UNITED STATES
ENVIRONMENTAL PROTECTION AGENCY
REGION III - PHILADELPHIA, PENNSYLVANIA

SLUDGE MANAGEMENT STUDY
BLUE PLAINS WASTEWATER TREATMENT PLANT
WASHINGTON, D.C.

DRAFT
ENVIRONMENTAL IMPACT STATEMENT

MARCH 1989

GANNETT FLEMING ENVIRONMENTAL ENGINEERS, INC.
HARRISBURG, PENNSYLVANIA

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
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LETTER OF TRANSMITTAL

TO: ALL INTERESTED CITIZENS, AGENCIES AND PUBLIC INTEREST GROUPS:

This draft Environmental Impact Statement (EIS) represents the culmination of a lengthy and detailed evaluation of disposal alternatives for sewage sludge generated at the District of Columbia's Blue Plains waste water treatment facility. Current sludge production is over 250 dry tons per day and is expected to increase to 410 dry tons per day within the next 20 years, based upon original figures supplied by D.C.. The draft EIS studies the options for long-term disposal of approximately one-half of the sludge generated at Blue Plains. For the remaining sludge production, the District and other jurisdictions involved in the operation of Blue Plains have agreed to composting, both on-site and in suburban Maryland. In 1984, EPA issued a Finding of No Significant Impact (FNSI) for the composting operation, pursuant to the requirements of the National Environmental Policy Act (NEPA) and regulations promulgated by the President's Council on Environmental Quality (CEQ). At the same time, the District proposed incineration of sludge as the other long-term solution to be operated in tandem with composting. Over the past five years land application has been utilized in addition to composting. However, the District and user jurisdictions view land application as a short-term solution to sludge management.

EIS's are required for projects that involve "major Federal actions" such as expenditure of Federal funds. Total capital costs for incineration are estimated at $96 to $113 million, depending upon the number of units and design configuration. The District has included incineration on the Construction Grants Priority List for proposed funding by EPA. Because of environmental concerns with incineration and the large expenditure of public funds, EPA initiated the EIS process under NEPA and CEQ regulations. As stated in CEQ Regulations, "The NEPA process is intended to help public officials make decisions that are based on understanding of environmental consequences, and take actions that protect, restore, and enhance the environment." A thorough comparison of all viable alternatives is required by the NEPA process. Public participation is part of the NEPA process and is critical to making significant policy decisions.

It is from this perspective that EPA has approached the evaluation of the various alternatives for sludge disposal. Composting, pelletizing, ocean disposal, and land application were evaluated in addition to incineration. These were narrowed down to three primary alternatives -- incineration, composting, and land application. All were evaluated in depth. It is important to note that none of these primary alternatives, if properly operated, would result in violations of existing environmental regulations and standards. Given the probable regulatory compliance of the alternatives, other factors were then considered. Most notably technical feasibility, cost effectiveness, environmental acceptability, and implementability were considered. These issues are addressed in the body of the report and refined in Appendix I, which was prepared in response to concerns raised during EPA's internal review of the preliminary document.

In regard to technical feasibility and costs, early analysis revealed that additional composting at Blue Plains could not be recommended because of constraints imposed by lack of space at the facility. This left incineration and land application as the primary alternatives for final consideration. From a cost effectiveness viewpoint, land application and incineration are comparable based on standard engineering estimating techniques.

From an environmental acceptability perspective, EPA policy for the funding of projects requires that recycling and reuse are to be considered options of choice wherever economically feasible. Given the policy and comparability of costs, land application is considered more environmentally desirable. EPA's reasons for preferring land application relate to the relatively low levels of chemical impurities in Blue Plains sludge, making the sludge highly desirable as a soil conditioner and agricultural fertilizer. Using incineration, this potentially valuable resource would be lost. In addition, the application of sludge reduces the adverse effects of soil erosion, nutrient runoff, and ground water contamination when compared to chemical fertilizers that would otherwise be used.

The District currently land applies an average of 140 dry tons per day, or nearly three-fifths of its production. The program has been successfully implemented over the past four to five years. Under EPA's preferred alternative, an additional 60 tons per day would be land applied, bringing the total to an average of 200 tons per day. Current composting accounts for about 100 tons; an additional 110 tons was part of the 1984 FNSI and will complement the tonnage disposal picture. Numerous municipalities employ land-based technology for sludge management with proven reliability. This includes larger municipalities which have higher levels of chemical impurities in their sludges than the Blue Plains material. Although concern has been raised about the availability of suitable land, EPA's evaluation indicates that there is sufficient acreage for Blue Plain's sludge in Maryland and Virginia. Land to accommodate Blue Plains sludge is available for at least the next 20 years.

Since 1984, the District of Columbia and the user jurisdictions have been on a course of developing independence in managing Blue Plains sludge. EPA acknowledges their desire to have total management control over sludge disposal and that construction of incinerators would maximize that control. The District and the user jurisdictions are particularly concerned over implementing and sustaining a viable, long-term land application solution. In addition, the District is concerned that the public acceptance of land application of sludge will diminish over time, leaving them with no adequate disposal system in place.

Land application requires a highly developed infrastructure of contract management and inter-governmental coordination and cooperation. Although incineration requires sophisticated technical management attention, it does not need the degree of inter-governmental coordination and cooperation required by land application. Overall, EPA recognizes that land application would impose more stringent sludge management requirements than incineration.

A primary purpose of this draft EIS is to encourage public involvement in this very important issue. Public involvement is essential to arriving at an informed and balanced public policy decision. This decision is of extreme significance to the residents of the District of Columbia, Maryland and Virginia. If land application is the selected alternative, implementation will require continued cooperation and involvement between the District and neighboring jurisdictions.

EPA is particularly interested in receiving comments on the implementability of the land application alternative. EPA will conduct a public meeting on this EIS, open to all interested parties. Written comments are also encouraged. All comments will be appreciated and considered in preparation of the final Environmental Impact Statement.

Stanley L. Laskowski
Acting Regional Administrator

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Those individuals from the Washington Suburban Sanitary Commission, the Council of Governments and the Blue Plains user counties of Montgomery, Fairfax and Prince George's who provided comments and suggestions.

The District's contractors who provided data and support documents for information presented in the land application and composting sections of the EIS.

And the staff at the Blue Plains plant who answered numerous questions regarding the present operations at the facility.

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EXECUTIVE SUMMARY

SHORT SUMMARY

The Blue Plains Wastewater Treatment Plant is a regional facility that receives wastewater from much of the Washington Metropolitan area. As the result of a major planning effort by the District of Columbia, recommendations were made that one portion of the wastewater sludge from the Blue Plains facility be composted and that a second portion be incinerated.

In August 1984, the U.S. Environmental Protection Agency (EPA) issued a Finding of No Significant Impact (FONSI) on the sludge composting portion of the plan, but decided that an Environmental Impact Statement (EIS) would be required to further evaluate the sludge incineration portion of the plan. A Notice of Intent to prepare this EIS was also issued in August 1984.

In September 1985, the District of Columbia, the Washington Suburban Sanitary Commission (WSSC) and the user Counties signed an Intermunicipal Agreement (IMA) fully endorsing the use of both composting and incineration. However, implementation of the incineration portion of the plan was held in abeyance subject to a favorable outcome from the EIS.

After extensive study, the EIS has been completed. Because the FONSI already approved composting as the method for managing one portion of the Blue Plains sludge, the EIS addresses only the portion considered for incineration. The seven alternatives evaluated were (1) no action, (2) incineration with ash landfilling, (3) land application of dewatered sludge, (4) in-vessel composting and product use, (5) heat drying and product use, (6) landfilling dewatered sludge, and (7) ocean disposal.

<u>Land application of dewatered sludge is the alternative preferred by EPA</u>. Compared with incineration, it maximizes resource reuse and minimizes energy consumption; it is less operationally complex; permitted farmland is available; has less environmental impacts; it keeps the District's long-term options open, and is economically competitive. Furthermore, land application represents a continuation of a current practice that has been successfully used at Blue Plains for many years.

DETAILED SUMMARY

INTRODUCTION

The Blue Plains Wastewater Treatment Plant receives wastewater from much of the Washington Metropolitan area. Because of the size of the plant and volume of sludge generated (approximately 2,000 wet tons per day or 400 dry tons per day based upon 20 percent solids) sludge handling and disposal have been a constant concern. In July 1984, the District of Columbia proposed a long-term plan based upon concurrent use of two disposal methodologies:

(1) Composting:

- Use of the Montgomery County Composting Facility (MCCF Site II) in suburban Maryland.
- Use of a new mechanical composting facility to be constructed at the Blue Plains site.

(2) Incineration:

- Use of new sludge incinerators to be constructed at the Blue Plains site.

In August 1984, the U.S. Environmental Protection Agency (EPA) issued a Finding of No Significant Impact (FONSI) on the composting portion of the plan, but decided that an Environmental Impact Statement (EIS) would be required to further evaluate the incineration portion of the plan. A Notice of Intent to prepare this EIS was also issued in August 1984.

The FONSI assured the District that on-site composting of dewatered sludge would remain a major long-term component of the sludge management plan. Management and environmental problems associated with the existing aerated static pile composting operations would be reduced with the introduction of in-vessel composting. Composting would be performed in an enclosed building and the process air would be treated before it is exhausted to the atmosphere. Under the District's proposal, approximately one-third of the sludge would be composted.

In September 1985, the District of Columbia, the Washington Suburban Sanitary Commission (WSSC) and the user Counties signed an Intermunicipal Agreement (IMA) fully endorsing the composting and incineration methods. However, implementation of the incineration portion of the plan was held in abeyance pending the issuance of a favorable EIS. The Intermunicipal Agreement assumes in-vessel composting of sludge at Blue Plains; composting of sludge at MCCF - Site II in Montgomery County, MD; and incineration of sludge at Blue Plains.

Only that quantity of sludge proposed for incineration (200 DTPD as established for the EIS) at Blue Plains was evaluated during preparation of this EIS. The alternatives to incineration have been evaluated in terms of their ability to handle and dispose of only that quantity; not the entire amount generated at Blue Plains, and in particular not the portion already approved for composting under the FONSI.

The District of Columbia has issued a series of background and preliminary engineering reports for the proposed sludge incineration plan. These reports address: concept, cost, and engineering of multiple hearth and fluidized bed incineration systems; sludge sampling and characterization; air emission inventory at the Blue Plains facility; air pollutant emission factors; and, projected air quality impacts using EPA-approved air dispersion models. Information from these reports was used extensively during the preparation of this EIS.

Sludge incineration and six other alternatives have been evaluated; giving consideration to regulatory constraints, engineering, environmental impacts, economics and mitigative measures. All alternatives were evaluated for a 20-year planning horizon. Potential air emissions from the proposed fluidized bed incinerators were also given considerable scrutiny.

EXISTING SLUDGE MANAGEMENT CONCERNS

The Blue Plains Wastewater Treatment facility has a design capacity of 309 million gallons a day and received flows averaging 287 mgd in 1986. The continuing growth of the region around metropolitan Washington and a regulatory trend toward improved treatment of wastewater has forced the District to evaluate several sludge disposal alternatives. Land application has been used with some success over the years, but the District and the user jurisdictions have encountered varying levels of public opposition to this sludge disposal method.

The District's experience with the aerated static pile method of composting has had only limited success. The compost facility at Blue Plains has historically experienced moisture problems that have prevented the District from producing a marketable compost. However, the District is currently attempting to resolve this problem. In contrast, Montgomery County has experienced success in composting 40 DTPD of dewatered sludge, but they have encountered local opposition to the compost facility because of its suburban location. Furthermore, odor control facilities are being installed at MCCF.

Several interim attempts at alternative disposal technologies by the District have culminated the utilization of in land application of sludge on permitted points in Maryland and Virginia. The land application program has experienced more longevity than other alternative methods. Although some public relations problems have been experienced, the land application program has been generally successful.

It is difficult to predict the level of public opposition that would result from an incineration system at Blue Plains. At nearby sludge incinerating facilities that have been operating for some time, there has generally not been overwhelming opposition; however, an incineration system constructed several years ago at the WSSC Piscataway treatment facility has never been operated because of public opposition.

DESCRIPTION OF POTENTIAL SLUDGE MANAGEMENT ALTERNATIVES

There are several sludge disposal technologies available to the District. These include: (1) no action; (2) incineration with ash landfilling; (3) land application of dewatered sludge; (4) in-vessel composting; (5) heat drying and product use; (6) landfilling dewatered sludge; and (7) ocean disposal.

No Action - Composting and Land Application

The no-action alternative presumes a continuation of the current sludge handling and disposal methods for the EIS sludge. All sludges not subjected to the FONSI (composting) or the MCCF (composting) would be dewatered and land applied to the limit of the ability of existing facilities. While land application has been successfully used for many years, the District has expressed concerns about its long-term viability because of a fear that disposal sites will become increasingly limited and that a sharp escalation in contract prices will also occur.

Incineration and Ash Landfilling

The District desires to construct six fluidized bed furnaces to process the equivalent of 200 DTPD of sludge. The incineration proposal includes final ash disposal at the Lorton Landfill. In preparing the EIS, both multiple hearth and fluidized bed furnaces have been considered. In addition, a scaled down incineration alternative using fewer fluidized bed furnaces has been considered. Clearance from the Federal Aviation Administration would be required. Also there has been considerable concern regarding the aesthetic impacts of the stacks in the area.

Land Application

Historically, land application of Blue Plains sludge has been part of the District's solids management program. Approximately 600 to 700 wet tons per day of dewatered sludge are presently transported off site, stored, and applied as required to support crop nutrient requirements. Furthermore, the quality of Blue Plains sludge is good because it is low in metals and toxics as indicated from recent testing of the sludge. With proper adherence to regulations, the practice can be safe and poses minimal threat to the environment.

Concerns about land application relative to its long-term use are the dependence on contractors to haul, store and land apply the dewatered sludge; weather constraints; and the requirement for permitted storage and land application sites. However, the high quality of the Blue Plains sludge is a positive factor that does encourage long-term acceptance by the farming community. Furthermore, there is more than sufficient acreage currently permitted in Virginia and Maryland to handle projected sludge quantities from Blue Plains during the 20-year planning horizon.

The "land application of dewatered sludge" and "no action" alternatives are similar but differ in detail and degree. While the "no action" alternative assumed that there would be no improvements to the sludge dewatering process, the "land application" alternative assumed that improved dewatering would be implemented. Similarly, where the "no action" alternative assumed that sludge handling and disposal constraints might limit loadings to the plant, the land application alternative assumed that the program would be constructed and operated so that sludge disposal would not be a constraint on the capacity of the Blue Plains plant to handle projected influent wastewater flows during the planning horizon.

Composting and Product Use

Composting of dewatered sludge is a major component of the District's long-term plan for non-EIS sludge. Under the FONSI, the present on-site aerated static pile composting is to be replaced with in-vessel composting to provide increased capacity while using less of the space-constrained Blue Plains site. On-site composting of the EIS portion of the sludge is not practical because of the site limitations. Nearly all remaining open space is being reserved for the anticipated additional wastewater treatment.

Drying and Product Use

Heat drying reduces the overall weight and volume of sludge to be removed from the site. The final dry sludge pellets, which are stable and pathogen-free, may be used for land application programs. Environmental concerns focus on the moist gas stream discharge to the atmosphere and the liquid sidestream from the scrubber unit.

Experience with heat drying the volume of sludge generated at the Blue Plains facility is limited. A market for dried sludge pellets has not been established in the northeastern United States.

Landfilling

The Lorton Landfill in Fairfax County, Virginia is currently the only site available to accept dewatered sludge. However, the landfill's location in the Occoquan Watershed, and Commonwealth of Virginia regulations that prohibit the disposal of dewatered sludge in this basin, would prevent disposal at this site.

Ocean Disposal

Ocean disposal was evaluated because of the location of Blue Plains on the shores of the Potomac River. Barges departing from Blue Plains would have access to the Atlantic Ocean; thus making ocean disposal a low-cost alternative.

However, ocean disposal sites are not being permitted. The regulatory trend away from ocean disposal would make site monitoring and management of ocean disposal operations difficult for the District. If an accidental spill occurs during the loading of sludge into barges, the risk of polluting the Potomac River is increased. The U.S. Senate has approved legislation that would ban ocean dumping of municipal sewage sludge by 1992.

Table ES-1

Comparison of Alternatives

Evaluation Factors	Incineration With Ash Landfilling		Land Application	In-Vessel Composting	Drying & Product Use	Landfilling	Ocean Disposal
	6 Units	4 Units					
Economic Analysis (Total Equivalent Annual Costs)	$21,298,000	$19,053,000	$20,218,000	$28,735,000	$15,130,000	$24,704,000	$8,164,000
Operability (Includes reliability, flexibility, and maintainability)	Moderate		Moderate	Moderate	Low	Low	Low
Implementability (Includes public acceptability and management requirements)	High		High	Moderate	Moderate	Low	Low
Potential Adverse Environmental Impacts							
Air Impacts							
o Stack Emissions	X	X			X		
o Odor Emissions			X	X		X	
Water Impacts							
o Surface Water	X[1]	X[1]	X[2]			X	X
o Groundwater	X[1]	X[1]	X[2]			X	
Land Impacts							
o Transportation			X	X			X
o Land Use Conflicts			X				
o Nutrients Overloading			X[3]	X	X	X	
o Landfill Capacity	X	X					
o Aesthetics	X	X					
Other Environmental Considerations							

[1] Potential impact at landfill; leachate generation from ash residue.

[2] Impacts are possible but extremely low because of guidelines and regulatory controls.

[3] Potential for nutrient overloadings are remote if state guidelines are followed.

SCREENING AND EVALUATION OF ALTERNATIVES

The screening and evaluation of alternatives was based on economic and engineering factors that are discussed in Chapter 3 of the EIS, and environmental factors that are discussed in Chapter 4 of the EIS. Table ES-1 provides a summary comparison of these factors for each alternative.

PREFERRED ALTERNATIVE

Land Application of dewatered sludge is EPA's preferred alternative. It includes the following major elements:

(1) Improved sludge handling and dewatering at Blue Plains.

(2) Continuation and renewal of long-term contracts to haul and dispose of the sludge including:

- o Contracts that provide for disposal of 200 DTPD on average land and for up to 384 DTPD during the maximum two months of the year, and

- o Contracts that provide for appropriate regulatory management, environmental impacts mitigation, and traffic control.

(3) Coordination with programmed development of the FONSI'd composting and with expanded use of MCCF.

The major factors behind EPA's selection of land application include:

(1) Of all of the alternatives, it best meets EPA's goals for maximum reuse of resources and minimization of energy use.

(2) It is a proven technique with known managerial and technical characteristics.

(3) There is sufficient land available for application; and a sufficient number of contractors are willing to implement the program.

(4) Adverse environmental impacts are known to be minor and controllable. It has a secondary benefit in that it reduces nutrient runoff to the Chesapeake Bay.

(5) It keeps the District's options open for implementation of other or different technologies in the future.

(6) It is economically competitive with other viable alternatives.

CHAPTER ONE

CHAPTER 1

BACKGROUND AND HISTORY OF THE PROJECT

1.1 BACKGROUND AND PURPOSE OF THE EIS

The Blue Plains Wastewater Treatment Plant, located on the Potomac River Estuary in Washington, D.C., was originally constructed in 1938 to serve the District of Columbia. During the past 50 years, the facility has been expanded and upgraded several times. Although the facility is owned and operated by the District of Columbia, it has become a regional treatment plant which receives wastewater from over 70 percent of the Washington Metropolitan Area. The facility currently treats wastewater from:

- *Portions of Prince George's and Montgomery Counties, Maryland;*
- *Portions of Loudoun, Arlington, and Fairfax Counties, Virginia; and*
- *The entire District of Columbia.*

The last major expansion and upgrade plan for the Blue Plains facility was developed in October, 1970. The plans called for the Blue Plains facility to provide advanced wastewater treatment for 419 mgd (later changed to 309 mgd). The upgrade plan was developed to enhance the water quality of the Potomac estuary and was one of the recommendations issued by the Potomac Enforcement Conference of April 1969. As a result, an Environmental Impact Statement (EIS) for the Blue Plains project was prepared by the EPA Region III office and released in draft form in April 1972. As part of the upgrade and expansion plan, it was proposed that sewage sludge generated at the facility be incinerated on site.

Public concern over the environmental impact of sludge incineration became a major issue after issuance of the DEIS. In the final EIS (released in 1974), it was stated that an evaluation of potential mercury and beryllium emissions from the proposed sludge incinerators should not constitute a threat to public health in the vicinity of the Blue Plains WWTP; however, there was limited specific information concerning the composition of the sludge and the fate of materials processed in sludge incinerators. Therefore, it was decided that EPA would assume the responsibility for further investigating the health aspects of the incinerator's emissions, and that the District's Department of Environmental Services would investigate alternatives to incineration. In addition, EPA decided it would prepare a supplement to the EIS which would report on developments connected with each of the sludge disposal alternatives; identify the alternative selected for implementation at Blue Plains; and present a discussion of the consequences of that action.

In July 1984, the District of Columbia's consultant presented a report which recommended a long-term sludge disposal plan. The recommended plan involves the following three components.

- *Composting sludge at an existing sludge composting facility in suburban Maryland;*
- *Composting sludge at a new sludge composting facility to be constructed at the Blue Plains site; and*
- *Sludge incineration in new sludge furnaces to be constructed at the Blue Plains site.*

In response to the proposed sludge incineration alternative, EPA served notice to prepare an EIS on the ultimate disposal alternatives regarded as feasible. In August 1984, Findings of No Significant Impact (FONSIs) were issued for the composting portion of the plan. A Notice of Intent to prepare an EIS on that portion of sludge to be disposed of at the Blue Plains WWTP was issued in August 1984. On September 5, 1985, the District of Columbia, the Washington Suburban Sanitary Commission (WSSC) and the user Counties signed an Intermunicipal Agreement (IMA) fully endorsing the composting and incineration methods. The adoption of the incineration method for Blue Plains; however, was subject to a favorable EIS by EPA.

1.2 HISTORY

The Blue Plains Wastewater Treatment Plant located in the District of Columbia is operated by the D.C. Public Works, Water and Sewer Utility Administration (WASUA). The plant treats wastewater from the District of Columbia, sections of Fairfax and Loudoun Counties in Virginia, and sections of Prince George's and Montgomery Counties in Maryland. These areas and their geographical relationship to the District and Blue Plains are shown on Plate 1.1.

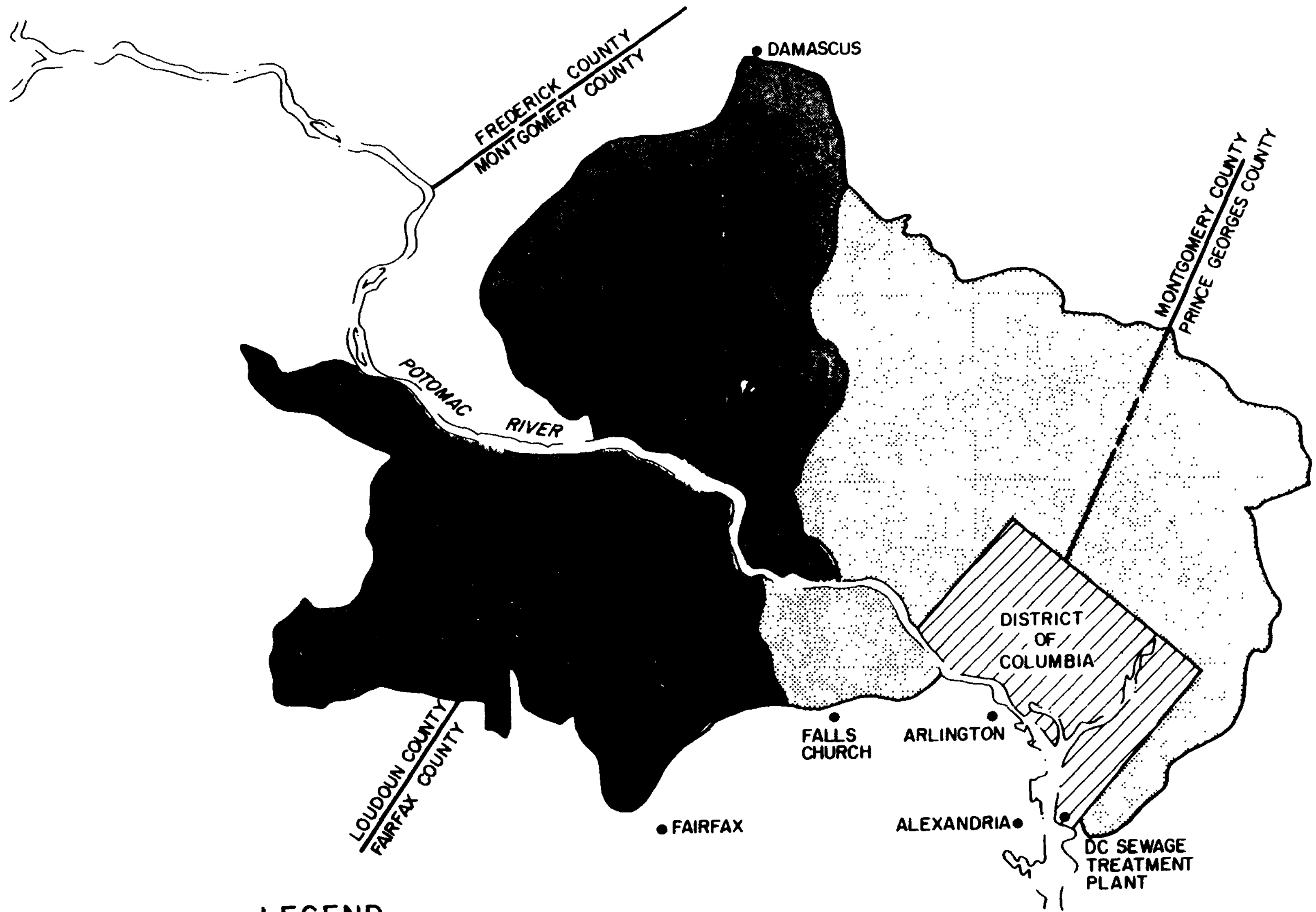
A series of agreements dating back to the 1950's defined the arrangements for allocating among the user jurisdictions the treatment and transmission capacity and the capital costs for wastewater treatment and solids management for the sludge generated at Blue Plains.

Two primary agreements dictate the present sludge management practices and preferred option for the planning period.

- *The 1984 Sludge Memorandum of Understanding; and,*
- *The 1985 Intermunicipal Agreement (IMA).*

The 1984 Sludge Memorandum of Understanding provided the mechanism for awarding five-year contracts for the hauling and disposal of sludge from Blue Plains. The contracts will continue in effect until the permanent sludge disposal facilities at Blue Plains are constructed and accepted by the District of Columbia for operation. The IMA, which was signed by the District of Columbia, Washington Suburban Sanitary Commission (WSSC) and the Counties of Fairfax, Montgomery and Prince George's, established the framework for future allocation of capacity at the Blue Plains facility and assigned responsibility for long-term sludge management.

The wastewater treatment plant currently has the capacity to provide advanced treatment at peak flows of 585 mgd with an additional 289 mgd of primary treatment and disinfection, thus providing a total peak flow capacity



LEGEND

AREAS FOR WHICH POTOMAC INTERCEPTOR WAS DESIGNED

OTHER AREAS IN MD AND VA TRIBUTARY TO DC PLANT

DISTRICT OF COLUMBIA

SOURCE: DISTRICT OF COLUMBIA STP BROCHURE

DISTRICT AND SUBURBAN AREAS TRIBUTARY TO DC SEWER SYSTEM

PLATE 1.1

of 874 mgd. Wastewater solids management has become increasingly more difficult as solids production increases with higher levels of wastewater treatment required by the facility's NPDES Permit and continuing population growth in the region. The Blue Plains treatment facility currently generates approximately 1,500 wet tons per day (WTPD) or 300 dry tons per day (DTPD) of dewatered raw sludge and 500 WTPD (100 DTPD) of dewatered digested sludge which must be disposed of or recycled. Methods of processing, recycling, and disposal currently in use include composting, compost distribution, and land application. The recycling and disposal methods in use require bulk hauling of lime stabilized raw and digested solids from the treatment plant. The District has discontinued the practices of co-composting and chemical fixation of sludge.

1.2.1 Wastewater Treatment

A historical chronology of events of wastewater treatment and solids management at the Blue Plains Wastewater Treatment Plant appears in Table 1.1 at the end of this chapter. The District of Columbia wastewater system has been in existence for approximately 170 years. During the first 125 years, the wastewater system functioned as a collector of sewage and stormwater and as a conveyor of these wastewaters to the nearest waterway for discharge without treatment. The practice of discharging untreated sewage directly to local waterways and increasing District population created a dramatic increase in water pollution and concern for public health by 1860. To improve the local water pollution conditions, many sewer discharge points were combined and relocated to the southern extreme of the District and were separated in certain areas by the District between 1870 and 1930. During the early 1930's the District determined that wastewater treatment was required prior to discharge in order to control the degree of pollution present in the Potomac River.

Construction of a wastewater treatment plant at the Blue Plains site within the District began in 1935 and was completed in 1938. The plant was initially designed to treat an average daily flow of 130 mgd from 650,000 people. The treatment process consisted of grit removal, grease separation, and sedimentation. Wastewater solids (sludge) produced by the treatment process were digested, elutriated, and dewatered prior to use as a soil conditioner. By 1951, the plant was expanded to 175 mgd to eliminate existing capacity problems and provided treatment capabilities for a design population of 975,000 people. This expansion provided additional sedimentation and digestion tankage.

With deteriorating water quality conditions again being observed in the Potomac River as the regional population increased, the District began planning for secondary treatment. Concurrently, pre- and post-chlorination facilities and a drying-incineration system were constructed at the plant between 1951 and 1953. The secondary treatment expansion was completed in 1959. Completion of this project increased the plant treatment capability to an average daily flow of 240 mgd with 75 percent removal efficiency of influent biochemical oxygen demand (BOD_5) and suspended solids.

Planning for the next plant expansion to process flows up to 309 mgd began in 1968. The upgrade plan provided for 90 percent removal efficiency of BOD_5 and suspended solids. Subsequently, the Federal Water Quality Administration, which later became part of the EPA, set the District's discharge limits in 1969 at 309 mgd annual average daily flow; 5 mg/l BOD_5; 0.22 mg/l phosphorus; and 2.4 mg/l total nitrogen. These limitations required the District to reevaluate the 1968 proposed expansion plan and initiate research programs to develop cost effective methods of meeting the discharge limitations. In 1975, denitrification was deferred; the remaining construction projects were completed in late 1982 providing primary treatment capacity of 874 mgd at peak flow, 585 mgd of peak flow secondary treatment along with a nitrification system, and a new combined multimedia filtration and chlorination facility.

1.2.2 Wastewater Solids Management

Wastewater solids management at the District of Columbia Blue Plains Wastewater Treatment Plant has developed and become more complex with each expansion of the plant. Initially, the digested dewatered solids were land applied to improve soil characteristics and provide necessary plant nutrients. The sludge land application users at this time consisted of three basic groups:

- *The largest quantity was distributed at no cost to the general public, truck farmers and homeowners for land application;*
- *Government facilities used dewatered sludge mixed with soil and lime to form a soil conditioner for use in landscape projects;*
- *The District land applied the sludge at its penal institution farms in Lorton, Virginia.*

This method of solids management was effective until around 1960 when biological sludge began to be produced by the new secondary treatment process.

In the early fifties a sludge incineration/drying building was constructed at Blue Plains which housed three flash dryer-incinerators. The dried product caused frequent dust explosions and the facility was abandoned because it failed to pass acceptance tests.

Between 1960 and 1970 little progress was made in establishing an effective solids processing and disposal program to manage the increasing sludge volumes. As the sludge production exceeded the demand for land application material, the practice of stockpiling sludge on site was instituted. During this time District public health regulations were adopted that required the sludge to be cured for one year, air dried, and mixed with soil prior to giving it to the general public. Also, summer hauling of sludge was not allowed because of excessive odor problems. These factors resulted in a constantly increasing inventory of stockpiled sludge which is prominent in 1968 photographs of the plant site. The stockpiled sludge was removed in 1970 under an excavation contract for expansion of the advanced treatment facilities. The expansion project included a new solids processing building large enough to contain dissolved air flotation thickeners, vacuum filter dewatering units, and space for multiple hearth incinerators.

The District needed an interim solids handling program until the new solids processing building could be completed; thus discussions with the other user jurisdictions began. In 1971, an Interim Treatment Program Agreement was executed which required plant effluent quality upgrading through chemical addition. Under the agreement, the WSSC was responsible for excess raw sludge disposal. As a result, the Maryland Environmental Service (MES), as an agent of the WSSC, implemented the following sludge disposal programs:

- *Sludge trenching in Montgomery and Prince George's Counties; and,*
- *Sludge drying with a toroidal dryer at Blue Plains.*

After several years of operational problems, strong public and political opposition and the development of local regulations which made new sites unavailable, the sludge trenching program ended. Thus, the Maryland Department of Health and Mental Hygiene stopped permitting sites for trenching of dewatered sludge.

Maryland Environmental Service contracted with Organic Recycling for the operation of the sludge drying project. The drying process was never completely successful due to the sludge characteristics which resulted in a product with a high dust component. Additionally, the air pollution controls on the system were never sufficient to meet the District's regulations. This ultimately led to the termination of the project.

The Blue Plains Sewage Treatment Plant Agreement of 1974 resulted from further wastewater solids disposal discussions. Under the 1974 agreement, user jurisdictions were responsible for their share of sludge disposal, based on their allotted flow, until a regional sludge program would be operational in 1977. During the agreement development period it was assumed that the incinerators would be operational by 1977. However, EPA directed deferred incinerator installation in 1975 because of high energy costs and other related concerns. While the agreements were being reached, approximately 150 DTPD of sludge were being applied to marginal and agricultural lands in Maryland and aerated static pile composting was developed at the Department of Agriculture's Beltsville Research Center in Maryland.

In 1976, the District proposed a new plan which involved construction of an interim composting facility at Oxon Cove, Maryland and the redesign of the Blue Plains combustion system with heat recovery. Based on this plan, the 1974 Agreement interim deadline was extended to 1978. In addition, a compost marketing study completed in 1977 indicated there was a potential market for finished compost in the region. However, the Oxon Cove compost facility project proposed to handle 120 DTPD, was cancelled in 1978 as the result of strong local opposition to the project.

The Federal District Court issued a two-part Order to the District, the WSSC and the Blue Plains user jurisdictions when the Oxon Cove facility was cancelled. The Order required the District to begin composting on-site at Blue Plains and the WSSC to construct a composting facility at Site II near Calverton, Maryland. Subsequently, WSSC had to shift its initial composting activity to an interim facility located in Dickerson, Maryland until local opposition to Site II was resolved in the court system and construction was completed.

The new Blue Plains solids processing building, initially proposed around 1970, was completed in the summer of 1978. Although the incineration units were not installed, the building shell and necessary structural foundations were constructed under the contract work.

Lacking a long-term solids disposal solution, the District continued to evaluate alternatives. An overview study of management options recommended dewatering the solids on filter presses, mixing it with refuse-derived fuel (RDF), and incinerating the mixture in on-site incinerators with heat recovery boilers (JRB Associates, 1979). The District decided not to implement the study recommendation because the EPA requested that a comprehensive feasibility study be performed.

The concept of shipping composted material to the Caribbean Islands for use in soil restoration was evaluated but never developed beyond the planning stages due to lack of U.S. Department of State and Caribbean governmental support.

During the later part of 1970, the District contracted with a group holding a license for the Dano drum composting system to develop an offsite sludge and solid waste composting system using barge transport from Blue Plains to a downriver site in King George's County, Virginia. However, local opposition in King George's County stopped the issuance of a building permit and this project also died.

In 1980, a second contract was structured with Dano to construct an on-site drum co-composting system using space in the denitrification area at the wastewater treatment plant site at Blue Plains. The contract supported a demonstration phase followed by a full operational phase. The demonstration facilities (200 tons per day) were constructed, operations initiated, and from 45,000 to 50,000 tons of product were generated. However, product was poorly composted, contained obvious refuse debris and was unmarketable. Attempts to dispose of the product in Virginia and West Virginia were thwarted by water quality regulators. The contract was therefore terminated, leaving the District with the disposal of the entire inventory.

The District then awarded a contract to Chem-Fix for the use of the processed sludge as a sanitary landfill cover material. When this procedure failed, Chem-Fix elected to switch to land application, which was successfully implemented through the duration of the contract.

During 1980, the Maryland Department of Health and Mental Hygiene required Prince George's County to implement alternative sludge disposal methods for its allotted quantity of Blue Plains sludge. The County determined that aerated static pile composting was the best alternative. Under the direction of the WSSC, the Maryland Environmental Service (MES) constructed the Western Branch Compost Facility in Prince George's County designed to process 1,000 WTPD (200 DTPD) adjacent to an existing wastewater treatment plant.

The facility was forced to start operation at 350 WTPD (70 DTPD) before the construction work was completed and within four months, the tonnage went to 1,000 WTPD (200 DTPD). This increase resulted from the Maryland Health Department's action to prohibit landspreading of sludge at several locations because of public opposition. Overloading the uncompleted facility resulted in operational problems and strong odors. The public demanded that the facility be closed. After construction was completed, the facility reopened at 350 WTPD (70 DTPD), but continued public pressure due to odor problems forced the permanent closing of the Western Branch site at the request of the Prince George's County Government. (19)

Montgomery County was also required to implement sludge disposal alternatives and likewise determined that aerated static pile composting provided the best solids management option. To comply with the 1978 court order for construction of the Site II Compost Facility and because of construction delays, the Dickerson Composting Interim Facility was built. Designed and constructed by MES, it was completed at the same time sludge trenching was discontinued. Dickerson was operated under an agreement with a local citizens group that called for the closing of the facility when Site II opened.

In 1981, Amendment No. 4 to the Blue Plains Agreement was drafted and set forth a new schedule for planning. The Agreement called for a long-term centralized sludge facility at or near Blue Plains to be operational by the end of 1987 and listed the quantity of sludge to be disposed of by the user jurisdictions in the interim period. The sludge quantity distribution no longer represents current conditions. Concurrently, the operational control of the I-95 Lorton Landfill owned by the District has been shifted to Fairfax County, Virginia.

Between 1982 and early 1986, the solids disposal program was moving in a number of directions. As mentioned earlier, the Dano co-composting and the chemical fixation on-site sludge projects, started in the early part of the 1980's, were terminated. Both demonstration projects failed to produce a final sludge product that could be effectively recycled, marketed or otherwise disposed of within the region. The WSSC stopped composting at the

Western Branch facility and began land application of about 350 WTPD (70 DTPD) of Prince George's County's allocation. The interim Dickerson compost facility was also closed with the start-up of the Site II Compost Facility in 1983. The Site II facility is now known as the Montgomery County Compost Facility (MCCF).

In May, 1984, the 1981 Amendment No. 4 to the Blue Plains agreement was superseded by a regional Memorandum of Understanding between Blue Plains and the WSSC. The 1984 Memorandum established a unified regional approach for disposing of sludge generated at the Blue Plains facility. Under this Memorandum, the parties agreed to jointly solicit and enter into contracts for the hauling and disposal of sludge from Blue Plains. The Memorandum was based upon the assumption that the contracts would be an interim solution to sludge management at Blue Plains. In addition, the Memorandum provided that 400 WTPD of sludge would be composted at the MCCF - Site II.

Since the IMA was reached in 1985, sludge in excess of the Montgomery County composting facility operating capacity is being managed under two contracts as a generic Blue Plains sludge. The JABB (Jones & Artis Construction Company, BioGro, and Bevard Brothers) contract covers raw sludge composting and raw and digested sludge land application. The ADEM (AD+Soil, EnviroGro, and MTI Construction Company) contract covers raw sludge land application. At this time, approximately 360 WTPD (72 DTPD) of sludge is being composted by the aerated static pile method on-site while the WSSC is composting about 200 WTPD (40 DTPD) at the MCCF. The MCCF is not currently operating at its 400 WTPD (80 DTPD) design capacity because of strong local opposition and odor complaints. Based on extensive study by WSSC, compost pad enclosure, exhaust air scrubbing, and dilution air fans have been added to the MCCF and are minimizing problems with odor. Upon completion of the modifications, it is expected that operations at the MCCF will resume at 400 WTPD. The remaining 600 to 700 WTPD (120-140 DTPD) of sludge are being successfully land applied. The current disposal practices are to continue until a decision is made on the selection of a long-term sludge management program.

1.3 EXISTING FACILITIES

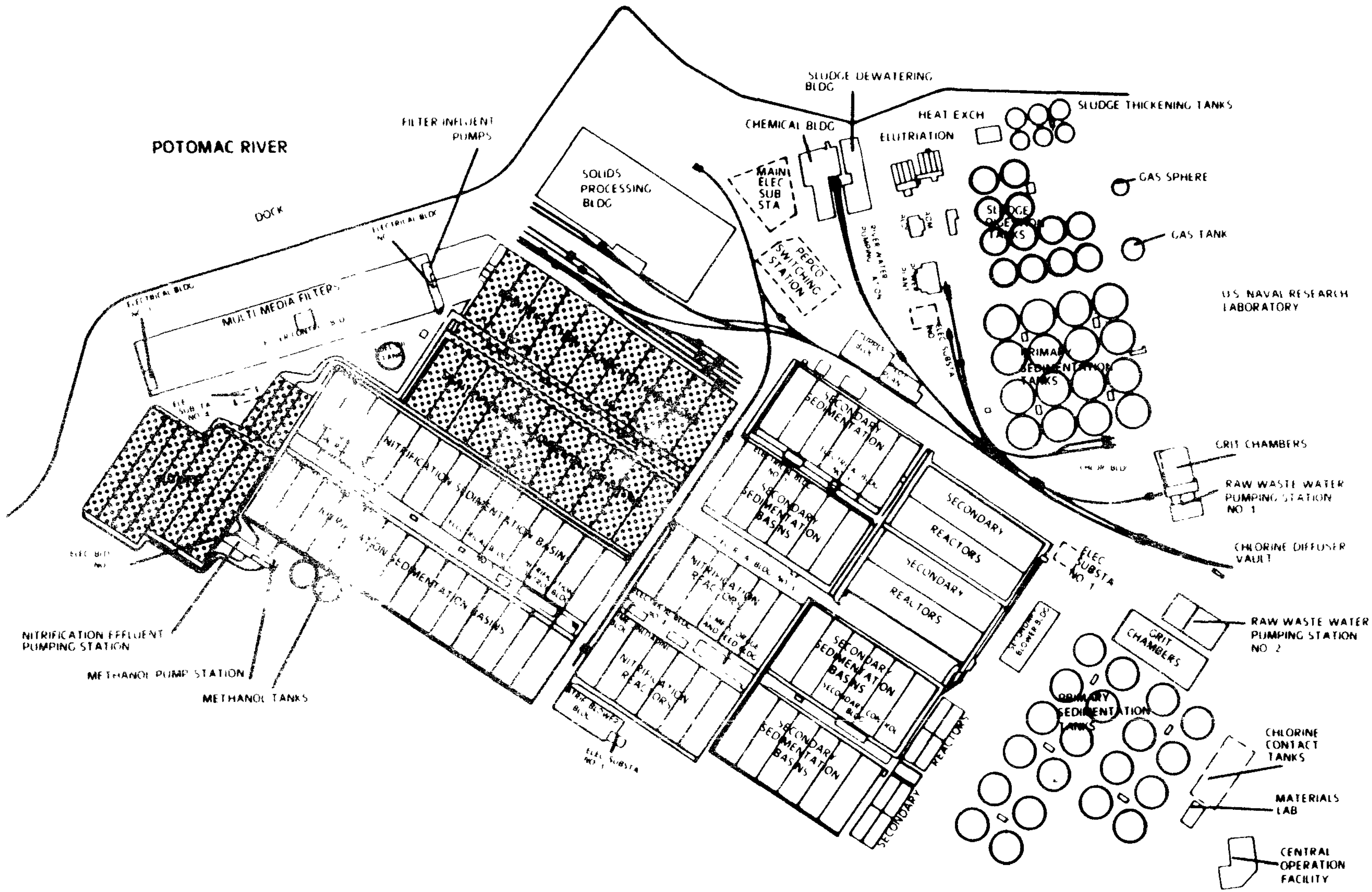
1.3.1 Wastewater Treatment

The Blue Plains Wastewater Treatment Plant processes include primary treatment, secondary treatment, nitrification, multimedia filtration and chlorination. The primary and secondary treatment systems are divided into independent east and west process trains. The existing layout of treatment plant units is as shown in Figure 1.1. The areas where the denitrification sedimentation and future basins shown here have not been constructed. These areas are currently being used for the composting operation and will be modified for the in-vessel facility and swing sedimentation basins.

Head works processing before primary treatment consists of screening, pumping, and grit removal. Thirteen mechanically cleaned bar screens with one-inch clear openings are used to screen wastewater. The screens have a design capacity of 1,300 mgd. The pumping stations contain 15 pumps with a total pump capacity of 1,300 mgd. Grit, which primarily enters through the combined sewer portion of the collection system, is removed in aerated grit chambers. The chambers are designed to provide a detention time of 3.4 minutes at a flow of 673 mgd with 10 of 16 units in service.

After the grit is removed, the wastewater flows to the primary treatment section of the plant. The primary treatment section consists of 16 clarifiers in the west train and 20 clarifiers in the east train. At maximum flows, the primary clarifiers provide one hour of detention time.

Nonsettleable solids and soluble organics not removed in the primary treatment units flow into the secondary treatment section for further processing. Secondary treatment is accomplished by the air-activated sludge process in four aeration tanks in the east train and two aeration tanks in the west train. The aeration tanks provide a detention time of two hours at a flow rate of 309 mgd. An iron salt is added to both primary and secondary process flows for phosphorus removal. There are 24 secondary sedimentation tanks which provide an average detention time of 2.7 hours for the sedimentation process.



Blue Plains Waste Water Treatment Plant

District of Columbia

SOURCE DISTRICT OF COLUMBIA STP BROCHURE

Existing Composting Area

See Figure 2.10 for Proposed use of Denitrification Basin Area

FIGURE I.1

Following secondary sedimentation, the wastewater is conveyed to the nitrification reactors for tertiary treatment. Biological nitrification converts ammonia nitrogen to nitrate nitrogen in 12 aeration tanks that provide an average detention time of about four hours. There are 28 nitrification sedimentation basins that provide an average detention time of 4.5 hours.

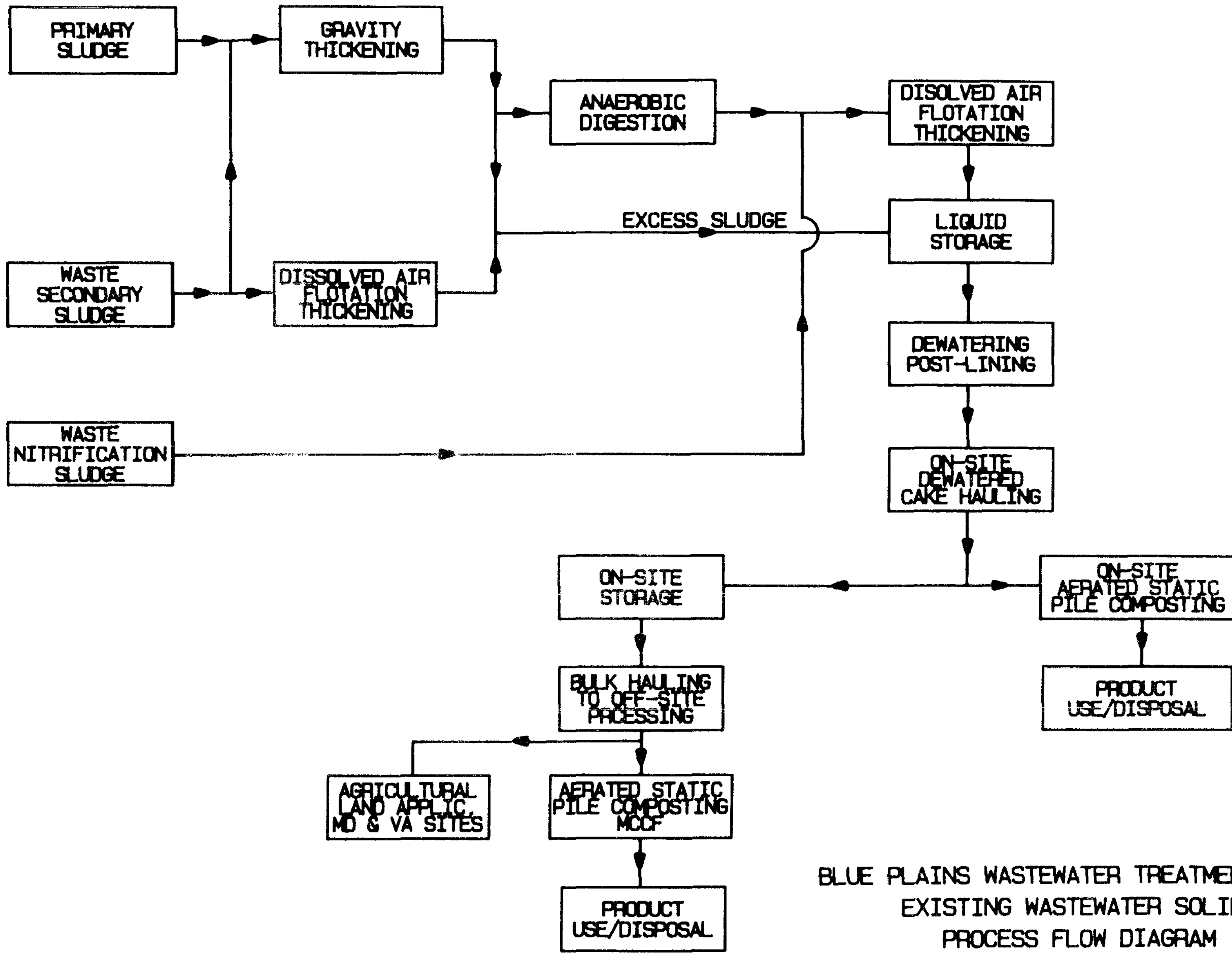
The final stage of wastewater treatment consists of multimedia filtration and chlorination of the nitrification system effluent. Filtration is accomplished through the use of 36 multimedia gravity flow filters and prechlorination of the filter feed is practiced to increase filter run time. Four chlorine contact tanks are located below the filters to provide proper disinfection. The contact tank detention time at average flow is approximately 48 minutes prior to discharge into the Potomac River. The ability to dechlorinate the effluent will be provided when current construction work on the dechlorination process is completed.

1.3.2 Wastewater Solids Treatment

1.3.2.1 Blue Plains

Wastewater solids generated at Blue Plains as the result of wastewater treatment undergo further processing prior to disposal. Solids processing includes thickening, anaerobic digestion, blending, dewatering, and on-site aerated static pile composting. A flow diagram showing the present solids treatment management system is shown in Figure 1.2 and the unit processes are described below. Dewatered sludge which is not processed further on-site is stored until it can be bulk hauled to off-site processing facilities.

Thickening of the wastewater solids after clarification is accomplished with the use of gravity and dissolved air flotation thickeners. There are six gravity thickening units that are generally used for primary sludge thickening but also have the operational flexibility of accepting activated sludge for thickening. The gravity units produce a thickened sludge containing about seven percent solids. The waste secondary sludge is thickened by



BLUE PLAINS WASTEWATER TREATMENT PLANT
EXISTING WASTEWATER SOLIDS
PROCESS FLOW DIAGRAM

FIGURE 1.2

18 dissolved air flotation units which produce a thickened sludge of four to six percent solids. After the separate thickening of primary sludge and waste activated sludge each can be pumped either to the digesters or blending tanks. Generally, 60 percent of the thickened primary is sent to the digestion system and excess thickened primary and biological sludges are pumped to the blending tanks.

There are 12 anaerobic digesters, each having a liquid volume capacity of approximately one million gallons. Approximately 100 dry tons of solids are digested daily and the daily output averages 60 dry tons of solids with a typical sludge concentration of three percent solids. Methane gas produced during digestion is stored in two gas storage tanks and used for maintaining the process or heat. Excess gas is flared when the storage tanks are full.

Following anaerobic digestion, the digested sludge and waste nitrification sludge are combined and thickened by dissolved air flotation to improve dewatering. Four dissolved air flotation units are used for this thickening process and polymer is used in the process to improve the solids capture rate. The units produce a sludge with a solids concentration of approximately seven percent.

Prior to dewatering, the digested-waste nitrification sludge and excess nondigested thickened sludge may be stored in one of four 300,000 gallon blending tanks. Two of these tanks are currently used for lime slurry storage. Digested-waste nitrification sludge is stored in one of the remaining two tanks while nondigested (raw) sludge is kept in the other.

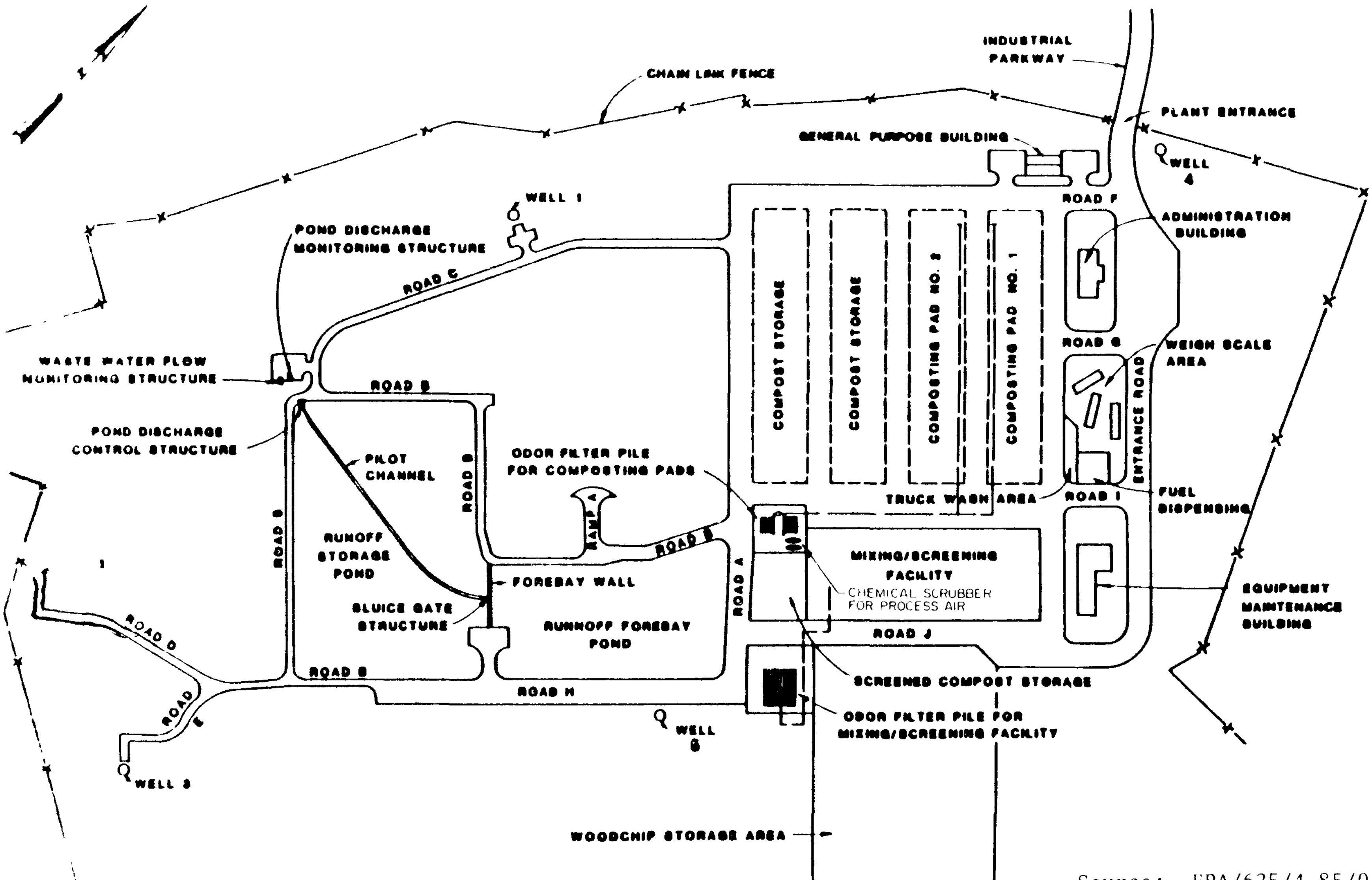
Sludge dewatering is done on 24 vacuum filters and one centrifuge. The nondigested raw sludge is dewatered on 15 of the vacuum filters with typical conditioning chemical doses of 34 percent lime and eight percent ferric chloride. The remaining nine filters or one centrifuge are used to dewater the digested-waste nitrification sludge. Digested-waste nitrification sludge dewatering usually consists of polymer conditioning with centrifuge dewatering followed by post-liming. The back-up method of operation includes lime and ferric chloride conditioning with vacuum filter dewatering. Once dewatered, the sludge is conveyed to a truck loading area for transport to the on-site composting operation or storage area.

At the present time, about 360 WTPD (72 DTPD) of dewatered sludge are being composted on-site using the aerated static pile method. Mixing, composting, and curing are done in the areas reserved for future and denitrification tank construction. Woodchip and sludge mixing is done with a four-wheeled horizontal auger mixer. Wheeled loaders with 10 cubic yard buckets are used for compost pile construction and localized material moving. Screening and final compost storage areas are located in an adjacent area also reserved for future tank construction. Operation of the on-site compost facility is managed under the JABB contract. Compost produced on-site which meets established quality standards is available for use regionally and the remaining unused compost is recycled.

1.3.2.2 Off-Site Processing

Dewatered sludge that is not composted at the Blue Plains facility is stored on-site until it can be loaded on trucks for bulk hauling to off-site disposal locations. Approximately 800 to 900 WTPD (160-180 DTPD) of dewatered sludge are transported off-site to be further processed under two basic programs. WSSC composts approximately 180 to 200 WTPD (36-40 DTPD) at its 30 acre MCCF site. The facility layout as originally constructed is shown in Figure 1.3. The compost facility has a design capacity of 400 WTPD (80 DTPD), but is operating at a reduced level until public concerns related to odor are resolved.

Dewatered sludge transported by trucks to the MCCF is unloaded in the mixing building. Wood chips are mixed with the sludge using a roto-shredder and front-end loaders. The mixture is composted for 21 days on pads one and two which are in a fixed roof building with movable curtain side walls. The aeration building in its current configuration has been constructed to control odors being generated on site. The 15 horsepower aeration blowers discharge into a main header system that conveys the air to a two-stage scrubber and dispersion fan odor control system. The scrubber



Source: EPA/625/4-85/014

Facility Layout
Site II Montgomery County Composting Facility
Washington Suburban Sanitary Commission

FIGURE 1.3

system replaces the large odor filter piles which were unsuccessfully used during facility start-up. After aeration, the compost is screened on three vibrating deck screens with dust control hoods and cured for an additional 30 days under positive aeration prior to product distribution. The Maryland Environmental Service under agreement with WSSC markets all of the compost produced at the MCCF in the regional area.

The remaining 600 to 700 WTPD (120-140 DTPD) of sludge are currently being land applied at permitted sites in Maryland and Virginia. Typically, dewatered sludge is transported from Blue Plains to several permitted sludge lagoon facilities for storage prior to land application. The contractors have permitted sludge storage capacity for approximately 100,000 cubic yards of solids within the regional area. The sludge is transported from the storage facilities to permitted agricultural fields and applied at rates to meet crop nutrient requirements in accordance with specific state regulated procedures. There are about 22,700 acres of land in Maryland and 47,200 acres of land in Virginia permitted for use in the Blue Plains land application program.

1.4 EXPANSION AND UPGRADING PLANS

In July, 1984 the District completed a long-term sludge study (Camp, Dresser and McKee (2)) to evaluate sludge disposal alternatives in the region. The study recommended the following solids management plan:

- *On an initial feed basis incineration of approximately 50 percent (180 DTPD) of the sludge with heat recovery;*
- *In-vessel composting of approximately 23 percent (83 DTPD) of the sludge on site;*
- *Composting about 27 percent (97 DTPD) of the sludge at the MCCF - Site II.*

The recommended plan was based on a total sludge production of 350 to 360 DTPD at a flow of 309 mgd and projected future sludge production around 500 DTPD at a flow of 370 mgd. Under the recommended plan the District would dispose of the incinerator ash at the Lorton Landfill and the WSSC would be responsible for marketing all of the compost produced.

