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WASTEWATER MANAGEMENT STUDY FOR CHICAGO-SOUTH END OF LAKE MICHI--ETC(U)

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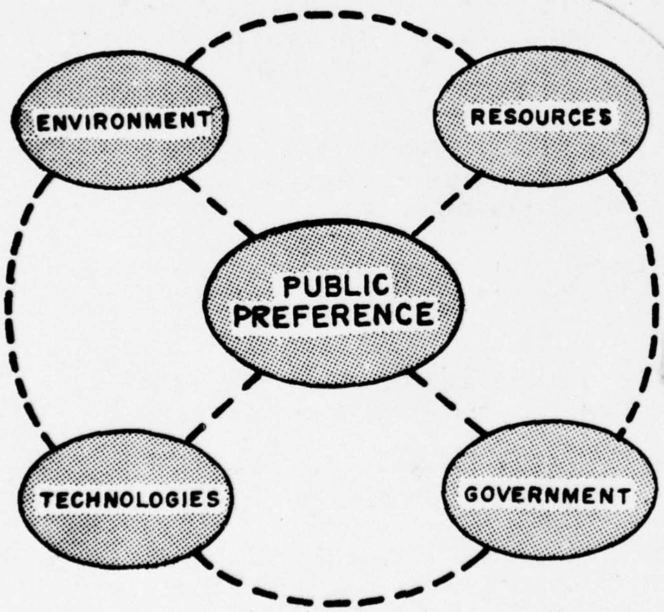
WASTEWATER MANAGEMENT STUDY FOR

CHICAGO SOUTH END of LAKE MICHIGAN



APPENDIX C

PLAN FORMULATION

DEPARTMENT OF THE ARMY
CHICAGO DISTRICT CORPS OF ENGINEERS
219 SOUTH DEARBORN STREET
CHICAGO, ILLINOIS 60604

JULY 1973

REPORT COMPOSITION

The survey report is divided into a Summary, and 9 Appendices. A charge for each appendix and summary report to cover the cost of printing will be required, should purchase be desired. The appendices each contain a different category of information. Alphabetically identified, the appendices are:

A. Background Information - This appendix includes the population and industrial projections, wastewater flows and the engineering data used as a basis for planning.

B. Basis of Design and Cost - This appendix contains the criteria and rationale used to design and cost the final alternative wastewater treatment system components.

C. Plan Formulation - The appendix presents the planning concepts and procedures used in developing the alternative wastewater management plans that were examined during the study.

D. Description and Cost of Alternatives - This appendix contains a cost description and construction phasing analysis for each of the final five regional wastewater management alternatives. Components of these alternatives are described in detail in Appendix B.

E. Social - Environmental Evaluation - This report provides an assessment of the social and environmental impacts likely to arise from the implementation of the final five alternatives.

F. Institutional Considerations - This report presents an assessment of the institutional impacts likely to arise from implementation of the final five alternatives.

G. Valuation - This appendix presents a broad evaluation of the implications and use potential inherent in the final five alternatives.

H. Public Involvement/Participation Program - This appendix documents the program used to involve the public in the planning process.

I. Comments - This appendix contains all of the formal comments from local, State and Federal entities as the result of their review of the other appendices and the Summary Report. Also capsulized are the views of citizens presented at public meetings.

The Summary document presents an overview of the entire study.

PREFACE

This appendix presents the planning concepts and procedures used in developing a range of alternative wastewater management plans for the Chicago-South End of Lake Michigan (C-SELM) area. The findings of this study do not mean that any of the alternative plans investigated would be constructed. Rather, the results are offered as a planning framework from which the area's decision-makers can select a system consistent with the national water quality goals and objectives set forth in the Federal Water Pollution Control Act Amendments of 1972. Final decisions as to which alternative, if any, is best suited to a particular part of the area and most acceptable to the people is left to the State and local governments which now have that responsibility.

The plan formulation process was as complex and elaborate as the problem it intended to solve. Significant efforts were made to assure that the approach be totally uncommited to any specific system aspect; and that environmental and institutional considerations, together with an extensive public participation and inter-agency coordination program be an integral part of the study.

Project elements of the framework plans were progressively refined by integrating the design with the needs of the area and the technical goals of the program. Throughout the process, the multiple-use concept of the water and related land resources was a predominant planning principle. The evolved wastewater management plans demonstrate: (1) the manner and extent to which the area's water and related land resources can be effectively managed in order to meet future water needs and "waste"-oriented functions and services; and (2) the range of implications, including social, environmental, natural resources, institutional, and economic that would be involved in fulfilling the technical goals and satisfying the area needs.

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SECTION I - INTRODUCTION

AUTHORITY

This study was authorized by Congressional resolutions from both the House and Senate Public Works Committees dated 10 and 23 November 1971, respectively. Included in the language of the Senate resolution was the mission to "Evaluate general alternatives for the management of wastewater on a regional basis, including the elimination of pollutant discharges."

PURPOSE

The purpose of this study is to identify and evaluate viable alternative wastewater treatment technologies and systems that: (1) would eliminate the discharge of pollutants into the lakes and streams of the Chicago-South End of Lake Michigan (C-SELM) area; and (2) could be incorporated into areawide or regional plans. Also examined is the potential for multiple-use planning, from both a resource conservation and reuse standpoint. All of these considerations are contained in the Federal Water Pollution Control Act Amendments of 1972 (Public Law 92-500) recently enacted by Congress. In addition, alternatives responsive to current water quality standards and guidelines were evaluated. This was done in order to identify the implications of the new national water quality goals and as a planning service to the study area.

SCOPE OF STUDY

This is a planning study only. It is intended to assist the States and local agencies in northeastern Illinois and northwestern Indiana who are responsible for planning wastewater management systems responsive to the provisions of PL 92-500. Such technical assistance should help designated agencies meet the requirements of Section 201(g)(2)(A) of PL 92-500 which stipulates that after 30 June 1974, requests for Federal grants must demonstrate that (1)..."alternative waste management techniques have been studied and evaluated..."; and (2)"...the works proposed for grant assistance will provide for the application of the best practicable waste treatment technology over the life of the works..."

The study, and this appendix in particular, document the objectives and strategies used: (1) the plan-formulation process; (2) to establish the basis for system design; and, (3) to assess and screen the array of alternatives considered during the course of this investigation. Each of the alternative systems were structured to meet the long-term needs for the year 2020. Final design, though, was based on the more immediate requirements of 1990. During the course of the study, the alternatives were evaluated from several different frameworks of consideration so as to identify the trade-offs involved in establishing areawide treatment systems. The evaluations involved assessments of costs, social-environmental effects, resource use and conservation, institutional aspects, management options, multiple-use opportunities, public response, phasing and implementation programs, and considerable related technical data. Accordingly, these findings can be used by the States and local entities in selecting a wastewater management program best suited to their needs.

PARTICIPATION AND COORDINATION

This study is complex, not only because it addresses highly technical issues concerned with wastewater treatment, but also because it includes consideration of related items dealing with environmental concerns, social aspects and regional needs. To effectively investigate the many facets involved in the study, the Chicago District sought and received assistance from numerous sources. These included interested Federal, State and local agencies; consultants under contract; representatives of commerce, industry and the academic community; farm leaders; environmentalists; and the public in general. While most of this assistance came from the study's Advisory Committees and Work Groups, a significant contribution was made through public forums and meetings. This participation is explained in greater detail throughout this and other appendices. This assistance was appreciated and helped strengthen the quality and results of the study.

PRIOR STUDIES AND REPORTS

GENERAL

There are numerous studies which have been conducted by other agencies or organizations concerning various topics pertinent to this study. These topics ranged from land use and population growth to regional wastewater management plans as well as the future programs of the local municipal and Sanitary Districts. In addition, the need inventories from the Upper Mississippi River Comprehensive Basin Study and the ongoing Great Lakes Basin Commission Study were used. These basin studies established a framework for development based on the cooperative effort of those Federal, State and local agencies concerned with the regions' resource management. Since all of portions of the C-SELM area were included, the findings of these two reports served as this study's framework for reuse considerations.

FEASIBILITY STUDY

Early in 1971, the Corps of Engineers in cooperation with the U.S. Environmental Protection Agency (USEPA) undertook five pilot planning studies to examine the feasibility of regional wastewater management alternatives for five key urban areas across the nation. The Greater Chicago Metropolitan Area and its environs was one of the sites investigated. That study was completed in the summer of 1971 and published as a two volume report entitled: "Alternatives for Managing Wastewater in Chicago-South End Lake Michigan Area, July 1971." The study recognized that improvement of the water pollution abatement program was a matter of high priority in the nation's overall commitment to improve its environment and enhance its quality of life. To achieve a more effective pollution abatement program, the study explored alternative wastewater management systems that extended beyond the present level of area-wide control. This included the examination of providing treatment beyond the level being considered in local plans and involved three different technologies, (Advanced Biological, Physical-Chemical, and Land). While all three technologies were capable of attaining the desired objective and level of treatment, it was concluded that a more detailed planning effort (this study) should be initiated:

1. To fill identified information deficiencies;

2. To answer concerns regarding the effectiveness of various treatment processes;

3. To develop a full range of alternatives and then compare the implication involved with emphasis placed on gathering information on certain systems and components; and

4. To investigate institutional considerations and include suggested modification to institutional arrangements for implementation of plans.

SECTION II - BACKGROUND INFORMATION

Prior to the initiation of this study, information pertinent to the study area and engineering considerations were obtained. This information is presented in Appendix A and summarized below. It is provided to establish an overview of the planning environment.

STUDY AREA

The study area extends from the Wisconsin border through portions of Illinois and Indiana, around the southwestern and southern perimeter of Lake Michigan to the Michigan stateline. As such, the wastewater management study encompasses some 2,600 square miles and includes all or portions of four counties in Illinois and three counties in Indiana. Within these counties, there are nearly 90 townships with a 1970 population of about 7-1/4 million people.

The plan-formulation of a wastewater management system, however, involved consideration of a much larger geographical area. In developing a wide array of alternatives, attention was directed to the various options available in designing the functional components of the systems. This, in turn, required consideration of planning concepts that would impact on sites outside the study area boundary. As a result, a much larger area of influence was involved in the planning efforts; one generally encompassing the tier of counties adjacent to the C-SELM area. Included in the outlying area were some 12 counties, 8 of which were in Illinois; the remaining four in Indiana. Together these 12 counties have a land mass of some 6,930 square miles and a 1970 population of approximately 670,000.

The C-SELM study area and outlying area of influence are shown in Figure C-II-1. Not shown are the more distant counties of Knox and Fulton Counties in Illinois and Clay County in Indiana where surface mines provide potential for effective recycling of the residual wastewater treatment by-products (sludge).

CHARACTERISTICS OF STUDY AREA

TOPOGRAPHY AND DRAINAGE

The topography of the C-SELM area is comparatively flat with poor definition existing between some of the watersheds. This lack of separation or elevation was caused by the glaciers which passed through the area. As the glaciers melted, they overlaid the area with drift material, some of it ranging in depth upwards to 400 feet. As a result, the few hilly areas that do exist are made up of broad, low ridges and contain numerous lakes and swamps.

CHICAGO - SOUTH END OF LAKE MICHIGAN STUDY AREA

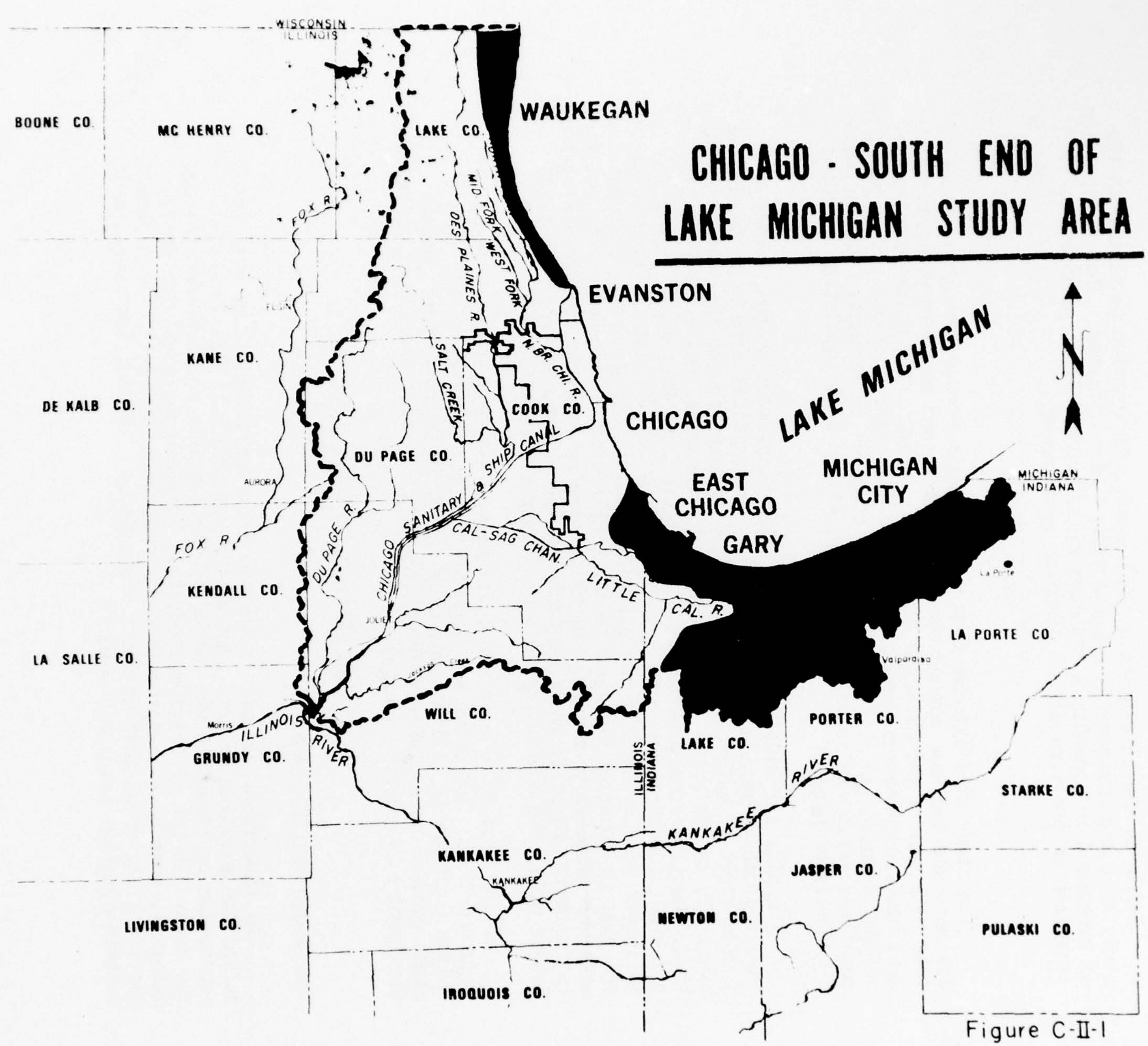


Figure C-II-1

The streams which drain the area, either flow to the Illinois River, or Lake Michigan, as shown on Figure C-II-2. Major tributaries to the Illinois River include the Chicago, Des Plaines and Du Page Rivers plus the Cal-Sag Channel, all of which drain generally south. Portion's of the Grand Calumet and Little Calumet Rivers are tributary to both the Cal-Sag Channel and Lake Michigan. Several small streams along the Lake Michigan shore are directly tributary to the Lake.

CLIMATE

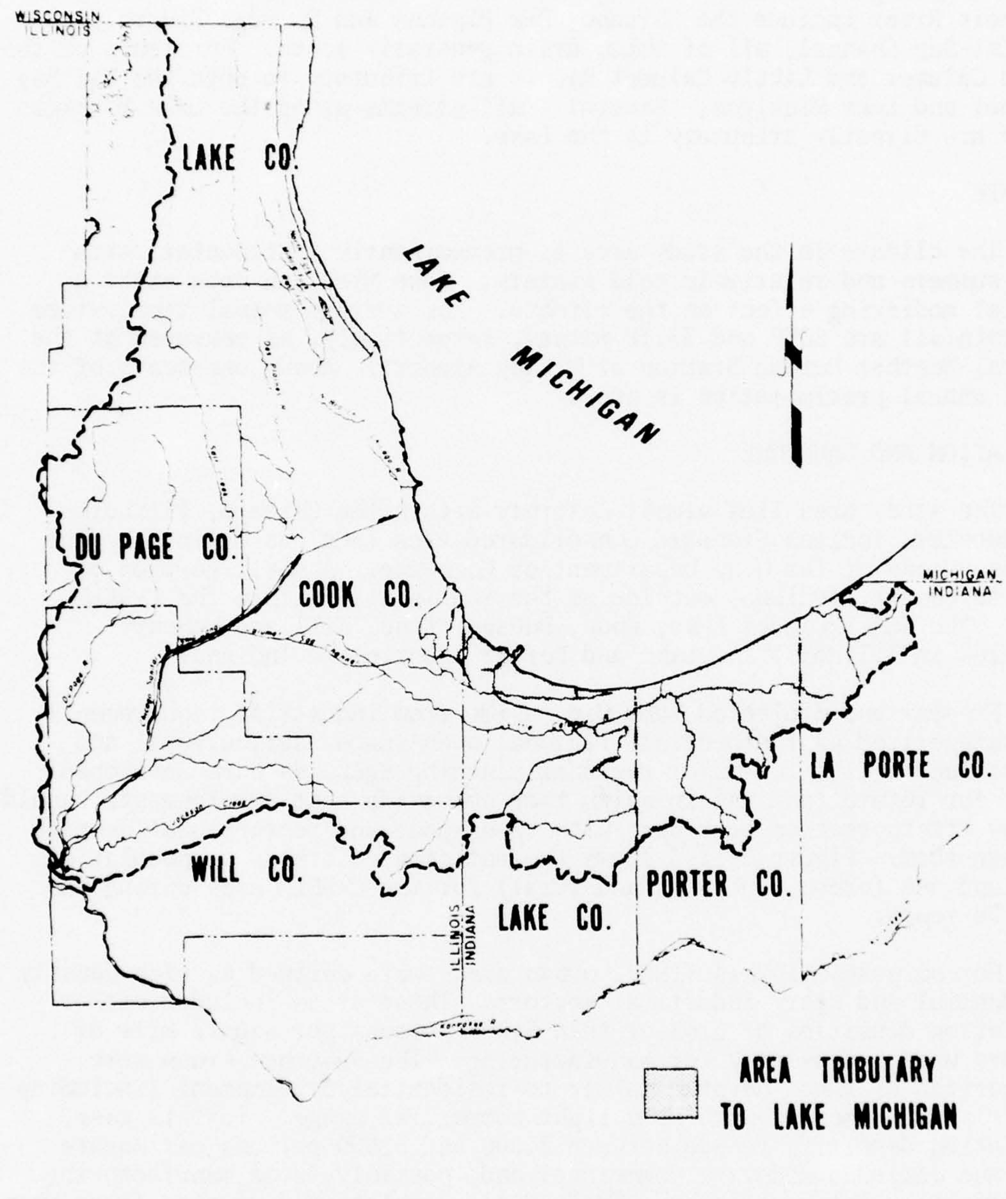
The climate in the study area is predominantly continental, with warm summers and relatively cold winters. Lake Michigan does exert a partial modifying effect on the climate. The average annual temperature and rainfall are 50°F and 33.18 inches, respectively, as measured at the Central Weather Bureau Station at Midway Airport. About one-tenth of the total annual precipitation is snow.

POPULATION AND LAND USE

The study area lies almost entirely within the Chicago, Illinois-Northwestern Indiana Standard Consolidated Area (SCA) as defined by the Census Bureau of The U.S. Department of Commerce. A small portion of LaPorte County, Indiana, outside of the SCA is also within the C-SELM area. The SCA includes Lake, Cook, DuPage, Kane, Will and McHenry Counties in Illinois, and Lake and Porter Counties in Indiana.

Present and projected land use, aside from industrial requirements, are categorized as residential, regional open-space, agricultural and vacant lands. The two major regional planning agencies have developed plans for future land use in which they emphasize that developments should follow transportation corridors with open-space and recreational acreage between them. Figure C-II-3 shows the anticipated trends in population and land use (urban, suburban and rural) for the C-SELM area during the next 50 years.

For purposes of this study, urban areas were defined as high-density residential and heavy industrial sectors. These areas included either population densities of greater than 5,000 persons per square mile or sectors used intensively for manufacturing. The suburban areas were categorized as lands devoted mainly to residential development (including high rise apartments) with some light commercial usage. In this case, population densities ranged between 2,000 and 5,000 persons per square mile and included moderate commercial and, possibly, some manufacturing commitments. The rural areas involved all population densities fewer than 2,000 persons per square mile and included agricultural areas as well. The time-phased distribution of the land-use categories within the study area for 1990 and 2020 are shown in Figures C-II-4 and C-II-5, respectively.



CHICAGO-SOUTH END OF LAKE MICHIGAN STUDY AREA

Figure C-II-2

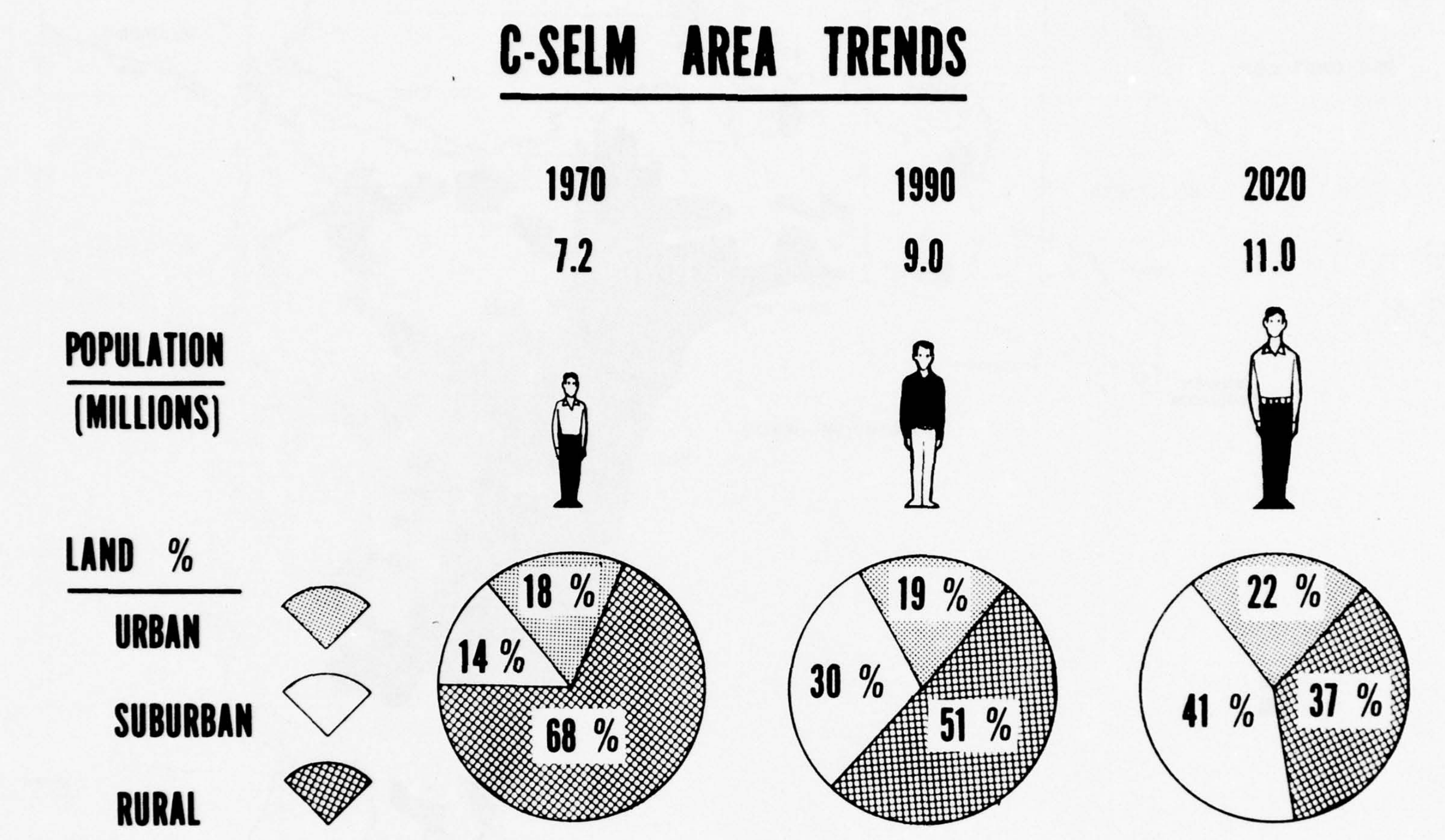
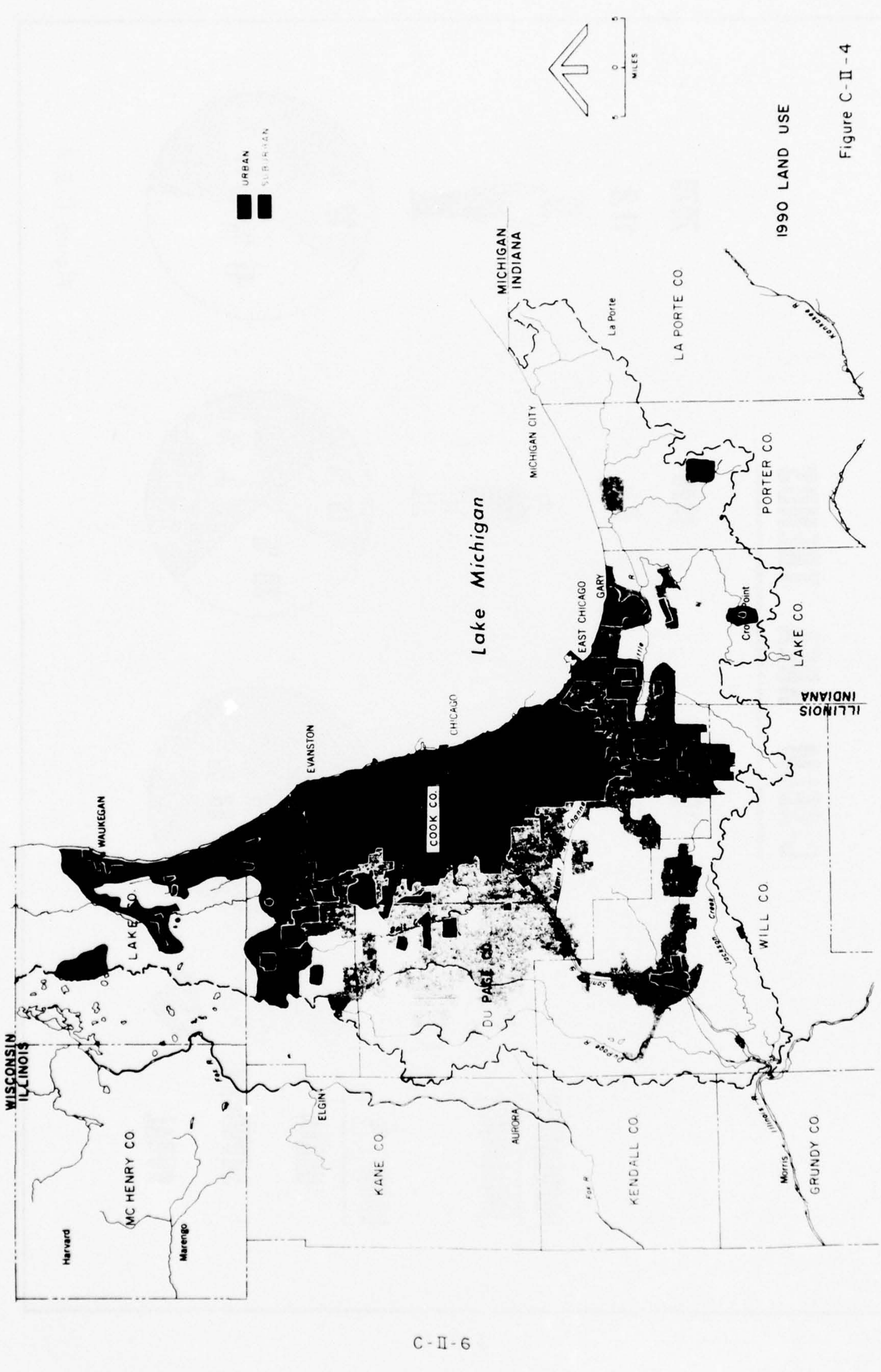
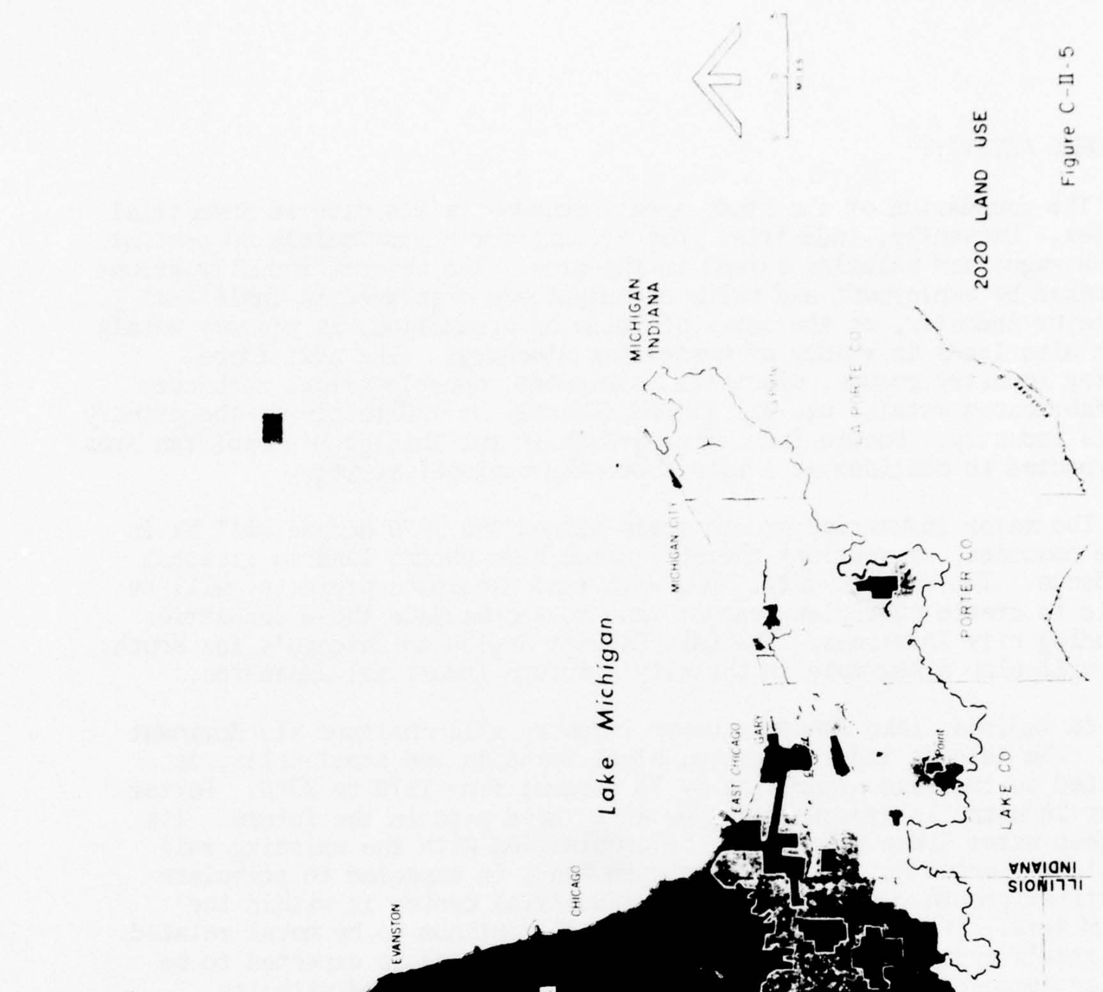

C-SELM AREA TRENDS
1970
7.2
1990
9.0
2020
11.0
POPULATION (MILLIONS)
LAND %
URBAN
SUBURBAN
RURAL
18 %
14 %
68 %
19 %
30 %
51 %
22 %
41 %
37 %

Figure C-II-3



1990 LAND USE

Figure C-II-4



2020 LAND USE

Figure C-II-5

ECONOMIC ACTIVITY

The foundation of the study area's economy is its diverse industrial complex. Presently, industrial jobs account for approximately 40 percent of the wages and salaries earned in the area. The primary industry groups as ranked by employment and value of output are displayed in Table C-II-1. The major industry, on the basis of value of production, is primary metals which also leads in volume of wastewater discharge. The next three ranking industry groups, electrical equipment, non-electrical machinery and fabricated metals, are all linked directly or indirectly to the primary metals industry. Future industrial growth in the Chicago Metropolitan Area is expected to continue at a rate above the national average.

The major industrial growth areas beyond the 1970 decade will be in those counties, or sections thereof, which have vacant land in greatest abundance. The central city, even with land clearance projects, will be unable to create sufficient vacant land to accommodate those industries demanding city locations. The Lake Calumet Region on Chicago's far south side will play a key role in the city's future industrial expansion.

In Indiana, Lake County's heavy industry will continue its dominant role. The largest industry group, blast furnaces and steel mills, is expected to increase production by 73 percent from 1970 to 2020. Porter County industry is expected to grow at a rapid pace in the future. Its new deep water Great Lakes Port, in combination with the existing rail and highway networks and available open land, is expected to stimulate industrial growth. LaPorte County's industrial center is within the C-SELM area. Its principal industries will continue to be metal related. This area's growth relative to the entire study area is expected to be greater because of its available undeveloped land coupled with its established industry.

EXISTING WASTEWATER MANAGEMENT FACILITIES

There are 132 municipal sewage treatment plants of one million gallons per day (MGD) capacity or greater now operating in the C-SELM study area. These municipal wastewater treatment plants provide secondary treatment in most cases. Usually, this results in an 85 to 90 percent reduction of the Biochemical Oxygen Demand (BOD) and Suspended Solids (SS) content of the raw wastes entering the plants. Industrial wastewater is generally treated by the user industry itself, although some is treated by the municipal plant servicing that area. In addition, approximately 400 square miles of the study area are serviced by combined sewers which carry both wastewater and storm water runoff. Combined sewer systems are designed to spill excess flows into a receiving stream whenever the sewer's capacity is exceeded. Typically, combined sewers deliver dry weather (municipal) flows to an interceptor sewer which conveys the flow to the treatment plant; but rainfalls of only 1-1/2 to 2 times dry weather

TABLE C-II-1

INDUSTRIAL EMPLOYMENT AND OUTPUT
CHICAGO METROPOLITAN AREA 1/

Standard Industrial Classification		Employment (1,000)	Rank	Value Added ($1,000,000)	Rank
20	Food	83.0	6	1,681.3	4
23	Apparel	27.0	13	228.1	13
24	Lumber	.3	18	2.5	16
25	Furniture	5.6	17	68.4	15
26	Paper & Allied Prod.	33.2	10	431.5	10
27	Printing & Publishing	91.0	5	1,416.0	6
28	Chemicals & Allied Prod.	45.2	7	1,308.8	7
29	Petroleum Refining	11.9	15	345.2	13
30	Rubber & Misc. Plastic	30.2	12	349.2	11
31	Leather & L. Prods.	6.6	16	74.1	14
32	Stone, Clay & Concrete	24.6	14	349.2	11
33	Primary Metals	136.5	2	2,146.3	1
34	Fabricated Metal	116.3	4	1,583.2	5
35	Non-electrical Mach.	124.4	3	1,760.8	3
36	Electric Equipment	163.6	1	1,926.1	2
37	Transportation Equip.	33.4	9	685.5	8
38	Instruments & Related Prod.	34.3	8	539.5	9
39	Misc. Manufacturing	31.8	11	345.3	12

1/ Census of Manufacturers, 1967; Chicago SMSA: Gary, Hammond, East Chicago SMSA flows, a fairly common occurrence, result in overflows to the waterways. Moreover, most sewage treatment plants have facilities to by-pass raw sewage when the volume of wastewater arriving at the plant exceeds the plant's treatment capacity. Thus, the combined impact of overflows and by-pass on stream water quality is significant.

CURRENT PLANS AND CONSTRAINTS

To insure that the wastewater management study was responsive to local objectives and concerns, the area's plans and constraints were examined. Where feasible, these proposals and requirements were incorporated into the study's plan-formulation process.

Many plans have been proposed for meeting various portions of the area's needs but legal problems, political feasibility and funding have prevented their implementation. There are two agencies responsible for the regional planning efforts for all but one (LaPorte, Indiana) of the seven counties in the study area. The agencies are the Northeastern Illinois Planning Commission (NIPC) and the Lake-Porter County Regional Transportation and Planning Commission (LPCRTPC) in Indiana. Studies completed by these two agencies have indicated the utility of a regional resource management approach.

A study by NIPC has established a suggested regional plan for wastewater management. It would consolidate the existing treatment systems, expand and upgrade some of the existing facilities and construct some new plants to replace those that would be abandoned. Inherent in its design is the intent to control the area's growth pattern by limiting access to the collection and conveyance system. In this way a land-use control could be adopted that would maintain open-space usage between corridors of urban and suburban development.

Open space has more than a social and environmental value. The open-space areas can also be used to hold water permanently or on a temporary basis. When this is done, the low-lying areas including flood plains can serve to minimize the damage from storm water runoff. Both NIPC and LPCRTPC have these types of multiple-purpose open-space plans to balance and control growth.

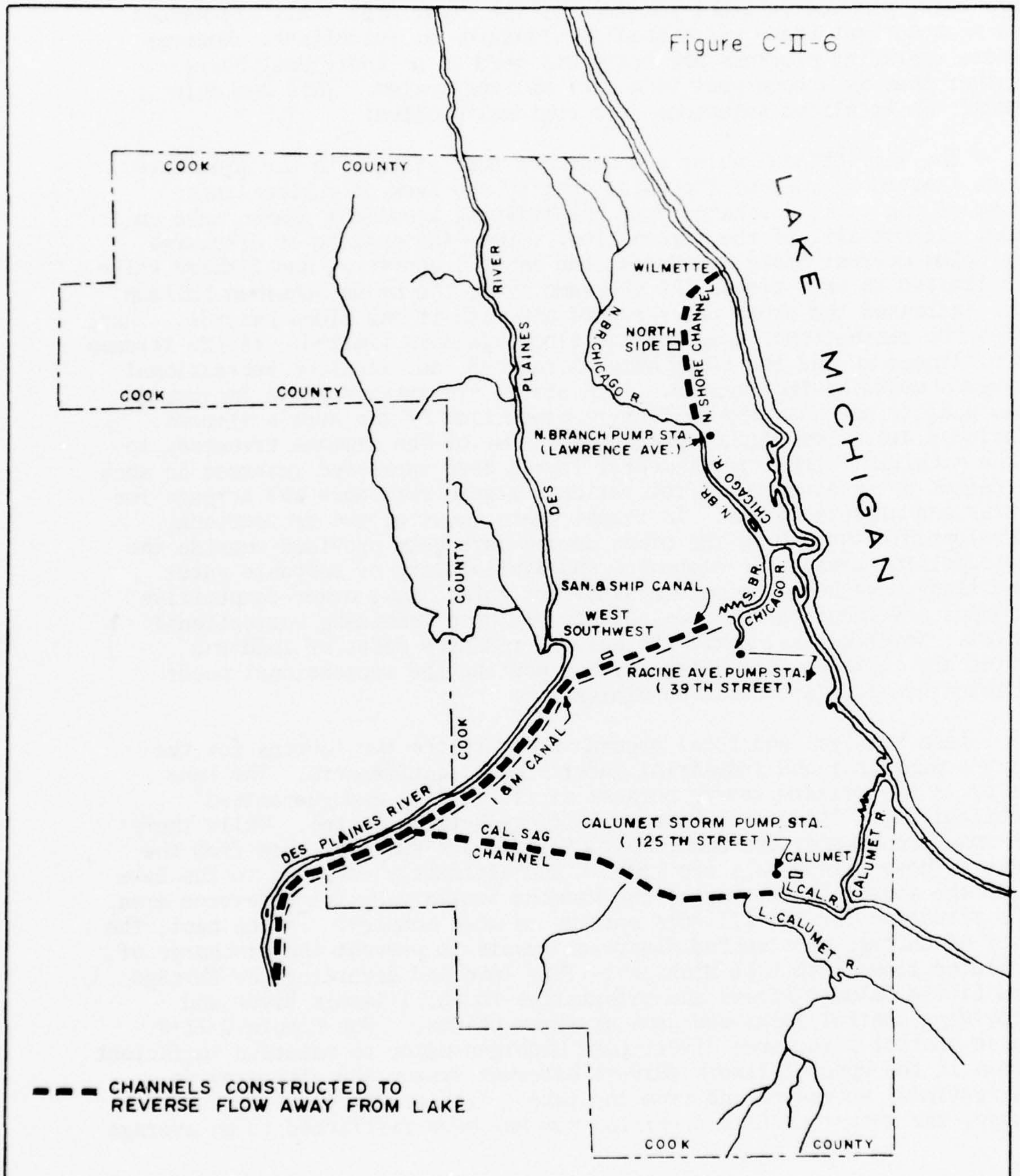
The Metropolitan Sanitary District of Greater Chicago (MSDGC) is currently improving its system's operational and treatment level. Included in its upgrading program is the "Chicago Underflow Plan". This plan involves the construction of a tunnel system, reservoir storage and additional treatment facilities. Implementation would greatly reduce the flood and pollution control problems caused by overflow from its existing combined sewer system.

Additional expansion and updating of existing treatment facilities are being planned in other portions of the study area. All are needed to meet current State water quality standards or guidelines. However, these upgrading programs are being designed on an individual basis rather than as a component to a regionalized system. This can only result in localized solutions to a regional problem.

The recreational value and usage of most streams in the area have been limited because of the water quality and lack of public lands. Most of the time, discharge from the existing treatment plants make up most, if not all, of the stream flow. Since the quality of discharge is below current State standards, the aquatic ecosystem and fishery value is limited in many areas. At the same time, the urban-suburban buildup has increased the storm water runoff and with it the flood hazards. Thus, even the recreational usage of the flood plain is limited. If the streams are cleaned up and the flood hazards reduced, an extensive recreational program could be implemented. Both States are interested in improving the quality and quantity of fishery production of the area's streams. Included are salmon (coho) programs on some of the streams tributary to Lake Michigan. Other governmental levels have expressed interest in such programs as fishing ponds, recreational stream corridors and acreage for parks and preserve areas. In recent years, most of the recreational developments that serve the urban demand have been provided outside the metropolitan area. The economics and availability of suitable water and lands have been the main reasons for this. Now, other competitive demands are reducing the availability of those remaining recreational sites. Nevertheless, until the natural resource bases of land and water are restored, the potential for meeting the recreational needs within the study area will be minimal.

Lake Michigan and local ground water are the two sources for the area's municipal and industrial water supply requirements. The Lake water is the primary source because of its quality and guaranteed availability. Its usage, however, differs between States. While there is some groundwater consumed, most of Indiana's supplies come from the Lake. These withdrawals are treated and ultimately returned to the Lake with the notable exception of the Hammond Sanitary District service area. The situation for the Illinois portion is more complex. In the past, the City of Chicago constructed diversion canals to prevent the discharge of polluted flows into Lake Michigan. This involved diverting the Chicago and Little Calumet Rivers and tributaries to the Illinois River and providing control locks and dams at three points. See Figure C-II-6. These control structures divert Lake Michigan water to maintain sufficient flows in the Upper Illinois (River) Waterway system and also provide navigational access to and from the Lake. With growth and increased usage, the amount of Lake diversion now has been restricted to an average

CANAL SYSTEM



3,200 cfs by the U.S. Supreme Court. Since Lake withdrawals for water supplies count against the diversion limit, increased usage of ground water has become a necessity. Unfortunately, water usage is already exceeding the recharge capability of the ground water aquifer in the western portion of the Illinois area. Therefore, additional sources of potable water are needed or the allowable Lake diversion must be reallocated.

DATA BASE

In addition to inventorying the existing treatment facilities, including collection and conveyance systems, projections were made of future water usage and the resultant wastewater volumes. This, together with other pertinent resource data, provided the basis for the planning and design efforts that followed.

The geographical location of the population and industrial projections were kept consistent with the availability of land and local land-use plans. Moreover, the population projections were disaggregated (sub allocated) to the township level in order to facilitate the determination of municipal wasteloads. Then, the study area was divided into 22 wastewater management watersheds. See Figure C-II-7. The boundaries generally followed the natural divides of the watershed areas with some exceptions. The most notable exception to this is watershed No. 4, whose boundaries are drawn along the combined sewer service area boundaries of the MSDGC. Table C-II-2 presents the description of these watersheds, including the drainage areas, total (1970) populations, and total populations served. Table C-II-3 summarizes the anticipated C-SELM wastewater flows for the time frame 1980-2020. Included are projections for both the municipal and industrial flows in each of the 22 watersheds. The industrial figures were considered preliminary, subject to coordination with the major water using industries concerning the degree of recycling that could be expected in the future. Additional information regarding the projected wastewater flow volumes and constituent characteristics can be found in Appendix B.

