

INDUSTRY OUTLOOK

The following information was provided by William T. Lorenz & Co., management consultants. It was extracted from the company's 1994 Update - Water and Wastewater Industry Outlook.

WATER SUPPLY

The Federal Data Reporting System estimates that there are 47,700 community ground water supplies, of which 38,000 are small systems serving fewer than 500 people. According to the National Well Water Association, there are 14 million working wells in the U.S., serving some 19 percent of the U.S. residences.

Approximately 53 percent of U.S. population and 100 percent of the rural population are dependent on groundwater supplies. Close to \$6.6 billion was spent in 1993 on water well drilling pumps, screens, water conditioners, treatment equipment and related water well services.

States that depend on groundwater for domestic supply needs for 75 percent or more of their population are:

- Alaska
- Florida
- Hawaii
- Idaho
- Iowa
- Minnesota
- Mississippi
- Nebraska
- New Mexico
- South Dakota

According to the United States Geological Survey, water withdrawals in the U.S. during 1990 were estimated to average 408 billion gallons per day (bgd) of fresh water and saline water for off-stream uses, 2 percent more than the 1985 estimate. Total fresh water withdrawals were an estimated 339 bgd during 1990, about the same as during 1985. Average per capita use for all off-stream uses was 1,620 gallons per day (gpd) of fresh water and saline water combined, and 1,340 gpd of fresh water.

During 1990, public supply withdrawals were estimated at 38.5 bgd, and self-supplied withdrawals were estimated as follows:

- domestic - 3.4 bgd
- commercial - 2.4 bgd
- irrigation - 137 bgd
- livestock - 4.5 bgd
- industrial - 22.6 bgd
- mining - 4.9 bgd
- thermoelectric power - 195 bgd

Investor-owned water systems tend to be smaller than public water systems. Investor-owned systems account for about 86 percent of the water systems serving fewer than 100 people.

More than 43 percent of the population is served by 0.5 percent of all systems, while 64 percent of the systems together serve less than 3 percent of the U.S. population. Over 80 percent of the large systems are publicly owned.

The waste and loss from public and irrigation supplies are large. About 14 percent of the water withdrawn from public supplies and about 20 percent of that withdrawn for irrigation use are lost before being used, mainly through leaking pipes and mains, and evaporation and other losses from irrigation ditches. Altogether, such water losses in just these two categories account for an average of almost 33 bgd.

EXPENDITURES

The cost of capital improvements and operations and maintenance for U.S. water treatment facilities is expected to grow to over \$20 billion by 1997.

PROJECTED PUBLIC WATER SUPPLY TREATMENT CAPITAL EXPENDITURES (MILLIONS OF 1993 DOLLARS)			
	1995	1996	1997
Design/Engineering	257	278	264
Equipment	423	444	455
Instruments	52	53	58
Construction	2,602	2,758	2,923
Total Spending	3,334	3,533	3,700
Source: William T. Lorenz & Co.			

TABLE 3

WASTEWATER

The Environmental Protection Agency (EPA) released a Needs Survey in 1992 that examined the current and projected needs of the nation's municipal wastewater treatment and collection facilities.

The EPA needs estimates included those facilities and activities for which a water quality or public health problem could be documented using specific criteria established by the EPA. Additional nonconstruction estimates are included for program development costs associated with stormwater and non-point source (NPS) pollution control. The EPA listed total documented and modeled needs of \$127.1 billion to satisfy all categories of needs eligible for State Revolving Fund money through 2012.

That amount included \$50.1 billion in modeled needs for combined sewer overflows (CSOs), stormwater and NPS control.

The total documented needs are \$111.9 billion, including the modeled categories, of which only \$1.9 billion is for the newer eligibilities: NPS (including ground water and wetlands) and estuarine pollution control. Small community needs were projected at \$13.4 billion, representing 12 percent of total documented needs.

The Needs Survey identified more than 20,000 treatment and collection facilities, of which 15,613 provided treatment. The facilities served a population of 180.6 million, representing 70 percent of the nation's population. When all needs are met, facilities providing treatment will increase to 18,966 and the population served will increase to more than 250 million, or 87 percent of the nation.