In 1985, the Blue Plains Intermunicipal Agreement (IMA) was developed and adopted by the District of Columbia, the Counties of Fairfax, Montgomery, and Prince George's, and the Washington Suburban Sanitary Commission. This Agreement was prepared for the purpose of upgrading Blue Plains and related sludge management facilities. The purpose of the intermunicipal agreement included the following:

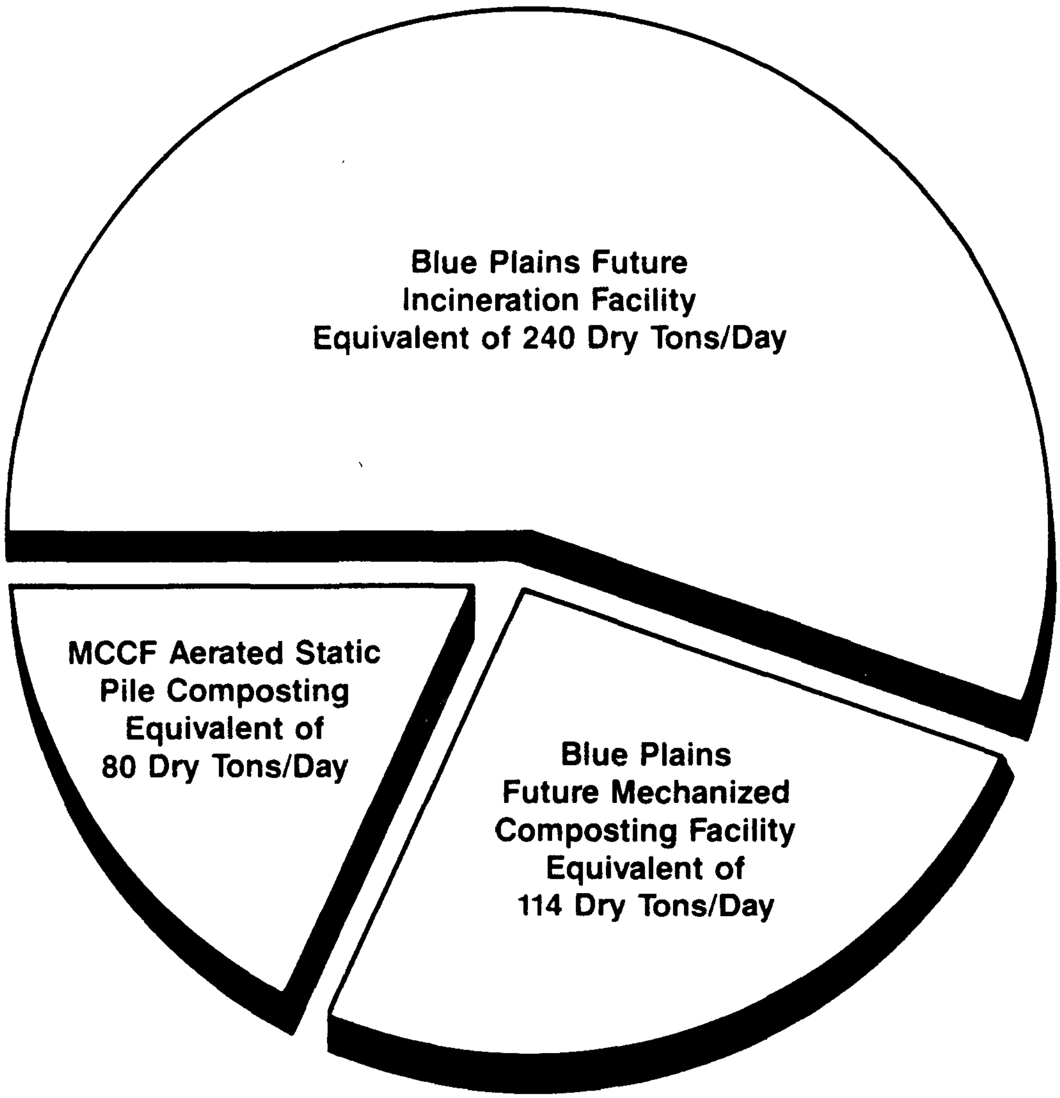
- *Supporting expansion of the Blue Plains Wastewater Treatment Plant to 370 mgd;*
- *Allocating the Blue Plains wastewater treatment capacity in accordance with projected 2010 needs;*
- *Equitably allocating the capital costs of wastewater treatment and sludge management;*
- *Equitably allocating the operation and maintenance costs;*
- *Defining responsibilities of sludge management;*
- *Defining the process of making future planning decisions;*

- o *Providing a mechanism for continuing coordination, cooperation and communication; and,*
- o *Supporting a continuing water quality monitoring and evaluation program.*

The Agreement addresses interim, and future Blue Plains sludge management in Section 5. On an interim basis all sludge produced at the treatment plant will be processed and disposed of under the contracts (ADEM, JABB, see below) awarded by the District in 1984, as amended, and the 1984 Sludge Memorandum of Understanding, as amended. The WSSC, for Montgomery County, is responsible for disposing of 80 DTPD of sludge from Blue Plains at the MCCF or by other alternatives for the agreement term. The District agreed to construct new dewatering and mechanized composting facilities and rehabilitate the digesters. The mechanized composting proposal is to process the equivalent of 114 DTPD of sludge at Blue Plains. A future incineration facility capable of processing 240 DTPD of sludge was proposed to be constructed by the District contingent upon EPA project approval. The equivalent amounts of sludge to be managed under the IMA are shown in Figure 1.4.

The IMA also establishes responsibilities for residuals management and operational contingency provisions for the sludge management system. The WSSC is required to remove an equivalent of 114 DTPD of cured sludge compost which meets specifically defined quality standards in the agreement from the Blue Plains site. Marketing, distribution, and sale of all compost produced is the responsibility of the WSSC. Ash, screenings, and grit were to be disposed of at the I-95 Landfill in Lorton, Virginia. If the sludge facilities at Blue Plains are inoperable for other than normal repair and maintenance or abandonment, the WSSC, in conjunction with Montgomery, Prince George's, and Fairfax Counties, will be responsible for removing and disposing up to 240 DTPD of sludge from Blue Plains until the situation is mutually resolved. In addition, the WSSC and the Counties agreed to secure emergency sludge disposal services which are to become active when the incinerators are started up. These emergency disposal services are to be available for use within three days after notification of need.

Responsibilities of Sludge Management as Defined in the Intermunicipal Agreement of 1985



SOURCE Blue Plains Intermunicipal Agreement. 1985

FIGURE 1.4

In 1985, Engineering-Science, Inc. initiated a series of studies to develop concept designs; technical, economic and air quality evaluations of the concept designs; and a recommended design and air permitting strategy as part of the District's long-term sludge management plan. The following scheme was developed in the concept design:

- *Mechanical composting of 123-132 dry tons of sludge per day at Blue Plains;*
- *Composting 87.5 dry tons of sludge per day at the Montgomery County Composting Facility; and,*
- *Incinerating an annual average of 200 dry tons of sludge per day and 384 peak month dry tons of sludge per day at Blue Plains.*

The above information is presented in Figure 1.5.

TABLE 1.1

A CHRONOLOGY OF EVENTS AT THE BLUE PLAINS PLANT

Year	Month	Events
1935-1938		Construction of primary treatment plant at Blue Plains. Designed for 309 mgd.
		Disposal by land application began shortly after the plant became operational.
1951		Plant expansion to treat 175 mgd.
		Land application continued.
1951-1953		Construction of pre- and post-chlorination facilities and a drying-incineration system at Blue Plains. Dryer abandoned.
		Land application continued.
1959		Plant expansion for secondary treatment.
		Land application continued.
1960		Stockpiling sludge at Blue Plains site.
1968		Upgraded secondary treatment to 309 mgd.
1970		Stockpiled sludge removed under a mass excavation contract.
1971		Interim Treatment Program Agreement. Greater dependence on land application under control of Washington Suburban Sanitary Commission (WSSC).
1973		Maryland Environmental Service implemented a sludge trenching program for WSSC.
1974		Blue Plains Sewage Treatment Plant Agreement. User jurisdictions responsible for share of sludge disposal.
		Proposed construction of sludge incinerators at Blue Plains to be operational by 1977.
1975		Incinerator installation deferred due to high energy costs.

TABLE 1.1 (Cont'd.)

A CHRONOLOGY OF EVENTS AT THE BLUE PLAINS PLANT

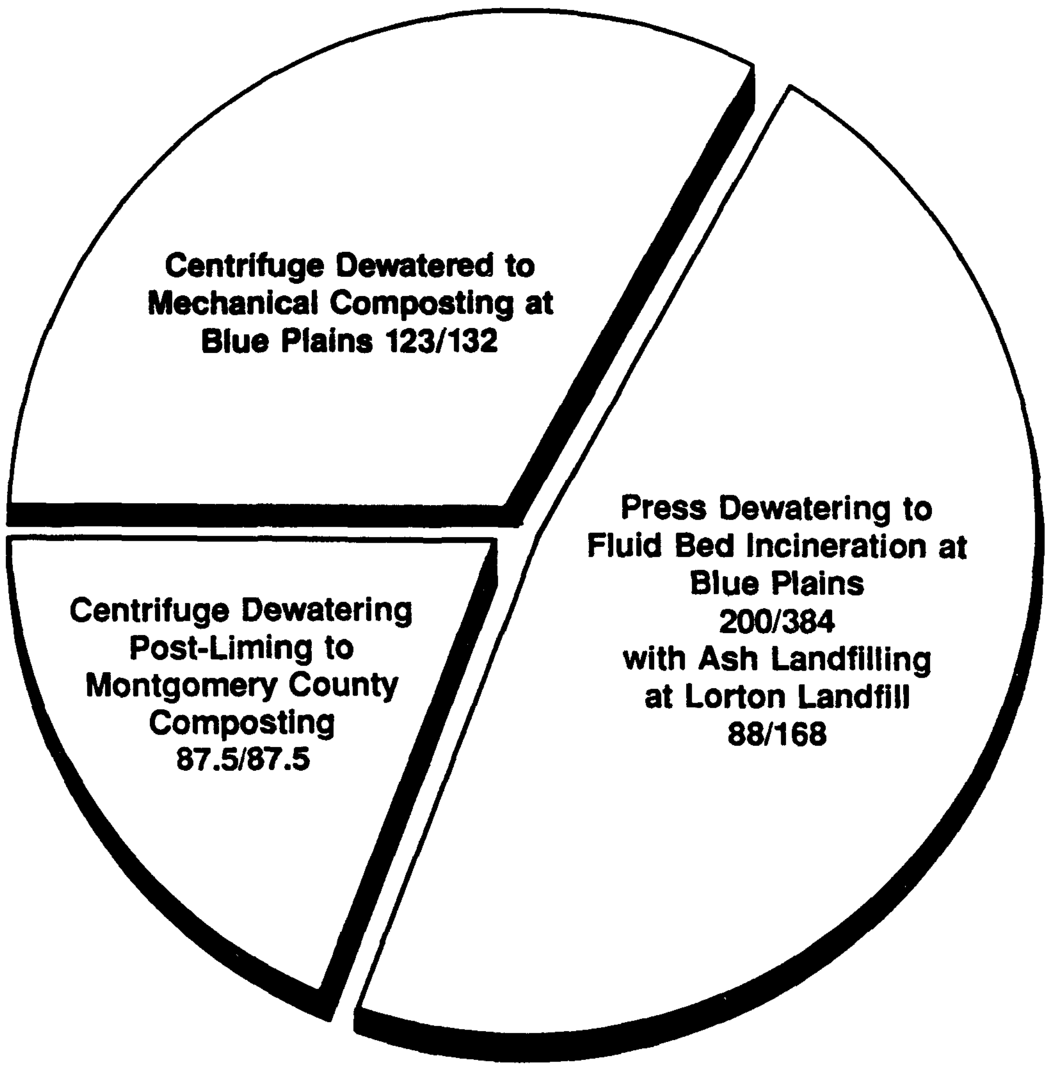
Year	*Month*	*Events*
		Land application continued and aerated static pile composting project began (Dept. of Agriculture, Beltsville Research Center, Maryland).
1976		*Oxon Cove Compost Facility in Maryland proposed.*
1977		*Marketing compost study concluded a compost market exists in region.*
		Oxon Cove Facility abandoned.
1978		*Federal District Court ordered the:* *o District to construct a compost facility at Blue Plains* *o WSSC construct compost facility in Montgomery County, Maryland (MCCF - Site II)*
		Solids processing building at Blue Plains completed.
1979		*Dano Resource Recovery Inc. composting operation at Blue Plains began.*
1980		*Maryland Department of Health and Mental Hygiene stopped permitting trenching sites for dewatered sludge disposal.*
		Maryland Environmental Service (MES) constructed the Western Branch Facility, Prince George's County.
		MES constructed Dickerson Composting Interim Facility in Maryland.
1981		*Amendment to Blue Plains Agreement:* *o Proposed central sludge facility* *o Listed quantity of sludge for disposal by user jurisdiction* *o Operational control of Lorton Landfill owned by District was shifted to Fairfax County, Virginia.*

TABLE 1.1 (Cont'd.)

A CHRONOLOGY OF EVENTS AT THE BLUE PLAINS PLANT

Year	Month	Events
1982		Advanced treatment: nitrification system and combined multimedia filtration and chlorination facility.
1982		Dano Resource Recovery Inc. composting operations closed.
		Western Branch Composting facility closed July 15.
1983		Interim Dickerson Compost facility closed.
		Start-up of MCCF - Site II
1984	May	Memorandum of Understanding between WSSC and Blue Plains to contract for hauling and disposal of Blue Plains sludge.
	July	Camp, Dresser and McKee completed "Sludge, Solid Waste, Co-Disposal Study" for the District recommending a long-term sludge disposal plan.
	August	Notice to Intent to prepare EIS.
	August	Findings of No Significant Impact (FONSIs) issued for composting portion of CDM plan.
1985	September	Blue Plains Intermunicipal Agreement.
1985-1986		Engineering-Science prepared sludge management studies for Blue Plains Facility. o Refer to list of ES reports in reference section. o Refer to Figure 1.5 for the sludge value designation used by ES for the fluidized bed incineration design for the District.

Proposed Long-Term Wastewater Solids Management Plan for Blue Plains Wastewater Treatment Plant



NOTE: Value Designation - Projected Average Annual Dry Tons of Sludge per Day/Peak Month Dry Tons of Sludge per Day.

SOURCE: Final Incineration System Concept Designs for the District of Columbia Wastewater Treatment Plant at Blue Plains (Task II-IOF) October 1986 Engineering Science

FIGURE 1.5

CHAPTER TWO

CHAPTER 2

DESCRIPTION OF SLUDGE MANAGEMENT METHODS

2.1 APPLICABLE METHODS

The proposed wastewater solids management plan as outlined in the 1984 Camp Dresser & McKee (CDM) Report calls for on-site in-vessel composting, off-site composting at the Montgomery County Composting Facility (MCCF) and incineration at Blue Plains. EPA has approved the composting portion of the plan (Finding of No Significant Impact, August, 1984), but has required that an EIS be completed for the incineration component. Sludge management methods considered, in addition to incineration, are:

- *No Action*
- *Land Application*
- *Composting and Compost Use*
- *Drying and Product Use*
- *Landfilling*
- *Ocean Disposal*

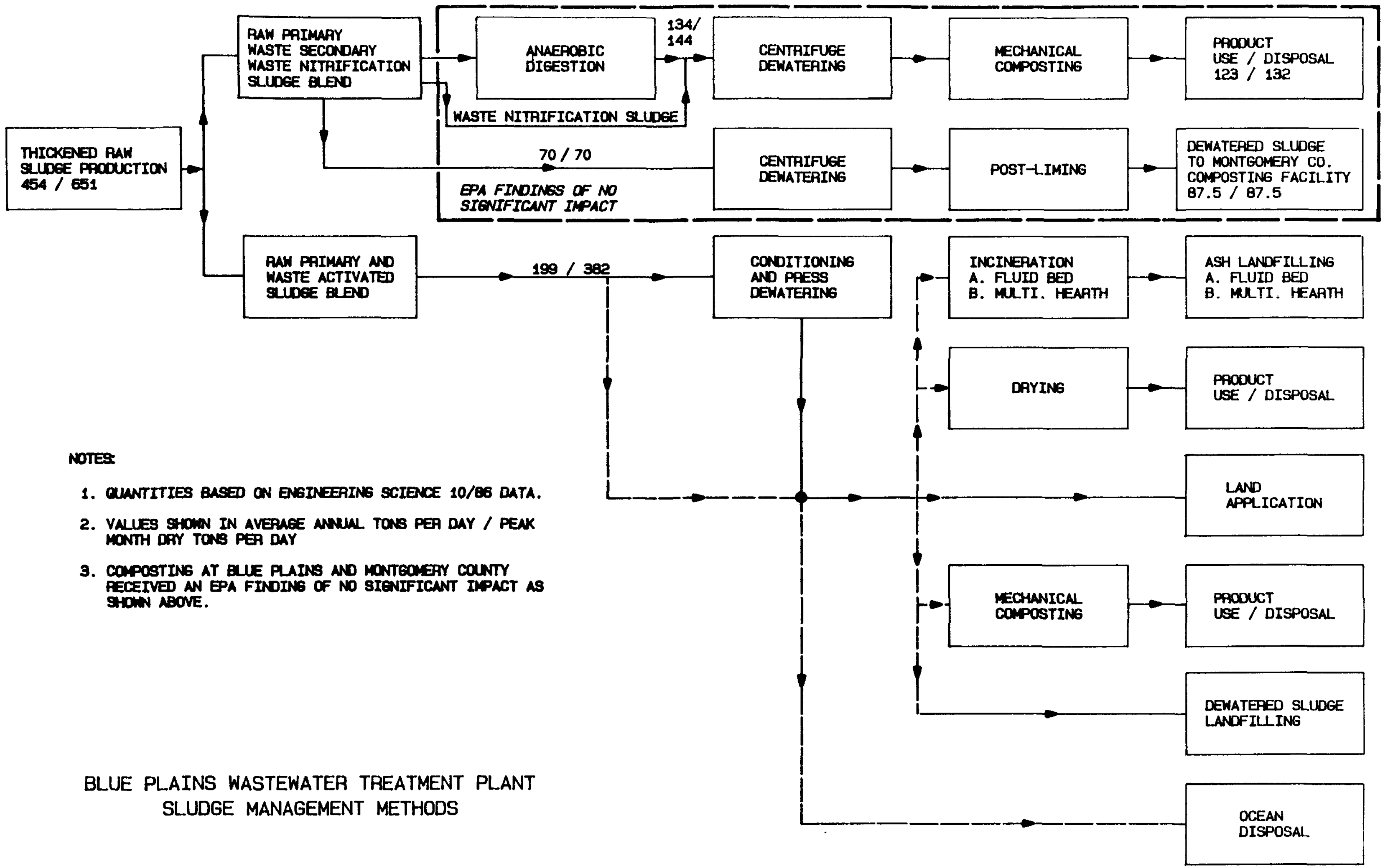
The management methods address only the estimated annual average 200 DTPD or peak month 384 DTPD proposed to be incinerated unless economies of scale or other factors indicate larger quantities are more suitable. Table 2 1 provides a summary of the process, site, and environmental concerns related to the management methods. In addition, a flow diagram of the long-term wastewater solids management alternatives and associated sludge quantities on a dry ton basis is shown in Figure 2.1.

TABLE 2.1

SLUDGE MANAGEMENT METHODS

Alternative	Process	Disposal Site	Environmental Concerns
INCINERATION/ASH LANDFILLING	Multiple Hearth; Fluidized Bed	Blue Plains STP and Lorton Landfill (Ash Disposal)	o Air emissions o Groundwater contamination o Scrubber water disposal o Particulate and ash disposal o Stack height
LAND APPLICATION OF DEWATERED SLUDGE	Surface Spreading and Subsurface Injection of Sludge	Agricultural/Reclamation Permitted Sites in Maryland and Virginia	o Food chain toxicity o Surface and groundwater contamination o Heavy metal and organic compound accumulation in soils
COMPOSTING/PRODUCT REUSE	Aerated Static Pile; In-Vessel	Blue Plains/DC Regional Market	o Odor emissions o Food chain toxicity o Surface and groundwater contamination o Heavy metal and organic accumulation in soils
DRYING/PRODUCT REUSE	Flash Drying Rotary Drying Paddle Dryer	Blue Plains STP/Lorton Landfill/Land Application Site	o Air emissions o Scrubber water disposal o Particulate disposal o Food chain toxicity o Surface and groundwater contamination o Volatile organic contamination o Heavy metal and organic compound accumulation in soils
LANDFILLING DEWATERED SLUDGE	Transportation to Disposal Site	(No Permitted Site Identified)	o Groundwater contamination o Volatized organic contamination
OCEAN DISPOSAL	Barge Transportation to Disposal Site	Atlantic Ocean (Sites to be located off continental shelf)	o Aquatic life toxicity o Human consumption of seafood o Effects of sedimentation on aquatic life
NO ACTION (1)			
o Land Application of Dewatered Sludge	Surface Spreading and Subsurface Injection of Sludge	Agricultural/Reclamation Permitted Sites in Maryland and Virginia	o Food chain toxicity o Surface and groundwater contamination o Heavy metal and organic compound accumulation in soils
o Composting/Product Reuse (FONSI)	In-Vessel	Blue Plains/DC Regional Market	o Air emissions o Food chain toxicity o Surface and groundwater contamination o Heavy metal and organic accumulation in soils

(1) Current sludge management program.



NOTES:

1. QUANTITIES BASED ON ENGINEERING SCIENCE 10/86 DATA.
2. VALUES SHOWN IN AVERAGE ANNUAL TONS PER DAY / PEAK MONTH DRY TONS PER DAY
3. COMPOSTING AT BLUE PLAINS AND MONTGOMERY COUNTY RECEIVED AN EPA FINDING OF NO SIGNIFICANT IMPACT AS SHOWN ABOVE.

BLUE PLAINS WASTEWATER TREATMENT PLANT
SLUDGE MANAGEMENT METHODS

FIGURE 2.1

2.2 NO-ACTION

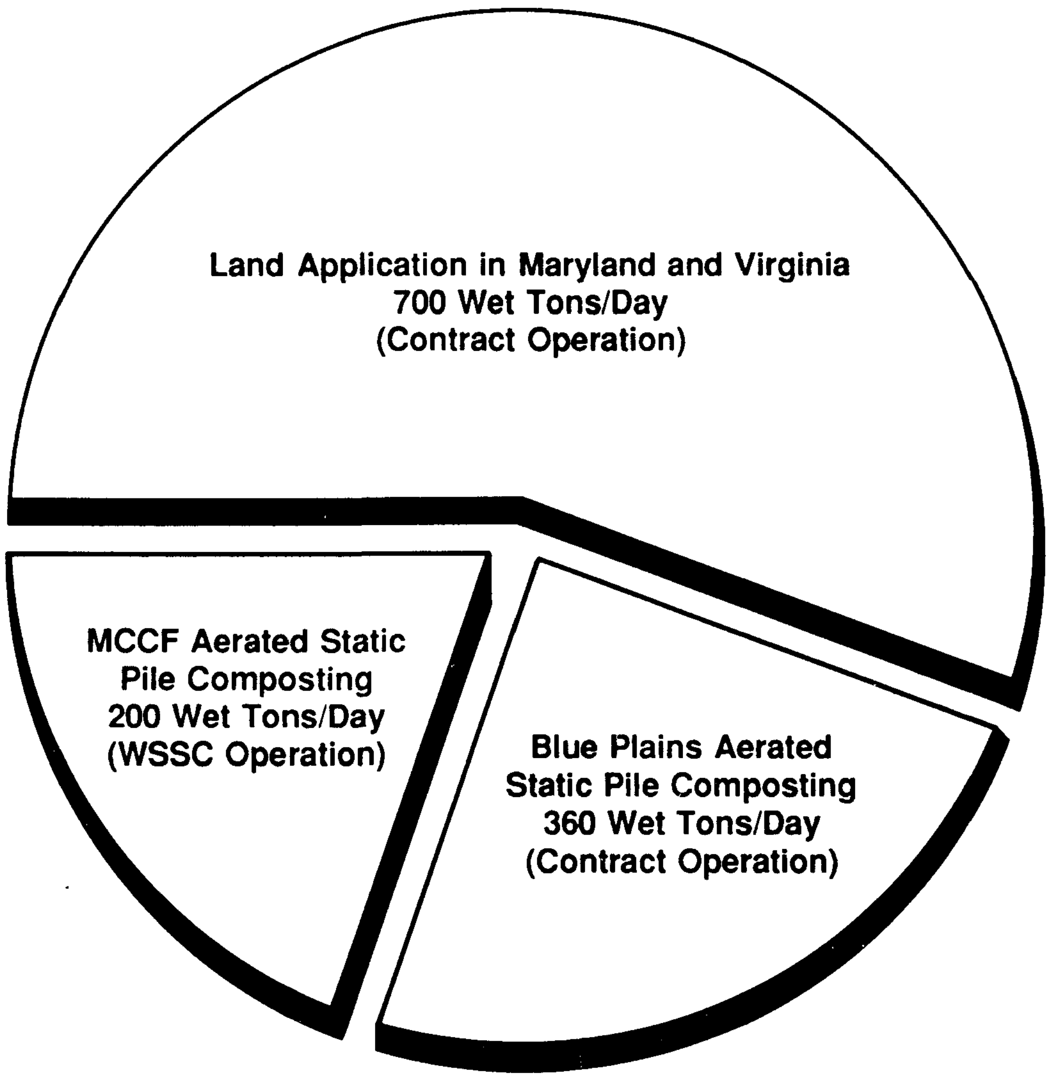
The use or disposal of sludge solids under a no action alternative would result in the use of the existing programs. Land application is the primary method of use or disposal at 55 percent of the solids, followed by Blue Plains composting at 29 percent, and composting at the MCCF at 16 percent on a wet tons basis. The use or disposal processes and approximate quantities of sludge currently being managed by each process are shown in Figure 2.2.

There is some capacity available to expand the existing methods of use or disposal. The MCCF is operating at 50 percent of its design capacity. Therefore, it could potentially process an additional 200 WTPD. The FONSIed in-vessel composting facility will replace the existing on-site aerated static pile system and increase the composting capacity to 123 DTPD (585 WTPD). In addition, utilization of the land application sites in Maryland and Virginia could be increased.

Increases in sludge management capacity would be minimized by imposition of a limit on new building construction and sewer connections in the area served by the collection system. The wastewater flow to the treatment facilities might be limited to the current capacity, and the resulting quantity of sludge generated limited.

Potential adverse environmental impacts from the no action alternative would be dependent on a number of singular or compounding events. If sludge quantities do not exceed the capacity of the current land application and composting programs, the level of any pollution would remain at present levels. Should one of the programs be shutdown for any length of time, sludge would have to be stockpiled and a pile leachate would be generated. This leachate could cause surface water and groundwater pollution if not properly managed.

Existing Wastewater Sludge Management at Blue Plains Wastewater Treatment Plant



SOURCE: District of Columbia Department of Public Works Bureau of Wastewater Treatment and Sludge Management

FIGURE 2.2

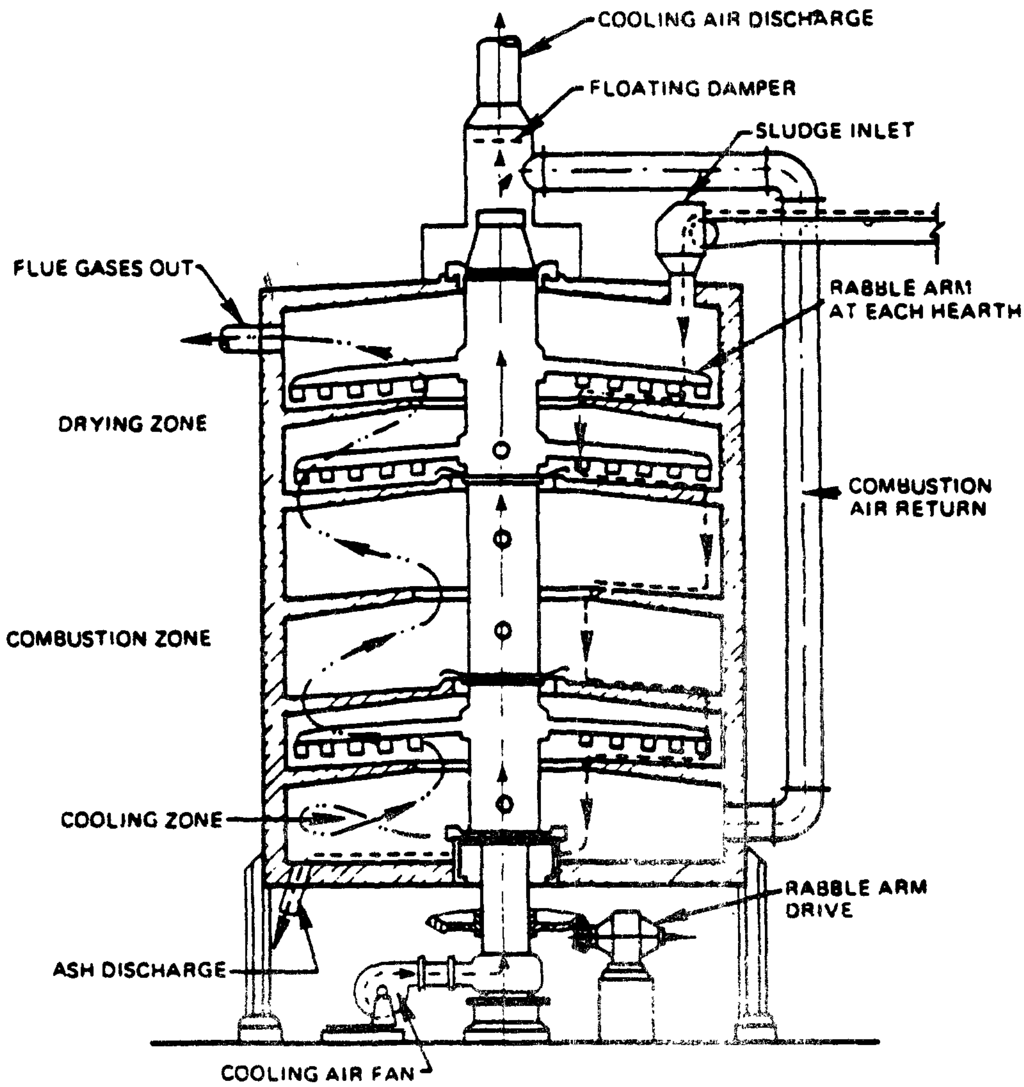
Continuation of the current interim sludge disposal practices at the Blue Plains facility provides a short-term solution to sludge management, and could through refinements and commitments provide an alternative that would be in keeping with EPA's sludge management policy. However, long-term sludge management alternatives that can process the projected quantities of sludge must be considered for use and implementation. Because the no action alternative includes land application and composting which are proposed program alternatives, it will receive further evaluation under these options.

2.3 INCINERATION WITH ASH LANDFILLING

The District proposes to use incineration at Blue Plains with final ash disposal at the Lorton Landfill as a major component of its long-term sludge management plan. Approximately 27 percent of the sludge processed in the United States is incinerated. An EPA inventory of incineration facilities completed in 1984 identified 268 facilities; of which 156 or 58 percent are operational. There were 196 multiple hearth furnaces with 61 percent currently operational, and 54 fluidized-bed furnaces with 46 percent of these units being operational. The facilities determined to be nonoperational were either no longer in service, still in construction or startup, being retrofitted, or used seasonally. Reasons given for nonuse included finding of lower cost options, air emission problems or major design and mechanical/operational problems. Sludge-only incineration by the District could use either multiple hearth or fluidized bed furnaces. The energy requirements in terms of using digester gas as an auxiliary fuel and potential energy recovery through electrical production for each furnace system need to be considered in the selection process.

2.3.1 Multiple Hearth Furnace (MHF)

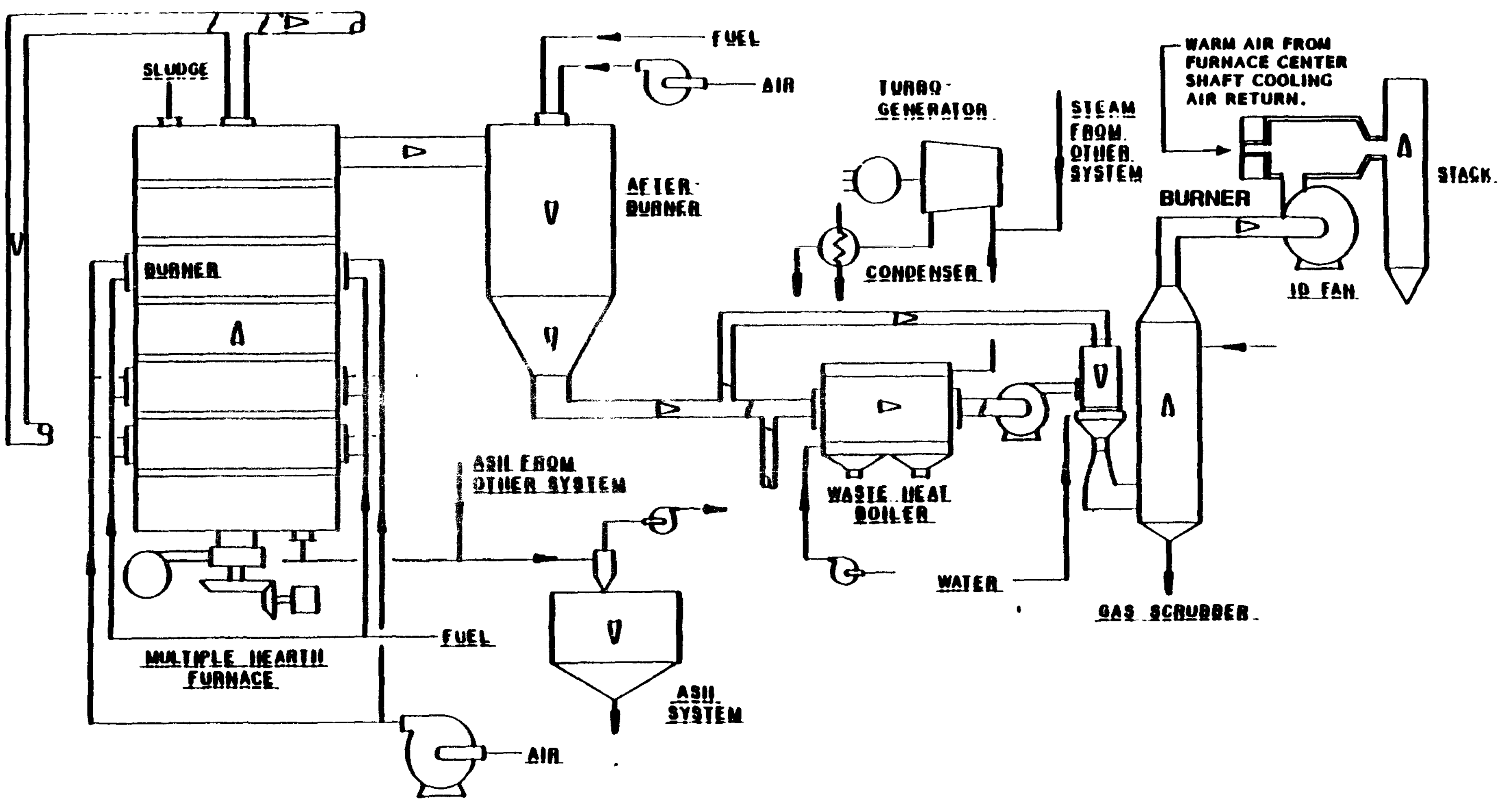
A multiple hearth furnace consists of a circular steel shell containing refractory hearths with a central rotating shaft and rabble arm system (see Figure 2.3). Typical furnace sizes range from 7 to 22 feet in outside diameter containing 4 to 12 hearths (see Appendix F and Reference 3 for facility listing). Common capacities range from [illegible] with operating temperatures of 1,400 to 1,700°F. Dewatered sludge enters the top of the furnace and is moved downward through the furnace by the rotating rabble arms. As the sludge is moved by the rabble arms it is broken into small particles, exposed to hot furnace gases, dried and burned. Natural gas, digester gas, or oil burners provide start-up and supplemental heat required for incineration. Auxiliary furnace equipment typically consists of afterburners for flue gas deodorization and scrubbers to meet air quality standards.



Source: **Operations Manual Sludge Handling and Conditioning** EPA 430/9-78-002

Cross section of a typical multiple hearth incinerator.

Figure 2.3



Source: Engineering-Science, "Final Incineration System Concept Designs for the District of Columbia Wastewater Treatment Plant at Blue Plains (Task II-10F)", 10/86

Blue Plains Wastewater Treatment Plant Flow Diagram for Multiple Hearth Furnaces

Figure 2.4

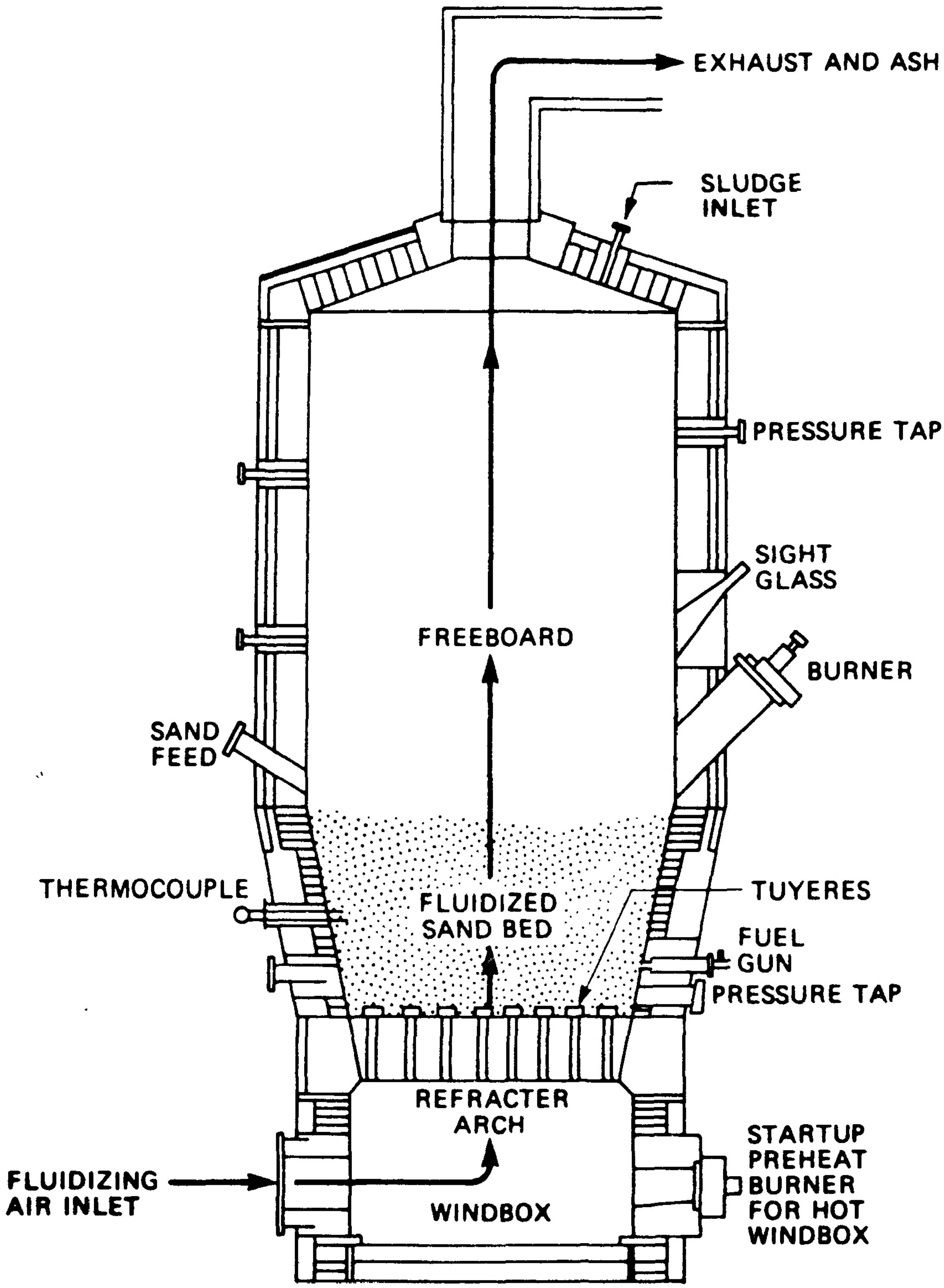
The multiple hearth furnace system proposed for Blue Plains would consist of six, 22.75 foot outside diameter, nine hearth units designed to incinerate 133 dry tons/day/unit at a 32 percent total solids feed. A flow diagram of the proposed system is shown in Figure 2.4. The proposed design assumes a 75 percent availability factor with each unit capable of incinerating 100 DTPD. Installation of six furnaces provides added redundancy in that two units are required for the annual average loads of 200 DTPD and three units required for peak month loads of 384 DTPD at a 96 percent availability factor.

Energy recovery in the multiple hearth system would depend on waste heat boilers, a turbo-generator, and use of gas produced on site. Approximately 660,000 standard cu. ft/day of digester gas are available for use and could maintain a furnace exhaust gas temperature of around 900°F. Two drum natural circulation waste heat boilers rated at 450 psig pressure with 100°F of superheat are proposed. They would produce an estimated 75,000 lbs/hr of steam at average incinerator loadings and 140,000 lbs/hr of steam at peak loads. The steam produced by the boilers would be used to drive a turbo-generator for on-site electrical production. The proposed generator system would produce 5,000 kw of electricity at average load conditions and around 9,000 kw at peak loadings.

Furnace exhaust gases pass through air pollution control equipment prior to reaching the stacks. The multiple hearth concept design proposes to use an afterburner at up to 1,600°F with one second retention time to destroy odor producing compounds; a Venturi scrubber for major particulate removal; an aftercooler; and a wet electrostatic precipitator for fine particulate removal. Before entering the stack, exhaust gases are reheated to 200°F for white plume suppression. The stack system proposed consists of two 225 foot stacks with three 4.5 foot diameter flues in each stack.

2.3.2 Fluidized Bed Furnace (FBF)

A fluidized bed furnace consists of a vertical cylindrical vessel with a grid to support a sandbed in the lower section as shown on Figure 2.5. Injection of dewatered sludge takes place above the support grid and



CROSS SECTION OF A FLUID BED FURNACE

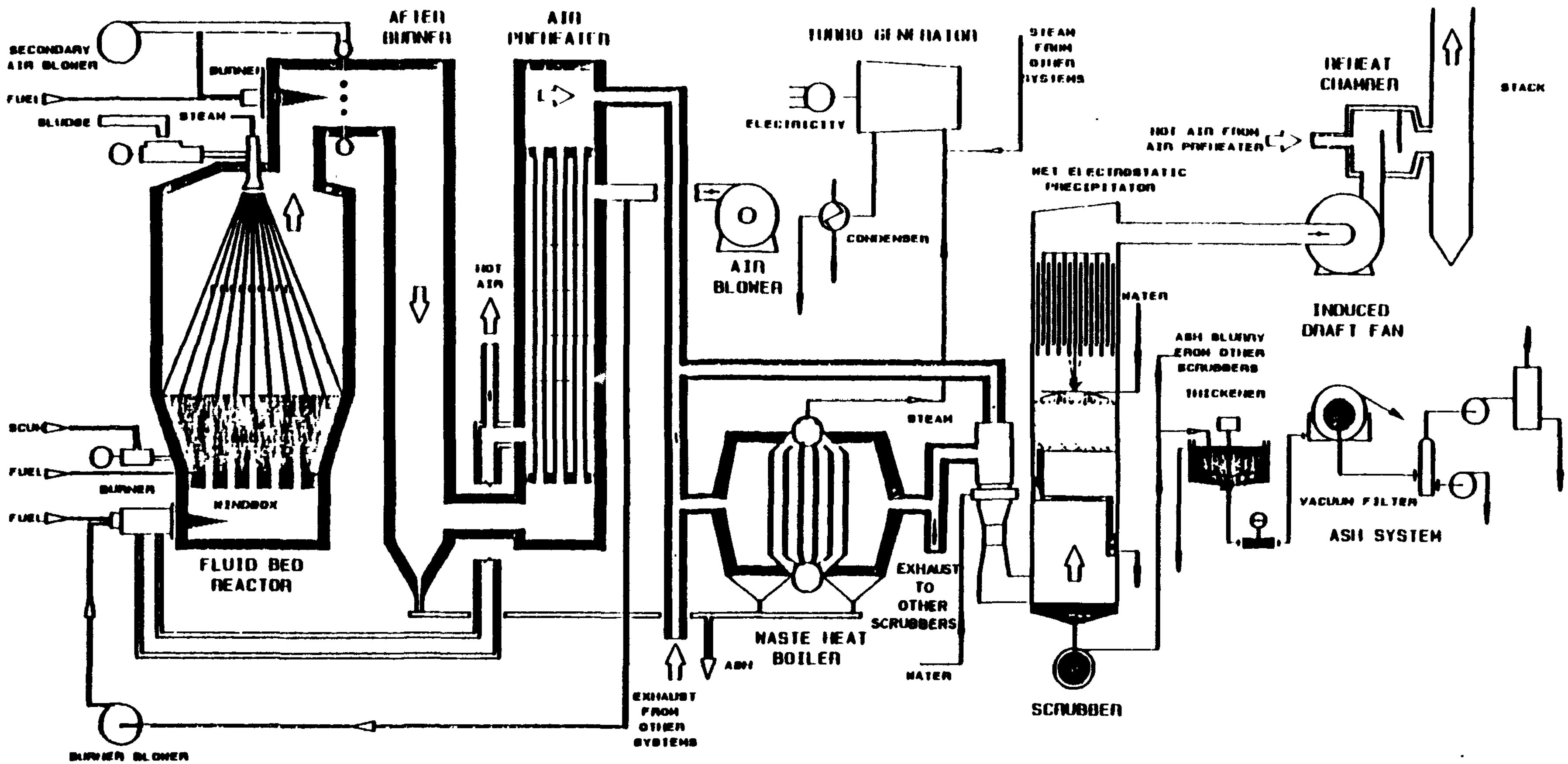
Source: EPA Process Design Manual Sludge Treatment and Disposal EPA 625/1-79-011

Figure 2.5

combustion air moving upward fluidizes the sandbed and sludge. Within the furnace, sludge moisture is evaporated and dried sludge is incinerated at 1,400 to 1,500°F in the fluidized hot sandbed. Supplemental fuel is supplied by burners located above or below the support grid. The ash resulting from the combustion process is carried out of the furnace with exhaust gases and removed in a scrubber system. (See Appendix F and Reference 3 for incinerator facility listing.)

The Blue Plains fluidized bed furnace system as proposed by Engineering-Science (ES) consists of six, 28 foot inside diameter, windbox-type fluid bed reactors. The units are designed to incinerate 133 dry tons/day/unit of sludge at 32 percent total solids feed. A flow diagram of the proposed system is shown in Figure 2.6. The sludge would be introduced to the furnaces with a top feeding device which includes a steam spreader system. This type of system is proposed by ES because it will improve combustion efficiency through proper sludge distribution. The fluid bed furnace proposed design assumes a 75 percent availability factor with each unit capable of incinerating 100 DTPD. Installation of six furnaces provides added redundancy in that two units are required for the annual average loads of 200 DTPD and three units required for peak month loads of 384 DTPD at a 96 percent availability factor.

An alternative to the six furnace construction concept is a four furnace installation. The four unit concept would utilize the same size and capacity furnaces and necessary auxiliary equipment as the six unit concept. Two of the furnaces would be required for the annual average loads of 200 DTPD and three units would be required for peak month loads of 384 DTPD. During average and peak loading periods the number of furnaces on standby would be two and one, respectively. In comparison, the six unit concept would have four and three furnaces on standby at similar loadings. The four furnace concept would have less inherent redundancy than a six unit system but equivalent six unit redundancy could be achieved through a flexible sludge management system. For example, additional redundancy could be provided to a four furnace system by having land application sites available and/or using any remaining excess capacity in the proposed composting systems.



Source: Engineering-Science, "Final Incineration System Concept Designs for the District of Columbia Wastewater Treatment Plant at Blue Plains (Task II-10F)," October, 1986.

District of Columbia Wastewater Treatment Plant at Blue Plains Flow Diagram Fluid Bed Incineation System

Figure 2.6

Energy recovery in the fluid bed system would consist of waste heat boilers, a turbo-generator, and use of gas produced on-site. An estimated 460,000 standard cubic feet per day of digester gas will be used to maintain the preheated air temperature in the windbox at approximately 1,140°F. Two drum natural circulation waste heat boilers rated at 450 psig pressure with 100°F of superheat are proposed. They would produce an estimated 28,000 lbs/hr of steam at average loadings and 60,000 lbs/hr of steam at peak loadings. The steam produced by the boiler would be used to power a turbo-generator which would produce electricity on-site. The generator would produce 2,000 kw (kwhr/hr, or 48,000 kwhr/day) of electricity at average load conditions and an estimated 3,700 kw at peak loads.

Furnace exhaust gases pass through air pollution control equipment prior to reaching the stacks. The fluid bed concept design proposes to use an afterburner, a Venturi scrubber, an aftercooler and a wet electro-static precipitator. The afterburner assures complete combustion of the sludge and aids in the destruction of volatile organic and nitrogen oxide compounds. The Venturi scrubber removes the majority of particulate material which is followed by the wet electrostatic precipitator for fine particulate removal. The exhaust gases are reheated to 200°F for white plume suppression. The stack system proposed consists of two 225 foot stacks with three 3.25 foot diameter flues in each stack.

Fluid bed incinerators require a sand make-up system to replace the bed material lost through operation. The Blue Plains proposed sand system would include a sand silo and pneumatic charging system for addition of sand to the incinerators.

The proper disposal of ash produced by either incinerator system completes the sludge management task. The multiple hearth incinerator ash system is a dry process consisting of pneumatic ash conveyance and storage. The fluid bed incinerator ash system is a wet slurry process consisting of thickening, dewatering and storage. Typically, incinerator ash which is landfilled is low in moisture, free of pathogens and organic compounds, and is thus easier to dispose of than a dewatered sludge. The heavy metals contained in the ash are usually in a less soluble oxidized form and when contained in an alkaline environment they are less mobile. Incinerator ash has been used as a soil conditioner and to supply necessary trace metals to improve plant growth.

The proposed Blue Plains multiple hearth and fluidized bed incinerator systems are projected to produce 88 and 168 dry tons of ash per day at annual average and peak month loads, respectively. The proposed long-term management plan indicates that the ash will be landfilled at the Lorton facility. The District has characterized the expected leachate and ash resulting from incineration through laboratory analysis (see Reference 7 for additional information). The ash laboratory results are contained in Tables 2.2 and 2.3. The ash leachate values shown in Table 2.2 are below the established EPA Extraction Procedures (EP) toxicity characteristics criteria.

Environmental concerns related to incineration and ash landfilling include air emissions, groundwater contamination, ash and particulate disposal, stack height and scrubber water treatment. Locating the sludge incinerators at Blue Plains enables the return of scrubber water to the wastewater treatment system for processing. The proposed multiple hearth scrubber system would have a recycle flow of 3.2 mgd which is estimated to contain 8,200 lbs/day of solids. This is equivalent to an increase of less than 3 mg/l in the 370 mgd plant flow. The fluid bed system as proposed would recycle 1.9 mgd and contain 7,200 lbs/day of solids which is equivalent to an increase of less than 3 mg/l in a 370 mgd plant flow. The disposal of ash and particulates at the Lorton Landfill will reduce the potential for groundwater contamination with proper leachate monitoring and control as compared to on-site stockpiling.

The remaining major concerns are the stack height and the impact of incineration on the regional air quality. Sludge incineration at Blue Plains will be regulated by the air pollution laws and guidelines listed below; and the regulations establish the criteria upon which control equipment are evaluated.

TABLE 2.2

BLUE PLAINS
BLENDED SLUDGE ASH LEACHATE CHARACTERIZATION (1)
(EP Toxicity Test)

Parameter	Concentration (mg/l liter leachate)	USEPA's Maximum Allowable Concentration (2) (mg/l)
Arsenic		
Mean	0.007	5.0
Stand. Dev.	0.004	
Barium		
Mean	0.869	100.0
Stand. Dev.	0.422	
Cadmium		
Mean	0.002	1.0
Stand. Dev.	0.001	
Chromium		
Mean	0.140	5.0
Stand. Dev.	0.290	
Lead		
Mean	0.107	5.0
Stand. Dev.	0.290	
Mercury		
Mean	0.0006	0.2
Stand. Dev.	0.0004	
Selenium		
Mean	0.004	1.0
Stand. Dev.	0.003	
Silver		
Mean	0.007	5.0
Stand. Dev.	0.014	

NOTE: Sludge Polymer was 0.3% of sludge dry solids

(1) Source: Engineering-Science, "Final Incineration System Concept Design for the District of Columbia Wastewater Treatment Plant at Blue Plains (Task II-10F)," October, 1986.
(2) EPA criteria based on 100 times the Primary Drinking Water Standards.

TABLE 2.3

BLUE PLAINS
SLUDGE CHARACTERIZATION SUMMARY (1)

Total Feed Rate to Incinerators	
Design Rate	266 DTPD
Average Rate	200 DTPD
Peak Rate	384 DTPD
Sludge Characteristics	
Solids (%)	32
Combustibles (%)	65
Heating Value (BTU/lb combustibles)(2)	9,000
Oil and Grease Content (% dry basis)	0.80
Combustible Ultimate Analysis (%)	
Carbon	54.60
Hydrogen	7.90
Nitrogen	4.50
Oxygen	32.00
Sulfur	1.00
Sludge Analysis (% dry weight basis)	
Chlorides	0.50
Phosphorus	1.04
Inert Analysis (mg/kg dry solids)	
Total Sodium	1,515
Water Soluble Sodium (mg/l)	83
Total Potassium	800
Water Soluble Potassium (mg/l)	53
Arsenic	4.58
Beryllium	0.38
Cadmium	3.27
Inert Analysis (mg/kg dry solids) continued	
Chromium	244
Copper	289
Iron	111,600
Lead	147
Zinc	468
Nickel	63
Mercury	0.68
Ash Characteristics (°F)	
Initial Deformation	1,969
Softening	2,000
Hemispherical	2,064
Fluid	2,114
Corrosivity	
Condensate	
mm penetration per year	0.0011
mils penetration per year	0.043
chloride, mg/l	626
pH	8.50
Scrubber Water	
mm penetration per year	0.0756
mils penetration per year	2.920
chloride, mg/l	11
pH	8.00

(1) Source: Engineering Science, "Final Incineration System concept Designs for the District of Columbia Wastewater Treatment Plant at the Blue Plains (Task II-10F)", October, 1986.

(2) Concept design used 5850 BTU/lb for energy balance (65% combustible x 9000 BTU/lb combustible = 5850 BTU/lb).

- *New Source Performance Standards (NSPS);*
- *National Emission Standards for Hazardous Air Pollutants (NESHAP);*
- *District of Columbia, Department of Consumer and Regulatory Affairs (DCRA) Environmental Standards; and*
- *Prevention of Significant Deterioration (PSD) Requirements.*

Generally, air quality standards regulate opacity, ozone, total suspended particulates, sulfur oxides, lead, nitrogen oxides, odor, and carbon monoxide. Additional new air quality standards are expected for certain heavy metals and toxic organic compounds.

The District has evaluated both the MHF and FBF alternatives in detail over a period of time. Based on their evaluation of the systems, the District has proposed to utilize the fluid bed incinerator alternative for the following reasons:

- *Operational characteristics expected to produce lower NOx and VOC emissions;*
- *More energy efficient than a multiple hearth design; and*
- *As proposed in the concept design, the FBF would not be subject to PSD review.*

This state-of-the-art incineration system proposed at Blue Plains can be classified as a high technology process. Many of the proposed incinerator features are yet to be demonstrated and pilot tested in the United States, such as the scrubber and afterburner arrangements, the combustion chamber diameter and top loading sludge system. The ability of the new incineration features and related dewatering components to function as a reliable full-scale system remains to be determined. The pilot testing of a full-scale FBF system as proposed should be considered prior to a multiple unit installation.

2.4 LAND APPLICATION

The process of land application involves the spreading of sludge on the surface or injecting sludge within the upper soil layer. Historically, land application of Blue Plains sludge has been used as part of the solids management program.

Land application can be subdivided into four basic site types which include: agricultural, forested, land reclamation, and dedicated land sites. The primary purpose in applying sludge in the first three types is to use the fertilizer and soil conditioning qualities of the sludge to improve the existing soil characteristics and plant growth. The goal of dedicated land application is to maximize the disposal quantity, with use of the sludge nutrients a secondary concern.

The characteristics of the application site, the rate of application, and the form of sludge being applied are interdependent factors which affect a land application program's success. Selecting an application site involves the review of specific site criteria to determine the potential for impacting the local environment. The site criteria include depth to groundwater, distance to surface water, site slope, soil permeability, soil pH, soil cation exchange capacity, and bedrock depth and type. Minimum distances to groundwater and surface water are established to reduce the potential for contamination. The potential for pollution resulting from site runoff depends on slope and soil permeability. Generally, slopes of less than 15 percent and medium permeability soil are acceptable. Application site soil pH's at or above 6.5 immobilize most metals and decrease plant uptake of metals. The soil's ability to hold positive ions (i.e. metals) is a measure of its cation exchange capacity. A soil having a high cation exchange capacity can retain higher levels of metals than a soil with a low capacity, thus concern for metal mobility is less in the high capacity soil. Sites containing fractured bedrock or sinkholes which allow a direct route for sludge contact with groundwater need to be identified and avoided. Finally, a buffer zone between human activity areas and the application site is needed to prevent direct contact with sludge.

The rate of sludge application will vary based on the site type and crop nutrient requirements. Application rates to meet crop requirements are usually based on nitrogen with additional monitoring of the heavy metals; cadmium, chromium, copper, nickel, mercury, lead, and zinc. High rates of application require less land area; therefore, the application rate is a major determining factor in establishing the number of acres a program will require.

A land application program can use various forms of sludge, including liquid, dewatered, air-dried, heat-dried, and composted. The degree of dewatering and processing beyond stabilization is dependent on sludge quantities, additional handling, and transportation distance to the application site.

Other factors affecting land application are climate and site availability. Land application operations are usually restricted during periods of precipitation, frozen soil, snow covered soil, and saturated soil to prevent site runoff and soil compaction. Site availability can be limited by agricultural cropping schedules, public opposition, and development. Sludge storage facilities and the allocation of additional land for application are methods used to overcome cropping schedules and maintain sludge removal at treatment facilities. Addressing local public opposition is a site specific task requiring good program management and public relations. The loss of sites as the result of regional development is a continuing problem in growth areas.

The present land application program for the Blue Plains wastewater treatment plant dewatered sludge is managed through a group of private contractors over a five year period. The contractors use agricultural sites located in Maryland and Virginia because there is no available area within the District. Approximately 600 to 700 WTPD of dewatered sludge are being transported off site, stored, and applied as required to meet crop nutrient requirements. Contractors applying the Blue Plains sludge report that the current agricultural demand for the high quality sludge (low heavy metals content, see Table 2.4) is greater than the supply, thus sufficient application area exists. However, District officials have reported an increase in controversy and public opposition related to land application of sludge as the region continues to develop. The quantity of sludge being applied annually is approaching the quantity proposed for incineration. Therefore, the land application alternative is one management option for which there is an operational record.

In order to dispose of the average 200 DTPY of sludge over the next 20 years, an estimated 37,700 permitted acres of land would be required. The land application acreage was determined through the use of the following conditions: an average corn crop nitrogen requirement of 180 lbs. per acre; a sludge nitrogen content of 70 lbs. per ton; a 1.4 application site availability factor; 32 percent of the sludge applied in Maryland; 68 percent of the sludge applied in Virginia with a 3 year cycle; and adherence to EPA regulations. The quantity of sludge (e.g. 32 percent) allocated for disposal in each state was based on the reported number of permitted acres shown in Table 2.5. The total acreage requirement would increase from 37,700 to approximately 59,400 acres if a 5 year application cycle is used at the Virginia sites. This could be offset by applying a larger quantity of sludge in Maryland. The typical application site life is beyond 20 years for cadmium and the most limiting metal (copper) at an annual loading rate of 6.4 dry tons per acre.

There are approximately 69,800 acres of permitted land available for application of Blue Plains sludge under the present contract management program (see Table 2.5). This permitted land area exceeds the average loading area demand. It is important to note that sludge from other treatment facilities has also been permitted for some of the same area, therefore, the quantity of excess area is difficult to evaluate. The contractors also have approximately 107,000 cu. yd. (19,300 dry tons) of permitted lagoon capacity which provides an estimated 96 days of storage at average loadings. The storage facilities allow the contractors to accept sludge on a regular schedule and land apply the sludge on an irregular basis.

Land application of sludge has been promoted as a sludge management method because the practice recycles the resource value of the sludge. Additionally, the risk of inorganic nitrogen runoff can be reduced if crops

TABLE 2.4

BLUE PLAINS
SLUDGE STREAM QUALITY SUMMARY (1)

Parameter	Raw Sludge ppm	Digested Sludge ppm	Recommended Maximum Concentration ppm (3)
Cadmium	6.5	5.64	25
Chromium	121.98	109.5	1,000
Copper	267.3	279.3	1,000
Lead	191.7	171.5	1,000
Mercury	0.9 (2)	-	10
Nickel	40.64	38.1	200
PCBs	-	-	10
Zinc	408.6	428.4	2,500

(1) Based on monthly sludge analyses provided by the Bureau of Wastewater Treatment, District of Columbia, January-May 1986.
(2) Based on monthly sludge analyses provided by Enviro-Gro Technologies from A&L Eastern Agricultural Laboratories Inc., March-July 1986.
(3) Levels reported in, "Criteria and Recommendations for Land Application of Sludge in the Northeast.

