Island County

Freeland Comprehensive Sewer Plan and Engineering Report/Facility Plan

FINAL

February 2005

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EXECUTIVE SUMMARY

Freeland is an unincorporated area of Island County approximately 10 miles west of the Clinton ferry terminal on Whidbey Island, which is in Puget Sound, about 30 miles north of Seattle. To preserve the rural character of Whidbey Island while meeting County obligations under Washington's Growth Management Act (GMA), Island County's 1998 comprehensive plan designated areas where growth would be concentrated, limiting growth in the remainder of the County and thus protecting the island from unchecked urban sprawl. Freeland and Clinton are two designated growth centers.

After adopting the countywide Comprehensive Plan, the County initiated the process of developing a Comprehensive Sub-Area Plan for the Freeland Area. A group called the Freeland Sub-Area Planning Committee was appointed to lead this work. The committee produced the "Phase I—Existing Conditions" element of the plan. The Committee then produced a "working draft" of the plan's land use element, upon which detailed infrastructure plans for new sanitary sewer systems could be based.

Currently, almost all of Freeland's population is served by septic systems. This report is intended to assist Freeland in planning for sewer capacity to match the County's population growth targets. Planning for collection, treatment, and discharge or reuse facilities will allow sewer capacity to match population growth in a cost-effective manner that minimizes potential harm to the environment.

Island County contracted with Tetra Tech/KCM on October 14, 2002 to prepare a single document that meets the Washington Administrative Code requirements for comprehensive sewer plans and engineering reports (WAC 173-240-050 and 173-240-060). This document will also meet the requirements for facilities plans established in the Code of Federal Regulations (40 CFR Part 35.917-1).

The following goals were established for preparation of this Comprehensive Sewer Plan and Engineering Report/Facility Plan:

- To develop and evaluate alternatives for wastewater collection, treatment, and disposal or reuse facilities to provide adequate hydraulic and treatment capacity for the planning period; provide planning level cost estimates for each; and recommend a preferred alternative.
- To estimate rate impacts for development of the recommended capital facilities.
- To evaluate implementation strategies for the recommended capital facilities.
- To develop a strategy for phased implementation of the recommended plan that will ensure adequate capacity throughout the planning period.

The proposed service area for the new facilities consists of the Freeland Non-Municipal Urban Growth Area (NMUGA), excluding the portions of the Holmes Harbor Sewer District and the Main Street Sewer District that are within the NMUGA.

PERMITS, REQUIREMENTS, AND REGULATIONS

Regulations with which the sewage facilities must comply include the following:

- Federal Water Quality Acts
- Federal and state National Pollutant Discharge Elimination System effluent limitations
- National and State Environmental Policy Acts
- Federal and state standards for use or disposal of sludge
- Federal and state reliability criteria
- Endangered Species Act and other federal environmental regulations
- Washington Department of Ecology Criteria for Sewage Works Design
- Washington Department of Ecology and Department of Health Water Reclamation and Reuse Standards
- Washington State Waste Discharge Permit
- Uniform Fire Code / National Fire Protection Association Standards
- Uniform Building Code / International Building Code / Washington State Energy Code
- Local permits and reviews
- Northwest Air Pollution Authority.

FLOW AND LOAD ANALYSIS

Island County and Tt/KCM staff prepared population and wastewater flow and projections for a 20-year horizon and a 50-year horizon. Low and high population growth projections were made, representing full development according to minimum and maximum development densities defined by zoning (for example, if an area is zoned to allow two to four residences per acre, the low growth projection assumes two residences per acre in the area, and the high growth project assumes four). Wastewater flows and loads were estimated for a sewer system expanding in phases, as follows:

- Phase 1: A system to serve development of the commercial core, including Nichols Brothers Boat Builders
- Phase 2: A system to serve the Phase 1 area, plus development of the medium-density zoning immediately north of the commercial core
- Phase 3: A system to serve the Phase 2 area, plus development of the area north and west of the commercial core and on both sides of Honeymoon Bay Road and Bercot Road
- Phase 4: A system to serve development of the entire service area at the low-growth scenario (20-year projection)
- Phase 5: Development of the entire NMUGA at the high-growth scenario (50-year projection)

Projections were generated for conventional gravity sewers and for septic tank effluent pump systems. The systems differ in the amount of inflow and infiltration as well as the concentrations of pollutants, such as biochemical oxygen demand (BOD) and total suspended solids (TSS). The projections are summarized in Table ES-1.

TABLE ES-1.
PROJECTED SERVICE POPULATION, FLOWS, AND LOADS

	Conventional Gravity Sewers					Septic Tank Effluent Pump Sewers				
	Ph 1	Ph 2	Ph 3	Ph 4	Ph 5	Ph 1	Ph 2	Ph 3	Ph 4	Ph 5
Service Area (acres)	120	150	380	780	780	120	150	380	780	780
Population Equivalents	746	1,229	2,426	3,645	7,323	746	1,229	2,426	3,645	7,323
Flows (million gallons per day)										
Annual Average	0.065	0.11	0.23	0.38	0.59	0.055	0.092	0.18	0.29	0.50
Maximum Month	0.093	0.16	0.34	0.57	0.83	0.074	0.13	0.25	0.41	0.68
Peak Day	0.13	0.22	0.49	0.83	1.15	0.10	0.17	0.35	0.57	0.89
Peak Hour	0.25	0.42	0.89	1.49	2.22	0.20	0.34	0.68	1.11	1.84
Biochemical Oxygen Demand Loads (pounds per day)										
Annual Average	149	246	445	689	1,173	90	147	267	413	704
Maximum Month	249	410	743	1,150	1,959	179	295	534	826	1,408
Peak Day	298	491	890	1,377	2,346	224	369	668	1,033	1,759
Total Suspended Solids Loads (pounds per day)										
Annual Average	149	246	445	689	1,173	37	61	111	172	293
Maximum Month	249	410	743	1,150	1,959	93	154	278	430	733
Peak Day	298	491	890	1,377	2,346	131	215	389	602	1,026

COLLECTION SYSTEM

Alternatives evaluated for a sewer collection system included conventional gravity systems, septic tank effluent pump (STEP) and grinder pump systems, small-diameter gravity systems, vacuum systems, and combinations of different types of systems.

Short-listed alternatives included conventional gravity systems, STEP systems, and combination gravity/STEP systems. Grinder pumps may still be considered as a subset of the short-listed alternatives.

The analysis showed that although STEP systems are more mechanically intensive than gravity systems, they have the lowest initial cost. Also, because most of the cost is in the homeowner connections (STEP tanks and pumps), implementation of STEP systems can be easily phased. For these reasons, STEP collection systems were selected as the recommended alternative.

EFFLUENT DISCHARGE/WATER RECLAMATION

Alternatives evaluated for effluent discharge included marine outfalls to Holmes Harbor and to Mutiny Bay. Alternatives for effluent reuse (beneficial water reclamation) included seasonal irrigation with wintertime storage, year-round surface percolation, year-round wetlands application, year-round direct aquifer recharge, and industrial reuse. Outfalls were eliminated from detailed evaluation due to technical, regulatory, and political issues.

All remaining alternatives were assumed to meet at least Washington State reclaimed water standards for Class A reclaimed water, based on discussions with the Departments of Ecology and Health and on the island's sole-source aquifer designation.

Of the remaining alternatives, seasonal irrigation with wintertime storage, year-round groundwater infiltration using drip irrigation, year-round groundwater infiltration using surface percolation basins, and wetland application were short-listed. Seasonal irrigation was not short-listed because of the excessive land required and high overall costs. Wetland application was not short-listed because of regulatory requirements and a lack of similar projects. The two groundwater infiltration strategies were short-listed. For these alternatives to meet reclaimed water standards, storage must be provided. The storage in these alternatives includes 20 days of long-term emergency storage and three days of wintertime ("alternative") storage.

It should be noted that in water reclamation facilities, the reclaimed water can be used for a beneficial purpose. The generator of the reclaimed water may retain the water rights for this useful resource. Freeland intends to retain the water rights to any reclaimed water generated as part of the work described in this document.

Specific design of any infiltration systems would be designed around results of a detailed hydrogeologic and water quality study, to be performed during later predesign efforts.

TREATMENT PROCESSES

Treatment alternatives included a new treatment plant to serve the Freeland service area and an expansion of the existing Holmes Harbor Sewer District (HHSD) treatment plant.

Joint Treatment Facilities with HHSD

The alternative for joint treatment with HHSD involves expanding the existing HHSD treatment plant to meet Freeland's capacity requirements. Based on HHSD preferences and space limitations, the existing treatment process of a sequencing batch reactor and filter would be converted to a membrane bioreactor process. Headworks equipment, along with odor control, would be required because of solids that would be conveyed to the plant from grinder pumps in HHSD's collection system. Additional treatment basins and new membrane equipment also would be required, and the existing chlorine contact basins would need to be enlarged.

If the HHSD treatment plant is upgraded to a different process, a majority of the existing basins, buildings, and mechanical systems could be utilized. However, Freeland would be

expected to bear the cost of all new treatment equipment and facilities, including the cost of equipment and facilities that would meet HHSD's capacity requirements.

Freeland-Only Treatment Plant

Several treatment processes were considered for a new treatment plant for Freeland.

Headworks

Because the recommended collection system is a STEP system, minimal headworks facilities will be required. In a STEP collection system, most of the settleable solids, rags, and other debris settles out in individual septic tanks. The required minimal headworks facilities are flow metering and sampling. Similar facilities would be required at the downstream end of the plant.

Treatment Process

Alternatives considered for the main treatment process were suspended growth, fixed-film, and physical-chemical treatment. All alternatives had to be able to meet Class A reclaimed water standards. A short-list of four best alternatives was developed for detailed analysis:

- Package extended aeration plus filtration
- Oxidation ditches plus filtration
- Sequencing batch reactors plus filtration
- Membrane bioreactors (no additional filtration required).

Package extended aeration was taken off the short-list due its lack of flexibility in sizing and phasing, since this type of process is sold in prepackaged units.

Filtration alternatives included several types of media filtration as well as cloth filters. Deep-bed media filters were recommended as a conservative approach.

The final analysis of treatment process alternatives was deferred until the rest of the treatment elements (disinfection and solids handling) were analyzed.

Disinfection Alternatives

Several disinfection alternatives were evaluated:

- Hypochlorite disinfection using 12-percent liquid hypochlorite and chlorine contact basins
- On-site generation of 0.8-percent hypochlorite using salt, water, and electricity and chlorine contact basins
- Ultraviolet (UV) disinfection (several types evaluated).

Because Class A Reclaimed Water Standards require a chlorine residual in the reclaimed water piping, all alternatives were assumed to have some minimal hypochlorite feed equipment.

The recommended disinfection alternative is hypochlorite feed using 12-percent liquid hypochlorite and chlorine contact basins. This recommendation is based on cost and the requirement of maintaining a chlorine residual in the reclaimed water piping.

Solids Handling Alternatives

Based on the small size of the system, relatively simple solids handling alternatives were considered. More complex alternatives, such as beneficial reuse of treated solids, require expensive solids handling equipment and stringent recordkeeping and monitoring and were not short-listed. The following alternatives were short-listed alternatives:

- Stabilizing waste solids and trucking the solids to the Island County Septage Handling Facility
- Stabilizing waste solids, thickening the solids to reduce haul costs, and trucking the solids to the King County's South Treatment Plant in Renton.

Based on overall cost-effectiveness and other qualitative factors, it was recommended to stabilize waste solids and haul them to the Island County Septage Handling Facility. However, it should be noted that although the Island County facility does accept local municipal treatment plant solids, it was designed primarily for septic tank pumpage. In the future, the facility may reach its design capacity and decide not to accept any more municipal treatment solids. At that point, additional solids management strategies should be evaluated. These could include assisting the Island County Septage Facility with upgrades to meet required capacity, hauling additional solids to an alternative location such as King County's South Treatment Plant, or developing more complex solids management strategies for beneficial reuse of biosolids.

Treatment Recommendation

All of the combined treatment elements were compared qualitatively and quantitatively. A cost analysis was prepared to compare four overall treatment alternatives:

- Joint treatment with HHSD, with conversion from sequencing batch reactors plus filters to membrane bioreactors, hypochlorite disinfection, and hauling solids to the Island County Septage Handling Facility
- A Freeland-only treatment plant, with oxidation ditches plus filters, hypochlorite disinfection, and hauling solids to the Island County Septage Handling Facility
- A Freeland-only treatment plant, with sequencing batch reactors plus filters, hypochlorite disinfection, and hauling solids to the Island County Septage Handling Facility
- A Freeland-only treatment plant, with membrane bioreactors, hypochlorite disinfection, and hauling solids to the Island County Septage Handling Facility

Although joint treatment with HHSD offers an economy of scale that is not achieved with a Freeland-only project, joint treatment also would require headworks and odor control, and Freeland would have to pay for HHSD's capacity in the joint plant upgrade. Based on an

analysis of qualitative factors and overall cost-effectiveness, the recommended alternative is a Freeland-only treatment plant with membrane bioreactors. Membrane bioreactors are the preferred technology due to their cost-competitiveness, simplicity of operation, and exceptional effluent quality.

The treatment plant would incorporate basic elements, including site landscaping and other mitigation for adjacent parcels, electrical systems, addition of a plant supervisory control and data acquisition system, an administration and laboratory building, general site considerations such as parking and loading area for solids hauling trucks, and storage space for other equipment and general tools.

OVERALL ALTERNATIVES AND RECOMMENDATION

Based on the recommendations for technologies for collection, reuse, storage, and treatment, County and Tt/KCM staff evaluated the local area for parcels that might be suitable for part or all of the facilities. Criteria included:

- Proximity to the service area
- Contiguous acreage
- Minimal number of landowners
- Access to State Route 525 or other access roads
- Lack of sensitive areas, such as wetlands, steep slopes, or floodplains
- Sparse development.

From this search, three parcels were identified that could be used for some or all of the recommended facilities. Figure ES-1 shows alternatives for using these parcels. The alternatives can be described as follows:

- Alternative 1a—Freeland-only treatment plant, storage basins, and land application at a parcel between Mutiny Bay and Holmes Harbor, immediately southwest of Highway 525.
- Alternative 1b—Freeland-only treatment plant and storage basins at the same parcel as Alternative 1a. Pumps at the plant and a conveyance pipeline to convey reclaimed water to land application facilities approximately 2 miles northwest of the treatment plant and storage basins, at a former tree farm west of Highway 525 and Mutiny Bay Road. Wintertime storage basins would be located at the land application site.
- Alternative 2—Pump station along Honeymoon Bay Road to convey raw sewage from Freeland to a joint treatment project with HHSD at the existing HHSD plant site. Storage basins and land application in the area immediately west of the HHSD plant.
- Alternative 3— Pump station along Honeymoon Bay Road to convey raw sewage from Freeland to a joint treatment project with HHSD at the existing HHSD plant site. Storage basins and land application in the former tree farm described as part of Alternative 1b.

HWA GeoSciences performed hydrogeological fieldwork to evaluate the ability of the soils to percolate at each site. Estimated percolation rates are by far the best for Alternatives 1b and 3, at the former tree farm, specifically in an area that has been used for a gravel pit. For Alternative 1a, percolation rates are estimated to be good at the southern portion of the site, but not the northern portion. For Alternative 2, percolation rates are estimated to be poor.

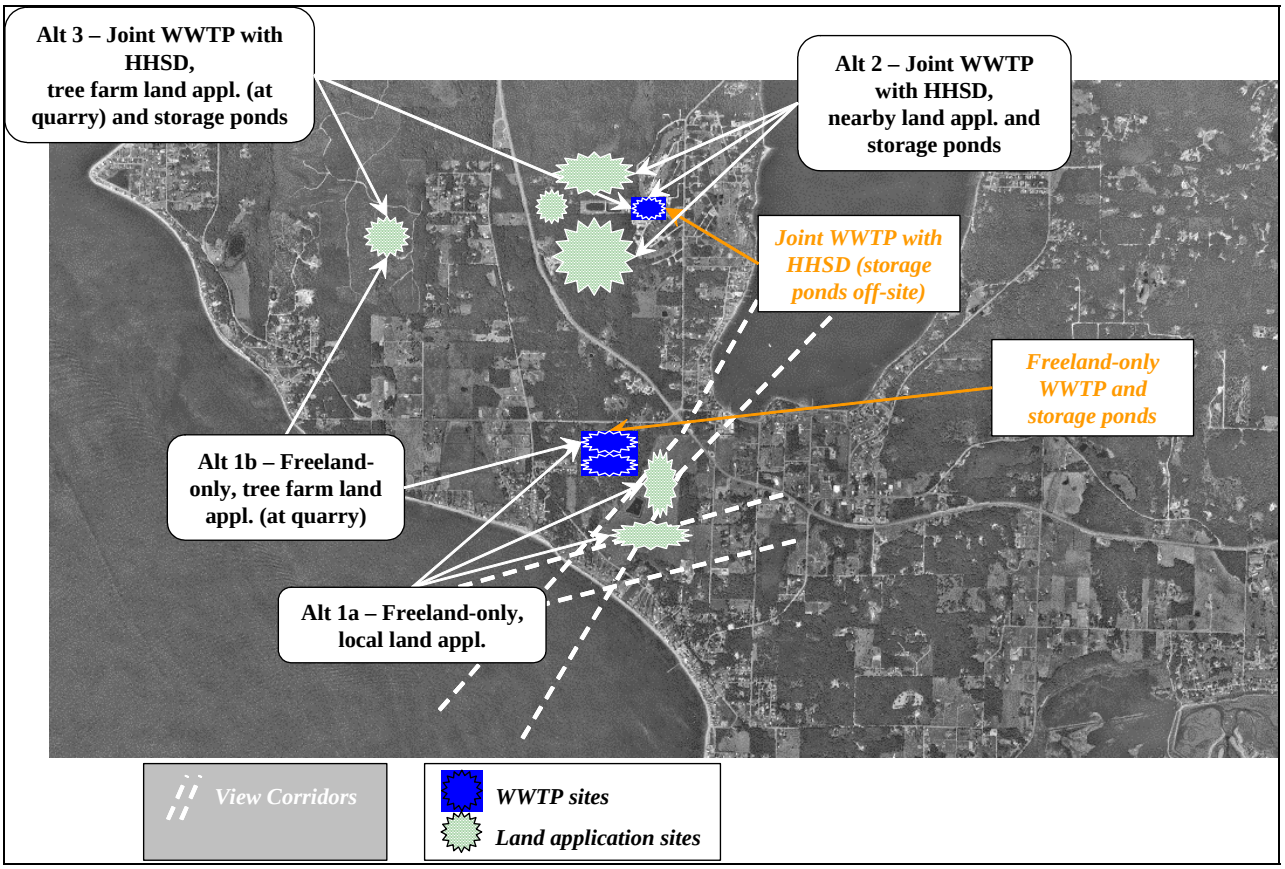


Figure ES-1. Potential Treatment Plant, Storage Basin, and Land Application Sites

For land application, Alternative 1a is risky due to the presence of adjacent drinking water wells and wetlands, as well as a seasonally high groundwater table. Alternative 2 is risky due to the poor percolation ability of the local soils, multiple landowners, and adjacent drinking water wells and wetlands. Alternatives 1b and 3 have the least amount of risk, based on the highest estimated percolation rates, a single landowner, and few adjacent landowners or drinking water wells or wetlands.

A planning-level cost analysis showed that Alternative 1a is the least expensive in capital cost and in total present worth. This is primarily because it is located close to Freeland. Alternatives 1b and 3 are similar in costs, although Alternative 3 is slightly higher due to longer conveyance routing. Alternative 2 was the most expensive alternative, primarily due to the large amount of land required for land application and long conveyance routing.

Alternative 1b is recommended based on cost and qualitative factors.

IMPLEMENTATION

The recommended plan includes the following:

- Collection System—Septic tanks and septic tank effluent pumps at each service connection, and pressurized mainline sewers throughout the service area.
- Treatment—Membrane bioreactor treatment plant with anoxic basins for nitrogen reduction, aerobic basins for oxygenation, and immersed membranes for clarification. Disinfection using 12-percent sodium hypochlorite and chlorine contact basins. Solids handling using stabilization of treatment plant solids, and hauling of stabilized solids to the Island County Septage Treatment Facility.
- Storage—20-day emergency storage and 3-day wintertime storage using open earthen basins. Lined basins for emergency storage and unlined basins for wintertime storage.
- Conveyance—Pumps and piping from the collection system to the treatment plant and from the treatment plant to surface percolation basins.
- Reuse—Land application using surface percolation basins.

The recommended plan accounts for phased growth in the service area. It also provides flexibility to Freeland to accommodate a wide range of future possibilities with the reclaimed water from the treatment plant, such as in-town irrigation systems, nearby forest irrigation, additional land application as sites are identified in the future, and summertime irrigation at the Useless Bay Golf Course. Any of these strategies would benefit the local environment by reducing the amount of groundwater pumped out of the local aquifer and/or helping to replenish the aquifer. Estimated costs for the Phase 1 facilities are presented in Table ES-2.

The capital cost represents the total project cost for implementation of each alternative. It includes 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. Annual operation and maintenance (O&M) costs account for power requirements, replacement of equipment and structures, chemicals, and labor (general maintenance and cleaning).

TABLE ES-2.
ESTIMATED COST OF RECOMMENDED PHASE 1 IMPROVEMENTS

Facility	Construction	Capital	Annual O&M	O&M Present Worth	**Total Present Worth**
Collection	$1,706,000	$2,274,000	$35,600	$520,000	**$2,794,000**
Treatment	$2,567,000	$3,399,000	$88,200	$1,288,000	**$4,687,000**
Storage	$402,000	$506,000	$1,500	$23,000	**$529,000**
Conveyance	$1,321,000	$1,761,000	$17,400	$254,000	**$2,015,000**
Reuse	$369,000	$474,000	$11,500	$168,000	**$642,000**
Total	$6,365,000	$8,414,000	$154,200	$2,253,000	**$10,667,000**

Notes:
Construction = Construction cost, including contractor's markup and 30% planning-level contingency.
Capital = Construction cost, plus 25% for design and construction management, plus 8.3% sales tax.
Annual O&M = Yearly costs of labor, power, chemicals, replacement cost for equipment and structures, and other miscellaneous costs.
O&M Present Worth = Annual costs of O&M converted into a 20-year present worth.
Total Present Worth = Sum of **Capital** and **O&M Present Worth**.

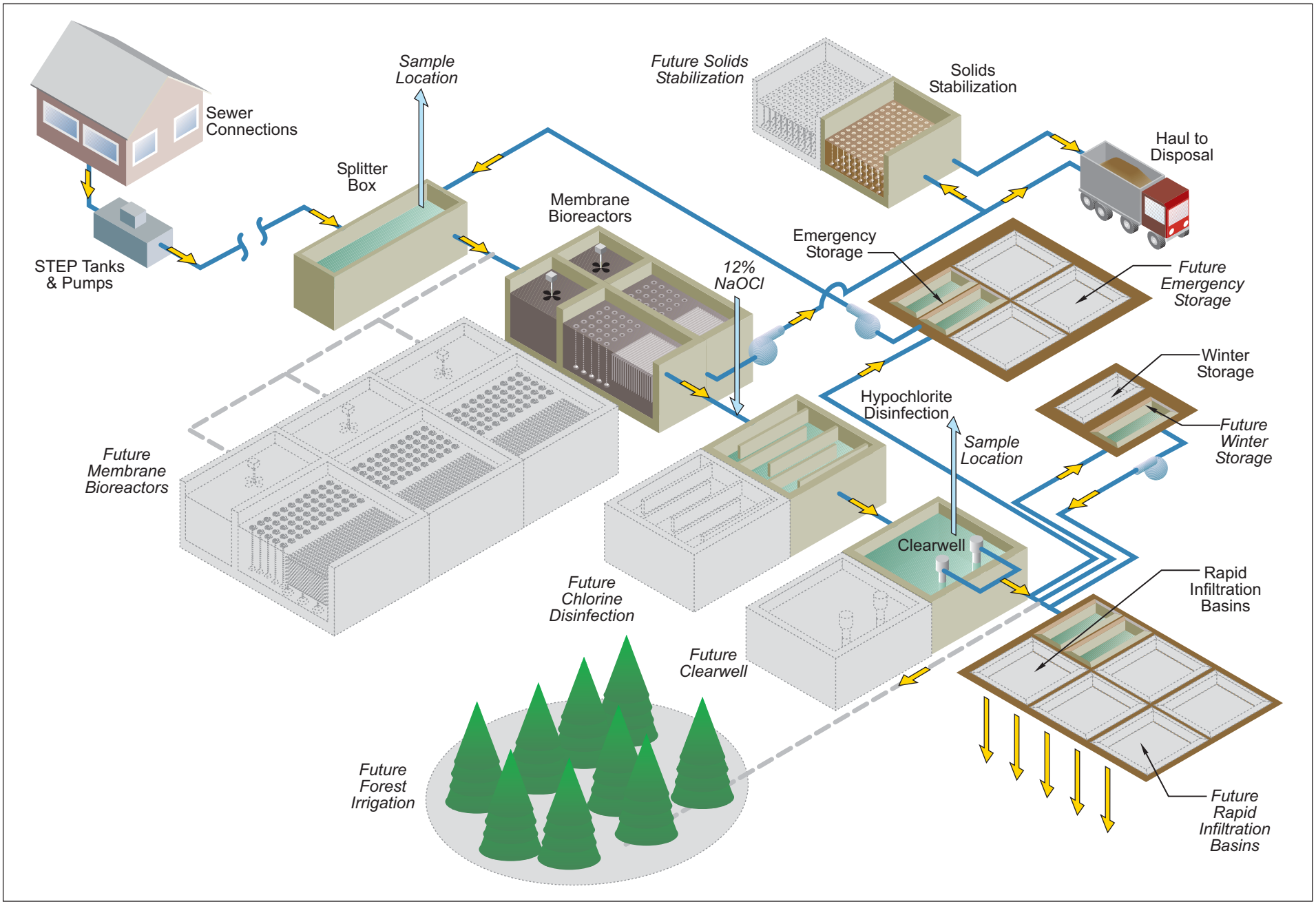
Figure ES-2 shows the liquids and solids-stream process flow schematics for the recommended alternative. Figure ES-3 shows the site plan of the recommended treatment plant. Figure ES-4 shows the location of treatment, storage and land-application facilities. Figure ES-5 shows the hydraulic profile for the recommended alternative. These planning-level figures may change during detailed design.

FINANCING CONSIDERATIONS

Financing for the new wastewater system may be funded from a variety of sources. Sources of funding may include developer contributions, local improvement districts (LIDs), user charges, special assessments, debt financing, connection fees, special surcharges or a combination of available resources. A portion of the recommended improvements may be funded through grants and/or low interest loans. Refer to Chapter 9 for more details on financing, including how costs vary with each phase of implementation.

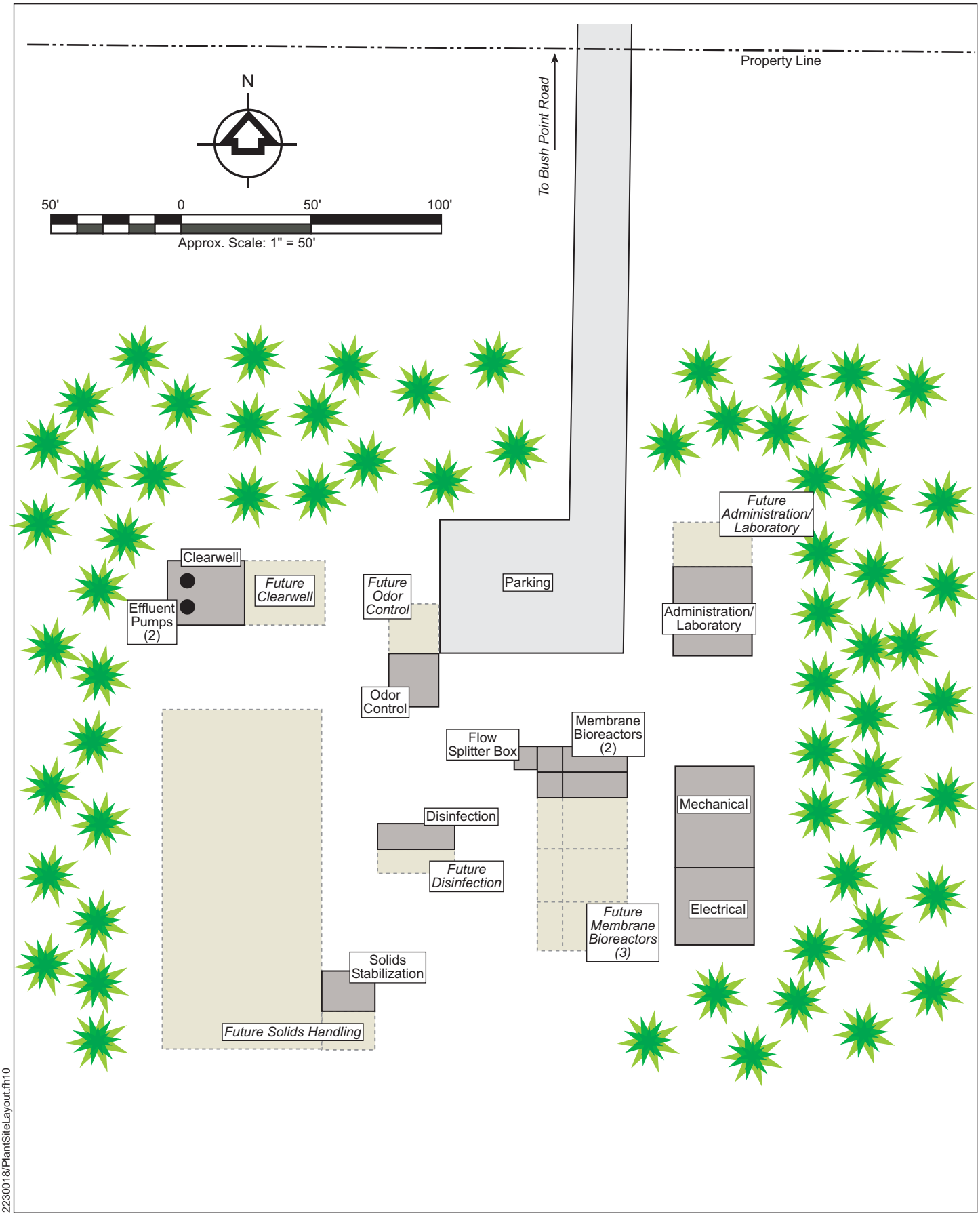
The financing analysis assumed that the STEP tanks, pumps, and lateral connections to the mainline sewers are paid for by the homeowner at the time of connection. This assumption is consistent with similar jurisdictions, such as HHSD.

Customer rates required to fund the annual O&M costs are estimated to be between $17 and $29 per equivalent residential unit (ERU) per month. To fund the capital improvements, the implementation will likely include a combination of funds from rates, connection fees and/or assessments to finance the operating and capital costs. A detailed analysis of the annual revenue requirement should be conducted to determine the level of funding required from user rates on an annual basis, based on anticipated customer growth, sources of funds and projected expenses.



2230018/FlowSchematic.fh10

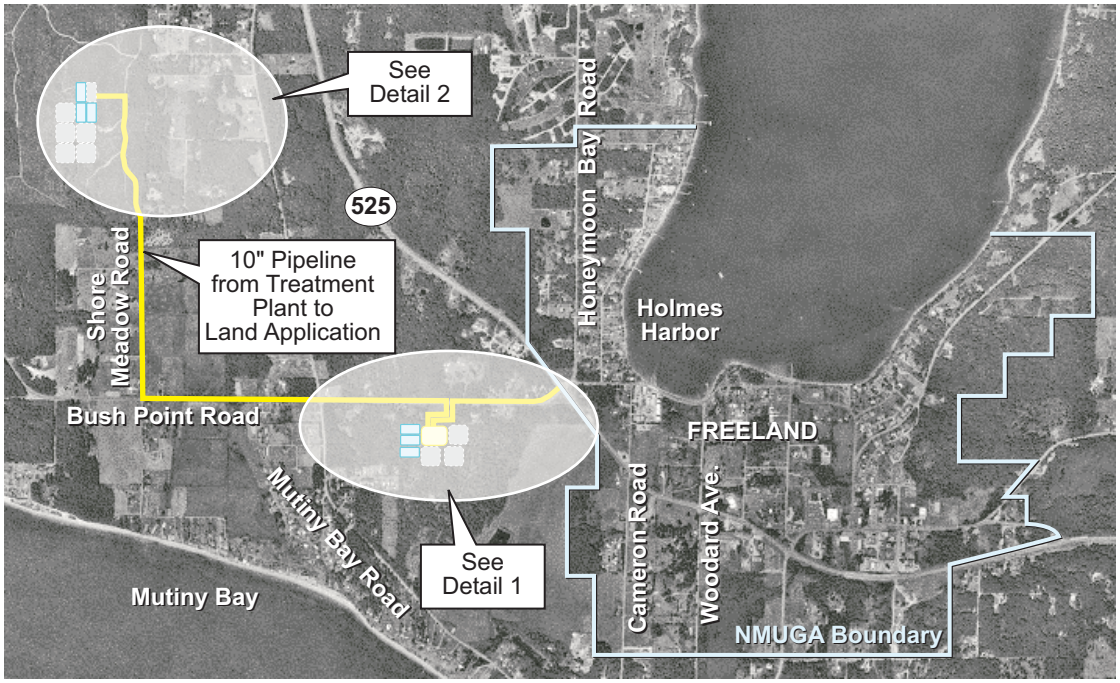
Tetra Tech/ KCM, Inc. 1917 First Avenue Seattle, Washington 98101	Island County FREELAND COMPREHENSIVE SEWER PLAN AND ENGINEERING REPORT	Figure ES-2. LIQUIDS- AND SOLIDS-STREAM PROCESS FLOW SCHEMATIC



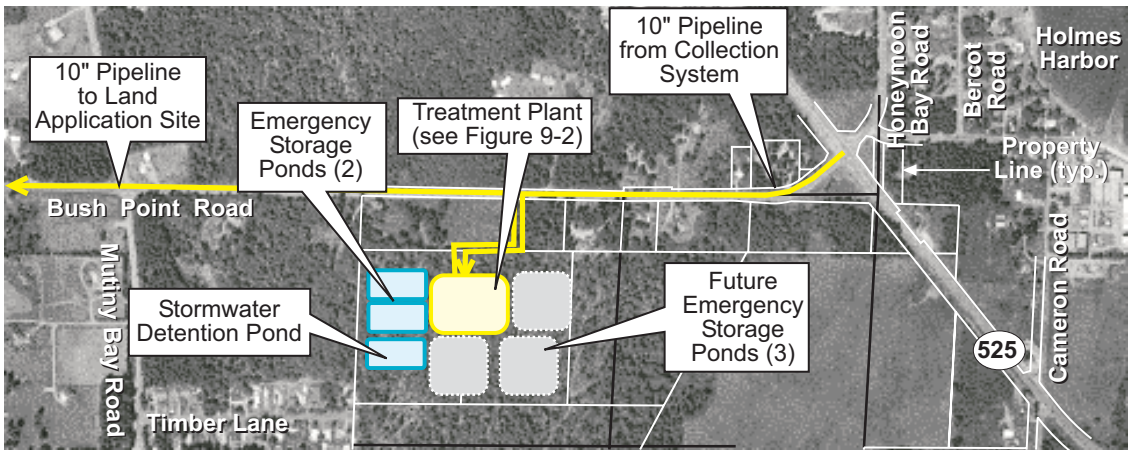
2230018/PlantSiteLayout.fh10

Tetra Tech/ KCM, Inc. 1917 First Avenue Seattle, Washington 98101	Island County FREELAND COMPREHENSIVE SEWER PLAN AND ENGINEERING REPORT	Figure ES-3. SITE PLAN FOR RECOMMENDED TREATMENT PLANT

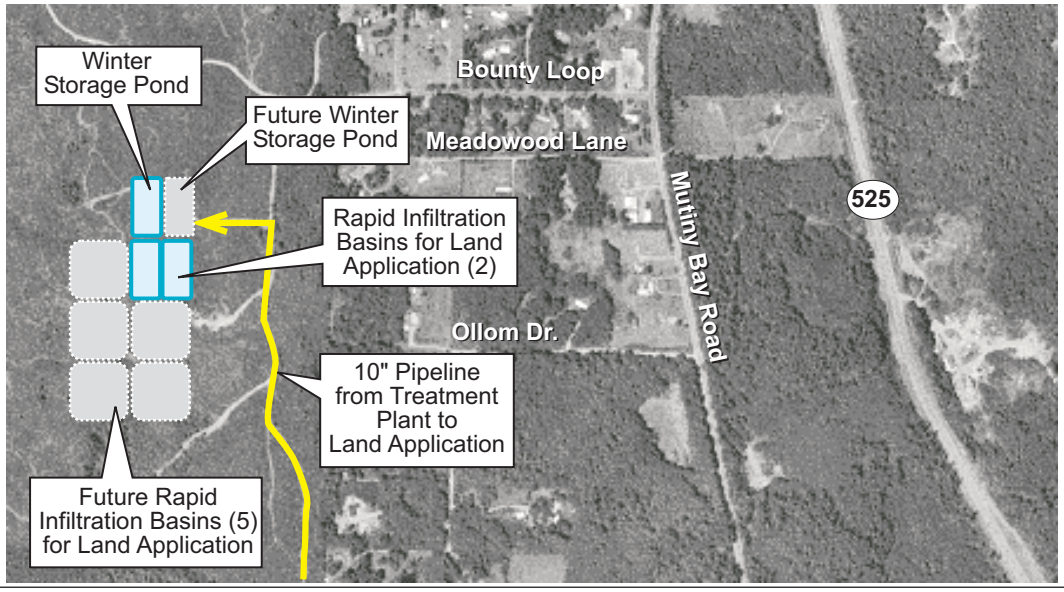
Treatment, Storage and Land Application Locations Approx. Scale: 1" = 3,000'



Detail 1. Treatment and Emergency Storage Locations Approx. Scale: 1" = 1,000'



Detail 2. Land Application and Winter Storage Locations Approx. Scale: 1"= 1,000'



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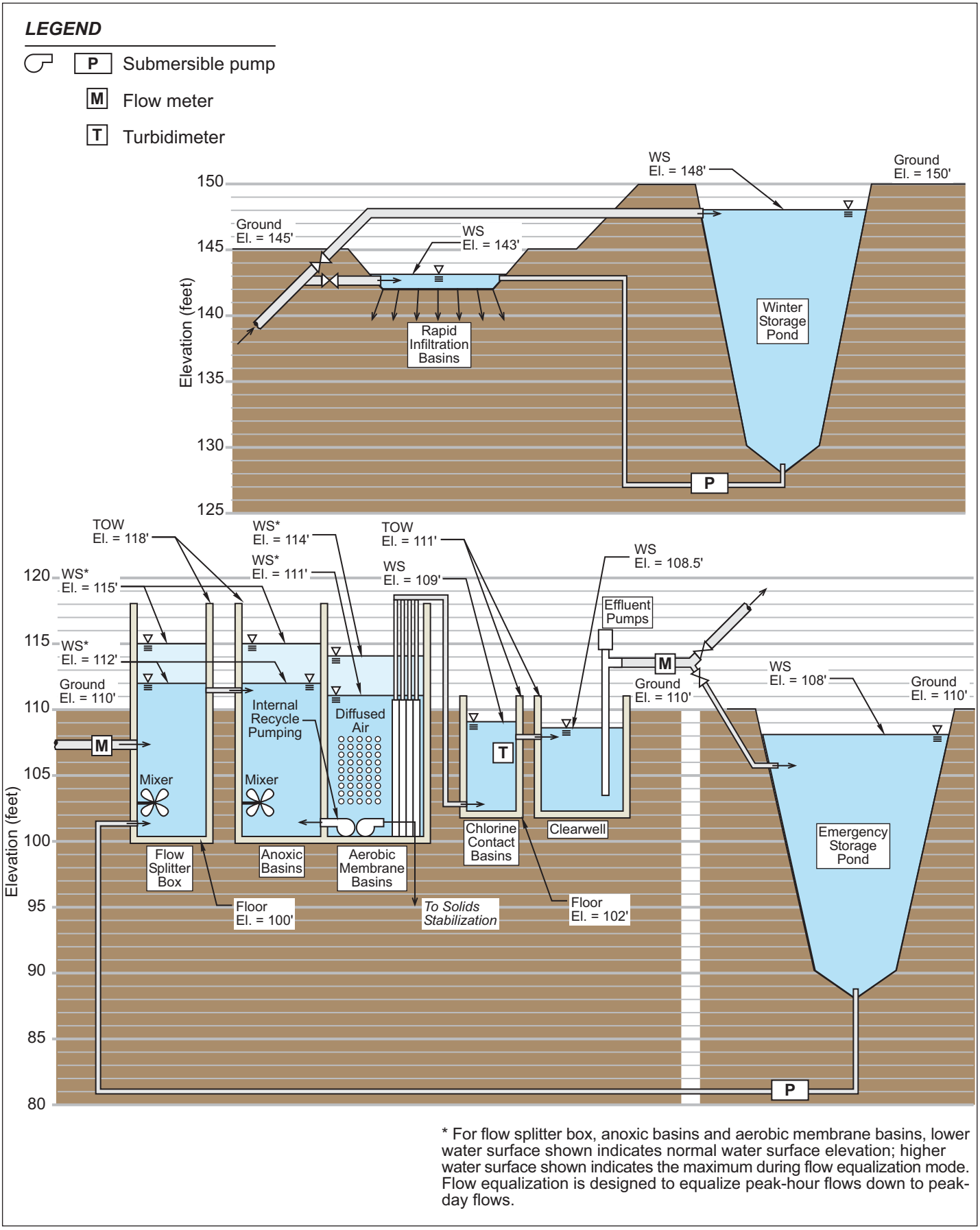
2230018/FacilityLocations.fh10

Tetra Tech/ KCM, Inc. 1917 First Avenue Seattle, Washington 98101	Island County FREELAND COMPREHENSIVE SEWER PLAN AND ENGINEERING REPORT	Figure ES-4. TREATMENT, STORAGE AND LAND APPLICATION LOCATIONS



* For flow splitter box, anoxic basins and aerobic membrane basins, lower water surface shown indicates normal water surface elevation; higher water surface shown indicates the maximum during flow equalization mode. Flow equalization is designed to equalize peak-hour flows down to peak-day flows.

2230018/FlowSchematic.fh10

Tetra Tech/ KCM, Inc. *1917 First Avenue* *Seattle, Washington 98101*	Island County FREELAND COMPREHENSIVE SEWER PLAN AND ENGINEERING REPORT	Figure ES-5. HYDRAULIC PROFILE FOR RECOMMENDED IMPROVEMENTS

Options for funding the capital improvements include the following three strategies:

- Option A: To fund improvements through an LID, an estimated lump sum assessment of between $6,000 and $61,000 per acre would be required, depending on the phase of construction and estimated service area boundary.
- Option B, part 1: The estimated growth-related connection fee for Freeland is approximately $8,000 per ERU to fund Phases 1 through 4 over the life of the improvements. The estimated fee to fund all identified improvements (Phases 1 through 5) over the life of the improvements would be $6,000 per ERU. This approach could introduce much variability in the rates, based on uncertainty associated with future connections.
- Option B, part 2: For the marginal cost or phased approach connection fee, the fees would range from $3,000 to $23,000 per ERU depending on the planning period, and funds would be more likely to be available as the costs are incurred (compared to Option B, part 1).
- Option C: Monthly sewer rates could be used to pay for a portion of the capital improvements, but they would result in very expensive sewer rates (from $80 to $120 per month for capital costs, plus $17 to $29 for O&M costs, depending on the phase of implementation). If the project is successful in obtaining significant grants, such as the maximum amount of 75 percent grant funding available from the U.S. Department of Agriculture Rural Development program, and if the remaining capital costs are financed through low-interest loans, then the additional monthly rates for capital costs would average $10 to $30 per ERU (plus $17 to $29 for O&M costs).

NEXT STEPS

Recommended next steps are as follows:

- Actively pursue grant and low-interest loan options for implementing and financing the recommended improvements.
- Conduct a detailed hydrogeological analysis for the recommended land application site(s), as described at the end of Chapter 8.
- Conduct detailed financial and implementation analysis, as described in Chapter 9.

CHAPTER 1.
INTRODUCTION

Freeland is an unincorporated area of Island County approximately 10 miles west of the Clinton ferry terminal on Whidbey Island, which is in Puget Sound, about 30 miles north of Seattle. To preserve the rural character of Whidbey Island while meeting County obligations under Washington's Growth Management Act (GMA), Island County's 1998 comprehensive plan designated areas where growth would be concentrated, limiting growth in the remainder of the County and thus protecting the island from unchecked urban sprawl. Freeland and Clinton are two designated growth centers. The comprehensive plan classifies Freeland as a "Residential Area of More Intensive Development" (RAID), with potential designation as a "Non-Municipal Urban Growth Area" (NMUGA). The implications of these County classifications are discussed in later chapters.

After adopting the countywide Comprehensive Plan, the County initiated the process of developing a Comprehensive Sub-Area Plan for the Freeland Area. A group called the Freeland Sub-Area Planning Committee was appointed to lead this work. The committee produced the "Phase I—Existing Conditions" element of the plan. The Committee then produced a "working draft" of the plan's land use element, upon which detailed infrastructure plans for new sanitary sewer systems could be based.

Currently, almost all of Freeland's population is served by septic systems. This report is intended to assist Freeland in planning for sewer capacity to match the County's population growth targets. Planning for collection, treatment, and discharge and/or reuse facilities will allow sewer capacity to match population growth in a cost-effective manner that minimizes potential harm to the environment.

AUTHORIZATION AND SCOPE

Island County contracted with Tetra Tech/KCM on October 14, 2002 to prepare a single document that meets the Washington Administrative Code requirements for comprehensive sewer plans and engineering reports (WAC 173-240-050 and 173-240-060). This document will also meet the requirements for facilities plans established in the Code of Federal Regulations (40 CFR Part 35.917-1). Under the project scope, the document is to address the following:

- Facilities planning constraints
- Planning area description
- Regulatory requirements
- Population, flow, and load analysis
- Collection system alternatives
- Wastewater treatment alternatives
- Disposal and reuse alternatives
- Alternatives evaluation and recommended facilities

- Public participation
- Implementation program
- Environmental documentation.

An interlocal agreement between Island County and the Freeland Water District was executed on October 14, 2002. The County, through this agreement, funded the development of this Sewer Plan as an essential element of the Comprehensive Sub-Area Plan. The Freeland Water District agreed to reimburse the County for the development of this plan in the event the District implements the plan and raises funds for its implementation. It is generally acknowledged that the implementing authority for a sewer system will be the Freeland Water District. A copy of the interlocal agreement is included in Appendix A.

GOALS

The following goals were established for preparation of this Comprehensive Sewer Plan and Engineering Report/Facility Plan:

- To develop and evaluate alternatives for wastewater collection, treatment, and disposal or reuse facilities to provide adequate hydraulic and treatment capacity for the planning period; provide planning level cost estimates for each; and recommend a preferred alternative.
- To estimate rate impacts for development of the recommended capital facilities.
- To evaluate implementation strategies for the recommended capital facilities.
- To develop a strategy for phased implementation of the recommended plan that will ensure adequate capacity throughout the planning period.

CHAPTER 2.
BACKGROUND

Whidbey Island was named for Joseph Whidbey, the first mate on Captain George Vancouver's ship, the HMS Discovery, which visited the island in 1792. At the time, the island was inhabited by members of the Skagit, Swinomish, Snohomish and Suquamish tribes. The Island was settled by non-native peoples in the mid-1800s (www.whidbey.net).

Figure 2-1 shows the vicinity of the island as well as the general location of Freeland. The proposed extent of sewer service is described later in this chapter.

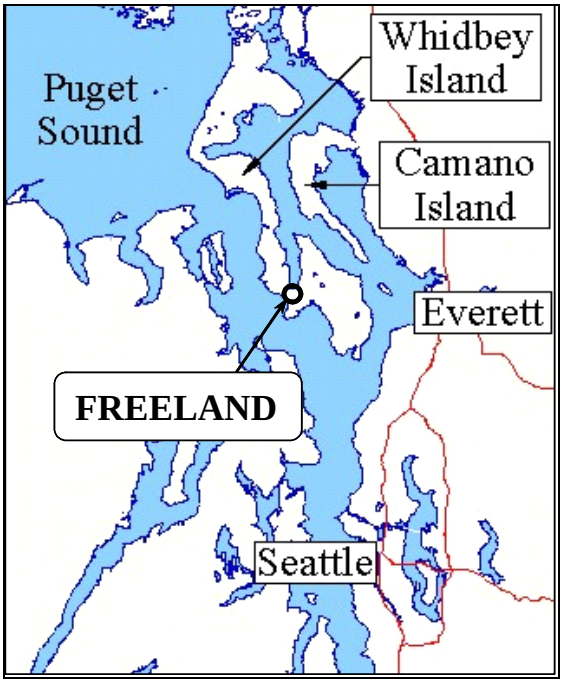


Figure 2-1. General Location Map

FREELAND VISION STATEMENT

The Freeland Sub-Area Plan contains the following vision for the Freeland area: "Freeland's mission is creating a vibrant, healthy and safe place where people love to visit, learn, work and live." Specifically, the vision for Freeland is stated as follows in the Sub-Area Plan (selected paragraphs):

> *"Freeland in the year 2020 is a comfortable waterfront community that is known for its unique character and expansive views of the surrounding environment.*
>
> *Surrounding Freeland are farms, open fields and forest land. Within the sub-area well thought out and consistently administered development regulations have influenced quality infill that is both regionally compatible and locally*

unique. Views have been preserved for all to enjoy, with parks and public areas sprinkled throughout, offering a variety of recreational opportunities to Freeland residents. Residents are offered a multitude of housing choices that are both architecturally intriguing and affordable to the average person.

Freeland is a community where people live, work and shop. The central commercial core offers mixed-use living, a vibrant and healthy downtown and a diverse array of retail, dining, employment, and cultural opportunities. Freeland residents encourage economic development by welcoming diverse economic growth that provides satisfying and stable jobs. Commercial development has been incorporated in a tasteful fashion with appropriate landscaping and building design that balances business opportunity with security and aesthetic value. Outdoor lighting is respectful of neighbors and protects the regional view of the night sky.

Freeland has committed to continually reducing traffic, conserving resources and protecting regionally important environmental systems. Sewer and stormwater infrastructure provide for higher water quality and infiltration instead of increased runoff. Residents are well educated and committed to aquifer recharge and protection of groundwater resources is a high priority.

Island County, Washington Department of Transportation, Island Transit, The Freeland Water & Sewer District, and all other agencies cooperate in creating creative and innovative solutions to required changes in capital facilities and future growth management. In the past, and into the future, available infrastructure and an overwhelming sense of community directs future growth to the sub-area thus, preserving un-incorporated area throughout Island County."

LAND USE AND ZONING

The 1998 Island County Comprehensive Plan's "Residential Area of More Intensive Development" (RAID) designation for the Freeland area applies to most of the "core area" north of State Highway 525. RAIDs are designated under the Revised Code of Washington (RCW) 36.70A.070 to establish logical outer boundaries for existing areas of more intensive rural development. The RAID has two basic zoning designations: "Rural Residential (RR)" and "Rural Center (RC)." The remaining areas in the vicinity are zoned "Rural (R)."

The County is proposing zoning changes to designate Freeland as a Non-Municipal Urban Growth Area, as established under RCW 36.70A.110. NMUGAs are unincorporated areas where urban growth is be encouraged and supported with urban levels of service. Lands within NMUGAs can be designated with a variety of zoning classifications.

The NMUGA land use designations proposed for Freeland include residential classifications of "Low Density (LD)," "Medium Density (MD)," "High Density (HD)," "Mixed Use (MU)" and "Rural Estate (RU)." Commercial classifications include "Business General (BG)," "Business Office (BO)," "Business Village (BV)," and "Industrial (I)." There is also a "Public (P)" designation for public spaces.

Island County requested that Tt/KCM conduct sewer planning for Freeland as an NMUGA. The service area established for this report is the NMUGA, excluding the portion within the Holmes Harbor Sewer District (HHSD) immediately north of Freeland, on the west shore of Holmes Harbor. The HHSD is not included in the Freeland sewer service area because it is already sewered. HHSD's wastewater facilities are discussed later in this chapter.

The Main Street Sewer District (also described later in this chapter) lies within the proposed NMUGA.

The service area and proposed NMUGA zoning are shown in Figure 2-2.

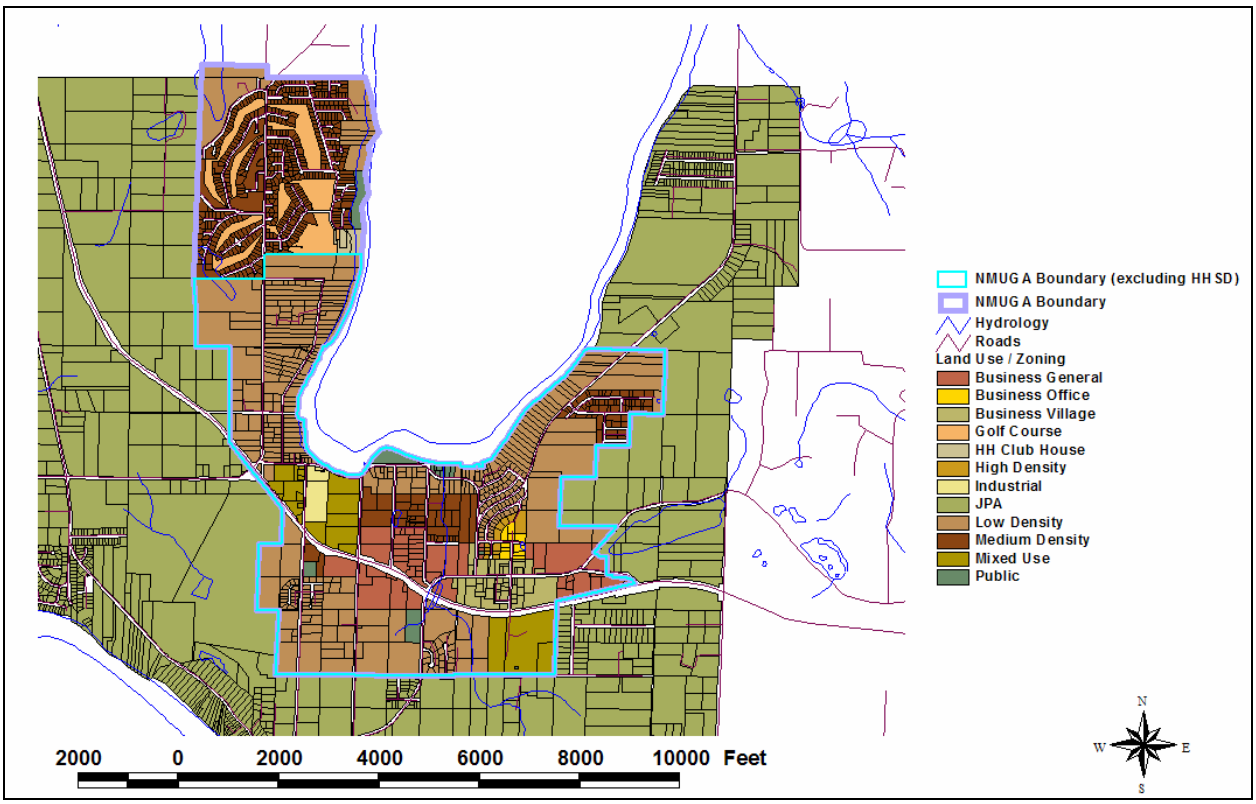


Figure 2-2. Proposed NMUGA Zoning

The proposed NMUGA (not including the HHSD service area) is approximately 800 acres in size. Commercial uses are primarily in the central part of the planning area. Residential areas surround the central commercial core. The major industry is Nichols Brothers Boat Builders, located just northwest of the commercial core, adjacent to Holmes Harbor.

POPULATION

This section describes countywide population; population within the proposed Freeland NMUGA area is described in Chapter 4. Washington State Office of Financial Management (OFM) population estimates have indicated countywide increases in population for several decades. According to the OFM estimates, which are shown in Table 2-1, the County's population increased by about 20 percent between 1990 and 2000. Table 2-1 also compares historical population in unincorporated versus incorporated areas. The three incorporated

cities in the County are Oak Harbor, Coupeville, and Langley. Approximately a third of the County's population is incorporated.

TABLE 2-1.
COUNTYWIDE HISTORICAL POPULATION

Year	Unincorporated	Incorporated	Total Population
1950	9,080	1,999	11,079
1960	14,508	5,130	19,638
1970	16,619	10,392	27,011
1980	30,117	13,931	44,048
1990	40,797	19,398	60,195
2000	49,081	22,477	71,558

Source: Washington State Office of Financial Management

Freeland and Clinton were being considered for NMUGA designation to accommodate some of the forecasted growth in the County. According to the County's comprehensive plan, "both Clinton and Freeland have developed as unincorporated communities, generally with a full range of land uses. As such, they are logical choices for further growth and to accommodate some of the forecasted population and employment for the county as a whole (p. 1-28)."

Clinton currently intends to remain a RAID. Freeland, as part of the Sub Area Planning process, is considering adoption of the NMUGA designation.

The County's Comprehensive Plan further states that "probably the key issue in answering these questions is the availability of basic infrastructure, particularly sewer (p. 1-28)."

UTILITY SERVICES

Nearby Water Systems

The Freeland Water District provides water to customers in the Freeland area. The supply is from two groundwater wells. The District's *Water Comprehensive Plan* (Roehl and Associates, 2002) reports that average water production has been approximately 70,000 gallons per day (gpd) in recent years. With approximately 350 connections receiving water service from the Freeland Water District, the average production has been approximately 200 gallons per connection per day. Peak-day production has been approximately 2.4 times the average-day production.

There are several public and private water systems in the vicinity. Within the District's boundary, there are four small Class B water systems. There are several larger water systems in the general area. W. B. Water Works #1 is adjacent to the south and west, serving approximately 350 connections with groundwater from four wells. The Harbor Hills Water Company is a large system serving the Holmes Harbor Golf Club area. It serves

about 150 homes from three wells. Additional adjacent water systems are described in detail in the Freeland Water District's *Water Comprehensive Plan*.

Nearby Wastewater Facilities

The Holmes Harbor Sewer District has a capacity to serve the equivalent of approximately 700 houses in and around the Holmes Harbor Golf Course. Currently, the district serves single-family residences. Future development may include multi-family units as well as non-residential services, such as restaurants.

Sewage is collected in septic tanks or grinder pump pits at each house and pumped by septic tank effluent pumps (STEPs) or grinder pumps to a wastewater treatment facility on Antelope Road. At the treatment facility, raw sewage is treated to Class A reuse standards using sequencing batch reactors (SBRs) with post-SBR equalization, shallow-bed media filtration, and sodium hypochlorite disinfection. Treated effluent (reclaimed water) is reused beneficially for golf course irrigation in the summer; at other times of year, the reclaimed water is stored in holding ponds on the treatment plant site for summer irrigation use. Figure 2-3 shows the treatment and storage facilities.

Figure 2-3. Holmes Harbor Sewer District Treatment Facilities and Storage Ponds

The Main Street Sewer District serves the Maple Ridge community center in Freeland; the center provides residential senior housing and an assisted care facility. It is a small system, sized for 41 units of senior housing, the assisted care facility, and a small amount of commercial and office development. It is located at the intersection of Newman and Scott Roads, east of the Main Street commercial core.

The system collects sewage at a small treatment plant on the site. Raw sewage is treated to Class A reuse standards using a package extended aerobic treatment plant with a media filter. The treatment plant has been approved by the Departments of Health and Ecology as a Class A reclamation facility with beneficial uses for landscape irrigation and toilet flushing, with remaining treated effluent (reclaimed water) sent to a nearby drainfield. Currently, all reclaimed water is being discharged directly to the drainfield. Figure 2-4 shows the treatment plant facilities.

Figure 2-4. Main Street Sewer District Treatment Facilities

The rest of the Freeland area is served by septic systems. According to the County's comprehensive plan, "many portions of Freeland do not 'perk' and, without a public sewer, are undevelopable (p. 1-28)." Periodically, septage must be pumped from septic tanks; it is typically hauled to the Island County Septage Handling Facility for further treatment and later beneficial reuse.

Nichols Brothers Boat Builders, the only major industrial user in the area, has a small industrial wastewater treatment system for its boat washing water and industrial storm water. Its domestic sewage is collected in a septic tank and pumped uphill to a drainfield behind the facility.

TOPOGRAPHY, SOILS AND HYDROGEOLOGY

Ground elevations in the Freeland area range from zero to about 250 feet above sea level. The terrain is generally gently sloping, with some areas having slopes greater than 20 percent. Figure 2-5 shows the U.S. Geological Survey (USGS) topographic map of the area.

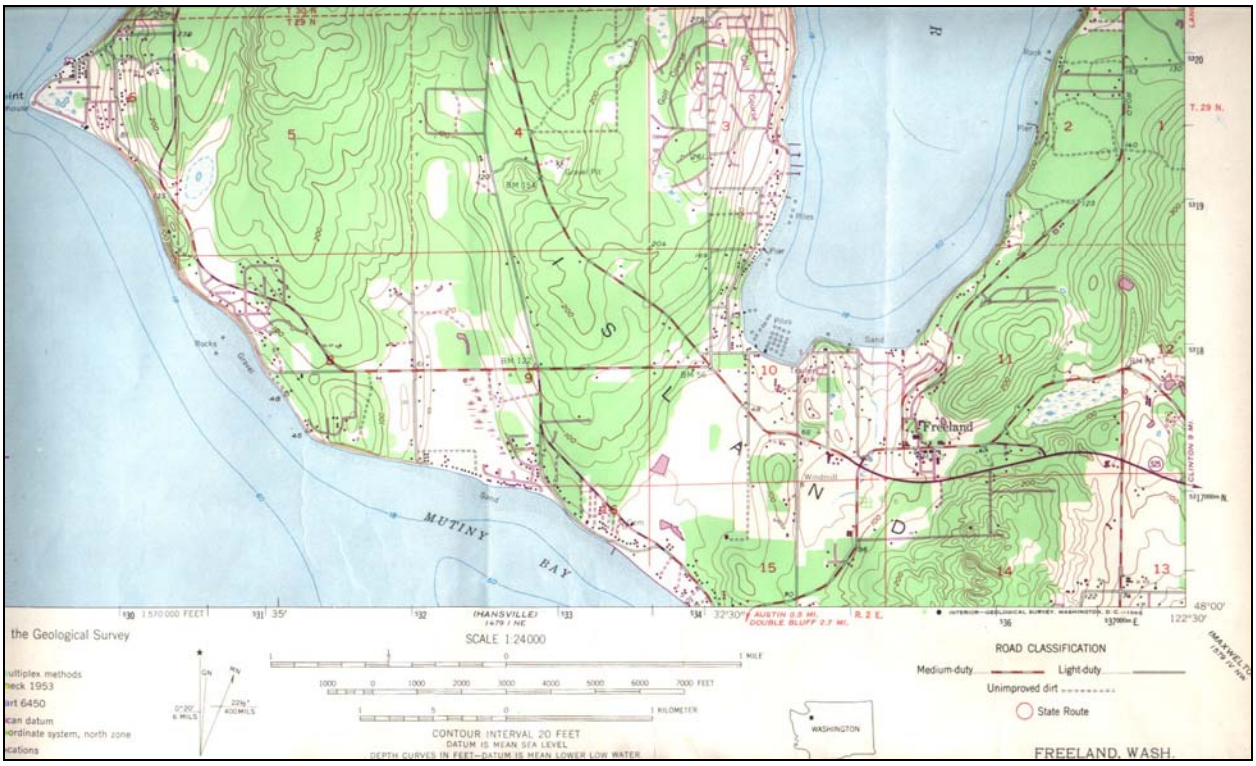


Figure 2-5. USGS Topographic Map

Soils throughout Whidbey Island originated mostly from glacial drift, deposited by glaciers that once moved over the region from the north. The U.S. Department of Agriculture Soil Conservation Service's (SCS) *Soil Survey, Island County, Washington* (SCS, 1958) indicates that the area has several different soil types, with Whidbey gravelly sandy loam and Keystone loamy sand as two of the predominant types. Figure 2-6 shows soil types in the area. Soils in the project area are likely to be discontinuous, meaning that soil conditions will be very site-specific.

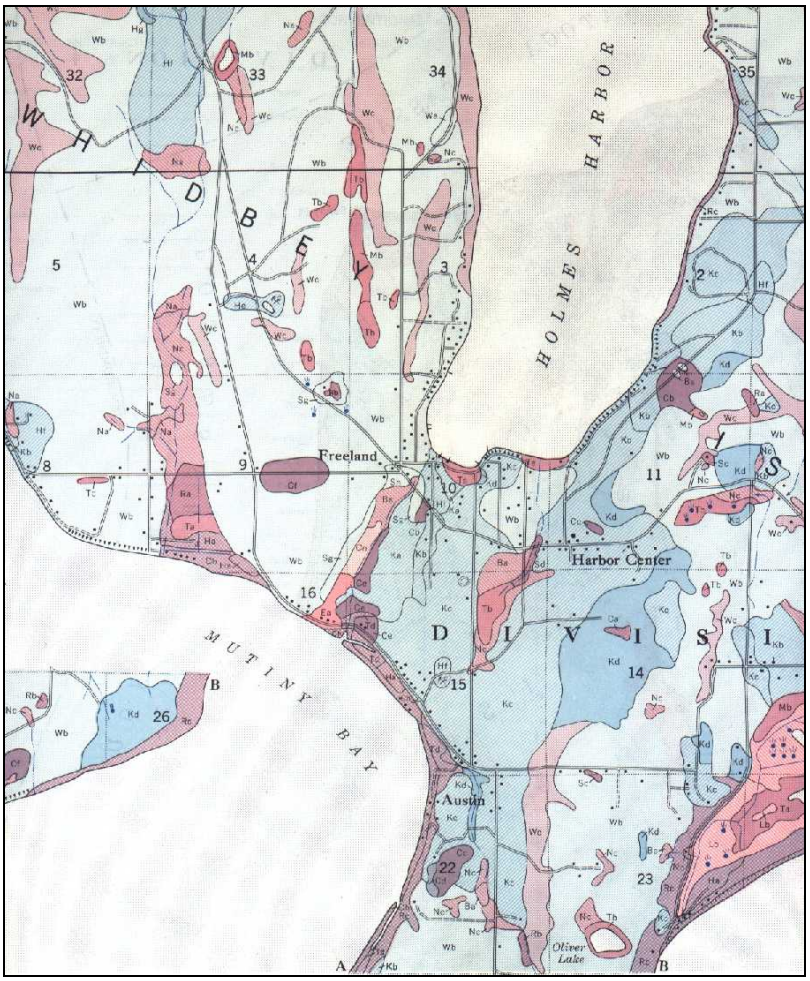


Figure 2-6. Soils Map of the Freeland Area
(W = Whidbey gravelly sandy loam, K = Keystone loamy sand)

Whidbey gravelly sandy loam is prevalent in the higher elevation areas west of Holmes Harbor and in the vicinity of the Holmes Harbor Golf Course. It is described as "cemented gravelly till… the surface layer and subsoil absorb the water readily. During the rainy season the lower part of the subsoil immediately above the hardpan remains saturated for long periods."

Keystone loamy sand, which is prevalent in the area between the southern end of Holmes Harbor through the southern end of Freeland, is defined as a "somewhat excessively drained soil…developed from sandy drift… it is sandier and more open and porous throughout than the associated Whidbey soils and is comparatively free of gravel… because of the open porous texture, water is absorbed readily and drains very rapidly through the soil."

Hydrogeological Reconnaissance

A hydrogeological reconnaissance was conducted by HWA Geosciences, Inc. to evaluate general hydrogeologic and soil conditions throughout the area for potential land application sites for treated wastewater effluent. The study found that in the areas closer to the

Holmes Harbor Golf Course, the prevalence of Whidbey gravelly sandy loam is not favorable for land application due to the cemented hardpan layer a few feet below the surface. However, the prevalence of Keystone loamy sand around the commercial core and all the way to the southern edge of the NMUGA boundary would be much better suited for land application due to the well-drained soils. The report is included as Appendix B.

HAZARD AREAS

Erosion Hazard

Erosion hazard areas contain soils that, according to the SCS Soil Classification System, may experience severe to very severe erosion. The erosion hazard for any given soil type increases as slope increases. Erosion hazard includes the transport of soil by wind and water. The susceptibility of soil to erosion depends on the size of the soil particles, the amount of precipitation, topography, and the type and density of vegetation. Some areas in Freeland have steep slopes that could be more susceptible to erosion. Figure 2-7 shows areas of steep slopes in the Freeland area. For the purposes of this map, steep slopes were defined by the County as slopes greater than 40 percent. Development in critical areas is regulated by Island County's Critical Areas Ordinance.

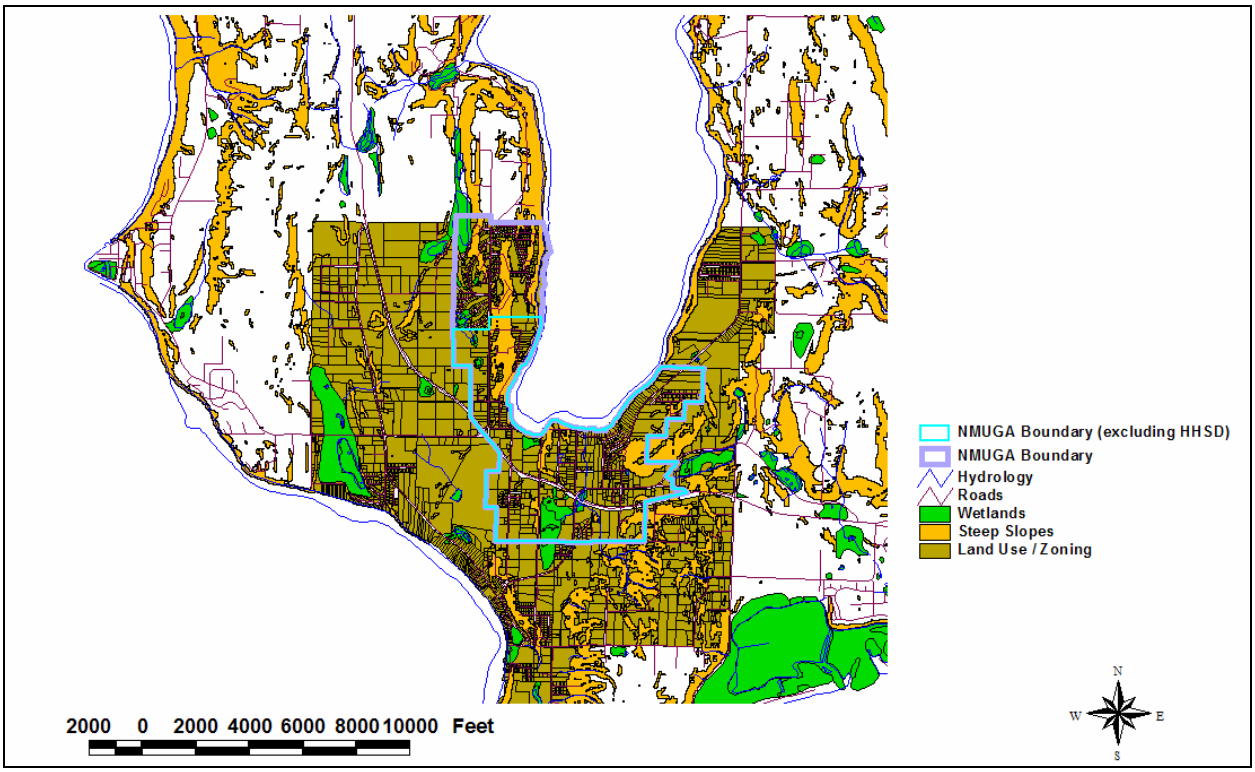


Figure 2-7. Wetlands and Steep Slopes in the Freeland Area

Landslide Hazard

Landslide hazard areas are areas potentially subject to landslides based on geologic, topographic and hydrological factors, including bedrock and soil characteristics and stratigraphy, slope, and hydrology. Landslide hazard areas on the island are areas on

slopes of 15 to 45 percent with other indicators of landslide hazard. Development in areas subject to landslides is regulated by Island County's environmental regulations. There are several areas with significant slopes in the Freeland area, as indicated on Figure 2-7.

Seismic Hazard

The Uniform Building Code defines four zones for seismic hazard, with Zone 4 as the highest risk zone and Zone 1 as the lowest risk zone. The Whidbey Island area has been classified in seismic Zone 3 (UBC 1997). Seismic hazard areas are areas associated with active faults and earthquakes. The potential for ground-shaking, differential settlement, or soil liquefaction in these areas poses significant, predictable hazards to life and property. Seismic-induced events also include tsunamis, surface faulting or seiches. Development in seismic hazard areas is regulated by Island County's environmental regulations.

CLIMATE

Whidbey Island has a mild, Mediterranean, marine climate, characterized by cool summers and mild winters. Due to the "rain-shadow" effect from the Olympic Mountain Range, the annual rainfall is about half that experienced in Seattle – typically about 20 inches of rain per year on Whidbey Island, compared to about 40 inches per year in Seattle. Peak rainfall typically occurs November through February.

Temperatures typically range from mid-30 to mid-80 degrees (Fahrenheit). Seasonal low temperatures occur from November through January, with highs occurring from July through September.

SURFACE WATER/WETLANDS

The main surface water in the study area is Puget Sound. Holmes Harbor defines the north end of Freeland, while Mutiny Bay is on its southwestern boundary. Washington Administrative Code 173-201A defines Holmes Harbor as a Class A (excellent) marine water as part of Saratoga Passage. Mutiny Bay is classified as a Class AA (extraordinary) marine water as part of Admiralty Inlet.

Holmes Harbor is a narrow inlet into the north Freeland area. Its shape likely contributes to a relatively low amount of mixing with other Puget Sound waters. According to the *2002 Puget Sound Update* (Puget Sound Action Team, 2002), Holmes Harbor is a marine water where eutrophication (receiving excess nutrients that stimulate excessive plant growth) may be a concern. It is characterized by "strong and persistent" stratification, low dissolved oxygen levels, and an overall "high" sensitivity to eutrophication.

In summer, algae can bloom in areas of the harbor fed by nutrients. The sources of nutrients into the harbor are not clearly known. They could include natural processes, failing septic tanks, and excessive fertilizer application. Figure 2-8 shows an example of algae growth in the harbor.

Wetlands in the Freeland area are shown on Figure 2-7. According to Island County Planning Department staff, most of the wetlands in the area are Category A wetlands, which is the highest quality designation per the Island County Critical Areas Ordinance.

Figure 2-8. Summertime Algae Growth in Holmes Harbor

GROUNDWATER

Whidbey Island uses groundwater from a sole-source aquifer, as designated by the U.S. Environmental Protection Agency (EPA), for drinking water. This designation was set by EPA Region 10 in 1982. Also, under WAC 173-200, "existing and future beneficial uses (of groundwater) shall be maintained and protected and degradation of ground water quality that would interfere with or become injurious to beneficial uses shall not be allowed."

A survey of groundwater wells in the Freeland area showed that groundwater quality is generally good. Nitrates, chlorides, and arsenic are indicators of groundwater contamination. Although there are scattered instances of elevated levels of nitrate, chloride, and arsenic throughout the area, there is no consistent pattern.

Nitrate levels are regulated by a national primary drinking water standard of 10 mg/l. Elevated nitrate levels are often symptomatic of septic tanks and drainfields being overloaded (in addition to other causes). Figure 2-9 shows that nitrates are scattered throughout the area, but there are few areas in Freeland with elevated nitrate levels. It appears that there is some concentration of wells with elevated nitrate levels south of Freeland, along Mutiny Bay Road.

Chloride levels are regulated by a national secondary drinking water standard of 250 mg/l. Elevated chloride levels are often an indication of seawater intrusion, which is a potential concern on Whidbey Island. Figure 2-10 shows that groundwater in Freeland is generally free of elevated chloride levels. However, there is a single well west of Freeland that has somewhat high chlorides; the circle on the map is a half-mile radius drawn around a well with chloride levels between 100 and 200 mg/l. A smaller, irregularly shaped boundary shown on the map is the boundary of an area of potential groundwater contamination around a former landfill off Highway 525.

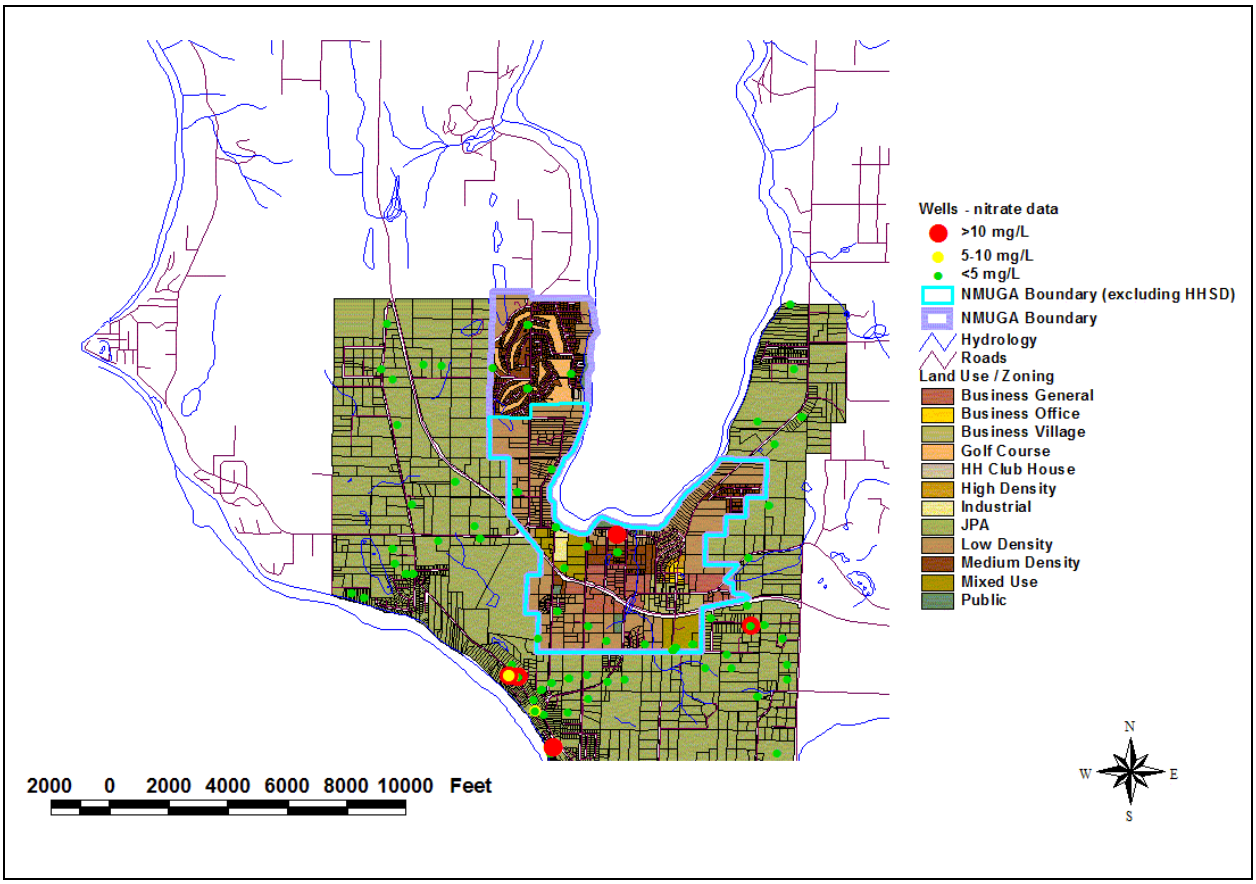


Figure 2-9. Areas of High Nitrate Levels in the Freeland Vicinity

Arsenic is regulated as a national primary drinking water standard and is a common contaminant in groundwater. A recent EPA rule reduced the arsenic standard from 50 parts per billion (ppb) to 10 ppb. Figure 2-11 shows that there are a few scattered instances of arsenic levels above 10 mg/l (large yellow circles) in the Freeland area.

RELATED STUDIES

The following plans, studies, and other documents were reviewed as background for the current study:

- Adams & Clark Inc., 1993. *Holmes Harbor Water District Comprehensive Sewer Plan and Engineering Report for Wastewater Facilities*.
- Freeland Sub-Area Planning Committee and Island County Department of Planning and Community Development, 2001. *Draft Freeland Sub-Area Plan: An Element of the Island County Comprehensive Plan*.
- Island County, 1998. *Island County Comprehensive Plan*.
- Island County Code Title XVII, Chapter 17.02 (Critical Areas Ordinance).
- U.S. Department of Agriculture, 1958. Soil Conservation Service, *Soil Survey, Island County, Washington*.

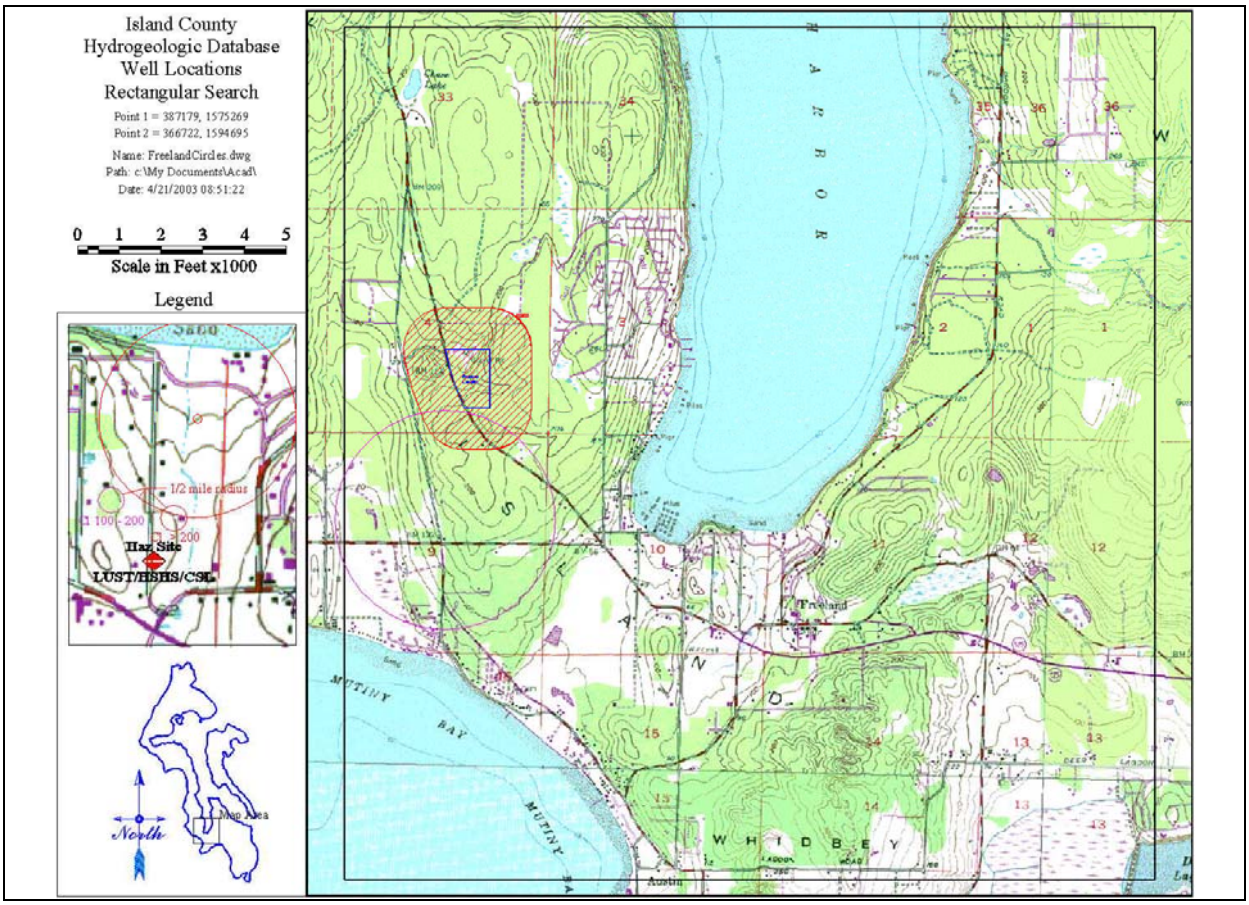


Figure 2-10. Areas of High Chloride Levels in the Freeland Vicinity

- Washington State Office of Financial Management, Historical Population Data.
- R. W. Beck, 2000. *Phase 1 Report for the Freeland Sub-Area Plan.*
- Roehl and Associates, 2002. *Freeland Water District Draft Water Comprehensive Plan.*

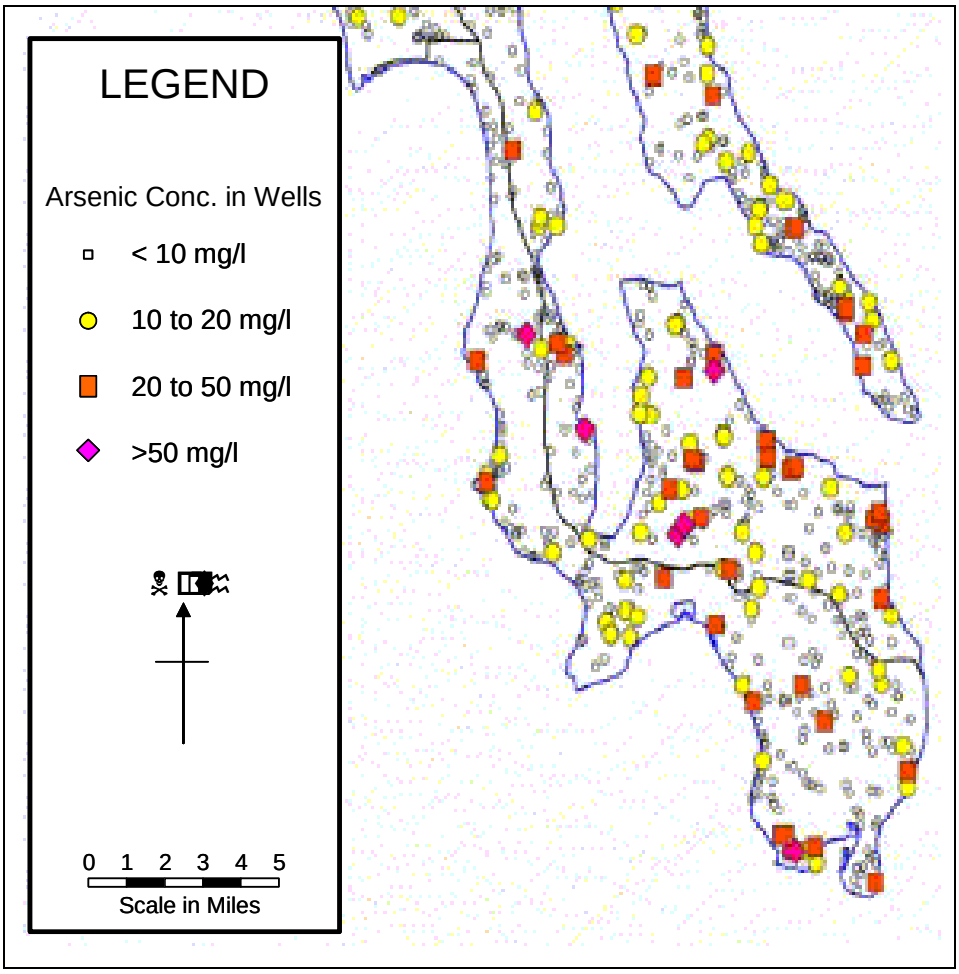


Figure 2-11. Areas of Elevated Arsenic Levels in the Freeland Vicinity

CHAPTER 3.
PERMITS, REQUIREMENTS, AND REGULATIONS

Wastewater must be collected, treated, and disposed of or reused in a way that protects public health and receiving water quality, generates no objectionable off-site odors or aesthetic nuisances, and complies with all applicable regulations. Wastewater treatment facilities must meet the regulations and requirements of many federal, state, and local regulatory agencies. This chapter summarizes applicable rules and regulations that typically apply to wastewater projects.

FEDERAL REGULATIONS

Federal Water Quality Acts

Programs and policies designed to protect water quality were first initiated on a nationwide scale by the Federal Water Pollution Control Act of 1956. This act was amended by the Water Quality Act of 1965, the Clean Water Restoration Act of 1966, and the Water Quality Improvement Act of 1970. The Federal Water Pollution Act Amendment of 1972 (Public Law 92-500) replaced the previous language of the Act entirely. This Act requires states to establish water quality standards for all of their water bodies. The standard must consist of two parts: a designation of the use of the water body; and the water quality criteria that water body must maintain to protect the designated uses from pollution. The State of Washington complies with this regulation through WAC 173-201A, which is described later.

The Clean Water Act of 1977, in further amending the Act, required any agency conducting an activity that may result in a discharge into navigable waters to obtain certification from the appropriate water pollution control agency, verifying that the discharge complies with applicable effluent limitations and water quality standards. Further, these amendments established the National Pollutant Discharge Elimination System (NPDES) permits, which regulate point discharges into water, and required various types of water quality planning by states. Grants for facilities and training were also authorized under these amendments.

With increased environmental awareness of the extent and effects of nonpoint pollution, including stormwater, additional amendments to the Federal Clean Water Act were passed by Congress in early 1987. These amendments, referred to as the Water Quality Act of 1987, and especially Section 319, direct the states in developing programs designed to reduce nonpoint source pollution. These sources of pollution have become increasingly evident over the past 25 years as abatement of source pollution has occurred. The Amendments required each state to do the following:

- Submit a report identifying navigable waters that cannot meet water quality standards without action to control pollution.
- Identify the categories of pollution sources.
- Describe processes for identifying best management practices and control strategies.

- Identify state and local programs for controlling pollution from both point and nonpoint sources.

These amendments resulted in the formation of the Puget Sound Water Quality Authority (PSWQA) and the Puget Sound Water Quality Management Plan.

Puget Sound Estuary Program

The Water Quality Act of 1987 formally established the National Estuary Program and declared that the increase in coastal population, demands for development, and other direct and indirect uses of estuaries threaten these unique bodies of water. The law further states that it is in the national interest to maintain the ecological integrity of the nation's estuaries through long-term planning and management. The EPA's designation of Puget Sound as an estuary of national significance is the federal government's formal recognition that Puget Sound is a resource of vital importance to fish and wildlife, to recreation, and to commerce and trade.

The Puget Sound Estuary Program, which is co-managed by the EPA, the Washington State Department of Ecology, and the Puget Sound Action Team (formerly the Puget Sound Water Quality Authority), has been designated as the management conference for Puget Sound. The management conference is responsible for the development and implementation of a site-specific "Comprehensive Conservation and Management Plan" (CCMP). Under the law, the management plans developed by each conference must do the following:

- Assess trends in water quality, natural resources, and uses of the estuary.
- Collect, characterize, and assess data on toxics, nutrients, and natural resources within the estuarine zone to identify the causes of environmental problems.
- Develop the relationship between the in-place loads and point and nonpoint loadings of pollutants to the estuarine zone and the potential uses of the zone, water quality, and natural resources.
- Develop a comprehensive conservation and management plan that recommends priority corrective actions and compliance schedules addressing point and nonpoint sources of pollution.
- Develop plans for the coordinated implementation of the plan by the states as well as federal and local agencies participating in the conference.
- Monitor the effectiveness of the actions taken pursuant to the plan.
- Review all federal financial assistance programs and federal development projects to determine whether such assistance program or project would be consistent with and further the purposes of the plan.

The 1987 Puget Sound Water Quality Management Plan developed by the Authority is recognized as being a partial CCMP by the National Estuary Program. Successive updates complete the requirements for a CCMP.

Federal Effluent Limitations

Section 301 of the federal Water Pollution Control Act requires all publicly owned wastewater treatment facilities to provide a minimum of secondary treatment unless a special waiver is obtained. This act requires the following:

- The monthly average of biochemical oxygen demand (BOD) and total suspended solids (TSS) concentrations shall not exceed 30 milligrams per liter (mg/L).
- The weekly average of BOD and TSS concentrations shall not exceed 45 mg/L.
- The monthly average removal of BOD and TSS shall be at least 85 percent.
- The pH of the effluent shall be between 6.0 and 9.0.

There can be exceptions to these regulations when treatment works receive combined sewer flows or certain industrial wastes. However, in general, these are the minimum federal requirements for effluent quality. The Washington State Department of Ecology administers these regulations under the NPDES.

National Environmental Protection Act

The National Environmental Protection Act (NEPA) requires appropriate environmental documentation for projects that could have a significant adverse impact on the quality of the natural and human environment. The EPA can declare that a proposed action is categorically exempt from these requirements. Otherwise, the proposing agency must prepare an Environmental Information Document (EID), commonly referred to as an Environmental Assessment or Environmental Report. An Environmental Report has been prepared for this project (Tt/KCM, 2004). An Environmental Report looks at various elements of the environment such as soils, water quality, and air quality. In addition, the document addresses how the proposed project complies with federal and state regulations. Letters were sent to various regulatory agencies in addition to the Tulalip Indian Tribes and Swinomish Tribal Community requesting input and comments regarding the proposed action. The EPA uses the Environmental Report to determine whether to issue a "finding of no significant impact" or to require an environmental impact statement.

Federal Standards for Use or Disposal of Sludge

The federal document that regulates the use and disposal of sewage sludge is the Code of Federal Regulations, Part 503 (40 CFR 503, EPA 1993). These regulations, published in February 1993, address three main sludge disposal options:

- Land application
- Surface disposal
- Incineration.

Land-applied sludge must meet requirements in the 503 regulations for pathogen and vector attraction reduction. Two basic classes for pathogen reduction are established in the regulations. In general, sludge distributed in bagged form must meet Class A requirements.

Sludge applied to the land in bulk form must meet Class B requirements. The discussion below focuses on the regulations applicable to bulk land application because that is the only disposal option evaluated in this report.

Pathogen Reduction

Class A sludge must have levels of fecal coliform organisms below 1,000 per gram of total solids and meet other time and temperature requirements, or the sludge must have been treated with an EPA-defined "process to further reduce pathogens." These processes include composting, heat drying, heat treatment, thermophilic aerobic digestion, irradiation, and pasteurization.

Class B sludge must have levels of fecal coliform organisms less than 2 million per gram of total solids, or meet other requirements, or the sludge must have been treated with an EPA-defined "process to significantly reduce pathogens." These processes include aerobic digestion for a mean cell residence time greater than 40 days at 20ºC or 60 days at 15ºC, air drying, anaerobic digestion, composting, or lime stabilization.

Vector Attraction Reduction

The regulations require that land-applied sludge be processed to reduce its "vector attraction." This means that the sludge should be stabilized sufficiently to not be an attraction to rodents or birds that could spread pathogens contained in the sludge and thereby increase the risk of human exposure. The basic measure of the adequacy of sludge stabilization in the regulations is that the volatile solids concentration in the sludge be reduced through processing by at least 38 percent. A series of alternative procedures are provided for reducing vector attraction, including injection below the ground surface.

Metals

Limits are specified for the concentration of various metals in the sludge and for the cumulative loading of these metals on the land used for its application. Table 3-1 lists the concentration limits for any sludge that is land applied. Table 3-2 lists further guidelines for sludge that is land applied in bulk. Either the monthly average concentration criteria or the cumulative pollutant loading rate criteria must be met.

Other Measures

In addition to regulating the quality of biosolids, the regulations require specific management measures, including the following:

- Record-Keeping and Reporting—Records must be kept by the owner describing the quantity and quality of the biosolids that have been applied to specific sites for up to five years. Even if the owner has a contract for biosolids disposal with a private contractor, the owner is ultimately responsible for the record-keeping and reporting.
- Monitoring—The owner is responsible for monitoring the biosolids for metals and specific pathogens on a regular basis.

- Management Practices—Biosolids should not be applied to flooded, frozen, or snow-covered ground, so that biosolids do not enter surface waters.

TABLE 3-1.
CEILING CONCENTRATIONS FOR METALS IN LAND-APPLIED SLUDGE

Parameter	Ceiling Concentration Limit (mg/kg)
Arsenic	75
Cadmium	85
Copper	4,300
Lead	840
Mercury	57
Molybdenum	75
Nickel	420
Selenium	100
Zinc	7,500

TABLE 3-2.
METAL CONCENTRATION LIMITS FOR BULK SEWAGE SLUDGE LAND APPLICATION

Parameter	Monthly Average Concentration Limit (mg/kg)	Cumulative Pollutant Loading Rate (kg/hectare)
Arsenic	41	41
Cadmium	39	39
Copper	1,500	1,500
Lead	300	300
Mercury	17	17
Nickel	420	420
Selenium	100	100
Zinc	2,800	2,800

Clean Air Act

The Federal Clean Air Act of 1992 requires that all federally funded projects be in compliance with state and regional air quality plans. The local air-quality authority for Island County is the Northwest Air Pollution Authority; agency requirements are discussed later in this chapter.

EPA Reliability Criteria

An important reference for wastewater treatment plant reliability is the EPA's *Design Criteria for Mechanical, Electric, and Fluid System and Component Reliability* (EPA 1974). This document outlines requirements in three reliability classes, with specific provisions for each unit process. Table 3-3 summarizes its requirements for component reliability.

TABLE 3-3.
SUMMARY OF EPA DESIGN CRITERIA FOR SYSTEM AND COMPONENT RELIABILITY

Component	Class I	Class II	Class III
Reliability classification	Works discharging into navigable waters that could be permanently or unacceptably damaged by effluent that was degraded in quality for only a few hours. Examples of Reliability Class I works might be those discharging near drinking water reservoirs, into shellfish waters, or in proximity to areas used for water contact sports.	Works discharging into navigable waters that would not be permanently or unacceptably damaged by short-term effluent quality degradation, but could be damaged by continued (on the order of several days) effluent degradation.	Works not otherwise classified as Reliability Class I or II
Trash removal	Required	Same as Class I	Same as Class I
Grit removal	Required if sludge is handled	Same as Class I	Same as Class I
Clean-out of solids	Provisions for cleaning of solids required for components prior to degritting or sedimentation	Same as Class I	Same as Class I
Controlled diversion	Screened, gravity overflow required with alarm, annunciation, and measurement of flow discharged. Holding basin required	Same as Class I, but no holding basin required	Same, as Class I but no holding basin required
Unit operation bypassing	Required except for unit operations with two or more open basins	Same as Class I	Same as Class I
Mechanically cleaned bar screens	Backup manual screen required	Same as Class I	Same as Class I
Pumps	Capacity to handle peak flow with any one pump out of service must be provided	Same as Class I	Same as Class I
Comminution	Overflow bypass must be provided with manual bar screen	Same as Class I	Same as Class I
Primary sedimentation basins	With largest unit out, remaining units shall have design flow of at least 50 percent of the total design flow to that unit operation	Same as Class I	At least two basins
Final and chemical sedimentation basins, trickling filters, filters, and activated carbon columns	With largest unit out, remaining units shall have design flow of at least 75 percent of the total design flow to that unit operation	With largest unit out, remaining units shall have design flow of at least 50 percent of the total design flow to that unit operation; backup not required for chemical sedimentation basins, filters, and activated carbon columns	At least two basins; backup not required for chemical sedimentation basins, filters, and activated carbon columns
Aeration basin	At least two equal volumes shall be provided	Same as Class I	Single basin permissible
Aeration blowers or aerators	Sufficient to provide for peak oxygen demands with the largest capacity unit out of service	Same as Class I	At least two units

TABLE 3-3 (continued).
SUMMARY OF EPA DESIGN CRITERIA FOR SYSTEM AND COMPONENT RELIABILITY

Component	Class I	Class II	Class III
Diffusers	Designed so that isolation of the largest section of diffusers does not measurably impair oxygen transfer capability	Same as Class I	Same as Class I
Chemical flash mixer	At least two basins or a backup means of adding chemicals	Backup not required	Backup not required
Flocculation basins	At least two basins	Backup not required	Backup not required
Disinfectant contact basins	With largest unit out, remaining units shall have design flow of at least 50 percent of the total design flow to that unit operation	Same as Class I	Same as Class I
Sludge handling	Alternate methods of sludge disposal and/or treatment shall be provided for each sludge treatment unit operation without installed backup capability. No recycles permitted that will compromise liquid treatment.	Same as Class I	Same as Class I
Sludge holding tanks	May be used to back up downstream tanks	Same as Class I	Same as Class I
Sludge pumps	A backup pump shall be provided for each set of pumps that performs the same function. The capacity of the pumps shall be such that with any one pump out of service, the remaining pumps will have capacity to handle the peak flow.	Same as Class I	Same as Class I
Anaerobic sludge digestion	At least two digestion tanks shall be provided. At least two of the digestion tanks provided shall be designed to permit processing all types of sludge normally digested. Tanks shall have sufficient flexibility or backup equipment to ensure that mixing is not lost when any one piece of equipment is out of service. Uninstalled backup is acceptable for mixing equipment	Same as Class I	Same as Class I
Aerobic sludge digestion	Backup aeration basin not required. At least two blowers shall be provided. Uninstalled backup is permissible. Largest section of diffusers can be isolated.		
Sludge holding tanks	May be used to back up downstream tanks	Same as Class I	Same as Class I
Vacuum filter	There shall be sufficient number of vacuum filters to enable the design flow to be dewatered with largest capacity unit out of service. Two vacuum pumps and two filtrate pumps shall service each vacuum filter. These may be uninstalled.	Same as Class I	Same as Class I
Centrifuges	There shall be sufficient number of units to enable the design flow to be dewatered with largest capacity unit out of service. The backup unit may be uninstalled.	Same as Class I	Same as Class I
Incinerators	A backup incinerator is not required. Auxiliary equipment shall be provided with backup.	Same as Class I	Same as Class I

TABLE 3-3 (continued).
SUMMARY OF EPA DESIGN CRITERIA FOR SYSTEM AND COMPONENT RELIABILITY

Component	Class I	Class II	Class III
Electric power source	Two separate and independent sources of electric power shall be provided to the works either from two separate utility substations or for a single substation and a works-based generator. Capacity of backup power shall be sufficient to operate all vital components, during peak wastewater flow conditions, together with critical lighting and ventilation.	Same as Class I except those vital components to support the secondary processes need not be included as long as treatment equivalent to sedimentation and disinfection is provided.	Sufficient to operate the screening or comminution facilities, the main wastewater pumps, the primary sedimentation basins, and the disinfection facility during peak flow together with critical lighting and ventilation.
Power distribution external to the works	The independent sources of power shall be distributed to the works transformers in a way to minimize common mode failures from affecting both sources.	Same as Class I	Same as Class I
Power distribution within the works	See Referenced EPA document	Same as Class I	Same as Class I
Instrumentation and control systems	Automatic control systems whose failures could result in a controlled diversion or a violation of the effluent limitations shall be provided with a manual override. Instrumentation whose failure could result in a controlled diversion or a violation of the effluent limitations shall be provided with an installed backup sensor and readout. Alarms shall be provided to monitor the condition of equipment whose failure could result in a controlled diversion or a violation of the effluent limitations. Vital instrumentation and control equipment shall be designed to permit alignment and calibration without requiring a controlled diversion or a violation of the effluent limitations	Same as Class I	Same as Class I
Auxiliary systems	If a malfunction of the system can result in controlled diversion or a violation of the effluent limitations and the required function cannot be done by any other means, then the system shall have backup capability.	Same as Class I	Same as Class I

Reference: U. S. Environmental Protection Agency. Design Criteria for Mechanical, Electric, and Fluid System and Component Reliability. MCD-05, EPA-430-99-74-001. Office of Water Program Operations. Washington, D. C.,

The EPA's requirements are very similar to Ecology's reliability requirements, which are discussed later in this chapter. The wastewater facilities proposed in this sewer plan and engineering report will comply with the EPA and Ecology Class II reliability criteria.

Historical and Archaeological Sites

Both federal and state laws require agencies to assess the effects of their proposed projects on significant archeological and historic properties. If facility improvement projects impact identified historical or archaeological sites, a more detailed evaluation of the site and potential impact of the project on the site will be required. An archaeological survey was conducted for this project; it is discussed in more detail in Chapter 9.

Floodplains, Wetlands, and Flood Insurance

The EPA restricts treatment projects on environmentally sensitive lands such as floodplains and wetlands.

Agricultural Lands

It is EPA policy under the Farmland Protection Policy Act (PL 97-98) to protect agricultural lands from "irreversible loss as an environmental or essential food production resource."

Coastal Zone Management

The Coastal Zone Management Act requires that all federal activities be consistent with approved state coastal zone management programs to the maximum extent possible. This project is located in a coastal zone county and is consistent with Washington's Coastal Zone Management Program and enforceable regulatory policies (State Environmental Policy Act, Water Quality, Air Quality and the Shoreline Master Program). Depending on the scope of the project, the Freeland Water District may be required to submit a Coastal Zone Certification of Consistency to the Department of Ecology for approval as part of obtaining the appropriate permits and approvals.

A shoreline development permit would be needed prior to construction if construction is planned within 200 feet of the ordinary high water mark.

Wild and Scenic Rivers

To comply with the Wild and Scenic Rivers Act, proposed projects should not directly and adversely impact any wild, scenic, or recreational river area.

Fish and Wildlife Protection

The Fish and Wildlife Coordination Act requires that projects "controlling or modifying any natural streams or other body of water" be done in a way that protects fish and wildlife resources and habitats.

Also, since wastewater treatment facilities can attract birds, coordination with federal wildlife and aviation officials is recommended if treatment facilities are within 2 miles of any airports. The closest airport to the Freeland area is South Whidbey Air Park, a local airport approximately 4 miles to the east.

Endangered Species Act

Projects with a federal "nexus," including federal permits, approvals or funding, require compliance with the Endangered Species Act. Listed fish species include the following:

- Bull trout—federally threatened and a state species of concern
- Chinook salmon—federally threatened and a state species of concern
- Coho salmon—federal candidate species.

In addition, the Bald Eagle is considered threatened by the federal and state government.

Magnuson-Stevens Fishery Conservation and Management Act

In December 1998, the National Marine Fisheries Service (which has since been renamed as NOAA Fisheries) issued interim final regulations to implement the Essential Fish Habitat (EFH) requirements of the 1996 Sustainable Fisheries Act. This act significantly amended the Magnuson-Stevens Fishery Conservation and Management Act of 1976.

The Magnuson-Stevens Act requires the following: for federal actions that may adversely affect EFH, except activities covered by a General Concurrence, federal agencies, must provide a written assessment of the effects of that action on EFH. EFH is defined as "waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." EFH must always include the critical habitat of endangered and threatened species.

If a project affects an endangered species of plant or wildlife, it should include mitigating measures to reduce the impact.

Public Participation

Island County has adopted a comprehensive approach for public participation for this project. The strategy includes public meetings and newspaper articles. Informational fliers have been mailed to all property owners within the Freeland NMUGA. Within this strategy, several public meetings were held to comply with a federal requirement for facilities plans. The federal requirement is for at least two public meetings. The first meeting was held on February 8, 2003, to discuss collection system alternatives. The second meeting was conducted on May 10, 2003 to discuss treatment and discharge or reuse alternatives. The third meeting was conducted on June 28, 2003 to review and comment on combined alternatives for collection, treatment, and reuse. The fourth meeting was conducted on May 8, 2004, and presented the recommended alternative, including phasing and financing of implementation.

At each meeting, questionnaires were distributed to each participant to gauge public sentiment. Each public meeting was followed by a meeting of the Freeland Sub-Area Planning Committee (FSAPC) to review the material presented and questionnaire results, discuss the alternative, and select a preferred alternative. These meetings were also open to the public.

Appendix C contains copies of the questionnaires distributed at the meetings, summaries of the results of the questionnaires, and meeting minutes from FSAPC meetings.

STATE POLICIES

The Clean Water Act allows states to establish more stringent water quality requirements than are required by federal law. Like most other states, Washington State has developed requirements pertaining to surface water quality more stringent than those developed by the federal government. Ecology administers the NPDES wastewater and stormwater permits and has requirements relating to protection of ground and surface waters.

Agencies other than Ecology can also have involvement in construction and operation of facilities located in critical areas. The Washington State Department of Fish and Wildlife (WDFW) has involvement in cases involving fish-bearing streams. In addition, the Washington State Department of Natural Resources (DNR) has authority for facilities to be constructed on tidelands or along shorelines. To promote efficiency and reduce overlap, state agencies and the U.S. Army Corps of Engineers developed a Joint Aquatic Resource Permit Application (JARPA), which can be submitted for the following permits:

- WDFW's Hydraulic Project Approval (HPA)
- Local agency shoreline management permits
- Department of Ecology Water Quality Certification and Approval for Exceedance of Water Quality Standards
- Corps of Engineers Section 404 and Section 10 Permits
- Marine and aquatic lease.

Of the work proposed in this Comprehensive Sewer Plan and Engineering Report/Facility Plan, a JARPA will be needed for the shoreline management permit. Depending on final alignment and design considerations relating to wetlands and streams, a Corps Permit and an HPA could be required.

Water Quality Standards for Surface Waters

The applicable water quality standards for construction in or near streams or the shoreline are those adopted by Ecology pursuant to Section 303 of the Federal Water Pollution Act Amendments. *Water Quality Standards for Surface Waters of the State of Washington* was last promulgated by Ecology in 1999 (WAC 173-201A). These standards describe general water quality conditions and classifications for specific surface waters and the water quality desired for each class. General conditions listed under the water quality standards are as follows:

- Existing beneficial uses shall be maintained and protected and no further degradation that could interfere with or become injurious to existing beneficial uses shall be allowed.
- Whenever the natural conditions of waters are of a lower quality than the criteria assigned, the natural conditions shall constitute the water quality criteria.

- Water quality shall be maintained and protected in waters designated as outstanding resource waters in WAC 173-201A-080. These waters are the following:
  - Waters in national parks, national monuments, national preserves, national wildlife refuges, national wilderness areas, federal wild and scenic rivers, national seashores, national marine sanctuaries, national recreation areas, national scenic areas, and national estuarine research reserves.
  - Waters in state parks, state natural areas, state wildlife management areas, and state scenic rivers.
  - Documented aquatic habitat of priority species as determined by the Department of Fish and Wildlife.
  - Documented critical habitat for populations of threatened or endangered species of native anadromous fish.
  - Waters of exceptional recreational or ecological significance.
- Whenever waters are of a higher quality than the criteria assigned for them, the existing water quality shall be protected and pollution of said waters that will reduce the existing quality shall not be allowed, except in instances where:
  - It is clear, after satisfactory public participation and intergovernmental coordination, that overriding considerations of the public interest will be served.
  - All wastes and other materials and substances discharged into said waters shall be provided with all known, available, and reasonable methods of prevention, control, and treatment by new and existing point sources before discharge. All activities that result in the pollution of waters from nonpoint sources shall be provided with all known, available, and reasonable best management practices.
  - When the lowering of water quality in high quality waters is authorized, the lower water quality shall still be of high enough quality to fully support all existing beneficial uses.

General classifications applying to various surface water bodies not specifically classified under WAC 173-201A-130 or 173-201A-140 are as follows (applicable items only):

1. All surface waters lying within national parks, national forests, and/or wilderness areas are classified Class AA or Lake Class.
2. All lakes and their feeder streams within the state are classified Lake Class and Class AA respectively, except for those feeder streams specifically classified otherwise.
6. (*Items 3 through 5 not repeated herein)* All unclassified surface waters that are tributaries to Class AA waters are classified Class AA. All other unclassified surface waters in the state are hereby classified Class A.

Ecology classifies Island County marine and fresh waters at the following levels (WAC 173-201A-140):

- **Class AA**—Mukilteo and all north Puget Sound west of longitude 122°39' W (Whidbey, Fidalgo, Guemes and Lummi islands and State Highway 20 Bridge at Deception Pass), except as otherwise noted
- **Class A**—Possession Sound, Port Susan, Saratoga Passage, and Skagit Bay east of Whidbey Island and State Highway 20 Bridge at Deception Pass between latitude 47°57' N (Mukilteo) and latitude 48°27'20" N (Similk Bay), except as otherwise noted
- **Class AA**—Puget Sound through Admiralty Inlet and South Puget Sound, south and west to longitude 122°52'30" W (Brisco Point) and longitude 122°51' W (northern tip of Hartstene Island).

State Environmental Policy Act

A State Environmental Policy Act (SEPA) review will be required upon completion of this document. A SEPA review is an environmental checklist completed to ensure to the State that there are no adverse environmental impacts from proposed projects. Island County will issue a threshold determination based on review of the environmental checklist. This determination will be sent to the Departments of Ecology and Health as well as USDA Rural Development for their concurrence. A copy of the SEPA checklist is included in Appendix D.

State Environmental Review Process; Department of Ecology Documentation

To be eligible for financial assistance from the State Water Pollution Control Revolving Fund, this plan must comply with the State Environmental Review Process (SERP, WAC 173-98-100). The SERP was established "to help ensure that environmentally sound alternatives are selected and to satisfy the state's responsibility to help ensure that recipients comply with the National Environmental Policy Act and other applicable environmental laws, regulations, and executive orders." This project included an extensive public involvement program and environmental documentation, and these efforts fully satisfy SERP.

In addition, the Department of Ecology has adopted a new set of requirements for environmental documentation in coordination with USDA Rural Development. Requirements include sending out a project description and summary of the proposed action to applicable regulatory agencies and requesting input and comments regarding the proposed action. The environmental report, which also serves as the Environmental Assessment for NEPA requirements, is included in Appendix E along with communication to the agencies.

Since the Department of Health also has regulatory responsibility for wastewater treatment and effluent management per WAC 246-271, a copy of the environmental report will be sent to them as well.

National Pollutant Discharge Elimination System Permit

Wastewater Effluent

The State of Washington administers the federal effluent limitations through the NPDES program. All wastewater discharges into the waters of the state, including treated effluent from treatment plants, must be permitted through the Department of Ecology with an NPDES Permit.

Stormwater Discharge

Construction projects that disturb more than 5 acres require a construction general permit for stormwater discharge under NPDES requirements; mitigation measures are required, including preparation of a Storm Water Pollution Prevention Plan. During construction, temporary erosion and sediment control measures are required.

State Waste Discharge Permit, Wastewater Effluent

All wastewater disposed of via land application must be permitted through the Department of Ecology with a State Waste Discharge Permit. As will be discussed in Chapter 6, "disposal" via land application is generally taken to mean that the land application process is relied on to provide further treatment. Effluent to be "disposed" via land application is assumed not to meet reclaimed water standards before being land applied (similar to septic tank drainfield systems).

In comparison, "water reclamation" via land application is taken to mean that the effluent is treated to a high degree before being land applied, the land is not needed for further treatment, and the land application is for a beneficial use, such as groundwater recharge. Refer to the "Standards for Water Reclamation" section on the next page.

Washington State Standards for Use and Disposal of Sludge

WAC 173-308, *Biosolids Management,* establishes guidelines for treatment and land application of biosolids generated by municipal wastewater treatment facilities. These mirror the federal guidelines in 40 CFR 503. The state Department of Ecology has authority to enforce these rules and may, if it chooses, delegate some of the authority to local health departments.

Washington Department of Ecology Criteria for Sewage Works Design

The Ecology-developed *Criteria for Sewage Works Design* (Ecology 1998), also known as the Orange Book, is a guide for design of sewage collection and treatment systems. The primary goals of the manual are as follows:

- To ensure that the design of sewage collection and treatment systems is consistent with state public health and water quality objectives
- To establish a basis for the design and review of plans and specifications for sewage treatment works and sewerage systems

- To establish the minimum requirements and limiting factors for review of sewage treatment work and sewerage system plans and specifications
- To assist the owner or the owner's authorized engineer in the preparation of plans, specifications, reports, and other data
- To guide departments in their determination of whether to issue approvals, permits, or certificates for sewage treatment works or a sewer systems.

Ecology uses the Orange Book design guidelines to review and approve reports, plans, and specifications. Design guidelines presented in this book will be used to evaluate the capacity of the proposed treatment facility and to establish design criteria. The Orange Book also presents guidelines for wastewater treatment component design, including the number of units required for operation during peak flows. In general, state requirements follow the federal requirements outlined in Table 3-3. The state reliability classification scheme is shown in Table 3-4.

TABLE 3-4.
RELIABILITY CLASS SYSTEM IN THE ORANGE BOOK

Reliability Class	Applies to
I	Works whose discharge, or potential discharge, (1) is into public water supply, shellfish, or primary contact recreation waters, or (2) as a result of its volume and/or character, could permanently or unacceptably damage or affect the receiving waters or public health if normal operations were interrupted.
II	Works whose discharge, or potential discharge, as a result of its volume and/or character, would not permanently or unacceptably damage or affect the receiving waters or public health during periods of short-term operations interruptions, but could be damaging if continued interruption of normal operations were to occur (on the order of several days).
III	Works not otherwise classified as Reliability Class I or II.

Standards for Water Reclamation

The Washington State Departments of Health and Ecology jointly released a set of standards for wastewater reclamation projects in September 1997. The *Water Reclamation and Reuse Standards* describe the treatment and quality requirements for a variety of beneficial end uses. Four basic classes of reuse quality are listed, along with their suitability for various end uses. The four classes vary from Class A (highest quality) to Class D (lowest quality). For uses such as direct injection into a drinking water aquifer, there are more stringent standards than any of these four classes. Landscape irrigation requires Class A reclaimed water, which is defined as follows:

> *"Class A Reclaimed Water"* means reclaimed water that, at a minimum, is at all times an oxidized, coagulated, filtered, disinfected wastewater. The wastewater shall be considered adequately disinfected if the median number of total coliform organisms in the wastewater after disinfection does not exceed 2.2 per 100 milliliters, as determined from the bacteriological results of the last 7 days for which analyses have been

completed, and the number of total coliform organisms does not exceed 23 per 100 milliliters in any sample.

If surface percolation is used for land application of reclaimed water, a nitrogen reduction step is required in addition to other Class A requirements.

The *Water Reclamation and Reuse Standards* also list requirements for redundancy, including redundant filtration and disinfection equipment. Storage requirements are also listed, including emergency storage and wintertime storage.

Land application of reclaimed water is permitted under a single reclaimed water permit. Since the reclaimed water is being beneficially reused instead of disposed of, a State Waste Discharge Permit (described previously) is not required.

Washington Department of Natural Resources/Shellfish Closure Zone

For treatment plants that discharge to aquatic lands, the use of the aquatic lands for the outfall is granted by the Washington Department of Natural Resources through an aquatic lands lease that must be periodically renewed. DNR also has the authority to condition uses of state lands as needed to ensure the well-being of lands and ecosystems, to deny uses not in compliance with applicable laws, codes, and policies, and to seek prosecution of users trespassing on state lands.

Additionally, the Washington Departments of Ecology, Fish and Wildlife, Health, and Natural Resources established a joint policy titled *Inter-Agency Permit Streamlining Document, Shellfish and Domestic Wastewater Discharge Outfall Projects* dated October 10, 1995. The policy requires that wastewater outfalls avoid impacts on shellfish altogether or, when that is not possible, do the following:

- Minimize shellfish impacts
- Rectify shellfish impacts
- Reduce or eliminate shellfish impacts over time
- Compensate for impacts to shellfish
- Monitor and take corrective measures over time.

The Department of Health establishes the closure zones for commercial and tribal shellfish harvesting around all wastewater treatment plant outfalls.

Office of Archaeology and Historic Preservation Approval

Cultural resources are addressed in over 100 federal laws, regulations, and guidelines, including the National Environmental Policy Act of 1969 (NEPA) and the National Historic Preservation Act of 1966, amended in 1992 (NHPA). Section 106 of the NHPA requires federally assisted undertakings to take into account the effects of those undertakings on historic properties that are included in or may be eligible to be included in the National Register of Historic Places. “Historic properties” refers to prehistoric archaeological sites as well as buildings, structures, and other historic sites.

Applicable state laws include the Indian Graves and Records Act (RCW 27.44), which prohibits knowingly disturbing a Native American or historic grave, and the Archaeological Sites and Resources Act (RCW 27.53), which requires that anyone proposing to excavate into, disturb, or remove artifacts from an archaeological site on public or private lands obtain a permit from the Office of Archaeology and Historic Preservation.

Three elements are involved in cultural resources studies following Section 106 procedures:

1. The identification and evaluation of historic properties.
2. Assessment of effects of the proposed undertaking on historic properties.
3. Consultation among principal parties to consider ways to avoid, reduce, or mitigate adverse effects.

The first element, identification and evaluation, is of most concern at the beginning stages of projects. Methods for identification of historic properties consist of archival research, field survey, and consultation.

Archival research, including a check of the Washington state site inventory and records at the Office of Archaeology and Historic Preservation (OAHP), is conducted prior to any field activity in order to determine if sites are already recorded in the project area or its vicinity. Other information is collected from ethnographic and historic accounts, previous regional cultural resource investigations, informants, maps, photographs, and environmental information. Research to determine the age of landforms involved and the extent of modern disturbance are especially important. Locations of archaeological sites may be identified by this process. The potential for buried and hence undiscovered sites, or uplifted former shorelines favorable for habitation, may also be determined. Field visits are made after completion of the background research to verify field conditions, discuss construction locations and methods, and to identify historic properties. The results of these investigations are presented in a report for submittal to appropriate agencies, the OAHP, and, in this case, to the Tulalip Tribes and the Swinomish Tribal Community. The report includes recommendations for dealing with any sites discovered, additional discovery measures, if necessary, monitoring high-potential locations, and a Discovery Plan to be enacted in the event archaeological material is encountered during construction.

Although not critical areas as defined in the County's Critical Areas Ordinance, archaeology sites are important and very sensitive areas. The County requires that best management practices be implemented in these areas. The County maintains a current inventory of all known and suspected historical and archaeological sites. The Department of Planning and Community Development should be contacted to determine whether a project near a shoreline is located in a historical or archaeological site. For such sites, County regulations require that a professional archaeologist evaluate the site to determine potential impacts and recommend mitigation. Local tribal authorities must be contacted if human remains or historical or archaeological resources are encountered. Tribal addresses and telephone numbers include the following

Tulalip Tribes (South Whidbey)
7615 Totem Beach Road
Marysville, WA 98271
Natural Resources Office:

Swinomish Tribal Community (North Whidbey and Camano)
11404 Moorage Way
LaConner, WA 98257

(360) 651-4480
(360) 651-4490 (fax)

(360) 466-1236
(360) 466-1615 (fax)
lcampbel@cnw.com (email)

LOCAL POLICIES

SEPA Review

An environmental checklist will be prepared to evaluate potential impacts of the work proposed in this report. The Island County Department of Planning and Community Development, as lead agency, will issue a threshold determination based on its evaluation of the checklist.

If the responsible official determines there will be no probable significant adverse environmental impacts from the projects proposed or that the impacts would be properly mitigated, the lead agency would prepare and issue a "determination of nonsignificance" (DNS) or "mitigated determination of nonsignificance" (MDNS). The responsible official would send the DNS and environmental checklist to agencies with jurisdiction, Ecology and affected tribes. These entities may submit comments to the lead agency within 15 days. An agency with jurisdiction may assume lead agency status within the 15-day period if it disagrees with the threshold determination.

A "determination of significance" (DS), which acknowledges the potential for significant environmental impacts, would require an environmental impact statement (EIS) that describes existing conditions, addresses and evaluates alternatives, analyzes potential environmental impacts and addresses mitigation measures. A scoping process would have to be conducted at the beginning of the EIS, in which the County would inform agencies and the public of the proposed projects and solicit comments that would have to be addressed in the EIS.

Critical Areas Review

In noting the importance of sensitive habitats and wildlife species, and in complying with the Washington State Growth Management Act of 1990, Island County has adopted a Critical Areas Section (17.02). Critical areas addressed in the Critical Areas Ordinance (CAO) include:

- Wetlands
- Aquifer recharge areas
- Fish and wildlife habitat conservation areas, including streams and shorelines
- Floodplains
- Geologically hazardous areas

The Island County Department of Planning and Community Development reviews projects as to their impact on these critical areas and requires protection standards and buffers for their protection.

Shoreline Management Program

Island County has adopted a Shoreline Management Program as required by the Shoreline Management Act of 1971, (RCW 90.58). Shorelines covered by each Shoreline Management Program generally include all water areas of the state, including marine and fresh waters and their associated wetlands together with the underlying lands, except: (a) shorelines along streams and their associated wetlands where the mean annual flow is less than 20 cubic feet per second; and (b) shorelines of lakes less than 20 acres in area. Shoreline jurisdiction includes lands extending landward for 200 feet in all directions or measured on a horizontal plane from the ordinary high water mark.

The program is administered by the Island County Department of Planning and Community Development. It defines six shoreline management designations to encourage uses appropriate to each environment: natural environment, conservancy, rural environment, urban environment, shoreline residential environment and aquatic environment.

Uniform Fire Code / National Fire Protection Association

Local County fire officials have authority to enforce the national Uniform Fire Code (UFC). Article 80 of the UFC identifies required measures to prevent, control, and mitigate dangers related to the use and storage of hazardous chemicals.

In addition, local officials have authority to enforce National Fire Protection Association (NFPA) standards. NFPA 820, "Fire Protection in Wastewater Treatment and Collection Facilities," is of particular interest.

Uniform Building Code / International Building Code / Washington State Energy Code

Local County building officials have authority to enforce the national Uniform Building Code (UBC) and/or the International Building Code (IBC) as well as the Washington State Energy Code. These codes govern structural, architectural, and mechanical design of buildings.

Northwest Air Pollution Authority

The Northwest Air Pollution Authority (NWAPA) is a local regulatory agency with jurisdiction over air emissions in the Puget Sound region (Island, Skagit and Whatcom Counties). The agency's primary concern with wastewater treatment facilities is from odor generation. The agency has indicated that permits are not required for wastewater treatment plants on the basis of occasional sewage odors. However, if a standby generator above 250 kW in capacity is used, a permit would be required. Also, if sludge drying or sludge incineration is used, a permit might be required, depending on the size of the facility.

Island County Solid Waste Division

The Island County Department of Public Works Solid Waste Division governs the handling of solid waste on Whidbey Island. Solid waste is centralized at the Island County Solid Waste Complex near Coupeville. From there, it is compacted into shipping containers before being trucked to Seattle to be combined into Seattle's waste stream and sent by rail to the Gilliam County Landfill near Arlington, Oregon.

For this project, a particular concern is the potential need to dispose of screenings and grit from a wastewater treatment plant. Some wastewater treatment plants require a headworks at the front of the plant to remove rags, sticks, plastics, grit, and/or other non-organic objects before they reach the treatment process. The organic content, dryness, and overall aesthetics of the screenings and grit can vary considerably, depending on the type of collection system and the type of headworks equipment.

The Solid Waste Department may have concerns about accepting screenings and grit from a treatment plant.

This consideration of screenings and grit may not apply. For example, treatment plants that have Septic Tank Effluent Pumping (STEP) systems do not require headworks facilities. This will be discussed in detail in Chapter 7.

The other consideration related to the Solid Waste Division is acceptance of solids generated as part of the wastewater treatment process. This issue will also be discussed in detail in Chapter 7.

CHAPTER 4.
FLOW AND LOAD ANALYSIS

This chapter projects future wastewater flows and pollutant loads for the Freeland area. No historical flow and load information is available, since Freeland is currently served primarily by septic systems. Future flows and loads were estimated using the County's population growth projections for the proposed service area, data from similar communities, engineering experience, and Orange Book (Ecology 1998) design criteria.

GROWTH PROJECTIONS

Development Projections and Phasing

At the County's request, the proposed zoning for the Freeland NMUGA, excluding the portion within Holmes Harbor Sewer District, was used for the flow and load analysis. Island County Department of Community Development staff performed a "buildable lands analysis" for the NMUGA that estimated residential, commercial, and industrial population growth on the basis of NMUGA land use designations. Details are provided in Appendix F.

County staff produced two sets of growth estimates for the proposed NMUGA, using different assumptions about housing density. The low-growth scenario assumed the lowest density based on proposed zoning, while the high-growth scenario assumed the highest density based on proposed zoning. For example, the NMUGA zoning defines low-density housing as having between one and three houses per acre. The low-growth scenario assumed one house per acre, and the high-growth scenario assumed three houses per acre.

In this report, the low-growth scenario is used to represent a 20-year planning horizon (approximately corresponding to the year 2025). The high-growth scenario is used to represent the ultimate buildout condition (the condition with the maximum development allowed by zoning). The high-growth scenario is also assumed to be a 50-year growth condition, corresponding to the year 2055.

Collection, treatment and discharge facilities will be sized so that the high-growth scenario can eventually be accommodated through phased expansions. Tt/KCM and County staff developed facility phasing from a small initial size up to the 20-year and 50-year projections. Phasing was developed because it is most likely that wastewater projects will be constructed in increments as the population grows within the NMUGA boundaries. Phasing of projects will make the facilities more cost-effective than constructing projects with much more capacity than can be initially used. Three initial phases were established in addition to the 20-year and 50-year projections, for a total of five phases corresponding to the following levels of development:

- Phase 1: Development of the commercial core, including Nichols Brothers (but not including the Main Street Sewer District)
- Phase 2: Phase 1, plus development of the medium-density residential zoning immediately north of the commercial core

- Phase 3: Phase 2, plus development of the area north and west of the commercial core and on both sides of Honeymoon Bay Road and Bercot Road
- Phase 4: Development of the entire NMUGA at the low-growth scenario (20-year projection)
- Phase 5: Development of the entire NMUGA at the high-growth scenario (50-year projection)

The five phases are shown in Figure 4-1. Actual wastewater system development will be driven by the local interest in implementing sewers and may differ from the phasing assumed in this report. Chapter 9 discusses implementation issues in detail.

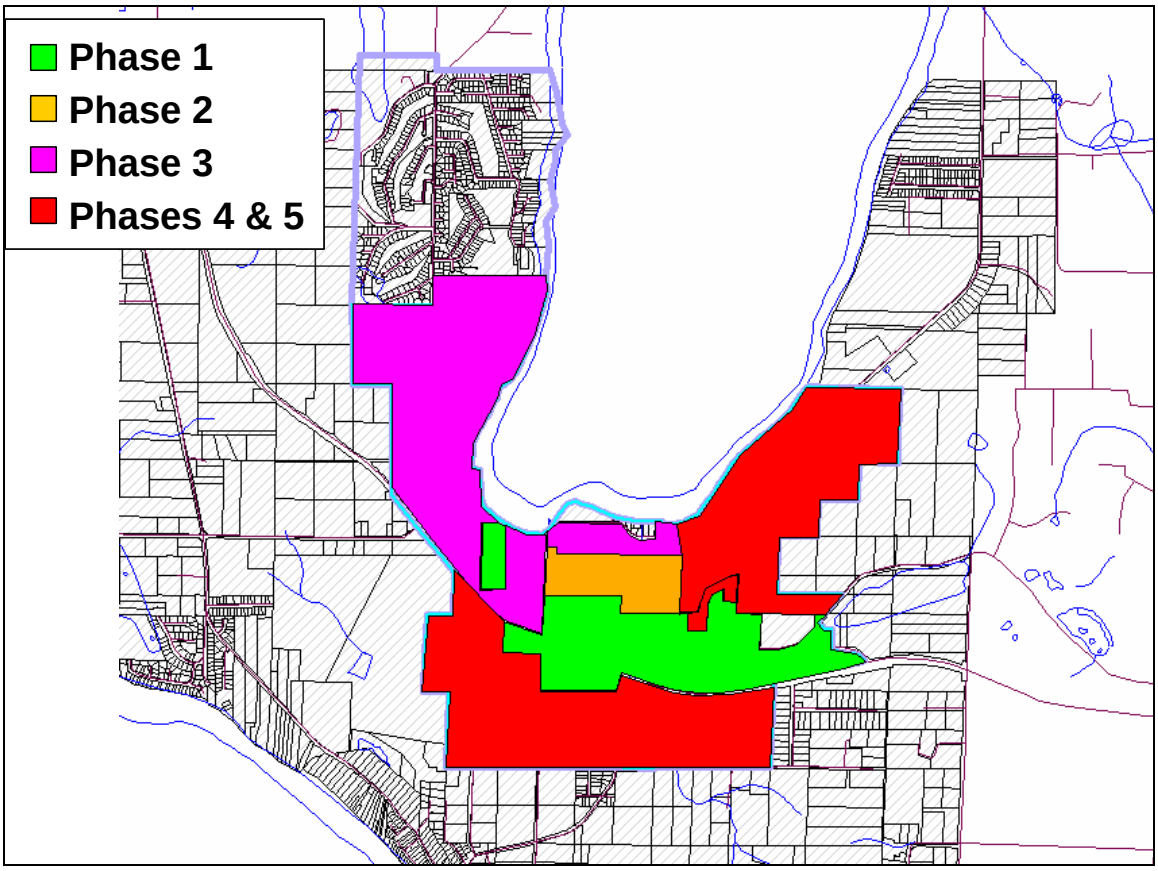


Figure 4-1. Phases of Projected Population Growth

Table 4-1 shows projected population equivalents and approximate acreages for the phased growth scenarios. Population equivalents represent the residential population that would contribute the equivalent amount of wastewater loading from any type of land use (e.g., residential, commercial or industrial).

TABLE 4-1.
PROJECTED SERVICE AREA AND POPULATION EQUIVALENTS

	Service Area, acres	Residential Population Equivalents	Commercial/ Industrial Population Equivalents	Total Population Equivalents
Phase 1: Commercial Core, including Nichols Brothers	120	0	746	746
Phase 2: Phase 1 plus areas described earlier	150	155	1,074	1,229
Phase 3: Phase 2 plus areas described earlier	380	1,346	1,080	2,426
Phase 4: NMUGA, "Low" Population Estimate	780	2,563	1,082	3,645
Phase 5: NMUGA, Ultimate Buildout ("High" Population Estimate)	780	5,167	2,156	7,323

Note: Island County staff determined that there are approximately 2.34 people per dwelling. Thus, the values in this table can be divided by 2.34 to obtain an equivalent number of dwellings.

It should be noted that substantial population growth has been projected for Freeland compared to the current population. Generally, when planning for growth, it is easier to phase facilities economically when future growth projections are not substantially greater than the existing population. The analysis in following chapters will attempt to account for this significant projected growth in a cost-effective, reasonable manner.

Flows and Loads from Industrial Sources

Table 4-2 lists estimated flow and load information for the only major industrial user in the service area, Nichols Brothers Boat Builders. Nichols Brothers has two waste streams: domestic sewage generated by employees and industrial discharge related to boat washing and stormwater. Industrial discharge is treated in a holding pond and infiltration system adjacent to Holmes Harbor. Domestic waste is collected in a septic tank and pumped uphill to a drainfield behind the facility.

TABLE 4-2.
INDUSTRIAL SOURCES

Industry	Source of Wastewater	Character of Wastewater	Estimated Flow (gallons per day)
Nichols Brothers Boat Builders	Industrial: Boat washing, storm water	Data not available	Data not available
Nichols Brothers Boat Builders	Domestic: Employee-generated sewage	Typical domestic sewage	Data not available

The company has expressed interest in sending its domestic sewage to a centralized sewage system. It has indicated that it intends to continue using its existing facilities for treatment of industrial discharge, but might be interested in discharging a portion of the industrial flows to a centralized sewage system. Since the company has not yet submitted an estimate of current or future employees, it has been treated as a commercially zoned development for this analysis.

No other major industry exists in the service area, and flow and load projections do not include provisions for future industry. Future industries that wish to participate in a centralized sewage system would have to pretreat their effluent to achieve a waste strength comparable to commercial waste.

It should be noted that if beneficial reuse of reclaimed water is anticipated, particularly direct recharge of reclaimed water into a groundwater aquifer, an industrial pretreatment program is required per the *Water Reclamation and Reuse Standards* (described in Chapter 3). Alternatively, industries discharging to the wastewater facilities must have current waste discharge permits issued by the Department of Ecology.

WASTEWATER FLOW PROJECTIONS

Historical Water Use Data

Local water consumption data can give an indication of per capita sewer flow rates. Freeland Water District records indicate that the District's average daily water demand is approximately 200 gallons per equivalent residential unit (ERU) per day. Based on Island County's estimates, there are approximately 2.34 people per ERU, which equates to a water use of approximately 85 gallons per capita per day (gpcd). Since a portion of that average daily demand is due to irrigation, which does not contribute to the sewer system, a lower per capita volume should be used for estimating wastewater flows. Average winter demand data is typically most representative of flows to the sewer system, since irrigation is minimal during winter months. However, such data was not available. The basis for estimating ERU use for this document is described later in this chapter.

Future Flow Projections

Flow projections were developed based on base flow rates (flows without infiltration and inflow or I/I), estimated new connections in the sewer service area under the two growth scenarios, and estimated rates of I/I.

Sewage flow rates are higher during wet-weather periods than during dry-weather periods due to I/I. Infiltration is groundwater that enters a sewer system through sites such as cracks in pipes and manholes, loose pipe joints, and foundation drains. Inflow is surface water that enters the system through sites such as cross connections with storm drains and downspouts, area drains, unplugged and leaking cleanouts, and ponding on manhole covers. High volumes of I/I use up the capacity of pipes, pump stations, and treatment facilities, requiring that larger facilities be designed to accommodate the increased flow in the wastewater system.

Because flows to a wastewater treatment plant vary considerably, several statistical values are required for sewage system facility design. The following design flows are typically used:

- Annual Average Flow: (AAF)—Daily wastewater flow averaged over the entire year
- Maximum Month Flow (MMF)—Average daily wastewater flow during the month with the highest flow; used to size treatment facilities for expected winter loading rates
- Peak Day Flow (PDF)—Average wastewater flow during the day with the highest flow; used to size treatment facilities for peak loading conditions
- Peak Hour Flow (PHF)—Maximum daily wastewater flow during a one-hour period; used to size wastewater facilities for peak hydraulic conditions.

Residential Flows

Annual average base flow rates were estimated to be 60 gpcd. The 60 gpcd estimate is partially based on average annual water use for the Freeland Water District, which is approximately 85 gpcd. The difference in the two numbers is because annual average water use includes summertime irrigation, and irrigation does not typically contribute to sewer flows. Therefore, the estimated amount of irrigation was subtracted out of 85 gpcd to result in 60 gpcd. 60 gpcd is approximately equivalent to typical annual wintertime water usage, where water use is mostly indoors (minimal irrigation) and almost all water used is sent to the sewer system.

Peaking factors were applied to the base flow rates to account for hourly, daily, and monthly variances in flows, as well as concurrent discharges to the sewer system.

Taking the 60 gpcd annual average flow rate and multiplying it by 2.34 (the average number of people per ERU, as described earlier) results in an average flow per ERU of approximately 140 gpd.

In addition to base flow rates (on which ERU estimates are based), there are also I/I flows. I/I unit flow rates can vary considerably with the age and material of sewers in the area being studied. Since Freeland is not currently sewered, it is assumed that a new collection system will have a relatively low amount of I/I.

The amount of I/I is also dependent on the type of collection system (the collection system analysis and recommendation is presented in the next chapter). Some portions of inflow apply to any type of collection system. These elements include connections at individual hookups, such as connections to storm drains, downspouts, and area drains. Other elements, such as ponding on manhole covers, only apply to gravity collection systems that are not pressurized.

Infiltration is more dependent on the type of collection system. Gravity sewer systems are most prone to infiltration due to low-pressure piping and joints, which tend to allow infiltration into the system. Pressurized collection systems such as STEP systems operate with pressurized piping, which prevents infiltration from entering the system. However,

they are still prone to infiltration from the sewer line from the building to the septic tank, as well as infiltration directly into the septic tank.

For gravity sewers, peak-hour I/I unit flow rates were taken to be 1,100 gallons per acre per day (gpad): 600 gpad for infiltration and 500 gpad for inflow. This is a typical design value for new sewers. I/I flow rates for other design conditions are shown in Table 4-3.

STEP collection systems were assumed to have half the I/I flow rates of gravity sewers. This assumption is based on previous experience; it was also checked using the following formula for estimating peak flows from STEP systems (Ecology, 1998):

$$Q = 15 + 0.5\ (D)$$

where
Q = peak design flow
D = equivalent dwellings

TABLE 4-3.
RESIDENTIAL WASTEWATER FLOWS

	Base Flow (gpcd)	I/I (gpad)
Gravity Collection System		
Annual Average	60	250
Maximum Month	75	450
Peak Day	90	750
Peak Hour	210	1,100
STEP Collection System		
Annual Average	60	125
Maximum Month	75	225
Peak Day	90	375
Peak Hour	210	550

Commercial Flows

Commercial flows are typically estimated based on the number of employees in the service area. Because such data was not available, the number of employees was estimated based on anticipated commercial density.

For the low-growth scenario, wastewater flow from commercial areas was assumed to be equivalent to residential areas with four houses per acre. At 2.34 people per house and a base flow of 60 gpcd this equates to approximately 560 gpad. Assuming a typical unit wastewater flow of 25 gpd for employees, this equates to about 22 employees per acre. For the high-growth scenario, wastewater flow from commercial areas was assumed to be equivalent to residential areas with eight houses per acre, equating to about 45 employees per acre.

Because commercial flows were estimated on an equivalent basis to residential flows, the same ERU estimate of 140 gpd per ERU applies. Again, in addition to base flows (upon which ERU estimates are based), there are also I/I flows. I/I flows were estimated similar to estimates for residential flows.

Total Flow Projections

Table 4-4 summarizes the flow projections for the growth scenarios. Appendix G contains the detailed assumptions and calculations used.

TABLE 4-4.
FUTURE WASTEWATER FLOW PROJECTIONS

Condition	Projected Wastewater Flows (million gallons per day)			
	Annual Average	Maximum Month	Peak Day	Peak Hour
Gravity Collection System				
Phase 1: Commercial Core, including Nichols Brothers	0.065	0.093	0.13	0.25
Phase 2: Phase 1 plus areas described earlier	0.11	0.16	0.22	0.42
Phase 3: Phase 2 plus areas described earlier	0.23	0.34	0.49	0.89
Phase 4: NMUGA, "Low" Population Estimate	0.38	0.57	0.83	1.49
Phase 5: NMUGA, Ultimate Buildout ("High" Population Estimate)	0.59	0.83	1.15	2.22
STEP Collection System				
Phase 1: Commercial Core, including Nichols Brothers	0.055	0.074	0.10	0.20
Phase 2: Phase 1 plus areas described earlier	0.092	0.13	0.17	0.34
Phase 3: Phase 2 plus areas described earlier	0.18	0.25	0.35	0.68
Phase 4: NMUGA, "Low" Population Estimate	0.29	0.41	0.57	1.11
Phase 5: NMUGA, Ultimate Buildout ("High" Population Estimate)	0.50	0.68	0.89	1.84

POLLUTANT LOADING PROJECTIONS

The major constituents of concern for loading projections are biochemical oxygen demand (BOD), a measure of the oxygen demand used by microorganisms, and total suspended solids (TSS).

Nitrogen is another constituent of concern. Nitrogen in domestic wastewater is typically in the form of organic nitrogen and ammonia. A total Kjeldahl nitrogen (TKN) analysis measures the combination of ammonia and organic nitrogen content. Excess nitrogen in receiving waters can spur the growth of nuisance biota such as algae. Specific forms of nitrogen also are of concern. Ammonia-nitrogen is associated with aquatic toxicity and can exert an oxygen demand under some circumstances. Nitrate-nitrogen is of importance as a primary drinking water standard; excess levels of nitrate-nitrogen in water supplies have

been correlated with "blue baby" syndrome. Although nitrate-nitrogen is not included in the TKN measurement, nitrate-nitrogen is not usually found in significant concentrations in untreated municipal sewage. Nitrate-nitrogen is typically found in partially treated municipal sewage, generally stemming from the conversion of ammonia-nitrogen to nitrate-nitrogen through wastewater treatment and/or septic system processes.

