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Alternatives to Ocean Dumping: A Municipal Dilemma

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I. Introduction to the Problem

Since the enactment of the Marine Protection Research and Sanctuaries Act of 1972 (MPRSA),[1] the New York Bight Apex is the only site in the United States where ocean dumping of sewage sludge still occurs legally.[2] The New York Bight is an area twelve miles off the coast of New York in the Atlantic Ocean, east of New Jersey and south of Long Island, New York. The use of this twelve mile sewage sludge dump site is now being phased out and the sludge dumping is being moved to a deepwater municipal sludge site which lies off the outer edge of the Continental Shelf.[3] Presently, nine sewage authorities are dumping sewage sludge into the ocean and they include New York City, Westchester County and northern New Jersey.[4]

Sewage sludge is defined as a mixture of water, inorganic, and organic solids removed from municipal wastewater by physical, biological, and/or chemical treatment and it [sewage sludge] and liquid effluent are the two products resulting from municipal wastewater treatment."[5]

In the early 1970's, Congress recognized that unregulated dumping of material from the United States or U.S. vessels or aircraft into ocean waters endangered human health, welfare, amenities, the marine environment, ecological systems, and economic potentialities. Consequently they enacted MPRSA

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1. 33 U.S.C. §§ 1401-1445 (1982).

2. Note, *The Regulation of Ocean Dumping After City of New York v. Environmental Protection Agency*, 12 B.C. ENVTL. AFF. L. REV. 701, 706 (1985).

3. CONGRESS OF THE UNITED STATES OFFICE OF TECHNOLOGY ASSESSMENT, WASTES IN MARINE ENVIRONMENTS, 67 (1987).

4. N.Y. Times, Feb. 19, 1989, at 58, col. 1.

5. Massey, *Municipal Wastewater Effluents*, 20 S. TEX. L. J. 1, 8 (1982).

and four other statutes concerning waste disposal.[6]

Title I of MPRSA provides for a dumping permit program and names the United States Environmental Protection Agency (EPA) as the lead agency in the administration of ocean dumping and directs them to establish regulations for controlling ocean dumping.[7]

The interest in preserving the integrity of the ocean waters has been on a sharp rise recently. On March 13, 1989, President George Bush announced that he "would support more aggressive criminal prosecution of ocean dumpers."[8] On September 15, 1988, thirteen expert mountain climbers associated with the national environmental support group, Greenpeace, suspended themselves from the Triborough Bridge in New York City in protest of New York's continued dumping of sewage sludge into the ocean.[9]

The crux of the problem facing municipalities in the New York metropolitan area that use the Bight as a disposal site for treated sewage waste is finding an environmentally sound alternative that is cost effective to the local governments.

The focus of this article is to afford the public an opportunity to briefly overview the problem of ocean dumping and to become more familiar with the legal and technical obstacles confronting the municipalities. Each section will discuss the technical aspects of the alternatives to ocean dumping. Moreover, a description and anaylsis will follow, outlining the laws and regulations mandated by the federal government and by the State of New York. Finally, a brief conclusion will be given which will outline the feasibility of the various alternatives presented, especially in a region similar to New York.

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6. Note, *Ocean Dumping: An Old Problem Continues*, 1 PACE ENVTL. L. REV. 37 (1983).

Federal Water Pollution Prevention and Control Act, 33 U.S.C. §§ 1251-1376 (1982); Safe Drinking Water Act, §§ 42 U.S.C. 300f-300j (1982 & Supp. IV 1986); Clean Air Act, 42 U.S.C. §§ 7401-7642 (1982); Resource Conservation and Recovery Act, 42 U.S.C. §§ 6901-6987 (1982 & Supp. IV 1986).

7. 33 U.S.C. § 1412(a) (1982).

8. 201 N.Y.L.J., Mar. 14, 1989, at 1 col. 2.

9. N.Y. Times, Sept. 16, 1988, at B1, col. 6.

The protesters were awaiting a barge dispatched from a New York City Sewage Treatment Plant on route to the Atlantic Ocean for deepwater disposal.

II. *City of New York v. United States EPA* - The Problem

The EPA, under the power vested in it through MRPSA, issued the City of New York an interim permit to dump in the Bight. The permit required the City to devise and implement an alternate method of disposal by December 31, 1981.[10] In 1989, the City of New York and surrounding municipalities are continuing to dump in the Atlantic Ocean because they have been unable to find an alternative to ocean dumping that is both environmentally safe, cost effective, and feasible for their communities.

The City developed a plan of composting and land spreading, however, since it was only a short range plan, the EPA allowed New York City until 1988 or 1989 to develop a long range plan.[11]

Upon the expiration of the interim permit and the EPA's refusal to renew it, the City of New York brought suit against the EPA[12] The City of New York sought to compel the EPA to consider New York City's evidence that land disposal of municipal sewage waste was a great expense and greatly exceeded the effects of continued dumping in the heavily polluted New York Bight.[13]

Although MPRSA absolutely bans all ocean dumping of sewage sludge found harmful to the marine environment after December 31, 1981,[14] the City of New York argued that the statute barred only dumping which "unreasonably" degraded the marine environment.[15] Moreover, New York City contended that the "EPA must evaluate the cost and potential hazards of land-based alternatives and the effects of the proposed dumping upon the particular dump site."[16] The City felt that by ceasing to dump, "no discernible improvement in the Bight" was foreseeable.[17]

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10. New York City v. EPA, 543 F. Supp. 1084, 1085 (S.D.N.Y. 1981).
11. *Id.* at 1085-1086.
12. *Id.* at 1086.
13. *Id.* 1086.
14. 33 U.S.C. § 1412a (b) (1982).
15. New York City v. EPA, 543 F. Supp. at 1086.
16. *Id.*
17. *Id.*

III. Ocean Disposal

"Ocean disposal of municipal [sewage] sludge is accomplished by releasing it into designated areas of the ocean, either from vessels or through outfall pipes."[18]

The only area in the United States where ocean disposal is still permitted is in the 106 mile site.[19] This site, located off the Continental Shelf, 125 miles southeast of the entrance of N.Y. Harbor and 132 miles off Atlantic City, New Jersey, is being used by those dumpers who are being phased out of the New York Bight Apex.[20] The New York Bight is being phased out because of the degradation of the water quality in the region.[21] The EPA has determined that the degraded condition in the area could be alleviated by moving the disposal site further out in the ocean.[22]

The process of ocean disposal is simple as compared to other municipal disposal plans. The sludge is dumped into the water to disperse and the,

> volatile hydrocarbons evaporate into the atmosphere, while grease, oil and scum remain on the water surface and may be transported long distances by winds and [water] currents. The remaining solids [in the sludge] either settle to the ocean floor or are retained in clouds dispersed at various depths.[23]

Throughout the process, many contaminants that are in the fine particles accumulate below the surface thereby causing contamination to sea organisms.[24] Moreover, "[H]azards to public health from ocean disposal include bacterial contamination of recreational areas or ingestion of contaminated

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18. N.Y. State Environmental Facilities Corp., STUDY OF SLUDGE MANAGEMENT ALTERNATIVES FOR SEVEN COUNTIES IN THE HUDSON VALLEY, 72 (N.Y. S. Dep't. of Envt'l Conserv. Oct. 31, 1986). (hereinafter "HUDSON VALLEY STUDY").

19. *Supra* note 3.

20. *Id.*

21. *Id.*

22. *Id.*

23. *Id.*

24. *Id.*

shellfish."[25] The concerns associated with ocean disposal of sewage sludge include the build up of heavy metals and synthetic hydrocarbons in marine life, increased levels of pathogenic organisms, decreased dissolved oxygen, increased turbidity levels, and adverse effects to water quality, bottom sediments and marine organisis.[26]

Because the disposal of the sludge reaches the ocean, which is a navigable water,[27] the process is regulated by the Federal Water Pollution Control Act. (Clean Water Act).[28] Both outfall pipes and sludge-carrying barges constitute point sources under the Act.[29] In order to discharge sludge into the ocean, the dumpers must first obtain the necessary permits under the Act.[30] These permits, the National Pollutant Discharge Elimination System (NPDES) permits, are granted by the EPA to dumpers who can meet nine criteria which include the weighing of such issues as health, economics, biology, and geography.[31] Once dumpers have satisfied the EPA criteria

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25. *Id.*

26. *Id.*

27. 33 U.S.C. § 1362(7) (1982).

"The term 'navigable waters' means the waters of the United States, including the territorial seas."

28. 33 U.S.C. §§ 1251-1376 (1982).

29. 33 U.S.C. § 1362(14) (1982).

"The term 'point source' means any discernible, confined and descrete conveyance, including, but not limited to any pipe, . . . or vessel or other floating craft, from which pollutants are or may be discharged."

30. 33 U.S.C. § 1342(a)(1) (1982).

31. 33 U.S.C. § 1412(a) (1982).

(A) The need for the proposed dumping.

(B) The effect of such dumping on human health and welfare, including economic, esthetic, and recreational values.

(C) The effect of such dumping on fisheries resources, plankton, fish, shellfish, wildlife, shorelines and beaches.

(D) The effect of such dumping on marine ecosystems . . . .

(E) The persistence and permanence of the effects of the dumping.

(F) The effect of dumping particular volumes and concentrations of such materials.

(G) Appropriate locations and methods of disposal or recycling, including land-based alternatives and the probable impact of requiring use of such alternate locations or methods upon considerations affecting the public interest.

(H) The effect on alternate uses of oceans, such as scientific study, fishing, and other living resource exploitation, and non-living resource exploitation.

and obtained a permit, they will be strictly monitored by the EPA, and any violation of the permit standards will result in the levying of a fine.[32] Moreover, under the citizen suit provision of the Clean Water Act,[33] a private citizen may sue illegal dumpers in order to bring them into compliance.

Ocean disposal is the least favored disposal alternative by proponents of the environment. With ocean disposal there is absolutely no attempt made to regain any of the rich nutrients in the sludge. In fact, ocean disposal has been characterized as the "throw-away approach."[34]

IV. Alternatives to Ocean Dumping

Five of the most common alternative methods of disposal of wastewater sludge are: land application, composting, landfilling, incineration, and heat drying.

A. *Land Application*

1. *Technical Analysis*

"Under the Federal Water Pollution Control Amendments of 1972,[35] land application is recognized as an alternative method for effecting stages of wastewater treatment and for ultimate disposal of solid wastes."[36] "Interest in the application of municipal wastewater sludge to land has increased dramatically over the past several years. This is due in part to the current trends in federal and state programs which regulate its use."[37]

In land application, sewage sludge or septage is injected below or on the soil surface in either a dewatered or liquid

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(I) In designating recommended sites, the Administrator shall utilize whatever feasible locations beyond the edge of the the Continental Shelf.