TABLE 2.5

SUMMARY OF CONTRACT LAND APPLICATION FACILITIES

State	County	Land Application Permitted Acreage Acres (1,2)	Permitted Off-Site Storage Capacity Cubic Yards (3)
Maryland	Caroline	467	
	Carroll	350	
	Frederick	533	
	Howard	2,915	20,000
	Kent	500	
	Montgomery	500	
	Prince Georges	7,515	30,000
	Queen Annes	8,216	
	Talbot	1,699	
Subtotal		22,695	50,000
Virginia	Caroline	3,536	
	Culpeper	400	
	Essex	6,161	
	Fauquier	11,957	17,000
	Goochland	3,287	40,000
	Hanover	6,856	
	King George	1,200	
	King and Queen	2,848	
	King William	1,609	
	Londoun	5,566	
	Louisa	3,759	
Subtotal		47,179	57,000
Total		69,874	107,000

(1) Based on information supplied by Enviro-Gro Technologies, BioGro Systems, Inc., and Ad+Soil, Inc. and reviewed with State agencies.
(2) Sludge from other treatment facilities has also been permitted for some of the same area.
(3) Based on information supplied by the District, WSSC, and Metropolitan Washington Council of Governments.

TABLE 2.6

BLUE PLAINS
INDIVIDUAL SLUDGE STREAM CHARACTERIZATION SUMMARY

JANUARY - MAY 1986 DATA PERIOD (1)

Parameter		Dewatered Raw Sludge			Dewatered Digested Sludge		
		Average	Minimum	Maximum	Average	Minimum	Maximum
Total Nitrogen	%	3.17	0.97	4.65	3.97	1.60	7.17
Ammonium Nitrogen	%	0.056	0.0034	0.12	0.048	0.0044	0.114
Phosphorus, Total	%	1.42	0.50	1.91	1.36	0.091	1.3
Potassium	%	0.079	0.04	0.142	0.085	0.031	0.2
Calcium	%	10.478	5.82	12.14	11.15	6.36	12.92
$CaCO_3$ Equiv.	%	26.83	15.54	31.15	28.54	17.91	35.32
Magnesium	%	0.217	0.121	0.301	0.231	0.114	0.492
Iron	%	8.049	6.30	11.57	7.92	4.00	12.8
Cadmium	ppm	6.5	4.1	9.5	5.64	3.3	8.45
Chromium	ppm	121.98	94	141	109.50	69.5	200
Copper	ppm	267.3	190	440	279.30	150.0	524
Lead	ppm	191.7	100	256	171.5	104	262
Nickel	ppm	40.64	21	59.5	38.1	23	57
Zinc	ppm	408.6	300	600	428.4	264	655
Total Volatile Solids	%	41.02	37	45.3	41.51	35.68	46.07
Soluble Salts	%	3.44	1.07	6.3	4.38	1.31	7.40
Moisture	%	81.47	77.81	85.34	85.21	78.48	84.67
pH		11.80	11	12.82	11.65	10.15	12.17

(1) Based on monthly sludge analyses provided by the Bureau of Wastewater Treatment, District of Columbia.

are fertilized with sludge rather than nitrogen fertilizer. Assuming available sludge quality data as shown in Table 2.6 and an average loading rate, the estimated average fertilizer value for the Blue Plains sludge is $45.17 per dry ton applied or $289 per acre (see Table 2.7). The estimated total annual equivalent fertilizer value is approximately $3,297,000.

Environmental concerns related to land application include contamination of water sources, food chain toxicity, site odors and increased heavy truck traffic in agricultural areas. State and local regulatory control and enforcement of land application site operations are designed to minimize concerns on the part of the local population. The application site permits and field conditions are reviewed on an annual or multiple year basis depending on the state location. Land application is a closely regulated sludge management option which when done in accordance with established procedures, can be used without adversely impacting the environment.

However, land application does have limitations which must be considered if it is to be used as a long-term sludge management alternative. These limitations include:

- *Vulnerability to seasonal conditions;*
- *Field storage capacity constraints;*
- *Increasing number of regulations; and,*
- *Strong public opposition to odors, trucks hauling sludge, location of storage facilities and land application sites.*

TABLE 2.7

LAND APPLICATION SLUDGE VALUE

Nutrient	Dewatered Raw Sludge			Dewatered Digested Sludge		
	Quantity (1) lbs/Ton of Sludge	Unit Value (2) $/lb	Total Applied Value $/Ton of Sludge	Quantity (1) lbs/Ton of Sludge	Unit Value (2) $/lb	Total Applied Value $/Ton of Sludge
Nitrogen, N_T	63	0.21	$13.23	79	0.21	$16.59
Phosphorus, P_2O_5 (3)	65	0.21	13.65	63	0.21	13.23
Potassium K_2O (4)	2	0.10	0.20	2	0.10	0.20
Lime, $CaCo_3$	537	0.03	16.11	571	0.03	17.13
Total Nutrient Value/Dry Ton of Sludge Applied			$43.19			$47.15

(1) Based on 1986 average sludge analysis data reported in Table 2.3.

(2) Based on established values for commercial fertilizer excluding transportation costs.

(3) Based on a P to P_2O_5 factor of 2.3.

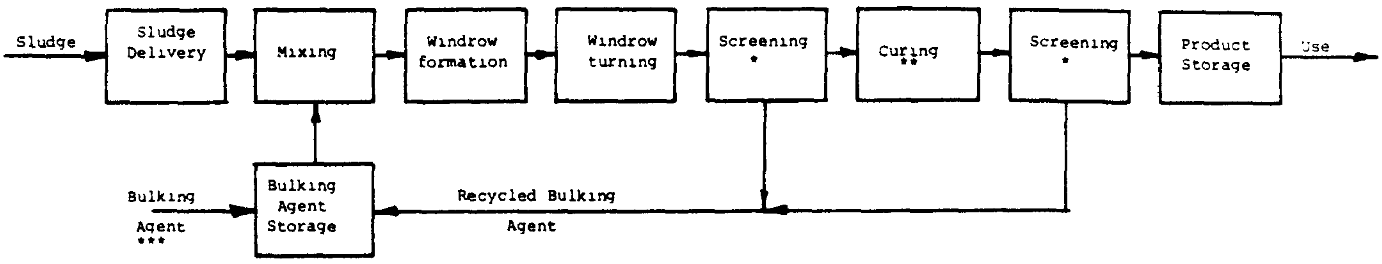
(4) Based on a K to K_2O factor of 1.2.

2.5 COMPOSTING AND PRODUCT USE

Composting of dewatered sludge is a major component of the present solids management program and will remain as part of the District's long-term plan. EPA approved the composting component of the plan (Finding of No Significant Impact) in August 1984. The present on-site aerated static pile composting is to be replaced with in-vessel composting to provide increased composting capacity in less area. The present large site area used for static pile composting will be needed for swing sedimentation tank construction. Also, the siting and operation of composting facilities off-site within the region is becoming increasingly difficult. The purpose of this section is to review composting as a process and evaluate its potential for processing additional quantities of sludge.

Composting is an aerobic process which allows microorganisms to decompose a portion of the organic matter to carbon dioxide and water. Successful composting occurs in the mesophilic to thermophilic temperature range (130° F to 160° F). The elevated temperature is attained by biochemical activity in the composting material, and no input of heat energy is required. The process develops the temperatures necessary to kill weed seeds and pathogens. The sludge is usually dewatered and is mixed with a bulking agent prior to composting. The purpose of the bulking agent, typically wood or bark chips, is to break up the solids mass and to absorb some of the moisture in the sludge. The optimum moisture content for composting a mixture of sludge and wood chips is between 50 to 60 percent by weight. Less moisture causes a retardation of biochemical activity, and greater moisture may clog pore spaces between particles, thus restricting oxygen transfer. Such clogging would encourage anaerobic conditions in the composting mass, with the resultant generation of unpleasant odors.

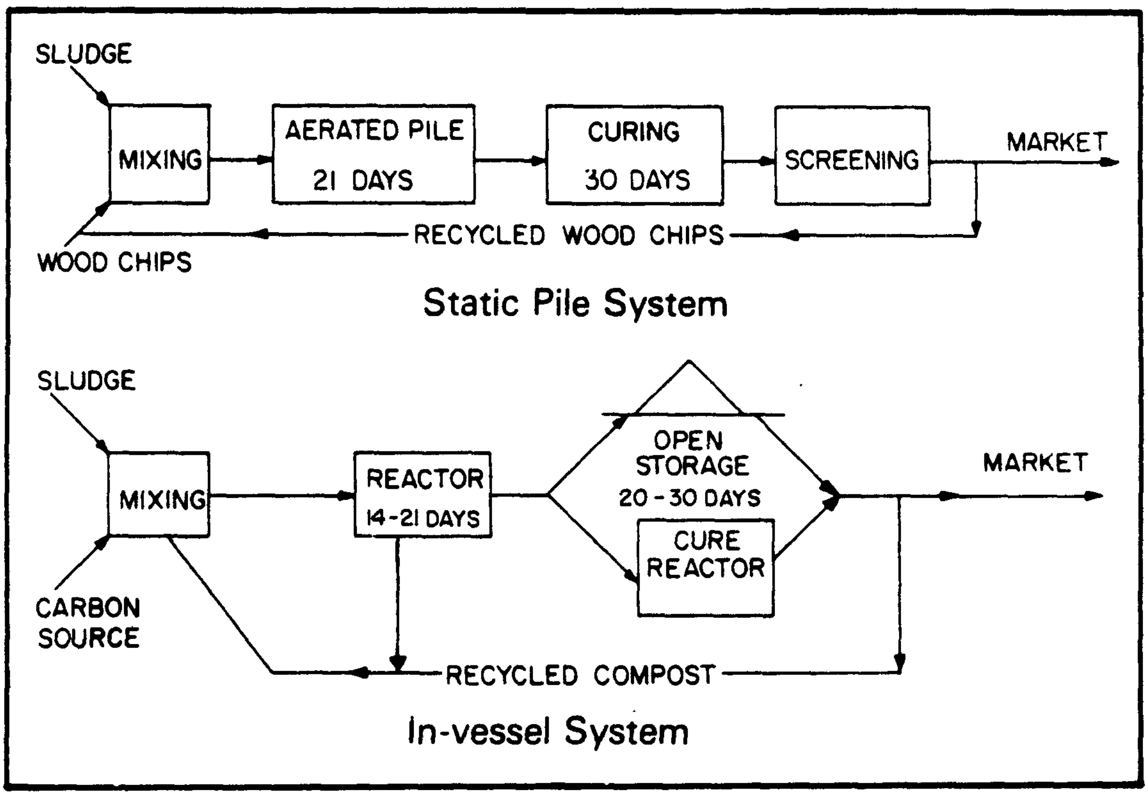
Composting of wastewater solids may be accomplished by several methods. Mechanical units, which confine, mix, and aerate the solids, are available from several manufacturers. The windrow method and aerated static pile processes are the conventional composting schemes most commonly used. Figure 2.7 provides schematic diagrams of the three composting processes.



Windrow Composting

* Screening will normally be accomplished either prior to or just after the curing step.
** The purpose of curing is provide storage time for the compost at elevated temperature for additional pathogen kill and stabilization.
*** The purpose of the bulking agent is to add porosity to the sludge so air can pass through more readily.

SOURCE: OPERATIONS MANUAL SLUDGE HANDLING AND CONDITIONING. EPA 430/19-78-002



SOURCE: SEMINAR PUBLICATION COMPOSTING OF MUNICIPAL WASTEWATER SLUDGES. EPA 625/4-85/014

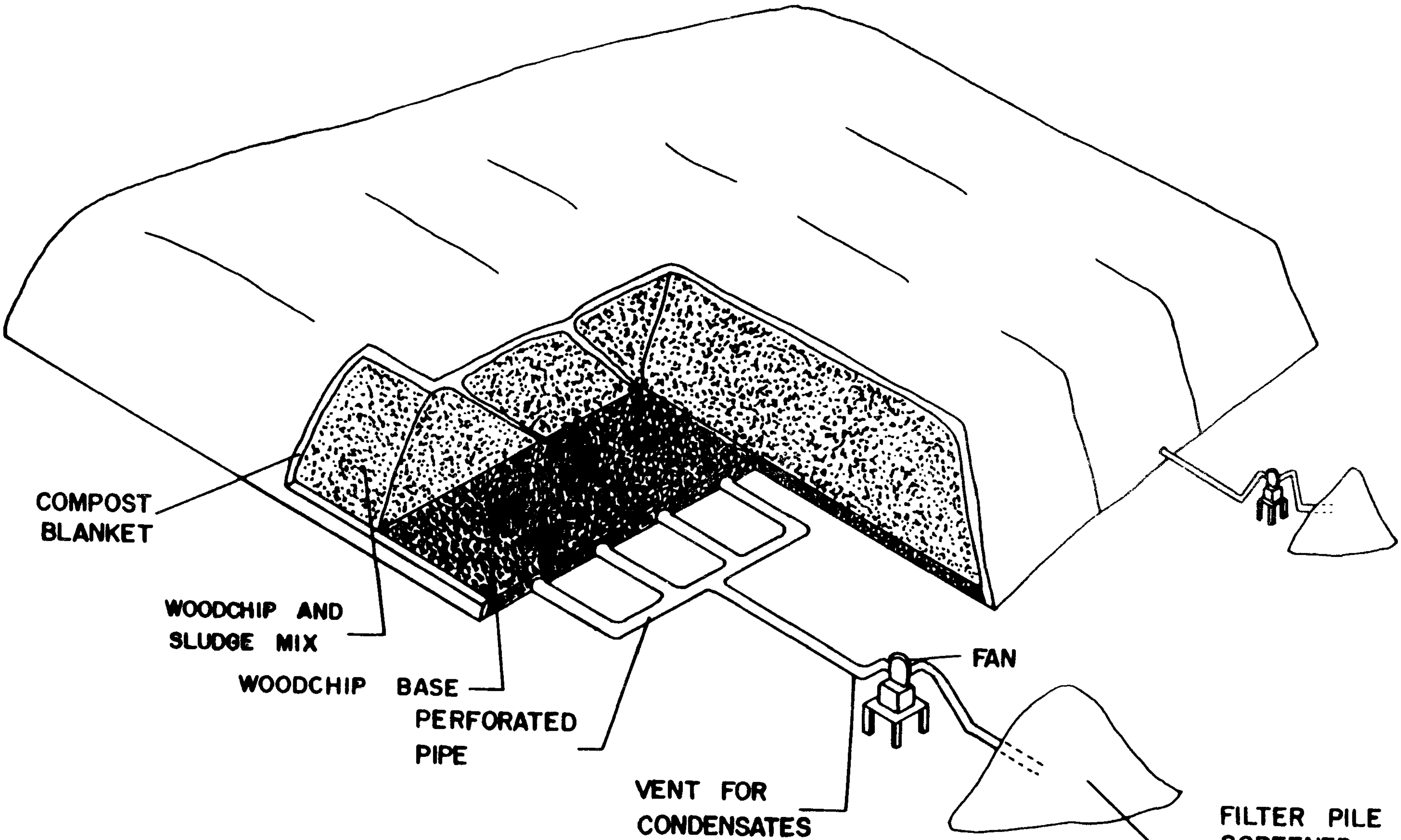
COMPARISON OF COMPOSTING PROCESSES BY METHOD

FIGURE 2.7

The windrow method of composting is accomplished by forming the sludge-bulking agent mixture into long piles having a triangular cross-sections. The windrows are maintained in an aerobic condition by daily mixing and turning. This composting method is only suitable for composting digested solids and requires a large working area which is not available at the Blue Plains site.

The aerated static pile method was developed at the experimental waste-water solids composting project at Beltsville, Maryland under the direction of the U.S. Department of Agriculture using Blue Plains sludge. This method involves the placement of either raw or digested solids mixed with a bulking agent over perforated piping. The piping system is connected to an air blower, which draws air through the pile, thus maintaining aerobic conditions. Aerated static pile composting operations may use either individual elongated piles or a more compact extended static pile approach. Figure 2.8 illustrates the typical extended static pile operation currently used at Blue Plain and the MCCF. Odor problems associated with the windrow method for raw solids are reduced in the forced aeration method. Construction of the swing sedimentation tanks to allow for plant expansion will reduce the available space for composting in the future and hinder processing of the existing and any future increased sludge quantities by the aerated static pile composting method.

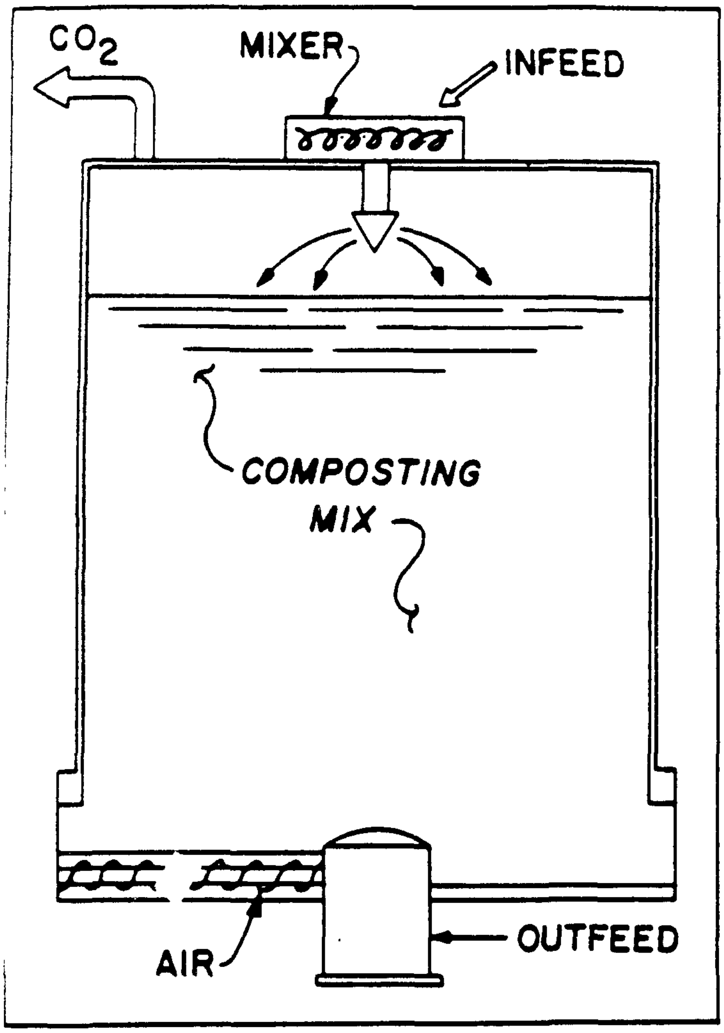
A number of mechanical reactor closed system composting units are becoming available and operate in a similar manner (see Figure 2.9). The plug flow composting process commonly used in the mechanical systems mixes dewatered sludge with a small amount of recycled compost and carbonaceous material. The mixture is then placed into the reactor chamber where composting begins. A continual supply of air is diffused into the reactor and off gases are collected and deodorized prior to release. The degree of mechanical and monitoring complexity varies from one in-vessel system to another. Microprocessors can be used to monitor the reactor environment and maintain the optimal composting conditions. Retention time within the composting reactors and type of curing, whether inside or outside the reactor, are system and site specific. The final product is similar to that of other composting methods.



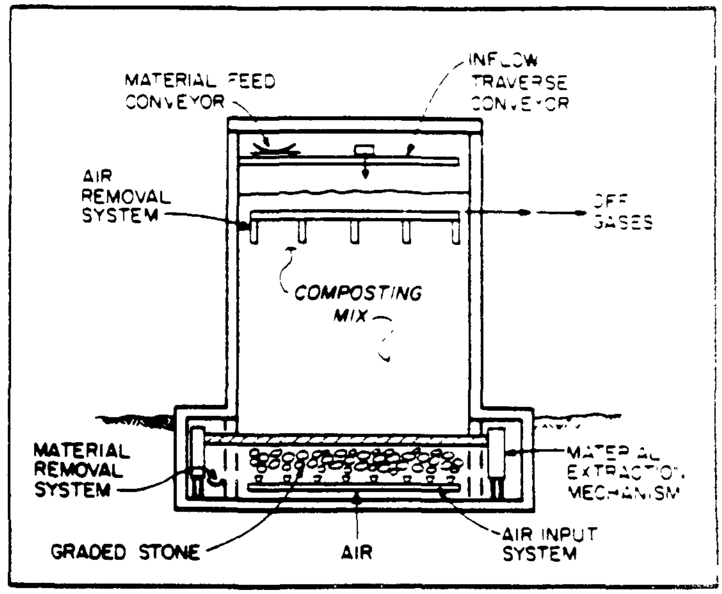
Source: G.B. Willson, "Forced Aeration Composting" 1983

Schematic Diagram of the Beltsville Extended Aerated Static Pile Composting System

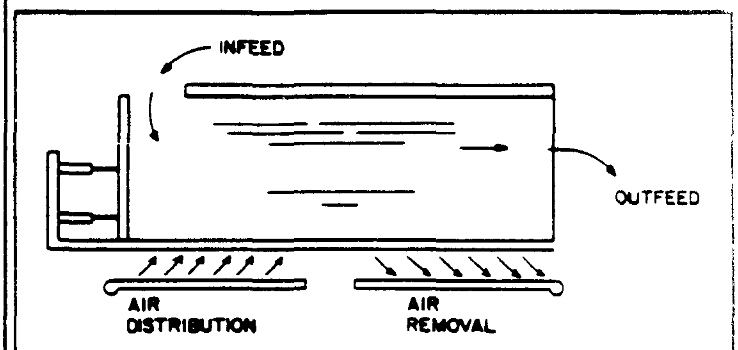
Figure 2.8



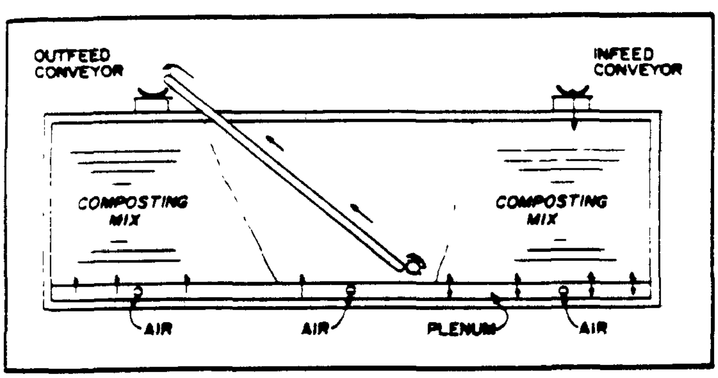
Cylinder Tower Reactor



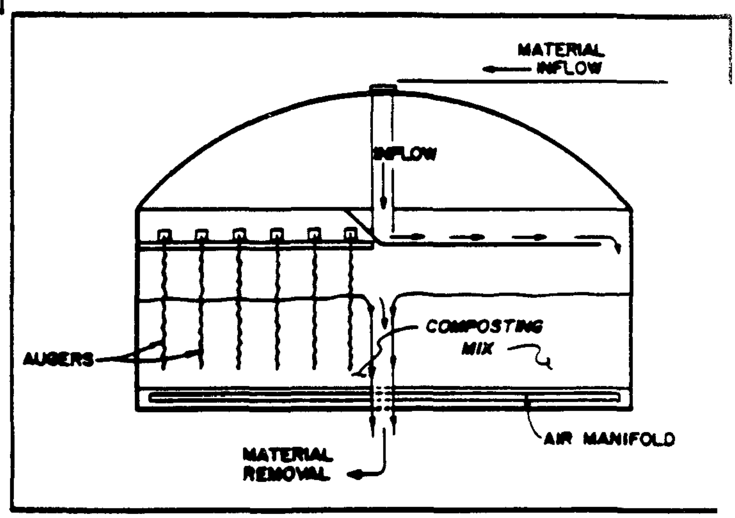
Rectangular Reactor



Tunnel Reactor



Cross-section of a Tank Dynamic System



Circular Dynamic Reactor

Source: Seminar Publication Composting of Municipal Wastewater Sludges. EPA 625/4-85/014

Schematic Diagram of Various Mechanical In-Vessel Composting Systems

Figure 2.9

The preliminary concept, developed by Engineering Science, for the proposed FONSIed Blue Plains in-vessel system may consist of 8 agitated bed composting bins, each 600 feet long by 20 feet wide by 12.5 feet deep with a retention time of 21 days for processing the peak loading of 132 DTPD. In addition, storage areas for recycle compost, curing, and bulking agent along with mixing areas are to be provided. The complete composting process will require approximately 8 acres of on-site area as shown in Figure 2.10. The District's present FONSIed in-vessel facility schedule calls for Phase I having a capacity of 60 DTPD to be operational in 1992 and a similar Phase II to be operational in 1995.

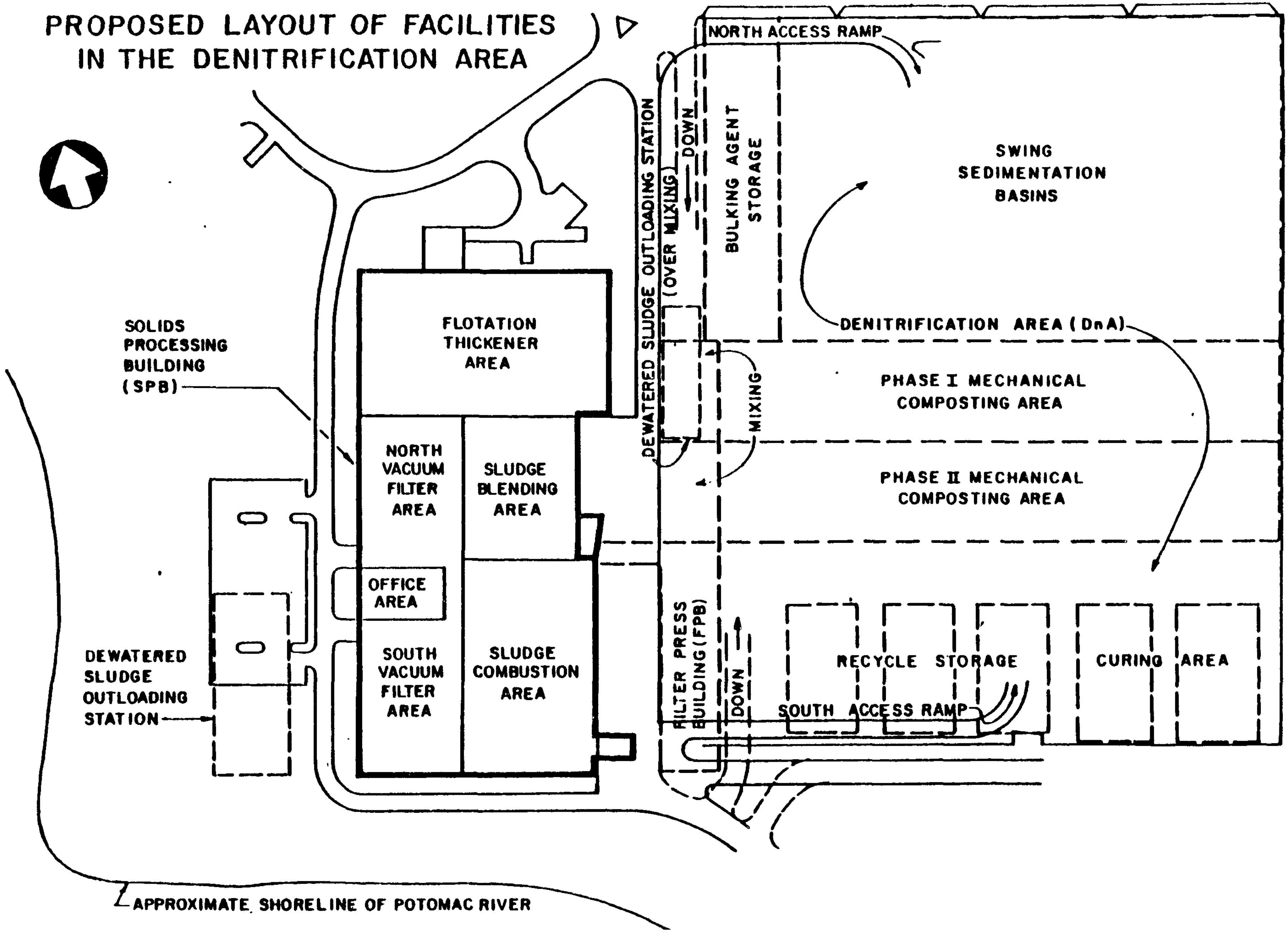
The design criteria developed by ES for the proposed in-vessel system and manufacturer's sizing information were used to develop the concept for composting an additional 200 to 384 DTPD of sludge at Blue Plains. Based on the peak month loading of 384 DTPD at 21 percent solids, an estimated 10 additional composting bins would be required. The bins as sized by the manufacturer would be 1,000 feet long by 20 feet wide by 12.5 feet deep with only 6 bins required at average loading conditions. Construction of this facility would require 16 acres of plant site if a standard layout were used.

In early 1988, the District was advised that nitrogen removal would be required at Blue Plains. The District has evaluated the nitrogen removal requirement and prepared a preliminary facilities layout showing that nearly all unallocated site space will be required for the denitrification function.

There is not sufficient space at the plant to compost both the FONSI'd sludge and the 200/384 DTPD of sludge if a single level, conventional layout is used. It will be necessary to develop a multiple level bin composting building to reduce area requirements.

Another way to reduce the area needed for composting is to dewater the sludge to 30-35% solids instead of the assumed 21%. The sludge compostability evaluation completed by Engineering-Science for the District concluded pulverizing and rewetting of a 32 percent solids sludge cake was required for adequate sludge composting in their laboratory test unit. However, a review of compost facility operational surveys has revealed that

PROPOSED LAYOUT OF FACILITIES IN THE DENITRIFICATION AREA



Source: Engineering Science, "Dewatering, Composting and Incinerator System Evaluations for Sludge Management at District of Columbia Wastewater Treatment Plant at Blue Plains," Volume I. Technical Report April 1985

Figure 2.10

the City of Windsor, Ontario composts a dewatered sludge with solids as high as 30 percent and the Upper Occoquan Sewage Authority, Virginia composts a sludge cake dewatered to approximately 35 percent solids. While neither of these facilities use an in-vessel system, they indicate that composting a sludge cake with solids greater than 21 percent and approaching 32 percent appears to be feasible. In addition, the control of excess moisture in the feed sludge to a mechanical composting system appears to be a major factor in the operational success or failure of the system. Therefore, additional full bed depth and larger scale compost testing using a high solids sludge cake and maintaining optimum process moisture, would be worthwhile based on the potential for economic and site area savings.

The final compost produced by the above methods contains a high humus content similar to peat. It has a slight musty odor, is moist, dark in color, and can be bagged. Compost is stable, usually has no objectionable odor, and is largely free of pathogenic organisms and weed seeds. Compost increases the water holding capacity of sandy soils, improves the structure of heavy clay soils, and increases the air content of the soils. The organic matter in compost improves the workability of soils, thereby making it easier for plant roots to penetrate. Compost contains relatively small amounts of slow release nitrogen, phosphorus, and potash with a typical fertilizer value of 1-2-0.2. The primary usefulness of a compost product is as a soil amendment.

Currently, about 100 total average DTPD of sludge are composted at Blue Plains and the MCCF, resulting in approximately 350 cubic yards/day of finished product for use/disposal management. Compost produced at the MCCF has been highly marketable, while Blue Plains compost has been more difficult to market. Composting all the sludge generated at Blue Plains, approximately 410 DTPD on an annual average basis, would produce an estimated 1,760 cubic yards/day (624,400 CYPY) of finished compost. The supply of compost resulting from the use of a full composting alternative will have a major impact on the regional supply when considering production from other large facilities such as Philadelphia and Baltimore.

The Washington, D.C. regional market for compost has already been established through activities at MCCF and Blue Plains. A preliminary marketing report completed in 1985 by Delchem Sales Inc. for the District indicated an initial annual potential market for 277,400 cubic yards with an estimated increase to 1,350,000 cubic yards after ten years of market penetration. The major problem reported in FY '87 for $COMPRO_R$ marketing was that demand exceeded the supply. Retail and wholesale clients in addition to 90 new clients were reportedly lost due to a lack of finished compost. This latest report indicates the market is well established and could distribute larger quantities of compost.

Phasing in the in-vessel facility construction and compost production with the compost market expansion while phasing out the existing land application program would provide program control. Selection of a full composting alternative would be assured a better marketing base through scheduled compost production increases in contrast to overloading an under developed market with the full production from the start. The marketing of this quantity of compost on an annual basis would continue to require an aggressive program and expansion into new use areas.

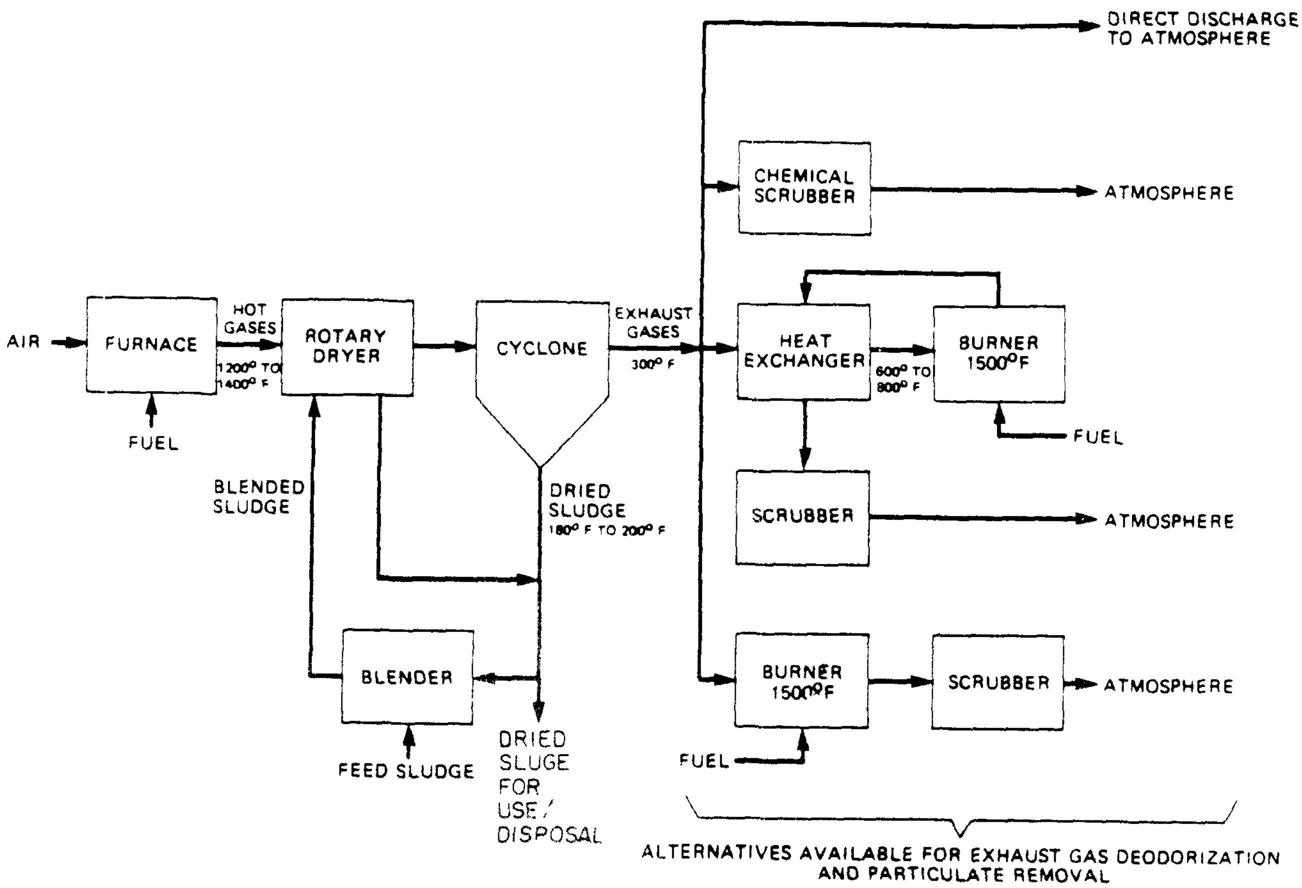
Environmental concerns associated with composting can be divided into on-site and off-site impacts. On-site impacts which could potentially affect the environment would include compost leachate, odor, dust, and operator working conditions. Composting facilities that have been operational for a period of time are not reporting any major operator health problems. Leachate, odor, and dust can be effectively controlled through proper in-vessel design and operation and their potential environmental impacts can be mitigated. The off-site concerns would primarily be related to the product quality and proper use. The lack of industrial discharges to the Blue Plains treatment plant results in a compost that is low in heavy metals (see Tables 2.4 and 2.6) and, when properly stabilized through the composting process, is accepted for use as a plant growth substance and soil conditioner.

2.6 DRYING AND PRODUCT USE

Sludge drying combined with product use is an alternative to incinerating a portion of the sludge produced at Blue Plains. This method of sludge processing and use or disposal has been successfully practiced in Milwaukee, Wisconsin; Houston, Texas; Chicago, Illinois; and Clayton County, Georgia. The District's earlier unsuccessful experience with sludge drying was discussed in the previous chapter. The ability to generate revenue to offset some of the drying costs through dry product sales has been demonstrated but varies regionally. Heat drying is a stabilization process that further reduces pathogens.

The process of heat drying dewatered sludge involves exposing the sludge directly or indirectly to hot gases resulting in a dried sludge containing 10 percent or less moisture. While drying the sludge, the temperature reachs above 80°C but temperatures that would destroy the organic content of the sludge are avoided. The final product form resulting from heat drying is usually a small sludge pellet or bead. A schematic of a direct rotary dryer unit is shown in Figure 2.11. Other types of drying units include: flash drying, indirect, direct-indirect rotary, toroidal, spray drying, and solvent extraction drying. Typically, the drying process is an energy consuming operation

The physical process of drying takes place in three zones within a drying unit. In the first zone, the sludge temperature is increased to that of the next zone and little drying occurs. The second zone is the area in which the majority of evaporation takes place. Sludge particles in this zone dry from the core toward the outer surface and the surface remains in a saturated state until the interior water is evaporated at the surface. The sludge particles are heated only to the wet bulb temperature of the gas stream as long as moisture remains on the particle surface. Therefore, the sludge particle temperature is cool when compared to the gas temperature it is exposed to. In the third zone, the sludge particle surface becomes unsaturated and the rate of evaporation decreases as the particle temperature



Source: Process Design Manual for
Sludge Treatment and Disposal
EPA 625/1-79-011

Schematic for a Rotary Dryer

Figure 2.11

begins to increase. The dried sludge then exits the drying unit where it cools and is either recycled with wet feed material or stored prior to use or disposal.

The dried sludge product that results from the heat drying process can be used as a soil conditioner and plant growth substance. The fertilizer value of the dried product would be approximately the same as the dewatered sludge. Drying the sludge improves the materials handling in terms of conveyance, transporting, and application. The overall mass and volume reduction achieved through drying greatly reduces the number of truck trips between Blue Plains and regional land application sites. The area required for on and off site final product storage would be less than dewatered sludge. The use of silos for product storage would also be less obtrusive in an agricultural setting than dewatered sludge lagoons. If the dried product land application uses were prohibited at any time, or storage of product during periods of low seasonal demand was not acceptable, then disposal of the product through landfilling or incineration with ash landfilling may become a process option.

The heat drying sludge process considered for this Blue Plains treatment plant alternatives evaluation is the direct rotary dryer unit system. The system could consist of six drying units with four units required during peak periods and three units utilized at average loads. Each dryer would be a 3-in-1 drum design, 12.5 feet in diameter and 42 feet long. Within the dryer the sludge moves forward through a center cylinder, then back through an intermediate cylinder and forward through an outer cylinder toward a fan on the discharge end. Heated air would be provided by a furnace which could burn natural gas, fuel oil, or other fuels such as digester gas or wood. The final exhaust air would be passed through an afterburner. The system requires 580,000 Btu per dry ton of sludge processed which would be equivalent to approximately 1.9 million cubic feet of digester gas at average loads. Typical dryer inlet air temperatures would be 427°C (800°F) and outlet temperatures would be about 82°C (180°F). The average gas temperature in the dryer would be 121°C (250°F) with cyclone separator exhaust gases expected to be around 49°C (120°F). The final dried product in a small pellet form would have a bulk density of 720 to 880 kg/m^3 (45 to 55 lbs/cu.

ft.). On-site storage of dried material in a silo would typically be equivalent to 30 days of production. The estimated building area required for the system described is about 68,000 square feet. This area requirement could be met by using the sludge combustion area in the solids processing building and area adjacent to the building.

The preferred use of the dried sludge product would be for a land application program. The dried sludge product in the southeast region of the country has been valued at $20/percent nitrogen/ton of product. A 3.5 percent average nitrogen value for Blue Plains sludge would equate to a possible market value of $14/ton of product excluding any transportation cost based on a unit price of $0.20/lb nitrogen. The lower product value is perceived to be more reflective of the northeast region as indicated by distributors. If the product were land applied to agricultural fields an estimated 37,700 acres of permitted land would be required and the existing land application sites could be used. The dried product form does allow application for turf grass management which is typically not a use associated with dewatered sludge.

In the case where land application sites would not be available, disposal of the dried sludge would be necessary. The options for disposal would be landfilling or incineration.

Environmental concerns associated with the sludge heat drying process are possible toxic contaminants emitted in the moist gas stream exhausted to the atmosphere, control of a liquid sidestream from a scrubber unit, and the dry sludge product itself. Heat dried sludge should not be allowed to become rewetted prior to application and incorporation into the soil. Rewetting the product creates a favorable environment for organism regrowth and anaerobic decompostition which generates noxious odors, particularly in sludges that were not stabilized prior to drying. Concerns that the dried sludge product may create conditions for spontaneous fires is reduced through the pelletization process.

Air pollution in the form of odors, volatile compounds, particulates and visible plume emissions may result from the heat drying system gas exhaust stream. Passing the exhaust through an afterburner, scrubber, and a plume suppression system prior to atmospheric discharge would reduce the potential environmental impact. If a wet scrubber is used, the liquid sidestream created is usually recycled to the head of the plant for treatment.

2.7 LANDFILLING

Sludge landfilling has commonly been used as a disposal method by many communities. Current reports indicate about 15 percent of the sludge produced in the United States is being landfilled. Within the political boundaries of the District, appropriate area for landfilling wastewater solids does not exist. Therefore, the District would have to look in Maryland and Virginia for potential landfill sites. The use of sites outside the District requires adherence to a number of local and state governing regulations specific to any given site.

The State of Maryland regulates the disposal of dewatered sludge in sanitary landfills under Refuse Disposal Regulations Title 10, Subtitle 17, Chapter 11 and new Chapter 10 Regulations on Sewage Sludge Management have been approved. The State's regulatory goal is to allow only sludges containing no free liquids in landfills. Mixing of sludge with soil to eliminate free liquids prior to disposal and use as a cover material is considered an acceptable practice.

The Commonwealth of Virginia regulates the disposal of dewatered sludge in sanitary landfills under the Solid and Hazardous Waste Management Law and the Solid Waste Regulations. The Virginia State Health Department has the regulatory power to stop sludge landfilling when a potential hazard to human health or the environment is created. The Department's concerns related to the impact of the I-95 Lorton Landfill on the Occoquan watershed have resulted in an order stopping the landfilling of dewatered sludge at the site.

The landfilling of sludge can be done on either a sludge-only or on a codisposal basis, which involves the mixing of sludge with municipal solid waste. Sludge-only landfilling techniques include trenching, area fill mounds, area fill layers and diked containment. Sludge solids of 20 percent are required for the support of cover material which should be applied daily. The soil cover reduces the odor potential and places a barrier between the sludge and possible vectors which could spread contaminants. Codisposal of sludge utilizes the absorption characteristic of solid waste to reduce excess sludge moisture. Typically, dewatered sludge containing at least 20 percent solids is deposited on top of refuse and mixed in, or sludge is mixed with soil and used as cover material. The rate of sludge disposal that a landfill can handle depends on the quantity of refuse being delivered and the sludge solids content. Table 2.8 summarizes the sludge and site characteristics which need to be considered in the planning selection process.

Various landfill sites surrounding the District have been evaluated in the past but none have proven to be acceptable. The I-95 Lorton Landfill, which previously received sludge, remains the only regional site with any potential for landfilling. The Virginia Health Department has prohibited the landfilling of sludge at Lorton due to environmental concerns (e.g. groundwater contamination). These environmental concerns would have to be addressed and satisfied prior to reuse of the site as a future dewatered sludge landfill. Thus, the use of Lorton has limited viability.

Use of the Lorton site as a landfill for Blue Plains sludge would require truck transportation of the sludge to the site. The round-trip transport distance to Lorton from the plant is about 50 miles. Approximately 270 dry tons or 1,500 cubic yards/day of dewatered sludge, including inorganic conditioning chemicals at a minimum of 20 percent solids, would have to be transported based on annual average projections. It is assumed that 25 to 30 cubic yard capacity vehicles would be used which would result in 60 to 70 truck trips per day, with increased traffic volume during peak periods. The number of truck trips would increase if local load limits restrict truck carrying capacities. The ability to store sludge at the treatment plant would also be necessary to provide scheduling flexibility to match landfill operational schedules and to adjust to poor weather conditions that prevent disposal.

The primary environmental concern related to landfilling of sludge is the potential for groundwater contamination by landfill leachate. Leachate is generated from the moisture fraction of the sludge in combination with rainfall percolating through the landfill. The organic acids formed during the anaerobic decomposition of sludge can enhance the leaching of metals from the solid waste/sludge mixture. The potential for groundwater contamination

TABLE 2.8

SLUDGE AND SITE CONDITIONS (1)

Method	Sludge Solids Content, Percent	Appropriate Sludge Characteristics	Appropriate Hydrogeology	Appropriate Ground Slope
Narrow trench	15 - 28	Unstabilized or stabilized	Deep groundwater and bedrock	20 percent
Wide trench	20	Unstabilized or stabilized	Deep groundwater and bedrock	10 percent
Area fill mound	20	Stabilized	Shallow groundwater or bedrock	Suitable for steep terrain as long as level area is prepared for mounding
Area fill layer	15	Unstabilized or stabilized	Shallow groundwater or bedrock	Suitable for medium slopes but level ground preferred
Diked containment	20	Stabilized	Shallow groundwater or bedrock	Suitable for steep terrain as long as a level area is prepared inside dikes
Sludge/refuse mixture	3	Unstabilized or stabilized	Deep or shallow groundwater or bedrock	30 percent
Sludge/soil mixture	20	Stabilized	Deep or shallow groundwater or bedrock	5 percent

(1) U.S. EPA "Process Design Manual Sludge Treatment and Disposal", Technology Transfer, September 1979, EPA 625/1-79-011

can be reduced by covering the landfill, installing a liner and use of a leachate collection and treatment system. Table 2.9 lists the range of pollutant concentrations commonly found in sludge landfill leachate. Sludge quality is directly related to the quality of leachate being generated.

Groundwater monitoring wells located above and down the hydraulic gradient through a landfill provide necessary monitoring information. Changes in down-gradient groundwater quality usually indicates that leachate has moved past the liner and that a potential pollution problem may be developing.

The proper control of gases resulting from the decomposition of organic matter in a landfill also aids in reducing environmental concerns. The gas primarily consists of methane, with small amounts of hydrogen sulfide, and can reach explosive concentrations around buildings within the site area. Use of a gas collection and venting system has proven to be a successful control method. The impact of increased truck traffic between Blue Plains and Lorton on regional air quality must also be considered with this alternative.

TABLE 2.9

RANGE OF CONSTITUENT CONCENTRATIONS IN LEACHATE FROM SLUDGE LANDFILLS (1)

Constituent	*Concentration (2)*
Chloride	20 - 600
SO_4	1 - 430
Total Organic Carbon	100 - 15,000
Chemical Oxygen Demand	100 - 24,000
Calcium	10 - 2,100
Cadmium	0.001 - 0.2
Chromium	0.01 - 50 (3)
Zinc	0.01 - 36
Mercury	0.0002 - 0.0011
Copper	0.02 - 37
Iron	10 - 350
Lead	0.1 - 10 (3)
Total Kjeldahl Nitrogen	100 - 3,600
Fecal Coliform	2,400 - 24,000 MPN/100 ml (4)
Fecal Streptococcus	2,100 - 240,000 MPN/100 ml (4)

(1) Technology transfer, "Environmental Regulations and Technology Use and Disposal of Municipal Wastewater Sludge", EPA 625/10-84-003

(2) Concentrations are in milligrams per liter unless otherwise noted.

(3) The maximum concentrations shown exceed the limits specified in 40 CFR 261.24 Table 1. These limits define hazardous wastes under RCRA.

(4) MPN/100 ml = Most Probable Number/100 ml.

2.8 OCEAN DISPOSAL

To date, ocean disposal has generally not been advocated by EPA as a management option. However, the disposal of municipal wastewater sludge in the ocean through an ocean outfall pipe or by vessel has been practiced by a number of large metropolitan areas. A current report by the EPA Office of Water Regulations and Standards noted approximately 4 percent of the sludge produced in the United States is disposed of in the ocean. The Marine Protection, Research, and Sanctuaries Act (MPRSA) of 1982, P.L. 92-532, and as amended by P.L. 99-272, April 7, 1986, regulates ocean disposal and requires EPA to select appropriate disposal sites. After evaluating suitable ocean disposal sites, EPA has designated the use of deepwater areas beyond the edge of the continental shelf. The use of deepwater disposal sites increases the separation distance from other competing ocean uses and generally decreases the degree of disposal impact. The EPA issuance of an ocean disposal site permit to the District would require the demonstration that no practicable alternative is available that has less impact on the environment.

Ocean disposal of wastewater solids generated at the Blue Plains Wastewater Treatment Plant would require thickened and dewatered sludge to be loaded on a vessel at the existing plant dock. The Potomac River and Chesapeake Bay shipping channels could provide access to the Atlantic Ocean and a potential deepwater disposal site.

The type of barge equipment needed to transport the sludge to the disposal site would depend on a number of factors. A critical item in the system planning is the transit time and how it is affected by waterway traffic and water conditions. Typical barge capacities and travel speeds are listed in Table 2.10. Estimated round trip mileage to a potential deepwater site could range from 350 to 450 miles and take 2 to 3 days to complete. Because of the lengthy travel time, the decision to initiate a trip would be highly dependent upon long range weather forecasting; thus reliability is reduced. Barges are usually custom built; therefore, physical dimensions are

TABLE 2.10

TYPICAL BARGE CAPACITIES AND SPEED (1)

Barge Capacity		Average Velocity, Knots (2)		Draft in
Barrels	Gallons	Loaded	Unloaded	Feet
25,000	1,050,000	6	7	N/A
50,000	2,100,000	7	8	18
100,000	4,200,000	8	10	N/A

(1) Source: Foss Tug, Seattle, Washington, a division of Dillingham Corporation, various personal interviews with Metropolitan Engineers/Brown and Caldwell staff members, 1975 through 1976. Contained in EPA 625/1-79-011

(2) Velocities in open water. Waterway restrictions reduce average speeds.

1 barrel = 159 l = 42 gallons
1 knot = 0.51 m/s = 1.85 km/hr = 1.151 miles/hr

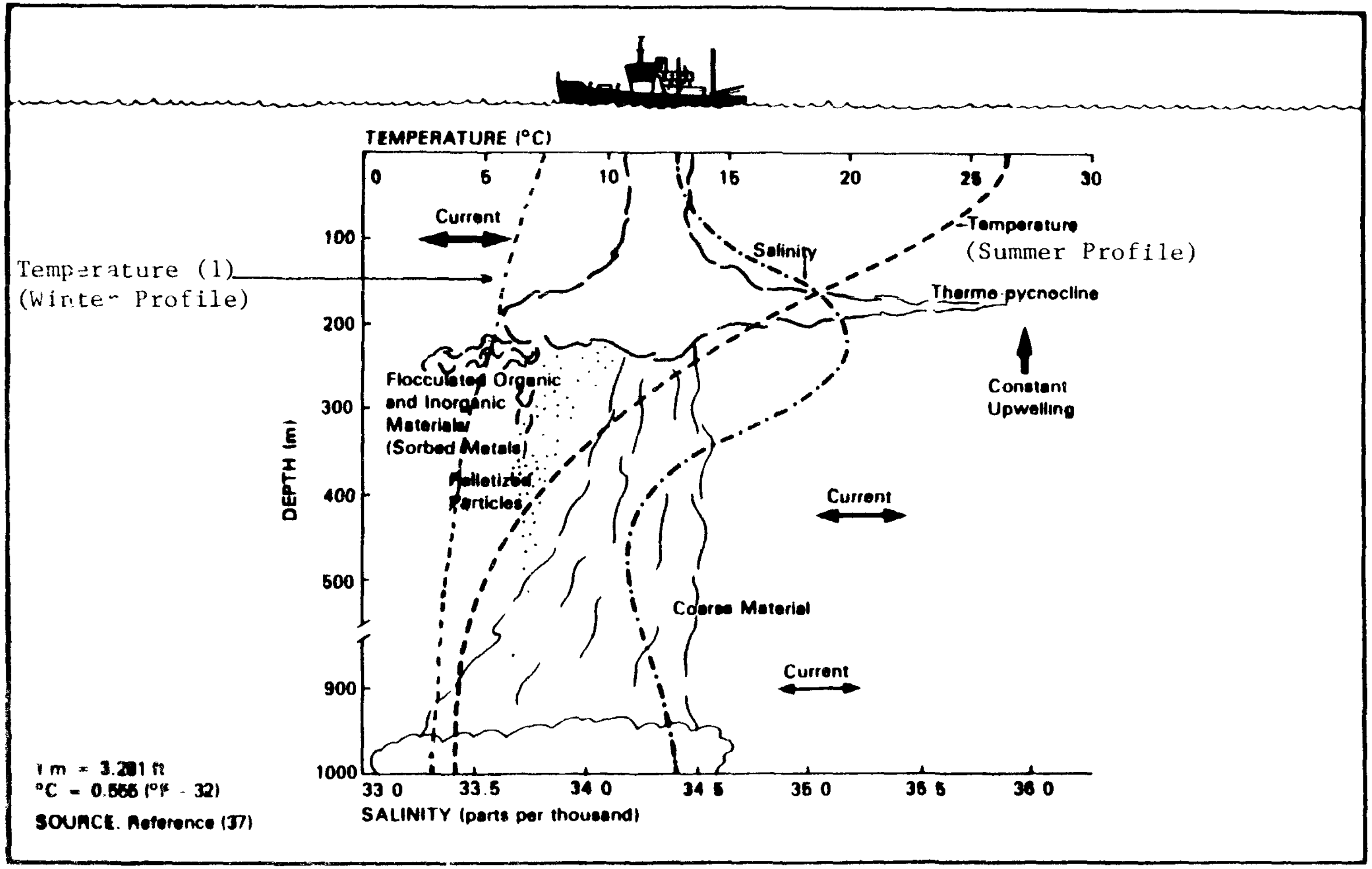
not standardized and construction lead times are around two years. Barge draft increases with capacity and would complicate navigation in the upper Potomac River.

The District would have to choose between contracting the complete barge transport services to a private firm or owning the barges and contracting just the tug services. Large capacity barges would be required because of the sludge volumes and transit time. Several days to two weeks or more of sufficient sludge storage would be required for holding solids between scheduled transit times and during inclement weather periods. Storage facilities could be constructed on-site or additional barges could be used for storage.

The EPA regulates ocean disposal activity at a given site by establishing a toxicity threshold of one-hundredth of a concentration proven to be acutely toxic to marine organisms. The Limiting Permissible Concentration (LPC) must be maintained outside the disposal site at all times and within the site for four hours after sludge discharge. The discharge rate for each vessel, the vessel speed, and ocean conditions required to obtain optimal mixing are some of the parameters considered to assure that the LPC is not exceeded.

Upon reaching the disposal site, self-propelled tankers or towed barges release the sludge which disperses in the vessel's wake. Volatile hydrocarbons contained in the sludge evaporate from the water and are dispersed in the atmosphere. The floatable sludge fraction, grease, oil, and scum remain on the surface and are moved about by the wind and currents at the disposal site.

The remaining sludge fraction sinks in an expanding cloud toward the ocean floor with the heavier sludge particles sinking ahead of the cloud (see Figure 2.12). The sinking and sludge material dispersion rates in the disposal area are dependent on temperature, salinity, depth and currents. Metals and chlorinated hydrocarbons have been observed accumulating at density gradients in the water column at disposal sites. Organisms living in the zones of accumulation are exposed to higher levels of contaminants.



Source: EPA 625/10-84-003

(1) EPA, Region III, NEPA Compliance, March, 1987.

Diagram of Wastewater Solids Deposition at Sea

Figure 2.12

Accumulation of sludge deposits on the ocean floor are dependent on disposal site depth, currents, erosional processes and storm activity. Generally, at the shallow, less turbulent sites, sludge accumulation on the seafloor has been reported.

Ocean disposal of sludge impacts the site environment through the addition of nutrients, pathogens, metals, and organic chemicals. The release of nutrients at deepwater sites tends to stimulate the ecosystem by adding limiting nutrients, such as nitrogen, necessary for biomass production. Increased production of phytoplankton and other plant life result in changes in local water quality and species composition. Pathogens released through sludge disposal may present a health risk to humans who consume shellfish that have accumulated pathogens. Stabilization of wastewater solids is not required prior to ocean disposal. However, it reduces the risk of pathogen exposure and odor potential.

The extent of increased metal and organic chemical concentration observed at a given disposal site is dependent on the sludge quality. The constituent concentrations of the Blue Plains sludge are contained in Table 2.6. The accumulation of toxic metals and organic compounds in the food chain are a concern based on the potential health effects of contaminated seafood. The biomagnification of metals in the food chain has not been reported except for methyl mercury. Regulations prohibit disposal of sludge containing mercury and mercury compounds that could raise background concentrations by 50 percent after dispersion.

Organic contaminants, such as halogenated hydrocarbons, tend to bioaccumulate up the food chain and have persistent long-term effects. Other compounds, like polycyclic aromatic hydrocarbons, do not tend to biomagnify and degrade more readily.

The risk of inland waterway pollution and potential health problems resulting from an accidental spill are also a concern. Spills during loading can be minimized through design and training. A spill prevention and cleanup program can also aid in reducing the effect of major spills. As with other alternatives, proper program management minimizes the potential for environmental impacts resulting from accidents and daily operation.

The increased barge activity on the waterways and its impact on recreational boating is an additional factor requiring consideration with this alternative. Bridge openings and potential land transportation delays at the Woodrow Wilson Bridge at I-95 are not expected from the barge activity.

CHAPTER THREE

CHAPTER 3

COST, OPERATIONAL, AND IMPLEMENTATION COMPARISON OF SLUDGE MANAGEMENT METHODS

3.1 INTRODUCTION

This chapter begins a three-phased evaluation and screening of sludge management options. The first phase includes cost, operation and implementation comparisons of the sludge management methods described in Chapter 2. The comparison presumes that all of the sludge subject to this EIS (200 DTPD/384 DTPD) is handled/disposed entirely by one of the management methods.

3.2 COST COMPARISON

A present worth analysis has been performed to compare the overall cost characteristics of the management methods. The present worth of an alternative is defined as the current value of future capital and operation and maintenance costs discounted at the EPA stipulated rate. The results of the present worth analysis are summarized in Table 3.1. Cost details are contained in Appendix G.

