TABLE 2-III. Typical Head Requirement Ranges for Different Unit Processes

Unit Process	Head Requirement (ft)
Screening (Coarse)	0.5 (minimum)
Grit Removal	0.2–2
Primary Treatment	3–8
Activated Sludge	3–6
Trickling Filters (Single Stage)	10–15
Effluent Filtration	10–15
Carbon Adsorption	10–20

Note: Ft × 0.3048 = m.

those listed in "Occupational Safety and Health Standards."[1] Some recommended background noise criteria are shown in Table 2-II. Noise control methods are covered elsewhere in other references.[5]

Plant Hydraulics

The hydraulic design provides adequate capacity for the maximum design rate of flow throughout the various plant structures and is established by calculating the hydraulic losses between and through the various units of the treatment plant. The design is generally started from the high water level in the receiving body of water and extended, in reverse direction, through the outlet conduit and the treatment units.

Water surface elevations are computed from the maximum and average rates of flow at the end of the design period and for the minimum initial flow. These computations, which take into consideration unit modules that may be out of service, are often summarized as a hydraulic profile. Hydraulic profiles usually are developed for all main paths of flow through the plant. They may include a profile of the ground surface, and are a necessity in establishing the optimum elevation of plant structures and hydraulic controls (Figures 2-7, 2-8, and 2-9).

Typical head requirements found for various types of wastewater treatment plants are shown in Table 2-III.

The functional hydraulic design of all treatment units and conduits is based on consideration of wastewater solids—either maintaining them in suspension or allowing their deposition. This establishes the design limits on velocities of flow. The various unit process chapters and the subsection on piping and valves (Chapter 5) should be referred to for velocity information.

A minimum velocity of 0.6 m/s (2.0 fps) at design average flow is usually considered adequate for channel flow of unsettled wastewater. At minimum flows, a minimum velocity of 0.3 to 0.5 m/s (1.0 to 1.5 fps) is necessary to transport suspended organic matter through the channel. In

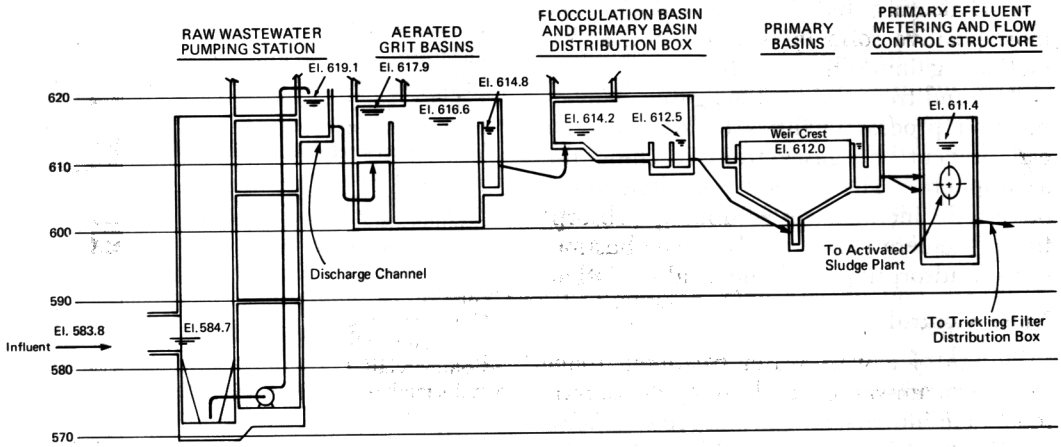

FIGURE 2-7. Typical hydraulic profile for influent pumping and primary treatment. Water surface elevations are as shown when flow is 160 000 m³/d (42 mgd).

