Massachusetts Infrastructure Investment Coalition

Infrastructure Status Report: Massachusetts Wastewater Facilities

Out of sight should not be out of mind!

May 2007 Volume 4, Number 1

Wastewater Facts and Terminology:

- ✓ **785,000,000 gallons** of treated sewage is discharged into streams, rivers, and oceans in Massachusetts each day by 126 state and federally permitted municipal wastewater plants.
- ✓ **Service life**, the expected time a piece of equipment can be expected to perform its designed operational function
- ✓ **WWTF**, Wastewater Treatment Facility
- ✓ **Primary treatment**, the primary stage of a WWTF process where up to 60% of the solids in the waste stream settle out as a mixture of sludge and water. This process removes very few toxic chemicals.
- ✓ **Secondary treatment**, the secondary stage of a treatment process where oxygen is added to the wastewater to speed up the growth of micro-organisms. These microbes then consume the wastes and settle to the bottom of the secondary settling tanks. After secondary treatment, 85-95% of waste products and other solids have been removed from the waste stream. A significant proportion of toxic chemicals are also removed by this process.
- ✓ **Tertiary treatment** process, the final process of wastewater treatment where chemicals, sand filtration, or activated carbon filtration, is utilized to remove very fine particles, residual toxins, or high levels of nutrients like Nitrogen and Phosphorus from waste stream before it is discharged into local rivers, streams, coastal waters, or the ground.

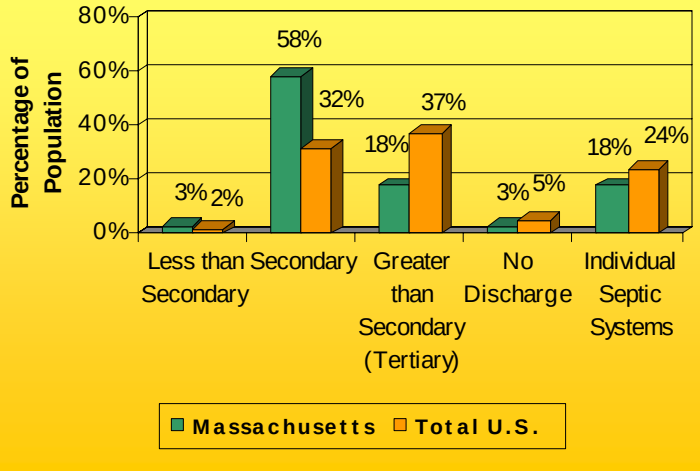
***Massachusetts faces a serious economic and environmental crisis in the next 5 to 10 years because there is inadequate funding available to rehabilitate or replace the existing wastewater treatment facilities and collection systems in operation in the Commonwealth*.**

Wastewater treatment facilities in Massachusetts discharge approximately **785,000,000 gallons** of treated wastewater into local waterways each day. Approximately 350,000,000 gallons per day is processed by the MWRA's Deer Island Treatment Plant, but the remaining 435,000,000 gallons of wastewater is treated by 126 state and federally permitted wastewater treatment facilities located in cities and towns throughout the Commonwealth. The majority of these facilities are small municipal treatment plants that have capacities that are below 2 million gallons per day. These facilities are owned and operated by local cities and towns and they rely on federal and state low interest loans, as well as the water and sewage fees charged to local residents, to operate and maintain their facilities.

Many of these small treatment facilities, and the sewage collection pipes that feed into the facilities, were constructed in the 1970's and 1980's when federal construction grant funding from the Environmental Protection Agency (EPA) was abundant. The overall **service life** of a treatment plant is about 30 to 40 years, but most of the equipment in these facilities (pumps, valves, electrical equipment, computer systems …etc.) have shorter service lives ranging from 10 to 25 years. Since many of these facilities are 25 to 35 years old, they are reaching the end of their service lives and they either need major rehabilitation or replacement. In addition, the EPA has recently enacted more stringent wastewater discharge regulations, which require the installation of more sophisticated wastewater treatment equipment. However, current federal and state funding programs, and the fees collected from local residents, are not adequate to rehabilitate or replace the existing treatment plants, let alone pay for the new sophisticated treatment equipment. The federal and state governments need to provide additional funding to assist municipalities in order to protect the waterways of the Commonwealth.

The basic components of a wastewater treatment process are the same for both large and small treatment facilities. Sewer pipes collect the wastewater from homes and industries and carry it to the treatment facility. The wastewater then flows through the **primary treatment** settling tanks where up to 60% of the solids are removed from the waste stream. In the **secondary treatment** process, concentrated micro-organisms are used to remove 85-95% of waste products and other solids. In addition to these standard treatment processes, some treatment plants also have a **tertiary treatment** process which removes very fine particles, residual toxins, or high levels of nutrients like Nitrogen and Phosphorus, from the waste stream before it is discharged into local rivers, streams, coastal waters, or the ground.

