CHAPTER 6.
EFFLUENT DISCHARGE/REUSE ALTERNATIVES

This chapter presents discharge and treatment alternatives for treatment plant effluent (effluent or final effluent) within the Pt. Hadlock sewer service area. Advantages and drawbacks of each alternative are presented along with a technical recommendation.

TREATMENT PLANT EFFLUENT – DISCHARGE VS. RE-USE

Wastewater treatment requirements vary significantly dependent upon the fate of the final effluent. This evaluation considers both discharge and re-use of final effluent from the proposed wastewater treatment plant. The distinction between use of the word "discharge" and "re-use" is significant in the eyes of the regulations and the regulatory community.

Surface Water Discharge vs. Land Application

Final effluent must be discharged or reused in some manner. Typically, effluent is discharged into a large receiving body of water, such as Puget Sound. For the Pt. Hadlock sewer service area, this approach, termed surface water discharge, would include a pipeline outfall discharging into Pt. Townsend Bay.

Alternatively, final effluent can be land-applied for "disposal" or for beneficial "reuse." Disposal strategies generally aim solely to dispose of the effluent and provide minimal treatment. Disposal relies on significant subsurface treatment of the effluent in the ground. This approach is typical of septic tank and drainfield systems.

Reuse strategies accomplish the goal of beneficially using effluent in some advantageous manner. This can be uses such as irrigating crops, supplying water for industrial processes, or supplementing groundwater aquifers. Reuse strategies require the effluent to be of very high quality, having been adequately and reliably treated before reaching the land application site. At this point, the treated effluent is no longer considered wastewater and is now termed "reclaimed water". The ground is no longer required to provide significant treatment. In fact, Washington Administrative Code (WAC) 173-240 prohibits the use of subsurface treatment and disposal for domestic wastewater facilities above a certain size (3,500 gallons per day for mechanical treatment plants and 14,500 gallons per day for septic tank-based disposal systems) "except under those extraordinary circumstances where no other reasonable alternative exists."

Discharge and Reuse Systems – Treatment Requirements

Treatment plant effluent which is discharged to surface water, such as Puget Sound or a stream, needs to be treated to secondary treatment standards or better. This typically involves primary treatment, a secondary treatment process (such as extended aeration with secondary sedimentation), and disinfection. Discharge of final effluent to a surface water of the United States is regulated by the US Environmental Protection Agency and requires a National Pollutant Discharge Elimination System permit.

Treatment plant effluent which is reused needs to be treated to standards defined by the Departments of Health and Ecology in the *Water Reclamation and Reuse Standards*. The highest reuse standard, Class A, usually involves advanced wastewater treatment. Advanced wastewater treatment can be an additional filtration process after secondary treatment or an advanced wastewater treatment process such as a membrane bioreactor plus additional disinfection as described in Table 6-1.

Reclaimed water standards vary depending on the type of end-use and the potential for human contact with the reclaimed water. The requirements range from Class A (highest quality) to Class D (lowest quality). Table 6-1 summarizes the basic requirements.

TABLE 6-1.
WATER QUALITY REQUIREMENTS FOR REUSE PROJECTS

Parameter	Class A	Class B	Class C	Class D
BOD	30 mg/L	30 mg/L	30 mg/L	30 mg/L
TSS	30 mg/L	30 mg/L	30 mg/L	30 mg/L
Total Coliforms	2.2/100 ml (7 day); 23/100 ml at any time	2.2/100 ml (7 day); 23/100 ml at any time	23/100 ml (7 day); 240/100 ml at any time	240/100 ml (7 day)
Turbidity	2 NTU monthly; 5 NTU at any time	N/A	N/A	N/A
Dissolved Oxygen	>0 mg/L	>0 mg/L	>0 mg/L	>0 mg/L
Chlorine residual	0.5 mg/L in conveyance piping	0.5 mg/L in conveyance piping	0.5 mg/L in conveyance piping	0.5 mg/L in conveyance piping

NTU = nephelometric turbidity unit

Additionally, the Washington State Department of Ecology's Criteria for Sewage Works Design stipulates reliability and redundancy requirements for the disposal system in Article 10 of the Water Reclamation and Reuse Standards. This article addresses the requirements for emergency storage and disposal of reclaimed water where no approved alternative disposal system exists. A copy of this Article can be found in Appendix E.