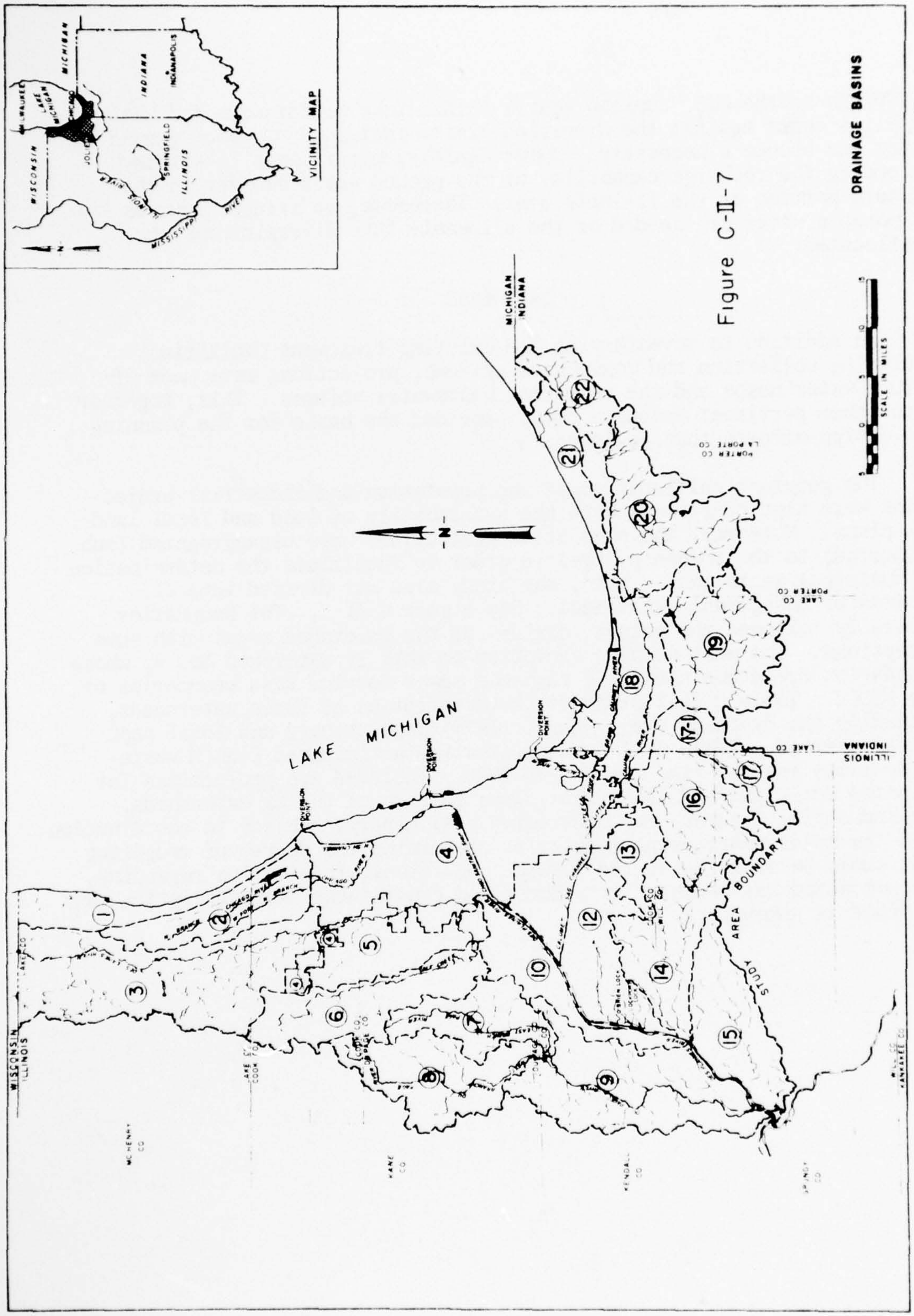


Figure C-II-7

DRAINAGE BASINS

TABLE C-II-2

MANAGEMENT WATERSHEDS

Watershed Number	Description	Drainage Area (Sq.Mi.)	Total Popu-lation (1000's)	Total Popu-lation[1] served (1000's)	Estimated Present Average Wastewater Flow (MGD)	Estimated Design Capacity Average (MGD)
1	Lake Michigan - North	59	121.5	138.6	18.76	19.83
2	North Branch Chicago River	92	187.1	60.1	7.51	9.05
3	DesPlaines River - North	249	292.7	49.58	5.15	7.73
4	Chicago Tributary	375	4143.0	5424.0	1369.0	1920.0
5	DesPlaines - Middle	82	304.5		-	-
6	Salt Creek	119	260.9	143.8	17.20	20.31
7	East Branch DuPage River	93	147.2	117.20	12.62	15.66
8	West Branch DuPage River	124	120.1	108.20	14.68	13.45
9	Main Stem DuPage River	181	51.8	6.6	0.66	0.99
10	Sani & Ship Canal - North	76	196.2	58.03	6.05	8.03
11	Cal-Sag Channel - North	51	151.7	-	-	-
12	Sani & Ship Canal - South	100	40.3	25.4	2.64	3.21
13	Cal-Sag Channel - South	43	58.5	-	-	-
14	Hickory & Spring Creeks	117	102.6	93.4	19.14	23.67
15	Jackson Creek	108	44.8	1.6	0.16	0.23
16	Thorn & Deer Creeks	111	299.2	157.4	17.71	22.71
17	Little Calumet - West[1]	31	6.0	0.8	N.A.	N.A.
17.1	Little Calumet - West[2]	32	41.8	7.55	0.73	N.A.
18	Indiana Harbor	140	417.30	475.0	88.40	120.6
19	Little Calumet - Middle	143	75.0	11.0	1.8	1.8
20	Little Calumet - East	173	69.5	24.7	3.8	4.5
21	Indiana Dunes	46	50.6	63.0	8.3	N.A
22	Trail Creek	49	34.7	-	-	-
	TOTAL	2,594	7,217.0	6,965.96	1,594.13	2,191.97

[1]The total population served by a sanitary treatment plant (STP) in a particular watershed may be greater than the population residing in that watershed since the service area of the STP may encompass more than one watershed.

TABLE C-II-3 WASTEWATER FLOWS, 1980-2020

Management Watershed	Total Population (1,000's)				Population Served (1,000's)				Municipal Flow (MGD)				Industrial Flow (MGD)				Total M & I Flow (MGD)			
	1980	1990	2000	2020	1980	1990	2000	2020	1980	1990	2000	2020	1980	1990	2000	2020	1980	1990	2000	2020
1. Lake Michigan - North	157.2	187.4	205.5	229.9	150.8	185.0	205.5	229.9	20.7	25.7	29.7	36.3	8.8	8.1	8.1	8.4	29.5	33.8	37.8	44.7
2. North Branch Chicago River	238.5	286.0	304.7	314.4	238.5	286.0	304.7	314.4	28.6	36.6	41.3	47.6	6.6	7.2	7.7	8.2	35.2	43.8	49.0	55.8
3. DesPlaines River - North	350.0	456.9	549.1	670.0	310.6	419.3	512.1	637.0	37.4	53.4	69.1	96.2	10.9	12.4	14.1	16.1	48.3	65.8	83.2	112.3
4. Chicago Tributary	4174.7	4219.1	4266.1	4341.1	4174.7	4219.1	4266.1	4341.1	604.7	632.7	662.8	722.0	767.2	720.9	723.4	738.4	1371.9	1353.6	1386.2	1460.4
5. DesPlaines - Middle	352.0	385.9	410.6	430.9	352.0	385.9	410.6	430.9	43.7	50.9	57.5	67.5	45.2	48.3	50.1	52.2	88.9	99.2	107.6	119.7
6. Salt Creek	368.0	443.6	495.6	515.5	364.9	443.6	495.6	515.5	43.2	55.9	66.4	77.4	12.0	14.5	16.7	19.9	55.2	70.4	83.1	97.3
7. East Branch DuPage River	207.6	267.7	317.4	364.3	199.7	264.5	315.7	364.3	23.6	33.3	42.4	54.7	2.3	3.1	3.8	4.5	25.9	36.4	46.2	59.2
8. West Branch DuPage River	180.9	267.5	361.4	473.4	159.4	258.5	361.4	473.4	18.9	32.7	48.5	71.1	3.1	4.1	5.4	6.9	22.0	36.8	53.9	78.0
9. Main Stem DuPage River	78.1	123.2	180.1	290.3	47.8	93.0	152.0	278.8	5.7	11.7	20.5	41.8	12.5	8.9	7.7	6.8	18.2	20.6	28.2	48.6
10. San-Ship Canal - North	245.9	283.8	315.2	361.1	239.8	278.5	312.4	361.1	29.5	36.4	43.3	55.5	23.6	21.2	21.4	21.9	53.1	57.6	64.7	77.4
11. Cal-Sag Channel - North	178.8	200.1	215.4	226.6	178.8	200.1	215.4	226.6	21.1	25.2	28.9	34.0	12.0	12.8	13.7	14.1	33.1	38.0	42.6	48.1
12. San-Ship Canal - South	64.6	98.3	128.5	170.1	58.4	94.8	125.7	170.1	6.9	11.9	16.9	25.5	16.4	15.3	14.1	13.3	23.3	27.2	31.0	38.8
13. Cal-Sag Channel - South	79.0	108.6	126.0	134.6	76.3	108.6	126.0	134.6	9.0	13.7	16.9	20.2	2.3	2.3	2.5	2.5	11.3	16.0	19.4	22.7
14. Hickory - Spring Creeks	162.0	244.2	312.5	395.4	144.6	230.6	304.8	392.3	18.4	30.3	42.2	60.2	6.8	6.0	6.8	8.2	25.2	36.3	49.0	68.4
15. Jackson Creek	51.9	70.3	91.5	128.1	45.5	59.9	80.2	109.7	6.5	8.6	11.9	17.7	11.0	8.0	7.7	8.1	17.5	16.6	19.6	25.8
16. *Thorn-Deer Creeks*	387.5	483.2	535.9	573.7	381.1	480.2	533.5	571.9	48.8	64.5	75.4	89.3	36.2	35.9	37.6	39.4	85.0	100.4	113.0	128.7
17. Little Calumet - West[1]	6.8	8.8	11.2	16.0	4.0	6.8	9.6	14.8	0.5	0.9	1.3	2.2	0	0	0	0	0.5	0.9	1.3	2.2
ILLINOIS TOTAL[3]	7285	8137	8827	9639	7127	8015	8733	9570	966.5	1124.4	1275.0	1519.2	976.9	929.0	940.8	968.9	1943.4	2053.4	2215.8	2488.1
17.1 Little Calumet - West[2]	48.3	56.9	65.6	84.2	44.3	54.9	62.3	84.2	6.2	7.8	9.2	13.3	47.2	28.8	20.6	15.7	53.4	36.6	29.8	29.0
18. Indiana Harbor	433.9	451.7	474.6	526.7	430.1	449.6	474.6	526.7	63.4	68.4	74.4	86.9	393.9	244.5	189.1	163.7	457.3	312.9	263.5	250.6
19. Little Calumet - Middle	103.9	136.1	171.8	204.8	72.4	107.2	148.7	224.3	8.6	13.5	19.8	35.8	0	0.2	0.3	0.4	8.6	13.7	20.1	36.2
20. Little Calumet - East	98.3	140.0	194.1	353.4	52.2	91.5	152.5	303.6	6.3	11.6	20.4	45.1	30.5	22.5	24.8	37.6	36.8	34.1	45.2	82.7
21. Indiana Dunes	58.5	67.3	77.6	107.8	46.5	54.5	65.0	98.6	6.9	8.1	9.9	15.7	21.0	14.2	14.3	18.9	27.9	22.3	24.2	34.6
22. Trail Creek	29.2	36.1	43.4	58.3	3.5	10.5	17.0	35.2	0.4	1.3	2.3	5.3	0.1	0.1	0.1	0.2	0.5	1.4	2.4	5.4
INDIANA TOTALS[3]	771	888	1027	1371	649	768	920	1276	91.8	110.7	136.0	202.1	492.7	310.3	249.2	236.5	584.5	421.0	385.2	438.6
C-SELM TOTALS[3]	8056	9025	9854	11010	7776	8783	9653	10846	1058.3	1235.1	1411.0	1721.3	1469.6	1239.3	1190.0	1205.4	2527.9	2474.4	2601.0	2926.7

Notes

1. Illinois portion
2. Indiana portion
3. Totals adjusted slightly to conform to over-all projections.

SECTION III - STUDY GOALS

STUDY VALUE

The long-range national water quality goal established by PL 92-500 seeks to eliminate the discharge of pollutants into navigable waters by 1985. It also encourages the development and implementation of area-wide wastewater treatment management plans to assure adequate control of pollutant sources and, implicitly, economies in cost. Furthermore, the law stresses the desirability to incorporate conservation practices into the treatment system design. This could involve:

1. the recycling of nutrients combined in the wastewater;

2. the reuse of the treated water, and

3. the combining of system components with other resource commitments that provide additional social, environmental or revenue-producing returns.

Therefore, the primary objective of this study was to develop alternative wastewater management systems that would treat 1990 wasteloads, yet still be capable of being expanded to meet 2020 requirements in the most cost effective manner. The levels of treatment would be designed to achieve a technical goal approaching "no discharge of critical pollutants" (NDCP) as well as current requirements with major emphasis placed upon plans to meet the higher technical goal. Concurrently, system design also provided the basis for maximizing the efficient reuse of the reclaimed resources. Accordingly, during the study's plan formulation process, components of the wastewater management alternatives were progressively refined by incorporating the design with the resource requirements of the area. In fact, throughout the process, the multiple-use of the water and related land resources was a predominant planning interest. The evolved wastewater management plans demonstrate: (1) the manner and extent to which the area's water and related land resources can be effectively managed in order to meet future water uses and "waste"-oriented functions and services; and (2) the range of implications, including social, environmental, natural resources, institutional, and economic that would be involved in fulfilling the technical goals and satisfying some of the area's water-related requirements.

The findings of this study do not mean that any of the alternative plans investigated would be constructed. Rather, the results are offered as a planning framework from which the area's decision-makers can select a system consistent with the national water quality goals and objectives set forth in PL 92-500. Final decisions as to which alternative, if any, is best suited to a particular part of the area and most acceptable to the people is left to State and local governments.

TECHNICAL GOAL

WATER QUALITY STANDARDS

In the comparatively brief history of concern over the pollution of our nation's water resources, a continual evolution has taken place. Water quality standards, in lieu of any other method, has become the basic control for restoring the aquatic environment. There are two types of standards now in use: (1) "Stream Water Quality Standards"; and (2) "Effluent" Standards. Both can be variable as to their requirements and are generally used for control of a specific geographical area and portion of a stream.

The stream water quality standards are established so as to maintain specified beneficial uses in streams, with consideration of the "assimilative capacity" (dilution) of the receiving waters an integral part of the standard setting process. There are many other considerations involved in this process, of which, the more important are: state of the art for specific constituent removal; effects on the environment; cost and economy of the area. Consequently, the established stream standards are generally a compromise between conflicting interests and represent the result of a conscientious effort to resolve the complex issues involved.

The effluent standards are the more recent type of control adopted, and reflect the attempt to enforce water quality at the source of potential pollution rather than in the receiving waters. Its usage also tends to place a more equitable burden on the water users. These standards inherently include virtually all of the considerations involved in setting stream water quality standards, including the indirect contribution of the assimilative capacity of receiving waters.

The State of Illinois presently employs both kinds of standards. The State of Indiana generally uses only stream water quality standards, though special provisions for treatment requirements have been specified for specific locations. The current level of treatment in the study area also will vary, depending upon the receiving stream. In general, those plants discharging into streams tributary to the Illinois River are designed to provide the equivalent of secondary treatment. A higher level of treatment is required on streams tributary to Lake Michigan.

NO DISCHARGE OF CRITICAL POLLUTANTS

Definition of Treatment Goal

To reverse the continued degradation of our water resources and facilitate the reuse of the treated water, required setting the equivalent of a new effluent standard. The standard would be representative of the NDCP water quality goal. The concept of standard, as used herein, is a basis against which to design the treatment process. Selection of the various wastewater constituents to be controlled together with the critical levels of concentration were based upon natural background levels of the watercourse into which the effluent was to be discharged. Also included were those specific constituents that could be highly toxic or otherwise injurious to the environment at trace levels. These levels were applied as the study's technical goals (water quality) with the exception that: (1) if current state water quality (effluent) standards were higher, these standards were applied; or (2) if the environmental scan provided the basis for allowing levels of constituents that were higher than natural levels but not highly toxic or otherwise injurious to the environment, these levels were applied.

Because the study was set within the planning framework of 2020 needs, the lists and acceptable levels of critical pollutants are more detailed and demanding than existing standards. As the basis of design, three groups of constituents and applicable acceptable levels were established through a literature search. The search involved a procedure for selecting desirable levels for human consumption as defined from the Public Health Service Drinking Water Standards. Other sources were examined to determine desirable levels for additional usages such as irrigation water, livestock water, and aquatic habitat. The most stringent level for each constituent was chosen from these four categories as possible water use. These levels were then defined as effluent levels to be achieved. Thus, when the equivalent of natural background levels or conditions for a particular watercourse could not be determined, the preceeding effluent levels were used.

While these treatment goals are similar in intent to the national goal established by PL 92-500, they are not the result of that legislation. Rather, these goals were established for this and other pilot studies authorized approximately one year prior to enactment of the law. Consequently, the specific water quality effluent requirements do not represent federally accepted or adopted standards.

Available Technologies

Concurrent with the establishment of the treatment goal, attention was directed to the methods by which this goal could be achieved. There are three basic technological approaches which can be used to attain the treatment standard. These are: (1) an Advanced Biological treatment plant system; (2) a Physical-Chemical treatment plant system; and (3) a Land treatment system.

None of the three are new or unique in concept. The unit processes of each system can be found in various parts of the nation and the world. What is comparatively new is (1) the combination of these systems' unit processes to achieve the treatment desired and (2) the scale to which these systems would be applied.

Most of the sewage treatment plants in the study area today achieve secondary treatment of the wastewater prior to discharge into nearby watercourses. Conventional Biological treatment is the technology most widely used. It basically involves a two-step process. The first step, or primary treatment phase, consists of some form of mechanical screening and holding basins to remove the trash and settleable solids. The last step, or secondary treatment, utilizes bacteria to consume the organic portions of the wastes. Prior to being discharged, the treated effluent is usually chlorinated for disinfection purposes.

The Advanced Biological treatment system involves the addition of various biological and chemical unit processes to the Conventional Biological treatment plant. The add-on unit processes are designed to achieve removal of specific constituents. On the other hand, the Physical-Chemical treatment system uses the principles of physics and chemistry to accomplish the same functions that the bacteria and other components perform in biological design. Both of these "plant" technologies rely on incineration as an integral part of the process providing internal recycling and reducing the volume of sludge generated. The Land treatment system also adds various biological and physical-chemical unit processes to the Conventional Biological treatment process. The wastewater having received the equivalent of conventional secondary treatment is sprayed on the soil by irrigation equipment for the final stage of purification. What is unique is that the biosystem of both the soil and cover crop provide the equivalent of the add-on unit process. Involved are the complex physical and chemical reactions in the soil, the biological processes of the soil's bacteria and fungi, and the natural crop uptake - all of which form the basis for designing the farmer's present fertility program and cropping practices.

In developing the design of the plant systems, certain basic assumptions were made. The most important related to the (1) sequential arrangements of the unit processes; and (2) design criteria for rating treatment performance under peak flow conditions. Similar design constaints were adopted in the land system for relating the application rates of the pre-treated irrigation water to the performance of the vegetative cover, soil column, and soil organisms. The various unit processes and sequential arrangements included in each of the three advanced treatment systems are graphically illustrated in Figures C-III-1 through C-III-3. Detailed discussions of each technology can be found in Appendix B.

Basis for Adopted Effluent Standard

The study's effluent goals were generated by the Office, Chief of Engineers, U.S. Army Corps of Engineers specifically to provide the water quality requirements that would assure the elimination of pollutant discharges on a regional basis. Consequently, the three groups of constituents selected for the basis of design included: (1) Constituents

ADVANCED BIOLOGICAL TREATMENT COMPONENTS

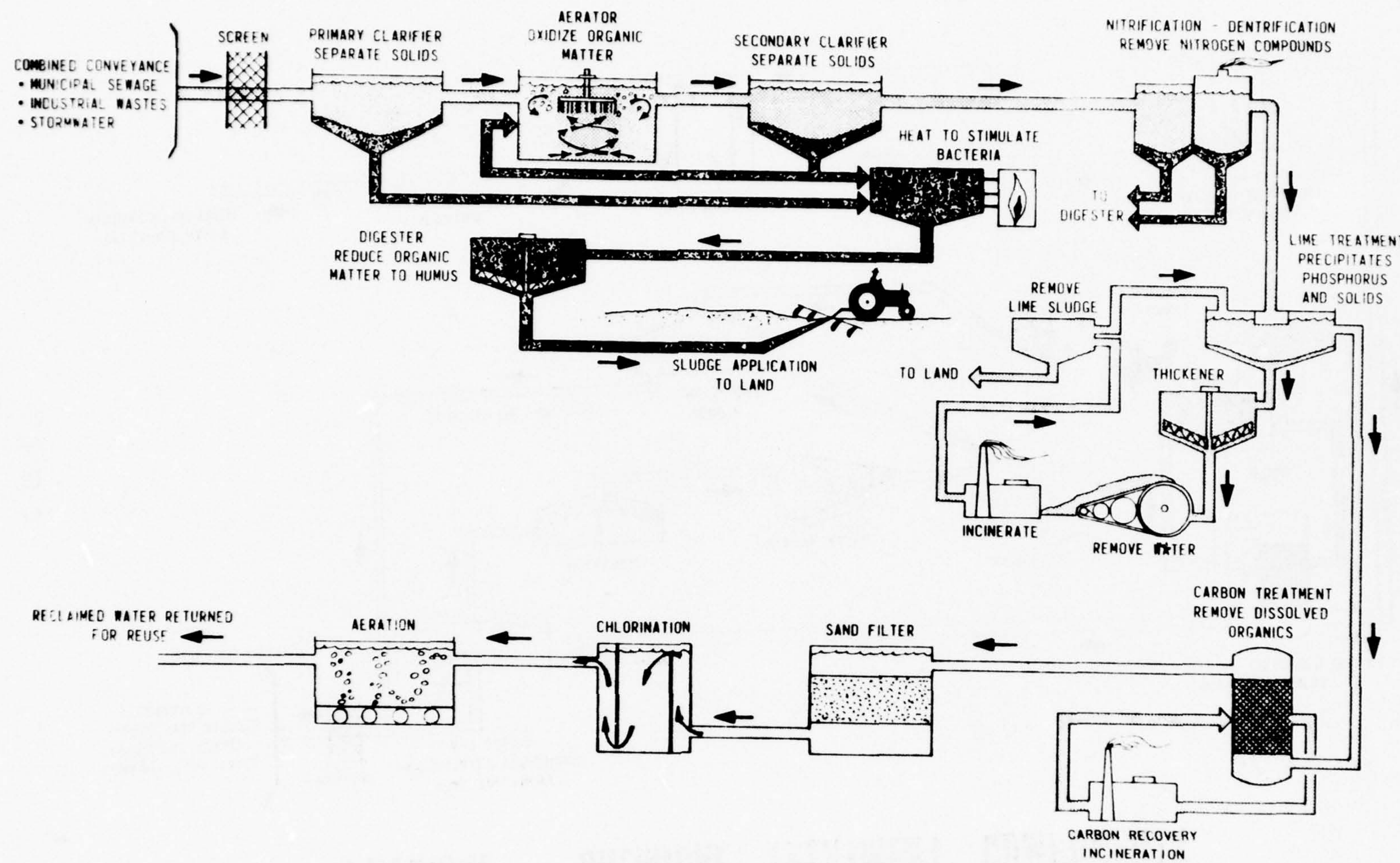


Figure C-III-1

PHYSICAL - CHEMICAL TREATMENT COMPONENTS

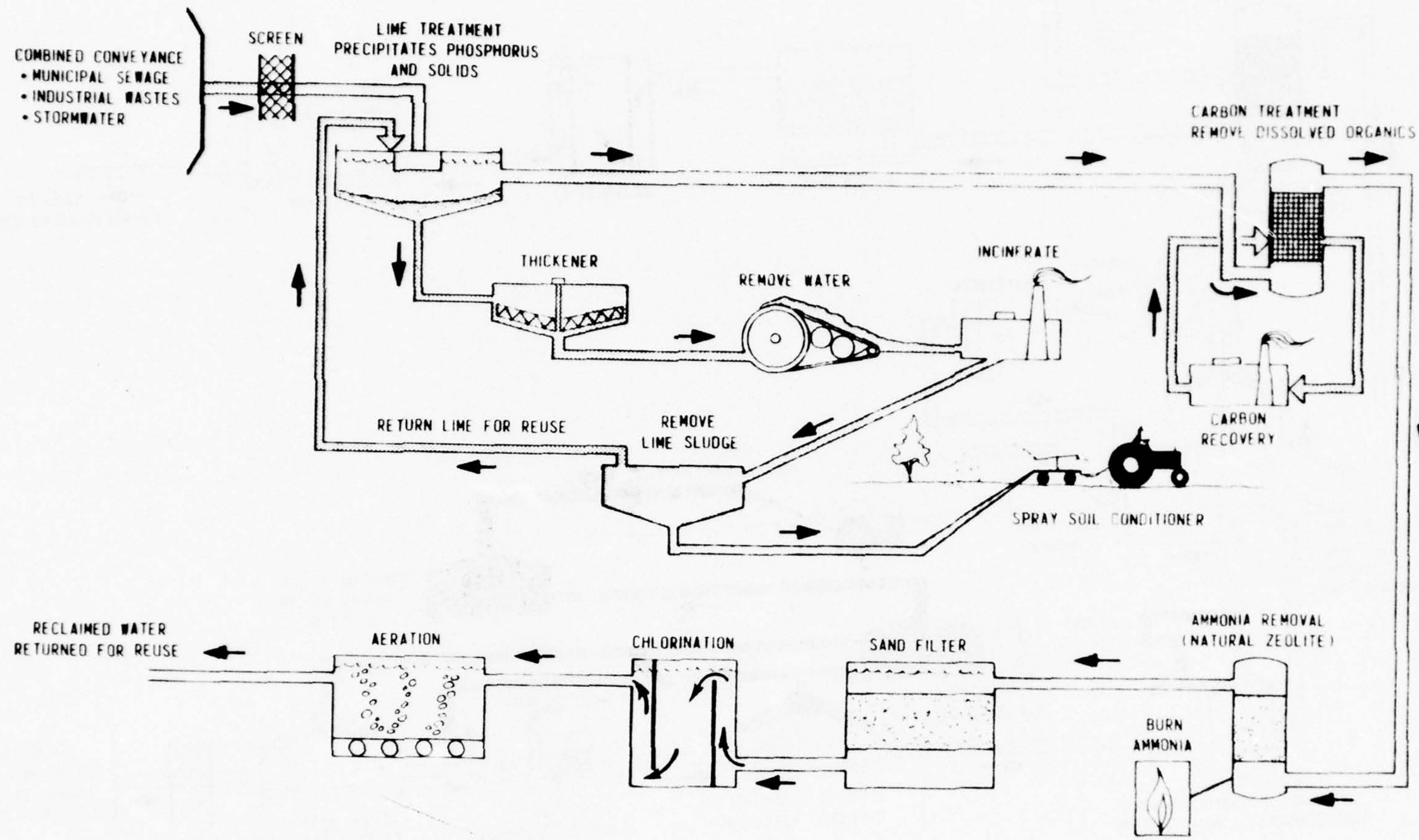


Figure C-III-2

LAND TREATMENT COMPOMENTS

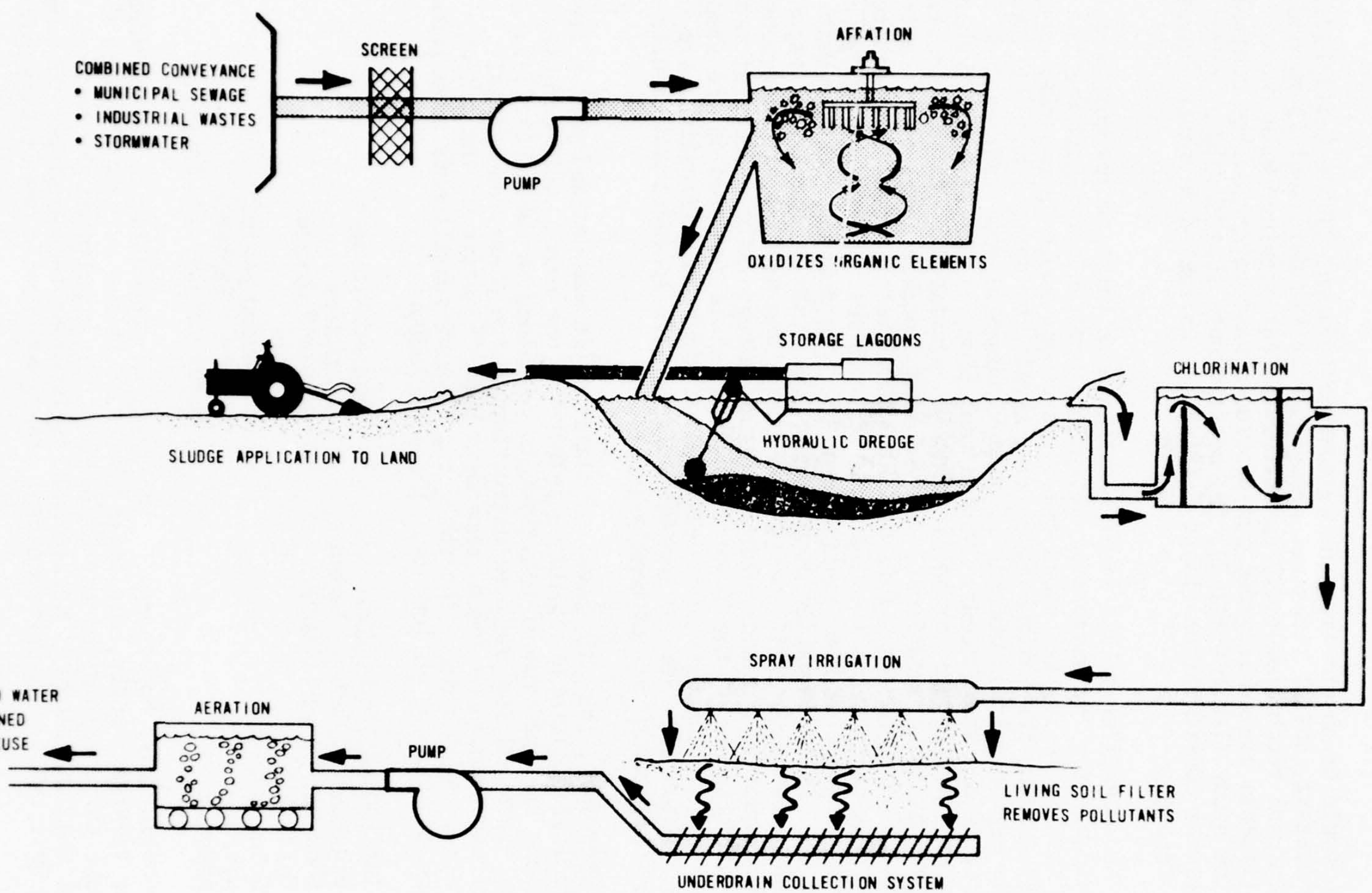


Figure C-III-3

that should be absent from the wastewater effluent (Table C-III-1) (In this context, absent means not detectable by standard testing methods and current techniques); (2) constituents that together with those constituents listed in group one provide a base water quality control for the study (Table C-III-2); (3) constituents that should be given particular consideration (Table C-III-3) as warranted by their impact in a region.

The constituents and levels contained in these tables were developed as guidance for the wastewater management program. Implicit was the fact that the levels in the second and third groups would be regarded as goals in determining the maximum acceptable levels for design, and that these levels may be relaxed upwards if an environmental scan indicated no adverse effect would occur. At the same time, it was recognized that there was very little, or no, information available as to what constitutes the present background level, or even an acceptable level of concentration for these constituents. This was due to an historic lack of adequate monitoring efforts and the high cost of analyses. Furthermore, concern for the presence of some constituents (e.g. mercury) is quite recent, and as of yet, is inadequately documented. The state of the art is expanding, but the relationships of constituent levels and biological consequences are inadequately defined. Synergistic or antagonistic effects of two or more constituents on the biota through the whole spectrum of the food chain, and the concepts of biostimulation and biomagnification, are largely untested. Studies on these effects are sporadic and results are often conflicting, if not contradictory.

Therefore, for this level of planning, it was decided that a list of critical pollutants should be selected - one which would adequately represent the spectrum of constituents contained in Tables C-III-1, 2 and 3. Then, during the preconstruction design phase, additional constituents could be added, dependent upon the state of the art at that time. Accordingly, the foregoing list of constituents were reduced to some 14 types of pollutants. These included:

Total Dissolved Solids	Organic Nitrogen
Biochemical Oxygen Demand	Phosphates
Chemical Oxygen Demand	Oils and Greases
Heat	Phenols
Color	Suspended Solids
Nitrates	Coliform Bacteria (Total)
Ammonia	Heavy metals and "Exotics"

These pollutants, together with the level of concentration recommended as the treatment goals, are shown in the first two columns of Table C-III-4. The next three columns of the Table shows the results of the environmental scan and study of background levels under the heading: "Ultimate Water Quality". The environmental scan demonstrated sensitivity for

TABLE C-III-1

GROUP 1 CONSTITUENTS (absent 1/ from effluent)

Antimony

Arsenic

Barium

Beryllium

Boron

Cadmium

Chromium

Cobalt

Copper

Cyanides

Lead

Mercury

Molybdenum

Nickel

Pesticides (Chlorinated Hydrocarbons)

Phenols

Selenium

Silver

Thallium

Tin

Titanium

Zinc

1/ Absent means not detectable by standard testing methods and current techniques.

TABLE C-III-2

BASE WATER QUALITY CONSTITUENT (GROUP 2) LEVELS

Constituent	Effluent Level
Total Dissolved Solids	(Less than) 500 mg/1
Biochemical Oxygen Demand	2 mg/1; BOD Level
Heat	Plus or Minus 1°C of Ambient Temperature
Color	75 Color Units
Nitrates and Nitrites	4 mg/1 total
Ammonia as Nitrogen	0.1 mg/1
Organic Nitrogen	Sum with Nitrates & Nitrites - 10 mg/1
Phosphates	50 mg/1 entering a lake 100 mg/1 entering a flowing stream
Oils and Greases	Trace
Fecal Coliform Organisms	200 per 100 ml
Suspended Solids	2 mg/1

TABLE C-III-3

CONSTITUENT (GROUP 3) LEVELS WARRANTING CONSIDERATION

Constituent	Effluent Level
Virus	Inactivated, but trace present
Surfactants	Trace
Fecal Streptococci	Inactivated, but trace present
Tastes and Odors	None Offensive
Floatables	None
Settleable Solids	Trace
Volatile Solids	Trace
Gamma Radiation	Trace
Alpha Radiation	1 pCi/l
Beta Radiation	100 pCi/l
Turbidity	5 Jackson Units
Alkalinity	100 to 130 mg/l at pH between 6.0 to 7.0
Carbon Dioxide	25 mg/l
Sulfates	10 mg/l
Calcium	30 mg/l
Chlorides	250 mg/l
Sodium	10 mg/l
Magnesium	125 mg/l
Flourides	From 1.7 mg/l @ 10°C to .8 mg/l @ 30°C
Aluminum	1 mg/l
Bicarbonates	Plus or minus 50 mg/l over ambient conc.
Manganese	.5 mg/l

TABLE C-III-4

COMPARISON OF EFFLUENT GOALS AND PERFORMANCE LEVELS

CRITICAL CONSTITUENTS		NO DISCHARGE OF CRITICAL POLLUTANT GOALS	ULTIMATE WATER QUALITY: CONTROLLING WATER USE	ULTIMATE WATER QUALITY: SOURCE OF INFO.	ULTIMATE WATER QUALITY: QUALITY LEVEL	PERFORMANCE LEVELS USED FOR DESIGN: ADVANCED BIOLOGICAL	PERFORMANCE LEVELS USED FOR DESIGN: PHYSICAL-CHEMICAL	PERFORMANCE LEVELS USED FOR DESIGN: LAND
Total Dissolved Solids	MG/L	< 500	(2)	(c)	500	500	535	500
Biochemical Oxygen Demand	MG/L	< 2; BOD ≤ DO	(1)	(a)	1-2	3	3	2
Chemical Oxygen Demand	MG/L	No Value Defined	(1)	(a)	3-6	10	10	6
Heat	^{o}C or ^{o}F	< ± $1^{o}C$ of Ambient Temp.	(1)	(c)	3^{o}-$5^{o}F$ (Above Amb. Temp.)	53-78	53-78	55-70
Nitrate and Nitrite Nitrogen	MG/L	< 4 Total	(2)	(c)	10	2-5	2	2
Ammonia Nitrogen	MG/L	< 0.1	(1)	(b)	<1	0.3	0.5	0
Organic Nitrogen	MG/L	Sum with NO_3 + NO_2 - N < 10	(1)	(a)	<0.3	0	0	0
Soluble Phosphorus	*μG/L or MG/L*	*(PO_4) <50μG/L Lake* < 100μG/L Stream	(1), (3)	(c)	0.01	0.1-0.2	0.1-0.2	0.01
Oils, Greases	MG/L	Trace	(1)	(c)	<0.3	1	1	0
Phenols	MG/L	Absent	(1)	(c)	<0.1	0.01	0.01	0
Suspended Solids	MG/L	< 2	(2)	(c)	0	1	1	0
Patnogens, Viruses		Inactivated, But Trace Pres.	(2), (3)	(c)	~ 0	Present	Present	0
Arsenic	MG/L	Absent	(1)	(c)	0.05	0.03	0.03	0
Boron	MG/L	Absent	(1), (4)	(c)	0.5-1.0	1	1	0.7
Cyanide	MG/L	Absent	(1)	(c)	0.02	0	0	0
Trace Metals: Aluminum	MG/L	< 1	(1),(2),(4) (all trace metals)	(c) (all trace metals)	1.0	0.1 (all trace metals)	0.1 (all trace metals)	~ 0 (all trace metals)
Cadmium	MG/L	Absent			0.005			
Chromium	MG/L	Absent			0.02			
Copper	MG/L	Absent			<1.0			
Lead	MG/L	Absent			0.05			
Nickel	MG/L	Absent						
Zinc	MG/L	Absent						
Iron	MG/L	No Value Defined						
Manganese	MG/L	< 0.5						
Mercury	MG/L	Absent						

(1) Aquatic Habitat
(2) Public Water Supply
(3) Recreation
(4) Irrigation Waters

(a) Background Concentration of Relatively Unpolluted Natural Waters
(b) European Inland Fisheries Advisory Commission, Rome 1970
(c) National Technical Advisory Committee Report on Water Quality Criteria, (FWPCA, 1968)

eutrophic water quality conditions and concomitant need for setting a very low concentration limitt on soluble phosphorus. Likewise, the permissible ammonia nitrogen concentration is quite low because of nitrogeneous oxygen demand and the toxic limits imposed by common fish species. Therefore, the concentration levels shown represent the limits on ultimate water quality as best as can be defined with present knowledge. These quality levels are use oriented, and include consideration of the aquatic habitat, public water supply, recreation and agriculture as controlling water uses. The sources of information for developing ultimate water quality levels are also shown.

The last three columns of the table show the expected performance levels for the three technological processes under consideration, i.e., Advanced Biological, Physical-Chemical and Land treatment systems. Performance data for the Advanced Biological treatment were based primarily on small scale operating systems, and for the Physical-Chemical and Land treatment on limited small scale operating experience and engineering and laboratory studies. Higher performance may be attainable by each process.

Table C-III-4 also provides a comparison between effluent goals, the ultimate water quality levels developed through environmental scan and study of background levels, and the performance levels used for design (NDCP goals) which include the additional consideration of best available technology. A comparison of these various constituent levels indicates the following:

Heat: The effluent goals call for $1^{o}C$ ($1.8^{o}F$) variation above or below ambient temperature, the ultimate water quality level is specified at 3 - $5^{o}F$ above ambient temperature, and the performance levels specified for design are 53 - $78^{o}F$ for the Advanced Biological and Physical-Chemical, and 55 - $70^{o}F$ for Land treatment technology. All of these values are within the range of a general requirement that can be established without reference to specific location and biota to be protected. Additionally, the ultimate water quality level is in agreement with the National Technical Advisory Committee report (FWPCA, 1968) on water quality criteria.

Nitrogen Forms: The effluent goals call for less than 4 mg/l total for the sum of nitrate and nitrite nitrogen, less than 0.1 mg/l for ammonia nitrogen, and less than 10 mg/l total for organic nitrogen including the sum of nitrate and nitrite nitrogen. The ultimate water quality levels specify 10 mg/l, and less than 1 mg/l for the first two nitrogen forms, respectively, and less than 0.3 mg/l for organic nitrogen. The performance levels, on the other hand, indicate 2 - 5 mg/l for Advanced Biological, 2 mg/l for Physical-Chemical and Land technologies for the nitrate plus nitrite nitrogen, 0.3, 0.5 and 0 mg/l, respectively, for ammonia nitrogen. Of these three technologies, only the Land treatment meets, and exceeds, the most stringent requirements. However, the concentrations shown for the treatment plant technologies are also below the ultimate water quality levels specified. Of the three nitrogen forms, ammonia nitrogen is the most critical with regard to toxicity to common fish species.

Phenol: While the effluent goals call for absence, the ultimate water quality level is specified at less than 0.1 mg/l. Concurrently, the performance levels specified for design are 0.01 mg/l for the two plant technologies and an absence for the land technology. The concentration shown for the plant technologies is below the ultimate water quality by a factor of ten. The desirability to hold phenols at trace levels stems primarily from the potential synergistic effects that could result from the interaction of chlorine and the production of unpleasant taste at as low as 0.001 mg/l in drinking water. Conversely, the documented toxicity to fresh water fish and lower aquatic life is 0.1 mg/l or above. Of the three technologies, only the Land treatment exceeds the most stringent requirements.

Arsenic: The effluent goals call for the absence of arsenic, the ultimate water quality level is specified at 0.05 mg/l, while the performance level specified for the two plant and land technologies is 0.3 mg/l, and trace, respectively. Toxicity of arsenic to humans is a function of body weight and has been known to accumulate in the tissues of many organisms. It is therefore desirable to remove it entirely. However, the permissible limits are: for drinking water 0.05 mg/l, and for irrigation, stock and wildlife watering, and fish and other aquatic life 1.0 mg/l. The performance levels used for design (0.03 mg/l) for the plant technologies are below these standards, as is the land technology which results in complete removal.

Oils and greases: The effluent goals call for trace only, while the ultimate water quality level is specified at less than 0.3 mg/l. The performance levels specified for design, however, are 1.0 mg/l for the two plant technologies, and a trace for the land technology. While the 1.0 mg/l satisfies the criteria, it has been reported that crude oil in concentrations as low as 0.3 mg/l is toxic to fresh water fish. Again, of the three technologies, only Land Treatment exceeds the most stringent requirements.

Boron: The effluent goals call for the absence of boron, the ultimate water quality level is specified at 0.5 - 1.0 mg/l, and the performance level specified for the two plant and land technologies is 1.0 and 0.7 mg/l, respectively. Boron in low concentrations in drinking water is not generally regarded as a hazard to human beings, and is an essential plant micronutrient almost up to concentrations of 1.0 mg/l in irrigation water. While the performance level for plant technologies does not meet the effluent quality goal of total absence, it is considered tolerable and in accord with the ultimate water quality level.

Total Dissolved Solids: Effluent goals, ultimate water quality levels performance levels used for design are in accord at the limit of 500 mg/l with the exception of the Physical-Chemical technology performance. The additional 35 mg/l is considered insignificant for virtually all beneficial uses of the effluent.

Based on the foregoing, it was concluded that the performance levels for all three advanced technologies are comparable and, for all intents and purposes, achieve the same treatment goals. Utilization of different unit processes make it virtually impossible to achieve identical levels of constituent removal. Moreover, no differential in impact on the aquatic ecosystem or other use consideration could be determined relative to the variations in constituent levels.

POLLUTANT SOURCES

Once the effluent standards for treatment were determined, the sources of pollutants requiring control also had to be identified. There were three major categories which affected the quality and/or natural background level of a watercourse. These were: point sources, in-place sources, and areal sources.

Point sources pertained to wastewater volumes discharged at a specific location; be it a collector (pipeline) system or stream outfall. Included in this category were controlled waste loads from the various municipalities and industrial plants. The volumes and waste constituents were determined as noted in the preceeding section.

The second category, in-place sources, was more subtle in that it involved the physical attributes of the watercourses themselves. Of particular concern in this category were the pollutants that had accumulated in the stream beds over time. It has been assumed that once a NDCP treatment system is in place and operation, the bottom deposits, especially the organic material, will stabilize due to anaerobic action. There may, however, be deposits or specific constituents such as heavy metals or toxicants which will require other remedial works such as dredging. The beneficial effects of the stream's increased assimilative capacity in eventually stabilizing these types of pollutants are not known; related decisions must be deferred until extensive monitoring has been completed.

The control of areal sources of pollutants was the major differential between the NDCP and current water quality standards. Prime concern was the contaminant loading that storm water runoff would contribute to the area's watercourses if not captured and treated. This consideration would exclude the amount of storm water that naturally infiltrates into the collection and conveyance sewer systems. It was recognized, however, that storm water runoff would become a carrier of the pollutants that are typical of the geographical area involved - be it urban, suburban, or rural in character. Specific pollutant sources would involve septic tank infiltration fields, fall-out of air-borne pollutants, and the commercial fertilizers used in both agricultural production and the suburban open-spaces including subdivisions. All of these had the potential of adding significant levels of critical constituents; enough to temporarily negate the water quality goal that otherwise would be achieved under the NDCP system design.

STORM WATER RUNOFF

In determining what, if any, portion of storm water runoff had to be captured, a search was made of published literature and available study-related data. Extensive work had been done by the Metropolitan Sanitary District of Greater Chicago (MSDGC), the Illinois Institute for Environmental Quality, and the Department of Public Works for the City of Chicago in relation to the pollutant loadings of storm water runoff from combined sewer systems. The findings supported a need to collect the first 2-1/2 inches of runoff since the flush of contaminants were significantly high enough to become a definite point source (outfalls) of pollution, even under existing standards.

The management system in the suburban areas, however, involved separate collection and conveyance lines; thus, constituent loadings of separate storm water discharge were needed. Related studies pertinent to this subject were found, but there were extensive variations in concentration levels. Most of the variations could be attributed to the time of sampling relative to rainfall occurrence and whether the samples were "grab" samples or taken on a flow-weighted basis. Consequently, the results of a study for Ann Arbor, Michigan as reported in the January 1968 issue of the Water Pollution Control Federation Journal was selected as the basis for this evaluation. The constituent loadings were reported in the form of flow weighted annual mean values, i.e., level of concentration correlated to a rainfall-flow relationship. Three constituents, Biochemical Oxygen Demand (BOD), phosphorus, and ammonia nitrogen were selected as the key discriminators because of their impact on the aquatic ecosystem through oxygen depletion and stream enrichment (a phenomenon similar to eutrophication).

An analysis was done to determine the effects on the receiving waterways if the first 2 1/2 inches of storm water runoff was not treated. In this analysis, two levels of treatment were considered for the 1990 municipal and industrial projections, local and NDCP standards. Furthermore, the local standards were subdivided: one reflecting current standards; the second the most stringent of known effluent requirements in the area - reflecting long range local planning goals. As such, these treated discharges reflected the most optimized (quality) base flow condition that could be expected in the area's waterways. Then using the typical loadings for the suburban runoff, the applicable concentration (on a weighted flow value) of the three key parameters were determined. The resultant BOD and ammonia nitrogen loadings, determined using the stream's assimilative capacity for the 7-day, 10-year low flow, exceeded the acceptable concentrations levels for not only the NDCP but both local standards. The phosphorus concentrations were low enough to justify assuming that additional dilution would maintain the concentration level acceptable under current standards, but unacceptable for NDCP standards. Based on this analysis, it was concluded that the storm water runoff in the suburban area should be captured and treated particularly if the water quality was to provide for the enhancement of fishery and other stream-related recreational opportunities. Similarly, the same concept was applied to the rural storm water runoff where management concerns would be compounded by the suspended solids and other constituents more closely related to agricultural production. Without capture of this portion of the study area's runoff, the stability of the aquatic ecosystem could not, in all probability, be maintained.