Residential Loads

Tt/KCM used a "unit load" approach to project future loads for the proposed Freeland NMUGA. Unit loads are typical values for loads expected per capita or per acre. Unit loads were based on data from similar communities, engineering experience, and Ecology's Orange Book (Ecology 1998).

As with flows, loads vary depending on the type of collection system used. Gravity collection systems collect all wastewater, including solids, and convey it to the treatment plant. A STEP system leaves much of the solid material in septic tanks, reducing the pollutant loads to the treatment plant. Solids in the septic tanks must be pumped every few years and will require additional treatment after they are pumped out.

For a gravity system, BOD and TSS loads are approximately equal. A unit loading factor of 0.2 pounds per capita per day (ppcd) was used for both BOD and TSS. These are typical unit loads; they are also referenced in the Orange Book (Ecology, 1998).

For a STEP system, BOD loads are usually higher than TSS loads. A unit loading factor of 0.12 ppcd was used for BOD, and a unit loading factor of 0.05 ppcd was used for TSS. These are typical unit loads based on recent data; examples of STEP systems' wastewater characteristics can be found in the Water Environment Federation's *Manual of Practice FD-12, Alternative Sewer Systems* (Water Environment Federation, 1986).

For both types of collection systems, TKN was assumed to be 18 percent of the BOD load. This percentage is based on previous engineering experience.

Peaking factors were used to generate statistically important values for the design of sewage facilities. The design factors for loads are annual average, maximum month, and peak day. The peak-hour load is not considered a useful value because peak-hour loads are assumed to be equalized in the treatment process. Maximum-month and peak-day peaking factors were based on data from similar communities, engineering experience, and Orange Book (Ecology 1998) values and are shown on Table 4-5.

Note that peaking factors differ between gravity and STEP systems. STEP systems have a lower unit load, and the higher peaking factor accounts for occasional pollutant overflows from septic tanks combined with desired conservatism in the treatment plant design. Even with the higher peaking factors, peak day loads are much higher for a gravity system than for a STEP system.

TABLE 4-5.
FUTURE WASTEWATER LOAD PEAKING FACTORS

Condition	Annual Average	Maximum Month	Peak Day
BOD			
Gravity Collection System	1.0	1.67	2.0
STEP Collection System	1.0	2.0	2.5
TSS			
Gravity Collection System	1.0	1.67	2.0
STEP Collection System	1.0	2.5	3.5
TKN			
Gravity Collection System	1.0	1.67	2.0
STEP Collection System	1.0	2.0	2.5

Commercial Loads

Commercial flows were assumed to be at a typical BOD strength of 400 milligrams per liter (mg/l), based on data from similar communities. This value corresponds to the previously described unit flows and loads of 60 gpcd and 0.2 ppcd. Peaking factors were the same as those used for domestic loads. Estimates for TSS and TKN used the same methodology as the approach for estimating residential loads.

The analysis does not account for high-strength commercial wastes, such as wastes from large industrial food processors. Such wastes generally have a significantly higher pollutant concentration than most domestic or commercial connections. If high-strength wastes are later added as part of the implementation, the flow and load analysis would need to be revised to account for these additional pollutant loads.

Total Load Projections

Table 4-6 shows future load projections. Appendix G contains the detailed assumptions and calculations used.

TABLE 4-6.
FUTURE WASTEWATER LOADING PROJECTIONS

Condition	Projected Wastewater Loads (pounds per day)		
	Annual Average	Maximum Month	Peak Day
BOD			
Gravity Collection System			
Phase 1: Commercial Core, including Nichols Brothers	149	249	298
Phase 2: Phase 1 plus areas described earlier	246	410	491
Phase 3: Phase 2 plus areas described earlier	445	743	890
Phase 4: NMUGA, "Low" Population Estimate	689	1,150	1,377
Phase 5: NMUGA, Ultimate Buildout ("High" Population Estimate)	1,173	1,959	2,346
STEP Collection System			
Phase 1: Commercial Core, including Nichols Brothers	90	179	224
Phase 2: Phase 1 plus areas described earlier	147	295	369
Phase 3: Phase 2 plus areas described earlier	267	534	668
Phase 4: NMUGA, "Low" Population Estimate	413	826	1,033
Phase 5: NMUGA, Ultimate Buildout ("High" Population Estimate)	704	1,408	1,759
TSS			
Gravity Collection System			
Phase 1: Commercial Core, including Nichols Brothers	149	249	298
Phase 2: Phase 1 plus areas described earlier	246	410	491
Phase 3: Phase 2 plus areas described earlier	445	743	890
Phase 4: NMUGA, "Low" Population Estimate	689	1,150	1,377
Phase 5: NMUGA, Ultimate Buildout ("High" Population Estimate)	1,173	1,959	2,346
STEP Collection System			
Phase 1: Commercial Core, including Nichols Brothers	37	93	131
Phase 2: Phase 1 plus areas described earlier	61	154	215
Phase 3: Phase 2 plus areas described earlier	111	278	389
Phase 4: NMUGA, "Low" Population Estimate	172	430	602
Phase 5: NMUGA, Ultimate Buildout ("High" Population Estimate)	293	733	1,026

TABLE 4-6 (continued).
FUTURE WASTEWATER LOADING PROJECTIONS

Condition	Projected Wastewater Loads (pounds per day)		
	Annual Average	Maximum Month	Peak Day
TKN			
Gravity Collection System			
Phase 1: Commercial Core, including Nichols Brothers	27	45	54
Phase 2: Phase 1 plus areas described earlier	44	74	88
Phase 3: Phase 2 plus areas described earlier	80	134	160
Phase 4: NMUGA, "Low" Population Estimate	124	207	248
Phase 5: NMUGA, Ultimate Buildout ("High" Population Estimate)	211	353	422
STEP Collection System			
Phase 1: Commercial Core, including Nichols Brothers	16	32	40
Phase 2: Phase 1 plus areas described earlier	27	53	66
Phase 3: Phase 2 plus areas described earlier	48	96	120
Phase 4: NMUGA, "Low" Population Estimate	74	149	186
Phase 5: NMUGA, Ultimate Buildout ("High" Population Estimate)	127	253	317

CHAPTER 5.
COLLECTION SYSTEM ALTERNATIVES

This chapter evaluates different types of collection systems for the Freeland area. Applicable technologies are evaluated according to qualitative factors and present worth cost. Treatment and discharge or reuse alternatives are discussed in Chapters 6 and 7.

DESCRIPTION OF ALTERNATIVES

Several types of collection system technologies could be used to serve the Freeland area: conventional gravity systems, septic tank effluent pumping systems, grinder pump systems, small-diameter gravity (SDG) systems, and vacuum systems. Each is described below.

Conventional Gravity Systems

Conventional gravity systems consist of pipe large enough to handle solids in wastewater flow, with manholes at angle points and grade changes. Conventional gravity systems are the most common type of collection system and do not require pretreatment of typical domestic wastewater.

Service connections convey flow by gravity to collection mains constructed at a generally uniform downhill grade. Figure 5-1 shows a typical service connection to a gravity sewer system. The grade of the collection system must be adequate to maintain a flow velocity that prevents the deposition of solids in the sewers. The typical minimum pipe diameter is 8 inches, but 6-inch-diameter pipe can be used for segments shorter than 250 feet that will never be extended and will receive only minimal use.

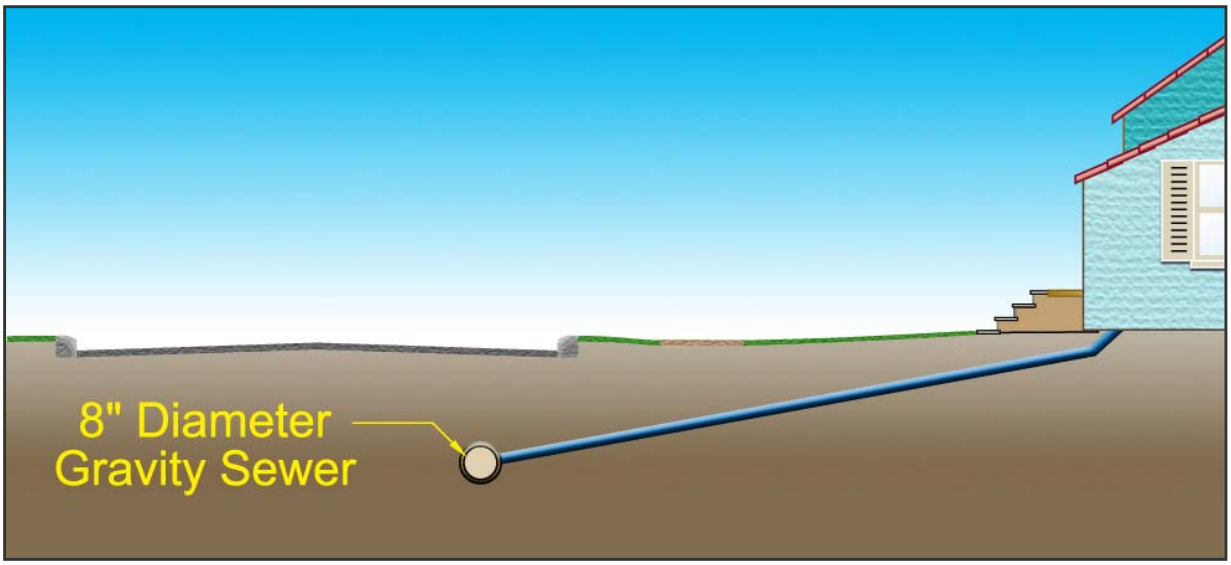


Figure 5-1. Conventional Gravity Sewer System Service Connection

Because of the minimum gradient required to maintain an adequate flow velocity, conventional gravity systems can get very deep in relatively flat areas unless lift stations are provided. Typically, pipe is buried at depths of 6 to 20 feet.

Septic Tank Effluent Pump and Grinder Pump Systems

Septic tank effluent pump and grinder systems are pressure collection systems, which use small-diameter pipe and small pumps at each service connection. Isolation valves are required for each service and each collection system branch. High points in the line require air/vacuum valves. Pipes are installed at a relatively shallow depth, generally following the contours of the ground.

Solids must be either ground or separated from the liquid stream to prevent plugging of the pumps and the small-diameter pipes. To accomplish this, the pump at each connection can be a grinder pump, which grinds solids and pumps them along with the liquid portion of the flow, or a septic tank effluent pump, which pumps only the liquid supernatant separated from solids and grit in a septic tank. Figure 5-2 shows a typical service connection in a STEP system. Grinder pumps pump the liquid and ground solids to a wastewater treatment plant, pump station, or location from which the wastewater can flow by gravity to a treatment plant or pump station. STEP systems transport only liquid and suspended waste to the same destination.

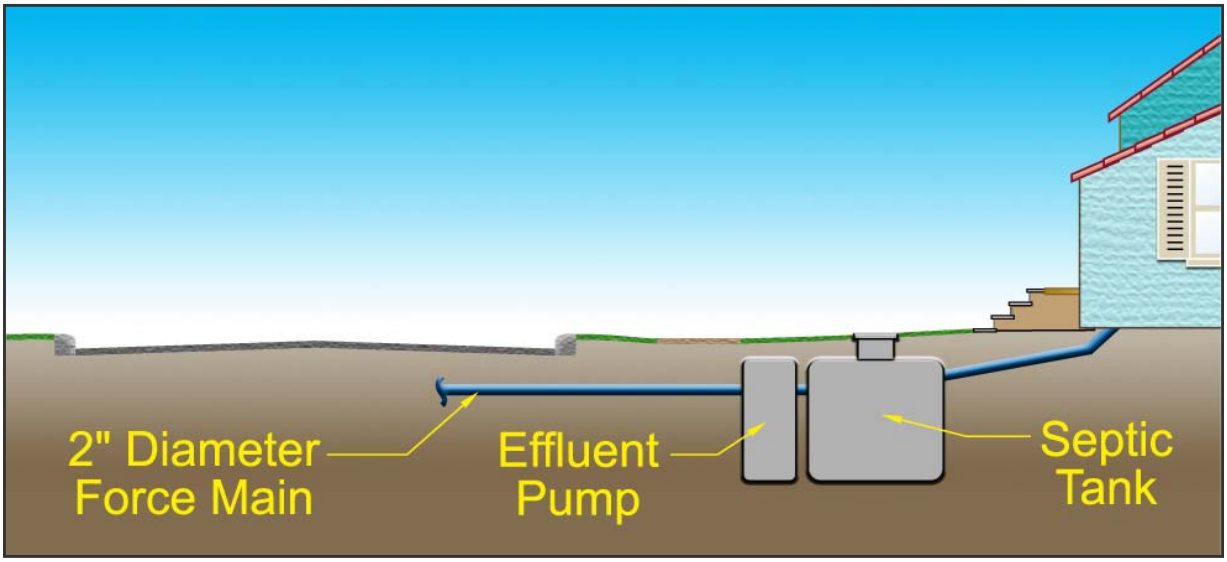


Figure 5-2. Septic Tank Effluent Pump System Service Connection

Pressure collection systems use pipes as small as 1.5 inches in diameter in shallow and narrow trenches. The pipe is generally buried 3 to 6 feet deep. Shallow burial and virtually leak-proof piping make pressure systems a good alternative for areas with a high water table.

Pressure systems do not have high maintenance requirements, but any maintenance required must be performed in a timely manner to avoid system failure. Electrical

connection and power costs associated with the pump at each service are typically incorporated into owner electrical costs at the residence or business.

Small-Diameter Gravity Systems

Small-diameter gravity systems are similar to STEP systems, but the sewage flows by gravity instead of being pumped. Supernatant is separated from solids and grit in a septic tank. The supernatant flows by gravity into small-diameter pipes. Figure 5-3 shows a typical service connection for a small-diameter gravity system. Pipes are generally 4 to 6 inches in diameter. Pipes are installed at a depth in between those required for pressure systems and conventional gravity sewers.

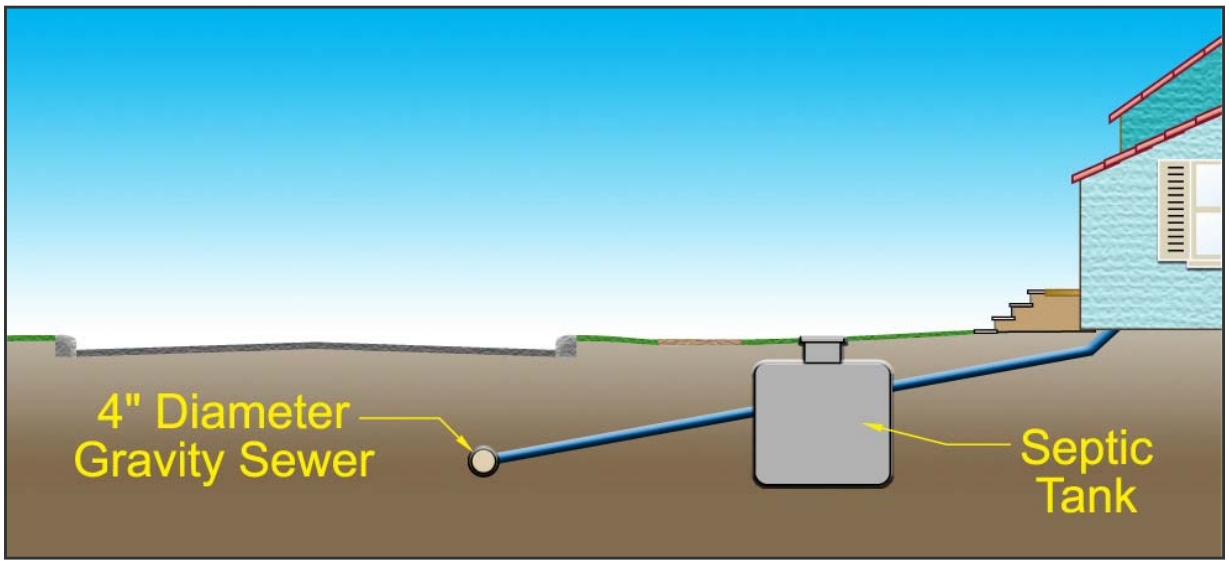


Figure 5-3. Small-Diameter Gravity System Service Connection

Service connections convey flow by gravity to collection mains. Since the system is not designed to carry solids, the required grade of the collection system is not as great as for conventional gravity sewers, and manholes are not required at all junctions or changes in grade or alignment. Additionally, the collection mains do not have to be at a constant grade; they can follow the natural terrain as long as an overall downhill gradient is maintained. High points in the line require air/vacuum valves.

Vacuum Systems

Vacuum collection systems have three primary components: service connections, a collection system, and a central vacuum station. One or more services are connected by gravity lines to a valve pit. The pit serves as a holding tank with valving to control evacuation into the collection piping. The collection piping is generally small (3 to 8 inches in diameter), and the system uses isolation valves much like the pressure system. The pipe is buried in a saw-tooth or similar arrangement to help the vacuum system work efficiently. Figure 5-4 shows a typical vacuum system service connection.

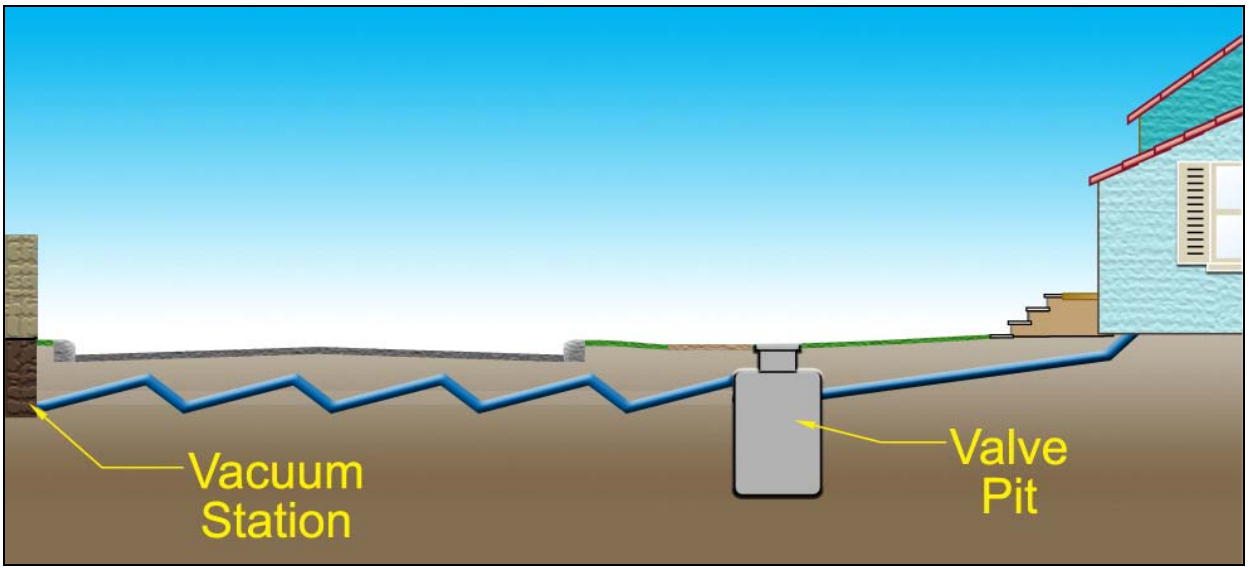


Figure 5-4. Vacuum System Service Connection

The saw-tooth profile allows flow to be transported uphill in a series of small elevation rises while maintaining relatively shallow burial. It also acts as an airlift and provides some additional aeration as waste is forced through the lift by rising air. The collection lines transport flow to the vacuum station, which houses a vacuum reservoir tank, vacuum pumps, wastewater pumps, controls and standby power facilities.

The topography of the area served must be relatively flat because the vacuum produced by a typical vacuum station is capable of lifting flow a maximum of 20 feet in elevation. Relatively shallow burial and leak-proof piping make the vacuum system a good alternative for areas with a high water table. There are a variety of designs for vacuum collection systems, each patented by its manufacturer.

Combination Systems

Several of these collection systems technologies are compatible. For example, STEP, vacuum, grinder pump, and SDG systems can all work in conjunction with a conventional gravity sewer. The combination of a conventional gravity system with one of the other systems is the most feasible combination. It is common to use conventional gravity sewers for a central collection system and another type of system to bring sewage to the central collection system from outlying areas.

Some combinations of these technologies are not compatible. For example, grinder pumps cannot be used in conjunction with STEP or SDG systems without modifications to pipe diameter and slope, since grinder pump systems are designed to carry solids and STEP and SDG systems are not. Also, vacuum systems are not easily compatible with pressure systems based on the operational philosophy of sewers being under vacuum or under pressure.

Decentralized Systems

The alternatives described above assume that sewage will be sent to a central treatment facility, then discharged or reused at a separate facility. This is typical for systems serving populations of more than a few hundred. An alternative is for sewage from homes and commercial and industrial connections to be treated and disposed of through drainfield percolation near the individual connections. This alternative was considered during the early planning process for this report but was rejected for further evaluation, partly due to technical, regulatory, and cost factors. Appendix H contains a technical memorandum describing the advantages and disadvantages of decentralized systems.

ALTERNATIVES ANALYSIS

Initial Qualitative Assessment

Each collection system alternative was evaluated with respect to its suitability for the Freeland area. The following considerations were important in the evaluation:

- The area to be served is relatively hilly with few flat spots.
- The area to be served has a relatively low water table (far from ground surface), except for areas near sea level, such as Shoreview Drive, Stewart Drive, and Myrtle Avenue near Freeland Park. The soil in the area is composed of glacial deposits that are typically well-cemented as well as some sands. There is quite a bit of discontinuity in soils throughout the area, so ground conditions are very site-specific (area soils are discussed in more detail in Chapter 2).
- The collection system eventually will serve the entire Freeland sewer service area, corresponding to the Freeland NMUGA minus the portion of the Holmes Harbor Sewer District that is within the NMUGA. It should be possible to phase construction of the system from the initial Phase 1 service area in the commercial core to the entire service area.

Conventional Gravity System

A conventional gravity collection system is the most susceptible of the collection system alternatives to infiltration and inflow. Larger pipes allow more I/I to enter the system, manholes are difficult to make water-tight, and there is no back pressure in the system to keep out I/I. The potential for high I/I flows is somewhat of a concern in this project because of occasional areas of a high water table. I/I flows add to the cost of the system due to the need to construct larger facilities to handle the extra flow.

A conventional gravity system also requires the deepest burial of the collection system alternatives. For this project, deep trenches could be a concern due to locally high water tables. Digging trenches in those areas would require extensive dewatering and appropriate shoring to minimize the potential for caving or sloughing soils.

Multiple pump stations would be required throughout the system, particularly in hilly areas where the ground contours slope away from the desired destination of the sewage.

Finally, conventional gravity systems generally require more attention to the front end (headworks) of the treatment plant. Because solids are allowed to pass through the system, larger non-organic solids, including sticks, rags, plastics, and grit, may require removal from the raw sewage stream to protect downstream elements of the treatment plant. Headworks considerations are discussed in detail in Chapter 7.

Operation and maintenance (O&M) on this type of system includes periodic cleaning of the lines and manholes and repair of leaking pipes and manholes. The cleaning may be required once a year; repairs are required as parts of the system fail. Pump stations would require periodic maintenance of pumps, motors, valves, controls, and the overall structure. Operation of a pump station requires at least daily monitoring. Even with these O&M requirements, gravity systems generally have the lowest O&M costs if properly maintained.

STEP and Grinder Pump Systems

Pressure collection systems have advantages over gravity systems in locations with high groundwater tables or difficult soils, but they are more complicated systems. Grinder pump systems require a small sump with a grinder pump at each service.

STEP systems require a septic tank and effluent pump at each service. Septic tanks must be pumped periodically to remove accumulated sludge, usually every five to seven years, which requires truck access through private property to reach septic tanks. Existing property owners are familiar with these issues, since septic systems are the main type of sewage facility in the area. Additionally, because of its anaerobic (absence of air) nature, septic tank effluent often causes odor problems in pump stations and corrosion issues in the sewer piping when the wastewater flow enters into atmospheric conditions, such as into a manhole, pump station wet well, or an open basin at a treatment plant. Existing septic tanks can sometimes be retrofitted to STEP service, but they must be tested for watertightness.

In pressure systems, services connect to pipes that are pressurized, thereby greatly reducing I/I into the system. I/I can enter the collection system only through the service pipe between the home or business and its sump or septic tank. However, if a pressure system leaks, it may result in sewage leaks into the surrounding soil.

The grade of the pipe in a pressure system is not critical as long as design velocities are maintained. Pipe is installed at a shallow depth, although solids transport velocities must be maintained for grinder pump systems. This avoids deep trenches, thereby reducing the costs of trench excavation and minimizing any concerns associated with localized shallow groundwater. Despite the hilly topography of the Freeland service area, centralized pump stations might not be required, depending on the type of pumping system and the final destination of the septic tank effluent.

Maintenance is generally higher for pressure systems than for gravity systems. The primary maintenance item is the pump and control package. Pumps occasionally become plugged, level control systems fail, and pumps must be replaced periodically. Isolation valves have to be closed and opened periodically to ensure that they are operating properly. Repair of broken pipes is also required. Staff must keep a spare parts inventory, including

an adequate number of spare pump units for normal replacement, to facilitate efficient maintenance.

Also, with either type of system, a pump station might be required to pump the flow from the collection system to the treatment and discharge/reuse facilities. The need for a separate main pump station depends on the elevation of the treatment and discharge facilities. This pump station would have ongoing maintenance requirements (as previously discussed for the gravity system). Due to the anaerobic condition of the flow coming from the STEP system, the pump station would require odor and corrosion control measures.

STEP and grinder systems have different impacts on the treatment plant. Because STEP systems leave most of the large non-organic solids such as sticks, rags, plastics, and grit in the septic tanks, the downstream treatment plant often does not require headworks facilities. Grinder systems may require headworks facilities to remove non-organic materials from the treatment plant stream to protect downstream treatment facilities.

Small-Diameter Gravity Systems

SDG systems share many advantages and disadvantages with STEP systems. As a septic tank-based system, SDGs require periodic septic tank pumping, and the anaerobic septic tank effluent can cause odor problems in pump stations and corrosion problems in sewers.

Like conventional gravity systems, SDGs are fairly susceptible to I/I. Burial depths are not as great as for conventional gravity systems, and the grade of the pipe is not as critical as long as an overall downhill gradient is maintained. This avoids deep trenches, thereby reducing the costs of trench excavation and reducing concerns of groundwater and trench caving.

O&M for SDG systems is similar to that for conventional gravity systems. However, there are septic tanks at each connection, meaning that truck access, septic tank solids disposal, and odor and corrosion are issues, as noted for pressure systems. Like conventional gravity systems, at least one pump station would be required, with its O&M requirements.

SDG systems are similar to STEP systems in their impact on the treatment plant. Because larger non-organic solids are retained in the septic tanks, no headworks is generally needed at the treatment plant.

Vacuum Systems

Like pressure collection systems, vacuum systems have advantages over gravity systems with regard to site-specific poor soils and locally high groundwater. An advantage of vacuum systems over pressure systems is the elimination of mechanical/electrical facilities at each service location throughout the District. The central vacuum/pump station, however, is more complex than a standard pump station; it includes vacuum pumps as well as pressure pumps.

The grade of the pipe in a vacuum system is not critical and the pipe is installed at a shallow depth. This avoids deep trenches, thereby reducing the costs of trench excavation and reducing concerns of groundwater and trench caving. However, vacuum systems have a

limited lift capacity (on the order of 20 feet) due to the suction lift possible with vacuum pumps. Freeland is too hilly for this type of system. Even if a vacuum station were located at the lowest elevation in the service area, there are many areas in which sewage must flow upwards over hills in order to reach the low points of the service area. These hills are too high for vacuum systems to overcome.

To maintain vacuum in the collection piping, vacuum systems must be airtight, which reduces the likelihood of I/I entering the system. In a properly designed and constructed vacuum system, locating leaks is not difficult. The presence of vacuum leaks in the system becomes very apparent when monitoring the operation of the vacuum pumps over a relatively short period. Only the service pipe between the home or business and the valve sump is susceptible to I/I in vacuum systems.

A vacuum station is able to draw flows to it from a distance of about 1 to 2 miles. This would allow Freeland to be served by a single station that could be located almost anywhere in the service area. To simplify O&M, the station should be located in a centralized area to allow convenient monitoring of the system. Odor is a potential concern at the vacuum station, depending on the detention time of the sewage in the vacuum collection pipes.

Maintenance on vacuum systems is similar to the maintenance for grinder pump systems. The primary maintenance items are the vacuum/pump stations and valve vaults. Operation of a vacuum/pump station requires at least daily monitoring. The isolation valves need to be operated periodically to ensure that they are working. Immediate repair of broken pipes is also required, since they compromise the system by breaking the vacuum in the pipes.

Vacuum systems are similar to conventional gravity systems in their impact on the treatment plant. Because larger non-organic solids are allowed to pass through the collection system, headworks facilities may be required at the treatment plant to remove the non-organic materials, protecting downstream treatment facilities.

Conclusion of Initial Qualitative Assessment

Based on the initial assessment of collection system alternatives, the following conclusions were made on the alternatives' suitability for further evaluation:

- Conventional gravity sewers will be evaluated further.
  - Grinder pump systems will be considered a subset of the conventional gravity sewers. In a conventional gravity system, when houses are too low to allow flow by gravity to the sewer system, grinder pumps are often used. Use of grinder pumps is consistent with the absence of septic tanks in the system.
- STEP systems will be evaluated further.
  - Grinder pump systems will be considered a subset of STEP systems. Use of grinder pumps is consistent with having a pump at each individual connection. However, grinder pumps cannot provide as much pressure as STEP pumps. In higher pressure applications, grinder pumps may not be suitable.

- SDG systems will not be evaluated further because they require relatively deep pipe depths and septic tanks at each house. If a house in a STEP system can connect to the collection main by gravity, an SDG system could be used as long as system hydraulics are favorable at that location.
- Vacuum systems will not be evaluated further because the terrain is too hilly. Vacuum systems are best suited for mostly flat areas.
- Decentralized systems will not be evaluated further because the large number of systems, requiring significant land area and operator monitoring, makes it inefficient for the size of the community to be served.

Out of the analysis above, the following combinations were selected for detailed evaluation:

- Conventional gravity sewers
- STEP systems
- Combination system: STEP systems discharging into conventional gravity sewers.

Detailed Evaluation of Short-listed Alternatives

The detailed evaluation of alternatives considers each alternative's constructability, susceptibility to I/I, O&M requirements, odor and corrosion potential, treatment plant headworks requirements, and cost.

Constructability

The main constructability issue for Freeland is local areas of high groundwater table and perhaps soils. In addition, the streets may already be relatively full of buried piping and wiring for other utilities, making deeper trenches difficult to construct because of utility interferences. The deeper the pipes must be buried, the more difficult and expensive the construction becomes. STEP systems allow for much shallower pipe burial than gravity systems.

I/I Flows

The main I/I risk comes from local areas of high groundwater tables. When I/I flows are high, larger, more costly treatment and discharge facilities are required, or the system runs the risk of having undersized facilities that do not operate efficiently. STEP systems are able to limit I/I flows much better than gravity systems. This is true even of new gravity systems, which are typically much less prone to I/I than older systems that have begun to reach the end of their design life.

O&M Requirements

Gravity systems are the simplest of the collection systems evaluated. However, Freeland may require many complex and expensive pump stations due to the terrain. STEP systems have pump units at each service; however, these are relatively simple installations. Grinder pumps are more complex, since they are designed to pass solids, and can be prone to frequent maintenance due to clogging. STEP systems have the added cost of handling and

disposing of the septic tank sludge, which should be considered as an overall part of the project cost.

Odor and Corrosion Potential

Gravity systems do not have a significant potential for odor or corrosion. STEP systems have septic tanks discharging into full-flow pipes, and septicity is a potential issue. Odor may be an issue where turbulent flows exist, such as the entrance point into a pump station wet well. Corrosion issues can arise throughout the collection system from the septicity of the septic tank effluent, especially where metallic or concrete pipes and concrete manholes are used. STEP systems might require odor control at pump stations and chemical injection and use of chemically non-reactive materials for corrosion control throughout the sewer system. HDPE manholes or lined concrete manholes could be used. A STEP/gravity combination system could have the greatest potential for odor and corrosion problems wherever the pressure/gravity interface is.

Treatment Plant Headworks Requirements

Gravity and combination systems would likely require headworks facilities at the treatment plant to remove larger non-organic solids from the waste stream to protect downstream treatment facilities. Headworks facilities can be expensive to design and construct, messy and labor-intensive to operate, and prone to generating odors.

STEP systems do not require headworks facilities, since larger non-organic particles are retained in the septic tanks. STEP systems can pump directly into an aeration basin, resulting in reduced capital cost, reduced O&M requirements, and low potential for odors.

Cost

Cost Estimate 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 attached in Appendix I. Estimated costs were identified from the following sources:

- Price quotes from local equipment suppliers
- Unit prices for construction based on industry standards (Means 2003 Building Construction Cost Data)
- Bid tabulations from similar projects.

The capital cost represents the total project cost for implementation of each alternative. It includes 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.

Annual O&M costs were estimated based on power requirements, replacement cost of equipment and structures, chemicals, and labor (general maintenance and cleaning).

Cost Estimates for Evaluated Alternatives

Costs were developed for the Phase 5 (ultimate buildout) conditions, since sewers should generally be sized to accommodate future expansion without having to be re-laid. Phasing of alternatives was estimated using planning projections and estimates of potential phases of implementation. Table 5-1 lists the number of equivalent residential units expected to be connected to the system for each phase, based on the projections described in Chapter 4.

TABLE 5-1.
EXPECTED NUMBER OF SEWER SYSTEM CONNECTIONS BY PHASE

Phase	Equivalent Residential Units
1	319
2	525
3	1,037
4	1,558
5	3,130

Hydraulic analysis of the collection system alternatives was performed using the SewerCAD computer model. The model verified pipe sizing and hydraulics based on population projections, projected flows and loads, and elevations throughout the service area.

Figure 5-5 shows the results of the cost analysis for the collection system alternatives. It shows estimated capital and present worth costs in terms of cost per Equivalent Residential Unit (ERU). Recall that as described in Chapter 4, an ERU is the equivalent of a single family household. Each ERU is estimated as approximately 140 gallons per day (gpd) on an average basis, not including inflow and infiltration (I/I) flows.

Each set of five bars represents one of the three alternatives. In each set of five bars, the left bar represents Phase 1 and the right bar represents Phase 5.

Capital costs are divided into costs for mainline sewers and costs for homeowner connections. Mainline sewers, which receive flows from individual connections, are typically buried beneath streets and other public right-of-ways. Homeowner connections are the connections between a residence or business and the mainline sewers. For conventional gravity sewers, the homeowner connection is the side sewer connecting the house or business to the mainline sewers. For STEP systems, the homeowner connection is the sewer from the house to the septic tank, the septic tank and pump with controls, and the pressure lateral from the pump to the mainline sewer.

Figure 5-5 shows that for Phase 5, STEP systems have the highest total present worth cost, and the costs are about equal for the conventional gravity and combined STEP/gravity

systems. For the STEP systems, the homeowner connection cost is a significant portion of the total present worth cost, while the mainline sewers are a relatively small portion of the total present worth cost. In comparison, for conventional gravity systems, the mainline sewers are the bulk of the cost, and homeowner connections are a relatively smaller portion of the cost.

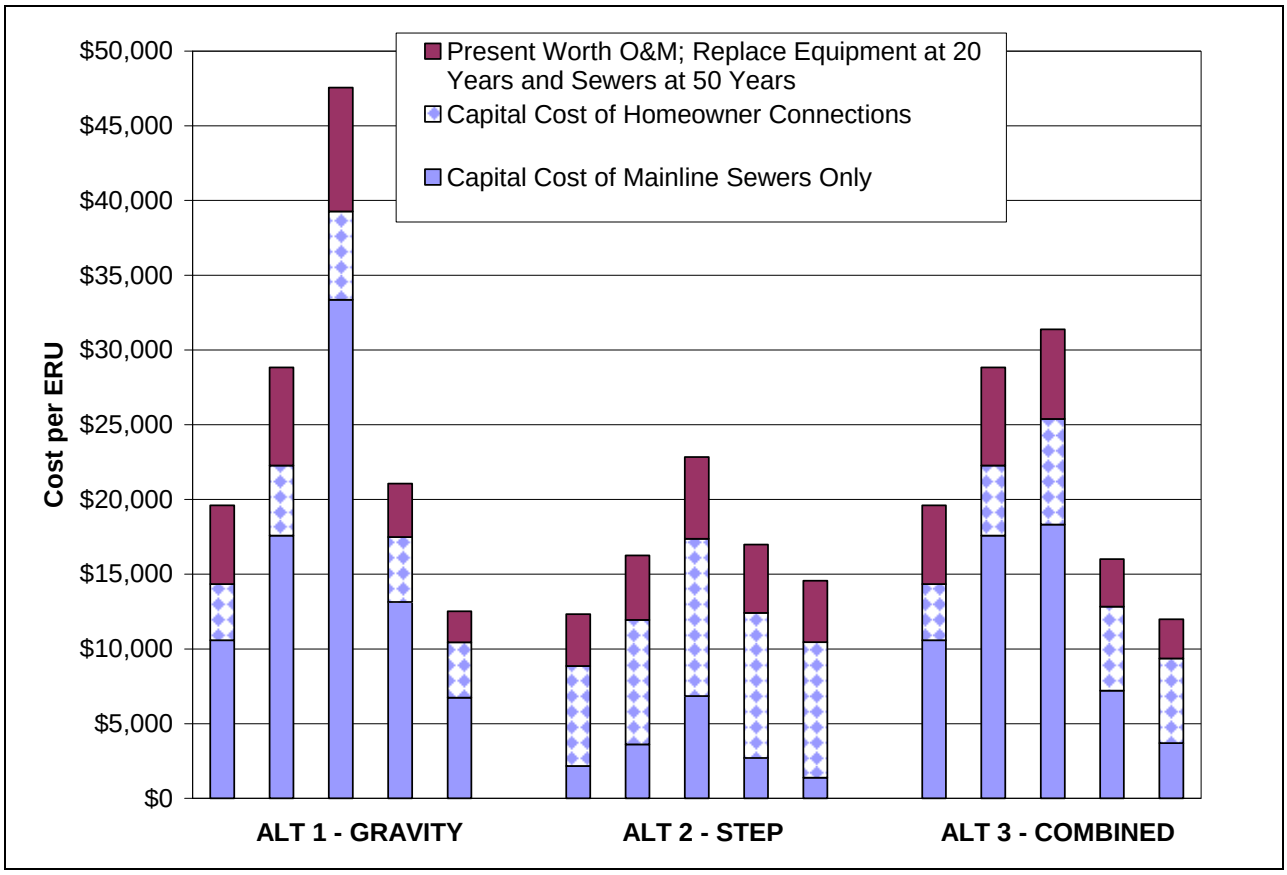


Figure 5-5. Estimated Costs of Collection System Alternatives (per ERU)

For some small communities, STEP systems have been viewed as a more flexible approach than gravity systems because for STEP systems, much of the collection system cost is in STEP tanks and pumps, not in the mainline sewers. If individual connections bear the cost of STEP tanks and pumps on their property, phased implementation is relatively easy. This is because the initial cost of the mainline sewers is low, and individual connections pay for the STEP tanks and pumps as they connect to the system.

In comparison, for gravity systems, much of the cost is in mainline sewers. This significant initial cost must be borne as the mainline sewers are installed. It must be shared among the participants in the first phase of implementation. Although financial tools such as rate structures and future connection charges can be assessed to shift some of the initial cost onto future connections, these strategies are based upon uncertain estimates of the number and timing of future connections.

The cost analysis in this chapter is based on preliminary planning-level estimates. More detailed costs for the recommended collection system alternative are presented in Chapters 8 and 9 as part of the overall recommendation.

Note that the more detailed costs shown in later chapters used slightly different assumptions than the analysis presented in this chapter. These assumptions include assumed discount and interest rates. This is because the more detailed costs were estimated at a later date.

RECOMMENDED ALTERNATIVE

On February 8, 2003 a public workshop was conducted to present the collection system alternatives. Following this workshop, the Freeland Sub-Area Planning Committee met and selected the STEP system as the preferred alternative. The selection was based on the low initial cost of shallow mainline sewers, the ability to phase implementation in proportion to population increases, the lack of large, complex main pump stations throughout the collection system, and simplicity in headworks requirements for the treatment plant. Grinder pumps could be used instead of STEP systems, although a headworks would be required at the treatment plant.

The results of the SewerCAD computer model runs for the preferred alternative are included as Appendix J.

CHAPTER 6.
WASTEWATER DISCHARGE AND REUSE ALTERNATIVES

This chapter evaluates different types of discharge and reuse systems for Freeland. Applicable technologies are evaluated according to qualitative factors and present worth cost. The focus of this chapter is to reduce a broad range of potential alternatives to a shorter list for more detailed evaluation, which is presented in Chapter 8.

SURFACE WATER DISCHARGE VS. LAND APPLICATION

Treated wastewater effluent must be discharged or reused in some manner. Commonly, effluent is discharged into a large receiving body of water, such as Puget Sound. For Freeland, this approach could include an outfall discharging into Holmes Harbor or into Mutiny Bay.

Alternatively, treated effluent can be land-applied for "disposal" or for "beneficial reuse." The definitions of "disposal" and "beneficial reuse" are given on the next page. For Freeland, treated effluent or reclaimed water could be land-applied in a number of ways, including seasonal irrigation, slow infiltration, rapid-rate surface percolation, direct groundwater recharge, wetlands discharge, or direct reuse.

Surface water discharge is a technically sound option for Freeland. Many treatment facilities in the Puget Sound area discharge treated effluent to Puget Sound or to a local surface water body. Initial alternatives considered for surface water discharge of effluent included discharge to Holmes Harbor and to Mutiny Bay. However, there are historical implementation issues with both options.

Our understanding is that there may have been a mixing zone study performed for Holmes Harbor that indicated poor dilution and mixing. As described in Chapter 2, Holmes Harbor has been designated by the Puget Sound Action Team as having an overall "high" sensitivity to eutrophication (receiving excess nutrients and stimulating excessive plant growth). Additionally, there may be regulatory constraints. Ecology has indicated that an outfall could be acceptable from a regulatory perspective if it were used only during the winter. Ecology also indicated that permitting such an outfall would likely be difficult.

The Island County Marine Resources Committee has mapped eelgrass beds in Holmes Harbor (Island County Marine Resources Committee, 2001); eelgrass is an important plant to several species of salmon, including listed endangered species. Research into summer chum has shown that juveniles entering saltwater for the first time feed on small invertebrates found in eelgrass beds. Young salmon also hide in the beds from predators. Eelgrass beds also serve as a nursery for herring, a favorite food for salmon, which lay their eggs on the eelgrass blades. Therefore, potential risk to eelgrass could represent an Endangered Species Act issue that would prevent an outfall into the harbor.

Mutiny Bay appears to have better dilution and mixing characteristics than Holmes Harbor, but political and potential implementation issues prevented a previous outfall proposal for Mutiny Bay from progressing past the initial stages of development.

These two outfall concepts were discussed with the Freeland Sub-Area Planning Committee at a February 20, 2003 meeting. It was agreed that outfall alternatives should not be pursued any further due to technical, regulatory, and implementation issues.

The Committee also expressed a desire for water reclamation with a goal of aquifer recharge if appropriate. Therefore, land-based application is explored as the preferred approach.

LAND APPLICATION FOR DISPOSAL VS. REUSE

"Disposal" and "reuse" have different regulatory definitions. Disposal strategies generally aim solely to dispose of the effluent; they generally provide minimal pretreatment and rely on the ground for additional treatment of the effluent. This approach is typical of septic tank and drainfield systems.

Reuse strategies accomplish the goal of beneficially using reclaimed wastewater by providing a useful purpose for it, such as watering crops, supplying water for industrial processes, or supplementing groundwater aquifers. Reuse strategies assume that the reclaimed water is highly treated before reaching the land application site. The ground is not required to provide significant treatment.

Reuse of reclaimed wastewater through land application is becoming increasingly common in the United States. In Washington State, the primary developers of land-based reuse and disposal systems have been municipalities in Eastern Washington, where drier climates make irrigation more feasible than in Western Washington. However, several projects have been constructed or are being studied in Western Washington:

- Holmes Harbor Sewer District (HHSD) on Whidbey Island uses reclaimed water for summer golf course irrigation; at other times of the year, reclaimed water is stored in holding basins during non-irrigation season.
- Yelm uses surface percolation basins for groundwater recharge of a non-sole-source aquifer.
- In Snoqualmie, a portion of reclaimed water is used for seasonal golf course irrigation.
- On the Olympic Peninsula, Sequim uses a portion of its reclaimed water for landscape irrigation at a local park. The reclaimed water can also be sent to wetlands that feed a small creek. The remaining reclaimed water is discharged through a marine outfall.
- King County uses a portion of its reclaimed water for landscape irrigation and industrial reuse at its treatment plants and has pilot-tested several advanced treatment technologies for a variety of reclamation uses.

In all these examples, the reclaimed water is treated to applicable standards before being applied to its end use or disposal.

Washington Administrative Code 173-240 indicates that domestic wastewater facilities above a certain size (3,500 gallons per day for mechanical treatment plants and 14,500 gpd for septic tank-based disposal systems) may not use subsurface treatment and disposal

strategies "except under those extraordinary circumstances where no other reasonable alternatives exist."

Since there are many options for land-based reuse, disposal strategies will not be considered further in this analysis. Only reuse strategies will be considered; for these strategies, wastewater must treated to reuse standards before being applied to land.

It should be noted that in water reclamation facilities, the reclaimed water can be used for a beneficial purpose. The generator of the reclaimed water may retain the water rights for this useful resource. Freeland intends to retain the water rights to any reclaimed water generated as part of the work described in this document.

REGULATORY CONSIDERATIONS FOR LAND-BASED REUSE

Aquifer Protection

Any wastewater reuse strategies for the Freeland area would have to consider the hydrogeologic characteristics of Whidbey Island. The island uses groundwater from an EPA-designated sole-source aquifer for drinking water. Because of the EPA's designation of the island's aquifer as a sole-source aquifer, a land-application water reclamation system would have to ensure that there is no possibility for groundwater contamination. Strict treatment and monitoring requirements would be applied, per the *Water Reclamation and Reuse Standards* (described in Chapter 3 and in the next section). Preliminary guidance from the Department of Health indicates that land-application water reclamation systems are consistent with the sole source aquifer designation.

Under WAC 173-200, "existing and future beneficial uses (of groundwater) shall be maintained and protected and degradation of ground water quality that would interfere with or become injurious to beneficial uses shall not be allowed." In this case, the requirement is an affirmation of the sole-source aquifer designation and the need to preserve the groundwater for drinking water throughout the island.

Water Quality Requirements

Washington's *Water Reclamation and Reuse Standards* describe treatment and quality requirements for a variety of end uses. Four basic classes of reuse quality are listed, along with their suitability for various end-uses. Class A is the classification for highest quality, and Class D is for the lowest quality. Quality requirements vary with the proposed end use and amount of potential public access to the site. Classes D through B are equivalent to secondary-treated wastewater, with increasing amounts of supplemental disinfection. Class A reclaimed water is secondary treated wastewater with the most stringent disinfection requirements; it also must be filtered.

Treatment requirements are more restrictive than Class A for reuse activities that could directly affect groundwater. For rapid groundwater recharge using surface percolation, nitrogen reduction is required in addition to Class A treatment (*Water Reclamation and Reuse Standards,* Section 1, Article 3, Section 2.2). For direct well injection into a drinking water aquifer, nitrogen reduction and reverse osmosis treatment to near-drinking water

quality are required (*Water Reclamation and Reuse Standards,* Section 3, Article 2, Section 1 and Section 3, Article 3, Section 1).

Chapter 7 describes reclaimed water quality requirements in more detail.

Water Storage Requirements

Per the *Water Reclamation and Reuse Standards*, reclaimed water facilities require storage. Three kinds of storage are described: alternative storage, short-term storage, and long-term storage.

Alternative storage is required "where no alternative disposal system is permitted." It is to "assure the retention of reclaimed water under adverse weather conditions or at other times when reuse is precluded." It is sometimes referred to as "wintertime storage," since land-application reclamation facilities are mostly likely to be hampered during the rainy winter months. Alternative storage is required for a minimum of three days of average flows or a 10-year storm event, whichever is greater.

Short-term storage is required as a reliability feature if the treatment plant is not meeting its permit limits. It is sometimes referred to as "emergency storage." The storage is provided as a means of storing the non-fully treated wastewater until the treatment plant begins to meet its permit limits again. Stored wastewater would then be pumped back through the plant for re-treatment. Short-term storage is required if the treatment plant has a very high level of redundancy (such as 100 percent treatment capability with a treatment unit out of service). A minimum of one days' worth of short-term storage is required.

Long-term storage is similar to short-term storage, except that more storage is provided for treatment plants that do not meet the strict redundancy requirements for short-term storage. Again, it is sometimes referred to as "emergency storage." A minimum of twenty days' worth of long-term storage is required.

For all alternatives evaluated in this chapter, alternative (wintertime) storage will be provided. In addition, it is generally more cost-effective to provide long-term storage and less treatment plant redundancy than it is to provide short-term storage and more treatment plant redundancy. This is because additional treatment redundancy is mechanically complex, often requiring concrete and metalwork, mechanical treatment and/or pumping equipment, electrical equipment, and instrumentation and controls. In comparison, additional storage is generally much simpler, involving large earthen basins or concrete tanks. This assumes that land is generally available for additional storage.

Therefore, all alternatives will include long-term storage (instead of short-term storage) to meet emergency storage requirements.

Water Supply Needs

The Department of Ecology has indicated that utilities incorporating reuse into their overall planning may be given a higher priority in their applications for water rights.

Therefore, a reuse program could benefit the Freeland Water District's pending applications for new water rights.

SCREENING OF REUSE STRATEGIES

An initial screening was conducted of the following reuse strategies that meet the treatment requirements outlined in the *Water Reclamation and Reuse Standards*:

- **Seasonal irrigation with off-season storage**—Reclaimed water would be used for irrigation, applied at agronomic rates (agronomic rates establish how much reclaimed water can be applied based on the water uptake needs of the plants being irrigated); these rates would allow little or no irrigation during winter, and storage facilities would be provided to hold the excess reclaimed water in winter.
- **Slow infiltration**—Reclaimed water would be land applied at agronomic rates, or for infiltrating to the aquifer through the soil. Application would be through a subsurface drainfield or network of drip emitters. Application rates would be at levels higher than agronomic rates, and winter storage might not be required above a minimum level.
- **Surface percolation**—Reclaimed water would be land applied to a system for infiltrating to the aquifer through the soil. Application would be through open surface percolation basins. Application rates would be at levels much higher than agronomic rates, and winter storage would not likely be required above a minimum level.
- **Wetlands application**—Reclaimed water would be land applied to natural or man-made wetlands, either above the ground or subsurface. Winter storage would not likely be required above a minimum level.
- **Direct aquifer recharge**—Reclaimed water would be applied directly into the aquifer using injection wells. Winter storage of reclaimed water might not be required above a minimum level.
- **Industrial reuse**—Reclaimed water would be used by industry for various purposes, including cooling water and process water. Generally, much of the reclaimed water would have to be further reused or disposed of after industrial usage.

It should be noted that "slow infiltration" does not strictly follow the language of the *Water Reclamation and Reuse Standards*. It is similar to seasonal irrigation, except that reclaimed water is applied just below the ground surface and at higher than agronomic rates. It is also similar to surface percolation, except that reclaimed water is applied just under the ground surface, instead of through open percolation basins. It is somewhat similar to direct aquifer recharge, except that the reclaimed water is applied just below the surface, instead of directly to the aquifer at depth. For the purposes of this report, "slow infiltration" will be grouped in a similar category to surface percolation. However, if slow infiltration is selected as a recommended strategy, the particular treatment requirements (which are discussed in Chapter 7) must be finalized through discussions with the Departments of Health and Ecology.

Two of the identified reuse strategies—seasonal irrigation with off-season storage and industrial reuse—would benefit the island's potable water supply by providing an alternate source of water for non-potable uses. The slow infiltration, surface percolation, wetlands application, and direct aquifer recharge strategies would benefit the water supply by helping to recharge to the groundwater aquifer.

Initial Screening of Potential Strategies

Seasonal Irrigation with Off-Season Storage

This approach has been used successfully by HHSD for several years. This strategy was short-listed for further evaluation.

Slow Infiltration

This approach may be feasible, depending on the hydrogeologic evaluation of the local area. This strategy was short-listed for further evaluation.

Surface Percolation

This approach may be feasible, depending on the hydrogeologic evaluation of the local area. This strategy was short-listed for further evaluation.

Wetlands Application

This approach may be feasible, depending on the hydrogeologic evaluation of the local area, as well as the presence of local wetlands or areas that could be constructed into wetlands. This strategy was short-listed for further evaluation.

Direct Aquifer Recharge

Year-round application via direct injection wells would be a difficult strategy to implement on the island. Stringent treatment requirements for direct injection into a potable aquifer, including secondary treatment, enhanced disinfection, filtration, nitrogen reduction, and reverse osmosis, would make the treatment process quite complex. In addition, the aggressive (corrosive) nature of reverse-osmosis-treated water would likely require corrosion control treatment to protect piping, valving, and fittings in addition to well casings and screens.

In addition, the soil matrix may react poorly to water low in dissolved salts. In some cases, corrosive water can leach salts out of the soil matrix, plugging the soil matrix and reducing the permeability of the soil.

Even with an extremely high level of treatment, public opposition to discharging reclaimed water directly into the source of drinking water supply would likely be too significant to overcome. Therefore, this strategy was not shortlisted for further consideration.

Industrial Reuse

Like irrigation, the industrial reuse strategy reduces demand on the potable water supply by providing an alternative water source for a non-potable use. Opportunities for industrial process use in the area are limited, though. The largest industrial water user in the area is Nichols Brothers Boat Builders, whose water use is less than the design flows. Additionally, once reclaimed water is used at an industrial site, it must still be sent to a land application or water-based site. Therefore, industrial reuse could be explored as a subset of an overall strategy, but not as the entire end-use strategy. It was not short-listed for further evaluation.

DESCRIPTION OF SHORT-LISTED REUSE ALTERNATIVES

Seasonal Irrigation with Off-Season Storage

Irrigation reuse systems are sized to apply reclaimed water at the uptake rate of grasses, crops, or other vegetation (the agronomic rate). Reuse for irrigation has the aesthetic benefit that the land application location can be a vegetated area that looks like natural land, such as pasture, cropland, park, or golf course. HHSD has been using this approach successfully to irrigate the Holmes Harbor Golf Course (see Figure 6-1).

Figure 6-1. Holmes Harbor Sewer District's Seasonal Reclaimed Water Storage Basins and Summertime Golf Course Irrigation

Agronomic-rate irrigation can be implemented using surface irrigation or subsurface drip emitters. Drip emitter systems avoid the potential for human contact with reclaimed water because the distribution network is fully underground. Drip emitter systems can also be used on more sloped terrain than surface irrigation systems. However, drip emitter systems generally have higher capital and O&M costs than surface irrigation systems. The higher costs are due to the more complex systems, with an extensive network of drip emitters that are more sensitive to plugging than surface irrigation fittings.

During the non-irrigation season, rainfall and the groundwater table limit the agronomic uptake rate, so little or no irrigation can be performed. Reclaimed water must be stored in

holding basins. At HHSD, storage basins are sized to store approximately seven months of reclaimed water.

Water Quality Requirements

Per the *Water Reclamation and Reuse Standards*, Class A reclaimed water would be required for golf course irrigation. For irrigation of other areas, such as crops, the reclaimed water quality requirements vary (from Class D through Class A), depending on the type of land or crop to be irrigated and the desired setback requirements.

Hydraulic Application Rate

Application rates of reclaimed water would be limited to the agronomic and hydraulic uptake of the vegetation on the application site. A typical application rate can be expressed in terms of gallons per day per square foot (gpd/sf) of application area.

A typical application rate for lawns is one inch per week, which converts to approximately 0.09 gpd/sf. The actual application rate would need to be verified as part of design efforts. For comparison, the HHSD system is designed for an application rate in the same range. It is designed to irrigate approximately 55 of the golf course's 65 acres. At HHSD's design average annual flow capacity of 100,000 gpd, assuming five months of irrigation, the application rate is approximately 0.1 gpd/sf. Of course, this is an oversimplification of the water balance calculations that account for daily, weekly, and seasonal variations in irrigation requirements.

With a STEP collection system, the projected average annual flow for Freeland for Phase 4, the NMUGA low population growth phase, is 0.29 million gallons per day (mgd). The projected annual average flow for Phase 5, the NMUGA high population growth phase, is 0.50 mgd. For these flows, and using a hydraulic application rate of 0.1 gpd/sf over a five-month irrigation period, the required application area would be about 160 acres for Phase 4 and 280 acres for Phase 5.

In addition to the actual irrigated area, minimum setback distances or buffers are identified in the *Water Reclamation and Reuse Standards.* These are dependent on the level of treatment and application rate. Operations and maintenance access, including access roads, would require additional area.

Storage Requirements

Assuming a five-month irrigation period, seven months of storage would be required, which amounts to 60 million gallons for Phase 4 and 105 million gallons for Phase 5. Storage would likely use earthen basins, similar to HHSD's system. Storage might be required to be lined. Assuming a basin depth of 20 feet with 2 feet of freeboard, an earthen basin with sloped sides (to minimize construction costs) would require a surface area of about 20 acres for Phase 4 and 35 acres for Phase 5, including the earthen dikes. This storage would meet the *Water Reclamation and Reuse Standards'* requirement for "alternative storage."

Wintertime storage facilities require some means to divert flow into the basin (for storage) and out of the basin when storage is not needed. Flow diversion can be accomplished by gravity, by pumping, or by a combination of the two.

In addition, per the *Water Reclamation and Reuse Standards*, emergency storage is required in case of plant upsets. Depending on the degree of redundancy in the treatment plant, either short-term or long-term emergency storage is required. Long-term storage is provided for all of the alternatives in this chapter, since additional storage is often less expensive to construct than additional treatment plant redundancy.

20 days of long-term emergency storage is included in this alternative. Emergency storage basins should be lined. To be conservative, peak-month flows should be used instead of average annual flows. Assuming a basin depth of 20 feet with 2 feet of freeboard, an earthen basin with sloped sides would require a surface area of approximately 4 acres for Phase 4 and seven acres for Phase 5, including the earthen dikes.

In general, emergency storage facilities are assumed to include flow diversion and pump-back facilities, so that stored water can be pumped back to the treatment plant for additional treatment.

Potential Sites

County staff performed a search of parcels in the vicinity to identify applicable sites. The number of sites with this amount of open acreage is limited. There is a former tree farm west of Highway 525, approximately 2 miles from the Freeland service area, that could be used for this purpose. There may also be adequate acreage immediately west of the Holmes Harbor Golf Course.

Summary

If adequately-sized areas can be located for off-season storage and irrigation, this alternative would be feasible. However, relatively large areas are required for both storage and irrigation.

If suitable sites are identified, to simplify the analysis, only one irrigation method will be considered. If the site(s) are relatively flat in slope, surface irrigation will be evaluated instead of subsurface drip irrigation due to its lower cost. If the site has too much slope to accommodate surface irrigation, subsurface drip irrigation will be evaluated. Both systems can be analyzed in greater detail during preliminary design if this strategy should be selected for implementation.

Slow Infiltration

Subsurface slow rate infiltration has not been widely used for wastewater systems in communities as large as Freeland. Slow rate infiltration land-applies reclaimed water year-round using subsurface drainfields or drip absorption (see Figure 6-2). During irrigation season, a portion of the reclaimed water would be taken up by the agronomic needs of the applied area. At other times, the reclaimed water would percolate downward, eventually reaching the groundwater. Drainfields of the size required are difficult to construct properly. The subsurface drip absorption system is easier to construct and can be adapted to variable terrain more easily.

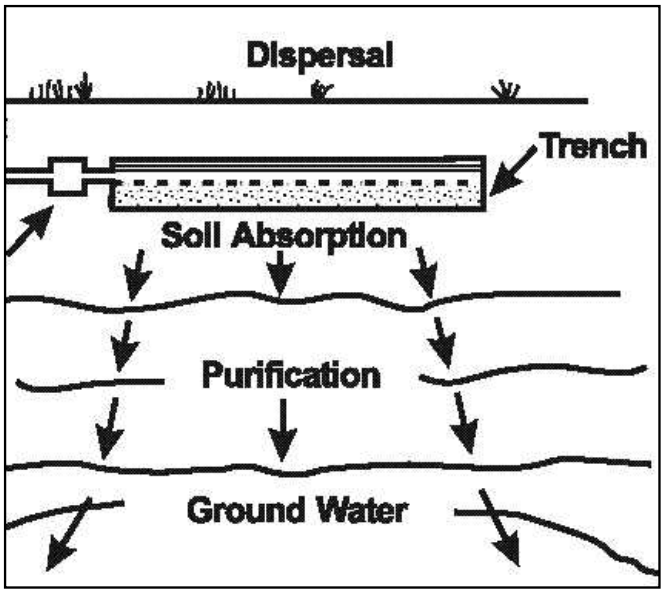


Figure 6-2. Slow-Rate Infiltration – General Schematic

Water Quality Requirements

Per the *Water Reclamation and Reuse Standards*, Class A reclaimed water would be required. Since the application rate is in excess of agronomic rates, a nitrogen reduction step might be required. This strategy is not clearly addressed in the standards, so specific water quality requirements should be discussed with the Departments of Ecology and Health if this strategy is selected.

Hydraulic Application Rate

Application rates for drip soil absorption vary considerably, depending on the type of soil. Typical application rates for clayey soils can be as low as 0.1 gpd/sf, while application rates for well-draining coarse sands can be as high as 2 gpd/sf.

An initial assumption is an application rate of 0.5 gpd/sf; this rate would need to be verified as part of the design. Since this is a year-round land application strategy, maximum-month flows should be used for conservative sizing (instead of average annual flows). With a STEP collection system, the projected maximum month flow is 0.41 mgd for Phase 4 and 0.68 mgd for Phase 5, requiring an application area of 20 acres and 30 acres, respectively. Operations and maintenance access, including access roads, would require additional area.

Storage Requirements

Per the *Water Reclamation and Reuse Standards*, emergency storage is required in case of plant upsets, and wintertime ("alternative") storage is required in case severe storms prevent land application strategies from working properly. Per discussion earlier in this chapter, 20 days of long-term emergency storage is included in this alternative. A minimum of three days of winter storage is also required. Both storage basins would be sized for

maximum-month flows as a conservative assumption. The emergency storage basins should be lined, but the winter storage basins would not need to be.

The space requirement for emergency storage would be the same as for the seasonal irrigation strategy: 4 acres for Phase 4 and 7 acres for Phase 5, including the earthen dikes. Winter storage would require a surface area of approximately 1 acre for Phase 4 and 2 acres for Phase 5, including the earthen dikes.

Potential Sites

County staff, Tt/KCM, and HWA GeoSciences evaluated sites for this land application strategy, based on available acreage, hydrogeological information, and hydrogeological field investigations. Several sites were identified, including the two described in the discussion of seasonal irrigation, as well as an approximately 100-acre parcel immediately southwest of the Freeland NMUGA, across Highway 525. Specific sites are discussed in detail in Chapter 8.

Summary

If adequately-sized areas can be identified, this alternative would be feasible. Proximity to public drinking water wells and other sensitive groundwater areas should be considered, since the land application rates would seasonally be in excess of agronomic rates.

Surface Percolation

Surface percolation would enhance the island's water supply by sending reclaimed water to open percolation basins. The reclaimed water would then infiltrate into the soil, eventually reaching and recharging the groundwater, providing a beneficial reuse of the reclaimed water. The percolation basins are often a series of unlined earthen basins that are cycled alternately empty and full (see Figure 6-3).

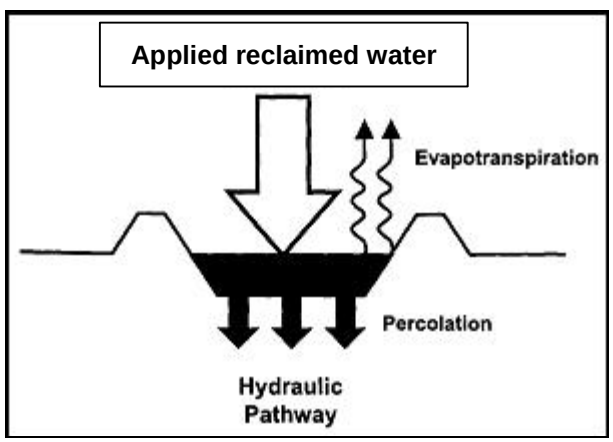


Figure 6-3. Surface Percolation General Schematic

Water Quality Requirements

Per the *Water Reclamation and Reuse Standards*, Class A reclaimed water would be required. A nitrogen reduction step would also be required.

Hydraulic Application Rate

Application rates for surface percolation vary considerably, depending on the type of soil. Typical application rates can range from as low as 1.4 gpd/sf to as high as 8.0 gpd/sf. Ideally, this alternative would be contingent upon finding a site with very well drained soils, to maximize the hydraulic application rate. The site would ideally also be located relatively far away from public drinking water wells, since some of the reclaimed water would percolate to the groundwater table.

An initial assumption is an application rate of 4.0 gpd/sf; this rate would need to be verified as part of the design. Since this is a year-round land application strategy, maximum-month flows should be used for conservative sizing (0.41 mgd for Phase 4 and 0.68 mgd for Phase 5). The resulting application area requirement is about 3 acres for Phase 4 and 4 acres for Phase 5. Operations and maintenance access, including access roads, would require additional area.

Storage Requirements

Storage requirements for this strategy would be the same as for the slow infiltration strategy. Long-term emergency storage, including earthen dikes, would need 4 acres for Phase 4 and 7 acres for Phase 5. Winter ("alternative") storage, including earthen dikes, would need 1 acre for Phase 4 and 2 acres for Phase 5.

Potential Sites

Potential sites identified for this strategy are the same as those identified for the slow-infiltration strategy.

Summary

This strategy requires the smallest area for a land application site. However, because the relatively high recharge rate corresponds to the most direct linkage between reclaimed water and the groundwater aquifer, this strategy would likely require the most hydrogeological analysis for water quality effects. Hydrogeological analyses may be required both before and after implementation of the alternative.

Wetlands

Wetlands are areas where the water surface is close to the ground surface for enough of the year to maintain saturated soil conditions and promote growth of vegetation. Application of reclaimed water can be to existing (natural) wetlands, or constructed wetlands. There are two types of constructed wetlands, free water surface wetlands consisting of a relatively shallow channel along which the wastewater flows (see Figure 6-4) and subsurface flow wetlands consisting of a layer of permeable media through which the wastewater flows. Both systems use emergent aquatic vegetation that assimilates water through evapotranspiration, promotes microbial growth, and takes up nutrients and other constituents in the reclaimed water.

Figure 6-4. Constructed Wetlands Demonstration Project in Stanwood, Washington

Water Quality Requirements

The state's rating system for wetlands (*Washington State Wetlands Rating System for Western or Eastern Washington)* defines four categories based on a combination of rarity, irreplaceability, sensitivity to disturbance, and habitat functions. Category 1 wetlands are the highest quality, while Category 4 wetlands are the lowest quality.

According to the *Water Reclamation and Reuse Standards*, application of reclaimed wastewater to natural wetlands is acceptable for Category 2 through 4 wetlands, contingent upon meeting criteria for quality, monitoring, and environmental studies. However, Island County Planning staff has indicated that most, if not all, of the natural wetlands in the Freeland area are Category 1 wetlands. Therefore, application of reclaimed wastewater to natural wetlands is not an option. Constructed wetlands will be developed as the only alternative for application to wetlands.

According to the *Water Reclamation and Reuse Standards*, application to wetlands requires a different set of quality requirements. Instead of Class A reclaimed water, the reclaimed water would have to meet more stringent BOD and TSS levels of 20 mg/l (versus 30 mg/l for Class A reclaimed water). Additionally, there would be limits for total nitrogen and phosphorus. These issues are discussed in Chapter 7.

Hydraulic Application Rate

Application rates for wetlands depend on hydrogeologic conditions, plant uptake rates, and weather. Typical application rates can range from as low as 0.5 gpd/sf to as high as 1.4 gpd/sf.

An initial assumption is an application rate of 0.75 gpd/sf, which would need to be verified as part of the design. The resulting application area requirement is about 9 acres for Phase 4 and 15 acres for Phase 5.

To minimize impacts on the wetlands, reclaimed water would have to be distributed as uniformly as possible along the upstream side of the wetland. However, this would also be the most expensive method of reclaimed water distribution. During dry-weather months, there would be relatively little flow through the wetland. As a result, the reclaimed water would receive very little dilution. If this alternative is selected, the following issues would require further investigation:

- The hydrology of the wetland would have to be established so that the reclaimed water plume and the impact on the wetland's hydroperiodicity could be estimated.
- Impacts of wetland application on water quality in the area might have to be modeled.
- The impact on the wetland vegetation of the additional nutrients from the reclaimed water would have to be modeled.

Storage Requirements

Per the *Water Reclamation and Reuse Standards*, emergency storage is required in case of plant upsets. 20 days of long-term storage is included in this alternative. However, depending on Ecology's opinion, since the wetlands provide some treatment capacity in addition to their function for land application, the storage requirement might be able to be relaxed. This would have to be checked with Ecology. For the 20-day sizing, the required surface area, including earthen dikes, would be the same as for the strategies previously described (about 4 acres for Phase 4 and 7 acres for Phase 5). Required winter storage volume and area would be the same as for the slow infiltration and surface percolation strategies (1 acre for Phase 4 and 2 acres for Phase 5).

Potential Sites

Potential sites identified for this strategy are the same as those identified for the slow infiltration and surface percolation strategies.

Summary

If adequately-sized areas can be identified, this alternative would be feasible. This strategy requires a relatively small area for a land application site. Based on regulatory requirements, relatively extensive hydrogeological and wetlands ecology and hydrology analyses could be required, perhaps both before and after implementation of the alternative.

ANALYSIS OF SHORT-LISTED REUSE ALTERNATIVES

All four short-listed beneficial reuse strategies could be used for Freeland:

- Seasonal irrigation with off-season storage could be pursued if relatively large amounts of land can be purchased. This strategy requires the least amount of hydrogeological analysis due to its low application rate.
- Slow rate infiltration is feasible, but requires the second-highest amount of land of the short-listed alternatives. It would also likely require additional hydrogeological studies, since there would be seasonal land application in excess of agronomic rates.
- Surface percolation would require the least amount of land. However, it would likely require the most detailed hydrogeological studies of these alternatives based on its relatively high hydraulic application rate. If a suitable site can be identified, and hydrogeological analyses can be performed to meet regulatory requirements, this alternative would be the least expensive strategy.
- Application to constructed wetlands requires relatively little land based on its relatively high hydraulic application rate. However, significant hydrogeological analyses, wetlands ecology analyses, and hydrological studies would be required.

Phasing

For any reuse strategy, the most important goal is to identify enough land to meet ultimate buildout conditions. The site can be planned so that enough capacity for the initial service population can be constructed first, with later phases to address future capacity.

The two phasing considerations would be storage and land application. Storage can be phased by adding a single storage basin at first, followed by basins of varying size as needed. Another approach is to build fewer basins because larger basins better capture an economy of scale. However, this second approach would result in overcapacity at times. Similar considerations apply to development of land application areas.

Cost

Costs were estimated for the reuse alternatives using the assumptions described in Chapter 5. A detailed breakdown of the estimates is attached in Appendix I.

Costs were developed for the ultimate buildout condition, since enough land should be set aside to accommodate the maximum capacity of the system. Phasing of alternatives was estimated using planning projections and estimates of potential phases of implementation.

Figure 6-5 shows the results of the cost analysis for the reuse alternatives in a graphical form. It shows estimated capital and present worth costs in terms of cost per Equivalent Residential Unit (ERU). Recall that as described in Chapter 4, an ERU is the equivalent of a single family household. Each ERU is estimated as approximately 140 gallons per day (gpd) on an average basis, not including inflow and infiltration (I/I) flows.

Each set of five bars represents one of the four alternatives. In each set of five bars, the left bar represents Phase 1 and the right bar represents Phase 5.

Capital costs are divided into "conveyance, storage, and reuse" and "land." "Conveyance, storage, and reuse" refers to land application facilities, storage basins, and piping and pumps required for transmission from the treatment plant to land application sites. Costs for monitoring wells were also included. "Land" refers to the cost of purchasing property for land application, including buffer areas around the land application site.

For this preliminary analysis, it was assumed that the land required would be purchased as needed. While this strategy reduces up front costs, it also assumes the risk that in the future, land will not be available when it is needed. In later chapters, the effect of purchasing all the land up front is examined.

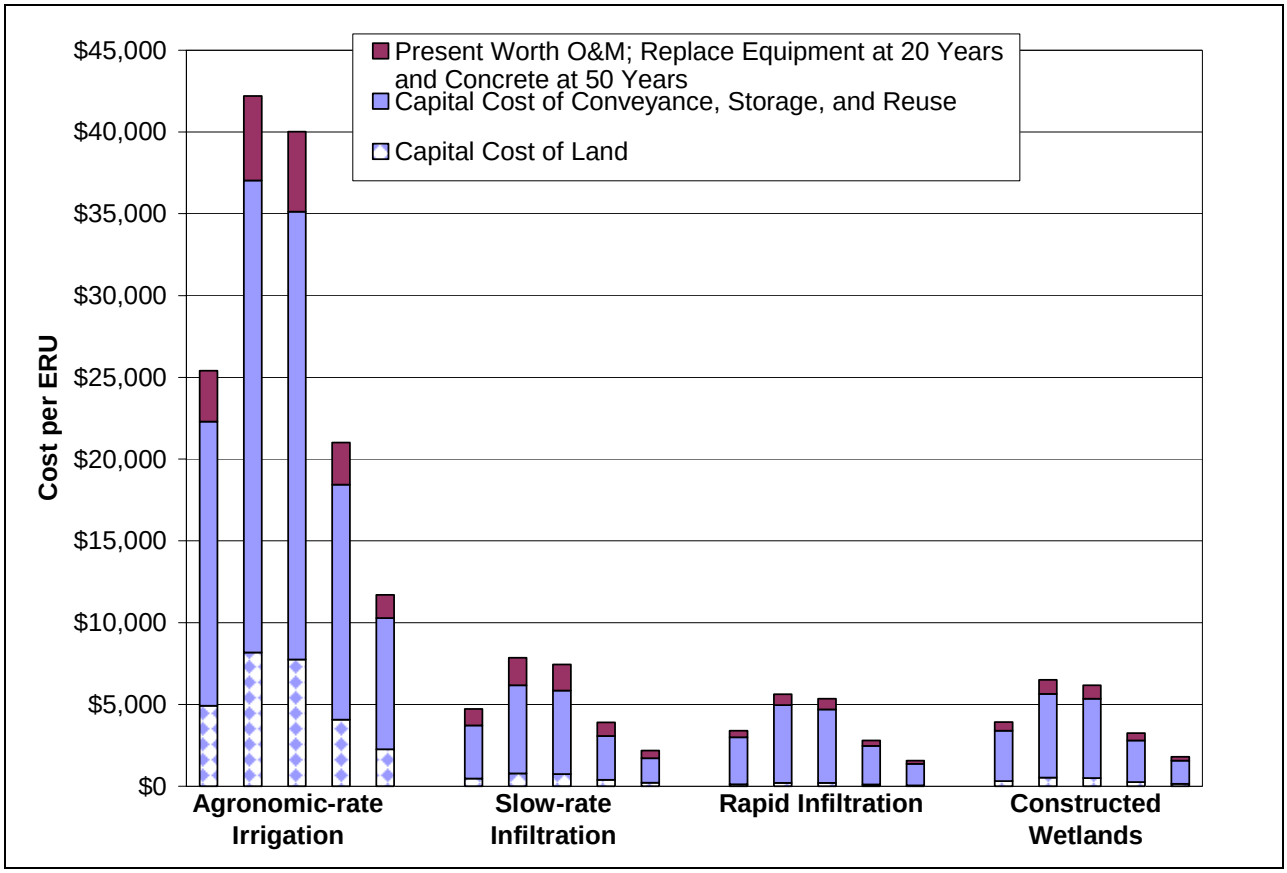


Figure 6-5. Estimated Costs of Reuse Alternatives (per ERU)

Figure 6-5 shows that agronomic-rate irrigation has a much higher present worth cost than the other alternatives. Thus, agronomic-rate irrigation should not be further considered due to its high cost, as well as the factors described previously in this chapter. The other three alternatives have relatively comparable capital and total present worth costs.

The cost analysis in this chapter was based on conceptual planning-level estimates. In Chapters 8 and 9, more detailed costs for the recommended alternative are presented as part of the overall recommendation.

Note that the more detailed costs shown in later chapters used slightly different assumptions than the analysis presented in this chapter. These assumptions include

assumed discount and interest rates. This is because the more detailed costs were estimated at a later date.

Hydrogeological Analysis

The Freeland Sub-Area Planning Committee, when presented with this analysis, asked for preliminary hydrogeological field work be performed to obtain a better sense of planning-level infiltration rates.

Chapter 8 describes the hydrogeological field work and analysis performed, including site visits and field work performed at the three potential land application sites. The hydrogeological analysis allowed for a better understanding of site-specific soils and hydrogeology.

RECOMMENDATION

At a May 15, 2003 meeting, the Freeland Sub-Area Committee was supportive of slow-rate infiltration, surface percolation, and constructed wetlands. However, since constructed wetlands are more considered for use in treatment and could require significant wetland and hydrologic studies, constructed wetlands should not be further considered. Therefore, slow-rate infiltration and surface percolation are recommended for further consideration, subject to the results of the field hydrogeological investigation described in Chapter 8.

Also, specific design of any such systems would be designed around results of a detailed hydrogeologic and water quality study, to be performed during later predesign efforts.

CHAPTER 7.
WASTEWATER TREATMENT ALTERNATIVES

This chapter evaluates wastewater treatment alternatives according to qualitative factors and present worth cost. Because the short-listed discharge and reuse alternatives described in Chapter 6 all involve reuse of effluent through land application, Washington State reclaimed water standards are assumed to apply for all treatment alternatives.

Due to the number of alternatives and the scope of this analysis, planning-level design data is only briefly described in this chapter; design data is included in Appendix K.

The general approaches considered for wastewater treatment are treatment at the Holmes Harbor Sewer District's (HHSD) treatment plant or construction of a new treatment plant for Freeland.

TREATMENT AT HOLMES HARBOR SEWER DISTRICT PLANT

A treatment partnership between Freeland and the HHSD offers the potential benefit of reducing capital and O&M costs per unit of treatment capacity. Connection costs and user charges for use of this facility would depend on negotiations with HHSD. To reach the HHSD treatment plant, Freeland wastewater would have to be pumped from a lowest elevation of near sea level, up to approximately 250 feet (the approximate elevation of the HHSD treatment plant).

The HHSD does not need any facility upgrades to meet its current and planned needs. District representatives have indicated a willingness to upgrade the treatment plant to accommodate Freeland's sewage, as long as Freeland bears all of the additional capital and O&M costs. If the HHSD treatment plant is upgraded to a different process, a majority of the existing basins, buildings, and mechanical systems could be utilized. However, Freeland would be expected to bear the cost of all new treatment equipment and facilities, including the cost of equipment and facilities that would meet HHSD's capacity requirements.

HHSD's existing treatment process consists of sequencing batch reactors (SBRs), post-SBR flow equalization, effluent filtration with a shallow bed media filter, and chlorination. Reclaimed water is stored in storage ponds on site throughout the rainy months. During irrigation season, reclaimed water is used for irrigation throughout the Holmes Harbor Golf Course.

HHSD has indicated that upgrading the plant to meet Freeland's capacity requirements would require the conversion of one or more SBR basins to the membrane bioreactor (MBR) process because the plant site is not large enough to accommodate Freeland's ultimate capacity using SBR technology. MBR technology is a more space-efficient technology.

For initial phases of the conversion from SBR to MBR, membrane cassettes would be set into one or more SBR basins to serve as clarifiers. The cassettes would contain membranes to serve as a barrier to solids. Either gravity flow or a slight vacuum would draw effluent through the membranes. The aeration system would require upgrading to meet additional

capacity requirements. Larger aeration blowers would be required, and more diffusers would be required in the basins. Because membranes do not handle peak flows well, one or more treatment tanks would require conversion into pre-equalization basins or a new basin would have to be added. In future phases, additional membrane basins and pre-equalization basins would be required.

Part of the HHSD system is served by grinder pumps (the rest is served by STEP pumps and septic tanks), and hairs and other fibrous materials passed by the grinder pumps tend to bind the membranes in an MBR, preventing their normal operation. To address this, an influent screen would be required to remove the hairs and fibrous material before they reach the membranes. HHSD anticipates that grinder pumps will comprise a larger portion of its system (up to an estimated 40 percent) as the number of hookups increases. The influent screen should be sized to remove materials 2 to 3 mm or larger. Screens typically capture organic material in addition to hairs and other fibrous materials, and mechanical odor control equipment would likely be required to minimize odors from the organic material.

The current HHSD plant discharges through a force main directly into the SBR basins. This setup is not compatible with influent screens, which typically use open-channel flow to make removal of screenings easier. Therefore, the current influent force main would discharge into a new open channel containing the new influent screen. Depending on its elevation, flow could either discharge to the MBR basins by gravity or be pumped to the MBR basins using new influent pumps.

The HHSD plant also would require an upgrade of its disinfection system. The plant uses liquid hypochlorite for disinfection. A disinfection contact chamber is used to provide contact time between the hypochlorite and the effluent. A larger contact chamber would be required. Ecology's basic requirements for treatment plants are for a minimum detention time of 20 minutes at peak flows and 60 minutes at average flows. Furthermore, for reclaimed water facilities, 30 minutes of contact time are required for peak flows.

These requirements correspond to a total chlorine contact chamber volume requirement of 17,500 gallons for the 20-year planning scenario (Phase 4) and 29,000 gallons for the buildout scenario (Phase 5). In comparison, the current HHSD chlorine contact chamber holds 6,280 gallons. Additional hypochlorite storage and feed facilities would also be required.

NEW TREATMENT PLANT ALTERNATIVES

Construction of new treatment facilities to accommodate the design flows and loads would provide greater autonomy but potentially at a higher cost. Purchase of a treatment plant site and construction of new treatment facilities may be expensive, and operations and maintenance would be more expensive than if they were combined with HHSD.

As part of the discharge and reuse analysis in Chapter 6, County staff identified several potential locations for a new treatment plant. Important issues considered in the site evaluation were accessibility, proximity to the service area, proximity to a point of discharge, distance from higher-density residential areas, and the presence of wetlands or other environmentally significant features.

A new treatment plant to treat Freeland's wastewater could require preliminary treatment (headworks), secondary treatment, advanced treatment to reclamation standards, disinfection, and solids management.

Headworks

Headworks facilities remove fine to coarse debris from wastewater flow to protect downstream equipment. Headworks facilities also allow more efficient treatment by downstream unit processes. Since Freeland has selected a septic tank effluent pump collection system, minimal headworks facilities will be required. In a STEP collection system, most of the settleable solids, rags, and other debris settles out in individual septic tanks. Several agencies with STEP collection systems, including HHSD and the City of Yelm, have treatment plants without headworks. However, some basic functions often provided at headworks, such as influent flow measurement and sampling, should be retained. Headworks facilities that would be suitable for a STEP system include the following:

- An influent flow meter to monitor influent wastewater flows.
- A sewage sampling system located near the flow meter to provide flow-paced or time-composite sampling; sampling requirements for influent flows would depend on the waste discharge permit, but would most likely include weekly BOD and TSS analyses.

Similar facilities will be required on the downstream end of the plant, for regulatory compliance purposes. The influent flow measurement facilities would be sized for the design peak-hour flow.

Odor control facilities would not be required at the headworks, since influent flow will be discharged directly into the secondary treatment process basins. Pressurized discharge into a full basin will minimize odors due to the water in the basin.

Secondary Treatment

Reuse systems must meet Class A treatment standards, as defined by the Departments of Health and Ecology in the *Water Reclamation and Reuse Standards*. Reclaimed water standards vary depending on the type of end-use and the potential for human contact with the reclaimed water. The requirements vary from Class A (highest quality) to Class D (lowest quality). Table 7-1 summarizes the basic requirements.

In addition to basic requirements, a nitrogen reduction step is required for beneficial-use land-application in excess of agronomic uptake rates, such as via surface percolation. Nitrogen reduction entails nitrification, the conversion of ammonia-nitrogen to nitrite-nitrogen and nitrate-nitrogen, and denitrification, the conversion of nitrate-nitrogen to nitrite-nitrogen and to nitrogen gas. For surface percolation facilities, nitrate levels must be reduced to 10 mg/l and nitrite levels reduced to 1 mg/l. These levels are based on the federal primary standards for drinking water.

If reclaimed water is discharged to wetlands, a different set of requirements applies. Reclaimed water would have to meet Class A, B, C, or D standards depending on the

potential for human contact or beneficial uses. Additionally, reclaimed water would have to meet more stringent BOD and TSS limits (a maximum of 20 mg/l). Under wetland nutrient limits, effluent nitrogen would be limited to 3 mg/l, and effluent phosphorus would be limited to 1 mg/l.

TABLE 7-1.
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

An initial review resulted in elimination of the following commonly used treatment options because they could not provide treatment to meet these standards:

- Facultative lagoons or stabilization ponds and aerated lagoons use large, open, earthen lagoons to store wastewater, provide aeration, and settle solids. These systems cannot consistently meet the TSS standards due to high levels of algae in their effluent. They also cannot provide consistent nitrogen reduction.
- Constructed wetlands, although they may be able to meet anticipated regulatory standards, require a large land area. Tt/KCM experience has been that they can only meet BOD, TSS, and nitrogen reduction requirements at relatively low loading rates. However, constructed wetlands could provide polishing treatment after all standards have been met.
- Fixed-film (or attached growth) processes use an inert media as attachment sites for growth of microorganisms that convert organic material in wastewater into biological cell matter. This type of system includes trickling filters, rotating biological contactors, and biofilters. Although fixed-film processes can meet the BOD and TSS requirements, their effluent is difficult to filter to an acceptable turbidity. In addition, fixed film processes are not able to meet nitrogen reduction requirements without supplemental treatment. Finally, the additional odor control required for fixed-film processes makes them less suitable for this project.

Suspended growth systems are the only feasible type of treatment for a new Freeland treatment plant. With suspended growth systems, microorganisms responsible for converting organic material in wastewater into biological cell matter are developed and kept in suspension in an aerated basin. These systems generally have high quality effluent and limited odor problems but require a high level of operation and maintenance.

Extended aeration activated sludge is the most common suspended growth system for smaller communities. Extended aeration activated sludge is a generic classification for systems that use aeration basins and clarifiers to aerate wastewater, convert waste organics into biomass, and remove solids from wastewater. These systems operate similarly to conventional activated sludge systems (such as those used for large cities) except that they have aeration basins with relatively long hydraulic retention times of 18 to 48 hours and relatively long solids retention times of 15 to 30 days or more.

The long residence times are designed so that the process operates in the endogenous respiration phase of the microbiological growth curve. This process minimizes costs by holding the solids in the system as long as possible to maximize their oxidation. The longer retention times make these systems easier to operate and more reliable than conventional activated sludge systems and provide consistent ammonia reduction. Properly designed and operated extended aeration activated sludge systems generally provide excellent treatment consistently achieving BOD/TSS/ammonia concentrations of 10/10/1 mg/l.

Common aeration basin configurations for the extended aeration activated sludge process include package extended aeration plants, oxidation ditches, and sequencing batch reactors (SBRs). These configurations require effluent filters downstream to meet Class A quality standards. Membrane bioreactors, which operate at a long sludge age but a relatively short hydraulic retention time of approximately 4 to 12 hours, require no filters.

Package Extended Aeration Plants

Several manufacturers offer pre-engineered, prefabricated package extended aeration treatment plants, which can reduce design and construction costs. Typical package extended aeration facilities include aeration tanks with diffused air followed by secondary clarifiers. Figure 7-1 is a simple schematic of the processes used for these plants.

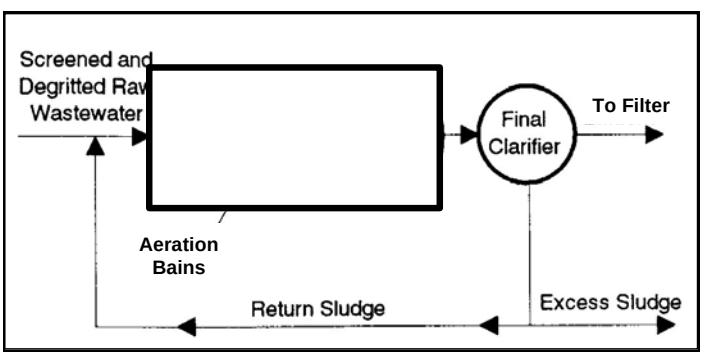


Figure 7-1. Package Extended Aeration Plant Process Schematic

Because these plants are pre-engineered, variations in process design to account for different wastewater characteristics or user preferences are difficult to accommodate. For

example, clarifier sizing is tied to the overall capacity of the plant. If larger clarifiers are desired because of conservatism, local standards, or anticipated poor-settling solids, the whole plant must be upsized.

The diffused air aeration used in package plants can be maintenance-intensive. Fine-bubble diffusers are often used due to their high energy-efficiency. However, they require periodic chemical cleaning with strong acids, which many small communities are reluctant to do. Fine-bubble diffuser systems can raise overall costs because additional building area is needed to house blowers, better upstream treatment is needed to minimize problems with grit, rags or other debris fouling the diffusers, and additional maintenance is required for the floor-mounted diffusers.

To provide nitrogen reduction and enhance sludge settleability, a selector basin would be provided upstream. This selector basin would provide a separate biological environment for the biomass, encouraging denitrification through the presence of an anoxic environment (without oxygen).

To maximize flexibility in process control, the basins would be valved to enable operation in plug flow, step feed, complete mix, or contact stabilization modes.

Sizing and Phasing

A package plant with two aeration basins would be needed to meet initial phasing requirements. Two aeration basins are required to meet Ecology's redundancy requirements. Additional aeration basins can be added later as necessary.

Two clarifiers would be included. Ecology's Orange Book recommends a peak overflow rate of 500 gallons per day per square foot (gpd/sf) for clarifiers following package extended aeration plants. Clarifiers could be sized for flows greater than initial flows, since there is an economy of scale in clarifier construction.

Sequencing Batch Reactor

SBRs are a variation of the activated sludge process that operate in a batch mode instead of a continuous-flow mode. Aeration and secondary clarification occur in the same tank. Two or more parallel basins are required so that influent flows can be treated continuously by this batch process.

Control valves, mixers, aerators, and decanters cycle the wastewater flow through different operational modes within the tanks. Aeration can be in the form of diffused air or jet aeration. The sequential operating modes, which take place in the same basin, include filling, reacting, settling, decanting, and sludge wasting. During the fill phase, the basin is filled with wastewater and aeration begins. Aeration continues through the react phase. The aerators are then turned off and the biomass is settled. During the decant phase, treated effluent is removed from the basin by a decanter. Finally, settled sludge is pumped from the basin for final treatment while the basin waits to receive the next batch of wastewater flow and repeat the cycle of phases. If designed and operated properly, this type of system can remove nutrients such as nitrogen and phosphorus through proper

programming of the batch process. Figure 7-2 shows a simple process diagram and a photo of a typical SBR facility.

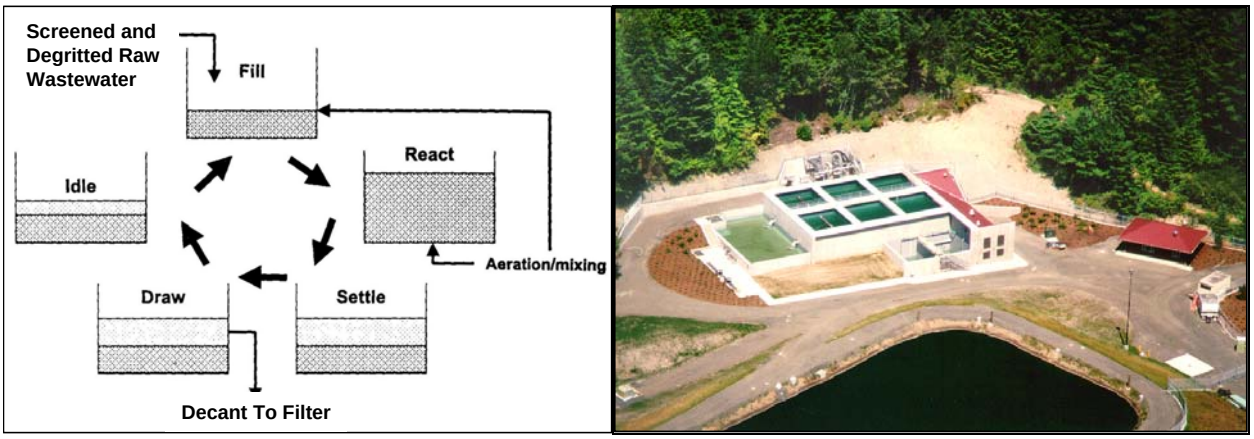


Figure 7-2. Sequencing Batch Reactor Process Schematic and Example Facility in Waldport, Oregon

Because mixed liquor is retained in the reactor during all cycles, separate secondary sedimentation tanks are not required. However, batch treatment operation leads to peaking flows downstream, and these flows would have to be equalized to minimize the size of downstream facilities. Flow equalization would be sized to process decant flows. Tanks would not be allowed to fill and decant simultaneously at high flows.

The control system allows for control over a range of flows; a batch-proportional program is used for low-flow conditions and a flow-proportional program is used for average and peak-flow conditions. SBR systems are computer-controlled and tend to be more complex and mechanically intensive than other extended aeration treatment processes. Variation of the cycles and their timing results in greater operational flexibility to meet different effluent requirements. However, the process is mechanically complex, requiring skilled operators and relatively intensive equipment maintenance.

Sizing and Phasing

An SBR with two basins would be needed to meet initial phasing requirements. Additional SBR basins could be added as needed. Another phasing option would be to construct three basins to avoid the operational difficulty of having only one tank available when one is taken out of service for maintenance. However, constructing three instead of two basins to provide the same total volume would not be very cost-efficient.

Oxidation Ditch

An oxidation ditch uses a long, continuous channel, typically oval or circular, to provide an aerobic environment where oxidation and nitrification occur. This aerobic environment is typically created by low-speed surface aerators that can also serve as mixers.

If nitrogen reduction is desired, separate selector basins are required to create anoxic (absence of oxygen) conditions, with internal recycle from the aerobic basins. A selector basin would also allow for greater control over the settleability of the wastewater.

Clarification is performed by separate clarifiers downstream of the oxidation ditches. Figure 7-3 shows a simple process diagram and a photo of a typical oxidation ditch facility.

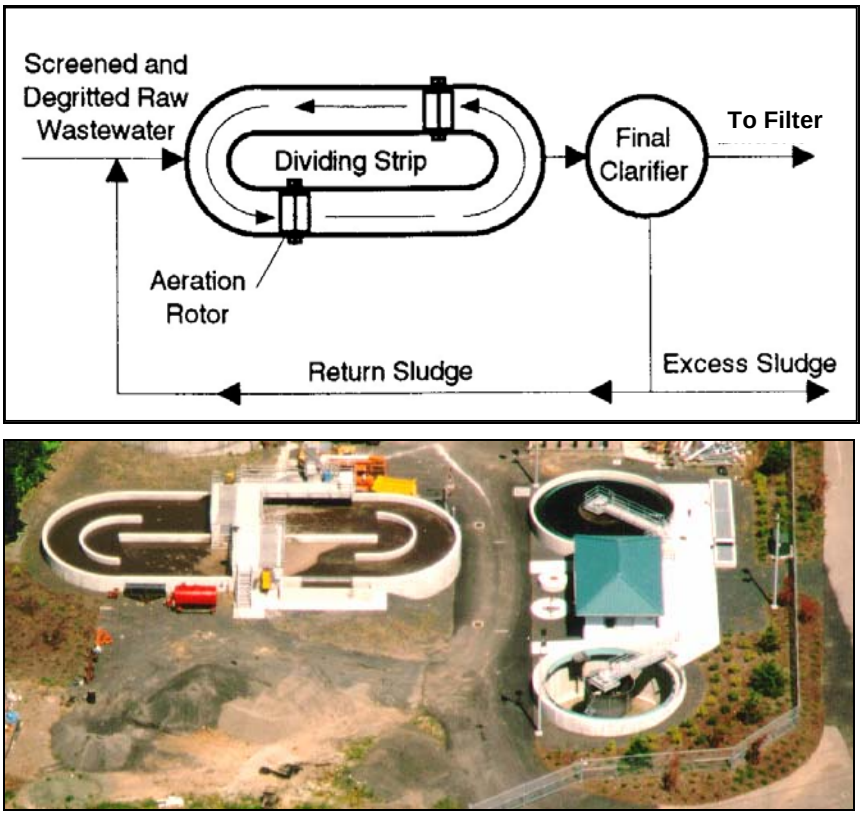


Figure 7-3. Oxidation Ditch Process Schematic and Example Facility in Stevenson, Washington

Oxidation ditches are capable of providing excellent treatment. They are also very simple to operate, not requiring complex computer control of batch cycles. A drawback of oxidation ditches is that they often require more land area than SBRs due to depth limitations. Historically, Ecology has favored oxidation ditches as simple and reliable.

Sizing and Phasing

Two oxidation ditches, for redundancy, would be needed to meet initial phasing requirements. Two clarifiers would also be required for redundancy.

Ecology's Orange Book recommends a peak overflow rate of 700 gpd/sf for clarifiers following oxidation ditches. Clarifiers would likely be sized for flows greater than initial flows, since there is an economy of scale in clarifier construction. Additional oxidation ditches and clarifiers could be added as needed.

The two ditches could be designed for parallel operation, and possibly to allow a range of operating strategies. Another option is series operation, in which one ditch would function as an anoxic reactor for denitrification and alkalinity recovery. A third option is a "peak flow" mode similar to contact stabilization for conventional activated sludge. Decisions on

whether to provide for these or other operating strategies will be made during the design phase of the project.

Membrane Bioreactor

The immersed membrane process is a relatively new technology that has shown good results in pilot plants and a few small treatment plants with flows of less than 1 mgd. The process is a variation of the extended activated sludge process, with membranes immersed in the aeration basins. The membranes replace separate downstream clarifiers. By providing a positive barrier to solids above the 0.1 micron range, the membranes produce an exceptional effluent quality, superior to that of extended aeration activated sludge followed by conventional filtration. Chemical coagulation is likely not required for membrane bioreactors to meet Class A standards. Figure 7-4 shows a simple process diagram and a photo of a typical MBR facility.

In addition to aeration air, coarse bubble diffused air is used to scour the membranes and prevent excessive fouling. Significant quantities of air are required for membrane scouring, usually equaling or exceeding the requirement for aeration air. This can result in significant operating costs, since aeration air is usually the most significant cost of operating a wastewater treatment plant. Back-pulsing with chemical cleansing agents may be required to remove accumulated solids, depending on the type of membranes.

Because the membranes provide a positive barrier to solids, the activated sludge system can operate at very high mixed-liquor suspended solids (MLSS) concentrations, on the order of 10,000 to 15,000 mg/l. Typical extended aeration activated sludge plants operate at MLSS concentrations between 2,000 and 4,000 mg/l. The high MLSS concentrations mean that the plant can run at a low hydraulic retention time and a high solids retention time, significantly reducing the size of the aeration basin compared to typical extended aeration activated sludge plants.

Two types of membranes are available: hollow fiber units composed of a membrane wrapped around a reinforced hollow fiber tube; and flat membrane sheets on top of plastic panels for reinforcement. In either case, wastewater is filtered through the membrane, and filtered effluent passes through the membrane onto the next step of the treatment plant.

Settleability is not a concern with this process due to the membranes' being a barrier to solids. This is a significant advantage over typical activated sludge plants, where the activated sludge biology must be monitored to encourage development of microorganisms that settle quickly in a clarifier basin.

A disadvantage of the MBR process is that the membranes are not well-suited to treating peak flows. Because membrane capacity must be designed for treating peak flows, much of the capacity will not be used until infrequent peak flows occur. In many cases, pre-MBR equalization basins are recommended to equalize peak flows to the MBRs. Alternatively, equalization can be achieved by providing additional freeboard in the membrane basins.

Another disadvantage is the requirement to replace membranes every five to 10 years, depending on the manufacturer. The membranes make up a significant portion of the cost of the facilities, so frequent replacement can translate into high present worth costs.

Addition of an anoxic selector tank upstream of the aeration basins with internal recycle allows for nitrogen reduction.

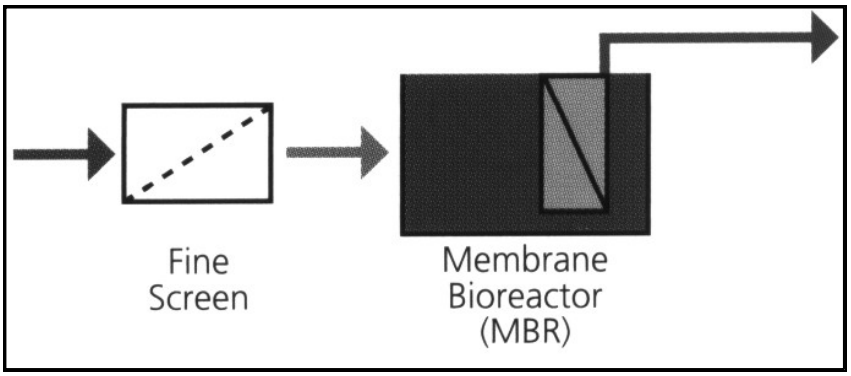


Figure 7-4. Membrane Bioreactor Process Schematic and Example Facility in Bandon Dunes, Oregon

Sizing and Phasing

A significant advantage of the MBR process is its ability to be implemented in phases. It can be constructed in many small increments by adding membrane cassettes as needed. Two new MBR basins with pre-equalization basins would be required initially. Additional membrane cassettes could be added as needed.

Discussion

Phasing is a critical issue for the secondary treatment process. The initial facilities will likely be much smaller than the ultimate buildout capacity or even the 20-year planning period. Phasing is easiest for the MBR alternative. SBRs are the next easiest. Package extended aeration and oxidation ditches are the most difficult for phasing. Since phasing is an very important part of this project, package extended aeration and oxidation ditches are less likely to be cost-effective during the initial phases of the project. In fact, because

package aeration plants are purchased in pre-set incremental sizes, they are not recommended because of that limit on the ability to phase implementation of the project.

Advanced Treatment

Of the four secondary treatment alternatives, only MBRs can achieve Class A effluent quality without further treatment. The other technologies would require supplemental filtration to meet Class A standards. If operated properly, all of the short-listed technologies (with filtration for the package extended aeration, SBR, and oxidation ditch alternatives) would be able to meet nitrogen limits, if required, and phosphorus limits for wetlands discharge. Several types of filters are described below.

Media Filters

The most common type of filter is the rapid rate media filter. There are two types of rapid sand filters: upflow and downflow. Both provide acceptable treatment.

The standard downflow filter consists of a filter bed filled with sand and/or anthracite coal media, a backwash tank and backwash pumps. Water passes downward through the filter bed; solids are trapped in the media, and filtered effluent is collected at the bottom of the filter. When the filter becomes dirty, it is temporarily shut down for a backwash cycle. During backwash, the media bed is fluidized by passing flow up through the bed. Solids are captured by backwash flows, and dirty backwash water is sent elsewhere for further treatment. Downflow filter varieties include conventional filters and traveling bridge filters. Traveling bridge filters have a filter bay that is compartmentalized along with backwashing pumps. A backwash tank is not required. When the filter is dirty, a backwashing cycle begins. During backwashing, only one compartment is backwashed at a time and other compartments continue to provide filtration.

In upflow filters (see Figure 7-5), the water to be filtered passes upward through the filter media, which causes the filter media to be in a constant state of fluidization. Solids are captured in the fluidized media, fall to the bottom of the filter, and are removed using airlift pumps. Media near the top of the filter passes through a washer compartment that assists in the removal of solids. This type of system does not require downtime for backwashing, since captured solids are continuously removed.

In both upflow and downflow filters, the depth of the media can influence the performance of the filter. Some filters have very shallow media beds, in the 12-inch range. Other filters have very deep media beds, as deep as 80 inches.

For both types of filters, a chemical coagulation feed system would be required in addition to flocculation tanks. Chemical coagulants assist in binding solids in the effluent so they can be more easily removed; flocculation provides detention time for the coagulants to bind solids.

Figure 7-5. Continuous Upflow Media Filter

Cloth Filters

The horizontal-flow cloth media filter is a relatively new filter consisting of vertical disks covered with cloth media. Refer to Figure 7-6. Water is passed through the cloth media. When the media clogs with solids, the disks are washed using spray nozzles or by back-flushing. The system allows for very compact installations, since the filter operates horizontally instead of vertically; filter disks can be stacked closely together. This system appears to work adequately on most activated sludge effluent. For effluents that are difficult to filter, such as attached-growth effluent (from trickling filters or rotating biological contactors, for example) and some activated sludge effluents, the thin filter media (equal to the thickness of the filter cloth) is not sufficient to provide adequate treatment.

Chemical coagulation and flocculation tanks are also required for this type of filter; due to the thin cloth media, chemical coagulation is extremely important.

Discussion

A deep-bed continuous upflow media filter is the most expensive of those considered for this report, but it would provide the best effluent quality. Cloth filters are by far the cheapest of those considered, but their performance is likely to be the worst. Cloth filters could be used to save cost, but pilot testing would be recommended to determine if their performance would be adequate. The cost and performance of shallow-bed downflow media filters are likely to be somewhere between those of upflow media filters and cloth filters. However, HHSD has a shallow-bed downflow media filter with flocculation and chemical coagulation, and it has experienced difficulties consistently meeting Class A turbidity requirements. HHSD is examining alternative means of meeting the requirements, including conversion to a deep-bed upflow filter or converting the whole treatment process to an MBR process. Although other municipalities have had more success with shallow-bed downflow filters, based on HHSD's experience, they are not recommended for Freeland.

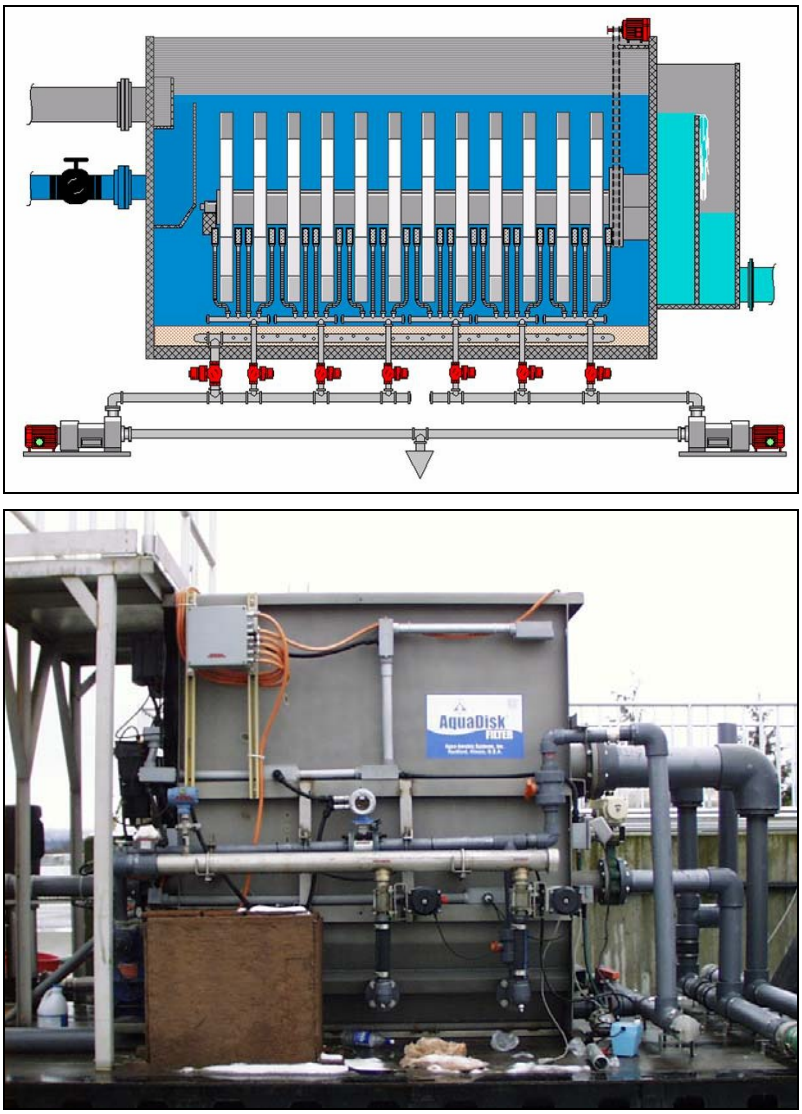


Figure 7-6. Cloth Filter (Schematic Shown Above; Pilot Test Unit Shown Below)

Disinfection

Effluent disinfection prevents the spread of waterborne diseases. The intent of the Class A reclaimed water standards are to produce reclaimed water that is essentially pathogen-free. This entire treatment process is geared towards this goal, with the disinfection step being the final means of achieving this goal.

Two commonly used types of disinfection are chlorination and ultraviolet (UV) radiation. Chlorine directly kills microorganisms through its strong oxidizing power. UV light mutates microorganism DNA, preventing cell reproduction, which effectively kills the microorganism population since the organisms' life expectancies are short.

The *Water Reclamation and Reuse Standards* require that a minimum chlorine residual of 0.5 mg/l be maintained in any distribution piping "from the reclamation plant to the use area," although no chlorine residual is required in final storage ponds or other

impoundments. The advantage of using a chlorine-based disinfection system is that addresses the chlorine residual requirement. However, to provide adequate disinfection, a contact chamber is needed to provide contact time between the chlorine and the effluent. Contact chambers must be sized to provide at least 20 minutes of contact time at peak design flows (30 minutes for reclaimed water facilities) and 60 minutes of contact time at average flows.

Disinfection with UV light has been feasible for many years, but it has only become accepted and economically competitive in the last 10 years. Operation and maintenance generally consist of periodically cleaning and replacing UV bulbs. UV disinfection systems are relatively safe and do not expose the operator to chemicals. UV disinfection requires consistently high effluent quality to guarantee effectiveness. The recommended secondary treatment option would provide adequate and consistent effluent quality for UV disinfection.

The benefit of using a UV system is that much less contact time is required due to the high germicidal efficiency. Contact chambers are sized on the order of seconds of contact time. However, if a UV system were to be used, a supplemental chlorine-based disinfection system would be required to provide a chlorine residual in the distribution system.

Chlorination Using 12-Percent Sodium Hypochlorite

This alternative includes storage and delivery of concentrated (12 percent) liquid sodium hypochlorite, chemical metering pumps, and miscellaneous instrumentation and controls. Liquid sodium hypochlorite solution is available at concentrations of 12 to 15 percent by weight. A 12-percent solution has an equivalent chlorine content of 1 pound of chlorine per gallon of solution. Liquid sodium hypochlorite results in a slight increase in the pH of the finished water. Figure 7-7 shows typical equipment for disinfection using 12-percent sodium hypochlorite.

Figure 7-7. Sodium Hypochlorite Feed Pumps at Vashon Island, Washington (left) and Chlorine Contact Tank at Marysville, Washington

The primary benefit of sodium hypochlorite is that it is a safer system than chlorine gas (which has historically been used due to its low cost) because there is no possibility of a catastrophic release that could harm operators or nearby residents.

The main drawbacks to hypochlorite are its tendency to degrade, which is affected by product concentration, temperature, and exposure to sunlight, and its potential for corrosion of piping systems. Degradation decreases the amount of effective hypochlorite disinfection in the liquid and increases the formation of byproducts such as chlorate ion. Dilution of the delivered product reduces the rate of degradation.

Twelve-percent sodium hypochlorite is a corrosive liquid, and care is required to minimize the effects of corrosion and off-gassing, additional operator handling precautions, and frequent maintenance of the feed equipment. Containment around the storage tanks is required in the event of a spill or leak.

Positive displacement diaphragm pumps are commonly used for metering sodium hypochlorite. Other pumps, such as peristaltic pumps, could also be used. Pump seals and O-rings must be made of materials that resist the hypochlorite's corrosive effects. Leaks at pipe joints and fittings should be anticipated, requiring additional maintenance. Hypochlorite also tends to generate off-gases through the formation of oxygen during degradation. The off-gassing can result in vapor lock of the pumps and piping system and must be vented properly. Venting of these gases must be provided immediately before the pumps and the metering pumps and system must be designed to handle the off-gassing. A small, heated and ventilated enclosure would be required to house the feed equipment.

Storage for 12-percent hypochlorite should provide for at least 14 days of disinfection at the peak-month dosage at a design dose of approximately 2 mg/l. A chlorine contact basin would be required to meet Department of Ecology requirements for 20-minutes of detention time at peak flows and 60 minutes of detention time at average flows.

Chlorination Using Sodium Hypochlorite Generated On Site

On-site hypochlorite generation is gaining increasing acceptance and is being installed at numerous facilities across the country and in the Northwest. It produces a dilute (0.8 to 1 percent) hypochlorite solution that is fed as the primary disinfectant. The process uses water, salt, and electricity to produce the hypochlorite solution. Each pound equivalent of chlorine requires approximately 3.5 pounds of salt, 15 gallons of water, and 2.5 kilowatt-hours (kW-h) of electricity.

The process provides greater safety than the use of chlorine gas or 12-percent hypochlorite because operators are only exposed to dry salt and weak hypochlorite solution. There is no risk of a catastrophic release of chlorine gas. On-site generation systems are generally automated. During normal operation, minimal operator attention is required. The on-site generation system consists of the following equipment:

- Brine tank/salt saturator
- Rectifier
- Programmable logic controller (PLC)

- Generating units
- Metering pumps for brine solution
- Metering pumps for hypochlorite solution
- Product storage tanks.

The brine solution can be stored for long periods, and with its low feed concentration there is no concern about chlorine degradation. High quality vacuum-dried salt is typically delivered in 50 pound bags. The water used for preparing the brine is typically softened to prevent scaling; brine waste from the softener is disposed of to the sanitary system.

The hypochlorite solution is transferred to a storage tank from which it is metered to the system. The tank vents hydrogen gas, a byproduct of the hypochlorite generation process, to the atmosphere. It provides a minimum of one day reserve of the feed product in the event of a short-term outage or routine maintenance of the generating unit. If a longer shutdown of the generating unit is anticipated, concentrated sodium hypochlorite can be delivered to and fed from the tank.

This system would be sized to provide an approximate dosage of 2 mg/l. A small, heated and ventilated enclosure would be required to house the feed equipment. As with the 12-percent sodium hypochlorite alternative, a chlorine contact basin would be needed in order to meet Ecology requirements for contact time.

Low-Pressure Open-Channel UV Disinfection

Low-pressure, low-intensity systems (see Figure 7-8) are the most common type of UV system. A low-pressure, low-intensity UV system consists of a power supply, ballasts, lamps, a reactor, cleaning equipment, and controls and instrumentation. The lamps emit a near-monochromatic radiation of 253.7 nanometers (nm). Generally, 40 to 60 lamps are required per million gallons per day (mgd) of effluent flow, with an energy requirement of 3.8 to 4.2 kW/mgd. Lamp output is not adjustable; to conserve energy, the number of lamps in service can be paced to the flow and transmittance of the effluent stream. As lamps age, power output gradually declines, reducing the system's energy efficiency. Conversion of applied power into UV radiation is approximately 35 to 40 percent.

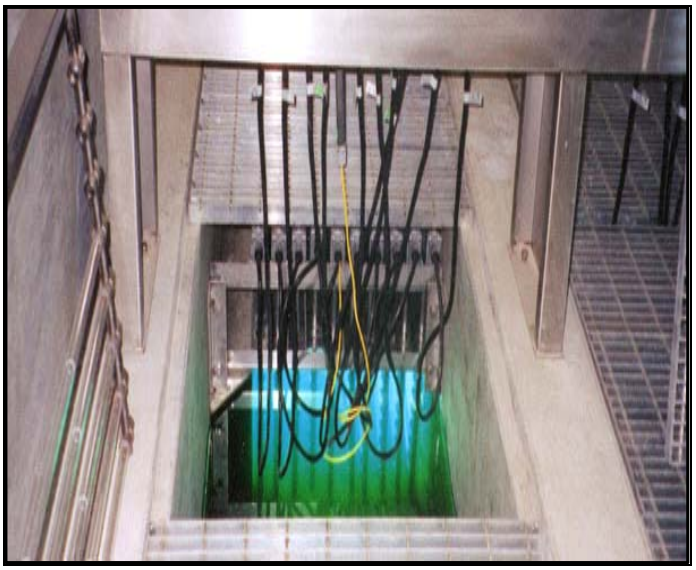


Figure 7-8. Low-pressure, Low-intensity Ultraviolet Disinfection System in Snoqualmie, Washington

Due to the high number of lamps required, most low-pressure systems do not have an automatic cleaning capacity. The most common methods of cleaning are in-channel air scouring and out-of-channel cleaning tanks that use cleaning solutions and/or air scouring.

Most low-pressure systems for wastewater consist of lamps suspended vertically or horizontally in an open channel. This is especially cost-effective in retrofits of existing plants, where an existing basin such as a chlorine contact tank can be converted into an open-channel reactor at minimal cost.

The effectiveness of a UV dosage is highly dependent on the wastewater's UV transmissivity (the ease with which the UV light can be transmitted through the flow). If transmissivity is low, an increased UV dosage is needed to achieve adequate disinfection. For UV disinfection processes to be cost-effective, it is critical that the transmissivity not be too low. A 10 percent drop in transmissivity will cause a 25 percent drop in UV intensity. This means that to receive the same level of disinfection would require 25 percent more lamps.

No transmissivity data is available for Freeland since there is no existing treatment plant. For this analysis, a typical transmissivity value of 65 percent is assumed. This value is conservative; most treatment plants producing Class A effluent have transmissivity values of 70 percent or higher.

This alternative would require a larger emergency generator than the chlorine-based disinfection alternatives, since the generator would have be sized to provide power to the UV disinfection system. A small sodium hypochlorite feed system would be required to maintain a chlorine residual in the effluent pipeline, per Department of Ecology standards.

Medium-Pressure UV Disinfection Equipment

Medium-pressure UV systems (see Figure 7-9) are more common outside the United States, although there are many installations in the U.S. They consist of a power supply,

transformers, capacitors, lamps, a reactor, and controls and instrumentation. They produce a high-intensity, broad spectrum light. Due to the high intensity of the lamps, only about four to six lamps are required per mgd. However, the lamps are significantly more expensive than for any other UV system.

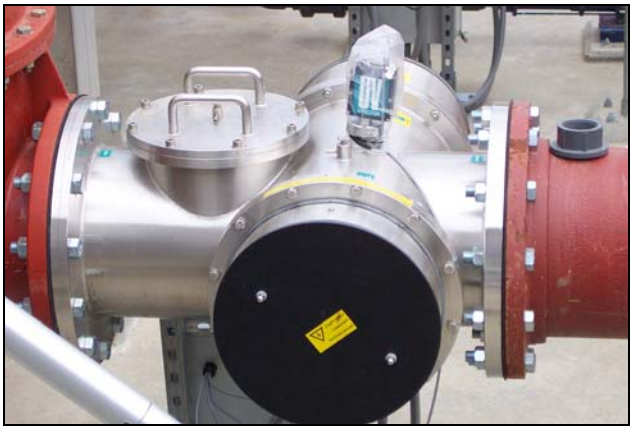


Figure 7-9. Medium-pressure Ultraviolet Disinfection System

Medium-pressure lamps are not as energy efficient as low-pressure lamps due to their broad spectrum output; they range from 15 to 25 percent conversion from applied power to UV radiation. The overall energy requirement is 7 to 10 kW/mgd. However, the reduced number of lamps facilitates cleaning of the system.

Medium-pressure systems typically have three transformer settings, allowing reduction of the individual lamps' power use to approximately 60 percent of the maximum during periods of low flow or high effluent transmissivity. This reduces overall energy consumption and can extend lamp life, although operating at reduced power per lamp tends to reduce the individual lamps' energy efficiency, partially mitigating any energy savings. Medium-pressure lamps typically have a life span of 2,000 to 5,000 hours, which is lower than the life span for low-pressure lamps. The expected lamp life has been raised to 8,000 hours in some recent suppliers' marketing materials.

Medium-pressure systems operate at higher temperature ranges than low-pressure systems. A typical range is between 600ºC and 800ºC. The high operating temperature makes the lamps more susceptible to a "bake-on" fouling effect. Automatic wiping is necessary to mitigate this effect.

Medium-pressure systems are available in closed-chamber, closed-channel, and open-channel designs, with an automated wiper system for lamp cleaning. Typically, the automatic cleaning cycle directs wipers to travel along the length of the lamp at timed intervals to remove deposits before they become encrusted onto the lamp surface. Chemical addition to prevent fouling is another means of maintaining the lamps; it can be used in combination with wipers.

As with the low-pressure UV system, additional emergency generator capacity would be required, and a small sodium hypochlorite feed system would be required to maintain a chlorine residual in the effluent pipeline.

Low-Pressure, High-Intensity UV Disinfection Equipment

Recently developed low-pressure, high-intensity lamp systems (see Figure 7-10) emit the same monochromatic emission as traditional low-pressure, low-intensity systems but require significantly fewer lamps. The energy demand is similar to that of low-pressure, low-intensity systems, generally between 3.8 and 4.8 kW/mgd. These newer systems typically have self-cleaning wiper mechanisms. Lamp life is estimated to range from 8,000 to 12,000 hours, depending on the intensity of use. Open channel configurations are available.

Conversion from applied power to UV radiation for these systems is in a range similar to that of low-pressure, low-intensity systems (35 to 40 percent). In some systems, the output of each lamp can be adjusted to generate a UV dose paced to the transmissivity and flow of effluent. Again, operating a lamp at a reduced power output generally reduces its energy efficiency.

As with the other UV alternatives, additional emergency generator capacity would be required, and a small sodium hypochlorite feed system would be required to maintain a chlorine residual in the effluent pipeline.

Figure 7-10. Low-pressure. High-intensity Ultraviolet Disinfection System at Olympus Terrace Sewer District, Washington

Discussion

The 12-percent sodium hypochlorite alternative should be considered in further detail. For communities the size of Freeland, concentrated liquid hypochlorite has been a cost-effective, relatively safe means of providing disinfection. On-site generation should not be considered further due to its relatively high equipment and O&M costs.

Of the UV disinfection alternatives, low-pressure, high-intensity UV is the recommended approach because of its combination of high energy efficiency, long lamp life, low lamp replacement cost, relatively low number of lamps required, and presence of an automatic

wiping system. Medium-pressure UV is not recommended because of its low energy efficiency, short lamp life, and high lamp replacement costs. Low-pressure, low-intensity UV is not recommended due the high number of lamps required and lack of an automatic wiping system.

For the UV alternative, a minimal amount of hypochlorite feed capacity is recommended to maintain a 0.5 mg/l chlorine residual in the distribution system.

Cost

Costs were estimated for the disinfection alternatives using the assumptions described in Chapter 5. A detailed breakdown of the estimates is attached in Appendix I.

Figure 7-11 shows the results of the cost analysis for the disinfection alternatives. It shows estimated capital and present worth costs in terms of cost per Equivalent Residential Unit (ERU). Recall that as described in Chapter 4, an ERU is the equivalent of a single family household. Each ERU is estimated as approximately 140 gallons per day (gpd) on an average basis, not including inflow and infiltration (I/I) flows.

The five bars for each alternative represent, from left to right, Phases 1 through 5. The sodium hypochlorite alternative was found to be considerably less expensive than the UV alternative with minimal sodium hypochlorite. Therefore, the sodium hypochlorite alternative is recommended.

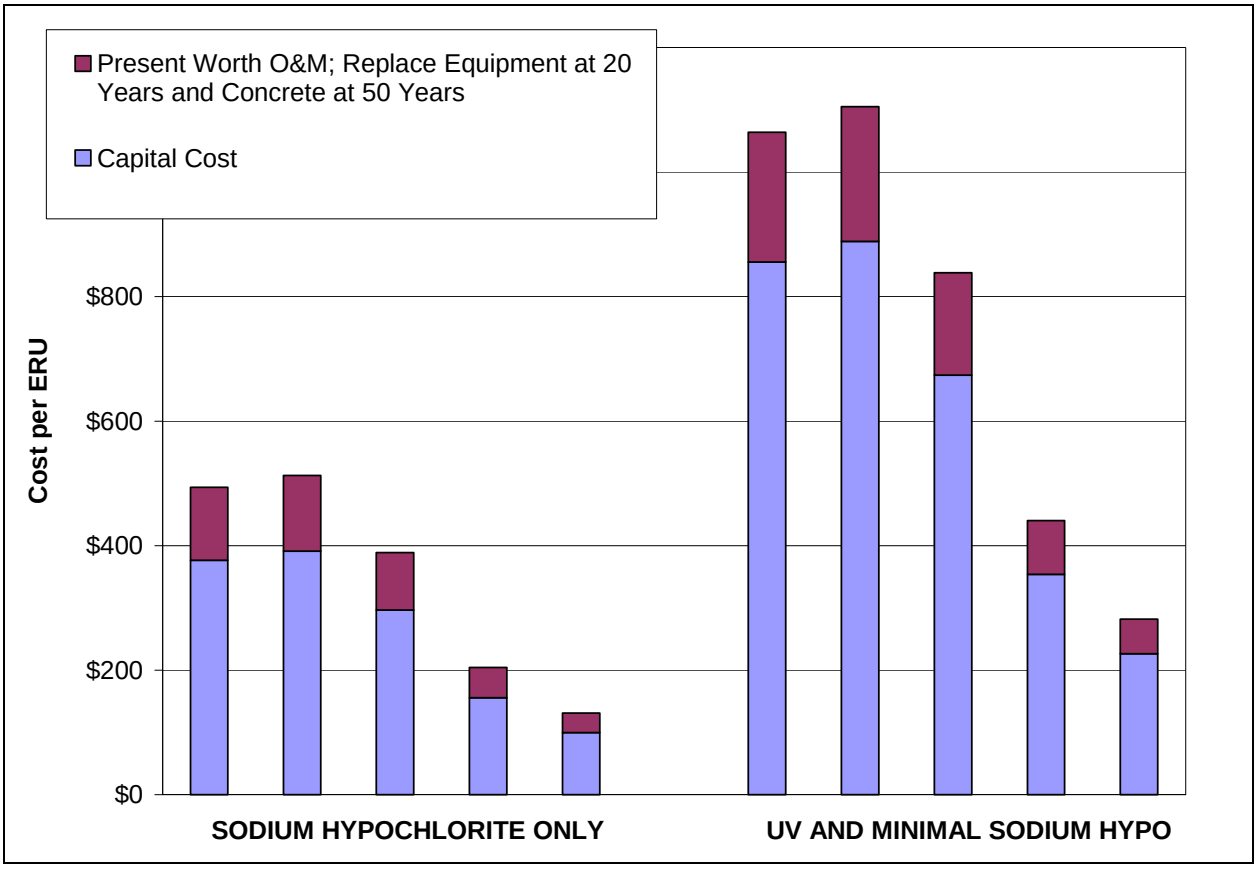


Figure 7-11. Estimated Costs of Disinfection Alternatives (per ERU)

Combined Liquids Treatment Costs

Planning-level cost estimates were developed for combinations of headworks, secondary treatment, advanced treatment, and disinfection alternatives. Cost estimates used the assumptions described in Chapter 5. A detailed breakdown of the estimates is attached in Appendix I.

The cost analysis includes three short-listed treatment alternatives for a Freeland-only treatment plant, as well as an MBR alternative for a joint treatment plant project with HHSD. Figure 7-12 shows the results of the cost analysis in terms of cost per ERU. Recall that as described in Chapter 4, an ERU is estimated as approximately 140 gallons per day (gpd) on an average basis, not including inflow and infiltration (I/I) flows.

The five bars for each alternative represent, from left to right, Phases 1 through 5.

The oxidation ditch alternative is very expensive in the initial phases because oxidation ditches are not as well suited to phased implementation. Therefore, oxidation ditches are not recommended. The SBR and MBR alternatives are relatively equal in estimated present worth cost for all phases. The MBR process is recommended due to its simplicity and exceptional effluent quality compared to SBRs and post-SBR filtration. The choice between a Freeland-only MBR and a joint MBR plant with HHSD is determined from consideration of conveyance and reuse costs, as described in Chapter 8 of this report.

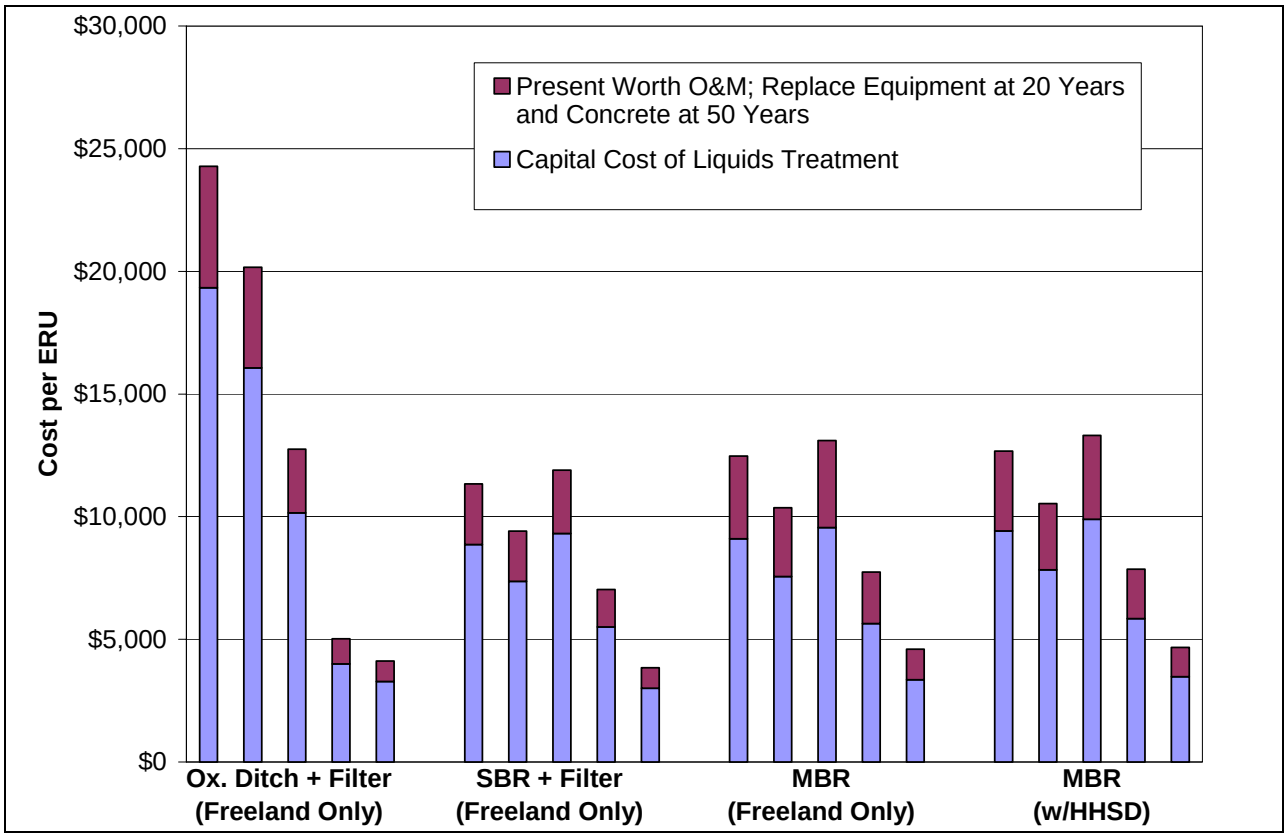


Figure 7-12. Estimated Costs of Liquids Treatment Alternatives (per ERU)

Solids Management

Management of solids from the treatment plant can encompass several components: solids stabilization, solids reduction by thickening or dewatering, solids storage, and solids disposal. All components together must achieve federal solids management standards.

Initial Screening of Alternatives

Wastewater solids can be stabilized to different levels defined by federal regulations—Class B and Class A. Class B stabilized biosolids are suitable for beneficial use on land with some site access and use restrictions. Class A biosolids products are suitable for beneficial reuse without significant restrictions. Class B stabilization processes include anaerobic digestion, aerobic digestion, and alkaline stabilization. Class A stabilization processes, which include composting, alkaline stabilization, and various thermal processes, achieve a higher level of pathogen reduction.

Stabilization of sludge to Class A or Class B quality was considered initially, but not evaluated in detail. The costs of Class A treatment and regulatory compliance would be significant and it would require facilities and operations for storage, distribution, and odor control, and face liability issues. Potential applications for Class B solids include trucking the treated solids to agricultural applications in Eastern Washington and trucking them to composting facilities in Western Washington. Both of these were dropped from further consideration because of their high cost. Tt/KCM has found that the cost of trucking to agricultural application sponsors ranges from $10 to $20 per ton, not including trucking fees. Local contract composters have indicated that costs would be in the range of $30 to $50 per ton, not including trucking fees. These costs are in addition to constructing, operating, and maintaining full solids digestion facilities on site.

Solids not meeting Class A or B standards typically are disposed of similarly to the contents of septic tanks. In some cases, larger municipal treatment plants will receive partially stabilized or unstabilized solids. King County's South Treatment Plant at Renton accepts this type of solids. On Whidbey Island, the Island County Septage Handling Facility will also receive solids not meeting Class A or B standards. The Septage Handling Facility aerates solids to stabilize them, achieving Class B quality. Stabilized solids are trucked to a local farm for land application.

Two short-listed alternatives were evaluated, both involving trucking partially stabilized solids to a disposal location:

- An aerobic sludge holding tank for stabilization with periodic disposal by trucking to the Island County Septage Handling Facility
- An aerobic sludge holding tank for stabilization, followed by thickening to reduce haul costs, with periodic disposal by trucking to King County's South Treatment Plant.

Both alternatives include a solids storage tank to store and stabilize several days worth of waste activated sludge. More storage allows for increased flexibility in scheduling truck

trips to the designated disposal facility. More storage also gives operators increased flexibility in their sludge-wasting schedule.

Stabilize and Haul to Island County Septage Handling Facility

This alternative is similar to the system at the Coupeville Wastewater Treatment Plant (see Figure 7-13) and at HHSD. Waste solids from the liquids treatment process would be sent to a stabilization tank for storage and for volatile solids reduction through aeration to reduce odors. Aeration would be provided using blowers and coarse bubble diffusers. Odors tend to be minimal from this type of aerobic stabilization basin, so supplemental odor control would not be required. Partially stabilized solids would be periodically hauled to the Island County Septage Handling Facility for disposal. Currently, towns on Whidbey Island pay $17.86 per ton for disposal at the facility, which includes trucking fees.

Staff at the Island County facility have indicated that they are not interested in solids above 2 percent concentration due to the design of their facility. Therefore, no thickening equipment is included in this alternative.

The staff at the facility also have indicated that although the facility accepts municipal treatment plant solids, the facility is designed for septic tank pumpage. In the future, increases in municipal solids may cause the facility to reach its design capacity. At that point, the facility would limit the amount of municipal solids accepted, and Freeland would have to identify alternative solids handling strategies, such as hauling solids to another receiving facility or developing relatively close land application sites for solids.

Figure 7-13. Solids Stabilization Basin in Coupeville, Washington

Stabilize, Thicken, and Haul to King County South Treatment Plant

The stabilization process for this alternative is the same as for the previous. After stabilization, the solids would be thickened. After thickening, trucks would haul the thickened solids to King County's South Treatment Plant. This practice is followed by a number of small utilities in the Puget Sound area.

A small belt filter press (see Figure 7-14) would be used to thicken solids. Solids are typically at a 1 or 2 percent concentration in the stabilization tank. Solids would be pumped using a centrifugal or progressive cavity pump to the belt filter press, which would thicken them to approximately 10 to 12 percent. A progressive cavity pump would pump the thickened solids to a tanker truck. Noticeable odors can emanate from a belt filter press, so mechanical odor control would be required with this alternative.

As an alternative to a belt filter press, membrane bioreactors (such as those discussed earlier in this chapter) have recently been promoted for thickening sludge to 10 to 15 percent. A separate membrane bioreactor would be required for solids thickening, since the solids concentrations in the bioreactor would be much higher than those in the secondary treatment process (typically between 1.5 and 2.5 percent, or 15,000 and 25,000 mg/l, for membrane bioreactors). For this analysis, a belt filter press was used for solids thickening because the membrane bioreactor process has limited installations in the U.S. for solids thickening.

Figure 7-14. Solids Thickening Equipment in Vashon Island, Washington

The benefit of thickening solids is that haul costs and number of trips would be significantly reduced due to the removal of water from the solids before hauling. However, at some septage handling facilities, there is a surcharge if solids are above a threshold concentration. At King County's South Treatment Plant, solids above 2 percent concentration are charged at a prorated rate. There, a 6 percent solids concentration would be charged three times the normal rate per gallon.

A typical operations schedule of thickening for two four-hour shifts per week was assumed. Schedules would have to be coordinated with the delivery service and with the South Treatment Plant. Thickening operations occur intermittently, and storage of thickened solids might have to be provided so that the hauling truck doesn't have to spend days at the plant waiting for a full load of thickened solids to be produced. It might be advisable for Freeland to purchase a solids tanker for storing thickened solids. The tanker could be picked up and delivered to the Treatment Plant when needed.

To minimize odors, the thickening equipment would be totally enclosed, with dedicated odor control provided for the enclosure's ventilation.

Cost

Costs were estimated for the solids handling alternatives using the assumptions described in Chapter 5. A detailed breakdown of the estimates is attached in Appendix I.

Figure 7-15 shows the results of the cost analysis for solids handling alternatives in terms of cost per ERU. Recall that as described in Chapter 4, an ERU is estimated as approximately 140 gallons per day (gpd) on an average basis, not including inflow and infiltration (I/I) flows.

The five bars shown for each alternative represent, from left to right, Phases 1 through 5.

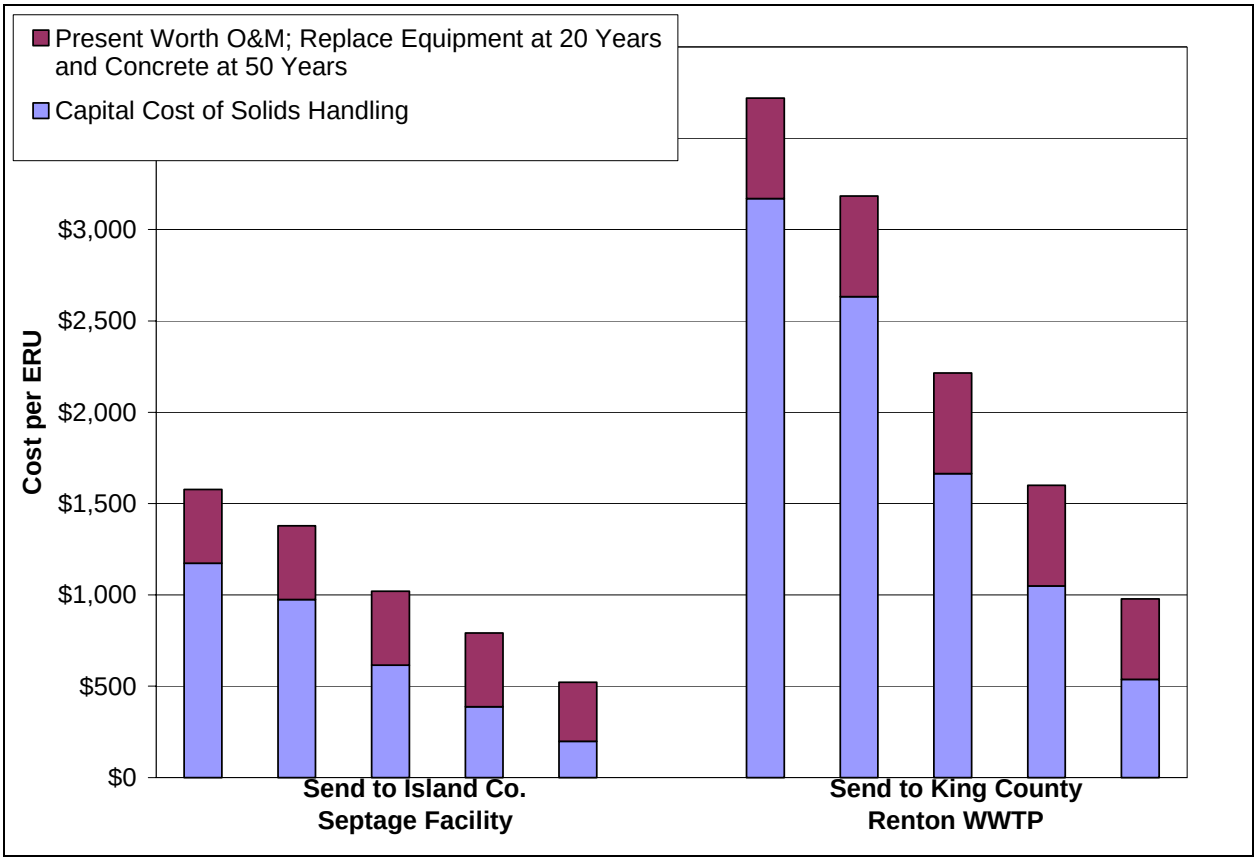


Figure 7-15. Estimated Costs of Solids Handling Alternatives (per ERU)

The figure shows that it is considerably more expensive to send stabilized solids to King County's South Treatment Plant than to send stabilized solids to the Island County Septage Handling Facility for all phases of implementation. However, it is likely that the Island County Septage Handling Facility will limit the amount of stabilized solids from Freeland in the future and that Freeland will have to identify alternative solids handling strategies at that point.

SUMMARY OF RECOMMENDATIONS

The qualitative and quantitative analysis described in this chapter resulted in the following recommendations:

- Minimal headworks facilities are required, because a STEP collection system is recommended. Recommended facilities include flow metering and sampling.
- For secondary and advanced treatment, membrane bioreactors are recommended for their flexibility in phasing and exceptional effluent quality.
- For disinfection, liquid sodium hypochlorite is recommended.

- For solids handling, it is recommended to stabilize solids and send them to the Island County Septage Facility.

In Chapters 8 and 9, more detailed costs for the recommended alternatives are presented as part of the overall recommendation.

Note that the more detailed costs shown in later chapters used slightly different assumptions than the analysis presented in this chapter. These assumptions include assumed discount and interest rates. This is because the more detailed costs were estimated at a later date.

CHAPTER 8.
RECOMMENDED ALTERNATIVE

This chapter describes and evaluates combined alternatives for wastewater collection, treatment, storage, conveyance, and reuse facilities for the Freeland area. Alternatives include specific locations for the facilities and are evaluated according to qualitative factors and present worth cost. The recommended alternative is identified and presented.

