SPECIFIC PLAN APPENDIX SP-13-A

WASTEWATER TREATMENT

Unit Process Descriptions

The process flowsheet is shown on Figure 13-A-1. The raw wastewater shall be provided secondary treatment and disinfection as required for reclamation. The treatment facilities shall be constructed in phases. When the facilities are designed, space will be provided for installation of future units required to handle increases in wastewater flow.

<u>Preliminary Treatment</u>
The raw wastewater collected from the Specific Plan I area of the project shall flow by gravity to the treatment facilities. The wastewater shall first enter a headworks where mechanically cleaned bar screens remove any material that cannot pass through the bars. The screenings shall be removed by a traveling rake that discharges them onto a traveling conveyor belt. The conveyor belt shall discharge the screenings into a hopper for disposal at a landfill.

The screened wastewater shall be metered by Parshall flumes before entering aerated grit chambers. Grit is removed because it can cause excess wear in downstream pumps and equipment, and take up volume in downstream treatment units. Air shall be introduced into the bottom, along one side, of the chambers. The rising air bubbles cause a rolling action which keeps fine organic particles in suspension while allowing the heavier particles to settle out. The grit removed from the chambers shall be washed prior to disposal at a landfill.

The bar screens, Parshall flumes, and aerated grit chambers basically operate automatically. However, the operating personnel shall verify that the processes are operating properly. The operator will need to adjust the frequency of cleaning cycles if needed, check the Parshall flume for calibration, and adjust air flow to the aerated grit chambers. Air flow shall be set so that grit is not carried out of the chamber, and organics do not settle out with the grit. All equipment shall be maintained in accordance with manufacturers' requirements. To facilitate odor control, scum and floating material shall be removed from the grit chambers and structures shall be washed down weekly.

<u>Facultative Treatment Lagoons</u>
Facultative lagoons shall provide secondary treatment of the wastewater generated by Specific Plan I. Low construction and operating costs offer a significant financial advantage over other treatment methods. All 60 acres of facultative treatment lagoons shall be designed at one time, but construction of the lagoons shall occur as required by increases in wastewater flows.

The facultative treatment lagoons have excellent resistance to shock loads of organics and toxic materials and can handle intermittent operations. Minimal operator skill is required. Three zones exist in a facultative lagoon: (1) an aerobic surface zone where aerobic bacteria and algae exist; (2) an anaerobic bottom zone where accumulated solids are decomposed by anaerobic bacteria; and (3) an intermediate zone that is partially aerobic and partially anaerobic, in which decomposition of organic wastes is carried out by facultative bacteria. Solids settle out to form the sludge layer at the bottom of the lagoon. Anaerobic decomposition of the sludge layer results in the production of dissolved organics and gases such as carbon dioxide, hydrogen sulfide, and methane, which are either oxidized by the aerobic bacteria or escape to atmosphere. Soluble and colloidal organic matter is oxidized by aerobic and facultative bacteria using oxygen produced by the algae growing near the surface. Carbon dioxide produced in oxidation of the organic matter serves as a carbon source for the algae.

The facultative lagoons shall be designed to maximize the control of odors and optimize effluent quality. Treatment objectives shall be to separate the solids from the wastewater, to anaerobically digest the settled solids, and to have an odorless operation.

As shown in Figure 13-A-1, multiple cells shall be provided for series operation. Aerators shall be provided for each cell, although it is anticipated that aeration will primarily be used to maintain an aerobic surface layer in the primary cells. Aerators allow either cell in each pair to have capacity to treat the wastewater with the other cell out of service. In siting the facilities, advantage will be taken of the existing topography. Flow shall be by gravity to the subsequent cells and storage lagoons.

Screened and degritted wastewater will enter a primary cell where solids settle out to form a sludge layer at the bottom of the lagoon. As a general rule, approximately 50 percent of the BOD load is removed from the wastewater in the settled solids. The secondary cell provides a holding cell in which the biomass (e.g. algae and microorganisms) resulting from bioconversion of nonsettleable and soluble organics can decay to acceptable levels. By providing primary and secondary cells, there will be physical separation between anaerobic decomposition of settled solids and the aerobic assimilation of solids from the liquid. As a result, conditions can be optimized to meet the requirements of the particular processes taking place in each cell. Since the majority of solids will settle out in the primary cell, the effect of the seasonal temperature changes in the sludge layer on effluent quality are virtually eliminated in the secondary cell. Therefore, there will be less fluctuation of the effluent quality.

