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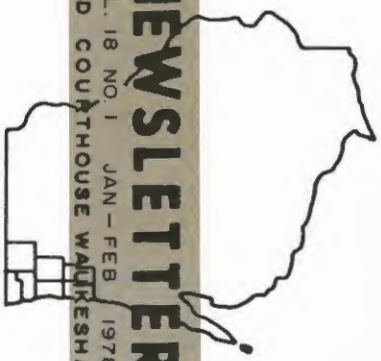

REGIONAL WASTEWATER SLUDGE MANAGEMENT PLAN COMPLETED

Sludges are a natural and unavoidable byproduct of liquid waste treatment. Increasing quantities and changing chemical and physical characteristics of sewage sludges can be expected as implementation of wastewater management plans results in higher volumes of waste-treated, changed sewage characteristics and higher levels of treatment. For example, primary treatment of municipal wastewaters typically produces 2,500 to 3,000 gallons of sludge per million gallons of wastewater treated. Five to eight times as much sludge results when secondary treatment is used. Use of chemicals for phosphorus removal—an advanced level of waste treatment—can add as much as 50 percent more to this amount and results in a total as high as 33,000 gallons of sludge per million gallons of wastewater.

Sludge handling and disposal costs can represent a significant portion of the total cost of wastewater treatment. For example, the capital, operation, and maintenance costs of providing secondary treatment for 10 million gallons per day (mgd) of municipal wastewater may be 20 to 25 cents per 1,000 gallons, while the cost of treating and disposing of the resultant sludges may be five to 10 cents per 100 gallons. Proper management of sludges also is important to ensure that they do not return to the waterways in runoff from agricultural lands or as leachate from landfills to pollute surface or groundwater. Thus, the selection of a cost-effective, environmentally acceptable, and technically feasible method for wastewater sludge management is an important consideration in the operation of any sewage treatment plant.

Recognizing the importance of these sludge management considerations, the Southeastern Wisconsin Regional Planning Commission in 1976 initiated a regional wastewater sludge management planning program as an element of the Section 208 areawide water quality planning effort.

The regional wastewater sludge management planning program thus becomes the ninth work program undertaken by the Commission to provide an element of the evolving regional plan encompassing all seven counties. Work on this important plan element has now been completed and a regional wastewater sludge mangagement plan recommended to the Commission for formal adoption and certification to the local, state, and federal units and agencies of government concerned.

The regional wastewater sludge management planning program was intended to serve a two-fold purpose:

1. To permit, within a comprehensive framework, public evaluation of alternative sludge management policies and plans and

2. To provide an agreed-upon areawide, long-range plan for the efficient and coordinated development of sludge processing and disposal facilities and for the coordination of such facility development with land use, transportation, sewerage, and other facility development within the Region.

Several important concepts were recognized in the regional wastewater sludge management systems planning program:

1. Sludge should be treated as a resource which, with proper management and control, can provide a valuable energy source at a wastewater treatment plant or a valuable nutrient supplement or soil conditioner for land application.

2. Sludge management system planning must be regional in scope, recognizing subregional planning areas related to existing systems, potential management agencies, natural watershed boundaries, and urban concentrations with well developed sewerage systems and related sludge handling systems.

3. Sludge management system planning must be compatible with land use planning.

4. Land use, wastewater treatment facility, and sludge management planning must recognize the existence of a limited natural resource base to which rural and urban development must be adjusted to ensure the continuation of a pleasant and habitable environment.

5. Sludge management systems must have minimum negative environmental impact and assist in attaining areawide land use, air quality, and water quality. Accordingly, harmful constituents such as heavy metals and other toxic substances should be carefully monitored and controlled.

6. Sludge management facilities must be planned as integrated systems or coordinated subsystems, with the capacity of each facility in the total system or subsystem carefully adjusted to present and probable future sludge loadings.

7. Primary emphasis should be placed on in-Region solutions to sludge management system development problems related to the environment, except in the sale of highly refined sludge products of value in the economic marketplace.

The proposed regional wastewater sludge management systems plan was prepared under the guidance of the Commission's Technical Advisory Committee on Areawide Wastewater Management Planning, a Committee composed of local planning and public works officials, sanitary engineers, agricultural specialists, university faculty, and interested citizens. The Committee membership, and the membership of the Regional Sludge Management Planning Subcommittee, are listed below:

TECHNICAL ADVISORY COMMITTEE ON AREAWIDE WASTEWATER TREATMENT AND WATER QUALITY MANAGEMENT PLANNING

Robert J. Borchardt* Chairman	Chief Engineer and General Manager, Milwaukee-Metropolitan Sewerage Commissions
Raymond J. Kipp Vice-Chairman	Dean, College of Engineering, Marquette University
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Vinton W. Bacon*	Professor, College of Applied Science and Engineering, University of Wisconsin-Milwaukee
Anthony S. Bareta	Director, Milwaukee County Planning Commission
Kurt W. Bauer*	Executive Director, SEWRPC
Frank R. Boucher	Director, Environmental Department, Wisconsin Electric Power Company
J. R. Castner	Executive Director, Wisconsin Solid Waste Recycling Authority
Frederick H. Chlupp	Land Use and Park Administrator, Washington County
Arnold L. Clement*	Planning Director and Zoning Administrator, Racine County
Norbert H. Dettmann	Washington County Board Supervisor

Alvin A. Erdman . . . . . District Conservationist, U. S. Soil Conservation Service, Milwaukee and Waukesha Counties
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Herbert A. Goetsch . . . . . Commissioner of Public Works, City of Milwaukee
Thomas N. Hentges . . . . . Former Racine County Board Supervisor; Former Chairman, Town of Burlington
Lester O. Hoganson . . . . . Manager, Racine Water and Wastewater Utility
Helen M. Jacobs* . . . . . League of Women Voters
Myron E. Johansen* . . . . . Former District Conservationist, U. S. Soil Conservation Service, Ozaukee and Washington Counties
James A. Johnson* . . . . . Walworth County Planner
Leonard C. Johnson. . . . . Soil and Water Conservation Specialist, Wisconsin Board of Soil and Water Conservation Districts
Melvin J. Johnson . . . . . Chairman, Town of Norway; Racine County Board Supervisor
Elwin G. Leet* . . . . . Racine County Agri-Business Agent
William G. Murphy . . . . . Professor, Marquette University; Engineers and Scientists of Milwaukee; Chairman, Citizens Advisory Panel for Public Participation
O. Fred Nelson* . . . . . Manager, Kenosha Water Utility
Wayne A. Pirsig. . . . . District Director, Farmers Home Administration, U. S. Department of Agriculture
Herbert E. Ripley* . . . . . Health Officer, Waukesha County Department of Health
Donald A. Roensch . . . . . Director of Public Works, City of Mequon
Harold F. Ryan. . . . . Washington County Board Supervisor
Bernard G. Schultz . . . . . Assistant District Director, Southeast District Office of the Wisconsin Department of Natural Resources
Walter J. Tarmann* . . . . . Executive Director, Park and Planning Commission, Waukesha County
Rodney M. Vanden Noven . . . . . Director of Public Works, City of Waukesha
Frank A. Wellstein. . . . . City Engineer, City of Oak Creek

Those Committee members whose names are marked with an asterisk served on the Regional Sludge Management Planning Subcommittee.

The technical work for the regional wastewater sludge management systems plan was carried out by the Commission staff in cooperation with a private engineering firm—Camp Dresser and McKee, Inc., Environmental Engineers, Milwaukee, Wisconsin.

The major findings and recommendations of the regional wastewater sludge management systems planning program are presented in SEWRPC Planning Report No. 29, A Regional Wastewater Sludge Management Plan for Southeastern Wisconsin. Copies of this report are available from the Commission. The report is priced at $10.00 inside the Southeastern Wisconsin Region and $20.00 outside of the Region. Under Commission policy, all local units of government within the Region, as well as those special purpose units of government, areawide agencies, and state and federal agencies directly concerned with wastewater sludge management, will receive copies of the report upon its formal adoption by the Regional Planning Commission.

The following discussion presents a synopsis of the findings and recommendations of the planning report and the public reaction to the plan received to date at three subregional informational meetings held during development of the plan. The Commission has scheduled a regional planning conference and a public hearing on the findings and recommendations set forth in the plan to be held on March 15, 1978, at the Waukesha County Exposition Center Arena located on CTH FT (Northview Road) between CTH F and CTH T near the Waukesha County Airport. The conference will be held from 9:00 A.M. to 4:00 P.M. and will include detailed presentations and discussions relating to the recommended plan. The public hearing will be held at 7:30 P.M. Announcements of the conference and hearing have been placed in the major newspapers of the Region and mailed to all Commission Newsletter recipients.

INVENTORY, ANALYSIS, AND FORECAST

Since the regional wastewater sludge management system planning program was conducted within the context of the comprehensive Commission planning program, relevant data and analyses from related Commission studies were utilized. Of particular importance are the Commission data on population and economic activity, soils, surface water quality, land use, and transportation system development.

The seven-county Region has an area of about 2,689 square miles, or 5 percent of the total area of the State of Wisconsin. The Region contains, however, about 40 percent of the State's population and employment. Of particular importance to regional sanitary sewerage system development is the fact that, in addition to the 154 general-purpose local units of government within the Region, there are 45 legally established town sanitary and utility districts and three metropolitan sewerage

districts operating in the Region—the Milwaukee-Metropolitan Sewerage District, the Walworth County Metropolitan Sewerage District, and the Western Racine County Sewerage District. The Region is traversed by a subcontinental divide which separates the Mississippi River drainage basin from the Great Lakes-St. Lawrence River drainage basin, and the Region encompasses all or parts of 11 major watersheds.

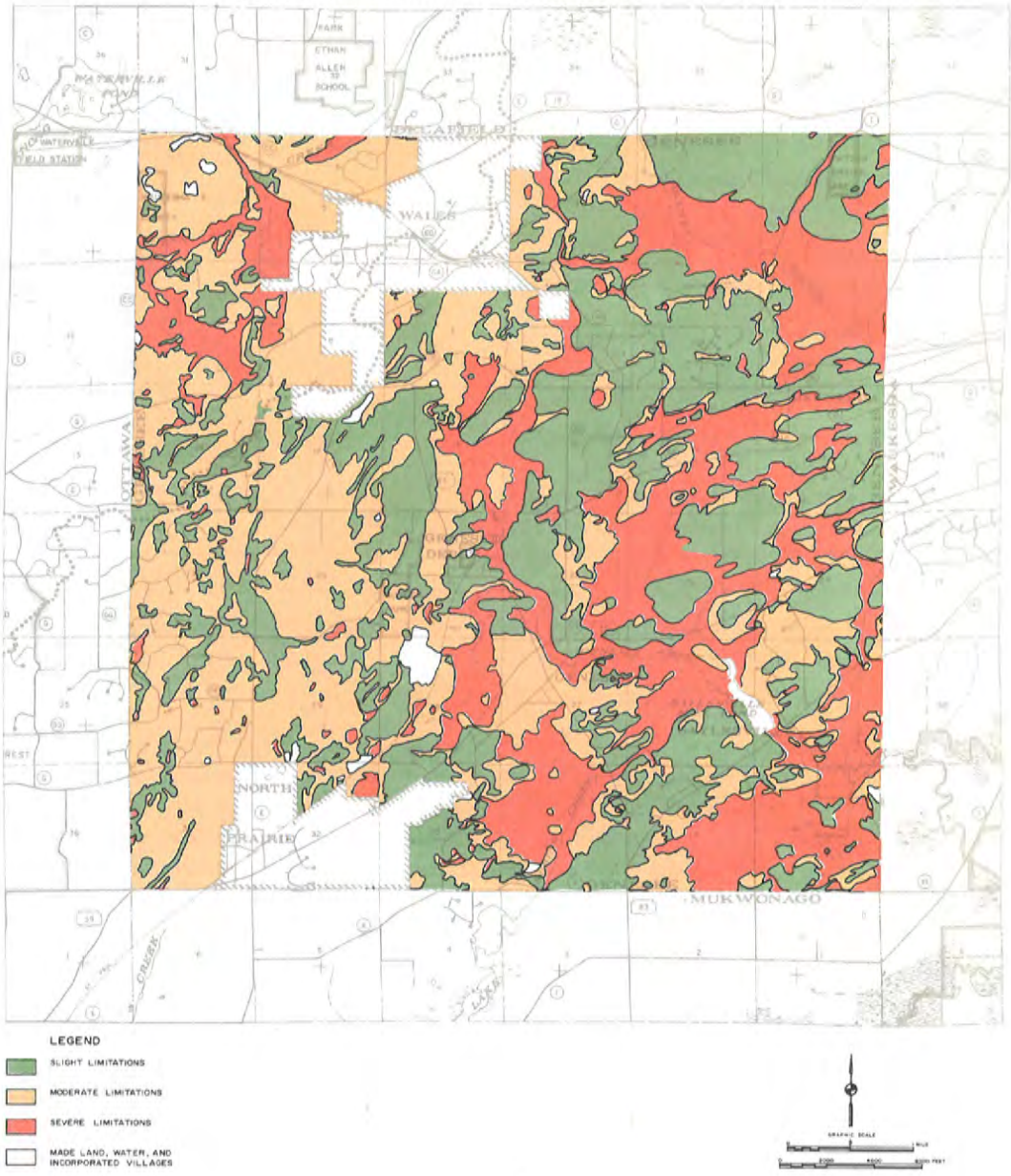
The population of the Region has been increasing at an average rate of about 7,200 persons per year, and in 1975 totaled about 1.79 million persons. An additional 429,000 persons can be expected to be added to the population of the Region by the year 2000. Land within the Region is undergoing rapid conversion from rural to urban use at a rate of about 10 square miles per year, with much of this conversion occurring in a discontinuous and highly diffused pattern consisting largely of scattered low-density residential development. If continued, this scattered growth will limit the availability of land acceptable for sludge application. Interpretive analysis conducted under the regional sludge management planning program indicates that about one-third of the Region is covered by soils which are severely limited for land spreading of sludge. A typical interpretive map showing suitability of land for sludge application is shown on Map 1.

