flood waters into the systems and discharges from the systems into flood waters.

b. On-site waste disposal systems to be located to avoid impairment to them or contamination from them during flooding."

D. BIOTIC RESOURCES

A range of habitats exists in the Nettle Lake Study Area. Although 49% of the Study Area is cropland, the forests and wetlands (157 acres or 18%) provide habitat for a variety of wildlife, including amphibians, reptiles, birds, and mammals. About 11% of the area is water, providing the basis for the recreational development around the lake.

1. AQUATIC BIOLOGY

a. Aquatic Vegetation

There is relatively little information about the aquatic vegetation of either Nettle Lake or Nettle Creek and none about changes in amounts of aquatic vegetation from year to year. The shallow shorelines of glacial pit lakes such as Nettle Lake are conducive to the establishment and growth of rooted aquatic vascular plants of both emergent and submergent types. These flowering plants provide substrates for attachment of many small animals and algae, and as importantly, they provide structure (feeding and hiding places) for young fish and other animals. Of course, there are also plankton (free-floating tiny plants and animals) that contribute to the productivity* of a lake, but such organisms provide no structure for the aquatic environment.

The ODNR, in their sampling of young-of-the-year fishes made in July and August of four different years, estimated that approximately 3% to 5% of the lake had either submergent or emergent vegetation in the sampled areas of shoreline. Such moderately low values do not indicate an explosive growth of aquatic plants. In one year the sampling was conducted in the vicinity of the Shady Shore section of the lake, where an estimated 25% of the lake bottom was vegetated by emergent plants, probably bulrushes (*Scirpus* sp.) and spikerushes (*Eleocharis* sp.). Emergent vegetation is usually less affected by the anaerobic conditions that produce the die-offs, and this growth is probably unrelated to late summer vegetation blooms. Based on this fragmentary evidence about the aquatic vegetation of Nettle Lake, there appears to be neither excessive aquatic growth nor the late summer die-offs that sometimes result from such growth of vegetation.

Although some nutrients may be entering the lake from nearby privies and from the drainage fields of septic tank systems, the fertilizers applied to croplands and lawns in the watershed upstream from the lake represent a greater potential source of phosphorus and nitrogen through run-off. The impacts of inundation of on-site treatment systems is discussed further in Section II.F.4.

The ODNR fish survey reports (1974, 1975, 1976, and 1977) describe Nettle Lake's few sand and gravel bars as covered with vegetation, and parts of the shoreline are bordered with water lilies. This survey also estimated that 90% of the shoreline was mud bank and that the remainder was composed equally of sand and gravel. Substrate type can be important in determining the presence and distribution of rooted aquatic vegetation. For example, yellow water lilies (*Nuphar* sp., also known as spatterdock) grow primarily in lakes and river backwaters or sloughs in which the bottom is silt or mud. Other rooted aquatic vegetation in the lake includes pondweeds (Potamogeton spp.), spikerushes, and bulrushes (by telephone, Mr. Darrell Allison, ODNR, Division of Wildlife, 2 May 1978).

b. Fishes

Primarily because of the summer surveys conducted each year from 1974 to 1977 by the ODNR, the fishes of Nettle Lake are better known than the other biota. During these years, studies were conducted in May, when adult fish populations were sampled with 6- and 14-foot fyke nets and in late July or August, when young-of-the-year were sampled using 4 ft x 8 ft x ¼ inch seine nets. The fyke nets were fished for 192 hours each year, except in 1976, when they were used for only 144 hours. The seining procedures sampled an area of 144 ft^2 during each year. These methods are judged to provide adequate information about centrarchids (bass and panfishes) but probably do not adequately sample minnows (Cyprinidae), the family with the largest number of species possibly present.

Table II-8 shows the results of the combined methods for the four years of study. A range of 14 to 16 species was obtained during the first three years, and 21 species were found in 1977. In all, 25 different species were obtained.

Fishes of the region that do or could possibly occur in Nettle Lake or Nettle Creek, according to Allison and Hothem (1975), are listed in Appendix B-1. All fishes caught in the summer surveys (see Table II-8) appear on Allison and Hothem's list.

The ODNR considers Nettle Lake to be an "excellent crappie and bass lake" (1974 et seq.), with northern pike also contributing to the fishery. Other sought fishes include bluegill and other sunfishes, yellow perch, channel catfish, bullheads, white suckers, and carp. Most of these species have been stocked during one or more years since the ODNR initiated its stocking program at Nettle Lake in 1940. In an effort to reduce the large percentage of stunted (old but small) panfish, northern pike fingerlings (average length of 4 inches) were stocked between 1969 and 1977 (except 1974). Northern pike, top predators that feed on any species of fish, were expected to improve the fishery in the lake by reducing the large numbers of small bluegills and other panfish, thereby improving conditions for the growth of the remaining fishes. (The analysis of the fyke netting data and the creel surveys also conducted in 1975 indicated that the desired results were being realized.) Northern pike may have been native to the lake. Although there is a chance that the necessary wetlands in which these fish spawn could be present in Nettle Lake, there was no indication in any of the netting or seining studies of successful reproduction by northern pike. Also, in 1975 and 1976, a total of 6,225 channel catfish were introduced.

The ODNR has conducted creel surveys to obtain information on the effectiveness of these stocking programs. For example, in 1975, anglers were asked to register their catches during a creel survey of 90 hours

Table II-8

FISH CATCHES BY FYKE NETS IN NETTLE LAKE
OHIO DNR SURVEYS 1974-1977

Species	Number of Fishes 1974 (192 Hrs.)	1975 (192 Hrs.)	1976 (192 Hrs.)	1977 (144 Hrs.)
Bowfin (*Amia calva*)	1	1	1	2
Gizzard shad (*Dorosoma cepedianum*)	38	57	183	245
Northern pike (*Esox lucius*)	-	1	1	4
Twillback (*Carpiodes carpio*)	10	-	19	34
Common white sucker (*Catostomus commersoni*)	12	41	31	6
Spotted sucker (*Minytrema melanops*)	11	15	10	10
Carp (*Cyprinus carpio*)	-	-	-	2
Bluntnose minnow (*Pinephales notatus*)	200	149	19	200
Spotfin shiner (*Notropis spilopterus*)	-	20	-	1
Yellow bulkhead (*Ictalurus natolis*)	2	-	-	-
Blackstripe topminnow (*Fundulus nototus*)	-	-	77	6
Brook silverside (*Labidesthesis sicculus*)	-	4	13	-
Black crappie (*Pomoxis nigromaculatus*)	117	156	58	40
White crappie (*Pomoxis annularis*)	102	320	91	84
Rock bass (*Ambloplites rupestris*)	-	-	3	1
Largemouth bass (*Micropterus salmoides*)	14	10	57	15
Bluegill (*Lepomis macrochirus*)	158	136	83	21
Green sunfish (*Lepomis cyanellus*)	1	-	-	2
Orange spotted sunfish (*Lepomis humilis*)	-	-	-	3
Pumpkinseed (*Lepomis gibbosus*)	-	1	-	-
Warmouth (*Lepomis gulosus*)	-	-	-	1
Sunfish, hybrid & bluegill	-	-	19	6
Yellow perch (*Perca flavescens*)	-	1	-	-
Logperch (*Percina caprodes*)	2	-	-	1
Johnny darter (*Etheostoma nigrum*)	4	4	19	5

distributed over seven months. Five northern pike were recorded, for 1,258 total hours of angling, or at the rate of four per thousand hours. Although no evaluation of this catch rate was made, ODNR believes that better northern pike fishing occurs in early spring and through the ice, when no creel censuses are made. Nevertheless, the majority of anglers at Nettle Lake are seeking panfishes, including bluegills, black crappies, white crappies, and others. Largemouth bass make up a relatively small proportion of the fish taken by anglers. In 1975, a representative year, bass were caught at the rate of one per 8.3 hours of angling.

c. Invertebrates

The number and kind of invertebrates in a lake can provide a basis for evaluating water quality data as well as fish and other biological data. No such data exist for Nettle Lake. However, ODNR did report that mayfly larvae (1974), snails, and crayfish (1977) were observed during the annual fish surveys of those years.

2. TERRESTRIAL ECOLOGY

a. Forests

The original primary forests of northwestern Ohio were dominated by oak-hickory associations. However, repeated clearings for cropland and lumber have eliminated the primary forest. The draining of forested swamplands, dating from the 19th century, resulted in a drop in the water table that has affected the forests of the region even more profoundly. Much of the farmland in Williams and neighboring counties is tillable only because the fields have been underlain with drainage tiles.

In the Study Area, the majority of the 157 acres of undeveloped land is in secondary forest, dominated by oaks and hickories (see Figure II-10). The forested areas are located primarily northeast and east of the lake, in areas where slopes are often too steep to be easily worked as farmland. Appendix B-2 lists the common and scientific names of the trees that are likely to be present in northwestern Ohio, including the Study Area (by telephone, Mr. Roger Herrett, Service Forester, Ohio Division of Forestry, January 3, 1979).

b. Wetlands

There are three major classes of wetlands surrounding Nettle Lake: emergent wetlands, scrub-shrub wetlands, and forested wetlands, all of which belong to the Palustine system. These areas are valuable habitats for a wide variety of amphibians, reptiles, birds, and mammals, many of which are considered to be important wildlife resources of the state and region.

The most productive, and most valuable wetlands are the swampy, marshlike areas at the northern end of the lake, where Nettle Creek and the unnamed creek enter and leave the lake (see Figure II-11). Lush growth of rooted aquatic vascular plants flourishes here due to the deposition of wind and water-borne sediments. These and similar areas

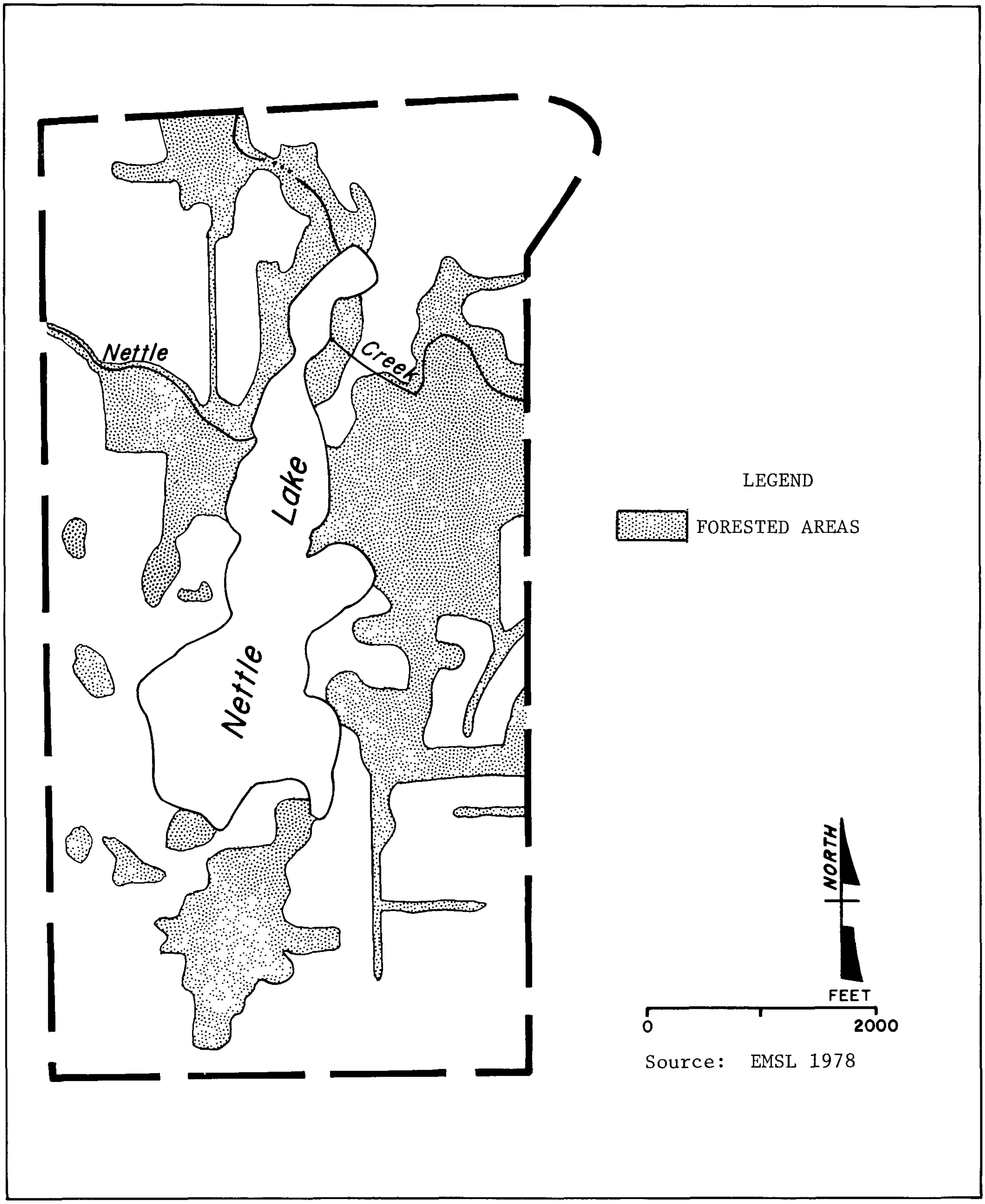


FIGURE II-10 NETTLE LAKE: FORESTED AREAS

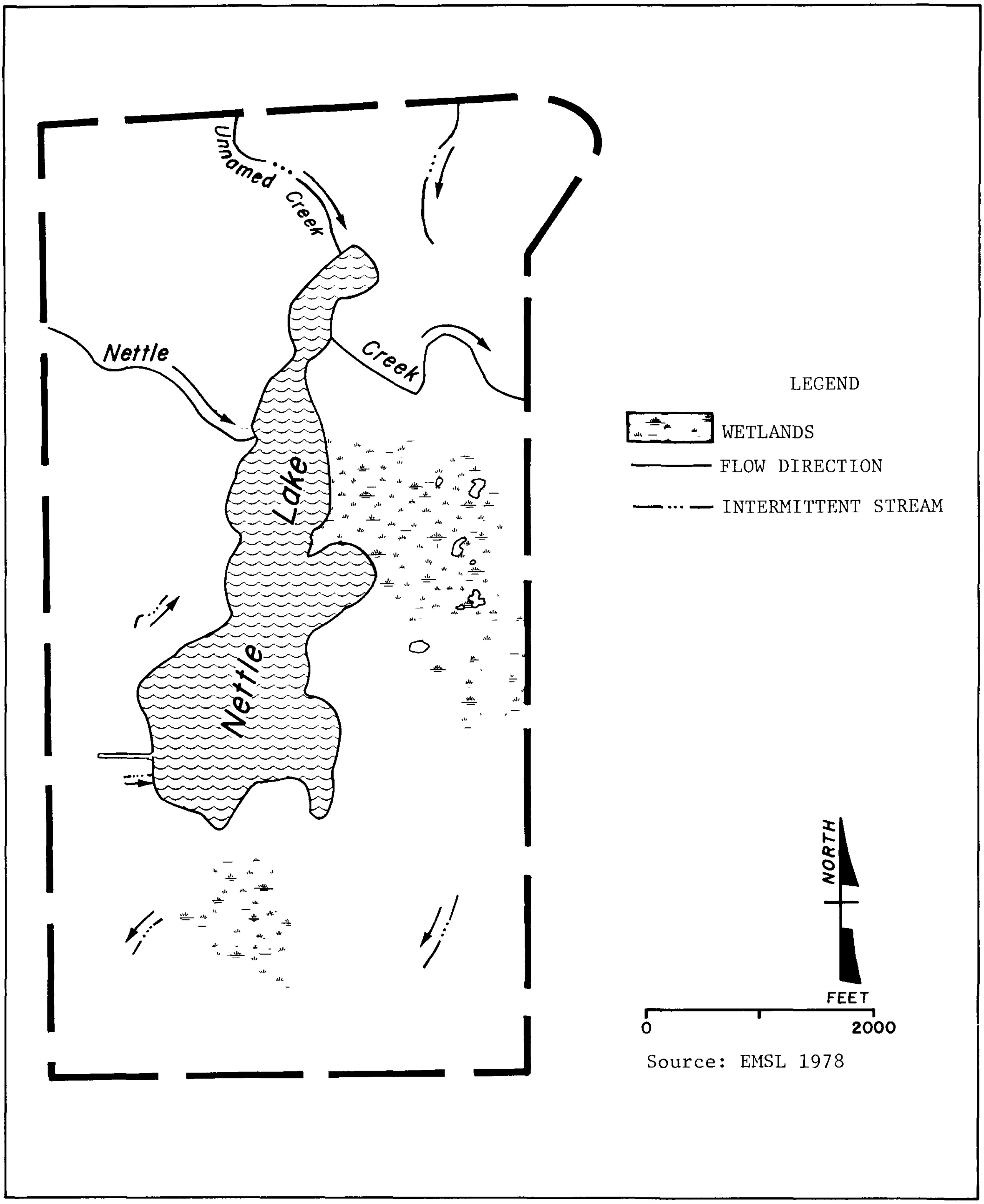


FIGURE II-11 NETTLE LAKE: WETLANDS

surrounding the lake are in the emergent wetland class, vascular subclass. They are in a semi-permanently flooded water regime and have an organic soil type. Vegetation is mostly herbaceous vascular plants consisting predominantly of: Typha spp. (cattails), Scirpus spp. (bulrushes), Sagittaria spp. (arrowheads), Carex spp. (sedges), and members of the Gramineae family (grasses). Ducks and shore birds nest in these areas and feed in the wetlands and open water, colonially nesting blackbirds are seasonal residents, and wading birds feed and nest here as well. Muskrats and meadow voles eat the vegetation and provide prey for minks and raccoons.

Slightly further from the water's edge are areas of the shrub-scrub class. The shrub layer is predominantly characterized by Alnus spp. (alder), and Salix spp. (willow). The diversity of wildlife in this area is increased due to the structural habitats provided and to the presence of saturated, not flooded, soils. These areas blend into the upper forested regions.

Areas belonging to the forested wetlands class (subclass broad-leaved deciduous; water regime: seasonally flooded; soil: organic are also apparent near the lake's edge (see Figure II-10). These areas are commonly flooded to depths greater than one foot for several weeks in the spring. These wet woodlands consist almost entirely of broad-leaved deciduous trees approximately 20 to 40 years old, and there is sparse understory vegetation. These forests are located east (approximately 50 acres) and south (approximately 10 acres) of Nettle Lake (see Figure II-11). Such an area provides relatively little food or other resources for wildlife.

The rich organic soil of these wetlands produces a large biomass of green vegetation and, consequently, supports a highly diverse and productive group of herbivores and carnivores. As wetlands are sensitive to the lowering and raising of the water table and to the altering of drainage patterns, it is important to minimize any outside impacts that may cause such occurrences and hence destroy important natural resources.

c. Wildlife

A great diversity of wildlife is supported by the forested and wetland habitats of the Study Area (see Figures II-10 and II-11). Mammals include foxes, deer, weasels, raccoons, woodchucks, squirrels, muskrats, mice, and voles. Lists of the birds and mammals likely to be found in the Study Area are contained in Appendixes B-3 and B-4.

3. THREATENED OR ENDANGERED SPECIES

Of the mammals (1), birds (4), fishes (3), mussels (2), plants (1) classified as Endangered or Threatened by the US Fish and Wildlife Service, and the four plants proposed for such classification, none has been found in Williams County, Ohio, except some of the migratory birds and the Indiana bat. In addition, endangered wild animals in Ohio, as designated in Publication 316 of the ODNR, are legally protected by the Ohio Revised Code, Section 1531.25, effective 1 January 1974, in conformity with Section 4(c)(4) of the Endangered Species Act of 1973.

a. Mammals

The Indiana bat, Myotis sodalis, is the only mammal of Williams County, Ohio, classified by the US Fish and Wildlife Service as Threatened or Endangered (44 FR, January 17, 1979). The Indiana bat is only a summer resident of Ohio, where its range is considered to encompass all of the State except a tier of counties in northeastern Ohio. The only information on summer breeding activity of Indiana bats is found in the study of Humphrey, Richter, and Cope (1977), conducted in 1974 and 1975 near Webster, Wayne County, in east central Indiana about half a state south of Williams County. Discovered by accident, the colony of females and their young alternatively used the loose bark of a living shagbark hickory tree or a dead bitternut hickory tree as its roosting place. Feeding flights were made well above ground level and primarily along the riparian forest of nearby streams. Humphrey and his colleagues studied the rate at which nursery bark was lost from weathering and concluded that any given roost is habitable only for a short time, perhaps 6 to 8 years. Consequently, Indiana bats need to move their nursery roosts every few years.

Although the summer range of Indiana bats is reasonably well known, there is no other specific information that may be used to predict their possible occurrence in the Nettle Lake Study Area. Certainly Williams County is well within the summer range of the species, and it is possible that one or more nursery colonies may occur there, because of the presence of large trees and the waterside habitat. However, owing to the small number of Indiana bats in the United States, and in view of the large number of summer habitats available to them along the floodplains in the eastern US, the probability that the bats use any specific, small segment of floodplain forest is low. If the selected alternative demonstrates potential for significantly altering riparian habitat, field studies will be required to determine if the Indiana Bat is present. This research must be conducted during the summer nesting period.

The Study Area is within the range of the badger, Taxidea taxus, listed in the Facilities Plan (F. G. Bourne & Associates, Ltd., 1976) as being rare in the State. It is not protected by Ohio law. Badgers may occur in the County, although the best habitat, large grassy fields, is uncommon in the Study Area, and the badger is unlikely to be numerous there.

There are no confirmed reports that the river otter, bobcat, or eastern woodrat (Ohio endangered mammals) occur in Williams County.

b. Birds

Of the Federally protected birds, both American and Arctic peregrine falcons and Kirtland's warbler are migratory throughout the State. The American bald eagle breeds and spends winters in seven Ohio counties, not including Williams County. However, the Ohio endangered list also includes the king rail, Rallus elegans, and the upland sandpiper, Bartramia longicauda, both of which are shore birds that have been sighted in the Study Area (by telephone, Mr. Larry Cunningham, Wildlife Biologist, ODNR Division of Wildlife, June 1978). Both species use cattail wetlands and adjacent mudflats as the focus of their nesting and feeding activities. There is no evidence that the other endangered species (sharp-shinned hawk and common tern) are residents of the Study Area.

c. Amphibians and Reptiles

Four species considered by the State of Ohio to be endangered are known to occur in the Study Area. The four-toed salamander, Hemidactylium scutatum, is known in the Nettle Lake area, and the blue-spotted salamander, Ambystoma laterale, has been caught very close to Nettle Lake (by letter, Mr. Robert H. Eversole, Supervisor, Wildlife Management Section, ODNR Division of Wildlife, July 25, 1978). The northern copperbelly, Nerodia (Natrix) erythrogaster neglecta, and the spotted turtle, Clemmys guttata, are confirmed inhabitants of the Study Area (by telephone, Mr. Larry Cunningham, ODNR, June 1978), but the same source indicated the probable absence of the eastern plains garter snake, Thamnophis radix. The status of populations of endangered amphibians and reptiles in the Study Area is unknown. All four species require the lake for at least a part of their annual and/or life cycles, and all rely on adjacent wetlands or wet woodlands as well. The possible occurrence of the remaining endangered species of amphibians and reptiles in the Study Area is unknown.

d. Fishes

ODNR gives endangered status to forty species of fishes, two of which have been collected in Nettle Lake in the past (by letter, Robert H. Eversole, ODNR). The lake chubsucker, Erimyzon sucetta, has been taken by ODNR in Nettle Creek upstream from the lake, and the Iowa darter, Etheostoma exile, is known from the region only in Nettle Lake. However, neither was taken during the 1974-1977 fish surveys conducted by the ODNR; consequently, their population status is unknown.

e. Crustaceans and Mussels

There is no information on the possible occurrence in the Nettle Lake Study Area of the one crustacean or 16 mussels considered by the Ohio Division of Wildlife to be endangered.

E. POPULATION AND SOCIOECONOMICS

1. POPULATION

Published information on population characteristics does not cover the Study Area by itself but the whole of Northwest Township or Williams County. Inasmuch as the Proposed Service Area (see Figure I-2) occupies only a small portion of the Township, the published socioeconomic data do not precisely describe the population characteristics for the subareas of Northwest Township that would be directly affected by the alternative wastewater management systems. Therefore, existing subarea housing stock and population were determined from 1975 aerial photographs. The methodology employed is explained in Appendix C-1.

a. Existing Population

Williams County has experienced continued population growth since 1960, increasing by 12.3% from 1960 to 1970 and by 4.0% from 1970 to 1975. Unlike most other minor civil divisions of the County, Northwest Township experienced a decline in population of 1.1%, from 1960 to 1970, but it grew by 4.3% from 1970 to 1975. No data prior to 1975 are available on population levels in the Proposed Service Area.

From an analysis of past County and Township population trends and aerial photography, a total in-summer population of 1,873 people was derived for 1975 for the Proposed Service Area, 128 (6.8%) permanent residents and 1,745 (93.2%) seasonal residents. The estimated permanent population of the Proposed Service Area constitutes only 13.0% of Northwest Township's permanent population and 0.3% of Williams County's permanent population. As indicated in Table II-9, the permanent population is relatively well-distributed throughout the Proposed Service Area, with the exception of the Crestwood, Camp DiClaire, and Shady Shore Camp subareas, which are entirely seasonal. All eight subareas have high percentages of seasonal population.

These population estimates for 1975 differ considerably from the Facilities Plan estimates of 110 permanent residents and 550 seasonal residents for that year. The difference is due to the smaller household sizes (permanent and seasonal) used in the Facilities Plan and to the exclusion of seasonal population estimates for Camp DeClair and Shady Shore Camp in the Facilities Plan.

b. Population Projections

Population projections for the Study Area must incorporate the following three growth factors:

- the rate of growth or decrease of the permanent population;
- the rate of growth or decrease of the seasonal population; and
- the potential conversion of seasonal to permanent dwelling units and the resulting effect on the permanent population.

Each of these factors represents a potential growth force that may significantly affect future total population levels and the distribution of population between permanent and seasonal residents.

Projections of permanent and seasonal baseline populations for the Nettle Lake Proposed Service Area in the year 2000 were based on the best available information regarding these three growth factors (see Appendix C-1 for methodology). As indicated in Table II-10, the total in-summer population for the Proposed Service Area is projected to be 1,904 by the year 2000. This total population is expected to consist of 228 permanent residents (12%) and 1,676 seasonal residents (88%). The net percentage increase of total in-summer population during the planning period would be only 1.7%. Seasonal population would actually decline by approximately 4.1% because of the conversion of seasonal to

Table II-9

PERMANENT AND SEASONAL POPULATION OF THE NETTLE LAKE PROPOSED SERVICE AREA (1975)[1]

Subarea	Population Permanent	Seasonal	Total	Percent Seasonal
Lazy Acres South	22	290	312	92.9%
Lakeview/Eureka Beach	32	307	339	90.6%
Shady Shore	13	105	118	89.0%
Lazy Acres North	13	197	210	93.8%
Roanza Beach	48	71	119	59.7%
Crestwood	0	55	55	100.0%
Camp DeClair	0	480	480	100.0%
Shady Shore Camp	0	240	240	100.0%
Total Service Area	128	1,745	1,873	93.2%

[1]The methodology utilized to develop these population estimates is described in Appendix C-1.

Table II-10

PERMANENT AND SEASONAL POPULATION OF THE NETTLE LAKE PROPOSED SERVICE AREA (2000)[1]

Subarea	Permanent	Seasonal	Total	Percent Seasonal
Lazy Acres South	60	268	328	81.7%
Lakeview/Eureka Beach	63	280	343	81.6%
Shady Shore	21	88	109	80.7%
Lazy Acres North	30	188	218	86.2%
Roanza Beach	51	60	111	54.1%
Crestwood	3	72	75	96.0%
Camp DeClair	0	480	480	100.0%
Shady Shore Camp	0	240	240	100.0%
Total Service Area	228	1,676	1,904	88.0%

[1]The methodology utilized to develop these population projections is described in Appendix C-1.

permanent dwelling units and the decrease forecast for seasonal dwelling unit occupancy rates (i.e., persons per unit). Permanent population would increase by over 78%, again because of the conversion of seasonal dwelling units to permanent. These figures are in line with general national and local trends indicating declines in seasonal populations and increasing conversion of seasonal dwelling units to permanent.

Of the eight subareas, only Crestwood is projected to have a significant rate of growth (36.4%), and even that increase would amount to only 20 people. The Camp DiClaire and Shady Shore Camp areas are not expected to expand even though use of both approaches peak capacity during summer weekends. In general, population growth in the Proposed Service Area would be relatively stagnant during the planning period. Contributory factors include the restrictions on development in the floodplain, the shortage of available lakeshore sites, marked competition from nearby lakeshore resort areas, and the minimal development pressures in the area. For all the subareas, with the exception of Camp DiClaire and Shady Shore Camp, the percentage of seasonal population would be lower.

2. CHARACTERISTICS OF THE POPULATION

a. Permanent Population

Income. The mean family income in Northwest Township, according to the 1970 Census, was $8,870, a figure significantly lower than the national, State, and County means (see Table II-11). Northwest Township also had a higher percentage of families with annual incomes below $2,000 (16.9%) than either the State (4.4%) or the County (4.5%). Likewise, in the upper income range, only 12.1% of Northwest Township's families had incomes over $15,000, while 14.3% of the County's and 21.6% of the State's families exceeded this annual figure (see Table II-12). Similarly, not only were per capita incomes in Northwest Township lower than the County's and the State's, but they increased by a smaller percentage from 1969 to 1974. During 1970, Northwest Township also exhibited a higher incidence of poverty among families (16.9%) than either the County (7.4%) or the State (7.6%).

Employment. In 1970, the economies of Williams County and Northwest Township depended heavily on the manufacturing industry as a source of employment. As indicated in Table II-13, manufacturing accounted for the employment of nearly 60% of Northwest Township residents and 44% of Williams County residents. In contrast with the State and the County, only a relatively small percentage of Northwest Township residents were employed in the wholesale and retail trade industry and the professional and personal services category. A relatively high percentage of Northwest Township's residents were employed in the "other industries" category, presumably largely in agricultural activities.

In 1976, the largest percentage of jobs available within Williams County was still in the manufacturing category (60%), according to County Business Patterns. Retail trade (17%) and services (10%) were also major employment categories in the County; tourist-oriented activities constituted an important portion of these. During 1972, sales

Table II-11

MEAN AND MEDIAN FAMILY INCOME (1969) AND
PER CAPITA INCOME (1969 and 1974)

	Mean	Median	Per Capita Income 1969	Per Capita Income 1974
United States	$10,999	$ 9,586	--	--
Ohio	$11,488	$10,313	$3,199	$4,561
Williams County	$10,060	$ 9,494	$2,851	$4,002
Northwest Township	$ 8,870	N/A	$2,581	$3,581

US Census of the Population and Housing. Fifth County Summary Tapes. 1970.

US Census. Population Estimates and Projections, Series P-25. May 1977.

Table II-12

PERCENT DISTRIBUTION OF FAMILY INCOME OF PERMANENT RESIDENTS, 1970

	State of Ohio	Williams County	Northwest Township
Under $1,000	1.8	1.3	10.0
$ 1,000 - $ 1,999	2.6	3.2	6.9
$ 2,000 - $ 2,999	3.5	4.7	2.2
$ 3,000 - $ 3,999	3.7	3.6	2.2
$ 4,000 - $ 4,999	3.9	3.9	-
$ 5,000 - $ 5,999	4.6	5.9	4.3
$ 6,000 - $ 6,999	5.4	6.0	4.3
$ 7,000 - $ 7,999	6.7	8.8	9.5
$ 8,000 - $ 9,999	15.5	16.9	14.7
$10,000 - $14,999	30.8	31.4	33.8
$15,000 - $24,999	17.4	12.3	12.1
$25,999 - $49,999	3.5	1.6	-
$50,000 and Over	.7	.4	-

US Census, General Social and Economic Characteristics. 1970.

US Census, Census of Population and Housing, Fifth Count Summary Tapes. 1970.

Table II-13

EMPLOYMENT BY INDUSTRY GROUP - 1970

	State of Ohio		Williams County		Northwest Township	
	Number	Percent	Number	Percent	Number	Percent
Total	4,063,780	100.0	13,007	100.0	313	100.0
Construction	204,493	5.0	633	4.9	17	5.4
Manufacturing	1,447,586	35.6	5,742	44.1	185	59.1
Transportation Communications	139,708	3.4	510	3.9	13	4.2
Communications and Utilities	111,114	2.7	376	2.9	9	2.9
Wholesale and Retail Trade	781,856	19.2	2,237	17.2	9	2.9
Finance, Insurance, Business, Repair	267,617	6.6	501	3.9	8	2.6
Other Professional and Related Services(1)	361,577	8.9	828	6.4	17	5.4
Educational Services	294,521	7.2	747	5.7	-	-
Public Administration	171,399	4.2	298	2.3	-	-
Other Industries (2)	283,909	7.0	1,135	8.7	55	17.6

(1) Other professional and related services include hospital; health services; welfare, religious and nonprofit membership organizations; and legal, engineering, and miscellaneous professional services.

(2) Other industries include agriculture, mining, private households; other personal services; and entertainment and recreation services.

US Census of Population and Housing. Fifth Count Summary Tapes, 1970.

US Bureau of the Census. General Social and Economic Characteristics, Ohio, 1970.

receipts from hotels accounted for more than 10% of all selected service receipts, while amusement services represented nearly 25%. Retail trade statistics for 1972 reinforce the observation that travel-related industries are important to the economy of Williams County. Sales from gasoline service stations (19.4%) and food stores (26.6%) were substantially higher on a percentage basis than the figures for the State, indicating high seasonal consumption of such goods and services.

b. Seasonal Population

No published statistics on income, age, employment, or other socioeconomic characteristics are available for the seasonal residents of Northwest Township or the Proposed Service Area. It can generally be assumed that seasonal residents have higher mean family incomes that allow them to own and maintain permanent as well as seasonal homes.

Property ownership data for the Proposed Service Area indicate that nearly all seasonal residents live in the midwestern states (Illinois, Indiana, Wisconsin, Michigan, Ohio, Pennsylvania, and Kentucky), with a small percentage of the seasonal residents from the South and West. Most live in Michigan or Ohio, particularly the Toledo, Ohio area. In general, the higher incomes of seasonal residents allow them greater mobility, and it is difficult to ascertain whether their seasonal residences would be their likely place of retirement. However, the property tax rolls show that several seasonal residents have become permanent residents of the Proposed Service Area, presumably upon retirement.

3. HOUSING CHARACTERISTICS

In order to develop a data base for the analysis of wastewater management alternatives, the number of existing dwelling units within the Proposed Service Area was obtained from 1975 aerial photographs and County property tax rolls. Dwelling unit equivalents for the Proposed Service Area during 1975 totalled 464. This total included 40 permanent units (8.6%) and 424 seasonal units (91.4%), including 180 camping spaces at Camp DeClair and Shady Shore Camp. The seasonal residency figures are much higher than the State (0.5%), County (1.6%), and Township (30.9%) percentages.

The existing dwelling units are all single-family units, and include a large number of mobile homes. Lot sizes in the Proposed Service Area are generally small; two or three lots are often combined for one dwelling unit. Age characteristics of the permanent housing stock indicate that Northwest Township has a relatively older housing stock than the State or County. Consequently, the median value of owner-occupied units and the median gross rent for rental units are considerably lower than national and State figures. The low values could be attributed partly to the rural location and to a high vacancy rate, but they are more likely the result of poorer structural conditions and lack of amenities in many older units. The US Bureau of the Census C-40 Construction Reports indicate a substantial increase in new residential construction in Williams County, amounting to over 750 new dwelling units (including 200 multiple-family units) since 1970. However, officials of the Williams County Regional Planning Commission indicated (by telephone, F.C. Michael, February 1, 1979) that none of this new development has occurred at Nettle Lake.

No substantive information regarding the characteristics of seasonal dwelling units is available. Seasonal units, by their nature as part-time residences, are generally smaller, lower in value, and often lacking in many of the amenities of permanent units. However, examination of the County property tax rolls revealed that the average value of seasonal residences in the Proposed Service Area equalled or slightly exceeded that of permanent residences, which may be due to the below-average condition of permanent dwelling units in the Proposed Service Area.

4. LAND USE

a. Existing Land Use

The Proposed Service Area consists of approximately 870 acres of land located in the northwest portion of Ohio near the Michigan and Indiana borders. It includes five major residential developments containing 148 acres of platted residential lots, approximately one-third of which are developed. Most private residences and seasonal dwelling units are located around the southern half of the lake (see Figure II-12).

Other land uses in the Proposed Service Area are agricultural (426 acres), recreational (26 acres), lake and water areas (104 acres), commercial (9 acres), and undeveloped (157 acres). The predominant crops of the agricultural land under cultivation are corn, soybeans, wheat, and hay. Recreational land is composed primarily of two camping areas and other small boating and beach facilities. Most undeveloped land in the Proposed Service Area lies north and east of the Lake.

The transportation network in the Study Area includes township highways, county highways, and Interstate Route 80/90 runs east-west approximately three miles south of the Study Area, and Interstate Route 69 runs north-south approximately 15 miles west of the area. These two highways along with State Route 20, provide excellent access to the Proposed Service Area from most parts of Indiana, Michigan, and Ohio.

b. Recreation

Recreation is the major attraction of the Nettle Lake area to both permanent and seasonal residents. Water-oriented activities such as fishing, boating, swimming, and camping, are important summer features there and at the various other lakes in the region. Nettle Lake has no public beaches or access points. However, 120 campsites, a general service building for water and sanitary facilities, and privies for tent sites are available at Camp DiClaire, and Shady Shore Camp has 60 campsites and a general service building for water and sanitary facilities. Winter recreational activities are not common in the Proposed Service Area or in Williams County.

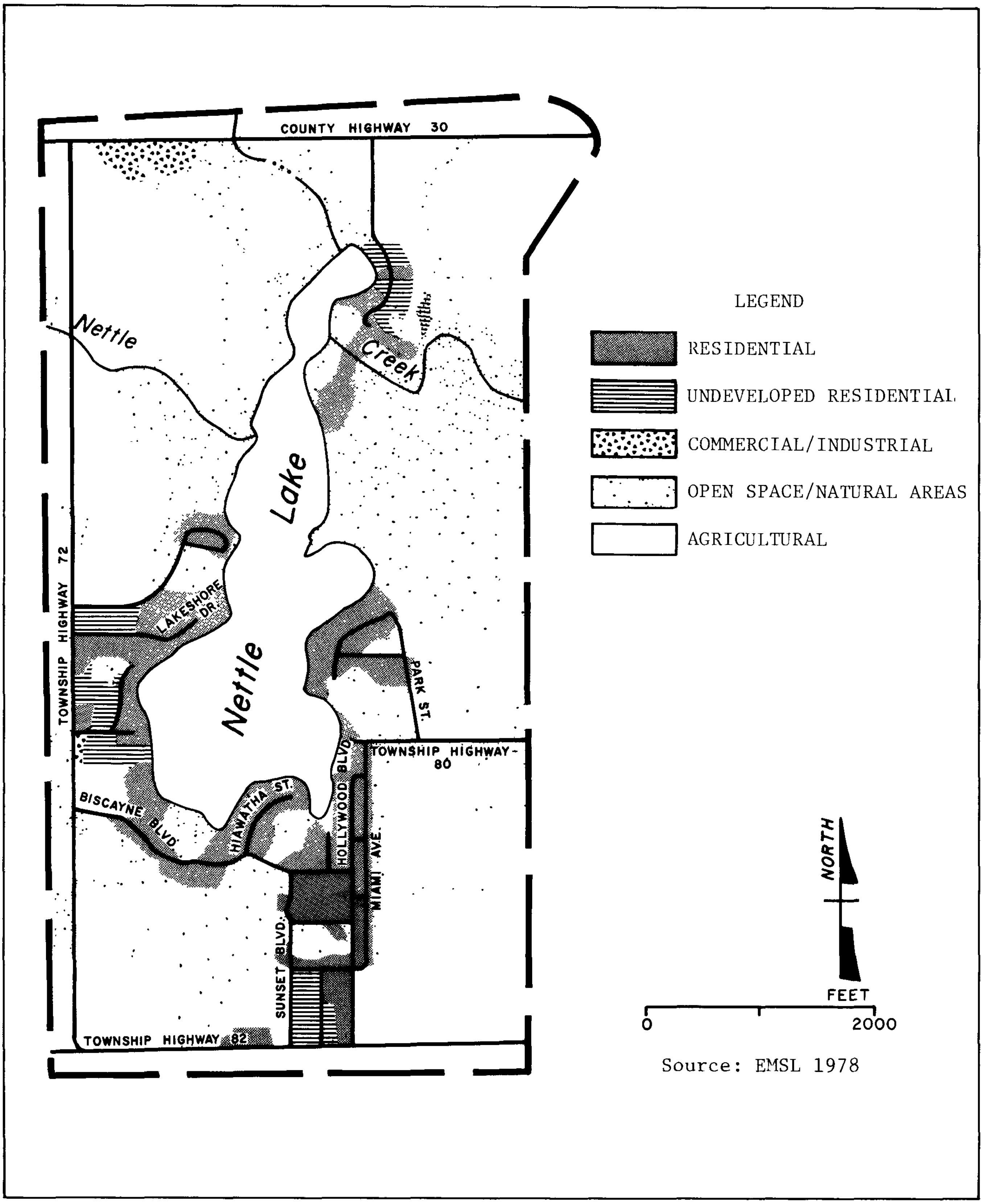


FIGURE II-12 NETTLE LAKE: EXISTING LAND USE

c. Future Land Use

The Williams County Land Use Plan was published in January 1980 and defines the goals and objectives for future land use in the county. The Nettle Lake area is shown as being located in an agricultural land use district. Policies for this area recommend that growth should occur in areas adjacent to existing development. It should be developed with due regard given to good conservation practices, and development should be discouraged in floodplains and other environmentally sensitive areas. Policy was also defined that residential growth should not occur on prime agricultural land.

The county has also adopted a number of policy recommendations to mitigate environmental hazards. These areas are indicated as occurring along rivers and streams and on agricultural lands. Measures to mitigate environmental problems include preservation of prime agricultural land and associated soil conservation practices. In order to protect private wells and groundwater resources from contamination by malfunctioning on-site wastewater treatment systems, the county has recommended the formation of an on-site management district to reduce or eliminate water pollution.

d. Growth Management

Williams County has no comprehensive zoning ordinance to control land use. The County adopted a set of subdivision regulations (1962, amended 1966) that apply to the subdivision of land along major County roads. However, no controls for lakeshore development are set forth in these regulations. These regulations have not been adopted by Northwest Township, which has no zoning regulations in force.

The County has also adopted a floodplain ordinance (1978) in compliance with the provisions of the National Flood Insurance Program. The Provisions of this ordinance effectively restrict development and alteration of the land lying within the 100-year floodplain. Within flood-prone areas, sanitary sewerage systems must be designed to minimize or eliminate infiltration of flood waters. On-site wastewater disposal systems are required to be located to avoid impairment of them or contamination from them during flooding.

5. FISCAL CHARACTERISTICS

Fiscal characteristics of Williams County and Northwest Township are indicated in Table II-14. This information is necessary for the evaluation of various alternatives available to the local governments for financing wastewater management improvements. In Ohio, townships act as the collectors of property taxes, which are redistributed to the county, the school districts, and various township activities. A total tax of 45.30 mills per $100 of assessed valuation was levied on property in Northwest Township in 1977, of which 3.90 mills were retained for Township operations and services. During the 1977 fiscal year, Northwest Township disbursements exceeded revenues by approximately $5,500.

Table II-14

FISCAL CHARACTERISTICS OF THE LOCAL GOVERNMENTS IN THE NETTLE LAKE STUDY AREA, 1977.

	Williams County	Northwest Township
Assessed Valuation	$200,750,847	$4,227,257
Total Revenues	$ 17,056,633	43,152
Total Disbursements	$ 17,041,173	48,760
Total Long Term Debt	- 0 -	- 0 -

Williams County, Ohio County Auditor's Office. Telephone Conversation, April 10, 1978.

Counties and townships are both authorized by the State of Ohio to issue bonds and incur long-term debt. As of April 1978, neither Williams County nor Northwest Township had any outstanding debt. Since Williams County anticipates using revenue bonds to finance the wastewater management improvements, there should be no difficulty in obtaining required matching funds.

6. HISTORICAL AND ARCHAEOLOGICAL RESOURCES

The only notable historic and archaeological resource known in the Nettle Lake Study Area is the site of the Hopewell Indian burial mounds. The mounds are situated along the shoreline of Nettle Creek about 1,200 feet from the inlet to Nettle Lake (see Figure II-13). The two-acre site was purchased by the Williams County Historical Society in the mid-1960's. The Society reconstructed the mounds, which had been excavated for their relics, and currently maintains them. Historically, the site is unique because it represents the northernmost boundary of the Hopewell Indian tribe, and is over 2000 years old (Farmland News, 5 September 1978). The site is of interest from an aesthetic as well as an historic point of view, because the Hopewell tribe was famous for its ceremonial earthworks and burial mounds.

The site has been listed on the National Park Service's National Register of Historic Places and relics and artifacts from the mounds are displayed in the Williams County Historical Society's Museum (EPA-EMSL 1978). An archaeological survey may be necessary for the chosen alternative to determine if any previously undiscovered cultural resources would be affected by the project.

F. <u>EXISTING WASTEWATER SYSTEMS</u>

All private residences within the Proposed Service Area are served by on-site systems. Privies and septic tanks discharging to drainfields are most common. The treatment facility serving Camp DiClaire uses a settling tank followed by a sand filter, and disinfects the effluent prior to discharge to Nettle Creek. This system has been conditionally approved by OEPA, pending the implementation of a regional collection and treatment system. The wastewater from Shady Shore Camp is treated by a septic tank leaching bed system.

When the Facilities Plan was drafted, information about on-site systems was very limited. It was known that site limitations for use of on-site systems were widespread, and that many systems could not comply with minimum standards set forth in the Ohio Sanitary Code (ODH 1977). Indeed, many of the existing systems predated the code. The code is discussed later in this section. Both OEPA and the Williams County Health Department reported malfunctioning on-site systems that were suspected of contributing to public health and water quality problems, although there was little documentation to support these suspicions.

1. SPECIAL STUDIES

Because more information was needed to evaluate the existing systems and to determine the nature and extent of problems resulting from

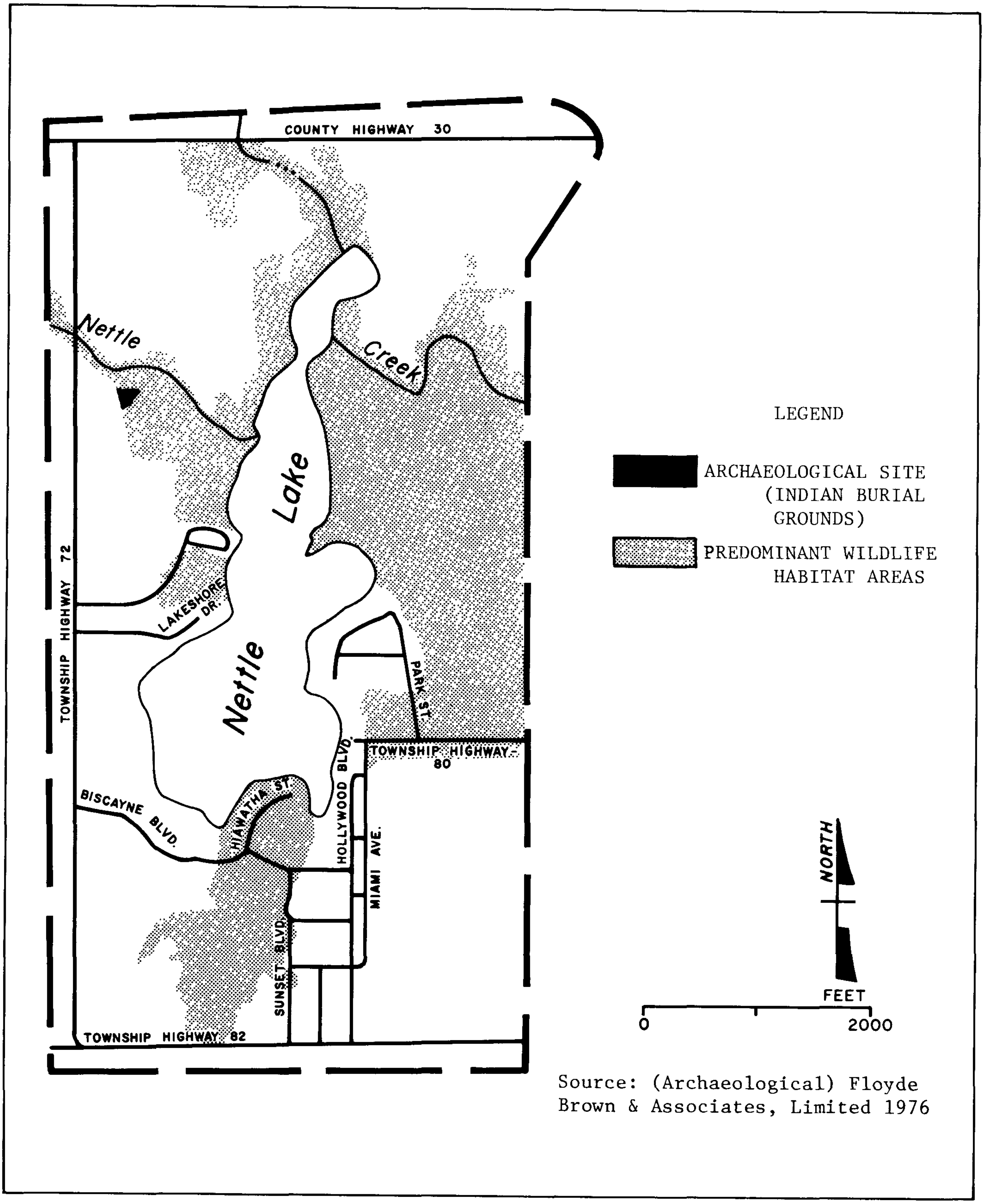


FIGURE II-13 NETTLE LAKE: PREDOMINANT WILDLIFE AREAS AND LOCATION OF ARCHAEOLOGICAL SITE these systems, US EPA undertook three additional studies. The results of these studies, discussed below, have been used in determining grant eligibility for collector sewers and for determining wastewater treatment needs.

a. "Investigation of Septic Leachate Discharges into Nettle Lake, Ohio" (Kerfoot, 1978)

This study was undertaken during December 1978 to determine whether groundwater plumes from nearby septic tanks were emerging along the shoreline and causing elevated concentrations of nutrients. Septic tank leachate* plumes were monitored with an instrument called the "Septic Snooper." The device is equipped with analyzers to detect both organic and inorganic chemicals from domestic wastewater. The "Septic Snooper" is towed along a shoreline to obtain a profile of septic leachate plumes discharging to surface water. Based upon experience from other rural lake projects, it is estimated that late fall is the best time to detect plumes. Plumes often take time to force their way through the soil into the lake, and therefore, it is not until long after the summer is over that they are detectable.

No distinct groundwater plumes of wastewater origin were detected along the shoreline of Nettle Lake. Surface and groundwater samples were collected for analysis of nutrients and specific conductance. High total phosphorus concentrations, ranging from 0.022 mg/l to 0.040 mg/l, were detected in shoreline water samples. Variation in background conductance, which would indicate different types of groundwater inflow, was not observed. These findings suggest that very little groundwater flows into Nettle Lake. However, interstitial groundwater* samples from the lakeshore sediments were consistently found to contain elevated nutrient concentrations common to eutrophic conditions and phosphorus precipitation in the lake. Apparently septic leachate is contained by the tight clayey soils, and discharge to surface water via groundwater is prevented. The Kerfoot report can be found in Appendix D-1.

b. "Environmental Analysis and Resource Inventory for Nettle Lake, Ohio" (EMSL, 1978)

The Environmental Monitoring and Support Laboratory (EMSL) of EPA prepared a detailed environmental analysis and resource inventory of the Nettle Lake Study Area. The data used for this purpose were obtained from color, color infrared, and thermal infrared imagery (at scales of 1:3,000 and 1:13,500) from an aerial photo mission flown on May 3 and June 4, 1978. EMSL's report presents colored photographs and data on annotated overlays for easy reference and assimilation. The original purpose of the study was to identify and locate malfunctioning septic tank/soil absorption systems in the Study Area. Subsequently, the study was expanded to include the environmental resource inventory.

Location of Malfunctioning Septic Tanks. The remote sensing technique used in the study can only detect those malfunctions that are noticeable on the ground surface. It does not detect malfunctions related to sewage backing up into the home, nor to too rapid transport through the soil to groundwater. The various "signatures" used as photo interpretation keys for identifying malfunctions included: 1) conspicuously lush vegetation, 2) dead vegetation (especially grass), 3) standing water or seepage, and 4) dark soil with accumulations of excess organic matter. Two suspected malfunctioning systems identified in the Proposed Service Area by remote sensing were later inspected on the ground, and neither was found to be failing at that time.

Environmental Resource Inventory. This inventory contains pertinent environmental, geographic, and hydrologic data that have been incorporated in appropriate sections of Chapter II. The major data categories displayed on the photographs and overlays are:

- Land use/cover based on the modified USGS Land Use Classification.
- Delineation of flood prone areas (in 100-year floodplain).
- Location of predominant wildlife habitat areas and archaeological sites.
- Geological features, including soil types and distribution, and bedrock and surficial geology.

c. Nettle Lake, Construction Grant Sanitary Survey, Williams County, Ohio (1978)

A sanitary survey of systems along the shore of Nettle Lake, conducted between November 29th and December 6, 1978, provided information on the extent of non-compliance with the Sanitary Code, and the nature and extent of problems with on-site systems. The survey, conducted at a time when only permanent residents were present, does not fully reflect the conditions of on-site systems throughout the Proposed Service Area. However, it does give an indication of the performance of on-site systems in full use. Permanent residents around Nettle Lake are generally served by ST/SAS's, while about half of the seasonal homes have privies. Although the survey results summarized in Table II-15 indicated widespread violations of the sanitary code, few (14%) of the permanent residents surveyed admitted to having any problems with their systems. However, the survey results suggested that problems with backups, ponding, and odors are common during the spring flooding, and the residents may have considered these problems too routine to mention. Appendix D-2 includes additional information on the sanitary survey.

2. TYPES OF EXISTING SYSTEMS

Treatment facilities serving Shady Shore Camp and Camp DiClaire were described earlier in this section. The following is a discussion of on-site systems serving private residences.

A survey conducted by Floyd G. Brown and Associates determined that about 50% of the on-site systems serving private homes are privies. This type of system, which is a waterless device for the collection and storage of human waste, is most prevalent in Roanza Beach and Shady Shore. Estel Cottrell, the County Sanitarian, stated that lakeshore

Table II-15

SUMMARY OF SANITARY SURVEY RESULTS

Subdivision	Type	Age	Site Limitations	Pumping History	Repairs	Problems	Tank Undersized	Drainfield Size (Ft.)	Well Setback Distance (Ft.)	Lot Size
Roanza Beach	Outhouse	32	GW < 1' Flooding	Never	None	None	Not Available	Not Applicable	>50	90 x 80
Roanza Beach	ST/DF	3	Flooding	Never	None	None	No	12 x 30 (?)	30	90 x 80
Roanza Beach	HT	4	GW ≤ 3 Flooding	Once/Year	None	None	Not Applicable	Not Applicable	25	60 x 120
Roanza Beach	HT	9	Flooding	Twice/Year	None	None	Not Applicable	Not Applicable	45	60 x 80
Roanza Beach	ST/DF	10	Flooding	Never	None	None	No	12 x 30 (?)	>50	30 x 80
Roanza Beach	HT	1	Flooding	Once/Year	None	None	Not Available	Not Applicable	>50	30 x 80
Roanza Beach	HT & Summer Outhouse	0	Flooding	Twice/Year	None	None	Not Applicable	Not Applicable	25	30 x 86
Roanza Beach	ST/DF; DF only for clothes	14	Flooding	Never	None	None	Not Available	Not Available	>50	90 x 80
Roanza Beach	ST/DF	5	Flooding	Never	None	None	No	400 Ft.^{2}	40	30 x 80
Roanza Beach	ST/DF/3TR	17	Flooding	Once in 1978	None	None	Yes	600 Ft.^{2} & 120 for each trench	40	30 x 80
Lazy Acres	ST/DF	10	GW ≤ 3 Flooding	Once in 1977	None	Backup in the spring	Not Available	Not Available	20	60 x 80
Lazy Acres	ST/DF	>13	Flooding	Never	None	Drains slow after rain	Yes	Not Available	>50	60 x 80
Lazy Acres	ST/DF	½	Flooding	Never	None	None	Yes	3000	>50	60 x 100
Lazy Acres	ST/DF	7	Flooding	Never	None	Open Trench	Yes	1120	>50	60 x 100
Lazy Acres	2 ST/2 DF	>6	None	Never	None	None	Not Available	Not Available	>50	90 x 100
Crestwood	ST/DF	15	Flooding	Never	None	None	Yes	Not Available	>50	5½ Acres
Lazy Acres	ST/DF	16	Flooding	Once in 1971	None	None	Yes	Not Available	>50	80 x 100
Lazy Acres	ST/DF	3	Flooding	Never	None	Frequently	Not Available	Not Available	>50	60 x 130
Lazy Acres	ST/DF	15	GW ≤ 4 ft. Flooding	Never	None	None	No	Not Available	>50	30 x 180
Lazy Acres	ST/DF	20	GW ≤ 4 ft. Flooding	Never	None	None	No	Not Available	>50	30 x 180
Shadey Shore	ST/DF	4	GW ≤ 6 ft. Flooding	Once in 1975	None	None	No	400 Ft.^{2}	>50	80 x 70
Shadey Shore	ST/DF	17	GW ≤ 1 ft. Flooding	Once in 1977	None	None	Not Available	Not Available	40	80 x 80
Shadey Shore	ST/DF	17	GW ≤ 1 ft. Flooding	Once in 1973	None	None	Not Available	Not Available	>50	40 x 80
Shadey Shore	ST/DF	4	GW ≤ 2 ft. Flooding	Once in 1977	None	None	Yes	Not Available	>50	70 x 70
Lakeview	ST/DF	6	GW ≤ 3 ft. Flooding	Once in 1977	None	Drains slow after rain	Yes	400 Ft.^{2}	>50	35 x 60
Lakeview	ST/DF	9	GW ≤ 3 ft. Flooding	Never	None	Never	No	400 Ft.^{2}	>50	35 x 60
Crestwood	ST/DF	7	GW ≤ 2 ft. Flooding	Never	None	Never	No	800 Ft.^{2}	>50	35 x 220
Crestwood	ST/DF	8	GW ≤ 6 ft. Flooding	Never	None	Never	Yes	400 Ft.^{2}	>50	40 x 200

development increased significantly after World War II and that on-site systems installed after 1959 were mainly septic tanks with tile leach fields (drainfields). This was confirmed by the results of the Sanitary Survey. The survey results indicated that, of 27 dwellings constructed since 1959, 23, or 85%, are served by a septic tank and drainfield, and the remaining 4 residences by holding tanks. The distribution of on-site systems determined by the sanitary survey is shown in Table II-16. Again, the survey results are representative of the systems serving the permanent residences but not necessarily of those serving seasonal ones.

3. COMPLIANCE WITH THE SANITARY CODE

The District Board of Health of Williams County is responsible for enforcement of a statewide sanitary code. A code for controlling individual sewage disposal systems was first adopted in 1974 and amended in July 1977. Current regulations are contained in "Home Sewage Disposal Regulations," Chapters 3701.01 to 3701.29, inclusive, of the Ohio Administrative Code (ODH, 1977a), and include the following: (see Appendix D-3).

Minimum design criteria for individual systems are set forth in the code, but local boards of health may establish more stringent criteria. The Williams County Health Department has adopted the State sanitary code as written.

The sanitary code requires that every household sewage disposal system be inspected and approved by the local health commissioner before it is put into operation. Important criteria regulating the use of ST/SAS's include:

- A minimum separation distance of 50 feet between the well and the drainfield (100 ft if the septic tank is followed by an absorption pit.)

- Percolation rates within the range of 10 to 60 min/in.

- Minimum depth to water table of 4 feet below the absorption system.

- Minimum septic tank capacities (not less than 1,000 gallons) based on the number of bedrooms in the residence.

The Ohio sanitary code does not specify standards for the use of holding tanks nor does it specify minimum setback distances from the shoreline for the construction of on-site systems. Currently, the sanitarian evaluates the setback distance on a case-by-case basis.

Because many of the on-site systems were constructed before the sanitary code was adopted, several existing systems do not comply with minimum standards. The sanitary survey was the basis for evaluating the nature and extent of non-conforming on-site systems. The survey, conducted at a time when only permanent residents were residing at the lake, probably gives a low estimate of the number of non-conforming

Table II-16

TYPES OF ON-SITE SYSTEMS
(BASED ON SANITARY SURVEY RESULTS)

	Number	Percent	Number More Than 20 Years Old
Drainfield*	1	3	0
Privy**	2	6	1
Holding Tank	4	13	0
Septic Tank/Drainfield	23	75	1
Septic Tank/Drainfield/Trench	1	3	0

*Drainfield alone was only used for clothes washing; residence also had ST/SAS.

**Privy for summer use only; residence also had holding tank.

systems. Permanent residents are generally served by septic tank soil absorption systems rather than privies. Table II-16 summarizes the findings of the sanitary survey.

Well Setback Distance. A minimum distance of 50 feet separating a well and a drainfield or privy is intended to provide sufficient soil to remove bacteria and nutrients (or dilution in the case of nitrates) as the wastewater percolates through the soil matrix and travels laterally in an aquifer to a well. Of those systems surveyed, 31% were located closer than 50 feet to the well. Violation of the minimum well setback distance was found to be most prevalent in Roanza Beach, where 50% of the systems surveyed did not comply with minimum standards. The number of non-complying systems may be much higher than the sanitary survey indicates. Residents served by pit privies were generally not available during the sanitary survey. Finally, the 50-foot minimum setback distance, also required for privies, cannot be met on some small lakeshore lots.

Undersized Septic Tanks. Twenty-four of the residences surveyed were served by ST/SASs; 17 residents knew the capacity of the septic tank. Of these systems, 8, or 47%, were undersized. Septic tanks that 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 can lead to clogging of the soil absorption unit.

Site Limitations. Ten of the 24 ST/SASs, or 42% of those surveyed, did not comply with the code's requirement for a minimum separation of 4 feet between the high water table and the absorption system; all but one of the systems surveyed, or 97%, were situated in the 100-year floodplain. Figure II-10, illustrating the flood hazard areas, indicates that only small parts of Lakeshore Drive and Biscayne Boulevard and the southernmost part of Lazy Acres lie outside the 100-year floodplain.

The site limitations common to the Nettle Lake area probably result in poor soil absorption of effluent, particularly during spring flood. Many of the leaching fields are inundated with water during flooding. The contents of many of the privies may be washed into Nettle Lake during flooding as well, although there is only indirect evidence to support this.

Undersized Drainfields. Very few of the residents knew the size of their drainfields, so non-compliance with standards for minimum drainfields size could not be ascertained. However, the severe site limitations suggest that, during spring flooding, drainfields cannot absorb effluent adequately regardless of the size.

4. PROBLEMS WITH EXISTING SYSTEMS

Severe site limitations and numerous violations of the standards for on-site systems 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 community improvement problems on the other. On-site systems known to contribute to violations of water quality standards or changes in lake trophic status pose water quality problems. Public health problems may result from recurring backups, ponding of the effluent on the surface of the soil, or contamination of the groundwater supply in excess of drinking water standards. Where lakes are used for contact recreation, swimming etc., violation of the fecal coliform standard also constitutes a public health hazard. Community improvement problems include odors, or restrictions on water use or building expansion, but they do not pose a threat to public health.

Backups/Ponding. Backups of septic tanks into residences, or ponding of effluent on the soil surface, could be verified for only four systems or 13% of those surveyed. These four systems were located in flood prone areas, and three of the four were situated in high groundwater areas. There is no definite indication that the problems can be attributed to site limitations; at least two of the systems experiencing problems were undersized, and two systems over 10 years old had poor maintenance records. The most recent report from the health department indicates only one malfunctioning drainfield in the Biscayne Boulevard area (by telephone Larry Vagho, District Sanitarian, 3 April 1981).

Problems with backups and ponding are probably more widespread than the results of the sanitary survey indicated. Most of the Proposed Service Area lies in the 100-year floodplain, and many residents may not have mentioned problems result from flooding. Several conversations the surveyor had with residents around the lake suggested that this was the case. The extent of spring flooding suggests that many of the leaching fields were completely inundated and that the waste in many of the privies could mix with flood waters.

Groundwater Contamination. Despite the large number of residences located in high groundwater areas and the large number of systems that cannot meet the minimum well set back distance, there are no reports of groundwater contamination. As described in Section II.B., groundwater supplies used for domestic purposes are generally under artesian conditions confined by thick impermeable clays. The thick surficial clays serve as a barrier to wastewater percolation to groundwater aquifers, and contamination would not be expected. Groundwater samples taken by the Health Department showed low levels of bacteria. However, well water was not sampled for nitrate contamination.

Water Quality Problems. Limited information available on water quality in Nettle Lake indicates that nutrient concentrations are high and that the lake is eutrophic. Although non-point sources are seemingly the major contributor to the total nutrient loading of Nettle Lake, on-site systems perhaps also contribute to eutrophication during spring flooding. During the rest of the year, the tight clayey soils prevent leaching of effluent from on-site systems into the lake. Based on samples collected during July and August 1976, there were no conclusive violations of fecal coliform standards associated with ST/SASs. One sampling point on the south shore of Nettle Lake was contaminated by fecal coliforms, but additional sampling would be required to determine if standards are being violated.

Odors. During interviews conducted for the sanitary survey, it became apparent that odors resulting from on-site systems are a nuisance for Proposed Service Area residents. There were complaints that the odor problems are severe during spring flooding, and some residents leave until the odors subside.