32. 33 U.S.C. § 1319 (1982).

33. 33 U.S.C. § 1365 (1982).

34. N.Y. Daily News, Sept. 11, 1988, at W1, col. 1.

35. 33 U.S.C. §§ 1251-1376 (1982).

36. U.S.E.P.A., APPLICATIONS OF SLUDGES AND WASTEWATERS ON AGRICULTURAL LAND: A PLANNING AND EDUCATIONAL GUIDE 1, (March 1978).

37. CENTRAL STATES WATER POLLUTION CONTROLL ASSOC., THE WISILLMINN, (Nov. 1984).

form in a manner which benefits the soil or crop, treats the sludge, and does not cause a negative environmental impact.[38] The methods of land application for sludge include spreading it on agricultural land for crop production, spreading it on forest land for tree growth,[39] and spreading it on wasteland with future reclamation possibilites.[40]

Land application serves as a soil conditioner as well as a partial replacement for commercial fertilizers.[41] In the treatment process,

> sunlight, soil micro-organisms, and desiccation help to destroy pathogens and many toxic organic substances in the sludge. Heavy metals and . . . nutrients in sludge are trapped by soil as a result of soil's various physical and chemical characteristics. Nutrients, which can cause eutrophication . . . if released into the surface waters, are . . . converted to a useful biomass such as crops or wood.[42]

2. *Legal Analysis*

a. *Federal - Resource Conservation and Recovery Act (RCRA)*

In 1976, Congress enacted the Resource Conservation and Recovery Act,[43] RCRA, the purpose of which was to promote the protection of health and the environment and to conserve

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38. HUDSON VALLEY STUDY, *supra* note 18, at 60.

39. U.S.E.P.A. ENVIRONMENTAL REGULATION AND TECHNOLOGY: USE AND DISPOSAL OF MUNICIPAL WASTE WATER SLUDGE, EPA 625/10-84-003, 15-16 (1984)(hereinafter USE AND DISPOSAL).

The application of sludge to forests can improve the productivity. Studies at the University of Washington on the use of sludge has shown height increases of up to 1,190% and diameter increases of up to 1,250% compared to controls in certain tree species. The forest may be the best recipient of land-applied sludge as compared to agricultural application in that the forest plays an insignificant role in the human food chain.

40. *Id.*

41. *Id.*

42. *Id.*

43. 42 U.S.C. §§ 6901-6991 (1984 & Supp. IV 1986).

valuable material and energy.[44] In addition to the federal goals of the statute, Congress included a section for state and regional solid waste plans.[45] "The objectives of this subchapter are to assist in developing and encouraging methods for the disposal of solid waste which are environmentally sound and which maximize the utilization of valuable resources including energy and materials which are recoverable from solid waste and to encourage resource conservation."[46]

The definition of "solid waste" under RCRA includes sludge from a waste treatment plant, but does not include solid or dissolved material in domestic sewage.[47]

The scope and purpose of the regulations under the RCRA is to determine which solid waste disposal facility and practices pose a "reasonable probability of adverse effects on health and environment."[48] There are eight criteria for the classification of solid waste facilities.[49] A land application site may be located in a flood plain,[50] however, it cannot "restrict the flow of the base flood, reduce the temporary water storage capacity of the flood plain, or result in washout of solid waste, so as to pose a hazard to human life, wildlife, or land or water resources."[51]

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44. 42 U.S.C. § 6902 (1984 & Supp. IV 1986).

45. 42 U.S.C. §§ 6941-6949 (1984 & Supp. IV 1986).

46. 42 U.S.C. § 6941 (1984 & Supp. IV 1986).

47. 42 U.S.C. § 6903(27) (1982).

The term "solid Waste" means any garbage, refuse, sludge from a waste treatment plant, water supply treatment plant, or air pollution control facility and other discarded material . . . . resulting from industrial, commercial, mining, and agricultural operation, and from community activities, but does not include solid or dissolved material in domestic sewage, or solid or dissolved materials in irrigation return flows or industrial discharges . . . .

See also 40 C.F.R. §257.2 (1988).

48. 40 C.F.R. § 257.1(a) (1988).

49. 40 C.F.R. § 257.3 (1988). Floodplains, Endangered species, Surface water, Ground water, Application to land used for the production of food-chain crops, Disease, Air, and Safety.

50. 40 C.F.R. § 257.3-1(a) (1988).

51. 40 C.F.R. § 257.3-1(b)(1) (1988).

"Base flood" means a flood that has a 1 percent or greater chance of recurring in any year or a flood of a magnitude equalled or exceeded once in 100 years on the average over a significantly long period.

40 C.F.R. § 257.3-1(b)(2) (1988).

b. *Federal Water Pollution Prevention and Control Act (Clean Water Act)*

The Clean Water Act[52] also plays a major regulatory role in the land application process.[53] The Clean Water Act section 405 pertains to the disposal or use of sewage sludge.[54] In any case, where the disposal of sewage sludge resulting from the operation of a treatment works would result in any pollutant from such sewage sludge entering navigable waters, such disposal is prohibited except in accordance with a permit[55] issued by the EPA under the National Pollutant Discharge Elimination System (NPDES).[56]

The Clean Water Act established a system of standards, permits, and enforcement methods aimed at achieving ambient water quality through the use of discharge standards in the form of effluent limitation for all point sources.[57] The Clean Water Act states that any discharge by a point source into a navigable water, without a permit, is illegal.[58]

A landspreading facility is not normally considered as having point source discharge when the sludge is incorporated into the soil for enhancement of vegetative growth.[59] "This is true even though there may be a discharge to waters of the United States from an outfall of clearly delineated channel that drains the landspreading area."[60]

In order to comply with Clean Water Act section 405, the

"Floodplain" means the lowland and relatively flat areas adjoining inland and coastal waters.

40 C.F.R. § 257.3-1(b)(3) (1988).

"Washout" means the carrying away of solid waste by waters of the base flood.

52. 33 U.S.C. §§ 1251-1376 (1982 & Supp III 1985).

"The objective of this chapter is to restore and maintain the chemical, physical, and biological integrity of the Nation's waters." 33 U.S.C. § 1251(a).

53. 33 U.S.C. §§1251-1376 (1982 & Supp. III 1985).

54. 33 U.S.C. § 1345 (1982).

55. 33 U.S.C. § 1345(a) (1982).

56. 33 U.S.C. § 1342 (1982).

57. 33 U.S.C. § 1312 (1982).

58. 33 U.S.C. § 1311 (1982 & Supp. III 1985).

59. U.S.EPA A GUIDE TO REGULATIONS AND GUIDANCE FOR THE UTILIZATION AND DISPOSAL OF MUNICIPAL SLUDGE, MCD-72, 38, (Sept. 1980). (hereinafter E.P.A. GUIDE).

60. *Id.*

owner of a publicly-owned treatment works must not violate the disposal criteria of sludge on land.[61]

c. *Safety of Public Water Systems, Public Health Service Act (Safe Drinking Water Act)*

The Safe Drinking Water Act (SDWA) is another federal environmental statute that plays a part in analyzing a land application site.[62] According to the SDWA, the underground injection or subsurface emplacement of fluids by well injection cannot be performed if the injection may result in the presence of underground water which supplies any public water system of any contaminant, and if the presence of such contaminant may result in the system's not complying with any national primary drinking water regulation or may otherwise adversely affect the health of persons.[63] However, "[a] sludge landspreading practice will not normally contaminate underground drinking water where the sludge has been applied to the soil for the enhancement of vegetative growth."[64]

d. *New York State Solid Waste Management Facilities Regulations*

Effective December 31, 1988, the State of New York Department of Environmental Facilities revised their regulations relating to solid waste management facilities. The state believes "that this comprehensive set of regulations sets a national standard for the safe and controlled management of solid waste."[65]

The New York State requirements for land application programs must be based upon the minimum standards set in the criteria for Classification of Solid Waste Disposal Facilities and Practices (Criteria).[66] State regulations may be more stringent than the Criteria as long as the minimum require-

61. 40 C.F.R. § 257.1(b) (1988).
62. 42 U.S.C. §§ 300f-300j (1982 & Supp. IV 1986).
63. 42 U.S.C. § 300h(d) (1982).
64. EPA GUIDE, *supra* note 59, at 39.
65. Letter from Thomas C. Jorling (Dec. 2, 1988 forwarding the regulations).
66. 40 C.F.R. § 257 (1988).

ments are met. States, for example, may require a higher level of dewatering to avoid leachate problems and potential groundwater contamination.

These regulations pertain to the construction and operation of land application facilities for sewage sludge.[67] In evaluating an application for a land application permit, the New York State Department of Environmental Conservation (NYSDEC) will take many factors into consideration. Initially, they will look at the potential impact the sludge will have on human and animal health.[68] Secondly, they will examine the potential impacts on the soil,[69] then the permanent impacts on vegetation[70] and the potential benefit of the material.[71] The final analysis that must be made is whether the site is suitable for land application of the sludge.[72]

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67. N.Y. Comp. Codes R. & Regs. tit. 6, § 360-4.1(a) (1988).

68. *Id.* § 360-4.2(a).

(a) Potential impact on human and animal health due to each of the following:

(1) heavy metal uptake by crops;

(2) pathogens;

(3) uptake of toxic organic compounds by crops;

(4) degredation of groundwater and surface water quality;

(5) potential loss of cropland resource due to contamination of the soil with heavy metals or other toxic substances; and

(6) odor and nuisance conditions.

69. *Id.* § 360-4.2(b).

70. *Id.* § 360-4.2(c).

71. *Id.* § 360-4.2(d).

"If the material cannot benefit the soil or crop, it cannot be land applied."

72. *Id.* § 360-4.2(e).

(1) The following order of priority will be used in evaluating the suitability of alternative sites for land application of sewage sludge. . . :

(i) surface reclamation projects such as distrubed lands, landfill closure. . . or land which does not support adequate vegetation for other reasons;

(ii) non-agriculture public and private owned lands which are not likely to be used for crop production in the foreseeable future;

(iii) agricultural soil groups 4 through 10 of the Land Classification System . . . ;and

(iv) agricultural soil groups 1 through 3 of the Land Classification System.

