CHAPTER 4
RAPID INFILTRATION SYSTEMS

4-1. Process description.

a. General. In rapid infiltration systems the wastewater is applied to moderately to very permeable soils (such as sands and gravels) by flooding basins or by sprinkling. The wastewater is treated as it travels through the soil matrix, and the treated percolate drains naturally to surface waters or moves downward to the groundwater. The objective of rapid infiltration is wastewater treatment. Uses of the treated water can include:

- Groundwater recharge
- Recovery by wells or underdrains for reuse or discharge
- Recharge of surface streams by interception of groundwater
- Temporary storage of groundwater in the aquifer.

Rapid infiltration systems consist of a number of infiltration basins that are flooded and then allowed to dry before they are flooded again. The drying period allows the organic material that collects on the soil surface to decay. It also allows the soil to reaerate. The hydraulic loading rate at existing rapid infiltration sites ranges from 50 to more than 200 feet per year. The hydraulic loading rate depends on the type of soil and depth to groundwater, as well as on the quality of the applied wastewater and the level of treatment desired.

b. Process requirements. The majority of rapid infiltration systems in the U.S. have some type of conventional wastewater treatment process to treat the wastewater before it is applied to the infiltration basins. The operation and maintenance (O&M) requirements for the particular process in use will be specified in the site-specific O&M manual.

4-2. Staffing requirements.

The numbers of and skill levels of personnel needed to operate a rapid infiltration system depend on two factors: the size of the system and the type of preapplication treatment process. The manpower requirements for the rapid infiltration basins should be less than one-half of the values given in figure 2-2 for slow rate systems.

4-3. Process control and monitoring.

a. Compliance monitoring. Compliance monitoring is required by local, state or Federal regulatory agencies to certify that the system is performing as required. For rapid infiltration systems, this will usually require periodic sampling and analysis of the groundwater from wells beneath and around the perimeter of the site. Nitrate-nitrogen is the greatest concern for groundwaters that enter a drinking water aquifer. Paragraph 2-8,f discusses groundwater monitoring in greater detail.

b. Process control monitoring.

(1) Preapplication treatment. The system is usually monitored by the operator to determine the level of performance of the different unit processes in the entire system, to make sure that the unit processes are operating properly, and to assist him in making operational changes to ensure the continued satisfactory operation of the system.

(2) Storage ponds. The majority of rapid infiltration systems are operated throughout the year; therefore, storage ponds are not typically required. The exception may be the inclusion of a small capacity storage pond for flow equalization or for emergency storage in case of a major mechanical failure. In the event it is necessary to use the pond for emergency storage, the operator must plan to empty the pond as soon as the emergency is resolved. The stored wastewater should be blended into the daily flows for application to the basins. Monitoring of storage basins is covered in paragraph 2-12.

(3) Application site. In order to minimize any problems with the basins the operator should inspect them daily. The operator should document in his daily log sheets the depth of standing water in the various basins and the amount of time it takes them to drain. This will allow calculation of the wastewater infiltration rate and identification of those basins where the infiltration rate has decreased to a level where restoration of the surface is needed. The operator should inspect the berms of the infiltration basins frequently. Vegetation such as tree seedlings and brush should be removed. The operator should also note any signs of erosion on the berms. The operator must also inspect the hydraulic system used to apply the wastewater to the basins to determine if it is functioning properly. Low spots where wastewater can remain ponded should be filled in. During winter operations the operator must inspect the entire system, paying particular attention to problems of freezing and ice formation.

4-4. Routine operating procedures.

a. Preapplication treatment. The routine operating procedures for the preapplication processes will be described in the site-specific portions of the O&M manual (see appendix A).

b. Storage ponds. Storage ponds are usually only included for emergencies and must therefore be empty at all other times. It is important that the operator empty the pond as soon as possible after the emergency.

c. Application site. The operator must keep accurate daily records of the depth of wastewater in each basin. This information should be used by the operator to compare the actual operating infiltration rates to the design rates. With this information he will be able to make the necessary changes in the operation of the system.

(1) An example of the calculations the operator would need to make to determine the new volumes to be applied to each basin are given in appendix A. It is very important that each basin be operated so that it has an adequate drying period before it is flooded again. This drying period is very important because it allows the solids on the soil surface to decompose, and it allows the soil to reaerate.

(2) The operator should also measure and record the depth to groundwater in the observation wells at the site. This information will be used to determine the extent of groundwater mounding beneath the site. Mounding is the rise of the water table above its normal level under the infiltration basins. If the water table rises so that it is within a few feet of the surface it will have adverse effects on the system. It will reduce the rate of movement of the wastewater into the soil and it will reduce the level of treatment. At rapid infiltration sites with recovery wells or underdrains, mounding may be reduced by increasing the pumping rate from the wells or underdrains. If the system does not have recovery wells or underdrains and mounding becomes a problem, the operator should get help from a qualified groundwater hydrologist.

(3) Winter operating procedures for the infiltration basins may, depending on the local climate, require that certain precautions be taken to stop freezing in the distribution network. The operator should check the site daily for these types of problems and correct them immediately.

4-5. Emergency procedures. One of the more serious things that can happen to a rapid infiltration system is an electrical power failure that can affect pumps and motorized valves. An emergency generator should be available. The operator should consider sudden basin clogging an emergency and he should take action to correct it as described in paragraph 4-6.

4-6. Maintenance considerations. Maintaining the soil infiltration capacity should be of prime concern to the operator. As stated previously, the operator should keep accurate records of the infiltration rates of the basins to determine when surface restoration is needed.

a. Restoring the basins to an acceptable infiltration capacity is normally accomplished by discing or scarifying the dry soil surface to break up the organic mat that develops. Another method is to completely remove the top layer of soil and replace it with a suitable soil. This method uses more labor and equipment than discing and it will also require large earth moving equipment. If this method is used, care must be taken to limit the amount of vehicular traffic on the beds to reduce the amount of compaction of the subsurface soil layers.

b. In colder climates the operator should disc the dry surface of the basins about once each year during the late summer and fall. This should keep the basins from clogging during the winter season. Another suggestion for cold climates is to plow the basin surface each fall and leave the ridges and furrows. As the water level in the basins decreases, sheets of

floating ice should come to rest on the ridges while the remaining water infiltrates into the furrows. During the next flooding sequence, the wastewater will initially fill the furrows and then as the water level rises, it will float the sheets of ice that are bridging the ridges. This floating ice helps to insulate the wastewater in the basins. Also, basins in cold climates that have grass or weeds growing in them should be mowed in the fall. This will keep ice from freezing to the vegetation near the soil surface; this attached ice will be submerged during the next flooding cycle and prevent infiltration. The standing water will then freeze and the basin won't work.

c. Mechanical equipment such as pumps, valves and flowmeters should be maintained in accordance with the manufacturers' guidelines.