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UNITED STATES
ENVIRONMENTAL PROTECTION AGENCY

REGION 5
230 S DEARBORN ST
CHICAGO ILLINOIS 60604

SEPTEMBER 1976

ENVIRONMENTAL IMPACT STATEMENT

DRAFT

Organic Solids Reuse Plan

Part I

Madison Metropolitan Sewerage District,
Dane County, Wisconsin

DRAFT ENVIRONMENTAL IMPACT STATEMENT

ORGANIC SOLIDS REUSE PLAN

PROPOSED BY

THE MADISON METROPOLITAN SEWERAGE DISTRICT

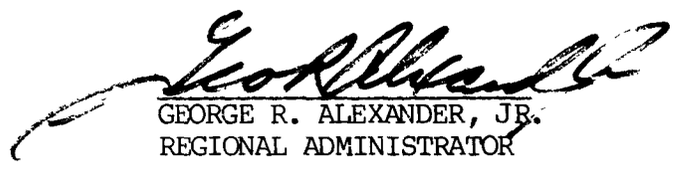
Prepared By The

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION V

CHICAGO, ILLINOIS

APPROVED BY:



GEORGE R. ALEXANDER, JR.
REGIONAL ADMINISTRATOR

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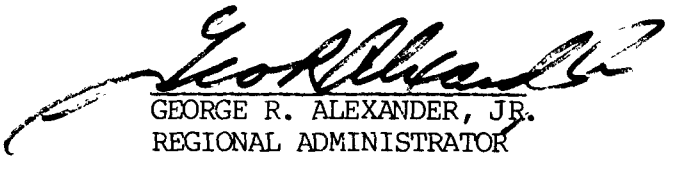

GEORGE R. ALEXANDER, JR.
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SEPTEMBER 1976

TABLE OF CONTENTS

Part I

	Page
Summary Sheet	i
I. Background	
A. Existing Water Quality Facilities and Agencies	
B. Existing Problems	
1. Background	1-1
2. History of the Sludge Disposal Program	1-1
C. Proposed Solution	1-2
II. Existing Environment	
A. Natural Environment	
1. Atmosphere	
Temperature, Precipitation, Snowfall, Winds	2-1
Severe climatological Events	2-1
2. Land	
Topography	2-1
Geology	2-1
Soils	2-3
Wetlands and Water/Land Interfaces	2-3
3. Water	
Water Quantity and Location	2-3
Water Quality	2-4
4. Natural Vegetation and Wildlife	
Habitat	2-4
Wildlife	2-5
5. Sensitive Natural Areas	2-6
B. Man-made Environment	
1. Air	
Air Quality	2-6
Noise	2-6
Odor	2-6
2. Land Use	
Existing Land Uses	2-6
Proposed Land Uses and Development Trends	2-13
3. Water Quality and Quantity	
Problem	2-15
Uses	2-15
Management	2-15
4. Summary of Sensitive Man-made Resources	
Historical and Archeological Sites	2-15
Recreation and Open Space Areas	2-19
Agricultural Land	2-19
Energy Resources	2-19
III. Alternatives to the Proposed Project	
A. Lagoon Abandonment Program Alternatives	3-1
B. Future Sludge Handling and Disposal Alternatives	

TABLE OF CONTENTS CONT.

1. Greeley and Hansen Reports 3-2
2. Weston Report 3-2
Land Application of Sludge 3-2
Sanitary landfill of sludge-milled refuse mixture 3-2
Land Application of Compost 3-2
Sludge Treatment Alternatives Considered in the Weston Report 3-3
3. MMSD Addendum 3-4
Alternative 1A-Land Trenching of Dewatered Sludge 3-4
Alternative 2A-Land Application of Liquid Sludge 3-5
Alternative 3A-Landfilling of Sludge/Milled Refuse Mixture 3-6
Alternative 3B-Land Application of Dewatered Sludge 3-8
4. CH2M Hill Study 3-8
5. Reuse Level Alternatives 3-9
6. Reuse Program Alternatives 3-9
7. Transportation Method Alternatives 3-9
8. Intermediate Storage Facility Alternatives 3-9
9. Application Method Alternatives 3-9
10. No Action Alternative 3-10
11. Other Considerations in Developing the Proposed Plan 3-10

IV. Description of the Proposed Actions

A. Sludge Treatment Facilities 4-1
1. Gravity Sludge Thickener Improvements 4-1
2. Dissolved Air Flotation Thickeners 4-1
3. Sludge Digester Improvements 4-1
B. Cost of the Organic Solids Reuse Program 4-1

V. Environmental Effects of the Proposed Actions

A. Sludge Lagoon Abandonment Program 5-1
B. Construction and Operation of Expanded Solids Treatment Facilities 5-1
C. Construction of Solids Handling Facilities = 5-2
D. Operation of the Organic Solids Reuse Program 5-2
1. Seasonal Sludge Storage in an Existing Lagoon 5-2
2. Sludge Transfer and Intermediate Storage 5-2
3. Sludge Application to Privately-owned Agricultural Land 5-2
a. General Discussion 5-2
b. Issues Not Considered in the Facilities Plan or Environmental Assessment or Which Require Further Discussion 5-3
PCB Monitoring 5-3
Nitrogen 5-3
Heavy Metal Considerations-Cadmium 5-3
Economic Effects 5-4

TABLE OF CONTENTS CONT.

VI. Relationship Between Local Short-Term Uses of Man's Environment and the Maintenance and Enhancement of Long-Term Productivity 6-1

VII. Federal/State Agency and Public Participation 7-1

Appendices

LIST OF TABLES

Chapter 2

Table		Page
2-1	Climatological Data, Madison, Wisconsin	2-2
2-2	Dane County, Natural Areas and Areas of Scientific Interest	2-7-10
2-3	Rock County, Natural Areas and Areas of Sientific Interest	2-11-12
2-4	Industrial Point Sources of Pollution, Lower Rock River Basin	2-16-18

SUMMARY SHEET

(X) Draft

( ) Final

U.S. Environmental Protection Agency Region V, Chicago

1. (X) Administrative Action

   ( ) Legislative Action

2. Description of the Action

The analysis of alternatives indicates that the sludge management needs of the Madison Metropolitan Sewerage District service area would most adequately be met by abandoning the present system of lagoon disposal of liquid anaerobically digested sludge and adopting a system of land disposal of liquid anaerobically-digested sludge on privately-owned agricultural land. The program would involve marketing the sludge to farmers at their request.

3. Environmental Impact

   a. Water

The abandonment of lagoon disposal of sludge at Nine Springs sewage treatment plant will eliminate the threat of lagoon dike failure and resultant toxic spills of the lagoon contents into Nine Springs Creek and the adjacent wetlands. As long as the proposed land disposal program is strictly managed and operated as planned, there will be no significant effect on water quality and quantity.

   b. Air quality

As long as the precautions which have been outlined in the facilities plan and environmental assessment are taken, potential odor problems will be minimized. Dust generated from construction of solids treatment and handling facilities will cause a temporary change in ambient conditions.

   c. Land Use

The only significant effect on land use which is expected to result from the proposed plan is the beneficial one which is the eventual return of the abandoned sludge lagoons to a wetland condition.

   d. Soils and Biota

Possible impacts on the soils and plant and animal life of the study area could result from the build-up of materials contained in the sludge to levels which may be toxic to normal life functions. This potential effect will be minimized because MMSD's plan proposes to limit annual application rates and total allowable loadings to levels which would provide for protection of the soils and plant and animal life of the area while at the same time obtaining the maximum soil amendment value to be gained from land application of the sludge.

Cadmium levels and the ratio of cadmium to zinc in MMSD sludge are higher than the United States Department of Agriculture would recommend for sludge being applied to privately-owned land. MMSD's conservative application rates and their proposed cadmium source control program should minimize the potential for build-up of cadmium to toxic levels.

e. General Concern

Since the potential adverse impacts of MMSD's proposed organic solids reuse plan can be minimized or avoided only if MMSD's proposed management and marketing programs are strictly carried out, it is imperative that MMSD strictly adhere to their plan.

4. Alternatives Considered

a) Ultimate disposal alternatives

1) Land application of dewatered sludge;
2) Land application of liquid digested sludge;
3) Land application of compost;
4) Landfill of sludge/milled refuse mixture;
5) Landfill of digested sludge;
6) Subsurface placement of sludge;
7) Incinerate raw sludge;
8) Incinerate digested sludge;
9) Lagoon storage - NO ACTION ALTERNATIVE.

b) Transportation Method Alternatives

1) Rail transport;
2) Truck transport;
3) Pipeline transport.

c) Application Method Alternatives

1) Sprinkler gun;
2) Subsurface injection;
3) Truck or tractor drawn spreader.

d) Sludge Reuse Program Alternatives

1) Sludge supplied by MMSD at farmer's request;
2) MMSD leases privately-owned land for sludge application;
3) Combination of 1) and 2).

5. Irreversible and Irretrievable Commitment of Resources

By the implementation of the proposed actions the only irreversible and irretrievable commitment of resources would be for the capital, labor and energy used in construction of the facilities and the operation and maintenance costs of the entire program including labor and energy.

6. Federal, State, and Local Agencies Notified of this Action

Federal

Senator William Proxmire
Senator Gaylord Nelson

Representative Robert William Kastenmeier
Council on Environmental Quality
Advisory Council on Historic Preservation
United States Department of Agriculture
Agricultural Research Service
Forest Service
Soil Conservation Service
Army Corps of Engineers, Rock Island District
United States Department of Health, Education and Welfare
United States Department of Housing and Urban Development
United States Department of Interior
United States Department of Labor
Upper Mississippi River Basin Commission
Water Resource Council

State

Wisconsin Department of Natural Resources
State Historical Society
Wisconsin Bureau of Planning and Budget
Wisconsin Department of Urban and Regional Planning
Wisconsin Department of Local Affairs and Development
Wisconsin Department of Health and Social Services
Wisconsin Department of Agriculture
Wisconsin Department of Administration
Office of the Governor

Local

University of Wisconsin, Department of Soil Science
Rock County Department of Environmental Protection
Madison Metropolitan Sewerage District
Rock Valley Metropolitan Council
Dane County Regional Planning Commission
City of Madison Planning Department
Dane County Health Department, Board of Supervisors

CHAPTER 1
BACKGROUND

A. Existing Water Quality Facilities and Agencies

The Madison Metropolitan Sewerage District (MMSD) which was organized under Wisconsin Statutes in 1930 is a metropolitan sewerage district with the responsibility for the transmission, treatment and discharge of wastewaters from the City of Madison, Wisconsin and its surrounding areas. The MMSD presently serves a total of three cities, five villages and twenty-six municipal customers located within ten townships. The MMSD includes approximately 142 square miles and is located entirely within Dane County.

The 36.5 MGD of wastewaters currently generated within the District receives secondary treatment at the Nine Springs Sewage Treatment Plant which is located on the southern edge of the City of Madison. Its location is shown on Figure 1-2 of the environmental assessment for this plan which is attached as a portion of Part II of this environmental impact statement (EIS).

B. Existing Problem

1. Background

On December 31, 1975, MMSD was awarded a Step 1 Grant (Grant No. C550826-01,-02) from this agency to prepare a facilities plan which would meet the requirements of Wisconsin Pollutant Discharge Permit No. WI-0025411. The facilities plan was to include documentation to determine the cost-effective construction of advanced waste treatment facilities and disposal of the effluent, and handling and disposal of sludge from the treatment facilities.

In July 1975 the facilities planning effort was segmented into two portions, 1) advanced waste treatment and effluent discharge (Grant No. C550826-01) and solids 2) handling and disposal (Grant No. C550826-02). This segmentation was done because of the need to expedite the solids handling portion of the study.

This EIS covers only the segment of MMSD's overall facilities planning effort concerned with solids handling and disposal. Advanced waste treatment and effluent discharge issues will be considered in a separate EIS.

The firms contracted by MMSD who were responsible for preparation of the documents in Part II of this EIS were: 1) CH2M Hill, who had primary responsibility for preparation of the organic solids reuse plan; and 2) O'Brien and Gere Engineers, Inc., Syracuse, New York, who were responsible for preparation of the environmental assessment for the plan.