Influent piping shall be designed to provide optimum distribution of the solids along the bottom of the primary cell. The ability to recycle flow from the secondary cell to the influent of the primary cell shall also be provided; literature studies have shown that recycling wastewater from the secondary cell to the influent of the primary cell drastically reduces or completely eliminates development of odors. Multiple effluent withdrawal depths shall be provided so a depth can be selected that minimizes the solids in the effluent. A withdrawal depth can also be selected where the effluent temperature is not the same as the influent temperature, thereby minimizing short-circuiting.

Operation of the facultative lagoons will be fairly simple. The primary task will be to check the lagoons for conditions that could potentially lead to problems, and to determine the judicious use of the aerators.. The lagoons shall be inspected for floating scum, weeds, excessive algal growth, development of blue-green algae, and erosion of the roads and dikes around the lagoons. Excessive algal accumulations may be removed by vacuum truck. If odors become a problem, even with aerators operating, it may be necessary to add an oxidizing chemical to the lagoons.

Disinfection

The secondary effluent from the facultative treatment lagoons system shall be disinfected prior to storage. Two alternatives were identified in the Mountain House New Town Master Plan: chlorination and ultraviolet light. Because of the potential for high solids in the facultative lagoon effluent, ultraviolet light disinfection is not considered appropriate for use during the first specific plan period. Ultraviolet light has also not been identified by the regulatory agencies as an acceptable means of disinfection, particularly for wastewater reclamation. Sanitary districts and municipalities seeking to use ultraviolet light disinfection are being required to conduct pilot studies to demonstrate effectiveness of the process at their plants. Therefore, chlorination shall be provided to disinfect the wastewater generated by Specific Plan I. However, the plant power system shall be designed to accommodate the possible conversion to ultraviolet light disinfection in the future.

The objective of providing chlorination is to disinfect the secondary effluent. The effectiveness of chlorination is measured in terms of coliform destruction. Because the treated effluent shall be used to irrigate nonfood-chain crops on land without public access, coliform destruction shall be adequate to meet the restricted use criteria of less than 23/100 mL coliform. As a process control technique to check that enough chlorine has been added to the secondary effluent, chlorine residual will be monitored.

Chlorination is not an instantaneous process. When chlorine is dissolved in water, hypochlorous acid and hypochlorite ions are formed. These compounds are known as free available chlorine and have the best disinfection efficiency of the chlorine compounds that form during the disinfection process. When chlorine solution is added to the wastewater, the chlorine will first react with any reducing agents present, and the free available chlorine will be reduced. The chlorine will next react with any ammonia in the wastewater to form chloramines. With the addition of more chlorine, the chloramines will be oxidized. It is at this stage that any additional chlorine will be available as free available chlorine.

Because of the nature of the chemical reactions that take place when chlorine is added to the wastewater, effective mixing of the chlorine solution and the wastewater, the chlorine contact time provided, and the chlorine residual, are key factors in the effectiveness of chlorine as a disinfectant.

The chlorination system shall be designed to maximize the effectiveness of using chlorine to disinfect the secondary effluent. Chlorine solution shall be added to the secondary effluent through a diffuser located at the entrance to the chlorine contact tank. A static mixer at the inlet of the tank will be provided for mixing. Since chlorination is not an instantaneous process, the chlorine contact tank shall provide the contact time needed for adequate disinfection. Drains and piping shall be provided in the chlorine contact tank design for maintenance purposes.

Instrumentation shall be provided so that the rate at which chlorine is added (dosage) can be automatically adjusted based on the chlorine residual. Equipment shall be provided for automatic measurement of the residual, and automatic adjustment of the chlorine dosage. An alarm system shall be provided to automatically annunciate the failure of any equipment, and any emergency conditions that occur.

Liquified chlorine gas supplied in containers under pressure is commonly used at wastewater treatment plants. However, sodium hypochlorite has increasingly been used as an alternate source of chlorine primarily because of chlorine handling issues. Some of the issues related to the use of chlorine gas are as follows:

- Chlorine gas is toxic and highly corrosive. Corrosion resistant materials must be used.

- Adequate ventilation at floor level must be provided because chlorine gas is heavier than air. At least 60 air changes per hour should be provided, with an emergency caustic scrubbing system provided to neutralize any leaking chlorine. The Uniform Fire Code contains specific requirements.

- Chlorine storage and chlorinator equipment rooms should be isolated from other plant facilities and should be accessible only from the outside. Fan controls should be provided at all entrances. Readily accessible breathing apparatus should be provided.

- Temperatures in the chlorine storage and chlorinator equipment rooms should be controlled to prevent freezing. Chlorine cylinders should be protected from direct sunlight to prevent overheating of full cylinders.