The following are the conclusions of alternative evaluations presented in the preceding chapters of this report:

- Septic tank effluent pumping collection systems are the recommended collection system alternative. Conventional gravity systems were not selected because of their very high capital cost that doesn't allow for cost-effective phasing and because they require multiple complex and expensive pump stations throughout the system. Combinations of gravity and STEP systems have similar drawbacks.
- Land application for beneficial reuse is the preferred strategy for treatment plant effluent. Discharge to Puget Sound through an outfall is not recommended due to political and regulatory constraints. Year-round land application strategies include slow-rate infiltration and surface percolation basins. Three potential sites were identified.

  Specific design of any such systems would be designed around results of a detailed hydrogeologic and water quality study, to be performed during later predesign efforts.
- Membrane bioreactors are recommended for secondary and advanced treatment due to their ease of operation and maintenance, cost-effective life cycle costs, ability to be implemented in phases, and exceptional effluent quality. Oxidation ditches with filters and sequencing batch reactors with filters were not recommended due to their operational complexity, less flexibility in phasing, and poorer effluent quality (although adequate to meet quality requirements). Solids were recommended to be stabilized and hauled to the Island County Septage Handling Facility.

SITE ALTERNATIVES

Combining the collection, reuse and treatment recommendations, County and Tt/KCM staff worked together to identify potential locations for a treatment plant, storage basins, and land application site. Parcels in the area were evaluated based on the following factors:

- Proximity to the service area
- Contiguous acreage
- Minimal number of landowners
- Access to State Route 525 or other access roads

- Lack of sensitive areas, such as wetlands, steep slopes, or floodplains
- Sparse development.

Chapter 6 describes three sites that meet these criteria for land application. Parcels on or near these sites were evaluated as potential locations for treatment and storage facilities. The sites are shown on Figure 8-1. View corridors are identified for one of the sites, based on the request of the Freeland Sub-Area Planning Committee. The elevation and location of each site determine whether it is more suitable for a separate treatment plant for Freeland or joint treatment at an expanded HHSD treatment plant.

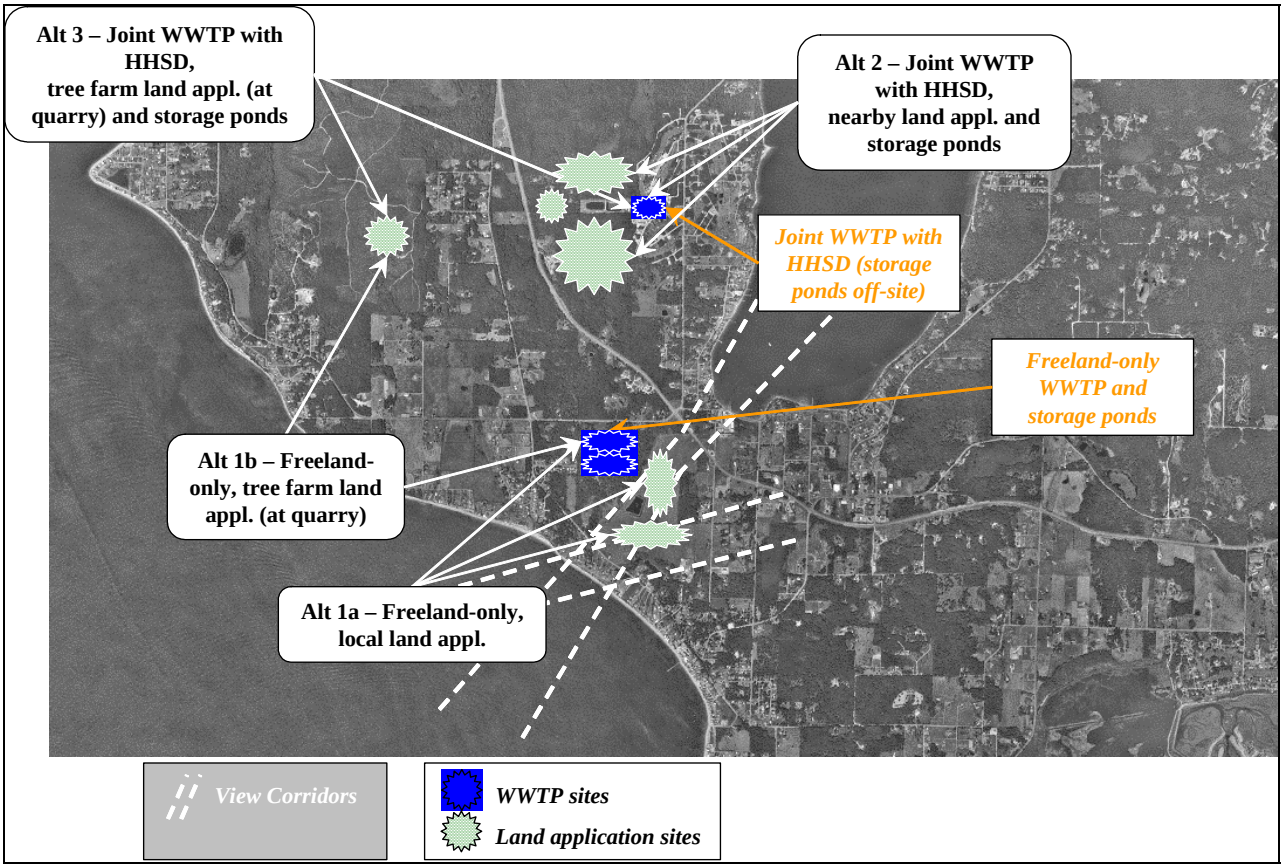


Figure 8-1. Potential Treatment Plant, Storage Basins, and Land Application Sites

DESCRIPTION OF COMBINED ALTERNATIVES

Alternative 1a—Freeland-Only Treatment, Local Land Application

This alternative would provide land application at a parcel between Mutiny Bay and Holmes Harbor, immediately southwest of Highway 525 (see Figures 8-1 and 8-2). It is owned by a single landowner. It is approximately 100 acres in size and is essentially flat, at an elevation of between 20 and 30 feet above sea level. It is a cleared area that was once farmland. It is also part of a view corridor that extends from Mutiny Bay Road north to Holmes Harbor.

Figure 8-2. Alternative 1a Site (photo taken from SR 525 looking south)

Based on its elevation and proximity to the Freeland collection system, use of this parcel would be consistent with a new treatment plant and storage basins for Freeland only rather than joint treatment with HHSD. Because the site is already cleared, installation of land application facilities such as drip irrigation lines or surface percolation basins would be relatively inexpensive.

Facilities would need to be located so that the view corridor from Mutiny Bay to Holmes Harbor and beyond would not be disturbed. Treatment, emergency storage, and winter storage facilities could be located on parcels northwest of the site. In the northwest area, the ground slopes upwards and becomes heavily forested, which would minimize impacts on the view corridor. The closest residences are a few hundred feet away (west and north) from the potential treatment plant and storage facilities. The areas east and south of the parcel are free of residences for several hundred feet.

The Freeland sewer service area varies in elevation from 0 to 250 feet above sea level. Individual STEP pumps at each service connection could provide the required pressure to pump sewage directly to the low elevation of this site. In fact, this alternative would reduce the costs of the collection system, because connections in higher elevation areas along Honeymoon Bay Road could deliver sewage to the parcel using small-diameter gravity systems, saving the cost of a STEP pump at each service connection (refer to the discussion in Chapter 5). No separate main pump station would be required for additional flow boosting.

Based on a discussion with the landowners, the northern portion of the parcel might be available for sale. However, the landowners have indicated that they would not be willing to sell the southern portion of the parcel. This limits the acreage available for land application.

Hydrogeology and Hydraulic Application Rate

HWA GeoSciences performed field studies of this site for potential infiltration. The report is included in Appendix L. The analysis indicated that there are coarse, well-drained soils along the southern portion of the parcel that are well suited for land application. Therefore, a relatively high design hydraulic application rate of at least 0.5 gallons per day per square foot (gpd/sf) can be used. Land application can either be through slow-rate infiltration (likely buried drip irrigation) or through surface percolation basins. Buried drip irrigation would be more likely at this site, due to view corridor constraints. However, surface percolation basins could be considered.

At Phase 5 (ultimate buildout), the maximum monthly flow of 0.68 mgd corresponds to a land application area of approximately 40 acres, including buffer areas around the application site. This approximately corresponds to the acreage available on the southern portion of the parcel.

On the northern portion of the parcel, well-cemented glacial tills correspond to a very low infiltration rate. In addition, there are some wetlands on the northeast corner of the site, indicating that there might be wintertime ponding and very limited or no ability to land-apply. A design rate of 0.1 gpd/sf or lower was recommended, with the understanding that the northern portion of the site might not be available for wintertime land application. At Phase 5 (ultimate buildout), the maximum monthly flow of 0.68 mgd corresponds to a land application area of approximately 225 acres, including buffer areas around the application site. This is far more land than is available on the northern portion of the parcel.

The hydrogeological analysis indicated that both the southern and northern portions of the parcel may be subject to high groundwater in winter. This could mean that significant winter storage could be required, depending on the actual winter infiltration rate. Instead of three days of winter storage, as described in Chapter 6, several months could be required. Alternatively, another means of winter discharge or reuse would be required.

There are public drinking water wells within a few hundred feet of the site. Some of these wells draw water from the shallow aquifer, meaning that sufficient environmental buffer area around the reclaimed water land application site may not be available. Detailed hydrogeological analysis would be required to better quantify this issue.

Island County has classified wetlands immediately south of the parcel as Category A, the County's highest quality designation. Given the seasonally high groundwater table, the hydrology of the wetlands could be influenced by nearby land application. Detailed wetlands hydrological studies would be required to better quantify this issue.

Because the southern portion of the parcel might not be available for purchase, the overall land application capacity of the parcel is limited. At a point in the future, when the land application capacity of the parcel is reached, pumps and pipelines would be installed to convey additional reclaimed water to a second location for land application.

Advantages and Disadvantages

Qualitative advantages of this alternative are as follows:

- Relatively small amount of land needed, if southern portion of parcel is available.
- Facilities are centrally located with respect to Freeland. There is maximum flexibility for future conveyance of reclaimed water to additional land application sites, for an in-town nonpotable irrigation system, or for golf course irrigation at the Useless Bay Golf Course (to the east of Freeland).
- Maintains view corridor at parcel.

Qualitative disadvantages of this alternative are as follows:

- Of all alternatives, facilities are closest to residential parcels. For land application, public contact most difficult to manage.
- Unfavorable soils for year-round land application (increased chance of needing additional winter storage).
- Probably cannot use southern portion of site due to landowner preferences.

Alternative 1b—Freeland-Only Treatment, Tree Farm Land Application

Alternative 1b includes treatment plant and storage basins for Freeland only, located similarly to Alternative 1a. To address Alternative 1a's site constraints, hydrogeological concerns, and wetland issues associated with land application at the site, reclaimed water would be conveyed to another site for land application.

The winter storage basins could be located on the land application site. The emergency storage basins would still be located adjacent to the treatment plant (as in Alternative 1a), because they store partially treated effluent and must pump it back to the treatment plant for re-treatment.

The site identified for land application is a former tree farm approximately 2 miles northwest of the Alternative 1a site, west-southwest of the intersection of Mutiny Bay Road and Highway 525. The site is about 874 acres in 24 parcels, with 4 owners. Much of it is owned by a single (partnership) landowner. The site slopes gently, varying in elevation between approximately 100 and 300 feet above sea level.

It has areas that are fairly heavily forested, which would increase the cost of constructing land application facilities such as drip irrigation lines throughout the area. However, a significant portion of the area is a tree farm that has been periodically logged, as evident from the aerial photo shown in Figure 8-3 Therefore, the ease of constructing land application facilities would depend on the specific portion of the area chosen. The hydrogeological field work identified a gravel pit in the site that would be best suited for land application based on estimated infiltration rates. The pit site is shown on Figure 8-4.

Figure 8-3. Aerial View of Land Application Site for Alternative 1b

Figure 8-4. Gravel Pit at Alternative 1b Land Application Site

Hydrogeology and Hydraulic Application Rate

The hydrogeological analysis by HWA GeoSciences indicated that for the gravel pit area and beyond (at least 20 acres), there are coarse, well-drained soils that are well suited for land application. A relatively high design hydraulic application rate of at least 1.5 gpd/sf

could be used. The groundwater table was too deep to be located by the hydrogeological testing.

Land application could either be through buried drip irrigation or through surface percolation basins. Surface percolation basins are recommended, given their low cost and ease of operation and maintenance compared to drip irrigation, and the lack of view corridor concerns in the area. Surface irrigation of nearby forest land could also be considered, but for now this alternative assumes using surface percolation basins.

At Phase 5 (ultimate buildout), the maximum monthly flow of 0.68 mgd corresponds to a land application area of approximately 15 acres, including buffer areas around the application site. This is within the extent of the gravel pit area.

Advantages and Disadvantages

Qualitative advantages of this alternative are as follows:

- Smallest amount of land needed for land application.
- Treatment facilities are centrally located with respect to Freeland. There is maximum flexibility for future conveyance of reclaimed water to additional land application sites, for an in-town nonpotable irrigation system, or for golf course irrigation at the Useless Bay Golf Course (to the east of Freeland).
- Single owner for most of the land application area.
- Least proximity to other owners and wells (for land application).
- Best soils for year-round land application (least chance of needing additional winter storage).
- Sufficient buffer available for land application; public contact easily managed.

The qualitative disadvantage of this alternative is as follows:

- Would require the purchase and control of two separate sites for treatment plant/storage basins and application site.

Alternative 2—Joint Treatment with HHSD, Near-Site Land Application

This alternative is based on land application at a site immediately west of the HHSD treatment plant (see Figures 8-1 and 8-5). The area is composed of 36 parcels owned by 19 landowners. It is about 300 acres in size and slopes gently, at an elevation of between 100 and 200 feet above sea level. The land application area is fairly heavily forested, which would increase the cost of constructing drip irrigation lines or other land application facilities throughout the area. There are wetlands in the northeast portion of the site.

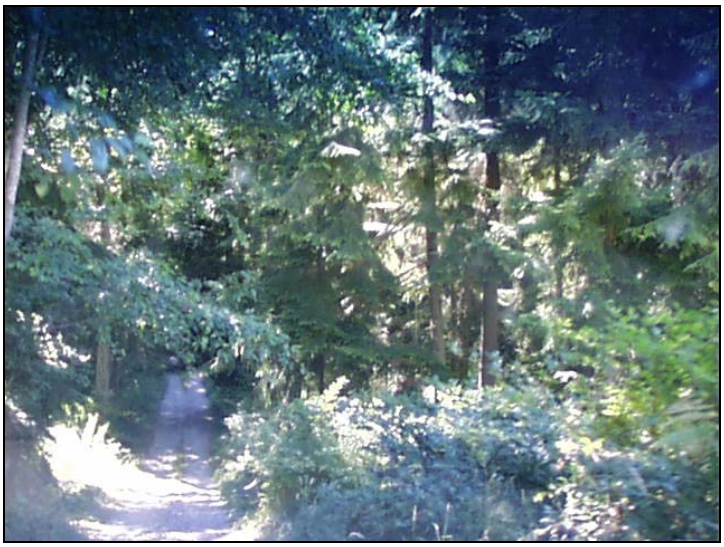


Figure 8-5. Alternative 2 Land Application Area

Since the HHSD treatment plant is immediately east of the land application site, this alternative assumes that Freeland's sewage would be pumped up Honeymoon Bay Road and treated at an expanded HHSD plant. STEP pumps at lower elevations would have to deliver 280 to 300 feet of pressure at design flows to pump up to the plant's elevation, (taking into account friction and head losses), which corresponds to a working pressure of 120 to 130 pounds per square inch. This is higher than most municipal piping systems are designed for (drinking water piping distribution systems, which are designed to be under continuous pressure, are usually designed for no more than 80 psi). Therefore, a main pump station would be required to boost the flow from individual low-elevation STEP systems up to the treatment plant. The main pump station would likely be located somewhere along Honeymoon Bay Road.

Based on discussions with HHSD, HHSD's existing storage basins would not be able to be used for Freeland's requirements. New storage basins would be constructed adjacent to the land application area.

Hydrogeology and Hydraulic Application Rate

The hydrogeological analysis indicated that although the top few feet of the land application area for this alternative might be well-suited for small septic drainfields, there is a prevalent glacial till layer throughout the area. The glacial till layer has a very low permeability, meaning that soil percolation rates would be limited. A relatively low design hydraulic application rate of 0.1 gpd/sf or lower would have to be used. Surface percolation basins are not recommended due to the low percolation rate. At ultimate buildout, the maximum monthly flow of 0.68 mgd corresponds to a land application area of approximately 220 acres, including buffer areas around the application site.

Advantages and Disadvantages

The qualitative advantage of this alternative is as follows:

- Closest land application site to HHSD (most compatible with joint treatment with HHSD).

Qualitative disadvantages of this alternative are as follows:

- Many landowners in vicinity (no contiguous ownership).
- Less flexibility for future reuse options.
- Unfavorable soils for year-round land application (increased chance of needing additional winter storage).
- Probably have to clear-cut forested parcels for drip system installation.
- Slow infiltration using shallow-buried drip systems is not clearly regulated in the Washington *Water Reclamation and Reuse Standards.*

Alternative 3—Joint Treatment with HHSD, Far-Site Land Application

This alternative includes joint expanded treatment at the HHSD treatment plant site and land application at the former tree farm site described for Alternative 1b. As with Alternative 2, the elevation difference between the lowest points in Freeland and the HHSD treatment plant would require a main pump station to be installed to boost STEP flows up to the HHSD treatment plant. The main pump station would be located somewhere along Honeymoon Bay Road.

Also as with Alternative 2, HHSD's storage basins would not be able to be used for Freeland's requirements. New storage basins would be constructed adjacent to the land application area.

Qualitative advantages of this alternative are as follows:

- Small amount of land needed.
- Single owner.
- Least proximity to other owners.
- Best soils for year-round land application (least chance of needing additional winter storage).
- Sufficient buffer available for infiltration basins or other facility; public contact easily managed.
- Potential for tree farm surface irrigation as a reuse option.

The qualitative disadvantage of this alternative is as follows:

- Least flexibility for future reuse options.

ALTERNATIVES EVALUATION AND COST ANALYSIS

Detailed planning-level cost estimates were developed for these alternatives. Cost estimates used the assumptions described in Chapter 5. A detailed breakdown of the estimates is attached in Appendix I.

The cost estimates include all aspects of the project, including STEP tanks and pumps, mainline sewers, conveyance from the collection system to the treatment plant, treatment plant, emergency and winter storage basins, conveyance from the treatment plant to the land application site, land application, purchase of land, and annual operations and maintenance costs.

For a new treatment plant, several supporting elements are assumed, including site landscaping and other mitigation for adjacent parcels, electrical systems, addition of a plant supervisory control and data acquisition system, an administration and laboratory building, general site considerations such as parking and loading area for solids hauling trucks, and storage space for other equipment and general tools.

Figure 8-6 shows the results of the cost analysis in terms of cost per Equivalent Residential Unit (ERU). Recall that as described in Chapter 4, an ERU is the equivalent of a single family household. Each ERU is estimated as approximately 140 gallons per day (gpd) on an average basis, not including inflow and infiltration (I/I) flows.

The five bars shown for each alternative represent, from left to right, Phases 1 through 5.

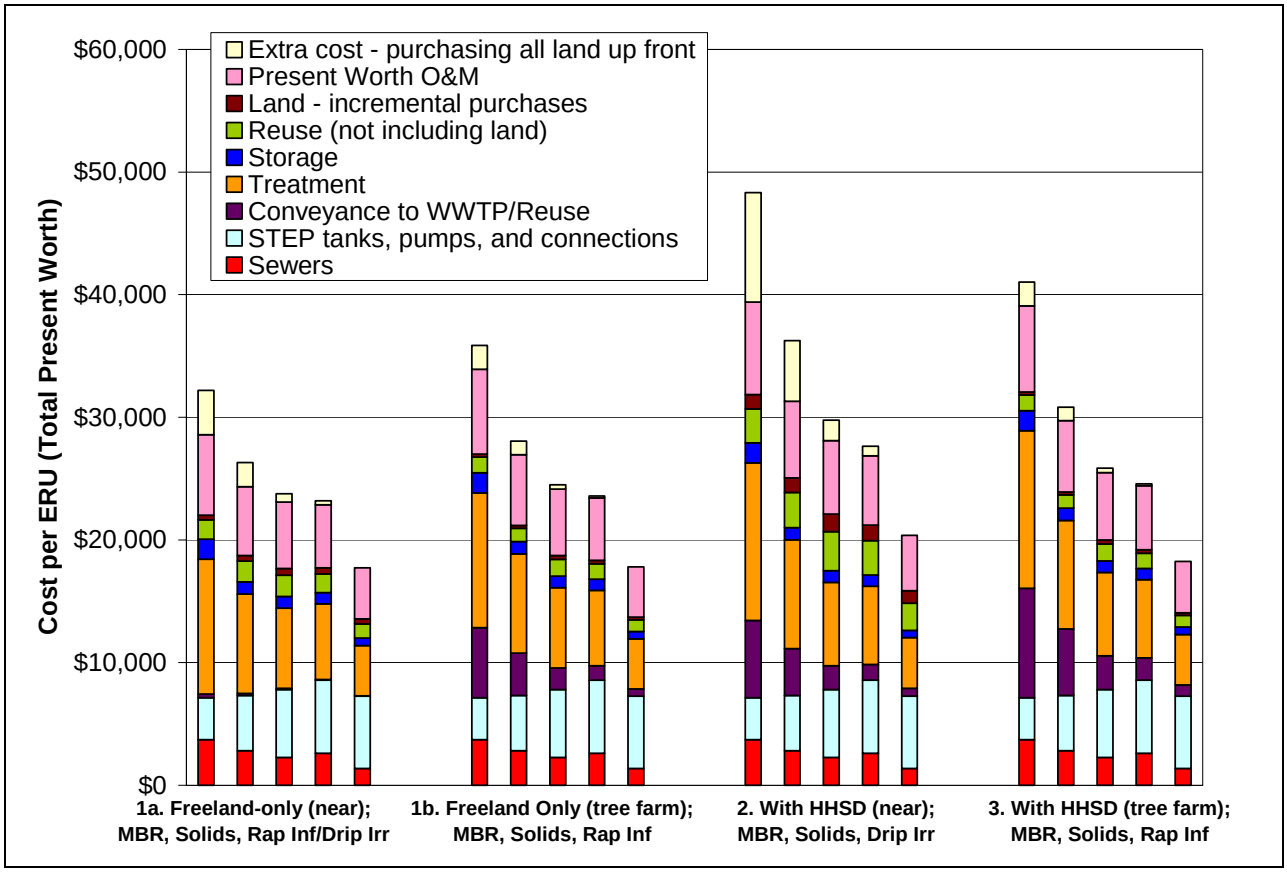


Figure 8-6. Estimated Costs of Combined Alternatives (per ERU)

Alternative 1a, the Freeland-only alternative with nearby land application, has the lowest total present worth cost. Although Alternative 1 has the highest treatment costs (based on the new plant versus expansion of an existing plant), it does not require a main pump

station for boosting all flow up to the higher elevation at Holmes Harbor or conveyance piping from Freeland to the HHSD plant. The land application site for Alternative 1a is also very close to the Freeland NMUGA, minimizing piping costs.

Alternative 1b, the Freeland-only alternative with land application at the former tree farm, has a higher total present worth cost than Alternative 1a due to pumps and pipelines required to convey reclaimed water from the treatment plant to the land application site. The impact of that additional cost is felt most during initial phases, since the pumps and piping would likely be put in all at once (instead of phased) to capture economies of scale. In later phases, the costs are more similar to those of Alternative 1a.

Alternatives 2 and 3 have higher total present worth costs than Alternative 1a or 1b, especially during the initial phases. The cost of a buried pump station and piping from Freeland to Holmes Harbor is significant, in addition to conveyance to the land application site. Alternative 2 has a significant cost for land application and for purchase of land, due to the significant acreage required at buildout. Alternative 3 has a lower land application and land purchase cost based on the more favorable soils. However, Alternative 3 does have a greater conveyance cost than Alternative 2 because the land application site is farther from the treatment plant than in Alternative 2.

RECOMMENDATION

Based on the qualitative and cost analysis presented herein, the Freeland Sub-Area Planning Committee agreed at a November 13, 2003 meeting that Alternative 1b should be selected as the recommended alternative. If suitable land application sites can be identified closer to Freeland, they should be investigated further because they could reduce the cost of conveyance to the former tree farm for land application.

For each selected land application site(s), a detailed hydrogeological and water quality analysis should be conducted. This work would include the following elements:

- Detailed survey of local site hydrogeology
- Groundwater flow modeling
- Nitrate and other water quality parameters – transport modeling
- Mounding analysis
- Analysis of surface water impacts

The results of the studies will shape the specific selection and design of land application system.

CHAPTER 9.
IMPLEMENTATION

This chapter summarizes the recommended plan for implementation of wastewater collection, treatment, storage, and reuse facilities for the Freeland area. The recommended plan includes phased implementation, from an initial service area that progressively expands as the population increases. A description is also presented on rate impacts, means of financing and implementation, and permitting.

RECOMMENDED PLAN

Description of Recommended Facilities

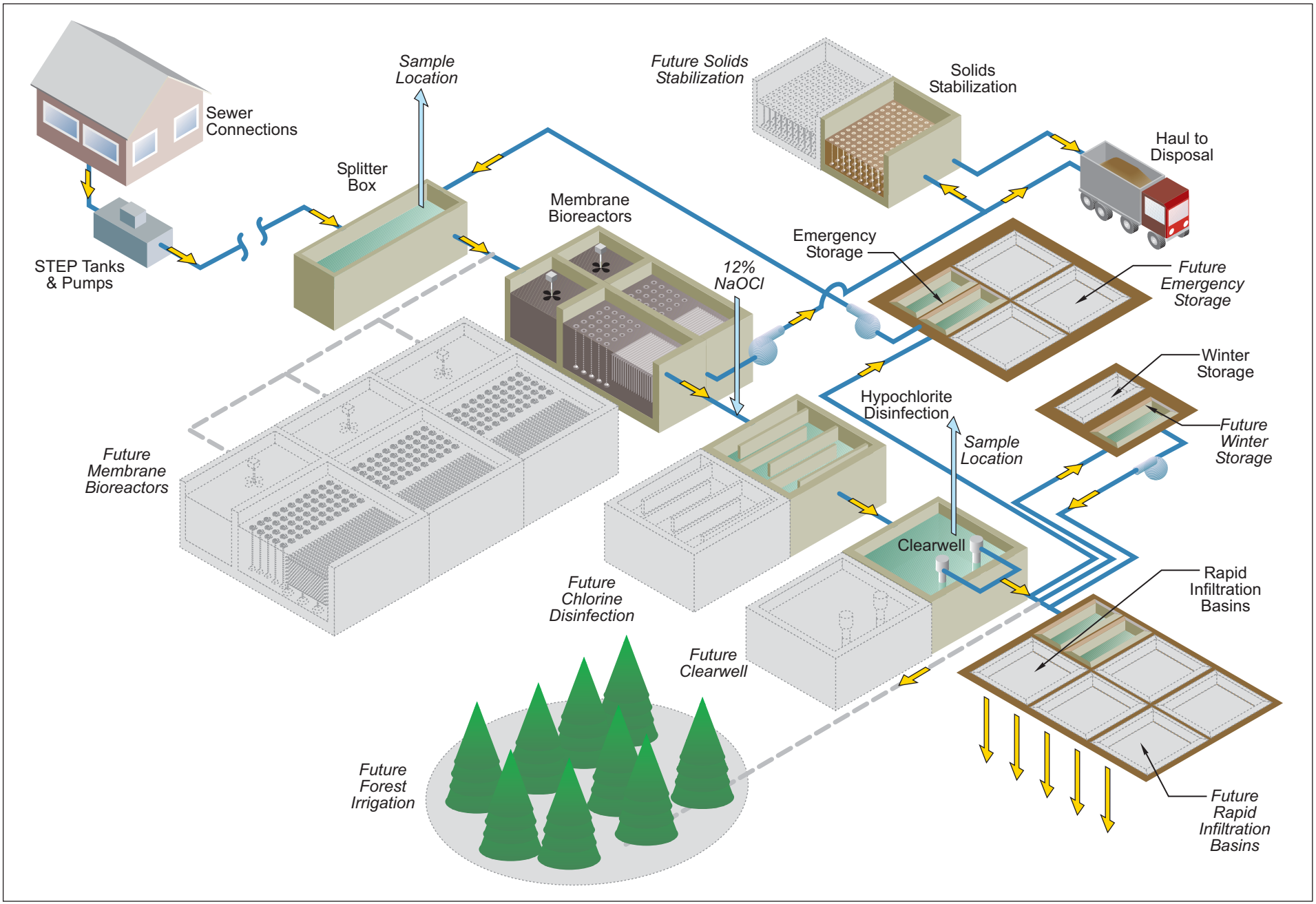
The recommended plan includes the following:

- Collection System—Septic tanks and septic tank effluent pumps at each building connection, and pressurized mainline sewers throughout the service area.
- Treatment—A membrane bioreactor treatment plant with anoxic basins for nitrogen reduction, aerobic basins for oxygenation, and immersed membranes for clarification. Disinfection using 12-percent sodium hypochlorite and chlorine contact basins. Solids handling using stabilization of treatment plant solids, and hauling of stabilized solids to the Island County Septage Treatment Facility.
- Storage—20-day emergency storage and 3-day winter storage using open earthen basins. Lined basins for emergency storage and unlined basins for winter storage.
- Conveyance—Pumps and piping from collection system to treatment plant and from treatment plant to surface percolation basins.
- Reuse—Land application using surface percolation basins.

Figure 9-1 shows the liquids and solids-stream process flow schematics for the recommended alternative. Figure 9-2 shows the site plan of the recommended treatment plant. Figure 9-3 shows the location of treatment, storage and land-application facilities. Figure 9-4 shows the hydraulic profile for the recommended alternative. These planning-level figures may change during detailed design. Design criteria for the recommended alternative are shown in Appendix K.

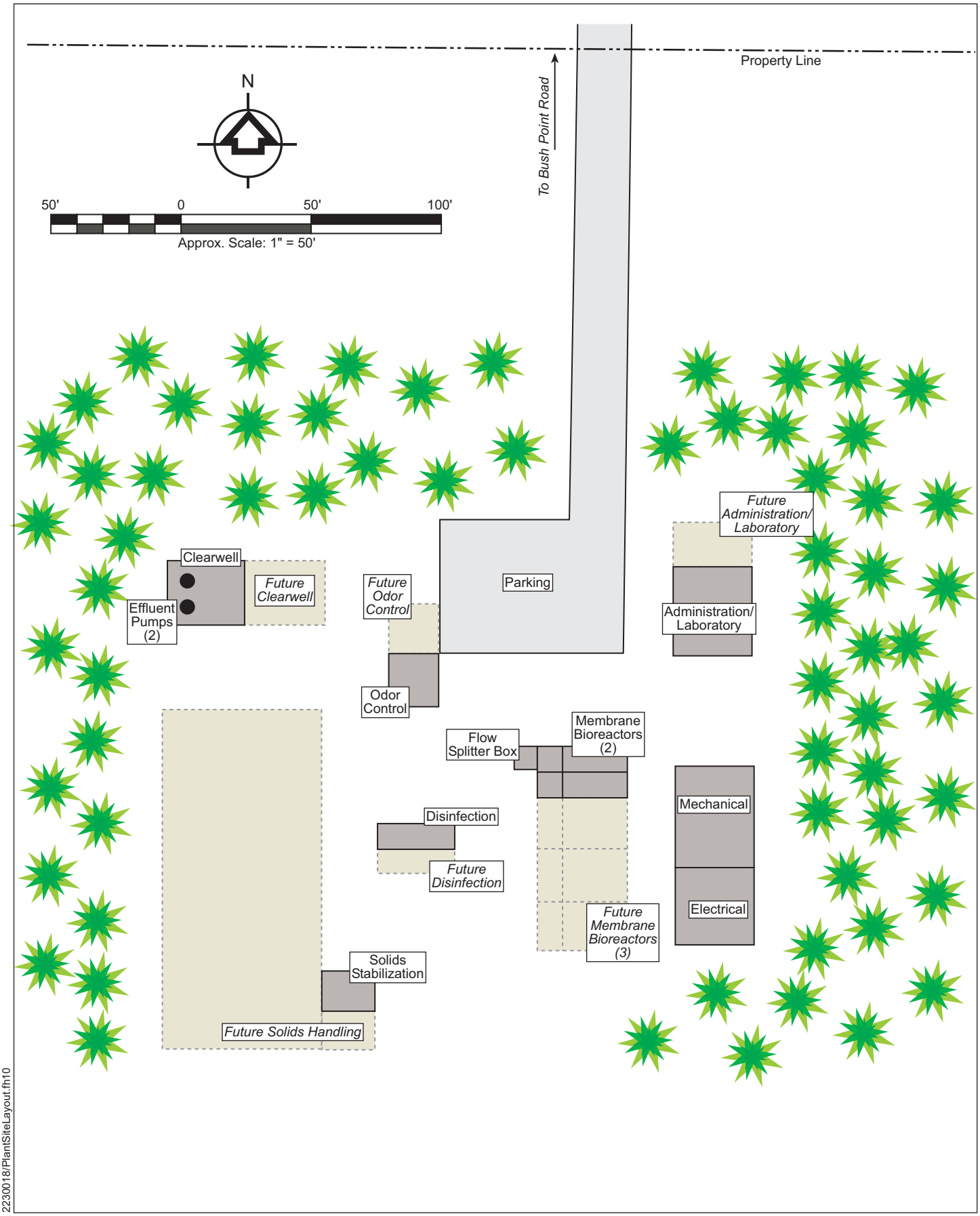
Proposed Phasing of Implementation

The recommended plan accounts for phased growth in the service area. Growth was planned as follows, and expressed in terms of the estimated number of Equivalent Residential Units (ERUs). Recall that as described in Chapter 4, an ERU is the equivalent of a single family household. Each ERU is estimated as approximately 140 gallons per day (gpd) on an average basis, not including inflow and infiltration (I/I) flows:



2230018/FlowSchematic.fh10

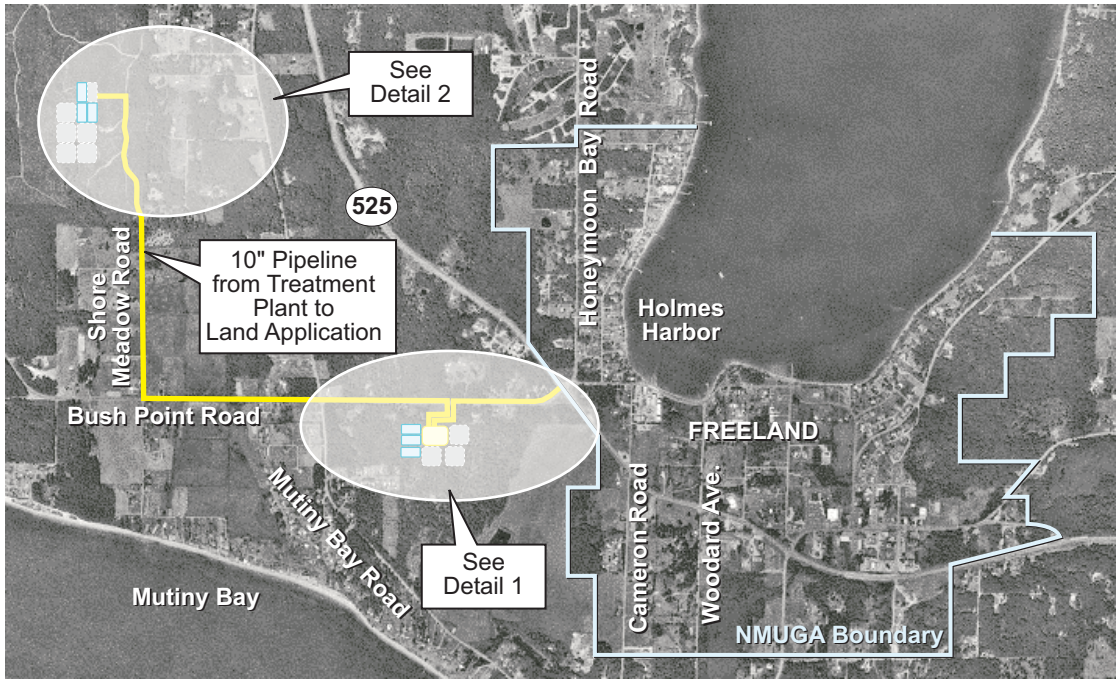
Tetra Tech/ KCM, Inc. 1917 First Avenue Seattle, Washington 98101	Island County FREELAND COMPREHENSIVE SEWER PLAN AND ENGINEERING REPORT	Figure 9-1. LIQUIDS- AND SOLIDS-STREAM PROCESS FLOW SCHEMATIC



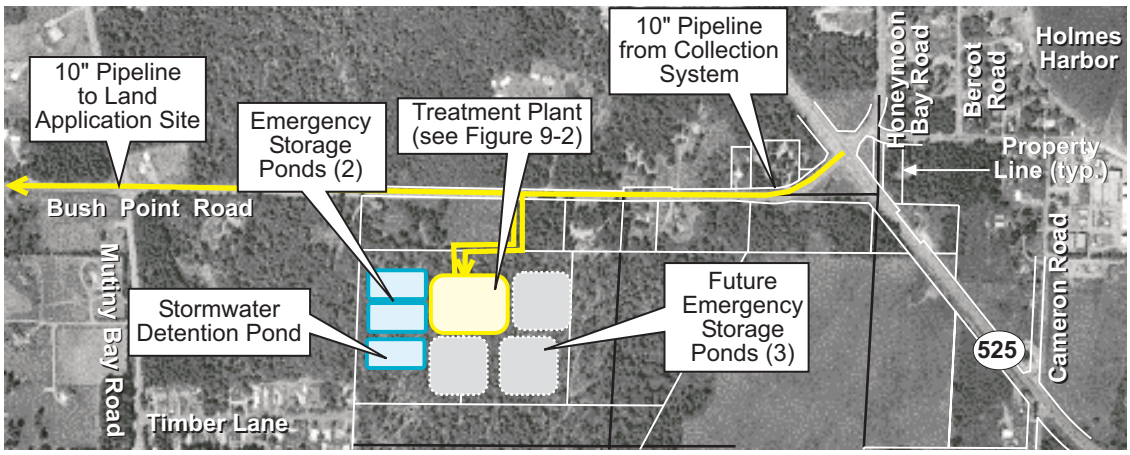
2230018/PlantSiteLayout.fh10

Tetra Tech/ KCM, Inc. 1917 First Avenue Seattle, Washington 98101	Island County FREELAND COMPREHENSIVE SEWER PLAN AND ENGINEERING REPORT	Figure 9-2. SITE PLAN FOR RECOMMENDED TREATMENT PLANT

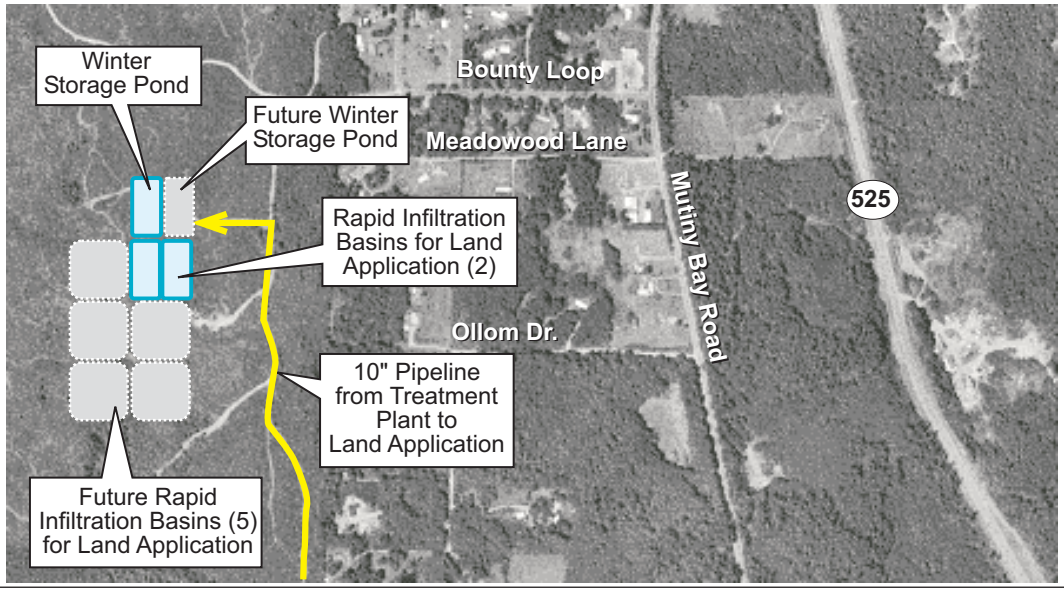
Treatment, Storage and Land Application Locations Approx. Scale: 1" = 3,000'

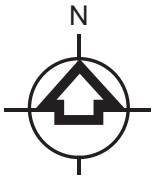


Detail 1. Treatment and Emergency Storage Locations Approx. Scale: 1" = 1,000'



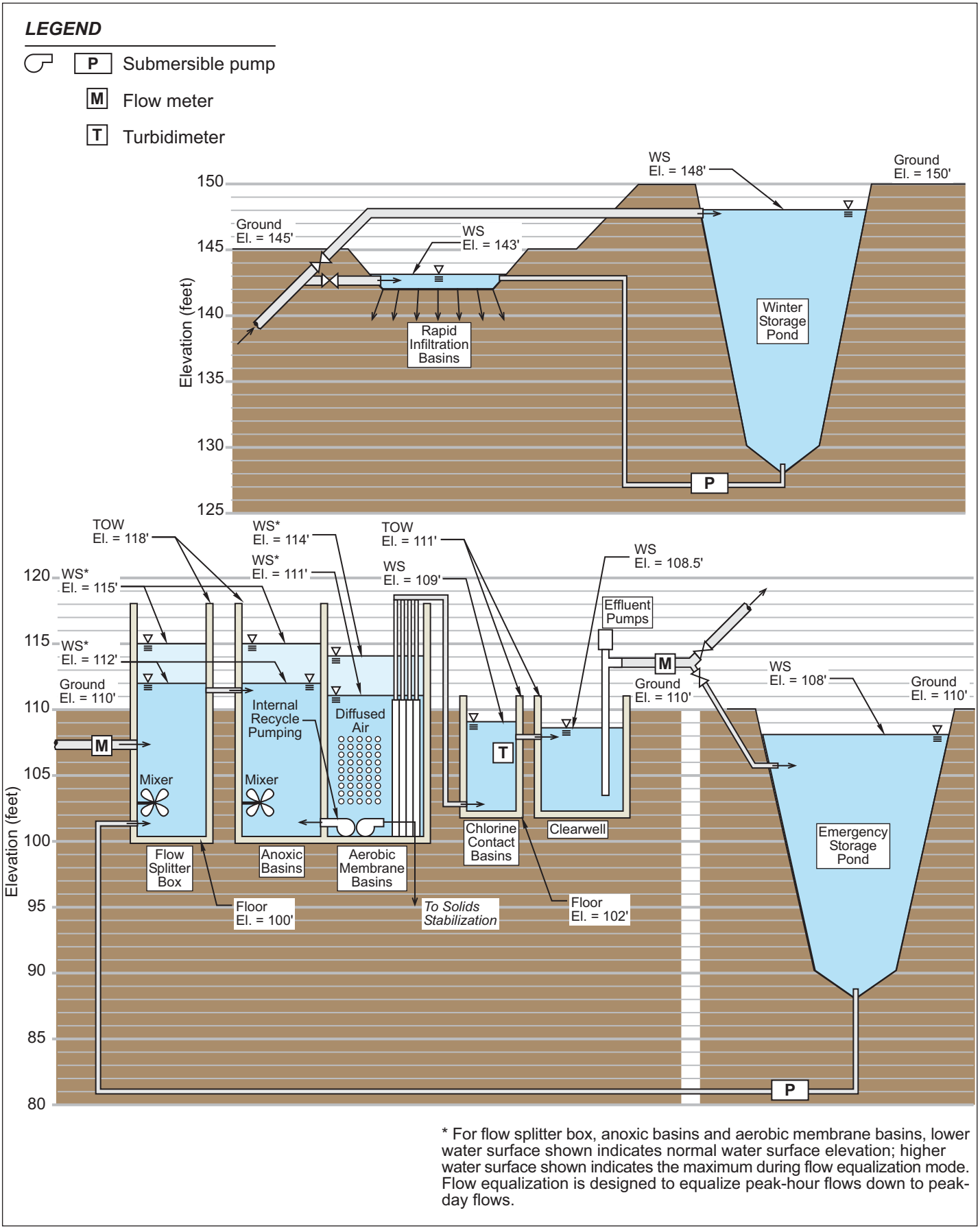
Detail 2. Land Application and Winter Storage Locations Approx. Scale: 1"= 1,000'





2230018/FacilityLocations.fh10

Tetra Tech/ KCM, Inc. 1917 First Avenue Seattle, Washington 98101	Island County FREELAND COMPREHENSIVE SEWER PLAN AND ENGINEERING REPORT	Figure 9-3. TREATMENT, STORAGE AND LAND APPLICATION LOCATIONS



* For flow splitter box, anoxic basins and aerobic membrane basins, lower water surface shown indicates normal water surface elevation; higher water surface shown indicates the maximum during flow equalization mode. Flow equalization is designed to equalize peak-hour flows down to peak-day flows.

2230018/FlowSchematic.fh10

Tetra Tech/ KCM, Inc. 1917 First Avenue Seattle, Washington 98101	Island County FREELAND COMPREHENSIVE SEWER PLAN AND ENGINEERING REPORT	Figure 9-4. HYDRAULIC PROFILE FOR RECOMMENDED IMPROVEMENTS

- Phase 1—Commercial Core, including Nichols Brothers; equivalent to 319 ERUs
- Phase 2—Phase 1 plus adjacent medium-density housing; equivalent to 525 ERUs
- Phase 3—Phase 2 plus development of the area north and west of the commercial core and on both sides of Honeymoon Bay Road and Bercot Road; equivalent to 1,037 ERUs
- Phase 4—Sewers for the entire NMUGA area, assuming low population growth projections; equivalent to 1,558 ERUs
- Phase 5—Sewers for the entire NMUGA area, assuming high population growth projections; equivalent to 3,130 ERUs.

Estimated Cost

Estimated costs for the Phase 1 facilities are presented in Table 9-1. Costs for future phases are presented in Appendix I. Total present worth and annualized costs were calculated over a 20-year period with 4 percent interest. A detailed breakdown of the estimates is presented in Appendix I. The capital cost represents the total project cost for implementation of each alternative. It includes 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. Annual operations and maintenance (O&M) costs were estimated based on power requirements, replacement cost of equipment and structures, chemicals, and labor (general maintenance and cleaning).

Staff Requirements

Estimated staffing requirements for the initial phase of the project are less than one full-time equivalent (FTE). This includes operations and maintenance activities, including laboratory work. In the ultimate buildout phase of the project, two to two and a half FTEs would be required.

In initial phases of the project, it is recommended to capture an economy of scale by hiring operations and maintenance staff from other sewer agencies. This could include HHSD, other nearby sewer or water systems, or a “roving” private contract operations agency. In initial phases, this economy of scale would address emergency and off-hours staffing issues typically associated with small treatment plants.

Operators must have experience with operation of water reclamation facilities, which require another level of expertise over and above that required for wastewater treatment facilities not designed for beneficial reuse.

In later phases of the project, Freeland could directly hire staff to perform operations and maintenance functions.

Flexibility for Future Improvements

The recommended plan provides flexibility for a wide range of future possibilities. The most significant flexibility is that since future population growth is difficult to anticipate accurately, most of the facilities can be phased very flexibly, as needed to account for growth as it occurs.

TABLE 9-1.
ESTIMATED COST OF RECOMMENDED PHASE 1 IMPROVEMENTS

Facility	Construction	Capital	Annual O&M	O&M Present Worth	**Total Present Worth**
Collection	$1,706,000	$2,274,000	$35,600	$520,000	**$2,794,000**
Treatment	$2,567,000	$3,399,000	$88,200	$1,288,000	**$4,687,000**
Storage	$402,000	$506,000	$1,500	$23,000	**$529,000**
Conveyance	$1,321,000	$1,761,000	$17,400	$254,000	**$2,015,000**
Reuse	$369,000	$474,000	$11,500	$168,000	**$642,000**
Total	$6,365,000	$8,414,000	$154,200	$2,253,000	**$10,667,000**

Notes:
Construction = Construction cost, including contractor's markup and 30% planning-level contingency.
Capital = Construction cost, plus 25% for design and construction management, plus 8.3% sales tax.
Annual O&M = Yearly costs of labor, power, chemicals, replacement cost for equipment and structures, and other miscellaneous costs.
O&M Present Worth = Annual costs of O&M converted into a 20-year present worth.
Total Present Worth = Sum of **Capital** and **O&M Present Worth**.

Also, the treatment plant's location relatively central to Freeland provides several flexibility benefits:

- It maximizes the potential for sending reclaimed water to alternative land application sites, if closer or better land application sites are identified in the future.
- It provides flexibility to construct a reclaimed water system for irrigation in Freeland in the future. Use of reclaimed water for irrigation in public areas such as parks and golf courses, or on residential or commercial lawns and gardens would help reduce demand on local potable water supplies.
- It maximizes the potential for a future connection to the Useless Bay Golf Course for summertime irrigation. Use of reclaimed water for irrigation at the golf course would eliminate the approximately 200,000 gpd of groundwater pumped by the golf course for summertime irrigation.

The land application site is in a forested area, so forest irrigation can be practiced in the future in addition to the recommended strategy of land application through surface percolation basins.

FINANCING IMPROVEMENTS

Financing for the new wastewater system may be funded from a variety of sources: developer contributions, user charges, special assessments, debt financing, connection fees, special surcharges, grants, low interest loans or a combination of available resources. This planning-level cost analysis assumes that new septic tanks, septic tank effluent pumps, and lateral connections to the mainline sewers will be paid by the homeowner as part of the requirements to connect to the sewer system. This assumption is consistent with neighboring jurisdictions, such as HHSD. There is a possibility that existing septic tanks can be used and retrofitted with an effluent pump for connection to the STEP system. This will need to be confirmed by a site inspection to determine the suitability of each existing septic system. Experience in other communities has shown that very few existing systems are useable for this purpose.

Grant and Loan Options

State and federal government agencies provide grants and loan funds for financing infrastructure improvements. The Freeland Water District may be able to obtain financing for some or all of the recommended improvements at a lower cost than alternative funding sources by applying for grants or loans available to public agencies. However, the grant and loan programs are competitive, may require a match of local funds and can have restrictions on the types of improvements that can be funded.

Public Works Trust Fund (PWTF)

The Washington State Department of Community Trade and Economic Development (CTED) manages the PWTF, which provides low-interest revolving loans to help local governments finance public works needs. Eligible projects include repair, replacement, rehabilitation, reconstruction, and improvement of sanitary sewers. Funding is provided to meet current standards for existing users and may include reasonable growth as part of the project. Funding is not available for O&M costs. Loans may also be used for emergency planning and capital improvement planning.

To qualify for loans, the agency must meet two criteria. First, counties and cities planning under GMA must be in conformance with adoption timelines for comprehensive plan regulations and those not planning under GMA (including special purpose districts) must have an adopted comprehensive plan that meets the PWTF Board standards. Second, the agency must levy a 1/4-percent real estate excise tax.

The PWTF provides up to $10 million per biennium for qualified communities. Loans for construction projects require a local match that must come from local revenues or state shared entitlements. A local match of between 5 and 15 percent is required for interest rates of 0.5 to 2 percent. The maximum loan term is 20 years, and project completion is required 48 months after contract execution. Applications are accepted in May, and funds are awarded the following year.

Rural Development

Rural Development (RD), an agency of the U.S. Department of Agriculture (USDA), provides grant and loan funds for the development and operation of safe and affordable water supply and sewerage systems. Eligible applicants are public entities including municipalities, counties, special purpose districts, Indian tribes and non-profit corporations in rural areas of up to 10,000 people. Preference is given to communities with less than 5,500 people. The County population is too large for the County to apply for funding from this program. However, the Freeland Water District would be eligible to apply if it were to become the managing entity for the sewer system.

The grants and loans may be used to construct, repair, modify, expand, or otherwise improve waste collection and treatment facilities. Costs can also include engineering, legal and land purchase costs when necessary to develop the facilities. Grants may be provided for up to 75 percent of the project costs when necessary to reduce user costs to a reasonable level. Loans may be provided for up to 40 years depending of the life of the facilities and have a variable interest rate, between 4.5 and 7 percent, depending on the income level of the community. Special preference is given to small towns that are experiencing identified sanitary problems. Applications are accepted year-round.

Historically, RD has awarded grants to communities that implement projects to reduce impacts on sensitive waters, including areas containing shellfish beds or areas that are otherwise environmentally sensitive. As described in previous chapters, Holmes Harbor is classified as a water body with a high eutrophication potential, and that status may be partially due to nutrient contributions from failing septic drainfields. By removing houses from their drainfields and connecting them to a centralized sewage system, the project could improve water quality in Holmes Harbor.

Washington State Revolving Loan Fund

Ecology manages the State Revolving Fund (SRF), which can be used to pay for water pollution control projects such as sanitary sewer projects, including secondary sewer treatment facilities and other water pollution control projects. The agency must have an approved comprehensive plan with a capital facilities plan that identifies the improvement project to be paid for by the SRF loan. The agency must also demonstrate that it will repay the loan through a dedicated source of funding.

SRF funds are intended to be used for existing residential service needs and reasonable amounts of growth. The SRF program allows loans for existing needs plus capacity for 20 years of growth based on GMA plans. Capacity beyond 20 years is considered excess capacity.

Ecology expects to have about $84.4 million of available funding for low-interest loans in 2004. For fiscal year 2004, Ecology plans to offer applicants a 0.5 percent interest rate for repayment within five years and a 1.5 percent interest rate for repayment between six and 20 years. Applicants may be considered for financial hardship terms if their proposed projects would cause user charges to exceed 1.5 percent of the median household income. If Ecology determines that financial hardship exists, it may structure SRF loan agreements with terms to help keep user charges below the financial hardship level. Hardship terms

may include lengthening the repayment period to a maximum of 20 years or adjusting the interest rate to as low as zero percent. There are no matching fund requirements. Applications are accepted between January and March each year.

Washington State Centennial Clean Water Fund (CCWF)

Ecology provides CCWF grants and loans for planning, design construction, or implementation of water pollution control facilities and other activities to meet state or federal requirements and protect water quality. Ecology expects to have $11.2 million in competitive grants and loans in 2004 to fund point and non-point pollution control projects.

After regulatory changes in 2000, there has been a shift from providing grants to offering loans for construction projects. Only loans may be used for site-specific facilities planning, design and construction of point source facilities, land acquisition, installing collection sewers, and side sewers. Loans are available for up to 100 percent of the eligible project cost and grants may be available for up to 50 percent of the eligible project costs where financial hardship can be demonstrated. Applicants may be considered for financial hardship terms if their proposed projects would cause user charges to exceed 1.5 percent of the median household income. Grants for nonpoint source activities are available for up to 75 percent of eligible costs. Ecology loans can be used to make up the local match required for grants.

CCWF funds are intended to be used for existing residential service needs and reasonable amounts of growth. The CCWF program allows loans for the portion of the project up to 110 percent of existing need, with the portion above 110 percent being considered excess capacity.

To be eligible for a CCWF grant or loan, capital improvement projects must be identified in the agency's comprehensive plan. In addition, an approved engineering report must be completed before applying for design funding, and an approved engineering report with specifications must be completed before applying for construction funding. Ecology administers the CCWF loan program in conjunction with the SRF loan program and interest rates, loan terms and financial hardship considerations are the same for both programs. Applications are accepted between January and March each year.

As a clarification, although reclaimed water is no longer technically considered wastewater, RCW 90.46 assures that reclaimed water facilities are eligible for funding from the State Revolving Fund and Centenntial Clean Water Fund.

Department of Community Development Block Grants

The Community Development Block Grant (CDBG) program provides funds from the U.S. Department of Housing and Urban Development as an annual entitlement. CDBG funds may be used to rehabilitate existing public infrastructure provided that the service area is predominantly low or middle income and primarily residential. The Freeland service area does not meet these conditions and it is unlikely that CDBG funds would be awarded to fund project improvements. However, individual low to moderate income home owners may qualify for zero interest CDBG loans to make home improvements such as connecting to the sewer system.

Community Economic Revitalization Board

The Washington State Community Economic Revitalization Board provides low-interest, long-term loans to local agencies for public facility projects that support business and industrial job growth in rural communities. CERB provides low-interest loans or, in unique circumstances grants, to local governments to help finance the construction of public facility projects required by private sector expansions and job creation.

Counties, cities, towns, port districts, special districts and municipal corporations and quasi-municipal corporations with economic development purposes (e.g., public development authorities) are eligible to apply for CERB assistance. Eligible public facilities include sanitary sewer facilities. The Office of Trade and Economic Development, under the Washington State Department of Community Development, administers the program. Applications are accepted every other month between December and October each year.

Table 9-2 provides a summary of the grant and loan programs available to fund wastewater projects.

TABLE 9-2.
SUMMARY OF GRANT AND LOAN PROGRAMS

Program	Agency	Grant/Loan Terms	Fund Growth	Application Date
PWTF	WA CTED	Loan program Loan Term: Up to 20 years Interest: 0.5-2% depending on loan term Local match required	Primarily for existing users. Funds limited growth.	May
Rural Development	USDA	Grants and Loans Grants up to 75% Loan Term: Up to 40 years Interest: 4.5-7% depending on income level	Yes	Year-round
SRF	WDOE	Loan program Loan Term: 6 to 20 years Interest: 0.5- 1.5% depending on loan term No match required	Up to 20 years of excess capacity.	January-March
CCWF	WDOE	Grants and Loans Loan Term: 6 to 20 years Interest: 0.5- 1.5% depending on loan term Loans up to 100% of eligible cost and grants to 50% of cost.	To 110% of existing capacity for loans only.	January-March

CDBG	US Dept of Housing and Urban Development	An annual entitlement programs with loans as low as 0% interest for facilities serving low-moderate income customers.	For existing infrastructure	Varies
CERB	WA OTEC	Grant and loans. To fund public projects that promote business growth and job creation in rural communities.	Facilities that promote private sector expansion & job growth.	Every other month

SRF and Rural Development grants and/or loans may be the most viable funding alternative for the District because of the favorable loan terms, opportunity for grant funding and their ability to provide financing for growth-related improvements.

CCWF grants and/or loans may also be viable, based on the reduction of eutrophication potential to Holmes Harbor from converting from septic systems to a centralized wastewater system.

Development-Based Funding and Local Improvement

For areas experiencing growth, new development may be a viable option for funding capital projects. This approach provides an opportunity for all or a portion of improvement capital costs to be funded by developers and customers directly benefiting from the improvements. Options within this category are most appropriate for large-scale developments.

In expanding areas, large land developers often stand to be the largest beneficiary of added municipal services. The added services almost always significantly increase property values. The presence of wastewater collection and treatment services enables the property to be developed at higher densities since large areas are not required for septic tanks or to protect groundwater from potential contamination. Costs for developing the new service can often be incorporated by the developer into the costs of the improved properties.

In-Lieu-of Fees

In-lieu-of fees can be either a regulatory requirement or a development option that would enable the District to offer developers the choice to construct on-site (septic) facilities in accordance with the District's design criteria, or to pay a fee into a fund dedicated to the construction and maintenance of community-wide wastewater facilities. This approach has the potential to generate dedicated revenues and to guide development patterns consistent with the District's comprehensive wastewater planning.

As a hypothetical example, in a proposed 100 acre development, zoning could allow 300 houses. With the land required for on site systems, only 150 houses could be constructed. Assuming each on site system cost the developer $10,000, the cost to the developer would be $1.5 million plus the lost revenue from the lower density development. In lieu of building on site systems, the developer could dedicate these funds to a regional facility and construct at the allowable density.

In-lieu-of construction fees guarantee new development's initial financing commitment in program development while enhancing the community's ability to construct and develop

regional systems in the most strategic and economic manner. In-lieu-of construction fees also offer an alternative to uniform requirements for construction of on-site systems for each new development.

A shortcoming associated with in-lieu-of construction fees is that the customary fee for a single property or development is rarely large enough to fund the construction of a regional facility. Therefore, either multiple developments must occur simultaneously in a given area to generate enough revenue to fund the construction of a regional facility, or, more realistically, the project must be initially funded from alternative sources.

Developer Extensions

In other areas of the country, it is common for the cost of design and construction of these services to be financed, all or in part, by the developer. In most cases, the developer is responsible for establishing the service to meet the development's ultimate requirements. Establishing service may take many forms, from main line sewer and pump station construction to providing a new collection system and treatment facility. The controlling agency (i.e., the Freeland Water District) would then provide funds to increase future capacity to the requirements identified in the District's planning documents.

New residents outside the establishing development would still be required to pay user fees at the same rate as others connected to the system. Following completion, ownership and responsibility for operation and maintenance of the collection and treatment system would be deeded to the District. The disadvantages of using this source of funds are the loss of control during the design process and the limited availability of large developers in some areas.

Latecomer Charge

A latecomer charge is levied when new customers connect to the wastewater system through facilities paid for by local district assessments, by developer extensions, or by the governing agency in anticipation of increased demand. The latecomer charge represents the new development's share of the cost of sewer facilities paid for by someone else.

If facilities are constructed by the utility and financed by existing customers through fees and/or assessments, the latecomer charge can be used to "pay back" existing customers, via the utility, when latecomer charges are collected. This is similar to the collection of connection fees. Additionally, local communities may allow developers to recuperate a portion of their cost of providing facilities that benefit others, by collecting latecomer charges and agreeing to repay the developer for some of the costs through a latecomer agreement.

The amount of the latecomer charge can be estimated by determining the ratio of the ERUs to be added by the new development to the total ERUs of capacity in the wastewater facilities, multiplied by the cost to construct the facilities.

Connection Fees

A connection fee is a one-time charge collected when a new customer connects to a wastewater system. The connection fee allows new customers to contribute to the cost of

facilities put in place by existing customers or to provide funds to pay for expansion of the system required by new customer growth. The charge may be based on the historical value of the existing facilities, replacement value of existing facilities, projected new facilities required to meet projected growth, or a combination of these and other factors. Revenues are collected as each new customer connects to the system so the District's income from connection fees may vary from year to year depending on area growth patterns. It is usually necessary for other sources of funding such as user rates or operating fund transfers to be available to pay for fixed costs when there are connection fee revenue shortfalls.

The primary goal in selecting a connection fee method is to develop a plan that equitably recovers costs from new customers and is legally defensible. Some generally accepted approaches for assessing connection fees include the system buy-in, growth-related and marginal cost methods.

Under the system buy-in approach, the connection fee is developed to recover the current value of capacity available in the system. It is a method for new customers to "buy-in" to facilities paid for and provided by current customers that also benefit new customers. Generally, the replacement cost of existing facilities, less debt and contributions from others related to those facilities, is used to determine the cost of existing facilities. Those costs are divided by the existing system capacity to determine the average connection fee per ERU. This method is most appropriate for systems with excess capacity available for growth.

The growth-related method relates to recovering the cost of specific facilities required to accommodate new customer growth. Under this method, a projection of expansion-related capital costs is determined and those costs are allocated to new customers. Expansion costs are divided by the added system capacity to develop a cost per unit of capacity which is then multiplied by the average use per ERU to determine the average connection fee per ERU. This method is most appropriate for systems that are expanding capacity to serve new customers. In some cases, the cost of excess capacity in existing facilities is also considered.

The marginal cost approach assumes that new customers should pay the next increment of capital costs incurred. This is similar to a pay-as-you-go financing method and recovers costs as they are incurred. Current capital improvement plan (CIP) costs are divided by the capacity added by the CIP to determine the average connection fee per ERU. The fees vary and are collected so that existing customer rates may not have to be increased over the planning period. This method provides the most financial stability but the fees may vary dramatically from year to year and may not equitably recover costs from each new customer in relation to other future customers.

Local Improvement Districts

Title 36 of the Revised Code of Washington offers counties the power to establish local improvement districts (LIDs) or utility local improvement districts (ULIDs) and to levy assessments against property owners in the identified district as one-time charges or on an annual basis for up to 20 years. This option is best for local facilities that provide a clearly identifiable benefit to the properties being served by the improvement. A benefit to this method of financing is that it does not usually impact debt capacity or debt service coverage requirements of the managing agency, since the repayment of the bond or loan is backed by

property within the LID. The method for levying and collecting assessments is the same for counties as for cities and towns.

LIDs are initiated by a petition of property owners, resolution by the governing body, or administrative recommendation. Formation of an LID involves an extensive administrative and legal process. Most local governments use petitions to determine the wishes of property owners regarding local improvements. A minimum percentage of property owners within the boundaries of the proposed district must agree to the establishment of the improvement district. Property owners representing 60 percent of the dollar amount assessed within the LID can veto the formation of an LID. Because of this, a strong public involvement program is recommended at the outset of the LID process to gauge customer acceptance.

The boundaries of the LID must be defined in the petition. The LID may include all or any portion of the service area, but must not include properties that will not be benefited by the improvement. If assessments are increased or the boundaries of the service area are changed after the initial LID is implemented, a new hearing and customer approval process must be conducted. This process can be costly and time consuming and property owners may veto additional improvements or assessments so it is important to clearly define the costs and boundaries of the LID at the outset.

Projects funded through special assessments must have an identifiable benefit to the properties included in the assessment area, and charges for each parcel must be consistent with the relative benefit to each property. Approved methods of allocating assessments for public facility improvements include the following

- Zone Termini—The zone method involves the division of land on either side of the improvement into zones or strips that parallel the improvement. Two or more zones are established and, typically, the rate of assessment decreases with distance from the improvement. The properties within a particular zone are assessed a percentage of the cost of the improvement, depending on that zone's proximity to the improvement.
- Front Footage—With the frontage method, each property abutting an improvement is assessed a part of the total cost of the improvement in proportion to its frontage compared to the total frontage of all properties abutting the improvement. This method may be inequitable in cases of irregularly shaped lots with varying frontages.
- Area—Sanitary and storm sewer improvements are frequently assessed to benefiting properties on the basis of area. Each property is assessed the proportion of the cost which its area bears to the total area served by the project.
- Unit—The service unit or lot unit method assesses each lot equally. In the case of a lot that could be subdivided, unit assessments may be made according to the number of potential building lots and applies to vacant as well as developed property.
- Property Value—An appraisal of each parcel in the LID is conducted to determine the value of the property before and after the improvement. The difference is considered the benefit amount the property receives and costs are apportioned based on that benefit.

- Combination—The basic allocation schemes are sometimes used in combination with each other. For example, a percentage of an improvement cost may be charged on a frontage basis and the remaining cost allocated by area; sewer improvements may be charged on service unit and frontage basis; etc.

LID assessments can provide an alternative to funding capital improvements from connection fees and user rates for certain improvements. The assessment can either be collected as a one-time fee or as a monthly or annual payment. Typically the formation of an LID involves issuing bonds to finance capital costs and allows customers to repay those costs over the term of the bonds through monthly or annual assessments.

Ad Valorem Taxes

Agencies with taxing authority may use revenues from ad valorem taxation to repay certain capital improvement loans. This method of financing distributes construction costs among all properties in the taxing jurisdiction. The tax on each property is apportioned on the basis of individual assessed values. The use of ad valorem taxation is most appropriate for special purpose districts and small communities—where projects are essentially local in character and the benefits of the improvements to properties within the jurisdiction are relatively uniform.

Financing Options

Options for financing capital improvement projects include pay-as-you-go (or reserve) funding, debt financing or a combination of the two. Financing from outside sources in the form of privatizing or leasing facilities may also be an option for some improvements. The appropriateness of each option depends on District policies and the nature of the improvement.

Pay-As-You-Go

Pay-as-you-go financing allows operating and capital costs to be funded based on the rate of revenues collected from monthly user charges or assessments. Pay-as-you-go financing is most often used for smaller projects since financing larger projects with this method may produce dramatic shifts in user charges and revenue requirements from year to year. Reserve funds may be built up over years to provide funding for future projects without changing rates each year. A benefit of using pay-as-you-go funding is avoiding the added interest and issuance expenses associated with debt financing. A downfall of this method is that it places the burden of financing projects, which may also benefit future customers, on existing customers and it may decrease customer user rate stability.

Bonds

Projects that are large and costly in relation to an agency's financial resources, that have a long useful life, and that are not frequently recurring are appropriate items to be financed by bonds. Using bonds to finance larger capital projects that have an extended useful life allows the cost of those facilities to be financed by existing as well as future customers that

benefit from the improvements. This provides an equitable method for recovering costs over the useful life of a project and does not unduly burden current residents.

The amount that a local agency may borrow to finance a project varies, depending on the amount of financing being sought, the agency's debt-paying capacity or credit rating, and the relationship of its outstanding debt to the statutory limitation on debt.

Interest rates on bonds vary depending on the type of bond, the amount of funds securing the bond, prevailing market conditions, the term of the bonds, and other factors. General obligation bonds, revenue bonds and special assessment bonds can all be used to finance improvements.

General Obligation (GO) bonds are supported by property taxes in the County. Financing construction with GO bonds places the costs in proportion to the assessed value of properties rather than the amount or type of sewage produced. Financing a capital improvement with general obligation bonds is accomplished in the following manner: The engineer prepares a detailed cost estimate on the construction. An election is held to ascertain whether the public wants the bonds to be sold to finance the improvement. If the bond issue receives voter approval, construction begins and the project is funded by interim financing. Once the project is completed and exact project cost determined, the bonds are sold. If the project directly benefits the entire community, the bonds are normally retired with revenues generated by a uniform ad valorem tax. However, if the project benefits only a segment of the community, the bonds are retired by special assessments or other funds received from benefiting property owners or service recipients.

Revenue bonds are supported by the income generated from monthly sewage charges. Existing and new sewer system customers pay for any bonds outstanding through assessments or monthly user rates. The District can issue revenue bonds at its discretion. The sewer rates must be high enough to pay system operation and maintenance costs plus the annual principal and interest cost (debt service) of the bond issue. For investors to buy revenue bonds, the rates must provide a cushion of revenue called debt service coverage. The normal coverage requirement is 25 to 40 percent of the annual debt service, depending on the financial strength of the bond issuer. This amount must be collected from revenues and available each year that the bonds are outstanding. However, the excess funds collected can be used in subsequent years to pay for improvements.

Interim Financing

Although it is technically possible to levy a special assessment in advance of the completion of a capital improvement, to do so has the disadvantage of requiring a second assessment or a refund in the event that the final costs of the improvement differ from the estimates. Therefore, it is necessary to use other means to pay for the work, performed prior to the actual assessment.

A common interim finance practice is for the District to issue general obligation warrants in anticipation of the revenue to be collected through special assessments. The jurisdiction or project contractors convert these warrants into cash by pledging them as security to lending institutions.

Another interim financing method involves the use of a revolving fund. Such an account holds funds derived from general bond issues, service charges, tax receipts, etc. A number of revolving funds may exist. Each fund is related to a specific category of capital improvements and all or a portion of its funds may be used to finance interim costs associated with those improvements for which the fund is intended. Once the project is completed, the fund is reimbursed with proceeds from special assessments and bonds, as well as other funds.

Using a revolving fund for interim financing has the advantage of eliminating the cost and complications involved in issuing general obligation debt. Of course, an even less complicated interim financing source than a revolving fund is the general fund. If a surplus is available, the cost of a project may be charged against the general fund. Once the project is completed, the general fund is reimbursed with proceeds from assessments, bonds, etc.

Privatization

The use of the private sector to finance wastewater facilities is becoming a more common method of financing capital facilities. The private finance option involves ownership of the capital facilities by entities other than the District. Typically, for new capital facilities, a private entity will finance, design, build and operate the new facilities and once completed, charge the governing agency a user fee that recovers the capital and operation and maintenance costs over the life of the facility. Privatization can involve the private entity undertaking all aspects of the project, just financing the new facilities or actually purchasing existing facilities and leasing them back to the governing agency to operate.

Leasing

Leasing is similar to privatization, except that it is much less complex and only the equipment is privatized (i.e., not the building, land and services). Advantages and disadvantages for leasing are similar to privatization except that the control of operations is maintained by the governing agency. Leasing may be beneficial if there are debt limitations restricting the purchase of equipment and needed facilities. Other advantages are that facilities may be built more quickly and cheaply through lease arrangements because there tend to be fewer delays for private industry. The lease could be written so that the governing agency would have the option to purchase the facility or equipment at the end of the lease. The most probable source of lease financing would be large banks, equipment manufacturers, real estate development firms and major leasing companies.

User Charges

User charges are regular payments from customers who use or benefit from services, facilities and resources. User charges are a common method for collecting annual revenues from sewer customers through monthly rates that fund operation and maintenance, repay bonds and loans and generate reserves to finance capital replacements and improvements.

To determine the appropriate allocation of costs among customers and develop a schedule of rates for service, it is necessary to complete a cost of service allocation analysis and rate study. This information will help to determine what the annual costs are, how different customers use the facilities and what portion of the costs should be recovered from each

customer class commensurate with their use of the system. Rates can also be designed to further policy goals of the governing agency such as revenue stability, conservation of resources, economic development objectives, and low income assistance programs.

Customer rates would most likely be used to fund the Freeland sewer system operation and maintenance (O&M) costs. They could also be used to fund all, or a portion of, capital costs. The cost analysis below describes rates in more detail.

Alternative Financing Evaluation

An appropriate funding mix balances the governing agency's policy goals and objectives while imposing the least cost on customers. In developing a financing plan, primary objectives to consider include revenue sufficiency, rate stability, equitable cost recovery, legal acceptability and practical administration and implementation. Other issues to consider are the impacts on the use of debt financing vs. pay-as-you-go funding and cost recovery from existing vs. new customers.

The cost analysis below shows how annual operation and maintenance costs and phased capital costs can be financed.

Operation and Maintenance Costs

O&M costs are typically financed by rates. They are not typically financed by debt. For the recommended improvements, O&M costs are projected to result in customer rates between $29 (Phase 1 O&M) and $17 (Phases 1-5 cumulative O&M) per month per ERU to fund O&M costs. Recall that as described in Chapter 4, an ERU is the equivalent of a single family household. Each ERU is estimated as approximately 140 gallons per day (gpd) on an average basis, not including inflow and infiltration (I/I) flows. Lower rates are achieved as the area reaches the maximum density growth projections, allowing more of an economy of scale.

Capital Costs

Revenues from LID assessments, connection fees, and/or user rates may be used to finance the capital portion of the costs. Note that as previously stated, it is assumed that the costs of STEP septic tanks and pumps, along with the pipe lateral from the septic tank to the sewer main in the street, would be borne separately by the connecting customer. In some instances, the existing septic tank could be re-used to save costs.

The cost of a new septic tank, pump, and lateral is estimated to range between $3,500 and $6,000, depending on site conditions, including local soil conditions, construction access, size of electrical service at the connection, and distance from septic tank to sewer main. In some cases, grants and loans may be available to help defray the cost to a homeowner.

Option A: LID. Capital costs can be recovered through an LID if the required majority of property owners approve of the plan. As described previously, LID costs can be apportioned per acre, per ERU, or in a number of different ways. Cost per acre is shown here as an example. To fund improvements through an LID, an estimated lump sum assessment per acre of between $61,000 (for Phase 1 only), $57,000 (for Phases 1 and 2 being implemented

at the same time) and $30,000 (average cost over the implementation of Phases 1 through 5) would be required.

Due to large lump sum payments required from property owners to fund some capital projects, it is common for an LID to issue bonds to finance the capital costs over the life of the facilities and spread out the customers' payments. This also may allow a portion of the project costs to be recovered by new customers as the service area expands. The projected annual payment could range between $4,000 (Phase 1 only), $3,000 (Phases 1 and 2 being implemented at the same time), and $2000 (average cost over the implementation of Phases 1 through 5) per acre per year for 20 years, assuming that a majority of the project cost is funded through low interest loans.

Option B: Connection Fees. Capital costs can also be financed through connection fees from new development. One method of determining the connection fee is to base it on a marginal cost or phased pay-as-you-go approach. Under this method, costs will vary dramatically from phase to phase, and Phase 1 customers will likely pay more than later customers for capacity provided because they will not be able to take advantage of the same economy of scale as later connections. However, the utility may avoid some of the revenue shortfalls during the planning period.

Under the marginal cost approach, the estimated connection fee would range from $23,000 per ERU (Phase 1), $16,000 per ERU (Phases 1 and 2 implemented at once), or between $3,000 to $23,000 per ERU, depending on the phase of construction over the 20+ year planning period.

The growth-related method establishes an equitable way to collect connection fees from new customers by determining the average cost per unit of added system capacity used by a typical ERU. That average amount is collected from each new customer over the life of the facility, rather than as costs are incurred from year to year. Under this approach, the connection fee for the District could range between $18,000 per ERU (Phase 1), $11,000 per ERU (Phases 1 and 2 being implemented at the same time), or an average of $6,000 per ERU to fund all identified improvements (average cost over the implementation of Phases 1 through 5) over the life of the improvements. However, a reasonable estimate of growth needs to be evaluated prior to establishing the fee so that costs are not based on a level of capacity that may not be realized. For this reason, it is not advisable to base a connection fee on capacity and costs that may not occur for over 20 years.

Connection fee revenues are collected as each new customer connects to the system, so the income from connection fees may vary from year to year depending on growth patterns. It is usually necessary for other sources of funding, such as user rates or operating fund transfers, to be available to pay for fixed costs when there are connection fee revenue shortfalls. The uncertainty inherent in this approach may result in high variability in the rates or operating fund transfers from year to year.

Option C: Debt Financing. Another option is to finance capital projects by issuing debt repaid through monthly rate revenues. Assuming a majority of the project costs are funded from low-interest loans and the debt is secured by monthly customer rates, the rate for the capital costs could average between approximately $120 (Phase 1), $80 (Phases 1 and 2 being implemented at the same time) and $40 (average cost over the implementation of

Phases 1 through 5) per month per ERU. These monthly rates would be in addition to the monthly rates required to pay for annual operations and maintenance costs (described in a previous paragraph).

However, if the project is successful in obtaining significant grants, such as the maximum amount of 75 percent grant funding available from the Rural Development program, and if the remaining capital costs were financed through low-interest loans, then the monthly rates for capital costs could average between approximately $30 (Phase 1), $20 (Phases 1 and 2 being implemented at the same time) and $10 (through Phase 5) per ERU.

Lower rates are achieved as the area reaches the maximum density growth projections. These estimates represent capital financing costs only and do not include additional funds to maintain debt service coverage requirements or reserves. The rates required to fund capital costs would be in addition to the rates required to fund O&M costs described previously.

The first portion of Table 9-3 summarizes the capital cost financing options for Phase 1 costs only.

Option A identifies the average lump sum cost or an estimated annual payment per acre for establishing an LID. The annual payment assumes that a majority of the costs will be financed from low interest loans.

Option B shows the connection fee that could be collected based on the marginal cost or the growth-related fee methods discussed above.

Option C identifies the monthly rates for capital facilities, assuming that low interest loans or grants are used to fund improvements and those costs are repaid by customer rates.

The second part of Table 9-3 shows the impact of the different financing options for constructing the combined Phase 1 and 2 facilities and allocating the combined costs over the Phase 1 and 2 estimated ERUs and service area.

The third part of Table 9-3 identifies the impact of the different financing options for each phase of the project and the overall average assessments or connection fee for staged implementation of all five phases.

Each of the capital financing options shown above assumes that either Option A, B or C will be solely used as a method for financing capital costs. The actual implementation of the project will likely include a combination of funds from rates, connection fees and/or assessments to finance the operating and capital costs. A detailed analysis of the annual revenue requirement should be conducted to determine anticipated customer growth, sources of funds and projected expenses to calculate the level of funding available from each resource and funds required from user rates on an annual basis.

TABLE 9-3.
FINANCING FOR PHASE 1 IMPROVEMENTS

Phasing:	Option A LID Formation		Option B Connection Fees		Option C Rates with Debt Financing or Grants[3]	
	Lump Sum $/AC	Annual Payment $/AC[1]	Marginal Cost Method $/ERU	Growth Related Method $/ERU[2]	$/Mo per ERU with 100% Debt[1]	$/Mo per ERU with 75% Grant
1. Implementation of Phase 1 only	$61,000	$4,000	$23,000	$18,000	$120	$30
2. Implementation of Phases 1 and 2 at the same time	$57,000	$3,000	$16,000	$11,000	$80	$20
3. 20+Year Capital Cost Financing Option Summary						
Phase 1	$61,000	$4,000	$23,000	$18,000	$120	$30
Phase 2	$8,000	$3,000	$6,000	$4,000	$80	$20
Phase 3	$12,000	$2,100	$9,000	$4,000	$60	$20
Phase 4	$7,000	$2,000	$11,000	$11,000	$60	$20
Phase 5	$6,000	$2,000	$3,000	$3,000	$40	$10
Average for Phases 1-4	$24,000			$8,000		
Average for Phases 1-5	$30,000			$6,000		

Notes:
1. Assumes annual payments over 20 years with 90% low interest loan financing and 10% bond financing.
2. May require funds from other sources (i.e. rates or grants) to recover revenue shortfalls in certain years.
3. In the "Implementation of Phases 1 and 2 at the same time" and "20+ Year Capital Cost Financing Option Summary," rates are cumulative based on financing costs for current and previous phases.

Affordability Criteria

Ecology has established that monthly user fees in excess of 1.5 percent of the median household income for the area present a hardship on customers. The state's Office of Financial Management's 2003 projected median household income for the County is $50,800. Based on that information, a user rate of $63.50 or more per month would present a hardship on Freeland customers under the Ecology standard.

Table 9-4 shows the results of a survey of local community rates. While the average sewer rate is relatively low, many of the lowest rates are for systems that are very large, such as Seattle, or that have already paid for significant portions of their systems' installation. In

island-based communities, such as Vashon Island and Whidbey Island, sewer rates tend to be more expensive due to the remote location and smaller size of communities. The average rate for the overall area is $33 per month.

TABLE 9-4.
TYPICAL SEWER RATES

Local Community	Monthly Residential Sewer Rate (based on 600 cubic feet residential winter water use/month)
Anacortes	$37
Bellingham	$24
Clinton (proposed)	$14-$45
Everett	$28
Holmes Harbor Sewer District	$55
Langley	$31
Lynnwood	$21
Marysville	$28-$34
Mukilteo	$28
Seattle	$28
Snohomish	$33
Vashon Island	$46
Average	**$33**

Freeland's sewer rates will depend on the funding mix selected for implementation of facilities, but O&M costs are projected to be in the range of $17 to $29 per month per ERU. Freeland's projected near-term rates to fund O&M costs are in line with other local rates, but the total rates could be higher, depending on the extent of capital costs funded through the sewer rates.

Typically, connection fees are collected to buy into an existing system or pay for expanding existing facilities. As a result, it is difficult to benchmark the cost of building an entirely new system against other local communities that constructed facilities years ago. In the Island County area, the City of Langley charges a $2,000 residential connection fee for wastewater treatment facilities completed in 1992. The facilities were funded from CDBG grants, SRF loans and revenue bonds backed by ULID assessments. The current Clinton Sewer District Comprehensive Sewer Plan shows projected connection fees of approximately $10,000 per ERU, based on a pro-rata allocation of costs over a 20-year planning period. The estimated connection fees for Clinton vary between $9,500 and $24,100, depending on the estimated number of customers.

The assessment for an LID cannot exceed the benefit the property is gaining from the improvement according to state law. The benefit is determined by the difference between the present value of the property and the property value after the improvement. However, there are other considerations such as the demographic make-up of the community and

customer acceptance of the LID assessments that may determine a lower threshold for affordability. Due to the unique nature of each LID project, it is difficult to compare the costs of LID improvements in different communities against one another. In the Island County area, the City of Langley charges a monthly surcharge of $2.00 plus $.007 per gallon of water used, approximately $32 per ERU, to commercial customers for LID improvements related to the wastewater treatment facilities. The current Clinton Sewer District Comprehensive Sewer Plan shows projected assessments of approximately $100,000 per commercial acre and $40,000 per residential acre, based on 50 percent of the total service area of 278 acres.

Recommendations

In order to proceed with the recommended system improvements, the County and the Freeland Water District should:

- Actively pursue grant and low-interest loan options for financing improvements.
- Survey customers to determine the desirability of an LID. If there is sufficient support for the project, the District should begin to formulate an LID implementation plan, develop a customer involvement program and form an LID administrative committee, including legal counsel, to guide the project through the process.
- Explore developer funding opportunities to assist the District with financing certain improvements.
- Conduct a detailed short- and long-term analysis of customer growth estimates, annual expenses and projected revenues to determine the annual revenues required from customer rates to construct and operate the system.
- Perform a cost of service analysis to equitably allocate costs to customers.
- Re-evaluate rates and connection fee estimates on a regular basis as costs and other factors change.
- Phase or stage project costs and implementation schedules as necessary to spread out or reduce the financial impact on customer rates, assessments and connection fees.

PERMITTING CONSIDERATIONS

Several permits will be required for the implementation of capital improvements as well as for operation of facilities after construction. More background on these permitting requirements is given in Chapter 3.

Construction-Related Permit Issues

Island County Permitting

Island County will require a SEPA Review. It will also require a Critical Areas Review, to identify critical areas that might be affected by the project. These could include wetlands, steep slopes, and floodplains.

This project is located in a coastal zone county and is consistent with Washington's Coastal Zone Management Program and enforceable policies (State Environmental Policy Act, Water Quality, Air Quality and the Shoreline Master Program). Because some collection system piping may be within 200 feet of Holmes Harbor (near Freeland Park), an Island County Shoreline Substantial Development Permit may be required.

The County will require a Clearing and Grading Permit and a Building Permit to construct facilities. These permits are typical for general building projects. The Island County Department of Planning and Community Development will issue these permits. Application can be made prior to the County's final decision on the Shoreline Permit, although approval of building and clear-and-grade permits cannot occur until the shoreline permit has been approved and the appeal period has run.

A Road Franchise must be obtained from the Island County Public Works Department to construct the sewage collection system and reclaimed water conveyance pipeline. This permit establishes requirements for construction, safety and road restoration. Permission to construct in the State Highway 525 right of way may also be required depending on the location and route of the pipelines.

Facilities must comply with the Uniform Fire Code. Island County Fire Protection District Number 3 will be the governing body for compliance with this code.

Historical and Archaeological Sites

The Washington State Office of Archeology and Historic Preservation requires a review of potential historic and archaeological resources in the project area. Robinson Cultural Resource Services performed such a study for the Freeland area. Preliminary results show that the proposed action will not affect cultural resources in the area.

Floodplains, Wetlands, and Flood Insurance

There are no wetlands on the treatment plant site or on the land application site. Conveyance pipelines will be constructed in the road and adjacent road shoulder, so they will not cross wetlands.

Federal Emergency Management Agency (FEMA) maps show that the treatment plant, conveyance pipeline and disposal areas are not located in floodprone areas. Most of the collection system piping in the commercial and residential areas also will be constructed in areas not prone to flooding. There are some low areas near Holmes Harbor that County and FEMA mapping show to have a flooding potential.

Agricultural Lands

The treatment plant and land application sites are forested. The land application site has been used as a tree farm. The route of the proposed conveyance pipeline along Bush Point Road from the plant site to Mutiny Bay Road also has not been recently used for agriculture. There is no significant farming activity is the areas where the collection system piping will be constructed in the service area.

Wild and Scenic Rivers

There are no rivers in the planning area identified as wild, scenic, or recreational.

Fish and Wildlife Protection

No streams or significant upland habitat features will be impacted by this project. In one of the later phases, a collection system pipe will have to be constructed within the roadway over the low area adjacent to Holmes Harbor, across an unnamed creek (a Class 4 waterway) that runs through Freeland Park. The stream passes under the road in a culvert. The collection system pipe will be constructed under the road surface and above the existing culvert, so no in-water work is required.

Endangered Species Act

Because no work is proposed in or adjacent to marine waters or salmonid bearing streams, this project will not directly impact listed fish species. Indirect impacts could occur over time with the increased amount of stormwater from additional impervious areas, which would eventually reach local marine waters and degrade water quality.

The bald eagle is listed as "threatened" by both the federal government and the State of Washington. Although bald eagles are frequently seen flying or perched in the service area, no construction for the collection system, treatment facility, storage basins, or land application site will occur near any known nest sites. To construct the treatment plant, storage basins, and land application facilities, approximately five acres of tertiary growth forest will be removed during Phase 1; approximately eight acres will be removed at ultimate buildout. No significant vegetation removal will occur for collection and conveyance facilities, because the major conveyance pipeline will be in the roadway and the collection system piping will mostly be in the roadways of commercial and residential areas. A letter of ESA compliance will be sent to the U.S. Fish and Wildlife Service and to National Oceanic and Atmospheric Administration Fisheries for their review and concurrence.

Washington Department of Fish and Wildlife

A Hydraulic Project Approval may be required from the Washington Department of Fish and Wildlife for the portion of the collection system piping crossing the unnamed creek that runs through Freeland Park, if in-water work is required.

NDPES Stormwater Permit

If the projects disturb over 5 acres, a construction general permit for stormwater discharge will be required under NPDES requirements. This permit is issued by the Washington Department of Ecology. Mitigation measures would be required, including preparation of a Storm Water Pollution Prevention Plan. During construction, temporary erosion and sediment control measures would be required.

Northwest Air Pollution Control Authority

A permit from the Northwest Air Pollution Authority would be required, since the standby generator for the treatment facility could be over 250 kW in capacity during later phases of implementation.

Operations-Related Permits

As described in Chapter 3, operations-related permits would include a State Waste Discharge Permit from Ecology, a water reclamation permit from Ecology and the Department of Health, and a permit or agreement with the Island County Septage Handling Facility for accepting stabilized solids from the treatment plant.

IMPLEMENTATION SCHEDULE

Table 9-5 shows the estimated schedule for the wastewater facilities improvements. Phasing of implementation is the most significant driver for the schedule. The schedule is subject to change and will be revised throughout the course of the project.

TABLE 9-5.
IMPLEMENTATION SCHEDULE

Item	Estimated Date of Completion
Prepare Environmental Reviews and Draft Comprehensive Sewer Plan and Engineering Report/Facility Plan	February 2004
Agency Planning for Implementation	July 2005
Wastewater Facilities Implementation	
Permitting	July 2006
Detailed Hydrogeological Analysis and Facilities Design	December 2006
Construction	July 2008

COMMUNITY RELATIONS

As described in Chapter 3, several community meetings were conducted to ensure that the local community had a chance to comment on the overall direction of the project. These public meetings were each followed by a meeting of the Freeland Sub-Area Planning Committee to review the material presented and questionnaire results, discuss the alternative, and select a preferred alternative. These meetings were also open to the public.

CONCLUSIONS

This Comprehensive Sewer Plan and Engineering Report/Facility Plan has met the project goals by developing and evaluating alternatives for wastewater collection, treatment, storage, and reuse facilities to provide adequate hydraulic and treatment capacity for the planning period. Planning level cost estimates were prepared for comparison of alternatives, and a recommended alternative was selected. Rate impacts and phased implementation strategies were also evaluated.

The estimated capital cost for these recommended projects, including construction costs, contingency, engineering, construction administration, and sales tax, is approximately $8.4 million for the initial phase of implementation.

Recommended next steps are as follows:

- Actively pursue grant and low-interest loan options for implementing and financing the recommended improvements.
- Conduct a detailed hydrogeological analysis for the recommended land application site(s), as described at the end of Chapter 8.
- Conduct detailed financial and implementation analysis, as described previously in this chapter.

LIST OF ABBREVIATIONS

AA—Average annual

AAF—Average annual flow

AEHT—Annual extreme high tide

AOR/SOR—Actual Oxygen Rate / Standard Oxygen Rate

bhp—Brake horsepower

BOD_5—Five-day biochemical oxygen demand

BOD—Biochemical oxygen demand

C—Initial solids concentration

C_{min}—Minimum attainable effluent solids concentration

cf—cubic feet

CFR—Code of Federal Regulations

DNR—Washington Department of Natural Resources

DO—Dissolved oxygen

EHT—Extreme high tide

EHTF—Extreme high tide and flood

EPA—U.S. Environmental Protection Agency

ERU—Equivalent residential unit

ESS—Effluent suspended solids

fps—Feet per second

F—Recurrence frequency

ft—Feet

gpad—Gallons per acre per day

gpcd—Gallons per capita per day

gpd—Gallons per day

gpm—Gallons per minute

hp—Horsepower

HRT—Hydraulic residence time

I/I—Infiltration and inflow

icfm—inlet cubic feet per minute

INV_{vss}—Inventory of volatile suspended solids in the liquid treatment process

in—Inches

k_1—Empirical coefficient in equation for settling velocity

k_2— Empirical coefficient in equation for settling velocity

kcf—1,000 cubic feet

k_d—Decay coefficient for calculation of total sludge production

lb—Pounds

ln—Natural logarithm

MCRT—Mean cell residence time

MD—Maximum day

mg/l—Milligrams per liter

mgd—Million gallons per day

MG—Million gallons

MHHW—Mean higher high water

MLLW—Mean lower low water

MLSS—Mixed liquor suspended solids

m—meters

MMF—Maximum-month flow

MM—Maximum month

MPN—Most probable number (a measure of count for coliform bacteria)

NOX—Oxidized nitrogen compounds (as nitrogen)

NMUGA— Non-Municipal Urban Growth Area

NPDES—National Pollutant Discharge Elimination System

PDF—Peak-day flow

PH—Peak hour

PHF—Peak-hour flow

ppcd—Pounds per capita per day

ppd—Pounds per day

pph—Pounds per hour

psig—Pounds per square inch gauge

Q—Wastewater flow

RAID—Residential Area of More Intensive Development

RAS—Return activated sludge

Reclaimed water—wastewater that has been through a high level of treatment and is beneficially reused following state reuse standards

SBOD—Soluble biochemical oxygen demand

$SBOD_r$—Soluble BOD removed in the liquid treatment process

scfm—standard cubic feet per minute

SCS—U.S. Department of Agriculture Soil Conservation Service

SEPA—State Environmental Policy Act

sf—Square feet

SRT—Solids residence time

SVI—Sludge volume index

TBOD—Total Biochemical Oxygen Demand

TDH—Total dynamic heat

TKN—Total Kjeldahl nitrogen

TP—Total phosphorus

TSS—Total suspended solids

TSS_p—Total sludge production

TSS_{in}—Total suspended solids influent to the liquid treatment process

UBC—Uniform Building Code

UFC—Uniform Fire Code

USDA—U.S. Department of Agriculture

V_0—Empirical coefficient in equation for settling velocity

V_{dig}—Volatile solids concentration of digested sludge

V_{raw}—Volatile solids concentration of mixed raw sludge

$V_{settling}$—Rate of subsidence of solids-liquid interface

VSS_r—Volatile solids reduction

VSS—Volatile suspended solids

WAC—Washington Administrative Code

WAS—Waste activated sludge

X_{dig}—Digested sludge total solids concentration

X_{raw}—Raw sludge total solids concentration

Y—Yield coefficient, pounds of volatile sludge produced per pound of soluble BOD removed

REFERENCES

Adams & Clark Inc., 1993. *Holmes Harbor Water District Comprehensive Sewer Plan and Engineering Report for Wastewater Facilities*.

Brater, Ernest F., and King, Horace Williams, 1976. *Handbook of Hydraulics*, McGraw-Hill Book Company, 6th Edition, New York.

Departments of Health and Ecology, 1997. *Water Reclamation and Reuse Standards*. Washington Department of Ecology Pub #97-23, Olympia, WA.

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Department of Ecology, 1994. *Permit Writer's Manual*, Washington Department of Ecology Pub #92-109, amended July 1998, Olympia, WA.

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U.S. Department of Agriculture, Soil Conservation Service, 1958. *Soil Survey, Island County, Washington*.

APPENDIX A.
AGREEMENT BETWEEN ISLAND COUNTY AND THE FREELAND WATER DISTRICT

When recorded return to:
The Freeland Water District
P. O. Box 517,
Freeland, WA., 98249

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WASHINGTON STATE COUNTY AUDITOR/RECORDER'S INDEXING FORM

Please Print or type information

Document Title(s) (Or transactions contained therein)

1. **RECORDING OF "Inter-Local Agreement"**

Grantor(s) (Last name first, then first name and initials)

1. **Between Island County & The Freeland Water District**
2. Additional names on Page _____ of document.

Grantee(s) (Last name first, then first name and initials)

1. **N/A**
2. Additional names on Page _____ of document.

Legal Description (abbreviated: i.e. lot, block, plat or section, township, range)

Portions of Township 29 North, Range 2, E.W.M.
All situate in the County of Island, State of Washington

Additional legal description is on Page(s) **N/A** of document

Assessor's Property Tax Parcel or Account Number:
Island County Assessor's Parcel Nos. **N/A**:

Reference Number(s) of Documents assigned or released: **N/A**

INTERLOCAL AGREEMENT
BETWEEN ISLAND COUNTY AND THE FREELAND WATER DISTRICT

This Agreement is hereby entered into by Island County (the "County"), a political subdivision of the State of Washington and the Freeland Water District, a municipal corporation of the State of Washington.

WHEREAS, RCW 36.70A.110, the Washington State Growth Management Act of 1990, as amended, allows each county to designate Non-Municipal Urban Growth Areas ("NMUGA"); and

WHEREAS, RCW 36.70A.110(3) states that urban growth should be located first in areas already characterized by urban growth that have adequate existing public facility and service capacities to serve such development, second in areas already characterized by urban growth that will be served adequately by a combination of both existing public facilities and services and any additional needed public facilities and services that are provided by either public or private sources, and third in the remaining portions of the urban growth areas; and

WHEREAS, RCW 36.70A.210(3)(a), the Washington State Growth Management Act of 1990, as amended requires that a county-wide planning policy shall address policies for promotion of contiguous and orderly development and provision of urban services to such development; and

WHEREAS, Island County-Wide Planning Policy #5 addresses policies for promotion of contiguous and orderly development and provision of urban services to such development, specifically the use of interlocal agreements to meet this objective; and

WHEREAS, RCW 36.70A.120, the Washington State Growth Management Act of 1990, as amended, requires that each county required to plan under RCW 36.70A.040 shall perform its activities and make capital budget decisions in conformity with its comprehensive plan; and

WHEREAS, the Island County Comprehensive Plan Capital Facilities Element states that a goal of the County is to provide new municipal public works facilities only within, and not beyond, urban growth areas. Such facilities include sanitary and storm sewer collection and treatment facilities; and

WHEREAS, RCW 57.16.010 requires that a comprehensive general plan be adopted by a water district or sewer district before any improvements are ordered or any vote on any proposition to incur any indebtedness is submitted; and

WHEREAS, RCW 57.16.015 states that no expenditure for carrying on any part of a general comprehensive plan shall be made by a water district or sewer district other than the necessary salaries of engineers, clerical, office expenses, and other professional expenses of the district, and the cost of engineering, surveying, preparation, and collection of data necessary for making and adopting a general plan of improvements in the district, until the general comprehensive plan of improvements has been adopted by the water district or sewer district commissioners and approved as provided in RCW 57.16.010; and

WHEREAS, RCW 36.94.190 allows counties, sewer districts, and water districts to contract for the establishment, maintenance and operation of all or a portion of a system or systems of sewerage and/or water supply; and

WHEREAS, RCW 57.16.050(l) allows a water district or sewer district to establish local improvement districts within its territory, levy special assessments, and allow annual installments to be paid on the special assessments; and

WHEREAS, RCW 57.08.005(15) allows a water or sewer district to loan and borrow funds and to issue bonds and instruments evidencing indebtedness under chapter 57.20 RCW and other applicable laws; and

WHEREAS, RCW 57.08.005(16) allows utility districts to transfer funds, real or personal property, property interests, or services subject to RCW 57.08.015;

NOW THEREFORE, Island County ("County") and the Freeland Water District ("District") agree as follows:

I. PURPOSE

A. Island County has designated the Freeland Rural Area of Intense Development ("RAID") as a possible NMUGA. The County is required by the Growth Management Act to develop a comprehensive plan, including provisions for urban governmental services, for areas that a county wishes to designate as NMUGAs.

B. The County acknowledges that planning for and the timely provision/extension of urban governmental services is a paramount prerequisite to facilitating the urban development of an NMUGA.

C. Sewers are an integral urban governmental service. The study, planning, and engineering of a sewer system in Freeland is a significant task that must be completed before the approval of a comprehensive plan for the proposed Freeland NMUGA. Because there is not yet a local mechanism to fund the requisite sewer studies for Freeland, the County has undertaken or will undertake the contracting and payment for such professional engineering studies in order to facilitate a timely conclusion to the NMUGA planning process.

D. This Agreement between the County and the District is intended to provide a mechanism for the County to be reimbursed for all County expenditures for professional engineering studies related to the development of a sewer system in the proposed Freeland NMUGA.

II. POLICIES AND PROCEDURES-REIMBURSEMENT OF COUNTY

A. The obligations to reimburse the County shall be in the amount of $ **185,100/00** (the "District Reimbursement Obligation"), except that if the District in writing requests or agrees to changes in the scope of the planning and engineering work to be undertaken, the amount of the District Reimbursement Obligation shall be reduced or increased to another amount to be agreed to by the parties, acting reasonably. This amount shall be paid by the District in accordance with Paragraph II.D below, if and when the District amends its comprehensive plan to include improvements within the proposed Freeland

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NMUGA and creates a local improvement district, utility local improvement district (ULID), issues bonds, and/or undertakes another infrastructure funding mechanism (e.g., State Public Works Trust Fund or State Revolving Fund loans) that will finance the construction of sewer infrastructure or further the goal of creating sewer infrastructure in the proposed Freeland NMUGA.

B. This agreement shall terminate on July 1, 2021, or when the District has repaid its respective obligations to the County, whichever occurs first. No interest shall accrue on the principal sum owed to the County.

C. Upon the creation of a local improvement district, utility local improvement district, issuance of bonds, and/or the undertaking of another infrastructure funding mechanism that will finance the construction of sewer infrastructure or further the goal of creating sewer infrastructure in the proposed Freeland NMUGA, the District shall communicate by letter to the County Planning Director that said action has taken place. The communication to the County Planning Director shall also include a copy of all financial documents associated with the funding mechanism(s).

D. After the District's undertaking of a funding mechanism as described in Paragraph C, above, the District shall pay the County (by transfer to the Island County Treasurer) the amount of the District Reimbursement Obligation no later than forty five (45) days after the first eligible funds are received by the District with respect to the improvements to be carried out.

E. The District's obligation to the County shall be a revenue-based obligation, payable solely from rates, assessments and other revenues resulting from the ULID or other funding mechanisms described in Paragraphs II.A. and II.C., above. In no case shall the District's obligation hereunder be a general obligation of the District.

F. The District may assign and transfer all or a part of its obligations hereunder by authorizing another water/sewer district to create and administer a ULID or other funding mechanism described above, upon the County's written consent, which consent shall be the sole discretion of the County, acting reasonably.

G. The District's obligation to pay the County under Paragraphs II.A., II.D. and II.E., above, shall be reduced to the extent any other municipal corporation finances and undertakes the improvements described in Paragraphs II.A. and II.C. and makes a payment to the County to reimburse the County for the costs it incurs carrying out the planning activities described in Paragraph I. C.

III. RELATIONSHIP TO EXISTING LAWS AND STATUTES

Unless expressly provided otherwise in this Agreement, this Agreement is not intended to modify or supersede existing laws and statutes and shall be construed in a manner that is consistent therewith. In meeting the commitments encompassed in this Agreement, all parties will comply with the requirements of the statutes, rules and regulations governing planning and zoning, land division, annexation, open meetings, environmental policy, growth management, the Island County County-wide Planning Policy, the Comprehensive Plan of Island County and any other applicable federal, state or local laws and regulations.

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IV. AMENDMENTS

This Agreement may be amended from time to time by written amendment. All amendments must be agreed to by the District and the County. Amendments shall be adopted in the same manner as the original execution of this Agreement.

V. DURATION AND TERMINATION

This Agreement shall be adopted and take effect on the date it is executed by all parties and shall remain in effect until July 1, 2021.

VI. SEVERABILITY

In the event that any provision of this Agreement is declared invalid or illegal, such declaration shall in no way affect or invalidate any other provision thereof, and such other provisions shall remain in full force and effect.

VII. INDEMNIFICATION

The County shall indemnify and hold harmless the District and its officers, agents and employees, or any of them from any and all claims, actions, suits, liability, loss, costs, expenses and damages of any nature whatsoever, by reason of or arising out of any negligent act or omission of the County, its officers, agents and employees, or any of them, in the performance of this Agreement. In the event that any such suit based upon such a claim, action, loss or damage is brought against the District, the County shall defend the same at its sole cost and expense; provided that the District reserve the right to participate in such suit if any principle of governmental or public laws is involved. If final judgment be rendered against the District and its officers, agents and employees, or any of them, or jointly against the District and the County and their respective officers, agents and employees, or any of them, the County shall satisfy the same.

In executing this Agreement, the County does not assume liability or responsibility for, or in any way release the District from liability or responsibility which arises in whole or in part from the existence or effect of the District's bylaws, rules or regulations. If any cause, claim, suit, action or administrative proceeding is commenced in which the enforceability and/or validity of any such of the District's bylaws, rules or regulations is at issue, the District shall defend the same at their sole expense and if judgment is entered or damages are awarded against the District, the County, or both, the District shall satisfy the same, including all chargeable costs and attorney's fees.

The District shall indemnify and hold harmless the County and its officers, agents and employees, or any of them from any and all claims, actions, suits, liability, loss, costs, expenses and damages of any nature whatsoever, by reason of or arising out of any negligent act or omission of the District, its officers, agents and employees, or any of them, in the performance of this Agreement. In the event that any such suit based upon such a claim, action, loss or damage is brought against the County, the District shall defend the same at its sole cost and expense; provided that the County reserves the right to participate in such suit if any principle of governmental or public laws is involved. If final judgment be rendered against the County and its officers, agents and employees, or any of them, or jointly against the District and the County and their respective officers, agents and employees, or any of them, the District shall satisfy same.

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In executing this Agreement, the District does not assume liability or responsibility for, or in any way release the County from liability or responsibility which arises in whole or in part from the existence or effect of County ordinances, rules or regulations. If any cause, claim, suit, action or administrative proceeding is commenced in which the enforceability and/or validity of any such County ordinance, rule or regulation is at issue, the County shall defend the same at its sole expense and if judgment is entered or damages are awarded against the District, the County, or both, the County shall satisfy the same, including all chargeable costs and attorney's fees.

VIII. ADMINISTRATION

A. No separate legal or administrative entity is created to fulfill this agreement.

B. The provisions of this Agreement shall be administered by the County Planning Director, and the District Commissioners or their designee.

C. The County Planning Director and Designated Representatives of the District shall meet as necessary to ensure that the provisions of this Agreement are fulfilled and will develop further policies and procedures as are required, and will maintain records of all actions as required to accomplish the work of the Agreement.

D. The parties will not jointly acquire or hold real or personal property to fulfill this agreement.

IX. FILING OF AGREEMENT

Prior to its entry into force, this agreement shall be filed with the Island County Auditor.

X. COUNTERPARTS & CONDITIONS

This agreement may be signed in counterparts by the parties at different times and/or locations.

ISLAND COUNTY

Date: 10-14-02

Chairman, Board of Island County Commissioners

FREELAND WATER DISTRICT

Date: 10/10/2002

President, Freeland Water District
Per FWD Resolution 01-02

Date: 10/10/2002

District Planning Officer
Per FWD Resolution 01-02

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RESOLUTION NO. 01-02
INTER-LOCAL AGREEMENT – Sewer Plan

A RESOLUTION of the Board of Commissioners of the Freeland Water District, a Washington State Municipal Corporation, located in Island County, Washington, approving an Inter-Local Agreement with Island County regarding County funding of planning and engineering for a Comprehensive Plan of Sewers for Freeland including provisions for re-payment to the County for such Funding under certain circumstances.

WHEREAS, Pursuant to RCW 36.70A, the Washington State Growth Management Act (GMA) of 1990, as amended, Island County is in the process of preparing a Comprehensive Plan element involving the potential designation of a Non-Municipal Urban Growth Area in the Freeland Area; and

WHEREAS, as part of this GMA implementation Island County will fully fund the planning and engineering and development of a Comprehensive Plan of Sewers of sufficient detail to meet all requirements for approval of such a plan by applicable State and Local agencies and provide a sufficient basis for pursuing its financing and implementation through the establishment of a Utility Local Improvement District (ULID) and/or other mechanisms by the Freeland Water District, should it choose to do so; and

WHEREAS, Island County desires to ensure through Inter-Local Agreement with the potential implementing water/sewer district, that its funding of said Comprehensive Plan of Sewers will be re-paid by the water/sewer district that pursues the financing and implementation of said Plan through ULID and/or other mechanisms pursuant to RCW 57.16, RCW 36.94, RCW 57.08, RCW 57.20, and other applicable statutes and the implementing Washington Administrative Code (WAC); and

WHEREAS, Said Inter-local agreement creates no general obligation of re-payment or burden upon the Freeland Water District or its constituents or subscribers except through the potential future public formation of an ULID based upon said Comprehensive Plan of Sewers funded by the County wherein obligations are limited to benefiting lands and proportionate to benefits derived;

NOW THEREFORE, The Freeland Water District Board of Commissioners, having reviewed the proposed Inter-local Agreement, hereto attached, does hereby approve it's content and intent and does hereby authorize its final execution now or hereafter, by the District's President and/or it's designated Planning Officer as the case may be. This authorization to sign and execute said inter-local agreement for the Freeland Water District also applies to any revised version of said agreement or addenda or amendments thereto arising out of further negotiations with the County and upon review by the District's Attorney.

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ADOPTED at a regular duly noticed public meeting of the Board of Commissioners of Freeland Water District, Island County, Washington, on this 19th day of JULY, 2001.

FREELAND WATER DISTRICT Board of Commissioners

Andrew Pringle Jr., President/Commissioner

Nolan A. Knickerbocker, Secretary/Commissioner

John C. A. Nestor, Commissioner

ATTEST:

Sandra J. Duncan, District Clerk

SPECIMEN SIGNATURE

Thomas J. Roehl, Planning Officer, Freeland Water District

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ATTACHMENT to Resolution 01-02
INTERLOCAL AGREEMENT
BETWEEN ISLAND COUNTY AND THE FREELAND WATER DISTRICT

This Agreement is hereby entered into by Island County, a political subdivision of the State of Washington and The Freeland Water District, a municipal corporation of the State of Washington.

WHEREAS, RCW 36.70A.110, the Washington State Growth Management Act of 1990, as amended allows each county to designate Non-Municipal Urban Growth Areas; and

WHEREAS, RCW 36.70A.110(3) states that urban growth should be located first in areas already characterized by urban growth that have adequate existing public facility and service capacities to serve such development, second in areas already characterized by urban growth that will be served adequately by a combination of both existing public facilities and services and any additional needed public facilities and services that are provided by either public or private sources, and third in the remaining portions of the urban growth areas; and

WHEREAS, RCW 36.70A.210(3)(a), the Washington State Growth Management Act of 1990, as amended requires that a county-wide planning policy shall address policies for promotion of contiguous and orderly development and provision of urban services to such development; and

WHEREAS, Island County-Wide Planning Policy #5 addresses policies for promotion of contiguous and orderly development and provision of urban services to such development, specifically the use of interlocal agreements to meet this objective; and

WHEREAS, RCW 36.70A.120, the Washington State Growth Management Act of 1990, as amended requires that each county required to plan under RCW 36.70A.040 shall perform its activities and make capital budget decisions in conformity with its comprehensive plan; and

WHEREAS, the Island County Comprehensive Plan Capital Facilities Element states that a goal of the county is to provide new municipal public works facilities only within, and not beyond, Urban Growth Areas. Such facilities include sanitary and storm sewer collection and treatment facilities; and

WHEREAS, RCW 57.16.010 requires that a comprehensive general plan be adopted by a water district or sewer district before any improvements are ordered or any vote on any proposition to incur any indebtedness is submitted; and

WHEREAS, RCW 57.16.015 states that no expenditure for carrying on any part of a general comprehensive plan shall be made by a water district or sewer district other than the necessary salaries of engineers, clerical, office expenses, and other professional expenses of the district, and the cost of engineering, surveying, preparation, and collection of data necessary for

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making and adopting a general plan of improvements in the district, until the general comprehensive plan of improvements has been adopted by the water district or sewer district commissioners and approved as provided in RCW 57.16.010; and

WHEREAS, RCW 36.94.190 allows counties, sewer districts, and water districts to contract for the establishment, maintenance and operation of all or a portion of a system or systems of sewerage and/or water supply; and

WHEREAS, RCW 57.16.050(1) allows a water district or sewer district to establish local improvement districts within its territory, levy special assessments, and allow annual installments to be paid on the special assessments; and

WHEREAS, RCW 57.08.005(15) allows a water or sewer district to loan and borrow funds and to issue bonds and instruments evidencing indebtedness under chapter 57.20 RCW and other applicable laws; and

WHEREAS, RCW 57.08.005(16) allows utility districts to transfer funds, real or personal property, property interests, or services subject to RCW 57.08.015;

NOW THEREFORE, Island County, hereinafter called "County" and the Freeland Water District, hereinafter called "District" agree as follows:

I. PURPOSE

A. Island County has designated the Freeland Rural Area of Intense Development (RAID) as a possible Non-Municipal Urban Growth Area (NMUGA). The County is required by the Growth Management Act to develop a comprehensive plan, including provisions for urban governmental services, for areas that a county wishes to designate as NMUGAs.

B. The County acknowledges that planning for and the timely provision/extension of urban governmental services is a paramount prerequisite to facilitating the urban development of the NMUGA.

C. Sewers are an integral urban governmental service. The study, planning, and engineering of a sewer system in Freeland is a significant task that must be completed before the approval of a comprehensive plan for the Freeland NMUGA. As there is not yet a local mechanism to fund the requisite sewer studies for Freeland, the County has undertaken or will undertake the contracting and payment for such professional engineering studies in order to facilitate a timely conclusion to the NMUGA planning process.

D. This Agreement between the County and the Districts is intended to provide a mechanism for the County to recoup all funds paid by the County for professional

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engineering studies related to the development of a sewer system in the proposed Freeland Non-Municipal Urban Growth Area (NMUGA).

II. POLICIES AND PROCEDURES-DEBT REPAYMENT

A. The obligations to the County shall be in the amount of $138,348.00. This amount shall be owed by the District which becomes responsible for the planning and construction of septic sewers in the proposed Freeland NMUGA. The Responsible District shall be defined as that district which has taken positive steps towards the planning and construction of a septic sewer in the proposed Freeland NMUGA. These positive steps shall include, at a minimum, amending the District Comprehensive Plan to include a proposed Freeland NMUGA sewer project and creating a local improvement district, utility local improvement district, bond issue, or other infrastructure funding mechanism that will create sewer infrastructure or further the goal of creating sewer infrastructure in the proposed Freeland NMUGA.

B. This agreement shall terminate on July 1, 2021 or when the responsible District has repaid its respective obligations to the County, whichever occurs first. No interest shall accrue on the principal sum owed to the County.

C. Upon the creation of a local improvement district, utility local improvement district, bond issue, or other infrastructure funding mechanism that will create sewer infrastructure or further the goal of creating sewer infrastructure in the proposed Freeland NMUGA by the Freeland Water District or such other water/sewer District it may authorize, either by petition or by initiation of the District's Commissioners, the District Chairperson will communicate by letter to the County Planning Director that said action has taken place. The communication to the County Planning Director shall also include a copy of all financial documents associated with the funding mechanism(s).

D. After the creation of a funding mechanism as described in Paragraph C by the District, $138,348.00 shall be transferred to the Island County Treasurer no later than ten days after funds are received by the Freeland Water District. .

E. If the funds received by the County from the District are less than $138,348.00, the District shall pay the balance owed after the creation of a second or any subsequent funding mechanism as described in Paragraph C by the Districts.

F. The District's obligation to the County shall be a revenue-based obligation, payable solely from rates, assessments and other revenues resulting from the ULID or other funding mechanisms described in Paragraphs II. A and II. C, above. In no case shall the District's obligation hereunder be a general obligation of the District. If the District transfers it's obligations hereunder by authorizing another water/sewer District to create and administer a ULID or other funding

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mechanism hereinabove described, it shall do so only by written consent of the County to a District approved for such action by the County through inter-local agreement.

III. RELATIONSHIP TO EXISTING LAWS AND STATUTES

Unless expressly provided otherwise in this Agreement, this Agreement is not intended to modify or supersede existing laws and statutes and shall be construed in a manner that is consistent therewith. In meeting the commitments encompassed in this Agreement all parties will comply with the requirements of the statutes, rules and regulations governing planning and zoning, land division, annexation, open meetings, environmental policy, growth management, the Island County County-wide Planning Policy, the Comprehensive Plan of Island County and any other applicable federal, state or local laws and regulations.

IV. AMENDMENTS

This Agreement may be amended from time to time by written amendment. All amendments must be agreed to by the Districts and the County. Amendments shall be adopted in the same manner as the original execution of this Agreement.

V. DURATION AND TERMINATION

This Agreement shall be adopted and take effect on the date it is executed by all parties and shall remain in effect until July 1, 2021.

VI. SEVERABILITY

In the event that any provision of this Agreement is declared invalid or illegal, such declaration shall in no way affect or invalidate any other provision thereof, and such other provisions shall remain in full force and effect.

VII. INDEMNIFICATION

The County shall indemnify and hold harmless the Districts and it's officers, agents and employees, or any of them from any and all claims, actions, suits, liability, loss, costs, expenses and damages of any nature whatsoever, by reason of or arising out of any negligent act or omission of the County, its officers, agents and employees, or any of them, in the performance of this Agreement. In the event that any such suit based upon such a claim, action, loss or damage is brought against the District, the County shall defend the same at its sole cost and expense; provided that the Districts reserve the right to participate in such suit if any principle of governmental or public laws is involved. If final judgment be rendered against The District and its officers, agents and employees, or any of them, or jointly against The district and the County and their respective officers, agents and employees, or any of them, the County shall satisfy same.

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10/24/2002 01:4
ISLAND COUNTY AUDITOR AGR

In executing this Agreement, the County does not assume liability or responsibility for, or in any way release the Districts from liability or responsibility which arises in whole or in part from the existence or effect of the District's bylaws, rules or regulations. If any cause, claim, suit, action or administrative proceeding is commenced in which the enforceability and/or validity of any such of the District's bylaws, rules or regulations is at issue, the Districts shall defend the same at their sole expense and if judgment is entered or damages are awarded against the Districts, the County, or both, the Districts shall satisfy the same, including all chargeable costs and attorney's fees.

The Districts shall indemnify and hold harmless the County and its officers, agents and employees, or an of them from any and all claims, actions, suits, liability, loss, costs, expenses and damages of any nature whatsoever, by reason of or arising out of any negligent act or omission of the Districts, its officers, agents and employees, or any of them, in the performance of this Agreement. In the event that any such suit based upon such a claim, action, loss or damage is brought against the County, the Districts shall defend the same at its sole cost and expense; provided that the County reserves the right to participate in such suit if any principle of governmental or public laws is involved. If final judgment be rendered against the County and its officers, agents and employees, or any of them, or jointly against the Districts and the County and their respective officers, agents and employees, or any of them, the Districts shall satisfy same.

In executing this Agreement, the Districts does not assume liability or responsibility for, or in any way release the County from liability or responsibility which arises in whole or in part from the existence or effect of County ordinances, rules or regulations. If any cause, claim, suit, action or administrative proceeding is commenced in which the enforceability and/or validity of any such County ordinance, rule or regulation is at issue, the County shall defend the same at its sole expense and if judgment is entered or damages are awarded against the Districts, the County, or both, the County shall satisfy the same, including all chargeable costs and attorney's fees.

VIII. ADMINISTRATION

A. No separate legal or administrative entity is created to fulfill this agreement.

B. The provisions of this Agreement shall be administered by the County Planning Director, and the District Commissioners or their designee.

C. The County Planning Director and Designated Representatives of the Districts shall meet as necessary to ensure that the provisions of this Agreement are fulfilled and will develop further policies and procedures as are required, and will maintain records of all actions as required to accomplish the work of the Agreement.

D. The parties will not jointly acquire or hold real or personal property to fulfill this agreement.

XII. FILING OF AGREEMENT

Prior to its entry into force, this agreement shall be filed with the Island County Auditor.

XIII. COUNTERPARTS & CONDITIONS:

This agreement may be signed in counterparts by the parties at different times and/or locations. The District signing hereunder agrees It shall not grant permission to any other District or entity to pursue implementation of the financing of a system of sewers based on the Planning and Engineering herein described and funded by the County unless said implementing District or entity is party to this or another inter-local agreement providing for re-payment to the County.

ISLAND COUNTY

Date: 10-14-02

Chairman, Board of Island County Commissioners

FREELAND WATER DISTRICT:

Date:

President

Date: 7/19/2001

Commissioner

Date: 7/19/2001

Commissioner

Date: 7/19/2001

Planning Officer:

4035126
Page: 14 of 14
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ISLAND COUNTY AUDITOR AGR

APPENDIX B.
HYDROGEOLOGIC RECONNAISSANCE REPORT

May 1, 2003
HWA Project No. 2003-042-22

TetraTech/KCM, Inc.
1917 First Avenue
Seattle, WA 98101

Attention: Alex Chen

Subject: **HYDROGEOLOGICAL EVALUATION**
WASTEWATER INFILTRATION FEASIBILITY
FREELAND COMPREHENSIVE SEWER PLAN
FREELAND, WASHINGTON

Dear Mr. Chen:

HWA GeoSciences Inc. (HWA) is pleased to submit this Wastewater Infiltration Feasibility review of the area around the City of Freeland, Island County, Washington.

INTRODUCTION

Our Wastewater Infiltration Feasibility review included the following areas within an approximately 3 mile radius of Freeland, Washington: T29N R2E Sections 1, 2, 3, 4, 5, 8, 9, 10, 11, 12, 13, 14, 15, 16, 22, 23, T30N R2E Sections 25, 26, 27, 28, 29, 32, 33, 34, 36, T29N R3E Sections 6, 7, 18, T30N R3E Sections 30, 31.

GOALS AND OBJECTIVES

The goals and objectives of this study were to review existing geologic and hydrogeologic data for infiltration potential within the area of interest described above, provide an opinion regarding the feasibility of land application or infiltration, discuss issues associated with various wastewater disposal methods and provide rough estimates of infiltration rates based on expected soil types.

Our data review included geologic maps, slope stability maps, Washington State Department of Ecology (Ecology) well logs and the Island County Draft Ground Water Management Plan.

INFILTRATION SITE EVALUATION

AREA GEOLOGY

Major stratigraphic units mapped in the area of interest include recessional outwash/meltwater deposits, Vashon till, and marsh deposits. Refer to Figure 1 for spatial distribution of these units.

Vashon Outwash/Meltwater Deposits

Undivided meltwater deposits are mapped (Pessl, 1989) predominately at the south end of Holmes Harbor in T29N R2E, Sections 2, 10, 11, 14, 15 and T29N R3E Sections 6 and 7. This unit can consist of both Vashon advance outwash and/or recessional deposits. These units typically contain mixtures of sand, gravel, silt and clay deposited by meltwater flowing from the advancing or retreating ice margins. Sections 22 and 23 are mapped as undifferentiated glacial outwash and glacial outwash sand (Dragovich, 2002). These units are essentially the same as the undivided meltwater deposits. Typically, meltwater/outwash deposits exhibit moderate to high permeabilities and infiltration rates depending on silt content.

Vashon Till

Vashon Till underlies the majority the study area (Pessl, 1989). It dominates T29N R2E Sections 1, 3, 4, 5, 12, T30N R2E Sections 25, 26, 27, 28, 29, 30, 32, and 33, T29N R3E Sections 6 and 7. The advancing glaciers overrode and compacted non-sorted ground moraine deposits and advance outwash or glacial deltaic deposits, creating a very dense, massive, poorly sorted mixture of silt, sand, gravel and cobbles with occasional boulders that often seems like concrete. Random sand and gravel lenses are present.

Till does not provide a favorable infiltration medium. Till acts as an aquitard that inhibits the flow of ground water, perches water on top of it in the recessional outwash, and also confines water below it in the advance outwash. In general, the permeability of till ranges from low in weathered surficial deposits to relatively impermeable in very dense non-weathered materials.

Marsh Deposits

Isolated marsh deposits are found throughout the study area, mostly in small (< 10 acre) pockets. Marsh deposits typically consist of sand, silt and clay mixed with decomposing organics. Marsh deposits are generally a poor infiltration medium.

Borrow Pits

A review of a borrow source map (Dethier 1983) indicated several areas of interest for rapid infiltration. The map is presented in Figure 2. Borrow source locations generally coincide with outwash/meltwater deposits. The map also depicts two locations in the southern portion of Section 4, T29N R2E as inactive or reclaimed gravel pits. Gravel pits generally would provide the medium necessary for rapid infiltration, depending on ground water levels.

SUBSURFACE GEOLOGY

HWA reviewed 494 Ecology Water Well logs in the area of interest (T29N R2E Sections 1, 2, 3, 4, 5, 8, 9, 10, 11, 12, 13, 14, 15, 16, 22, 23; T29N R3E Sections 6, 7, 8; T30N R2E Sections 28, 29, 32, 33, 34; T30N R3E Sections 30, 31). Well logs are required by Ecology for all water wells drilled in the State. Logs are prepared by the well driller and contain information about the installed well and the stratigraphy encountered during drilling. Well logs can vary widely in the amount and usefulness of the information provided.

In our well log review we looked for logs indicating the presence of a suitable infiltration receptor. Our criteria was:

- The presence of a likely suitable infiltration receptor described in the log as: sand, gravel, sand and gravel, silty sand, silty gravel, silty sand and gravel, dirty sand or dirty gravel; and
- infiltration receptor is within 20 feet of the surface; and
- infiltration receptor is a minimum of 10 feet thick; and
- ground water is a minimum of 10 feet below the top of the infiltration receptor.

Examples of well log lithology descriptions defined as not suitable for infiltration receptors include; till, hardpan, clay, sand with clay, gravel with clay, cemented sand and gravel.

Well logs meeting the above criteria were then plotted within their respective quarter/quarter sections. Figure 3 shows the approximate distribution of these logs, indicated on the legend as sub surface geology. It is important to note that the absence of a well log meeting the selection criteria in any one quarter/quarter section does not necessarily mean that the area is not suitable for infiltration. Often no well log data is

available from Ecology. Additionally we observed that it is not uncommon for a quarter/quarter section to contain both accepted and rejected wells.

SURFACE WATER BODIES / WETLANDS

Site topography and subsequent drainage patterns can have a significant impact on infiltration capacity and siting. Infiltration near surface water drainages or wetlands may increase stream base flows or wetland water levels. Increased base flows may have negative impacts on stream or wetland hydrology, including: increased flow volume, decreased time to reach receiving water, increased frequency and duration of high stream flows, and greater stream velocities (Ecology, 2001). Numerous discrete watersheds exist with the area of interest, each with unique topography and drainage patterns. Natural drainage patterns must be taken into consideration when selecting an infiltration site.

AQUIFER PROTECTION AREAS

Other criteria which should be evaluated for specific sites under consideration include:

- Nearby domestic or multiple use water wells
- Nearby municipal wells, and associated wellhead protection areas
- Designated critical aquifer recharge areas

Our review of the *Island County Draft Ground Water Management Plan* did not indicate any wellhead protection or critical aquifer recharge areas, although local municipalities, water purveyors, or well owners should be contacted prior to selecting an infiltration site.

The U.S. Environmental Protection Agency (EPA) has designated the Whidbey Island Aquifer as a sole source aquifer. This designation applies to federal funding of projects which may impact ground water, and allows for EPA review of such projects.

STEEP SLOPES

Slopes greater than 15% are found within the area of interest and are generally not suitable for infiltration sites. These steep slopes are scattered throughout the site and are shown on Figure 3. Slope less than 15% predominate within the area of interest and will generally be suitable for infiltration sites provided that adequate erosion control measures be taken during construction and site use.

Infiltration near steep slopes may impact slope stability, or may cause undesirebale discharge (daylighting) at the base of the slope or on slope faces.

POTENTIAL INFILTRATION LOCATIONS

From a combined look at the reviewed geologic and hydrogeologic data we have identified several areas that are suitable for further study as potential infiltration areas. Potentially suitable sites were identified as having 1) outwash deposits mapped at the surface or a suitable infiltration receptor near the surface, 2) adequate depth to ground water, and 3) absence of surface water features or steep slopes. Figure 3 shows potential infiltration sites based on a combination of surface geology and sub-surface geology, shaded red and blue respectively, and steep slopes and wetlands, shaded tan and light green, respectively. Areas where the sub- and surface geology overlap (shaded dark blue) and are lacking steep slopes and wetlands are considered favorable sites for infiltration. Field exploration will be required to verify the presence of a suitable infiltration receptor prior to final site selection.

RAPID INFILTRATION

Rapid infiltration sites will require coarser grained soils (sands and gravels) with relatively few fines. Our data review has indicated that potential sites for rapid infiltration do exist within the area of interest. These sites are typically located in areas mapped as outwash/meltwater deposits. Sections 10, 11, 14, 15 of T29N R2E and the northern half of Section 1 are mapped as such. The review of water well logs also showed subsurface stratigraphy to be favorable in these areas. The water well log review also indicated a number of other locations that could serve as rapid infiltration sites. These are often located in regions mapped as glacial till. Construction of the infiltration site would necessitate the removal of the overburden until a suitable receptor was reached. Part of our search criteria for indicating these sites was that the infiltration medium be within 20 feet of the ground surface. Shallower depths are preferable, and would decrease infiltration facility construction costs.

SLOW INFILTRATION

“Slow infiltration” sites will also benefit from favorable infiltration capacity, requiring less area. For sites with glacial till soils, very large areas (hundreds of acres) may be required to infiltrate the design flows of approximately 0.5 MGD. Domestic septic drainfields in these kinds of soils rely on lateral migration of water, in addition to downwards percolation. Water (wastewater, precipitation) generally moves downwards until the low permeability unweathered till is reached, then migrates laterally. The

implication of this for large systems is that increasing the area has a smaller proportional effect on increasing infiltration capacity.

SEASONAL IRRIGATION

Only sites using land application at agronomic rates would not be limited by site infiltration capacity. Other factors such as sensitive areas and vegetation should be considered. Area required for off-season water storage may also be quite large, decreasing the feasibility of this approach.

CONSTRUCTED WETLANDS

Constructed wetlands sites, although not evaluated as part of this study, can be screened or evaluated using the criteria listed above.

GENERAL INFILTRATION RATES

Table 1 shows general infiltration rates based on soil type. For estimating purposes, outwash sands of the type found in the study area can be assumed to have long-term infiltration rates of 2-10 in/yr. Glacial till deposits may have infiltration rates far below the lower values shown.

Table 1 – Recommended Infiltration Rates
based on USDA Soil Textural Classifications (Ecology, 2001)

	Short-Term Infiltration Rate (in./hr)	Correction Factor	Estimated Long-Term (Design) Infiltration Rate (in./hr)
Clean sandy gravels and gravelly sand*	20	2	10
Sand	8	4	2
Loamy Sand	2	4	0.5
Sandy Loam	1	4	0.25
Loam	0.5	4	0.13

* 90% of the total soil sample is retained in the No. 10 sieve

RECOMENDTAIONS

Based on this information and other factors, such as property availability and distance to wastewater infrastructure, several potential sites may be selected. HWA recommends a more detailed data review of the selected sites, followed by on-site geologic investigations. The detailed data review would identify potential impacts such as nearby receptors (water wells) and permitting issues. The geologic investigation would likely consist of test pit explorations followed by classification and laboratory grain size

distribution analysis of potential receptor soils. This evaluation would allow selection of the most appropriate site and estimation of infiltration capacities. Once a site is selected, infiltration pilot testing would be needed to size the facility for design flows. The pilot test typically entails an 8-24 hour period of infiltration at rates scaled to design flows, into an approximately 100 square-foot pit. Discharge and water levels are monitored and long term infiltration rates can be approximated.

REFERENCES

Dethier, D.P. and Safioles, S.A., 1983, *Map Showing Potential Sources of Sand, Gravel, and Quarry Rock, Port Townsend Quadrangle, Washington*, Folio of the Port Townsend Quadrangle, Washington, Map I-1198-B, USGS

Dragovich, J, et al., 2002, *Geologic Map of Washington-Northwest Quadrant*, Geologic Map GM-50, Washington State Department of Natural Resources.

Ecology, Washington State Department of, 2001, *Stormwater Management Manual for Western Washington*, Publications Numbers 99-11 through 99-15, Water Quality Program, Washington State Department of Ecology

Island County, 1991, *Island County Draft Ground Water Management Plan*, Island County Planning Department.

Miller, R.A., et al., 1985, Map Showing Relative Slope Stability in the Port Townsend 30' x 60' Quadrangle, Puget Sound Region, Washington, Folio of the Port Townsend Quadrangle, Washington, Map I-1198-C, USGS.

Pessl, F, Jr., et al., 1989, *Surficial Geologic Map of the Port Townsend 30- by 60- Minute Quadrangle, Puget Sound Region, Washington,* Folio of the Port Townsend Quadrangle, Washington, Map I-1198-F, USGS.

We appreciate the opportunity to provide our services. Please feel free to call us if you have any questions or need more information.

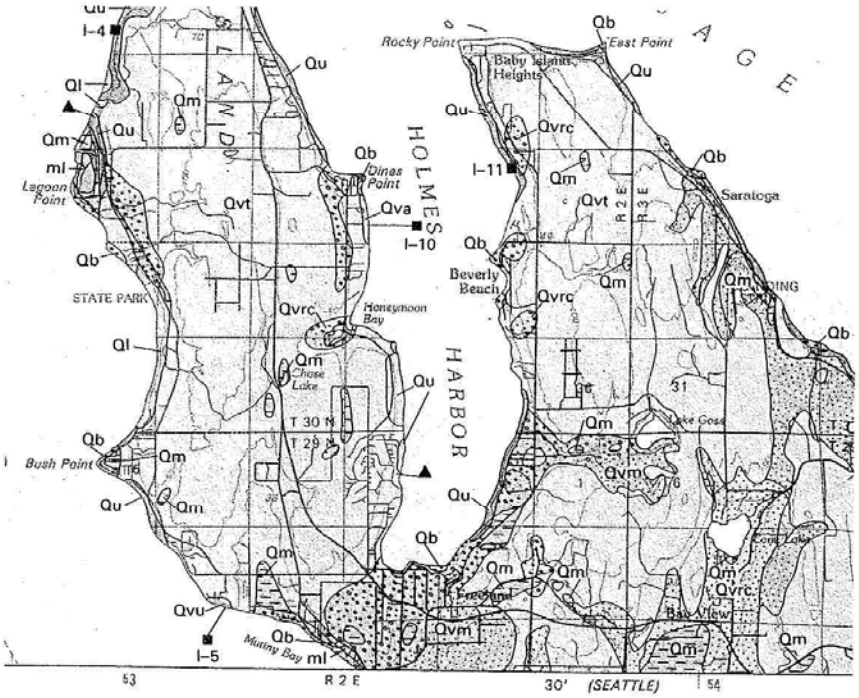
Sincerely,

HWA GEOSCIENCES INC.

Greg W. Emens, P.G.
Hydrogeologist

Arnie Sugar, P.G.
Senior Environmental Geologist

GWE:AS:gwe (2003-042-22 Ph 1 rpt email.doc)



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Legend

Qvm – Meltwater Deposits, Undivided, - advance and/or recessional deposits
Qvt – Glacial Till – poorly sorted mixture of clay, silt, sand and gravel
Qm – Marsh Deposits – sand, silt and clay mixed with decomposed organic matter
Qb – Beach Deposits – moderate to well sorted sands and gravels
Qu – Glacial and Nonglacial sedimentary deposits - Pleistocene

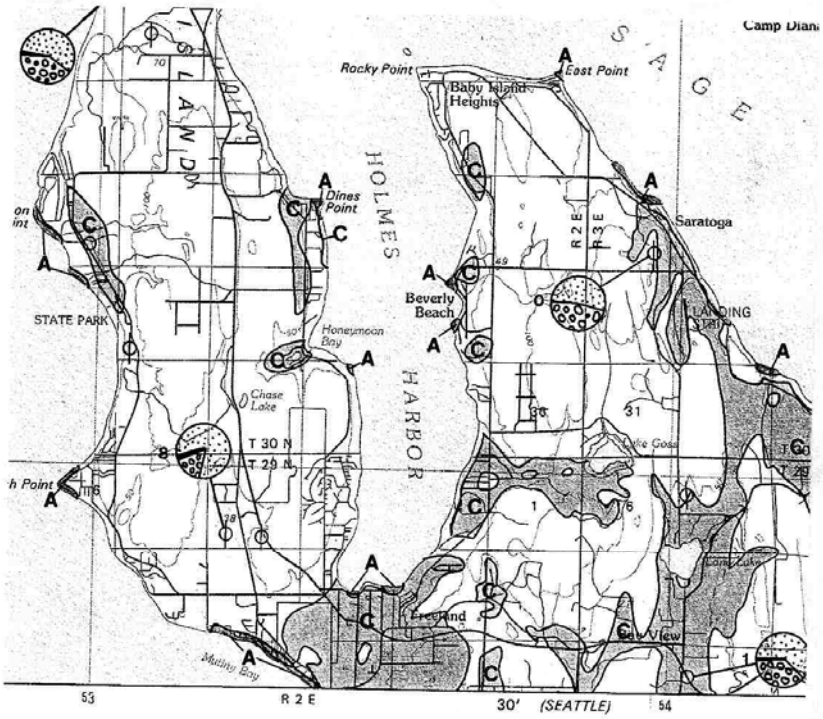
Source: Pessl, F, Jr., et al., 1989, *Surficial Geologic Map of the Port Townsend 30- by 60- Minute Quadrangle, Puget Sound Region, Washington,* Folio of the Port Townsend Quadrangle, Washington, Map I-1198-F, USGS.

HWA GEOSCIENCES INC.

Freeland Comprehensive
Sewer Plan
Freeland, Washington

Geologic Map

PROJECT NO.: 2003-042 FIGURE: 1



Legend

A – Beach deposits of sand and gravel
C – Glacial sand and gravel, older alluvium preserved as terraces along river valleys, and alluvial-fan deposits in upland areas

ϕ - Inactive or reclaimed gravel pit with overburden

8 - Relative amount of sand and gravel. Number indicates percentage of fines

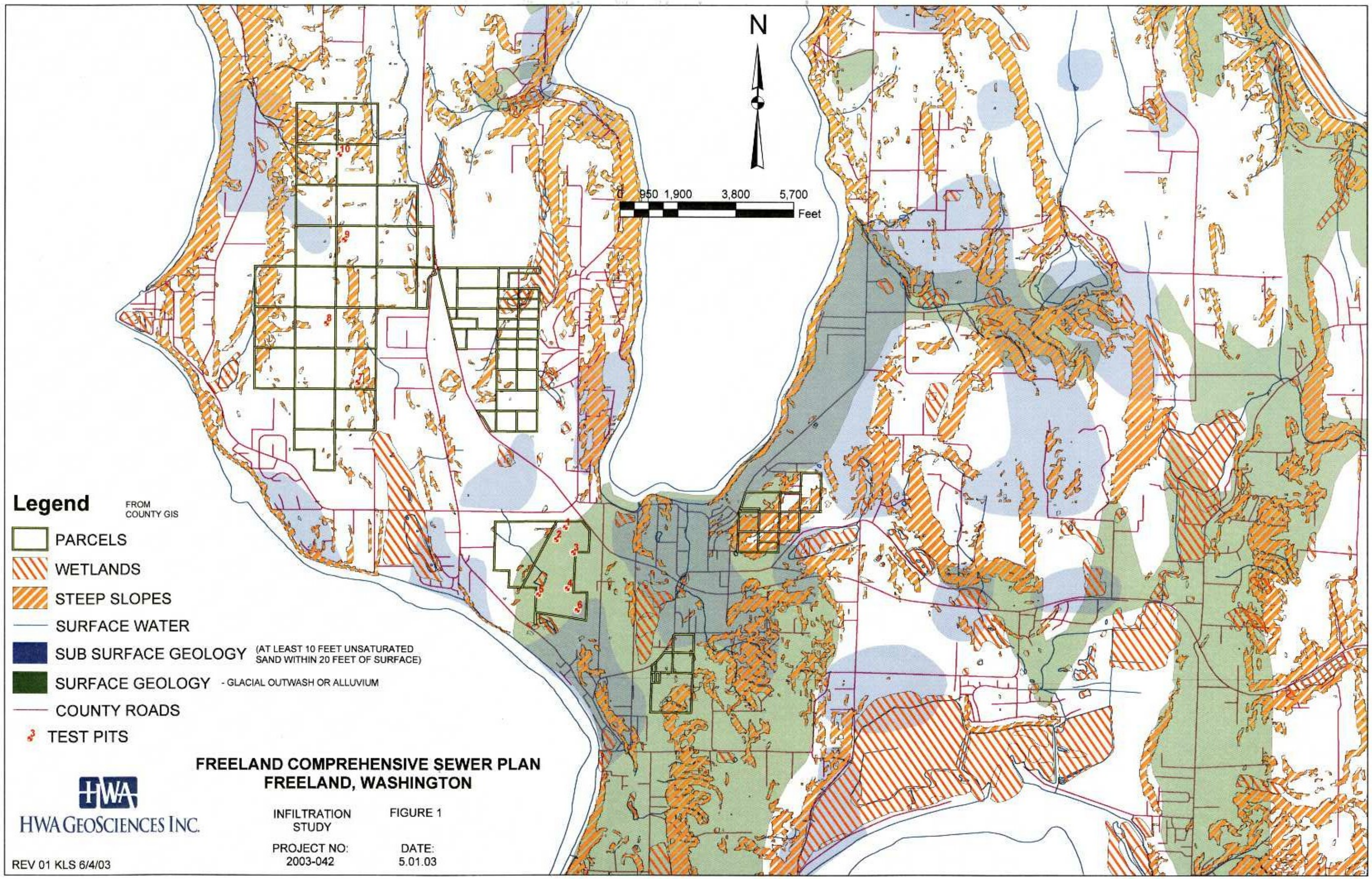
Source: Dethier, D.P. and Safioles, S.A., 1983, *Map Showing Potential Sources of Sand, Gravel, and Quarry Rock, Port Townsend Quadrangle, Washington*, Folio of the Port Townsend Quadrangle, Washington, Map I-1198-B, USGS

HWA GEOSCIENCES INC.

Freeland Comprehensive Sewer Plan
Freeland, Washington

Borrow Source Map

PROJECT NO.: 2003-042 FIGURE: 2



FREELAND COMPREHENSIVE SEWER PLAN
FREELAND, WASHINGTON

APPENDIX C.
PUBLIC PARTICIPATION

Questionnaire February 8, 2003 Workshop

PLEASE RETURN COMPLETED QUESTIONNAIRE BEFORE YOU LEAVE.
THANK YOU FOR YOUR PARTICIPATION.