2. History of the Sludge Disposal Program

Since the Nine Springs Wastewater Treatment Plant was put into operation in the early 1930's the problem of disposing of the sludge produced during wastewater treatment has been present. From the 1930's until 1942, the sludge produced was dried on sand beds and utilized as a fertilizer for lawns, gardens, and flower beds. Small amounts were ground and bagged. With the outbreak of World War II the manpower required to operate and maintain this system was no longer available.

In 1942, Lagoon 1 was constructed and the sludge produced at the plant was diverted to it for storage. This lagoon has been in continuous use since that time. As the capacity of the original lagoon was reached, a second lagoon (Lagoon 2) was constructed immediately to the east of Lagoon 1 in 1968. The total lagoons area is approximately 145 acres.

In April 1970, portions of the dike of Lagoon 2 failed, allowing lagoon supernatant to flow into Nine Springs Creek and thence into the Yahara River just upstream of Lake Waubesa. An additional dike failure occurred in November 1973, but spillage was negligible at that time. As a result of the first failure, MMSD paid $20,000 in damages and entered into an agreement with WDNR stipulating that an alternative method of sludge disposal was to be implemented by MMSD as soon as practicable.

A number of studies were then initiated which investigated the alternatives for sludge disposal and the stability of the lagoon dikes. A major finding of these reports (Warzyn Engineering and Service Co., Inc., 1970; CH2M-Hill Engineers, Inc., 1975) concluded that the dikes of Lagoon 2 were quite unstable and were subject to probable failures in the future. Other reports (Greeley and Hansen Engineers, 1971; Roy F. Weston, Inc., 1974) evaluated and concluded that sludge reduction and disposal methods such as incineration, heat treating, mechanical dewatering and landfilling were not feasible. The staff of MMSD prepared an addendum to the Weston report evaluating other sludge handling and disposal alternatives not considered in the Weston Report. For a number of reasons, including the physical and chemical characteristics of the MMSD sludge and high energy requirements, these methods were eliminated from further consideration. The recommended method of sludge disposal was land application of the sludge to utilize its nutrient value as a fertilizer substitute.

The sludge disposal portion of the facilities plan has evaluated the various methods presently available to implement a land application program. Consideration was given to the factors necessary to develop site location and management, environmental factors and program costs. In addition, various methods of sludge treatment have also been considered. Also, several lagoon abandonment options were evaluated.

3. Proposed Solution

MMSD proposes to abandon the present program of lagoon disposal of liquid anaerobically digested sludge and to pursue a program of land application of liquid anaerobically digested sludge to privately-owned agricultural land. The program involves marketing the sludge to farmers for its fertilizer and soil amendment value at their request. The total present-worth cost of the organic solids reuse program is $14,949,000. The applicant is requesting $3,833,000 in Federal and $256,000 in state grants to fund the project. MMSD's portion of the cost is expected to be approximately $10,860,000 which represent the operation and maintenance costs and their share of the construction costs. The Federal and state grant amounts cited above are tentative in that it remains to be determined by Region V, USEPA and the State of Wisconsin which costs are actually grant eligible.

CHAPTER 2
EXISTING ENVIRONMENT

A. Natural Environment

1. Atmosphere (Climate)

Chapter 6 of the facilities plan and Section 2 of the environmental assessment present an adequate summary of climatological conditions in the study area. Some additional information is provided to supplement these sections. The main source of this supplemental information is the environmental inventory for the project prepared by the applicant and its consultants.

Temperature, Precipitation, Snowfall, Winds

Table 2-1 is presented to provide a summary of temperature, precipitation, snowfall and winds data for Madison, Wisconsin.

Severe Climatological Events

No additional information is necessary.

2. Land

Topography

Section 2.03 of the assessment is an adequate summary of topography. The following information has been extracted from the environmental inventory for the plan to supplement the discussion of drainage basins.

> "There are numerous lakes and wetland areas found in central and eastern Dane and Rock Counties (WDNR, 1970, 1976). The Yahara River flows generally southeastward to the Rock River, closely following its pre-glacial course. Partial damming of the river valley with moraine left by the receding glaciers has resulted in the formation of the Madison Lakes (Mendota, Monona, Wingra, Waubesa, and Kegonsa). There are numerous wetland areas adjacent to the Yahara River.
>
> "The Rock River also closely follows its pre-glacial course, flowing generally southward from its headwaters in Dodge County through Jefferson and Rock Counties. The two major impoundments on the Rock River, Lakes Koshkonong and Sinissippi were formerly marsh areas which have been turned into shallow lakes by the placement of dams across the river channel.

Geology

Section 6.1 of the facilities plan and Section 2.04 of the environmental assessment provide an adequate discussion of the geology of the project area and how the geology influences surface and ground water resources.

TABLE 2-1

CLIMATOLOGICAL DATA[1]
MADISON WISCONSIN

	Temperature (°F)[2]			Precipitation (in)[3]			Snowfall (in)[4]		Winds (mph)[5]		
	Max	Min	Mean	Max	Min	Mean	Max	Mean	Prevailing	Max	Mean
January	54	-30	16.8	2.45	0.19	1.25	21.9	8.9	WNW	68	10.5
February	56	-23	20.3	2.77	0.08	0.95	16.1	6.5	WNW	57	10.7
March	78	-29	30.2	5.04	0.38	1.93	25.4	9.8	NW	70	11.4
April	87	9	45.3	7.11	0.96	2.66	17.4	1.7	NW	73	11.7
May	91	20	56.0	6.26	0.98	3.41	0.7	T	S	77	10.5
June	95	31	65.8	8.15	0.81	4.33	0.0	0.0	S	59	9.2
July	98	36	70.1	10.30	1.38	3.81	0.0	0.0	S	72	8.2
August	95	36	68.7	7.47	0.70	3.05	0.0	0.0	S	47	8.1
September	90	25	59.7	9.51	0.49	3.36	T	T	S	52	8.8
October	90	15	49.4	5.55	0.06	2.16	0.9	0.1	S	73	9.6
November	76	1	34.7	3.94	0.34	1.87	8.9	2.8	S	56	10.8
December	62	-22	21.9	3.64	0.25	1.47	20.8	9.9	W	65	10.2
Year			44.9			30.25		39.7			10.0

[1]Taken from "Local Climatological Data - Annual Summary with Comparative Data, 1974 - Madison, Wisconsin"; National Oceanic and Atmospheric Administration

[2]Period of record, 15 years

[3]Period of record, 35 years

[4]Period of record, 26 years

[5]Period of record, prevailing direction - 14 years; speed - 28 years

(Extracted from Environmental Inventory for MMSD's Comprehensive Facilities Plan.)

Soils

Sections 6.3 and 6.5 and Figure 6-4 (general soil map) of the facilities plan and Section 2.05 and Table 2-2 of the environmental assessment present sufficient information related to soils. Section 6.3 discusses soils from the standpoint of suitability for sludge application. Figure 6-4, Section 6.5, Section 2.05 and Table 2-2 provide a display and discussion of the location and characteristics of various soil types. The information presented is of necessity of a general nature. More detailed soils series data would be required for detailed agricultural management or construction design work when specific project sites are under consideration.

Wetlands and Water/Land Interfaces

Section 2.10 B of the environmental assessment presents a summary of wetlands in the study area. This summary does not give an idea of the amount of wetlands within Dane County. The environmental inventory for the study lists 16 priority, No. 1, 19 priority No. 2, and 12 priority No. 3 wetland areas in Dane County and their location and importance. However, the acreage of each area is not listed. Figure 6-4 in the facilities plan shows the general location of wetlands within the study area. The various wetland priority types are not distinguished on the figure. The wetlands shown on the figure fall primarily within the areas designated as "few of the soils suitable for application" or secondarily within the areas designated as "some soils suitable for sludge application".

Related to flood hazards, the environmental setting description, Section 2.03 and Table 2-3 include flow value data, however, no discussion is presented on flood hazard areas. Section 2.06 of the environmental inventory for the facilities plan does indicate that in respect to flooding in the lower Rock River basin (includes Yahara River basin):

"Flood flows are relatively low due to the small relief of the basin, as well as the storage capacity provided by the many lakes, reservoirs and wetlands. Flooding in headwater areas is generally limited to low-lying agricultural or undeveloped land adjoining waterways, although some springtime flooding of low-lying residences near the Madison Lake and Lake Koshkonong does occur. Substantive flood potential does exist in the cities of Janesville and Beloit where commercial and residential construction has taken place on the floodplain."

Although they have not been included in this report, there are flood hazard maps available from the United States Department of Housing and Urban Development, Federal Insurance Administration for portions of the study area. These delineate the approximate area of a 100 year flood. In addition, the United States Geological Survey published a series of flood prone area maps. These maps also delineate the approximate area of a 100 year flood. They are available for certain portions of the study area.

3. Water

Water Quantity and Location

Section 6 of the facilities plan and Section 2.06 of the environmental assessment provide an adequate discussion of ground water resources.

The discussion of surface water quantity in Section 2.06 of the environmental assessment is sufficient.

Water Quality

Section 6 of the facilities plan and Section 2.06 of the environmental assessment present sufficient information on groundwater quality. Section 2.6 and Table 2-4 of the environmental assessment adequately summarize surface water quality conditions. Additional monitoring information is included in backup appendices to the facilities plan. They have not been included because of their voluminous nature. As a point of clarification, Table 2-4 presents two sets of monitoring data. The 1955-1958 data was for a period prior to MMSD's diversion of their effluent into Badfish Creek. The 1972-1975 data is post-diversion.

4. Natural Vegetation and Wildlife

Habitat

Section 2.07 I of the environmental assessment is a summary of existing vegetation in the study area. Some clarification and supplementation of this section is necessary. Additional species information is included in backup appendices to the facilities plan.

One plant species which possibly occurs within the study area has been included as a proposed endangered species on the proposed list of "Endangered and Threatened Plant Species of the United States" published in the Federal Register on June 16, 1976. Lespedeza leptostachya (bushclover) is expected to occur on dry prairies in the study area.

Related to the discussions of aquatic vegetation some clarification is required. The discussion refers to an Appendix D which was described as including the results of an algal survey of Badfish Creek. This appendix was not, however, attached to the environmental assessment. The survey referred to was a survey of fish and algae of the Badfish Creek (main stem and and Rutland Branch) and Yahara River conducted in 1975 by John Magnuson and Gary Herbst from the University of Wisconsin. From their survey of fish and algae they concluded that:

1) in relation to Badfish Creek a) Badfish Creek is most severely polluted upstream of Cooksville, b) limited recovery occurs in the lower regions of the stream, c) water quality of Badfish Creek is inferior to both the Rutland Branch and the Yahara River;

2) the fish found in the Yahara River appear unaffected by Badfish Creek;

3) diatom species abundance and diversity in the Yahara River is reduced downstream of the mouth of Badfish Creek (indicating therefore, that the algal flora of the Yahara River is influenced by the Badfish Creek);

4) the Rutland Branch (of the Badfish Creek) is a pristine stream;

5) further detailed investigations of the fish fauna are warranted.

Wildlife

Section 2.07 of the environmental assessment summarizes wildlife in the study area. Additional backup information is included in the environmental inventory to the facilities plan. However that information is voluminous in nature and has therefore not been reproduced in this report. Section 2.07 is adequate with some clarification and supplementation. Section 2.07 F refers to Appendix E and Section 2.07 G refers to Appendix D. Those appendices were not attached to the environmental assessment. However, they are included as backup information to the comprehensive facilities plan.

The investigation of the macroinvertebrate found of Badfish Creek referred to in Section 2.07 F of the environmental assessment was completed by William L. Hilsenhoff and Thomas S. Karl of the Department of Entomology, University of Wisconsin, Madison in 1975. Their conclusions were that:

1. Effluent from the Madison Metropolitan Sewerage District's treatment plant has severely altered the macroinvertebrate fauna of Badfish Creek. This fauna in 1975 was characteristic of that which is normally found in moderately large streams severely polluted by organic wastes.

2. Faunal alteration was caused by a greatly increased volume of water flowing through the stream and by increased nutrient and BOD loads. The BOD creates a depression of dissolved oxygen levels, especially in the summer, which severely restricts the macroinvertebrate fauna that can exist in Badfish Creek. The increased nutrient loads that promote abnormal amounts of plant growth and abnormally high concentrations of certain ions may also be contributing factors in limiting the fauna.

