K. SEWAGE SLUDGE

K.1. Introduction

The Statewide Sludge Management Plan (SSMP) is a component of the Statewide Solid Waste Plan and is mandated under the Solid Waste Management Act (N.J.S.A. 13:1E-1 et seq.) and also satisfies the residual management planning mandate of the Water Quality Planning Act (N.J.S.A. 58:11A-1 et seq.). In addition, pursuant to the Water Pollution Control Act (N.J.S.A. 58:10A-1 et seq.), the Department is responsible for regulating the management of residual generated by domestic and industrial treatment works in a manner that protects public health and the environment.

In 1983, the decision was made to delegate to the wastewater management program (which is currently within the Division of Water Quality) general administration of the SSMP and the overall programmatic responsibility for regulation of residual management (that is sewage sludge, domestic septage, potable water treatment plant sludge, food processing sludge, and other nonhazardous industrial sludge), however, certain specific responsibilities have been delegated to several other Departmental programs. For example, the regulation of air emissions associated with residual management facilities is the responsibility of the Air Quality Permitting Program under the authority of the Air Pollution Control Act (N.J.S.A. 26:2C-1 et seq.), and the regulation of landfill management of residual (where allowed) is the responsibility of the Division of Solid and Hazardous Waste under the authority of the New Jersey Solid Waste Management Act.

New Jersey has adopted a number of residual management regulations pursuant to its authority under the New Jersey Water Pollution Control Act. Specifically, the New Jersey Pollutant Discharge Elimination System (N.J.A.C. 7:14A), Subchapters 22 and 23, address the issuance of Treatment Works Approvals for all treatment works. Treatment works, as defined by the New Jersey Pollutant Discharge Elimination System (NJPDES), includes all structures associated with, among other things, residual processing, treatment and storage facilities. Further, New Jersey's Standards for the Use or Disposal of Residual under Subchapter 20 address issuance of permits for residual use or disposal, including residual land application operations and residual transfer stations. In addition, based upon the general conditions included in all NJPDES permits for all wastewater treatment plants, the Division of Water Quality (DWQ) is responsible for assuring that all treatment plants comply with applicable residual planning and management requirements. It should be noted, due to the multi-media nature of residual management, the Department promulgated the NJPDES Rules under multiple statutory authorities, including air, water and solid waste. Thus, the NJPDES Rules, to some degree, reconcile under what circumstances the statutory and regulatory provisions of the three Acts apply.

Under the authority of the New Jersey Solid Waste Management Act, the Department has exempted certain solid waste management facilities and operations from solid waste registration requirements as detailed under the Solid Waste Management Rules (N.J.A.C. 7:26). The Department exempts from solid waste registration all operations that receive a NJPDES permit for the land application of nonhazardous solid waste, including wastewater and potable water

treatment residual. In addition, under Solid Waste Rules, the Department has exempted all remaining types of sewage sludge management equipment and operations from solid waste permitting as long as they are otherwise permitted under the Air or Water Pollution Control Acts. This includes, but is not limited to, residual transfer stations, except those which co-process or co-dispose sewage sludge with municipal solid waste. Exempting these types of operations from solid waste registration served to eliminate duplicative regulation without compromising the Department's evaluation of the engineering design and anticipated environmental impact of the proposed facility. Exempted sewage sludge management equipment and operations are still required to comply with Treatment Works Approval requirements under the NJPDES Rules in lieu of a solid waste engineering design approval. Air quality permits are also required, where applicable.

The Department has also exempted the haulage of marketable residual products from solid waste registration. Marketable residual products are a stable product suitable for use as a soil amendment in agricultural practices and/or for potential distribution to the public, landscapers and other horticultural and nursery users. Marketable residual products that have received all necessary approvals for reuse are not subject to the solid waste transportation requirements outlined in Solid Waste Rules. However, the transportation of any residual for disposal or for further processing or conversion to a product would be considered a regulated solid waste transportation activity.

The DWQ is also responsible for the Sludge Quality Assurance Regulations (N.J.A.C. 7:14C). Under the Sludge Quality Assurance Regulations (SQAR), the DWQ monitors sludge quality, quantity and ultimate management methods by all domestic and industrial treatment works.

Twenty years ago, approximately 86% of the sewage sludge generated in New Jersey was going either to a New Jersey landfill or to the ocean for disposal. However, beginning in March 1985, under provisions of the New Jersey Solid Waste Management Act, New Jersey landfills were restricted from accepting sewage sludge for disposal. Then beginning in March 1991, under the New Jersey Ocean Dumping Elimination Act, New Jersey sewage sludge generators were no longer allowed to dispose of their sewage sludge in the ocean. Thus, by the end of 1991 out-of-State disposal of sewage sludge had increased to almost 60% of New Jersey's total sludge production. These two statutory initiatives, occurring within a time period of six years, essentially eliminated the sewage sludge management alternative for 86% of New Jersey's sewage sludge production. This severely stressed New Jersey's sewage sludge management infrastructure. Figures K-1 and K-2 depict these changes in sewage sludge management from 1983 to 2003. Figure K-1 depicts the history of sewage sludge management in New Jersey during this time period for each management method. Figure K-2 focuses on the overall decreasing reliance on out-of-State disposal since 1991 as well as the shift from out-of-State disposal to out-of-State beneficial use alternatives.

K.2. Planning Process

In 1978, in response to increased concerns over the effects ocean disposal of sewage sludge had on coastal water quality, the Legislature found the interests of the citizens of New Jersey would best be served through an integration of sewage sludge management with the regional solid

waste planning and management process and thereby amended the New Jersey Solid Waste Management Act.

The 1978 amendments also included a provision (N.J.S.A. 13:1E-46) requiring that the Statewide Solid Waste Management Plan contain a sewage sludge management strategy, which shall provide for the maximum practical processing of all sewage sludge generated within the State, and for the processing or land disposal of any such sewage sludge generated. The Department was empowered to direct any Solid Waste Management District (1) to plan for the utilization of any existing "solid waste facility" or "recycling facility" for the land disposal or processing of sewage sludge, or (2) to develop a program, singly or with one or more other Districts, to provide for the land disposal or processing of sludge generated within such District or Districts. When adopted in 1987, the SSMP provided a formal framework to guide the Solid Waste Management Districts in sewage sludge management planning, or, as a second option, to delegate planning activities to a selected agency such as a domestic treatment works. The Solid Waste Management Districts have not, for the most part, integrated sewage sludge management planning into the District planning process. As a result, sewage sludge generators essentially have maintained sewage sludge planning and management responsibilities throughout the past twenty years. The legal requirement for every domestic treatment works to plan and provide for management of its sewage sludge production is part of every NJPDES operating permit. Upgrades, as well as expansions to the wastewater treatment facilities and construction of new facilities, have served as the leading mechanism for requiring the domestic treatment works to address changing sewage sludge management needs.

The overall mandate of the Legislature to provide for safe and effective management of sewage sludge is best fulfilled by requiring the individual domestic treatment works to retain the responsibility to ensure proper management of their current and future sewage sludge productions.

As of 2003, about 6 percent of all sewage sludge generated in New Jersey is exported for out-of-State disposal. Thus, domestic treatment works have proven to be an efficient and effective entity for addressing sewage sludge management responsibilities. Only one District, Burlington County, has assumed sewage sludge planning responsibility and developed plans to integrate the long-term management of sewage sludge and solid waste, although some additional counties have played a limited role in sewage sludge planning. The current planning process has been successful and shall continue. The regional multi-County, cross-District nature of many domestic treatment works service areas further emphasizes the logic of continuing with domestic treatment works planning responsibility. Flexibility has been provided to integrate County governments into the planning process, where counties do desire to play a role. Any District which does decide to assume sewage sludge planning responsibility must incorporate as part of their plan all sewage sludge processing and manufacturing infrastructure existing at the point in time the decision to plan is made. This infrastructure shall, at a minimum, include any existing sewage sludge management contracts, permitted facilities and operations, sewage sludge and septage management plans, fully executed design contracts, and designs that have been authorized for funding. Existing permitted sewage sludge management facilities and operations are discussed further under the Existing Conditions section of this SSMP.

As discussed above, the domestic treatment works are the primary entity responsible for sewage sludge management planning. Therefore, in absence of a District Sewage Sludge Management Plan, any domestic treatment works with a permitted flow equal to or greater than 1.0 million gallons per day (mgd), or which seeks an expansion to 1.0 mgd or greater, must submit a generator sewage sludge management plan if the domestic treatment works is proposing to upgrade or expand wastewater treatment capacity. This requirement to plan is also applicable to any proposed new domestic treatment works with a permitted flow of 1.0 mgd or greater. The generator plan must include, at a minimum, the following information:

- A brief statement on the current amount of sewage sludge generated (in dry metric tons per year) for the last complete calendar year, and the sewage sludge management alternative(s) used over that year;

- A brief description of the domestic treatment works upgrade and/or expansion (including rerates) which is necessitating submission of a generator plan, and the purpose for the upgrade or expansion;

- The projected completion date for the proposed upgrade and/or expansion;

- A projection of the annual quantity and quality of sewage sludge generated (in dry metric tons) upon completion of the proposed upgrade and/or expansion as well as at 5-years and 10-years after the projected completion date;

- The projected sludge quantities must be accompanied by a mass balance, including wastewater flow projections, supporting derivation of the projections;

- A brief statement of the sewage sludge management strategy which will be followed, and the current and projected sludge management alternative(s) to be used over the 10-year planning period, including an available capacity analysis for the selected sewage sludge management alternative(s); and,

- An implementation strategy to denote the completion of any important milestones during the 10-year planning period, including the expiration date of any existing contract(s), where applicable, and an implementation schedule for renewal of subsequent contracts.

K.3. New Jersey Policy on Land Based Residual Management

General Policy Statements

1. New Jersey is a densely populated State with minimal land area available for commitment to waste disposal. Therefore, it is the Department's Policy to encourage beneficial use (such as the conversion of sewage sludge into products to be used as a fertilizer or soil conditioner) wherever possible.

2. It is the Department's Policy to prohibit the landfill disposal of sewage sludge, because landfilling is a land-intensive waste disposal mode which commits land areas for the

foreseeable future. This alternative may be permitted only on a short-term basis under limited overriding circumstances as determined by the Department under the terms of an Administrative Consent Order.

3. It is the Department's policy that the use of marketable residual products or stabilized sewage sludge as a supplement to the final soil overlying the final landfill cap shall not be considered landfill disposal but shall be considered beneficial use. The use of stabilized sewage sludge or other marketable residual products can improve the productivity of the final soil cover of certain completed landfills, and thus aid in revegetation and ultimate reclamation efforts without creating environmental harm. Use of stabilized sewage sludge or other marketable residual products in final landfill cover applications requires the approval of the Division of Solid and Hazardous Waste.

4. It is the Department's policy that the use of marketable residual products or stabilized sludge as daily or intermediate cover shall not be considered landfill disposal but shall be considered beneficial use. The use of appropriate approved stabilized sewage sludge or marketable residual products as daily cover can replace or reduce the need for virgin soils; thus, reducing the need for the land-intensive soil mining. Use of stabilized sewage sludge or marketable residual products in daily and intermediate landfill cover applications requires the approval of the Division of Solid and Hazardous Waste.

5. It is the Department's Policy that sewage sludge thermal reduction facilities are an integral and necessary part of the State's diversified sewage sludge management strategy. Dedicated sewage sludge thermal reduction facilities impart a vast volume reduction on the sewage sludge introduced into the facilities, do not require significant land commitment for disposal, operate in all seasons, safely manage one quarter of the State's sewage sludge production without nuisance, and are fully regulated by the Department's Air Pollution Control Program.

Domestic Residual Quality

The SQAR were initially promulgated in October 1979. With the SQAR, the Department embarked on a major program of monitoring the quality and quantity of sewage sludge generated throughout the State by domestic treatment works. The SQAR have been in effect for nearly 25 years, and the information submitted by the treatment works under these regulations has been extremely useful to the Department in evaluating management plans as well as long term trends, and to the generators in developing appropriate management alternatives.

Since 1983, there has been a steady improvement in the overall quality of sewage sludge generated by New Jersey's domestic treatment works (see Table K-3). Only arsenic has shown an increase in median concentration since 1983. The increase in the arsenic concentration is believed to be related to improvements in drinking water quality. There are some areas of the state where arsenic is naturally occurring in the source water used for drinking water. As the standards for drinking water are strengthened, water purveyors must improve their level of treatment which often generates an additional residual for disposal. When this residual is discharged to a public sewer, an increase in the arsenic concentrations in the sewage sludge generated by the wastewater treatment plant can result. Beginning in 1994, selenium has shown

an increase in median concentrations. However, the 2003 median concentration for selenium is still well below Federal and State risk-based standards for land application (See Table K-4 of this SSMP).