Flooding. The principle need identified for upgrading wastewater treatment facilities in the study area is the suspected water pollution and public health problems associated with the inundation of on-site systems during flood events. The different varieties of on-site wastewater treatment have different impacts associated with each form of technology. There are also different construction and management mechanisms for mitigating these problems.

Flood water intrusion into existing privy systems results in the mixing of these waters and allows for transfer of bacteria and nutrients to the lake water column. However, this mixing allows for only a limited transfer of solids. The release of bacteria and viral disease vectors presents the possibility of contaminating surface water resources and may intrude into poorly sealed wells. Nutrient release may result in increases in biochemical oxygen demand and oxygen depletion stress causing fish die-off.

Flooding of septic tank soil absorption systems results in saturation of the absorption field. This can result in backups into the house or in ponding of effluent on the ground surface with attendant potential for public health problems. Flooding of these systems also results in temporary limitations on use or inaccessability.

5. CONCLUSIONS

This analysis shows that flooding, seasonal high water, and poor permeability combine to present severe site limitations to on-site wastewater treatment systems in the service area. However, field work conducted for this EIS shows that recurrent problems are associated primarily with spring flood events. The septic leachate detector found no effluent plumes entering the lake. The aerial photo survey located only two suspected malfunctions that were not confirmed by ground inspection. The sanitary survey results indicated that, of the residents surveyed, only 14% have recurrent problems with their on-site systems.

On the issue of public health and water quality problems, residents reported that backups of effluent into houses occurred in four systems, all located in floodplain areas with a seasonal high water table. Recent health department records show one surface malfunction where effluent is ponded on the ground surface. In spite of poor well separation distances, there are no reports of groundwater or well water contamination. Bacterial surveys of beach areas show no violation of water quality standards. While the lake is characterized as eutrophic, the major source of nutrients is non-point, from the watershed above the lake. On-site systems may contribute to eutrophication during flooding; however, clayey soils and intermittent use probably prevent leaching into the lake for most of the year.

CHAPTER III

DEVELOPMENT OF ALTERNATIVES

A. INTRODUCTION

1. GENERAL APPROACH

This chapter explains the development of the new alternative systems for wastewater collection and treatment in the Proposed Service Area. Chapter IV describes and compares these alternatives, for cost-effectiveness, with the Facilities Plan Proposed Action (Floyd G. Browne & Associates, Ltd., 1976). Chapter V assesses the environmental and socioeconomic impacts of all these systems.

The development of the EIS alternatives has focused on those aspects and implications of the proposed wastewater management plan for the Proposed Service Area that (a) have been identified as major issues or concerns, or (b) were not adequately addressed in the Facilities Plan.

Chapter I emphasizes that one of the main issues is the high cost of the centralized facilities proposed in the Facilities Plan, and its impact on area residents. Since the collection system accounts for most (75%) of the construction costs of the Proposed Action, low-cost decentralized systems should be considered. Attention was therefore centered on advanced on-site and cluster systems for groups of homes, as well as on other alternative and innovative technologies.

This approach made it necessary to determine the suitability of the soils for effluent absorption systems. The soils data (see Figure II-4) showed that soils suitable for on-site and cluster systems are mainly north and west of the lake, thus limiting the use of these systems in the EIS Alternatives.

A second important issue is the overall need for the Facilities Plan proposal. Documenting a clear need for new wastewater facilities is sometimes difficult, requiring evidence directly relating existing on-lot systems to water quality and public health problems. Such a need is shown by one or more of the following conditions:

- 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; and
- Contaminated private wells clearly associated with sewage disposal systems.

The Proposed Service Area exhibits some indirect evidence of unsuitable site conditions for on-site soil absorption systems--high groundwater, slowly permeable soils, small lot sizes, proximity to lakeshores, and substandard setback distances between wells and private wastewater facilities. The most direct need identified is the public health and water pollution problems associated with the inundation of on-site systems during flood events. Flood water intrusion into privy systems will result in mixing of these waters, allowing for transfer of bacteria and nutrients.

Indirect evidence cannot justify Federal funding, however. Federal water pollution control legislation and regulations require documentation of actual water quality or public health problems. Section II.F summarizes the extensive efforts mounted during this EIS to document and quantify the need for improved facilities around Nettle Lake.

The extent of sewering needed and the use of newer technologies for wastewater collection have been investigated in detail here, as have alternative wastewater treatment systems. The technologies assessed were:

WASTEWATER MANAGEMENT COMPONENTS AND OPTIONS

Functional Component	Options
Flow and Waste Load Reduction	- household water conservation measures
Collection of Wastewaters	- limited service area - pressure sewers - gravity sewers - holding tanks
Wastewater Treatment Processes	- conventional centralized treatment - on-site treatment - land application - cluster systems
Effluent Disposal	- subsurface disposal - land application - discharge to surface waters
Sludge Handling	- aerobic digestion - dewatering (drying beds)
Sludge Disposal	- land application - landfilling

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

2. COMPARABILITY OF ALTERNATIVES: DESIGN POPULATION

The various alternatives for wastewater management in the Proposed Service Area must provide equivalent or comparable levels of service if their designs and costs are to be properly compared. The design population is that number of people projected to reside in the Proposed Service Area (see Figure I-2) in the year 2000. The following comparison of alternatives assumes a design population of 1,904.

This 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. Please note, however, that each alternative carries its own constraints, and that the wastewater management system chosen may determine much of the Study Area's actual population in the year 2000. Centralized systems would have a greater tendency to induce growth than decentralized systems. Chapter V discusses the importance of this factor.

3. COMPARABILITY OF ALTERNATIVES: FLOW AND WASTE LOAD PROJECTIONS

Design flows for centralized treatment facilities and for the cluster systems assumed a flow rate of 60 gallons per capita per day (gpcd) in residential areas for both permanent and seasonal residents. Infiltration and inflow (I/I) to gravity sewers was added to the calculated sewage flow in appropriate alternatives. The rate of I/I to new sewers is usually lower than that of old sewers and has been assumed at 200 gallons per inch-mile of gravity sewers.

The design flow used in the Facilities Plan Proposed Action was 100 gpcd, including I/I. To compare costs properly in this EIS, flows developed for the EIS Alternatives were also used for the Facilities Plan Proposed Action.

The rate of sewage generation depends upon the mix of residential, commercial, and institutional sources in the area. No industrial sources exist or are anticipated in the Study Area. Studies on residential water usage (Witt, Siegrist, and Boyle, 1976; Bailey, et al., 1969; Cohen and Wallman, 1974) reported individual household water consumptions varying widely between 20 and 100 gpcd. However, average values reported in those studies generally ranged between 40 and 56 gpcd. On a community-wide basis, non-residential domestic (commercial, small industrial, and institutional) water use increases per capita flows. The extent of such increases is 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 of 60 to 70 gpcd where existing per capita flow data are lacking. 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 using the following multipliers:

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

A multiplier of 1.0 instead of a figure in the 0.5-0.8 range was applied to the projected seasonal population to account for unquantified day-use 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 generous--i.e., it probably overestimates flows.

The design flow rate of 60 gpcd does not reflect potential reductions in flow from water conservation. Residential water conservation devices, discussed in Section III.B.1.a, could reduce flows by 16 gpcd. In Chapter IV, the Facilities Plan Proposed Action has been redesigned and recosted in order to evaluate the effects of flow reduction.

B. COMPONENTS AND OPTIONS

1. FLOW REDUCTION

Reducing flow and pollutant loads to a wastewater management system can:

- o Reduce the sizes and capital costs of new collection and treatment facilities;
- o Delay the time when future expansion or replacement facilities will be needed;
- o Reduce the operational costs of pumping and treatment; and
- o Mitigate the sludge and effluent disposal impacts.

A variety of devices that reduce water consumption and sewage flow are available. The most effective are those that control shower and toilet flows, which are the major sources of domestic water consumption. Some of these flow reduction devices are listed in Appendix E-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 hygienic practices and/or maintenance. The use 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 are economic.

Table III-1 lists proven flow reduction devices and homeowners' savings resulting from their use. Data on the devices listed in Appendix E-1 and local cost assumptions listed beneath the table were used to develop these estimates. The homeowners' savings include savings for well water supply, water heating, and wastewater treatment. A combination of shower flow control insert device, dual cycle toilet, and lavatory faucet flow control device could save approximately $98.89 per year.

If all residences in the Proposed Service Area were to install these flow reduction devices, not all families would save $2.11/1000 gallons in wastewater treatment costs (see assumption in Table III-1). This is because a substantial portion of this charge goes to pay off capital and operation and maintenance costs, which will remain constant even if flow is reduced. For all to benefit fully from flow reduction, wastewater collection, treatment, and disposal facilities would have to be designed with flow capacities reflecting 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 with a design flow based on 44 gpcd instead of 60 gpcd.

Estimated savings in project capital costs due to flow reduction would be small. All of the gravity sewers in the Facilities Plan Proposed Action are already at the minimum diameter allowed, 8 inches. There would be a small savings in downsizing the force main leading to the aerated lagoon from 6" to 4". This savings is estimated to be $2,268, less than 1% of the collection system's capital cost. Additional capital savings might also come from downsizing the aerated lagoon and from reduced electricity requirement at the pump stations. These savings would be small but cannot be appropriately estimated at the level of design detail used to develop alternatives for this EIS. Cost savings for the lagoon would be limited by the need to provide aeration equipment and lagoon surface area sufficient to oxidize the organic load, a parameter that would not be altered significantly by most water conservation methods.

These economic analyses of homeowner's saving and total present worth reduction assume sewering of all dwellings. However, for dwellings that still 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. [This is possible in Ohio, under Section 3701-29-20 variance of the ODH's Home Sewage Disposal Regulations, subject to the discretion of the local board of health--by telephone, Glen Hackett, ODH, 7 November 1979]. However, it is likely that reduced flows will prolong

Table III-1

ESTIMATED SAVINGS WITH FLOW REDUCTION DEVICES

	First Year Savings (or Cost)	Annual Savings After First Year
Shower flow control insert device	45.71	47.71
Dual cycle toilet[a]	21.92	41.92
Toilet damming device	17.71	20.96
Shallow trap toilet[a]	15.96	20.96
Dual flush adapter for toilets	13.47	17.47
Spray tap faucet	(63.70)	13.50
Improved ballcock assembly for toilets	10.97	13.97
Faucet flow control device	6.26	9.26
Faucet aerator	1.36	3.86

[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 $2.11/1000 gallons. Rate is based on a 1980 Study Area sewage flow of 0.14 mgd and an average annual household cost of $185/yr. estimated in this EIS for the Facilities Plan Proposed Action.

the life of soil absorption systems, thereby saving money in the long run.

Some decentralized systems require substantial reductions in flow regardless of costs. Holding tanks, soil absorption systems that cannot be enlarged, evaporation or evapotranspiration systems, and sand mounds are examples of systems that would operate more reliably at minimal sewage flows. Sewage flows of 15 to 30 gpcd can be achieved by combinations of the following:

- Reduce lavatory water usage by installing spray tap faucets.
- Replace standard toilets with dual cycle or other low-volume toilets.
- Reduce shower water use with 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 alternative to in-house composting toilets 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.
- Use commercially available pressurized toilets and air-assisted shower heads with a common air compressor of small horsepower to reduce sewage volume from these two largest household sources up to 90%.

2. COLLECTION

The collection system in the Facilities Plan is estimated to cost $1.3 million--75% of the total cost of the Proposed Action--and is the single most expensive portion of the sewerage facilities. Since only some parts of collection systems are eligible for Federal and State funding, collection system costs would affect the local community more than other project components. 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 where site conditions would 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 systems.

The alternative most extensively studied in the literature is collection by a pressure sewer system. The principles behind the pressure system are just the opposite of those of a water distribution system. 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. They differ in 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;
- suitability for use in varied site and climatic conditions.

The disadvantages include relatively high operation and maintenance cost, and the need to use 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. Wastewater is transported by suction through the mains rather than by pressure. Significant differences in design have been noted among the four major types of vacuum sewer systems currently in use (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 not affected. Preliminary studies suggest that gravity effluent sewers become cost-preferable at linear housing densities greater than 50 dwellings per mile.

A comparative analysis of the costs of STEP and grinder pump types of low pressure sewer systems indicated that the STEP system would be slightly more cost-effective. An important assumption in this analysis was that 35% of existing septic tanks would need to be replaced for use in the STEP system. Based on the above finding, STEP systems are used in almost all EIS alternatives. This decision should be reviewed during the detailed design stage (Step 2 of the construction grant process) on the basis of a detailed field survey of the existing septic tank systems. Figure III-1 illustrates the STEP system.

3. WASTEWATER TREATMENT

Wastewater treatment options fall into three categories: centralized treatment followed by surface water discharge; centralized treatment followed by land disposal; and decentralized treatment.

Centralized treatment means the treatment of wastewater collected by a single system and transported to a central location. Centralized treatment systems may serve all or part of a 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 means treatment of a relatively small amount of wastewater on-site or off-site. Typically, effluent is disposed near the sewage source, thus eliminating costly transmission of sewage to distant disposal sites.

a. Centralized Treatment--Discharge to Surface Water

The Facilities Plan evaluated the use of aerated lagoons, disinfection, and surface water disposal of treated effluent. Nettle Creek was selected by the Facilities Plan and this EIS as the receiving stream for treated wastewater.

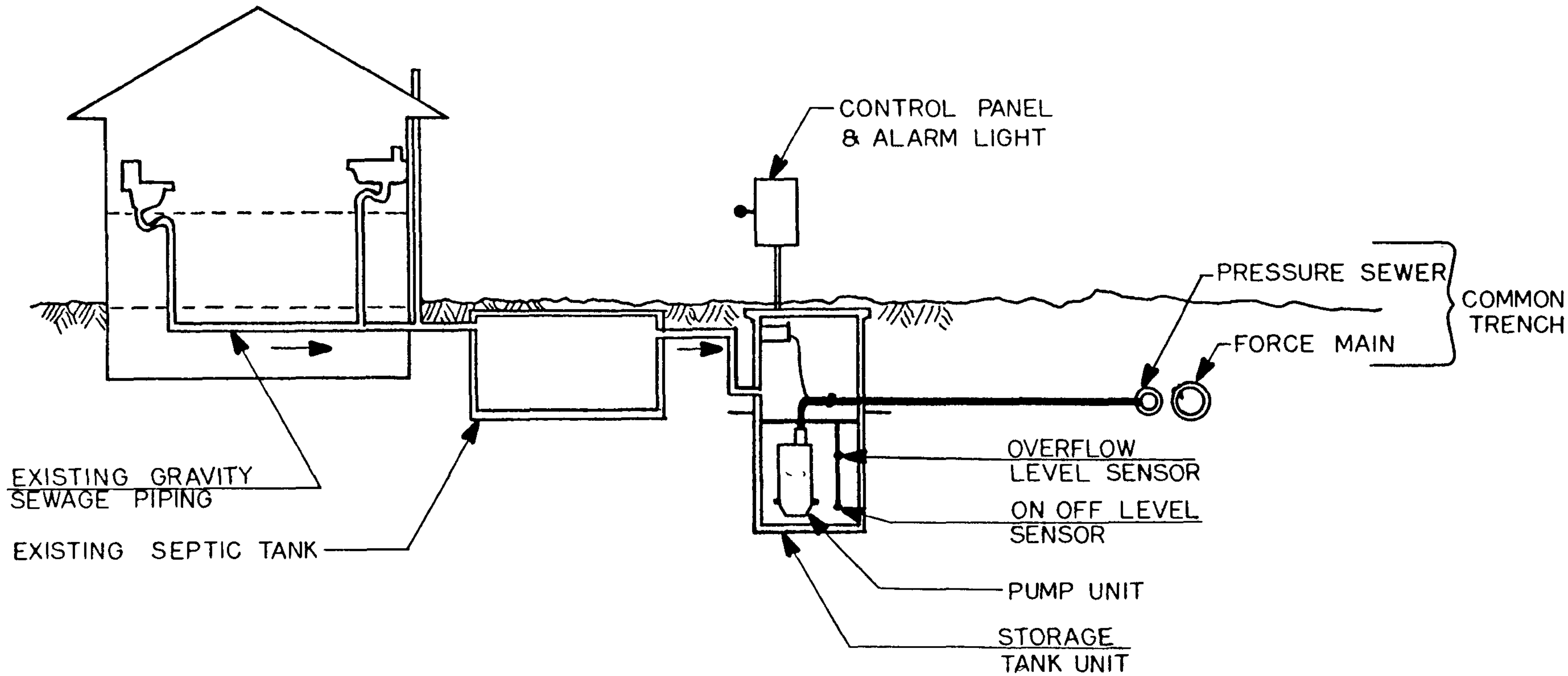
In addition to the options examined by the Facilities Plan, this EIS also examined the use of oxidation ditches and rotating biological contactors (RBCs) for conventional centralized treatment. Renovated wastewater recovered by wells from rapid infiltration sites would also be discharged to Nettle Creek.

The use of oxidation ditches to treat wastewater is relatively new in the United States. This technique employs a ring-shaped channel, approximately 3 feet deep, containing wastewater. A brush-like aeration device, placed across the channel, provides aeration and circulation.

In the RBC system, settleable solids would be removed and wastewater would flow through a series of tanks containing rotating plastic discs that support the treatment microorganisms. Excess sludge removed in the secondary settling tank would be recycled to the primary settling tank.

b. Centralized Treatment--Land Disposal

Land treatment of municipal wastewater uses vegetation and soil to remove many constituents of wastewater. Available processes may be used



TYPICAL PUMP INSTALLATION FOR PRESSURE SEWER

FIGURE III-1

for a variety of objectives, such as water reuse, nutrient recycling. and crop production. The three principal types of land application systems are (US EPA, 1977):

- o Slow rate (spray irrigation)
- o Rapid infiltration (infiltration-percolation)
- o Overland flow.

Figures III-2 and III-3 show the techniques of irrigation and infiltration. The effluent quality required for land application in terms of BOD and suspended solids is not so high as for stream discharge. Preliminary wastewater treatment is needed to prevent health hazards, maintain high soil treatment efficiency, reduce soil clogging, and ensure reliable operation of the distribution system. In this EIS, wetlands discharge, which is a modification of overland flow, was examined as an alternative method of land disposal. In this technique, most of the wastewater flows over a relatively impermeable soil surface. Renovation depends on microbial and plant activity, and secondary treatment is required prior to discharge.

A recent EPA memorandum (PRM 79-3) explains Federal eligibility 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 preapplication increment needed to meet more stringent preapplication 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. It encourages their use by allowing Federal funding of land used for storage, and by underwriting the risk of failure for certain land-related projects.

Land treatment systems require wastewater storage during periods of little or no application caused by factors such as unfavorable weather. In Ohio, storage facilities for the winter months are necessary. Considerations in selecting the method of land application and potential sites are discussed in Appendix F-1.

c. Decentralized Treatment and Disposal

A number of technologies are available for decentralized treatment 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:

- o Alternative low flush toilets

Figure III-2

SPRAY IRRIGATION

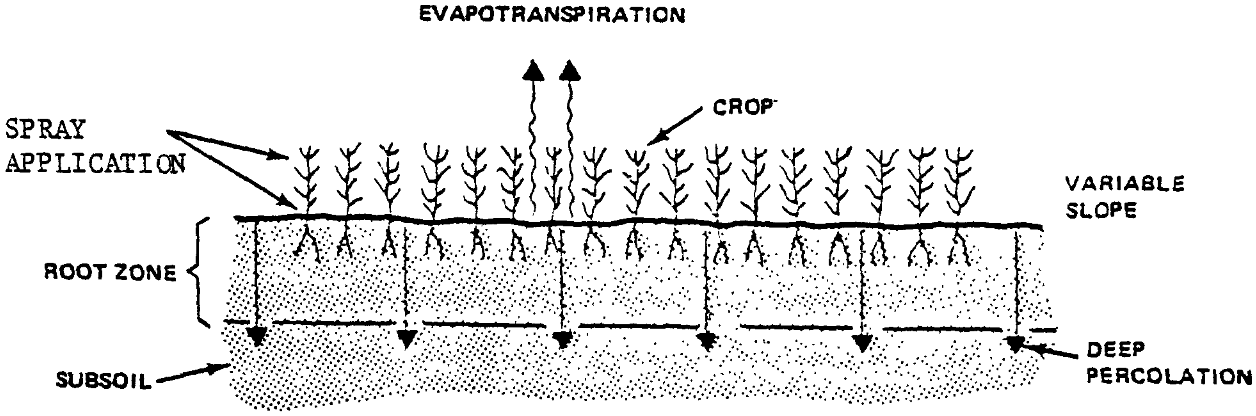
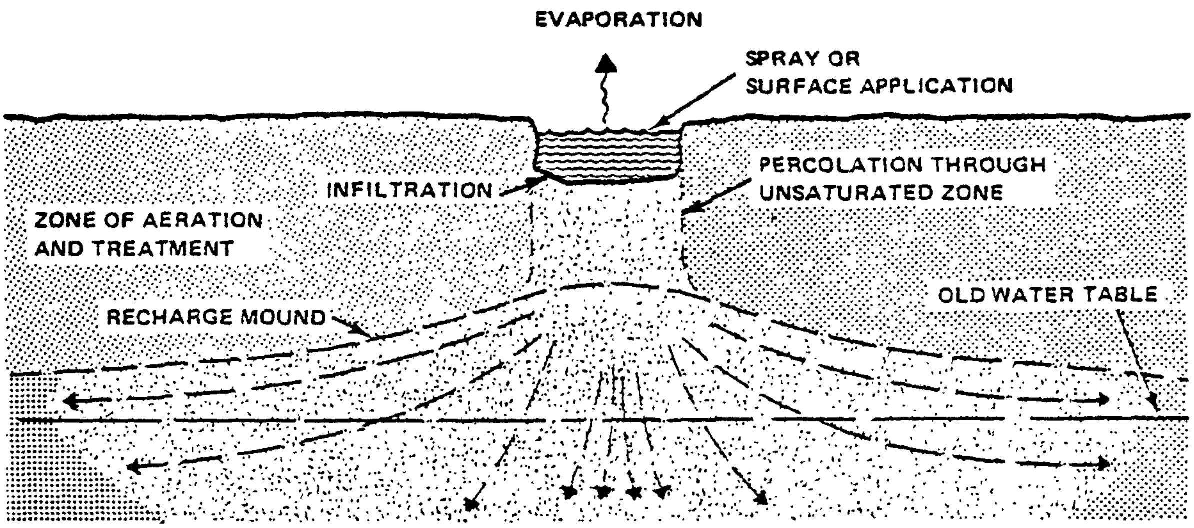


Figure III-3

RAPID INFILTRATION



Outdoor vault toilets

Composting toilets

Toilets using filtered and disinfected bath and laundry wastewater

Waterless toilets using oils to carry and store wastes

Chemical toilets

Incineration toilets

- On-lot treatment and disposal

Septic tank and soil-disposal systems

Septic tank and dual, alternating soil-disposal systems

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 elevated sand mound system

- Off-lot treatment and disposal

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

For a graphic portrayal of these types of systems please see Appendix F-2.

Because many of the developed portions of the Study Area are located along the lakeshore rather than streams, decentralized systems with discharges to surface waters were not considered appropriate. Combinations of the remaining technologies could be useful in specific situations within the Study Area. If the decentralized approach to wastewater management is selected, technologies will be "tailored" to the problem being remedied at each dwelling, to soil and groundwater site characteristics, and to expected systems use. This detailed analysis would occur during the Step 2 design period, after the EIS and facilities planning are completed.

In the absence of detailed site-by-site data with which to select appropriate technologies, this EIS assumes the use of the best known and most reliable decentralized technologies. The on-site septic tank and soil absorption system is the technology of choice where acceptable public health and environmental impacts are attainable with it. Where on-site systems (including alternatives to ST/SAS) are not economically, environmentally, or otherwise feasible, cluster systems will be used. The assumption that only these two technologies will be used is made here only as the basis for cost and feasibility estimation, and is not meant to preclude the use of other technologies. Estimates of their frequency of repair and construction costs are conservative to reflect the possibility that other more appropriate technologies may be more costly.

Continued use of septic tank-soil absorption systems for most dwellings in the Proposed Service Area would perpetuate violations of the Ohio Sanitary Code, as discussed in Section II.F.3. However, the field investigation undertaken for this EIS has indicated that most existing systems are operating with acceptable environmental and public health impacts, with the exceptions of privy floodings and suspected sluggish operation of ST/SASs during spring floods (see Section II.F.5). 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 was assumed that 35% of on-site systems will be replaced with new septic tanks, and 20% with new soil absorption systems.

The major water quality and public health problem that occurs in the Study Area is the inundation of pit privies. Of approximately 132 privies believed to be located within the service area, 90% are located within the 100-year floodplain, and many are inundated annually. In order to address this problem, two approaches have been developed. Existing privies would either be replaced with in-house plumbing and holding tanks, or alternative forms of toilet technology would be applied.

If toilets and holding tanks were employed, each residence would be required to: abandon and backfill their privy, install a water supply, construct a bathroom with water-saving plumbing devices, and install a holding tank. The other recourse that was developed was to replace existing privies with outdoor vault toilets, chemical toilets, electrical composting toilets, or air-assisted low flush toilets. The last three forms of technology may be installed in a corner of the existing dwelling and paritioned off, or a bathroom may be built by the homeowner to include the new toilet.

Detailed site evaluations of some dwellings may show that continued use of on-site systems is not feasible, or that repairs to existing systems for a group of dwellings may be more expensive than joint disposal by means of cluster systems. Cluster systems are subsurface absorption systems, similar in operation and design to on-site soil absorption systems, but large enough to accommodate flows from a number of (approximately 40) dwellings. Cluster systems include limited collection facilities using pressure sewers, small diameter sewers and/or pumps and force mains. Generally, use of existing septic tanks would continue for settling and stabilization of wastewater.

As indicated in Section II.B.3.b, suitable soils exist near enough to residential development in parts of the Study Area to permit the use of cluster and on-site systems. Further field surveys of soils and groundwater conditions at specific sites selected for cluster systems should be undertaken prior to use (see Appendix F-3 for a discussion of soil characteristics). The exact number and locations of dwellings requiring off-site disposal of wastewater would be determined after detailed evaluation of existing systems.

Appendix F-4 contains design assumptions for the cluster systems. Design criteria recommended by the State of Ohio were considered in the development of the typical cluster system design. The costs were developed specifically for the two cluster systems serving residences in Segment 2 along the western shore of Nettle Lake, and include replacement of 35% of existing septic tanks. Presently, there are successfully operating cluster systems in many states, notably Minnesota and California.

4. *EFFLUENT DISPOSAL*

Treated wastewater may be disposed of in one of three basic ways. Reuse, perhaps the most desirable, implies recycling of the effluent by industry or agriculture or to 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 as the ultimate receiving body for treated effluent.

a. Reuse

Industry Reuse. There is no industrial development in the Study Area, nor is any planned. Consequently, reuse by industry is not a feasible means of effluent disposal.

Agricultural Irrigation. The use of treated wastewaters for irrigation is addressed in Section III.B.4.c.

Groundwater Recharge. Groundwater supplies all potable water in the Study Area. The sand and gravel deposits of the Study Area contain ample quantities of water and are an important resource. There is no evidence that this resource is being depleted to an extent requiring supplemental recharge. Furthermore, the volume of wastewater generated is insignificant compared to the available groundwater resources.

b. Discharge to Surface Waters

In the Facilities Plan Proposed Action, effluent from the aerated lagoon would be discharged to Nettle Creek. Treated effluent from the rapid infiltration site would percolate down through the soil and enter the water table. Recovery wells would collect the renovated wastewater, which would be pumped directly to Nettle Creek; approximately 75% of the effluent would be recovered.

c. Land Application

Two land application methods were examined during the preparation of this EIS: wetlands discharge and rapid infiltration/percolation. For wetlands discharge, which was proposed as an alternative to stream discharge, wastewater would be conveyed to the site located east of Nettle Lake.

In rapid infiltration, wastewater is treated by infiltration and percolation through the soil. Wastewater is applied to the soil by means of spreading basins. Besides treating wastewater, rapid infiltration may also recharge groundwater supplies. However, in the Nettle Lake area, recovery wells would be constructed in the rapid infiltration sites to protect the groundwater from pollution by nitrates. After treatment, the renovated water would be withdrawn by the recovery wells and discharged to Nettle Creek downstream of the Lake.

The potential sites for rapid infiltration have seasonally high groundwater tables deeper than 6 feet, and moderately to rapidly permeable soils. The renovated wastewater will meet State NPDES requirements for surface water discharges. Facilities to store wastewater for 8 weeks of inclement weather would be necessary, and wastewater would be applied to the land at a rate of 20 inches per week. The site identified for use is located southwest of the Lake.

5. SLUDGE HANDLING AND DISPOSAL

Two types of sludge would be generated by the wastewater treatment options considered above--chemical/biological sludges from conventional treatment; and solids pumped from septic tanks (septage). The residues from treatment by lagoons and land application are grit and screenings.

Aerobic digestion of sludges, followed by land application, was the sludge handling and disposal option considered in the Facilities Plan. Aerobic digestion of sludge is accomplished during aeration of wastewater in the aerated lagoons. The cost-effectiveness of aerobic digestion for those alternatives that produce biological/chemical sludges has been evaluated and the results incorporated in Section IV.D.

To remove water from digested sludge, a dewatering process is used following digestion. After digestion, solids concentrations in sludge usually range from 4 to 6%. Dewatering devices such as vacuum filters, filter presses, and drying beds can usually increase the solids content to 20 to 45%, simplifying handling during disposal. Sludge drying beds, the dewatering option selected in the Facilities Plan, have been evaluated further in this EIS with respect to costs, reliability, and ease of operation.

Sludge disposal would be by hauling either to a landfill site or to farmland sites (by farmers or a contract hauler). Sludge application to farmland is beneficial because it conditions the soil and recycles nutrients. Both options are examined in this EIS.

Alternatives using residential septic tanks for on-lot systems, cluster systems, or STEP sewer systems must provide for periodic removal and disposal of sludge. For the purposes of designing and costing these alternatives, it was assumed that the average cost of pumping and disposal would be $65 per year. Local septage haulers are licensed to operate in Williams County; farmlands are typical disposal sites.

C. FLEXIBILITY OF COMPONENTS

Flexibility measures the ability of a system to accommodate growth or future changes in requirements. This section examines the flexibility of the components in each alternative, and restraints on the operation and design of facilities. These are discussed in terms of their impacts upon choices of systems and decisions of planning and design.

1. TRANSMISSION AND CONVEYANCE

For gravity and pressure sewer systems, flexibility is the ability to handle future increases in flow. For flows greater than the original design, this is generally low; an increase in capacity is usually expensive. Also, the layout of the system depends upon the location of the treatment facility. Relocation or expansion of a finished facility requires costly redesign and addition of sewers.

Both gravity and pressure sewers require minimum flow velocities to prevent deposition of solids, which could cause blockage. The velocity of the fluid in gravity sewers depends mainly upon pipe slope. Contour of the ground surface may determine pipe slope and depth, and, consequently, construction costs. Pressure sewers, however, can carry sewage uphill under pressure, independent of slope, to maintain the flow velocity; they offer the designer somewhat more flexibility than gravity sewers.

2. CONVENTIONAL WASTEWATER TREATMENT

Ability to expand a conventional wastewater treatment plant depends largely upon the process used, facility layout, and availability of additional land for expansion. Compared to many systems for land application, conventional treatment processes require little land, increasing expansion flexibility. However, unless the the plant was designed to facilitate future increments of capacity, expansion may be difficult. Establishment of a facility such as a sewage treatment plant reduces flexibility for future planning decisions within the affected municipalities.

Because operators can, to some extent, vary the components of treatment, most conventional processes have good operational flexibility. By alteration of the amounts and types of chemicals, flow rates, detention times, or even process schemes, the required effluent quality can usually be obtained.

a. Oxidation Ditch

Oxidation ditches are simple to operate. They are similar in theory to extended aeration, long employed in the United States. Operational flexibility of such plants is good because of their relative simplicity.

Oxidation ditches require relatively shallow basins (3 to 6 feet), another advantage. Less structural strength for the basin is necessary because of the shallow depth. There is also more leeway in choosing a site since soils and geologic factors are less critical.

There are several disadvantages to these ditches. The shallow basin limits the quantity of wastewater that can be treated. However, design flows are limited to the range of 0.1 to 10 mgd because of the large tracts of land needed. In addition, oxidation ditches cannot be readily converted to another process should the need arise. Similarly, expansion flexibility is low because of the land requirements.

b. Rotating Biological Contactor (RBC)

The use of rotating biological contactors to treat wastewater is relatively new in the United States. The RBC rotates circular discs covered with a film of aerobic bacteria in a basin through which wastewater flows. The disc is usually 40% submerged for aerobic treatment.

RBCs are simple to operate. They are similar in theory to trickling filters, which have been used in the United States since 1908. The RBC units do not require sludge recycling or maintenance of a suspended microbial culture, as in activated sludge treatment. The relatively simple operation, therefore, makes operational flexibility high for RBC plants.

The modular nature of RBC reactors makes expansion or upgrading of the plant relatively easy. With proper design of other components of the treatment plant, and proper planning of the facility layout, the cost and effort required for expansion may be relatively small. RBCs are therefore well suited to projects constructed in phases over an extended period. Their use is usually limited to design flows in the range of 0.1 to 20 mgd (well suited to the Study Area) because of the large land areas required to accommodate the multiple discs of bigger plants.

The relatively shallow basin depths (6 to 8 feet) required by RBCs constitute another advantage. Structural strength is required for the basin because water volume per square foot of basin area is reduced. There is, therefore, more leeway in choosing a site, since a greater variety of soil types and ground conditions is available for locating the RBC units.

There are several disadvantages to the RBC reactor. The mechanical components have relatively low salvage value, and converting RBC units to other uses may be costly, since components cannot be reused or sold.

3. ON-SITE SEPTIC SYSTEMS

Septic tank-soil absorption systems (SA/SAS) are flexible in that they can be designed for each user. As long as spatial and environmental standards are met, the type of system can be chosen according to individual requirements. This flexibility is useful in some rural areas where centralized treatment would be neither cost-effective nor desirable.

Existing septic systems can be expanded by adding tank and drainfield capacity, if suitable land is available. Flow can then be distributed to a second system with little disturbance of the first one.

Alternative toilet technologies described in this EIS are very flexible since they do not depend on on-site soils suitability. They may be used in any of the existing dwelling units with only minor modification and, with proper design, operation, and maintenance, can provide adequate treatment for either seasonal or permanent use. See Table VI-2 for a comparison of technologies considered for privy replacement.

Cluster systems are similar to on-site ST/SAS with the exception that they treat wastewater from more than one house, usually 35 to 50. The flexibility for design and expansion of such a system is somewhat less than for a standard septic system. Sizes of cluster system absorption fields range from one-quarter acre to one acre, a substantial increase compared to a standard absorption system (about 1000 square feet). Right-of-way requirements for piping must be considered because the system crosses property boundaries and may cross public property. The location of other underground utilities, such as water, electricity, gas, and telephone, must also be considered in the design.

An alternative system for on-site sewage treatment, such as an elevated sand mound, is required where siting restrictions prohibit the use of standard septic systems, and where centralized collection of sewage is not available. In these cases future expansion may be difficult or impossible. Stipulations of the health codes restrict the potential of the alternative system for alteration or expansion.

4. LAND APPLICATION

To be flexible, a land application system should operate efficiently under changing conditions and should be easy to modify or expand. These factors depend largely upon geographical location.

The ability to handle changes in treatment requirements and wastewater characteristics is a specific measure of flexibility for a land application facility. Furthermore, the level of treatment provided by the land application system will in part determine whether it can handle possible increases in flows in the future. Wastewater in the Nettle Lake Study Area consists primarily of domestic sewage, and future changes in composition of the wastewater are not likely to occur. If industrial wastewater were added in the future, pretreatment at the industrial source could be required.

Expandability is an important element of flexibility. Efficient and economical land acquisition for future flow increases depends upon the proximity of the facility to populated areas, design and layout of the system, additional transmission requirements, and the type of application system used. A number of application mechanisms are available--spray, overland flow, or rapid infiltration. Sites can be forest land, cropland, or open fields. Attention must be paid, however, to characteristics of the surrounding land, and to possible future changes in land use. Also, requirements related to hydraulic and geologic conditions of the proposed site are stringent. When initially planning the facility, all of the above-mentioned conditions should be taken into consideration if maximum flexibility for future expansion is desired.

Land itself accounts for much of the capital cost of a land application facility, greatly affecting the possibility of expansion or ease of discontinuing the site. Because land normally appreciates in value, the final salvage value of the site may be very high after the expected 20-year design life. If the site is abandoned, much of the initial capital cost of the facility may be recovered by reselling the land at the appreciated price. Note, however, that the public may be reluctant because of its former use to use the land; this would depend largely upon the appearance of the land at the time of resale.

Finally, operational flexibility of land application systems depends upon climate. When heavy rains saturate the soil or flooding occurs, treatment efficiency is greatly reduced. Where cold temperatures periodically make land application impracticable, storage facilities are required. In very cold climates, up to 6 months of storage capacity might be needed (see Appendix I-1 for assumptions used in this EIS).

D. RELIABILITY OF COMPONENTS

Reliability measures the ability of a system or component to operate without failure at the level of efficiency for which it was designed. It is particularly important to have dependable operation in situations where environmental or economic harm may result from system failure. This section examines the reliability of local components used in the EIS alternatives.

1. SEWERS

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

Gravity sewer problems 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 tends to be more prevalent in older systems.

Where ground slope opposes 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 that increases operation and maintenance (O&M) requirements and decreases the system reliability. To assure uninterrupted operation, two pumps are generally installed, providing a backup if one malfunctions. Each is usually designed to handle at least twice the peak flow. A standby generator is usually provided to ensure operation of the pumps in times of 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 condition known as "water hammer," marked by sudden sharp surges in water pressure that may burst pipes. However, both problems can be controlled through proper design procedures. The reliability of properly designed force mains approaches that of gravity sewers.

Pressure Sewers. Pressure sewers transmit wastewater uphill when topography does not allow gravity flow. Because the system is always under pressure, pumping is needed 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 of either 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 then be without sewage removal. This is a lesser problem than might be supposed, for a power failure would also 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 in their design and construction have been made, and the second generation of these pumps has proved 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 septic tank effluent pumps* (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 pumps 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, allowing septic tank effluent to reach 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 flow volumes require multiple units per treatment process. For instance, a large facility will have several primary clarifiers; if one malfunctions, the remaining units can handle the entire load. Therefore, difficulties arising 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.

Land Application. Land application of treated sewage effluent is still uncommon 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 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 benefitted 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 2 or 3 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, limit the cases where septic systems can be used.

Sand Mounds. Elevated sand mounds 4 or 5 feet above original ground level are an alternative drainage mechanism where siting restrictions do not allow standard drainfields. Because they do not always provide satisfactory service and are considerably more expensive than conventional drainfields, they have not been universally accepted. In states where proper design standards are enforced, such as Minnesota and Wisconsin, they do have a very good record of reliability.

Alternative Toilets. All of these devices have not experienced widespread use in the US; however, considerable information is available from years of use in European and Scandinavian countries. These systems are gaining broader acceptance in the US, to the point where some localities now have design and plumbing codes to cover them. Vault toilets have the highest reliability, since they perform only limited treatment in storing wastes. Air-assisted toilets have been in use for a number of years, and perform very well. Chemical toilets require some operator upkeep to charge the toilet with chemicals and monitor its performance. Electrical composting toilets require preparation with a mixture of soil and sawdust, monitoring of performance, owner disposal of residue, and limitations to 2 or 3 person households.

4. CLUSTER SYSTEMS

Cluster systems are localized wastewater disposal mechanisms serving several 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.

E. IMPLEMENTATION

The implementation of a wastewater management plan 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 wastewater collection and treatment, 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 related management experience.

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

- Legal authority for a managing agency to exist and financial authority for it to operate.

- Agency management of construction, ownership, and operation of the sanitary facilities.
- Choice between the several types of long-term financing that are generally required to pay for project capital expenditures.
- A system of user charges to retire capital debts, to cover expenditures for operation and maintenance, and to provide a reserve for contingencies.

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 Facilities Plan identified the Williams County Commissioners as the legal authority for implementing the Plan's Proposed Action. This is in accord with Chapter 6117 ORC (see Section II-C-3-c), which establishes the County as the authority to provide wastewater treatment and collection facilities in areas, such as the Study Area, which are outside municipal corporate limits. This law permits the establishment of sanitary sewer districts only within corporate limits, cities, and villages.

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 line. For STEP or grinder pump stations connected to pressure sewers, several options exist, in which all individual residences are treated equally:

- The pump 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

Appendix G-2 discusses in detail various financing methods for capital expenses associated with a project. Briefly, they are:

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

The Facilities Plan indicated that 75% of the Proposed Action would be funded by a Federal grant, and assumed that funds for part of the local share would be lent by the Farmers Home Administration.

d. User Charges

User charges are set at a level adequate to repay long-term debt and cover operating and maintenance expenses. In addition, prudent management agencies often 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 the Williams County Commissioners to recover the costs of wastewater management from 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:

- o Permanent residents/Seasonal residents
- o Residential/Commercial/Industrial users
- o Presently sewered users/Newly sewered users
- o 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 FLOWS 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, at which time 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 broadly enough to include monitoring and control of other effects of on-lot system use or misuse. The lack of knowledge of the operation of on-site systems has consequently been coupled with a general absence of information concerning impacts of septic systems on ground and surface water quality.

Methods of identifying and dealing with the adverse effects of on-lot systems without building expensive sewers are being developed throughout the United States. Technical methods include both the wastewater treatment and disposal alternatives discussed in Section III.B, and improved monitoring of water quality. Appendix H-1 discusses managerial methods already developed and applied by small waste flows districts in dozens of communities in California. As with centralized districts, the issues of legal and fiscal authority, agency management, project financing, and user charges must all be resolved by small waste flows districts.

a. Authority

Ohio presently has no legislation that explicitly authorizes governmental entities to manage wastewater facilities other than those of conventional centralized systems. However, statutes in Michigan, Minnesota, and Wisconsin have been interpreted as providing counties, townships, villages, cities, and special purpose districts 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 H-2.

b. Management

The purpose of a small waste flows 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 H-3 discusses this concept in detail.

Table III-2 presents the range of functions a management agency may exercise for adequate control and use of decentralized technologies. 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 to be made by the locality concerning the development of this agency relate to the following questions:

- o Should engineering and operation functions be provided by the agency or by private organizations under contract?
- o Would off-site facilities require acquisition of property and right-of-way?

Table III-2

BASIC AND SUPPLEMENTAL FUNCTIONS FOR SMALL WASTE FLOWS DISTRICTS

Component	Basic functions*	Supplemental functions*
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 for approval of plans* Evaluate Existing systems/design rehabilitation measures 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

* Function normally provided by local governments at present.

- o Would public or private ownership of on-site wastewater facilities be more likely to provide cost savings and improved control of facilities operation?

- o 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:

- o Develop a site-specific environmental and engineering data base;

- o Design the management organization;

- o Start up the agency;

- o Construct and rehabilitate facilities; and

- o Operate facilities.

Site-Specific Environmental and Engineering Data Base. The data base should include groundwater monitoring, a house-to-house investigation (sanitary survey), soils and engineering studies, and a survey of available technologies likely to be feasible in the area. This baseline information will provide the framework for the systems and technologies appropriate to the district. Such detailed work is accomplished during the Step 2 design phase of the project.

A program for monitoring groundwater should include water quality 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; borings for soil samples; and the installation of shallow groundwater observation shafts. Sampling of the groundwater downhill from leach fields aids in evaluating the potential for transport of nutrients and pathogens through the soil. Study of soil classifications near selected leach fields may improve correlations between soil characteristics and leach field failures. An examination of the reasons for the inadequate functioning of existing wastewater systems may avoid such problems with the rehabilitated or new systems.

Design of the Management Organization. Both the Facilities Plan and this EIS have recommended the Williams County Commission as the agency best suited to managing wastewater facilities in both unsewered and sewered areas of the Study Area. The Commission's technical and administrative capabilities should be analyzed as outlined in Table III-2, concurrently with development of the environmental and engineering data base. The roles of organizations such as the Williams County Health Department should be examined with respect to avoiding inter-agency 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.

Agency Start-Up. 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 made. Acquisition of property should also be initiated.

Construction and Rehabilitation of Facilities. Site data collected for the environmental and engineering data base should support selection and design of appropriate systems for individual residences. Once construction and rehabilitation begin, site conditions may be revealed that suggest technology or design changes. Since decentralized systems 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 operation functions listed in Table III-2 are primarily applicable to this phase. The role of the management agency would have been determined in the organizational phase. However, the experience of agency start-up and project construction may indicate the need to modify the levels of effort established at that time in order to ensure 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 is discussed in Section III.E.1.c and Appendix G-2.

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, unless there is public ownership or public access and control (such as by perpetual easement or a binding covenant) of the treatment works. A major difference in the financing of permanent and seasonally owned on-site systems results where there is no public ownership or public access and control. 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. Public ownership or public access and control of all small alternative wastewater systems would therefore be in the best interests of the residents of the Study Area.

User charges and classes as applied to centralized districts are discussed in Section III.E.1.d. The significance of decentralized districts lies in the creation of an additional class of users. Since some households of such districts may be in centrally sewered areas and others in 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 the former's 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, and user charges have been assumed to be based on an equal distribution of local costs among all users.

CHAPTER IV

EIS ALTERNATIVES

A. APPROACH

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 for the Study Area, including a No Action Alternative.

The Proposed Action developed in the Facilities Plan (described earlier) provided for centralized collection and treatment of wastewater. In response to questions about the 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 would manage wastewaters in the same service area as the Facilities Plan Proposed Action, but the EIS Alternatives use decentralized collection and treatment to avoid some of the costs of sewers.

Because of the high cost of collection in the Proposed Action, the cost-effectiveness of pressure sewers, vacuum sewers, and small-diameter gravity sewers were compared. Of these, pressure sewers were the most cost-effective. Similarly, the use of a septic tank effluent pumping (STEP) system was analyzed as an alternative to grinder pumps. Assuming 35% of the septic tanks would be replaced, the STEP system was computed to be more cost-effective and was used in the EIS Alternatives. This selection should be reviewed during the preparation of detailed designs.

Analysis of decentralized treatment technologies and site conditions showed feasible alternatives to sewering the entire Study Area. 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 parts of the Study Area. Additionally, on-site upgrading of existing treatment systems is examined, which includes abandoning privies in flood-prone areas and replacing them with vault toilets, composting toilets, or other technologies.

Appendix I-1 presents the assumptions used in design and costing of the alternatives. Section IV.B lists the major features of the Proposed Action and of the EIS Alternatives.

B. ALTERNATIVES

The Facilities Plan Proposed Action has been compared with the No Action Alternative and eight new approaches developed in this EIS. Table IV-1 summarizes these alternatives.

1. NO ACTION

The No Action Alternative implies that EPA would not provide funds to support new construction, upgrading, or expansion of existing waste-

Table IV-1

ALTERNATIVES -- SUMMARY OF MAJOR COMPONENTS

Alternative	Centralized Treatment	Treatment Plant Siting	Effluent Disposal	On-lot and Cluster Systems	Alternative Collection Method
Facilities Plan Proposed Action	Aerated lagoon serving entire Proposed Service Area	Northwest Township Section 24	Discharge to Nettle Creek	No	No
EIS Alternative 1	Aerated lagoon serving Segments 1,3,4,5,7 and 8	Northwest Township Section 24	Discharge to Nettle Creek	Segment 2: Cluster systems Segment 6: ST/SASs	No
EIS Alternative 2	Aerated lagoon serving Segments 1,3,4,5,7 and 8	Northwest Township Section 24	Discharge to wetlands (aquaculture)	Segment 2: Cluster systems Segment 6: ST/SASs	No
EIS Alternative 3	Aerated lagoon serving Segments 1,3,4,5,7 and 8	Northwest Township Section 24	Discharge to Nettle Creek	Segment 2: Cluster systems Segment 6: ST/SASs	Use of pressure sewers/septic tank effluent pumping (STEP) system in suitable sections of the central collection system
EIS Alternative 4	Aerated lagoon serving Segments 1,3,4,5,7 and 8	Northwest Township Section 24	Discharge to wetlands (aquaculture)	Segment 2: Cluster systems Segment 6: ST/SASs	Use of pressure sewers/STEP system in suitable sections of the central collection system
EIS Alternative 5	Stabilization Pond/land application system serving Segments 1,3,4,5,7 and 8	Northwest Township	Land application by rapid infiltration with recovery of renovated wastewater and discharge to Nettle Creek	Segment 2: Cluster systems Segment 6: ST/SAS	No
EIS Alternative 6	No	No	No	Segments 1,3,4,5: Holding tanks (maximum flow reduction) and septic tanks with mounds and "super systems" Segment 2: Cluster systems Segments 6 to 8: ST/SAS Repair, replacement and hydrogen peroxide treatment of existing systems as necessary	No
EIS Alternative 7	No	No	No	Segments 1 to 5: Holding tanks (maximum flow reduction) and septic tanks with mound and "super system" absorption fields. Segments 6 to 8: ST/SASs Repair, replacement and hydrogen peroxide treatment of existing systems as necessary	No
EIS Alternative 8	No	No	No	Segment 1 to 5: Replace privies with alternative technologies and septic tank with mound or "super system" absorption fields Segment 6 to 8: ST/SAS Repair, replacement, and hydrogen peroxide treatment of existing systems as necessary	No

water collection and treatment systems. Any changes or improvements of malfunctioning systems would be at the initiative and expense of either the property owner or local government.

2. FACILITIES PLAN PROPOSED ACTION

The Facilities Plan recommended construction of a regional collection system and centralized treatment. The collection system would comprise a combination of gravity sewers with lift stations and force mains.

The Facilities Plan proposed treatment of 0.14 mgd of wastewater by aerated lagoons, with discharge to Nettle Creek. Figure IV-1 is a representation of the proposed treatment process. The proposed layout for this alternative is illustrated in Figure IV-2.

3. EIS ALTERNATIVE 1

EIS Alternative 1 is similar to the Facilities Plan Proposed Action. Segments 1, 3, 4, 5, 7, and 8 would be sewered as in the Facilities Plan Proposed Action (see Figure IV-3). Similarly, wastewater would be treated in an aerated lagoon and discharged to Nettle Creek. However, Segment 2 would be served by cluster systems, while Segment 6 would remain with the existing on-site ST/SAS systems, since soils in this segment are suitable for on-lot treatment. The design flow for the aerated lagoon would be reduced to 0.09 mgd. This alternative is depicted in Figure IV-4.

4. EIS ALTERNATIVE 2

EIS Alternative 2 differs from EIS Alternative 1 only in the type of discharge provided after centralized collection and treatment. In this alternative, treated wastewater from the aerated lagoon would be discharged to nearby wetlands, thus reducing the length of the outfall line. Figure IV-5 depicts this alternative.

5. EIS ALTERNATIVE 3

EIS Alternative 3 employs pressure sewers instead of gravity sewers wherever suitable. Septic tank effluent pumping (STEP) was selected over grinder pumps on the basis of cost-effectiveness. This alternative was intended to investigate whether the different methods of collection would reduce costs; in a few parts of the Service Area, notably Segment 1, gravity sewers were retained. This was because gravity sewers could be more cost-effective than pressure sewers in this higher density area.

As in EIS Alternative 1, 0.09 mgd of wastewater would be conveyed to an aerated lagoon for treatment and discharge to Nettle Creek. EIS Alternative 3 is illustrated in Figure IV-6.

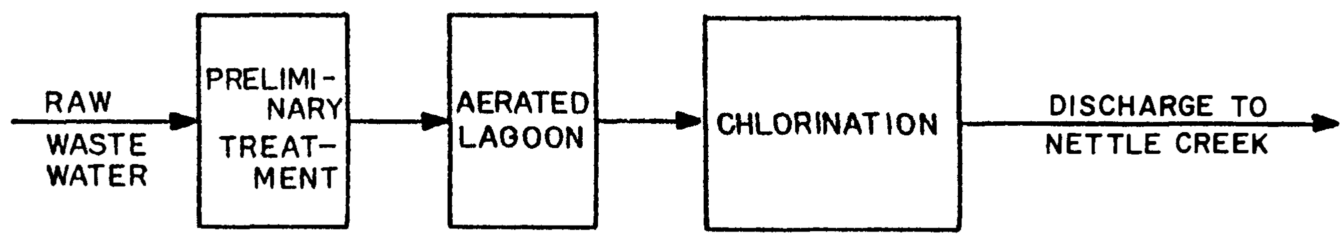


FIGURE IV-1 FACILITIES PLAN PROPOSED ACTION TREATMENT PROCESSES

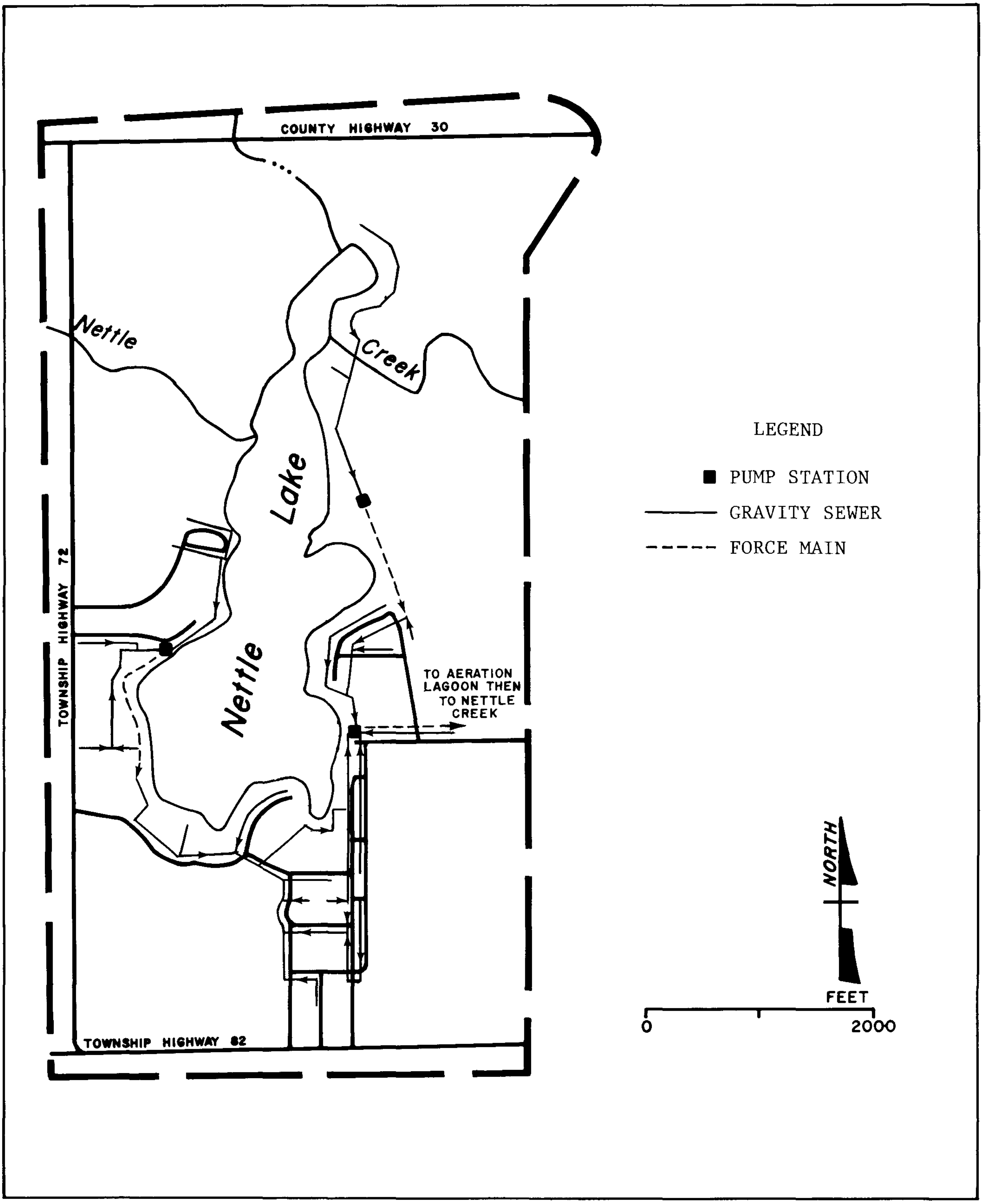


FIGURE IV-2 NETTLE LAKE: FACILITIES PLAN PROPOSED ACTION

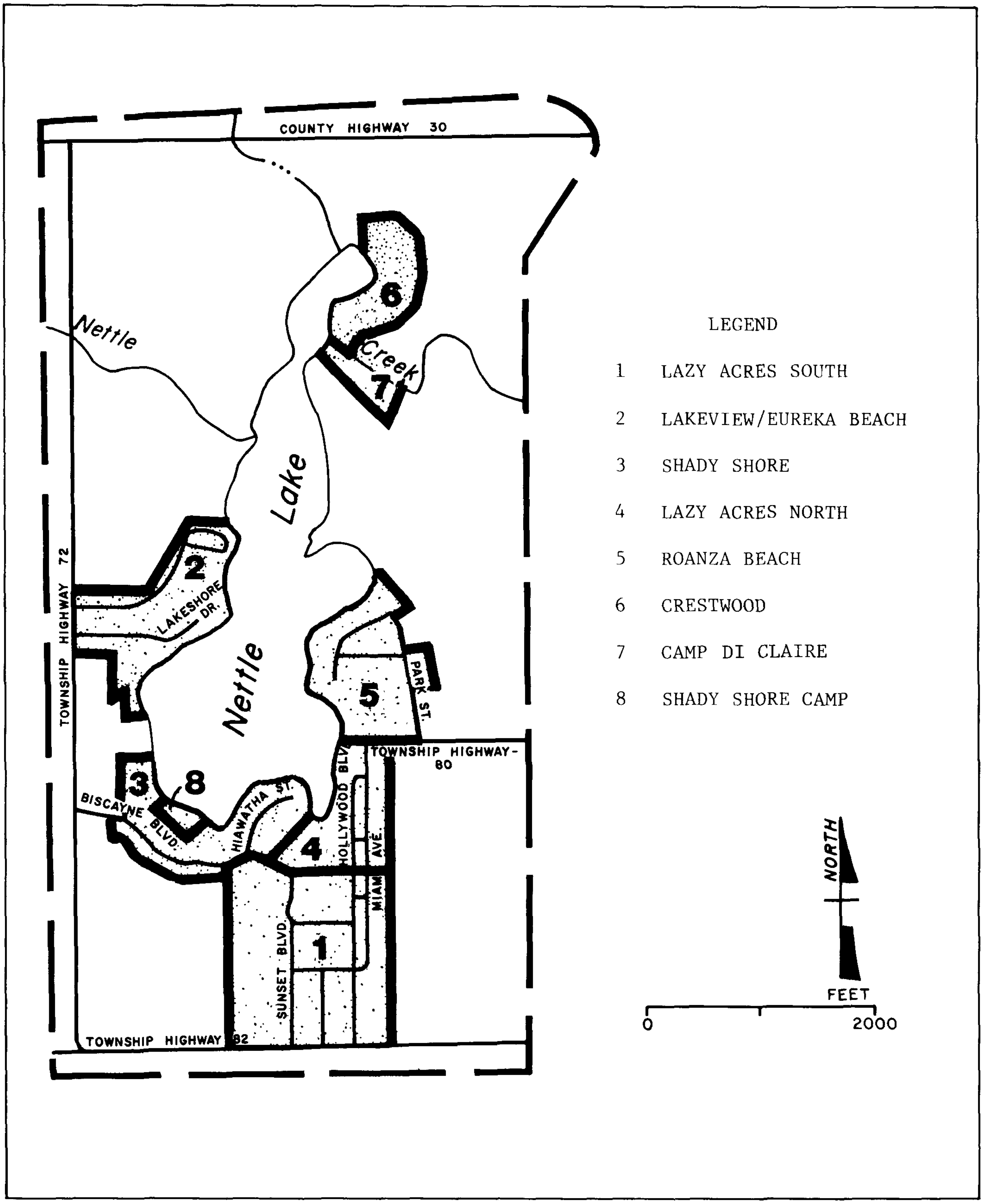


FIGURE IV-3 NETTLE LAKE: SEGMENTED SUBDIVISIONS IN THE PROPOSED SERVICE AREA

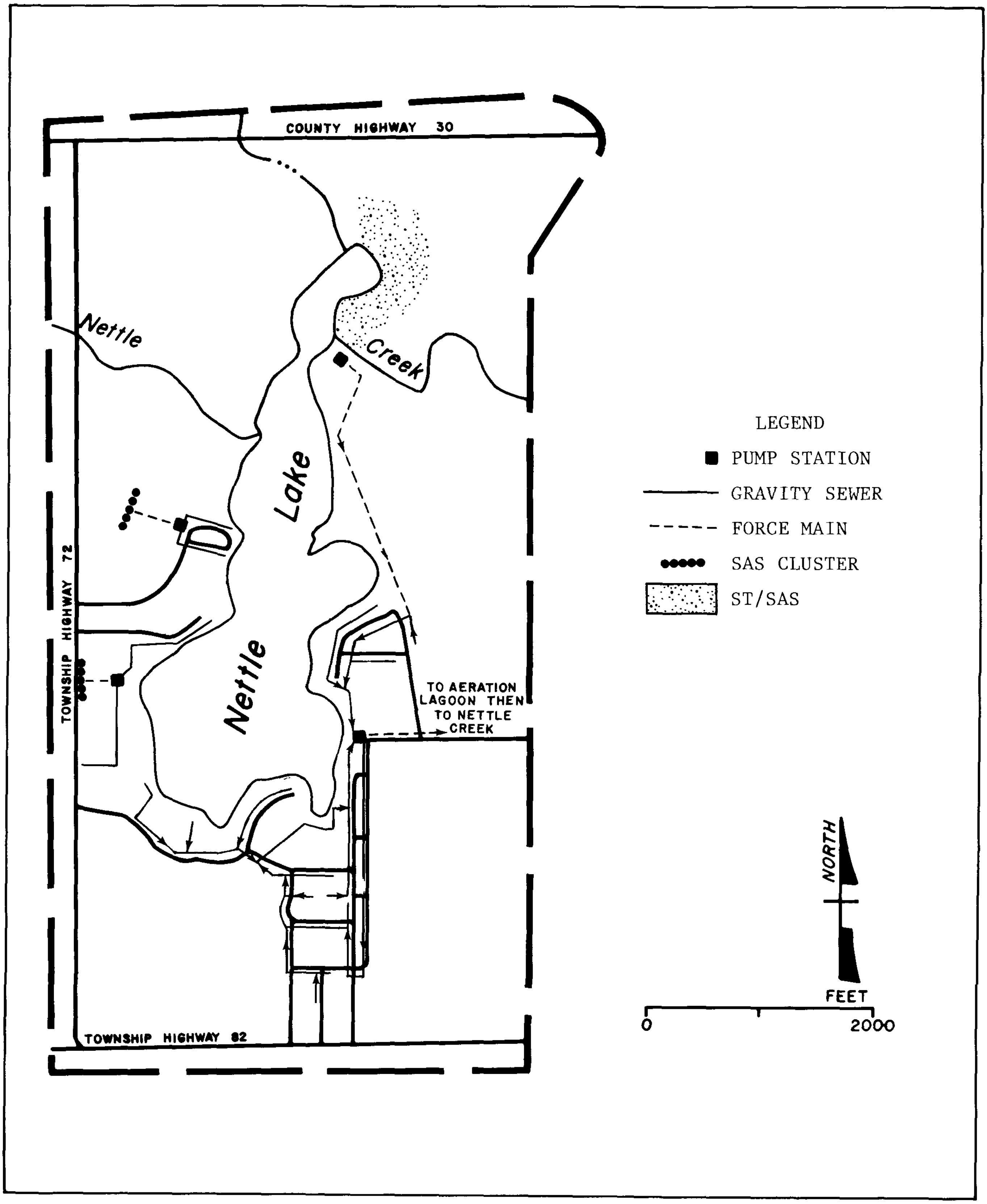


FIGURE IV-4 NETTLE LAKE: EIS ALTERNATIVE 1

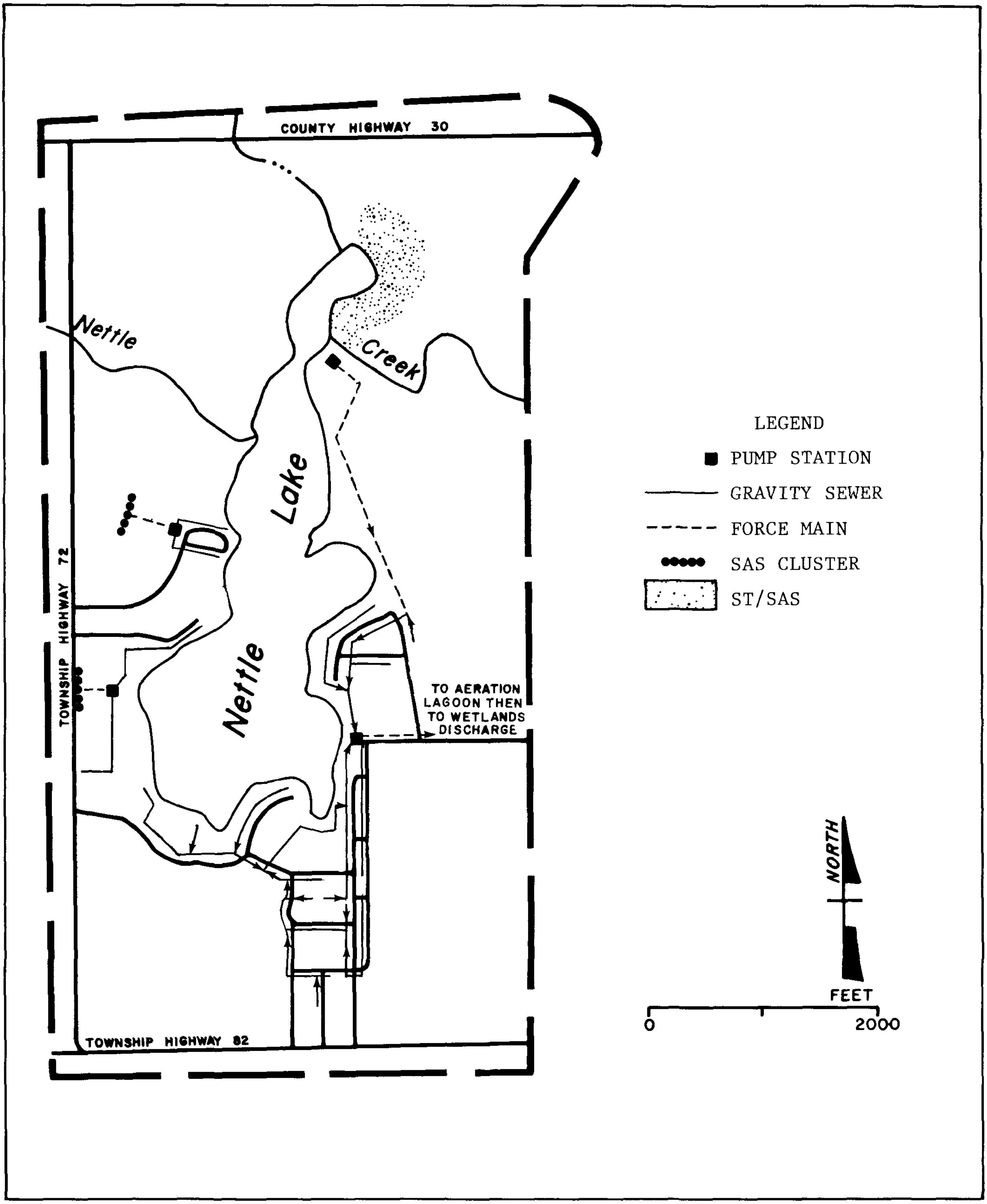


FIGURE IV-5 NETTLE LAKE: EIS ALTERNATIVE 2

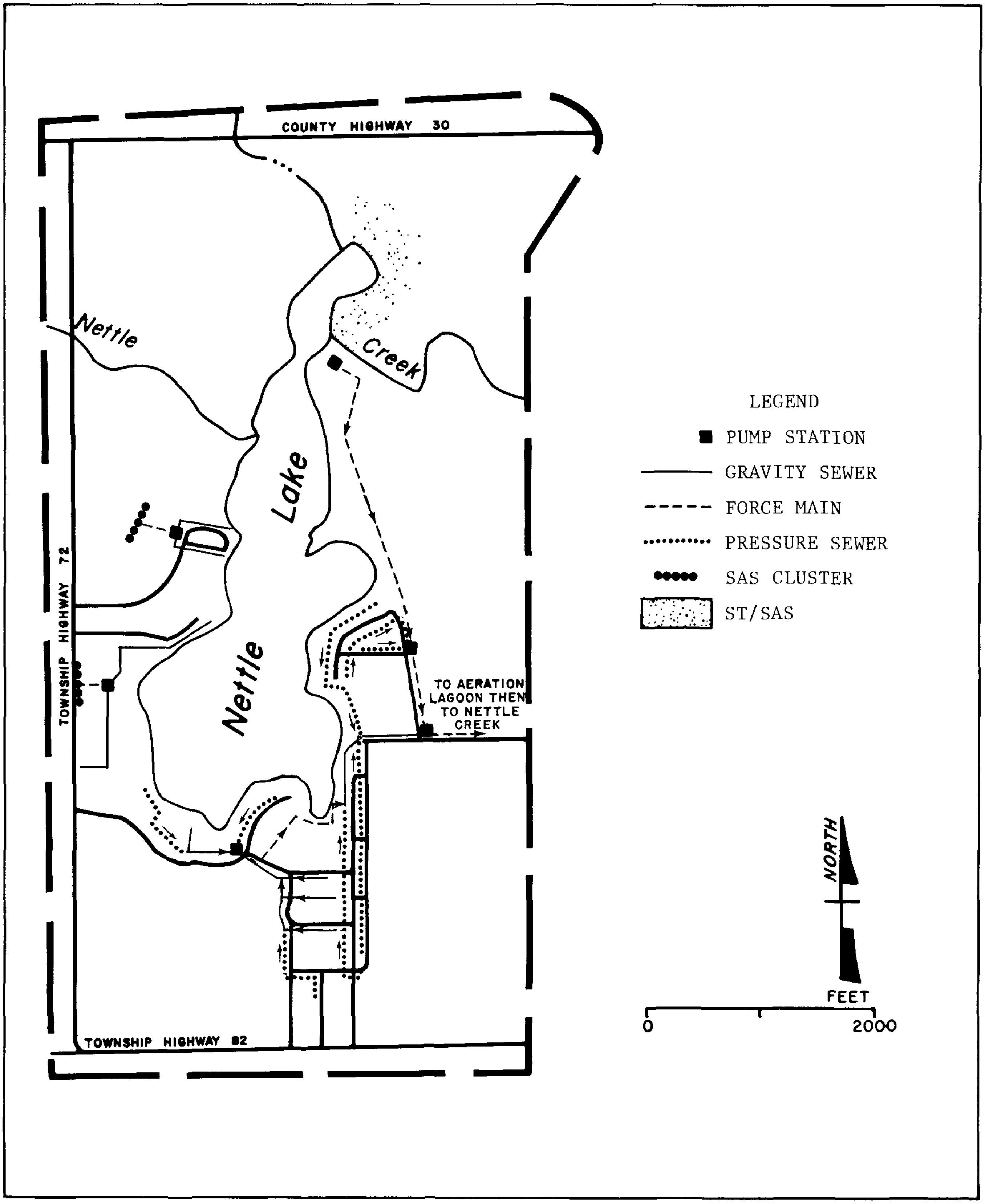


FIGURE IV-6 NETTLE LAKE: EIS ALTERNATIVE 3

6. EIS ALTERNATIVE 4

EIS Alternative 4 would employ the STEP system of pressure collection, with on-site ST/SAS treatment in Segment 6 and two cluster systems in Segment 2. The difference between this and the previous alternative is that, in this alternative treated wastewater would be discharged to wetlands instead of directly to Nettle Creek. This alternative would employ pressure sewers instead of gravity sewers. Figure IV-7 depicts this alternative.