About 94 percent of existing treatment facilities are providing secondary treatment or better. Currently, 14,745 facilities are providing secondary or better levels of treatment. There are about 1,100 communities served by 1,303 CSO facilities in the nation. Of these, 375 have documented needs totaling \$22.4 billion to correct CSO problems. Total CSO needs are estimated to be \$41.2 billion.

With a 1992 Needs Survey total of \$137.1 billion, the breakdown of the needs documented and modeled in the survey, in billions, are:

- secondary treatment - \$31.3
- advanced treatment - \$15.5
- infiltration/inflow correction - \$2.8
- replacement/rehabilitation - \$3.6
- new collector sewers - \$17.9
- new interceptor sewers - \$14.7
- combined sewer overflows - \$41.2
- nonpoint source (agriculture/silviculture) - \$8.8
- groundwater, estuaries, wetlands - \$1.2

The states with the greatest documented needs for Publicly Owned Treatment Works (POTWs) in 1992, and the total needs in millions, are:

- California - \$8,396
- Florida - \$6,934
- Massachusetts - \$7,734
- New Jersey - \$4,759
- New York - \$23,136
- North Carolina - \$4,045
- Ohio - \$5,093
- Texas - \$4,653

In 1992 there were 15,613 POTWs with treatment levels as follows:

- no discharge - 1,981
- less than secondary treatment - 868
- secondary treatment - 9,086
- greater than secondary treatment - 3,678

If all needs are met, by the year 2012 there will be an incremental 3,353 POTWs operating in the U.S. with an average design capacity of 4.8 mgd. The additional POTWs will break down by design size as follows:

- less than 0.10 mgd - 448
- 0.11 to 1.0 mgd - 1,549
- 1.01 to 10 mgd - 988
- 10.01 mgd and greater - 282.

In 2012, over 4,000 additional POTWs will be providing secondary or greater than secondary treatment. About 800 of the 4,000 are today providing less than secondary treatment. The remaining 3,200 will be new facilities. By 2012 there will be almost 1,900 POTWs with an aggregate design capacity of 45,542 mgd serving 251 million people.

The 15,700 existing POTWs will spend an estimated \$2 billion in 1995 to clean the nation's wastewater, according to the Water Environment Federation.

The fastest growth will be in plant spending for odor control (19 percent) and nitrification/denitrification systems (12.9 percent). Pumps (\$124.9 million) and dewatering equipment (\$92 million) were the individual categories projecting the highest dollar volume of sales.

PROJECTED MUNICIPAL WASTEWATER CAPITAL EXPENDITURES			
(MILLIONS OF 1993 DOLLARS)			
	1995	1996	1997
Design/Engineering	260	276	301
Equipment/Systems	363	389	428
Instruments	78	85	90
Construction/Labor	1,368	1,450	1,552
Materials	583	606	643
Total Spending	2,653	2,806	3,013
Source: William-T. Lorenz & Co.			

TABLE 4

Technology Review

Managing a Special Waste: Sewage Sludge

Sewage sludge escapes being accounted for as a municipal waste, yet its disposal is an important public responsibility. This peer-reviewed article examines the disposal options, giving special emphasis to combustion, which is increasingly being used.

By George A. Ravenscroft

Sludge from municipal sewage poses a disposal challenge in many communities. Nationwide, the quantity of solids from sludge equals 5 percent (by weight) of municipal solid waste. The methods communities use to manage their sewage sludge are varied and changing rapidly. Prohibition of ocean dumping, decreasing landfill capacity, and concerns about the environmental effects of land application are favoring combustion as a means of long-term, effective management. Despite regulatory encouragement of other "beneficial reuse" strategies, the amount of sludge being burned has increased in some regions of the country.

Burning sludge can provide several benefits. Volume reduction is one, with the residue taking up less than 5 percent of the volume of the original sludge. Further, the residue from combustion itself can have beneficial use: for example, it is frequently used as daily cover in landfills, and more combustion facilities are developing projects for its beneficial use in construction applications. Perhaps most

George Ravenscroft is a principal of New England Treatment Company, which specializes in residual management services for government and industry.