REUSE AND CONSERVATION OBJECTIVES

WATER REUSE

The necessity to capture and treat storm water runoff in itself imposed two new conditions. First, it provided a new source with which to meet the projected water requirements of the study area. Secondly, it effected a change in the existing streams' flow characteristics and provided the potential for land-use changes in the flood plain. Based on the foregoing factors, it became apparent that the wastewater management system could serve as a primary vehicle to meet the water and related land requirements. In essence, a more effective water balance for the study area could be obtained and multiple usage of both the water and land resources could be realized. In lieu of a detailed water use assessment, the inventory of needs from the comprehensive studies for the Upper Mississippi River and Great Lakes Regions were used. Among the water-based needs cited, flood control, general recreation, fish and wildlife conservation, commercial navigation, and water supply were pre-eminent. These needs served as the basic framework for evaluating the potential reuse and redistribution of the treated water.

The potential for meeting the projected water supply requirement was primarily a problem associated with the Illinois portion of the study area. The Indiana portion has no constraints imposed on its use of Lake Michigan waters. As a result, attention was focused on the requirements for meeting the Illinois usage. Involved were the institutional constraints of the Supreme Court decision and the possible need to either change the present withdrawal allocations or reuse the treated water.

RESIDUAL WASTE BY-PRODUCTS

The constituents removed by the treatment processes are actually the consumptive wastes from the municipal and industrial usage of our natural resources and agricultural products. These residual by-products called sludges are comparatively high in organic and nutrient value, but also contain such elements as heavy metals and other industrial by-products. None of the industrial wastes, though, are available in sufficient concentrations to prevent their reuse. In fact, these sludges have been dried and marketed as a fertilizer or an additive to commercial fertilizer. In the latter case, the sludge is used to provide a slow release of the nitrogen contained in the organic solids. Accordingly, there is a real potential for the effective reuse of the residual wastes.

The method of recapture and potential for recycling the nutrients varies with each of the three treatment technologies. In both plant processes, the nutrients along with other elements are at least partially extracted from the wastewater and recovered in the sludge. The sludge from the Physical-Chemical process is rich in lime, but the nitrogen and organic matter have been lost by incineration. Consequently, it can only be used as a soil conditioner. On the other hand, the sludge from the Advanced Biological plant can be used as a fertilizer and humus builder since it contains much of the organic matter and nutrients removed from the wastewater.

The land system achieves a recycling of the waterborne nutrients in a dual way. Part of the organic matter and nutrients are allowed to settle out in large storage lagoons like the Conventional Biological systems now being used. The sludge is similar to that produced by the other biological processes and can be used as a fertilizer and humus builder. The remaining reuseable wastes are still in the form of waterborne plant nutrients and other organic and mineral elements. These nutrients are then applied by field irrigation and equipment as fertilizer for the agricultural cover crop.

MULTIPLE-USE OPPORTUNITIES

Another possibility for resources conservation can be realized by developing the multiple-use potential (add-on features) inherent in the physical layout or design of a system component. These add-ons represent an opportunity to meet other area or regional needs with significant savings in costs and resources. In some cases, the system provides the resource base with which the dual benefit can be readily attained. In other cases, the potential for achieving the dual benefit is enhanced, but additional resource commitments are required. In both cases, additional investments (although at a lower level) are needed but the opportunity for realization is greatly improved. Most of the potential for the add-on gain are dependent upon the technology involved, but a few are affected by other system components.

SECTION IV - PLANNING OVERVIEW

PLANNING FRAMEWORK

As with any other program involving water and related land resource developments, this study was directed towards the attainment of the multiple objectives cited by Congress. These objectives included the enhancement of the environment, social well-being and the development of the regional and national economies.

As noted, the formulation of the alternative wastewater management systems included an evaluation of multiple-use programs responsive to the categories of need identified for the Upper Mississippi River and Great Lakes Basins. Since these basin studies were concerned with the regions' resource management, they provided an interrelationship between the nation and the region (with its subdivision) for the production of goods and services and population distribution. Consequently, any proposal to meet the requirements of the C-SELM area would also contribute to the economic development of both the region and nation.

At the same time, attention was focused on those aspects that make-up the environment and life-style (social well-being) of the area. This was done by requiring independent assessments of the socio-environmental and institutional implications inherent in the alternatives. In addition, specific add-on programs were investigated that would not only help preserve, but also enhance the area's physical, cultural and aesthetic characteristics.

BASE APPROACH

The study effort was structured to facilitate the formulation and design of the alternative wastewater management systems in a logical manner. This involved organizing the plan-formulation procedure so as to assure a logical sequence of consideration.

The basic approach was to progressively develop a viable set of wastewater management plans from an initial set of alternatives that were successively screened and refined. This reiterative process emphasized a continuous evaluation of system-related impacts and effects. Involved in this interface with the planners were the socio-environmental and institutional evaluators as well as the various segments that make-up the general public. This interaction helped assure that the alternatives retained for final study would: (1) be as responsive to local, social, environmental and economic concerns as is possible; (2) contribute to the over-all water and related land requirements and priorities of the area; and (3) meet the intent and goals of PL 92-500.

Open planning was maintained throughout the plan-formulation process in order to provide all segments of the public an opportunity to contribute to the development of the alternatives. Public meetings were held, formal coordination conducted with many public organizations, and the assistance of various citizen groups enlisted to assure that the alternatives and evaluations accurately reflected the viewpoints of those concerned.

PLAN-FORMULATION PROCESS

Basically, the planning process was divided into three stages. The initial stage was used to help establish pertinent planning and design parameters for the functional components of an alternative. The functional components of each alternative were designed to treat the 2020 wasteloads. This provided an insight into the management and operational problems that the area would eventually face and provided a planning framework within which to shape the 1990 systems. In addition, the design of the alternatives were modified to differentiate: (1) the economic effects of regionalization on the functional components; (2) the extent to which the storm water could be used to meet the area's water demands; (3) the recycling potential and economic implication of various sludge utilization programs; (4) the economic relationship, both capital and annual costs, associated with each technology; (5) the comparative advantage of combining or separating the collection of storm water runoff and municipal and industrial wastes; (6) economic advantage of siting the treatment facilities relative to the water demand centers; and (7) the comparative advantages of intermixing different technologies or using the technologies to accomplish other add-on gains.

The intermediate stage involved a redirection of the design effort and basis for assessment. Basic planning guidelines had been established during the initial stage. Now attention was focused on the evaluation of the socio-environmental, institutional and resource implications involved in those alternatives retained for further study. As the first step, all of the alternatives were redesigned to treat the 1990 wasteloads. Where economies of scale and construction dictated, the 2020 requirements were retained as part of the system design. Due to the volume of water involved for redistribution, attention was focused on economies of transportation and the use of Lake Michigan as a supply and return source. Adjustments were made in system design to reflect cost savings identified in the previous study stage. For example: (1) separate collection and storage of storm water runoff was found to be the most economical for suburban areas; (2) the storage capacity of the suburban storm water systems was increased to reduce the peak treatment rates and costs of the plant technologies; and (3) the rural storm water system was developed on a modular basis and soil conservation practices incorporated into the design. Based on the foregoing, the degree of regionalization was again reexamined to further define the optimum point of consolidation. Once the redesign had been completed, a preliminary evaluation was made of the impacts associated with each alternative. This information then was furnished to the public to determine their viewpoints and preferences.

The third stage involved a refinement of the design for the individual functional components and a more in-depth assessment of the alternatives retained for final study. A major effort was devoted to the redesign of the Land treatment system. The physical layout of the treatment facilities had been designed to achieve maximum efficiencies in operational and economic considerations. This resulted in large geographical areas being committed without proper regard to the growth patterns, environment and life-style of the agricultural community. The redesign significantly changed the siting as well as the operational and managerial considerations. Another modification to design criteria involved the water (reuse) distribution program and its impact on Lake Michigan. The U.S. Environmental Protection Agency had expressed concern about the potential discharge of dissolved solids and the need to maintain the non-degradation provisions of the Lake. Accordingly, adjustments were made to conform to the current "water return" regimen now in effect. This meant constraints for the Illinois portion of the study area as opposed to the Indiana area. These constraints primarily involved the necessity to continue diverting all treated water down the Illinois River. It also meant balancing this diversion and future water requirements within the 3,200 cfs limitation on Lake withdrawals imposed by the U.S. Supreme Court.

Subsequent to the final design, each alternative then was critically assessed. This involved the quantification or qualification of (1) changes in water quality, (2) changes in land use both inside and outside the study area caused by the technology and system design, (3) consumption of resources, (4) displacement of people, (5) employment potential, (6) potential for meeting future water demands, (7) potential for multi-purpose add-ons, both water and land related, and (8) system associated costs. These assessments in turn, served as the basis for evaluating the socio-environmental, institutional and economic implications inherent in each alternative.

Shown in Figure C-IV-1 is a schematic diagram summating the three study stages and depicting the phasing and interaction between the various study elements.

SOCIO-ENVIRONMENTAL STUDIES

PURPOSE

The basic purpose of this element of the study was to assure that the socio-environmental impacts attributable to the wastewater management alternatives were identified. Therefore, the first task of these studies was to develop an acceptable methodology for performing an unbiased assessment of the impacts. The second task of the studies was to evaluate the alternatives under study and interact with the engineering and institutional studies to successively screen and refine the remaining alternatives.

PLAN FORMULATION PROGRESS

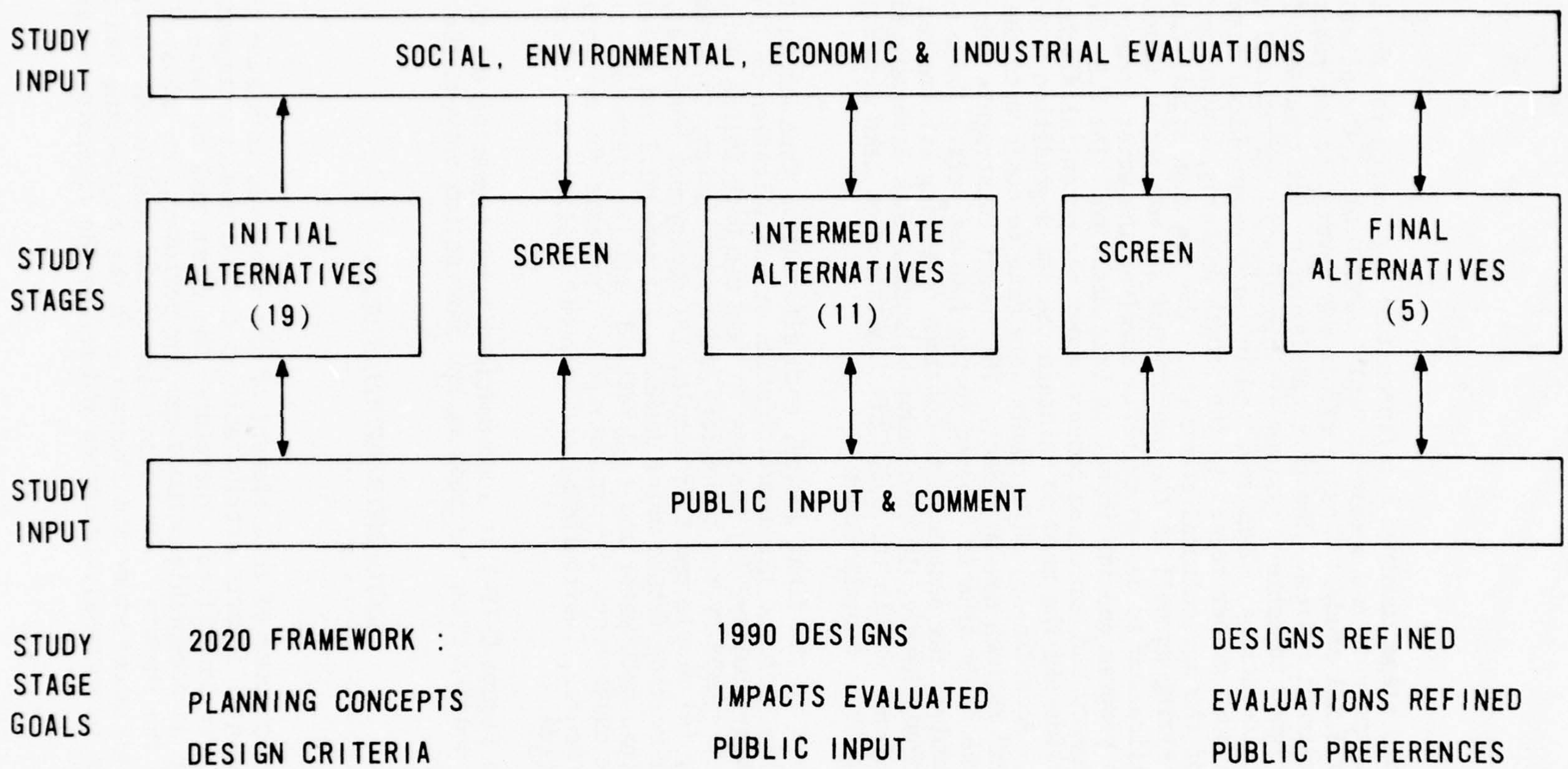


Figure C-IV-1

This involvement in the iterative process helped assure that the final alternatives were as complimentary to the maintenance and enhancement of the area's social and physical environment as was possible.

GENERAL APPROACH

The development of the impact evaluation procedure was based on an analysis of the processes by which alternative wastewater management systems would affect the environment and likewise the quality of life. It was concluded that four sets of parameters interacted in the impact process. These were: (1) system components, the physical and output characteristics; (2) those resources which comprise the environmental attributes of the area; (3) those human activities which make-up man's social well-being; and, (4) the relative worth of human values and goals. It also was concluded that the system elements and characteristics create changes (positive or negative) in environmental conditions and the availability of resources. These changes can modify the effectiveness with which people conduct their activities and the range of alternative activities that are available to them. Thus, the modified activities or states-of-being will affect the human satisfaction achieved relative to the values and goals being pursued. Values placed on these activities or goals vary among people and groups of people, so the same changes (impacts) are valued differently, depending on the point of view.

The impact of the alternatives on the area's environment and human activities was evaluated in terms of over-all implications rather than on a site specific basis. It was recognized that one of the major factors in the final decision-making process will be the extent to which the area's treatment system will be consolidated. Aside from the effects that resource commitments impose on a community's lifestyle, regionalization was considered the one variant with the most potential for impacting on the natural and social environment. Therefore, attention was focused on the socio-environmental effects associated with the system components and the alternative's degree of regionalization. Impacts specific to a site and surrounding locality should, of necessity, be evaluated once a wastewater management program is adopted for the study area. At that time, an effect assessment and environmental impact statement must be prepared before any phase of the plan is implemented.

IMPACT ANALYSIS METHODOLOGY

In order to fulfill the purpose of evaluation, a procedure was needed capable of describing the relative magnitude and direction of both direct and induced impacts, while lending itself to the comparative ranking of either the individual components or aggregate systems. The approach taken involved the use of a series of linked matrices. The first, or A Matrix (see Table C-IV-1) numerically rated on a comparative basis, the positive or negative impact a particular system component would have on a set of 14 environmental elements. The average ratings developed for each environmental element in Matrix A by the evaluation team was then used as input to Matrix B (see Table C-IV-2) which assessed the impacts of environmental conditions on human activities. Again, a numerical rating on a comparative basis was done. This time to identify the positive or negative impact a change in an environmental element would have on the set of 19 categories that characterize man's state-of-being. The average output ratings from Matrix A were then multiplied by the average output ratings from Matrix B to obtain a gross rating (Matrix C). Since the primary vector for the environmental elements were common to both Matrices, a comparative measure of the systems' components acting through the environmental changes on the human dimensions was obtained. The comparative measure or gross rating was then adjusted by a value vector (see Table C-IV-3) to reflect the relative socio-environmental worth (importance) of each of the 19 human dimensions. The gross ratings of Matrix C when multiplied by the value weightings, Vector V, produced an adjusted series of ratings for both the individual components and aggregate alternatives.

The evaluation teams which performed the assessment established value weighting constants which represented their opinion as to which human activities are of more relative "value" than other activities. Briefly summated then, the evaluation procedure attached numerical ratings to alternative wastewater management systems and their components by first identifying the impacts on environmental elements, then determining how this affects human activities, and finally ascribing a "value" or significance weighting to those effects. It should be noted, however, that the evaluation was based on "hard" engineering data. This supportive data included alternative descriptions and graphics and system specifications. These specifications presented information on the physical (resource) requirements and outputs of each alternative.

Since inputs to the developed impact analysis formula shown below were largely judgmental, the numbers produced were used with judgment, primarily

IMPACT ANALYSIS FORMULA

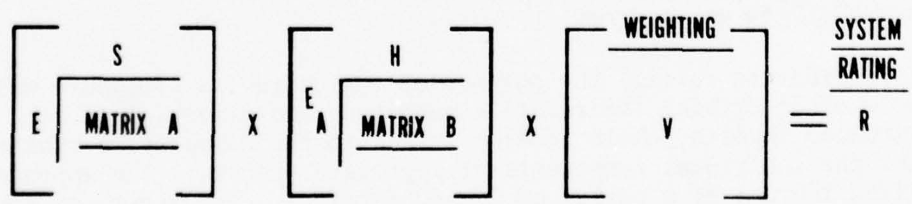


TABLE C-IV-1

MATRIX A
SOCIO - ENVIRONMENTAL IMPACT ANALYSIS

VECTOR E
ENVIRONMENTAL ELEMENTS

1. Surface Water Quality
2. Surface Water Quantity
3. Subsurface Water Quality
4. Subsurface Water Quantity
5. Air Quality
6. Sensory Quality of the Environment
7. Present Land Use and Facilities
8. Potential Land Use and Facilities
9. Soil Quality
10. Mineral Resources
11. Energy
12. Access
13. Biotic Communities
14. Unique or Rare Things

VECTOR S
SYSTEM ELEMENTS

1. Collection, Transportation, & Storage of Wastewater
2. Treatment Facilities
3. Treatment Process(es)
4. Liquid Effluent & Reuse
5. Sludge Management
6. Synergisms (add-on programs)

TABLE C-IV-2

MATRIX B
SOCIO - ENVIRONMENTAL IMPACT ANALYSIS

VECTOR E ENVIRONMENTAL ELEMENTS	VECTOR H HUMAN ACTIVITIES
1. Surface Water Quality	1. Commercial Production
2. Surface Water Quantity	2. Industrial Production
3. Subsurface Water Quality	3. Food Production
4. Subsurface Water Quantity	4. Construction Services
5. Air Quality	5. Public Service
6. Sensory Quality of the Environment	6. Private Service
7. Present Land Use and Facilities	7. Residential Activity
8. Potential Land Use and Facilities	8. Migration
9. Soil Quality	9. Population Density
10. Mineral Resources	10. Health & Safety
11. Energy	11. Employment
12. Access	12. Income
13. Biotic Communities	13. Cultural/Educational
14. Unique or Rare Things	14. Public Finance
	15. Recreation
	16. Aesthetics
	17. Ecosystem Status
	18. Political
	19. Sociological

TABLE C-IV-3

HUMAN FACTORS WEIGHTS
SOCIO - ENVIRONMENTAL IMPACT ANALYSIS

Factors	Weights*
Aesthetic	2.8
Health and Safety	2.7
Ecosystem Status	2.5
Recreation	2.4
Cultural/Educational	2.4
Public Service	2.1
Employment	2.1
Public Finance	1.9
Income	1.7
Commercial Production	1.7
Food Production	1.6
Private Service	1.3
Residential Activity	1.3
Community Social Structure	1.1
Construction Services	.8
Community Political Structure	.7
Industrial Production	.6
Immigration	-1.5
Population Density	-1.9

*Weighting values established by evaluation teams.

on a relative or comparative basis. Included with this rating system was the supplemental written analysis that identified the major impacts of the system components on the environmental elements and the human dimensions. This supplement, together with the debriefing sessions which followed each assessment, served not only to explain the results of the analysis, but also served as the basis for modifying system design.

A more detailed explanation of the methodology is presented in Appendix E.

INSTITUTIONAL STUDIES

PURPOSE

The basic purpose of this aspect of the study was to determine the institutional arrangements that would be necessary before any of the alternative wastewater management systems could be implemented. In so doing, the assessment underscored the institutional concerns that would have to be considered from an operational and management standpoint. To obtain this information and incorporate it into the planning process, data concerning existing institutions in the region was needed; selected criteria had to be established by which to characterize the organizational qualities considered necessary if the financial and managerial responsibilities required by the new quality standards were to be met; and the types of arrangements which could be considered for either modifying existing institutions or establishing new institutions had to be generally described.

INSTITUTIONAL BASE DATA

The institutional base data was published in report form. The report entitled "Evaluation of Institutional, Financial and Manpower Factors" presented a cross section of the state, regional and local institutions directly or indirectly involved in wastewater management. The report characterized the organizations in terms of types of institutions, their geographic (service area) constraints and their authority and functions; discussed the flexibility of the institutions' revenue sources by identifying their financing methods, restrictions, and allowances; described the elements affecting manpower availability such as job regulations, training opportunities and certification, compensation, job image and career ladders; and identified the existing manpower situation in these institutions. This data subsequently served as one of the bases for assessing the institutional implications of the various alternative systems considered during the study.

INSTITUTIONAL QUALITIES

A list of institutional qualities considered necessary to meet the new financial and organizational requirements imposed by system operations was prepared. In effect, the list served to help identify the institutional problems and direct attention to these arrangements which should be considered in: (1) either modifying existing wastewater management institutions and/or (2) establishing new institutions for the study area. In preparing the list, it was recognized that the qualities were not completely compatible with one another in all circumstances. The qualities, however, did represent general needs for institutional viability which must be weighted to satisfy overall objectives. Basically, the institutional qualities were categorized into three broad areas: economic, administrative and political. Involved were the concerns for institutional ability to: accommodate change; have an adequate financial base together with control for operation and enforcement; and be politically accountable and responsive to the public interest.

INSTITUTIONAL ANALYSIS

The institutional requirements imposed by alternative systems were determined and the capability of existing institutions to meet these requirements was assessed. This assessment was carried out concurrently with the refinement of the technical solutions. Institutional constraints were not applied during the development of the initial alternatives in order to totally assess the advantages or disadvantages of regional planning and economies of scale. The institutional problems inherent in these and other aspects, however, were evaluated during the plan-formulation process. The results were then utilized for both the screening of alternatives and for modification of system design.

Pertinent information concerning the institutional aspects of the study, particularly the alternatives retained for final study, are contained in Appendix F.

PUBLIC INVOLVEMENT

The purpose of the public involvement program was to assure participation by the area's residents in the plan-formulation and review process of the alternative wastewater management systems. The nature and extent of the public participation program is discussed in the following paragraphs. There were basically three major categories of involvement: Public Meetings, Citizens Advisory Committees and Work Groups, and organizational and media briefings. "Public" in the sense used here includes governmental or private agencies, organizations, groups, or individuals other than Corps personnel and its consultants.

Transcripts of the public meetings have been made and are on file in the Chicago District Office for review. Details of the entire public participation effort are summarized in Appendix H.

PUBLIC MEETINGS

Three public meetings were scheduled to be held during the course of the study, the final not being held until completion of the study effort. Because of the interstate nature of the C-SELM area, separate meetings were held in each State during the planning process. In each case, the notice of public meetings were widely distributed to all known interested parties in order to provide for the broadest possible presence of the interested public.

The initial public meetings were held on 29 February 1972 in Illinois, and on 7 March 1972 in Indiana. The general approach of the planning process was presented to help the public understand the scope of study, the need for involvement, the general time frame of the study effort, and how the planning service could be of use to the local governmental agencies and area residents. During the second set of public meetings, the intermediate set of alternatives were presented. The presentation involved a level of detail that allowed the various segments of the public to see how they may be affected. These second group of meetings were held on 14 September 1972 in Indiana, and on 18 September 1972 in Illinois. The types of information presented included: (1) The major impacts of the various alternative systems on local areas, identified by use of maps and visual aids; (2) the effects of the alternatives on the planning objectives of the region; (3) explanation of plant and land treatment technologies; (4) the type of institutional arrangements required for implementation; and (5) the comparative impacts imposed by the plant and land treatment systems in both the study and outlying area. All of the systems received equal emphasis in presentation, although not in response.

Subsequent to the general public meetings held in September 1972, the planning criteria used to design the land treatment system were significantly changed. The changes reflected the concern raised by both the socio-environmental evaluators and the residents in the land site areas. Although the alternatives under consideration included variations of the three treatment technologies, it was Land treatment that became the subject of most questions and public concern. In response to this concern the Chicago District subsequently held a series of public meetings in each of the three basic agricultural areas that could be affected if some form of the land system were to be implemented. These were held after the land system design had been revised. The meetings were held on 12 March 1973 in Joliet, Illinois, 14 March 1973 in Woodstock, Illinois, 15 March 1973 in DeMotte, Indiana and 3 April 1973 in Watseka, Illinois. The primary purpose of these meetings was to ascertain the viewpoints of the agricultural community in regard to the potential use of their lands for treatment of wastewater from the C-SELM area. Consequently, these meetings were basically confined to explaining how the land treatment systems would work and how it could affect the existing life style of the agricultural community.

CITIZENS ADVISORY COMMITTEES AND WORK GROUPS

On-going communication had to be established with key institutions and various civic interest groups to supplement the public meetings. The representatives of these entities provided the degree of close coordination that was necessary in the planning process. There were numerous forms by which the coordination was affected, including advisory groups, workshop sessions, technical and non-technical conferences, and individual meetings with various civic organizations. The intent was basically to keep all key civic groups informed of the study effort and in turn receive inputs for continual refinement of the alternatives.

A so-called "Steering Committee" was formed to better organize the interagency relationship between the Federal, State and major local agencies. The role of this committee was to insure better communication and exchange of agency viewpoints, particularly those involved directly or indirectly with wastewater management. Committee membership included representatives from those Federal and State agencies concerned with water resources, environmental quality protection, and public health; multiple governmental levels of planning, public works, and transportation agencies; major sanitary districts; and key civil action groups. The committee meetings did not replace, but only supplemented the normal channels of inter-agency communications.

A Local Planning Organization and Sanitary Districts Advisory Committee was organized to involve local agencies in the planning and screening processes. In this way, the viewpoint and expertise of the membership in making known its position on all issues, provided needed input and assisted in the conduct of the study. The committee included representatives from County Council of Governments, Planning, Public Works, and Sanitary Agencies, City and Town Treatment Facility Managers and representation of the Illinois State Office of Planning and Analysis, Indiana State Budget Agency, Illinois Association of Sanitary Districts, and the Illinois Section of the American Society of Planning Officials.

A Commerce and Industry Citizens Advisory Committee also was organized to facilitate working directly with the major commercial and industrial entities in the study area, particularly those directly or indirectly concerned with water and land usage. The role of the committee was two-fold: one to present the viewpoint of the membership, making known its position on all issues; and to provide specific design input required for the conduct of the study. In providing study input, members of the committee assisted the Corps in projecting trends in commercial and industrial water usage and recycling, on-site wastewater treatment, sludge disposal, and the economics implicit therein. The committee included representatives from the steel, oil, coal, gas and manufacturing industries, investment, finance and merchandising firms as well as engineering and industrial development organizations.

A Conservation and Environmental Interests Citizens Advisory Committee was formed to obtain input from those citizens concerned with conservation, recreation and enhancement of the environment. The role of the committee was two-fold: to make known its position on all issues; and to provide information on which to base conservation-related programs. In regards to the latter role, an Ad-Hoc subcommittee was formed which assisted in the preparation of a prototype model for the enhancement and wise use of the flood plain and adjacent lands. This substudy addressed the concern as to the future use of these lands once the (flood) control of surface runoff as a point source of pollution was achieved. This type of program would be supplemental to the structural improvement required for the technical water quality goals and would provide an effective balance in the development of the area's water and land related resources. The composition of the committee include representatives from national, regional and local environmental and conservation groups, women's and students' organizations, wildlife and recreation federations and coalitions, and concerned individuals.

Separate work groups were formed in each of the three basic agricultural areas. Each included a cross-section of the agricultural community. Formation of those work groups was delayed until the planning process had reached the stage of identifying the specific area's warranting detailed study. To facilitate the work groups involvement, a paper was prepared entitled "The Use of Land As A Method of Treating Wastewater (Its Meaning to the Agricultural Community)". A revised version of this paper is contained in the Annex to Appendix B. The paper explained the design concepts of the land treatment technology and illustratively demonstrated how the system could be operated if implemented. The role of the work groups was to make known area's concern relative to the design of Land treatment system and to help assess the impact on the life style of the agricultural area. The composition of the work groups included representatives from the U.S. Soil Conservation Service, State Departments of Agriculture, Soil and Water Conservation Districts, State Agricultural Extension Services, farm bureaus, county boards, planning commissions, health departments, State universities, environmental organizations, financial interests, news media, and individual farmers.

ORGANIZATIONAL AND MEDIA BRIEFINGS

During the study period, formal coordination meetings took place with a large number of Federal, State, regional and local agencies. These meetings can be divided into three major categories: (1) Briefings at various study stages and exchange of information; (2) Coordination on resource development and recreation; and (3) Technical discussions of plans and disposal systems. The degree of coordination and cooperation varied considerably, depending upon the interest and manpower capability of the particular agency.

Concurrently, special efforts were made to keep the public informed via the communication media. This involved press briefings and participation in radio and television programs. Individual presentations concerning the study also were given in response to invitations from a wide range of local organizations. All of the above took place in addition to the Advisory Committees and Agricultural Work Group meetings.

SECTION V - PLAN FORMULATION, INITIAL STAGE

STRATEGY CONSIDERATIONS

In compliance with the study's technical goal and Congressional directives, since reinforced by PL 92-500, major emphasis was placed on the design of alternative systems to meet the NDCP objectives. At the same time, plans were formulated to meet current standards. The latter would also serve as a comparative base for evaluating the socio-environmental, institutional, and resource implications associated with the national NDCP goals.

The plans to meet existing water quality standards were predicated on: (1) accepting those improvements which were at or near the drawing board stage as firm elements of the base plan; (2) examining State and/or local proposals for future implementation and modification of the existing system; and then (3) develop an optimum plan(s), incorporating the concepts of regionalization (economies of scale) and effluent (treated water) reuse potential consistent with the identified need categories. In this way the study could identify opportunities for improving current plans without adversely impacting on the on-going programs.

BASIS FOR SELECTION OF ALTERNATIVES

Special effort was made to insure that the plan-formulation procedure for the NDCP alternatives was totally uncommited to any specific design approach. To do this, the initial set of alternatives were structured to help establish pertinent planning and design parameters. Consequently, the specifications for the initial alternatives were derived from a "decision-making matrix". This matrix was constructed to facilitate comparisons of changes in the system's key components, thereby permitting an analysis of the most effective manner in which to achieve the component's function.

To determine the number and characteristics of the initial alternatives, the functional components of a wastewater management system were defined and considered together with key secondary planning factors. The key system components included the functional requirements of collection facilities, treatment processes, and the handling and management systems for residual wastes. The secondary factors selected as significant design considerations were regionalization (economies of scale), conservation (recycling) of industrial processing water, water reuse to satisfy local needs, and specific resource philosophies such as greenbelts to reflect local planning goals. These factors, in essence, provided the framework for the basic "decision-making" matrix. See Figure C-V-1.

DECISION-MAKING MATRIX FRAMEWORK

Alternative Systems (Number)	QUALITY STANDARD & TECHNOLOGY				
	Current		N D C P		
		PLANT			
System Criteria	Conventional Biological	Advanced Biological	Physical Chemical	Land	NEW SYSTEM CONCEPTS
Level of Treatment					
Treatment Technology					
Collection System					
Regionalization					
Water Reuse					
Residual (Sludge) Reuse					

FIGURE C-V-1

INITIAL MATRIX CRITERIA

Based on the foregoing, the criteria for meaningful differentiation between alternative systems were developed in detail. These criteria (independent variables or significant planning options) and the rationale used to constrain or eliminate those not used in the matrix are listed below:

A. Level of Treatment - Effluent Quality Goal

1. Current Standards

2. No Discharge of Critical Pollutants

   a. Direct - Designed to achieve immediate attainment of NDCP standard.

   b. Phased - Initial upgrading to existing standards, then proceeding to achieve higher quality goals. This criterion was considered a refinement applicable to all NDCP alternatives and not a differentiating factor. Therefore, it was eliminated from inclusion in the matrix.

B. Treatment Technology

1. Current Standards - Conventional Biological Treatment Plants

2. No Discharge of Critical Pollutants

   a. Advanced Waste Treatment (AWT) Plants - Advanced Biological and Physical-Chemical.

   b. Land Treatment (AWT) Facility - All effluent will have received the equivalent of secondary treatment before being applied to the land.

C. Water Reuse - Direction of Emphasis toward reuse optimization

1. No recycling, no reuse - This criterion was not to be used for differentiation since it is contrary to current trends and, thus, was eliminated from inclusion in the matrix.

2. Maximum utilization of reuse potential of the final effluent.

   a. Maximum utilization of the recycling potential (primarily industrial) only. This criterion is reflective of conditions under current treatment standards, but not applicable as a differentiating factor for the NDCP alternatives.

b. Maximum utilization of recycling and the reuse potential of the final effluent. This criterion retained as a constant for all NDCP alternatives since it is responsive to the intent of PL 92-500.

D. Economy of Scale - Regionalization

1. Maximum consideration of existing institutional arrangements and proposals for consolidation of treatment facilities

2. Disregarding existing institutional arrangement and providing consolidation of facilities

   a. Within state boundaries only.

   b. Within entire study area.

E. Collection System - direction of emphasis according to source

1. All-combined sewer system. This criterion was not used to differentiate between systems designed to meet current standards since the need for storm water capture and treatment was not specifically required.

2. Retention of the present (and proposed) combined sewer facilities. In all new facilities, storm water collection to be separate from domestic or industrial wastes. Implicit in this NDCP criterion is that no rural storm runoff will enter the collection system.

3. Elimination of all or most of the combined sewer facilities. This criterion is not to be used for differentiation. The combined sewers are located in urban areas and restructuring sewer systems obviously would be too costly and the socio-environmental impact too severe.

F. Non-Structural Elements - Direction of emphasis for their employment

1. Employment of existing non-structural elements only

2. Maximum utilization of all reasonable non-structural approaches. This category was dropped as a differential between alternatives. Instead, it was decided to incorporate the non-structural considerations as part of the system design and/or as an add-on program to the wastewater system.

G. Sludge Management

1. Emphasis on current sludge handling and disposal methods

2. Emphasis on the "Liquid Fertilizer" concept

3. Emphasis on recovery (conservation of resources) of all recoverable sludge constituents. This category was also dropped as a differential between alternatives. Instead the sludge management proposals were incorporated as add-on options to the individual alternatives and evaluated separately.

H. New System Concepts - Synergisms

1. Emphasis on utilizing the "Synergistic Linkages" concept (implies use of influent and of treated wastewater at various stages of treatment up to but not including final effluent)

   a. Cooling water service to thermal and/or nuclear power generating facilities by wastewater system

   b. Relief of rural storm water problem through simultaneous flood relief, low flow augmentation and aquifer recharge

2. Emphasis on utilization of the "Limited Access Sewer" or "finger plan" concept developed by the regional planning agency (NIPC) as a means of providing open space and recreational lands

3. Emphasis on utilization of the "Cluster System" concept involving multiple usage of (existing) facilities as base treatment points to advanced treatment plant(s).

All of Criteria "H" were removed from consideration as variables in constructing specifications for the initial set of alternatives. Instead, it was decided that some of the synergisms could be better incorporated as separable features of system design or as add-on programs.

FINAL MATRIX CRITERIA

Based on the above, the eight main criteria (A through H) were reduced to five. Further reductions of variables within each category resulted in the following plan formulation criteria being used to determine the initial set of alternatives:

A. Level of Treatment - Effluent Quality Goal.

1. Existing standards.

2. No discharge of critical pollutants.

B. Treatment Technology (NDCP only).

1. Advanced Waste Treatment (AWT) Plants.

   a. Physical-Chemical Technology.

   b. Advanced Biological Technology.

2. Land Treatment.

C. Reuse.

1. Recycle only. (current standards only)

2. Recycle and Reuse.

   a. Option No. 1 for reuse (transport of treated water to reuse centers by pipeline.

   b. Option No. 2 for reuse (transport of treated water to reuse centers by stream and pipeline).

D. Regionalization - Economy of Scale.

1. Existing institutional constraints.

2. Regionalization:

   a. AWT Plants: Regionalization within County boundaries
      Land Treatment: 3 sites.

   b. AWT Plants: Regionalization within State boundaries.
      Land Treatment: 1 site.

E. Collection System.

1. Combined Sewer.

2. Separate Sewer.

3. Combination of Separate and combined sewer.

SELECTION OF ALTERNATIVES

The foregoing criteria significantly reduce the number of alternatives systems which could be formed. They would be different from each other by a minimum of one and a maximum of five variables. However, maximum diversity even with this reduced criteria would still require too large a number of systems. In order to further reduce this number, additional logic was applied. The system specifications used to form what ultimately proved to be 17 conceptually different alternatives, are displayed in Table C-V-1. Also shown are the minor variables not identified in the following logic discussion:

TABLE C-V-1

KEY COMPONENTS OF THE INITIAL ALTERNATIVES

Alt. No.	Effluent Quality Goal: Exist.	Effluent Quality Goal: NDCP a/	Treatment Technology b/: Adv. Biol.	Treatment Technology b/: Adv. P.-C.	Treatment Technology b/: Land	Economy of Scale: Max.	Economy of Scale: Interm.	Economy of Scale: Min.	Collection System: Comb.	Collection System: Separ.	Reuse c/	Sludge Management: Type	Sludge Management: Not Incl.	Sludge Management: Incl. but Separate	Design Emphasis & Remarks
1	x		x					x	x &	x	Incidental	Current practice			Existing Regional Plans
2	x		x			x			x &	x	Maximum	Current practice			Exist. Reg. Plans, modified for maximum reuse and economy
3		x	x			*		*	x		Incremental add-on (option 2)		x	*	*Max. for centralized AWT facilities, min. for existing reg. plans for secondary treatm. fac.
4		x	x &	x			x		x		"	Variety of techn.			
5		x	x &	x		x			x		"	"			
6		x	x or	x		x			x &	x	"		x		
7		x	x or	x			x		x		Maximum (option 1)		x		Plant location controlled by reuse considerations
8		x	x or	x			x		x		Maximum (option 2)		x		
9		x	x or	x		x			x		Maximum (option 1)		x		" "
10		x	x or	x		x			x		Maximum (option 2)		x		" "
11		x			x		x		x		Inc. add-on (option 2)			x	3 land sites
12		x			x	x			x		"			x	1 land site
13		x	x or	x	x		x		x		"			*	*Land treatment sludge only. 1 land site plus 2 treatm. plants
14		x	x or	x		x			x		"		x		Max. consideration of "Finger Plan" concept
15		x			x		x		x		"			x	3 land sites; Max. consideration of "Finger Plan" concept
16		x			x		x		x		"			x	3 land sites; integrated facilities (power generation & heat dissipation, pumped storage)
17		x			x	x			x		"			x	1 land site; integrated facilities (as above)

Notes: a/ All alternatives designed for "No discharge of critical pollutants" (NDCP) include capture and treatment of storm water flows.

b/ Choice of Advanced Biological (Adv. Biol.) or Advanced Physical-Chemical (Adv. P.-C.) treatment technology for Alternatives 6 - 10 and 13 - 14 is based on cost-effectiveness analysis of Alternatives 4 & 5. Conventional Biological treatment used for existing standard alternatives.

c/ Level of water reuse for need satisfaction is the same for all NDCP alternatives. Differentiation pertains to how needs are integrated into design, either as a major factor in locating facilities or by incremental add-ons as a consequence of facilities locations. Options 1 and 2 pertain to the manner in which top priority reuse needs are satisfied.

CURRENT TREATMENT STANDARDS

Develop two alternatives to meet current water quality standards. Alternative 1 assumes the number and location of treatment plants (64) provided for in existing regional plans, extended to meet 2020 conditions. Alternative 2 in contrast with Alternative 1 was designed to determine if economies and other beneficial effects could be achieved through consolidation (regionalization) of treatment plants (41) and implementation of recycling opportunities.

Most of the industrial wastewater volume generated within the study area is discharged back into the watercourses rather than the municipal sewers. This practice would be expected to continue if current standards were to be retained as the governing water quality goals. Even so, industry would have to upgrade its treatment and incorporate these facilities into their manufacturing processes. This would include expanding the current trend of recycling the wastewater which not only reduces the water volume used, but also the cost of treatment. Where, however, existing plans call for collection systems to capture municipal and industrial wastes and storm water flows, these were retained for both alternatives. Separate collection systems were provided for developing areas with treatment of the municipal and industrial wastes only.

NDCP TREATMENT LEVEL

Plant Technologies

Develop eight alternatives employing the treatment plant technologies. Alternatives 3, 4 and 5 utilized combined collection systems for conveyance of storm water and wastewater to the treatment plants or storage facilities. In Alternative 3, the 64 plant scheme of Alternative 1 was upgraded to the NDCP treatment level using the Advanced Biological treatment process.

An intermediate 17 plant scheme was developed for Alternative 4 while a minimum 8 plant layout was utilized in Alternative 5. Both Advanced Biological and Physical-Chemical treatment processes were alternately analyzed for the two alternatives. Also developed were a variety of sludge management systems including agricultural utilization, land reclamation and incineration. A cost evaluation of the three alternatives was designed to demonstrate the comparability between regionalization, treatment technology, and sludge management practices.

Alternative 6 was directly comparable with the more economical treatment technology option identified in Alternative 5 with the exception that the collection and treatment systems for wastewater and storm water flows were kept separate for those areas that are presently serviced by separate collection systems. Thus, the cost comparability of a separate versus combined collection and treatment system was illustrated by comparison of Alternatives 5 and 6.

Alternatives 7, 8, 9 and 10 were basically the same as the cost preferred treatment technology option for Alternatives 4 and 5, respectively. However, the plant sites were located relative to the reuse areas for water supply and in-stream purposes of navigation and recreation.

Land Technology

Develop two alternatives using the land technology and one alternative which employs a combination of land and plant technologies. Alternatives 11 and 12 were designed to demonstrate the effects of economies of scale (consolidation) of land treatment sites and a comparison in cost-effectiveness between the plant and land treatment technology. Combined collection and storm water storage systems were utilized with sludge disposal (agricultural usage) within site boundaries.

Alternative 13 was directly comparable to Alternative 11 in all respects except that it involved the use of land as a supplement to the area's larger key plants. Thus, the alternatives provide a comparative basis for evaluating both the cost-effectiveness of the treatment process and the potential for using a combination of technologies.

Synergisms

Alternative 14 and 15 were designed to determine the feasibility and cost effect on system design as a result of designing a collection system that physically follows the finger-plan of development for the Chicago Metropolitan Area as proposed by the Northeastern Illinois Planning Commission. The concept of these plans would be to foster growth along the major transportation corridors (fingers) thereby using the area's in between as open-space recreational lands.

Alternatives 16 and 17 were directly comparable to Alternative 11 and 12 except for the synergistic use of the land system's storage lagoons as sources for generating pumped storage energy and the dissipation of waste heat from conventional power stations. Site restrictions precluded similar considerations for the treatment plant processes. The comparison between these sets of alternatives was intended to illustrate the cost comparability and potential for co-siting.

ADDITIONAL ALTERNATIVES

During the course of developing the detailed specifications, two more were added resulting in a total of 19 initial wastewater management alternatives.

The two additional alternatives employed the land treatment technology in conjunction with the Northeastern Illinois Planning Commission open space finger plan. Both were formulated to explore the potential economies in using the open-space "finger" areas for treatment of wastewater (primarily storm water) as well as for recreational usage. The amount of wastewater to be treated was limited and applied only at night; the day being reserved for public uses. Open space needs were projected and large acreage defined within the study area which could be utilized for treating the selected portion of the projected wastewater flows. In Alternative 18, the remaining untreated flows were conveyed to a single land site. In Alternative 19, multiple land treatment sites were used with the remaining flows transported to the outlying agricultural areas located at the extensions of the open space "finger" areas.

Table C-V-2 summates the key components and comparative relationships of the 19 initial wastewater management alternatives.

FIRST STAGE PERSPECTIVE

Pertinent information and graphics regarding the nineteen initial alternatives were furnished to the members of the Citizens Advisory Committees and Evaluation Contractors (under contract to the Chicago District) in the form of a report entitled: "Wastewater Management Study, Chicago-South End of Lake Michigan Area, Progress Report No. 2."

This publication contained considerable data on the basis of design and engineering details concerning treatment technologies, sludge management, conveyance systems, storm water provisions, flow projections, reuse of reclaimed water, synergistic effects, and the cost of the alternatives, including cost basis and cost of alternative components.

The main intent in formulating the initial set of alternatives was to establish meaningful criteria for differentiating between any wastewater management system. The planning concepts along with the design criteria were the main considerations. The technical, reuse, and conservation issues and add-on potentials were the bases with which the analyses were made.

WATER QUALITY GOALS AND TREATMENT

To achieve the equivalent of the NDCP water quality goals, the cost of industrial pre-treatment will be materially increased. There are potential savings possible, however, if industry was to discharge its recycled wastewater into the regional system. This was the assumption used for the design of the NDCP systems. Under this situation, industry would still be required to pre-treat its wastewater but would rely on the regional treatment plant to provide "final" treatment.

TABLE C-V-2

COMPARATIVE SUMMARY - INITIAL ALTERNATIVES

Alt. No.	Effluent Quality		Treatment			Regionalization (No. of Plants)			Collection System		Reuse of Water	Remarks	Comparative Relationships
	Exist.	NDCP	Adv. Bio.	Adv. P-C	Land	Min.	Int.	Max.	Comb.	Sep.			
1	x		x					x	x &	x	Curr.	Exist. Plans	Evaluate potential for economies in scale and reuse where feasible.
2	x		x			x			x &	x	Max.	Modified Base	
3		x	x					x	x		Add-on		Evaluate potential economies due to differences in plant technologies and degree of regionalization. Assess options for sludge management for each plant technology.
4		x	x &	x			x		x		Add-on	Sludge Manag. Alts.	
5		x	x &	x		x			x		Add-on	Sludge Manag. Alts.	
6		x	x or	x		x			x &	x	Add-on	Collection Manag. Options	Evaluate worth of combining or maintaining separate municipal and storm water collection systems.
7		x	x or	x			x		x		Opt. 1	Reuse Options	Evaluate method of redistributing the treated water to the reuse centers. Assess the implication of siting the plants relative to reuse centers.
8		x	x or	x			x		x		Opt. 2	Reuse Options	
9		x	x or	x		x			x		Opt. 1	Reuse Options	
10		x	x or	x		x			x		Opt. 2	Reuse Options	
11		x			x		x		x		Add-on	3 land sites	Evaluate potential economies from regionalization of the land treatment sites and between the three NDCP technologies.
12		x			x	x			x		Add-on	1 land site	
13		x	x or	x &	x		x		x		Add-on	1 land site, 2 plants	Evaluate potential gain for combining plant and land technology.
14		x	x or	x		x			x		Add-on	NIPC Finger Plan	Evaluate potential gain from restrictive access to collector. Assess potential gain for combining plant and land technologies.
15		x			x		x		x		Add-on	NIPC Finger Plan	
16		x			x		x		x		Add-on	Integrated Power Fac.	Evaluate potential gain from synergism for co-siting power facilities with land treatment facilities.
17		x			x	x			x		Add-on	Integrated Power Fac.	
18		x			x		x		x		Add-on	1 Land Site + Fingers	Evaluate potential gain from open-space synergism. Assess potential for different forms of an all-land treatment system both in and outside study area.
19		x			x		x		x		Add-on	Fingers + Extension	

The comparative analysis between alternatives focused on the differential in capital investment and operating costs between technologies and between different levels of regionalization. Furthermore, the degree of locational impact both within and outside the C-SELM area was of concern. All have impacts on the communities and counties outside the study area; the disposal of sludge being the common external factor. A third factor was the variance and magnitude of other resource commitments. The initial alternatives were designed to provide a framework for subsequent evaluation of this aspect.