(2) When evaluating the potential of alternative sites for a land application facilitiy on agricultural soils, the following order of priority will apply:

(i) soil texture of loam or silt loam having a coefficient or permeability of six tenths to six inches per hour;

(ii) soil texture of silty clay loam or sandy loam having a coefficient of permeability less than six tenths to six hundreths inch per hour; and

The sludge that is destined for a land application facility cannot exceed certain contaminant concentrations.[73] The sludge must be stabilized before land application to reduce pathogens.[74] The regulations give guidelines for the location of land application facilities which include the topography of the area, the geological composition, and the location of the site to water supplies and residential housing.[75] Once a site has been in operation in the land application program, public access is prohibited for at least twelve months.[76]

The key to the land application process is the value of the sludge to the land. The state will only permit land application of sewage sludge "when the beneficial value of the sludge . . . as a supply of nutrients or as a soil conditioner can be demonstrated."[77]

The enforcement of the regulations falls under the auspices of the Environmental Conservation Law of the State.[78] Unlike federal law, no express provision exists for citizens to commence an action should a facility fail to act in accordance with a permit. The state has the authority to check permits and to inspect premises. However, there is no check by the public.[79]

3. *Analysis*

The choice of a site for land application is greatly affected by the surrounding environment. "Factors of concern include depth to ground water, distance to surface waters, slope of the site, soil permeability, soil pH, soil cation exchange capacity, and depth and type of bedrock."[80]

(iii) soil texture of sand, loamy sand, or clay having a coefficient or permeability of less than six hundreths or greater than six inches per hour.

73. *Id.* § 360-4.4(a).

74. *Id.* § 360-4.4(b).

The methods used in the stabalization process include aerobic digestion, air drying, anaerobic digestion, composting, and lime stabalization.

75. *Id.* § 360-4.4(d).

76. *Id.* § 360-4.4(q).

77. *Id.* § 360-4.4(t).

78. *Id.* § 360-1.4(2). N.Y. Envtl. Conserv. Law § 71 (McKinney 1988).

79. *Id.* § 360-1.4(a).

80. USE AND DISPOSAL, *supra* note 39.

It is obvious that the greater the depth and the greater the distance from any source of water, the less probable it is for any water contamination to exist.[81] The slope of a land application site is important in determining the potential for runoff from the disposal site.[82] Moreover, if the soil at the site is not very permeable, the chance exists for waste to collect and ponds to form during high rainfall.[83] Since high soil pH immobilizes most metals and reduces their absorption into plants, when land application is used for agricultural purposes, the soil pH must be at or above 6.5 at the time of the sludge application.[84] The geologic formations of the site are very important as areas underlain with fractured bedrock or containing sinkholes may provide a vehicle for rapid transportation of pollutants to aquifers.[85]

Land application is the most common disposal method for sludge with forty-two percent of the sludge disposed of in the United States being done so in this manner.[86] A reason for its popularity is its economic value where municipal land or land for grazing is available. Very often, municipalities offer the sludge to farmers or other residents in the community to apply to their land usually with little or no cost to the residents.

Large cities with high volumes of sludge and little or no immediate access to agricultural lands have not been the best candidates for land application programs.[87]

4. *Conclusion*

Several draw-backs in land application exist in metropolitan regions such as New York. Very little undeveloped land exists and there are very few farms or reclamation projects that would require sludge in the amounts generated by the

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81. *Id.*
82. *Id.*
83. *Id.*
84. *Id.*
85. *Id.* at 11.
86. JOURNAL OF WATER POLLUTION CONTROL, 1260, (Sept. 1982).
87. USE AND DISPOSAL, *supra* note 39, at 22.

region. Overall, it appears that state and local support for the land application is more favorable in states with an orientation to agriculture. This land based alternative can be effective if several communities work together that share in the problem.

B. *Landfilling*

1. *Technical Analysis*

Landfilling is a disposal method that makes no attempt to regain the nutrients from the sludge. During landfilling, sludge is either left alone or mixed with solid waste and buried beneath a soil cover. Currently, about twenty-five percent of municipal wastewater sludge generated in the United States is disposed of by landfilling.[88]

Municipal sludge and septage can be disposed of in sanitary landfills and is regulated by the New York State Department of Environmental Conservation. The sewage sludge is stabilized into a non-odorous form and must be dewatered to at least twenty percent solids by weight.[89] Sludges with a lower content of solids may be co-disposed with municipal refuse if the sludge makes up only a small portion of the total amount of waste being landfilled.[90] The proportion of sludge accepted may exceed twenty-five percent only if a leachate collection, monitoring and treatment system is provided at a facility. "Sludge-Only" landfills require very strict operation and management controls to prevent technical and aesthetic

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88. USE AND DISPOSAL, *supra* note 39.

89. HUDSON VALLEY STUDY, *supra* note 18, at 33. New York State requires that: "1. sewage sludge must be dewatered to a minimum of 20 percent solids by weight and be digested or otherwise stabilized so it is not odorous; 2. the proportion of sludge (wet weight) accepted at a landfill should not exceed 25 percent of the total weight of municipal solid waste with which it is to be mixed unless leachate monitoring treatment and collection is provided; 3. NYSDEC must approve the type, quantity, and general quality of the sludge to be accepted at the site; 4. NYSDEC will approve a "sludge only" landfill under specific conditions set forth in the regulations and guidelines."

90. EPA GUIDE, *supra* note 59, at 29. "Sludges with a solid content less than 15% may be codisposed. . .An acceptable ratio of refuse to sludge depends on many factors (e.g. sludge solids content, type of refuse, site characteristics and climate). Refuse to total liquid ratios from 5:1 to as low as 2:1 have been reported."

problems. The ash from sludge-burning incinerators may also be landfilled and such disposal is regulated by either the hazardous waste sections of RCRA or the New York State solid waste regulations.[91]

Landfilling is a sludge disposal method in which sludge is deposited in a dedicated area, by itself or mixed with solid waste; and there is merely occasionally an attempt to recover energy.[92] There are two types of landfilling techniques: sludge-only sites (sludge alone is buried in trenches) and co-disposal (sludge is disposed of in municipal/solid waste landfills in a mixed form).[93]

a. *Sludge-Only Landfills*

When sludge is landfilled by itself and not mixed with solid waste, it is usually dewatered and then deposited in a trench and covered over with soil. In order to landfill sludge in a narrow trench, it must be less than thirty percent solids and the trench floor must be nearly level to ensure that the sludge will be spread evenly throughout the trench.[94] If a wide trench is used for the landfill, the sludge should be at least thirty percent solids to ensure that it will remain in the piles.[95] This is readily done by using bulking materials. After the sludge is placed in the trenches, it should be covered over the same day to prevent odors and to prevent vectors (i.e., birds, insects) from contacting the sludge and spreading contaminants.[96]

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91. 42 U.S.C. §§ 6921 - 6924 (1984 & Supp. IV 1986); N.Y. Comp. Codes R. & Regs. tit. 6 § 360 (1988).

92. USE AND DISPOSAL, *supra* note 39 at 37. "Adherence to proper sanitary landfilling procedures minimizes many potential health, environmental, and aesthetic problems associated with sludge landfilling. However, groundwater contamination by constituents in landfilled sludge remains a concern. It may be difficult to detect and even more difficult to correct. Proper planning and management can prevent such problems."

93. *Id.* "In both cases, adherence to proper sanitary landfill procedures helps to maximize successful performance and minimize potential problems."

94. *Id.*

95. *Id.*

96. *Id.* As each new trench is dug, the excvated soil can be used to cover the sludge in a nearby trench and if the sludge is solid enough, soil can be applied by

b. *Co-disposal*

In co-disposal, wastewater sludge is mixed with solid waste and deposited in the landfill.[97] The purpose of co-disposal is to utilize the absorption characteristics of the solid waste and the soil conditioning characteristics of the sludge to complement one another.[98] The solid waste absorbs the excess moisture from the sludge and reduces leachate migration. If excessive rainfall occurs and moisture is generated in the sludge, the leachate may seep out.

The primary concern with landfilling sewage sludge is that organic solids formed during decomposition could enhance the leaching of metals from the solid waste/sludge mixture. If leachate reaches an aquifer, heavy metals and toxic organic materials could pose adverse health effects. If the leachate reaches surface waters, nutrient levels could rise causing eutrophication,[99] and undesirable fish kills and algal blooms.[100] Water contamination can be reduced by efficiently covering the landfills and establishing leachate collection systems, in addition to properly lining the site. Once a facility is in operation, a groundwater monitoring system should be created and maintained.[101] A surface water monitoring program would also be a prudent investment.

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motorized vehicle.

97. *Id.* at 38. In sludge/refuse mixtures, the sludge is deposited on top of refuse and then mixed in. In sludge/soil mixtures, the sludge and soil are mixed and spread on top of the refuse. This promotes revegetation of the site.

98. *Id.* Most sludge/refuse operations use sludges with at least 20 percent solids but low-solids sludge requires large refuse volumes (as much as 7 tons of refuse for each wet ton of sludge). The excessive moisture of low-solids sludge increases solid waste decomposition and increases the likelihood of leachate; low-moisture and high-solid composition is therefore recommended.

99. F.J. MONKHOUSE AND JOHN SMALL, A DICTIONARY OF THE NATURAL ENVIRONMENT, 111 (1979). "eutrophic" - the increase of plant nutrients in bodies of surface waters, which leads to excessive growth of vegetation resulting in decreased dissolved oxygen levels in the water, ultimately leading to decreases in fish and other non-plant life which require oxygen for survival.

100. USE AND DISPOSAL, *supra* note 39 at 39.

101. *Id.* The majority of states (72 percent) require or can require that soil-based liners, synthetic liners, or both be installed in a sludge landfill. A leachate collection system should be installed in any landfill where leachate is being contained or where water tends to pond in the fill area.

Another important concern with the landfilling alternative to ocean dumping is the amount of acreage required. A municipality which generates twenty-eight dry tons of sludge each day (approximate population of 230,000) would require four to fifty acres of land per year for a sludge-only landfill, depending on various factors. Areas suited for this type of landfill are limited by community land use concerns.[102]

2. *Legal Restrictions on Landfilling*

There is an extensive federal and state legal network which must be investigated in order to implement landfilling as an alternative to ocean dumping of sewage sludge. The reason for the need to address a wide range of statutory and regulatory materials is that the sludge in municipal sewage treatment plants may contain toxic or hazardous substances in addition to organic matter. Determinative factors include the pretreatment techniques used by commercial or industrial facilities that dispose of wastes into the sewage system, as well as the level of treatment utilized at the sludge-generating plants themselves. Any land-based alternative will be affected by solid waste regulations, hazardous waste management strategies, and laws governing water pollution because of the possibility of leaching.

a. *Federal - Resource Conservation and Recovery Act*

Sewage sludge generated by a treatment plant falls within the RCRA definition and is regulated as a solid waste in terms of landfilling as an alternative. If the sludge or the ash from a sludge-burning incinerator could be characterized as hazardous waste,[103] then it shall be subject to regulation under Sec-

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102. *Id.* at 41. A landfill has a finite size and therefore a finite operating life. Its lifespan can be estimated by dividing the volume of sludge it can hold by the volume of sludge landfilled each year. Landfill capacity is the product of the usable fill area times the depth of the landfill. The remaining percentage of the site is used for buffer zones, access roads, and soil stockpiles.