This article has been evaluated and edited in accordance with reviews conducted by professionals with relevant expertise. These peer reviewers judge manuscripts for technical accuracy and overall importance within the field of solid waste management.

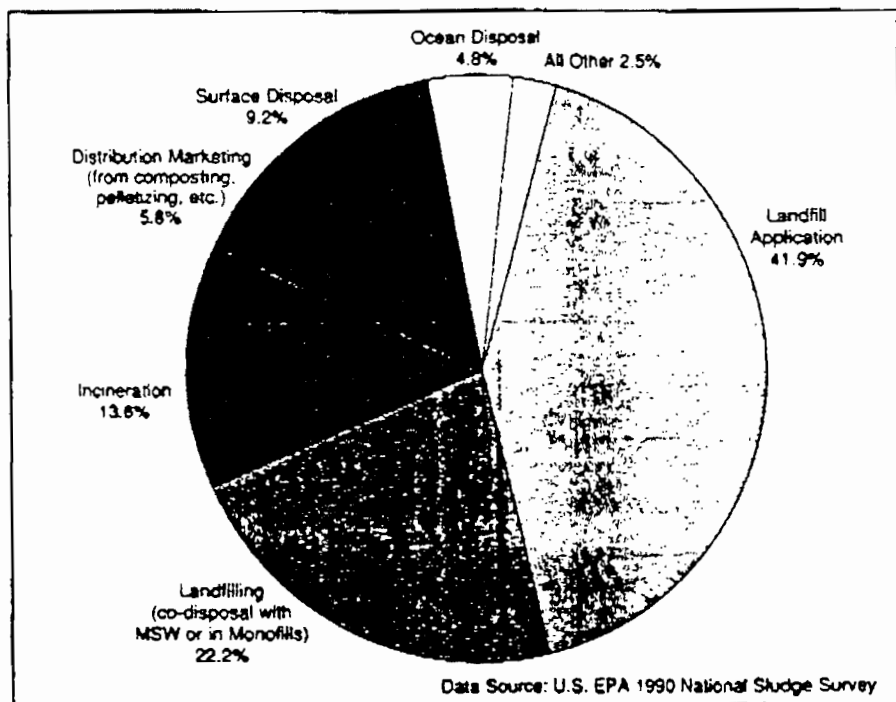


Figure 1: Methods of sludge disposal in the U.S. Ocean disposal has ceased since this data was tabulated.

important, the high temperatures of combustion assure that any pathogens in the sludge are killed.

Sludge is the residual solid and liquid material generated by the treatment of sewage wastewater from our cities and towns at approximately 15,000 treatment facilities in the U.S. After treatment in sedimentation basins or digesters, the remaining sludge material typically consists of liquid with 1 to 3 percent solids. This material, without further processing, is sometimes transported by tanker trucks for spreading on large land parcels such as farms. Most often, however, sludge is placed in drying beds, or processed in

filter presses, centrifuges, or other systems that yield a cake-like product with 15 to 30 percent solids. This material is easier to handle, weighs significantly less for more economical transport, and is suitable for a number of final options, including composting, land application, and combustion.

According to a survey by the U.S. Environmental Protection Agency (EPA), approximately 8.5 million dry tons of sludge were produced in the nation's publicly owned treatment works in 1990. The top two management methods for managing sludge were co-disposal in MSW landfills and land application (see Figure 1).¹

Table 1: Proposed Sludge Combustion Emissions Limits

Pollutant	Proposed Limit (ppm)
Arsenic	30-60
Cadmium	20-50
Chromium	2000-3000
Copper	1500-2000
Lead	300-600
Mercury	25-40
Molybdenum	30-35
Nickel	250-300
Selenium	25-30
Zinc	2500-3000

ppm = parts per million

Source: The U.S. EPA Part 503 Regulations for Municipal Wastewater Sludge Management

Regulatory Background

Sludge use and disposal is regulated by state agencies and the EPA. The EPA currently plans to issue new sludge management regulations in November 1992. The new regulations will provide criteria for beneficial use of and environmental effects of sludge that is land applied, monofilled, incinerated, composted, and distributed or marketed.² The rules will not apply to sludge that is co-disposed in MSW landfills or burned in municipal waste combustors. The new regulations will be enforced through the National Pollutant Discharge Elimination System permit process. Table 1 lists proposed ranges for air emissions limits, which are likely to change somewhat in final form.