DISCHARGE/RE-USE ALTERNATIVES

Alternatives Considered

Seven alternatives were considered in the discharge/reuse evaluation. These alternatives are described below:

- Marine Outfall: Discharge of treatment plant effluent to Port Townsend Bay through a pipeline outfall.
- Irrigation at Agronomic Rates: Reuse of reclaimed water to irrigate a crop or timberland at rates not to exceed the plants' ability to absorb the water and nutrients.
- Natural Wetlands: Discharge of final effluent into a natural wetland. The wetland would provide additional treatment, nutrient removal and water uptake through transpiration and evapo-transpiration.
- Constructed Beneficial Use Wetlands: Reuse of reclaimed water using a Constructed Beneficial Use Wetlands. Constructed wetlands provide wildlife habitat and associated public benefits, water uptake through transpiration and evaporation and additional treatment of the reclaimed water.
- Groundwater Recharge by Surface Percolation – Slow Rate Infiltration: Reuse of reclaimed water by surface percolation into the groundwater by land application using a slow rate infiltration gallery. The rate of application is controlled by the treatment plant operator.

- Groundwater Recharge by Surface Percolation – Rapid Rate Infiltration: Reuse of reclaimed water by surface percolation into the groundwater by land application using a rapid rate infiltration basin (often described as a leaky bottom pond). The rate of application is limited only by the percolation rate of the pond bottom.
- Salinity Barrier: This is a form of reuse in which the reclaimed water is injected into the groundwater to provide an intrusion barrier between a potable water aquifer and a saltwater body such as Puget Sound or the Port Townsend Bay.

Rejected Alternatives

Three alternatives were rejected early in the evaluation process. The rationale for their rejection is as follows:

Marine Outfall

The marine outfall alternative was not considered for further evaluation following a discussion with DOE Staff in which an inter-agency agreement involving the Washington State Department of Ecology, Washington State Department of Fish and Wildlife, Washington State Department of Health, and Washington State Department of Natural Resources was discussed. This agreement titled *Inter-Agency Permit Streamlining Document, Shellfish and Domestic Wastewater Discharge Outfall Projects, Dated October 10, 1995* addresses the permitting of new marine outfalls for wastewater treatment plant effluent discharge into Puget Sound. Section III(3) states:

> *"In exercising existing regulatory authority, state agencies with jurisdiction will authorize domestic wastewater discharge outfall projects proposed in, near, or upon shellfish harvesting areas only upon a demonstration of compelling reasons for approval of the domestic wastewater discharge outfall project in question. Compelling reasons for approval include: No other reasonable, feasible, or practical siting alternative exists."*

A marine outfall serving the proposed Port Hadlock sewer system would necessarily be adjacent to existing harvestable shellfish beds. There are other reasonable and feasible alternatives to a marine outfall. Therefore, a marine outfall was removed from consideration.

Natural Wetlands

The natural wetlands alternative was not considered for further evaluation since the regulatory requirements for discharge of treatment plant effluent to a natural wetlands are quite extensive. There is a natural wetland within the study area boundary. However, there is question as to whether the size of the wetland would be adequate and whether the regulatory community would approve such use for a natural wetland.

Salinity Barrier

The salinity barrier alternative was not considered for further evaluation since there are not any local salt water intrusion issues identified for the local aquifer and water wells. Additionally, the costs associated with treatment to the standard for direct groundwater recharge, usually requiring reverse osmosis, are very prohibitive.

ALTERNATIVES CONSIDERED FOR FURTHER EVALUATION

Irrigation at Agronomic Rates

Technology Description

Irrigation at agronomic rates involves applying reclaimed water to forested land or a crop. The reclaimed water is applied only to the rate that the plants can accept water and nutrients. This reuse method does not rely on infiltration of the reclaimed water through the ground and into the groundwater. The level of treatment required for irrigation at agronomic rates is dependent upon the use of the application site, the crops, and how the crops will be used. Table 6-2 summarizes treatment and quality requirements for reclaimed water used for irrigating crops.