103. 40 C.F.R. § 261.3 (1986). "Definition of Hazardous Waste
(a) A solid waste, as defined in § 261.2, is a hazardous waste if: (1) it is not excluded from regulation as a hazardous waste under § 261.4(b); and (2) it meets any of the following criteria: (i) it exhibits any of the characteristics of hazardous waste identi-

tions 3001, 3002, 3003 and 3004 of RCRA.[104] The sludge and ash must be tested before disposal and if it contains any substance listed as hazardous[105] or if it could be considered "EP Toxic,"[106] compliance with RCRA must be satisfied. The sludge and ash would be monitored from generation, through transport to its ultimate disposal site. Section 6924[107] of the Act describes the standards applicable to owners and operators of hazardous waste treatment, storage and disposal facilities (i.e., landfills). Subpart (d) of that section deals with prohibition on land disposal of specified wastes and is a very important provision.[108] It discusses disposal of sludges or

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fied in Subpart C [Ignitability, corrosivity, reactivity, and EP toxicity]. (ii) It is listed in Subpart D. . . (iii) It is a mixture of a solid waste and a hazardous waste that is listed in Subpart D solely because it exhibits one or more of the characteristics of hazardous waste identified in Subpart C, unless the resultant mixture no longer exhibits any characteristic of hazardous waste identified in Subpart C."

104. 42 U.S.C. §§ 6921-6924 (1984 & Supp. IV 1986). RCRA § 6921 deals with identification and listing of hazardous waste; § 6922 defines standards applicable to generators of hazardous waste; § 6823 discusses standards applicable to transporters of hazardous waste; and § 6924 sets out the standards applicable to owners and operators of hazardous waste treatment, storage and disposal facilities.

105. 40 C.F.R. § 261.30 (1986). Hazardous wastes from non-specific sources (Subpart D). This section of the regulations contains a listing of hazardous wastes.

106. 40 C.F.R. § 261.24 (1986). Characteristic of EP toxicity. "(a) A solid waste exhibits the characteristic of EP toxicity if, the extract from a representative sample of the waste contains any of the contaminants listed in Table I at a concentration equal to or greater than the respective value give in that Table. Where the waste contains less than 0.5 percent filterable solids, the waste itself, after filtering, is considered to be the extract for the purposes of this section." (Table I includes arsenic, barium, cadmium, chromium, lead, mercury, selenium and silver). It is quite possible that some of these metals would be found in sludge from a sewage treatment plant.

42 U.S.C. § 6921(g) (1984 & Supp. IV 1986). EP toxicity - extraction procedure characteristic is a predictor of the leaching potential of wastes and it is necessary to regulate such wastes which pose a threat to human health and the environment and to encourage resource conservation. Such objectives are to be accomplished through Federal technical and financial assistance to states or regional authorities for comprehensive planning. . . ."

107. 42 U.S.C. § 6924 (1984 & Supp. IV 1986). Standards include maintaining records of all hazardous wastes identified or listed, reporting and monitoring and compliance with the manifest system, location, design, and construction descriptions, contingency plans to minimize unanticipated damage, and with regard to the maintenance of operation requiring additional qualifications as to ownership, continuity of operation, training for personnel, etc.

108. 42 U.S.C. § 6924(d) (1984 & Supp. IV 1986). This section states that the land disposal of hazardous wastes specified is prohibited unless it is determined by the

solids containing certain metals, elements or compounds present at specified concentrations.[109] Such substances include arsenic, cadmium, lead, and mercury. It is possible that the sludge itself or the ash product from sludge incinerators could contain such metals. If the sludge or ash is tested and does not meet the definition of hazardous waste, then the New York State Solid Waste Management Plan applies.[110] Under RCRA, section 6941 authorized states to devise their own solid waste regulations.[111]

b. *40 C.F.R. Part 257 - Criteria for the Classification of Solid Waste Disposal Facilities and Practices*

The state requirements for landfill facilities must be based upon the minimum standards set in the Criteria for Classification of Solid Waste Disposal Facilities and Practices (Criteria).[112] State regulations may be more stringent than the Criteria as long as the minimum requirements are met. States, for example, may require a higher level of dewatering to avoid leachate problems and potential groundwater contamination. If a state does not enforce the Criteria directly, through its solid waste management program, the "citizen suit" provision

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Administrator that one or more methods of land disposal of such waste is not required in order to protect human health and the environment for as long as the waste remains hazardous. . . . The prohibition relates to hazardous wastes, including liquids associated with any solid or sludge, containing the following metals (or elements) or compounds of these metals at concentrations greater than or equal to those specified:arsenic, cadmium, chromium, lead, mercury, nickel, selenium,and thallium.

109. *Id.* arsenic at 500 mg/l; cadmium at 100 mg/l; chromium at 500 mg/l; lead at 500 mg/l; mercury at 20 mg/l; nickel at 134 mg/l; selenium at 100 mg/l and thallium at 130 mg/l.

110. N.Y. Comp. Codes R. & Regs. tit. 6, § 360 (1988).

111. 42 U.S.C. § 6941 (1984 & Supp. IV 1986). "The objectives of this subchapter are to assist in developing and encouraging methods for the disposal of solid waste which are enviromentally sound and which maximize the utilization of valuable resources including energy and materials which are recoverable from solid waste and to encourage resource conservation. Such objectives are to be accomplished through Federal technical and financial assistance to States or regional authorities for comprehensive planning pursuant to Federal guidelines designed to foster cooperation among Federal, State, and local governments and private industry."

112. 40 C.F.R. § 257.3 (1988). "Criteria For Classification of Solid Waste Disposal Facilities and Practices."

of RCRA can be used by the State or private individuals.[113]

c. *Federal Water Pollution Prevention & Control Act (Clean Water Act) - Applicability and Analysis*

Section 405 of the Clean Water Act[114] states that in any situation where disposal of sewage sludge from a treatment plant would result in pollutants entering navigable waters, such disposal is prohibited without a permit.[115] Subsection (c) allows for state permitting of the same activities and subsection (e) requires compliance with federal guidelines for such disposal.[116]

The landfill facility must obtain an NPDES permit if there is a point source discharge into navigable waters. If site

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113. 42 U.S.C. § 7002 (1984 & Supp. IV 1986). Citizens' suits - Except as provided . . . . any person may commence a civil action on his own behalf - (1)(A) against any person (including (a) the United States, and (b) any other governmental instrumentality or agency . . .) who is alleged to be in violation of any permit, standard, regulation . . . . or (B) against any person, including . . . and including past or present generator, past or present transporter, or past or present owner or operator of a treatment, storage, or disposal facility, who has contributed or who is contributing to the past or present handling, storage, treatment, transportation, or disposal of any solid or hazardous waste which may present an imminent and substantial endangerment to health or the environment. . . .

114. 33 U.S.C. § 1345 (1982). "Disposal or use of sewage sludge. Notwithstanding any other provision of this chapter or of any other law, in any case where the disposal of sewage sludge resulting from the operation of a treatment works . . . would result in any pollutant from such sewage sludge entering the navigable waters, such disposal is prohibited except in accordance with a permit issued by the Administrator under section 1342 of this title."

115. *Id.* § 1342 (1982). "National pollutant discharge elimination system. This section of the Act provides that except as provided in . . . the Administrator may, after opportunity for public hearing issue a permit for the discharge of any pollutant, or combination of pollutants, notwithstanding . . . upon condition that such discharge will meet either all applicable requirements under . . . or prior to the taking of necessary implementing actions relating to all such requirements, such conditions as the Administrator determines are necessary to carry out the provisions of this chapter."

116. *Id.* § 405(c). "Each State desiring to administer its own permit program for disposal of sewage sludge subject to subsection (a) of this section within its jurisdiction may do so in accordance with section 1342 of this title."

Id. § 1345. "The determination of the manner of disposal or use of sludge is a local determination except that it shall be unlawful for the owner or operator of any publicly owned treatment works to dispose of sludge from such works for any use for which guidelines have been established pursuant to subsection (d) of this section, except in accordance with those guidelines."

selection is done properly, along with efficient design, operation and maintenance practices (i.e., leachate collection , management and protection of site form flooding), this need for a permit can be avoided.[117]

3. *Applicable Sections of the New York State Solid Waste Regulations Concerning Landfill Operations*

Subpart 360-2 of the New York State Solid Waste regulations regulates the design, construction, operation and closure of landfills. It also provides for disposal of combined ash and bottom ash from solid waste incinerators.[118]

Complete applications for permits to construct and to operate a landfill facility must contain the following:
(a) engineering plans setting forth the proposed location, boundaries, adjacent land uses and detailed construction plans pursuant to section 360-2.4 of the same subpart;
(b) operation plans that prescribe how the landfill will fulfill the regulatory requirements set forth in the Part and applicable Subparts;
(c) a landscape plan prepared in accordance with section 360-2.6;
(d) an engineering report comprehensively describing the existing site conditions and an analysis of the landfill, including closure and post-closure criteria. . .;
(e) a quality assurance/quality control report. . .;
(f) an operation and maintenance report prepared in accordance with section 360-2.9 . . . demonstrating how the landfill will meet the operation requirements set forth. . .;
(g) a contingency plan report prepared in accordance with section 360-2.10. . .;
(h) a hydrogeologic report and water quality monitoring plan

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117. EPA GUIDE, *supra* note 59, at 31. "the facility must obtain an NPDES permit if there is a point source discharge into surface waters. Point source discharges can be avoided by proper site selection, design, operation and maintenance practices, such as leachate management and protecting the site from floodwaters. Facilities must also comply with areawide plan for non-point source pollution of surface water, authorized by section 208 of the CWA."