Figure 1 – Type of Wastewater Treatment by Population



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Wastewater Facts and Terminology:

- ✓ **18%** of wastewater facilities in Massachusetts utilize a tertiary treatment process. In comparison, **37%** of treatment facilities across the US provide tertiary treatment.
- ✓ Local Cities and Towns are responsible for inspecting, cleaning and rehabilitating over **20,000 miles** of sewer in Massachusetts. Older sewer pipes are made out of lead, brick, cast iron, clay, or even wood; modern sewer pipes are made of concrete or PVC
- ✓ **Asset management** is a systematic process of maintaining, upgrading, and operating physical assets cost-effectively. Asset management combines engineering principles with sound business practices and economic theory and provides tools to facilitate an organized, logical approach to decision-making. Asset management provides a framework for both short-term and long range planning.
- ✓ **Predictive maintenance** techniques, the process where a piece of equipment has a maintenance plan based on operating characteristics in order to extend its useful life.
- ✓ **Preventive maintenance** techniques, the process in which a piece of equipment is maintained in accordance with manufactures recommended procedures.
- ✓ **Corrective maintenance** techniques, the process in which a piece of equipment is required to be repaired due to mechanical malfunction.

Regulations recently enacted by the EPA require the treatment of wastewater to remove high levels of Nitrogen and Phosphorus. High levels of these nutrients are known to contribute to algae blooms and fish kills in aquatic ecosystems. Massachusetts has 126 treatment facilities, but as shown in Figure 1, only 18% of the facilities (by population) have the tertiary treatment process. In comparison, 37% of treatment facilities across the US provide tertiary treatment. As noted above, many local treatment plants only provide primary and secondary treatment. These plants are reaching the end of their service lives and local municipalities are struggling to pay the operating expenses for these aging facilities. The cost to upgrade these facilities to meet the new EPA requirements is in most cases beyond the financial resources of many municipalities.

There are over **20,000 miles of sewer pipe** in Massachusetts. In some of the older cities and towns in Massachusetts, these pipes can be over 100 years old. The expected service life of sewer pipe is about 50 to 75 years, but the service life can vary depending upon the type of pipe material, the conditions of the soil in which it is buried, and the character of the wastewater flowing through it. In addition, pipes do not deteriorate at a constant rate. During the initial period following installation, the deterioration rate is likely to be slow, and repair and upkeep expenses low. For pipe, this period may last several decades. Later in the life cycle, pipe will deteriorate more rapidly. Figure 2 is an example of the life-cycle of sewer pipes. The majority of the sewer lines in Massachusetts were installed in four phases: at the end of the 19th century, in the 1920s, after World War II, and in the 1970's and 1980's. Since a large portion of the existing pipe is reaching or exceeding its service life, a significant portion of sewer pipes are cracked or have loose joints which allow raw sewage to seep into the groundwater, causing harm to the environment. The cracks also allow groundwater to seep into the pipes, artificially increasing the volume of sewage that has to be processed by treatment facilities.

Figure 2 – A Projected Deterioration Pattern for 100 Year Pipe

Some municipalities have developed **asset management** programs, which utilize **predictive** and **preventive maintenance** techniques, to maximize the service life of sewer pipe and the equipment in wastewater treatment plants. However, other communities have not invested in proactive asset management programs and hence, a significant portion of their budget is devoted to unexpected emergency or **corrective maintenance**. This reactive approach diminishes the expected service life of the equipment and results in higher operations and maintenance costs. As an example, the cost to maintain a sewer pipe and replace it as part of a scheduled program is much less than the cost to replace a pipe that has unexpectedly collapsed. The labor and overtime costs of the emergency crews are compounded by the costs of the damage to the environment and the local economy by the raw sewage spill. The state government should encourage municipalities to develop asset management programs for their wastewater infrastructure in order to reduce the long-term maintenance costs and extend the service lives of these assets.

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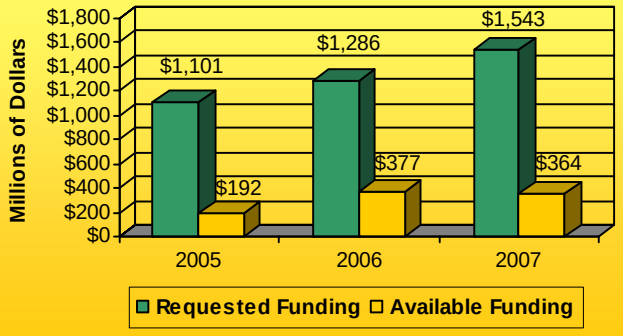
Wastewater Facts and Terminology:

- ✓ **$61.5 Billion in Federal Construction Grants** were provided through the Environmental Protection Agency in the 1970's and 1980's to construct sewage treatment facilities and sewage collection pipe systems.
- ✓ The **CWSRF** program utilizes a "leveraging" financing model where federal and state loan capitalization grants are used as a source of security for bonds issued by the **MWPAT.** As the bonds are repaid, the federal and state grants are released from the pledge and become available for other projects.
- ✓ **Massachusetts Water Pollution Abatement Trust (MWPAT)** made its first loan in 1993 and during the past 14 years they have provided over $3.4 Billion (averaging $250 Million annually) in low interest loans for wastewater projects.
- ✓ The **Congressional Budget Office** (CBO) estimates that **$17 Billion annually** is needed in each of the next 20 years ($340 Billion in total) for wastewater infrastructure investments in the US.
- ✓ The **US Environmental Protection agency** (EPA) estimates that **$19.5 Billion annually** ($390 Billion in total) is needed for wastewater infrastructure over the next 20 years in the US. This estimate includes $6.3 Billion for Massachusetts.