TABLE 6-2.
TREATMENT AND QUALITY REQUIREMENTS FOR RECLAIMED WATER USED FOR IRRIGATING CROPS

	Type of Reclaimed Water Allowed			
Use	Class A	Class B	Class C	Class D
Irrigation of Nonfood Crops				
Trees and Fodder, Fiber, and Seed Crops	YES	YES	YES	YES
Sod, Ornamental Plants for Commercial Use, and Pasture to which Milking Cows or Goats Have Access	YES	YES	YES	NO
Irrigation of Food Crops				
Spray Irrigation:				
All Food Crops	YES	NO	NO	NO
Food Crops Which Undergo Physical or Chemical Processing Sufficient to Destroy All Pathogenic Agents	YES	YES	YES	YES
Surface Irrigation:				
Food Crops Where There is No Reclaimed Water Contact with Edible Portion of Crop	YES	YES	NO	NO
Root Crops	YES	NO	NO	NO
Orchards and Vineyards	YES	YES	YES	YES
Food Crops Which Undergo Physical or Chemical Processing Sufficient to Destroy All Pathogenic Agents	YES	YES	YES	YES
Landscape Irrigation				
Restricted Access Areas (e.g., Cemeteries and Freeway Landscapes	YES	YES	YES	NO
Open Access Areas (e.g., Golf Courses, Parks, Playgrounds, School Yards and Residential Landscapes)	YES	NO	NO	NO

Irrigation Design Criteria

The key criteria for design of an irrigation system for application of reclaimed water involves the rate at which it can be applied to the land, and the requirements for storage during the wet season when the plants cannot accept additional moisture. For the purposes of comparing alternatives a representative rate at which plants can use water and nutrients from the reclaimed water was used. Additionally, a representative amount of storage was used. Actual rates for application of reclaimed water and storage would be verified depending upon the type of crop used and its actual water and nutrient requirements.

The key design criteria used for estimating land area requirements for irrigation at agronomic rates are as follows:

Application rate: 0.1 gpd/square foot

Storage Requirements: 7 months of storage for treated effluent

Advantages and Drawbacks of Irrigation at Agronomic Rates

Several advantages and drawbacks of irrigation at agronomic rates were identified during the evaluation process. Below is a summary of the advantages and drawbacks of irrigation:

Advantages

- Fewest regulatory issues – This system, when implemented correctly, is subject to the fewest regulatory requirements. This is because this method does not involve disposal of treatment plant effluent to surface water bodies or to the groundwater.
- Range of uses – Can be applied for forest lands, grasses, or non-food crops.
- Has been implemented in Western Washington.

Drawbacks

- Largest land area required of all the land based reuse options.
- Largest standby storage area required of all the land based reuse options.
- Potential for public contact.

Groundwater Recharge by Surface Percolation – Slow Rate Infiltration

Technology Description

Groundwater recharge by surface percolation using slow rate infiltration involves applying reclaimed water to the land using a series of pipes and diffuser such that the reclaimed water is applied to the land at a slow and controlled rate. The reclaimed water infiltrates through the ground to the groundwater.

Since the end fate of the treatment plant effluent is to the groundwater, it must be treated to Class A water reuse standards plus appropriate treatment to reduce the nitrogen content to the level required by the groundwater recharge criteria (RCW 90.46.080 and 1997 DOE Water Reclamation and Reuse Standards).

Design Criteria for Groundwater Recharge by Surface Percolation - Slow Rate Infiltration

The key criteria for the design of a slow rate infiltration system is the rate at which reclaimed water is applied to the land and the amount of storage required for severe wet weather during winter months when the land is too wet to accept any water. For the purposes of comparing alternatives a representative rate at which soil can accept the reclaimed water was used. Additionally, a representative amount of storage was used. Actual rates for application of reclaimed water and storage would be verified depending upon the hydrogeologic conditions at the site.

Typical design criteria used for estimating land requirements for groundwater recharge by surface percolation – slow rate infiltration are as follows:

Application rate: 0.1 – 2.0 gpd/sf (dependent upon the local geology)

Storage Required: 3 days of storage for treated effluent

A preliminary geologic investigation of the area indicates that the soils in the Pt. Hadlock area have a comparatively high acceptance rate. Soils acceptance rates may be approximately 30 – 150 gpd/sf (2 -10 inches per hour).

Advantages and Drawbacks of Groundwater Recharge by Surface Percolation – Slow Rate Infiltration

Advantages

- Minimizes potential for public contact.
- Provides groundwater recharge.

Drawbacks

- Relatively high land area required.
- Regulatory considerations (sub-surface vs. surface application critical to regulatory requirements), aquifer protection.

Groundwater Recharge by Surface Percolation – Rapid Rate Infiltration

Technology Description

Groundwater recharge by surface percolation using rapid rate infiltration involves applying reclaimed water to the land at a rate which is not necessarily controlled. The reclaimed water infiltrates into the earth as fast as the soils can accept it. Reclaimed water infiltrates through the soil to the groundwater below. Typically and simply stated, treatment plant effluent is introduced into a “leaky bottom” pond where it infiltrates into the earth.