7. EIS ALTERNATIVE 5

EIS Alternative 5 investigated land application as an alternative method of treatment. The only soils near Nettle Lake suitable for land treatment are located southwest of the lake and their characteristics dictate the type of land application that would be appropriate. Since the two basic soils are Spinks sand and Ottokee sand, both of which have a permeability greater than 6 inches per hour, rapid infiltration was selected. Pretreatment for the 0.09 mgd of flow would include preliminary treatment, a stabilization pond, and chlorination. Recovery wells would collect renovated effluent and would discharge to Nettle Creek.

As in previous alternatives, Segment 6 would employ on-site systems and Segment 2, cluster systems. Wastewater would be collected by a combination of gravity sewers and lift stations with force mains. The treatment process is illustrated in Figure IV-8 and the alternative in Figure IV-9.

8. EIS ALTERNATIVE 6

EIS Alternative 6 would provide service to residences in Segment 2 by two cluster systems with drainfields located west of the segment. Cluster systems are examined as a solution in Segment 2 because soils within the residential developments are indicated as being unsuitable for absorption systems, while suitable soils exist within short distances to the west of the developments. All other segments would be served by upgraded on-site ST/SAS systems. In this alternative, all privies would be abandoned, backfilled, and indoor plumbing would be installed. This alternative is illustrated in Figure IV-10.

9. EIS ALTERNATIVE 7

EIS Alternative 7 is based upon on-site disposal for all residences. No central collection or treatment would be provided. A small waste flows agency would be responsible for maintaining, repairing, and/or replacing on-site systems as appropriate.

In Segments 1-5, holding tanks would replace the existing privies. A water supply would be installed, bathrooms constructed, and maximum water-saving devices would be installed in these residences, reducing consumption to 13.4 gpcd. For on-site ST/SAS systems in these segments, it is assumed that 35% of the septic tanks and 20% of the drainfields would require replacement. Half of these drainfields would be replaced by sand mounds and half by dual drainfields. The latter would consist

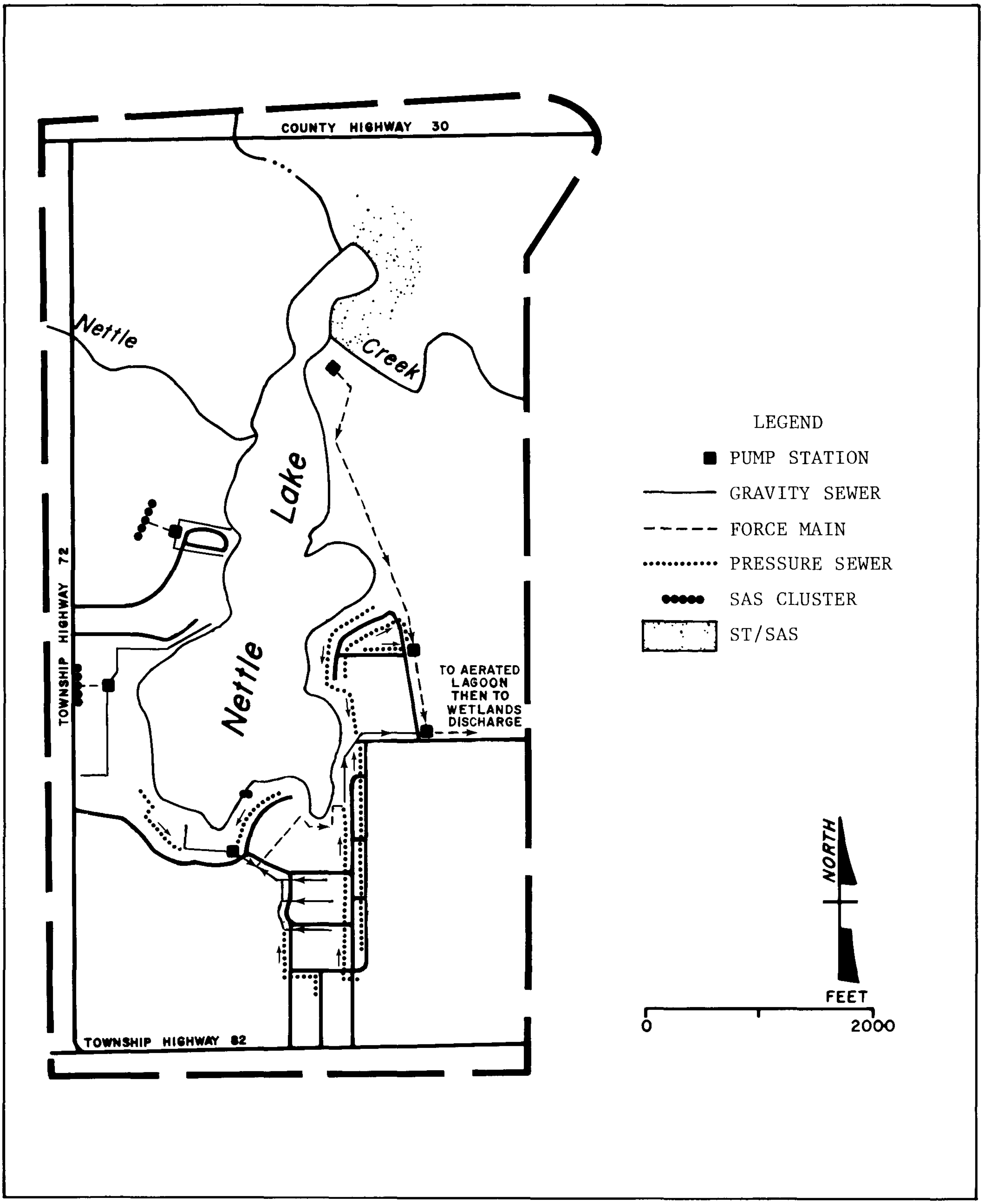


FIGURE IV-7 NETTLE LAKE: EIS ALTERNATIVE 4

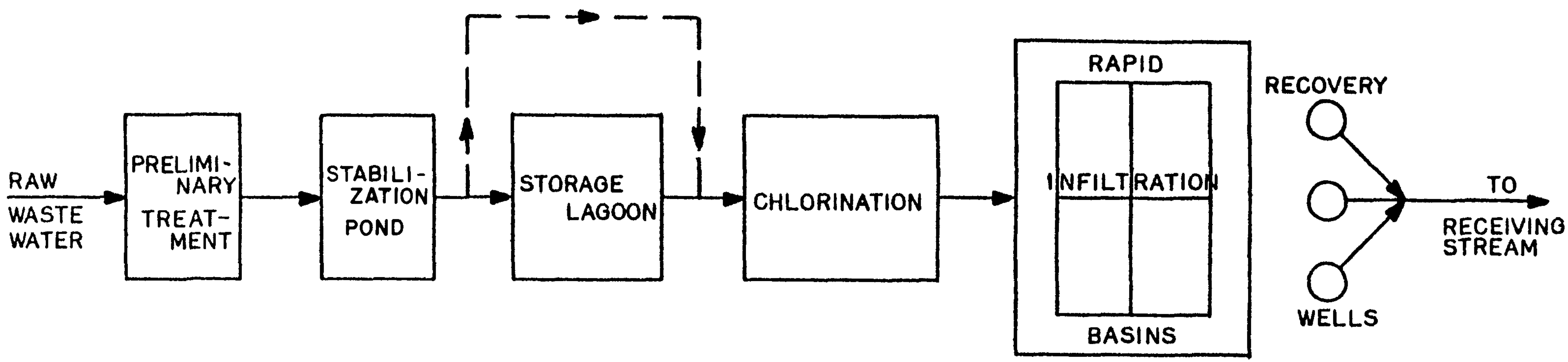


FIGURE IV-8 EIS ALTERNATIVE 5 TREATMENT PROCESSES

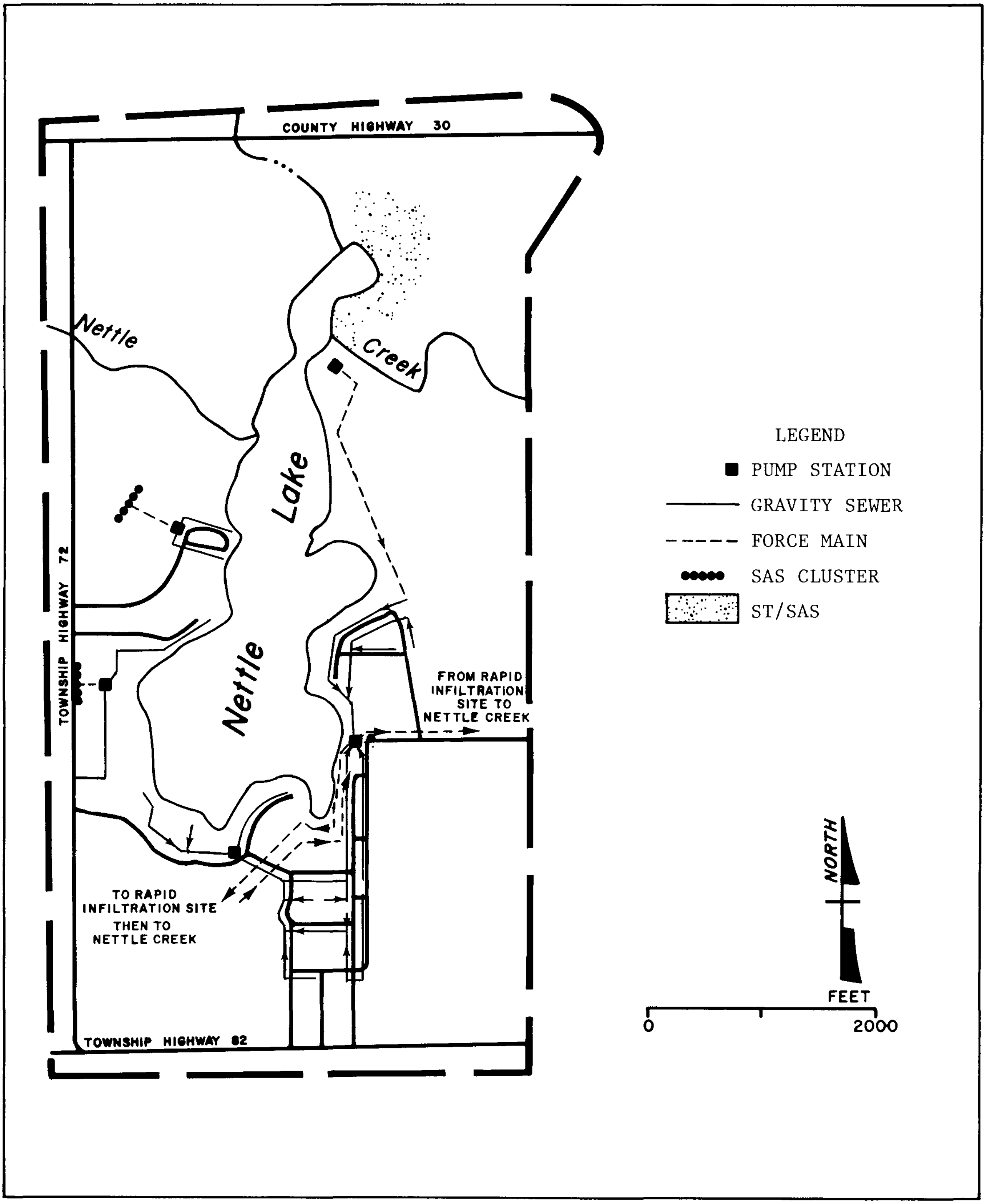


FIGURE IV-9 NETTLE LAKE: EIS ALTERNATIVE 5

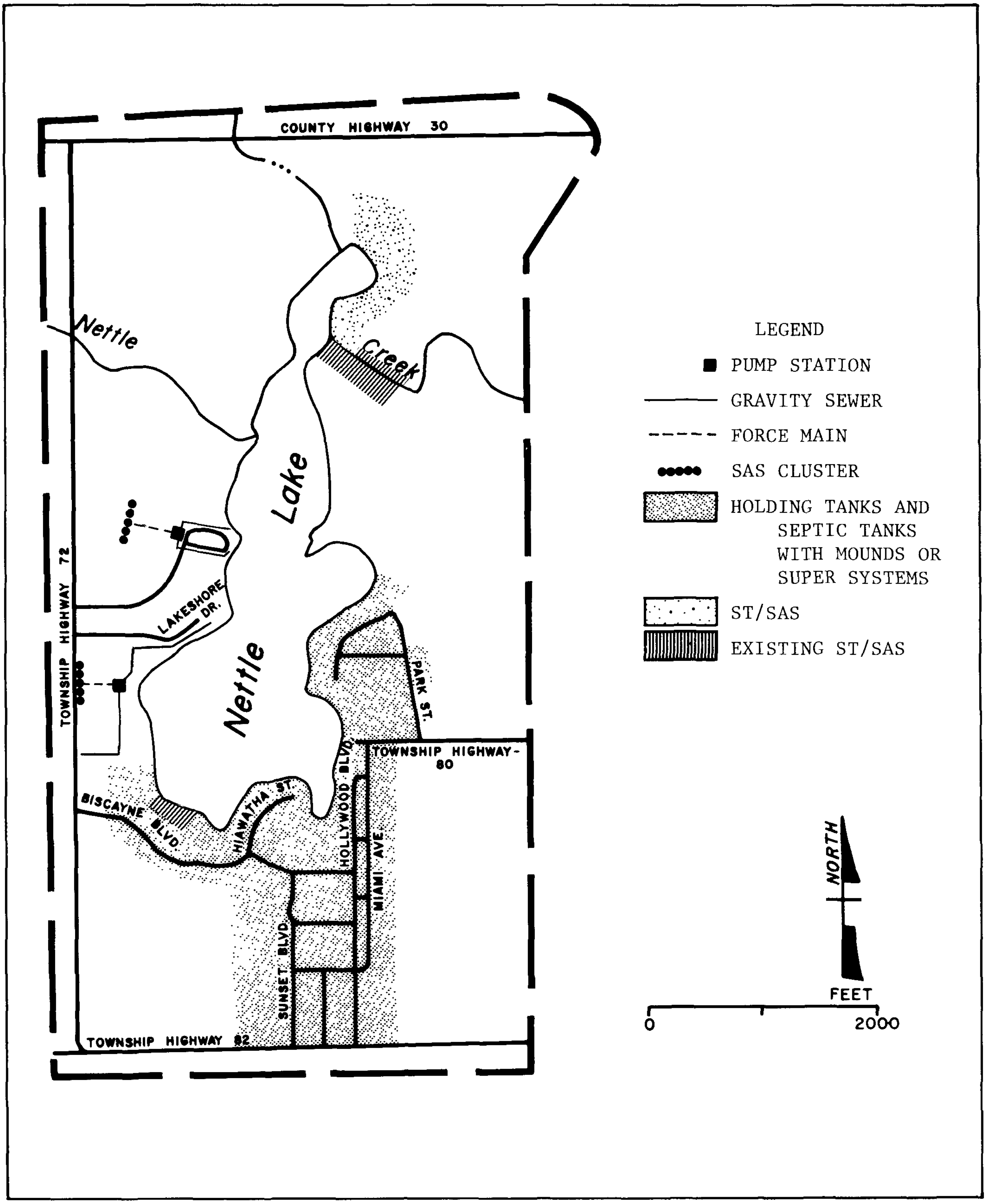


FIGURE IV-10 NETTLE LAKE: EIS ALTERNATIVE 6

of two full-sized drainfields and a valving arrangement, permitting one field to function while the other is inactive.

The large lot sizes and suitable soils permit the existing on-site systems in Segment 6 to continue in use. As in Segments 1 through 5, 35% of the septic tanks and 20% of the drainfields are assumed to require replacement. Conventional drainfields would be used to replace faulty ones in this segment.

In Segments 7 and 8 the existing on-site systems would continue in use. It is assumed that the only costs associated with these systems would be those for ordinary operation and maintenance.

In all segments it was assumed that 10% of the septic systems would require hydrogen peroxide treatment at some time during the planning period. Figure IV-11 illustrates this alternative. A small waste flows agency would be responsible for maintaining, repairing and/or replacing on-site systems as appropriate.

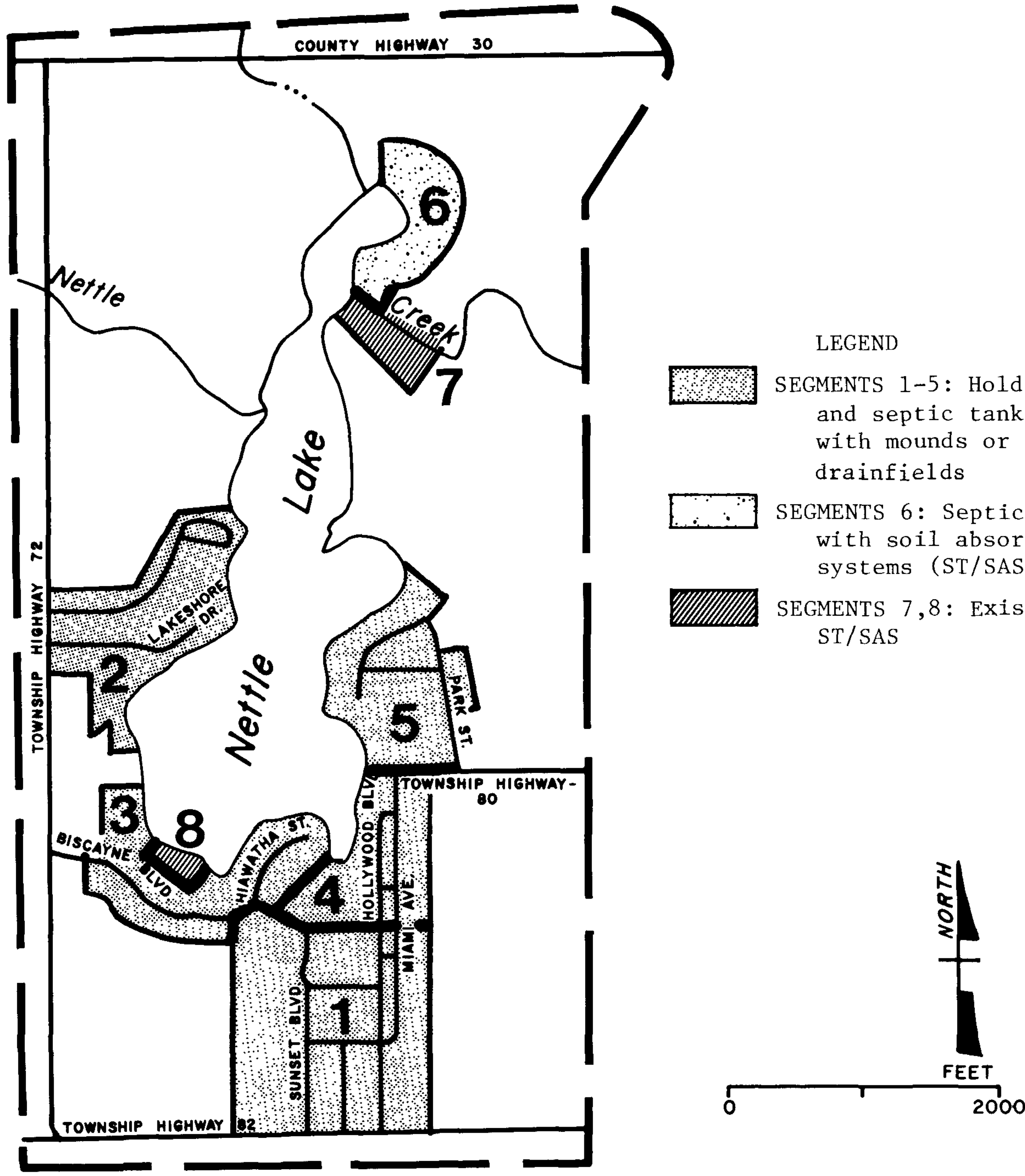
10. EIS ALTERNATIVE 8

EIS Alternative 8 also recommends on-site wastewater treatment for all residences. In segments 1 through 5 all privies would be replaced with different technologies. This EIS estimates that 132 privies exist in the Study Area, and many of them are inundated and washed out annually. In order to address this problem, this alternative recommends abandonment of these privies. The alternative assumes replacement of privies equally with four different forms of technology selected by the homeowner in cooperation with the small waste flows district. The replacement technologies would consist of outdoor vault toilets, air assisted low flush toilets and a holding tank, chemical toilets, and electrical composting toilets. All other segments would upgrade on-site systems as described in Alternative 7.

The small waste flows district would work with the homeowner to select, install, operate, and maintain the technology appropriate to a particular site. Figure IV-12 illustrates this alternative. The small waste flows district would also contract for a septage hauler or would apply for the eligible 85% funding for purchase of a "honey wagon." A post summer pumpout program would probably be initiated for holding tanks and vault toilets. Pumpings would continue to be land-spread on agricultural areas.

C. FLEXIBILITY OF ALTERNATIVES

This section evaluates the flexibility of the Proposed Action and the EIS Alternatives to accommodate future Service Area growth, along with their operational flexibility over the design period. It should be recognized that flexibility for accommodating future growth relies upon certain conditions that are opposed to the accommodation of planning for the future. Specifically, flexibility for future expansion implies a commitment to provide growth and its associated infrastructure. Retaining the flexibility to provide planning for the future implies deferment of any such commitment. Viewed in this context, the No Action Alterna-



LEGEND

SEGMENTS 1-5: Holding and septic tanks with mounds or dual drainfields

SEGMENTS 6: Septic tanks with soil absorption systems (ST/SAS)

SEGMENTS 7,8: Existing ST/SAS

FIGURE IV-11 NETTLE LAKE: EIS ALTERNATIVE 7

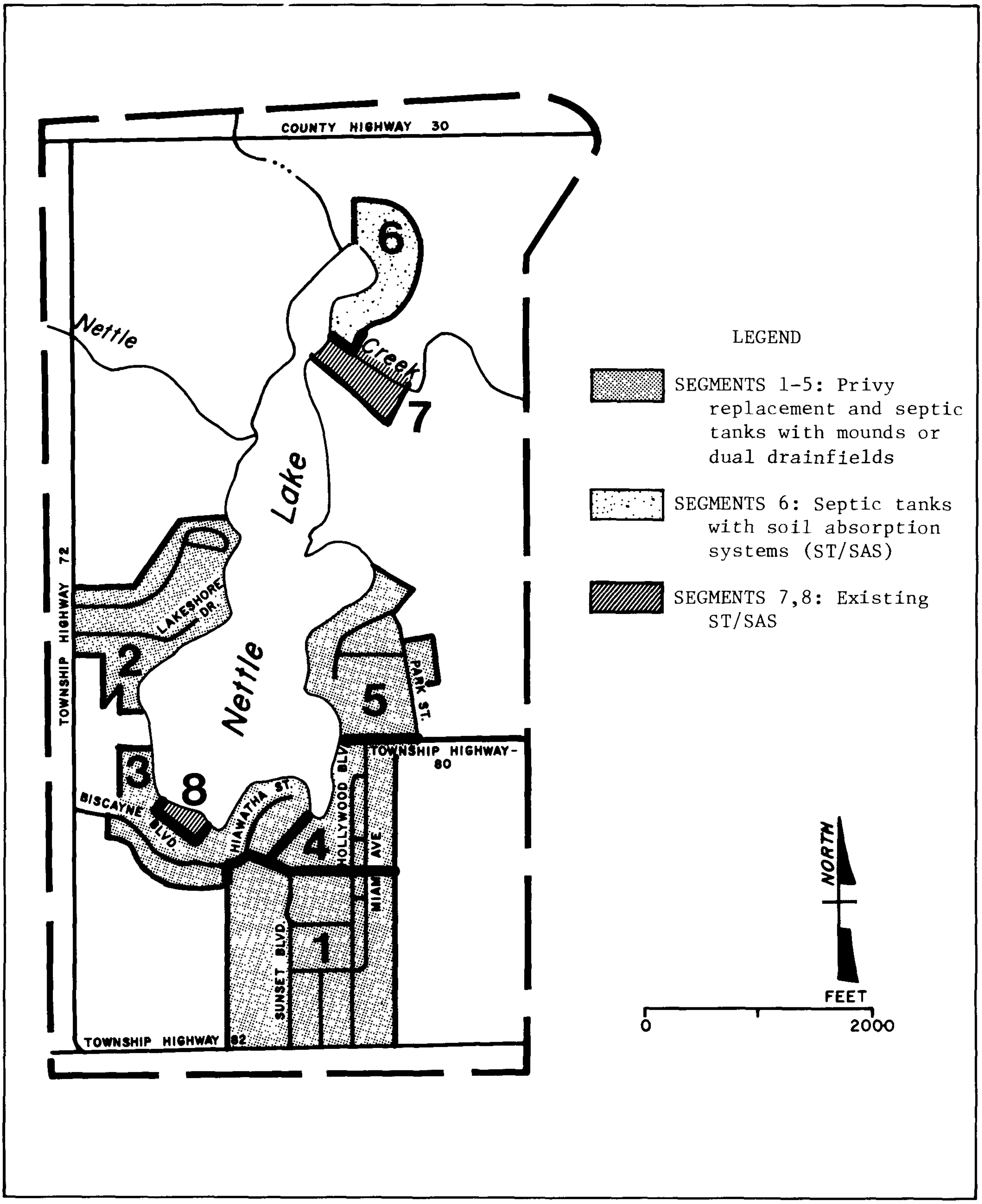


FIGURE IV-12 NETTLE LAKE: EIS ALTERNATIVE 8

tive offers the greatest flexibility for planning for the future and the least flexibility for fu' .re growth. Conversely, the Facility Plan Proposed Action offers the least flexibility for planning for the future and the greatest flexibility for future growth.

1. NO ACTION

By maintaining the status quo, the No-Action Alternative provides the greatest flexibility in planning for the future. Conversely, the flexibility for accommodating future growth is minimal because no action would be taken that would permit progress in that direction.

2. FACILITIES PLAN PROPOSED ACTION

This alternative offers good flexibility for growth; as long as land is available, aerated lagoons can be expanded to accommodate increased flows relatively easily. Flexibility for future growth is, however, reduced somewhat because the entire Proposed Service Area is sewered. Greater flexibility for future expansion is usually available with alternatives that require a smaller initial commitment of resources.

3. EIS ALTERNATIVE 1

Because of the similarity between Alternative 1 and the Facilities Plan Proposed Action, this alternative similarly offers high flexibility in accommodating future growth by employing cluster systems in Segment 2. By retaining septic systems in Segment 6, less growth is possible than would be expected with the Facilities Plan Proposed Action. To this extent, the flexibility in planning for the future has been increased in Alternative 1 relative to the Facilities Plan Proposed Action.

4. EIS ALTERNATIVE 2

EIS Alternatives 1 and 2 are essentially identical differing only in the point of discharge of treated wastewater. Consequently, the flexibilities of the two alternatives are also quite similar. The flexibility of EIS Alternative 2 to accommodate future growth is high, and there is somewhat limited flexibility in planning for the future, though, like Alternative 1, it is greater than that of the Facilities Plan Proposed Action. The changed point of discharge is not expected to appreciably alter these flexibilities.

5. EIS ALTERNATIVE 3

Because EIS Alternative 3 is similar to Alternative 1, differing only in the type of collection system, the flexibilities of the two alternatives are also similar. Ability of the alternative to accommodate future growth depends more upon the layout of the collection system than upon the type of collection. Since the layouts of the two alternatives are virtually identical, the flexibilities of each are comparable.

6. EIS ALTERNATIVE 4

Since the only difference between Alternative 4 and Alternative 3 lies in the point of discharge of treated wastewater, there is no appreciable difference in the flexibilities of the two alternatives.

7. EIS ALTERNATIVE 5

EIS Alternative 5 differs from Alternatives 1 to 4 and the Facilities Plan Proposed Action in the method of wastewater treatment. Where the previous alternatives proposed aerated lagoons for treatment, EIS Alternative 5 would employ rapid infiltration and recovery wells. The use of land application for treatment provides somewhat greater flexibility to accommodate future growth than aerated lagoons. This is because it is easier to expand the capacity of a land treatment facility than to expand an aerated lagoon. Consequently, if pressures for additional growth develop, a land treatment facility can be more easily expanded to meet the pressure. Conversely, this decreases the flexibility to plan for the future. This alternative's flexibility for growth, while higher than those of EIS Alternatives 1 to 4, is lower than that of the Facilities Plan Proposed Action because of the decentralized systems that would serve Segments 2 and 6 in Alternative 5. Its flexibility for future planning is higher only than the Facilities Plan Proposed Action.

8. EIS ALTERNATIVE 6

Because of the similarity between Alternative 6 and Alternatives 7 and 8, this alternative offers high flexibility in planning for the future. By providing cluster systems in Segment 2, the flexibility to accommodate future growth is somewhat greater than for Alternatives 7 and 8.

9. EIS ALTERNATIVES 7 and 8

Alternatives 7 and 8 offer the most decentralized approach of all wastewater management plans evaluated in this EIS and thus the most flexibility for future planning. Lacking centralized collection and treatment facilities for present and future residents, they are the least flexible of all alternatives in terms of accommodating future growth.

D. COSTS OF ALTERNATIVES

Project costs were grouped by capital expenses, operating and maintenance expenses, and salvage values of the equipment for each alternative. A contingency fund amounting to 25% of capital and 20% of salvage value was included to provide for such expenses as engineering and legal fees, acquisition of rights-of-way, and administration. The assumptions used in the analyses are described in Appendix I-1. Detailed costs for each alternative are presented in Appendix I-2.

Table IV-2 summarizes present and future project costs for each of the alternatives. The analyses of total present worth and annual equiv-

Table IV-2

COST-EFFECTIVE ANALYSIS OF ALTERNATIVES

	FACILITIES PLAN PROPOSED ACTION	EIS 1	EIS 2	EIS 3	EIS 4	EIS 5	EIS 6	EIS 7	EIS 8
Present Project Cost (x$1,000)	1,976.6	1,885.7	1,885.2	2,121.2	2,120.7	2,308.0	1,287.3	1,059.2	557.1
Future Project Constuction Costs (x$1,000/yr)	2.2	3.7	3.7	5.5	5.5	3.7	4.3	3.2	3.2
Total Present Worth (x$1,000)	1,842.5	1,904.9	1,896.3	2,339.9	2,331.3	2,334.3	1,599.7	1,394.3	796.5
Average Annual Equivalent Cost (x$1,000)	168.8	174.5	173.7	214.3	213.5	213.8	146.5	127.7	73.0

alent costs of each alternative are also included. (Debt service of financing the local share is not included.) A discussion of Federal and state cost-sharing and remaining local costs is presented in Section V.E.

E. RESOURCES NEEDED TO OPERATE AND MAINTAIN WASTEWATER FACILITIES (By Alternative)

The operation and maintenance (O&M) costs cover the costs of labor, electricity, fuel, chemicals, and materials needed to run wastewater facilities proposed by the alternatives. To enable direct comparison of resources needed to run these facilities, the annual labor, energy, and chemical/material/supply requirements of each alternative have been estimated and are shown in Table IV-3.

The labor required to operate and maintain the sewers and the sewage treatment plant proposed by the Facilities Plan appears to be less than the labor required for alternative facilities. However, note that the labor estimates for the Alternatives 7 and 8 and Alternative 6 are conservatively high because they are based in part on the assumption that 5 hours per system will be spent to monitor septic systems and to pump septic tanks (once per tank per 4 years). Also, note that use of flow reduction devices lowers the labor required to operate the Facilities Plan Proposed Action facilities.

The energy required to collect and to treat area wastewater is less for Alternatives 7 and 8 and Alternatives 5 and 6 than for remaining alternatives. The Alternatives 6, 7, and 8 rely on extensive use of on-site wastewater systems, which generally require less energy to operate than centralized treatment facilities. (Note, however, that the energy requirements shown for these alternatives do not include energy required to haul septage and holding tank wastes to a disposal site.) Similarly, Alternative 5 proposes use of rapid infiltration treatment, a process that requires less energy than the aerated lagoon process proposed by remaining alternatives. As was the case with labor, use of flow reduction devices lowers energy required to operate the Facilities Plan Proposed Action facilities.

Finally, although costs of chemicals, materials, and other supplies appear to be higher for Alternatives 5, 6, 7, and 8 than for remaining alternatives, the costs given for Alternatives 6, 7, and 8 are almost certainly overstated. These alternative costs are for chemicals, materials, and supplies needed to treat holding tank wastes at a treatment plant (probably the Montpelier municipal plant), yet these costs are higher than costs shown for treatment of all area wastewater at a treatment plant. Therefore, these costs should be considered to be rough estimates only.

Table IV-3. Annual Resource Requirements by Alternative

RESOURCE	FPPA*	1	2	3	4	5	6	7&8	FPPA (reduced flow)
LABOR (manhours/yr.)	1,991	2,387	2,379	4,403	4,394	2,635	3,461+	3,573+	1,660
ENERGY● (kwh/yr.)	202,780	141,880	141,880	177,480	177,480	70,079	60,750	69,750	122,862
CHEMICALS, MATERIALS & SUPPLIES° ($/year)	2,421	1,954	1,954	1,954	1,954	3,037	5,350+	6,600+	1,757

* Facility Plan Proposed Action
● Not including energy used for pumping and hauling of septage and holding tank wastes, but including energy used for treatment of these wastes
o Not including materials needed for sewer or pump station maintenance
\+ These figures are conservatively stated

CHAPTER V

IMPACTS

A. IMPACTS ON SURFACE WATER QUALITY

1. PRIMARY IMPACTS

a. Analysis of Eutrophication Potential

This section discusses the effects of the phosphorus loadings associated with the different wastewater management alternatives. The discussion focuses on phosphorus because phosphorus is generally believed to be the aquatic plant nutrient most frequently controlling eutrophication in natural waters (Vollenweider 1968, Lee 1971). Furthermore, the phosphorus input to a water body is usually easier to control than the nitrogen input.

The major sources of phosphorus were identified in Chapter II as:

- tributaries and non-point sources
- privies and septic tanks
- precipitation.

Future Phosphorus Loadings. The relative contributions of the major phosphorus sources to Nettle Lake were shown in Table II-4 for the existing conditions. In this analysis, future phosphorus loading levels are projected to the year 2000 for each alternative. The estimated loads were calculated using the assumptions discussed in Chapter II. Changes in the non-point source load attributable to land use changes were estimated for the Proposed Service Area but were assumed to be constant for the rest of the watershed. The estimated loading levels for the various alternatives, including no action, are shown in Table V-1. Changes in the phosphorus loading of the lake associated with the alternatives are expressed as percentages of the existing loading. The relative contributions of the major sources of phosphorus to the total phosphorus load for each alternative are shown in Figure V-1. The results of this analysis show that the total load to Nettle Lake would be only slightly affected by the wastewater management alternatives. This is because the load from septic tanks and privies is relatively small compared to the load from tributaries and non-point sources. A centralized sewer system for the area would be expected to reduce the phosphorus load to Nettle Lake by about 13%. The Limited Action Alternative and EIS Alternative 1, which would replace privies with holding tanks and upgrade ST/SASs, would reduce the total phosphorus load by 3%. EIS Alternatives 2 through 6 would reduce the phosphorus loading by 9%, while the No Action Alternative would increase it by 2%.

As the discussion of surface water quality in Chapter II indicated, these predictions were based on limited but best available data. However, the estimations of phosphorus loads from Nettle Lake and from on-site systems may be modified by the results of a more extensive sampling program.

TABLE V-1

PHOSPHORUS LOADS FOR WASTEWATER MANAGEMENT ALTERNATIVES IN YEAR 2000

Existing Conditions	kg/yr	$gm/m^2/yr$	Change
Precipitation	6.7	.018	
On-site Systems	103.4	.283	
Tributaries	692.0	1.900	
	802.1	2.200	
Proposed Action			
Precipitation	6.7	.018	
On-site Systems	---	---	
Tributaries	699.0	1.900	
	705.7	1.918	-13%
No Action			
Precipitation	6.7	.018	
On-Site Systems	114.6	.315	
Tributaries	699.0	1.920	
	819.8	2.252	+ 2%
Alternatives 1,2,3,4,5			
Precipitation	6.7	.018	
On-site Systems	20.0	.055	
Tributaries	699.0	1.920	
	725.7	1.993	- 9%
Alternative 6			
Precipitation	6.7	.018	
On-site Systems	72.6	.199	
Tributaries	699.0	1.920	
	777.3	2.137	- 3%
Alternatives 7,8			
Precipitation	6.7	.018	
On-site Systems	70.1	.192	
Tributaries	699.0	1.920	
	775.8	2.130	- 3%

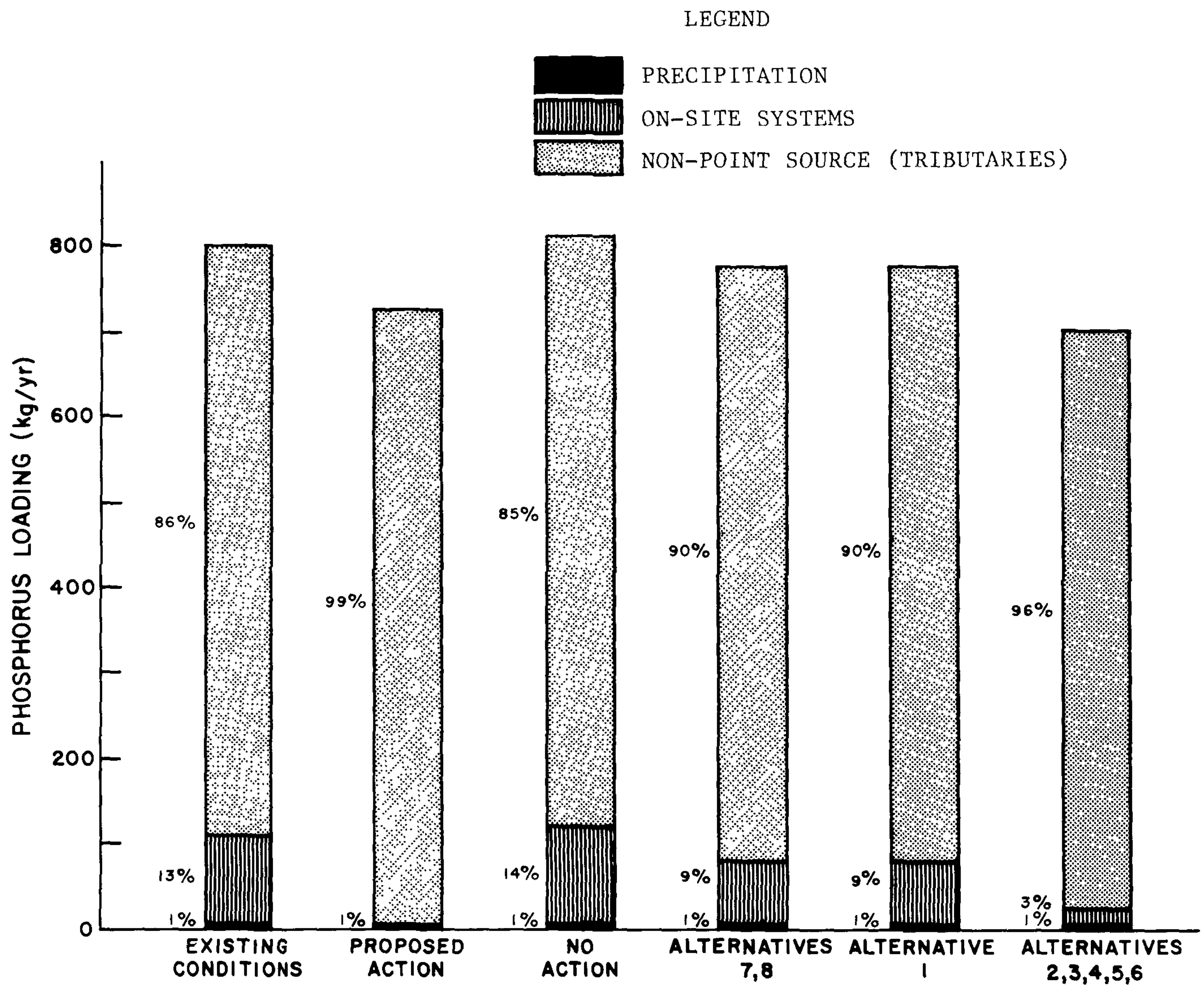


FIGURE V-1 COMPARISON OF PHOSPHORUS LOADINGS BY SOURCE CONTRIBUTIONS FOR EXISTING CONDITIONS, PROPOSED ACTION AND ALTERNATIVES

Future Trophic Conditions. Future trophic conditions will be determined by the in-lake phosphorus concentration, which is a function of the phosphorus load as well as certain physical characteristics of the lake basin that determine retention of phosphorus. The Dillon model (see Appendix A-4) was used to determine the trophic status of Nettle Lake for each alternative. The model results (see Figure V-2) indicate that Nettle Lake will remain eutrophic no matter which wastewater management alternative is implemented. Even if the use of on-site systems were eliminated, the lake would probably remain eutrophic because of the significant non-point source load.

Shoreline Conditions. It is not expected that shoreline algal growth would be significantly affected by any of the wastewater management alternatives. Because of the tight clay soils along the lakeshore, septic leachate does not readily discharge to Nettle Lake. Kerfoot (1978) did not detect any septic leachate plumes along the shore during a 1978 survey. Most of the septic discharges that reach Nettle Lake do so during flooding, when they are dispersed into open water and do not stay close to the shoreline.

b. Bacterial Contamination and Public Health

Data regarding bacterial contamination of Nettle Lake under existing conditions are somewhat inconclusive. Bacterial sampling was conducted in 1976, but only one sample was taken at each station. Ohio Draft Water Quality Regulations require that violations of standards be based on the geometric mean of a minimum of five samples. As stated in section II.C.1.b, human wastes were the likely source of bacterial contamination at one backwater area south of Nettle Lake.

Continued reliance on privies and malfunctioning ST/SASs in flood prone areas (No Action Alternative) could result in bacterial contamination, particularly during spring flooding. However, the potential for bacterial contamination would be minimized by the replacement of pit privies, as proposed. Alternative toilet and on-site treatment technologies would eliminate contamination by exporting the effluent by pump truck prior to spring flooding or by containing it above flood levels. The replacement and upgrading of malfunctioning ST/SASs in flood-prone areas (Limited Action and all EIS Alternatives) would further reduce the potential for bacterial contamination. Although ST/SASs are generally very effective in removing bacteria, operation of these systems can be impeded by flooding, which reduces the zone of aeration and may cause effluent to pond on the surface. By sewering all areas, the Facilities Plan Proposed Action would essentially eliminate the potential for bacterial contamination of the lake by human wastes.

c. Non-Point Source Loads

Temporary increases in soil erosion, and therefore in the non-point source load of sediment and nutrients to Nettle Lake, are likely to occur during construction of a centalized collection system or rehabilitation of on-lot systems. Because of the greater area disturbed and the necessity of traversing drainage ways, the non-point source impacts

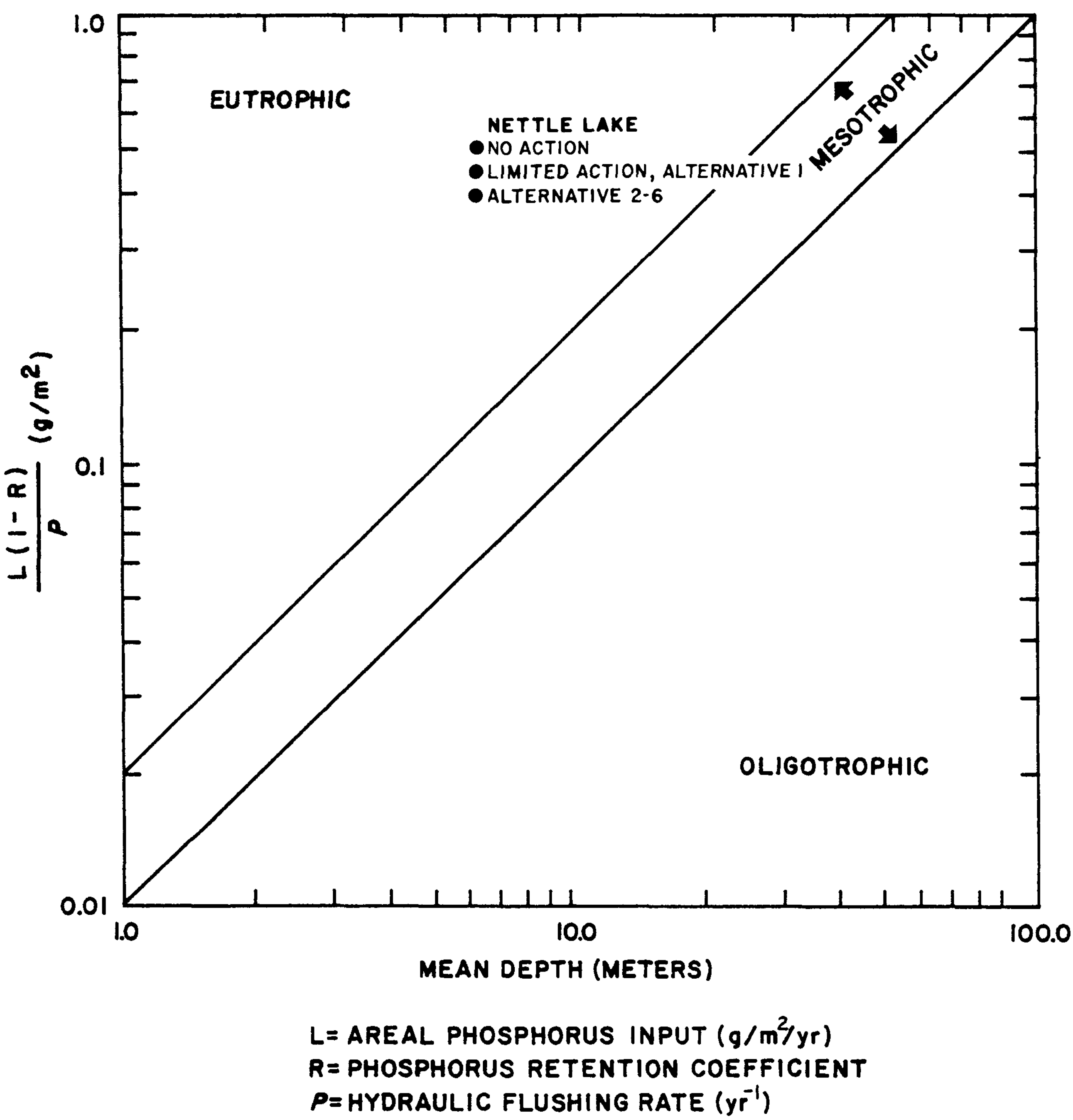


FIGURE V-2 TROPHIC STATUS OF NETTLE LAKE FOR EACH ALTERNATIVE would be much more severe with sewer construction than with the rehabilitation of on-lot systems. These impacts can be minimized by adhering to standards for soil erosion control.

2. SECONDARY IMPACTS

The Proposed Service Area is anticipated to grow very little over the planning period. Growth is particularly limited by the location in the floodplain. As a result, significant increases in non-point source loads from induced growth in the immediate watershed are unlikely. The 20 square mile drainage basin of Nettle Lake is largely agricultural and residential. This accounts for the large non-point load under existing conditions, a situation that will remain relatively unchanged regardless of which wastewater management alternative is implemented in the Proposed Service Area.

3. MITIGATIVE MEASURES

Measures should be taken to ensure compliance with existing Williams County requirements for erosion control (Chapter 1515, ORC: Am. Sub. H.B. 513) during construction, particularly of sewers. Similarly, compliance with the provisions of the Williams County Floodplain Ordinance of 28 March 1978 (pursuant to ORC Sec. 307.37) pertaining generally to sanitary sewerage systems and specifcally to on-site systems must be assured. This ordinance requires that within flood prone areas:

- o New and replacement sanitary sewage systems be designed to minimize or eliminate infiltration of flood waters into the systems and discharges from the systems into flood waters

- o On-site waste disposal systems be located to avoid impairment to them or contamination from them during flooding

- o New structures and substantial improvements to existing structures be elevated or flood-proofed to or above the base flood level.

Non-point, largely agricultural sources of phosphorus are the largest sources of "pollution" in Nettle Lake, and these sources are not directly related to the proposed project. Thus this project would only have a limited effect on reducing phosphorus loads under any of the alternatives. Under the mandate of Section 208 of the Federal Water Pollution Control Act of 1972, Ohio EPA has been directed to address non-point source water quality problems. The initial Water Quality Management Plan, Maumee/ Portage River Basins (Ohio EPA, 1979) states that the Maumee River basin is a priority for agricultural pollution abatement. Programs will be ongoing to implement voluntary approaches to agricultural pollution abatement. Coordination may be made with the USDA Soil Conservation Service District in Bryan.

B. GROUNDWATER IMPACTS

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

1. GROUNDWATER QUANTITY IMPACTS

No significant primary or secondary impacts on groundwater quantity should result from any of the various alternatives. This is mainly because all of the water quantities associated with the alternatives are small, and the thick, impermeable clays that confine the aquifer in the Study Area would essentially prevent vertical recharge in the area.

Generally, the conversion from sewage disposal practices based on individual soil absorption systems to centralized sewage treatment systems without effluent land disposal can result in loss of groundwater recharge. However, the maximum possible wastewater recharge to the Study Area's aquifers in the design year 2000 is estimated to average 0.07 mgd for the No Action Alternative. Assuming that all of this water were to percolate downward to the aquifer(s), its effect would be unnoticeable because of its relatively small magnitude in comparison with the storage and flow through the aquifer(s). The thick, confining clays of the artesian aquifer in the Study Area indicate that recharge of the aquifer takes place outside the Study Area and that essentially no wastewater would reach the aquifer. Hence, none of the alternatives would be expected to have any impacts on groundwater availability.

2. GROUNDWATER QUALITY IMPACTS

No significant short- or long-term impacts on groundwater quality should result from the construction and operation of any of the alternatives. This conclusion is discussed in more detail in the following sections.

Short-term impacts. Construction-related soil erosion releases sediment, which may cause short-term impacts on water quality. However, the clayey soils found throughout the area provide an effective barrier against sediments reaching the aquifers by means of filtration and adsorption. Therefore, no significant impacts of this type are expected from any of the alternatives.

Long-term impacts on groundwater quality are mainly associated with the following three types of pollutants: (1) bacteria, organics, and suspended solids; (2) phosphorus; and (3) nitrogen in the form of nitrates.

Bacteria and suspended organics are readily removed by filtration and adsorption onto soil particles. Five feet of soils are ample to remove bacteria, except in very coarse-grained, highly permeable material. In the Study Area, clayey soils also provide a barrier through which bacteria do not pass, thus preventing groundwater contamination of drinking water supplies.

Land application of treated effluent on soils should not cause bacterial contamination of groundwater. The land application site was chosen for the effectiveness of its soils in removing bacteria and suspended solids. Pretreatment and subsequent die-off due to dehydration will greatly reduce viable bacteria.

Phosphorus in groundwater is important because of its potential role in lake eutrophication. Jones et.al. (1977) reviewed relevant studies on this subject for the Environmental Protection Agency and concluded that:

> ... it is unlikely that under most circumstances, sufficient available phosphate would be transported from septic tank wastewater disposal systems to significantly contribute to the excessive aquatic plant growth problems in water courses recharged by these waters.

Field studies, they pointed out, have shown that most soils, even medium sandy soils, typically remove over 95% of phosphates within short distances from effluent sources. The review shows the two primary factors in the removal of phosphates applied to the land. The first is phosphorus adsorption on small amounts of clay minerals, iron oxide, and aluminum oxide in soil and aquifer materials. The second is calcium carbonate in hard water, which precipitates phosphate as hydroxyapatite.

Jones et al. (1977) have also indicated several studies in areas similar to the Study Area (loamy, clayey soils over glacial moraine and outwash deposits) where the soil has essentially removed all of the phosphorus present in septic tank effluents. They also stated that, in hard water areas, the "likelihood of significant phosphate transport from septic tank wastewater disposal system effluent to the surface waters is greatly reduced because of the calcium carbonate present in the soil and subsoil systems."

Because the soils and subsoil systems throughout the Study Area are mostly clayey and the groundwaters are also very hard (306 mg/l as $CaCO_3$), very little phosphate transport from groundwaters to surface waters should take place. This was confirmed by the "Septic Snooper" survey of groundwater leachate plumes entering Nettle Lake (Kerfoot, 1978). No groundwater plumes were found entering the lake, an indication that the tight clayey soils were containing the septic leachate and effectively preventing its seepage through the ground into the lake.

Groundwater nitrates are of concern at high concentrations. This is because high concentrations can cause methemoglobinemia in infants who consume food prepared with such waters. The National Interim Primary Drinking Water Regulations (40 CFR 141) of the Safe Drinking Water Act (P.L. 93-523) set a limit of 10 mg/l of nitrates as nitrogen (NO_3-N). Since groundwater recharge by downward percolation in the Study Area is essentially blocked by the thick tight clays confining the aquifer, wastewater disposal on land by any means is not expected to have any impact on nitrates or groundwater quality in general. This is true of all the alternative wastewater management systems considered.

3. MITIGATIVE MEASURES

Since no significant impacts of any type on groundwater quantity and quality are expected to result from implementing any of the alternatives, no mitigative measures are necessary.

C. IMPACTS ON POPULATION AND LAND USE

For the purposes of evaluating population and land use impacts, the various wastewater management alternatives considered in this EIS have been combined into three groups. The No Action and Limited Action Alternatives and EIS Alternative 1 represent the fully decentralized alternatives, which would have minimal impacts on population growth and land use development. EIS Alternatives 2, 3, 4, 5, and 6 represent combinations of centralized and decentralized systems. The Facilities Plan Proposed Action represents a fully centralized collection and treatment system, which would have the most significant impact on population and land use. The impacts resulting from each of these three groups are summarized below:

- Because of the limited development pressures for both seasonal and permanent residences in the Nettle Lake area, it is anticipated that the greatest induced population growth would occur under the Facilities Plan Proposed Action and would result in a maximum population increase of approximately 5.0% over the baseline projections.

- Adoption of the No Action Alternative, or EIS Alternatives 6, 7, or 8 would not induce significant population growth beyond the baseline population projections.

- EIS Alternatives 1, 2, 3, 4, and 5 would induce population growth in the Proposed Service Area by 3.0% to 4.0% over the baseline population projections.

- Higher degrees of centralization of wastewater treatment should not significantly affect residential densities. The density of new dwelling units constructed during the planning period is likely to continue at approximately 3 to 4 dwelling units per acre.

- Under the maximum induced population growth level of 5.0% over baseline projections, residential land use would increase by approximately 10 acres over projected baseline conditions. No other major land use conversions are anticipated during the planning period.

- The Facilities Plan Proposed Action and EIS Alternatives 1, 2, 3, 4, and 5 may accelerate the conversion rate of seasonal to year-round dwelling units or change ownership patterns. Because of higher costs associated with the centralized systems, seasonal residents may not wish to bear these costs for only part-time use of their dwellings.

- Community composition and character may be altered somewhat under the centralized wastewater management alternatives. A more affluent population base that can afford the higher costs would be likely to emerge.

1. POPULATION

Throughout many parts of the country, the capacity of an area to support development and population growth varies with the availability and the degree of site-relatedness of wastewater management facilities. On-site wastewater treatment facilities, although generally available to any potential user, limit development to areas with suitable soils and site characteristics. Sewer systems, while not always available at a specific location or with adequate capacity, allow development to be much more site-independent, since soil, slope, and drainage become less constraining site characteristics. Consequently, the introduction of sewers into an area increases the inventory of developable land and the density of development, often unleashing pent-up demand for growth and development.

In the case of the Proposed Service Area, these development pressures are not evident nor are they anticipated during the planning period. As pointed out in Section II-E, the Proposed Service Area is not located in close proximity to employment centers, retail trade and service activities, or other needed amenities. Private recreational developments located north and east of Nettle Lake offer more attractive second home sites that are nearer to the major metropolitan areas. Also, there is a lack of available sites with direct access to the very small lake. As a result, development pressures in the Proposed Service Area are extremely limited and there are no known growth factors that are anticipated to change this trend.

Based on these projected trends, even the introduction of a fully centralized wastewater treatment system, as proposed in the Facilities Plan, would be likely to induce population growth of no more than 5.0% over the baseline population projections. In order to achieve the maximum induced growth, seasonal home development would have to double during the planning period from 20 new units to 40 units, and permanent population growth would have to increase by another 0.25% per year. This would result in a year 2000 population of approximately 1,995 people, or an increase of 4.8% over the baseline projections. EIS Alternatives 1, 2, 3, 4, and 5 could also induce population growth of this magnitude, but are more likely to induce growth in the range of 3.0% to 4.0% over the baseline projections. This slightly lower induced growth rate results primarily from the restrictions imposed by the Williams County Floodplain Ordinance (1978) in regard to the use of on-site treatment systems. The No Action Alternative, and EIS Alternatives 6, 7, and 8 are not likely to induce any significant population growth during the planning period.

2. LAND USE

Residential development, in accordance with the level of induced population growth anticipated, will be relatively small during the planning period. Even under the maximum induced growth of the Facilities Plan Proposed Action, residential land use is expected to increase by only a maximum of ten acres (30 new dwelling units at 3 to 4 dwelling units per acre) over the baseline projections. All of this land would probably be converted from currently platted but vacant residential lots. No conversion of agricultural, recreational, or other undeveloped land would be expected. In a similar manner, EIS Alternatives 1, 2, 3, 4, and 5 would be expected to convert 7 to 8 acres of platted residential lots to residential use, while the decentralized alternatives would induce no significant land use conversion. No major non-residential land use conversions are anticipated to occur, and no change in residential densities are projected to take place under any of the alternatives being considered.

D. ENCROACHMENT ON ENVIRONMENTALLY SENSITIVE AREAS

Threats to environmentally sensitive areas may be categorized as primary or secondary impacts. Primary impacts result in the immediate loss or alteration of an area as a result of construction or operation of a facility. Secondary impacts are long-term changes that result from providing for induced growth.

1. FLOODPLAINS

a. Primary Impacts

Because the flood-prone areas around Nettle Lake are so extensive, construction of wastewater facilities for existing homes in the floodplain is unavoidable with all alternatives. Construction-related impacts could result in a temporary increase in sedimentation to Nettle Lake if the area were flooded during facilities construction. These impacts would be most severe under the Facilities Plan Proposed Action and would occur to a lesser extent for EIS Alternatives 1, 2, 3, 4, and 5. None of the alternatives would increase the probability of flooding.

The County's Floodplain Ordinance, adopted in 1978, requires that sanitary sewers and other facilities be designed to eliminate or minimize infiltration of flood waters. Sewer manholes, septic tanks, and other similar facilities located in flood-prone areas would have to be of water tight or flood-proof construction, in accordance with EPA requirements. Compliance with this ordinance should ensure that no significant long-term primary impacts result from any of the alternatives.

b. Secondary Impacts

None of the alternatives is likely to have a significant secondary impact on flood-prone areas. The constraints of the local floodplain zoning ordinance will actively discourage new building in flood-prone areas. In addition, development pressure is very limited around Nettle Lake since the area is far from employment opportunities and because there are other nearby areas with more attractions for seasonal homes. Furthermore, the very modest induced growth, which would at most require 30 dwelling units (under the Facilities Plan Proposed Action), could be fully accommodated on currently platted but vacant residential lots with a capacity for 630 dwelling units. Additional sewering and related impacts on the floodplain would, therefore, be insignificant.

c. Mitigative Measures

Sewers should not be constructed during the spring months in order to minimize the potential for flood-related impacts. Adherence to the provisions of the Floodplain Ordinance and EPA requirements would also minimize construction-related impacts.