3. Faunal alteration is most severe in the upstream areas of Badfish Creek, with some indications of recovery in downstream sections.

4. The macroinvertebrate fauna of the Yahara River was distinctly altered by waters from Badfish Creek during spring and early summer of 1975, but in late summer and fall alteration of the fauna was insignificant.

Table 2-6 in the environmental assessment is taken after "Surface Water Resources of Dane County", 1961, WDNR, "Surface Water Resources of Rock County", 1970, WDNR and "Wisconsin Mapped Lakes", Clarkson Map Company. More recent sampling was completed for Badfish Creek and the Yahara River in 1975 by John Magnuson and Gary Herbst from the University of Wisconsin. That survey showed additional species existing in the Yahara River such as bluegill, crappie, and white bass. Their Badfish Creek survey data show some trout and bluegills living there in addition to those shown on the table. Refer back to the section on habitat for a discussion of the general conclusions of their study.

5. Sensitive Natural Areas

Section 2.10 of the environmental assessment summarizes sensitive natural areas. As indicated in this section there are many sensitive natural areas and areas of scientific interest within the project area which should be given special consideration when planning any specific project action. Tables 2-2 and 2-3 have been extracted from the environmental inventory for the study and are included here to provide additional information on sensitive areas which should be protected.

B. Man-made Environment

1. Air

Air Quality

Section 2.08 of the environmental assessment is an adequate discussion of air quality.

Noise

There has been no discussion of noise levels in the project area in the environmental assessment. In 1970, the Madison Standard Metropolitan Statistical Area (SMSA) had registrations of 494 motor vehicles per 1000 population and 16 motor cycles per 1000 population. A recent USEPA publication used this index of vehicle registration as an index of noise population with the Madison SMSA ranking 19th and 37th lowest, respectively, for these two categories among 83 SMSA's with population between 200,000 and 500,000. In both cases Madison ranked in the quieter half of those towns of its size surveyed. This kind of an analysis could be somewhat misleading considering the study area includes both urban and rural areas which would by their nature have different noise sources and levels. However, no better information is available.

Odor

The environmental assessment does not present an adequate picture of potential odor problems created by the proposed project and how they should be mitigated. Since the majority of the project area is agricultural land, it would be expected that the types of odor sources in these areas would be typical of agricultural areas. In addition, Nine Springs Sewage Treatment Plant has been reported as an odor source to the Wisconsin Department of Natural Resources; however, no action orders have been issued to MMSD. The potential for odor problems would be minimized or eliminated by implementation of the facilities plan proposed by MMSD.

2. Land Use

Existing Land Uses

Section 6.1 and 6.5 and Figure 6.5 of the facilities plan and Section 2.09 and Table 2-10 of the environmental assessment present a general summary of existing land uses. Figure 6.5 shows the types of areas which have uses incompatible with an agricultural reuse plan and should therefore be avoided. Some correction and supplementation of these sections is needed.

TABLE 2-2

DANE COUNTY
NATURAL AREAS AND FEATURES OF SCIENTIFIC INTEREST[1]

	Area Name	Acres	General Description, Geology, Comments
	Springfield Township		
1.	Missouri Tavern Prairie	5	Prairie remnant on land unfit to cultivate - good number species
2.	South of Waunakee Marsh Wild Life Area[2]		
3.	Mainholz Woods	20	Oak hickory woods Bot. No. 1079 - Form A
	Deerfield Township		
4.	Barn Swallow Colony		Barn Swallow colony on barn exterior - long history use.
	Blooming Grove Township		
5.	Mc Farland Quarry	20	Limestone quarry collection area for calcite and chert nodules
6.	Upper Mud Lake		Cattail marsh, aquatics, waterfowl
	Madison Township		
7.	Second Point Woods[2]	10	Red oak woods
8.	Greene Prairie & Oak Openings[2]	70	Sandy soil prairie, different gradients, restored from farmland.
9.	Curtis Prairie[2]	60	Silt loam prairie, different gradients, restored from farmland.

TABLE 2-2 (cont.)

	Area Name	Acres	General Description, Geology, Comments
10.	Wingra Fen	25	
11.	Wingra Marsh	70	Emergent vegetation, sedge meadows.
12.	Gardner Marsh	100	Emergent vegetation, sedge meadows.
13.	Noe Oak Woods	30	Black and White Oaks on silt loam, butternut trees.
14.	Gallistel	35	Oak Woods underplanted.
15.	Wingra Woods	45	Different gradients of Oaks. Indian effigy mounds.
	Middleton Township		
16.	Johnstown Terminal Moraine		Cut in prominent terminal moraine wooded small park, private
17.	Pheasant Branch Creek, Woods		Bot. 4032, 4046, 4020 creek cut through lake terraces. Bottom land Forest
18.	Middleton-Black Earth RR Prairie[2]		Along RR between Black Earth and Middleton Managed by Game Management
	Cross Plains Township		
19.	Camel's Back Hill West of Johnstown Moraine		Sandstone-limestone contact in roadcut, just east of terminal moraine
20.	Norway Pine Bluff	30	Sandstone outcrop with Norway Pine, birch, red oak.
21.	Festge Springs[2]		Springs into Black Earth Creek
	Vermont Township		
22.	Talinum Hill	3	Sandstone outcrop, prairie on steep hill, small area, good quality - A-frame development

TABLE 2-2 (cont.)

	Area Name	Acres	General Description, Geology, Comments
	Fitchburg Township		
23.	Vroman Woods	26	Red oak, cherry, hardwoods, for sale 1969
24.	Dunn's Marsh		Pond, marsh, best bird area in county
25.	Nine Springs Creek	80	Springs formerly grazed
	Christiana		
26.	Hanson Prairie	3	Dry to dry mesic, small prairie. Needs management. Good quality. Best dry prairie in eastern Dane County.
	Albion		
27.	Albion Oak Opening near Saunders Creek	20	Grazed but well known oak opening, oaks, scenic.
	Dunkirk		
28.	Sundby Quarry		Best outwash gravel pit in eastern Dane County.
29.	Grass Lake	70	Deep marsh, habitat for a variety of birds.
	Oregon		
30.	Story Creek[2]		Story Creek - ½ mile fair trout stream
	Roxbury		
31.	Carlson Cedar Forest	20	Steep SW-facing slope covered with low juniper and red cedars, few prairie species (see also Cactus Rock to west).

TABLE 2-2 (cont.)

	Area Name	Acres	General Description, Geology, Comments
	Mazomanie		
32.	Mazomanie Mesic Prairie[2]	6	Rich mesic prairie with scattered black oaks - easy access.
	Black Earth Township		
33.	Lark Sparrow Site	10	Small, shallow sand blow, scattered black oak pastured - not botanically significant.
34.	Black Earth Prairie[2]	5	Rich low to mesic prairie, between County F and Fensenfeld Road
35.	Black Earth Road Cut		A complete section of the Cambrian Formation worms stone fossiles - in area of dendritic drainage pattern-scattered red cedars on "goat pastures".
	Berry Township		
36.	Marx Prairie	35	South-facing hill, thin black soil over limestone, zeric forest, cedar glade, prairie.
37.	Ketelboeter Oak Opening and Prairie	10	Prairie on steep bluff many open grown burr oaks with red oaks, aspen.
	Dunn Township		
38.	Hook Lake		Tamarack bog, marsh.
39.	Mud Lake		Large cattail sedge marsh.
40.	Lower Waubesa Wetlands	129	Diversified wetland area, waterfowl and marsh bird habitat.

[1]State of Wisconsin Scientific Areas Preservation Council - 1969

[2]These areas are not numbered on the Plan since they are a part of other proposals

(Extracted from Environmental Inventory for MMSD's Comprehensive Facilities Plan)

TABLE 2-3

ROCK COUNTY

NATURAL AREAS AND FEATURES OF SCIENTIFIC INTEREST[1]

	Area Name	Acres[2]	General Description
	Union Township		
1.	Brooklyn Prairie	+	Mesic, good condition
2.	Union Bog	10	Open bog, excellent condition
	Porter Township		
3.	Kessler Road Prairie	+	Wet-M. + Mesic, excellent condition
4.	Gibbs Lake		Marsh, Shrub Carr
5.	Gibbs Marsh	20	Cattail Marsh, Shrub Carr
6.	Kessler Road Prairie	+	Fen (dry), good condition
	Fulton Township		
7.	Mill Pond Bottoms		Lowland, fair condition
8.	Fulton Bottoms	10	Lowland, fair condition
	Milton Township		
9.	Milton Prairie	10	Dry-mesic, good condition[3]
10.	Camp Wakowpa	40	Dry-mesic Oak Woods, good condition
11.	Thiebeau Marsh	150	Cattail Marsh excellent condition
12.	Grass Lake	30	Cattail Marsh, excellent condition
13.	Storrs Lake	80	Grassy Cattail Marsh, fair condition
14.	Otter Creek Springs	+	Springs, excellent condition

TABLE 2-3 (cont.)

	Area Name	Acres	General Description
15.	Bingham Fen	+	Fen
16.	Newville Carr		Shrub-Carr
17.	Bingham Fen	+	Shrub-Carr, good condition
	Janesville Township		
18.	Janesville Nature Prairie		Dry-Mesic and Oak Savannah, good condition
19.	Janesville Prairie	+	Mesic
20.	Riverside Park	+	Mesic Oak
21.	Janesville Nature Preserve	40	Dry-Mesic Oak Savannah, good condition
22.	Fox Woods	10	Dry-Mesic Oak, good condition
23.	Riverside Park	+	Shaded Cliff

Source:

[1]State of Wisconsin Scientific Areas Preservation Council
[2]Acreage of areas under 10 acres or along railroads indicated by +
[3]Areas in imminent danger of destruction

(Extracted from Environmental Inventory for MMSD's Comprehensive Facilities Plan)

Two corrections of the text of Section 2.09 of the assessment should be noted. The figure 345,715 given for the population in the MMSD planning area in the year 2000 should be 345,215. The figure 2,040 acres given for the amount of additional acres of land for development (commercial, residential, and manufacturing) demanded by the year 2000 should be changed to 4,049 acres of additional land. (Personal communication with O'Brien and Gere Engineers staff).

Land use around the existing plant and sludge lagoon site was one item not discussed in the environmental assessment. It should have been at least briefly considered in this portion of the plan since this plan proposes a modification of the existing sludge lagoon use and expansion of sludge treatment facilities. The following information was taken from a portion of the advanced waste treatment and discharge segment of the facilities plan related to plant siting.

> "The plant site is bound on the northeast, east, and southeast by undeveloped property. On the east side is a wetland, in public ownership, of 800-900 acres. Industrially-zoned property to the northeast can be expected to develop in the future, while land to the east and southeast has limited development potential. Property immediately south of the plant is a mobile home subdivision. The area farther south and to the southeast is under cultivation. An undeveloped parcel of land lies immediately west of the plant, with an apartment complex and residential subdivisions beyond to the west. Land to the northwest is undeveloped, and an industrial complex lies to the north."

> "Zoning ordinances are administered by the respective jurisdictions within the vicinity of the plant and sludge lagoons; the City of Madison, the City of Monona, and Dane County. Land adjoining the treatment plant on the north is zoned industrial; the lands to the west are zoned manufacturing, agricultural, conservancy, and residential. The areas to the east and south of the plant are zoned manufacturing, agricultural and planned residential development."

> "Existing zoning is compatible with the present operation of the Nine Springs plant, but a mix of uses, including residential, has developed near the plant. Any nearby residential development can be considered a potential source of opposition to the further expansion of the plant."

Proposed Land Uses and Development Trends

The facilities plan and environmental assessment include only a minimal amount of discussion of proposed land uses and development trends for either the plan area in general or for the vicinity of the treatment plant and sludge lagoons specifically. To provide a better picture of future land use and development trends for the general study area the following information was extracted from the environmental inventory for the study.

> "Definite statements cannot be made regarding future land use trends. The lack of strong, uniform land use planning implementation programs (personal communication, Mary Louise

Symon, Dane County Board Chairman), and uncertain factors such as future birth rates and economic development, prohibit a clear estimation of future land use requirements. There is also no assurance that the trends noted in the past decade are indicative of long range land use patterns. However, based on the data available for the 1964 to 1973 period, some general land use trends seem apparent.