1. Do you currently live or own property within the proposed Freeland sub-area? ***(Please circle one)***

   a) **No**
   b) **Yes**
   c) **I am not sure, but I live close to the boundary**

2. What is your current housing status? ***(Please circle one)***

   a) **Resident Home Owner**
   b) **Resident Renter**
   c) **Vacation/Weekend Resident**
   Property Owner *(No buildings currently on land)*

3. How many people currently make up your household? ***(Please circle one)***

   a) **1-Person**
   b) **2-People**
   c) **3-People**
   d) **3+ People**

4. Is your land currently developed? ***(Please circle one)***

   a) **Vacant**
   b) **Residential**
   c) **Commercial**

5. What type of sanitary system currently exists on your lot? ***(Please circle one)***

   a) **N/A** *(Vacant Lot)*
   b) **Septic System**
   c) **Sewer** *(Example Holmes Harbor)*
   d) Local treatment system on nearby property *(describe)*

6. Do you have more than one building on your lot? ***(Please circle one)***

   a) **No**
   b) **Yes,** *(connected to the main septic tank)*
   c) **Yes** *(with its own septic tank)*

7. What is the approximate age of your home? ***(Please circle one)***

   a) **N/A** *(Vacant Lot)*
   b) **0-5 years old**
   c) **5-15 years old**
   d) **15+ years old**
   e) **Older (please indicate approximate age of home)**

8. How do you feel about sewers in Freeland? ***(Please circle one)***

Strongly Desire		Depends on cost		Opposed to Sewers
5	**4**	**3**	**2**	**1**

9. How do you feel about having to accommodate access on your property for routine maintenance (of septic tank/septic tank effluent pump or grinder pump) and/or occasional pumping of a septic tank? ***(Please circle one)***

Strongly Support		Don't Care		Strongly Opposed
5	**4**	**3**	**2**	**1**

10. If you have a septic tank, is it easily accessible (e.g. in the front yard)? If not, please describe the location and any difficulty for maintenance access **a) Yes b) No**

11. Which one of the three sewer collection system alternatives do you think would be best for possible implementation within the Freeland Sub-Area?
(Please circle your preference even if you do not favor sewers.)

    a) **Collection System Alternative #1 Conventional Gravity**
    b) **Collection System Alternative #2 STEP (Septic Tank Effluent Pumping)**
    c) **Collection System Alternative #3 Combined STEP/Gravity**

12. Please describe existing septic facilities on your property

    a) **Age** *(years):*_____ **Year Installed** *(If Known):*_____

    b) **Septic Tank size** *(Volume in Gallons):*_____

    c) **System Style: ☐ Standard Gravity** *(No Pump)* **P☐ssure System** *(With Pump)*

    d) **Conditon of System:**

    - ❑ **Excellent:** *(New, well maintained, with expansion capacity)*
    - ❑ **Good:** *(Older, fully operational with standard maintenance)*
    - ❑ **Fair:** *(Operational, but has required repairs in the past)*

    Note: Please provide any additional information about your system that you think might be useful to sewer design engineers: _____
    _____
    _____

13. Additional Comments related to the Sub-Area Planning Process in Freeland:

14. Additional Comments related to the Comprehensive Sewer Planning Process in Freeland:

15. Notification for Future workshops will depend on having a current address for you. Please help us in keeping you notified of future meetings/workshop by providing us with your current address and contact information:

_____
_____
_____

Email: _____

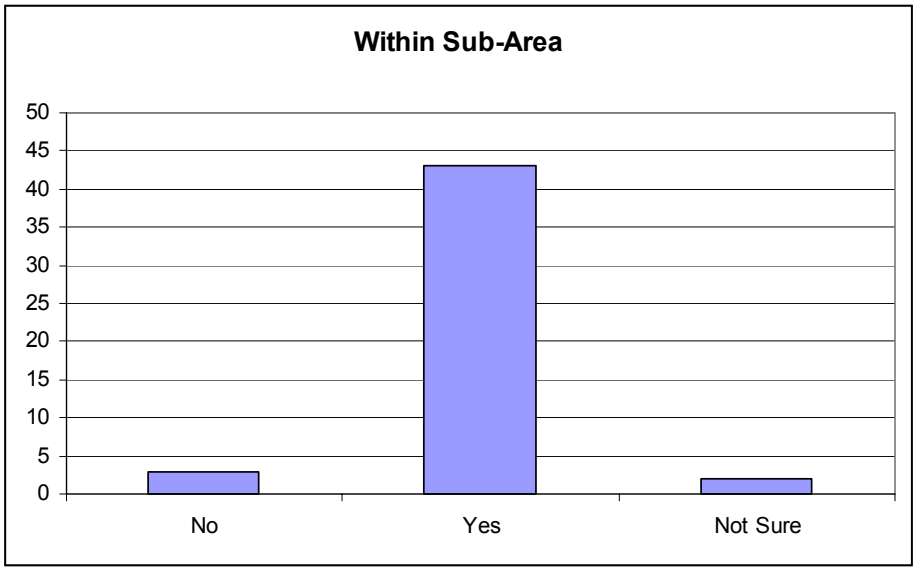
PLEASE RETURN COMPLETED QUESTIONNAIRE BEFORE YOU LEAVE. THANK YOU FOR YOUR PARTICIPATION.

Results of Questionnaire: February 8, 2003 Workshop

Approximately 75 people showed up to the am session of the February 8th, 2003 sewer collection system alternative workshop and 11 people attended that PM session. A total of 48 questionnaires were returned as of February 12, 2003. The numbers in (X) indicate the frequency of answers on the returned questionnaire.

1. Do you currently live or own property within the proposed Freeland sub-area? ***(Please circle one)***

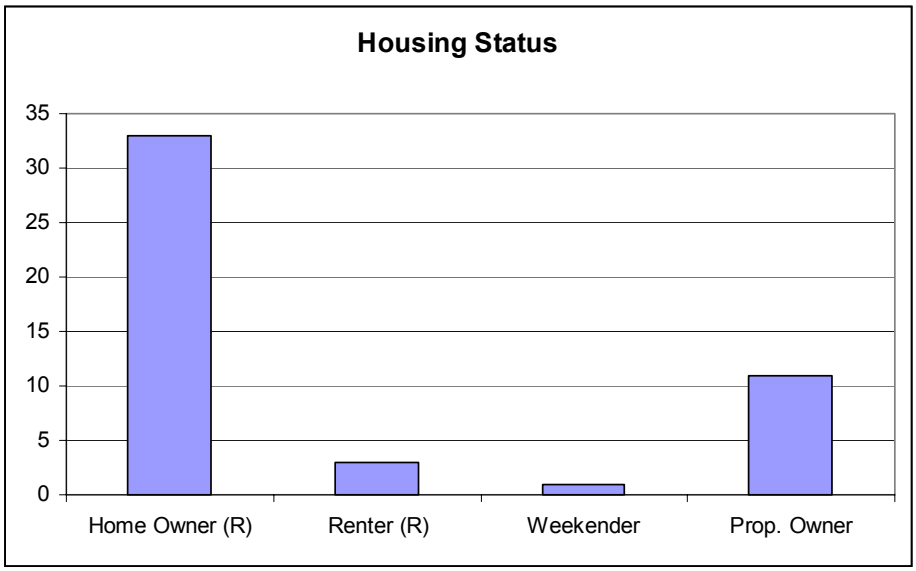
   a) **No (3)**
   b) **Yes (43)**
   c) **I am not sure, but I live close to the boundary (2)**



2. What is your current housing status? ***(Please circle one)***

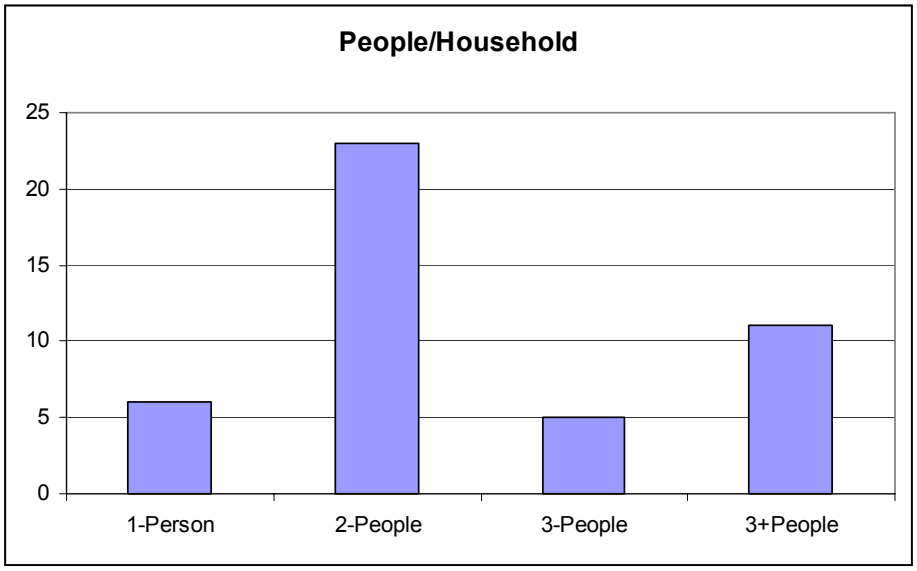
   a) **Resident Home Owner (33)**
   b) **Resident Renter (3)**
   c) **Vacation/Weekend Resident (1)**

   Property Owner *(No buildings currently on land)* **(11)**



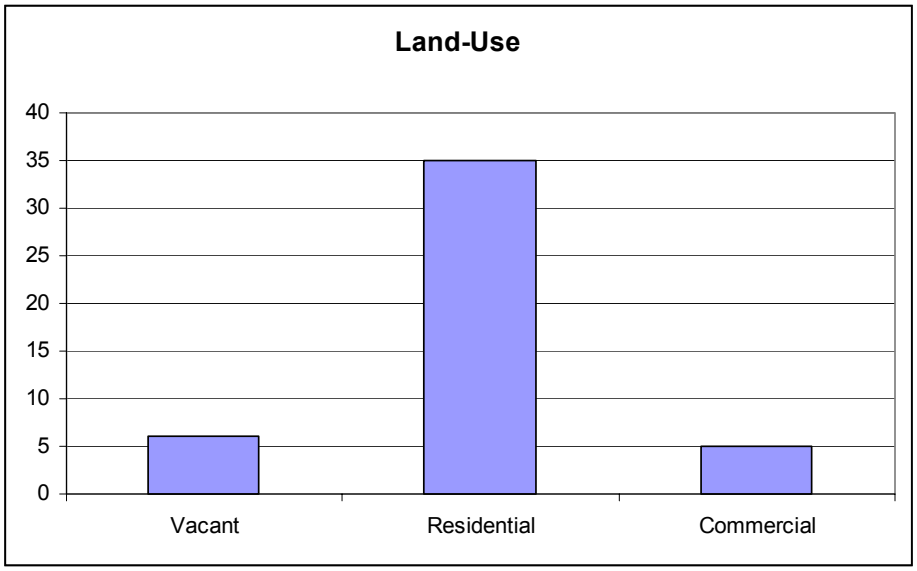
3. How many people currently make up your household? ***(Please circle one)***

a) **1-Person (6)**
b) **2-People (23)**
c) **3-People (5)**
d) **3+ People (11)**



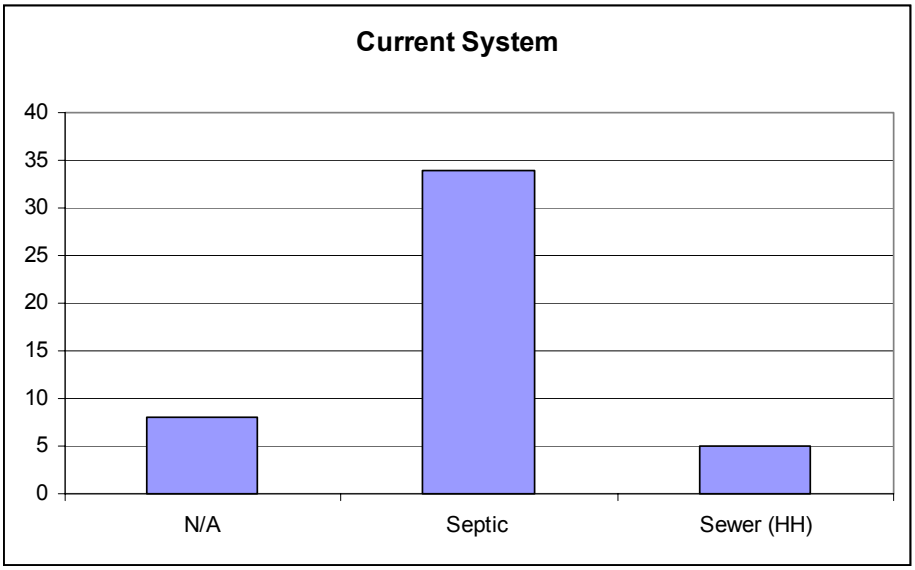
4. Is your land currently developed? ***(Please circle one)***

a) **Vacant (8)**
b) **Residential (33)**
c) **Commercial (5)**



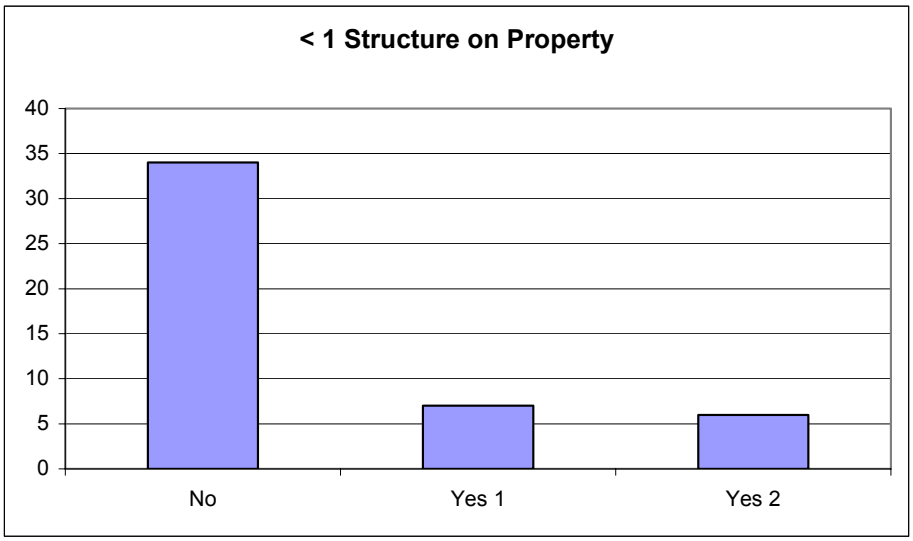
5. What type of sanitary system currently exists on your lot? ***(Please circle one)***

a) **N/A** *(Vacant Lot)* **(8)**
b) **Septic System (34)**
c) **Sewer** *(Example Holmes Harbor)* **(5)**
d) Local treatment system on nearby property *(describe)* **(0)**



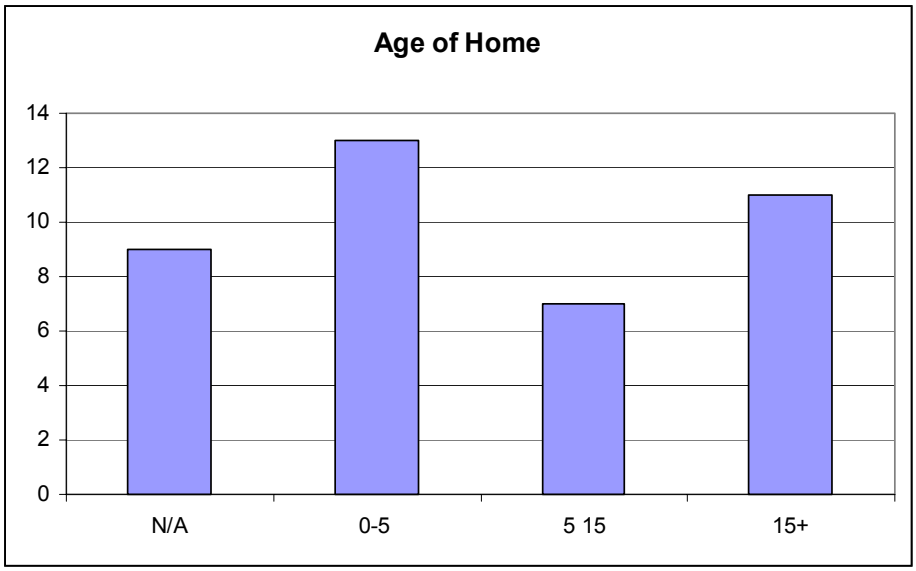
6. Do you have more than one building on your lot? ***(Please circle one)***

a) **No (34)**
b) **Yes, (7)**
c) **Yes** *(with its own septic tank)* **(6)**



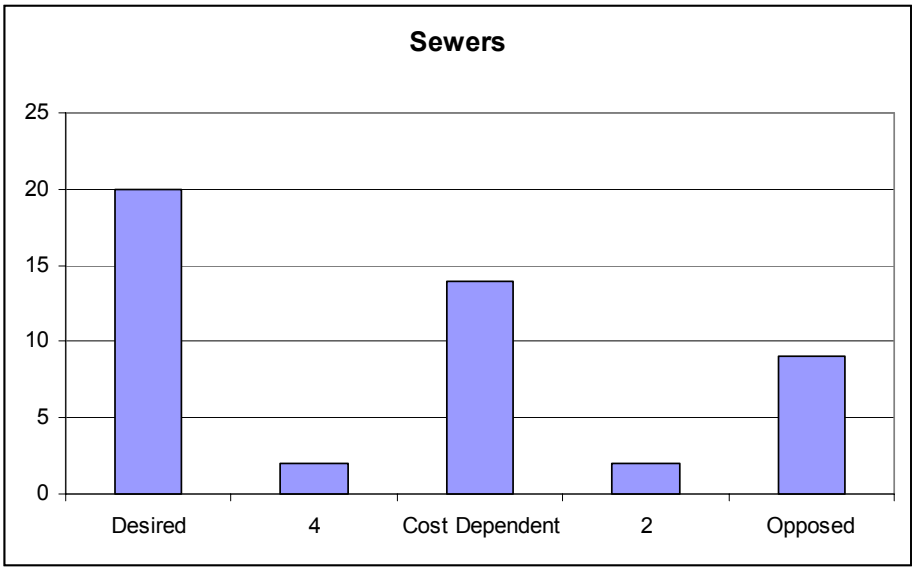
7. What is the approximate age of your home? ***(Please circle one)***

a) **N/A** *(Vacant Lot)* **(9)**
b) **0-5 years old (13)**
c) **5-15 years old (7)**
d) **15+ years old (11)**
e) **Older (AVG 42) (please indicate approximate age of home)**



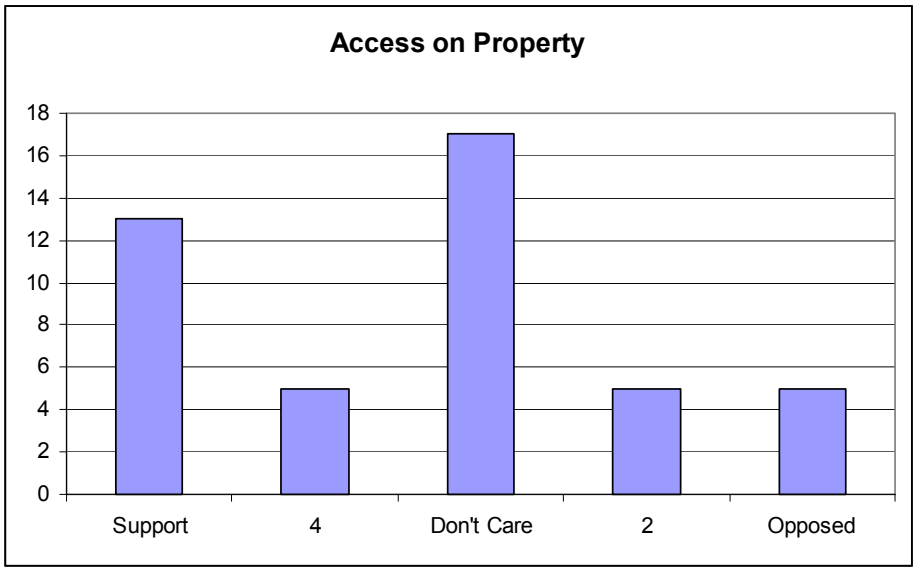
8. How do you feel about sewers in Freeland? ***(Please circle one)***

Strongly Desire		Depends on cost		Opposed to Sewers
5 (20)	**4 (2)**	**3 (14)**	**2 (2)**	**1 (9)**

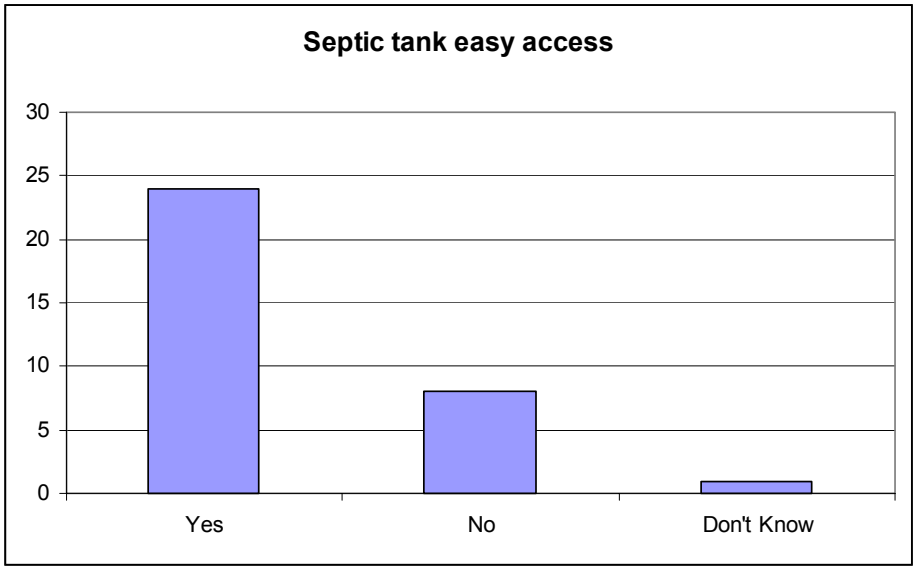


9. How do you feel about having to accommodate access on your property for routine maintenance (of septic tank/septic tank effluent pump or grinder pump) and/or occasional pumping of a septic tank? ***(Please circle one)***

Strongly Support		Don't Care		Strongly Opposed
5 (13)	**4 (5)**	**3 (17)**	**2 (5)**	**1 (5)**

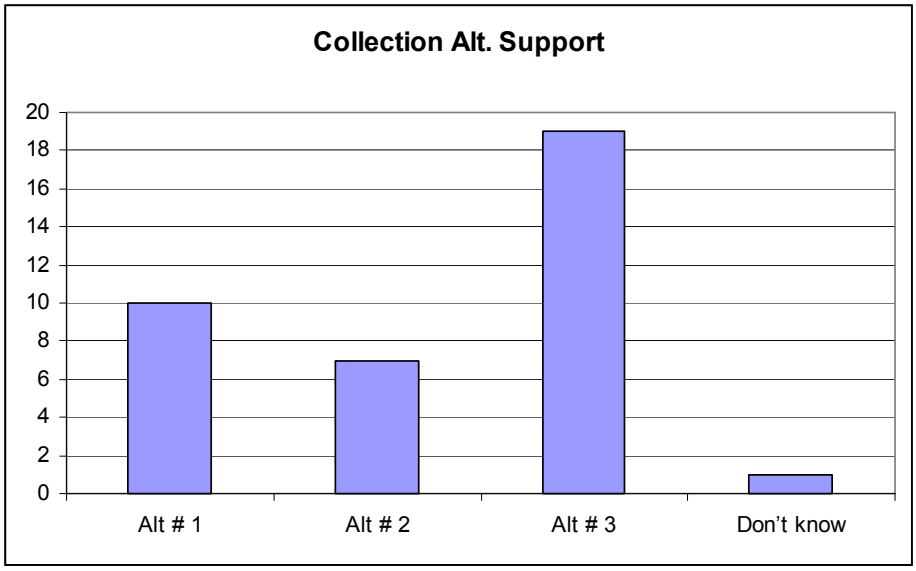


10. If you have a septic tank, is it easily accessible (e.g. in the front yard)? <u>If not</u>, please describe the location and any difficulty for maintenance access **a) Yes (24) b) No (8)**



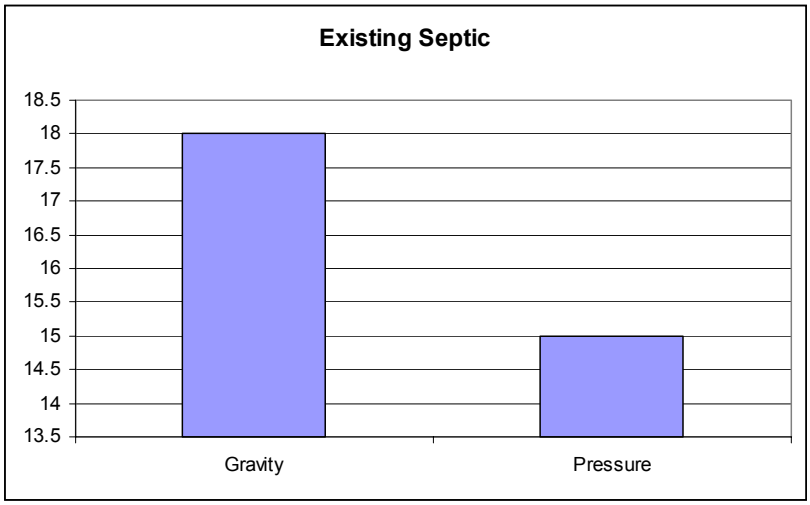
11. Which one of the three sewer collection system alternatives do you think would be best for possible implementation within the Freeland Sub-Area?
(Please circle your preference even if you do not favor sewers.)

a) **Collection System Alternative #1 Conventional Gravity (10)**
b) **Collection System Alternative #2 STEP (Septic Tank Effluent Pumping) (7)**
c) **Collection System Alternative #3 Combined STEP/Gravity (19)**



12. Please describe existing septic facilities on your property

a) **Age** *(years):*_**(Avg. 11)**__**Year Installed** *(If Known):*_____
b) **Septic Tank size** *(Volume in Gallons):*_**(Avg. 250-3000 Gal)**_____
c) **System Style: ☐ Standard Gravity (18)** *(No Pump)* ☐ **Pressure System (15)** *(With Pump)*



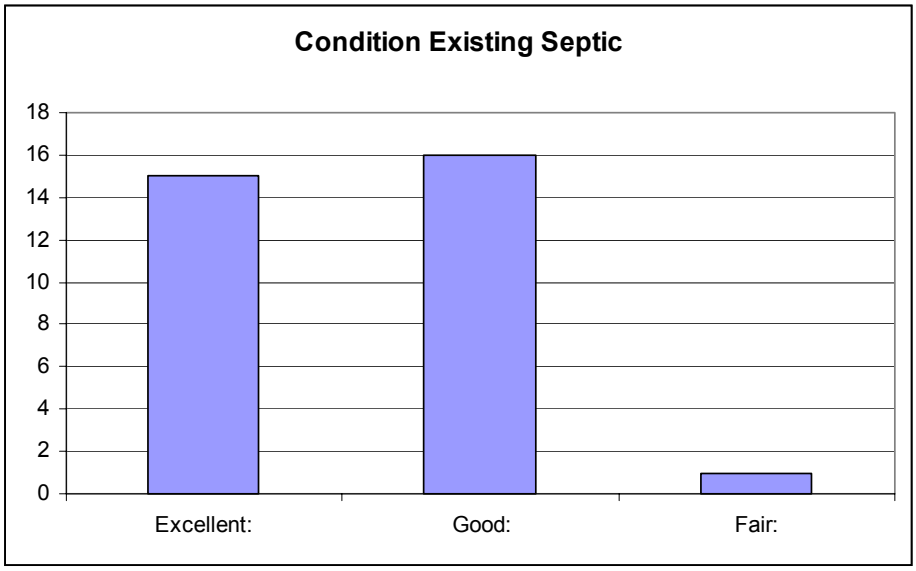
d) **Conditon of System:**

- **Excellent: (15)** *(New, well maintained, with expansion capacity)*
- **Good: (16)** *(Older, fully operational with standard maintenance)*
- **Fair: (1)** *(Operational, but has required repairs in the past)*

Note: Please provide any additional information about your system that you think might be useful to sewer design engineers: _____

_____

_____



13. Additional Comments related to the Sub-Area Planning Process in Freeland:

    A few comments, see attached

14. Additional Comments related to the Comprehensive Sewer Planning Process in Freeland:

    A few comments, see attached

15. Notification for Future workshops will depend on having a current address for you. Please help us in keeping you notified of future meetings/workshop by providing us with your current address and contact information:

_____**60% to 70% gave address**_____ _____

_____

Attached list of responses on the 48 questionnaires that were returned as of February 12, 2003.

Question # 13 on the survey gave an opportunity to provide additional comments related to the Sub-Area Planning Process in Freeland.

Responses:

- *What is the location of the Treatment Plant(s)? What level of treatment? Where is the outfall from the treatment plant?*
- *Discharge is my biggest concern, I don't want to have effluent pumped out of the NMUGA.*
- *I want sewers*
- *I am not happy with the potential for dense growth so close to my property.*
- *5 pieces of property, I have a marginal useable system, some people need sewers to develop property.*
- *Too much talk.*
- *From a pure cost point of view, a traditional septic system is cheaper to install, own, and maintain. Help me to understand the environmental impacts.*
- *We should make up our minds about NMUGA Vs RAID now.*

Question # 14 on the survey gave an opportunity to provide additional comments related to the Comprehensive sewer planning process.

Responses:

- *Gravity & grinder pumps for those who need them on the shoreline seems to make the most sense to me.*
- *NMUGA-yes*
- *Not in favor of sewers due to dense growth potential*
- *Lets do something to accommodate the future*

Questionnaire May 10, 2003 Workshop

PLEASE RETURN COMPLETED QUESTIONNAIRE BEFORE YOU LEAVE. THANK YOU FOR YOUR PARTICIPATION.

1. Do you currently live or own property within the proposed Freeland sub-area? ***(Please circle one)***

   a) **No**
   b) **Yes**
   c) **I am not sure, but I live close to the boundary**

2. What is your current housing status? ***(Please circle one)***

   a) **Resident Home Owner**
   b) **Resident Renter**
   c) **Vacation/Weekend Resident**
   d) **Property Owner** *(No buildings currently on land)*

3. How many people currently make up your household? ***(Please circle one)***

   a) **1-Person**
   b) **2-People**
   c) **3-People**
   d) **3+ People**

4. Is your land currently developed? ***(Please circle one)***

   a) **Vacant** b) **Residential** c) **Commercial**

5. In terms of a treatment and discharge system, how important is the local ability to reuse/recycle treated effluent and solids to you? ***(Please circle one)***

   Very important — Not important

   5 4 3 2 1

6. How do you feel about the reuse/recycling of treated effluent to recharge groundwater? ***(Please circle one)***

   Support Groundwater Recharge — No Recharge

   5 4 3 2 1

7. Would you be interested in having recycled treated effluent for irrigation of landscape and non-potable home/business uses in the Freeland Community? ***(Please circle one)***

   Very interested — Not interested

   5 4 3 2 1

8. Land application of effluent by irrigation and constructed wetlands for infiltration may require large areas of land. These lands may be available as wildlife habitat and public open space. How important are open space benefits to you? ***(Please circle one)***

   Very important — Not important

   5 4 3 2 1

9. Please rank the following land application alternatives in the order of importance *(with 1 being most important)* for possible implementation for the Freeland Sub-Area?

   __ **Irrigation**

   __ **Slow-rate Infiltration**

   __ **Rapid Infiltration**

   __ **Constructed Wetlands**

<u>Please continue the survey on the other side of this page.</u>

__ **No opinion**

10. Did you attend the first Freeland Sewer Planning workshop on February 8, 2003, If so proceed to question "a)". If you did not attend the first Freeland Sewer Planning Workshop please answer question "b)"

    a) After you previously filled out a questionnaire at the February 8, 2003 workshop has you opinion on sewer in the sub-area changed?

    i. No change in opinion ***(Please provide any additional Comments)***

    _____
    _____
    _____
    _____
    _____

    ii. My opinion has changed. Please provide any additional comments as to <u>why</u> your opinion has changed.

    _____
    _____
    _____
    _____
    _____

    b) What are your overall feelings on sewage treatment and land application in Freeland?

Strongly Desire		Depends on cost		Opposed to Sewers
5	**4**	**3**	**2**	**1**

11. Additional Comments related to the Sub-Area Planning Process in Freeland:

12. Additional Comments related to the Comprehensive Sewer Planning Process in Freeland:

13. Notification for Future workshops will depend on having a current address for you. Please help us in keeping you notified of future meetings/workshop by providing us with your current address and contact information:

_____

_____

_____

Email: _____

PLEASE RETURN COMPLETED QUESTIONNAIRE BEFORE YOU LEAVE. THANK YOU FOR YOUR PARTICIPATION.

PLEASE RETURN COMPLETED QUESTIONNAIRE BEFORE YOU LEAVE. THANK YOU FOR YOUR PARTICIPATION.

1. Do you currently live or own property within the proposed Freeland sub-area? ***(Please circle one)***

   a) **No (6)**
   b) **Yes (16)**
   c) **I am not sure, but I live close to the boundary**

2. What is your current housing status? ***(Please circle one)***

   a) **Resident Home Owner (16)**
   b) **Resident Renter**
   c) **Vacation/Weekend Resident**
   d) **Property Owner** *(No buildings currently on land)* **(1)**

3. How many people currently make up your household? ***(Please circle one)***

   a) **1-Person (4)**
   b) **2-People (10)**
   c) **3-People**
   d) **3+ People (5)**

4. Is your land currently developed? ***(Please circle one)***

   a) **Vacant (3)** b) **Residential (12)** c) **Commercial (5)**

5. In terms of a treatment and discharge system, how important is the local ability to reuse/recycle treated effluent and solids to you? ***(Please circle one)***

   Very important — Not important

   5 (8) **4 (5)** **3 (4)** **2 (1)** **1 (3)**

6. How do you feel about the reuse/recycling of treated effluent to recharge groundwater? ***(Please circle one)***

   Support Groundwater Recharge — No Recharge

   5 (10) **4 (7)** **3 (3)** **2 (1)** **1 (0)**

7. Would you be interested in having recycled treated effluent for irrigation of landscape and non-potable home/business uses in the Freeland Community? ***(Please circle one)***

   Very interested — Not interested

   5 (7) **4 (4)** **3 (5)** **2 (2)** **1 (2)**

8. Land application of effluent by irrigation and constructed wetlands for infiltration may require large areas of land. These lands may be available as wildlife habitat and public open space. How important are open space benefits to you? ***(Please circle one)***

   Very important — Not important

   5 (7) **4 (6)** **3 (6)** **2 (1)** **1(1)**

9. Please rank the following land application alternatives in the order of importance *(with 1 being most important)* for possible implementation for the Freeland Sub-Area?

   __ **Irrigation 1(4), 2(5), 3(3), 4(5)**

   __ **Slow-rate Infiltration 1(4), 2(7), 3(3), 4(5)**

   __ **Rapid Infiltration 1(2), 2(4), 3(4), 4(7)**

   __ **Constructed Wetlands 1(7), 2(2), 3(6), 4(2)**

   __ **No opinion 1(2), 2(0), 3(0), 4(1)**

Please continue the survey on the other side of this page.

10. Did you attend the first Freeland Sewer Planning workshop on February 8, 2003, If so proceed to question "a)". If you did not attend the first Freeland Sewer Planning Workshop please answer question "b)"

    a) After you previously filled out a questionnaire at the February 8, 2003 workshop has you opinion on sewer in the sub-area changed?

        i. No change in opinion *(Please provide any additional Comments)* (10)

        _____
        _____
        _____
        _____
        _____

        ii. My opinion has changed. Please provide any additional comments as to <u>why</u> your opinion has changed. (None Submitted)

        _____
        _____
        _____
        _____
        _____

    b) What are your overall feelings on sewage treatment and land application in Freeland?

Strongly Desire	Depends on cost	Opposed to Sewers		
5 (9)	**4 (5)**	**3 (4)**	**2 (1)**	**1 (0)**

11. Additional Comments related to the Sub-Area Planning Process in Freeland:

    See attached comments

12. Additional Comments related to the Comprehensive Sewer Planning Process in Freeland:

    See attached comments

13. Notification for Future workshops will depend on having a current address for you. Please help us in keeping you notified of future meetings/workshop by providing us with your current address and contact information:

_____

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Email: _____

PLEASE RETURN COMPLETED QUESTIONNAIRE BEFORE YOU LEAVE. THANK YOU FOR YOUR PARTICIPATION.

Questionnaire June 28, 2003 Workshop

PLEASE RETURN COMPLETED QUESTIONNAIRE BEFORE YOU LEAVE. THANK YOU FOR YOUR PARTICIPATION.

1. Do you currently live on or own property within the proposed Freeland sub-area? ***(Please circle one)***

   a) **No**
   b) **Yes**
   c) **I am not sure, but I live close to the boundary**

2. Do you currently live on or own property proposed as a treatment plant/land application site? ***(Please circle one)***

   a) **No**
   b) **Yes**
   c) **No, but I live/own close to these properties**

3. What is your current housing status? ***(Please circle one)***

   a) **Resident Home Owner**
   b) **Resident Renter**
   c) **Vacation/Weekend Resident**
   d) **Property Owner** *(No buildings currently on land)*

4. How many people currently make up your household? ***(Please circle one)***

   a) **1-Person**
   b) **2-People**
   c) **3-People**
   d) **3+ People**

5. Is your land currently developed? ***(Please circle one)***

   a) **Vacant** b) **Residential** c) **Commercial**

6. In terms of a treatment and discharge system, how important is the local ability to reuse/recycle treated effluent and solids to you? ***(Please circle one)***

   Very important Not important

   5 4 3 2 1

7. How do you feel about the reuse/recycling of treated effluent to recharge groundwater? ***(Please circle one)***

   Support Groundwater Recharge No Recharge

   5 4 3 2 1

8. Would you be interested in having recycled treated effluent for irrigation of landscape and non-potable home/business uses in the Freeland Community? ***(Please circle one)***

   Very interested Not interested

   5 4 3 2 1

9. Please rank the following land application alternatives in the order of importance *(with 1 being most important)* for possible implementation for the Freeland Sub-Area?

   __ **Irrigation**

   __ **Slow-rate Infiltration**

   __ **Rapid Infiltration**

   __ **Constructed Wetlands**

   __ **No opinion**

Please continue the survey on the other side of this page.

10. Land application of effluent by irrigation and constructed wetlands for infiltration may require large areas of land. These lands may be available as wildlife habitat and public open space. How important are open space benefits to you? ***(Please circle one)***

Very important				Not important
5	**4**	**3**	**2**	**1**

11. Please rank the following open space benefits in the order of importance *(with 1 being most important)* for possible implementation for the Freeland Study Area?

    __ **Parks and Recreation/Athletic Fields**

    __ **Public Forest Lands**

    __ **Hiking & Biking Trails**

    __ **Wildife Habitat**

    __ **Open Space/Views**

    __ **No opinion**

12. Did you attend the first two Freeland Sewer Planning workshops on February 8, and/or May 10, 2003, If so proceed to question "a)". If you did not attend the first Freeland Sewer Planning Workshops please answer question "b)"

    a) After you previously filled out a questionnaire at the February 8, 2003 workshop has you opinion on sewer in the sub-area changed?

    i. No change in opinion ***(Please provide any additional Comments)***

    _____
    _____
    _____

    ii. My opinion has changed. Please provide any additional comments as to <u>why</u> your opinion has changed.

    _____
    _____
    _____

    b) What are your overall feelings on sewage treatment and land application in Freeland?

Strongly Desire		Depends on cost		Opposed to Sewers
5	**4**	**3**	**2**	**1**

13. Additional Comments related to the Sub-Area Planning Process in Freeland:

14. Additional Comments related to the Comprehensive Sewer Planning Process in Freeland:

<u>Please continue the survey on the other side of this page.</u>

15. Additional Comments related to the selection of treatment plant/water reuse sites:

16. Notification for Future workshops will depend on having a current address for you. Please help us in keeping you notified of future meetings/workshop by providing us with your current address and contact information:

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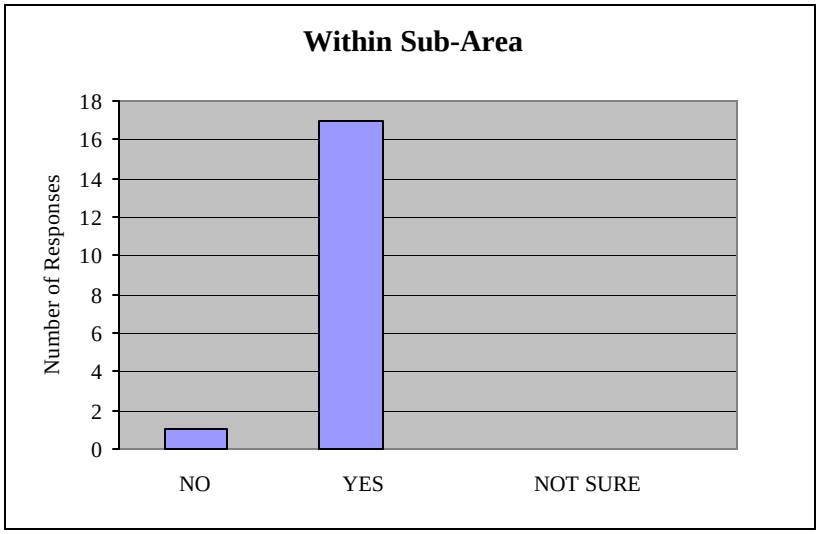
Email: _____

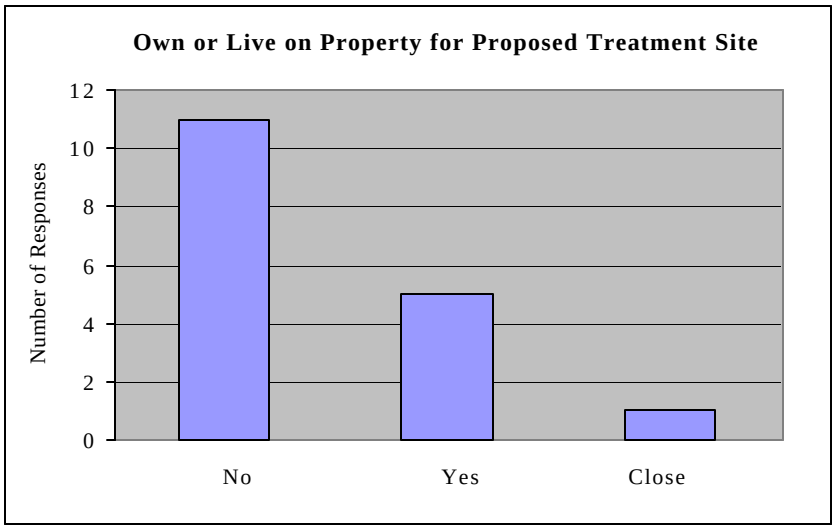
Please continue the survey on the other side of this page.

Results of Questionnaire: June 28, 2003 Workshop

Question 1

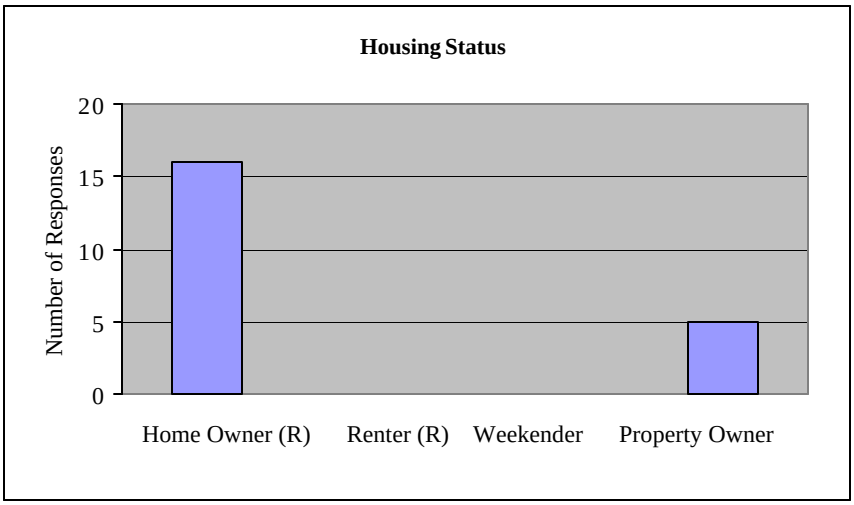


Question 2

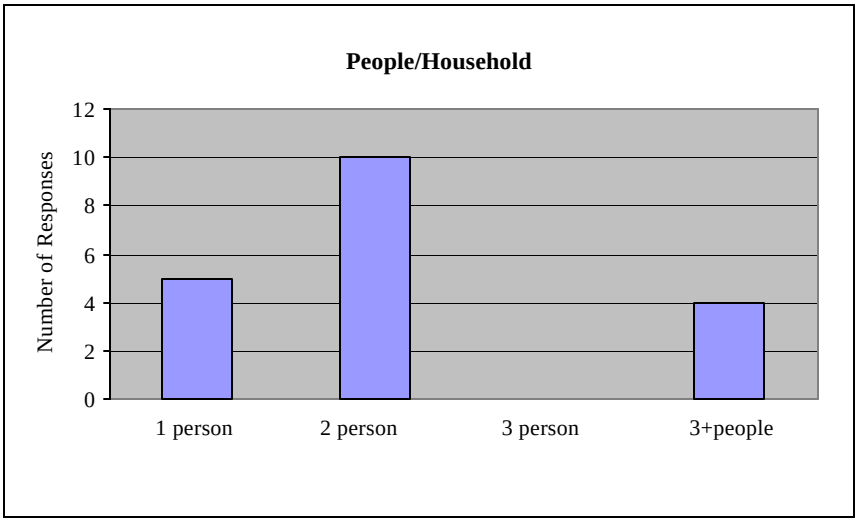


Results of Questionnaire: June 28, 2003 Workshop

Question 3

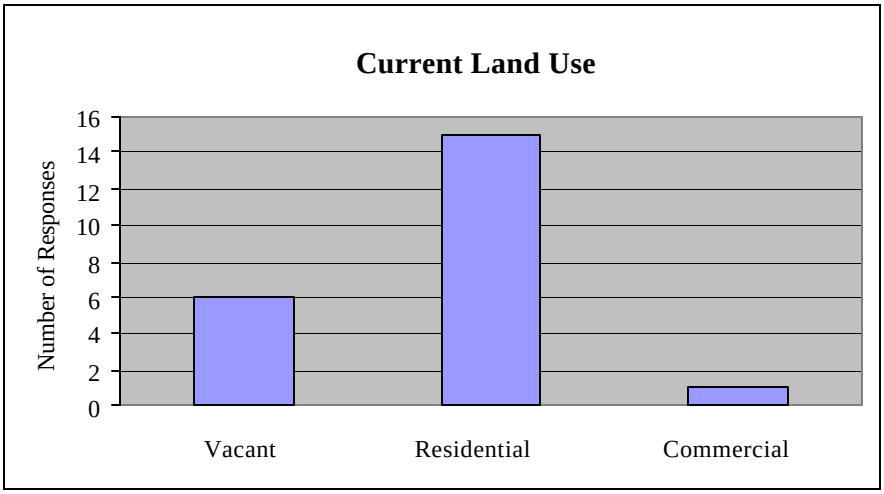


Question 4

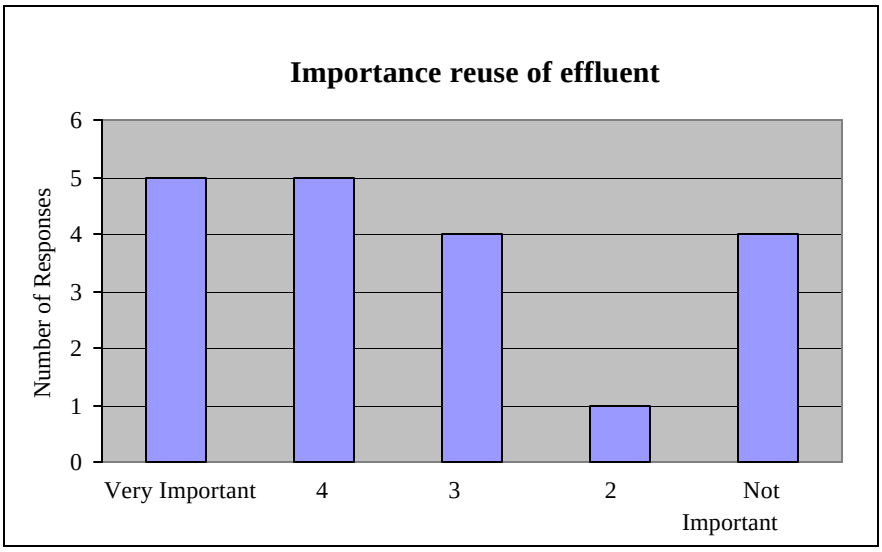


Results of Questionnaire: June 28, 2003 Workshop

Question 5

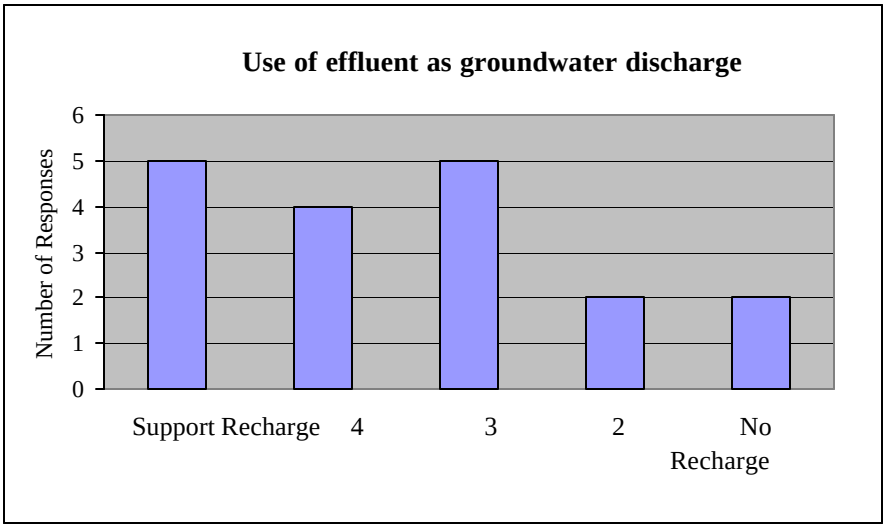


Question 6

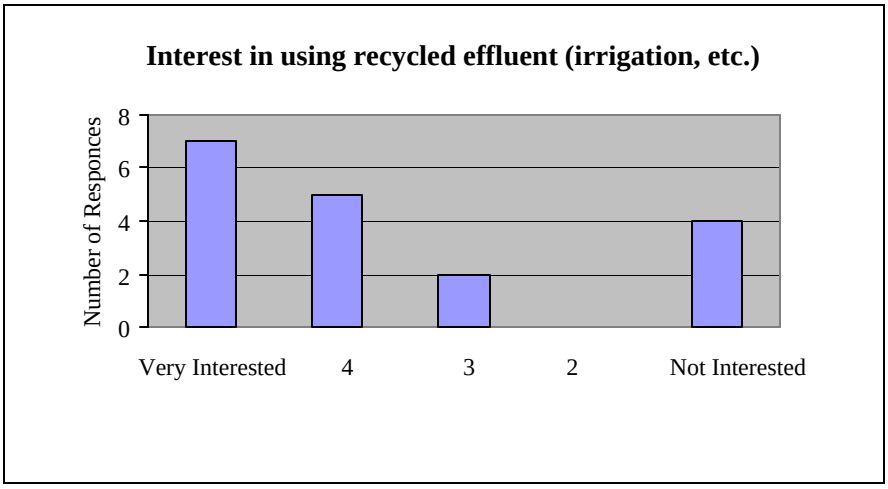


Results of Questionnaire: June 28, 2003 Workshop

Question 7

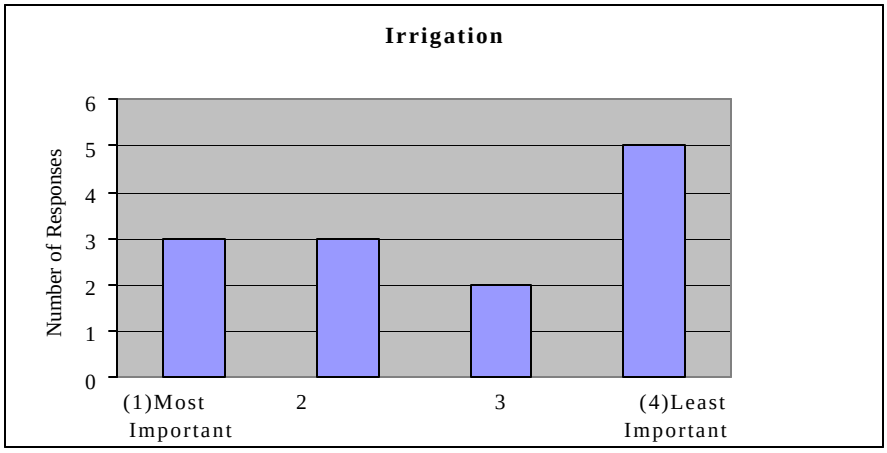


Question 8

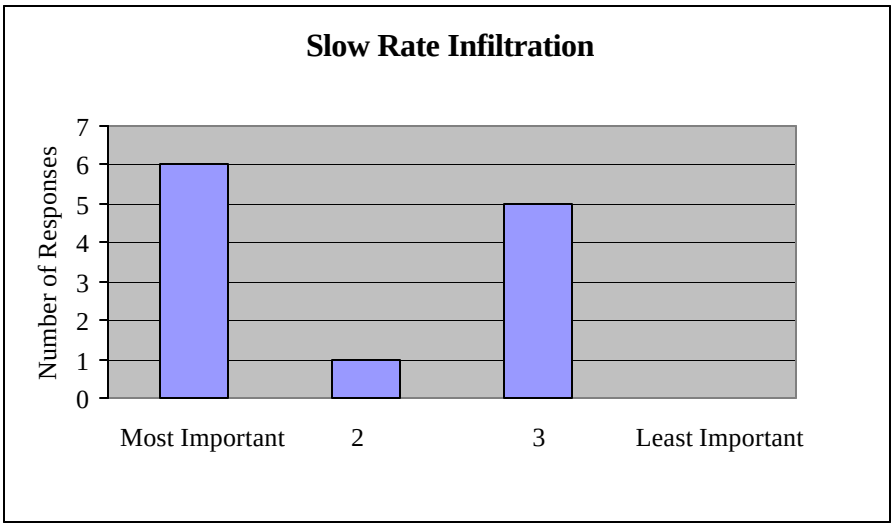


Results of Questionnaire: June 28, 2003 Workshop

Question 9 (a)

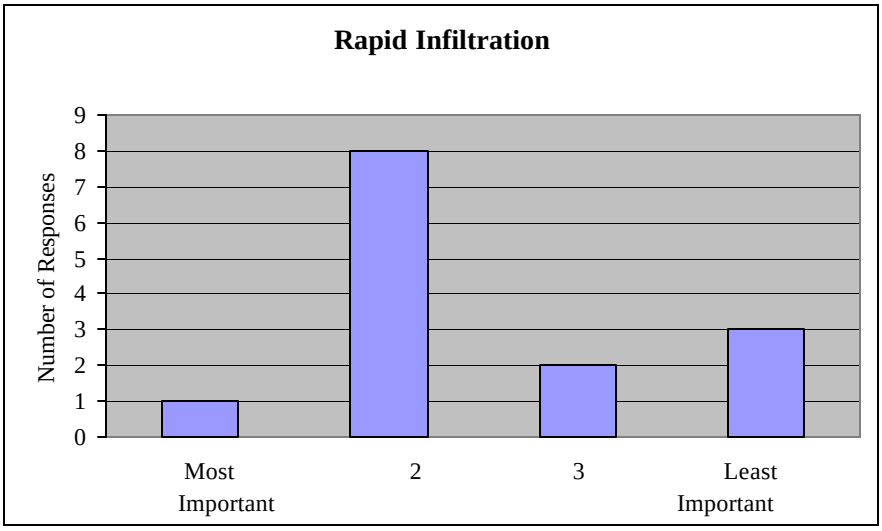


9(b)

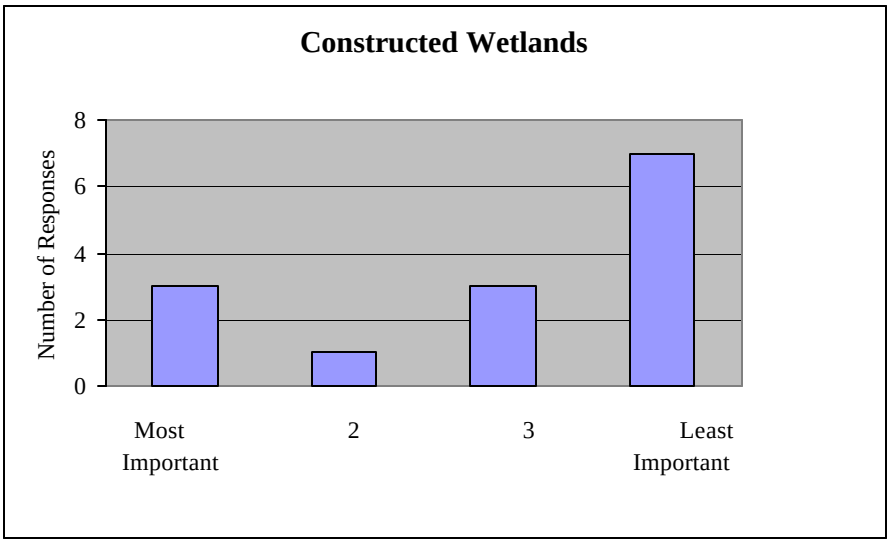


Results of Questionnaire: June 28, 2003 Workshop

9(c)

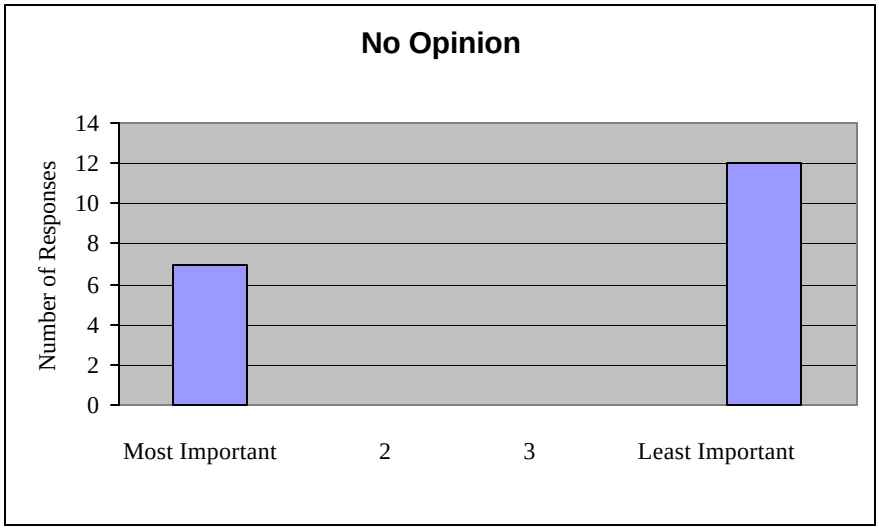


9(d)

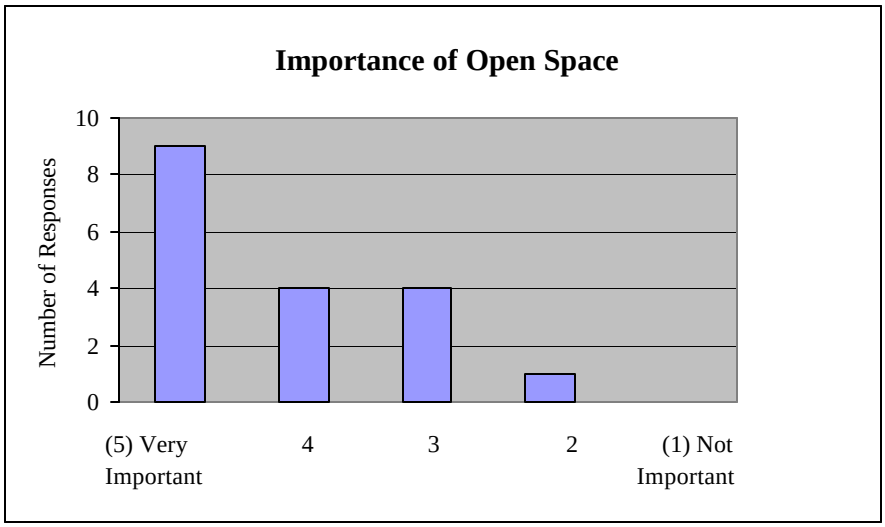


Results of Questionnaire: June 28, 2003 Workshop

9(e)

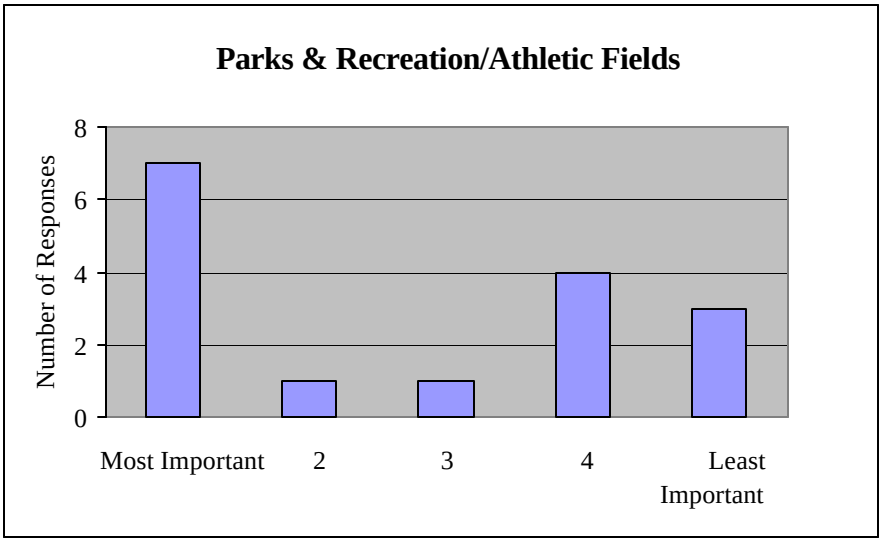


Question 10

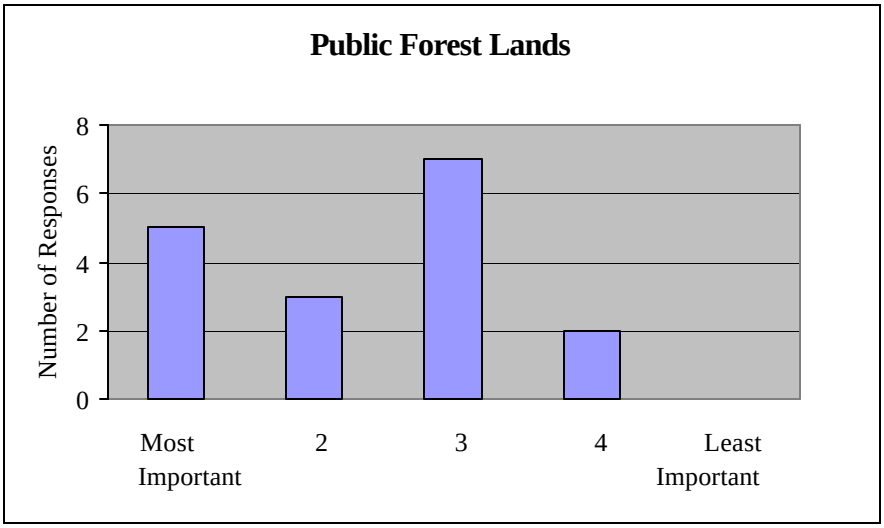


Results of Questionnaire: June 28, 2003 Workshop

Question 11 (a)

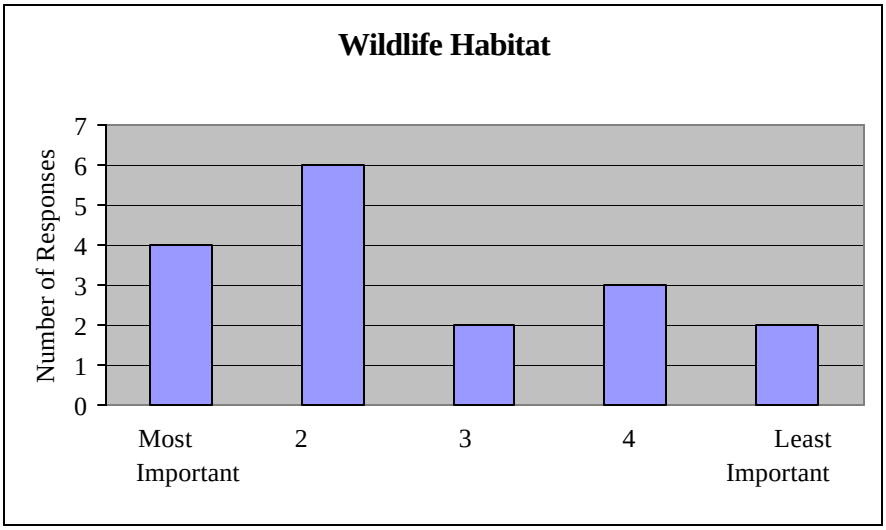


11(b)

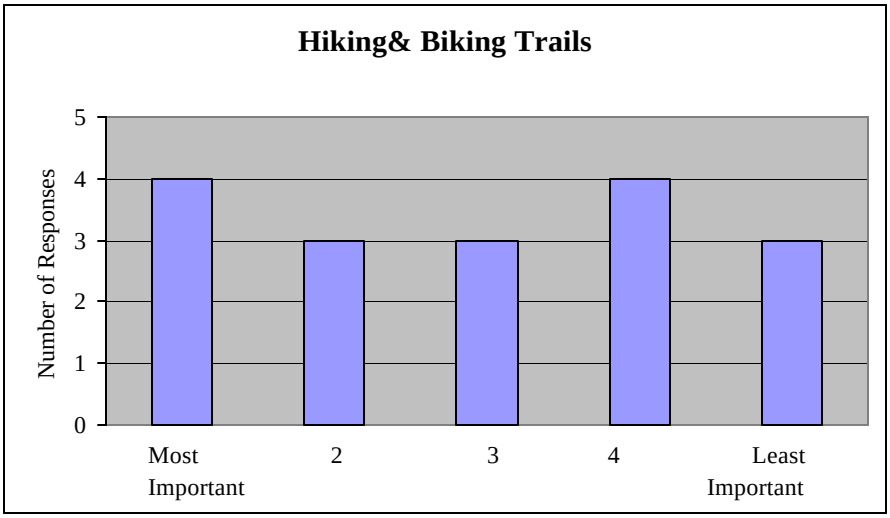


Results of Questionnaire: June 28, 2003 Workshop

11 (c)

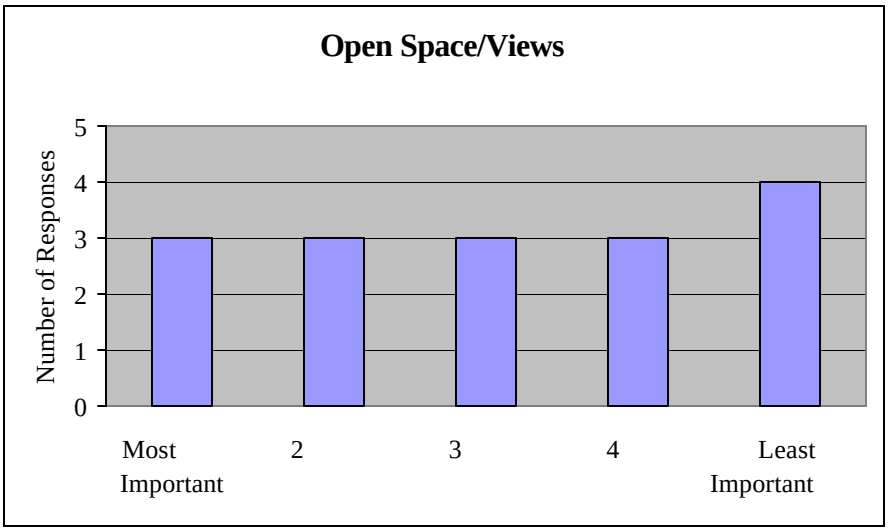


11(d)

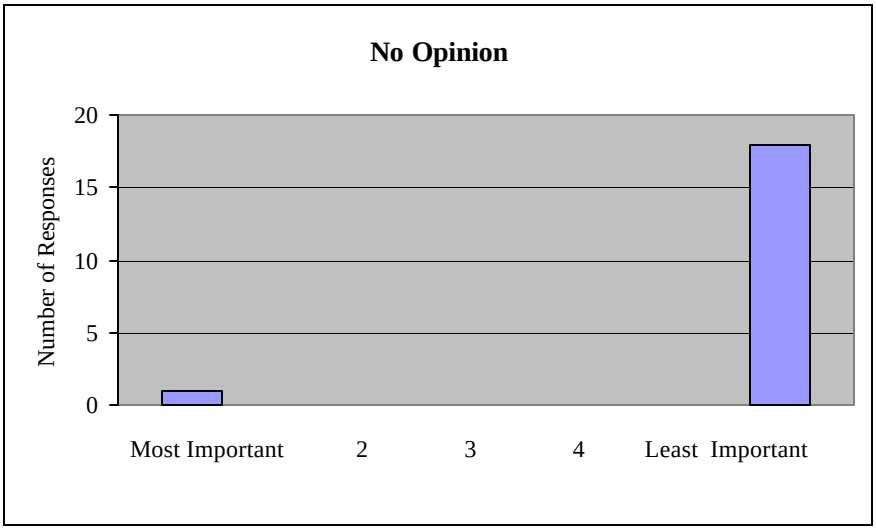


Results of Questionnaire: June 28, 2003 Workshop

11(e)

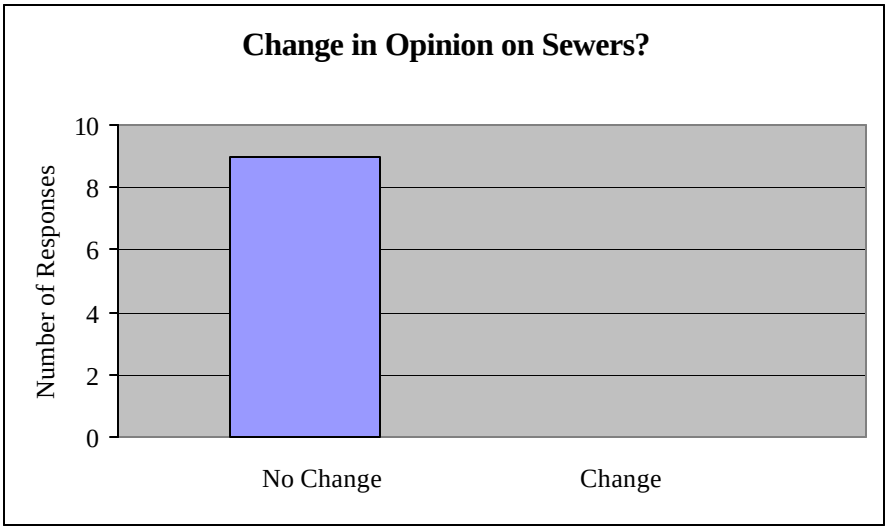


11(f)



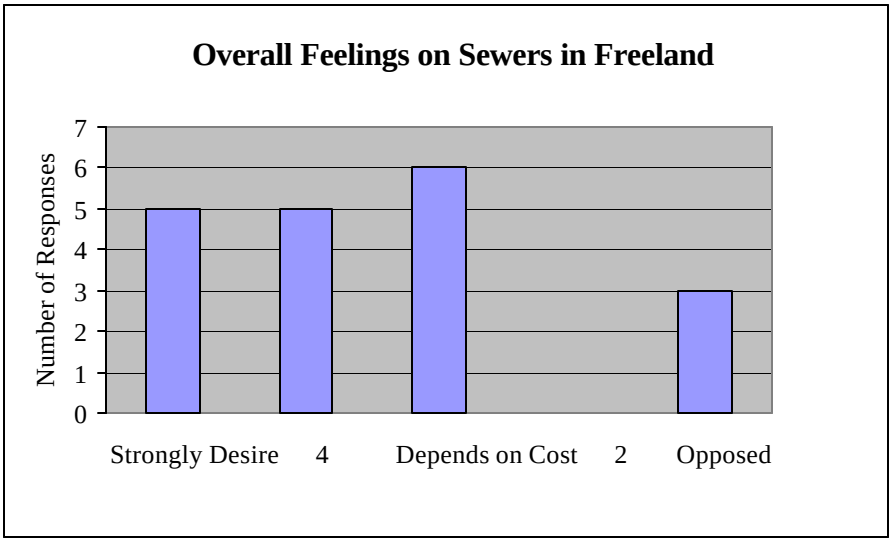
Results of Questionnaire: June 28, 2003 Workshop

Question 12(a)



Comments: Want a sewer sized for our community phase 1 as soon as possible.

Question 12(b)



Results of Questionnaire: June 28, 2003 Workshop

13. Additional Comments related to the Sub-Area Planning Process in Freeland.
    - This is Freeland Business Area problem not the problem of farm people around the area. Business wants this not the people who have been here for 60 years.
    - Excellent! Comprehensive and attentive-
    - A lot of money is being spent on this process especially related to sewer planning when you don't know if the people (majority) want the sewer system or want any changes.
    - Already have expensive new septic system and want nothing to do with new community sewer system.
    - Let Freeland business cover the cost in conjunction with Holmes Harbor Golf.
    - I thought this was very informative- thanks.
    - Want it to go faster. Would like to see more land designated for Condos.
    - Would you have holding tanks for retreated effluent? That becomes expensive. What State regs. would cover the reuse-need more info.
    - Desire proposed sewage treatment provided future allowable development is attractively and wisely done to make a tremendous addition in attractiveness of Freeland to visitors and residents.

14. Additional comments related to the Comprehensive Sewer Planning Process in Freeland.
    - It is needed for the core of Freeland that's all!
    - Seems clear to us that a Freeland only plan is most practical.
    - Presentations make it sound like NMUGA and sewer are a done deal. The whole process is putting the cart before the horse. We are still a RAID and frankly we feel it should stay that way.
    - Want "village" to be sewered first.
    - Does a chlorine product need to be used to "decontaminate" effluent- my concern is in leaching to salt water. How about ozone- also no need to transport.
    - Add purple pipe particular-sewer purple pipe separation specs; cost-benefit options of timing of installing purple pipe. Add more detail comparing-contrasting features-benefits and costs need to be put into presentation and handout materials. $20-40 –20yrs operations present worth needs to be clearly indicated.

15. Additional Comments related to the selection of treatment plant/water reuse sites.
    - I think there are better and closer alternatives than my 30 acres on Bush Point Road.
    - If the Freeland Plan isn't available then please look at the Far Plan as it will give more changes to expand.
    - The Freeland area seems best if possible.
    - Pastures adjacent to 525 and nearby most desirable good perk-pleasing appearance-single owner.
    - Up to the engineers.
    - Emphasize the costs of present costs and project future inflation projections not

Miscellaneous Comments

- Presentations are very informative/educational- we just can't see the need at this time. There is not an apparent demand for great influx of population in this area or Whidbey Island in general other than retirees who replace those who have passed on. There is no major industry on the Island to provide jobs/income for younger families and it is difficult and expensive to commute to mainland where job market is very poor now. So what is the push for?

Results of Questionnaire: June 28, 2003 Workshop

- Don't really want sewer system!
- Excellent, clear presentation from Alex and Gary.
- Deal with HHSD impact on liquid wastes storage system expansion if Freeland used their treatment process and construction cost feed back to customers.
- Deal with LID options clearly and reference details to answer questions of interested potential customers. Rapid infiltration proves more visually appealing? From SS. Grants available based on land Use or view corridor applications- conservation futures- IACS. Who make s ultimate decision? Plan? Final "go" decisions? Going on sewer system allow added bedrooms over present? Well protection form surge infiltration during peak flow?
- Interested depending on costs.
- Conservation Futures?

PLEASE RETURN COMPLETED QUESTIONNAIRE BEFORE YOU LEAVE. THANK YOU FOR YOUR PARTICIPATION.

1. Do you currently live on or own property within the proposed Freeland sub-area? ***(Please circle one)***

   a) **No**
   b) **Yes**
   c) **I am not sure, but I live close to the boundary**

2. What is your current housing status? ***(Please circle one)***

   a) **Resident Home Owner**
   b) **Resident Renter**
   c) **Vacation/Weekend Resident**
   d) **Property Owner** *(No buildings currently on land)*

3. How many people currently make up your household? ***(Please circle one)***

   a) **1-Person**
   b) **2-People**
   c) **3-People**
   d) **3+ People**

4. Is your land currently developed? ***(Please circle one)***

   a) **Vacant** b) **Residential** c) **Commercial**

5. In terms of a treatment and discharge system, how important is the local ability to reuse/recycle treated effluent and solids to you? ***(Please circle one)***

   Very important Not important

   5 4 3 2 1

6. How do you feel about the reuse/recycling of treated effluent to recharge groundwater? ***(Please circle one)***

   Support Groundwater Recharge No Recharge

   5 4 3 2 1

7. Would you be interested in having recycled treated effluent for irrigation of landscape and non-potable home/business uses in the Freeland Community? ***(Please circle one)***

   Very interested Not interested

   5 4 3 2 1

8. Did you attend any of the first three Freeland Sewer Planning workshops on February 8, May 10, June 28 2003, If so proceed to question "a)". If you did not attend the previous Freeland Sewer Planning Workshops please answer question "b)"on the following page:

   a) After you previously filled out a questionnaire has your opinion on sewers in the sub-area changed?

      i. No change in opinion ***(Please provide any additional Comments)***

      _____
      _____
      _____

      ii. My opinion has changed. Please provide any additional comments as to <u>why</u> your opinion has changed.

      _____
      _____
      _____

<u>Please continue the survey on the other side of this page.</u>

b) What are your overall feelings on sewage treatment and land application in Freeland?

Strongly Desire		Depends on cost		Opposed to Sewers
5	**4**	**3**	**2**	**1**

11. Additional Comments related to the Sub-Area Planning Process in Freeland:

12. Additional Comments related to the Comprehensive Sewer Planning Process in Freeland:

13. Comments on the draft Freeland Comprehensive Sewer Plan and Engineering Report:

If you would like a CD-ROM copy of the draft Freeland Comprehensive Sewer Plan and Engineering Report or have any questions regarding the report, please contact Gary Hess, Island County Public Works (360) 679-7331 x 7223 or (360) 321-5111 x 7223 (South Whidbey local call) or by email: garyh@co.island.wa.us.

Please forward any comments on the draft plan by email or in writing by Friday May 21, 2004 so that we can consider your ideas in the final plan.

PLEASE RETURN COMPLETED QUESTIONNAIRE BEFORE YOU LEAVE. THANK YOU FOR YOUR PARTICIPATION.

1. Do you currently live on or own property within the proposed Freeland sub-area? ***(Please circle one)***

   a) **No**
   b) **Yes(5)**
   c) **I am not sure, but I live close to the boundary**

2. What is your current housing status? ***(Please circle one)***

   a) **Resident Home Owner(4)**
   b) **Resident Renter**
   c) **Vacation/Weekend Resident**
   d) **Property Owner** *(No buildings currently on land)* **(1)**

3. How many people currently make up your household? ***(Please circle one)***

   a) **1-Person**
   b) **2-People (4)**
   c) **3-People**
   d) **3+ People**

4. Is your land currently developed? ***(Please circle one)***

   a) **Vacant (1)**
   b) **Residential (4)**
   c) **Commercial (2)**

5. In terms of a treatment and discharge system, how important is the local ability to reuse/recycle treated effluent and solids to you? ***(Please circle one)***

   Very important — Not important

   5 (2) **4 (1)** **3** **2 (1)** **1 (1)**

6. How do you feel about the reuse/recycling of treated effluent to recharge groundwater? ***(Please circle one)***

   Support Groundwater Recharge — No Recharge

   5 (1) **4 (3)** **3** **2 (1)** **1**

7. Would you be interested in having recycled treated effluent for irrigation of landscape and non-potable home/business uses in the Freeland Community? ***(Please circle one)***

   Very interested — Not interested

   5 (1) **4 (2)** **3** **2 (1)** **1**

8. Did you attend any of the first three Freeland Sewer Planning workshops on February 8, May 10, June 28 2003, If so proceed to question "a)". If you did not attend the previous Freeland Sewer Planning Workshops please answer question "b)"on the following page:

   a) After you previously filled out a questionnaire has your opinion on sewers in the sub-area changed?

      i. No change in opinion ***(Please provide any additional Comments)***

      Whole process is very stressful. My neighbors all feel the same. Say they would have to move if sewer system went in, as they could not afford paying for it.

      _____

      ii. My opinion has changed. Please provide any additional comments as to why your opinion has changed.

      _____
      _____
      _____

Please continue the survey on the other side of this page.

b) What are your overall feelings on sewage treatment and land application in Freeland?

Strongly Desire		Depends on cost		Opposed to Sewers
5 (3)	**4**	**3**	**2 (1)**	**1**

11. Additional Comments related to the Sub-Area Planning Process in Freeland:

"Whole process of forcing growth does not make sense. People live here because of low population, low density, rural atmosphere not because they want concentrated population and forced growth."

12. Additional Comments related to the Comprehensive Sewer Planning Process in Freeland:

"Comments of " it would raise property values" and at same time "we need low-income housing" Goals don't jive!"

13. Comments on the draft Freeland Comprehensive Sewer Plan and Engineering Report:

"Concerned re 2" sewer main would not be adequate. Main concerns are costs. Huge costs for most people who do no need this system."

If you would like a CD-ROM copy of the draft Freeland Comprehensive Sewer Plan and Engineering Report or have any questions regarding the report, please contact Gary Hess, Island County Public Works (360) 679-7331 x 7223 or (360) 321-5111 x 7223 (South Whidbey local call) or by email: garyh@co.island.wa.us.

Please forward any comments on the draft plan by email or in writing by Friday May 21, 2004 so that we can consider your ideas in the final plan.

FREELAND SUB-AREA ADVISORY PLANNING COMMITTEE
SUMMARY MINUTES
TRINITY LUTHERAN CHURCH
DECEMBER 12, 2002

MEMBERS PRESENT:	Tom Roehl	Steve Shapiro
	Carmen Falso	Rocky Knickerbocker
	Jim Short	Herb Hunt
	Rick Brown	
MEMBERS ABSENT:	Chuck Edwards	Jerry Robillard

Staff Present: Jeff Tate, Assistant Director
Joe Burcar, Planner

Public in attendance: Peggy Berto, Warren Berto, Mitchell Streicher, Jan Beall, Bill Frederick, Dave Braathen, Tom Talbot, Linda Rhodes, Vernon Brisley, Gayle Saran

Attachments referenced herein are available upon request.

PLANNING DIRECTOR'S REPORT

Jeff Tate, Assistant Director, noted that planning staff has been working on fine tuning the Buildable Lands Analysis. They have incorporated figures received from the Office of Financial Management that adjust the average household size. That information was transmitted to the sewer and storm water consultants in order to provide them with as up to date information as possible to work from in dealing with current population and population projections.

He pointed out that notebooks had been put together for the committee containing the following:

- Existing Conditions Report
- Buildable Lands Analysis
- List of motions made since the process started
- Quarterly reports
- Interlocal Agreement between Island County and the Freeland Water District
- Tetra Tech/KCM Scope of Services for the Sewer Plan
- Tetra Tech Freeland Comprehensive Sewer Plan, Project Management Plan
- Freeland Comprehensive Plan.

Steve Shapiro requested the notebooks include those issue papers that have been either accepted or adopted by the committee.

NEW BUSINESS

Tetra Tech/KCM contract/task discussion

Gary Hess, Island County Public Works Engineer, noted that Tt/KCM is currently in the data collection mode. Once Tt/KCM has finished reviewing all the historical reports and data they will begin to identify three alternatives for collection, treatment, and discharge of Freeland's sewage. Those alternatives will be presented in a draft report and a meeting will be scheduled to select the alternative that makes the most sense.

The obvious treatment alternative would be participation with the Holmes Harbor Sewer District, which would require some expansion of Holmes Harbor Sewer District's treatment and discharge systems. However the County wants to make sure that Tt/KCM does a through job on this project so they will also be analyzing other alternatives such as a new treatment plant.

They will be evaluating a couple of discharge alternatives. One would be a saltwater outfall into Puget Sound and the other would be various land applications. All of these alternatives will be analyzed and Tt/KCM will come back with recommendations for the type of sewer, where the pipes are going to run, and the sewer treatment plant alternative that makes the most sense. Each step along the way we will get a chance to review alternatives and weigh in with our opinions. As they go along they will be developing cost estimates for the alternatives. Funding sources for financing capital costs will be identified.

Tt/KCM will be conducting an environmental review to look into the environmental impacts of implementing a comprehensive sewer plan. The Board of County Commissioners will review and approve the final plan. The Freeland Water District would be the implementing authority. The final plan adoption is set for sometime around August of 2003 and then we will have to decide collectively and as a community how to move forward.

Tom Roehl clarified that the Freeland Water District was not conducting the study. The Freeland Water District has signed an agreement stating that if it implements whatever plan comes out of this process and uses that plan then it will build the cost of the study into whatever funding mechanism is created and pay the County back. The Interlocal Agreement between the County and the Freeland Water District makes it very clear that it cannot be a general obligation of the district. Whether the Freeland Water District Commissioners implement the plan will depend on whether they receive a petition to form a ULID from enough of the property owners who will benefit from such a facility.

He noted that he was grateful that with this study the people in the community would have the opportunity to make an informed choice.

Herb Hunt said he wanted to make sure that the Freeland Sub-Area Committee and the community are included in the future elements of the sewer plan and requested they be provided with a time schedule.

Gary Hess, pointed out the proposed schedule provided by Tt/KCM on Page 4 of the Freeland Comprehensive Sewer Plan. Tt/KCM is currently working on collection system alternatives and an anticipated review meeting has been set for January 23, 2003.

Tt/KCM is looking at conventional gravity sewers, STEP systems, and a hybrid of the two.

Tom Roehl noted that once Tt/KCM has a draft report there are plans to have workshops where there would be a significant mail out to all the property owners in Freeland to try to make some of these choices as a community about the collection & distribution system.

Steve Shapiro pointed out that the committee has previously identified areas in Freeland where they feel property owners are not going to want sewers. If the engineers do cost estimates for the entire study area and it turns out that certain areas do not want sewers that will change the cost for those that do. For example, let's say there are 400 potential hookups, if the engineers base the cost on those 400 hookups and only 250 are interested in hooking up that changes the cost and then those 250 may no longer be interested because of the new higher cost.

Tom Roehl noted that if the public process is done wisely they should be able to screen out those kinds of problems. One of the options that has been discussed is a phased system where they could start with the downtown core and other areas would come in based on input received by the public.

Jan Beall asked at what point the financial stability of the Holmes Harbor Sewer District would be taken into consideration.

Gary Hess said he did not know if that was addressed directly in the financial analysis. Operationally, if they were to come to an agreement with the Holmes Harbor Sewer District it would have to be addressed, at this point he could not really give a good answer to her question.

Jan Beall said it was her recollection that the committee had asked that one of the options to be considered in this study were very small regional sewer systems throughout Freeland.

Herb Hunt indicated that he recalled the concept of small regional sewer systems coming up in their meeting with the consultant. The consultant responded that they would take that into consideration.

Gary Hess noted that he would bring that to the attention of Tt/KCM and get back to the committee with regards to whether or not that concept is going to be addressed or not.

Tom Roehl said it was his opinion that small regional sewer systems, that require high tech maintainance, are what will evolve naturally in Freeland if they do nothing.

Mitch Streicher asked if it was possible that if the class action suit against Holmes Harbor is successful that they will not be allowed to enter into any contractual relationship with any outside entities.

Gary Hess said that is a good question for the lawyers not one that he could answer.

Rick Brown said it had been his understanding that the Freeland Sub-Area committee or at least some members of the committee would be participants in the technical workshops along with County staff and Tt/KCM.

Tom Roehl proposed that they form a subcommittee of those members interested in participating in the technical workshops.

Herb Hunt felt that in order to make this study truly successful they need to include the community and really help to educate, inform and service their questions.

Gary Hess agreed, noting that they as a committee should take a very large role in getting the word out.

Jeff Tate pointed out that in the Scope of Services wherever you see anything dealing with alternatives and workshops the sub-area committee is going to be involved. The County staff is the one that is going to be involved in the day to day stuff but all decision making is going to occur at the committee level.

Gary Hess said what he would like to see happen would be to have an open house where the alternatives can be presented to everyone in Freeland, gather their comments and opinions and then have a workshop with the consultants to analyze those comments and then make an informed decision.

Carmen Falso noted that a lot of property owners in Freeland who would benefit from sewers do not live here. He was in favor of providing more communication by mail to the absentee property owners and people who are just too busy to attend meetings.

Tom Roehl noted that staff will query the data base for property owners in the target area and send out a mailing. The content of that mailing will be very important.

Steve Shapiro said they can notify the property owners that the process is going on, but ultimately the information they need is what is the system going to look like and what is it going to cost and until that information is provided people can't make a decision.

He questioned whether as part of the engineers study they would be collecting data on individual parcels such as is it developed, does it have a septic system, how old is the system, are they interested in sewers.

Gary Hess said ideally that would be a good thing to do but economically that would be prohibitive.

Steve Shapiro said if they are planning on doing a mailing they could include a questionnaire along with it.

Tom Roehl asked if anyone was interested in participating on the subcommittee workshops.

Rick Brown, Herb Hunt, Steve Shapiro and Tom Roehl volunteered to participate in the subcommittee workshops.

Bill Frederick questioned whether any involved citizens would be allowed to participate in the subcommittee.

Her Hunt asked how many people could comfortably attend these workshops not including county staff.

Gary Hess acknowledged that they need to get community input but they also have to get closure. They need to keep it to a reasonable number of people who can remain on task through an afternoon of reviewing sewage system designs. Four committee members, two or three consultants, himself and someone from planning is probably enough.

As long as they can stay on task and with the idea that when they adjourn they have reached a conclusion then it should work fine. If it quickly becomes apparent that this format is not going to work then it will have to be changed.

Herb Hunt said he would gladly withdraw his name from the technical subcommittee group and instead form a public participation subcommittee to help in the process of involving the public.

Gary Hess noted that a public participation subcommittee that is represented by the sub-area committee would be a wonderful idea. Public participation is extremely important to this study and there is only so much the consultants can do to facilitate that.

> *Steve Shapiro moved to form a public participation subcommittee to assist county staff in developing the materials needed to include in the community mailing. The motion was seconded by Herb Hunt and opened for discussion.*

Tom Roehl felt that they should wait until the next meeting to receive a report from staff in terms of how they intend to address the public. He felt that the public involvement process was something that the entire committee could participate in via email.

Steve Shapiro said the idea of the subcommittee is to take some of the burden off of county staff by helping to draft letters as needed for review by the whole committee by email.

Jeff Tate noted that staff would put together some sort of a strategy for public outreach and bring it back to the committee at the next meeting. An extension of that strategy may be the formation of a subcommittee or some other alternative on how to handle public participation.

Bill Frederick offered to be part of the public participation subcommittee. He also noted that developing a website would help to keep the public informed.

The motion passed with a vote of 4 in favor and 2 opposed.

Tom Roehl appointed Herb Hunt, Bill Frederick and himself , as an ex officio member, to the public participation subcommittee.

The date for the next meeting was set for January 9th, 2003.

Mitch Streicher read the attached letter into the record. (Growth Management Record # 7347)

The meeting adjourned at 8:50 p.m.

Respectfully submitted,

Pam Dill
Adm. Asst.

FREELAND SUB-AREA ADVISORY PLANNING COMMITTEE
SUMMARY MINUTES
TRINITY LUTHERAN CHURCH
FEBRUARY 20, 2003

MEMBERS PRESENT:	Tom Roehl	Rocky Knickerbocker
	Carmen Falso	Chuck Edwards
	Ray Gabelein	Herb Hunt
	Jim Short	Steve Shapiro
MEMBERS ABSENT:	Rick Brown	

Staff Present: Phil Bakke, Planning Director
Joe Burcar, Planner
Gary Hess, Public Works

Public in attendance: Mitch Streicher, Al Peyser, Kathy Cado,

Attachments referenced herein are available upon request.

UNFINISHED BUSINESS

Recommendation for Sewer Collection Alternative

Alex Chen, Tetra Tech/KCM, presented a synopsis of the collection system technologies and alternatives. The elements of a comprehensive sewer plan include:

- Purpose and background
- Service area boundaries
- Population, flows, and loads
- Collection system
- Treatment
- Discharge
- Solids handling
- Implementation (Phased implementation, Funding strategy, rate impacts)
- Permitting and environmental documentation
- Public outreach

Wastewater collection technologies:

- Conventional gravity sewers
- Pressure sewers (septic tank effluent pumping STEP, Grinder pumps)
- Small diameter gravity sewers
- Vacuum sewers
- Decentralized systems

Conventional gravity sewers have a proven reliability and the lowest O & M costs. There is no need for septic tanks or pumps for individual connections. A conventional gravity system does require a constant downward slope with intermediate pump stations for hilly areas and has the highest initial cost because of the deep sewers.

Septic Tank Effluent Pumping systems (STEP), have a low initial cost because of the ability to have smaller sewers that can follow the terrain. Some of the drawbacks are the O & M for the septic tank and the electrical cost of operating the pump.

Grinder systems are a lot like the STEP system except the pump is rated to handle both solids and liquids, which requires additional maintainance, because it is more difficult for the pump to pass solids. This type of system is typically used when the terrain doesn't allow gravity sewers and septic tanks are not desired.

Small diameter gravity sewers have a lower initial cost because of the smaller sewers that can follow the terrain. The downside is having to deal with the O & M costs of a septic tank. The sewers are deeper than STEP or grinder systems because they are not pumped.

Vacuum sewers have a low initial cost because of the ability to have smaller sewers that can follow the terrain. Vacuum sewers have a limited lift capacity and are best suited for a flat terrain. Downsides include dealing with O & M costs on the valve pit and vacuum station as well as odor control.

Decentralized systems are basically small community systems such as the existing system in the Maple Ridge development. Tetra Tech/KCM was asked to look at decentralized systems to see if they were economical for all of Freeland. What they found was that with decentralized systems you can stage implementation and there is a lower cost for the collection system because the collection is all local. However, the regulations as they stand now strongly discourage this sort of system by system approach in favor of a centralized system. Some of the reasons for that is when you have lots of systems distributed around your service area you have a lot more O & M costs because each system has to deal with its own operation, maintainance, reporting, record keeping, etc. It is also harder for a smaller treatment plant to comply with regulations and because of that they have a greater potential for public health and environmental impacts. For those reasons Tetra Tech/KCM decided to remove decentralized systems as one of the alternatives.

In evaluating the four technologies left, their short list includes the gravity system, with a grinder pump where lift is required, and the STEP system. They rejected the small diameter gravity system because of the relatively deep pipe depths as well as septic tanks at each house and the vacuum system because of the hilly terrain in Freeland.

Another alternative is a combination gravity/STEP system. The gravity system is used where the housing density is higher and the STEP system is used in the lower density areas.

He discussed the graphs showing the estimated implementation costs and estimated cost per Equivalent Residential Units (ERUs) for the gravity system, STEP system and combined gravity/STEP system. (see attached)

An ERU could be a single family residence at 2.4 people per house or it could be a commercial connection discharging the equivalent amount or load of wastewater as a single family dwelling.

The estimated implementation costs graph shows the gravity system with a high up front cost. With the STEP system you don't pay very much up front because the sewers are shallow and small, but the capital cost to the homeowner is higher. The combined system is a mix of the two.

In comparing costs between the gravity system and the STEP system there is a break even point at about 3.5 houses per acre. More than 3.5 houses per acre and the gravity system starts to become more cost effective per homeowner, less than 3.5 houses per acre the STEP system becomes more cost effective.

Carmen Falso asked if homeowners would be able to use their existing septic tanks.

Alex Chen said that would depend on the utilities preference. The costs shown include the assumption that existing septic tanks will be replaced across-the-board. Money could be saved by not doing that, but testing becomes an issue because existing septic tanks are in varying conditions. Some of them are more prone to ground water infiltration or sometimes the connection from the house is not all that tight.

Tanks should be basically 1,000 gallon tanks and the pump can either be internal or it can be attached externally which would mean that it is possible to retrofit existing septic tanks. Experience has shown that if you go ahead with existing septic tanks you end up being a little more prone to peaks at the plant based on ground water leaking into the septic tank which ends up finding its way to the treatment plant. The treatment plant and discharge systems need to be designed for average and peak conditions so it could end up being more of a cost on the treatment side.

Steve Shapiro asked if it was feasible from a planning and engineering standpoint to remove the cost of the septic tanks from the sewer systems as a whole and make it the

responsibility of the property owner. That way if there is an existing tank or pump the property owner doesn't have to pay that cost until the tank or pump needs to be replaced.

Alex Chen, using Holmes Harbor as an example, pointed out that the assumption in the original engineering report was that the homeowner would be responsible for the cost of the electrical hookup, septic tank and pump and the district would do the maintainance on those items. By that same logic the white hatched section of the bar in the Estimated Implementation Cost graph could assume that the homeowner is responsible for all of that and the cost would be lower to the district.

Steve Shapiro asked what the value of an ERU was in gallons.

Alex Chen indicated about 150 gallons plus an allowance for infiltration into the septic tank.

Steve Shapiro asked how much of a problem ground water intrusion was in gravity systems.

Alex Chen noted that ground water intrusion was a significant issue in gravity systems, however it was getting better because of more modern joints for pipes. It is also an issue for STEP systems if the connection is bad between the building and the septic tank or if the septic tank itself is not in good condition. With a STEP system the sewers in the streets are not prone to ground water getting in because the system is under pressure.

Steve Shapiro asked if it was feasible to allow shared septic tanks for apartment complexes or dense housing developments.

Alex Chen said it was unrealistic to think that a very high density housing area would have individual septic tanks. They have tried to take that into account noting that the numbers don't assume that every single ERU has an individual septic tank. There is some allowance for multiple septic tanks for high density and commercial ventures.

Steve Shapiro noted that Tom Roehl, speaking for the Freeland Water District, which is assumed to be the lead agency in creating an LID, has said that no one will be required to hook up. What happens to the cost analysis if the number of hookups decreases because people choose not to hook up.

Alex Chen agreed that you can't force someone to connect to the system but in order to get additional revenue some utilities have implemented a policy that would require the property owner to pay some kind of equivalent monthly fee.

Tom Roehl indicated that issue was currently going through the courts.

He felt that most property owners would be more interested in comparing the M & O costs of their current septic system drainfield to a sewer system versus comparing the M & O costs for a STEP system versus a gravity system.

He liked the idea of a combination system but was concerned that they wouldn't be able to afford it especially if they rely on a smaller number of people to form an LID for Phase 1.

The existing system at Holmes Harbor has a certain excess capacity right now and with a STEP system you could conceivably put some initial phase capacity into the existing excess capacity while you are building the new treatment facilities. Assuming that is accurate would that same potential exist if you had a combination system.

Alex Chen said to a lesser degree. For example, with a gravity system you almost always have a headworks at the treatment plant that screens out rags, sticks, and debris that can effect the downstream process and that can be an expensive item. With a STEP system you don't have to have headworks because just the liquid effluent is coming out of the septic tank, you don't have to deal with the solids. At Holmes Harbor all of the collection system discharges right into the sequencing batch reactors without having to be screened. With a combined system at some point you would have to screen out those solids.

Tom Roehl said if you intercepted and screened out those solids from the part that is gravity then you could conceivably still go to their existing plant.

Alex Chen said that was certainly true. The other issues though are when you have screening or any sort of headworks type activity it is a maintainance item especially if that headworks is located far from the treatment plant. It can also generate some odors that might be of concern at the pump station or wherever you are screening.

Ray Gabelein noted that the STEP systems shows a 2" diameter force main and he wondered if at some point that size main would not be able to handle the flow.

Alex Chen noted that the 2" lateral is just the connection at the individual house. The mains in the street are a minimum 4" and they can go up to whatever size is necessary.

Gary Hess said based on the terrain you might have to use intermediate pump stations. It would be a stretch to think that a small pump in Freeland would make it all the way to Holmes Harbor.

Alex Chen noted that the costs for some intermediate pump stations were factored into all of the alternatives. The gravity system would have small ones throughout the system to deal with hills that drain the wrong way and for the STEP system we have assumed a single pump station that would take the effluent to either Holmes Harbor or another discharge location as yet to be determined.

Ray Gabelein asked if there was a town similar in size to Freeland that has installed one of these systems.

Alex Chen noted that Yelm has installed a STEP system. He indicated he would provide the committee with a list. STEP systems are particularly good for small communities especially when there is high ground water or rocky soils where putting in deep sewers would be cost prohibitive.

Chuck Edwards noted that the numbers they were looking at were strictly for a collection system and did not include the treatment or discharge systems. His concern was that the committee was supposed to recommend one of the collection alternatives with only part of the equation.

He said his gut reaction was to pursue the STEP system and the feasibility of hooking up to Holmes Harbor assuming that the treatment costs would be substantially lower.

Steve Shapiro said if hooking up with Holmes Harbor is not a possibility how does the cost of the combined system compare to the STEP system if they have to go with a separate treatment facility.

Alex Chen said he felt he could address qualitatively what kind of effects the different types of collection systems have on treatment whether it be at Holmes Harbor or elsewhere. In some cases the STEP system is cheaper than the gravity or combined systems until you get towards the ultimate build out where the costs start to get similar.

With a STEP system you don't need to put in headworks for the treatment plant which is an immediate cost savings that the gravity or combined system does not have and since most of the solids are handled at the septic tank the overall facilities could be considerably smaller.

Steve Shapiro asked if the liquid volume was essentially the same.

Alex Chen said it was somewhat the same. With a STEP system the peak factors are only 10 to 20% less. The discharge capability is about the same as it is directly related to the amount of liquid that is coming in.

Herb Hunt said he was concerned that they did not have a viable treatment plant yet. He asked how much acreage a treatment plant would require.

Alex Chen noted that the biggest land acreage requirements were going to be on the discharge side. For example, the Holmes Harbor plant is graded for an average annual flow of 100,000 gallons per day. It is currently receiving about a quarter of that flow. The flows that are being projected for Freeland depending on the housing density and the build out conditions could go as high as 5 times that to ½ million gallons per day. Initially the flows will be much lower than that but you want to set aside enough land to deal with that much.

Gary Hess noted that the processing plant itself could easily fit on ½ acre, but to be conservative if your looking at a ½ mgd plant you would want at least a couple of acres.

Alex Chen said in order for Freeland to combine with Holmes Harbor the treatment plant needs to be expandable but Freeland will still need to identify an alternative discharge because the golf course capacity is almost all spoken for assuming that all 500 houses in Holmes Harbor eventually connect up.

Ray Gabelein inquired about the acreage of the golf course.

Alex Chen indicated that the golf course has 65 acres of irrigatable land. If all of the houses were connected up and the treatment plant was at full capacity they would take up 55 acres of it.

PUBLIC COMMENT

Mitch Streicher asked if the estimated cost per ERU included the cost to the homeowner for hooking up from his house.

Alex Chen noted that the capital cost of the homeowners connection was included in the estimated cost per ERU.

Cathy Cato asked the expected cost of power usage to keep everything flowing and what happens during an extended power outage.

Alex Chen said if money isn't an issue most conservative traditional engineers favor gravity systems because they are simple and reliable and if the power goes out you don't have to worry about it. STEP systems generally have some free space in the system and at least a days worth of typical use before bad things start to happen. Power usage of the pump is not a big factor.

Al Peyser submitted a letter regarding sewers for Freeland Village. (GMA #7381)

He noted that sewers in Freeland are too big and costly and issue not to cause concern with the pubic, thus delaying the acceptance of the plan for the whole of Freeland. He suggested breaking the planning process into two separate projects; sewers for the Freeland Village and a Comprehensive Plan for Freeland with or without sewers. The sewer design for Freeland Village might be nothing more than a large septic tank facility and a large drainfield, which could become a park in the future. He felt the funding was available and there was nothing to stop the process from starting immediately and having plans ready within six months.

Herb Hunt agreed that it was going to be difficult to get a large area of Freeland to come on board with sewers. He felt more confident about the Freeland Village and some of the surrounding neighborhoods and wondered if there could be a parallel process without conflicting with what was currently taking place.

Gary Hess noted that the requirements of a Comprehensive Sewer Plan are well defined by the state in the administrative code. If those requirements are not followed then the Department of Ecology will not buy off on it and it can not be implemented.

He agreed that taking less than the whole makes the most sense, but they need to go through the entire process and get DOE approval before they can take the next step of implementation. Tetra Tech/KCM has financial analyst on staff looking at rates, costs and how this thing makes the most sense to put together. It is important for them, and we will make sure they understand, that the implementation probably will be a much smaller subset of the whole and they will need to give us guidance on how to do that.

Tom Roehl pointed out that there were a lot of property owners beyond the village boundary who are interested in sewers. The implementation part of the plan will address how it might be phased in.

Chuck Edwards said he hoped that the plan included a step implementation that would take into account that the Freeland Village downtown core was an obvious place to get a LID through and be Phase 1 and go from there.

> *Chuck Edwards moved to adopt the STEP sewer system. The motion was seconded by Carmen Falso and opened for discussion.*

Ray Gabelein felt it was important, as they move forward in the process, to be able to factor in the use of sound existing septic tanks.

Gary Hess said that would be best addressed in the policy of the implementing body.

Herb Hunt asked if staff could give an outline of the next steps in the process.

Gary Hess pointed out that they were still following what is laid out in Task 4 of the Scope of Services.

> *The motion passed with a vote of six in favor and one opposed.*

Presentation on treatment and discharge

Alex Chen noted that the governing factor for a treatment plan design really depends on the discharge strategy. Marine outfall requires a secondary treatment. A land application discharge requires tertiary treatment or better.

Treatments include filtration and other “Class A” requirements. Holmes Harbor filters their effluent from their sequencing batch reactor to the secondary treatment plant. Class A is a state defined term for a certain set of treatment requirements. There are other requirements such as nitrogen/phosphorus removal. Typically rapid infiltration of the ground water requires nitrogen removal and discharge into native wetlands requires

phosphorus removal. Another treatment is reverse osmosis. With each additional treatment it gets more expensive.

Wastewater discharge options include:

- New outfall
    - Holmes Harbor
    - Mutiny Bay
- Holmes Harbor WWTP
- Groundwater infiltration
- Water reuse
    - Crop irrigation/public spaces
    - Spray/subsurface
- Wetlands
    - Native/man-made
    - Surface/sub-surface

Almost all of the options, excluding outfall, require a higher advanced level of treatment, Class A or better.

Treatment Options – "Low-Tech"

- Recirculating sand filters
- Wetlands
- Lagoons
- Disinfection

Treatment Options – Conventional and Advanced

- Fixed-film reactors
    - Trickling filters
    - Rotating biological contactors
- Activated sludge
    - Extended aeration
    - Oxidation ditch (used in Coupeville)
    - Sequencing batch reactor (used at Holmes Harbor)
- Advanced treatment for water reuse
    - Media filtration
    - Membrane treatment (Holmes Harbor wants to upgrade to this option)
    - Nitrogen/phosphorus removal
- Disinfection
    - Ultraviolet light

Treatment – Solids Handling

- Septic tank pumping

    - Haul to Island County
    - Compatible with STEP and SDG systems
- Treatment plant sludge – similar to Coupeville
    - Haul to Island County
    - Thickening may reduce costs
- Other alternatives
    - On-site stabilization
        - Aerobic digestion
        - Stabilization lagoons
    - Local beneficial reuse
        - Class A- highest quality; unrestricted public use
        - Class B- lower quality for permitted sites

Tetra Tech/KCM's Thoughts – Treatment and Discharge

- Holmes Harbor WWTP amenable to expansion
    - Prescribed technology: membranes
    - Storage and discharge: still need definition
- Freeland- only WWTP
    - Greater control
    - No pumping to HHSD required
- Most feasible discharges:
    - Irrigation
    - Rapid or slow infiltration
    - Man-made wetlands
- Phase implementation reduces cost impacts

Ray Gabelein said he didn't want to see them spend a lot of time and energy on the outfall into the saltwater option. It was his opinion that Island County being a sole source aquifer needed to put the water back into the ground.

> *Chuck Edwards moved to not spend any extra money or time on salt water discharge. The motion was seconded by Steve Shapiro and carried unanimously.*

Herb Hunt asked if there was a way, given the current regulations, to put a man-made wetland next to a native wetland so that the discharge could filter through the man-made wetland first.

Alex Chen said there was some potential for that but it was a gray area in the regulations. Island County's regulations call for a 100 foot buffer on Category A wetlands.

The committee had asked earlier about acreage requirements for discharge as well as treatment and that varies tremendously with the overall strategy. Using a ballpark loading rate for a constructed wetland you would need a maximum of 25 to 30 acres. That would again depend on what the hydrologist gives us as far as the estimated soil infiltration rate.

Herb Hunt said he would like to see discharging in several different locations around the Freeland area. He felt there were different areas that would take different types of discharge.

Steve Shapiro said he thought that the Holmes Harbor system could be upgraded in a number of ways and infiltration in addition to storage would be one of those ways

Phil Bakke noted that prior to the next meeting on March 13th staff would distribute a revised schedule, revised draft plan that incorporates the buildable land analysis, comments previously made on issue papers, and the vision statement in whatever state it is by that date.

The meeting adjourned at 9:00 p.m.

Respectfully submitted,

Pam Dill
Administrative Assistant

FREELAND SUB-AREA ADVISORY PLANNING COMMITTEE
SUMMARY MINUTES
TRINITY LUTHERAN CHURCH
MAY 15, 2003

MEMBERS PRESENT:	Rick Brown	Ray Gabelein
	Rocky Knickerbocker	Tom Roehl
	Steve Shapiro	Herb Hunt
MEMBERS ABSENT:	Carmen Falso	Jim Short
	Chuck Edwards	

Staff Present: Phil Bakke, Planning Director
Jeff Tate, Assistant Director
Gary Hess, Public Works

Public in attendance: Mitch Streicher, Bill Russell, Jan Beall, Kathy Cado, Geoff Hornsby, Dave Braathen

Attachments referenced herein are available upon request.

UNFINISHED BUSINESS

Tom Roehl requested that the committee members work during the next month on any suggested changes they want to make to the Freeland Sub-Area Plan and provide them to staff so they can possibly act on them at their next committee meeting.

Gary Hess presented a synopsis of the power point presentation from the May 10th discharge and treatment workshop.

The bulk of the presentation centered on the treatment system basics. Land applications require a tertiary treatment which means solids and dissolved solids are removed from the waste water and then a further processing step which usually includes filtration and disinfection to treat it to a Class A effluent. The shortlisted discharge alternatives include, irrigation at agronomic rates, groundwater recharge (slow-rate or rapid infiltration) or constructed wetlands.

All of these alternatives have their pros and cons. Irrigation has the fewest regulatory issues, but requires the largest land and storage areas.

Ground water infiltration takes less land area but because Island County is a sole source aquifer the state requires treatment to a higher level for groundwater infiltration and there are safeguards that they want built into the system to prevent degrading the quality of the groundwater.

Constructed wetlands have both wildlife habitat and public open space benefits.

The highest cost alternative for discharge is for the agronomic irrigation and that is primarily because of the large land area that is required.

There are two general treatment strategies; combining with the Holmes Harbor treatment plant and a Freeland only treatment plant. Holmes Harbor has the benefit of having an already established system. Holmes Harbor has talked about upgrading from an SBR to an MBR. A Freeland only plant would give you more flexibility in the location but would potentially have a higher cost.

Treatment alternatives include oxidation ditches, sequencing batch reactors and membrane treatment. The sequencing batch reactor works like a washing machine, it fills and dries and would require a separate filter just like Holmes Harbor does now. The oxidation ditch is a continuous flow through process and is what the Town of Coupeville uses. The advantage of the membrane bioreactor is that it does all the treatment and filtration in one unit.

The treatment plant would be built piece by piece and added on to as the service area grows and sewage flows increase. The Department of Ecology requires complete redundancy for a treatment plant because things can break down.

The down side of the oxidation ditch is those two units are going to be well oversized because you just can't get them that small for the initial flows so you would be running on the ragged edge and probably have one unit that would be sitting idle for many years before the flows to the plant got high enough. The sequencing batch reactors are somewhat the same but because you have the redundancy in two there is less idle treatment plant capacity. The membrane bioreactors will also have smaller units. With both the MBRs and SBRs alternatives you have less capital dollars tied up that aren't really doing any treatment for a period of time. One of the issues that is worth thinking about as we go through this analysis is what makes the most sense and what will be the most cost effective when we look at implementing this system.

Steve Shapiro asked when you add a third module to the MBRs and SBRs does it have to be adequate to handle the entire treatment or is it two out of the three.

Gary Hess said it would have the capacity to treat 1/3 of the total capacity.

Tom Roehl asked about the function of the two ponds at Holmes Harbor.

Gary Hess noted that the capacity of the Holmes Harbor plant is 100,000 gallons per day or .1 mgd. Freeland's plant is approximately 5 times that large. Holmes Harbor has roughly 16 million gallons of storage capacity because they have to store all of the sewage that they produce until the irrigation season starts.

Tom Roehl asked how forest application would apply. He was thinking about the forest area to the west of the golf course, which they wouldn't necessarily have to buy all at once.

Gary Hess indicated that forest application would fit very well into this program. He cautioned against purchasing the application property in pieces.

The other issue that they need to look at is disinfecting the wastewater after it has been treated. A couple of the alternatives are using liquid hypochlorite or ultraviolet light disinfection. The only downfall with ultraviolet light disinfection is that for reuse the state requires there be a chlorine residual in the pipes after it leaves the plant. This is to ensure that there is no re-growth of bacteria or viruses in the pipes that could then lead to contamination problems. Teta Tech/KCM's preference would be to recommend a liquid hypochlorite disinfection.

Ray Gabelein asked if there was any concern about using chlorine with a ground water application.

Gary Hess said the chlorine does not last very long and it leaves the plant at about one part per million of chlorine as a residual.

TetraTech/KCM looked at the costs of each of the treatment options. The oxidation ditch, because of the process unit size that you would have to install, has the highest cost and is not something that they are going to be looking at much further. The SBR and MBR are much lower in cost and are pretty comparable. They also looked at the cost of a MBR at Holmes Harbor. The costs are nearly the same between the MBR Freeland only option and with Holmes Harbor because the infrastructure costs pretty well balance out.

With the STEP system a fair portion of the solids will be retained in the septic tanks on each individual site. Those will be pumped and handled just as septic tanks are now but probably at a higher frequency just to make sure that the effluent going to the treatment plant is not contaminated by excess solids.

There are a couple of ways to get rid of the stuff that is generated in the treatment process. Short-term alternatives include stabilizing it and hauling it to the Island County plant or another treatment plant off the island. The reason for looking at another treatment plant is because the Island County plant has limited capacity to accept non-septic tank pumped solids.

Long-term alternatives include looking into taking care of the solids generated by the plant with our own system and doing some kind of beneficial reuse, such as composting

or land and forest application. There are a lot of things you can do with treatment plant sludge it actually can become a useful product to recycle.

Rick Brown said he was curious why one of the treatment options was not a SBR with Holmes Harbor.

Gary Hess noted that Holmes Harbor has indicated that they would like to convert from the SBR process to the MBR process mainly because they are having problems with how they are able to filter their effluent to reuse standards. Because Holmes Harbor is running at such low capacity they are getting into a situation that is called "sludge bulking" which means that the solids don't settle out and provide a nice clear effluent coming out and going into your filters.

If you have excessive solids going into your filters the filters can't do as good a job at filtering it to the quality that is needed. When Holmes Harbor has those kinds of process upsets, which happen once in a while, they can't use that water and have to put it somewhere else. They are using one of their basins for that and eventually if they get the chance they will run it back to their plant.

Holmes Harbor is looking at ways of upgrading their plant to get out from under this process issue and the one that their engineer is suggesting is the MBR process. They could put the MBR units in their SBR tanks and that does all the filtration right in one tank.

Rick Brown said if Freeland were to join Holmes Harbor they would obviously get substantially more effluent, which should offset the sludge bulking problem. He felt that one of the alternatives they should be looking at was sharing an SBR with Holmes Harbor.

Gary Hess pointed out that the unused capacity at Holmes Harbor is already committed, people are paying for that unused capacity.

Tom Roehl said if they can provide the financial assurances to do all the upgrading necessary to handle any of their additional hookups then there wouldn't be any risk to the HHSD in letting us use their current excess capacity as long as we are designing a system that picks it up.

Gary Hess noted that those are issues that would have to be worked out. At this time they don't have enough of the details and are just looking at comparisons. Just because the SBR option with Freeland doesn't show as an alternative doesn't mean they have completely discarded it, however Holmes Harbor is telling them that if there were any changes to the plant they would like to upgrade to an MBR process.

He noted that he had discussions with the engineers and operator of the HHSD after the workshop and he made the strong point that maybe they need to optimize their SBR

system before they look at converting the process. The bottom line is that it is their system and they can do whatever they want with it.

Rick Brown said if Holmes Harbor is definitely not offering a shared SBR system then that should be clarified for the benefit of the public.

Gary Hess said when they start fleshing out the report it will cover the pros and cons and the reasons why they are or are not going with Holmes Harbor and what the process selection would be.

Jan Beall asked what an ERU was and how they arrived at the numbers.

Gary Hess explained that ERU stands for Equivalent Residential Unit. 125 gallons per day is the analysis unit used to bring it down to the level of a cost per household type basis. The bars on the chart represent different population scenarios.

Jan Beall asked what the difference was between the 2002 population with NMUGA sewers and the 2002 Commercial/Residential core.

Gary Hess explained that the NMUGA was a much larger boundary then what they consider to be the commercial/residential core.

Marilyn Abrahamson said if Holmes Harbor is having difficulty with its SBR currently because it is under capacity, isn't there a lesson there and wouldn't Freeland have that same problem in the early stages with an SBR system. She also understood from what she heard at the May 10th workshop that the MBR was an approach that was better phased over time.

Gary Hess noted that the SBR and the MBR lend themselves better to growth phasing then the oxidation ditch because the process units are smaller.

There are different ways to look at the problem, one approach would be to say its not working let's try something different and another approach would be let's mess with it and see if we can make it work better.

Tetra Tech/KCM's thoughts are that the agronomic rate irrigation from a regulatory standpoint is easy to do but is too expensive because it takes a lot of land area. The slow rate and rapid infiltration has lower costs because of the decreased land area but there are regulatory issues that will need to be worked through with the Department of Ecology. Constructed wetlands have a fairly low cost and ecological benefits but have some regulatory issues. Another alternative that has been suggested is the ability to use this effluent for landscape irrigation or to be used as a gray water system in new construction for things like flushing toilets. The disadvantage is that means installing an entirely separate infrastructure of "purple pipes" to distribute that from the treatment plant back into the community.

With regard to treatment the MBR is easiest for phasing and produces the best effluent quality, but liquid hypochlorite is inexpensive and effective as well.

Most of the people who responded to the questionnaire provided at the workshop were residential homeowners with 2 people/household. They were generally in favor of having the ability locally to reuse/recycle treated effluent and solids. In favor of reuse/recycling of treated effluent to recharge groundwater and split on having recycled treated effluent for irrigation of landscape and non-potable home/business uses in the Freeland community. In favor of constructed wetlands as wildlife habitat/open space. When ranking land application alternatives, constructed wetlands were the first choice, slow rate infiltration was second and rapid infiltration and irrigation came in third.

Mitch Streicher asked what the significance was in the lengths of the bars in the estimated cost per ERUs.

Gary Hess explained that each one is a progression of the cost as you build the system. For example, the residents of the commercial core, represented by their 324 ERUs, decide they want to foot the bill for a sewer system. Five years later the residents adjacent to the area want to hook up and the plant needs to be expanded to accommodate the additional capacity.

At the June 21st workshop the engineers will have put together the combined collection, treatment and discharge alternatives that make the most sense. In the meantime they will be talking to DOE to find out what they think will work from a regulatory side and also look at likely places for treatment plant sites.

Ray Gabelein asked if DOE was familiar enough with Freeland's particular situation to be able to factor that into their preferred alternative.

Gary Hess said they are going to ask DOE what their range of options are knowing that Whidbey Island is a soul source aquifer. They are trying to put a meeting together to discuss the sole source aquifer, wetlands, surface water and the treatment side of things. He felt that DOE was doing a good job of listening to them and understanding what Freeland's situation is.

Herb Hunt asked if there were separation requirements for purple pipes.

Gary Hess noted that there were separation requirements, but he did not know what they were.

Ray Gabelein noted that generally the standards are 10 feet horizontally or 3 feet vertical.

Herb Hunt said it seems like there would be a good scale of continuity, if the distance was short enough, to be able to put both the sewer and purple pipes in the same trench.

Gary Hess noted that what he needs to find out from the committee is whether they are supportive of the options and the reuse of waste water either through aquifer recharge or the purple pipe system.

Steve Shapiro said he would support the type of reuse that gives the most benefit even if that benefit can't be quantified economically. He liked the idea of a purple pipe system and ground water recharge that results in open space, wildlife habitat or even forest land benefits. He did not like the groundwater recharge with rapid-rate infiltration option. He also felt that slow infiltration via a huge drainfield also makes some sense because then you can plant grass on top of it.

Tom Roehl said he felt like most of the people who answered the questionnaire, he was in favor of all of the options "depending" on various factors and it's those factors that they don't know yet. We need to keep in mind how much things are going to cost because if the initial start up costs are prohibitive then we will have a plan that everybody wants but nobody can afford.

Ray Gabelein pointed out that the purple pipes won't get used a lot for irrigation in the winter.

Rocky Knickerbocker said they could still be used for flushing toilets.

Steve Shapiro did not feel there would be enough volume to make it worthwhile.

Gary Hess said one of the benefits would be that it would off set the size of the land application.

Tom Roehl noted that any of the options could be used on high ground forestland.

Gary Hess noted that they are in the process of looking at candidate sewage plant sites and asked if they should be considering larger tracts of land for purchase to support public open space as a benefited criteria for reuse. They are looking for large contiguous undeveloped tracts of land that are not necessarily in someone's backyard. The county hydrologist will then need to look at the land to determine what will work on it.

Ray Gabelein noted that he had a problem with identifying exact sites at this point.

Tom Roehl expressed concern about identifying specific pieces of property in a public document.

Gary Hess said they will have to get reasonably specific in the near future because DOE is not going to approve a plan that says we don't know where the plant is going to go or how much it is going to cost.

Jan Beall said they need to look at how the sewer system fits with what else the people of Freeland have said they want and that is park land. They may be more willing to pay for the cost of sewers if they get something they want in return. She asked when the cost of the collection system would be identified.

Gary Hess noted that the planning level costs for the collection system were identified at the last workshop. The May 10th workshop looked at treatment and discharge and at the next workshop they will put them all together.

Jan Beall asked if there were any SBR or MBR systems like the ones Freeland is looking at that are currently functioning successfully. She felt it was important to have some sort of a track record.

Gary Hess noted that there is a MBR/STEP system in Bandon, Oregon that he would be interested in finding out how they operate. The new casino in Marysville will also be using an MBR system. The SBR system at Holmes Harbor is successful most of the year. There are just a few times when they have a process upset.

Ray Gabelien agreed that he would not want to buy a system without having seen it function properly.

Jan Beall said given the concern about West Nile Virus how was the county planning on treating all the standing water and was that being considered in the cost analysis.

Gary Hess noted that was an ongoing concern, especially with constructed wetlands, a more conventional treatment plant doesn't have that problem.

Marilyn Abrahamson said looking for land in Freeland to put a sewer treatment plant seems absurb to her, nobody is going to want something like that near their property. She did not understand why hooking up to the Holmes Harbor system was not included as one of the options.

Tom Roehl pointed out that all of the options that are being explored can be done with or without Holmes Harbor.

Gary Hess noted that hooking up with Holmes Harbor is still a very strong possibility, however they will still need land for the application of the discharge system.

The meeting moved to a discussion of the memo dated April 21, 2002 from the Board of County Commissioner's to the Freeland Sub-Area Planning Committee.

Steve Shapiro noted that the memo requests that the committee finalize the current draft by July 1, 2003, including recommendations for designation.

Tom Roehl assumed they were referring to the land use element. He did not see how they could include the entire plan because the sewer study is supposed to go to the end of the year.

Steve Shapiro noted that the memo goes on to say that the Board understands that this will come prior to the completion of the Sewer and Storm Water Plan. His response was that they would not be ready by July 1 and he did not want to make a recommendation before the sewer and storm water plan was complete. He also felt that the committee should be involved in drafting the development regulations.

Ray Gabelein said he was not interested in coming up with development regulations.

Phil Bakke said he believed that the Board was referencing the draft sub-area plan up to this point. The reasoning being that a lot of land use assumptions are being forwarded and they are serving as the foundation for the sewer and storm water planning effort and there is a desire for more certainty. At this point it may be premature to consider development regulations because it is so tentative whether or not anything will happen and under state law any development regulations that are adopted have to compliment and implement the sub-area plan.

Ray Gabelein said it was his opinion that this planning process has gone on so long that people are starting to forget things that have already happened. The committee has lost its continuity through turnover. He would like to see them move forward at a reasonable pace and not get bogged down in the minutia.

Steve Shapiro agreed but still did not feel that they could wrap up the process in six weeks.

Herb Hunt also felt that the July 1st date was not attainable.

Tom Roehl agreed and asked what the committee thought was a reasonable date to tell the Board.

Steve Shapiro said there are two components of the plan that the Board is requesting. One is the text and the other is the land use designations. It was his understanding that those designations were all tentative in that they would be revisited in the context of the overall plan and the public could provide some input. He did not want to finalize the plan in the next couple of weeks without getting public input.

Tom Roehl said the did need to get the own individual text edits to staff so that a revised draft could get put out, which is something they can be working on between meetings.

Phil Bakke noted that at one of their previous public workshops the question of sewer costs continually came up and there was some real hesitation on the part of the committee to pursue massive public input without being able to tell them what it is going to cost.

He did not think that the Board's intention was for the committee to finalize the plan and then never look at it again. He felt that there was some expectation that when some of those bigger questions get answered there would be an opportunity for more public input and review based on information that is gathered between now and when the studies are completed.

The main issue is to make sure the committee is relatively comfortable with the draft, that it represents what they have heard from the public over the last few years and that it can be relied upon for these expensive sewer and storm water studies.

Tom Roehl inquired of the committee whether they were comfortable in extending the public comment period on the Freeland sub-area plan draft to June 1st, 2002. He asked if staff could put some kind of public notice in the newspaper announcing that they were accepting public comment on the draft and how to obtain a copy of it.

Herb Hunt requested Phil get some clarification from the Board on their April 21, 2003 memo. He also requested clarification on the development regulations process.

Phil Bakke said perhaps the best way to do that is schedule another staff session with the Board.

Tom Roehl said his assumption is that the County will develop a set of development regulations to implement the sub-area plan and then they will route those to the committee for their comments.

The meeting adjourned at 9:10 p.m.

Respectfully submitted,

Pam Dill
Administrative Assistant

FREELAND SUB-AREA ADVISORY PLANNING COMMITTEE
SUMMARY MINUTES
TRINITY LUTHERAN CHURCH
JULY 24, 2003

MEMBERS PRESENT:	Rocky Knickerbocker	Ray Gabelein
	Steve Shapiro	Carmen Falso
	Jim Short	Chuck Edwards
	Herb Hunt	
MEMBERS ABSENT:	Rick Brown	
Staff Present:	Joe Burcar, Planner Mitzi Hall, Planner Gary Hess, Public Works	
Public in attendance:	Don LaMontagne, Bill Russell, Jan Beall, Charlie Stromberg, Todd Bitts, Mark Schuster, Dave Voigt, Phil Thornton, Pam Naschke, Norm Brocard, Terry Otey, Jack Sikma, Jan Mulder	

Attachments referenced herein are available upon request.

UNFINISHED BUSINESS

Rocky Knickerbocker opened the meeting and called for a moment of silence for former Chair Tom Roehl.

Gary Hess, Public Works Engineer, noted that they have reached a point where they need to make a decision on the preferred alternative for the combined collection, treatment and discharge of sewage collected in Freeland and the location for putting the infrastructure. He indicated that in order to keep Tetra Tech/KCM going on the project it was extremely important that they reach a decision tonight.

Alex Chen, TetraTech/KCM, noted that the June 28th public workshop on alternatives for collection, treatment and discharge/reuse was the 3rd of 4 public workshops. During the committee meeting following the first workshop on February 8th the committee selected the STEP collection system. At the 2nd public workshop on May 10th discharge and treatment alternatives were discussed as well as overall strategies. The overall strategies are twofold, combining treatment with the Holmes Harbor Sewer District and a new treatment plant for Freeland only.

On June 16, 2003 county staff and TetraTech/KCM met with the Department of Ecology and the Department of Health and discussed the following:

- **Disposal vs. Reuse**
  - Disposal – no benefit to groundwater; no exceeding groundwater quality; become state's water
  - Reuse – benefits to groundwater; can exceed ground water quality slight, if drinking water quality standards are met; water right retained by district
- **Treat to Class A for reuse alternatives**
  - Based on irrigation at agronomic rates or infiltration at higher than agronomic rates
- **Constructed wetlands for recharge**
  - No experience in this application
- **Hydrogeological analysis and water quality monitoring required**
- **Decentralized systems:**
  - Ecology prefers centralized systems
  - Decentralized systems must have individual treatment units for the community to meet groundwater quality requirements
  - Costs vary widely
  - Land area requirement may be significant
  - Ecology may require increased monitoring over a wider area

After the meeting with the Department of Ecology and the Department of Health reuse strategies focused on slow rate infiltration and rapid infiltration. Local summertime irrigation with reclaimed water is a possibility with either alternative.

Rapid infiltration gets the water into the ground as fast as it wants to go. Drip irrigation gets the water into the ground at a relatively slower pace using shallow buried piping. For rapid infiltration you need a site that has soils that drain very well. Drip irrigation can be used for lots of different types of soils whether they drain well or drain poorly.

TetraTech/KCM's hydrogeologist took a look at the local soils and essentially found that in the vicinity of the commercial core and then southward toward Mutiny Bay Road the soils appear to be fairly well drained. In contrast, in the Holmes Harbor area, just west of the golf course, there is a large area of glacial till, a hardpan layer that is 3 to 4 feet below the surface. For that type of soil rapid infiltration does not work you would have to go to a slower application rate.

For rapid infiltration the ultimate buildout conditions would require 10 acres. For drip irrigation, depending on the local soil you would need around 40 acres for a Freeland only site and upwards of 100 acres in the Holmes Harbor area.

As far as treatment and solids handling goes TetraTech/KCM believes that the Membrane Bioreactor (MBR) treatment process is the easiest one to phase and results in the best effluent quality. For disinfection they would be looking at liquid hypochlorite. It is the most inexpensive and effective way to meet treatment requirements. The least expensive way to handle the solids is to haul them to the Island County facility. If the Island County facility is limited in space they can be hauled to the Renton wastewater treatment plant.

Overall there is a long-term need to develop a local recycling program to do something beneficial with the solids generated at the treatment plant somewhere in the local area.

Facilities for the collection and treatment of discharge need to be expandable enough to deal with the ultimate buildout. They have looked at 5 phases of implementation.

Phase	Description	ERUs	Area, Acres	Max Month Flow, gpd
1	Commercial Core	319	120	74,000
2	Phase 1 + Localized Residential	525	150	132,000
3	Phase 2 + Additional Residential	1,037	380	315,000
4	"LOW" population estimate (20-year planning)	1,558	780	415,000
5	"HIGH" population estimate (ultimate buildout)	3,130	780	677,000

Potential Locations:

1. Freeland Only Site – 100 acres of flat pasture land between Cameron & Bush Point Rd off Hwy 525 with a view corridor from Mutiny Bay to Holmes Harbor. The site is close to the Freeland NMUGA, has well drained soils and a single owner.

2. Holmes Harbor Near Site – 300 heavily forested acres available with several different landowners of which one company owns a major portion. 100 acres would be required for land application. The site is further away from the Freeland NMUGA which means more money in pipe lines. From an elevation standpoint Freeland varies in elevation from zero to about 150 and it raises up to about 250 in elevation at the Holmes Harbor Sewer Treatment Plant. From a practical standpoint the STEP system is limited to somewhere on the order of about 180 in elevation gain so from the lower point of Freeland at zero its not really that practicable to go all the way up to the Holmes Harbor area. There would have to be a pump station located on the shoulder of the road on Honeymoon Bay to provide additional pumping pressure to get up to this higher elevation. On the plus side the location is next to the Holmes Harbor Treatment Plant so there is a lot of opportunity for synergy with the plant. The plant is already spoken for as far as capacity goes both in storage and in treatment so in order to use that synergy Freeland would have to construct new storage basins.

   Soil on the site is basically characteristic of the glacial till and does not accept the water very well. The site is heavily forested which could present a significant problem with a drip irrigation type system. Basically there would need to be some severe clearing or thinning of the forest in order to get the irrigation lines piped in.

3. Holmes Harbor Far Site – Former Trillium tree farm approximately 780 acres of which 100 acres would be required. This site basically has some of the same disadvantages and advantages as the Holmes Harbor Near Site. The additional disadvantage is the further distance to go in pumping and pipeline. A large portion of the property was cleared back in the early 90's.

For the Freeland only alternative the average costs are somewhere in the range of $27,000 to $28,000 per ERU. The Holmes Harbor Near Site is around $30,000 per ERU with the Holmes Harbor Far site a little bit higher.

At the September public workshop they will discuss the recommended alternatives, size and layout, implementation and financing. They will also have a draft sewer plan and engineering report ready for the committee's review. The next step is briefings before the Board of Island County Commissioners and by the end of the year looking at finishing the planning report and moving on to the next step which is implementation.

Bill Russell, Freeland, asked where on the 100 acre Freeland only site the 40 acres would be located. He also pointed out that the site was full of water in the wintertime.

Gary Hess noted that the site does have wet layers in some places in the lowlands because it does drain towards the center. On a very preliminary basis, from a site visit conducted today, they have identified what could be wetlands and yes they do pond up in the wintertime, but their is a lot of land on the site that does drain well.

Charlie Stromberg, Freeland, asked if there were any bogs on the Freeland only site.

Gary Hess said they were not aware of any.

Ray Gabelein noted that the County soils maps are not accurate as far as using them for the permeability of the ground. The soil on the Freeland only site will vary quit a bit, some parts will drain very well and other parts won't drain well at all. He suggested doing some soil testing before making any assumptions.

Alex Chen noted that their hydrogeologist looked at the soils maps and also backed that up with a review of the soil logs of the area. Admittedly that is only a paper study and they won't know for sure until they get out there and do some test digs.

Ray Gabelein pointed out that they are being asked to make a decision on a site tonight.

Gary Hess noted that it would be very expensive to go out and perform test digs on each of the three sites. To be efficient they would like to be able to reach a decision on a preferred site and then go out and work with the landowners and dig some test pits and verify their assumptions.

Carmen Falso felt it would be a good use of time and money to get each of the sites appraised.

Herb Hunt asked if the land, using a drip irrigation system, could be used for ballfields, parks or pasture for cows and horses.

Alex Chen said the potential is there for an open grass field and pasture land depending on the depth of the irrigation lines. You would not want to plant trees because the roots would get into the irrigation lines and you end up having to eventually dig them out again.

Gary Hess, noted that Jerry Stonebridge, Stonebridge Construction, has installed these types of systems and has heard of people running cattle on them but he wouldn't recommend it. However, ballfields or something of that nature would be fine and that is a benefit that has not been included in this discussion.

Don LaMontagne asked if they could selectively choose which 40 acres they would like to use of the 100 acres Freeland only site. The example in the slide shows the holding tanks in Forks surrounded by trees. He wanted to know how they plan on screening all the tanks on the Freeland only site.

Rocky Knickerbocker said they are not talking about major ponds they are talking about a grid system under the ground with one holding pond.

Alex Chen added that the Freeland only site has a holding pond out there already. They are looking at either a single holding pond or a series of smaller cells that would allow you to build on to them as you need them. They would be bermed so that you would not have to look down into a big basin. Potentially it would look exactly as it does today.

He noted that the 40 acres they decide on will depend on what they find out from the soil studies and the preferences of the landowners.

Charlie Stromberg indicated that there is a major flooding problem on the other side of Mutiny Bay Road. He was concerned that if the site wasn't able to contain the water that will be put on it, it could cause the flooding problems in the area to get worse.

Rocky Knickerbocker asked if the stormwater plan that is currently being worked on for Freeland will be taking that area into account.

Gary Hess said he did not know. The ultimate effect on the drainage in the entire area if they load that pasture land with effluent and it doesn't go straight down is something that needs to be looked at in more detail.

Steve Shapiro asked if any other sites were considered.

Gary Hess noted that they originally looked at 5 sites. One site south of the Freeland NMUGA on Fish Road and another to the east of the Freeland NMUGA. Both of the sites had multiple owners, less acreage and steep slopes so they were eliminated

Ray Gabelein asked if the maintenance costs would be less if they combined with the Holmes Harbor Sewer District.

Gary Hess said they would be adding on to the Holmes Harbor plant and that addition would have to be maintained. Holmes Harbor currently has one full time employee maintaining their operating system which would be all they would need for Freeland.

Terry Otey said he would like to see what the real costs of the structures are. The bar graphs are just shadows of what the real costs per site are.

Alex Chen noted that the bar graph depicts the approximate cost per ERU for each of the three sites along with the 5 phases of implementation.

Terry Otey said all they were doing was throwing out big numbers. TectaTech/KCM may say that it cost $100.00 a foot to pump the effluent up the hill but they really don't know for sure.

Gary Hess indicated that they could make the preliminary cost information available to Mr. Otey if he wanted to go through it line by line. He acknowledged that the numbers they were presenting are based on some broad assumptions. They don't know if the land is going to cost $10,000 or $15,000 and they don't have the budget to have all the sites appraised and studied to the level of detail that would give them hard and fast numbers at this time.

Bill Russell said with the Freeland only site you are basically taking a relatively nice chunk of land and putting a sewage treatment plant practically in downtown Freeland with its lights, odor, and everything else. The other sites have a lot more land and little bit more flexibility to screen all the infrastructure that a lot of people are going to be upset about.

Gary Hess indicated that they had not heard a lot of opposition from the public with regard to the Freeland only site.

Bill Russell said he was not very happy about having to look out his front door at a treatment plant.

Herb Hunt asked if it was possible to explore the Freeland only site at a real early preliminary level to discover whether the facility can be kept up on the northwest corner of the site where there are actually existing trees now. The could give a tentative go ahead and meet again to confirm it.

Gary Hess said he would like the committee to select one site so they could look at the soils and talk to the landowner about the location of the facility keeping in mind that whatever facility they put in there they will do whatever they can to minimize the visual impact.

The important consideration is not to make the treatment plant a landmark for Freeland. They will do what they can to tuck it back into the terrain to minimize impact on the view corridor and utilize what is in the view corridor for the application of the effluent.

> *Herb Hunt moved to move forward to evaluate the Freeland only Site #1 so they can answer some of the questions that have been brought up tonight about Site #1 so they can confirm whether it would be in an appropriate location and not visible, or have minimal impact visually so that they can then come back and approve the site at a later date. The motion was seconded by Steve Shapiro and opened for discussion.*

Carmen Falso thought it would be advantageous for the committee to go out and physically look at the site.

Chuck Edwards felt they should go ahead and select the Freeland only site and if for whatever reason that site doesn't work they can move on to the other sites.

Ray Gabelein strongly suggested that they do some soil testing.

Steve Shapiro suggested that they come back with a sketch of how it would be laid out on the land and what the view corridor would look like.

Jim Short asked where they were in terms of funding. Once the money is spent on coming up with the preliminary information for the Freeland only site will there be any left to investigate the other sites if needed.

Gary Hess said they still have money in the budget to spend on soil testing. Putting both time and money into the Freeland only site and then rejecting it and doing the same thing for one of the other sites will effect both the budget and the timeline. If we feel strongly about doing that it is a risk we will have to take and he will have to go back before the BOCC and ask for more money.

Jim Short expressed concern about the Freeland only site from view standpoint and the flooding issues.

> *Herb Hunt amended the motion to select Site #1 as the preferred site with a further study to provide hydrogeology, view corridor, lighting & visual impacts and consider the public benefit for the committee's further discussion Steve Shapiro seconded the motion and it was opened for discussion.*

Terry Otey inquired as to why the committee was choosing the Freeland only site. If it is a cost issue he would like to be shown proof that site #1 would be less expensive then the other sites.

Steve Shapiro said it was a cost issue along with the potential open space benefits, as long as any potential problems, flooding in particular, can be resolved.

Herb Hunt said he assumed that if site #1 doesn't work out that the other sites would also have public open space benefits.

Rocky Knickerbocker asked if it would be possible to thin the forestland to put in the infrastructure rather than clear it. The main trunkline would be a pathway and the lateral lines could be plowed into the root structure without destroying the forest.

Alex Chen said it depends on the thickness or the spacing between trees. The trees on the near site are probably too close together for that right now so they would need to be thinned at the very least and there would definitely have to be some corridors for the major piping run. The drip irrigation system has been put in areas with trees with the lines between the trees it just requires more effort and might ultimately require more land.

Don LaMontagne inquired as to what kind of negotiations went on between the committee and the HHSD for combined use of the golf course. He felt that if they been able to work out an agreement they could have saved a lot of money.

Rocky Knickerbocker said the golf course was never available, the actual amount of water the Holmes Harbor Sewer District produces at full buildout is what that acreage will absorb.

Pam Neschke, Freeland, pointed out that the three proposed sites are private property and the owners have the prerogative to do what they want on their land without any public involvement. If the property owners want to develop the land with houses the public does not have the option to add their input. At least at this point the public can be part of the sewer discussion and help determine what the facility will look like.

The vote on the motion was unanimous.

Gary Hess distributed a revised Freeland Sewer Plan public involvement plan and schedule. A tentative public workshop is scheduled for September 20th with a follow-up meeting with the FSAPC on September 25th and a presentation to the BOCC at their August 8, 2003 staff session, just for informational purposes.

The next meeting of the committee was scheduled for Thursday, August 21, 2002.

The meeting adjourned at 9:00 p.m.

Respectfully submitted,

Pam Dill
Administrative Assistant

FREELAND SUB-AREA ADVISORY PLANNING COMMITTEE
SUMMARY MINUTES
TRINITY LUTHERAN CHURCH
NOVEMBER 13, 2003

MEMBERS PRESENT:	Rocky Knickerbocker	Carmen Falso
	Rick Brown	Steve Shapiro
	Ray Gabelein	Chuck Edwards
	Herb Hunt	Bryan Nichols
MEMBERS ABSENT:	Jim Short	
Staff Present:	Phil Bakke, Planning Director	
	Jeff Tate, Assistant Director	
	Gary Hess, Engineer	
Public in attendance:	Lou & Em Malzone, Jan Beall, Dave Voight, Mark Schuster, Jim Gervais, Faith Smith, Marlene Parker, Gayle Saran, Tina Windeler, Mike Joselyn, Bob Neschke	

Attachments referenced herein are available upon request.