Higher standards for air emissions from sludge combustion units and heat drying processes will require capital investment in sophisticated pollution control devices. Land application, monofill, and surface disposal sites will be closely monitored, particularly for metals emissions; detailed records will be kept on sludge quality and application rates. The benefits of the new regulations will be cleaner water and air. The costs include the elimination

of some sludge disposal alternatives and higher rates for water users.

The narrowing of options for sludge disposal began when Congress passed the Federal Ocean Dumping Ban Act of 1988 prohibiting ocean dumping of sludge. Ocean dumping has ceased in the years since, diverting significant volumes of sludge to disposal by other methods. New York City in January became the last major city to halt its ocean dumping practices.

A Review of the Options

With mounting environmental and economic pressures, policy and decision makers need to be able to choose from as many viable disposal alternatives as possible. All technologies should be evaluated based on a review of several factors. Evaluations should include volume reduction, energy consumption, emissions, and other environmental and social factors.

Land Application

Land application is the use of sludge or sludge-derived products as a soil conditioner or fertilizer on large land tracts, or as a fill material in land reclamation projects. Land application currently represents the most common method of sludge management in the U.S., handling more than 40 percent of the volume generated. Land application is a favored approach for its "beneficial reuse" of sludge. It is distinguished from surface disposal, a means of disposing sludge by spreading it on vacant or undeveloped land, but not using the sludge for its soil-conditioning benefits.

To produce a soil conditioner from sludge, the material frequently is "bulked" by adding wood chips or other organic material. To upgrade sludge to a fertilizer usually requires addition of nitrogen, phosphorous, and potassium or other nutrients. Sludge makes a good soil conditioner, since it

adds microbes and organics to the soil, helps stabilize pH, and enhances moisture and nutrient retention. Even so, sludge products may have difficulty competing against other commercially available fertilizers and soil conditioners.

Land application is a viable option for many communities, but it has its limits, the most significant being its requirement for large land parcels far from businesses and residences. The farther the end user from the site of sludge generation, the higher the transportation cost. Also, air pollution from transport vehicles results when the end product is hauled long distances.

There is also increased concern over environmental effects from land application, particularly regarding potential for heavy metals to get into the food chain or water supplies. In addition, many communities have experienced difficulty in obtaining long-term sites for land application, especially as some communities attempt to reject wastes not generated locally. New York City is now facing legal challenges of contracts it has to transport some of its sludge to range and in Texas for land application.

Landfilling

Landfilling, once a low-cost sludge disposal alternative, is becoming more impracticable due to landfill closures and higher tipping fees. Nonetheless, landfilling continues to be selected to manage sludge, and 20 percent of sludge is landfilled—either by co-disposing with MSW or in sludge monofills. As recently as 1987, the EPA estimated that 64 percent of sludge generated in New England was disposed of in landfills.

With some 600 landfill sites facing closure in Massachusetts by the end of the decade, there is greater pressure to find alternatives for sludge management. The same holds true for other densely populated areas—many face increasing sludge volumes and diminishing landfill capacities. A few states, including Rhode Island, have enacted legislation banning or limiting the amount of sewage sludge that may be disposed of in landfills—to help preserve landfill capacity, to encourage more beneficial use of sludge, and to avoid odor and other operational problems associated with co-disposal practices.

Table 2: Summarizes Energy Consumption for Sludge Management Methods (in millions of Btu per day).

Process*	Transportation	Total
Combustion	0	1
Land Application	0	19
Post-Lime Stabilization	24	44
Chemical Solidification	104	132
Heat Drying	140	144
Composting	193	201

* Based on energy consumed to process 10 dry tons of sludge at 20 percent solids. Energy for dewatering and drying to 20 percent solids has been discounted from all processes.

Clean Water Act **GOP Reform Plan May End Funding, Lower Standards, Democrat Alleges**

Funding for many clean water programs may end under a Clean Water Act reform package now awaiting debate in the Senate, a new report by a top-ranking Democrat said. The bill also may lower cleanliness standards for sewage sludge, according to the report.