"Agricultural land use will probably continue to decline for a number of reasons. Increased production per acre of farm land will probably require that less land will be needed to produce the crops needed to feed increased future populations. Also, present economic conditions have led to a decreasing number of farms in operation.

"Dane County farms have decreased only slightly from 3,950 in 1972 to 3,940 in 1973, while the total land area has remained constant at 660,600 acres (Wisconsin Legislative Bureau, 1975).

"These figures all indicate a steady decline in both the total number of farms in operation and in the total number of acres devoted to agricultural practices on a state wide basis. Dane and Rock Counties do not seem to be affected as greatly.

"Population increases will require that additional lands be developed for housing, commercial establishments, services, utilities, etc. It is also anticipated that increased demand for recreation facilities will result in an increase of acreage devoted to this purpose."

One of the assumptions made by Dane County Regional Planning Commission in preparing their forecasts for area socioeconomic development is that an increasing proportion of future population increases will be located outside the Central Madison) Urban Services Area.

Related to land use plans and zoning for the area in proximity to the Nine Springs treatment plant (including sludge lagoons) some potential for conflicts appear to exist. As stated in a portion of the comprehensive facilities plan related to plant siting:

"..... At the present time, existing zoning does not represent any serious conflicts with maintenance, operation and possible expansion of the treatment plant. Zones considered incompatible are fully developed, i.e., R-1 (the apartment complex) and PRD (the mobile home subdivision).

"There is reason for concern, however, when the comprehensive land use plan is compared to existing zoning. Existing zoning does not totally reflect proposed land use patterns in the area, and the land use plan is the guiding reference in approving zone changes. Under the proposed plan, areas to the southwest, south, and southeast currently zoned agricultural could conceivably be altered to permit low-

density or medium-density residential development. This would result in further encroachment of residential development around the plant."

3. Water quality and quantity

Problem

Section 2.06 discusses surface and groundwater quality and quantity considerations. General reference is made to the types of pollution sources (point and nonpoint) affecting the area. Specific reference is made to the municipal point source discharges. However, no reference is made to industrial discharges. In the general area considered for sludge application the environmental inventory for the study shows eleven industrial point sources of pollution. These industries, the receiving waters into which they discharge, and the quantity and quality of their discharges are listed on Table 2-4 extracted from the environmental inventory for the study.

The most critical water quality problem most directly applicable to this organic solids reuse study is related to the storage lagoon problems which MMSD has experienced at Nine Springs sewage treatment plant. Those problems are summarized in Section 1.2 of the facilities plan and Section 1.04 E of the environmental assessment.

Uses

The discussion of water uses in Section 2.06 of the environmental assessment is sufficient for the level of detail of this report. Additional information is available in backup appendices to the comprehensive facilities plan.

Management

Sections 2.06 and 2.12 of the environmental assessmental adequately summarize water management programs in force in the study area.

4. Summary of Sensitive Man-made Resources

Historical and Archeological Sites

Section 2.16 is an adequate discussion of historical and archeological sites. The State Historic Preservation Officer (SHPO) was contacted related to the potential impacts that the proposed actions in the MMSD facilities plan could have on historical and archeological sites. The letter of response from the SHPO is included in Appendix A.

Related to the impact of the organic solids reuse plan segment of MMSD's facilities plan it was indicated in the letter that "... the application of sludge to agricultural lands will have no effect on any historical or archeological sites." No reference was made in the letter to potential impacts resulting from construction of the expanded sludge treatment facilities, per se. However, because the expanded sludge treatment facilities will be constructed on a portion of the already disturbed treatment plant site no request was made to survey the site.

TABLE 2-4

INDUSTRIAL POINT SOURCES OF POLLUTION,[a]
LOWER ROCK RIVER BASIN

	Industry	Receiving Waters	Flowrate, MGD		Peak Contamination, mg/l		
			Peak	Average	BOD_5	TKN	SS
1.	Madison Gas and Electric Co., Madison	Lake Monona to Yahara River, to Rock River	177.8	88.1	5.0	0.02	0.24
2.	Oscar Mayer and Co., Madison	Yahara River, to Rock River	3.4	2.0	6.0	4.0	87.0
3.	Chicago, Milwaukee, St. Paul and Pacific Railroad, Madison	Lake Monona to Yahara River to Rock River	0.04	0.001	75.0	0.07	21.0
4.	ARS - Sprague Dawley Farm, Madison	Nine Springs Cr., to Yahara River, to Rock River	--	0.01	0.0	2.4	27.0
5.	Webcrafters, Madison	Yahara River to Rock River	0.20	0.18	0.6	4.1	6.0
6.	Bowman All Star Dairy, Madison	Nine Springs Cr., to Yahara River, to Rock River	0.01	0.005	2.4	0.8	2.0
7.	Schoep's Ice Cream Company, Madison	Yahara River, to Rock River	0.003	0.003	8.1	0.2	7.0
8.	Madison Newspapers, Inc., Madison	Lake Monona, to Yahara River to Rock River	0.05	0.01	5.0	0.16	21.0
9.	Giddings and Lewis Foundaries, Madison	Yahara River, to Rock River		0.24	8.0	1.48	249.0
10.	Graber Company, Middleton	Graber Pond	0.10	0.09	6.0	1.26	0.0
11.	Milwaukee Cheese Company, Waunakee	Six Mile Cr., to Yahara River, to Rock River	0.005	0.004	0.0	0.2	0.0
12.	Del Monte Corp., Arlington	Goose Lake	0.41	0.19	30.0	0.0	35.0
13.	Goodyear Tire and Rubber Co. Sun Prairie	Koshkonong Cr., to Rock River	0.08	0.05	7.0	0.0	9.0

TABLE 2-4 (cont'd.)

	Industry	Receiving Waters	Flowrate, MGD		Peak Contamination, mg/l		
			Peak	Average	BOD_5	TKN	SS
14.	Oconomowoc Canning Company, Sun Prairie	Koshkonong Cr., to Rock River	0.08	0.04	315	1.4	86.0
15.	Uniroyal, Inc. Stoughton	Yahara River, to Rock River	0.64	0.57	1.0	0.0	0.0
16.	General Motors, Janesville	Rock River	0.64	0.56	49.8	5.3	12.4
17.	Armstrong Chemical, Janesville	Rock River	0.04	0.04	5.5	6.4	10.0
18.	Park Pen Plant, Janesville	Rock River	2.40	1.09	9.0	3.9	0.4
19.	Parker Pen Offices, Janesville	Rock River	0.11	0.10	1.8	1.75	0.2
20.	Beloit Box Board, Beloit	Rock River	0.17	0.12	751	4.2	171
21.	Colt Industries, Beloit	Rock River	2.40	2.08	6.0	0.34	12.0
22.	Beatrice Foods Co., Beloit	Rock River	0.26	0.11	11.0	0.20	2.1
23.	George A. Hormel and Co., Beloit	Spring Br. to Rock River	0.08	0.06	28.8	0.0	0.2
24.	Larsen Co., Fort Atkinson	Rock River	0.49	0.39	80.0	80.0	210
25.	Jones Dairy Farm, Plant No. 1, Fort Atkinson	Rock River	0.64	0.56	49.8	5.3	12.4
26.	Jones Dairy Farm, Plant No. 2, Fort Atkinson	Rock River	0.05	0.05	12.9	2.3	34.0
27.	Thomas Industries, Fort Atkinson	Rock River	0.56	0.56	0.0	3.11	66.0
28.	Godfrey Company, Cold Spring	Spring Cr. to Bark River, to Rock River	0.003	0.002	60.0	8.6	51.0

TABLE 2-4 (cont'd.)

	Industry	Receiving Waters	Flowrate, MGD		Peak Contamination, mg/l		
			Peak	Average	BOD_5	TKN	SS
29.	Alpha Cast, Inc., Whitewater	Whitewater Cr., to Rock River	0.098	0.096	38.19	5.0	0.8
30.	Bunker Rams Corp., Delevan	Swan Cr., to Turtle Cr., to Rock River	0.009	0.004	1.0	0.0	2.0
31.	Triangle Pipe and Tube Co., Footville	Bass Cr., to Rock River	0.17	0.17	0.0	0.3	0.0

[a] Source: NR101 Files, Surveillance Section, Wisconsin Department of Natural Resources.

Recreation and Open Space Areas

The discussion of recreational areas and activities in Section 2.13 of the environmental assessment is an adequate summary of these subjects. A list of parks in the area was included in the environmental inventory but has not been incorporated into this report.

Agricultural Land

Chapter 6 (Section 6.1 and 6.4) of the facilities plan and the previous discussion of land use in this chapter together provide sufficient information on the agricultural economy and trends in agriculture in the study area.

Energy Resources

Energy uses by MMSD are adequately discussed in Section 2.14 of the environmental assessment. Other present or projected electrical power, natural gas and heating oil needs in the study area were not identified. "The Upper Mississippi River Comprehensive Basin Study" published in 1970 predicts a substantial increase in energy requirements in the basin between 1970 and the year 2000. The figures cited for Power Supply Area 13 which includes Dane County show that energy requirements will increase from 9,690 million kwh in 1970 to 50,560 million kwh in the year 2000. While these predictions may have changed somewhat since 1970, it can be expected that there will be an increasing demand for energy as the population increases.

CHAPTER 3
ALTERNATIVES TO THE PROPOSED PROJECT

The organic solids reuse plan and the environmental assessment are accurate as far as they go in their presentation of how Madison Metropolitan Sewerage District systematically evaluated the various alternatives and arrived at their proposed plan. However, some supplementation and clarification of what is presented in these two reports is required to allow the public to fully understand how various alternatives were eliminated from consideration. In some cases these reports compare the alternatives on the basis of economics when in reality MMSD and its consultants took other factors into account in addition to monetary costs. There is some additional information related to various alternatives which has not been considered in eliminating certain alternatives. Sludge treatment alternatives were discussed only briefly in the facilities plan, and environmental assessment. Instead of repeating what has been presented in the facilities plan and environmental assessment, this section will reference the sections of the facilities plan and environmental assessment which provide the information necessary to understanding how alternatives were evaluated and eliminated and supplement, clarify, or summarize this information where necessary.

The proposed plan includes a proposed lagoon abandonment program as well as a proposed plan for future sludge handling and disposal. Therefore, the alternatives discussion is broken up into those two categories.

A. Lagoon Abandonment Program Alternatives

Sections 1.2 and 1.3 of the facilities plan and Sections 1.04 and 1.05 of the environmental assessment give an adequate history of sludge lagoon problems at Nine Springs Sewage Treatment Plant. They show why MMSD was forced to cease their previous program of lagoon disposal of sludge and adopt a course of action to stop the threat of lagoon dike failure.

Chapter 5 of the facilities plan adequately discusses how the various alternative lagoon abandonment options were evaluated in selecting the proposed plan. Appendix B, Tables B-1 - B-4 of the facilities plan compare costs for the various alternatives.

It appears that MMSD has systematically and adequately considered all reasonable and feasible alternatives to lagoon abandonment and lagoon sludge disposal.

B. Future Sludge Handling and Disposal Alternatives

This category includes the alternative methods of treating, transporting and disposing of sludge produced by MMSD in the future.

As indicated in Sections 2.1 - 2.4 of the facilities plan and Section 3.01 of the environmental assessment, MMSD has had several studies done related to sludge treating, transport, and disposal. The results of the reports are summarized in the above-referenced sections. From the information presented in these sections it would appear that feasible alternatives were screened solely on the basis of monetary costs. Although monetary cost was certainly the overriding concern in the screening of alternatives, the various reports did include consideration of other factors in the screening process. The following discussion of the various reports is meant to supplement and evaluate what has been presented in the referenced sections of the facilities plan and environmental assessment.