Inventories conducted under the program further indicate that there are 61 municipal sewage treatment plants; 67 private treatment plants using treatment processes similar to those used at municipal plants but serving isolated industrial, commercial, institutional, governmental and utility land uses; 80 industrial treatment facilities providing specialized treatment of industrial wastes; and 17 water supply treatment plants that produce wastewater sludges within the Region (see Table 10). Altogether, these sources generate about 390 tons of sludge per day. The 61 municipal sewage treatment plants in the Region generate about 350 tons, or 90 percent of the total sludge generated in the Region daily, with the remaining 10 percent generated by all other sources. Of the 61 municipal sewage treatment plants, 46 rely exclusively on land application or fertilizer production for sludge disposal, while burial in landfills is used exclusively by only three plants. The remaining 12 plants use a combination of the land application, landfill, and/or public pickup options for sludge disposal (see Map 2).

The planning report includes descriptions of sludge processing, transportation, and utilization or disposal facilities associated with each of the 61 municipal sewage treatment plants in the Region. Special consideration was given to 21 major municipal treatment facilities (see Table 2). These 21 plants generate about 99 percent of the average daily sludge production by municipal sewage treatment plants. Each description of these 21 major facilities includes information on existing practices along with flows and loads and compares the latter with the plant design criteria.

Map 1

SOIL SUITABILITY FOR LAND APPLICATION OF WASTEWATER SLUDGE IN THE TOWN OF GENESEE



Source: SEWRPC.

Table 1

SUMMARY OF SLUDGE GENERATION SOURCES IN THE REGION: 1975

Sludge Generating Facility	Raw Sludge Ouantity Produced (tons/day dry solids)
Major Municipal Sewage Treatment Plants (21 plants) . . .	346.6
Other Municipal Sewage Treatment Plants (40 plants) . . .	3.5
Private Sewage Treatment Plants (67 plants)	1.8
Industrial Treatment Facilities (80 plants)	
Tanneries	2.7
Metal Plating	3.6
Metal Machinery	17.1
Food Processing	1.4
Truck and Car Wash Operations	0.1
Subtotal	24.9
Municipal Water Tratment Plants (17 plants)	12.6
Septic and Holding Tanks[a] (Estimated 87,200 tanks)	(6.2)
Total	389.4

[a] *Discharged to municipal sewage treatment plants; value is included in municipal quantities and in total sludge quantity.*

Source: Camp, Dresser and McKee, Inc., and SEWRPC.

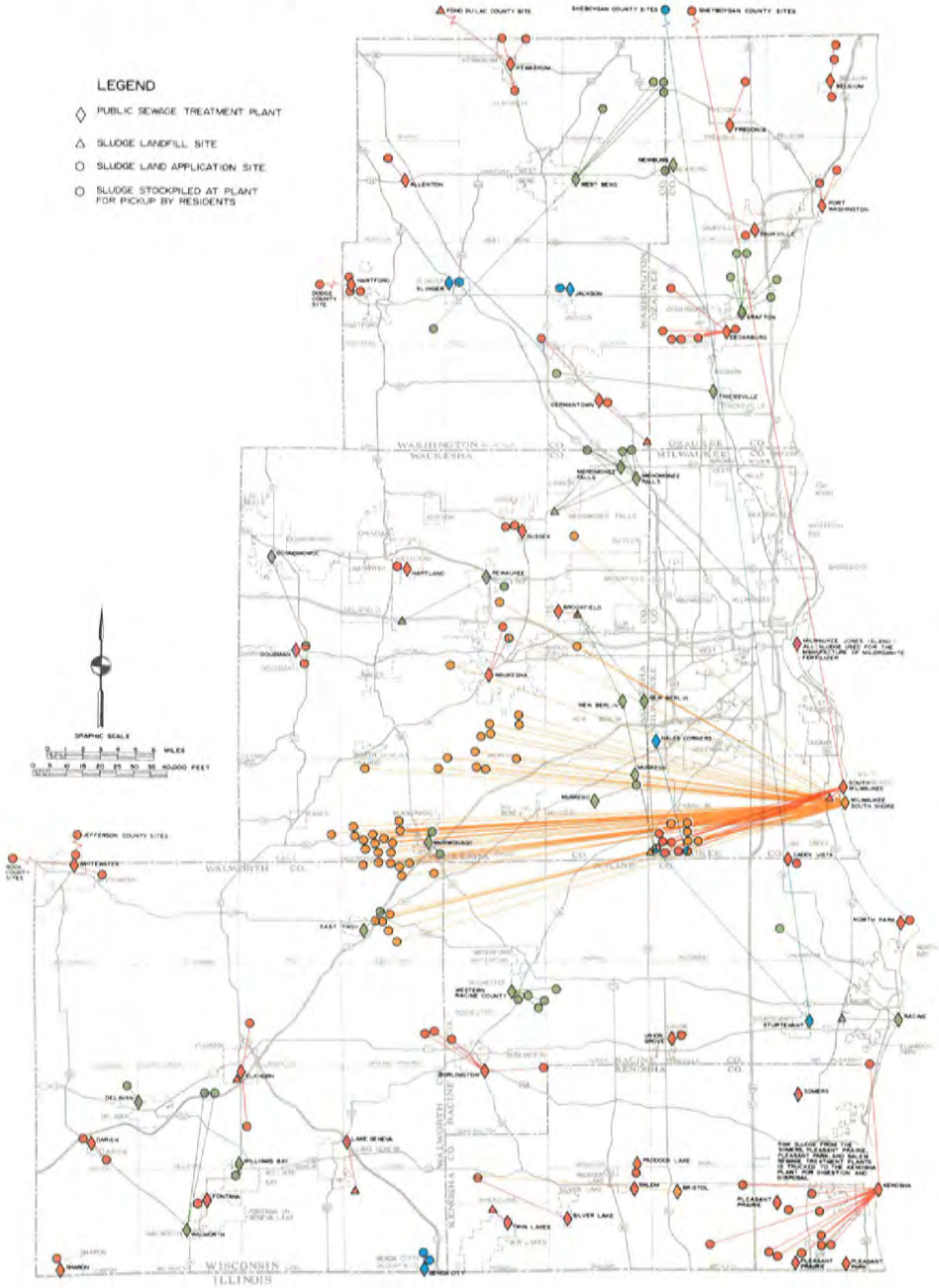
Industries also were considered in the study but were generally limited to those discharging a flow of more than 10,000 gallons per day. In some cases these industries discharge their flow to a municipal sanitary sewerage system after pretreatment. In other cases the wastes are treated and discharged to storm sewers and surface waters. In either case industrial waste sludges requiring disposal are generated. The current industrial sludge practices in the Region were determined; the amounts and characteristics of industrial sludges inventoried, and the relative useful life and capacity of the existing sludge processing facilities estimated. The inventories indicated that the industrial treatment facilities generated about 25 tons of sludge per day.

OBJECTIVES AND DESIGN STANDARDS

Six regional wastewater treatment sludge management objectives, together with supporting principles and standards, were formulated under the regional wastewater sludge management system planning program. Together with the land use and

Map 2

EXISTING METHODS AND SITES OF UTILIZATION OR DISPOSAL OF MUNICIPAL SEWAGE SLUDGE IN THE REGION: 1975-1976



Source: SEWRPC.

Table 2

SLUDGE MANAGEMENT PRACTICES AT MAJOR MUNICIPAL SEWAGE TREATMENT PLANTS IN THE REGION: 1975

Sewage Treatment Facility	Treatment Processes		Sludge Processing											Transport			Utilization/Disposal							
	Existing	Proposed	Thickening Gravity/ Flotation	Centrifuge	Aerobic Digestion	Anaerobic Digestion	Wet Oxidation	Chemical Conditioning	Vacuum Filter	Filter Press	Drying Lagoon	Sand Beds	Sludge Dryers	Truck	Rail	Pipeline	Incineration/ Pyrolysis	Landfilling	Land Spreading	Public Pickup	Composting	Soil Conditioner	Organic Fertilizer	Other
Milwaukee MSD—Jones Island	AS-C		E					E	E				E	E	E								E	
Milwaukee MSD—South Shore	AS-C		E			E					E			E				E	E					
Racine	AS-C					E		E	E					E				E	E					
Kenosha	AS-C		E			E		E		E				E					E					
Waukesha	TF-C	TF/AS-C	Po			E Po					E Po									E Po				
West Bend	AS-C	TF/AS-C	Po			E Po		Po	Po		E			E				Po	E Po					
South Milwaukee	AS-C					E Po	E	Po		Po[b]	E	E		E				E Po	E	E				
Whitewater	TF/AS	RBC	Po			E Po		Po		Po[b]		E		E				Po	E	Po				
Oconomowoc	AS		E			E		E	E		E	E		E				E	E					
Burlington	AS-C			E	E	E		E						E					E					
Walworth County MSD[c]	AS/TF	TF	Po			E Po						E		E Po				E	Po					
Brookfield	AS-C				E[a]			E		E				E			E	E						
Port Washington	AS-C				E	E								E					E					
Grafton	AS-C				E	E								E					E					
Cedarburg	AS/TF-C		E			E					E	E		E					E					
Hartford	AS-C				E							E Po		E					E					
Twin Lakes	TF/AS-C				E	E						E		E					E	E				
Williams Bay	AS		E			E						E		E					E					
West Racine County MSD	AS-C	AS-C			E Po	Po						E Po		E					E Po					
Hartland-Delafield	AS	RBC				E Po					E Po	Po		E Po					E					
Union Grove	AS-C	AS/RBC-C			Po	E					E	Po		E Po				E	Po					

[a] *Used as a holding tank.*

[b] *Belt filter press.*

[c] *Delavan and Elkhorn.*

Source: Camp Dresser & McKee, Inc. and SEWRPC.

Letter Key

E = Existing
Po = Proposed
AS = Activated sludge

TF = Trickling filter
RBD = Biocontactor
C = Chemical addition

related water control facility and regional sanitary sewerage system development objectives previously established under related Commission work programs, these development objectives, principles, and standards provide the basic framework within which the alternative regional wastewater sludge management systems were formulated and a recommended regional wastewater sludge management system plan synthesized. The six objectives, together with their supporting principals and standards, are set forth in Table 3.

While the wastewater sludge management system development objectives provided the broad framework for plan formulation and evaluation, it was necessary in the program also to select engineering design criteria to be utilized in the design of alternative system plans and in the comparison of such plans. These design criteria are set forth in SEWRPC Technical Report No. 18, State of the Art of Water Pollution Control for Southeastern Wisconsin, Volume II, Sludge Management, prepared for the Commission by Stanley Consultants, Inc. This report describes techniques for sludge processing, transportation, and utilization/disposal, and sets forth criteria used in the analysis and screening of alternatives leading to the selection of the recommended regional sludge management system plan.