2. STEEP SLOPES

a. Primary Impacts

Most of the area immediately surrounding Nettle Lake is level; therefore, increased erosion and sedimentation resulting from construction of wastewater management facilities on steep slopes would be minimal. Only a small area along Township Highway 80 would be impacted by construction of sewers or on-site systems.

b. Secondary Impacts

Secondary impacts on steep slopes are anticipated to be minimal for all alternatives. Development pressure is low throughout the Study Area and steep slopes are found only occasionally.

c. Mitigative Measures

No mitigative measures are necessary since impacts on steep slopes will be minimal.

3. WETLANDS

a. Primary Impacts

The gravity sewer and force main linking segments 5 and 7 in the Facilities Plan Proposed Action and EIS Alternatives 1, 2, 3, 4, and 5 involves a 1,200-foot crossing of the forested wetland along the east central shoreline of Nettle Lake. No other wetland crossings are proposed in any of the alternatives. In order to construct any alternative in wetland areas, the applicant will be responsible for securing the necessary Section 404 permits from U.S. Army Corps of Engineers.

The impacts of construction of these small-diameter (8" and 4") sewers across the forested wetland would be minimal and very short-lived if the work is scheduled during dry weather, if best construction practices are adopted, and if the surface configuration is carefully restored upon completion. Since the trees in this wetland are widely spaced and there is very little understory vegetation such as small trees, shrubs and herbs, impacts on the natural vegetation are likely to be insignificant. Laying of the small-diameter sewers at the relatively shallow depths of 6 to 7 feet could be undertaken by means of a lightweight back-hoe trencher moving on steel mats. This would avoid the need for building berms and/or roadways that would interrupt and/or change drainage patterns within the wetland. It should be possible to complete the construction of these sewers within 10 days. The effects of dewatering operations on water levels should therefore be very transient and insignificant. Construction of this relatively short length of sewer during dry weather would ensure that sedimentation from erosion of excavation spoils would be minimal. As stated in Section II.D.2.a, the wetland's lack of understory vegetation make it a poor wildlife habitat. The proposed sewer construction would therefore cause no significant impact on wildlife.

EIS Alternatives 2 and 4 involve the application of treated effluent to wet woodlands east of Nettle Lake. This application would be beneficial in polishing the effluent by pH neutralization, and in reduction of nutrients, BOD, COD, organics, and bacteria. The associated increased vegetation may be useful as animal feed, composted fertilizers/soil conditioners, and in enhancing available wildlife habitats (US EPA, 1978).

b. Secondary Impacts

Because development pressure is low, none of the wastewater management alternatives is likely to induce significant growth in wetland areas because of low development pressure. Furthermore, these areas coincide with flood-prone areas where future growth has been restricted by the Floodplain Ordinance 1978.

c. Mitigative Measures

Primary impacts to wetland areas could be minimized by restoring the right-of-way to its original configuration as soon as possible. Construction work should be undertaken during dry weather, making use of construction methods described in the previous section.

4. ENDANGERED SPECIES

a. Primary Impacts

No significant short-term or long-term impacts on endangered species should result from the construction and operation of any of the alternatives.

Upgrading existing on-site systems (Alts 7 and 8) will not destroy any wooded riparian habitat, the habitat type designated as potential nesting areas for the Indiana bat. Alternatives changing riparian habitat would require additional summer biological studies by a qualified researcher to determine if the Indiana bat nests near Nettle Lake. If the species is present, modifications of the project or construction outside the summer season are potential mitigative measures.

The king rail, Rallus elegans and the upland sandpiper, Bartramia longicauda are the only birds classified as endangered by the ODNR (none federally) that are known in the Study Area. No construction is planned for the mud flat nesting and feeding places near the junctions of the creeks and Nettle Lake in any of the alternatives. No significant impact on these species is therefore expected.

The status of the populations of the four species of amphibians and reptiles designated as endangered by the ODNR (none federally)--the four-toed salamander Hemidactylium scutatum, the blue spotted salamander Ambystoma laterale, the northern copperbelly Nerodia erythrogaster neglecta and the spotted turtle Clemmys guttata--is unknown (see Section II.D.3.c). The laying of the gravity sewer and/or forcemain between segments 5 and 7 through the forested wetland east of Nettle Lake (Facility Plan Proposed Action and EIS Alternatives 1 through 5) is the only construction activity likely to have any impact on these species. The impact would be insignificant if the construction method proposed in Section V.C.3.a were adopted.

Neither of the two species of fish designated endangered by the ODNR (none federally) and known in Nettle Lake were taken during the 1974-77 fish surveys (see Section II.D.3.d.). Of the two, the lake chubsucker Erimyzon sucetta and the Iowa darter Etheostoma exile, the latter is more likely to be affected by construction-related sedimentation. Increases in erosion and sedimentation resulting from construction activities in the flat terrain surrounding Nettle Lake are likely to be minimal. Related impacts of all alternatives on the Iowa darter would therefore be expected to be insignificant. There are no stream or lake crossings in any of the alternatives, and therefore no related impacts.

b. Secondary Impacts

None of the alternatives is expected to induce significant growth in any of the likely habitat areas or in any other way significantly affect any of the designated endangered species. Development pressures are insignificantly low. Furthermore, any induced growth is likely to take place in currently unoccupied platted areas.

c. Mitigative Measures

Construction activities in the forested wetland east of Nettle Lake should be limited to the period October to April in order to minimize the potential for impacts on the Indiana bat. Dry-weather construction of the sewer through this wetland would also limit effects on the Iowa darter of erosion and sedimentation from excavation spoils (also see Section V.C.3.a). Mitigation, if needed, would have to be planned in consultation with endangered species authorities.

5. PRIME AGRICULTURAL LANDS

a. Primary Impacts

Although construction of sewers for EIS Alternatives 2, 3, 4, 5, 6, and the Facilities Plan Proposed Action will pass through soils that meet the State's tentative criteria for prime farmland soil units, none of these soils is currently in agricultural production. Most of these designated soils are located in forested wetlands and areas needing artificial drainage in order to become agriculturally productive. Consequently, no primary impacts on prime agricultural lands are anticipated as the result of sewering.

b. Secondary Impacts

As indicated for the other environmentally sensitive areas, growth potential in the Study Area is very low and consequently growth-induced impacts would be minimal. There are no prime farmland soil units within the Proposed Service Area that are currently in agricultural production.

c. Mitigative Measures

No mitigative measures are considered necessary since there are no anticipated impacts to prime agricultural lands.

6. HISTORIC AND ARCHAEOLOGIC RESOURCES

None of the alternatives would in any way impinge upon the Indian burial mounds northwest of Nettle Lake. The Facilities Plan Proposed Action was revised by an addendum to remove the originally proposed sewer past the mounds site along Nettle Creek. No impacts of any type would be expected and no mitigative measures would be necessary.

A Phase I archaeological survey may be necessary before any "build" alternative is undertaken, to ensure that the project does not destroy previously undiscovered cultural resources. US EPA will ensure compliance with historic preservation requirements.

E. ECONOMIC IMPACTS

1. INTRODUCTION

The economic impacts of the proposed wastewater system alternatives proposed for the Nettle Lake area are evaluated in this section. These impacts include: financial burden on system users; financial pressure causing residents to move away from the Study Area (displacement pressure); and financial pressure to convert seasonal residences to full-year residences (conversion pressure).

2. USER CHARGES

User charges are the costs periodically billed to customers of the wastewater system. User charges consist of three parts: debt service (repayment of principal and interest), operation and maintenance costs, and a reserve fund allocation assumed to equal 20% of the debt service amount. The reserve fund is a portion of current revenues invested to accumulate adequate funds to finance future needed capital improvements. Estimated user charges for each alternative are presented in Table V-2.

Table V-2. Estimated Annual User Charges

Alternative	User Charges
Facilities Plan Proposed Action ---------	335
EIS Alternative 1 ----------------------	270
EIS Alternative 2 ----------------------	325
EIS Alternative 3 ----------------------	320
EIS Alternative 4 ----------------------	361
EIS Alternative 5 ----------------------	355
EIS Alternative 6 ----------------------	376
EIS Alternative 7 ----------------------	255
EIS Alternative 8 ----------------------	110

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 and the Clean Water Act of 1977. The 1972 and 1977 Acts enable EPA to fund 75% of total eligible capital costs of conventional systems and 85% of the eligible capital costs of innovative and alternative systems. Innovative and alternative systems considered in the EIS include land treatment, pressure sewers, cluster systems, and septic tank rehabilitation and replacement. The funding formula in Ohio thus requires localities to pay 25% of the capital costs of conventional systems and 15% of the capital costs of innovative/alternative systems. Operation and maintenance costs are not funded by the Federal government and must be paid by the users of the facilities.

The percentage of capital costs eligible for Federal and State funding greatly affects the cost that local users must bear. Treatment capital costs were assumed to be fully eligible for grant funding, while collection system capital costs were subject to the terms of Program Requirements Memorandum (PRM) 78-9 and 79-8. These PRMs establish three main conditions that must be satisfied before collector sewer costs may be declared eligible:

- o 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.
- o Two-thirds of the design population (year 2000) served by a sewer must have been in residence in 18 October 1972.

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

US EPA Region V evaluated the eligibility of the treatment and collection systems proposed in the Facility Plan and the EIS (by letter, Mr. Gene Wojcik, US EPA Region V, to Dr. Ulric Gibson, WAPORA, Inc., 19 November 1979). US EPA's eligibility evaluation concluded that all system components, with the exception of customer sewer hook-up charges and flow reduction devices, are eligible for Federal funding. The annual household user charges presented in Table V-2 and the local share of capital costs presented in Table V-3 are based on the US EPA determination of eligibility.

A final determination of grant eligibility will be prepared by the Ohio Environmental Protection Agency (OEPA). OEPA's determination will be based upon Step 2 plans and specifications for the alternative selected to be funded. The OEPA determination may differ from the US EPA determination in two respects:

- o US EPA did not have detailed plans and specifications for all alternatives upon which to base its computation. Consequently, a detailed sewer-by-sewer determination was impossible.

- o In estimating collector sewer eligibilities, US EPA did not compare the alternatives to one another in regard to cost-effectiveness or to their probable success in satisfying documented public health, groundwater or point source problems. Each alternative was considered on its own merits and on its ability to meet the "two-thirds" rule. Enforcement of the "need" criteria may further reduce the eligibility of the centralized alternatives.

b. Calculation of User Charges

The user charges developed for the Nettle Lake alternative systems consist of local capital costs, operation and maintenance costs, a reserve fund charge, and private (not grant-eligible) costs. The calculation of debt service was based on local costs being paid through the use of a 30-year bond at 6 7/8% interest. The user charges in Table V-2 are presented on an annual charge per household basis.

The estimated annual household user charges range from a low of $110 (EIS Alternative 8) to a high of $376 (EIS Alternative 6). The Facilities Plan Proposed Action has an estimated annual user charge of $335.

All households will not have to pay the same user charge because the private (non-grant eligible) costs will vary considerably from one household to another. For the user charge calculation, these private costs were averaged over all the households. The private costs consist of $1,000 for a gravity sewer hook-up, $1,941 for indoor bathroom construction, $1,124 for a cluster system hook-up, $271 for water saving devices, and $10 for a toilet seat.

TABLE V-3

Total Local Share of Capital Costs
(1979 Dollars)

Alternative	(1) Local Share of Public Costs	(2) Local Share of Private Costs	(3) Total Local Share
Facilities Plan Proposed Action	396,271	540,212	936,483
EIS Alternative 1	126,255	349,504	475,759
EIS Alternative 2	344,200	537,504	881,704
EIS Alternative 3	325,110	537,504	862,614
EIS Alternative 4	289,149	537,504	826,653
EIS Alternative 5	270,059	537,504	807,563
EIS Alternative 6	392,717	537,504	930,221
EIS Alternative 7	90,446	291,984	382,430
EIS Alternative 8	83,568	1,320	84,888

TABLE V-4

Financial Burden And Displacement Pressure

Alternative	Displacement Pressure	Financial Burden
Proposed Alternative	20-25%	30-35%
EIS Alternative #1	15-20%	20-75%
EIS Alternative #2	20-25%	30-35%
EIS Alternative #3	15-20%	25-30%
EIS Alternative #4	20-25%	35-40%
EIS Alternative #5	20-25%	35-40%
EIS Alternative #6	20-25%	40-45%
EIS Alternative #7	15-20%	25-30%
EIS Alternative #8	10-15%	20-25%

In the Proposed Facilities Plan, for example, the annual user charge for a house with a bathroom would be $185 plus the hook-up fee of $80 ($1,000 spread out over 30 years at 6-7/8% interest). For houses without bathrooms, the annual charge would be $185 plus $80 for hook-up plus $155 ($1,941 spread out over 30 years at 6-7/8% interest) or $420 per year. For EIS Alternative 8, the only private cost was toilet seats for houses that use privies because bathrooms were not included in the alternative.

3. LOCAL COST BURDEN

a. Significant Financial Burden

High-cost wastewater facilities may place an excessive financial burden on users of the system. Such burdens may cause families to alter their spending patterns substantially. 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
- 2.5% of median household incomes greater than $10,000.

The 1978 median household income for the permanent residents of Northwest Township service area has been estimated to be $17,500. (No data are available for seasonal resident income characteristics.) According to the Federal criteria, annual user charges should not exceed 2.5% ($437) of the $17,500 median household income figure. Any alternative having annual user charges exceeding $437 is identified as a high-cost alternative and is likely to place a financial burden on users of the system. None of the alternatives would be classified as high-cost according to the Federal criteria.

Significant financial burden is determined by comparing annual user charges with the distribution of household incomes. Families not facing a significant financial burden would be the only families able to afford the annual wastewater system user charges. Table V-4 shows the percentage of households estimated to face a significant financial burden under each of the alternatives. The proportion of families in the proposed service area facing a financial burden ranges from a low of 20-25% (EIS Alternative 8) to a high of 40-45% (EIS Alternative 5).

b. Displacement Pressure

Displacement pressure is the stress placed upon families to move away from the service area as a result of costly user charges. Displacement pressure is measured by determining the percentage of households having annual user charges exceeding 5% of their annual income. The displacement pressure induced by each of the alternatives is listed in Table V-4.

Displacement pressure is lowest under EIS Alternative 8 (10-15%) and highest under the Facilities Plan Proposed Action, as well as EIS Alternatives 2, 4, 5, and 6 (20-25%).

c. Conversion Pressure

In a seasonal home area, the conversion of seasonal to permanent units can be expected to result from: (1) retirement age households permanently relocating to their seasonal residence; (2) local households converting a seasonal residence to a permanent home; and (3) previously seasonal households converting their second home to a permanent residence in an effort to move away from metropolitan areas while retaining access to employment opportunities and other urban amenities. In the proposed Nettle Lake Service Area, the introduction of centralized and/or decentralized wastewater management systems is likely to accelerate conversion by further encouraging the first two of these three factors.

Alternatives providing any form of centralized wastewater management service to the existing seasonal units will make the conversion of such homes by retirement age and local households more attractive by eliminating the problems associated with on-lot systems. A number of conversions are already occurring and are projected to continue to occur during the planning period.

Continued use of septic tank systems may result in the highest increase in the conversion rate. Since there is only a limited amount of developable land available without the provision of centralized or decentralized wastewater management facilities, the demand for permanent units by local households will have to be met largely by existing seasonal units. As the development pressures for new permanent units continue to increase and the existing environmental constraints continue to limit the amount of new residential development, many second home owners may take advantage of the opportunity to profit from the sale of their relatively costly (in terms of amount of use) seasonal residences.

4. MITIGATIVE MEASURES

The significant financial burden and displacement pressure may be mitigated by selection of a lower cost decentralized alternative, or 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 the high costs to seasonal users may be mitigated by not charging for operation and maintenance during the months that seasonal residences are vacant.

F. IMPACT MATRIX

IMPACT CATEGORY	IMPACTED AREA	IMPACT TYPE & DEGREE	IMPACT DESCRIPTION
Surface Water Resources	Nutrient Loading and Eutrophication Potential of Nettle Lake	Primary: Long-term	Facilities Plan Proposed Action: Total phosphorus loading decrease of 12% No Action: Phosphorus loading increase of 2% Alternatives 1, 7, 8: Phosphorus loading decrease of 3% Alternatives 1 - 5: Phosphorus loading decrease of 8%
	Shoreline Algae and Aquatic Weed Growth	Primary: Long-term	All Alternatives: No significant impacts
	Bacterial Contamination	Primary: Long-term	Facilities Plan Proposed Action: Bacterial contamination potential considerably reduced due to replacement of privies and malfunctioning septic tank systems by a centralized collection and treatment system No Action: Potential exists for localized bacterial contamination from privies and malfunctioning ST/SASs particularly during spring flooding Alternatives 1 - 8: Appreciably reducted potential for bacterial contamination due to replacement of privies and malfunctioning ST/SASs
	Non-Point Source Loading of Nettle Lake	Secondary: Long-term	All Alternatives No significant impacts expected since induced growth loadings (partially and fully sewered alternatives) would be miniscule in relation to total loading

NETTLE LAKE (continued)

F. IMPACT MATRIC

IMPACT CATEGORY	IMPACTED AREA	IMPACT TYPE & DEGREE	IMPACT DESCRIPTION
Groundwater Resources	Groundwater Quality	Primary: Short- and Long-Term	All Alternatives: No significant impacts expected since water quantities are miniscule and recharge area of artesian aquifer is outside of Study Area
		Secondary: Long-term	All Alternatives: No significant induced growth related impacts
	Groundwater Quality	Primary: Short- and Long-Term	All Alternatives: No significant recharge through thick confining clay layer and therefore no significant impacts
		Secondary: Long-term	All Alternatives: No significant inudced growth related impacts
Population	Rate of Growth	Secondary: Long-term	Facilities Plan Proposed Action: Growth anticipated by maximum of 5% over baseline projections Alternatives 1 - 5: Growth anticipated to increase by 3 to 4% over baseline projections No Action and Alternatives 1, 7, and 8: No induced action would result
Land Use	Developable Acreage; Growth Patterns	Secondary: Long-term	Facilities Plan Proposed Action: No land use conversions anticipated. Projected induced growth requirement of 10 acres would be met from currently unoccupied platted areas Alternatives 1 - 5: Growth anticipated to increase by 3 to 4% over baseline projections No Action and Alternatives 1, 7, and 8: No induced growth requirements would result

NETTLE LAKE (continued)

F. IMPACT MATRIX

IMPACT CATEGORY	IMPACTED AREA	IMPACT TYPE & DEGREE	IMPACT DESCRIPTION
Environmentally Sensitive Areas	Flood Plains	Primary: Short-term	Facilities Plan Proposed Action, Alternatives 1 - 5: Sewer construction in flood plains may increase sediment loading of the lake particularly during Spring floods No Action and Alternatives 1, 7, and 8: No significant impacts expected from construction of decentralized systems
		Primary: Long-term	All Alternatives Except No Action: Compliance with the Floodplain Ordinance should result in no significant long-term impacts No Action: Existing privies and many ST/SASs do not comply with Floodplain Ordinance and are potential sources of surface wtter pollution during floods
		Secondary: Long-term	All Alternatives: No significant induced growth related impacts
	Steep Slopes	Primary and Secondary	All Alternatives: No significant impacts on the very few steep slopes expected
	Wetlands	Primary: Short-term	Facilities Plan Proposed Action, Alternatives 1 - 5: Construction of 1200 ft of shallow, small diameter sewers in wetlands with little understory vegetation would cause no significant impacts if done during dry months by good construction methods No Action and Alternatives 1, 7, and 8: No significant impacts expected
		Primary: Long-term	Alternatives 2 and 4: Agriculture system would serve as a nutrient sink, enhancing effluent quality and available wildlife habitat
		Secondary: Long-term	All Alternatives: No significant induced growth related impacts

NETTLE LAKE (continued)

F. IMPACT MATRIX

IMPACT CATEGORY	IMPACTED AREA	IMPACT TYPE & DEGREE	IMPACT DESCRIPTION
	Prime Agricultural Land	Primary and Secondary	All Alternatives: No significant impacts expected
	Historical and Archaeological Resources	Primary and Secondary	All Alternatives: No impacts expected on the Indian burial mounds. Additional survey may be necessary prior to construction to ensure against impacts on currently undiscovered cultural resources
	Endangered Species	Primary and Secondary	All Alternatives No significant impacts expected on the endangered mammals, birds, amphibians, reptiles, and fishes identified in the Study Area
Local Economy	Local Cost Burden	Primary: Long-term	Proposed Action Annual user charge would be $335. One time household charge for hookup to the sewer would be approximately $1,000/household Alternative 1, 2, 3 Annual user charge would range from $270-$325. Alternative 4 and 5 Annual user charge would be $361 and $355 respectively Alternative 6 Annual user charge would be $376 Alternative 7 and 8 Annual user charge would be $255 and $110 respectively
	Financial Burden, Displacement Pressure	Primary: Long-term	EIS Alternatives 1, 2, 3, 7, and 8 Displacement pressure is lowest with these alternatives. Displacement pressure will be felt by 10 - 20% of the residents. A financial burden would be felt by 20 - 35% of the residents Facility Plan Proposed Action and Alternatives 4, 5, and 6 Displacement pressure will be felt by 20 - 25% of the residents and the cost may place a financial burden on 30 - 45%

F. IMPACT MATRIX

IMPACT CATEGORY	IMPACTED AREA	IMPACT TYPE & DEGREE	IMPACT DESCRIPTION
Local Economy (cont.)	Conversion Pressure	Primary: Long-term	Alternatives 6, 7, and 8 These alternatives will result in the highest rate of dwelling unit conversion from seasonal to permanent since there is only a limited amount of developable land Facilities Plan and Alternatives 1, 2, 3, 4, and 5 These alternatives will also increase conversion pressure but to a lesser degree

CHAPTER VI

CONCLUSIONS AND RECOMMENDATIONS

A. EVALUATION

Four primary criteria were used in selecting the cost-effective EIS Recommendation: costs, environmental impact, reliability, and flexibility. Within each category several factors were compared; cost factors, for example, included present worth, user charges, and total 1980 private costs. Impacts that US EPA considers to be decisive in selection of an alternative are identified and considered. Alternatives reliability is measured against centralized collection and treatment as the standard.

The relationship between the alternatives and the criteria used to evaluate them are easily visualized in a matrix. A matrix relating alternatives to environmental impacts is presented in Section V.F. Table VI-1 presents a matrix summarizing the relationship between 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:

- o Costs are easily quantifiable, perhaps the least subjective measure of value.

- o US 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 and 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 US EPA has determined to be most important in identifying trade-offs for this project.

B. CONCLUSIONS

Information gathered during the preparation of this EIS has provided the following insights regarding the status of existing systems:

- o Despite the large number of systems in soils with severe limitations for on-site wastewater treatment, the total phosphorus contribution to the lake from these systems accounts for less than 13%.

- o Only one location of ten sampled showed bacterial contamination of surface waters that could be attributable to human sources. This sample was taken in a drainage swale on the lake's south shore and was in violation of State and Federal standards.

Table VI-1. Decision Matrix.

Alternatives	Costs ($) Present Worth (x 1,000)	Costs ($) Annual User Charges	Environmental Impacts: Surface Water Quality	Environmental Impacts: Groundwater Quality	Environmental Impacts: Environmentally Sensitive Areas	Environmental Impacts: Population and Land Use	Socioeconomic Impacts: Financial Burden	Socioeconomic Impacts: Displacement Pressure	Flexibility	Reliability
EIS Alternative 8	796.5	110	• Minimal reduction in nutrient loading of the lake • Non-point sources continue to be the most significant sources of nutrients to the lake • Reduced potential for bacterial contamination • No significant impacts on shoreline algal growth	No significant impact on chemical or bacteriological quality.	• No significant construction impacts expected on floodplains, steep slopes, wetlands, prime agricultural lands, or historical sites • No significant long-term impacts expected in any of the above categories; all facilities must comply with the floodplain zoning ordinance • No secondary impacts expected.	No induced growth or land use impacts	10-15%	20-25%	Highest for future planning, lowest for future growth	Lowest, maximum use of on-site systems implies maximum opportunity for system failure
EIS Alternative 7	1,394.3	255	Same as EIS Alternative 8.	Same as EIS Alternative 8	Same as EIS Alternative 8	Same as EIS Alternative 8.	25-30%	15-20%	Same as EIS Alternative 8	Same as EIS Alternative 8
EIS Alternative 6	1,599.7	376	Same as EIS Alternatives 7 and 8	Same as EIS Alternatives 7 and 8	Same as EIS Alternatives 7 and 8.	Same as EIS Alternatives 7 and 8	40-45%	20-25%	Similar to EIS Alternatives 7 and 8 for future planning, greater for future growth.	Somewhat higher than EIS Alternatives 7 and 8; use of two cluster systems eliminate several potential system failures
Facilities Plan Proposed Action	1,842.5	335	• 12% reduction in nutrient loading of the lake • Non-point sources continue to be the most significant sources of nutrient to the lake • Greatest reduction in the potential for bacterial contamination • No significant impacts on shoreline algal growth	Same as EIS Alternatives 7 and 8.	Sewer construction during dry weather expected to have no significant impacts on forested wetland with little understory vegetation.	No significant impacts -- insignificant induced growth would result in no land use conversions	30-35%	20-25%	Lowest for future planning, highest for future growth	Highest, pumping facilities decrease reliability because of maintenance requirements
EIS Alternative 2	1,896.3	325	Similar to Facilities Plan Proposed Action except for 9% reduction in nutrient loading of the lake	Same as EIS Alternatives 7 and 8.	Same as Facilities Plan Proposed Action; but in addition, agriculture system enhances effluent quality and wildlife habitat.	Similar to Facilities Plan Proposed Action.	30-35%	20-25%	Higher than EIS Alternative 6 and the Facilities Plan Proposed Action for future planning, good but lower than both for future growth.	Slightly less than EIS Alternative 2, discharge to wetlands introduces the possibility of flooding and freezing problems
EIS Alternative 1	1,904.9	270	Same as Alternative 3	Same as EIS Alternatives 7 and 8.	Same as Facilities Plan Proposed Action	Similar to Facilities Plan Proposed Action	15-70%	20-25%	Same as EIS Alternative 3	Somewhat lower than Facilities Plan Proposed Action because of decentralized treatment provided for Segments ' and 6
EIS Alternative 4	2,331.3	361	Same as Alternative 3.	Same as Alternatives 7 and 8	Same as Alternative 3	Similar to Facilities Plan Proposed Action	35-40%	20-25%	Same as EIS Alternative 3	Slightly less than EIS Alternative 4; discharge to wetlands introduces the possibility of flooding and freezing problems
EIS Alternative 5	2,334.[illegible]	355	Same as Alternative 3	Same as Alternatives 7 and 3	Same as Facilities Plan Proposed Action	Similar to Facilities Plan Proposed Action	35-40%	20-25%	Higher only than the Facilities Plan Proposed Action for future planning; second to it for future growth	Same as EIS Alternative 3
EIS Alternative 3	2,339.[illegible]	320	Same as Alternative 3.	Same as Alternatives 7 and 8	Same as Facilities Plan Proposed Action	Similar to Facilities Plan Proposed Action	20-25%	15-20%	Same as EIS Alternative 3	Somewhat less than EIS Alternative 2 because extensive use of grinder pumps introduces an issue of maintenance

- The sanitary survey demonstrated that of the residences examined, 14% indicated having problems with their systems. Survey results suggest that problems with backups, surface ponding of effluent, and privy flooding are common during spring flooding.

- Even though many systems do not meet State of Ohio standards for on-site wastewater design, most are operating satisfactorily.

Most of the on-site systems in use within the Proposed Service Area are poorly maintained and many are inadequately designed based upon criteria established by the State of Ohio for design of on-site systems. Existing on-site systems have not been found to degrade water quality of the whole lake; however, localized water quality impacts may be occurring. Localized impacts of greatest concern are the flooding of on-site systems and privies. Of approximately 132 privies believed to be located within the service area, 90% are located within the 100 year floodplain and many are inundated annually. Effluent from these systems is thus entering the lake on a seasonal basis and presenting a potential public health hazard.

A comparison of the impacts of the various alternatives provides a basis for the following conclusions considered in selecting an alternative. The population in the Proposed Service Area would increase by a maximum of 5% with the most centralized EIS alternatives. The more centralized wastewater treatment systems may allow for higher density development along some shoreline segments.

The surface water quality and trophic status of the lake is not anticipated to change as the result of implementing any wastewater alternative. Limited improvement in Nettle Lake's trophic status will occur with the centralized alternatives because of the small contribution of septic tanks to the total nutrient load. The potential for flooding of on-site systems, nutrient release, and bacterial contamination will exist under EIS Alternative 8; however, a seasonal pump-out program would reduce this to an acceptable level of risk.

Centralized wastewater treatment would eliminate septic tanks as a possible source of groundwater pollution. Improvement in the quality of drinking water aquifers would not result, however, because they are separated from on-site systems by thick containing layers.

EIS Alternative 8 at a cost of $796,500, has a total present worth that is 45% of the Facilities Plan Proposed Action, with a total present worth of $1,842,500. The local share of the capital cost of EIS Alternative 8 is $83,568, or approximately 21% of the $396,271 local cost of the Facilities Plan Proposed Action. The annual user charges are estimated to be $110 and $335 per household, respectively. Table VI-I shows the financial burden and displacement pressure that would result from these alternatives.

In EIS Alternative 8, many technologies were considered for replacement of existing pit privies. The criteria considered for evaluation included capital cost and operation and maintenance cost as well as reliability and applicability to seasonal use. Some of the technologies considered are listed below and compared in Table VI-2.

- o Vault toilets
- o Holding tanks
  - Low-flush toilets
- o Chemical toilets
  - Oil flush toilets
  - Incinerating toilets
  - Compost toilets
- o Electrical composting toilets
- o Air-assisted toilets
- o Selected as viable options for EIS Alternative 8

Vault toilets were selected because their similarity to the existing privies would result in greater public acceptance, and maintenance would be low, requiring only periodic pumping. Holding tanks were selected because only periodic pumping is required to prevent flood water exchange of the contents. Indoor toilets chosen for use with the holding tanks include chemical and air-assisted types because of the small quantities required per flush. Electrical composting toilets were chosen as an example of higher technologies available. The major advantage of the electrical compost toilets is that no pumping is required, which greatly reduces the operation and maintenance costs. Electrical composting toilets do have limitations, such as a hydraulic capacity of 2 or 3 persons' waste and start-up requirements that include adding soil and sawdust. These toilets must also be emptied periodically and the compost incorporated into lawns or flower beds or thrown in the garbage.

Of the technologies not chosen, low-flush toilets require more water than chemical or air-assisted toilets and also require indoor running water. Oil flush toilets were considered too costly and required periodic filter maintenance. Incinerating toilets require 1 KWH of electricity per use plus a wax paper liner per use (approximate cost is 5¢/liner). These costs for operation were considered significant. Large composting toilets are expensive and would possibly be inundated by floods because they require a large amount of basement space below the house floor.

The No Action Alternative is not recommended for the following reasons:

- o There are some problems with on-site systems in the Proposed EIS Service Area that should be addressed through monitoring, improved maintenance of the existing and future systems, residential water conservation, and renovation or replacement of existing systems.

TABLE VI-2

TECHNOLOGIES CONSIDERED FOR PRIVY REPLACEMENT

CRITERIA / TECHNOLOGY	COST	RELIABILITY	MAINTENANCE	MANAGEMENT REQUIRED	ADVANTAGES/ DISADVANTAGES
Vault Toilets	$850 per 1000 g. vault. Building & labor not included	Good	Medium (periodic pumping)	Necessary	• Bldg. construction required • No change in habits req'd • Must be floodproofed or pumped
Holding Tanks	$850 for tank 1000 g.	Good	High (frequent pumping)	Necessary	• Toilet fixtures req'd • Bathrooms req'd
Low-Flush Toilets	~$85 (Est.)	Good	Low	Necessary	• Holding tanks req'd along with: • water supply, and • bathrooms
Nipon Pearl	$600		Medium	Necessary	• Infreq. pumping • Water supply not req'd
Chem Toilets	$722	Fair (user upkeep)	High	Necessary	• Chem. odors • No water supply req'd • Enclosed units available (at higher cost)
Oil Flush Toilets	$5,000 Inclusive	Fair to Poor	Medium to High	Necessary	• Filters may clog and need replacement • No water supply req'd
Incinerating	$1,000 (7/80) 1 kwh/use 5¢/liner/use	Fair to Good	High empty & line bowl	Not Necessary	• Elec. or propane req'd • Self enclosed units available • No water req'd
Compost Toilets	$2,495	Good	Low	Not Necessary	• Hard to floodproof access port below house • No water supply req'd
Elec. Compost	$850 $4/mo. elec.	Fair	Medium	Not Necessary	• Elec. req'd • No water req'd • Max. capacity 2-3 people
Air-Assisted Toilets	$440/toilet $300 compressed	Good	Low	Necessary	• Water supply not req'd • Bathroom construction required

- The level of risk of water quality degradation and bacterial contamination from unmanaged on-site systems, subject to flooding, is unacceptable.

- Improved surveillance and regulation of on-site systems in the Proposed Service Area are justified to maintain the area's recreational values and to protect public health.

Alternatives 7 and 8, as well as the partially decentralized EIS Alternative 6, would require that the problems with on-site systems be corrected through a program for upgrading and repair.

C. DRAFT EIS RECOMMENDATION

The Recommended Action in this EIS is EIS Alternative 8. This Alternative would provide:

- Site-specific environmental and engineering analysis of existing on-site systems throughout the Proposed Service Area during the Step 2 design period;

- Repair and renovation of on-site wastewater treatment systems as needed;

- Replacement of privies with alternative forms of on-site technology; and

- Management of the on-site systems by a Small Waste Flows District.

The recommended action, EIS Alternative 8, will result in only a modest improvement in overall lake water quality, an improvement comparable to that under any of the EIS Alternatives. The recommended action would provide a satisfactory solution to the limited problems defined in the Service Area. It would be cost-effective and would result in no significant adverse impacts upon the environment or the residents of the Study Area.

D. IMPLEMENTATION

If the recommended action were accepted by the applicant and the State and local jurisdictions, it would be equivalent to a revised Facilities Plan Proposed Action. A small waste flows district would need to be established for the operation and management of the proposed on-site systems.

1. COMPLETION OF STEP 1 (FACILITIES PLANNING) REQUIREMENTS FOR THE SMALL WASTE FLOWS DISTRICT

As part of the Step 1 process, and to assure the timely release of Step 2 funds the applicant would need to:

- o Certify that the project will be constructed and an operation and maintenance program established to meet local, State, and Federal requirements including those protecting present or potential underground potable water sources.

- o Obtain assurance (such as an easement or County Ordinance) of unlimited access to each individual system at all reasonable times for such purposes as inspections, monitoring, construction, maintenance, operations, rehabilitation, and replacement. An option would satisfy this requirement if it would be exercised no later than the initiation of construction.

- o Establish a comprehensive program for regulations and inspection of individual systems before EPA approves the plan and specifications. Planning for this comprehensive program would be completed as part of the facilities plan.

2. SCOPE OF STEP 2 FOR THE SMALL WASTE FLOWS DISTRICT

A five step program for wastewater management in small waste flows districts was suggested in Section III.E. The first three would appropriately be completed in Step 2 the design period. These are:

- o Develop a site-specific environmental and engineering data base in a house by house survey;

- o Design the management organization; and

- o Agency start-up.

US EPA will assist the applicant in defining specific objectives and tasks for Step 2 work.

3. COMPLIANCE WITH STATE AND LOCAL STANDARDS IN THE SMALL WASTE FLOWS DISTRICT

As discussed in Section II.F, many existing on-site systems do not conform to current design standards for size, 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 1) infeasible or too expensive and 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 systems 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 are likely to 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, and has 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.

4. OWNERSHIP OF ON-SITE SYSTEMS SERVING SEASONAL RESIDENCES

Construction Grants regulations allow Federal funding for 1) renovation and replacement of publicly owned on-site systems serving permanent or seasonally occupied residences, and 2) 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 upon 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. Under EPA Program Requirements Memorandum 79-8, however, an easement giving the district access to and control of on-site systems would be considered tantamount to public ownership--without an actual transfer of property.

In other states, existing public health and regulatory powers have allowed counties to pass laws or ordinance giving sanitarians or small waste flows districts access to all on-site systems and authority to require repair and upgrading. To a considerable extent, these powers are already exercised by local sanitarians in Ohio. EPA Headquarters has indicated that such a law would be a binding commitment tantamount to public ownership, and that if this were done, no easements at all might be required. Preliminary discussion with the Attorney General's staff suggests that existing police and public health powers are sufficient to allow passage of such a county law. An Attorney General's opinion is being requested.

5. TECHNOLOGY SELECTION

Identification of on-site system problems and the causes of the problems is the first step to be taken to specify technologies for individual residences. A site-specific analysis of each residence is necessary to accomplish this. The analysis should be sequential, beginning with accessing available health department records, interviewing residents on the use and maintenance of their systems, inspecting the site for obvious malfunctions, and inspecting the location and condition of any on-site wells or springs. On the basis of information gathered, additional investigations may be warranted to identify the causes and possible remedies for recognized problems.

In the selection of technologies for individual sites, this EIS strongly recommends that:

- o Alternatives other than those covered by existing codes be considered
- o The availability and cost of skilled manpower for maintaining and monitoring innovative or sub-code systems be weighed against the feasibility and cost of requiring conventional on-site systems or off-site systems
- o There be a multidisciplinary team, consisting of an experienced sanitarian and available specialists in a number of fields, to advise local homeowners on a case-by-case basis
- o The individual homeowner be informed of the different options being considered (and their costs) when technology selections are being made, and that the owners' opinions and advice be solicited.

Using information gained from the site-by-site analysis, a technical expert should discuss with the owners the feasible approaches to solving any problems. Primary criteria for identifying the appropriate technology should be costs, benefits, and risk of failure. Undoubtedly, the analysis will also consider 85% eligibility for Federal Construction Grants funding.

It is recognized that some developed lots may never be serviceable by standard on-site technologies. Off-site treatment and disposal systems then will be eligible for Federal funding if:

- o A public health or water resource contamination problem is documented that no combination of on-site conventional, innovative, sub-code, flow reduction, or waste restriction methods can abate, or
- o The life cycle costs of off-site treatment and disposal for an individual building or group of buildings is less than costs of appropriate on-site technologies for the same buildings.

CHAPTER VII

THE RELATIONSHIP BETWEEN SHORT-TERM USE AND LONG-TERM PRODUCTIVITY

A. SHORT-TERM USE OF THE STUDY AREA

Nettle Lake has been and will continue to be used as a residential/recreational area. Disturbance of the site by routine residential/recreational activities will continue regardless of which alternative is implemented.

B. IMPACT UPON LONG-TERM PRODUCTIVITY

1. COMMITMENT OF NONRENEWABLE RESOURCES

The pressure for development in the Proposed Service Area would increase slightly as the result of implementing the Facility Plan Proposed Action, or the other centralized alternatives. Filling-in development of available shoreline areas would occur to a lesser extent under the Recommended Alternative of this EIS.

Non-renewable resources associated with any of the wastewater treatment scenarios would include concrete and other building materials for construction. Consumption of electric power by pumps would be associated to varying degrees with all actions except the Recommended Alternative of this EIS. Labor would also be committed to the construction, operation and management of new or rehabilitated facilities.

2. LIMITATIONS ON THE BENEFICIAL USE OF THE ENVIRONMENT

The Recommended Action will not have any significant adverse effect on beneficial use of the environment. The implementation of a centralized wastewater management plan may increase the current level of recreational activity slightly through induced near-shore development.

CHAPTER VIII

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

Those resources associated with construction and maintenance of wastewater systems would be committed. These were discussed in Section VI.B.

In addition the growth expected in the Study Area would require a commitment of resources to the construction of new dwellings, construction or improvement of roads, and facilities associated with water sports. Besides construction materials, such as lumber, steel, concrete and glass, electricity and labor would also be committed to new development.

Human resources would include construction personnel and, perhaps public service personnel to service the added community needs.

CHAPTER IX

PROBABLE ADVERSE IMPACTS WHICH CANNOT BE AVOIDED

The Recommended Action would not induce significant development above that projected to accommodate the baseline population. Any new development is anticipated to be in less sensitive areas, avoiding wetlands and floodplains. Construction of upgraded on-site systems would minimally disturb the soil, resulting in only small amounts of sediment runoff. This runoff would cause a minor temporary increase in siltation in both streams and lakeshore areas.

BIBLIOGRAPHY

Allison, D. and H. Hothem, Ohio Department of Natural Resources, Division of Wildlife. June 1975. "An evaluation of the status of fisheries and the status of other selected wild animals in the Maumee River Basin, Ohio." 15 pp. mimeo.

Bailey, J.R., R.J. Benoit, J.L. Dodson, J.M. Robb, and H. Wallman. 1969. A study of flow reduction and treatment of wastewater from households. Cincinnati, OH. US Government Printing Office (GPO).

Clean Water Act of 1977. Public Law 95-217. (33 U.S.C. 466 et seq.)

Cohen, S., and H. Wallman. 1974. Demonstration of waste flow reduction from households. Environmental Protection Agency, National Environmental Research Center, Cincinnati, OH.

Cooper, I.A., and J.W. Rezek. 1977. Septage treatment and disposal. For EPA, Technology Transfer.

Dearth, K.H. 1977. Current costs of conventional approaches. Presented at EPA National Conference of Less Costly Wastewater Treatment Systems for Small Communities, 12-14 April 1977, Reston, VA.

Dillon, P.J. 1975. The application of the phosphorus-loading concept to eutrophication research. Scientific Series No. 46, Canada Center for Inland Waters, Burlington, Ontario, 14 p.

Environmental Monitoring Support Laboratory (EMSL). 1978. Nettle Lake environmental inventory and assessment. EMSL-LV Project RSD 7851. EPA Office of Research and Development. Las Vegas, NV.

Farmland News. 5 September 1978.

Federal Water Pollution Control Act Amendments of 1972, Public Law 92-500.

Floyd G. Browne and Associates, Ltd. 1976. Facilities plan, Nettle Lake area, Williams County, Ohio. Marion OH.

Groszyk, Walter. 1977. Septic tank problem analysis: Impact on groundwater. Information memorandum 77-164. USEPA, Water Planning Division, Washington DC.

Humphrey, S.R., A.R. Richter, and J.B. Cope. 1977. Summer habitat and ecology of the endangered Indiana bat, Myotis sodalis. Journal of Mammalogy, 58:334-346.

Johnson, Gerald and Stanley Keller. 1972. Geologic map, 1° X 2° Fort Wayne Quadrangle Indiana, Michigan, and Ohio, showing unconsolidated deposits and bedrock. Indiana Geological Survey.

Jones, R.A. and G.F. Lee. 1977. Septic tank disposal systems as phosphorus sources for surface waters. EPA-600/3-77-129. Robert S. Kerr Environmental Research Laboratory.

Kaser, Paul and Leonard J. Harstine. 1975. An inventory of Ohio soils, Williams County. Progress Report No. 44. Ohio Department of Natural Resources, Division of Lands and Soils.

Kerfoot, W. 1978. Investigation of septic leachate discharges into Nettle Lake, Ohio. K-V Associates, Inc. Falmouth, MA.

Mazur, Paul. 1976. Water quality data, Nettle Lake. (Unpublished reports). Ohio Department of Health.

Nettle Lake construction grants sanitary survey. Williams County, OH. November 29-December 6, 1978.

NOAA, Environmental Data Service. 1973. Monthly normals of temperature, precipitation, and heating and cooling degree days 1941-1970: Ohio. Climatography of the U.S. No. 81. USDC National Climatic Center, Asheville NC.

NOAA, Environmental Data Service. 1975. Climatological data, Ohio: Annual summary. USDC National Climatic Center, Asheville NC. Vol.80, No. 13.

NOAA, Environmental Data Service. 1976a. Climatological data, Ohio: Annual summary. Vol. 81, No. 13. USDC National Climatic Center, Asheville NC.

NOAA, Environmental Data Service. 1976b. Local climatological data, Toledo OH: Annual summary with comparative data. USDC National Climatic Center, Asheville NC.

NOAA, Environmental Data Service. 1977. Climatological data: Ohio. Vol. 82, No. 8 (Aug.). USDC National Climatic Center, Asheville NC.

ODNR (Ohio Department of Natural Resources), Division of Water. 1965. Ground-water levels in Ohio, October 1959-September 1964. Bulletin 41.

ODNR, Division of Geological Survey. 1977. Publications list.

ODNR, Division of Water. 1962. Ohio hydrologic atlas. Ohio Water Plan Inventory Report No. 13.

OEPA (Ohio Environmental Protection Agency). 1974a. Regulations EP-9-01 and EP-38-01 through EP-38-08. (Mimeo) Columbus OH.

OEPA. 1974b. Water supply, sewerage, and sewage treatment for public buildings in Ohio. Columbus OH.

OEPA. 1975a. Rotating biological disc treatment systems. (Mimeo) Columbus OH.

OEPA. 1975b. Tertiary treatment high rate sand filters. Draft. (Mimeo) Columbus OH.

OEPA. 1976a. Sanitary sewer design and installation guidelines. Part I: Gravity sewers. (Mimeo) Office of Water Pollution Control, Columbus OH.

OEPA. 1976b. Solid waste disposal licenses regulations. OAC-3745-27. Columbus OH.

OEPA. 1976c. Solid waste disposal regulations. OAC-3745-27. Columbus OH.

OEPA. 1976d. Standards, guidelines, and references. (Mimeo) Public Wastewater Engineering Section, Columbus OH.

OEPA. 1977. Final Draft, water quality standards. (Revised.) (Unpublished).

OEPA. Undated. Water quality standards. OAC-3745-1.

Ohio Department of Health and Ohio Water Development Authority. 1971. Engineering report standards and design criteria for small wastewater treatment plants: Contact stabilization, extended aeration, oxidation ditch.

Ohio Department of Health. 1968. General policy in regard to waste stabilization lagoons for domestic wastes, as amended. (Mimeo) Columbus OH.

Ohio Department of Health. 1974. Policy relative to aeration type treatment systems in the Ohio Sanitary Code effective 7/1/74. (Mimeo) Columbus OH.

Ohio Department of Health. 1976a. Approved individual aeration type treatment systems. (Mimeo) Columbus OH.

Ohio Department of Health. 1976b. Duties and responsibilities: Board of Health. Columbus OH.

Ohio Department of Health. 1976c. Evaluation procedures for individual aerobic wastewater treatment plants. (Mimeo) Columbus OH.

Ohio Department of Health. 1977a. Policy relative to special processes or devices used in treating wastewater. (Mimeo) Columbus OH.

Ohio Department of Health. 1977c. Rules: Household sewage disposal systems. Ohio sanitary code, Chapter 3701-29. (Mimeo) Columbus OH.

Ohio Department of Health. Undated. Individual aerobic wastewater treatment plants approved by the Ohio Department of Health. (Mimeo) Columbus OH.

Ohio Division of Lands and Soil. 1974. Soil maps, Williams County, OH.

Ohio State University Cooperative Extension Service. 1976. Ohio guide for land application of sewage sludge. Bulletin 598. Prepared in cooperation with Ohio Agricultural Research and Development Center. Columbus OH.

Omernik, J.M. 1977. Non-point source stream nutrient level relationships: A nationwide survey. EPA-600/3-77-105. National Environmental Research Laboratory, Corvalis, OR.

Otis, R.J. and E.E. Steward. 1976. Alternative wastewater facilities for small unsewered communities in rural America. Annual report to the Upper Great Lakes Region Commission.

Stone, Kenneth L., Jr., and Kenneth L. Powell. 1975. An inventory of Ohio soils: Williams County. Progress Report No. 44. Ohio Department of Natural Resources, Division of Lands and Soil. Columbus, OH.

Subdivision Regulations for Williams County, Ohio as amended 1967.

Sutfin, Charles H. 11 July 1977. US EPA Region III Decision Memo for the Seven Lakes Project to George R. Alexander, Regional Administrator. Chicago, IL.

Troyan, J.J. and D.P. Norris. March 1977. Cost-effectiveness analysis of alternatives for small wastewater treatment systems. For the US Environmental Protection Agency Technology Transfer, Municipal Design Seminar on Small Wastewater Treatment Systems, Seattle, WA.

US Department of Housing and Urban Development. 27 January 1978. Flood hazard boundary map, Williams County, OH.

US EPA (United States Environmental Protection Agency). 1975. Cost-effective comparison of land application and advanced wastewater treatment.

US EPA. 1977a. National interim primary drinking water regulations of the Safe Drinking Water Act. 40 CFR 141.

US EPA. 1977b. Process design manual for land treatment of municipal wastewater. EPA-625/1-77-008. Technology Transfer.

US EPA. 1978a. Construction grants program requirements memorandum 78-9. 3 March 1978.

US EPA. 1978b. Construction grants program requirements memorandum 79-3. 15 November 1978.

US EPA. 1978c. Grants for construction of treatment works-Clean Water Act (40 CFR 35 Part E): Rules and regulations. 43 FR 44022, 27 September 1978.

US EPA. 1978d. Innovative and alternative technology assessment manual. 1978 Draft. Municipal Environmental Research Laboratory, Cincinnati, OH.

US EPA. 1978e. Microbiological methods for monitoring the environment--water and wastes. EPA-600/8-78-017. Environmental Monitoring and Support Laboratory. Cincinnati, OH.

US Geological Survey (USGS). 1952.

US Public Health Service. 1962. Drinking water standards. US Department of Health, Education, and Welfare, Public Health Service Publication No. 956. Washington, DC.

USDA SCS. 1978. Soil survey of Williams County, Ohio.

USDA SCS (Soil Conservation Service). 1977. Proposed rule, prime and unique farmlands: Important farmland inventory. 42 FR 42359, 23 August 1977.

USDA SCS. 1979. List of prime farmland map units in Williams County.

USGS. 1961. Nettle Lake 7.5 minute series topographic quadrangle. (Photo-revised 1973).

USGS. 1970. Climate.

USGS. 1978.

White House Rural Development Initiatives. August 1978. Making water and sewer programs work. Washington, DC.

Williams County Floodplain Ordinance 1978.

Witt, M., R. Siegrist, and W.C. Boyle. 1976. Characteristics of rural household wastewater. Journal of the Environmental Engineering Division, American Society of Civil Engineers, No. EES, Proceedings Paper 12200:533-548.

GLOSSARY

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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 simpler materials, and energy.

ADVANCED WASTE TREATMENT. Wastewater treatment beyond the secondary or biological stage which 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. Alternative waste treatment processes and techniques are proven methods which provide for the reclaiming and reuse of water, productively recycle waste water constituents or otherwise eliminate the discharge of pollutants, or recover energy. Alternative technologies may not be variants 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.

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 plants 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. Those functions that small waste flow districts would be required to perform in order 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.

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 bacteria, 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.

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 for water to flow through a basin. Also called retention time. Or, the time required for natural processes to replace the entire volume of a lake's water, assuming complete mixing.

DETRITUS. (1) The heavier mineral debris moved by natural watercourses (or in wastewater) usually in bed-load form. (2) The sand, grit, and other coarse material removed by differential sedimentation in a relatively short period of detention. (3) Debris from the decomposition of plants and animals.

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 sometimes are due to presence, in inadequately treated wastewater, of high levels of organic compounds.

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.

DRYWELL. A device for small installations, comprising one or more pits extending into porous strata and lined with open-jointed stone, concrete block, precast concrete or similar walls, capped, and provided with a means of access, such as a manhole cover. It serves to introduce into the ground, by seepage, the partly treated effluent of a water-carriage wastewater disposal system.

EFFLUENT. Wastewater or other liquid, partially or completely treated, or in its natural state, flowing out of a reservoir, basin, treatment plant, or industrial plant, or part thereof.

EFFLUENT LIMITED. Any stream segment for which it is known that water quality will meet applicable water quality standards after compliance with effluent discharge standards.

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). Michigan's list includes those species on the Federal list that are resident for any part of their life cycle in Michigan. Also includes indigenous species the State believes are uncommon and in need of study.

ENDECO. Type 2100 Septic Leachate Detector. 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) when a Federal action would significantly affect the quality of the human environment. Used in the decision-making process to evaluate the anticipated effects (impacts) of the proposed action on the human, biological and physical environment.

EPILIMINION. The upper layer of generally warm, circulating water in lakes.

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 high concentration of nutrients and hence a large production of vegetation and frequent die-offs of plants and animals.

EUTROPHIC LAKES. Shallow lakes, weed-choked at the edges and very rich in nutrients. The water is characterized by large quantities 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. In the process, a once oligotrophic lake becomes mesotrophic and then eutrophic.

EVAPOTRANSPIRATION. A process by which water is evaporated and/or transpired from water, soil, and plant surfaces.

FECAL COLIFORM BACTERIA. See Coliform Bacteria.

FLOE. A sheet of floating ice.

FORCE MAIN. Pipe designed to carry wastewater under pressure.

GLACIAL DEPOSIT. A landform of rock, soil, and earth material deposited by a melting glacier. Such material was originally picked up by the glacier and carried along its path; it 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. An area in which the requirements of a specific plant or animal are met.

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 the lakes of temperate and arctic regions.

IGNEOUS. Rock formed by the solidification of magma (hot molten material).

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.

INNOVATIVE TECHNOLOGIES. Technologies whose use has not been widely documented by experience. They may not be variants of conventional biological or physical/chemical treatment but offer promise as methods for conservation of energy or wastewater constituents, or contribute to the elimination of discharge of pollutants.

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 with 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.

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 soil, air, vegetation, bacteria, and/or fungi are employed to remove pollutants from wastewater. In its simplest form, the method includes three steps: (1) pretreatment to screen out large solids; (2) secondary treatment and chlorination; and (3) application to cropland, pasture, or natural vegetation to allow plants and soil microorganisms to remove additional pollutants. Some of the applied wastewater 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.

LIMITING FACTOR. A factor whose absence, or excessive concentration, exerts some restraining influence upon a population of plants, animals or humans.

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, compared to eutrophic waters, having less production of organic matter.

MESOTROPHIC LAKE. Lakes of characteristics intermediate between oligotrophic and eutrophic, with 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 that 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. Surface water runoff is an example as it does not originate from a single source and 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 the growth and development of organisms, especially carbon, oxygen, nitrogen and phosphorus.

OLIGOTROPHIC. Surface waters with good water quality, relatively low concentrations of nutrients, and modest production of vegetation.

OLIGOTROPHIC LAKES. Lakes with highly transparent water of good quality, high DO levels, and modest production of aquatic vegetation.

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 capacity 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. Phosphorus can limit additional algal growth, or if abundant, can stimulate growth of algae.

PHYTOPLANKTON. Floating plants, microsopic in size, that 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 nearly 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 percolate into the soil.

RAPID INFILTRATION BASIN. Unlined wastewater lagoons designed so that all or part of the wastewater percolates into the underlying 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. Used as official classification by some states.

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.

RETENTION TIME. See Detention Time.

ROTATING BIOLOGICAL CONTACTOR (RBC). A device, consisting of plastic disks that rotate alternately through wastewater and air, used for secondary treatment of wastewater.

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. Surface runoff is the water from rainfall, melted snow or irrigation water that flows over the surface of the land. Groundwater runoff, or seepage flow from groundwater, is the water that enters the ground and reappears as surface water. Hydraulic runoff is groundwater runoff plus the surface runoff that flows to stream channels, and represents that part of the precipitation on a drainage basin that is discharged from the basin as streamflow. Runoff can pick up pollutants from the air or the land and carry them to the receiving waters.

SANITARY SEWERS. Sewers that transport only domestic or commercial sewage. Storm water runoff is carried in a separate system. See sewer.

SANITARY SURVEY. (1) A study of conditions related to the collection, treatment, and disposal of liquid, solid, or airborne wastes to determine the potential hazards contributed from these sources to the environment. (2) A study of the effect of wastewater discharges on sources of water supply, on bathing or other recreational waters, on shellfish culture, and other related environments.

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. The second stage in the treatment of wastewater in which bacteria are utilized to decompose the organic matter in sewage. This step is accomplished by using such processes as a trickling filter or activated slugde. Effective secondary treatment processes remove virtually all floating solids and settleable solids as well as 90% of BOD and suspended solids. Disinfection of the effluent by chlorination customarily is the last step in this process.

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 flucrescence 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 collects and conducts 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 a pattern of occurrence of soil types in a geographic area.

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 assessed valuation upward to approximate true market value. In this way it is possible to relate debt burden to the full value of taxable property in each community within that State.

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, or periods of mixing, occur in the spring and autumn. Stratification is most common in middle latitudes and is related to weather conditions, basin morphology, and altitude.

STUB FEE. See Connection Fee.

SUBSTRATE. (1) The surface on which organisms may live; generally the soil, the bottom of the ocean, of a lake, a stream, or other body of water, or the face of a rock, piling, or other natural or man-made structure. (2) The substances used by organisms in liquid suspension. (3) The liquor in which activated sludge or other matter is kept in suspension.

SUCCESSION. A gradual sequence of changes or phases in vegetation (or animals) over a period of time, even if the climate remains unaltered; hence plant succession. This will proceed until some situation of equilibrium is attained, and a climax community is established.

SUPPLEMENTAL USAGE. Those functions that small waste flow districts are not required to perform in order to comply with EPA Construction Grants regulations governing individual, on-site wastewater systems. These functions may, however, be necessary to achieve administrative or environmental objectives.

SUSPENDED SOLIDS (SS). Undissolved particles that are suspended in water, wastewater or other liquid, and that contribute to turbidity. The examination of suspended solids plus the BOD test constitute the two main determinations for water quality performed at wastewater treatment facilities.

TERTIARY 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 manmade features.

TRICKLING FILTER PROCESS. A method of secondary wastewater treatment in which biological growth is attached to a fixed medium, such as a bed of rocks, over which wastewater is sprayed. The filter organisms biochemically oxidize the complex organic matter in the wastewater to simpler materials 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.

TURBIDITY. (1) A condition in water or wastewater caused by the presence of suspended matter, resulting in the scattering and absorption of light rays. (2) A measure of fine suspended matter in liquids. (3) An analytical quantity usually reported in arbitrary turbidity units determined by measurements of light diffraction.

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. This level varies seasonally with the amount of percolation. Where it intersects the ground surface, springs, seepages, marshes or lakes may occur. Also known as the groundwater level.

WATERSHED. The land area drained by a stream, or by an entire river system.

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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APPENDIX A

SURFACE WATER

OEPA Permit No. G746*BD

Application No. OH0053376

Effective Date: September 26, 1978

Expiration Date: September 25, 1983

OHIO ENVIRONMENTAL PROTECTION AGENCY

AUTHORIZATION TO DISCHARGE UNDER THE

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM

In compliance with the provisions of the Federal Water Pollution Control Act, as amended (33 U.S.C. 1251 et. seq. hereinafter referred to as "the Act"), and the Ohio Water Pollution Control Act (Ohio Revised Code Section 6111),

Board of County Commissioners
Williams County
Nettle Lake Area

is authorized by the Ohio Environmental Protection Agency, hereafter referred to as "Ohio EPA", to discharge from the proposed wastewater treatment works to be located

near Nettle Lake, Northwest Township, Williams County, Ohio

and discharging to Nettle Creek

in accordance with the conditions specified in Parts I, II and III of this permit.

This permit and the authorization to discharge shall expire at midnight on the expiration date shown above. In order to receive authorization to discharge beyond the above date of expiration, the permittee shall submit such information and forms as are required by the Ohio EPA no later than 180 days prior to the above date of expiration.

Ned E. Williams

Ned E. Williams, P.E.
Director

OEPA-NPDES-48

C. SCHEDULE OF COMPLIANCE.

The permittee shall achieve compliance with specified effluent limitations in accordance with the following schedule:

1. N/A

2. N/A

3. Submit an approvable Step II Grant Application, as defined by 40CFR 35.920-3(b), within 2 months after written notification from the Ohio EPA of the availability of Federal funds for the specified treatment works or treatment works segment, as defined in 40CFR 35.905-23 and 35.905-24, respectively.

4. Submit approvable detail plans and specifications to the State not later than the final date stipulated in the payment schedule specified in the Step II Grant Agreement(s) or amended Grant Agreement(s).

5. Submit an approvable Step III Grant Application, as defined by 40CFR 35.920-3(c), within 2 months after written notification from the Ohio EPA of the availability of Federal funds for the specified treatment works or treatment works segment, as defined in 40CFR 35.905-23 and 35.905-24, respectively.

6. Commence construction as soon as possible after award of a Step III Grant but, in any event, not later than one year from the date of the grant award unless the Regional Administrator has approved an extension in accordance with 40CFR 35.935-9.

7. Notify the appropriate Ohio EPA District Office within 7 days of the initiation of construction of the treatment works or treatment works segment.

8. Notify the appropriate Ohio EPA District Office within 7 days completion of construction of the treatment works or treatment works segment.

9. Attain operational level of the constructed treatment works or treatment works segment(s) not later than the final date stipulated in the payment schedule specified in the Step III Grant Agreement(s) or amended Grant Agreement(s).

10. Notify the appropriate Ohio EPA District Office within 7 days after attaining operational level of the constructed treatment works or treatment works segment(s).

11. Comply with final effluent limitations upon the attainment of operational level of the treatment works required by the approved facility plan for achieving such limitations. The attainment of operational levels shall be in accordance with the implementation schedule of the approved facility plan, or as the schedule is amended by Grant Agreements, amended Grant Agreements, or Special Grant Conditions.

Failure to execute a grant Agreement within the time specified by U.S. EPA shall constitute a violation of this schedule of compliance.

In cases where there are a sufficient number of municipalities in a planning area to warrant the designation of a lead applicant, it shall be the responsibility of all entities to designate a mutually acceptable lead applicant after written notification of the availability of funds. Failure to reach timely agreement on a lead applicant can result in the modification of this schedule of compliance to a schedule which is not contingent on the receipt of Federal Funds.

All grant applications, plans and reports required by the above schedule shall be submitted to the appropriate Ohio EPA District Office.

If the time necessary for completion of an interim requirement (any item in the schedule) is more than 9 months, Federal Regulations stipulate that interim dates shall be specified for the submission of reports on the progress towards completion of the interim requirement. When appropriate, interim progress reports shall be submitted. These reports may accompany grant payment requests.

SEE PART III, "NONCOMPLIANCE NOTIFICATION".

PART I, A - FINAL EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

1. During the period beginning on attainment of operational level and lasting until the expiration date, the permittee is authorized to discharge in accordance with the following limitations and monitoring requirements from the following outfalls: G746001. SEE PART II, OTHER REQUIREMENTS, for location of effluent sampling.

EFFLUENT CHARACTERISTIC			DISCHARGE LIMITATIONS				MONITORING REQUIREMENTS	
			Concentration Other Units (Specify)		Loading* kg/day			
REPORTING Code	UNITS	PARAMETER	30 day	7 day	30 day	7 day	Meas. Freq.	Sample Type
50050	MGD	Flow	-	-	-	-	Daily	Continuous
00010	Deg. Cent.	Temperature	-	-	-	-	Daily	Max. Ind. Thermometer
00530	mg/l	Suspended Solids	12	18	6	9	1/week	8 hr. Comp.
00310	mg/l	BOD_5	10	15	5	7	1/week	8 hr. Comp.
31616	Count /100ml	Fecal Coliform	1000	2000	-	-	1/week	Grab

2. The pH (Reporting Code 00400) shall not be less than 6.5 S.U. nor greater than 9.0 S.U. and shall be monitored daily by grab sample

3. The Chlorine Residual (Reporting Code 50060) shall be maintained at a level not to exceed 0.5 mg/l and monitored daily by grab sample.

4. The Dissolved Oxygen (Reporting Code 00300) shall be monitored daily by grab sample.

5. See PART II, OTHER REQUIREMENTS.

* The average effluent loading limitations are established using the following flow value: 0.125 MGD

PART I, B. - ADDITIONAL MONITORING REQUIREMENTS (con't)

1. Influent Monitoring. The permittee shall monitor the treatment work's influent wastewater at Station Number G746601 and report to the Ohio EPA in accordance with the following table. Samples of influent used for determination of net values or percent removal must be taken the same day as those samples of effluent used for that determination. SEE PART II, OTHER REQUIREMENTS, for location of influent sampling.

EFFLUENT CHARACTERISTIC			MONITORING REQUIREMENTS	
REPORTING Code	UNITS	PARAMETER	Measurement Frequency	Sample Type
00530	mg/l	Suspended Solids	1/week	8 hr. Comp.
00310	mg/l	BOD_5	1/week	8 hr. Comp.
00400	S.U.	pH	Daily	Grab
00010	Deg. Cent.	Temperature	Daily	Max. Ind. Thermometer

PART II, OTHER REQUIREMENTS

A. The wastewater treatment works must be under supervision of a State certified operator as required by Rule 3745-7-02 of the Ohio Administration Code (formerly OEPA Regulation EP-06-02/Ohio Sanitary Code Regulation HE-37-02) for a Class I Operator.

B. Description of the location of the required sampling stations are as follows:

Sampling Station	Description of Location
G746001	Effluent Pipe
G746601	Influent Pipe

C. All parameters, except flow, need not be monitored on days when the plant is not normally staffed (Saturdays, Sundays, and Holidays). On those days report "AN" on the monthly report forms.

D. Composite samples shall be comprised of at least 5 grab samples proportionate in volume to the sewage flow rate at the time of sampling and collected at 2 hour, intervals during the period that the plant is staffed on each day for sampling.

E. Grab samples shall be collected at such times and locations, and in such fashion, as to be representative of the monitored flow.

1. DEFINITIONS

A. 1. The "daily load limitations" is the total discharge by weight during any calendar day. If only one sample is taken during a day, the weight of pollutant discharge calculated from it is the daily load.

2. The "daily concentration limitation" means the arithmetic average (weighted by flow) of all the determinations of concentration made during the day. If only one sample is taken during the day its concentration is the daily concentration. Coliform bacteria limitations compliance shall be determined using the geometric mean.

3. The "7-day load limitation" is the total discharge by weight during any 7-day period divided by the number of days in that 7-day period that the facility was in operation. If only one sample is taken in a 7-day period the weight of pollutant discharge calculated from it is the 7-day load. If more than one sample is taken during the 7-day period the 7-day load is calculated by determining the daily load for each day sampled, totaling the daily loads for the 7-day period and dividing by the number of days sampled.