Pursuant to the New Jersey Water Pollution Control Act, NJPDES permits require the permittee to limit concentrations of heavy metals, pesticides, organic chemicals and other contaminants in the sludge in conformance with the land-based sludge management criteria established pursuant to the Federal Clean Water Act Amendments of 1972, 33 U.S.C. 1251 et seq., or any regulations adopted pursuant thereto, including the Federal Standards for the Use or Disposal of Sewage Sludge. Any treatment works with sewage sludge that does not meet the standards for a use or disposal practice must clean up its influent (for example, by strengthening pretreatment or pollution prevention programs), improve the treatment of sewage sludge (for example, by reducing the densities of pathogenic organisms), or select another sewage sludge use or disposal method. All generators are required to maintain a sewage sludge quality compatible with their method of sewage sludge management and to report those instances where applicable sewage sludge quality criteria are exceeded, as outlined in the SQAR. Compliance with standards is determined by the quality of the sewage sludge or marketable residual product at the end of the sewage sludge treatment process, not the inflow to that process. However, it is the responsibility of both the sewage sludge management facility and the generator to assure that all sewage sludge sent or accepted for processing is compatible with the sewage sludge quality limitations imposed on the management facility.

Consistent with the Federal Standards for the Use or Disposal of Sewage Sludge (40 CFR Part 503), the Department will not accept the mixing of sewage sludges with non-process oriented materials (e.g. materials added solely for the purpose of dilution that do not aid in processing to achieve pathogen or vector attraction reduction) for the purpose of reducing pollutant concentrations. Furthermore, acceptance of customer sewage sludges for blending shall not be a defense for exceeding any sewage sludge quality limitation in the blended sewage sludge.

Waste Reduction and the Beneficial Use of Residual

The Department strongly supports the beneficial use of sewage sludge and other residual suitable for beneficial use. Improving the productivity of land using the soil conditioning properties and nutrient content of sewage sludge has human health and environmental advantages beyond those that are directly associated with applying sewage sludge to the land. For example, secondary or related benefits of beneficially using sewage sludge include a decreased dependence on chemical fertilizers.

The organic and nutrient content of sewage sludge makes it a valuable resource to use both in improving marginal lands and as a supplement to fertilizers and soil conditioners. Due to its organic nature, sewage sludge is well suited to agronomic purposes and the Department encourages its use as a soil amendment and in preference to inorganic fertilizers. With proper application, sewage sludge will: (1) increase soil organic matter content, which decreases nitrate nitrogen leaching due to ammonium fixation, decreases soil compaction, increases soil cation exchange capacity, increases plant available water in soil, increases the substrate for soil microbes, and enhances soil structure, thereby improving aeration and reduction/oxidation

potential; (2) provide a source of slow release nitrogen thereby reducing the need for top or side dress applications; and (3) provide a source of both primary nutrients and of primary and secondary micro-nutrients (iron, molybdenum, copper, zinc, calcium, magnesium, manganese and sulfur), which will lower costs of fertilization and reduce the number of equipment passes over a given amount of agricultural land.

The beneficial uses of sewage sludge are not limited to the production of agricultural or horticultural commodities. Sewage sludge has been and continues to be used to fertilize highway median strips and cloverleaf exchanges by the New Jersey Department of Transportation. In addition, sewage sludge is currently used to successfully stabilize and re-vegetate areas destroyed by mining, dredging, and construction activities and also as a raw material for topsoil manufacturing operations.

Policy on Industrial Residual

The primary focus of the DWQ has been on sewage sludge and sewage sludge management. Although the DWQ has historically dedicated fewer resources to non-hazardous industrial sludge management, the DWQ has applied increased oversight in this area in recent years. As previously stated, the DWQ is responsible for administering a regulatory program for the use and management of residual generated by industrial treatment works. Under the SQAR, the DWQ requires such facilities to report on the quantity and quality of non-hazardous residual generated. Generally, all residual management alternatives that are discussed in this SSMP as being available to sewage sludge generators are also available to non-hazardous industrial sludge generators, with restrictions or limitations as noted. One exception is that industrial non-hazardous residual generators that produce a dewatered sludge for disposal are not restricted from landfill disposal as regulated by the Division of Solid and Hazardous Waste.

Where other nonhazardous residual meets the pollutant limits and pathogen requirements specified in the NJPDES Rules, the Department will consider land application programs for these materials. In these cases the following additional requirements apply: a benefit to the soil or cover vegetation from the land application of the residual must be demonstrated; the impacts of the residual on soil fertility, soil physical properties and plant growth must be understood; and the land application of the residual must have been successfully tested or demonstrated.

The successful implementation of land application for residual other than sewage sludge requires an understanding of the impacts of the residual on soil fertility as well as its impact on soil physical properties. The physical characteristics of soil that determine whether it can support vegetative growth include cohesion, aggregation, strength and texture. These parameters directly affect the hydraulic properties of soil such as moisture-holding capacity, infiltration, permeability and drainage. Any adverse impact on these hydraulic soil characteristics from land-applied residual can ultimately degrade groundwater quality in addition to affecting crop growth. Therefore, as part of the application for residual other than sewage sludge, the applicant must document that the land application program has been developed to the extent that full-scale use will not degrade soil physical properties.

The Department also requires that the land application of a particular residual be successfully tested or demonstrated in a field application or pilot program as required by the NJPDES Rules (N.J.A.C. 7:14A-20.7(a)4). Once this has been accomplished, the Department may permit its application on an experimental basis. The Department's intent is to develop additional residual land application programs, through closely controlled applications, to evaluate their usefulness on a large scale (much the way the land application program was originally developed for sewage sludge). Ultimately, a sufficient database will have to be collected from the field application or pilot program in order for the Department to determine the adequacy or appropriateness of a larger scale program. Two examples of a residual which have been approved for land application in this manner are food processing residual and water treatment plant residual.

Policy on Domestic Septage

It is the Department's position that the use of domestic treatment works is the most environmentally sound and controllable method of septage management and is the Department's preferred septage management method. Pursuant to the NJPDES Rules, land application alternatives for domestic septage (a sub-category of sewage sludge) will only be approved on a case-by-case basis where no reasonable alternative exists. Requirements specifically applicable to land application of domestic septage include: certification of domestic origin; analyses for selected chemical parameters; compliance with the pollutant limits applicable to sewage sludge in the Federal Standards for the Use or Disposal of Sewage Sludge; compliance, at a minimum, with the Class B pathogen reduction standards and one of the vector attraction reduction standards applicable to sewage sludge; screening of septage to remove foreign materials; and, application of domestic septage at no more than the agronomic rate appropriate for crops grown based on actual analyses rather than a standardized formula.

Although not excluded by these rules, the Department has not, to date, issued any permit authorizing the land application of septage under the NJPDES Rules and does not envision doing so in the future.

Policy on Prohibition on Use as Clean Fill

The use of sewage sludge or soil blends made with sewage sludge for clean fill is prohibited. This prohibition is often misunderstood since existing Department regulations, consistent with the Federal Standards for the Use or Disposal of Sewage Sludge, state that the land application subpart does not apply to a material derived from Exceptional Quality (EQ) residual that is applied to the land in bulk or that is sold or given away in a bag or other container in order to be applied to the land. To be considered EQ, a residual must meet both the ceiling concentrations in 40 CFR 503.13(b)1 and the pollutant concentrations in 40 CFR 503.13(b)3, the Class A pathogen reduction requirements in 40 CFR 503.32(a), and one of the vector attraction reduction options in 40 CFR 503.33(b) 1 through 8. The key to this exemption is that the material derived from sewage sludge must be **applied to the land** as defined in the NJPDES Rules. In other words, the sewage sludge must be used as a fertilizer or soil conditioner and applied at an agronomic rate. If a material derived from sewage sludge is used as fill then it is not being used as a fertilizer or soil conditioner and would be subject to regulation under the Federal Standards for the Use or

Disposal of Sewage Sludge and the NJPDES Rules as surface disposal. Therefore, placing an EQ residual or a topsoil blend made from EQ residual at depths below any reasonable root zone would be considered surface disposal which is prohibited under the NJPDES rules.

Policy on Importation of Out-of-State Sludge

Out-of-State generators may bring residual into New Jersey to be prepared at a NJPDES permitted operation, or other Department approved residual management operation. However, the out-of-State residual generator must comply with all applicable New Jersey regulations regarding residual management, including, but not limited to, the Sludge Quality Assurance Regulations and the NJPDES Rules. As the first step, any out-of-State residual generator transporting residual into New Jersey for any purpose must comply with the SQAR. The SQAR requires that out-of-State generators notify the Department in writing prior to the transport of residual into the State and that this notification be accompanied by a complete set of analyses as required to be reported under the regulations. Thereafter, the out-of-State domestic or industrial treatment works must report as if it was a New Jersey generator.

Specific to the land application of residual, residual can either be prepared out-of-State into products and brought into New Jersey or they can be brought into New Jersey to be prepared. In order for the Department to ensure that all residual land application activities are conducted in a manner consistent with Department rules, the Department must first be aware of the activity. Therefore, any person who prepares residual out-of-State to be applied to the land in New Jersey must first notify the Department of their intentions and submit copies of those permits and approvals issued by the permitting authority for the State in which the residual was prepared. This requirement is necessary for the Department to ensure that the residual to be applied will satisfy the requirements of both the Department's rules and the New Jersey Water Pollution Control Act. This notice requirement is applicable to any person who prepares residual (including EQ residual) out-of-State and who desires to apply such residual in New Jersey. This requirement is also applicable to residual sold or given away in a bag or other container and to bulk residual. Upon receipt of the notification, the Department will notify the out-of-State preparer of the applicable requirements which must be met. Two such products the Department has approved are compost generated by the City of Philadelphia and Milorganite (a heat dried product) prepared by the City of Milwaukee, Wisconsin.

Policy on Storage of Residual

Storage alone is not a method of ultimate management. Storage is a mechanism which is incorporated in an overall residual management program which adds flexibility and improves the efficiency of the program. Storage capacity can serve as a component of a contingency plan for periods when selected management modes are closed for repairs, or due to inclement weather provided the stored residual can be ultimately managed in an acceptable manner when normal operations resume.

Storage can have many forms. It can consist of tanker trailers, frac tanks, slurry tanks, surface impoundments, bunkers, or sheds. Storage can be located at the treatment plant site, at the residual management site, or located in consideration of transportation and/or development and

population density factors. Although many treatment plant components have included some storage capacity in the design (for example, digesters, thickeners, and drying beds), these components are primarily intended for treatment or processing and are not considered to be storage installations. Storage beyond the structural, permitted capacity of any treatment or processing component will be subject to enforcement action.

Storage in permanent storage installations is only acceptable to address short term management requirements. Storage is intended to provide residual management flexibility during periods of inclement weather, and to serve as a contingency plan if regular management is temporarily interrupted. Accordingly, all residual must be removed from storage installations for ultimate management.

Storage is only appropriate as a component of a contingency alternative when it can be demonstrated that the ultimate residual management alternative has the capacity to manage daily residual generation concurrently with management of backlogged stored residual which have accumulated during the contingency management period.

Generally, the storage of residual for more than six months constitutes surface disposal (see the subsection on surface disposal under Management Modes below). It is possible for residual to be stored for periods longer than six months in permitted, approved storage installations provided that the person who prepares the residual demonstrates why the site is not a surface disposal site. The demonstration must explain why residual must remain for a period longer than six months prior to final use or disposal, discuss the approximate time period during which the residual shall be used or disposed, and provide documentation of ultimate management arrangements. Said demonstration must be in writing, kept on file by the person who prepares residual and submitted to the Department upon request.

K.4. Existing Conditions

Over the past 20 years tremendous changes have taken place in the regulation and management of residual Statewide. The primary emphasis of sludge management policy has shifted away from reliance on end-of-the-pipe disposal management strategies to adequate sludge treatment and processing as necessary to ensure beneficial use. As shown in Table K-3, there generally has been a steady improvement in sludge quality since 1983. In addition, when current sludge quality (using 2003 medians) is compared to the Federal "high quality" Standards for the Use or Disposal of Sewage Sludge, and to the Rutgers Cooperative Extension's more stringent suggested limits, it is apparent that nearly all New Jersey sludges are much cleaner than these standards (see Table K-4). This demonstrates that most “biosolids” being produced by New Jersey generators are low in pollutants and suitable for beneficial use.

