# Water Pollution Control Plant

**Town of Greenfield, Massachusetts**

***Design Engineer:*** **Metcalf & Eddy, Inc.**
***Contractor (1974):*** **Leominister Engineering Co., Inc.**
***Contractor (Upgrade 1999):*** **Carlin Contracting, Waterford, CT**

*This plant is the result of efforts of former Superintendent of Public Works, William B. Allen*

Thousands of years ago there was little need for water pollution control. The human pollution was small and scattered over vast regions of land. As cities and towns grew man was confronted with a serious problem - how to dispose of his own wastes. Most cities "solved" the problem by dumping it into a nearby waterway. When a stream receives small amounts of waste nature's purification processes can handle the problem. First, the sheer volume of clean water dilutes the wastes. Bacteria and other organisms in the water then consume and break down the organic matter in the sewage, turning it into new cells, carbon dioxide and water. However, when large amounts of untreated waste is dumped into waterways, the oxygen in the water is consumed by organic matter, causing the death of the beneficial bacteria, organisms, fish and plants required to carry out natural purification. Soon the waters become foul and threaten the health of those using the water further downstream. The advent of industrialization further degraded waterways by the introduction of manufacturing wastes and chemicals. Prompted by these bad conditions and outbreaks of cholera, typhoid and dysentery, cities began building facilities to treat waste. Thus, we can see that the main function of a sewage treatment plant is to speed up the natural processes by which water purifies itself. This is accomplished by removing and stabilizing the materials in the wastewater that would cause an oxygen demand on the receiving water and destroying the microorganisms that could potentially produce disease.

Greenfield's WPC Plant treats an average of 3,400,000 gallons of sewage each day. Thus, in one year, the Plant treats 1,241,000,000 gallons of water. If this water were pooled it would form a lake 30 times the size of our Leyden Glen Reservoir!

## Pretreatment System

The raw sewage referred to as influent, flows to the treatment plant by gravity. Influent consists of 99+% water, the remaining ingredients being dissolved and suspended solids, oils, greases, and other compounds. It also contains some very large and stringy material, which must be removed so it does not clog pipes and pumps. This is done by an automated bar screen, which continually rotates through the flow as it enters the channel and removes this debris. The material is collected daily, drained and sent out for incineration.

Wastewater also contains a great deal of heavy inorganic material such as sand, small stones, grit, etc. The removal of this matter from the wastewater is necessary to prevent abrasive action on mechanical equipment such as pumps. The grit chamber is designed to reduce the velocity of the wastewater and create a cyclone effect with the introduction of air. This causes the heavier particles to "spin out" and fall to the bottom of the chamber. Every month the chamber is dewatered and the settled material removed by the Town's vactor truck. After leaving the grit chamber, the volume of wastewater entering the treatment system is measured by an ultrasonic device in a Parshall flume. This is an important step since an accurate evaluation of plant performance cannot be made without measuring the flow. The flow is recorded on a meter near the flume and also transmitted to the main operations building where it is permanently recorded on a chart and totalized.

## Primary Treatment System

The primary treatment system consists of four underground settling tanks and their related structures. Primary treatment is a physical process whereby the wastewater velocity is greatly reduced so that heavy solids in the wastewater will fall to the bottom of the settling tanks. These settled solids are referred to as primary sludge and collected in the tanks by a system of rake arms. The sludge is then pumped to the sludge thickening tank. Oil, grease, and plastic material which float to the top of the tanks is skimmed off and pumped to the thickening tank also. The liquid which remains after the floating matter and sludge are removed is referred to as primary effluent. Although the majority of settable solids have been removed, the water still contains a large amount of unsettleable solid matter, which would create a high oxygen demand on the river if it were directly discharged to the river. Consequently, it receives further treatment in the secondary system.

## Secondary Treatment System

The secondary treatment system consists of two trickling filters, two final clarifiers and associated structures. This is a biological and physical process, which greatly reduces the oxygen demand, thereby diminishing the harmful effect that the wastewater would have upon the Deerfield River.

The trickling filters each consist of a ten-foot bed of stacked plastic media and are large biological reactors, which speed up and harness nature's own water purification process. The primary effluent is distributed evenly over the surface of the media by rotating distributors. Numerous organisms such as algae, fungi, bacteria, protozoa and worms grow on the media. As the primary effluent passes through the filter, this slimy growth retains much of the suspended and dissolved matter. The organisms utilize this matter for their own life processes breaking it down into less complex solids, carbon dioxide and water. Like all living things, the organisms in the filters continually reproduce and die off. Because the "corpses" of the organisms themselves would produce an oxygen demand on the river, they must be removed. This is accomplished in another set of settling tanks called the final clarifiers.

The final clarifiers are circular and above ground. The solids that are collected in these tanks are by-products of the trickling filter process and referred to as humus sludge. This sludge is mechanically collected from the bottom of the tanks and transferred to the sludge thickening tank while floating material is skimmed off the tanks. The settled or "clarified" water then flows to the chlorine contact chamber, which was constructed in 1999. At this point, chlorine, in the form of liquid sodium hypochlorite, is added to the wastewater. Chlorine is a disinfectant that kills pathogenic organisms such as bacteria and viruses. Chlorine is toxic to fish so any residual amounts of chlorine left in the water are destroyed by the addition of sodium bisulfite. Analyzers continually monitor the chlorine residual in the effluent and adjust chemical dosage rates accordingly. The fully treated water, referred as effluent, is discharged into the Deerfield River. This water meets federal Class B water quality standards and is safe for recreational activities such as fishing and swimming.

## Sludge Handling

Sludge is the material that is collected from the bottom of the primary settling tanks and final clarifiers. It is pumped to the sludge thickening tank where it is treated with chlorine and thickened. Three or four times per week, depending on the quantity, the sludge is pumped into a tanker and transported to specially designed incinerators in the Worcester area where is it dewatered and burned. Approximately 32,000 gallons of sludge are trucked out weekly.

## Quality Assurance

The EPA issues all treatment plants permits called NPDES permits. These permits set forth the quality standards the treated water must achieve before discharge to the river and the analyses that must be performed on the water. Most chemical and bacteriological testing is done in the DPW's certified laboratory within the Plant. Monthly the Town must report all test data to the State and EPA. Violations of permit standards are very serious offenses.