4. The "7-day concentration limitation" means the arithmetic average (weighted by flow) of all the determinations of daily concentration limitation made during the 7-day period. If only one sample is taken during the 7-day period, its concentration is the 7-day concentration limitation for that 7-day period. Coliform bacteria limitations compliance shall be determined using the geometric mean.

5. The "30-day load limitation" is the total discharge by weight during any 30-day period divided by the number of days in the 30-day period that the facility was in operation. If only one sample is taken in a 30-day period the weight of pollutant discharge calculated from it is the 30-day load. If more than one sample is taken during one 30-day period the 30-day load is calculated by determining the daily load for each day sampled, totaling the daily loads for the 30-day period and dividing by the number of days sampled.

6. The "30-day concentration limitation" means the arithmetic average (weighted by flow) of all the determinations of daily concentration made during the 30-dry period. If only one sample is taken during the 30-day period, its concentration is the 30-day concentration for that 30-day period. Coliform bacteria limitations compliance shall be determined using the geometric mean.

7. "Weighted by flow" means the summation of each sample concentration times its respective flow in convenient units divided by the summation of the respective flows.

B. "85 percent removal limitations" means the arithmetic mean of the values for effluent samples collected in a period of 30 consecutive days shall not exceed 15 percent of the arithmetic mean of the values for influent samples collected at approximately the same times during the same period.

C. 1. Absolute Limitations. Compliance with limitations having descriptions of "shall not be less than", "nor greater than", "shall not exceed", "minimum", or "maximum", shall be determined from any single value for effluent samples and/or measurements collected.

2. "Net concentration" shall mean the difference between the concentration of a given substance in a sample taken of the discharge and the concentration of the same substances in a sample taken at the intake which supplies water to the given process. For the purposes of this definition samples that are taken to determine the net concentration shall always be 24-hour composite samples made up of at least six increments taken at regular intervals throughout the plant day.

3. "Net load" shall mean the difference between the load of a given substance as calculated from a sample taken of the discharge and the load of the same substance in a sample taken at the intake which supplies water to given process. For purposes of this definition samples that are taken to determine the net loading shall always be 24-hour composite samples made up of at least six increments taken at regular intervals throughout the plant day.

D. 1. When Quarterly sampling frequency is specified, the sampling shall be done in the months of March, June, August and December.

2. When a Yearly sampling frequency is specified, the sampling shall be done in the month of September.

3. Winter shall be considered to be the period from November 1 thru April 30.

4. Summer shall be considered to be the period from May 1 thru October 31.

E. 1. "MGD" means million gallons per day

2. "mg/l" means milligrams per liter

3. "ug/l" means micrograms per liter

F. "Reporting Code" is a five digit number used by the Ohio EPA in processing reported data. The reporting code does not imply the type of analysis used nor the sampling techniques employed.

2. GENERAL EFFLUENT LIMITATIONS

The effluent shall, at all times, be free of substances:

A. In amounts that will settle to form putrescent, or otherwise objectionable, sludge deposits; or that will adversely affect aquatic life or water fowl;

B. Of an oily, greasy, or surface-active nature, and of other floating debris, in amounts that will form noticeable accumulations of scum, foam or sheen;

C. In amounts that will alter the natural color or odor of the receiving water to such degree as to create a nuisance;

D. In amounts that either singly or in combination with other substances that are toxic to human, animal, or aquatic life;

E. In amounts that are conducive to the growth of aquatic weeds or algae to the extent that such growths become inimical to more desireable forms of aquatic life, or create conditions that are unsightly, or constitute a nuisance in any other fashion;

F. In amounts that will impair designated instream or downstream water uses.

3. FACILITY OPERATION AND QUALITY CONTROL

All wastewater treatment works shall be operated in a manner consistent with the following:

A. At all times, the permittee shall maintain in good working order and operate as efficiently as possible all treatment or control facilities or systems installed or used by the permittee to achieve compliance with the terms and conditions of this permit.

B. The permittee shall effectively monitor the operation and efficiency of treatment and control facilities and the quantity and quality of the treated discharge.

C. Maintenance of wastewater treatment works that results in degradation of effluent quality shall be scheduled during non-critical water quality periods and shall be carried out in a manner approved by the Ohio EPA as specified in the Paragraph in this PART III entitled, "UNAUTHORIZED DISCHARGES".

4. REPORTING

A. Monitoring data required by this permit shall be reported on the Ohio EPA report form (EPA-Sur-1) on a monthly basis. Individual reports for each sampling station for each month are to be received no later than the 15th day of the next month. The original plus first copy of the report form must be signed and mailed to:

Ohio Environmental Protection Agency
Technical Records Section
Post Office Box 1049
Columbus, Ohio 43216

B. If the permittee monitors any pollutant at the location(s) designated herein more frequently than required by this permit, using approved analytical methods as specified below, the results of such monitoring shall be included in the calculation and reporting of the values required in the reports specified above.

C. Analyses of pollutants not required by this permit, except as noted in the preceding paragraph, shall not be re-reported on Ohio EPA report form (EPA Sur-1) but records shall be retained as specified in the paragraph entitled "RECORDS RETENTION".

5. SAMPLING & ANALYTICAL METHODS

Samples and measurements taken as required herein shall be representative of the volume and nature of the monitored flow. Test procedures for the anlysis of pollutants shall conform to regulation 40 CFR 136, "Test Procedures For The Analysis of Pollutants". The permittee shall periodically calibrate and perform maintenance procedures on all monitoring and analytical instrumentation at intervals to insure accuracy of measurements.

6. RECORDING OF RESULTS

For each measurement or sample taken pursuant to the requirements of this permit, the permittee shall record the following information:

A. The exact place, date, and time of sampling;

B. The date and time the analyses were performed on those samples;

C. The person(s) who performed the analyses;

D. The analytical techniques or methods used; and

E. The results of all analyses and measurements

7. RECORDS RETENTION

The permittee shall retain all of the following records for the wastewater treatment works for a minimum of three years.

A. All sampling and analytical records (including internal sampling data not reported);

B. All original recordings for any continuous monitoring instrumentation;

C. All instrumentation, calibration and maintenance records; and

D. All plant operation and maintenance records.

These periods will be extended during the course of any unresolved litigation, or when so requested by the Regional Administrator or the Ohio EPA.

8. AVAILABILITY OF REPORTS

Except for data determined by the Ohio EPA to be entitled confidential status, all reports prepared in accordance with the terms of this permit shall be available for public inspection at the appropriate District Offices of the Ohio EPA. Both Section 308, Public Law 92-500 and Section 6111.05 Ohio Revised Code state that effluent data and receiving water quality data shall not be considered confidential. Knowingly making any false statement on any such report may result in the imposition of criminal penalties as provided for in the Ohio Revised Code Section 6111.99.

9. RIGHT OF ENTRY

The permittee shall allow authorized representatives of the Ohio EPA and US EPA upon the presentation of credentials;

A. To enter upon the permittee's premises where an effluent source is located or in which any records are required to be kept under the terms and conditions of this permit; and

B. At reasonable times to have access to and copy any records required to be kept under the terms and conditions of this permit; to inspect any monitoring equipment or monitoring method required in this permit; and to sample any discharge of pollutants.

10. UNAUTHORIZED DISCHARGES

A. Unless specifically authorized in Part 1 of this permit, deliberate by-passing or diverting of wastewater from the treatment works is prohibited except when necessary:

1. To prevent loss of life;
2. To prevent severe property damage;
3. To prevent damage to treatment works or processes; or
4. To allow essential maintenance to be performed according to a schedule approved in writing by the Ohio EPA District Office.

B. While typical unauthorized discharges are those resulting from pipeline breaks, equipment malfunctions or failures, operator errors, accidents, process interruptions, or power failures, all unauthorized discharges shall be reported according to the following procedure:

1. Report within one hour of discovery to Ohio EPA by calling (toll free) 1-800-282-9378.

2. Report within one hour of discovery to U.S. EPA National Spill Response Center by calling (toll free) 1-800-424-8802.

3. For these telephone reports the following information must be included:

   a. the times at which the discharge occurred, and was discovered;
   b. the approximate amount and the characteristics of the discharge;
   c. the stream(s) affected by the discharge;
   d. the circumstances which created the discharge;
   e. the names and telephone numbers of the persons who have knowledge of these circumstances;
   f. what remedial steps are being taken;
   g. the names and telephone numbers of the persons responsible for such remedial steps.

4. These reports shall be confirmed in writing within seven days of the discharge and submitted to the appropriate Ohio EPA District Office and to the U.S. EPA Regional Adminstrator. This report should include the information required under "NONCOMPLIANCE NOTIFICATION".

11. NONCOMPLIANCE NOTIFICATION

A. Effluent Limitations:

If the permittee is unable to meet any effluent limitations specified in this permit, the permittee shall submit a written report to the appropriate Ohio EPA District Office within seven days of becoming aware of the conditions. The report shall include the following:

1. The limitation(s) which has been violated;
2. The extent of the violation(s);
3. The cause of the violation(s);
4. The period of the violation(s) including exact dates and times;
5. If uncorrected, the anticipated time the violation(s) is expected to continue; and
6. Steps being taken to reduce, eliminate and/or prevent recurrence of the violation(s).

B. Compliance Schedule Events:

If the permittee is unable to meet any date for achieving an event, as specified in the Schedule of Compliance, the permittee shall submit a written report to the appropriate District Office of the Ohio EPA within seven days of becoming aware of such situation. The report shall include the following:

1. The compliance event which has been or will be violated;
2. The cause of the violation;
3. The remedial action being taken;
4. The probable date by which compliance will occur; and
5. The probability of complying with subsequent and final events as scheduled.

12. POWER FAILURES

The failure of the primary source of power to a wastewater control facility will not be considered a justifiable basis for non-compliance with effluent limitations. The permittee is responsible for maintaining adequate safeguards to prevent the discharge of untreated or inadequately treated wastewater during electrical power failures either by means of alternate power sources, standby generators, retention of inadequately treated wastewater or reduced production. Should the treatment works not include the above capabilities at time of issuance of this permit, the provision for such necessary facilities is an integral part of the schedule of compliance. If a schedule of compliance is not included in this permit, a letter with a detailed schedule for providing necessary facilities shall be submitted within 180 days of the effective date of this permit. Such letter will be submitted to the appropriate Ohio EPA District Office.

13. ADVERSE IMPACT

In the event of either an unauthorized discharge or a violation of effluent limitations, the permittee shall take all reasonable steps to minimize any adverse impact on the waters of the State. This may include accelerated or additional monitoring to determine the extent of the impact of unauthorized discharge or the violation of limitations. If such additional monitoring is performed, the data collected shall be included in the written report submitted to the appropriate Ohio EPA District Office.

14. AUTHORIZED DISCHARGES

All discharges authorized herein shall be consistent with the terms and conditions of this permit. The discharge of any pollutant identified in this permit more frequently then, or at a level in excess of, that authorized by this permit shall constitute a violation of the terms and conditions of this permit. Such a violation may result in the imposition of civil and/or criminal penalities as provided for in Section 309 of the Act, and Ohio Revised Code Sections 6111.09 and 6111.99

15. DISCHARGE CHANGES

The following changes must be reported to the appropriate Ohio EPA District Office as soon as practicable.

A. For publicly owned treatment works:

1. Any proposed plant modification, addition and/or expansion that will change the capacity or efficiency of the plant;

2. The addition of any new significant industrial discharge; and

3. Changes in the quantity or quality of the wastes from existing tributary industrial discharges which will result in significant new or increased discharges of pollutants.

B. For non-publicly owned treatment works, any proposed facility expansions, production increases, or process modifications, which will result in new, different, or increased discharges of pollutants.

Following this notice, modifications to the permit may be made to reflect any necessary changes in permit conditions, including any necessary effluent limitations for any pollutants not identified and limited herein. A determination will also be made as to whether a National Enviromental Policy Act (NEPA) review will be required. Chapters 6111.44 and 6111.45, Ohio Revised Code, require that plans for treatment works or improvements to such works be approved by the Director of the Ohio EPA prior to initiation of construction.

16. TOXIC POLLUTANTS

If a toxic effluent standard or prohibition (including a schedule of compliance) is established under Section 307(a) of the Act for a toxic pollutant which is present in the permittee's discharge and such standard or prohibition (including a schedule of compliance) is more stringent than any limitation upon such pollutant in this permit, the Director shall modify this permit in accordance with the toxic effluent standard and so notify the permittee.

17. PERMIT MODIFICATION, SUSPENSION, OR REVOCATION

A. After notice and opportunity for a hearing, this permit may be modified, suspended, or revoked, by the Ohio EPA, in whole or in part during its term for cause including, but not limited to, the following:

1. violation of any terms or conditions of this permit;
2. obtaining this permit by misrepresentation or failure to disclose fully all relevant facts; or
3. a change in any condition that requires either a temporary or permanent reduction or elimination of the permitted discharge.

B. Pursuant to Rule 3745-33-06, Ohio Administrative Code (Formerly Reg. EP-31-06) the permittee may at any time apply to the Ohio EPA for modification of any part of this permit. The application for modification should be received by the appropriate Ohio EPA District Office at least ninety days before the date on which it is desired that the modification become effective. The application shall be made only on forms approved by the Ohio EPA.

18. TRANSFER OF OWNERSHIP OR CONTROL

This permit cannot be transferred or assigned nor shall a new owner or successor be authorized to discharge from this facility, until the following requirements are met:

A. The permittee shall notify the succeeding owner or successor of the existence of this permit by a letter, a copy of which shall be forwarded to the appropriate Ohio EPA District Office;

B. The appropriate Ohio EPA District Office must be notified in writing sixty days prior to any proposed transfer of an Ohio NPDES permit. The new owner or successor shall submit a letter to the Ohio EPA requesting the permit be transferred and stating that he will assume the responsibility for this permit; and

C. The new owner or successor receives written confirmation and approval of the transfer from the Director of the Ohio EPA.

19. OIL AND HAZARDOUS SUBSTANCE LIABILITY

Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties to which the permittee is or may be subject under Section 311 of the Act.

20. SOLIDS DISPOSAL

Collected screenings, slurries, sludges, and other solids shall be disposed of in such a manner as to prevent entry of those wastes into waters of the State.

21. CONSTRUCTION AFFECTING NAVIGABLE WATERS

This permit does not authorize or approve the construction of any onshore or offshore physical structures or facilities or the undertaking of any work in any navigable waters.

22. CIVIL AND CRIMINAL LIABILITY

Except as exempted in the permit conditions on UNAUTHORIZED DISCHARGES and POWER FAILURES, nothing in this permit shall be construed to relieve the permittee from civil or criminal penalities for non-compliance.

23. STATE LAWS AND REGULATIONS

Nothing in this permit shall be construed to preclude the institution of any legal action nor relieve the permittee from any responsibilities, liabilities, or penalties established pursuant to any applicable state law or regulation under authority preserved by Section 510 of the Act.

24. PROPERTY RIGHTS

The issuance of this permit does not convey any property rights in either real or personal property, or any exclusive privileges, nor does it authorize any injury to private property or any invasion of personal rights, nor any infringement of Federal, state, or local laws or regulations.

25. SEVERABILITY

The provisions of this permit are severable, and if any provision of this permit, or the application of any provision of this permit to any circumstance, is held invalid, the application of such provision to other circumstances, and the remainder of this permit, shall not be affected thereby.

ANALYTICAL RESULTS OF USGS WATER QUALITY SAMPLING

APPENDIX A-2

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
CENTRAL LABORATORY, ATLANTA, GEORGIA

WATER QUALITY ANALYSIS
LAB ID # 151114 RECORD # 13713

SAMPLE LOCATION: NETTLE LK NR MIDPOINT AT SITE L-1 OH
STATION ID: 414055084433700 LAT.LONG.SEQ.: 414055 0844337 00
DATE OF COLLECTION: BEGIN--780522 END-- TIME--1555
STATE CODE: 39 COUNTY CODE: 171 PROJECT IDENTIFICATION: 443902700
DATA TYPE: 2 SOURCE: LAKE OR RESERVOIR GEOLOGIC UNIT:
COMMENTS:
TOP SAMPLE

CARBON TOT ORGANIC	MG/L	8.5	NITROGEN TOT ORG N	MG/L	0.74
COD HI LEVEL	MG/L	30	NITROGEN TOTKJD AS N	MG/L	0.90
NITR. NO2 AS N TOTAL	MG/L	0.03	NO2 + NO3 AS N TOT	MG/L	0.61
NITR. NO3 AS N TOTAL	MG/L	0.58	PH FIELD		~~8.2~~
NITROGEN NH4 ASN TOT	MG/L	0.16	PHOS ORTHO TOT AS P	MG/L	0.00
NITROGEN TOT AS N	MG/L	1.5	PHOSPHORUS TOT AS P	MG/L	0.04
NITROGEN TOT AS NO3	MG/L	6.7	SILICA DISSOLVED	MG/L	0.8
			SP. CONDUCTANCE FLD		450

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
CENTRAL LABORATORY, ATLANTA, GEORGIA

WATER QUALITY ANALYSIS
LAB ID # 151115 RECORD # 13715

SAMPLE LOCATION: NETTLE LK NR MIDPOINT AT SITE L-1 OH
STATION ID: 414055084433700 LAT.LONG.SEQ.: 414055 0844337 00
DATE OF COLLECTION: BEGIN--780522 END-- TIME--1630
STATE CODE: 39 COUNTY CODE: 171 PROJECT IDENTIFICATION: 443902700
DATA TYPE: 2 SOURCE: LAKE OR RESERVOIR GEOLOGIC UNIT:
COMMENTS:
BOTTOM SAMPLE

CARBON TOT ORGANIC	MG/L	9.7	NITROGEN TOT ORG N	MG/L	0.75
COD HI LEVEL	MG/L	30	NITROGEN TOTKJD AS N	MG/L	1.4
NITR. NO2 AS N TOTAL	MG/L	0.01	NO2 + NO3 AS N TOT	MG/L	0.19
NITR. NO3 AS N TOTAL	MG/L	0.18	PH FIELD		7.3
NITROGEN NH4 AS N TOT	MG/L	0.65	PHOS ORTHO TOT AS P	MG/L	0.00
NITROGEN TOT AS N	MG/L	1.6	PHOSPHORUS TOT AS P	MG/L	0.05
NITROGEN TOT AS NO3	MG/L	7.0	SILICA DISSOLVED	MG/L	5.6
			SP. CONDUCTANCE FLD		460

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
CENTRAL LABORATORY, ATLANTA, GEORGIA

WATER QUALITY ANALYSIS
LAB ID # 229012 RECORD # 33622

SAMPLE LOCATION: NETTLE LK NR MIDPOINT AT SITE L-1 OH
STATION ID: 414055084433700 LAT.LONG.SEQ.: 414055 0844337 00
DATE OF COLLECTION: BEGIN--780814 END-- TIME--1535
STATE CODE: 39 COUNTY CODE: 171 PROJECT IDENTIFICATION: 443902700
DATA TYPE: 2 SOURCE: LAKE OR RESERVOIR GEOLOGIC UNIT:
COMMENTS: Top (2 feet)

ANALYZING AGENCY		80010	NITROGEN TOT ORG N	MG/L	0.95
CARBON TOT ORGANIC	MG/L	6.9	NITROGEN TOTKJD AS N	MG/L	1.0
COD HI LEVEL	MG/L	22	NO2 + NO3 AS N TOT	MG/L	0.64
NITR. NO2 AS N TOTAL	MG/L	0.04	PH FIELD		8.2
NITR. NO3 AS N TOTAL	MG/L	0.60	PHOS ORTHO TOT AS P	MG/L	0.00
NITROGEN NH4 ASN TOT	MG/L	0.05	PHOSPHORUS TOT AS P	MG/L	0.04
NITROGEN TOT AS N	MG/L	1.6	SILICA DISSOLVED	MG/L	2.2
NITROGEN TOT AS NO3	MG/L	7.3	SP. CONDUCTANCE FLD		450

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
CENTRAL LABORATORY, ATLANTA, GEORGIA

WATER QUALITY ANALYSIS
LAB ID # 229011 RECORD # 33620

SAMPLE LOCATION: NETTLE LK NR MIDPOINT AT SITE L-1 OH
STATION ID: 414055084433700 LAT.LONG.SEQ.: 414055 0844337 00
DATE OF COLLECTION: BEGIN--780814 END-- TIME--1605
STATE CODE: 39 COUNTY CODE: 171 PROJECT IDENTIFICATION: 443902700
DATA TYPE: 2 SOURCE: LAKE OR RESERVOIR GEOLOGIC UNIT:
COMMENTS:

ANALYZING AGENCY		80010	NITROGEN TOT ORG N	MG/L	1.5
CARBON TOT ORGANIC	MG/L	11	NITROGEN TOTKJD AS N	MG/L	3.3
COD HI LEVEL	MG/L	35	NO2 + NO3 AS N TOT	MG/L	0.00
NITR. NO2 AS N TOTAL	MG/L	0.01	PH FIELD		7.1
NITR. NO3 AS N TOTAL	MG/L	0.00	PHOS ORTHO TOT AS P	MG/L	0.16
NITROGEN NH4 ASN TOT	MG/L	1.8	PHOSPHORUS TOT AS P	MG/L	0.30
NITROGEN TOT AS N	MG/L	3.3	SILICA DISSOLVED	MG/L	9.3
NITROGEN TOT AS NO3	MG/L	15	SP. CONDUCTANCE FLD		500

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
CENTRAL LABORATORY. ATLANTA. GEORGIA

WATER QUALITY ANALYSIS
LAB ID # 151122 RECORD # 13729

SAMPLE LOCATION: NETTLE LK NR MIDPOINT AT SITE L-1 OH
STATION ID: 414055084433700 LAT.LONG.SEQ.: 414055 0844337 00
DATE OF COLLECTION: BEGIN--780522 END-- TIME--1610
STATE CODE: 39 COUNTY CODE: 171 PROJECT IDENTIFICATION: 443902700
DATA TYPE: 2 SOURCE: LAKE OR RESERVOIR GEOLOGIC UNIT:
COMMENTS:
COMPOSITE SAMPLE

BARIUM TOTAL	UG/L	0	MANGANESE TOTAL	UG/L	170
BORON TOTAL	UG/L	70	MERCURY TOTAL	UG/L <	0.5
CADMIUM TOTAL	UG/L	0	MOLYBDENUM TOTAL	UG/L	5
CALCIUM DISS	MG/L	66	NICKEL TOTAL	UG/L	6
CHLORIDE DISS	MG/L	11	PH FIELD		7.7
CHROMIUM TOTAL	UG/L <	10	POTASSIUM DISS	MG/L	2.6
COBALT TOTAL	UG/L	0	SAR		0.1
COPPER TOTAL	UG/L	4	SELENIUM TOTAL	UG/L	0
FLUORIDE DISS	MG/L	0.1	SILVER TOTAL	UG/L	0
HARDNESS TOTAL	MG/L	220	SODIUM DISS	MG/L	4.6
IRON TOTAL	UG/L	310	SODIUM PERCENT		4
LEAD TOTAL	UG/L	6	SP. CONDUCTANCE FLD		469
MAGNESIUM DISS	MG/L	14	SULFATE DISS	MG/L	56
			ZINC TOTAL	UG/L	20

CATIONS	(MG/L)	(MEQ/L)	ANIONS	(MG/L)	(MEQ/L)
CALCIUM DISS	66	3.294	CHLORIDE DISS	11	0.310
MAGNESIUM DISS	14	1.152	FLUORIDE DISS	0.1	0.005
POTASSIUM DISS	2.6	0.067	SULFATE DISS	56	1.166
SODIUM DISS	4.6	0.201			
TOTAL		4.712	TOTAL		1.481

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UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
CENTRAL LABORATORY, ATLANTA, GEORGIA

WATER QUALITY ANALYSIS
LAB ID # 151428 RECORD # 13413

SAMPLE LOCATION: NETTLE LK NR MIDPOINT AT SITE L-1 OH
STATION ID: 414055084433700 LAT.LONG.SEQ.: 414055 0844337 00
DATE OF COLLECTION: BEGIN--780522 END-- TIME--1603
STATE CODE: 39 COUNTY CODE: 171 PROJECT IDENTIFICATION: 443902700
DATA TYPE: 2 SOURCE: LAKE OR RESERVOIR GEOLOGIC UNIT:
COMMENTS:

PHYTO TYPE-I C/ML 6100

414055084433700 NETTLE LK NR MIDPOINT AT SITE L-1 OH
LAT 41-40-55 LONG 084-43-37 SEQ 00

AGENCY : USGS
STATE CODE : 39

MAY 22, 1978
1603 HOURS

PHYTOPLANKTON IDENTIFICATION

8,100 CELLS/ML

ORGANISM NAME	COMMON NAME	CELLS/ML	PERCENT	
CHLOROPHYTA	GREEN ALGAE			
.CHLOROPHYCEAE				
..CHLOROCOCCALES				
...OOCYSTACEAE				
....ANKISTRODESMUS		300	4	
....DICTYOSPHAERIUM		250	3	
....KIRCHNERIELLA		99	1	
...SCENEDESMACEAE				
....CRUCIGENIA		990	12	
....SCENEDESMUS		200	2	
..VOLVOCALES				
...CHLAMYDOMONADACEAE				
....CARTERIA		350	4	
....CHLAMYDOMONAS		300	4	
	TOTALS	2,500	30	2.5=DIVERSITY
CHRYSOPHYTA				
.BACILLARIOPHYCEAE	DIATOMS			
..CENTRALES	CENTRIC			
...COSCINODISCACEAE				
....CYCLOTELLA		200	2	
..PENNALES	PENNATE			
...FRAGILARIACEAE				
....ASTERIONELLA		1,200	15	
...NITZSCHIACEAE				
....NITZSCHIA		890	11	
	TOTALS	2,300	28	1.3=DIVERSITY
.CHRYSOPHYCEAE	YELLOW-BROWN ALGAE			
..CHRYSOMONADALES				
...OCHROMONADACEAE				
....DINOBRYON		50	1	
....OCHROMONAS		550	7	
	TOTALS	600	7	0.4=DIVERSITY
CYANOPHYTA	BLUE-GREEN ALGAE			
.CYANOPHYCEAE				
..CHROOCOCCALES	COCCOID BLUE-GREENS			
...CHROOCOCCACEAE				
....ANACYSTIS		940	12	
	TOTALS	940	12	0.0=DIVERSITY
EUGLENOPHYTA	EUGLENOIDS			
.CRYPTOPHYCEAE	CRYPTOMONADS			

.CRYPTOPHYCEAE	CRYPTOMONADS				
..CRYPTOMONADALES					
...CRYPTOCHRYSIDACEAE					
....CHROOMONAS			830	7	
...CRYPTOMONADACEAE					
....CRYPTOMONAS			450	4	
		TOTALS	1,300	11	0.9=DIVERSITY
.EUGLENOPHYCEAE					
..EUGLENALES					
...EUGLENACEAE					
....TRACHELOMONAS			300	3	
		TOTALS	300	3	0.0=DIVERSITY
PYRRHOPHYTA	FIRE ALGAE				
.DINOPHYCEAE	DINOFLAGELLATES				
..PERIDINIALES					
...GLENODINIACEAE					
....GLENODINIUM			76	1	
		TOTALS	76	1	0.0=DIVERSITY

NOTE: CELL/ML VALUES ARE BASED ON ACTUAL COUNTS AND REPORTED TO TWO(2) SIGNIFICANT FIGURES
\# - DOMINANT ORGANISM, GREATER OR EQUAL TO 15%
ANALYSIS METHOD: GLASS CHAMBER(12.4 CIRC), INVERTED MICROSCOPE
DIVERSITY INDICES, BASED ON ACTUAL COUNTS:
PHYL/DIV 1.8
CLASS 2.3
ORDER 2.7
FAMILY 3.4
GENERA 3.5

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
CENTRAL LABORATORY. ATLANTA. GEORGIA

WATER QUALITY ANALYSIS
LAB ID # 151427 RECORD # 13411

AMPLE LOCATION: NETTLE LK NR MIDPOINT AT SITE L-1 OH
TATION ID: 414055084433700 LAT.LONG.SEQ.: 414055 0844337 00
ATE OF COLLECTION: BEGIN--780522 END-- TIME--1605
TATE CODE: 39 COUNTY CODE: 171 PROJECT IDENTIFICATION: 443902700
ATA TYPE: 2 SOURCE: LAKE OR RESERVOIR GEOLOGIC UNIT:
OMMENTS:

HYTO TYPE-I C/ML 12000

414055084433700 NETTLE LK NR MIDPOINT AT SITE L-1 OH
LAT 41-40-55 LONG 084-43-37 SEQ 00

AGENCY : USGS
STATE CODE : 39

MAY 22, 1978
1605 HOURS

PHYTOPLANKTON IDENTIFICATION

12,000 CELLS/ML

ORGANISM NAME	COMMON NAME	CELLS/ML	PER CENT	
CHLOROPHYTA	GREEN ALGAE			
.CHLOROPHYCEAE				
..CHLOROCOCCALES				
...MICRACTINIACEAE				
....GOLENKINIA		230	2	
....MICRACTINIUM		150	1	
...OOCYSTACEAE				
....ANKISTRODESMUS		300	3	
....CHLORELLA		150	1	
....CHODATELLA		76	1	
...SCENEDESMACEAE				
....SCENEDESMUS		750	7	
..VOLVOCALES				
...CHLAMYDOMONADACEAE				
....CARTERIA		230	2	
....CHLAMYDOMONAS		1,100	9	
	TOTALS	3,000	26	2.5=DIVERSITY
CHRYSOPHYTA				
.BACILLARIOPHYCEAE	DIATOMS			
..CENTRALES	CENTRIC			
...COSCINODISCACEAE				
....CYCLOTELLA		230	2	
..PENNALES	PENNATE			
...[illegible]				
....[illegible]		1,900	16	
....[illegible]		75	1	
...[illegible]	[illegible]			
....[illegible]		75	1	
...NITZSCHIACEAE				
....NITZSCHIA		1,700	15	
	TOTALS	4,000	35	1.5=DIVERSITY
.CHRYSOPHYCEAE	YELLOW-BROWN ALGAE			
..CHRYSOMONADALES				
...OCHROMONADACEAE				
....OCHROMONAS		1,800	16	
	TOTALS	1,800	16	0.0=DIVERSITY
CYANOPHYTA	BLUE-GREEN ALGAE			
.CYANOPHYCEAE				
..CHROOCOCCALES	COCCOID BLUE-GREENS			
...CHROOCOCCACEAE				
....ANACYSTIS		1,100	9	

....CHROOMONAS		650	8	
...CRYPTOMONADACEAE				
....CRYPTOMONAS		1,100	13	
	TOTALS	1,700	21	1.0=DIVERSITY
.EUGLENOPHYCEAE				
..EUGLENALES				
...EUGLENACEAE				
....EUGLENA		50	1	
	TOTALS	50	1	0.0=DIVERSITY
PYRRHOPHYTA FIRE ALGAE				
.DINOPHYCEAE DINOFLAGELLATES				
..PERIDINIALES				
...GLENODINIACEAE				
....GLENODINIUM		50	1	
	TOTALS	50	1	0.0=DIVERSITY

NOTE: CELL/L VALUES ARE BASED ON ACTUAL COUNTS AND REPORTED TO TWO(2) SIGNIFICANT FIGURES
= DOMINANT ORGANISM GREATER OR EQUAL TO 15%
ANALYSIS METHOD: GLASS [illegible] CIRCLE, INVERTED MICROSCOPE
DIVERSITY INDICES, BASED ON ACTUAL COUNTS:
PHYL/DIV 1.9
CLASS 2.2
ORDER 2.6
FAMILY 3.3
GENERA 3.6

[illegible], OCT. 6, 1976

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
CENTRAL LABORATORY, ATLANTA, GEORGIA

WATER QUALITY ANALYSIS
LAB ID # 151109 RECORD # 13703

SAMPLE LOCATION: NETTLE C AB NETTLE LK AT SITE I-1 OH
STATION ID: 414120084435800 LAT.LONG.SEQ.: 414120 0844358 00
DATE OF COLLECTION: BEGIN--780522 END-- TIME--1500
STATE CODE: 39 COUNTY CODE: 171 PROJECT IDENTIFICATION: 443902700
DATA TYPE: 2 SOURCE: SURFACE WATER GEOLOGIC UNIT:
COMMENTS:
INFLOW

CARBON TOT ORGANIC	MG/L	4.9	NO2 + NO3 AS N TOT	MG/L	0.7
NITROGEN TOT AS N	MG/L	1.6	PH FIELD		7.3
NITROGEN TOT AS NO3	MG/L	7.1	PHOSPHORUS TOT AS P	MG/L	0.0
NITROGEN TOTKJD AS N	MG/L	0.89	SP. CONDUCTANCE FLD		505

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WATER QUALITY ANALYSIS
LAB ID # 229010 RECORD # 33618

SAMPLE LOCATION: NETTLE C AB NETTLE LK AT SITE I-1 OH
STATION ID: 414120084435800 LAT.LONG.SEQ.: 414120 0844358 00
DATE OF COLLECTION: BEGIN--780814 END-- TIME--1430
STATE CODE: 39 COUNTY CODE: 171 PROJECT IDENTIFICATION: 443902700
DATA TYPE: 2 SOURCE: SURFACE WATER GEOLOGIC UNIT:
COMMENTS:

ANALYZING AGENCY		80010	NITROGEN TOTKJD AS N	MG/L	1.1
CARBON TOT ORGANIC	MG/L	7.7	NO2 + NO3 AS N TOT	MG/L	0.46
NITROGEN TOT AS N	MG/L	1.6	PH FIELD		7.6
NITROGEN TOT AS NO3	MG/L	6.9	PHOSPHORUS TOT AS P	MG/L	0.05
			SP. CONDUCTANCE FLD		855

Chorophyll a as ug/l from Lake primary station

	May	Aug
2 feet	19.5	19.5
composite	21.9	11.9
5.5 feet	21.4	—
Surface	—	18.3

SEASONAL AND LONG-TERM CHANGES IN LAKE WATER QUALITY

Seasonal changes of temperature and density in lakes are best described using as an example a lake in the temperate zone which freezes over in winter. When ice coats the surface of a lake, cold water at $0^{o}C$ lies in contact with ice above warmer and denser water between 0^{o} and $4^{o}C$.

With the coming of spring, ice melts and the waters are mixed by wind. Shortly, the lake is in full circulation, and temperatures are approximately uniform throughout (close to $4^{o}C$). With further heating from the sun and mixing by the wind, the typical pattern of summer stratification develops. That is, three characteristic layers are present: (1) a surface layer of warm water in which temperature is more or less uniform throughout; (2) an intermediate layer in which temperature declines rapidly with depth; and (3) a bottom layer of cold water throughout which temperature is again more or less uniform. These three layers are termed epilimnion, metalimnion (or thermocline), and hypolimnion, respectively. The thermocline usually serves as a barrier that eliminates or reduces mixing between the surface water and the bottom water.

In late summer and early fall, as the lake cools in sympathy with its surroundings, convection currents of cold water formed at night sink to find their appropriate temperature level, mixing with warmer water on their way down. With further cooling, and turbulence created by wind, the thermocline moves deeper and deeper. The temperature of the epilimnion gradually approaches that of the hypolimnion. Finally, the density gradient associated with the thermocline becomes so weak that it ceases to be an effective barrier to downward-moving currents. The lake then becomes uniform in temperature indicating it is again well mixed. With still further cooling, ice forms at the surface to complete the annual cycle.

The physical phenomenon described above has significant bearing on biological and chemical activities in lakes on a seasonal basis. In general, growth of algae, which are plants, in the epilimnion produces dissolved oxygen and takes up nutrients such as nitrogen and phosphorus during the summer months. Algal growth in the hypolimnion is limited mainly because sunlight is insufficient. As dead algae settle gradually from the epilimnion into the hypolimnion, decomposition of dead algae depletes a significant amount of dissolved oxygen in the bottom water. At the same time, stratification limits oxygen supply from the surface water to the bottom water. As a result, the hypolimnion shows a lower level of dissolved oxygen while accumulating a large amount of nutrients by the end of summer. Then comes the fall overturn to provide a new supply of dissolved oxygen and to redistribute the nutrients via complete mixing.

Over each annual cycle, sedimentation builds up progressively at the bottom of the lake. As a result, this slow process of deposition of sediments reduces lake depth. Because major nutrients enter the lake along with the sediments, nutrient concentrations in the lake increase over a long period of time. This aging process is a natural phenomenon and is measured in hundreds or thousands of years, depending on specific lake and watershed characteristics.

Human activities, however, have accelerated this schedule considerably. By populating the shoreline, disturbing soils in the watershed, and altering hydrologic flow patterns, man has increased the rate of nutrient and sediment loading to lakes. As a result, many of our lakes are now characterized by a state of eutrophication that would not have occurred under natural conditions for many generations. This cultural eutrophication can in some instances be beneficial, for example by increasing both the rate of growth of individual fish and overall fishery production. In most cases, however, the effects of this accelerated process are detrimental to the desired uses of the lake.

The eutrophication process of lakes is classified according to a relative scale based on parameters such as productivity, nutrient levels, dissolved oxygen, and turbidity in the lake water. Lakes with low nutrient inputs and low productivity are termed oligotrophic. Dissolved oxygen levels in the hypolimmion of these lakes remain relatively high throughout the year. Lakes with greater productivity are termed mesotrophic and generally have larger nutrient inputs than oligotrophic lakes. Lakes with very high productivity are termed eutrophic and usually have high nutrient inputs. Aquatic plants and algae grow excessively in the latter lakes, and algal blooms are common. Dissolved oxygen may be depleted in the hypolimnion of eutrophic lakes during the summer months.

NON-POINT SOURCE MODELING - OMERNIK'S MODEL

Because so little data was available on non-point source runoff in the Study Area, which is largely rural, empirical models or statistical methods have been used to derive nutrient loadings from non-point sources. A review of the literature led to the selection of the model proposed by Omernik (1977). Omernik's regression model provides a quick method of determining nitrogen and phosphorus concentrations and loading based on use of the land. The relationship between land use and nutrient load was developed from data collected during the National Eutrophication Survey on a set of 928 non-point source watersheds.

Omernik's data indicated that the extent of agricultural and residential/urban land vs. forested land was the most significant parameter affecting the influx of nutrient from non-point sources. In the US, little or no correlation was found between nutrient levels and the percentage of land in wetlands, or range or cleared unproductive land. This is probably due to the masking effects of agricultural and forested land.

Use of a model which relates urban/residential and agricultural land use to nutrient levels seems appropriate where agricultural and/or forest make up the main land-use types.

The regression models for the eastern region of the US are as follows:

$$\text{Log } P = 1.8364 + 0.00971A + \sigma_P \text{ Log } 1.85 \qquad (1)$$

$$\text{Log } N = 0.08557 + 0.00716A - 0.00227B + \sigma_N \text{ Lot } 1.51 \qquad (2)$$

where:

P = Total phosphorus concentration - mg/l as P

N = Total nitrogen concentration - mg/l as N

A = Percent of watershed with agricultural plus urban land use

B = Percent of watershed with forest land use

σ_P = Total phosphorus residuals expressed in standard deviation units from the log mean residuals of Equation (1). Determined from Omernik (1977), Figure 25.

σ_N = Total nitrogen residuals expressed in standard deviation units from the log mean residuals of Equation (2). Determined from Omernik (1977), Figure 27.

1.85 = f, multiplicative standard error for Equation 1.

1.51 = f, multiplicative standard error for Equation (2).

The 67% confidence interval around the estimated phosphorus or nitrogen consideration can be calculated as shown below:

$$\text{Log } P_L = \text{Log } P \pm \text{Log } 1.85 \qquad (3)$$

$$\text{Log } N_L = \text{Log } N \pm \text{Log } 1.51 \qquad (4)$$

where:

P_L = Upper and lower values of the 67% phosphorus confidence limit - mg/l as P

The 67% confidence limit around the estimated phosphorus or nitrogen concentrations indicates that the model should be used for purposes of gross estimations only. The model does not account for any macro-watershed* features peculiar to the Study Area.

SIMPLIFIED ANALYSIS OF LAKE EUTROPHICATION

Introduction

Two basic approaches to the analysis of lake eutrophication have evolved:

1) A complex lake/reservoir model which simulates the interactions occurring within ecological systems; and

2) the more simplistic nutrient loading model which relates the loading or concentration of phosphorus in a body of water to its physical properties.

From a scientific standpoint, the better approach is the complex model; with adequate data such models can be used to accurately represent complex interactions of aquatic organisms and water quality constituents. Practically speaking, however, the ability to represent these complex interactions is limited because some interactions have not been identified and some that are known cannot be readily measured. EPAECO is an example of a complex reservoir model currently in use. A detailed description of this model has been given by Water Resources Engineers (1975).

In contrast to the complex reservoir models, the empirical nutrient budget models for phosphorus can be simply derived and can be used with a minimum of field measurement. Nutrient budget models, first derived by Vollenweider (1968) and later expanded upon by him (1975), by Dillon (1975a and 1975b) and by Larsen - Mercier (1975 and 1976), are based upon the total phosphorus mass balance. There has been a proliferation of simplistic models in eutrophication literature in recent years (Bachmann and Jones, 1974; Reckhow, 1978). The Dillon model has been demonstrated to work reasonably well for a broad range of lakes with easily obtainable data. The validity of the model has been demonstrated by comparing results with data from the National Eutrophication Survey (1975). The models developed by Dillon and by Larsen and Mercier fit the data developed by the NES for 23 lakes located in the northeastern and northcentral United States (Gakstatter et al 1975) and for 66 bodies of water in the southeastern US (Gakstatter and Allum 1975). The Dillon model (1975b) has been selected for estimation of eutrophication potential for Crystal Lake and Betsie Lake in this study.

Historical Development

Vollenweider (1968) made one of the earliest efforts to relate external nutrient loads to eutrophication. He plotted annual total phosphorus loadings ($g/m^2/yr$) against lake mean depth and empirically determined the transition between oligotrophic, mesotrophic and eutrophic loadings. Vollenweider later modified his simple loading mean depth relationship to include the mean residence time of the water so that unusually high or low flushing rates could be taken into account.

Dillon (1975) further modified the model to relate mean depth to a factor that incorporates the effect of hydraulic retention time on nutrient retention.

The resulting equation, used to develop the model for trophic status, relates hydraulic flushing time, the phosphorus loading, the phosphorus retention ratio, the mean depth and the phosphorus concentration of the water body as follows:

$$L\,\frac{(1-R)}{\rho} = zP$$

where: L = phosphorus loading ($gm/m^2/yr.$)
R = fraction of phosphorus retained
ρ = hydraulic flushing rate (per yr.)
z = mean depth (m)
P = phosphorus concentration (mg/l)

The graphical solution, shown in Figure E-4-a, is presented as a log-log plot of $L\,\frac{(1-R)}{P}$ versus z.

The Larsen-Mercier relationship incorporates the same variables as the Dillon relationship.

In relating phosphorus loadings to the lake trophic condition, Vollenweider (1968), Dillon and Rigler (1975) and Larsen and Mercier (1975, 1976) examined many lakes in the United States, Canada and Europe. They established tolerance limits of 20/ug/l phosphorus above which a lake is considered eutrophic and 10 mg/l phosphorus above which a lake is considered mesotrophic.

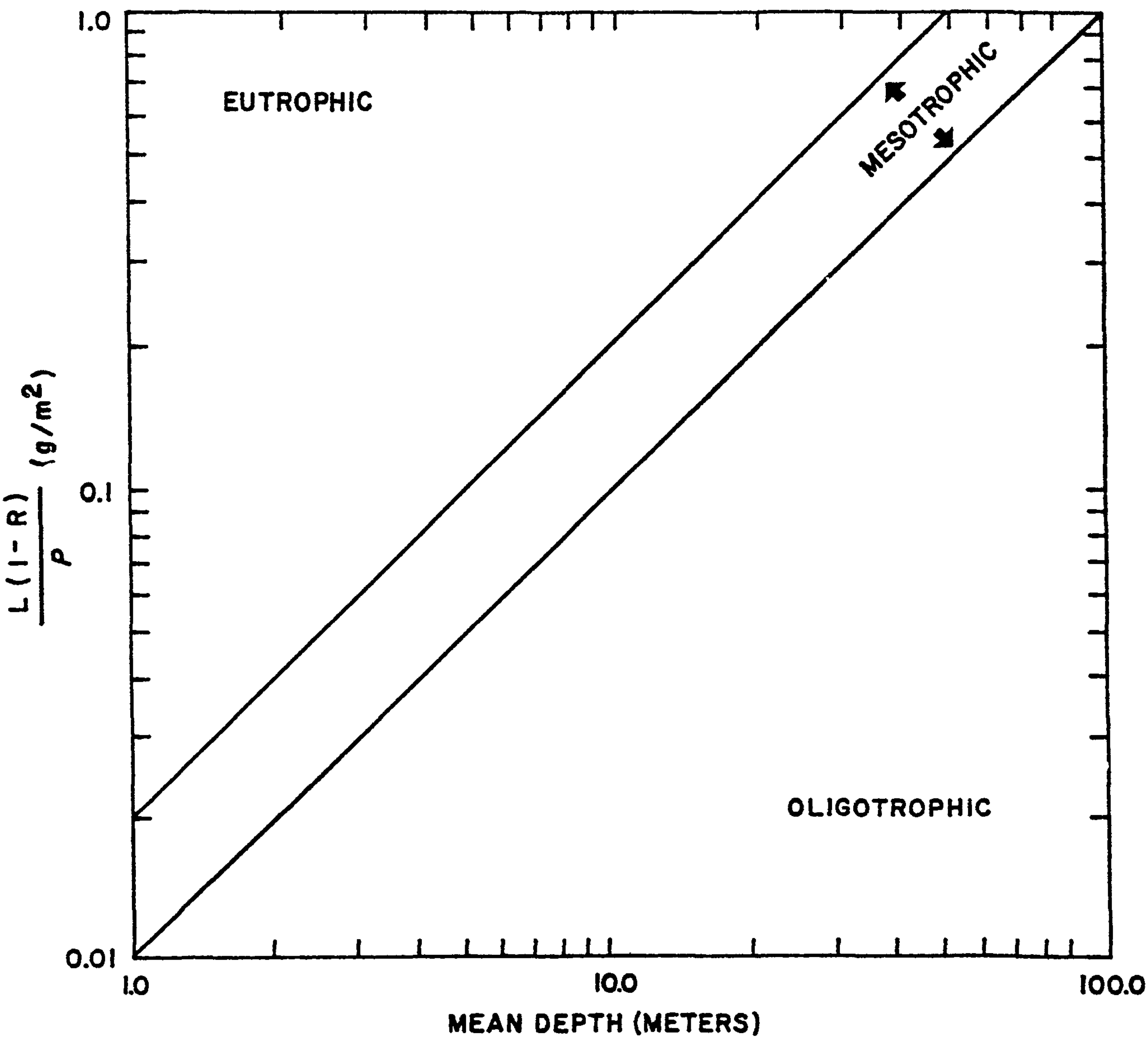
Assumptions and Limitations

The Vollenweider-Dillon model assumes a steady state, completely mixed system, implying that the rate of supply of phosphorus and the flushing rate are constant with respect to time. These assumptions are not totally true for all lakes. Some lakes are stratified in the summer so that the water column is not mixed during that time. Complete steady state conditions are rarely realized in lakes. Nutrient inputs are likely to be quite different during periods when stream flow is minimal or when non-point source runoff is minimal. In addition, incomplete mixing of the water may result in localized eutrophication problems in the vicinity of a discharge.

Another problem in the Vollenweider-Dillon model is the inherent uncertainty when extrapolating a knowledge of present retention coefficients to the study of future loading effects. That is to say, due to chemical and biological interactions, the retention coefficient may itself be dependent on the nutrient loading.

The Vollenweider/Dillon model or simplified plots of loading rate versus lake geometry and flushing rates can be very useful in describing the general trends of eutrophication in lakes during the preliminary

FIGURE E-4-a



L= AREAL PHOSPHORUS INPUT ($g/m^2/yr$)

R= PHOSPHORUS RETENTION COEFFICIENT (DIMENSIONLESS)

P= HYDRAULIC FLUSHING RATE (yr^{-1})

planning process. However, if a significant expenditure of monies for nutrient control is at stake, a detailed analysis to calculate the expected phytoplankton biomass must be performed to provide a firmer basis for decision making.

OHIO SURFACE WATER QUALITY STANDARDS

3745-1-04 STANDARDS APPLICABLE TO ALL WATERS

The following general water quality standards shall apply to all surface waters of the State including mixing zones. To every extent practical and possible as determined by the Director, these waters shall be:

(A) Free from suspended solids or other substances that enter the waters as a result of human activity and that will settle to form putrescent or otherwise objectionable sludge deposits, or that will adversly affect aquatic life;

(B) Free from floating debris, oil, scum and other floating materials entering the waters as a result of human activity in amounts sufficient to be unsightly or cause degradation;

(C) Free from materials entering the waters as a result of human activity producing color, odor or other conditions in such a degree as to create a nuisance;

(D) Free from substances entering the waters as a result of human activity in concentrations that are toxic or harmful to human, animal or aquatic life and/or are rapidly lethal in the mixing zone;

(E) Free from nutrients entering the waters as a result of human activity in concentrations that create nuisance growths of aquatic weeds and algae.

3745-1-07 WATER USE DESIGNATIONS

(A) WARMWATER HABITAT

Waters capable of supporting reproducing populations of fish normally referred to as warmwater species and associated vertebrate and invertebrate organisms and plans on an annual basis. These standards will apply outside the mixing zone.

All values are expressed as total concentration and milligrams per liter unless specified otherwise. Concentrations are not to be exceeded unless noted differently.

(1) Ammonia - not to exceed the concentration of ammonia as N for corresponding pH and temperature as indicated in Table 2. These values are based on 0.05 mg/l un-ionized ammonia, and at no time shall the ammonia-N concentration exceed 13 mg/l.

(2) Beryllium - 1.100 mg/l

(3) Cadmium - 0.012 mg/l

(4) Chlorine(total residual) - 0.002 mg/l

(5) Chromium - 0.100 mg/l

(6) Copper - not to exceed the concentrations in Table 3 based on total hardness. These values are based on 0.1 x 96 hour LC_{50}.

(7) Cyanide - 0.025 mg/l

(8) Dissolved Oxygen - Not less than 5.0 mg/l during at least 16 hours of any 24-hour period. It may be less than 5 mg/l for a period not to exceed 8 hours within any 24-hour period, but at no time shall the oxygen content be less than 4.0 mg/l.

(9) Dissolved Solids - may exceed one but not both of the following:

(1) 1500 mg/l (Equivalent 25^{o}C specific conductance values is 2400 micromhos/cm) or

(2) 150 mg/l attributable to human activities (Equivalent 25^{o}C specific conductance value is 240 micromhos/cm).

(10) Iron - 1.000 mg/l

3745-1-07 WATER USE DESIGNATIONS

(11) Lead - 0.030 mg/l

(12) MBAS - (Foaming Agents) - 0.500 mg/l

(13) Mercury - not to exceed 0.0005 mg/g (wet weight) in any whole sample of a representative aquatic organism or 0.00005 mg/l as a monthly average concentration in water or 0.0002 mg/l at any time.

(14) Nickel - not to exceed 0.01 x 96 hour LC_{50} of any representative aquatic species.

(15) Oil and Grease - Surface waters shall be free from floating oils and shall at no time produce a visible sheen or color film. Levels of oils or petrochemicals in the sediment or on the banks of a watercourse which cause deleterious effects to the biota will not be permitted. At no time will chlorofluorocarbon extractable materials in water exceed 5 mg/l.

(16) Pesticides - not to exceed the concentrations in Table 4, or section 307 of Public Law 92-500, whichever is more stringent.

(17) pH - 6.5 to 9.0

(18) Phenolic compounds - 0.010 mg/l

(19) Phosphorus - total phosphorus as P shall be limited to the extent necessary to prevent nuisance growths of algae, weeds, and slimes that result in a violation of the water quality standards set forth in Chapter 3745-1 of the Ohio Administrative Code. In areas where such nuisance growths exist, phosphorus discharges from point sources determined significant by the Ohio Environmental Protection Agency shall not exceed a daily average of one millgram per liter as total P, or such stricter requirements as may be imposed by Ohio EPA in accordance with the International Joint Commission (US-Canada agreement).

(20) Phthalate esters - 0.003 mg/l

3745-1-07 WATER USE DESIGNATIONS

(21) Polychlorinated biphenyls (PCB's) - not to exceed 0.000001 mg/l at any time in a water sample, or 0.01 mg/l (wet weight) in any whole sample of any representative organism.

(22) Selenium - not to exceed 0.01 x 96 hour LC_{50} of any representative aquatic species.

(23) Silver - not to exceed 0.01 x 96 hour LC_{50} of any representative aquatic species.

(24) Zinc - not to exceed the concentrations in Table 3 based on total hardness. These values are based on 0.01 x 96 hour LC_{50}.

(25) Toxic Substances

(a) All pollutants or combinations of pollutants shall not exceed, at any time, one-tenth of the 96 hour median tolerance limit (TLm) or LC_{50} for any representative aquatic species. However, more stringent application factors shall be imposed where justified by "Quality Criteria for Water," US Environmental Protection Agency, 1976; "Water Quality Criteria 1972," National Academy of Sciences and National Academy of Engineering, 1973; or other scientifically based publications.

(b) Pollutants or combinations of pollutants which are known to be persistent toxicants in the awuatic environment shall not exceed, at any time, an application factor of one one-hundredth applied to the 96 hour TLm or LC_{50}.

(c) Any criteria established for a water course or segment by this regulation shall supersede less stringent criteria established in Rule 3745-1-07 of the Ohio Administrative Code after appropriate public hearings as required by Section 6111.041 of the Ohio Revised Code.

3745-1-07 WATER USE DESIGNATIONS

(d) The median tolerance limit (TLm) or LC_{50} shall be determined by static or dynamic bioassays performed in accordance with methods outlined in "Standard Methods for the Examination of Water and Wastewater," Fourteenth Edition, American Public Health Association, American Water Works Association and Water Pollution Control Federation, 1976. Tests will be conducted using actual effluent, receiving water and representative species of aquatic life whenever possible, and performed in accordance with proceedures outlined in Methods of acute Toxicity Tests with Fish, Macroinvertebrates and Amphibians, USEPA 660/3-75-009.

(26) Temperature

(a) There shall be no water temperature changes as a result of human activity that cause mortality, long-term avoidance, exclusion from habitat, or adversely affect the reproductive success of representative aquatic species, unless caused by natural conditions.

(b) At no time shall water temperature exceed a monthly or bi-weekly average, or at any time exceed the daily maximum temperature as indicated in Table 5a through 5i. The average and daily maximum temperature standard shall apply and be measured outside of a thermal mixing zone at any point on a thermal mixing zone boundary as such is defined in Rule 3745-1-06(B)(1) and (2) of the Ohio Administrative Code.

(B) EXCEPTIONAL WARMWATER HABITAT

Waters capable of supporting exceptional or unusual populations of fish normally referred to as warmwater species and associated vertebrate and invertebrate organisms and plants on an annual basis. This would include waters of exceptional chemical quality that are capable of supporting sensitive species of fish and other aquatic organisms. Waters supporting Salmonid migration and waters having a high diversity of aquatic organisms should be included. These standards will apply outside the mixing zone.

3745-1-07 WATER USE DESIGNATIONS

(H) INDUSTRIAL WATER SUPPLY

Waters suitable for commercial and industrial uses, with or without treatment. Standards for the support of this use designation will vary with the type of industry involved.

(I) BATHING WATERS

Waters suitable for swimming where a lifeguard and/or bathhouse facilities are present, during the recreation season.

Fecal coliform - Geometric mean fecal coliform content (either MPN or MF), based on not less than five samples within a 30 day period shall not exceed 200 per 100 ml and shall not exceed 400 per 100 ml in more than ten percent of the samples taken during any 30 day period.

(J) PRIMARY CONTACT RECREATION

Waters suitable for full body contact recreation, such as, but not limited to; swimming and scuba diving with minimal threat to public health as a result of water quality, during the recreation season.

Fecal coliform - Geometric mean fecal coliform content (either MPN or MF), based on not less than five samples within a 30 day period shall not exceed 1000 per 100 ml and shall not exceed 2000 per 100 ml in more than ten percent of the samples taken during any 30 day period.

(K) SECONDARY CONTACT RECREATION

Waters suitable for partial body contact recreation, such as, but not limited to; canoeing and wading with minimal threat to public health as a result of water quality during the recreation season.

Fecal coliform - shall not exceed 5000 per 100 ml (either MPN or MF) in more than ten percent of the samples taken during any 30 day period.

3745-1-07 WATER USE DESIGNATIONS

(15) Phenolic compounds - 0.001 mg/l

(16) Polychlorinated biphenyls (PCB's) - absent from public water supplies.

(17) Selenium - 0.010 mg/l

(18) Silver - 0.050 mg/l

(19) Sulfates - 250.0 mg/l

(20) Zinc - 5.0 mg/l

(G) AGRICULTURAL WATER SUPPLY

Waters suitable for irrigation and livestock watering without treatment.

All values are expressed as total concentration and milligrams per liter, and are not to be exceeded.

(1) Arsenic - 0.100 mg/l

(2) Beryllium - 0.100 mg/l

(3) Cadmium - 0.050 mg/l

(4) Chromium - 0.100 mg/l

(5) Copper - 0.500 mg/l

(6) Fluoride - 2.0 mg/l

(7) Iron - 5.0 mg/l

(8) Lead - 5.0 mg/l

(9) Mercury - 0.010 mg/l

(10) Nickel - 0.200 mg/l

(11) Nitrates + Nitrites - 100.0 mg/l

(12) Selenium - 0.050 mg/l

(13) Zinc - 25.0 mg/l

FEDERAL, STATE, AND LOCAL RESPONSIBILITIES FOR WATER QUALITY MANAGEMENT

1. Federal Agency Responsibilities for Study Area Waters

USEPA

Administers the Clean Water Act
Sets Federal water quality standards

US EPA Region V

Administers the grant program described above for the Great Lakes Region. Region V's general and specific responsibilities in this program are discussed in Section I.B.

Army Corps of Engineers

Under the Rivers and Harbors Act of 1899, grants or denies permits required for dredging, filling or construction activities in navigable waters of the US, their 100-year floodplains and adjacent wetlands.

Section 404 of the Clean Water Act allows States to take over the issuance of permits, except in coastal or commercially navigable waters. Ohio has not requested authority to administer this program, and therefore the authority to grant or deny permits required for filling activities in wetlands remains with the Corps of Engineers. The OEPA must, however, issue a water quality certificate under Section 401 before the Corps can issue a permit to fill. The Corps has no record of permit activity in the Study Area.

US Department of Agriculture

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

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.

Drew up 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.

In the Study Area SCS has recently published a Soil Survey for Williams County, containing not only material descriptive of the soils but also detailed sections on the suitability of the various County soil series for various purposes, including sanitary facilities and building as well as for agricultural purposes. Soils considered to be "prime" have also been identified.

Land resources are now being monitored as part of a "County Reliability Study." In this project 3 selected points on each 160 acres are being checked for several factors, including water and wind erosion, building, crop rotation, etc. Earlier, in 1967, the district SCS participated in the national Conservation Needs Inventory.

Farmers Home Administration

Provides grants and loans to small rural communities to build or improve drinking water and waste treatment facilities.

US Department of the Interior

Fish and Wildlife Service

Provides technical assistance in development of 208 plans.

US Geological Survey (USGS)

Monitors surface water flows. The nearest stream gauge is near Blakelee on the St. Joseph River.

2. State Responsibilities

Pertinent Ohio Laws

Chapter 6111 of the Ohio Revised Code (ORC), which is the State's water pollution control legislation, assigns responsibility for water quality management to the Ohio Environmental Protection Agency (OEPA). It declares all acts of pollution of Ohio surface or ground waters to be a public nuisance. It prohibits discharge from any sewage treatment or industrial plant without a valid and unexpired permit from OEPA under the NPDES program.

Rule 6111.041 ORC directs OEPA to establish State standards for surface water quality.

Chapter 6117 ORC establishes the county as the authority to provide community wastewater treatment and collection facilities outside municipal corporate limits and to assess costs. Within corporate limits, cities and villages may set up a sanitary sewer district, or they may participate in a regional system administered by the county. Where treatment units are to be used by two or more owners, the system must be owned and operated as a public utility. A developer must turn the unit over to the local public utility, or must obtain a license to operate as a public utility from the Public Utility Commission of Ohio.

Title XV, ORC - Conservation of Natural Resources

Chapter 1501 ORC is the enabling legislation for the Ohio Department of Natural Resources (ODNR).

Sections 1501.16 through .19 contain the scenic rivers legislation, which enables ODNR to designate segments of streams as scenic rivers and to cooperate with localities in their management.

Chapter 1515 ORC, Sections .01 through .33, contains the legislation dealing with the Division of Soil and Water Districts within the ODNR. A Soil and Water Conservation District may be formed upon petition to the 7-member soil and Water Conservation Commission by any 75 owners within a proposed area.

A new law dealing with non-point agricultural pollution and urban sediment went into effect 12 January 1979. Labeled "Agricultural Pollution Abatement and Urban Sediment Pollution Act," it calls for the setting of standards and rules for controlling both waterborne and airborne agricultural sediment, animal wastes from operations handling 1,000 animal units or less, and urban sediment pollution. It establishes a cost-sharing program for the agricultural aspects, with a start of $225,000 for the first year. Enforcement of the animal waste standards is tied to issuance of administrative orders by the Soil and Water Division which can be backed up by cost-sharing up to 75% but not to exceed $5,000 per operation. Noncompliance with an order is a minor misdemeanor and carries a maximum penalty of $100 per day. The State has no authority to enforce the sediment provisions, either agricultural or urban, but localities are authorized to assume enforcement and injunctive powers for urban sediment.

Chapter 1517 establishes a Natural Areas Program and contains rules and regulations governing designated nature reserves.

Section 1531.25 contains the endangered species legislation. (See Section II.D.3.)

Section 1531.29, the Stream Litter Law, prohibits littering on any lands or waters in such a way that the litter will enter any stream.

Chapter 3701.29 of the Ohio Administrative Code contains the Ohio Sanitary Code.

State Agencies

Ohio Environmental Protection Agency

OEPA is responsible for the regulation of community wastewater treatment and disposal systems in the State and approves or disapproves plans for all wastewater treatment and disposal facilities that may affect surface or ground water, other than those for a private 1-, 2- or 3-family dwelling. It exercises control through issuance or denial of NPDES permits to discharge effluent. (Details of the permit granted to the Williams County Commission for the Nettle Lake area are contained in Appendix A-6.) District offices of OEPA may request review of a project by the agency's groundwater office.

Before the Corps of Engineers can issue a permit to fill in a lake, stream or wetland under Section 404 of the Clean Water Act, (see above), a water quality certificate from OEPA is required, under Section 401 of that Act.

Under its Statewide responsibility to prevent and abate pollution and to carry out Federal environmental protection laws (Section 6111.03 ORC), OEPA is examining non-point sources of pollution. The draft 208 plan covering the Study Area contains sections on "Agricultural Runoff," prepared by the Maumee Valley Resource Conservation Development and Planning Organization, and on "Home (on-site) Sewage Disposal Systems." It also states that additional data and analyses are needed on the relationship between on-site wastewater disposal systems and water quality. The draft plan is awaiting certification after a 22 August 1979 public hearing, although additional work may be required (by telephone, Gene Wright, OEPA 13 August 1979).

Ohio Department of Natural Resources (ODNR)

ODNR administers its responsibilities for the protection of the natural resources of the State through 13 divisions. Most planning, including water resources planning, is locally oriented.

ODNR's Division of Water works with regional and local planning agencies to map land capabilities in the Ohio Land Capabilities Analysis Program (OCAP). This computerized mapping program then serves as a resource for planning decisions by the local agencies. ODNR also inspects and approves (or disapproves) the location of sewage treatment plants with respect to floodplains.

The Department is presently evaluating a recommendation that the Nettle Lake area be designated as a natural preserve because of its wetlands. ODNR approval would be needed for any Corps of Engineers permit to fill in or drain wetlands.

The Division of Wildlife administers the Stream Litter Law, which it has used successfully to prosecute both industries and sewage treatment plants for pollution spills and dumping.

The Division of Soil and Water Districts, which works with the SWCDs, administers the new non-point source statutes. After a public hearing on administrative procedures and management guidelines scheduled 30 August 1979, full operation of the agricultural pollution provisions will get under way. The Division will provide guidance, procedures and model ordinances for controls on urban sediment for the use of cities and counties, but adoption will be voluntary.

ODNR supports land use planning at the local level and is developing publications for use by local governments, but the State has no land use legislation. Although the State owns the water in a stream or lake and the fish and wildlife, the landowner owns even the submerged land. The State does not control riparian rights.

Ohio Department of Health (ODH)

ODH is responsible for statewide health policies, rules and regulations to be applied by local agencies. By law, the State is divided into "health districts." Each district has a board of health and a staff headed by a health commissioner.

The Bureau of Environmental Health drew up the State Sanitary Code, which is contained in Chapter 3701-29 of the Ohio Administrative Code, adopted in 1974 and amended effective 1 July 1977. In "Household Sewage Disposal Regulations" the Bureau sets minimum design criteria for individual systems but allows local boards to establish more stringent criteria. The Bureau advises health districts on the regulation of individual on-site systems and strives for uniformity in the application of statewide minimum rules. It consults with local authorities regarding approval of proposed subdivision developments that are to be served by individual wastewater systems.

In new subdivisions, individual sewage systems are not permitted unless the local board of health and the Bureau consider a centralized sewerage system to be impractical and inadvisable. There is no formal policy regarding disposal on the land.

Bureau regulations require upgrading of a system only where there is a nuisance and complaint. Where physical conditions such as small lot size rule out full compliance, a variance is usually granted for some type of system that will eliminate the nuisance and prevent undue hardship.

3. Local Agencies and Responsibilities

Williams County General Health District

The county health department has jurisdiction over single-family wastewater disposal systems. Before the first county code was adopted in 1959, there were no sanitary restrictions; the County adopted the State Sanitary Code in 1974. The district has enforcement powers and can impose penalities for non-compliance with the code. However, no enforcement actions have been required with systems installed since adoption of the code. The District has not enforced compliance upon pre-existing systems because of limited staff and the difficulty of proving which individual system is at fault before enforcement action can be taken.