The analysis was performed under the following assumptions:

- *A 20 year planning period beginning in 1988*
- *Equipment life of 20 years and structure life of 40 years*
- *Federal discount rate of 8.625 percent*
- *No phasing of construction activity*
- *All construction within current plant site*
- *Any investments in existing wastewater treatment facilities made before or during facilities planning are sunk costs and excluded from the cost analysis.*

TABLE 3.1

SUMMARY OF SOLIDS MANAGEMENT METHODS
PRESENT WORTH COST ANALYSIS (1)

Cost Component	Dewatering Incineration and Ash Landfilling (2)		Dewatering Drying and Product Use (3)	Dewatering In-Vessel Composting and Product Use (3)	Ocean Disposal of Dewatered Sludge (4,5)	Land Application of Dewatered Sludge (2,5)	Landfilling of Dewatered Sludge (2,5)
	Alternative I Six Units (8)	Alternative II Four Units (9)					
CAPITAL COSTS							
1988 Estimated Project Cost	$112,868,000	$96,347,000	$75,147,000	$184,190,000	$0	$17,490,000	$17,490,000
OPERATION AND MAINTENANCE COSTS							
Annual O&M Cost	9,460,000	8,966,000	7,283,000	9,833,000	8,164,000	18,360,000	22,847,000
Present Worth Annual Cost (9.3778)	88,714,000	84,081,000	68,299,000	92,212,000	76,560,000	172,176,000	214,255,000
SALVAGE VALUE (6)							
Plant Structures 40 Years (50%)	18,657,000 9,329,000	17,759,000 8,880,000	15,839,000 7,920,000	71,547,000 35,774,000	0 0	0 0	0 0
Present Worth Salvage Value (0.1912)	1,784,000	1,698,000	1,514,000	6,840,000	0	0	0
PRESENT WORTH (PW)							
Capital Cost +	112,868,000	96,347,000	75,147,000	184,190,000	0	17,490,000	17,490,000
PW Annual Cost -	88,714,000	84,081,000	68,299,000	92,212,000	76,560,000	172,176,000	214,255,000
PW Salvage Value	1,784,000	1,698,000	1,514,000	6,840,000	0	0	0
PW of Alternative	199,798,000	178,730,000	141,932,000	269,562,000	76,560,000	189,666,000	231,745,000
TOTAL ANNUAL EQUIVALENT COSTS (0.1066)	$21,298,000	$19,053,000	$15,130,000	$28,735,000	$8,164,000	$20,218,000	$24,704,000
ESTIMATED ANNUAL EQUIVALENT COST PER DRY TON (7)	$292	$261	$207	$394	$112	$277	$338
Alternative Ranking	5	3	2	7	1	4	6

(1) Values based on a 20 year planning period, 8.625% federal discount rate, EPA construction cost index base year 1973 large city, consumer price index and Appendix
(2) Based on Engineering-Science concept design cost information and excludes sunk cost associated with incinerator section of Solids Processing Building.
(3) Based on cost documentation from Engineering-Science and Manufacturer's information.
(4) Based on current contract cost information provided by Eastern Research Group Inc., Arlington, Massachusetts.
(5) Based on cost information supplied by the District.
(6) Based on EPA established guidelines.
(7) Based on an annual loading of 73,000 dry tons of sludge solids.
(8) Based on Engineering-Science concept design for construction of six units.
(9) Based on EPA recommendation for costing the construction of four units.

The management methods were assigned the ranking shown in the last row of Table 3.1 based on their equivalent cost values. Ocean disposal has the lowest overall and unit cost as compared with composting which has the highest unit cost. In terms of cost, the six unit sludge incineration with ash landfilling alternative, which is proposed by the District, ranks fifth out of the seven alternatives. The four unit incineration option ranked third. The second and fourth ranked alternatives respectively are drying with product use and land application with product use.

The cost analysis is limited to the existing conditions. Alternatives which are highly dependent on private sector contracts (such as land application) have a higher risk of a substantial increase in unit cost over the period(1). This risk factor is not reflected in the evaluation, but must be considered in the overall decision making process. Generally, methods which maximize fixed cost and minimize variable costs (e.g. annual O&M costs) have a lower likelihood of varying substantially from the cost estimate results shown here.

The component costs per dry ton for each method are summarized in Table 3.2. The impact of upgrading the dewatering process is reflected in all of the methods except ocean disposal. The composting, land application, and landfilling cost evaluations assume the use of centrifuge dewatering units which would be installed in the existing Solids Processing Building. The land application and landfilling costs include the chemical cost for post-liming and account for the additional disposal tonnage resulting from the lime addition. The in-vessel composting facility capital cost factor was developed on a peak facility loading of 384 DTPD.

The incineration, drying, and composting component values include credits for power, dry product contract sale revenue and compost product contract sale revenue. It was assumed the District staff would not be involved with the marketing, transportation, and distribution of sludge products. These activities would be completed by a contractor who would also guarantee removal of the sludge product from the site on a regular basis.

(1) Multiple competitive bid contracts with long-terms of at least 5 years and fee increases limited by an appropriate economic index represent management practices available to lower the risk of increase.

TABLE 3.2

SUMMARY OF ANNUAL EQUIVALENT COST PER DRY TON (1)

Cost Component	Estimated Annual Equivalent Cost Per Ton						
	Dewatering Incineration and Ash Incineration		Dewatering Drying and Product Use	Dewatering In-Vessel Composting and Product Use	Ocean Disposal of Dewatered Sludge	Land Application of Dewatered Sludge	Landfilling of Dewatered Sludge
	I (3)	II (4)					
Dewatering	$125	$125	$125	$76	$65	$95 (5)	$95 (5)
Incineration	$125	$94					
Drying			$82				
In-Vessel Composting				$318			
Ocean Disposal (2)					$47		
Land Application (2)						$182	
Landfilling (2)	$42	$42					$243
Total Estimated Annual	$292	$261	$207	$394	$112	$277	$338

(1) Based on information from Table 3.1, Appendix G, and the proposed annual loading rate of 73,000 dry tons of sludge solids.
(2) Values include cost of transportation.
(3) Based on Engineering-Science concept design for construction of six units.
(4) Based on EPA recommendation for costing the construction of four units.
(5) Equivalent Cost includes Costs Associated with Post-Liming.

The product unit prices shown in Appendix G are based on discussions with sludge product distribution firms; are intended to be conservative; and would ultimately be set by future product availability and demand.

3.3 OPERABILITY EVALUATION

Assessment of operability provides a measure of the ability of a given solids management system to continuously provide the intended disposal service. The evaluation of operability includes the following three factors:

- *Reliability;*
- *Flexibility; and*
- *Maintainability.*

Reliability concerns the propensity of the process to continually function over the planning period. Flexibility is a measure of the system's ability to adapt to changing conditions and meet the disposal requirements. Maintainability reflects the complexity of equipment, frequency of maintenance down time, and maintenance ease. The results of the operability evaluation are summarized in Table 3.3.

3.3.1 Reliability

The reliability of a given method is judged by a combined measure of the process complexity and the ability of the District to control the management system. The greater the complexity, the less reliable the system because of the greater potential for failure. Also, the greater the degree of vertical management integration the greater the reliability because of decreasing impact of uncontrolled factors. The degree of vertical management integration has been weighted equally with system complexity in this rating.

A major component of each system management includes the labor requirements. Generally, the greater the complexity or dependence on high technology and the longer the operating period, the greater the impact of the labor component on system reliability. The incineration method is dependent

TABLE 3.3

SUMMARY OF OPERABILITY EVALUATION

Method	Reliability(1)	Flexibility(2)	Maintainability(3)	Overall Operability(4)
Incineration With Ash Landfilling	Moderate	Moderate	Low	Moderate
Agricultural Land Application of Dewatered Sludge	Moderate	Moderate	High	Moderate
In-Vessel Composting and Product Use/ Disposal	Moderate	Moderate	Moderate	Moderate
Drying and Product Use/Disposal	Moderate	Low	Low	Low
Landfilling Dewatered Sludge	Low	Low	Moderate	Low
Ocean Disposal	Low	Low	Moderate	Low

Note: Rating Value

High - Positive or Desirable; 3
Moderate - Neutral; 2
Low - Negative or Undesirable; 1

Rating ranges, 4-12 possible

4-6 Low
7-9 Moderate
10-12 High

(1) Based on process complexity and management control of system.

(2) Based on the ability to adapt to changing conditions.

(3) Based on equipment complexity, frequency of maintenance, and general accessibility.

(4) Calculated by assigning the numerical values noted above, multiplying the reliability by two and adding across.

on the highest skilled labor force over a 24-hour operational period. In contrast, land application of sludge requires a lower skilled labor force and the operational period is typically dawn to dusk.

Each of the methods being evaluated has reliability hindering characteristics over the planning period and none of the alternatives received a high reliability rating. Incineration has been given a moderate rating based on its high degree of process complexity and high level of management control required for the system to remain functional. Drying, composting, and land application have a moderate rating based on the degree of risk associated with final product disposal site availability. In addition, these methods are dependent on private contractors for final use or disposal of the sludge. Ocean disposal and landfilling methods were given a low rating because of the assumed unavailability of existing disposal sites, the current regulatory trend against those forms of disposal, and because disposal would be dependent on private contractors.

3.3.2 Flexibility

Flexibility is an assessment of a system's ability to adapt to changing conditions while continuing to meet the disposal requirements. Methods with minimum dependence on fixed facility processing equipment, with low energy input, and with readily expandable disposal capacity earn a high rating. The incineration, land application, and composting methods satisfy a majority of the flexibility criteria through system redundancy and received a moderate rating. The drying method has a low rating primarily as the result of end product characteristics which limit its use. Landfilling and ocean disposal methods have low ratings because of their inability to meet disposal needs caused by a lack of potentially permittable disposal sites.

3.3.3 Maintainability

The maintainability rating of a method is based on a number of criteria. These criteria include the equipment complexity, required degree of maintenance, and the general accessibility of items to be maintained. The incineration and drying methods involve the use of large, highly mechanical, high temperature process and air pollution control equipment. These equipment components by nature require a high level of maintenance. Therefore, the incineration and drying methods have a low maintainability rating. The land application method has a high maintainability rating because it uses a minimum amount of commonly available equipment. Ocean disposal and composting methods use specialized equipment which is relatively less complex than the incineration or drying equipment so they are assigned a moderate rating. Landfilling also receives a moderate rating based on a concern for leachate pollution and inaccessibility of leachate collection and containment systems once installed.

3.3.4 Overall Operability

Overall operability is based on a weighted summation of reliability, flexibility and maintainability. Reliability is considered to be of greater importance than flexibility and maintainability and is "weighted" at twice the value of the other factors. High, moderate, and low ratings of 3, 2, and 1 respectively, were assigned to each factor for each alternative. The ratings were added and the totals compared. The totals ranged from 6 to 9 with a possible range of 4 to 12. Through the rating procedure, land application, incineration, and composting received a moderate rating, and ocean disposal, drying, and landfilling received a low rating.

3.4 IMPLEMENTABILITY EVALUATION

The implementability evaluation considers the practicalities of implementing a specific sludge management method. The implementability evaluation rating provides a method for assessing the factors that affect the successful implementation of the methods based on public and institutional realities. The factors to be considered and assessed are public acceptability and management concerns.

Unlike the other evaluations, the implementability rating is not independent, but rather is somewhat dependent on the results of the other evaluations. This is especially the case with public acceptance which is influenced by costs, the environmental impacts of the various alternatives, and project location.

3.4.1 Public Acceptability

Public acceptability of a sludge management method is crucial to the alternative's total implementability. The degree of public acceptance for each alternative is listed in Table 3.4 and is based on the historical and current public reactions related to sludge management in the area. The landfilling and ocean disposal methods are considered unacceptable because of the high risk of environmental impact associated with each alternative.

Land application of sludge at existing permitted sites, and composting at Blue Plains, are presently accepted by the public. Some people who live in the immediate vicinity of land application sites object to the odors and to the truck traffic. The District staff have reported that local opposition groups have been formed in some areas and strong opposition has resulted in the termination of land application permits. The long-term public acceptance of land application and composting in the region is difficult to predict. Public opposition to land application and composting may increase as the regional population increases. However, this could be offset through a public relations program.

TABLE 3.4

SUMMARY OF IMPLEMENTABILITY CHARACTERISTICS

Alternative	Public Acceptability	Management Concerns	Overall Implementability Rating
Incineration With Ash Landfilling	Public Concern Related to Air Pollutants Stack Height	o Control of Air Pollutants to Meet Approved Emission Rates o Continued Availability of Ash Landfill Disposal Site o Maintenance and Repair Scheduling	High
Agricultural Land Application of Dewatered Sludge	Publicly Acceptable at Most Current Sites Local Opposition to Site Odors, Truck Traffic	o Contract Management o Continue Application Site Availability, State and any Local Permit Requirements o Sludge quality o Seasonal Limitations o Hauling Distance	High
In-Vessel Composting and Product Use/	Publicly Acceptable at Blue Plains (FONSI)	o Very Limited On-Site Area to Construct and Expand Composting Facility o Product Marketability o Contract Sale Management o Sludge Quality	Moderate
Drying and Product Use/Disposal	Public Acceptability Unknown at Blue Plains	o Control of Air Pollutants to Meet Approved Emission Rates o Product Marketability o Contract Application Management o Continued Application Site Availability o Sludge Quality o Fire Hazards	Moderate
Landfilling Dewatered Sludge	Publicly Unacceptable	o Approval of Lorton Landfill to Receive Sludge or Establishment of a New Disposal Site o Continued Landfill Capacity o Control of Leachate and Protection of Groundwater Quality.	Low
Ocean Disposal	Publicly Unacceptable	o Contract Tug and Barge Equipment o Transportation to and from Disposal Site o Approval of Disposal Site and Continued Site Monitoring	Low

Public acceptability of both incineration and sludge drying at Blue Plains is unknown, but both have been accepted in other regional areas. Public acceptance of these alternatives is dependent on not only the control but the perception of air pollutants at levels below which health related concerns are an issue. In addition, the public acceptance of the visual impact of the incinerator stacks where no major stacks exist is difficult to assess.

3.4.2 Management Concerns

Management concerns associated with the sludge management methods involve aspects of construction, operation, and maintenance. The concerns related to each method are shown in Table 3.4. Method has to effectively address the management concerns to be successfully implemented. The District staff, for example, have indicated a reluctance to enter a long-term sludge management program which is heavily dependent on variables beyond the District's control. This reluctance is based on experiences with sludge disposal through the 1970's and early 1980's.

In the view of the District staff, the incineration method provides a disposal system having a minimum number of variables outside its control. The success of the incineration method would be dependent on the ability of highly qualified personnel operating the complex incinerators. In contrast, the methods which rely on final disposal sites that are not owned by the District and are impacted by changing public attitudes have more uncontrollable variables.

3.4.3 Overall Implementability

The overall implementability rating of each method is shown in Table 3.4. A low rating was assigned to the ocean disposal and landfilling method because of the lack of public acceptance and existing permitted disposal sites; and because of the expected difficulty in obtaining a new disposal site permit.

Land application has been given a high implementability ranking. Land application is currently a functioning management practice which, through good management to minimize public opposition and meet regulatory control, could continue to meet the disposal needs. While long-term availability of sites and continuing regulatory measures require careful management, this method has proven to be highly implementable.

Drying and product use merits a moderate rating because of uncertainties associated with the ability to control air pollutants cost effectively, and because of questions about final disposal of the product.

Incineration is given high rankings for implementability. Incineration will handle, on a long-term basis, the volumes of sludge designated for this process. In addition, there is space available for the units and this technology is functioning and permitted in other areas. The major concerns with incineration are air pollution and the visual impact of the stacks.

Lorton landfill is remote from developed areas and is therefore unlikely to be found more aesthetically unappealing through the disposal of ash or dewatered sludge. The site is surrounded by trees which provide an effective visual buffer for all local roadways except the weigh station area off Furnace Road. No significant aesthetic impact is foreseen from the use of Lorton landfill as a disposal site.

In-vessel composting is given a moderate rating. The generally favorable experience with composting, and the decision relative to the FONSIed portion of the sludge favor its implementability. However, the severe site restrictions, the substantial structural requirements associated with "stacking" the in-vessel units, and the somewhat experimental aspects of constructing and operating an overall composting facility of this size, partially offset the favorable aspects.

3.5 REGULATORY FRAMEWORK

The development of any management method at Blue Plains must abide within a network of regulations at the Federal, state and local levels. A list of pertinent regulations relating to sludge handling and disposal are provided in Appendix A. This section will review some of the regulatory obstacles that lie in the path of developing any particular method.

3.5.1 Incineration With Ash Disposal

Major considerations here are air pollution regulations for emissions and disposal of the ash resulting from the incineration process. Emissions from the incinerator must meet New Source Performance Standards (NSPS), Prevention of Significant Deterioration (PSD) criteria and District of Columbia, Department of Consumer and Regulatory Affairs Environmental Standards.

The proposed air pollution control systems - the afterburner, the wet scrubber and the wet electrostatic precipitator - would allow the incineration system to meet existing emission requirements in the area. Furthermore, with proper attention to restricting the burn rate of sludge, emissions can be held at levels that would not trigger a PSD review.

Ash generated from the incineration process would be landfilled. The Lorton Landfill is the logical recipient of the ash. This landfill is controlled by Commonwealth of Virginia regulations that currently prohibit the landfilling of dewatered sludge at Lorton because of its location in the Occoquan River watershed.

3.5.2 Land Application

Land application of dewatered sludge from Blue Plains is currently used by both Virginia and Maryland. Both states require permits for land application and have established guidelines for land application siting, pathogen, nutrient and heavy metal content and for determination of application rates.

3.5.3 Composting

Composting of Blue Plains sludge is currently performed at Blue Plains and in Montgomery County, Maryland. The State of Maryland regulates compost quality, including moisture content and nutrient and metal content. Maryland requires a distribution permit and both Maryland and Virginia require permits for construction of a composting facility.

3.5.4 Drying and Product Use

The primary method of disposal of the dried sludge pellets that result from heat drying sludge is land application. Dried sludge pellets will have the same properties as dewatered sludge once they are land applied. Therefore, it is assumed that the regulatory guidelines established by the Commonwealth of Virginia and the State of Maryland for land application will also apply to the dried sludge pellets.

3.5.5 Landfilling

Lorton Landfill in Virginia, which is located in the Occoquan River watershed, previously received sludge and remains the only regional site with potential for landfilling dewatered sludge. However, because of concern by the Commonwealth of Virginia regarding the potential contamination of the watershed, landfilling of dewatered sludge at the site is prohibited. The District has evaluated the development of various new landfill sites within the region but none have met necessary siting specifications.

3.5.6 Ocean Disposal

The Marine Protection, Research and Sanctuaries Act establishes a schedule for phasing out ocean disposal of sewage sludge in favor of other land-based management programs. EPA will grant a permit for disposal only if the applicant can clearly demonstrate that no practicable alternative is available that has less impact on the environment. In the case where ocean disposal is deemed a feasible method, locating a suitable site and completing the permitting process are difficult.

3.6 SUMMARY COMPARISON

Table 3.5 provides a summary comparison of the cost, operability and implementability evaluations for each method. Also included is a ranking relative to the existing local, state and federal regulations and guidelines.

Incineration and in-vessel composting have a good rating for operability and implementability but rank fifth and seventh respectively in the cost analysis. The present worth cost analysis for the incineration alternative was determined for both the construction of the proposed six unit system and for construction of a four unit system. Option I (six units) had a higher cost ranking than option II (four units), placing option II in a moderate ranking in cost when compared to the other alternatives. Landfilling of sludge and ocean disposal have low operability and implementability ratings. Ocean disposal has the lowest present worth ranking while landfilling is ranked sixth. Land application ranks fourth while drying and product use is ranked second.

The ocean disposal and landfilling methods have a low ranking within the existing regulatory framework. Since landfilling of dewatered sludge at the Lorton Landfill is currently prohibited by the Commonwealth of Virginia, this method is not feasible until a suitable landfill site is found and permitted. The current regulatory trend is against ocean disposal and EPA will grant a permit to the District only if no practicable alternative is available with less impact to the environment.

Incineration, land application, composting, and drying and product use all received a moderate regulatory framework ranking. Each of these alternatives must be implemented and operated within a well-defined regulatory network.

In summary, the incineration, composting, and land application appear to have moderate operability and regulatory status with moderate to high implementation potential. The four unit incineration alternative has the lowest cost ranking of this group followed by land application, six unit incineration, and composting. Landfilling, which has the sixth highest present worth cost, and ocean disposal, with the lowest, both appear to have the lowest status for operability and implementability. The regulatory framework, as previously stated, appears to discourage the use of these alternatives.

TABLE 3.5

SUMMARY OF TECHNICAL EVALUATIONS
AND REGULATORY FRAMEWORK

Alternative	Cost Ranking[1]	Operability	Implementability	Regulatory Framework
Incineration With Ash Landfilling				
Alternative I (*)	5	Moderate	High	Moderate
Alternative II (**)	3	Moderate	High	Moderate
Land Application of Dewatered Sludge	4	Moderate	High	Moderate
In-Vessel Composting	7	Moderate	Moderate	Moderate
Drying and Product Use and Disposal	2	Low	Moderate	Moderate
Landfilling Dewatered Sludge	6	Low	Low	Low
Ocean Disposal	1	Low	Low	Low

* I - Based on construction of six units.
** II - Based on construction of four units.

(1) Based on Table 3.1 cost evaluation data.

CHAPTER FOUR

CHAPTER 4

AFFECTED ENVIRONMENT OF THE METHODS AND MITIGATIVE MEASURES

4.1 ENVIRONMENTAL IMPACTS OF THE METHODS

The potential impacts of the sludge management methods are reviewed in terms of their effects on the natural environment and the man-made environment. Methods evaluated are incineration, land application, composting, drying and product use, landfilling, ocean disposal and no action. The no action method is considered the combination of land application and the FONSI'd composting which proposes the in-vessel composting of 123 DTPD on an average basis.

Concerns for the natural environment include potential impacts on soil, water quality, air quality, noise levels and life systems. Impacts on the man-made environment include effects on the transportation systems, community facilities, land-use planning, socioeconomics and aesthetic quality. Prior to any new construction or expansion at the Blue Plains facility, consideration was given to permit requirements, the availability of disposal sites and the implementability of mitigative measures.

4.2 NO ACTION

The no action method at the Blue Plains Wastewater Treatment Plant is the continuation of land application, and the use of in-vessel composting at Blue Plains, and composting at the Montgomery County Composting Facility - Site II.

The present dewatered raw sludge at Blue Plains amounts to about 1,000 WTPD at an average of 17 percent total solids. Dewatered sludge is hauled on a scheduled basis from the outloading stations to the existing JABB composting operation, to the Montgomery County Composting Facility (MCCF), or to an on-site temporary sludge storage tank. From the storage tank, the dewatered sludge is transported by truck to land application sites.

About 360 WTPD are hauled to the JABB composting operation located on the Blue Plains site during the midnight to noon time period each day, and from 150 to 200 WTPD are hauled to the MCCF - Site II location during the morning to early afternoon hours. The remaining 600 to 700 WTPD are transferred to the sludge storage tank and hauled off site for land disposal during daylight hours. (13) Existing sludge management methods at the Blue Plains facility and those proposed by the District of Columbia for the next 20 years are compared on Table 4.1.

TABLE 4.1

EXISTING AND DISTRICT PROPOSED
BLUE PLAINS SLUDGE DISPOSAL METHODS

	Existing(1)	Percent of Total	Future (Ave.)(2)	Percent of Total
Composting On-Site	72.0 DTPD	28.5	123.0 DTPD	30
Composting MCCF	40.0 DTPD	16.0	87.5 DTPD	21
Land Application	140.0 DTPD	55.5	-	
Incineration	-	-	200.0 DTPD(3)	49
Ash Disposal/Lorton Landfill	-	-	(88.0 DTPD)	-
Total	252.0 DTPD	100	410.5 DTPD	100

(1) District of Columbia, Department of Public Works, Bureau of Wastewater Treatment and Sludge Management. Calculations based on 20% solids.
(2) Engineering-Science, Task 11-10F, October, 1986.
(3) Incineration results in 88 DTPD to be landfilled.

4.2.1 Land Application

A number of environmental problems may result from stockpiling sludge prior to land application. The potential for leachate formation is increased, and if the guidelines are not followed, the leachate may eventually pollute groundwater and surface waters. Surface water pollution would affect bird and small mammal habitats on the southern shore of the site. The Potomac River and Oxon Cove provide substantial aquatic habitats and numerous federal agencies have made an effort to improve water quality within these areas. Unmanaged leachate could lead to a loss of habitat. Groundwater pollution could also be a problem where nitrates would be the major problem if any exist at all.

The stockpiling of dewatered sludge creates conditions for anaerobic decomposition and an environment for bacterial growth. This situation could result in odors which are difficult to control.

Measures to reduce the impacts of increased solids include:

- *Off-site storage facilities;*
- *Expansion of sludge product market;*
- *Diversion of wastewater to other treatment facilities; and*
- *Limits on new construction in the area served by the collection system.*

Approximately 600 to 700 WTPD of dewatered sludge are presently being transported from Blue Plains, stored and applied to meet crop nutrient requirements at specific application sties in Maryland and Virginia.

The potential for overloading the soils with nutrients and trace metals affects the acceptability of land application. Metal accumulations in soils are strictly regulated by Maryland and Virginia. The transfer of metals into soils depends on the metal content of the sludge. Blue Plains sludge contains low concentrations of metals thus reducing the impact from contamination of the soils at the application sites. An estimate of the loading rates for nutrients and regulated metals from the Blue Plains sludge appears in Table 4.13. It is important to note that the calculation of loading rates and life expectancies for land application sites is affected by the topography, soil characteristics and the potential for pollution of surface and groundwater at a particular site.

Land application of sludge may pose a public health risk if certain spore-forming bacteria or parasite ova are transferred to the site. Plants, especially root crops, may pick up contaminants and run-off from agricultural fields where sludge has been applied may also pollute surface waters. If groundwater is polluted, wells that are the source of drinking water for some residences may become contaminated. A number of criteria and processes which are described in Section 4.4 have been established by regulatory agencies which significantly reduce the risk to the public from pathogens in sludge.

The dewatered sludge to be used for land application will be transported from the Blue Plains site to permitted storage lagoons. Proper maintenance and operation of the storage lagoons is necessary to avoid spillage of sludge and leachate formation.

4.2.2 Composting

Environmental concerns associated with existing composting operations include odor and leachate formation. Proper management of the compost operation is necessary to produce a quality product. In general, leachate and odor problems depend upon the moisture content of the compost and can be controlled with proper site management and leachate collection systems. Proper aeration and mixing of the compost material should help to reduce odor and moisture problems. The composting area at Blue Plains contains a leachate collection system and the potential for surface or groundwater contamination should be controlled.

Personnel at Blue Plains report problems with the composting operation caused by excessive moisture and mechanical problems with the aeration equipment. At the present time, approximately 75 percent of the compost is being recycled back into the compost pile as bulking material and for use as cover for the sides of the piles. The remaining 25 percent is supplied to the District for use as soil conditioner by the Parks Department, Fort Meyer and Washington National Airport.

Blue Plains staff report that much emphasis is being placed on producing a marketable compost material. The District plans to contract with a marketing service to find and develop a market for sludge compost. The delays in marketing Blue Plains compost are, in part, attributable to the fact that Maryland requires a general distribution permit and before a permit can be obtained, the compost must meet certain quality criteria.

Blue Plains is planning to replace their aerated static-pile composting operation with an enclosed in-vessel system. This facility would handle an average of 123 DTPD and has already received a Finding of No Significant Impact. Current planning by Blue Plains would have this facility fully operational by 1995. The District plan indicates that a Phase I composting project capable of processing about 60 DTPD will be completed by 1992 and a Phase II project of similar capacity by 1995. Impacts from this facility would be similar to those outlined in Section 4.5, Composting, of this Chapter.

Space at Blue Plains has been set aside for this in-vessel operation and should not conflict with planned construction of denitrification facilities at Blue Plains.

Composting operations at the MCCF Site II have been successful and little difficulty in marketing the compost has occurred. Site II is presently operating at 50 percent capacity and could handle an additional 200 WTPD. Efforts to expand the Site II operation have been met with opposition by nearby residents who fear the potential for odor from the dewatered sludge. Compost has only a slight musty odor and should not contribute to odor problems.

The composting alternative for managing sludge represents an environmentally acceptable practice. Proper management of the composting operations can result in a high quality soil conditioner that is environmentally safe.

4.2.3 Man-Made Environmental Impacts

The primary method of transporting dewatered sludge to storage facilities and land application sites is by large capacity trucks. Trucks are also necessary to deliver compost material to buyers. Both of these methods are dependent on a large number of trucks and can have a significant impact on the regional transportation system. Traffic flow patterns on I-295 and I-95 would be affected by trucks entering and leaving the Blue Plains site. Trucks emit pollutants that would contribute to existing regional air quality problems. The region around Blue Plains is a nonattainment area (NA) for ozone and carbon monoxide. Any truck noise due to the large number of trucks would be buffered by other vehicular traffic on I-295 and I-95. (See References #1 and 2, CDM, District of Columbia Final Report, Sludge, Solid Waste, Co-Disposal Study and Supplemental Report, July 1984).

The present composting operations and land application practices are managed through a group of contractors. The District feels that dependence on outside contractors makes them vulnerable to labor disputes and general uncertainty due to the lack of management control. Another variable they perceive is the extent of the compost market. The District is presently exploring the idea of contracting with a marketing service in an effort to stabilize the composting operations and gain access to the marketplace.

The availability of land application sites for Blue Plains sludge disposal has frequently been an issue. Currently there are 22,695 acres in Maryland permitted to receive sludge. Virginia has permitted 47,179 acres. Table 2.5 in Chapter 2 provides a summary of contract land applications in the various counties in Maryland and Virginia.

It should be noted that both Virginia and Maryland do not permit sites exclusively for Blue Plains sludge, but from several wastewater treatment plants. Nevertheless, there is adequate permitted land available for the foreseeable future to dispose of the 200 dry tons per year of sludge that is the concern of this EIS.

Public acceptance, which is crucial to the success of any sludge management alternative, will remain a major consideration in the use of sludge on agricultural lands. Farmers are interested in using sludge and compost to reduce commercial fertilizer costs within state or federal guideline.

4.3 INCINERATION (District's Proposal)

The District of Columbia has proposed to use incineration at Blue Plains with final ash disposal at the Lorton Landfill as a major component of its long-term sludge management plan. An average of 200 DTPD of polymer-conditioned dewatered sludge would be incinerated on an annual basis in fluidized bed furnaces. The ash resulting from the combustion process would be carried out of the furnace with exhaust gases and removed in a scrubber system.

4.3.1 Air Quality Impacts

Engineering-Science (ES) performed various analyses for the District of Columbia in order to evaluate the impacts of air emissions on the ambient air quality in the region surrounding the Blue Plains facility. The studies identified the specific air pollutants emitted from existing sources at Blue Plains and projected the levels of the significant air pollutants emitted from the proposed incineration system as determined through the use of EPA-approved dispersion models. This section summarizes the findings of those studies.

4.3.1.1 Regulations

Sludge incineration at Blue Plains will be regulated by the criteria established by the New Source Performance Standards (NSPS); the National Emission Standards for Hazardous Air Pollutants (NESHAP); the District of Columbia, Department of Consumer and Regulatory Affairs (DCRA) Environmental Standards; and the Prevention of Significant Deterioration (PSD) standards. The regulated pollutants are ozone (O_3), total suspended particulates (TSP), sulfur oxides (SO_x), nitrogen oxides (NO_x), carbon monoxide (CO), lead (Pb), mercury (Hg) and beryllium (Be). The control of visible emissions and odors will fall under the District's regulations. Since the Blue Plains facility is located within a nonattainment (NA) area for O_3 and CO; thus NA regulations will apply if emissions of CO and volatile organic compounds (VOC) exceed the established limits. VOCs are precursors to the formation of O_3.

The area around the Blue Plains plant is classified as a PSD Class II area. There are no PSD Class I areas within 10 kilometers of the plant. The nearest Class I is located 103 kilometers from Blue Plains. Class I areas are designated environmentally sensitive and have very stringent air quality deterioration limits. Examples are national parks and wildlife preserves. Class II areas are those areas which consist of populated and industrial centers where limited industrial growth is allowed.

According to PSD and District of Columbia regulations, the Blue Plains facility is presently not considered a major pollution source. However, a PSD permit review will be required if expected emissions of TSP, SO_2 or NOx from the proposed sludge incinerators are equal to or greater than 250 tons per year. EPA requires that State Implementation Plans (SIP) address stationary sources with lead (Pb) levels in excess of 5 tons per year (40 CFR Part 51). Nonattainment area review will be required if CO or VOC emissions are equal to or greater than 100 tons per year. The NESHAP standards regulate emissions of mercury to 3,200 grams and beryllium to 10 grams over a 24-hour period.

The District's regulations are restrictive regarding visible emissions. Discharges from stationary sources may not exceed 40 percent opacity for two minutes in a 60-minute period or 12 minutes in any 24-hour period during start-up, cleaning, soot blowing, adjustment of combustion controls or malfunction. (DCRA, Section 600.3). Zero opacity emissions are required at all other times. The District's regulations also prohibit the emission of odorous or other nuisance air pollutants which are likely to be injurious to public health and welfare.

4.3.1.2 Emissions - Existing Sources

An analysis of air emissions from existing sources at the Blue Plains facility determined that the regulated air pollutants were below the established levels. Table 4.2 summarizes the average annual emissions of TSP, SO_2, CO, VOC and NOx. The major source of SO_2, NOx and CO is from the burning of fuel in boilers for space heating. Flaring digester gas emits NO_x and CO. Particulate emissions result primarily from composting operations and, to a lesser extent, from the boilers.

During the month of February 1986, Engineering-Science (ES) conducted a sampling program to identify individual VOCs present in the Blue Plains wastewater influent and effluent. (14) The results are summarized in Table 4.3 and are shown with results of a similar study performed by Black and Veatch in 1980. The Black and Veatch study was limited to priority pollutants as defined by EPA (see Appendix C) while the ES study determined total VOC emissions.

The Black and Veatch findings were comparable with results of EPA treatment plant sampling programs in other cities. (48) Concentrations of VOCs found in the influent at Blue Plains were, on the average, lower than what was detected in samples from 20 other cities. Also, the frequency of the occurrence of priority pollutants was generally lower at Blue Plains than in other cities.

Results of the ES survey indicated several findings:

- *No benzene was detected during the Engineering-Science survey,*
- *Engineering-Science sampling identified 13 VOCs, of which only eight were priority pollutants,*
- *Acetone (not a priority pollutant) constituted 86 percent of the VOCs in the influent.*

The ES findings are comparable to those of an EPA study of acetone loading to receiving waters. (49)

4.3.1.3 Emission Factors

In order to establish criteria to project emissions from the proposed Blue Plains incineration system, current emission test data from 60 sludge incinerators were reviewed and compiled by the District. The EPA source data (AP-42 document) was also reviewed but did not include data for

TABLE 4.2

AIR EMISSIONS SUMMARY
EXISTING BLUE PLAINS OPERATIONS

Process	Annual Average Emissions (tons per year)				
	TSP	SO_2	CO	VOC	NO_x
Wastewater (1) Treatment	-	-	-	58	-
Boilers (2)	2	22	9	-	33
Flares (3)	-	-	3	-	12
Composting	4	-	-	-	-
Total	6	22	12	58	45

(1) Based on Engineering-Science sampling for total and individual VOCs.

(2) Based on burning 194,319 gallons of #2 fuel oil with a sulfur content of 0.2%, 237,713 gallons of #4 fuel oil with a sulfur content of 1% and 374 million cubic feet of digester gas with an H_2S content of 4 ppm by volume.

(3) Based on burning 174 million cubic feet of digester gas in flares.

Source: Engineering-Science, Task 11-14G, December 1986.

TABLE 4.3

SUMMARY OF VOCs DETECTED IN BLUE PLAINS INFLUENT AND EFFLUENT SAMPLES

	Average Concentration (ug/l)			
	Black and Veatch-1980(1)		Engineering-Science-1986	
Pollutant	Influent	Effluent	Influent	Effluent
Methylene Chloride (2)	10	-	7.1	6.7
Acetone			415.0	196.7
Chloroform (2)	10	-	5.2	5.5
2-Butanone			8.8	8.7
Bromodichloromethane			2.4	7.0
Trichloroethene (2)			0.7	0.14
Chlorodibromomethane			0.8	4.7
Tetrachloroethene (2)			23.2	3.2
Toluene (2)			3.7	3.2
Ethyl Benzene (2)			3.9	2.1
Xylene			6.0	3.6
Bromoform (2)			1.8	5.0
Trans-1,2-Dichloroethane (2)			2.5	2.5
Benzene (2)	31	44	-	-
Tetrachloroethylene	25	-	-	-
Trichloroethylene	10	-	-	-

(1) Study limited to priority pollutants as defined by EPA. (Appendix C)

(2) Priority pollutant.

Source: Engineering-Science, Task II-13, October, 1986.

fluidized bed systems. The emission factors are used for calculating the amount of pollutants to be emitted in relation to the amount of sludge that will be burned each day by the incinerators. Table 4.4 lists the emission factors for the pollutants for which emission data are available. The fluidized bed furnace (FBF) is the District of Columbia's preferred technology for Blue Plains.

The emission factors, assuming the worst case sludge loading rates, were then used to project the estimated emissions for all pollutants identified in available test data. These include particulate matter, heavy metals, sulfur dioxide, nitrogen oxides, VOCs and toxic organic compounds.

4.3.1.4 Emission Rates

Table 4.5 lists the maximum hourly emissions and the annual emissions to be expected from sludge combustion. The projected hourly emissions were based on a maximum burn rate of 16 dry tons per hour or 384 dry tons per day with three incinerators operating at 96 percent load. The annual emissions were based on a maximum burn rate of 99,790 tons per year of dry sludge with three incinerators operating at approximately 70 percent load. This is an artifically proposed limit on operations to avoid the need for a PSD review.

Based on the emission factors listed in Table 4.4, the 99,790 tons per year burn rate is the maximum amount of sludge that can be burned without triggering review under the Prevention of Significant Deterioration regulations. A burn rate of 99,790 dry tons per year (273.4 dry tons per day) would emit an estimated 249 tons of nitrogen oxides (NO_X) annually. The District proposes to incinerate an annual average of 200 DTPD or 73,000 dry tons of sludge per year and 384 DTPD during peak periods. (15)

The emission of VOCs is significant due to their contribution to ozone formation. Assuming the worst case emission rate of 0.3 pounds of VOCs per dry ton of sludge, the estimated VOC emissions would be 15 tons per year,

TABLE 4.4

EMISSION FACTORS (1)

Pollutant	Controlled Emission Factor (Pounds per Dry Ton Sludge)	
	Multiple Hearth Furnace	Fluidized Bed Furnace
TSP	0.83	0.84
SO_2	2.4	2.4
CO	Neg	Neg
VOC	1.0	0.3
NOx	9.1	5.0
Pb	0.0065	0.0011
As	0.00009	0.00004
Cu	0.0027	0.0004
Cd	0.0008	0.00004
Cr (hexavalent)	0.000000014	0.000000014
Ni	0.0002	0.0007
Zn	0.0038	0.0023
Hg	0.0001	0.0003
Be	0.000009	0.000009
PCB	0.00003	0.00003
2,3,7,8 TCDD (equivalent)	0.000000009	0.000000009
HCl	0.3	0.3
H_2SO_4	0.11	0.11

(1) Based on review of emission test data for more than 60 municipal sewage sludge incinerators and all available data on pollutants.

Source: Engineering-Science, "Air Pollutant Emission Factors for Sludge Incineration", (Task II-11), September 1986.

TABLE 4.5

ESTIMATED EMISSIONS FOR THE
FLUIDIZED BED FURNACE SYSTEM PROPOSED FOR BLUE PLAINS

Pollutant	Maximum Hourly Emissions (pounds per hour) (1)	Annual Emissions (tons per year) (2)	Annual Established Emission Values (tons per year)(3)
TSP	13.4	42	250(3)
SO_2	38.4	120	250(3)
CO	Neg.	Neg.	100(4)
VOC	4.8	15	100(4)
NOx	80.0	249	250(3)
Pb	0.018	0.055	5.0(5)
As	0.0006	0.002	NA (7)
Cu	0.006	0.020	NA (7)
Cd	0.0006	0.002	NA (7)
Cr (hexavalent)	0.00000019	0.0000007	NA (7)
Ni	0.011	0.035	NA (7)
Zn	0.037	0.115	NA (7)
Hg	0.005	0.015	3,200 gm/24 hr.(6
Be	0.0001	0.0004	10 gm/24 hr.(6
PCB	0.0005	0.001	NA (7)
2,3,7,8 TCDD (equivalent)	0.00000014	0.0000004	NA (7)
HCl	4.8	15	NA (7)
H_2SO_4	1.8	5	NA (7)

(1) Based on maximum burn rate of 16 dry tons/hour or 384 DTPD which requires three incinerators operating at 96% load.

(2) Based on maximum burn rate of 99,790 tons/year of dry sludge which requires three incinerators operating at approximately 70% load.

(3) Major source determinant based on the prevention of significant deterioration (PSD) regulations.

(4) Major source determinant based on nonattainment (NA) regulations.

(5) 40 CFR 51; EPA requirements for State Implementation Plans.

(6) NESHAP emission limits.

(7) NA - not currently regulated.

Source: Engineering-Science, Task 11-14G, December 1986.

which falls below the established limit of 100 tons per year. With proper operation of the FBF and proposed afterburner control, VOCs would be effectively destroyed.

Pollutants of major environmental concern are the metals chromium (Cr), mercury (Hg), lead (Pb), cadmium (Cd), nickel (Ni) and beryllium (Be) and the toxic organic compounds, PCBs, dioxins (PCDD), and furans (PCDF). The inorganic metals interact harmfully with biological systems and are potentially most dangerous because they have a cumulative effect. The toxic organics as well as some metals warrant careful consideration due to their carcinogenic and mutagenic potential.

Hypothetically, all metals are entrained or volatilized in the flue gas stream in a FBF. Heavy metals such as Cd, Cr, Ni, Pb and As deposit onto flyash particles and volatilize in the high temperature combustion zone. Upon cooling these metals are absorbed or condensed onto fine particles and comprise some portion of the total particulate matter. Volatile metals such as Hg are volatilized and entrained in the flue gas stream. Emission rates of the volatile metals (Cd, As, Hg, Zn; and, to a lesser extent Pb) have been shown to be related to incineration temperatures. Emissions of Ni, Cr and Cu are only slightly affected by the temperature within sludge incinerators. (16)

Emission data from other FBF incinerators for mercury (Hg) and beryllium (Be) are limited but the EPA studies published in 1985 indicate that the estimated emission rates of Hg and Be from the proposed Blue Plains sludge incinerators will fall below the NESHAP limit of 3,200 grams and 10 grams per 24-hour period, respectively. (16)

It is significant to note that the emissions of the trace metals into the atmosphere are dependent upon the metals content of the sludge and the removal efficiencies of the air pollution control equipment to be used. Table 2.6 summarizes the metals content of Blue Plains sludge. The Blue Plains treatment plant receives little flow from heavy industrial discharges, therefore, metals content of the sludge is low.

Although much attention has been directed to dioxins and other toxic organics, little information is available as to their emissions from FBF sludge incinerators. Available data on emissions of dioxins from MHF incinerators show that most of the PCDD (dioxin) compounds detected in sludge feed are destroyed during the incineration process. (16) The destruction is dependent upon temperature, residence time and available oxygen for combustion. Additional factors which have been suggested to have an impact on dioxin formation are:

- *The amount of dioxin precursors in the sludge feed; and*
- *The moisture content of the sludge.*

Testing of Blue Plains sludge for the toxic organics shows that these compounds are below the detectable levels based on EPA Extraction Procedure (EP) toxicity tests (see Table 2.4).

4.3.1.5 Dispersion Modeling Analysis

The determination of the potential impact for the sludge incineration system on the National Ambient Air Quality Standards and the potential for the systems to consume available PSD increments in the area are a necessary part of this EIS. The methodology used by ES to evaluate the air quality impacts of the incinerators was based on EPA-approved computer dispersion models. The models predict the ground level concentrations expected at all points in the area of concern for the significant air pollutants. The types of models used were the Industrial Source Complex (ISC), Complex-I, the PTPLU and the Human Exposure Model (HEM).

The area where emissions from the proposed sludge incinerators will have a significant impact was determined with the UNAMAP series 5 and 6 models (ISCST, ISCLT, Complex-I, PTPLU). The pollutants of concern were TSP, SO_2 and NOx. Carbon monoxide (CO) was not included because CO emissions from the existing Blue Plains facility and the proposed incinerators are negligible. Emission rates used in the analysis were the maximum hourly emissions corresponding to 100 percent (full) load. (Table 4.5) The 100 percent load condition results in the worst-case air quality impacts.

Meteorological input data included hourly surface observations of wind speed and direction, temperature, and cloud cover at the Washington National Airport and upper air data consisting of morning and afternoon mixing heights measured at Dulles International Airport.

4.3.1.6 Air Quality Impact Areas

Table 4.6 summarizes the results of the model runs for the determination of short-term and long-term concentrations of TSP, SO_2 and NOx. The table indicates that the maximum annual impact for TSP and SO_2 and the maximum 24-hour impact for TSP is less than the significance levels. The maximum distance to the significance levels for the 3-hour and 24-hour concentrations of SO_2 are 11.7 km and 3.0 km from Blue Plains, respectively. The impact area for NOx is a circular area with a 5 km radius. The results indicate that the 3-hour and 24-hour SO_2 and the NO_x concentrations of 30, 6 and 1.9 ug/m^3, respectively, are the only pollutant levels for which the Blue Plains incinerator impacts are significant. Their impacts are significant because their concentrations exceed the significance levels of 25, 5 and 1, respectively. (15)

The largest impact area for which any pollutant would have significant impact was determined to be an area 18 km by 13 km (11 miles by 8 miles) around Blue Plains.

The impact areas described are based on the use of UNAMAP-5 models. Although the impact areas would be somewhat smaller if computed with the UNAMAP-6 models, which are an updated version of the UNAMAP-5, the larger impact areas are more conservative estimates.

4.3.1.7 Existing Ambient Air Quality - PSD Increments

To assess the potential impact of emissions from the proposed sludge incinerators at Blue Plains on the air quality in the area, the existing ambient air quality levels and the available PSD increments were determined. Measured air quality data for monitoring sites operated by the District, Maryland and Virginia within the impact area of Blue Plains were

TABLE 4.6

PREDICTED AVERAGE CONCENTRATIONS

Pollutant	Averaging Time	Pollutant Concentration (ug/m^3) Blue Plains	Significance Level[1]	Distance from Blue Plains Plant (km)	Maximum Distance to Significant Levels (km)
TSP	Annual	0.2	1	3.5	b (2)
	24-hour	3	5		b (2)
SO_2	Annual	0.9	1	2.0	b (2)
	3-hour	30	25	4.5	11.7
	24-hour	6	5	2.8	3.0
NO_x	Annual	1.9	1	2.0	4.5

(1) Significance levels as defined by USEPA in terms of ambient air quality impacts.

(2) "b" means there is no impact area because the maximum predicted concentration is less than the significance level.

Source: Engineering-Science, Task 11-14G, December, 1986.

reviewed. The concentration levels of the regulated pollutants indicate that the area is in compliance with the air quality standards except for ozone. The maximum observed pollutant concentrations within the impact area are shown in Table 4.7.

The pollutants for which PSD increments have been established are TSP and SO_2. The available increment is the difference between the existing air quality levels and the ambient air quality standard or the maximum allowable increment, whichever is less. Table 4.8 summarizes the air quality impacts resulting from the proposed Blue Plains incinerators and other sources consuming PSD increments. As indicated, the incinerators consume only a small fraction (less than 10 percent for SO_2 and less than 25 percent for TSP) of the total available increments.

The maximum SO_2 concentrations resulting from the proposed incinerators and the two other major PSD sources consume less than 18 percent and 8 percent of the 24-hour and 3-hour PSD increments, respectively. (15) Maximum concentrations for other averaging times or pollutants are below the significance levels defined by USEPA.

4.3.1.8 Projected Ambient Air Quality

Table 4.7 summarizes both the ambient air quality levels expected from other air pollution sources in the Blue Plains region combined with emissions from the proposed incinerators as determined by the UNAMAP-6 dispersion models. The analyses indicate that emissions from the proposed incinerators will not interfere with attainment or maintenance of the National Ambient Air Quality Standards (NAAQS). Since the incinerators will consume only a small fraction of the available PSD increments, no significant deterioration of existing air quality will result. Under the conservative, worst-case conditions used for analysis, the maximum SO_2 concentrations in the impact area are 80 percent and 70 percent of the 24-hour and 3-hour NAAQS, respectively. The annual SO_2 and TSP impacts were not modeled because the proposed incinerators have an insignificant impact on annual SO_2 and TSP concentrations. The maximum annual NO_x concentration in the impact area is 70 percent of the NAAQS.

TABLE 4.7

PROJECTED AMBIENT AIR QUALITY

Pollutant	Averaging Time	Blue Plains Impact(1) (ug/m^3) FBF	Impact of Main Sources(2) (ug/m^3)	Baseline Air Quality (ug/m^3)	Total Predicted Concentration (ug/m^3)	Ambient Air Quality Standard (ug/m^3)
TSP	Annual	0.2	NM1	49	NM1	75
	24-hour	3(3)	NM1	138(120)	NM1	150
	Annual	0.7	NM1	35	NM1	80
SO_2	24-hour	8(8)	182(174)	108(108)	290(282)	365
	3-hour	42(24)	501(498)	402(268)	903(766)	1,300
NOx	Annual	1.5	13	57	70	100
CO	8-hour	NM2	NM1	8,340(7,314)	NM1	10,000
	1-hour	NM2	NM1	11,400(10,970)	NM1	40,000
O_3	1-hour	NM3	NM3	254(235)	NM3	235
Pb	Quarterly	0.004	NM2	0.60(0.38)	NM2	1.5

NM1 = Not modeled because Blue Plains impacts are not significant.
NM2 = Not modeled because Blue Plains emissions are negligible.
NM3 = No point source model available.

(1) Based on modeling five years of meteorological data.
(2) Based on modeling the worst year (1983 for short-term and 1981 for long-term averages).

Note: Numbers in parentheses represent the second highest concentrations predicted.

Source: Air Quality Modeling Analysis for Sludge Incineration at Blue Plains, Engineering-Science, Task 11-14G, December 1986.

TABLE 4.8

PSD INCREMENT CONSUMPTION

Pollutant	Averaging Time	Blue Plains Impact[1] (ug/m³) FBF[4]	Impact of All PSD Sources[2] (ug/m³)	Available PSD Increment (ug/m³)
TSP	Annual	0.2	NM	19
	24-hour	3(3)[3]	NM	12
SO_2	Annual	0.7	NM	20
	24-hour	8(8)	16(12)	91
	3-hour	42(24)	42(25)	512

NM - Not modeled because Blue Plains impacts are not significant.

(1) Based on modeling five years of meteorological data.

(2) Based on modeling the worst year of meteorological data.

(3) Numbers in parentheses represent the predicted second highest concentrations.

(4) Impacts for the fluidized bed furnace are shown although it is not subject to PSD.

Source: Engineering-Science, Task 11-14G, December, 1986.

4.3.1.9 Health Risk Assessment

For the purpose of determining the potential impacts on human health due to pollutants, health risk assessments were made utilizing the Human Exposure Model (HEM). HEM is used to estimate the population exposed to air pollutants emitted from stationary sources and the increased carcinogenic risk associated with this exposure. Analysis for carcinogens or suspected carcinogens that may be emitted into the environment were performed in order to estimate the increased cancer risk from a lifetime (70 years) exposure to the maximum annual concentration. The inputs needed to run the HEM include stack parameters, plant location, and the estimated maximum annual emission rates shown on Table 4.5.

The results of the analyses are provided in Table 4.9. They indicate that the increased risk of contracting cancer from emissions of all carcinogens or suspected carcinogens from the fluidized bed reactors is 0.049 per million for maximum exposed individual. The increased risk of contracting cancer from dioxin emissions is less than 0.02 per million. In setting NESHAPs, EPA has generally assumed that a one per million risk to the most exposed individual is acceptable.

The results of the HEM, which used 1980 population data and the annual concentrations predicted by the ISCLT-5 model indicate the cumulative number of excess cancers for the entire population located within a 20-kilometer radius of Blue Plains over a 70-year life-span due to emissions of all pollutants from FBFs. The data on Table 4.9 shows that the expected number of excess cancers for all pollutants over a 70-year lifetime is 0.00014 (1.4×10^{-4}) which is much less than one in 70 years. It should be noted that risk assessment methodology is performed in a way so that actual risks and excess cancers are likely to be less than those predicted but extremely unlikely to be greater.

For noncriteria pollutants with threshold health effects, the ISCLT model was used with the maximum annual emissions and the five-year STAR summary to determine maximum concentrations. Pollutants that are carcinogens

TABLE 4.9

HEALTH RISK ASSESSMENT RESULTS

FLUIDIZED BED FURNACES

Pollutant Name	Maximum Annual Emission Rate[4] (TPY)	Maximum Annual Avg. Concentration (ug/m^3)	Unit Risk[3] Cancer / ug/m^3	Increased Risk to MEI	Maximum Human Exposure (Person-ug/m^3)	Excess Cancers Over 70-yr. Lifetime
As	$2.0x10^{-3}$	$2.6x10^{-6}$	$4.3x10^{-3}$	$1.1x10^{-8}$	$7.5x10^{-3}$	$3.2x10^{-5}$
Cd	$2.0x10^{-3}$	$2.6x10^{-6}$	1.7x10-3	$4.4x10^{-9}$	$7.5x10^{-3}$	$1.3x10^{-5}$
CR (1)	$7.0x10^{-7}$	$9.1x10^{-10}$	$1.2x10^{-2}$	$1.1x10^{-11}$	$2.6x10^{-6}$	$3.1x10^{-8}$
Ni	$3.5x10^{-2}$	$4.6x10^{-5}$	$3.0x10^{-4}$	$1.4x10^{-8}$	0.13	$3.9x10^{-5}$
Be	$4.0x10^{-4}$	$5.0x10^{-7}$	$2.5x10^{-3}$	$1.2x10^{-9}$	$1.5x10^{-3}$	$3.7x10^{-6}$
PCB	$1.0x10^{-3}$	$1.3x10^{-6}$	$1.2x10^{-3}$	$1.6x10^{-9}$	$3.8x10^{-3}$	$4.5x10^{-6}$
2,3,7,8 TCDD (2)	$4.0x10^{-7}$	$5.2x10^{-10}$	33	$1.7x10^{-8}$	$1.5x10^{-6}$	$5.0x10^{-5}$
			TOTAL	$0.049x10^{-6}$		$1.4x10^{-4}$

(1) Hexavalent form.

(2) All dioxins and furans as equivalent 2,3,7,8 TCDD.

(3) Source: Carcinogenic Assessment Group of the U.S. EPA.

(4) Source: Engineering-Science, Task II-11, September, 1986.

or suspected carcinogens but have threshold effects levels were also considered. The maximum concentrations were compared to ambient or reference concentration criteria based on threshold limit values, other state regulations, or data from EPA's Environmental Criteria and Assessment Office. In general, such reference criteria are intended to protect the general population from chronic health effects. The results of the analysis are shown in Table 4-10. The maximum annual average concentrations are, in general, orders of magnitude below the reference ambient criteria values found in the literature. Therefore, no chronic adverse health impacts are expected from the proposed incinerator emissions.

4.3.2 Ash Disposal

Although the primary emphasis of this section is the impacts of incinerating sludge on the regional air quality, environmental concerns related to final ash and particulate disposal and scrubber water treatment are significant. The proposed fluidized bed furnace at Blue Plains is estimated to produce an average of 88 dry tons and a peak load of 168 dry tons of ash per day that will require landfilling. The proposed long-term plan is to dispose of the ash at the Lorton landfill.

Typically, the ash resulting from incinerating sludge is low in moisture, free of pathogenic organisms and organic compounds. Any heavy metals in the ash would be in an insoluble oxidized form and less mobile in an alkaline environment.

In order to characterize the ash that would result from the incineration of Blue Plains sludge, EPA Extraction Procedure (EP) toxicity tests were performed by ES on sludge ash samples. Data on leachable metals from the ash samples show that the metals concentrations in the Blue Plains sludge ash were at least an order of magnitude lower than the maximum allowable concentrations for toxic metals and would comply with the Resource Conservation Recovery Act regulations. The incinerator ash is expected to be classified as a non-hazardous waste. Tables 2.2 and 2.3 contain the results of the EP toxicity tests. In some instances the ash from sludge incineration

TABLE 4-10

RESULTS OF ANALYSIS FOR POLLUTANTS WITH THRESHOLD HEALTH EFFECTS

Pollutant Name	Maximum Annual Emission Rate[4] (TPY) FBR	Maximum Annual Average Concentration (ug/m^3) FBR	Reference Ambient Concentration Criteria (ug/m^3)	Percentage of Criteria Value FBR
As	0.002	0.0000026	0.48 (1)	0.0005
Cn	0.020	0.000026	4.0 (2)	0.0006
Cd	0.002	0.000026	0.12 (1)	0.0022
Cr	0.0000007	0.00000000091	0.12 (1)	0.0000008
Ni	0.035	0.000046	0.24 (1)	0.0192
Zn	0.115	0.000150	0.03 (2)	0.050
Hg	0.015	0.000020	0.12 (1)	0.0167
Be	0.0004	0.0000005	0.0048 (1)	0.0104
PCB	0.001	0.0000013	1.2 (1)	0.0001
2,3,7,8 TCDD	0.0000004	0.00000000052	0.0000035 (3)	0.0149
HCl	15	0.0195	14.0 (2)	0.139
H_2SO_4	5	0.00650	2.4 (1)	0.271

(1) Based on TLV-TWA/420.
(2) Based on New York Air Guide.
(3) Based on daily oral reference dose from EPA's Environmental Criteria and Assessment Office (November 1983).
(4) Source: Based on burning 99,790 DTPY, the maximum annual sludge quantity. Engineering-Science, Task II-11, September, 1986.

has been used as a soil conditioner. The proposed disposal by landfilling should have negligible impact to the ecosystems in the area of Lorton due to the nature of the resultant ash matter.

The liquid sidestream resulting from the scrubber system would be treated by recycling the scrubber water back to the head of the plant's wastewater treatment process. The recycle stream from the fluid bed system under average loading conditions is estimated at 1.9 mgd, with a suspended solids burden of 7,200 lbs./day. This load is equivalent to an increase of less than 3 mg/liter of suspended solids in a proposed 370 mgd plant influent flow. (13)

4.3.3 Man-Made Environment Impacts

The incineration of sludge at Blue Plains would result in a significant reduction of the mass and volume of solids. Transporting the resultant ash to Lorton landfill would require significantly fewer trucks when compared to transporting dewatered sludge. Fewer trucks and a reduced number of trips to Lorton would favorably affect traffic flow patterns on Interstate Highways 295 and 95 and on the Woodrow Wilson Memorial Drawbridge. Although fewer trucks would be entering and leaving, effects upon noise levels would be minimal. Although sludge incinerators create some noise when in operation, much of the increased noise will be buffered by the traffic traveling on the surrounding interstates.

The environmental considerations associated with the construction of two 225 foot stacks on the Blue Plains site include the potential impact on air traffic safety for aircraft landing and departing from Washington National Airport and nearby military fields and the impact on the visual aesthetics in the region around Blue Plains.

The proposed 225 feet height of the stacks follow EPA's good engineering practice (GEP) guideline. (15) Before construction of the stacks can proceed, the District must notify the Federal Aviation Administration which will review the potential impacts on all aircraft operations in the area. Federal aviation regulations (Part 77, Section

77.13) state that any construction of more than 200 feet in height above the ground level at its site requires notice and review by the FAA prior to the start of construction. On November 2, 1987 the FAA issued a Determination of No Hazard to Air Navigation. The study conducted by FAA concluded that:

- *The structures would not interfere with any airport traffic patterns;*

- *The structures would not adversely impact any VFR or IFR terminal procedure;*

- *The structures would not adversely impact any VFR or IFR enroute procedure;*

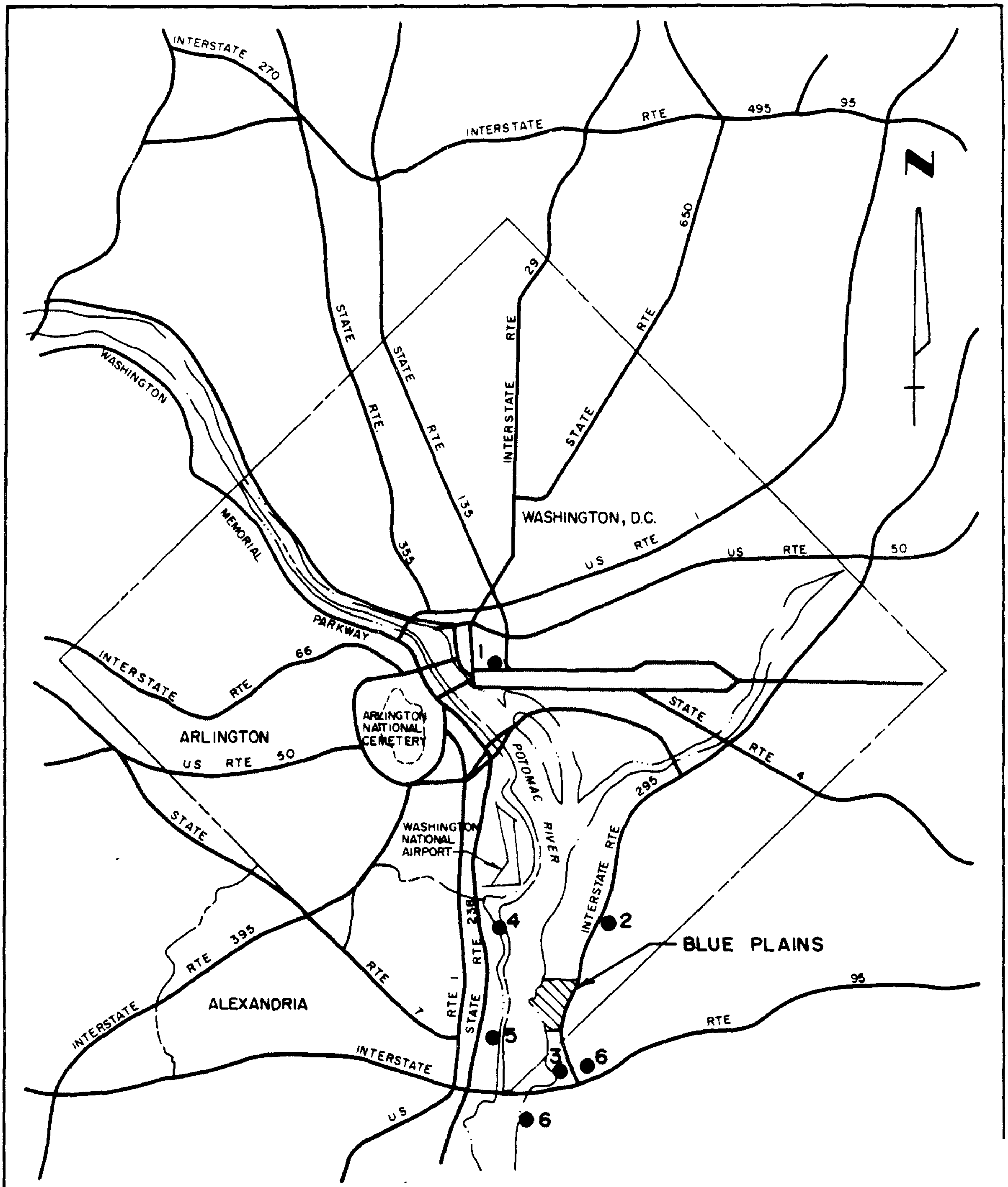
- *The proposal would not impact any plans on file; and*

- *The structures would exceed obstruction standards and should be marked and lighted.*

The visual impact of the stacks will affect the aesthetic quality of parks along the Potomac River including the Shepard Parkway Park to the north, the Bald Eagle Hill Park located 2,000 feet to the east and Oxon Hill Children's Farm located to the southeast of Blue Plains. The Daingerfield Island Park, which is on the west shore of the Potomac River in Alexandria, is a major recreational area and will be a part of a waterfront open space system along the Potomac River. (1) Other areas that would be visually affected would include Old Town in Alexandria and the Port America complex to be located to the south of Blue Plains as well as from the White House and Tidal Basin area. (See Plate 4.1 for the locations of those sites).