H.R. 961, the 1995 Clean Water Amendments, increases only the authorized funding level for these programs, but it provides no real funding, according to the report, *The Browning of America: The Republican Assault on the Environment, 1995*. The report was prepared by Democratic staff on the House Resources Committee for Rep. George Miller (D-Calif.), ranking minority member on the committee.

The bill would roll back standards for industrial and municipal wastewater treatment in several ways, the report said, including:

- lowering treatment standards on toxic substances;
- resuming ocean dumping of partially treated sewage;
- permitting increased water pollution in exchange for decreased air pollution or solid waste; and
- allowing daily exceedences of point-source discharges if average discharges are within permitted levels.

The amendments also call for reduced water quality standards in low-income areas, increased development of wetlands and relaxed requirements on pollution runoff, Miller's staff said. "The bill contains dozens of loopholes and special exemptions for a variety of polluting industries, including agriculture, mining and chemical manufacturers," the report said. Republican staff on the House Transportation Committee did not consult environmental groups in drafting the bill, it added.

Under GOP control, the House has moved environmental legislation through committee far more effectively than Democrats did, a spokesman for the House Transportation and Infrastructure Committee said.

Congress did little under Democratic control to improve the CWA and other environmental laws, said the committee's Jeff Nelligan. A reauthorization package cleared the full House twice in 1995, but Democrats in the 103rd Congress could not get a reform bill out of subcommittee markup, Nelligan said.

"There's a realization, even among Democrats, that EPA is out of control," he said. "The most visible sign of that is [CWA]." EPA already has approved the discharge at sea of sludge from San Diego's Point Loma plant, and California's Democratic senators support the agency's waiving restrictions on the plant, Nelligan said. **D** Copies of the report, (22 pp.), are available for purchase through BPI DocuDial as #54-1120.

Guidance **New Hampshire Drafts Interim Rules On Use, Disposal of Sludge, Septage**

Emergency regulations adopted by the New Hampshire Department of Environmental Services (DES) in late November likely will facilitate the development of a full program for the beneficial reuse of sludge and septage while protecting public health, an industry consultant said Jan. 3.

The department also has formed an advisory committee to discuss implementation of final rules on land application of septage and industrial sludge. Both the interim and final rules will insure DES or project operators notify property owners of sludge and septage land-spreading projects that border their property by 500 feet or less, said Mark Lang, a consultant with Dufresne-Henry Inc., North Springfield, Vt. The rules also require public information meetings for each project.

Public concern about land application revolves around odor, said Selina Makofsky, of the department's sludge and septage management section. To address that concern, the emergency rules prohibit stockpiling of unstabilized wastewater solids at land application sites.

Private interests planning land application projects also must control odor by covering stockpiles with lime, wood ash or other materials. These rules do not apply to Class A biosolids, however, the department said. New Hampshire will require permits for each sludge and septage land application site, but not for each biosolids land application site.

Following several December and January meetings, advisory committee members listed concerns regarding the importation of out-of-state biosolids, as well as neighboring state regulations. State and local officials should have access to all information on generators of biosolids being managed in the state, the committee decided. Dufresne-Henry also has compiled a comparison of biosolids regulations in the five New England states and New York, as well as summaries of each committee meeting.

(Continued)

Ocean Dumping Environmental Group Opposes Plans To Build U.S.-Mexico Treatment Plant

A planned wastewater treatment plant to handle effluent from San Diego and Tijuana, Mexico will not remedy sewage problems in the area, a local environmental group said recently.

The proposed International Wastewater Treatment Plant and Outfall Facilities Project likely will not prevent chronic spills of Mexican sewage into the San Diego area, said Helge Weissig, of the San Diego County Chapter of the Surfrider Foundation, which will argue against the facility's construction next week in federal court. The project may worsen sewage problems in the area, a foundation document said.

Proponents of the plant and outfall, which will discharge sewage into the Pacific Ocean 3.5 miles offshore at a depth of 95 feet, argue they are needed to cope with excess Mexican sewage. The treatment plant will not process raw sewage that flows into the Tijuana River, however, the foundation said.