ALTERNATIVE PLANS

In preparing the recommended regional wastewater sludge management systems plan, a concerted effort was made to prepare and offer for public examination all reasonable physically feasible alternative plan elements which might satisfy the stated development objectives. Alternatives were considered for the various types of sludge handling, treatment, and disposal/utilization processes, as well as the geographic alternatives related to the degree of centralization of sludge management facilities. The following six geographic alternatives were given detailed consideration in the study:

1. Individual sludge management at each municipal sewage treatment plant.

2. Subregional sludge management centers at six major municipal sewage treatment plants.

3. Subregional sludge management centers at four major municipal sewage treatment plants.

4. A subregional sludge management center serving six major municipal sewage treatment plants with individual sludge management at all other plants.

5. Subregional sludge management centers at seven major municipal sewage treatment plants with one serving each county in the Region.

Table 3

WASTEWATER SLUDGE MANAGEMENT SYSTEM PLANNING OBJECTIVES, PRINCIPLES, AND STANDARDS[a]

OBJECTIVE NO. 1

The development of a regional wastewater sludge management system which will effectively support the existing regional development pattern and serve to aid in the implementation of the regional land use plan while meeting the anticipated wastewater sludge management needs generated by the existing and proposed land uses.

PRINCIPLE

The generation of sludges is an unavoidable result of the treatment of wastewaters from residential, commercial, industrial, institutional, and other intensive land uses in an industrialized society. Such generation creates a need for land for treatment and application—a need which should be accommodated properly within the overall existing and desirable future land use pattern of the Region.

STANDARDS

1. To assure a continuing potential for sludge application on land, the spatial arrangement of suitable land uses should be compatible with the spatial arrangement of existing and planned urban land use, to provide at least 60 acres of suitable and accessible agricultural or silvicultural land per 1,000 residents.

2. Sludge processing and utilization facilities should be sized and located so as to efficiently and effectively serve the recommended future land use pattern of the Region, as well as the existing land use pattern within the Region.

3. Systems for processing and disposal of sludge should be available at a reasonable cost to all owners or operators of publicly or privately owned sanitary or combined storm and sanitary or industrial sewage treatment plants, stormwater treatment facilities, large[b] industrial wastewater pretreatment facilities, on-site sewage treatment systems, or holding tanks.

4. The location of new and replacement wastewater sludge processing, storage, and handling facilities should be properly related to the existing and proposed future urban development pattern, as reflected in the adopted regional land use plan and any community or neighborhood unit development plans prepared pursuant to and consistent with the regional land use plan; and, more specifically, should be located only in areas designated for industrial or public utility areas.

5. The location of new and replacement wastewater sludge utilization sites should be properly related to the existing and proposed future urban development patterns as reflected in the adopted regional land use plan in existence at the time of disposal, as reflected in local community plans and zoning prepared pursuant to and consistent with the regional land use planning objectives, principles, and standards; and should, more specifically, be located only in areas designated for agricultural, woodland, industrial, utility, transportation, or specially managed park and recreation uses.

OBJECTIVE NO. 2

The development of a regional wastewater sludge management system which will meet established air and water use objectives and supporting standards; which will not result in pollution of the land, impairing its desirable uses; and which will be properly related to the natural resource base and enhance the overall quality of the environment in the Region.

PRINCIPLE

Wastewater sludges contain physical, chemical, and biological substances which could potentially present a threat to human health and to the chemical, biological, and ecological integrity of the air, water, and land of the Region; and to desirable uses of these and other elements of the underlying and sustaining natural resource base.

Table 3 (continued)

STANDARDS

1. Wastewater sludges should be treated and utilized only in a manner compatible with and supportive of the water use objectives and supporting water quality standards for the surface waters of the Region; and, sludge application shall be conducted only on lands where good soil and water conservation practices are implemented in order to avoid pollution of lakes and streams.

2. Operations conducted for land utilization of solid or liquid sludges should provide for a minimum of six months of sludge storage, should be performed only on lands where good soil and water conservation practices are implemented, should be properly timed and performed to account for meteorological conditions--inclusive of moisture and temperature--and, where feasible, should include incorporating the sludge into the soil immediately following application in order to avoid pollution of lakes and streams.

3. Wastewater sludge application should occur only on suitable soils, as identified in detailed soil survey maps.

4. The continuous or recurring application of wastewater sludges to land or in sanitary landfills should be avoided unless the recurring land area has been carefully selected, designed, operated, and monitored to avoid creation of a pollution or a public health hazard in the groundwaters of the Region.

5. Incineration of wastewater sludges shall be practiced in such a manner as to assure that the air quality standards will be maintained within the Region.

6. New and replacement installations for wastewater sludge treatment, handling, storage, and disposal, as well as additions to existing facilities and operations, should be located outside of the 100-year recurrence interval floodplains of the Region. If, in order to maximize the use of existing facilities, it is necessary to use floodplain lands for wastewater sludge treatment, handling, or storage, the facilities should be located outside of the floodway so as not to increase the 100-year recurrence interval flood stage and should be floodproofed to a flood protection elevation of two feet above the 100-year recurrence interval flood stage, so as to assure adequate protection against flood damage and avoid disruption of the processes of wastewater handling and disposal during flood periods. In the event that a floodway has not been established, or if it is necessary to encroach upon an approved floodway, the hydraulic effect of such encroachment shall be evaluated on the basis of an equal degree of encroachment for a significant reach on both sides of the stream, and the degree of encroachment shall be limited so as not to raise the peak stage of the 100-year recurrence interval flood by more than 0.5 feet.

7. Existing wastewater sludge storage and handling facilities located in the 100-year recurrence interval flood plain should be floodproofed to a flood protection elevation of two feet above the 100-year recurrence interval flood stage so as to assure adequate protection against flood damage and avoid disruption of wastewater sludge management processes during flood periods.

OBJECTIVE NO. 3

The development of a regional wastewater sludge management system which will effectively protect the public health within the Region.

PRINCIPLE

Sanitary wastewater sludges contain pathogenic organisms and toxic substances harmful to human and other life. The improper handling and disposal of such sludges might, therefore, create serious public health hazards.

STANDARDS

1. All sludges derived from sanitary wastes to be handled, stored, or land-applied off the wastewater treatment site, or in any other way allowing for substantial, noncontrolled public contact, should be digested, heated, or otherwise processed to reduce the hazard from pathogenic organisms.

Table 3 (continued)

2. Wastewater sludge storage facilities and landfills used for sludge application should be provided with protective fencing, suitable buffer zones, and evergreen plantings for visual screening.

3. Wastewater sludge land application sites should be located a minimum of 1,000 feet from the nearest public water supply well and 200 feet from the nearest private water supply well when sludge is incorporated into soil immediately after spreading.

4. No sludges should be applied on land to be used in the same or following year for the production of root crops intended for direct and uncooked consumption by humans, or directly onto trees bearing fruit which is to be consumed uncooked by humans.

5. Animal grazing or the harvesting of silage or other animal feed crops should be avoided on land where sludge has recently been spread.

6. The soil pH at sludge application sites should be maintained at 6.5 or greater in order to minimize uptake of cadmium and other heavy metals by plants.

7. Toxic and hazardous substances which would be present in harmful quantities in wastewater sludges must be reduced to acceptable levels by pretreatment of the contributing wastewater to make the sludges amenable to safe handling and disposal.

OBJECTIVE NO. 4

The development of a regional wastewater sludge management system which will help to maintain or enhance the productivity of agricultural land within the Region.

PRINCIPLE

As one of the most important renewable natural resources in the Region, soil, with its complex chemical and living organic characteristics, constitutes a particularly valuable and increasingly precious resource. Except on engineered sites, designed specifically and only for the purpose, sludge application practices should not preclude the continued and essentially unconstrained use of the prime agricultural lands of southeastern Wisconsin for the safe and healthful production of food and fiber.

STANDARDS

1. Long-term sludge utilization activities should not limit the capacity of the land for the production of food and fibers and should not be located on prime agricultural lands, as identified in the regional land use plan.

2. Soil and sludge tests should be utilized together in the analysis of sludge application sites to avoid damage to the long-term productivity of the land, through the addition of sludges of known characteristics.

3. Written records of wastewater sludges applied to land should be maintained for long-term reference for the analysis of the total loadings which have been applied.

OBJECTIVE NO. 5

The development of a regional wastewater sludge management system which will maximize the recovery and utilization of resources in the handling and disposal of wastewater sludges.

PRINCIPLE

A substantial amount of energy is expended in the conduct of activities which precede and cause the generation of sludge, which then contains natural organic substances and concentrated chemicals and thereby presents an opportunity to reduce the net resources needed to conduct the activities of human society and economy within the Region.

Table 3 (continued)

STANDARDS

1. Wastewater sludge management systems should be designed and developed wherever feasible in coordination with the design and construction of solid waste disposal facilities.

2. Where technically feasible, consideration should be given to the reclamation, from wastewater sludges, of substances having economic value, or to the use of pretreatment of wastewaters to remove substances having economic value prior to discharge of those substances to sewerage systems.

3. Wastewater sludge management systems should be designed and developed to provide for maximum use of the organic and nutrient components of sludge through application to enhance soil fertility.

OBJECTIVE NO. 6

The development of a regional wastewater sludge management system which is both economical and efficient, meeting all other objectives at the lowest cost possible.

PRINCIPLE

The total resources of the Region are limited and any undue investment in wastewater sludge handling and utilization systems must occur at the expense of other public and private investment; total wastewater sludge management systems' costs, therefore, should be minimized while meeting, to the maximum extent practicable, all of the other system development operations.

STANDARDS

1. The sum of wastewater sludge management system operating and capital investment costs, inclusive of any revenues received from resource recovery, should be minimized.

2. Maximum feasible use should be made of all existing and committed wastewater sludge management facilities. Such facilities should be supplemented with additional facilities only as necessary, to meet the anticipated wastewater sludge demand generated by substantial implementation of the regional land use plan and the regional sanitary sewerage system plan, while meeting pertinent water quality use objectives and standards.

3. The use of new or improved methods for wastewater sludge handling and utilization should be allowed and encouraged if such methods are adequately monitored in a suitable environmental sampling program; offer economies in operational costs; or, by their superior performance, lead to the achievement of air quality and water quality standards at lesser costs, providing they do not detract from the achievement of other objectives set forth herein.

4. The development of wastewater sludge handling and utilization processes and facilities should be conducted in such a manner as to allow the maximum feasible flexibility in the provision of technical alternatives for sludge handling and utilization and should always provide, as a temporary measure and as a possible future alternative, at least one alternative to the primary method of sludge disposal.

5. When technically feasible and otherwise acceptable, the application of wastewater sludge on land should utilize existing public lands in order to minimize land acquisition or easement costs.

6. Wherever possible, wastewater sludge handling and utilization systems should be designed and developed concurrently with power generation facilities, in order to effect engineering and construction economies as well as to assure the separate function and integrity of wastewater sludge management systems and power generation facilities.

[a] *The standards presented here serve multiple roles. First they are used by the Commission to compare the suitability and relative performance of physical plan alternative. Second, they are technical standards advised by the Commission for use by local units of government. In this role, standards may be considered minimum standards by local units of government which desire to impose more stringent limitations on waste management activities.*

[b] *Large industrial pretreatment facilities are defined as those treating at least 10,000 gallons per day of waste.*

Source: Camp Dresser & McKee, Inc., and SEWRPC.

6. A single centralized sludge management facility for the entire Region.

One sludge processing alternative examined for each alternative geographic sludge management plan involved the land application of wastewater sludges. As already noted, land application is now practiced at least in part by 58 of the 61 municipal sewage treatment plants in the Region.