In New Jersey, domestic treatment works currently generate about 233,300 dry metric tons of sewage sludge per year. The implementation of the New Jersey Water Pollution Control Act has resulted in greater levels of treatment of and pollutant removal from wastewater before discharge to surface or ground waters, and the generation of larger quantities of residual as a by-product of this treatment.

Table K-5 presents a summary of County and State sludge production and management modes for calendar year 2003. An inventory by County of each domestic treatment works NJPDES permit number, their existing and design wastewater flow, the volume of sludge, and the management mode utilized for their sludge production is maintained and available on the Department's website. Figure K-6 summarizes the percent of the total sludge production by management method for calendar year 2003. (See the Management Modes - Land Application section of this SSMP for a discussion on Class A and Class B beneficial use alternatives.)

For the calendar year 2003, about 6 percent of the State's total sewage sludge production was disposed out-of-State. In addition, almost 67 percent of the State's sewage sludge production was beneficially used either in-State or out-of-State. However, the percentage of sewage sludge beneficially used in-State has been falling due to increased program enforcement and to the pressures on available land on which to apply sewage sludge products. New Jersey is the most densely populated State in the nation, which creates additional challenges for biosolids preparers to find and develop appropriate markets for their products. Therefore, although it is the Department's stated policy to encourage beneficial use alternatives, it must be recognized, due to these pressures, that a policy that also encourages diversity in management alternatives is necessary. It is for these reasons that the Department's General Policy Statement on the land-based management of sewage sludge incorporates various alternatives as discussed earlier in the SSMP. See the Management Modes - Land Application Section for a further discussion on pressures to sustain land application in New Jersey.

Table K-7 is a County by County list of all existing permitted residual management facilities and operations. Please note, transfer stations are not considered ultimate management operations, but are included on Table K-7 as part of the existing infrastructure that could be utilized by generators prior to ultimate management. The facilities and operations on this list are to be considered a part of the existing management infrastructure which must be used to the maximum possible extent to resolve immediate and long-term sludge management needs. However, it is important that planners and sludge generators not interpret this list as restrictive, but rather, as a starting point.

Table K-8 summarizes information obtained from domestic treatment works for the 2003 calendar reporting year, and summarizes the number of treatment works and sewage sludge production by the SQAR category. (The SQAR categories are defined as a footnote to Table K-3.)

As reflected in Table K-8, in New Jersey, there is a large disparity in the quantities of sewage sludge produced by various generators. There are 341 domestic treatment works in New Jersey. Of these, 45 domestic treatment works, or less than 15 percent of the total number of domestic treatment works, produce more than 89 percent of all of the sewage sludge generated. As is clear from the data presented in Table K-8, there are a small number of large quantity generators and a significant number of very small quantity generators. In fact, just eight domestic treatment works generated about 64 percent of New Jersey's total sewage sludge production for calendar year 2003 (see Table K-9).

K.5. Management Modes

Overview

The Bureau of Pretreatment and Residual (BPR) within the DWQ regulates the discharge of contaminants to domestic treatment works, regulates the management of residual associated with domestic and industrial treatment works, and oversees the implementation of approved pretreatment programs. The BPR also issues NJPDES permits for discharge of contaminants to domestic treatment works that do not have an approved pretreatment program and for various types of residual management operations in conformance with the New Jersey Water Pollution Control Act and the NJPDES Rules.

Regardless of the management method selected, industrial pretreatment plays an integral part in protecting and enhancing sewage sludge quality. Although not all indirect users require individual NJPDES permits, all must comply with at least minimum regulatory requirements under the NJPDES Rules (N.J.A.C. 7:14A-21). When this type of discharge meets one or more specific criteria, the discharger becomes a significant indirect user (SIU), and requires a permit. These criteria include discharging from specific operations, discharging high strength or high volume wastewaters, being subject to Federal Categorical Pretreatment Standards and failure to comply with regulatory requirements.

Regulating SIUs is particularly important because the wastewater they produce often has a higher pollutant loading than the normal domestic sewage generated by residential uses. As a result, improperly pretreated wastewater from an SIU may upset the biological processes of a domestic treatment works, which may ultimately pollute the receiving waterbody, and it may contaminate the sewage sludge to a level where it is unsuitable for a particular management method or methods. To protect the domestic treatment works from potential problems, each local agency must, in accordance with the NJPDES Rules, develop local limits or demonstrate that such limits are not necessary. Local limit development and/or evaluation takes into consideration site-specific conditions. Among the factors that local agencies will consider include compliance with NJPDES permit limits; sludge quality criteria; protection against domestic treatment works upset and interference; and, worker health and safety.

In New Jersey, SIUs are regulated by delegated local agencies in some areas of the State and directly by the Department in the remaining areas. The Department may grant "delegated" status to a local agency which demonstrates to the department that it has the legal authority, procedures, and resources to adequately administer an SIU permitting program, as required under the Federal Pretreatment Regulations (40 CFR 403). Such a program requires both setting appropriate discharge limits for SIUs and enforcing those limits to ensure compliance. Once a pretreatment program has been delegated to a local agency, SIU permits are no longer issued by the Department in that service area. SIU permits issued by the DLA are considered NJPDES permits.

In New Jersey, there are 24 delegated local agencies (DLAs). These DLAs currently regulate 1,007 industrial users.

The first step in preparing an application for any permit for residual use or disposal is to prepare an Environmental Assessment. Residual land application sites are exempt from having to obtain a permit and an Environmental Assessment. The controls imposed on the processing of the residual in order to meet the land application requirements, combined with any applicable general requirements or management practices that may be required, are adequate to protect public health and the environment at the point where application to the land occurs. Therefore, the preparation and submittal of an Environmental Assessment is only required for:

- any location where a residual will be prepared to be applied to the land;
- any location where a residual was placed on a surface disposal site;
- a residual transfer station;
- a sewage sludge incinerator; or
- as otherwise determined necessary by the Department in accordance with the procedures outlined in the NJPDES Rules (specifically, N.J.A.C. 7:14A-20.5).

The Department shall waive this requirement if no additional infrastructure or capacity is proposed. For example, if a domestic treatment works already operates anaerobic digesters and is applying for a permit to land apply the sewage sludge from the existing digesters, an environmental assessment is not required.

The requirements of an Environmental Assessment are more fully discussed in the Department's Technical Manual for Residual Management which is available on the Department's website at www.state.nj.us/dep/dwq.

Land Application

Residual have been land applied and researched as long as wastewater treatment plants have worked to protect the quality of the waters of the State. However, the regulation of land application on a statewide level is a relatively recent occurrence. The regulation of land application Statewide began with the application of Federal guidelines developed in the 1970's. By 1987, the Department adopted its first comprehensive standards in the Statewide Sludge Management Plan. The Federal Standards for the Use or Disposal of Sewage Sludge were promulgated in 1993 by the USEPA and New Jersey followed with similar, but more restrictive regulations in 1997.

In 2001, the Rutgers Cooperative Extension issued guidelines solely for use by Rutgers Cooperative Extension faculty and staff with knowledge of standard agronomic and horticultural practices, including soil-environment interactions and plant growth requirements. These guidelines added to the information base upon which the Department makes decisions and are available at http://www.rce.rutgers.edu/pubs/pdfs/e228.pdf.

This evolution of land application regulation has occurred for various reasons in New Jersey.

Changes in State law eliminated the options of landfill disposal in 1985 and ocean disposal in 1991. Residual generators have tried with varying degrees of failure and success to develop marketable residual products such as pellets, composts and liming agents. New Jersey is the most densely populated State in the Nation, and by 1984 the State's population density had grown to over 1,000 people per square mile. The demand for housing has led to the steady development of agricultural land and has pushed the number of homes adjoining active agricultural land to all time highs. One way of illustrating the pressure exerted on those who would land apply residual in New Jersey is shown in Table K-10.

New Jersey's "Standards for the Use or Disposal of Residual" found in the NJPDES Rules provide six different programs for land application based on the level of quality, pathogen reduction, and vector attraction reduction achieved. These programs are described in more detail in the Department's Technical Manual for Residual Management.

All sites that prepare (i.e. generate or process) residual to meet a regulatory standard for land application must obtain a NJPDES permit. NJPDES permits to prepare residual contain conditions regulating the subsequent distribution of prepared residual. Once prepared, residual must be land applied in conformance with either Scenario 1 or 2 discussed below:

Scenario 1 - Exceptional Quality (EQ) residual: EQ residual meet pollutant, pathogen reduction and vector attraction reduction criteria such that the risks of land applying them are commensurate with other types of fertilizers or soil amendments. Therefore, the Department has determined that product literature, labeling and the application of common agronomic practices are adequate to protect human health and the environment. Under this scenario, Department approvals for the residual land application site are not required; however, the Department will propose as part of the readoption of the New Jersey Pollutant Discharge Elimination System, rule changes that would necessitate Department site approval or general permits for certain large operations such as Topsoil Blending Facilities. Nevertheless, the permittee (preparer) is strictly responsible for overseeing distribution, especially of bulk quantities, of EQ residual in a manner that conforms to the agronomic practices dictated in a NJPDES permit.

To be considered EQ, a residual must meet the following requirements from the Federal Standards for the Use or Disposal of Sewage Sludge: both the ceiling concentrations in 40 CFR 503.13(b)1 and the pollutant concentrations in 40 CFR 503.13(b)3, the Class A pathogen reduction requirements in 40 CFR 503.32(a), and one of the vector attraction reduction options in 40 CFR 503.33(b) 1 through 8.

Applicants for Exceptional Quality residual land application permits must demonstrate a program based on agronomic rate; must address product maturity and nuisance potential; must develop Department approved instructional literature and package labeling; and must obtain appropriate licensing from the New Jersey Department of Agriculture when the residual will be sold, offered for sale, or intended for sale as a fertilizer, soil conditioner, or agricultural liming agent. Preparers of EQ marketable residual product must stress agronomic rate; consider residual quality beyond the standards of pollutant concentration (for example, characteristics which might cause a nuisance upon distribution), pathogen reduction and vector attraction reduction;

implement a strong program of user information and education; and adhere to the standards established in agricultural products law.

Instructional literature and an oversight and marketing program must be created by the product manufacturer based on the mode of marketing conforming to the Department's Technical Manual for Residual Management. The Department's Technical Manual for Residual Management has been created to provide a set of guidelines to all producers and all customers on appropriate uses of residual and residual products. The Department requires that information found in the Technical Manual for Residual Management along with any specific requirements of the preparer's permit to be the absolute minimum which must be provided for in instructional literature, and in an oversight and marketing program.

Most New Jersey generators which prepare a sewage sludge for land application do so under scenario 1. As shown in Figure K-11, about 24 percent of the State's total sludge production is processed in-State for beneficial use. This is about a 19 percent decrease since in-State beneficial use reached its peak in the year 2000. During this same time period out-of-State options, primarily beneficial use management methods, increased by about the same amount (see Figure K-2). This shift in management methods can be primarily attributed to action the Department has taken to address nuisance issues associated with some Class A products. Of the amount beneficially used in-State in the year 2003, over 57 percent was distributed under scenario 1. (Scenario 1 is represented by the Class A beneficial use alternative depicted in Figure K-11.)

Scenario 2 - Non-EQ residual: Non-EQ residual can only be applied to land that has been evaluated by the Department and approved by Letter of Land Application Management Approval (LLAMA). The LLAMA will detail site-specific restrictions applicable to non-EQ residual and to the site where application will occur. At the time of permit application, the applicant for a NJPDES permit to prepare non-EQ residual must detail the geographic area of distribution and identify any specific land application sites known at that time. The Department will publish notice of the draft NJPDES permit to prepare residual within the geographic area identified by the applicant. The applicant must also provide a notification plan that ensures advance public notice of land application sites not identified at the time of application for the NJPDES permit. Notification must be provided (prior to submission of a LLAMA request to the Department) to all landowners and occupants adjacent to or abutting a proposed residual land application site. This requirement may be satisfied through public notice in a newspaper of local circulation. The Department also requires that a copy of all LLAMA applications be forwarded to the clerk of the municipality in which land application is proposed. The Department will not issue a LLAMA unless all the required public notices have been provided.

The application for a LLAMA shall include information necessary to determine if the proposed residual land application site is appropriate for land application. These requirements are discussed in detail in the Department's Technical Manual for Residual Management.