Further, recent improvements in Tijuana's sewage collection systems have enabled the city to handle all of its dry weather flows. The upgrades also have decreased the number of breakdowns the system experiences each year, the group said. Mexico does not require industries to treat wastewater before discharging it, however, and U.S. regulations treat Mexican wastewater as low-level hazardous waste.

Under one federal proposal, untreated sewage sludge may be discharged into the river after the treatment plant is brought on-line but before the South Bay Ocean Outfall is completed, the document said. Combined with likely continued breakdowns in Mexican sewage processing, this may force some area beaches to be closed year-round, according to the foundation. One San Diego beach was closed more than half the year in 1994, the group said.

Congress has appropriated only about half the \$466 million it will cost to build an advanced primary treatment unit at the plant, and no money has been earmarked for secondary treatment, the document said. The outfall also will have no primary treatment component, the group said. Further, neither federal nor local officials have devised disposal or reuse plans for sludge from the plant, it added. At presstime, San Diego wastewater officials had not returned calls from *Sludge*.
Contact: Helge Weissig, Surfrider Foundation, (619) 792-9940.

Enforcement Slowdown in Fines, Penalties Marks First Year of Ridge Administration

Under the administration of Gov. Tom Ridge (R), Pennsylvania's Department of Environmental Protection (DEP) issued fewer violation notices and assessed fewer fines and penalties in 1995 than in 1994, an environmental lobby in the state said recently. The transfer of several divisions that monitor water quality from DEP to the state Agriculture Department also could weaken water quality programs, a spokesman for the group said.

The department's Bureau of Waste Management issued 437 violation notices through September of last year, compared to 1,094 in 1994, said Joe Turner of the Pennsylvania Chapter of the Sierra Club.

The department assessed \$1.7 million in fines for air quality violations in 1995, compared to \$2.9 million the previous year. Also last year, environmental officials referred fewer than half as many criminal cases to the state attorney general as they did in 1994, Turner said.

Money collected from these sources goes into several department funds, including the Clean Water Fund and the Solid Waste Abatement Fund. Both funds reported significantly less income in 1995 than in the year before.

The Ridge administration has not documented any concurrent improvement in environmental performance by Pennsylvania industries, said Turner. The administration is working to weaken environmental and public health protection, he said.

Under Ridge, the department shifted several water pollution reduction programs from DEP to the Agriculture Department. Following that move, DEP issued new rules raising the amount of metals wastewater treatment plants can discharge into state waterways (*Sludge*, Aug. 29, 1995, p. 147), the group said.

The new rules, which look at dissolved metals instead of total recoverable metals, allow plants to avoid measuring metals in sediments and look only at dissolved metals in the water column, Turner said. "By failing to adopt a sediment limit, DEP guarantees an overall increase in metals in the environment," he said.

New initiatives by the department and the Ridge administration also threaten cleanup in the Chesapeake Bay and wetlands protection, Turner said. Further, the state government has supported
(Continued)

Pennsylvania (Cont.)

moves to relax hazardous waste cleanup and disposal laws, he said. A new environmental education packet from the state Department of Education amounts to propaganda for the mining industry, Turner added.

Judging DEP's effectiveness in terms of fines and criminal citations is outdated, said Secretary James Seif. In a letter responding to a *Philadelphia Inquirer* story last month that echoed many of the Sierra Club's charges, Seif said the department is emphasizing training programs to help industries become more knowledgeable about their legal responsibilities.

The department is developing a new system to track compliance, Seif said. DEP's newly-created Office of Pollution Prevention and Compliance Assistance also will educate industries on compliance issues and will try to anticipate pollution problems, he said.

Requiring safety or environmental training or plant modifications assures future compliance better than one-time fines, Seif said. The *Inquirer* has not printed Seif's letter. *Contact:* Joe Turner, Sierra Club, (717) 232-0101; Bruce Dallas, DEP, (717) 787-1323.

Local Agencies' Authority To Increase Under Pennsylvania Sewage Proposal

Local environmental officials in Pennsylvania may receive more funding for administration of on-lot sewage facilities, under a proposal released Jan. 5 as part of the state Department of Environmental Protection's (DEP) six-month regulatory agenda.