118. N.Y. Comp. Codes R. & Regs. tit. 6, § 360 (1988).

prepared in accordance with section 360-2.11. . .;
(i) a landfill siting study prepared in accordance with section 360-2.12. . .;
(j) a comprehensive recycling analysis and a plan for implementing a feasible recycling program, prepared in accordance with section 360-1.9; and
(k) either a legal document (contract, local permit, etc.) certifying acceptance of leachate by the operator of a wastewater treatment facility for the discharge of leachate to that facility, or an application for an SPDES permit pursuant to ECL Article 17.[119]

Landfill siting requirements must include soils which minimize migration of leachate (i.e., homogeneous clay or silty soils) and bedrock subject to rapid or unpredictable groundwater flow must be avoided. Groundwater flow and quality must be evaluated along with natural topography, and hydrogeologic relationship to water supply sources.[120] In addition, the applicant must evaluate population density and growth, adequacy of transport routes and traffic, proximity of incompatible structures (i.e., schools, churches, etc.), proximity to utility lines, impacts upon the host community and its land use controls, and environmental quality and visual impacts.[121] A landfill must not be constructed, expanded or operated over primary water supply aquifers, principal aquifers, or within public water supply wellhead areas, or on a floodplain, in unstable areas where inadequate support for structural components of the landfill exist, or in areas where environmental monitoring and site remediation cannot be conducted.[122]

All landfills regulated under the state plan must contain a liner system. The minimum liner requirement for all landfills accepting mixed solid waste must consist of a double composite liner separated by a secondary leachate collection and removal system if bottom areas where the landfill slopes is less

119. *Id.* § 360-2.3. Permit application requirements.
120. Id. § 360-2.12(d). Landfill siting requirements.
121. *Id.* § 360-2.12(e). Site evaluation requirements.
122. *Id.* § 360-2.12(c).

than or equal to twenty-five percent;[123] (where the landfill slope is greater than twenty-five percent, the liner system need only consist of an upper liner and a lower composite liner separated by a secondary leachate collection system). On side slope areas where the landfill slope is greater than twenty-five percent, the liner system need only consist of an upper geomembrane liner and a lower composite liner separated by a secondary leachate collection and removal system.[124]

4. *Conclusion*

Landfilling as an alternative to ocean dumping is a viable method, however, it is limited in the extent to which it could be practiced in New York City and surrounding areas. The primary restrictions are the lack of available facilities and the trend toward phasing out this solid waste disposal practice. In addition, the New York area does not encompass acreage in appropriate settings and quantity to develop more landfills. It would be possible to dispose of some of the sludge in existing landfills in the area but not a large percentage of the total generated.

Technical and legal barriers make this method a very effective one because the state and federal requirements for permitting and operation are so comprehensive. Owners and

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123. *Id.* § 360-2.13(f) (1988). "The double composite liner system must include a primary leachate collection and removal system consisting of a 24-inch granular soil layer with a leachate collection pipe network. The primary leachate collection and removal system lies above the primary (upper) composite liner. The primary composite liner consists of a 60 mil geomembrane that directly overlays an 18-in thick low permeability soil layer. The primary composite liner lies above the secondary leachate collection system. The secondary leachate collection and removal system consists of either a leachate collection pipe network with a 12-inch thick granular soil layer or an effective layer of geosynthetic material. The secondary leachate collection and removal system lies above the secondary (lower) composite liner which consists of a 60 mil geomembrane that directly overlays a 24-inch thick low permeability soil layer."

124. *Id.* § 360-2.13(g). A primary leachate collection system, located over the upper composite liner, must be hydraulically designed to remove leachate from the landfill and ensure that the leachate head on the upper composite liner does not exceed one foot at the expected flow capacity. . . A secondary leachate collection system must be located between the upper and lower liner systems to effectively collect and rapidly remove leachate from the lower liner system.

operators have a justifiably high burden to meet, due to the nature of this land based disposal method and the potential for severe environmental impacts if regulations are not complied with fully. Landfilling is an alternative that could not be utilized independently, but could be quite effective in alleviating a portion of the sludge disposal problem in conjunction with other methods.

C. *Composting*

1. *Technical Analysis*

"Sludge composting is the aerobic decomposition of organic materials to a relatively stable, humus-like product."[125] The composting of sludge is not technically a disposal process, but a stabilization process because the sludge, in its composted form, must then be disposed of.[126] The disposal of composted sludge is done through a system of distribution and marketing whereby the sludge product is either sold or given away to commercial farmers or the public at large.[127]

In wastewater composting, the sludge is dewatered and then mixed with a bulking agent and allowed to decompose aerobically.[128] The bulking agents include woodchips, bark, shredded tires, rice hulls, straw and previously composted sludge.[129] The bulking agents serve the purpose of controlling moisture levels, maintaining adequate carbon-nitrogen ratios, providing porosity for air circulation and providing structural stability for the compost pile construction.[130]

The composting process removes approximately fifty percent of the available nitrogen present in sewage sludge,[131] however, the sludge is known to be deficient in potassium and

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125. HUDSON VALLEY STUDY, *supra* note 18, at 36.

The stabalization process is performed by the activity of microbial organisms (bacteria and fungi) inherant in the wastewater sludge.

126. *Id.*

127. USE AND DISPOSAL, *supra* note 39, at 27.

128. *Id.*

129. *Id.*

130. HUDSON VALLEY STUDY, *supra* note 18, at 36.

131. *Id.*

phosphorus as compared to commercial fertilizers.[132] Therefore, the compost should not be used as a fertilizer, but as a soil amendment.[133] The use of compost in soil increases the water retention capacity of sandy soils, increases the porosity of clay soils, increase microbiological populations in soil, increases the availability of micronutrients, and provides for slow release of nitrogren, phosphorus and potassium.[134]

The three processes employed for composting are windrow composting and aerated static piles composting which are open and unconfined types and in-vessel composting which is a confined process.[135] The objective in all composting systems is to produce, through aerobic decomposition of sludge, a humus-like product resembling soil.[136] Sludge is composted for approximately twenty-one to thirty days, at which time the pile temperatures reach fifty-five degrees celsius.[137] The compost is screened and allowed to cure for thirty days, and is often stored for sixty to ninety days following curing to ensure that the product has no residual odors.[138] The product is screened again to remove the bulking material.[139]

a. *Windrow System Composting*

"In windrow composting, the sludge-bulking agent mixture is formed into long, open-air piles. The sludge is turned frequently to ensure an adequate supply of oxygen throughout the compost pile and to ensure that all parts of the pile are exposed to temperatures capable of killing all pathogens and parasites."[140]

Numerous disadvantages exist in the use of the windrow system. There is only a limited control of odors.[141] The system

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132. *Id.* at 43.
133. *Id.*
134. *Id.*
135. *Id.* at 38.
136. USE AND DISPOSAL, *supra* note 39, at 31.
137. *Id.*
138. *Id.*
139. *Id.*
140. USE AND DISPOSAL, *supra* note 39, at 29.
141. HUDSON VALLEY STUDY, *supra* note 18, at 39.

may be adversely affected by the cold or wet weather and a large area is needed to spread out these piles.[142] The most severe problem is the lechate containment situation. In Maryland, one windrow system project has poured concrete below the piles and this has served as an ideal base for effective leachate collection.[143]

The greatest advantage to the windrow system may be its simplicity of operation and low capital cost.[144] A municipality can accomplish a basic composting operation on a small scale with little capital investment by using conventional heavy equipment.[145]

b. *Aerated Pile System*

"Aerated piles . . . are rectangular piles that are supplied with air via blowers connected to perforated pipes running under the piles.[146] The sludge is mixed with bulking agents and previously composted sludge to help insulate the pile and "assure that sufficient temperatures are achieved throughout the pile."[147] Unlike windrow compostion, the piles here do not have to be turned during the process.[148] The normal composting time under this system takes fourteen to twenty-one days in order to achieve a satisfactory final product.[149] "An additional curing period of a few days to one month is necessary to remove excess moisture and complete the stabilization process."[150]

There are four major advantages of the aerated pile system. First, there are less odors from the piles because the piles are covered with old composted material.[151] Second, the piles are less susceptible to adverse weather conditions once the

142. *Id. See also*, USE AND DISPOSAL, *supra* note 39, at 29.
143. HUDSON VALLEY STUDY, *supra* note 18, at 39.
144. *Id.*
145. *Id.*
146. USE AND DISPOSAL, *supra* note 39, at 30.
147. *Id.*
148. *Id.*
149. HUDSON VALLEY STUDY, *supra* note 18, at 40.
150. *Id.*
151. *Id.* at 39.

temperature in the pile has stabilized.[152] Third, the land requirements for static pile composting are approximately twenty-five percent less than that of windrow composting. [153] Finally, by using the forced air blowers, the final product is more consistent and the stablization time is speeded up over windrow.[154]

c. *In-Vessel Composting Systems*

"In-vessel composting takes place completely in completely enclosed containers, where environmental conditions such as temperature and oxygen supply can be closely monitored and controlled."[155] The process of confined composting shields the process from inclement weather conditions and the constant temperature leads to faster decomposition of the sludge.[156]

2. *Legal Restrictions*

a. *Federal Statutes*

The statutes and regulations on composting are almost identical to land application and landfilling. The regulations for the Classification of Solid Waste Disposal Facilities and Practices[157] that were examined in the land application section are similar for composting.[158]

Because a composting system may require construction of a facility, or the use of federal funds, it may be considered a "major federal action" and therefore, fall under the guise of the National Environmental Policy Act (NEPA).[159]

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152. *Id.*
153. *Id.*
154. *Id.*
155. USE AND DISPOSAL, *supra* note 39, at 31.
156. HUDSON VALLEY STUDY, *supra* note 18, at 43.
157. 40 C.F.R. § 257.
158. *See* Supra note 52-58, 61 and accompanying text.
159. 42 U.S.C. §§ 4321 - 4370a (1982 & Supp. IV 1986).

"The Congress authorizes and directs that . . . (2) all agencies of the Federal Government shall . . . (c) include in every recommendation . . . and other major federal actions significantly affecting the quality of the human environment a detailed statement by the responsible official . . ." *Id.*, § 4332.

b. *New York State Solid Waste Management Facilities Regulations*

The comprehensive New York regulations apply to the construction and operation of composting facilities.[160]

The New York regulations recognize windrow, static pile and in-vessel composting as acceptable means of sludge disposal that reduce pathogens.[161] The finished compost cannot contain sharp objects and the surface drainage must be diverted around and away from the operating area so as to prevent leaching.[162] Any leachate that is collected must be treated by a method approved by the DEC in the engineerng report.[163]

The state regulations set up a two-tiered system of distribution for the composted sludge and this system is based on the quality of the compost.[164] The compost is classified by the applicable use and the classes are Class I and Class II compost.[165]

The Class I criteria are for public distribution or agricultural use of the compost.[166] Parameters are developed for numerous metals allowing for maximum concentration levels.[167] The purpose behind these parameters is to insure the safety of crops grown in the soil treated with the compost.

The Class II criteria are for the non-food chain crops.[168] This Class II compost can be used as landfill cover and similar uses.[169]

The composting systems will be monitored for heavy metal content as well as for chlorine, fluorides, and sulfates.[170] If the waste is to be distributed to the public it must first be

160. N.Y. Comp. Codes R & Regs. tit. 6, § 360-5.1(a) (1988).
161. *Id.* § 360-5.3(a).
162. *Id.* § 360-5.3(d) & (f).
163. *Id.* § 360-5.3(g).
164. *Id.* § 360-5.3.
165. *Id.*
166. *Id.* § 360-5.3(1).
167. *Id.* § 360-5.3 (1)(i).
168. *Id.* § 360-5.3(2).
169. *Id.*
170. *Id.* § 360-5.3(q) & (r).

bagged and labeled to indicate the type of waste that the compost was derived from, any restrictions on use, and the recommended safe uses and the rates of application of the compost.[171]

3. *Conclusion*

The compost is a good source of nutrients and makes a good soil conditioner in which nutrients become available slowly and are effective over a period of years.