Less than 3 percent of the State's total sludge production, and less than 11 percent of the amount processed in-State for beneficial use is done so under scenario 2. (Scenario 2 is represented by the Class B beneficial use alternative depicted in Figure K-11). The remaining 32 percent processed in-State for beneficial use is used for landfill daily cover.

New Jersey's residual land application program parallels but is in some ways more stringent than the requirements of the Federal Standards for the Use or Disposal of Sewage Sludge. Based upon factors that include New Jersey's high population density, limited agronomic land base, guidance from Rutgers University on the agricultural and horticultural use of sewage sludge, and the Department's experience in regulating the activity Statewide, New Jersey's program is more restrictive than the Federal rules in the following areas:

- Individual site review and approval (Letter of Land Application Management Approval) is required for each Class B residual land application site and, if determined necessary based on the characteristics of a specific residual, may be required for Exceptional Quality residual land application sites;

- Agronomic Rate applies to Exceptional Quality materials;

- Agronomic Rate is based on any nutrient (including Phosphorous – see the section entitled "Looking Ahead", later in this SSMP);

- Management practices, including nutrient management planning and the requirement to obtain Agricultural Conservation Plans, are required for the land application of Non-EQ residual and for certain bulk applications of any residual product, including Exception Quality;

- Additional requirements can be added by the Department in a permit based on the nature of the residual to be land applied;

- Additional processing steps may be required of processes generating products which create nuisances;

- Pollutants other than those limited by USEPA may be restricted;

- Foreign materials (for example, aeration piping or *Phragmites* rhizomes) must be removed from products prior to their distribution for land application;

- Programs for the land application of septage must include all requirements applicable to sewage sludge. As a result, all septage is, in actuality, processed at wastewater treatment plants – no land application permits have been granted. (See discussion on Department's Policy on Domestic Septage under New Jersey Policy on Land Based Sludge Management section of this SSMP); and

- Minimum quarterly monitoring and reporting.

The Department is committed to maintaining a program that is protective of the citizens, and the resources of New Jersey and continues to refine its program by supporting and reviewing ongoing research, and by continuing a long-standing collaboration with the environmental agencies responsible for residual management regulation in all 50 States. In addition, as

compared to its Federal and most State counterparts, New Jersey has committed a greater number of staff hours to the permitting, oversight and enforcement of the land application program.

Policy on Agricultural Conservation Plans

Appropriate management practices should be instituted to ensure the safe agricultural use of all fertilizers and soil conditioners - whether in the form of residual, other organic amendments, or chemically based fertilizers. Therefore, the Department requires Agricultural Conservation Plans for all Non-EQ and certain EQ agricultural and horticultural applications. Runoff and erosion controls are essential to sound land management. Overland flow increases the potential for contamination of surface waters. Erosion decreases soil productivity and increases sediment loads in streams. Soil conservation practices are designed to slow down velocity of water that flows over the soil surface. Sometimes runoff is inevitable, even from well-protected fields. This is especially true during high-intensity storms and when the soil is frozen. It is for these reasons that the Department has determined that the requirement for an Agricultural Conservation Plan is appropriate except under certain circumstances for EQ residual**.**

The benefits of requiring Conservation Plans include decreased nutrient and soil loss from agricultural and horticultural land which has been identified as a significant contributor of nonpoint source pollution in many parts of the country. This approach is consistent with the Department's direction and the nationwide trends to address total nutrient management planning.

Incineration

Sewage sludge incineration can reduce sewage sludge volume by combustion. The extent of reduction can range to as high as 90 percent of the input sewage sludge (to a sterile ash) through combustion (dependent on the mineral content of the sewage sludge). In addition, sewage sludge incinerators do not require significant land commitment for disposal, operate in all seasons, safely manage almost one-quarter of the State's sewage sludge production without nuisance, and are fully regulated by the Department's Air Pollution Control Program. Based on the above, the Department fully recognizes the role of sewage sludge thermal reduction facilities as an important part of a diversified sewage sludge management strategy.

All thermal reduction facilities require permits from the Air Quality Permitting Program to control air pollution emissions to the atmosphere. Solid Waste Facility permits are not required for sewage sludge-only incinerators. Treatment Works Approvals from the Division of Water Quality are required for all sewage sludge handling and processing equipment (for example, dewatering equipment, storage tanks, and conveyors) prior to the point of incineration. In addition, for new or expanded sewage sludge incinerators, an environmental assessment is required. The review of an Environmental Assessment for a sewage sludge incinerator is a joint effort between the Division of Water Quality and the Air Quality Permitting Program. The Air Quality Permitting Program is responsible for review of potential air impacts, and the Division of Water Quality is responsible for all other aspects consistent with the NJPDES Rules.

The purpose of air pollution control apparatus requirements are to mitigate possible environmental impacts. The air pollution control equipment of a sewage sludge incinerator may include a scrubber which creates a scrubber liquor that needs to be discharged. In most cases scrubber water is returned to the head of the domestic treatment works where it is introduced at a design rate that does not affect the ability of the treatment plant to meet effluent limitations. However, the domestic treatment works must be capable of handling the increase in flow and loading in order to avoid plant upset.

The issuance of air emission permits and associated approvals of emission control devices is predicated on the applicant's disclosure of the quantity and quality of material to undergo incineration and the ability of the emission control devices to achieve air emission standards, while processing the disclosed quantity and quality of material. In order for a sewage sludge incinerator to accept customers, it must be determined that the quantity and quality of the customer residual do not violate the criteria on which the emission permit was based. This determination is made by the Air Quality Regulation Program on a case-by-case basis for each customer source and each specific incineration facility.

Sewage sludge incineration facilities may, however, accept customer sludges without the Department's case-by-case determination, if the emission permit issued to the sewage sludge incinerator so provides. Permits to accept customer residual without Department case-by-case determinations generally require that the emissions be evaluated while the incinerator is operating at maximum design capacity and processing worst case quality residual. Where emission standards can be met under these worst case conditions, approval to burn customer residual may be included in the emission permit.

In addition to the air emissions and scrubber discharges created by sewage sludge incinerators, these facilities also create a solid product that must be managed. In many cases, this solid product is an ash which is landfilled. However, sewage sludge incinerator ash is not required to be disposed in a landfill. Some ashes are suitable for landfill interim or daily cover, or for other uses as approved by the Division of Solid and Hazardous Waste. Sewage sludge incinerator operators are encouraged to develop and seek approval for alternative uses for ash that are consistent with the resource recovery, reuse and recycling goals of the Solid Waste Management Act.

Surface disposal or Landfilling of residual

The State of New Jersey restricts, but does not prohibit, the co-disposal of sewage sludge in a municipal solid waste landfill consistent with the mandates on sewage sludge under the New Jersey Solid Waste Management Act. However, the NJPDES Rules prohibit the surface disposal (or monofilling) of sewage sludge. Since the New Jersey Solid Waste Management Act does not contain similar restrictions on the landfilling (defined as storage for periods of greater than six months) of industrial residual, landfilling of industrial residual is allowed provided the landfill is fully permitted and authorized in accordance with the New Jersey Solid Waste Management Rules.

Nevertheless, all domestic or industrial wastewater or sludge impoundments and lagoons must be designed, maintained and operated to provide for periodic residual removal. This requirement ensures the treatment units do not become surface disposal sites. Where the person who prepares the sewage sludge can explain why the material is being held for longer than six months and can supply documentation of ultimate management, the site would not be considered a surface disposal site.

Landfilling or surface disposal as a mode of waste disposal requires extensive and long-term commitment of land. This mode of sludge disposal must be considered a method of last resort in New Jersey which is the most densely populated State in the Country and has limited land available to be committed for waste disposal. Therefore, the Department restricts the landfilling of sewage sludge to those instances where overriding circumstances, including emergencies, exist. Such circumstances include but are not limited to: (1) influent quality problems at the treatment plant which could render sludge unsuitable for reuse or resource recovery, or (2) unforeseen upsets or operational problems at an approved management site where the generator can prove to the Department's satisfaction that no other suitable alternative exists. Landfilling of sewage sludge under these circumstances will be permitted only as long as the overriding circumstances exist. In addition, the Department will only consider proposals for the temporary landfilling of sewage sludge at approved landfills with a liner and leachate collection system.

Generally, under New Jersey Solid Waste Management Rules, surface disposal sites for industrial residual would be classified as "sanitary landfills." Therefore, permitting for the surface disposal of nonhazardous industrial residual (other than sewage sludge) is accomplished through the New Jersey Solid Waste Management Rules (although a ground water monitoring component is issued under the NJPDES Rules). However, it should be noted that there are several active and inactive nonhazardous industrial residual lagoons and wastewater impoundments that have many years of residual build-up. These lagoons and impoundments have primarily received discharge to groundwater permits under the NJPDES Rules; thus, the NJPDES Rules may provide the most effective and efficient means for closure and/or management of the residual generated. Therefore, the closure of these types of facilities will be conducted through the NJPDES Rules as opposed to the New Jersey Solid Waste Management Rules.

Reed beds

The Reed Bed system of residual management combines the action of conventional drying beds with the effects of aquatic plants upon water-bearing substrates. While conventional drying beds are used to drain 20-25 percent of water content from sewage sludge, the resultant residue must be hauled away for further treatment. By having the drying beds built in a specific manner, the beds can be planted with reeds, and further desiccation of the residual is accomplished through the plants' voracious demand for water. To satisfy this demand, the plants extend their root systems continually into the residual deposits. The extended root system causes the establishment of a rich microflora that feeds upon the organic content of the residual. Aerobic conditions needed by the microflora are created through the root action of the plants. Eventually substantial portions of the residual solids are converted into carbon dioxide and water with a

corresponding volume reduction. These drying beds can be operated for over five years before the remaining residues have to be removed.

The Department issued a NJPDES General Permit incorporating the process and monitoring requirements for Phragmites Reed Beds in December 2002. The Reed Bed General Permit provides a streamlined process for applying for and seeking authorization to operate this type of residual treatment system. In order to qualify for coverage under the general permit a domestic treatment works must limit loadings to the Reed Beds based on the type of sewage sludge (for example, anaerobically or aerobically digested) and the total solids of the sewage sludge discharged. The maximum total solids allowed under the general permit are 3 percent for aerobic sludges and 7 percent for anaerobic sludges. Persons seeking authorization under the general permit shall submit to the Department a written request for authorization as detailed in the general permit.

Residual Transfer Stations

Transfer stations are not a method of ultimate residual management. However, such transfer programs can produce significant transportation cost savings, and eliminate unnecessary truck traffic. In this way, trucks can be dispatched to collect septage and sludge from small generators, and fewer large trucks are needed to haul residual from the transfer station to ultimate management sites.

The New Jersey Water Pollution Control Act authorizes the Department to prepare, adopt, amend, repeal and enforce reasonable codes, rules and regulations which may include, but shall not be limited to, provisions concerning the storage of any liquid or solid pollutant in a manner designed to keep it from entering the waters of the State.

As previously discussed, under Solid Waste Rules, the Department has exempted all types of sewage sludge management equipment and operations from solid waste permitting, including residual transfer stations, except those which co-process or co-dispose sewage sludge with municipal solid waste.

Exempted sewage sludge management equipment and operations are still required to comply with Treatment Works Approval requirements under the NJPDES Rules in lieu of a solid waste engineering design approval. Air quality permits are also required, where applicable.

Operational and reporting requirements for residual transfer stations include procedures for routine inspection of structural integrity, spill control and emergency response. Submission requirements for the NJPDES permit include site information including, but not limited to, topography, proximity to surface water, critical areas, proximity of neighboring development, roads and plot plans.

The Department has excluded from regulation as a residual transfer station those operations which transfer closed residual transport containers directly from vehicle to vehicle, including truck to train. Based on the operational history of such facilities, it is not necessary to control

such activities through issuance of a NJPDES permit; however, requirements under the Solid Waste Rules do apply.

The Department has issued a NJPDES General Permit for residual transfer stations. This General Permit provides a streamlined process and limited monitoring for relatively small residual transfer stations (defined as having less than 50,000 gallons total storage capacity). In order to qualify for coverage under the general permit, a residual transfer station must limit storage capacity to less than 50,000 gallons, provide no treatment, and accept only liquid residual of domestic origin. Persons seeking authorization under the general permit shall submit to the Department a written request for authorization as detailed in the general permit.

K.6. Looking Ahead

The use of biosolids has been one of the most extensively studied waste management practices in the United States. Some public uses have occurred in the United States for more than 80 years. Throughout this long history of use, biosolids have repeatedly been shown to be a valuable soil conditioning and fertilizing product. Despite the successes, questions continue to be raised with regards to the safety of biosolids use. While many of these questions have already been answered, this information is often published in academic journals and textbooks, and is not necessarily readily available to the public.