More people in Pennsylvania receive sewage treatment from on-lot systems than in any other state, DEP said. The department will try to give municipalities more authority to develop permitting and planning programs for these systems. The state also intends for the new legislation to lead to the creation of multi-municipal local agencies to improve sewage planning, DEP said.

The proposal would increase reimbursements for qualifying municipalities to administer on-lot system permitting programs. It also would delegate the department's new land development planning program to local agencies. The department intends to streamline permitting by waiving several current requirements and changing local agency permitting procedures.

The department last month finalized other amendments to the state Sewage Facilities Act.

The amendments establish procedures for resolving disputes involving mottled soils. They also provide for the issuance of general permits for beneficial reuse or processing of sewage sludge and municipal waste.

DEP will hold several meetings this month to discuss the proposed and final amendments. The state Bar Institute will hold meetings Jan. 26 and Jan. 29 to discuss the amendments' impact on real estate development.

Changes to the department's water quality management (Part II) permit applications take effect Jan. 22. The department will try to reduce processing time by giving private engineers full responsibility over the design of new sewer systems, treatment works and intercepting sewers, or extensions to existing sewer systems.

The changes cover new and pending permits. *Contact:* Steven Socash, DEP, (717) 787-7381.

Wastewater Trends

ERM Provides Advice on Negotiating Less Burdensome Limits on Effluent

Manufacturing sites can negotiate less burdensome water quality-based effluent limits (WQBELs) if managers understand how limits are calculated and the data on which they are based. Environmental Resources Management Group says it may be easy to persuade authorities to grant more favorable limits.

In a paper on negotiating WQBELs, William Hall, project manager at the Exton, Pa.-based company, discusses how ERM negotiated less stringent WQBELs with the Pennsylvania Department of Environmental Resources (DER) for an electronic components manufacturer.

ERM reviewed data and methods that had been used to develop the WQBELs for copper, lead and fluoride at the plant. The draft limits were low due to inappropriate design flow, river hardness and mixing allowance values for copper and lead, Hall says. Further, statistical methods used to set fluoride limits were also conservative and would have resulted in significant noncompliance, he adds.

ERM persuaded DER that the limits were based on reinforcing conservative assumptions that yielded overprotective discharge limits, and DER accordingly increased the admissible effluent levels for copper and lead. To obtain a copy of *Negotiating Less Conservative Water Quality-Based Effluent Limits — A Case Study*, call Gregory Lloyd at (800) 544-3117.

.. Introduction

The Clean Water Act requires municipalities to cleanse their wastewaters prior to discharging them into the environment. This cleansing process — wastewater treatment — generates sludge which in turn must be used or disposed of. Sludge management begins with sludge generation and continues through sludge treatment and sludge use and disposal (Figure 1). It is an integral consideration in the planning and design of wastewater treatment plants, and can be the most complex and costly part of wastewater management. This document provides guidance on the final step in the sludge management process — the ultimate use and disposal of municipal wastewater sludge.

The need for effective sludge management is continual and growing. The quantity of municipal sludge produced annually has almost doubled since 1972, when the Clean Water Act imposed uniform minimum treatment requirements for municipal wastewater. In addition, the sludges generated by more advanced treatment are more difficult to handle than the sludges produced by less advanced treatment. Municipalities currently generate approximately 6.2 million dry metric tons (mt) (6.5 million dry tons) of wastewater sludge a year, or approximately 26 kilograms (kg) (57 dry pounds (lb)) per person per year. Sludge production is expected to about double to approximately 12 million dry mt (13 million dry tons) per year by the year 2000 as the population increases, as more municipalities comply with Clean Water Act requirements, and as more sophisticated wastewater treatment systems are developed and installed.

When properly used, sludge can be a valuable resource as a soil conditioner and partial fertilizer and as a source of methane for producing energy. The U.S. Environmental Protection Agency (EPA), the primary Federal regulatory agency responsible for sludge management, encourages the beneficial use of sludge wherever environmentally feasible (Figure 2).

This guidance document describes the five major sludge use/disposal options currently available — land application, distribution and marketing of sludge products, landfilling, incineration, and ocean disposal — and factors influencing their selection and implementation. The document is intended for a broad audience of individuals and organizations, including state and local officials, managers and operators of wastewater treatment systems, planners, resource managers, and concerned citizen groups.