4.3.4 Air Pollution Control Systems

The proposed air pollution control systems for the Blue Plains sludge incinerators include an afterburner, a Venturi scrubber, an aftercooler and a wet electrostatic precipitator. (See Figure 2.7). Table 4.11



1 WHITE HOUSE AND TIDAL BASIN AREA

2 SHEPARD PARKWAY PARK

3 OXON HILL CHILDREN'S FARM

4 DAINGERFIELD ISLAND PARK

5 OLD TOWN ALEXANDRIA

6 PORTAMERICA DEVELOPMENT

SITES VISUALLY IMPACTED BY INCINERATOR STACKS

FIGURE 4-1

TABLE 4.11

ESTIMATED REMOVAL EFFICIENCIES FOR POLLUTION DEVICES PROPOSED FOR BLUE PLAINS INCINERATORS (1)

Pollutant	Control	Estimated Removal Efficiency
TSP	Venturi Scrubber, ESP (2)	99.9%
SOx	Venturi Scrubber, ESP	90.2%
CO	FBF, Afterburner (4)	NA (3)
VOC	FBF, Afterburner (4)	NA (3)
NOx	FBF, VS (4)	16.7%
Pb	Venturi Scrubber, ESP	99.6%
As	VS, ESP	90.0%
Cu	VS, ESP	NA (5)
Cd	VS, ESP	99.0%
Cr (hexavalent)	VS, ESP	98.7%
Ni	VS, ESP	97.7%
Zn	VS, ESP	NA (5)
Hg	Venturi Scrubber, ESP	78.6%
Be	Venturi Scrubber, ESP	NA (5)
TCDD (dioxins and furans)	FBF, Afterburner (4)	NA (3)
HCl	Venturi Scrubber, ESP	80%
H_2SO_4	VS, ESP	82.3%

(1) Calculations based on uncontrolled and controlled emission factor data obtained from Engineering-Science, Task II-11, September, 1986 and Task II-14G, December, 1986.
(2) Wet electrostatic precipitator.
(3) NA - not applicable. Removal dependent on incinerator combustion efficiency. Controlled emissions will be negligible.
(4) Addition of afterburner increases retention time of gases, assures complete combustion, destroys remaining organics.
(5) Uncontrolled emission rate unavailable to estimate removal efficiency.

summarizes the removal efficiencies for the proposed pollution control devices.

With proper operation, the FBF could maintain a high combustion efficiency which would reduce CO production to negligible amounts and destroy any toxic organic compounds that may be present. Proper operation would also help to control NO_x and VOCs. The addition of an afterburner to the incineration process would assure complete combustion and increase the destruction of VOCs and organics.

The proposed Venturi scrubber operates on the principle that as gas enters a contracted throat area followed by a expanded section, high turbulence is created. The water in the combustion gases condenses in the contraction and water is injected at the throat. This water atomizes and is mixed with the combustion gases by the turbulence. Particles are collected on the atomized water droplets using interception, impingement, and gravitational mechanisms. The Venturi scrubber and aftercooler will remove approximately 99 percent of the particulates by weight dependent on the particulate size. It will also remove some gaseous pollutants such as SO_2, hydrogen chloride (HCl), H_2SO_4, NO_x and oxidized mercury. Because the melting temperature of Be is high, it is unlikely to volatilize and will be removed much the same as the particulates. The Venturi scrubber and subsequent aftercooler would cool the combustion gases, allowing condensation of the trace metals into fine particles. These particles will tend to deposit on small flyash particles. Finally, the cooling will reduce the volume of combustion gas moving through the wet electrostatic precipitator (ESP).

A wet ESP operates by charging the suspended liquid droplets and particles in the combustion gases with a positive electrode and allowing these charged particles and droplets to migrate toward a negative potential collector plate. The liquid droplets collect on the plates and form a water film which washes the plates clean.

Based on data from ES the proposed Blue Plains wet ESP system would collect 90 percent of the remaining TSP and some SO_2. Hydrogen chloride and sulfuric acid (H_2SO_4) mist removal could be increased to 80 percent. Removal of 90 percent or more of the trace metals Pb, Cr, Cd, Ni, As, Zn, and Cu would be expected, along with over 75 percent removal of Hg. The ESP would reduce the water in the combustion gases to help suppress the steam plume. The steam plume is further reduced by the reheat chamber before the cleaned combustion gases are emitted.

4.4 LAND APPLICATION

Land application of sewage sludge involves the utilization of sludge as a source of fertilizer and as a soil conditioner in primarily agricultural areas. Loading rates are based upon nutrient requirements of given crops and the life expectancy of a site is dependent upon the metals content of the sludge. Adherence to the limits set by state regulations is an effective mitigative measure in avoiding such impacts as groundwater contamination, phytotoxicity and sickness in animals and humans. However, land application programs have unavoidable impacts on the transportation system, surrounding land use and may involve the generation of malodors. These impacts need to be considered along with the value of the sludge as a fertilizer and the cost of operating a land application system when evaluating the suitability of land application as part of the total sludge management program.

4.4.1 Natural Environmental Impacts

4.4.1.1 Nutrients

The impacts of land application of municipal sludge on the natural environment are dependent upon sludge quality and specific site characteristics. Typically, prior to land spreading of sludge, at least three composite samples from the treatment plant should be analyzed for total nitrogen, ammonia as nitrogen, phosphorus, potassium, magnesium, manganese, iron, zinc, copper, nickel, lead, cadmium, chromium, mercury, PCB's, percentage total solids and pH in order to determine the optimal loading rate. Table 4.12 shows the concentrations of these constituents in Blue Plains sludge with the exception of manganese, mercury and PCB's. Manganese is a trace metal common in sludges is necessary for proper plant growth and influences uptake of various heavy metals, but is not regulated in Maryland or Virginia. Maryland and Virginia both regulate for various items including mercury and PCB's by prohibiting land application of sludges which contain levels of these elements. The remaining constituents are controlled in these state's regulations to establish sludge suitability for land application and to determine proper loading rates and site life expectancy.

TABLE 4.12

INDIVIDUAL SLUDGE STREAM CHARACTERIZATION SUMMARY
JANUARY - MAY 1986 DATA PERIOD (1)

Parameter			Dewatered Raw Sludge Average	Dewatered Raw Sludge Minimum	Dewatered Raw Sludge Maximum	Dewatered Digested Sludge Average	Dewatered Digested Sludge Minimum	Dewatered Digested Sludge Maximum
Nitrogen, Total	N	%	3.17	0.97	4.65	3.97	1.60	7.17
Ammonium Nitrogen	NH_4-N	%	0.056	0.0034	0.12	0.048	0.0044	0.114
Phosphorus, Total	P	%	1.42	0.50	1.91	1.36	0.091	1.3
Potassium	K	%	0.079	0.04	0.142	0.085	0.031	0.2
Calcium	Ca	%	10.478	5.82	12.14	11.15	6.36	12.92
$CaCO_3$ Equiv.		%	26.83	15.54	31.15	28.54	17.91	35.32
Magnesium	Mg	%	0.217	0.121	0.301	0.231	0.114	0.492
Iron	Fe	%	8.049	6.30	11.57	7.92	4.00	12.8
Cadmium	Cd	ppm	6.5	4.1	9.5	5.64	3.3	8.45
Chromium	Cr	ppm	121.98	94	141	109.50	69.5	200
Copper	Cu	ppm	267.3	190	440	279.30	150.0	524
Lead	Pb	ppm	191.7	100	256	171.5	104	262
Nickel	Ni	ppm	40.64	21	59.5	38.1	23	57
Zinc	Zn	ppm	408.6	300	600	428.4	264	655
Total Volatile Solids		%	41.02	37	45.3	41.51	35.68	46.07
Soluble Salts		%	3.44	1.07	6.3	4.38	1.31	7.40
Moisture		%	81.47	77.81	85.34	85.21	78.48	84.67
pH			11.80	11	12.82	11.65	10.15	12.17

(1) Based on monthly sludge analyses provided by the Bureau of Wastewater Treatment, District of Columbia.

Potential for overloading the soil with nutrients and heavy metals has led to current methodologies for determining site and sludge suitability for land application. Adherence to these methodologies will minimize the potential impacts of heavy metal concentrations in soil, phytotoxity, and disease from ingestion of sludge amended crops.

Loading rates for municipal sludges like that from Blue Plains are based on the amount of nitrogen necessary to produce maximum yields of a given crop. Exceeding this rate will produce an excess of nitrogen which may cause adverse effects on some crops such as lodging of small grains and leaching of nitrates into the groundwater. Table 4.13 lists the nitrogen requirements for various yields of selected crops grown in the Maryland-Virginia region.

Nitrogen runoff, the movement of nitrogen from land surfaces to surface water bodies, is one type of nonpoint source pollution currently of great concern to the Chesapeake Bay area. This form of pollution is highly variable because it depends on precipitation and local conditions. Research has shown that the risk of inorganic nitrogen runoff from agricultural fields can be reduced if crops are fertilized with sludge rather than nitrogen fertilizer. A recent Clemson University study (Pasture Runoff Water Quality from Application of Inorganic and Organic Nitrogen Sources - McLeod & Hogg, 1984) compared ammonia nitrogen (NH_4-N) and nitrate nitrogen (NO_3-N) runoff from fescue pastures that were fertilized with either municipal sewage sludge or a common inorganic nitrogen fertilizer (NH_4 NO_3). The sewage sludge plots had lower rates of nitrogen runoff than the fertilizer plots. This reduced transport may be attributed to high organic versus inorganic fractions of nitrogen which are contained in sludge. Organic nitrogen tends to hold to soil particles and not to move with runoff water. Inorganic nitrogen, both NH_3 and NO_3, is highly mobile and will move freely with runoff water.

An issue not considered by the above referenced study is that organic nitrogen can contribute to nitrogen runoff, if sediment is being carried by the runoff water. However, guidelines and regulations guard against this. This is commonly called erosion and occurs most frequently in areas with little vegetative cover, such as corn fields. Land application operators often inject sludge below the soil surface to decrease surface runoff of organic nitrogen. Also there is some evidence that long-term applications of sewage sludge can improve soil structure and decrease soil erodibility.

An estimated maximum loading rate for Blue Plains sludge can be calculated by dividing crop nitrogen requirements by the amount of nitrogen present in the sludge which is available for crop uptake (estimated here at 40 percent of total N). For example:

Expected Corn Yield = 125 bu/ac
Nitrogen Requirement = 155 lbs/ac(1)
N content of Sludge = 70 lbs/ton(2)

$$\frac{155\ \text{lbs/acre}}{70\ \text{lbs/ton}\ (40\%\ \text{avail.})} = 5.5\ \text{tons/acre}$$

(1) Based on Maryland sludge management regulations, Table 4.14
(2) Taken from Table 4.12, D.C. sludge stream characterization

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The actual method for calculating nitrogen loading rates varies with the regulations of the state receiving the sludge. This loading rate should then be compared to those calculated for the other constituents tested in order to determine the limiting factor and life expectancy of the site.

Excess phosphorus in surface waters has been a key factor contributing to the eutrophication of streams and lakes throughout the U.S. The major source is agricultural land runoff burdened with excess phosphorus from fertilizers, manure and sewage sludges. For this reason, estimated phosphorus requirements for crops should be considered along with nitrogen requirements. Table 4.12 shows that sludge from Blue Plains typically has less than one half the amount of phosphorus as compared to nitrogen (27.8 lbs/ton P vs. 71.4 lbs/ton N). In this case, nitrogen is the limiting factor to be used in determining loading rates and phosphorus poses no long-term or short-term threat at levels found in the sludge. In addition, as noted above, there is the reduced erosion potential from soils treated with sludge.

TABLE 4.13

NITROGEN REQUIREMENTS FOR SELECTED CROP YIELDS

Crop	Yield	Lbs N/Acre
Corn Grain	100 bu/ac	120
	115	140
	120	145
	125	155
	125	add 15 lbs N for each 10 bu above 125
Wheat	40 bu/ac	60
	45-60	add 1 lb N for each bu over 40
	70	95
Oats	55 bu/ac	55
	55	add 1 lb N for each bu over 55
Soybeans	35 bu/ac	140
	40	180
	45	195
	50	210
	60	240

Source: Maryland Sewage Sludge Management Regulations COMAR 10.17.10.

4.4.1.2 Heavy Metal

The actual calculation of loading rates and site life expectancies is highly site specific due to the variability in soil and sludge. Sites which are used in successive years must be retested to determine the movement of nutrients and metals in the soil-plant environment. Maximum metal accumulations allowed in Maryland and Virginia are listed in Table 4.14.

The U.S. EPA, U.S. Food and Drug Administration, and the U.S. Department of Agriculture have adopted a Statement of Federal Policy and Guidance for the Land Application of Municipal Sewage Sludge for the Production of Fruits and Vegetables. This policy sets forth technical guidance on lands that will subsequently be utilized for fruit and vegetable crop production.

TABLE 4.14

MAXIMUM METAL ACCUMULATIONS
FOR SLUDGE AMENDED SOILS

	Maryland		Virginia		
	Soil Cation Exchange Capacity		Soil Cation Exchange Capacity		
Metal	Less Than 5 lbs/ac	5 or Greater lbs/ac	Less Than 5 lbs/ac	5 to 15 lbs/ac	15 or Greater lbs/ac
Cadmium	4.4	8.9	2.22	4.45	8.9
Copper	125	250	111	222	445
Nickel	125	250	44	89	178
Lead	500	1,000	445	890	1,780
Zinc	250	500	222	445	890

Source: Maryland Sewage Sludge Management Regulations.
Virginia Sewerage Regulations.

Once the loading rate has been chosen, the cumulative addition of heavy metals to levels causing phytotoxicity, animal or human health problems must be restricted. For this reason, the life expectancy of a site is calculated based upon regulated maximum heavy metal concentrations. These factors are calculated for the Blue Plains sludge being land applied in typical Maryland soils.

Lead is a nonessential element for plants and animals and acts as a cumulative poison in mammals. There has been relatively little concern about lead contamination of soils in the past because of the relative insolubility of adsorbed and precipitated lead in soils. Current regulatory action reflects an increased concern dealing with lead levels now found in the environment. Therefore, the levels of lead introduced by a land application system are a potential health impact. Lead concentration in plants is generally low, although lead may reach higher accumulations in roots and contamination of root crops may be of concern. Translocation of this lead from the roots to plant tops may take place if background phosphate levels are low. Additional concerns about crops grown for human consumption include contamination through contact with soil particulates and increased soil accumulation as a result of aerial contamination from leaded gasoline. An increase in vehicular traffic for a land application system or site location adjacent to a major thoroughfare may therefore be an additional contributor to the threat of high lead concentrations in soil or plants.

Zinc is the most abundant and often the most valuable heavy metal occurring in sewage sludge with respect to plant, animal and human nutrition. In terms of toxicity, excessive zinc levels can be more detrimental to plants by contributing to chlorosis (marked by yellowing) than to animals or humans which can accept much higher levels before reaching toxicity. The mobility of zinc in soil is influenced by soil pH, organic matter and texture although it is unlikely to leach deep enough to cause groundwater contamination.

Chromium, in its trivalent form (CR III), is not required for plant growth but is essential for human nutrition. On the other hand, hexavalent chromium, or chromate, is toxic to aquatic life, microorganisms, higher plants, and animals and is a suspected human carcinogen. Concern with toxic chromium levels in soils and drainage to groundwater is limited to hexavalent chromium since it constitutes a risk to humans. Considerable research is taking place to determine the extent to which trivalent chromium may oxidize into the toxic hexavalent form by contact with manganese oxides present in the soil. This process can create the more mobile and toxic hexavalent chromium anion which can leach into groundwater supplies. The amount of chromium in Blue Plains sludge is comparably low with respect to more industrially related sludges. However, the monitoring process should include testing of chromium III and VI in order to determine the oxidation rate and the potential for groundwater contamination.

Copper is essential for plant growth but can also be toxic. The level of difference in concentrations between a copper deficiency or toxic condition is relatively narrow. Thus, determination of proper loading rates is difficult. In addition, the interaction between soil and plants with respect to copper is very complex. However, several observations can be made regarding the impacts of copper content in municipal sludge. First of all, copper content of roots is generally several times higher than in plant stems and leaves and phytotoxicity is often manifested through a reduction in root activity. Secondly, copper interactions are tied to the level of organic matter in the soil and therefore the addition of low copper sludge should provide protection for plants. On the other hand, as soil pH decreases, availability of copper increases along with the threat of phytotoxicity. Finally, copper does not move rapidly through the soil by leaching unless found in excessive amounts. It is therefore less likely to cause contamination of water supplies but more likely to have residual effects on plants.

Absorption and retention of nickel by animals and humans is generally low and the threat of toxicity is therefore unlikely. However, nickel is more mobile in acid soils and plants in these soils have a high uptake rate which may cause phytotoxicity before it reaches levels that could affect animals or humans. Due to nickel's high toxicity to plants, it is one of the metals found in sludges most likely to cause reductions in crop yields. Cumulative limits are generally held to no more than a few times the background level.

Cadmium is the trace metal in sludges which produces the greatest concern for human health. Concentrations of cadmium in levels greater than three pounds per acre in silt loam soils (level varies for other soil types) have been shown to cause accumulations in the liver and kidneys of laboratory animals. In fact, the relatively high soil and plant concentrations of cadmium which are toxic to plants are irrelevant when considering loading levels which may create toxic conditions for animals and humans. There is an additional concern of adverse impacts on soil microorganisms and invertebrates from cadmium additions. Although no toxic effect on earthworms has been found, toxicity with respect to microorganisms, invertebrates, higher animals and humans may indeed occur if levels exceed those recommended by current regulations.

The potential for environmental contamination through land application of Blue Plains sludge is dependent upon the levels of the metals found in the sludge and the procedures used in the land application process. Nitrogen overloading from the sludge is unlikely if loading rates are based on state regulations and crop requirements. Groundwater and crop contamination is mitigated by matching the amount of available nitrogen to the amount necessary for maximum yields. Lead contamination is also unlikely due to the low level found in Blue Plains sludge. However, other localized sources, may contribute to lead levels in soil and plants and may increase the potential for reaching toxic levels. Zinc and nickel both cause phytotoxicity well before reaching levels which are hazardous to animals and are found in low concentrations in Blue Plains sludge. Therefore, these metals are unlikely to cause environmental contamination if loaded at properly calculated rates. The amount of chromium found in Blue Plains sludge is relatively low in comparison to other metals. Copper is calculated to be the limiting factor with respect to site life expectancy and is therefore likely to be the first metal to reach toxic levels. Adherence to loading rates set by state regulations should keep copper levels within an acceptable range. Cadmium is a highly toxic element and is strictly regulated to reduce the threat to human health. Blue Plains sludge typically contains from 3.3 to 9.5 ppm of cadmium which is well within the Maryland Class I limit of 25 ppm. Blue Plains sludge is therefore suited for land application if loading rates are kept below regulatory and toxic limits.

4.4.1.3 Pathogens

In addition to concern over the potential overloading of soil with nutrients and heavy metals, land application of sludge carries the threat of possible pathogen transfer since pathogens may survive treatment processes. The disease-causing agents commonly found in municipal sludges are listed in Table 4.15. Pathogen transfer is a concern in the land application of municipal sewage sludge. EPA has set forth regulations that establish criteria for municipal sewage sludge disposal practices. These regulations provide for Processes to Significantly Reduce Pathogens (PSRP) and Processes to Further Reduce Pathogens (PFRP). As stated, these processes are to be utilized by municipal wastewater facilities to reduce pathogens in the sludge and therefore reduce the potential for transfer during the land application process.

The survival of pathogens in soil is highly variable and may extend to as much as 12-14 years for the eggs of parasites and spore-forming bacteria. The actual survival time is dependent on such factors as moisture availability, temperature and soil pH.

Most bacteria and parasite ova are immobilized in the soil through physical and chemical straining. Therefore, the greatest threat to water supplies is through runoff into surface streams and ponds. Virus removal is primarily through adsorption on soil, although some removal may take place through physical sieving. Since mechanical removal of pathogens is the primary method of pathogen reduction, soil texture is a major factor in predicting and preventing pathogen transport to groundwater supplies. Areas with a soil cover of 20 inches or less and highly fractured bedrock should be avoided in a land application program in order to further reduce the threat of toxicity from pathogen transfer into the groundwater.

TABLE 4.15

PATHOGENS FOUND IN SLUDGES
AND RESULTANT DISEASES

Type of Organism	Pathogen	Disease
Bacteria	Salmonella	Typhoid fever, gastroenteritis
	Mycobacterium	Tuberculosis
	Shigella	Dysentery
	Escherichia coli	Gastroenteritis
	Leptospira	Leptospirosis
Viruses	Enteroviruses	Gastroenteritis, polio
	Adenoviruses	Acute respiratory disease
	Hepatitus virus	Hepatitis
Protozoa	Toxoplasma	Toxoplasmosis
	Giardia	Gastroenteritis
Nematodes	Ascaris	Ascaritis pneumonitis
	Toxacara	Visceral larva migrans
Cestodes	Taenia	Cysticerocis

Source: Criteria and Recommendations for Land Application of Sludges in the Northeast, 1984.

Land application of sludge for agricultural use represents the useage of a potentially valuable resource rather than the disposal of a waste product. Table 2.7 indicates that sludge from Blue Plains has an approximate fertilizer value of $42 to $46 per dry ton of sludge. This represents a total value of over $25,000 if spread over 100 acres at a rate of 5.5 dry tons per acre. This value can be further enhanced through the inclusion of the value of the increased level of crop production. Therefore, the potential adverse impacts of nutrient, metal and pathogen overloading caused by improper operating procedures must be weighed against the beneficial utilization of a resource. These have been taken into consideration by the regulatory agencies in the preparation of regulations and guidelines regarding land application.

Another area of potential impacts from a land application program involves off-site storage of sludge in temporary facilities. Both Maryland and Virginia regulate the design and operation of storage lagoons in order to avoid many of these potential impacts.

Specific areas of concern include many of those items previously discussed in this section such as leachate control, generation of malodors, the potential for spills and metal accumulation in soils and pathogen transfer into the local environment. Leachate and excessive accumulations of heavy metals could occur in the event of accidental spillage or leakage from the lagoon. The impacts of these occurrences has been discussed previously in this section. Generation of unpleasant odors is an unavoidable impact due to the amount of sludge in contact with the air. The most effective mitigative measures are pretreatment and timely incorporation of sludge into the soil using modern equipment that discs or injects the sludge beneath the surface. Pathogen transfer is made possible through aerosols and direct contact with the sludge. Once again, these impacts are mitigated through pathogen reduction in pretreatment and rapid incorporation into the soil.

4.4.2 Impacts on the Man-Made Environment

In addition to the potential impacts on the natural environment, a land application program may influence the man-made environment through the existing transportation system and existing land use patterns.

A major concern in an agricultural land application program is the transportation of dewatered sludge from the treatment plant to the farm. In the case of Blue Plains, sludge must be transported to available land in Maryland and Virginia. If the sludge is dewatered to 21 percent solids, the transport of 200 dry tons plus 50 dry tons of post lime, or 1,100 cubic yards per day would require a minimum of 37 to 44 truck trips per day (25-30 cubic yard/truck). Specialized agricultural vehicles are also required to properly apply the sludge. The overall impact on the transportation system is related to the availability and location of land application sites as well as the loading capacity of the individual farms.

In addition to the transportation impacts in rural areas, the land use of these areas may also be restricted by land application of sludge. Legislation in Maryland and Virginia limits the types of crops which can be grown in sludge amended soils, determines the areas suitable for land application and establishes buffer areas in which sludge may not be applied. According to information from the Virginia Department of Health, the State strongly encourages a one-time land application of agricultural sites. The State requires soil testing and groundwater monitoring at sites where an application is repeated within a three year period. These factors may increase the amount of necessary acreage and create the potential for conflicts with areas of non-conforming land use. Future land use may also be affected through limits placed on sludge amended areas, especially those areas dedicated for sludge disposal.

4.5 IN-VESSEL COMPOSTING

This section will define the potential impacts of in-vessel composting an average of 200 dry tons/day of Blue Plains sludge. Sludge compost is a stable soil conditioner which is considered to be free of pathogenic organisms and weed seeds and lacking in objectionable odors. The nutrient value of the final product is low, with a typical Blue Plains Nitrogen-Phosphate-Potassium value of only 1-2-0.1. However, the texture and high organic matter content of sludge compost increases the air and water holding capacity of most soils, improves the structure of clay soils, decreases erosion potential, improves soil workability, and increases the metal holding ability (cation exchange capacity) of the soil. The use of compost by the general public necessitates that adequate monitoring of the product take place to avoid potential adverse impacts and assure the long-term marketability of the final product.

4.5.1 Natural Environmental Impacts

Many of the impacts of a sludge composting program are similar to those discussed under the land application alternative due to the similar use of the final product. However, the composting process transforms the sludge so that several of the impacts previously mentioned are mitigated or altered. These impacts include metal and nutrient loading in soil and vegetation, pathogen transfer, leachate and condensate production, odors and related impacts on the man-made environment.

The heavy metal concentrations in compost from Blue Plains and Site II are relatively low due to the low metals content of the sludge. Table 4.16, Comparison of Sludge and Compost Constituents, shows the nutrient, metal and pathogen content of dewatered raw and digested sludge and compost from Blue Plains and Site II. The slightly lower metal concentrations of the compost may be attributed to absorption onto the bulking material.

In addition to the lower heavy metal concentrations of compost, the stabilized organic matter binds the metals more tightly through an increased cation exchange capacity. This indicates that the potential impact of metals

TABLE 4.16

COMPARISON OF SLUDGE AND COMPOST CONSTITUENTS

Parameter	Blue Plains Dewatered Digested Sludge(1)	Blue Plains Compost(2)	Site II Compost(3)
Total N	3.17%	1.32%	1.02%
Total P	1.42	1.50	.43 (phosphate only)
Potassium	.08	.07	.12
Solids	20.00	58.31	50.80
pH	11.80	7.28	7.30
Cadmium	6.50 ppm	5.40 ppm	4.60 ppm
Copper	267.30	365.00	90.00
Iron (4)	80,490.00	65,000.00	22,596.00
Mercury	---	---	1.20
Nickel	40.64	38.80	15.50
Zinc	408.60	468.70	147.10
Lead	191.70	75.10	227.10

(1) January - May 1986 average monthly values - See Table 2.6 in Chapter 2.

(2) June, August and September 1986 biweekly average values.

(3) 1985 average monthly values.

(4) Ferric (iron) chloride is added in the wastewater treatment systems for phosphorus removal.

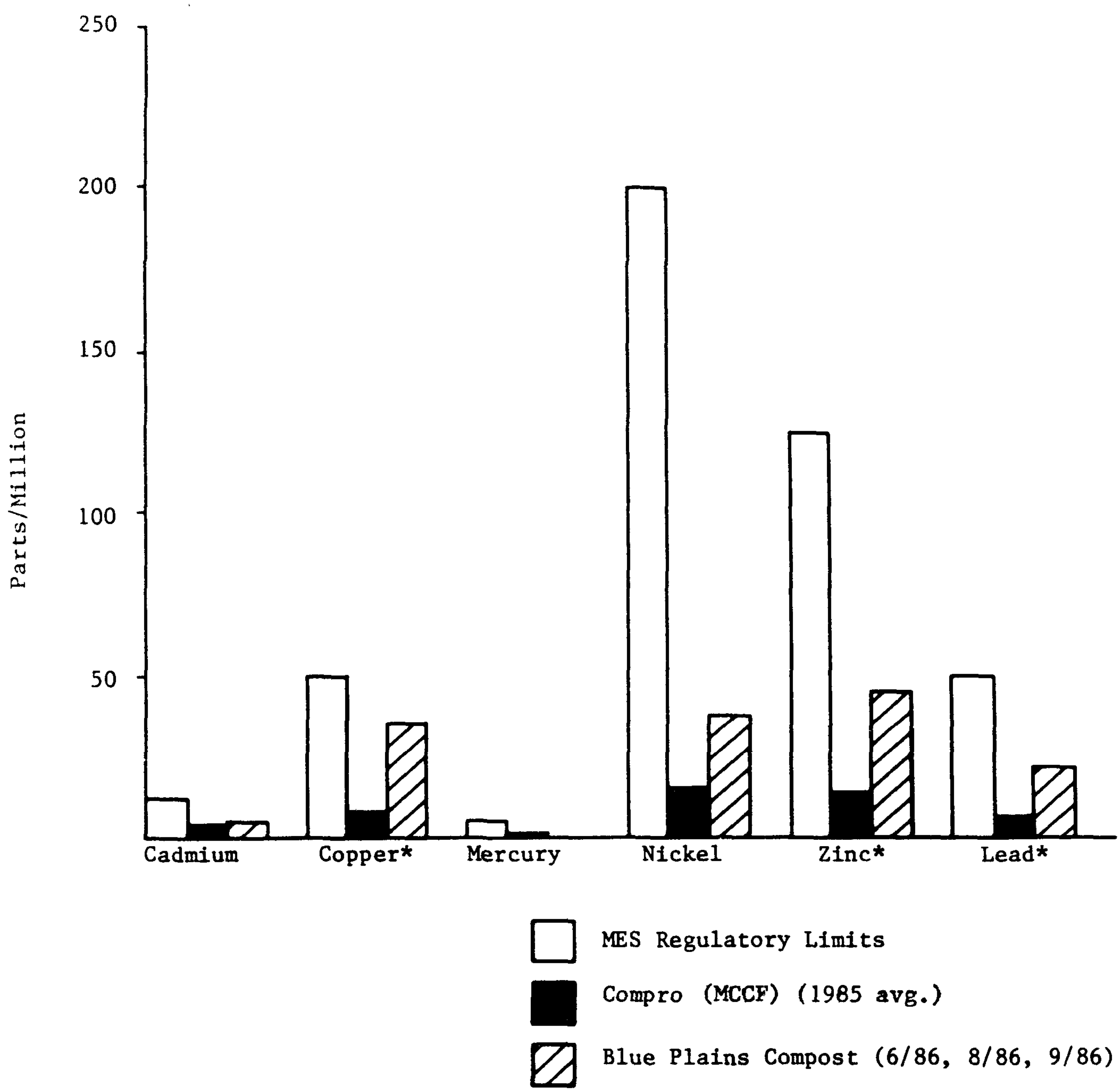
(5) All values are based on dry weight.

reaching the groundwater from compost application is unlikely. These metals may still be taken up by some plants and application on vegetable gardens should be done with great care and avoided when possible.

In order to assure long-term marketability, a consistent product quality and low metal levels must be maintained within regulatory constraints established by Maryland and Virginia. Figure 4.2 shows that the metal content of compost from Blue Plains and MCCF is well below the metals levels established by the Maryland Environmental Service.

Figure 4.2

Comparison of Compost Metal Concentrations



* Values expressed in tenths of actual value.

The N-P-K ratio of 1-2-0.1, illustrates the fact that compost has limited fertilizer value and that its use is primarily as a soil conditioner. There is little threat of significant nitrate leaching or nutrient runoff problems from the use of sludge compost. In addition, compost nitrogen is a slow release form rather than the rapid release form commonly found in dewatered sludge.

Composting is listed by EPA as a process to further reduce pathogens (PFRP) which indicates that the final product is safe for distribution to the general public. Although composting typically destroys pathogens, there still exists the potential threat of survival of resistant primary and secondary pathogens (those affecting healthy and susceptible people, respectively) in the final product as the result of improper process operation and insufficient volatile solids destruction (Reference 20). The increased process control achieved through in-vessel composting should minimize these problems.

One of the major concerns at a composting site is the control of leachate, condensate and runoff in order to mitigate potential water quality impacts. The amount of condensate and leachate generated during composting is related to the moisture content of the sludge and bulking material and other ambient conditions. Approximately 2,000 to 6,000 gallons per day (10-30 gpd/dry ton) would typically be generated in an aerated static pile composting operation with an input of 200 DTPD. Levels found in an in-vessel system would be similar, although system design allows for easier capture of these liquids. Most precipitation falling on a compost pile is absorbed or evaporated and runoff levels are typically low. If these liquids are allowed to collect on the surface, odors, or ice in winter may result. Inadequate collection systems may also result in ground and surface water contamination. In-vessel composting permits liquid capture and recycling into the wastewater treatment process. Water input from precipitation is not a factor in the in-vessel composting system. Table 4.17, Analysis of Condensate, Leachate and Runoff from a Composting Operation, indicates typical contaminant levels found in these liquids.

TABLE 4.17

ANALYSIS OF CONDENSATE, LEACHATE AND RUNOFF FROM A COMPOSTING OPERATION

Constituent	Condensate	Leachate	Runoff(1)
BOD	2,000 mg/l	2,070 mg/l	91 mg/l
COD	4,050	12,400	61.3
PO_4-P	1.87	2.13	.31
NO_3-N	.73	.46	.16
Organic N	139	655	58
NH_3-N	1,140	905	115
TKN	1,279	1,560	173
$CaCO_3$ (Alkalinity)	4,030	2,930	361
pH	7.7	7.7	8.2

(1) Runoff characteristics are a function of rainfall rate and volume.

Source: Composting of Municipal Wastewater Sludges, U.S. EPA 625/4-85/014.

Perhaps the most readily recognized impact of sludge composting is the potential for the production of malodors. These odors tend to predominate at facilities where sludge piles are left exposed before mixing and where composting is left incomplete. One of the most common odor causing problems is inadequate aeration and anaerobic conditions within the compost. The best method for controlling potential odor generation is by maintaining a proper oxygen supply, adequate temperatures and by keeping the site clean. In the case of the proposed in-vessel system, off-gases would be captured and deodorized in a scrubber system and temperature and oxygen levels would be monitored by microprocessors.

Odor and noise control are major concerns of an in-vessel composting facility. The manufacturers of the various in-vessel reactors have addressed the control of these concerns with their specific designs. Generally, the reactors are contained within a building or system enclosure which reduces noise levels and assures odorous process exhaust air is collected for treatment.

Typically, all exhaust air from a reactor building is treated by a multi-stage odor control system consisting of:

- *Exhaust air fan system*
- *Heat exchanger for cooling*
- *Two-stage wet scrubber chemical reactor for particulate removal and chemical treatment of odorous compounds*

This control system is intended to assure treatment of all odorous air contained within the building prior to discharge outside of the building.

4.5.2 Man-Made Environmental Impacts

Most of the potential impacts on the man-made environment are directly related to the large volume of compost that would be produced if all of the sludge from Blue Plains were to be composted. This would lead to a total production of approximately 1,300 cubic yards/day of finished compost. An estimated 600 cubic yards/day of the total production would result from the 200 DTPD of sludge. While the 600 cubic yard volume is less than the current volume of sludge transported off-site, the total volume may potentially impact the transportation systems in the area.

Transportation of 1,300 cubic yards/day of compost requires a minimum of 44-52 trucks (25 and 30 cubic yard capacities) if the compost is delivered in large volumes to only a few buyers. In comparison, an estimated 1,000 cubic yards/day of dewatered sludge are currently being transported off-site under the interim management program. It is more likely that the transportation of the final product will require a larger number of smaller capacity vehicles to reach all markets. However, this is not the total traffic volume because the transportation requirements for the bulking agent must also be taken into account. Therefore, the composting alternative has the largest potential impact of any of the alternatives on the existing transportation system because of the transport of both the compost and a bulking agent.

The total number of vehicles and routes taken in the composting alternative are related to the marketability of the final product. Compost from Site II has been highly marketable within the region while compost from Blue Plains has been more difficult to market. The proposed composting of all of the Blue Plains sludge would have to overcome this problem and expand the existing market area in order to dispose of the increased quantity of compost. The supply of compost resulting from the use of a full composting alternative will have a major impact on the regional supply when production from other facilities is accounted for. A preliminary market report prepared for the District in 1985 stated that the initial annual market potential demand was 277,400 cubic yards, with an estimated increase to 1,350,000 cubic yards within ten years. In addition, the compost market roughly corresponds to the growing season which takes place in the warmer months, when traffic volumes are at their peaks. Successful marketing of compost year-round will be required in order to decrease the impact of this alternative during times of peak activity.

Section 2.5, Composting and Product Use, indicates that an estimated 24 acres of land may be required for in-vessel composting of an average of 346 DTPD of sludge at Blue Plains. Available land at the Blue Plains site is finite and a majority of the remaining area is committed to treatment basin expansion (e.g. swing sedimentation basins) to improve treatment capabilities. The use of the remaining site area, even with a specific site minimizing design approach, for a full composting option must consider the future inability to expand the wastewater treatment processes due to site constraints. Additional land may therefore have to be acquired to handle this volume of compost based on the final system design.

Compost has a potential to catch fire during the composting or curing process if the material becomes too dry and internal temperatures approach peak levels. The threat of fire can be minimized through adequate mixing, aeration and prompt marketing of the finished product. In-vessel composting should have a lessened potential for igniting through closer monitoring of the product throughout the composting process. Proper on-site controls and adequate fire protection should be maintained at all times to reduce the potential for a serious fire.

The aesthetic aspects of in-vessel composting are highly subjective. However, the removal of the aerated static piles at Blue Plains and subsequent replacement with an enclcsed unit should be seen as an aesthetic improvement. Improved quality control and odor control will add to the aesthetic advantages of this alternative.

4.5.3 Health Risk Assessment

The health risks associated with composting have been evaluated and assessed periodically since the early Beltsville aerated static pile composting work. A study was conducted between 1979 and 1981 at wastewater sludge composting facilities in Camden, N.J., Philadelphia, PA, Beltsville, MD, and Washington, D.C. to evaluate operator exposure to bacteria, fungi, and microbial products. The investigation used clinical, microbiological and immunological methods to evaluate the health effects related to composting dewatered sludge.

A potential risk to workers at wastewater sludge composting sites may occur because of possible exposure to Aspergillus Fumigatus spores. They are pathogenic, through inhalation of dust generated during composting operations. No consistent increase in antibody to A. Fumigatus was detected in some compost workers. However, throat and nasal cultures indicated exposure to the fungus A. Fumigatus and one worker had a serious ear infection caused by exposure to Aspergillus Niger. Physical examinations of exposed workers found they had an excess of nasal, ear, and skin disorders compared to non-exposed workers. Illness symptoms of burning eyes and skin irritation were also reported more often in exposed workers and there was some indication of low-grade inflammatory responses.

Appropriate work practices including facilities for daily showers and separation of clothing used on the job and after work has been recommended, along with continued exposed-worker studies. (54, 55).

4.6 DRYING AND PRODUCT USE

The environmental considerations associated with heat drying sludge include impacts from the moist gas stream that would be discharged into the atmosphere, the liquid sidestream from scrubber units and particulate emissions that may result from the storage and transport of the dried sludge pellets. The final sludge pellets resulting from the drying process would be transported by truck to permitted land application sites. Therefore, the transportation systems in the vicinity of Blue Plains would be affected. Storage of the pellets would be in enclosed silos constructed at the Blue Plains site and at the land application sites.

The process of exposing dewatered sludge to hot gases will result in the release of moist air due to evaporation of water from the sludge. The temperatures in a drying unit typically reach 121°C (250°F) and will result in the removal of volatile organic compounds (VOCs), the destruction of disease-causing organisms and the stabilization of the sludge to a point where further decomposition will not occur. The dried sludge product is a solid that contains about 10 percent moisture and most of the organic and nutrient value found in dewatered sludge.

4.6.1 Natural Environmental Impacts

Heat drying sludge at Blue Plains would impact the available on-site storage area, the regional ambient air quality and the need for permitted land application sites for the dried sludge product.

4.6.1.1 Air Quality

The impact on the ambient air quality in the region around Blue Plains is linked to the pollutants emitted in the gases exhausted from the dryer. The sources of pollutants would be from fuels burned in the furnace, the sludge feed, the remining volatile organic compounds after the drying process and the hot moist air that causes a plume in the exhaust.

The combustion fuels considered were fuel oil, natural gas or digester gas. The pollutants that result from the combustion of fuel would be transported through the rotary dryer and discharged into the atmosphere along with pollutants emitted from the drying process.

The region surrounding the Blue Plains facility is classified as a nonattainment area for CO and O_3. Volatile organic compounds (VOCs) that are not removed by the pretreatment process will contribute to ozone formation. The control of VOCs will rest primarily within the rotary heat dryer and the average temperature levels inside. Temperatures reaching 250°F should be high enough to remove any VOCs remaining in the sludge after pretreatment processes. The installation of an afterburner and a wet scrubber unit would reduce SO_2, NOx, VOC and CO emissions.

Particulate emissions due to dust particles from the dried sludge are an environmental concern from the standpoint of air quality. Dust particles may result during the storage and transport of the dried sludge product. Control of dust due to these operations would be difficult. The pelletization of the final dried sludge product reduces dust emissions. Particles escaping with the exhaust gas would be removed by the scrubber unit.

4.6.1.2 Soil and Surface Waters

The impacts of the heat drying process on soil and the surface waters near Blue Plains and near land application sites depend on the quality of the sludge, the management of the liquid sidestream, and the topography and soil characteristics of the land application sites. The impacts on the Blue Plains site would result from removal and treatment of the liquid sidestream from the scrubber unit and from any accidental leachate rewetting of the product. Treatment of the sidestream by recycling it back to the head of the plant will reduce the potential for pollution to the nearby surface waters. Leachate collection systems will also be necessary to avoid pollution of surface waters.

The removal of dried sludge pellets to storage silos, and the transport of the pellets from Blue Plains to the site where the product will be land applied may create environmental problems if the pellets are rewetted. The addition of moisture will create an environment for bacterial regrowth and decomposition. Rewetting will also contribute to odor problems due to decomposition. Proper moisture-free storage areas on-site, in transit and at application sites are necessary in order to control rewetting problems.

The recommended use for the heat dried sludge pellet is land application on agricultural fields. The pellet is primarily a soil conditioner with a fertilizer value comparable to that of dewatered sludge. It will be assumed in this assessment that the impact of land applying the pellet will be similar to that of land applying dewatered sludge. Section 4.4 contains an assessment of the environmental impacts associated with the land application of Blue Plains sludge. Land application is regulated by federal, state and local agencies.

The chemical content of sludge feed determines what components will be found in the final sludge product. Numerous analyses have been performed on Blue Plains sludge to characterize the components and the concentrations of soil nutrients, trace metals and organic compounds. The results have been summarized on Table 2.3. Table 4.18 compares the chemical components of Blue Plains sludge with that of the average concentrations of municipal sludges from over 150 U.S. wastewater treatment plants. The metals content of Blue Plains sludge is comparatively low. Metals that may pose an environmental threat due to their accumulative nature or toxicity such as cadmium (Cd), chromium (Cr), and lead (Pb) fall well below the average concentrations reported in other municipal sludges. The Blue Plains treatment plant does not receive large volumes of industrial wastewater and therefore, the sludge or sludge products have these low levels of metals and other industrial chemicals.

The evaluation and continued monitoring of metals content in sludge will affect the success of the land application program. The heavy metals of greatest environmental concern are mercury (Hg), cadmium (Cd), chromium (Cr) and lead (Pb) due to their accumulative nature and toxicity to plants, animals

TABLE 4.18

AVERAGE MAJOR CHEMICAL COMPONENTS OF SLUDGE
A COMPARISON WITH BLUE PLAINS SLUDGE

		Blue Plains Sludge(1)		U.S. Sludge(2)
Component		Raw	Digested	Anaerobic
Nitrogen, Total N	%	3.17	3.97	5.0
Ammonium Nitrogen NH_4-N	%	0.056	0.048	0.94
Phosphorus, Total P	%	1.42	1.36	3.3
Potassium	%	0.079	0.085	0.52
Calcium (3)	%	10.478	11.15	5.8
Magnesium	%	0.217	0.231	0.58
Iron (4)	%	8.049	7.92	1.6
Cadmium	ppm	6.5	5.64	106.0
Chromium	ppm	121.98	109.50	2,070.0
Copper	ppm	267.3	279.30	1,420.0
Lead	ppm	191.7	171.5	1,640.0
Nickel	ppm	40.64	38.1	400.0
Zinc	ppm	408.6	428.4	3,380.0
Mercury	ppm	N/A (5)	N/A (5)	1,100.0

(1) Refer Table 2.4. Monthly sludge analyses from D.C. - January-May 1986.

(2) Analysis of 150 municipal sewage treatment plants in northcentral and eastern U.S.

(3) Lime (calcium carbonate) is added for pH adjustment in the nitrification reactors during wastewater treatment.

(4) Ferric (iron) chloride is added in the wastewater treatment systems for phosphorus removal.

(5) Below detectable levels.

Source: Evaluation of Sludge Management Systems (EPA - 430/9-80-001).

and humans. Section 4.4, Land Application, examines the movement of metals into the soil from dewatered sludge. It is assumed that the transfer of nutrients and metals into soils from dried sludge pellets is comparable to that of dewatered sludge.

The nutrient value of dried sludge pellets impacts its effectiveness as a soil conditioner and will impact the loading of nutrients into soils. Life expectancies of land application sites can be determined if the nutrient and metals content of sludge are known. Section 4.4 presents specific methodology for calculating nutrient loading rates.

Concern over the potential transfer of pathogenic organisms into soils is minimized by the heat drying process. There is little possibility for disease-causing organisms to survive the temperatures inside the dryer and the dried sludge pellet should be pathogen-free and stable. However, if the pellet is accidentally rewetted prior to land application, the possibility for anaerobic decomposition and organism regrowth exists. Care must be taken to avoid rewetting of the dried pellets during the transfer, storage and all steps prior to land application.

4.6.2 Man-Made Environmental Impacts

The Blue Plains site is situated in an area of diverse land use most of which does not appear compatible with treatment plant operations. However, the least compatible use, the residential complexes, are located to the east of Blue Plains and Interstate 295 serves as a buffer between the two. The installation of sludge drying units at Blue Plains would require a building with an estimated area of about 68,000 square feet. The visual impact of silos on the surrounding area may be objectionable. However, silos in an agricultural setting, as in the case where pellets are land applied to farmlands, have little visual impact.

Drying sludge into pellets should reduce dusting problems. However, in the event that heavy dusting occurs during the transport and storage of the sludge pellets, the potential for spontaneous fires exists. If dust particles are in close proximity with high temperatures, high gas velocities and oxygen, a fire hazard may exist.

The transport of dried sludge from the Blue Plains site would be by truck. The number of trucks and frequency of trips will impact traffic flow patterns on I-295, I-95 and across the Woodrow Wilson Memorial drawbridge. Traffic problems have been identified at the signal light at the intersection north of the site which is the access point for I-295. Since heat drying substantially reduces the mass and volume of sludge, the number of trucks required to transport the dried sludge pellets to land application sites will also be substantially reduced when compared to transporting dewatered sludge. A reduction of vehicles on the surrounding interstates, in addition to improved traffic flow conditions, may contribute favorably to the ambient air quality in the region around Blue Plains. Any noise to the area due to truck traffic from the site will also be reduced.

The drying process would result in direct discharge of exhaust gases into the atmosphere in the formation of a plume. Plumes consist of steam heat and any pollutants that are not removed during the sludge drying process. If not controlled, visible plumes may contribute to degradation of the air quality in the Blue Plains region. The presence of a plume from stacks will also have an adverse visual impact. The District's regulations regarding visible emissions from stationary sources is restrictive and controls to remove the plume will be necessary.

Odors may also be apparent from the exhaust gases or may result from improper management of the sludge pellets. Accidental rewetting of the pellets or inadequate removal of moisture during the heat drying process will create an odor problem. Removal of a visible plume and deodorization of the moist exhaust gases will be possible by installing an afterburner. Careful operational practices can reduce odor problems that may result from accidental rewetting of the dried sludge.

Economic considerations associated with heat drying include the need to find markets for the product and competition for permitted land application sites. The transport, storage and application of sludge pellets would require a dependency on a group of contractors. These conditions could impact overall management control.

There are several limitations to heat drying and product use that would affect the feasibility of using this alternative at the Blue Plains facility. These include:

- *The District's prior unsuccessful experience with heat drying;*
- *Undetermined market for the dried sludge pellets in the region;*
- *Unproven experience with heat drying the quantities of sludge generated at the Blue Plains facility; and,*
- *Uncertainty of the costs and methods of disposal of the dried sludge (incineration or landfilling) if a land application site is not available.*

4.7 LANDFILLING

The District has evaluated various landfill sites within the regional area but none have been proven to be acceptable. (1) The I-95 Lorton Landfill, which is owned by the District and operated by Fairfax County, appears to be the only regional site acceptable for landfilling at this time.

Maryland regulates sludge landfilling through Maryland Refuse Disposal Regulations, Title 10, and new sewage sludge management regulations. Virginia duplicates this with its Solid and Hazardous Waste Management Law, Title 32.1, and solid waste regulations. In addition, the concerns of the Virginia State Health Department regarding the potential hazard to human health and the environment have caused the prohibition of dewatered sludge landfilling at the Lorton facility which is located in the Occoquan River watershed. This is a major concern in the implementability of a landfilling alternative for Blue Plains sludge. This section will analyze the potential environmental impacts of codisposal of solid waste and 200 dry tons of sludge with 50 dry tons of post lime per day at the Lorton facility.

4.7.1 Natural Environmental Impacts

Under this alternative stabilized sludge with 20 percent solids would be applied on top of the working face of the Lorton landfill. The sludge and refuse would then be thoroughly mixed before they are spread, compacted and covered with soil. Sludge typically represents at least ten percent of this mixture to assure adequate absorption of liquids by the refuse. Application rates range from 500 to 4,200 cubic yards of sludge per acre.

A major concern of sludge landfills is the control of ground and surface water contamination by leachate and runoff. Monitoring of surface water total solids, dissolved oxygen, BOD, chloride, hardness and fecal coliform levels at Lorton, both up and down gradient, indicates that the landfill is not currently detrimentally affecting surface water. The site is located so that 1) no upland drainage flows into the site, 2) springs and streams originating on-site, or adjacent to the site, are protected by culverts, and 3) runoff is collected in on-site basins. However, the addition of dewatered sludge to the landfill could potentially lead to surface water pollution and degradation of groundwater quality with improper management or operation.

Typical quality of sludge-only landfills is shown in Table 4.19. The actual quality and quantity of the leachate which would be produced at a Lorton co-disposal facility is dependent on the sludge composition, soil conditions, drainage characteristics, climate, along with chemical and biological activity within the landfill. For this reason the composition of the leachate cannot be defined at this point. In any co-disposal program, the leachate components of particular concern are nitrogen, heavy metals and pathogens. The content of Blue Plains sludge with respect to these elements is given in several previous tables (see Tables 2.2 and 4.12).

Under anaerobic landfill conditions the predominant nitrogen compounds are ammonia (NH_3) and ammonium (NH_4+). Typical low pH conditions in landfills tend to promote a predominance of ammonium which binds with negatively charged soil particles and becomes relatively immobile. The amount of the more mobile nitrate form (NO_3) is dependent on site specific conditions. Heavy metals are more mobile under acid conditions and are likely to leach toward the groundwater. However, the total amount of metals in the leachate is reduced through adsorption onto soil particles. This condition indicates that the addition of sludge may increase the levels of these metals reaching the groundwater unless additional leachate controls are installed such as underground collection systems or increased drainage modifications.

Maryland and Virginia both have regulations stating that sludge must be treated by processes which significantly reduce pathogens (PSRP) as a minimum requirement prior to landfilling. These processes reduce the threat of pathogen transfer into the ecosystem, but to an extent less than that of the incineration or composting alternatives. There is, therefore, pathogen survival into the landfill environment. Many of the pathogens found in the sludge (see Table 4.15) are filtered by the physical properties of the soil

TABLE 4.19

LEACHATE QUALITY FROM SLUDGE-ONLY LANDFILL

Constituents	Values(1)
Constituents	
pH	6.7
TOC	1,000
COD	5,100
Ammonia nitrogen	198
Nitrate nitrogen	0.28
Chloride	6.7
Sulfate	10
Cadmium	0.017
Chromium	1.1
Copper	1.3
Iron	170
Mercury	0.0004
Nickel	0.31
Lead	0.60
Zinc	5.0

(1) Values expressed as mg/l except for pH.

Source: Process Design Manual: Sludge Treatment and Disposal, EPA 625/1-79-011.

as they move downward. Daily covering of the landfill will also help to reduce the potential impacts of pathogens carried by aerosols or airborne solid particulates.

Landfills can potentially impact plant and animal life through the deleterious effects of metals, pathogens, toxic organics and through the destruction of habitat. The removal of habitat is an unavoidable impact which can only be mitigated through the use of the maximum environmentally safe loading rate. This action will minimize the overall acreage requirement of the site but it may increase the threat of toxicity from overloading of metals or pathogens, especially for those elements with relatively low toxic levels, such as cadmium or mercury.

The extent of the impact on the natural environment can be correlated to the quality of the sludge and solid waste in the landfill. Metals are at comparatively low levels in Blue Plains sludge (see Table 4.18). Current monitoring practices would continue to measure the solids content, volatile solids, nitrogen, inorganic ions, bacteriological quality, toxic organic compounds and pH of the sludge and the extractable portions of the sludge/refuse mixture. This program would help identify potential contamination problems and adequate mitigative measures before the environmental impacts become severe.

Another impact of landfilling is the production of gases and odors. Decomposition of organic matter in a landfill produces methane and smaller amounts of hydrogen sulfide. These gases may reach explosive concentrations around site buildings and gas collection and venting systems are necessary for safe operations. Hydrogen sulfide, along with other gases, can also produce malodors in the vicinity of the landfill. The Lorton facility currently experiences this problem and sludge addition has the potential of further contributing to this problem. Daily cover and thorough mixing of materials will help in minimizing the amount of these odors produced through absorption of liquids and filtering of the waste through soil.

4.7.2 Man-Made Environmental Impacts

One of the major areas of concern with respect to the development of the landfilling alternative is the unavailability of a suitable site. The District has evaluated potential landfill sites in the past and determined that the Lorton facility is the only suitable site for sludge landfilling. However, Virginia has prohibited the landfilling of dewatered sludge at Lorton because of its location in the Occoquan River watershed. This restriction would have to be overcome prior to serious planning consideration of the alternative. In addition, Maryland prohibits the landfilling of sludges with free liquids. This increases the costs involved in dewatering the sludge prior to landfilling.

This alternative also has the potential of affecting the community and cultural resources of the area by impacting upon local schools and recreational facilities. Two elementary schools are located in the vicinity of the Lorton site. One school is located 5,000 feet northeast of the site on Legion Drive near Lorton Road, the other, Gunston School, is 8,000 feet east of the site on Route 611, near the intersection of Gunston Hall Road. These facilities may be impacted by odors and transportation vehicles if a route passes by the school. Trucks may introduce noise, air pollutants, traffic congestion and the potential for spills into the environment. Local recreation facilities include an area south of the landfill along the Occoquan River and extending northward along I-95 and the Pohick Bay Regional Park, located east of the site on Mason Neck. These areas may be impacted in ways similar to the educational facilities. Proper operating and emergency programs will aid in minimizing the potential for substantial environmental impact.

At least 37 to 44 truck trips per day would be required for disposal of sludge generated at the Blue Plains WWTP. The hauling route from the Blue Plains WWTP to Lorton landfill is via Interstate I-95 to within three miles of the disposal site. Furnace Road serves as the access road to the Lorton landfill from I-95. Interstate I-95 was designed to handle heavy trucks and could easily accommodate the impact of increased traffic. Traffic volumes on I-95 in the vicinity of the Lorton site range from 67,490 vehicles/day (between Route 124 to Route 1) to 87,200 vehicles/day (from Backlick Road to Old Keene Mill Road). Average traffic volume between Route 1 and the District of Columbia is 99,870 vehicles/day; 6,300 vehicles/day are trailer trucks and 760 are 3-axle, 6-to-10 tire trucks. The highest volume of traffic on this thoroughfare is encountered from Route 644, Springfield, to Route 395-495 (139,500 vehicles/day). Furnace Road is paved and is in good condition. Traffic volume on Furnace Road from Route 123 to Hoes Road averages 1307 vehicles/day and increases to 1414 vehicles/day at Lorton Road. The highest traffic volumes on Furnace Road are encountered between the north intersection of Lorton Road to the south intersection of Lorton Road (4,421 vehicles/day). Within the Lorton site, all roads are paved and approach within 0.25 miles of the operating face of the landfill. (All traffic counts are 1984 values).

Another area of impact on the man-made environment is the potential degradation of the local aesthetics. However, the site is surrounded by trees which provide an effective visual buffer for all local roadways except the weigh station area off Furnace Road. This minimizes the overall aesthetic impact of the landfill and the addition of sludge will not greatly alter existing conditions. The most effective methods of mitigating the aesthetic impacts include daily covering of the landfill and maintenance of the vegetative buffer zone.

4.8 OCEAN DISPOSAL

Currently, about four percent of municipal wastewater sludge produced in the U.S. is ocean disposed. The dispersion of sludge in the water column is described in Section 2.8 and illustrated in Figure 2.12. Basically, volatile organics evaporate into the atmosphere; grease, oil and scum remain on the surface; and the remaining sludge fraction sinks in an expanding cloud toward the ocean floor. The dispersion rate is site specific and is dependent on the temperature, salinity, depth, currents and composition of the sludge. EPA issuance of an ocean disposal site permit to the District would require a demonstration that no practicable alternative is available that has less impact on the environment.

4.8.1 Natural Environmental Impacts

The impact of sewage sludge on the marine environment is dependent upon the interactions of sludge and seawater. Ocean disposal of sludge has the potential for adverse impacts on ocean sediments, the water column and marine biota. Ecosystem impacts may be minimized either by containing the pollutants in a very small area (to concentrate the toxic substances) or by dispersion. Impacts on biota, especially benthos, can best be mitigated by dispersing the contaminants in the water column, thereby diluting them before they reach bottom.

The release of nutrients at deepwater sites tends to stimulate the ecosystem by adding limiting nutrients, such as nitrogen, necessary for biomass production. Increased production of phytoplankton and other plant life result in changes in local water quality and species composition. However, studies of phytoplankton nutrients and productivity indicate that the effects of sludge dumping on planktonic composition in the New York Bight are localized and almost imperceptible. (37) The annual production of the Inner Bight, which is comparable to that of very productive upwelling systems, is caused by the influx of nutrient rich water from the estuaries which flow into the Bight. (37) Therefore, the overall impact of nutrient loading is highly site specific and dependent on background conditions surrounding the disposal site.