MANAGEMENT OPTIONS

Various options for the functional components of sludge disposal, collection and conveyance systems and the reuse of the treated water were also evaluated. Again, the interest was to establish meaningful criteria to differentiate between managerial concepts.

Sludge Management

The sludge disposal programs for the treatment technologies was primarily concerned with two types of residual wastes, biological and physical-chemical. Biological sludges are generated by both the Conventional Biological and Advanced Biological plant processes as well as the Land treatment system. Consequently, the constituencies are similar and the potential for disposal are comparable. On the other hand, sludge from the Physical-Chemical process is chemically inert. This is due to the fact that sludge is incinerated as part of the treatment process in order to recycle the treatment chemicals and partially remove the ammonia nitrogen from the wastewater. However, because of its lime content, the sludge can be used on agricultural lands for soil pH control and as a soil conditioner.

The amount of sludge generated was also a concern. Preliminary evaluations for treatment plants utilizing Advanced Biological treatment processes indicated an expected rate of 1.0 ton of anaerobically digested sludge produced per million gallons of inflow, while Physical-Chemical treatment plants were expected to produce sludge at the rate of 0.5 ton per million gallons of raw sewage treated. Land treatment was expected to produce 0.8 ton of anaerobically stabilized sludge per million gallons of inflow, as are existing Conventional Biological treatment plants.

Based on the foregoing, various options were investigated with respect to their suitability for such sludge management techniques as agricultural utilization, land reclamation, land fill, and incineration. The potential sites suitable for each option were located both inside and outside of the C-SELM area. The applicable land disposal sites, management methods and treatment plant sludge types considered are identified in Table C-V-3.

TABLE C-V-3

TREATMENT PLANT SLUDGE MANAGEMENT OPTIONS

Option No.	Type of Sludge	Sludge Utilization	Sites of Application
1	Advanced Biological	Agricultural	Fulton County
2	Advanced Biological	Agricultural	McHenry, Will Counties and Kankakee Area
3	Advanced Biological	Land Reclamation	Southern Illinois
4	Advanced Biological	Incineration	In C-SELM Area
5	Physical-Chemical	Agricultural	Fulton County
6	Physical-Chemical	Agricultural	McHenry, Will Counties and Kankakee Area
7	Physical-Chemical	Landfill	Indiana Quarry Area

Collection and Conveyance Systems

For the purposes of design, management of the storm water runoff in the entire C-SELM area was divided into three categories: urban, suburban, and rural. Where the combined dry weather and storm water collection systems exist, such as for the City of Chicago, Illinois and Gary, Indiana, these were incorporated into the system design of all alternatives. Also included were those improvements being planned to supplement the capacity of the combined systems for the MSDGC area. The geographical area serviced by the combined sewers are shown in Figure C-V-2. A schematic diagram of the urban storm water concept is shown in Figure C-V-3.

In the suburban area, two options were considered. The first involved the installation of sewers to handle the combined overflow of storm water and sewage. The second involved provision of separate collection and conveyance systems. The separate storm water management system included a network of collector lines and storage sites designed on a modular basis to deliver the runoff to the treatment sites or access points of major conveyance systems.

The strategy for the rural area was different. The basic approach was to utilize on-stream impoundments and/or off-stream pit excavations to capture and regulate the storm runoff so that it can be subsequently irrigated (Land treatment system) on adjacent agricultural lands. A schematic diagram of this storm water management concept is shown on Figure C-V-4. Management sites were assumed to be uniformly distributed in the rural areas at the rate of one 1.2 MGD detention pond per 2000 acres. It was assumed that the drainage design for this portion of the region will include local land treatment of the major runoff in order to prevent increased levels of nitrogen and phosphorus being induced into the C-SELM waterways. Suitable retention capacity was included to provide not only an effective flood reduction but also a restricted water-based recreational program.

For the purposes of this study it was assumed that the collection system for municipal and industrial wastewater flows would be extended by local interests to the 64 plants recommended for consolidation by the regional planners. The costs to achieve this base condition, (Alternative No. 1) were not included in this phase of the study. These plants served as terminal points for the collection systems of the storm water runoff and municipal and industrial flows. In addition, these same plants served as access points to and beginning point of the major conveyance systems required for transporting the combined flows to the regional treatment plants. All of the conveyance pipelines and tunnels have been placed within public right-of-ways such as streets, highways and public waterway easements in accordance with current planning and construction procedures. In so doing, it eliminates what would prove to be a costly and time-consuming procedure for obtaining easements and mining rights from an indefinable number of individual property owners.

COMBINED SEWER AREA

Figure C-V-2

URBAN WASTEWATER MANAGEMENT

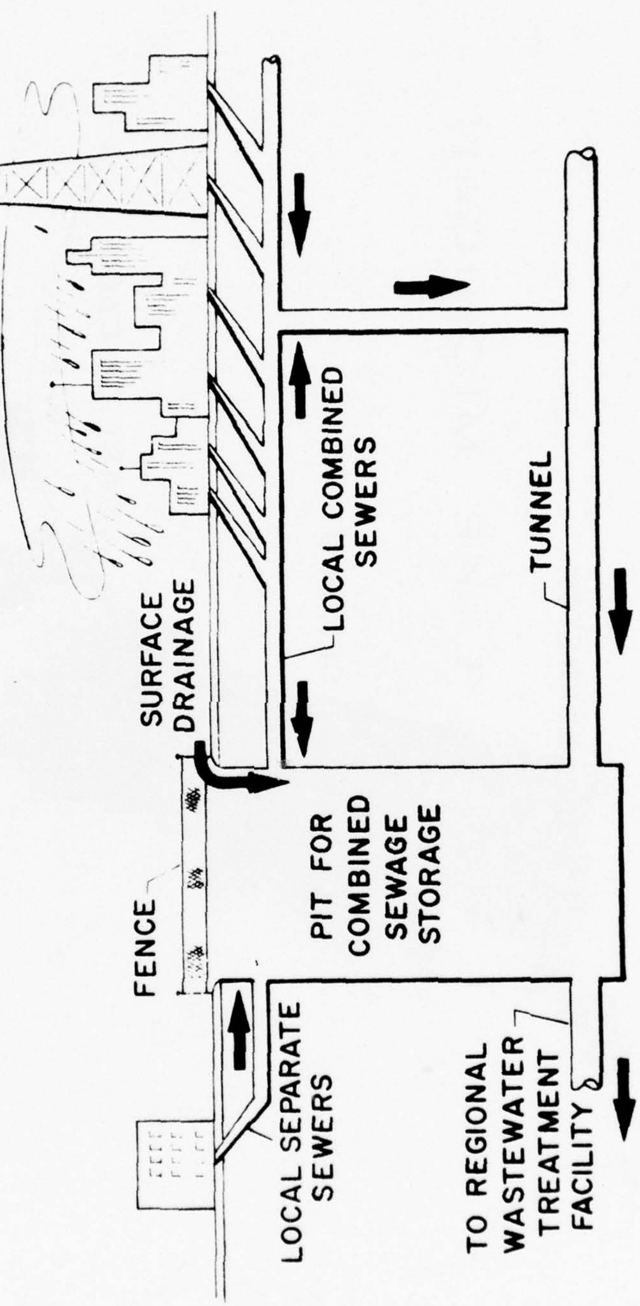


Figure C-V-3

TYPICAL RURAL STORMWATER MANAGEMENT

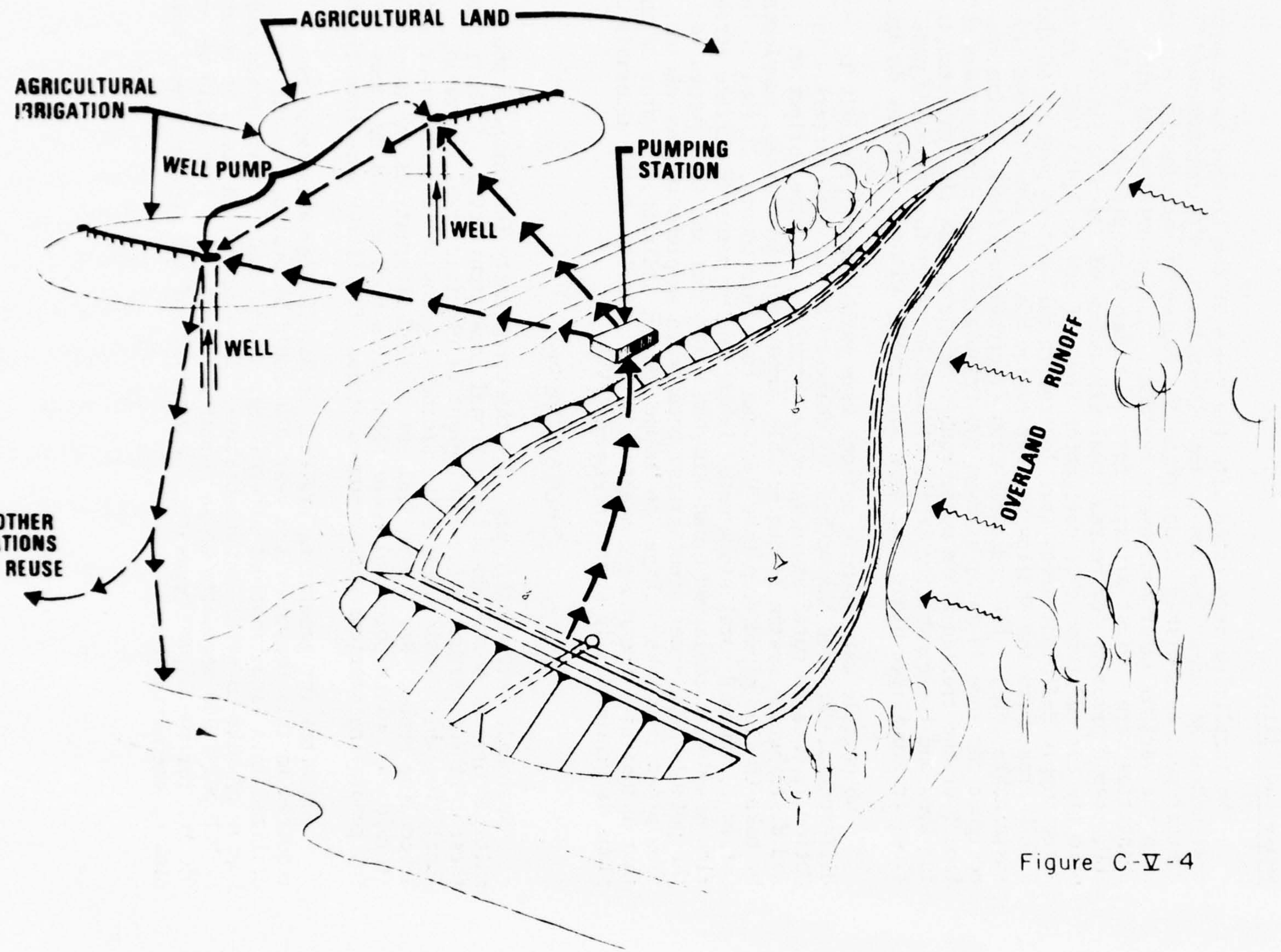


Figure C-V-4

Reuse Facilities

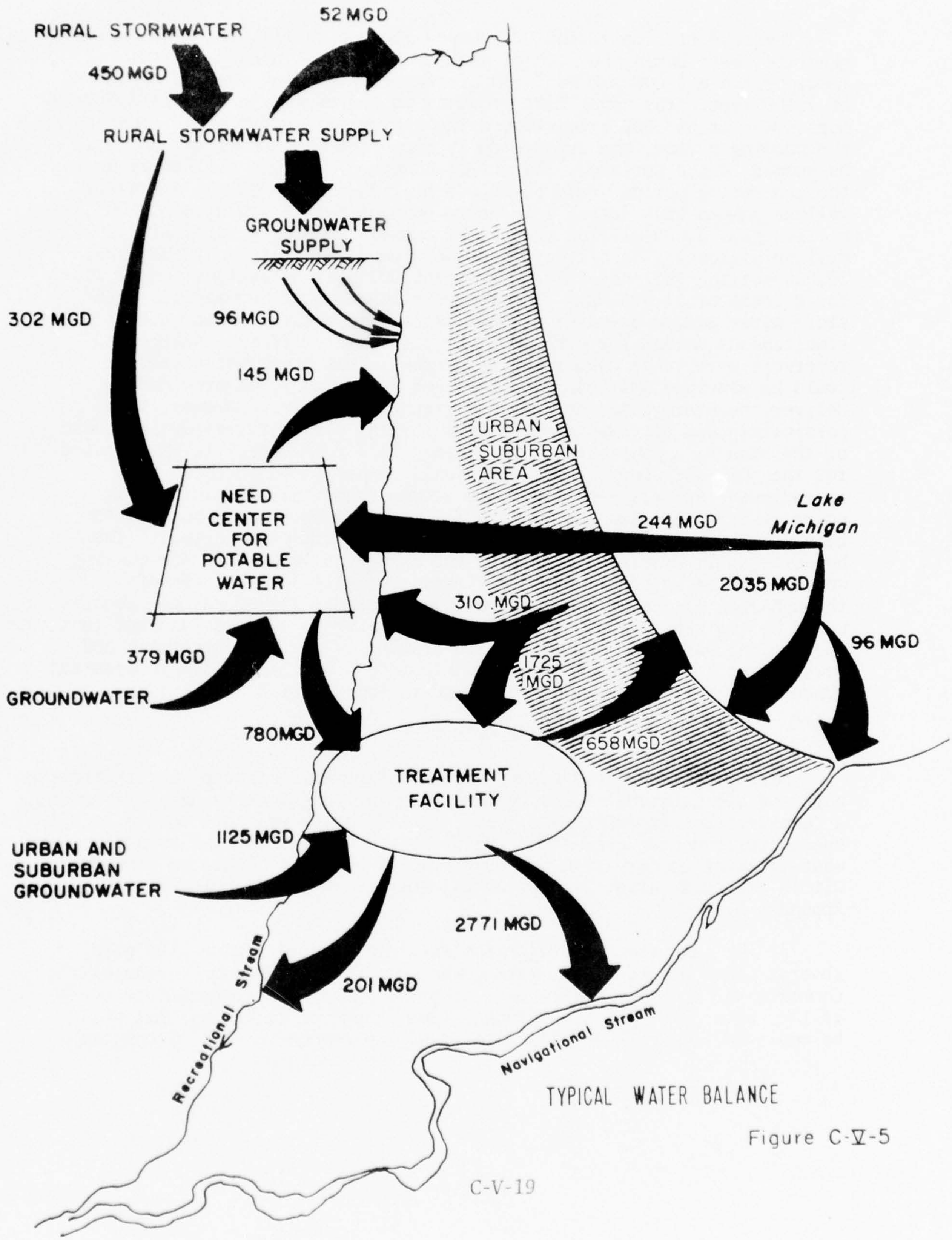
The facilities associated with the reuse of the treated water were designed as an add-on feature to the alternatives. Preliminary need centers were established to determine the degree of satisfaction possible with the various water management regimens. The priorities and water quantities were: First priority for water supply requirements of 546 MGD; second priority for recreational streamflow of 201 MGD; third priority for maintenance of navigation flows of 860 to 3,000 MGD. Potable water supply deficient areas were located in the western portion of the C-SELM area where the shallow aquifer system has been mined beyond its sustainable level. The redistribution (recreational flows) system was designed for some 40 major streams and tributaries. Of interest was the impact of the treated storm water runoff on the stream flow patterns in the area and the capability of the streams to carry the increased peak flows (regionalized plant discharge and runoff) without overbank damage.

Two potable water supply options were established, primarily to differentiate between the methods of delivery to the need centers. In Option 1, managed rural storm water was brought by a pipe collection and distribution system to the potable supply deficient areas, supplemented by make-up flow piped from Lake Michigan to DuPage County, Illinois. In Option 2, managed rural storm water is carried by means of surface streamflow mixed with reclaimed urban-suburban wastewater and then pumped to the potable supply deficient areas; once again supplemented by make-up flow piped from Lake Michigan to DuPage County, Illinois. A water balance that illustrates the reuse concepts, for the majority of the alternative plans is schematically shown in Figure C-V-5

POWER SYNERGISM

Regional system design provides the opportunity for expanded and multiple uses at a reduced but additional investment level. Primary among these is the opportunity for development of electric power generating facilities which would utilize the storage lagoons at land treatment sites as cooling ponds. For the initial set of land alternatives the use of storage lagoons as potential power plant sites both as cooling ponds for the generating stations and/or pumped storage facilities were investigated.

The sites for generating stations of 55,000 megawatts capacity required in this region by the year 2020 could be provided by the land utilized in a land treatment alternative, as could the cooling ponds and the supply of make-up water for evaporation. The evaporation would be about 12 MGD per 1,000 megawatts on an annual average basis. This would be roughly 600 MGD for the 55,000 megawatts, or about 17% of the average annual design flow of the wastewater.



TYPICAL WATER BALANCE

Figure C-V-5

The land site could include pumped storage facilities which would generate power during periods of peak demand. Preliminary designs incorporated a 5,000 MGD or 7,500 cfs capacity pumping station at a head of 1,100 feet. The power corresponding to the energy in time is 1,100,000 horsepower or 865,000 kilowatts, using appropriate efficiency. During the pumping period, the average daily flow from the tunnel system would be pumped to the surface. The actual number of gallons discharged during the generating period would be 10,000 million and the actual number of gallons pumped back during a 16 hours pumping period would be 10,000 million plus 5,000 million gallons of tunnel flow for a total of 15,000 million gallons. The size of the underground reservoir would be about 10,000 million gallons plus 1/3 of the 5,000 million gallons tunnel flow for a total of 11,700 MG. The reservoir space would be used for both storm water and power-water storage as the probability of occurrence of simultaneous demand for both would be very small. If the underground reservoir were to be used for this purpose, less storm water storage could be provided upstream, and a larger tunnel would be provided to deliver the storm water to the underground reservoir. However, this possibility was not evaluated in this initial alternatives' design phase of the study. A power ratio of 3 (used) to 2 (generated) is anticipated for the pump-back operation as is usually experienced in these type operations. Primary benefits would accrue from: (1) obtaining peak power at reduced costs and (2) the internal economies attributable to being able to utilize base load demands during off-peak periods. The benefits attributable to co-siting and using the wastewater for cooling would be based on construction savings. Normally some 1.5 cfs of through-flow is required per kilowatt generated. Therefore, the benefit would be the net savings achieved in not having to buy the land and construct the cooling basins. An illustrative drawing of the land treatment and power plant combination is shown in Figure C-V-6. Background information concerning this synergism may be found in Appendices B and G.

PUBLIC INVOLVEMENT

During this stage of study, various other work efforts were initiated. With the aid Citizens' Advisory Committee for Conservation and Environment, a "Conservation Inventory and Needs" questionnaire was sent out to locally known environmental groups and individuals. The purpose was to determine what types of conservation and recreational programs should be considered within the study area. A copy of the questionnaire is included in Appendix H.

At the same time, coordination was initiated in conjunction with several other programs. A meeting was held with an "Ad Hoc" group of the Commerce and Industry Committee. Of prime interest was the future needs of the area's two major water users and extent of recycling that would be employed if the NDCP goals were to be implemented. Also of concern

LAND TREATMENT - POWER PLANT COMBINATION

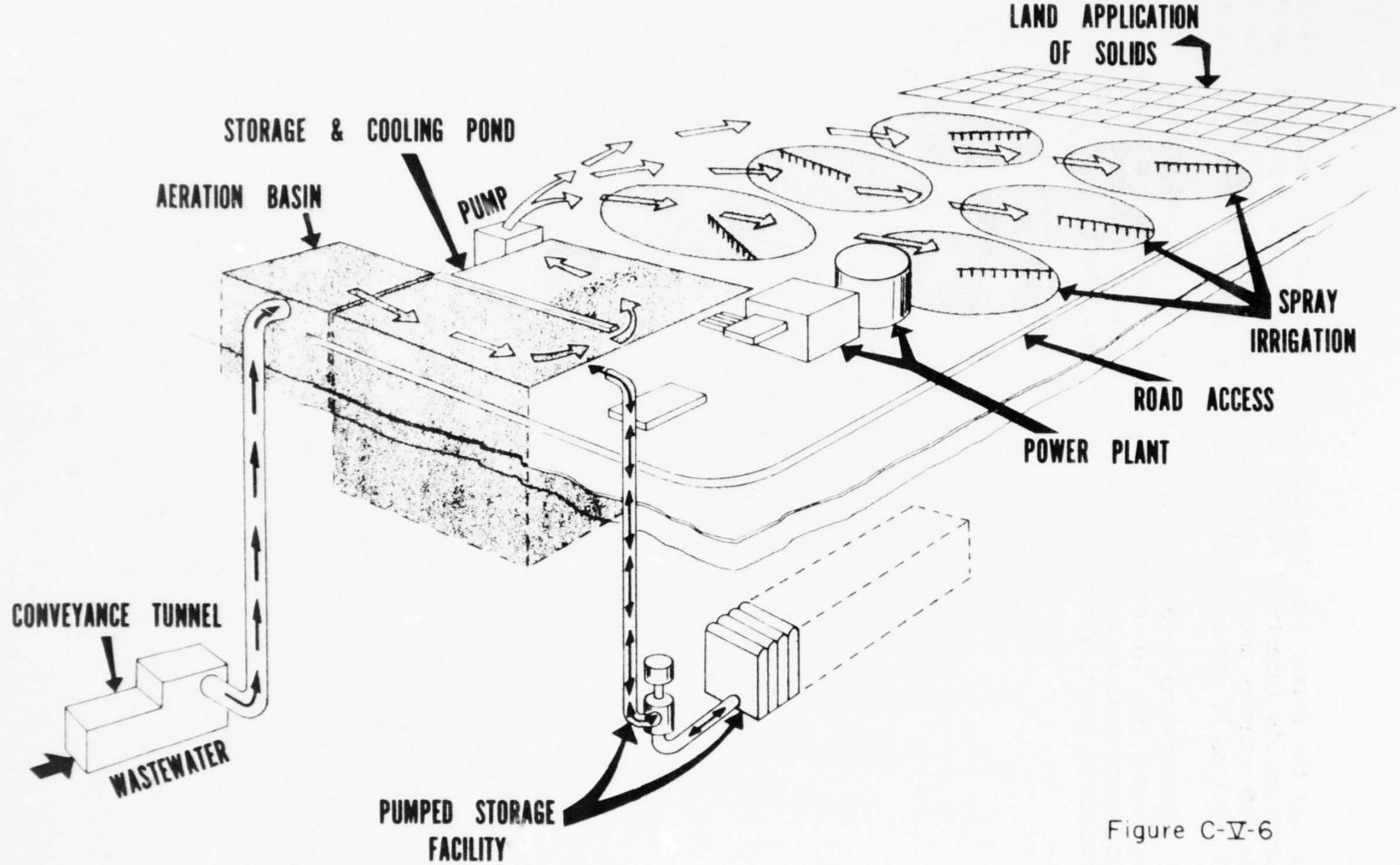


Figure C-V-6

was (1) the feasibility for assuming industry would discharge the blowdown from its industrial process into the municipal system rather than the watercourses and (2) the degree of on-site, pre-treatment that would be required if the regional system was to provide "final" treatment.

Discussions were also initiated with the Mid-West Coal Producers Institute, Inc. concerning the implications involved in the sludge management program for reclamation of surface mined areas. Information concerning possible disposal sites was also sought.

SECTION VI - PLAN-FORMULATION, INTERMEDIATE STAGE

STAGE RELATIONSHIP

In the initial stage of the plan-formulation process, main emphasis was placed on differentiating between the conceptual and functional aspects of the system components on a regional basis. No constraints had been adopted relative to institutional considerations, resource consumption and socio-environmental implications at the local level. Therefore, a redirection in the design and subsequent evaluation was needed. Design of the individual system components were to be refined and redirected to meet the more immediate needs of 1990 as opposed to the year 2020 used in the initial stage. Furthermore, the resource implications had to be assessed as did the impact on the area's social, environmental and economic structures. Land was isolated as the basis of a separate evaluation. Its use impact was multiple, not only in relation to the system components, but also in meeting other local and regional needs. Greater emphasis was also given to the area's water balance including the reuse of the treated water and the use of Lake Michigan as a source of supply. Finally, the economies of scale achievable from regionalization had to be assessed in relation to such associated problems as institutional, operational and geographical (service area) balance. With this in mind, a screening of the initial alternatives was undertaken. Two basic objectives were used: (1) to maintain a diversity in technologies and system management concepts; and (2) to eliminate the more costly and least effective functional system or system elements.

COST COMPARISONS, INITIAL ALTERNATIVES

The following is a summary of the cost relationship among the initial 19 alternatives. It should be noted that the costs are comparative and do not include the base costs which were common to all systems. Shown in Table C-VI-1 is a summary of costs for each of the alternatives. Not all system elements are included in each alternative nor are all comparable as to component function.

EXISTING STANDARD ALTERNATIVES

The reference plan, Alternative 1, has a total annual cost of $385 million. With the increased economy of scale achieved with the screening base, this cost was reduced to $362 million in Alternative 2. This is an indication of the cost savings obtained through greater regionalization. The water reuse option increases this cost about $5 million. Both alternatives lack the level of storm water collection included in the NDCP alternatives.

TABLE C-VI-1
SUMMARY COST TABLE a/
(Initial Stage Alternatives)

No.	Description	Capital Cost b/ Millions of Dollars		Amortization Cost c/ Millions of Dollars/Yr.		Operation & Maintenance Cost Millions of Dollars/Yr.		Replacement Cost Millions of Dollars/Yr.		Total Costs Millions of Dollars	
		w/o Storm Water	w/Storm Water	w/o Storm Water	w/Storm Water	w/o Storm Water	w/Storm Water	w/o Storm Water	w/Storm Water	w/o Storm Water	w/Storm Water
1	Reference Plan	3,261.0	-	216.0	-	146.4	-	23.1	-	385.5	-
2	Modified Plan	3,795.6	-	224.0	-	119.9	-	23.2	-	367.1	-
*3	Maximum Dispersion AWT Plan	6,729.1	10,653.4	397.1	628.7	314.0	410.2	104.3	110.6	815.4	1,149.5
4	Intermediate Dispersion AWT Plan, Biological Treatment Option, Single Sludge site	6,847.5	11,877.2	404.0	700.7	321.7	412.2	103.9	118.0	829.6	1,230.9
4	Intermediate Dispersion AWT Plan, Physical-Chemical Treatment Option, Single Sludge Site	6,012.8	10,814.2	354.7	638.0	300.5	385.1	98.1	108.5	753.3	1,131.6
5	Minimum Dispersion AWT, Biological Treatment Option, Single Sludge Site	6,995.4	12,163.2	412.8	717.6	327.7	419.0	104.5	118.6	845.0	1,255.2
5	Minimum Dispersion AWT Plan, Physical-Chemical Option, Single Sludge Site	6,007.8	10,917.7	354.6	644.2	299.5	384.3	97.8	107.6	751.9	1,136.1
*6	Minimum Dispersion AWT Separate Collection Plan, Physical-Chemical Treatment Option	5,776.8	11,048.8	340.8	651.8	293.0	377.5	97.1	115.2	730.9	1,144.5
*7	Intermediate Dispersion AWT, Reuse Option 1 Plan, Physical-Chemical Treatment Option	5,756.9	10,588.3	339.6	622.9	292.9	377.1	97.5	107.9	729.6	1,107.9
*8	Intermediate Dispersion AWT Reuse Option 2 Plan, Physical-Chemical Treatment Option	5,756.9	10,479.0	339.6	618.3	292.5	376.6	97.5	107.8	729.6	1,102.7

TABLE C-VI-1 (Cont'd)
SUMMARY COST TABLE a/
(Initial Stage Alternatives)

No.	Description	Capital Cost b/ Millions of Dollars w/o Storm Water	Capital Cost b/ Millions of Dollars w/Storm Water	Amortization Cost c/ Millions of Dollars/Yr. w/o Storm Water	Amortization Cost c/ Millions of Dollars/Yr. w/Storm Water	Operation & Maintenance Cost Millions of Dollars/Yr. w/o Storm Water	Operation & Maintenance Cost Millions of Dollars/Yr. w/Storm Water	Replacement Cost Millions of Dollars/Yr. w/o Storm Water	Replacement Cost Millions of Dollars/Yr. w/Storm Water	Total Costs Millions of Dollars w/o Storm Water	Total Costs Millions of Dollars w/Storm Water
*9	Minimum Dispersion AWT Reuse Option 1 Plan, Physical-Chemical Treatment Option	5,756.2	10,666.1	339.7	629.3	291.5	376.3	97.2	107.0	728.4	1,112.6
*10	Minimum Dispersion AWT, Reuse Option 2 Plan, Physical-Chemical Treatment Option	5,756.2	10,575.0	339.7	623.9	291.5	375.7	97.2	106.9	728.4	1,106.5
11	Intermediate Dispersion Land Plan	4,215.8	8,848.1	248.8	522.6	201.1	268.8	7.6	10.9	457.5	802.3
12	Minimum Dispersion Land Plan	4,152.4	8,762.2	245.1	514.5	214.3	273.2	7.5	11.4	466.9	799.1
*13	Intermediate Dispersion Land and AWT Plan, Physical-Chemical Treatment Option	4,242.2	8,577.6	250.3	505.3	214.1	281.9	14.8	17.1	479.2	804.3
*14	Minimum Dispersion AWT, Limited Collector Access Plan, Physical-Chemical Treatment Option	5,756.2	9,666.1	339.7	629.3	291.5	376.3	97.2	107.0	728.4	1,112.6
15	Intermediate Dispersion Land Limited Collector Access Plan	4,215.8	8,848.1	248.8	522.6	201.1	268.8	7.6	10.9	457.5	802.3
16	Intermediate Dispersion Land Synergism Plan	3,967.6	8,593.3	234.1	507.4	8.1	75.8	7.6	10.9	249.8	594.1
17	Minimum Dispersion Land, Synergism Plan	3,907.5	8,510.9	230.5	499.6	21.3	80.2	7.5	11.4	259.3	591.2
18	Minimum Dispersion Land, Open Space Plan	7,895.7	12,163.3	465.9	717.5	200.1	254.2	7.6	9.3	673.6	981.0
19	Integrated Land and Open Space Plan	8,163.8	12,788.1	481.8	754.2	182.1	237.6	7.5	9.3	671.4	1,001.1

a/ All costs are for the year 2020, using 2020 flows. Unit costs are for Chicago area, January 1972 (ENR Index of 1850 and a WQO of 180).
b/ Includes 20% contingency allowance and a 15% engineering, design, supervision and administration allowance.
c/ Based on an interest rate of 5.5 percent and amortized over 50 years.

*Sludge management costs excluded.

No.	Alternative Description	Total Costs ($ Million/Year)
1	Existing Plans Without Reuse	385.5
2	Modified Base Without Reuse	362.1
2	Modified Base With Reuse	367.1

ADVANCED TREATMENT PLANT ALTERNATIVES

Regionalization

For the first three advanced waste treatment alternatives, regionalization produced a cost situation contrary to what was expected from economies in scales, i.e., the cost increased with the lesser number of plants. Further evaluation indicated that the economies in plant were offset by the costs in combined collection systems. Therefore, separation of the collection system for storm water runoff was indicated. The lower costs in Alternative 3 resulted largely from a reduction in the amortized capital costs attributable to the system when maximum use was made of existing facilities.

In Alternatives 4 and 5, the Physical-Chemical (P-C) systems were somewhat less costly than the Advanced Biological systems (Adv. Bio.) when using the same number of treatment plants. The trend in dispersion for both treatment systems also indicated that eight plants may be too great an employment of regionalization.

Alternative No.	Number of Plant	Total Cost Adv. Bio.	($Million/Year) P-C
3	64	1,149.5	-
4	17	1,217.9	1,107.9
5	8	1,227.5	1,112.6

Sludge Management Options

The multiple site agricultural option was the least costly of the four sludge management options when combined with the Advanced Biological system (Alternative 4). When the Physical-Chemical process was considered, land reclamation (fill) appeared to be most promising from a cost basis. For Alternative 5 with eight plants, the single site agricultural option was the least costly, although the cost difference between single and multiple sites was not appreciable. For the Physical-Chemical system with Alternative 5, the land reclamation (fill) was again the least costly.

Alt. No.	No. of Plants	Sludge Mgt. Options	Sludge Mgt. Cost ($ Million/Year) Adv. Bio.	P-C
4	17	Agric. - Single Site	13.0	23.7
4	17	Agric. - Mult. Site	9.9	26.5
4	17	Land Reclamation	40.0	7.2
4	17	Incineration	38.3	-
5	8	Agric. - Single Site	27.7	23.5
5	8	Agric. - Mult. Site	30.6	26.1
5	8	Land Reclamation	39.4	16.9
5	8	Incineration	38.3	-

COMBINED VERSUS PARTIALLY SEPARATE SYSTEMS

Alternative 6, using a combined and separate collection system was shown to cost about $32 million more annually than Alternative 5 which used an all combined system. The additional costs, however, result mostly from the increased number of treatment plants in Alternative 6.

	Alternative 5	Alternative 6	Cost Difference
Collection System	Combined	Comb. & Sep.	
Number of Plants			
-Combined	8	4	
-Storm Water		4	
-Wastewater		6	
-Total	8	14	
Cost ($ Million/Year)			
-Collection/Storage	379.6	381.2	1.6
-Treatment	714.0	744.3	30.3
-Reuse	19.0	19.0	0.0
-Total	1,112.6	1,144.5	31.9

WATER REUSE (TREATMENT PLANT ALTERNATIVES)

In the 17 plant systems of Alternatives 4, 7 and 8, Alternative 4 was sited without any consideration of water reuse; water reuse being added on as an option. Facilities in Alternatives 7 and 8 were sited considering water reuse and then Options 1 and 2, respectively, were incorporated. In Option 1 water is piped from rural areas to the need areas, while in Option 2 the water is transported from the rural areas in streams. There was not a noticeable cost difference if plants are sited with or without reuse considerations, and the two plans were essentially identical. Using streams instead of pipes resulted in a cost savings of about $5 million/year. The results for the eight treatment plant systems of Alternatives 5, 9 and 10 were similar, with savings of about $6 million/year by using streams as the transportation network.

	Alt. No.	No. of Plants	Cost ($ Million/Year) Reuse	Total
Normal Plant Siting	4	17	18.8	1,107.9
Option No. 1	7	17	18.8	1,107.9
Option No. 2	8	17	13.6	1,102.7
Normal Plant Siting	5	8	19.0	1,112.6
Option No. 1	9	8	19.0	1,112.6
Option No. 2	10	8	12.9	1,106.5

TECHNOLOGY COST COMPARISON

In comparing the Land treatment alternatives, there was a small increase in costs for Alternative 11 using more sites, as compared to Alternative 12 using a single site. Alternatives 18 and 19 employed greenbelts with limited spray application, with the surplus secondary effluent sent to one site for Alternative 18 and to the greenbelt extensions for Alternative 19. The costs for these alternatives have increased when compared to Alternatives 11 and 12 due to the larger amount of land required for limited application in the park areas. These latter alternatives, however, represent multipurpose systems serving recreational and environmental functions which could make the additional costs worthwhile.

Alternative 13 was similar to Alternative 11 except that two of the land sites are replaced by two Physical-Chemical systems. The difference in costs between these alternatives was quite small, resulting primarily from an increase in costs by using a mixed Land and Treatment Plant system, and a decrease in conveyance costs. The slight net increase indicates there is a potential for combining treatment plant and Land treatment facilities.

The least costly Physical-Chemical system (Alternative 4) and the least costly Advanced Biological system (Alternative 3), were more expensive than some of the various Land alternatives in meeting the treatment needs. Costing each of the systems without the provision for storm water treatment illustrated that a large amount of the system costs were attributable to storm water treatment. A comparison of these latter costs to the costs to meet the present standards in Alternatives 1 and 2 indicated that the costs for the NDCP goal are comparable in many cases to Alternatives 1 and 2, although somewhat more costly.

Treatment Technology	Alternative No.	Description	Total Costs With Storm Water ($ Million/Year)	Total Costs W/O Storm Water ($ Million/Year)
Land	12	1 Site	799.1	466.9
Land	11	3 Sites	802.3	457.5
Land	18	Parks & 1 Site*	981.0	673.6
Land	19	Parks & Extensions*	1,001.1	671.4
Mixture	13	1 Site & 2 P-C Plants	804.3	479.2
Phys.-Chem	4	17 Plants	1,107.9	729.6
Adv. Bio.	3	64 Plants	1,149.5	815.4
Conv. Bio.	2	Modified Base	-	367.1
Conv. Bio.	1	Existing Plans	-	385.5

*Multipurpose Systems

SYNERGISTIC LAND SYSTEMS

Alternatives 16 and 17 incorporated an add-on for power generation facilities in coordination with the waste treatment facilities. A comparison of Alternatives 11 with 16 and 12 with 17 indicated a potential savings in excess of $200 million/year due to the synergistic effect of the power supply add-on. This saving represented the equivalent cost investment that would have to be made by the utility and hence a savings to the system.

Alt. No.	No. of Sites	Power Add-on	Cost ($ Million/Year) Total	Diff.
11	3	None	785.3	-
16	3	Yes	577.1	208
12	1	None	782.1	-
17	1	Yes	574.2	207.9

SELECTION OF INTERMEDIATE ALTERNATIVES

Based on the results of the foregoing comparative cost screening, attention was focused on other screening factors particularly diversity in technologies and management concepts. The eleven alternatives which ultimately were selected differed in effluent quality - either the existing or the NDCP water quality standards; by the number or degree of regionalization; type of treatment - Conventional and Advanced Biological, Physical-Chemical or Land; and by other factors. Table C-VI-2 identifies the base alternatives retained for further study.

TABLE C-VI-2

INTERMEDIATE STAGE ALTERNATIVES

- - - CURRENT STANDARDS - - -

NEW CODE	CONVENTIONAL BIOLOGICAL PLANT ALTERNATIVES	OLD CODE
A.	EXISTING REGIONAL PLANS	(ALT. 1)
B.	MODIFIED BASE (OPTIMAL)	(ALT. 2)

- - - NO DISCHARGE OF CRITICAL POLLUTANTS - - -

	AWT (A-B & P-C) PLANT ALTERNATIVES	
C. 1/	MAXIMUM DISPERSION (64 PLANTS)	(ALT. 3)
D. 1/	INTERMEDIATE DISPERSION, RANGE 1 (41 PLANTS)	(NEW)
E. 1/	INTERMEDIATE DISPERSION, RANGE 2 (17 PLANTS)	(ALT. 4)
F. 1/	MINIMUM DISPERSION (8 PLANTS)	(ALT. 5)
G.	COMBINATION OF AWT PLANT TECHNOLOGIES	(NEW)
	AWT, LAND ALTERNATIVES	
H.	SINGLE SITE	(ALT. 12)
I.	DISPERSED SITES	(ALT. 11) 2/
	VARIATIONS IN SYSTEM DESIGNS	
J.	PLANT & LAND COMBINATION	(ALT. 13) 2/
K.	OPEN SPACE (NIPC) & RECREATIONAL DEVELOPMENTS	(ALT. 18) 2/

1/ To be developed for both Advanced Biological and Physical-Chemical technologies.

2/ Modified version.

SELECTED ALTERNATIVES

Alternatives A and B were designed to meet the existing standards and corresponded to Alternatives 1 and 2 of the initial set. Both of these alternatives were retained for use as a comparative base. Alternative A is the reference plan (Alternative 1) and reflects the existing regional plans, while Alternative B is a modification of the base plan and represents the optimization of existing regional plans. The former achieves existing water quality standards with 64, and the latter with 41 Conventional Biological treatment plants.

Alternatives C thru K, nine alternatives in all, were designed to achieve the adopted "No Discharge of Critical Pollutants" effluent standards.

Alternative C was designed with two options, either all Advanced Biological or all Physical-Chemical treatment plants, and represented a maximum dispersion of 64 plants. This system corresponded to Alternative 3 of the initial set.

Alternative D was designed with the same two options as C, but represented an intermediate dispersion of 41 plants. With regard to selecting an optimum point for regionalization of the NDCP alternatives, this system represented an interim level between Alternatives 3 and 4 of the initial set. The alternative was designated as intermediate dispersion, Range I system.

Alternative E was also designed with the same two options as C, but represented an intermediate dispersion of 17 plants. This system corresponded to Alternative 4 of the initial set, and was designated as intermediate dispersion, Range II system.

Alternative F was similarly designed with the same two options as C, but represented a minimum dispersion of 8 plants. This system corresponded to Alternative 5 of the initial set.

Alternative G was designed as a combination 17 plant system in accordance with the objective to further evaluate the advantages of combining technologies. In this system, the five largest existing plants--the North Side, West-Southwest, Calumet, Hammond, and Gary plants-- were upgraded as Advanced Biological plants and employed in combination with 12 Physical-Chemical plants in the outlying area. There was no alternative of this nature in the initial set.

Alternative H was designed as a single large site land treatment system located in the Kankakee River Basin in Indiana and Illinois. The system represents a minimum level of "plant" dispersion for this technology and corresponded to Alternative 12 of the initial set.

Alternative I was designed as an intermediate level of "plant" dispersion for the Land treatment system and consisted of six sites. These sites were located in the Kankakee River basin area in Indiana, a Will-Grundy-Kankakee Counties site in Illinois, a Kendall County site, and three McHenry County sites. The system was a modified version of Alternative II in the initial set.

Alternative J was designed as an AWT Plant - Land treatment combination system. It is an intermediate dispersion alternative which included the five Advanced Biological plants described for Alternative G plus scaled-down versions of the six land sites described for Alternative I. As such, it provided a similar evaluation function as Alternative G. The system was a modified version of Alternative 13 of the initial set.

Alternative K was designed as an open space - Land treatment combination system, similar to Alternative I in some respects. It is an intermediate dispersion alternative which includes use of open land space for recreation and controlled storm water irrigation application. With this open space spray application, the outlying six land sites were reduced somewhat in size. The system was a modified version of Alternative 18 of the initial set and provided the basis for assessing the worth of achieving concurrently an increased and multiple level of environmental enhancement.

ALTERNATIVES ELIMINATED

These eleven systems continued study on modified versions of Alternatives 1, 2, 3, 4, 5, 11, 12, 13 and 18, and eliminated from further consideration Alternatives 6 thru 10, 14 thru 17, and 19 of the initial set.

Of the 10 alternatives dropped from the initial set, almost all were formulated to help establish planning and engineering criteria applicable to a particular system component or its function. Consequently, they were no longer needed once their purpose was served and the criteria established. Alternative 6 focused on the comparative advantages of combining or maintaining separate wastewater and storm water systems. Alternatives 7 through 10 were used to analyze the reuse implications, both the two options and relative to plant locations. Alternatives 16 and 17 were used to evaluate both the potential for power synergism and alternative sludge disposal options for the Land treatment system. Finally, Alternatives 14 and 15 (Limited Access) and 19 (Finger Plan with extention treatment sites) were found to be too costly and were dropped since the same objectives could be achieved by Alternative 18 which was retained.

MODIFICATIONS TO DESIGN CRITERIA

Major changes were made at this stage of study relative to the basis used for system design. The changes were the results of additional technical studies carried forward from the start and the evaluation of the initial alternatives. The major changes concerned the design approach used for: (1) storm water control and system design; (2) collection and conveyance systems; (3) wastewater quantities; (4) water management; (5) sludge managements; and (6) synergisms.

STORM WATER CONTROL AND TREATMENT SYSTEM DESIGN

The change in the storm water management program was two-fold. The first was related to achieving further economies in treatment plant design. In this case, the capacity of the wastewater storage system was increased and regulated pump-out was employed to reduce the treatment and conveyance facility capacities required. Second, separate collection and more localized dispersed storm water storage system was provided in suburban areas to reduce costs and achieve a more effective runoff control.

COLLECTION AND CONVEYANCE SYSTEMS

Designs of the collection and conveyance systems differed for the urban, suburban, and rural areas. In urban areas, municipal, industrial, and storm wastewater was combined and conveyed in tunnels. The combined storage capacity, equivalent to 2.5 inches of runoff, as previously established, was retained.

In suburban areas, the storm water was collected separately and stored in surface ponds or deep pits depending on land availability. Sufficient storage capacity was provided for 2.85 inches of runoff. The increased capacity from 2.5 inches permitted economies to be achieved in sizing both the collection systems and the treatment plants. Reduction of the pump-out rate and the peak diurnal (daily) flow permitted maintaining a more reasonable (regulated) ratio of storm water to dry weather flows. This, in turn, allowed the design of a more cost efficient plant both in terms of capacity and operations. Storm water was conveyed from the storage areas by gravity or force mains to access points where it was combined with other wastewater for treatment. Figure C-VI-1 shows the basic concept of suburban storm water storage utilizing surface and deep pit storm water storage sites. These storage sites were dispersed to enable local suburban collection systems to deliver storm water directly to the storage areas. Storm water was then moved from the storage areas through existing or future regulated suburban conveyance systems to the access points. Where open surface ponds were used, the area would be graded and landscaped to be compatible with the surrounding developments. If desired, a permanent pool could be incorporated into the impoundment's design. While body contact pursuits would be prohibited, the impoundments can serve as the base source of local park-type developments. Pit storage will be required where sites are limited and the area is highly populated. The pits will be covered so as not to be an aesthetic blight to the area nor a safety hazard for small children. Space above these covered storage areas could be utilized to help meet other community needs, be it recreational, commercial or municipal.