An analysis was made to determine whether or not all sludge anticipated to be generated in the Region by the year 2000 could be disposed of through land application. Maps 3 and 4 summarize the results of this analysis. Map 3 identifies through a hatching pattern the general areas that would be needed to accommodate land application of sludge at 19 of the 21 major sewage treatment plants in the Region. That area of the Region not cross hatched represents the residual which could be used for land application of sludge from the Milwaukee-Metropolitan Sewerage District plants and the smaller municipal and private sewage treatment plants scattered throughout the Region. The land application zones identified on Map 3 are based upon the current practices at local industries to control the discharge of heavy metals. These land application zones also assume agricultural cropping conditions including the selection of crops which results in relatively poor crop yields, low nitrogen uptake by the crops, and thus lower allowable land application rates. Map 4 identifies similar, although significantly smaller, application zones for land spreading of sludge based upon a different set of assumptions. These assumptions include a significantly greater degree of control by local industries over the discharge of heavy metals into the municipal sewerage systems, as well as different cropping conditions which result in increased nitrogen uptake in order to maximize the amount of sludge that could be spread on the land.

The key variables, then, in determining the amount of land necessary for land spreading of sludge in the Region are the amount of heavy metals discharged into sewage by industries and the crop uptake of nitrogen as determined in part by the selection of crops by farmers whose lands are used for sludge spreading. Maps 3 and 4 represent the probable extremes when considering these variables. As shown in Table 4, the amount of land required for spreading of sludge ranges from about 69,000 acres to about 103,000 acres under the conditions graphically summarized on Map 3, and from about 43,000 acres to about 65,000 acres under the conditions graphically summarized on Map 4. The range in acreage is due to the fact that the final sludge process selection for the Milwaukee-Metropolitan Sewerage District sewage treatment plants has not yet been determined. The amount of sludge to be handled in the Milorganite process is a key variable. Thus, the amount of sludge to be applied to the land and the acreage required for sludge application varied with the level of Milorganite production capacity assumed in the alternative plans. Also, as shown in Table 4, the Region contains about 358,000 acres of land with

only slight and moderate limitations for sludge application. Thus, even under the most limited conditions, it would appear that there exists within the seven-county Region at least three times the amount of land needed to accommodate land disposal of all sewage sludge in the year 2000.

Table 4

SUMMARY OF LAND AVAILABLE FOR APPLICATION OF SLUDGE TO AGRICULTURAL LAND

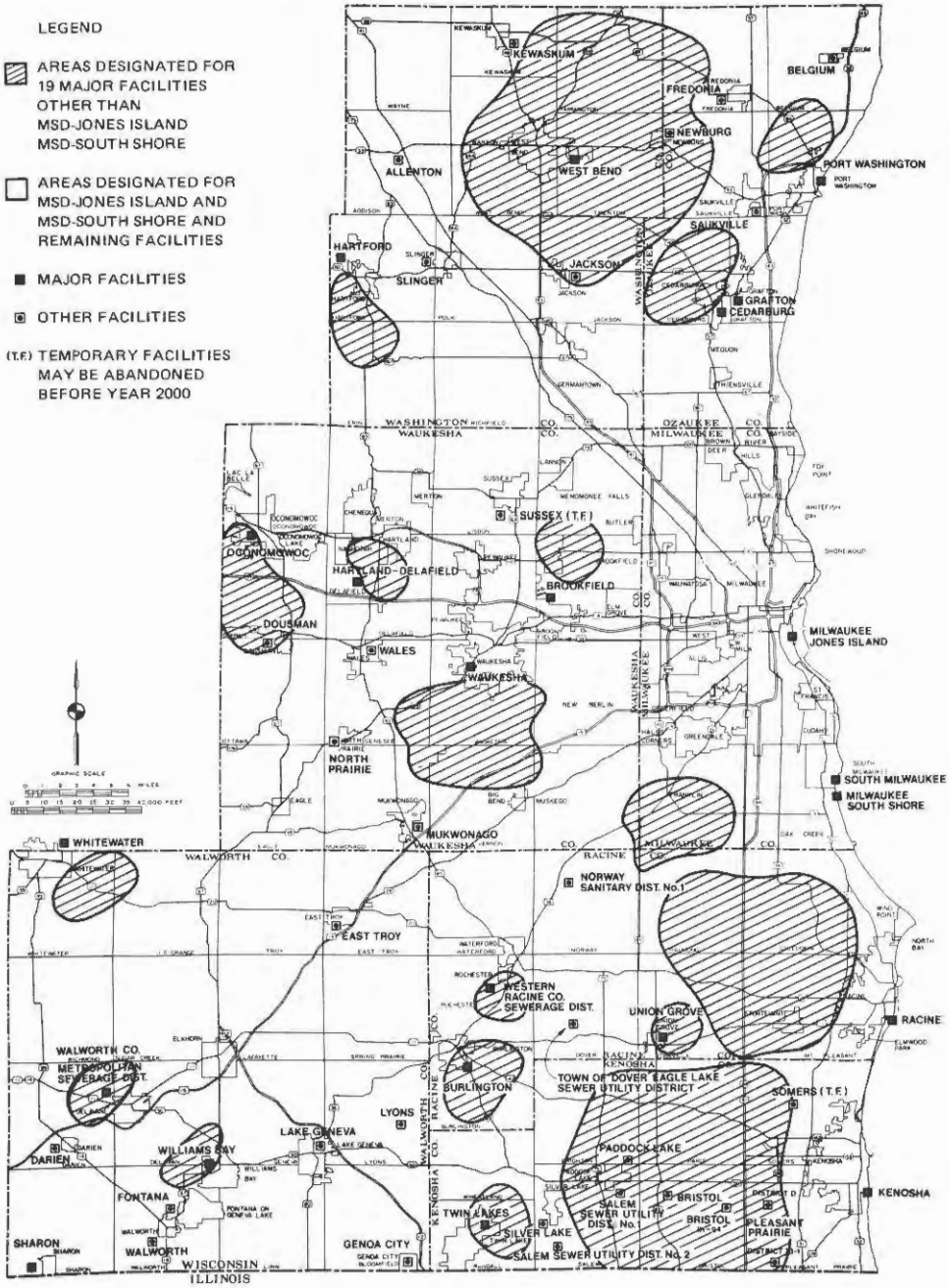
Source of Sludge	Conditions of Load			
	Range for Average Sludge Quality and "Poor" Crop Yield		Range for Contaminant Controlled Sludge Quality and "Better" Crop Yield	
	Acres	Acres	Acres	Acres
MSD-Jones Island and MSD-South Shore[a]	39,125	72,857	27,563	48,933
Other Major Plants	28,381	28,381	14,933	14,933
Other Plants	1,500	1,500	1,000	1,000
Total	69,006	102,738 (worst case)	43,496	64,648
Total Land Area with Slight and Moderate Limitations for Sludge Application: Acres Existing in Region After Subtracting a Portion of the Land as Needed for Incompatible Land Uses	358,000	358,000	358,000	358,000

[a] *Does not include combined sewer overflow solids land application or the effect of the possible 5 mg/l BOD_5 and SS effluent criteria for the Milwaukee treatment plants.*

Source: Camp Dresser & McKee, Inc.

Map 3

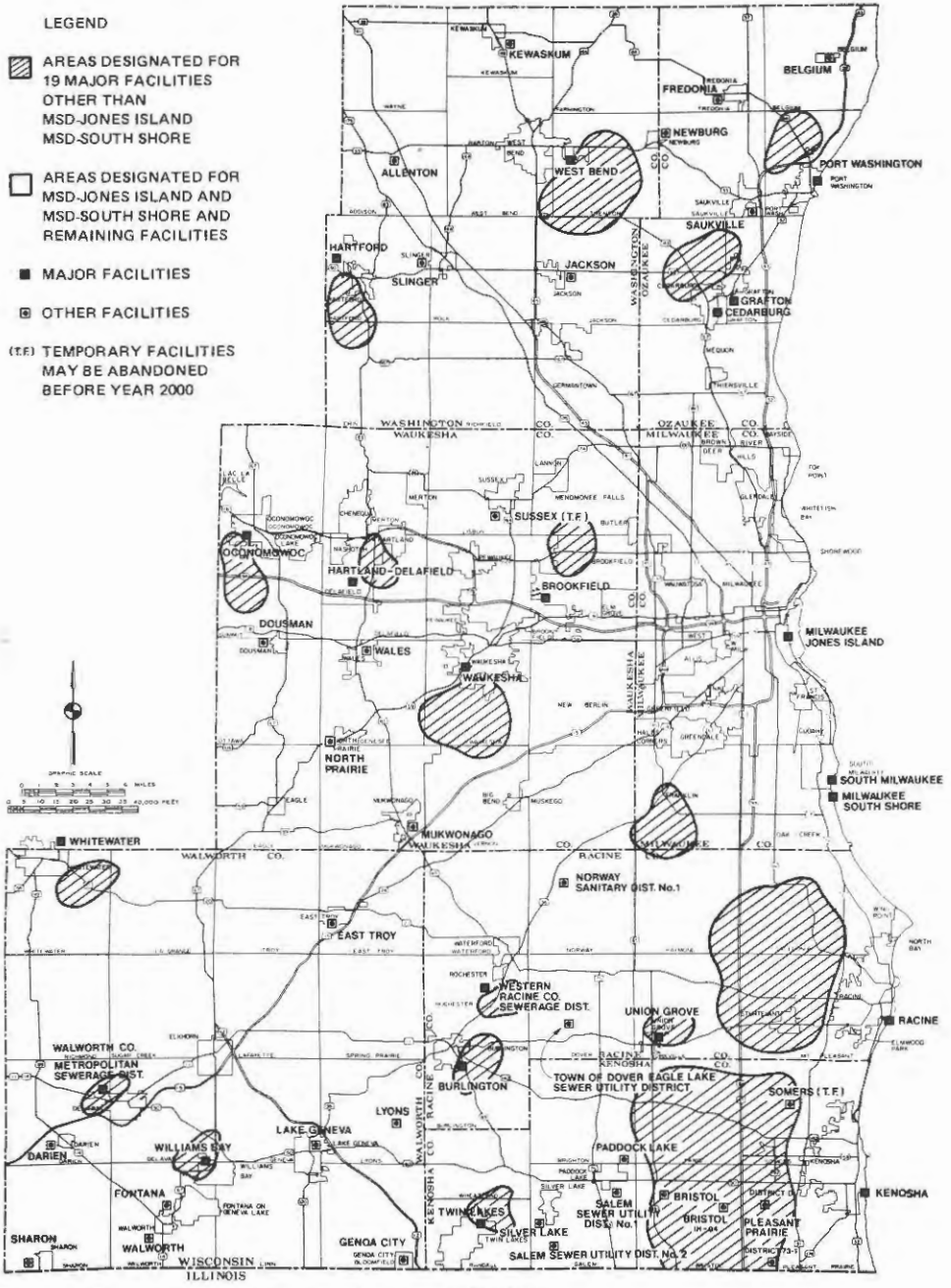
PRIMARY LAND APPLICATION ZONES BASED ON EXISTING AVERAGE SLUDGE QUALITY AT EACH PLANT: 2000



Source: Camp Dresser & McKee, Inc., and SEWRPC.

Map 4

PRIMARY LAND APPLICATION ZONES BASED ON ASSUMED HEAVY METAL SOURCE CONTROL AND CORRESPONDING IMPROVED SLUDGE QUALITY AT EACH PLANT: 2000



Source: Camp Dresser & McKee, Inc., and SEWRPC.

The analysis of alternatives under this study took into account not only the dollar costs of constructing, operating, and maintaining sludge management facilities, but also noneconomic factors, including environmental and energy considerations. The specific sludge management processes evaluated included not only land application through sludge spreading but also public pickup of dried sludge, organic fertilizer production, incineration-pyrolysis with ash landfills, landfill disposal, and industrial waste source control of heavy metals. For the sludge management alternatives considered, the following environmental impacts were analyzed:

- Increase in consumption of energy resources.
- Increase in harmful emissions to the atmosphere.
- Additional wear and volume on existing transport routes.
- Potential construction requirements of roads, rail lines, or pipelines, depending on transport mode utilized.
- Increased potential for spills or leaks of sludge material during loading and transport operations.
- Commitment of transport resources, manpower, and construction resources.
- Required large capacity landfill sites for pyrolysis/incineration options.
- Commitment of land for structural development.

RECOMMENDED PLAN

The plan contains recommendations for the management and disposal of municipal sewage treatment plant sludges, private sewage treatment plant sludges, industrial facility sludges, water treatment plant sludges, leachate, and septage and holding tank wastes.