1. Greeley and Hansen Reports

The discussion presented in Section 2.1 of the facilities plan and Section 3.01 of the environmental assessment is accurate. The alternatives include consideration of handling and disposal of sludge. It should be realized that alternatives A-D assume 25-mile truck transport of sludge and alternative E (liquid sludge application) assumes 25-mile pipeline or rail transport. The current proposed plan includes immediate truck and potential future pipeline transport of liquid sludge. It would appear that on the basis of monetary costs no comparisons could be made of the proposed immediate plan of truck transport of liquid sludge with the alternatives in the Greeley and Hansen report since the assumed modes and distance of transport presented vary. However, Appendix B to the facilities plan compares the costs for various modes of transport so that comparisons can be drawn.

2. Weston Report

This report was discussed in Section 2.2 of the facilities plan and Section 3.01 of the environmental assessment. These sections present an adequate discussion of how lagoon disposal, land application of dried sludge, incineration of sludge and subsurface placement or trenching were eliminated from consideration on the basis of monetary costs. However, the discussion of how the three remaining alternatives (land application of liquid sludge, sanitary landfill of a sludge-milled refuse mixture and land application of compost) were compared only includes information on monetary costs. The Weston report had also compared these three alternatives on a non-monetary basis. Some additional factors considered related to these alternatives were:

Land application of sludge - In addition to the cheaper dollar cost of this alternative the report gave a shorter implementation time and retrieval of the fertilizer value of sludge as advantages. This alternative requires lagooning over the winter months. The report also indicated that virus survival, odor, heavy metals and runoff could be problems. However, with adequate control they are surmountable difficulties.

Sanitary landfill of sludge-milled refuse mixture - With this alternative the report indicated that sludge dewatering would be required and would probably provide a centrifuge effluent return of unacceptable quality. Cover material would probably be required in this alternative. The availability of a reliable source of milled refuse was considered questionable.

Land application of compost - According to the Weston report, some of the advantages of composting are: 1) Composting would return a valuable resource to the soil; and 2) Composting the Nine Springs sludge with wood chips or milled refuse would present additional dewatering benefits considering the poor dewatering characterics of the sludge. After consideration of mechanical composting as an alternative, the Weston report concluded that it would be difficult or impossible to achieve the optimum moisture content which would promote effective growth of the aerobic organisms necessary to achieve composting. In addition, it was felt that the effluent from the centrifuge dewatering system could potentially impact on the balance of the treatment system. Open windrow

composting such as has been tested at Beltsville, Maryland was also considered in the Weston report. It was felt that this type of composting could only be accomplished during summer months because of the low nighttime temperatures common to winter in Madison. It would be difficult to achieve an acceptable dewatered state as with mechanical composting. The problems with centrate quality affecting treatment balance would also be the same. A negative concern related to composting in general was the doubt of finding reliable sources of wood chips or milled refuse.

The Weston report was prepared based on initial test results at Beltsville, Maryland. More recent experiences by the United States Department of Agriculture at Beltsville and subsequent experiences at Bangor, Maine vary from the discussion of windrow composting presented in the Weston report. The experience at Bangor, Maine (personal communication, USDA Laboratory, Bangor, Maine) has been that adequate windrow composting can be achieved year-round with proper controls. Also, the costs associated with composting would be lower than those cited in the Weston report. The cost of composting is less than the $140/dry ton cited in the Weston report. Estimated cost figures cited in a paper by Epstein and Wilson related to the sludge composting project at Beltsville, Maryland are $30/dry ton at a 40/dry ton/day plant receiving dewatered sludge. Personal communication with Dan Kowaseco, USDA Beltsville, Maryland indicated that the estimated cost would be in the range of $30-$60/ dry ton. This estimated cost does not include haul costs or any revenue resulting from sale of the product. This would still be higher than Madison's proposed plan. The Weston report also indicated that the highest practical and economical level of solids which could be attained at Nine Springs STP was around 12% and that this was below the level necessary to achieve composting. In recent tests at Beltsville, Maryland composting has been achieved using sludges with as low as 5% solids. The results of the tests have not yet, however, been published. (Personal communication, Dan Kowaseco, USDA, Beltsville, Maryland).

The Weston report did not consider additional benefits of composting which have been experienced at Beltsville, Maryland. These include better kill-off of pathogens and fewer potential odor problems. The recent experiences at Beltsville have shown that composting can produce a soil amendment product which could either be sold to offset the processing cost or used with the municipality for a variety of purposes, decreasing the amount of inorganic fertilizers which would otherwise be purchased.

Related to the composting alternative for MMSD it would appear that certain problems discussed in the Weston report such as finding a reliable source of wood chips and finding a market for the product would still offset the benefits to be gained from using composting. If the proposed farm market for liquid sludge does not develop as anticipated, it may be possible to reconsider composting as an alternative backup program.

Sludge treatment alternatives considered in the Weston report - The selection of sludge treatment alternatives was based on the need to produce sludges of a quality which would be suitable for the alternative methods of suitable ultimate disposal. Various combinations of processes were considered for each of the major sludge handling systems (Sanitary Landfill System, Land Application of Compost System and Land Application of Liquid Sludge System). The proposed system of land application of liquid sludge incorporated the process of blending of primary and secondary sludges, gravity thickening, and anaerobic digestion.

3. MMSD Addendum

Section 2.3 of the facilities plan and Section 3.01 of the environmental assessment discuss this report. The report analyzed several sludge treatment and disposal alternatives on the basis of costs and environmental impacts. The system proposed in the report as most cost-effective includes thickening and anaerobic digestion followed by pipeline transport and land application of liquid sludge. The evaluation of how three of the alternative systems were eliminated in a preliminary screening was adequately discussed. However, the evaluation of the four remaining alternatives was not sufficiently detailed. The following evaluation of these alternatives was excerpted from the MMSD Addendum to supplement the information in the facilities plan and environmental assessment. The costs of the four alternatives considered in the final screening in MMSD's Addendum is presented in Appendix B.

Alternative 1A - Land Trenching of Dewatered Sludge

Advantages

This option does not require digestion of the sludge. Elimination of a unit operation eliminates operational and control problems associated with that unit operation. The operation would be continuous, without the need for lengthy sludge storage which has the potential for odor problems. There would be very little visible evidence of sludge disposal at the final disposal site. A relatively small land area would be required to handle the sludge in this manner. If a farm were purchased by MMSD for the purpose of trench disposal, the farmer could continue to work the undisturbed property with minimal interference due to the sludge disposal. Odor problems at the disposal site would be minimal.

Implementation time for this system would be short and primarily dependent on the delivery time for the dewatering equipment. The final disposal site could be switched easily because of the small area required per year and the fact that the dewatered sludge would be transported by truck.

Disadvantages

The main disadvantage of the trenching option is the inability to predict whether the land used for disposal would be stable enough to be brought back into useful crop production. The dewatered sludge at 16% solids content is still pliable and may not readily lose enough of its remaining moisture to the surrounding earth or the atmosphere to stabilize. If the dewatered sludge would not stabilize, productive land may be lost.

A site with suitable geological characteristics would have to be found to prevent uncontrolled discharge of pollutants to the surrounding groundwater. The trenches might have to be lined with an impermeable membrane prior to

sludge placement or drain tiles might be required to catch any downward movement of leachate. This leachate may have to be treated, probably by spraying it back on productive land.

The sludge dewatering step would produce a recycle stream which must enter the secondary treatment system. The recycle stream would use some plant capacity and may also have a harmful effect on the effluent discharged from the secondary plant. The 1990 loading from this recycle stream would equal 3.5 per cent of the anticipated 1990 BOD load, 3.9 per cent of the anticipated 1990 suspended solids load and 3.3 per cent of the anticipated 1990 ammonia nitrogen load in the secondary treatment plant. The suspended solids in the recycle stream would be very fine in nature and may accumulate in the secondary treatment system. Chemicals which may become increasingly expensive and hard to get must be used for conditioning prior to dewatering.

Elimination of the digestion step would eliminate production of methane gas now used to heat buildings and run specific equipment at the treatment plant.

Another disadvantage of this option would be the loss of the fertilizer value in the sludge because of the manner of disposition. The nutrients in the sludge may be discharged to the groundwater as a pollutant rather than recovered as a resource. Frozen ground may make winter trenching difficult.

Alternative 2A - Land Application of Liquid Sludge

Advantages

This disposal option utilizes the high fertilizer value in the sludge. Crop uptake of the nutrients would turn a problem into a benefit. Very little land would be permanently taken out of useful crop production. The same site could be continually used with no loss in aesthetic or economic value during or beyond the design period.

The implementation time of this system could be short relative to the other alternatives. With this system, it would also be easy to slowly reduce the sludge volume in the existing lagoon if this action were necessary. There would be limited expansion necessary at the existing Nine Springs Treatment Works. No recycle stream, with the associated problem of BOD , SS and NH-N removal, would be returned to the secondary treatment plant. There would be no dependence on chemicals for sludge conditioning or no worry about fines buildup in the secondary treatment system.

Disadvantages

The major disadvantage associated with this option is the expected difficulty in locating and purchasing or leasing the large land areas required for controlled successful land irrigation of sludge. If the land were not purchased or leased, there would be difficulty in coordination with local farmers for land use.

The necessity for a temporary sludge storage lagoon could lead to an odor problem if proper controls were not maintained. The land application of sludge may result in a musty odor which could be offensive to some individuals. A buffer area would have to be provided around the land used for storage and application. Possible virus survival is also of concern. With increased digestion capacity, more complete digestion should minimize the potential odor and virus problems.

Aeration of the lagoons would help prevent odors. The sludge lagoon would be storing sludge primarily during the winter months when odors are not normally a problem. In summer the lagoons would be used as a transfer point and would not hold large volumes of sludge, therefore minimizing potential odor problems. New efforts directed at reducing odor problems would have to be implemented.

For this option it may also be necessary to line the final disposal site with drain tiles, collect the leached water and return it to the surface for crop irrigation. Careful control of runoff would be necessary along with adjacent stream monitoring.

Laying a pipeline to a specific point severely limits the location of the final disposal site. The permanence of a pipeline, along with the time and money associated with construction of a such a line, tend to make this option inflexible. It would be difficult to justify abandoning or severely altering this system once it was operational.

The entire application and cropping procedures would require agricultural management expertise which would have to be acquired by MMSD.

Alternative 3A - Landfilling of Sludge/Milled Refuse Mixture

Advantages

This alternative would take advantage of the expertise available in the operation of traditional sanitary landfill operations. It would utilize the absorptive capacity of existing refuse to act as a dewatering agent for the sludge. It would be necessary to dewater the sludge but not to a high degree.

Site control could be insured from experience gained in the solid waste handling field. There should be no odor problem associated with this operation if proper cover techniques were used.

The land requirements would not be excessive. There would also be minimal sludge storage requirements which could result in potential odor problems. Also, with this option, it would be easy to reduce the volume of sludge in the existing lagoons by gradual inclusion in the mixing process if more milled solid waste were to become available.

Disadvantages

Land utilized as the final disposal site could be recovered as cropland or for some other use but, may have some limitations. Once the landfill has been placed and the original site filled, a new site must be located.

The necessity of dewatering produces a recycle stream which must be treated and may have a harmful effect on the effluent from the secondary treatment plant. The 1990 loading from this recycle stream would equal 1.0 per cent of the anticipated 1990 BOD load, 1.5 per cent of the anticipated 1990 suspended solids load and 13.5 per cent of the anticipated 1990 ammonia nitrogen load in the secondary treatment plant. The suspended solids in the recycle stream would be very fine in nature and may accumulate in the secondary treatment system. Chemicals which may become increasingly expensive and hard to get must be used for conditioning prior to dewatering.

This option involves rehandling the sludge several times, once before mixing and once after mixing. Again, the fertilizer value associated with the sludge is lost in the landfill.

This option is dependent on obtaining a certain quantity of milled refuse from the City. If that refuse were not available or very high in moisture content, sludge disposal would be impaired.

This option limits the potential resource recovery from the milled refuse unless it were used in a compost operation. Sludge/milled refuse in a landfill would generate leachate which would have to be collected and treated. The nutrients associated with the sludge would be a potential groundwater pollutant.

Alternative 3B - Land Application of Dewatered Sludge

Advantages

The major advantage of this option is the use of the fertilizer value associated with the sludge. Nutrient uptake would be accomplished by crop production. No land would be taken out of farm use. The same site could be used in future years with no physical or economic loss.