The document provides an initial framework for evaluating sludge use/disposal alternatives. It describes accepted and proven use/disposal technologies and Federal regulations pertinent to sludge management (Table 1). Additional sources must be consulted for more detailed information and design criteria, and for the most current information on emerging technologies. In addition, state and local authorities should be consulted to determine regulations and good management practices applicable to local areas.

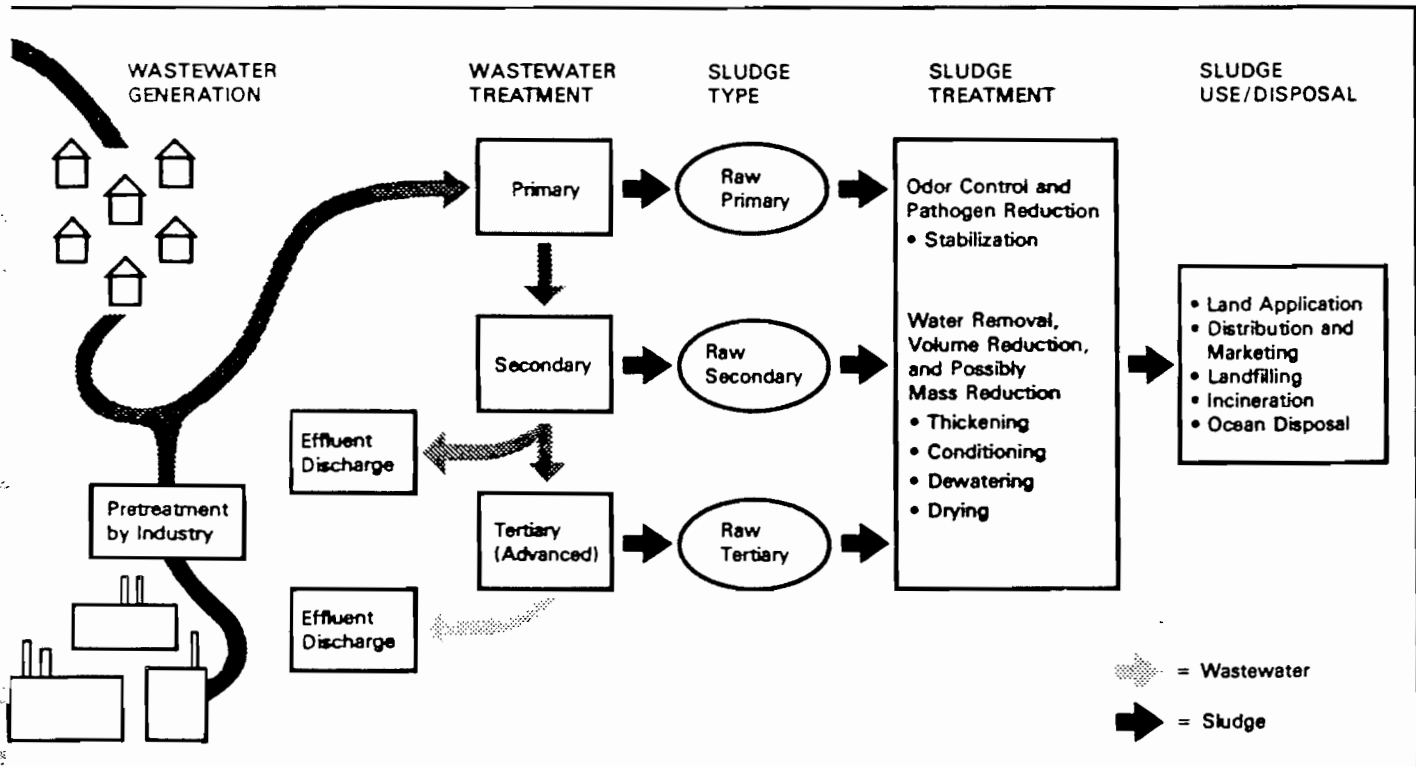


Figure 1. Generation, Treatment, and Disposal of Municipal Wastewater Sludge