Municipal and Private Sewage Treatment Plants

As noted earlier, six geographic alternative management plans were considered for sludge management at the municipal sewage treatment plants. The alternatives differed in the degree of centralization of sludge management. The evaluation included an analysis of the capital and operation and maintenance costs as well as noneconomic environmental considerations associated with each alternative. Alternatives 1 through 5, as described above, had virtually the same present worth cost, ranging from a low of $93.7 million for alternative 2 to a high of $95.8 million for

alternatives 1 and 4. Alternative 6, which assumes totally centralized sludge management at a single regional facility, was significantly more costly. It had a total present worth of about $125.1 million. Based upon this evaluation, it was apparent that no substantial economies could be gained in considering any significant degree of centralization of sludge management for the municipal sewage treatment facilities. Accordingly, it was determined to refine and detail alternative 1 involving the provision of individual sludge management facilities for each municipal sewage treatment plant as the primary element of the final recommended regional sludge management plan.

The primary sludge management process recommendations contained in the plan for each of the 21 major public sewage treatment facilities are summarized in Tables 5, 6, and 7. The following six sludge management processes were selected for use at plants throughout the Region:

1. Sludge dewatering, incineration, and landfill of residue.

2. Sludge digestion and land application in liquid form.

3. Sludge digestion, dewatering, and land application in partially dried form.

4. Sludge digestion, dewatering, and landfill in partially dried form.

5. Sludge dewatering, composting, and marketing of compost.

6. Sludge dewatering and production and marketing of commercial fertilizer.

The application of these six alternative primary sludge management processes to the 21 major public sewage treatment plants may be summarized as follows:

KENOSHA COUNTY

- City of Kenosha—The plan recommends sludge digestion, dewatering, and land application in partially dried form as at present. The capacity of the anaerobic digester and the thickeners is recommended to be expanded to meet year 2000 demands. The partially dried sludge should continue to be trucked to land spreading sites.

- Village of Twin Lakes—The plan recommends sludge digestion and land application as a liquid or in partially dried form in addition to continuation of the existing program of providing partially dried sludge for public pickup. A gravity thickener is recommended to improve the operating characteristics

Table 5

SUMMARY OF PRIMARY SLUDGE MANAGEMENT PROCESS RECOMMENDATIONS AT THE MAJOR PUBLIC SEWAGE TREATMENT PLANTS IN THE REGION

Major Public Sewage Treatment Plant	Recommended Primary Sludge Management Process					
	Dewatering, Incineration, and Landfill of Residue	Digestion and Land Application in Liquid Form[a]	Digestion, Dewatering, and Land Application in Partially Dried Form[a]	Digestion, Dewatering, and Landfill in Partially Dried Form	Dewatering, Composting, and Marketing of Compost	Dewatering and Production and Marketing of Commercial Fertilizer
Kenosha County						
City of Kenosha			X			
Village of Twin Lakes		X	X			
Milwaukee County						
Milwaukee-Metropolitan Jones Island	X		X	X		X
Milwaukee-Metropolitan South Shore	X		X	X	X	
City of South Milwaukee			X			
Ozaukee County						
City of Cedarburg		X				
Village of Grafton		X				
City of Port Washington		X				
Racine County						
City of Burlington			X			
City of Racine			X			
Village of Union Grove			X			
Western Racine County Sewerage District		X	X			
Walworth County						
Walworth County Metropolitan Sewerage District		X				
City of Whitewater			X			
Village of Williams Bay		X	X			
Washington County						
City of Hartford			X			
City of West Bend				X		
Waukesha County						
City of Brookfield	X					
Hartland-Delafield		X	X			
City of Oconomowoc			X			
City of Waukesha		X	X			

[a] *Sludge lagoons generally are included in the recommendations for treatment plant facilities under the category of transport of sludge in liquid form. This allows the option of transporting partially dried sludge from the lagoon as an alternate to liquid sludge transport. Conversely, plants included under the category of transport of partially dried sludge following vacuum filters, filter presses, centrifuges, or sand beds generally will have the option of bypassing the dewatering step and then transporting sludge in liquid form.*

Source: Camp Dresser & McKee, Inc., and SEWRPC.

of the existing anaerobic digester. Additional lagoon storage capacity is recommended. Sludge should be transported in liquid form by truck to land spreading sites. A sludge lagoon also is recommended to provide the option of partially dewatering the sludge prior to transportation by truck to the land application sites.

MILWAUKEE COUNTY

- Milwaukee-Metropolitan Sewerage District—Jones Island Plant—Sludge at this plant is presently dewatered and produced and marketed as the commercial fertilizer Milorganite. The plan recommends that four primary sludge management processes be examined in detail, including continued Milorganite production; sludge dewatering, incineration, and landfill of residue; sludge digestion, dewatering, and land application in partially dried form; and sludge digestion, dewatering, and landfill in partially dried form. The volume of sludge produced at this plant is too great to rely on only one primary management process. Accordingly, the plan recommends that the detailed facilities planning program now under way for the Milwaukee-Metropolitan Sewerage District determine the optimum combination of these four processes, recognizing that optimization may result in an ultimate recommendation to discontinue Milorganite production entirely or to not include one or more of the other three processes. The selection of at least three sludge management processes for the Jones Island plant will give the Milwaukee-Metropolitan Sewerage District the flexibility it needs to resolve the sludge management problems.

- Milwaukee-Metropolitan Sewerage District—South Shore Plant—Sludge at this plant is presently digested and applied to the land in liquid form. The plan recommends that four primary sludge management processes be examined in detail, including sludge dewatering, incineration, and landfill of residue; sludge digestion, dewatering, and land application in partially dried form; sludge digestion, dewatering, and land fill in partially dried form; and sludge dewatering, composting, and marketing of the compost. Like the Jones Island plant, the volume of sludge produced at this plant is too great to rely on one primary process. The detailed facilities planning program now under way should determine the optimum combination of these four processes, recognizing that optimization may result in an ultimate recommendation not to include one or more of the processes. The facilities planning process should also determine whether or not it is cost-effective to transport sludge from the Jones Island plant to the South Shore plant, or vice versa, in order to effect possible economies of scale. The selection of an optimum combination of sludge management processes will enable the

Table 6

SUMMARY OF SPECIFIC SLUDGE PROCESSING FACILITIES RECOMMENDED AT 19 OF THE 21 MAJOR PUBLIC SEWAGE TREATMENT PLANTS IN THE REGION

Major Public Sewage Treatment Plant	Recommended Sludge Processing Facilities	Required Additional Solids Capacity (dry tons per day)	Date of Approximate Startup	Date of Approximate End of Useful Life
Kenosha County				
City of Kenosha.	Gravity Thickener (primary)	11.8	1981	2011
	Anaerobic Digester	10.5	1981	2011
Village of Twin Lakes. . . .	Gravity Thickener	1.0	1980	2010
	Lagoon	0.6	1980	2010
Milwaukee County				
City of South Milwaukee. .	Gravity Thickeners	2.5	1981	2011
	Vacuum Filters	1.7	1981	2011
Ozaukee County				
City of Cedarburg	Lagoon	1.6	1980	2010
Village of Grafton	Gravity Thickeners	2.3	1981	2011
	Anaerobic Digester	1.3	1989	2019
	Lagoon	1.7	1981	2011
City of Port Washington . .	Gravity Thickener	2.0	1980	2010
	Lagoon	1.5	1980	2010
Racine County				
City of Burlington	Gravity Thickeners	2.3	1981	2011
	Centrifuge	0.7	1981	1996
City of Racine.	Gravity Thickener (primary)	24.0	1982	2012
	Dissolved Air Flotation Thickening (secondary)	6.0	1982	2012
	Anaerobic Digester	18.6	1982	2012
Village of Union Grove . . .	Aerobic Digester	1.0	1979	2009
	Lagoon	0.8	1979	2009
Western Racine County Sewerage District	Gravity Thickener	0.9	1981	2011
	Anaerobic Digester	0.9	1981	2011
	Lagoon	0.7	1983	2013

Table 6 (continued)

Major Public Sewage Treatment Plant	Recommended Sludge Processing Facilities	Required Additional Solids Capacity (dry tons per day)	Date of Approximate Startup	Date of Approximate End of Useful Life
Walworth County				
Walworth County Metropolitan Sewerage District.	Gravity Thickeners	2.3	1981	2011
	Anaerobic Digesters	2.3	1981	2011
	Holding Tanks (aerated)	(150 days)	1981	2011
City of Whitewater.	Dissolved Air Flotation Thickening	4.0	1982	2012
	Anaerobic Digesters	4.9	1982	2012
	Belt Filter Presses	3.0	1982	2012
Village of Williams Bay . . .	Lagoon	0.2	1990	2020
Washington County				
City of Hartford	Lagoon	0.8	1980	2010
City of West Bend	Gravity Thickener (primary)	8.8	1981	2011
	Anaerobic Digester	4.5	1981	2011
	Vacuum Filters	6.6	1981	2011
Waukesha County				
City of Brookfield	Gravity Thickener	9.8	1980	2010
	Filter Press	5.6	1980	2010
Hartland-Delafield	Gravity Thickener	2.2	1980	2010
	Anaerobic Digesters	2.2	1980	2010
	Anaerobic Digesters	2.2	1980	2010
	Lagoon	1.6	1980	2010
City of Oconomowoc	New Plant Completed	0.0	1977	2007
City of Waukesha.	Gravity Thickener (primary)	10.3	1981	2011
	Dissolved Air Flotation Thickening (secondary)	4.0	1981	2011
	Anaerobic Digester	5.9	1981	2011
	Lagoon	6.0	1981	2011

Source: Camp Dresser & McKee, Inc., and SEWRPC.

Table 7

RECOMMENDATIONS FOR FACILITY PLANNING EVALUATION FOR THE METROPOLITAN SEWERAGE DISTRICT (MSD) OF THE COUNTY OF MILWAUKEE

MSD-Jones Island Plant

Sludge processing facilities evaluation:

1. With Milorganite Production
   Thickening by gravity
   Chemical conditioning
   Dewatering with drying for Milorganite and

   A. Incineration/pyrolysis followed by residue landfilling and/or

   B. Anaerobic digestion prior to dewatering followed by landspreading or

   C. No other processing

2. With No Milorganite Production
   Thickening by gravity and/or dissolved-air flotation with

   A. Dewatering and incineration/pyrolysis with residue landfilling and/or

   B. Anaerobic digestion with dewatering and landspreading

MSD-South Shore Plant

Sludge processing facilities evaluation of thickening by dissolved-air flotation with:

1. Anaerobic digestion, chemical conditioning, and dewatering with landspreading and/or

2. Dewatering, Composting and/or

3. Dewatering, Incineration/Pyrolysis with Residue Landfilling

NOTES:

1. If effluent requirements are changed to 5 mg/l BOD_5 and 5 mg/l suspended solids, these recommendations are not expected to change. Recommendations to be evaluated under MSD Total Solids Management Program.

2. Backup system to all those shown is transport of sludge to landfill.

3. Evaluation should include transportation of sludge between plants in the MSD Total Solids Management Program.

4. Development of CSO facilities plans by the District may necessitate reevaluation of the above recommendations.

Source: Camp Dresser & McKee, Inc.

Milwaukee-Metropolitan Sewerage Commissions to deal with changing technology, regulatory considerations, and energy and marketing considerations.

- City of South Milwaukee—The plan recommends sludge digestion, dewatering, and land application in partially dried form. To accomplish this the plan recommends that gravity thickeners be added to the treatment system prior to the existing digesters with dewatering of the digested sludge by vacuum filtration.

OZAUKEE COUNTY

- City of Cedarburg—The plan recommends sludge digestion and land application in liquid form. The existing gravity thickeners and anaerobic digesters should be adequate through the year 2000. The plan recommends that additional storage lagoon capacity be provided at a site near which land spreading operations are to occur. The current joint sewerage facilities planning effort with Grafton should determine whether or not the sludge from the Cedarburg plant should be managed separately from that in the Grafton plant.

- Village of Grafton—The plan recommends sludge digestion and land application in liquid form. Consideration should be given to the addition of gravity thickeners to the plant prior to digestion and to increasing the digestion capacity. As in the case of Cedarburg, storage lagoons should be provided near land spreading sites.

- City of Port Washington—The plan recommends sludge digestion and land application in liquid form. Thickeners should be added to the plant prior to digestion. The plan recommends that sludge storage lagoons be provided at locations near land spreading sites. Transportation should be by truck as at present.