No storage lagoons are necessary. The sludge could be stockpiled on the land on which it would be eventually spread. Odor problems associated with the dewatered completely digested sludge should be minimal. Spreading of the sludge could probably be accomplished with normal farm equipment. The necessary nutrient loading could be provided with one pass over the land.

Disadvantages

Hauling the dewatered sludge to rural farmland may result in some objection from the local residents. The same large amounts of purchased or leased land is required as in the liquid sludge application alternative. If the land were not purchased or leased, coordination with the local farmers might be difficult. Virus survival may again be a question not to be overlooked.

The sticky character of the dewatered sludge due to the polymer addition may make it very difficult to spread or plow under evenly. These problems would result in poor acceptance by farmers. This problem might possibly be reduced by lowering the polymer dose to the centrifuge such that the centrate stream character degrades but the sludge cake solids content does not appreciably change. The centrate stream might then be air floated or recentrifuged to clean up the centrate.

This option involves treatment of a recycle stream. This stream would use part of the planned secondary expansion and could degrade the treatment plant effluent. The percentages of anticipated 1990 BOD , SS and NH-N loading attributable to the recycle stream are the same as for Alternative 3A. Again there would be a dependence on chemicals for conditioning.

4. CH2M Hill Study

The aforementioned studies all came to the same basic conclusion, that the most cost-effective method of sludge management for MMSD is land disposal of liquid digested sludge. Therefore, MMSD resolved to pursue that method of disposal. The firm of CH2M Hill was hired by MMSD subsequent to the aforementioned studies to further evaluate the sludge treatment processes which would be employed prior to land application. They compared aerobic vs. anaerobic digestion and determined that anaerobic digestion should be utilized for primary and secondary sludges due to the higher power consumption requirements and requirements for separate land

application required for aerabic digestion. They also compared various type thickeners (gravity, air flotation, centrifuge, and centrifugal screen concentrators) and determined that a two-stage thickening process first employing gravity thickening and then air flotation thickening would be least costly. The system of land application of liquid sludge which they propose includes gravity and air flotation thickening and anaerobic digestion prior to disposal.

5. Reuse level alternatives

Section 3.1 and Table 3-1 of the facilities plan give a complete summary of the three reuse categories, (fertilization, high rate fertilization and disposal) including loading rates, objectives, suitable soils and impact on soil and water. Section 7.1 is somewhat misleading because it implies that high rate fertilization and disposal would definitely affect surface and groundwater. Those impacts can be avoided, however, only with a very strict management program. The selected reuse program is a fertilization type program.

6. Reuse Program Alternatives

Section 7.2 and 7.6 of the facilities plan adequately discusses how the reuse program of supplying sludge to farmers at their request was selected as the proposed reuse plan.

7. Transportation Method Alternatives

Section 3.02 of the environmental assessment adequately discusses the advantages and disadvantages of the three most feasible methods of sludge transport which are rail, truck, and pipeline transport. Section 7.5 and Appendix B compare truck and pipeline transport. As was discussed, although pipeline transport is less expensive and has other advantages, a pipeline route could not be determined until a reliable and sufficiently large sludge market develops. Therefore, Madison proposes to use truck transport in the immediate future until a market develops.

8. Intermediate Storage Facility Alternatives

Section 7.5 of the facilities plan and Section 3.02 of the environmental assessment adequately discuss the two types of intermediate storage facilities considered for on-site sludge storage to increase the efficiency of the sludge transportation and application systems. The additional alternative exists of not providing for intermediate sludge storage. Not utilizing such facilities would result in a less efficient system, especially during peak application periods.

9. Application Method Alternatives

Section 7.5 of the facilities plan and Section 3.02 of the environmental assessment are adequate in their discussion of application methods with one exception. Since air borne pathogens at sludge irrigation sites has been considered by some as a potential public health problem, the subject should be discussed. According to Burge (1974), "The threat of infection to sprinkler irrigation site workers and to the surrounding communities through exposure to aerosols containing pathogens has not been completely defined, but experience and what literature is available seem to indicate that the threat is minimal." A USEPA - sponsored research project currently being conducted at the Fulton County, Illinois sludge disposal area of the Metropolitan Sanitary District

of Greater Chicago is expected to provide some additional information related to airborne transmission and survival of pathogens in aerosols from big gun sprinkler irrigation systems. It would appear unlikely that truck spreader and soil injection systems would present any kind of potential airborne pathogen problem since the formation of aerosols is not a problem, with those methods.

10. No Action Alternative

The "No Action" alternative is adequately discussed in Section 3.03 of the environmental assessment.

11. Other Considerations in Developing the Proposed Plan

Existing State and Federal guidelines were followed in formulating the proposed plan. The Federal guidelines mentioned on page 3-6 of the environmental assessment will be superceded by a technical bulletin (published in draft form in the Federal Register on June 3, 1976) when it becomes final. This bulletin is meant as guidance and does not have the force of a regulation. Where state guidelines exist, the stricter of the two guidelines, Federal or state, would be followed in developing a sludge management plan.

CHAPTER 4
DESCRIPTION OF THE PROPOSED ACTIONS

Chapter 8 of the facilities plan and Section 4 of the environmental assessment present an adequate description of the proposed actions with two exceptions. Construction of additional sludge treatment facilities is now considered part of the organic solids reuse plan. Therefore, some information on the proposed treatment facilities is provided. Related to the cost of the proposed system; some supplementation and correction is required.

A. Sludge Treatment Facilities

Additional facilities are necessary for thickening and digestion of the additional organic sludges produced by the expanded and upgraded treatment plant. The Basis of Design for the solids handling facilities and construction staging is presented in Appendix C.

1. Gravity Sludge Thickener Improvements

The mechanisms on the two original gravity thickeners should be refurbished and worn parts should be replaced as needed. An additional 55' diameter gravity thickener may be needed to supplement the two original units. Facilities should be constructed to facilitate the addition of secondary effluent to the thickeners in order to reduce odors caused by septic conditions.

2. Dissolved Air Flotation Thickeners

Dissolved air flotation thickeners should be constructed in order to pre-thicken waste activated sludge prior to digestion.

3. Sludge Digester Improvements

A total of five new digesters (two primary and three secondary digesters) should be constructed to serve the plant through the year 2000. The units should be two-stage digesters operating in the mesophilic temperature range. A new digester control building should also be constructed.

Modifications should be made to the existing digesters including resealing, replacement of heat exchangers, the addition of gas mixing equipment and the renovation of the waste gas burners. In addition, MMSD should consider installation of a supernatant draw-off system and a supernatant treatment system in order to return supernatant from the secondary digester back to the head end of the treatment plant. The supernatant draw off systems would be used only on the secondary digesters (non-mixed tanks).

B. Cost of the Organic Solids Reuse Program

Table 8-1 of the organic solids reuse program is incorrect as shown. Table C-3 in Appendix C is a revised version of Table 8-1. Information on total present worth of the proposed system was not included in the organic solids reuse plan or environmental assessment. Table C-4 in Appendix C summarizes the calculation of the total present worth of the proposed system.

CHAPTER 5
ENVIRONMENTAL EFFECTS OF THE PROPOSED ACTIONS

In many cases the environmental effects section of an EIS would compare the environmental impacts of the proposed action and its alternatives. For this plan the information available on the effects of various alternatives was discussed in Chapter 3 of this EIS and in sections of the facilities plan and environmental assessment referenced therein. Although the information available on the environmental affects of system and subsystem alternatives considered by MMSD is not presented in a great level of detail, we feel that it is adequate to assess how the most cost-effective sludge management plan was selected. It remains, then, to ensure that the plan proposed by MMSD is environmentally sound and should indeed be pursued. The discussion of impacts will therefore relate strictly to the effects of MMSD's proposed plan and not to the effects of alternatives.

MMSD's organic solids reuse plan has been developed to be in accordance with Wisconsin DNR Technical Bulletin No. 88 entitled "Guidelines for the Application of Wastewater Sludge to Agricultural Land" and with recommendations of the proposed USEPA Technical Bulletin on "Municipal Sludge Management: Environmental Factors" published June 3, 1976, in the Federal Register.

Since, overall, MMSD's plan has been carefully formulated to minimize adverse environmental effects and the facilities plan and environmental assessment systematically discuss the potential effects of the proposed plan in a generally adequate fashion, we will identify here only those critical impact issues which require further discussion or have not been mentioned. The discussion of impacts of the proposed plan is divided into sections which correspond to various segments of the organic solids reuse plan.

A. Sludge Lagoon Abandonment Program

The impacts resulting from these actions are adequately discussed in the environmental assessment Sections 5.02 D, 5.02 F, 5.02 K, 5.02 L and 5.02 M. The effects of transporting of lagoon sludge and applying it to agricultural land will be considered under "Operation of the Organic Solids Reuse Plan."

B. Construction and Operation of Expanded Solids Treatment Facilities

The construction of the expanded solids treatment facilities is expected to have a substantial net beneficial impact because the facilities will alleviate the problems created by overloading the existing facilities. There will be no significant adverse impact on the site where the facilities will be constructed because the facilities will be built on a portion of the existing treatment plant site which has been graded several times. (Personal communication with staff of MMSD). There will be temporary adverse impacts caused by truck traffic carrying construction supplies and the operation of construction equipment. The major impact of truck traffic will be in the immediate area of the construction site where there will be an increase in traffic volume and therefore an increase in the required road maintenance, an increase in noise levels and consumption of fuel by the vehicles. The temporary effects of operation of construction machinery will be an increase in noise levels, temporary deterioration of air quality and consumption of fuel. Since the construction site is not in a heavily populated area, the number of persons temporarily affected will be minimized.

C. Construction of Solids Handling Facilities

The impacts of this action (i.e. constructing loading docks, etc.) are briefly but adequately discussed in the environmental assessment Section 5.03 C.

D. Operation of the Organic Solids Reuse Program

This segment of the plan includes use of one of the existing lagoons for seasonal sludge storage, sludge transfer and intermediate storage, and marketing of the liquid anaerobically digested sludge to farmers for application to their agricultural land as a fertilizer.

1. Seasonal Sludge Storage in an Existing Lagoon

The impacts of use of the western half of Lagoon 1 for seasonal storage of sludge is accurately discussed in Section 5.02 I of the environmental assessment.

2. Sludge Transfer and Intermediate Storage

The impacts of sludge transfer by trucks and potential storage in on-farm lagoons is adequately considered in the environmental assessment Sections 5.02 H, 5.02 I, 5.02 L, 5.02 M and 5.03 A.

3. Sludge Application to Privately-owned Agricultural Land

a. General Discussion

Of all segments of the organic solids reuse program this segment has the potential for the most adverse short-term and long-term effects if the management and monitoring programs are not carried out strictly as planned. At the same time the plan represents substantial benefits to be gained by return of the organic solids and nutrients contained in the sludge back to the land.

With only minor exception the potential adverse environmental effects which could result from operation of this sludge marketing and application program have been considered and the plan has been developed to minimize or eliminate the potential for those effects. The facilities plan and environmental assessment present very clearly the environmental considerations which went into development of the plan.

The critical issues which must be addressed in a sludge management plan with sludge applied as a fertilizer to privately-owned land include the following: 1) effects on soils, especially potential for accumulation of heavy metals and nutrients; 2) effects on groundwater and surface water quality; 3) effects on water quantity; 4) effects on air quality; 5) effects on land use; 6) effects on vegetation, primarily crops; and 7) effects on public health. These critical issues as well as some less significant concerns have been addressed in the facilities plan and environmental assessment. In each case the measures which will be taken to minimize or eliminate the potential for these effects have also been addressed. The key to minimizing or eliminating the most significant effects is to insure that the management program (which includes limiting maximum annual application rates and total allowable loading rates and controlling time and method of application) and monitoring program are carried out as planned.