One common misconception is that testing for contaminants is limited to nine heavy metals. As previously discussed in this SSMP under the section on Residual Quality, the Department has a historic database on residuals quality, with data on over 125 parameters including many organic compounds, including certain pesticides. By far, most of the organic compounds have <u>not been detected</u> in biosolids, or have been detected in less than 5 percent of all samples. The Department will continue to monitor the quality of residual generated for these compounds, and will work with New Jersey Certified Laboratories to consistently improve levels of detection.

Extensive feeding studies with biosolids, composts, and crops grown on biosolids amended soils have been conducted. It has become generally accepted that only field data from the actual long-term use of sewage sludge can provide data appropriate for risk assessment and environmental regulation. Research using metal salts, massive single applications, pots of soil, and greenhouses have been found to over-estimate risk. Field research to date supports the agronomic use of high-quality biosolids.

The Department re-evaluates its regulations on a regular basis to ensure they are still appropriate and protective. To that end, new research is conducted and used for making those determinations. In this regard, biosolids regulation is no different than drinking water standards, wastewater effluent standards, or any other regulatory program. What follows is a discussion of several areas the Department has identified as needing further study. The Department is committed to working on these issues.

National Research Council Recommendations

The final report prepared by the National Research Council (NRC) entitled Biosolids Applied to Land: Advancing Standards and Practices, July 2002, was requested by the United States Environmental Protection Agency to help address questions and the requirement for periodic reassessment of the 40 CFR Part 503 rule. A final EPA response on how they plan to proceed in addressing the recommendations of the NRC report was published in the December 31, 2003 Federal Register.

As stated in the report Summary, the NRC's overarching findings were that "there is no documented scientific evidence that the Part 503 rule has failed to protect public health. However, additional scientific work is needed to update the science to (1) ensure chemical and pathogen standards are supported by current data and risk assessment, (2) demonstrate effective enforcement of rule, and (3) validate effectiveness of management practices (for example, setback distance to surface water)."

Specifically, the NRC recommends that "(1) improved risk-assessment methods which have been advanced over the past decade be used to update the scientific basis for standards for chemicals and pathogens, (2) a new national survey of chemicals and pathogens in sewage sludge be conducted, (3) a framework for an approach to implement human health investigations be established, and (4) increase resources devoted to EPA's biosolids program." Other key recommendations of the NRC report include:

a. Additional "risk-management" practices should be considered: setbacks to residences or businesses, setbacks to private and public water supplies, limitations on holding or storage practices, slope restrictions, soil permeability and depth to groundwater or bedrock, and greater distance to surface water. (It should be noted that New Jersey already has more stringent management practices in place. These management practices are explained in detail in the Department's Technical Manual for Residual Management.)

b. Alternatives need to be viewed holistically, that is, if all land application should cease, how would the overall risk be altered if additional landfills, surface disposal sites, and incinerators were constructed and operated to accommodate the additional volumes.

c. Exemptions from nutrient management and site restrictions for land application of bulk EQ biosolids should be eliminated. (It should be noted that New Jersey already requires compliance with agronomic rate for EQ biosolids as well as additional site restrictions depending on the type of market outlet (for example, agricultural, topsoil blending, reclamation) used.)

d. A revised multipathway risk assessment is recommended with particular attention paid to arsenic and indirect pathways for cadmium and mercury.

e. It is important for EPA to continually think about the types of chemicals released into wastewaters and added during wastewater and sewage sludge treatment as part of its process for updating the Part 503 rule. Particular attention should be paid to those compounds that are organochlorines (persistent and biomagnification), and lipophilic (more likely to partition to sewage sludge).

In summary, the Federal Standards for the Use or Disposal of Sewage Sludge are over a decade old. It is prudent that the standards established be reevaluated against current risk-assessment practices and scientific knowledge. In general, the Department endorses the findings and recommendations made in the report prepared by the National Research Council. As demonstrated in this SSMP, in most cases the actual concentrations of the regulated contaminants in biosolids generated in New Jersey are well below the regulatory limits. Additionally, New Jersey has already adopted more stringent general requirements and management practices.

The Department remains committed to ensure that the land application of biosolids is conducted in a manner that is protective of public health and the environment. The Department is also committed in ensuring that stakeholders have a role and that their valid concerns are addressed. To this end, the Department was an active participant at the Biosolids Research Summit held during August 2003. The Department will remain active in assisting all stakeholders in moving forward to implement the ambitious research agenda that was identified during this summit.

Phosphorus

Historically, residual application rates have been based on either the available nitrogen content of the residual correlated with the nitrogen requirement of the crop to be grown, or the liming equivalency of the residual correlated with the pH of the soil, whichever was more limiting. The renewal of the NJPDES regulations in 1997 provided the opportunity for a change in the manner in which residual application rates could be calculated. Bulk residual (i.e., not bagged) was to be applied at a rate equal to or less than the agronomic rate. The agronomic rate is an application rate calculated using the most limiting nutrient needed by the crop to be grown, or the liming rate to neutralize soil acidity if more limiting than the nutrient application rate.

In residuals, the phosphorus content is approximately twice that of the available nitrogen content, and crops typically remove much less phosphorus than nitrogen (concentration of a plant leaf is about 2 percent nitrogen and 0.25 percent phosphorus, NRCS Agricultural Waste Management Field Handbook). Therefore, the most controlling factor in determining application rate is usually phosphorus, and land-applying residual at the nitrogen requirement of the crop can result in phosphorus application rates in excess of what the crop can remove. Phosphorus is readily adsorbed to soil particles so this excess phosphorus accumulates in the soil, with the potential to cause a problem in surface water if run-off is not controlled.

The Department has historically required soil fertility test results be obtained from each agricultural and horticultural field prior to distribution of Class B marketable residual products (and annually thereafter) and is moving to require the same level of testing for distribution of Class A bulk marketable residual products. The results of the soil fertility test are used to project if, or how much residual is required for optimum crop growth. Soil fertility test results are not a direct measurement of the total plant available nutrient content of a soil but rather an index of soil nutrient availability that is correlated with plant response. The results (in lbs/acre) from different soil test extraction methods are based on different indices and are therefore not comparable. The Department currently limits the soil fertility test extraction method to the

Mehlich-3 method, which is recommended by Rutgers Cooperative Extension as the most appropriate for New Jersey soils.

The phosphorus soil fertility test results and distance of the edge of a field to surface water will determine the method to calculate residual application rates. If a field has a soil test phosphorus level below 200 ppm (400 lbs/acre) and has a minimum 200-foot buffer to surface water, the nitrogen or liming requirement will continue to be utilized to calculate residual application rates. If a field has either a soil test phosphorus level greater than 200 ppm or is closer than 200 feet to surface water, a Nutrient Management Plan (NMP) must be developed and implemented prior to residual application.

A NMP is a plan prepared by a certified nutrient management consultant to manage the amount, placement, timing, and application of animal waste, commercial fertilizer, biosolids, or other plant nutrients to prevent pollution transport of bioavailable nutrients (i.e. phosphorus and nitrogen) and to maintain field productivity. A NMP for residual must contain a Phosphorus Index (PI) component. The PI is a field evaluation tool that evaluates the relative risk of surface water impacts from the phosphorus contained in land applied residual, determines where residual application can occur, and if the residual application rate will be nitrogen or phosphorus based.

Odor

The stability of biosolids is a concern in both residential and non-residential areas. Biosolids are increasingly being beneficially used and applied to rural and residential areas as soil conditioners and fertilizers. The control of odors associated with biosolids is extremely important because of the public's increased proximity to biosolids and negative reaction to these odorants.

To help better understand the causes of odor generation in biosolids, and to help develop solutions to reduce odors in residual products, the Department entered into a joint research project with the Pennsylvania Department of Environmental Protection and the Pennsylvania State University. This research project focused on the analysis and identification of odorous compounds released from biosolids. Air sampling and analysis with a standardized method for gas chromatography and mass spectrometry has been used to identify the malodorous compounds released from sewage sludge. Odorous emissions from biosolids processes have been quantified and reported. An odor index has been developed and documented to allow comparison of the odorous emissions from different types of stabilization processes and products. The effect of treatment technique on biosolids status (Class A, B or unclassified), pH, and odorous emissions has been evaluated. Tests have been conducted to monitor the stability characteristics prior to treatment, immediately after the prescribed treatment period, and for a period of 60 days thereafter. As discussed below, all applicants for a NJPDES permit for land application are required to demonstrate the characteristics of the marketable residual product to be produced with regards to the potential to create odors. This research project has provided biosolids managers with a new tool to address and reduce biosolids odors. The Department will consider rule changes to require use of the odor index on new proposals, and on existing products that have been documented to be a nuisance.

As previously discussed in this SSMP, the National Research Council released a report entitled Biosolids Applied to Land: Advancing Standards and Practices at the request of the USEPA. The NRC report recognized that additional studies are needed to identify odorants typically released from biosolids. The NRC report also recognized that there is a need to determine the range of likely air concentrations near biosolids application sites, and that particular attention should be paid to the degree to which effective biosolids treatment reduces odorant concentrations and impacts.

In addition to ongoing research, the Department has already implemented regulatory requirements to address residual products that may, or have been found to, create a nuisance. The Department has found that certain residual products have the potential to create a nuisance. The Department has exercised its authority under the NJPDES Rules (specifically, N.J.A.C. 7:14A-20.5(a)iii) to require site specific approvals or other product specific restrictions in order to control odors. As a result, the Department requires information that new residual products will meet marketable residual product standards and that the product will not exhibit nuisance characteristics.

For example, it has been the Department's experience with the distribution of marketable residual products that there is a relationship between the maturity of the product and its potential to create an odor and a nuisance upon distribution. The Department typically requires a 30-day curing period following the active phase of the sewage sludge composting process. During this 30-day period, further decomposition, stabilization and degassing take place, which help to make the compost more marketable.

Excessive moisture, excessive temperature and excessive dustiness are undesirable in a material that has otherwise met all Federal and State criteria for pathogen and vector attraction reduction. The proper maintenance and handling of marketable residual products subsequent to achievement of the Federal criteria will reduce nuisance characteristics and the related release of undesirable odors. Thus, it is important for an applicant to demonstrate a thorough understanding of the proposed system, and to provide a written proposal to optimize the characteristics of the marketable residual product produced, including temperature, pH, and total solids to reduce the potential for the creation of odor. The NJPDES Rules allow for the denial of applications for new permits and for permit renewals to operate systems of technologies known to create nuisance products.

The Department requires the production and land application of a particular residual to be successfully tested or demonstrated in a pilot program. Once this has been accomplished, the Department may permit the process on an experimental basis. The applicant is required to prove that the experimental system reliably produces the intended marketable residual product, that this product has viable field applications, and that these field applications represent a viable market that can be reached without introducing air contaminants (including odors) to the public. The Department's intent is to develop additional residual land application programs, through closely controlled applications, to evaluate their usefulness on a large scale. Ultimately, a sufficient database will have to be collected from the pilot program in order for the Department to determine the adequacy or appropriateness of a larger scale program.

Mercury

Mercury concentrations reported in sewage sludge represent total mercury. It is likely that much of the mercury present in wastewater discharges is present in the divalent (Hg^{++}) form, since other forms are not as soluble. There could be some mercury that is associated with suspended solids in the effluent. Mercury species in air emissions from incinerated sludge may be similar to those from other combustion sources. Limited estimates of the species of mercury emitted from combustion sources suggest that elemental mercury, oxidized gaseous species, such as $HgCl_2$, and species bound to particulates are present.

The median mercury concentration in sewage sludge has dropped over 50% in the past 19 years (see Table K-1). Although data are not readily available to pinpoint all reasons for this decline, the following actions have apparently played a significant role:

a. The Industrial Pretreatment Program has reduced the amount of mercury and other pollutants allowed to be discharged from permitted industries to domestic treatment works.

b. The Pollution Prevention Program has provided industries with incentives to reduce the amounts of regulated waste produced through process changes and/or substitution.

c. Mercury has been removed from household products (e.g., latex paint) that often found their way into domestic treatment works collection/treatment systems.

d. More stringent clean up and spill reporting procedures for mercury spills/breakage for sources ranging from schools to research facilities have been implemented.

e. Other products and/or technologies have gradually been substituted for historically mercury based products, e.g., electronic thermometers, blood pressure measuring instruments, etc.