RACINE COUNTY

- City of Burlington—The plan recommends sludge digestion, dewatering, and land application in partially dried form. Consideration should be given to sludge thickening by gravity. Depending upon experience in operation of the existing centrifuge, expansion of the centrifuge capacity may be required. Alternatively, it may be desirable to land-spread liquid sludge in excess of the centrifuge capacity. Trucking of sludge to land spreading sites should be continued.

- City of Racine—The plan recommends sludge digestion, dewatering, and land application in partially dried form. Thickening of sludge prior to digestion is recommended with expansion of the digesters as required. The partially dried sludge should be trucked to land spreading sites as at present.

- Village of Union Grove—The plan recommends sludge digestion, sand bed dewatering, and land application in partially dried form. A new treatment plant is currently under construction. Additional sludge handling capacity may be required later in the planning period in which case aerobic digestion and lagoons should be added.

- Western Racine County Sewerage District—The plan recommends sludge digestion and land application in liquid or partially dried form. The existing sludge handling facilities at the plant will have to be expanded, including thickening anaerobic digestion and lagoons. Transportation of liquid sludge to spreading sites should be by truck as at present.

WALWORTH COUNTY

- Walworth County Metropolitan Sewerage District—A new sewage treatment facility is to be constructed to serve the Cities of Delavan and Elkhorn, the Delavan Lake Sanitary District, and the Walworth County institutions. The plan recommends sludge digestion and land application in liquid form. The new plant will have gravity thickening anaerobic digestion and sludge holding tanks. Truck hauling is to be used for transporting sludge to spreading sites.

- City of Whitewater—The plan recommends sludge digestion, dewatering, and land application in partially dried form. The proposed new Whitewater treatment plant will include sludge thickening, anaerobic digestion, and chemical conditioning, and belt filter presses. The partially dried sludge should be trucked to spreading sites.

- Village of Williams Bay—The plan recommends sludge digestion and land application in liquid or partially dried form. The plan further recommends the construction of a new sewage holding lagoon to be constructed near land spreading sites.

WASHINGTON COUNTY

- City of Hartford—The plan recommends sludge digestion and land application in partially dried form. Existing sludge processing facilities at the plant are expected to be adequate through the year 2000 with the exception of

dewatering. Accordingly, the plan recommends expansion of the existing sand bed dewatering capacity with a lagoon. Truck hauling to land spreading sites should be continued as at present.

- City of West Bend—The plan recommends sludge digestion, dewatering, and landfill in partially dried form. The proposed new treatment facilities at the West Bend plant are to include gravity thickening anaerobic digestion and vacuum filters. The West Bend sludge has high concentrations of heavy metals and should be disposed of through landfilling at least until such time as sludge quality can be improved through a program of contaminate control at the source. Land application should be considered if the sludge quality can be improved through source controls.

WAUKESHA COUNTY

- City of Brookfield—The plan recommends sludge dewatering, incineration, and landfill of residue. To accomplish this, the plan recommends installation of gravity thickeners and expansion of the filter capacity.

- Hartland-Delafield—The plan recommends that the proposed new Hartland-Delafield treatment facility include sludge digestion and provide for land application of sludge in liquid or partially dried form. In addition to the anaerobic digestion and lagoons recommended in the Hartland-Delafield facilities plan, the plan recommends consideration of the addition of a gravity thickener prior to digestion to improve the sludge handling process.

- City of Oconomowoc—The plan recommends sludge digestion, dewatering, and land application in partially dried form. The new Oconomowoc sewage treatment facility should be capable of handling projected sludge loads through the year 2000.

- City of Waukesha—The plan recommends sludge digestion and land application in liquid or partially dried form in addition to continuation of the existing program of providing partially dried sludge for public pickup. Additional facilities required at Waukesha would include gravity thickeners, dissolved air flotation thickening, anaerobic digester, and lagoons. Sludge lagoons are recommended to provide the option to partially dewater the sludge prior to transport by truck to the land application sites and prior to public pickup.

In addition to the foregoing recommendations for the major sewage treatment facilities, the regional sludge management plan sets forth general recommenda-

tions for the remaining municipal and private sewage treatment plants. These recommendations, which are summarized in Table 8, rely upon analyses of two examples of trickling filter plants—Lake Geneva and East Troy—and two examples of sludge plants—Darien and Thiensville. The plan recommends that the specific process options to be selected for each plant be defined in the locally developed facilities plans.

In addition to the foregoing primary sludge management plan recommendations, the plan contains the following auxiliary plan recommendations relating to sludge management:

1. Landfilling is recommended as a standby disposal process if land spreading cannot be carried on for whatever reason. At present insufficient available landfill capacity exists in the Region to handle large volumes of sludge should landfilling be required for extended periods of time. Accordingly, the plan recommends that "backup" landfill sites be identified under a regional solid waste management planning program and ultimately be made available for sludge management use, particularly for a short-term emergency situation.

2. Additional storage capacity for liquid or partially dried sludge should be developed on a case-by-case basis at plant sites or in remote locations near land spreading areas in order to accommodate problems that may be due to severe weather conditions and cropping practices.

Table 8

RECOMMENDATIONS FOR OTHER PUBLIC AND PRIVATE SEWAGE TREATMENT PLANTS FOR SLUDGE PROCESSING, TRANSPORTATION, AND UTILIZATION

PROCESSING OPTIONS	TRANSPORTATION OPTIONS	UTILIZATION/DISPOSAL OPTIONS
Gravity Thickening Anaerobic Digestion Lagoons Vacuum Filters Sand Beds	Truck	Landspreading Public Pickup Landfilling (generally as a backup)

NOTE: Specific process train options for each plant to be refined in locally developed facilities plans.

Source: Camp Dresser & McKee, Inc.

Map 5

RECOMMENDED SLUDGE MANAGEMENT PLAN

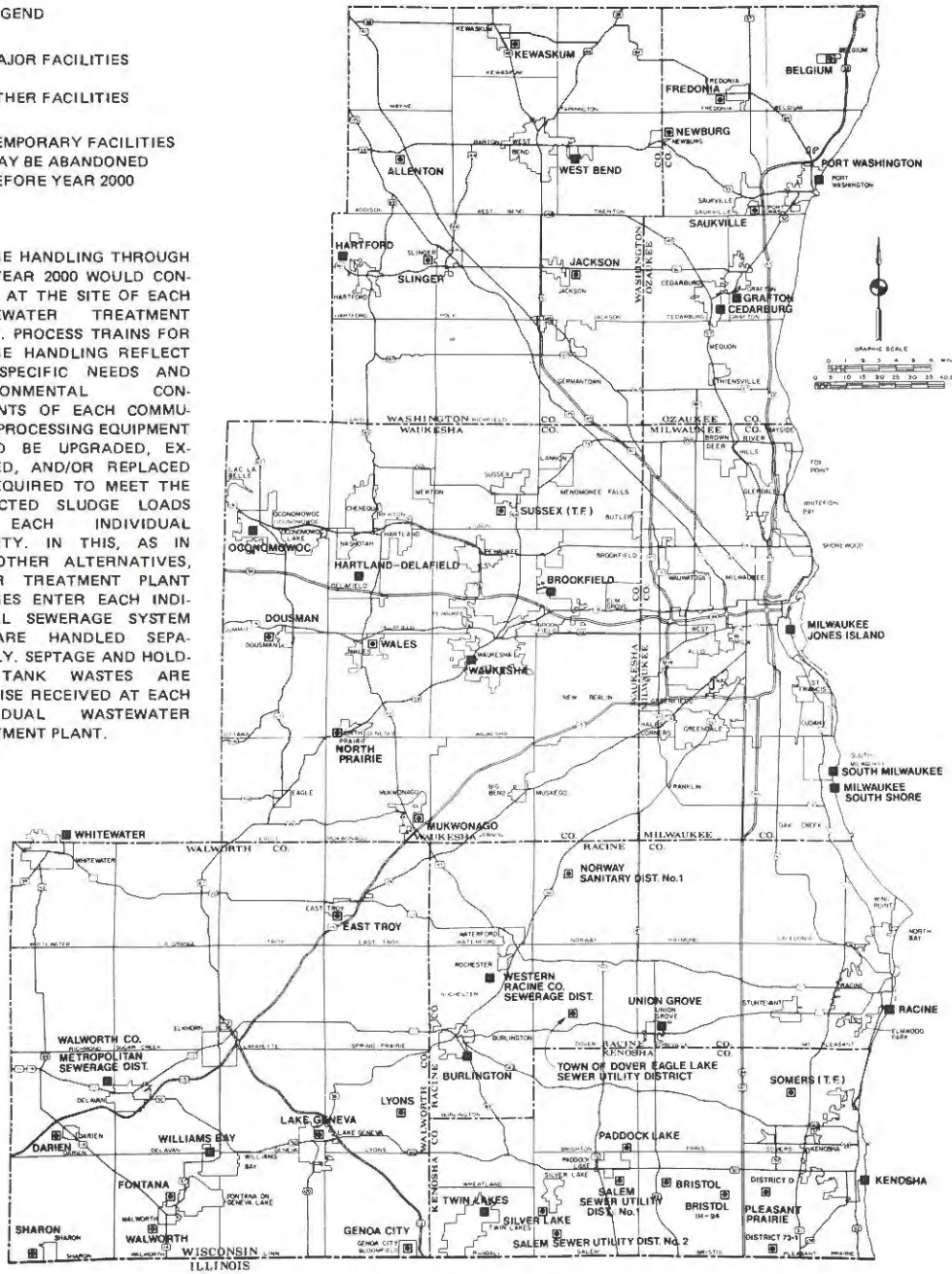
LEGEND

■ MAJOR FACILITIES

◙ OTHER FACILITIES

(T.F.) TEMPORARY FACILITIES MAY BE ABANDONED BEFORE YEAR 2000

SLUDGE HANDLING THROUGH THE YEAR 2000 WOULD CONTINUE AT THE SITE OF EACH WASTEWATER TREATMENT PLANT. PROCESS TRAINS FOR SLUDGE HANDLING REFLECT THE SPECIFIC NEEDS AND ENVIRONMENTAL CONSTRAINTS OF EACH COMMUNITY. PROCESSING EQUIPMENT WOULD BE UPGRADED, EXPANDED, AND/OR REPLACED AS REQUIRED TO MEET THE PROJECTED SLUDGE LOADS AT EACH INDIVIDUAL FACILITY. IN THIS, AS IN THE OTHER ALTERNATIVES, WATER TREATMENT PLANT SLUDGES ENTER EACH INDIVIDUAL SEWERAGE SYSTEM OR ARE HANDLED SEPARATELY. SEPTAGE AND HOLDING TANK WASTES ARE LIKEWISE RECEIVED AT EACH INDIVIDUAL WASTEWATER TREATMENT PLANT.



Source: Camp Dresser & McKee, Inc. and SEWRPC.

3. Joint use of land spreading sites should be explored on a case-by-case basis by those municipal sludge management operations recommended to use land spreading for sludge management.

4. Contaminate control programs for heavy metals and toxic substances should be developed, implemented, and enforced by municipalities where such action will result in an improved sludge quality and thereby assist in long-term land application.

5. An information storage and retrieval system should be developed to produce a complete record of where, when, and in what amount sludge has been applied to a given parcel of land.

Industrial Wastewater Treatment Plant Sludges

Table 9 summarizes the general recommendations for industrial pretreatment sludges. Recycle of materials within industries should be encouraged to reduce the material entering the pretreatment process and the sewerage system, to recover valuable materials where possible, and to reduce the quantities of waste materials entering the environment. With proper pretreatment, source control, or other contaminant control measures, industries presently discharging to a municipal treatment facility generally may continue to do so; however, the operator of a municipal treatment plant should receive prior notice of any major industrial process change which might affect the existing treatment. Those sludges containing large amounts of heavy metals or toxics so as to preclude landspreading should be landfilled at approved sites with proper groundwater and surface water protection. The three landfills in the Region presently licensed to accept toxic and hazardous wastes have limited future capacity for these wastes; additional site requirements should be evaluated as a top priority matter.

In municipalities where there is little or no industry, sludge should not have a high concentration of heavy metals or other toxic substances. These municipal sludges present few problems for landspreading. Where industries which have toxic wastes operate in the sewer service area, three possibilities exist for a sludge that may require special permits and special considerations in its disposal:

1. The industry pretreats and has a sludge which could be classified as toxic or hazardous—no toxic material enters the municipal sludge.