There is no mechanism by which the Federal government can insure that the management and monitoring programs will be carried out as planned. The Wisconsin Department of Natural Resources, however, is setting up a program to regulate sludge disposal activities in Wisconsin which includes requirements for self-monitoring of sludge disposal activities and reporting to the State. It is felt that the Madison Metropolitan Sewerage District will have the resources and capabilities necessary to carry out their proposed management and monitoring programs.

b. Issues Not Considered in the Facilities Plan or Environmental Assessment or Which Require Further Discussion

PCB Monitoring

The facilities plan and environmental assessment did not consider the potential problem of PCB's in the sludge. Region V is recommending that MMSD analyze their sludge for PCB's and include monitoring for PCB's as part of their monitoring program. Since MMSD has not previously analyzed its sludge for PCB's, it is not known whether their sludges are contaminated by PCB's and to what level. PCB's are of concern because of their known toxic effects. Background information on PCB's in particular is discussed in a July 1975, paper by the USEPA titled "Statement of Concerns of the Lake Michigan Toxic Substances Committee Related to Polychlorinated Biphenyls". The proposed USEPA Technical Bulletin titled "Municipal Sludge Management: Environmental Factors published in the Federal Register on June 3, 1976, recommends that sludge management programs include monitoring for persistent organics such as PCB's because of their potential toxic effects.

Nitrogen

Sections 5.02 C, 5.02 D and 5.02 J of the environmental assessment discuss some problems resulting from excess nitrogen leaching into groundwater and to surface water if application rates are not based on crop uptake of nitrogen. One issue related to nitrogen leaching which has not been discussed here is the fact that through groundwater contamination excessive nitrates in drinking water can cause human and animal health problems. Excessive accumulation of nitrate will not be a problem if proper annual application rates based on crop uptake of nutrients are followed.

Heavy Metal Considerations - Cadmium

Cadmium is a heavy metal which demands special consideration in developing a sludge land application program because it can be relatively mobile in the soil and is not excluded by plants (see page 6-29 of the facilities plan). It is of particular concern in this plan because the level of cadmium in sludge from Nine Springs Sewage Treatment Plant is relatively high compared to the levels recommended by the USDA. USDA recommendations related to sludge which is to be applied to privately owned land are:

> If sludge Cd is greater than 25 mg/kg the ratio of Cd/Zn must be less than 0.015. Soil ph should initially be greater than 6.5 and greater than 6.2 thereafter. Do not apply on land normally cropped to leafy vegetables.

The level of cadmium in MMSD's treatment plant sludge is currently 73 mg/kg dry sludge. The Cd/Zn ratio of the sludge is .001. Both of these values are above USDA's recommendations. Region V, USEPA is recommending that this sludge management program be implemented even though MMSD sludge has higher cadmium levels than USDA recommendations. Several factors which should minimize the effects of applying MMSD sludge on land support our recommendation. These factors include: 1) application rates which are very conservative, 2) a source control program which will identify cadmium sources and decrease these levels significantly, and 3) a monitoring program designed to detect cadmium uptake in plant tissues. It is essential that MMSD carry out their strict management and monitoring program as proposed so that effects of cadmium uptake will be minimized.

Related to cadmium uptake by leafy vegetables, there are certain precautionary measures which MMSD should take. On page 6-20 of the organic solids reuse plan it is stated that "The total loading should be reduced for land which will be used for leafy vegetables, by one-half because cadmium tends to accumulate in the leaves." Because of the relatively high level of cadmuim in MMSD sludge, it is strongly advised that MMSD follow USDA's recommendation as a precautionary measure and not apply their sludge to land on which leafy vegetables will be grown until the source control program has significantly lowered the sludge cadmium levels.

Economic Effects

Since the sludge will be applied to cropland as fertilizer, it would appear that this program could potentially impact on the commercial fertilizer market. In reality, this program will have little impact on the commercial fertilizer market for the reasons stated in Section 6.4 of the facilities plan.

CHAPTER 6

RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG TERM PRODUCTIVITY

Section 5.04 of the environmental assessment adequately discusses this topic with the exception that it does not discuss the potential for effects on long-term productivity of the land on which sludge is applied if the buildup of metal concentrations is not carefully managed and limited as the plan proposes. Proper program management will insure that total allowable loadings are not exceeded and the private agricultural land on which the sludge will be applied will be useable and productive for future generations.

CHAPTER 7

FEDERAL/STATE AGENCY AND PUBLIC PARTICIPATION

Section 6 of the environmental assessment presents a good history of agency and public participation in the development of this organic solids reuse plan.

Appendix A

THE STATE HISTORICAL
SOCIETY OF WISCONSIN

816 STATE STREET / MADISON, WISCONSIN 53706 / JAMES MORTON SMITH, DIRECTOR

State Historic Preservation Office

June 4, 1976

Mr. Ralph McClurg
O'Brien and Gere Engineers, Inc.
1304 Buckley Road
Syracuse, New York 13201

SHSW 0279-76

Dear Mr. McClurg:

This letter is in response to your letter of May 25, 1976 concerning the potential impacts of the MMSD-201 Facilities Planning Study proposed action on historical and archeological resources (File 1533.002).

Since the existing pipeline route and discharge to Badfish Creek will be utilized in the future, these actions will have no impact on sites or structures of historical or archeological significance. Additionally, the application of sludge to agricultural lands will have no effect on any historical or archeological sites.

The area designated in Figure 13-4, as the recommended location for an expanded treatment plant, should be surveyed by an archeologist to determine if any such sites will be affected by the proposed construction. Dr. Joan Freeman (608/262-9566), State Archeologist and a member of our staff, will be pleased to help you locate a qualified person to perform this survey.

Sincerely,

James Morton Smith
State Historic Preservation Officer

JMS:cm

Appendix B

TABLE B-1 **

CAPITAL COST ESTIMATE*

ALTERNATIVE 1A - LAND TRENCHING OF DEWATERED SLUDGE

Thickening Tanks	$	0.(1)
Sludge Storage Tanks		0.(2)
Centrifuges 8 @ 46 GPM		1,155,000.
Centrifuge Building		124,000.
Centrate Storage Tank		86,000.
Sludge Cake Storage Tank		0.(3)
Trucks and Associated Equipment		374,000.
Secondary Treatment Plant Requirements		328,000.
Land		
Sub-total		2,091,000.
Process Contingencies (8%)		167,000.
Sub-total		2,258,000.
Engineering (7%)		158,000.
TOTAL CAPITAL COST		$2,416,000.

*The ENR Index used throughout is 2000.

(1) Thickener costs are included in the cost of the proposed Greeley and Hansen plant expansion.

(2) The existing sludge storage tanks can be used.

(3) All trucks and associated equipment are amortized to $0. over 5 years and included in annual operating cost only.

**Source: "Addendum to Nine Springs Sewage Treatment Works Sludge Disposal Study for Madison Metropolitan Sewerage District," prepared by Staff of the Madison Metropolitan Sewerage District, Madison, Wisconsin, April 1974

TABLE B-2**

CAPITAL COST ESTIMATE*

ALTERNATIVE 2A - LAND APPLICATION OF LIQUID SLUDGE

Thickening Tanks	$	0.(1)
Digestion Tanks 2 @ 160,000 cu. ft. each		948,000.
Sludge Transfer Pipeline		
Pipe - Purchase and Installation		528,000.
Manholes		13,000.
Pumping Stations w/o Pumps		60,000.
Pumps		56,000.
Sludge Storage Lagoon		620,000.
Sludge Irrigation Equipment		51,000.
Land		2,377,000.
Sub-total		4,653.000.
Process Contingencies (8%)		372,000.
Sub-total		5,025,000.
Engineering (7%)		352,000.
TOTAL CAPITAL COST		$ 5,377,000.

(1) Thickener costs are included in the cost of the proposed Greely and Hansen plant expansion.

**Source: "Addendum to Nine Springs Sewage Treatment Works Sludge Disposal Study for Madison Metropolitan Sewerage District," prepared by Staff of the Madison Metropolitan Sewerage District, Madison, Wisconsin, April 1974

TABLE B-3**

CAPITAL COST ESTIMATE*

ALTERNATIVE 3A - LANDFILLING OF SLUDGE/MILLED REFUSE MIXTURE

Thickening Tanks	$	0.(1)
Digestion Tanks 2 @ 160,000 cu. ft. each		948,000.
Storage Tanks		0.(2)
Centrifuges 7 @ 46 GPM		1,012,000.
Centrifuge Building		112,000.
Centrate Storage Tank		86,000.
Sludge Cake Storage Tank		13,000.
Trucks and Associated Equipment		0.(3)
Secondary Treatment Plant Requirements		154,000.
Sludge Receiving and Unloading Area		27,000.
Drum Mixes		1,431,000.(4)
Land		0.(5)
Sub-total		3,783,000.
Process Contingencies (8%)		303,000.
Sub-total		4,086,000.
Engineering (7%)		286,000.
Total Capital Cost	$	4,362,000.

(1) Thickener costs are included in the cost of the proposed Greeley and Hansen plant expansion.

(2) The existing sludge storage tanks can be used.

(3) All trucks and associated equipment are amortized to $0. over 5 years and included in annual operating costs only.

(4) A more economical mixer could possibly be designed.

(5) All costs associated with the landfilling operation are considered operating costs.

**Source: "Addendum to Nine Springs Sewage Treatment Works Sludge Disposal Study for Madison Metropolitan Sewerage District," prepared by Staff of the Madison Metropolitan Sewerage District, Madison, Wisconsin, April 1974

TABLE B-4**

CAPITAL COST ESTIMATE*

ALTERNATIVE 3B - LAND APPLICATION OF DEWATERED SLUDGE

Thickening Tanks	$ 0.(1)
Digestion Tanks 2 @ 160,000 cu. ft. each	948,000.
Sludge Storage Tanks	0.(2)
Centrifuges 7 @ 46 GPM	1,012,000.
Centrifuge Building	112,000.
Centrate Storage Tank	86,000.
Sludge Cake Storage Tank	18,000.
Trucks and Associated Equipment	0.(3)
Secondary Treatment Plant Requirements	154,000.
Land	2,377,000.
Sub-total	4,707,000.
Process Contingencies (8%)	377,000.
Sub-total	5,084,000.
Engineering (7%)	356,000.
TOTAL CAPITAL COST	$ 5,440,000.

(1) Thickener costs are included in the cost of the proposed Greeley and Hansen plant expansion.

(2) The existing sludge storage tanks can be used.

(3) All trucks and associated equipment are amortized to $0. over 5 years and included in annual operating costs only.

**Source: "Addendum to Nine Springs Sewage Treatment Works Sludge Disposal Study for Madison Metropolitan Sewerage District," prepared by Staff of the Madison Metropolitan Sewerage District Madison, Wisconsin, April 1974

TABLE B-5**

CAPITAL COST DATA SOURCES

MAJOR UNIT	DATA SOURCES
Digesters	Weston Cost Estimate
Centrifuges	Weston Cost Estimate
Pipeline	MMSD Staff Estimates
Pumping Stations	MMSD Staff Estimates
Pumps	L.W. Allen and ITT Marlow
Manholes and Valving	MMSD Staff Estimates
Buildings	MMSD Staff Estimates
Storage Tanks	MMSD Staff Estimates
Trucks	Verona International Trucks
Sludge Transportation Trailers	Fruehauf Trailer Div., Fruehauf Corporation
End Loaders, Farm Machinery	Brooks Industrial Sales
Sludge Storage Lagoon	Weston Cost Estimate
Drum Mixers	Buhler Co. Cost Estimate and E.P.A. Report (1)
Irrigation Equipment	Roberts Irrigation Company
Secondary Treatment Plant Requirements	MMSD Staff Estimate and Greeley and Hansen Projected Cost Estimate for Plant Addition

(1) Recovery and Utilization of Municipal Solid Waste, by M.L. Drobny, M. E. Hull, and R. L. Testim, Battelle Memorial Institute, Columbus, Laboratories E.P.A. Contact No. PH 86-67-265.

**Source: "Addendum to Nine Springs Sewage Treatment Works Sludge Disposal Study for Madison Metropolitan Sewerage District," prepared by Staff of the Madison Metropolitan Sewerage District, Madison, Wisconsin, April 1974

TABLE B-6**

1975 ANNUAL OPERATING COST ESTIMATE

ALTERNATIVE 1A - LAND TRENCHING OF DEWATERED SLUDGE

ASSOCIATED OPERATING COSTS

Cost of Thickening and Sludge Storage Absorbed in Present Operation

Polymers	$ 150,000.
Labor	30,000.
Power	5,600.
Maintenance	21,400.
Air Blowers	4,900.
Labor, fuel, maintenance, tires, license, taxes, etc.	52,000.
Amortization of three 20-ton tri-axle trucks over 5 yrs.	20,500.
Labor	12,000.
Power	3,100.
Maintenance	1,300.
Amortization of field equip.	7,500.
Payment in lieu of taxes	1,300.
1975 ANNUAL OPERATING COST	$ 309,600.