In the early 1970's, the federal government faced an environmental crisis. River and streams throughout the United States were being polluted by raw, or minimally treated, sewage from local sewage collection systems. To address this environmental crisis, the federal government passed the Clean Water Act and provided **$61.1 Billion** in federal construction grants over 24 years to cities and towns for the construction of primary and secondary sewage treatment facilities. In the late 1980's, the federal government modified the program to provide low interest loans, instead of grants, for the construction of wastewater treatment facilities and sewage collection systems. In this program, called the **Clean Water State Revolving Fund** (CWSRF), the federal and state government provides annual loan capitalization grants to secure loans for wastewater infrastructure projects. In this revolving loan program, local municipalities are required to repay the loan over a 20 or 30 year period. The interest and loan payments made by the municipalities are used to fund additional projects. Since the interest rate on the loans (2%) is below the rates a municipality would normally be charged by banks or other lending institutions, the municipalities pay approximately 66% less interest, which represents about a 27% total project savings to the municipalities.

The CWSRF program in Massachusetts is administered through the **Massachusetts Water Pollution Abatement Trust** (MWPAT). The federal government has provided approximately $830 Million (or about $47 Million annually) in capitalization grants to MWPAT since 1989. These grants have been augmented annually with a 20% matching state appropriation. Each year municipalities submit projects to be funded by MWPAT. For the past several years, the total value of the projects requested by municipalities has been significantly higher than the prioritized list approved for funding. Figure 3 compares the total requested amount with the total approved amount since 2005. Although the CWSRF and WPAT programs have been very successful, the funding needs are significantly greater than the available funding. Given the current deterioration of the wastewater infrastructure identified previously in this report, the requests for additional funding will increase rapidly over the next 10 years. Unfortunately, the federal government has reduced funding for the CWSRF program during the past few years. The federal government has reduced the annual capitalization grant amount for Massachusetts to $37 Million in 2005 and $30 Million in 2006. This is a 22% (2005) and a 37% (2006) reduction in funding as compared to the $47 Million, average grant amount, provided each year from 1989 to 2004. The Environmental Protection Agency estimates that $19.5 Billion annually ($390 Billion in total) is needed for wastewater infrastructure across the US. The EPA estimates $320 Million annually ($6.3 Billion in total) is needed in Massachusetts for wastewater infrastructure during the same time period. Many experts in the wastewater industry believe the EPA estimates underestimate the true need for wastewater infrastructure investment. The gap between the requested funding and available funding in Massachusetts (shown in Figure 3) is evidence of the shortfall. The federal and state governments need to increase the level of capitalization grants to the CWSRF program, or they need to provide grants or other funding sources, for wastewater infrastructure investment. It is easy to ignore deteriorating wastewater assets because most of them are buried underground. **Out of sight should not be out of mind!**

Figure 3 – Massachusetts Wastewater Infrastructure Funding Needs



Massachusetts Infrastructure Investment Coalition – Infrastructure Status Report

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The **Massachusetts Infrastructure Investment Coalition** is identifying the long-term needs for infrastructure investments to support economic development and improve the quality of life for the citizens of Massachusetts. The Infrastructure Status Report for **Massachusetts Wastewater Facilities** was prepared to provide information about the investment requirements for Massachusetts wastewater treatment facilities and collection systems. The coalition is currently preparing status reports for other infrastructure elements including: **Aviation, Bridges, Dams, Drinking Water, Energy, Government Facilities, Hazardous Waste, Homeland Security, Housing, Navigable Waterways, Ports and Harbors, Railroads (Freight), Roadways, Schools, Transit (Rapid/Bus/Commuter Rail), and Telecommunications.** These reports are available at www.engineers.org.

Massachusetts Infrastructure Investment Coalition

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Aviation – Bridges – Dams – Drinking Water – Energy – Government Buildings - Hazardous Waste – Homeland Security – Housing - Navigable Waterways – Ports and Harbors – Railroads (Freight) – Roads and Highways - Schools – Transit (Rapid/Bus/Commuter Rail) – Telecommunications - Wastewater

*The **Massachusetts Infrastructure Investment Coalition** is supported by:*

- A Better City
- American Planning Association/Massachusetts Chapter
- American Council of Engineering Companies of Massachusetts
- American Public Works Association of New England
- Associated Builders and Contractors of Massachusetts
- Associated General Contractors of Massachusetts
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