A significant portion of the heavy metals in sewage sludge is contained in the particulate fraction. Field analyses at the Hyperion Sewage Treatment Plant in Los Angeles, California, show that many of these metals become soluble in seawater (See Table 4.20). As soon as the sludge is dumped, there is a rapid, initial first-stage release of metals, followed by a slower, second-stage release. The first-stage release is attributable to the oxidation of organic particles and metal sulfides and to the desorption of metals from particles. Metals not dissolved or oxidized during first-stage release may be released in time as the organic matter with which they are bound decomposes or as they are desorbed from inorganic material. The amount of metals typically released into the water column is shown in Table 4.19.

TABLE 4.20

RELEASE IN SEAWATER OF HEAVY METALS FROM SLUDGE(1)

Metal	Percent Released	Est. Annual Tons of Metals Released From Blue Plains (2)
Cadmium	93-96	3.2-3.3 tons/year(3)
Chromium	2	1.3
Copper	5-9	8.5-15.4
Lead	35	36.8
Manganese	35	
Nickel	49-64	11.4-14.9
Zinc	18-39	47.2-102.4

(1) Source: Rohatgi and Chen, 1975.
(2) Gannett Fleming Environmental Engineers, 1987.
(3) Values based on discharge of 346 dry tons/day.

The extent of metal and organic chemical concentration increases observed at a given disposal site is dependent on the sludge quality. The constituent concentrations of the Blue Plains sludge are contained in Table 4.12. The accumulation of toxic metals and organic compounds in the food chain poses the potential human health effects of ingesting contaminated seafood. The biomagnification of metals in the food chain has not been reported, except for methyl mercury. USEPA regulations currently prohibit disposal of sludge containing mercury and mercury compounds that would raise background concentrations by 50 percent after dispersion. Organic contaminants, such as halogenated hydrocarbons, tend to bioaccumulate up the food chain and have persistent long-term effects. Other compounds, like polycyclic aromatic hydrocarbons, do not tend to biomagnify and degrade more readily.

Organic constituents of ocean dumped sludge are subject to oxidation and scavenging in both the water column and bottom sediments. Duedall et al. demonstrated that the organic carbon content of bottom sediments in the vicinity of existing sewage sludge dump sites is not high when compared with that in other coastal areas. Further, they postulated that different microorganisms act to hydrolyze the organic matter in sludge, and this leads to a reduction in the dissolved oxygen levels in seawater.

Several studies have shown that materials within the surface slick may be released into the atmosphere on jet drops from bursting bubbles. Typically higher concentrations of bacteria near the surface should then be reflected in the bacterial content of the jet drops. This has been found to be the case in laboratory studies but has not been tested under field conditions. (41) This process presumably has the same impact on particulate trace metals. Lead, iron, manganese, chromium and vanadium have been found in significantly higher concentrations in the surface layer. In addition, enrichments of organic carbon on the seasalt aerosol have been measured in levels which indicate the same sea to air transfer process. (42) The significance of this process is related to the known impacts of aerosols from sewage treatment plants, cooling towers and tanneries. These emissions contain bacterial aerosols that travel to outlying areas and have produced viral disease. (Wellock, 1960). Therefore the potential exists of diseases being caused by these agents in oceanic and coastal environments.

Most oxygen in the ocean enters from the atmosphere through the air-water interface. The rate of this exchange is fairly slow and depends on surface mixing rates and boundary layer diffusion. The concentration of oxygen at saturation is a function of both salinity and temperature of the water and, therefore, varies on a seasonal basis. Waste disposal may cause an initial transient decrease in oxygen due to microbial actions and inorganic oxidation of reduced compounds. (Odum, 1960). Oxygenated seawater will oxidize such materials as ferrous and manganous ions, causing them to precipitate. There will then be a longer term oxygen demand as disposal materials slowly degrade. The relatively low levels of these materials in Blue Plains sludge (see Table 4.17) will reduce the potential impact of an increased oxygen demand although overloading and periodic site conditions which concentrate the contaminants may result in lessened water quality.

The presence of hydrogen sulfide, a product of anaerobic reduction of sulfur compounds, indicates conditions which may affect biological communities. Hydrogen sulfide is toxic in low concentrations to many aerobic organisms. When this compound is released into oxygenated water, it is oxidized within hours and may account for a major fraction of the initial chemical oxygen demand of certain wastes. Because of its short half-life in aerated water columns, hydrogen sulfide does not normally represent a long-term hazard.

Studies at the Philadelphia sewage disposal site, located approximately 35 miles east of Ocean City, Maryland, found evidence of pollution of the benthic environment in the vicinity of the disposal site within 5 years after sludge disposal commenced in 1973. Positive indications of bacterial and viral contamination were in evidence up to 3 years after sludge dumping ended. Pollution included accumulations of metals in organisms and sediments, sludge deposits on the ocean bottom, bacteria normally associated with sewage, a change in the structure of the benthic community, and pathological conditions in bottom dwelling crustaceans. (40) Studies conducted in the New York Bight showed bacteria in disposal sites 3-5 years after dumping ceased.

Bacterial contamination may occur as a result of the ocean disposal of sludge. Shellfish near the New York Bight sludge dumpsites contain high concentrations of coliform bacteria. (37) Coliform counts exceeding FDA's standards have been found in surf clams collected five miles from the center of the site. Pathogens released through sludge disposal may present a human health risk by consumption of contaminated shellfish. Sludge stabilization prior to ocean disposal reduces the risk of bacterial contamination.

Benthic organisms are usually in contact with polluted sediments and overlying water for long periods of time, and therefore are good indicators of chronic pollution. Benthic organisms form an important link in the marine food chain as they are important food sources for many sport and food fishes. They also accumulate contaminants such as trace metals, petrochemicals and organic pollutants. (34) The small fraction of dumped sludge which reaches the sea floor is further affected by biological activities and physical forces. Benthic organisms burrowing in the deposits incorporate the material into existing substrates, reducing the possibility that it will be transported out of the area. Benthic organisms consume fine sludge solids and excrete them, along with other waste products, as coarse pellets, thus reducing the potential for resuspension.

Contamination of benthic organisms and plankton can impact the human environment through biomagnification of pollutants and entrance into the food chain. For this reason, EPA established limiting permissible concentrations (LPC) based on a toxicity threshold of .01 of the concentration proven to be acutely toxic to sensitive marine organisms in bioassays. The result of the bioassay is the concentration of sludge in ocean water that is acutely toxic to half of the marine organisms within a 96 hour period.

4.8.2 Man-Made Environmental Impacts

The Potomac River is approximately 3,000 feet wide at the Blue Plains site. There are many activities associated with loading and transport of sludge on the Potomac River that may impact the river. The increase in barge activity could impact recreational activities such as boating and fishing. The risk of inland waterway pollution and the potential for health problems are also increased if an accidental spill should occur during the loading and transport of sludge.

The land requirements at Blue Plains for ocean disposal would include area for sludge storage, barge docking and loading facilities. Spare barges and/or excess tank capacity are needed for sludge storage during periods when the vessels are in transit and during times when disposal operations are disrupted. Numerous factors which may impact storage requirements include inclement weather, equipment breakdown, labor disputes and the distance the barge must travel to and from the disposal site. Sludge management problems will be magnified if sludge must be stored for lengthy periods of time due to disrupted barge transport.

The risk of pollution to the Potomac River is increased if sludge is accidentally spilled during loading operations. The presence of floating sludge, grease, oil and scum on the surface of the water will create an aesthetically undesirable appearance. The fraction of the spilled sludge that sinks to the river bottom will impact the ecosystem through the addition of nutrients, pathogens, metals and organics. Measures to minimize the adverse affects from an accidental spill should include the development of a spill prevention plan and the proper training of personnel to handle containment techniques and cleanup.

Ocean pollution due to accidents at sea will impact disposal sites and, if weather conditions are severe and high winds exist, the sludge may be widely dispersed. Containment and cleanup at sea is difficult and would require a temporary storage barge and an additional tugboat. In some cases severe weather may hinder efforts to protect the environment due to accidental spills.

Weather conditions are a major consideration when looking at the ocean disposal alternative. Delays in barge trips due to inclement weather will impact storage capacity and can prevent disposal of the sludge at the designated site. If weather is too severe, the vessel may be required to return and make a second trip. The scheduling of longer trips necessitates the use of long-range forecasting which is generally unreliable. Measures to avoid impacts associated with bad weather are proper on-site storage facilities for the sludge and the availability of extra barge equipment. The use of larger barges, which will withstand harsher weather conditions, could reduce the risk of delays.

Increased barge traffic along the Potomac River will increase the potential for erosion of the river bank due to the wakes created by a moving barge. Daingerfield Island Park, on the west shore of the Potomac River in Alexandria, is a major recreational facility and barges at Blue Plains will be completely visible to anyone in the park area. Small craft operators risk serious injury if the craft accidentally gets into the path of an on-coming barge.

Barges departing from Blue Plains would pass under the Woodrow Wilson Memorial drawbridge. If bridge openings are required for the barge operations, which usually includes a tugboat, traffic patterns on I-95 across the bridge will be disrupted.

A significant environmental impact of the disposal of sludge in the ocean will result if sludge materials wash to the shoreline from the off-shore disposal sites. Not only will the presence of sludge or sludge by-products degrade the beaches, public reaction to sludge washing up on the beaches will be negative.

On June 23, 1988 the Senate Environment and Public Works Committee approved a bill that would ban ocean dumping of municipal sewage sludge by 1992. The Bill (S.2030) establishes a deadline of December 31, 1991 on ocean disposal and would require municipalities dumping at the 106-mile site to enter into consent agreements with EPA to submit detailed alternative disposal plans. Failure to meet consent agreement deadlines could result in fines of $20 to $40 per ton of sludge dumped with a maximum penalty of $50,000 per day under the bill.

The House Merchant Marine and Fisheries Committee approved a similar measure (H.R. 4338) on June 9, 1988. The House bill extends the ocean dumping deadline to December 31, 1992 and has higher penalties.

The House Public Works and Transportation Committee is expected to consider ocean dumping legislation under a 60-day limitation that could result in House consideration by the end of 1988.

4.9 ADVERSE IMPACTS OF THE ALTERNATIVES AND MITIGATIVE MEASURES

This chapter describes the potential environmental impacts of the seven sludge management alternatives under consideration. This Section reviews the most significant impacts and identifies the measures that can be used to mitigate those impacts. Table 4.21 provides a summary of the impacts with a corresponding list of measures to minimize their effects on the natural and man-made environment. Some of the impacts listed in the Table cannot be mitigated and must be accepted as consequences of a given alternative. Other impacts can be partially or completely mitigated through pretreatment, transportation management and off-site controls.

4.9.1 Sludge Management

Consistent and adequate (based on regulations) pretreatment of sludge is a key factor in minimizing the impacts of any of the sludge management alternatives. Maintaining consistent sludge characteristics makes product processing easier and allows for regular loading rates in land application and drying/product use programs. Pretreatment which includes Processes to Significantly Reduce Pathogens (PSRP) will reduce the threat of pathogen transfer under each of the alternatives. Part of maintaining a consistent product is the utilization of proper sludge processing controls. This includes consistent pretreatment as well as a constant moisture content, maintaining combustion efficiency under incineration, adequate mixing and aeration of compost and proper operation of pollution control devices described in the incineration and drying sections.

Providing adequate cover for the sludge or sludge products will help reduce product moisture levels, potential leachate and runoff production and the presence of malodors. This is particularly appropriate under the no action, composting and drying/product use alternatives.

TABLE 4.21

SUMMARY OF POTENTIAL IMPACTS
AND MITIGATIVE MEASURES

ALTERNATIVE	IMPACTS	MITIGATIVE MEASURES
NO ACTION	Stockpiling materials at Blue Plains o Pile leachate o Surface and groundwater contamination o Rodents	o Leachate collection and treatment system o Off-site storage o Expansion of sludge product market o Divert wastewater to other treatment facilities o Limit new construction in area served by collection system
	Production of malodors	o Restrict stockpiling o Complete aeration and mixing of compost o Prompt incorporation using modern methods
	Nutrient and metal overloading of soil	o Calculation of loading rates with current sludge properties
	Heavy transportation requirements o Costs o Disruption of traffic patterns o Lack of management control	o Long-term competitive contracts o Schedule truck trips for off-peak hours o Unavoidable
INCINERATION	Air emissions	o Proper maintenance and operation of furnace to ensure combustion efficiency o Install proper pollution control system o Restrict sludge feed rates
	Scrubber water	o Recycle to head of plant
	Stack height o Visual o Air traffic safety	o Unavoidable o Proper markings on stacks o Coordination with F.A.A.
	Ash landfilling o Ash transport o Ash disposal	o Proper management o Leachate collection and treatment systems at landfill o Groundwater monitoring o EP toxicity testing
LAND APPLICATION	Nutrient and metal overloading of soil	o Calculation of loading rates with current sludge properties o Adhere to Virginia, Maryland regulations
	Production of malodors	o Prompt incorporation
	Pathogen transfer	o Pretreatment with Process to Significantly Reduce Pathogens
	Ground and Surface water contamination	o Proper loading rates o On-site run-off controls o Groundwater monitoring
	Off-site storage requirements o Costs o Disruption of traffic patterns o Lack of management control	o Long-term competitive contracts o Schedule truck trips for off-peak hours o Avoidable through proper contractor selection and management
	Land use conflicts	o Site availability o Proper siting and buffering of application sites
	Seasonal limitations	o Unavoidable, but overcome through storage practices

TABLE 4.21 (Cont'd.)

SUMMARY OF POTENTIAL IMPACTS AND MITIGATIVE MEASURES

ALTERNATIVE	IMPACTS	MITIGATIVE MEASURES
COMPOSTING/PRODUCT USE	Heavy metal concentrations in soil and crops	o Chelated in compost process o Restricted loading on crops for human consumption
	Fire	o Proper operating procedures (aeration, mixing)
	Production of malodors	o Treatment of gaseous discharges
	Leachate, condensate and runoff to surface waters	o Proper mixing with bulking agent o Liquids collection system o Recycle liquid runoff to head of treatment plant
	Heavy transportation requirements	o Long-term competetive contracts o Schedule truck trips for off-peak hours
	Use of remaining plant area at Blue Plains	o Design that includes efficient use of space
	Product market	o Quality assurance of product o Aggressive regional marketing program with contract sales agreement
	Seasonal limitations	o Unavoidable, but amenable to management
DRYING/PRODUCT USE	Particulate emissions/gas plume o Fire hazard from dust accumulation	o Installation of proper pollution control systems o Pelletization
	Rewetting dried sludge pellets o Malodors o Leachate o Bacterial decomposition	o Proper storage facilities o Proper handling o Proper endpoint use
	Nutrient and metal overloading of soil	o Calculation of loading rate with current product properties
	Pathogen transfer	o Pretreatment with Processes to Significantly Reduce Pathogens
	Liquid sidestream	o Recycle to head of treatment plant
	Land application seasonal	o Unavoidable, but amenable to management
LANDFILLING	Ground and surface water contamination	o Leachate collection and treatment system
	Pathogen transfer	o Proper mixing o Daily soil cover o Pretreatment
	Gas and odor production	o Proper mixing o Daily soil cover o Landfill gas collection and venting systems
	Landfilling Occoquan watershed prohibited for dewatered sludge	o Location of new landfill o Siting landfill outside watershed

TABLE 4.21 (Cont'd.)

SUMMARY OF POTENTIAL IMPACTS
AND MITIGATIVE MEASURES

ALTERNATIVE	IMPACTS	MITIGATIVE MEASURES
OCEAN DISPOSAL	Water pollution (metals, toxic organics, DO reduction)	o Pretreatment to remove pollutants
	Biomagnification of pollutants	o Concentration or dilution in larger area
	Sludge spill	o Spill prevention practices o Operator training o Equipment maintenance
	Barge traffic o Riverbank erosion o Disrupted recreational boating and fishing	 o Structural controls on riverbanks o Use of smaller barges at slower speeds
	Disruption of vehicular traffic at drawbridge	o Unavoidable, but timing departures/ arrivals could reduce impacts
	Weather conditions o On-site storage facilities o Barge storage	 o Construct sludge storage facilities

4.9.2 Sludge Transport

Transport of sludge/sludge products has the potential of environmental impact through spillage or riverbank erosion and/or impacts related to traffic disruption and additions to the present traffic volume. Spill prevention procedures include vehicular maintenance and personnel training. Emergency procedures should be outlined and adequate equipment made available in the event of an accidental spill. Large barges necessary for the ocean disposal alternative will contribute to riverbank erosion. The use of smaller barges at slower speeds may reduce this problem but will require the use of more barges. This will in turn increase the amount of traffic disruption by increasing the number of times the Woodrow Wilson bridge must be raised. The composting, no action, land application, drying/product use and landfilling alternatives have high truck transportation requirements. These requirements are unavoidable impacts if all of the sludge products are to be utilized or disposed in either a single or mixed alternative(s) scenarios.

4.9.3 Sludge Disposal

Surface application of sludge or sludge products has the potential of overloading soil and crops with nutrients and heavy metals. One method of mitigating this impact is through proper calculation of loading rates based upon current sludge characteristics, site specific properties, and maximizaing of the amount of land available for land application. Sample calculation of loading rates based upon sludge nutrient and metal content and soil properties can be found in Section 4.4, Land Application. Actual calculations must follow state regulations in order to mitigate the potential impacts of nutrient and metal overloading. The amount of land available for application of sludge, dried sludge pellets or compost can be increased by maintaining the quality of the sludge and aggressive marketing of sludge products. Current problems with marketing Blue Plains compost may be alleviated through the increased process control achieved through in-vessel composting and contract sale program. However, an effective marketing campaign is the key in developing an adequate area for either compost or sludge application programs.

In-vessel composting an average of 200 DTPD would require an estimated 16 acres of land. This land requirement may conflict with the installation of the swing sedimentation basins at Blue Plains and other land uses for solids management.

The landfilling alternative involves the use of the Lorton landfill for co-disposal of dewatered sludge. This has been prohibited in the Occoquan watershed by the Virginia State Department of Health. This may be an unavoidable impact unless another existing landfill or new site outside of the Occoquan watershed can be located.

The no action, incineration, land application, composting, drying and landfilling alternatives will all require the use of leachate collection and treatment systems and surface water controls. Control of leachate at landfill sites includes the use of underdrains and liners. Specific areas must be separated for collection and treatment of leachate. Runoff from the landfill site or sludge processing areas should be collected and treated prior to discharge into surface waters.

Grading to minimize slopes and slope length as well as protective structures such as swales or culverts to nearby streams will mitigate runoff into surface waters from land application sites. If these measures are implemented at the sites erosion and off-site transfer of sludge or the enriched soil will be minimized.

Prior to land applying dewatered sludge or dried sludge products, off-site storage areas must be set up and maintained. Measures to avoid leachate formation, runoff or spillage of sludge are necessary to protect the environment at the site and the surrounding areas. Adequate storage capacity, regular inspection of temporary lagoons and operator training are requirements for spill prevention and facility maintenance. Therefore, off-site storage can help alleviate on-site storage problems but can result in other environmental impacts if not managed properly.

Landfilling dewatered sludge has the potential for pathogen transfer and gas and odor production. Pretreatment of sludge contributes to the mitigation of these impacts. Additional controls include proper mixing with the solid waste at the working face of the landfill to assure absorption of excess liquids and daily soil covering to minimize the amount of airborne particulates and aerosols. These actions will help improve the aesthetics as well as mitigate the other impacts listed here.

CHAPTER FIVE

CHAPTER 5

SCREENING OF SLUDGE MANAGEMENT METHODS

5.1 INTRODUCTION

In the preceding chapters of this document, six sludge management methods have been examined. With the exception of the no-action option, which combined land application and composting, each uses a single technology (excluding FONSI'd and MCCF sludge).

In this chapter these methods are screened to eliminate those which are the least desirable.

5.2 BASIS FOR SCREENING

Table 5.1 provides a summary of the evaluation factors and characteristics of the six sludge management methods which have been described in detail in Chapters 2, 3, and 4. In addition to the evaluation factors identified on Table 5.1 (i.e. costs, operability, implementability and environmental factors) comparison of the sludge management methods must include consideration of Section 101(b)(6) of Title I of the National Environmental Policy Act of 1969 (NEPA).

Table 5-1

Comparison of Alternatives

Alternatives

Evaluation Factors	Incineration With Ash Landfilling		Land Application	In-Vessel Composting	Drying & Product Use	Landfilling	Ocean Disposal
	6 Units	4 Units					
Total Equivalent Annual Costs	$21,298,000	$19,053,000	$20,218,000	$28,735.000	$15,130,000	$24,704,000	$8,164,000
Operability	Moderate		Moderate	Moderate	Low	Low	Low
Implementability	High		High	Moderate	Moderate	Low	Low
Potential Environmental Adverse Impacts							
Air Impacts							
o Stack Emissions	X	X			X		
o Odor Emissions			X	X		X	
Water Impacts							
o Surface Water	X[1]	X[1]	X[2]			X	X
o Groundwater	X[1]	X[1]	X[2]			X	
Land Impacts							
o Transportation			X	X			X
o Land Use Conflicts			X				
o Nutrients Overloading			X[3]	X	X	X	
o Landfill Capacity	X	X					
o Aesthetics	X	X					

[1] Potential impact at landfill; leachate generation from ash residue.

[2] Impacts are possible but extremely low because of guidelines and regulatory controls.

[3] Nutrient overloadings are remote if state guidelines are followed.

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Section 101(b)(6) specifies that it is the responsibility of the Federal Government to "enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources". In addition, and in concert with this responsibility, EPA established on June 12, 1984 a policy dealing with municipal sludge management that states, "The Agency will actively promote those municipal sludge management practices that provide for the beneficial use of sludge while maintaining or improving environmental quality and protecting public health." (18)

Many federal laws require environmentally sound management of municipal sludge and several of these laws emphasize the importance for sludge utilization and reuse. These include the Clean Water Act; Clean Air Act; Resource Conservation and Recovery Act; Marine Protection, Research and Sanctuaries Act; and the Toxic Substances Control Act. To implement the policy, the EPA has established the following guidance:

- *EPA believes that the risks, benefits, and costs of all sludge use and disposal practices should be considered on an intermedia basis when formulating and implementing sludge regulations and management programs. Potential short-term and long-term impacts to public health and the environment should be addressed to ensure that the options chosen protect human health and the environment.*

- *EPA believes that minimization of potential widespread or irreversible impacts, as well as involuntary hazards, should receive primary emphasis in both regulations and sludge management decisions. Where the risks are uncertain but potentially significant, additional safeguards may be needed.*

- *EPA believes that the planning and operation of wastewater and sludge treatment processes should be closely integrated to control both sludge volume and sludge quality.*

- *EPA believes that contaminant levels in municipal sludge which interfere with its management should, whenever possible, be controlled at the source through changes in waste generating activities or through local pretreatment requirements beyond the minimum requirements specified by Federal categorical standards.*

- *EPA believes that beneficial sludge use should be the intent of major sludge management technologies of the future and has devoted research in support of them. Regulations and guidelines that establish the requirements for these systems are essential to the wider use of these technologies.*

- *EPA believes that in most cases States should have the primary responsibility for implementing regulatory programs for sludge use and disposal which provide for clear and expeditious decision-making, and the States should help local governments and others to develop, implement, and maintain proper sludge management systems.*

- *EPA encourages public and private sector development of improved sludge management and pretreatment technologies and practices that increase the number of cost effective and environmentally acceptable sludge management methods available.*

5.3 SCREENING

The screening of the sludge management methods was performed by eliminating the weakest methods first. The results of the screening are summarized below in order of elimination of methods.

5.3.1 Landfilling (eliminated)

Landfilling is the weakest method. It has high cost and has low operability and implementability rankings. It does not meet EPA's goal of beneficial use.

5.3.2 Ocean Disposal (eliminated)

Ocean disposal is not implementable because other methods of disposal are available to the District. Additionally, it also does not meet EPA's goal of beneficial use.

5.3.3 Composting (eliminated)

Composting does meet EPA's beneficial use criterion. The District is already committed to composting 210.5 DTPD (51.3%) of the sludge through the FONSI'd project and MCCF. However, there are significant problems associated with additional composting. There is not sufficient space on site. Essentially all new unused space will be used for nitrogen removal facilities mandated by the Chesapeake Bay Agreement. Therefore, to fit the necessary in-vessel units on-site it would be necessary to place them in an expensive multi-story structure. Additionally, there would be significant technical obstacles associated with handling exhaust air from this large number of in-vessel units.

5.3.4 Drying and Product Use (eliminated)

Sludge drying is an attractive method from the standpoint of cost and reuse of the sludge. However, sludge drying on this scale in the Washington, D.C. area may have implementation problems. Unlike composting or land application, there is no experience demonstrating that the dried sludge can effectively be marketed and disposed. Although drying may be worth considering on a trial pilot basis for a small part of the sludge, there appear to be unreasonable risks associated with implementing it on the scale of 200 DTPD.

5.3.5 Incineration and Ash Landfilling (retained)

Incineration has significant implementation advantages to the District in that it enables the District to independently control sludge management. It also can be effectively accomplished within the limited Blue Plains site. Its chief disadvantage is that (other than some energy generation) it does not meet EPA's goal for beneficial use.

5.3.6 Land Application (retained)

Land application is a proven method that meets EPA's goal for beneficial use. It's principal disadvantage is that it relies on outside contractors and jurisdictions. This makes it more uncertain and difficult than incineration for the District to administer. Nevertheless because of its economic and reuse advantages, it is retained for further consideration.

CHAPTER SIX

CHAPTER 6

DEVELOPMENT AND EVALUATION OF FINAL ALTERNATIVES

6.1 INTRODUCTION

Preceding chapters examined and screened sludge management methods. This chapter describes a procedure in which final alternatives are developed from the sludge management methods that remained after the Chapter 5 screening process.

To develop the final alternatives, it is useful to review and further consider the overall sludge management needs facing the District.

6.2 OVERALL SLUDGE MANAGEMENT

The District will be managing and disposing of sludge in several ways. The long-term plans are that 87.5 DTPD will go to the Montgomery County Composting Facility, and 123 DTPD will be composted by an in-vessel system at Blue Plains. The remaining sludge (200 DTPD average, 384 DTPD peak month) is the subject of this EIS.

Figure 6.1 is a representation of the quantities of sludge, and their disposition, over the planning period. Assuming that total sludge quantities increase rapidly by 1998, approximately 200 DTPD will be going to agricultural land application if further action is not taken. With a more moderate growth in sludge quantities, the total sludge handling capacity of 410.5 DTPD will not be needed until around 2010.

The District has indicated that the rate of increase in sludge quantities cannot be predicted accurately. The rate will depend upon population increases in the Washington metropolitan area and process changes at the treatment plant. This uncertainty is a factor to be considered in developing sludge management alternatives.

6.3 DEVELOPMENT OF ALTERNATIVES

6.3.1 Methodology

EPA recognizes that there are planning and environmental advantages in developing and maintaining a flexible and technically varied management program. This is reflected in the decisions to send some of the sludge off-site (to MCCF), and to compost some on-site (FONSI'd sludge). Consistent with that approach, this EIS endeavors to develop alternatives that will continue to provide the desired long and short-term flexibility for the remainder of the sludge.

6.3.2 No Action Alternative

The no-action alternative would rely upon full utilization of the MCCF, on-site in-vessel composting as approved by the FONSI, and continued use of land application at approximately current levels. The disposition of all sludges under this alternative is represented in Figure 6.2.

6.3.3 Incineration (District Concept)

The District proposes to construct 6 fluid bed incinerators to dispose of the sludge. Figures 6.3 and 6.4 show the disposition of sludge in this alternative under both average and peak month conditions, assuming 4 incinerators are operating. The figures show that 4 incinerators are adequate for both average and peak periods. They also indicate that for the "average rate sludge production" scenario, all 4 incinerators will not be required until 2010.

In previous chapters, information was provided on a "4 incinerator" system as well as the proposed 6 incinerator system. Inasmuch as 4 incinerators are adequate to handle the 200/384 DTPD, 6 incinerators are clearly not required.

TOTAL AVERAGE SLUDGE DISTRIBUTION OVER PLANNING PERIOD

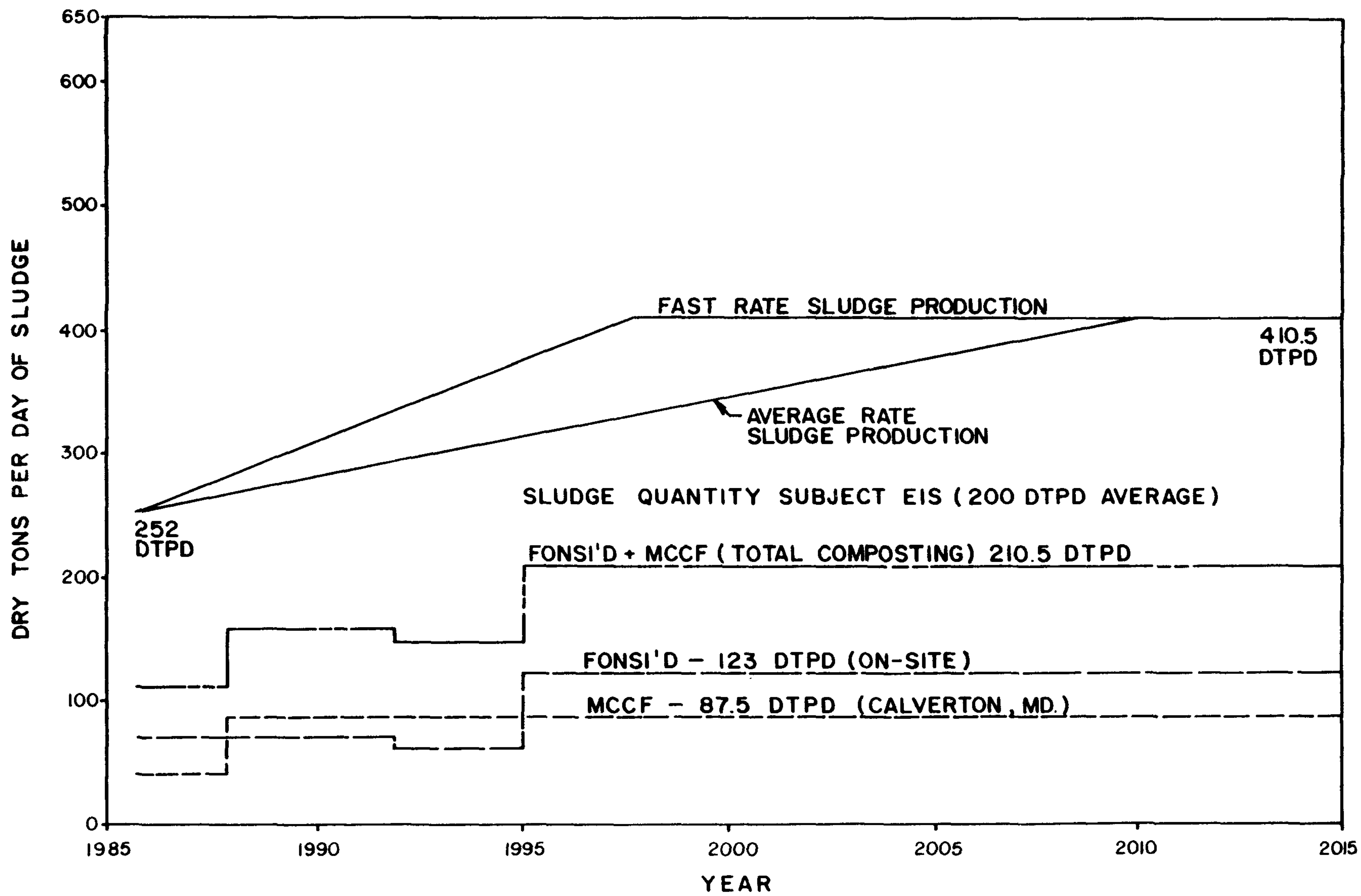


FIGURE 6.1

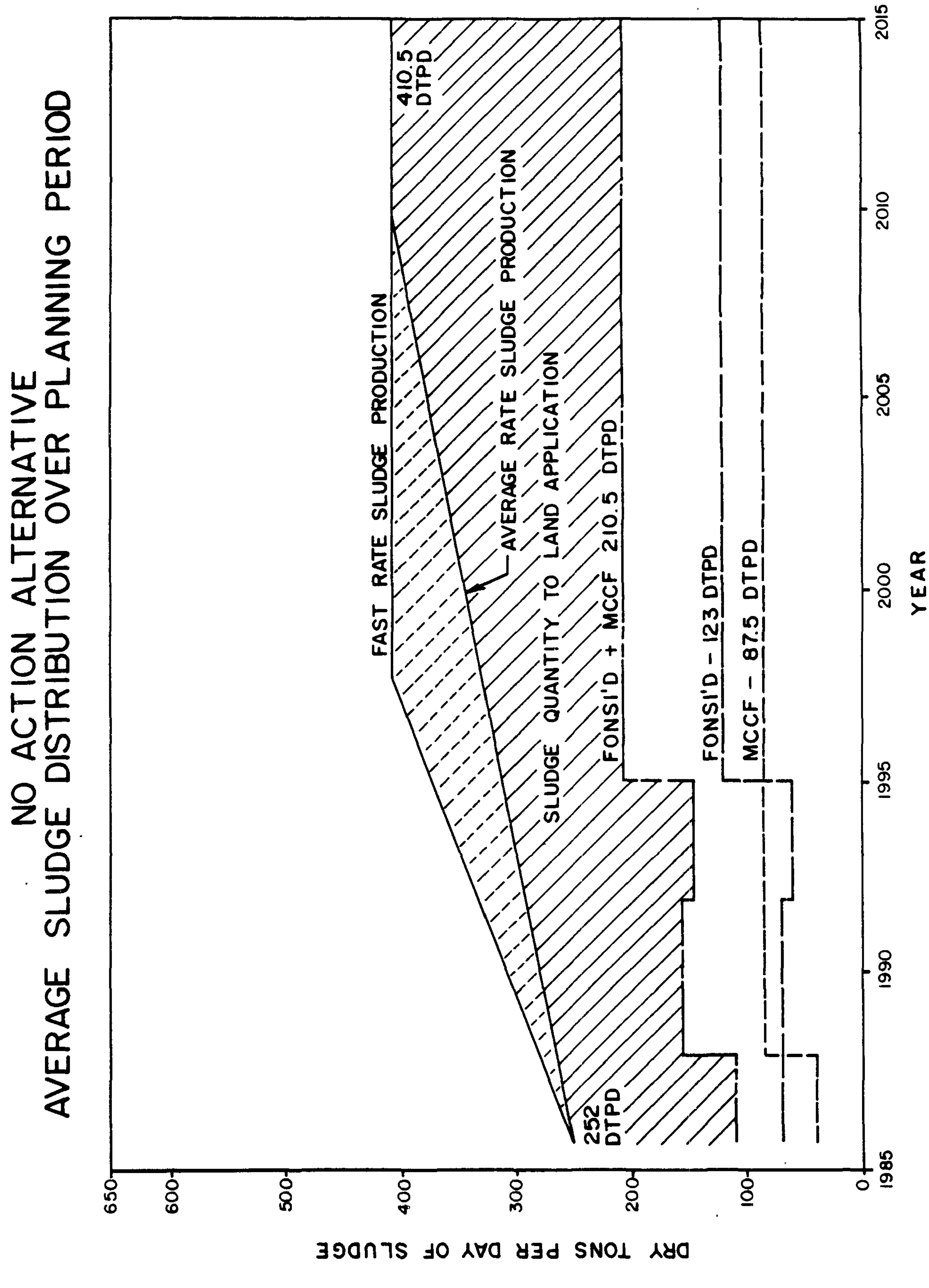

NO ACTION ALTERNATIVE
AVERAGE SLUDGE DISTRIBUTION OVER PLANNING PERIOD
DRY TONS PER DAY OF SLUDGE
YEAR
0
100
200
300
400
500
600
650
1985
1990
1995
2000
2005
2010
2015
252 DTPD
410.5 DTPD
FAST RATE SLUDGE PRODUCTION
AVERAGE RATE SLUDGE PRODUCTION
SLUDGE QUANTITY TO LAND APPLICATION
FONSI'D + MCCF 210.5 DTPD
FONSI'D - 123 DTPD
MCCF - 87.5 DTPD

FIGURE 6.2

FOUR UNIT INCINERATION AT AVERAGE LOADING CONDITIONS

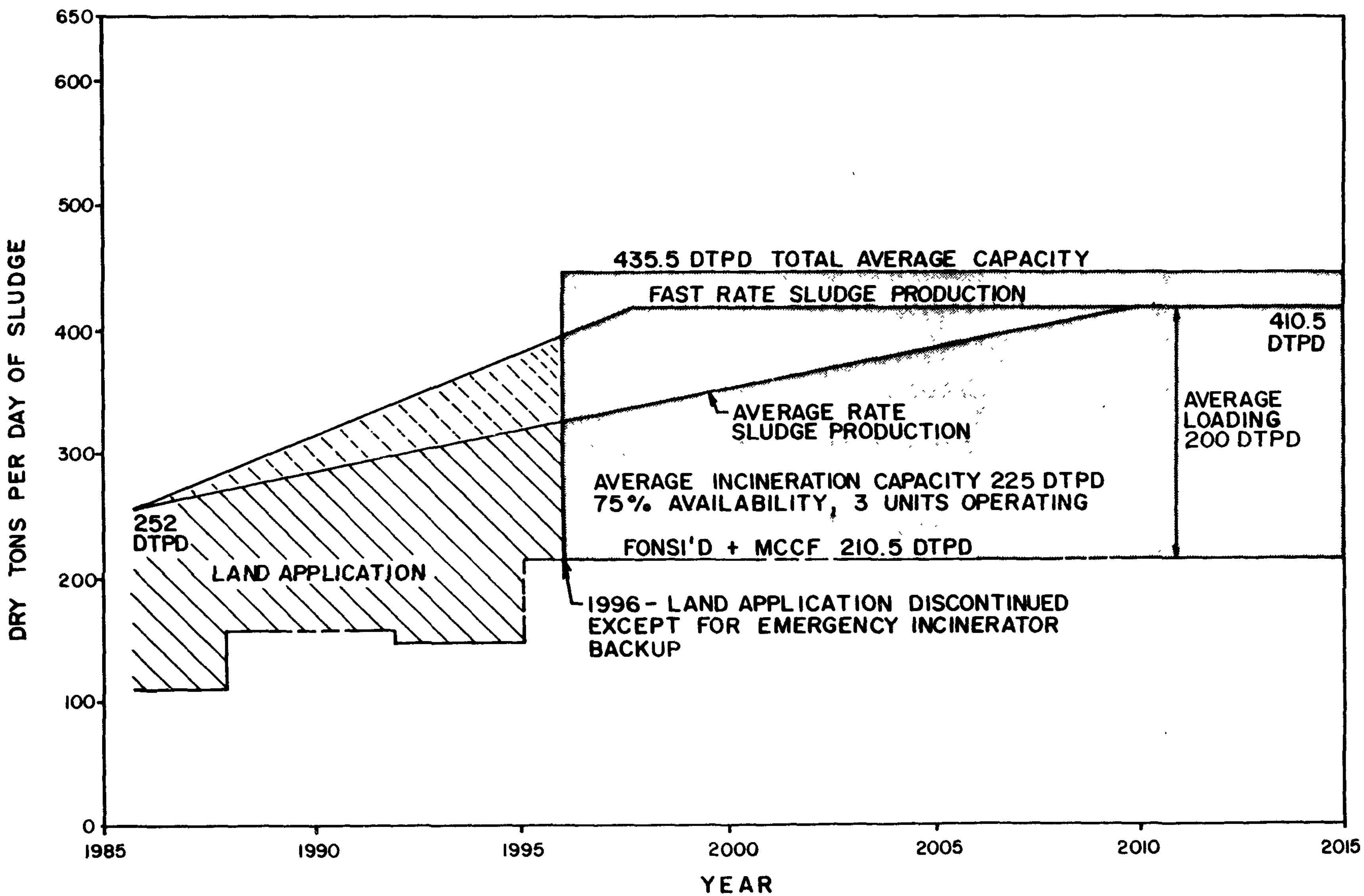
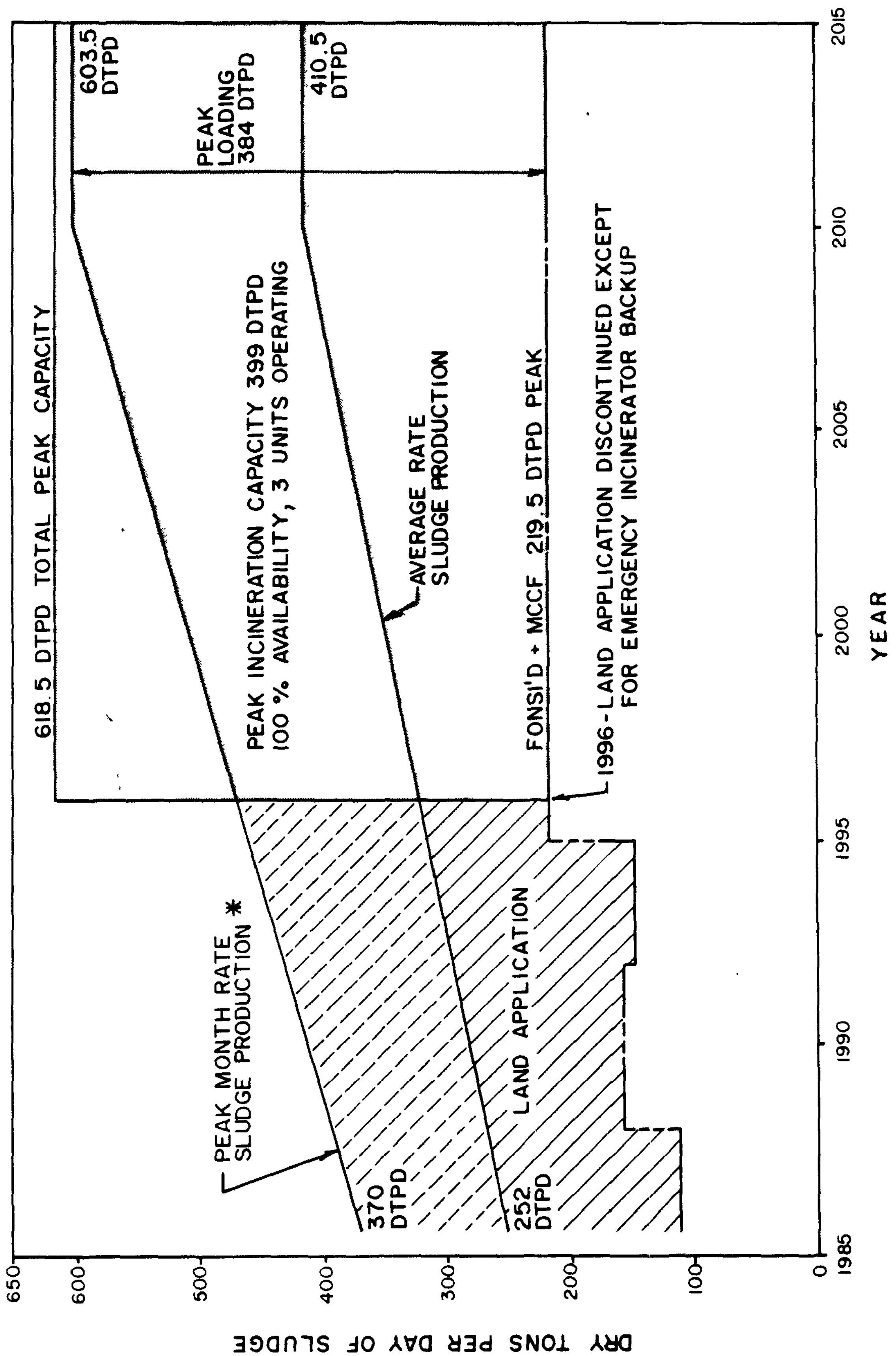


FIGURE 6.3

FOUR UNIT INCINERATION
AT PEAK LOADING CONDITIONS



* - PEAK RATE OF 384 DTPD OCCURS ON TWO MONTHS ON AN ANNUAL BASIS. SEE APPENDIX H.

FIGURE 6.4

6.3.4 Land Application

The land application alternative would continue indefinitely. As shown by Figure 6.5, overall quantities of sludge going to land in the long-term would be comparable to current quantities. The primary differences between the no-action and land application alternatives are that under the land application alternative, dewatering would be upgraded and the program would expand to meet both average and peak disposal needs of the District.

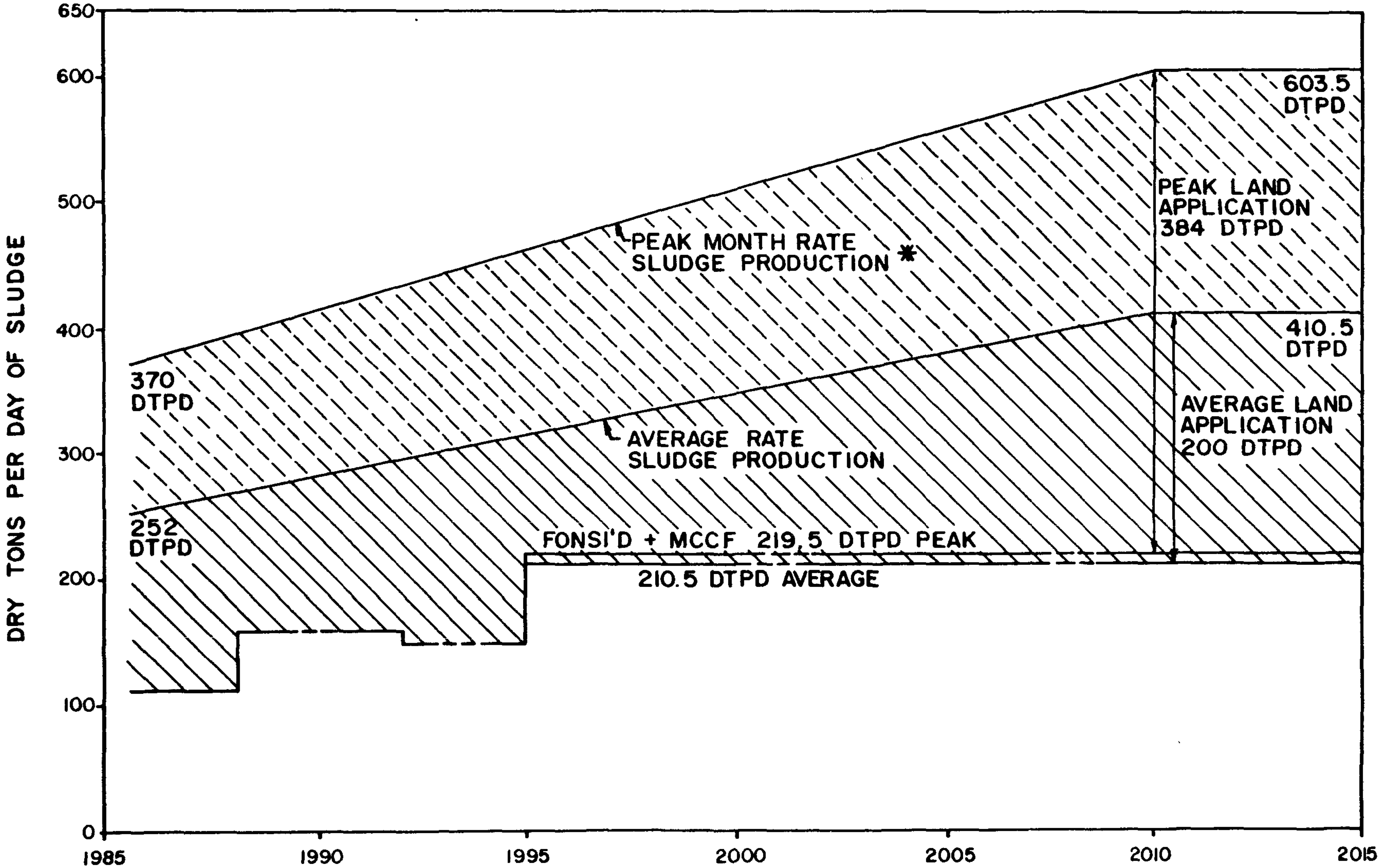
6.3.5 Combined Incineration/Land Application

Combined incineration/land application provides flexibility in the short and long-term that neither of the single-method alternatives provides. This alternative is based on:

- *Construction of two fluid bed incinerators and related facilities (rated capacity; 133 DTPD each).*
- *Operation of one incinerator at a derated capacity (100 DTPD) and the second kept as standby under average conditions. (This is considered very conservative. Most of the time, both incinerators could be operating).*
- *Operation of both incinerators during the peak month at an assumed capacity of 100 DTPD each.*
- *Land application of all other sludges during both average and peak periods.*

Figures 6.6 and 6.7 depict the disposition of sludge using the combination alternative. Figure 6.6 shows that when only one incinerator is operating, approximately 100 DTPD on average would go to land application in 2010. Under peak conditions, 184 DTPD would be land applied.

LAND APPLICATION AT AVERAGE AND PEAK LOADING CONDITIONS



* - PEAK RATE OF 384 DTPD OCCURS ON TWO MONTHS ON AN ANNUAL BASIS. SEE APPENDIX H.

FIGURE 6.5

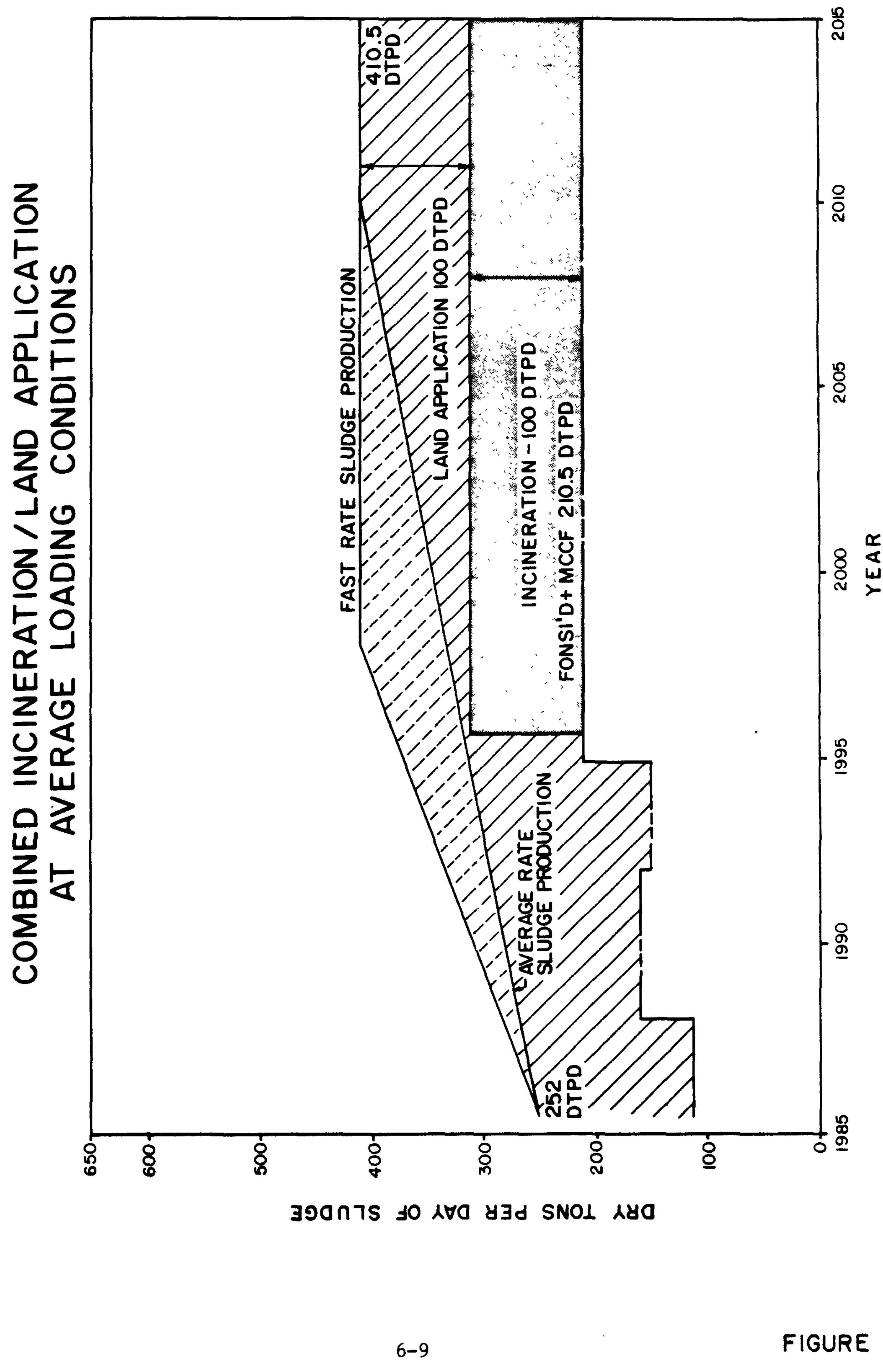
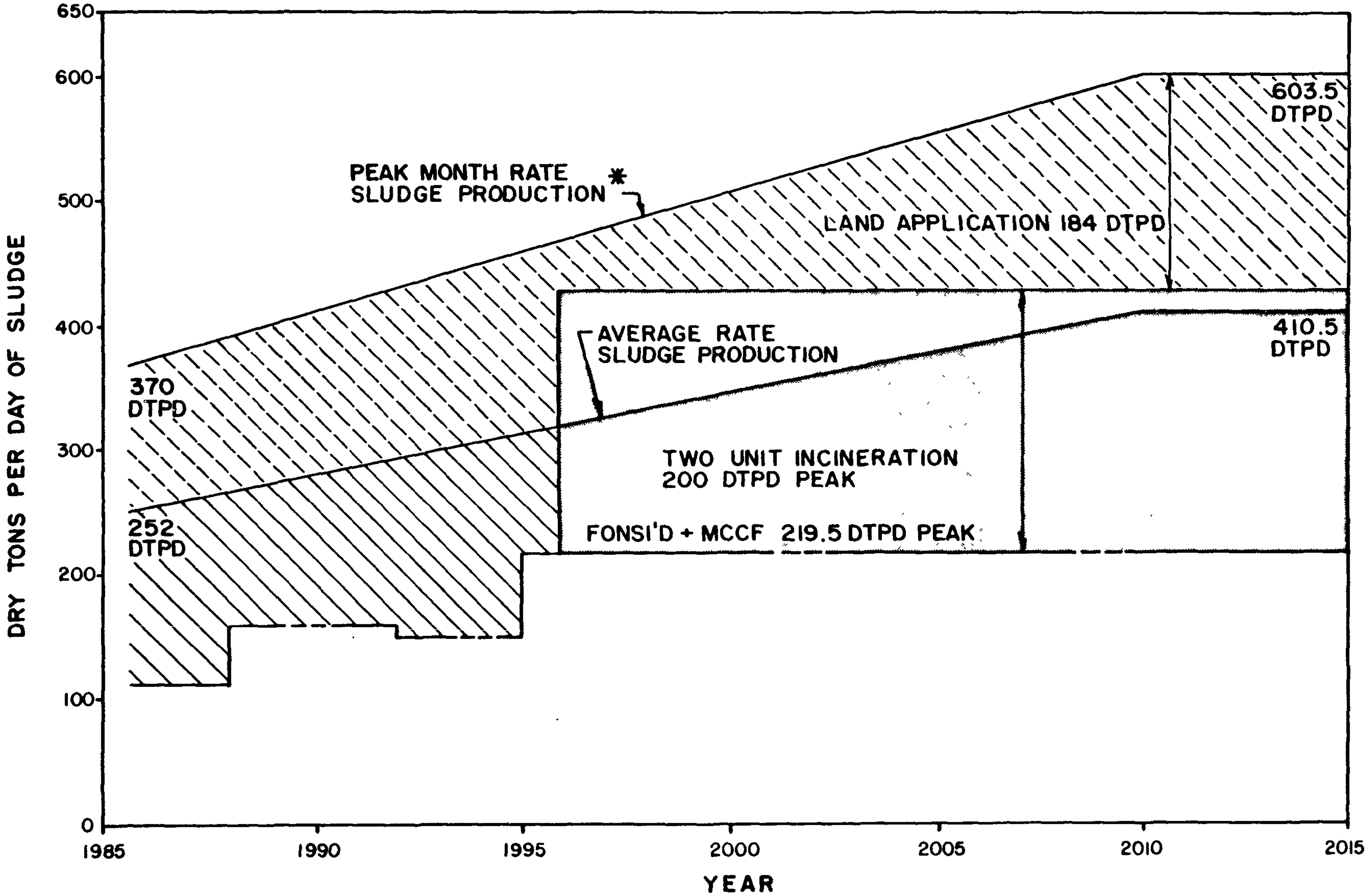

COMBINED INCINERATION/LAND APPLICATION
AT AVERAGE LOADING CONDITIONS
FAST RATE SLUDGE PRODUCTION
LAND APPLICATION 100 DTPD
410.5
DTPD
INCINERATION - 100 DTPD
FONSI'D+ MCCF 210.5 DTPD
AVERAGE RATE
SLUDGE PRODUCTION
252
DTPD
DRY TONS PER DAY OF SLUDGE
0
100
200
300
400
500
600
650
1985
1990
1995
2000
2005
2010
2015
YEAR

FIGURE 6.6

COMBINED INCINERATION / LAND APPLICATION AT PEAK LOADING CONDITIONS



* - PEAK RATE OF 384 DTPD OCCURS ON TWO MONTHS ON AN ANNUAL BASIS. SEE APPENDIX H.

FIGURE 6.7

6.4 EVALUATION OF THE ALTERNATIVES

6.4.1 Costs

Capital, operating, and present worth costs have been estimated for each of the three final sludge management alternatives. The costs are summarized in Table 6.1. All cost estimates are consistent with estimates developed in previous chapters. Additional cost details are shown in the Appendix.

The present worth and total annual equivalent cost of all three alternatives are similar. Considering the range of accuracy of these estimates, they must be considered essentially equal.

The distribution of costs, however, is extremely variable. The land application alternative has a low capital cost and high operating costs. The alternatives that include incineration have higher capital costs and lower operating costs than land application.

Capital costs associated with the incineration alternatives are lower than they would normally be because it is assumed that existing structures would be used to contain the proposed incinerators. As a consequence, the cost of the structures are considered "sunk costs" and are not included in this evaluation.

Costs for the "No-Action" alternative will be essentially the same as those for the land application alternative.

6.4.2 Environmental Impacts

The environmental impacts of the three alternatives were reviewed, and are summarized in Table 6.2. The impacts of the total incineration and land application alternatives were detailed in Chapter 4.

TABLE 6.1

SUMMARY OF SOLIDS MANAGEMENT ALTERNATIVES
PRESENT WORTH COST ANALYSIS (1)

Cost Component	LAND APPLICATION	TWO UNIT INCINERATION/ LAND APP.	FOUR UNIT INCINERATION
CAPITAL COSTS			
1988 Estimated Project Cost	$17,490,000	$76,294,000	$96,347,000
OPERATION AND MAINTENANCE COSTS			
Annual O&M Cost	18,360,000	11,377,000	8,966,000
Present Worth Annual Cost (9.3778)	172,176,000	106,691,000	84,081,000
SALVAGE VALUE (5)			
Plant Structures	0 (6)	1,7759,000	17,759,000
40 Years (50%)	0	0	8,880,000
Present Worth Salvage Value (0.1912)	0	0	1,698,000
PRESENT WORTH (PW)			
Capital Cost +	17,490,000	76,294,000	96,347,000
PW Annual Cost -	172,176,000	106,691,000	84,081,000
PW Salvage Value	0	0	1,698,000
PW of Alternative	189,666,000	182,985,000	178,730,000
TOTAL ANNUAL EQUIVALENT COSTS (0.1066)	$20,218,000	$19,506,000	$19,053,000
ESTIMATED ANNUAL EQUIVALENT COST PER DRY TON (7)	$277	$267	$261

(1) Values based on a 20 year planning period, 8.625% federal discount rate, EPA construction cost index base year 1973 large city, and consumer price index
(2) Based on Appendix G Table 5
(3) Based on Appendix G Table 7 and excludes sunk costs associated with incinerator section of Solids Processing Building
(4) Based on Appendix G Table 1 and excludes sunk costs associated with incinerator section of Solids Processing Building
(5) Based on EPA established guidelines and Appendix G Table 8
(6) Capital cost is for process equipment which has a design life of 20 years and no salvage value over the planning period
(7) Based on an annual loading of 73,000 dry tons of sludge solids

TABLE 6.2

SUMMARY OF ENVIRONMENTAL IMPACT POTENTIAL

Potential Environmental Adverse Impacts	Incineration With Ash Landfilling	Land Application	Combined Incineration Land Application
Air Impacts			
Stack Emissions	X		X
Odor Emissions		X	X
Water Impacts			
Surface Water	X[1]	X[2]	X[1,2]
Groundwater	X[1]	X[2]	X[1,2]
Land Impacts			
Transportation		X	X
Land Use Conflicts		X	X
Nutrient Overloading		X[3]	X[3]
Landfill Capacity	X		X
Aesthetics	X		X

1 Potential impact at landfill; leachate generation from ash residue.

2 Impacts are possible but extremely low because of guidelines and regulatory controls.

3 Nutrient overloadings are remote if state guidelines are followed.

The land application alternative has an indirect positive environmental benefit related to nutrient loadings from non-point sources to the Chesapeake Bay. With the land application of sludge, farmers are able to partially avoid addition of commercial fertilizers. The commercial fertilizers in general, provide "fast-release" of nutrients (including nitrogen) into the soils, some of which are washed into the Bay. The "slow-release" characteristics and soil conditioning effects of sludge nutrients precludes some of the wash-off. As a result, the District may not have to provide the same level of nutrient removal in wastewater treatment at Blue Plains because of the benefit obtained from use of the sludge on farmlands.