There are two major considerations in implementing a composting system in a municipality or region. The first is the availability of a market for the composted sludge. An area with little greenery or open space would not be an ideal location for a composting system. A location is needed that will welcome the system with a continuing support of the project by using the composting on residential lawns, local parks, and along roadways or in reclamation projects. The second consideration is not to enter the project expecting the market value for the compost to offset against the capital expenditures for the operation of the facility. This is true because often the value of the compost is generally unstable.

D. *Incineration*

1. *Technical Analysis*

Incineration is the burning of volatile materials in sludge solids in the presence of oxygen. Incineration is not a true disposal method in that the sludge is reduced approximately twenty percent in volume by being converted into ash which must then be disposed of or used.[172] "This combustion process converts organic solids to carbon dioxide and water vapor, while reducing the inorganic matter to ash."[173] The multiple hearth furnace is the most common type of incinerator utilized in the United States today and is simple, reliable and

171. *Id.* § 360-5.3¶(3).
172. USE AND DISPOSAL, *supra* note 39, at 46-47.
173. HUDSON VALLEY STUDY, *supra* note 18, at 80.

can handle loadings and fluctuation sludge materials.[174] Another type of incinerator is the fluidized bed incinerator. It is designed to use a bed of sand into which sludge is introduced. Combustion takes place in the bed and the entering sludge dries and burns in this medium. Most of the ash exits through exhaust.[175] Other methods of incineration are not widely used for sludge processing.

Incineration is an effective process for volume reduction and stabilization of the sludge constituents. After incineration, approximately thirty-five percent dry weight of the solids remain and twenty percent of the volume.[176] As of 1979, roughly three hundred fifty to four hundred municipal sludge incinerators were in operation and eighty percent of those are multiple hearth furnaces; the remainder are fluidized bed systems.[177] Ash contains variable amounts of fertilizer materials depending upon the concentration of heavy metals.[178]

Another method of thermal reduction is co-incineration. To achieve this process, municipal solid waste and sludge are burned by a mutually-compatible technique.[179] The only such plant in New York and one which is "state of the art," exists in Glen Cove, Long Island. The simplest and most direct method of co-incineration is burning partially dewatered sludge in a municipal solid waste incinerator and mixing it with the refuse.[180] Another practice in co-incineration is dry-

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174. *Id.* at 80. The sludge burned in a multiple hearth furnace must contain fifteen percent solids due to the evaporation capacity of the furnace. Generally, wet scrubbers and after burners must be employed to meet required emission standards and eliminate odors.

175. *Id.* at 82. This method requires a substantial amount of ancillary equipment (i.e. wet scrubbers and afterburners) to meet required emissions standards and eliminate odors.

176. EPA GUIDE, *supra* note 59, at 11.

177. *Id.*

178. *Id.*

179. HUDSON VALLEY STUDY, *supra* note 18, at 86. Technology for the express purpose of combined incineration of sewage sludge and municipal refuse is still evolving. There are presently four approaches to co-incineration: 1. combustion of dewatered sludge in a refuse incinerator, 2. combustion of pre-dried sludge in a refuse incinerator, 3. use of refuse derived fuel in a multiple-hearth sludge incinerator, 4. and use of refuse derived fuel in a fluidized bed sludge incinerator.

180. *Id.* at 87. "The sludge can be fed separately into the furnace by either

ing the sludge to reduce it to less than twenty percent moisture content before burning. The dried sludge is then mixed with the refuse at a ratio of approximately ten part refuse to one part sludge when fed into the incinerator.[181]

A third type of co-incineration procedure is the combustion of refuse in a multiple hearth sludge furnace. In this system, municipal waste is used to generate energy for the multiple hearth furnace in place of fossil fuels. The refuse-derived fuel can be treated alone, as fuel, or can be mixed with the sludge and fed into the incinerator.[182] Reduction in fuel costs is a major benefit associated with this method of incineration and fuel costs represent the greatest portion of the total annual operation expenses for a multiple hearth furnace incinerator.[183] The ash residue which results from all types of sludge incineration requires proper disposal. Usually, the amount of ash produced represents ten to fifteen percent of the original volume or twenty to twenty-five percent of the original weight.[184] The product consists of either bottom ash which accumulates in the furnace or fly ash which is a particulate extracted from the flue.[185] The composition of the ash depends on the composition of the waste burned.[186] The toxicity of the

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spraying it into the combustion chamber or by dumping it onto the grate. . . . Although mass burning has the advantage of simplicity, it has not proved very successful. . . . Conventional incinerators usually provide insufficient time for the sludge to burn completely."

181. *Id.* at 89. This method has been relatively successful. Pre-drying mitigates the combustion problems associated with the use of only partially dewatered sludges, such as loss of BTU value and accumulation of non-combustible materials at the bottom of the incinerator. . . . Also, separation of the drying process from the combustion process simplifies furnace operations.

182. *Id.* at 89.

183. *Id.*

184. *Id.* at 95.

185. *Id.* The composition of the ash will vary according to the technology used to process the waste. Mass burn technology, which is being proposed most frequently, usually burns over 95 percent of the organic matter. The largest constituent by weight is glass which is almost completely non-reactive. Iron and aluminum combined with oxygen comprise about 15 percent of the residue by weight. Other materials, such as calcium, magnesium and zinc form oxides which are present in smaller quantities. Ash residue will contain some heavy metals such as lead, zinc, or cadmium so toxicity must be considered.

186. *Id.* at 96.

ash residue generated at co-disposal facilities, municipal incinerators and resource recovery plants is assessed using Environmental Protection Agency procedures designed to identify leachable toxics.[187] Most toxic organic compounds are destroyed during the combustion process and recent EP toxicity tests[188] on ash from various facilities on the eastern coast prove that the ash is non-hazardous.

2. *Legal Restrictions on Incineration*

Before exploring, in detail, the regulatory framework which applies to the various methods of sewage sludge incineration, it is necessary to identify the general requirements which must be met. They are: 1) air quality regulations, both federal and state, and 2) regulations which apply to ash disposal.

a. *Applicable Federal Law*

Pursuant to Section 109 of the Clean Air Act,[189] the United States EPA promulgated National Primary and Secondary Ambient Air Quality Standards for certain pollutants (NAAQS).[190] Existing sludge incinerators are subject to the emissions standards for particulate matter and new facilities would be subject to the New Source Performance Standards (NSPS) for that pollutant.[191] The Clean Air Act requires each

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187. *Id.* Facilities use the extraction procedure (EP test) designed to identify some toxics that could leach from the given waste material. If the test identifies any metal or regulated organic compound at certain concentrations, the ash is defined as toxic and hazardous and requires special handling and disposal under the Federal Resource Conservation and Recovery Act.

188. *See supra*, note 106.

189. 42 U.S.C. § 7409 (1982); This section states in relevant part that "(1) National primary ambient air quality standards, prescribed. . . shall be ambient air quality standards the attainment and maintenance of which in the judgment of the Administrator, based on such criteria and allowing an adequate margin of safety, are requisite to protect the public health. (2) Any national secondary ambient air quality standard . . . shall specify a level of air quality the attainment . . . of which . . . is requisite to protect the public welfare from any known or anticipated adverse effects associated with the presence of such air pollutant in the ambient air."

190. *Id.* 40 C.F.R. §§ 50.1-50.12 (1987).

191. 40 C.F.R. §§ 60.1-60.685 (1987)(Part 60 - Standards of performance for new

state to develop its own pollution control scheme or State Implementation Plan (SIP) in order to meet the NAAQS. The SIP provides for approval policies for new sources, air quality monitoring, emission controls and other factors.[192]

If a new incinerator is to be built in an "attainment area" (an area where the pollutant emissions [particulates for sludge] result in ambient air quality equivalent to or better than the national standards), then the plans must pass Prevention of Significant Deterioration (PSD) review by the EPA.[193] New York City and Westchester County are both con-

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stationary sources). This section states that no owner or operator subject to the provisions of this part shall cause to be discharged into the atmosphere from any affected facility any gases which contain particulate matter in excess of 0.18 g/dscm (0.08 gr/dscf) corrected to 12 percent CO_2.

40 C.F.R. § 60.152 (1987) (Subpart O - Standards of Performance for Sewage Treatment Plants). This section states that "no owner or ojperator of anyh sewage sludge incinerator subject to the provisions of this subpart shall discharge or cause the discharge into the atmosphere of: (1) Particulate matter at a rate in excess of 0.65 g/kg dry sludge input (1.30 lb/ton dry sludge input). (2) any gases which exhibit 20 percent opacity or greater."

192. 42 U.S.C. § 7410 (1982). Each state was required to submit to the Administrator a plan which provide for implementation, maintenance, and enforcement of primary standard in each air quality control region in each state. The plan must also provide for attainment of the secondary standards. It must include emission limitations, schedules, and timetables for compliance, provision for establishment and operation of appropriate devices, methods, systems and procedures necessary for monitoring and analyzing data, and a program to provide for the enforcement of emission limitations and regulation of the modification, construction, and operation of any stationary source.

193. 42 U.S.C. § 7471 (1982). ". . . each applicable implementation plan shall contain emission limitations and such other measures as may be necessary, as determined under regulations promulgated under this part, to prevent significant deterioration of air quality in each region (or portion thereof) identified pursuant to section 7407(d)(1)(D) or (E) of this title";
42 U.S.C. § 7475 (1982). No major emitting facility . . . may be constructed in any area to which this section applies unless a permit is issued in accordance with emission limitations, the permit has been subject to proper procedural formalities, the owner has demonstrated that emissions will not cause or contribute to pollution in excess of any limitations, the facility is subject to the best available control technology for each pollutant to be emitted, there has been an analysis of any air quality impacts that might result from operation, etc.
40 C.F.R. § 51.166 (1987). Prevention of significant deterioration of air quality. Each applicable State implementation plan shall contain emission limitations and such other measures as may be necessary to prevent significant deterioration of air quality. The program or its equivalent shall apply to any new major stationary source or major modification that would locate in a designated attainment or the unclassifiable

sidered attainment for particulates and therefore such review would be required for new sources or incinerators which emit such material.[194] As mentioned above, NSPS in section 111 of the Clean Air Act must be satisfied.[195] Under the Act "new source" includes construction or modification of a stationary source which may emit air pollutants. This would pertain to upgrading or remodeling existing municipal incinerators, those operating at sewage treatment plants, and additions of furnaces at such facilities. The New York State SIP, however, contains a part that deals with such standards and will be discussed in the coming pages. Compliance with the SIP will be sufficient.