The level of wastewater treatment required for rapid rate infiltration is the same as for surface percolation – slow rate infiltration, both requiring Class A reclaimed water.

Design Criteria for Groundwater Recharge by Surface Percolation – Rapid Rate Infiltration

The key criteria for the design of a rapid rate infiltration system is the rate at which reclaimed water is applied to the land and the amount of storage required for severe wet weather during winter months when the land is too wet to accept any water. For the purposes of comparing alternatives a representative rate at which soil can accept the reclaimed water was used. Additionally, a representative amount of storage was used. Actual rates for application of reclaimed water and storage would be verified depending upon the hydrogeologic conditions at the site.

Typical design criteria used for estimating the land requirements for groundwater recharge by surface percolation – rapid rate infiltration are as follows:

Application rate:	1.5 – 8.0 gpd/sf (dependent upon the local geology)
Storage Required:	3 days of storage for treated effluent

A preliminary geologic investigation (see Appendix A) of the area indicates that the soils in the Pt. Hadlock area have a comparatively high acceptance rate. Soils acceptance rates may be approximately 30 – 135 gpd/sf (2 -9 inches per hour). These high acceptance rates make rapid rate infiltration a viable alternative. These values will be confirmed with a more extensive geological study during design. A conservative application rate of 8.0 gpd/sf will be used for the purposes of estimating at this facilities planning stage.

Advantages and Drawbacks of Groundwater Recharge by Surface Percolation – Rapid Rate Infiltration

Advantages

- Least land area required.
- Least expensive approach due to less capital and land expenditures, low O&M costs.
- Provides groundwater recharge.

Drawbacks

- Regulatory considerations regarding aquifer protection.

Constructed Wetlands

Technology Description

Constructed wetlands can be employed for either beneficial reuse of Class A reclaimed water or for additional treatment of Class B reclaimed water. Constructed wetlands are an artificial, man-made wetland into which reclaimed water is introduced. Resident plants, animals and microorganisms utilize any available nutrients and moisture for growth, metabolism and reproduction. These activities result in improved water quality, wildlife habitat (and associated public benefits), and water uptake through transpiration and evaporation. The wetland is often constructed by installing a liner in an excavated depression and bringing in topsoil and plants to create the wetland habitat. The reclaimed water is then discharged at the opposite end where it can infiltrate into the groundwater, or in some cases, discharge to surface water (such as a stream or a bay).

Constructed Wetlands Design Criteria

For the purposes of comparing alternatives a representative rate at which a constructed *beneficial use* wetland can use water and nutrients from the reclaimed water was used. Additionally, a representative amount of storage was used. Actual rates for application of reclaimed water and storage would be verified depending upon the type of wetland plants used, their actual water and nutrient requirements, and the wetland design.

Typical design criteria used for estimating land area requirements for constructed wetlands are as follows:

Application rate:	0.5 – 1.2 gpd/sf
Storage Required:	3 days of storage for treated effluent

Advantages and Drawbacks of Constructed Wetlands

Advantages

- Provides wildlife habitat and associated public benefit.
- Works in association with groundwater recharge.
- Provides additional treatment of plant effluent.

Drawbacks

- Requires more land than other land base options including, in most cases, an infiltration basin
- Creates mosquito habitat.
- Regulatory considerations (wetlands and aquifer protection).

EVALUATION OF DISCHARGE/REUSE ALTERNATIVES

Evaluation Criteria

The following evaluation criteria were used when comparing the discharge/reuse alternatives:

Land Required

How much land is required to implement the proposed method? The higher the land requirement, the less desirable the alternative. Both land costs and future use potential were considered.

Storage Required

How much storage is required based upon the storage criteria for the proposed method? The higher the land requirement, the less desirable the alternative. Both land costs and future use potential were considered

Treatment Requirements

What is the treatment requirement associated with the proposed method? Methods requiring a higher level of treatment to protect groundwater, the environment, and/or the public are less desirable than methods which require a lower level of treatment.

Opportunities for Beneficial Reuse

Does the proposed method provide opportunities for one or more means of beneficial reuse for the treatment plant effluent? Methods which provide more opportunities for beneficial reuse are preferable.

Life Cycle Costs

What is the life cycle cost of the proposed method? These include costs for land purchase, equipment design and installation, operation and maintenance, and equipment replacement costs. Alternatives with lower life cycle costs are preferable.