UNFINISHED BUSINESS – *Update on sewer planning program & selection of preferred Alternative*

Alex Chen, TetraTech/KCM, noted that since the last meeting in July they have performed hydrogeological investigations of all potential sites, a visual/aesthetic analysis for the Freeland only site, and attended a meeting with the HHSD to discuss details for a joint waste water treatment plant project.

For the hydrogeological investigation, HWA GeoSciences, Inc., dug test pits and performed soil analysis on 3 different sites:

- Fletcher/Pennau
- HHSD "near"
- Tree farm

The north side of the Fletcher/Pennau property showed mostly glacial till which is not good for infiltration. The south side of the site has sands underlying the till and is better for infiltration, however the landowner is not interested in selling the south side of the property. They also discovered that some of the wells in the area take water from relatively shallow depths and there are wetlands fairly close to the site.

The investigation of the HHSD near site showed mostly glacial till throughout. The results of septic tank investigations in this area showed that Alternate systems were the best way to go because the soil did not perc that well.

The investigation of the tree farm also showed generally glacial till. However the area of the quarry site has good infiltration characteristics. Sands and gravel that look like they go down pretty deep.

Overall what they are looking at on an infiltration basis is how fast the water percs when it goes into the soil. For rapid infiltration the south side of the Fletcher/Pennau property, and the quarry at the tree farm look pretty good for getting water into the ground quickly. For the other areas they would have to look at other types of applications, such as drip irrigation applied at agronomic rates. The more quickly you can get water into the ground the less area you need to preserve for your land application site. The slower the water goes into the ground the more area you need.

The results of the meeting with the Holmes Harbor Sewer District confirmed that they are not able to assist Freeland financially, other then the fact that they already have a treatment center that has some available area that could be expanded into. They cited some recent rate increases and a limited bonding capacity as reasons for why they couldn't participate and would expect any joint project to be fully financed by Freeland. A joint project with the HHSD would involve converting the existing treatment center from a sequencing batch reactor with a filter to a membrane reactor.

They also discussed the potential of using the existing storage ponds that are on site at the Holmes Harbor treatment plant and for now the HHSD has said that they would be more comfortable if Freeland could find their own storage. There is some potential for sharing O & M costs with the HHSD in a joint project.

As a result of the hydrogeological investigation the Alternative sites were redefined:

- **Alt 1a – Freeland only – local land application**

Pros:

Flexibility to go to tree farm.
Flexibility for in-town "purple pipe" irrigation system.
Lowest initial cost.
Maintains viewshed.

Cons:

Wooded area for WWTP potentially not far enough away from nearby houses.
Depth to groundwater is the least of all three Alternatives.
Chance of influencing nearby wells, which do take water from shallow depths.

Chance of influencing nearby wetlands and properties south of Mutiny Bay Rd.
Property owners do not want to sell south side of property which has the best soils for infiltration.

- **Alt 1b – Freeland only – send to tree farm (quarry site)**

Pros:

Small amount of land needed.
Flexibility to go to Useless Bay Golf Course in future phases.
Flexibility for in-town "purple pipe" irrigation system.
Relatively low initial cost.
Single owner for land application area.
Least proximity to other owners and wells.
Best soils for land application year-round.
Sufficient buffer available for infiltration basins .

Cons:

Wooded area for WWTP potentially not far enough away from nearby houses.
Require purchase and control of two separate sites for treatment works and application site.

- **Alt 2 – Joint WWTP with HHSD, adjacent land application**

Pros:

Closest land application site to HHSD.

Cons:

Lots of landowners in vicinty.
Chance of influencing nearby wells & wetlands.
Less flexibility for future reuse options.
Would need to clear cut forested parcels for drip system installation.

- **Alt 3 – Joint WWTP with HHSD, send to tree farm (quarry site)**

Pros:

Small amount of land needed.
Single owner.
Least proximity to other owners and wells.
Best soils for land applciaiton year-round.
Sufficient buffer available for infiltration basins.

Potential for tree farm surface irrigation as a reuse option.

Cons:

Higher initial cost compared to Alt 1 a or 1b.
Least flexibility for future reuse options.

Generally speaking with regard to the capital costs the Freeland only Alternatives, 1a & 1b and to some degree Alt 3 are relatively similar in costs. Alt 2 has a higher cost at least up front.

The Net Present Value O & M costs are relatively similar basically because the type of equipment is pretty similar in all of the Alternatives. There are a few differences, for example, Alt 2 has a lot more land involved and maintaining it has a certain cost to it.

When you combine the capital cost and the O & M costs you get a total present worth cost. The present worth costs are similar to the capital costs with Alt 1a the lowest, Alt 1b second lowest, Alt 3 third lowest and the most expensive being Alt 2. The conveyance costs for Alt 1a are less. With Alt 1b, 2 & 3 you will have to pay quit a bit in conveyance costs especially up front when there are not that many people participating in the system.

The treatment costs are actually more expensive with the HHSD joint project. Holmes Harbor has grinder pumps in its system that the membrane process is sensitive to and so there is an additional significant cost in headworks and fine screening for grit removal to protect those membranes. Whereas with the Freeland only wastewater treatment plants there isn't the need for a headworks at the treatment plant. The sewage from the septic tanks and pumps can go straight into the membrane treatment plant.

Chuck Edwards questioned the need to upgrade to a membrane system at Holmes Harbor and wondered why a batch reactor system would not work.

Alex Chen indicated that it was a space consideration. The existing footprint is pretty tight for that type of expansion.

Steve Shapiro asked about the possibility of two separate systems, one for Holmes Harbor using the existing system and then a membrane bioreactor for Freeland.

Alex Chen noted that the HHSD was not real big on the concept. The problem with that sort of approach is when two separate treatment processes are on one site you really loose the economy of scale. The two treatment processes will have different operational requirements as well as sampling requirements, which will increase your operation and maintenance costs.

Rick Brown asked if there was excess capacity to discharge on the golf course.

Alex Chen explained that right now it is a summertime only application and the golf course takes as much water as it needs. Holmes Harbor has to store all of the effluent in the wintertime. They have about 65 acres and are using about 55 acres for land application in the summertime. They are talking about the possibility of trying to land apply or irrigate year round.

Chuck Edwards asked about the possibility of land application somewhere else.

Alex Chen said it was a matter of costs. With a surface irrigation system there is certainly the possibility that the cost will go up just because of the additional piping. Basically you are looking at an open pit versus a network of irrigation piping sprinkler heads. You also have a better chance of water traveling into the surface run off instead of percolating into the ground.

Gary Hess noted that it was an option in the summertime at the tree farm with a rapid infiltration sub-surface in the wintertime.

Herb Hunt noted that for the first phases of sewer service in Freeland, the size requirements of the distribution could potentially fit into the north end of the Fletcher/Pennau property. Later phases, as Freeland's sewer system grows, the gravel site could come on-line as the distribution field. This would lower the initial costs and increase financial viability for the first group's being serviced. In the initial sewer size, less area for distribution will be needed, and not knowing what the time period for expansion or phases will be, we should plan for the future and safeguard ourselves by purchasing the gravel site now so the land is available for future service needs. He felt this might be a cost effective way of starting the system within the next few years. By doing this we would be combining the lower cost of the two distribution systems, spread out initial costs differently and hold off on the long distance pumping till more services are added to the sewer system.

Ray Gabelein said he would like to see them proceed, but would also like to try and pursue a closer site then the tree farm. He is not convinced that there isn't 10 or 20 acres somewhere closer to Freeland, even if it involved more than one site.

Alex Chen said he felt Herb had a good idea. The cost savings are going to be balanced against risk. When you look at land application of highly treated wastewater DOE likes to look at a few things, 1) What is the depth of the groundwater; 2) Where are the local wells; and 3) Where do those wells take water from or are there local wetlands that might be hydrologically effected by that discharge.

For all of the alternatives the hydrogeologists are strongly recommending further study to look at those types of potential impacts. There is inherently more risk at the Fletcher/Pennau property because of the proximity of wells and wetlands, whereas with the tree farm where there are not any property owners within a mile in either direction the

risk goes down significantly. There are also no significant wetlands in that vicinity either. There is a real tradeoff between cost and risk. If you put in a drip system on the north part of the Fletcher/Pennau property you might not be able to get very much out of it in the winter time and if that risk does not pan out then you have to go and look at other sites.

Regarding Ray's concern about a closer site, he felt it was important to keep the process moving forward and would like to get some concurrence on a recommendation today with the understanding that if another site comes up they will go in that direction with the final plan and save some money.

Ray Gabelein said it just seems to him that if they are going to try to reuse the wastewater in the Freeland area that they are going in the wrong direction by heading up to the tree farm. Wastewater is too valuable to just dispose of when we could be using it for tree farm application, purple pipes or possibly the Useless Bay Golf Course in the future.

Regarding the wetland issue, if wastewater is treated to the quality that has been discussed how much of an issue is it for this water to find its way into a wetland because in some areas they are using wastewater to recharge wetlands.

Alex Chen indicated that the regulations do not allow for the discharge of highly treated wastewater directly into wetlands classified as "highest quality" which is what most of the wetlands are in this area. As far as indirect impacts, if the water seeps into the ground and it happens to find its way into the wetlands there are no cut and dry regulations. However with any sort of utility project if you start dealing with indirect or direct impacts to wetlands you do raise a lot of red flags.

Gary Hess noted that in his opinion the best long term Alternative for a Freeland Sewage collection treatment and reuse system was Alternative 1b: Freeland-Only with Tree Farm Application. His primary reasons for recommending Alternative 1b are:

- Site availability for a treatment plant and application site.
- Potential flexibility for an effluent reuse distribution system at lower cost.
- Lower potential risk to surface water and shallow groundwater.
- Ability to reuse treated effluent on a single site 12 months a year.
- Lower estimated cost with more manageable risk.

Steve Shapiro asked if they had an actual cost of the property or whether they were still doing a per acre estimate, particularly with the tree farm site.

Alex Chen noted that they were still doing a per acre estimate.

Steve Shapiro asked if they had looked into the cost of a distribution line down to Useless Bay Golf Course.

Alex Chen pointed out that it would only be a summertime application and they would still need to find land for the wintertime storage.

Jan Beall asked how much, if any, thought has been given to land application throughout Freeland. Freeland water would go a lot farther if the water at the sewer plant was treated well enough that it could be used for landscaping type needs.

Steve Shapiro pointed out that there was still the problem with what to do with it in the winter months.

Alex Chen noted that one of the reasons that they are looking at an alternative that has the treatment plant close by is so they can get the wastewater treated and send it right back. With the HHSD alternative you send it up, treat it and send it all the way back so there are additional conveyance costs. The purple pipe solution is more of an added bonus that would be at a later stage and just for the summertime.

Gary Hess said using treated water for landscaping was a good idea as well as being able to water the Useless Bay Golf Course. Both would be significant benefits to the Freeland area and the aquifers. However in the initial phases of implementing this plan there is going to be very limited ability to afford that kind of capital outlet so we have to look at what we can do early in the phasing that has the least cost, stands the best chance of being implemented and doesn't preclude those options in the future.

Ray Gabelein asked if it was possible to proceed forward but also leave the door open for a period of time to check on other options.

Gary Hess said the ability to go out and find closer sites remains an option but that activity becomes a function of when this plan actually gets into the implementation stage.

> ***Chuck Edwards moved to select Alternative 1b Freeland –Only with Tree Farm Application as the preferred Alternative. The motion was seconded by Ray Gabelein and carried unanimously.***

Alex Chen indicated that they anticipate being able to provide a draft report sometime in January. A 4th and final workshop will follow the issuance of the draft report to provide more detail with regard to implementation and financing.

The next meeting was scheduled for December 11, 2003. Agenda items will include:

- Election of Officers
- Report on the Stormwater Plan for Freeland
- Zoning issues

The meeting adjourned at 8:45 p. m.

Respectfully submitted,

Pam Dill
Administrative Assistant

FREELAND SUB-AREA ADVISORY PLANNING COMMITTEE
SUMMARY MINUTES
TRINITY LUTHERAN CHURCH
FEBRUARY 26, 2004

MEMBERS PRESENT:	Rocky Knickerbocker Byran Nichols Chuck Edwards Herb Hunt	Jim Short Ray Gabelein Rick Brown
MEMBERS ABSENT:	Steve Shapiro	Carmen Falso
Staff Present:	Jeff Tate, Assistant Director Mitzi Hall, Planner Gary Hess, Public Works	
Public in attendance:	Lou & Em Malzone, Chet Ross, Jan Beall, Sam Wolfe, Dave Voigt, Kevin & Kate Crhistian, Fred Ludtke, Mick Olsen, Dan Gambill, Ann Sullivan, Elaine Wachowiak, Mitch & Karen Streicher, Bobbi Stanik, Michael Dolan, Norm Brocard, Dave Braathen, Marlene LaGasse, Norman LaVine, Richard Soto, Rob Hallbauer, Bridget Lopez, Art Peterson, Mark Schuster, Bill Frederick, Van Brown, Roseann Alspeictor, Eric Lopez, Kathy Cado	

Attachments referenced herein are available upon request.

APPROVAL OF THE MINUTES

Ray Gabelein moved to approve the minutes of January 29, 2004 & February 12, 2004 as written. The motion was seconded by Rick Brown and carried unanimously.

PLANNING DIRECTOR'S REPORT

Jeff Tate indicated that Gwenn Maxfield, Assistant Public Works Director, e-mailed him an update on the stormwater plan which he read into the record.

"I met with the consultant completing the Freeland Drainage Basin Plan, and according to their review of the contract, the Basin Plan is approximately 80% complete. The following is a summary of tasks completed and outstanding.

Under the survey category, all field surveys, research and photogrammetric mapping have been completed, per contract agreement. The majority of the Stormwater Runoff analysis is complete, with the final product being ~~th3~~ the

calibration of a stormwater model and revisions utilizing existing runoff conditions, rainfall and flow data.

Portions of the Preliminary comprehensive stormwater plan are complete, with the 70%, 90% and final submittals to be prepared. These reports will include cost estimates, recommended and preferred alternatives, a schedule of improvements based on priority, and a recommended fee structure for financing. The basic message is that the research and back ground information has been collected; outstanding is the "pulling together" of the information into a report the public can read and Public Works can use for capital and maintenance planning purposes.

Public meetings also need to be held. If the committee would like an update/status report by the consultants, that would be possible anytime after the middle of March. I would appreciate it if the committee would give us at least a 2-week lead time to prepare for a presentation. (GMA Record #7459)

Jeff Tate responded to Steve Shapiro's e-mail regarding the implementation strategies and the fact that there is a quite a lot of work left to be done in that regard. The implementation strategies that are in the draft are pulled from the County's Comprehensive Plan and as he has said from the beginning they are extremely weak.

He has put together some revised implementation strategies that he will e-mail to the committee tomorrow. The revised strategies will in no way represent a full comprehensive list. What the committee already has and what he will be sending tomorrow will be a starting point.

UNFINISHED BUSINESS – Sewer Plan Presentation

Gary Hess presented the Freeland Area Comprehensive Sewer Plan/Engineering Report (GMA Record #7458)

He provided some background information and noted that at the November 13, 2003 meeting the committee recommended Alternative 1b – Freeland only, with the effluent being sent up to the tree farm.

Elements of Recommended Alternative

- STEP collection system
- Membrane bioreactor treatment
  Treatment to reuse standards
- WWTP solids ~~stabliization~~stabilization
  Send to Island County Septage facility
- 20-day emergency storage basins
- Conveyance from WWWTP to reuse
- 3-day wintertime storage basins

- Land application reuse
  - Rapid infiltration basins

Recommended Alternative – Phase 1 (Commercial Core) Costs

Facility	Construction	Capital	Annual O & M	O & M Present Worth	**Total Present Worth**
Collection	$1,706, 000	$2,274,000	$35,600	$520,000	**$2,794,000**
Treatment	$2,567,000	$3,399,000	$88,200	$1,288,000	**$4,687,000**
Storage	$402,000	$506,000	$1,500	$23,000	**$529,000**
Conveyance	$1,321,000	$1,761,000	$17,400	$254,000	**$2,015,000**
Reuse	$369,000	$474,000	$11,500	$168,000	**$642,000**
Total	$6,365,000	$8,414,000	$153,800	$2,247,000	**$10,667,000**

Notes:
Construction – Construction cost, including contractor's markup and 30% planning-level contingency.
Capital – Construction cost, plus 25% for design, construction management, administrative costs, and sales tax.
Annual O & M – Yearly cost of labor, power, chemicals, replacement cost for equipment and structures, and other miscellaneous costs.
O & M Present Worth – Annual costs of O & M converted into a 20-year present worth.
Total Present Worth – Sum of Capital and O & M Present Worth.

Recommended Alternative – Financing

- Timing and phasing of implementation affects costs greatly
- O& M costs paid by rates:
  - $17 to $29 per month per ERU
  - Approx. 140 gpd/ERU (average annual)
- Three options for paying capital costs:
  - Option A: Local Improvement District (LID)
  - Option B: Connection fees
    - Marginal cost method
    - Growth-related method
  - Option C: Monthly Rates
- Costs will be lower if grant funds available
- Cost estimates do not include on-premises STEP installation
  - Estimated at $3,000 to $5,000
  - Depends on condition of existing system
- Grants may be available to qualified residents for STEP connections

	Option A	Option B	Option C

	LID Formation		Connection Fees		Rates with Debt Financing or Grants[3]	
Phasing:	Lump Sum $/AC	Annual Payment $/AC[1]	Marginal Cost Method $/ERU	Growth Related Method $ERU[2]	$/Mo per ERU with 100% Debt[1]	$Mo per ERU with 75% Grant
1. Implementation of Phase 1	$61,000	$4,000	$23,000	$18,000	$120	$30
2. Implementation of Phases 1 & 2 at the same time	$57,000	$6,000	$16,000	$11,000	$80	$20
3. 20 + Year Capital Cost Financing Option Summary Phase 1	$61,000	$3,700	$23,000	$18,000	$120	$30
Phase 2	$8,000	$3,400	$6,000	$4,000	$80	$20
Phase 3	$12,000	$2,100	$9,000	$4,000	$60	$20
Phase 4	$7,000	$1,500	$11,000	$11,000	$60	$20
Phase 5	$6,000	$1,800	$3,000	$3,000	$40	$10
Average for Phases 1-4	$24,000			$8,000		
Average for Phases 1-5	$30,000			$6,000		

[1] Assumes annual payments over 20 years with 90% low interest loan financing and 10% bond financing.
[2] May require funds from other sources (i.e. rates or grants) to recover revenue shortfalls in certain years.
[3] In the "Implementation of Phases 1 and 2 at the same time" and "20 +Year Capital Cost Financing Option Summary" rates are cumulative based on financing costs for current and previous phases.

Other Unsewered Communities

- **CLINTON**
  - Plans still in development
    Engineering Report still needed
  - Alternatives include outfalls and reuse (land application)
  - LID
    $1000,000 - $109,000 per commercial acre
    $40,000 - $44,000 per residential acre
    OR
  - Connection fees $9,500 - $26,500

- **CARNATION**
  - Plans still in development
    Engineering Report in progress
  - Alternatives include stream discharge and reuse (land application, wetlands application)
  - $155 per month sewer rates
    Assumes no grant funding

Plan Review and Adoption

- Comments on the draft sewer plan by March 12

- WDOE and WDOH Reviews
- Final report in May
- Adoption by Freeland Water District
- Approval by the County

Plan – Next Steps

- Public Workshop 4: Mid – March
- ➢ Review draft report
- ➢ Discuss recommended alternative
  - Layout
  - Financing
  - Implementation
  - Solicit comments from the public

Implementation Steps

- By request of property owners to Freeland Water District
- Detailed financial and implementation analysis
- Create appropriate financing mechanism
- Pursue grant and low-interest loans
- Detailed engineering for construction
- Bid and build system
- Phase 1 implementation could take 5 years or longer

Ray Gabelein asked if the grants and low interest loans would be pursued prior to a vote so that people would know the cost of what they were voting for.

Gary Hess noted that the typical way a LID is enacted is by having 60% of the property owners in the benefit area come forward with a petition to whatever body it is that would be the implementer. At that point you would start looking at the funding mechanisms.

Ray Gabelein said theoretically if the Phase 1 group came forward with a petition could they make it contingent on either getting a grant or low interest loan.

Gary Hess supposed that could be the case as long as they were willing to reimburse the implementing body for expenses incurred in pursuing it.

Rocky Knickerbocker noted that eleven people in the Bercot Road area put money together for an engineering study and were then reimbursed after the process was complete.

Gary Hess noted that the final assessment, what you are actually going pay once the district is created, doesn't come into play until you reach the end of construction. He said it would be prudent to start working on the financing as soon as possible.

Chuck Edwards said if they start with the Phase 1 property owners will there be some provision in the LID for a “late comers” fee for the remaining Phases.

He also inquired as to the scenario used to determine the area for Phases 4 & 5 being that the area already has adequate septic.

Gary Hess said ultimately that is going to be a decision made by the people in that area. He noted that they used the land use maps that were generated by the committee for the NMUGA and then took their best guess as to what would make the most sense in developing the phasing. From an engineering point of view it seemed to layout fairly logically, but how it gets implemented in the future, as far as phasing goes, is really up to the property owners.

Ray Gabelein said looking at the map it appears that the County park has been left out.

Gary Hess said they should talk to the Commissioner’s of the South Whidbey Port District.

A member of the audience asked how you would determine how many ERUs your acreage or parcel can carry.

Gary Hess said the quickest way of determining how many ERUs you actually have now would be to look at your water bill. To determine future ERUs you would have to take a look at the section in the Freeland Sub-Area Plan that describes the planned zoning density for that area.

The same audience member asked about the voting process and whether the number of votes a person has was based on the size of the property.

Rick Brown clarified that a person with a 5,000 square foot tax parcel would have the same vote as a person with a ¼ acre tax parcel. The voting is by tax parcel, independent of size.

Mitch Streicher asked if there would be additional LID’s for each phase.

Chuck Edwards said in his opinion there would probably be multiple LID’s as people decide they want to join the sewer system.

Jan Beall said the way it has been explained is once the plan is adopted the sewer system would go in phases. How would that affect the decision of whether or not Freeland becomes an NMUGA. ? It was her understanding that the sewer system had to be planned and funded for the entire NMUGA.

Jeff Tate said there has to be an approved sewer plan in place that serves the entire NMUGA, but it doesn’t have to be funded for the whole area. The GMA states that funding and infrastructure plans need to be in place but it doesn’t go beyond that and say

exactly how that needs to be set up because there are a myriad of different ways that it could be set up.

Jan Beall asked if designating Freeland an NMUGA would then require everyone, whether they wanted to or not, to follow suit into the sewer.

Jeff Tate said no.

Jan Beall asked if someone within an area where an LID was passed does not want to hook up to sewers would they be required to participate anyway. Tom Roehl had indicated in the past that it would be set up so that if someone did not want to hookup to the sewer they didn't have to.

Gary Hess indicated that Mr. Roehl was incorrect. You can be somewhat creative on your boundaries but you have to be very careful about that. The LID process is full of legal pitfalls.

Rick Brown said you do have some flexibility in terms of the connection. For example, in Holmes Harbor you are assessed for the right to have sewer and you do have to pay a fee for that but you don't have to abandon your septic system and connect to Holmes Harbor until you are ready to. You don't have that connection fee, but you do have to pay your share of the bond and you may or may not pay the same monthly fee if you are not connected.

Ray Gabelein asked if it was possible for a neighborhood or street inside the LID who did not want to connect up to have the boundaries drawn so they were not included.

Gary Hess said there are dangers in doing that, but if for example there was a street on the edge of the LID that did not want to connect up to the sewer, the boundaries could possibly be drawn to exclude it, however it would not be practical if it was in the middle of the LID and you had to run pipes all around it.

Mitch Streicher, Freeland~~, made~~, made note of an inconsistency in the population projections. In the Freeland Comprehensive Plan the Office of Financial Management (OFM) population allocation for Freeland is 4,000 people in 2020. The phased implementation chart in the sewer report projects a population estimate at ultimate buildout, based on 2.3 ERUs, of
7, 199 people. Why are we planning for 7,000 people when we only have to plan for 4,000 people. His concern is that the County is planning for a large number of people to divide the cost of sewers and they are not going to be there according to the OFM.

Gary Hess noted that Table 4-1 in the draft of the Freeland Comprehensive Sewer Plan and Engineering Report in Phase 5: NMUGA, Ultimate Buildout (High Population Estimate) projects total population equivalents of 7,323. He pointed out that population equivalents also include commercial and industrial.

Jeff Tate explained that 4,000 is the population number that is being planned for however under both State law and case law we are really obligated to plan for 125% of that which is 5,000. You have to add into that number a capacity that makes it so you are not affecting land prices negatively. The assumption is if you were planning for 4,000 people and you sized the area and established a density that would allow exactly 4,000 people as you get closer to that number the supply is restricted and that causes t land prices to go up.

He noted that the 7,300 figure also represents every commercial and industrial ERU. A grocery store, for example, might have up to 10 ERUs.

Gary Hess said another example would be the Island Athletic Club. They use about 3,000 gallons of water a day, which adds up to quite a number of population equivalents.

Jan Beall Freeland, noted that she had asked Alex Chen, from Tetra Tech, at a previous meeting if he had taken into consideration the earthquake fault that runs somewhere between Double Bluff and Windmill Heights and he said he hadn't but he would look into it. She felt that might be something that could change the cost estimates or the feasibility of the chosen site.

Gary Hess said they take into account the current codes for design and construction for the seismic zone designation in this area.

Jan Beall asked what the County's approach was for dealing with mosquito problems from all the still water in the holding ponds.

Gary Hess explained that the rapid infiltration basins should have the potential of taking the effluent and percolating it into the soil fairly quickly. We are not talking about stagnant water we're talking about a lot of water going in and a lot water going out. We are not creating ponds that just sit there and go nowhere because ultimately ½ million gallons a day will be going into these and that water needs to disappear.

Jan Beall asked if any nearby wells could be affected because of the lowlands and wetlands not ~~to~~too far from the rapid infiltration ponds.

Gary Hess noted that there were very few wells in that area. Before this rapid infiltration land application for reuse option is implemented or even designed they have to do a very detailed hydrogeological study which involves test pits, infiltration rate analysis, soil borings, test wells, etc. Whidbey Island is also designated as a sole source aquifer and that raises the bar higher still.

Jan Beall said property values would most likely be raised once they have sewer. Is that a property value that the County Assessor will take into account and raise your property taxes.

Gary Hess said that is usually the way it works, improve your property and your taxes go up.

Elaine Wachowiak, Freeland~~, noted~~, noted that the Freeland Water District was created for Harbor Terrace and Village Green and that obviously would be the place that you would start looking for your 60% because you have to include the people who are within the Freeland Water District.

Gary Hess noted that they only need to include the people that request the creation of a sewer system.

Mike Dolan, Freeland~~, said~~, said if everything went in and the sewer system was implemented would you have the water district as the sewer system operator or would there be a separate entity~~.~~ ?

Gary Hess said the way the agreement exists between the County and the Freeland Water District the Freeland Water District would become a water and sewer district and would be the owner/operator of the sewer district.

Bill Frederick, Freeland~~, asked~~, asked Rocky Knickerbocker who reimbursed the eleven property owners on Bercot Road for the cost of the engineering study.

Rocky Knickerbocker indicated that the Freeland Water District reimbursed them for the engineering study.

Chuck Edwards clarified that the Freeland Water District reimbursed the property owners, but that money came from the ULID, not the Freeland Water District.

A member of the public expressed concern about how much growth the water supply on the island could support.

Gary Hess said when the committee discussed what to do with the effluent from the sewer plant they were in agreement that the best thing to do was to put it back into the ground so that ultimately it would wind up recycled in the aquifer.

Art Peterson, Greenbank, said he had trouble, from a technology standpoint, understanding why there wasn't a separate district for the water and sewer.

Gary Hess indicated that when he was given this project the Interlocal Agreement was already in place between the Commissioner's of both the County and the Freeland Water District. It can certainly be done separately. The Freeland Water District already manages one of the basic infrastructures in Freeland, the water supply and they have a Board of Commissioners and staff to take care of the system. He felt the reason the Freeland Water District was chosen was because you would have the advantage of combining the benefits of already having that infrastructure that is in place. Creating a new district doesn't give you the advantage of combining those benefits already in place.

Ray Gabelein asked if the 140gpd/ERU was set in stone or just an example and could change. He felt it was a fairly low number compared to both the County and State's on-site design.

Gary Hess said the 140 gpd is a number used for the engineering analysis. An ERU can be different in different locations.

Bryan Nichols asked how a commercial business, for example Nichols Brothers, would figure out how many ERU's they have.

Gary Hess said the meter readings from the Freeland Water District would give you a fairly good estimate of how much you were consuming and you can take that and divide it by 140 and that represents roughly the number of ERUs. You can adjust that for what goes into process, landscaping, etc.

He ~~said going~~said going into this they didn't get detailed information from the Freeland Water District on water usage. It would be a whole lot easier to figure out what each commercial enterprise in Phase 1 represents if they had detailed water usage information for both winter and summer. Wintertime usage is going to be a lot closer to what your sewage production is because you are not irrigating.

Gary Hess thanked the committee and audience members and requested comments back on the sewer plan by March 12th.

The committee discussed briefly their work schedule and assignments.

ITEMS FROM THE PUBLIC

Louis Malzone, Freeland, felt that the change made at the last meeting to designate the 10 acre parcel adjacent to the Freeland Library from Low Density to High Density was done too hastily. The proposed change would cause the growth projection used by the County as a basis for developing the Freeland Sub-Area Plan to be exceeded by 6%. He recommended additional studies be done on the property to determine traffic and storm water run-off impacts.

Bridget Lopez, Freeland, indicated that she lives on Pleasant View Lane and does not like the idea of the proposed 10-acre parcel going from low density to high density for any reason. Pleasant View Lane is currently a cul-de-sac and already handles the traffic from the apartments on Cherry Street and she did not want it to become the access road for more apartments.

Mitch Streicher asked what the zoning was there currently.

Jeff Tate indicated that the current RAID zoning is 1du/5 acres. The current proposed NMUGA zoning is 1du/3 acres.

Rick Brown agreed that they might have acted a little hastily at the last meeting, but he felt that the intent of the motion, which was the need for a transition zone between commercial and 1du/5acre, was still valid.

Chuck Edwards noted that his original motion was to change the zoning from low to medium density. He felt that the parcel was a prime area for sewers and could help with spreading out the cost. It does not make sense to take an area within ¼ mile of downtown Freeland and make it low density.

In response to concerns by Pleasant View Lane residents he pointed out that access does not have to be via Pleasant View Lane it could be routed through Layton Road.

Ray Gabelein said he felt the issue needed revisiting.

Jan Beall said her recollection is that the density of the entire NMUGA was borderline for the GMA required 4du/acre.

Jeff Tate noted that the buildable lands analysis shows an overall density of around 3.89du/acre, which he believed, was in the ballpark. Any lowering of density would concern him.

Emyle Malzone, Freeland, asked if staff had looked into Maple Ridge, which is currently being proposed as Business General zoning.

Mitzi Hall indicated that currently there are 41 houses at Maple Ridge. There were two 3-story buildings approved that contain 78 units as well as the proposed office building have never been constructed nor the building permits applied for. The site plan approval for the project expires in October of 2005.

Emyle Malzone asked if Maple Ridge should be zoned Residential rather than Business General.

Jeff Tate noted that the 41 residences at Maple Ridge were counted into the buildable lands analysis.

Jim Short noted that the discussion would be tabled to the next meeting.

The meeting adjourned at 9:10 p.m.

Respectfully submitted,

Pam Dill
Administrative Assistant

APPENDIX D.
SEPA CHECKLIST

ISLAND COUNTY
PLANNING & COMMUNITY DEVELOPMENT

Phillip Bakke, AICP, Director

PHONE: (360) 679-7339 ■ from Camano (360) 629-4522 ■ from S. Whidbey (360) 321-5111
FAX: (360) 679-7306 ■ P. O. Box 5000, Coupeville, WA 98239-5000
Internet Home Page: http://www.islandcounty.net/planning/

-Memorandum-

TO: Gary Hess

FROM: _____
Jeff Tate, Assistant Director

DATE: November 9, 2004

RE: Freeland Sewer Plan – SEPA 333/04

Planning and Community Development has completed SEPA review of the Freeland Comprehensive Sewage Plan and Engineering Report. A notice was published in the South Whidbey Record on September 22, 2004 which provided a 14 day comment period. No comments were received during this timeframe which expired on October 6, 2004. A final threshold determination of non-significance was issued on October 25, 2004. The decision was followed by a 14 day appeal period which expired on November 8, 2004. No appeals of the threshold determination were filed. SEPA review of the Plan has been completed.

ISLAND COUNTY
PLANNING & COMMUNITY DEVELOPMENT

Phillip Bakke AICP, Director

PHONE: (360) 679-7344 ■ from Camano (360) 629-4522 ■ from S. Whidbey (360) 321-5111
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Internet Home Page: http://www.islandcounty.net/planning/

FINAL SEPA THRESHOLD DETERMINATION

Application Number:	Applicant:
ENV 333/04	Island County Public Works

Assessor's Parcel Number:	Location:
N/A – Freeland Sub Area	Freeland, Washington

Proposal:
Approval of the Freeland Comprehensive Sewage Plan and Engineering Report for the purposes of submittal to the Washington State Department of Ecology (DOE) for their final review and approval. DOE completed their review of the draft plan on June 22, 2004. Comments and concerns have been incorporated into this plan as a result of their review. This environmental review is limited to the detailed aspects of the sewer system design and engineering, which include such issues as methods of collection, treatment, conveyance and discharge/reuse alternatives. Environmental review of designation of Freeland as a non-municipal urban growth area, establishing residential densities, establishing commercial/industrial uses and intensities and other land use issues related to the quantity, scale and type of development that a sewer system could support are currently being reviewed and addressed through preparation of a complete environmental impact statement.

DNS LIKELY	COMMENTS	FINAL THRESHOLD DETERMINATION
Date of Complete Application: **July 28, 2004**	Comment Period: **October 6, 2004**	Date of Final Determination: **October 25, 2004**
Publication Date: **September 22, 2004**	Comments Received: **No Comments**	Final Determination: **DNS**

The Optional DNS process of WAC 197-11-355 and ICC 16.14C.095 was used for review and notice of this proposal. The notice published in the newspaper declared the use of this process. This notice constitutes the final threshold determination.

Pursuant to ICC 16.14C.040 and WAC 197-11-680 this threshold determination may be appealed within 14 days following the date of the final threshold determination. The final threshold determination was issued on October 25, 2004. Any appeals of this threshold determination shall be made by November 8, 2004.

Responsible Officials:

Phil Bakke, Planning Director
Island County Planning and Community Development
P.O. Box 5000
Coupeville, WA 98239-5000
360-679-7309

Date: October 25, 2004

Signature: _____
Phil Bakke, Director
By Jeff Tate, Assistant Director

ISLAND COUNTY
NOTICE of APPLICATION with SEPA

Island County has received the following applications for review. For each of the following applications, Island County has reviewed the proposed project for probable adverse environmental impacts and expects to issue a determination of non-significance (DNS). The optional DNS process established by WAC 197-11-355 is being used. Agencies, tribes and the public are encouraged to review and comment on the proposed project and its probable environmental impacts. **The public comment period as described below may be the only opportunity to comment on the environmental impacts of the following proposals.**

File Number:	**333/04 ENV**
Applicant:	Island County Public Works
Date of Notice of Application:	September 22, 2004
Description of Proposal:	Approval of the Freeland Comprehensive Sewage Plan & Engineering Report for the purposes of submittal to the Washington State Department of Ecology (DOE) for their final review and approval. DOE completed their review of the draft plan on June 22, 2004. Comments and concerns have been incorporated into this plan as a result of their review. This environmental review is limited to the detailed aspects of the sewer system design & engineering, which include such issues as methods of collection, treatment, conveyance and discharge/reuse alternatives. Environmental review of designation of Freeland as a non-municipal Urban Grown Area, establishing residential densities, establishing commercial/industrial uses & intensities and other land use issues related to the quantity, scale & type of development that a sewer system could support are currently being reviewed and addressed through preparation of a complete environmental impact statement.
Location:	Freeland
Staff Contact:	Jeff Tate

The proposal may include mitigation under applicable codes, and the project review process may incorporate or require mitigation measures regardless of whether an EIS is required.

FILES A VAILABLE FOR REVIEW: The application files are available for inspection at no cost, and will be provided at the cost of reproduction in a timely manner. A copy of the final threshold determination(s) may be obtained upon request.

OPPORTUNITY FOR PUBLIC COMMENT: Your written comments on the project are requested. Comments on environmental impacts must be received by 4:30 p.m. on **October 6, 2004**

Comments may be: mailed to Island County Planning & Community Development, P.O. Box 5000, Coupeville, WA 98239; personally delivered to 6th & Main Street, Coupeville; or sent by facsimile to (360) 679-7306. Comments should be as specific as possible.

ADDITIONAL INFORMATION: A copy of the final threshold determination is available upon request. To submit written comments by the end of the public comment period, to request notice of hearings, or to receive a copy of the decision or final threshold determination, information on appeal procedures, or any additional information, contact Island County Planning & Community Development by mail, in person, or by phone at (360) 679-7339, 321-5111, or 629-4522.

FOR PUBLICATION IN THE SEPTEMBER 22, 2004 ISSUE OF THE WHIDBEY PAPER

Island County

Freeland Comprehensive Sewage Plan and Engineering Report

SEPA Checklist

July 2004

TETRA TECH/KCM

1917 First Avenue
Seattle, Washington 98101-1027

Freeland Comprehensive Sewage Plan and Engineering Report
SEPA Checklist

July 2004

Prepared for:
Gary Hess, P.E.
Department of Public Works
Island County
P.O. Box 5000
1 NE 6th Street
Coupeville, WA 98239

Prepared by:

TETRA TECH/KCM

Tetra Tech/KCM, Inc.
1917 First Avenue
Seattle, Washington 98101-1027
(206) 443-5300

Project #2230018

ENVIRONMENTAL CHECKLIST

The State Environmental Policy Act (SEPA), Chapter 43.21C RCW, requires all governmental agencies to consider the environmental impacts of a proposal before making decisions. The purpose of this checklist is to provide information to help Island County staff identify impacts of the Freeland Comprehensive Sewage Plan and Engineering Report, propose mitigation measures to reduce or avoid impacts from the proposal and assist the staff in deciding whether an EIS is required.

A. BACKGROUND

1. Name of proposed project:

Freeland Comprehensive Sewage Plan and Engineering Report

2. Name of applicant:

Island County, Washington

3. Address and phone number of applicant and contact person:

Gary Hess, P.E.
Department of Public Works
Island County
P.O. Box 5000
1 NE 6th Street
Coupeville, Washington 98239
(360) 679-7331

4. Date checklist prepared:

July 2004 by
Render Denson
Environmental Services Manager
Tetra Tech/KCM
1917 First Ave.
Seattle, WA 98101
(206) 443-5300

5. Agency requesting checklist:

Washington Department of Ecology

Island County Department of Planning and Community Development

6. Proposed timing or schedule:

A comprehensive Environmental Review is being conducted for the purposes of adopting a Freeland Comprehensive Sub Area Plan which designates Freeland as a Non-Municipal Urban Growth Area (NMUGA). A draft Environmental Impact Statement will be transmitted and public noticed issued in August of 2004. It is anticipated that a Final Environmental Impact Statement will be transmitted in January of 2005. Pursuant to Chapter 36.70A RCW designation of Freeland as an NMUGA requires the provision of such urban services as sewers. Environmental Review of the Sewer Plan and Engineering Report is being conducted now in order to enable submittal of the Plan and Report to the Washington State Department of Ecology for their review and approval. Comments on, and/or approval of, the Comprehensive Sewer Plan and Engineering Report are needed in order to fully address Environmental Review of the Sub Area Plan. WDOE, among other state agencies, will have an opportunity to also comment on the Environmental Review of the NMUGA designation and Sub Area Plan.

The draft Island County Comprehensive Sewer Plan and Engineering Report was completed in February 2004 and given to WDOE for review and comment. WDOE completed their review of the draft on June 22, 2004. The Report will be finalized once this SEPA review is complete.

7. Are there any plans for future additions, expansions, or further activity related to or connected with this proposal? If yes, explain.

As described above, a much broader environmental review of the Sub Area Plan and designation of Freeland as an NMUGA will be conducted from August 2004 to January 2005. This review will consider a variety of growth scenarios ranging from the status quo of keeping Freeland a Rural Area of More Intensive Development to a high, medium and low growth scenarios of Freeland as an NMUGA. The Sewer Plan and Engineering Report is necessary in order to support one of the alternative growth scenarios of Freeland as an NMUGA. As an NMUGA, Freeland will have a range of residential densities ranging from one dwelling unit per acre to ten dwelling units per acre. Additional zoning designations would allow for a variety of commercial, industrial and mixed use developments that would be urban in nature.

The Comprehensive Sewer Plan and Engineering Report proposes five phases for providing wastewater treatment, collection, and beneficial reuse of reclaimed water to the Freeland service area occurring over the next 50 years. "Reclaimed water" is the commonly-used term for wastewater that has been treated to a very high degree and is beneficially reused, such as for irrigation or groundwater recharge.

The first phase would include construction of the first phase of the collection system and wastewater treatment plant, the 2 mile conveyance pipe and 2 acres of surface percolation basins. The fifth and last phase addressing build-out in the service area includes a total of 15 acres of

surface percolation basins. Throughout the phasing, collection system pipes and side sewers will be constructed as needed.

8. **List any environmental information you know about that has been prepared, or will be prepared, directly related to this proposal.**

- Adams & Clark Inc., 1993. Holmes Harbor Water District Comprehensive Sewer Plan and Engineering Report for Wastewater Facilities.
- Freeland Sub Area Planning Committee and Island County Department of Planning and Community Development, 2001. Draft Freeland Sub Area Plan: An Element of the Island County Comprehensive Plan.
- Island County, 1998. Island County Comprehensive Plan.
- Island County Code Title XVII, Chapter 17.02 (Critical Areas Ordinance).
- U.S. Department of Agriculture, 1958. Soil Conservation Service, Soil Survey, Island County, Washington.
- Washington State Office of Financial Management, Historical Population Data.
- R.W. Beck, 2000. Phase 1 Report for the Freeland Sub-Area Plan.
- Roehl and Associates, 2002. Freeland Water District Draft Water Comprehensive Plan.

9. **Do you know whether applications are pending for governmental approvals of other proposals directly affecting the property covered by the proposal?**

There are no pending governmental approvals for other proposals affecting the property covered by this proposal.

10. **List any government approvals or permits that will be needed for the proposal, if known.**

- Grading Permit Review – Island County
- Critical Areas Review – Island County
- State Environmental Policy Act Review – Island County
- US Fire Code Compliance – Island County
- National Pollution Discharge Elimination System (NPDES) (wastewater discharge) – Washington Department of Ecology (WDOE)

- NPDES (stormwater discharge) - WDOE
- Archaeology and Cultural Resource Preservation Approval – Washington Office of Archaeology and Historic Preservation
- Water Reclamation Standards Compliance – Washington Departments of Ecology (WDOE) and Health (WDOH)
- Environmental Species Act (ESA) Compliance – US Fish and Wildlife Service/ National Marine Fisheries Service

11. Give brief, complete description of the project including (but not limited to) its size, general design elements, and other factors that will give an accurate understanding of its scope and nature.

Freeland is an unincorporated area on Whidbey Island, approximately ten miles west of the Clinton ferry terminal. Whidbey Island is approximately 30 miles north of Seattle.

As part of its 1998 county-wide Comprehensive Plan, Island County (County) desired to preserve the rural character of Whidbey Island while meeting its Growth Management Act (GMA) obligations. As part of the Plan, the County designated areas where growth would be concentrated and limited growth in the remainder of the County, thus protecting the island from unchecked urban sprawl. Freeland was one of two designated growth centers. In the Comprehensive Plan, Island County classified Freeland as a Residential Area of More Intensive Development (RAID), with potential designation as a Non-Municipal Urban Growth Area (NMUGA).

After adopting the county-wide Comprehensive Plan, the County initiated the process of developing a Comprehensive Sub Area Plan for the Freeland Area. A group called the Freeland Sub Area Planning Committee was appointed to lead this work. The committee produced the "Phase-I Existing Conditions" element of the Plan. The Committee then produced a "Working Draft" of the Plan's Land Use Element, upon which detailed infrastructure plans for new sanitary sewer systems could be based.

Currently, almost all of Freeland's population is served by septic systems. The Freeland Comprehensive Sewer Plan is intended to assist Freeland in planning for sewage capacity to match the County's population growth targets. Planning for collection, treatment, and discharge and/or reuse facilities will allow sewage capacity to match population growth in a cost-effective manner and to minimize potential harm to the surrounding environment.

After evaluating many alternatives for wastewater treatment, conveyance and disposal/reuse, the preferred alternative includes constructing a membrane bioreactor treatment plant and emergency storage basins adjacent to the Fletcher/Pennau property, conveying the Class A reclaimed water with a 10-inch high density polyethelene (HDPE) pipeline approximately 2 miles along Bush Point Road and Shore Meadow Road

west of Mutiny Bay Road to a former tree farm adjacent to Mutiny Bay Road for beneficial reuse by means of surface percolation within specially designed basins as well as wintertime storage basins. In addition, collection system pipelines will be constructed within the roads of the commercial and residential areas and septic tanks and pumps with side sewers or laterals will convey the wastewater from the individual businesses and residents to the collector pipes.

12. Location of the proposal.

The project site is located in Island County and the unincorporated city of Freeland, Washington. Freeland is located on State Highway 525. Figure 1 shows the location of the wastewater facilities and wastewater service area.

B. ENVIRONMENTAL ELEMENTS

1. Earth

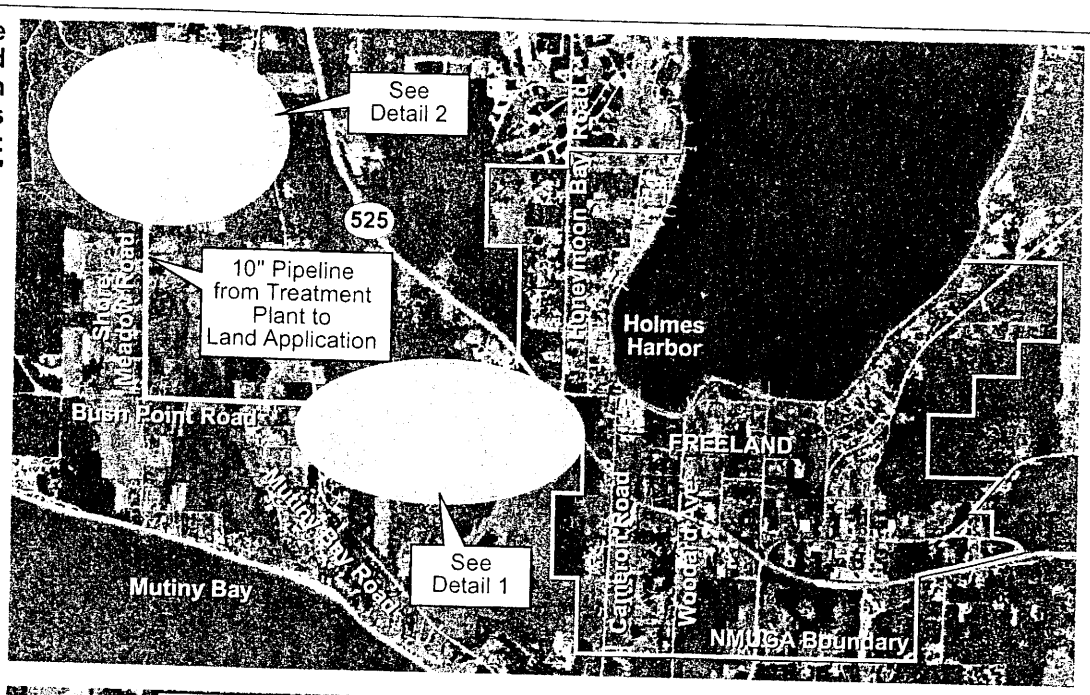
a. General description of the site:

Wastewater Treatment Facility – The proposed site is located at the corner of Highway 525 and Bush Point Road. The site will be located within the wooded area just west of and adjacent to the Fletcher/Pennau property which slopes to the south creating a flat low area used for pasturage and which has been cleared and is vegetated primarily with grass and a scattering of other herbaceous plants.

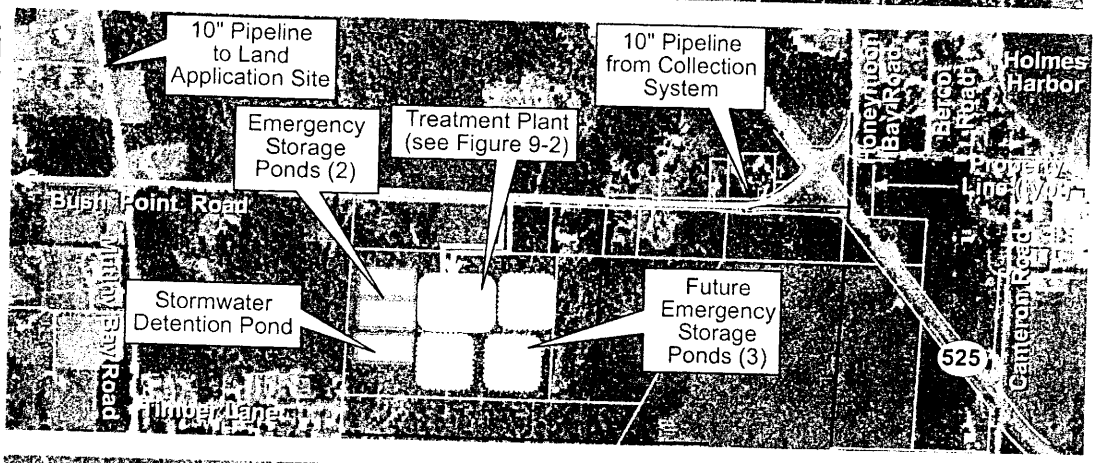
Land Application Facility – This site is approximately located west of Mutiny Bay Road near its juncture with Highway 525 and 2 miles northwest of the proposed treatment plant. It is an old tree farm containing an area which has been mined for gravel. The surface percolation basins will be constructed in the area of the gravel pit where soil studies have shown that the underlying gravels are appropriate for infiltration. Vegetation is fairly thick with a preponderance of young Douglas fir and cottonwood saplings.

Conveyance Route – The two mile conveyance route from the treatment plant to the surface percolation basins is primarily within the roadway of Bush Point Road west of Highway 520 and Shore Meadow Road west of Mutiny Bay Road.

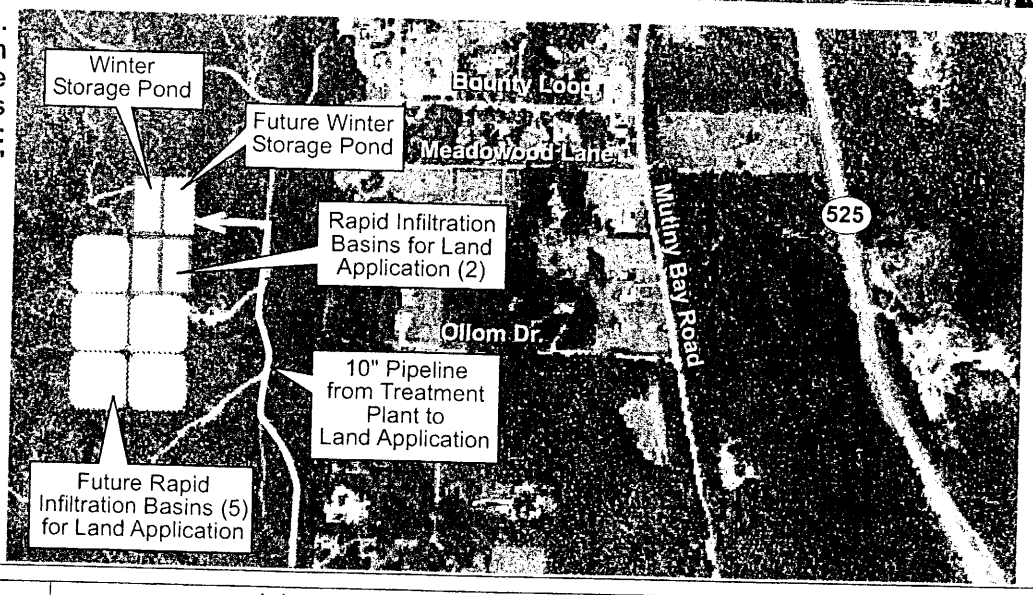
Treatment, Storage and Land Application Locations
Approx. Scale: 1" = 3,000'



Detail 1. Treatment and Emergency Storage Locations
Approx. Scale: 1" = 1,000'



Detail 2. Land Application and Winter Storage Locations
Approx. Scale: 1"= 1,000'



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Tetra Tech/ KCM, Inc. 1917 First Avenue Seattle, Washington 98101	Island County FREELAND COMPREHENSIVE SEWER PLAN AND ENGINEERING REPORT SEPA Checklist	Figure 1. TREATMENT, STORAGE AND LAND APPLICATION LOCATIONS

Collection System Piping – Collection system piping will be constructed in the residential and commercial districts of the service area which are essentially the existing built areas in Freeland. Septic tanks with pumps and side sewers or laterals will connect the users to the collector pipeline.

b. What is the steepest slope on the site (approximate percent slope)?

Ground elevations in the Freeland area are in the range of 0 to 250 feet above sea level. The terrain is generally gently sloping, with some areas having slopes greater than 20 percent.

c. What general types of soils are found on the site (for example, clay, sand, gravel, peat, muck)? If you know the classification of agricultural soils, specify them and note any prime farmland.

The soils throughout Whidbey Island originated mostly from glacial drift, deposited by glaciers that once moved over the region from the north. The U.S. Department of Agriculture Soil Conservation Service's (SCS) *Soil Survey, Island County, Washington* (SCS 1958) indicates that the area is comprised of several different soil types, with Whidbey gravelly sandy loam and Keystone loamy sand as two of the predominant types.

Whidbey gravelly sandy loam is prevalent in the higher elevation areas west of Holmes Harbor and in the vicinity of the Holmes Harbor Golf Course. It is described as "cemented gravelly till...the surface layer and subsoil absorb the water readily. During the rainy season the lower part of the subsoil immediately above the hardpan remains saturated for long periods."

Keystone loamy sand, which is prevalent in the area between the southern end of Holmes Harbor through the southern end of Freeland, is defined as a "somewhat excessively drained soil...developed from sandy drift...and is sandier and more open and porous throughout than the associated Whidbey soils and is comparatively free of gravel...because of the open porous texture, water is absorbed readily and drains very rapidly through the soil.

d. Are there surface indications of history of unstable soils in the immediate vicinity? If so, describe.

Erosion hazard areas contain soils that, according to the SCS Soil Classification System, may experience severe to very severe erosion. The erosion hazard for any given soil type increases as slope increases. Erosion hazard includes the transport of soil by wind and water. The susceptibility of soil to erosion depends on the size of the soil particles, the amount of precipitation,

topography, and the type and density of vegetation. There are some areas in Freeland that have steep slopes that could be more susceptible to erosion. Steep slopes were defined by the County as "critical areas" and as slopes greater than 40 percent. Development in critical areas is regulated by Island County's Critical Areas Ordinance.

There are no surface indications of a history of unstable soils on either the treatment plant site or the location for the surface percolation basins.

Landslide hazard areas are areas potentially subject to landslides based on geologic, topographic and hydrological factors, including bedrock and soil characteristics and stratigraphy, slope, and hydrology. Landslide hazard areas on the island are areas on slopes of 15 to 45 percent with other indicators of landslide hazard. Development in areas subject to landslides is regulated by Island County's Critical Areas Ordinance and other regulations. There are several areas with significant slopes in the Freeland service area including areas east of the Freeland service area and along Honeymoon Bay Road in the Freeland service area.

e. Describe the purpose, type, and approximate quantities of any filling or grading proposed. Indicate source of fill.

Table 1

Freeland Wastewater Treatment Plant and Related Facilities Excavation Quantities (a)

	New Impervious Area (sf)	Disturbed Area (sf)	Excavation Quantity (cy)	Length (miles)
Wastewater Treatment Plant	22,000	88,000	23,000	-
Conveyance Pipeline	0	53,000	10,000	2
Surface Percolation Basins	176,000	1,300,000	145,000	-
Collector Piping	0	400,000	75,000	15

a. Estimates are preliminary and are subject to change during design.
b. Estimates of disturbed area include clearing and grubbing, landscaping, and access roads. Some areas along the wastewater plant site perimeter will remain undisturbed to preserve existing trees, but have been included in the estimate for disturbed area for contingency.

f. **Could erosion occur as a result of clearing, construction, or use? If so, generally describe.**

A minimal amount of erosion could occur during construction. Soils will be exposed during construction. Implementation of Best Management Practices (BMPs) will lessen the erosion potential.

g. **About what percent of the site will be covered with impervious surfaces after project construction (for example, asphalt or buildings)?**

The proposed treatment facilities would occupy approximately three acres. No additional impervious surface will be created by construction of the conveyance or collector pipelines or surface percolation basins.

h. **Proposed measures to reduce or control erosion, or other impacts to the earth, if any:**

Typical construction and operational BMPs for grading and drainage that comply with the Island County Code and the Island County Stormwater Manual will be in place during this project. These may include temporary cover, hay bales and erosion fencing, spill control for fueling operations, limiting construction vehicle access whenever possible, and street sweeping. Disturbed areas will be hydroseeded or hand-seeded with a native grass seed mix.

It is not anticipated that areas of bare soil will be exposed for extended periods of time. Dirt piles will be covered. The use of BMPs, including hay bales and erosion control fencing, will reduce the potential for erosion.

2. **Air**

a. **What types of emissions to the air would result from the proposal (for example: dust, automobile odors, industrial wood smoke) during construction and when the project is completed? If any, generally describe and give approximate quantities if known.**

Typical construction machinery will be used in this project. There will be minimal impacts from exposed dirt from grading and truck traffic during construction.

Gravity collection systems do not have a significant potential for odor or corrosion. STEP systems have septic tanks discharging into full flow pipes, and septicity is a potential issue. Odor may be an issue where turbulent flows exist, such as the discharge point into a pump station wetwell. Corrosion issues can arise

throughout the collection system from the septic effluent, especially where metallic or concrete pipes and concrete manholes are used. STEP systems might require odor control at pump stations and chemical injection and use of chemically non-reactive materials for corrosion control throughout the sewer system. HDPE manholes or lined concrete manholes could be used.

There will be no significant impacts to air quality after project completion; odor control facilities will reduce the potential for odors which might emanate from the treatment plant. The closest residence to the treatment plant is at least 100 feet. Reclaimed water will be held in surface percolation basins and storage basins and is not expected to be an odor source. There are no residences within at least 500 feet of this area.

b. Are there any offsite sources of emissions or odor that may affect your proposal? If so, generally describe.

There are no off-site emissions sources or odors affecting this project.

c. Proposed measures to reduce or control emissions or other impacts to air, if any:

During construction, measures will be taken to cover dirt piles and dampen exposed dirt in the project area. Standard emission prevention equipment will be used on all equipment. As described above, odor control facilities will reduce the potential for odors emanating from the treatment plant.

3. Water

a. Surface:

1) Is there any surface water body on, or in, the immediate vicinity of the site (including year-round and seasonal streams, saltwater, lakes, ponds, wetlands)?

The main surface water in the study area is Puget Sound. Holmes Harbor defines the north end of Freeland, while Mutiny Bay is on its southwestern boundary. Per the Washington Administrative Code (WAC 173-201A), Holmes Harbor is defined as a Class A (excellent) marine water as part of Saratoga Passage. Mutiny Bay is classified is classified as a Class AA (extraordinary) marine water as part of Admiralty Inlet. A small-unnamed stream flows into Holmes Harbor near Freeland Park and is classified as Class A because it flows into Class A waters.

Constructing the treatment plant, storage basins, conveyance pipeline and surface percolation basins will not impact any wetland. It is possible that constructing the collector lines could impact an isolated wetland; however, most of the lines will be installed within roadways in the built up areas. In the event of a collection system pipeline impacting a wetland, appropriate permits will be sought with the Island County Department of Planning and Community Development and, if necessary, the Corps of Engineers.

2) **Will the project require any work over, in, or adjacent to (within 200 feet) the described waters?**

None of the construction involved with the treatment plant, storage basins, surface percolation basins nor the conveyance pipeline will be constructed within 200 feet of Holmes Harbor or Mutiny Bay. The conveyance pipeline will be constructed within the roadway of Mutiny Bay Road and Bush Point Road; this construction could occur within 200 feet of a number of small wetlands which occur adjacent to these roadways. In addition, constructing collection system pipelines in the low area adjacent to Holmes Harbor and through the roadway over a small unnamed creek in this area would occur within 200 feet of these waters.

3) **Estimate the amount of fill and dredge material that would be placed in or removed from surface waters or wetlands and indicate the area of the site that would be affected. Indicate the source of fill material.**

No filling or dredging will occur in surface waters or wetlands.

4) **Will the proposal require surface water withdrawals or diversions? Give general description, purpose, and approximate quantities if known.**

This proposal will not require surface water withdrawals or diversions.

5) **Does the proposal lie within a 100-year floodplain? If so, note location on the site plan.**

The only area of the project within the service area which occurs in the 100-year floodplain is the low area adjacent to Holmes Harbor.

6) **Does the proposal involve any discharges of waste materials to surface waters? If so, describe the type of waste and anticipated volume of discharge.**

No waste materials will be discharged to surface water bodies.

b. Ground:

1) Will groundwater be withdrawn, or will water be discharged to groundwater? Give general description, purpose and approximate quantities if known.

There will be no withdrawals of groundwater due to the project. Reclaimed water held in the surface percolation basins and discharged into the ground will percolate into the soil and possibly groundwater. The Soils Investigation (HWA Geosciences, 2003) found that the groundwater table is at least 15 feet below the surface or greater.

2) Describe waste material that will be discharged into the ground from septic tanks or other sources, if any (for example: Domestic sewage; industrial, containing the following chemicals; agricultural; etc.). Describe the general size of the system, the number of such systems, the number of houses to be served (if applicable), or the number of animals or humans the system(s) are expected to serve.

Wastewater, treated to Class A reclaimed water standards, will be discharged into the ground through surface percolation basins. The surface percolation basins will occupy approximately 2 acres at the beginning of the project and 15 acres at buildout.

The Water Reclamation and Reuse Standards (WDOE and WDOH September 1997) require that wastewater that is beneficially reused by being percolated into a drinking water aquifer must be treated to Class A reclaimed water standards through secondary treatment and must also undergo nitrogen reduction treatment. Region 10 of EPA designated the Freeland aquifer as a "sole-source aquifer" in 1982.

c. Water Runoff (including storm water):

1) Describe the source of runoff (including storm water) and method of collection and disposal, if any (include quantities, if known). Where will this water flow? Will this water flow into other waters? If so, describe.

This project will not generate significant amounts of stormwater. The impervious portions of the wastewater treatment plant and associated impervious areas will occupy one to two acres and generate stormwater runoff which will be detained in a retention/detention pond and released into a

nearby vegetated drainage swale and eventually percolate into the soils.

2) **Could waste materials enter ground or surface waters? If so, generally describe.**

A significant part of this project is conveying the reclaimed water treated by the proposed treatment plant to the surface percolation basins approximately 2 miles away. These basins will occupy approximately 2 acres in area at the first phase with a maximum area of 15 acres at build-out. This land application technology involves infiltrating reclaimed water into the soil where it could enter groundwater aquifers.

d. Proposed measures to reduce or control surface, ground and runoff water impacts, if any:

During construction, straw bales, filter fabric and other temporary erosion control measures will be installed to control runoff and possible erosion. The disturbed areas will be revegetated with a native grass mix. Use of appropriate BMPs will reduce potential contamination of surface water runoff by construction equipment (e.g., hydraulic fluids, gasoline and oil). The contractor will be required to follow the guidelines in the Island County Stormwater Manual and adhere to the Island County Code.

4. Plants

a. What kind of vegetation is found on the site?

Wastewater Treatment Plant
The wastewater treatment plant is being located in a forested area at the corner of Bush Point Road and Highway 525. The area has probably been logged several times and is vegetated with Douglas fir, red alder and bigleaf maple. Among shrubs, salal, blackberry, red elderberry and snowberry are scattered throughout the site. Herbaceous vegetation includes a variety of grasses, sword, deer and licorice ferns, trillium and a number of other plants.

Conveyance Pipeline
The conveyance pipeline will be constructed within the road beds of Bush Point and Shore Meadows Roads. Vegetation similar to that noted above occurs along the sides of the road shoulder where residential yards have not been cleared.

Surface Percolation Basins
The surface percolation basins are being located in and near a gravel pit on land previously used as a tree farm. Again, much of the vegetation noted above on the treatment plant site also occurs on the site which will contain the surface percolation basins.

Collection System Pipelines
The collector piping will be constructed primarily within the roadways of the built-up areas in Freeland within the service area.

Most adjacent lands are residential yards and paved parking areas. Laterals will connect the users to the collector pipes.

b. What kind and amount of vegetation will be removed or altered?

The wastewater treatment plant will occupy approximately three acres. Vegetation removed includes many of the species noted above. The treatment plant will be landscaped.

The site containing the surface percolation basins is primarily vegetated with species noted above. Phase 1 will require the removal of approximately 2 acres of vegetation. A total of 15 acres is necessary for the build-out configuration of the surface percolation basins.

c. List threatened or endangered species known to be on or near the site.

There are no known endangered or threatened plant species present in the Freeland wastewater service area.

Table 2 lists plant and animal species Island County has designated or is likely to designate as "protected species" and "species of local importance" as addressed in the Island County Code (ICC) 17.02.110.C.1(h). The CAO defines "protected species" as "Species of flora and fauna listed by the federal government or the State of Washington as endangered, threatened, or sensitive which are present in Island County and those species of flora and fauna which, while not necessarily endangered or threatened, are unique in Island County and worthy of protection, designated as Habitats and Species of Local Importance."

TABLE 2

Protected Species and Species of Local Importance as Designated by Island County

Protected Species	Common name	Classification
Fauna		
Eumetopias jubatus	Northern sea lion	Threatened
Haliaeetus leucocephalus	Bald eagle	Threatened
Falco peregrinus	Peregrine falcon	Endangered
Eschrichtius glaucus	Gray whale	Sensitive
Brachyramphus marmoratum	Marbeled murrelet	Threatened
Flora		
Agroseris elata	Tall agroseris	Sensitive
Aster curtus	White-top aster	Sensitive
Castilleja levisecta	Golden indian paintbrush	Endangered
Cicuta bulbifera	Bulb bearing water hemlock	Sensitive
Fritillaria camschatcensis	Black lily	Sensitive
Meconella oregana	White meconella	
Puccinella nutkaensis	Alaska alkaligrass	Sensitive
Species of Local Importance	Common name	Protected habitat
Fauna		
Ardea herodias	Great blue heron*	Nests
Gavia immer	Common loon	Nests
Pandion haliaetus	Osprey*	Nests
Dryocopus pileatus	Pileated woodpecker	Nests
Cygnus buccinator	Trumpeter swan	

*Designation is effective on the date the Board of Commissioners approves a habitat management plan.

d. Proposed landscaping, use of native plants, or other measures to preserve or enhance vegetation on the site, if any:

The disturbed areas will be revegetated with a grass mix. In addition, the site will be landscaped with native trees and shrubs.

5. Animals

a. Birds and animals, which have been observed on or near the site or are known to be on or near the site:

Mammals which inhabit the project area include rabbits, squirrels, raccoons, deer and various small rodents. Most of the

project area is well developed, and therefore current wildlife populations and migration may be limited by roads, fences, domestic pets and other projects of development. Natural wildlife populations may also be forced to compete for forage with domestic livestock in some areas.

The study area supports an abundance of bird species. Common perching species of birds within the study area include robin, crow, black-capped chickadee, winter wren, European starling, song sparrow, junco, red-winged blackbird, spine siskin, tree swallow, and red-breasted nuthatch. Upland game birds include ruffed grouse and California quail. Pileated and downey woodpeckers and northern flickers have been seen in the study area, as have several species of owls, hawks and other raptors. Great blue herons, Canada geese, mallards, and several other species of waterfowl inhibit the wetland areas within the project area, and various shorebirds may be found along the marine shorelines.

b. List any threatened or endangered species known to be on or near the site.

The project area is located within the Puget Sound/Strait of Georgia Evolutionarily Significant Unit or "ESU". An ESU is defined as "a distinctive group of Pacific salmon, steelhead, or sea-run cutthroat trout. The ESU includes all naturally spawned populations of chinook and coho salmon from rivers and streams flowing into Puget Sound."

The present federal status of listed fish species in Admiralty Inlet and Holmes Harbor is:

Threatened – chinook, Puget Sound ESU
Candidate – coho, Puget Sound/Strait of Georgia ESU
Threatened – bull trout, Coastal-Puget Sound distinct population unit

The following listed species and species of concern may occur within the vicinity of the proposed project:

- There are 3 bald eagle (Haliaeetus leucocephalus) nesting territories located along the east side of Holmes Harbor with the closest nest approximately 1200 feet from the service area boundary. Nesting activities occur from January 1 through August 15.
- Wintering bald eagles also occur in the vicinity of the project. Wintering activities occur from October 31 through March 31.

- Foraging marbled murrelets (Brachyramphus marmoratus) may occur in Homes Harbor and Admiralty Inlet.

Federal Species of Concern
Cascades frog (*Rana cascadae*)
Long-eared myotis (*Myotis evotis*)
Long-legged myotis (*Myotis volans*)
Northern goshawk (*Accipiter gentilis*)
Olive-sided flycatcher (*Contopus cooperi*)
Pacific Townsend's big-eared bat (*Corynorhinus townsendii townsendii*)
Peregrine falcon (*Falco peregrinus*)
River lamprey (*Lampetra ayresi*)

There are no known endangered animal species on the project sites. Bald eagles, which are considered threatened by both Washington State and the federal government, regularly fly over the project sites and service area.

c. Is the site part of a migration route? If so, explain.

The entire Puget Sound area is part of the Pacific Flyway.

d. Proposed measures to preserve or enhance wildlife, if any:

Island County considers all streams and Holmes Harbor as a fish and wildlife habitat conservation area and accords these natural features special protection. Consequently, any development near these areas must meet stringent construction requirements. The project area will be revegetated with native grasses, shrubs and trees.

6. Energy and Natural Resources

a. What kinds of energy (electric, natural gas, oil, wood stove, solar) will be used to meet the completed project's energy needs? Describe whether it will be used for heating, manufacturing, etc.

Electrical energy will be required to provide lighting and run the pumps and treatment facilities at the wastewater treatment plant. Lighting will also be provided at the site of the surface percolation basins.

b. Would the project affect the potential use of solar energy by adjacent properties? If so, generally describe.

This project will not affect the potential use of solar energy by adjacent properties.

c. **What kinds of energy conservation features are included in the plans of this proposal? List other proposed measures to reduce or control energy impacts, if any:**

The proposed wastewater treatment process will use an energy-efficient technology. The added step of nitrogen reduction will reduce the overall oxygen demand of the treatment process by using nitrate-nitrogen as a replacement for some oxygen as an energy source for microorganisms residing within treatment basins. Since the oxygenation of treatment basins is generally the largest energy requirement for a wastewater treatment plant, a reduction in oxygenation requirements will be a significant energy savings.

7. **Environmental Health**

a. **Are there any environmental health hazards, including exposure to toxic chemicals, risk of fire and explosion, spill, or hazardous waste that would occur as a result of this proposal? If so describe:**

After considering a number of alternatives for wastewater treatment and disposal or beneficial reuse, Island County and the Freeland Subarea Planning Commission decided that beneficial reuse through surface percolation of reclaimed water was the preferred method. Wastewater, treated to Washington State Class A reclaimed water standards in addition to nitrogen reduction, will be sent to surface percolation basins where the reclaimed water will percolate into the soil and likely the groundwater. Wastewater treatment plant staff rigorously monitors reclaimed water quality to ensure it meets applicable standards prior to infiltrating into the soil.

1) **Describe special emergency services that might be required.**

Fire District #3 located at 5535 Cameron Road in Freeland is responsible for the Freeland service area. It may be required for assistance in case of fire, diesel spill, or employee injury during construction.

2) **Proposed measures to reduce or control environmental health hazards, if any:**

The construction contractor will be required to develop a spill prevention and contingency plan. This requirement will be included in the construction specifications for this project.

b. **Noise**

1) **What types of noise exist in the area which may affect the project (for example: traffic, equipment, operation, other)?**

Ambient noise is primarily traffic-related and will not affect this project. There are no major sources of noise within the project area that would affect the proposed project.

2) **What types and levels of noise would be created by or associated with the project on a short-term or a long-term basis (for example traffic, construction, operation, other)? Indicate what hours noise would come from the site.**

During construction, various pieces of heavy equipment will increase the overall background noise during normal working hours of 7 a.m. to 7 p.m. Following construction, no operational noise is expected.

3) **Proposed measures to reduce or control noise impacts, if any:**

Vehicles and heavy equipment will be required to have standard noise reduction equipment and comply with the Island County Noise Ordinance.

8. **Land and Shoreline Use**

a. **What is the current use of the site and adjacent properties?**

Freeland Wastewater Service Area

The Freeland Wastewater Service Area is mainly a combination of commercial and residential properties. The Nichols Brothers Boat Builders is the only major industrial business in the area.

Wastewater Treatment Plant site

The site is currently a forested area near the juncture of Highway 525 and Bush Point Road. A large pasture is adjacent to the south. The nearest residences would be at least 100 feet from the treatment plant property boundaries.

Surface Percolation Basin site

The site, an abandoned tree farm approximately 800 acres in size, is located west of Mutiny Bay Road near the juncture with Highway 525. The area surrounding the basin site supports a tree farm and is not visible from adjacent properties.

b. Has the site been used for agriculture? If so, describe.

The treatment plant site lies in a forested area due north of a large pasture. It could have been used for agriculture in the past.

c. Describe any structures on the site.

There are no structures located on the wastewater treatment plant site or the surface percolation basin site.

d. Will any structures be demolished? If so, what?

No structures will be demolished.

e. What is the current zoning classification of the site?

The Freeland wastewater service area comprises most of the developed commercial and residential areas around Freeland.

Wastewater Treatment Plant site

Rural Forest

Surface Percolation Basin site

Rural Forest

Conveyance Pipeline

Rural

f. What is the current comprehensive plan designation of the site?

In the 1998 Island County Comprehensive Plan, the County designated most of the "core area" north of State Highway 525 as a Residential Area of More Intensive Development (RAID). RAIDs are designated pursuant to RCW 36.70A.070 for establishing logical outer boundaries for existing areas of more intensive rural development. The RAID has two basic zoning designations of "Rural Residential (RR)" and "Rural Center (RC)." The remaining areas in the vicinity are zoned "Rural (R)."

g. If applicable, what is the current shoreline master program designation of the site?

Neither the treatment plant, conveyance line nor surface percolation basins are located within a shoreline management

zone. The portions of the service area located within 200-feet of Holmes Harbor consist of various Shoreline designations including Urban, Conservancy, Residential and Rural.

h. Has any part of the site been classified as an "environmentally sensitive" area? If so, specify.

Neither the treatment plant site nor the surface percolation basin site is classified as "environmentally sensitive". The marine shoreline of Holmes Harbor, a small unnamed creek entering Holmes Harbor at Freeland Park and wetlands within the wastewater service area would be classified as "environmentally sensitive."

i. Approximately how many people would reside or work in the completed project?

The present population of the wastewater service area is approximately 1,000 individuals. The estimated population of the service area at build-out is approximately 5,000 individuals. Regarding the wastewater facilities, approximately two operators will be necessary for operations.

j. Approximately how many people would the complete project displace?

None.

k. Proposed measures to avoid or reduce displacement impacts, if any:

None are necessary.

l. Proposed measures to ensure the proposal is compatible with existing and projected land uses and plans, if any:

As noted previously, in the 1998 Island County Comprehensive Plan, the County designated most of the "core area" north of State Highway 525 as a Residential Area of More Intensive Development (RAID). RAIDs are designated pursuant to RCW 36.70A.070 for establishing logical outer boundaries for existing areas of more intensive rural development. The RAID has two basic zoning designations of "Rural Residential (RR)" and "Rural Center (RC)." The remaining areas in the vicinity are zoned "Rural (R)."

The County is proposing zoning changes for the Freeland area. The proposed changes would designate Freeland as a Non-Municipal Urban Growth Area (NMUGA). NMUGAs are designated pursuant to RCW 36.70A.110. They are unincorporated areas where urban growth is be encouraged and supported with urban

levels of service. Lands within NMUGAs can be designated with a variety of zoning classifications.

The NMUGA land use designations proposed for Freeland include residential classifications of "Low Density (LD)," "Medium Density (MD)," "High Density (HD)," "Mixed Use (MU)" and "Rural Estate (RU)." Commercial classifications include "Business General (BG)," "Business Office (BO)," "Business Village (BV)," and "Industrial (I)." There is also a "Public (P)" designation for public spaces.

9. Housing

a. Approximately how many units would be provided, if any? Indicate whether high, middle, or low-income housing.

The project does not involve the construction of housing units. With the advent of sewers, population density will increase.

b. Approximately how many units, if any, would be eliminated? Indicate whether high, middle, or low-income housing.

Not applicable.

c. Proposed measures to reduce or control housing impacts, if any:

Island County has zoning statutes and applicable density and building requirements.

10. Aesthetics

a. What is the tallest height of any proposed structure(s), not including antennas; what is the principal exterior building material(s) proposed?

The wastewater treatment plant will be located within an existing forested area south of Bush Point Road. The tallest structure will be approximately 10 feet in height.

b. What views in the immediate vicinity would be altered or obstructed?

No views in the immediate vicinity will be altered or obstructed as a result of this project. The wastewater treatment plant will be located with a forested area at the corner of Bush Point Road and Highway 525. Certain treatment facilities may be partially observable from Bush Point Road and Highway 525, but will likely be screened by existing or newly planted trees.

c. **Proposed measures to reduce or control aesthetic impacts, if any:**

The treatment plant will be landscaped with native trees, shrubs and grasses.

11. Light and Glare

a. **What type of light or glare will the proposal produce? What time of day would it mainly occur?**

Both the wastewater treatment plant and the surface percolation basins will be lighted with downward aiming and shaded lights. Construction will occur during normal business hours.

b. **Could light or glare from the finished project be a safety hazard or interfere with views?**

The downward aiming and shaded lights will not be a safety hazard or significantly interfere with views.

c. **What existing off-site sources of light or glare may affect your proposal?**

None.

d. **Proposed measures to reduce or control light and glare impacts, if any:**

Lights will be aimed downward and shaded. Lighting will be designed to meet or exceed the Island County Lighting Ordinance.

12. Recreation

a. **What designated and informal recreational opportunities are in the immediate vicinity?**

There are no recreational opportunities at either the plant site or surface percolation basin site; they are located on private property and are not adjacent to recreational areas. There are a number of parks within the Freeland wastewater service area along with the marine shoreline of Holmes Harbor.

b. **Would the proposed project displace any existing recreational use? If so, describe.**

The proposed project will not affect recreational use in the area.

c. **Proposed measures to reduce or control impacts on recreation, including recreation opportunities to be provided by the project, if any:**

None are necessary.

13. Historic and Cultural Preservation

a. **Are there any places or objects listed on, or proposed for, national, state, or local preservation registers known to be on or next to the site? If so, generally describe.**

There are no places or objects listed on or proposed for national, state or local preservation registers known to be on or next to the site.

b. **Generally describe any landmarks or evidence of historic, archaeological, scientific, or cultural importance known to be on or next to the site.**

Based on an archaeological review of the project area, there are two recorded archaeology sites and a burial site near Holmes Harbor. In addition, the unnamed creek at Freeland Park may have cultural resource potential, since it is one of the few year-round streams in the area that has had salmon runs.

c. **Proposed measures to reduce or control impacts, if any:**

If potentially significant archaeological sites are discovered during excavation, construction will be halted, Island County notified and a qualified archaeologist will be retained to determine an appropriate course of action.

14. Transportation

a. **Identify public streets and highways serving the site, and describe proposed access to the existing street system. Show on site plans, if any.**

The wastewater treatment plant site is located near the junction of Highway 525 and Bush Point Road. The surface percolation basin site is located off of Mutiny Bay Road and Bounty Road.

b. **Is site currently served by public transit? If not, what is the approximate distance to the nearest transit stop?**

Island Transit serves the general Freeland wastewater service area.

c. **How many parking spaces would the completed project have? How many would the project eliminate?**

The wastewater treatment plant will have five to ten parking spaces, depending on the phasing of the project; the surface percolation basin site will have five to ten parking spaces, depending on the phasing of the project.

d. **Will the proposal require any new roads or streets, or improvements to existing roads or streets, not including driveways? If so, generally describe (indicate whether public or private).**

The project will require improvement of an existing access road from the northern end of Shore Meadows Road to the proposed application site.

e. **Will the project use (or occur in the immediate vicinity of) water, rail, or air transportation? If so, generally describe.**

Not applicable.

f. **How many vehicular trips per day would be generated by the completed project? If known, indicate when peak volumes would occur.**

Construction of sewers in the service area will allow a greater population density and ostensibly more traffic. Workers at the treatment plant and the surface percolation basins will generate approximately 8 trips per day.

g. **Proposed measures to reduce or control transportation impacts, if any:**

Not applicable.

15. Public Service

a. **Would the project result in an increased need for public services (for example: fire protection, police protection, health care, schools, other)? If so, generally describe.**

No significant increase in public services will be required.

b. **Proposed measures to reduce or control direct impacts on public services, if any.**

Not applicable.

16. Utilities

a. List utilities currently available at the site: electricity, water, refuse service, telephone, sanitary sewer, other.

There are no utilities on either the treatment plant or surface percolation basin sites.

b. Describe the utilities that are proposed for the project, the utility providing the service, and the general construction activities on the site or in the immediate vicinity which might be needed.

All the utilities noted above will be necessary for both sites.

C. SIGNATURE

The above answers are true and complete to the best of my knowledge.

Signature: Kendr Denson

Date Submitted: 26 July 2004

APPENDIX E.
ENVIRONMENTAL REPORT AND LETTERS TO AGENCIES

DRAFT ENVIRONMENTAL REPORT
FREELAND COMPREHENSIVE SEWER PLAN AND ENGINEERING REPORT

1.0 PURPOSE AND NEED OF PROJECT

1.1 Project Description

Freeland is an unincorporated area on Whidbey Island, approximately ten miles west of the Clinton ferry terminal. Whidbey Island is approximately 30 miles north of Seattle.

Currently, almost all of Freeland's population is served by septic systems. After evaluating many alternatives for wastewater treatment, conveyance and disposal or reuse, the preferred alternative includes constructing a treatment plant and emergency storage basins at approximately the corner of Highway 525 and Bush Point Road. From the treatment plant, effluent will be conveyed by a 10-inch pipeline approximately 2 miles along Bush Point Road and Shore Meadow Road to a tree farm west of Mutiny Bay Road. Here, it will be land applied and reused by means of rapid infiltration within specially designed basins. Wintertime storage basins will also be constructed at the site. In addition, collection system pipelines will be constructed within the roads of the commercial and residential areas. Septic Tank Effluent Pumping (STEP) tanks and pumps will be installed at each user site along with side sewers or laterals to convey the wastewater from the individual businesses and residents to the collection system.

1.2 Purpose and Need of Project

As part of its 1998 county-wide Comprehensive Plan, Island County (County) desired to preserve the rural character of Whidbey Island while meeting its Growth Management Act (GMA) obligations. As part of the Plan, the County designated areas where growth would be concentrated and limited growth in the remainder of the County, thus protecting the island from unchecked urban sprawl. Currently, Freeland is designated as an area where limited growth can occur. The Western Washington Growth Management Hearings Board declared that Freeland appeared more like an Urban Growth Area and ordered Island County to study the possibility of designating it as such. In response to that order, in the Comprehensive Plan, Island County classified Freeland as a Residential Area of More Intensive Development (RAID), with potential designation as a Non-Municipal Urban Growth Area (NMUGA). The implications of these County classifications will be discussed in later chapters.

After adopting the county-wide Comprehensive Plan, the County initiated the process of developing a Comprehensive Sub Area Plan for the Freeland Area. A group called the Freeland Sub-Area Planning Committee was appointed to lead this work. The committee produced the "Phase-I Existing Conditions" element of the Plan. The Committee then produced a "Working Draft" of the Plan's Land Use Element, upon which detailed infrastructure plans for new sanitary sewer systems could be based.

Currently, almost all of Freeland's population is served by septic systems. This report is intended to assist Freeland in planning for sewage capacity to match the County's population growth targets. Planning for collection, treatment, and discharge and/or reuse facilities will allow sewage capacity to match population growth in a cost-effective manner and to minimize potential harm to the surrounding environment.

2.0 ALTERNATIVES TO THE PROJECT ACTION

Chapters 5, 6, and 7 of the Freeland Comprehensive Sewer Plan and Engineering Report (Sewer Plan and Engineering Report) (Tt/KCM, 2004) describe and evaluate various alternatives for collection, treatment, and discharge or reuse facilities for Freeland.

In Chapter 5, septic tank effluent pumping (STEP) collection systems were selected as the recommended collection system alternative. Conventional gravity systems were not selected because they had a very high capital cost that did not allow for cost-effective phasing of implementation. They also required multiple complex and expensive pump stations throughout the system. Combinations of gravity and STEP systems were not shortlisted due to similar factors. Decentralized treatment and disposal systems comprised of numerous large on-site septic systems were considered during the early planning process and rejected due to technical, regulatory, and cost factors.

In Chapter 6, land application for beneficial reuse was identified as the preferred strategy. Discharge to Puget Sound through an outfall was not shortlisted due to political and regulatory constraints. Year round land application strategies include drip irrigation and rapid infiltration basins. Three potential sites were identified and the tree farm west of Mutiny Bay Road was selected for the land application site.

In Chapter 7, treatment processes were evaluated to treat sewage to the quality required for beneficial reuse land application. Of the shortlisted treatment technologies, membrane bioreactors were recommended due to their ease of operations and maintenance, cost-effective life cycle costs, ability to phase implementation, and exceptional effluent quality. Oxidation ditches and filters and sequencing batch reactors and filters were not recommended due to their operational complexity, less flexibility in phasing implementation, and effluent quality less than that for membrane bioreactors (although adequate to meet quality requirements). Solids were recommended to be stabilized and hauled to the Island County Septage Handling Facility.

Combining these recommendations, County and Tt/KCM staff worked together to identify potential locations for a treatment plant, storage basins, and land application site. Parcels in the area were evaluated based on the following factors:

- Proximity to the service area
- Contiguous acreage
- Minimal number of landowners
- Access to State Route 525 or other access roads
- Lack of sensitive areas, such as wetlands, steep slopes, or floodplains
- Sparse development

- Availability of effluent receptor soils

Chapter 6 describes three sites that meet these criteria for land application. Parcels on or near these sites were evaluated as potential locations for treatment and storage facilities. The sites are shown on Figure 1. View corridors are identified for one of the sites, based on the request of the Freeland Sub-Area Planning Committee. The elevation and location of each site determine whether it is more suitable for a separate treatment plant for Freeland or joint treatment at an expanded HHSD treatment plant.

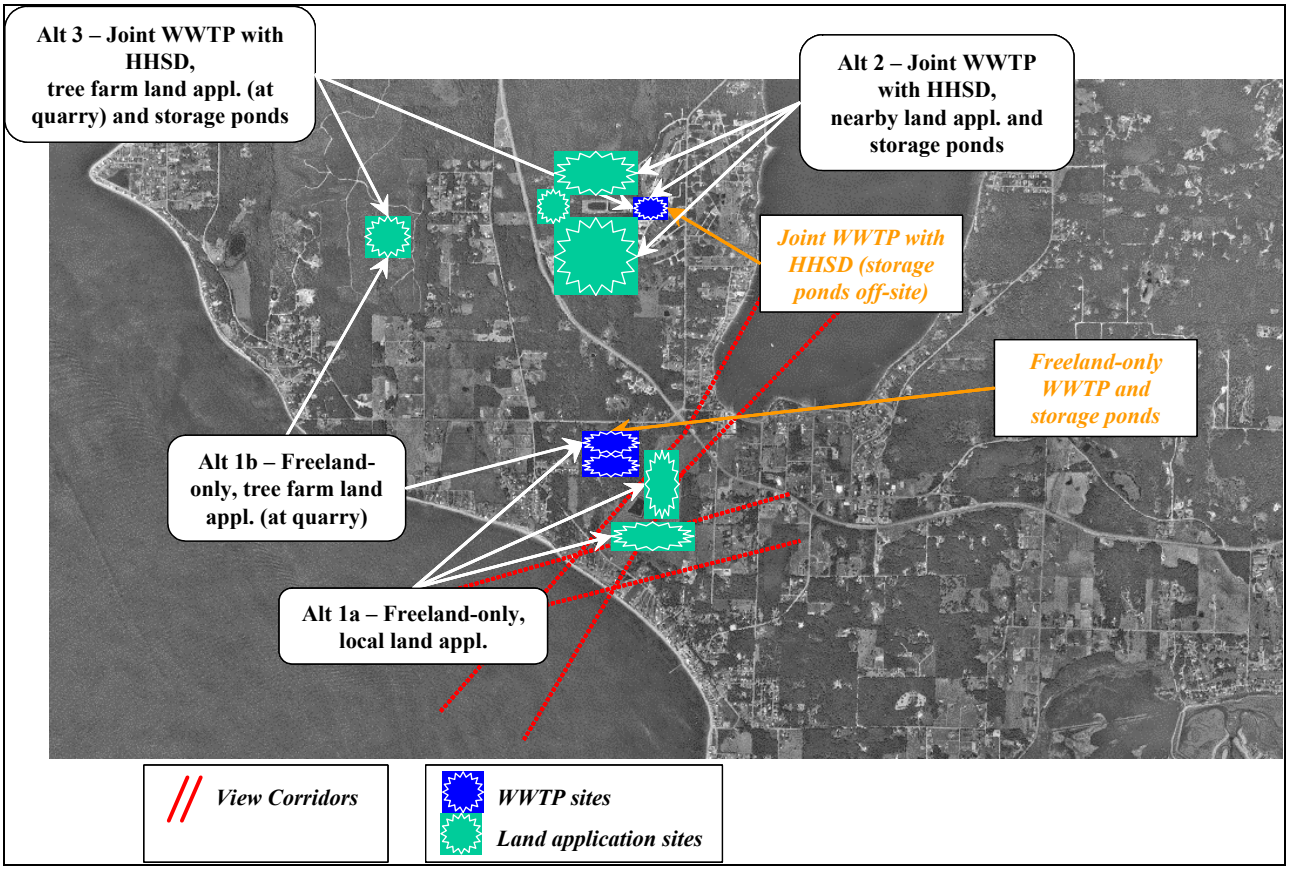

Figure 1. Potential Treatment Plant, Storage Basins, and Land Application Sites

2.1 Alternative 1 – Freeland-only Treatment, Local Land Application

This alternative would provide land application at a parcel between Mutiny Bay and Holmes Harbor, immediately southwest of Highway 525 (see Figures 1 and 2). It is owned by a single landowner. It is approximately 100 acres in size and is essentially flat, at an elevation of between 20 and 30 feet above sea level. It is a cleared area that is currently being used as pasture land. It is also part of a view corridor that extends from Mutiny Bay Road north to Holmes Harbor.

Based on its elevation and proximity to the Freeland collection system, use of this parcel would be consistent with a new treatment plant and storage basins for Freeland only rather than joint treatment with HHSD. Because the site is already cleared, installation of land

application facilities such as drip irrigation lines or rapid infiltration basins would be relatively inexpensive.

Facilities would need to be located so that the view corridor from Mutiny Bay to Holmes Harbor and beyond would not be disturbed. Treatment, emergency storage, and winter storage facilities could be located on parcels northwest of the site. In the northwest area, the ground slopes upwards and becomes heavily forested, which would minimize impacts on the view corridor.

The Freeland area varies in elevation from 0 to 250 feet above sea level. Individual STEP pumps at each service connection could provide the required pressure to pump sewage directly to the low elevation of this site. In fact, this alternative would reduce the costs of the collection system, because connections in higher elevation areas along Honeymoon Bay Road could deliver sewage to the parcel using small-diameter gravity systems, saving the cost of a STEP pump at each service connection (refer to the discussion in Chapter 5). No separate main pump station would be required for additional flow boosting.

Based on a discussion with the landowners, the northern portion of the parcel might be available for sale. However, the landowners have indicated that they would not be willing to sell the southern portion of the parcel, due to future development plans. This limits the acreage available for land application.

Figure 2. Alternative 1a Site (photo taken from SR 525 looking south)

2.1.1 Hydrogeology and Hydraulic Application Rate

The hydrogeological analysis indicated that there are coarse, well-drained soils along the southern portion of the parcel that are well suited for land application. Therefore, a relatively high design hydraulic application rate of at least 0.5 gallons per day per square foot (gpd/sf) can be used. Land application can either be through buried drip irrigation or

through rapid infiltration basins. Buried drip irrigation would be more likely at this site, due to view corridor constraints. However, rapid infiltration basins could be considered.

At Phase 5 (ultimate buildout), the maximum monthly flow of 0.68 mgd corresponds to a land application area of approximately 40 acres, including buffer areas around the application site. This approximately corresponds to the acreage available on the southern portion of the parcel.

On the northern portion of the parcel, well-cemented glacial tills correspond to a very low infiltration rate. In addition, there are some wetlands on the northeast corner of the site, indicating that there might be wintertime ponding and very limited or no ability to land-apply. A design rate of 0.1 gpd/sf or lower was recommended, with the understanding that the northern portion of the site might not be available for wintertime land application. At Phase 5 (ultimate buildout), the maximum monthly flow of 0.68 mgd corresponds to a land application area of approximately 225 acres, including buffer areas around the application site. This is far more land than is available on the northern portion of the parcel.

The hydrogeological analysis indicated that both the southern and northern portions of the parcel may be subject to high groundwater in winter. This could mean that significant winter storage could be required, depending on the actual winter infiltration rate. Instead of three days of winter storage, as described in Chapter 6, several months could be required. Alternatively, another means of winter discharge or reuse would be required.

There are public drinking water wells within a few hundred feet of the site. Some of these wells draw water from the shallow aquifer, meaning that nearby land application of treated wastewater might influence those wells. Detailed hydrogeological analysis would be required to better quantify this issue.

Because the southern portion of the parcel might not be available for purchase, the overall land application capacity of the parcel is limited. At a point in the future, when the land application capacity of the parcel is reached, pumps and pipelines would be installed to convey additional effluent to a second location for land application.

2.2 Alternative 1b – Freeland-only Treatment, Tree Farm Land Application

Alternative 1b includes a treatment plant and storage basins for Freeland only, located similarly to Alternative 1a. To address Alternative 1a's site constraints, hydrogeological concerns, and wetland issues associated with land application at the site, treated effluent would be conveyed to another site for land application.

The winter storage basins could be located on the land application site. The emergency storage basins would still be located adjacent to the treatment plant (as in Alternative 1a), because they store partially treated effluent and must pump it back to the treatment plant for re-treatment.

The site identified for land application is a tree farm approximately 2 miles northwest of the Alternative 1a site, west-southwest of the intersection of Mutiny Bay Road and Highway 525. The site is about 780 acres in size, and much of it is owned by a single

landowner; the rest is divided among several landowners. Surrounding properties are held by few owners. The site slopes gently, varying in elevation between approximately 100 and 300 feet above sea level.

It has areas that are fairly heavily forested, which would increase the cost of constructing land application facilities such as drip irrigation lines throughout the area. However, a significant portion of the area is a tree farm that has been periodically logged, as evident from the aerial photo shown in Figure 8-3 Therefore, the ease of constructing land application facilities would depend on the specific portion of the area chosen. The hydrogeological field work identified a gravel pit on the site that would be best suited for land application based on estimated infiltration rates. The pit site is shown on Figure 3.

Figure 3. Alternative 1b Land Application Site

There are few landowners in the vicinity, based on the site's history as a tree farm.

2.2.1 Hydrogeology and Hydraulic Application Rate

The hydrogeological analysis indicated that for the gravel pit area and beyond (at least 20 acres), there are coarse, well-drained soils that are well suited for land application. A relatively high design hydraulic application rate of at least 1.5 gpd/sf could be used. The groundwater table was too deep to be located by the hydrogeological testing.

Land application could either be through buried drip irrigation or through rapid infiltration basins. Rapid infiltration basins are recommended, given their low cost and ease of operation and maintenance compared to drip irrigation, and the lack of view corridor concerns in the area. Surface irrigation of nearby forest land could also be considered, but for now this alternative assumes using rapid infiltration basins.

At Phase 5 (ultimate buildout), the maximum monthly flow of 0.68 mgd corresponds to a land application area of approximately 15 acres, including buffer areas around the application site. This is within the extent of the pit area.

2.3 Alternative 2 – Joint Treatment with HHSD, Near-Site Land Application

This alternative is based on land application at a site immediately west of the HHSD treatment plant (see Figures 8-1 and 8-5. The area is composed of 36 parcels owned by 19 landowners. It is about 300 acres in size and slopes gently, at an elevation of between 100 and 200 feet above sea level. The land application area is fairly heavily forested, which would increase the cost of constructing drip irrigation lines or other land application facilities throughout the area. There are wetlands in the northeast portion of the site.

Figure 4. Alternative 2 Land Application Area

Since the HHSD treatment plant is immediately east of the land application site, this alternative assumes that Freeland's sewage would be pumped up Honeymoon Bay Road and treated at an expanded HHSD plant. STEP pumps at lower elevations would have to deliver 280 to 300 feet of pressure at design flows to pump up to the plant's elevation, (taking into account friction and head losses), which corresponds to a working pressure of 120 to 130 pounds per square inch. This is higher than most municipal piping systems are designed for (drinking water piping distribution systems, which are designed to be under continuous pressure, are usually designed for no more than 80 psi). Therefore, a main pump station would be required to boost the flow from individual low-elevation STEP systems up to the treatment plant. The main pump station would likely be located somewhere along Honeymoon Bay Road.

Based on discussions with HHSD, HHSD's existing storage basins would not be able to be used for Freeland's requirements. New storage basins would be constructed adjacent to the land application area.

2.3.1 Hydrogeology and Hydraulic Application Rate

The hydrogeological analysis indicated that although the top few feet of the land application area for this alternative might be well-suited for small septic drainfields, there is a prevalent glacial till layer throughout the area. The glacial till layer has a very low

permeability, meaning that soil percolation rates would be limited. A relatively low design hydraulic application rate of 0.1 gpd/sf or lower would have to be used. Rapid infiltration basins are not recommended due to the low percolation rate. At ultimate buildout, the maximum monthly flow of 0.68 mgd corresponds to a land application area of approximately 220 acres, including buffer areas around the application site.

2.4 Alternative 3 – Joint Treatment with HHSD, Far-Site Land Application

This alternative includes joint expanded treatment at the HHSD treatment plant site and land application at the tree farm site described for Alternative 1b. As with Alternative 2, the elevation difference between the lowest points in Freeland and the HHSD treatment plant would require a main pump station to be installed to boost STEP flows up to the HHSD treatment plant. The main pump station would be located somewhere along Honeymoon Bay Road.

Also as with Alternative 2, HHSD's storage basins would not be able to be used for Freeland's requirements. New storage basins would be constructed adjacent to the land application area.

2.4.1 Hydrogeology and Hydraulic Application Rate

The hydrogeology of this site is similar to that of the gravel pit in Alternative 1b. Again, approximately 15 acres would be required for land application, including buffer areas.

2.5 Alternatives Evaluation

Detailed planning-level cost estimates were developed for these alternatives. The cost estimates include all aspects of the project, including STEP tanks and pumps, mainline sewers, conveyance from the collection system to the treatment plant, treatment plant, emergency and wintertime storage basins, conveyance from the treatment plant to the land application site, land application, purchase of land, and annual operations and maintenance costs.

Cost assumptions for these planning-level costs are described in Chapter 5 of the Sewer Plan and Engineering Report. Costs were developed for each phase of implementation, considering how to phase facilities from initial phase to ultimate buildout conditions.

As in Chapter 5, phasing of alternatives was estimated using planning projections and estimates of potential phases of implementation. As in Chapter 4, phasing was estimated based on Phases 1 through 5:

1. Phase 1: Commercial Core, including Nichols Brothers, equivalent to 319 Equivalent Residential Units (ERUs)
2. Phase 2: Phase 1 plus adjacent medium-density housing, equivalent to 525 ERUs
3. Phase 3: Phase 2 plus additional service described in Chapter 4, equivalent to 1,037 ERUs

4. Phase 4: Sewers for the entire NMUGA area, assuming "low" population growth projections, equivalent to 1,558 ERUs
5. Sewers for the entire NMUGA area, assuming "high" population growth projections, equivalent to 3,130 ERUs

Figure 5 shows the results of the cost analysis in a graphical form. It shows estimated capital and present worth costs in terms of cost per ERU. Each set of five bars represents one of the four alternatives. In each set of five bars, the leftmost bar represents Phase 1, while the right-most bar represents Phase 5.

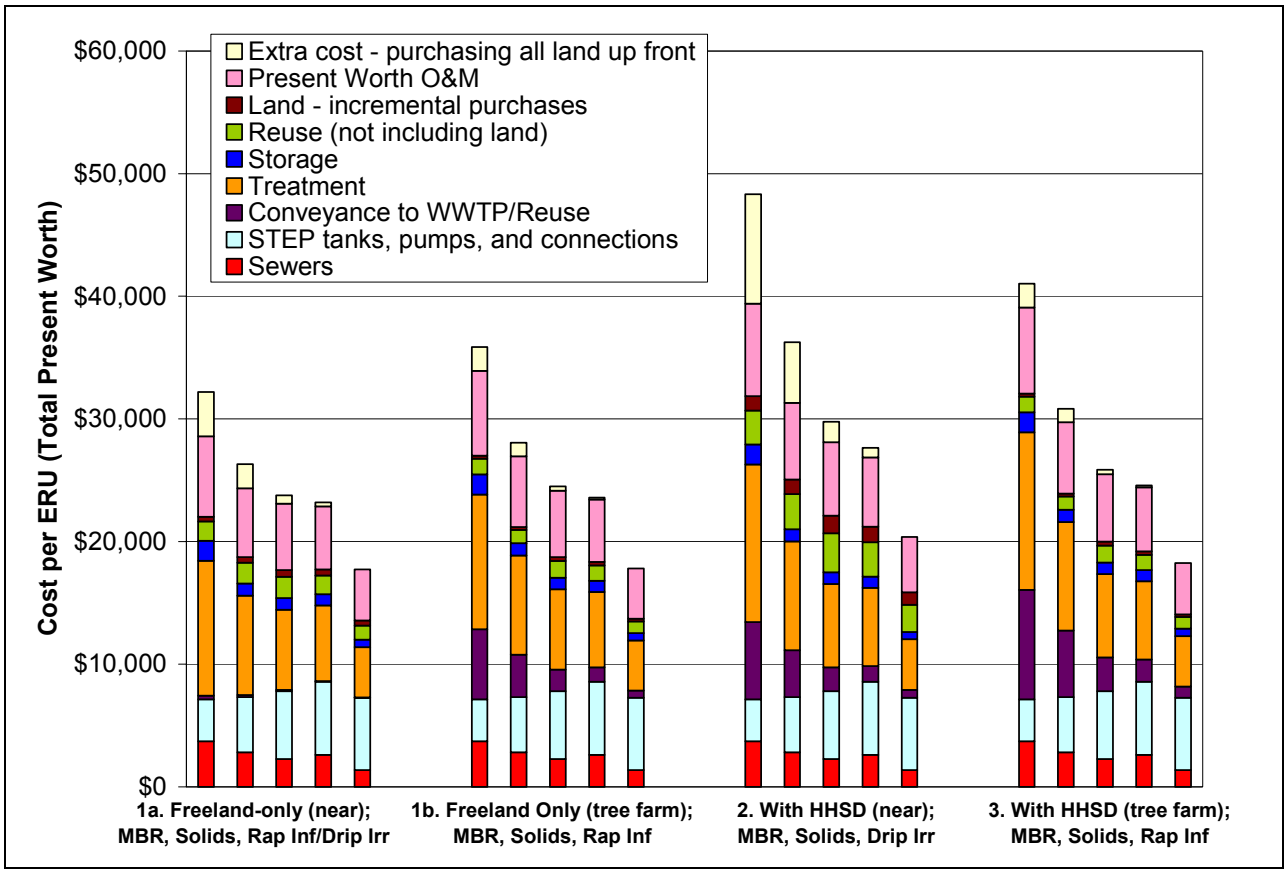

Figure 5. Estimated Costs of Combined Alternatives (per ERU)

Figure 5 shows that Alternative 1a, the Freeland-only alternative with nearby land application, has the lowest total present worth cost of the three alternatives. Although Alternative 1 has the highest treatment costs (based on the new plant versus expansion of an existing plant), it does not require a main pump station for boosting all flow up to the higher elevation at Holmes Harbor, as well as the cost for conveyance piping. The land application site is also very close to the Freeland NMUGA, minimizing piping costs.

Alternative 1b, the Freeland-only alternative with land application at the tree farm, has a higher total present worth cost than Alternative 1a. This higher cost is due to pumps and pipelines required to convey from the treatment plant to the land application site. The impact of that additional cost is felt most during initial phases, since the pumps and piping would likely be put in all at once (instead of phased) to capture the economy of scale. In

later phases, the costs are more similar to Alternative 1b, since there are many people sharing the cost of the conveyance.

Alternatives 2 and 3 have higher total present worth costs than Alternative 1a or 1b. This is especially true during the initial phases of implementation. The cost of a buried pump station and piping from Freeland to Holmes Harbor is significant, in addition to conveyance to the land application site. Alternative 2 has a significant cost for land application and for purchase of land, due to the significant acreage required at buildout. Alternative 3 has a lower land application and land purchase cost based on the more favorable soils. However, Alternative 3 does have a greater conveyance cost than Alternative 2 because the land application site is farther from the treatment plant than in Alternative 2.

Based on the qualitative and cost analysis presented herein, the Freeland Sub-Area Planning Committee agreed at a November 13, 2003 meeting that Alternative 1b should be selected as the recommended alternative. If suitable land application sites can be identified closer to Freeland, they should be investigated further because they could reduce the cost of conveyance to the tree farm for land application.

3.0 AFFECTED ENVIRONMENT/ ENVIRONMENTAL CONSEQUENCES

3.1 Land Use/Important Farmland/Formally Classified Lands

3.1.1 Affected Environment

There are no important farmlands or formally classified lands in the project area. This section will provide a general description of the site, address land use and describe soils and topography.

3.1.1.1 General description of the site

Wastewater Treatment Facility and Emergency Storage Basins – The proposed site is located at the corner of Highway 525 and Bush Point Road. The site will be located within the wooded area south of Bush Point Road. The property slopes to the south creating a flat low area used for pasturage. It has been drained and cleared and is vegetated primarily with grass and a scattering of other herbaceous plants.

Land Application Facility and Wintertime Storage Basins – This site is approximately located west of Mutiny Bay Road south of its juncture with Highway 525 and 2 miles northwest of the proposed treatment plant. It is a tree farm containing an area which has been mined for gravel. The rapid infiltration basins will be constructed in the area of the gravel pit where soil studies have shown that the underlying gravels are appropriate for infiltration. The wintertime storage basins will be constructed adjacent to these infiltration basins. Vegetation is fairly thick with a preponderance of young red alder, Douglas fir and cottonwood saplings.

Conveyance Pipeline – The two mile conveyance route from the treatment plant to the rapid infiltration basins is primarily within the roadway of Bush Point Road west of Highway 525 and Shore Meadow Road west of Mutiny Bay Road. Residences, hobby farms and fields occur on each side to the roadways.

Collection System Piping – The collection system piping will be constructed in the residential and commercial districts of the service area which are essentially the existing built areas in Freeland. Side sewers or laterals will connect the STEP systems of the users to the collection system pipelines.

3.1.1.2 Land Use

In the 1998 Island County Comprehensive Plan, the County designated most of the "core area" north of State Highway 525 as a Residential Area of More Intensive Development (RAID). RAIDs are designated pursuant to RCW 36.70A.070 for establishing logical outer boundaries for existing areas of more intensive rural development. The RAID has two basic zoning designations of "Rural Residential (RR)" and "Rural Center (RC)." The remaining areas in the vicinity are zoned "Rural (R)."

The County is proposing zoning changes for the Freeland area. The proposed changes would designate Freeland as a Non-Municipal Urban Growth Area (NMUGA). NMUGAs are designated pursuant to RCW 36.70A.110. They are unincorporated areas where urban growth is be encouraged and supported with urban levels of service. Lands within NMUGAs can be designated with a variety of zoning classifications.

The NMUGA land use designations proposed for Freeland include residential classifications of "Low Density (LD)," "Medium Density (MD)," "High Density (HD)," "Mixed Use (MU)" and "Rural Estate (RU)." Commercial classifications include "Business General (BG)," "Business Office (BO)," "Business Village (BV)," and "Industrial (I)." There is also a "Public (P)" designation for public spaces.

3.1.1.3 Topography and Soils

The soils throughout Whidbey Island originated mostly from glacial drift, deposited by glaciers that once moved over the region from the north. The U.S. Department of Agriculture Soil Conservation Service's (SCS) *Soil Survey, Island County, Washington* (SCS 1958) indicates that the area is comprised of several different soil types, with Whidbey gravelly sandy loam and Keystone loamy sand as two of the predominant types.

Whidbey gravelly sandy loam is prevalent in the higher elevation areas west of Holmes Harbor and in the vicinity of the Holmes Harbor Golf Course. It is described as "cemented gravelly till…the surface layer and subsoil absorb the water readily. During the rainy season the lower part of the subsoil immediately above the hardpan remains saturated for long periods."

Keystone loamy sand, which is prevalent in the area between the southern end of Holmes Harbor through the southern end of Freeland, is defined as a "somewhat excessively drained soil…developed from sandy drift…it is sandier and more open and porous throughout than the associated Whidbey soils and is comparatively free of gravel…because of the open porous texture, water is absorbed readily and drains very rapidly through the soil.

Erosion hazard areas contain soils that, according to the SCS Soil Classification System, may experience severe to very severe erosion. The erosion hazard for any given soil type

increases as slope increases. Erosion hazard includes the transport of soil by wind and water. The susceptibility of soil to erosion depends on the size of the soil particles, the amount of precipitation, topography, and the type and density of vegetation. There are some areas in Freeland that have steep slopes that could be more susceptible to erosion. Steep slopes were defined by the County as slopes greater than 40 percent and designated as "critical areas". Development in critical areas is regulated by Island County's Critical Areas Ordinance (17.02 Island County Code (ICC).

Landslide hazard areas are areas potentially subject to landslides based on geologic, topographic and hydrological factors, including bedrock and soil characteristics and stratigraphy, slope, and hydrology. Landslide hazard areas on the island are areas on slopes of 15 to 45 percent with other indicators of landslide hazard. Development in areas subject to landslides is also regulated by Island County's Critical Areas Ordinance and other regulations. There are several areas with significant slopes in the Freeland service area including areas east of the Freeland service area and along Honeymoon Bay Road in the Freeland service area. There are no surface indications of a history of unstable soils on either the treatment plant or land application sites.

3.1.2 Environmental Consequences

Construction of the wastewater facilities as recommended in the Sewage Plan and Engineering Report would not result in significant impacts to land use, farmland or formally classified lands. These facilities are permitted uses within their various zoning classifications.

A letter sent to the U.S. Department of Agriculture requesting comments to the proposed action is contained in Section 6.1 of this report.

3.1.3 Mitigation

Design of all the facilities should take into consideration the soil limitations of the sites. Properly designing foundations and footings and diverting runoff away from buildings would help to prevent structural damage caused by shrinking and swelling. Wetness can be reduced by building on a pad and installing drainage tile around footings if a suitable outlet is available.

3.2 Floodplains

3.2.1 Affected Environment

Most of the project areas are not located within a designated floodplain. Flooding in the Freeland area usually occurs during the winter months, when storms with high winds cause storm surges and high waves. The principal areas of flooding occur along the beaches and marine areas. The only area of the project within the service area which occurs in the 100-year floodplain is the low area adjacent to Holmes Harbor.

3.2.2 Environmental Consequences

Review of FEMA data indicates no impact to floodplains would occur from the project. A letter sent to the Washington Department of Natural Resources requesting comments to the proposed action is contained in Section 6.1 of this report.

3.2.3 Mitigation

No mitigation is recommended.

3.3 Wetlands

Wetlands are regulated under Island County's Critical Areas Ordinance, Chapter17.02 of the Island County Code. Island County regulations consider Category A wetlands less than 0.25 acres in size, Category B wetlands less than one acre in size and Class C wetlands (artificially created wetlands that were not required as mitigation for wetland impacts) as exempt from CAO regulations. These artificial wetlands may include but are not limited to irrigation and drainage ditches, grass-lined swales, canals, detention facilities, reservoirs, wastewater treatment ponds, farm ponds and landscape amenities. All marine related wetlands of any size are covered by the CAO.

3.3.1 Affected Environment

Island County Critical Areas mapping indicate the closest wetlands are located approximately 1600 feet from the treatment facility along Holmes Harbor and adjacent to Nichols Brothers Boat Builders and along Mutiny Bay Road east of the treatment plant site. Both are considered Class A wetlands.

3.3.2 Environmental Consequences

The proposed action would not result in significant impact to wetlands. None of the wastewater facilities will be located in wetlands or their buffers. The conveyance pipeline will be constructed within the Bush Point and Shore Meadow roadways. The collection system piping will primarily be in roadways. Laterals will be located in yards, driveways and parking lots. There is a possibility that the conveyance line or the collection system piping could occur within buffers of adjacent wetlands. In the event construction of any portion of the collection system or laterals would occur in a wetland, appropriate permits from Island County and, if necessary, the Corps of Engineers will be obtained.

Requests were made to the US Department of Fish and Wildlife (USFWS), Washington Department of Fish and Wildlife (WDFW) and Washington Department of Natural Resources (DNR) to review the proposed project for any wetlands that may occur in the project area. Letters sent to these agencies are included in Section 6.1 of this report.

3.3.3 Mitigation

If construction in a wetland is required, appropriate mitigation as required by Island County will be implemented.

3.4 Cultural Resources

3.4.1 Affected Environment

Based on an archaeological review of the project area, there are two recorded archaeology sites and a burial site near Holmes Harbor

If potentially significant archaeological sites are discovered during excavation, construction will be halted, Island County will be notified and a qualified archaeologist will be retained to determine an appropriate course of action.

If Federal funds or permits are involved in implementing the Sewage Plan and Engineering Report and recommended projects, Section 106 of the National Historic Preservation act, as amended, and its implementing regulations (36CFR800) must be followed. The Section 106 process seeks to accommodate historic preservation concerns with the needs of Federal undertakings through consultation among the agency official and other parties with an interest in the effects of the undertaking on historic properties, commencing at the early stages of project planning. The goal of consultation is to identify historic properties potentially affected by the undertaking, assess its effects and seek ways to avoid, minimize or mitigate any adverse effects on historic properties (36CFR800.1).

The Washington State Office of Archaeology and Historic Preservation (SHPO), the Tulalip Tribes and the Swinomish Tribal Community were contacted as part of a procedural request for a determination of the presence of any archaeological and/or historic resources in the project area. Letters sent to these parties are contained in Section 6.1 of this report.

3.4.2 Environmental Consequences

No direct impacts to archaeological or historic resources are expected to result from implementation of the Sewage Plan and Engineering Report and recommended projects. The conveyance line and collection system and side sewer piping will be constructed in roadways, parking lots and yards. Neither the treatment plant nor land application site were identified as having any potential for cultural or historic resources.

3.4.3 Mitigation

As the SHPO recommended, a professional archaeological survey of the project area will be conducted. In addition, the County has sent letters to the Tulalip Tribes and the Swinomish Tribal Community regarding cultural resource issues.

3.5 Biological Resources

Federal agencies that provide funding, permitting, licensing, or other authorization for this project must assure that its responsibilities under section 7(a)(2) of the Endangered Species Act of 1973, as amended, are met. Section 7(a) – Consultation/Conference requires:

1. Federal agencies to utilize their authorities to carry out programs to conserve endangered and threatened species;
2. Consultation with the US Fish and Wildlife Service when a Federal action may affect a listed endangered or threatened species to ensure that any

action authorized, funded, or carried out by a Federal agency is not likely to jeopardize the continued existence of listed species or result in the destruction of adverse modification of critical habitat. The process is initiated by the federal agency after it has determined if its action may affect (adversely or beneficially) a listed species.

3. Conference with the US Fish and Wildlife Service when a Federal action is likely to jeopardize the continued existence of a proposed species or result in destruction or an adverse modification of proposed critical habitat.

In addition to threatened and endangered species, Federal agencies are obligated, under Section 305(b)(2) of the Magnuson-Stevens Fisheries Conservation and Management Act (MSA) to consult with NMFS regarding actions that are authorized, funded, or undertaken by that agency, that may adversely affect Essential Fish Habitat (EFH). The MSA defines EFH as those waters and substrate necessary to fish covered under the MSA for spawning, breeding, feeding, or growth to maturity.

Requests were made to the US Department of Fish and Wildlife (USFWS), National Oceanic and Atmospheric Administration – National Marine Fisheries Service (NMFS), Washington Department of Fish and Wildlife (WDFW) and Washington Department of Natural Resources (DNR) to review the proposed project for any State and Federally-listed threatened and endangered species, habitat and any other important State natural resources that may occur in the project area. Letters sent to these agencies for comments regarding to the proposed action are included in Section 6.1 of this report.

3.5.1 Affected Environment

Wastewater Treatment Facility and Emergency Storage Basins - The wastewater treatment facility and emergency storage basins will be located in a forested area at the corner of Bush Point Road and Highway 525. The area has probably been logged several times and is vegetated with Douglas fir, red alder and bigleaf maple. Among shrubs, salal, blackberry, red elderberry and snowberry are scattered throughout the site. Herbaceous vegetation includes a variety of grasses, sword, deer and licorice ferns, trillium and a number of other plants.

Conveyance Pipeline - The conveyance pipeline will be constructed within the road beds of Bush Point and Shore Meadow Roads. Vegetation similar to that noted above occurs along the sides of the road shoulder where residential yards have not been cleared.

Land Application Facility and Wintertime Storage Basins - The rapid infiltration basins and winter storage basins are being located in and near a gravel pit on land currently used as a tree farm. Again, much of the vegetation noted above on the treatment plant site also occurs on the basin site which will contain the rapid infiltration and winter storage basins.

Collection System Piping - The collection system piping will be constructed primarily within the roadways of the built-up areas in Freeland within the service area. Most adjacent lands are residential yards and paved parking areas. Laterals will connect the users to the collector pipes.

3.5.1.1 Threatened and Endangered Species

Most of the wastewater service area is built-up with residences and commercial facilities. Both the proposed treatment facility site and land application facility site are forested. The USFWS, NMFS, WDFW and WDNR have been contacted regarding threatened or endangered species, habitat or other important State natural resources in the vicinity of the project site. Bald eagles, threatened according to both the Federal and State governments, are seen in the Freeland area.

The project area is located within the Puget Sound/Strait of Georgia Evolutionarily Significant Unit or "ESU". An ESU is defined as "a distinctive group of Pacific salmon, steelhead, or sea-run cutthroat trout. The ESU includes all naturally spawned populations of chinook salmon from rivers and streams flowing into Puget Sound."

The present status of salmonids in the project area is:

Threatened – chinook, Puget Sound ESU
Candidate – coho, Puget Sound/Strait of Georgia ESU

As a candidate species, coho salmon are not afforded protection under the ESA. If a project may be ongoing for some period (perhaps a year or longer) it may be prudent to address coho in the event the candidate species could be reclassified as threatened.

The following listed species and species of concern may occur within the vicinity of the proposed project:

- There are 3 bald eagle (Haliaeetus leucocephalus) nesting territories located along the east side of Holmes Harbor with the closest nest approximately 1200 feet from the service area boundary. Nesting activities occur from January 1 through August 15.
- Wintering bald eagles also occur in the vicinity of the project. Wintering activities occur from October 31 through March 31.
- Bull trout (Salvelinus confluentus) may occur in the waters of Holmes Harbor and Admiralty Inlet.
- Foraging marbled murrelets (Brachyramphus marmoratus) may occur in Homes Harbor and Admiralty Inlet.

Federal Species of Concern

California Wolverine (*Gulo gulo luterus*)
Cascades frog (*Rana cascadae*)
Long-eared myotis (*Myotis evotis*)
Long-legged myotis (*Myotis volans*)
Northern goshawk (*Accipiter gentilis*)
Olive-sided flycatcher (*Contopus cooperi*)
Pacific fisher (*Martes pennanti pacifica*)
Pacific Townsend's big-eared bat (*Corynorhinus townsendii townsendii*)
Peregrine falcon (*Falco peregrinus*)
River lamprey (*Lampetra ayresi*)

Tailed frog (*Ascaphus truei*)

There are no known threatened or endangered animal species on the project sites. Bald eagles, which are considered threatened by both Washington State and the federal government, occasionally fly over the project sites and service area.

3.5.1.2 Island County Species of Concern

Table 1 lists plant and animal species Island County has designated or is likely to designate as "protected species" and "species of local importance" as addressed in the Island County Code (ICC) 17.02.110.C.1(h). The CAO defines "protected species" as "Species of flora and fauna listed by the federal government or the State of Washington as endangered, threatened, or sensitive which are present in Island County and those species of flora and fauna which, while not necessarily endangered or threatened, are unique in Island County and worthy of protection, designated as Habitats and Species of Local Importance.

TABLE 1. PROTECTED SPECIES AND SPECIES OF LOCAL IMPORTANCE AS DESIGNATED BY ISLAND COUNTY		
Protected Species	Common name	Classification
Fauna		
Eumetopias jubatus	Northern sea lion	Threatened
Haliaeetus leucocephalus	Bald eagle	Threatened
Falco peregrinus	Peregrine falcon	Endangered
Eschrichtius glaucus	Gray whale	Sensitive
Brachyramphus marmoratum	Marbeled murrelet	Threatened
Flora		
Agroseris elata	Tall agroseris	Sensitive
Aster curtus	White-top aster	Sensitive
Castilleja levisecta	Golden indian paintbrush	Endangered
Cicuta bulbifera	Bulb bearing water hemlock	Sensitive
Fritillaria camschatcensis	Black lily	Sensitive
Meconella oregana	White meconella	
Puccinella nutkaensis	Alaska alkaligrass	Sensitive
Species of Local Importance	Common name	Protected habitat
Fauna		
Ardea herodias	Great blue heron*	Nests
Gavia immer	Common loon	Nests
Pandion haliaetus	Osprey*	Nests
Dryocopus pileatus	Pileated woodpecker	Nests
Cygnus buccinator	Trumpeter swan	

*Designation is effective on the date the Board of Commissioners approves a habitat management plan.

3.5.1.3 Fish and Wildlife

Mammals which inhabit the project area include rabbits, squirrels, raccoons, deer and various small rodents. Most of the project area is well developed, and therefore current wildlife populations and migration may be limited by roads, fences, domestic pets and other projects of development. Natural wildlife populations may also be forced to compete for forage with domestic livestock in some areas.

The study area supports an abundance of bird species. Common perching species of birds within the study area include robin, crow, black-capped chickadee, winter wren, European starling, song sparrow, junco, red-winged blackbird, spine siskin, tree swallow, and red-breasted nuthatch. Upland game birds include ruffed grouse and California quail. Pileated and downey woodpeckers and northern flickers have been seen in the study area, as have several species of owls, hawks and other raptors. Great blue herons, Canada geese, mallards, and several other species of waterfowl inhibit the wetland areas within the project area, and various shorebirds may be found along the marine shorelines.

Critical habitat within the Puget Sound/Strait of Georgia ESU includes all marine, estuarine and river reaches accessible to listed chinook salmon in Puget Sound as well as adjacent riparian zones. Puget Sound Marine areas include South Sound, Hood Canal, and North Sound to the international boundary at the outer extent of the Strait of Georgia, Haro Strait and the Strait of Juan De Fuca to the west end of Freshwater Bay.

NMFS has prepared lists of species and life history stages that vary according to the types of EFH waters and substrates encountered (see Section 6.2). EFH waters include aquatic areas and their associated physical, chemical, and biological properties currently used by fish, and may include aquatic areas historically used by fish where appropriate. Substrate includes sediment, hard bottom, structures underlying the waters, and associated biological communities. Necessary means the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem and "spawning, breeding, feeding, or growth to maturity" covers a species' full life cycle.

Streams are designated as Fish and Wildlife Habitat Conservation Areas (FWHCA) by the Island County Critical Areas regulations. Island County Critical Areas Maps show a Type 4 stream running roughly south to north and approximately paralleling Myrtle Road. The stream currently discharges to Holmes Harbor through a small brackish wetland leading to a tidegate located on the shoreline.

Holmes Harbor provides habitat for priority fish including Chinook salmon, chum salmon, searun cutthroat trout and steelhead trout. Holmes Harbor also provides spawning areas for surf smelt, sandlance, rocksole and herring. The Island County Coastal Zone Atlas shows eelgrass off much of the shore of Holmes Harbor. Eelgrass provides habitat for numerous marine organisms including juvenile salmonids, various species of crab and nudibranchs. Hardshell intertidal clams are present along the shorelines and Dungeness crab are known to occur throughout the harbor.

3.5.2 Environmental Consequences

3.5.2.1 Plants and Animals

The wastewater treatment plant will occupy approximately three acres. The emergency storage basins will occupy approximately two acres in the initial phase and approximately eight acres for the buildout condition. Vegetation removed includes many of the species noted above. The treatment plant will be landscaped. The treatment plant complex will contain approximately one acre of impervious area.

The site containing the rapid infiltration basins and wintertime storage basins is primarily vegetated with species noted above. Phase 1 will require the removal of approximately 2 acres of vegetation. A total of 15 acres is necessary for the build-out configuration of infiltration and storage basins. Impervious surfaces will be minimal.

The collection system piping will be constructed primarily within the roadways of the built-up areas in Freeland within the service area. Most adjacent lands are residential yards and paved parking areas. Laterals will connect the users to the collector pipes. There will be no significant increase in impervious area from constructing the collection system piping.

The potential for the proposed project to impact threatened, endangered plant and animal species would be minimal. No construction is proposed through priority habitats. Implementation of projects that are identified in the Freeland Comprehensive Sewer Plan and Engineering Report would have a beneficial impact to animal habitat by improving water quality. Improvements identified in the documents address system capacity and reliability. Discharging the treated effluent by means of rapid infiltration basins removes the need for an outfall into Holmes Harbor and the consequent water quality degradation. Removing septic systems and drainfields will reduce the potential of groundwater contamination.

3.5.2.2 Fisheries and Aquatic Resources

No significant impact to fisheries or aquatic resources is expected from the facilities proposed in the Sewer Plan and Engineering Report. During construction, site clearing, earthwork, and other construction activities will create a potential for soil erosion and sedimentation into adjacent marine waters. Construction activities of collector pipes near the city park could occur within 200 feet of the shoreline; if so, a shoreline permit would be required.

Residential and commercial development occupy most of the service area; consequently much of the area is impervious due to buildings, parking lots, streets and driveways. With the increase in commercial and residential development permitted by installing sewers, impervious area will increase and the potential for stormwater runoff Holmes Harbor and aquatic and marine resources will correspondingly increase.

3.5.3 Mitigation

3.5.3.1 Plants and Animals

The treatment plant, storage basins, and land application sites will be surrounded by forest and landscaped with native trees, shrubs and grasses, so that are attractive and an asset to the community. A detailed plan for enhancements of both sites will be developed during the design phase.

3.5.3.2 Fisheries

An erosion and sedimentation control plan will be developed as part of the final design of all facility construction and will be incorporated into construction documentation to minimize impacts from erosion during construction. Construction would likely be performed during dry periods followed by immediate revegetation as appropriate. Structural erosion controls might include fabric filter fences, gravel berms, and other Best Management Practices (BMPs). Monitoring and maintenance of such control measures would be conducted throughout construction to ensure proper performance. In addition, all future development will have to meet current Island County Code regarding stormwater management. These measures will lessen the potential for impact to fish habitat.

3.6 Water Quality Issues

Washington State Department of Ecology's Water Quality Program is charged with protecting, preserving and enhancing Washington's surface and ground water quality,

preventing generation of pollutants and achieving a water quality stewardship ethic and an educated public. The Program focuses on wastewater discharge permits, nonpoint sources of pollution, water quality standards, and financial and technical assistance (Ecology 2002).

Ecology is responsible for issuing wastewater discharge permits under the State Water Pollution Control Act (Chapter 90.48). Under the act, Ecology operates a state waste discharge permit program for discharges to surface and ground water, sewerage systems, and storm drains. Ecology also has authority to carry out provisions of the federal Clean Water Act. Ecology issues both State Water Pollution Control Act and National Pollutant Discharge Elimination System permits.

3.6.1 Affected Environment

The main surface water in the study area is Puget Sound. Holmes Harbor defines the north end of Freeland, while Mutiny Bay is on its southwestern boundary. Per the Washington Administrative Code (WAC 173-201A), Holmes Harbor is defined as a Class A (excellent) marine water as part of Saratoga Passage. Mutiny Bay possesses a classification of Class AA (extraordinary) marine water as part of Admiralty Inlet. A small stream flows into Holmes Harbor near Freeland Park, and is classified as Class A because it flows into Class A waters.

According to the 2002 Puget Sound Update (Puget Sound Action Team, 2002), Holmes Harbor is a marine water where eutrophication (receiving excess nutrients that stimulate excessive plant growth) may be a concern. It is characterized by "strong and persistent" stratification, low dissolved oxygen levels, and an overall "high" sensitivity to eutrophication. In summer, algae can bloom in areas of the harbor fed by nutrients. The sources of nutrients into the harbor are not clearly known. They could include natural processes, failing septic tanks, and excessive fertilizer application.

3.6.2 Environmental Consequences

Wastewater, treated to Class A standards, will be discharged into the ground through rapid infiltration basins. The rapid infiltration basins will occupy approximately 2 acres at the beginning of the project and 15 acres at buildout. The estimated acreage includes winter time storage basins, occupying approximately two acres at ultimate buildout, that will be constructed on the site.

The Water Reclamation and Reuse Standards (WDOE and WDOH September 1997) require that wastewater that is discharged into a drinking water aquifer must be treated to Class A standards through secondary and advanced treatment and undergo nitrogen removal. Region 10 of EPA designated the Freeland aquifer as a "sole-source aquifer" in 1982.

None of the construction involved with the treatment plant and emergency storage basins, rapid infiltration and winter time storage basins nor the conveyance pipeline will be constructed within 200 feet of Holmes Harbor or Mutiny Bay. The conveyance pipeline will be constructed within the roadway of Bush Point Road and Shore Meadow Road; this piping could occur within 200 feet of a number of small wetlands which occur adjacent to these roadways. In addition, constructing collection system pipelines in the low area adjacent to

Holmes Harbor and through the roadway over the unnamed stream at Freeland Park would occur within 200 feet of these waters.

Implementation of projects that are identified in the Sewer Plan and Engineering Report would improve water quality by eliminating onsite wastewater treatment facilities including septic systems and drainfields, which have the potential of degrading both ground and surface water quality. More dense development and accompanying impervious surfaces which would occur because of sewer installation could generate more stormwater, which has the potential for degrading surface water quality.

No construction activities are proposed within marine waters; however, construction activities could occur within 200 feet of the shoreline. During construction, on-land clearing, grubbing, grading and excavation to construct the various facilities could result in temporary erosion from disturbed soil and increased sedimentation. Overall, potential for erosion and sedimentation to enter marine waters from construction and operational activity on the existing site is expected to be minimal due to the lack of slope and low erosion potential for site soils.

3.6.3 Mitigation

During construction, straw bales, filter fabric and other temporary erosion control measures will be installed to control runoff and possible erosion. The disturbed areas will be revegetated with a native grass mix approved by Island County. Use of appropriate BMPs will reduce potential contamination of surface water runoff by construction equipment (e.g., hydraulic fluids, gasoline and oil). The contractor will be required to follow the guidelines in the Island County Stormwater Manual and adhere to the Island County Municipal Code.

As discussed in the Biological Resources section above, an erosion and sedimentation control plan will be developed as part of the final design of the proposed facility construction projects and will be incorporated into construction documentation to minimize impacts from erosion during construction. Construction would likely be performed during dry periods followed by immediate revegetation as appropriate. Structural erosion controls might include fabric filter fences, gravel berms, and other Best Management Practices (BMPs). Monitoring and maintenance of such control measures would be conducted throughout construction to ensure proper performance.

Revegetation of the site will prevent erosion and excessive runoff, thereby protecting water quality. Due to the proximity of the service area to marine waters, it is recommended that a pesticide management program be developed for maintenance of site vegetation.

As addressed previously, all new construction will have to adhere to Island County Code and the stormwater management provisions will be strongly enforced. This will lessen the potential for surface water degradation.

3.7 Coastal Resources

3.7.1 Affected Environment

Island County is a coastal zone county. The Coastal Zone Management Act requires that all federal activities be consistent with approved state coastal zone management programs to the maximum extent possible. This project is located in a coastal zone county and appears to be consistent with Washington's Coastal Zone Management Program and enforceable policies (State Environmental Policy Act, Water Quality, Air Quality and the Shoreline Master Program).

3.7.2 Environmental Consequences

No significant impacts to coastal resources are expected from the proposed projects recommended in the Sewer Plan and Engineering Report.

During construction, site clearing, earthwork, and other construction activities will create a potential for soil erosion and sedimentation into adjacent marine waters. Because construction activities could occur within 200 feet of the shoreline, a shoreline permit would be required. Island County will be required to submit a Coastal Zone Certification of Consistency to the Department of Ecology for approval once the appropriate permits and approvals have been obtained.

Implementation of projects that are identified in the Sewer Plan and Engineering Report would improve water quality by removing, over time, onsite treatment facilities and their potential for degrading both ground and surface waters and eliminating the need for an outfall in Holmes Harbor.

The Washington Coastal Zone Management Program is administered by the Department of Ecology (Ecology). A request was made to the Ecology's Coastal Zone Management division requesting review of the proposed project and identification of significant coastal resources that may occur in the project area (see letter in Section 6.1).

3.7.3 Mitigation

As discussed in the Biological Resources section above, an erosion and sedimentation control plan will be developed as part of the final design of the proposed facilities and will be incorporated into construction documentation to minimize impacts from erosion during construction. Construction would likely be performed during dry periods followed by immediate revegetation as appropriate. Structural erosion controls might include fabric filter fences, gravel berms, and other Best Management Practices (BMPs). Monitoring and maintenance of such control measures would be conducted throughout construction to ensure proper performance.

Consistency with CZM requirements would be enforced through the County's Shoreline Master Program.

3.8 Socio-Economic/Environmental Justice Issues

3.8.1 Affected Environment

Environment Justice communities include low-income and minority populations. Federal agencies are required to identify and address disproportionately high and adverse human health or environmental effects of proposed actions on minority and low-income populations. This requires identifying minority and low-income populations currently living in the project area, as well as identifying cultural, social, occupational, historical, and economic characteristics of these populations that may cause the proposed action to have a disproportionately high and adverse effect on them.

Demographic information for the Freeland area was found in the Census 2000 information on the government website (www.census.gov). Table 2 summarizes 2000 U.S. Census data on ethnicity and race for the Freeland area. Racial minorities make up 5.6 percent of the population of 1313 individuals. American Indian and Alaska Native populations make up one percent of the population. Ethnic information on Hispanic/Latino populations, which overlay several racial groups, indicates that Hispanic/Latino residents make up 2.7 percent of the population.

TABLE 2.
2000 U.S. CENSUS POPULATION DATA FOR FREELAND CENSUS DEMOGRAPHIC PROFILE (CDP)

Total	
Population of one race	1275
White alone	1239
Black or African American alone	6
American Indian and Alaska Native alone	13
Asian alone	11
Native Hawaiian Other Pacific Islander alone	1
Other race alone	5
Population of two or more races	38

Lacking location data, it is not possible to determine whether any groups of identified tribes may be geographically concentrated. However, the available data do not suggest the presence of such groups.

Economic information from the 2000 U.S. Census for the Freeland CDP indicates a median annual household income of $ 38,409.

3.8.2 Environmental Consequences

Population would not be immediately affected, as there would be no housing or business displacement. All households in the service area, including low-income households, would pay sewer charges to cover facility costs. As discussed in the Financial Issues section of Chapter 9 of the Sewer Plan and Engineering Report, potential rates and implementation costs could be as follows:

Customer rates required to fund the annual O&M costs are estimated to be between $17 and $29 per equivalent residential unit (ERU) per month. To fund the capital improvements, the implementation will likely include a combination of funds from rates, connection fees and/or assessments to finance the operating and capital costs. A detailed analysis of the annual revenue requirement should be conducted to determine the level of funding required from user rates on an annual basis, based on anticipated customer growth, sources of funds and projected expenses. Options for funding the capital improvements include the following:

- To fund improvements through an LID, an estimated lump sum assessment of between $6,300 and $68,000 per acre would be required, depending on the phase of construction and estimated service area boundary.
- The estimated growth-related connection fee for Freeland is approximately $8,400 per ERU to fund Phases 1 through 4 over the life of the improvements. The estimated fee to fund all identified improvements (Phases 1 through 5) over the life of the improvements would be $6,300 per ERU.
- For the marginal cost or phased approach, the fees range from $3,100 to $25,500 per ERU depending on the planning period, but funds would likely be available as the costs are incurred.
- Monthly sewer rates could be used to pay for a portion of the capital improvements, but they would not be able to pay for all of the facilities. If the project is successful in obtaining significant grants, such as the maximum amount of 75 percent grant funding available from the U.S. Department of Agriculture Rural Development program, and if the remaining capital costs are financed through low-interest loans, then the additional monthly rates for capital costs would average $10 to $33 per ERU.

The portion of low-income households that live within the service area is not known, due to lack of available information.

Subsistence and commercial shellfishing could benefit from the water quality improvements to Mutiny Bay and Holmes Harbor. The project would help to meet the longer-term goals for restoration of water quality in Holmes Harbor.

3.8.3 Mitigation

The cost of providing the proposed facilities will be minimized by obtaining grants and low-interest loans from various sources. A final funding plan has not been determined. However, projections for service fees indicate that charges would be in the range typical of local urban areas.

3.9 Miscellaneous Issues

3.9.1 Air Quality

The Northwest Air Pollution Authority (NWAPA) is the regional agency responsible for enforcing air quality laws in Island, Skagit and Whatcom counties. It is one of seven local air pollution authorities in Washington State.

NWAPA regulates over 400 sources of air pollution ranging from large refineries, hospitals, dry cleaners, gas stations and auto body shops, to home fireplaces and wood stoves. The agency's primary source of funding is through operating permit and registration fees collected from industrial sources.

Similar agencies typically are concerned about odor generation from wastewater treatment facilities. In this case, the NWAPA has indicated that permits are not required for wastewater treatment plants on the basis of occasional sewage odors.

3.9.1.1 Affected Environment

The treatment facility and land application areas are located approximately 0.8 and 2.25 miles respectively from Payless Shopping Center which contains the highest concentration of pedestrians during the daytime in Freeland. No air quality monitoring stations are located near the proposed project site.

3.9.1.2 Environmental Consequences

In the review of alternatives, locating the treatment facility and land application site at their present locations was considered a good option due to their location away from the City's business district, lessening the risk of problems with odors.

The proposed action is not expected to result in significant air quality impacts. If odors do occur, there is a potential for nearby residents to be affected.

Some short-term exhaust and particulate emissions would be generated by construction equipment and construction activities. Vehicles entering and leaving construction sites would generate dust. Any restorative paving operations using asphalt would result in short-term odors.

3.9.1.3 Mitigation

Odor control will be provided for the treatment plant. Because the rapid infiltration and winter storage basins contain treated wastewater, odors are not likely to emanate from the land application site.

3.9.2 Transportation

3.9.2.1 Affected Environment

Highway 525 and Bush Point Road serve the treatment plant. Shore Meadow Road serves the land application site.

3.9.2.2 Environmental Consequences

Construction traffic would increase on each of the roads mentioned above. Temporary traffic disruption could occur. In addition, some impact could be experienced during the construction of the collection system piping which will occur primarily in the urban roadways. However, no significant traffic impact on local properties is anticipated.

3.9.2.3 Mitigation

Traffic safety and access would be provided to mitigate potential adverse impacts resulting from construction traffic.

3.9.3 Noise

3.9.3.1 Affected Environment

No specific noise data exist for the project area. Noise levels are not generally high at the project site. Vehicular traffic on Highway 525 contributes to ambient noise levels. Because of distance, it is unlikely that nose from the treatment plant would be noticeable from the central commercial core.

3.9.3.2 Environmental Consequences

No significant noise impacts would result from the proposed action. Although noise levels from the treatment plant might be noticeable to nearby residences, sound-proofing noisy equipment, distance and adjacent forested area will significantly lessen disturbance.

A temporary increase in noise levels would result from construction activities and truck traffic. Construction noise is regulated under an Island County Noise Ordinance.

3.9.3.3 Mitigation

Noise pollution will be controlled by soundproofing noisy equipment and adherence to the County's noise ordinance.

4.0 SUMMARY OF MITIGATION

Table 3 summarizes proposed mitigation and implementing criteria for each of the resource areas analyzed in this report.

TABLE 3
SUMMARY OF MITIGATION

Resource	Recommended Mitigation	Implementing Criteria
Land Use/Important Farmland/ Formally Classified Lands	Design of the treatment plant and emergency storage basins and the rapid infiltration and winter time storage basins should take into consideration the soil limitations of the sites.	Island County Code
Floodplains	No mitigation is recommended.	FEMA
Wetlands	No mitigation is recommended.	WDFW, Corps of Engineers and Island County Critical Areas Ordinance
Cultural Resources	SHPO recommends a professional archaeological survey of the identified area of potential effect. This survey has been undertaken. In addition, all work will be halted and the County and Tribe shall be notified if archaeological remains or artifacts are uncovered.	SHPO, Tribal Historic Preservation Officer, Section 106 regulations, 36 CFR Part 800
Biological Resources	An erosion and sedimentation control plan that implements BMPs would be developed to minimize impacts from erosion during construction. Implementation of the stormwater management regulations in the Island County Code will reduce the impact of additional impervious service due to more dense construction.	Island County Code

TABLE 3, CON'T.
SUMMARY OF MITIGATION

Resource	Resource	Resource
Water Quality Issues	An erosion and sedimentation control plan that implements BMPs would be developed to minimize impacts from erosion during construction. Monitoring and maintenance of such control measures would be conducted throughout construction to ensure proper performance. Revegetation of the site will prevent erosion and excessive runoff, thereby protecting water quality. A pesticide management program should be developed for maintenance of site vegetation, due to the proximity of the site to marine waters. See Biological Resources.	Ecology's Water Quality Management Program has authority to carry out provisions of the federal Clean Water Act. Ecology issues both State Water Pollution Control Act and National Pollutant Discharge Elimination System permits. Island County Code
Coastal Resources	An erosion and sedimentation control plan that implements BMPs would be developed to minimize impacts from erosion during construction. Construction would likely be performed during dry periods followed by immediate revegetation as appropriate. Monitoring and maintenance of such control measures would be conducted throughout construction to ensure proper performance. A Shoreline Substantial Development Permit and adherence to BMPS and other conditions contained in the permit would be necessary if construction occurs within 200 feet of the shoreline.	Ecology's Coastal Zone Management Program, State Environmental Policy Act, State and Island County Shoreline Master Program
Socio-Economic/ Environmental Justice Issues	The cost of providing the proposed facilities will be minimized by obtaining grants and low-interest loans from various sources.	Island County
Transportation	Traffic safety and access would be provided to mitigate potential adverse impacts resulting from construction traffic.	Island County Code
Noise	Noise pollution will be controlled by soundproofing noisy equipment and adherence to the County's noise ordinance.	Island County Noise Ordinance

5.0 CORRESPONDENCE

The following agencies were contacted to request information and solicit comments on the Freeland Comprehensive Sewer Plan and Engineering Report, summaries sent to these agencies are provided in Section 6 of this report. This includes records from follow-up telephone conversations and responses received from these agencies.