The New Jersey Mercury Task Force completed their recommendations for reducing mercury impacts to the environment in November 2001, and the three volume Mercury Task Force Report was released to the public during January 2002. Included in the Mercury Task Force report were the following source reduction and pollution prevention recommendations:

a. Phase out use of mercury-containing amalgam for dental fillings coupled with drain traps until phase out is complete.

b. Develop a public education program among identified cultural/ethnic groups to reduce use of mercury in ceremonial and/or cultural practices.

c. Increase public awareness programs to all medical practitioners, medical institutions, research facilities, educational facilities/institutions and testing laboratories, stressing the proper clean-up of breakage and spills as well as proper handling methods.

d. Phase out use of mercury in other products that could find their way into wastewater; thus, subsequently the sewage sludge generated.

e. Develop a central clearinghouse to keep abreast of national and international developments that chronicle the elimination, substitution, or reduction of mercury in products or processes. Provide this information to appropriate in-State end users.

Nationally, there is a downward trend in the use of mercury in products, with many uses having been discontinued over the last two decades. It is believed that this trend will continue. Source reduction options such as those discussed above should ensure the continuation of the downward trend in the use of mercury in products, which should translate to a declining concentration of mercury in sludge.

Domestic treatment works are a passive recipient of mercury from residential, commercial, and industrial source activities. Sewage sludge typically contains mercury in the parts per million (mg/kg) range. Using existing authority, domestic treatment works can help reduce influent mercury by limiting concentrations in incoming wastewater streams through the establishment of technically based local pretreatment limits, which they can impose on non-domestic users to achieve compliance with applicable environmental endpoints.

Domestic treatment works, most of which are publicly owned, would be positively affected by programs that sought to limit the amount of mercury passing through and subsequently released, either in sludge, wastewater effluent, or air emissions. Many of New Jersey's domestic treatment works report concentrations of mercury in their sludge at or near the detection limit. In fact, the median concentration of mercury in New Jersey sewage sludge is 1.47 mg/kg (see Table K-3).

The Department intends to establish a workgroup to conduct surveys and studies to gather information on the causes of mercury discharges into wastewater treatment plants.

The Department is working with the sewerage authorities that operate sewage sludge incinerators to reduce permitted mercury concentrations in their Air Pollution Control Operating Permits to reflect reductions in mercury concentrations in sewage sludge. Depending upon the degree of success of ongoing and anticipated mercury reduction initiatives, the Department may develop rules to further restrict the mercury content of sewage sludge being incinerated or require add-on control for mercury emissions from sewage sludge incinerators.

Radionuclides

There are currently no Federal concentration limits for radionculides in land-applied sewage sludge. Because New Jersey has elevated levels of naturally occurring radionuclides in groundwater, they may be present in sludge that is land-applied. The Department has adopted rules that establish remediation standards for radium and other radionuclides in soil (N.J.A.C. 7:28-12). In addition, the Department has recently adopted a more stringent standard for radionuclides in drinking water than the USEPA. This has resulted in community and non-community water systems being out of compliance with the radionuclide drinking water standards. Removing radium from drinking water could generate a concentrated waste stream that may be discharged to the sewage treatment plant. These recent developments have made it

necessary to evaluate radionuclides in biosolids. The Department plans to work closely with biosolids and other residual generators to determine the impacts on residual quality from radium and other naturally occurring radionuclides.

In 1983-89, the US Geological Survey[1] conducted a study of the effects of geology, geochemistry, and land use on the distribution of naturally occurring radionuclides in ground water in the aquifer system in the Coastal Plain of New Jersey. They concluded that leaching of uranium and radium from the minerals of the Bridgeton Formation (predominantly gravel) is suspected to be a source of the radium in the ground water. The correlation of radium concentration with the concentrations of chemical constituents added to soil in agricultural areas indicates that leaching of radium may be enhanced by the chemical processes in ground water that are associated with the addition of agricultural chemicals to the geochemical system.

Public drinking water supplies depend upon ground water as their source of water in the Coastal Plain. The naturally occurring radionuclides in these drinking water supplies ultimately find their way to wastewater treatment facilities either via the sewer in those areas that are sewered or by the haulage of domestic septage from non-sewered areas. Some of these drinking water supplies have radium levels that exceed the drinking water standard for radionuclides. In treating the drinking water to remove the radium, a wastewater is created, which contains the radium that is removed. If this wastewater is discharged to the sanitary sewer, the radium will become reconcentrated in the sewage sludge produced by the treatment plant. Considering the potential uncontrollable contribution of radionuclides to some wastewater treatment facilities, in order to protect sludge quality, the Department will have to focus much greater attention to reduce those discharges of radionuclides that can be considered controllable. For example, rather than treating the radium in groundwater, it might be possible to find an alternative water supply that is low in radium. If an alternate water supply is unavailable, other treatment options could be investigated that either do not have a discharge, or that have a less concentrated discharge. Although radionuclides in domestic septage in those areas of the State with high groundwater radionuclide concentrations are largely uncontrollable, the Department would need to evaluate whether it could control which wastewater treatment facilities receive the domestic septage.

The Department has collected data, through a grant from the USEPA, on naturally occurring radionuclides in residual, especially biosolids to be land applied. In addition, radionuclides are being evaluated on a national level by the Interagency Steering Committee on Radiation Standards (ISCORS), Sewage Sludge Subcommittee, composed of representatives from the USEPA, Nuclear Regulatory Commission, Department of Energy, Department of Defense, State of New Jersey, the city of Cleveland and the County of Middlesex, New Jersey. A draft report was released in November 2003, and the final report to include guidance and recommendations for the management of sewage sludge with radionuclides is anticipated sometime during 2005. After sufficient data has been obtained, and after receipt of the final ISCORS report, the Department will determine if there is a need to propose amendments to the SQAR and/or the

1 Kozinski, J., Szabo,Z., Zapecza, O.S., and Barringer, T.H., 1995, *Natural Radioactivity in, and Inorganic Chemistry of, Ground Water in the Kirkwood-Cohansey Aquifer System, Southern New Jersey, 1983-89,* US Geological Survey Water-Resources Investigations Report 92-4144, West Trenton, NJ.

NJPDES Rules to incorporate monitoring requirements, and potentially numeric standards, for radionuclides.

Dioxins

In December 1999, the United States Environmental Protection Agency proposed to amend the Federal Standards for the Use or Disposal of Sewage Sludge by adding a numeric concentration limit for dioxins in land-applied sewage sludge. Based on the initial risk assessment, the proposed limit would prohibit land application of sewage sludge that contains more than 300 parts per trillion toxic equivalents (TEQ) of dioxins. EPA proposed this limit to protect public health and the environment from unreasonable risks of exposure to dioxins.

On October 24, 2003 the USEPA announced their decision not to regulate dioxin in land-applied sewage sludge. After five years of study, the USEPA concluded that dioxin from biosolids does not pose a significant risk to human health or the environment. The USEPA instead will encourage proper biosolids handling and management.

Since the 1999 proposal, both the USEPA and the Association of Metropolitan Sewage Agencies (AMSA) have conducted surveys to update information on the concentrations of dioxins in sewage sludge. Samples from these surveys indicate biosolids from most domestic treatment works are below 100 ppt TEQ. However, these surveys also had "outliers", with the highest concentrations of each survey at 718 and 3,590 ppt TEQ, respectively.

The Department felt it would be prudent to test biosolids that are land applied in New Jersey for dioxin. Therefore, the Department applied for a grant from the USEPA to collect data on the presence of dioxin compounds in New Jersey sewage sludges. Based on the results of these analyses, the Department will recommend a course of action. The Department expects the sampling, analysis, and evaluation of the results to be finished by the summer of 2005.

Below is a list of important links where additional information on sewage sludge and biosolids can be obtained:

1. The New Jersey Department of Environmental Protection, Division of Water Quality's WebPage for Information on Residual: http://www.state.nj.us/dep/dwq/sludge.htm

2. The U.S. Environmental Protection Agency's Office of Wastewater Management WebPage on Biosolids: http://www.epa.gov/owm/mtb/biosolids/index.htm

3. The U.S. Environmental Protection Agency's Office of Water Science WebPage on Biosolids – See the NRC/NAS Report: Biosolids Applied to Land: Advancing Standards and Practices: http://www.epa.gov/waterscience/biosolids/

4. The U.S. Environmental Protection Agency's Office of the Inspector General WebPage. Visit the link to perform a search on 'biosolids' for relevant publications: http://www.epa.gov/oigearth/

5. See the March 28, 2002 Status Report on the Land Application of Biosolids (2002-S-000004): http://www.epa.gov/oig/reports/2002/BIOSOLIDS_FINAL_REPORT.pdf.

6. The Rutgers Cooperative Extension WebPage of Publications: http://www.rce.rutgers.edu/pubs/

7. The U.S. Department of Agriculture's Natural Resources Conservation Service WebPages (Links to Soils Information and the Electronic Field Office Technical Guide 'eFOTG'): http://soils.usda.gov/ and http://www.nrcs.usda.gov/technical/efotg/

8. The National Biosolids Partnership's WebPage: http://biosolids.org/

9. The Mid-Atlantic Biosolids Association's WebPage: http://biosolids.policy.net/maba/

10. The Water Environment Federation's WebPage: http://www.wef.org/

11. The New Jersey Water Environment Association's WebPage: http://www.njwea.org/

12. The U.S. Environmental Protection Agency's WebPage on Analytical Method-846 for Solid Waste (SW-846): http://www.epa.gov/epaoswer/hazwaste/test/main.htm

13. The Interagency Steering Committee on Radiation Standards (ISCORS) WebPage - United States Environmental Protection Agency & United States Nuclear Regulatory Commission: http://www.iscors.org/

14. The Centers for Disease Control and Prevention's National Institute for Occupational Safety and Health (NIOSH) WebPage – Visit the link to perform a search on 'biosolids' for relevant publications): http://www.cdc.gov/niosh/homepage.html

15. The National Academies' WebPage, a Publication on "The Science of Recycling Sewage Sludge": http://www4.nationalacademies.org/onpi/oped.nsf/(Op-EdByDocID)/5ED2E11CD195F1C285256C2C00613208?OpenDocument

16. The New Jersey U.S. Geological Survey WebPage: http://wwwnj.er.usgs.gov/

17. The New Jersey Pinelands Commission WebPage: http://www.state.nj.us/pinelands/

18. The Pennsylvania Department of Environmental Protection's WebPage on Biosolids: http://www.dep.state.pa.us/dep/biosolids/biosolids.htm

19. The Pennsylvania Nutrient Management WebPage: http://panutrientmgmt.cas.psu.edu/

20. The Penn State University's College of Agricultural Sciences, Cooperative Extension WebPage: http://www.extension.psu.edu/

21. The New York State Department of Environmental Conservation's WebPage on Biosolids: http://www.dec.state.ny.us/website/dshm/redrecy/orgwste.htm

22. The Maryland Department of the Environment's WebPage on Sewage Sludge Utilization: http://www.mde.state.md.us/permits/wastemanagementpermits/sewagesludge/

23. The Delaware Department of Natural Resources and Environmental Control's WebPage: http://www.dnrec.state.de.us/dnrec2000/

24. The Virginia Department of Health's Biosolids WebPage: http://www.biosolids.state.va.us

25. The Virginia Cooperative Extension's WebPage – Visit the link to perform a search on 'biosolids' for relevant publications: http://www.ext.vt.edu/

26. See the Agricultural Land Application of Biosolids in Virginia: Risks and Concerns: http://www.ext.vt.edu/pubs/compost/452-304/452-304.html

27. The New England Interstate Water Pollution Control Commission's WebPage: http://www.neiwpcc.org

28. The New England Biosolids and Residual Association's WebPage: http://www.nebiosolids.org/intro.html

29. The Environmental Health Perspectives' WebPage, a Publication on "Biosolids": http://ehpnet1.niehs.nih.gov/docs/1997/105-1/focusbeauty.html