SUBURBAN STORMWATER MANAGEMENT

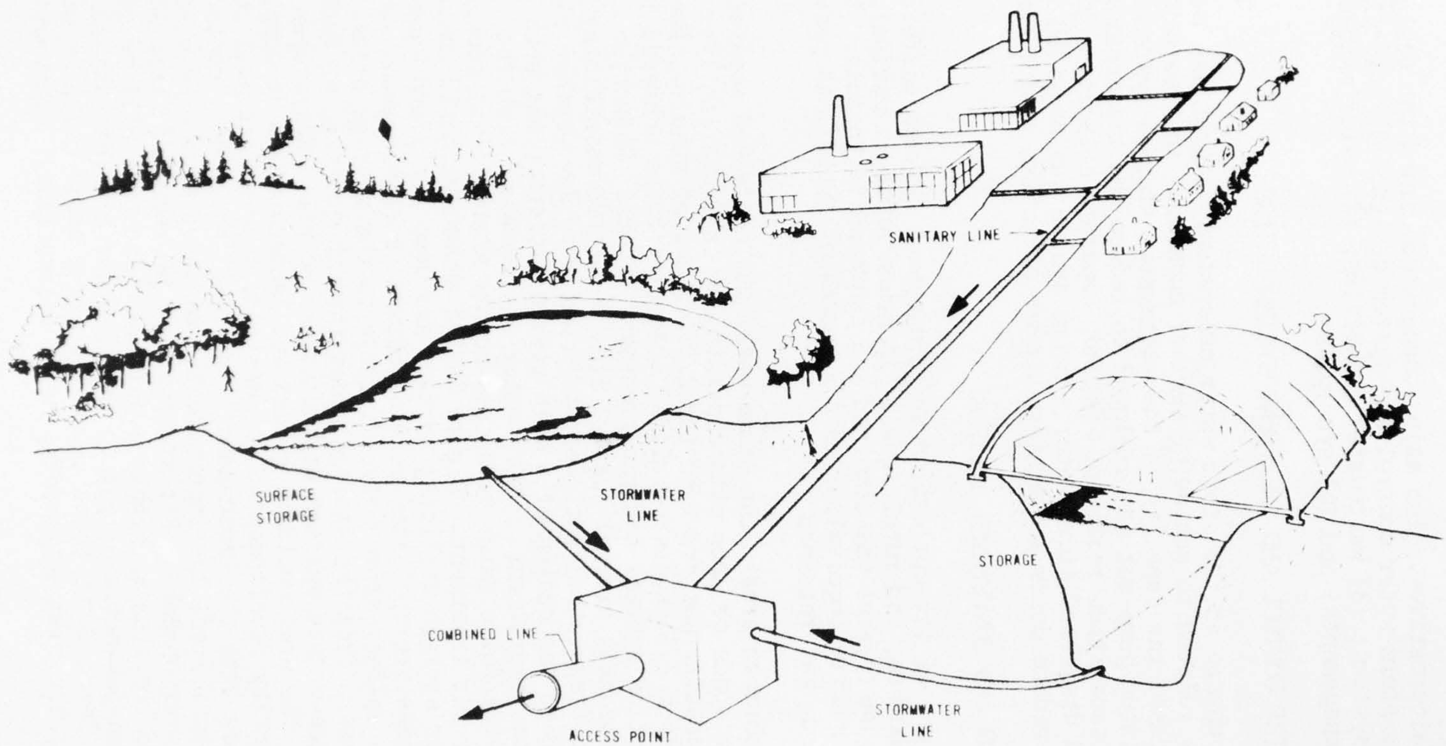


Figure C-VI-1

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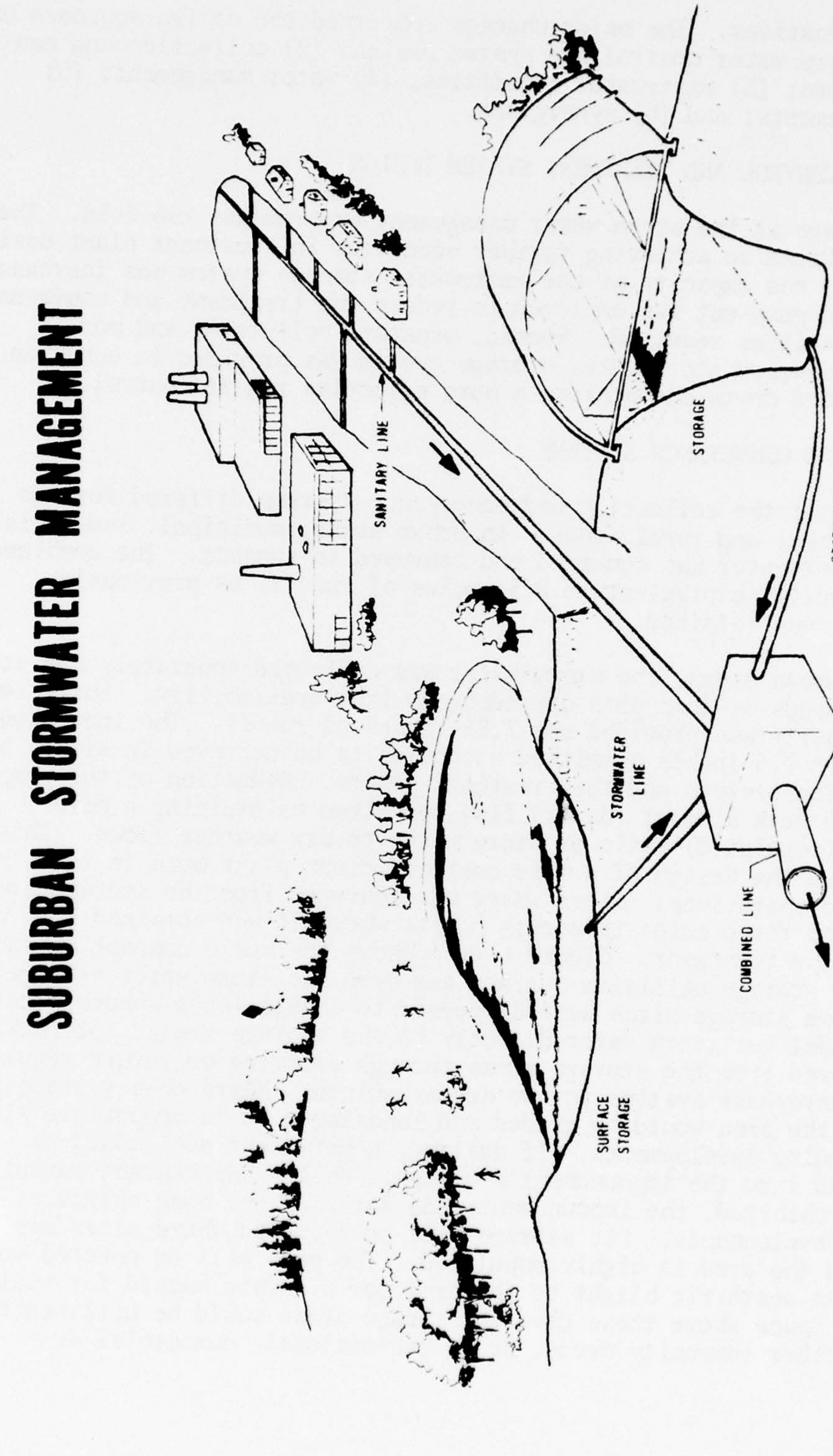

SUBURBAN STORMWATER MANAGEMENT
SANITARY LINE
STORAGE
STORMWATER LINE
STORMWATER LINE
ACCESS POINT
COMBINED LINE
SURFACE STORAGE

Figure C-VI-1

In the rural areas, the basic approach, previously discussed, was retained. The design of this rural system was, however, expanded to 422 units of 2,000 acres each. Within a typical module, a permanent pond would occupy 100 acres and the land treatment site 240 acres. The remaining area of 1,660 acres is the tributary area providing runoff to the pond. These 1,660 acres will have essentially the same land use as they now have and their use will be consistent with good conservation practices necessary to prevent runoff into the streams. As before, the management facility included a detention pond with a permanent pool available for recreational use, a pump station, irrigation rigs on agricultural land, and a pump system to reclaim the purified water.

WASTEWATER QUANTITIES

Shown in Table C-VI-3 is a breakdown of the anticipated wastewater volume to be treated, projected from 1970 to the year 2020.

TABLE C-VI-3

WASTEWATER QUANTITIES (MGD)
(Intermediate Study Stage)

	PRESENT	1990	2020
DOMESTIC - COMMERCIAL	1,000	1,235	1,720
INDUSTRIAL	3,450	1,240	1,205
STORM WATER (LESS INFILTRATION)	1,185	1,155	1,155
	5,635	3,630	4,080

These figures were revised somewhat from the initial phase of the study, but were still subject to revision based on input from the Commerce and Industry Advisory Committee.

WATER MANAGEMENT

Heretofore, the water balance for each of the alternatives have been generalized reflecting an over-all framework of analysis. There were, however, significant variances between the two broad categories of AWT technologies, i.e., plants and lands. The basic components of any system's water balance were the water needs and transfer (transport) economics which, when translated into use requirements, reflected the total water volume input to the study area and regulated (output) flow regimen. Consequently, the water balance had a direct impact on system design and costs. Initially, a base water need framework was established which would meet the projected use deficiencies. The need categories included municipal and industrial water supply deficiencies and maintenance of a minimum base flow for stream-related recreational, esthetics, and public health concerns, and water-borne navigation.

Results of the study's first phase of investigation indicated that the capture and treatment of some 2 1/2 inches of storm water throughout the area resulted in an available water volume actually in excess of the minimum level of projected needs previously used; moreover, the projected population concentrations and regionalization (economies of scale) of plants necessitated a controlled water transfer in order to avoid flooding and/or stream bank erosion. Thus, greater attention was given the economics of water transfer within the study area; the use of Lake Michigan both as a source of supply and for return; and the variances feasible for consideration in meeting a range of needs outside the study area.

Planning Considerations

The maximum volume of water available for use within the study area by the year 1990 would amount to 3,995 MGD. Of this amount, 379 MGD could be withdrawn from groundwater sources (without depletion) and 1,155 MGD of storm water runoff would be available after treatment. The balance, some 2,421 MGD could come from Lake Michigan with Illinois usage limited to 2,068 MGD by the Supreme Court decision. These figures established a framework within which to analyze the transfer economics, legal allowances and projected uses of the available sources, particularly Lake Michigan. A breakdown of the water balances actually used in the design of the 11 alternatives is shown in Table C-VI-4.

The design of the NDCP plant systems utilized a base volume of 3,711 MGD. The requirements for low-flow augmentation in the interest of water-borne navigation on the Illinois River (700 MGD) and recreational flows amounting to 201 MGD for the selected 40 major streams and tributaries were automatically met and even exceeded by effective transfer of plant discharge. The outflow component of the water balance was maintained as a constant with 3,159 MGD discharged into the Des Plaines-Illinois River Systems and 552 MGD returned to Lake Michigan - 72 MGD from Illinois and 480 MGD from Indiana.

The design of the pure land systems utilized a higher water balance equivalent to 4,612 MGD. The difference (901 MGD) in water balance between the plant and land treatment system involved increased withdrawals from Lake Michigan and changes in the return regimen. Greater emphasis was placed on the use of Lake Michigan waters, the resulting implications in transfer economics and the net between withdrawals and returns. While a general comparability was maintained within the C-SELM area, different diversion schemes which could be adopted for various types of synergistic

TABLE C-VI-4
WATER BALANCE (MGD) - (Year 1990)

	Plants	Alternatives			Land & Plant
		Land			
	(C-G)	1 Site (Alt II)	6 Sites (Alt I)	6 Sites & Open Space (Alt K)	(Alt J)
Area Input					
1. Rural Storm Water	630	630	630	630	630
2. Urban & Suburban Storm Water	880	880	880	880	880
Subtotal, treated Storm Water	1,510	1,510	1,510	1,510	1,510
3. Ground Water Supply	379	379	379	379	379
4. Lake Michigan Withdrawal	1,822	2,723	2,723	2,723	2,023
Illinois	(1,469)	(2,370)	(2,370)	(2,370)	(1,670)
Indiana	(353)	(353)	(353)	(353)	(353)
5. Total Water Input	3,711	4,612	4,612	4,612	3,912
Area Distribution (Outflow)					
1. Lake Michigan Return	552	3,072	1,501	1,475	552
Illinois	(72)	(2,592)	(1,021)	(995)	(72)
Indiana 1/	(480)	(480)	(480)	(480)	(480)
2. Des Plaines-Illinois River Outflow	3,159	1,540	3,111	3,137	3,360
3. Total Water Output	3,711	4,612	4,612	4,612	3,912
Lake Michigan Balance					
1. Withdrawal: Illinois	1,469	2,370	2,370	2,370	1,670
Indiana	353	353	353	353	353
2. Diversion (Illinois only) 2/	360	360	360	360	360
3. Return: Illinois	72	2,592	1,021	1,995	72
Indiana	480	480	480	480	480
4. Net Withdrawal: Illinois	1,757	138	1,709	1,735	1,958
Indiana	-	-	-	-	-

1/ Includes Lake Michigan withdrawal plus storm water runoff.
2/ Diversion of storm water that normally flows into Lake Michigan.

uses outside the study area were also evaluated. The outflow components of the three water balances varied considerably with ultimate diversion (from within or outside the study area) to the Des Plaines-Illinois River system ranging from 1,540 to 3,137 MGD. Conversely, returns to Lake Michigan ranged from 3,072 MGD to a minimum of 1,475 MGD.

SLUDGE MANAGEMENT

Based upon the analysis of sludge management options during the initial phase, the following management schemes were dropped from further consideration: A quarry site in Southern Indiana for disposal (land fill) of Physical-Chemical sludge; land reclamation sites in the Shawnee National Forest; and total sludge incineration. Cost was the prime factor for the options being dropped though environmental considerations did act as an additional constraint. Incineration with its air emissions (particulates) posed the potential for adversely affecting the existing ambient levels. Concern was also expressed over the possibility that the chemical sludges would affect the aquifers surrounding the limestone quarry sites. These added factors were sufficient to preclude further consideration of the two options. Consequently, the intermediate study stage continued the evaluation of land reclamation sites in Fulton and Knox Counties, Illinois, and of the use of sludge as fertilizer on nearby agricultural sites in Illinois and Indiana for both the Biological and Land technologies. The sludge from the Physical-Chemical technology, because of its physical properties, was limited to use as a soil conditioner and pH control on agricultural lands.

SYNERGISMS

<u>Recreational-Environmental Stream Corridors</u>

Through the efforts of the Citizens Advisory Committee for Conservation and Environment, a special study was initiated to determine the feasibility of incorporating open-space land corridors with the wastewater management programs. As the area upgrades the water quality of its streams, the recreational value of these watercourses will be increased. Moreover, as storm water runoff is controlled, treated, and used to augment the stream flow, the opportunity to utilize the adjacent flood plain land for recreational and environmental purposes is enhanced. Therefore, this special study was undertaken to provide the basis for incorporating an effective recreation and conservation program in the open space lands bordering the area's streams.

In order to provide a realistic framework for development, it was decided to select a stream for detailed analysis. In this case, the North Branch of the Chicago River was used. The North Branch of the Chicago River was selected because: (1) it involves an area where the residents are actively promoting specific conservation and recreation programs and thus are knowledgeable of the local problems; (2) the nature and diversity of the stream and land-related problems are such as to be considered typical of those expected to occur over time throughout the study area; and, (3) the demographic conditions (population characteristics) are considered representative of the urban area. Consequently, any plan which would be responsive to the problems and opportunities for recreational and conservation programs along this river would be feasible for being implemented elsewhere.

Surface-Mine Reclamation

Coordination with the coal producers in Illinois was continued. Of major concern were the liabilities involved, the reuse of the reclaimed lands and the acceptance of the proposal by the local counties. Therefore, attention was directed to establishing some guidelines whereby this management option could be implemented.

Open-Space and Recreational Development

In connection with the design of Alternative K, the open-space requirements of the regional planning agencies were obtained. Since the open-space lands were designed to control growth patterns, continuous blocks of lands could be located and used for treatment during the night and recreational pursuits during the day. This concept was similar to the one used in the Golden Gate Park in San Francisco, California. However, only storm water runoff from the suburban and rural areas would be treated. In this case, an underground sprinkler system, rather than overhead, rotating irrigation rigs would be used to apply the storm water runoff.

Power Generation

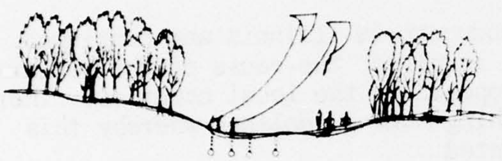
The projections of the regional power needs were obtained from the Federal Power Commission. The feasibility of co-siting the power plants with the Land treatment system was discussed as was the integration of the power into the grid systems of the locally designated power supply areas. See Annex A to Appendix G. Refinement of the site plan if power was to be incorporated into the Land treatment system was completed. A sketch of one such site is shown in Figure C-VI-2, as are schematics of the other synergisms.

PUBLIC INVOLVEMENT

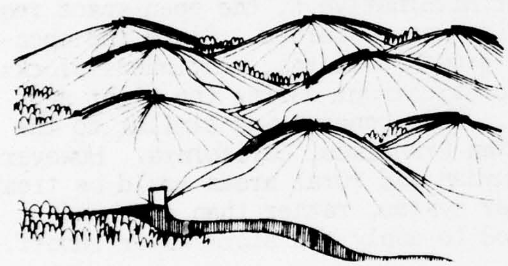
During this time, many questions were being posed by various members of the Advisory groups. Most were technical in nature and represented an effort to understand the basis of design. Accordingly, a paper was prepared, identifying and answering the individual questions. This paper was then distributed to all participating individuals. Work continued with the major industrial water users in refining the projections of their requirements. At the same time, discussions were held with a representative of the local aggregate producers to determine if the rock mined from the conveyance tunnels could be integrated into their market.

SYNERGISMS

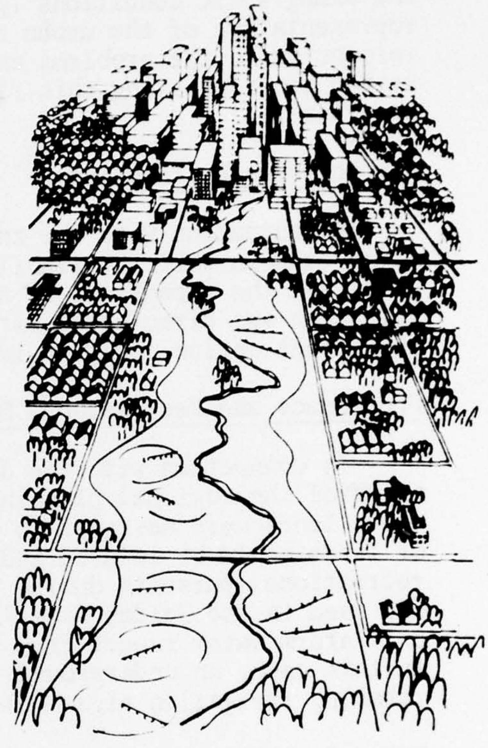
WASTEWATER IRRIGATION OF RECREATIONAL OPEN SPACE



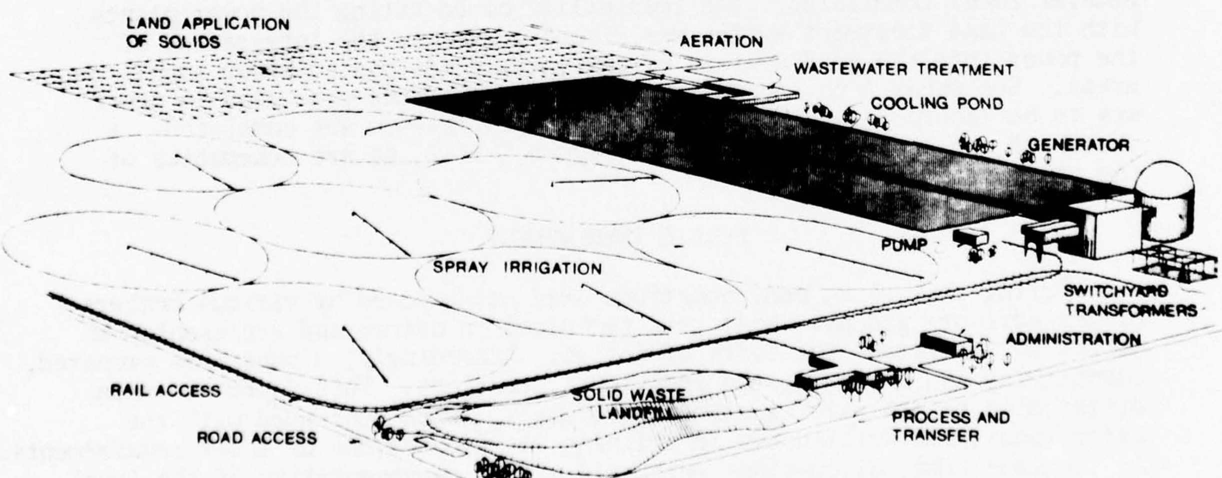
SUBURBAN STORMWATER AREAS WITH PART-TIME RECREATIONAL USAGE



SURFACE-MINE RECLAMATION WITH SLUDGE



STREAM CORRIDOR DEVELOPMENT



POWER DEVELOPMENT OF IRRIGATION SITE

Figure C-VI-2

SECTION VII - DESCRIPTION OF INTERMEDIATE ALTERNATIVES

Presented in this section are indivudual descriptions of the 11 wastewater management alternatives retained during this stage of study. Also included are graphical layouts of the alternatives, depicting treatment facility locations, treatment plant service area boundaries and wastewater conveyance systems. All designs were still on a comparative basis; preliminary in nature and subject to refinements in the later stage of study.

COMMON SYSTEM COMPONENTS

STORMWATER MANAGEMENT SYSTEMS.

Urban

Common to all alternatives is the proposed "Chicago Underflow Plan" for the combined sewer area of the Metropolitan Sanitary District of Greater Chicago (MSDGC). This plan incorporates storage in an existing sludge storage lagoon area of the MSDGC, and existing quarry and a surface storage site. The tunnels which are mined in deep rock formations, augment the existing combined sewers and prevent backwater flooding problems both locally and to Lake Michigan. The remainder of the study area serviced by combined sewers, which includes portions of Hammond, Gary, Joliet and North Chicago, would be managed in a similar manner. In this case, however, combined storm water and wastewater flows would be conveyed in force mains to covered deep-pit surface reservoirs where it would be held prior to controlled release to treatment facilities.

Suburban and Rural

The suburban and rural stormwater systems are common to Alternative C through K. Both were designed on a modular basis. For presently suburbanized areas, with or without combined sewers, covered pits were used, supplemented by aeration facilities to prevent odor problems from developing. For those suburban areas which will be developed between the 1970-1990 period, open ponds were used, draining some 2,000 acres. The module size was similar to that used for the rural area. The retention basins in the rural system, however, were sized as 100 acre units or five percent of the drainage area. Land treatment was accomplished on a 240 acre area adjacent to the retention basin.

WATER REUSE (NDCP ALTERNATIVES)

In-Stream Use

In the case of the plant alternatives (C through G), the treated water is pumped to the headwaters of the major streams and tributaries selected for recreational flow augmentation. While the reuse is common, the degree of pumping will increase along with the regionalization of the system. For the land treatment alternatives (H through K) portions of the water is returned to Lake Michigan via a return tunnel. In this case, a pipeline system is designed to provide Lake Michigan (withdrawals) to the streams instead. The remaining water not returned to the study area is used to augment the low-flow regimen of the major streams outside the study area.

Potable Water Supply

Portions of the treated water from the rural stormwater management system were used to help augment the supplies in the ground water deficient areas. Two options were used to transfer the water. In Option 1, which is common to Alternatives C through K, the reclaimed water is conveyed where possible via the streams to water deficient areas. In Option 2, which was only studied for Alternative E and H, the reclaimed water is conveyed from the rural management site to the deficient area via a pipeline system. Common to both these reuse options is a potable water supply pipeline from Lake Michigan servicing need areas in DuPage County.

SLUDGE MANAGEMENT

For the current standard alternatives (A and B) the sludge management system includes disposal of the MSDGC solids via a pipeline to Fulton County, Illinois as is presently proposed. This sludge is applied to the land, utilizing land reclamation techniques. The rest of the system would continue to truck their sludge out to the rural areas as they now do. Two options were used for the NDCP alternatives. For Alternatives C through K the sludge is applied to rural lands for agricultural utilization purposes. The sludge is transported via pipeline to three disposal sites, located in McHenry and Will Counties in Illinois, and the Kankakee river area in Indiana. The Physical-Chemical sludge is applied at the rate of 3 dry tons per acre per year while the Biological sludge is applied at the rate of 13.3 dry tons per acre per year. For Alternatives E and H, biological sludge disposal is also utilized for land reclamation techniques. This involves a single large sludge application (150-200 dry tons per acre) to surface-mined lands in central Illinois.

DESCRIPTION OF INTERMEDIATE STAGE ALTERNATIVES

(Alternatives A and B)

ALTERNATIVE A

This alternative, shown in Figure C-VII-1 reflects the level of consolidation for an area wide wastewater management system as presently proposed by the regional planning agencies in the study area. This alternative includes 64 plants of which 54 now exist. These 54 plants, however, would be expanded to meet the 1990 flows. The remaining 10 plants are proposed for new construction. The water quality goal is based on current standards and guidelines as set forth by the two States. Depending on the specifics, there are five basic types of treatment levels:

Type A - Conventional Secondary (Stream Dilution Ration 5:1)

Type B - Conventional Secondary + Filtration of 1/2 Flow (Stream Dilution Ration 1:1) for BOD and SS reductions of 10 and 12 mg/1, respectively.

Type C - Conventional Secondary + Conventional Secondary + Filtration of Total Flow (Stream Dilution Ratio 1:1) for BOD and SS reductions of 4 and 5 mg/1, respectively.

Type D - Type C + Nitrification (Chicago & Calumet River systems) for ammonia removal to 2.5 mg/1.

Type E - Type A + 80% Phosphorus Removal (Discharges to Lake Michigan).

ALTERNATIVE B

Alternative B is similar to Alternative A in terms of the effluent quality goals and the type of treatment provided. This alternative is further regionalized into a 41 plant system which abandons the smaller, 1-2 MGD treatment facilities, contained in Alternative A. This alternative is shown in Figure C-VII-2

The same stormwater storage system is provided as in Alternative A. The conveyance system tying in the abandoned plants to regional facilities is based on the regulated 2020 average flows while the treatment facilities are designed for 1990 flows.

REFERENCE P

Alternative

(INTERMEDIATE S

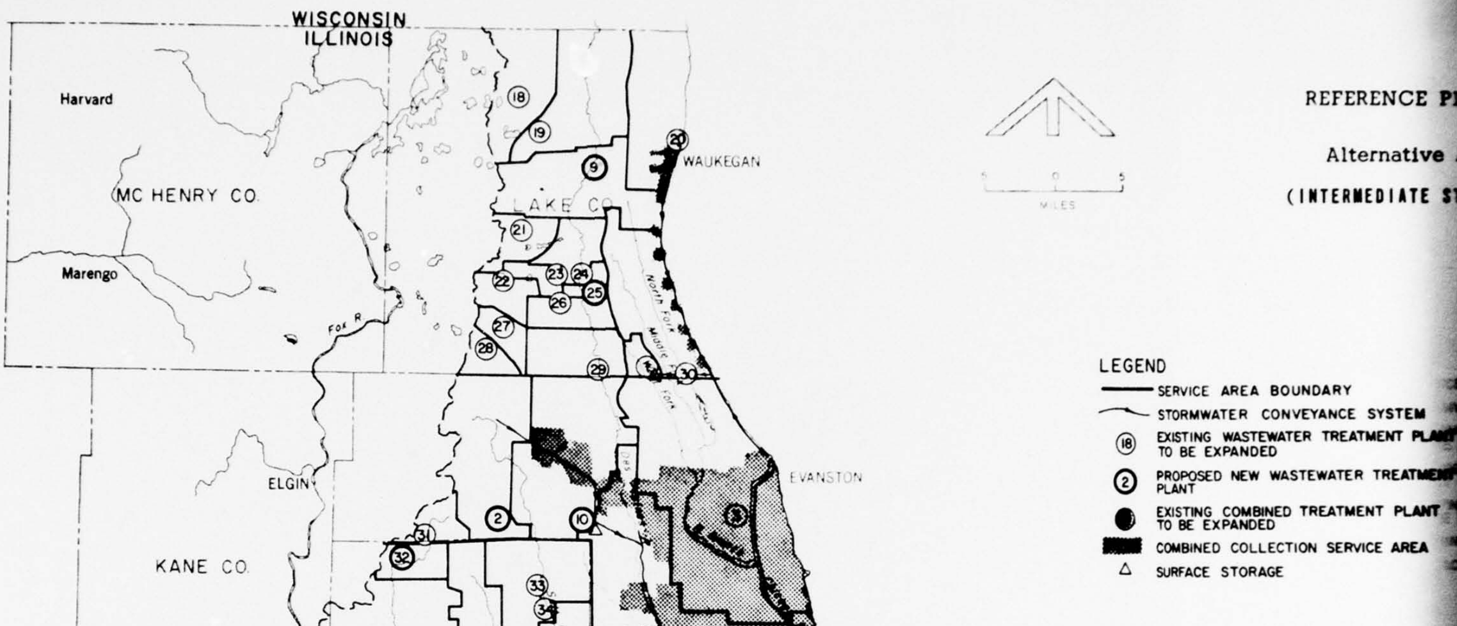


Figure C-VII-

REFERENCE PLAN

Alternative A

(INTERMEDIATE STAGE)

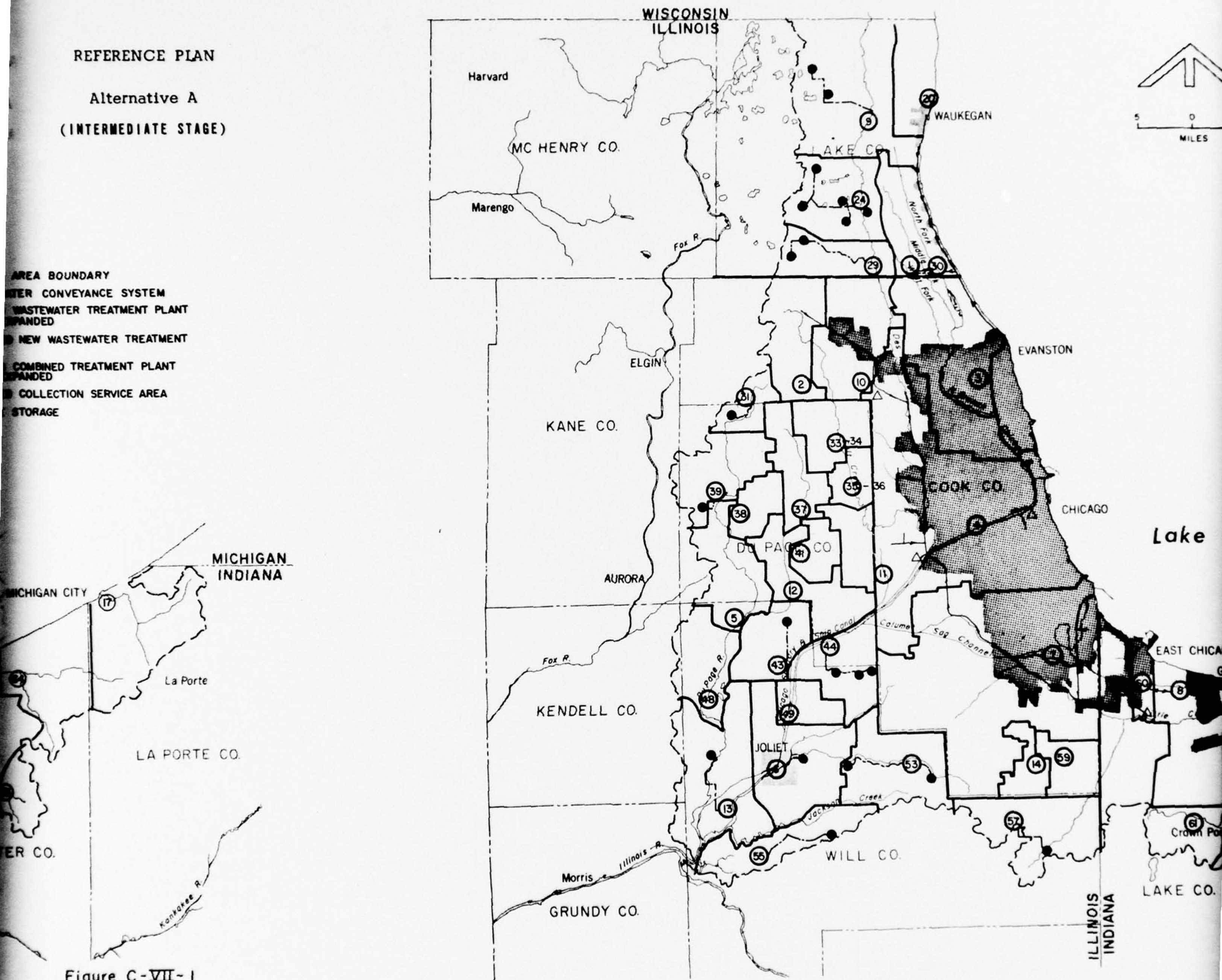


Figure C-VII-1

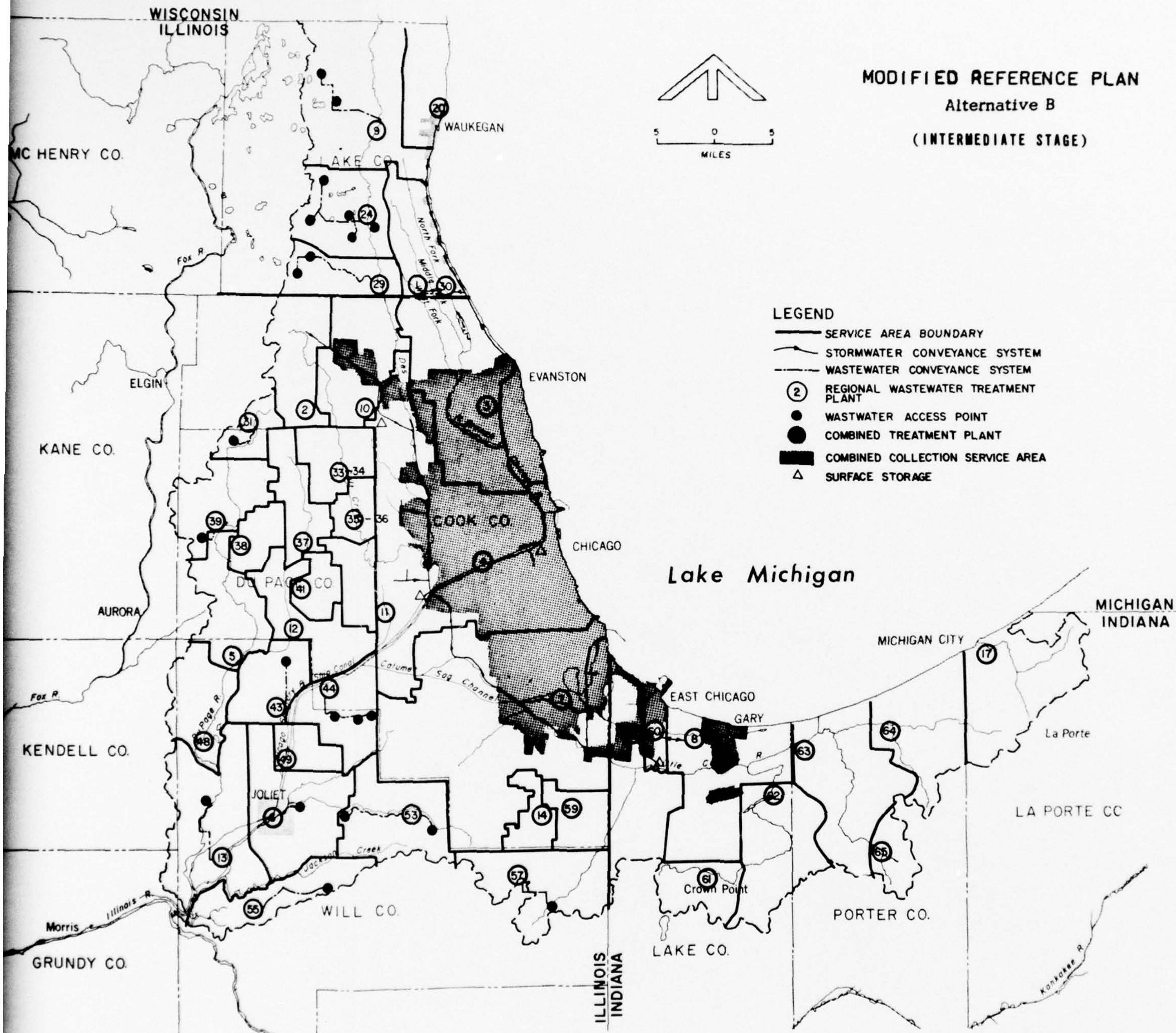


Figure C-VII-2

DESCRIPTION OF INTERMEDIATE STAGE ALTERNATIVES

(Alternatives C, D and E)

ALTERNATIVE C

Alternative C is similar to Alternative A in that the same 64 plant system is used, but the plants are upgraded to meet the NDCP water quality goals. Both the Advanced Biological (Option 1) and the Physical-Chemical (Option 2) processes have been used to cost out this alternative. The sludge management system incorporates the agricultural option on three disposal sites. A pipeline system is used to pump the recreational flows to selected stream reaches while the treated rural runoff is conveyed via the streams. All treatment facilities were designed for the 1990 average flow conditions. When peak diurnal flows are projected to exceed the plant capacity, storage is provided to regulate these flows. Existing secondary treatment facilities are incorporated into the Advanced Biological plants. For the Physical-Chemical systems, the existing conventional Biological plants are abandoned and not integrated into the new facilities.

ALTERNATIVE D

Alternative D is similar to Alternative C except that the 64 plant system is consolidated to 41 plants. See Figure C-VII-3. The purpose of this alternative is to determine the economics of scale feasible of being achieved under the NDCP quality goal. The conveyance system interconnecting the abandoned plants to the regionalized facilities are sized for 2020 capacity. This avoids the necessity for staged constructions and the resultant higher cost. Recreational reuse conveyance facilities are more extensive in this alternative than in Alternative C due to the elimination of the small plants in the headwaters of the streams; thereby requiring return lines to these areas.

ALTERNATIVE E

Alternative E again is similar to Alternative C, except the 64 plants are regionalized into a 17 plant system as shown in Figure C-VII-4. The purpose of this alternative is to study the effect of abandoning treatment facilities within the 1-10 MGD range upon the alternative's total system cost. Although further treatment facility economies of scale will be realized with this degree of regionalization, a corresponding increase in the conveyance system costs will be incurred. As previously discussed, two sludge management systems are considered, as are two reuse options for conveying potable water to the deficient areas.

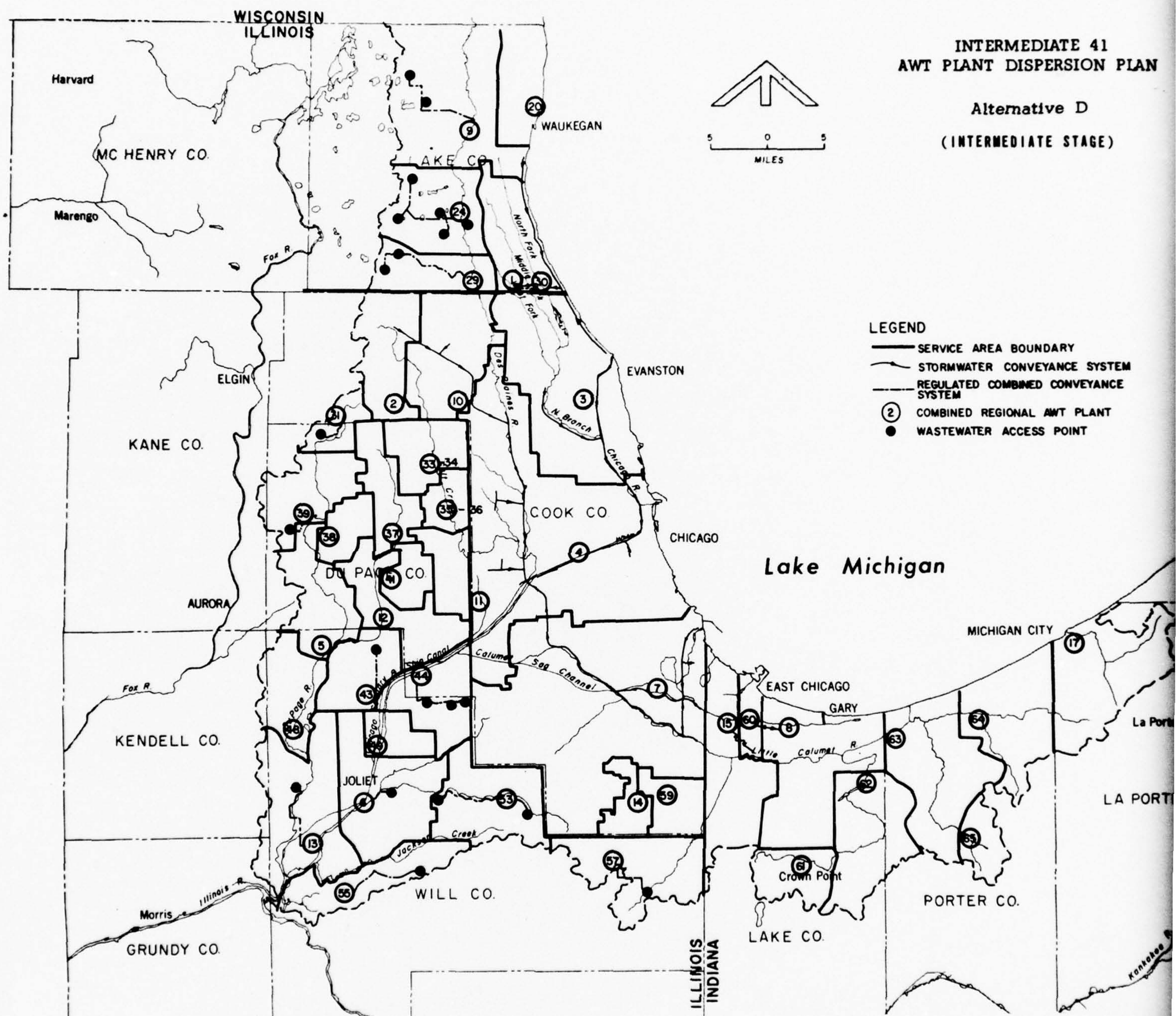


Figure C-VII-3

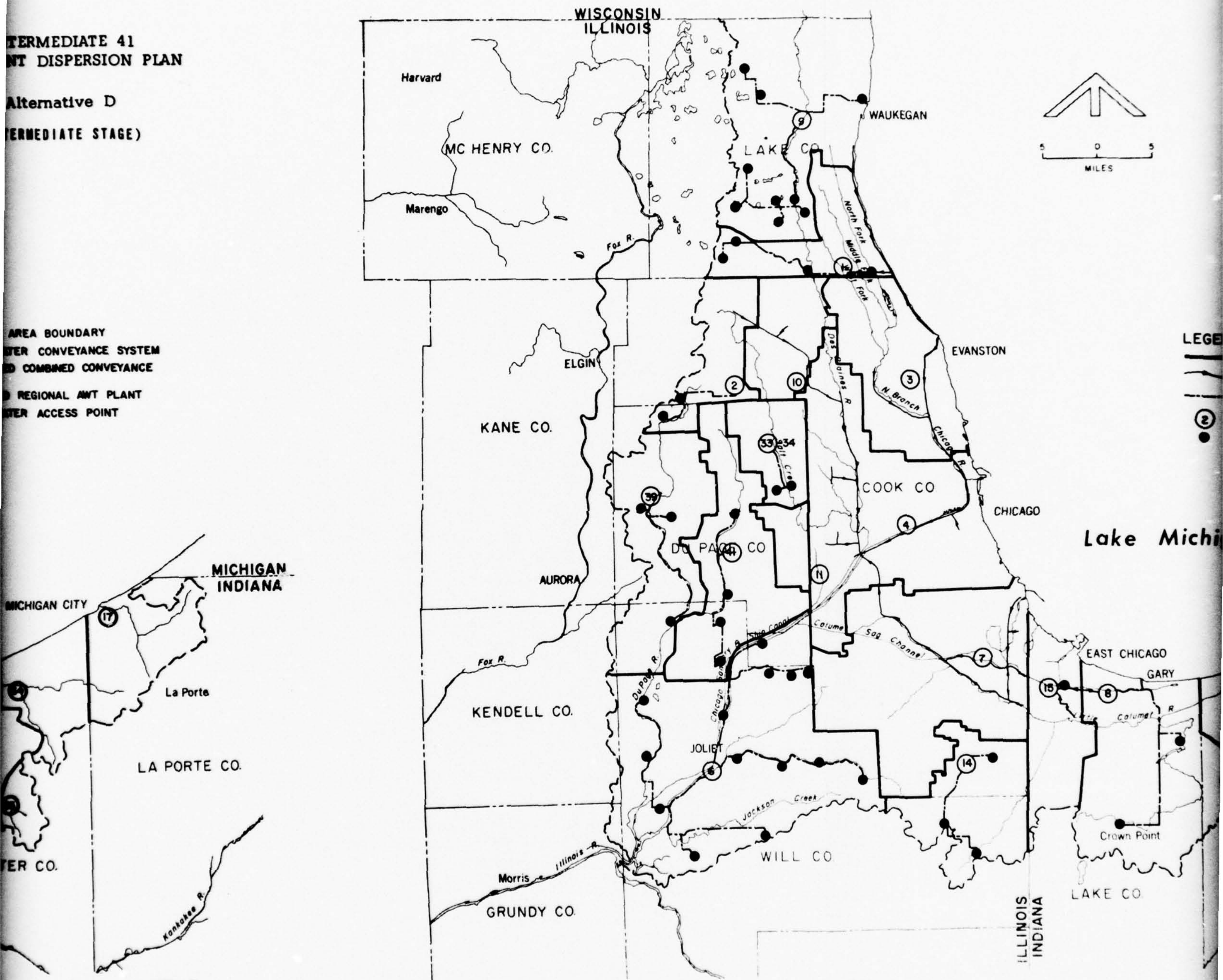


Figure C-VII-3

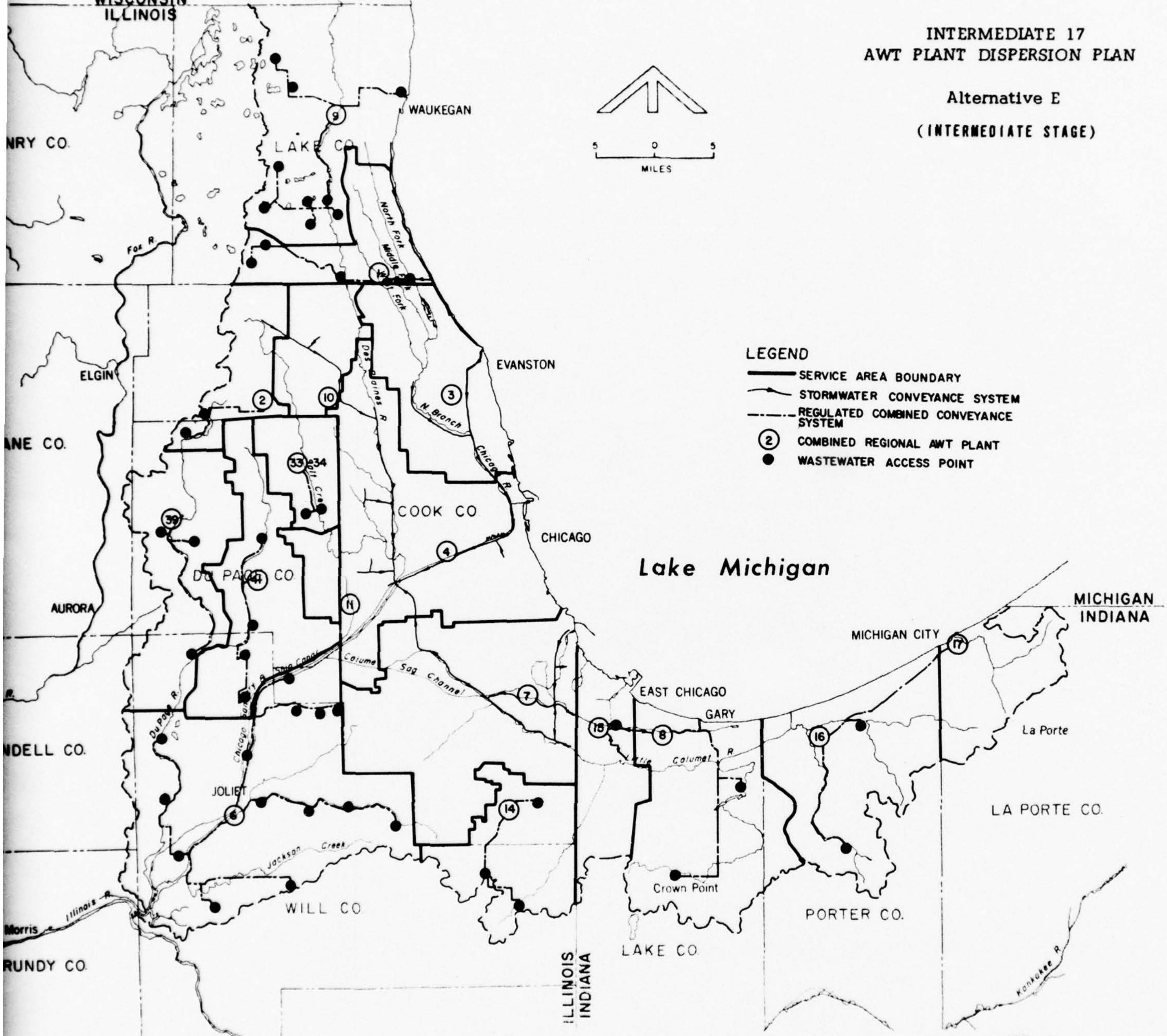


Figure C-VII-4

DESCRIPTION OF INTERMEDIATE STAGE ALTERNATIVES

(Alternatives F and G)

ALTERNATIVE F

This alternative consolidates the proposed regional plan from 64 down to 8 dispersed plants. See Figure C-VII-5. The purpose is to determine the cost-effectiveness of regionalizing the system into 8 large plants. Because the discharge of the treatment plants exceeds the capacity of the adjacent receiving streams, an additional design consideration is involved in this alternative. Therefore, the transfer lines are designed to redistribute the outflows so that the streams' capacity, limited by bank erosion, will not be exceeded.