Federal Agencies

Federal Emergency Management Agency
Attn: John Pennington, Regional Director
Federal Regional Center
130 228th Street, SW
Bothell, WA 98021-9796

Natural Resource Conservation Service
Attn: Steve Nissley
2021 East College Way Suite 214
Mt. Vernon, WA 98273

United States Department of Commerce
Attn: Tom Sibley
National Oceanic and Atmospheric Administration
National Marine Fisheries
7600 Sandpoint Way NE
Seattle, WA 98115

Ken Berg
U.S. Fish and Wildlife
Olympia Field Office
North Pacific Coast Ecoregion
510 Desmond Drive SE, Suite 102
Lacey, WA 98503-1292

State Agencies

Office of Archaeology and Historic Preservation
Attn: Rob Whitlam, Ph.D., State Archaeologist
1063 South Capitol Way, Suite 106
P.O. Box 48343
Olympia, WA 98504-8343
(360) 586-3080

Washington Department of Fish and Wildlife
Attn: Doug Thompson
P.O. Box 1100
La Conner, WA 98257

Washington Department of Ecology
Attn: Linda Rankin
CZM/Shorelines Management
PO Box 47600
Olympia, WA 98504-7600
(360) 407-6527

Washington Department of Natural Resources
Natural Heritage Program
Attn: Sandy Swope Moody
P.O. Box 47014
Olympia, WA 98504-7014
(360) 902-1667

Tribes

The Honorable Herman A. Williams, Jr. Chairman
The Tulalip Tribes
6700 Totem Beach Road
Marysville, WA 98271
Attention: Mr. Hank Gobin, Cultural Resources Manager

The Honorable Brian Cladoosby
The Swinomish Tribal Community
P.O. Box 817
La Conner, WA 98257
Attention: Linda Day, Cultural Resources Manager

6.0 EXHIBITS

6.1 Letters to Agencies and Responses

Exhibit 6.1 includes the letters that were sent to agencies. Responses have not been received at this time.

6.2 Essential Fish Habitat – Species and Life History

Exhibit 6.2 is the National Marine Fisheries Service list of species and life history stages associated with Essential Fish Habitat waters and substrates encountered in the waters of Puget Sound.

TETRA TECH/KCM
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Seattle, Washington 98101-1027
(206) 443-5300 FAX (206) 443-5372

January 21, 2004

«Title» «First_Name» «Middle_Initial»«Last_Name»
«Job_Title»
«AgencyCompany»
«Address_1»
«Address_2»
«City_State_Zip»

Subject: Freeland Comprehensive Sewer Plan and Engineering Report – Environmental Report

Dear «Title» «Last_Name»:

Island County is preparing a Comprehensive Sewer Plan and Engineering Report for the unincorporated area of Freeland on Whidbey Island. Freeland is located approximately ten miles west of the Clinton ferry terminal. Whidbey Island is approximately 30 miles north of Seattle. The two figures attached show the Freeland service area (NMUGA) and an aerial view of the proposed project.

As part of its 1998 county-wide Comprehensive Plan, Island County (County) desired to preserve the rural character of Whidbey Island while meeting its Growth Management Act (GMA) obligations. As part of the Plan, the County designated areas where growth would be concentrated and limited growth in the remainder of the County, thus protecting the island from unchecked urban sprawl. Currently, Freeland is designated as an area where limited growth can occur. The Western Washington Growth Management Hearings Board declared that Freeland appeared more like an Urban Growth Area and ordered Island County to study the possibility of designating it as such. In response to that order, in the Comprehensive Plan, Island County classified Freeland as a Residential Area of More Intensive Development (RAID), with potential designation as a Non-Municipal Urban Growth Area (NMUGA).

Currently, almost all of Freeland's population is served by septic systems. The Freeland Comprehensive Sewer Plan and Engineering Report is intended to assist Freeland in planning for sewage capacity to match the County's population growth estimates. Planning for collection, treatment, and discharge and/or reuse facilities will allow sewage capacity to match population growth in a cost-effective manner and to minimize potential harm to the surrounding environment.

After evaluating many alternatives for wastewater treatment, conveyance, and disposal or reuse, the preferred alternative includes constructing a treatment plant and emergency storage basins at approximately the corner of Highway 525 and Bush Point Road. From the treatment plant, effluent will be conveyed by a 10-inch pipeline approximately 2 miles along Bush Point Road and Mutiny Bay Road to a tree farm adjacent to Mutiny Bay Road.

Here it will be land applied and reused by means of rapid infiltration within specially designed basins. Wintertime storage basins will also be constructed at the land application site. In addition, raw sewage collection system pipelines will be constructed within the roads of the commercial and residential areas. Septic Tank Effluent Pumping (STEP) tanks and pumps will be installed at each user site along with side sewers, or laterals, to convey the wastewater from the individual businesses and residents to the collection system.

Wastewater Treatment Facility and Emergency Storage Basins – The wastewater treatment facility and emergency storage basins will be located in a forested area at the corner of Bush Point Road and Highway 525. The area has probably been logged several times and is vegetated with Douglas fir, red alder, and bigleaf maple. Among shrubs, slal, blackberry, red elderberry and snowberry are scattered throughout the site. Herbaceous vegetation includes a variety of grasses, sword, deer and licorice ferns, trillium, and a number of other plants.

The wastewater treatment plant will occupy approximately three acres. The emergency storage basins will occupy approximately two acres in the initial phase and approximately eight acres for the buildout condition. Vegetation removed includes many of the species noted above. The treatment plant will be landscaped. The treatment plant complex will contain approximately one acre of impervious area.

Conveyance Pipeline – The conveyance pipeline will be constructed within the road beds of Bush Point and Mutiny Bay Roads. Vegetation similar to that noted above occurs along the sides of the road shoulder where residential property has not been cleared.

Land Application Facility and Wintertime Storage Basins – The rapid infiltration basins and winter storage basins will be located in and near a gravel pit on the 780 acre tree farm. Again, much of the vegetation noted above on the treatment plant site also occurs on the basin site which will contain the rapid infiltration and winter storage basins.

The site containing the rapid infiltration basins and wintertime storage basins is primarily vegetated with species noted above. Phase 1 will require the removal of approximately 2 acres of vegetation. A total of 15 acres is necessary for the buildout configuration of infiltration and storage basins. Impervious surfaces will be minimal.

Collection System Piping – The collection system piping will be constructed primarily within the roadways of the built-up areas in Freeland within the service area. Most adjacent lands are commercial properties, residential yards, and paved parking areas. Laterals will connect the users to the collector pipes.

Implementation of projects that are identified in the Freeland Comprehensive Sewer Plan and Engineering Report would have a beneficial impact to fish habitat by improving water quality. Improvements identified in the documents address system capacity and reliability. Discharging the treated effluent by means of rapid infiltration basins removes the need for an outfall into Holmes Harbor and the consequent water quality degradation. Removing septic systems and drainfields will reduce the potential of groundwater or surface water contamination.

No significant direct impact to fisheries or aquatic resources is expected from the facilities proposed in the Sewer Plan and Engineering Report. During construction, site clearing, earthwork, and other construction activities will create a potential for soil erosion and sedimentation into adjacent marine waters. Rigorous implementation of best management practices and the Island County Code will reduce the potential for this habitat degradation.

Residential and commercial developments occupy most of the service area; consequently much of the area is impervious due to buildings, parking lots, streets, and driveways. With the increase in commercial and residential development permitted by installing sewers, indirect impacts could occur with some increase in impervious area and the potential for stormwater runoff impacting Holmes Harbor and aquatic and marine resources will correspondingly increase.

The Washington Department of Ecology (WDOE) requires an environmental review of sewer plans and engineering reports according to the United States Department of Agriculture Rural Development protocol for an Environmental Report. Part of the protocol is obtaining comments from the regulatory agencies on items of concern regarding the Freeland Comprehensive Sewer Plan and Engineering Report and the recommended activities which are summarized in this letter.

Island County requests that you review our proposal and target your comments toward those items of concern to your office including direct, indirect and cumulative impacts of our proposal. A response within 30 days of the date of this letter would enable your comments to be incorporated into the final Environmental Report. Please call me at (206)443-2663 if you have any questions or would like to discuss the project.

Sincerely,

Tetra Tech/KCM, Inc.

Render Denson
Environmental Services Manager

RD:ks

Attachments

c: Gary Hess, P.E.
Island County Department of Public Works

2230018-008

Title	First Name	Middle Init	Last Name	Job Title
Mr.	John		Pennington	Regional Director
Mr.	Steve		Nissley	
Mr.	Tom		Sibley	
Mr.	Ken		Berg	
Mr.	Calvin		Torado	
Ms.	Linda		Rankin	CZM/Shorelines Management
Mr.	Doug		Thompson	
Ms.	Sandy		Swope Moody	Natural Heritage Program
Dr.	Rob		Whitlam	State Archaeologist
	The Honorable Herman	A.	Williams, Jr.	Chairman
	The Honorable Brian		Cladoosby	ATTN: Linda Day, Cultural Resources Manager

Agency/Company	Address 1	Address 2	City, State, Zip
Federal Emergency Management Agency	Federal Regional Center	130 - 228th Street SW	Bothell, WA 98021-9796
Natural Resource Conservation Service	2021 East College Way	Suite 214	Mt. Vernon, WA 98273
United States Department of Commerce	NOAA - National Marine Fisheries	7600 Sandpoint Way NE	Seattle, WA 98115
U.S. Fish and Wildlife	Olympia Field Office - NPCE	510 Desmond Drive SE, Suite 102	Lacey, WA 98503-1292
Groundwater Office	Sole Source Aquifers	1200 - 6th Avenue	Seattle, WA 98101
Washington Department of Ecology	P.O. Box 47600		Olympia, WA 98504-7600
Washington Department of Fish and Wildlife	P.O. Box 1100		La Conner, WA 98257
Washington Department of Natural Resources	P.O. Box 47014		Olympia, WA 98504-7014
Office of Archaeology and Historic Preservation	1063 South Capitol Way, Suite 106	P.O. Box 48343	Olympia, WA 98504-8343
The Tulalip Tribes	6700 Totem Beach Road		Marysville, WA 98271
The Swinomish Tribal Community	P.O. Box 817		La Conner, WA 98257

APPENDIX F.
FREELAND BUILDABLE LANDS ANALYSIS
(POPULATION PROJECTIONS)

APPENDIX B

Buildable Lands Analysis

Revised 4-18-2002

Purpose:

The buildout estimate that follows attempts to answer 'What growth is possible given existing parcels, uses, and the potential for creation of new parcels under the *Freeland Sub-Area Plan* designations and densities'. This analysis focuses on the population potential for residential and mixed use land use designations that have been proposed in the Freeland Sub Area Plan but also contains buildout and population potentials for the existing land use designations which can be used as a frame of reference. These scenarios are defined as follows:

1. **Existing Land Use Designations - RAID:** Rural Area of Intensive Development (RAID). This scenario is based on the current zoning classifications adopted on September 29, 1998. The analysis includes a Residential, Mixed Use and Commercial component for estimating buildout.

2. **Proposed Land Use Designations - NMUGA:** Non-Municipal Urban Growth Area (NMUGA). This planning scenario would provide for greater densities and growth potential if Freeland is designated an NMUGA, and would incorporate infrastructure improvements that address area-wide storm water runoff, sewage disposal and potable water. The analysis includes a Residential, Mixed Use and Commercial component for estimating buildout.

Data Source Information:

The initial database was created using the Island County Assessors data, providing parcel numbers, land and structure value, and size of the parcel. This information along with ground truthing resulted in the ***Freeland Sub-Area Planning Phase 1-Exsting Conditions Report.*** This document identifies attributes of the Natural and Built Environment. Existing communities and neighborhoods were evaluated and reports were documented identifying the number of parcels, residents, and the current percentage of build-out. The communities were also evaluated by identifying critical area locations. In March of 2000 a private consultant R.W. Beck created the 'Existing Infrastructure Report'. The report evaluated the existing water, sewer and storm drainage requirements for the Freeland sub-area. The current draft ***Freeland Sub-Area Plan***, is a collection of all the previous reports as well as a more comprehensive analysis of future projections in implementing the NMUGA planning scenario. Information gathered for the Buildable Lands Analysis represents field evaluations of all the affected parcels in the NMUGA designation.

Data Sources:

1. **Assessors Data:** The assessors office assigns a 13 digit number to each parcel in Island County to link important information such as: size of the parcel, owners of the parcels, current land-use of the parcel, assessed value and current rate of taxation of the property and any structures located on the parcel.

2. **GIS:** Identify Critical Areas including: wetlands identified by the National Wetlands Inventory (NWI), prepared by the United States Fish & Wildlife Service (USFW), 'floodplains' identified by the Federal Emergency Management Agency (FEMA), Marine FHWCA's identified by the Washington Department of Ecology (WDOE), geologically hazardous areas identified by Coastal Zone atlas 1974, and the Freeland Parcel Layer digitized by the Island County Assessors office and exported into the GIS.

3. **Planning and Zoning:** The Island County Comprehensive Plan regarding future urban growth projections.

4. **Island County Comprehensive Plan, Exhibit A:** Findings of Fact and Legislative intent. Population projections for Urban Growth Areas and RAIDs including Freeland and Clinton.

Table 1. Example of Data Gathered

Key	Parcel Number	Current Zoning	Sub Area	Convert or Divide	Acres
678190	S8245-00-00001-4	R	LD	Y	3.755
279415	S7165-08-0000A-1	RR	HD	G	0.369
279424	S7165-08-0000A-2	RR	HD	G	3.844
279460	S7165-08-0000B-4	RR	HD	G	4.733
279479	S7165-08-0000B-5	RR	HD	G	0.368

<u>Definitions:</u>

Key = The Key is the unique identifier in the Island County Assessor's Database.

Parcel Number = A thirteen- (13) digit number assigned by the Island County Assessor's office.

Sub Area = A defined area that identifies the geographic extent of Freeland for the purpose of establishing a non-municipal urban growth and land use designations within.

Residential Classifications:

LD: Low Density consisting of parcels intended for single-family residents and duplexes at a density of less than three (3) dwelling units per acre.

MD: Medium Density consisting of parcels intended for single-family dwellings at a density of three (3) to six (6) dwelling units per acre, including single-family homes, duplexes, triplexes, and fourplexes.

HD: High Density consisting of parcels dedicated to the development of multifamily dwellings. Provides an area of higher density housing while ensuring full access to services. Parcel densities are six (6) to ten (10) dwelling units per acre.

MU: Mixed Use densities were calculated for five (5) to eight- (8) dwelling unites per acre. Designation allows for a variety of residential, commercial, and light-manufacturing uses defined more specifically within three categories:

Mixed Use Transitional: Serves as a transitional area between one land use designation and another

Mixed Use Residential: Areas were the character of the neighborhood is primarily residential, but where specified low impact non-residential uses are encouraged

Mixed Use Commercial: Commercial pedestrian friendly areas, where residential and non-residential uses within a project compliment each other. These areas typically provide for higher density housing opportunities with an integrated non-residential component.

RE: Rural Estate preservation of existing and future single-family developments at a density of 1 dwelling unit per acre.

Commercial Sub-Area Classifications:

BG: Business General consisting of parcels intended for lands in and around the Freeland "Central Business District" on which general commercial development exists. Incorporates a broad range of commercial and retail service uses.

BO: Business Office consisting of parcels designated for business and professional uses with little or no retail sales

BV: Business Village consisting of parcels providing for retails sales of convenience goods as well as personal and business services needed to support people residing in rural areas.

I: Industrial A business use or activity at a scale greater than home industry involving manufacturing, fabrication, assembly, warehousing and/or storage.

P: Public consisting of parcels that are in public ownership such as parks and public utilities.

Convert: The buildout potential is based on a few assumptions regarding the effect of the change in zoning classification due to the transition to the NMUGA planning scenario. Also see **Develop:** Development of vacant or underutilized parcels of land in otherwise built-up areas.

Y: Indicates a "Yes", meaning the parcel is anticipated to convert to the new designated use.

N: Indicates a "No", meaning the parcels is not anticipated to convert to the new designated use or the use is not predicted to change.

G: Refers to the Holmes Harbor Golf course.

Acres: Gross acreage of parcel, and converted acreage dependent on existence of critical areas or infrastructure.

NMUGA: Non Municipal Urban Growth Area (NMUGA),

RAID: Rural Area of Intensive Development (RAID),

Current Zoning: Island County Zoning ordinance adopted September 28 1998.

Zoning Classifications:

Rural: The Rural zone is the principal classification for Island County. Densities are restricted to (1) dwelling unit per five (5) acres.

Rural Residential: The Rural Residential Zone purpose is to define the logical outer boundary of development of densities of more intensity than the **Rural Zone.** In Freeland the Rural Residential Zone allows a density of 3 dwelling units per acre.

Rural Center: The Rural Center Zone is applied to Existing areas of intense Non-Residential and Mixed-Use development and encompasses the Logical Outer Boundary of the Existing pattern of development. Densities range from three (3) dwelling units per acre to (14) dwelling units per acre.

Dwelling Unit: Any building or portion thereof which contains living facilities for not more than one family. Living facilities include provisions for sleeping, cooking and sanitation, as required by Island County.

Density: A measure of intensity of development, generally expressed in terms of dwelling unites per acre. It can also be expressed in terms of population density.

Growth Management: A method to guide development in order to minimize adverse environmental and fiscal impacts and maximize the health, safety and welfare benefits to the residents of the community.

Land Use: A term used to indicate the utilization of any piece of land.

Parcel: A unit of land with legally defined boundaries

Population Projections: Exhibit A 'Finding of Facts and Legislative Intent'. Information is in the section titled 'Areas of more Intensive Rural Development', Countywide projections are provided by the Office of Financial Management. The County determines regional and sub-area projections.

Zoning: A police power measure, enacted by local government, in which the community is divided into districts or zones within which permitted and special uses are established as are regulations governing lot size, building bulk, placement, and other development standards. The Zoning Ordinance consists of two parts, the text and the map.

Carrying Capacity: The maximum number current and potential dwelling units factoring in the presence of critical areas and other regulated restrictions.

Field Verification: Ground truthing and analysis was done on 12-13-01, 12-14-01, 12-18-01, and 01-??-02. Parcels were identified in the field to verify and document the following: New construction Vacant Parcels, Parcels structural value greater than

$25,000, Parcel lines, Condition of structures relative to the willingness to redevelop, documentation of underdeveloped parcels, and documentation of the existing uses. Parcels that were found to be developed with a perceived structural value greater than $25,000 that were not documented in our database were assigned a generic structural value of $99,999. Information and updates were imported into the counties GIS project for the Freeland Buildable Lands Analysis.

Critical areas ground truthing was done on 01-03-02, mapped wetlands and hydrology were verified for areas with-in the NMUGA boundaries.

Persons per Household: The number of people per household was calculated for the Freeland sub-area based on 2000 Census block data. Twenty-six census blocks were identified that were located completely with-in the NMUGA boundaries. Information that was obtained from the individual Census Blocks included the following information: block number, tract number, total population, total number of households, number of occupied households, and the number of vacant household. For the purposes of the Freeland buildable lands analysis the number of occupied households was divided by the total population which resulted in an average of 2.34 people per household.

Critical Areas:

Wetlands: The wetland information was obtained from the United States Department of Fish and Wildlife Services (USF&WS) National Wetland Inventory (NWI) Database. In 1986, A private consultant Pentec used the NWI data as a baseline from which they added other delineated wetland information to mylar maps of Island County. The mylar maps were then digitized and imported into our current GIS system projected in a stateplane south coordinate system.

Geological Hazardous Area: The Geologic Hazardous area data was derived from the 1979 Coastal Zone Atlas. The areas were digitized by Island County Staff in 1998. The following codes were assigned to the Island County Slopes: **U:** Unstable, **URS:** Unstable Recent Slide, **UOS:** Unstable, old Slide.

Streams: The Streams coverage comes from Washington State Department of Natural Resources (DNR). The Coverage identifies water types numbered from 1-9. With-in the Freeland NMUGA boundary only water types 4,5,9 exist.

Water Types:

4: Pursuant to Island County Code table17.02.110.C, type 4 streams have a channel width of two (2) feet or wider at the Ordinary High Water Mark

(OHWM). Type 4 streams are all natural waters not classified as type 1,2,or 3 and for the purpose of protecting downstream waters.

5: Pursuant to Island County Code table17.02.110.C, type 5 streams have a channel width less than two (2) feet at the Ordinary High Water Mark (OHWM). Type 5 streams are all natural waters not classified as type 1, 2,3,or 4 or seepage areas, ponds and drainage ways having short run-off periods.

9: Type 9 streams are water-types that are undefined by the Island County Critical Areas Ordinance.

Critical Area Analysis:

Available Acres: Each parcel was assessed a 15% reduction in the total gross acreage to accommodate building setbacks, infrastructure easements etc. The 15% reduction was assessed after the critical areas were subtracted from the gross acreage using the following formula:

X= Gross Acreage Y= Critical area Acreage

(X-Y-((X-Y)*0.15)) = Available Acreage

Wetlands: A 100-foot buffer was applied to all of the known wetlands documented on the Island County GIS. The GIS system was used to 'Clip' the known wetland and buffer locations to the Freeland Sub-Area NMUGA boundary. The next step was to use the 'Intersect' command to apply each individual parcel boundary to the known wetlands and buffers. Once all of the boundaries were identified in the GIS the total acreage of known wetlands and buffers for each parcel could be extracted from the GIS database.

Each parcel was assessed a 15% reduction in the total gross acreage to accommodate building setbacks, infrastructure easements etc. All of the parcels with-in the NMUGA were then re-evaluated applying the wetland buffers and the parcel improvement restrictions to come up with an individual parcels report on available build-out acreage.

Geologic Hazardous Areas: A 100-foot buffer was applied to all of the known Geologic Hazardous areas within Island County. The Geologic Hazardous Areas and buffer theme was then 'Clipped' to the Freeland Sub-Area NMUGA boundary. The next step was to use the 'Intersect' command to apply each individual parcel boundary to the known Geologic Hazardous Areas and associated buffer. Once all of the boundaries were identified in the GIS we were able to extract the total acreage of known Geologic Hazardous Areas and buffer on each parcel.

Each parcel was assessed a 15% reduction in the total gross acreage to accommodate building setbacks, infrastructure easements etc. All of the parcels with-in the NMUGA were then re-evaluated applying the Geologic Hazardous buffers and the parcel improvement restrictions to come up with an individual parcels report on available build-out acreage.

Hydrology: The Island County Hydrology theme was 'Clipped' to the Freeland Sub-area NMUGA boundary. All known Hydrology within the NMUGA boundary was identified. The GIS theme showed that only water types 4-9 existed within the Freeland NMUGA. Pursuant to the Island County Critical Areas Ordinance 17.02.030 water types 4-9 require a 50-foot Buffer. A 50-foot buffer was applied to the Freeland hydrology layer; the theme was again clipped to the NMUGA boundary so none of the applied buffer outside the NMUGA boundary would be calculated into the analysis. The next step was to use the 'Intersect' command to apply each individual parcel boundary to the known Hydrology and associated buffer. Once all of the boundaries were identified in the GIS we were able to extract the total acreage of known Hydrology and buffer on each parcel.

Each parcel was assessed a 15% reduction in the total gross acreage to accommodate building setbacks, infrastructure easements etc. All of the parcels with-in the NMUGA were then re-evaluated applying the hydrology and buffers and the parcel improvement restrictions to come up with an individual parcels report on available build-out acreage.

Critical Areas Merged: For the purpose of establishing a accurate assessment of the total Freeland NMUGA acreage affected by Critical Areas, we needed to merge all of the Critical Area themes into one. By merging all of the themes into one we can identify any overlapping Critical Areas or buffer boundaries that may have otherwise been subtracted from the total available acreage more than one time.

The Wetland and Hydrology themes were first merged preserving the affected parcel numbers and the affected acreage. The goal of this process was to only account for overlapping critical area boundaries once. Example: A 2-acre parcel that was 50 % covered by a wetland and stream would only subtract the 1-acre from the total acreage once. The Geologic Hazardous areas were then merged to the Wetland/Hydrology theme resulting in a comprehensive Critical Areas theme. The Critical Areas Merged theme identified all Critical Areas and buffers within the Freeland

NMUGA and was used to calculate the Scenario 5 Buildable Lands Analysis

Analysis of Current Zoning:

The following analysis is a projection of Freeland buildout under the current Island County Zoning Ordinance adopted September 28, 1998. The sum of this analysis can be compared to the analysis of the proposed NMUGA to show the differences in population density due to the identification of Freeland as a Non Municipal Urban Growth Area (NMUGA). Currently the Freeland NMUGA boundaries are defined by five zoning designations.

Rural: 1 dwelling unit per 5 acres

Rural Residential: 3 dwelling units per acre

Rural Center: 3 to 14 dwelling units per acre

Public: Not designated for dwelling units, public space for public access

Rural Forest: 1 dwelling unit per 10 acres

Table: ( ) Current Zoning NMUGA Boundaries

Rural: ***1 dwelling Unit per 5 acres***

		Frequency	Acreage	Critical Acreage	Available Acreage
	Vacant:	*126*	*212.87*	*25.66*	*159.13*
Currently	Developed:	80	185.8	26.4	*135.49*
	Total:	**206**	**398.67**	**52.06**	**294.62**

Rural Residential: ***3 dwelling Units per acre***

	Vacant:	*431*	*219.18*	*56.55*	*138.24*
Currently	Developed:	376	163.32	17.37	*124.05*
	Total:	**807**	**382.5**	**73.92**	**262.29**

Rural Center: ***3-14 dwelling units per acre***

	Vacant:	*50*	62.9	*.9*	*52.7*
Currently	Developed:	77	102.87	7.28	*82.25*
	Total:	**127**	**165.77**	**8.18**	**134.95**

Public & Institution:

	NMUGA:	*24*	*87.6*	*19.6*	*N/A*
Currently	Developed:	8	19.91	7.55	*N/A*
	Total:	**32**	**107.51**	**27.15**	**N/A**

		Frequency	Acreage	Critical Acreage	Available Acreage
Rural Forest:		***1 dwelling Unit per 10 acres***			
	Vacant:	*1*	*6.21*	*0*	*5.28*
Currently	Developed:	0	0	0	*0.00*
	Total:	**1**	**6.21**	**0**	**5.28**
Freeland Totals					
Residential:		*1014*	*787.38*	*125.98*	*562.19*
Commercial:		127	165.77	8.18	134.95
Public/INS.		32	107.51	27.15	79.15
Totals:		**1173**	**1060.6**	**161.31**	**776.29**

Current Zoning Methodology:

This inventory was based on the most up to date information from with in the Freeland NMUGA following field verification completed in January 2002. The updates were compiled in the GIS layer and designated as Scenario 5. Parcels were initially evaluated by looking at the structural value field. Structural values greater than $25,000 were assumed to equal one dwelling unit and were given a value of 1 and were designated as '**Developed**'. Values less than $25,000 were assumed to be vacant and were not given a value, but were designated as '**Vacant**'.

The next step was to calculate the percentage of critical areas for each parcel. The critical area field was updated during the previous field verification and consisted of wetland, streams, and geologic hazardous areas. Each of the three critical area themes were merged together into one theme that reported the effected acreage for each parcel with out overlapping boundaries. This critical acreage was divided by parcel acreage to report the percentage of critical acreage for each parcel with in the NMUGA boundary. The percentage of critical area was used to determine the availability of acreage for future development. Each parcel in the NMUGA is entitled to "Reasonable Use." For parcels that are 90% or more covered in critical area, it was assumed that there was little development potential, therefore, regardless of the parcel size it was determined that only a single dwelling unit could be built on the site. Based on this conclusion, 1 dwelling unit has been allocated to these parcels. For parcels that are 75 to 90% effected by critical areas, 1/4 of the gross acreage will be calculated for development. Likewise, 1/2 of the gross acreage will be calculated for parcels that indicate 50 to 75% critical areas. Parcels in the 25 to 50% range will be assessed ¾ of the gross acreage for future development. Any parcel with less than 25% critical area will be calculated using the full acreage. The table (CC) below summarizes the formula that was used to calculate potential dwelling units.

Table (CC) Potential Dwelling Units with Critical Areas

% Critical Area	% of Developable Land
Less than 25%	**100%**
26% to 50%	**75%**
51% to 75%	**50%**
76% to 90%	**25%**
Greater than 90%	**1 dwelling Unit**

Developed parcels were evaluated to determine if additional dwelling units could be created on the property. The percentage of critical areas that encumbers each lot was used to determine the percentage of gross acreage that should be multiplied by the allowed density in order to determine the potential number of dwelling units. Where a range of densities may be allowed within a specific zoning designation the potential number of dwelling units is displayed as a low and high value.

Vacant parcels were first evaluated looking at the percentage of critical areas; the number of dwelling units was then calculated by applying the zoning density permitted under the existing land use designation to the amount of land that is not encumbered by critical areas using the above identified range of percentages. **Vacant** dwelling units were reported with a low and a high number depending on the range of zoning density.

Population was derived by multiplying the dwelling units by 2.34 to predict the potential infill during the 20-year period.

Rural:

Zoning in the rural zone pursuant to the Island County Zoning code chapter 17.02, is one (1) dwelling unit per five (5) acres. In the **Rural** zone there are 80 currently developed parcels on 185.8 acres with 26 acres of critical areas. Vacant lands make up 126 parcels on 212 acres with 25 acres of critical acres. 136 dwelling units could potentially be developed on the 126 vacant parcels. Currently there is a population of 177 people on parcels zoned rural with in the proposed NMUGA boundaries. At full build out 495 residents would occupy the rural zone.

Rural Residential:

Seven parcels in this zone are part of the Holmes Harbor golf course. The golf course will not be calculated as buildable land for the purposes of this analysis. Zoning density in the rural residential zone is 3 dwelling units per acre. Currently, there are 376 developed parcels on 163 acres with 17 acres of critical areas. The current population in the rural residential zone within the NMUGA boundary is 877 residents. At 3 dwelling units per acre, this zone could potentially handle an

additional 142 dwelling units that translates to an additional 332 residents on parcels currently developed. Vacant lands make up 219 acres on 431 parcels, with 56 acres of critical areas. At 3 dwelling units per acre 621 dwelling units could be created on the vacant parcels at full buildout. Assuming full buildout of the vacant land in this zone would translate to an additional 1453 people for a total population in the Rural Residential zone of 2662.

Rural Center:

The current zoning in the rural center district applies a range of densities with 3 dwelling units per acre being the low and 14 dwelling units per acre being the high. Consideration was given in this analysis to not apply any potential dwelling units to existing uses that are not likely to change within the next 20 years. Existing use was confirmed in field observations completed 12-??-2001, information was updated to the GIS database summarizing the existing use. Currently, there are 77 developed dwelling units on 102 acres with 7 acres of critical acres. At 3 (low) dwelling units per acre, 86 more dwelling units could potentially be created. At 14 (high) dwelling units per acre, an additional 501 dwelling units could potentially be created on parcels that are underdeveloped. Currently there are 50 vacant parcels on 62 acres with .9 acres of critical areas. The vacant parcels could potentially create 174 additional dwelling units at 3 (low) dwelling units per acre and 843 at 14 (high) dwelling units per acre.

Population estimates for underdeveloped parcels are purely based on the formula of the number of dwelling units per acre multiplied by 2.34. Critical areas were factored into this equation by applying a standard formula based on the ratio of critical areas to gross acreage. The ratio that is applied to all of the underdeveloped parcels is summarized in table (CC) under the heading Residential Methodology. The following figures are estimated potential populations based on formulas and are an attempt to ascertain the likely buildout potential. In the Rural center zone there currently are 36 developed dwelling units with a population of 84 at 3 (low) dwelling units per acre. At 3 (low) dwelling units per acre under developed parcels could potentially be intensified by an additional 86 dwelling units resulting in an increase in population of 201 people. At 14 (high) dwelling units per acre, underdeveloped parcels could potentially be increased by 501 dwelling units resulting in an increase in population of 1172 people. Vacant lands developed at 3 (low) dwelling units per acre would result in 174 dwelling units and a population increase of 407 residents. At 14 (high) dwelling units per acre, 843 dwelling units could potentially be developed in this zone resulting in an additional 1973 people. Total populations in this zone are 692 at 3 dwelling units per acre and 3229 at 14 dwelling units per acre.

Public/Institutional:

Thirty-two parcels on 107 acres are designated as public, golf or institutional land. For the purposes of this analysis these parcels are not considered to have a potential to develop. The intent of the public/institutional zoning designation is to preserve the area for public access and open space.

Rural Forest:

There is only one parcel inside of the NMUGA boundaries that is designated as Rural Forest. The parcel is 6.2 acres with 0 known acres of critical areas. The Island County Zoning Ordinance Chapter 17.03 shows density in the rural forest zone shall be 1 dwelling unit per 10 acres. The existing parcel is less than 10 acres, but 'Reasonable Use' would allow 1 dwelling unit to be developed on this parcel.

Table ( ) Freeland Dwelling Units/Population Current Zoning

		# of Parcels	Dwelling Units (low)	Dwelling Units (high)	Population (low)	Population (high)
Rural:	***1 dwelling Unit per 5 acres***					
	Vacant:	*126*	*130*	N/A	*304*	N/A
Currently	Developed:	80	76	N/A	177	N/A
	Potential:		6		14.04	
	Total:	**206**	**212**	**N/A**	**495**	**N/A**
Rural Residential:	***3 dwelling Units per acre***					
	Vacant:	*431*	*621*	N/A	*1453*	N/A
Currently	Developed:	376	376	N/A	877	N/A
	Potential:		142	N/A	332	N/A
	Total:	**807**	**1138.0**	**N/A**	**2662**	**N/A**
Rural Center:	***3-14 dwelling units per acre***					
	Vacant:	*50*	*174*	*843*	*407*	*1973*
Currently	Developed:	77	36	36	84	84
	Potential:		86	501	201	1172
	Total:	**127**	**296**	**1380**	**692**	**3229**
Public & Institution						
	NMUGA:	*24*	*N/A*	*N/A*	*N/A*	*N/A*
Currently	Developed:	8	N/A	N/A	N/A	N/A
	Total:	**32**	**N/A**	**N/A**	**N/A**	**N/A**

		# of Parcels	Dwelling Units (low)	Dwelling Units (high)	Population (low)	Population (low)

Rural Forest ***1 dwelling Unit per 10 acres***

	Vacant:	*1*	*1.0*	N/A	*3*	N/A
Currently	Developed:	0	0.0	N/A	0	N/A
	Total:	**1**	**1.0**	**N/A**	**3**	**N/A**

Freeland Totals:

Residential		*1014*	*1351*	*1351*	*3159*	*3159*
Commercial		127	296	1380	740	3450
Freeland	**Totals:**	**1173**	**1647**	**2731**	**3851**	**6388**

Population Projections for Freeland as a RAID:

Table ( ) Island County Population Projections

Population	1996	2020	24-year Growth	% of Growth
South Whidbey	**13,600**	**26,000**	**12,400**	**28%**
Langley UGA	1,000	2,200	1,200	
Freeland RAID	1,400	2,500	1,100	
Clinton RAID	900	2,000	1,100	
Unincorporated	12,600	23,800	11,200	

Employment	1996	2020	22-year Growth	% of Growth
South Whidbey	**2,708**	**5,634**	**2,926**	**25%**
Langley UGA	509	1,310	801	7%
Unincorporated	2,199	4,324	2,125	18%

Source: Island County Comprehensive Plan 1998, Washington State Office of Financial Management 1995

The population estimates are projected through the year 2020. The data was adopted through countywide Planning Policies based on three factors:

1. 1995 Washington State Office of Financial Management (OFM) 2020 High Series population growth forecast;
2. Municipal population projections prepared by the cities for their individual planning periods projected to the year 2020 using the rate of growth assumed by the municipalities in their comprehensive plans;
3. The Island County EDC Jobs Forecast dated February 2, 1998.

NMUGA Infill Analysis:

The Freeland NMUGA buildout potential is based on maximum buildout with the only allowances made being those for critical areas and infrastructure. Infill analysis accounts

for structural value, structures age and parcel acreage in determining future subdivision of parcels, as well as lots converting to their zoned use under current zoning.

The Freeland Buildable Lands analysis is based on a few general assumptions. The development of a sanitary sewer system and stormwater system is a primary assumption for this analysis based on a 20-year timeframe. For the purpose of this analysis, parcels with a structural value of less than $25,000 are considered vacant. Population is a result of the number of dwelling units multiplied by 2.34.

5 Analysis: Scenario 5 utilizes the Freeland NMUGA zoning classifications and densities identified in the June ##, 2001 draft Freeland Sub-Area Plan. The summary shows the total gross acres and the total acreage effected by the existence of known critical areas from the Island County GIS database. Ground truthing on 01-03-02 was performed in the field to verify the existence of critical areas within the scenario 5 NMUGA boundaries.

Residential Analysis:

The residential analysis was based on Scenario 5 that was adjusted by the Freeland Sub-Area Planning Committee on July 12, 2001. The analysis is based on a 20-year timeframe. The Infill analysis accounts for structural value, structural age/condition, and the size of the parcel. Populations are calculated as 2.34 multiplied by the number of dwelling units. Density ranges for the four zones were as follows:

Rural Estate: 1 dwelling unit per acre

Low Density: 1 to 3 dwelling units per acre.

Medium Density: 3+ to 6 dwelling units per acre.

High Density: 6 to 10 dwelling units per acre.

Mixed Use: 5 to 8 dwelling units per acre.

The Freeland Buildable Lands Analysis will report the existing dwelling units and populations as well as the potential dwelling units and population growth under the 5 NMUGA planning scenario.

Table ( ) NMUGA Residential Parcels

	Frequency	Acreage	Critical Acreage	Available Acreage
Low Density:	***1 to 3 dwelling units per acre***			

	Vacant:	151	251.48	58.67	189.92
Currently	*Developed:*	*209*	*216.6*	*34.85*	*179.02*
	Potential				
	Total:	**360**	**468.08**	**93.52**	**368.94**

Med. Density: ***3 to 6 dwelling units per acre***

	Vacant:	389	131.18	18.43	111.06
Currently	*Developed:*	*218*	*62.91*	*6.22*	*55.84*
	Potential				
	Total:	**607**	**194.09**	**24.65**	**166.90**

High Density: ***6 to 10 dwelling units per acre***

	Vacant:	4	3.57	0	3.52
Currently	*Developed:*	*9*	*2.83*	*0*	*2.79*
	Potential				
	Total:	**13**	**6.4**	**0**	**6.30**

Mixed Use: ***5 to 8 dwelling units per acre***

	Vacant:	15	35.41	5.25	29.71
Currently	*Developed:*	*12*	*46.97*	*2.98*	*43.33*
	Potential				
	Total:	**27**	**82.38**	**8.23**	**73.04**

Rural Estate

	Vacant	14	43.07	.03	42.39
Currently	*Developed:*	*15*	*34.31*	*0*	*33.80*
	Potential:				
	Total:	**29**	**77.38**	**.03**	**76.19**

Residential Totals:	**1036**	**828.33**	**126.43**	**691.37**

<u>Residential Methodology:</u>

The data exported from the GIS consisted of the following fields; Parcel Numbers, Parcel Acreage, Critical Areas Acreage, Available Acreage, Structural Value, Likely to Convert, Current Use, Likely to redevelop, Sub-Area Zoning, and Overlay Zone information.

Parcel acreage was calculated in the GIS using the existing parcel boundaries exported to the Appendix B database. Updates were made to the GIS consulting the Island County Assessor's CAD drawings of updated parcel boundaries (12-18-2001). The available acreage was calculated by reducing each parcel area by 15% after the Critical Areas were subtracted to account for future development lot and building setbacks and easements.

The Structural Value field was used as an identifier of parcels currently qualifying as improved or not improved. Improved parcels were assign a "1" to represent a Structural Value of $25,000 or more. A "0" was applied to Not Improved parcels with a structural value of less then $25,000.

To calculate the total number of dwelling units within each of the land use designations, parcel acreage was multiplied by the given land-use density and each existing dwelling unit was subtracted.

Example: (Acreage * Land-Use Density) – Existing Dwelling Units = Land-Use Dwelling Unit

(2.5 acres * LD High 2.99) – 1 = (6.47) Low Density High Dwelling Unit

The calculations resulted in dwelling units for both low and high densities with-in each land-use category. Subtracting the improved/not improved from the dwelling unit's result in data reflecting the potential dwelling units and growth for the Freeland NMUGA.

The existing dwelling units are calculated by the sum of the improved (1), not improved (0) for each Land-Use category. Populations are calculated by multiplying 2.5 by the Improved/Not Improved Land-Use category.

Total dwelling units are a result of the total Available Acres multiplied by the Land-Use Density. The dwelling units were than multiplied by 2.34, resulting in the total population for each residential land-use category.

Convert: The convert field was initially based on structural value: A vacant lot or a structural value of less than $25,000 is believed to convert and is assigned a "YES". For parcels that are not likely to change use even though the zoning would allow for a different use are designated as "NO". Parcels that the existing use and zoning intensity will not change the designation "NA" is used. The Holmes Harbor Golf Course have identified parcels as "Golf". In this analysis, parcels outside of the Freeland NMUGA are designated as "JPA". Field verifications were applied heavily to this field.

Develop: The convert field provides us with a very general overview of the effects of the 5 NMUGA. The Develop field was created to look at a more specific reaction for each parcel within the 5 NMUGA. Structural value and parcel acreage were used to create some objective thresholds in determining how many parcels were likely to redevelop within the next 20 years. Each parcel was evaluated using four different categories.

Parcels that have a high potential to develop are categorized as **Yes-**. **Yes-** parcels mostly consist of vacant buildable lots, but can also be lots were the current structure is worth less than $25,000 and will potential be removed from the property and replaced with a newer structure of greater value.

Parcels that are at the low end of their density threshold, but have a structure worth between $25,000 and $75,000 are designated as **Remodel-**. Lots in this category have a high potential of being remodeled, but lack the acreage to build an additional structure or sub-divide.

Add- refers to parcels that are underdeveloped in relation to the allowed lot density. Structural values over $75,000 assume that existing structure will most likely be left alone with-in the next 20 years, but additional structures could be built on the parcel.

No- are parcels that are currently built close to the full potential of the lot, structural values above $75,000 indicate the lot will not be redeveloped during the next 20 years. Field observations were applied heavily to this field.

Current Use: A result of field observations, Single family homes are designated as "Residential". Commercial structures were identified and specific uses were entered into the database.

Low Density (1): ***1 to 3 dwelling units per acre***

Low-density residential lands are intended for single-family residences and duplexes at a density of less than 3 dwelling units per acre. For the purposes of this analysis a threshold of 1.0 acres was established. Any parcels at or smaller than 1 acre would be allowed 1 dwelling unit on the property, parcels larger than 1 acre would allow for more than 1 dwelling unit to be developed.

Yes-1: This category represents lots that are likely to redevelop within the next 20 years. Lots in this category can range from vacant lots to lots with structures valued at less than $25,000.

Remodel-1: Lots in this category are likely to be remodeled within the next 20 years. The zoning is low density with a structural value between $25,000 and $75,000 on lots less than 1.0 acres in size.

Example: A $50,000 home that will probably not be rebuilt, but will more than likely be remodeled. The parcel lacks the acreage for an addition to the home, but the structural value indicates that the structure has a good chance of being remodeled in the next 20 years.

Add-1: Lots in this category have the potential for additions to the current structures. The zoning is low density with a structural value of greater than $25,000 on lots larger than 1.0 acres.

Example: A home that will not be demolished and rebuilt, but the parcel has the acreage to allow for expansion of the existing structure or development of additional dwelling units.

No-1: This category represents parcels that are more than likely to not change from their current state within the next 20 years. Structural values within this category are greater than $75,000 on lots less than 1.0 acres in size.

Example: A home with a high structural value on a parcel less than 1.0 acre in size. The parcel is too small for development of an additional dwelling unit, but the structural value of the house is more than likely too high to remodel.

Yes-1: Structural value < $25,000

Remodel-1: Structural value between $25,000 - $75,000, lots < 1 acre

Add-1: Structural Value > $25,000 lots > 1 acre

No-1: Structural Value > $75,000 lots < 1 acre

Medium Density (2): ***3 to 6 dwelling units per acre***
The medium density zone is intended for single family homes, including duplexes, triplexes and fourplexes. For the purposes of this analysis a threshold of .35 acres is set. Any parcels at or smaller than .35 acres would only be allowed 1 dwelling unit, parcels larger than .35 acres could accommodate multiple dwelling units.

Yes-2: This category represents lots that are likely to redevelop within the next 20 years. Lots in this category can range from vacant lots to lots with structures valued at less than $25,000.

Remodel-2: Lots in this category are likely to be remodeled within the next 20 years. The zoning is medium density with a structural value between $25,000 and $75,000 on lots less than .35 acres in size.

Add-2: Lots in this category have the potential for additions to the current structures. The zoning is medium density with a structural value of greater than $75,000 on lots larger than .35 acres.

No-2: This category represents parcels that are more than likely to not change from their current state within the next 20 years. Structural values within this category are greater than $75,000 on lots less than .35 acres in size.

Yes-2: Structural value < $25,000

Remodel-2: Structural value between $25,000 - $75,000, lots < .35 acre

Add-2: Structural Value > $25,000 lots > .35 acre

No-2: Structural Value > $75,000 lots < .35 acre

High Density (3): ***6 to 10 dwelling units per acre***

The high-density zone is established to provide concentrated areas of multi-family dwellings. For the purposes of the Buildable Lands Analysis a threshold of .16 acres was set to distinguish between currently developed parcels that are likely to further develop and parcels that can only be remodeled. The .16 is a calculation of the amount of acreage that would be required to meet the established zoning density at the low end of the range of densities.

Yes-3: This category represents lots that are likely to redevelop within the next 20 years. Lots in this category can range from vacant lots to lots with structures valued at less than $25,000.

Remodel-3: Lots in this category are likely to be remodeled within the next 20 years. The zoning is medium density with a structural value between $25,000 and $75,000 on lots less than .16 acres in size.

Add-3: Lots in this category have the potential for additions to the current structures. The zoning is medium density with a structural value of greater than $75,000 on lots larger than .16 acres.

No-3: This category represents parcels that are more than likely to not change from their current state within the next 20 years. Structural values within this category are greater than $75,000 on lots less than .16 acres in size.

Yes-3: Structural value < $25,000

Remodel-3: Structural value between $25,000 - $75,000, lots < .16 acre

Add-3: Structural Value > $25,000 lots > .16 acre

No-3: Structural Value > $75,000 lots < .16 acre

Mixed Use (4): ***5 to 8 dwelling units per acre***

Areas designated as mixed use are characteristic of transitional zones between areas of differing uses. For example a mixed-use zone might be established between an industrial area and a residential to soften the impact of the dramatic change is use. For the purpose of this analysis a threshold of .2 acres is established to distinguish parcels appropriate for development of multiple dwelling units and parcels that are restricted to one dwelling unit. Parcels larger than .2 acres could potentially accommodate multiple dwelling units, parcels less than .2 acres would be restricted to 1 dwelling unit.

Yes-4: This category represents lots that are likely to redevelop within the next 20 years. Lots in this category can range from vacant lots to lots with structures valued at less than $25,000.

Remodel-4: Lots in this category are likely to be remodeled within the next 20 years. The zoning is mixed use with a structural value between $25,000 and $75,000 on lots less than .2 acres in size.

Add-4: Lots in this category have the potential for additions to the current structures. The zoning is medium density with a structural value of greater than $75,000 on lots larger than .2 acres.

No-4: This category represents parcels that are more than likely to not change from their current state within the next 20 years. Structural values within this category are greater than $75,000 on lots less than .2 acres in size.

Yes-4: Structural value < $25,000

Remodel-4: Structural value between $25,000 - $75,000, lots < .2 acre

Add-4: Structural Value > $25,000 lots > .2 acre

No-4: Structural Value > $75,000 lots < .2 acre

Rural Estate

The Rural Estate zone is established with the intention of preserving the existing relativly low density single-family land-use pattern. Existing view amenities of the western marine environment in this zone well be preserved by limiting lot density to one (1) dwelling unit per acre

Yes-5: Structural value < $25,000

Remodel-5: Structural value between $25,000 - $75,000, lots < 1 acre

Add-5: Structural Value > $25,000 lots > 1 acre

No-5: Structural Value > $75,000 lots < 1 acre

Table ( ) NMUGA Residential dwelling units & populations

		# of Parcels	Dwelling Units (L)	Dwelling Units (H)	Population (low)	Population (high)
Low Density:		***1 to 3 dwelling units per acre***				
	Vacant:	151	246	574	575	1343
Currently	*Developed:*	*209*	*209*	*209*	*489*	*489*
	Potential		66	262	154	613
	Total:	**360**	**521**	**1045**	**1218**	**2445**
Med. Density:		***3 to 6 dwelling units per acre***				
	Vacant:	389	479	657	1120	1537
Currently	*Developed:*	*218*	*218*	*218*	*510*	*510*

	Potential		31	89	72	208
	Total:	**607**	**728**	**964**	**1702**	**2255**

High Density: ***6 to 10 dwelling units per acre***

	Vacant:	4	21	36	49	84
Currently	*Developed:*	*9*	*9*	*9*	*21*	*21*
	Potential		11	17	25	39
	Total:	**13**	**41**	**62**	**95**	**144**

Mixed Use: ***5 to 8 dwelling units per acre***

	Vacant:	15	140	231	327	540
Currently	*Developed:*	*11*	*11*	*11*	*25*	*25*
	Potential:		184	305	430	713
	Total:	**27**	**335**	**547**	**782**	**1278**

Rural Estate: ***1 dwelling unit per acre***

	Vacant:	14	40	40	93	93
Currently	*Developed:*	15	15	15	35	35
	Potential:		16	16	37	37
	Total:	**29**	**71**	**71**	**165**	**165**

Residential Totals:	**1036**	**1696**	**2689**	**3962**	**6287**

<u>Commercial Methodology:</u>

Commercial parcels are very subjective in relation to how they would be affected by the zoning changes of the scenario 5 NMUGA. For this reason field observations were a key indicator of whether the parcels is underdeveloped or currently developed to its full potential. Location, structural condition, accessibility, parking etc. were key components in determining the potential of the commercial parcels.

Table ( ) NMUGA Commercial Parcels

Business General:

		Frequency	Acreage	Critical Acreage	Available Acreage
	Vacant:	18	18.37	.69	17.41
Currently	*Developed:*	*29*	*55.16*	*5.13*	49.28
	Potential				
	Total:	**47**	**75.53**	**5.82**	**66.69**

Business Village:

	Vacant:	14	16.89	0	16.64
Currently	*Developed:*	31	18.80	0	18.52
	Potential				
	Total:	**45**	**35.69**	**0**	**35.15**

Business Office

	Vacant:	2	1.14	0	1.12
Currently	*Developed:*	*7*	*3.76*	*0*	3.70
	Potential				
	Total:	**9**	**4.90**	**0**	**4.82**

Industrial

	Vacant:	1	0.05	0	0.04
Currently	*Developed:*	*3*	*10.65*	*1.87*	8.65
	Potential				
	Total:	**4**	**10.7**	**1.87**	**9.14**

Commercial Totals:	**105**	**124.82**	**7.69**	**115.81**

Business General: (BG)

The business general zone is intended for general commercial development in and around the Freeland "central business district". General commercial development includes a broad range of commercial, retail and service activities. Dwelling units are defined as a secondary permitted use. Structures with a value of less than $50,000 are assumed to redevelop, values less than 50,000 are assumed to redevelop.

Yes-BG: This category represents parcels with a high potential to develop. A combination of field observations and relatively low structural values indicated a high probability that the parcel will redevelop.

No-BG: Parcels in this category are either currently utilizing the full potential of the lot or the structure on the parcel has a relatively high enough value to indicate that the parcel has a low probability of redeveloping with-in the next 20 years.

UD-BG: This designation refers to parcels that are currently under developed, structural values or field observations indicate that the parcel could be further developed in the future.

Business Office: (BO)

The business office designation is intended to provide professional and business office space. Dwelling units are encouraged in a location above or behind the business activity.

Yes-BO: This designation represents parcels with a high potential to develop. Parcels in this category could either be vacant or have a relatively low structural value.

No-BO: Parcels in this category are either currently utilizing the full potential of the lot or the structure on the parcel has a relatively high enough value to indicate that the parcel has a low probability of redeveloping with-in the next 20 years.

UD-BO: This designation refers to parcels that are currently under developed, structural values or field observations indicate that the parcel could be further developed in the future.

Business Village: (BV)

The business village designation is intended for a mixed commercial/retail and residential development. Dwelling units are encouraged to develop above the street level to promote a "traditional" atmosphere.

Yes-BV: This designation represents parcels with a high potential to develop. Parcels in this category could either be vacant or have a relatively low structural value.

NO-BV: Parcels in this category are either currently utilizing the full potential of the lot or the structure on the parcel has a relatively high enough value to indicate that the parcel has a low probability of redeveloping with-in the next 20 years.

UD-BV: This designation refers to parcels that are currently under developed, structural values or field observations indicate that the parcel could be further developed in the future.

Industrial: (I)

The industrial designation is the most intense commercial zone with in the NMUGA, Parcels are intended for a broad range of manufacturing, technological and industrial uses. Dwelling units are not intended for this zone.

Yes-I: The parcels has a high probability of either being further developed or is currently a vacant parcels ready for future development.

No-I: Parcels designated Industrial that the use is either currently industrial or the structural value is high enough that the parcels would not redevelop.

Public: (P)

No-P: Parcels in this category range from public parks to areas providing essential public services. None of the public parcels will convert or develop in

the next 20 years; therefore all of these parcels have been removed from the Freeland Buildable Lands Analysis.

Institution: (INS)

INS: Institutional uses, for churches, post office, power substations, etc.

Residential Conclusions:

Low Density: In scenario 6, 360 parcels on 468 acres will be designated as Low Density. Critical Areas make up for 93 acres in this zone, which reduces the total available acreage with the 15% setback & easement reduction to 368 acres. Currently there are 209 dwelling units on parcels currently zoned Rural and Rural Residential. The NMUGA would allow for an additional 312 dwelling units at 1 dwelling unit per acre, or 836 dwelling units at 3 dwelling units per acre. Population in the Low Density zone would increase from the current 489, to 1218 at 1 dwelling unit per acre and 2445 at 3 dwelling units per acre.

Medium Density: In scenario 6, 607 parcels on 194 acres will be designated as Medium Density. Critical Areas make up for 24 acres, which reduces the total available acreage to 153 with the 15% for setbacks & easements. Currently there are 218 dwelling units on parcels currently zoned Rural and Rural Residential. The NMUGA would allow for an additional 510 dwelling units at 3 dwelling unit per acre, or 746 dwelling units at 6 dwelling units per acre. Population on the Medium Density zone would increase from the current 510, to 1702 at 3 dwelling units per acre and 2255 at 6 dwelling units per acre.

High Density: In scenario 6, 13 parcels on 6 acres will be designated as High Density. There are no Critical Areas in this zone, so only the 15% setback and easement reduction would be applied. The total available acreage in the High-Density zone is 6.3 acres. Currently there are 9 dwelling units on parcels currently zoned Rural and Rural Residential. The NMUGA would allow for an additional 32 dwelling units at 6 dwelling units per acre, or 53 dwelling units at 10 dwelling units per acre. Population in the High-Density zone would increase from the current 21, to 95 at 6 dwelling units per acre or 144 at 10 dwelling units per acre.

Mixed Use: In scenario 6, 27 parcels on 82 acres will be designated as Mixed Use. Critical Areas make up 8 acres, which reduces the total available land to 73 acres including the 15% setback reduction. Currently there are 11 dwelling units on parcels currently zoned Rural and Rural Residential. The NMUGA would allow for an additional 324 dwelling units at 5 dwelling units per acre, or 535 dwelling units at 8 dwelling units per acre. Population in the Mixed-Use zone would increase from the current 25, to 782 at 5 dwelling units per acre or 1278 at 8 dwelling units per acre.

Rural Estate: In scenario 6, 29 parcels on 77 acres will be designated as Rural Estate. Critical Areas make up .03 acres, which reduces the total available land to 76.19 acres. Currently there are 15 dwelling units on parcels currently zoned Rural and Rural Residential. The NMUGA would allow for an additional 56 dwelling units at 1dwelling unit per acre. Population in the Rural Estate zone would increase from the current 35 to 165 people.

Public/Institutional/Golf Course: In scenario 6, 32 parcels on 107 acres will be designated as Golf Course, Institutional or Public land. Critical Areas make up 27 acres; these areas are not intended for future developments so available acreage and population figures are not applicable.

Commercial Conclusions:

Business General: In scenario 6, 47 parcels on 73 acres will be designated as Business General. Critical Areas make up 5 acres which reduces the total available land to 66 acres with the 15% setback and easement reduction.

Business Office: In scenario 6, 9 parcels on 4.9 acres will be designated as Business Office. There are no critical areas within the business office zone therefore the 15% setback & easement reduction would be applied directly to the gross acreage resulting in an available acreage of 4.83. Dwelling units are only documented with existing residential structures with values above $50,000 of which there are none in this zone.

Business Village: In scenario 6, 45 parcels on 35.7 acres will be designated as Business Village. There are no critical areas in this zone so only the 15% setback and easement reduction will be applied. The total available acreage in the Business Village zone is 35.15 acres.

Industrial: In scenario 6, 4 parcels on 10.7 acres will be designated as industrial. Critical Areas make up 1.9 acres, which reduces the total available land to 9.14 acres.

Table ( ) Commercial Dwelling Units &Population

		# of Parcels	Dwelling Units (L)	Dwelling Units (H)	Population (low)	Population (high)
Business General:						
	Vacant:	18	0	0	0	0
Currently	*Developed:*	*29*	*26*	*26*	*60*	*60*
	Potential		0	0	0	0
	Total:	**47**	**26**	**26**	**60**	**60**

Business Village:

	Vacant:	14	19	80	44	*187*
Currently	*Developed:*	31	1	0	2	*2*
	Potential		12	29	28	*67*
	Total:	**45**	**32**	**110**	**74**	**256**

Business Office

	Vacant:	2	0	0	0	0
Currently	*Developed:*	*7*	*0*	*0*	*0*	*0*
	Potential					
	Total:	**9**	**0**	**0**	**0**	**0**

Industrial

	Vacant:	1	N/A	N/A	N/A	N/A
Currently	*Developed:*	*3*	*N/A*	*N/A*	*N/A*	*N/A*
	Potential					
	Total:	**4**	**0**	**0**	**0**	**0**

Commercial Totals:	**105**	**84**	**162**	**194**	**376**

<u>Freeland Buildable Lands Conclusions:</u>

Freeland NMUGA Current Zoning:

The following table represents the Freeland NMUGA boundaries at the full buildout potential with the current Island County zoning. The commercial zone was evaluated under the current zoning and the NMUGA scenarios, exempt parcels were identified in both analysis.

Table ( ) Current Zoning Totals

Current Zoning:

	# of Parcels	Acreage	Dwelling Units (L)	Dwelling Units (H)	Population (low)	Population (high)
Residential Totals:	1014	787.38	1351	1351	3159	3159
Rural Center	*127*	*165.77*	*296*	*1380*	*692*	*3229*
Public/Golf/INS:	32	107.51	N/A	N/A	N/A	N/A
Freeland Totals:	**1173**	**1060.7**	**1647**	**2731**	**3851**	**6388**

Freeland NMUGA Zoning:

The following conclusions are based on the scenario 5 planning analysis of the Freeland sub area proposed NMUGA designation. The analysis is based of field observations and Island County data that is explained above.

Table ( ) NMUGA Zoning

NMUGA Zoning:

	# of Parcels	Acreage	Dwelling Units (L)	Dwelling Units (H)	Population (low)	Population (high)
Residential Totals:	1036	823.33	1696	2689	3962	6287
Commercial Totals:	*105*	*124.82*	*84*	*162*	*194*	*376*
Public/Golf/INS:	32	107.51	0	0	0	0
Freeland Total:	**1173**	**1060.7**	**1780**	**2851**	**4156**	**6663**

<u>Freeland Buildable Lands Conclusions:</u>

Population function: Dwelling Units X 2.34 (2.34 = Avg. Persons per Household)

Current Zoning:

	# of Parcels	Acreage	Dwelling Units (L)	Dwelling Units (H)	Population (low)	Population (high)
Residential Totals:	1014	787.38	1351	1351	3159	3159
Rural Center	*127*	*165.77*	*296*	*1380*	*692*	*3229*
Public/Golf/INS:	32	107.51	N/A	N/A	N/A	N/A
Freeland Totals:	**1173**	**1060.7**	**1647**	**2731**	**3851**	**6388**

NMUGA Zoning:

	# of Parcels	Acreage	Dwelling Units (L)	Dwelling Units (H)	Population (low)	Population (high)
Residential Totals:	1036	828.33	1707	2698	3988	6308
Commercial Totals:	*105*	*124.82*	*84*	*162*	*194*	*376*
Public/Golf/INS:	32	107.51	0	0	0	0
Freeland Total:	**1173**	**1060.7**	**1791**	**2860**	**4182**	**6684**

NMUGA Zoning W/O Holmes Harbor:

	# of Parcels	Acreage	Dwelling Units (L)	Dwelling Units (H)	Population (low)	Population (high)
Residential Totals:	519	652.75	1015	2050	2369	4791
Commercial Totals:	*105*	*124.82*	*84*	*162*	*194*	*376*
Public/Golf/INS:	20	31.23	0	0	0	0
Freeland Total:	**644**	**808.8**	**1099**	**2212**	**2563**	**5167**

Current Population:

- Complete NMUGA **1197**
- Population NMUGA W/O Holmes Harbor **770**

APPENDIX G.
FLOW AND LOAD PROJECTIONS

Class		Acreage: Gross	Acreage: Critical	Acreage: Gross-Critical	Acreage: Available	Dwelling units LOW	Dwelling units HIGH	Population LOW	Population HIGH
Low density	Vacant	214.00	31.24	182.76	155.35	157	569	367	1,331
	Developed	210.29	31.56	178.73	151.92	206	206	482	482
	Potential					61	259	142	606
	Total	*424.29*	*62.80*	*361.49*	*307.27*	*424*	*1,034*	*991*	*2,419*
Medium density	Vacant	45.36	2.57	42.79	36.37	90	235	210	549
	Developed	16.94	1.10	15.84	13.46	12	12	28	28
	Potential					31	80	72	187
	Total	*62.30*	*3.67*	*58.63*	*49.83*	*133*	*327*	*310*	*764*
High density	Vacant	3.57	0.00	3.57	3.04	21	36	49	84
	Developed	2.83	0.00	2.83	2.40	22	22	51	51
	Potential					0	4	0	9
	Total	*6.40*	*0.00*	*6.40*	*5.44*	*43*	*62*	*100*	*144*
Mixed use	Vacant	35.41	5.25	30.16	25.64	149	240	348	561
	Developed	46.97	2.98	43.99	37.39	11	11	25	25
	Potential					184	305	430	713
	Total	*82.38*	*8.23*	*74.15*	*63.03*	*344*	*556*	*803*	*1,299*
Rural estate	Vacant	43.07	0.03	43.04	36.58	40	40	93	93
	Developed	34.31	0.00	34.31	29.16	15	15	35	35
	Potential					16	16	37	37
	Total	*77.38*	*0.03*	*77.35*	*65.74*	*71*	*71*	*165*	*165*
Business general	Vacant	18.37	0.69	17.68	15.03	0	0	0	0
	Developed	55.16	5.13	50.03	42.53	26	26	60	60
	Potential					26	26	60	60
	Total	*73.53*	*5.82*	*67.71*	*57.56*	*52*	*52*	*120*	*120*
Business village	Vacant	16.89	0.00	16.89	14.36	19	80	44	187
	Developed	18.80	0.00	18.80	15.98	1	1	2	2
	Potential					12	29	28	67
	Total	*35.69*	*0.00*	*35.69*	*30.34*	*32*	*110*	*74*	*256*
Business office	Vacant	1.14	0.00	1.14	0.97				
	Developed	3.76	0.00	3.76	3.20				
	Potential								
	Total	*4.90*	*0.00*	*4.90*	*4.17*	*0.00*	*0.00*	*0.00*	*0.00*
Industrial	Vacant	0.05	0.00	0.05	0.43				
	Developed	10.65	1.87	8.78	7.46				
	Potential								
	Total	*10.70*	*1.87*	*8.83*	*7.89*	*0.00*	*0.00*	*0.00*	*0.00*
TOTALS		778	82	695	591	1,099	2,212	2,563	5,167

Class	Base Flow - AA AAF/person, gpd		LOW	HIGH	Base Flow - MM Peak Factor	LOW	HIGH	Base Flow - PD Peak Factor	LOW	HIGH	Base Flow - Peak Flow Peak Factor	LOW	HIGH	I/I Flows - AA Flow I/I, gpad	
Low density	60		22,020	79,860	1.25	27,525	99,825	1.5	33,030	119,790	3.5	77,070	279,510	250	45,690
	60		28,920	28,920	1.25	36,150	36,150	1.5	43,380	43,380	3.5	101,220	101,220	250	44,683
	60		8,520	36,360	1.25	10,650	45,450	1.5	12,780	54,540	3.5	29,820	127,260	250	0
Medium density	60		12,600	32,940	1.25	15,750	41,175	1.5	18,900	49,410	3.5	44,100	115,290	250	10,698
	60		1,680	1,680	1.25	2,100	2,100	1.5	2,520	2,520	3.5	5,880	5,880	250	3,960
	60		4,320	11,220	1.25	5,400	14,025	1.5	6,480	16,830	3.5	15,120	39,270	250	0
High density	60		2,940	5,040	1.25	3,675	6,300	1.5	4,410	7,560	3.5	10,290	17,640	250	893
	60		3,060	3,060	1.25	3,825	3,825	1.5	4,590	4,590	3.5	10,710	10,710	250	708
	60		0	540	1.25	0	675	1.5	0	810	3.5	0	1,890	250	0
Mixed use	60		20,880	33,660	1.25	26,100	42,075	1.5	31,320	50,490	3.5	73,080	117,810	250	7,540
	60		1,500	1,500	1.25	1,875	1,875	1.5	2,250	2,250	3.5	5,250	5,250	250	10,998
	60		25,800	42,780	1.25	32,250	53,475	1.5	38,700	64,170	3.5	90,300	149,730	250	0
Rural estate	60		5,580	5,580	1.25	6,975	6,975	1.5	8,370	8,370	3.5	19,530	19,530	250	10,760
	60		2,100	2,100	1.25	2,625	2,625	1.5	3,150	3,150	3.5	7,350	7,350	250	8,578
	60		2,220	2,220	1.25	2,775	2,775	1.5	3,330	3,330	3.5	7,770	7,770	250	0
	Commercial base flow, gpad				***Commercial flow***			***Commercial flow***			***Commercial flow***				
Business general	550	1,100	9,724	19,448	1.25	12,155	24,310	1.5	14,586	29,172	3.5	34,034	68,068	250	4,420
	550	1,100	27,517	55,033	1.25	34,396	68,791	1.5	41,275	82,550	3.5	96,308	192,616	250	12,508
	550	1,100	0	0	1.25	0	0	1.5	0	0	3.5	0	0	250	0
Business village	550	1,100	9,290	18,579	1.25	11,612	23,224	1.5	13,934	27,869	3.5	32,513	65,027	250	4,223
	550	1,100	10,340	20,680	1.25	12,925	25,850	1.5	15,510	31,020	3.5	36,190	72,380	250	4,700
	550	1,100	0	0	1.25	0	0	1.5	0	0	3.5	0	0	250	0
Business office	550	1,100	627	1,254	1.25	784	1,568	1.5	941	1,881	3.5	2,195	4,389	250	285
	550	1,100	2,068	4,136	1.25	2,585	5,170	1.5	3,102	6,204	3.5	7,238	14,476	250	940
	550	1,100	0	0	1.25	0	0	1.5	0	0	3.5	0	0	250	0
Industrial	550	1,100	28	55	1.25	34	69	1.5	41	83	3.5	96	193	250	13
	550	1,100	4,829	9,658	1.25	6,036	12,073	1.5	7,244	14,487	3.5	16,902	33,803	250	2,195
	550	1,100	0	0	1.25	0	0	1.5	0	0	3.5	0	0	250	0
TOTALS			206,562	416,303		258,202	520,379		309,842	624,455		722,965	1,457,061		173,788

Class	I/I Flows - MM Flow I/I, gpad		I/I Flows - Peak Day I/I, gpad		I/I Flows - Peak Flow I/I, gpad	
Low density	450	82,242	750	137,070	1,100	201,036
	450	80,429	750	134,048	1,100	196,603
	450	0	750	0	1,100	0
Medium density	450	19,256	750	32,093	1,100	47,069
	450	7,128	750	11,880	1,100	17,424
	450	0	750	0	1,100	0
High density	450	1,607	750	2,678	1,100	3,927
	450	1,274	750	2,123	1,100	3,113
	450	0	750	0	1,100	0
Mixed use	450	13,572	750	22,620	1,100	33,176
	450	19,796	750	32,993	1,100	48,389
	450	0	750	0	1,100	0
Rural estate	450	19,368	750	32,280	1,100	47,344
	450	15,440	750	25,733	1,100	37,741
	450	0	750	0	1,100	0
Business general	450	7,956	750	13,260	1,100	19,448
	450	22,514	750	37,523	1,100	55,033
	450	0	750	0	1,100	0
Business village	450	7,601	750	12,668	1,100	18,579
	450	8,460	750	14,100	1,100	20,680
	450	0	750	0	1,100	0
Business office	450	513	750	855	1,100	1,254
	450	1,692	750	2,820	1,100	4,136
	450	0	750	0	1,100	0
Industrial	450	23	750	38	1,100	55
	450	3,951	750	6,585	1,100	9,658
	450	0	750	0	1,100	0
TOTALS		312,818		521,363		764,665

Class	AA BOD/ person, ppd	AA BOD, ppd LOW	AA BOD, ppd HIGH	LOW AA BOD conc, mg/l	Commercial AA BOD, ppd	HIGH AA BOD/ person, ppd	Commercial AA BOD, ppd
Low density	0.2	73.4	266.2	400		400	
	0.2	96.4	96.4				
	0.2	28.4	121.2				
Medium density	0.2	42	109.8				
	0.2	5.6	5.6				
	0.2	14.4	37.4				
High density	0.2	9.8	16.8				
	0.2	10.2	10.2				
	0.2	0	1.8				
Mixed use	0.2	69.6	112.2				
	0.2	5	5				
	0.2	86	142.6				
Rural estate	0.2	18.6	18.6				
	0.2	7	7				
	0.2	7.4	7.4				
Business general					32.4		64.8
					91.7		183.4
					0.0		0.0
Business village					31.0		61.9
					34.5		68.9
					0.0		0.0
Business office					2.1		4.2
					6.9		13.8
					0.0		0.0
Industrial					0.1		0.2
					16.1		32.2
					0.0		0.0
TOTALS		474	958		215		429

SUMMARY FOR CONVENTIONAL GRAVITY SYSTEM
Phase 4="LOW"; Phase 5="HIGH"

Base Flow (low), mgd	0.207	Assuming commercial development at 5	
AA Flow (low), mgd	0.380		
MM Flow (low), mgd	0.571	1.50	Peaking Factor (rel to AA)
PD Flow (low), mgd	0.83	2.19	Peaking Factor (rel to AA)
Peak Flow (low), mgd	1.49	3.91	Peaking Factor (rel to AA)
Base Flow (high), mgd	0.416		
AA Flow (high), mgd	0.590		
MM Flow (high), mgd	0.833	1.41	Peaking Factor (rel to AA)
PD Flow (high), mgd	1.146	1.94	Peaking Factor (rel to AA)
Peak Flow (high), mgd	2.22	3.77	Peaking Factor (rel to AA)
BOD Peaking - MM/AA	1.67		
BOD Peaking - PD/AA	2.0		
AA BOD (low), ppd	689		
MM BOD (low), ppd	1,150		
PD BOD (low), ppd	1,377		
AA BOD (high), ppd	1,173		
MM BOD (high), ppd	1,959		
PD BOD (high), ppd	2,346		
TSS Peaking - MM/AA	1.67		
TSS Peaking - PD/AA	2.0		
AA TSS (low), ppd	689	Assumes TSS load equals BOD load (co	
MM TSS (low), ppd	1,150		
PD TSS (low), ppd	1,377		
AA TSS (high), ppd	1,173	Assumes TSS load equals BOD load (co	
MM TSS (high), ppd	1,959		
PD TSS (high), ppd	2,346		
AA TKN (low), ppd	124	Assumes TKN is 18% of BOD based on	
MM TKN (low), ppd	207	Assumes TKN peaking factors are equa	
PD TKN (low), ppd	248		
AA TKN (high), ppd	211	Assumes TKN is 18% of BOD based on	
MM TKN (high), ppd	353		
PD TKN (high), ppd	422		

SUMMARY FOR GRAVITY SYSTEM - 1
Phase 1

Base Flow (lo	0.045
AA Flow (low	0.065
MM Flow (lo	0.093
PD Flow (low	0.13
Peak Flow (lo	0.25
Base Flow (h	N/A
AA Flow (hig	N/A
MM Flow (hi	N/A
PD Flow (hig	N/A
Peak Flow (h	N/A
BOD Peaking	1.67
BOD Peaking	2.0
AA BOD (low	149
MM BOD (lo	249
PD BOD (low	298
AA BOD (high), ppd	
MM BOD (high), ppd	
PD BOD (high), ppd	
TSS Peaking	1.67
TSS Peaking	2.0
AA TSS (low)	149
MM TSS (low	249
PD TSS (low)	298
AA TSS (high), ppd	
MM TSS (high), ppd	
PD TSS (high), ppd	
AA TKN (low	27
MM TKN (lo	45
PD TKN (low	54
AA TKN (high), ppd	
MM TKN (high), ppd	
PD TKN (high), ppd	

SUMMARY FOR GRAVITY SYSTEM - INI

Phase 2

Base Flow	0.074
AA Flow (l	0.11
MM Flow (	0.16
PD Flow (l	0.22
Peak Flow	0.42
Base Flow	N/A
AA Flow (l	N/A
MM Flow (	N/A
PD Flow (l	N/A
Peak Flow	N/A
BOD Peak	1.67
BOD Peak	2.0
AA BOD (l	246
MM BOD (	410
PD BOD (l	491
AA BOD (high), ppd	
MM BOD (high), ppd	
PD BOD (high), ppd	
TSS Peaki	1.67
TSS Peaki	2.0
AA TSS (lc	246
MM TSS (l	410
PD TSS (lc	491
AA TSS (high), ppd	
MM TSS (high), ppd	
PD TSS (high), ppd	
AA TKN (l	44
MM TKN (	74
PD TKN (l	88
AA TKN (high), ppd	
MM TKN (high), ppd	
PD TKN (high), ppd	

SUMMARY FOR GRAVITY SYSTEM - NMUGA minus S, NE

Phase 3

Base Flow	0.134
AA Flow (l	0.23
MM Flow (	0.34
PD Flow (l	0.49
Peak Flow	0.89
Base Flow	N/A
AA Flow (l	N/A
MM Flow (	N/A
PD Flow (l	N/A
Peak Flow	N/A
BOD Peak	1.67
BOD Peak	2.0
AA BOD (l	445
MM BOD (	743
PD BOD (l	890
AA BOD (high), ppd	
MM BOD (high), ppd	
PD BOD (high), ppd	
TSS Peaki	1.67
TSS Peaki	2.0
AA TSS (lc	445
MM TSS (l	743
PD TSS (lc	890
AA TSS (high), ppd	
MM TSS (high), ppd	
PD TSS (high), ppd	
AA TKN (l	80
MM TKN (	134
PD TKN (l	160
AA TKN (high), ppd	
MM TKN (high), ppd	
PD TKN (high), ppd	

SUMMARY FOR STEP SYSTEM
Phase 4="LOW"; Phase 5="HIGH"

Equivalent dwellings (low)	1,558	Assuming commercial dev		
Equivalent dwellings (high	3,130			
Population equivalents (lo	3,645	commercial= 1,082		
Population equivalents (hi	7,323	commercial= 2,156		
Peak Flow (low), mgd	1.1	used as a check on the esti		
Peak Flow (high), mgd	2.3	used as a check on the esti		
Base Flow (low), mgd	0.207			
AA Flow (low), mgd	0.293			
MM Flow (low), mgd	0.41	1.41	Peaking Fact	
PD Flow (low), mgd	0.57	1.94	Peaking Fact	
Peak Flow (low), mgd	1.11	3.77	Peaking Fact	
Base Flow (high), mgd	0.416			
AA Flow (high), mgd	0.503			
MM Flow (high), mgd	0.677	1.34	Peaking Fact	
PD Flow (high), mgd	0.885	1.76	Peaking Fact	
Peak Flow (high), mgd	1.84	3.66	Peaking Fact	
BOD Peaking - MM/AA	2.0			
BOD Peaking - PD/AA	2.5			
AA BOD (low), ppd	413	BOD at 0.12 ppcd		
MM BOD (low), ppd	826			
PD BOD (low), ppd	1,033			
AA BOD (high), ppd	704	BOD at 0.12 ppcd		
MM BOD (high), ppd	1,408			
PD BOD (high), ppd	1,759			
TSS Peaking - MM/AA	2.5			
TSS Peaking - PD/AA	3.5			
AA TSS (low), ppd	172	TSS at 0.05 ppcd		
MM TSS (low), ppd	430			
PD TSS (low), ppd	602			
AA TSS (high), ppd	293	TSS at 0.05 ppcd		
MM TSS (high), ppd	733			
PD TSS (high), ppd	1,026			
AA TKN (low), ppd	74	Assumes TKN is 18% of B		
MM TKN (low), ppd	149	Assumes TKN peaking fac		
PD TKN (low), ppd	186			
AA TKN (high), ppd	127	Assumes TKN is 18% of B		
MM TKN (high), ppd	253			
PD TKN (high), ppd	317			

SUMMARY FOR STEP SYSTEM - IN
Phase 1

Equivalent d	319	**Assuming c**		
Equivalent d	N/A			
Population e	746	commercial=		
Population e	N/A	commercial=		
Peak Flow (l	0.25	used as a che		
Peak Flow (h	N/A	used as a che		
Base Flow (l	0.045			
AA Flow (low	0.055			
MM Flow (lo	0.074	1.35		
PD Flow (low	0.10	1.78		
Peak Flow (l	0.20	3.67		
Base Flow (h	N/A			
AA Flow (hig	N/A			
MM Flow (hi	N/A		N/A	
PD Flow (hig	N/A		N/A	
Peak Flow (h	N/A		N/A	
BOD Peakin	2.0			
BOD Peakin	2.5			
AA BOD (low	90	BOD at 0.12		
MM BOD (lo	179			
PD BOD (low	224			
AA BOD (hig	N/A		BOD at 0.12	
MM BOD (hi	N/A			
PD BOD (hig	N/A			
TSS Peaking	2.5			
TSS Peaking	3.5			
AA TSS (low)	37	TSS at 0.05 p		
MM TSS (low	93			
PD TSS (low)	131			
AA TSS (hig	N/A		TSS at 0.05 p	
MM TSS (hig	N/A			
PD TSS (hig	N/A			
AA TKN (low	16	Assumes TK		
MM TKN (lo	32	Assumes TK		
PD TKN (low	40			
AA TKN (hig	N/A		Assumes TK	
MM TKN (hi	N/A			
PD TKN (hig	N/A			

SUMMARY FOR STEP SYSTEM - INIT

Phase 2

Equivalen	525	**Assuming commerc**	
Equivalen	N/A		
Population	1,229	ommercial	1,074
Population	N/A	ommercial=	
Peak Flow	0.40	used as a check on th	
Peak Flow	N/A	used as a check on th	
Base Flow	0.074		
AA Flow (l	0.092		
MM Flow (	0.125	1.36	
PD Flow (l	0.17	1.80	
Peak Flow	0.34	3.68	
Base Flow	N/A		
AA Flow (l	N/A		
MM Flow (	N/A	N/A	
PD Flow (l	N/A	N/A	
Peak Flow	N/A	N/A	
BOD Peak	2.0		
BOD Peak	2.5		
AA BOD (l	147	BOD at 0.12 ppcd	
MM BOD (	295		
PD BOD (l	369		
AA BOD (l	N/A	BOD at 0.12 ppcd	
MM BOD (	N/A		
PD BOD (l	N/A		
TSS Peaki	2.5		
TSS Peaki	3.5		
AA TSS (lc	61	TSS at 0.05 ppcd	
MM TSS (l	154		
PD TSS (lc	215		
AA TSS (h	N/A	TSS at 0.05 ppcd	
MM TSS (l	N/A		
PD TSS (h	N/A		
AA TKN (l	27	Assumes TKN is 18%	
MM TKN (	53	Assumes TKN peakin	
PD TKN (l	66		
AA TKN (l	N/A	Assumes TKN is 18%	
MM TKN (	N/A		
PD TKN (l	N/A		

SUMMARY FOR STEP SYSTEM - NMUGA minus S, NE

Phase 3

Equivalen	1,037	Assuming commercial development at 50% of "HIGH" scenario	
Equivalen	N/A		
Population	2,426	ommercial=	1,080
Population	N/A	ommercial=	
Peak Flow	0.77	used as a check on the estimates above; formula from EPA Manual	
Peak Flow	N/A	used as a check on the estimates above; formula from EPA Manual	
Base Flow	0.134		
AA Flow (l	0.182		
MM Flow (	0.254	1.40	
PD Flow (l	0.35	1.90	
Peak Flow	0.68	3.74	
Base Flow	N/A		
AA Flow (l	N/A		
MM Flow (	N/A	N/A	
PD Flow (l	N/A	N/A	
Peak Flow	N/A	N/A	
BOD Peak	2.0		
BOD Peak	2.5		
AA BOD (l	267	BOD at 0.12 ppcd	
MM BOD (	534		
PD BOD (l	668		
AA BOD (l	N/A	BOD at 0.12 ppcd	
MM BOD (	N/A		
PD BOD (l	N/A		
TSS Peaki	2.5		
TSS Peaki	3.5		
AA TSS (lc	111	TSS at 0.05 ppcd	
MM TSS (l	278		
PD TSS (lc	389		
AA TSS (h	N/A	TSS at 0.05 ppcd	
MM TSS (l	N/A		
PD TSS (h	N/A		
AA TKN (l	48	Assumes TKN is 18% of BOD based on historical data	
MM TKN (	96	Assumes TKN peaking factors are equal to BOD peaking factors	
PD TKN (l	120		
AA TKN (l	N/A	Assumes TKN is 18% of BOD based on historical data	
MM TKN (	N/A		
PD TKN (l	N/A		

APPENDIX H.
ANALYSIS OF DECENTRALIZED WASTEWATER SYSTEMS

Memo **Tetra Tech/KCM, Inc.**

Date: **January 3, 2003**

To: Gary Hess, P.E.
Island County Public Works

c: *Central Files 2230018 (4-3.1)*

From: Alex Chen, P.E.
Jim Santroch, P.E.

Project No.: 2230018-004

Subject: Freeland Comprehensive Sewer Plan
Analysis of Decentralized Systems

INTRODUCTION

This technical memorandum evaluates the general feasibility of decentralized collection, treatment, and discharge systems for Freeland. This approach entails a group of small, decentralized systems, each responsible for wastewater collection, treatment, and discharge for clusters of houses or small developments. This strategy differs from the more traditional approach of a centralized wastewater system.

BACKGROUND

The EPA defines decentralized systems as "characterized by the absence of central wastewater collection and treatment." Historically, decentralized systems have been implemented when there is no opportunity for a small community to connect to a large, centralized wastewater system and when septic tanks are not feasible due to local constraints.

Treatment technologies tailored to small communities include recirculating filters, package treatment plants, and mound systems. Disposal includes drip disposal, infiltration through gravel beds, and drainfield disposal. Some of the treatment and disposal technologies are already proven, having been used on a larger scale for centralized sewage facilities. Disposal by irrigation and reuse require a higher level of treatment and treatment system redundancy which would be uneconomical in a decentralized system approach.

There is one decentralized collection, treatment, and discharge system in Freeland. The Maple Ridge Development, which is a retirement community, constructed a small collection system, package treatment plant, and drainfield for disposal. All other developed parcels in Freeland are on septic tanks.

ANALYSIS

Regulatory Requirements

The Washington State Criteria for Sewage Works Design (Ecology, 1998) defines decentralized systems as "on-site sewage systems." These systems can be defined as

- "a septic tank with subsurface sewage treatment and disposal and an ultimate design capacity of less than 14,500 gpd (gallons per day)…," or
- "a mechanical treatment system or lagoon followed by subsurface disposal with an ultimate design capacity of less than 3,500 gpd…" (G1-35)

The first definition applies to Freeland's current decentralized sewage system. Freeland is currently served by septic tanks, but the proposed housing density does not allow for their continued use in many areas. Additionally, the use of septic tanks in densely developed areas would tax the ability of the soil to treat septic tank effluent adequately.

The second definition would apply to a network of small mechanical treatment plants each serving sections of the Freeland area. It too would impact the proposed housing density and the soil's capacity for discharge.

Additionally, in Section E3-2.2, Ecology states that "proposals for large community on-site sewage systems (greater than 14,500 gpd) must demonstrate that it is not possible to connect to an existing sewage treatment facility." The strong implication is that Ecology will not allow a network of decentralized sewage systems if there is a possibility to construct or connect to a single, centralized system.

Estimated Quantities

Based on population projections and proposed zoning for the Freeland NMUGA provided by Island County, the estimated maximum monthly flows (based on the "low" population projections) are approximately 0.5 million gallons per day (mgd). Assuming that mechanical treatment plants would be used to reduce the treatment requirements of the soil, each decentralized sewage system would be sized no greater than 3,500 gpd. That sizing corresponds to 143 individual systems.

Cost

Generally, a single centralized sewage system is better able to capture an economy of scale than a network of small decentralized sewage systems. Larger systems can better capture economies of scale during construction based on reduced contractor mobilization, better unit costs based on quantity, more economical equipment costs per unit of capacity, reduced labor requirements per unit of capacity, and other construction factors.

The same economy of scale applies for operations and maintenance (O&M) requirements. Every system has a basic set of O&M requirements, such as maintaining the treatment process in a stable operating range, sampling for process optimization and regulatory requirements, recordkeeping, maintaining and replacing pumps, aerators, or other equipment, and responding to trouble calls.

In a single centralized system, although the system is large, basic O&M requirements are not anticipated to be much greater than for a single decentralized system. In a network of decentralized systems, the basic O&M requirements for one system must be multiplied by the number of systems.

In particular, overall sampling and recordkeeping requirements could be very different for a centralized system versus decentralized systems. Depending on Ecology's requirements, the number of samples for a single centralized system might not be much more than for a single decentralized system. The combined sampling requirements for all of the decentralized systems would then be much more than for a single centralized system.

Feasibility

One advantage of a centralized system is that the location of discharge facilities can be selected based on a feasible disposal methodology, such as irrigation or rapid infiltration.

Decentralized systems are more dependent on their local conditions. For example, not all decentralized systems would be able dispose of effluent through drainfields due to their local surroundings. Some of the Freeland area is near a large wetland southwest of the downtown area, across the highway. The developments in that area would likely have to pump treated effluent to another location for disposal, increasing capital costs.

Growth Potential

Decentralized systems may jeopardize the ability of Freeland to meet GMA targets. Local parcels near each system would need to be dedicated to drainfield disposal, similar to the septic leachfields currently being used. The amount of land needed for disposal might not be as high as required for septic tanks, since the decentralized systems would be providing secondary treatment or better before disposal, instead of utilizing the soil as part of the treatment strategy. However, sizing of drainfields would still be limited based on the soil's allowable hydraulic infiltration rate.

In a centralized facility, the disposal site would be selected in an area where concentrated development is not projected. The rest of the parcels in the Freeland area could be used for proposed development.

Risk

Decentralized facilities run a higher risk to the environment than centralized facilities. In decentralized systems, each system must be monitored for performance

upsets. Centralized systems have a single point of monitoring. Also, the O&M of decentralized systems may be performed by many different entities, each of which could have different protocols and internal quality control standards. In a centralized system, there is a single point of responsibility for the overall wastewater system.

Decentralized systems also discharge treated effluent in many locations throughout the area, so if a process upset goes undetected, it will be very difficult to ascertain the exact effect on local groundwater. In a centralized system, the effluent is discharged to a single area that would more readily reflect any upsets in the treatment process. Alternatively, the centralized disposal system could be located farther away from water wells, minimizing risk of aquifer contamination.

As an example of this risk, the Freeland area already has a few groundwater wells that have high nitrates (over 10 mg/L), which is an indirect indication that nearby septic systems may have failed. However, it is very difficult to tell which septic systems may have failed due to the number of systems in the area. Similar risks may apply with decentralized wastewater systems.

As a last risk factor, risks are generally reduced when the overall approach is a proven one. Centralized sewage facilities have been a very common strategy, having been used by most, if not all, major cities in the United States. Decentralized systems are not as common – many small communities either rely on septic tanks or connect to a centralized facility for reduced O&M and better economy of scale.

The EPA is currently conducting studies, including in Burnett, Washington, to select and demonstrate the feasibility of decentralized systems. However, the studies are still in progress.

CONCLUSION

Decentralized sewage systems are not recommended for Freeland. This recommendation is based on the regulatory environment, the high number of decentralized systems that would be required, the reduced economy of scale compared to centralized systems, reduced feasibility based on local constraints on disposal, impaired growth potential, and increased risk to the environment.

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APPENDIX I.
COST ESTIMATES

TECHNICAL MEMORANDUM
COST ESTIMATING CRITERIA

An important element of all Sewer Plans and Engineering Reports is a cost-effectiveness analysis comparing different alternatives for accomplishing the goal of collection and treatment of sanitary sewage. This evaluation must include consideration of both capital and operating and maintenance costs for new or upgraded facilities. A convenient method to compare the combined capital and annual operating and maintenance cost of alternatives is to present both capital and operating and maintenance costs on the same basis, either a present value or an equivalent annual cost. The purpose of this memorandum is to document cost estimating criteria and formulas to be used in evaluation of alternatives for the Freeland Comprehensive Sewer Plan and Engineering Report.

A summary of proposed criteria are presented in Table 1.

TABLE 1.
COST ESTIMATING CRITERIA

Item	Value
Period of analysis, years	20
Discount rate, percent	3.2 percent
Inflation rate, percent	2.6 percent
Construction date	Jul-09
Operations labor, $/hr (with fringes)	$30
Diesel oil, $/gal	$2.00
Propane, $/gal	$1.00
Power cost, $/kWh	$0.07
Chemical Cost, $/lb	
Sodium Hypochlorite	$0.60
Polymer	$3.00
Structural Maintenance Cost, percent per year	1 percent
Equipment Maintenance Cost, percent per year	2 percent
Engineering design, percent	15 percent
Construction management, percent	10 percent
Sales tax, percent	8.3 percent
Contingency, percent	30 percent
ENR Construction Cost Index (as of December 2003)	6782

It should be noted that these criteria were as applied at the end of the cost estimating (as shown in Chapter 8). Earlier estimating (in Chapter 5, 6, and 7) used slightly different criteria, reflecting the current conditions at the time those estimates were performed.

PERIOD OF ANALYSIS

The planning period is chosen to approximate the life of the capital facilities to be compared in the economic analysis. It is chosen to capture the influence of significant factors on economic choices. For this project a planning period of 20 years was chosen. This is a typical period for facilities planning and approximates the life of major equipment in sewage treatment plants. 20 years is the planning period required in EPA Facilities Planning (Federal Register, 40 CFR Part 35 Paragraph 35.2030 (b) (3)).

DISCOUNT RATE

The discount rate is the rate used for calculation of the present worth of future costs, usually expressed as an annual percentage rate. The discount rate is used to reduce operating costs to a comparable value to capital expenditures so capital-intensive and operations cost-intensive alternatives can be evaluated on a fair basis. As discussed below, if future costs are calculated in terms of future purchasing power (adjusted for inflation), then the appropriate discount rate for cost-effectiveness analysis is the same as the expected market rate for interest on borrowed money. If future costs (operating costs) are calculated in constant dollars, however, then the appropriate discount rate is the expected market rate for borrowing less the inflation rate inherent in the market interest rate. Prior to 1980, cost effectiveness analyses performed as a part of Facilities Plans funded by the Environmental Protection Agency (EPA) required that the discount rate be the one dictated by EPA for the purpose. This rate was adjusted on a quarterly basis. With the demise of the EPA construction grants program a variety of capital sources are available to publicly owned treatment works for new facilities and EPA does not require that plans use a particular rate. EPA still updates the discount rate, however, on a quarterly basis, as an aid to those preparing Facilities Plans. A selection of possible funding options with corresponding interest rates are presented in Table 2.

In the current work the discount rate will be used to compare the cost of operation and maintenance costs on an equivalent basis to costs for construction of new facilities. A present worth factor, PWF, will be calculated to reduce annual operation and maintenance costs, A, to a present value, P.

$$PWF = P / A = [(1 + i)^n - 1] / [i (1 + i)^n]$$

Where,

PWF	=	Present Worth Factor
P	=	Present Value, 2003 dollars (Present Value of Operations and Maintenance Cost)
A	=	Annual Value, 2003 dollars (Operations and Maintenance Cost)
i	=	Discount Rate, percent
n	=	Period of Analysis, n (years)

TABLE 2.
DISCOUNT RATE OPTIONS

Funding Option	Administering Agency	Rate, percent
State Revolving Fund	Washington State Department of Ecology	
Less than 5-year payback period		0 – 2.1%
5 - 15 year payback period		3.2%
15 - 20 year payback period		4.0
Rural Development Funding	USDA Rural Development	
Median income < $16,700 per year		4.5%
Median income < $26,591 per year		4.5%
Median income < $33,239 per year		4.75%
Median income > $33,239 per year		5.0%
Public Works Trust Fund	Washington State Department of Community Trade and Economic Development	
10% Matching Funds		3%
20% Matching Funds		2%
30% Matching Funds		1%
Nominal Interest Rate on Treasury Notes and Bonds	Federal Office of Management and Budget	
10 year maturity		6.1%
30 year maturity		6.3%
Real Interest Rate on Treasury Notes and Bonds	Federal Office of Management and Budget	
10 year maturity		3.5%
30 year maturity		3.6%
Federal Discount Rate	USEPA	6.875%

A low discount rate increases the present worth factor and therefore increases the influence of operating and maintenance cost in a comparison of alternatives with both capital and operating and maintenance costs. In consideration of two alternatives, for example, one with a high operating cost and a low capital cost and the other with a lower operating cost and a higher capital cost, a low discount rate would tend to favor the alternative with the lower operating and higher capital cost. Conversely, a higher discount rate would tend to favor the alternative with the lower capital and higher annual cost.

For cost-effectiveness analysis, the appropriate discount rate for calculation of present worth is either the real or nominal rate, depending on whether future costs are calculated based on constant value in a given year. The nominal rate is the rate paid for a bank loan or municipal bond. It includes an assumed compensation for inflation added by the lender.

For this project, operation and maintenance costs will be calculated based on their constant value in the year 2003. Therefore, the appropriate discount rate is the real discount rate, that is, the discount rate "that has been adjusted to eliminate the effect of expected inflation." (1994, Office of Management and Budget (OMB), Circular Number A-94, "Memorandum for heads of executive departments and establishments, Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs."

The real discount rate is given in a January 2003 update to the OMB circular referenced above as 2.5 percent for 10-year notes and 3.2 percent for 30-year notes. (http://www.whitehouse.gov/omb/circulars/a094/a94_appx-c.html.) The document states that for "programs with durations longer than 30 years may use the 30-year interest rate." Therefore, for the planning period used in this analysis, a discount rate of 3.2 percent was used.

INFLATION RATE

The inflation rate is the rate of decrease in the value of money expressed as an annual percentage. In comparison of alternatives, the inflation rate is used to escalate construction costs from their current value to their estimated value at the time of construction. The average inflation rate for a common index of construction costs, the Engineering News Record Construction Cost Index (ENRCCI), was 2.6 percent from January 2000 to December 2003. This is in line with the average inflation rate since 1990, which is approximately 2.7 percent.

CONSTRUCTION DATE

The estimated construction date for new facilities or for facility upgrade projects may vary for different alternatives. For an estimate based on analysis of lump sum bid breakdowns from previous projects, the appropriate construction date for escalation is the construction bid date. The reason for this is that the construction bids upon which the estimate is based have already been adjusted for the length of construction by the bidding contractor. For cost estimates based on estimates of individual construction components using current prices, the appropriate reference date for analysis is the estimated mid-point in the construction cash flow. For the current project component estimates will be used, and the default value for the mid-point of construction is assumed to be July of 2009.

OPERATIONS LABOR RATE

This rate is estimated at $30 per hour with fringe costs.

DIESEL OIL COST

The current rate is approximately $2.00 per gallon.

PROPANE COST

The current rate is $1.00 per gallon.

POWER COST

A placeholder value of $0.07/kWhr will be used. Power costs can differ for various uses. For example, rates for pump stations may be higher than for treatment because demand charges play a more significant role in determining the annual charge.

CHEMICAL COST

Estimated costs for commonly used chemicals at the wastewater treatment plants are shown in the table. Costs are shown for sodium hypochlorite and polymer. These costs have been estimated based on historical experience.

MAINTENANCE COST

To estimate the cost of maintenance of new facilities an allowance is made based on the original construction cost of the facilities. For this analysis an allowance of 1 percent per year is used for structural maintenance and 2 percent for maintenance of mechanical equipment.

CONTINGENCY

Contingency allowances are made to reflect uncertainty in engineering estimates for construction. Higher contingency allowances are appropriate for projects earlier in the cycle of planning, design, and construction. For a project with a construction bid in hand, for example, a contingency amount of 5 percent may be appropriate to cover unanticipated changes in the project which occur during construction. For projects where a detailed engineering design is complete, but bids are not yet in hand, an allowance of 15 percent may be appropriate. For planning projects, where a detailed engineering design has not been completed, uncertainty in the estimate is greater. Tt/KCM recommends an uncertainty allowance of 30 percent for planning projects.

ENGINEERING DESIGN

Allowances must be made for project costs including engineering design and other owner costs during the process of design. Based on the experience of similar projects, an allowance of 15 percent is proposed for this project.

CONSTRUCTION MANAGEMENT

Similarly, an allowance must be made for the costs of construction administration, on-site inspection of construction projects, engineering review of construction submittals, preparation of operating and maintenance manuals, start-up services, and other owner costs occurring during construction, over and above the contractor bid price. Based on the experience of similar projects, Tt/KCM recommends an allowance of 10 percent for construction management costs.

SALES TAX

The implementing agency is liable for sales tax on construction projects in the State of Washington. The current sales tax rate is 8.3 percent.

TYPICAL ALLOWANCES

Cost estimates are based on an estimate of major structural and mechanical components with allowances made for piping and miscellaneous mechanical components, electrical and instrumentation costs, contractor overhead and profit, site work, and costs for mobilization, demobilization, and construction bonds. Appropriate allowances may vary, depending on the individual alternate. For example, on buried piping, no allowances would typically be used because pricing is fairly straightforward, and unit costs are generally based from recent bid tabs that may be fairly similar to the projects being evaluated.

Typical values are presented in Table 3.

TABLE 3.
TYPICAL COST ESTIMATING ALLOWANCES

Construction Element	Allowance
Piping and Miscellaneous Mechanical	40 percent of Equipment Cost
Electrical	20 percent of Equipment Cost
Instrumentation and Control	15 percent of Equipment Cost
Contractor Overhead and Profit	15 percent of Subtotal Cost
Site work	15 percent of Subtotal Cost
Mobilization, demobilization, & bond	8 percent of Subtotal Cost

Project: Freeland Comprehensive Sewer Plan - Ch 5, 6, 7 analysis
Subject: Collection System Analysis
By : Tt/KCM
Date : 24-Jan-03

Conventional Gravity System

Capital Cost Estimate

Item	Description	Quantity	Unit	Unit cost, $	Cost, $
	8" PVC Gravity Main (8' to 10' deep)	76,263	LF	$80	$6,101,040
	8" PVC Gravity Main (10' to 12' deep)	802	LF	$90	$72,180
	8" PVC Gravity Main (12' to 14' deep)	3,901	LF	$100	$390,100
	8" PVC Gravity Main (14' to 16' deep)	1,638	LF	$125	$204,750
	4" PVC Force Main	4,480	LF	$32	$143,360
	6" PVC Force Main	4,550	LF	$45	$204,750
	4" PVC Gravity Laterals (Side Sewers)	[redacted]	EA	$2,000	$910,000
	4" PVC Gravity Laterals - extra for existing hou	[redacted]	EA	$1,000	$293,000
	1.5" HDPE Pressure Laterals - Grinder	[redacted]	EA	$2,400	$192,000
	Lateral Kits	[redacted]	EA	$250	$20,000
	48" MH (8' to 10' deep)	255	EA	$2,400	$612,000
	48" MH (8' to 12' deep)	5	EA	$2,800	$14,000
	48" MH (12' to 14' deep)	15	EA	$3,000	$45,000
	48" MH (14' to 16' deep)	5	EA	$3,200	$16,000
	Dewatering	1	LS	$50,000	$50,000
	AC Surface Restoration	99,375	SY	$12	$1,192,500
	Native Surface Restoration	44,000	SY	$1	$44,000
	Abandon Septic Tank	[redacted]	EA	$750	$219,750
					$0
	Subtotal Structural				*$10,724,430*
	Grinder Pump (Installed)	[redacted]	EA	$4,500	$360,000
	Site Electrical Connections - Grinder	[redacted]	EA	$500	$40,000
	Main Pump Station	1	EA	$500,000	$500,000
	Medium Pump Station	3	EA	$375,000	$1,125,000
	Small Pump Station	3	EA	$250,000	$750,000
					$0
	Subtotal Equipment				*$2,775,000*
	Total estimated current construction cost				*$13,499,430*
	Escalation to time of construction	2.60%			$350,985
	Total estimated construction cost				$13,850,415
	Contingency	30%			$4,155,125
	Engineering Design	15%			$2,700,831
	Construction Management	10%			$1,800,554
	Sales Tax	8.8%			$1,584,487
	Total Estimated Capital Cost				$24,091,000

Operations and Maintenance Cost Estimate (per year)

Item	Description	Quantity	Unit	Unit Cost	Annual Cost
	Labor	684	hr	$30	$20,520
	Septic tank pumping		ea	$300	$0
	Diesel oil		gal	$2.00	$0
	Power	97985	kWh	$0.07	$6,859
	Structural Maintenance	2%			$220,065
	Equipment replacement	4%			$113,886
	Chemicals			$0.00	$0
	Hypochlorite	0	lb	$0.60	$0
	Sodium Bisulfite	0	gal	$0.20	$0
	Polymer		lb	$3.00	$0
	Misc expenses		allowance		$0
	Total Annual Cost				$361,330
	Present Worth Factor	14.6061			
	Present Worth Cost				$5,278,000

Total Present Worth Project Cost Estimate

Capital	$24,091,000
Operations and Maintenance	$5,278,000
Total Present Worth	$29,369,000

Project: Freeland Comprehensive Sewer Plan - Ch 5, 6, 7 analysis
Subject: Collection System Analysis
By : Tt/KCM
Date : 24-Jan-03

STEP System

Capital Cost Estimate

Item	Description	Quantity	Unit	Unit cost, $	Cost, $
	2" PVC Pressure Mains	20,368	LF	$15	$305,520
	3" PVC Pressure Mains	32,150	LF	$16	$514,400
	4" PVC Pressure Mains	21,458	LF	$18	$386,244
	6" PVC Pressure Mains	5,535	LF	$22	$121,770
	1.5" HDPE Pressure Laterals - STEP	[redacted]	EA	$1,000	$455,000
	1.5" HDPE Pressure Laterals - extra for existing	[redacted]	EA	$500	$146,500
	Lateral Kits	[redacted]	EA	$250	$113,750
	Clean Out Installation	100	EA	$1,500	$150,000
	Air Release Valve Installation	10	EA	$2,000	$20,000
	Dewatering	1	LS	$5,000	$5,000
	AC Surface Restoration	24,700	SY	$12	$296,400
	Native Surface Restoration	18,200	SY	$1	$18,200
	Abandon Septic Tank	[redacted]	EA	$750	$219,750
					$0
	Subtotal Structural				*$2,752,534*
	Septic Tank w/ Pump (Installed)	[redacted]	EA	$4,000	$1,820,000
	Septic Tank w/ Pump - extra for existing houses	[redacted]	EA	$1,500	$439,500
	Site Electrical Connections - STEP	[redacted]	EA	$250	$113,750
	Site Electrical Connections - STEP, extra for exi	[redacted]	EA	$1,000	$293,000
	Main Pump Station	1	EA	$500,000	$500,000
	Odor Control	1	LS	$50,000	$50,000
					$0
	Subtotal Equipment				*$3,216,250*
	Total estimated current construction cost				*$5,968,784*
	Escalation to time of construction	2.60%			$155,188
	Total estimated construction cost				$6,123,972
	Contingency	30%			$1,837,192
	Engineering Design	15%			$1,194,175
	Construction Management	10%			$796,116
	Sales Tax	8.3%			$660,777
	Total Estimated Capital Cost				$10,612,000

Operations and Maintenance Cost Estimate (per year)

Item	Description	Quantity	Unit	Unit Cost	Annual Cost
	Labor	507	hr	$30	$15,210
	Septic tank pumping	91	ea	$300	$27,300
	Diesel oil		gal	$2.00	$0
	Power	123842	kWh	$0.07	$8,669
	Structural Maintenance	2%			$56,482
	Equipment replacement	4%			$131,995
	Chemicals			$0.00	$0
	Hypochlorite	0	lb	$0.60	$0
	Sodium Bisulfite	0	gal	$0.20	$0
	Polymer		lb	$3.00	$0
	Misc expenses		allowance		$0
	Total Annual Cost				$239,656
	Present Worth Factor	14.6061			
	Present Worth Cost				$3,500,000

Total Present Worth Project Cost Estimate

Capital	$10,612,000
Operations and Maintenance	$3,500,000
Total Present Worth	$14,112,000

Project: Freeland Comprehensive Sewer Plan - Ch 5, 6, 7 analysis
Subject: Collection System Analysis
By : Tt/KCM
Date : 24-Jan-03

Combined Gravity/STEP System

Capital Cost Estimate

Item	Description	Quantity	Unit	Unit cost, $	Cost, $
	8" PVC Gravity Main (8' to 10' deep)	26,344	LF	$80	$2,107,520
	8" PVC Gravity Main (10' to 12' deep)	802	LF	$90	$72,180
	8" PVC Gravity Main (12' to 14' deep)	3,551	LF	$100	$355,100
	8" PVC Gravity Main (14' to 16' deep)	1,638	LF	$125	$204,750
	2" PVC Pressure Mains	15,952	LF	$15	$239,280
	3" PVC Pressure Mains	26,269	LF	$16	$420,304
	4" PVC Pressure Mains	6,584	LF	$18	$118,512
	6" PVC Force Main	4,550	LF	$22	$100,100
	4" PVC Gravity Laterals (Side Sewers)	[illegible]	EA	$2,000	$498,000
	4" PVC Gravity Laterals - extra for existing hous	[illegible]	EA	$1,000	$160,300
	1.5" HDPE Pressure Laterals - STEP	[illegible]	EA	$1,000	$206,000
	1.5" HDPE Pressure Laterals - extra for existing	[illegible]	EA	$500	$66,350
	Lateral Kits	[illegible]	EA	$250	$51,500
	48" MH (8' to 10' deep)	90	EA	$2,400	$216,000
	48" MH (8' to 12' deep)	5	EA	$2,800	$14,000
	48" MH (12' to 14' deep)	15	EA	$3,000	$45,000
	48" MH (14' to 16' deep)	5	EA	$3,200	$16,000
	Clean Out Installation	60	EA	$1,500	$90,000
	Air Release Valve Installation	10	EA	$2,000	$20,000
	Dewatering	1	LS	$25,000	$25,000
	AC Surface Restoration	56,873	SY	$12	$682,471
	Native Surface Restoration	18,200	SY	$1	$18,200
	Abandon Septic Tank	293	EA	$750	$219,750
					$0
	Subtotal Structural				*$5,946,317*
	Grinder Pump (Installed)	[illegible]	EA	$4,500	$0
	Septic Tank w/ Pump (Installed)	[illegible]	EA	$4,000	$824,000
	Septic Tank w/ Pump - extra for existing houses	[illegible]	EA	$1,500	$199,050
	Site Electrical Connections - STEP	[illegible]	EA	$250	$51,500
	Site Electrical Connections - STEP, extra for ex	[illegible]	EA	$1,000	$132,700
	Main Pump Station	1	EA	$500,000	$500,000
	Medium Pump Station	2	EA	$375,000	$750,000
	Odor Control	1	LS	$100,000	$100,000
					$0
	Subtotal Equipment				*$2,557,250*
	Total estimated current construction cost				*$8,503,567*
	Escalation to time of construction	2.60%			$221,093
	Total estimated construction cost				$8,724,660
	Contingency	30%			$2,617,398
	Engineering Design	15%			$1,701,309
	Construction Management	10%			$1,134,206
	Sales Tax	8.3%			$941,391
	Total Estimated Capital Cost				$15,119,000

Operations and Maintenance Cost Estimate (per year)

Item	Description	Quantity	Unit	Unit Cost	Annual Cost
	Labor	362	hr	$30	$10,860
	Septic tank pumping	41	ea	$300	$12,360
	Diesel oil		gal	$2.00	$0
	Power	83287	kWh	$0.07	$5,830
	Structural Maintenance	2%			$122,018
	Equipment replacement	4%			$104,950
	Chemicals			$0.00	$0
	Hypochlorite	0	lb	$0.60	$0
	Sodium Bisulfite	0	gal	$0.20	$0
	Polymer		lb	$3.00	$0
	Misc expenses		allowance		$0
	Total Annual Cost				$256,018
	Present Worth Factor	14.6061			
	Present Worth Cost				$3,739,000

Total Present Worth Project Cost Estimate

Capital	$15,119,000
Operations and Maintenance	$3,739,000
Total Present Worth	$18,858,000

Project: **Freeland Comprehensive Sewer Plan - Ch 5, 6, 7 analysis**
Subject: **Secondary Treatment Analysis**
By : **Tt/KCM**
Date : **7-Apr-03**
Oxidation Ditches (Freeland Only)
Capital Cost Estimate

Item	Description	Quantity	Unit	Unit cost, $	Cost, $
	Administration/Lab Building	1,500	SF	$125	$187,500
	Electrical Building (generator outside)	1,200	SF	$100	$120,000
	Mechanical Building	450	SF	$100	$45,000
	Filter & Chemical Building	1,200	SF	$100	$120,000
	Slab Concrete and Rebar	1,540	CY	$300	$461,879
	Straight Wall Concrete and Rebar	293	CY	$400	$117,333
	Curved Wall Concrete and Rebar	469	CY	$500	$234,572
	Deck - Aerator Support Concrete	89	CY	$600	$53,333
	Access Bridge Concrete	0	CY	$500	$0
	Effluent Weir Concrete	16	CY	$500	$8,000
	Misc Metals (Handrailing, Covers, etc.)	1	LS	$80,000	$80,000
	Site Stormwater Piping and Valving	1	LS	$30,000	$30,000
	Site Process Piping and Valving	1	LS	$500,000	$500,000
	Indoor Process Piping and Valving	1	LS	$100,000	$100,000
	Manholes	5	EA	$6,000	$30,000
	Stormwater Detention Tank and Control Struct	1	LS	$100,000	$100,000
	Sitework	1	LS	$300,000	$300,000
	Landscaping	1	LS	$50,000	$50,000
	Electrical Conduit, Sitework	1	LS	$50,000	$50,000
	Site Lighting	1	LS	$40,000	$40,000
	Laboratory Equipment	1	LS	$25,000	$25,000
	Furniture	1	LS	$20,000	$20,000
	Land Acquisition	3	AC	$10,000	$30,000
					$0
	Subtotal Structural				*$2,702,618*
	Aerators - 20 hp	5	EA	$25,000	$125,000
	Mixer for anoxic zone	4	EA	$5,000	$20,000
	Mixer for aerobic zone	4	EA	$15,000	$60,000
	Ditch Effluent Weirs - 10 ft	4	EA	$10,000	$40,000
	Clarifiers - 40-ft diam, 12 ft deep	3	EA	$55,000	$165,000
	RAS/WAS Pumps	8	EA	$7,500	$60,000
	Magnetic Flow Meters	2	EA	$5,000	$10,000
	Yard Pump Station Pumps	2	EA	$7,500	$15,000
	Plant Water Pumps	2	EA	$5,000	$10,000
	Strainer (Manual duplex)	1	EA	$2,000	$2,000
	Hydro Tank	1	EA	$4,000	$4,000
	Odor Control - Carbon Adsorber, Fans, Piping	0	LS	$75,000	$0
	Generator	750	kW	$175	$131,250
	Generator Silencer, Louvers, Acoustics	1	LS	$5,000	$5,000
	Underground Fuel Storage Tank, Pumps	1	LS	$10,000	$10,000
	Automatic Transfer Switch	1	LS	$15,000	$15,000
	Motor Control Centers/Variable Frequency Driv	1	LS	$75,000	$75,000
	PLC	1	LS	$100,000	$100,000
	Filter Equipment + installation	1	LS	$150,000	$150,000
	Chemical Storage Tanks	1	LS	$10,000	$10,000
	Chemical Feed Pumps	1	LS	$7,500	$7,500
	Flow Pacing Controller	1	LS	$5,000	$5,000
	Flocculation Tank	1	LS	$2,500	$2,500

			$0
Subtotal Equipment			*$1,022,250*
Installation, Miscellaneous Mechanical	40%	of Equip	$408,900
Electrical	20%	of Equip	$204,450
Instrumentation and Control	15%	of Equip	$153,338
Subtotal Structural, Mechanical, Elect, I&C			*$4,491,556*
Contractor O&P	15%	of Sub Cost	$673,733
Mobilization, demobilization, bond	6%	of Sub cost	$269,493
Total estimated current construction cost			*$5,434,782*
Escalation to time of construction	2.60%		$141,304
Total estimated construction cost			$5,576,087
Contingency	30%		$1,672,826
Engineering Design	15%		$1,087,337
Construction Management	10%		$724,891
Sales Tax	8.3%		$601,660
Total Estimated Capital Cost			$9,663,000

Operations and Maintenance Cost Estimate (per year)

Item	Description	Quantity	Unit	Unit Cost	Annual Cost
	Labor	1,820	HR	$30	$54,600
			EA	$300	$0
	Diesel oil		GAL	$2.00	$0
	Power	228,632	kWh	$0.07	$16,004
	Structural Maintenance	2%			$55,458
	Equipment replacement	4%			$41,953
	Chemicals - alum coagulant for filter	38,051	LB	$0.15	$5,708
	Hypochlorite	0	LB	$0.60	$0
	Sodium Bisulfite	0	GAL	$0.20	$0
	Polymer		LB	$3.00	$0
	Misc expenses		allowance		$0
	Total Annual Cost				$173,723
	Present Worth Factor	14.6061			
	Present Worth Cost				$2,537,000

Total Present Worth Project Cost Estimate

Capital	$9,663,000
Operations and Maintenance	$2,537,000
Total Present Worth	$12,200,000

Project: Freeland Comprehensive Sewer Plan - Ch 5, 6, 7 analysis
Subject: Secondary Treatment Analysis
By : Tt/KCM
Date : 7-Apr-03

Sequencing Batch Reactors (Freeland Only)

Capital Cost Estimate

Item	Description	Quantity	Unit	Unit cost, $	Cost, $
	Administration/Lab Building	1,500	SF	$125	$187,500
	Electrical Building (generator outside)	1,200	SF	$100	$120,000
	Mechanical Building	900	SF	$100	$90,000
	Filter & Chemical Building	1,200	SF	$100	$120,000
	Slab Concrete and Rebar	871	CY	$300	$261,422
	Straight Wall Concrete and Rebar	1,052	CY	$400	$420,622
	Curved Wall Concrete and Rebar	0	CY	$500	$0
	Deck - Aerator Support Concrete	0	CY	$500	$0
	Access Bridge Concrete	60	CY	$500	$30,000
	Effluent Weir Concrete	0	CY	$500	$0
	Misc Metals (Handrailing, Covers, etc.)	1	LS	$80,000	$80,000
	Site Stormwater Piping and Valving	1	LS	$30,000	$30,000
	Site Process Piping and Valving	1	LS	$150,000	$150,000
	Indoor Process Piping and Valving	1	LS	$400,000	$400,000
	Manholes	5	EA	$6,000	$30,000
	Stormwater Detention Tank and Control Struct	1	LS	$100,000	$100,000
	Sitework	1	LS	$250,000	$250,000
	Landscaping	1	LS	$50,000	$50,000
	Electrical Conduit, Sitework	1	LS	$50,000	$50,000
	Site Lighting	1	LS	$40,000	$40,000
	Laboratory Equipment	1	LS	$25,000	$25,000
	Furniture	1	LS	$20,000	$20,000
	Land Acquisition	3	AC	$10,000	$30,000
					$0
	Subtotal Structural				*$2,484,544*
	SBR Equipment	1	LS	$375,000	$375,000
	(5 motive pumps @ 10 hp)				$0
	(4 WAS pumps @ 7.5 hp)				$0
	(4 Blowers @ 25 hp)				$0
	Magnetic Flow Meters	2	EA	$5,000	$10,000
	Yard Pump Station Pumps	2	EA	$7,500	$15,000
	Plant Water Pumps	2	EA	$5,000	$10,000
	Strainer (Manual duplex)	1	EA	$2,000	$2,000
	Hydro Tank	1	EA	$4,000	$4,000
	Odor Control - Carbon Adsorber, Fans, Piping	0	LS	$75,000	$0
	Generator	750	kW	$175	$131,250
	Generator Silencer, Louvers, Acoustics	1	LS	$5,000	$5,000
	Underground Fuel Storage Tank, Pumps	1	LS	$10,000	$10,000
	Automatic Transfer Switch	1	LS	$15,000	$15,000
	Motor Control Centers/Variable Frequency Driv	1	LS	$75,000	$75,000
	PLC	1	LS	$100,000	$100,000
	Filter Equipment + installation	1	LS	$150,000	$150,000
	Chemical Storage Tanks	1	LS	$10,000	$10,000
	Chemical Feed Pumps	1	LS	$7,500	$7,500
	Flow Pacing Controller	1	LS	$5,000	$5,000
	Flocculation Tank	1	LS	$2,500	$2,500
					$0
					$0

			$0
Subtotal Equipment			*$927,250*
Installation, Miscellaneous Mechanical	40%	of Equip	$370,900
Electrical	20%	of Equip	$185,450
Instrumentation and Control	15%	of Equip	$139,088
Subtotal Structural, Mechanical, Elect, I&C			*$4,107,232*
Contractor O&P	15%	of Sub Cost	$616,085
Mobilization, demobilization, bond	6%	of Sub cost	$246,434
Total estimated current construction cost			*$4,969,751*
Escalation to time of construction	2.60%		$129,214
Total estimated construction cost			$5,098,964
Contingency	30%		$1,529,689
Engineering Design	15%		$994,298
Construction Management	10%		$662,865
Sales Tax	8.3%		$550,178
Total Estimated Capital Cost			$8,836,000

Operations and Maintenance Cost Estimate (per year)

Item	Description	Quantity	Unit	Unit Cost	Annual Cost
	Labor	2,080	HR	$30	$62,400
			EA	$300	$0
	Diesel oil		GAL	$2.00	$0
	Power	228,632	kWh	$0.07	$16,004
	Structural Maintenance	2%			$50,983
	Equipment replacement	4%			$38,054
	Chemicals - alum coagulant for filter	38,051	LB	$0.15	$5,708
	Hypochlorite	0	LB	$0.60	$0
	Sodium Bisulfite	0	GAL	$0.20	$0
	Polymer		LB	$3.00	$0
	Misc expenses		allowance		$0
	Total Annual Cost				$173,149
	Present Worth Factor	14.6061			
	Present Worth Cost				$2,529,000

Total Present Worth Project Cost Estimate

Capital	$8,836,000
Operations and Maintenance	$2,529,000
Total Present Worth	$11,365,000

Project: Freeland Comprehensive Sewer Plan - Ch 5, 6, 7 analysis
Subject: Secondary Treatment Analysis
By : Tt/KCM
Date : 7-Apr-03

Membrane Bioreactors (Freeland Only)

Capital Cost Estimate

Item	Description	Quantity	Unit	Unit cost, $	Cost, $
	Administration/Lab Building	1,500	SF	$125	$187,500
	Electrical Building (generator outside)	1,200	SF	$100	$120,000
	Mechanical Building	900	SF	$100	$90,000
	Filter & Chemical Building	0	SF	$100	$0
	Slab Concrete and Rebar	390	CY	$300	$117,000
	Straight Wall Concrete and Rebar	607	CY	$400	$242,607
	Curved Wall Concrete and Rebar	0	CY	$500	$0
	Deck - Aerator Support Concrete	0	CY	$500	$0
	Access Bridge Concrete	40	CY	$500	$20,000
	Effluent Weir Concrete	0	CY	$500	$0
	Misc Metals (Handrailing, Covers, etc.)	1	LS	$60,000	$60,000
	Site Stormwater Piping and Valving	1	LS	$20,000	$20,000
	Site Process Piping and Valving	1	LS	$150,000	$150,000
	Indoor Process Piping and Valving	1	LS	$300,000	$300,000
	Manholes	5	EA	$6,000	$30,000
	Stormwater Detention Tank and Control Structu	1	LS	$60,000	$60,000
	Sitework	1	LS	$200,000	$200,000
	Landscaping	1	LS	$40,000	$40,000
	Electrical Conduit, Sitework	1	LS	$40,000	$40,000
	Site Lighting	1	LS	$30,000	$30,000
	Laboratory Equipment	1	LS	$25,000	$25,000
	Furniture	1	LS	$20,000	$20,000
	Land Acquisition	3	AC	$10,000	$30,000
					$0
	Subtotal Structural				*$1,782,107*
	Equipment	1	EA	$1,360,000	$1,360,000
	(membranes, cleaning tanks, vacuum pumps)				$0
	(process air blowers and diffusers)				$0
	Influent Screen - 1/8 in.	0	LS	$100,000	$0
	Washer Compactor	0	LS	$25,000	$0
	WAS Pumps	4	EA	$7,500	$30,000
	Magnetic Flow Meters	2	EA	$5,000	$10,000
	Yard Pump Station Pumps	2	EA	$7,500	$15,000
	Plant Water Pumps	2	EA	$5,000	$10,000
	Strainer (Manual duplex)	1	EA	$2,000	$2,000
	Hydro Tank	1	EA	$4,000	$4,000
	Odor Control - Carbon Adsorber, Fans, Piping	0	LS	$75,000	$0
	Generator	1,000	kW	$175	$175,000
	Generator Silencer, Louvers, Acoustics	1	LS	$5,000	$5,000
	Underground Fuel Storage Tank, Pumps	1	LS	$15,000	$15,000
	Automatic Transfer Switch	1	LS	$15,000	$15,000
	Motor Control Centers/Variable Frequency Driv	1	LS	$75,000	$75,000
	PLC	1	LS	$100,000	$100,000
					$0
					$0
					$0
					$0
					$0

				$0
	Subtotal Equipment			*$1,816,000*
	Installation, Miscellaneous Mechanical	30%	of Equip	$544,800
	Electrical	15%	of Equip	$272,400
	Instrumentation and Control	10%	of Equip	$181,600
	Subtotal Structural, Mechanical, Elect, I&C			*$4,596,907*
	Contractor O&P	15%	of Sub Cost	$689,536
	Mobilization, demobilization, bond	6%	of Sub cost	$275,814
	Total estimated current construction cost			*$5,562,258*
	Escalation to time of construction	2.60%		$144,619
	Total estimated construction cost			$5,706,877
	Contingency	30%		$1,712,063
	Engineering Design	15%		$1,112,841
	Construction Management	10%		$741,894
	Sales Tax	8.3%		$615,772
	Total Estimated Capital Cost			$9,889,000

Operations and Maintenance Cost Estimate (per year)

Item	Description	Quantity	Unit	Unit Cost	Annual Cost
	Labor	2,080	HR	$30	$62,400
	Membrane Replacement	700	panel	$75	$52,500
	Diesel oil		GAL	$2.00	$0
	Power	496,457	kWh	$0.07	$34,752
	Structural Maintenance	2%			$36,569
	Equipment replacement	4%			$74,529
	Chemicals - membrane cleaning	1	LS	$1,000	$1,000
	Hypochlorite	0	LB	$0.60	$0
	Sodium Bisulfite	0	GAL	$0.20	$0
	Polymer		LB	$3.00	$0
	Misc expenses		allowance		$0
	Total Annual Cost				$261,749
	Present Worth Factor	14.6061			
	Present Worth Cost				$3,823,000

Total Present Worth Project Cost Estimate

Capital	$9,889,000
Operations and Maintenance	$3,823,000
Total Present Worth	$13,712,000

Project: Freeland Comprehensive Sewer Plan - Ch 5, 6, 7 analysis
Subject: Secondary Treatment Analysis
By : Tt/KCM
Date : 7-Apr-03

Membrane Bioreactors (with HHSD)

Capital Cost Estimate

Item	Description	Quantity	Unit	Unit cost, $	Cost, $
	Administration/Lab Building	0	SF	$125	$0
	Electrical Building (generator outside)	1,200	SF	$100	$120,000
	Mechanical Building	900	SF	$100	$90,000
	Filter & Chemical Building	0	SF	$100	$0
	Slab Concrete and Rebar	260	CY	$300	$78,000
	Straight Wall Concrete and Rebar	404	CY	$400	$161,738
	Curved Wall Concrete and Rebar	0	CY	$500	$0
	Deck - Aerator Support Concrete	0	CY	$500	$0
	Access Bridge Concrete	27	CY	$500	$13,333
	Effluent Weir Concrete	0	CY	$500	$0
	Misc Metals (Handrailing, Covers, etc.)	1	LS	$40,000	$40,000
	Site Stormwater Piping and Valving	1	LS	$15,000	$10,000
	Site Process Piping and Valving	1	LS	$150,000	$150,000
	Indoor Process Piping and Valving	1	LS	$300,000	$300,000
	Manholes	5	EA	$6,000	$30,000
	Stormwater Detention Tank and Control Struct	1	LS	$50,000	$50,000
	Sitework	1	LS	$100,000	$100,000
	Landscaping	1	LS	$25,000	$25,000
	Electrical Conduit, Sitework	1	LS	$40,000	$40,000
	Site Lighting	1	LS	$20,000	$20,000
	Laboratory Equipment	0	LS	$25,000	$0
	Furniture	0	LS	$20,000	$0
	Land Acquisition	0	AC	$10,000	$0
	Site Demolition	1	LS	$50,000	$50,000
					$0
	Subtotal Structural				*$1,278,072*
	Equipment	1	EA	$1,560,000	$1,560,000
	(membranes, cleaning tanks, vacuum pumps)				$0
	(process air blowers and diffusers)				$0
	Influent Screen - 1/8 in.	0	LS	$100,000	$0
	Washer Compactor	0	LS	$25,000	$0
	WAS Pumps	4	EA	$7,500	$30,000
	Magnetic Flow Meters	2	EA	$5,000	$10,000
	Yard Pump Station Pumps	2	EA	$7,500	$15,000
	Plant Water Pumps	0	EA	$5,000	$0
	Strainer (Manual duplex)	0	EA	$2,000	$0
	Hydro Tank	0	EA	$4,000	$0
	Odor Control - Carbon Adsorber, Fans, Piping	0	LS	$75,000	$0
	Generator	1,000	kW	$175	$175,000
	Generator Silencer, Louvers, Acoustics	1	LS	$5,000	$5,000
	Underground Fuel Storage Tank, Pumps	1	LS	$15,000	$15,000
	Automatic Transfer Switch	1	LS	$15,000	$15,000
	Motor Control Centers/Variable Frequency Driv	1	LS	$75,000	$75,000
	PLC	1	LS	$100,000	$100,000
	Intermediate Pump Station from Freeland	1	LS	$250,000	$250,000
					$0
					$0
					$0
					$0

			$0
Subtotal Equipment			*$2,250,000*
Installation, Miscellaneous Mechanical	30%	of Equip	$675,000
Electrical	15%	of Equip	$337,500
Instrumentation and Control	10%	of Equip	$225,000
Subtotal Structural, Mechanical, Elect, I&C			*$4,765,572*
Contractor O&P	15%	of Sub Cost	$714,836
Mobilization, demobilization, bond	6%	of Sub cost	$285,934
Total estimated current construction cost			*$5,766,342*
Escalation to time of construction	2.60%		$149,925
Total estimated construction cost			$5,916,267
Contingency	30%		$1,774,880
Engineering Design	15%		$1,153,672
Construction Management	10%		$769,115
Sales Tax	8.3%		$638,365
Total Estimated Capital Cost			$10,252,000

Operations and Maintenance Cost Estimate (per year)

Item	Description	Quantity	Unit	Unit Cost	Annual Cost
	Labor	1,040	HR	$30	$31,200
	Membrane Replacement	780	panel	$75	$58,500
	Diesel oil		GAL	$2.00	$0
	Power	605,329	kWh	$0.07	$42,373
	Structural Maintenance	2%			$26,226
	Equipment replacement	4%			$92,340
	Chemicals - membrane cleaning	1	LS	$1,000	$1,000
	Hypochlorite	0	LB	$0.60	$0
	Sodium Bisulfite	0	GAL	$0.20	$0
	Polymer		LB	$3.00	$0
	Misc expenses		allowance		$0
	Total Annual Cost				$251,639
	Present Worth Factor	14.6061			
	Present Worth Cost				$3,675,000

Total Present Worth Project Cost Estimate

Capital	$10,252,000
Operations and Maintenance	$3,675,000
Total Present Worth	$13,927,000

Project: Freeland Comprehensive Sewer Plan - Ch 5, 6, 7 analysis
Subject: Disinfection Analysis
By : Tt/KCM
Date : 7-Apr-03

Liquid Sodium Hypochlorite Disinfection

Capital Cost Estimate

Item	Description	Quantity	Unit	Unit cost, $	Cost, $
	Building enclosure for equipment	100	SF	$100	$10,000
	Slab Concrete and Rebar	72	CY	$300	$21,667
	Straight Wall Concrete and Rebar	62	CY	$400	$24,889
	Misc Metals (Handrailing, Covers, etc.)	1	LS	$500	$500
	Misc Concrete (NaOCl secondary containment)	5	CY	$500	$2,500
	Site Process Piping and Valving	1	LS	$20,000	$20,000
	Sitework	1	LS	$10,000	$10,000
	Electrical Conduit, Sitework	1	LS	$2,000	$2,000
	Site Lighting	1	LS	$20,000	$20,000
	Contact Tank Baffles	1	LS	$10,000	$10,000
					$0
	Subtotal Structural				*$121,556*
	Storage Tank (3-55 gal drums)	3	ea	$200	$600
	Pumps w/ installation (hypo)	2	ea	$2,500	$5,000
	Tank Mixers	1	ea	$1,000	$1,000
	Feed Pacing Controller	1	ea	$2,500	$2,500
	Chemical Flow Meter	1	ea	$2,000	$2,000
					$0
					$0
					$0
	Subtotal Equipment				*$11,100*
	Installation, Miscellaneous Mechanical	40%	of Equip		$4,440
	Electrical	20%	of Equip		$2,220
	Instrumentation and Control	15%	of Equip		$1,665
	Subtotal Structural, Mechanical, Elect, I&C				*$140,981*
	Contractor O&P	15%	of Sub Cost		$21,147
	Mobilization, demobilization, bond	6%	of Sub cost		$8,459
	Total estimated current construction cost				*$170,586*
	Escalation to time of construction	2.60%			$4,435
	Total estimated construction cost				$175,022
	Contingency	30%			$52,507
	Engineering Design	15%			$34,129
	Construction Management	10%			$22,753
	Sales Tax	8.3%			$18,885
	Total Estimated Capital Cost				$303,000

Operations and Maintenance Cost Estimate (per year)

Item	Description	Quantity	Unit	Unit Cost	Annual Cost
	Labor	52	hr	$30	$1,560
	Septic tank pumping		ea	$300	$0
	Diesel oil		gal	$2.00	$0
	Power	4899	kWh	$0.07	$343
	Structural Maintenance	2%			$2,494
	Equipment replacement	4%			$456
	Chemicals			$0.00	$0
	Hypochlorite	3044	lb	$0.60	$1,826
	Sodium Bisulfite	0	gal	$0.20	$0
	Polymer		lb	$3.00	$0
	Misc expenses		allowance		$0
	Total Annual Cost				$6,679
	Present Worth Factor	14.6061			
	Present Worth Cost				$98,000

Total Present Worth Project Cost Estimate

Capital	$303,000
Operations and Maintenance	$98,000
Total Present Worth	$401,000

Project: Freeland Comprehensive Sewer Plan - Ch 5, 6, 7 analysis
Subject: Disinfection Analysis
By : Tt/KCM
Date : 7-Apr-03

Ultraviolet Disinfection + Liquid Hypochlorite for Residual

Capital Cost Estimate

Item	Description	Quantity	Unit	Unit cost, $	Cost, $
	Building enclosure for equipment	100	SF	$100	$10,000
	Slab Concrete and Rebar	22	CY	$300	$6,667
	Straight Wall Concrete and Rebar	36	CY	$400	$14,222
	Misc Metals (Handrailing, Covers, etc.)	1	LS	$5,000	$5,000
	Misc Concrete (NaOCl secondary containment)	5	CY	$500	$2,500
	Site Process Piping and Valving	1	LS	$20,000	$20,000
	Sitework	1	LS	$10,000	$10,000
	Electrical Conduit, Sitework	1	LS	$10,000	$10,000
	Site Lighting	1	LS	$20,000	$20,000
	Jib Crane for UV Unit	1	LS	$5,000	$5,000
					$0
	Subtotal Structural				*$103,389*
	Lamps and Equipment with installation	1	ea	$100,000	$100,000
	Additional Generator Capacity - for UV and add.	65	kW	$200	$12,948
	Storage Tank (3-55 gal drums)	3	ea	$200	$600
	Pumps w/ installation (hypo)	2	ea	$2,500	$5,000
	Tank Mixers	1	ea	$1,000	$1,000
	Feed Pacing Controller	1	ea	$2,500	$2,500
	Chemical Flow Meter	1	ea	$2,000	$2,000
					$0
	Subtotal Equipment				*$124,048*
	Installation, Miscellaneous Mechanical	40%	of Equip		$49,619
	Electrical	20%	of Equip		$24,810
	Instrumentation and Control	15%	of Equip		$18,607
	Subtotal Structural, Mechanical, Elect, I&C				*$320,474*
	Contractor O&P	15%	of Sub Cost		$48,071
	Mobilization, demobilization, bond	6%	of Sub cost		$19,228
	Total estimated current construction cost				*$387,773*
	Escalation to time of construction	2.60%			$10,082
	Total estimated construction cost				$397,855
	Contingency	30%			$119,357
	Engineering Design	15%			$77,582
	Construction Management	10%			$51,721
	Sales Tax	8.3%			$42,929
	Total Estimated Capital Cost				$689,000

Operations and Maintenance Cost Estimate (per year)

Item	Description	Quantity	Unit	Unit Cost	Annual Cost
	Labor	104	hr	$30	$3,120
	Septic tank pumping	0	ea	$300	$60
	Diesel oil		gal	$2.00	$0
	Power	15208	kWh	$0.07	$1,065
	Structural Maintenance	2%			$2,122
	Equipment replacement	4%			$5,091
	Chemicals			$0.00	$0
	Hypochlorite	761	lb	$0.60	$457
	Sodium Bisulfite	0	gal	$0.20	$0
	Polymer		lb	$3.00	$0
	Misc expenses		allowance		$0
	Total Annual Cost				$11,914
	Present Worth Factor	14.6061			
	Present Worth Cost				$174,000

Total Present Worth Project Cost Estimate

Capital	$689,000
Operations and Maintenance	$174,000
Total Present Worth	$863,000

Project: Freeland Comprehensive Sewer Plan - Ch 5, 6, 7 analysis
Subject: Solids Handling Analysis
By : Tt/KCM
Date : 28-Apr-03

Stabilize, Haul Unthickened to Island County

Capital Cost Estimate

Item	Description	Quantity	Unit	Unit cost, $	Cost, $
	Slab Concrete and Rebar	46	CY	$300	$13,889
	Straight Wall Concrete and Rebar	119	CY	$400	$47,407
	Curved Wall Concrete and Rebar	0	CY	$500	$0
	Access Bridge Concrete	0	CY	$500	$0
	Earthwork	2,315	CY	$20	$46,296
	Misc Metals (Handrailing, Covers, etc.)	1	LS	$10,000	$10,000
	FRP Covers	1	LS	$10,000	$10,000
	Site Process Piping and Valving	1	LS	$15,000	$15,000
	Sitework	1	LS	$25,000	$25,000
	Electrical Conduit, Sitework	1	LS	$15,000	$15,000
	Building Space for Solids Equipment	300	SF	$100	$30,000
					$0
	Subtotal Structural				*$212,593*
	Blowers - 10 Hp	2	EA	$15,000	$30,000
	Sludge Storage Tank Diffusers	1	LS	$10,000	$10,000
			EA	$5,000	$0
			EA	$5,000	$0
			EA	$5,000	$0
			EA	$5,000	$0
			EA	$5,000	$0
					$0
	Subtotal Equipment				*$40,000*
	Installation, Miscellaneous Mechanical	40%	of Equip		$16,000
	Electrical	20%	of Equip		$8,000
	Instrumentation and Control	15%	of Equip		$6,000
	Subtotal Structural, Mechanical, Elect, I&C				*$282,593*
	Contractor O&P	15%	of Sub Cost		$42,389
	Mobilization, demobilization, bond	6%	of Sub cost		$16,956
	Total estimated current construction cost				*$341,937*
	Escalation to time of construction	2.60%			$8,890
	Total estimated construction cost				$350,827
	Contingency	30%			$105,248
	Engineering Design	15%			$68,411
	Construction Management	10%			$45,608
	Sales Tax	8.3%			$37,854
	Total Estimated Capital Cost				$608,000

Operations and Maintenance Cost Estimate (per year)

Item	Description	Quantity	Unit	Unit Cost	Annual Cost
	Labor	208	HR	$30	$6,240
		0	EA	$300	$0
	Contract Haul @ 1.5%	680,368	GAL	$0.07	$50,671
	Power	48,992	kWh	$0.07	$3,429
	Structural Maintenance	2%			$4,362
	Equipment replacement	4%			$1,642
	Chemicals	0	LB	$0.15	$0
	Hypochlorite	0	LB	$0.60	$0
	Sodium Bisulfite	0	GAL	$0.20	$0
	Polymer	426	LB	$3.00	$1,277
	Misc expenses		allowance		$0
	Total Annual Cost				$67,621
	Present Worth Factor	14.6061			
	Present Worth Cost				$988,000

Total Present Worth Project Cost Estimate

Capital	$608,000
Operations and Maintenance	$988,000
Total Present Worth	$1,596,000

Project: Freeland Comprehensive Sewer Plan - Ch 5, 6, 7 analysis
Subject: Solids Handling Analysis
By : Tt/KCM
Date : 28-Apr-03

Stabilize, Thicken, Send to Renton WWTP

Capital Cost Estimate

Item	Description	Quantity	Unit	Unit cost, $	Cost, $
	Slab Concrete and Rebar	46	CY	$300	$13,889
	Straight Wall Concrete and Rebar	119	CY	$400	$47,407
	Curved Wall Concrete and Rebar	0	CY	$500	$0
	Access Bridge Concrete	0	CY	$500	$0
	Earthwork	2,315	CY	$20	$46,296
	Misc Metals (Handrailing, Covers, etc.)	1	LS	$10,000	$10,000
	FRP Covers	1	LS	$10,000	$10,000
	Site Process Piping and Valving	1	LS	$30,000	$30,000
	Sitework	1	LS	$25,000	$25,000
	Electrical Conduit, Sitework	1	LS	$15,000	$15,000
	Building Space for Solids Equipment	1,200	SF	$100	$120,000
					$0
	Subtotal Structural				*$317,593*
	Blowers - 10 Hp	2	EA	$15,000	$30,000
	Sludge Storage Tank Diffusers	1	LS	$10,000	$10,000
	Belt Filter Press - 350 gpm	1	LS	$100,000	$100,000
	Sludge thickener feed pump	1	LS	$15,000	$15,000
	Thickened sludge pump	1	LS	$15,000	$15,000
	Polymer feed system	1	LS	$10,000	$10,000
	Odor Control - Carbon Adsorber, Fans, Piping	1	LS	$75,000	$75,000
					$0
	Subtotal Equipment				*$255,000*
	Installation, Miscellaneous Mechanical	40%	of Equip		$102,000
	Electrical	20%	of Equip		$51,000
	Instrumentation and Control	15%	of Equip		$38,250
	Subtotal Structural, Mechanical, Elect, I&C				*$763,843*
	Contractor O&P	15%	of Sub Cost		$114,576
	Mobilization, demobilization, bond	6%	of Sub cost		$45,831
	Total estimated current construction cost				*$924,250*
	Escalation to time of construction	2.60%			$24,030
	Total estimated construction cost				$948,280
	Contingency	30%			$284,484
	Engineering Design	15%			$184,915
	Construction Management	10%			$123,276
	Sales Tax	8.3%			$102,319
	Total Estimated Capital Cost				$1,643,000

Operations and Maintenance Cost Estimate (per year)

Item	Description	Quantity	Unit	Unit Cost	Annual Cost
	Labor	624	HR	$30	$18,720
		0	EA	$300	$0
	Contract Haul @ 10%	102,055	GAL	$0.51	$51,793
	Power	48,992	kWh	$0.07	$3,429
	Structural Maintenance	2%			$6,517
	Equipment replacement	4%			$10,465
	Chemicals	0	LB	$0.15	$0
	Hypochlorite	0	LB	$0.60	$0
	Sodium Bisulfite	0	GAL	$0.20	$0
	Polymer	426	LB	$3.00	$1,277
	Misc expenses		allowance		$0
	Total Annual Cost				$92,201
	Present Worth Factor	14.6061			
	Present Worth Cost				$1,347,000

Total Present Worth Project Cost Estimate

Capital	$1,643,000
Operations and Maintenance	$1,347,000
Total Present Worth	$2,990,000

Project: Freeland Comprehensive Sewer Plan - Ch 8 Analysis
Subject: Collection System Analysis
By : Tt/KCM
Date : 4-Jun-03