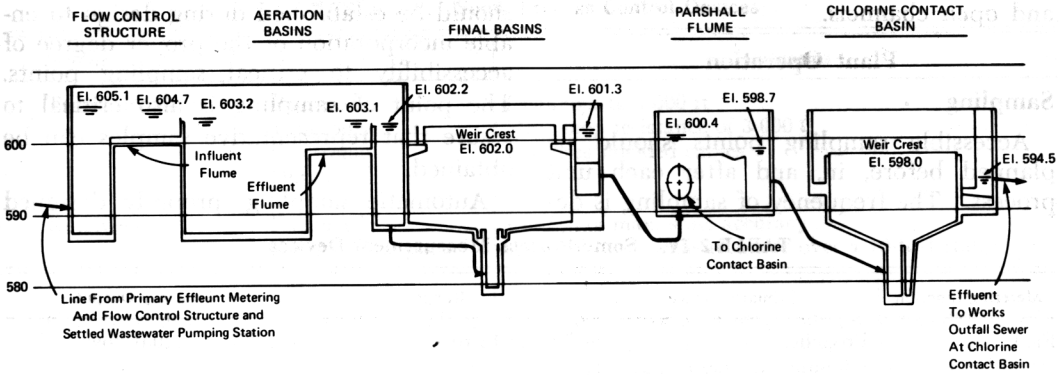

FIGURE 2-8. Typical hydraulic profile for an activated sludge plant. Water surface elevations are as shown when flow is 160 000 m³/d (42 mgd).

both instances, somewhat lower velocities could be used for settled wastewater. With large ratios of peak to minimum flow, the minimum velocity may be such as to require mixing in channels. Also, the frequency of occurrence of the minimum rate is considered. If the lower velocity is infrequent and somewhat above 0.3 m/s (1 fps), the cleansing effect of the higher rates of flow might be depended on to flush the channel free of deposited solids. Quite often, all channels carrying activated sludge mixed liquor, returned activated sludge, and waste activated sludge are artifically mixed with air regardless of flow velocity.

In the conveyance of wastewater between the elements of a treatment plant, the losses of head may be grouped as follows:

1. Frictional resistance to flow in conduits;
2. Miscellaneous losses associated with flow in conduits, such as in bends;
3. Head required for discharge over weirs and other hydraulic controls;
4. Free-fall surface allowances;
5. Head allowances for future expansions of the treatment plant.

The head losses through the plant must be determined prior to structural detail and design.

Methods for calculating head losses are available in many texts. The manual "Design and Construction of Sanitary and Storm Sewers" [11] presents an excellent sum-

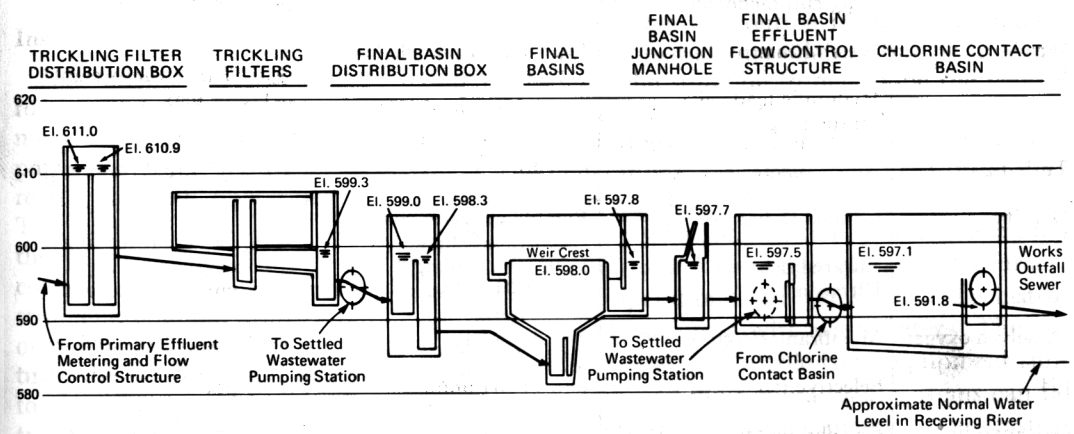

FIGURE 2-9. Typical hydraulic profile for a trickling filter plant. Water surface elevations are as shown when flow is 85 000 m³/d (24 mgd).