The combination incineration/land application alternative is necessarily a hybrid of the impacts associated with the other two. Since both disposal techniques are included in the combination, the negative impacts of both are included. However, the degree of most of the impacts is reduced.

This evaluation did not place relative values on the environmental impacts or on the degree to which impacts are additive or mitigated in the combination alternative. It is judged that overall impacts of the combination alternative are comparable to those associated with the other two.

6.4.3 Implementation Characteristics

Implementability depends upon three major factors, which in some ways are interrelated: flexibility to meet current and variable future needs, public acceptability, and management characteristics. Table 6.3, 6.4 and 6.5 summarize the characteristics of the alternatives.

The flexibility comparison in Table 6.3 indicates that the combination incineration/land application is best. The single method alternatives (all incineration, all land application) are self limiting. The combination alternative allows suitability or emphasizing of disposal methods. The land application alternative provides superior flexibility in that (because of it's low capital cost) it does not preclude switching to another method later. The high capital cost of incineration will make switching difficult.

The public acceptability comparison is inconclusive. All three alternatives present concerns. In a way, the combined alternative combines the problems associated with the other two. However, the degree of the problem is mitigated somewhat by splitting the sludge into two disposal methods.

Land application is now generally accepted by the public. However, continued public acceptance will require strict adherence to regulations and competent program management.

Public acceptability of incineration and Blue Plains has not been tested. However, there is no doubt there will be at least some adverse public reaction to potential emissions and to the visual impact of the incinerator stacks.

EPA, to a great extent, represents the public. Therefore, EPA's policy to encourage reuse of natural resources, is considered a part of the public acceptability comparison. The public will be favorably inclined to methods that are directed towards EPA's policy. The land application method best meets the EPA goal; the incineration method is least effective; and the combination alternative falls in between the other two.

The management characteristics summary on Table 6.5 indicates that there may be management advantages to the District with total incineration. The advantage lies principally in that the District would not have to rely on outside contractors, or deal with the public beyond the plant site limits. Nevertheless, all three alternatives do have both advantages and disadvantages and the District has dealt successfully with most of these management characteristics in the past.

The land application alternative, in addition to the characteristics summarized in Table 6.5, also has the advantage that it may permit the District to take "credit" for the reduced non-point nitrogen discharge from lands tributary for the Chesapeake Bay (as was discussed in Section 6.4.2). This credit could not be applied to an incineration alternative because it

TABLE 6.3

FLEXIBILITY CHARACTERISTICS

Incineration with Ash Landfilling	o Flexible to changing sludge quantities o Inflexible to regulatory changes (e.g. emission requirements, ash disposal requirements). o High capital costs commits District to long-term use. Discourages future changes.
Agricultural Land Application of Dewatered Sludge	o Flexible to changing sludge quantities o Inflexible to regulatory changes (e.g. agricultural loading rates, aesthetic requirements). o Low capital cost permits District to change to other methods later.
Combined Incineration/ Land Application	o Flexible to changing sludge quantities and characteristics. Allows switching between disposal methods. o Flexible in meeting changing regulations by switching between methods. o Intermediate capital costs discourages switching off incineration.

TABLE 6.4

PUBLIC ACCEPTABILITY CHARACTERISTICS

Incineration with Ash Landfilling	o Public concern with air pollutants and with stacks (appearance). o Minimal use of natural resource (Public and EPA concern).
Agricultural Land Application of Dewatered Sludge	o Local concern with site odors and truck traffic. o Maximize reuse of natural resource (Public and EPA goal).
Combined Incineration/ Land Application	o Local concern with site odors and truck traffic (at land sites). o Public concern with air pollutants as with stacks (appearance). o Moderate use of natural resource.

TABLE 6.5

MANAGEMENT CHARACTERISTICS

Incineration with Ash Landfilling	o	Independent of outside contractors, etc.
	o	Must meet air pollution regulations.
	o	Must have ash disposal available.
	o	Has high operating, maintenance requirements.
Agricultural Land Application of Dewatered Sludge	o	Has reduced operating, maintenance requirements.
	o	Must maintain site availability, site permits.
	o	Must maintain sludge quality.
	o	Must work around seasonal limitations.
	o	Must negotiate/renegotiate outside contracts.
	o	Has continuing high public visibility.
Combined Incineration/ Land Application	o	Provides District with options for disposal.
	o	Relies partially on outside contractors.
	o	Must meet both air pollution and land application regulations.
	o	Has continuing high public visibility.

would increase the use of commercial fertilizer and non-point nitrogen discharge. If the land application nutrient control advantage can be demonstrated, there is a possibility that the District could avoid some additional nutrient control at Blue Plains. This would allow alternative uses for the plant site in lieu of the intended denitrification facilities.

6.5 SUMMARY

The District will be managing and disposing of sludge in various ways. It is committed to dispose of 87.5 DTPD through the MCCF and 123 DTPD by an on-site FONSI'd composting facility. The sludge that is the subject of this EIS could be disposed in various ways.

Three alternatives are viable. Land application is superior in that it more fully meets EPA's reuse goals and has been shown by the District to be an effective technique. Incineration has management advantages in that the District will not be dependent upon outside contractors, municipalities, public opinion land use. The combined incineration/land application alternative provides flexibility to the District in both for the present and for meeting future changes.

CHAPTER SEVEN

CHAPTER 7

PREFERRED SLUDGE MANAGEMENT ALTERNATIVE AT BLUE PLAINS

7.1 INTRODUCTION

The history of sludge management at Blue Plains has ranged from the earliest practice of land disposal, to sludge trenching, to drying, and to the current practice of composting and land application at agricultural sites. During the 1950's flash drying/incineration was used briefly followed by a return to land application during the 1960's. However, land application at that time was hampered by transportation difficulties and uneven product quality. As a result, sludge was stockpiled and eventually removed through a crash program starting in 1970.

From 1971 to the present, a succession of interim sludge management methods have been used. Among these were trenching, drying on-site, land application, composting, and chemical-fixing. Eventually, the methods narrowed to just composting and land application on agricultural lands.

Currently, Blue Plains is composting 72 DTPD on-site, and transporting 40 DTPD to the MCCF for composting. The remaining 120 - 140 DTPD is applied to agricultural lands. These disposal methods are a subject of the IMA which places the responsibility on the District to manage an average of 323 DTPD. Eventually, the MCCF will compost 87.5 DTPD and Blue Plains will compost 123 DTPD in the FONSI'd facility. Disposition of the remaining 200 DTPD is the subject of this EIS.

Sludge disposal alternatives at Blue Plains have been subjected to rigorous study during this EIS and previous studies. It has been confirmed that the sludge is of high quality, with low metal concentrations. It is a valuable material for both composting and land application.

Since 1975, composting and land application have been, collectively, a common denominator for sludge management. Difficulties have been encountered ranging from storage to overflowing on site and odor problems at MCCF to complaints at application sites. Current composting and land application have alleviated the sludge storage problem on-site and upgrading at MCCF is intended to alleviate odor complaints there. Problems at the land application sites are intermittent with most resolved, generally, to the satisfaction of all parties. However, the District government and user jurisdictions view total recycling as fraught with regulatory and management implications. Long-term dependence on this alternative is regarded as unwieldy.

7.2 SLUDGE MANAGEMENT ALTERNATIVES

7.2.1 Management Concerns

The following discussion summarizes the management implications of each alternative:

Incineration: The District has already constructed a solids processing building with space available for incinerators. The District would not need to rely upon land availability, or markets outside its jurisdiction, if incinerators were used. All personnel hired or contracted to operate the incinerators would be solely reporting to the District management and therefore not subject to other authority.

Incineration is attractive and competitive because it minimizes management variables. Major capital costs occur at the outset, followed by lower operating costs over the life of the facility. This differs from the other alternatives that rely upon recycling, where the costs are spread over a number of years. For these reasons, the incineration option is attractive to those responsible for plant operation.

Land Application: To implement this alternative, the District would most likely continue the contractual arrangements already in place or institute similar ones. The contractors or the District would have the responsibility of maintaining land availability through obtaining permits and compliance with state and federal guidelines. Land application requires good public relations on the part of the District or its contractor so that state and local officials are agreeable to a continuing land application program. The uncertainty of a continuing demand for this product is also a legitimate concern, but one that appears to be lessening with time, as refinements in application methods develop. The state management agencies are refining land application through revisions to the regulations, as problems are recognized and defined.

Successful operation of the land application program involves many long-term management concerns, ranging from contract management through scheduling of many interdependent operations. However, it has been a successful disposal method for the past several years, although requiring efforts on the part of the contractors to alleviate problems. In addition, it has been used at large cities throughout the Nation, e.g., Chicago.

Land Application/Incineration Combination: This alternative incorporates the management concerns and advantages of both of the alternatives. However, it presents a duplication of effort for operations that are markedly different. That is, little similarity exists between the land application and the incineration alternatives. Inasmuch as the District is also managing a composting program, this combination of three disposal methods requires a large management effort.

The combination alternative, incineration and land application, is viewed as the least attractive from the management viewpoint because of the complications of short and long-term costs, and the need for intensive management.

Discussion: Management of sludge over the past few years has depended heavily on reuse by land application and composting. Both composting, as conducted at MCCF, and land application, as demonstrated through the contractual arrangements entered into by the District, have successfully alleviated the sludge disposal problems experienced prior to the 1980's. Although reuse is a continuing management concern, the District has demonstrated it can be done. Both composting and land application require constant attention, but once instituted and with experience gained over time, they have proven to be acceptable and successful alternatives.

The District government takes issue with a program that relies at least partly on management outside their jurisdictional control. Since 1984, the District of Columbia has been on a course towards developing independence in sludge management. EPA acknowledges the District's desire to have total management control over sludge disposal and that incineration represents that control. Their major concern is a view that implementing and sustaining a long-term land application program will be difficult. It requires a highly developed infrastructure of contract management and inter-governmental coordination and coordination. Although incineration requires sophisticated technical management attention, it does not require the degree of inter-governmental coordination and cooperation required by land application. EPA recognizes that land application imposes different sludge management requirements than incineration. However, EPA also believes that successes achieved thus far in the recycling effort can continue and be a long-term solution to sludge management at Blue Plains.

7.2.2 Environmental Concerns

In keeping with EPA's municipal sludge management policy, which states that recycling and reuse are the alternative of choice, (see page 5-3 for a description of this policy), the preferred alternative should maximize recycling and reuse. This policy, combined with NEPA's purpose of fostering good environmental decisions, leads towards a non-destructive alternative with reuse as a major component.

Incineration: The incineration option carries little if any reuse value and involves the loss of nutrients that are both of value to the soil and potentially helpful in improving water quality in the Chesapeake Bay. Nutrients returned to farmland replace some uses of inorganic fertilizers and in that way nutrient runoff is reduced because organic nutrients tend to incorporate into the soil better than inorganic nutrients. The incinerator ash, which must be landfilled, constitutes a further loss in resource because it cannot be used again and because of its long-term land use commitment.

Incineration results in a two-thirds reduction in mass and a similar reduction in truck traffic. Therefore, there will be less air pollution compared to the other alternatives from hauling. However, this is offset to a degree by the emissions from the incineration stacks. Additionally, the incinerator stacks will significantly detract from the visual quality of the District's horizon.

Land Application: Roughly 70,000 acres of land in Maryland and Virginia are currently permitted for this use. The replacement of nutrients in the farmland soils with sludge is a reuse method with few drawbacks. In addition, the fertilizer and soil conditioner values of sludge reduce the use of inorganic fertilizers and runoff of polluting nutrients to the Chesapeake Bay. Reduction in fertilizer use not only saves on natural resources, but also has secondary benefits of energy surveys.

The disadvantages of high volumes of truck traffic, and associated noise and exhausts, are problems that can be mitigated through timing of departures and arrivals, and by using alternative transportation modes where feasible. The use of proper land application methods, which incorporate sludge into the soil within a short period of time, will also mitigate odors. These proper land application methods are being incorporated into state environmental management programs, thus easing any environmental concerns regarding impacts.

Land Application/Incineration Combination: This alternative combines both the positive and the negative aspects of the other alternatives. Reuse would be provided, but at a reduced rate. Air pollution from incineration would be reduced because the amounts would not exceed 100 DTPD, except during peak conditions when 200 DTPD would be incinerated.

However, truck traffic would remain high, requiring hauling of both ash and sludge. Benefits to the Chesapeake Bay from reduced uses of inorganic fertilizers would be less than half, because of the reduction in the levels of high quality sludge applied to the land. Aesthetic considerations would also be an issue because the proposed incinerators would still require stacks.

7.2.3 Economic Concerns

Capital, operating, and present worth costs have been estimated for each of these three major sludge management alternatives. Costs for each alternative have been developed in Table 6.1 in Chapter 6. The following are the key components of this table.

	Land Application Alone	Incineration and Land Application	Incineration Alone
1988 Estimated Project Cost	$17,490,000	$76,294,000	$96,347,000
Annual Operation & Maintenance Cost	$18,360,000	$11,372,000	$ 8,966,000
Total Annual Equivalent Costs	$20,218,000	$19,325,000	$19,053,000
Estimated Annual Equivalent Cost Per Dry Ton	$277	$265	$261

The estimated total annual equivalent cost of the three alternatives, considering the bounds of statistical error in engineering estimates, are nearly equal.

The initial capital investment for construction of the incinerators is considerably higher than land application. Conversely, land application has a higher annual O&M cost. Lower annual operations and maintenance costs, and the salvage values, of the incineration alternatives make them competitive with land application on an annual equivalent cost basis.

7.3 PREFERRED ALTERNATIVE

Under 40 CFR 1500.1(c), it is stated that "the NEPA process is intended to help officials make decisions that are based upon understanding of environmental consequences, and take actions that protect, restore, and enhance the environment." While the incineration alternative has certain management advantages, and it appears from the air emissions modeling that it will not violate existing regulations, it does not meet NEPA's purpose as effectively as does land application. However, the incinerator alternative would require the management of a high level of sophisticated, on-site engineering technology.

There are potential secondary benefits to the Chesapeake Bay from land application of sludge. Through reducing the amount of inorganic fertilizers, soluble nutrients in runoff will be lessened. The organically bound nutrients in sludge are released more slowly and are more readily bound in soils than the nutrients from inorganic fertilizers. In addition, potential pollution from fertilizer manufacturing will be reduced along with a reduction in raw materials usage.

This EIS applies to the disposition of 200 DTPD, with peaks occasionally reaching as high as 384 DTPD. However, the peak level may not be reached until as late as 2010. The FONSI'd in-vessel composting on-site will be increased to accommodate some of the additional sludge, up to at least 123 DTPD. This will leave substantial amounts for disposal. However, the period of time until that level is reached can be used to develop and refine the alternative selected.

Current reliance on reuse by composting and land application is consistent with the generally successful application of these techniques in the late 1970's and early 1980's. As the regulatory agencies refine their guidelines and the contractors increase public awareness, the problems have eased. Although land application appears to cost slightly more than incineration, that disadvantage is somewhat offset by the value of nutrients returned to the land, and the benefits to water quality from lower nutrient concentrations in runoff that results from inorganic fertilizers.

From the conclusion of this EIS, EPA has determined that land application, in combination with FONSI'd composting, as shown by Figures 6.1 and 6.5, is the preferred alternative. Land application of roughly 200 DTPD will be required throughout the year. The occasional peak will be offset by the equally occasional lower-than-average quantity. The management scheme in place is currently operating efficiently and in time this already successful course can be improved upon.

The preferred alternative is supported by a number of management and environmental considerations. Each of these has been discussed previously in the EIS but needs to be again emphasized in support of the preferred alternative.

7.3.1 Management Benefits

A management infrastructure for reuse of sludge solids is already in place in the Washington, D.C. area. The Washington Suburban Sanitary Commission (WSSC) through its MCCF facility is successfully marketing its compost materials. This facility will be expanded and along with a new in-vessel facility at Blue Plains will produce a high quality compost product that is in demand as a soil conditioner.

Lands permitted for sludge application in Maryland and Virginia are abundant. As indicated in Chapter 2 (see Table 2.5) there are approximately 70,000 acres of permitted land available for application of Blue Plains sludge under the present contract management program. This availability of land substantially exceeds the land required to dispose of the average 200 DTPY over the next 20 years.

The District and its contractors have accumulated valuable operational experience with land application. This experience is substantial and can be utilized to improve and enhance the success of this technology. Although occasional public relations problems associated with land application have arisen, they can be handled by contractors with a minimum of impact to users and the District because of increased sensitivity to this need. It is anticipated that public acceptance of this practice will continue to grow.

Land application is probably the least complicated operation of any of the alternatives under consideration. However, land application still requires good planning, careful field operations and a keen awareness of what is required to gain and maintain public support and awareness. It has been in practice at Blue Plains over the past several years. It is an alternative that is economically competitive with other alternative sludge disposal techniques; ample land has been consistently available and permitted to receive sludge; and it is the simplest alternative to operate.

7.3.2 <u>Environmental Benefits</u>

There are numerous environmental benefits from the use of land application. These include the return of nutrients to the land as a valuable commodity rather than their loss through a non-recycling, disposal alternative. Sludge can be used to replace some of the uses of inorganic fertilizers, with the accrued environmental benefits and the reduction in surface and groundwater pollution potential from inorganic fertilizers.

The reduction of nutrients to the Bay is an overall goal of the Chesapeake Bay program. Using sludge as a supplement or even replacement for commercial inorganic fertilizers can assist in the effort to clean up the Bay.

Land application will also assist in preserving the visual integrity of the Washington, D.C. area. The D.C. area has always attempted to maintain its low profile skyline and, with few exceptions, this has been successfully maintained. The proposed incinerator stacks would be approximately 225 ft. in height and would clearly penetrate the low profile horizon.

Emissions from the stacks would be eliminated as a source of air pollution in the area. They would be somewhat replaced by diffused mobile sources from the trucks that would transport the sludge material to land application sites throughout the region.

7.4 CONCLUSIONS

- The preferred alternative is land application of all wastewater sludge generated at Blue Plains. The District should continue its current practice of land application.

- There is contractor interest in land application and sufficient permitted lands are available.

- Land application provides for recycling and utilization of a valuable commodity.

- Land application is economically competitive with other alternatives.

- Land application can be managed with relative ease provided there is good planning and implementation.

- Land application will not impact upon any of the current space utilization problems at Blue Plains.

- Land application will have the least environmental impacts, through recycling an important source of nutrients, comply with goals for protection of the Chesapeake Bay, reduce air emission in the area and eliminate visual impacts on the D.C. skyline.

- EPA acknowledges that the preferred alternative does not provide the autonomous control over sludge management that the District government believes is necessary.

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APPENDIX A - LOCAL, STATE AND FEDERAL REGULATIONS

APPENDIX A

LOCAL, STATE AND FEDERAL REGULATIONS

FEDERAL REGULATIONS

Clean Water Act and Federal Water Pollution Control Act

- o Authorizes EPA to issue comprehensive sewage sludge management guidelines and regulations.
- o Authorizes the National Pollutant Discharge Elimination System (NPDES).
- o Authorizes Federal funding for eligible costs of municipal WWTP's sludge treatment and disposition facilities.

Resource Conservation and Recovery Act

- o Requires regulations for the safe disposal of hazardous and nonhazardous waste.

Clean Air Act

- o Authorizes the development of State Implementation Plans to meet Federal ambient air quality standards.
- o Authorizes regulations for the control of hazardous air pollutants and new source performance standards.

Toxic Substances Control Act

- o Requires coordination with the Clean Air and Clean Water Acts to restrict disposal of hazardous wastes (PCB from sludge).

National Environmental Policy Act

- o Requires EIS's to be performed if potential adverse impacts are suspected for a new or modified sludge disposition facility.

Safe Drinking Water Act

- o Requires coordination of CWA and RCRA to protect drinking water from contamination.

Marine Protection, Research and Sanctuaries Act

- o Regulates ocean dumping of sewage sludge and establishes a schedule for phasing out ocean disposal in favor of other land-based methodologies.

40 CFR, Part 761, PCB Regulations

- o Regulates all sludges containing more than 50 mg/kg.

40 CFR, Parts 220-228 - Ocean Discharge Regulations

- o Regulates the discharge of sludge from barges or other vessels.

40 CFR, Part 60, New Sources of Air Emissions

- o Sets standards for emissions from sludge incineration operations at rates above 1,000 kg/day.

40 CFR, Part 61, Mercury Regulations

- o Regulates the incineration and heat drying of sludge.

40 CFR, Part 257, Hazardous Waste Regulations

- o Sets standards for cadmium, PCB's and pathogenic organisms for land application, landfills and storage lagoons.

40 CFR, Part 261, Appendix II - Extraction Procedure Toxicity Regulations

- o Determine whether sludges are hazardous wastes.

STATE REGULATIONS

Virginia

Virginia Solid and Hazardous Waste Management Law

- o Regulates the collection, handling and disposal of solid and hazardous wastes.
- o Establishes the waste management permitting system and justification for permit revocation.

Virginia Solid Waste Regulations

- o Prohibits ocean disposal of solid waste, with the exception of certain inert solid waste (concrete, rubble, ash, etc.).
- o Outlines accepted methods of solid waste disposal including sanitary landfills, incinerators and acceptable new and unique methods.
- o Prohibits disposal of hazardous wastes in sanitary landfills except as permitted.
- o Establishes guidelines of sanitary landfill and incinerator operating procedures.

Virginia Draft Revisions to the Sewerage Regulations, May 16, 1986

- o Sets the standards for sludge testing to determine sludge characteristics.
- o Requires sludge treatment which significantly reduces pathogen content, volatile solids content and potential for odor problems.
- o Prohibits public access and excavation of sludge amended land for twelve months and grazing or feeding of green forage from these areas for 30 days and 60 days for livestock and dairy animals respectively.
- o Establishes standards for emergency, temporary and routine storage of sludge.
- o Establishes guidelines for land application siting, including a 750 foot buffer zone (some exceptions), prohibition of areas within the 100-year flood/wave area and conformance with local zoning regulations.
- o Supernatant/leachate may be returned to the treatment plant, incorporated with sludge and land applied or treated and land applied separately.
- o Sludge used for agricultural purposes must be treated by a process to significantly reduce pathogens.
- o Agricultural soils must be at least 18 inches deep and the sludge/soil moisture must have a pH of 6.5 or greater if the sludge cadmium content is greater or equal to 2 mg/kg.
- o Slopes for agricultural utilization should not exceed 12 percent unless incorporated within 48 hours.
- o Agricultural application rates shall not exceed 15 dry tons per acre per year, 10% of maximum cumulative loading of any metals the maximum CCE loading rate, or the previous years' sludge nitrogen mineralization rates for frequently used areas.
- o Groundwater and surface water monitoring may be required for frequent agronomic rates or for application with cumulative metal loadings above 50% of the maximum allowed.

Maryland

Maryland Refuse Disposal Regulations

- o Defines solid waste as not containing solids or dissolved materials in domestic sewage.
- o Regulates the design and operation of sanitary landfills.

Maryland Proposed Regulations under COMAR 10.17.10, Sewage Sludge

- $100,000 set aside in Sludge Utilization Fund for mitigation of adverse environmental impacts of sewage sludge impacts.
- Requires permits for collection, handling, burning, storage, treatment, land application, disposal or transportation of sewage sludge, treated sewage sludge or any product containing these materials (with exceptions).
- All sludge must be treated by a process to significantly or further reduce pathogens including aerobic digestion, air drying, anaerobic digestion, composting, heat drying, heat treatment thermophilic aerobic digestion or other methods acceptable to the Department.
- Groundwater and soils monitoring must take place in areas used for sludge storage.
- Methods and calculations are set to determine maximum sludge loading rates in a land application program.
- Only Class I sewage sludge may be applied to agricultural land.
- Application on the land may not exceed limits for metals set in the regulations.
- After January 1, 1987 the annual application of cadmium may not exceed .04 pounds per acre.
- Crops for direct human consumption may not be grown in a sludge amended area for three years.
- Incineration of sludge must take place in a manner which does not cause environmental degradation, meets air quality standards and must be 1,000 feet from the nearest off-site inhabited building (possible exceptions).
- Sludge to be incinerated must be tested for content by Department standards.
- Sludge placed in sanitary landfills may not contain free liquids.

LOCAL REGULATIONS

Montgomery County, Maryland

- Landfilling prohibited for municipal sludge.
- No sludge trenching permitted.
- Solid waste plan sets composting and thermal processing as the goal.

Prince Georges County, Maryland

- o Contents of sludge, compost, etc. tested and regulated.
- o Haul roads and sites must be approved if disposal is not under contract with WSSC.
- o Methods of land application must be approved.
- o Trucks used for sludge transport must be covered.
- o No current sludge incineration regulations.

Fairfax County, Virginia

- o No land application permitted within the Occoquan River watershed.
- o No other direct County regulations; State regulations apply.

Washington, D.C.

- o National Capital Planning Commission must approve the project if it alters or significantly impacts the District's Comprehensive Plan.
- o Home Rule Act requires Advisory Neighborhood Commission review of any proposed alternative.
- o District of Columbia, Department of Consumer and Regulatory Affairs (DCRA) regulates emissions of particulates from sewage sludge incinerators.
- o DCRA regulates visible emissions from smokestacks and emissions of odors.

APPENDIX B - PREVENTION OF SIGNIFICANT DETERIORATION (PSD) CATEGORIES, MAJOR SOURCE DEFINITION

APPENDIX B

PSD SOURCE CATEGORIES

1. Fossil fuel-fired steam electric plants of more than 250 million BTU/hr. heat input
2. Coal cleaning plants (with thermal dryers)
3. Kraft pulp mills
4. Portland cement plants
5. Primary zinc smelters
6. Iron and steel mill plants
7. Primary aluminum ore reduction plants
8. Primary copper smelters
9. Municipal incinerators capable of charging more than 250 tons of refuse per day
10. Hydrofluoric acid plants
11. Sulfuric acid plants
12. Nitric acid plants
13. Petroleum refineries
14. Lime plants
15. Phosphate rock processing plants
16. Coke oven batteries
17. Sulfur recovery plants
18. Carbon black plants (furnace process)
19. Primary lead smelters
20. Fuel conversion plants
21. Sintering plants
22. Secondary metal production plants
23. Chemical process plants
24. Fossil fuel boilers (or combinations thereof) totaling more than 250 million/BTU/hr. heat input
25. Petroleum storage and transfer units with a total storage capacity exceeding 300,000 barrels
26. Taconite ore processing plants
27. Glass fiber processing plants
28. Charcoal production plants

These source categories are listed in both the Clean Air Act and PSD regulations. A source is considered major if:

(1) listed in PSD source category with emissions of any criteria pollutant greater than 100 tons per year.
(2) not listed in one of these categories with emissions of any criteria pollutant exceeding 250 tons per year.
(3) it is a source which is located within or impacts a nonattainment area (NA) and emits 100 tons per year or more of any pollutant for which the area has been designated as NA.

Source: Engineering Science, Task II-13, October 1986.

APPENDIX C - LIST OF PRIORITY POLLUTANTS

APPENDIX C

LIST OF EPA PRIORITY POLLUTANTS (1)
(Listed by EPA Numerical Order)

1	acenaphthene
2	acrolein
3	acrylonitrile
4	benzene
5	benzidine
6	carbon tetrachloride
7	chlorobenzene
8	1,2,4-trichlorobenzene
9	hexachlorobenzene
10	1,2-dichloroethane
11	1,1,1-trichloroethane
12	hexachloroethane
13	1,1-dichloroethane
14	1,1,2-trichloroethane
15	1,1,2,2-tetrachloroethane
16	chloroethane
17	bis(chloromethyl)ether (a)
18	bis(2-chloroethyl)ether
19	2-chloroethyl vinyl ether
20	2-chloronaphthalene
21	2,4,6-trichlorophenol
22	parachlorometacresol
23	chloroform
24	2-chlorophenol
25	1,2-dichlorobenzene
26	1,3-dichlorobenzene
27	1,4-dichlorobenzene
28	3,3-dichlorobenzidine
29	1,1-dichloroethylene
30	1,2-trans-dichloroethylene
31	2,4-dichlorophenol
32	1,2-dichloropropane
33	1,3-dichloropropylene
34	2,4-dimethylphenol
35	2,4-dinitrotoluene
36	2,6-dinitrotoluene
37	1,2-diphenylhydrazine
38	ethylbenzene
39	fluoranthene
40	4-chlorophenyl phenyl ether
41	4-bromophenyl phenyl ether
42	bis-(2-chloroisopropyl)ether

(a) Deleted February 24, 1981.

(1) Priority Pollutants - Toxic with respect to carcinogenicity, mutagenicity, teratogenicity, and/or persistence.

43	bis(2-chloroethoxy)methane
44	methylene chloride
45	methyl chloride
46	methyl bromide
47	bromoform
48	dichlorobromomethane
49	trichlorofluoromethane (a)
50	dichlorodifluoromethane (a)
51	chlorodibromomethane
52	hexachlorobutadiene
53	hexachlorocyclopentadiene
54	isophorone
55	naphthalene
56	nitrobenzene
57	2-nitrophenol
58	4-nitrophenol
59	2,4-dinitrophenol
60	4,6-dinitro-o-cresol
61	N-nitrosodimethylamine
62	N-nitrosodiphenylamine
63	N-nitrosodi-n-propylamine
64	pentachlorophenol
65	phenol
66	bis(2-ethylhexyl)phthalate
67	butyl benzyl phthalate
68	di-n-butyl phthalate
69	di-n-octyl phthalate
70	dimethyl phthalate
71	benzo(a)anthracene
72	benzo(a)pyrene
73	3,4-benzofluoranthene
74	benzo(k)fluoranthene
75	chrysene
76	acenaphthylene
77	anthracene
78	benzo(ghi)perylene
79	fluorene
80	phenanthrene
81	dibenzo(a,h)anthracene
82	indeno(1,2,3-cd)pyrene
83	pyrene
84	tetrachloroethylene
85	toluene
86	trichloroethylene
87	vinyl chloride

(a) Deleted February 3, 1981.

89	aldrin
90	dieldrin
91	chlordane
92	4,4'-DDT
93	4,4'-DDE
94	4,4'-DDD
95	alpha-endosulfan
96	beta-endosulfan
97	endosulfan sulfate
98	endrin
99	endrin aldehyde
100	heptachlor
101	heptachlor epoxide
102	alpha-BHC
103	beta-BHC
104	gamma-BHC
105	delta-BHC
106	PCB-1242
107	PCB-1254
108	PCB-1221
109	PCB-1232
110	PCB-1248
111	PCB-1260
112	PCB-1016
113	toxaphene
114	antimony
115	arsenic
116	asbestos
117	beryllium
118	cadmium
119	chromium
120	copper
121	cyanide
122	lead
123	mercury
124	nickel
125	selenium
126	silver
127	thallium
128	zinc
129	2,3,7,8-tetrachlorodibenzo-p-dioxin

APPENDIX D - SURVEY: FACILITIES COMPOSTING MUNICIPAL SLUDGE IN THE UNITED STATES

APPENDIX D

FACILITIES COMPOSTING MUNICIPAL SLUDGE IN THE U.S. - A SUMMARY

	Number of Facilities
OPERATIONAL:	
In-Vessel	8
Aerated Static Pile	52.5 (1)
Windrow	20.5
Aerated Windrow	6
Vermicomposting	1
Not Specified	1
TOTAL OPERATIONAL:	89
UNDER CONSTRUCTION:	
In-Vessel	11
Aerated Static Pile	8
Windrow	2
Aerated Windrow	1
TOTAL UNDER CONSTRUCTION:	22
PLANNING, DESIGN, BID:	
In-Vessel	11
Aerated Static Pile	10
Windrow	3
Aerated Windrow	3
Not Specified	1
TOTAL PLANNING, DESIGN, BID:	28
PILOTS:	
In-Vessel (Also counted in "Consideration" Category)	4
Aerated Static Pile	5
Windrow	3
Aerated Windrow	1
Vermicomposting	1
TOTAL PILOTS:	14
CONSIDERATION:	
In-Vessel	14
Aerated Static Pile	5.5
Windrow	2
Aerated Windrow	.5
Not Specified	5
TOTAL CONSIDERATION:	27
SURVEY TOTALS:	
Operational	89
Under Construction	22
Planning, Design, Bid	28
Pilots	14 (4 in Consideration)
Consideration	27
Not Specified	2
TOTAL:	178

(1) Decimal points indicate that facilities utilize more than 1 technology.

Source: Biocycle, November-December, 1986.

APPENDIX D

FACILITIES COMPOSTING
MUNICIPAL SLUDGE IN THE U.S.

State	Plant Name	Status	Type	Sludge Volume dry ton/day (unless noted)
1. Alabama	1. Dothan City	Operational (10/29/86)	In-Vessel (Taulman-Weiss)	6.75 (Design)
2. Alaska	1. Juneau	Design	In-Vessel (Taulman-Weiss)	3-4
3. Arizona	1. Phoenix: 23rd St. Plant	Operational (by Western Agricultural Products)	Windrow	
4. Arkansas	None			
5. California	1. Chino	Operational (by Garden Mate)	A-SP (1)	
	2. Fallbrook	Pilot	Vermicomposting	1
	3. Hayward	Operational (by Miltona Brothers)	Windrow	
	4. Los Alisos: El Toro	Operational	A-SP	.25
	5. Los Angeles County JWPCP	Operational	Windrow	300
	6. North San Diego County	Consideration	Air drying w/windrow composting)	52 (max. size)
	7. Oakland: East Bay Mud	Operational	A-SP	60
	8. Oxnard	Design	In-Vessel w/windrow curing (Fairfield)	30
	9. San Diego	Planning	Windrow	25
	10. Santa Barbara	Planning	In-Vessel	10
	11. City of S. San Francisco	Operational	Windrow	10
	12. Simi Valley	Design	Air drying w/windrow composting	11
6. Colorado	1. Denver Metro	Operational	Aerated windrow	73
	2. Ft. Collins	Bid stage	Aerated windrow	6
	3. Greeley	Consideration	A-SP or aerated windrow	10
	4. Longmont	Pilot	A-SP	
	5. Wheatridge	Operational	Windrow	3/month
7. Connecticut	1. Bristol	Construction	A-SP	10
	2. Greenwich	Operational	A-SP	2500 cu. yd./yr.
	3. Hartford	Planning	In-Vessel (Paygro)	33
	4. Killingly	Consideration (short-term pilot w/Intl. Processing Systems: IPS)	In-Vessel	2
	5. New London	Consideration (short-term pilot w/IPS)	In-Vessel	5-6
	6. Norwich	Consideration (short-term pilot w/IPS)	In-Vessel	.5
	7. Windham	Consideration (short-term pilot w/IPS)	In-Vessel	1.7
8. Delaware	1. Middletown/Odessa	Construction	In-Vessel	.5
	2. Seaford	Construction	A-SP	6
	3. Wilmington	Operational (Co-composting)	In-Vessel (Fairfield)	70
9. Florida	1. Broward Cty. Streets & Highway Div.	Operational	Windrow	7.93
	2. Collier Cty.	Consideration	Windrow	
	3. Cooper City Utilities	Planning	Windrow	
	4. Fort Lauderdale	Construction	In-Vessel (Purac)	30
	5. Hillsborough Cty. Utilities	Consideration	In-Vessel	35

(1) A-SP - Aerated Static Pile.

APPENDIX D (Cont'd.)

FACILITIES COMPOSTING
MUNICIPAL SLUDGE IN THE U.S.

State	Plant Name	Status	Type	Sludge Volume dry ton/day (unless noted)
	6. Jacksonville: Buckman Plant	Operational	A-SP	2
	7. Kissimee: Martin St. Plant	Operational	Vermicomposting	
	8. Lee County	Consideration		16
	9. Loxahatchee River Dist.	Consideration		4
	10. Manatee Cty. Southeast	Consideration	A-SP	2-3
	11. Mandarin Cty. Utilities	Construction	Windrow	3
	12. Margate	Planning		
	13. Meadowwood Utilities	Operational	Windrow	5
	14. Orange County	Planning	A-SP	
	15. Orlando	Consideration		
	16. Plant City		A-SP	6
	17. Reedy Creek	Construction	In-Vessel (Taulman-Weiss)	9
	18. Sarasota	Construction	In-Vessel (Purac)	
10. Georgia	1. Plains	Consideration (Privatized regional facility—Green Grow Industries)	A-SP	10 (pilot) 200 (design)
	2. Northeast Clayton County WPCP	Operational	In-Vessel (Taulman)	1 (operational) 3 (design)
11. Hawaii	1. Waimanalo WWTP (Oahu)	Operational (Private arrangement w/nursery)	Windrow	
		Planned (1990)	A-SP	5
12. Idaho	None			
13. Illinois	None			
14. Indiana	1. Blucher Poole WWTP (Bloomington)	Operational	Windrow & A-SP	2-3
15. Iowa	None			
16. Kansas	1. Mission (Johnson Cty.)	Pilot (Full-scale under consideration)	Windrow	16-18
	2. Topeka: Oakland WWTP	Operational	Windrow	
	3. Wichita: WPCP #1 & #2	Operational	Windrow	10
17. Kentucky	1. West Hickam Creek WWTP (Nicholsville)	Operational	A-SP	4.5-5 (5 days/wk.)
18. Louisiana	None			
19. Maine	1. Bangor	Operational	A-SP	3500 cu. yd./yr.
	2. Bar Harbor	Operational	A-SP	@ 2000 cu. yd./yr.
	3. Gardiner	Operational	A-SP	1.5
	4. Kennebunkport	Operational	A-SP	@1
	5. Old Orchard Beach (& Saco)	Operational	A-SP	160-170 cu. yd./wk.
	6. Old Town (& Orono)	Operational	A-SP	350 cu. yd./month
	7. Portland Water Dist.	Operational	A-SP	16.2
	8. Scarborough San. Dist.	Operational	A-SP	30 cu. yd./wk.
	9. South Portland	Operational	A-SP	5
	10. Yarmouth	Operational	A-SP	.25-.5

APPENDIX D (Cont'd.)

FACILITIES COMPOSTING
MUNICIPAL SLUDGE IN THE U.S.

State	Plant Name	Status	Type	Sludge Volume dry ton/day (unless noted)
20. Maryland	1. Aberdeen	Design	Aerated Windrow	1.4
	2. Baltimore: Back River	Construction	In-Vessel (Paygro)	120-150
	3. Cambridge	Operational	A-SP	5
	4. Elkton	Operational	Aerated Windrow	2
	5. Havre de Grace	Construction	Aerated Windrow	2-3
	6. Montgomery Cty.	Operational	A-SP	40
	7. Parkway WWTP (WSSC)	Consideration	In-Vessel	3.2
	8. Perryville	Operational	Aerated Windrow	2.5
21. Massachusetts	1. Amherst	Design	A-SP (Pilot)	6
	2. Barre		A-SP	5 yds./week
	3. Billerica	Design	A-SP	5
	4. Boston	Consideration (Long-term)		
	5. Bridgewater	Planning	Aerated Windrow	3.5
	6. Concord	Operational		
	7. Deer Island (MWRA)	Pilot	A-SP	3
	8. Gloucester	Planning	A-SP	2,000/yr.
	9. Haverhill	Design	A-SP	500 cu. yd./wk.
	10. Leicester	Construction	A-SP	@.20
	11. Leominster	Bid stage	A-SP	6
	12. Mansfield	Construction	A-SP	@300/yr.
	13. Marlboro	Design	A-SP	12
	14. Nantucket	Construction	A-SP	
	15. Orleans	Operational	A-SP	
	16. Pepperell	Planning	A-SP	
	17. Somerset	Consideration	A-SP	
	18. Southbridge	Construction: (Start-up: 1/87)	A-SP	18 cu. yd./day
	19. Swampscott	Operational	A-SP	1.4/week
	20. Westborough	Construction (Start-up: 2/87)	A-SP	35 cu. yd./day
	21. Williamstown/Hoosac	Operational	A-SP	120 cu. yd./day
22. Michigan	1. Battle Creek	Consideration	In-Vessel or AS-P	24 (if full scale)
	2. Mackinac Island	Operational	Windrow	
23. Minnesota	1. Pine River	Operational	Aerated Windrow	3-4/month
24. Mississippi	None			
25. Missouri	None			
26. Montana	1. Missoula	Operational	A-SP (EKO Systems)	5+
27. Nebraska	1. Beatrice	Operational	Windrow	@1.5
	2. Grand Island	Operational	Windrow	7-10
	3. Kearney	Operational	Windrow	1.5-2
	4. Omaha: Papillion Creek WPCP	Construction (Retrofit-1987 Start-up)	Windrow	40
	5. Omaha: Missouri River	Pilot	Windrow	
28. Nevada	1. Las Vegas	Operational (Private contractor)	Windrow	
	2. Clark County San. District	Pilot	Aerated windrow	30 (At full scale)

APPENDIX D (Cont'd.)

FACILITIES COMPOSTING
MUNICIPAL SLUDGE IN THE U.S.

State	Plant Name	Status	Type	Sludge Volume dry ton/day (unless noted)
29. New Hampshire	1. Claremont	Operational (Start-up: 11/86)	A-SP	6.4
	2. Durham	Operational	A-SP	.6
	3. Keene	Operational	A-SP	.8
	4. Lebanon	Operational	A-SP	1
	5. Littleton	Pilot	A-SP	
	6. Merrimack WWTP	Operational	A-SP	21
	7. Merrimack: Lagoon	Operational (Seasonal)	A-SP	15
	8. Milford	Construction (Start-up: 12/86)	A-SP	2.5
	9. Plymouth	Operational	A-SP	.5
30. New Jersey	1. Buena Borough MUA	Operational	A-SP	3.5
	2. Burlington County	Design	In-Vessel (Co-Composting)	30
	3. Camden County MUA	Consideration	In-Vessel	20-25
	4. Cape May County MUA	Operational	In-Vessel (Purac)	12
	5. Manville Boro STP	Operational	A-SP	1.5
	6. Middletown Township	Operational	A-SP	2.7
	7. Pennsville	Operational	A-SP	
	8. Rockaway Valley MUA	Consideration (Long-term)	In-Vessel	5.5
	9. Sussex County MUA (Upper Walkill)	Operational	A-SP	7
	10. Wanaque Valley MUA	Consideration	In-Vessel	
	11. Warren County MUA (Pequest River)	Consideration	A-SP	1
31. New Mexico	None			
32. New York	1. Alden	Operational	A-SP	
	2. Binghamton	Design	In-Vessel (Taulman-Weiss)	15
	3. Clinton County (Plattsburgh)	Operational	In-Vessel (Fairfield)	25
	4. Endicott	Operational	In-Vessel (Taulman-Weiss)	2
	5. Guilderland	Operational	A-SP	
	6. Herkimer County	Consideration		
	7. Schenectady	Construction	In-Vessel (American Bio-Tech)	
	8. Sylvan Beach	Operational (Intermittent)	A-SP	
33. North Carolina	1. Charlotte	Design	In-Vessel	
	2. Hickory, Newton, Conover & Catawba Counties	Bid stage	In-Vessel	20
	3. Morganton (Catawba River Plant)	Operational	A-SP	24
	4. Valdese	Operational	A-SP	1
34. North Dakota	None			
35. Ohio	1. Akron	Construction (Dry run: 11/86)	In-Vessel (Paygro)	60
	2. Columbus	Operational	A-SP w/In-Vessel drying (Paygro)	24
	3. Hamilton WWTP	Construction	In-Vessel (Ashbrook-Simon-Hartley)	17
	4. Lake County	Operational	Aerated windrow	7
36. Oklahoma	1. Tulsa	Pilot	A-SP	

APPENDIX D (Cont'd.)

FACILITIES COMPOSTING
MUNICIPAL SLUDGE IN THE U.S.

State	Plant Name	Status	Type	Sludge Volume dry ton/day (unless noted)
37. Oregon	1. Newberg	Construction	In-Vessel (Ashbrook-Simon-Hartley)	3.5 (at 15% solids)
	2. Portland	Operational	In-Vessel (Taulman-Weiss)	60
38. Pennsylvania	1. Hazleton Joint Sewer Auth.	Design	A-SP	11.4
	2. Lancaster	Construction	In-Vessel (Taulman-Weiss)	30
	3. Lancaster	Operational (by A&M Composting)	A-SP	20-40 cu. yd./day
	4. Philadelphia	Operational	A-SP	300
	5. Scranton	Operational	A-SP	9.2
	6. Springettsbury Township	Operational	A-SP	6
39. Rhode Island	1. Jamestown	Operational	Windrow	350 cu. yd./yr.
	2. West Warwick	Operational	A-SP	3-5
40. South Carolina	1. East Richland County PSD (Gills Creek)	Operational	In-Vessel (Taulman-Weiss)	4-5
	2. Greenville	Consideration	In-Vessel	35
	3. Hilton Head	Consideration	In-Vessel or A-SP	
	4. Myrtle Beach	Operational	A-SP	393 tons of compost/yr.
41. South Dakota	None			
42. Tennessee	1. Bristol	Bid stage	In-Vessel	14.3
	2. Nashville: Central Treatment Plant	Operational	A-SP	20 (1987: 40)
	3. Nashville: Dry Creek	Operational	A-SP	5-6
43. Texas	1. Austin	Pilot (6 yd./every few days)	Windrow	75-100 (Potential)
	2. El Paso: Haskell St. Plant	Operational	Windrow	18
	3. El Paso: Socorro Plant	Operational	Windrow	14
	4. Fredricksburg	Operational	Windrow	
44. Utah	1. Salt Lake City: Central Valley Plant	Consideration	In-Vessel	25-30
45. Vermont	1. Bennington	Design	In-Vessel	2
46. Virginia	1. Fairfax Cty. & City of Alexandria	Operational	A-SP	65
	2. Hampton Roads San. Dist.	Operational	A-SP	12
	3. Henrico County	Bid stage	In-Vessel	17.5
	4. Moores Creek (Charlottesville)	Operational	A-SP	2.5
	5. Upper Occoquan	Operational	Aerated Windrow	7.5
47. Washington	1. Seattle	Operational (by Groco, Inc.)	A-SP	18
	2. Seattle METRO	Consideration	In-Vessel	45
	3. Miller Creek & Salmon Creek (Southern King Cty.)	Consideration	In-Vessel	6-8
48. West Virginia	None			

FACILITIES COMPOSTING
MUNICIPAL SLUDGE IN THE U.S.

State	Plant Name	Status	Type	Sludge Volume dry ton/day (unless noted)
49. Wisconsin	1. Portage	Construction	In-Vessel (Co-Composting: Eweson)	2.4
	2. Stevens Point (Univ. of Wisconsin)	Pilot	A-SP (Co-Composting)	
50. Wyoming	None (interest expressed in starting a pilot research project)			
51. District of Columbia	1. Blue Plains	Operational (In-Vessel under consideration)	A-SP	40
52. Puerto Rico	1. Arecibo	Design	A-SP	15

Source: Biocycle, "Sewage Sludge Composting Maintains Momentum", November-December, 1986.

APPENDIX E - SURVEY: FACILITIES INCINERATING MUNICIPAL SLUDGE IN THE UNITED STATES

APPENDIX E

FACILITIES INCINERATING MUNICIPAL SLUDGE IN THE UNITED STATES

State	Plant Name	Status	Type	Sludge Volume (dry tons/day)
1. Georgia	R.M. Clayton, Atlanta	Operational (1970-1971 start-up)	Multiple Hearth (10 hearth, 2 units)	37 @ 22% solids
2. Louisiana	East Bank WWTP, New Orleans	a) Operational (1966)	a) Multiple Hearth (9 hearth, 2 units)	a) 30 @ 18% solids
		b) Out of Service (1980 start-up)	b) Fluidized Bed (1 unit)	b) 41 (Design)
3. New Jersey	Two Bridges WWTP, Lincoln Park	Operational (1979 start-up)	Fluidized Bed (1 unit)	24 @ 20% solids
4. Ohio	a) Akron WWTP	a) Operational (1953 start-up)	a) Multiple Hearth (5 hearth, 4 units)	a) 49 @ 31.6% solids
	b) Mill Creek WWTP, Cincinnati	b) Operational (1959 start-up; 1974 rebuilt)	b) Multiple Hearth (9 hearth, 4 units)	b) 231 @ 34% solids
	c) Southerly WWTP, Cleveland	c) Operational (1977-1979 start-up)	c) Multiple Hearth (9 hearth, 4 units)	c) 10 @ 45% solids

Source: EcolSciences, "Incineration and Composting Technology Inventory", August, 1986.

APPENDIX F - SUMMARY AND CONCLUSIONS: INCINERATION AND COMPOSTING TECHNOLOGY INVENTORY, ECOLSCIENCES, INC., AUGUST, 1986

APPENDIX F

SUMMARY AND CONCLUSIONS OF INCINERATION AND COMPOSTING TECHNOLOGY INVENTORY

ECOLSCIENCES, INC.
AUGUST, 1986

Based upon a review of the information compiled for the incineration facilities, the following are important considerations in the implementation of an incineration alternative:

- Incineration facilities have a longer operational history than composting. Multiple hearth furnaces are most common, fluidized bed furnaces are a more recent incineration technology, with few operational facilities.
- Advantages of incineration include:
    - Flexibility and reliability.
    - Provides for on-site sludge management with reduced dependence on haulers, weather conditions, application sites or decreasing landfill capacity.
- In terms of cost, when selected incineration was often the most cost effective alternative. These facilities are significantly effected by rising fuel costs; however, depending upon the region, incineration may still be less costly than land intensive operations.
- System reliability is dependent on age and availability of backup units. Of the facilities surveyed, operational time ranged from 7 days per week, 24 hours per day to 200 operation days per year.
- Operation problems noted include: induced draft fans, clinker formation, low percent solids in sludge cake.
- Ash disposal is required; methods used by facilities surveyed include on-site storage in lagoons and landfilling.
- Problems meeting particulate standards are common and may be related to a variety of factors. Facilities surveyed corrected particulate problems by adding wet scrubbers and changing sludge processing from chemical to thermal conditioning.

A similar review of the information compiled for the composting facilities, indicates the following to be important considerations when implementing a composting alternative.

- Composting large volumes of sludge on a full scale basis has a shorter operational history than incineration. This is particularly evident for in-vessel processes which have been in operation for only a few years in the U.S.

- Advantages of the composting alternative include:

  - Provides for the beneficial reuse of sludge and the recovery of a marketable product.

  - Cost effective.

  - Process reliability.

  - Flexibility in terms of processing and end product characteristics.

- The cost of constructing and operating a composting facility varies widely and is dependent on process chosen and site specific factors. All facilities surveyed indicated that composting was the most cost effective sludge management alternative.

- Composting method should be tailored to regional weather conditions (i.e. seasonal variations, wet weather conditions), adjacent land use (for aesthetics and odor reasons), and land costs (certain methods require large areas for processing and storage).

- Provisions to capture runoff, leachate and condensate are required.

- Operation problems identified include: wet weather extends drying time and causes much downtime in screening operations, fire hazard in storage areas.

- Odor problems are easily controlled by a number of methods, including: increasing the bulking agent; fresh sludge ratio, changing bulking agent, reduce frequency of turning piles, increase windrow size, provide odor filler of screened compost or woodchips or vent through scrubbers (such as wet or granular activated carbon) prior to exhaust, chemical bath and misting methods, lime and masking agents.

- Routine temperature and oxygen monitoring is required through the composting process; nutrients, metals and pH also sampled.

- Compost product analyzed for nutrients, pH, metals, organics, salmonella and other pathogens.

- Compost products can be utilized for many purposes: nurseries, retail outlets, agricultural application, land reclamation, Highway and Parks Departments, landfill cover, turf grass production, hydroseeding, fertilizer carrier, soil amendment, ballfield renovation, public. The facilities surveyed indicated that demand for compost products generally outweighed production.

- Not all compost products are suitable for unrestricted public distribution.