Section 112 of the Clean Air Act establishes the authority for promulgation of National Emission Standards for Hazardous Air Pollutants (NESHAP).[196] Such regulated pollutants include beryllium, inorganic arsenic, and mercury. Cadmium, chromium, nickel, and zinc appear on a separate list of substances which could cause serious health effects from air exposure.[197] This would be of concern when dealing with incinerators which burn mixtures of refuse and sludge. In addition,

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area and would exceed the significant increments.

194. 40 C.F.R. § 52.1682 (1987).

195. 42 U.S.C. § 7411 (1982). Standards of perforance for new stationary sources. The term "new source" means any stationary source, the construction or modification of which is commenced after the publication of regulations prescribing a standard of perforance under this section which will be applicable to such source. The term "stationary source" means any building, structure, facility, or installation which emits or may emit any air pollutant.

See also, Supra note 191.

196. 42 U.S.C. § 7412 (1982). National emission standards for hazardous air pollutants. "The term "hazardous air pollutant" means an air pollutant to which no ambient air quality standard is applicable and which in the judgment of the Administrator causes, or contributes to, air pollution which may reasonably be anticipated to result in an increase in mortality or an increase in serious irreversible, or incapacitating reversible illness."

The list of hazardous air pollutants appears at 40 C.F.R. § 61.01 (1988).

197. 40 C.F.R. § 61.01 (1988). The following list presents the substances that, pursuant to section 112 of the Act, have been designated as hazardous air pollutants: asbestos, benzene, beryllium, coke oven emissions, inorganic arsenic, radionuclides, mercury, and vinyl chloride. Cadium, chromium and zinc are on a list of substances that have been recognized as posing potential health hazards, including cancer, from ambient air exposure to the substance.

the sludge itself could contain hazardous or toxic substances since sewage treatment plants often receive industrial or commercial wastes which have been disposed through the system.

b. *Analysis—Federal Law*

The New York State Implementation Plan does not incorporate NESHAP and therefore compliance with the Federal standards is necessary for any incineration system which might emit any substances regulated as hazardous. The United States EPA enforces these standards in New York. The sludge would be tested for content of hazardous components and if the amounts found are minimal then the incineration process would only be subject to the emission standards for particulate matter. In recent testing, many sewage treatment plants have passed the test for various hazardous contents. However, plants which co-incinerate sludge with municipal refuse might have a slightly greater burden to meet depending upon the content of the material burned.

As mentioned above, NSPS[198] are the federal mechanism for regulating new stationary sources of emissions, including particulate matter (the main concern with sludge-burning incinerators). The state of New York has enforcement authority in this area and its SIP contains sections for regulating new or modified sources, incinerators which burn primarily municipal refuse (co-incineration facilities) and incinerators located in New York City, Nassau and Westchester counties.[199] As long as the State has enacted regulations at least as stringent as the Federal law requirements, compliance with those standards will be sufficient.

Since New York City and Westchester County are "attainment" for particulate emissions, new sources would also need to comply with the Prevention of Significant Deterioration increments set up by the State in its SIP.[200] The Federal

198. *See supra* notes 191 & 195.

199. N.Y. Comp. Codes R. & Regs. tit. 6, §§ 222 & 231 (1988).

200. All areas of New York are considered Class II for PSD purposes. This means that new sources could emit annually an average of nineteen micrograms per cubic meter and thirty-seven micrograms per cubic meter per twenty-four hour pe-

provision, as described in the earlier section on Federal restrictions, should be noted and is one portion of the law that an owner or operator of a new or modified incinerating facility must comply with. The United States EPA would carry out the PSD review for a new emission source if the state had not acted in legislating provisions for such enforcement and regulation.

3. *Applicable Provisions of New York's State Implementation Plan and Analysis*

Part 231 of New York's SIP is of particular concern to sludge incineration as an alternative to ocean dumping. It is applicable to facilities comprised of modifications or new emission sources for which permits for construction are issued and for which particulate permissible emissions exceed certain levels.[201] As noted earlier, New York City and Westchester County are attainment areas for particulate matter, but this review must be conducted on all new sources if a significant impact on a nonattainment area could occur. The owner of such a facility must apply the best available control technology (BACT) to any new emission source or modification at a major facility.[202] The owner must submit information, at the time of application for permit to construct, to establish that the BACT or lowest achievable emission rate, will be applied.[203] In addition, the owner must submit to the Commissioner of the New York State Department of Environmental Conservation an air quality impact evaluation report for any major facility construction or modification.[204] The report must demonstrate that emissions from the facility will not cause violations of any ambient air quality standard for particulates.[205] It shall also demonstrate that emissions will not cause or contribute to ambient concentrations exceeding the sum of

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riod. *Id.* § 231.10(a).

201. *Id.* § 231.1. New Source Review in Nonattainment Areas.

202. *Id.* § 231.3.

203. *Id.* § 231.3(d).

204. *Id.* § 231.5.

205. *Id.* § 231.5(b).

the PSD increments for particulates.[206] The Commissioner of the DEC shall not issue a permit to construct for any new emission source or modification of a major facility located in a nonattainment area, or attainment area significantly impacting on a nonattainment area, if the owner cannot demonstrate that there will be no violation of air quality standards.[207] If the Commissioner issues a permit to construct or operate emission sources of a major facility, the owner may be required to conduct ambient air quality monitoring and to submit periodic reports to the DEC.[208]

4. *Applicable Sections of the New York State Solid Waste Regulations Regarding Permitting and Operation of Incinerators*

New York State has promulgated extensive solid waste regulations which include a section which deals with incineration and processing facilities.[209] That subpart regulates the construction and operation of such incinerators. Those facilities which are in existence at the time the regulations take effect will be deemed to have a permit and will only be subject to the operating provisions. They must, however, submit to the DEC information regarding the facility location and size and the characteristics and quantity of the waste received there.[210]

Those incinerators that are in the preconstruction phase must include several types of information in the permit application. For instance, the DEC must receive thorough engineering reports[211] before a permit will be issued by the

206. *Id.* § 231.5(c).

207. *Id.* § 231.6.

208. *Id.* § 231.7.

209. N.Y. Comp. Codes R. & Regs. tit. 6, § 360-3.1 (1988).

210. "Applicability. (a) Except as provided in subdivision (d) of this section, this Subpart regulates the construction and operation of solid waste incinerators and refuse-derived fuel processing facilities. . . . (b) Existing facilities. The owner or operator of each solid waste incinerator and refuse-derived fuel processing facility operating on the effective date of this Part that, before the effective date of the Part, did not require a permit to operte must apply for an initial permit under the provisions of § 360-1.7(a)(2) of this Part. *Id.* § 360-3.1.

211. "An engineering report that, in addition to the requirements of subdivision

agency. A site analysis must also be conducted and must contain such specifications as location, topography, and site description.[212] In addition, a comprehensive recycling analysis, description of personnel training program, and identification of the landfill or landfills to be used must be included in the permit application.[213]

There are additional application requirements for a permit to operate, including the creation of a maintenance and operation manual, a personnel training plan, a facility monitoring and inspection plan, a written staffing plan, a waste control plan, a contingency plan designed to minimize hazards to human health and the environment and a closure plan.[214]

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§ 360-1.9(e) of this Part, must include the following:

(1) A general description of the overall process and functional description of all equipment to be used, with design criteria, anticipated performance, process flow diagrams;

(2) Pertinent facts and calculations relating to the development of the material and energy balances;

(3) A description of the proposed service area;

(4) Identification of sufficient support equipment to maintain operation of equipment functions;

(5) A description of the facility operation. . . .

(6) A description of the solid waste proposed to be treated, processed, or disposed of for the initial year and yearly for the projected life of the facility, in terms of: (i) Quantity. . .(ii) Heating values. . . .

(7) Storage. . . .

(8) A summary of utility requirements. . . .

(9) Estimates of stormwater run-off and drainage and a description of its use or disposal, including point of discharge;

(10) A list and description of all authorizations, permits, approvals. . . .

(11) A description of the facility's equipment. . . .

(12) Auxiliary power. . . .

(13) Economic information. . .

Id. § 360-3.2(a).

212. "The site plan must show the facility's property boundaries; site acreage; distances from adjacent residences, property owners and population centers; off-site utilities such as electric, gas, water, storm, and sanitary sewer systems; a north arrow; site topography; the location of screening provided, regulated wetlands, . . . floodplains, buildings, . . .

Id. § 360-3.2(b)(2)(i).

213. *Id.* § 360-3.2(c), (d), (e).

214. (a) A draft operation and maintenance manual. This manual must establish operating and maintenance procedures that will enable the faclity to achieve a goal of at least 85 percent equipment availability and minimize downtime and bypass solid waste: . . .

With regard to operational requirements, all solid waste incinerators and processing facilities subject to the subpart must perform all activities in accordance with manuals, plans and programs required by and approved by the department.[215] Operational requirements include sections dealing with receipt and handling of solid waste,[216] drainage, process changes, access to the facility and reporting.[217] A prepared-

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(b) A personnel training plan.

(1) This plan must describe how all facility personnel will successfully complete a program of instruction that teaches them to perform their duties in a way that ensures the facility's compliance with the requirements of this Part. . . .

(2) This plan must identify the positions which will be trained in and knowledgeable of teh procedures, equipment, and processes at the facility. . . .

(3) The plan must be designed to ensure that facility personnel are able to respond effectively to emergencies . . . .

(c) A facility monitoring and inspection that, inaddition to the matters identified . . .

(d) A written staffing plan that will demonstrate adequate staff coverage of essential positions whenever the facility is operational.

(e) A waste control plan.

(1) A waste control that ensures that the facility receives and treats only household waste, non-hazardous commercial waste, non-hazardous industrial waste, and solid waste specifically authorized by the department to treated at the facility. . . .

(f) A contingency plan designed to minimize hazards to human health and the environment resulting from fires, explosions, or releasesinto the air, onto the soil, or into groundwater or surface water. . . .

(g) Closure plan.

Id. § 360-3.3(a) - (g).

215. (a) All activities at the facility must be performed in accordance with the manuals, plans, and programs required by this Part and approved by the department. All manuals, plans, and programs required must be maintained and be available for reference and inspection at the facility. They must be updated no less frequently than the duration of the permit to operate.

Id. § 360-3.4(a).

216. The facility is authorized to receive only solid waste authorized by the department. All solid waste received at the facility and residues, ash residues and bypass waste leaving the facility must be weighed and recorded and the results must be incorporated into the quarterly report.

(2) All solid waste must be processed and contained within a completely enclosed area to minimize the effects of weather, wind and precipitation. . . .

(3) All rejected, oversized, bulky, untreatable waste must be disposed of at an authorized facility in the state or without. . . .

Id. § 360-3.4(b).