STEP System - Phase 1

Capital Cost Estimate

Item	Description	Quantity	Unit	Unit cost, $	Cost, $
	2" PVC Pressure Mains	11,400	LF	$15	$171,000
	3" PVC Pressure Mains	1,100	LF	$16	$17,600
	4" PVC Pressure Mains	2,300	LF	$18	$41,400
	6" PVC Pressure Mains	3,000	LF	$22	$66,000
	8" PVC Pressure Mains	4,400	LF	$28	$123,200
	10" PVC Pressure Mains	800	LF	$40	$32,000
	1.5" HDPE Pressure Laterals - STEP	[redacted]	EA	$400	$64,000
	1.5" HDPE Pressure Laterals - extra for existing	[redacted]	EA	$250	$0
	Lateral Kits	[redacted]	EA	$200	$32,000
	Clean Out Installation	25	EA	$1,500	$37,500
	Air Release Valve Installation	3	EA	$2,000	$6,000
	Dewatering	1	LS	$5,000	$5,000
	AC Surface Restoration	7,700	SY	$12	$92,400
	Native Surface Restoration	6,400	SY	$2	$12,800
	Abandon Septic Tank	[redacted]	EA	$750	$0
					$0
	Subtotal Structural				*$700,900*
	Septic Tank w/ Pump (Installed)	[redacted]	EA	$2,500	$400,000
	Septic Tank w/ Pump - credit for ex. houses (reu	[redacted]	EA	($2,000)	$0
	Septic Tank w/ Pump - extra for ex. houses (new	[redacted]	EA	$1,000	$0
	Site Electrical - STEP	[redacted]	EA	$200	$32,000
	Site Electrical - STEP, extra for existing houses	[redacted]	EA	$500	$0
					$0
	Subtotal Equipment				*$432,000*
	Total estimated current construction cost				*$1,132,900*
	Escalation to time of construction	15.81%			$179,073
	Total estimated construction cost				$1,311,973
	Contingency	30%			$393,592
	Engineering Design	15%			$255,835
	Construction Management	10%			$170,556
	Sales Tax	8.3%			$141,562
	Total Estimated Capital Cost				$2,274,000

Operations and Maintenance Cost Estimate (per year)

Item	Description	Quantity	Unit	Unit Cost	Annual Cost
	Labor	160	hr	$30	$4,800
	Septic tank pumping	32	ea	$300	$9,600
	Diesel oil		gal	$2.00	$0
	Power	43549	kWh	$0.07	$3,048
	Structural Maintenance	1%			$8,117
	Equipment replacement	2%			$10,006
	Chemicals			$0.00	$0
	Hypochlorite	0	lb	$0.60	$0
	Sodium Bisulfite	0	gal	$0.20	$0
	Polymer		lb	$3.00	$0
	Misc expenses		allowance		$0
	Total Annual Cost				$35,571
	Present Worth Factor	14.6061			
	Present Worth Cost				$520,000

Total Present Worth Project Cost Estimate

Capital	$2,274,000
Operations and Maintenance	$520,000
Total Present Worth	$2,794,000

Project: Freeland Comprehensive Sewer Plan - Ch 8 Analysis
Subject: Collection System Analysis
By : Tt/KCM
Date : 4-Jun-03

STEP System - Phase 2

Capital Cost Estimate

Item	Description	Quantity	Unit	Unit cost, $	Cost, $
	2" PVC Pressure Mains	14,500	LF	$15	$217,500
	3" PVC Pressure Mains	2,000	LF	$16	$32,000
	4" PVC Pressure Mains	2,300	LF	$18	$41,400
	6" PVC Pressure Mains	4,600	LF	$22	$101,200
	8" PVC Pressure Mains	4,400	LF	$28	$123,200
	10" PVC Pressure Mains	800	LF	$40	$32,000
	1.5" HDPE Pressure Laterals - STEP	[redacted]	EA	$400	$136,000
	1.5" HDPE Pressure Laterals - extra for existing	[redacted]	EA	$250	$12,500
	Lateral Kits	[redacted]	EA	$200	$68,000
	Clean Out Installation	35	EA	$1,500	$52,500
	Air Release Valve Installation	4	EA	$2,000	$8,000
	Dewatering	1	LS	$5,000	$5,000
	AC Surface Restoration	9,500	SY	$12	$114,000
	Native Surface Restoration	13,600	SY	$2	$27,200
	Abandon Septic Tank	[redacted]	EA	$750	$18,750
					$0
	Subtotal Structural				*$989,250*
	Septic Tank w/ Pump (Installed)	[redacted]	EA	$2,500	$850,000
	Septic Tank w/ Pump - credit for ex. houses (reu	[redacted]	EA	($2,000)	($50,000)
	Septic Tank w/ Pump - extra for ex. houses (new	[redacted]	EA	$1,000	$25,000
	Site Electrical - STEP	[redacted]	EA	$200	$68,000
	Site Electrical - STEP, extra for existing houses	[redacted]	EA	$500	$12,500
					$0
	Subtotal Equipment				*$905,500*
	Total estimated current construction cost				*$1,894,750*
	Escalation to time of construction	15.81%			$299,495
	Total estimated construction cost				$2,194,245
	Contingency	30%			$658,274
	Engineering Design	15%			$427,878
	Construction Management	10%			$285,252
	Sales Tax	8.3%			$236,759
	Total Estimated Capital Cost				$3,802,000

Operations and Maintenance Cost Estimate (per year)

Item	Description	Quantity	Unit	Unit Cost	Annual Cost
	Labor	390	hr	$30	$11,700
	Septic tank pumping	78	ea	$300	$23,400
	Diesel oil		gal	$2.00	$0
	Power	92541	kWh	$0.07	$6,478
	Structural Maintenance	1%			$11,456
	Equipment replacement	2%			$20,973
	Chemicals			$0.00	$0
	Hypochlorite	0	lb	$0.60	$0
	Sodium Bisulfite	0	gal	$0.20	$0
	Polymer		lb	$3.00	$0
	Misc expenses		allowance		$0
	Total Annual Cost				$74,007
	Present Worth Factor	14.6061			
	Present Worth Cost				$1,081,000

Total Present Worth Project Cost Estimate

Capital	$3,802,000
Operations and Maintenance	$1,081,000
Total Present Worth	$4,883,000

Project: Freeland Comprehensive Sewer Plan - Ch 8 Analysis
Subject: Collection System Analysis
By : Tt/KCM
Date : 4-Jun-03

STEP System - Phase 3

Capital Cost Estimate

Item	Description	Quantity	Unit	Unit cost, $	Cost, $
	2" PVC Pressure Mains	24,000	LF	$15	$360,000
	3" PVC Pressure Mains	3,700	LF	$16	$59,200
	4" PVC Pressure Mains	4,700	LF	$18	$84,600
	6" PVC Pressure Mains	7,300	LF	$22	$160,600
	8" PVC Pressure Mains	5,600	LF	$28	$156,800
	10" PVC Pressure Mains	800	LF	$40	$32,000
	1.5" HDPE Pressure Laterals - STEP	[redacted]	EA	$400	$322,400
	1.5" HDPE Pressure Laterals - extra for existing	[redacted]	EA	$250	$73,250
	Lateral Kits	[redacted]	EA	$200	$161,200
	Clean Out Installation	50	EA	$1,500	$75,000
	Air Release Valve Installation	5	EA	$2,000	$10,000
	Dewatering	1	LS	$5,000	$5,000
	AC Surface Restoration	15,400	SY	$12	$184,800
	Native Surface Restoration	32,200	SY	$2	$64,400
	Abandon Septic Tank	[redacted]	EA	$750	$110,250
					$0
	Subtotal Structural				*$1,859,500*
	Septic Tank w/ Pump (Installed)	[redacted]	EA	$2,500	$2,015,000
	Septic Tank w/ Pump - credit for ex. houses (reu	[redacted]	EA	($2,000)	($292,000)
	Septic Tank w/ Pump - extra for ex. houses (new	[redacted]	EA	$1,000	$147,000
	Site Electrical - STEP	[redacted]	EA	$200	$161,200
	Site Electrical - STEP, extra for existing houses	[redacted]	EA	$500	$73,000
					$0
	Subtotal Equipment				*$2,104,200*
	Total estimated current construction cost				*$3,963,700*
	Escalation to time of construction	15.81%			$626,525
	Total estimated construction cost				$4,590,225
	Contingency	30%			$1,377,068
	Engineering Design	15%			$895,094
	Construction Management	10%			$596,729
	Sales Tax	8.3%			$495,285
	Total Estimated Capital Cost				$7,954,000

Operations and Maintenance Cost Estimate (per year)

Item	Description	Quantity	Unit	Unit Cost	Annual Cost
	Labor	1099	hr	$30	$32,970
	Septic tank pumping	220	ea	$300	$65,940
	Diesel oil		gal	$2.00	$0
	Power	219377	kWh	$0.07	$15,356
	Structural Maintenance	1%			$21,534
	Equipment replacement	2%			$48,736
	Chemicals			$0.00	$0
	Hypochlorite	0	lb	$0.60	$0
	Sodium Bisulfite	0	gal	$0.20	$0
	Polymer		lb	$3.00	$0
	Misc expenses		allowance		$0
	Total Annual Cost				$184,537
	Present Worth Factor	14.6061			
	Present Worth Cost				$2,695,000

Total Present Worth Project Cost Estimate

Capital	$7,954,000
Operations and Maintenance	$2,695,000
Total Present Worth	$10,649,000

Project: Freeland Comprehensive Sewer Plan - Ch 8 Analysis
Subject: Collection System Analysis
By : Tt/KCM
Date : 4-Jun-03

STEP System - Phase 4

Capital Cost Estimate

Item	Description	Quantity	Unit	Unit cost, $	Cost, $
	2" PVC Pressure Mains	44,800	LF	$15	$672,000
	3" PVC Pressure Mains	9,200	LF	$16	$147,200
	4" PVC Pressure Mains	13,200	LF	$18	$237,600
	6" PVC Pressure Mains	7,300	LF	$22	$160,600
	8" PVC Pressure Mains	5,600	LF	$28	$156,800
	10" PVC Pressure Mains	800	LF	$40	$32,000
	1.5" HDPE Pressure Laterals - STEP	[redacted]	EA	$400	$530,400
	1.5" HDPE Pressure Laterals - extra for existing	[redacted]	EA	$250	$73,250
	Lateral Kits	[redacted]	EA	$200	$265,200
	Clean Out Installation	100	EA	$1,500	$150,000
	Air Release Valve Installation	10	EA	$2,000	$20,000
	Dewatering	1	LS	$5,000	$5,000
	AC Surface Restoration	27,000	SY	$12	$324,000
	Native Surface Restoration	53,000	SY	$2	$106,000
	Abandon Septic Tank	[redacted]	EA	$750	$110,250
					$0
	Subtotal Structural				*$2,990,300*
	Septic Tank w/ Pump (Installed)	[redacted]	EA	$2,500	$3,315,000
	Septic Tank w/ Pump - credit for ex. houses (reu	[redacted]	EA	($2,000)	($292,000)
	Septic Tank w/ Pump - extra for ex. houses (new	[redacted]	EA	$1,000	$147,000
	Site Electrical - STEP	[redacted]	EA	$200	$265,200
	Site Electrical - STEP, extra for existing houses	[redacted]	EA	$500	$73,000
					$0
	Subtotal Equipment				*$3,508,200*
	Total estimated current construction cost				*$6,498,500*
	Escalation to time of construction	15.81%			$1,027,190
	Total estimated construction cost				$7,525,690
	Contingency	30%			$2,257,707
	Engineering Design	15%			$1,467,510
	Construction Management	10%			$978,340
	Sales Tax	8.3%			$812,022
	Total Estimated Capital Cost				$13,041,000

Operations and Maintenance Cost Estimate (per year)

Item	Description	Quantity	Unit	Unit Cost	Annual Cost
	Labor	1619	hr	$30	$48,570
	Septic tank pumping	324	ea	$300	$97,140
	Diesel oil		gal	$2.00	$0
	Power	360911	kWh	$0.07	$25,264
	Structural Maintenance	1%			$34,630
	Equipment replacement	2%			$81,255
	Chemicals			$0.00	$0
	Hypochlorite	0	lb	$0.60	$0
	Sodium Bisulfite	0	gal	$0.20	$0
	Polymer		lb	$3.00	$0
	Misc expenses		allowance		$0
	Total Annual Cost				$286,858
	Present Worth Factor	14.6061			
	Present Worth Cost				$4,190,000

Total Present Worth Project Cost Estimate

Capital	$13,041,000
Operations and Maintenance	$4,190,000
Total Present Worth	$17,231,000

Project: Freeland Comprehensive Sewer Plan - Ch 8 Analysis
Subject: Collection System Analysis
By : Tt/KCM
Date : 4-Jun-03

STEP System - Phase 5

Capital Cost Estimate

Item	Description	Quantity	Unit	Unit cost, $	Cost, $
	2" PVC Pressure Mains	44,800	LF	$15	$672,000
	3" PVC Pressure Mains	9,200	LF	$16	$147,200
	4" PVC Pressure Mains	13,200	LF	$18	$237,600
	6" PVC Pressure Mains	7,300	LF	$22	$160,600
	8" PVC Pressure Mains	5,600	LF	$28	$156,800
	10" PVC Pressure Mains	800	LF	$40	$32,000
	1.5" HDPE Pressure Laterals - STEP	[redacted]	EA	$400	$1,067,600
	1.5" HDPE Pressure Laterals - extra for existing	[redacted]	EA	$250	$73,250
	Lateral Kits	[redacted]	EA	$200	$533,800
	Clean Out Installation	100	EA	$1,500	$150,000
	Air Release Valve Installation	10	EA	$2,000	$20,000
	Dewatering	1	LS	$5,000	$5,000
	AC Surface Restoration	27,000	SY	$12	$324,000
	Native Surface Restoration	106,800	SY	$2	$213,600
	Abandon Septic Tank	[redacted]	EA	$750	$110,250
					$0
	Subtotal Structural				*$3,903,700*
	Septic Tank w/ Pump (Installed)	[redacted]	EA	$2,500	$6,672,500
	Septic Tank w/ Pump - credit for ex. houses (reu	[redacted]	EA	($2,000)	($292,000)
	Septic Tank w/ Pump - extra for ex. houses (new	[redacted]	EA	$1,000	$147,000
	Site Electrical - STEP	[redacted]	EA	$200	$533,800
	Site Electrical - STEP, extra for existing houses	[redacted]	EA	$500	$73,000
					$0
	Subtotal Equipment				*$7,134,300*
	Total estimated current construction cost				*$11,038,000*
	Escalation to time of construction	15.81%			$1,744,730
	Total estimated construction cost				$12,782,730
	Contingency	30%			$3,834,819
	Engineering Design	15%			$2,492,632
	Construction Management	10%			$1,661,755
	Sales Tax	8.3%			$1,379,257
	Total Estimated Capital Cost				$22,151,000

Operations and Maintenance Cost Estimate (per year)

Item	Description	Quantity	Unit	Unit Cost	Annual Cost
	Labor	2962	hr	$30	$88,860
	Septic tank pumping	592	ea	$300	$177,720
	Diesel oil		gal	$2.00	$0
	Power	726450	kWh	$0.07	$50,851
	Structural Maintenance	1%			$45,207
	Equipment replacement	2%			$165,240
	Chemicals			$0.00	$0
	Hypochlorite	0	lb	$0.60	$0
	Sodium Bisulfite	0	gal	$0.20	$0
	Polymer		lb	$3.00	$0
	Misc expenses		allowance		$0
	Total Annual Cost				$527,879
	Present Worth Factor	14.6061			
	Present Worth Cost				$7,710,000

Total Present Worth Project Cost Estimate

Capital	$22,151,000
Operations and Maintenance	$7,710,000
Total Present Worth	$29,861,000

Project: Freeland Comprehensive Sewer Plan - Ch 8 Analysis
Subject: Secondary Treatment and Solids Handling Analysis
By : Tt/KCM
Date : 4-Jun-03

Membrane Bioreactors (Freeland Only) - Phase 1

Capital Cost Estimate

Item	Description	Quantity	Unit	Unit cost, $	Cost, $
MBR	Administration/Lab Building	1,000	SF	$125	$125,000
	Electrical Building (generator outside)	720	SF	$100	$72,000
	Mechanical Building	540	SF	$100	$54,000
	Filter & Chemical Building	0	SF	$100	$0
	Slab Concrete and Rebar	56	CY	$300	$16,667
	Straight Wall Concrete and Rebar	117	CY	$400	$46,667
	Curved Wall Concrete and Rebar	0	CY	$500	$0
	Deck - Aerator Support Concrete	0	CY	$500	$0
	Access Bridge Concrete	5	CY	$500	$2,500
	Effluent Weir Concrete	0	CY	$500	$0
	Misc Metals (Handrailing, Covers, etc.)	1	LS	$11,250	$11,250
	Site Stormwater Piping and Valving	1	LS	$7,500	$7,500
	Site Process Piping and Valving	1	LS	$37,500	$37,500
	Indoor Process Piping and Valving	1	LS	$28,125	$28,125
	Manholes	2	EA	$6,000	$12,000
	Stormwater Detention Tank and Control Structu	1	LS	$25,300	$25,300
	Sitework	1	LS	$42,200	$42,200
	Landscaping	1	LS	$16,900	$16,900
	Electrical Conduit, Sitework	1	LS	$16,900	$16,900
	Site Lighting	1	LS	$12,700	$12,700
	Laboratory Equipment	1	LS	$20,000	$20,000
	Furniture	1	LS	$10,000	$10,000
	Land Acquisition	3	AC	$15,000	$45,000
NaOCl	Building enclosure for equipment	100	SF	$100	$10,000
	Slab Concrete and Rebar	36	CY	$300	$10,833
	Straight Wall Concrete and Rebar	36	CY	$400	$14,222
	Misc Metals (Handrailing, Covers, etc.)	1	LS	$1,250	$1,250
	Misc Concrete (NaOCl secondary containment)	5	CY	$500	$2,500
	Site Process Piping and Valving	1	LS	$10,000	$10,000
	Sitework	1	LS	$5,000	$5,000
	Electrical Conduit, Sitework	1	LS	$2,000	$2,000
	Site Lighting	1	LS	$20,000	$20,000
	Contact Tank Baffles	1	LS	$5,000	$5,000
Solids	Slab Concrete and Rebar	0	CY	$300	$0
Stabilizat	Straight Wall Concrete and Rebar	0	CY	$400	$0
	Curved Wall Concrete and Rebar	0	CY	$500	$0
	Access Bridge Concrete	0	CY	$500	$0
	Earthwork	0	CY	$20	$0
	Misc Metals (Handrailing, Covers, etc.)	0	LS	$5,000	$0
	FRP Covers	0	LS	$5,000	$0
	Site Process Piping and Valving	0	LS	$7,500	$0
	Sitework	0	LS	$12,500	$0
	Electrical Conduit, Sitework	0	LS	$15,000	$0
	Building Space for Solids Equipment	0	SF	$100	$0
	Subtotal Structural				*$683,014*
MBR	Equipment	1	EA	$154,000	$154,000
	(membranes, cleaning tanks, vacuum pumps)				$0
	(process air blowers and diffusers)				$0
	Hoist for Membrane Racks	1	EA	$25,000	$25,000
	Influent Screen - 1/8 in.	0	LS	$100,000	$0
	Washer Compactor	0	LS	$25,000	$0
	WAS Pumps	2	EA	$7,500	$15,000
	Magnetic Flow Meters	3	EA	$5,000	$15,000
	Yard Pump Station Pumps	2	EA	$7,500	$15,000
	Plant Water Pumps	2	EA	$5,000	$10,000

	Strainer (Manual duplex)	1	EA	$2,000	$2,000
	Hydro Tank	1	EA	$4,000	$4,000
	Odor Control - Carbon Adsorber, Fans, Piping	0	LS	$50,000	$0
	Standby Generator	200	kW	$175	$35,000
	Generator Silencer, Enclosure, Acoustics	1	LS	$5,000	$5,000
	Underground Fuel Storage Tank, Pumps	1	LS	$15,000	$15,000
	Automatic Transfer Switch	1	LS	$15,000	$15,000
	Motor Control Centers/Variable Frequency Driv	1	LS	$37,500	$37,500
	PLC	1	LS	$100,000	$100,000
NaOCl	Storage Tank (2-55 gal drums)	2	ea	$200	$400
	Pumps w/ installation (hypo)	2	ea	$2,500	$5,000
	Tank Mixers	1	ea	$1,000	$1,000
	Feed Pacing Controller	1	ea	$2,500	$2,500
	Chemical Flow Meter	1	ea	$2,000	$2,000
Solids	Blowers - 10 Hp	0	EA	$15,000	$0
Stabilizat	Sludge Storage Tank Diffusers	0	LS	$10,000	$0
	Sludge Transfer Pumps	2	EA	$7,500	$15,000
					$0
	Subtotal Equipment				*$473,400*
	Installation, Miscellaneous Mechanical	30%	of Equip		$142,020
	Electrical	15%	of Equip		$71,010
	Instrumentation and Control	10%	of Equip		$47,340
	Subtotal Structural, Mechanical, Elect, I&C				*$1,416,784*
	Contractor O&P	15%	of Sub Cost		$205,768
	Mobilization, demobilization, bond	6%	of Sub cost		$82,307
	Total estimated current construction cost				*$1,704,859*
	Escalation to time of construction	15.81%			$269,480
	Total estimated construction cost				$1,974,338
	Contingency	30%			$592,301
	Engineering Design	15%			$374,834
	Construction Management	10%			$249,889
	Sales Tax	8.3%			$207,408
	Total Estimated Capital Cost				$3,399,000

Operations and Maintenance Cost Estimate (per year)

Item	Description	Quantity	Unit	Unit Cost	Annual Cost
	Labor - Secondary Process	1,560	HR	$30	$46,800
	Labor - Disinfection	52	hr	$30	$1,560
	Labor - Solids Handling	0	HR	$30	$0
	Membrane Replacement	55	panel	$75	$4,125
	Contract Haul Solids @ 1.5%	148,672	GAL	$0.07	$11,073
	Diesel oil		GAL	$2.00	$0
	Power - Secondary Process	61,888	kWh	$0.07	$4,332
	Power - Disinfection	4899	kWh	$0.07	$343
	Power - Solids Handling	0	kWh	$0.07	$0
	Structural Maintenance	1%			$7,910
	Equipment replacement	2%			$10,869
	Chemicals - membrane cleaning	1	LS	$1,000	$1,000
	Hypochlorite	337	lb	$0.60	$202
	Sodium Bisulfite	0	GAL	$0.20	$0
	Polymer	0	LB	$3.00	$0
	Misc expenses		allowance		$0
	Total Annual Cost				$88,214
	Present Worth Factor	14.6061			
	Present Worth Cost				$1,288,000

Total Present Worth Project Cost Estimate

Capital	$3,399,000
Operations and Maintenance	$1,288,000
Total Present Worth	$4,687,000

Project: Freeland Comprehensive Sewer Plan - Ch 8 Analysis
Subject: Secondary Treatment and Solids Handling Analysis
By : Tt/KCM
Date : 4-Jun-03

Membrane Bioreactors (Freeland Only) - Phase 2

Capital Cost Estimate

Item	Description	Quantity	Unit	Unit cost, $	Cost, $
MBR	Administration/Lab Building	1,000	SF	$125	$125,000
	Electrical Building (generator outside)	720	SF	$100	$72,000
	Mechanical Building	540	SF	$100	$54,000
	Filter & Chemical Building	0	SF	$100	$0
	Slab Concrete and Rebar	94	CY	$300	$28,333
	Straight Wall Concrete and Rebar	136	CY	$400	$54,222
	Curved Wall Concrete and Rebar	0	CY	$500	$0
	Deck - Aerator Support Concrete	0	CY	$500	$0
	Access Bridge Concrete	10	CY	$500	$5,000
	Effluent Weir Concrete	0	CY	$500	$0
	Misc Metals (Handrailing, Covers, etc.)	1	LS	$15,000	$15,000
	Site Stormwater Piping and Valving	1	LS	$10,000	$10,000
	Site Process Piping and Valving	1	LS	$50,000	$50,000
	Indoor Process Piping and Valving	1	LS	$37,500	$37,500
	Manholes	3	EA	$6,000	$18,000
	Stormwater Detention Tank and Control Structu	1	LS	$33,750	$33,750
	Sitework	1	LS	$56,250	$56,250
	Landscaping	1	LS	$22,500	$22,500
	Electrical Conduit, Sitework	1	LS	$22,500	$22,500
	Site Lighting	1	LS	$16,875	$16,875
	Laboratory Equipment	1	LS	$20,000	$20,000
	Furniture	1	LS	$10,000	$10,000
	Land Acquisition	3	AC	$15,000	$45,000
NaOCl	Building enclosure for equipment	100	SF	$100	$10,000
	Slab Concrete and Rebar	36	CY	$300	$10,833
	Straight Wall Concrete and Rebar	36	CY	$400	$14,222
	Misc Metals (Handrailing, Covers, etc.)	1	LS	$1,250	$1,250
	Misc Concrete (NaOCl secondary containment)	5	CY	$500	$2,500
	Site Process Piping and Valving	1	LS	$10,000	$10,000
	Sitework	1	LS	$5,000	$5,000
	Electrical Conduit, Sitework	1	LS	$2,000	$2,000
	Site Lighting	1	LS	$20,000	$20,000
	Contact Tank Baffles	1	LS	$5,000	$5,000
Solids	Slab Concrete and Rebar	0	CY	$300	$0
Stabilizat	Straight Wall Concrete and Rebar	0	CY	$400	$0
	Curved Wall Concrete and Rebar	0	CY	$500	$0
	Access Bridge Concrete	0	CY	$500	$0
	Earthwork	0	CY	$20	$0
	Misc Metals (Handrailing, Covers, etc.)	0	LS	$5,000	$0
	FRP Covers	0	LS	$5,000	$0
	Site Process Piping and Valving	0	LS	$7,500	$0
	Sitework	0	LS	$12,500	$0
	Electrical Conduit, Sitework	0	LS	$15,000	$0
	Building Space for Solids Equipment	0	SF	$100	$0
	Subtotal Structural				*$776,736*
MBR	Equipment	1	EA	$286,000	$286,000
	(membranes, cleaning tanks, vacuum pumps)				$0
	(process air blowers and diffusers)				$0
	Hoist for Membrane Racks	1	EA	$25,000	$25,000
	Influent Screen - 1/8 in.	0	LS	$100,000	$0
	Washer Compactor	0	LS	$25,000	$0
	WAS Pumps	2	EA	$7,500	$15,000
	Magnetic Flow Meters	3	EA	$5,000	$15,000
	Yard Pump Station Pumps	2	EA	$7,500	$15,000
	Plant Water Pumps	2	EA	$5,000	$10,000

	Strainer (Manual duplex)	1	EA	$2,000	$2,000
	Hydro Tank	1	EA	$4,000	$4,000
	Odor Control - Carbon Adsorber, Fans, Piping	0	LS	$50,000	$0
	Standby Generator	200	kW	$175	$35,000
	Generator Silencer, Enclosure, Acoustics	1	LS	$5,000	$5,000
	Underground Fuel Storage Tank, Pumps	1	LS	$15,000	$15,000
	Automatic Transfer Switch	1	LS	$15,000	$15,000
	Motor Control Centers/Variable Frequency Driv	1	LS	$37,500	$37,500
	PLC	1	LS	$100,000	$100,000
NaOCl	Storage Tank (2-55 gal drums)	2	ea	$200	$400
	Pumps w/ installation (hypo)	2	ea	$2,500	$5,000
	Tank Mixers	1	ea	$1,000	$1,000
	Feed Pacing Controller	1	ea	$2,500	$2,500
	Chemical Flow Meter	1	ea	$2,000	$2,000
Solids	Blowers - 10 Hp	0	EA	$15,000	$0
Stabilizat	Sludge Storage Tank Diffusers	0	LS	$10,000	$0
	Sludge Transfer Pumps	2	EA	$7,500	$15,000
					$0
	Subtotal Equipment				*$605,400*
	Installation, Miscellaneous Mechanical	30%	of Equip		$181,620
	Electrical	15%	of Equip		$90,810
	Instrumentation and Control	10%	of Equip		$60,540
	Subtotal Structural, Mechanical, Elect, I&C				*$1,715,106*
	Contractor O&P	15%	of Sub Cost		$250,516
	Mobilization, demobilization, bond	6%	of Sub cost		$100,206
	Total estimated current construction cost				*$2,065,828*
	Escalation to time of construction	15.81%			$326,537
	Total estimated construction cost				$2,392,365
	Contingency	30%			$717,710
	Engineering Design	15%			$456,349
	Construction Management	10%			$304,233
	Sales Tax	8.3%			$252,513
	Total Estimated Capital Cost				$4,123,000

Operations and Maintenance Cost Estimate (per year)

Item	Description	Quantity	Unit	Unit Cost	Annual Cost
	Labor - Secondary Process	1,560	HR	$30	$46,800
	Labor - Disinfection	52	hr	$30	$1,560
	Labor - Solids Handling	0	HR	$30	$0
	Membrane Replacement	93	panel	$75	$6,950
	Contract Haul Solids @ 1.5%	244,678	GAL	$0.07	$18,223
	Diesel oil		GAL	$2.00	$0
	Power - Secondary Process	101,930	kWh	$0.07	$7,135
	Power - Disinfection	4899	kWh	$0.07	$343
	Power - Solids Handling	0	kWh	$0.07	$0
	Structural Maintenance	1%			$8,995
	Equipment replacement	2%			$13,861
	Chemicals - membrane cleaning	1	LS	$1,000	$1,000
	Hypochlorite	564	lb	$0.60	$339
	Sodium Bisulfite	0	GAL	$0.20	$0
	Polymer	0	LB	$3.00	$0
	Misc expenses		allowance		$0
	Total Annual Cost				$105,205
	Present Worth Factor	14.6061			
	Present Worth Cost				$1,537,000

Total Present Worth Project Cost Estimate

Capital	$4,123,000
Operations and Maintenance	$1,537,000
Total Present Worth	$5,660,000

Project: Freeland Comprehensive Sewer Plan - Ch 8 Analysis
Subject: Secondary Treatment and Solids Handling Analysis
By : Tt/KCM
Date : 4-Jun-03

Membrane Bioreactors (Freeland Only) - Phase 3

Capital Cost Estimate

Item	Description	Quantity	Unit	Unit cost, $	Cost, $
MBR	Administration/Lab Building	1,500	SF	$125	$187,500
	Electrical Building (generator outside)	720	SF	$100	$72,000
	Mechanical Building	540	SF	$100	$54,000
	Filter & Chemical Building	0	SF	$100	$0
	Slab Concrete and Rebar	159	CY	$300	$47,778
	Straight Wall Concrete and Rebar	249	CY	$400	$99,556
	Curved Wall Concrete and Rebar	0	CY	$500	$0
	Deck - Aerator Support Concrete	0	CY	$500	$0
	Access Bridge Concrete	10	CY	$500	$5,000
	Effluent Weir Concrete	0	CY	$500	$0
	Misc Metals (Handrailing, Covers, etc.)	1	LS	$30,000	$30,000
	Site Stormwater Piping and Valving	1	LS	$10,000	$10,000
	Site Process Piping and Valving	1	LS	$75,000	$75,000
	Indoor Process Piping and Valving	1	LS	$56,250	$56,250
	Manholes	3	EA	$6,000	$18,000
	Stormwater Detention Tank and Control Structı	1	LS	$45,000	$45,000
	Sitework	1	LS	$75,000	$75,000
	Landscaping	1	LS	$30,000	$30,000
	Electrical Conduit, Sitework	1	LS	$30,000	$30,000
	Site Lighting	1	LS	$22,500	$22,500
	Laboratory Equipment	1	LS	$20,000	$20,000
	Furniture	1	LS	$10,000	$10,000
	Land Acquisition	3	AC	$15,000	$45,000
NaOCl	Building enclosure for equipment	100	SF	$100	$10,000
	Slab Concrete and Rebar	36	CY	$300	$10,833
	Straight Wall Concrete and Rebar	36	CY	$400	$14,222
	Misc Metals (Handrailing, Covers, etc.)	1	LS	$1,250	$1,250
	Misc Concrete (NaOCl secondary containment)	5	CY	$500	$2,500
	Site Process Piping and Valving	1	LS	$10,000	$10,000
	Sitework	1	LS	$5,000	$5,000
	Electrical Conduit, Sitework	1	LS	$2,000	$2,000
	Site Lighting	1	LS	$20,000	$20,000
	Contact Tank Baffles	1	LS	$5,000	$5,000
Solids	Slab Concrete and Rebar	28	CY	$300	$8,333
Stabilizat	Straight Wall Concrete and Rebar	59	CY	$400	$23,704
	Curved Wall Concrete and Rebar	0	CY	$500	$0
	Access Bridge Concrete	0	CY	$500	$0
	Earthwork	556	CY	$20	$11,111
	Misc Metals (Handrailing, Covers, etc.)	1	LS	$5,000	$5,000
	FRP Covers	1	LS	$5,000	$5,000
	Site Process Piping and Valving	1	LS	$7,500	$7,500
	Sitework	1	LS	$12,500	$12,500
	Electrical Conduit, Sitework	1	LS	$15,000	$15,000
	Building Space for Solids Equipment	300	SF	$100	$30,000
	Subtotal Structural				*$1,131,537*
MBR	Equipment	1	EA	$616,000	$616,000
	(membranes, cleaning tanks, vacuum pumps)				$0
	(process air blowers and diffusers)				$0
	Hoist for Membrane Racks	1	EA	$25,000	$25,000
	Influent Screen - 1/8 in.	0	LS	$100,000	$0
	Washer Compactor	0	LS	$25,000	$0
	WAS Pumps	2	EA	$7,500	$15,000
	Magnetic Flow Meters	3	EA	$5,000	$15,000
	Yard Pump Station Pumps	2	EA	$7,500	$15,000
	Plant Water Pumps	2	EA	$5,000	$10,000

	Strainer (Manual duplex)	1	EA	$2,000	$2,000
	Hydro Tank	1	EA	$4,000	$4,000
	Odor Control - Carbon Adsorber, Fans, Piping	0	LS	$50,000	$0
	Standby Generator	500	kW	$175	$87,500
	Generator Silencer, Enclosure, Acoustics	1	LS	$7,500	$7,500
	Underground Fuel Storage Tank, Pumps	1	LS	$15,000	$15,000
	Automatic Transfer Switch	1	LS	$15,000	$15,000
	Motor Control Centers/Variable Frequency Driv	1	LS	$37,500	$37,500
	PLC	1	LS	$100,000	$100,000
NaOCl	Storage Tank (2-55 gal drums)	2	ea	$200	$400
	Pumps w/ installation (hypo)	2	ea	$2,500	$5,000
	Tank Mixers	1	ea	$1,000	$1,000
	Feed Pacing Controller	1	ea	$2,500	$2,500
	Chemical Flow Meter	1	ea	$2,000	$2,000
Solids Stabilizat	Blowers - 10 Hp	2	EA	$15,000	$30,000
	Sludge Storage Tank Diffusers	1	LS	$10,000	$10,000
	Sludge Transfer Pumps	2	EA	$7,500	$15,000
					$0
	Subtotal Equipment				*$1,030,400*
	Installation, Miscellaneous Mechanical	30%	of Equip		$309,120
	Electrical	15%	of Equip		$154,560
	Instrumentation and Control	10%	of Equip		$103,040
	Subtotal Structural, Mechanical, Elect, I&C				*$2,728,657*
	Contractor O&P	15%	of Sub Cost		$402,549
	Mobilization, demobilization, bond	6%	of Sub cost		$161,019
	Total estimated current construction cost				*$3,292,225*
	Escalation to time of construction	15.81%			$520,388
	Total estimated construction cost				$3,812,613
	Contingency	30%			$1,143,784
	Engineering Design	15%			$733,298
	Construction Management	10%			$488,865
	Sales Tax	8.3%			$405,758
	Total Estimated Capital Cost				$6,584,000

Operations and Maintenance Cost Estimate (per year)

Item	Description	Quantity	Unit	Unit Cost	Annual Cost
	Labor - Secondary Process	1,625	HR	$30	$48,750
	Labor - Disinfection	52	hr	$30	$1,560
	Labor - Solids Handling	208	HR	$30	$6,240
	Membrane Replacement	188	panel	$75	$14,120
	Contract Haul Solids @ 1.5%	440,948	GAL	$0.07	$32,840
	Diesel oil		GAL	$2.00	$0
	Power - Secondary Process	184,456	kWh	$0.07	$12,912
	Power - Disinfection	4899	kWh	$0.07	$343
	Power - Solids Handling	48,992	kWh	$0.07	$3,429
	Structural Maintenance	1%			$13,104
	Equipment replacement	2%			$23,538
	Chemicals - membrane cleaning	1	LS	$2,000	$2,000
	Hypochlorite	1115	lb	$0.60	$669
	Sodium Bisulfite	0	GAL	$0.20	$0
	Polymer	276	LB	$3.00	$827
	Misc expenses		allowance		$0
	Total Annual Cost				$160,334
	Present Worth Factor	14.6061			
	Present Worth Cost				$2,342,000

Total Present Worth Project Cost Estimate

Capital	$6,584,000
Operations and Maintenance	$2,342,000
Total Present Worth	$8,926,000

Project: Freeland Comprehensive Sewer Plan - Ch 8 Analysis
Subject: Secondary Treatment and Solids Handling Analysis
By : Tt/KCM
Date : 4-Jun-03

Membrane Bioreactors (Freeland Only) - Phase 4

Capital Cost Estimate

Item	Description	Quantity	Unit	Unit cost, $	Cost, $
MBR	Administration/Lab Building	1,500	SF	$125	$187,500
	Electrical Building (generator outside)	1,200	SF	$100	$120,000
	Mechanical Building	900	SF	$100	$90,000
	Filter & Chemical Building	0	SF	$100	$0
	Slab Concrete and Rebar	224	CY	$300	$67,222
	Straight Wall Concrete and Rebar	362	CY	$400	$144,889
	Curved Wall Concrete and Rebar	0	CY	$500	$0
	Deck - Aerator Support Concrete	0	CY	$500	$0
	Access Bridge Concrete	20	CY	$500	$10,000
	Effluent Weir Concrete	0	CY	$500	$0
	Misc Metals (Handrailing, Covers, etc.)	1	LS	$45,000	$45,000
	Site Stormwater Piping and Valving	1	LS	$20,000	$20,000
	Site Process Piping and Valving	1	LS	$100,000	$100,000
	Indoor Process Piping and Valving	1	LS	$75,000	$75,000
	Manholes	5	EA	$6,000	$30,000
	Stormwater Detention Tank and Control Structı	1	LS	$60,000	$60,000
	Sitework	1	LS	$100,000	$100,000
	Landscaping	1	LS	$40,000	$40,000
	Electrical Conduit, Sitework	1	LS	$40,000	$40,000
	Site Lighting	1	LS	$30,000	$30,000
	Laboratory Equipment	1	LS	$25,000	$25,000
	Furniture	1	LS	$20,000	$20,000
	Land Acquisition	3	AC	$15,000	$45,000
NaOCl	Building enclosure for equipment	100	SF	$100	$10,000
	Slab Concrete and Rebar	72	CY	$300	$21,667
	Straight Wall Concrete and Rebar	58	CY	$400	$23,111
	Misc Metals (Handrailing, Covers, etc.)	1	LS	$2,500	$2,500
	Misc Concrete (NaOCl secondary containment)	5	CY	$500	$2,500
	Site Process Piping and Valving	1	LS	$20,000	$20,000
	Sitework	1	LS	$10,000	$10,000
	Electrical Conduit, Sitework	1	LS	$2,000	$2,000
	Site Lighting	1	LS	$20,000	$20,000
	Contact Tank Baffles	1	LS	$10,000	$10,000
Solids	Slab Concrete and Rebar	46	CY	$300	$13,889
Stabilizat	Straight Wall Concrete and Rebar	119	CY	$400	$47,407
	Curved Wall Concrete and Rebar	0	CY	$500	$0
	Access Bridge Concrete	0	CY	$500	$0
	Earthwork	1,157	CY	$20	$23,148
	Misc Metals (Handrailing, Covers, etc.)	1	LS	$10,000	$10,000
	FRP Covers	1	LS	$10,000	$10,000
	Site Process Piping and Valving	1	LS	$15,000	$15,000
	Sitework	1	LS	$25,000	$25,000
	Electrical Conduit, Sitework	1	LS	$15,000	$15,000
	Building Space for Solids Equipment	300	SF	$100	$30,000
	Subtotal Structural				*$1,560,833*
MBR	Equipment	1	EA	$902,000	$902,000
	(membranes, cleaning tanks, vacuum pumps)				$0
	(process air blowers and diffusers)				$0
	Hoist for Membrane Racks	2	EA	$25,000	$50,000
	Influent Screen - 1/8 in.	0	LS	$100,000	$0
	Washer Compactor	0	LS	$25,000	$0
	WAS Pumps	3	EA	$7,500	$22,500
	Magnetic Flow Meters	3	EA	$5,000	$15,000
	Yard Pump Station Pumps	2	EA	$7,500	$15,000
	Plant Water Pumps	2	EA	$5,000	$10,000

	Strainer (Manual duplex)	1	EA	$2,000	$2,000
	Hydro Tank	1	EA	$4,000	$4,000
	Odor Control - Carbon Adsorber, Fans, Piping	0	LS	$50,000	$0
	Standby Generator	1,000	kW	$175	$175,000
	Generator Silencer, Enclosure, Acoustics	1	LS	$7,500	$7,500
	Underground Fuel Storage Tank, Pumps	1	LS	$15,000	$15,000
	Automatic Transfer Switch	1	LS	$15,000	$15,000
	Motor Control Centers/Variable Frequency Driv	1	LS	$75,000	$75,000
	PLC	1	LS	$100,000	$100,000
NaOCl	Storage Tank (2-55 gal drums)	2	ea	$200	$400
	Pumps w/ installation (hypo)	2	ea	$2,500	$5,000
	Tank Mixers	1	ea	$1,000	$1,000
	Feed Pacing Controller	1	ea	$2,500	$2,500
	Chemical Flow Meter	1	ea	$2,000	$2,000
Solids Stabilizat	Blowers - 10 Hp	2	EA	$15,000	$30,000
	Sludge Storage Tank Diffusers	1	LS	$10,000	$10,000
	Sludge Transfer Pumps	2	EA	$7,500	$15,000
					$0
	Subtotal Equipment				*$1,473,900*
	Installation, Miscellaneous Mechanical	30%	of Equip		$442,170
	Electrical	15%	of Equip		$221,085
	Instrumentation and Control	10%	of Equip		$147,390
	Subtotal Structural, Mechanical, Elect, I&C				*$3,845,378*
	Contractor O&P	15%	of Sub Cost		$570,057
	Mobilization, demobilization, bond	6%	of Sub cost		$228,023
	Total estimated current construction cost				*$4,643,458*
	Escalation to time of construction	15.81%			$733,972
	Total estimated construction cost				$5,377,429
	Contingency	30%			$1,613,229
	Engineering Design	15%			$1,038,437
	Construction Management	10%			$692,291
	Sales Tax	8.3%			$574,602
	Total Estimated Capital Cost				$9,296,000

Operations and Maintenance Cost Estimate (per year)

Item	Description	Quantity	Unit	Unit Cost	Annual Cost
	Labor - Secondary Process	1,716	HR	$30	$51,480
	Labor - Disinfection	52	hr	$30	$1,560
	Labor - Solids Handling	208	HR	$30	$6,240
	Membrane Replacement	307	panel	$75	$23,034
	Contract Haul Solids @ 1.5%	680,368	GAL	$0.07	$50,671
	Diesel oil		GAL	$2.00	$0
	Power - Secondary Process	285,206	kWh	$0.07	$19,964
	Power - Disinfection	4899	kWh	$0.07	$343
	Power - Solids Handling	65,323	kWh	$0.07	$4,573
	Structural Maintenance	1%			$18,075
	Equipment replacement	2%			$33,604
	Chemicals - membrane cleaning	1	LS	$2,000	$2,000
	Hypochlorite	1798	lb	$0.60	$1,079
	Sodium Bisulfite	0	GAL	$0.20	$0
	Polymer	426	LB	$3.00	$1,277
	Misc expenses		allowance		$0
	Total Annual Cost				$213,900
	Present Worth Factor	14.6061			
	Present Worth Cost				$3,124,000

Total Present Worth Project Cost Estimate

Capital	$9,296,000
Operations and Maintenance	$3,124,000
Total Present Worth	$12,420,000

Project: Freeland Comprehensive Sewer Plan - Ch 8 Analysis
Subject: Secondary Treatment and Solids Handling Analysis
By : Tt/KCM
Date : 4-Jun-03

Membrane Bioreactors (Freeland Only) - Phase 5

Capital Cost Estimate

Item	Description	Quantity	Unit	Unit cost, $	Cost, $
MBR	Administration/Lab Building	1,500	SF	$125	$187,500
	Electrical Building (generator outside)	1,200	SF	$100	$120,000
	Mechanical Building	900	SF	$100	$90,000
	Filter & Chemical Building	0	SF	$100	$0
	Slab Concrete and Rebar	289	CY	$300	$86,667
	Straight Wall Concrete and Rebar	476	CY	$400	$190,222
	Curved Wall Concrete and Rebar	0	CY	$500	$0
	Deck - Aerator Support Concrete	0	CY	$500	$0
	Access Bridge Concrete	30	CY	$500	$15,000
	Effluent Weir Concrete	0	CY	$500	$0
	Misc Metals (Handrailing, Covers, etc.)	1	LS	$60,000	$60,000
	Site Stormwater Piping and Valving	1	LS	$20,000	$20,000
	Site Process Piping and Valving	1	LS	$200,000	$200,000
	Indoor Process Piping and Valving	1	LS	$150,000	$150,000
	Manholes	5	EA	$6,000	$30,000
	Stormwater Detention Tank and Control Structu	1	LS	$60,000	$60,000
	Sitework	1	LS	$100,000	$100,000
	Landscaping	1	LS	$40,000	$40,000
	Electrical Conduit, Sitework	1	LS	$40,000	$40,000
	Site Lighting	1	LS	$30,000	$30,000
	Laboratory Equipment	1	LS	$25,000	$25,000
	Furniture	1	LS	$20,000	$20,000
	Land Acquisition	3	AC	$15,000	$45,000
NaOCl	Building enclosure for equipment	100	SF	$100	$10,000
	Slab Concrete and Rebar	72	CY	$300	$21,667
	Straight Wall Concrete and Rebar	58	CY	$400	$23,111
	Misc Metals (Handrailing, Covers, etc.)	1	LS	$2,500	$2,500
	Misc Concrete (NaOCl secondary containment)	5	CY	$500	$2,500
	Site Process Piping and Valving	1	LS	$20,000	$20,000
	Sitework	1	LS	$10,000	$10,000
	Electrical Conduit, Sitework	1	LS	$2,000	$2,000
	Site Lighting	1	LS	$20,000	$20,000
	Contact Tank Baffles	1	LS	$10,000	$10,000
Solids	Slab Concrete and Rebar	46	CY	$300	$13,889
Stabilizat	Straight Wall Concrete and Rebar	119	CY	$400	$47,407
	Curved Wall Concrete and Rebar	0	CY	$500	$0
	Access Bridge Concrete	0	CY	$500	$0
	Earthwork	1,157	CY	$20	$23,148
	Misc Metals (Handrailing, Covers, etc.)	1	LS	$10,000	$10,000
	FRP Covers	1	LS	$10,000	$10,000
	Site Process Piping and Valving	1	LS	$15,000	$15,000
	Sitework	1	LS	$25,000	$25,000
	Electrical Conduit, Sitework	1	LS	$15,000	$15,000
	Building Space for Solids Equipment	300	SF	$100	$30,000
	Subtotal Structural				*$1,820,611*
MBR	Equipment	1	EA	$1,496,000	$1,496,000
	(membranes, cleaning tanks, vacuum pumps)				$0
	(process air blowers and diffusers)				$0
	Hoist for Membrane Racks	3	EA	$25,000	$75,000
	Influent Screen - 1/8 in.	0	LS	$100,000	$0
	Washer Compactor	0	LS	$25,000	$0
	WAS Pumps	4	EA	$7,500	$30,000
	Magnetic Flow Meters	3	EA	$5,000	$15,000
	Yard Pump Station Pumps	2	EA	$7,500	$15,000
	Plant Water Pumps	2	EA	$5,000	$10,000

	Strainer (Manual duplex)	1	EA	$2,000	$2,000
	Hydro Tank	1	EA	$4,000	$4,000
	Odor Control - Carbon Adsorber, Fans, Piping	0	LS	$50,000	$0
	Standby Generator	1,000	kW	$175	$175,000
	Generator Silencer, Enclosure, Acoustics	1	LS	$7,500	$7,500
	Underground Fuel Storage Tank, Pumps	1	LS	$15,000	$15,000
	Automatic Transfer Switch	1	LS	$15,000	$15,000
	Motor Control Centers/Variable Frequency Driv	1	LS	$75,000	$75,000
	PLC	1	LS	$100,000	$100,000
NaOCl	Storage Tank (2-55 gal drums)	2	ea	$200	$400
	Pumps w/ installation (hypo)	2	ea	$2,500	$5,000
	Tank Mixers	1	ea	$1,000	$1,000
	Feed Pacing Controller	1	ea	$2,500	$2,500
	Chemical Flow Meter	1	ea	$2,000	$2,000
Solids	Blowers - 10 Hp	3	EA	$15,000	$45,000
Stabilizat	Sludge Storage Tank Diffusers	1	LS	$20,000	$20,000
	Sludge Transfer Pumps	3	EA	$7,500	$22,500
					$0
	Subtotal Equipment				*$2,132,900*
	Installation, Miscellaneous Mechanical	30%	of Equip		$639,870
	Electrical	15%	of Equip		$319,935
	Instrumentation and Control	10%	of Equip		$213,290
	Subtotal Structural, Mechanical, Elect, I&C				*$5,126,606*
	Contractor O&P	15%	of Sub Cost		$762,241
	Mobilization, demobilization, bond	6%	of Sub cost		$304,896
	Total estimated current construction cost				*$6,193,743*
	Escalation to time of construction	15.81%			$979,019
	Total estimated construction cost				$7,172,762
	Contingency	30%			$2,151,829
	Engineering Design	15%			$1,388,527
	Construction Management	10%			$925,684
	Sales Tax	8.3%			$768,318
	Total Estimated Capital Cost				$12,407,000

Operations and Maintenance Cost Estimate (per year)

Item	Description	Quantity	Unit	Unit Cost	Annual Cost
	Labor - Secondary Process	1,820	HR	$30	$54,600
	Labor - Disinfection	52	hr	$30	$1,560
	Labor - Solids Handling	208	HR	$30	$6,240
	Membrane Replacement	501	panel	$75	$37,599
	Contract Haul Solids @ 1.5%	1,158,540	GAL	$0.07	$86,284
	Diesel oil		GAL	$2.00	$0
	Power - Secondary Process	485,818	kWh	$0.07	$34,007
	Power - Disinfection	4899	kWh	$0.07	$343
	Power - Solids Handling	65,323	kWh	$0.07	$4,573
	Structural Maintenance	1%			$21,084
	Equipment replacement	2%			$48,530
	Chemicals - membrane cleaning	1	LS	$2,000	$2,000
	Hypochlorite	3083	lb	$0.60	$1,850
	Sodium Bisulfite	0	GAL	$0.20	$0
	Polymer	725	LB	$3.00	$2,174
	Misc expenses		allowance		$0
	Total Annual Cost				$300,843
	Present Worth Factor	14.6061			
	Present Worth Cost				$4,394,000

Total Present Worth Project Cost Estimate

Capital	$12,407,000
Operations and Maintenance	$4,394,000
Total Present Worth	$16,801,000

Project: Freeland Comprehensive Sewer Plan - Ch 8 Analysis
Subject: Secondary Treatment and Solids Handling Analysis
By : Tt/KCM
Date : 4-Jun-03

Membrane Bioreactors (with HHSD) - Phase 1

Capital Cost Estimate

Item	Description	Quantity	Unit	Unit cost, $	Cost, $
MBR	Administration/Lab Building	0	SF	$125	$0
	Electrical Building (generator outside)	720	SF	$100	$72,000
	Mechanical Building	540	SF	$100	$54,000
	Filter & Chemical Building	0	SF	$100	$0
	Slab Concrete and Rebar	56	CY	$300	$16,667
	Straight Wall Concrete and Rebar	89	CY	$400	$35,556
	Curved Wall Concrete and Rebar	0	CY	$500	$0
	Deck - Aerator Support Concrete	0	CY	$500	$0
	Access Bridge Concrete	0	CY	$500	$0
	Effluent Weir Concrete	0	CY	$500	$0
	Misc Metals (Handrailing, Covers, etc.)	0	LS	$15,000	$0
	Site Stormwater Piping and Valving	0	LS	$10,000	$0
	Site Process Piping and Valving	1	LS	$37,500	$37,500
	Indoor Process Piping and Valving	1	LS	$28,125	$28,125
	Manholes	0	EA	$6,000	$0
	Stormwater Detention Tank and Control Structı	0	LS	$60,000	$0
	Sitework	0	LS	$50,000	$0
	Landscaping	0	LS	$20,000	$0
	Electrical Conduit, Sitework	1	LS	$40,000	$40,000
	Site Lighting	0	LS	$30,000	$0
	Laboratory Equipment	0	LS	$25,000	$0
	Furniture	0	LS	$20,000	$0
	Land Acquisition	0	AC	$15,000	$0
NaOCl	Building enclosure for equipment	0	SF	$100	$0
	Slab Concrete and Rebar	36	CY	$300	$10,833
	Straight Wall Concrete and Rebar	36	CY	$400	$14,222
	Misc Metals (Handrailing, Covers, etc.)	1	LS	$1,250	$1,250
	Misc Concrete (NaOCl secondary containment)	0	CY	$500	$0
	Site Process Piping and Valving	1	LS	$10,000	$10,000
	Sitework	1	LS	$5,000	$5,000
	Electrical Conduit, Sitework	1	LS	$2,000	$2,000
	Site Lighting	1	LS	$20,000	$20,000
	Contact Tank Baffles	1	LS	$5,000	$5,000
Solids	Slab Concrete and Rebar	0	CY	$300	$0
Stabilizat	Straight Wall Concrete and Rebar	0	CY	$400	$0
	Curved Wall Concrete and Rebar	0	CY	$500	$0
	Access Bridge Concrete	0	CY	$500	$0
	Earthwork	0	CY	$20	$0
	Misc Metals (Handrailing, Covers, etc.)	0	LS	$5,000	$0
	FRP Covers	0	LS	$5,000	$0
	Site Process Piping and Valving	0	LS	$7,500	$0
	Sitework	0	LS	$12,500	$0
	Electrical Conduit, Sitework	0	LS	$15,000	$0
	Building Space for Solids Equipment	0	SF	$100	$0
	Subtotal Structural				*$352,153*
MBR	Equipment	1	EA	$374,000	$374,000
	(membranes, cleaning tanks, vacuum pumps)				$0
	(process air blowers and diffusers)				$0
	Hoist for Membrane Racks	1	EA	$25,000	$25,000
	Influent Screen - 1/8 in.	1	LS	$100,000	$100,000
	Washer Compactor	1	LS	$25,000	$25,000
	WAS Pumps	2	EA	$7,500	$15,000
	Magnetic Flow Meters	3	EA	$5,000	$15,000
	Yard Pump Station Pumps	0	EA	$7,500	$0
	Plant Water Pumps	0	EA	$5,000	$0

	Strainer (Manual duplex)	0	EA	$2,000	$0
	Hydro Tank	0	EA	$4,000	$0
	Odor Control - Carbon Adsorber, Fans, Piping	1	LS	$50,000	$50,000
	Standby Generator	200	kW	$175	$35,000
	Generator Silencer, Enclosure, Acoustics	1	LS	$5,000	$5,000
	Underground Fuel Storage Tank, Pumps	1	LS	$15,000	$15,000
	Automatic Transfer Switch	1	LS	$15,000	$15,000
	Motor Control Centers/Variable Frequency Driv	1	LS	$37,500	$37,500
	PLC	1	LS	$100,000	$100,000
NaOCl	Storage Tank (2-55 gal drums)	0	ea	$200	$0
	Pumps w/ installation (hypo)	0	ea	$2,500	$0
	Tank Mixers	0	ea	$1,000	$0
	Feed Pacing Controller	0	ea	$2,500	$0
	Chemical Flow Meter	0	ea	$2,000	$0
Solids	Blowers - 10 Hp	0	EA	$15,000	$0
Stabilizat	Sludge Storage Tank Diffusers	0	LS	$10,000	$0
	Sludge Transfer Pumps	2	EA	$7,500	$15,000
					$0
	Subtotal Equipment				*$826,500*
	Installation, Miscellaneous Mechanical	30%	of Equip		$247,950
	Electrical	15%	of Equip		$123,975
	Instrumentation and Control	10%	of Equip		$82,650
	Subtotal Structural, Mechanical, Elect, I&C				*$1,633,228*
	Contractor O&P	15%	of Sub Cost		$244,984
	Mobilization, demobilization, bond	6%	of Sub cost		$97,994
	Total estimated current construction cost				*$1,976,206*
	Escalation to time of construction	15.81%			$312,370
	Total estimated construction cost				$2,288,576
	Contingency	30%			$686,573
	Engineering Design	15%			$446,272
	Construction Management	10%			$297,515
	Sales Tax	8.3%			$246,937
	Total Estimated Capital Cost				$3,966,000

Operations and Maintenance Cost Estimate (per year)

Item	Description	Quantity	Unit	Unit Cost	Annual Cost
	Labor - Secondary Process	1,040	HR	$30	$31,200
	Labor - Disinfection	52	hr	$30	$1,560
	Labor - Solids Handling	0	HR	$30	$0
	Membrane Replacement	55	panel	$75	$4,125
	Contract Haul Solids @ 1.5%	148,672	GAL	$0.07	$11,073
	Diesel oil		GAL	$2.00	$0
	Power - Secondary Process	61,888	kWh	$0.07	$4,332
	Power - Disinfection	4899	kWh	$0.07	$343
	Power - Solids Handling	0	kWh	$0.07	$0
	Structural Maintenance	1%			$4,078
	Equipment replacement	2%			$19,047
	Chemicals - membrane cleaning	1	LS	$1,000	$1,000
	Hypochlorite	337	lb	$0.60	$202
	Sodium Bisulfite	0	GAL	$0.20	$0
	Polymer	0	LB	$3.00	$0
	Misc expenses		allowance		$0
	Total Annual Cost				$76,960
	Present Worth Factor	14.6061			
	Present Worth Cost				$1,124,000

Total Present Worth Project Cost Estimate

Capital	$3,966,000
Operations and Maintenance	$1,124,000
Total Present Worth	$5,090,000

Project: Freeland Comprehensive Sewer Plan - Ch 8 Analysis
Subject: Secondary Treatment and Solids Handling Analysis
By : Tt/KCM
Date : 4-Jun-03

Membrane Bioreactors (with HHSD) - Phase 2

Capital Cost Estimate

Item	Description	Quantity	Unit	Unit cost, $	Cost, $
MBR	Administration/Lab Building	0	SF	$125	$0
	Electrical Building (generator outside)	720	SF	$100	$72,000
	Mechanical Building	540	SF	$100	$54,000
	Filter & Chemical Building	0	SF	$100	$0
	Slab Concrete and Rebar	56	CY	$300	$16,667
	Straight Wall Concrete and Rebar	89	CY	$400	$35,556
	Curved Wall Concrete and Rebar	0	CY	$500	$0
	Deck - Aerator Support Concrete	0	CY	$500	$0
	Access Bridge Concrete	0	CY	$500	$0
	Effluent Weir Concrete	0	CY	$500	$0
	Misc Metals (Handrailing, Covers, etc.)	0	LS	$15,000	$0
	Site Stormwater Piping and Valving	0	LS	$10,000	$0
	Site Process Piping and Valving	1	LS	$50,000	$50,000
	Indoor Process Piping and Valving	1	LS	$37,500	$37,500
	Manholes	0	EA	$6,000	$0
	Stormwater Detention Tank and Control Structı	0	LS	$60,000	$0
	Sitework	0	LS	$50,000	$0
	Landscaping	0	LS	$20,000	$0
	Electrical Conduit, Sitework	1	LS	$40,000	$40,000
	Site Lighting	0	LS	$30,000	$0
	Laboratory Equipment	0	LS	$25,000	$0
	Furniture	0	LS	$20,000	$0
	Land Acquisition	0	AC	$15,000	$0
NaOCl	Building enclosure for equipment	0	SF	$100	$0
	Slab Concrete and Rebar	36	CY	$300	$10,833
	Straight Wall Concrete and Rebar	36	CY	$400	$14,222
	Misc Metals (Handrailing, Covers, etc.)	1	LS	$1,250	$1,250
	Misc Concrete (NaOCl secondary containment)	0	CY	$500	$0
	Site Process Piping and Valving	1	LS	$10,000	$10,000
	Sitework	1	LS	$5,000	$5,000
	Electrical Conduit, Sitework	1	LS	$2,000	$2,000
	Site Lighting	1	LS	$20,000	$20,000
	Contact Tank Baffles	1	LS	$5,000	$5,000
Solids Stabilizat	Slab Concrete and Rebar	0	CY	$300	$0
	Straight Wall Concrete and Rebar	0	CY	$400	$0
	Curved Wall Concrete and Rebar	0	CY	$500	$0
	Access Bridge Concrete	0	CY	$500	$0
	Earthwork	0	CY	$20	$0
	Misc Metals (Handrailing, Covers, etc.)	0	LS	$5,000	$0
	FRP Covers	0	LS	$5,000	$0
	Site Process Piping and Valving	0	LS	$7,500	$0
	Sitework	0	LS	$12,500	$0
	Electrical Conduit, Sitework	0	LS	$15,000	$0
	Building Space for Solids Equipment	0	SF	$100	$0
	Subtotal Structural				*$374,028*
MBR	Equipment	1	EA	$506,000	$506,000
	(membranes, cleaning tanks, vacuum pumps)				$0
	(process air blowers and diffusers)				$0
	Hoist for Membrane Racks	1	EA	$25,000	$25,000
	Influent Screen - 1/8 in.	1	LS	$100,000	$100,000
	Washer Compactor	1	LS	$25,000	$25,000
	WAS Pumps	2	EA	$7,500	$15,000
	Magnetic Flow Meters	3	EA	$5,000	$15,000
	Yard Pump Station Pumps	0	EA	$7,500	$0
	Plant Water Pumps	0	EA	$5,000	$0

	Strainer (Manual duplex)	0	EA	$2,000	$0
	Hydro Tank	0	EA	$4,000	$0
	Odor Control - Carbon Adsorber, Fans, Piping	1	LS	$50,000	$50,000
	Standby Generator	200	kW	$175	$35,000
	Generator Silencer, Enclosure, Acoustics	1	LS	$5,000	$5,000
	Underground Fuel Storage Tank, Pumps	1	LS	$15,000	$15,000
	Automatic Transfer Switch	1	LS	$15,000	$15,000
	Motor Control Centers/Variable Frequency Driv	1	LS	$37,500	$37,500
	PLC	1	LS	$100,000	$100,000
NaOCl	Storage Tank (2-55 gal drums)	0	ea	$200	$0
	Pumps w/ installation (hypo)	0	ea	$2,500	$0
	Tank Mixers	0	ea	$1,000	$0
	Feed Pacing Controller	0	ea	$2,500	$0
	Chemical Flow Meter	0	ea	$2,000	$0
Solids Stabilizat	Blowers - 10 Hp	0	EA	$15,000	$0
	Sludge Storage Tank Diffusers	0	LS	$10,000	$0
	Sludge Transfer Pumps	2	EA	$7,500	$15,000
					$0
	Subtotal Equipment				*$958,500*
	Installation, Miscellaneous Mechanical	30%	of Equip		$287,550
	Electrical	15%	of Equip		$143,775
	Instrumentation and Control	10%	of Equip		$95,850
	Subtotal Structural, Mechanical, Elect, I&C				*$1,859,703*
	Contractor O&P	15%	of Sub Cost		$278,955
	Mobilization, demobilization, bond	6%	of Sub cost		$111,582
	Total estimated current construction cost				*$2,250,240*
	Escalation to time of construction	15.81%			$355,686
	Total estimated construction cost				$2,605,926
	Contingency	30%			$781,778
	Engineering Design	15%			$508,156
	Construction Management	10%			$338,770
	Sales Tax	8.3%			$281,179
	Total Estimated Capital Cost				$4,516,000

Operations and Maintenance Cost Estimate (per year)

Item	Description	Quantity	Unit	Unit Cost	Annual Cost
	Labor - Secondary Process	1,040	HR	$30	$31,200
	Labor - Disinfection	52	hr	$30	$1,560
	Labor - Solids Handling	0	HR	$30	$0
	Membrane Replacement	93	panel	$75	$6,950
	Contract Haul Solids @ 1.5%	244,678	GAL	$0.07	$18,223
	Diesel oil		GAL	$2.00	$0
	Power - Secondary Process	101,930	kWh	$0.07	$7,135
	Power - Disinfection	4899	kWh	$0.07	$343
	Power - Solids Handling	0	kWh	$0.07	$0
	Structural Maintenance	1%			$4,331
	Equipment replacement	2%			$22,039
	Chemicals - membrane cleaning	1	LS	$1,000	$1,000
	Hypochlorite	564	lb	$0.60	$339
	Sodium Bisulfite	0	GAL	$0.20	$0
	Polymer	0	LB	$3.00	$0
	Misc expenses		allowance		$0
	Total Annual Cost				$93,120
	Present Worth Factor	14.6061			
	Present Worth Cost				$1,360,000

Total Present Worth Project Cost Estimate

Capital	$4,516,000
Operations and Maintenance	$1,360,000
Total Present Worth	$5,876,000

Project: Freeland Comprehensive Sewer Plan - Ch 8 Analysis
Subject: Secondary Treatment and Solids Handling Analysis
By : Tt/KCM
Date : 4-Jun-03

Membrane Bioreactors (with HHSD) - Phase 3

Capital Cost Estimate

Item	Description	Quantity	Unit	Unit cost, $	Cost, $
MBR	Administration/Lab Building	0	SF	$125	$0
	Electrical Building (generator outside)	1,200	SF	$100	$120,000
	Mechanical Building	540	SF	$100	$54,000
	Filter & Chemical Building	0	SF	$100	$0
	Slab Concrete and Rebar	94	CY	$300	$28,333
	Straight Wall Concrete and Rebar	207	CY	$400	$82,963
	Curved Wall Concrete and Rebar	0	CY	$500	$0
	Deck - Aerator Support Concrete	0	CY	$500	$0
	Access Bridge Concrete	0	CY	$500	$0
	Effluent Weir Concrete	0	CY	$500	$0
	Misc Metals (Handrailing, Covers, etc.)	1	LS	$30,000	$30,000
	Site Stormwater Piping and Valving	0	LS	$10,000	$0
	Site Process Piping and Valving	1	LS	$75,000	$75,000
	Indoor Process Piping and Valving	1	LS	$56,250	$56,250
	Manholes	0	EA	$6,000	$0
	Stormwater Detention Tank and Control Structı	0	LS	$60,000	$0
	Sitework	0	LS	$50,000	$0
	Landscaping	0	LS	$20,000	$0
	Electrical Conduit, Sitework	1	LS	$40,000	$40,000
	Site Lighting	0	LS	$30,000	$0
	Laboratory Equipment	0	LS	$25,000	$0
	Furniture	0	LS	$20,000	$0
	Land Acquisition	0	AC	$15,000	$0
NaOCl	Building enclosure for equipment	0	SF	$100	$0
	Slab Concrete and Rebar	36	CY	$300	$10,833
	Straight Wall Concrete and Rebar	36	CY	$400	$14,222
	Misc Metals (Handrailing, Covers, etc.)	1	LS	$1,250	$1,250
	Misc Concrete (NaOCl secondary containment)	0	CY	$500	$0
	Site Process Piping and Valving	1	LS	$10,000	$10,000
	Sitework	1	LS	$5,000	$5,000
	Electrical Conduit, Sitework	1	LS	$2,000	$2,000
	Site Lighting	1	LS	$20,000	$20,000
	Contact Tank Baffles	1	LS	$5,000	$5,000
Solids	Slab Concrete and Rebar	28	CY	$300	$8,333
Stabilizat	Straight Wall Concrete and Rebar	59	CY	$400	$23,704
	Curved Wall Concrete and Rebar	0	CY	$500	$0
	Access Bridge Concrete	0	CY	$500	$0
	Earthwork	556	CY	$20	$11,111
	Misc Metals (Handrailing, Covers, etc.)	1	LS	$5,000	$5,000
	FRP Covers	1	LS	$5,000	$5,000
	Site Process Piping and Valving	1	LS	$7,500	$7,500
	Sitework	1	LS	$12,500	$12,500
	Electrical Conduit, Sitework	1	LS	$15,000	$15,000
	Building Space for Solids Equipment	300	SF	$100	$30,000
	Subtotal Structural				*$673,000*
MBR	Equipment	1	EA	$836,000	$836,000
	(membranes, cleaning tanks, vacuum pumps)				$0
	(process air blowers and diffusers)				$0
	Hoist for Membrane Racks	1	EA	$25,000	$25,000
	Influent Screen - 1/8 in.	1	LS	$100,000	$100,000
	Washer Compactor	1	LS	$25,000	$25,000
	WAS Pumps	2	EA	$7,500	$15,000
	Magnetic Flow Meters	3	EA	$5,000	$15,000
	Yard Pump Station Pumps	0	EA	$7,500	$0
	Plant Water Pumps	0	EA	$5,000	$0

	Strainer (Manual duplex)	0	EA	$2,000	$0
	Hydro Tank	0	EA	$4,000	$0
	Odor Control - Carbon Adsorber, Fans, Piping	1	LS	$50,000	$50,000
	Standby Generator	500	kW	$175	$87,500
	Generator Silencer, Enclosure, Acoustics	1	LS	$7,500	$7,500
	Underground Fuel Storage Tank, Pumps	1	LS	$15,000	$15,000
	Automatic Transfer Switch	1	LS	$15,000	$15,000
	Motor Control Centers/Variable Frequency Driv	1	LS	$37,500	$37,500
	PLC	1	LS	$100,000	$100,000
NaOCl	Storage Tank (2-55 gal drums)	0	ea	$200	$0
	Pumps w/ installation (hypo)	0	ea	$2,500	$0
	Tank Mixers	0	ea	$1,000	$0
	Feed Pacing Controller	0	ea	$2,500	$0
	Chemical Flow Meter	0	ea	$2,000	$0
Solids Stabilizat	Blowers - 10 Hp	2	EA	$15,000	$30,000
	Sludge Storage Tank Diffusers	1	LS	$10,000	$10,000
	Sludge Transfer Pumps	2	EA	$7,500	$15,000
					$0
	Subtotal Equipment				*$1,383,500*
	Installation, Miscellaneous Mechanical	30%	of Equip		$415,050
	Electrical	15%	of Equip		$207,525
	Instrumentation and Control	10%	of Equip		$138,350
	Subtotal Structural, Mechanical, Elect, I&C				*$2,817,425*
	Contractor O&P	15%	of Sub Cost		$422,614
	Mobilization, demobilization, bond	6%	of Sub cost		$169,046
	Total estimated current construction cost				*$3,409,084*
	Escalation to time of construction	15.81%			$538,859
	Total estimated construction cost				$3,947,944
	Contingency	30%			$1,184,383
	Engineering Design	15%			$769,849
	Construction Management	10%			$513,233
	Sales Tax	8.3%			$425,983
	Total Estimated Capital Cost				$6,841,000

Operations and Maintenance Cost Estimate (per year)

Item	Description	Quantity	Unit	Unit Cost	Annual Cost
	Labor - Secondary Process	1,300	HR	$30	$39,000
	Labor - Disinfection	52	hr	$30	$1,560
	Labor - Solids Handling	208	HR	$30	$6,240
	Membrane Replacement	188	panel	$75	$14,120
	Contract Haul Solids @ 1.5%	440,948	GAL	$0.07	$32,840
	Diesel oil		GAL	$2.00	$0
	Power - Secondary Process	184,456	kWh	$0.07	$12,912
	Power - Disinfection	4899	kWh	$0.07	$343
	Power - Solids Handling	48,992	kWh	$0.07	$3,429
	Structural Maintenance	1%			$7,794
	Equipment replacement	2%			$31,717
	Chemicals - membrane cleaning	1	LS	$2,000	$2,000
	Hypochlorite	1115	lb	$0.60	$669
	Sodium Bisulfite	0	GAL	$0.20	$0
	Polymer	276	LB	$3.00	$827
	Misc expenses		allowance		$0
	Total Annual Cost				$153,452
	Present Worth Factor	14.6061			
	Present Worth Cost				$2,241,000

Total Present Worth Project Cost Estimate

Capital	$6,841,000
Operations and Maintenance	$2,241,000
Total Present Worth	$9,082,000

Project: Freeland Comprehensive Sewer Plan - Ch 8 Analysis
Subject: Secondary Treatment and Solids Handling Analysis
By : Tt/KCM
Date : 4-Jun-03

Membrane Bioreactors (with HHSD) - Phase 4

Capital Cost Estimate

Item	Description	Quantity	Unit	Unit cost, $	Cost, $
MBR	Administration/Lab Building	0	SF	$125	$0
	Electrical Building (generator outside)	1,200	SF	$100	$120,000
	Mechanical Building	900	SF	$100	$90,000
	Filter & Chemical Building	0	SF	$100	$0
	Slab Concrete and Rebar	198	CY	$300	$59,444
	Straight Wall Concrete and Rebar	421	CY	$400	$168,296
	Curved Wall Concrete and Rebar	0	CY	$500	$0
	Deck - Aerator Support Concrete	0	CY	$500	$0
	Access Bridge Concrete	10	CY	$500	$5,000
	Effluent Weir Concrete	0	CY	$500	$0
	Misc Metals (Handrailing, Covers, etc.)	1	LS	$45,000	$45,000
	Site Stormwater Piping and Valving	1	LS	$20,000	$20,000
	Site Process Piping and Valving	1	LS	$100,000	$100,000
	Indoor Process Piping and Valving	1	LS	$75,000	$75,000
	Manholes	2	EA	$6,000	$12,000
	Stormwater Detention Tank and Control Structı	1	LS	$30,000	$30,000
	Sitework	1	LS	$50,000	$50,000
	Landscaping	1	LS	$20,000	$20,000
	Electrical Conduit, Sitework	1	LS	$40,000	$40,000
	Site Lighting	1	LS	$20,000	$20,000
	Laboratory Equipment	0	LS	$25,000	$0
	Furniture	0	LS	$20,000	$0
	Land Acquisition	0	AC	$15,000	$0
NaOCl	Building enclosure for equipment	100	SF	$100	$10,000
	Slab Concrete and Rebar	72	CY	$300	$21,667
	Straight Wall Concrete and Rebar	58	CY	$400	$23,111
	Misc Metals (Handrailing, Covers, etc.)	1	LS	$2,500	$2,500
	Misc Concrete (NaOCl secondary containment)	5	CY	$500	$2,500
	Site Process Piping and Valving	1	LS	$20,000	$20,000
	Sitework	1	LS	$10,000	$10,000
	Electrical Conduit, Sitework	1	LS	$2,000	$2,000
	Site Lighting	1	LS	$20,000	$20,000
	Contact Tank Baffles	1	LS	$10,000	$10,000
Solids	Slab Concrete and Rebar	46	CY	$300	$13,889
Stabilizat	Straight Wall Concrete and Rebar	119	CY	$400	$47,407
	Curved Wall Concrete and Rebar	0	CY	$500	$0
	Access Bridge Concrete	0	CY	$500	$0
	Earthwork	1,157	CY	$20	$23,148
	Misc Metals (Handrailing, Covers, etc.)	1	LS	$10,000	$10,000
	FRP Covers	1	LS	$10,000	$10,000
	Site Process Piping and Valving	1	LS	$15,000	$15,000
	Sitework	1	LS	$25,000	$25,000
	Electrical Conduit, Sitework	1	LS	$15,000	$15,000
	Building Space for Solids Equipment	300	SF	$100	$30,000
	Subtotal Structural				*$1,165,963*
MBR	Equipment	1	EA	$1,122,000	$1,122,000
	(membranes, cleaning tanks, vacuum pumps)				$0
	(process air blowers and diffusers)				$0
	Hoist for Membrane Racks	1	EA	$25,000	$25,000
	Influent Screen - 1/8 in.	1	LS	$100,000	$100,000
	Washer Compactor	1	LS	$25,000	$25,000
	WAS Pumps	3	EA	$7,500	$22,500
	Magnetic Flow Meters	3	EA	$5,000	$15,000
	Yard Pump Station Pumps	0	EA	$7,500	$0
	Plant Water Pumps	0	EA	$5,000	$0

	Strainer (Manual duplex)	0	EA	$2,000	$0
	Hydro Tank	0	EA	$4,000	$0
	Odor Control - Carbon Adsorber, Fans, Piping	1	LS	$50,000	$50,000
	Standby Generator	1,000	kW	$175	$175,000
	Generator Silencer, Enclosure, Acoustics	1	LS	$7,500	$7,500
	Underground Fuel Storage Tank, Pumps	1	LS	$15,000	$15,000
	Automatic Transfer Switch	1	LS	$15,000	$15,000
	Motor Control Centers/Variable Frequency Driv	1	LS	$75,000	$75,000
	PLC	1	LS	$100,000	$100,000
NaOCl	Storage Tank (2-55 gal drums)	0	ea	$200	$0
	Pumps w/ installation (hypo)	0	ea	$2,500	$0
	Tank Mixers	0	ea	$1,000	$0
	Feed Pacing Controller	0	ea	$2,500	$0
	Chemical Flow Meter	0	ea	$2,000	$0
Solids Stabilizat	Blowers - 10 Hp	2	EA	$15,000	$30,000
	Sludge Storage Tank Diffusers	1	LS	$10,000	$10,000
	Sludge Transfer Pumps	2	EA	$7,500	$15,000
					$0
	Subtotal Equipment				*$1,802,000*
	Installation, Miscellaneous Mechanical	30%	of Equip		$540,600
	Electrical	15%	of Equip		$270,300
	Instrumentation and Control	10%	of Equip		$180,200
	Subtotal Structural, Mechanical, Elect, I&C				*$3,959,063*
	Contractor O&P	15%	of Sub Cost		$593,859
	Mobilization, demobilization, bond	6%	of Sub cost		$237,544
	Total estimated current construction cost				*$4,790,466*
	Escalation to time of construction	15.81%			$757,209
	Total estimated construction cost				$5,547,675
	Contingency	30%			$1,664,302
	Engineering Design	15%			$1,081,797
	Construction Management	10%			$721,198
	Sales Tax	8.3%			$598,594
	Total Estimated Capital Cost				$9,614,000

Operations and Maintenance Cost Estimate (per year)

Item	Description	Quantity	Unit	Unit Cost	Annual Cost
	Labor - Secondary Process	1,560	HR	$30	$46,800
	Labor - Disinfection	52	hr	$30	$1,560
	Labor - Solids Handling	208	HR	$30	$6,240
	Membrane Replacement	307	panel	$75	$23,034
	Contract Haul Solids @ 1.5%	680,368	GAL	$0.07	$50,671
	Diesel oil		GAL	$2.00	$0
	Power - Secondary Process	285,206	kWh	$0.07	$19,964
	Power - Disinfection	4899	kWh	$0.07	$343
	Power - Solids Handling	65,323	kWh	$0.07	$4,573
	Structural Maintenance	1%			$13,503
	Equipment replacement	2%			$41,203
	Chemicals - membrane cleaning	1	LS	$2,000	$2,000
	Hypochlorite	1798	lb	$0.60	$1,079
	Sodium Bisulfite	0	GAL	$0.20	$0
	Polymer	426	LB	$3.00	$1,277
	Misc expenses		allowance		$0
	Total Annual Cost				$212,247
	Present Worth Factor	14.6061			
	Present Worth Cost				$3,100,000

Total Present Worth Project Cost Estimate

Capital	$9,614,000
Operations and Maintenance	$3,100,000
Total Present Worth	$12,714,000

Project: Freeland Comprehensive Sewer Plan - Ch 8 Analysis
Subject: Secondary Treatment and Solids Handling Analysis
By : Tt/KCM
Date : 4-Jun-03

Membrane Bioreactors (with HHSD) - Phase 5

Capital Cost Estimate

Item	Description	Quantity	Unit	Unit cost, $	Cost, $
MBR	Administration/Lab Building	0	SF	$125	$0
	Electrical Building (generator outside)	1,200	SF	$100	$120,000
	Mechanical Building	900	SF	$100	$90,000
	Filter & Chemical Building	0	SF	$100	$0
	Slab Concrete and Rebar	198	CY	$300	$59,444
	Straight Wall Concrete and Rebar	421	CY	$400	$168,296
	Curved Wall Concrete and Rebar	0	CY	$500	$0
	Deck - Aerator Support Concrete	0	CY	$500	$0
	Access Bridge Concrete	10	CY	$500	$5,000
	Effluent Weir Concrete	0	CY	$500	$0
	Misc Metals (Handrailing, Covers, etc.)	1	LS	$60,000	$60,000
	Site Stormwater Piping and Valving	1	LS	$20,000	$20,000
	Site Process Piping and Valving	1	LS	$200,000	$200,000
	Indoor Process Piping and Valving	1	LS	$150,000	$150,000
	Manholes	5	EA	$6,000	$30,000
	Stormwater Detention Tank and Control Structu	1	LS	$30,000	$30,000
	Sitework	1	LS	$50,000	$50,000
	Landscaping	1	LS	$20,000	$20,000
	Electrical Conduit, Sitework	1	LS	$40,000	$40,000
	Site Lighting	1	LS	$20,000	$20,000
	Laboratory Equipment	0	LS	$25,000	$0
	Furniture	0	LS	$20,000	$0
	Land Acquisition	0	AC	$15,000	$0
NaOCl	Building enclosure for equipment	100	SF	$100	$10,000
	Slab Concrete and Rebar	72	CY	$300	$21,667
	Straight Wall Concrete and Rebar	58	CY	$400	$23,111
	Misc Metals (Handrailing, Covers, etc.)	1	LS	$2,500	$2,500
	Misc Concrete (NaOCl secondary containment)	5	CY	$500	$2,500
	Site Process Piping and Valving	1	LS	$20,000	$20,000
	Sitework	1	LS	$10,000	$10,000
	Electrical Conduit, Sitework	1	LS	$2,000	$2,000
	Site Lighting	1	LS	$20,000	$20,000
	Contact Tank Baffles	1	LS	$10,000	$10,000
Solids	Slab Concrete and Rebar	46	CY	$300	$13,889
Stabilizat	Straight Wall Concrete and Rebar	119	CY	$400	$47,407
	Curved Wall Concrete and Rebar	0	CY	$500	$0
	Access Bridge Concrete	0	CY	$500	$0
	Earthwork	1,157	CY	$20	$23,148
	Misc Metals (Handrailing, Covers, etc.)	1	LS	$10,000	$10,000
	FRP Covers	1	LS	$10,000	$10,000
	Site Process Piping and Valving	1	LS	$15,000	$15,000
	Sitework	1	LS	$25,000	$25,000
	Electrical Conduit, Sitework	1	LS	$15,000	$15,000
	Building Space for Solids Equipment	300	SF	$100	$30,000
	Subtotal Structural				*$1,373,963*
MBR	Equipment	1	EA	$1,716,000	$1,716,000
	(membranes, cleaning tanks, vacuum pumps)				$0
	(process air blowers and diffusers)				$0
	Hoist for Membrane Racks	1	EA	$25,000	$25,000
	Influent Screen - 1/8 in.	1	LS	$100,000	$100,000
	Washer Compactor	1	LS	$25,000	$25,000
	WAS Pumps	4	EA	$7,500	$30,000
	Magnetic Flow Meters	3	EA	$5,000	$15,000
	Yard Pump Station Pumps	0	EA	$7,500	$0
	Plant Water Pumps	0	EA	$5,000	$0

	Strainer (Manual duplex)	0	EA	$2,000	$0
	Hydro Tank	0	EA	$4,000	$0
	Odor Control - Carbon Adsorber, Fans, Piping	1	LS	$50,000	$50,000
	Standby Generator	1,000	kW	$175	$175,000
	Generator Silencer, Enclosure, Acoustics	1	LS	$7,500	$7,500
	Underground Fuel Storage Tank, Pumps	1	LS	$15,000	$15,000
	Automatic Transfer Switch	1	LS	$15,000	$15,000
	Motor Control Centers/Variable Frequency Driv	1	LS	$75,000	$75,000
	PLC	1	LS	$100,000	$100,000
NaOCl	Storage Tank (2-55 gal drums)	0	ea	$200	$0
	Pumps w/ installation (hypo)	0	ea	$2,500	$0
	Tank Mixers	0	ea	$1,000	$0
	Feed Pacing Controller	0	ea	$2,500	$0
	Chemical Flow Meter	0	ea	$2,000	$0
Solids Stabilizat	Blowers - 10 Hp	3	EA	$15,000	$45,000
	Sludge Storage Tank Diffusers	1	LS	$20,000	$20,000
	Sludge Transfer Pumps	3	EA	$7,500	$22,500
					$0
	Subtotal Equipment				*$2,436,000*
	Installation, Miscellaneous Mechanical	30%	of Equip		$730,800
	Electrical	15%	of Equip		$365,400
	Instrumentation and Control	10%	of Equip		$243,600
	Subtotal Structural, Mechanical, Elect, I&C				*$5,149,763*
	Contractor O&P	15%	of Sub Cost		$772,464
	Mobilization, demobilization, bond	6%	of Sub cost		$308,986
	Total estimated current construction cost				*$6,231,213*
	Escalation to time of construction	15.81%			$984,941
	Total estimated construction cost				$7,216,155
	Contingency	30%			$2,164,846
	Engineering Design	15%			$1,407,150
	Construction Management	10%			$938,100
	Sales Tax	8.3%			$778,623
	Total Estimated Capital Cost				$12,505,000

Operations and Maintenance Cost Estimate (per year)

Item	Description	Quantity	Unit	Unit Cost	Annual Cost
	Labor - Secondary Process	1,820	HR	$30	$54,600
	Labor - Disinfection	52	hr	$30	$1,560
	Labor - Solids Handling	208	HR	$30	$6,240
	Membrane Replacement	501	panel	$75	$37,599
	Contract Haul Solids @ 1.5%	1,158,540	GAL	$0.07	$86,284
	Diesel oil		GAL	$2.00	$0
	Power - Secondary Process	485,818	kWh	$0.07	$34,007
	Power - Disinfection	4899	kWh	$0.07	$343
	Power - Solids Handling	65,323	kWh	$0.07	$4,573
	Structural Maintenance	1%			$15,911
	Equipment replacement	2%			$55,550
	Chemicals - membrane cleaning	1	LS	$2,000	$2,000
	Hypochlorite	3083	lb	$0.60	$1,850
	Sodium Bisulfite	0	GAL	$0.20	$0
	Polymer	725	LB	$3.00	$2,174
	Misc expenses		allowance		$0
	Total Annual Cost				$302,691
	Present Worth Factor	14.6061			
	Present Worth Cost				$4,421,000

Total Present Worth Project Cost Estimate

Capital	$12,505,000
Operations and Maintenance	$4,421,000
Total Present Worth	$16,926,000

Project: Freeland Comprehensive Sewer Plan - Ch 8 Analysis
Subject: Conveyance Analysis
By : Tt/KCM
Date : 4-Jun-03

Conveyance to Freeland (Discharge SW of Highway)

Capital Cost Estimate

Item	Description	Quantity	Unit	Unit cost, $	Cost, $
	10" PVC Pressure Mains - to HHSD	0	LF	$40	$0
	10" PVC Pressure Mains - to Discharge	1,000	LF	$40	$40,000
	Dewatering	1	LS	$5,000	$5,000
	AC Surface Restoration	0	SY	$12	$0
	Native Surface Restoration	300	SY	$2	$600
					$0
	Subtotal Structural				*$45,600*
	Pump Station - from Collection to Treatment	0	EA	$425,000	$0
	Pump Station - from Treatment to Discharge	0	EA	$150,000	$0
	Odor Control	0	LS	$50,000	$0
					$0
	Subtotal Equipment				*$0*
	Total estimated current construction cost				*$45,600*
	Escalation to time of construction	15.81%			$7,208
	Total estimated construction cost				$52,808
	Contingency	30%			$15,842
	Engineering Design	15%			$10,298
	Construction Management	10%			$6,865
	Sales Tax	8.3%			$5,698
	Total Estimated Capital Cost				$92,000

Operations and Maintenance Cost Estimate (per year)

Item	Description	Quantity	Unit	Unit Cost	Annual Cost
	Labor	0	hr	$30	$0
	Septic tank pumping		ea	$300	$0
	Diesel oil		gal	$2.00	$0
	Power	0	kWh	$0.07	$0
	Structural Maintenance	1%			$528
	Equipment replacement	2%			$0
	Chemicals			$0.00	$0
	Hypochlorite	0	lb	$0.60	$0
	Sodium Bisulfite	0	gal	$0.20	$0
	Polymer		lb	$3.00	$0
	Misc expenses		allowance		$0
	Total Annual Cost				$528
	Present Worth Factor	14.6061			
	Present Worth Cost				$8,000

Total Present Worth Project Cost Estimate

Capital	$92,000
Operations and Maintenance	$8,000
Total Present Worth	$100,000

Project: Freeland Comprehensive Sewer Plan - Ch 8 Analysis
Subject: Conveyance Analysis
By : Tt/KCM
Date : 4-Jun-03

Conveyance to Freeland (Discharge to tree farm)

Capital Cost Estimate

Item	Description	Quantity	Unit	Unit cost, $	Cost, $
	10" PVC Pressure Mains - to HHSD	0	LF	$40	$0
	10" PVC Pressure Mains - to Discharge	11,000	LF	$40	$440,000
	Dewatering	1	LS	$5,000	$5,000
	AC Surface Restoration	0	SY	$12	$0
	Native Surface Restoration	3,700	SY	$2	$7,400
					$0
	Subtotal Structural				*$452,400*
	Pump Station - from Collection to Treatment	0	EA	$425,000	$0
	Pump Station - from Treatment to Discharge	1	EA	$425,000	$425,000
	Odor Control	0	LS	$50,000	$0
					$0
	Subtotal Equipment				*$425,000*
	Total estimated current construction cost				*$877,400*
	Escalation to time of construction	15.81%			$138,687
	Total estimated construction cost				$1,016,087
	Contingency	30%			$304,826
	Engineering Design	15%			$198,137
	Construction Management	10%			$132,091
	Sales Tax	8.3%			$109,636
	Total Estimated Capital Cost				$1,761,000

Operations and Maintenance Cost Estimate (per year)

Item	Description	Quantity	Unit	Unit Cost	Annual Cost
	Labor	52	hr	$30	$1,560
	Septic tank pumping		ea	$300	$0
	Diesel oil		gal	$2.00	$0
	Power	10887	kWh	$0.07	$762
	Structural Maintenance	1%			$5,239
	Equipment replacement	2%			$9,844
	Chemicals			$0.00	$0
	Hypochlorite	0	lb	$0.60	$0
	Sodium Bisulfite	0	gal	$0.20	$0
	Polymer		lb	$3.00	$0
	Misc expenses		allowance		$0
	Total Annual Cost				$17,405
	Present Worth Factor	14.6061			
	Present Worth Cost				$254,000

Total Present Worth Project Cost Estimate

Capital	$1,761,000
Operations and Maintenance	$254,000
Total Present Worth	$2,015,000

Project: Freeland Comprehensive Sewer Plan - Ch 8 Analysis
Subject: Conveyance Analysis
By : Tt/KCM
Date : 4-Jun-03

Conveyance to HHSD (Discharge at Near Site)

Capital Cost Estimate

Item	Description	Quantity	Unit	Unit cost, $	Cost, $
	10" PVC Pressure Mains - to HHSD	10,000	LF	$40	$400,000
	10" PVC Pressure Mains - to Discharge	1,000	LF	$40	$40,000
	Dewatering	1	LS	$15,000	$15,000
	AC Surface Restoration	3,300	SY	$12	$39,600
	Native Surface Restoration	300	SY	$2	$600
					$0
	Subtotal Structural				*$495,200*
	Pump Station - from Collection to Treatment	1	EA	$425,000	$425,000
	Pump Station - from Treatment to Discharge	0	EA	$150,000	$0
	Odor Control	1	LS	$50,000	$50,000
					$0
	Subtotal Equipment				*$475,000*
	Total estimated current construction cost				*$970,200*
	Escalation to time of construction	15.81%			$153,355
	Total estimated construction cost				$1,123,555
	Contingency	30%			$337,067
	Engineering Design	15%			$219,093
	Construction Management	10%			$146,062
	Sales Tax	8.3%			$121,232
	Total Estimated Capital Cost				$1,947,000

Operations and Maintenance Cost Estimate (per year)

Item	Description	Quantity	Unit	Unit Cost	Annual Cost
	Labor	52	hr	$30	$1,560
	Septic tank pumping		ea	$300	$0
	Diesel oil		gal	$2.00	$0
	Power	54436	kWh	$0.07	$3,811
	Structural Maintenance	1%			$5,735
	Equipment replacement	2%			$11,002
	Chemicals			$0.00	$0
	Hypochlorite	0	lb	$0.60	$0
	Sodium Bisulfite	0	gal	$0.20	$0
	Polymer		lb	$3.00	$0
	Misc expenses		allowance		$0
	Total Annual Cost				$22,107
	Present Worth Factor	14.6061			
	Present Worth Cost				$323,000

Total Present Worth Project Cost Estimate

Capital	$1,947,000
Operations and Maintenance	$323,000
Total Present Worth	$2,270,000

Project: Freeland Comprehensive Sewer Plan - Ch 8 Analysis
Subject: Conveyance Analysis
By : Tt/KCM
Date : 4-Jun-03

Conveyance to HHSD (Discharge at Far Site)

Capital Cost Estimate

Item	Description	Quantity	Unit	Unit cost, $	Cost, $
	10" PVC Pressure Mains - to HHSD	10,000	LF	$40	$400,000
	10" PVC Pressure Mains - to Discharge	7,000	LF	$40	$280,000
	Dewatering	1	LS	$25,000	$25,000
	AC Surface Restoration	3,300	SY	$12	$39,600
	Native Surface Restoration	2,300	SY	$2	$4,600
					$0
	Subtotal Structural				*$749,200*
	Pump Station - from Collection to Treatment	1	EA	$425,000	$425,000
	Pump Station - from Treatment to Discharge	1	EA	$150,000	$150,000
	Odor Control	1	LS	$50,000	$50,000
					$0
	Subtotal Equipment				*$625,000*
	Total estimated current construction cost				*$1,374,200*
	Escalation to time of construction	15.81%			$217,214
	Total estimated construction cost				$1,591,414
	Contingency	30%			$477,424
	Engineering Design	15%			$310,326
	Construction Management	10%			$206,884
	Sales Tax	8.3%			$171,714
	Total Estimated Capital Cost				$2,758,000

Operations and Maintenance Cost Estimate (per year)

Item	Description	Quantity	Unit	Unit Cost	Annual Cost
	Labor	104	hr	$30	$3,120
	Septic tank pumping		ea	$300	$0
	Diesel oil		gal	$2.00	$0
	Power	65323	kWh	$0.07	$4,573
	Structural Maintenance	1%			$8,676
	Equipment replacement	2%			$14,476
	Chemicals			$0.00	$0
	Hypochlorite	0	lb	$0.60	$0
	Sodium Bisulfite	0	gal	$0.20	$0
	Polymer		lb	$3.00	$0
	Misc expenses		allowance		$0
	Total Annual Cost				$30,845
	Present Worth Factor	14.6061			
	Present Worth Cost				$451,000

Total Present Worth Project Cost Estimate

Capital	$2,758,000
Operations and Maintenance	$451,000
Total Present Worth	$3,209,000

Project: Freeland Comprehensive Sewer Plan - Ch 8 Analysis
Subject: Conveyance Analysis
By : Tt/KCM
Date : 4-Jun-03

Storage - Phase 1

Capital Cost Estimate

Item	Description	Quantity	Unit	Unit cost, $	Cost, $
	Land Acquisition	4	AC	$15,000	$60,000
	Storage - Earthen Basin	5	MG	$40,000	$180,000
	Storage - Liner	54,450	SF	$0.50	$27,225
					$0
	Subtotal Structural				*$267,225*
					$0
	Subtotal Equipment				*$0*
	Total estimated current construction cost				*$267,225*
	Escalation to time of construction	15.81%			$42,239
	Total estimated construction cost				$309,464
	Contingency	30%			$92,839
	Engineering Design	15%			$46,796
	Construction Management	10%			$31,197
	Sales Tax	8.3%			$25,894
	Total Estimated Capital Cost				$506,000

Operations and Maintenance Cost Estimate (per year)

Item	Description	Quantity	Unit	Unit Cost	Annual Cost
	Labor	0	hr	$30	$0
	Septic tank pumping		ea	$300	$0
	Diesel oil		gal	$2.00	$0
	Power	0	kWh	$0.07	$0
	Structural Maintenance	1%			$1,547
	Equipment replacement	2%			$0
	Chemicals			$0.00	$0
	Hypochlorite	0	lb	$0.60	$0
	Sodium Bisulfite	0	gal	$0.20	$0
	Polymer		lb	$3.00	$0
	Misc expenses		allowance		$0
	Total Annual Cost				$1,547
	Present Worth Factor	14.6061			
	Present Worth Cost				$23,000

Total Present Worth Project Cost Estimate

Capital	$506,000
Operations and Maintenance	$23,000
Total Present Worth	$529,000

Project: Freeland Comprehensive Sewer Plan - Ch 8 Analysis
Subject: Conveyance Analysis
By : Tt/KCM
Date : 4-Jun-03

Storage - Phase 2

Capital Cost Estimate

Item	Description	Quantity	Unit	Unit cost, $	Cost, $
	Land Acquisition	5	AC	$15,000	$75,000
	Storage - Earthen Basin	9	MG	$40,000	$360,000
	Storage - Liner	108,900	SF	$0.50	$54,450
					$0
	Subtotal Structural				*$489,450*
					$0
	Subtotal Equipment				*$0*
	Total estimated current construction cost				*$489,450*
	Escalation to time of construction	15.81%			$77,365
	Total estimated construction cost				$566,815
	Contingency	30%			$170,045
	Engineering Design	15%			$93,592
	Construction Management	10%			$62,395
	Sales Tax	8.3%			$51,788
	Total Estimated Capital Cost				$945,000

Operations and Maintenance Cost Estimate (per year)

Item	Description	Quantity	Unit	Unit Cost	Annual Cost
	Labor	0	hr	$30	$0
	Septic tank pumping		ea	$300	$0
	Diesel oil		gal	$2.00	$0
	Power	0	kWh	$0.07	$0
	Structural Maintenance	1%			$2,834
	Equipment replacement	2%			$0
	Chemicals			$0.00	$0
	Hypochlorite	0	lb	$0.60	$0
	Sodium Bisulfite	0	gal	$0.20	$0
	Polymer		lb	$3.00	$0
	Misc expenses		allowance		$0
	Total Annual Cost				$2,834
	Present Worth Factor	14.6061			
	Present Worth Cost				$41,000

Total Present Worth Project Cost Estimate

Capital	$945,000
Operations and Maintenance	$41,000
Total Present Worth	$986,000

Project: Freeland Comprehensive Sewer Plan - Ch 8 Analysis
Subject: Conveyance Analysis
By : Tt/KCM
Date : 4-Jun-03

Storage - Phase 3

Capital Cost Estimate

Item	Description	Quantity	Unit	Unit cost, $	Cost, $
	Land Acquisition	6	AC	$15,000	$90,000
	Storage - Earthen Basin	14	MG	$40,000	$540,000
	Storage - Liner	163,350	SF	$0.50	$81,675
					$0
	Subtotal Structural				*$711,675*
					$0
	Subtotal Equipment				*$0*
	Total estimated current construction cost				*$711,675*
	Escalation to time of construction	15.81%			$112,491
	Total estimated construction cost				$824,166
	Contingency	30%			$247,250
	Engineering Design	15%			$140,388
	Construction Management	10%			$93,592
	Sales Tax	8.3%			$77,682
	Total Estimated Capital Cost				$1,383,000

Operations and Maintenance Cost Estimate (per year)

Item	Description	Quantity	Unit	Unit Cost	Annual Cost
	Labor	0	hr	$30	$0
	Septic tank pumping		ea	$300	$0
	Diesel oil		gal	$2.00	$0
	Power	0	kWh	$0.07	$0
	Structural Maintenance	1%			$4,121
	Equipment replacement	2%			$0
	Chemicals			$0.00	$0
	Hypochlorite	0	lb	$0.60	$0
	Sodium Bisulfite	0	gal	$0.20	$0
	Polymer		lb	$3.00	$0
	Misc expenses		allowance		$0
	Total Annual Cost				$4,121
	Present Worth Factor	14.6061			
	Present Worth Cost				$60,000

Total Present Worth Project Cost Estimate

Capital	$1,383,000
Operations and Maintenance	$60,000
Total Present Worth	$1,443,000

Project: Freeland Comprehensive Sewer Plan - Ch 8 Analysis
Subject: Conveyance Analysis
By : Tt/KCM
Date : 4-Jun-03
Storage - Phase 4

Capital Cost Estimate

Item	Description	Quantity	Unit	Unit cost, $	Cost, $
	Land Acquisition	8	AC	$15,000	$120,000
	Storage - Earthen Basin	18	MG	$40,000	$720,000
	Storage - Liner	217,800	SF	$0.50	$108,900
					$0
	Subtotal Structural				*$948,900*
					$0
	Subtotal Equipment				*$0*
	Total estimated current construction cost				*$948,900*
	Escalation to time of construction	15.81%			$149,989
	Total estimated construction cost				$1,098,889
	Contingency	30%			$329,667
	Engineering Design	15%			$187,185
	Construction Management	10%			$124,790
	Sales Tax	8.3%			$103,575
	Total Estimated Capital Cost				$1,844,000

Operations and Maintenance Cost Estimate (per year)

Item	Description	Quantity	Unit	Unit Cost	Annual Cost
	Labor	0	hr	$30	$0
	Septic tank pumping		ea	$300	$0
	Diesel oil		gal	$2.00	$0
	Power	0	kWh	$0.07	$0
	Structural Maintenance	1%			$5,494
	Equipment replacement	2%			$0
	Chemicals			$0.00	$0
	Hypochlorite	0	lb	$0.60	$0
	Sodium Bisulfite	0	gal	$0.20	$0
	Polymer		lb	$3.00	$0
	Misc expenses		allowance		$0
	Total Annual Cost				$5,494
	Present Worth Factor	14.6061			
	Present Worth Cost				$80,000

Total Present Worth Project Cost Estimate

Capital	$1,844,000
Operations and Maintenance	$80,000
Total Present Worth	$1,924,000

Project: Freeland Comprehensive Sewer Plan - Ch 8 Analysis
Subject: Discharge and Reuse Analysis
By : Tt/KCM
Date : 5-Jun-03

Slow-rate Infiltration (Freeland) - Phase 1

Capital Cost Estimate

Item	Description	Quantity	Unit	Unit cost, $	Cost, $
	Earthwork for Discharge - included in drip emit	0	CY	$8	$0
	Site Process Piping and Valving	1	LS	$25,000	$25,000
	Electrical Conduit, Sitework, Lighting	1	LS	$15,000	$15,000
	Land Acquisition	4	AC	$15,000	$56,250
	Monitoring Wells	3	EA	$10,000	$30,000
	Drip Emitter Network	74,250	LF	$1	$74,250
					$0
	Subtotal Structural				*$200,500*
	Distribution Piping & Equipment	1	EA	$20,000	$20,000
	Reclaimed Water Pumps/Filter	1	EA	$50,000	$50,000
					$0
	Subtotal Equipment				*$70,000*
	Contractor O&P	15%	of Sub Cost		$32,138
	Mobilization, demobilization, bond	6%	of Sub cost		$12,855
	Total estimated current construction cost				*$315,493*
	Escalation to time of construction	15.80%			$49,846
	Total estimated construction cost				$365,339
	Contingency	30%			$109,602
	Engineering Design	15%			$58,539
	Construction Management	10%			$39,026
	Sales Tax	8.3%			$32,392
	Total Estimated Capital Cost				$605,000

Operations and Maintenance Cost Estimate (per year)

Item	Description	Quantity	Unit	Unit Cost	Annual Cost
	Labor	520	HR	$30	$15,600
			EA	$300	$0
	Diesel oil		GAL	$2.00	$0
	Power	16,331	kWh	$0.07	$1,143
	Structural Maintenance	1%			$2,322
	Equipment replacement	2%			$1,621
	Chemicals	0	LS	$5,000	$0
	Hypochlorite	0	LB	$0.60	$0
	Sodium Bisulfite	0	GAL	$0.20	$0
	Polymer		LB	$3.00	$0
	Misc expenses		allowance		$0
	Total Annual Cost				$20,686
	Present Worth Factor	14.6061			
	Present Worth Cost				$302,000

Total Present Worth Project Cost Estimate

Capital	$605,000
Operations and Maintenance	$302,000
Total Present Worth	$907,000

Project: Freeland Comprehensive Sewer Plan - Ch 8 Analysis
Subject: Discharge and Reuse Analysis
By : Tt/KCM
Date : 5-Jun-03

Slow-rate Infiltration (Freeland) - Phase 2

Capital Cost Estimate

Item	Description	Quantity	Unit	Unit cost, $	Cost, $
	Earthwork for Discharge - included in drip emit	0	CY	$8	$0
	Site Process Piping and Valving	1	LS	$50,000	$50,000
	Electrical Conduit, Sitework, Lighting	1	LS	$30,000	$30,000
	Land Acquisition	8	AC	$15,000	$112,500
	Monitoring Wells	3	EA	$10,000	$30,000
	Drip Emitter Network	125,102	LF	$1	$125,102
					$0
	Subtotal Structural				*$347,602*
	Distribution Piping & Equipment	1	EA	$40,000	$40,000
	Reclaimed Water Pumps/Filter	1	EA	$100,000	$100,000
					$0
	Subtotal Equipment				*$140,000*
	Contractor O&P	15%	of Sub Cost		$56,265
	Mobilization, demobilization, bond	6%	of Sub cost		$22,506
	Total estimated current construction cost				*$566,373*
	Escalation to time of construction	15.80%			$89,484
	Total estimated construction cost				$655,857
	Contingency	30%			$196,757
	Engineering Design	15%			$102,489
	Construction Management	10%			$68,326
	Sales Tax	8.3%			$56,710
	Total Estimated Capital Cost				$1,080,000

Operations and Maintenance Cost Estimate (per year)

Item	Description	Quantity	Unit	Unit Cost	Annual Cost
	Labor	520	HR	$30	$15,600
			EA	$300	$0
	Diesel oil		GAL	$2.00	$0
	Power	32,662	kWh	$0.07	$2,286
	Structural Maintenance	1%			$4,025
	Equipment replacement	2%			$3,242
	Chemicals	0	LS	$5,000	$0
	Hypochlorite	0	LB	$0.60	$0
	Sodium Bisulfite	0	GAL	$0.20	$0
	Polymer		LB	$3.00	$0
	Misc expenses		allowance		$0
	Total Annual Cost				$25,154
	Present Worth Factor	14.6061			
	Present Worth Cost				$367,000

Total Present Worth Project Cost Estimate

Capital	$1,080,000
Operations and Maintenance	$367,000
Total Present Worth	$1,447,000

Project: Freeland Comprehensive Sewer Plan - Ch 8 Analysis
Subject: Discharge and Reuse Analysis
By : Tt/KCM
Date : 5-Jun-03

Slow-rate Infiltration (Freeland) - Phase 3

Capital Cost Estimate

Item	Description	Quantity	Unit	Unit cost, $	Cost, $
	Earthwork for Discharge - included in drip emit	0	CY	$8	$0
	Site Process Piping and Valving	1	LS	$100,000	$100,000
	Electrical Conduit, Sitework, Lighting	1	LS	$60,000	$60,000
	Land Acquisition	15	AC	$15,000	$225,000
	Monitoring Wells	4	EA	$10,000	$40,000
	Drip Emitter Network	254,162	LF	$1	$254,162
					$0
	Subtotal Structural				*$679,162*
	Distribution Piping & Equipment	1	EA	$80,000	$80,000
	Reclaimed Water Pumps/Filter	1	EA	$150,000	$150,000
					$0
	Subtotal Equipment				*$230,000*
	Contractor O&P	15%	of Sub Cost		$102,624
	Mobilization, demobilization, bond	6%	of Sub cost		$41,050
	Total estimated current construction cost				*$1,052,836*
	Escalation to time of construction	15.80%			$166,342
	Total estimated construction cost				$1,219,178
	Contingency	30%			$365,753
	Engineering Design	15%			$186,933
	Construction Management	10%			$124,622
	Sales Tax	8.3%			$103,436
	Total Estimated Capital Cost				$2,000,000

Operations and Maintenance Cost Estimate (per year)

Item	Description	Quantity	Unit	Unit Cost	Annual Cost
	Labor	780	HR	$30	$23,400
			EA	$300	$0
	Diesel oil		GAL	$2.00	$0
	Power	48,992	kWh	$0.07	$3,429
	Structural Maintenance	1%			$7,865
	Equipment replacement	2%			$5,327
	Chemicals	0	LS	$5,000	$0
	Hypochlorite	0	LB	$0.60	$0
	Sodium Bisulfite	0	GAL	$0.20	$0
	Polymer		LB	$3.00	$0
	Misc expenses		allowance		$0
	Total Annual Cost				$40,021
	Present Worth Factor	14.6061			
	Present Worth Cost				$585,000

Total Present Worth Project Cost Estimate

Capital	$2,000,000
Operations and Maintenance	$585,000
Total Present Worth	$2,585,000

Project: Freeland Comprehensive Sewer Plan - Ch 8 Analysis
Subject: Discharge and Reuse Analysis
By : Tt/KCM
Date : 5-Jun-03

Slow-rate Infiltration (Freeland) - Phase 4

Capital Cost Estimate

Item	Description	Quantity	Unit	Unit cost, $	Cost, $
	Earthwork for Discharge - included in drip emit	0	CY	$8	$0
	Site Process Piping and Valving	1	LS	$158,333	$158,333
	Electrical Conduit, Sitework, Lighting	1	LS	$95,000	$95,000
	Land Acquisition	24	AC	$15,000	$356,250
	Monitoring Wells	5	EA	$10,000	$50,000
	Drip Emitter Network	414,611	LF	$1	$414,611
					$0
	Subtotal Structural				*$1,074,194*
	Distribution Piping & Equipment	1	EA	$126,667	$126,667
	Reclaimed Water Pumps/Filter	1	EA	$200,000	$200,000
					$0
	Subtotal Equipment				*$326,667*
	Contractor O&P	15%	of Sub Cost		$156,692
	Mobilization, demobilization, bond	6%	of Sub cost		$62,677
	Total estimated current construction cost				*$1,620,229*
	Escalation to time of construction	15.80%			$255,987
	Total estimated construction cost				$1,876,216
	Contingency	30%			$562,865
	Engineering Design	15%			$285,418
	Construction Management	10%			$190,278
	Sales Tax	8.3%			$157,931
	Total Estimated Capital Cost				$3,073,000

Operations and Maintenance Cost Estimate (per year)

Item	Description	Quantity	Unit	Unit Cost	Annual Cost
	Labor	1,040	HR	$30	$31,200
			EA	$300	$0
	Diesel oil		GAL	$2.00	$0
	Power	65,323	kWh	$0.07	$4,573
	Structural Maintenance	1%			$12,439
	Equipment replacement	2%			$7,566
	Chemicals	0	LS	$5,000	$0
	Hypochlorite	0	LB	$0.60	$0
	Sodium Bisulfite	0	GAL	$0.20	$0
	Polymer		LB	$3.00	$0
	Misc expenses		allowance		$0
	Total Annual Cost				$55,777
	Present Worth Factor	14.6061			
	Present Worth Cost				$815,000

Total Present Worth Project Cost Estimate

Capital	$3,073,000
Operations and Maintenance	$815,000
Total Present Worth	$3,888,000

Project: Freeland Comprehensive Sewer Plan - Ch 8 Analysis
Subject: Discharge and Reuse Analysis
By : Tt/KCM
Date : 5-Jun-03

Slow-rate Infiltration (Freeland) - Phase 5

Capital Cost Estimate

Item	Description	Quantity	Unit	Unit cost, $	Cost, $
	Earthwork for Discharge - included in drip emit	0	CY	$8	$0
	Site Process Piping and Valving	1	LS	$258,333	$258,333
	Electrical Conduit, Sitework, Lighting	1	LS	$155,000	$155,000
	Land Acquisition	39	AC	$15,000	$581,250
	Monitoring Wells	6	EA	$10,000	$60,000
	Drip Emitter Network	676,788	LF	$1	$676,788
					$0
	Subtotal Structural				*$1,731,371*
	Distribution Piping & Equipment	1	EA	$206,667	$206,667
	Reclaimed Water Pumps/Filter	1	EA	$250,000	$250,000
					$0
	Subtotal Equipment				*$456,667*
	Contractor O&P	15%	of Sub Cost		$241,018
	Mobilization, demobilization, bond	6%	of Sub cost		$96,407
	Total estimated current construction cost				*$2,525,463*
	Escalation to time of construction	15.80%			$399,009
	Total estimated construction cost				$2,924,472
	Contingency	30%			$877,342
	Engineering Design	15%			$439,021
	Construction Management	10%			$292,680
	Sales Tax	8.3%			$242,925
	Total Estimated Capital Cost				$4,776,000

Operations and Maintenance Cost Estimate (per year)

Item	Description	Quantity	Unit	Unit Cost	Annual Cost
	Labor	1,300	HR	$30	$39,000
			EA	$300	$0
	Diesel oil		GAL	$2.00	$0
	Power	97,985	kWh	$0.07	$6,859
	Structural Maintenance	1%			$20,049
	Equipment replacement	2%			$10,576
	Chemicals	0	LS	$5,000	$0
	Hypochlorite	0	LB	$0.60	$0
	Sodium Bisulfite	0	GAL	$0.20	$0
	Polymer		LB	$3.00	$0
	Misc expenses		allowance		$0
	Total Annual Cost				$76,484
	Present Worth Factor	14.6061			
	Present Worth Cost				$1,117,000

Total Present Worth Project Cost Estimate

Capital	$4,776,000
Operations and Maintenance	$1,117,000
Total Present Worth	$5,893,000

Project: Freeland Comprehensive Sewer Plan - Ch 8 Analysis
Subject: Discharge and Reuse Analysis
By : Tt/KCM
Date : 5-Jun-03

Slow-rate Infiltration (HHSD) - Phase 1

Capital Cost Estimate

Item	Description	Quantity	Unit	Unit cost, $	Cost, $
	Earthwork for Discharge - included in drip emit	0	CY	$8	$0
	Site Process Piping and Valving	1	LS	$50,000	$50,000
	Electrical Conduit, Sitework, Lighting	1	LS	$30,000	$30,000
	Land Acquisition	11	AC	$15,000	$168,750
	Monitoring Wells	3	EA	$10,000	$30,000
	Drip Emitter Network	185,625	LF	$1	$185,625
					$0
	Subtotal Structural				*$464,375*
	Distribution Piping & Equipment	1	EA	$50,000	$50,000
	Reclaimed Water Pumps/Filter	1	EA	$50,000	$50,000
					$0
	Subtotal Equipment				*$100,000*
	Contractor O&P	15%	of Sub Cost		$59,344
	Mobilization, demobilization, bond	6%	of Sub cost		$23,738
	Total estimated current construction cost				*$647,457*
	Escalation to time of construction	15.80%			$102,295
	Total estimated construction cost				$749,751
	Contingency	30%			$224,925
	Engineering Design	15%			$108,096
	Construction Management	10%			$72,064
	Sales Tax	8.3%			$59,813
	Total Estimated Capital Cost				$1,215,000

Operations and Maintenance Cost Estimate (per year)

Item	Description	Quantity	Unit	Unit Cost	Annual Cost
	Labor	780	HR	$30	$23,400
			EA	$300	$0
	Diesel oil		GAL	$2.00	$0
	Power	16,331	kWh	$0.07	$1,143
	Structural Maintenance	1%			$5,377
	Equipment replacement	2%			$2,316
	Chemicals	0	LS	$5,000	$0
	Hypochlorite	0	LB	$0.60	$0
	Sodium Bisulfite	0	GAL	$0.20	$0
	Polymer		LB	$3.00	$0
	Misc expenses		allowance		$0
	Total Annual Cost				$32,237
	Present Worth Factor	14.6061			
	Present Worth Cost				$471,000

Total Present Worth Project Cost Estimate

Capital	$1,215,000
Operations and Maintenance	$471,000
Total Present Worth	$1,686,000

Project: Freeland Comprehensive Sewer Plan - Ch 8 Analysis
Subject: Discharge and Reuse Analysis
By : Tt/KCM
Date : 5-Jun-03

Slow-rate Infiltration (HHSD) - Phase 2

Capital Cost Estimate

Item	Description	Quantity	Unit	Unit cost, $	Cost, $
	Earthwork for Discharge - included in drip emit	0	CY	$8	$0
	Site Process Piping and Valving	1	LS	$77,778	$77,778
	Electrical Conduit, Sitework, Lighting	1	LS	$46,667	$46,667
	Land Acquisition	18	AC	$15,000	$262,500
	Monitoring Wells	3	EA	$10,000	$30,000
	Drip Emitter Network	312,755	LF	$1	$312,755
					$0
	Subtotal Structural				*$729,699*
	Distribution Piping & Equipment	1	EA	$77,778	$77,778
	Reclaimed Water Pumps/Filter	1	EA	$100,000	$100,000
					$0
	Subtotal Equipment				*$177,778*
	Contractor O&P	15%	of Sub Cost		$96,747
	Mobilization, demobilization, bond	6%	of Sub cost		$38,699
	Total estimated current construction cost				*$1,042,922*
	Escalation to time of construction	15.80%			$164,776
	Total estimated construction cost				$1,207,698
	Contingency	30%			$362,310
	Engineering Design	15%			$176,226
	Construction Management	10%			$117,484
	Sales Tax	8.3%			$97,512
	Total Estimated Capital Cost				$1,961,000

Operations and Maintenance Cost Estimate (per year)

Item	Description	Quantity	Unit	Unit Cost	Annual Cost
	Labor	780	HR	$30	$23,400
			EA	$300	$0
	Diesel oil		GAL	$2.00	$0
	Power	32,662	kWh	$0.07	$2,286
	Structural Maintenance	1%			$8,450
	Equipment replacement	2%			$4,117
	Chemicals	0	LS	$5,000	$0
	Hypochlorite	0	LB	$0.60	$0
	Sodium Bisulfite	0	GAL	$0.20	$0
	Polymer		LB	$3.00	$0
	Misc expenses		allowance		$0
	Total Annual Cost				$38,254
	Present Worth Factor	14.6061			
	Present Worth Cost				$559,000

Total Present Worth Project Cost Estimate

Capital	$1,961,000
Operations and Maintenance	$559,000
Total Present Worth	$2,520,000

Project: Freeland Comprehensive Sewer Plan - Ch 8 Analysis
Subject: Discharge and Reuse Analysis
By : Tt/KCM
Date : 5-Jun-03

Slow-rate Infiltration (HHSD) - Phase 3

Capital Cost Estimate

Item	Description	Quantity	Unit	Unit cost, $	Cost, $
	Earthwork for Discharge - included in drip emit	0	CY	$8	$0
	Site Process Piping and Valving	1	LS	$161,111	$161,111
	Electrical Conduit, Sitework, Lighting	1	LS	$96,667	$96,667
	Land Acquisition	36	AC	$15,000	$543,750
	Monitoring Wells	4	EA	$10,000	$40,000
	Drip Emitter Network	635,405	LF	$1	$635,405
					$0
	Subtotal Structural				*$1,476,932*
	Distribution Piping & Equipment	1	EA	$161,111	$161,111
	Reclaimed Water Pumps/Filter	1	EA	$150,000	$150,000
					$0
	Subtotal Equipment				*$311,111*
	Contractor O&P	15%	of Sub Cost		$186,644
	Mobilization, demobilization, bond	6%	of Sub cost		$74,658
	Total estimated current construction cost				*$2,049,345*
	Escalation to time of construction	15.80%			$323,785
	Total estimated construction cost				$2,373,131
	Contingency	30%			$711,939
	Engineering Design	15%			$339,977
	Construction Management	10%			$226,651
	Sales Tax	8.3%			$188,121
	Total Estimated Capital Cost				$3,840,000

Operations and Maintenance Cost Estimate (per year)

Item	Description	Quantity	Unit	Unit Cost	Annual Cost
	Labor	1,170	HR	$30	$35,100
			EA	$300	$0
	Diesel oil		GAL	$2.00	$0
	Power	48,992	kWh	$0.07	$3,429
	Structural Maintenance	1%			$17,103
	Equipment replacement	2%			$7,205
	Chemicals	0	LS	$5,000	$0
	Hypochlorite	0	LB	$0.60	$0
	Sodium Bisulfite	0	GAL	$0.20	$0
	Polymer		LB	$3.00	$0
	Misc expenses		allowance		$0
	Total Annual Cost				$62,838
	Present Worth Factor	14.6061			
	Present Worth Cost				$918,000

Total Present Worth Project Cost Estimate

Capital	$3,840,000
Operations and Maintenance	$918,000
Total Present Worth	$4,758,000

Project: Freeland Comprehensive Sewer Plan - Ch 8 Analysis
Subject: Discharge and Reuse Analysis
By : Tt/KCM
Date : 5-Jun-03

Slow-rate Infiltration (HHSD) - Phase 4

Capital Cost Estimate

Item	Description	Quantity	Unit	Unit cost, $	Cost, $
	Earthwork for Discharge - included in drip emit	0	CY	$8	$0
	Site Process Piping and Valving	1	LS	$266,667	$266,667
	Electrical Conduit, Sitework, Lighting	1	LS	$160,000	$160,000
	Land Acquisition	60	AC	$15,000	$900,000
	Monitoring Wells	5	EA	$10,000	$50,000
	Drip Emitter Network	1,036,527	LF	$1	$1,036,527
					$0
	Subtotal Structural				*$2,413,193*
	Distribution Piping & Equipment	1	EA	$266,667	$266,667
	Reclaimed Water Pumps/Filter	1	EA	$200,000	$200,000
					$0
	Subtotal Equipment				*$466,667*
	Contractor O&P	15%	of Sub Cost		$296,979
	Mobilization, demobilization, bond	6%	of Sub cost		$118,792
	Total estimated current construction cost				*$3,295,630*
	Escalation to time of construction	15.80%			$520,692
	Total estimated construction cost				$3,816,322
	Contingency	30%			$1,144,897
	Engineering Design	15%			$540,955
	Construction Management	10%			$360,637
	Sales Tax	8.3%			$299,328
	Total Estimated Capital Cost				$6,162,000

Operations and Maintenance Cost Estimate (per year)

Item	Description	Quantity	Unit	Unit Cost	Annual Cost
	Labor	1,560	HR	$30	$46,800
			EA	$300	$0
	Diesel oil		GAL	$2.00	$0
	Power	65,323	kWh	$0.07	$4,573
	Structural Maintenance	1%			$27,945
	Equipment replacement	2%			$10,808
	Chemicals	0	LS	$5,000	$0
	Hypochlorite	0	LB	$0.60	$0
	Sodium Bisulfite	0	GAL	$0.20	$0
	Polymer		LB	$3.00	$0
	Misc expenses		allowance		$0
	Total Annual Cost				$90,125
	Present Worth Factor	14.6061			
	Present Worth Cost				$1,316,000

Total Present Worth Project Cost Estimate

Capital	$6,162,000
Operations and Maintenance	$1,316,000
Total Present Worth	$7,478,000

Project: Freeland Comprehensive Sewer Plan - Ch 8 Analysis
Subject: Discharge and Reuse Analysis
By : Tt/KCM
Date : 5-Jun-03

Slow-rate Infiltration (HHSD) - Phase 5

Capital Cost Estimate

Item	Description	Quantity	Unit	Unit cost, $	Cost, $
	Earthwork for Discharge - included in drip emit	0	CY	$8	$0
	Site Process Piping and Valving	1	LS	$433,333	$433,333
	Electrical Conduit, Sitework, Lighting	1	LS	$260,000	$260,000
	Land Acquisition	98	AC	$15,000	$1,462,500
	Monitoring Wells	6	EA	$10,000	$60,000
	Drip Emitter Network	1,691,969	LF	$1	$1,691,969
					$0
	Subtotal Structural				*$3,907,802*
	Distribution Piping & Equipment	1	EA	$433,333	$433,333
	Reclaimed Water Pumps/Filter	1	EA	$250,000	$250,000
					$0
	Subtotal Equipment				*$683,333*
	Contractor O&P	15%	of Sub Cost		$469,295
	Mobilization, demobilization, bond	6%	of Sub cost		$187,718
	Total estimated current construction cost				*$5,248,149*
	Escalation to time of construction	15.80%			$829,179
	Total estimated construction cost				$6,077,328
	Contingency	30%			$1,823,198
	Engineering Design	15%			$854,833
	Construction Management	10%			$569,889
	Sales Tax	8.3%			$473,008
	Total Estimated Capital Cost				$9,798,000

Operations and Maintenance Cost Estimate (per year)

Item	Description	Quantity	Unit	Unit Cost	Annual Cost
	Labor	1,950	HR	$30	$58,500
			EA	$300	$0
	Diesel oil		GAL	$2.00	$0
	Power	97,985	kWh	$0.07	$6,859
	Structural Maintenance	1%			$45,252
	Equipment replacement	2%			$15,826
	Chemicals	0	LS	$5,000	$0
	Hypochlorite	0	LB	$0.60	$0
	Sodium Bisulfite	0	GAL	$0.20	$0
	Polymer		LB	$3.00	$0
	Misc expenses		allowance		$0
	Total Annual Cost				$126,437
	Present Worth Factor	14.6061			
	Present Worth Cost				$1,847,000

Total Present Worth Project Cost Estimate

Capital	$9,798,000
Operations and Maintenance	$1,847,000
Total Present Worth	$11,645,000

Project: Freeland Comprehensive Sewer Plan - Ch 8 Analysis
Subject: Discharge and Reuse Analysis
By : Tt/KCM
Date : 5-Jun-03

Rapid Infiltration (HHSD) - Phase 1

Capital Cost Estimate

Item	Description	Quantity	Unit	Unit cost, $	Cost, $
	Earthwork for Discharge - included in line below	0	CY	$8	$0
	Site Process Piping and Valving	1	LS	$25,000	$25,000
	Electrical Conduit, Sitework, Lighting	1	LS	$10,000	$10,000
	Land Acquisition	3	AC	$15,000	$37,500
	Monitoring Wells	3	EA	$10,000	$30,000
	Rapid Infiltration Basins - Sitework	12,100	CY	$8	$96,800
					$0
	Subtotal Structural				*$199,300*
	Distribution Piping & Equipment	1	EA	$10,000	$10,000
	Reclaimed Water Pumps/Filter	0	EA	$50,000	$0
					$0
	Subtotal Equipment				*$10,000*
	Contractor O&P	15%	of Sub Cost		$25,770
	Mobilization, demobilization, bond	6%	of Sub cost		$10,308
	Total estimated current construction cost				*$245,378*
	Escalation to time of construction	15.80%			$38,768
	Total estimated construction cost				$284,146
	Contingency	30%			$85,244
	Engineering Design	15%			$46,941
	Construction Management	10%			$31,294
	Sales Tax	8.3%			$25,974
	Total Estimated Capital Cost				$474,000

Operations and Maintenance Cost Estimate (per year)

Item	Description	Quantity	Unit	Unit Cost	Annual Cost
	Labor	260	HR	$30	$7,800
			EA	$300	$0
	Diesel oil		GAL	$2.00	$0
	Power	16,331	kWh	$0.07	$1,143
	Structural Maintenance	1%			$2,308
	Equipment replacement	2%			$232
	Chemicals	0	LS	$5,000	$0
	Hypochlorite	0	LB	$0.60	$0
	Sodium Bisulfite	0	GAL	$0.20	$0
	Polymer		LB	$3.00	$0
	Misc expenses		allowance		$0
	Total Annual Cost				$11,483
	Present Worth Factor	14.6061			
	Present Worth Cost				$168,000

Total Present Worth Project Cost Estimate

Capital	$474,000
Operations and Maintenance	$168,000
Total Present Worth	$642,000

Project: Freeland Comprehensive Sewer Plan - Ch 8 Analysis
Subject: Discharge and Reuse Analysis
By : Tt/KCM
Date : 5-Jun-03

Rapid Infiltration (HHSD) - Phase 2

Capital Cost Estimate

Item	Description	Quantity	Unit	Unit cost, $	Cost, $
	Earthwork for Discharge - included in line belov	0	CY	$8	$0
	Site Process Piping and Valving	1	LS	$37,500	$37,500
	Electrical Conduit, Sitework, Lighting	1	LS	$15,000	$15,000
	Land Acquisition	4	AC	$15,000	$56,250
	Monitoring Wells	3	EA	$10,000	$30,000
	Rapid Infiltration Basins - Sitework	18,150	CY	$8	$145,200
					$0
	Subtotal Structural				*$283,950*
	Distribution Piping & Equipment	1	EA	$15,000	$15,000
	Reclaimed Water Pumps/Filter	0	EA	$100,000	$0
					$0
	Subtotal Equipment				*$15,000*
	Contractor O&P	15%	of Sub Cost		$36,405
	Mobilization, demobilization, bond	6%	of Sub cost		$14,562
	Total estimated current construction cost				*$349,917*
	Escalation to time of construction	15.80%			$55,285
	Total estimated construction cost				$405,202
	Contingency	30%			$121,561
	Engineering Design	15%			$66,313
	Construction Management	10%			$44,208
	Sales Tax	8.3%			$36,693
	Total Estimated Capital Cost				$674,000

Operations and Maintenance Cost Estimate (per year)

Item	Description	Quantity	Unit	Unit Cost	Annual Cost
	Labor	260	HR	$30	$7,800
			EA	$300	$0
	Diesel oil		GAL	$2.00	$0
	Power	32,662	kWh	$0.07	$2,286
	Structural Maintenance	1%			$3,288
	Equipment replacement	2%			$347
	Chemicals	0	LS	$5,000	$0
	Hypochlorite	0	LB	$0.60	$0
	Sodium Bisulfite	0	GAL	$0.20	$0
	Polymer		LB	$3.00	$0
	Misc expenses		allowance		$0
	Total Annual Cost				$13,722
	Present Worth Factor	14.6061			
	Present Worth Cost				$200,000

Total Present Worth Project Cost Estimate

Capital	$674,000
Operations and Maintenance	$200,000
Total Present Worth	$874,000

Project: Freeland Comprehensive Sewer Plan - Ch 8 Analysis
Subject: Discharge and Reuse Analysis
By : Tt/KCM
Date : 5-Jun-03

Rapid Infiltration (HHSD) - Phase 3

Capital Cost Estimate

Item	Description	Quantity	Unit	Unit cost, $	Cost, $
	Earthwork for Discharge - included in line belov	0	CY	$8	$0
	Site Process Piping and Valving	1	LS	$75,000	$75,000
	Electrical Conduit, Sitework, Lighting	1	LS	$30,000	$30,000
	Land Acquisition	8	AC	$15,000	$112,500
	Monitoring Wells	4	EA	$10,000	$40,000
	Rapid Infiltration Basins - Sitework	36,300	CY	$8	$290,400
					$0
	Subtotal Structural				*$547,900*
	Distribution Piping & Equipment	1	EA	$30,000	$30,000
	Reclaimed Water Pumps/Filter	0	EA	$150,000	$0
					$0
	Subtotal Equipment				*$30,000*
	Contractor O&P	15%	of Sub Cost		$69,810
	Mobilization, demobilization, bond	6%	of Sub cost		$27,924
	Total estimated current construction cost				*$675,634*
	Escalation to time of construction	15.80%			$106,746
	Total estimated construction cost				$782,380
	Contingency	30%			$234,714
	Engineering Design	15%			$127,161
	Construction Management	10%			$84,774
	Sales Tax	8.3%			$70,362
	Total Estimated Capital Cost				$1,299,000

Operations and Maintenance Cost Estimate (per year)

Item	Description	Quantity	Unit	Unit Cost	Annual Cost
	Labor	390	HR	$30	$11,700
			EA	$300	$0
	Diesel oil		GAL	$2.00	$0
	Power	48,992	kWh	$0.07	$3,429
	Structural Maintenance	1%			$6,345
	Equipment replacement	2%			$695
	Chemicals	0	LS	$5,000	$0
	Hypochlorite	0	LB	$0.60	$0
	Sodium Bisulfite	0	GAL	$0.20	$0
	Polymer		LB	$3.00	$0
	Misc expenses		allowance		$0
	Total Annual Cost				$22,169
	Present Worth Factor	14.6061			
	Present Worth Cost				$324,000

Total Present Worth Project Cost Estimate

Capital	$1,299,000
Operations and Maintenance	$324,000
Total Present Worth	$1,623,000

Project: Freeland Comprehensive Sewer Plan - Ch 8 Analysis
Subject: Discharge and Reuse Analysis
By : Tt/KCM
Date : 5-Jun-03

Rapid Infiltration (HHSD) - Phase 4

Capital Cost Estimate

Item	Description	Quantity	Unit	Unit cost, $	Cost, $
	Earthwork for Discharge - included in line belov	0	CY	$8	$0
	Site Process Piping and Valving	1	LS	$137,500	$137,500
	Electrical Conduit, Sitework, Lighting	1	LS	$55,000	$55,000
	Land Acquisition	14	AC	$15,000	$206,250
	Monitoring Wells	5	EA	$10,000	$50,000
	Rapid Infiltration Basins - Sitework	66,550	CY	$8	$532,400
					$0
	Subtotal Structural				*$981,150*
	Distribution Piping & Equipment	1	EA	$55,000	$55,000
	Reclaimed Water Pumps/Filter	0	EA	$200,000	$0
					$0
	Subtotal Equipment				*$55,000*
	Contractor O&P	15%	of Sub Cost		$124,485
	Mobilization, demobilization, bond	6%	of Sub cost		$49,794
	Total estimated current construction cost				*$1,210,429*
	Escalation to time of construction	15.80%			$191,241
	Total estimated construction cost				$1,401,670
	Contingency	30%			$420,501
	Engineering Design	15%			$226,753
	Construction Management	10%			$151,168
	Sales Tax	8.3%			$125,470
	Total Estimated Capital Cost				$2,326,000

Operations and Maintenance Cost Estimate (per year)

Item	Description	Quantity	Unit	Unit Cost	Annual Cost
	Labor	520	HR	$30	$15,600
			EA	$300	$0
	Diesel oil		GAL	$2.00	$0
	Power	65,323	kWh	$0.07	$4,573
	Structural Maintenance	1%			$11,362
	Equipment replacement	2%			$1,274
	Chemicals	0	LS	$5,000	$0
	Hypochlorite	0	LB	$0.60	$0
	Sodium Bisulfite	0	GAL	$0.20	$0
	Polymer		LB	$3.00	$0
	Misc expenses		allowance		$0
	Total Annual Cost				$32,808
	Present Worth Factor	14.6061			
	Present Worth Cost				$479,000

Total Present Worth Project Cost Estimate

Capital	$2,326,000
Operations and Maintenance	$479,000
Total Present Worth	$2,805,000

Project: Freeland Comprehensive Sewer Plan - Ch 8 Analysis
Subject: Discharge and Reuse Analysis
By : Tt/KCM
Date : 5-Jun-03

Rapid Infiltration (HHSD) - Phase 5

Capital Cost Estimate

Item	Description	Quantity	Unit	Unit cost, $	Cost, $
	Earthwork for Discharge - included in line belov	0	CY	$8	$0
	Site Process Piping and Valving	1	LS	$212,500	$212,500
	Electrical Conduit, Sitework, Lighting	1	LS	$85,000	$85,000
	Land Acquisition	21	AC	$15,000	$318,750
	Monitoring Wells	6	EA	$10,000	$60,000
	Rapid Infiltration Basins - Sitework	102,850	CY	$8	$822,800
					$0
	Subtotal Structural				*$1,499,050*
	Distribution Piping & Equipment	1	EA	$85,000	$85,000
	Reclaimed Water Pumps/Filter	0	EA	$250,000	$0
					$0
	Subtotal Equipment				*$85,000*
	Contractor O&P	15%	of Sub Cost		$189,795
	Mobilization, demobilization, bond	6%	of Sub cost		$75,918
	Total estimated current construction cost				*$1,849,763*
	Escalation to time of construction	15.80%			$292,252
	Total estimated construction cost				$2,142,015
	Contingency	30%			$642,605
	Engineering Design	15%			$345,716
	Construction Management	10%			$230,478
	Sales Tax	8.3%			$191,296
	Total Estimated Capital Cost				$3,552,000

Operations and Maintenance Cost Estimate (per year)

Item	Description	Quantity	Unit	Unit Cost	Annual Cost
	Labor	650	HR	$30	$19,500
			EA	$300	$0
	Diesel oil		GAL	$2.00	$0
	Power	97,985	kWh	$0.07	$6,859
	Structural Maintenance	1%			$17,359
	Equipment replacement	2%			$1,969
	Chemicals	0	LS	$5,000	$0
	Hypochlorite	0	LB	$0.60	$0
	Sodium Bisulfite	0	GAL	$0.20	$0
	Polymer		LB	$3.00	$0
	Misc expenses		allowance		$0
	Total Annual Cost				$45,686
	Present Worth Factor	14.6061			
	Present Worth Cost				$667,000

Total Present Worth Project Cost Estimate

Capital	$3,552,000
Operations and Maintenance	$667,000
Total Present Worth	$4,219,000

		Capital Cost / Present Worth O&M / Net Present Value (Capital + Present Worth O&M)														
		Capital Cost														
	ERUs	Sewers	STEP tanks, pumps, and connections	Conveyance to Treatment/Reuse	Treatment	Storage	Reuse (not including land)	Land - incremental purchases	Extra cost - purchasing all land up front	Sewers & Step Systems O&M	Conveyance O&M	Treatment O&M	Storage O&M	Reuse O&M	Present Worth O&M	Total
Alt 1a. Freeland Only; MBR + Solids + Rapid Infiltration (near)																
Phase 1	319	$1,214,178	$1,059,822	$92,000	$3,399,000	$506,000	$481,250	$123,750	$1,155,000	$520,000	$8,000	$1,288,000	$23,000	$302,000	$2,141,000	**$10,172,000**
Phase 2	525	$1,512,974	$2,289,026	$92,000	$4,123,000	$506,000	$832,500	$247,500	$1,031,250	$1,081,000	$8,000	$1,537,000	$23,000	$367,000	$3,016,000	**$13,650,250**
Phase 3	1,037	$2,392,802	$5,561,198	$92,000	$6,584,000	$945,000	$1,505,000	$495,000	$783,750	$2,695,000	$8,000	$2,342,000	$41,000	$585,000	$5,671,000	**$24,029,750**
Phase 4	1,558	$4,036,017	$9,004,983	$92,000	$9,296,000	$1,383,000	$2,289,250	$783,750	$495,000	$4,190,000	$8,000	$3,124,000	$60,000	$815,000	$8,197,000	**$35,577,000**
Phase 5	3,130	$4,251,997	$17,899,003	$92,000	$12,407,000	$1,844,000	$3,497,250	$1,278,750	$0	$7,710,000	$8,000	$4,394,000	$80,000	$1,117,000	$13,309,000	**$54,579,000**
Alt 1b. Freeland Only; MBR + Solids + Rapid Infiltration (to tree farm)																
Phase 1	319	$1,214,178	$1,059,822	$1,761,000	$3,399,000	$506,000	$391,500	$82,500	$618,750	$520,000	$254,000	$1,288,000	$23,000	$168,000	$2,253,000	**$11,285,750**
Phase 2	525	$1,512,974	$2,289,026	$1,761,000	$4,123,000	$506,000	$550,250	$123,750	$577,500	$1,081,000	$254,000	$1,537,000	$23,000	$200,000	$3,095,000	**$14,538,500**
Phase 3	1,037	$2,392,802	$5,561,198	$1,761,000	$6,584,000	$945,000	$1,051,500	$247,500	$453,750	$2,695,000	$254,000	$2,342,000	$41,000	$324,000	$5,656,000	**$24,652,750**
Phase 4	1,558	$4,036,017	$9,004,983	$1,761,000	$9,296,000	$1,383,000	$1,872,250	$453,750	$247,500	$4,190,000	$254,000	$3,124,000	$60,000	$479,000	$8,107,000	**$36,161,500**
Phase 5	3,130	$4,251,997	$17,899,003	$1,761,000	$12,407,000	$1,844,000	$2,850,750	$701,250	$0	$7,710,000	$254,000	$4,394,000	$80,000	$667,000	$13,105,000	**$54,820,000**
Alt 2. With HHSD (Near Site); MBR + Solids + Slow-rate Infiltration																
Phase 1	319	$1,214,178	$1,059,822	$1,947,000	$3,966,000	$506,000	$843,750	$371,250	$2,846,250	$520,000	$323,000	$1,124,000	$23,000	$471,000	$2,461,000	**$15,215,250**
Phase 2	525	$1,512,974	$2,289,026	$1,947,000	$4,516,000	$506,000	$1,383,500	$577,500	$2,640,000	$1,081,000	$323,000	$1,360,000	$23,000	$559,000	$3,346,000	**$18,718,000**
Phase 3	1,037	$2,392,802	$5,561,198	$1,947,000	$6,841,000	$945,000	$2,643,750	$1,196,250	$2,021,250	$2,695,000	$323,000	$2,241,000	$41,000	$918,000	$6,218,000	**$29,766,250**
Phase 4	1,558	$4,036,017	$9,004,983	$1,947,000	$9,614,000	$1,383,000	$4,182,000	$1,980,000	$1,237,500	$4,190,000	$323,000	$3,100,000	$60,000	$1,316,000	$8,989,000	**$42,373,500**
Phase 5	3,130	$4,251,997	$17,899,003	$1,947,000	$12,505,000	$1,844,000	$6,580,500	$3,217,500	$0	$7,710,000	$323,000	$4,421,000	$80,000	$1,847,000	$14,381,000	**$62,626,000**
Alt 3. With HHSD (Far Site); MBR + Solids + Rapid Infiltration																
Phase 1	319	$1,214,178	$1,059,822	$2,758,000	$3,966,000	$506,000	$391,500	$82,500	$618,750	$520,000	$451,000	$1,124,000	$23,000	$168,000	$2,286,000	**$12,882,750**
Phase 2	525	$1,512,974	$2,289,026	$2,758,000	$4,516,000	$506,000	$550,250	$123,750	$577,500	$1,081,000	$451,000	$1,360,000	$23,000	$200,000	$3,115,000	**$15,948,500**
Phase 3	1,037	$2,392,802	$5,561,198	$2,758,000	$6,841,000	$945,000	$1,051,500	$247,500	$453,750	$2,695,000	$451,000	$2,241,000	$41,000	$324,000	$5,752,000	**$26,002,750**
Phase 4	1,558	$4,036,017	$9,004,983	$2,758,000	$9,614,000	$1,383,000	$1,872,250	$453,750	$247,500	$4,190,000	$451,000	$3,100,000	$60,000	$479,000	$8,280,000	**$37,649,500**
Phase 5	3,130	$4,251,997	$17,899,003	$2,758,000	$12,505,000	$1,844,000	$2,850,750	$701,250	$0	$7,710,000	$451,000	$4,421,000	$80,000	$667,000	$13,329,000	**$56,139,000**

Table 9-3. Phase I Capital Cost Financing Option Summary

	Option A LID Formation		Option B Connection Fees		Option C Rates with Debt Financing or Grants	
	Lump Sum $/AC	Annual Payment $/AC[1]	Marginal Cost Method $/ERU	Growth Related Method $/ERU[2]	$/Mo per ERU with 100% Debt[1]	$/Mo per ERU with 75% Grant
Phase 1	$61,000	$4,000	$23,000	$18,000	$120	$30

[1] Assumes annual payments over 20 years with 90% low interest loan financing and 10% bond financing.