ALTERNATIVE G

Alternative G is a 17 plant system, similar in all concern to Alternative E, except that the five largest existing secondary plants (North Side, West, Southwest, Calumet, Hammond and Gary) will be expanded and converted into Advanced Biological plants. The 12 remaining plants will be converted to the Physical-Chemical treatment process. This alternative is presented in Figure C-VII-6.

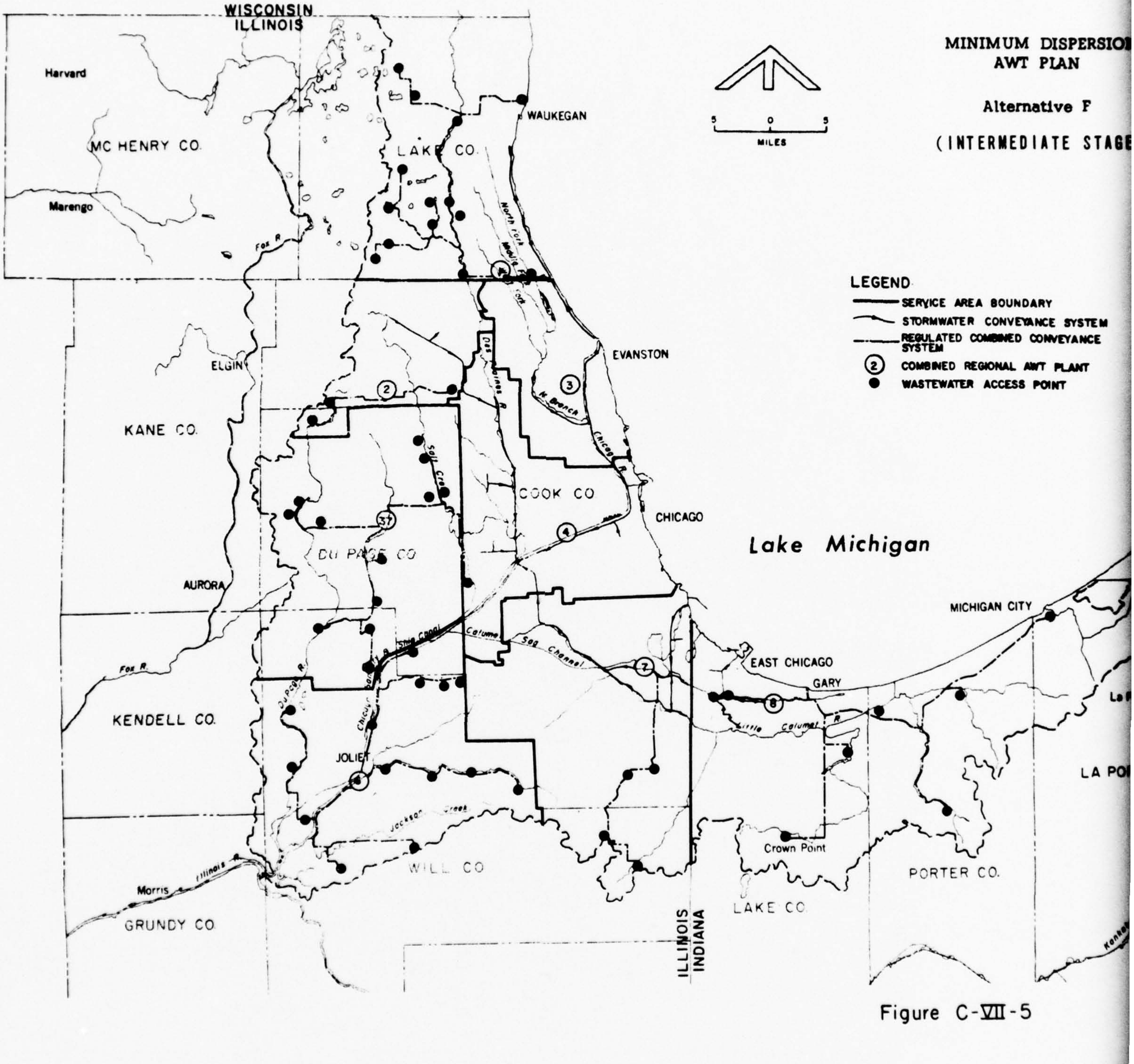


Figure C-VII-5

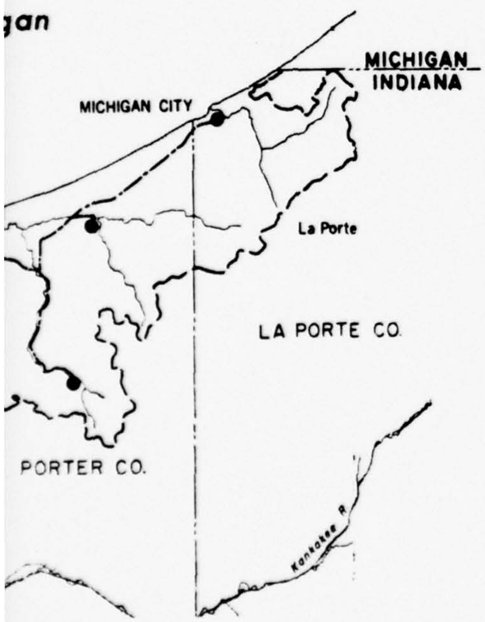
MINIMUM DISPERSION
AWT PLAN

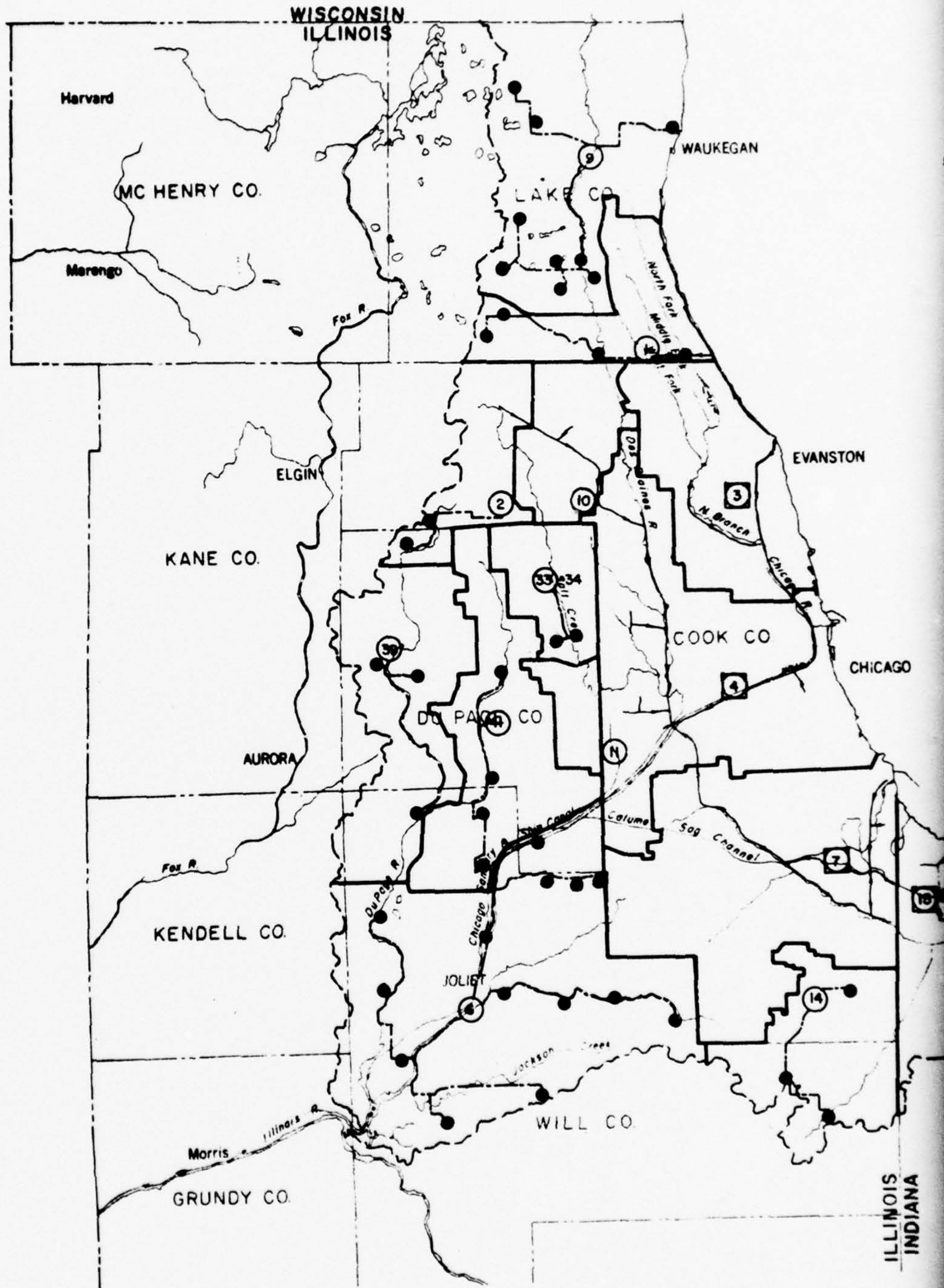
Alternative F

(INTERMEDIATE STAGE)

ND

SERVICE AREA BOUNDARY
STORMWATER CONVEYANCE SYSTEM
REGULATED COMBINED CONVEYANCE SYSTEM
COMBINED REGIONAL AWT PLANT
WASTEWATER ACCESS POINT





gure C-VII-5

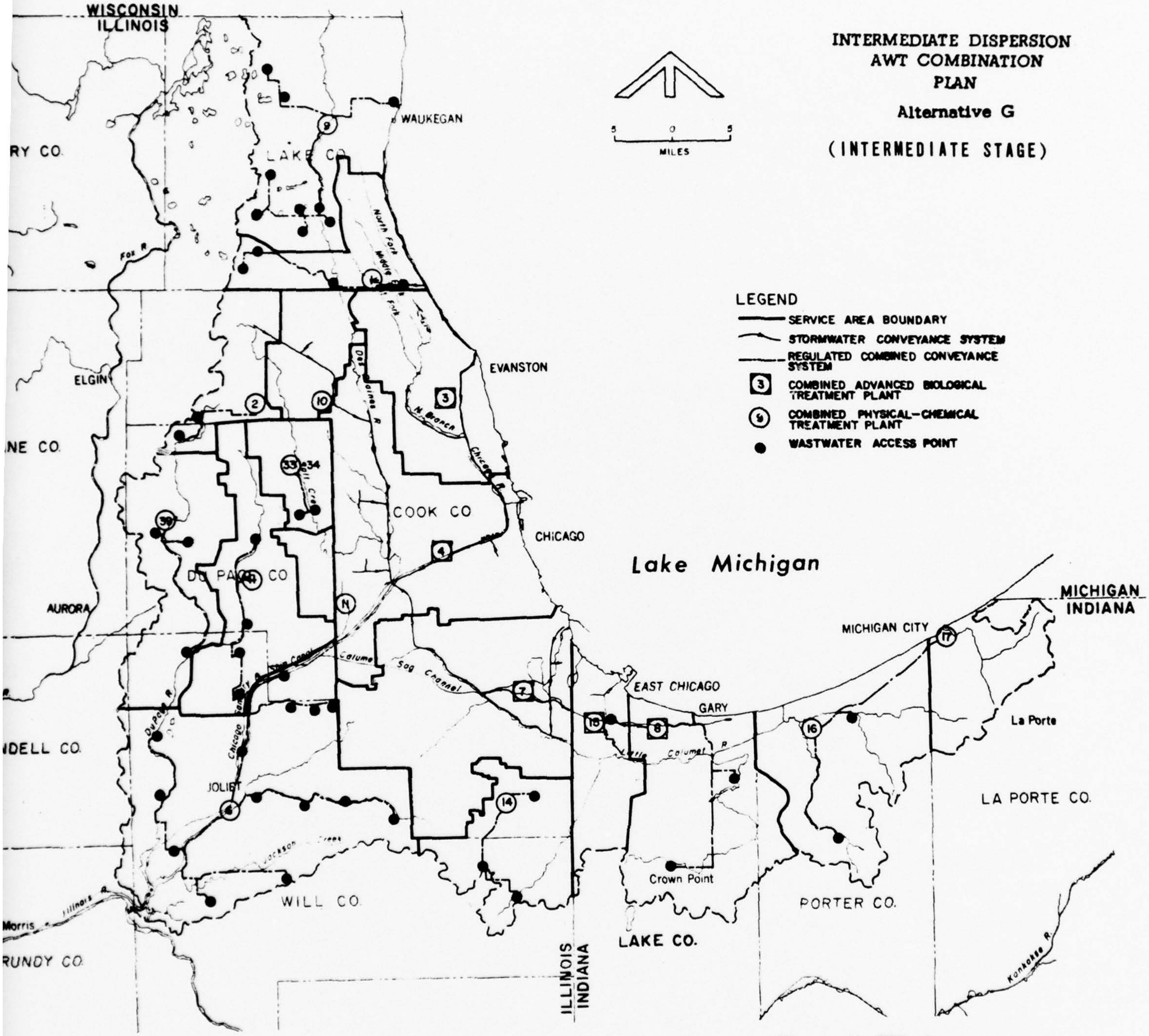


Figure C-VII-6

DESCRIPTION OF INTERMEDIATE STAGE ALTERNATIVES

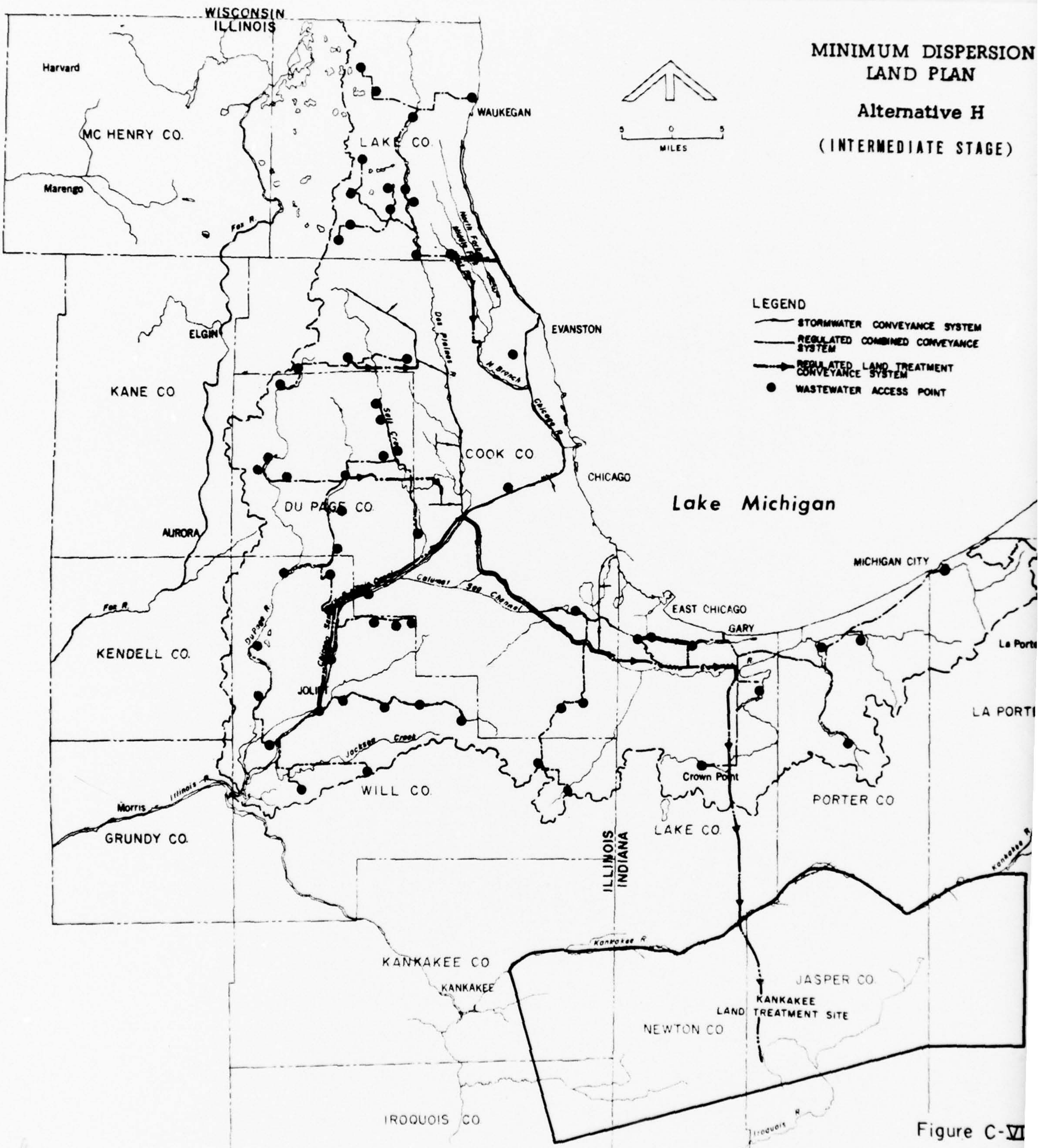
(Alternatives H and I)

ALTERNATIVE H

This alternative employs the land treatment technology at one large site along the Kankakee River in both Indiana and Illinois. See Figure C-VII-7. Tunnels are used to convey the wastewater from the study area to the land treatment site. In this alternative all regional treatment facilities are abandoned. However, they serve as access points by which the waste load from local collection systems enter the regional conveyance system. Two options are employed for the sludge management program. For agricultural utilization of sludge, the solids from the land treatment storage lagoons are dredged and conveyed to nearby agricultural disposal areas. In the second option, the sludge is conveyed to surface mines in central Illinois for land reclamation purposes. The reclaimed water from the single land site is collected by means of a drainage system and returned to Lake Michigan by a separate tunnel. A pipeline distribution network is then designed for conveying Lake Michigan water to the headwaters of the study area's streams for recreational purposes.

ALTERNATIVE I

Alternative I is similar to Alternative H, except that instead of one land site, there are six land sites: 3 sites located in McHenry County; 1 site in Kendall County; 1 site in Will-Grundy-Kankakee counties in Illinois and a scaled-down Kankakee site in Indiana as shown in Figure C-VII-8. There are a number of land conveyance tunnels servicing the dispersed land site. However, unlike Alternative H, the treated water is used where needed to help augment the receiving streams in the land site areas for recreational and other purposes locally and for commercial navigation on the Illinois River. The treated water from the Kankakee-Indiana site area is returned via a tunnel to Lake Michigan. The McHenry and Kendall County sites discharge their waters into the Fox River. The Grundy-Will-Kankakee land site discharges its waters directly to the Illinois River. As was done in Alternative H, a pipeline distribution network is designed for conveying Lake Michigan water to the headwaters of the major C-SELM streams for recreational purposes.



MINIMUM DISPERSION
LAND PLAN
Alternative H
(INTERMEDIATE STAGE)
MILES
LEGEND
STORMWATER CONVEYANCE SYSTEM
REGULATED COMBINED CONVEYANCE SYSTEM
REGULATED LAND TREATMENT CONVEYANCE SYSTEM
WASTEWATER ACCESS POINT
WISCONSIN
ILLINOIS
Harvard
Marengo
MC HENRY CO.
LAKE CO
WAUKEGAN
EVANSTON
ELGIN
KANE CO
COOK CO
CHICAGO
Lake Michigan
DU PAGE CO.
AURORA
KENDELL CO.
JOLIET
WILL CO.
Morris
GRUNDY CO.
EAST CHICAGO
GARY
MICHIGAN CITY
La Porte
LA PORTE
PORTER CO
Crown Point
LAKE CO.
ILLINOIS
INDIANA
KANKAKEE CO
KANKAKEE
JASPER CO.
KANKAKEE
LAND TREATMENT SITE
NEWTON CO
IROQUOIS CO

Figure C-VI

UM DISPERSION
ND PLAN

ernative H

EDIATE STAGE)

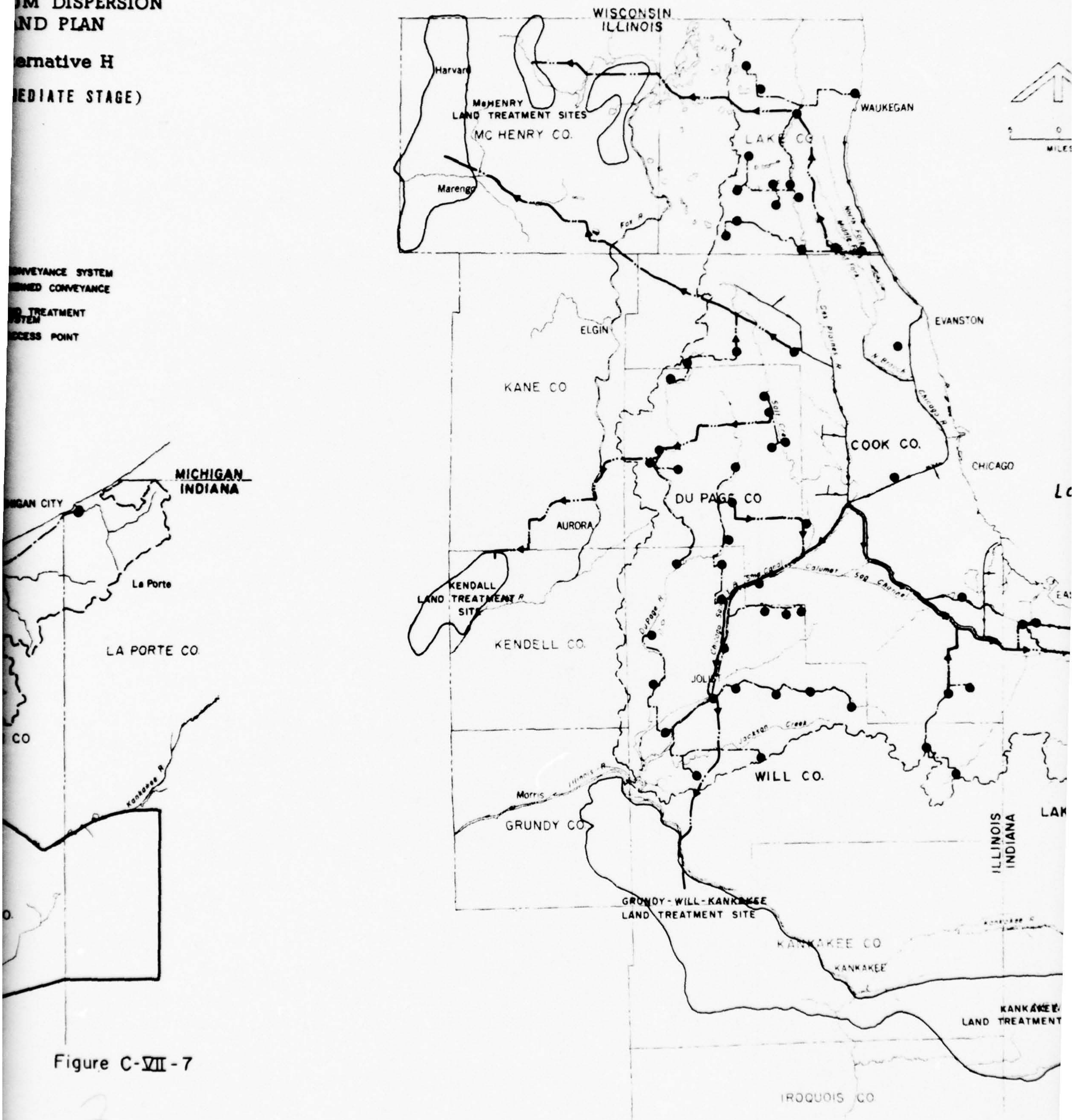


Figure C-VII-7

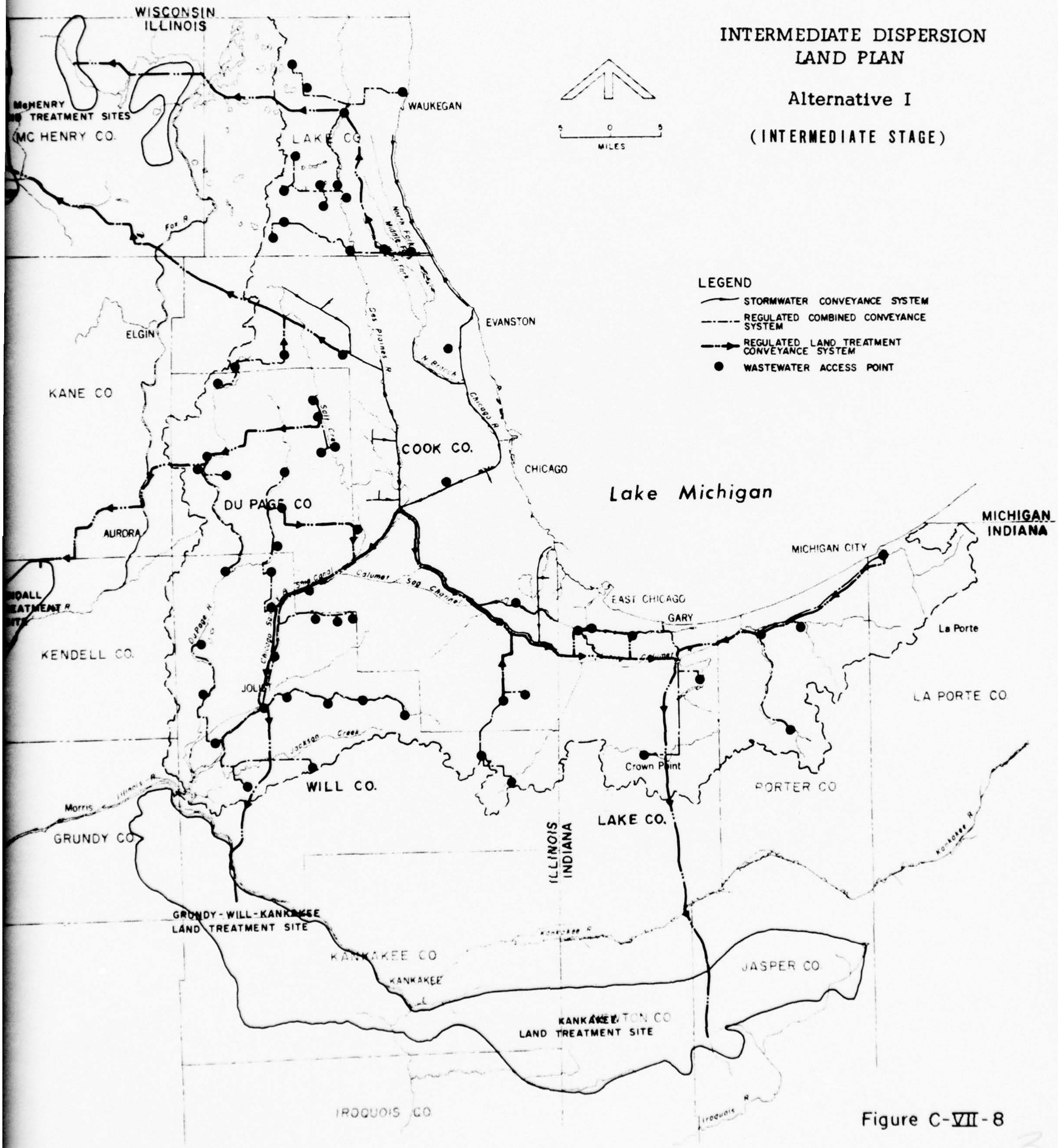


Figure C-VII-8

DESCRIPTION OF INTERMEDIATE STAGE ALTERNATIVES

(Alternatives J and K)

ALTERNATIVE J

Alternative J utilizes both an Advanced Biological and Land treatment system. The same 5 large plants as described in Alternative G utilize an Advanced Biological treatment system. These plants are the North Side, West-Southwest, and Calumet plants of the MSDGC and the Hammond and Gary plants in Indiana. All other flows from the C-SELM area are conveyed to the 6 land treatment sites, as discussed in Alternative I. However, the size of the Kendall site will be reduced 20% from Alternative I; the size of the Will-Grundy-Kankakee site will be reduced by 80%; and the size of the Kankakee-Indiana site will be reduced by 94%. This alternative system is shown in Figure C-VII-9.

The alignment of the conveyance tunnels is similar to that presented in Alternative I. However, their capacities are greatly reduced since the 5 plants treat the major portion of the flow. Unlike Alternative I, the treated water from the Kankakee-Indiana site is discharged to the Kankakee River. The treated water from the McHenry and Kendall County sites is discharged into the Fox River as in Alternative I.

ALTERNATIVE K

Alternative K, shown in Figure C-VII-10, is similar to Alternative I, using the same six land treatment sites. The one variation in this alternative is the utilization of open space areas to treat local stormwater. A portion of the urban-suburban stormwater will be treated through an unobtrusive sprinkler-irrigation system on existing open space areas. To accommodate future open space needs, the rural stormwaters also will be applied to areas which are programmed for use as open space by the regional planning agencies.

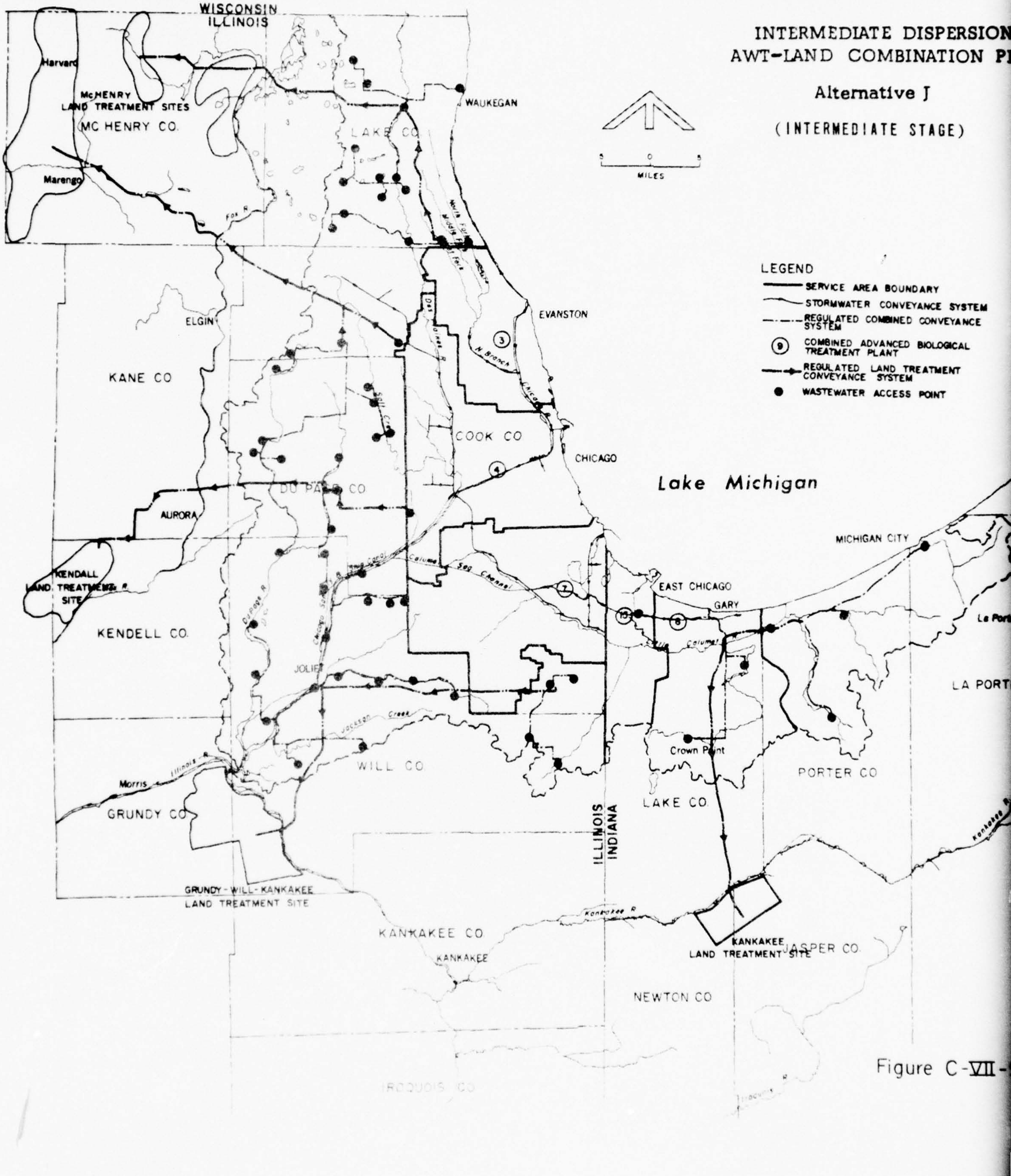

INTERMEDIATE DISPERSION
AWT-LAND COMBINATION PL
Alternative J
(INTERMEDIATE STAGE)
MILES
LEGEND
SERVICE AREA BOUNDARY
STORMWATER CONVEYANCE SYSTEM
REGULATED COMBINED CONVEYANCE SYSTEM
COMBINED ADVANCED BIOLOGICAL TREATMENT PLANT
REGULATED LAND TREATMENT CONVEYANCE SYSTEM
WASTEWATER ACCESS POINT
WISCONSIN
ILLINOIS
Harvard
McHENRY LAND TREATMENT SITES
MC HENRY CO.
Marengo
LAKE CO.
WAUKEGAN
Fox R.
EVANSTON
ELGIN
KANE CO
COOK CO
CHICAGO
Lake Michigan
DU PAGE CO
AURORA
KENDALL LAND TREATMENT SITE
KENDELL CO.
Calumet Sag Channel
EAST CHICAGO
GARY
MICHIGAN CITY
La Porte
LA PORTE
JOLIET
Jackson Creek
WILL CO.
Crown Point
PORTER CO
Morris
Illinois R.
GRUNDY CO
LAKE CO.
ILLINOIS
INDIANA
GRUNDY - WILL - KANKAKEE LAND TREATMENT SITE
Kankakee R.
KANKAKEE CO.
KANKAKEE
KANKAKEE LAND TREATMENT SITE
JASPER CO.
NEWTON CO
IROQUOIS CO.

Figure C-VII-

INTERMEDIATE DISPERSION
-LAND COMBINATION PLAN

Alternative J

(INTERMEDIATE STAGE)

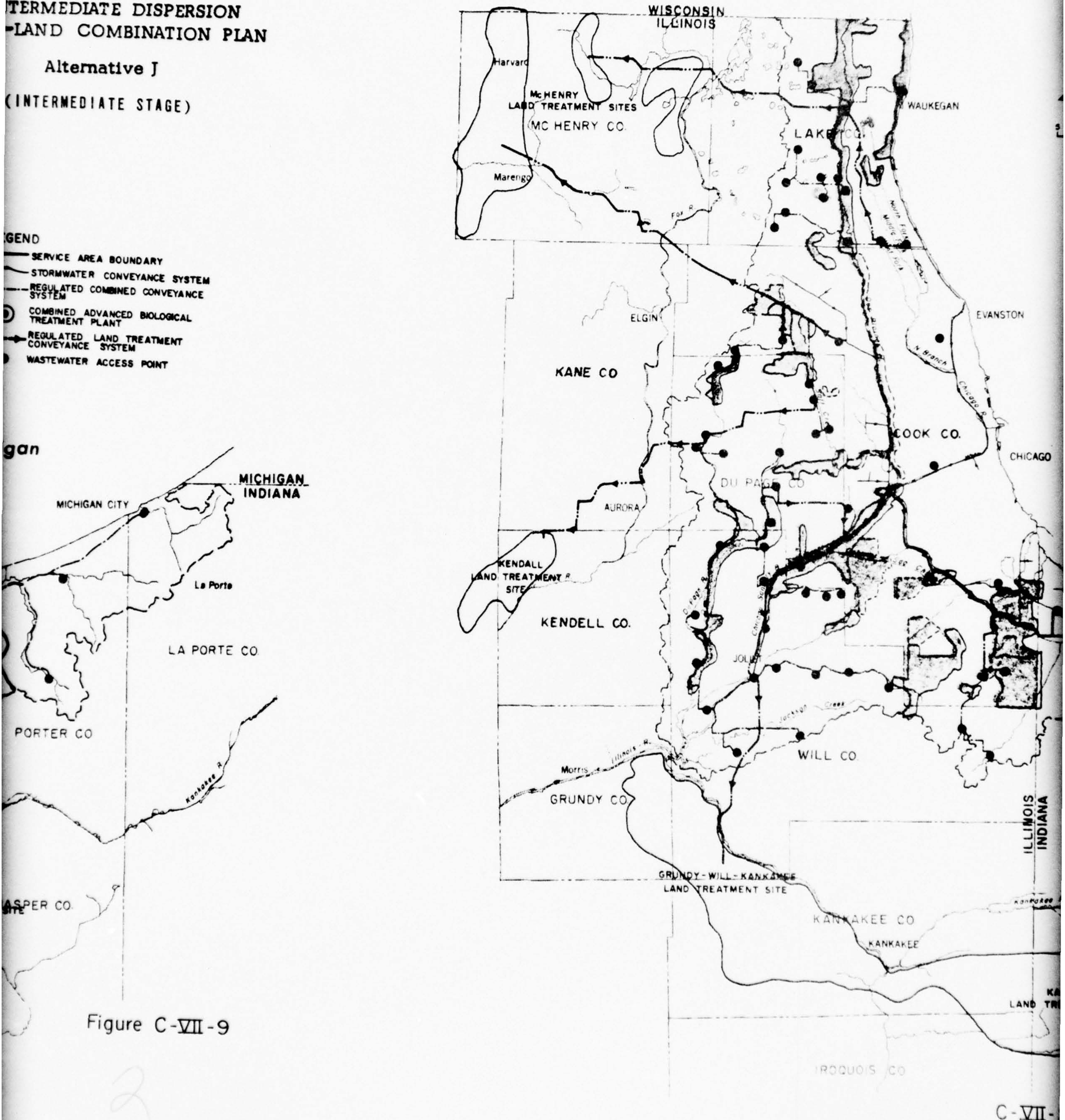


Figure C-VII-9

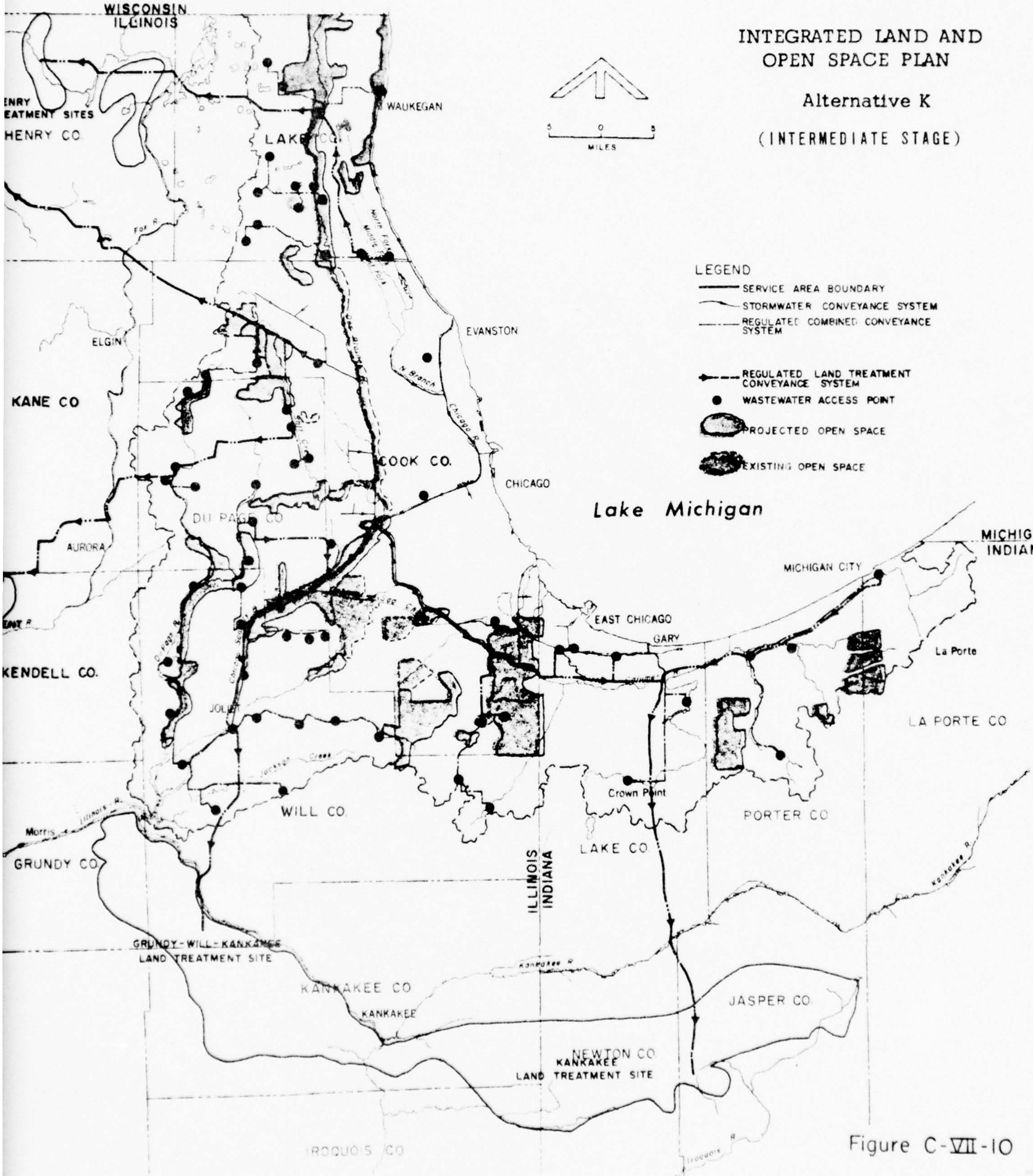


Figure C-VII-10

SECTION VIII - FRAMEWORK FOR ASSESSMENT

BACKGROUND

The alternatives retained in the intermediate stage had been purposely structured to focus on those planning and policy aspects which had to be resolved before development of final plans could be accomplished.

The degree of regionalization feasible for both the plant and land technologies had to be addressed. Concurrent with this decision were the related issues of: the water balance and use of Lake Michigan; the sludge management program; and the synergistic potential for power potable water supply, in-stream recreation and open-space needs.

The total resource commitment associated with the alternatives also had to be evaluated. This data was required to further differentiate between the alternatives. Resource consumption associated with each of the technological processes had implications beyond the local level. At the local level, the area resources of land (required), people (affected or displaced), social well-being (human dimension) and costs were basic considerations. At the regional level, the competitive demands induced by the wastewater system on such growth factors as energy, chemicals, labor skills and land-use had to be identified and the causal effects scaled. Finally, an assessment had to be made of the national implications for both the foregoing and the capability to meet those needs that contribute to the nation's economic development and the national environmental quality goals..

In addition, the institutional problems associated with the alternatives had to be evaluated to determine the practicality of the planning effort. Concurrent with this evaluation was the need to determine the public reaction and attitude to each alternative.