217. (c) Drainage. The site and facility must have adequate drainage and be free of standing water.

(d) Process changes. The department must be notified of all process changes

ness and prevention section concerns safety and everyday procedures[218] and portions address closure requirements and personnel training requirements.[219]

The New York State Solid Waste Management Plan was promulgated pursuant to RCRA,[220] which regulates hazardous and solid wastes. The SIP was enacted pursuant to the Clean Air Act.[221] Potential operators of sludge-burning incinerators must comply with both regulatory schemes. Incineration facilities that dispose of their ash in landfills must comply with the appropriate sections of the State Solid Waste Management Plan[222] and the applicable sections which regulate hazardous waste if the ash is determined to be hazardous in nature. The section of this article which analyzed landfilling as an alternative describes the requirements necessary to meet for sludge ash disposal.

5. *Conclusion*

Incineration is likely to be the primary alternative to ocean dumping that New York should/will use. Of course, there are many hurdles to overcome but overall it could be considered a safe and effective option. New York City and Westchester both have wastewater and sewage treatment plants within their boundaries. Some of those facilities already contain incinerators and others do not. The ones with furnaces could be modified to accommodate greater amounts of sludge and those without incinerators could remodel to incorporate sludge burners. This would be costly but vast amounts of land would not be needed; most plants are fairly

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before they are implemented.

(e) Access. The operator must restrict the presence of, and must minimize the possibility for any unauthorized entry into the facility . . . .

(f) Reporting. .. all facilties must (1) notify the department's solid waste engineer if an unscheduled total facility shutdown exceeds 24 hours. (2) Prepare and file a quarterly report. . .

Id. § 360-3.4(c), (d), (e), (f).

218. *Id.* § 360-3.4(g).

219. *Id.* § 360-3.4(h) & (i).

220. *Supra* note 111 § 6941.

221. 42 U.S.C. § 7401 et. seq. (1982).

222. N.Y. Comp. Codes R. & Regs. tit. 6, § 360-3.5 (1988).

compact.

Another option would be to mix some of the sludge with municipal waste and burn it in solid waste incinerating plants as a co-disposal method. A third option is to build a plant that would burn sludge only to handle a large portion of the sludge. Siting would be the major obstacle to overcome but it would be possible with state of the art technology and adequate funding. Since New York is an attainment area for the main resulting pollutant (particulates), complying with the standards would be possible with a good system. In addition, the ash would require proper disposal. Incineration of sewage sludge is an efficient, sounder (environmentally) alternative to direct ocean disposal.

E. *Heat Drying*

1. *Technical Analysis*

Heat drying of sewage sludge involves removing the water from the waste at very high temperatures.[223]

Commercially, this heat drying method is employed by several municipalities,[224] but the product of the Milwaukee Metropolitan Sewage District (M.M.S.D.) is probably the most famous and widely used. Heat dried sludge and its product will serve as the example for heat drying in this paper.

Milorganite (MILorganite ORGanic NITrogen)[225] is the fertilizer produced by the M.M.S.D. and sold in every state as a soil conditioner.[226] The most common use for Milorganite is on golf courses "including seventy-five percent of the Profession Golfers Association courses."[227]

The production of Milorganite is a three step process.[228]

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223. USE AND DISPOSAL, *supra*, note 39, at 33.

224. *Id.* at 27. Chicago, Ill; Houston, Tex; Largo, Fla; Greater Atlanta, Ga; Newport News, Va.

225. WISCONSIN GOLF COURSE SUPERINTENDENTS ASSOCIATION, THE GRASS ROOTS (May/June 1986) (hereinafter GRASS ROOTS).

226. USE AND DISPOSAL, *supra* note 39, at 27.

227. Saturday Windsor Star (Wisconsin) Oct. 25, 1986, at E1, Col. 1.

228. JONES ISLAND WASTEWATER TREATMENT PLANT, VISITOR HANDBOOK, 7-15 (1986) (hereinafter VISITOR HANDBOOK).

The first step in processing the sludge that enters the plant is to remove debris and solids.[229] This is known as Primary Treatment and it consists of course bar screening,[230] grit removal[231] and finally fine screening.[232] "The Primary Treatment process removes less than five percent of total pollutants in wastewater."[233]

The next process is the secondary treatment which removes solid and pollutants from the water.[234] This is accomplished by activating the sludge.[235] The sludge is activated by tiny aerobic bacteria, protozoa and actinomycetes, and then mixed with return sludge to allow for the activation process to begin.[236] The mixed sludge is then sent through an aeration tank so that the bacteria can feed on the solids and multiply to keep the process going.[237] After the sludge is aerated, the air is removed from the liquid and the bacteria die.[238] Part of the treated sludge is sent back to through the process to be used in the bacterial process while the rest is heated to 1,400 degrees fahrenheit to remove the water; the solid left is Milorganite.[239] "The effluent discharge flows over weirs into Lake Michigan.[240] It is almost clear as drinking water and 99.9 percent free of bacteria."[241]

In order to produce one pound of the finely ground fertilizer, six hundred and twenty-five gallons of raw material is

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229. *Id.* at 7.

230. *Id.*

This process includes the removal of sticks, branches, rags, cans, tires and other large objects.

231. *Id.*

In this process the sludge is routed through eight long grit channels where heavier particles are settled out.

232. *Id.*

In this process the wastewater flows through revolving drums which screen out fine particles such as hair, paper, grain hops.

233. *Id.*

234. *Id.* at 8.

235. *Id.*

236. THE GRASS ROOTS, *supra* note 225, at 6.

237. *Id.*

238. *Id.*

239. *Id.*

240. *Id.*

241. *Id.*

needed.[242]

2. *Legal Restrictions*

After the completion of the heat drying process, water is placed back into Lake Michigan, therefore invoking provisions of the Clean Water Act.[243] The Milorganite plant operates under a NPDES permit issued by the E.P.A.[244]

Moreover, the State of Wisconsin has its own environmental discharge statute[245] and the M.M.S.D. has formulated a program which is even more stringent than the state or federal government.[246]

3. *Analysis*

Each year the M.M.S.D. sells five million dollars worth of Milorganite, but this is still not profitable in the economic sense for the city.[247] It costs about $150 per ton to manufacture Milorganite, which is fifty dollars higher than the selling price, but considering the cost of dumping or burning sludge would be about double, and landfill space is not readily available in the area.[248]

4. *Conclusion*

Milwaukee appears to have found a solution to disposal of sewage waste, so why can't other municipalities develop a similar product? Many sewage districts have tried to create a product consistent and high quality as Milorganite but they

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242. *Id.*
243. 33 U.S.C. § 1311 (1982 & Supp. III 1985).
See *supra* notes 27-33, 52, 54, 56-58 and accomanying text.
244. VISITORS HANDBOOK, *supra* note 228, at 17.
The permit limits include:
BOD - 45 mg/l weekly 30 mg/l monthly
SS - 45 mg/l weekly 30 mg/l monthly
P - 1 mg/l monthly
Fecal Coliform - 400 #/100 ml weekly and 200#/100ml monthly.
245. Wis. Stat. Ann. § 147 (West 1970).
246. Telephone interview with Jim Anderson, Esq., February 1, 1989.
247. *Supra* note 227.
248. *Id.*

have not been successful.

There are three main reasons why Milorganite stands alone. First is the cost of building a plant similar to the one located at Jones Island in Milwaukee would be too expensive. In 1923, when the plant was first built, it cost the Sewage Commission fifteen million dollars and another twenty million for the main sewage lines.[249] This plant was constructed to serve only half a million people and in order to build a plant today the cost would be astronomical and the capacity would be unable to meet the demands of the number of residents in the metropolitan New York area.

The second reason Milorganite is not produced elsewhere is because of the unique combinations of industry.[250]

Finally, no other group has developed a technique of producing constant-sized granular, dust-free fertilizer.[251]

V. Conclusion

As the curtain closes on the City of New York and the other sewage authorities which continue to dump sewage sludge in the ocean, no single alternative has been proven economically, technologically and environmentally sound. However, the use of a combination of any of the alternatives may be the best solution to a problem that won't disappear by itself.

The land application alternative will not work alone. It requires the availability of a lot of land and the metropolitan New York area does not have an overabundance of open space. The idea of transporting the sludge is viable, however, the areas that could use the sludge are already using that sludge that is generated in their own region.

The alternative of landfilling is viable, however, limited. The limitations that are placed on the alternative stem from the lack of available facilities that are still open and able to accept the sludge. Furthermore, little open space is available to construct new landfills and many areas are presently phas-

249. THE GRASS ROOTS, *supra* note 225, at 2.
250. *Id.* at 4.
251. *Id.*

ing out landfilling operations. Technologically, landfilling is an effective alternative because of the strict regulations governing the permit and operation requirements of landfills on both the federal and state level. Independently, however, landfilling cannot work. It must be done in conjunction with other alternatives, especially incineration.

The use of composting as a means to discontinue ocean dumping can be effective if tied in with other alternatives such as landfilling or incineration. The composted sludge can be distributed and marketed for use in residential areas, but the amount of compost that would be generated in the New York area is so great the market would be too small and the supply too great.

Realistically, incineration could be the alternative which would alleviate most of the problem of developing land based disposal methods. Sludge could be burned in furnaces located right at the sewage treatment plants, it could be mixed with solid waste and burned in municipal incinerators, or it could be combusted in a facility designed to handle sludge only at a site away from the wastewater plants. This alternative must be used in conjunction with landfilling because of the ash product resulting from this type of thermal reduction. Particulate emission would be the main pollutant of concern and those particulates released into the air in New York (an attainment area) would probably not significantly affect this status.

Heat drying the sludge and marketing it in a way similar to that employed in Milwaukee is an extremely effective approach to the problem. The capital costs to institute such a system would be too great for the region to handle and with Milorganite being used nationwide, the market may not accept a lower quality product.

Financially, the burdens of noncompliance on those who continue to ocean dump sewage sludge will be very great. The cost of compliance, however, will likewise be great. "New York officials have predicted that developing alternatives will cost more than $700 million and will result in high sewer and

water fees."[252] At first glance, this figure might seem astronomical but the impact on human health, welfare and the environment that would result from continued ocean dumping cannot even be weighed in financial and economic terms.

Should New York not be able to comply with the legislation banning ocean dumping, the EPA would be willing to compromise. In an effort to provide an incentive for expeditious development of feasible alternatives, the EPA will agree to rechannel a percentage of the fines levied for ocean disposal to such development.[253]

Overall, there is light at the end of the tunnel for the municipalities that continue to dispose of their sewage sludge in the ocean. Through the use of various alternatives and intermunicipal agreements, the sludge can be disposed of in a maner that will not cause harm to human health or the environment.

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252. N.Y. Times, Feb. 19, 1989, at 58, col. 1.
253. *Id.*