APPENDIX G - SOLIDS MANAGEMENT ALTERNATIVES COST ANALYSIS VALUES

TABLE 1

DEWATERING INCINERATION AND ASH LANDFILLING
COST ANALYSIS VALUES
(MARCH 1988 DOLLARS)

COST COMPONENT	ESTIMATED COSTS ALTERNATIVE I SIX UNITS	ALTERNATIVE II FOUR UNITS
Capital Costs		
Filter Press Building (1)		
Site Work	$1,697,000	$1,697,000
Building	10,400,000	10,400,000
Process Equipment	24,771,000	24,771,000
Subtotal	$36,868,000	$36,868,000
Engineering & Contingencies	11,060,000	11,060,000
Subtotal	$47,928,000	$47,928,000
Fluid Bed System (1)		
Fluid Bed Reactor	$10,794,000	$7,196,000 (2)
Afterburner	1,270,000	847,000 (2)
Air Preheater	3,238,000	2,159,000 (2)
Sludge Feed System	1,428,000	952,000 (2)
Scrubber	4,127,000	2,752,000 (2)
Dry Ash System	847,000	847,000
Wet Ash System	794,000	794,000
Fluidizing Blower	825,000	551,000 (2)
Induced Draft Fan	825,000	551,000 (2)
Duct and Dampers	2,858,000	1,905,000 (2)
Wasteheat Boiler	2,064,000	2,064,000
Boiler Feedwater Pumps	286,000	286,000
Boiler Make-Up System	445,000	445,000
Condensor	365,000	365,000
Turbo-Generator	1,111,000	1,111,000
Electrical Switchgear	211,000	211,000
Stacks	1,798,000	980,000 (3)
Process Piping	3,175,000	2,117,000 (2)
Instrumentation	3,810,000	2,540,000 (2)
Power Wiring	3,334,000	2,223,000 (2)
Sand Handling System	529,000	529,000
Building Modifications	4,762,000	4,762,000
Demolition Work	1,058,000	1,058,000
Subtotal	$49,954,000	$37,245,000
Engineering & Contingencies	14,986,000	11,174,000
Subtotal	$64,940,000	$48,419,000
1988 Estimated Project Cost	$112,868,000	$96,347,000

(1) Based on Engineering Science concept design cost information
(2) Based on EPA four unit concept with values 4/6 of six unit concept costs
(3) Based on EPA four unit concept with value 1/2 of six unit concept

TABLE 1 (Continued)

DEWATERING INCINERATION AND ASH LANDFILLING
COST ANALYSIS VALUES
(MARCH 1988 DOLLARS)

COST COMPONENT	ESTIMATED COSTS ALTERNATIVE I SIX UNITS	ALTERNATIVE II FOUR UNITS
Operation And Maintenance Costs		
Filter Press Dewatering (1)		
Labor	$1,206,000	$1,206,000
Power	541,000	541,000
Chemicals and Supplies	2,333,000	2,333,000
Materials	42,000	42,000
Subtotal	$4,122,000	$4,122,000
Fluid Bed Incineration (1)		
Labor	$865,000	$865,000
Power (3)	686,000	686,000
Ash Transport & Disposal	3,056,000	3,056,000
Makeup Sand	55,000	55,000
Maintenance Materials	1,484,000	990,000 (2)
Subtotal	$6,146,000	$5,652,000
Power Credit (1)	($808,000)	($808,000)
Subtotal	$5,338,000	$4,844,000
Total Annual O&M Cost	$9,460,000	$8,966,000

(1) Based on Engineering Science concept design cost information
(2) Based on EPA four unit concept with value 4/6 of six unit concept cost
(3) Based on Engineering Science Information Indicating 9% of Cost is for Startup Fuel and 91% of Cost is for Electrical Power

TABLE 2

DEWATERING, DRYING AND PRODUCT USE
COST ANALYSIS VALUES
(MARCH 1988 DOLLARS)

COST COMPONENT	ESTIMATED COSTS
Capital Costs (1)	
Filter Press Building	
Site Work	$1,697,000
Building	10,400,000
Process Equipment	24,771,000
Subtotal	$36,868,000
Engineering & Contingencies	11,060,000
Subtotal	$47,928,000
Drying System (2)	
Building and Site Work	$3,742,000
Process Equipment	17,196,000
Subtotal	$20,938,000
Engineering & Contingencies	6,281,000
Subtotal	$27,219,000
1988 Estimated Project Cost	$75,147,000
Operation And Maintenance Costs	
Filter Press Dewatering (1)	
Labor	$1,206,000
Power	541,000
Chemicals and Supplies	2,333,000
Materials	42,000
Subtotal	$4,122,000
Drying System (2)	
Labor	$741,000
Power	721,000
Fuel (3)	2,061,000
Maintenance (4)	705,000
Subtotal	$4,228,000
Dried Product Revenue (5)	($1,067,000)
Subtotal	$3,161,000
Total Annual O&M Cost	$7,283,000

(1) Based on Engineering Science concept design cost information
(2) Based on MEANS' and Manufacturer's info., 68,000 SQ FT bldg., 6 units, 215 KW/DT, 580,000 BTU/DT, 6 Man/Shift
(3) Value includes energy credit of 240 mil. cu. ft. of available gas from Engineering Science reference
(4) Value based on 20% of labor, power, and fuel subtotal cost
(5) Based on 73,000 DTPY, 3.5% Nitrogen, $0.21/Lb N contract sale price and no cost for transport or marketing

TABLE 3

DEWATERING IN-VESSEL COMPOSTING AND PRODUCT USE
COST ANALYSIS VALUES
(MARCH 1988 DOLLARS)

COST COMPONENT	ESTIMATED COSTS
Capital Costs (1)	
Centrifuge Dewatering	
Centrifuge Process	
Equipment	$13,454,000
Engineering & Contingencies	4,036,000
Subtotal	$17,490,000
In-Vessel Composting System (2)	
Site Work	$6,825,000
Buildings & Covered Storage Areas	64,722,000
Scrubber System	22,600,000
Process Equipment	33,249,000
Front End Loaders	835,000
Subtotal	$128,231,000
Engineering & Contingencies	38,469,000
Subtotal	$166,700,000
1988 Estimated Project Cost	$184,190,000
Operation And Maintenance Costs (1)	
Centrifuge Dewatering	
Labor	$1,206,000
Power	310,000
Chemicals	1,785,000
Materials	220,000
Sidestream Treatment	145,000
Subtotal	$3,666,000
In-Vessel Composting System (2)	
Labor	$1,052,000
Bulking Agent	1,546,000
Power	1,637,000
Chemicals	1,383,000
Fuel and Lubricants	220,000
Maintenance	582,000
Supplies	139,000
Subtotal	$6,559,000
Compost Product Revenue (3)	($392,000)
Subtotal	$6,167,000
Total Annual O&M Cost	$9,833,000

(1) Based on District Cost Data and Engineering Science concept design cost information
(2) Based on Engineering Science and Manufacturer's cost information
(3) Based on average producer contract sale price of $2.50/TON; 4.3 cy compost/D.T. sludge; 50% solids in final product

APPENDIX G 08/23/88

TABLE 4

OCEAN DISPOSAL OF DEWATERED SLUDGE
COST ANALYSIS VALUES
(MARCH 1988 DOLLARS)

COST COMPONENTS	ESTIMATED COSTS
Capital Costs	
1988 Estimated Project Costs	None
Operation And Maintenance Costs	
Annual O&M Costs	
Vacuum Filter Dewatering (1)	
Labor	$1,810,000
Power	365,000
Chemicals and Supplies	2,535,000
Materials	57,000
Subtotal	$4,767,000
Contract Ocean Disposal (2)	$3,088,000
Administrative Costs (3)	$309,000
Total	$8,164,000

(1) Based on FY86 costs for dewatering supplied by District staff adjusted to 1/87 rounded dollars
(2) Based on available contract ocean disposal costs on east coast; $6.27/WT at 20% solids; 450 mile round trip; 73,000 DTPY sludge solids plus 25,500 DTPY conditioning chemicals
(3) Based on 10% of contract ocean disposal cost and complexity of contract operation

TABLE 5

LAND APPLICATION OF DEWATERED SLUDGE
COST ANALYSIS VALUES
(MARCH 1988 DOLLARS)

COST COMPONENTS	ESTIMATED COSTS
Capital Costs	
Centrifuge Dewatering (1)	
Centrifuge Process	
Equipment	$13,454,000
Engineering & Contingencies	4,036,000
1988 Estimated Project Cost	$17,490,000
Operation And Maintenance Costs	
Centrifuge Dewatering (1)	
Labor	$1,206,000
Power	310,000
Chemicals	1,785,000
Post-Liming Chemical	1,381,000
Materials	220,000
Side Stream Treatment	145,000
Subtotal	$5,047,000
Contract Land Application (2)	$12,988,000
Administrative Costs (3)	$325,000
Total	$18,360,000

(1) Based on District Cost Data and Engineering Science Concept Design Cost Information
(2) Based on District Contracts for Land Application; 73,000 DTPY Sludge Solids and Conditioning Chemical, Dewatered to 21% Solids, 18,250 DTPY Post Lime, $35.50/WT
(3) Based on 2.5% of Contract Land Application Cost and Complexity of Contract Operation

TABLE 6

LANDFILLING OF DEWATERED SLUDGE
COST ANALYSIS VALUES
(MARCH 1988 DOLLARS)

COST COMPONENTS	ESTIMATED COSTS
Capital Costs	
Centrifuge Dewatering (1)	
Centrifuge Process	
Equipment	$13,454,000
Engineering & Contingencies	4,036,000
1988 Estimated Project Cost	$17,490,000
Operation And Maintenance Costs	
Centrifuge Dewatering (1)	
Labor	$1,206,000
Power	310,000
Chemicals	1,785,000
Post-Liming Chemical	1,381,000
Materials	220,000
Side Stream Treatment	145,000
Subtotal	$5,047,000
Contract Hauling (2)	$9,513,000
Landfill Disposal Fee (3)	$8,049,000
Administrative Costs (4)	$238,000
Total	$22,847,000

(1) Based on District Cost Data and Engineering Science Concept Design Cost Information
(2) Based on MEANS' and District Contract Hauling Prices; $26/WT; 50 Mile Round Trip, 73,000 DTPY of Sludge Solids and Conditioning Chemical, Dewatered to 21% Solids, 18,250 DTPY Post Lime
(3) Based on Landfill Disposal Fee of $22/WT at 21% Solids for 73,000 DTPY Plus 18,250 DTPY Post Lime
(4) Based on 2.5% of Contract Hauling Cost and Complexity of Contract Operation

APPENDIX G

TABLE 7

DEWATERING INCINERATION AND ASH LANDFILLING 100 DTPD
WITH LAND APPLICATION 100 DTPD AND PEAK LOADS
(MARCH 1988 DOLLARS)

COST COMPONENT	ESTIMATED COSTS
Capital Costs	
Filter Press Building (1)	
Site Work	$1,697,000
Building	10,400,000
Process Equipment	24,771,000
Subtotal	36,868,000
Engineering & Contingencies	11,060,000
Subtotal	47,928,000
Two Unit Incineration	
Fluid Bed System (1)	
Fluid Bed Reactor, 2 Units	$3,562,000 (2)
Afterburner	419,000 (2)
Air Preheater	1,069,000 (2)
Sludge Feed System	471,000 (2)
Scrubber	1,362,000 (2)
Dry Ash System	424,000 (3)
Wet Ash System	396,000 (3)
Fluidizing Blower	272,000 (3)
Induced Draft Fan	272,000 (2)
Duct and Dampers	943,0000 (2)
Wasteheat Boiler	1,032,000 (3)
Boiler Feedwater Pumps	143,000 (3)
Boiler Make-Up System	222,000 (3)
Condenser	183,000 (3)
Turbo-Generator	555,000 (3)
Electrical Switchgear	106,000 (3)
Stacks	900,000 (3)
Process Piping	1,048,000 (2)
Instrumentation	1,257,000 (2)
Power Wiring	1,100,000 (2)
Sand Handling System	264,000 (3)
Building Modifications	4,762,000
Demolition Work	1,058,000
Subtotal	$21,820,000
Engineering & Contingencies	6,546,000
Subtotal	$28,366,000
Land Application	None
1988 Estimated Project Costs	$76,294,000

(1) Based on Engineering Science concept design cost information.
(2) Based on two unit concept with values 2/6 of six unit concept costs
(3) Based on two unit concept with values 1/2 of six unit concept costs

TABLE 7 (Continued)

DEWATERING INCINERATION AND ASH LANDFILLING 100 DTPD
WITH LAND APPLICATION 100 DTPD AND PEAK LOADS
(MARCH 1988 DOLLARS)

COST COMPONENT	ESTIMATED COSTS
Operation And Maintenance Costs	
Filter Press Dewatering (1)	
Labor	$1,206,000
Power	541,000
Chemicals and Supplies	2,333,000
Materials	42,000
Subtotal	$4,122,000
Fluid Bed Incineration (1)(4)	
Labor	$536,000 (5)
Power	343,000 (6)
Ash Transport & Disposal	1,528,000
Makeup Sand	28,000
Maintenance Materials	742,000 (3)
Subtotal	$3,177,000
Power Credit	($404,000)
Subtotal	$2,773,000
Land Application	
Contract Land Application	$4,373,000 (7)
Administration Cost	109,000 (8)
Subtotal	$4,482,000
Total Annual O&M Cost	$11,377,000

(1) Based on Engineering Science concept design cost information
(2) Based on two unit concept with values 2/6 of six unit concept costs
(3) Based on two unit concept with values 1/2 of six unit concept costs
(4) Based on two unit concept loading of 100 DTPD which is 1/2 of the six unit concept cost
(5) Based on Engineering Science information with 1/2 the operating staff of the 6 unit system and same maintenance staff level
(6) Based on Engineering Science information indicating 9% of cost is for startup fuel and 91% of cost is for electrical power
(7) Based on District contracts for land application; 36,500 DTPY sludge solids and conditioning chemical, dewatered to 32% solids, 9,125 DTPY post lime, $35.50/W.T.
(8) Based on 2.5% of contract land application cost and complexity of contract operation

APPENDIX G

TABLE 8

SOLIDS MANAGEMENT ALTERNATIVE
SALVAGE VALUE COSTS (1)

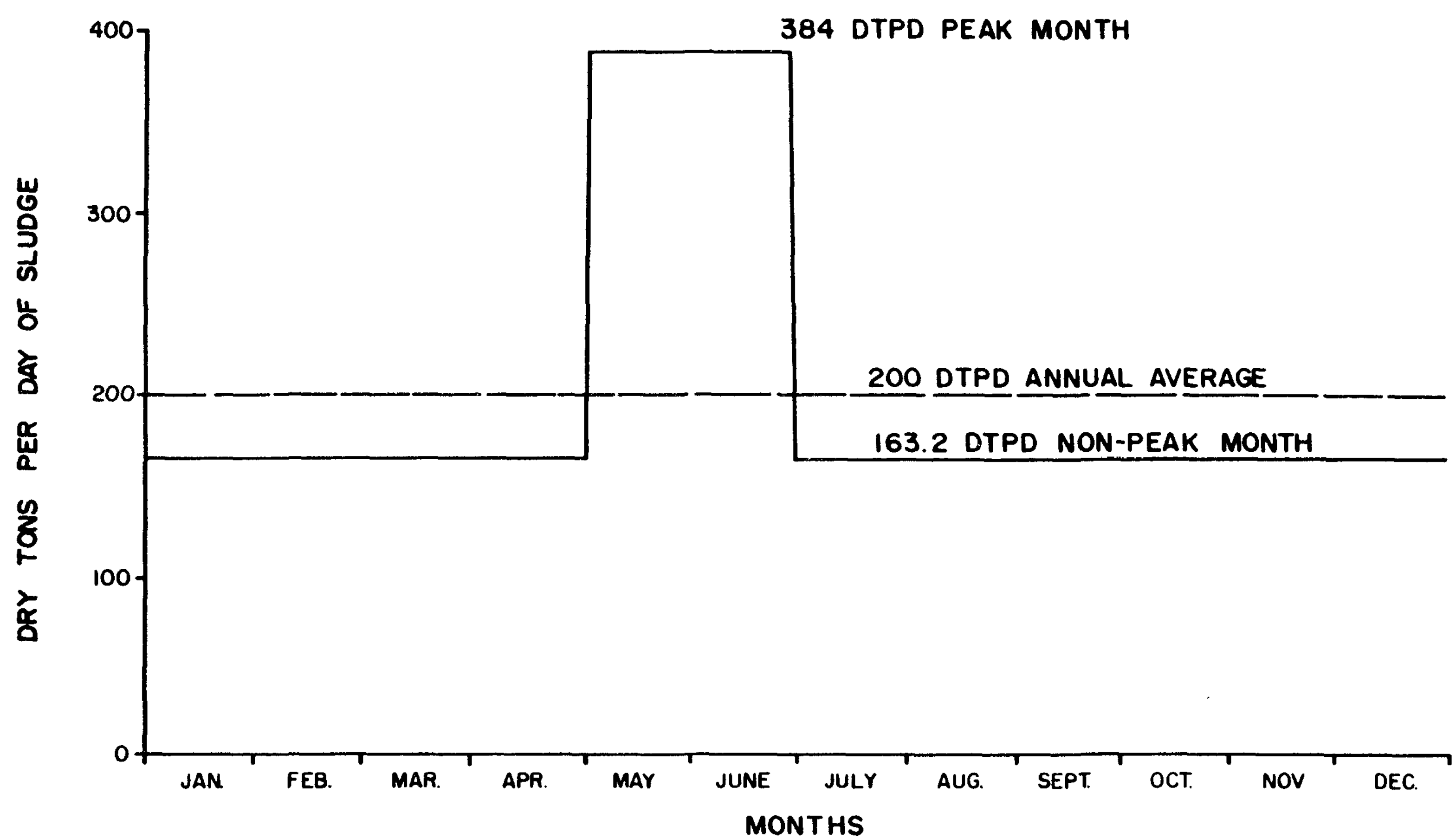
SALVAGE VALUE PLANT STRUCTURES	INCINERATION ALTERNATIVE I SIX UNITS	INCINERATION ALTERNATIVE II FOUR UNITS	DEWATERING DRYING AND PRODUCT USE	DEWATERING IN-VESSEL COMPOSTING AND PRODUCT USE	INCINERATION TWO UNIT WITH LAND APPLICATION
Filter Press Bldg.					
Site Work	$1,697,000	$1,697,000	$1,697,000		$1,697,000
Building	10,400,000	10,400,000	10,400,000		10,400,000
Solids Processing Building					
Stacks	$1,798,000	$900,000			$900,000
Building Modifications	4,762,000	4,762,000			4,762,000
Drying Building & Site Work			3,742,000		
Compost Buildings					
Site Work				6,825,000	
Buildings & Covered Areas				64,722,000	
Total Plant Structures	$18,657,000	$17,759,000	$15,839,000	$71,547,000	$17,759,000

(1) Based on values in Tables 1, 2, 3 and 7 of Appendix G and existing facilities were considered sunk cost in accordance with EPA guidelines. The salvege value is the value based on a straight-line depreciation from the initial new facility cost at the time of analysis to the end of the planning period. Process equipment given a design life of 20 years has no salvage value.

APPENDIX H - DESIGN YEAR SLUDGE QUANTITIES SUBJECT TO EIS

(Graph of Annual Average, Peak, and Non-Peak Month Sludge Quantities)

DESIGN YEAR SLUDGE QUANTITIES SUBJECT TO EIS*



* BASED ON 5/23/88 DISTRICT INFORMATION INDICATING AVERAGE SLUDGE PRODUCTION OF 200 DTPD AND 2 CONSECUTIVE MONTHS AT 384 DTPD PEAK (PEAK MONTHS ASSUMED), RESULTS IN A NON-PEAK MONTH AVERAGE OF 163 2 DTPD.

APPENDIX I - ADDITIONAL CONSIDERATIONS REGARDING LAND APPLICATION OF SEWAGE SLUDGE IN VIRGINIA AND MARYLAND

U.S. ENVIRONMENTAL PROTECTION AGENCY

REGION III

PHILADELPHIA, PENNSYLVANIA

ADDITIONAL CONSIDERATIONS REGARDING LAND APPLICATION OF SEWAGE SLUDGE IN VIRGINIA AND MARYLAND

A SUPPLEMENT TO THE BLUE PLAINS SLUDGE MANAGEMENT EIS

MARCH 1989

PREPARED BY:

GANNETT FLEMING ENVIRONMENTAL ENGINEERS, INC.
HARRISBURG, PENNSYLVANIA

ADDITIONAL CONSIDERATIONS
REGARDING LAND APPLICATION
OF SEWAGE SLUDGE
IN VIRGINIA AND MARYLAND

A SUPPLEMENT TO THE
BLUE PLAINS SLUDGE MANAGEMENT EIS

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A. HISTORIC BLUE PLAINS SLUDGE DISPOSAL PRACTICES

1. Historic Practices

A critical period for sludge management at Blue Plains was from 1974 to 1984 when a number of events occurred that have influenced the District's outlook on sludge management. This was the period known locally as the "sludge war" which was finally settled by the negotiation of the 1974 Sludge Memorandum of Understanding and the 1985 Intermunicipal Agreement. In chronological sequence, these are the major events that occurred during that time frame:

- 1974 - The Blue Plains STP Agreement between the District and the users of the plant established the principle that the users of the plant would accept their proportion of the sludge for disposal.

- 1975 - The EIS reached the conclusion that incinerators were unacceptable due to the potential for air pollution and fuel costs.

- 1976 - Maryland continued to accept 150 DTPD for land disposal, but public and official opposition was building. Composting at Beltsville began operations using Blue Plains sludge. The 1974 agreement was extended to 1978 and composting was considered for the site near Blue Plains known as Oxon Cove. This alternative was opposed by local citizens and abandoned. Some trenching continued in Maryland.

- 1978 - A solids building that could accommodate incinerators was constructed at Blue Plains.

- 1979 - A Court Order was issued requiring the District to compost on-site and Montgomery County to accept its share, which led to the development of Site-II.

- 1980 - Composting at Western Branch and Dickerson, Maryland began. Maryland stopped permitting trenching sites for dewatered sludge disposal.

- 1981 - In an amendment to the 1974 agreement among users and the District government, it was agreed to have a centralized sludge handling facility in place and operational by 1987.

- 1982 - 1984 - Interim composting sites at Western Branch and Dickerson shut down. The District contracted with Dano and other companies to alleviate the sludge problem.

- 1984 - WSSC contracted with haulers to dispose of the residues. The District had hoped that these materials would be marketable, but none were and the materials remained at the site until the current haulers removed it. At the same time, the District contracted for the interim land application of sludge at about the same time as EPA published its sludge recycling policy.

- 1984 to present - Blue Plains sludge is being land applied at the rate of 140 DTPD.

The design rate of sludge production used for the EIS is 410.5 DTPD. It is assumed that the earliest date this level will be reached is 1997. An average (and probably more realistic) sludge production rate of 410.5 DTPD rate will probably not be reached until well into the 20th century, at 2010. In any event, the EIS was only to consider 200 DTPD, the amount the District has proposed for incineration.

In effect, a phased approach to land application is already in place. Currently, 37.5 DTPD is being composted at Site-II and an increase to 87.5 DTPD has been FONSI'd. A FONSI also applies to the nearly 123 DTPD that is to be composted at Blue Plains. For its part, the District has considered composting up to nearly 150 DTPD. Land application currently accounts for roughly 140 DTPD.

- Site-II will phase up from 37.5 DT/dy to 87.5 DTPD:
- On-site will phase up from the current 70 DT/dy to 123 DTPD; and
- Land application would involve a phase up from the current 140 DTPD to 210.5 DTPD.

2. <u>Summary</u>

Sludge management at Blue Plains has had a long and complicated history. Sludge is currently being composted at Site II and at Blue Plains. The remainder is being land applied, a practice that is recommended in the draft EIS for continuation.

B. LAND AVAILABILITY FOR LAND APPLICATION OF SEWAGE SLUDGE

1. Currently Permitted Acreage

Table 2.5 in the Draft EIS contains a summary of the permitted acreage for land application of sludge in each of 20 counties in Maryland and Virginia. This information was supplied by the three land application contractors operating at Blue Plains and verified by the appropriate state agencies. At the time when this data was collected, there were 69,874 acres permitted for land application. This acreage is not solely permitted for Blue Plains sludge and includes acreage which could be used for sludges from other treatment plants. Based upon information from BioGro Systems, acreage permitted only to receive Blue Plains sludges are in Louisa County, Virginia (3,759 current permitted acres).

This data has been updated as part of this report and is presented in Table 1 and illustrated in Figure 1. The three contractors have provided permitted acreage numbers as of January 1989. Culpeper County, Virginia no longer has permitted acreage. Calvert, Charles and St. Mary's County, Maryland and Orange and Prince William County, Virginia have been added to the list. The total permitted acreage has increased to 78,280. This is an increase of 8,406 acres since the last inventory. In addition to the 78,280 acres currently permitted, there are 27,543 additional acres pending permit approval. Approval of these applications would bring the total permitted acreage to over 105,800 acres.

2. <u>Acreage Required</u>

The draft EIS states (Pg. 2-21) that the disposal of 200 DTPD over the next 20 years would require an estimated 37,700 permitted acres based on the assumed conditions. Changing the application cycle from 3 years to 5 years at the Virginia sites to provide increasingly conservative estimates while maintaining the other conditions results in increasing the acreage requirement to about 59,400 acres. Based on information supplied from state regulatory agencies and contractors it is apparent that about 78,280 acres of permitted land are available for the application of sewage sludge. The 78,280 acres represent 5.1 percent of the total agricultural acreage in the counties in which permitted acreage exists, according to information obtained from the "1982 Census of Agriculture" for Maryland and Virginia.

<u>Calculations</u>

Given:
- Corn Crop: 180 lbs N/ac required
- Sludge: 70 lbs N/ton and 40% available
- EPA Site Availability Factor: 1.4
- Permitted Acres: 27,215 Ac Maryland; 51,065 Ac Virginia
- Sludge Production: 73,000 DTPY

Loading Rate

Tons/ac = 180 lbs N/ac/ (70 lbs N/ton) (0.40)
= 6.4 tons sludge/ac

Land Application Potential Based on Permitted Sites

Maryland Tons/yr. = 27,215 Ac (1/1.4) 6.4 ton/Ac
= 124,411 tons/yr.

Virginia $Tons/yr._3$ = 51,065 Ac (1/1.4) (1/3) 6.4 ton/Ac
= 77,813 tons/yr.

$Tons/yr._5$ = 51,065 Ac (1/1.4) (1/5) 6.4 ton/Ac
= 46,688 tons/yr.

Table 1

Permitted Acreage
for Land Application of Sewage Sludge

County	Total[1] Cropland	Total Permitted Acreage Enviro-Gro	Total Permitted Acreage Bio-Gro	Total Permitted Acreage Ad + Soil	Total Permitted Acreage	Acreage Pending Approval
Maryland						
Calvert	26,918	0	500	0	500	0
Caroline	107,719	1,000[2]	1,734	0	2,734	32
Carroll	136,433	350	260	0	610	0
Charles	43,372	0	670	0	670	1,225
Frederick	187,201	200	0	0	200	0
Howard	40,349	2,500	416	0	2,916	305
Kent	N/A	500	0	0	500	0
Prince George's	39,231	1,100	7,977	0	9,077	1,303
Queen Anne's	134,909	1,000[2]	3,056	1,866	5,922	2,317
St. Marys	50,729	0	104	0	104	0
Talbot	97,951	0	3,982	0	3,982	0
Subtotal	864,812	6,650	18,699	1,866	27,215	5,182
Virginia						
Caroline	42,617	0	2,875	0	2,875	8,915
Essex	51,173	0	9,575	0	9,575	555
Fauquier	135,736	0	5,301	0	5,301	783
Goochland	27,991	2,000	1,297	0	3,297	2,531
Hanover	69,300	2,000	4,699	0	6,699	295
King George	21,502	1,200	1,608	0	2,808	2,567
King and Queen	34,256	0	4,562	0	4,562	3,843
King William	40,641	0	4,649	0	4,649	1,534
Loudoun	135,040	0	4,596	0	4,596	1,348
Louisa	40,950	0	3,759	0	3,759	0
Orange	60,528	0	1,944	0	1,944	0
Prince William	N/A	1,000	0	0	1,000	0
Subtotal	659,734	6,200	44,865	0	51,065	22,361
Total	1,524,546	12,850	63,564	1,866	78,280	27,543

1. Data prepared by BioGro based upon the "1982 Census of Agriculture" for Maryland and Virginia.

2. The actual acreage values for these two counties is unknown, but was estimated by Enviro-Gro as 2000 to 5000 acres for both. A conservative estimate of 1000 acres for each county is given here.

Sources: 1, 2, 3.

FIGURE 1

PERMITTED LAND APPLICATION ACREAGE
AND TOTAL CROPLAND ACREAGE

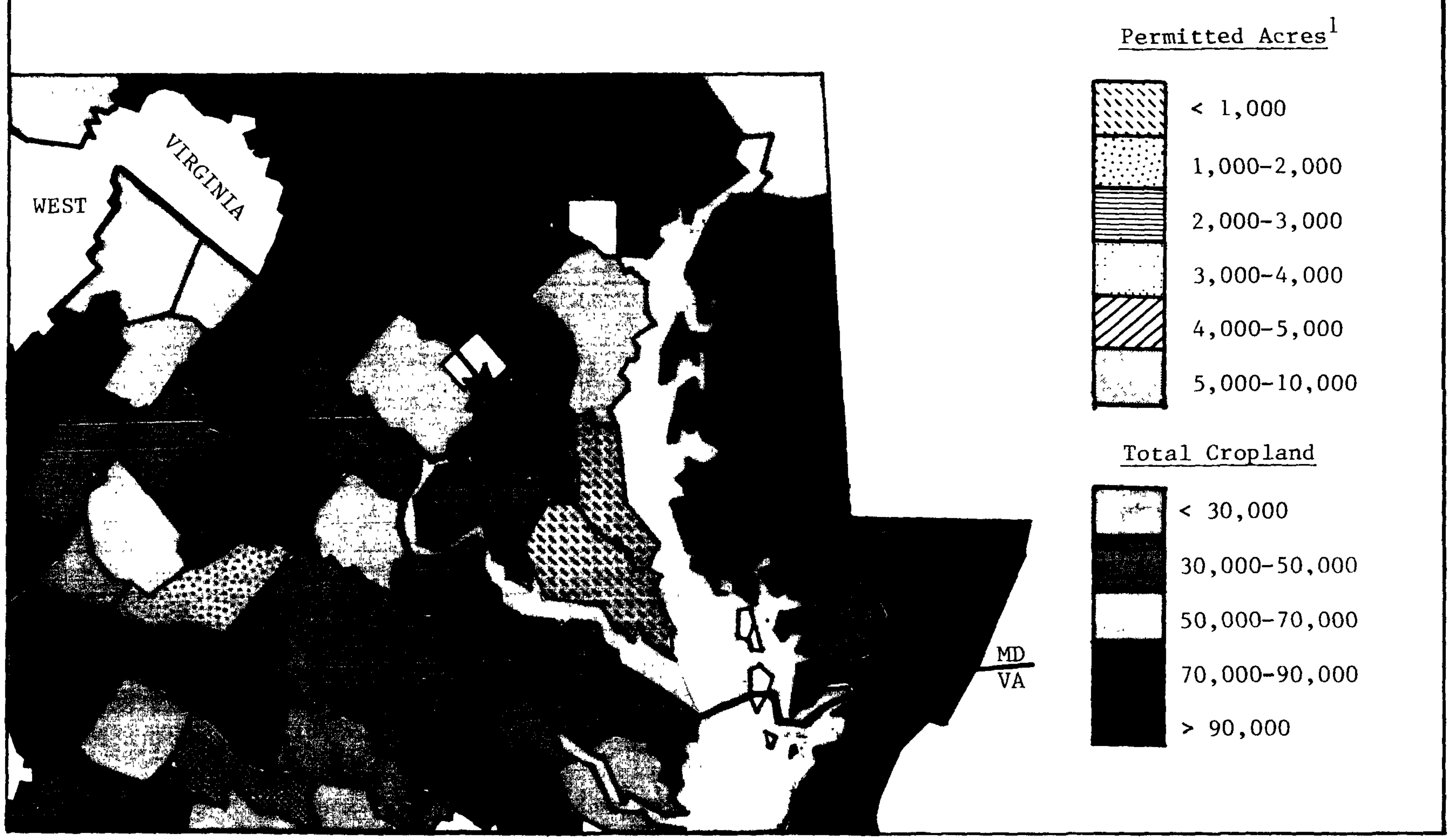


FIGURE 1

[1] Acreages shown represent the totals for BioGro, EnviroGro and Ad+Soil from Table 1 for the counties inventoried.

Potential Range - 171,099 to 202,224 tons of sludge/year could be applied as compared to 73,000 DTPY of sludge produced, based on given conditions.

Land Application Required Acreage

Maryland Tons/yr. = 73,000 DTPY (0.32)
= 23,360 DTPY

Acres = (23,360 DTPY / 6.4 tons/Ac) 1.4
= 5,110 acres

Virginia Tons/yr. = 73,000 DTPY (0.68)
= 49,640 DTPY

$Acres_3$ = (49,640 DTPY / 6.4 tons/Ac) 1.4 (3 yr. cycle)
= 32,576 acres

$Acres_5$ = (49,640 DTPY / 6.4 tons/Ac) 1.4 (5 yr. cycle)
= 54,294 acres

Required Range 37,686 to 59,404 acres/year depending on the application cycle used at Virginia sites. This requirement is lower than the 78,280 acres currently permitted.

A second scenario involves the approach where reclamation application rates are used. Under this approach, assuming the production of 1,800 wet tons per day, and the application rate of 60 tons per acre, this program would require 30 acres per day and a total of about 11,000 acres per year. However, the regulations allow a program of reuse of the acreage over a period of several years with a following period of "rest" prior to intensive farming or development.

Several other alternative analyses are also possible resulting in the reduction of total acreage needed. Therefore, even by using the most conservative approach, permitted land for sludge application is available well in excess of the acreages actually required.

3. Trends in Land Availability

The permitted acreage for land application of sludge in the D.C. area has been gradually increasing since land application was initiated for Blue Plains sludge in 1984. The amount has increased 8,406 acres since the last inventory in 1988. An additional 27,543 acres is pending permit application approval. While this area is not reserved strictly for sludge from Blue Plains, it represents only 5.1 percent of the total agricultural acreage in the two state area. In addition, since sludge application was begun in 1984, the hauling distance has been reduced by roughly 25%; from a one way average of 87 miles to 67 miles.

The haulers do not enter into long-term contracts with farmers because: a) the demand is so great that farmers make their needs known sufficiently in advance for planning; and b) contracts require commitment on the part of the hauler to provide a certain quantity of plant nutrients. They are reluctant to make such guarantees because of demands and business considerations.

4. Land Application of Agricultural Activities

Figure 1 in this section shows the number of acres permitted for land application of Blue Plains sludges in Maryland and Virginia. This information is based upon data provided by three land application contractors including: Enviro-Gro, Bio-Gro and Ad+Soil. Figure 1 also shows the acreage of farmland in Virginia and Maryland that is potentially available for land application.

The area in Virginia stretching from the Norfolk/Newport News area to Richmond and north to Washington, D.C. will see heavy development along the rivers, bay and ocean front over the next 10-20 years. However, the inland areas are projected to remain largely in agricultural uses and therefore provide the available land for future land application needs.

The picture in Maryland is virtually identical to Virginia, with the Eastern Shore and southern Maryland farming areas remaining fairly stable for the next 20 years. Only 5% of these agricultural lands are currently under permit to accept sludge, however, the acreage under permit does not mean that every permitted area is receiving sludge. At the current application rates, only about half of the acreage is being used.

In Virginia, sludge from Blue Plains represents about 75% of the total that is applied to lands. The competition for sludge is actually keener among the farmers than among the generators since the only major centers of sludge production are Richmond, the Atlantic Plant (serving the Norfolk, Newport News, Virginia Beach area), and Roanoke.

In Maryland, about 40,000 DTPY of sewage sludge from Blue Plains are land applied to agricultural lands. This represents nearly 90% of that state's land application program. Heavy competition may soon come from Baltimore's 60,000 DTPY that is planned for land application. Most of the time, the sludge is of sufficient quality, meaning that it can be used for application on agricultural lands. Currently, an abundance of lands is available so that Baltimore's program is no threat to the land available to Blue Plains. Other sources of sludge are Carroll County, MD (650 DTPY), Charles County, MD (2,000 DTPY), and Howard County, MD (2,500 DTPY).

5. Summary

The trend over the past five years has been toward increasing availability of land permitted for land application of sludge. The current amount of 78,280 acres of permitted land has an estimated capacity for 171,099 to 202,224 DTPY; well in excess of the 73,000 DTPY proposed for land application from Blue Plains. The amount of land required for Blue Plains is estimated at 37,700 to 59,400 acres. This represents 48.2% to 75.9% of the current permitted acreage. Only 5.1 percent of the existing agricultural acreage in the counties inventoried has been permitted for land application.

C. THE PERMITTING PROCESSES FOR SEWAGE SLUDGE LAND APPLICATION SYSTEMS

1. Virginia Permitting Process

This section of the report is based upon the "Draft Revisions to the Sewerage Regulations Pursuant to Section 62.1-44.19(8) of the Code of Virginia (1950), as amended" dated April 1, 1988. Although these regulations are subject to further revision before they are adopted, discussion with the Virginia Department of Health[4] revealed that little, if any, changes to the permitting process are expected. Variations from the existing permitting process are noted when applicable.

Under the proposed regulations, the owner (sludge generator) will apply for a Virginia Pollution Abatement (VPA) permit through submission of a sludge management plan in compliance with applicable sections of Part 3, Article 7 and Appendix G. If the plan includes the construction of sludge storage or processing facilities, the owner must submit final engineering documents, in accordance with Section 1.6 concurrently with the submission of the plan. The owner submits copies of these documents to the appropriate regional office of the State Department of Health and copies to the appropriate regional office of the State Water Control Board. If the owner contracts out the sludge application program, the owner must be permitted, but may have the contractor included as a co-permittee. The owner should notify landowners adjacent to proposed application site(s).

In the existing system the contractor holds the permit. Part of the justification for the change involves giving the owner the responsibility for the land application program. The Commonwealth makes no bonding or other assurance requirements in the draft regulations as this is to be left up to the owner's discretion.

The Department and the Board will review the plan and engineering documents (if applicable) to determine if they are complete. The Department notifies appropriate local governments in accordance with current statutes and procedures. The Department may schedule a public meeting in accordance with these statutes. The Board develops a draft certificate and forwards a complete copy to the owner.

The owner then authorizes the Board to advertise the permit application in the form of a public notice by publication for two successive weeks, one week apart, in a newspaper of general circulation in the county, city, or town in which the land application or storage site(s) are located. The public comment period extends 30 days from the first day after the publication of the notice. The Board will evaluate the comments received as a result of the public notice and determine whether a public hearing is necessary. If so, the Board will prepare a public notice of the hearing and hold the hearing after completion of the public notice period. The Board will then issue, reissue, modify or deny the certificate.

If the determination proposed is to deny the certificate, the Board must so advise the owner along with the requirements, if any, necessary to modify that determination.

Upon issuance (reissuance or modification) of the certificate, the owner may initiate operation of the plan and may begin construction of the storage facilities. Prior to operation of the storage facilities, the owner must submit an O&M manual in accordance with Section 1.8.

According to a 1986 article entitled "Winning Strategies for Land Application" published in BioCycle magazine and written by Mr. John Walker of the U.S. EPA, the Virginia sludge permitting process frequently requires six months or longer. This statement was verified by the Virginia Health Department. The permit is then valid for 5 years, if limitations are met. The permit renewal process is very similar to the original process, with the exception that public hearings may not be required. Therefore, the renewal process is sometimes shorter than six months.

Under the current system the contractors obtain a permit for a site and add other sites through amendments to the permit. The only change in the revised regulations is the owner will be the holder of the permit. Separate permits for all sites used by the owner will not be required.

A flow diagram on the next page illustrates the permitting processes of Virginia.

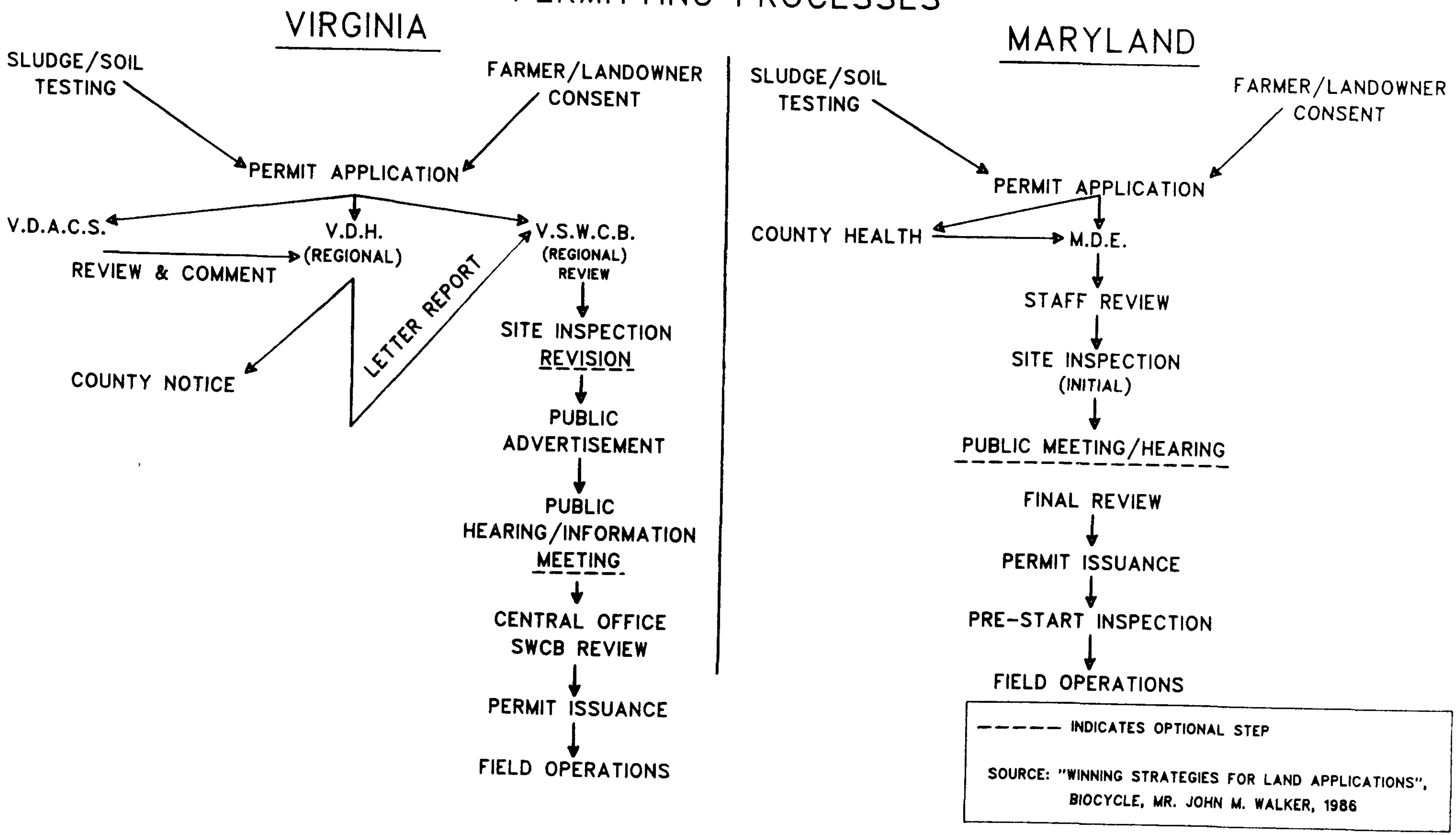
2. Maryland Permitting Process

Basic differences between the Virginia and Maryland permitting process include bonding requirements; contractor, rather than owner permitting; and a shorter permit approval and renewal process in Maryland.

Sewage sludge utilizers must file a bond or other approved security with the Maryland Department of the Environment that will be conditioned upon the fulfillment of any requirement related to the sewage sludge utilization permit. The amount of the bond for land application permits is $25,000 for agricultural loading rates and $50,000 for marginal land loading rates. Although each site is permitted separately in Maryland, applicants for agricultural or marginal land application sites may file one bond for several sites equivalent to the costs listed above for the first site and 40 percent of that bond amount for each additional site, up to a maximum total bond of $200,000.

There are specific procedures for any complete application to either land apply sewage sludge on marginal land or before construction can begin on any permanent facility designed primarily for sewage sludge utilization. The Department shall publish notice in a local newspaper having a substantial circulation in the affected county and mail a copy of the notice and the application to the local health official, the chairman of the county legislative body, and the elected executive, if any, of the respective county or municipality in which these activities would occur. Within 15 days of the receipt of the complete application, the executive or legislative body of the county or municipality may request a public hearing. If requested, the Department will make all arrangements and publish a notice in a newspaper of

VIRGINIA AND MARYLAND LAND APPLICATION PERMITTING PROCESSES



general circulation in the affected area 7 days in advance of the hearing and will then hold the hearing. Any comments received must then be taken into account in the permit approval or denial process.

For permit applications for land application of sewage sludge to other than marginal land, the Department still mails notices to appropriate local officials. Those officials then have 10 days to request a public informational meeting. The Department must then publish notice of the meeting 5 days prior to the meeting and hold the meeting. Comments received should be reviewed in the permit approval or denial process.

For either type of application, the local governments have 20 days after notification to provide the Department with written comments and suggestions regarding issuance, denial or restrictions for the permit. Notification is also given to counties within one mile of a proposed application site if one exists other than the county in which the site is located.

The Department may consolidate the hearings or informational meetings for more than one permit application if several exist in one general area.

Permit applications cannot be denied strictly because of public opposition. Denial must be based upon undue risk of environmental hazards; inability to meet application or regulatory requirements; the applicant's inability to fulfill permit requirements for other sites; or a lack of sufficient resources on the part of the applicant to meet the provisions of the permit. The permit approval process, upon receipt of a complete application, typically takes between 45 and 90 days, unless significant modifications need to be made.

Sewage sludge land application permits may not exceed 5 years. Renewals may be granted if the proper renewal application form is completed, appropriate fees are paid and permit requirements have been met and can continue to be met. The renewal process is typically faster than the initial permitting process.

The Department will consider all applications to change cover crops, adjust application rates for different cover crops or current sludge analyses, to add other sludges from the same source treated by PSRP or PFRP, change haul routes, change application methods or change transportation vehicles to be minor permit modifications and these changes can be made without going through the permit approval process again. Other modifications may necessitate a repeat of the approval process.

3. Permit Approval Success Rates

According to the Virginia Department of Health[4], the success rate for land application permits is approximately 95 percent. Some sites have been turned down due to elevated water tables, soil limiting zones, or other similar restrictions. The Department or Board cannot deny a permit application based upon public opposition. Some applicants have been requested to withdraw their application because of anticipated public opposition, but no permits have been denied because of it.

The success rate for permit applications in Maryland[5] is similar to the Virginia rate. Permits are often modified from the initial application to account for soil or sludge limiting factors, but the application is rarely denied in total.

4. Local and National Policies and Trends

Virginia has a "pro-sludge" land application policy[4] and the Commonwealth sees sludge application on agricultural and disturbed lands as a beneficial use of a resource.

The existing and draft regulations contain several waivers of requirements where application rates of less than once in five years are proposed. These waivers are included because of the excess available land around the state for land application, not from a fear of environmental degradation resulting from more frequent loadings. Most sites do have resting periods between applications but sites with annual loadings do exist.

Maryland also has a policy supporting the reuse of resources[5]. While the state's regulations are expected to be tightened over time to ensure proper land application practices, their policy prefers composting and land application of sewage sludge over other disposal practices.

Information provided by both state contacts and contractors is in close agreement.

- A permit for land application has rarely been denied because farmers who want the material have thorough soil and parent material analyses included with the permit application. Therefore, permit approval is a virtual certainty in all cases.

- Permits encountering public opposition are few in number because the state agencies discourage applications from those areas where opposition is anticipated. In questionable areas, the state agency carries out pre-permit surveys to ascertain the potential for opposition, does pre-project coordination, and may hold public meetings and hearings prior to permitting.

- On two occasions, sites were lost to a sludge hauler due to development. Both sites were selected for proximity to the sludge source and were not sufficiently investigated prior to permit application for development pressures. These experiences were early in the history of the contractor's sludge application business in Pennsylvania.

- No sites have been revoked for these reasons in the District's program, but none of the contractors are concerned because the demand is so great that loss of sites would be quickly rectified. In fact, one contractor has already begun the process of permitting lands farther from the District in anticipation of development pressures and to accommodate other municipalities' needs.

- One contractor has been cited for 12 - 15 violations over the 15 years or more of his business. Violations were for odors and corrections were immediately made without loss of permit.

- EPA's John Walker relates that the permitting process is evolving nationally and the possibility exists that regulations too restrictive to allow for land application of some sludges will result. However, it appears that the District's material is of sufficiently high quality to preclude any permit denials in the foreseeable future.

- Permit criteria are based upon USDA and EPA regulations that are backed up by state land grant college research.

In addition to these state policies and trends, John Walker explains the historical perspective for the period since 1976, as follows:

- From 1976 through 1980, recycling of sludge rose to nearly 40% of the total sludge generated.

- By 1988, this figure was up to 50%, with more than half of the nation's wastewater treatment plants operating some variety of recycling process.

- Baltimore has incorporated pretreatment and now recycles most of its materials.

- In Maryland, approximately 80% of the sludge is recycled.

- Land application and composting are used in disposing of 50% of the sludge produced in Virginia.

- Site II, in Calverton, Md. (where 40 DTPD of Blue Plains sludge is composted) won this year's sludge recycling award for their efforts at controlling odors.

- The current attitude in Maryland is that proper land application practices are a statewide concern and efforts towards increased state control are underway. However, Maryland[5] views land application of properly treated sewage sludges in appropriate areas as a beneficial reuse of a resource and the state prefers the recycling of resources over product disposal.

5. Summary

The permitting process in Virginia is a lengthy (6 months or longer) and thorough process that provides necessary safeguards and public input into the process. Under the current system, the contractors obtain and hold the permits. With proposed draft regulations the owner (sludge generator) will apply for and obtain the permit. Permits are valid for 5 years.

Procedures in Maryland are similar except that bonding is required by the applicant; the contractor holds the permit; and the approval process can take less time for approval. Permits are valid for 5 years.

Most land application permits are approved. According to both states approximately 95 percent of the land application permits are approved.

Both states support a policy of beneficial reuse of a resource. This is reflected in state-wide regulations that are stringent yet provide a process that provides for permitting of sites throughout both states.

D. Environmental Concerns

1. Contamination of Water Sources

Regarding land application, studies by Clemson University, the University of Iowa, and the Virginia Polytechnic Institute show that groundwater pollution is more severe with chemical based fertilizers than with organic based soil amendment due to the greater solubility of the chemical salts commonly used in chemical based amendments. The Clemson study is briefly summarized and referenced in the EIS on page 4-35. Both application rates and tillage are being further studied by Virginia Polytechnic Institute and State University and Pennsylvania State University.

The EIS (Page 4-35) presents the concept of reduced nitrogen runoff from fields receiving sludge to meet crop fertilizer needs as compared to commercial fertilizer. As stated in the EIS, "This form of pollution is highly variable because it depends on precipitation and local conditions."

Calculations of a quantity appears to be difficult at this time because of a range of varying reported results. However, an illustrative value can be determined if one applies the values for ammonium nitrogen, NH_4-N from Table 4 of the Clemson paper cited earlier and EIS Table 4-12:

Calculation

Given: Blue Plains Sludge NH_4-N 1.04 lbs/ton
Fertilizer NH_4-N loss in runoff 7.1%
Sludge NH_4-N loss in runoff 2.1%
Application rate 73,000 DTPY

Fertilizer NH_4-N = Sludge NH_4-N
Sludge NH_4-N = 73,000 DTPY (1.04 lbs/ton)
= 75,920 lbs NH_4-N

Fertilizer NH_4-N runoff = 75,920 lbs NH_4-N (0.071)
= 5,390 lbs NH_4-N/yr.

Sludge NH_4-N runoff = 75,920 lbs NH_4-N (0.021)
= 1,594 lbs NH_4-N/yr.

Estimated ammonium nitrogen reduction due to sludge replacement of fertilizer is about 3,780 lbs/yr. based on the above conditions.

Ground and surface water contamination from sludge land application sites is estimated to be less than the amount originating from the same site using commercial fertilizer. Both Maryland and Virginia have groundwater monitoring requirements, loading rate limits, and sludge constituent and treatment requirements as safeguards to limit potential water contamination.

Development of a nitrogen removal offsetting credit for the Blue Plains Wastewater Treatment Facility if land application of sludge nitrogen is used in place of commercial nitrogen fertilizer is difficult to calculate and presents a complex regulatory policy issue.

Summary

Existing research shows that nutrient runoff from sludge amended sites is less than the amount from the same sites using commercial fertilizer. Maryland and Virginia have strict regulatory requirements to limit the potential of environmental impacts on ground and surface waters. Development of a nitrogen removal credit for land application used in place of commercial nitrogen fertilizer is difficult to calculate and presents a complex regulatory policy issue.

2. Food Chain Toxicity

In order to determine the potential threat of food chain toxicity resulting from a Blue Plains sewage sludge land application program, a series of "Environmental Profiles and Hazard Indices for Constituents of Municipal Sludge" printed by US EPA were consulted. Specifically, the hazard indices for cadmium, chromium, copper, lead, nickel and zinc were evaluated to determine the potential food chain toxicity hazards arising from land applying Blue Plains sludge at agricultural and marginal land rates.

Cadmium, lead and zinc were the only metals for which food chain toxicity hazard indices were exceeded for sludge loading rates below 100 tons per acre per day. Although no loading rate maximums for marginal lands were given in the Maryland or Virginia regulations, the 100 ton level was established here as a conservative estimate of the maximum permittable loading rate.

Cadmium

The background level of cadmium in the soil used in the EPA testing (0.2 ppm) was high enough to cause decreased egg production in chickens fed a diet of earthworms from the site. Chickens were used as the indicator species because of their high level of sensitivity to cadmium. Background levels on sites used for Blue Plains sludge may be higher or lower than the background level in the study. The addition of 22 tons per acre of sludge to the test site increased the risk of this hazard by 2.5 times. The amount of the increased risk from applying dewatered raw Blue Plains sludge would be less because the average cadmium level in Blue Plains sludge is 80 percent of the sludge used in the EPA study. In addition, the chance of this impact actually taking place is decreased further by the common use of commercial feeds in chicken farming.

The cadmium level in soil loaded with 22 tons per acre of sludge was also high enough to exceed the recommended daily cadmium intake of human vegetarians fed a diet of crops grown on the site. Crops grown for direct human consumption cannot be grown in sludge amended soils in Virginia for a period of 1½ to 3 years. The limitation in Maryland is for three yeras. In addition, the plant tissue level at which the hazard-index is first exceeded (8.9 ppm) is equivalent to the maximum cumulative loading of cadmium in Maryland in Virginia. Therefore, even if the crops withdraw all of the soil's cadmium in the application year, the likelihood of a significant health hazard is low. The three year waiting period is an additional safeguard to mitigate the potential hazard.

Lead

The only hazard index exceeded for lead involved exceeding the acceptable daily intake of 150 ug for toddlers ingesting crops grown on sludge amended soils; animal products from animals ingesting crops grown on sludge amended soil; and the sludge amended soil itself from sites loaded at rates of 22 tons per acre or more. The existing regulatory safeguards limiting crop production and human access to land application sites are adequate to reduce the risk of this hazard.

Zinc

The background level in the soil used in the EPA studies (44 ppm) was sufficient to cause a decrease in growth, hemoglobin and hematocrit in Japanese quail. However, this species is not typically found in this region of the United States. No hazard indices were exceeded for chickens or turkeys, which were the two other species evaluated in the EPA study.

Summary

The most significant risk of food chain toxicity resulting from metals typically found in a sewage sludge land application program is from cadmium. Virginia and Maryland have maximum annual and cumulative loading rates that appear to be sufficient to at least significantly reduce, if not eliminate altogether, the potential of any impact. Use of commercial chicken feed or otherwise restricting the interaction of chickens and products from sites with high cadmium levels will further reduce the potential for any impact.

3. Gaseous Emissions

A Dialog Science literature search for titles describing gaseous emissions from sewage sludge was conducted to determine the extent of the research involving gaseous emissions associated with the land application of sewage sludge. There are odors associated with non-volatile gas emissions from treated sludge. These gases include, among others, sulfur dioxide (SO2), ammonia (NH_3), and methane. Although these gases give off an unpleasant odor, they are not harmful in the concentrations typically present and the odor is alleviated once the treated sludge is incorporated into the soil.

There is a paucity of available information in relation to environmental hazards linked to VOCs given off by treated sludge, as evidenced by the location of only one reference to literature through the Dialog search. An EPA Project Summary document stated that volatile priority pollutant organics were rarely detected.[7] The document further stated that if VOCs were detected, they were detected at a level far below toxic detection limits. However, the sludge is not the prime source of VOCs and other gaseous emissions in a land application system. The transportation of sludge and lime generates the greatest volume of gases. Table 2 is a comparison of estimates of gaseous emissions from land application and incineration of 73,000 DTPY of Blue Plains Sludge.

Table 2
Comparison of Emissions (lbs/year)
Land Application vs. Incineration
(73,000 DTPY)

Pollutant	Land Application (260,000 gpy of fuel)	Stack Emissions	Incineration Ash Haul (26,000 gpy of fuel)	Total
TSP	3,725	84,000	400	84,400
SO_2	8,025	240,000	1,000	241,000
CO	82,250	Negligible	8,230	8,230
NO_x	59,900	498,000	6,000	504,000
VOC	13,200	30,000	1,300	31,300

Source: 8.

The Table shows that the transportation of sludge will result in higher carbon monoxide emissions than incineration, but otherwise incineration is the greater source.

To further analyze the impact of transporting 200 DTPD of Blue Plains Sludge to land application sites, the Air Programs Planning Section of the U.S. EPA, Region III completed an analysis of the air quality impact of diesel truck exhaust. They determined that the impact of hydrocarbons, carbon monoxide, nitrogen oxides, and particulates will be insignificant.

The following information, provided by EPA, Region III was used to complete the analysis:

1986 Mack 686 ST diesel trucks
80 trips per day (a highly conservative estimate)
Operating 8 hours per day
Idling 2 hours per day
Average trip is 150 miles round trip

The analysis was made assuming the area of impact to be the National Capital Interstate Air Quality Control Region (AQCR), which is defined to include: Montgomery and Prince George's Counties in Maryland, the District of Columbia, and Arlington, Fairfax, Loudoun and Prince William Counties in Virginia.

The emission factors for the heavy duty diesel trucks were calculated using the fourth edition of AP-42, Compilation of Air Pollutant Emission Factors, Volume II: Mobile Sources. The basic and idle emissions were determined on a gram per day basis and summed to get a total emission for each pollutant; specifically hydrocarbons, carbon monoxide and nitrogen oxides. These values were converted to tons per day based upon 80 trips per day and a 150 mile trip. Then these values were compared to the estimated 1987 mobile emissions inventory found in the Final Washington Metropolitan Air Quality Plan for Control of Ozone and Carbon Monoxide, Appendices, Volume I, December 1982 which was prepared by the Metropolitan Washington Council of Governments as part of the 1982 State Implementation Plan revision (SIP) for the National Capital Interstate AQCR.

Based on the 1987 mobile source inventory, the diesel truck emissions generated by the Blue Plains proposal are estimated to be 0.04% and 0.08% of the total emissions of hydrocarbons and nitrogen oxides, respectively. Therefore, the hydrocarbon and nitrogen oxide emissions appear to be insignificant. The total carbon monoxide emissions were calculated to be 0.01 tons per day. The 1982 SIP revision analyzed carbon monoxide on a "hot spot" level and therefore cannot be used for comparison with the calculated emission values. However, the carbon monoxide emissions are very small and appear to be insignificant in impact.

The particulate emissions were estimated to be 0.22 tons per day. These estimates were made using the report entitled Size Specific Total Particulate Emission Factors for Mobile Sources, prepared by Energy and Environmental Analysis, Inc. for EPA, August 1985. Diesel particulates are very small (less than 10 microns in size (PM-10)). There is no emissions inventory for PM-10 in the National Capital AQCR. In 1970, the District of Columbia submitted a SIP for total suspended particulates. This emissions inventory cannot be compared with the calculated particulate emissions because the SIP inventory is over 18 years old, only covers the District of Columbia and not the entire AQCR, and because the inventory includes those particulates larger than 10 microns in size. In conclusion, the particulate emissions are very small and appear to be insignificant in impact.

It should be noted that the calculated emissions discussed herein are estimates. The MOBILE3 mobile source model was used to make the calculations. However, in the 1982 SIP which was used for comparison, the 1987 mobile emission inventory was estimated using MOBILE2, an outdated version of the mobile source model.

<u>Summary</u>

The results of a literature search and two sludge transport emissions analyses show that the environmental impacts of gaseous emissions from a sludge land application program are insignificant. Carbon monoxide was the only gas from a land application program which exceeds the projected emissions from the incineration alternative. However, even the carbon monoxide emissions were described in an EPA analysis as insignificant in impact.

Emissions from sludge are minor, including VOC emissions. Additional emissions from sludge transporting the sludge appear to be insignificant in terms of their impacts upon air quality in the Washington area.

E. ENERGY CONSUMPTION

1. Energy Consumption

The land application and incineration-ash landfilling sludge management alternatives consume various types of energy for system operation and by design each supplements energy consumption of other processes. Comparing the energy usage of land application and incineration has generally shown energy use to be a very important alternative selection parameter for information while it is not important in selecting land application[9]. Both alternatives consume electrical power for dewatering sludge, but the incineration dewatering power consumption is greater due to the system complexity and higher degree of dewatering required. The incineration process as proposed would use 460,000 SCF of digester gas per day, 60,000 gallons of No. 2 fuel oil for startup fuel and the combustible fraction (65%) of the dewatered sludge which has a heating value of about 5,850 BTUs/lb. The electrical power expected to be generated from the incineration process auxiliary equipment is 48,000 kwhr/day. The land application program as proposed would use about 669,000 gal/yr of diesel fuel. Also, through replacement of commercial fertilizer with equivalent sludge nutrient value, fertilizer production energy requirements would be offset.

Based on the information available, an energy summary of each alternative was developed as shown in Table 3. The dewatering and incineration energy cost data came from the EIS and ES* reports excluding ash transportation which was adjusted to be on a similar basis as sludge transportation. The land application energy costs were based on information supplied by the current District sludge hauling contract operators. A review of the total dollar value of the input energy for the alternatives indicates there is an energy savings of about $770,700/yr if land application were used in place of incineration-ash landfilling.

* Engineering Science - Consultant to D.C. to provide concept design for the incineration alternative.

Table 3

Summary of Energy Cost (1)

Energy Item	Four Unit Incineration	Land Application
Dewatering		
Electrical Power		
Filter Press	$ 541,000	
Centrifuge		$ 310,000
Incineration		
Electrical Power	$ 624,300	
Startup Fuel	61,700	
Digester Gas Value (2)	503,700	
Ash Transportation Fuel (3)	19,000	
Subtotal	$1,208,700	
Land Application	N/A	
Sludge Transportation and Spreading Fuel (4)		$ 669,000
Total	$1,749,700	$ 979,000

(1) Based on information in the EIS as based on ES reports and other sources.

(2) Based on 460,000 SCFD digester gas requirement valued at $3/1000 CF.

(3) Based on 88 DTPD, 50% solids, 1.25 T/CY, 50 mile round trip, 5 MPG, 27 CY/truck and $1/gal. fuel.

(4) Based on 73,000 DTPY, 21% solids, 18,250 DTPY post lime, 0.825 T/CY, 160 mile round trip, 5 MPG, 27 CY/truck, $1/gal. fuel, tractor and loader 8 gal/hr, 90 hrs/wk, spreader 1 gal/hr, 70 hrs/wk, 20 minute cycle time, and 10% additional for miscellaneous and support vehicle fuel.

Each of the alternatives has an offsetting energy output which should also be considered. The 48,000 kwhr/day of electrical power generated by the incineration auxiliary equipment has an estimated market value of $808,000/yr. The estimated average fertilizer value for the Blue Plains sludge is $45.17/dry ton applied which results in a total annual market value of $3,297,000. While the total annual market values indicate land application has the higher offsetting value, it is important to consider the market value of the end product includes other non-energy cost factors.

A comparison of the offsetting energy outputs of each alternative based on the number of therms/day(*) provides a more direct result. The incineration electrical power therms/day equivalent was determined to be 1,638. The energy to produce a ton of nitrogen fertilizer has been reported to require 44,760 SCF of natural gas, 150 kwhr of electricity and 8.95 gallons of fuel oil[10]. Based on this information, the land application alternative equivalent therms/day was determined to be at least 3,462 and excludes the additional energy to provide the phosphorus, potassium, and lime fertilizer components. Land application again has a higher offsetting energy component than incineration when the therms/day are compared.

2. Summary

In summary, the land application alternative appears to have a lower energy input dollar cost and a higher offsetting energy component than the incineration-ash landfilling alternative.

F. Land Purchase/Leasing

1. Land Purchase/Leasing

One of the factors in considering land application is both the availability of land and the cost of that land. In most land application programs, land value is not a factor since the land owner provides the use of

(*) 1 therm = 100,000 Btus

the land for sludge disposal purposes. However, land purchase for land application of sewage sludges is grant eligible.

However, the consideration in this section is the potential cost of land either on a purchase or rental basis. Table 4 provides a comparison of approximate cost on both a rental or purchase basis for land in selected counties in Virginia and Maryland.

The purchase or rental/lease of land for sludge disposal is not the normal practice. For instance, the purchase of land by one community within another may create public distrust and opposition in the host community, could impact local tax revenues and could present other legal obstacles.

The purchase or lease of lands for wastewater or solids disposal is grant eligible and has been done many times across the country. However, as Table 4 indicates, the rental or leasing of agricultural land on an annual basis is far less expensive than purchasing the land.

2. Summary

Land application processes should not consider rental/leasing or purchase of land. Sufficient land is currently permitted and leasing/purchase arrangements could send the wrong signals to those counties who are currently participating in land application programs.

G. Lorton Landfill Capacity

The Lorton Landfill or I-95 Landfill, as it is locally known, is owned and operated by Fairfax County, Virginia. In conversations with the Fairfax County Division of Solid Waste regarding the operation of this facility, the following information was offered:

- Without implementation of the resource recovery facility (I-95 energy recovery facility) at Lorton, the landfill will reach

Table 4

Summary of Land Costs for Sludge Land Application Sites (1)

State	County	Number of Permitted Acres	Local Contact	Approximate Rental Cost Agricultural Land $/ac	Approximate Purchase Cost Agricultural Land $/ac (2)
Maryland	Howard	2,916	Roberta Weber (301) 992-2030	30-45	1,900 - 3,800
	Prince Georges	9,077	David Conrad (301) 868-8783	-	---
	Queen Annes	5,922	Paul Gunther (301) 758-0166	65	2,000 - 5,000
	Talbot	3,982	Don Osburn (301) 822-1244	55	2,700 - 4,000
			Average	58	3,233
Virginia	Caroline	2,875	Dan Moody (804) 633-6550	60	800 - 1,500
	Essex	9,575	Keith Balderson (804) 443-3551	30-45	1,200 (Non Water Front)
	Fauquier	5,301	W. C. Brown (703) 347-8650	20-60	1,800 - 10,000 (2)
	Goochland	3,297	Jim Grove (804) 556-5341	15-60	500 - 1,200
	Hanover	6,699	Timothy Ethridge (804) 537-6030	35-40	2,000 - 5,000
	Loudoun	4,596	Gary Hornbaker (703) 478-1852	3-35	3,500
			Average	39	2,000 (2)

(1) Based on land prices provided by county extension agents.

(2) The higher range values were reported to represent agricultural land being sold for development.

(3) Average excludes Fauquier County high range value.

capacity in the mid 1990's. However, once the resource recovery operation is in operation, the capacity should be expanded by 10-15 years.

- Average daily intake at the landfill is currently 5,000 tons/day.

- Ash is currently being disposed at Lorton. Ash comes from the Arlington Resource Recovery facility and sludge incinerator ash from Fairfax County.

SOURCES

1. Telephone conversation with Mr. Robert Pepperman, Enviro-Gro Technologies, January 5, 1989.

2. Telefax from Mr. Timothy Ford, Ad + Soil, January 16, 1989.

3. Telefax from Ms. Carol Pavon, BioGro Systems, January 17, 1989.

4. Telephone conversations with Mr. Paul Farrell, Virginia Department of Health, January 5 and 10, 1989.

5. Telephone conversations with Mr. Doug Proctor, Maryland Department of the Environment, Manuary 5 and 12, 1989.

6. Environmental Profiles and Hazard Indices for Constituents of Municipal Sludge, US EPA, June 1985.

7. "Trace Organics and Inorganics in Distribution and Marketing Municipal Sludges, " US EPA 600/51-88/001, 1988.

8. Written communication from John E. Touchstone, Director, D.C. Department of Public Works, to Greene A. Jones, Director, Environmental Services Division, US EPA, December 9, 1988.

9. EPA 625/10-84-003 Technology Transfer, Environmental Regulations and Technology, Use and Disposal of Municipal Wastewater Sludge, September 1984, Pg. 61.

10. Energy requirements for New York State Agriculture Part II Indirect Energy Inputs, Agricultural Engineering Extension Bulletin, Cornell University.

11. Telephone conversation with Mr. James Maglione, Division of Solid Waste, Department of Public Works, Fairfax County, Virginia, December 20, 1988.