To accomplish the foregoing, the resource commitments, engineering data and costs associated with each alternative and the individual components were determined by the technical contractor. This information was then published in report form and furnished the other study participants including members of the Citizens Advisory Committees. The information in this report provided the basis for the subsequent assessments by the socio-environmental and institutional evaluators. At the same time, the information was summarized in an informational brochure and mailed to the area's residents and news media prior to holding the Plan-Formulation Public Meeting.

RESOURCE CONSUMPTION

The resource consumption associated with the design and operation of the eleven alternatives were divided into two broad categories: energy demands and chemical consumptions. Land with its associated socio-environmental implications, was evaluated separately.

The range of daily energy and chemical requirements for each of the eleven alternatives was determined. The results of the preliminary estimates are shown in Figure C-VIII-1. The energy demands included the electrical energy required for the collection and conveyance of the wastewater to the treatment facility (plant and/or land sites) and the redistribution of both treated water and the sludge accrued during the treatment process. The second source of energy demand was the fuel required for incineration as part of the treatment process. Natural gas was the fuel selected in this latter assessment because of its minimal impact on air pollution. The other category, chemical consumption reflected the various key chemicals required for the daily operation of the three technologies. The key chemical requirements of the three technologies were first determined on a unit volume of wastewater to be treated. These preliminary estimates are listed in Table C-VIII-1 below. This data then was used to evaluate the daily chemicals requirements for each of the alternatives.

TABLE C-VIII-1
KEY CHEMICAL REQUIREMENTS (PER 100 MGD)

	ADV. BIO	PHYS-CHEM	LAND
Chlorine	3.3 tons	3.3 tons	3.3 tons
Lime	46.0 tons	56.4 tons	None
Carbon	0.9	1.9 tons	None
Clinoptilolite	None	25.0 tons	None

AREAL RESOURCE IMPACT

The impact on the area's natural resources was also quantified. This quantification was done on a comparative basis in an effort to develop a secondary level of differentiation between the treatment technologies. As such, the evaluation focused on the effects that the technologies would have on the area's water, air and land resources.

WATERWAYS

The impact on the area's waterways was assessed in terms of three critical constituents, i.e., phosphate, ammonia nitrogen and the total dissolved solids. The first two constituents were of a concern relative to the enhancement of the waterway's aquatic ecosystem. The third factor, the dissolved solids, including salts, were of interest in concern to waterway's natural background levels and the reuse implications relative to the area's water balance. The relative impact of each of the alternatives are shown in Figure C-VIII-2.

COMPARATIVE RESOURCE REQUIREMENTS

RESOURCE	A & B EXISTING STANDARDS	C THROUGH F: ADVANCED BIOLOGICAL	C THROUGH F: PHYSICAL - CHEMICAL	G PLANT COMBINATION	H, I & K LAND TREATMENT	J LAND + ADV. BIO.
ELECTRICITY (MEGAWATT - HOURS PER DAY) *	3,000 - 3,400	10,500 - 11,400	10,500 - 11,400	11,200	23,000 - 26,000	12,200
CHEMICALS (TONS PER DAY)	28	1,500	2,600	1,800	100	1,360
GAS (MILLION CUBIC FEET PER DAY)	~ 0	90	90	90	~ 0	81

* INCREASES AS NUMBER OF TREATMENT SITES DECREASES

Figure C-VIII-1

COMPARATIVE IMPACT ON WATERWAYS

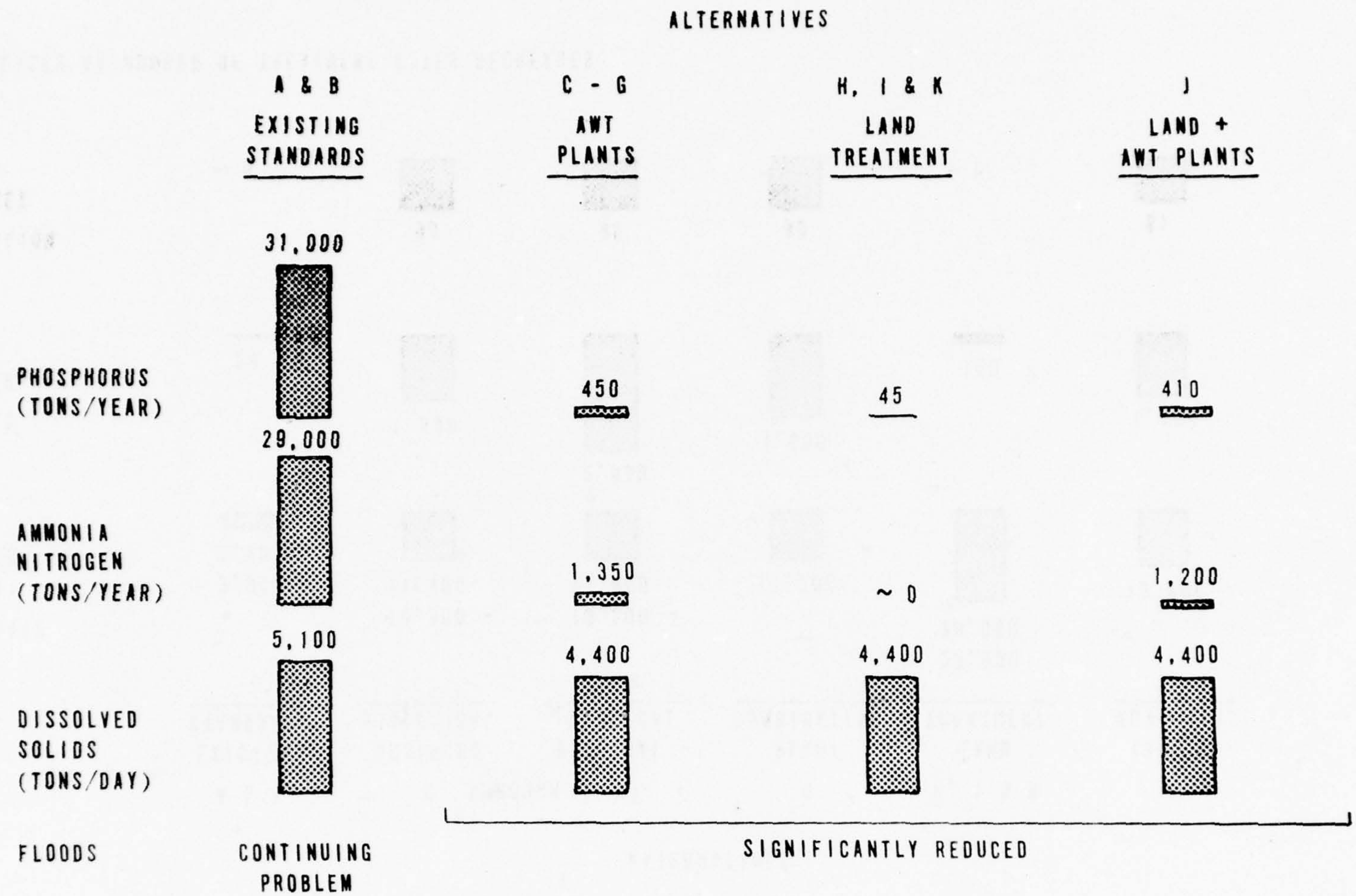


Figure C-VIII - 2

AIR

Similarly, the effects of the individual treatment processes on the air quality was scaled on a preliminary basis. It should be noted that all technologies were designed to meet current USEPA air emission standards; but the residual discharges still provided an adverse impact to the area's total environment. Odor problems associated with the treatment plant technologies would be minimal except for the Physical-Chemical process. However, any odors produced would be quickly noticed since the plants are generally located in densely populated areas. With the land technology, significant short term odors could be produced by lagoon turnover in the spring. Nevertheless, with proper lagoon depth design and use of mechanical aerators, this problem can be minimized. The results of this analysis is shown in Figure C-VIII-3. As is noted, the results do not include the secondary level of impacts associated with the production of the alternatives' energy requirements. This aspect was considered beyond the scope of the study.

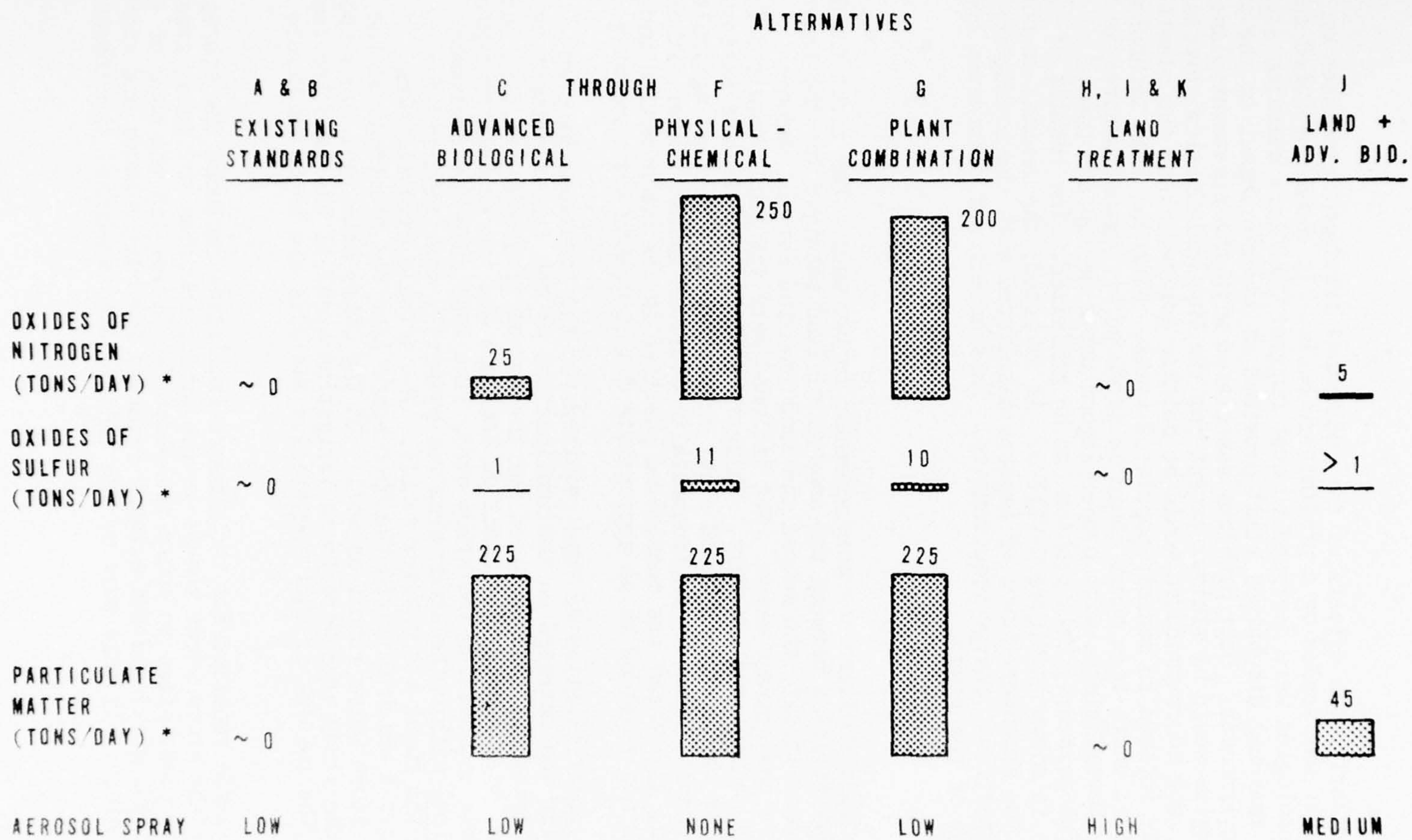
LAND

The land implications were assessed in two ways. The first involved the differentiation between the amounts of land required for the treatment process itself; the second the land required for the support facilities and storage areas. Not included were the lands required for the sludge management programs. While these latter needs were assessed, the program objectives involved a net enhancement for either agricultural and/or rehabilitation of environmentally degraded lands. Under either situation, the output was considered positive in its contribution and thus, was not regarded as an appropriate discriminator for screening.

The quantification of land required for the treatment program essentially concentrated on the implications of the land treatment system. By identifying the land required for the actual treatment process, the assessment underscored the impact on land-use and the social structure both within and outside the study area. The land used for treatment (irrigation) within the study area was primarily that required for treating the rural storm water runoff. The notable exception was Alternative K which utilized the open-space land for treatment of the suburban storm water runoff as well. On the other hand, the lands required outside the study area were those irrigation areas of the land treatment system. The results of this comparative analysis are shown in Figure C-VIII-4.

The lands required for the support facilities included the storage areas for the storm water runoff in the urban, suburban and rural areas; the actual plant sites to house the plant facilities (in the case of the plant technologies) and the acreage required for buffer zones and administrative buildings. In this part of the land-related analysis, the impacts were

COMPARATIVE IMPACT ON THE AIR



* AIR POLLUTANTS PRODUCED BY SUPPORTING POWER FACILITIES ARE NOT INCLUDED

Figure C-VIII-3

COMPARATIVE IMPACT ON LAND IRRIGATION AREAS (1,000 ACRES)

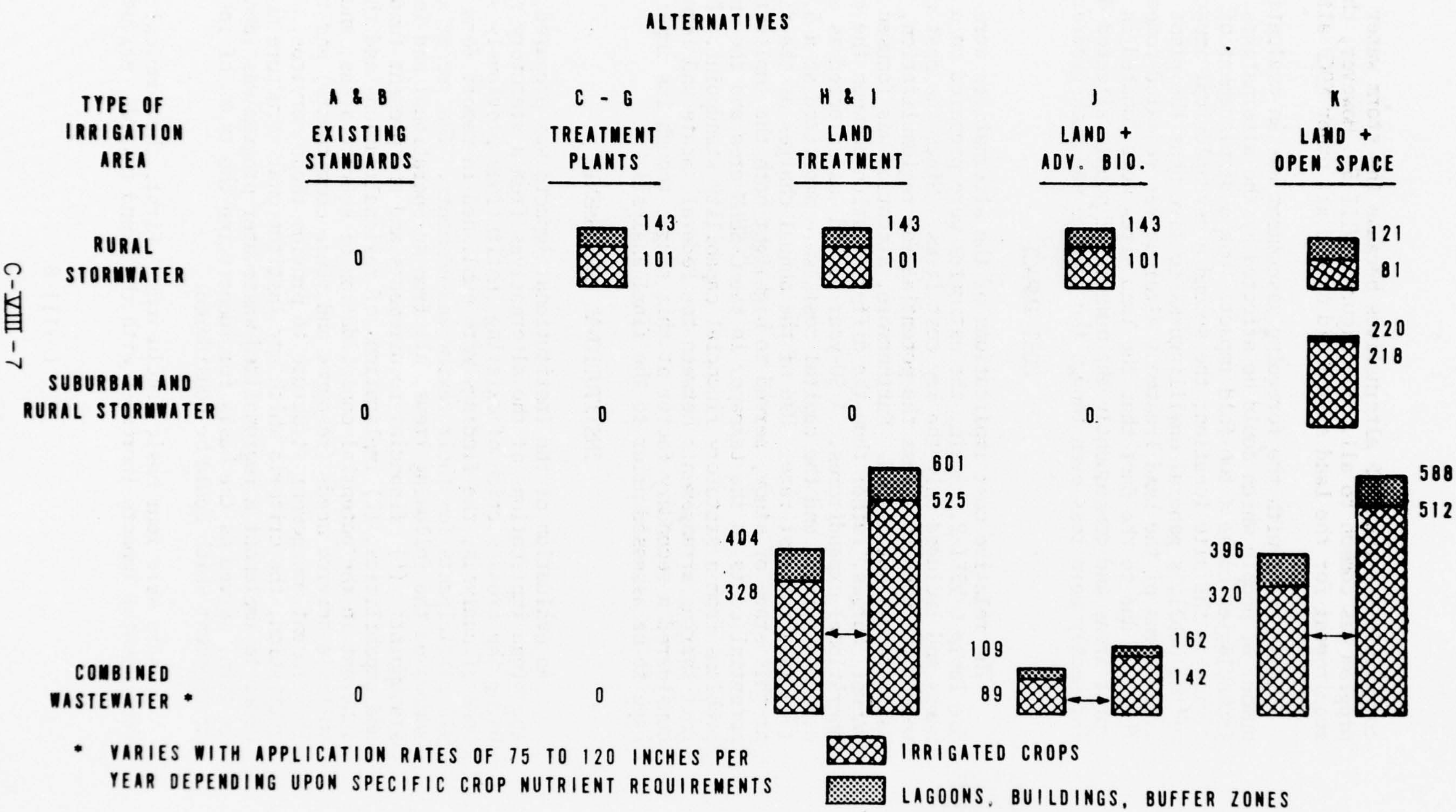


Figure C-VIII-4

comparable for the NDCP alternatives because the storm water management program was common to all. See Figure C-VIII-5. However, the total land requirement for the Land system did exceed all other NDCP alternatives.

Concurrent with the foregoing assessment was an evaluation of the number of people which could be affected by the alternatives. The plant technologies cause a two-fold impact: one a displacement of the people living in the site location; the second a psychological impact reflective of the public's general unwillingness to live near the plant site. Similar evaluations of the Land Treatment Alternatives revealed comparable results. This was due to the fact that the land sites were located in low-density rural areas and consequently the numbers of people affected directly and indirectly were less even though the acreage was much greater.

COST IMPACT

The relative cost implications of the alternatives were also evaluated. See Table C-VIII-2. Again, the estimates were prepared on a component basis and included only the key cost items. Since the cost comparisons were to be used to assess the potential for regionalization, a detailed cost estimate was not needed. Furthermore, attention was focused on the total annual charges, rather than the differentiation between the capital and operational expenditures. A 50-year period was selected as an appropriate economic period, and the capital costs were amortized at a 5.5 percent (Federal) interest rate. Use of the annual charges as the discriminator at this stage of study, served to highlight both the implications of potential costs to the taxpayer in the C-SELM area and the institutional problems from a statutory financial capability standpoint. Possible cost-sharing arrangements between the Federal, State and local level was considered a secondary factor at this stage, though its implications would have to be assessed prior to the final analysis.

INSTITUTIONAL ASSESSMENTS

An evaluation of the institutional impacts was prepared, identifying the broad implications of the alternatives from a statutory standpoint. Using the cross-section of existing institutions previously selected as a base of analysis, the findings were published in report form and furnished all participants for their review and comments. The report specifically addressed the following items, all from an operational and legal capability standpoint: (1) financial requirements and the present funding arrangements and capabilities; (2) implications of regionalizations and the problems inherent in the potential consolidation of service areas; and (3) the multiple service needs (resource and reuse commitments) and the ability of the present management structure to provide these services. From this evaluation, the criteria which any institutional structure must meet in order to implement a regionalized wastewater program was identified. This, in turn, served as the basis for identifying the types of institutional arrangement which could be considered.

There were four basic conclusions. First, the complexity of inter-governmental impacts increases with the trend towards regionalization -

COMPARATIVE IMPACT ON LAND—FACILITY & STORAGE AREAS (ACRES)

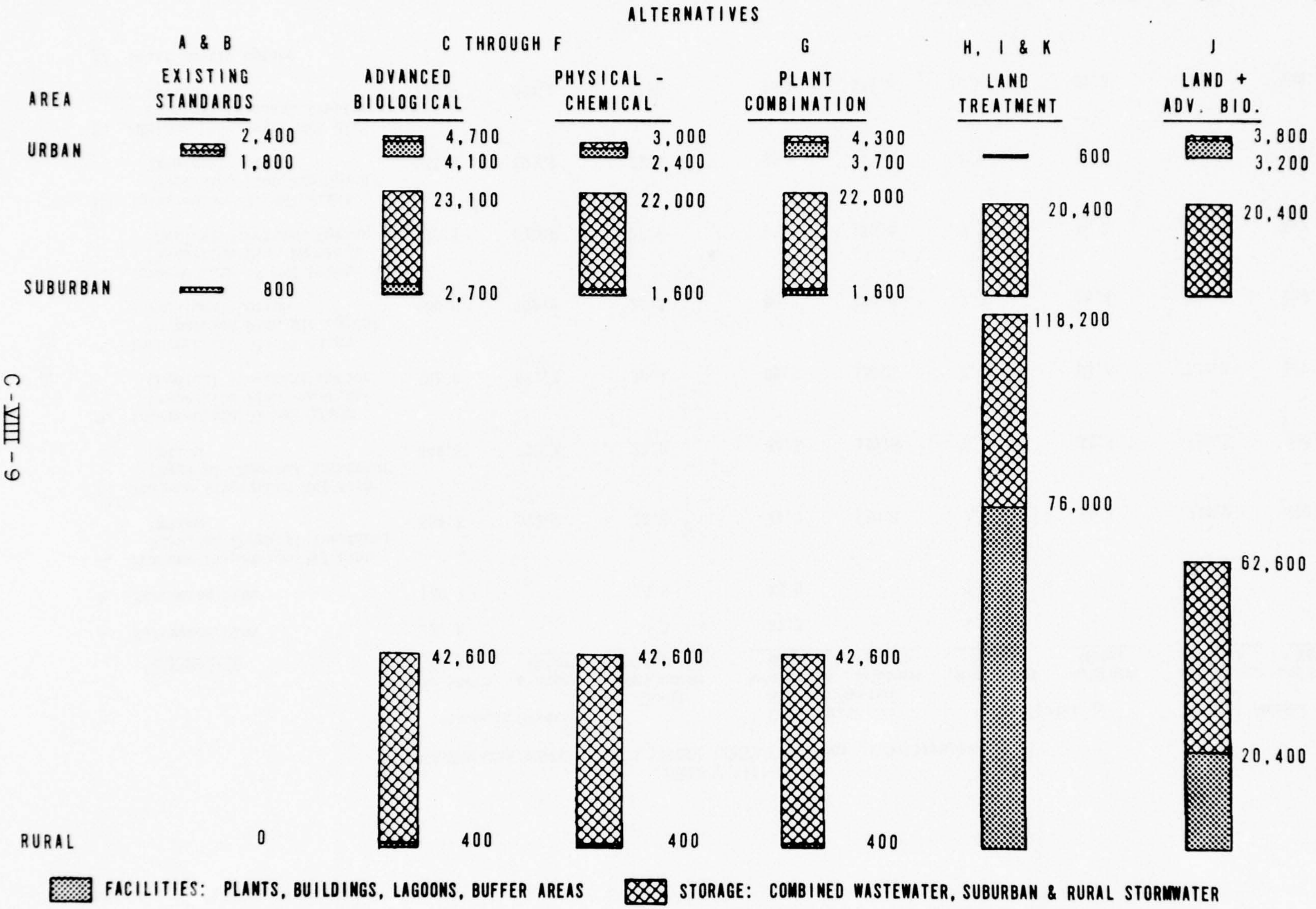


Figure C-VIII-5

TABLE C-VIII-2
SYSTEM COMPONENTS - TOTAL ANNUAL COSTS (Millions of Dollars/Year)

Alternative	Treatment System		Sludge Management System 1/	Conveyance and Storage System		Reuse System 1/		Total Annual	
	w/o Storm Water	w/Storm Water		w/o Storm Water	w/Storm Water	w/o Storm Water	w/Storm Water	w/o Storm Water	w/Storm Water
A. Reference Plan	191.8	-	24.3	81.3	-	1.6	-	299.0	-
B. Screening Plan	188.2	-	23.9	85.9	-	2.8	-	300.8	-
C. Maximum Dispersion AWT Plan Physical-Chemical Treatment Option	604.5	602.4	31.2	81.3	130.8	7.2	58.4	724.2	882.7
C. Maximum Dispersion AWT Plan Physical-Chemical Treatment Option	645.6	722.3	22.2	81.3	130.8	7.2	58.3	756.3	933.6
D. Intermediate 41 AWT Plant Dispersion Plan Physical-Chemical Treatment Option	598.0	652.7	30.4	86.5	136.0	7.3	58.4	722.2	877.5
D. Intermediate 41 AWT Plant Dispersion Plan Biological Treatment Option	636.0	709.6	21.3	86.5	136.0	7.3	58.4	751.1	925.3
E. Intermediate 17 AWT Plant Dispersion Plan Physical-Chemical Treatment Option	590.1	635.8	29.3	93.6	143.4	7.5	58.6	720.5	867.1
E. Intermediate 17 AWT Plant Dispersion Plan Biological Treatment Option	631.4	695.9	21.0	93.6	143.4	7.5	58.7	753.5	919.0
F. Minimum Dispersion AWT Plan Physical-Chemical Treatment Option	586.9	634.6	27.9	96.8	144.6	10.4	61.5	722.0	868.6

1/ Least costly option

TABLE C-VIII-2 (Cont'd)
SYSTEM COMPONENTS - TOTAL ANNUAL COSTS (Millions of Dollars/Year)

Alternative	Treatment System		Sludge Management System 1/	Conveyance and Storage System		Reuse System 1/		Total Annual	
	w/o Storm Water	w/Storm Water		w/o Storm Water	w/Storm Water	w/o Storm Water	w/Storm Water	w/o Storm Water	w/Storm Water
F. Minimum Dispersion AWT Plan Biological Treatment Option	631.6	696.3	17.3	96.8	144.6	10.4	61.5	756.1	919.7
G. Intermediate Dispersion AWT Technology Combination Plan	608.2	661.9	24.0	93.6	143.4	10.1	61.4	735.9	890.5
H. Minimum Dispersion Land Plan Without Synergism Option	216.2	236.0	17.4	126.6	176.5	24.2	81.3	384.4	511.2
I. Intermediate Dispersion Land Plan Without Synergism Option	228.1	248.1	17.4	123.2	173.0	27.1	83.3	395.8	521.8
J. Intermediate Dispersion AWT Land Technology Combination Plan	529.2	548.5	20.2	119.5	169.3	15.4	68.0	684.3	806.0
K. Integrated Land and Open Space Plan Without Synergism Option	-	401.3	17.4	-	173.0	-	83.3	-	675.0

1/ Least costly option

particularly the assumption of debts (abandoned plants) and reduction of some institution's functions. Second, the NDCP alternatives would significantly increase the scope of operations and the associated capital and operating costs - requiring statutory changes in the debt ceiling and service responsibilities. Third, consideration would have to be given the options of either: (1) establishing cooperative arrangements for the joint use of individual components, (2) entering into contractual (service) agreements, or (3) creating new institutions - in order to expand the legally constrained geographic limits of the major service entities. Lastly, authority would have to be provided requiring the adoption of non-structural measures and, where appropriate, to help establish regional and interstate agreements.

The report concluded that although the various NDCP alternatives do have different institutional impacts, the differences were not of sufficient significance to favor any particular alternative. This conclusion was based on the fact that the major institutional impacts centered around the objectives and functions (achieving higher standards) of the alternatives and not on the configuration and technology involved. Therefore, the institutional impacts were not considered a major determinant and were not used in the screening process.

SOCIO-ENVIRONMENTAL ASSESSMENT

The socio-environmental evaluation differentiated the impacts of each alternative's system components on the 19 human dimensions that characterize the life-style of an area. In this way, the major differences between alternatives were identified on an aggregate and component basis and both could be used as an effective screening level. The assessment first was done on a comparative numerical (matrix) basis. Then, the major differences were identified and discussed in quantitative or qualitative terms as they related to the environmental elements. This, in turn, provided input for further design modifications.

The findings together with a discussion of the refined evaluation methodology was published in report form and furnished all participants. The numerical values, particularly the range within component groupings were the factors that were carefully assessed - both from a comparative sense and as guidance for redesign efforts. The redesign was considered necessary to mitigate the major adverse effects so that a closer comparability in the human dimensions (social well-being) would be achieved.

The findings of the evaluation team was supplemented by the public reaction at the Plan-Formulation Meeting held at this time. Most of the general public input was directed at the Land Treatment System with little or nothing said about the other alternatives and the system components.

Reaction to the Land Treatment System was directed to at least three key aspects of the design concept then being used. The first pertained to the social and economic impact of the system under a fee acquisition program and its adverse implications in disrupting the life-style of the agricultural area. The second point pertained to the land sites, particularly the single site (Alternative H) tending to act as a barrier to the existing regional growth patterns, even if some through-access corridors were provided. A third factor was the negative reaction towards using the rural area lands to solve the wastewater problems of the urban area. These concerns, together with the other evaluations, then served as input to the screening process which followed.

SECTION IX - PLAN-FORMULATION, FINAL STAGE

GUIDELINES FOR FINAL SCREENING

Determining which alternatives should be retained for final study proved to be extremely difficult. Preliminary assessment of the resource consumption, costs, socio-environmental and institutional implications indicated a wide and diversified range of impacts. Furthermore, the concept of using agricultural lands to treat the study area's wastewater had generated a strong political and social opposition in the outlying area. Involved was a reluctance of the agricultural community to commit local resources to treat metropolitan wastes and their concerns as to the long-term effects on local land-use and socio-economic patterns. Accordingly, the legislative drafts for what eventually was enacted as PL 92-500 were reviewed. In order to be responsive to these intents, the following decisions were made:

(1) One of the two existing standard alternatives would be retained. The detailed assessment could provide information relative to on-going and near-future program commitments at the local level. At the same time, it would facilitate a comparison between water quality goals and identify the implication of going to such high effluent standards as were adopted for this study.

(2) Consideration should be given to retention of at least one alternative involving each of the three NDCP technologies. This would be responsive to the requirement, that after 30 June 1974 local interests must demonstrate that alternative waste management techniques have been studied and evaluated before Federal grant assistance can be made (Section 201(g)(2)(A)).

(3) The alternatives should reflect a variable degree of regionalization. This would be responsive to the requirement that to the extent practicable, waste treatment management shall be on an areawide basis (Section 201 (c)).

(4) Consideration should be given to retention of at least one alternative involving a combination of treatment technologies. This would tend to underscore the inherent advantages and/or disadvantages of different system balances, particularly if designed from a geographical and wasteload standpoint.

(5) As much flexibility in system design should be maintained by using options as add-on considerations. This applied to both sludge management and withdrawals from Lake Michigan.

(6) Maximum effort be made to identify the potential for multiple-purpose planning ranging from revenue production facilities (Section 201(d))

and integration of wastewater facilities to seek solutions to other pollution problems (Section 201(e)) to combining treatment management with open-space and recreational considerations (Section 201(f)).

The result of the foregoing was that it not only outlined the procedure to be used in the screening process but also stressed the importance of structuring the system components in such a way as to provide the most effective evaluation of system performance. This latter factor was significant if the study findings were to be of value and usable as a framework of consideration by those having the responsibility for selecting the alternatives to meet the new National and State goals. It also meant that a minimum of five alternatives should be retained for final study, depending upon the complexity of the add-on options.

SCREENING CRITERIA

Of the five factors originally evaluated to help differentiate between the alternatives, only two were used in the final screening process. As previously stated, the institutional considerations were not regarded as a significant factor for discrimation between the NDCP alternatives. Moreover, the resource consumptive requirements including land, and the impacts on areal resources were reflected in the effects on the various categories of human dimensions used by the evaluators. Use of these resource implications would tend to duplicate and possibly outweigh the social well-being considerations inherent in the socio-environmental assessment. Therefore, only the results of the socio-environmental assessment and the system costs were used as screening factors.

A scan of the parameters used in the socio-environmental evaluation was then made to further eliminate those considerations of insignificant value. The factors evaluated by the socio-environmental evaluation team includes the following system elements. The collection, transportation and storage of input wastewater; treatment facilities and processes, liquid effluent quality and water reuse; sludge management; and synergisms.

The socio-environmental impacts attributable to the first two system elements varied considerably between alternatives. Therefore, these two elements were retained for use in the screening process. Liquid effluent quality and water reuse potential were considered comparable and, for purposes of this study, a constant for the NDCP alternatives. Hence, this factor did not influence screening. It should be noted that the evaluation team strongly endorsed redistribution of reuse water by stream whenever possible rather than by pipeline. This recommendation was the basis for screening the reuse option.

Land reclamation had been identified as a better environmental option for sludge management than agricultural use, even reclamation costs were somewhat higher because of longer transportation distances. The basic reasons were that the reclamation option tended to: restore acreage to the area's usable land inventory; alleviate existing aesthetic blights; and be less disruptive to the area's community structure. After a policy decision has been made concerning the treatment to be used, the sludge management program can be designed as a constant and, therefore, should not be a factor for use in screening. In the interim, however, both options were retained for final design and evaluation, since the information would be of use to local interests. Many synergisms were considered for the alternative systems. Since, however, final decisions must be based on a full assessment of the trade-offs involved in achieving the additional benefits (synergisms), these add-ons also were not considered an appropriate screening factor.

SCREENING PROCESS

The steps employed in the screening process are shown in Figure C-IX-1. The initial steps which were done concurrently included:

a. Compare the existing standard alternatives and reduce them to one alternative which would be retained for final design.

b. Compare the four Advanced Biological plant alternatives, the four Physical-Chemical plant alternatives and the two Land treatment alternatives. Reduce these to one alternative from each technology for a total of three.

The second part of the screening process involved comparing the three NDCP alternatives previously selected (b above) to the combined Advanced Biological and Physical-Chemical plant alternative, the combined Advanced Biological and Land treatment alternative, and the combined land and open-space alternative. Out of this comparative analysis, four NDCP alternatives were retained for final design and evaluation.

Each of these steps are discussed in the following paragraph. To facilitate the screening, the comparative socio-environmental ratings developed by the evaluation team were normalized to a maximum rating of one (1.0).

SCREENING RESULTS

CURRENT STANDARD PLANS

The comparative analysis of the existing standards, Alternatives A and B, which had 64 and 41 plants, respectively, is shown in Figure C-IX-2. The 64 plant system received a relatively higher socio-environmental score for the collection, transport and storage element while the 41 plant system received the higher score for treatment facilities and processes. The total score was slightly higher for

SCREENING PROCESS, INTERMEDIATE ALTERNATIVES

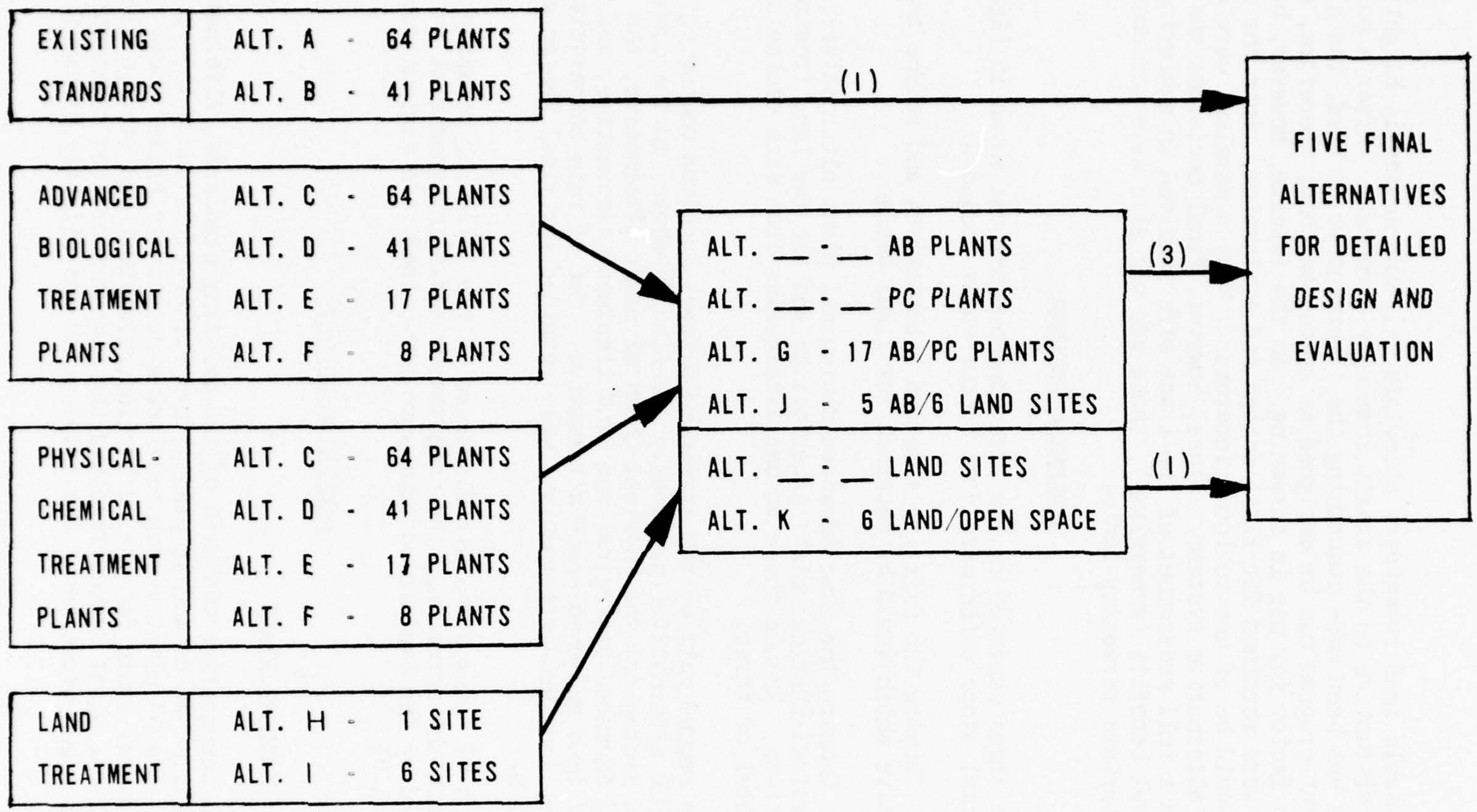


Figure C-IX-1

COMPARISON OF EXISTING STANDARDS ALTERNATIVES
(INTERMEDIATE STAGE)

	NO. OF PLANTS 64	NO. OF PLANTS 41
SOCIO-ENVIRONMENTAL RATING		
COLLECTION, TRANSPORT & STORAGE	1.00	0.03
TREATMENT FACILITIES & PROCESSES	0.02	1.00
TOTAL	1.02	1.03
RANKING	2	1

SOCIO-ENVIRONMENTAL FACTORS

COLLECTION, TRANSPORT & STORAGE

INCREASED REGIONALIZATION ENTAILS:

- INCREASED POWER DEMANDS
- INCREASED MOVEMENT OF TREATED WATER CAUSING DISRUPTIONS IN:
  - Δ NEIGHBORHOOD ENVIRONMENT
  - Δ RECREATIONAL ACTIVITIES
  - Δ ECOSYSTEM STATUS

TREATMENT FACILITIES & PROCESSES

INCREASED REGIONALISM ENTAILS REDUCED IMPACT FROM PLANTS IN:

- Δ AESTHETICS
- Δ ECOSYSTEM STATUS
- Δ RECREATIONAL ACTIVITIES
- Δ NEIGHBORHOOD ENVIRONMENT
- Δ HEALTH & SAFETY

	64	41
ANNUAL COSTS ($ MILLIONS)	299	301
RANKING	1	2

TENTATIVE PREFERENCE: 64 PLANT SYSTEM

Figure C-IX-2

the 41 plant system. The collection, transport, and storage facilities for the 41 plant system received a lower score since, with a lesser number of plants, the electric power needed for pumping is increased. Moreover, the increased need for more treated water at redistribution points causes disruptions in neighborhood environments, recreational activities, and the ecosystem status. Nevertheless, the treatment facilities and process scored higher with the 41 plants since less localities have a treatment plant and the resultant plant impacts on aesthetics, ecosystem status, recreational activities, neighborhood environments and health and safety are less. Annual costs for the 64 plant system were two million dollars per year lower, which indicated that the existing regional plans reflected a cost optimum system. Considering the minor variation in socio-environmental scores between systems, the 64 plant system which reflected local preference was retained for final study.

ADVANCED BIOLOGICAL TREATMENT PLANS

For the four Advanced Biological plant alternatives, as with the current standards plants, an increase in regionalization from 64 to 8 plants produced a progressive decrease in the reflective socio-environmental scores for the collection, transport and storage elements. See Figure C-IX-3. Conversely, a progressive increase in the scores for treatment facilities and processes occured up to the 17 plant system which had the highest composite score. The reasons for the collection, transport and storage element scores systems were similar to those discussed previously; regionalization entailed increased power demands and increased disruptions caused by the transport of reuse water. Gains stemming from the reduction in the number of locales having a plant in their midst were developed considering the general locality of the plants. While the gains were greatest for the 17 plant alternative, a further reduction (8 plants) resulted in these plants being located in areas where the positive gains lessened. Considering annual system costs, the 17 plant system ranked first with the lowest cost. It was thus decided to retain the 17 Advanced Biological plant alternative which ranked first in both the socio-environmental and cost comparisons, as input to the next screening step.

PHYSICAL-CHEMICAL TREATMENT PLANS

Figure C-IX-4 compares the four Physical-Chemical plant alternatives. From an over-all socio-environmental standpoint, the 41 plant system recieved the highest composite score. The relative ratings for the collection, transport and storage systems were identical to those for the four Advanced Biological plants. However, in this case, the ratings for the treatment facilities and processes increased with regionalization continuing to the 8 plant level. In the evaluation of treatment facilities and processes, air quality was critical. Each decrease in the number of plants reduces the number of areas which could be affected by the air pollutants produced by these plants. Therefore, the 8 plant system received

COMPARISON OF ADVANCED BIOLOGICAL PLANT ALTERNATIVES (INTERMEDIATE STAGE)

	NUMBER OF PLANTS			
	64	41	17	8
SOCIO-ENVIRONMENTAL RATING				
COLLECTION, TRANSPORT & STORAGE	1.00	0.94	0.83	0.63
TREATMENT FACILITIES & PROCESSES	0.02	0.78	1.00	0.73
TOTAL	1.02	1.72	1.63	1.36
RANKING	4	2	1	3

SOCIO-ENVIRONMENTAL FACTORS

COLLECTION, TRANSPORT & STORAGE

INCREASED REGIONALIZATION ENTAILS:

- INCREASED POWER DEMANDS
- INCREASED MOVEMENT OF REUSE WATER CAUSING DISRUPTIONS IN:
  - Δ NEIGHBORHOOD ENVIRONMENT
  - Δ RECREATIONAL ACTIVITIES
  - Δ FLORA & FAUNA SUPPLY
  - Δ AESTHETICS
  - Δ ECOSYSTEM STATUS

TREATMENT FACILITIES & PROCESSES:

INCREASED REGIONALIZATION (TO 17 PLANTS) ENTAILS REDUCED IMPACT FROM PLANTS IN:

- Δ NEIGHBORHOOD ENVIRONMENT
- Δ RECREATIONAL ACTIVITIES
- Δ AESTHETICS
- Δ ECOSYSTEM STATUS
- Δ HEALTH & SAFETY

NOTE: 8 PLANTS ARE LOCATED IN AREAS WHERE GAINS LESSEN

	64	41	17	8
ANNUAL COSTS ($ MILLION)	934	925	919	920
RANKING	4	3	1	2

TENTATIVE PREFERENCE: 17 PLANTS (ALT. E)

Figure C-IX-3

COMPARISON OF PHYSICAL - CHEMICAL PLANT ALTERNATIVES (INTERMEDIATE STAGE)

	NUMBER OF PLANTS			
	64	41	17	8
SOCIO-ENVIRONMENTAL RATING				
COLLECTION, TRANSPORT & STORAGE	1.00	0.94	0.83	0.63
TREATMENT FACILITIES & PROCESSES	0.82	0.98	0.97	1.00
TOTAL	1.82	1.92	1.80	1.63
RANKING	2	1	3	4

SOCIO-ENVIRONMENTAL FACTORS

COLLECTION, TRANSPORT & STORAGE

INCREASED REGIONALIZATION ENTAILS:

- INCREASED POWER DEMANDS
- INCREASED MOVEMENT OF REUSE WATER CAUSING DISRUPTIONS IN:
  - Δ NEIGHBORHOOD ENVIRONMENT
  - Δ RECREATIONAL ACTIVITIES
  - Δ FLORA & FAUNA SUPPLY
  - Δ AESTHETICS
  - Δ ECOSYSTEM STATUS

TREATMENT FACILITIES & PROCESSES

INCREASED REGIONALISM ENTAILS REDUCED IMPACT FROM PLANTS IN:

- Δ NEIGHBORHOOD ENVIRONMENT
- Δ RECREATIONAL ACTIVITIES
- Δ AESTHETICS
- Δ ECOSYSTEM STATUS
- Δ HEALTH & SAFETY
- Δ FLORA & FAUNA SUPPLY

NOTE: AIR QUALITY IS CRITICAL

	64	41	17	8
ANNUAL COSTS ($ MILLION)	883	878	867	869
RANKING	4	3	1	2

TENTATIVE PREFERENCE: 41 PLANTS (ALT. D) (MODIFIED ?)

Figure C-IX-4

the highest score. Otherwise, the reasons for the scores for both system elements were similar to those discussed in previous plant comparisons. One added element associated with the Physical-Chemical treatment facilities and processes was the potential for adversely affecting local flora and fauna. From a cost standpoint, the 17 plant system ranked first. The 41 plant system ranked third with an increased cost differential of 6 million dollars per year compared to the 17 plant system. Considering the relatively minor variation in costs between the 17 and 41 plant systems, the 41 Physical-Chemical plant system was retained. By so doing, the design and cost implication of three levels of collection and conveyance system i.e., 64 plants (existing standards), 17 plants (AB) and 41 plants (PC) would be provided in the final study stage.

LAND TREATMENT PLANS

Figure C-IX-5 compares the land treatment alternatives employing a single site and six dispersed sites. With both system elements, the six site alternative scored highest. Considering the collection, transport and storage system elements, the single site scored lower than the 6 sites since the single site required greater movement of treated water, thereby producing disruptions in neighborhood environments, recreational activities, aesthetics and existing flora and fauna. Treatment facilities and processes for the single site also tended to act more as a barrier to development; and have comparatively greater negative impact on the cultural, educational, recreational and environmentally unique areas. All of these factors help make up the life-style of the agricultural area. Annual costs for the single site alternative were some 2 percent or 11 million dollars less than for the six site alternative. Considering the comparative socio-environmental superiority of the 6 site system and the relatively minor difference in system costs, the 6 site alternative was retained for further comparison with Alternative K which involved six land sites in the outlying area and utilization of open space for storm water treatment in the study area. See Figure C-IX-6. The socio-environmental rating for Alternative K was considerably higher than for Alternative I, reflecting the major environmental benefits that could be achieved with additional open space. However, the difference in total annual costs for the two systems was 153 million dollars. Equivalent open space benefits can be achieved for less cost if a similar amount of the open space was purchased and not used for storm water treatment. In other words, the cost differential between I and K showed that Alternative I was an inefficient system in which the additional wastewater transportation and irrigation system costs outweighed the potential benefits achieved by not treating the wastewater at a regional site. Hence, Alternative K was dropped from further consideration.

