This paper documents the treatment of domestic wastewater at a secondary wastewater treatment facility utilizing the extended aeration sludge process. This 14-MGD facility was completed in 1974 at a cost of $3.3 million. More recently a 7-MGD expansion along with sludge de-watering facility and a post-aeration pumping station has increased the capacity of this facility to 21 MGD of wastewater.

**Influent Bar Screens and Pumping Station**

Raw wastewater is received at the WWTP through gravity and force mains. Three types of wastewater enter the facility: domestic or municipal wastewater, combined domestic and industry wastewater, and industrial wastewater. The raw wastewater first passes through traveling bridge bar screens that remove large debris, rags, cigarette butts, etc. Figures 1 and 2 shows the influent bar screens.

**Figure 1. Influent Bar Screen.**
Figure 2. Top of Influent Bar Screens.

Figure 3. Sluice gate.
After passing through the bar screens, the screened wastewater is pumped up to the headworks, by one of four centrifugal pumps. Figures 4 and 5 show a centrifugal pump and motor which provides energy to the pump.

Figure 4. Centrifugal Pump.

Figure 5. Pump motor.
Headworks
The screened wastewater is pumped from the influent pumping station to the headworks. Wastewater flows by gravity from this point through the treatment process. Figures 6, 7, and 8 show the different types of wastewater entering the treatment train. Each of the influent chambers in aerated to mix and aerate the wastewater.

**Figure 6. Screened domestic wastewater.**

![Figure 6. Screened domestic wastewater.](image)

**Figure 7. Screened domestic & industrial wastewater.**

![Figure 7. Screened domestic & industrial wastewater.](image)
Wastewater flows from each influent chamber through a parshall flume. These flumes are used for measuring the wastewater flowrate. Figure 9 shows one of the parshall flumes. After the flow is measured, the wastewater flows through an aerated, concrete, channel to the grit chamber (Figure 10). Figure 10 shows one of the aerated grit chambers and Figure 11 shows a grit washer used for removing organics from the grit. A microscreen is used for removing additional materials that were not removed by the bar screens (Figure 12). Figure 13 shows the materials removed by the microscreen. They are emptied into a dumpster and transported to the landfill for disposal. Grit from the grit washers is discharged into a dumpster and hauled to a landfill for disposal.
Figure 10. Aerated concrete channel.

Figure 11. Aerated grit chamber.
Figure 12. Grit washer.

Figure 13. Microscreen.
Secondary Treatment
After preliminary treatment, the wastewater flows into one of three extended aeration basin trains. Secondary treatment consists of aeration followed by secondary clarification. Substrate is used by microorganisms during aeration followed by solids-liquid separation in the secondary clarifiers. Here the wastewater is completely-mixed by mechanical aerators. This provides oxygen from the air to the heterogeneous culture of microorganisms in the wastewater that use it to oxidize the organic matter and to keep the microorganisms in suspension. The microbes also utilize some of the nitrogen and phosphorus in the wastewater in cell synthesis. The typical composition of a microorganism may be represented by the following formula: $\text{C}_{60}\text{H}_{87}\text{O}_{23}\text{N}_{12}\text{P}$. The microorganisms use carbon, nitrogen, phosphorus, and oxygen to synthesize new microbial cells that are removed in the secondary clarifiers. Thickened sludge or biomass in the secondary clarifiers is returned to the head of the aeration basin in order to maintain a specified concentration of microorganisms or solids in the aeration basins. The recycled sludge or biomass is called return activated sludge (RAS) and must be pumped back to the head of the aeration basins. The wastewater within the aeration basin is called “mixed liquor”. The average unit of time that the biomass or microorganisms remain in the activated sludge process is called “mean cell residence time” or “sludge age” or “solids retention time”. Generally, the longer the biomass remains in the system, the better quality effluent that is achieved. To maintain a given “sludge age” in the system, a certain quantity of sludge or biomass must be wasted from the system. At steady-state conditions, the amount of biomass that is wasted from the system is equal to the quantity of biomass or microorganisms that are grown. The sludge that is wasted
from the system is called “waste activated sludge” or WAS. Waste sludge is also pumped from the bottom of the secondary clarifiers to the gravity thickeners where it is thickened prior to aerating and dewatering. Figures 15, 16, 17, and 18 show the aeration basins, mechanical aerators, secondary clarifiers, and secondary clarifier effluent weirs.

**Figure 15. Aeration basin.**

**Figure 16. Mechanical aerator.**
Filtration
After secondary clarification, the wastewater flows by gravity to the sand filters that remove additional suspended solids that were not removed during clarification. Figure 19 shows a picture of the sand filters and Figure 20 is a photo of the mudwell that
receives the backwash water when the filters are backwashed. There are a total of eight sand filters in operation at Rocky Creek.

**Figure 19. Sand filters.**

**Figure 20. Mudwell.**
Chlorination and Chlorine Storage Building
After filtration, the wastewater must be disinfected prior to discharge. Chlorine is added to the wastewater before it enters the chlorine contact chamber where it remains approximately 30 minutes. This allows enough time for the chlorine to kill pathogens in the wastewater. Oxygen is also added to the wastewater though diffusers. The chlorine residual is measured continuously and must be removed from the wastewater before discharging into a river. Chlorine is stored in 2-ton cylinders in an open metal frame building. Chlorinators are used for dissolution of chlorine gas into water prior to injection into the wastewater. Figure 21 shows the chlorine contact basin. Figure 22 shows the effluent from the chlorine contact basin. Figure 23 is a photo of the blowers used for providing air for post-aeration. Figure 24 is the chlorine residual analyzer that continuously monitors the chlorine residual so that the proper dose of sodium bisulfite (Figure 25) can be injected into the wastewater prior to discharge. Normally, the effluent will flow by gravity to the river. During periods when the water level in the river is high, effluent pumps (Figure 26) must be used for pumping the water into the river. Figure 27 is a photo of the chlorine building and Figure 28 shows the chlorine cylinders. Figure 29 show one of the chlorinators.

Figure 21. Chlorine contact basin.
Figure 22. Effluent from chlorine contact basin.

Figure 23. Blowers for post-aeration.
Figure 24. Chlorine residual analyzer.

Figure 25. Sodium bisulfite feed pumps.
Figure 26. Effluent Pumps.

Figure 27. Chlorine Building.
Figure 28. Chlorine cylinders.

Figure 29. Chlorinator.
**Sludge Treatment and Disposal**

Sludge or biosolids from the secondary clarifiers is wasted to the gravity thickeners (Figure 30). Here the sludge is thickened prior to sending it to the aerated holding tanks (Figure 31). From the aerated holding tanks, the thickened sludge is pumped to the belt filter press (Figure 32). Polymer is added to enhance dewatering of the sludge. The dewatered sludge is loaded onto trucks (Figure 33) and hauled to a processing facility, which composts the sludge, and then land applies it onto agricultural land. Figures 34, 35, and 36 show different types of sludge composted at the facility.

**Figure 30. Gravity thickeners.**
Figure 31. Aerated Holding Tanks.

Figure 32. Belt Filter Press.
Figure 33. Dewatered Sludge from BFP.

Figure 34. Sludge Loading Dock.
Figure 35. Composted Wastewater Sludge.

Figure 36. Composted Sludge.
Figure 37. Water Treatment Plant Solids.

Figure 38. Sludge Spreader Truck.