LIFE CYCLE COST ESTIMATING

Cost Assumptions

Total present worth and annualized costs were estimated for a 20-year period assuming 4 percent interest. The 20-year period is consistent with an approach of designing mechanical equipment to its expected life.

Structures, such as buildings, were sized based on anticipated needs for a 50-year time span. A detailed breakdown of the estimates is in Appendix C. Estimated costs were identified from the following sources:

- Land value per acre estimated from Jefferson County Assessor's parcel database. Per acre estimates were calculated using representative parcels adjacent to the service area for slow rate and rapid rate infiltration ($28,000/acre) and remote to the service area for irrigation and constructed wetlands ($25,000/acre). These values were estimated by multiplying representative assessed values for properties by a factor of 50 percent.
- Price quotes from local equipment suppliers.
- Unit prices for construction based on industry standards (Means 2008 Building Construction Cost Data).
- Bid tabulations from recent, similar projects.

Table 6-3 summarizes factors used when estimating quantities for the comparative life cycles costs.

TABLE 6-3.
CRITERIA USED FOR ESTIMATING COST QUANTITIES

Criteria	Value/Factor
Flow Condition	2030 Maximum Monthly Flow
Storage Ponds (for constructed wetlands)	4 feet deep, 2.5 acres
Land Area Contingency	100% (estimated twice the land needed for 100% reliability)
Land Buffers	Added 25% of the total land area
Acceptance Rate/Days Storage: Rapid Rate Infiltration	8 gpd/square foot/3 days
Acceptance Rate/Days Storage: Slow Rate Infiltration	2 gpd/square foot/3 days
Acceptance Rate/Days Storage: Wetlands	1.2 gpd/square foot/3 days
Acceptance Rate/Days Storage: Irrigation	0.1 gpd/square foot/210 days
Land Value –Infiltration	$28,000/acre
Land Value – Irrigation & Wetlands	$25,000/acre

The capital cost represents the total project cost for implementation of each disposal/reuse alternative.

The life cycle costs include land cost, equipment costs, installation costs for piping, electrical, and controls, site work, mobilization/demobilization/bonding, contractor overhead and profit, escalation to mid-point of construction, planning-level contingency, engineering design and construction management, and Washington state sales tax. These amounts are reflected in the attached cost estimates.

Annual O&M costs for each disposal/reuse alternative were estimated based on power requirements, chemicals, and labor (general operation, maintenance and cleaning). Additionally, replacement cost of equipment and structures are included in the comparative life cycle costs. Replacement costs represent a dollar amount required each year to be set aside in order to replace buildings, structures, and equipment. Replacement allowances of 2 percent for buildings and structures (replace every 50-years), and 4 percent for equipment (replace every 20 to 25 years) were included in the life cycle cost estimates. These amounts are reflected in the attached cost estimates.

Summary of Life Cycle Costs

Summaries of the 20-year life cycle costs for each of the disposal/reuse alternatives are located at the bottom of Table 6-4 in the next section.

Structural costs include costs for site work, process piping, valving and electrical. Equipment costs include pump stations and force main/distribution piping associated with the pump station. The operation and maintenance costs represent a net present value of the annual operations and maintenance costs over the next 20 years for each alternative.

The life cycle costs do not include costs for associated treatment processes. An evaluation of the costs for treatment alternatives is presented in Chapter 7 – Wastewater Treatment Alternatives.

SUMMARY OF EVALUATION OF DISPOSAL/REUSE ALTERNATIVES

Each of the alternatives was evaluated against the above described criteria. Table 6-4 is a summary of the evaluation of the alternatives against the criteria. The Land Application areas shown in Table 6-4 include the necessary area for a 100% redundant disposal field.