2. The industry partially pretreats—both the industry and the municipality may have a sludge that could be classified as toxic and hazardous requiring special considerations in its disposal.

Table 9

GENERAL RECOMMENDATIONS–DISPOSAL OF INDUSTRIAL WASTEWATER TREATMENT SLUDGES

Industrial Category	Sludge Disposal Option[a]
Tannery Sludges	Landfill
Metal Plating	Landfill
Metal Machining	Landfill or incineration
Milk Processing and Other Dairy Wastes Sludges	Landfill or landspreading[b]
Meat Processing	Landfill or landspreading[b]
Vegetable Processing Wastes Sludges	Landfill or landspreading[b]
Battery Manufacturing Waste Sludges	Landfill
Truck and Car Wash Operations	Landfill
Power Plants Wastes Sludges	Landfill

[a] *Sludge not discharged to municipal system. Landfills licensed by Wisconsin DNR to accept hazardous and toxic wastes. These are currently Metro Disposal Service Inc.–Franklin, Land Reclamation Ltd. (Oakes), and United Waste Systems (Lauer).*

[b] *Following stabilization (digestion).*

Source: Camp Dresser & McKee, Inc.

3. The industry does not pretreat—the industry has no sludge but the municipality may have a sludge that could be classified as toxic and hazardous requiring special considerations in its disposal.

Water Treatment Plant Sludges

Water treatment plant sludges may be discharged to the nearest sewerage system if rates are controlled to avoid upsets at the wastewater treatment plant. Water treatment plant sludges do not appear to present a serious future problem. If no sewerage system is available, these sludges should be dewatered and disposed of in landfills.

Leachate Collection, Treatment, and Disposal

All landfills, and particularly those accepting hazardous and toxic wastes, should be designed to minimize the production of leachate and for the protection of groundwater, or to collect and treat it before discharge to nearby water courses. Treatment may be provided at a municipal wastewater facility or at a self-contained onsite facility.

Septage and Holding Tank Wastes

The plan recommends that municipal treatment plants receive no more than 10 percent of their average influent flow from septage and holding tank wastes. All munici-

pal plants in the Region appear capable of providing capacity for receiving controlled quantities of septage and holding tank wastes as part of their sludge management plan. Such wastes preferably should be discharged from tank trucks directly into aerated holding tanks for metered introduction to the plant influent as a percentage of the influent flow rate, in order to minimize the "shock-load" effects, which are especially important with activated-sludge-type sewage treatment plants. The number and size of tank trucks discharging wastes to a plant should be closely monitored by the plant operator to avoid overloading. The haul distance is not considered to be overriding inasmuch as economics and convenience govern the area serviced by haulers for discharge to a given facility. Map 6 identifies general allocation areas of private septage to municipal treatment facilities.

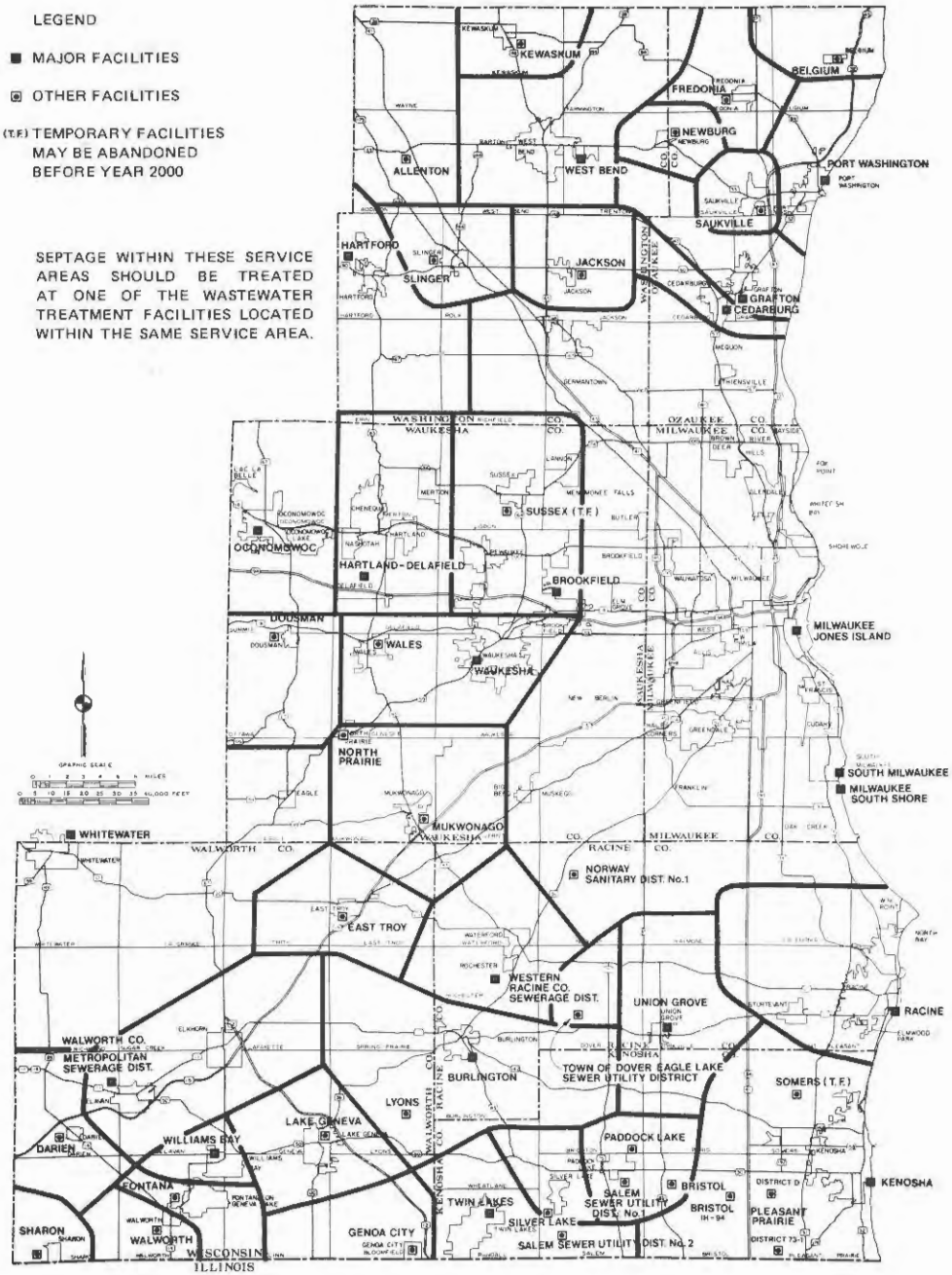
Cost of Recommended Plan

Total capital costs of implementing the recommended sludge management plan for the Region are estimated to range from $97,500,000 to $146,500,000, depending on the final mix of sludge processes selected for application at the Milwaukee Jones Island and South Shore plants (see Table 10). Expenditures for sludge management associated with the two Milwaukee treatment plants are expected to account for about 61 to 67 percent of the total capital cost requirement of the recommended plan. The capital expenditures associated with the other municipal sewage treatment plants and the private sewage treatment plants are expected to account for an additional 15 to 23 percent of the total capital cost of the plan, with the sludge management capital costs associated with industrial facilities and combined sewer overflows making up the remaining portion of the total program capital cost.

The expected average annual cost of the capital improvements and operation and maintenance of facilities needed to implement the sludge management plan for the two Milwaukee treatment plants is estimated to range from $7.00 to $11.00 per capita. These costs do not include costs associated with the facilities for treatment of solids which might be generated through treatment of combined sewer overflows or additional solids which would be generated if a 5 mg/l BOD_5 and 5 mg/l SS effluent requirement is established. The average per capita cost for the capital improvements and operation and maintenance of the facilities needed to implement the plan recommendations at the other municipal treatment plants is expected to approximate $8.00 per capita. It is anticipated that most of the components of the plan requiring capital investment will be eligible for federal and state grants-in-aid which could serve to reduce the local plan implementation costs for capital investment by as much as 75 to 80 percent. The present (1975) expenditure for public sanitary sewerage systems in the Region is $40.00 per capita which includes the capital and operation and maintenance costs associated with municipal wastewater conveyance and treatment and costs for processing, transporting, and disposal/utilization of the solids generated in the treatment process.

Map 6

ALLOCATION OF PRIVATE SEPTAGE TO PUBLIC SEWAGE TREATMENT FACILITIES



Source: Camp Dresser & McKee, Inc., and SEWRPC.

Table 10

APPROXIMATE TOTAL CAPITAL COST OF RECOMMENDED SLUDGE MANAGEMENT PLAN FOR THE REGION THROUGH YEAR 2000

Facility Type[a]	Estimated Total Capital Cost[b]
MSD-Jones Island and MSD-South Shore[c]	$59,000,000 to $ 98,000,000
Other Major Plants	22,200,000
Other Plants	1,300,000
Industrial Categories[d]	3,000,000
Total for Combined Sewer Overflow Solids[e]	$12,000,000 to $ 22,000,000
Total Program Costs	$97,500,000 to $146,500,000

[a] *Septic and holding tank wastes accepted at municipal facilities. Most water treatment plant sludges accepted at municipal facilities.*

[b] *ENR Construction Cost Index 2445 (August 1976 Base). Costs are only those associated with the recommended sludge management components of the treatment facilities in the Region. Estimates for the wastewater treatment components are presently being developed under other phases of the areawide water quality management planning program and will be published in SEWRPC Planning Report No. 30, A Water Quality Management Plan for Southeastern Wisconsin.*

[c] *These costs do not reflect the additional costs that would be required if advanced wastewater treatment is implemented to meet 5 mg/l BOD_5 and 5 mg/l SS effluent standards.*

[d] *This value does not include costs for major in-plant process changes instituted to reduce contaminant levels in wastewaters.*

[e] *Includes only sludge handling facilities required to comply with Department of Natural Resources stipulation. Does not include increased solids expected from compliance with 5 mg/l BOD_5 and 5 mg/l SS effluent standards.*

Source: Camp Dresser & McKee, Inc.

It is expected that the costs for treatment and disposal/utilization of wastewater sludges in the Region will increase at such time as additional solids are generated from the treatment of combined sewer overflows or from increased levels of sewage treatment to meet effluent limitations of 5 mg/l of BOD_5 and suspended solids as ordered in a recent federal court decision. It is estimated that the sludge solids which would be generated from these potential additional sources would be expected to increase the total regional sludge production by an estimated 35 to 65 tons per day on an annual average basis, or by less than 15 percent. Thus, the previously noted conclusions regarding the adequacy of the land in the Region suitable for the application of sludge should remain valid. The quality of the sludges

generated from plants treating combined sewer overflows could be adversely affected. The alternative processes previously recommended for further evaluation and optimization as part of the Milwaukee facilities planning program include systems—incineration/pyrolysis and landfilling—which would be applicable to the disposal of poor quality sludges. The final mix of these recommended processes as determined by the local facility planning effort should include provisions for quality as well as quantity variations in the sludges produced as a result of any future requirements for increased treatment levels and treatment of combined sewer overflows. The range of costs set forth above for the Milwaukee area encompasses various levels of continued Milorganite production and land application—processes which are particularly dependent upon sludge quality. Thus it may be concluded that changes in these cost ranges due to possible changes in the amount and character of the sludge should be small. However, changes in these cost due to increased sludge generation resulting from increased treatment requirements or treatment of combined sewer overflows should be expected. The plan recommendations for the Cities of Kenosha and Racine—the other two communities which may be generating additional amounts of sludge from treatment of combined sewer overflow and/or are presently considering the need to provide higher levels of treatment prior to discharge to Lake Michigan—include provisions for land application of partially dried sludge with landfill of partially dried sludge as a backup. The most significant affect on the recommended plan which can be foreseen is a change in sludge quality due to variations in treatment requirements which would preclude land application as the primary disposal/utilization process. In such a case, the plan would have to be updated in the future to provide for landfill of partially dried sludge or another alternative system as the primary disposal/utilization process with land application or another process as a backup system. The unit cost of sludge processing for these communities would be expected to increase by 20 to 70 percent should this process change occur.