**Source: "Addendum to Nine Springs Sewage Treatment Works Sludge Disposal Study for Madison Metropolitan Sewerage District," prepared by Staff of the Madison Metropolitan Sewerage District, Madison, Wisconsin, April 1974

TABLE B-7**

1975 ANNUAL OPERATING COST ESTIMATE

ALTERNATIVE 2A - LAND APPLICATION OF LIQUID SLUDGE

ASSOCIATED OPERATING COSTS

Cost for Thickening Absorbed in Present Operation

Labor	$ 52,000.
Power	2,400.
Maintenance	9,500.
Power	3,200.
Maintenance	2,000.
Maintenance	1,000.
Labor	33,000.
Power	3,800.
Amortization of field equip.	2,300.
Maintenance	6,500.
Payment in lieu of taxes	9,700.
Sub-total	125,400.
Return from leasing land	-33,600.
1975 ANNUAL OPERATING COST	$ 91,800.

**Source: "Addendum to Nine Springs Sewage Treatment Works Sludge Disposal Study for Madison Metropolitan Sewerage District," prepared by Staff of the Madison Metropolitan Sewerage District, Madison, Wisconsin, April 1974

TABLE B-8**

1975 ANNUAL OPERATING COST ESTIMATE

ALTERNATIVE 3A - LANDFILLING OF SLUDGE/MILLED REFUSE MIXTURE

ASSOCIATED OPERATING COSTS

Cost for Thickening Absorbed in Present Operation	
Labor	$ 52,000.
Power	2,400.
Maintenance	9,500.
Use Available Tank	0.
Polymers	77,500.
Labor	24,000.
Power	4,500.
Maintanence	30,000.
Air Blowers	12,600.
Labor, fuel, maintenance, tires, license, taxes, etc. to haul sludge portion	54,600.*
Amortization of two 20-ton capacity trucks over 5 years	13,700.
Labor	12,000.
Power	1,100.
Maintenance	3,000.
Purchase, preparation and operation	134,400.*
Payment in lieu of taxes	1,700.
1975 ANNUAL OPERATING COST	$ 438,000.

*Only includes handling & disposal of sludge portion.

**Source: "Addendum to Nine Springs Sewage Treatment Works Sludge Disposal Study for Madison Metropolitan Sewerage District," prepared by Staff of the Madison Metropolitan Sewerage District, Madison Wisconsin, April 1974

TABLE B-9*

1975 ANNUAL OPERATING COST ESTIMATE

ALTERNATIVE 3B - LAND APPLICATION OF DEWATERED SLUDGE

Cost for Thickening Absorbed in Present Operation

Labor	$ 52,000.
Power	2,400.
Maintenance	9,500.
Polymers	77,500.
Labor	24,000.
Power	4,500.
Maintenance	30,000.
Air Blowers	12,600.
Labor, fuel, maintenance, tires, license, taxes, etc.	54,600.
Amortization of two 20-ton capacity trucks over 5 years	13,700.
Labor	24,000.
Power	1,300.
Maintenance	1,000.
Amortization of field equip.	4,500.
Payment in lieu of taxes	9,700.
Sub-total	321,300.
Return from leasing land	-33,600.
1975 ANNUAL OPERATING COST	$ 287,400.

**Source: "Addendum to Nine Springs Sewage Treatment Works Sludge Disposal Study for Madison Metropolitan Sewerage District," prepared by Staff of the Madison Metropolitan Sewerage District, Madison, Wisconsin, April 1974

TABLE B-10**

BASIC COST FACTORS FOR CALCULATION OF OPERATING COSTS

Labor:	$12,000/operator/year $8/hr./truck driver
Power:	1.2 cent/kw-hr
Chemicals:	Altasep 105C - $1.25/lb. Hercafloc 814.3 - $1.60/lb.
Maintenance:	A given percentage of the unit capital cost or experience.
Recycle Stream Treatment	
Air Requirements:	1200 cu. ft./lb. BOD applied 7500 cu. ft./lb. NH_3-N applied
Capital Investment:	The portion of the unused capacity of the planned expansion which would be used by the recycle stream.
Fuel:	$0.50/gallon

**Source: "Addendum to Nine Springs Sewage Treatment Works Sludge Disposal Study for Madison Metropolitan Sewerage District," prepared by Staff of the Madison Metropolitan Sewerage District, Madison, Wisconsin, April 1974

TABLE B-11**

ANNUAL SYSTEM COSTS - 1975

Sludge Handling System	Fixed Annual Cost	Annual Operating Cost	Total Annual Cost	Cost Per Ton Dry Solids
Alternative 1A - Land Trenching of Dewatered Sludge	$225,000	$309,600	$534,600	$50
Alternatice 2A - Land Application of Liquid Sludge	$342,000	$ 91,800	$433,800	$41
Alternative 3A - Landfilling of Sludge/Milled Refuse Mixture	$406,000	$438,000	$844,000	$79
Alternative 3B - Land Application of Dewatered Sludge	$348,000	$287,400	$635,400	$60

(1) Cost per ton is based on 1975 dry solids of 58500 lbs/day = 10,676 tons/year.

(2) Includes interest payments for purchase of land for final disposal.

(3) Includes a return from leasing 2/3 of the productive land per year for $35/acre.

(4) Does not include any costs for milling, transporting or landfilling the refuse portion of sludge/milled refuse mixture.

(5) Assumes no land recovery after use as final disposal site. Cost of land amortized to $0 over 15 years.

**Source: "Addendum to Nine Springs Sewage Treatment Works Sludge Disposal Study for Madison Metropolitan Sewerage District," prepared by Staff of the Madison Metropolitan Sewerage District, Madison, Wisconsin, April 1974

Appendix C

TABLE C-1

BASIS OF DESIGN FOR ADDITIONAL SLUDGE FACILITIES

ANAEROBIC DIGESTERS	
Type - Mesophilic, high rate, completely mixed mixing mode compressed digester gas	
Primary Digesters	
Hydraulic Detention Time	10 days
Volatile Solids Loading Rate	0.1 lb. VSS/cu.ft./day
Secondary Digester (thickening mode, supernatant draw-off; mixing mode, compressed digester gas)	
Hydraulic Detention Time	10 days
GRAVITY THICKENERS	
Type - Center feed	
Surface Overflow Rate	800 gal/day/sq.ft.
Solids Loading Rate	
Primary	20 lbs/day/sq. ft.
Secondary	5 lbs/day/sq.ft.
FLOTATION THICKENERS	
Type - Dissolved air	
Surface Overflow Rate	1 gal/min/sq.ft.
Solids Loading Rate	3 lbs/hr/sq.ft.

Courtesy CH2M Hill (Taken from Table 9-2, draft copy of "Summary Facilities Plan-MMSD", May 1976)

Note: Values used for preliminary design estimates

TABLE C-2

RECOMMENDED CONSTRUCTION STAGING FOR IMPROVEMENTS IN THE SOLIDS TREATMENT FACILITIES AT NINE SPRINGS WASTEWATER TREATMENT PLANT

Item (Quantity)	Description	Year On Line
GRAVITY THICKENERS		
Refurbish Mechanisms (2)	Inspect and repair as needed	1980
Gravity Thickener No. 5	55 feet diameter	1980
Thickener Sweetening Equipment	500 gpm secondary clarifer effluent to each gravity thickener	1980
DISSOLVED AIR FLOTATION THICKENERS		
Flotation Thickeners No. 1 and 2	500 square feet surface area	1980
Flotation Thickener No. 3	250 square feet surface area	1990
Sludge Blenders No. 1 and 2	15 feet diameter	1980
ANAEROBIC DIGESTERS		
Digester Upgrading	Gas mixers, roof sealing, overall refurbishing	1980
Heat Exchanger Modifications	New external heat exchanger with water softener	1980
Digester Control Building No. 2	Housing for controls, boilers, pumps & mixers	1980
Primary Digester No. 4	Volume 181,000 cu. ft., diameter 85 ft.	1980
Primary Digester No. 5	Volume 181,000 cu. ft., diameter 85 ft.	1985
Secondary Digester No. 3	Volume 181,000 cu. ft., diameter 85 ft.	1980
Secondary Digester No. 4	Volume 181,000 cu. ft., diameter 85 ft.	1980
Secondary Digester No. 5	Volume 181,000 cu. ft., diameter 85 ft.	1985
Digested Sludge Thickening Equipment	Supernatant drawoff piping	1980

Courtesy CH2Hill (Taken from Table 9-3, draft copy of "Summary Facilities Plan, MMSD," May 1976.)

TABLE C-3

REVISED TABLE 8-1 OF THE ORGANIC SOLIDS REUSE PLAN*
ESTIMATED INITIAL CONSTRUCTION COST
SLUDGE REUSE PROGRAM

Madison Metropolitan Sewerage District

ITEM	COST
REUSE PROGRAM	
Lagoon Sludge Removal Equipment	$ 100,000
Sludge Distribution Equipment (6 tanker trucks, 1 sludge loading dock, 2 nurse tanks, 1 slurry pump).	351,000
Sludge Application Equipment (4 truck spreaders, 1 soil injector, 1 tractor spreader)	240,000
Subtotal Reuse Program	$ 691,000
SOLIDS TREATMENT FACILITIES	
Gravity Thickeners	
Refurbishment	5,000
Sweetening Equipment	15,000
Gravity Thickener No. 5	110,000
Flotation Control Building	100,000
Flotation Thickeners No. 1 and 2	550,000
Anaerobic Digesters	
Refurbishment and Upgrading	430,000
Digester Control Building No. 2	350,000
Digester Utility Tunnel	220,000
New Digesters and Equipment**	1,390,000
Supernatant Drawoff Equipment	70,000
Subtotal Solids Treatment Facilities	$ 3,240,000
Subtotal Initial Construction Costs	$ 3,931,000
Engineering (12%)	472,000
Legal and Fiscal Costs (2.5%)	98,000
Administration (0.5%)	20,000
Contingency (15%)	590,000
Total Initial Construction Costs	$ 5,111,000
Less Federal Grant (75%)	3,833,000
Less State Grant (5%)	256,000
NET COST TO MMSD	$ 1,022,000

TABLE C-3 Cont.

*The solids treatment facilities costs were revised to correspond to those on Table 13-8 of Volume II, Wastewater Treatment Systems. All costs are in January 1976, dollars.

**Primary Digesters No. 4 and 5 and Secondary Digester No. 3

TABLE C-4

PRESENT WORTH COST OF ORGANIC SOLIDS REUSE PLAN

Madison Metropolitan Sewerage District

BASIS:

Reuse plan construction and O&M costs were computed by converting the year-by-year costs in Table B-14 of the organic solids reuse plan to January 1976, present worths.

Solids treatment construction present worth costs were computed for the facilities listed in Table 13-8 of Volume II of the comprehensive facilities plan assuming construction will begin in 1978.

Solids treatment power and other O&M present worth costs were computed from a fraction of the upgraded secondary treatment and advanced wastewater treatment costs listed in Table 13-9 of Volume II of the comprehensive facilities plan.

Engineering, legal and fiscal administrative and contingency costs are included in the present worth cost estimate.

CONSTRUCTION COSTS:

Solids Treatment	
Gravity Thickeners	$ 148,000
Flotation Thickeners	738,000
Anaerobic Digesters	2,793,000
Reuse Program	
Lagoon Program	250,000
Sludge Distribution	1,100,000
Sludge Application	418,000
Subtotal P.W. of Construction Costs	$ 5,447,000

OPERATING AND MAINTENANCE COSTS:

Solids Treatment	
Power	$ 3,115,000
Other O&M	4,361,000
Reuse Program	
Lagoon Program	130,000
Sludge Distribution	875,000
Sludge Application	385,000
Program Management	336,000
Monitoring Program	360,000
Income	- 60,000

TABLE C-4 Cont.

Subtotal P.W. of O&M Costs	$ 9,502,000
PRESENT WORTH:	
Total Present Worth	$14,949,000

Appendix D

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