Williams County Commissioners

The Commissioners of Williams County have adopted zoning resolutions that may in turn be adopted voluntarily and implemented by the several townships in the county. These have not been adopted by Northwest Township, which has no zoning regulations.

A petition to the County Commissioners for a "clean-out" of the 16 miles of Nettle Creek from the outlet of Nettle Lake to the St. Joseph River will be discussed at a public meeting set for 17 September 1979. A dredging and brush-clearing operation would be intended to improve drainage of farmland and decrease flooding of the Lake.

Maumee Valley Resource Conservation, Development and Planning Organization

This advisory association of five counties in the Maumee River Valley has been designated as a State district and recognized as an A-95 review board. Under contract to OEPA, pursuant to Section 208 of the Clean Water Act, it has prepared a plan for the 5 counties. In the plan, rankings are proposed for water-quality-limited stream segments of the region, including the St. Joseph River Basin, which includes the Study Area. Nettle Lake is considered to be a problem area. Maumee Valley RC&D planners have given priority to agricultural non-point source pollution. They would like to address agricultural problems through "Best Management Practices" activities, but this approach would hinge on funding's becoming available for the Rural Clean Water program.

APPENDIX B

BIOTIC RESOURCES

FISH SPECIES FOUND IN NETTLE CREEK AND NETTLE LAKE AND THEIR RELATIVE ABUNDANCE DISTRIBUTION STATUS OF FISHES WITHIN THE MAUMEE RIVER BASIN

Species	Relative Abundance*	Distribution	Population Trend
Bowfin Amia calva	U	Occasionally in Maumee and St. Joseph River systems	None
Gizzard shad Dorosoma cepedianum	VC	Abundant in Maumee River, less common in smaller streams	None
Central mudminnow Umbra limi	U	Only in Nettle Creek, where abundant	None
Northern pike Esox lucius	C	Mostly in the Maumee River, St. Joseph River and Swan Creek although spawning occurs in many smaller tributaries	Declining
Grass pickerel Esox americanus vermiculatus	U	Found in backwater areas in all moderate to large streams; never in very large numbers	None
Quillback Carpiodes cyprinus	C	Present throughout the Maumee River, very abundant in the Maumee and Anglaize Rivers	
Common white sucker Catostomus commersoni	VC	Well distributed throughout Maumee River Basin	None
Spotted sucker Minytrema melanops	U	Well distributed throughout Basin, but never in large numbers	None
Northern hog sucker Hypentelium nigricans	C	Found in most streams of Basin in small to moderate number	None
Lake chubsucker Erimyzon sucetta	E	Recorded in upstream Nettle Creek/ may still be present in tributaries of St. Joseph River system	Declining
Golden redhorse Moxostoma erythrurum	C	General - throughout the Basin	None
Carp Cyprinus carpio	VC	Well distributed throughout the Maumee River Basin	None

*Abundance terms in order of decreasing numbers: A-abundant; VC-very common; C-common; U-uncommon; R-rare; E-endangered in Ohio.

Species	Relative Abundance*	Distribution	Population Trend
Fathead minnow Pimephales promelas	C	General throughout the Basin in small to moderate numbers	None
Bluntnose minnow Pimephales notatus	A	Well distributed throughout Maumee River Basin	None
Stoneroller Campostoma anomalum	C	Well distrubuted; generally small to moderate numbers, locally abundant	None
Silverjaw minnow Ericymba buccata	C	General throughout Maumee Basin in moderate and occasionally large numbers	None
Spotfin shiner Notropis spilopterus	A	General throughout the Maumee Basin	None
Redfin shiner Notropis umbratilis	A	Well distributed throughout Maumee River Basin	None
Common shiner Notropis cornutus	VC	General throughout Basin	None
Spottail shiner Notropis hudsonius	C	Mostly in Maumee River	None
Sand shiner Notropis stramineus	U	General throughout the Basin, but never in large numbers	None
Creek chub Semotilus atromaculatus	VC	Well distributed throughout River Basin	None
Golden shiner Notemigonus crysoleucas	U	Well distributed throughout River Basin	None
Channel catfish Ictalurus punctatus	C	Mostly in the larger streams of the River Basin	None
Black bullhead Ictalurus melas	C	General throughout Maumee Basin	None
Yellow bullhead Ictalurus natalis	C	General throughout Maumee Basin	None
Brown bullhead Ictalurus nebulosus	C	Mostly in Maumee, but found throughout Basin	None

*Abundance terms in order of decreasing numbers: A-abundant; VC-very common; C-common; U-uncommon; R-rare; E-endangered in Ohio.

Species	Relative Abundance*	Distribution	Population Trend
Tadpole madtom _Noturus gyrinus_	U	Found throughout the Maumee Basin but never in large numbers	None
Brindled madtom _Noturus miurus_	U	Found throughout the Maumee Basin but less frequently than the Tadpole madtom	None
Blackstripe topminnow _Fundulus notatus_	C	General throughout Basin	None
Brook silverside _Labisdesthes sicculus_	C	Mostly in the St. Joseph and Maumee systems but found throughout the Basin. Present in Nettle Lake	None
Black crappie _Pomoxis nigromaculatus_	C	Common throughout the Basin in the larger streams	None
White crappie _Pomoxis annularis_	C	Common throughout the Basin in the larger streams	None
Rock bass _Ambloplites rupestris_	C	Common throughout Basin in the larger streams	None
Largemouth bass _Micropterus salmoides_	C	Common throughout Basin in the larger streams	None
Smallmouth bass _Micropterus dolomieui_	C	Common throughout Basin in the larger streams	None
Bluegill _Lepomis macrochirus_	C	General throughout Basin	None
Green sunfish _Lepomis cyanellus_	VC	General throughout Basin	None
Longear sunfish _Lepomis megalotis_	U	General throughout Basin	None
Orangespotted sunfish _Lepomis humilis_	C	General throughout Basin	None
Pumpkinseed _Lepomis gibbosus_	C	General throughout Basin	None
Warmouth _Lepomis gulosus_	R	Recorded only in West Branch of St. Joseph River and Nettle Creek	Declining

*Abundance terms in order of decreasing numbers: A-abundant; VC-very common; C-common; U-uncommon; R-rare; E-endangered in Ohio.

Species	Relative Abundance*	Distribution	Population Trend
Yellow perch *Perca flavescens*	C	Primarily in Maumee River although present throughout the Basin in limited numbers	None
Logperch *Percina caprodes*	C	Throughout the Basin predominantly in larger tributaries	None
Blackside darter *Percina maculata*	C	General throughout Basin	None
Johnny darter *Etheostoma nigrum*	C	General throughout the Basin	None
Iowa darter *Etheostoma exile*	RE	Recorded only from Nettle Lake	None

Source: Allison, D. and H. Hothem, Ohio Department of Natural Resources, Division of Wildlife. "An evaluation of the status of fisheries and the status of other selected wild animals in the Maumee River Basin, Ohio." Dated June 1975. 15 pp. mimeo.

*Abundance terms in order of decreasing numbers: A-abundant; VC-very common; C-common; U-uncommon; R-rare; E-endangered in Ohio.

TREES AND SHRUBS OF NORTHWESTERN OHIO

Red cedar	Juniperus virginiana
Elderberry	Sambucus canadensis
White ash	Fraxinus americana
Black ash*	Fraxinus nigra
Green ash*	Fraxinus pennsylvanica var. Subintegerrina
Flowering dogwood*	Cornus florida
Red-osier dogwood*	Cornus stolonifera
Silver maple	Acer saccharinum
Sugar maple	Acer saccharum
Black locust	Robinia pseudo-acacia
Prickley-ash	Xanthoxylum americanum
Black walnut	Juglans nigra
Shagbatk hickory	Carya ovata
Pignut hickory	Carya glabra
Bitternut hickory	Carya cordiformis
Hawthorn	Crataegus spp.
Gooseberry*	Ribes spp.
Basswood	Tilia americana
Sassafras	Sassafras albidum
Bigtooth aspen*	Populus grandidentata
Cottonwood	Populus deltoides
Quaking aspen*	Populus tremuloides
White oak	Quercus alba
Bur oak	Quercus macrocarpa
Red oak	Quercus rubra
Pin oak*	Quercus palustris
American elm	Ulmus americanus
Ironwood	Carpinus caroliniana
Hazelnut	Corylus americana
Black cherry	Prunus serotina
Willows	Salix spp.
Black gum*	Nyssa sylvatica
Spicebush*	Lindera benzoin

Source: By telephone, Mr. Roger Herrett, Service Forester, Ohio Division of Forestry, 3 January 1979.

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* Species that might be found in the area, based on habitat that may be found in that section of Ohio.

BIRDS OF NORTHWESTERN OHIO, NETTLE LAKE STUDY AREA

*Canada goose	Branta canadensis
*Mallard duck	Anas platyrhynchos
*Black duck	Anas rubripes
*Blue-winged teal	Anas discors
*Wood duck	Aix sponsa
Turkey vulture	Cathartes aura
Sharp-shinned hawk	Accipter striatus
Red-tailed hawk	Buteo jamaicensis
*Golden eagle	Aquila chrysaetos
*Bald eagle	Haliaeetus leucocephalus
Marsh hawk	Circus cyaneus
Pigeon hawk	Falco columbarius
Sparrow hawk	Falco sparverius
*Osprey	Pandion haliaetus
*Peregrine falcon	Falco peregrinus
*Bobwhite quail	Colinus virginianus
*Hungarian partridge	Perdix perdix
Ringed-necked pheasant	Phasianus colochicus
*Sandhill crane	Grus canadensis
*King rail	Rallus elegans
*Sora	Poranza carolina
*Coot	Fulica americana
Killdeer	Charadrius vociferus
*Woodcock	Philohela minor
Rock dove	Columba Livia
Mourning dove	Zenaida macroura
Screech owl	Otus Asio
Great horned Owl	Bubo virginianus
Yellow-shafted flicker	Colaptes auratus
Red-bellied woodpecker	Centurus carolinus
Red-headed woodpecker	Melanerpes erythrocephalus
Hairy woodpecker	Dendrocopos villosus
Downy woodpecker	Dendrocopos pubescens
Horned lark	Eremophila alpestris

Purple martin	Progne subis
Blue jay	Cyanocitta cristata
Common crow	Corvus brachyrhynchos
Black-capped chickadee	Parus atricapillus
Tufted titmouse	Parus bicolor
White-breasted nuthatch	Sitta carolinensis
Red-breasted nuthatch	Sitta canadensis
Brown creeper	Certhia familiaris
Carolina wren	Thryothorus ludovicianus
Catbird	Dumetella carolinensis
Eastern bluebird	Sialia sialis
Ruby-crowned kinglet	Regulus calendula
Cedar waxwing	Bombycilla cedrorum
Starling	Sturnus vulgaris
Kirtland's warbler	Dendroica kirtlandii
House sparrow	Passer domesticus
Meadowlark	Sturnella sp.
Common grackle	Quiscalus quiscala
Brown-headed cowbird	Molothrus ater
Indigo bunting	Passerina cyanea
Cardinal	Cardinalis cardinalis
Grossbeak	
American gold finch	Spinus tristis
Junco	Junco sp.
Tree sparrow	Spizella passerina
Chipping sparrow	Spizella arborea
White-crowned sparrow	Zonotrichia leucophrys
White-throated sparrow	Zonotrichia albicollis
Song sparrow	Passerella melodia

Sources: Summer and Winter Birds; by letter, Mrs. Garland Crawford, Audubon Society, 11 October 1978.

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* Allison, Hothem, "An evaluation of the status of fisheries and the status of other selected wild animals in the Maumee River Basin, Ohio", 1975.

** List includes summer and winter birds. * Indicates species, selected by the ODNR, with different degrees of status in the area and many of which are migrants to the area. A complete list of migrant species is not included but all species in the northern part of the Mississippi Flyway would be expected to be found in the drainage basin.

MAMMALS OF NORTHWESTERN OHIO, NETTLE LAKE STUDY AREA

Opossum	Didelphis virginiana
Masked shrew	Sorex cinereus
Short-tailed shrew	Blarina brevicauda
Least shrew	Cryptotis parva
Eastern mole	Scalopus aquaticus
Star-nosed mole	Condylura cristata
Little brown myotis	Myotis lucifugus
Keen's myotis	Myotis keenii
Small-footed myotis	Myotis subulatus
Indiana myotis	Myotis sodalis
Silver-haired bat	Lasionycteris noctivagans
Eastern pipistrelle	Pipistrellus subflavus
Big brown bat	Eptesicus fuscus
Red bat	Lasiurus borealis
Hoary bat	Lasiurus cinereus
Evening bat	Nycticeius humeralis
Eastern chipmunk	Tamias striatus
Woodchuck	Marmota monax
Thirteen-lined ground squirrel	Spermophilus tridecemlineatus
Gray squirrel	Sciurus carolinensis
Fox squirrel	Sciurus niger
Red squirrel	Tamiasciurus hudsonicus
Southern flying squirrel	Glaucomys volans
Beaver	Castor canadensis
Deer mouse	Peromyscus maniculatus
White-footed mouse	Peromysyscus leucopus
Meadow vole	Microtus pennsylvanicus
Woodland (pine) vole	Microtus pinetorum
Muskrat	Ondrata zibethicus
Norway rat	Rattus norvegicus
House mouse	Mus musculus
Meadow jumping mouse	Zapus hudsonius
Coyote	Canis latrans

Mammals (cont'd.)

Red fox	Vulpes vulpes
Gray fox	Urocyon cineroargenteus
Raccoon	Procyon lotor
Least weasel	Mustela nivalis
Long-tailed weasel	Mustela frenata
Mink	Mustela vison
Badger	Taxidea taxus
Striped skunk	Mephitis mephitis
River otter	Lutra canadensis
White-tailed deer	Odocoileus virginianus

Sources:

Burt, W. H., and R. P. Grossenheider. A field guide to the mammals. Houghton Mifflin Company, Boston. 284 p.

Jones, J. K., Jr., D. C. Carter, and H. H. Genoways. 1975. Revised checklist of North American mammals north of Mexico. Occasional Papers, The Museum, Texas Tech University, No. 28, 14 p. (Used for current scientific names and accepted common names.)

Mumford, R. E. 1969. Distribution of the mammals of Indiana. Indiana Academy of Sciences Monograph 1:1-114.

APPENDIX C

POPULATION

METHODOLOGY FOR PROJECTING PROPOSED SERVICE AREA PERMANENT AND SEASONAL POPULATIONS, 1975 and 2000

Population Estimate In Year 1975

The 1975 population estimate for the Nettle Lake Proposed Service Area was based on an analysis of existing aerial photography, discussions with local officials knowledgeable about occupancy rates and permanent and seasonal resident relationships, an examination of local property tax rolls, and past population trends. These discussions and analyses yielded the following information concerning the Nettle Lake Proposed Service Area:

- A 1975 dwelling unit count by subarea
- Permanent and seasonal dwelling unit percentage breakdowns
- Permanent and seasonal dwelling unit occupancy rates (persons per household).

Table 1 presents the dwelling unit count by subarea and the permanent and seasonal population totals derived by applying the permanent/seasonal dwelling unit percentage and occupancy rates to the farmer. Seasonal population totals of the two campgrounds in the Proposed Service Area were added to the count. Camp DeClair's reported 120 campsites and Shady Shore Camp's 60 campsites accommodated peak seasonal populations of 480 and 240 people, respectively, which are attained during most summer weekends.

Population Projections 1975-2000

The year 2000 permanent and seasonal baseline population projections considered the three growth factors influencing future population levels in the Nettle Lake Proposed Service Area: (1) the rate of growth or decline of the permanent population; (2) the rate of growth or decline of the seasonal population; and (3) the potential conversion of seasonal to permanent dwelling units. The best available information regarding each of these factors was utilized and resulted in the following assumptions:

- The rate of permanent population growth in the Nettle Lake Proposed Service Area will be equivalent to that projected for Northwest Township by 1990. This growth rate, extrapolated to year 2000, is approximately .75% annually or 20% during the planning period.
- Existing seasonal dwelling units will be converted to permanent dwelling units at a rate of approximately 0.5% annually or 10.0% during the planning period. An examination of property tax rolls indicated that, generally, one seasonal dwelling unit per year was converted to a permanent residence, usually when seasonal residents of retirement age relocated permanently to the Proposed Service Area.
- There is a very limited demand for seasonal dwelling units in the Proposed Service Area. Two private recreational developments east of Nettle Lake (one lake is near Bridgewater and

Table 1

Nettle Lake Service Area
Distribution of Dwelling Units and Estimated Population in 1975

	Dwelling Unit Equivalents					Occupancy Rates		Population		
Subarea	Total	Percent Permanent[1]	Permanent	Percent Seasonal[1]	Seasonal	Permanent[2]	Seasonal[3]	Permanent	Seasonal	Total
Lazy Acres South	76	9.2%	7	90.8%	69	3.2	4.2	22	290	312
Lakeview/Eureka Beach	83	12.0%	10	88.0%	73	3.2	4.2	32	307	339
Shady Shore	29	13.8%	4	86.2%	25	3.2	4.2	13	105	118
Lazy Acres North	51	7.8%	4	92.2%	47	3.2	4.2	13	197	210
Roanza Beach	32	46.9%	15	53.1%	17	3.2	4.2	48	71	119
Crestwood	13	0.0%	0	100.0%	13	3.2	4.2	0	55	55
Camp DeClair[4]	120	0.0%	0	100.0%	120		4.0	0	480	480
Shady Shore Camp[4]	60	0.0%	0	100.0%	60		4.0	0	240	240
Total Service Area	464	8.6%	40	91.4%	424			128	1,745	1,873

1 Based on local property tax roll records and discussions with local individuals knowledgeable about the area.

2 Based on 1970 Census data for household size in Northwest Township.

3 Based on the national and locally observed trend that seasonal residences have substantially higher occupancy rates than permanent residences.

4 Based on correspondence with the Williams County Regional Planning Commission, Camp DeClair has 120 campsites and Shady Shore Camp 60 campsites.

one in Amboy Township, Michigan) have had limited second home development activity even though they offer more attractive second home sites (larger lakes, closer to major metropolitan area users) than Nettle Lake.

The Williams County Floodplain Ordinance (March 1978) has limited the potentially developable areas in the Nettle Lake Proposed Service Area. In view of the development restrictions and the limited demand for seasonal units, it is projected that a maximum of 20 new seasonal units, primarily mobile homes or trailers, will be added in the Proposed Service Area during the planning period. The limited development activity that will occur will be in the Crestwood, Lazy Acres North, Lazy Acres South, and Lakeview/Eureka Beach subareas.

Based on these observed trends and assumptions, the population projections and dwelling unit equivalents for each subarea for the year 2000 were developed as indicated in Table 2. The seasonal populations for Camp DeClair and Shady Shore Camp were assumed to remain constant during the planning period. The smaller occupancy rates utilized for both permanent and seasonal dwelling units reflect the national trend toward smaller family sizes. The resulting total in-summer population for Nettle Lake for the year 2000 is projected to be 1,904 people: 228 permanent residents and 1,676 seasonal residents.

Comparison of Facilities Plan's and EIS Estimates of 1975 Population

The Facilities Plan for Nettle Lake estimated the 1975 Proposed Service Area population at 660 people. This estimate was based on 300 dwelling units at 2.2 persons per dwelling unit. The seasonal-permanent population distribution was estimated at 110 permanent residents and 550 seasonal residents. The Facilities Plan total in-summer population estimate differs from the EIS estimate by more than 1,300. This difference is directly attributable to three factors: (1) the Facilities Plan's use of an incorrect occupancy rate of 2.2 persons per unit for permanent units (the 1970 US Census figure was 3.2 persons per unit); (2) the Facilities Plan's conservative use of this low permanent occupancy rate figure for seasonal occupancy as well (national trends indicate that occupancy rates for seasonal units are generally higher); and (3) the Facilities Plan did not consider the seasonal population accommodated at the 180 campsites in Camp DeClair and Shady Shore Camp. Consequently, the bases for the EIS estimate for 1975--more accurate data and a more comprehensive examination of occupancy rates and permanent/seasonal dwelling unit ratios--appear to be more valid.

Comparison of Population Projections for Year 2000

The Facilities Plan projection for the population in year 2000 was based on a count of remaining developable lots in the Proposed Service Area. It resulted in a total of 560 dwelling units by the year 2000, to which an occupancy rate of 2.2 persons per dwelling unit was applied to derive a total in-summer population of 1,250 people--1,000 seasonal and 250 permanent.

Table 2

Permanent and seasonal population and dwelling unit equivalent for the Nettle Lake proposed service area (2000).

Subarea	Permanent Dwelling Units				Seasonal Dwelling Units				Occupancy Rates		Population		
	1975	New[1]	Converted[2]	Total	1975	New[3]	Converted[4]	Total	Permanent[5]	Seasonal[5]	Permanent	Seasonal	Total
Lazy Acres South	7	6	7	20	69	5	7	67	3.0	4.0	60	268	328
Lakeview/Eureka Beach	10	4	7	21	73	4	7	70	3.0	4.0	63	280	343
Shady Shore	4	0	3	7	25	0	3	22	3.0	4.0	21	88	109
Lazy Acres North	4	1	5	10	47	5	5	47	3.0	4.0	30	188	218
Roanza Beach	15	0	2	17	17	0	2	15	3.0	4.0	51	60	111
Crestwood	0	0	1	1	13	6	1	18	3.0	4.0	3	72	75
Camp DeClair	0	0	0	0	120	0	0	120	-	4.0	0	480	480
Shady Shore Camp	0	0	0	0	60	0	0	60	-	4.0	0	240	240
Total Service Area	40	11	25	76	424	20	25	419			228	1,676	1,904

1 The number of new permanent dwelling units constructed between 1975 and 2000 is based on population projections for Northwest Township. The distribution of these units is based on the developable land outside the 100-year floodplain available in each subarea.

2 Seasonal units converted to permanent units, based on a .5% annual conversion rate.

3 The number and distribution of new seasonal dwelling units constructed between 1975 and 2000 is based on current development pressures for seasonal residences and the availability of developable land in each subarea.

4 Seasonal dwelling units lost to conversion as permanent units.

5 Occupancy rates for the year 2000 were reduced to reflect the national trend toward smaller family sizes.

6 Camp DeClair and Shady Shore Camp are not expected to expand their facilities during the planning period because developable land is not available nearby.

In comparison to the EIS projection for the year 2000, the dwelling unit projection is high and the population projection is low. The EIS projection assumes that development pressures in the Proposed Service Area will be minimal and available developable land limited due to the floodplain ordinance restrictions; resulting in a total dwelling unit equivalent projection of 495 (including 180 camping sites). However, the EIS projection uses more realistic permanent (3.0 persons/unit) and seasonal (4.0 persons/unit) occupancy rates to derive a total in-summer population of 1,904 people, including 228 permanent and 1,676 seasonal residents. While the Facilities Plan's permanent population projection is similar to this EIS (due to an overestimation of permanent dwelling unit projection), the seasonal projection is nearly 700 lower, primarily because it used a lower seasonal occupancy rate and excluded the campground sites.

APPENDIX D

STUDIES AND REGULATIONS OF EXISTING SYSTEMS

INVESTIGATION OF SEPTIC LEACHATE DISCHARGES INTO NETTLE LAKE, OHIO

December, 1978

Prepared for

WAPORA, Inc.
Washington, D.C.

Prepared by

K-V Associates, Inc.
Falmouth, Massachusetts
January, 1979

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INTRODUCTION

Septic Leachate Plumes - Types and Characteristics

In porous soils, groundwater inflows frequently convey wastewaters from nearshore septic units through bottom sediments and into lake waters, causing attached algae growth and algal blooms. The lake shoreline is a particularly sensitive area since: 1) the groundwater depth is shallow, encouraging soil water saturation and anaerobic conditions; 2) septic units and leaching fields are frequently located close to the water's edge, allowing only a short distance for bacterial degradation and soil adsorption of potential contaminants; and 3) the recreational attractiveness of the lakeshore often induces temporary overcrowding of homes leading to hydraulically overloaded septic units. Rather than a passive release from lakeshore bottoms, groundwater plumes from nearby on-site treatment units actively emerge along shorelines, raising sediment nutrient levels and creating local elevated concentrations of nutrients (Kerfoot and Brainard, 1978). The contribution of nutrients from subsurface discharges of shoreline septic units has been estimated at 30 to 60 percent of the total nutrient load in certain New Hampshire lakes (LRPC, 1977).

Wastewater effluent contains a mixture of near UV fluorescent organics derived from whiteners, surfactants and natural degradation products which are persistent under the combined

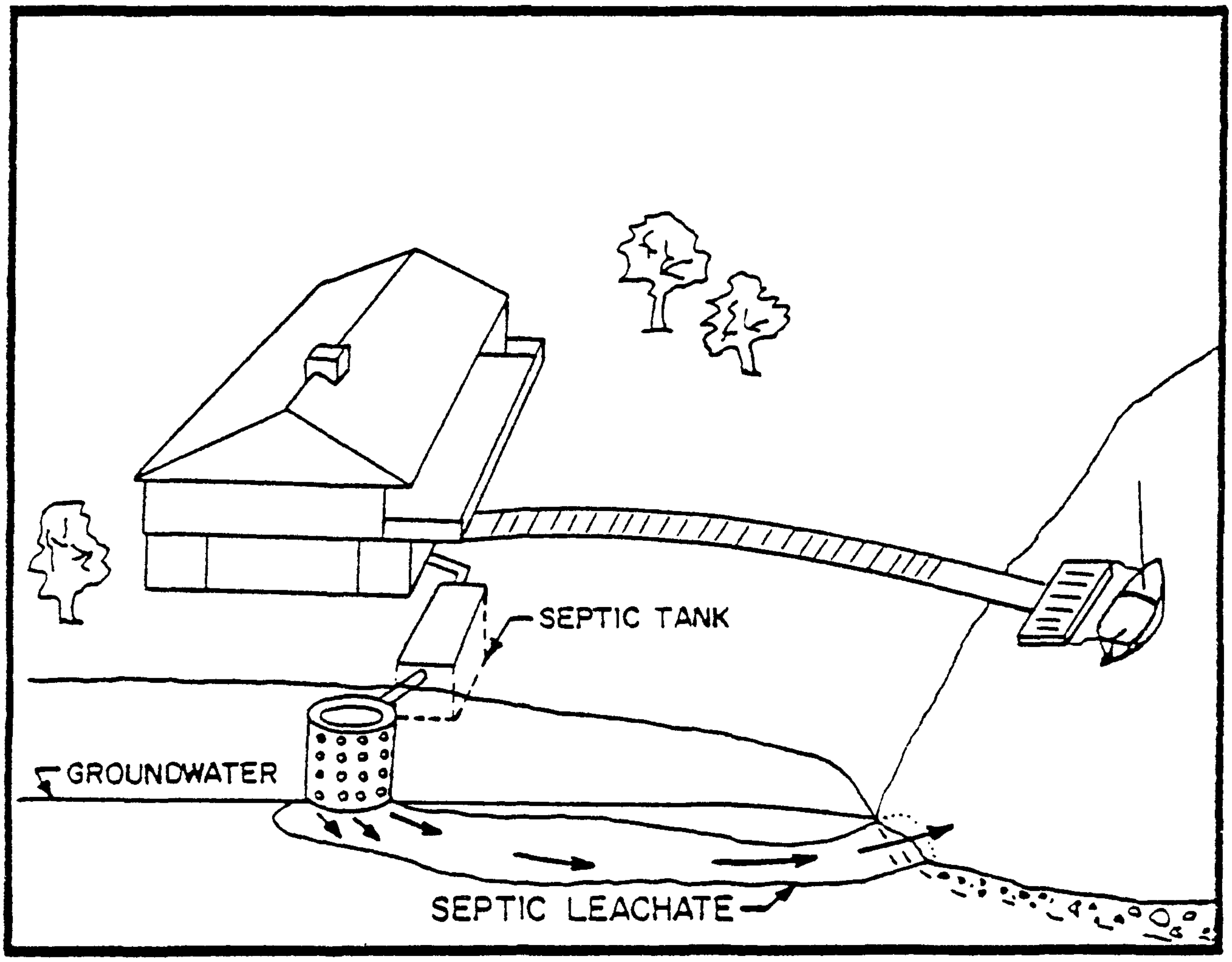
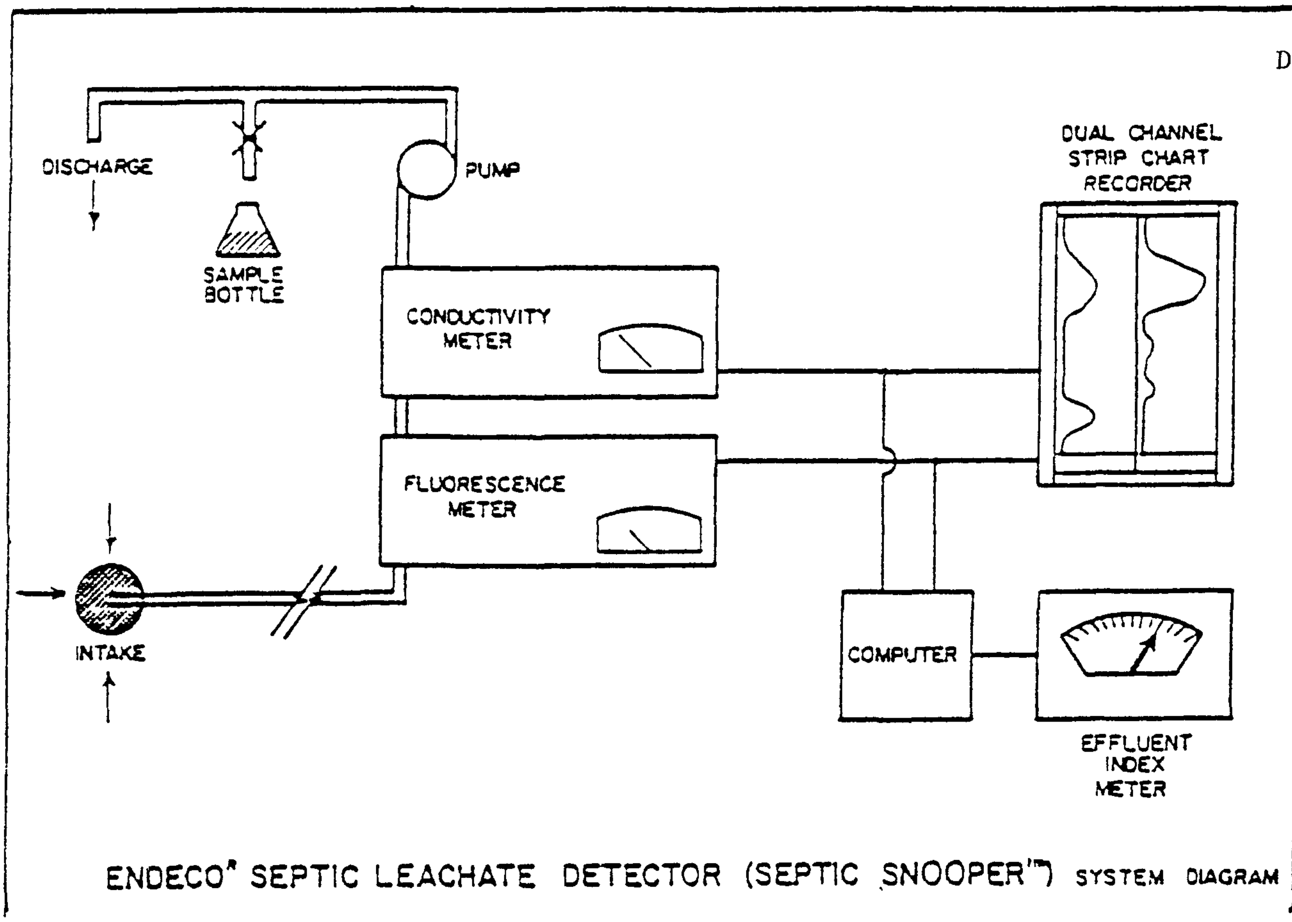


FIGURE 1. Excessive Loading of Septic Systems on Porous Soils Causes the Development of Plumes of Poorly-treated Effluent Which Move Laterally with Groundwater Flow and May Discharge Near the Shoreline of Nearby Lakes.

conditions of low oxygen and limited microbial activity. Figure 2 shows two samples of sand-filtered effluent from the Otis Air Force Base sewage treatment plant. One was analyzed immediately and the other after having sat in a darkened bottle for six months at 20°C. Note that little change in fluorescence was apparent, although during the aging process some narrowing of the fluorescent region did occur. The aged effluent percolating through sandy loam soil under anaerobic conditions reaches a stable ratio between the organic content and chlorides which are highly mobile anions. The stable ratio (cojoint signal) between fluorescence and conductivity allows ready detection of leachate plumes by their conservative tracers as an early warning of potential nutrient breakthroughs or public health problems.

The Septic Leachate Detector (ENDECO Type 2100 "Septic Snooper") consists of the subsurface probe, the water intake system, the analyzer control unit, and the graphic recorder (Figure 3). Initially the unit is calibrated against stepwise increases of wastewater effluent, of the type to be detected, added to the background lake water. The probe of the unit is then placed in the lake water along the shoreline. Groundwater seeping through the shoreline bottom is drawn into the subsurface intake of the probe and travels upwards to the analyzer unit. As it passes through the analyzer, separate conductivity and specific fluorescence signals are generated and sent to a signal processor which registers the separate signals on a



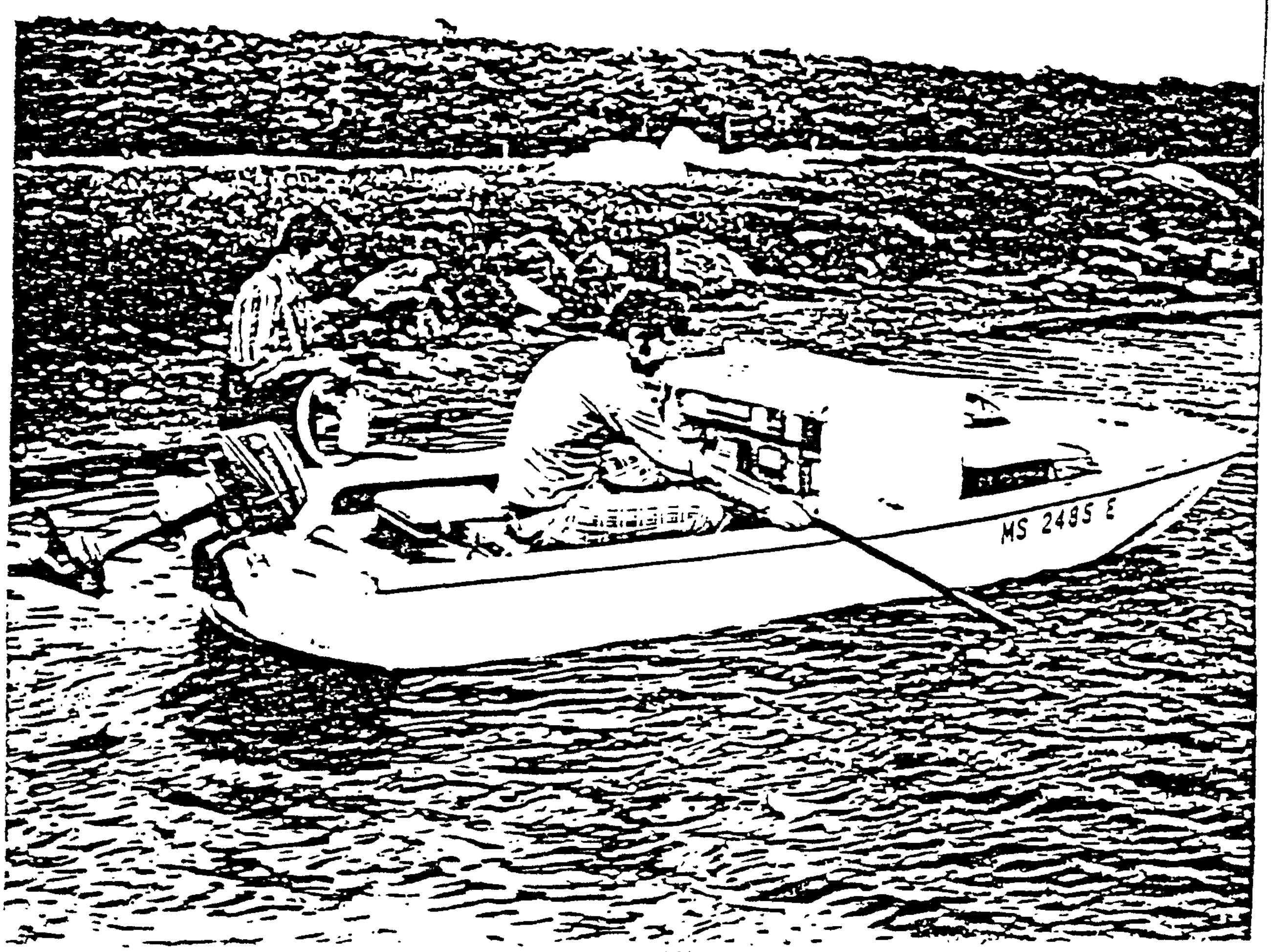


FIGURE 3. The Type 2100 "SEPTIC SNOOPER™" Consists of Combined Fluorometer/ Conductivity Units Whose Signal is Adjusted to Fingerprint Effluent. The Unit is Mounted in a Boat and Piloted Along the Shoreline. Here the Probe is Shown in the Water with a Sample Being Taken at the Discharge of the Unit for Later Detailed Analysis.

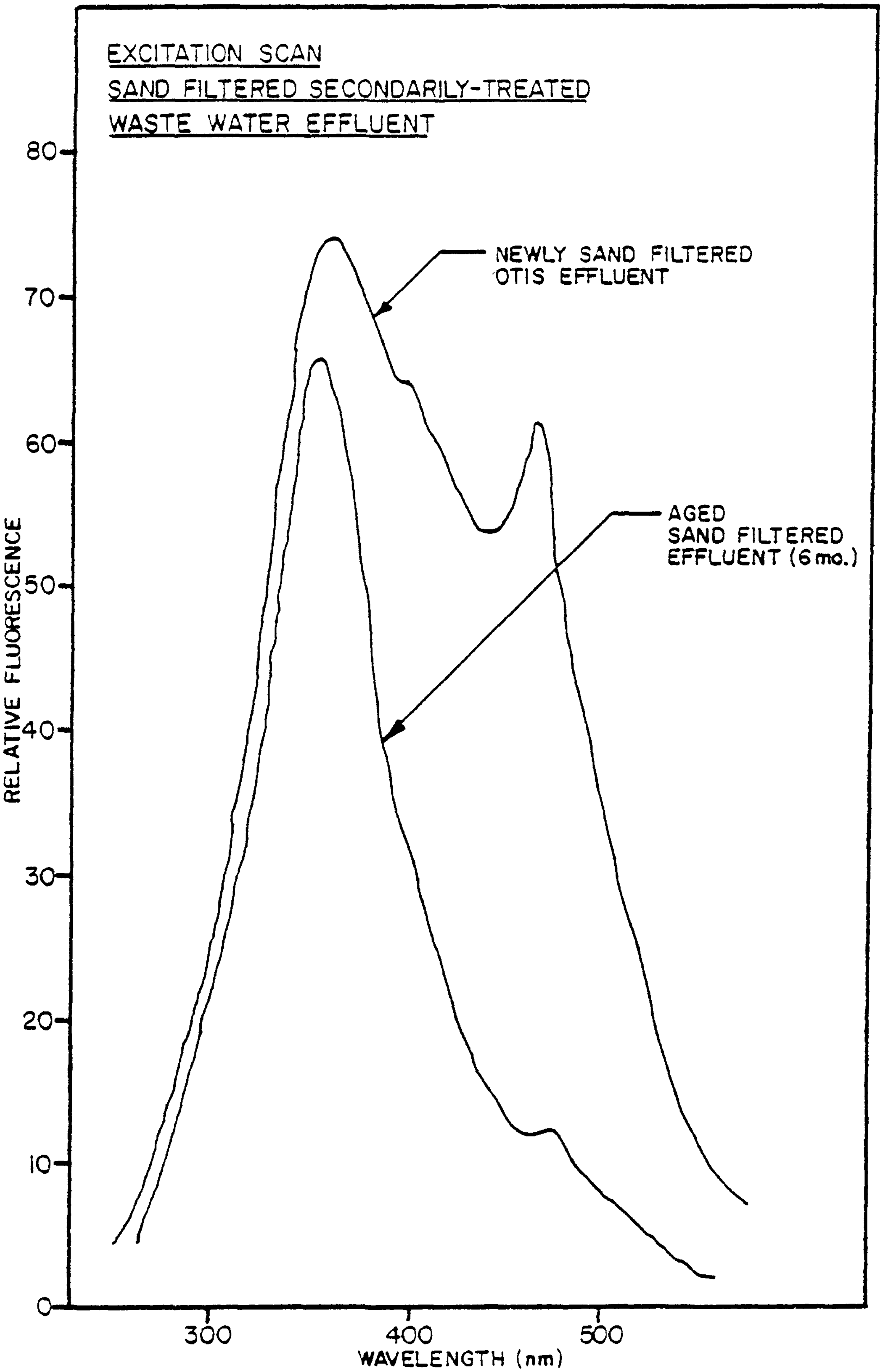


FIGURE 2. Sand-filtered Effluent Produces a Stable Fluorescent Signature, Here Shown Before and After Aging.

strip chart recorder as the boat moves forward. The analyzed water is continuously discharged from the unit back into the receiving water.

Types of Plumes

The capillary-like structure of sandy porous soils and horizontal groundwater movement induces a fairly narrow plume from malfunctioning septic units. The point of discharge along the shoreline is often through a small area of lake bottom, commonly forming an oval-shaped area several meters wide when the septic unit is close to the shoreline. In denser subdivisions containing several overloaded units the discharges may overlap, forming a broader increase.

Three different types of groundwater-related wastewater plumes are commonly encountered during a septic leachate survey: A) erupting plumes, B) passive plumes, and C) stream source plumes. As the soil becomes saturated with dissolved solids and organics during the aging process of a leaching on-lot septic system, a breakthrough of organics occurs first, followed by inorganic penetration (principally chlorides, sodium, and other salts). The active emerging of the combined organic and inorganic residues into the shoreline lake water describes an erupting plume. In seasonal dwellings where wastewater loads vary in time, a plume may be apparent during late summer when shoreline cottages sustain heavy use, but retreat during winter during low flow conditions. Residual organics from the waste-water often still remain attached to soil particles in the vicinity of the previous erupting plume, slowly releasing into the shoreline waters. This dormant plume indicates a previous breakthrough, but sufficient treatment of the plume exists under current conditions so that no inorganic discharge is apparent. Stream source plumes refer to either groundwater leachings of nearstream septic leaching fields or direct pipe discharges into streams which then empty into the lake.

2.0 METHODOLOGY - SAMPLING AND ANALYSIS

Water sampling for nutrient concentrations along the shoreline is coordinated with the septic leachate profiling to clearly identify the source of effluent. A profile of the shoreline for emergent plumes was obtained by manually towing the septic leachate detector along the lee side of the shoreline in a 5 meter aluminum rowboat. As water was drawn through the probe and through the detector, it was scanned for specific organics and inorganics common to septage leachate.

A standard septic leachate survey proceeds in the following manner: If elevated concentrations of leachate are indicated on the continual chart recorder, a search is made of the area to pinpoint the location of maximum concentration. At that time 1) a surface water sample is taken from the discharge of the detector for later nutrient analysis, 2) an interstitial groundwater sample is taken with a hand-driven well-point sampler to a depth of .3 meter and 3) finally a surface water sample for bacterial content (total and fecal coliform) is also taken. The combination of the triple sampling serves to identify the source of effluent. If the encountered plume originates from groundwater seepage, the concentration of nutrients would be considerably elevated in the well-point sample. If the source were surface effluent runoff, a low nutrient groundwater content would exist with an elevated bacterial content. If a stream source occurred, an isolated single plume would not be found during search, but instead a broadening plume traced back to a surface water inlet. Groundwater samples taken in the vicinity of the surface outflow would also not show as high a nutrient content as the surface water samples. However in the case of Nettle Lake, only one plume was located. In such a situation, numerous background samples are taken to evaluate the condition of interstitial and surface waters of the lake.

All water samples are analyzed by EPA Standard Methods for the following chemical constituents:

Conductivity (cond.)
Ammonia-nitrogen (NH_4-N)
Nitrate-nitrogen (NO_3-N)
Total phosphorus (TP)
Orthophosphate phosphorus (PO_4-P)

A total of 19 water samples for chemical analysis were obtained. Almost all of these represented broad background sampling. Only one was obtained at a plume location. The samples were placed in polyethylene containers, chilled, and frozen for transport and storage. Conductivity was determined by a Beckman (Model RC-19) conductivity bridge, ammonium-nitrogen by phenolate method, nitrate nitrogen by the brucine sulfate procedure, and orthophosphate-phosphorus and total phosphorus by the single reagent procedures following standard methods (EPA, 1975).

Water samples for bacterial analysis were placed in sterilized 150 ml glass containers obtained from the Williams County Health Department and mailed to the Ohio Department of

Health Laboratories, Columbus, Ohio, for analysis. Analyses were performed for total coliform bacteria and fecal coliform by the membrane filter method.

3.0 PLUME LOCATIONS

Nettle Lake is a kettle or pit lake of glacial origin. It was formed during the recession of the last glaciation when ice was buried under glacial till, melted, and formed a depression of relatively impermeable soils. The developments around the lake house a few year-round residents, but the majority are seasonals which occupy summer cottages. The cottages use septic tank and leaching field systems for effluent disposal. However, the shoreline soils are not recommended for use as leach or drain fields due to poor permeability, slow percolation rates, seasonal flooding, and ponding problems (Filbey, 1978).

No substantial groundwater plumes of effluent from near-shore septic units were observed along the shoreline of Nettle Lake. Some variation in background conductance usually occurs as a result of the inflow of different types of groundwater; this was lacking along the shoreline of Nettle Lake indicating very little groundwater inflow. The sole plume observed was a distinct isolated surface water plume at the inflow of Nettle Creek, suggesting a source of elevated dissolved solids from upstream. A slight organic deflection occurred in the vicinity of sample 15, but was hardly noticeable above background.

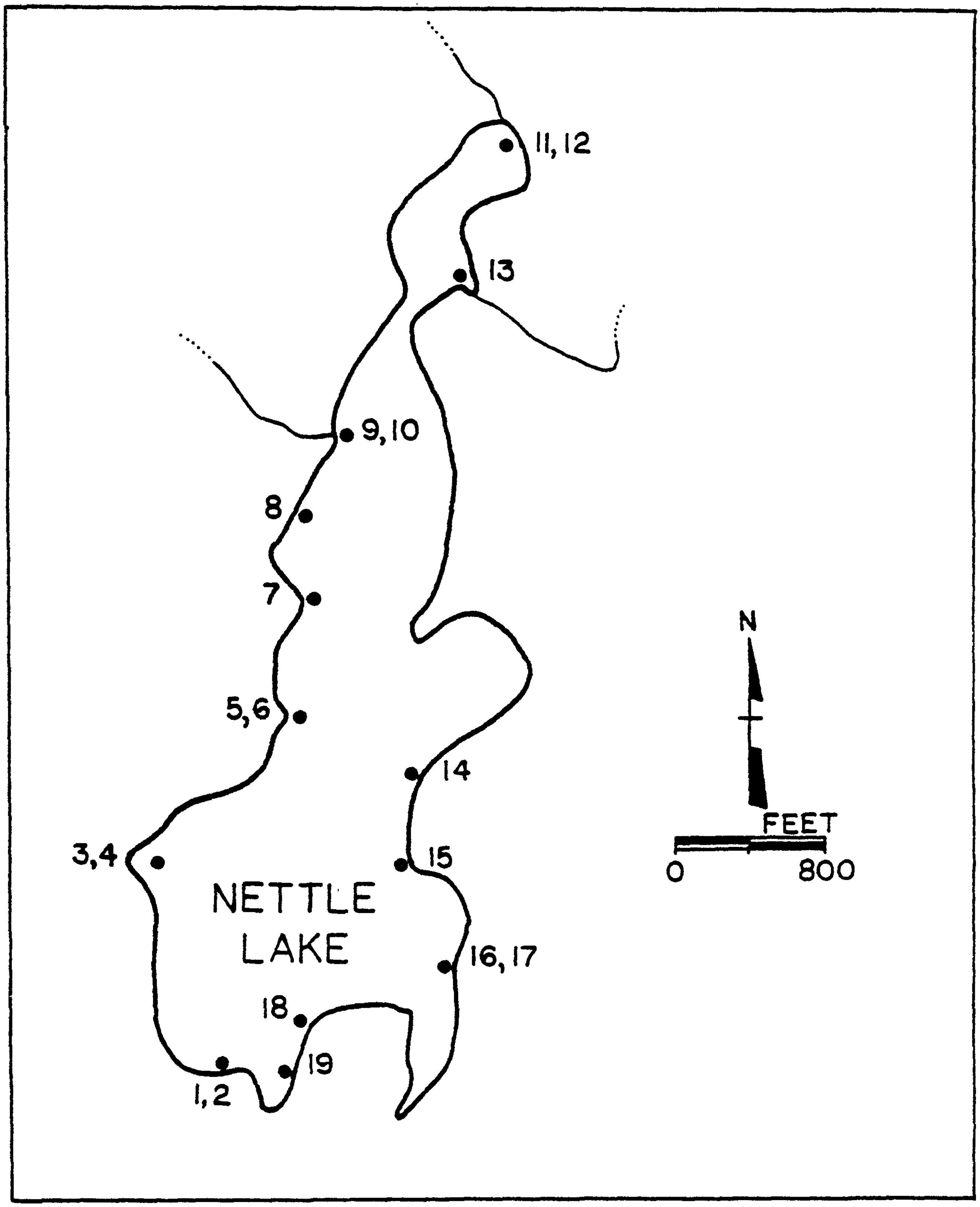


Figure 4. Dots indicate locations of samples taken along shoreline.

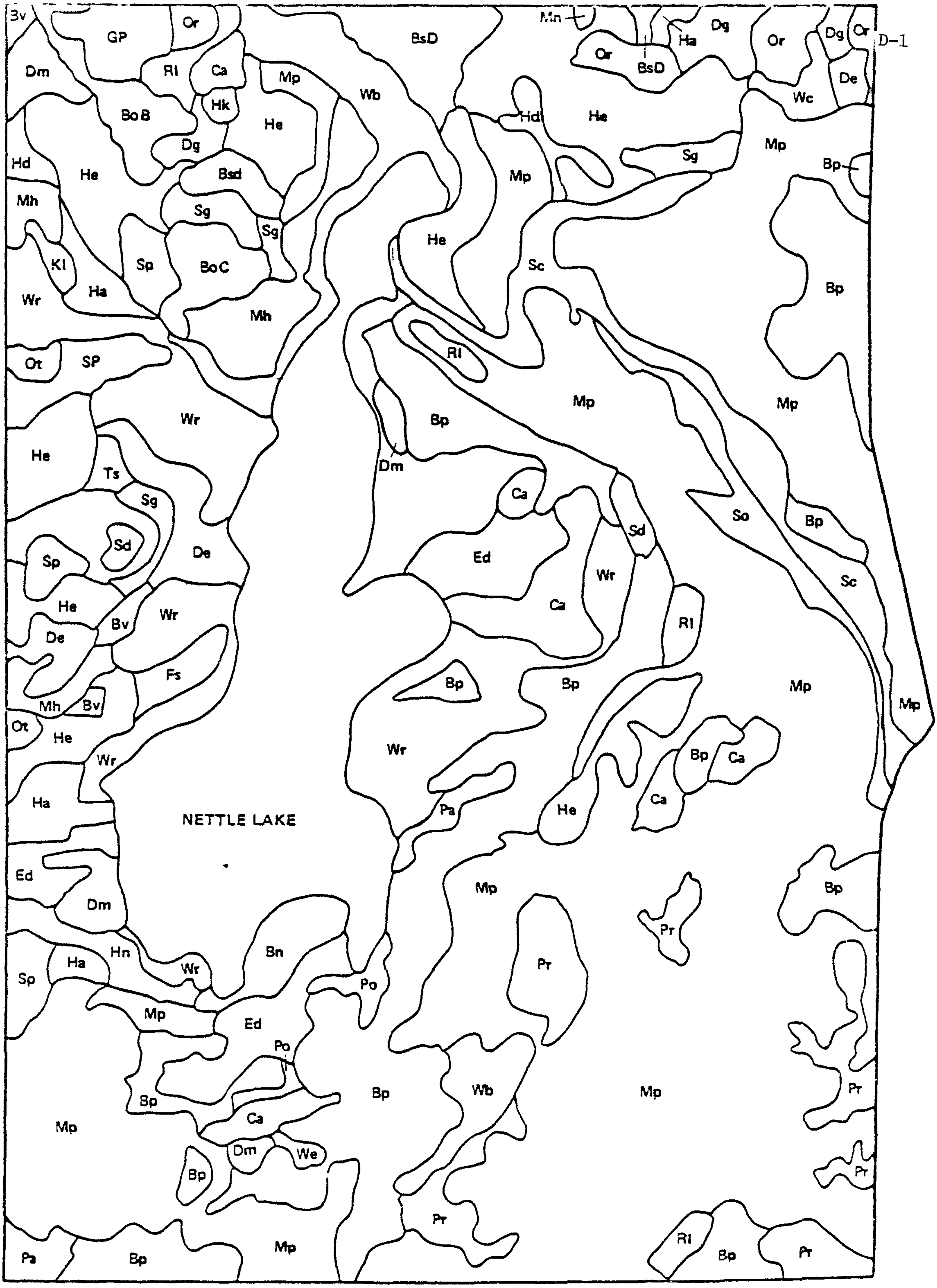
NETTLE LAKE AREA
SOIL TYPES AND DISTRIBUTION

LEGEND

Bn	Blount Loam
BoB	Boyer Loamy Sand
BoC	Boyer Loamy Sand
Bp	Blount Loam, Loam Substratum Variant
BsD	Boyer Gravelly Loamy Sand
Bv	Bono Silty Clay Loam
Ca	Carlisle Muck
De	Del Rey Loam
Dg	Digby Sandy Loam
Dm	Digby Loam
Ed	Edwards Muck
Fs	Fulton Loam
GP	Gravel Pit
Ha	Haney Sandy Loam
Hd	Haney Loam
He	Haney - Rawson Sandy Loams
Hk	Haskins Sandy Loam
Hn	Haskins Loam
Kl	Kibbie Very Fine Sandy Loam
Mh	Millgrove Loam
Mp	Glynwood Loam, Loam Substratum Variant
Or	Oshtemo Loamy Sand
Ot	Ottokee Sand
Pa	Paulding Clay
Po	Pewamo Silty Clay Loam, Loam Substratum Variant
Pr	Pewamo Silty Clay Loam, Loam Substratum Variant
Rl	Rawson Sandy Loam
Sc	Bono Silty Clay Loam
Sd	Seward Loamy Fine Sand
Sg	Shinrock Silt Loam
So	Sloan Silty Clay Loam
Sp	Spinks Sand
Ts	Tuscola Very Fine Sandy Loam
Wb	Wallkill Silty Clay Loam, Clayey Subsoil Variant
Wc	Wallkill Silt Loam
Wr	Martisco Muck

Approximate Scale 1" = 800'

Figure 5. Legend and map showing soil types surrounding Nettle Lake reproduced from Filbey, 1978.


Bv
Or
GP
Dm
Rl
Ca
Mp
BsD
Mn
Ha
Dg
Or
BsD
Or
Dg
Or
De
Wc
Hk
BoB
He
Wb
Hd
He
Sg
Mp
Bp
Hd
He
Dg
Bsd
Mh
Sg
Sg
Mp
He
Kl
Sp
BoC
Sc
Bp
Wr
Ha
Mh
Ot
SP
Rl
Wr
Mp
Mp
Bp
He
Ts
Dm
Ca
Sg
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Wb
Mp
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Mp
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Bp
Dm
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Bp
Pr
Pr
Rl
Pa
Bp
Mp
Bp
Pr

4.0 NUTRIENT ANALYSES

Completed analyses of the chemical content of 19 samples taken along the Nettle Lake shoreline are presented in Table 1. The sample letters refer to the locations given in Figure 4. The symbol "S" refers to surface water sample and the symbol "G" to groundwater sample. The conductivity of the water samples as conductance (umhos/cm) is given in the second column. The nutrient analyses for orthophosphorus (PO_4-P), total phosphorus (TP), ammonium-nitrogen (NH_4-N), and nitrate-nitrogen $(N)_3$-N) are presented in the next four columns in parts-per-million (ppm - mg/l).

5.0 NUTRIENT RELATIONSHIPS

Since no distinct groundwater effluent plumes were observed, a ratio analysis of nutrient breakthrough with the plumes is not presented. Interstitial groundwater samples were found to contain elevated nutrient concentrations common to eutrophic conditions. Since groundwater inflow was severely limited by the tight bottom soils, the nutrients are apparently not being actively transported into the lake waters by groundwater flow.

Table 1. Analysis of surface water (S) and groundwater (G) samples taken along the shoreline of Nettle Lake.

Sample Number	Cond.	Concentration (ppm - mg/l) PO_4-P	TP	NH_4-N	NO_3-N
1 G	448	.003	1.876	14.245	.035
2 S	275	.002	.028	.148	.069
3 S	280	.002	.027	.171	.081
4 G	560	.002	.285	7.280	.028
5 S	250	.002	.027	.132	.134
6 G	440	.001	.116	4.634	.011
7 G	320	.016	.539	2.205	.028
8 S	232	.001	.036	.162	.009
9 S	330	.002	.025	.119	.150
10 G	458	.007	.022	8.722	.022
11 S	275	.002	.026	.213	.085
12 G	400	-	2.635	.637	.147
13 S	205	.002	.022	.179	.060
14 S	290	.002	.025	.161	.077
15 S	300	.002	.030	.158	.083
16 G	340	.002	.029	.171	.087
17 G	360	.004	3.584	1.442	.055
18 S	360	-	.279	.123	.057
19 S	340	.002	.040	.199	.084

6.0 COLIFORM LEVELS

On December 14, six samples of surface waters were taken along the shoreline and forwarded to the Ohio Department of Health Laboratories for analysis (Figure 6, samples N1 - N6). Although total coliform and fecal coliform analyses were requested, only total coliform determinations were performed. All samples contained total coliform concentrations too numerous to count (TNTC) because of a procedural error in which the total volume of water was processed through the culture membrane filter. The results are therefore misleading and should not be considered as indicative of true water condition. For useful information, the analyses should be repeated with fecal coliform determinations.

7.0 CONCLUSIONS

Nettle Lake basin consists of predominantly tight soils, Martisco muck, Digby loam, Wallkill silty clay loam, Del Rey loam, and Blount loam which limit groundwater inflow. It is not surprising, then, that no distinct groundwater leachate plumes were observed from individual septic systems along the shoreline. Elevated bacterial counts were found in water samples taken along the periphery of the lake. Since extensive shoreline areas lie within the floodplain (flood prone zone), the leaching fields may be inundated during periods of high water.

Heavy concentrations of cattails, bulrushes, reeds, sedges, and grasses found around the shore of the lake is an indication of plant succession in the lake aging (eutrophication) process (Filbey, 1978). Interstitial water samples do show significant nutrient concentrations in the lake sediments, although the source most likely is deposited material and not groundwater inflow. Storm runoff and flood waters are probably sources of nutrients and appear to be far more important than groundwater transport.

REFERENCES

EPA, 1975. Methods for chemical analysis of water and wastes. Environmental Protection Agency, NERC, Analytical Control Laboratory, Cincinnati, Ohio 45268.

Kerfoot, W. B. and E. C. Brainard, II, 1978. Septic leachate detection - a technological breakthrough for shoreline on-lot system performance evaluation. In: State of Knowledge in Land Treatment of Wastewater, H. L. McKim, ed., International Symposium at the Cold Regions Research and Engineering Laboratory, Hanover, New Hampshire.

LRPC, 1977. Discussion of nutrient retention coefficients, Draft Report 6F2 from Phase II Nonpoint Source Pollution Control Program, Lakes Region Planning Commission, Meredith, New Hampshire.

Filbey, R. D., 1978. Nettle Lake environmental inventory and assessment, June, 1978. EMSL-LV Project RSD 7851, Office of Research and Development, U.S. Environmental Protection Agency, Las Vegas, Nevada 89114.