COMBINATION NDCP PLANS

The final NDCP comparison included the treatment plant Alternatives: D with 41 Physical-Chemical plants, E with 17 Advanced Biological plants,

COMPARISON OF LAND TREATMENT ALTERNATIVES
(INTERMEDIATE STAGE)

	NUMBER OF SITES 1	NUMBER OF SITES 6
SOCIO-ENVIRONMENTAL RATING		
COLLECTION, TRANSPORT & STORAGE	0.86	1.00
TREATMENT FACILITIES & PROCESSES	0.02	1.00
TOTAL	0.88	2.00
RATING	2	1

SOCIO-ENVIRONMENTAL FACTORS

COLLECTION, TRANSPORT & STORAGE

SINGLE SITE REQUIRES GREATER MOVEMENT OF TREATER WATER PRODUCING DISRUPTIONS IN:

- Δ NEIGHBORHOOD ENVIRONMENT
- Δ RECREATIONAL ACTIVITIES
- Δ AESTHETICS
- Δ FLORA & FAUNA

TREATMENT FACILITIES & PROCESSES

SINGLE SITE PRODUCES GREATER POTENTIAL IMPACT:

- Δ ON SOCIAL STABILITY
- Δ AS BARRIER TO DEVELOPMENT
- Δ ON CULTURAL, EDUCATIONAL, RECREATIONAL & ECO-UNIQUE AREAS
- Δ ON FLORA & FAUNA

	1	6
ANNUAL COSTS ($ MILLION)	511	522
RANKING	1	2

TENTATIVE PREFERENCE: 6 SITES

Figure C-IX-5

COMPARISON OF ALTERNATIVES I AND K
(INTERMEDIATE STAGE)

<u>SOCIO-ENVIRONMENTAL RATING</u>

ALTERNATIVE I	-	0.97	OPEN SPACE PROVIDES MAJOR ENVIRONMENTAL BENEFITS
ALTERNATIVE K	-	2.00	

<u>ANNUAL COSTS ($ MILLION)</u>

ALTERNATIVE I	-	522	EQUIVALENT OPEN SPACE BENEFITS CAN BE ACHIEVED FOR LESS COST WITHOUT TREATMENT SYSTEM COMBINATION
ALTERNATIVE K	-	675	
DIFFERENCE	-	153	

<u>TENTATIVE CONCLUSION:</u> DROP ALTERNATIVE K

Figure C-IX-6

G with a combination of five Advanced Biological and 12 Physical-Chemical plants, and J with a combination of 5 Advanced Biological plants and 6 Land sites. The same relative ratings developed by the evaluators were used again. See Figure C-IX-7. The alternatives containing Physical-Chemical plants rated third and fourth from a socio-environmental standpoint because of the air pollution and waste of nutrients through partial incineration which are associated with these plants. From an annual cost standpoint, the 41 Physical-Chemical plant alternative ranked second while the Physical-Chemical/Advanced Biological plant combination ranked third. The conclusion was to retain Alternative D with 41 Physical-Chemical plants, Alternative E with 17 Advanced Biological plants, and Alternative J with the Advanced Biological/Land treatment combination. The latter alternative reflected the resources and environmental preference for the Advanced Biological technology of the two plant processes. This combination of alternatives provided a clear comparison of the Advanced Biological and Physical-Chemical system designs which may be valuable if later developments solve the air pollution problem associated with the Physical-Chemical plants; a collection, transport and storage system design for 41 and 17 plant systems; and a plant/Land combination system for design and analysis.

DESIGN MODIFICATIONS

Subsequent to their selection, the five alternatives were subject to further review and refinement, based on input from the evaluators, the Citizens Advisory Committees and work groups, and the general public. As a result, some significant changes were made in the criteria used for system design. While these modifications are described in detail in Appendix B, Basis of Design and Costs, some of the major changes are discussed in the following paragraph.

REGIONALIZATION

A significant change has been made with regard to Alternative D of the Intermediate Set, now redesignated as Alternative II in the final set. Based on the trends in economies of scale (regionalization) shown in Figure C-IX-4, it was concluded that further system savings could be realized if the Physical-Chemical plants of less than 10 MGD capacity (treatment) were consolidated. Thus, Alternative II was subsequently redesigned; the plants reduced in number from 41 to 33 with corollary changes to the collection and conveyance, and reuse distribution system.

LAND TREATMENT SYSTEM

Originally, the land sites had been designed to achieve the most effective system from a treatment standpoint. However, as a direct result of the social and environmental concerns expressed by both the evaluation team and the people residing in the agricultural areas, the planning and

FINAL COMPARISON OF NDCP TREATMENT ALTERNATIVES
(INTERMEDIATE STAGE)

	ALT. D	ALT. E	ALT. G	ALT. J
	41 P-C	17 AB	5AB/12P-C	5AB/6 LAND
SOCIO-ENVIRONMENTAL RATING				
COLLECTION, TRANSPORT & STORAGE	1.00	0.89	0.89	0.78
TREATMENT FACILITIES & PROCESSES	0.01	1.00	0.41	0.84
TOTAL	1.01	1.89	1.30	1.52
RANKING	4	1	3	2

SOCIO-ENVIRONMENTAL FACTORS

PHYSICAL-CHEMICAL RATES LOW BECAUSE OF AIR POLLUTION AND WASTE OF NUTRIENTS THROUGH PARTIAL INCINERATION PROCESS

	ALT. D	ALT. E	ALT. G	ALT. J
ANNUAL COSTS ($ MILLION)	878	919	891	806
RANKING	2	4	3	1

TENTATIVE CONCLUSION: RETAIN ALTERNATIVES D, E & J TO GIVE:

- CLEAR COMPARISON OF ADVANCED BIOLOGICAL & PHYSICAL-CHEMICAL SYSTEMS
- PROVISION OF PHYSICAL-CHEMICAL SYSTEM IF LATER DEVELOPMENT SOLVES POLLUTION PROBLEM
- COLLECTION, TRANSPORT & STORAGE DESIGN FOR 41 & 17 PLANTS
- EVALUATION OF PLANT/LAND COMBINATION

Figure C-IX-7

design criteria for the Land treatment system were extensively revised. Involved was a change in the physical layout of the system and the management objectives. The major change involved modifying the physical layout of the system to fit the general land-use patterns of the surrounding area. This was done in an effort to minimize any possible adverse effects on the area's social well-being, economic structure and environmental attributes. The second change involved adopting an agricultural management program that could be implemented by normal farming practices and selective cropping patterns. For all intents and purposes, this meant that the best farming procedures must be adopted and system operations must be responsive to pertinent agricultural requirements, as well as treatment considerations. As a result, extensive engineering and design refinements were made relative to the system's operation and management. Consequently, the cost of the system increased appreciably from what previously had been determined. The basic cause for the cost increase was the necessity to disperse the irrigated acreage over a wider geographical area. This was necessary in order to: avoid disruption to eco-unique areas, communities, commercial developments and public institutions; maintain the integrity of the transportation system within the area, at least to the level of the township road; and minimize the impact to the participating farmer - his home, plant and land use. The changes in criteria as well as the design and operational concepts of the land treatment process are discussed extensively in a paper prepareed by the Chicago District and entitled: "The Use of Land as a Method of Treating Wastewater (Its Meaning to the Agricultural Community)". In it, are illustrative examples of the types of agricultural practices; crop production and management considerations best suited to enhance the farmer's net income; and an assessment of what the land system can mean to the farmer and the agricultural community as a whole. The final version of the paper is included as part of the annex to Appendix B.

SLUDGE MANAGEMENT

Although the basic concepts of the two sludge management options (agricultural usage and land rehabilitation) remained essentially unchanged, there have been several modifications. These changes were effected in two distinct categories: (1) Utilization distribution philosophy, and (2) Sludge yields and applications rates. In the first category, it was decided that where possible, sludge should be utilized within the State boundaries where it was generated; primarily in response to the institutional concern over inter-state problems. This philosophy has been incorporated as basic economics permit into the sludge management schemes for all alternatives. In the second category, sludge yield per million gallons of wastewater was adjusted relative to the refinement and final design of each technological process. Accordingly, the application rate criteria were also modified where the controlling constituent level required. Information pertinent to the final design of the sludge management program for each technology is presented in Appendix B. These modifications generally resulted in larger land requirements with the most substantial increases in the Physical-Chemical technology.

WATER MANAGEMENT

The most significant modification to design criteria regarding water management was the result of the USEPA concern over the potential interjection of dissolved solids into Lake Michigan. The preliminary reaction of that agency was based on the non-degradation provisions of the water quality standards and the recent United States-Canadian agreement which expresses a need for dissolved solids control. Recognizing that the dissolved solid levels of both water quality standards are higher than the "natural background level" of the adjacent portion of Lake Michigan, adjustments were made to conform to the current "return" regimen now in effect. This meant constraints for the Illinois portion of the study area as opposed to the Indiana area. A second change was made in relation to the water reuse options. The in-stream flows and over-all water balance were adjusted to reflect the same relationship between technologies and alternatives; one which would tend to maintain a higher level of recreational potential.

Furthermore, the reuse option was changed to analyze the implications of the U.S. Supreme Court decision relative to limiting the diversion of Lake Michigan waters for multiple usage. With attainment of the NDCP standard, the potential for reallocating the usage of the 3,200 cfs to meet projected water supply deficiencies and in-stream needs was assessed. Capture and treatment of the storm water provided a source of water which heretofore was not available. Consequently, the reuse options were restructured to evaluate the implications of using Lake Michigan water to meet the area's potable water supply needs. In one option, the withdrawal was limited to 3,200 cfs; the other had no such limitation. The purpose was to focus on the problems that could face the C-SELM area in the future. Under the option limited by the 3,200 cfs constraint, the C-SELM area still faces the necessity to re-use its treated water in order to meet the projected needs.

DESCRIPTION OF FINAL ALTERNATIVES

The detailed design of the five alternatives retained for final study was the basis for evaluation by the other three study elements, namely the socio-environmental and institutional evaluators, and the general public including the citizens advisory committees and other participants. The following is a brief description of the alternatives. For a more detailed presentation, including engineering details, socio-environmental and institutional evaluations, consult the appropriate study appendices. The first of the five final alternatives was designed to produce effluent meeting existing standards; the remaining were designed to meet the "No Discharge of Critical Pollutants" goal.

REFERENCE PLAN

Alternative I reflects the study area's present planning goals for a regionalized wastewater management system. There are some 64 treatment plants included in this plan. This represents an extensive reduction from the some 132 plants (one million gallons per day capacity or greater) presently in operation. The 64 sites, as shown in Figure C-IX-8, were based on the number and locations provided for in existing regional plans extended to meet 2020 conditions. As such, the alternative represents a screening base with which to compare the four other alternatives which are designed to the higher NDCP water quality goal and reuse considerations.

In essence the regional facilities will meet the current effluent (plant discharge) and water quality guidelines (for receiving streams) for Illinois and Indiana, respectively. Moreover, the level of treatment will vary, depending upon the receiving stream. In general, those plants discharging into streams tributary to the Illinois River are designed to provide the equivalent of secondary treatment. On streams tributary to Lake Michigan, a higher level of treatment is achieved.

The existing or proposed collection systems in all areas would be utilized, with consolidation achieved by connecting conveyance systems. No treatment of storm water runoff is achieved other than in areas serviced by combined sewers, either presently and/or proposed. Nor do these plans provide for a redistribution of the treated water. This would adversely affect the aquatic ecosystem of some streams in dry periods since many are presently dependent upon existing treatment plant discharges for their low flows. Without the availability of storm water there also will be problems in meeting future water requirements and additional resources and financial commitments will be needed.

The sludge management system reflects the current trend of disposal by recycling the sludge as an agricultural fertilizer and humus builder. However, some reclamation of surface mined land is included where current arrangements exist. To insure that the sludge presents no health or odor-related problem, the process design requires stabilization by anaerobic biological digesters. A comparable constraint in one form or another is used in all the other alternatives too.

Most of the industrial wastewater volume generated within the study area will continue to be discharged back into the watercourses rather than the municipal sewers. However, as with the municipal treatment plants, industry would have to upgrade its treatment and incorporate these facilities into their manufacturing processes. Since these requirements and costs are internal to the industry and hence a cost of doing business, they have been classified as charges external to the alternative's system and its operations. However, from an areawide standpoint, the costs must be recognized as a related monetary commitment.

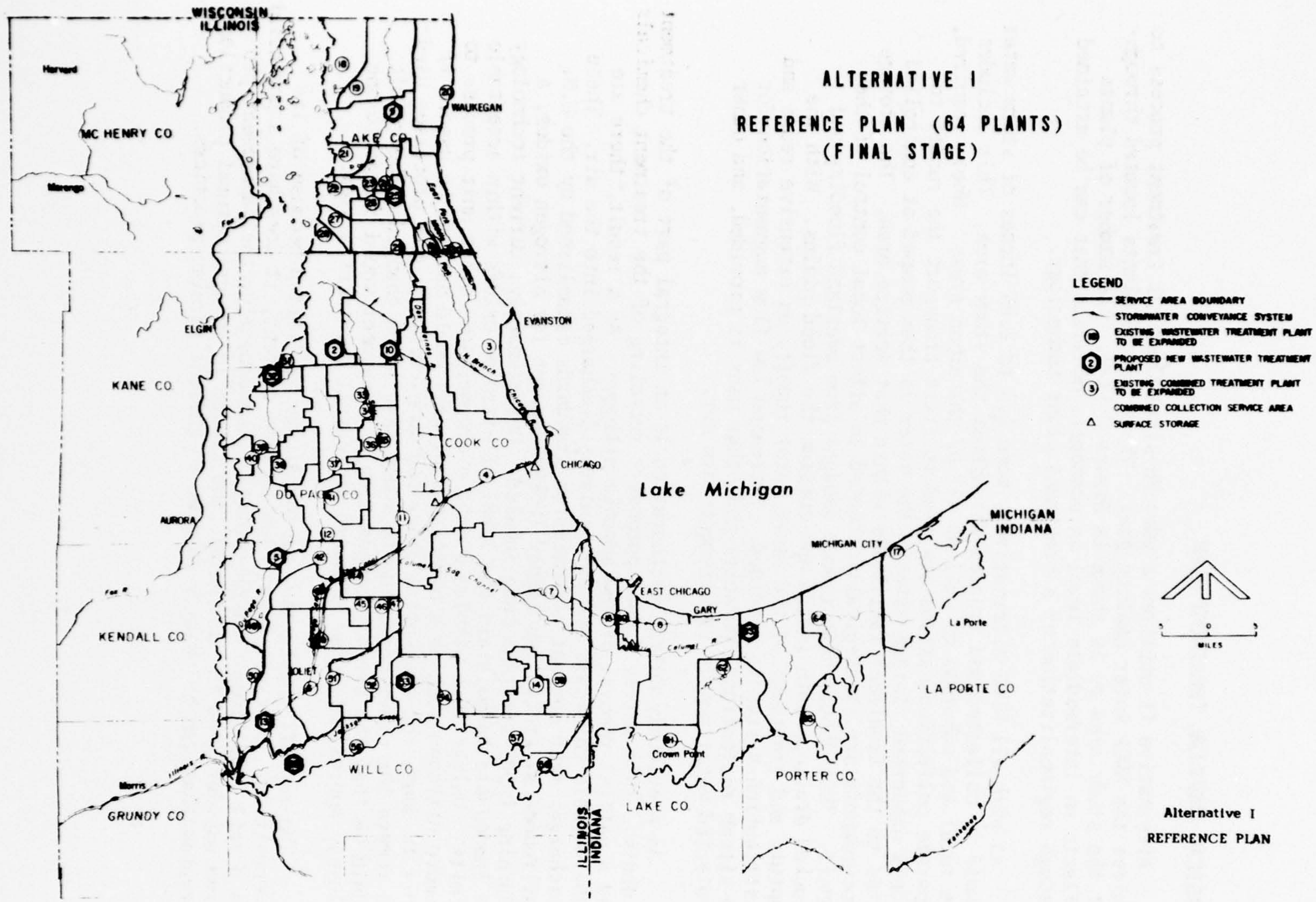

ALTERNATIVE I
REFERENCE PLAN (64 PLANTS)
(FINAL STAGE)
LEGEND
SERVICE AREA BOUNDARY
STORMWATER CONVEYANCE SYSTEM
EXISTING WASTEWATER TREATMENT PLANT TO BE EXPANDED
PROPOSED NEW WASTEWATER TREATMENT PLANT
EXISTING COMBINED TREATMENT PLANT TO BE EXPANDED
COMBINED COLLECTION SERVICE AREA
SURFACE STORAGE
MILES
WISCONSIN
ILLINOIS
MC HENRY CO
LAKE CO
WAUKEGAN
EVANSTON
CHICAGO
COOK CO
KANE CO
ELGIN
AURORA
DU PAGE CO
KENDALL CO
JOLIET
WILL CO
GRUNDY CO
Lake Michigan
EAST CHICAGO
GARY
Crown Point
LAKE CO
ILLINOIS
INDIANA
PORTER CO
MICHIGAN CITY
MICHIGAN
INDIANA
La Porte
LA PORTE CO
Alternative I
REFERENCE PLAN

Figure C-IX-8

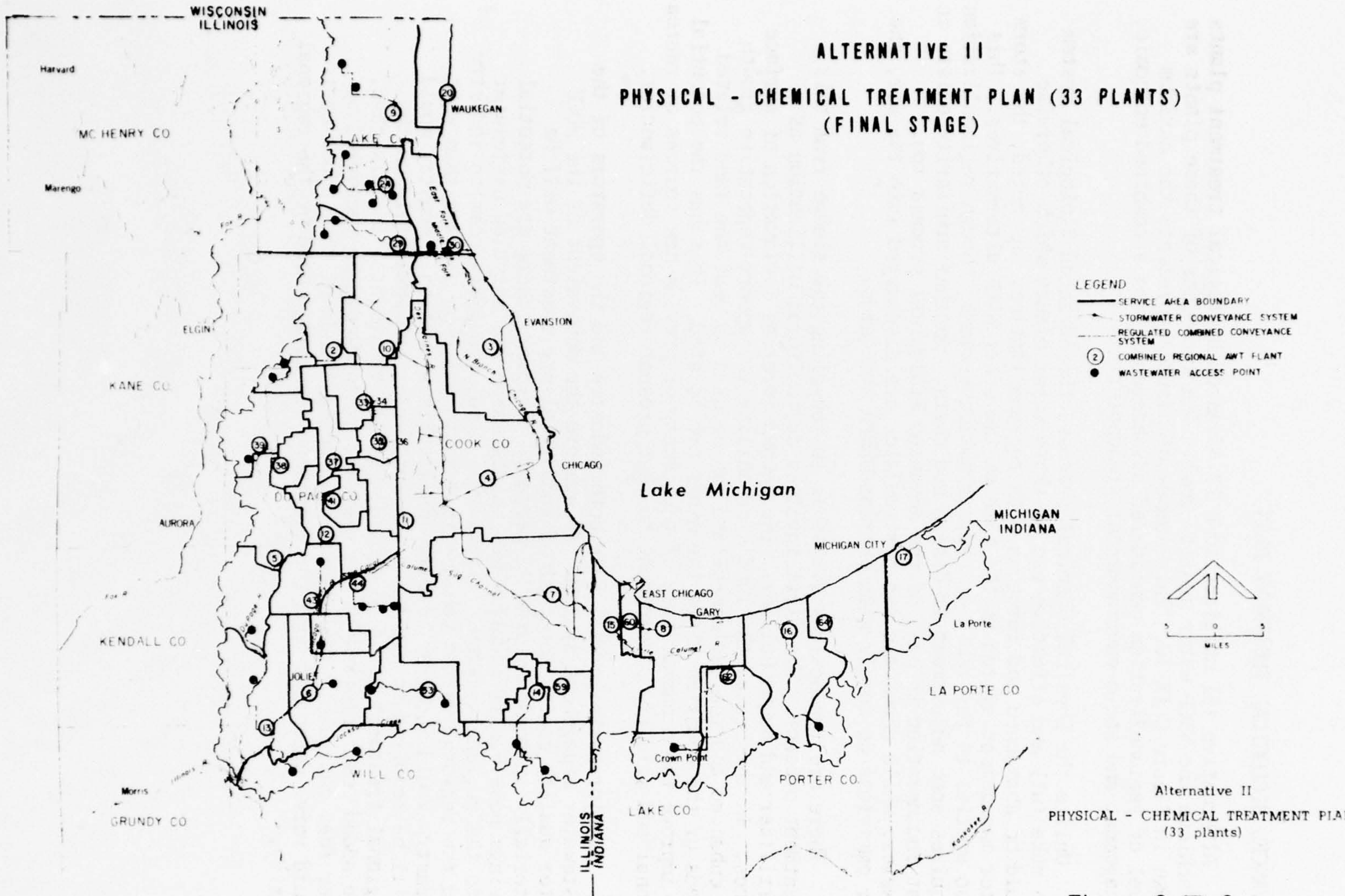
PHYSICAL-CHEMICAL TREATMENT PLAN

Alternative II utilizes a pure Physical-Chemical treatment process to achieve the NDCP water quality goal. There are 33 plants located throughout the study area as is shown in Figure C-IX-9. The number of plants reflects an intermediate level in economies of scale that can be attained through regionalization of a treatment plant technology.

As with all NDCP alternatives, some 2.5 to 2.85 inches of storm water runoff is collected and treated throughout the study area. This includes the rural and suburban as well as all of the urban areas. Where required, separate collection systems are used to first transport the runoff to widely dispersed storage sites. The water is then pumped at controlled rates to the treatment facilities within that service area. The storage impoundments are strategically located to affect local control of the runoff. This should help reduce damages from overland flooding and blocked drainage both inside and outside the flood plains. With the capture and treatment of the storm water runoff, an extensive reuse and distribution system is provided. Increased low-flow augmentation for in-stream recreational pursuits and other uses is provided, and other projected water supply requirements are met.

As previously noted, incineration is an integral part of the treatment process. This serves a dual purpose - recycling of the treatment chemicals and a partial removal of the ammonia nitrogen. As a result, there are considerable chemicals and particulates discharged into the air. These discharges meet current air emission standards established by the U.S. Environmental Protection Agency (USEPA) except for nitrogen oxides, a "burning type" irritant once inhaled. Unfortunately, current technology is inadequate to maintain the level of nitrogen oxides within acceptable limits. Unless this problem can be overcome, some other unit process to remove nitrogen such as a biological process would have to be used. If this is done, the sequential order and complementary unit processes used to remove the other constituents would have to be changed. The result would be that the overall composition of treatment would change to one closely approximating an Advanced Biological treatment system.

The recycling potential of the sludge is limited because of its composition. However, being high in lime content, it does have a potential as a soil conditioner and pH control. Consequently, the management program was designed to incorporate the sludge in an agricultural production program that can be readily adapted to current farming practices.



Alternative II

PHYSICAL - CHEMICAL TREATMENT PLAN
(33 plants)

Figure C-IX-9

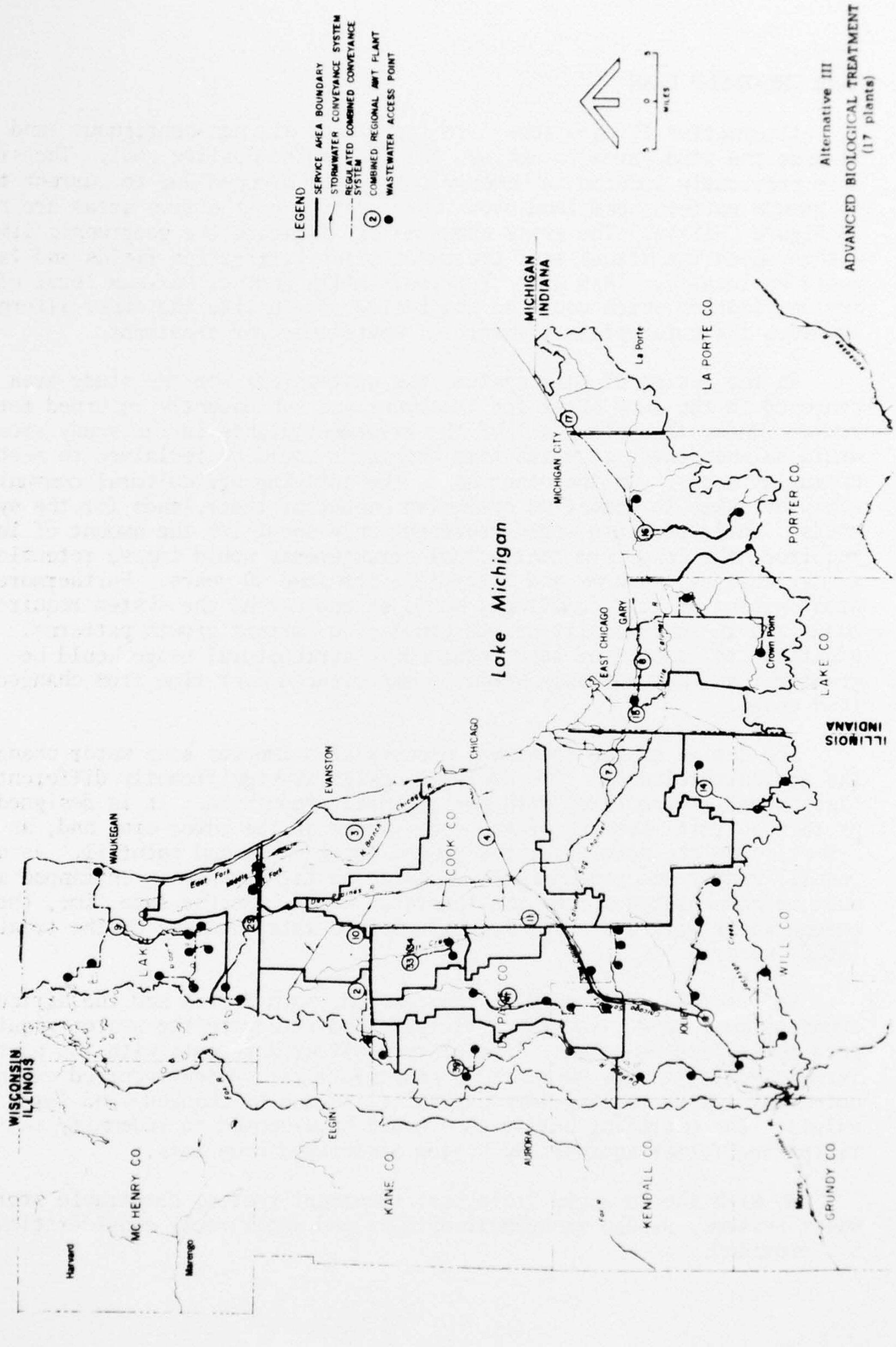
ADVANCED BIOLOGICAL TREATMENT PLAN

Alternative III utilizes some 17 Advanced Biological treatment plants to achieve the NDCP water quality goal. The locations of these plants are shown in Figure C-IX-10. This number of plants represents the maximum level of regionalization considered advantageous from a combined economic, management and socio-environmental standpoint.

Unlike the Physical-Chemical process, the Advanced Biological system can make full and effective use of those major plants which otherwise would be abandoned and foregone with regionalization. As noted, the storm water management system is the same as the other NDCP alternatives. This also applies to the reuse or redistribution systems, though regionalization requires some adjustment in design and costs. Another similarity exists in that incineration is part of the Advanced Biological process too. However, while chemicals and particulates are discharged into the air, the air emissions do comply with current USEPA standards.

There are two options available in recycling the sludge from this treatment process. The first involves agricultural utilization as a fertilizer and humus builder. The second involves reclamation of surface mines. In this case, the land's capability to support vegetative growth is enhanced and the reclaimed land can be used to meet the land related needs of the counties where the mines are located. This has the potential to improve the economic base of the county or provide new sources of recreational and wildlife development to meet present regional deficiencies.

A major decision will face both industry and the operators of the wastewater management system. To achieve the equivalent of the NDCP water quality goals, the cost of industrial pre-treatment will be materially increased - some 40 percent. However, there are potential savings possible if industry was to discharge its recycled wastewater into the regional system. If this was done, the gross cost to industry and the regional system would either approximate or be less than what industry would incur by itself. Under this situation, industry would still be required to pre-treat its wastewater but would rely on the regional treatment plant to provide "final" treatment. In this case, the added cost incurred by the regional system would be recovered by user fees chargeable to industries. The magnitude of this added cost would vary, dependent upon the treatment technology used by the regional entity.



Alternative III
ADVANCED BIOLOGICAL TREATMENT PLAN
(17 plants)

Figure C-IX-10

LAND TREATMENT PLAN

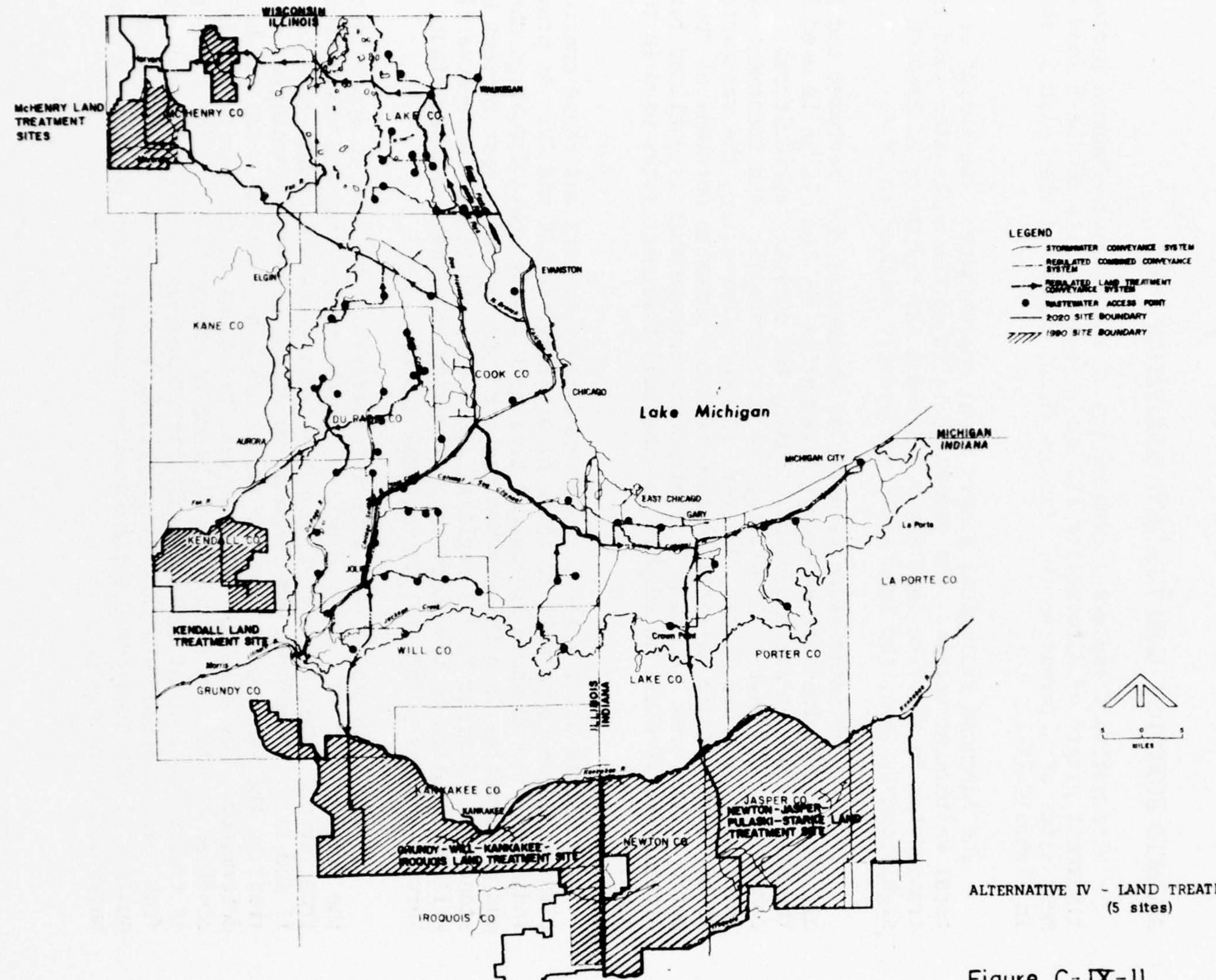
Alternative IV uses some five instead of six non-contiguous land areas outside the study area to achieve the NDCP water quality goal. The sixth site previously located in McHenry County was dropped due to current trends in growth patterns and land use. The location of the five areas are shown in Figure C-IX-11. The areas shown merely indicate the geographic limits within which the actual land treatment sites (irrigation fields and lagoons) would be located. This plan represents still another maximum level of regionalization which could be considered but, unlike the other alternatives, involves the inter-state transfer of wastewater for treatment.

In the design of this system, the wastewaters for the study area are conveyed to the land sites for treatment and subsequently returned for reuse. Under this plan, all of the treatment plants in the study area would be abandoned, at which time the lands could be reclaimed to meet community needs. On the other hand, the outlying agricultural community would be asked to commit an extensive amount of their lands for the system needs. While purchase would represent only about 1/6 the amount of land required, the long term contractual arrangements would impose retention of an agricultural economy and life-style for some 50 years. Furthermore, the areal extent of this commitment would extend beyond the system required lands and in some localities run counter to current growth patterns. In addition, the amount of land retained in agricultural usage would be greater than what normally would be experienced over time from changed land usage.

The design of the treatment process also imposes some water changes in the agricultural area. The drainage design is significantly different from that normally associated with agricultural production. It is designed to protect against flooding of the root system of the cover crop and, as such, effects complete control of the ground water table and rainfall. As a result, runoff and ground water recharge to the streams is entrapped and must be compensated for by the renovated water. At the same time, the ground water will over time approximate the water quality of the treated (NDCP) water.

Before this plan could be implemented, both States and the agricultural counties must be willing to participate and integrate the system requirements into their land use plans. The contractual arrangements with the participating farmers would include payments to compensate for system-incurred expenses and potential losses in long-term capital gains due to changed land (use) values. The operating entity also would be expected to indemnify the participating farmer against any system associated crop loss.

As with the Advanced Biological treatment system, comparable storm water systems, sludge management options and water reuse considerations are provided.



ALTERNATIVE IV - LAND TREATMENT PLAN
(5 sites)

Figure C-IX-11

ADVANCED BIOLOGICAL-LAND TREATMENT COMBINATION PLAN

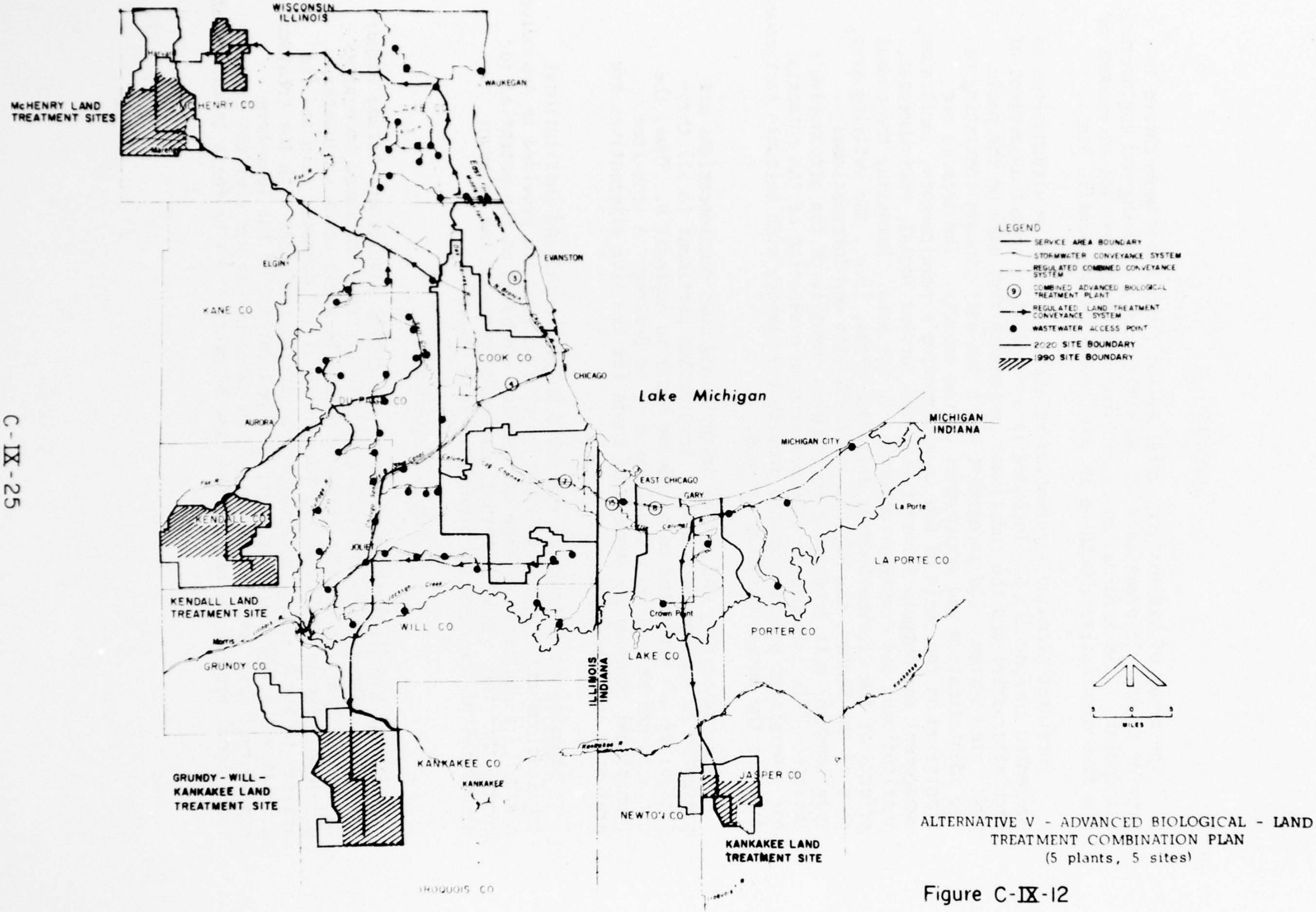
Alternative V employs a combination of the 5 major Advanced Biological treatment plants of Alternative III and a reduced scale of the 5 land treatment sites of Alternative IV. The graphical layout of this plan is shown in Figure C-IX-12.

The Advanced Biological plants treat approximately two-thirds of the total wastewater volume. The remaining third of the wastewater load is transported to the five land areas. Because the volume to be treated is significantly less, the land sites are greatly reduced in size.

There is no inter-state transfer of wastewater for treatment and like all other NDCP alternatives except Alternative IV, the sludge is used in the state where it was generated. Again, the outlying agricultural community would have to be willing to incorporate the land treatment system into their land use plans. However, in this alternative, the wastewater to be treated would essentially come from the suburban portions of the metropolitan area. Comparable contractual arrangements as outlined for Alternative IV would be adopted for the land treatment sites used in this plan.

The storm water system, sludge management options and reuse considerations would be comparable to those of Alternatives III and IV. As previously indicated, the Advanced Biological treatment plants would discharge chemical and particulates into the air but the air emission would meet current USEPA standards. Similar to all regionalized plans, additional conveyance lines will be required to transport the wastewater from the abandoned plants which serve as access points to the regional system.

It should be noted that this alternative can be used to approximate the differential in costs and other impacts for treating the wastewater from various subareas. The five major plant sites are common to Alternatives II and III. Therefore, the comparative values between technologies for treating the wasteloads from the mainly urban or suburban areas can be determined. For all NDCP alternatives, treatment in the rural area is confined to storm water runoff and hence is common to all. The rural runoff is treated to prevent agricultural-related sediment, phosphorus and nitrogen from being carried into the main watercourse. Otherwise, the enhanced quality of the downstream areas would be intermittently degraded by the untreated storm runoff.



ALTERNATIVE V - ADVANCED BIOLOGICAL - LAND
TREATMENT COMBINATION PLAN
(5 plants, 5 sites)

Figure C-IX-12

SUMMARY

The array of alternatives retained for final study were chosen to provide as much information as is possible from a planning and engineering standpoint. This information is obtainable from an over-all assessment of the five alternatives, both on an individual and comparative basis.

Pertinent planning information relative to the five alternatives is presented in Appendix G. Included is a comparative impact assessment of each alternative and the functional components that make up the basic wastewater system. The assessment was a two-part process consisting of the identification and measurement of the impacts. The impacts are identified on the basis of how an alternative's requirements, facilities, management and outputs interact with the current social, environmental, institutional and economic conditions in the area. Examining the causal effects of the alternatives on different areas, (i.e., the outlying area, rest of the States, the Region, and the Nation and International relationship) will generate a geographical profile of the alternative's impacts. This information together with an evaluation of the potential for synergistic programs should provide the planner with suitable background data for the decision-making process.

The engineering and design criteria and cost considerations are presented in Appendices B and D. Information pertinent to all three categories are presented on a modular basis in Appendix B. Thus, the criteria can be used on a local basis if so desired. A line-item (functional components) summary of costs for the five alternatives are presented in Appendix D.

Separate assessments of the socio-environmental and institutional implications attributable to the five alternatives are provided in Appendices E and F, respectively. These assessments are based on the potential for change that the 5 final alternatives could impose on the relevant structures of the area and other political levels.

PUBLIC INVOLVEMENT

During the final stage of study, the public involvement became rather extensive. The residents of the agricultural areas continued to express an unwillingness to use the rural resources to solve urban wastewater problems. Skepticism regarding the potential for economic gain and the ability to successfully integrate agricultural practices with the treatment process was evidenced. Moreover, the implications of the long-term contractual arrangements have raised an inherent concern over the farmer's traditional freedom in raising the type of money crops he feels is warranted.

This concern has not been mitigated by the operational requirement of income protection, though it should as more experience and knowledge is developed in the field.

In working with the industrial concerns, the cost and extent to which on-site pretreatment must be undertaken became of real interest. The internal "on-line" processes of the two major water users, steel and petroleum were synthesized and the costs to the industries and the regional treatment systems determined. Information pertinent to this phase of the study is presented in Appendix D. Concurrently, the concerns and constraints involved in incorporating the biological sludge in with the surface mine operation were formalized. The optional considerations that the mine operators must consider are presented in Annex A to Appendix G. So are the implications of the alternative's energy aspects, including a power synergism set forth by a local gas utility and the Federal Power Commission.

The prototype model for a recreational-environmental land corridor on the North Branch of the Chicago River was completed. Then, after extensive coordination with the local communities and special governmental entities, the model was applied to the selected streams within the study area. A summary of the study, together with its findings are presented in Annex B to Appendix G. A map showing the potential for development and control on the North Branch is shown in Figure C-IX-13. As detailed in Appendix G, all of the NDCP alternatives are multiple-purpose in nature and provide an effective management framework. The rate with which any of the five alternatives is implemented, however, will be dependent upon when the various solutions to the area's needs are to be implemented. The programs for pollution and flood control, potable water supply and stream flow augmentation, recreation and wildlife conservation, and open-space and floodplain management are separable and can be phased over time, if required.

Because of a concern over the costs and other resource commitments, interest was expressed in a plan comparable to Alternative I (Reference Plan), but upgraded to meet the volume and the NDCP water quality goals. This sixth alternative would involve attaining the higher water quality goals in stages - first consolidating the existing system, upgrading the remaining plants to current standards. Then, at some future time, these plants (64) could be further upgraded to meet the NDCP goals. The implications involved, including an increase in total system costs (or savings foregone) are presented in Appendix G.

NORTH BRANCH, CHICAGO RIVER

PROTOTYPE STUDY

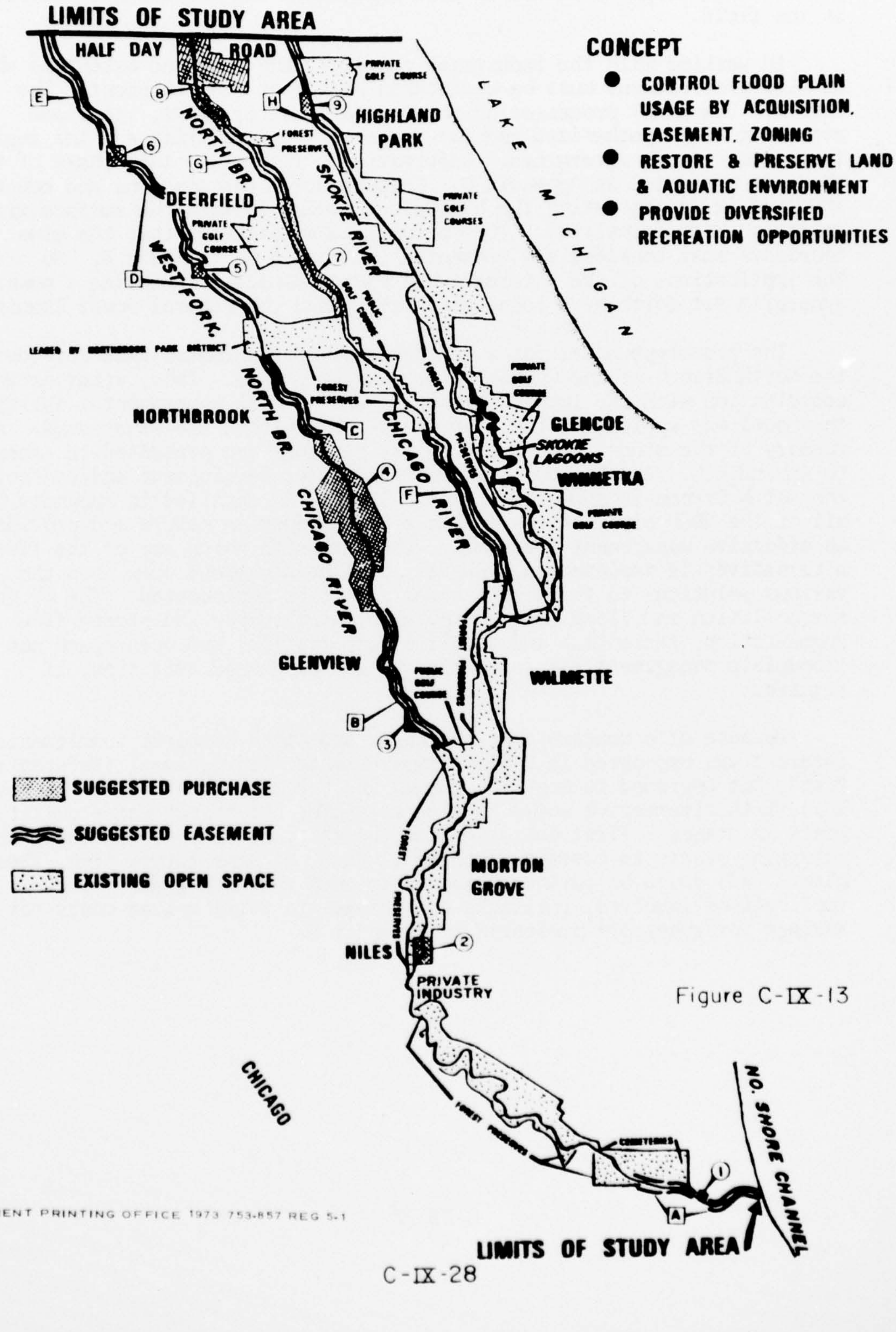


Figure C-IX-13