30. A Measurement Conversion WebPage: http://www.convertit.com/Go/ConvertIt/

31. A Topographic Map WebPage: http://topozone.com/

Figure K-1
New Jersey Sewage Sludge Management History

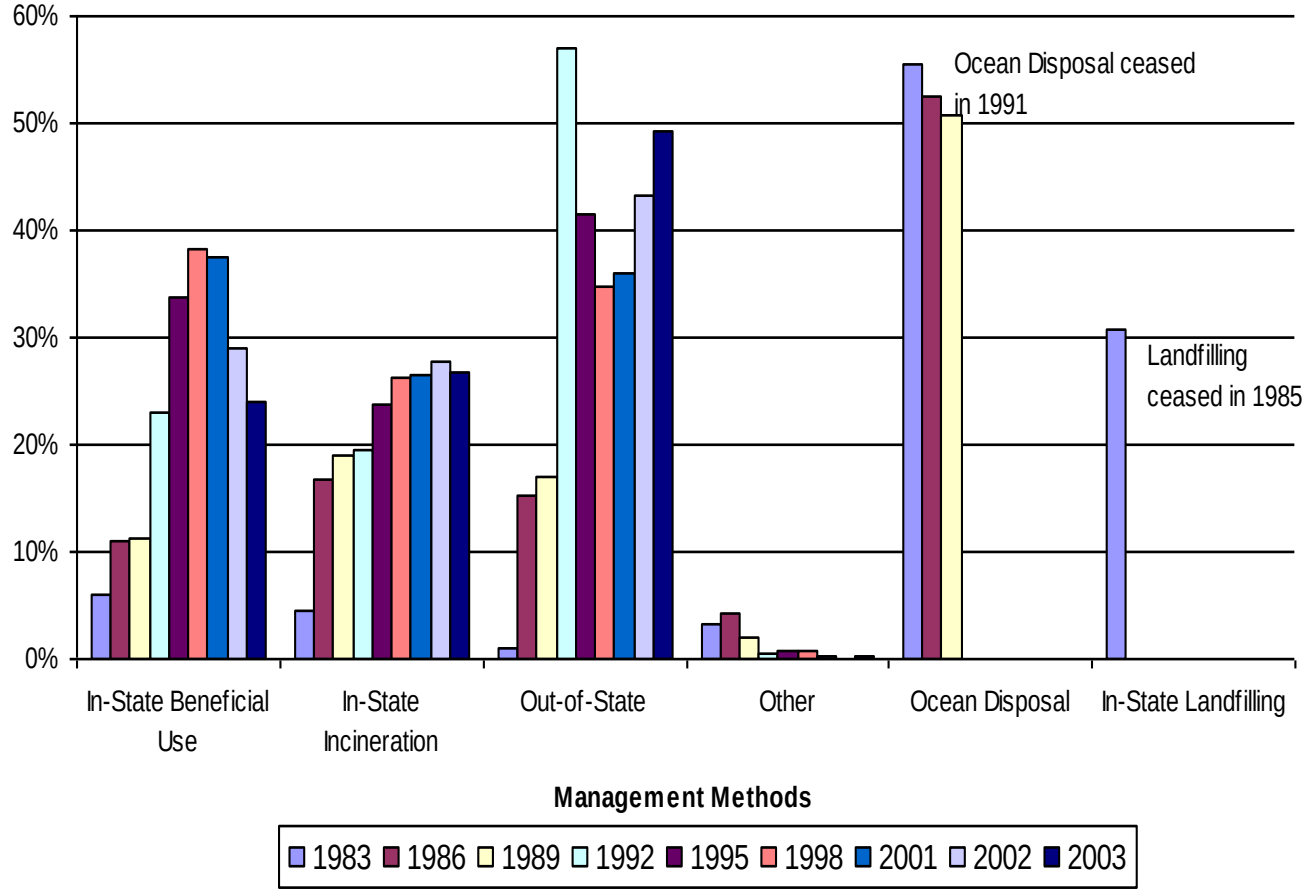

Figure K-2
Out-of-State Management of Sewage Sludge

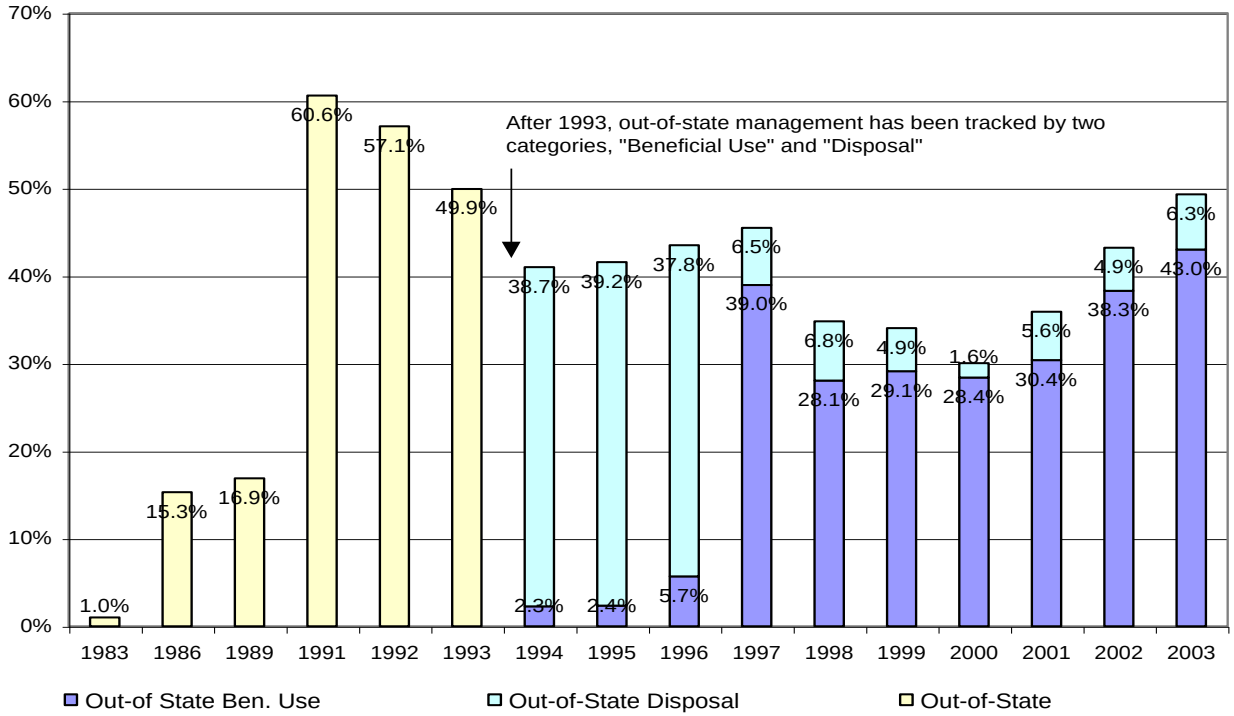

TABLE K-3 - New Jersey Median Sludge Quality (1983 - 2003)

PARAMETER:	Year	CAT 1[1]	CAT 2[1]	CAT 3[1]	CAT 4[1]	CAT 5[1]	Number of Samples	Percent of Samples w/ Detects (%)	STATEWIDE MEDIAN (mg/kg)
Arsenic:	1983	2.09	2	2.5	3.05	3.52	NA	NA	2.7
	1994	2.79	3.11	2.52	3.06	2.8	NA	NA	2.85
	1997	4.19	4.02	3.33	4.92	4.77	1183	61.4	4.33
	2001	4.31	3.59	3.9	4.695	NA	1003	43.0	4.4
	2002	6.66	5.63	4.38	4.96	NA	1060	56.0	5.0
	2003	5.08	4.35	4.14	5.03	NA	1077	49.1	4.86
Cadmium:	1983	7.38	2	10.1	9.9	11.45	NA	NA	9.4
	1994	6.6	4.9	4.9	5.68	6.53	NA	NA	5.63
	1997	3	3.85	3.3	3.36	5.4	1185	65.2	3.5
	2001	2.63	1.965	2.67	2.845	NA	1006	62.0	2.7
	2002	2.25	1.93	2.29	2.52	NA	1061	58.7	2.4
	2003	2.22	1.95	2.06	2.75	NA	1077	60.7	2.48
Chromium:	1983	33.6	29	88.83	115	600	NA	NA	93
	1994	27	23	27	39	88	NA	NA	39
	1997	19.7	25	20	29.6	42.4	1185	89.3	25.99
	2001	15.1	14.3	22.25	28.85	NA	1008	92.5	24.45
	2002	13.81	14.8	21.0	30.95	NA	1061	93.0	24.8
	2003	15.6	15.7	20.95	26.4	NA	1077	93.1	22.4
Copper:	1983	697	657	949	776	1170	NA	NA	825
	1994	594	679	658	667	819	NA	NA	679
	1997	524	669	662.8	621.5	832	1185	99.2	627.8
	2001	500	538	667	527	NA	1009	99.8	552
	2002	518.2	546.5	700	569.5	NA	1062	99.4	583.5
	2003	496	588	581.5	532	NA	1077	99.6	545
Lead:	1983	127	122	195	196	411	NA	NA	210
	1994	100	74	86	108	137	NA	NA	100
	1997	62	75.8	57.1	64.5	82	1186	84.8	65.22
	2001	40.18	25.25	44.2	53.8	NA	1009	93	48.5
	2002	38.5	27.7	46.9	58.85	NA	1061	91.3	52.2
	2003	30.2	26.8	36.8	54.4	NA	1077	92	43.7
Mercury:	1983	1.3	2.9	5	3.25	3.77	NA	NA	3.6
	1994	2.08	2.24	2.5	2.4	2.29	NA	NA	2.34
	1997	1.74	1.96	2.2	1.65	2.89	1185	78	1.93
	2001	1.04	1.23	1.88	1.74	NA	1007	91	1.66
	2002	1.1	1.22	1.88	1.95	NA	1062	90.2	1.8
	2003	0.79	1.19	1.47	1.62	NA	1077	88.3	1.47
Molybdenum:	1983	NA	NA	NA	NA	NA	NA	NA	NA
	1994	15.3	20	12.16	14.9	15.2	NA	NA	15.03
	1997	12.8	20.8	12	9.6	16.3	1183	60.5	12.6
	2001	18.7	8.52	11.55	10.86	NA	1007	62	11.1
	2002	16.5	8.71	12.6	11.33	NA	1059	67.3	11.5
	2003	14.05	8.35	12.1	11.0	NA	1076	64	11.0
Nickel:	1983	29.5	34	49.5	43.15	90	NA	NA	45.8
	1994	31	26	26	30	48	NA	NA	31
	1997	18	27.2	23.2	24.1	33	1185	86.5	23.41
	2001	15.2	12.2	18.9	21.35	NA	1009	92	18.7
	2002	15.9	12.7	19.2	22.1	NA	1061	92.0	19.3
	2003	16.3	13.2	17.45	22.5	NA	1077	91.4	19.05

PARAMETER:	Year	CAT 1[1]	CAT 2[1]	CAT 3[1]	CAT 4[1]	CAT 5[1]	Number of Samples	Percent of Samples w/ Detects (%)	STATEWIDE MEDIAN (mg/kg)
Selenium:	1983	NA	NA	NA	NA	NA	NA	NA	NA
	1994	2.38	2.7	2.4	1.74	1.3	NA	NA	2.07
	1997	4.8	4.83	3.08	5.74	5.78	1184	66.2	4.91
	2001	7.38	6.11	6.92	7.27	NA	1007	43	7.02
	2002	10.08	6.81	7.72	6.59	NA	1060	52	7.1
	2003	9.66	6.76	7.28	6.91	NA	1077	48.6	7.11
Zinc:	1983	803	825	1200	1010	2300	NA	NA	1110
	1994	904	684	738	846	999	NA	NA	826
	1997	674	666	740	936	1000	1185	98.9	809.89
	2001	745.6	574	785	901.5	NA	1007	99.8	832
	2002	836.25	629.5	737	1015	NA	1062	99.3	869.5
	2003	702	705	678	936	NA	1077	99.99	820

Notes for Table K-3:

[1] Denote the SQAR reporting category as follows:

Cat 1: domestic treatment works with a permitted flow less than 0.1 MGD.
Cat 2: domestic treatment works with a permitted flow of 0.1 to 0.999 MGD.
Cat 3: domestic treatment works with a permitted flow from 1.0 to 4.999 MGD.
Cat 4: domestic treatment works with a permitted flow equal to or greater than 5.0 MGD.
Cat 5: domestic treatment works with a flow to which more than 10 percent of the permitted daily flow or the permitted daily mass loading of BOD, COD or Suspended Solids is contributed by SIUs. (This category was deleted in the 1999 readoption of the SQAR.)
Notes: Due to large ranges reported for some parameters there is a considerable difference in magnitude between mean and median values. The true central tendency for the concentration is better represented by the median than by the mean value. For determining median concentrations, if analytical testing did not yield a pollutant concentration above the minimum detection level**, the pollutant concentration was assumed to be the minimum amount of pollutant that could be measured. Equating undetected data points to their minimum detection level is a conservative assumption since it tends to overestimate pollutant concentrations**. The percent of detected samples is indicated on the table.