APPENDIX

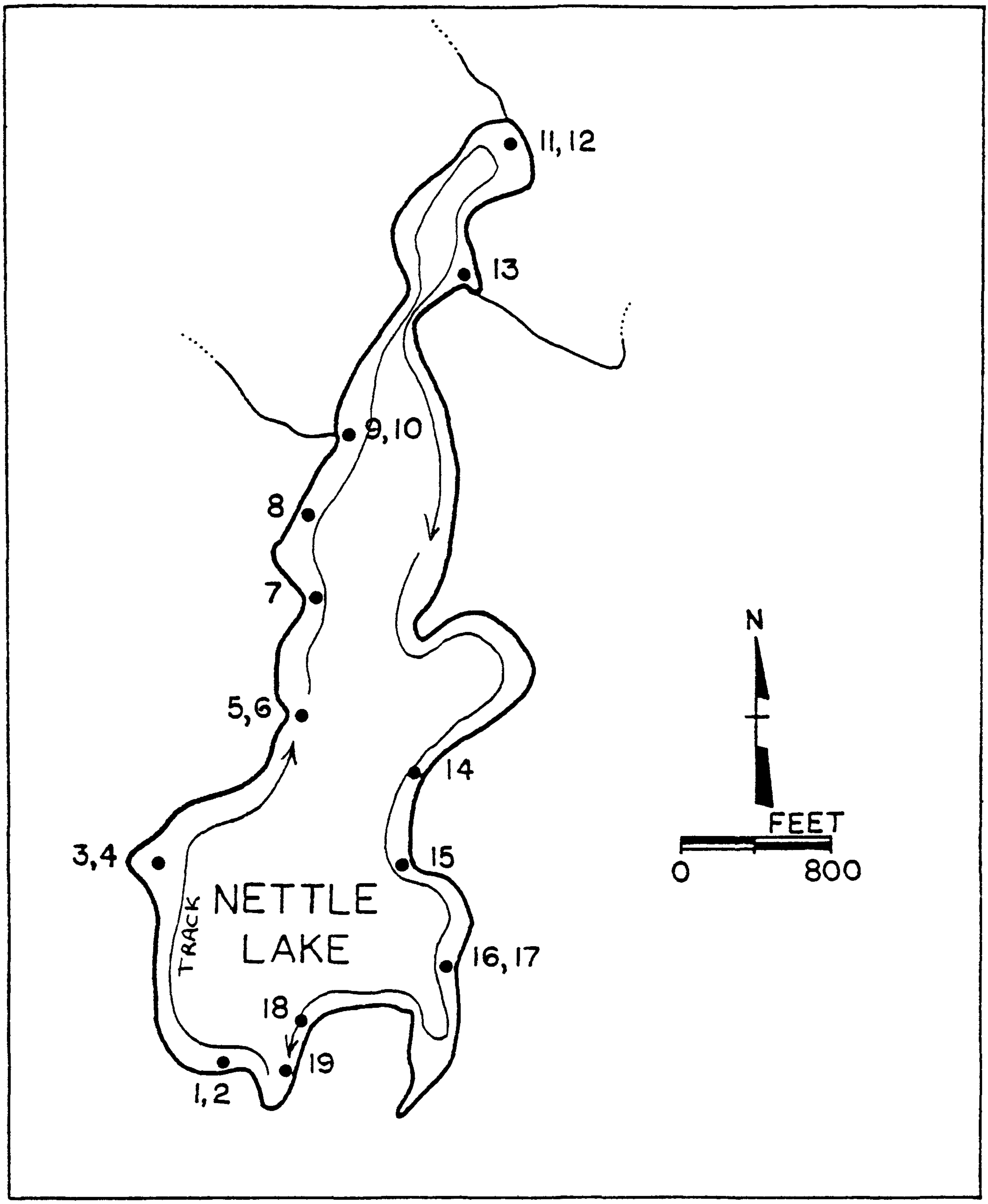
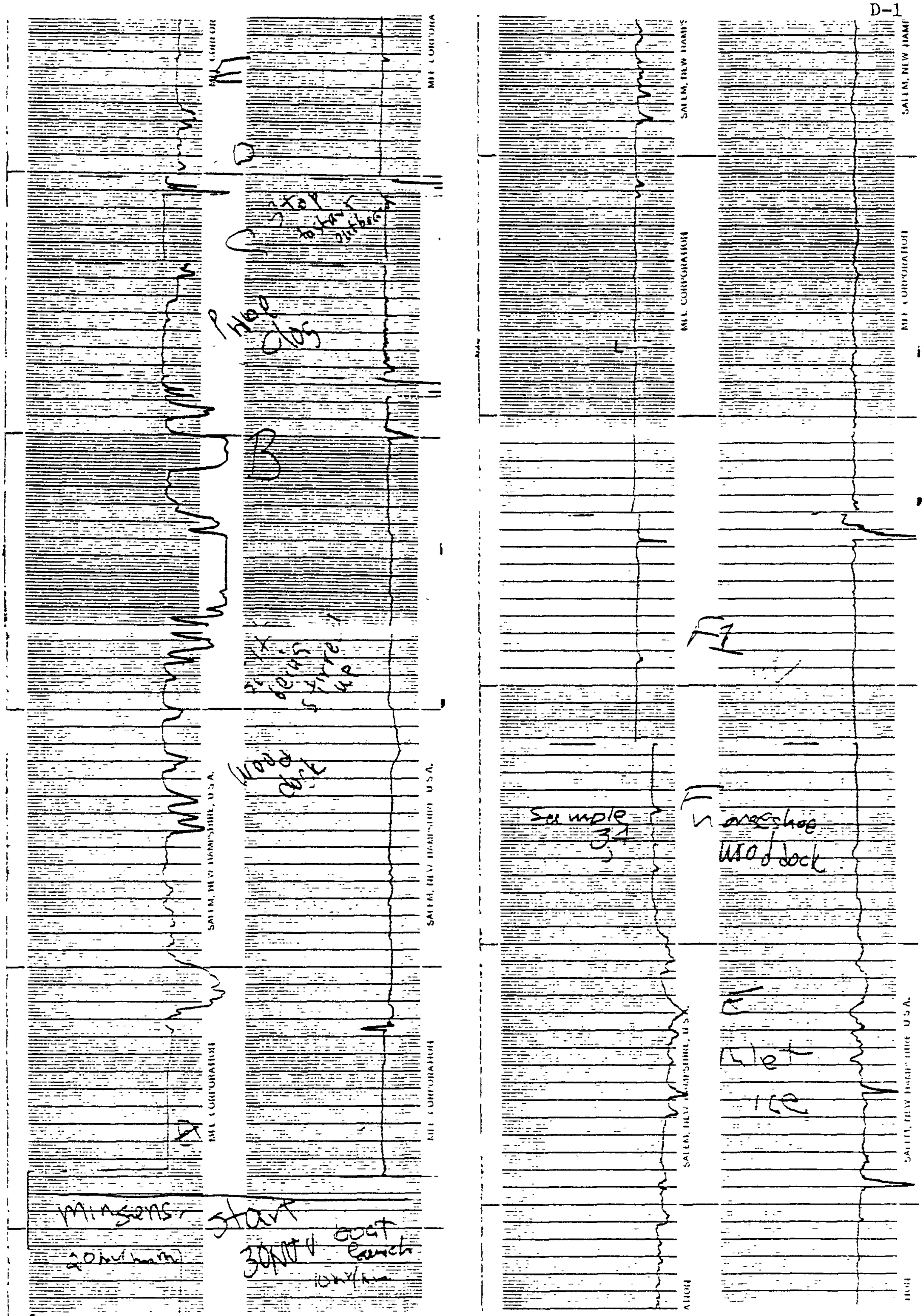
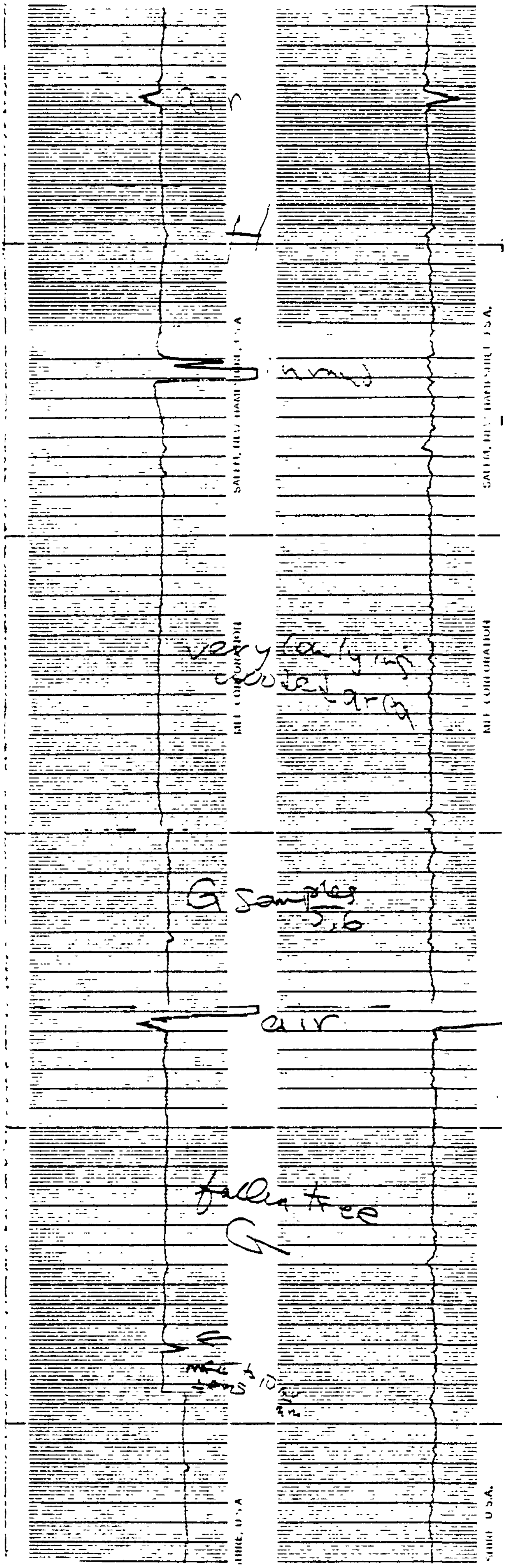
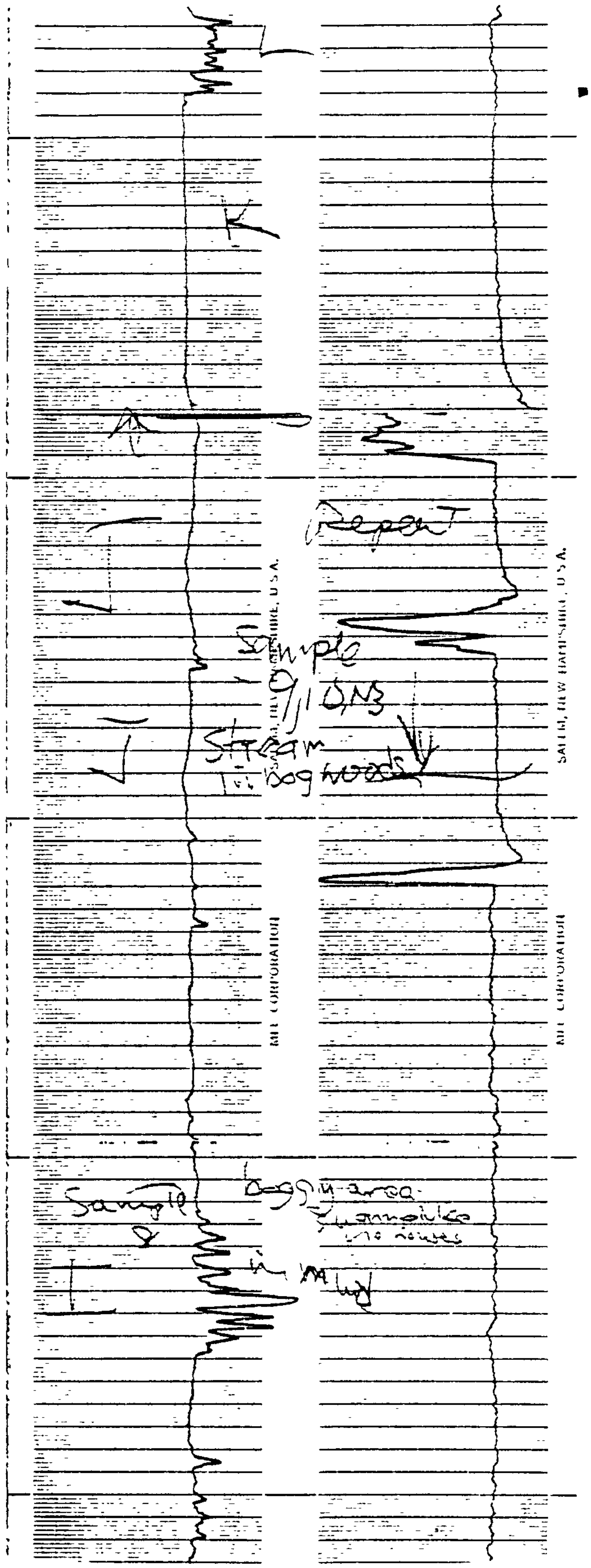


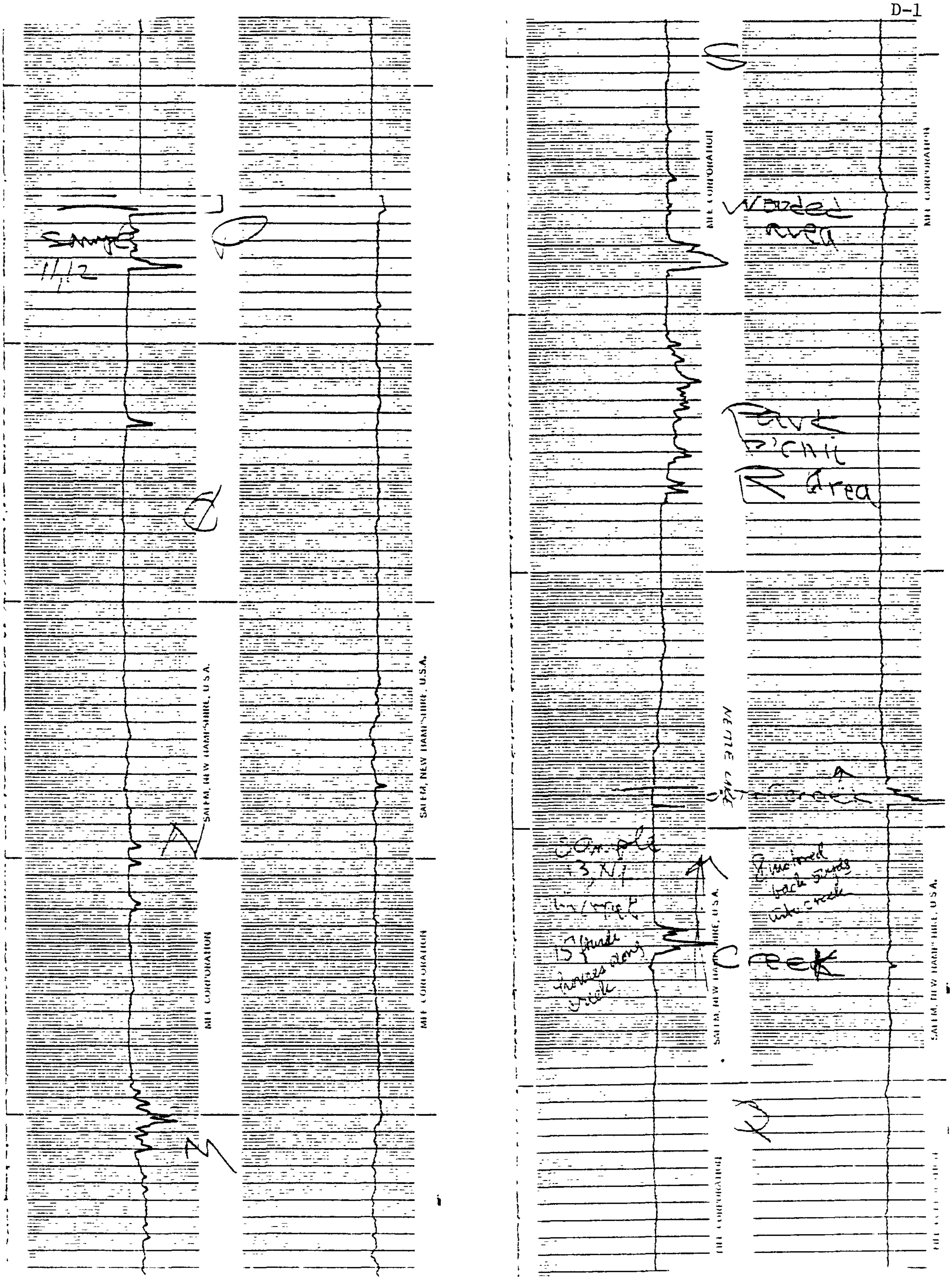
Figure 5. Path of survey.

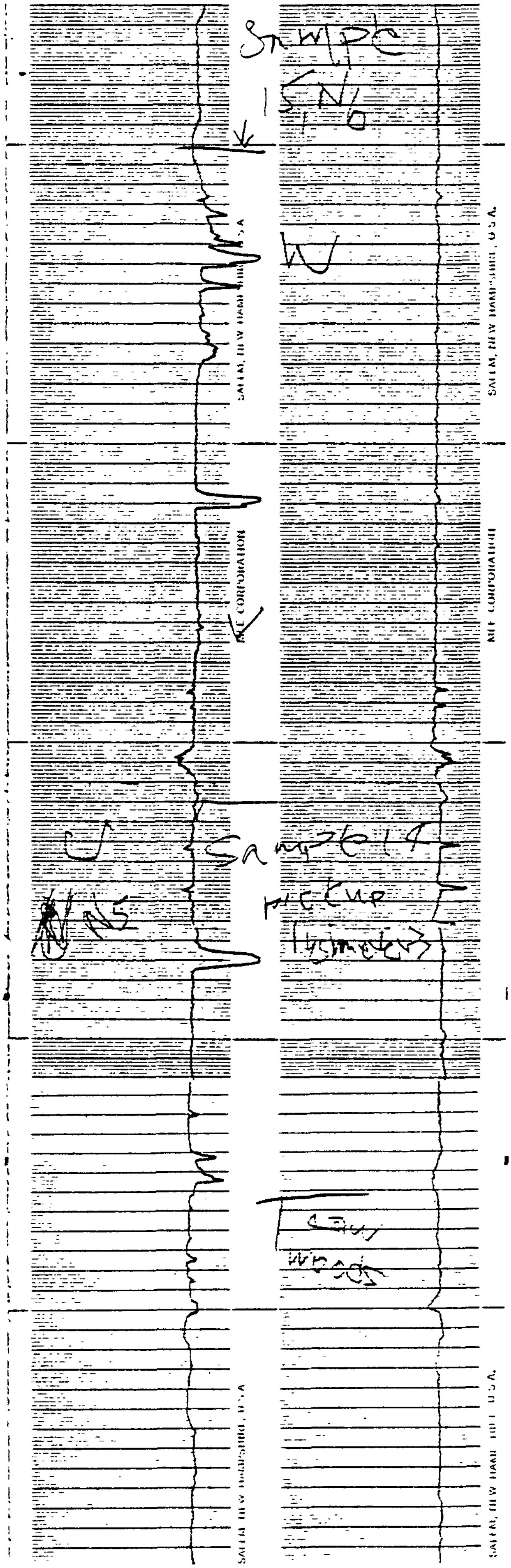

MEE CORPORATION
SALEM, NEW HAMPSHIRE, U.S.A.
start
Wood dock
Sample 34
wood dock

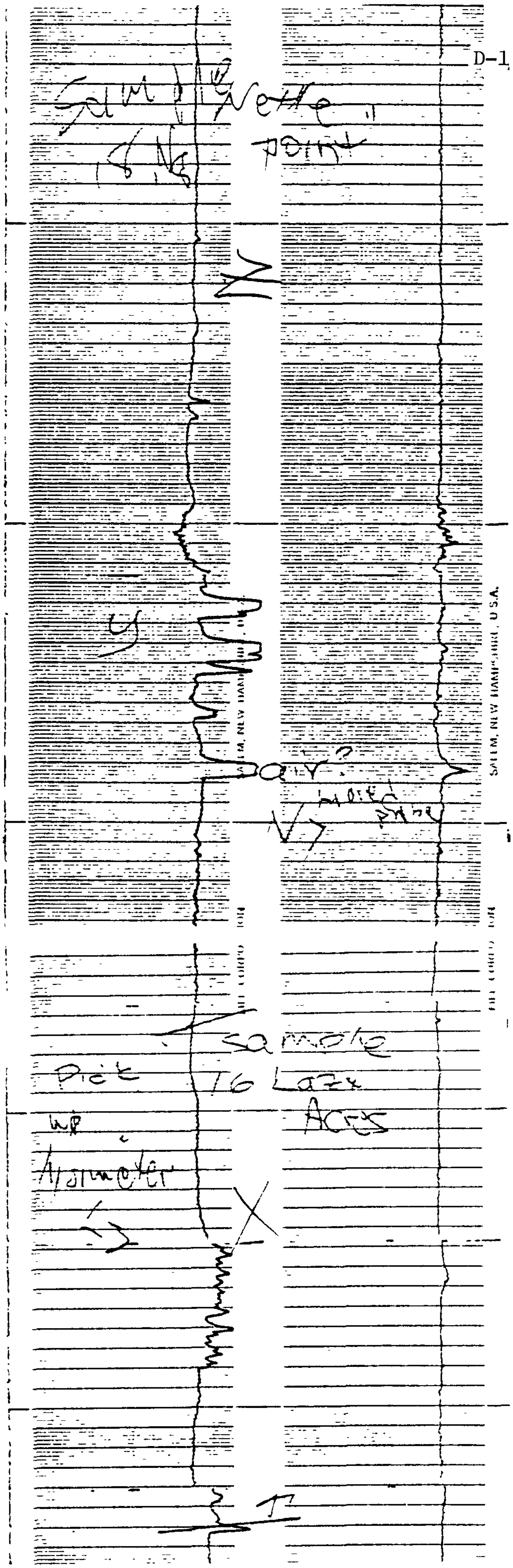

air
G Samples 5,6

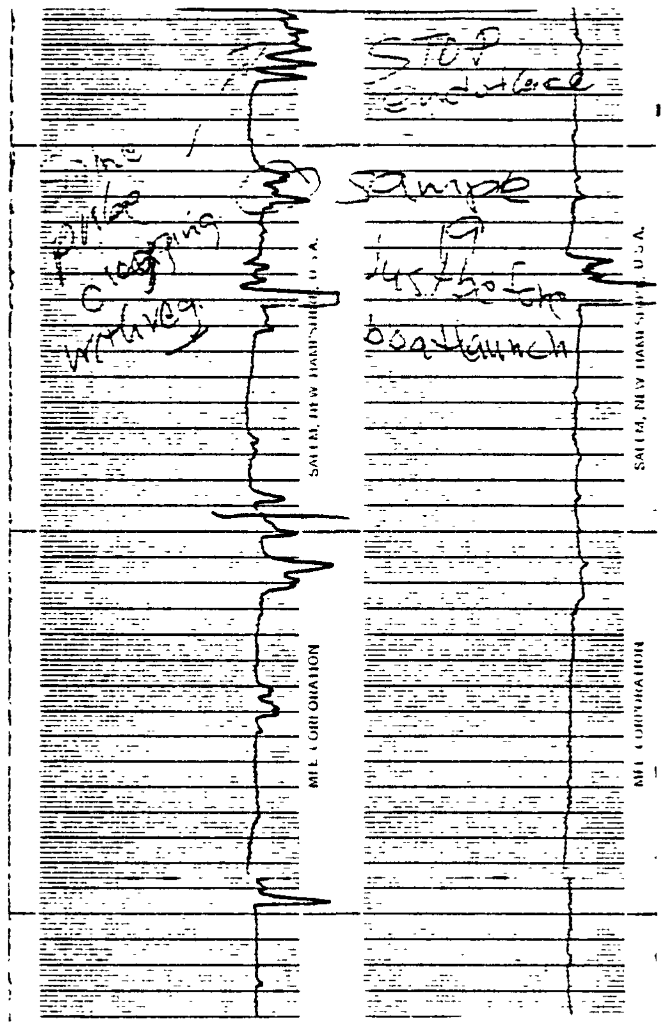

Repeat
Sample
Stream
bog woods
boggy area
Sample 8

D-1-25


MFE CORPORATION
SALEM, NEW HAMPSHIRE, U.S.A.
Sample
11/12
Wooded area
Creek


Sample 15 No
Sample 14 pickup Hydrometer
SALEM, NEW HAMPSHIRE, U.S.A.
CORPORATION


Sample 16 Lazy Aces
Pick up Hydrometer
SALEM, NEW HAMPSHIRE, U.S.A.


STOP
Sample
SALEM, NEW HAMPSHIRE, U.S.A.
MFE CORPORATION

NETTLE LAKE CONSTRUCTION GRANTS SANITARY SURVEY

INTRODUCTION

The purpose of this survey was to aid in planning and designing rural wastewater systems for the Nettle Lake Study Area by establishing the need for improved wastewater treatment, and evaluating the feasibility of using on-site technology in alternative solutions.

Residents of the Nettle Lake Study Area, Williams County, Ohio, were interviewed by Mark Hummel between November 29th and December 6th, 1978, in order to identify existing septic problems and provide a basis for assessing a range of possible solutions.

There were three specific goals in the study:

1. Identify possible sources of water quality and public health problems to aid in determining grant eligibility.
2. Evaluate reasons for inadequate functioning of existing systems.
3. Provide a quantitative basis for selecting feasible technologies and estimating life cycle costs of on-site alternatives.

METHODOLOGY

THE QUESTIONNAIRE

The survey questionnaire was developed by Gerald Peters, of WAPORA, Inc., to be used as a standard form for all Environmental Impact Statement (EIS) sanitary surveys. A copy of the questionnaire is included.

The first part of the questionnaire described the location of each dwelling well enough for someone to come back and find each site surveyed. The next part dealt with size and location of the septic system, along with problem and maintenance histories. There was a brief section on number of residents and water-using fixtures, another on drainage patterns into or over the septic system. A visual inspection was followed by a drawing locating the septic system in relation to the house, lake, well, and main road.

RESULTS

The Nettle Lake Study Area contained approximately 284 private residences, 100 of them fronting on Nettle Lake. A total of 31 wastewater disposal systems in 29 interviews (10% of the total) were surveyed in 8 days.

The survey was taken at a time when many summer-only residents were not home. According to WAPORA (1976), seasonal homes accounted for 91% of all dwellings in the area, not including 180 seasonal campsites. The WAPORA estimates were used in calculating winter-minimum and summer-maximum populations around Nettle Lake.

The winter population of 128 expanded up to 8.0 times, to 1025, during busy summer weekends.

Fifty-three percent of the permanent dwellings were surveyed while only three percent of the seasonal were accounted for (Table 1). Table 2 indicates the residents' knowledge of the survey questions.

Table 1

PERCENT OF PERMANENT AND SEASONAL DWELLINGS SURVEYED, AND NUMBER OF PROBLEMS

Occupancy	WAPORA '76 Estimate of % of Each	# Dwellings in Planning Area	Number Surveyed	Percent Surveyed	# with Problems	% of those Interviewed with Problems
Seasonal	91.4	244	8	3	1	13
Permanent	8.6	40	21	53	4	19
Total	100.0	284	29	10	5	17

Table 2

RESIDENT KNOWLEDGE OF SEPTIC SYSTEMS

Extent of Knowledge		Residents #	Residents %
0	Answered no questions	1	3
½	Answered some questions (usually didn't know size)	12	41
1	Answered all questions	16	55
Total		29	99

SANITARY SURVEY FOR CONSTRUCTION GRANTS APPLICATION

(Page One)

Resident: Study Area:

Owner: Surveyor/Date:

Address of Property: Weather:

Lot Location:

Tax Map Designation: Approximate Lot Size: ____________ acres

Preliminary Resident Interview

Age of Dwelling: _____ years

Age of Sewage Disposal System: _____ years

Type of Sewage Disposal System:

Maintenance: ________ years since septic tank pumped
________ years since sewage system repairs (Describe below)

Accessibility of septic tank manholes (Describe below)

Dwelling Use: Permanent Residents ________ adults, ________ children

Seasonal Use:

Problems Recognized by Resident:

Surveyor's Visual Observations of Soil Disposal Area:

SANITARY SURVEY FOR CONSTRUCTION GRANTS APPLICATION

(Page Two)

Sanitary and Drainage Facilities

Water Using Fixtures:

______ Shower Heads	______ Kitchen Lavatories	______ Clothes washing machine
______ Bathtubs	______ Garbage Grinder	______ Water softener
______ Bathroom Lavatories	______ Dishwasher	______ Utility sink
______ Toilets	______ Other Kitchen	______ Other

Drainage Facilities and Discharge Location:

Basement Sump

Footing Drains

Roof Drains

Driveway Runoff

Property and Facility Sketch

SANITARY SURVEY FOR CONSTRUCTION GRANTS APPLICATION

(Page Three)

Water Supply

Water Supply Source (check one)
- ____ Public Water Supply
- ____ Community or Shared Well
- ____ On-Lot Well
- ____ Other (Describe)

If public water supply or community well:
- ____ Fixed Billing Rate $ /
- ____ Metered Rate $ /

Average usage for prior year: /

If shared or on-lot well:
- ____ Drilled Well
- ____ Bored Well
- ____ Dug Well
- ____ Driven Well

Well Depth (if known):
- ____ feet total
- ____ feet to house
- ____ feet to soil disposal area
- ____ feet to water table
- ____ feet to septic tank
- ____ feet to surface water

Visual Inspection:
- Type of Casing
- Integrity of Casing
- Grouting Apparent?
- Vent Type and Condition
- Seal Type and Condition

Water Sample Collected:

____ No

____ Yes

(Attach Analysis Report)

OHIO SANITARY CODE

3701-29-02. Sewage disposal requirements.

(A) The design, construction, installation, location, maintenance, and operation of household sewage disposal systems including, but not limited to, septic tanks, aerobic type treatment systems, filters, leaching tile fields, leaching wells, building sewers, and privies or part thereof shall comply with these rules and engineering practices acceptable to the Ohio department of health and current Ohio environmental protection agency effluent standards.

(B) Any dwelling which is not connected to a sanitary sewerage system shall be provided with an approved household sewage disposal system prior to its being occupied.

(C) Each household sewage disposal system shall serve one dwelling on an individual lot and shall be properly maintained and operated by the owner. All the sewage from the dwelling shall discharge into the system.

(D) No household sewage disposal system or part thereof shall create a nuisance.

(E) No person shall discharge, or permit to be discharged, treated or untreated sewage, the overflow drainage or contents of a sewage tank, or other putrescible, impure, or offensive wastes into an abandoned water supply, well, spring, or cistern or into a natural or artificial well, sink hole, crevice, or other opening extending into limestone, sandstone, shale, or other rock formation, or normal ground water table.

(F) No person shall discharge, or permit or cause to be discharged, treated or untreated sewage, the drainage or contents of a sewage tank, or other putrescible or offensive wastes onto the surface of the ground, into any street, road, alley, open excavation, or underground drain.

3701-29-04. Installation permit and operation permit.

(A) No person shall install or alter a household sewage disposal system without an installation permit issued to him by the board of health. The owner or his designated agent shall obtain such installation permit from the board of health for the installation of a household sewage disposal system prior to the start of construction of a dwelling.

(B) No person shall maintain or operate a household sewage disposal system installed after the effective date of this rule without an operation permit obtained from the board of health.

(C) Application for permit shall be in writing and contain pertinent information as required by the board of health. Any fee established for a permit by law or authority of law shall accompany the application.

(D) The board of health shall issue a permit when the pertinent information indicates that the provisions of rules 3701-29-01 to 3701-29-21 of the Ohio Sanitary Code can be met. The board of health may specify terms consistent with rules 3701-29-01 to 3701-29-21 on the permit governing the installation, alteration, and operation of the household sewage disposal system.

(E) The board of health shall deny a permit if the information on the application is incomplete, inaccurate, or indicates that the provisions of rules 3701-29-01 to 3701-29-21 of the Ohio Sanitary Code cannot be met.

(F) An installation permit shall remain in force until completion of the household sewage disposal system or for one year from the date of issuance, whichever occurs first. The permit may be revoked or suspended by the board of health. An operation permit shall remain in force until it expires, is revoked, or suspended by the board of health.

(3701-29-04. Continued.)

(G) The installation and operation of the household sewage disposal system or any part thereof shall conform with the requirements of rules 3701-29-01 to 3701-29-21 of the Ohio Sanitary Code and the terms of the permit as required by the board of health in division (D) of this rule.

Adopted January 17, 1974; effective July 1, 1974.
Amended March 17, 1977; effective July 1, 1977.

3701-29-05. Registration of installers of household sewage disposal systems or parts thereof.

(A) No person shall perform the services of an installer unless he holds a valid registration issued to him by the board of health.

(B) Application for registration shall be in writing and contain pertinent information as required by the board of health. Any fee established for a registration by law or authority of law shall accompany the application.

(C) Each registration issued hereunder shall expire annually.

(D) A renewal application for registration shall be submitted to the board of health at least thirty days prior to the expiration date.

(E) Every registrant shall maintain and submit to the board of health such data and records as may be required for determining compliance with rules 3701-29-01 to 3701-29-21 of the Ohio Sanitary Code.

(F) The owner shall not be required to have a registration for performing work on the household sewage disposal system for the dwelling which he occupies.

(G) Whenever the health commissioner finds that an installer is or has engaged in practices which are in violation of any provision of rules 3701-29-01 to 3701-29-20 of the Ohio Sanitary Code or the terms of any permit as required by the board of health in rule 3701-29-04(D) under which installation is performed, the board of health shall give notice in writing to the registrant describing the alleged violation and state that an opportunity for a hearing will be provided by the board of health to show cause why his registration should not be suspended or revoked.

Adopted January 17, 1974; effective July 1, 1974.
Amended March 17, 1977; effective July 1, 1977.

3701-29-06. Registration of sewage tank cleaners.

(A) No person shall perform the services of a sewage tank cleaner unless he holds a valid registration issued to him by the board of health.

(B) Application for registration shall be in writing and contain pertinent information as required by the board of health. Any fee established for registration by law or authority of law shall accompany the application.

(C) The board of health shall issue a permit when the pertinent information indicates that the provisions of rules 3701-29-01 to 3701-29-21 of the Ohio Sanitary Code can be met. The board of health may specify terms consistent with rules 3701-29-01 to 3701-29-21 on the permit governing the collection, transportation, and disposal of the contents of sewage tanks or privies.

(D) Each registration issued hereunder shall expire annually.

(E) A renewal application for registration shall be submitted to the board of health at least thirty days prior to the expiration date.

(F) Every registrant shall maintain and submit to the board of health such data and records as may be required for determining compliance with rules 3701-29-01 to 3701-29-21 of the Ohio Sanitary Code.

(G) Whenever the health commissioner finds that a sewage tank cleaner is or has engaged in practices which are in violation of any provision of rules 3701-29-01 to 3701-29-21 of the Ohio Sanitary Code, the terms of the registration permit as required by the board of health in rule 3701-29-06(C), or applicable laws of the state, the board of health shall give notice in writing to the registrant describing the alleged violation and state that an opportunity for a hearing will be provided by the board of health to show cause why his registration should not be suspended or revoked.

Adopted January 17, 1974; effective July 1, 1974.
Amended March 17, 1977; effective July 1, 1977.

3701-29-07. Septic tanks.

(A) The minimum capacity of septic tanks shall be:

(1) Single family dwelling;

(a) One to two bedroom - 1000 gallons,

(b) Three bedroom - 1500 gallons in one or two tanks or compartments,

(c) Four to five bedroom - 2000 gallons in two tanks or compartments,

(d) Six or more bedroom - 2500 gallons in two tanks or compartments.

(2) Two or three family dwelling - the sum of the volumes for each single family residential unit within the dwelling as defined by rule 3701-29-07(A)(1).

(B) In systems using two tanks, the septic tanks shall be connected in series and all sewage shall initially enter the first tank.

(C) The invert level of the inlet shall be not less than two inches above the liquid level of the tank.

(D) A vented inlet baffle shall be provided to divert the incoming sewage downward. The baffle shall penetrate at least six inches below the liquid level, but the penetration shall not be greater than that allowed for the outlet device.

(E) The outlet shall be fitted with a vented tee, vented ell, or baffle which shall extend not less than six inches above and not less than eighteen inches below the liquid level of the tank.

(F) The septic tank shall have a liquid drawing depth of not less than four feet.

(3701-29-07. Continued.)

(G) The distance from the flow line to the cover shall be at least twelve inches.

(H) The septic tank shall be installed with a minimum of one secured cover extended to grade to provide access to each compartment of the tank for inspection and cleaning. The cover shall have a minimum inside diameter of ten inches.

Adopted January 17, 1974; effective July 1, 1974.
Amended March 17, 1977; effective July 1, 1977.

3701-29-10. <u>Installation requirements for soil absorption and percolation.</u>

(A) Leaching systems utilizing soil absorption or percolation shall not be permitted where the depth to normal ground water table or rock strata is less than four feet below the bottom of the proposed system.

(B) Leaching systems utilizing soil absorption or percolation shall not be installed where the texture, structure, or permeability of the soil is not suitable to provide internal drainage. The health commissioner may require the owner at the owner's expense to provide a written site evaluation by a qualified person before a final decision is made in issuing a permit. The criteria of the national cooperative soil survey shall be used as a guideline by the health commissioner to determine the suitability of the soils in lieu of a more detailed guideline relating to code requirements and soil characteristics.

Adopted January 17, 1974; effective July 1, 1974.
Amended March 17, 1977; effective July 1, 1977.

3701-29-11. Leaching tile field.

(A) Total field requirement shall be divided into two equal sections and provided with a diversion device equipped to provide alternate flow to each section of the field. The diversion device and inspection ports shall be brought to grade and shall be provided with secured covers.

(B) Leaching field absorption area requirements for household sewage disposal systems shall be adequate to prevent water pollution or a nuisance, except those sites eliminated by rules 3701-29-01 to 3701-29-21 of the Ohio Sanitary Code.

(C) The minimum distance between any leaching lines shall be six feet.

(D) The minimum distance between any leaching line and any drain line located on the lot shall be eight feet.

(E) A leaching trench shall have a minimum of twelve inches of clean gravel or stone fill, extending at least two inches above and six inches below the leaching line; such fill shall be three-fourths inch to one and one-half inches in size.

(F) A leaching trench shall have a minimum width of eight inches. The depth shall be a minimum of eighteen inches but not more than thirty inches.

(G) A leaching line shall have a maximum length of one hundred-fifty feet.

(H) A leaching line shall have a minimum diameter of four inches and shall have a relatively level grade. The grade shall not exceed a fall of three inches in fifty feet.

(I) The top of the gravel stone fill shall be covered with a pervious material such as untreated paper or a two inch layer of hay, straw, or similar material before being covered with earth.

(J) The land surface shall be graded so as to exclude surface drainage from the household sewage disposal site.

3701-29-13. Leaching pit.

(A) A leaching pit shall be installed only in areas where gravel deposits underlie the ground surface and the seasonally high water table is not less than ten feet below the bottom of the leaching pit. Test borings to determine the suitability of the soil shall be constructed to a depth of at least ten feet below the bottom of a proposed leaching pit prior to issuance of an installation permit.

(B) A leaching pit shall be a minimum of one hundred feet from any water supply source, ten feet from any lot or right-of-way line, and twenty feet from any occupied building.

(C) A leaching pit shall be provided with a secured cover extended to ground level.

Adopted January 17, 1974; effective July 1, 1974.
Amended March 17, 1977; effective July 1, 1977.
Replaces rule 3701-29-12.

3701-29-15. Privy.

(A) A privy shall be provided with watertight vaults or other watertight receptacles of not less than five hundred gallons capacity except as specified in division (B) of this rule and shall be a minimum of fifty feet from any water supply source, and twenty feet from any occupied building or lot or right-of-way line.

(B) A vault may be constructed with an open or porous bottom if it is located not less than one hundred feet from any water supply source, and so located that the liquids leaching from the vault will not discharge at the ground surface, or into limestone, sandstone, shale, or other rock formation. The vault shall not be permitted where the depth to the seasonally high water is less than four feet below the bottom of the proposed vault.

(C) The construction and design of the vault and superstructure shall prevent access by insects, fowl, or animals.

(D) A privy shall be cleaned before the contents reach the top level of the vault.

Adopted January 17, 1974; effective July 1, 1974.
Amended March 17, 1977; effective July 1, 1977.
Replaces rule 3701-29-14.

Table 1

SITE SUITABILITY REQUIREMENTS FOR COMMONLY APPROVED ON-SITE SEWAGE SYSTEMS (OHIO)

	Minimum horizontal separation distances (feet)				Max. slope where installation permitted (%)	Min. depth to water table from orig. grade (feet)	Min. depth to water table below absorption system (feet)	Percolation rates where installation permitted (min/in)	Depth of permeable soil required below original grade (feet)	Depth of permeable soil required below absorption system (ft.)
	Wells	Surface waters	Dwelling	Property lines						
Septic tank followed by:	50	ND*	10	10	--	--	--	--	--	--
1. Absorption trench system	50	ND	10	10	ND	ND	4	10-60	ND	ND
2. Absorption pit system	100	ND	50	10	--	--	10	10-60	--	--
3. Subsurface sand filter	50	ND	10	10	--	--	--	--	--	--
Aerobic unit followed by:	50	ND	10	10	--	--	--	--	--	--
1. Absorption system	50	ND	10	10	ND	ND	4	ND	ND	ND
2. Surface sand filter	50	ND	10	10	--	--	--	--	--	--
3. Off-lot disposal	--	--	--	--	--	--	--	--	--	--

*Not defined.

Great Lakes-Upper Mississippi River Board of State Sanitary Engineers. Undated. Summary of on-site sewage program for Illinois, Indiana, Iowa, Michigan, Minnesota, Missouri, New York, Ohio, Ontario, Pennsylvania, and Wisconsin. (Mimeo)

APPENDIX E

FLOW REDUCTION

Flow Reduction and Cost Data for Water Saving Devices

Device	Daily Conservation (gpd)	Daily Conservation (hot water) (gpd)	Capital Cost	Installation Cost	Useful Life (yrs.)	Average Annual O&M
Toilet modifications						
Water displacement device—plastic bottles, bricks, etc.	10	0	0	H-0[a]	15	0
Water damming device	30	0	3.25	H-0	20	0
Dual flush adaptor	25	0-	4.00	H-0	10	0
Improved ballock assembly	20	0-	3.00	H-0	10	0
Alternative toilets						
Shallow trap toilet	30	0-	80.00	55.20	20	0
Dual cycle toilet	60	0-	95.00	55.20		0
Vacuum toilet	90	0-				
Incinerator toilet	100	0				
Organic waste treatment system	100	0				
Recycle toilet	100	0				
Faucet modifications						
Aerator	1	1	1.50	H-0	15	0
Flow control device	4.8	2.4	3.00	H-0	15	0
Alternative faucets						
Foow control faucet	4.8	2.4	40.00	20.70		0
Spray tap faucet	7	3.5	56.50	20.70	15	0
Shower modification						
Shower flow control insert device	19	14	2.00	H-0	15	0
Alternative shower equipment						
Flow control shower head	19	14	15.00	H-0 or 13.80	15	0
Shower cutoff valve			2.00	H-0		0
Thermostatic mixing valve			62.00	13.80		0

[a]H-0 = Homeowner-installed; cost assumed to be zero.

INCREMENTAL CAPITAL COSTS OF FLOW REDUCTION IN THE NETTLE LAKE STUDY AREA

Dual-cycle toilets:

\$20/toilet x 2 toilets/permanent dwelling x 76 permanent dwellings in year 2000	= \$3,040
\$20/toilet x 1 toilet/seasonal dwelling x 419 seasonal dwellings in year 2000	= 8,380
Shower flow control insert device:	
\$2/shower x 2 shower/permanent dwelling x 76 permanent dwellings in year 2000	= 304
\$2/shower x 1 shower/seasonal dwelling x 419 seasonal dwellings in 2000	= 838
Faucet flow control insert device:	
\$3/faucet x 3 faucets/permanent dwelling x 76 permanent dwellings in year 2000	= 684
\$2/faucet x 2 faucets/seasonal dwelling x 419 seasonal dwellings in 2000	= 1,676
TOTAL	\$14,922

Note: The \$20 cost for dual-cycle toilets is the difference between its full purchase price of \$95 and the price of a standard toilet, \$75.

APPENDIX F

WATER TREATMENT AND DISPOSAL

COMPARISON OF SITE CHARACTERISTICS FOR LAND TREATMENT PROCESSES

Characteristics	Principal processes			Other processes	
	Slow rate	Rapid infiltration	Overland flow	Wetlands	Subsurface
Slope	Less than 20% on cultivated land; less than 40% on noncultivated land	Not critical; excessive slopes require much earthwork	Finish slopes 2 to 8%	Usually less than 5%	Not critical
Soil permeability	Moderately slow to moderately rapid	Rapid (sands, loamy sands)	Slow (clays, silts, and soils with impermeable barriers)	Slow to moderate	Slow to rapid
Depth to groundwater	2 to 3 ft (minimum)	10 ft (lesser depths are acceptable where underdrainage is provided)	Not critical	Not critical	Not critical
Climatic restrictions	Storage often needed for cold weather and precipitation	None (possibly modify operation in cold weather)	Storage often needed for cold weather	Storage may be needed for cold weather	None

1 ft = 0.305 m

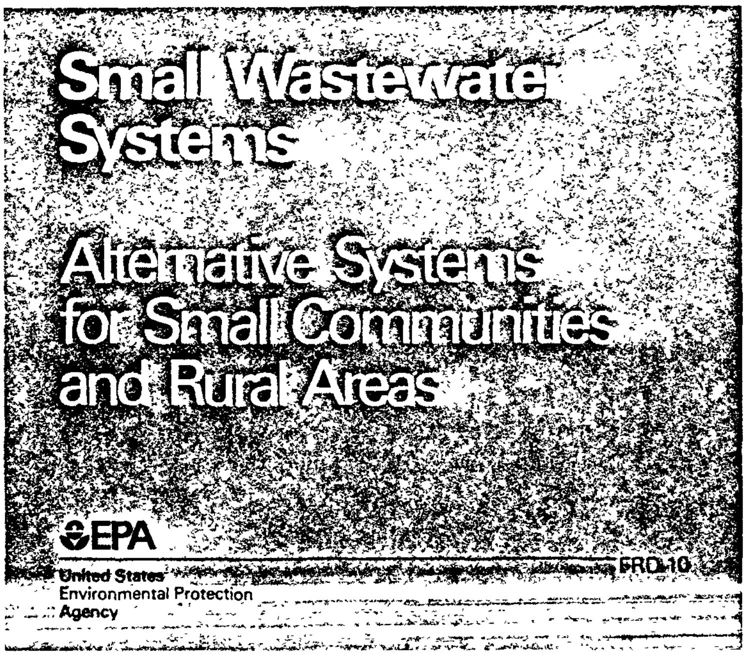
Technology Transfer Program. 1977. Process Design Manual for Land Treatment of Municipal Wasteworks. EPA.

United States Environmental Protection Agency
Office of Water Program Operations Washington DC 20460
January 1980
FRD-10

EPA

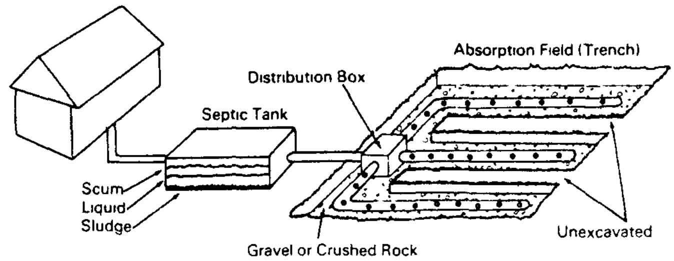
Small Wastewater Systems

Alternative Systems for Small Communities and Rural Areas



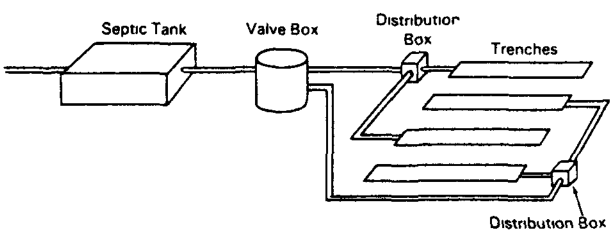
1 Septic Tank & Soil Absorption Field (Trench)

Sewage bacteria break up some solids in tank. Heavy solids sink to bottom as sludge. Grease & light particles float to top as scum. Liquid flows from tank through closed pipe and distribution box to perforated pipes in trenches; flows through surrounding crushed rocks or gravel and soil to ground water (underground water). Bacteria & oxygen in soil help purify liquid. Tank sludge & scum are pumped out periodically. Most common onsite system. Level ground or moderate slope.



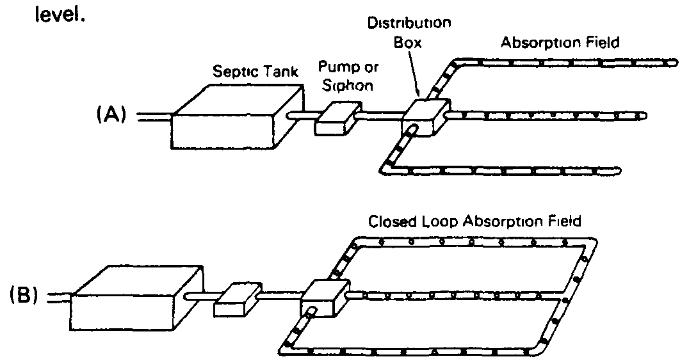
4 Septic Tank with Alternating Absorption Fields

One field rests while other is in use. Allows field to renew itself. Extends life of field. Provides standby if one field fails. Valve directs sewage liquid to proper field. Fields usually switched every 6-12 months.



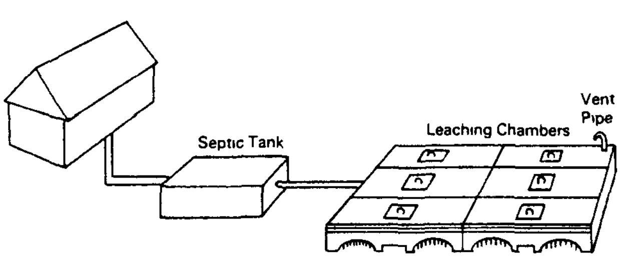
5 Septic System Refinements: (A) Dosing (B) Closed Loop

(A) Pump or siphon forces liquid to perforated pipes in controlled doses so all pipes discharge liquid almost at same time (dosing). Spreads liquid more evenly & gives field chance to dry out between dosings. (B) Variation of Sketch 1 absorption field. Can be used for dosing & where ground is level or nearly level.



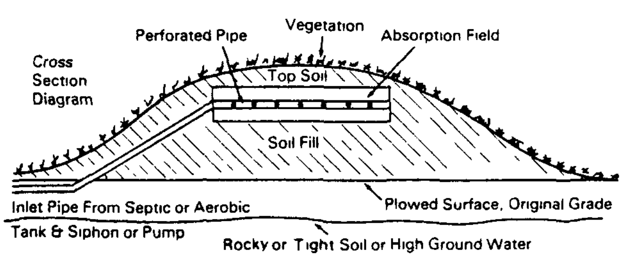
8 Septic Tank & Leaching Chambers

Open-bottom concrete chambers create underground cavern over absorption field. Liquid is piped into cavern & spread over field by troughs, splashplates, or dams. Liquid filters through soil. Chambers replace perforated pipe, trenches, & rocks of conventional absorption field. Access holes at top allow maintenance & soil inspection.



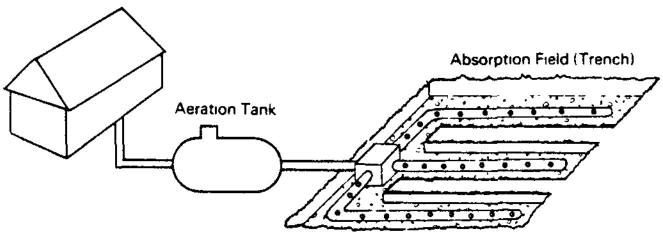
9 Mound System (Used with Septic or Aerobic Tank)

Liquid is pumped from storage tank (as in Sketch 21) to perforated plastic pipe in sand mound that covers plowed ground. Liquid flows through rocks or gravel, sand, & natural soil. Mound vegetation helps evaporate liquid. Rocky or tight soil or high water table.



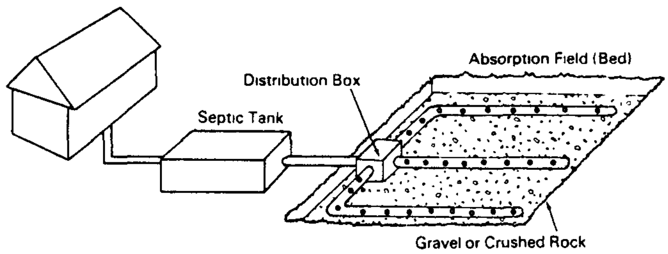
2 Aerobic System & Soil Absorption Field

Air and wastewater are mixed in tank. Oxygen-using (aerobic) bacteria grow, digest sewage, liquefy most solids. Liquid discharges to absorption field where treatment continues. Can use same treatment & disposal methods as septic tank. Maintenance essential. Uses energy.



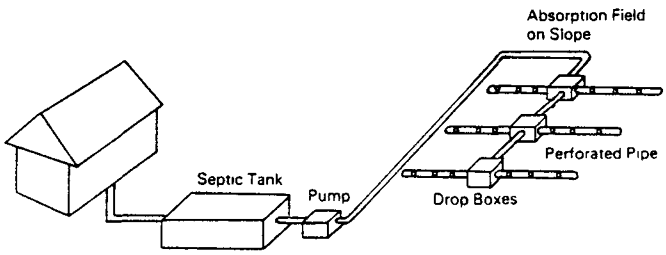
3 Septic Tank & Soil Absorption Field (Bed)

Similar to Sketch 1 but smaller field. Total field excavated. Used where space limited. Nearly level ground.



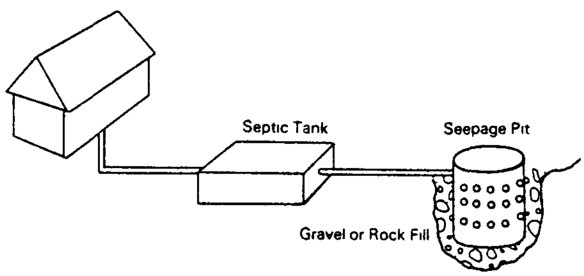
6 Septic Tank with Sloping Field—Serial Distribution

Pump forces liquid to perforated pipes in contoured absorption field. Drop boxes regulate liquid flow so highest trench fills up first, second fills up next, & lowest fills up last. Plastic fittings can be used instead of drop boxes to regulate flow. Used on slopes.



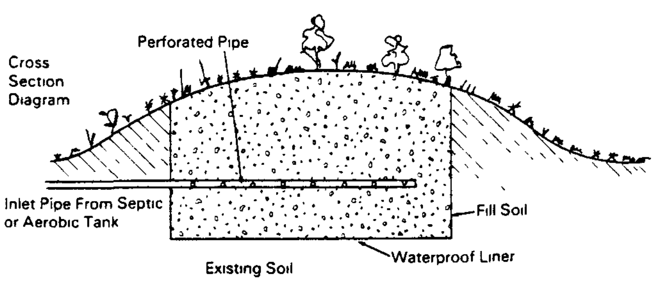
7 Septic Tank with Seepage Pit

Liquid flows to pit that has open-jointed brick or stone walls surrounded by rocks. Precast tanks with sidewall holes can also be used. Liquid seeps through walls & rocks to surrounding soil. Pit sides are cleaned periodically to prevent clogging.



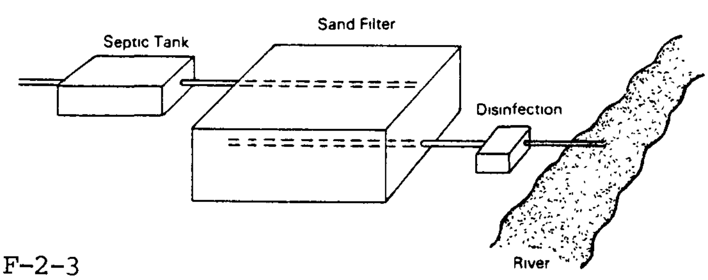
10 Evapotranspiration Bed (Used with Septic or Aerobic Tank)

Similar to Sketch 9 but sand bed is lined with plastic or other waterproof material. Bed could be mound or level. Liquid evaporates because liner prevents it from filtering through natural soil. Plants speed evaporation by drawing moisture from soil & breathing it into the air. Used where conventional absorption field not possible.



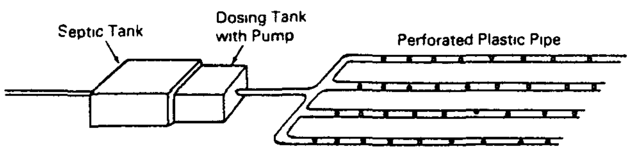
11 Septic Tank, Sand Filter, Disinfection & Discharge

Filter is ground-level or buried sand pit. Liquid enters perforated pipe at top & filters through sand & gravel to bottom pipe. Bottom pipe conducts liquid to disinfection tank. Liquid discharges to stream or ditch. Variations are intermittent sand filter & recirculating sand filter. Used where soil absorption field not possible.



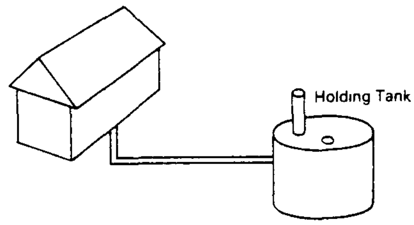
12 Low-Pressure Subsurface Pipe Distribution

Network of small-diameter perforated plastic pipes are buried 6"- 18" in 4"- 6"-wide trenches. Pump forces liquid through pipes in controlled doses so liquid discharges evenly. Site & soil determine pipe layout & pipe-hole size & number. Absorption field is same size as conventional field. Rocky or tight soil or high water table.



13 Holding Tank

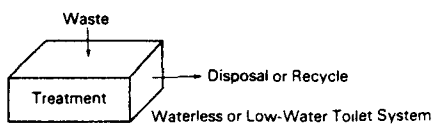
Sewage flows to large, underground, watertight storage tank. Tank is pumped periodically & sewage hauled away. Isolated or remote areas where absorption field not possible. Sewage hauling cost high.



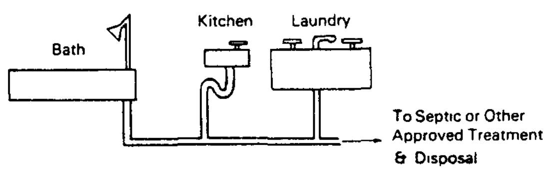
16 Dual Systems: Blackwater & Graywater

Many systems. In this one: (A) toilet wastes (blackwater) are handled by waterless or low-water toilet system [Sketch 15]. (B) Other household wastewater from kitchen, bath, laundry (graywater) needs separate treatment & disposal.

(A) Blackwater (Toilet Wastes)

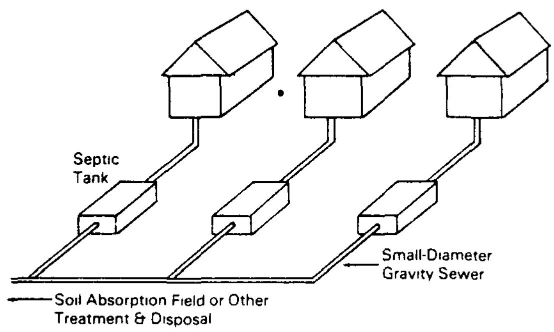


(B) Graywater (Other Household Wastewater)



17 Small-Diameter Gravity Sewers (Collection System)

4"- 6" pipe is sloped so liquid from septic or aerobic tank flows through pipe to treatment & disposal. Treatment & disposal system can be conventional or alternative. Small pipe costs less than conventional 8" pipe.



19 Land Application

Sewage liquid is applied to land to nourish vegetation & purify liquid. Methods:

1. **Irrigation**—Liquid is applied to crops or to forests (silviculture) by sprinkling, flooding, or ridge & furrow. Liquid is sometimes disinfected before application.

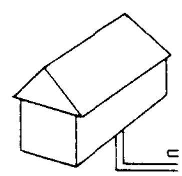
2. **Overland flow**—Liquid flows through vegetation on graded slope. Runoff is collected at bottom & reused or discharged to river or stream. Suitable for tight soils.

3. **Rapid infiltration**—Partly treated sewage is applied in controlled doses to sandy soil. Solids break down. Liquid purifies as it seeps to ground water (underground water) or is collected & may be reused.

Aquaculture:

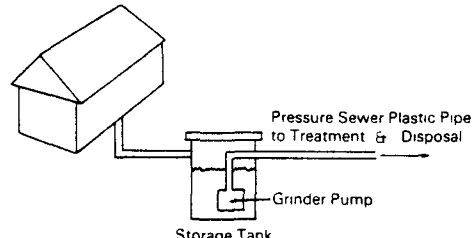
Plants & animals that grow in wastewater help purify water by digesting pollutants. Harvest is used as food, fertilizer, etc.

20 Pressure Sewers, GP (Grinder Pump)

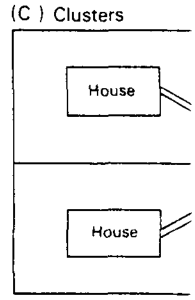


Unit grinds sewage & pumps it through small-diameter plastic pipe to central or alternative treatment & disposal. Doesn't use septic tank but existing tank (B) may remain for emergency storage. Used for one or several homes (C).

(A) No Septic Tank

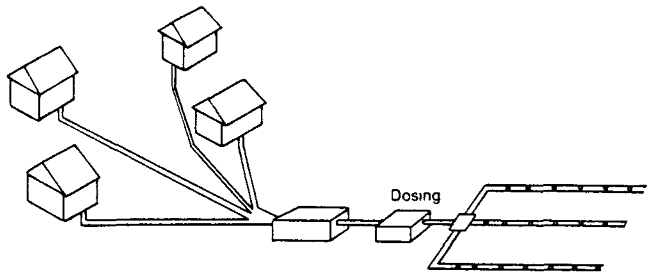


(C) Clusters



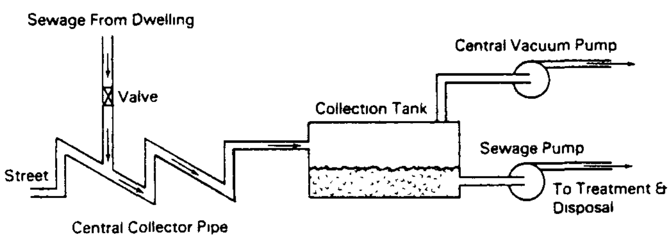
14 Cluster System
(Two or More Users on One Alternative System)

Several houses are served by common treatment & disposal system. Houses could also have onsite septic or aerobic tanks with liquid conducted to common absorption field. Clusters of houses can also use other alternative systems, such as mounds (Sketch 9), pressure & vacuum sewers (Sketches 18, 20, 21), & sewage treatment lagoons.



18 Vacuum Sewers
(Collection System)

Vacuum pump creates vacuum in collector pipes. Valve opens when sewage from dwelling presses against it. Sewage & plug of air behind it enter pipe. Air forces sewage to collection tank. Sewage pump forces sewage from tank to treatment system. Needs standby electric power & failure alarm system. Can be used with large cluster systems (Sketch 14).



15 Waterless or Low-Water Toilet Systems*

Composting: No water.
Large & small systems. Converts toilet wastes & most food wastes to compost. Electric vent fan & heating element optional on large systems; essential on small systems. Proper care vital.

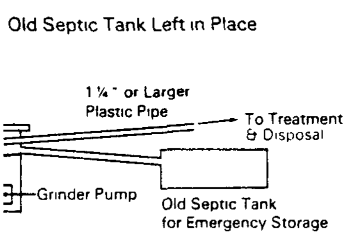
Incinerating: No water.
Electricity, gas, or oil burns solids & evaporates liquid. Small amount of ash is removed weekly. Roof vent. Proper care essential.

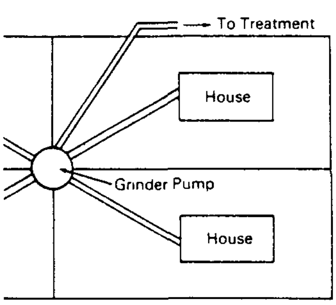
Recycling Oil Flush: No water.
Similar to water-flush toilet but uses oil for flush. Oil & wastes go to large storage tank where wastes settle at bottom & oil rises to top. Filtered oil recycles for flush. Storage tank is pumped & oil replaced periodically. Uses electricity. Proper care essential.

Recycling Chemical: Low water.
Water-chemical flush mixture is pumped into toilet bowl. Mixture & wastes go to storage tank. Filtered liquid recirculates for flush. Permanent or portable types. Permanent needs water hookup. Storage tank is pumped & chemicals added periodically. Uses electricity. Proper care essential.

Recycling Water: Low water.
Various systems. Some reduce wastes to water, gas, & vapor. Treated wastewater recycles to flush toilet. System vents to outside. Multiflush commercial units available. Most systems use electricity. Professional maintenance essential.

**Treat toilet wastes (blackwater). Other household wastewater (graywater) needs separate treatment & disposal system.*

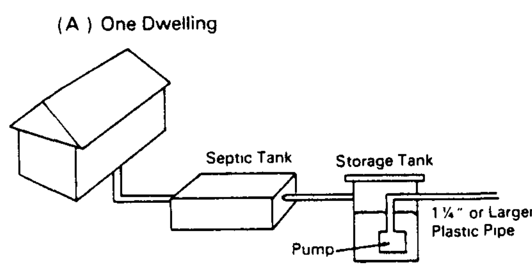


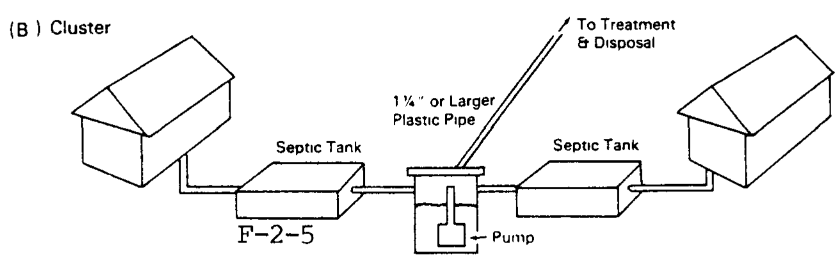


21 Pressure Sewers, STEP
(Septic Tank Effluent Pump)

(A) One dwelling. Pump forces liquid from septic tank through plastic pipe to further treatment & disposal. Sludge is pumped from septic tank periodically.

(B) Cluster system. Liquid from several septic tanks flows to one pumping tank. Pump forces liquid through plastic pipe to treatment & disposal.





Why Small Systems?

Lower Water & Sewer Rates

Rates skyrocket when a few people have to pay for a large system.

Save Energy, Water, Materials

Most small systems use less.

Save Prime Farmland, Prevent Urban Sprawl

Large central sewage systems in rural areas can bring unwanted development.

Federal Government Pays 85%

EPA Construction Grants Program

If you're a *small community* or a *sparsely populated area of a large community* and have a water pollution problem caused by buildings in use December 27, 1977:

- The Government pays 85% of eligible costs for alternative systems if your State, local government, and EPA approve them for your project. Your community, often with State help, pays the other 15%. Farmers Home Administration, Economic Development Administration, Housing & Urban Development, and Community Services Administration programs also help in some areas.

- The Government pays to repair or replace the system if it fails within 2 years of final inspection because it proves unsuited to the project or its design concept is faulty.

- Systems can be *publicly or privately owned.* They can be for residences or small commercial establishments.

— *Publicly owned* systems are owned by the local government.

— *Privately owned* systems are owned by the property owner or a community organization. They can be funded if:

- An authorized local government unit applies for the grant; guarantees a system for inspection, proper operation, maintenance, and user charges; and says public ownership isn't practical;
- They're more cost effective than a conventional central system;
- The residence is a principal dwelling; vacation or second homes are not eligible.
- Commercial users pay back their share of system cost.

You Must Consider Alternatives

EPA can't approve a central system plan submitted after Sept. 30, 1978, unless the community shows it considered alternative systems.

More Information From:

- **EPA National Small Wastewater Flows Clearinghouse**
  West Virginia University; Morgantown, WV 26506; 800-624-8301.

- **Center for Environmental Research Information**
  26 W. St. Clair; Cincinnati, OH 45268; 513-684-7391.

- **Your EPA Regional Office**

1. Boston
(Conn., Maine, Mass., N.H., R.I., Vt.); JFK Federal Bldg.; Boston, MA 02203; 617-223-7210.

2. New York
(N.J., N.Y., P.R., V.I.); 26 Federal Plaza; New York, NY 10007; 212-264-2525.

3. Philadelphia
(Del., Md., Pa., Va., W.Va., D.C.); 6th & Walnut Sts.; Philadelphia, PA 19108; 215-597-9814.

4. Atlanta
(Ala., Ga., Fla., Miss., N.C., S.C., Tenn., Ky); 345 Courtland St., N E.; Atlanta, GA 30308; 404-881-4727.

5. Chicago
(Ill., Ind., Ohio, Mich., Minn., Wis.); 230 S. Dearborn St.; Chicago, IL 60604; 312-353-2000.

6. Dallas
(Ark., La., Okla., Tex., N.Mex.); 1201 Elm St.; Dallas, TX 75270; 214-767-2600.

7. Kansas City
(Iowa, Kans., Mo., Nebr.); 324 E. 11th St.; Kansas City, MO 64108; 816-374-5493.

8. Denver
(Colo., Utah, Wyo., Mont., N.D., S.D.); 1860 Lincoln St.; Denver, CO 80203; 303-837-3895.

9. San Francisco
(Ariz., Calif., Guam, Hawaii, Nev., Amer. Samoa, Trust Territories of the Pacific); 215 Fremont St.; San Francisco, CA 94105; 415-556-2320.

10. Seattle
(Alaska, Idaho, Oreg., Wash.); 1200—6th Ave.; Seattle, WA 98101; 206-442-1220.

Engineers and consultants: For detailed technical information get EPA's onsite systems manual free from Center for Environmental Research Information; 26 W. St. Clair; Cincinnati, OH 45268; 513-684-7391 ; and Innovative and Alternative Technology Assessment Manual from Municipal Construction Division (WH-547), OWPO, EPA, 401 M St. SW., DC 20460; 202-426-8976 .

This publication isn't meant to be a comprehensive guide to alternative systems. It tries to acquaint the layperson with some representative systems used in the United States. EPA does not endorse, approve, or disapprove any system described here. Not all systems shown are approved by all jurisdictions. To get EPA funds, a project must meet Federal, State, and local standards.

SOIL FACTORS THAT AFFECT ON-SITE WASTEWATER DISPOSAL

Evaluation of soil for on-site wastewater disposal requires an understanding of the various components of wastewater and their interaction with soil. Wastewater treatment involves: removing suspended solids; reducing bacteria and viruses to an acceptable level; reducing or removing undesirable chemicals; and disposal of the treated water. For soils to be able to treat wastewater properly they must have certain characteristics. How well a septic system works depends largely on the rate at which effluent moves into and through the soil, that is, on soil permeability. But several other soil characteristics may also affect performance. Groundwater level, depth of the soil, underlying material, slope and proximity to streams or lakes are among the other characteristics that need to be considered when determining the location and size of an on-site wastewater disposal system.