TABLE 6-4.
SUMMARY OF ALTERNATIVES EVALUATION

	Alternative			
Evaluation Criteria	**Irrigation**	**Slow Rate Infiltration**	**Rapid Rate Infiltration**	**Constructed Wetlands**
Land Required	Land Application: 460 acres Storage: 81 acres Buffers (25% of total): 135 acres	Land Application: 23 acres Storage: Included in land application area Buffers (25% of total): 8 acres	Land Application: 5.7 acres Storage: Included in land application area Buffers (25% of total): 3 acres	Land Application: 29 acres Storage: 2.5 acres Buffers (25% of total: 9 acres)
Storage Required	Estimated that effluent will need to be stored for 7 months during the year when the soil will be too wet for irrigating. At 1 mgd maximum monthly flow, 210 million gallons of storage will be required	Effluent will be stored for 3 days during severe wet conditions when soils cannot infiltrate any additional water. At 1 mgd maximum monthly flow, 3 million gallons of storage will be required.	Effluent will be stored for 3 days during severe wet conditions when soils cannot infiltrate any additional water. At 1 mgd maximum monthly flow, 3 million gallons of storage will be required.	Effluent will be stored for 3 days during severe wet conditions when soils cannot infiltrate any additional water. At 1 mgd maximum monthly flow, 3 million gallons of storage will be required.
Treatment Requirement	Effluent can be treated to secondary treatment standards. Plants will provide additional treatment. Water will be applied at a rate which plants will use. No infiltration through the soil to groundwater.	Must treat to Class A Reuse standards with nitrogen removal to meet groundwater recharge criteria since effluent will reach groundwater after infiltration through soil.	Must treat to Class A Reuse standards with nitrogen removal to meet groundwater recharge criteria since effluent will reach groundwater after infiltration through soil.	Complicated regulatory requirements specify level of treatment to Class A through Class C standards depending on potential for human contact, type and use of constructed wetland, hydrologic conditions.

TABLE 6-4 (CONTINUED).
SUMMARY OF ALTERNATIVES EVALUATION

	Alternative			
Evaluation Criteria	Irrigation	Slow Rate Infiltration	Rapid Rate Infiltration	Constructed Wetlands
Opportunities for Beneficial Reuse	This method does not lend itself to many opportunities for beneficial reuse because of the level of treatment. The secondary effluent must be reused at the designated irrigation site since the effluent is not adequately treated for unrestricted reuse and/or human contact. This method may produce the additional benefit of a harvestable product such as timber, or some other non-food crop.	This method lends itself to several opportunities for beneficial reuse since the effluent must be treated to Class A reuse standards. The level of treatment and disinfection result in effluent which is suitable for reuse and public contact. The effluent can be used to recharge groundwater and some or all of it can be used for other uses such as irrigation in parks/golf courses, industrial/commercial use, sewer line flushing, etc.	Same as for slow rate infiltration.	Constructed Beneficial Use Wetlands provide maximum opportunity for reuse excluding only groundwater recharge. Constructed Treatment Wetlands provide more limited opportunities, depending on the ultimate level of treatment obtained by the system.
Comparative 20-year Life Cycle Costs				
Storage	$3,357,500	--	--	$104,200
Land Application	$19,134,400	$1,136,450	$268,250	$1,594,800
Structural/Equipment	$16,539,700	$2,673,550	$1,410,750	$46,998,500
Subtotal Capital	**$39,031,600**	**$3,810,000**	**$1,679,000**	**$48,697,500**
NPV O&M	$2,821,000	$629,000	$728,000	$8,200,000
Total 20-Year Life Cycle Costs	**$41,852,600**	**$4,439,000**	**$2,407,000**	**$56,987,500**

RECOMMENDED RE-USE ALTERNATIVE

Stakeholder Workshop Process

The results of the alternative evaluation were presented to the Jefferson County Board of County Commissioners at a workshop on May 25, 2006. The workshop was open to the public and some key stakeholders in the community were invited to attend. A presentation was given outlining the alternative disposal/reuse options, their relative advantages and drawbacks, and their respective life cycle costs.

The design team presented its technical perspective on each of the alternatives and received feedback and questions from the Board of County Commissioners, County staff, the stakeholders/public attending the workshop. This feedback was considered in the technical recommendation.

Recommendation

It was recommended that treatment plant effluent reuse through rapid rate infiltration be selected as the preferred alternative for the proposed wastewater treatment facility.

Reuse through rapid rate infiltration was recommended based upon the following key reasons:

- Lowest 20-year life cycle cost. This alternative has the lowest 20-year life cycle costs because the amount of land required is less than any of the other land based reuse or disposal alternatives considered. Additionally, rapid rate infiltration requires the least amount of piping and associated equipment further reducing the capital cost and the operation and maintenance requirements.
- Provides opportunities for beneficial reuse. This alternative provides good opportunities for beneficial reuse. Stakeholders and the community have expressed interest in beneficial reuse opportunities for treatment plant effluent. A specific reuse strategy mentioned by members of the public was water recharge for Chimacum Creek. The use of rapid rate infiltration at a site located in the vicinity of Chimacum Creek would provide recharge through local groundwater. Determination of an advantageous site would be part of a hydrogeologic survey of potential reuse sites.