- Adequate storage of standby cylinders should be provided.

- Chlorine storage and feed facilities should be protected from fire hazards.

- Chlorine detectors should be provided, and tied to an alarm system and to the emergency scrubbing system.

- Operators and maintenance personnel should receive regular training on the safe handling of chlorine gas, and emergency procedures.

Sodium hypochlorite is available in bulk quantities at strengths of 12 to 15 percent available chlorine. It does not have to be stored under pressure, and spills are more easily contained than chlorine gas leaks. Metering pumps are used to meter and feed the chlorine solution. Some of the issues related to use of sodium hypochlorite are as follows:

- Sodium hypochlorite is toxic and highly corrosive. Corrosion resistant materials must be used.
- Fumes can be a problem.

- Chemical costs can be high. Sodium hypochlorite can cost as much as 3 to 4 times the cost of liquified chlorine gas.

- The strength of sodium hypochlorite will degrade with time, and is affected by exposure to light and heat.

The selection of chlorine gas or sodium hypochlorite as the source of chlorine shall be made during design of the wastewater treatment facilities for the Mountain House project. The form of chlorine supplied will affect the equipment needs and the design of the disinfection system.

Equipment shall be maintained in accordance with the manufacturers' recommendation. Adequate supply of chemical shall be maintained to meet the chlorine demand of the secondary effluent. During low flow periods, the chlorine contact tank shall be flushed to remove any accumulated solids.

Odor Control

Odor control measures shall be taken so that odors from the wastewater treatment plant are not detectable at the boundary line of adjacent private properties. Structures will be designed to facilitate housekeeping and other maintenance needs. Odor control measures include:

- incorporating setbacks in the plant layout
- containment of odor sources including enclosing headworks, and installing offgas removal systems
- using submerged inlets whenever possible
- designing for conservative process loadings
- good housekeeping practices

Additional odor control measures for specific unit processes shall include the following:

Preliminary Treatment - All structures shall be washed down at least weekly. Scum and floating material shall be removed from grit chambers. Headworks shall be enclosed and the offgases treated.

Facultative Treatment Lagoons - Odors from facultative lagoons are caused primarily by mats of dead decomposing algae, and hydrogen sulfide evolving from the anaerobic zone of the lagoon.

The decaying algal mats are usually the result of periodic occurrences of excessive quantities of filamentous blue-green algae. The blue-green algae tends to bloom during warm summer months, and flourishes in environments where dissolved oxygen concentrations are very low. The algae does not settle like green algae, but remains floating at the surface where it decays in the sun and gives off noxious odors.

Hydrogen sulfide is formed primarily from sulfates present in the wastewater that are reduced in the anaerobic zone of the lagoon. The form of sulfate that exists depends on the pH of the wastewater. Hydrogen sulfide exists in significant amounts when pH is less than 8. When photosynthesis is very active and carbon dioxide concentrations are very low, the pH will be greater than 8, and the upper zone of the lagoon will act as a cap that prevents the escape of the noxious gas. Supplemental aeration will also help to maintain an aerobic surface layer that prevents the escape of hydrogen sulfide.

Odors also result when lagoons are overloaded, excessive surface scum has accumulated, or aquatic and slope weeds are not controlled. Odors can also occur as a result of lagoon overturn. Overturns occur particularly in the spring and fall when temperature stratification of the lagoon contents decrease and anaerobic material is brought to the surface.

Typical design loadings for facultative lagoons with supplemental aeration range from 50-180 lbs BOD/acre/day. The primary cell of the Mountain House lagoons will have an organic loading of 118-122 lbs BOD/acre/day, which is a conservative loading. Therefore, odors resulting from organic overload are not anticipated to be a problem.

Scum can result from debris entering the lagoon with the influent, dead and decaying algae that remains floating, and debris that enters the lagoon from surrounding areas and decomposes without sinking. Debris can also remain in flotation by becoming attached to the aquatic growth or other floating debris. Spray nozzles will be provided around each lagoon to provide the ability to break up any scum accumulations on the lagoon surface. A program of regular housekeeping shall be implemented to control weed growth. Excessive algal accumulations shall be removed by vacuum truck.

The ability to recirculate effluent through the lagoon shall also be provided. Recirculation will contribute to mixing throughout the lagoon, which has been demonstrated at other treatment facilities to eliminate scum accumulations. Mixing of the lagoon contents will also reduce the temperature stratification of the lagoon contents. By reducing the occurrence of temperature stratification, lagoon overturns will be minimized.