Soil permeability - Soil permeability is that quality of the soil that enables water and air to move through it. It is influenced by the amount of gravel, sand, silt and clay in the soil, the kind of clay, and other factors. Water moves faster through sandy and gravelly soils than through clayey soils.

Some clays expand very little when wet; other kinds are very plastic and expand so much when wet that the pores of the soil swell shut. This slows water movement and reduces the capacity of the soil to absorb septic tank effluent.

Groundwater level - In some soils the groundwater level is but a few feet, perhaps only one foot, below the surface the year around. In other soils the groundwater level is high only in winter and early in spring. In still others the water level is high during periods of prolonged rainfall. A sewage absorption field will not function properly under any of these conditions.

If the groundwater level rises to the subsurface tile or pipe, the saturated soil cannot absorb effluent. The effluent remains near the surface or rises to the surface, and the absorption field becomes a foul-smelling, unhealthful bog.

Depth to rock, sand or gravel - At least 4 feet of soil material between the bottom of the trenches or seepage bed and any rock formations is necessary for absorption, filtration, and purification of septic tank effluent. In areas where the water supply comes from wells and the underlying rock is limestone, more than 4 feet of soil may be needed to prevent unfiltered effluent from seeping through the cracks and crevices that are common in limestone.

Different kinds of soil - In some places the soil changes within a distance of a few feet. The presence of different kinds of soil in an absorption field is not significant if the different soils have about the same absorption capacity, but it may be significant if the soils differ greatly. Where this is so, serial distribution of effluent is recommended so that each kind of soil can absorb and filter effluent according to its capability.

Slope - Slopes of less than 15% do not usually create serious problems in either construction or maintenance of an absorption field provided the soils are otherwise satisfactory.

On sloping soils the trenches must be dug on the contour so that the effluent flows slowly through the tile or pipe and disperses properly over the absorption field. Serial distribution is advised for a trench system on sloping ground.

On steeper slopes, trench absorption fields are more difficult to lay out and construct, and seepage beds are not practical. Furthermore, controlling the downhill flow of the effluent may be a serious problem. Improperly filtered effluent may reach the surface at the base of the slope, and wet, contaminated seepage spots may result.

If there is a layer of dense clay, rock or other impervious material near the surface of a steep slope and especially if the soil above the clay or rock is sandy, the effluent will flow above the impervious layer to the surface and run unfiltered down the slope.

Proximity to streams or other water bodies - Local regulations generally do not allow absorption fields within at least 50 feet of a stream, open ditch, lake, or other watercourse into which unfiltered effluent could escape.

The floodplain of a stream should not be used for an absorption field. Occasional flooding will impair the efficiency of the absorption field; frequent flooding will destroy its effectiveness.

Soil maps show the location of streams, open ditches, lakes and ponds, and of alluvial soils that are subject to flooding. Soil surveys usually give the probability of flooding for alluvial soils.

Soil conditions required for proper on-site wastewater disposal are summarized in the Appendix A-3.

Source: Bender, William H. 1971. Soils and Septic Tanks. Agriculture Information Bulletin 349, SCS, USDA.

SUGGESTED PROCEDURES AND CRITERIA FOR
DESIGNING COLLECTOR SEWAGE SYSTEMS
(For Discussion at the 1978 Home Sewage Treatment Workshops)

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Extension Agricultural Engineer
University of Minnesota

1. For collector systems serving more than 15 dwellings or 5,000 gallons per day, whichever is less, an application for a permit must be submitted to the Minnesota Pollution Control Agency. If the Agency does not act within 10 days upon receipt of the application, no permit shall be required.

2. A permit likely will be required by the local unit of government and they should be involved in preliminary discussions and design considerations.

3. Estimating sewage flows:

   A. Classify each home as type I, II, III, or IV. (See table 4, Extension Bulletin 304, "Town and Country Sewage Treatment.)

   B. Determine the number of bedrooms in each home and estimate the individual sewage flows.

   C. Total the flows to determine the estimated daily sewage flow for the collector system. Add a 3-bedroom type I home for each platted but undeveloped lot.

   D. For establishments other than residences, determine the average daily sewage flow based on water meter readings or estimate the flow based on data furnished by the Minnesota Department of Health or Pollution Control Agency. See Workbook pages I-2, I-3 and I-4.

   Note: Always install a water meter on any establishment other than a private residence and maintain a continuous record of the flow of sewage.

4. Whenever possible, transport or pump septic tank effluent over long distances rather than raw sewage.

5. Each residence should have a septic tank so that solids are separated and effluent only flows in the collector line.

6. Size individual septic tanks according to the recommendations of WPC-40 or local ordinances.

7. If a common septic tank is used, the minimum capacity should be at least 3,000 gallons and compartmented if a single tank.

8. The diameter and grade of the collector sewer line should be based on a flow equal to 35 percent of the flow quantities in Point 3 occurring in a one-hour period.

9. When raw sewage flows in the collector line, the diameter and grade of the sewer pipe must be selected to provide a mean velocity of not less than 2 feet per second when flowing full (0.7% for 4-inch and 0.4% for 6-inch). The maximum grade on 4-inch should be no more than 1/4-inch per foot (2%) to prevent the liquids from flowing away from the solids.

10. A gravity collector line, whether for raw sewage or sewage tank effluent, shall not be less than 4 inches in diameter.

11. Cleanouts, brought flush with or above finished grade, shall be provided wherever an individual sewer line joins a collector sewer line, or every 100 feet, whichever is less, unless manhole access is provided.

12. The pumping tank which collects sewage tank effluent should have a pumpout capacity of 10 percent of the estimated daily sewage flow plus a reserve storage capacity equal to at least 25 percent of the average daily sewage flow.

13. The pumping tank should have a vent at least 2 inches in diameter to allow air to enter and leave the tank during filling and pumping operations.

14. The pumping tank should have manhole access for convenient service to the pumps and control mechanisms.

15. The pumping tank must be watertight to the highest known or estimated elevation of the groundwater table. Where the highest elevation of the groundwater table is above the top of the pumping tank, buoyant forces shall be determined and adequate anchorage provided to prevent tank flotation.

16. Pumps for sewage tank effluent:

    A. There should be dual pumps operating on an alternating basis. The elevation of the liquid level controls should be adjustable after installation of the pumps in the pumping tank.

    B. Each pump should be capable of pumping at least 25 percent of the total estimated daily sewage flow in a one-hour period at a head adequate to overcome elevation differences and friction losses.

    C. The pumps should either be cast iron or bronze fitted and have stainless steel screws or be of other durable and corrosion-proof construct

    D. A warning device should be installed to warn of the failure of either pump. The warning device should actuate both an audible and visible alarm. The alarm should continue to operate until manually turned off. The alarm should be activated each time either pump does not operate as programmed.

    E. A pump cycle counter (cost approximately $10) should be installed to monitor the flow of sewage. The number of pump cycles multiplied by the gallons discharged per dose will provide an accurate measurement of sewage flow.

17. Some site conditions may dictate that all or part of the sewage be pumped as raw sewage. The following recommendations should be followed:

    A. When the raw sewage is pumped from 2 or more residences or from an establishment other than a private residence, dual sewage grinder pumps should be used. The pumps should operate on an alternate basis and have a visible and audible warning device which should be automatically activated in the event of the failure of either pump to operate as programmed.

B. The pumps should either be cast iron or bronze fitted and have stainless steel screws or be of other durable and corrosion-proof construction.

C. To minimize physical agitation of the septic tank into which the raw sewage is pumped, a pumping quantity not in excess of 5 percent of the initial liquid volume of the septic tank shall be delivered for each pump cycle and a pumping rate not to exceed 25 percent of the total estimated daily sewage flow occurring in one hour.

D. The diameter of the pressure pipe in which the raw sewage flows shall be selected on the basis of a minimum flow velocity of 2.0 feet per second.

E. The discharge head of the pump shall be adequate to overcome the elevation difference and all friction losses.

F. The diameter of the pressure pipe for the sewage shall be at least as large as the size of sewage solids the pump can deliver.

18. In some cases a pressure main may be the most feasible method to collect septic tank effluent.

A. Each residence or other establishment has a septic tank and a pumping station.

B. The required discharge head of the pump depends upon the pressure in the collector main. The hydraulics of flow and friction loss must be carefully calculated.

C. The pressure main does not need to be installed on any grade but can follow the natural topography at a depth sufficient to provide protection against freezing.

D. A double checkvalve system should be used at each pumping station.

E. A corporation stop should be installed on the individual pressure line near the connection to the main pressure line.

F. Cleanouts along the pressure main are not required.

G. Discharge the pumped septic tank effluent into a settling tank prior to flow into the soil treatment system. The settling tank will serve as a stilling chamber and also separate any settleable solids.

19. Sizing the soil treatment unit:

A. Make soil borings in the area proposed for the soil treatment unit at least 3 feet deeper than the bottom of the proposed trenches. Look for mottled soil or other evidences of seasonal high water table in the soil.

B. Make 3 percolation tests in each representative soil present on the site.

C. Using the percolation rate of the soil and the sewage flow estimate from point 3, refer to table III of WPC-40 or table 4 of Extension Bulletin 304, "Town and Country Sewage Treatment" to determine the total required trench bottom area.

20. Lay out the soil treatment unit using trenches with drop box distribution of effluent, so only that portion of the trench system which is needed will be used. Drop boxes also provide for automatic resting of trenches as sewage flow fluctuates or as soil absorption capacity varies with amount of soil moisture. Trenches can extend 100 feet each way from a drop box so that a single box can distribute effluent to 200 feet of trench.

APPENDIX G

FINANCING

COST SHARING

The Federal Water Pollution Control Act of 1972 (Public Law 92-500, Section 202), authorized EPA to award grants for 75% of the construction costs of wastewater management systems. Passage of the Clean Water Act (P. L. 95-217) authorized increased Federal participation in the costs of wastewater management systems. The Construction Grants Regulations (40 CFR Part 35) have been modified in accordance with the later Act. Final Rules and Regulations for implementing this Act were published in the Federal Register on September 27, 1978.

There follows a brief discussion of the eligibility of major components of wastewater management systems for Federal funds.

Federal Contribution

In general, EPA will share in the costs of constructing treatment systems and in the cost of land used as part of the treatment process. For land application systems the Federal government will also help to defray costs of storage and ultimate disposal of effluent. The Federal share is 75% of the cost of conventional treatment systems and 85% of the cost of systems using innovative or alternative technologies. Federal funds can also be used to construct collection systems when the requirements discussed below are met.

The increase in the Federal share to 85% when innovative or alternative technologies are used is intended to encourage reclamation and reuse of water, recycling of wastewater constituents, elimination of pollutant discharges, and/or recovering of energy. Alternative technologies are those which have been proven and used in actual practice. These include land treatment, aquifer recharge, and direct reuse for industrial purposes. On-site, other small waste systems, and septage treatment facilities are also classified as alternative technologies. Innovative technologies are those which have not been fully proven in full scale operation.

To further encourage the adoption and use of alternative and innovative technologies, the Cost Effectiveness Analysis Guidelines in the new regulations give these technologies a 15% preference (in terms of present worth) over conventional technologies. This cost preference does not apply to privately owned, on-site or other privately owned small waste flow systems.

States that contribute to the 25% non-Federal share of conventional projects must contribute the same relative level of funding to the 15% non-Federal share of innovative or alternative projects.

Individual Systems (Privately or Publicly Owned)

P.L. 95-217 authorized EPA to participate in grants for constructing privately owned treatment works serving small commercial establishments or one or more principal residences inhabited on or before December 27, 1977 (Final Regulations, 40 CFR 35.918, September 27, 1978). A public body must apply for the grant, certify that the system will be properly operated and maintained, and collect user charges for operation and maintenance of the system. All commercial users must pay industrial cost recovery on the Federal share of the system. A principal residence is defined as a voting residence or household of the family during 51% of the year. Note: The "principal residence" requirement does not apply to publicly owned systems.

Individual systems, including sewers, that use alternative technologies may be eligible for 85% Federal participation, but privately owned individual systems are not eligible for the 115% cost preference in the cost-effective analysis. Acquisition of land on which a privately owned individual system would be located is not eligible for a grant.

Publicly owned on-site and cluster systems, although subject to the same regulations as centralized treatment plants, are also considered alternative technologies and therefore eligible for an 85% Federal share.

EPA policy on eligibility criteria for small waste flow systems is still being developed. It is clear that repair, renovation or replacement of on-site systems is eligible if they are causing documentable public health, groundwater quality or surface water quality problems. Both privately owned systems servicing year-round residences (individual systems) and publicly owned year-round or seasonally used systems are eligible where there are existing problems. Seasonally used, privately owned systems are not eligible.

Several questions on eligibility criteria remain to be answered and are currently being addressed by EPA:

- For systems which do not have existing problems, would preventive measures be eligible which would delay or avoid future problems?

- Could problems with systems other than public health, groundwater quality or surface water quality be the basis for eligibility of repair, renovation or replacement? Examples of "other problems", are odors, limited hydraulic capacity, and periodic backups.

- Is non-conformance with modern sanitary codes suitable justification for eligibility of repair, renovation or replacement? Can non-conformance be used as a measure of the need for preventive measures?

- If a system is causing public health, groundwater quality or surface water quality problems but site limitations would prevent a new on-site system from satisfying sanitary codes, would a non-conforming on-site replacement be eligible if it would solve the existing problems?

In this EIS estimates were made of the percent repair, renovation or replacement of on-site systems that may be found necessary during detailed site analyses. Those estimates are felt to be conservatively high and would probably be appropriate for generous resolutions of the above questions.

Collection Systems

Construction Grants Program Requirements Memorandum (PRM) 78-9, March 3, 1978, amends EPA policy on the funding of sewage collection systems in accordance with P.L. 95-271. Collection sewers are those installed primarily to receive wastewaters from household service lines. Collection sewers may be grant-eligible if they are the replacement or major rehabilitation of an existing system. For new sewers in an existing community to be eligible for grant funds, the following requirements must be met:

- Substantial Human Habitation -- The bulk (generally 67%) of the flow design capacity through the proposed sewer system must be for wastewaters originating from homes in existence on October 18, 1972. Substantial human habitation should be evaluated block by block, or where blocks do not exist, by areas of five acres or less.

- Cost-Effectiveness -- New collector sewers will only be considered cost-effective when the systems in use (e.g. septic tanks) for disposal of wastes from existing population are creating a public health problem, violating point source discharge requirements of PL 92-500, or contaminating groundwater. Documentation of the malfunctioning disposal systems and the extent of the problem is required.

  Where population density within the area to be served by the collection system is less than 1.7 persons per acre (one household per two acres), a severe pollution or public health problem must be specifically documented and the collection sewers must be less costly than on-site alternatives. Where population density is less than 10 persons per acre, it must be shown that new gravity collector sewer construction and centralized treatment is more cost-effective than on-site alternatives. The collection system may not have excess capacity which could induce development in environmentally sensitive areas such as wetlands, floodplains or prime agricultural lands. The proposed system must conform with approved Section 208 plans, air quality plans, and Executive Orders and EPA policy on environmentally sensitive areas.

- Public Disclosure of Costs -- Estimated monthly service charges to a typical residential customer for the system must be disclosed to the public in order for the collection system to be funded. A total monthly service charge must be presented, and the portion of the charge due to operation and maintenance, debt service, and connection to the system must also be disclosed.

Elements of the substantial human habitation and cost-effectiveness eligibility requirements for new collector sewers are portrayed in Figure 1 in a decision flow diagram. These requirements would apply for any pressure, vacuum or gravity collector sewers except those serving on-site or small waste flow systems.

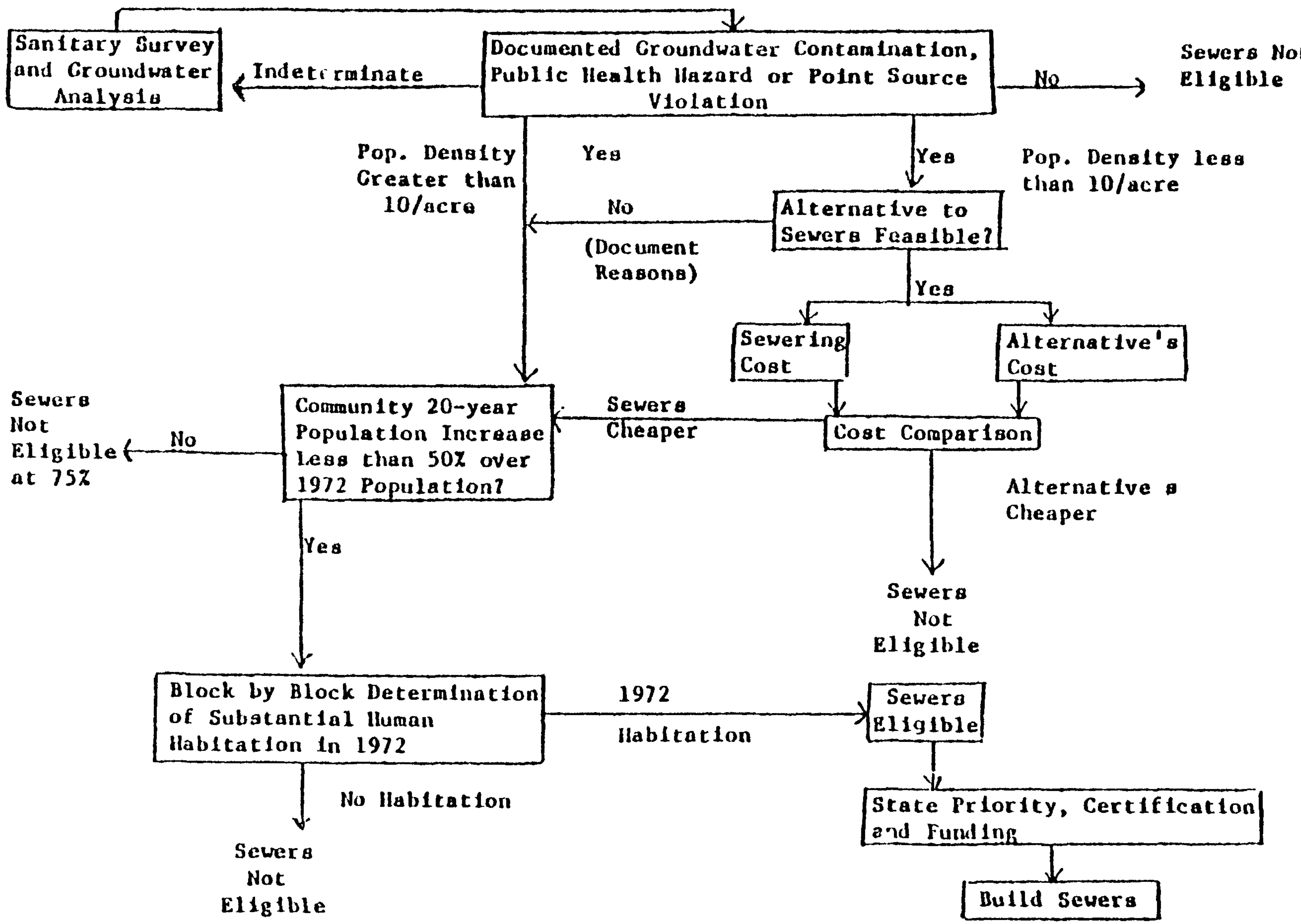
Household Service Lines

Traditionally, gravity sewer lines built on private property connecting a house or other building with a public sewer have been built at the expense of the owner without local, State or Federal assistance. Therefore, in addition to other costs for hooking up to a new sewer system, owners installing gravity household service lines will have to pay about $1,000, more or less depending on site and soil conditions, distance and other factors.

Pressure sewer systems, including the individual pumping units, the pressure line and appurtenances on private property, however, are considered as part of the community collection system. They are, therefore, eligible for Federal and State grants which substantially reduce the homeowner's private costs for installation of household service lines.

FIGURE 1

Collector Sewer Eligibility - Decision Flow Diagram
Based on PRM 78-9



ALTERNATIVES FOR FINANCING THE LOCAL SHARE OF WASTEWATER TREATMENT FACILITIES IN THE NETTLE LAKE STUDY AREA, OHIO

The financing of wastewater facilities requires a viable strategy. In exercising the authority delegated to them by the state to finance local activities, local governments need not only expertise in budgeting and debt administration but also a general knowledge of the costs and benefits of various complex financial tools and alternative investment strategies.

This section reviews several possible ways to fund the Proposed Action or alternative wastewater management systems in the Steuben Lakes Regional Wastes District, Indiana. It will:

- Describe options available for financing both the capital and the operating costs of the wastewater facilities; and

- Discuss institutional arrangements for financing and examine the probable effects of various organizational arrangements on the marketability of the bond.

FINANCING CAPITAL COSTS: OPTIONS

The several methods of financing capital improvements include: (1) pay-as-you-go methods; (2) special benefit assessments; 3) reserve funds; and (4) debt financing.

The pay-as-you-go method requires that payments for capital facilities be made from current revenues. This approach is more suitable for recurring expenses such as street paving than for one-time long-term investments. As the demand for public services grows, it becomes increasingly difficult for local governments to finance capital improvements on a pay-as-you-go basis.

In situations where the benefits to individual properties from capital improvements can be assessed, special benefit assessments in the form of direct fees or taxes may be used to apportion costs.

Sometimes reserve funds are established to finance capital improvements. A part of current revenues is placed in a special fund each year and invested in order to accumulate adequate funds to finance needed capital improvements. Although this method avoids the expense of borrowing, it requires foresight on the part of the local government.

Debt financing of capital facilities may take several forms. Local governments may issue short-term notes or float one of several types of bonds. Bonds are generally classified by both their guarantee of security and method of redemption.

GUARANTEE OF SECURITY

General Obligation (G.O. Bonds)

Debt obligations secured by the full faith and credit of the municipality are classified as general obligation bonds. The borrower is pledging the financial and economic resources of the community to support the debt. Following are some of the advantages:

- Interest rates on the debt are usually lower than on revenue or special assessment bonds. With lower annual debt service charges, the cash flow position of the jurisdiction is improved.

- G.O. bonds for sewerage offer financial flexibility to the municipality since funds to retire them can be obtained through property taxes, user charges or combinations of both.

- When G.O. bonds are financed by ad valorem property taxes, households have the advantage of a deduction from their Federal income taxes.

- G.O. bonds offer a highly marketable financial investment since they provide a tax-free and relatively low-risk investment venture for the lender.

Revenue Bonds

Revenue bonds differ from G.O. bonds in that they are not backed by a pledge of full faith and credit from the municipality and therefore require a higher interest rate. The interest is usually paid, and the bonds eventually retired, by earnings from the enterprise.

A major advantage of revenue bonds over general obligation bonds is that municipalities can circumvent constitutional restrictions on borrowing. Revenue bonds have become a popular financial alternative to G.O. bonds in financing wastewater facilities.

Special Assessment Bond

A special assessment bond is payable only from the collection of special assessments, not from general property taxes. This type of obligation is useful when direct benefits are easily identified. Assessments are often based on front footage or area of the benefited property. This type of assessment may be very costly to individual property owners, especially in rural areas. Agricultural lands may require long sewer extensions and thus impose a very high assessment on one user. Furthermore, not only is the individual cost high, but the presence of sewer lines places development pressures on the rural land and often portends the transition of land from agriculture to residential/commercial use. Because the degree of security is lower than with G.O. bonds, special assessment bonds represent a greater investment risk and therefore carry a higher interest rate.

METHODS OF REDEMPTION

Two types of bonds are classified according to their method of retirement -- (1) serial bonds and (2) term bonds. Serial bonds mature in annual installments while term bonds mature at a fixed point in time.

Serial Bonds

Serial bonds provide a number of advantages for financing sewerage facilities. First, they provide a straightforward retirement method by maturing in annual installments. Secondly, since some bonds are retired each year, this method avoids the use of sinking funds.* Third, serial bonds are attractive to the investor and offer wide flexibility in marketing and arranging the debt structure of the community. Serial bonds fall into two categories (1) straight serials and (2) serial annuities.

Straight Serial Bonds provide equal annual payments of principal for the duration of the bond issue. Consequently, interest charges are higher in the early years and decline over the life of the bond. This has the advantage of 'freeing up' surplus revenues for future investment. The municipality has the option of charging these excess revenues to a sinking or reserve fund or of lowering the sewer rates imposed on households.

Serial Annuities provide equal annual installment payments of principal and interest. Total debt service charges in the early years of the bond issue are thus equal to the charges in later years. The advantage to this method of debt retirement is that the total costs of the projects are averaged across the entire life of the bond. Thus, peak installment payments in the early years are avoided, and costs are more equitably distributed than with straight serial bonds.

Although straight and annuity serials are the most common types of debt retirement bonds, methods of repayment may vary. Such "irregular" serial bonds may result in:

- Gradually increasing annual debt service charges over the life of the issue;
- Fluctuating annual installments producing combinations of rising then declining debt service; or
- Large installments due on the last years of the issue. These are called "ballooning" maturity bonds.

Term Bonds

Term bonds differ from serial issues in that term bonds mature at a fixed point in time. The issuing entity makes periodic payments (including interest earned on investments) to a sinking fund which will be used to retire the debt at maturity. The major disadvantage to this approach to financing is management of the sinking fund -- a complex operation requiring expertise in national and regional monetary markets to insure maximum return on investment. Mismanagement of the fund could lead to default on the bond.

OPERATING COSTS

In most cases, operating costs are financed through service charges. Service charges are generally constructed to reflect the physical use of the system. For example, charges may be based on one or a combination of the following factors:

- Volume of wastewater
- Pollutional load of wastewater
- Number or size of connections
- Type of property serviced (residential, commercial, industrial).

Volume and pollutional load are two of the primary methods for determining service charges. Basing service charges on volume of wastewater requires some method for measuring or estimating volume. Because metering of wastewater flows is expensive and impractical, many communities utilize existing water supply meters and, often, fix wastewater volume at a percentage of water flows. When metering is not used, a flat rate system may be employed, charging a fixed rate for each connection based on user type.

INSTITUTIONAL ARRANGEMENTS

There are two basic organizational arrangements available in the State of Indiana to finance and administer rural sewerage systems: (1) Regional Water and Sewer Districts and (2) Conservancy Districts.

1. Chapter 19-3-1.1 of the Indiana State Code and subsequent amendments allows for the organization of a Regional Waste District. A petition of organization must be filed with the Stream Pollution Control Board by the participating political subdivisions and be authorized by the County Council. Upon approval by the council and the Stream Pollution Board, an elected governing body has the power to operate, administer and finance the wastewater facilities.

The Regional Waste District is restricted in the type of financing available to fund the capital costs of the system. Chapter 19-3.1.1-14 of the State Code permits only revenue bonds which must be payable solely from the net revenues of the facilities. In addition, the govening body, by ordinance, must create a sinking fund for the payment of the debt service charges, administrative costs and operating and maintenance expenses of the sewerage system. This could cause financial problems. Management of a sinking fund is complex. Expertise in national and regional monetary markets is necessary to insure maximum return on investment. Mismanagement of the fund could lead to default on the bond.

2. An institutional alternative to the Regional Waste District approach is the Conservancy District. This arrangement is specifically designed to cope with regional water management problems between and among political subdivisions. One difference between the Regional Waste District and the Conservancy District is in the power of administration. In the regional district, authorization is provided by the county, the Stream Pollution Board or the Natural Resource Commission. However, the residents of the Conservancy District must petition the clerk of the circuit court to authorize and establish the district.

The administrative costs and court costs necessary to establish the Conservancy District are financed through a number of funding mechanisms available at the state and local levels. These include funding through a special benefits tax, borrowing from the general revenue accounts of the county, borrowing from the revolving fund of the state board of finance; or borrowing from the flood control revolving fund. If the petition for conservancy is denied, the court costs must be paid by the petitioners. If the district is established the revolving fund and general revenue accounts must be reimbursed from the net revenues from the wastewater system.

Further, the Conservancy District Act provides for two basic methods to finance the cost of the sewerage facilities: (1) Federal agency financing and (2) Private market financing.

Federal Agency Financing. Chapter 19-3-2-71 of the Conservancy District Act provides authorization for the district board to apply to the Farmers Home Administration and other Federal agencies to finance the local share of the project costs. The district must file a petition of approval with the clerk of the circuit court. If the court finds that the conditions of the loan are beneficial to the district, then the governing board is authorized to levy a special beneifit tax, or user charge to repay the loan and retire the debt.

Private Market Financing. Chapter 19-3-2-845 of the Conservancy District Act provides for the payment of the collection transmission and treatment components of the wastewater facilities through the issuance of revenue bonds. Principal and interest charges are paid through a combination of either special benefit taxes, assessment of exceptional benefits or user charges.

The advantage to the Conservancy District is the financial option available to finance the sewerage system. Whereas the Regional Waste District can only issue revenue bonds to finance the capital costs of the system, the Conservancy approach can finance through the Farmer's Home Administration, and issue revenue bonds. Further, the Conservancy arrangement provides for a user charge and a special beneift tax levy for collection of revenues to retire the debt.

A major disadvantage of the Conservancy district is the cumbrous legal and administrative arrangements that are necessary to establish the district and finance the facilities. For example, the Court has the full authority to set the time and date of hearings to determine the feasibility of loans and bond sales (Chapter 19-3-2-71 [27-1571]). Although state statutes indicate that the court must give priority to these hearings, actual practice indicates that authorization and approval is a protracted and expensive experience.

Considering the strengths and weaknesses of each institutional approach, the recommended organizational arrangement to finance and administer the wastewater facilities is the Regional Waste District. This is primarily due to two reasons. First, since a Regional Waste District (the Steuben Lakes Regional Waste District) has recently been established, the administrative costs of dismantling the present organizational arrangement and implementing the court authorized Conservancy District may be prohibitive. Second, bond attorneys familiar with both organizational arrangements have indicated that the Regional Waste District would be successful in the commercial bond market. This eliminates the need for the authorization of a Conservancy District to provide financial commitments to the Farmers Home Administration and other Federal agencies.

FUNDING MECHANISMS TO FINANCE THE WASTEWATER SYSTEMS

The proposed wastewater facilities and each of the six alternative technologies under evaluation are characterized by a distinct set of capital and operating expenditures necessary to construct and maintain the systems. The capital costs typically constitute the largest portion of the costs and are distributed over the life of the project. The annual capital charge is dependent on the type of mechanisms used to finance the project. For the Regional Sewer District, a revenue bond approach was selected to finance the capital costs of the wastewater systems. Constitutional restrictions prohibit the issuance of any other type of private funding mechanism.

The revenue bonds were assumed to carry a 6 percent interest rate for a term of 20 years. In addition a reserve margin of 10 and 20 percent of total debt service charges were added to improve the marketability of the bond.[1] The 10 percent reserve requirement represent the minimum reserve that the market would require to provide a reasonable margin of safety. The margin is based on the Farmer's Home Administration reserve requirements of 10 percent. This is traditionally the measure by which commercial paper requirements are compared.[2] The 20

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[1] The bond market requires earnings from revenue bonds to be some multiple of total debt service charges in order to protect the investor from adverse economic conditions. This improves the marketability of the bond but adds to the cost of the wastewater system.

[2] The Farmers Home Administration provides loans for sewer services to rural areas with populations less than 10,000. When it is apparent that the financial choices of a rural sewer district are exhausted with no method to finance the local share of the project, FHA will provide 5%, 40 year loan. If FHA covers a revenue bond issue, then it requires a 10% reserve requirement as a margin of safety.

percent reserve requirement represents a conservative estimate for the additional funds needed to finance the capital facilities. This is a reasonable requirement considering that there is no record of earnings for a regional sewerage system that includes Jackson, Jamestown, Millgrove and Pleasant Township.

SUMMARY

The above analysis provides the policymaker with information to access the impacts associated with each alternative sewer system. A brief review of the analysis is presented below:

- The existing organizational arrangement for the Steuben County Regional Water and Sewer District should be maintained to finance, administer and operate the sewerage system.

- A revenue bond approach supported by a user charge will provide adequate financing for the district. The 20 percent reserve requirement is a reasonable estimate based on current revenue bond sales to areas similar to the Steuben County study area.

APPENDIX H

MANAGEMENT

SOME MANAGEMENT AGENCIES FOR DECENTRALIZED FACILITIES

Central management entities that administer non-central systems with various degrees of authority have been established in several States. Although many of these entities are quasi-public, few of them both own and operate each component of the facility. The list of small waste flow management agencies that follows is not comprehensive. Rather, it presents a sampling of what is currently being accomplished. Many of these entities are located in California, which has been in the vanguard of the movement away from conventional centralized systems to centrally managed decentralized systems to serve rural areas (State of California, Office of Appropriate Technology, 1977).

Westboro (Wisconsin Town Sanitary District)

Sanitary District No. 1 of the Town of Westboro represents the public ownership and management of septic tanks located on private property. In 1974 the unincorporated community of Westboro was selected as a demonstration site by the Small Scale Waste Management Project (SSWMP) at the University of Wisconsin to determine whether a cost-effective alternative to central sewage for small communities could be developed utilizing on-site disposal techniques. Westboro was thought to be typical of hundreds of small rural communities in the Midwest which are in need of improved wastewater treatment and disposal facilities but are unable to afford conventional sewerage.

From background environmental data such as soils and engineering studies and groundwater sampling, it was determined that the most economical alternative would be small diameter gravity sewers that would collect effluents from individual septic tanks and transport them to a common soil absorption field. The District assumed responsibility for all operation and maintenance of the entire facility commencing at the inlet of the septic tank. Easements were obtained to allow permanent legal access to properties for purposes of installation, operation, and maintenance. Groundwater was sampled and analyzed during both the construction and operation phases. Monthly charges were collected from homeowners. The system, now in operation, will continue to be observed by the SSWMP to assess the success of its mechanical performance and management capabilities.

Washington State

Management systems have been mandated in certain situations in the State of Washington to assist in implementing the small waste flow management concept. In 1974 the State's Department of Social and Health Services established a requirement for the management of on-site systems: an approved management system would be responsible for the maintenance of sewage disposal systems when subdivisions have gross densities greater than 3.5 housing units or 12 people per acre (American Society of Agricultural Engineers 1977). It is anticipated that this concept will soon be applied to all on-site systems.

Georgetown Divide (California) Public Utility District (GDPUD)

The GDPUD employs a full-time geologist and registered sanitarian who manage all the individual wastewater sytems in the District. Although it does not own individual systems this district has nearly complete central management responsibility for centralized systems. The Board of Directors of the GDPUD passed an ordinance forming a special sewer improvement district within the District to allow the new 1800-lot Auburn Lake Trails subdivision to receive central management services from the GDPUD. The GDPUD performs feasibility studies on lots within the subdivision to evaluate the potential for the use of individual on-site systems, designs appropriate on-site systems, monitors their construction and installation, inspects and maintains them, and monitors water quality to determine their effects upon water leaving the subdivision. If a septic tank needs pumping, GDPUD issues a repair order to the homeowner. Service charges are collected annually.

Santa Cruz County (California) Septic Tank Maintenance District

This district was established in 1973 when the Board of Supervisors adopted ordinance No. 1927, "Ordinance Amending the Santa Cruz County Code, Chapter 8.03 Septic Tank System Maintenance District." Its primary function is the inspection and pumping of all septic tanks within the District. To date 104 residences in two subdivisions are in the district, which collects a one-time set-up fee plus monthly charges. Tanks are pumped every three years and inspected annually. The County Board of Supervisors is required to contract for these services. In that the District does not have the authority to own systems, does not perform soil studies on individual sites, or offer individual designs, its powers are limited.

Bolinas Community (California) Public Utility District (BCPUD)

Bolinas, California is an older community that faced an expensive public sewer proposal. Local residents organized to study the feasibility of retaining many of their on-site systems, and in 1974 the BCPUD Sewage Disposal and Drainage Ordinance was passed. The BCPUD serves 400 on-site systems and operates conventional sewerage facilities for 160 homes. The District employs a wastewater treatment plant operator who performs inspections and monitors water quality. The County health administration is authorized to design and build new septic systems.

Kern County (California) Public Works

In 1973 the Board of Supervisors of Kern County, California, passed an ordinance amending the County Code to provide special regulations for water quality control. County Service Area No. 40, including 800 developed lots of a 2,900-lot subdivision, was the first Kern County Service Area (CSA) to arrange for management of on-site disposal systems. Inspections of installations are made by the County Building Department. Ongoing CSA responsibilities are handled by the Public Works Department. System design is provided in an Operation and Maintenance Manual.

Marin County (California)

In 1971 the Marin County Board of Supervisors adopted a regulation, "Individual Sewage Disposal Systems," creating an inspection program for all new installations (Marin County Code Chapter 18.06). The Department of Environmental Health is responsible for the inspection program. The Department collects a charge from the homeowner and inspects septic tanks twice a year. The homeowner is responsible for pumping. The Department also inspects new installations and reviews engineered systems.

LEGISLATION BY STATES AUTHORIZING MANAGEMENT OF SMALL WASTE FLOW DISTRICTS

In a recent act, the California legislature noted that then-existing California law authorized local governments to construct and maintain sanitary sewerage systems but did not authorize them to manage small waste flow systems. The new act, California Statutes Chapter 1125 of 1977, empowers certain public agencies to form on-site wastewater disposal zones to collect, treat, and dispose of wastewater without building sanitary sewers or sewage systems. Administrators of such on-site wastewater disposal zones are to be responsible for the achievement of water quality objectives set by regional water quality control boards, protection of existing and future beneficial uses, protection of public health, and abatement of nuisances.

The California act authorizes an assessment by the public agency upon real property in the zone in addition to other charges, assessments, or taxes levied on property in the zone. The Act assigns the following functions to an on-site wastewater disposal zone authority:

- To collect, treat, reclaim, or dispose of wastewater without the use of sanitary sewers or community sewage systems;
- To acquire, design, own, construct, install, operate, monitor, inspect, and maintain on-site wastewater disposal systems in a manner which will promote water quality, prevent the pollution, waste, and contamination of water, and abate nuisances;
- To conduct investigations, make analyses, and monitor conditions with regard to water quality within the zone; and
- To adopt and enforce reasonable rules and regulations necessary to implement the purposes of the zone.

To monitor compliance with Federal, State and local requirements an authorized representative of the zone must have the right of entry to any premises on which a source of water pollution, waste, or contamination including but not limited to septic tanks, is located. He may inspect the source and take samples of discharges.

The State of Illinois recently passed a similar act. Public Act 80-1371 approved in 1978 also provides for the creation of municipal on-site wastewater disposal zones. The authorities of any municipality (city, village, or incorporated town) are given the power to form on-site wastewater disposal zones to "protect the public health, to prevent and abate nuisances, and to protect existing and further beneficial water use." Bonds may be issued to finance the disposal system and be retired by taxation of property in the zone.

A representative of the zone is to be authorized to enter at all reasonable times any premise in which a source of water pollution, waste, or contamination (e.g., septic tank) is located, for the purposes of inspection, rehabilitation and maintenance, and to take samples from discharges. The municipality is to be responsible for routinely inspecting the entire system at least once every 3 years. The municipality must also remove and dispose of sludge, its designated representatives may enter private property and, if necessary, respond to emergencies that present a hazard to health.

MANAGEMENT CONCEPTS FOR SMALL WASTE FLOW DISTRICTS

Several authors have discussed management concepts applicable to decentralized technologies. Lenning and Hermason suggested that management of on-site systems should provide the necessary controls throughout the entire lifecycle of a system from site evaluations through system usage. They stressed that all segments of the cycle should be included to ensure proper system performance (American Society of Agricultural Engineers 1977).

Stewart stated that for on-site systems a three-phase regulatory program would be necessary (1976). Such a program would include: 1) a mechanism to ensure proper siting and design installation and to ensure that the location of the system is known by establishing a filing and retrieval system; 2) controls to ensure that each system will be periodically inspected and maintained; and 3) a mechanism to guarantee that failures will be detected and necessary repair actions taken.

Winneberger and Burgel suggested a total management concept, similar to a sewer utility, in which a centralized management entity is responsible for design, installation, maintenance, and operation of decentralized systems (American Society of Agricultural Engineers 1977). This responsibility includes keeping necessary records, monitoring ground and surface water supplies and maintaining the financial solvency of the entity.

Otis and Stewart (1976) have identified various powers and authorities necessary to perform the functions of a management entity:

- To acquire by purchase, gift, grant, lease, or rent both real and personal property;
- To enter into contracts, undertake debt obligations either by borrowing and/or by issuing bonds, sue and be sued. These powers enable a district to acquire the property, equipment, supplies and services necessary to construct and operate small flow systems;
- To declare and abate nuisances;
- To require correction or private systems;
- To recommend correction procedures;
- To enter onto property, correct malfunctions, and bill the owner if he fails to repair the system;
- To raise revenue by fixing and collecting user charges and levying special assessments and taxes;
- To plan and control how and when wastewater facilities will be extended to those within its jurisdiction;
- To meet the eligibility requirements for loans and grants from the State and Federal government.

APPENDIX I

ENGINEERING

DESIGN AND COSTING ASSUMPTIONS

Treatment

(1) Aerated Lagoons

- Medium-depth basins designed for continuous biological treatment of wastewater.
- Mechanical aeration.
- A non-aerated polishing cell following the last aerated cell is used to enhance suspended solids removal prior to discharge.
- An impervious flexible lining is used for the lagoons.
- Costs for preliminary treatment include all costs that might be incurred at the headworks (comminutor, bar screen, controls, or metering).

(2) Land Application

- storage period - 8 weeks per year
- application rate - 20 inches per week
- application technique - rapid infiltration
- Facilities for recovery and recycling of tailwater provided.

(3) Wetlands Discharge

- Wetland systems are somewhat similar to overland flow systems in that most of the water flows over a relatively impermeable soil surface and the renovation action is more dependent on microbial and plant activity than soil chemistry.
- Secondary treatment and 120 day storage capacity is required prior to discharge.
- Length of application is 245 days at a rate of one inch per week.
- A simple surface discharge system is assumed rather than spray due to low flows.

- Individual pumping units for the pressure sewer system include a 2- by 8-foot basin with discharge at 6 feet, control panel, visual alarm, mercury float level controls, valves, rail system for removal of pump, antiflotation device, and the pump itself. (See Figure III-1).
- Effluent pumps are 1-1/2 and 2 HP pumps which reach a total dynamic head of 80 and 120 feet respectively.
- On-site and effluent pumping units (STEP) require the use of septic tanks. Due to undersize and faulty units, a 35 percent replacement of all septic tanks was assumed. All units are to be 1,000 gallon concrete septic tanks.
- An even distribution of population was primarily assumed along collection lines for all alternatives indicated.
- Replacement of all existing privies is required. For the on-site treatment alternatives this will mean replacement of the privies with holding tanks or other appropriate technology. Where privies are now being used an improvement to the home has been estimated for the addition of an indoor bathroom in all alternatives except EIS Alternative 8.
- For all on-site treatment alternatives 20 percent of the existing drainfields need replacing. One half of these replacements are to be super systems and the other half are to be mound systems.
- Ten percent of the total septic tank-soil absorption systems will require hydrogen peroxide (H_2O_2) treatment during the 20 year period.
- All flows are based on a 60 gallon per capita per day (gpcd) design flow for residential areas. Infiltration for new sewers is based on a rate of 200 gallons per inch-mile for gravity sewer lines.
- For EIS Alternative 8 the cost for indoor bathrooms was removed. Indoor toilets can be sectioned off in the corner of a room by use of folding partitions or a curtain. Holding tanks were assumed to receive blackwater only as no water supply in houses with privies was assumed. Because of this assumption, the water conservation devices were not costed into this alternative either.

Analysis of Cost-Effectiveness

- Quoted costs are in 1979 dollars
- Engineering News Record Index of 3000 used for updating costs
- i, interest rate = 6-5/8%
- Planning period = 20 years
- Life of facilities, structures - 50 years
  Mechanical components - 20 years

- Straight line depreciation
- Land valued at $16000/acre
- Debt service for user charge calculations assumed 30 years at 6-7/8%

(4) Cluster Systems

- Design assumptions -

  flow - 60 gpcd
  3-bedroom home - 190 sq. feet trench bottom/bedroom
  35% of existing septic tanks need to be replaced with new 1000-gallon tanks

- Collection of wastewaters is by a gravity system conveying all wastes to a central lift station where wastes are lifted up to 60 feet to the drain field.
- Cluster system includes the following requirements

  monitoring wells
  hydrogeological survey

- Pump station capacity 50 gpm.

<u>Collection</u>

- All sewer lines are to be placed at or below 5 feet of depth to allow for frost penetration in the Nettle Lake area. Gravity lines are assumed to be placed at an average depth of 11 feet.
- A minimum velocity of 2 fps will be maintained in all pressure sewer lines and force mains to provide for scouring.
- Peaking factor used for design flows was based on Ten State Standards.
- All pressure sewer lines and force mains 8 inches in diameter or less will be PVC SDR26, with a pressure rating of 160 psi. Those force mains larger than 8 inches in diameter will be constructed of ductile iron with mechanical joints.
- When possible, force mains and pressure sewer collectors will be placed in a common trench.
- Cleanouts in the pressure sewer system will be placed at the beginning of each line, with one every 500 feet of pipe in line. Cleanout valve boxes will contain shut-off valves to provide for isolation of various sections of line for maintenance and/or repairs.

Appendix I-2

No Action

Assumptions

Existing Residences	275 houses (98% seasonal) 132 privies 143 septic tank/soil absorption systems
Residences to be built in the next 20 years	-0-
Privies	No pumping as floods wash out privies seasonally. No replacement expected.
Septic tank-soil absorption systems	Assume 1%/yr. failure replaced by septic tank soil absorption systems
-----	@ $1650/system
-----	$65 per pumping & disposal of septage once each 10 years for all tanks
-----	$8.65* x 12 hrs./replacement system perm.

Costs

Construction	Septic systems @ $650/system x (1.43) say 1/year	$1,650/yr.
	Permit @ $8.65/hr. x 12 hrs. x 1/yr.	104/yr.
O & M	Septic systems @ $65/pumping x 14/yr.	910/yr.
Salvage	Septic systems 16 x 1650 (PW=16A x 0.2772)	264.00

* Sanitarian at $18,000/yr.

NETTLE LAKE
PROPOSED ALTERNATE
COST ESTIMATE

TREATMENT - AERATED LAGOON

Q = 0.14 MGD ENR = 3000

PROCESS	CAPITAL COST	O&M COSTS		SALVAGE VALUE
Preliminary Treatment	11,800	1,875		5,300
Aerated Lagoon	43,660	2,420		26,196
Chlorination	7,100	1,000		4,600
Lab/Maint. Bldg.	22,400	2,500		10,100
Administration	-0-	1,800		-0-
Mobilization	4,100	-0-		-0-
Site Work incl. Excav.	14,800	-0-		-0-
Electrical	17,700	-0-		-0-
Yard Piping	13,000	-0-		-0-
HVAC	2,400	-0-		7,800
Controls & Inst.	-0-	-0-		-0-
Land (15 Ac.)	24,000	-0-		43,300
Effluent Pipe 1,000LF	20,000	75		12,000
	180,960	9,670		109,296
Engr. and Cont. @ 25%	45,240	-0-	@20%	21,860
	226,200	9,670		131,156

NETTLE LAKE - COLLECTION

COST ESTIMATE

Proposed Alternate

Costs in 1979 Dollars

ENR INDEX = 3000

SERVICE AREA	CAPITAL COST	O&M COSTS		SALVAGE VALUE
1980				
Central Collection	962,683	1,685		580,307
Gravity Interceptor	44,200	55		26,520
Pump Stations	27,000	2,820		8,100
Transmission	77,225	60		46,335
Bathrooms	289,209	-0-		173,525
	1,400,317	4,620		834,787
25% Engr. and Cont.	350,079	-0-	@20%	166,957
	1,750,396	4,620		1,001,744
1980-2000				
Gravity Hook-ups	34,844			
25% Engr. and Cont.	8,711			
	43,555			

ECONOMIC ANALYSIS OF ALTERNATIVE
($1,000)

Proposed Alternate

Item	Year	Capital Dollars	O & M Dollars	Salvage Value	(1) Capital Dollars	(2) O & M Dollars	(3) Salvage Value	Total Present Worth (1+2-3)	Average Annual Equivalent Cost
Collection	1980	1,750.4	4.6	1,001.7	1,750.4	50.2	277.7	1,522.9	
Treatment	1980-	226.2	9.7	131.2	226.2	105.8	36.4	295.6	
Collection	2000	2.2*	0	0	24.0	0	0	24.0	
								1,842.5	168.8

*Future Hook-ups @ 2.2/Year

NETTLE LAKE - COLLECTION

COST ESTIMATE

Alternate - 1

Costs in 1979 Dollars
ENR INDEX = 3000

SERVICE AREA		CAPITAL COST	O&M COSTS		SALVAGE VALUE
1980					
SEGMENT					
1	Same as Proposed	275,290	333		113,920
2	Cluster System	365,396	5,845		92,844
3	Same as Proposed	167,111	214		80,709
4	Same as Proposed	205,471	237		88,888
5	Same as Proposed	222,926	232		112,175
6	Same as Limited Action	11,964	360		6,910
7	New	44,608	979		24,740
8	Same as Proposed	7,949	16		4,095
Transmission		55,800	34		28,080
		1,356,515	8,250		552,361
25% Engr. Cont.		339,129	-0-	@20%	110,472
		1,695,644	8,250		662,833

*Costs include bathroom addition inside home

2000				
Segment 6	9,900	270		1,080
Gravity Hook-ups	19,108	0		0
Segment 2	30,781	525		6,489
	59,789	795		7,569
25% Engr. Cont.	14,947	0	@ 20%	1,514
	74,736	795		9,083

ECONOMIC ANALYSIS OF ALTERNATIVE

($1,000)

Alternate 1

Item	Year	Capital Dollars	O & M Dollars	Salvage Value	(1) Capital Dollars	(2) O & M Dollars	(3) Salvage Value	Total Present Worth (1+2-3)	Average Annual Equivalent Cost
Treatment	1980	190.1	8.9	110.8	190.1	97.1	30.7	256.5	
Collection	1980	1,695.6	8.3	662.8	1,695.6	90.5	183.7	1,602.4	
Collection	2000	3.7*	0.1**	9.1	40.4	8.1	2.5	46.0	
								1,904.9	174.5

*Future Hook-ups @ 3.7/year
**Gradient

NETTLE LAKE

COST ESTIMATE

ALTERNATE 2

TREATMENT - AERATED LAGOON

Q = 0.09 MGD

ENR = 3000

PROCESS	CAPITAL COST	O&M COSTS*		SALVAGE VALUE
Preliminary Treatment	11,800	1,800		5,310
Aerated Lagoon	26,550	2,400		15,930
Chlorination	5,900	1,000		2,300
Lab/Maint. Bldg.	18,900	2,500		8,500
Administration	-0-	1,100		-0-
Mobilization	3,300	-0-		-0-
Site Work incl. Excav.	14,200	-0-		-0-
Electrical	14,200	-0-		-0-
Yard Piping	13,000	-0-		7,800
HVAC	1,800	-0-		-0-
Controls & Instr.	-0-	-0-		-0-
Land (25 Ac.)	40,000	-0-		72,210
Effluent Pipe 100	2,000	-0-		1,200
	151,650	8,800		113,250
Engr. and Cont. @ 25%	37,913	-0-	@ 20%	22,650
	189,563	8,800		135,900

*Labor based on $7.50/Man Hour

NETTLE LAKE - COLLECTION

COST ESTIMATE

Alternate - 2

Costs in 1979 Dollars
ENR INDEX = 3000

SERVICE AREA		CAPITAL COST	O&M COSTS		SALVAGE VALUE
1980					
SEGMENT					
1	Same as Proposed	275,290	333		113,920
2	Cluster System	365,396	5,845		92,844
3	Same as Proposed	167,111	214		80,709
4	Same as Proposed	205,471	237		88,888
5	Same as Proposed	222,926	232		112,175
6	Same as Limited Action	11,964	360		6,910
7	New	44,608	979		24,740
8	Same as Proposed	7,949	16		4,095
Transmission		55,800	34		28,080
		1,356,515	8,250		552,361
25% Engr. Cont.		339,129	-0-	@20%	110,472
		1,695,644	8,250		662,833

*Costs include bathroom addition inside home

2000				
Segment 6	9,900	270		1,080
Gravity Hook-ups	19,108	0		0
Segment 2	30,781	525		6,489
	59,789	795		7,569
25% Engr. Cont.	14,947	0	@ 20%	1,514
	74,736	795		9,083

ECONOMIC ANALYSIS OF ALTERNATIVE

($1,000)

Alternate 2

Item	Year	Capital Dollars	O & M Dollars	Salvage Value	(1) Capital Dollars	(2) O & M Dollars	(3) Salvage Value	Total Present Worth (1+2-3)	Average Annual Equivalent Cost
Treatment	1980-2000	189.6	8.8	135.9	189.6	96.0	37.7	247.9	
Collection	1980	1,695.6	8.3	662.8	1,695.6	90.5	183.7	1,602.4	
Collection	2000	3.7*	0.1**	9.1	40.4	8.1	2.5	46.0	
								1,896.3	173.7

*Future Hook-ups 3.7/year

**Gradient

NETTLE LAKE - COLLECTION

COST ESTIMATE

Alternate 3

Costs in 1979 Dollars
ENR INDEX = 3000

SERVICE AREA		CAPITAL COST*	O&M COSTS		SALVAGE VALUE*
1980					
SEGMENT					
1		341,363	4,907		89,033
2	Cluster	365,396	5,845		92,844
3		182,122	1,814		64,063
4		244,314	3,068		72,019
5		245,418	3,098		82,527
6	Same as Limited Action	11,964	360		6,910
7		51,488	995		28,868
8	Same as Proposed	7,949	16		4,095
Transmission		94,857	3,050		56,915
		1,544,871	23,153		497,274
Engr. and Cont. @ 25%		386,218	0		99,455
		1,931,089	23,153		596,729

*Costs include costs for bathroom addition inside home

2000				
Entire Service Area	83,946	2,410		10,629
25% Engr. and Cont.	26,437	0	@ 20%	2,126
	110,383	2,410		12,755

ECONOMIC ANALYSIS OF ALTERNATIVE

($1,000)

Alternate 3

Item	Year	Capital Dollars	O & M Dollars	Salvage Value	(1) Capital Dollars	(2) O & M Dollars	(3) Salvage Value	Total Present Worth (1+2-3)	Average Annual Equivalent Cost
Treatment	1980	190.1	8.9	110.8	190.1	97.1	30.7	256.5	
Collection	1980	1,931.1	23.2	596.7	1,931.1	253.1	165.4	2,018.8	
Collection	2000	5.5*	0.1**	12.8	60.0	8.1	3.5	64.6	
								2,339.9	214.3

I-2-11

*Future Hook-ups @ 5.5/year

**Gradient

NETTLE LAKE
COST ESTIMATE
Alternate 4

TREATMENT - AERATED LAGOON

Q = 0.09 MGD | ENR = 3000

PROCESS	CAPITAL COST	O&M COSTS*	SALVAGE VALUE
Preliminary Treatment	11,800	1,800	5,310
Aerated Lagoon	26,550	2,400	15,930
Chlorination	5,900	1,000	2,300
Lab/Maint. Bldg.	18,900	2,500	8,500
Administration	-0-	1,100	-0-
Mobilization	3,300	-0-	-0-
Site Work incl. Excav.	14,200	-0-	-0-
Electrical	14,200	-0-	-0-
Yard Piping	13,000	-0-	7,800
HVAC	1,800	-0-	-0-
Controls & Instr.	-0-	-0-	-0-
Land (25 Ac.)	40,000	-0-	72,210
Effluent Pipe 100	2,000	-0-	1,200
	151,650	8,800	113,250
Engr. and Cont. @ 25%	37,913	-0-	@ 20% 22,650
	189,563	8,800	135,900

*Labor based on $7.50/Man Hour

NETTLE LAKE - COLLECTION

COST ESTIMATE

Alternate - 4

Costs in 1979 Dollars
ENR INDEX = 3000

SERVICE AREA		CAPITAL COST*	O&M COSTS		SALVAGE VALUE *
1980					
SEGMENT					
1		341,363	4,907		89,033
2	Cluster	365,396	5,845		92,844
3		182,122	1,814		64,063
4		244,314	3,068		72,019
5		245,418	3,098		82,527
6	Same as Limited Action	11,964	360		6,910
7		51,488	995		28,868
8	Same as Proposed	7,949	16		4,095
Transmission		94,857	3,050		56,915
		1,544,871	23,153		[illegible]
Engr. and Cont. @ 25%		386 218	0		99,455
		1,931,089	23,153		[illegible]

*Costs include costs for bathroom addition inside home

2000				
Entire Service Area	83,946	2,410		10,629
25% Engr. and Cont.	26,437	0	@ 20%	2,126
	110,383	2,410		12,755

ECONOMIC ANALYSIS OF ALTERNATIVE
($1,000)

Alternate 4

Item	Year	Capital Dollars	O & M Dollars	Salvage Value	(1) Capital Dollars	(2) O & M Dollars	(3) Salvage Value	Total Present Worth (1+2-3)	Average Annual Equivalent Cost
Treatment	1980-2000	189.6	8.8	135.9	189.6	96.0	37.7	247.9	
Collection	1980	1,931.1	23.2	596.7	1,931.1	253.1	165.4	2,018.8	
Collection	2000	5.5*	0.1**	12.8	60.0	8.1	3.5	64.6	
								2,331.3	213.5

*Future Hook-ups @ 5.5/year
**Gradient

NETTLE LAKE

COST ESTIMATE

Alternate 5

RAPID INFILTRATION - CENTRAL

Q = 0.09 MGD

ENR = 3000

PROCESS	CAPITAL COST	O&M COSTS	SALVAGE VALUE
Influent Pumping	INCLUDED IN COLLECTION		
Influent Pipe	INCLUDED IN COLLECTION		
Preliminary Treatment	10,000	1,750	4,500
Stabilization Pond	50,000	1,650	30,000
Chlorination	5,900	1,450	2,400
Rapid Infiltration Basin (incl. Lab.)	115,800	1,550	87,500
Mobilization	2,900	-0-	-0-
Site Work incl. Excav.	15,000	-0-	-0-
Electrical	15,340	-0-	-0-
Administration	-0-	1,700	-0-
Laboratory	-0-	6,750	-0-
Yard Piping	15,000	-0-	7,200
HVAC	1,900	-0-	-0-
Controls and Instr.	-0-	-0-	-0-
Land (30 Ac.)	48,000	-0-	86,400
Effluent Pipe (6,800 LF)	129,948	130	77,970
Effluent Outfall	500	-0-	300
	436,288	15,980	297,570
Engr. and Cont. @ 25%	109,072		@ 20% 59,314
	545,360	15,080	35[illegible],[illegible]84

NETTLE LAKE - COLLECTION

COST ESTIMATE

Alternate - 5

Costs in 1979 Dollars

ENR INDEX = 3000

SERVICE AREA		CAPITAL COST *	O&M COSTS		SALVAGE VALUE *
1980					
SEGMENT					
1	Same as Proposed	275,290	311		113,920
2	Clusters	365,396	5,845		92,844
3	Same as Proposed	167,111	214		80,709
4	Same as Proposed	205,471	237		88,888
5	Same as Proposed	222,926	232		112,175
6	Same as Limited Action	11,964	360		6,910
7	New	42,984	985		27,816
8	Same as Proposed	7,949	16		4,095
Transmission		102,987	3,212		49,642
		1,402,078	11,412		576,999
Engr. and Cont. @ 25%		350,520	0	@ 20%	115,400
		1,752,598	11,412		692,399

*Costs include costs for bathroom addition inside house

2000	CAPITAL COST	O&M COSTS	SALVAGE VALUE
Segment 6	9,900	270	1,080
Gravity Hook-ups	19,108	0	0
Segment No.2	30,781	525	6,489
	59,789	795	7,569
Engr. and Cont. @ 25%	14,947	0	1,514
	74,736	795	9,083

ECONOMIC ANALYSIS OF ALTERNATIVE

($1,000)

Alternate - 5

Item	Year	Capital Dollars	O & M Dollars	Salvage Value	(1) Capital Dollars	(2) O & M Dollars	(3) Salvage Value	Total Present Worth (1+2-3)	Average Annual Equivalent Cost
Treatment	1980	545.4	15.1	356.5	545.4	164.7	98.8	611.3	
Collection	1980	1,752.6	11.4	692.4	1,752.6	124.4	191.9	1,685.1	
Collection	2000	3.7*	0	9.1	40.4	0	2.5	37.9	
								2,334.3	213.8

*Future Hook-ups at 3.7/Year

NETTLE LAKE - COLLECTION

COST ESTIMATE

Alternate 6

Costs in 1979 Dollars
ENR INDEX = 3000

SERVICE AREA	CAPITAL COST	O&M COSTS	SALVAGE VALUE
1980			
SEGMENT			
1 Same as Limited Action	179,014	9,640	106,055
2 Cluster	365,396	5,845	92,844
3 Same as Limited Action	99,557	5,870	59,463
4 Same as Limited Action	133,599	7,380	79,349
5 Same as Limited Action	151,345	8,000	90,810
6 Same as Limited Action	11,964	360	6,910
7	0	0	0
8	0	0	0
Sludge Hauling Truck	60,000	0	0
Water Sug. Devices	29,000	214	3,210
	1,029,875	37,309	438,641
25% Engr. and Cont.	257,469	0	@ 20% 87,728
	1,287,344	37,309	526,369

*Costs include cost of inside bathroom

SERVICE AREA	CAPITAL COST	O&M COSTS	SALVAGE VALUE
2000			
Segment 2	30,781	525	6,489
Remaining Service Area	37,781	1,035	4,140
	68,731	1,560	10,629
25% Engr. and Cont.	17,183	0	2,126
	68,914	1,560	12,755

ECONOMIC ANALYSIS OF ALTERNATIVE

($1,000)

Alternate 6

Item	Year	Capital Dollars	O & M Dollars	Salvage Value	(1) Capital Dollars	(2) O & M Dollars	(3) Salvage Value	Total Present Worth (1+2-3)	Average Annual Equivalent Cost
Collection	1980	1,287.3	37.3	526.4	1,287.3	406.9	145.9	1,548.3	
Collection	2000	4.3*	0.1**	12.8	46.9	8.1	3.6	51.4	
								1,599.7	146.5

*Future Hook-ups @ 4.3/year

**Gradient

NETTLE LAKE - COLLECTION

COST ESTIMATE

Limited Action Alternative - 7

Costs in 1979 Dollars

ENR INDEX = 3000

SERVICE AREA	CAPITAL COST	O&M COSTS	SALVAGE VALUE
1980			
SEGMENTS			
1	179,014*	9,640	106,055
2	176,105	9,190	104,043
3	99,557	5,870	59,463
4	133,599	7,380	79,349
5	151,345	8,000	90,810
6	11,964	360	6,910
7	0	0	0
8	0	0	0
Sludge Hauling Truck	60,000	0	0
Water Sug. Devices	35,772	264	3,960
	847,356	40,704	450,590
25% Engr. and Cont.	211,839	0	@ 20% 90,118
	1,059,195	40,704	540,708

*Includes cost of inside bathrooms

2000			
Entire Service Area	51,150	1,395	5,580
Engr. & Cont. @ 25%	12,788	0	1,116
	63,938	1,395	6,696

ECONOMIC ANALYSIS OF ALTERNATIVE 7

($1,000)

Limited Action - 7

Item	Year	Capital Dollars	O & M Dollars	Salvage Value	(1) Capital Dollars	(2) O & M Dollars	(3) Salvage Value	Total Present Worth (1+2-3)	Average Annual Equivalent Cost
Limited Action	1980	1,059.2	40.7	540.7	1,059.2	444.0	150.0	1,353.2	
	2000	3.2*	0.1**	6.7	34.9	8.1	1.9	41.1	
								1,394.3	127.7

*Future Hook-ups @ 3.2/year

**Gradient

Project 662-007

COST SUMMARY ALT. 8

1980

SEGMENT	CAPITAL COST	ANNUAL O & M COST	YEAR 2000 SALVAGE VALUE
1	$118,563	$ 5,975	$ 62,303
2	122,566	6,022	67,124
3	51,532	3,251	24,234
4	83,289	4,332	42,748
5	59,032	3,936	26,866
6	4,200	360	2,250
7	0	0	0
8	0	0	0
	$439,182	$23,876	$225,525
Annual Operation Cost for small waste flows Agency	----	10,305	----
Engr., Contingencies & Administration			
1) 9% of Const. Cost	39,525	----	----
2) Site Analysis	78,410	----	----
	$557,117	$34,181	$225,525

Notes: Water saving devices not included, sludge hauling truck not included, indoor bathrooms not included

2000

Entire Service Area	$ 51,150	$ 1,395	$ 5,580
Engr. & Const. @ 25%	12,788	0	0
	$ 63,938	$ 1,395	$ 5,580

ECONOMIC ANALYSIS OF ALTERNATIVE 8
($1000)

ALTERNATIVE 8

Year	Capital Cost	Annual O & M Cost	Salvage Value	(1) Capital Cost	(2) PW O & M	(3) PW Salvage	(1+2-3) Total PW	Average Annual Equiv. Cost
1980	357.1	34.2	225.5	557.1	373.1	62.5	867.7	79.5

Notes: Interest Rate = 6-5/8%
PW Factor O & M = 10.9099
PW Factor Salvage = 0.2772

NO ACTION ALTERNATIVE - PRESENT WORTH COST

1980 - 2000

ITEM	CAPITAL COST	O & M COST	SALVAGE VALUE
Septic Systems	$1,650/yr.	$910/yr.	$26,400
Permits	104/yr.	———	———
TOTAL	$1,754/yr.	$910/yr.	$26,400

Present Worth Cost = (1,754 + 910) x 10.9099 - 26,400 x 0.2772 + $21,746

Interest rate = 6-5/8%
PW factor O & M = 10.9099
PW factor salvage = 0.2772

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