TABLE K-4 - NEW JERSEY 2003 SLUDGE QUALITY

Parameter	Number of Samples	New Jersey Median (mg/kg)	New Jersey % Samples detected over High Quality	EPA / NJDEP "High Quality" (mg/kg)	Rutgers Cooperative Extension Suggested Limits (mg/kg)
Arsenic	1077	4.86	0.4%	41	41
Cadmium	1077	2.48	0.7%	39	21
Chromium	1077	22.4	NA	No limit	1200
Copper	1077	545	3.6%	1500	1500
Lead	1077	43.7	3.5%	300	300
Mercury	1077	1.47	0.9%	17	17
Molybdenum	1076	11.0	1.9%	75	18
Nickel	1077	19.05	0%	420	420
Selenium	1077	7.11	0%	100	28
Zinc	1077	820	7.3%	2800	2800

Table K-5: EXISTING SLUDGE PRODUCTI0N BY MANAGEMENT MODES (DMT/YR):

For the Calendar Year 2003

	OTHER	INCIN. (CUST.)	INCIN. (OWNER)	CLASS A BEN USE	CLASS B BEN USE	IN-STATE BEN USE LF COVER	OUT OF STATE BEN USE	OUT OF STATE DISPOSAL	COUNTY TOTAL
Atlantic	0.0	362.9	8790.9	184.1	0.0	0.0	0.0	0.0	9337.9
Bergen	0.0	299.8	2321.1	0.0	0.0	0.0	10109.1	0.0	12730.0
Burlington	38.0	966.0	0.0	8012.8	575	0.0	0	2087.9	11679.7
Camden	3.4	5583.7	0.0	831.0	2399.0	0.0	0.0	4764.4	13581.5
Cape May	0.7	0.9	0.0	4740.5	0.0	0.0	0.0	5.2	4747.3
Cumberland	0.0	955.6	0.0	0.0	1363.1	0.0	0.0	213.4	2532.1
Essex	0.0	412.0	0.0	0.0	0.0	7928.4	35228.8	5.2	43574.4
Gloucester	0.0	240.5	10466.6	0.0	192.1	0.0	0.0	0.0	10899.2
Hudson	0.0	1698.3	0.0	0.0	0.0	0.0	4460.2	0.0	6158.5
Hunterdon	0.0	1595.0	0.0	0.0	0.0	0.0	29.1	71.0	1695.1
Mercer	0.0	2899.2	7326.9	358.9	246.1	0.0	0.0	2715.8	13546.9
Middlesex	0.0	310.2	0.0	6600.3	0.0	10081.0	30189.5	1281.3	48462.3
Monmouth	309.1	2796.7	1975.1	0.3	433.2	0.0	2998.7	2572.0	11085.1
Morris	4.3	3266.3	3816.0	703.9	0.0	0.0	3120.4	313.8	11224.7
Ocean	0.0	1.1	0.0	9556.1	0.0	0.0	5.5	2.4	9565.1
Passaic	0.0	60.8	1365.5	0.0	0.0	0.0	1089.4	0.2	2515.9
Salem	0.0	203.5	0.0	0.0	529.2	0.0	0.0	12.1	744.8
Somerset	0.0	572.1	3884.0	0.0	0.0	0.0	215.3	649.8	5321.2
Sussex	0.0	9.1	0.0	939.8	0.0	0.0	168.6	0.0	1117.5
Union	0.0	0.5	0.0	0.0	0.0	0.0	11881.5	0.0	11882.0
Warren	0.0	16.9	0.0	0.0	0.0	0.0	867.9	48.7	933.5
TOTALS	355.5	22251.0	39946.1	31927.7	5737.7	18009.4	100364.0	14743.2	233334.5
%TOTAL	0.15%	9.54%	17.12%	13.68%	2.46%	7.72%	43.01%	6.32%	100.00%

Figure K-6
New Jersey Sewage Sludge Management

2003

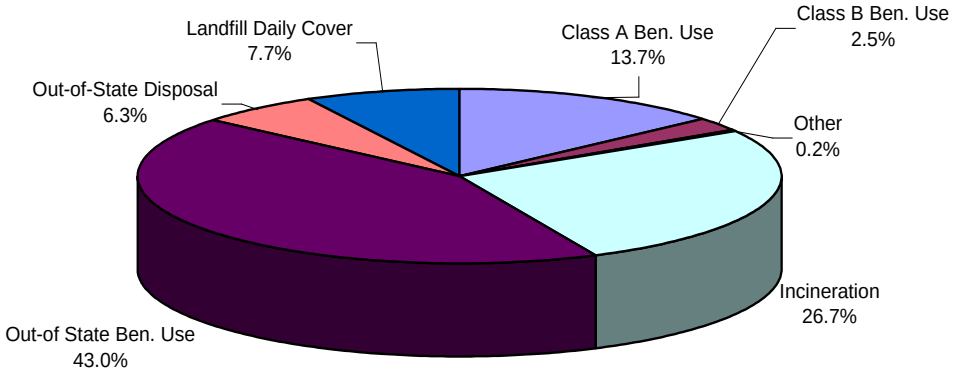

Table K-7 - Existing New Jersey Residual Management Operations

COUNTY	PERMITTEE	TYPE OF OPERATION
Atlantic	Atlantic Co. UA	Incineration
	Buena Borough MUA	Class A Composting with Distribution
	ONYX Waste Services, Inc. - Tuckahoe Turf Farms	Class B Lime Stabilization and Land Application
Bergen	Northwest Bergen Co. UA	Incineration
	United Water Company	Water Treatment Plant Residual Land Application
Burlington	Beverly City SA	Reed Beds
	Burlington County	Class A Composting with Distribution
	Mount Holly MUA	Drying, On-site Dewatering
	New Lisbon Development Center	Reed Beds
	Ocean Spray Cranberries Inc.	Food Processing Residual Land Application
	Pemberton Township MUA	Class B Aerobic and Anaerobic Digestion and land Application
Camden	Ancora Psychiatric Hospital	Reed Beds
	Camden Co. MUA [1]	Class A Composting with Distribution
	Pneumo Abex	Industrial Treatment Works Residual Land Application
Cape May	Cape May Co. MUA	Class A Composting with Distribution
	Township of Lower MUA	Class A High Temperature/High pH Stabilization with Distribution
	Woodbine Developmental Center	Reed Beds
Cumberland	Cape May Foods	Food Processing Residual Land Application
	Casa Di Bertacchi Corp.	Food Processing Residual Land Application
	Clement Pappas & Co. Inc.	Food Processing Residual Land Application
	Cumberland Co. UA	Class B Anaerobic Digestion and Land Application
	Cumberland Dairy Inc.	Food Processing Residual Land Application
	F & S Produce Co.	Food Processing Residual Land Application
	F & S Produce – Lebanon Rd.	Food Processing Residual Land Application
	Landis SA	Class B Anaerobic Digestion and Land Application
	Seabrook Brothers & Sons Inc.	Food Processing Residual Land Application
	White Wave Processing	Food Processing Residual Land Application
Essex	Passaic Valley SC	Wet Air Oxidation (ZIMPRO), On-site Dewatering

Gloucester	Gloucester Co. UA	Incineration
	Grasso Foods Inc.	Food Processing Residual Land Application
	Missa Bay Plant #1[2]	Food Processing Residual Land Application
	Missa Bay Plant #2[2]	Food Processing Residual Land Application
	Violet Packing Co.	Food Processing Residual Land Application
Hudson	Spectraserv	Liquid and Dewatered Residual Transfer Station, On-site Dewatering
Hunterdon	Johanna Foods Inc.	Food Processing Residual Land Application
	Russell Reid	Liquid Residual Transfer Station
	Salvation Army - Camp Tecumseh	Reed Beds
Mercer	Stony Brook Regional SA	Incineration
Middlesex	Middlesex Co. UA	Class A High Temperature/High pH Stabilization with Distribution
	Mr. John Portable Sanitation Service	Liquid Residual Transfer Station
	Nestle USA Inc.	Food Processing Residual Land Application
	NJ Transfer - Park Management	Liquid Residual Transfer Station
	Old Bridge Board of Education [1]	Reed Beds
	Sayreville Boro Bordentown Ave. WTP	Water Treatment Plant Residual Land Application
	WEB Hauling	Liquid Residual Transfer Station
Monmouth	Bayshore Regional SA	Incineration
	Marlboro Psychiatric Hospital [1]	Reed Beds
	New Jersey Water Supply – Manasquan	Water Treatment Plant Residual Land Application
	New Jersey American Water Co. – Jumping Brook	Water Treatment Plant Residual Land Application
	Sandy Hook	Reed Beds
	Western Monmouth UA	Reed Beds
Morris	Musconetcong SA	Class A Composting with Distribution
	Parmalat Welsh Farms Inc.[1]	Food Processing Residual Land Application
	Pequannock, Lincoln Park, Fairfield SA	Incineration
	Parsippany - Troy Hills	Incineration
	Washington Twp. - Schooleys Mtn.	Reed Beds
Ocean	Ocean Co. UA	Class A Pelletization/Heat Treatment with Distribution

Passaic	North Jersey District Water Supply Commission[2] Township of Wayne	Water Treatment Plant Residual Land Application Incineration
Salem	Ash Lane Farms, Inc. B & B Poultry Co. Inc. English Sewerage Disposal, Inc.	Class B Lime Stabilization and Land Application Industrial Treatment Works Residual Land Application Liquid Residual Transfer Station
Somerset	Applied Wastewater Services Elizabethtown Water Co. North Princeton Developmental Center Somerset Raritan Valley RSA	Liquid Residual Transfer Station Water Treatment Plant Residual Land Application Reed Beds Incineration
Sussex	Sussex Co. MUA	Class A Composting with Distribution
Union	Joint Meeting of Essex and Union[1]	Class A Pelletization/Heat Treatment with Distribution
Warren	NONE	NONE
Out-of-State	Milwaukee Metropolitan Sewerage District Natural Soil Products[2] Philadelphia Water Department	Class A Pelletization/Heat Treatment with Distribution Class A Composting with Distribution Class A Composting with Distribution

1 - Permitted but not presently active
2 - Application submitted but not presently permitted

TABLE K-8 - SEWAGE SLUDGE PRODUCTION BY THE SQAR CATEGORY

(dry metric tons for 2003)

SQAR CATEGORY	TOTAL NUMBER DTWs	SLUDGE PRODUCTION	PERCENT OF TOTAL
1	170	510.2	0.2%
2	70	3428.7	1.5%
3	56	21505.6	9.2%
4	45	207890.0	89.1%
TOTALS	**341**	**233334.5**	**100.0**

TABLE K-9 - Eight Largest Sewage Sludge Generators - 2003

Domestic Treatment Works	Sewage Sludge Production Dry Metric Tons
Middlesex County Utilities Authority	45,135
Passaic Valley Sewerage Commission	42,278
Camden County Municipal Utilities Authority	13,402
Gloucester County Utilities Authority	10,467
Ocean County Utilities Authority (3 plants)	9,555
Joint Meeting Essex and Union Counties	9,363
Bergen County Utilities Authority	9,253
Atlantic County Utilities Authority	8,791

Table K-10: Biosolids Pressure Chart

State	Population[1]	Total Acreage	People per Acre	Annual Sewage Sludge Production[2]	Agricultural Acreage[3]	Tons of Sewage Sludge per Ag. Acre per Year
Iowa	2,923,179	35,760,000	0.08	298,164	29,857,698	0.01
Virginia	7,187,734	25,342,720	0.28	733,149	5,710,389	0.13
Delaware	796,165	1,251,200	0.64	81,209	518,693	0.16
Pennsylvania	12,287,150	28,684,800	0.43	1,253,289	5,784,500	0.22
Maryland	5,375,156	6,256,000	0.86	548,266	1,820,869	0.30
New York	19,011,378	30,223,360	0.63	1,939,160	5,767,304	0.34
New Jersey	8,484,321	4,748,160	1.79	868,000	698,551	1.24

1 – Year 2001 Estimated. Source: http://quickfacts.census.gov/qfd/
2 – Wet Metric Tons. New Jersey - dry metric tons reported to the Department and converted to wet metric tons at 25% total solids. Other States' production estimated based on population and in comparison to NJ production. Septage treated as sewage sludge.
3 – Source: 1997 Census of Agriculture, Issued March 1999, USDA. Includes crop, pasture, range and other agricultural land. Excludes woodland.

Figure K-11
In-State Beneficial Use of Sewage Sludge