PUBLIC PARTICIPATION IN PLAN DEVELOPMENT

The public was invited to participate in the development of the regional sludge management plan through a variety of citizen participation activities including newsletters, fact sheets, workshop meetings, educational television-telephone network programs, citizen advisory panels, and informational news releases. The overall purpose of these activities was to keep the public informed on the progress and interim results of the study and to solicit comments and plan input from the public. A more formalized and periodic method of participation was achieved through a Citizens' Advisory Panel composed of representatives of environmental groups, farm organizations, businesses and industry, educational institutions, community organizations, and local government as well as citizens not representing a specific organization. This Panel met several times during the development and screening of plan alternatives.

The Regional Planning Commission, in cooperation with the University of Wisconsin Extension Service, has published a series of fact sheets on water quality management. The February and June 1977 issues of these fact sheets, called "Update," were devoted to sludge management. "Update" is mailed periodically to a cross section of approximately 3,600 citizens and officials in the Region. The lead article in the January-February 1977 edition of the SEWRPC Newsletter also contained a discussion of sludge management.

Another element in the public participation program was an Educational Telephone Network utilized on March 24, 1977. This two-way audio hookup between central locations in each county in the Region permitted interested citizens and officials to interact with the staff through participation at these local, conveniently located meetings.

As part of the overall public participation program being carried out cooperatively by the SEWRPC and the University of Wisconsin Extension Service, three subregional sludge management alternatives workshops were held in 1977. The purpose of the meetings was to present preliminary alternatives for regional sludge management so that persons attending the meetings could offer opinions and make comments that might ultimately render final recommendations more implementable. The intent was to get citizen input prior to final plan selection. Participants included farmers, sewage treatment plant operators, public officials, representatives of environmental groups, and local citizenry. Participants were invited through news releases and through direct contacts by the University of Wisconsin Extension Service. The county agricultural extension agents were instrumental in encouraging participation. These three workshops were attended by a total of about 120 persons.

The presentations at the meetings were subdivided into the four major aspects of the planning effort: sludge processing, transportation, utilitization, and management and were followed by public comment. The major areas of concern raised at these meetings were:

- Aesthetic concerns, whether or not certain alternative plan elements—specifically land application and composting—can be accomplished with provisions to avoid such potential aesthetic problems as odors. The potential need for buffer zones between land application sites and surrounding land uses was raised as one specific example of such a provision to avoid aesthetic problems.
- Public health concerns, whether or not the sludge management process alternatives can be accomplished with provisions to avoid potential public health problems due to heavy metals and other potentially hazardous sludge constituents. The need to protect water quality by preventing runoff from land application sites was raised as one specific example.

- Resource conservation, whether or not sludge is a valuable resource and the need for considering resource recovery in the evaluation of plan alternatives. Specifically, the fertilizer value of sludges and heat recovery in incineration systems were cited as examples of resource conservation techniques which might be considered.
- Specific practical design considerations, the need for awareness of existing agricultural practices when developing land application recommendations. Specifically, the need to tailor the sludge processing alternative to the sludge application equipment and the possible need to provide sludge storage capacity to facilitate application during the proper times in the growing cycle were cited as examples of practices which should be considered.

The plan development process included careful consideration of the comments and reactions brought out during the sludge management workshops. In particular, evaluation of the aforementioned specific four areas of concern was incorporated into the planning process. Specifically, public acceptance of land application of sludges was considered to be achievable because of several factors addressed in the plan, including: evaluation of existing practices which include successful land application operations; evaluation and incorporation into the plan of proven and environmentally acceptable land application technology based upon state of the art studies and State of Wisconsin guidelines; and a proposed key plan element which has been started as part of the plan development process—a public participation and education process.

The final recommended plan was selected after consideration of economic as well as noneconomic factors such as energy consumption and other resource conservation factors. In general, systems which appeared most technically feasible and least expensive were also rated high on the environmental scale and, hence, no major conflicts developed between economics and environmental considerations. The selected sludge treatment and disposal/utilization processes did take into account present agricultural practices within the Region. Specifically, storage facilities were generally recommended to be included in the plan elements involving land application of sludges in order to account for periods when application of sludge would be impractical due to climatic conditions or agricultural practices. In addition, sludge processing and dewatering recommendations were coordinated with final disposal/utilization options.

PLAN IMPLEMENTATION

Plan implementation will occur in several phases and will require coordination and communication between several levels of agencies. The phases critical to successful implementation are: adoption, detailed planning, funding, construction, and operation and maintenance of the sludge management facilities. The responsibility for developing a local sludge management plan for the treatment and disposal/utilization

of sludge within the framework of the regional plan is recommended to remain with the local units of government generating the sludges. Town and county government are recommended to perform an important role in plan implementation as the public regulators of much of the land resource needed for sludge utilization. Certain monitoring, technical assistance, and data collection and regulatory functions of the plan are recommended to be maintained at a regional and state level. The Department of Natural Resources is recommended to have responsibility for administering the permit and licensing programs for land application and landfill sites.

The Regional Planning Commission can provide assistance in facilitating the necessary coordination between levels of government and between this portion of the water quality management plan and other regional planning efforts. In addition, information on governing regulations, permit procedures, restrictions and monitoring requirements is available through the Regional Planning Commission.

The ultimate responsibility for program development and site selection lies with the local management agencies. Provision must be made for adequate backup systems and interaction with neighboring communities. Sludge is a product and its utilization is recommended to be promoted by the local agency.

SUBSEQUENT ADJUSTMENT OF THE PLAN

Subsequent adjustment of the plan will be the responsibility of the regional planning agency as the designated areawide 208 management agency.

After final adoption of the plan, annual updates will be prepared to reflect:

1. Subsequent 201 facilities planning.
2. Additions or deletions to the plan.
3. Progress of plan implementation activities.
4. Progress toward meeting the stated goals or policies set forth in the plan.

The annual plan updates may be supplemented with more in-depth plan updates prepared at three- to five-year intervals.

IMPLEMENTATION SCHEDULES

The requirements for construction and the associated costs incurred for each of the 21 major wastewater treatment plant sludge facilities are discussed in the report.

Those locations with immediate needs for improvements are the MSD-Jones Island and the MSD-South Shore plants of the Metropolitan Sewerage District of the County of Milwaukee, Waukesha, West Bend, Whitewater, Walworth County MSD, Western Racine County MSD, and Hartland-Delafield. Those plants believed to require improvements during the planning period are Racine, Kenosha, South Milwaukee, Burlington, Brookfield, Port Washington, Grafton, Cedarburg, Hartford, Twin Lakes, and Williams Bay. The Oconomowoc and Union Grove plant improvements currently under construction or recently completed will be adequate throughout the planning period. Several other treatment plants included by category in the plan such as Lake Geneva, East Troy, and Darien will also need improvements during the planning period.

For the other sludge management facilities, a construction period of eight to 24 months should be anticipated for sludge handling facilities. Prior to construction, a planning stage of four to 12 months and a design stage of eight to 14 months should be included. In addition, regulatory agency approval for design and construction grants may require as much as six to 10 months. Therefore, planning and design should be initiated about two to four years prior to the time additional capacity is needed.

SUMMARY

Implementation of the recommended regional wastewater sludge management plan as presented here, should provide for the sound management of wastewater sludges in the Region area through the year 2000 and beyond. Based on the investigations and analyses conducted by and for the Commission, as described here, a prime conclusion is that the present sludge management systems in the Region are basically sound in concept from a technological viewpoint. From an environmental viewpoint, the Region has been and continues to be among the leaders in the United States in environmentally sound sludge management practices.

Milorganite production, distribution, and use is a prime example of environmentally sound waste recycling. The extensive practice of landspreading of sludge in the Region is another such example. However, aging and overutilized facilities, heavy metals and toxic wastes, and changing government regulations and citizen attitudes have rendered various aspects of the existing systems inadequate. As technology and governmental regulations, environmental and energy requirements, and knowledge of the effects of toxic materials change, the concept of recycling and reuse should not change; however, the processing, transportation, and utilization techniques followed must adapt to these changing conditions. The regional sludge management plan recommended in this report meets these conditions by recognizing the need for maximum resource conservation and reuse. Sludge is thus considered as a resource to be properly utilized rather than an undesirable material to be disposed of.

COMMISSION TO ASSIST IN PREPARATION OF LOCAL PARK PLANS

The completion and adoption of the new regional park and open space plan has enabled the Commission to now be of assistance to local communities in the Region in the preparation of more detailed local park and open space plans within the framework of the regional plan. The Commission has to date received requests from Ozaukee County, the Village of Darien in Walworth County, and the Town of Eagle in Waukesha County to provide such assistance. Most of the data necessary to prepare these three plans are already available from studies conducted by the Commission. While the plans will be prepared within the framework of the regional plan, they will focus on specific park and open space needs in the local communities over the next five years.

The preparation of park and open space plans, in addition to being a traditional part of any comprehensive local planning effort, is a prerequisite to the continued receipt by counties, cities, villages, and towns of federal park acquisition and development funds under the Land and Water Conservation Fund Act (LAWCON) and of state funds for such purposes under the Outdoor Resources Act Plan (ORAP). The Wisconsin Department of Natural Resources, which administers both the state and federal programs, has indicated that adoption by counties of the regional park and open space plan can serve to qualify counties for such funds thereby obviating the need to prepare separate county park plans for this purpose. The Department has also indicated that adoption of the regional plan by a city, village, or town in a county where the county has adopted the plan can qualify that unit of government for federal and state funds in support of the acquisition or development of any facilities specifically identified in the regional park and open space plan. Thus, some local communities may simply wish to adopt the regional park and open space plan as the local plan. Other communities, however, may wish to prepare their own park and open space plans, thereby refining and detailing the regional plan. To date Kenosha, Washington, and Racine Counties have adopted the new regional park and open space plan.

WHITTIER NEIGHBORHOOD PLAN REPORT PUBLISHED

The Commission has recently completed and published a neighborhood plan for the Whittier Neighborhood, a developing neighborhood within the City of Kenosha and the Town of Pleasant Prairie in Kenosha County. The report was prepared by the Commission in response to a request from the City of Kenosha, a request precipitated by a local controversy over the desirable extent of industrial land use development within the neighborhood area.

In order to assist the City, the Town, and Kenosha County in resolving this problem, the Commission staff prepared two alternative neighborhood plans. These plans show how the neighborhood could be fully developed, both with and without the extension of industrial land uses south of the Chicago and North Western Transport

Company railroad tracks which bisect the neighborhood. This neighborhood is atypical in that it contains a significant proportion of land already committed to industrial and commercial land uses. The Commission staff has recommended to the city, town, and county that no industrial development take place in that portion of the neighborhood located south of the railroad tracks.

The Commission long has urged the preparation of detailed neighborhood unit development plans as an aid to the making of local development and redevelopment decisions. The Commission has been working for nearly a decade now with various local communities in the development of such neighborhood plans, and such plans have indeed proven to be useful aids in local development decisionmaking.

SEWRPC Community Assistance Planning Report No. 16, A Plan for the Whittier Neighborhood, is available at the Commission offices for a cost of $2.00 for regional residents and $4.00 for nonregional residents.

QUESTION BOX

WHO IS ULTIMATELY RESPONSIBLE FOR SLUDGE UTILIZATION AND DISPOSAL?

The generator, whether a municipal wastewater treatment plant, a private wastewater treatment plant, or industrial waste treatment facility—such as food processors, tanneries, metal platers—is responsible under U. S. Environmental Protection Agency and Wisconsin Department of Natural Resources guidelines, through the Wisconsin Pollution Discharge Elimination System (WPDES) permit program, and in accordance with the regional sludge management plan recommendations. The generator should insure that proper sites are identified; that proper sludge testing to determine application rates is completed on an individual site basis, that proper state and local approvals are obtained; and that a backup utilization or disposal system exists.

HOW CAN I TELL HOW MUCH SLUDGE, IF ANY, IS SAFE TO PUT ON MY LAND?

Have the generator of the sludge advise you as to a safe application rate. This advice should be based upon sludge characteristics, the soil types, results of soil tests, crops to be grown, cropping practices, and applied conservation practices of the specific site in question.

As for home lawn and garden use, proper application rates should be available at the sludge pickup site or through the sludge generator. Repeated heavy applications of sludges containing high levels of heavy metals is not recommended.

Quotable Quote.....

"...It is life which rules over the work of death and the dissolution of animal and vegetable matter. This constant return to the atmospheric air and to the mineral kingdom of the constitutents which vegetables and animals have borrowed from them is an act related to the development and multiplication of organized beings."

Louis Pasteur
French Research Chemist
of the 19th Century
(1822-1895)

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