[2] May require funds from other sources (i.e. rates, grants etc...) to recover revenue shortfalls in certain years.

Table 9-4 Phase I&II Capital Cost Financing Option Summary

	Option A LID Formation		Option B Connection Fees		Option C Rates with Debt Financing or Grants[3]	
	Lump Sum $/AC	Annual Payment $/AC[1]	Marginal Cost Method $/ERU	Growth Related Method $/ERU[2]	$/Mo per ERU with 100% Debt[1]	$/Mo per ERU with 75% Grant
Phase 1&2	$57,000	$6,000	$16,000	$12,000	$80	$20

[1] Assumes annual payments over 20 years with 90% low interest loan financing and 10% bond financing.

[2] May require funds from other sources (i.e. rates, grants etc...) to recover revenue shortfalls in certain years.

[3] Rates are cummulative based on financing costs for current and previous phases.

Table 9-5. 20+Year Capital Cost Financing Option Summary

	Option A LID Formation		Option B Connection Fees		Option C Rates with Debt Financing or Grants[3]	
	Lump Sum $/AC	Annual Payment $/AC[1]	Marginal Cost Method $/ERU	Growth Related Method $/ERU[2]	$/Mo per ERU with 100% Debt[1]	$/Mo per ERU with 75% Grant
Phase 1	$61,000	$3,700	$23,000	$18,000	$120	$30
Phase 2	$8,000	$3,500	$6,000	$4,000	$80	$20
Phase 3	$12,000	$2,100	$9,000	$4,000	$60	$20
Phase 4	$7,000	$1,500	$11,000	$11,000	$60	$20
Phase 5	$6,000	$1,900	$3,000	$3,000	$40	$10
Average	$31,000					
Phase 1-4 (20 Yr CIP Total)				$8,000		
Phase 1-5 (20+ Yr CIP Total)				$6,000		

[1] Assumes annual payments over 20 years with 90% low interest loan financing and 10% bond financing.

[2] May require funds from other sources (i.e. rates, grants etc...) to recover revenue shortfalls in certain years.

[3] Rates are cummulative based on financing costs for current and previous phases.

Annual Cost per ERU per Phase

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5
Annual Debt for CIP	$447,590	$522,012	$790,099	$1,144,329	$1,449,490
Annual O&M Cost	$112,650	$154,750	$282,800	$405,350	$655,250
Total Cost/Yr	$560,240	$676,762	$1,072,899	$1,549,679	$2,104,740
ERU's	319	525	1037	1558	3130
Monthly $/ERU	$146	$107	$86	$83	$56
Monthly CIP $/ERU	$117	$83	$64	$61	$39
Monthly O&M $/ERU	$29	$25	$23	$22	$17

Annual Cost per ERU per Phase with 75% Grant Funding

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5
Annual Debt for CIP:	$121,312	$139,290	$204,429	$289,848	$362,372
Total O&M Cost	$112,650	$154,750	$282,800	$405,350	$655,250
Total Cost/Yr	$233,962	$294,040	$487,229	$695,198	$1,017,622
ERU's	319	525	1037	1558	3130
Monthly $/ERU	$61	$47	$39	$37	$27
Monthly CIP $/ERU	$32	$22	$16	$16	$10
Monthly O&M $/ERU	$29	$25	$23	$22	$17

One-time LID Assessment $/AC

gray added by AKC 1/29/04

	CIP $	Acres	$/AC	Cumulative $/AC	Incremental $/AC	ERU	$/ERU	Incremental $/ERU	
Phase 1	$7,354,178	120	$61,285	$61,285	$61,285	319	$23,054	$23,054	3064.24096
Phase 2	$1,222,796	150	$8,152	$69,437	$57,180	525	$2,329	$16,337	2858.991424
Phase 3	$4,404,828	380	$11,592	$92,620	$34,163	1037	$4,248	$12,519	1708.131852
Phase 4	$5,820,215	780	$7,462	$95,952	$24,105	1558	$3,736	$12,068	1205.257527
Phase 5	$5,013,979	780	$6,428	$101,347	$30,533	3130	$1,602	$7,609	1526.666451
Total	$23,815,997	780	$30,533						
Phases 1-4	$18,802,017	780	$24,105						

Table 4

LID Debt Financed Annual $/AC

	CIP Pmt $/Yr	Acres	Annual $/AC
Phase 1	$447,590	120	$3,730
Phase 2	$522,012	150	$3,480
Phase 3	$790,099	380	$2,079
Phase 4	$1,144,329	780	$1,467
Phase 5	$1,449,490	780	$1,858
Total	$4,353,520	780	$5,581

Note: Debt is cummulative and later phases include assessments for earlier phases.

Connection Fee Evaluation

Marginal Cost Method	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5
Incremental CIP Cost	$7,354,178	$1,222,796	$4,404,828	$5,820,215	$5,013,979
Added Capacity (ERU's)	319	207	511	521	1,572
Cost / ERU	$23,071	$5,919	$8,614	$11,168	$3,190

Growth Related Method	Phase 1	Phase 2	Phase 3	Phase 4	20 Yr CIP	Phase 5	Total System
Projected Total CIP Cost	$7,354,178	$1,222,796	$4,404,828	$5,820,215	$18,802,017	$5,013,979	$23,815,997
Added Capacity, gpd	70,000	60,000	190,000	90,000	410,000	270,000	680,000
Cost per Unit of Capacity	$105	$20	$23	$65	$46	$19	$35
Use per ERU, gpd	176	176	176	176	176	176	176
Cost / ERU	$18,438	$3,577	$4,069	$11,349	$8,048	$3,259	$6,147

Growth Related Method	Phase 1&2
Projected Total CIP Cost	$8,576,974
Added Capacity, gpd	130,000
Cost per Unit of Capacity	$66
Use per ERU, gpd	176
Cost / ERU	$11,579

Marginal Cost Method	Phase 1&2
Incremental CIP Cost	$8,576,974
Added Capacity (ERU's)	525
Cost / ERU	$16,326

APPENDIX J.
SEWERCAD COMPUTER MODEL ANALYSIS

Scenario: Phase 5 (larger pipes shown)

Pressure Pipe Report

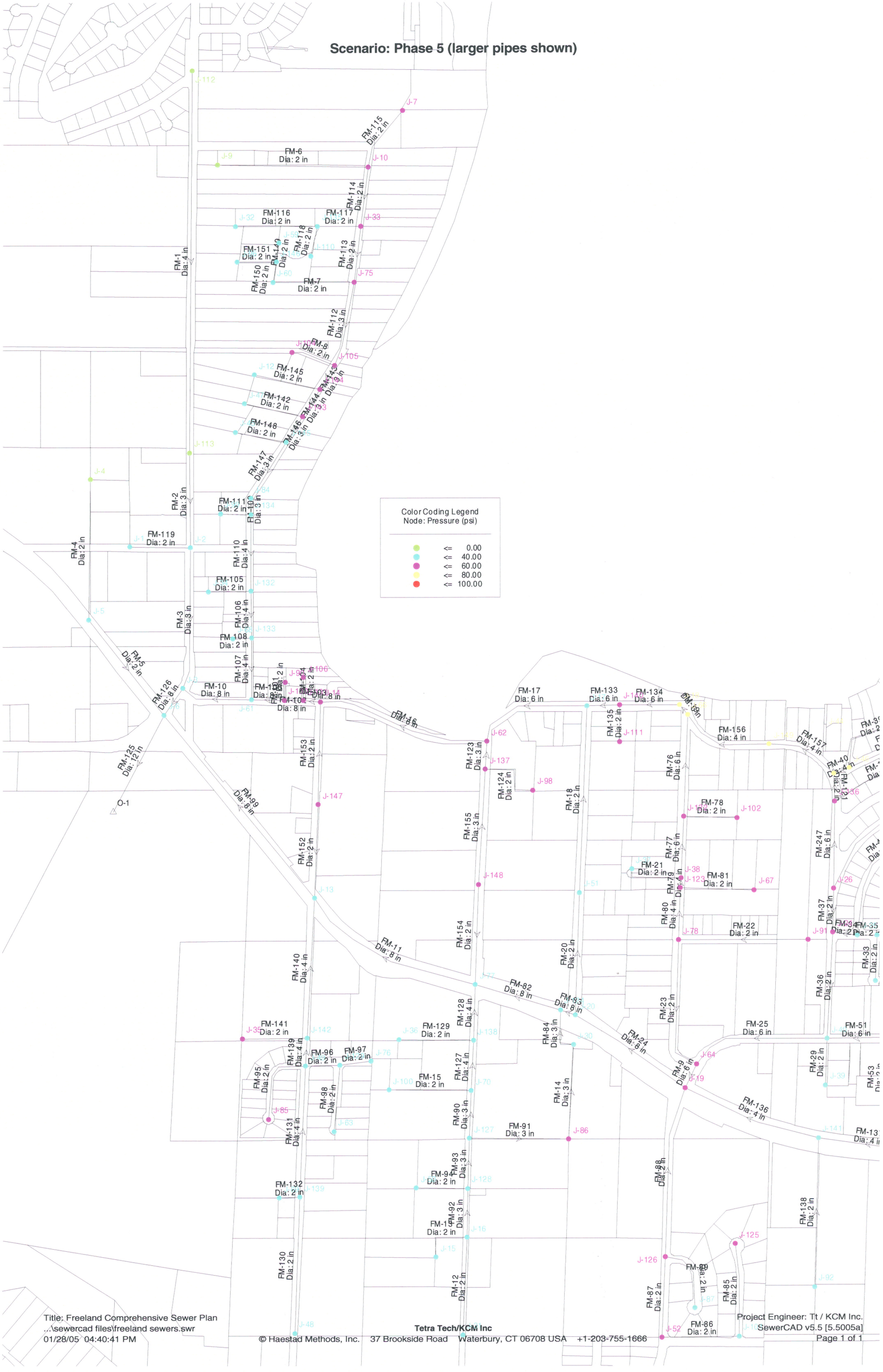
Label	Upstream Node	Upstream Invert Elevation (ft)	Downstream Node	Downstream Invert Elevation (ft)	Length (ft)	Diameter (in)	Material	Mannings n	Pressure Flow (gpm)	Velocity (ft/s)
FM-1	J-112	250.00	J-113	240.00	2,534.00	4	PVC		75.49	1.93
FM-2	J-113	240.00	J-2	106.00	632.00	3	PVC		75.49	3.43
FM-3	J-2	106.00	J-3	65.00	942.00	3	PVC		75.49	3.43
FM-5	J-5	100.00	J-6	70.00	808.00	2	PVC		19.24	1.96
FM-7	J-60	120.00	J-75	35.00	538.00	2	PVC		37.78	3.86
FM-9	J-19	63.00	J-64	60.00	178.00	6	PVC		-399.65	4.53
FM-10	J-3	65.00	J-61	39.00	483.00	8	PVC		-618.01	3.94
FM-11	J-77	70.00	J-13	51.00	1,252.00	8	PVC		725.16	4.63
FM-14	J-30	65.00	J-86	60.00	628.00	3	PVC		-12.00	0.54
FM-16	J-14	15.00	J-62	7.00	1,158.00	6	PVC		-451.02	5.12
FM-17	J-62	7.00	J-17	71.00	792.00	6	PVC		-376.31	4.27
FM-18	J-51	88.00	J-17	71.00	1,241.00	2	PVC		5.76	0.59
FM-19	J-18	9.00	J-66	9.00	85.00	6	PVC		-370.55	4.20
FM-20	J-20	73.00	J-51	88.00	810.00	2	PVC		5.76	0.59
FM-22	J-91	65.00	J-78	63.00	863.00	2	PVC		49.38	5.04
FM-23	J-64	60.00	J-78	63.00	906.00	2	PVC		-11.41	1.17
FM-24	J-19	63.00	J-20	73.00	875.00	8	PVC		575.35	3.67
FM-25	J-40	103.00	J-64	60.00	936.00	6	PVC		388.23	4.41
FM-26	J-21	130.00	J-22	115.00	953.00	3	PVC		58.12	2.64
FM-27	J-53	200.00	J-21	130.00	788.00	3	PVC		58.13	2.64
FM-30	J-42	114.00	J-22	115.00	713.00	2	PVC		-7.15	0.73
FM-32	J-41	119.00	J-42	114.00	684.00	2	PVC		45.97	4.69
FM-34	J-24	79.00	J-25	91.00	163.00	2	PVC		-15.62	1.60
FM-36	J-40	103.00	J-24	79.00	704.00	2	PVC		-22.48	2.30
FM-37	J-26	71.00	J-24	79.00	290.00	2	PVC		6.85	0.70
FM-40	J-44	25.00	J-46	25.00	113.00	4	PVC		-135.55	3.46
FM-41	J-83	48.00	J-46	25.00	647.00	4	PVC		135.55	3.46
FM-42	J-26	71.00	J-27	89.00	1,345.00	2	PVC		-17.71	1.81
FM-43	J-25	91.00	J-56	117.00	1,149.00	2	PVC		-15.62	1.60
FM-44	J-94	105.00	J-74	120.00	447.00	2	PVC		-26.25	2.68
FM-45	J-27	89.00	J-56	117.00	448.00	2	PVC		15.62	1.60
FM-46	J-29	117.00	J-27	89.00	1,810.00	4	PVC		168.89	4.31
FM-48	J-58	125.00	J-29	117.00	184.00	4	PVC		64.65	1.65
FM-50	J-8	140.00	J-58	125.00	592.00	3	PVC		64.65	2.93
FM-51	J-40	103.00	J-114	113.00	389.00	6	PVC		-274.99	3.12
FM-52	J-114	113.00	J-42	114.00	314.00	6	PVC		-274.99	3.12
FM-55	J-118	180.00	J-119	160.00	244.00	2	PVC		-0.00	0.00
FM-57	J-8	140.00	J-119	160.00	324.00	2	PVC		0.00	0.00
FM-64	J-116	118.00	J-73	113.00	284.00	6	PVC		-102.64	1.16
FM-66	J-42	114.00	J-117	116.00	267.00	4	PVC		-102.64	2.62
FM-67	J-117	116.00	J-116	118.00	846.00	6	PVC		-102.64	1.16
FM-69	J-120	115.00	J-22	115.00	76.00	3	PVC		-50.98	2.31
FM-70	J-107	130.00	J-120	115.00	172.00	4	PVC		65.14	1.66
FM-71	J-94	105.00	J-41	119.00	236.00	2	PVC		26.25	2.68
FM-73	J-121	120.00	J-41	119.00	42.00	2	PVC		19.72	2.01
FM-75	J-83	48.00	J-27	89.00	419.00	4	PVC		-135.55	3.46
FM-76	J-66	9.00	J-122	40.00	680.00	6	PVC		-187.55	2.13
FM-77	J-122	40.00	J-38	60.00	408.00	6	PVC		-153.66	1.74
FM-79	J-38	60.00	J-123	60.00	67.00	4	PVC		-89.49	2.28
FM-80	J-123	60.00	J-78	63.00	343.00	4	PVC		-89.49	2.28

Scenario: Phase 5 (larger pipes shown)

Pressure Pipe Report

Label	Upstream Node	Upstream Invert Elevation (ft)	Downstream Node	Downstream Invert Elevation (ft)	Length (ft)	Diameter (in)	Material	Mannings n	Pressure Flow (gpm)	Velocity (ft/s)
FM-82	J-77	70.00	J-124	69.00	588.00	8	PVC		-610.54	3.90
FM-83	J-124	69.00	J-20	73.00	107.00	8	PVC		-569.59	3.64
FM-84	J-30	65.00	J-124	69.00	312.00	3	PVC		40.95	1.86
FM-88	J-126	72.00	J-19	63.00	1,133.00	2	PVC		37.01	3.78
FM-90	J-127	80.00	J-70	95.00	315.00	3	PVC		53.49	2.43
FM-91	J-86	60.00	J-127	80.00	659.00	3	PVC		-0.40	0.02
FM-92	J-16	70.00	J-128	75.00	326.00	3	PVC		53.89	2.45
FM-93	J-128	75.00	J-127	80.00	329.00	3	PVC		53.89	2.45
FM-99	J-13	51.00	J-6	70.00	1,576.00	8	PVC		858.38	5.48
FM-100	J-61	39.00	J-130	30.00	218.00	8	PVC		-479.47	3.06
FM-102	J-130	30.00	J-131	20.00	127.00	8	PVC		-479.47	3.06
FM-103	J-131	20.00	J-14	15.00	114.00	8	PVC		-479.47	3.06
FM-106	J-132	55.00	J-133	45.00	308.00	4	PVC		115.00	2.94
FM-107	J-133	45.00	J-61	39.00	410.00	4	PVC		115.00	2.94
FM-109	J-84	77.00	J-134	75.00	108.00	3	PVC		84.10	3.82
FM-110	J-134	75.00	J-132	55.00	510.00	4	PVC		115.00	2.94
FM-112	J-75	35.00	J-105	30.00	568.00	3	PVC		84.10	3.82
FM-113	J-75	35.00	J-33	50.00	375.00	2	PVC		-46.32	4.73
FM-114	J-33	50.00	J-10	60.00	397.00	2	PVC		-46.32	4.73
FM-121	J-136	48.00	J-44	25.00	180.00	2	PVC		27.25	2.78
FM-123	J-137	9.00	J-62	7.00	186.00	3	PVC		61.65	2.80
FM-125	O-1	120.00	J-6	70.00	727.00	12	PVC		1,571.12	4.46
FM-126	J-3	65.00	J-6	70.00	214.00	8	PVC		693.50	4.43
FM-127	J-70	95.00	J-138	80.00	335.00	4	PVC		53.49	1.37
FM-128	J-138	80.00	J-77	70.00	370.00	4	PVC		98.42	2.51
FM-131	J-139	60.00	J-49	55.00	868.00	4	PVC		75.97	1.94
FM-133	J-17	71.00	J-140	60.00	218.00	6	PVC		-370.55	4.20
FM-134	J-140	60.00	J-18	9.00	400.00	6	PVC		-370.55	4.20
FM-136	J-19	63.00	J-141	90.00	952.00	4	PVC		-138.69	3.54
FM-137	J-141	90.00	J-120	115.00	669.00	4	PVC		-116.12	2.96
FM-138	J-92	130.00	J-141	90.00	988.00	2	PVC		22.57	2.30
FM-139	J-49	55.00	J-142	55.00	185.00	4	PVC		75.97	1.94
FM-140	J-142	55.00	J-13	51.00	930.00	4	PVC		86.46	2.21
FM-143	J-105	30.00	J-144	40.00	185.00	3	PVC		84.10	3.82
FM-144	J-144	40.00	J-143	50.00	213.00	3	PVC		84.10	3.82
FM-146	J-143	50.00	J-145	60.00	200.00	3	PVC		84.10	3.82
FM-147	J-145	60.00	J-84	77.00	441.00	3	PVC		84.10	3.82
FM-152	J-13	51.00	J-147	35.00	621.00	2	PVC		-5.99	0.61
FM-153	J-147	35.00	J-14	15.00	685.00	2	PVC		28.45	2.91
FM-154	J-77	70.00	J-148	60.00	662.00	2	PVC		-16.20	1.65
FM-155	J-148	60.00	J-137	9.00	769.00	3	PVC		61.65	2.80
FM-156	J-66	9.00	J-149	9.00	627.00	4	PVC		-162.80	4.16
FM-157	J-149	9.00	J-44	25.00	496.00	4	PVC		-162.80	4.16
FM-247	J-136	48.00	J-26	71.00	582.00	6	PVC		-10.86	0.12

Scenario: Phase 5 (larger pipes shown)



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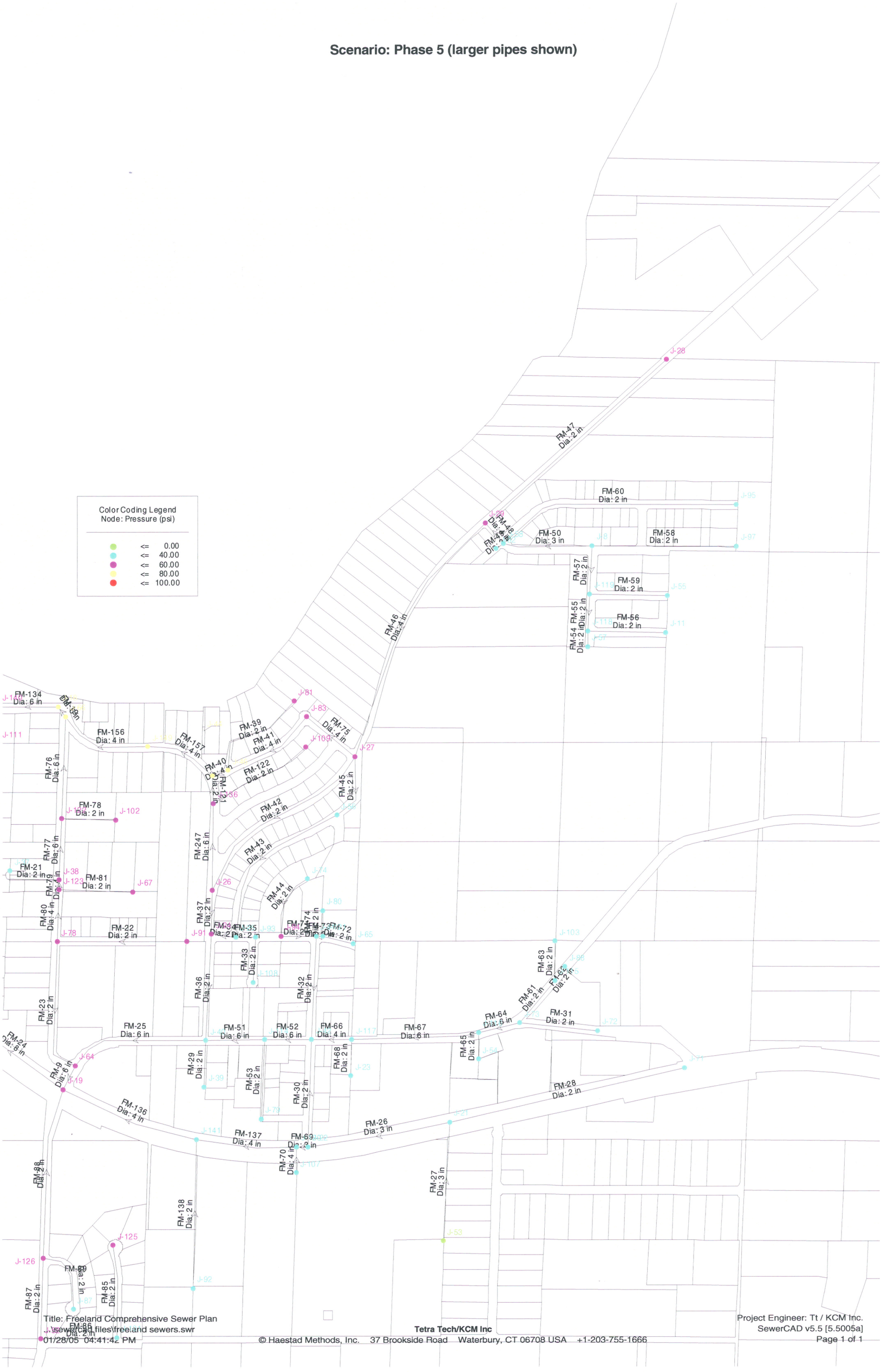
Scenario: Phase 5 (larger pipes shown)



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APPENDIX K.
DESIGN DATA FOR TREATMENT PLANT ALTERNATIVES

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WWTP Design Data Sheet

ISLAND COUNTY DEPARTMENT OF PLANNING / PUBLIC WORKS
FREELAND COMPREHENSIVE SEWER PLAN
WASTEWATER TREATMENT PLANT DESIGN DATA
OXIDATION DITCHES - Freeland only

ITEM	Initial - Existing Com/Ind	Initial - Com/Ind + Minor Res.	Phase 3	20-Year "LOW" Population Projection	Ultimate Buildout Population Projection
OXIDATION DITCHES					
NUMBER OF DITCHES	2	2	2	2	3
LENGTH, EACH (FT.)	90	90	90	90	2 @ 90; 1@ 135
WIDTH, EACH (FT.)	40	40	40	40	40
SIDE WATER DEPTH (FT.)	10	10	10	10	10
VOLUME, EACH (MG)					
ANOXIC ZONE	0.043	0.043	0.043	0.043	0.086
AERATED ZONE	0.17	0.17	0.17	0.17	0.345
ANOXIC + AEROBIC	0.215	0.215	0.215	0.215	0.431
VOLUME, TOTAL (MG)					
ANOXIC ZONE	0.086	0.086	0.086	0.086	0.172
AERATED ZONE	0.345	0.345	0.345	0.345	0.689
ANOXIC + AEROBIC	0.431	0.431	0.431	0.431	0.862
HYDRAULIC DETENTION TIME, ANOXIC ZONE (HOURS)					
AA	37	22	11	7	8
MM	27	16	8	5	6
HYDRAULIC DETENTION TIME, AERATED ZONE (HOURS)					
AA	148	89	45	28	32
MM	109	65	32	20	24
HYDRAULIC DETENTION TIME, TOTAL (HOURS)					
AA	185	111	56	35	41
MM	136	81	40	24	30
NET YIELD (LB TSS / LB BOD)	0.6	0.6	0.6	0.6	0.6
SRT AT MM (DAYS)	18	18	18	18	18
MLSS (MG/L)	3,500	3,500	3,500	3,500	3,500
MLVSS (MG/L)	2,800	2,800	2,800	2,800	2,800
F/M RATIO (PPD BOD/LB MLVSS)					
AA	0.01	0.02	0.03	0.04	0.04
MM	0.02	0.03	0.06	0.09	0.07
ORGANIC LOADING (PPD BOD/1000 CF)					
AA	1.7	2.7	4.9	7.6	6.5
MM	3.3	5.5	9.9	15.3	13.0
TOTAL AERATED VOLUME REQUIRED, MGAL (MM)	0.06	0.11	0.19	0.29	0.50
TOTAL ANOXIC VOLUME REQUIRED, MGAL (MM)	0.023	0.038	0.066	0.102	0.17
BODrem (AA)	85	140	252	389	662
WASTE SLUDGE (PPD)	51	84	151	233	397
VOLUME WASTE SLUDGE @ 0.7% (GPD)	873	1,436	2,589	3,994	6,802
BODrem (MM)	173	284	513	792	1,351
WASTE SLUDGE (PPD)	104	171	308	475	811
VOLUME WASTE SLUDGE @ 0.7% (GPD)	1,776	2,923	5,272	8,136	13,886
BODrem (MD)	216	355	639	985	1,686
WASTE SLUDGE (PPD)	129	213	383	591	1,011
VOLUME WASTE SLUDGE @ 0.7% (GPD)	2,216	3,647	6,566	10,126	17,324
VOLATILE SOLIDS INVENTORY (LBS.)	10,032	10,032	10,032	10,032	20,064
SYSTEM MASS AT MM (LBS)	1,866	3,072	5,540	8,550	14,592
	305	503	906	1,398	2,381
O2 REQUIREMENT - BOD	1.75	1.75	1.75	1.75	1.75
O2 REQUIREMENT - NH3-N	4.6	4.6	4.6	4.6	4.6
O2 CREDIT - DENITRIFICATION	2.86	2.86	2.86	2.86	2.86
OXYGEN REQUIREMENT (INCLUDING DENITRIFICATION CREDIT)					
AOR (PPD)					
AA	203	334	604	934	1,592
MM	407	670	1,213	1,875	3,195
PEAK	507	834	1,509	2,333	3,976
SOR @ 20 DEG C (PPD)					
AA (DO = 2.0 MG/L)	342	563	1,019	1,576	2,685
MM (DO = 2.0 MG/L)	686	1,130	2,045	3,163	5,390
PEAK (DO = 0.5 MG/L)	703	1,159	2,096	3,240	5,522
AERATION	LOW-SPEED VERTICAL TURBINE	LOW-SPEED VERTICAL TURBINE	LOW-SPEED VERTICAL TURBINE	LOW-SPEED VERTICAL TURBINE	LOW-SPEED VERTICAL TURBINE
AERATION HORSEPOWER, FIRST DITCH					
DUTY	20	20	20	20	20
STANDBY	0	0	0	20	20
TOTAL	20	20	20	40	40
AERATION HORSEPOWER, SECOND DITCH					
DUTY	20	20	20	20	20
STANDBY	0	0	0	20	20
TOTAL	20	20	20	40	40
AERATION HORSEPOWER, THIRD DITCH					
DUTY	0	0	0	0	20
STANDBY	0	0	0	0	0
TOTAL	0	0	0	0	20
TOTAL FIRM AERATION HP	20	20	20	60	80
STD. OXYGEN TRANSFER EFF. (LBS/HP-HR)	3.3	3.3	3.3	3.3	3.3
STD. OXYGEN TRANSF. CAPACITY (PPD)	1,584	1,584	1,584	4,752	6,336
SUPPLEMENTAL MIXING, EACH DITCH					
ANOXIC ZONE					
NUMBER OF MIXERS	1	1	1	1	1
TYPE OF MIXER	SUBMERGED PROPELLER	SUBMERGED PROPELLER	SUBMERGED PROPELLER	SUBMERGED PROPELLER	SUBMERGED PROPELLER
NAMEPLATE HP, EACH	2.5	2.5	2.5	2.5	2.5
AERATED ZONE					
NUMBER OF MIXERS	1	1	1	1	1
TYPE OF MIXER	SUBMERGED PROPELLER	SUBMERGED PROPELLER	SUBMERGED PROPELLER	SUBMERGED PROPELLER	SUBMERGED PROPELLER
NAMEPLATE HP, EACH	5	5	5	5	5
SECONDARY CLARIFIER					
NUMBER OF CLARIFIERS	2	2	2	2	3

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TYPE	CIRCULAR, CENTER-FEED	CIRCULAR, CENTER-FEED	CIRCULAR, CENTER-FEED	CIRCULAR, CENTER-FEED	CIRCULAR, CENTER-FEED
DIAMETER (FT.)	40	40	40	40	40
SIDE WATER DEPTH (FT.)	12	12	12	12	12
SURFACE LOADING (GPD/SF)					
AA	22	37	73	118	203
PH	81	136	273	444	739
SOLIDS LOADING (PPD/SF)					
AA	12.3	12.8	13.8	15.1	23.4
PH	14.0	15.6	19.6	24.6	39.0
SOLIDS REMOVAL	SPIRAL SCRAPER	SPIRAL SCRAPER	SPIRAL SCRAPER	SPIRAL SCRAPER	SPIRAL SCRAPER
NAMEPLATE HORSEPOWER, EACH	0.75	0.75	0.75	0.75	0.75
SCUM REMOVAL	SURFACE SCUM SKIMMER	SURFACE SCUM SKIMMER	SURFACE SCUM SKIMMER	SURFACE SCUM SKIMMER	SURFACE SCUM SKIMMER
RAS/WAS PUMPS					
NUMBER OF DUTY PUMPS (1 STANDBY PUMP PER CLARIFIER)	2	2	2	2	3
TYPE OF PUMPS	CENTRIFUGAL	CENTRIFUGAL	CENTRIFUGAL	CENTRIFUGAL	CENTRIFUGAL
CAPACITY, EACH PUMP (GPM)	350	350	350	350	350
TDH (FT)	22	22	22	22	22
PUMP HORSEPOWER, EACH PUMP	5	5	5	5	5
TOTAL CAPACITY (DUTY PUMPS), % OF MM FLOW	1326%	787%	389%	238%	219%
TOTAL CAPACITY (DUTY PUMPS), % OF PH FLOW	495%	295%	147%	90%	81%
EFFLUENT FILTRATION					
TYPE	DEEP BED, UPFLOW MEDIA FILTER	DEEP BED, UPFLOW MEDIA FILTER	DEEP BED, UPFLOW MEDIA FILTER	DEEP BED, UPFLOW MEDIA FILTER	DEEP BED, UPFLOW MEDIA FILTER
NUMBER OF UNITS	2	2	2	3	5
FILTER SURFACE AREA, EACH (SF)	50	50	50	50	50
TOTAL FILTER SURFACE AREA (SF)	100	100	100	150	250
HYDRAULIC LOADING RATE AT MM (GPM/SF)	0.53	0.89	1.80	1.96	1.92
HYDRAULIC LOADING RATE AT PH (GPM/SF)	1.41	2.38	4.77	5.16	5.16
CHEMICAL ADDITION					
COAGULANT	ALUMINUM SULFATE	ALUMINUM SULFATE	ALUMINUM SULFATE	ALUMINUM SULFATE	ALUMINUM SULFATE
DOSE (MG/L)	10	10	10	10	10
STORAGE TANK VOLUME REQD. (GAL)	94	157	310	500	857
NUMBER OF STORAGE TANKS	1	1	1	2	3
STORAGE TANK VOLUME, EACH (GAL)	350	350	350	350	350
TOTAL STORAGE TANK VOLUME (GAL)	350	350	350	700	1,050
CHEMICAL FEED	METERING PUMPS	METERING PUMPS	METERING PUMPS	METERING PUMPS	METERING PUMPS

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ISLAND COUNTY DEPARTMENT OF PLANNING / PUBLIC WORKS
FREELAND COMPREHENSIVE SEWER PLAN
WASTEWATER TREATMENT PLANT DESIGN DATA
SEQUENCING BATCH REACTORS - Freeland only

ITEM	Initial - Existing Com/Ind	Initial - Com/Ind + Minor Res.	Phase 3	20-Year "LOW" Population Projection	Ultimate Buildout Population Projection
SEQUENCING BATCH REACTORS					
NUMBER OF BASINS	2	2	2	3	4
LENGTH, EACH (FT.)	22.5	45	45	45	45
WIDTH, EACH (FT.)	22.5	22.5	45	45	45
HIGH WATER DEPTH (FT.)	18	18	18	18	18
LOW WATER DEPTH (FT.)	14	14	14	14	14
VOLUME, EACH, AT HIGH WATER LEVEL (MG)	0.07	0.14	0.27	0.27	0.27
VOLUME, EACH, AT LOW WATER LEVEL (MG)	0.05	0.11	0.21	0.21	0.21
TOTAL VOLUME AT HIGH WATER LEVEL (MG)	0.14	0.27	0.55	0.82	1.09
TOTAL VOLUME AT LOW WATER LEVEL (MG)	0.11	0.21	0.42	0.64	0.85
NUMBER OF CYCLES PER DAY	4	4	4	4	4
CYCLE TIMING (MIN.)					
MIXED FILL	45	45	45	45	45
AERATED FILL	135	135	135	135	135
REACT	36	36	36	36	36
MIX	36	36	36	36	36
SETTLE	45	45	45	45	45
DECANT	54	54	54	54	54
WASTE	9	9	9	9	9
TOTAL	360	360	360	360	360
HYDRAULIC DETENTION TIME, TOTAL, AT MAX VOL (HOURS)					
AA	60	71	72	67	52
MM	44	52	51	47	39
HYDRAULIC DETENTION TIME, TOTAL, AT MIN VOL (HOURS)					
AA	46	55	56	52	40
MM	34	41	40	37	30
NET YIELD (LB TSS / LB BOD)	0.6	0.6	0.6	0.6	0.6
SRT AT AA (DAYS)	67	81	90	88	69
SRT AT MM (DAYS)	33	40	44	43	34
MLSS AT HIGH WATER LEVEL (MG/L)	3,000	3,000	3,000	3,000	3,000
MLVSS AT HIGH WATER LEVEL (MG/L)	2,400	2,400	2,400	2,400	2,400
VOLATILE SOLIDS INVENTORY (LBS.)	2,721	5,442	10,883	16,325	21,766
SYSTEM MASS AT MM (LBS)	3,401	6,802	13,604	20,406	27,208
F/M RATIO (PPD BOD/LB MLVSS)					
AA	0.03	0.03	0.03	0.03	0.03
MM	0.07	0.06	0.05	0.05	0.07
ORGANIC LOADING (PPD BOD/1000 CF)					
AA	5.2	4.3	3.9	4.0	5.1
MM	10.5	8.6	7.8	8.0	10.3
TOTAL AERATED VOLUME REQUIRED, MGAL (MM)	0.12	0.19	0.34	0.53	0.91
TOTAL ANOXIC VOLUME REQUIRED, MGAL (MM)	0.021	0.034	0.060	0.092	0.16
BODrem (AA)	85	140	252	389	662
WASTE SLUDGE (PPD)	51	84	151	233	397
VOLUME WASTE SLUDGE @ 0.7% (GPD)	873	1,436	2,589	3,994	6,802
BODrem (MM)	173	284	513	792	1,351
WASTE SLUDGE (PPD)	104	171	308	475	811
VOLUME WASTE SLUDGE @ 0.7% (GPD)	1,776	2,923	5,272	8,136	13,886
BODrem (MD)	216	355	639	985	1,686
WASTE SLUDGE (PPD)	129	213	383	591	1,011
VOLUME WASTE SLUDGE @ 0.7% (GPD)	2,216	3,647	6,566	10,126	17,324
O2 REQUIREMENT - BOD	1.75	1.75	1.75	1.75	1.75
O2 REQUIREMENT - NH3-N	4.6	4.6	4.6	4.6	4.6
O2 CREDIT - DENITRIFICATION	2.86	2.86	2.86	2.86	2.86
OXYGEN REQUIREMENT (INCLUDING DENITRIFICATION CREDIT)					
AOR (PPD)					
AA	203	334	604	934	1,592
MM	407	670	1,213	1,875	3,195
PEAK	507	834	1,509	2,333	3,976
SOR @ 20 DEG C (PPD)					
AA (DO = 2.0 MG/L)	342	563	1,019	1,576	2,685
MM (DO = 2.0 MG/L)	686	1,130	2,045	3,163	5,390
PEAK (DO = 0.5 MG/L)	703	1,159	2,096	3,240	5,522
AERATION					
CLEAN WATER OTE	18.2%	18.2%	18.2%	18.2%	18.2%
TOTAL AIR REQD (SCFM)	163	269	486	751	1,280
TOTAL AIR REQD (ICFM)	173	285	515	797	1,358
LOSS ALLOWANCE (PSIG)	2.0	2.0	2.0	2.0	2.0
DISCHARGE PRESSURE (PSIG)					
HIGH WATER LEVEL	9.8	9.8	9.8	9.8	9.8
LOW WATER LEVEL	8.1	8.1	8.1	8.1	8.1
BLOWER EFFICIENCY (%)	70%	70%	70%	70%	70%
TOTAL BLOWER HP REQD.	9	14	26	40	69
NUMBER OF BLOWERS					
DUTY	1	1	1	2	3
STANDBY	1	1	1	1	1
HORSEPOWER, EACH BLOWER	25	25	25	25	25
TOTAL FIRM BLOWER HP	25	25	25	50	75
MAXIMUM DECANT RATE (GPM)	281	561	1,122	1,122	1,122
MAXIMUM DECANT RATE (MGD)	0.40	0.81	1.62	1.62	1.62
MAXIMUM DECANT OVERFLOW RATE (GPD/SF)	798	798	798	798	798
MOTIVE PUMPS					
DUTY	1	1	2	3	4
STANDBY	1	1	1	1	1
TOTAL	2	2	3	4	5
TYPE OF PUMP	CENTRIFUGAL	CENTRIFUGAL	CENTRIFUGAL	CENTRIFUGAL	CENTRIFUGAL
CAPACITY, EACH PUMP (GPM)	1,500	1,500	1,500	1,500	1,500

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TOTAL PUMPING CAPACITY (GPM)	1,500	1,500	3,000	4,500	6,000
TDH (FT)	22	22	22	22	22
PUMP HORSEPOWER, EACH PUMP	10	10	10	10	10
WAS PUMPS					
WASTING RATE (GPM)	62	101	182	281	481
DUTY	1	1	1	2	3
STANDBY	1	1	1	1	1
TOTAL	2	2	2	3	4
TYPE OF PUMP	CENTRIFUGAL	CENTRIFUGAL	CENTRIFUGAL	CENTRIFUGAL	CENTRIFUGAL
CAPACITY, EACH PUMP (GPM)	250	250	250	250	250
TOTAL PUMPING CAPACITY (GPM)	250	250	250	500	750
TDH (FT)	22	22	22	22	22
PUMP HORSEPOWER, EACH PUMP	7.5	7.5	7.5	7.5	7.5
POST-SBR EQUALIZATION					
EQ VOLUME REQD (MG)	0.011	0.024	0.048	0.100	0.149
NUMBER OF BASINS	2	2	2	3	4
LENGTH, EACH (FT.)	16	16	16	16	16
WIDTH, EACH (FT.)	16	16	16	16	16
SIDE WATER DEPTH (FT.)	10	10	10	10	10
VOLUME, EACH (MG)	0.019	0.019	0.019	0.019	0.019
TOTAL VOLUME (MG)	0.038	0.038	0.038	0.057	0.077
EFFLUENT FILTRATION					
TYPE	DEEP BED, UPFLOW MEDIA FILTER	DEEP BED, UPFLOW MEDIA FILTER	DEEP BED, UPFLOW MEDIA FILTER	DEEP BED, UPFLOW MEDIA FILTER	DEEP BED, UPFLOW MEDIA FILTER
NUMBER OF UNITS	2	2	2	3	5
FILTER SURFACE AREA, EACH (SF)	50	50	50	50	50
TOTAL FILTER SURFACE AREA (SF)	100	100	100	150	250
HYDRAULIC LOADING RATE AT MM (GPM/SF)	0.53	0.89	1.80	1.96	1.92
HYDRAULIC LOADING RATE AT PH (GPM/SF)	1.41	2.38	4.77	5.16	5.16
CHEMICAL ADDITION					
COAGULANT	ALUMINUM SULFATE	ALUMINUM SULFATE	ALUMINUM SULFATE	ALUMINUM SULFATE	ALUMINUM SULFATE
DOSE (MG/L)	10	10	10	10	10
STORAGE TANK VOLUME REQD. (GAL)	1	2	4	7	11
NUMBER OF STORAGE TANKS	1	1	1	2	3
STORAGE TANK VOLUME, EACH (GAL)	350	350	350	350	350
TOTAL STORAGE TANK VOLUME (GAL)	350	350	350	700	1,050
CHEMICAL FEED	METERING PUMPS	METERING PUMPS	METERING PUMPS	METERING PUMPS	METERING PUMPS

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ISLAND COUNTY DEPARTMENT OF PLANNING / PUBLIC WORKS
FREELAND COMPREHENSIVE SEWER PLAN
WASTEWATER TREATMENT PLANT DESIGN DATA
MEMBRANE BIOREACTORS - Freeland only

ITEM	Phase 1 Initial - Existing Com/Ind	Phase 2 Initial - Com/Ind + Minor Res.	Phase 3 Phase 3	Phase 4 20-Year "LOW" Population Projection	Phase 5 Ultimate Buildout Population Projection
POPULATION EQUIVALENTS	746	1,229	2,426	3,645	7,323
FLOWS					
INFLUENT FLOW (MGD)					
AVERAGE ANNUAL (AA)	0.055	0.09	0.18	0.29	0.50
MAXIMUM MONTH (MM)	0.074	0.13	0.25	0.41	0.68
MAXIMUM DAY (MD)	0.10	0.17	0.35	0.57	0.89
PEAK HOUR (PH)	0.20	0.34	0.68	1.11	1.84
RECYCLE FLOW FROM SOLIDS HANDLING (MGD)					
AA	0.000	0.001	0.001	0.002	0.003
MM	0.001	0.001	0.002	0.004	0.006
MD	0.001	0.002	0.003	0.005	0.008
PH	0.001	0.002	0.003	0.005	0.008
TOTAL FLOW (MGD)					
AA	0.06	0.09	0.18	0.30	0.51
MM	0.08	0.13	0.26	0.42	0.68
MD	0.10	0.17	0.35	0.58	0.89
PH	0.20	0.34	0.68	1.11	1.85
5-DAY BIOCHEMICAL OXYGEN DEMAND (BOD) (PPD)					
AA	90	147	267	413	704
MM	179	295	534	826	1,408
MD	224	369	668	1,033	1,759
RECYCLE LOADS FROM SOLIDS HANDLING					
AA	6	9	17	26	44
MM	12	19	34	53	91
MD	14	24	43	66	113
TOTAL					
AA	95	157	284	439	748
MM	191	314	569	879	1,498
MD	238	392	711	1,099	1,873
TOTAL SUSPENDED SOLIDS (TSS) (PPD)					
AA	37	61	111	172	293
MM	93	154	278	430	733
MD	131	215	389	602	1,026
RECYCLE LOADS FROM SOLIDS HANDLING					
AA	5	8	15	23	40
MM	10	17	31	48	81
MD	13	21	38	59	101
TOTAL					
AA	42	70	126	195	333
MM	104	171	309	478	814
MD	143	236	428	662	1,127
TOTAL KJELDAHL NITROGEN (TKN) (PPD)					
AA	16	27	48	74	127
MM	32	53	96	149	253
MD	40	66	120	186	317
RECYCLE LOADS FROM SOLIDS HANDLING					
AA	1	2	3	5	8
MM	2	3	6	10	16
MD	3	4	8	12	20
TOTAL					
AA	17	28	51	79	135
MM	34	57	102	158	270
MD	43	71	128	198	337
PRE-MBR EQUALIZATION (ADDED FREEBOARD IN MBR TANKS)					
VOLUME REQUIRED (MG)	0.009	0.014	0.028	0.045	0.080
NUMBER OF BASINS	1	2	2	3	4
LENGTH, EACH (FT.)	30	30	30	30	30
WIDTH, EACH (FT.)	10	10	20	20	20
SIDE WATER DEPTH (FT.)	3	3	3	3	3
VOLUME, EACH (MG)	0.007	0.007	0.013	0.013	0.013
TOTAL VOLUME (MG)	0.007	0.013	0.027	0.040	0.054
MEMBRANE BIOREACTORS					
ANOXIC BASINS					
NUMBER OF BASINS	1	2	2	3	4
LENGTH, EACH (FT.)	10	10	10	10	10
WIDTH, EACH (FT.)	10	10	20	20	20
SIDE WATER DEPTH (FT.)	10	10	10	10	10
VOLUME, EACH (MG)	0.007	0.007	0.015	0.015	0.015
VOLUME, TOTAL (MG)	0.007	0.015	0.030	0.045	0.060
AEROBIC BASINS					
NUMBER OF BASINS	1	2	2	3	4
LENGTH, EACH (FT.)	20	20	20	20	20
WIDTH, EACH (FT.)	10	10	20	20	20
SIDE WATER DEPTH (FT.)	12	12	12	12	12
VOLUME, EACH (MG)	0.018	0.018	0.036	0.036	0.036
VOLUME, TOTAL (MG)	0.018	0.036	0.072	0.108	0.144
TOTAL VOLUME (MG)	0.025	0.051	0.102	0.153	0.203
HYDRAULIC DETENTION TIME, ANOXIC ZONE (HOURS)					
AA	3	4	4	4	3
MM	2	3	3	3	2
HYDRAULIC DETENTION TIME, AERATED ZONE (HOURS)					
AA	8	9	9	9	7
MM	6	7	7	6	5

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HYDRAULIC DETENTION TIME, TOTAL (HOURS)					
AA	11	13	13	12	10
MM	8	10	10	9	7
NET YIELD (LB TSS / LB BOD)	0.6	0.6	0.6	0.6	0.6
SRT AT AA (DAYS)	50	61	67	65	51
SRT AT MM (DAYS)	24	30	33	32	25
MLSS (MG/L)	12,000	12,000	12,000	12,000	12,000
MLVSS (MG/L)	9,600	9,600	9,600	9,600	9,600
VOLATILE SOLIDS INVENTORY (LBS.)	2,030	4,061	8,121	12,182	16,243
SYSTEM MASS AT MM (LBS)	2,538	5,076	10,152	15,227	20,303
F/M RATIO (PPD BOD/LB MLVSS)					
AA	0.05	0.04	0.03	0.04	0.05
MM	0.09	0.08	0.07	0.07	0.09
ORGANIC LOADING (PPD BOD/1000 CF)					
AA	28.0	23.1	20.9	21.5	27.5
MM	56.1	46.2	41.8	43.1	55.1
TOTAL AERATED VOLUME REQUIRED, MGAL (MM)	0.02	0.03	0.06	0.09	0.15
TOTAL ANOXIC VOLUME REQUIRED, MGAL (MM)	0.007	0.011	0.019	0.030	0.051
BODrem (AA)	85	140	252	389	662
WASTE SLUDGE (PPD)	51	84	151	233	397
VOLUME WASTE SLUDGE @ 1.5% (GPD)	407	670	1,208	1,864	3,174
BODrem (MM)	173	284	513	792	1,351
WASTE SLUDGE (PPD)	104	171	308	475	811
VOLUME WASTE SLUDGE @ 1.5% (GPD)	829	1,364	2,460	3,797	6,480
BODrem (MD)	216	355	639	985	1,686
WASTE SLUDGE (PPD)	129	213	383	591	1,011
VOLUME WASTE SLUDGE @ 1.5% (GPD)	1,034	1,702	3,064	4,725	8,084
O2 REQUIREMENT - BOD	1.75	1.75	1.75	1.75	1.75
O2 REQUIREMENT - NH3-N	4.6	4.6	4.6	4.6	4.6
O2 CREDIT - DENITRIFICATION	2.86	2.86	2.86	2.86	2.86
OXYGEN REQUIREMENT FOR AERATION (INCLUDING DENITRIFICATION CREDIT)					
AOR (PPD)					
AA	203	334	604	934	1,592
MM	407	670	1,213	1,875	3,195
PEAK	507	834	1,509	2,333	3,976
SOR @ 20 DEG C (PPD)					
AA (DO = 2.0 MG/L)	342	563	1,019	1,576	2,685
MM (DO = 2.0 MG/L)	686	1,130	2,046	3,163	5,390
PEAK (DO = 0.5 MG/L)	704	1,159	2,096	3,240	5,522
PROCESS AERATION					
CLEAN WATER OTE	12.6%	12.6%	12.6%	12.6%	12.6%
TOTAL AIR REQD (SCFM)	236	388	702	1,085	1,849
TOTAL AIR REQD (ICFM)	250	412	744	1,151	1,962
LOSS ALLOWANCE (PSIG)	2.0	2.0	2.0	2.0	2.0
DISCHARGE PRESSURE AT HIGH WATER LEVEL (PSIG)	7.2	7.2	7.2	7.2	7.2
OXYGEN REQUIREMENT FOR MEMBRANE AIR SCOUR					
SOR @ 20 DEG C (PPD)					
AA (DO = 2.0 MG/L)	342	563	1,019	1,576	2,685
MM (DO = 2.0 MG/L)	686	1,130	2,046	3,163	5,390
PEAK (DO = 0.5 MG/L)	704	1,159	2,096	3,240	5,522
MEMBRANE SCOUR AERATION					
CLEAN WATER OTE	12.6%	12.6%	12.6%	12.6%	12.6%
TOTAL AIR REQD (SCFM)	236	388	702	1,085	1,849
TOTAL AIR REQD (ICFM)	250	412	744	1,151	1,962
LOSS ALLOWANCE (PSIG)	2.0	2.0	2.0	2.0	2.0
DISCHARGE PRESSURE (PSIG)	7.2	7.2	7.2	7.2	7.2
BLOWER EFFICIENCY (%)	70%	70%	70%	70%	70%
TOTAL BLOWER HP REQD.	19	32	58	90	153
NUMBER OF BLOWERS					
DUTY	1	1	1	2	3
STANDBY	1	1	1	1	1
HORSEPOWER, EACH BLOWER	30	30	50	50	50
TOTAL FIRM BLOWER HP	30	30	50	100	150
SUPPLEMENTAL MIXING, EACH ANOXIC ZONE					
NUMBER OF MIXERS	1	1	1	1	1
TYPE OF MIXER	SUBMERGED PROPELLER	SUBMERGED PROPELLER	SUBMERGED PROPELLER	SUBMERGED PROPELLER	SUBMERGED PROPELLER
NAMEPLATE HP, EACH	2.5	2.5	2.5	2.5	2.5
HOLLOW FIBER MEMBRANE DESIGN					
NUMBER OF MEMBRANE RACKS	6	6	12	18	28
NUMBER OF MODULES PER RACK	40	40	40	40	40
NUMBER OF MODULES	240	240	480	720	1120
TOTAL MEMBRANE AREA (SF)	16,128	16,128	32,256	48,384	75,264
MEMBRANE FLUX RATE (GFD)					
AAF	3.4	5.7	5.7	6.1	6.7
MMF	4.7	7.8	8.0	8.6	9.1
MDF	6.1	10.4	10.8	11.9	11.9
ALLOWABLE MEMBRANE FLUX RATE (GFD)					
AAF	8	8	8	8	8
MMF	10	10	10	10	10
MDF	12	12	12	12	12
FLAT PLATE MEMBRANE DESIGN					
NUMBER OF MEMBRANE MODULES	2	4	10	12	18
NUMBER OF CARTRIDGES PER MODULE	8	8	8	8	8
NUMBER OF MEMBRANE CARTRIDGES	16	32	80	96	144
NUMBER OF PLATES PER CARTRIDGE	16	16	16	16	16
NUMBER OF MEMBRANE PLATES	256	512	1,280	1,536	2,304
TOTAL MEMBRANE AREA (SF)	7,245	14,490	36,224	43,469	65,203
MEMBRANE FLUX RATE (GFD)					

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AAF	7.6	6.4	5.1	6.8	7.8
MMF	10.4	8.7	7.1	9.6	10.5
MDF	13.6	11.5	9.6	13.2	13.7
ALLOWABLE MEMBRANE FLUX RATE (GFD)					
AAF	10	10	10	10	10
MMF	14	14	14	14	14
MDF	18	18	18	18	18
INTERNAL RECYCLE PUMPS					
NUMBER OF DUTY PUMPS (1 STANDBY PUMP)	1	1	1	1	2
TYPE OF PUMPS	CENTRIFUGAL	CENTRIFUGAL	CENTRIFUGAL	CENTRIFUGAL	CENTRIFUGAL
CAPACITY, EACH PUMP (GPM)	500	500	1500	1500	1500
TDH (FT)	22	22	22	22	22
PUMP HORSEPOWER, EACH PUMP	10	10	10	10	10
TOTAL CAPACITY (DUTY PUMPS), % OF AA FLOW	1301%	777%	1179%	731%	853%
TOTAL CAPACITY (DUTY PUMPS), % OF MM FLOW	959%	569%	842%	516%	632%
TOTAL CAPACITY (DUTY PUMPS), % OF MD FLOW	730%	431%	619%	375%	484%
WAS PUMPS					
NUMBER OF DUTY PUMPS (1 STANDBY PUMP)	1	1	1	2	2
TYPE OF PUMPS	CENTRIFUGAL	CENTRIFUGAL	CENTRIFUGAL	CENTRIFUGAL	CENTRIFUGAL
REQUIRED CAPACITY, EACH PUMP (GPM)	34	57	102	79	135
PUMP CAPACITY (GPM)	100	100	100	100	210
TDH (FT)	15	15	15	15	15
PUMP HORSEPOWER, EACH PUMP	2.5	2.5	2.5	2.5	2.5
VACUUM PUMPS					
NUMBER OF DUTY PUMPS (1 STANDBY PUMP)	1	1	1	2	2
TYPE OF PUMPS	SUCTION	SUCTION	SUCTION	SUCTION	SUCTION
REQUIRED CAPACITY, EACH PUMP (GPM)	69	116	242	200	310
PUMP CAPACITY, EACH (GPM)	210	210	325	325	325
TDH (FT)	15	15	15	15	15
PUMP HORSEPOWER, EACH PUMP	2.5	2.5	2.5	2.5	2.5
DISINFECTION SYSTEM - UV ALTERNATIVE					
TYPE	LOW-PRESSURE, HIGH-INTENSITY UV	LOW-PRESSURE, HIGH-INTENSITY UV	LOW-PRESSURE, HIGH-INTENSITY UV	LOW-PRESSURE, HIGH-INTENSITY UV	LOW-PRESSURE, HIGH-INTENSITY UV
NUMBER OF CHANNELS	2	2	2	2	2
BANKS PER CHANNEL	1	1	2	2	2
UV MODULES PER BANK	2	2	2	3	5
LAMPS PER MODULE	7	7	7	7	7
TOTAL NUMBER LAMPS	14	14	28	42	70
DESIGN TRANSMITTANCE (%)	65	65	65	65	65
DESIGN LAMP FOULING FACTOR	0.9	0.9	0.9	0.9	0.9
DESIGN LAMP AGING FACTOR	0.8	0.8	0.8	0.8	0.8
DESIGN LAMP LIFE, HOURS	10,000	10,000	10,000	10,000	10,000
MINIMUM UV DOSE (micWs/cm2)	100,000	100,000	100,000	100,000	100,000
DISINFECTION CAPACITY (MGD)	0.2	0.2	0.4	0.6	1.0
DISINFECTION SYSTEM - CHLORINE CONTACT ALTERNATIVE					
TYPE	12.5% NaOCl	12.5% NaOCl	12.5% NaOCl	12.5% NaOCl	12.5% NaOCl
DELIVERY SYSTEMS	METERING PUMPS	METERING PUMPS	METERING PUMPS	METERING PUMPS	METERING PUMPS
DESIGN DOSE (MG/L)	2.0	2.0	2.0	2.0	2.0
14-DAY STORAGE REQD. AT MM FLOW (GAL)	17	29	59	97	158
STORAGE PROVIDED (GAL)	55	55	110	110	165
CHLORINE CONTACT TANK	0.35	0.35	0.72	1.11	1.84
NUMBER OF BASINS	2	2	2	4	4
LENGTH, EACH (FT.)	15	15	15	15	15
WIDTH, EACH (FT.)	10	10	10	10	10
SIDE WATER DEPTH (FT.)	7	7	7	7	7
VOL REQ AT MM FLOWS, 60-MIN CONTACT (GAL)	3,128	5,269	10,693	17,434	28,469
VOL REQ AT PD FLOWS, 30-MIN CONTACT (GAL)	2,056	3,483	7,266	11,984	18,609
VOL PROVIDED (GAL)	15,708	15,708	15,708	31,416	31,416
SOLIDS HANDLING					
SLUDGE LOADINGS (PPD)					
AA	51	84	151	233	397
MM	104	171	308	475	811
SLUDGE LOADINGS (GPD) @ 1.5%					
AA	407	670	1,208	1,864	3,174
MM	829	1,364	2,460	3,797	6,480
SLUDGE HOLDING TANK					
NUMBER	1	1	1	2	2
DEPTH (FT.)	15	15	15	15	15
VOLUME, EACH (GAL)	20,000	20,000	20,000	20,000	20,000
VOLUME, TOTAL (GAL)	20,000	20,000	20,000	40,000	40,000
DAYS STORAGE AT MM FLOW	24.1	14.7	8.1	10.5	6.2
SLUDGE TANK AERATION	DIFFUSED AIR	DIFFUSED AIR	DIFFUSED AIR	DIFFUSED AIR	DIFFUSED AIR
OXYGEN REQUIREMENT					
BLOWER CAPACITY REQUIRED (SCFM)	78	78	146	203	203
MIXING REQUIREMENT (SCFM/KCF)	20	20	20	20	20
BLOWER CAPACITY REQUIRED (SCFM)	53	53	53	107	107
BLOWER CAPACITY (SCFM) - GOVERNED BY O2 REQ	350	350	350	350	350
BLOWER HORSEPOWER					
DUTY	10	10	10	15	20
STANDBY	10	10	10	15	20
SOLIDS TRANSFER PUMPING (8 HOURS/WEEK PRESS OPERATION)					
NUMBER OF PUMPS	1	1	1	1	1
TYPE OF PUMPS	PROGRESSIVE CAVITY	PROGRESSIVE CAVITY	PROGRESSIVE CAVITY	PROGRESSIVE CAVITY	PROGRESSIVE CAVITY
REQUIRED CAPACITY (GPM)	12	20	36	55	95
CAPACITY (GPM)	125	125	125	125	125
TDH (FT)	50	50	50	50	50
PUMP HORSEPOWER	5	5	5	5	5
AUXILIARY SYSTEMS					
PLANT WATER SYSTEM					

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PEAK SYSTEM DEMAND (GPM)					
STRAINER BACKWASH - INTERMITTENT	10	10	10	10	10
MISCELLANEOUS (HOSE BIBBS) - INTERMITTENT	20	20	20	20	20
STORAGE VOLUME (GAL)	6,000	6,000	6,000	6,000	6,000
PLANT WATER PUMPS					
TYPE	VERTICAL TURBINE	VERTICAL TURBINE	VERTICAL TURBINE	VERTICAL TURBINE	VERTICAL TURBINE
DUTY	1	1	1	1	1
STANDBY	1	1	1	1	1
TOTAL	2	2	2	2	2
CAPACITY, EACH (GPM)	50	50	50	50	50
TDH (FT)	200	200	200	200	200
NAMEPLATE HP, EACH	5	5	5	5	5
SYSTEM PRESSURE (PSIG)	60-80	60-80	60-80	60-80	60-80
HYDROPNEUMATIC TANK					
VOLUME (GAL)	317	317	317	317	317
CHLORINATION SYSTEM					
TYPE	12.5% NaOCl	12.5% NaOCl	12.5% NaOCl	12.5% NaOCl	12.5% NaOCl
TYPICAL DOSE (MG/L)	2-10	2-10	2-10	2-10	2-10
FEED	METERING PUMPS	METERING PUMPS	METERING PUMPS	METERING PUMPS	METERING PUMPS
YARD PUMP STATION					
TYPE OF PUMPS	SUBMERSIBLE	SUBMERSIBLE	SUBMERSIBLE	SUBMERSIBLE	SUBMERSIBLE
NUMBER					
DUTY	1	1	1	1	1
STANDBY	1	1	1	1	1
TOTAL	2	2	2	2	2
CAPACITY, EACH (GPM) - TWO PUMPS RUNNING	300	300	300	300	300
TDH (FT)	41	41	41	41	41
NAMEPLATE HP, EACH	7.5	7.5	7.5	7.5	7.5
STANDBY POWER					
TYPE	DIESEL GENSET	DIESEL GENSET	DIESEL GENSET	DIESEL GENSET	DIESEL GENSET
CAPACITY (kW)	135	135	135	275	275
FUEL STORAGE CAPACITY (GAL)	1000	1000	1000	1000	1000
FUEL TANK RUN TIME (HOURS)	100	100	100	50	50
FLOW MEASUREMENT					
INFLUENT					
TYPE	MAGNETIC	MAGNETIC	MAGNETIC	MAGNETIC	MAGNETIC
SIZE (IN.)	10	10	10	10	10
NUMBER	1	1	1	1	1
RANGE (GPM)	0-4000	0-4000	0-4000	0-4000	0-4000
EFFLUENT					
TYPE	MAGNETIC	MAGNETIC	MAGNETIC	MAGNETIC	MAGNETIC
SIZE (IN.)	10	10	10	10	10
NUMBER	1	1	1	1	1
RANGE (GPM)	0-4000	0-4000	0-4000	0-4000	0-4000
SLUDGE					
RAS/WAS FLOW					
TYPE	MAGNETIC	MAGNETIC	MAGNETIC	MAGNETIC	MAGNETIC
NUMBER	2	2	2	2	2
SIZE (IN.)	6	6	6	6	6
RANGE (GPM)	0-1200	0-1200	0-1200	0-1200	0-1200
YARD PUMP STATION					
TYPE	MAGNETIC	MAGNETIC	MAGNETIC	MAGNETIC	MAGNETIC
NUMBER	1	1	1	1	1
SIZE (IN.)	4	4	4	4	4
RANGE (GPM)	0-800	0-800	0-800	0-800	0-800

APPENDIX L.
HYDROGEOLOGIC INFILTRATION STUDY – REPORT

October 16, 2003
HWA Project No. 2003-042-22

TetraTech/KCM, Inc.
1917 First Avenue
Seattle, WA 98101

Attention: Alex Chen

Subject: **PRELIMINARY INFILTRATION EVALUATION**
FREELAND COMPREHENSIVE SEWER PLAN
FREELAND, WASHINGTON

Dear Mr. Chen:

HWA GeoSciences Inc. (HWA) was contracted by Tetra Tech/KCM, on behalf of Island County to perform a preliminary infiltration evaluation at three sites near Freeland, Island County, Washington. HWA's previous Wastewater Infiltration Feasibility Study provided a general evaluation of infiltration potential over the area of interest (an approximately three mile radius around Freeland) based on review of existing geologic and hydrogeologic data. The scope of work for the preliminary infiltration evaluation included:

- Plan and conduct a preliminary subsurface investigation to provide information relative to soil, ground water, and other geologic conditions at selected sites
- Monitor backhoe test pits to depths of up to 17 feet below grade, collect soil samples
- Conduct laboratory soil testing for natural moisture and grain size analysis
- Evaluate infiltration feasibility at the sites, and provide preliminary infiltration rates based on grain size analyses and site conditions
- Prepare a letter report containing results of our investigation, including descriptions of surface and subsurface conditions and a site plan showing approximate exploration locations.

This report describes the results of the site investigation.

SITE DESCRIPTION

The three sites were selected based on the results of HWA's Wastewater Infiltration Feasibility Study and input from Tetra Tech/KCM and Island County. Figure 1 shows the site vicinity map. Exploration locations are shown on Figures 2 through 4 and are listed below:

- Fletcher & Pennau Properties, Sections 10, 15 and 16, T29N R2E
- Nolan/Benbow Tree Farm Site, Section 5, T29N R2E, Section 32, T30N R2E
- Holmes Harbor Development, Section 4, T29N R2E
- Sievers Property, Section 12, T29N R2E

AREA GEOLOGY

Major stratigraphic units mapped in the area of interest include recessional outwash/meltwater deposits and Vashon till.

Vashon Outwash/Meltwater Deposits

This unit can consist of both Vashon advance outwash and/or recessional deposits. These units typically contain stratified sand and gravels, with variable silt content and some silt layers deposited by meltwater flowing from the advancing or retreating ice margins. Typically, meltwater/outwash deposits exhibit moderate to high permeabilities and infiltration rates depending on silt content.

Vashon Till

Vashon Till, commonly referred to as "hardpan" or "boulder clay", consists of very dense, massive, unsorted deposits of sand, gravel, and boulders firmly encased in a compact matrix of silt and clay. Occasional sand and gravel lenses may be present. Glacial till's compact nature is the result of it being deposited beneath a heavy mass of glacial ice.

Till does not provide a favorable infiltration medium. Till acts as an aquitard that inhibits the flow of ground water, perches water on top of it in the overlying recessional outwash, and also confines water below it in the advance outwash. In general, the permeability of till ranges from low in weathered surficial deposits to relatively impermeable in very dense non-weathered materials.

SITE EXPLORATIONS

The objective of this study was to identify suitable infiltration receptor soils at the selected locations. Explorations in three general areas were conducted on two separate days. On August 13, 2003, and September 30, 2003, HWA monitored the excavation of 21 backhoe test pits. Island County Public Works Department provided a rubber-tire backhoe and operator. Test pit logs are included in Appendix A.

In order to maximize coverage of the sites in a limited time, the level of exploration (number, spacing, and depth of explorations) was relatively sparse, and can be considered a preliminary or screening level investigation.

Ground water, where encountered, is noted on the test pit logs. We did encounter soil mottling in several test pits, indicating the likelihood of seasonally-saturated or perched water conditions. Perched ground water occurs when water percolating downward through the soil encounters less permeable soil such as silt, clay, and till, and temporarily mounds, slowly spreading laterally. Depending on depth and lateral extent, perched ground water and saturated soils may significantly reduce infiltration rates. HWA conducted this study during summer under near drought conditions, and soil moisture/ground water conditions will likely change in response to rainfall, time of year, and other factors.

LABORATORY TESTING

Laboratory tests were conducted on selected soil samples to characterize relevant properties of the on-site soils. Laboratory testing included determination of moisture content and grain size distribution. All testing was conducted in accordance with appropriate ASTM standards. The test results and a discussion of laboratory test methodology are presented in Appendix B.

INFILTRATION ESTIMATES

We estimated hydraulic conductivity (K) using grain size distribution data for selected samples. Grain size distribution analyses were performed on homogenized samples. In many of these samples, a high degree of horizontal stratification was present. Horizontal layering of fine and coarse grained sediments is common in alluvial deposits, due to the depositional environment (i.e., streams, rivers, overbank deposits, etc.). Because infiltration depends primarily on vertical hydraulic conductivity, these estimates are biased, and require some correction factor. Corrections were applied according to Ecology recommendations and literature values, depending on the analysis. We used several interpretive methods, suitable for granular soils:

- Long term (corrected) infiltration rates based on USDA soil textural classifications per the Ecology *Stormwater Management Manual for Western Washington* (Ecology 2001). These values are based on Ecology Short term infiltration rates with a correction factor of 4.

- Estimated long-term infiltration rates that have been correlated to soil gradation parameters using the ASTM soil gradation procedure. These values have been corrected by a factor of 4 due to the presence of mottling or layering (Ecology 2001).

- Hazen formula, K (cm/sec) = D_{10}^2 (mm) (Powers, 1992). D_n refers to the grain size of which n% of the soil particles are finer (n% passing). This method is designed for saturated, uniform material, and is not directly applicable to infiltration, although provides a good correlation with the Ecology methods when adjusted by a factor of 10 to account for stratification. Literature values indicate stratified soils can have vertical hydraulic conductivities one or more orders of magnitude lower than their horizontal hydraulic conductivities.

Hydraulic conductivity estimates of selected soil samples are summarized below:

Test Pit	Location	Depth (feet)	USCS Soil Class	USDA Soil Class	Long-Term Ecology USDA Rate (in/hr)	Long-Term Ecology ASTM Rate (in/hr)	Hazen /10 (in/hr)
TP1	North Fletcher	1.0 - 1.3	SM	Sandy loam	0.25		
TP2	North Fletcher	1.0 - 1.3	ML	Silt Loam			
TP4	South Fletcher	8.5 - 8.8	SM	Loamy sand	0.5	0.5	1.2
TP5	South Fletcher	2.0 - 2.3	SM	Loamy sand	0.5	0.5	1.2
TP6	South Fletcher	10.5 - 10.8	SP	Sand	2	0.5	2.0
TP7	South Nolan	10.0 - 10.3	SM	Sandy loam	0.25		
TP10	North Nolan	5.5 - 5.8	SP	Sand	2	0.5	1.4
TP13	South Fletcher	7.0 - 8.0	SM	Loamy sand	0.5	0.2	0.4
TP16	South Nolan	4.0 - 5.0	SW-SM	Loamy sand	0.5	0.5	1.2
TP17	South Nolan	8.0 - 9.0	SM	Sandy loam	0.25	0.2	0.4
TP19	Holmes Harbor	4.0 - 5.0	SM	Sandy loam	0.25		

Blank - analysis not appropriate for soil type

A caution on using the values in this table: in most cases, the most granular material from a test pit was selected for grain size analysis. Infiltration rate is controlled by the least permeable layer, and subject to other limitations such as ground water mounding, or surfacing (daylighting). Infiltration rates for fine grained soils (silts, clays and other soils

with >50% fines) can not be reliably estimated based on grain size distribution, and require other methods, such as laboratory permeability testing or in situ pilot testing.

Estimation of infiltration capacity per area is based on Darcy's law, Q=KiA, where:

Q = discharge (ft^3/hr)
K = infiltration rate (ft/hr)
I = gradient = 1
a = area (ft^2)

Based on this relationship 300,000 gallons per day could be infiltrated at a rate of 1 inch/hour over 1 acre, 0.5 inch/hour over 2 acres, 0.1 inch/hour over 10 acres, etc.

DISCUSSION

Fletcher/Pennau property

Five test pits were excavated at the Fletcher property on August 13, 2003 (TP1 - TP5). Follow-up explorations on September 30, 2003 included two test pits at the adjacent Pennau property (TP11, TP12) and one pit at the Fletcher property (TP13). Figure 2 shows the approximate locations of the explorations. Latitude and longitude, obtained from a portable GPS receiver (accuracy +/- 50 feet) are shown on the test pit logs.

At the northern portion of the Fletcher property (TP1, TP2, and TP3) soils encountered consisted mostly of silts, clay and silty sands, to depths of up to ten feet. Based on these three explorations, reported seasonal ponding, and presence of wetlands vegetation, this area is not considered to have a high potential for infiltration. Seasonal slow infiltration at agronomic or slightly higher rates may be feasible in this area.

TP11, at the southwestern portion of the Pennau property, encountered silty sands over Vashon till. This area may also be suitable for slow infiltration over a large area (up to 300 acres).

Test pits TP4, TP6, TP12 and TP13, at the southeastern portion of the Fletcher property and western Pennau property, encountered clean to silty sands at depths of six to eight feet. TP5 was terminated at four feet, therefore the occurrence, depth, and nature of this sand, if present, is undetermined at this location. Soil overlying the sand consisted predominantly of relatively low permeability silts and clays. Ground water was encountered in TP12 and TP13 at 11 to 12 feet depth. This likely represents the seasonal low ground water level.

This area appears to have some potential for rapid infiltration, assuming a design that penetrates through the surficial low permeability soils (e.g., trenches, gravel-less infiltration chambers, or ponds). Limiting factors include depth to ground water, which was three to six feet below the top of the sandy receptor in TP12 and TP13, at the presumed seasonal low, and potential surface water impacts of infiltration (i.e., effects on nearby wetlands and ponds). For planning level purposes, we estimate infiltration rates of 0.1 to 0.2 inches per hour, or five to ten acres of infiltration surface (pond bottom surface) for 300,000 gallons/day.

Nolan/Benbow Tree Farm Property

Four test pits were excavated at this site on August 13, 2003 (TP7 - TP10). Follow-up explorations on September 30, 2003 included five additional test pits (TP14 - TP18). Figure 3 shows the approximate location of the explorations.

The test pit at the northern end of the site (TP10) encountered silt from the surface to six feet, underlain by a relatively clean sand (<4% fines) to at least seven feet depth. This area may be suitable for potential deep rapid infiltration, but was not investigated further due to the distance from Freeland. TP9 encountered silt to a depth of six feet. This area may be suitable for slow infiltration over a large area (up to 300 acres).

TP7 at the southern portion of the tree farm property was located near a gravel pit. TP7 encountered stratified gravels at the surface to a depth of ten feet, with silty sands below to at least 17 feet. TP17 and TP18, located north and south of the gravel pit and TP7, encountered similar sands and gravels, indicting this deposit extends over at least 20 acres. The gravel pit near TP7 provides an excellent exposure of the very stratified and cross-bedded sand, gravel and fine silty sand layers. For planning level purposes, we estimate infiltration rates of 0.1 to 0.2 inches per hour, or five to ten acres of infiltration surface for 300,000 gallons/day.

TP8, TP14, TP15 and TP16, north and west of the gravel pit, encountered silt and silty sands (weathered till) over very dense glacial till, at depths of six to eight feet. This area may be suitable for slow infiltration over a large area (up to 300 acres).

Holmes Harbor Property

Three test pits were excavated at this site on September 30, 2003 (TP19, TP20 and TP21). Figure 4 shows the approximate location of the explorations. These test pits encountered dense silty sands (weathered till) over very dense glacial till, at depths of five to six feet. This area may be suitable for slow infiltration over a large area (up to 300 acres).

Sievers Property

No test pit explorations were conducted at this site, although a "gravel" pit was visited. Materials in the pit wall consisted of stratified layers of sandy gravel, laminated very fine sand, and silts. The bulk of material exposed in the pit wall was relatively fine grained (silt to fine sand).

Based on the visual classification of soils in the pit, and the assumption that these soils represent the coarsest, or most permeable deposits at this site, this site does not appear favorable for rapid infiltration, but may be feasible for slow infiltration over large areas. Additional explorations would be needed to confirm this

CONCLUSIONS

Of the sites investigated, the following areas had the highest potential for development of rapid infiltration facilities:

- Fletcher/Pennau property, southern portion
- Nolan/Benbow Tree Farm, southern portion

Estimated infiltration rates shown above are based on soil grain size distributions of a few samples. For design and facility sizing, additional testing and evaluation are recommended, as described below.

Once a site is selected, infiltration pilot testing would be needed to size the facility for design flows. The pilot test typically entails an 8-24 hour period of infiltration at rates scaled to design flows, into an approximately 100 square-foot pit or 8 foot diameter ring excavated to the receptor soils. For surface infiltration, several short term tests would be performed directly at the ground surface. Discharge and water levels are monitored and long term infiltration rates can be estimated.

Additional test pits are also recommended to confirm lateral extent, quality, and depth of receptor soils. Borings and monitoring wells should be installed to establish ground water levels, gradients, and quality. Seasonal ground water changes should be evaluated, although project timing may not allow for long term monitoring. Monitoring during one wet season at a minimum is recommended. Aquifer hydraulic properties (e.g., horizontal hydraulic conductivity) should be evaluated, to evaluate the transport of infiltrated water once it reaches the saturated zone. This is typically achieved through pumping tests. A ground water mounding analysis and modeling to predict impacts to nearby surface water features should also be performed. Other information needed includes a site survey with

topographic control, evaluation of potential ground water and surface water receptors, and determination/negotiation of permitting requirements such as the need for background and operational ground water quality monitoring.

LIMITATIONS

The conclusions expressed by HWA are based solely on material referenced in this report. Within the limitations of scope, schedule and budget, HWA attempted to execute these services in accordance with generally accepted professional principles and practices in the area at the time the report was prepared. No warranty, expressed or implied, is made. Experience has shown that subsurface soil and ground water conditions can vary significantly over small distances. HWA's findings and conclusions must not be considered as scientific or engineering certainties, but rather as our professional opinion concerning the significance of the limited data gathered and interpreted during the course of the assessment.

REFERENCES

Powers, J. Patrick, *Construction Dewatering, New Methods and Applications,* John Wiley and Sons, Inc., New York, 1992.

Washington State Department of Ecology, August 2001, *Stormwater Management Manual for Western Washington,* Water Quality Program, Publication Numbers 99-11 through 99-15.

We appreciate the opportunity to provide our services. Please feel free to call us if you have any questions or need more information.

Sincerely,

HWA GEOSCIENCES INC.

Greg W. Emens, P.G.
Hydrogeologist

Arnie Sugar, P.G.
Senior Environmental Geologist

APPENDIX A

TEST PIT LOGS

APPENDIX B

LABORATORY TESTING

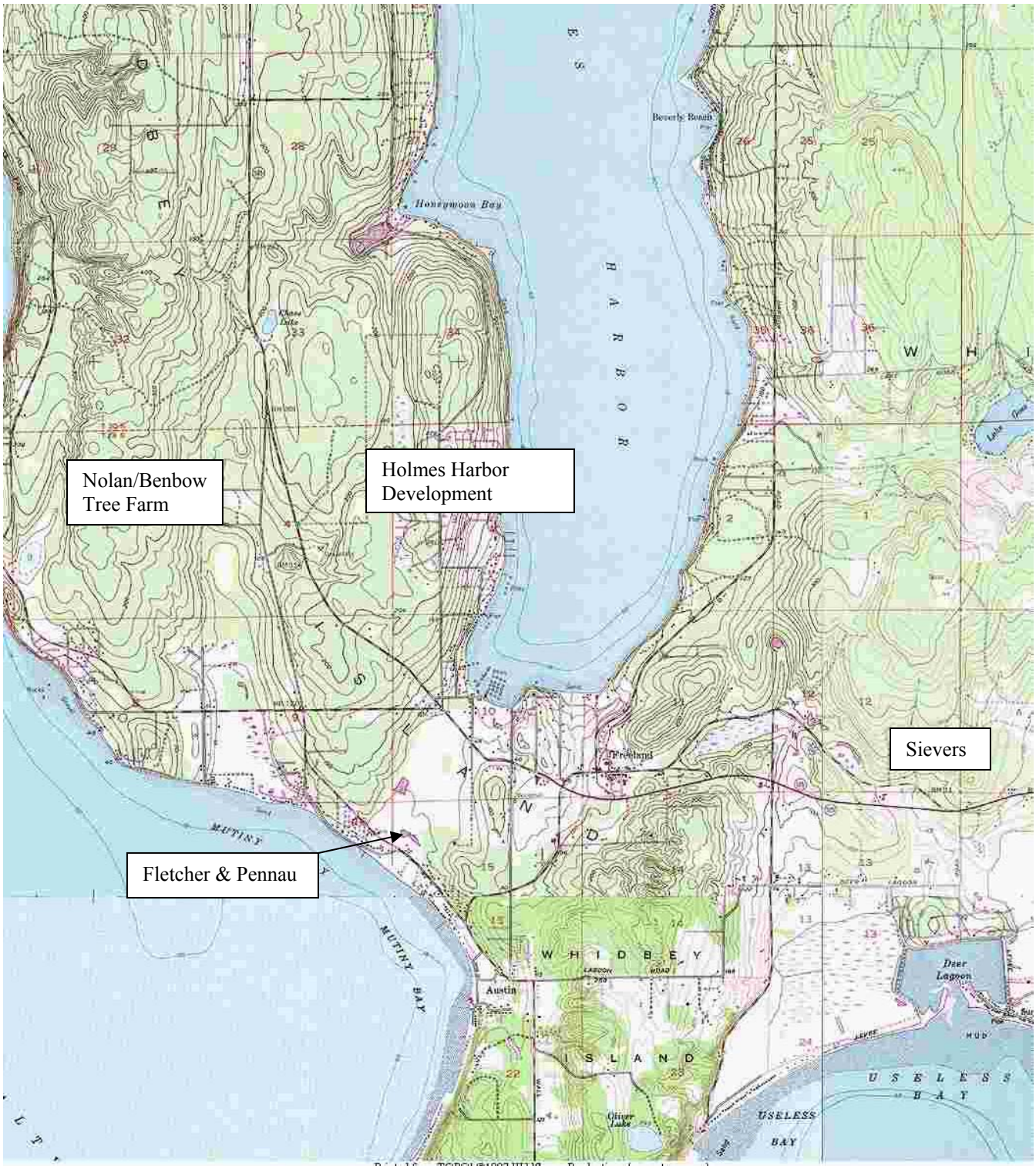
Representative soil samples obtained from the borings were returned to the HWA laboratory for further examination and testing. Laboratory tests were conducted on selected soil samples to characterize certain properties of the on-site soils. Laboratory tests, as described below, included determination grain size distribution.

MOISTURE CONTENT

The natural moisture contents of selected samples were determined in general accordance with ASTM D 2216. The results are plotted at the sampled intervals on the exploration log as appropriate.

GRAIN SIZE ANALYSIS

The grain size distribution of selected soil samples was determined in general accordance with ASTM D 422. Grain size distribution curves for the tested samples are presented in figures B-1 through B-4.

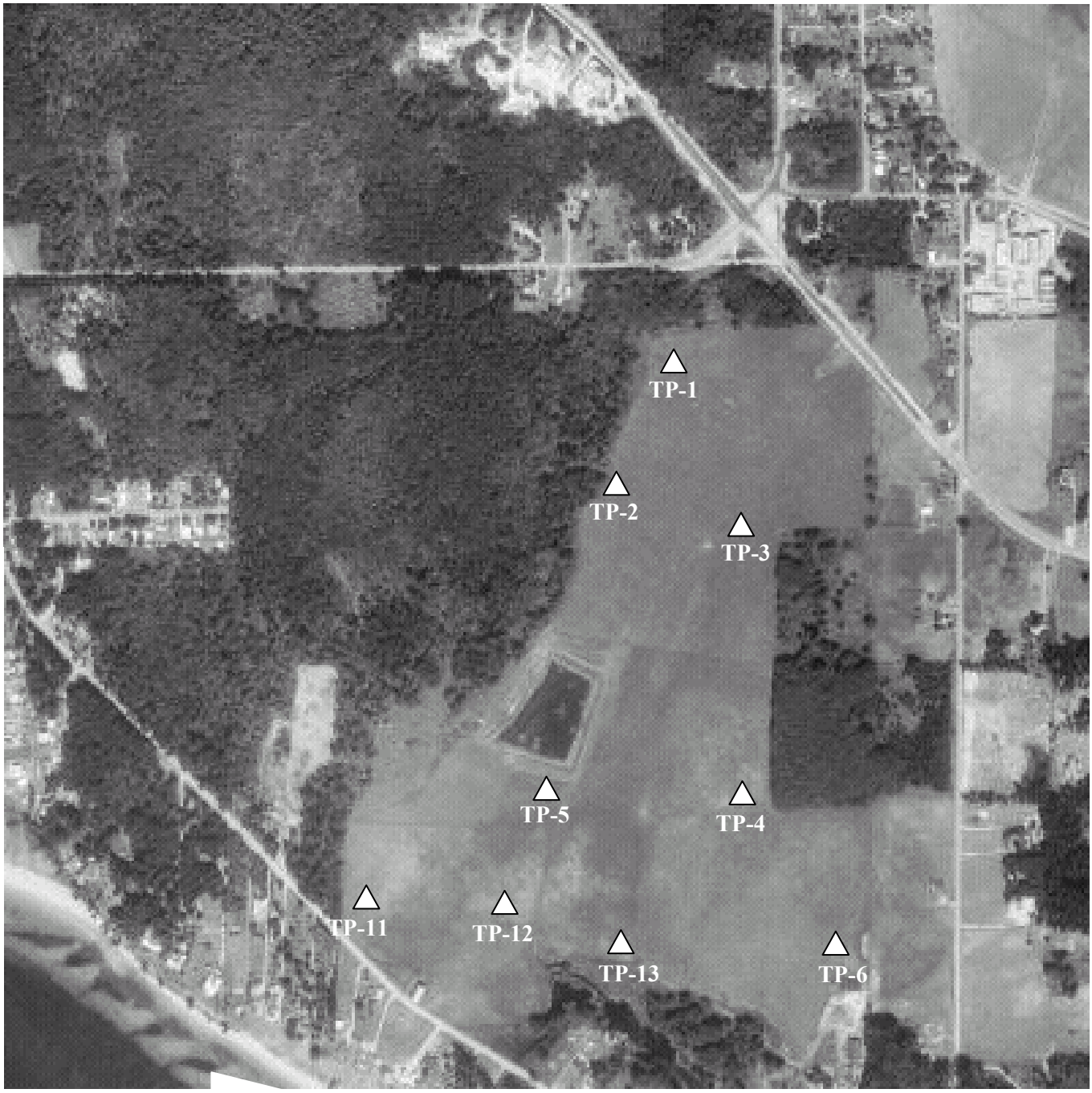


HWA GEOSCIENCES INC.

Freeland Comprehensive
Sewer Plan
Freeland, Washington

Location Map

PROJECT NO.: 2003-042 FIGURE: 1



Legend

△ Test Pit Approximate Location

HWA GEOSCIENCES INC.

Freeland Comprehensive
Sewer Plan
Freeland, Washington

Fletcher/Pennau Property

PROJECT NO.: 2003-042 FIGURE: 2

Legend

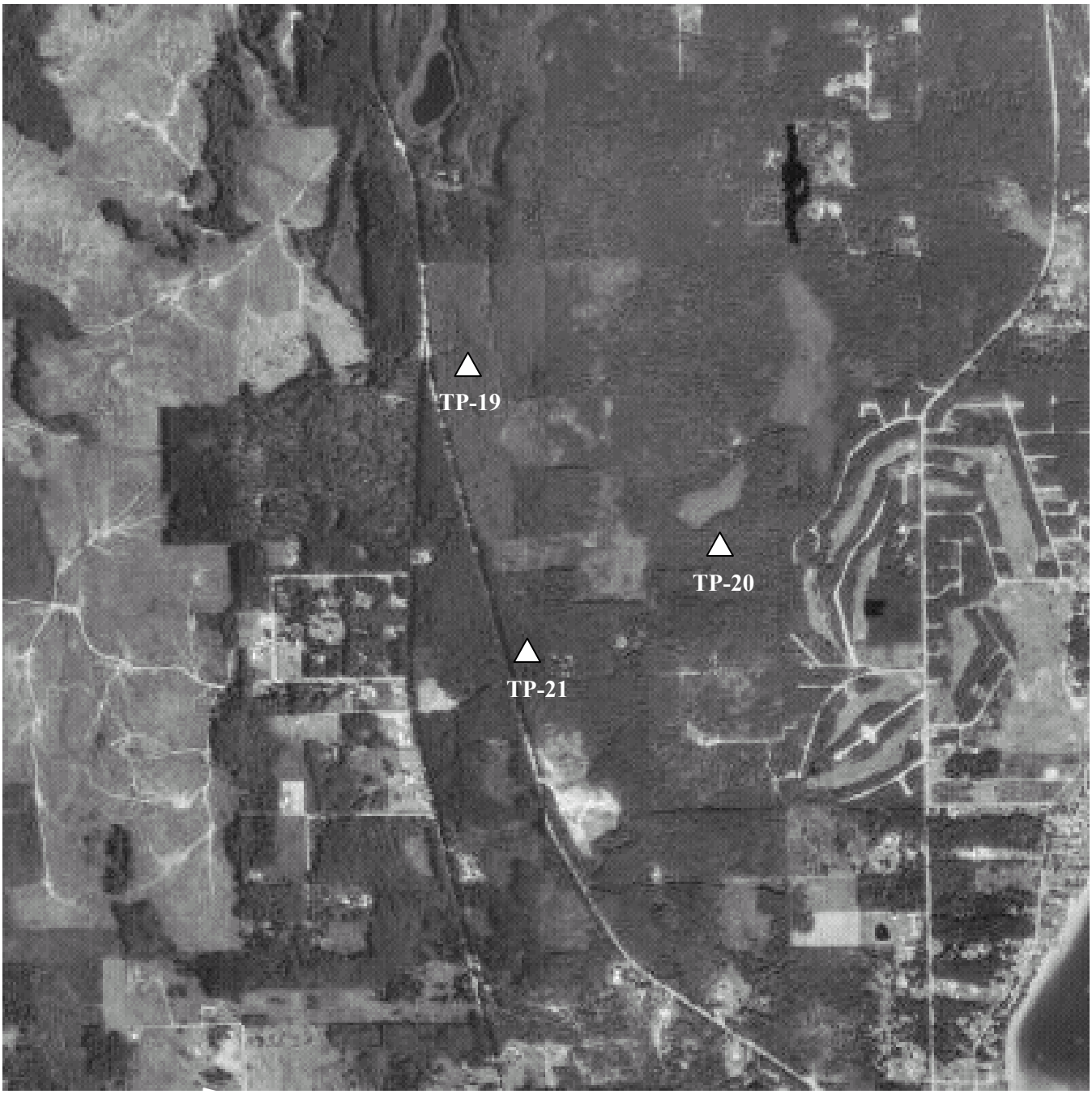
△ Test Pit Approximate Location

HWA GEOSCIENCES INC.

Freeland Comprehensive
Sewer Plan
Freeland, Washington

Tree Farm Property

PROJECT NO.: 2003-042 FIGURE: 3



Legend

△ Test Pit Approximate Location

HWA GEOSCIENCES INC.

Freeland Comprehensive
Sewer Plan
Freeland, Washington

Holmes Harbor Property

PROJECT NO.: 2003-042 FIGURE: 4

RELATIVE DENSITY OR CONSISTENCY VERSUS SPT N-VALUE

COHESIONLESS SOILS			COHESIVE SOILS		
Density	N (blows/ft)	Approximate Relative Density(%)	Consistency	N (blows/ft)	Approximate Undrained Shear Strength (psf)
Very Loose	0 to 4	0 - 15	Very Soft	0 to 2	<250
Loose	4 to 10	15 - 35	Soft	2 to 4	250 - 500
Medium Dense	10 to 30	35 - 65	Medium Stiff	4 to 8	500 - 1000
Dense	30 to 50	65 - 85	Stiff	8 to 15	1000 - 2000
Very Dense	over 50	85 - 100	Very Stiff	15 to 30	2000 - 4000
			Hard	over 30	>4000

USCS SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			GROUP DESCRIPTIONS	
Coarse Grained Soils	Gravel and Gravelly Soils	Clean Gravel (little or no fines)	GW	Well-graded GRAVEL
			GP	Poorly-graded GRAVEL
	More than 50% of Coarse Fraction Retained on No. 4 Sieve	Gravel with Fines (appreciable amount of fines)	GM	Silty GRAVEL
			GC	Clayey GRAVEL
More than 50% Retained on No. 200 Sieve Size	Sand and Sandy Soils	Clean Sand (little or no fines)	SW	Well-graded SAND
			SP	Poorly-graded SAND
	50% or More of Coarse Fraction Passing No. 4 Sieve	Sand with Fines (appreciable amount of fines)	SM	Silty SAND
			SC	Clayey SAND
Fine Grained Soils	Silt and Clay	Liquid Limit Less than 50%	ML	SILT
			CL	Lean CLAY
			OL	Organic SILT/Organic CLAY
50% or More Passing No. 200 Sieve Size	Silt and Clay	Liquid Limit 50% or More	MH	Elastic SILT
			CH	Fat CLAY
			OH	Organic SILT/Organic CLAY
Highly Organic Soils			PT	PEAT

TEST SYMBOLS

%F	Percent Fines	
AL	Atterberg Limits:	PL = Plastic Limit LL = Liquid Limit
CBR	California Bearing Ratio	
CN	Consolidation	
DD	Dry Density (pcf)	
DS	Direct Shear	
GS	Grain Size Distribution	
K	Permeability	
MD	Moisture/Density Relationship (Proctor)	
MR	Resilient Modulus	
PID	Photoionization Device Reading	
PP	Pocket Penetrometer Approx. Compressive Strength (tsf)	
SG	Specific Gravity	
TC	Triaxial Compression	
TV	Torvane Approx. Shear Strength (tsf)	
UC	Unconfined Compression	

SAMPLE TYPE SYMBOLS

- 2.0" OD Split Spoon (SPT) (140 lb. hammer with 30 in. drop)
- Shelby Tube
- 3-1/4" OD Split Spoon with Brass Rings
- Small Bag Sample
- Large Bag (Bulk) Sample
- Core Run
- Non-standard Penetration Test (3.0" OD split spoon)

GROUNDWATER SYMBOLS

- Groundwater Level (measured at time of drilling)
- Groundwater Level (measured in well or open hole after water level stabilized)

COMPONENT DEFINITIONS

COMPONENT	SIZE RANGE
Boulders	Larger than 12 in
Cobbles	3 in to 12 in
Gravel	3 in to No 4 (4.5mm)
Coarse gravel	3 in to 3/4 in
Fine gravel	3/4 in to No 4 (4.5mm)
Sand	No. 4 (4.5 mm) to No. 200 (0.074 mm)
Coarse sand	No. 4 (4.5 mm) to No. 10 (2.0 mm)
Medium sand	No. 10 (2.0 mm) to No. 40 (0.42 mm)
Fine sand	No. 40 (0.42 mm) to No. 200 (0.074 mm)
Silt and Clay	Smaller than No. 200 (0.074mm)

COMPONENT PROPORTIONS

PROPORTION RANGE	DESCRIPTIVE TERMS
< 5%	Clean
5 - 12%	Slightly (Clayey, Silty, Sandy)
12 - 30%	Clayey, Silty, Sandy, Gravelly
30 - 50%	Very (Clayey, Silty, Sandy, Gravelly)
Components are arranged in order of increasing quantities.	

NOTES: Soil classifications presented on exploration logs are based on visual and laboratory observation. Soil descriptions are presented in the following general order:

Density/consistency, color, modifier (if any) GROUP NAME, additions to group name (if any), moisture content. Proportion, gradation, and angularity of constituents, additional comments. (GEOLOGIC INTERPRETATION)

Please refer to the discussion in the report text as well as the exploration logs for a more complete description of subsurface conditions.

MOISTURE CONTENT

DRY	Absence of moisture, dusty, dry to the touch.
MOIST	Damp but no visible water.
WET	Visible free water, usually soil is below water table.

HWA GEOSCIENCES INC.

HYDROGEOLOGICAL EVALUATION
WASTEWATER INFILTRATION FEASIBILITY
FREELAND, WASHINGTON

LEGEND OF TERMS AND SYMBOLS USED ON EXPLORATION LOGS

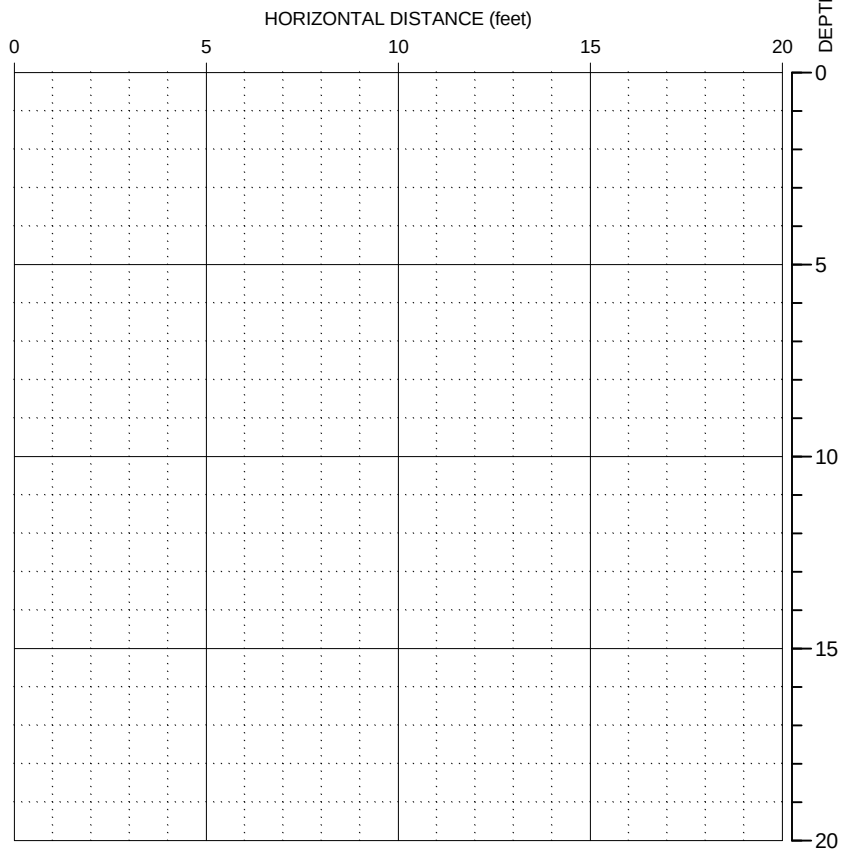
PROJECT NO.: 2003-042 FIGURE: 1

EXCAVATION COMPANY: Island County
EXCAVATING EQUIPMENT: JD 410G Backhoe
SURFACE ELEVATION: ± Feet

LOCATION: 48.01318, 122.54633
DATE COMPLETED: 8/13/03
LOGGED BY: G. Emens

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0		ML	Brownish gray, silt with organics (roots), fine sand and occasional sub-angular to rounded gravel, dry.		1			
		SM	Light gray, fine to medium, silty sand with trace fine gravel, FeOx staining, friable, dry.		2	8		
			Becomes moist.					
5			Dense, moist to wet.					
10								
15								
20								

SKETCH OF SIDE OF PIT



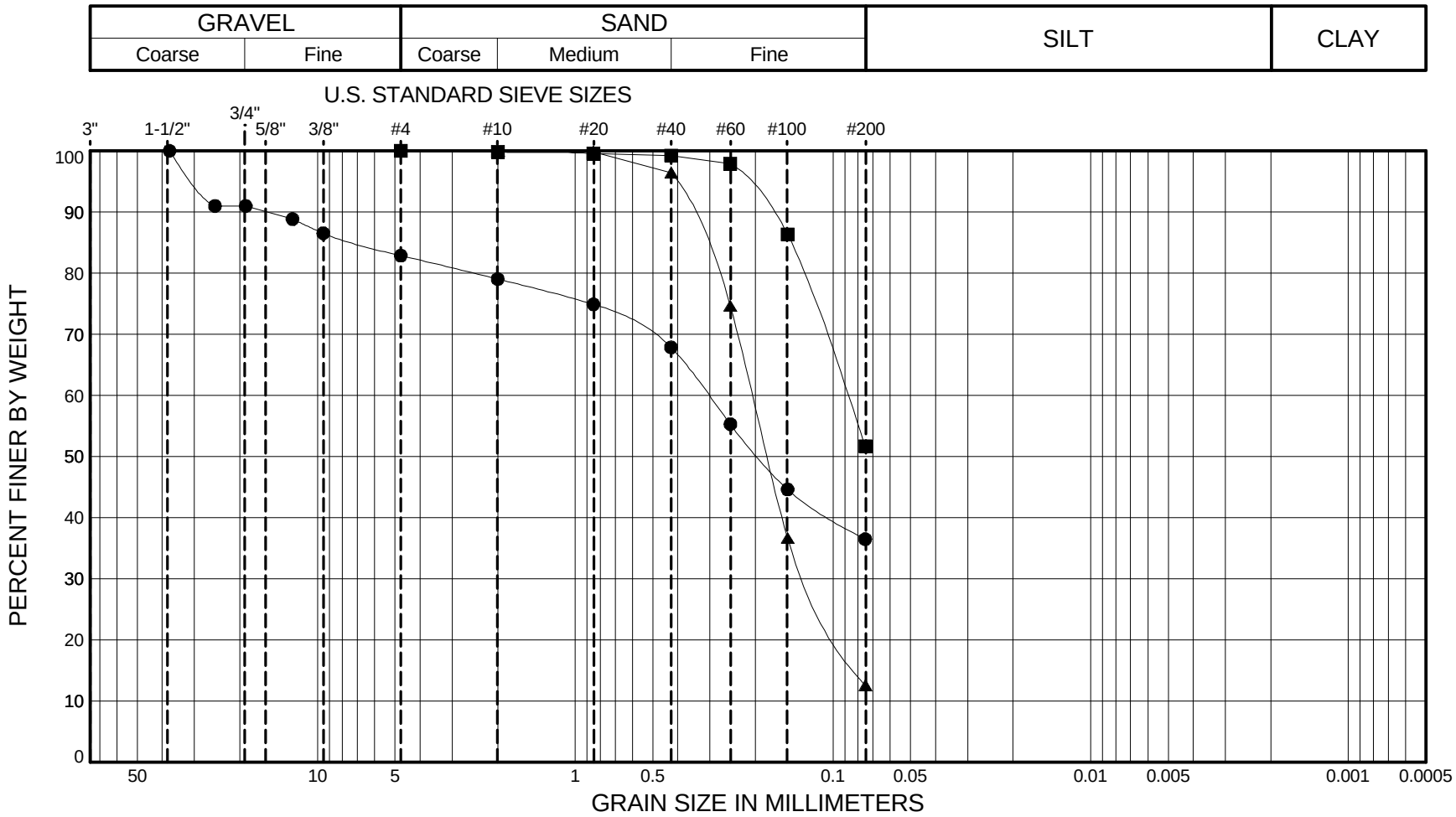
NOTE: For a proper understanding of the nature of subsurface conditions, this exploration log should be read in conjunction with the text of the geotechnical report. This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

HYDROGEOLOGICAL EVALUATION
WASTEWATER INFILTRATION FEASIBILITY
FREELAND, WASHINGTON

LOG OF TEST PIT
TP- 1

PROJECT NO.: 2003-042 FIGURE: 2



SYMBOL	SAMPLE		DEPTH (ft)	CLASSIFICATION OF SOIL- ASTM D2487 Group Symbol and Name	% MC	LL	PL	PI	Gravel %	Sand %	Fines %
●	TP- 1	2	1.0 - 1.3	(SM) light yellowish-brown, silty SAND with gravel	8				17.1	46.4	36.5
■	TP- 2	2	1.0 - 1.3	(ML) light yellowish-brown, sandy SILT	8				0.0	48.3	51.7
▲	TP- 4	1	8.5 - 8.8	(SM) olive-brown, silty SAND	14				0.0	87.5	12.5

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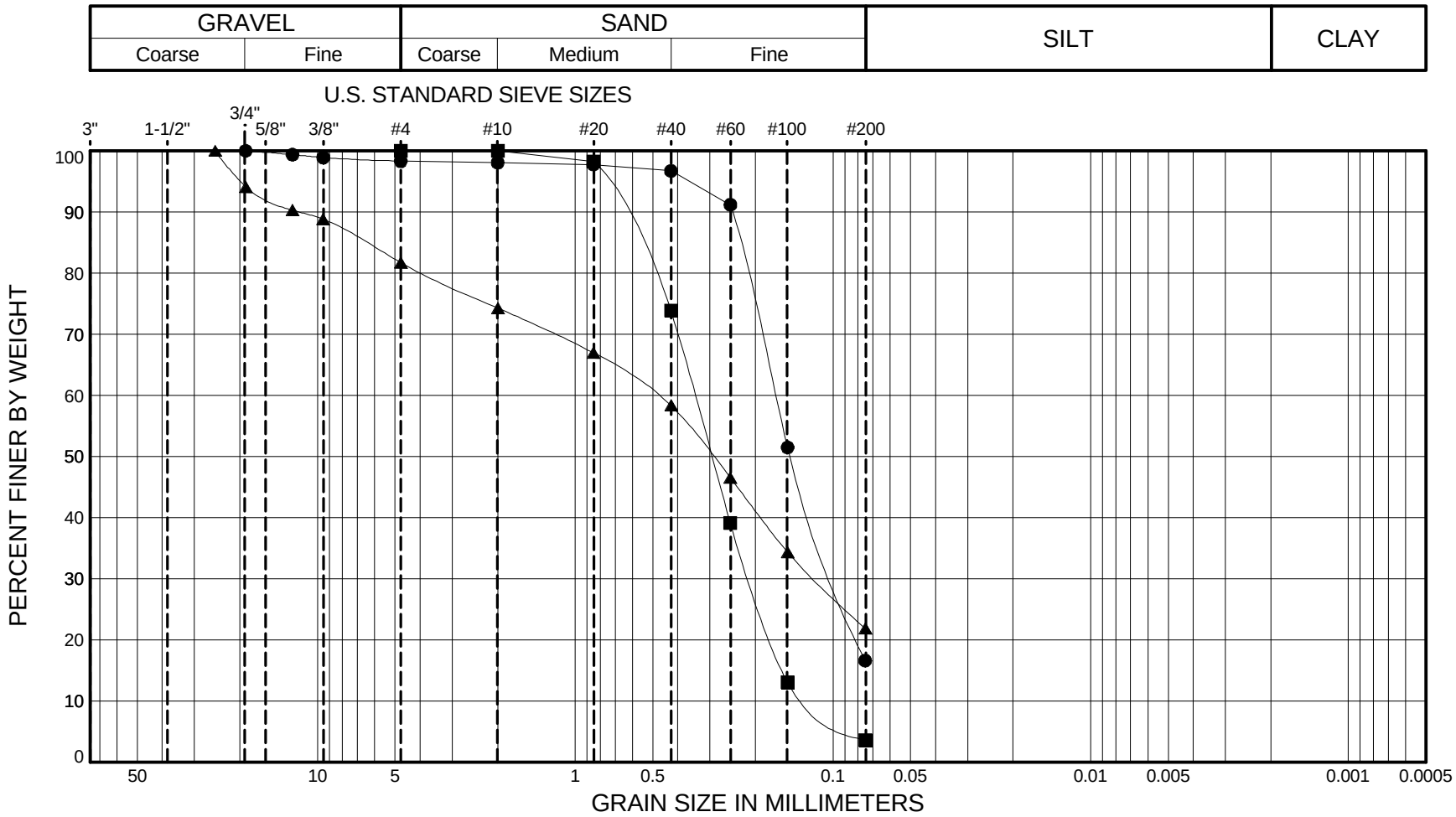
HYDROGEOLOGICAL EVALUATION
WASTEWATER INFILTRATION FEASIBILITY
FREELAND, WASHINGTON

PARTICLE-SIZE ANALYSIS
OF SOILS
METHOD ASTM D422

PROJECT NO.: 2003-042 FIGURE: B-1



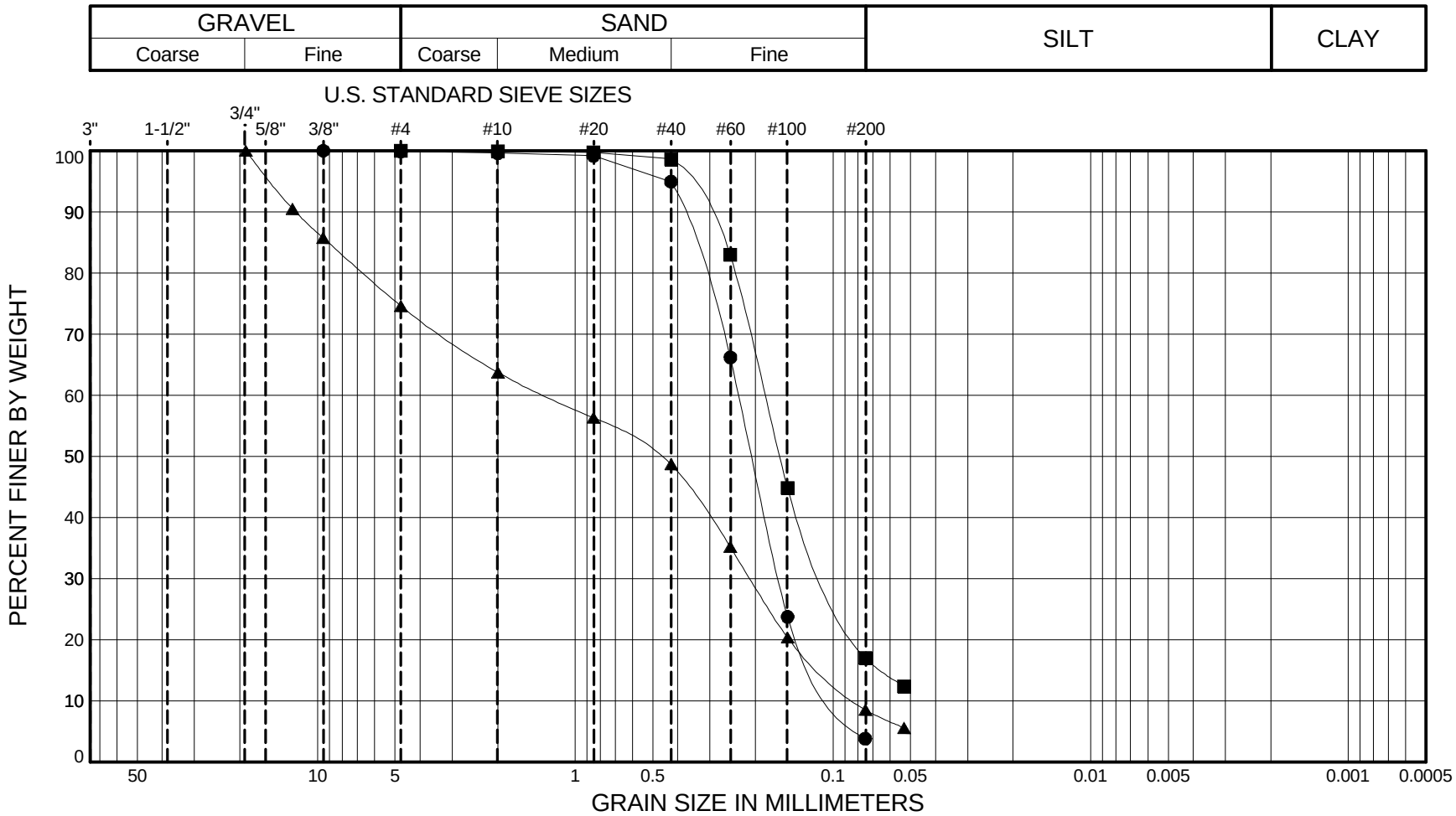
SYMBOL	SAMPLE		DEPTH (ft)	CLASSIFICATION OF SOIL- ASTM D2487 Group Symbol and Name	% MC	LL	PL	PI	Gravel %	Sand %	Fines %
●	TP- 5	1	2.0 - 2.3	(SM) yellowish-brown, silty SAND	6				1.7	81.7	16.6
■	TP- 6	2	10.5 - 10.8	(SP) olive-gray, poorly graded SAND	4				0.0	96.4	3.6
▲	TP- 7	2	10.0 - 10.3	(SM) olive-gray, silty SAND with gravel	5				18.3	59.8	21.9

HWA GEOSCIENCES INC.

HYDROGEOLOGICAL EVALUATION
WASTEWATER INFILTRATION FEASIBILITY
FREELAND, WASHINGTON

PARTICLE-SIZE ANALYSIS
OF SOILS
METHOD ASTM D422

PROJECT NO.: 2003-042 FIGURE: B-2



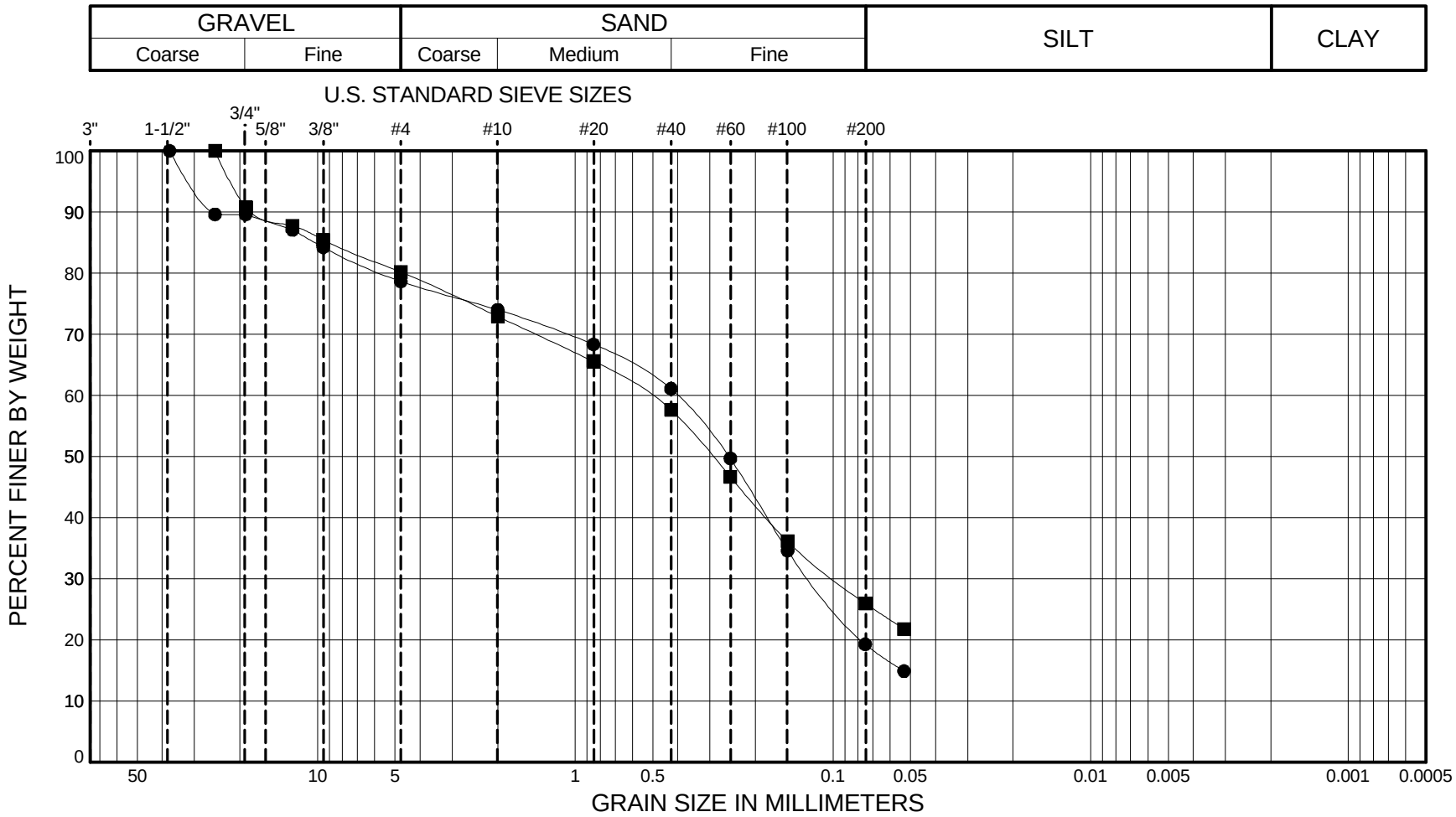
SYMBOL	SAMPLE		DEPTH (ft)	CLASSIFICATION OF SOIL- ASTM D2487 Group Symbol and Name	% MC	LL	PL	PI	Gravel %	Sand %	Fines %
●	TP-10	1	5.5 - 5.8	(SP) grayish-brown, poorly graded SAND	11				0.1	96.0	3.8
■	TP-13	S-7	7.0 - 8.0	(SM) Brown, silty sand	16				0.0	83.0	17.0
▲	TP-16	S-4	4.0 - 5.0	(SW-SM) Reddish brown, well graded sand with silt and gravel	4				25.4	66.0	8.5

HWA GEOSCIENCES INC.

HYDROGEOLOGICAL EVALUATION
WASTEWATER INFILTRATION FEASIBILITY
FREELAND, WASHINGTON

PARTICLE-SIZE ANALYSIS
OF SOILS
METHOD ASTM D422

PROJECT NO.: 2003-042 FIGURE: B-3



SYMBOL	SAMPLE		DEPTH (ft)	CLASSIFICATION OF SOIL- ASTM D2487 Group Symbol and Name	% MC	LL	PL	PI	Gravel %	Sand %	Fines %
●	TP-17	S-8	8.0 - 9.0	(SM) Gray, silty sand with gravel	6				21.4	59.3	19.3
■	TP-19	S-4	4.0 - 5.0	(SM) Yellowish brown, silty sand with gravel	5				19.8	54.2	26.0

HWA GEOSCIENCES INC.

HYDROGEOLOGICAL EVALUATION
WASTEWATER INFILTRATION FEASIBILITY
FREELAND, WASHINGTON

PARTICLE-SIZE ANALYSIS
OF SOILS
METHOD ASTM D422

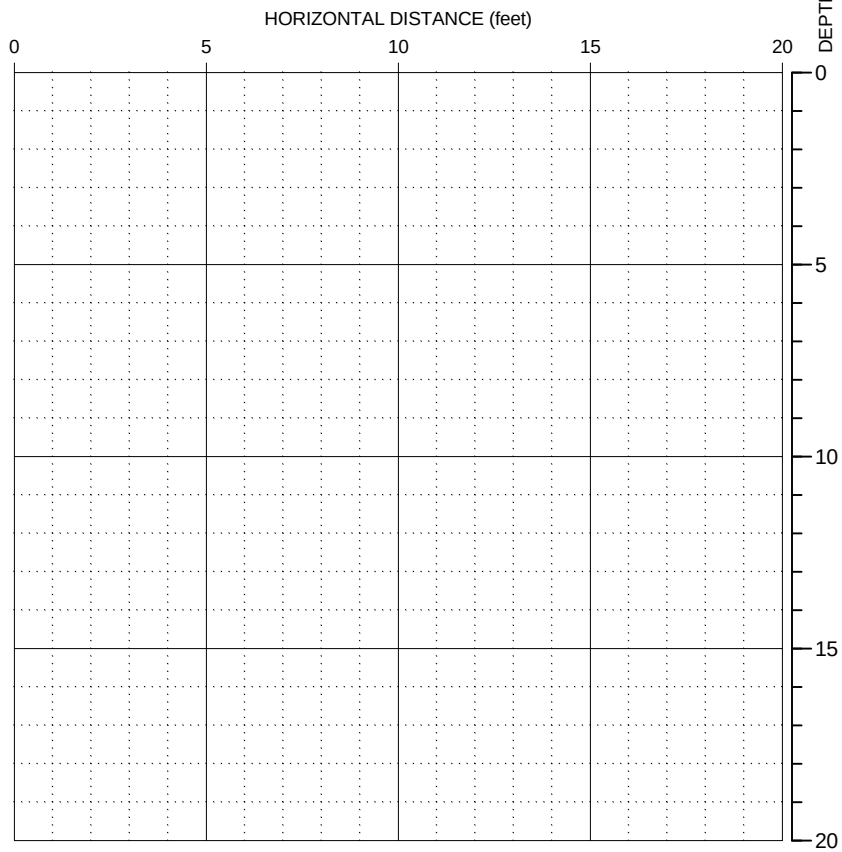
PROJECT NO.: 2003-042 FIGURE: B-4

EXCAVATION COMPANY: Island County
EXCAVATING EQUIPMENT: JD 410G Backhoe
SURFACE ELEVATION: ± Feet

LOCATION: 48.01206, 122.54749
DATE COMPLETED: 8/13/03
LOGGED BY: G. Emens

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0		OH	Dark brown, highly organic, clayey silt, with roots, moist.		1			
		ML	Light brown, silty fine sand with trace sub-angular to rounded fine gravel, FeOx staining, mottled, some roots, dry. Becomes moist, decrease in gravel		2	8		
			Increase in clay content					
		CL	Brown, silty clay with fine gravel, mottled, plastic					
5								
10								
15								
20								

SKETCH OF SIDE OF PIT



NOTE: For a proper understanding of the nature of subsurface conditions, this exploration log should be read in conjunction with the text of the geotechnical report. This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

HYDROGEOLOGICAL EVALUATION
WASTEWATER INFILTRATION FEASIBILITY
FREELAND, WASHINGTON

LOG OF TEST PIT
TP- 2

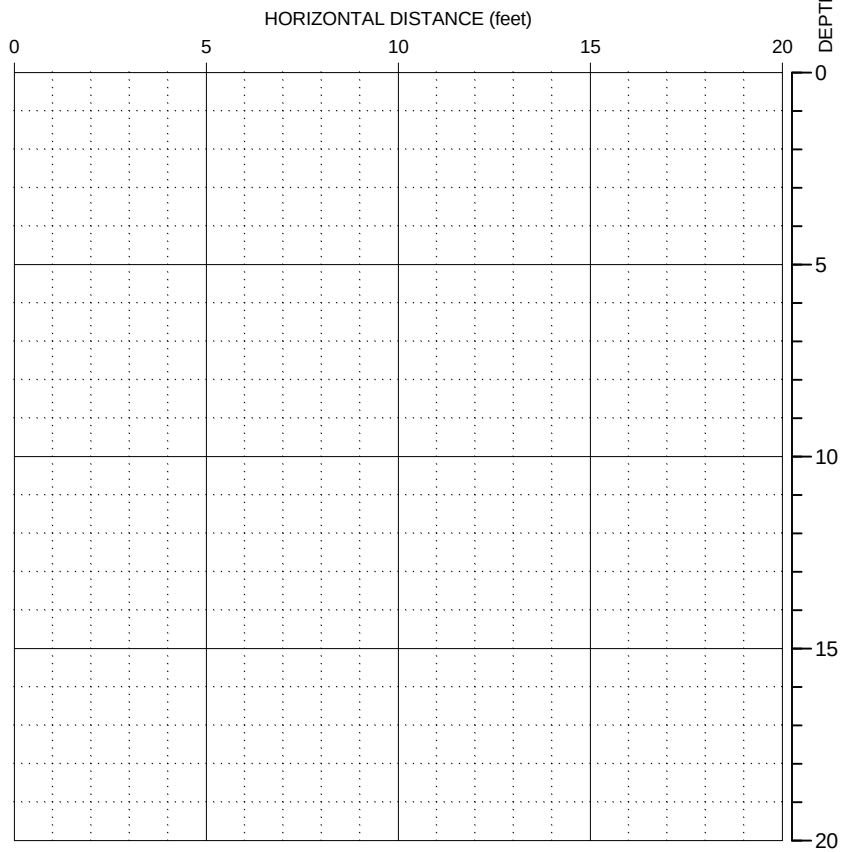
PROJECT NO.: 2003-042 FIGURE: 3

EXCAVATION COMPANY: Island County
EXCAVATING EQUIPMENT: JD 410G Backhoe
SURFACE ELEVATION: ± Feet

LOCATION: 48.01093, 122.54515
DATE COMPLETED: 8/13/03
LOGGED BY: G. Emens

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0		ML	Brownish gray, fine sandy silt with organics and trace fine gravel, dry.					
		SM	Decrease in organics		1			
		ML	Light brown, silty fine sand with FeOx staining.					
			Light browinsh gray silty with fine sand and clay, dry to moist. Clay grades out with depth.					
5			Decrease in silt content. Horizontal bedding, friable.					
			Increase in fine to medium sand, possible SM, moist.					
10								
15								
20								

SKETCH OF SIDE OF PIT



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HWA GEOSCIENCES INC.

HYDROGEOLOGICAL EVALUATION
WASTEWATER INFILTRATION FEASIBILITY
FREELAND, WASHINGTON

LOG OF TEST PIT
TP- 3

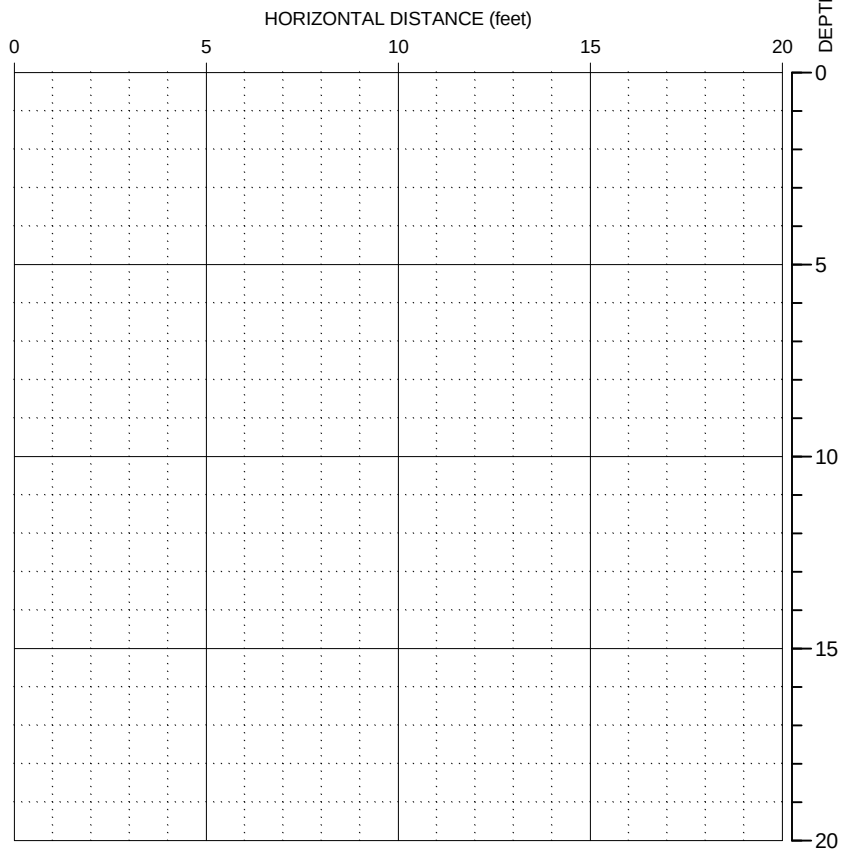
PROJECT NO.: 2003-042 FIGURE: 4

EXCAVATION COMPANY: Island County
EXCAVATING EQUIPMENT: JD 410G Backhoe
SURFACE ELEVATION: ± Feet

LOCATION: 48.00770, 122.54588
DATE COMPLETED: 8/13/03
LOGGED BY: G. Emens

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0		ML	Light grayish brown, fine sandy silt (possible silty fine sand) with organics, dry. Becomes friable, weathered Increase in clay content, color becomes yellowish brown, moist.					
5		SM	Brownish gray, silty fine to medium sand, moist. Distinct color change and decrease in silt content. Horizontally bedded, friable.		1	14		
10								
15								
20								

SKETCH OF SIDE OF PIT



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HWA GEOSCIENCES INC.

HYDROGEOLOGICAL EVALUATION
WASTEWATER INFILTRATION FEASIBILITY
FREELAND, WASHINGTON

LOG OF TEST PIT
TP- 4

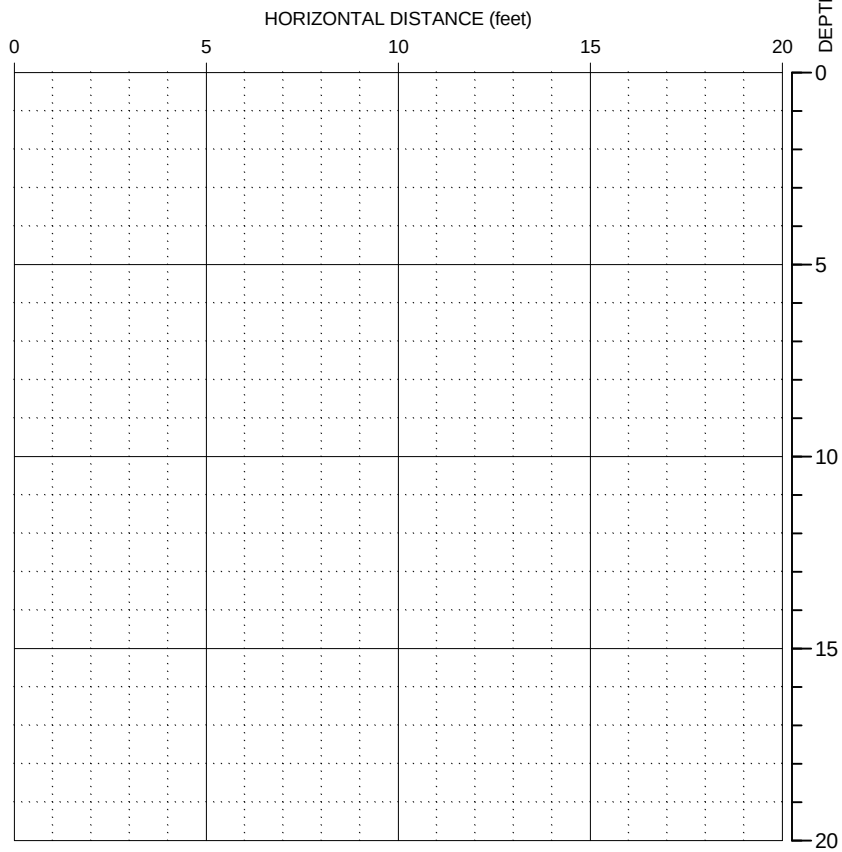
PROJECT NO.: 2003-042 FIGURE: 5

EXCAVATION COMPANY: Island County
EXCAVATING EQUIPMENT: JD 410G Backhoe
SURFACE ELEVATION: ± Feet

LOCATION: 48.00711, 122.54972
DATE COMPLETED: 8/13/03
LOGGED BY: G. Emens

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0		ML	Light brown, fine sandy silt with organics, dry.					
		SM	Light brown, silty fine to medium sand, mottled with FeOx staining, friable, dry.		1	6		
		CL	Olive gray, silty clay, mottled, moist.					
5								
10								
15								
20								

SKETCH OF SIDE OF PIT



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HYDROGEOLOGICAL EVALUATION
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LOG OF TEST PIT
TP- 5

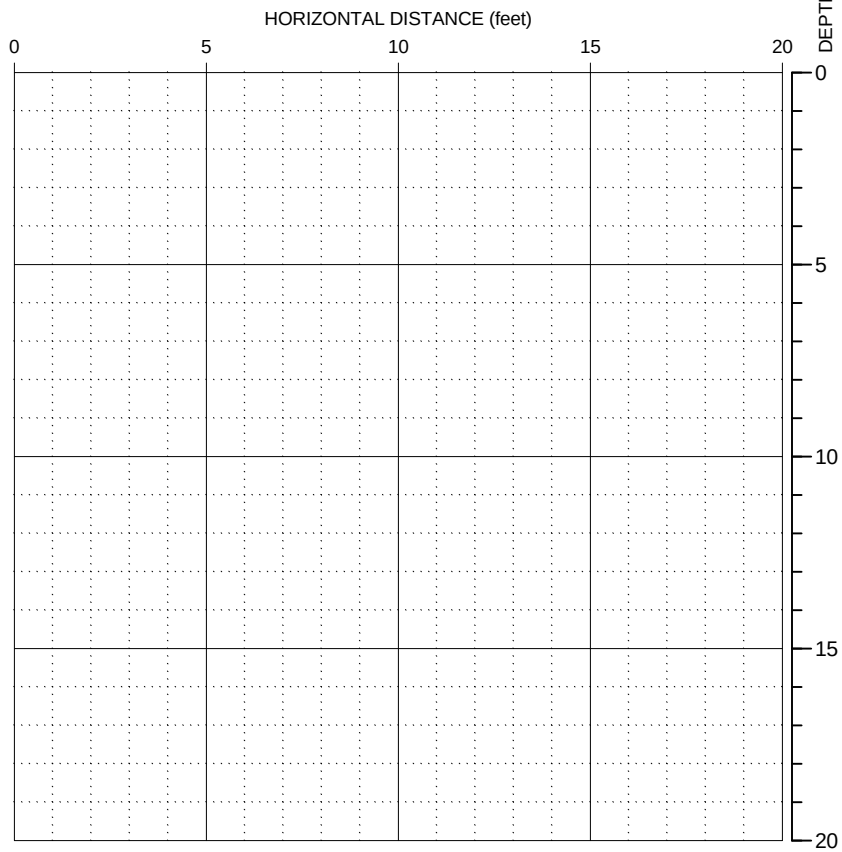
PROJECT NO.: 2003-042 FIGURE: 6

EXCAVATION COMPANY: Island County
EXCAVATING EQUIPMENT: JD 410G Backhoe
SURFACE ELEVATION: ± Feet

LOCATION: 48.00579, 122.54449
DATE COMPLETED: 8/13/03
LOGGED BY: G. Emens

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0		ML	Brownish gray, silty with fine sand and organics (roots), dry.					
		SM	Browinsh gray, silty fine sand, mottled, FeOx staining, friable.					
		ML	Yellowish brown, slightly plastic silt, moist. Sand content increase with depth					
5								
		SP SM	Brownish gray, fine to medium sand with silt, moist.		1			
10			Becomes gray, medium sand with trace silt, moist.		2	4		
15								
20								

SKETCH OF SIDE OF PIT



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LOG OF TEST PIT
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PROJECT NO.: 2003-042 FIGURE: 7

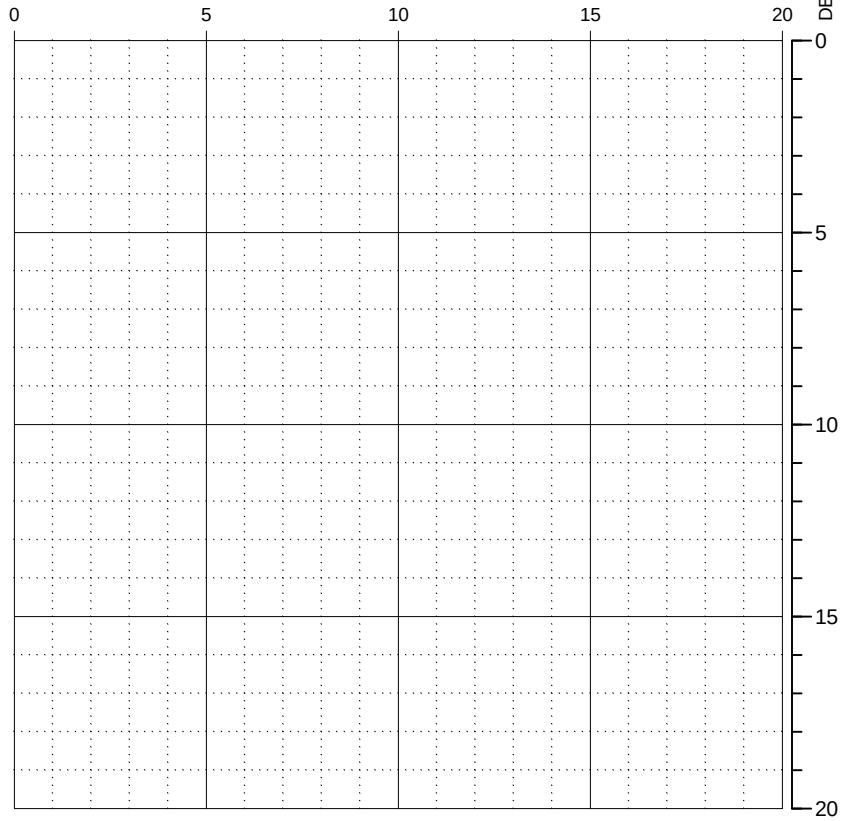
EXCAVATION COMPANY: Island County
EXCAVATING EQUIPMENT: JD 410G Backhoe
SURFACE ELEVATION: ± Feet

LOCATION: 48.02575, 122.57448
DATE COMPLETED: 8/13/03
LOGGED BY: G. Emens

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0		ML	Light brown, silty with organics (roots), dry.					
		GM	Light brown, silty, sandy fine to coarse gravel with occasional cobbles, dry. Unit is highly stratified with occasional 1-2 in. silt lenses/beds and occasional 2-4 in. fine to medium sand beds.		1			
5								
10		SM	Gray, silty, gravely fine to medium sand, moist. Gravel is fine to coarse with variable content.		2	5		
15			Distinct color change to brownish gray.					
20								

SKETCH OF SIDE OF PIT

HORIZONTAL DISTANCE (feet)



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FREELAND, WASHINGTON

LOG OF TEST PIT
TP- 7

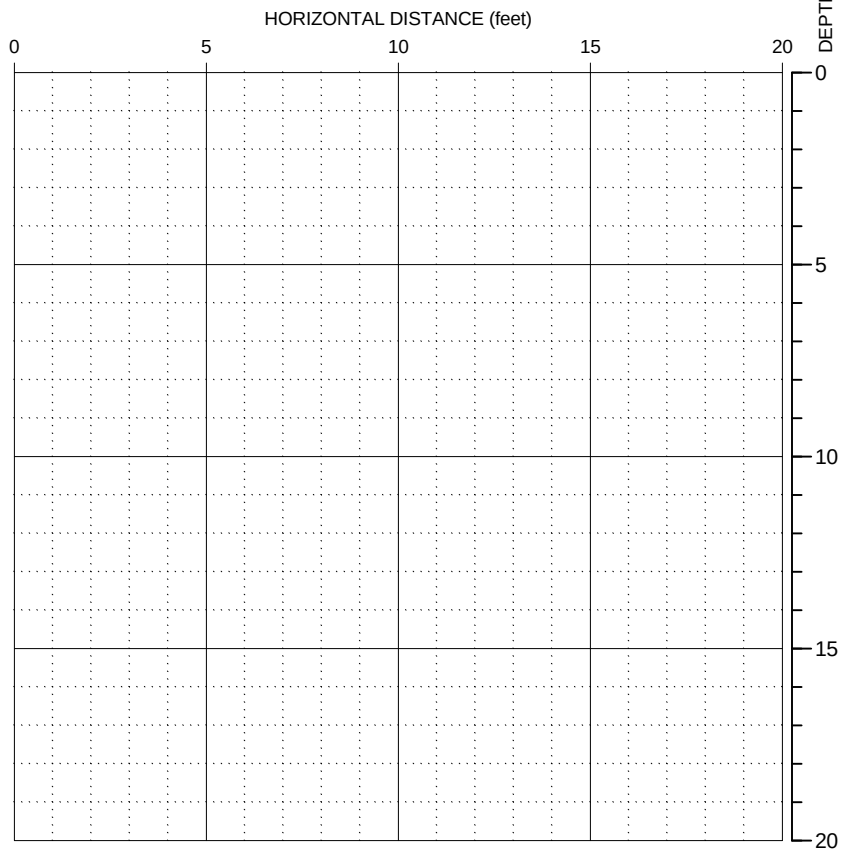
PROJECT NO.: 2003-042 FIGURE: 8

EXCAVATION COMPANY: Island County
EXCAVATING EQUIPMENT: JD 410G Backhoe
SURFACE ELEVATION: ± Feet

LOCATION: 48.03096, 122.57886
DATE COMPLETED: 8/13/03
LOGGED BY: G. Emens

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0		ML	Light brown, silt with organics (roots), dry.					
		GM	Light brown silty, sandy gravel, dry. Gravel is fine to coarse, sand is fine to medium. Overlies 2 inch medium silty sand bed.					
		ML	Brown, sandy, gravely silt, moist, mottled. Sand is fine to medium.					
			Color becomes greenish gray with increase in silt content.					
5								
10								
15								
20								

SKETCH OF SIDE OF PIT



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HWA GEOSCIENCES INC.

HYDROGEOLOGICAL EVALUATION
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LOG OF TEST PIT
TP- 8

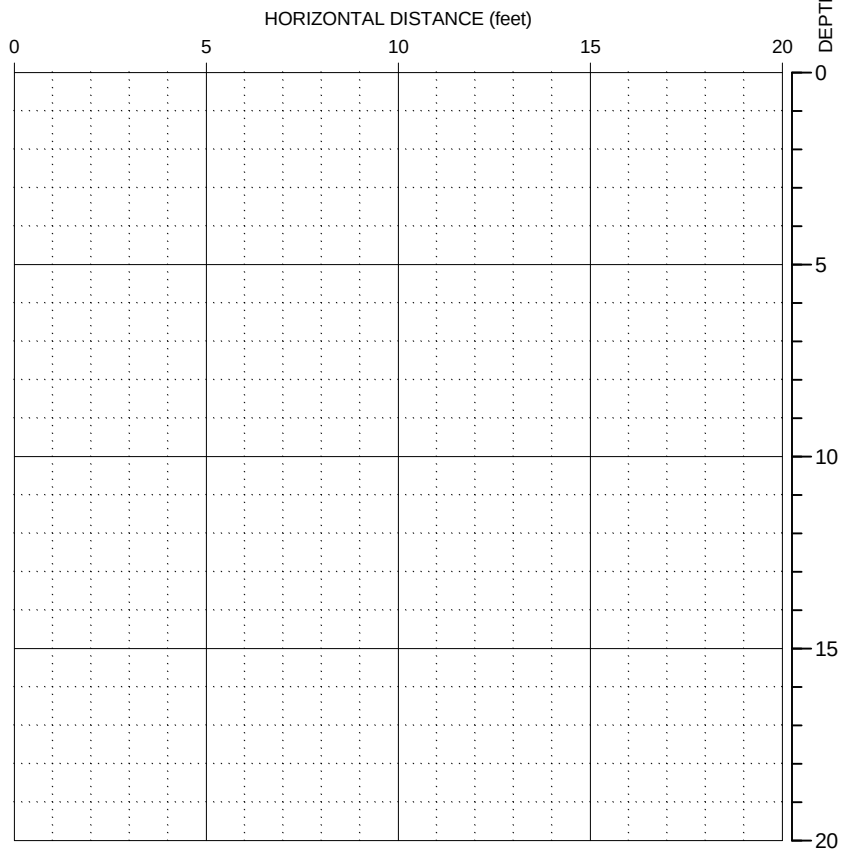
PROJECT NO.: 2003-042 FIGURE: 9

EXCAVATION COMPANY: Island County
EXCAVATING EQUIPMENT: JD 410G Backhoe
SURFACE ELEVATION: ± Feet

LOCATION: 48.03848, 122.57675
DATE COMPLETED: 8/13/03
LOGGED BY: G. Emens

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0		ML	Light brown silt with organics (roots), dry.					
		ML	Brown, sandy, gravely silt, moist to wet. Gravel is sub-angular to rounded, fine to coarse. Contains a 6 inch lense of wet silty gravel at 4.5 ft.					
5								
10								
15								
20								

SKETCH OF SIDE OF PIT



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HWA GEOSCIENCES INC.

HYDROGEOLOGICAL EVALUATION
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LOG OF TEST PIT
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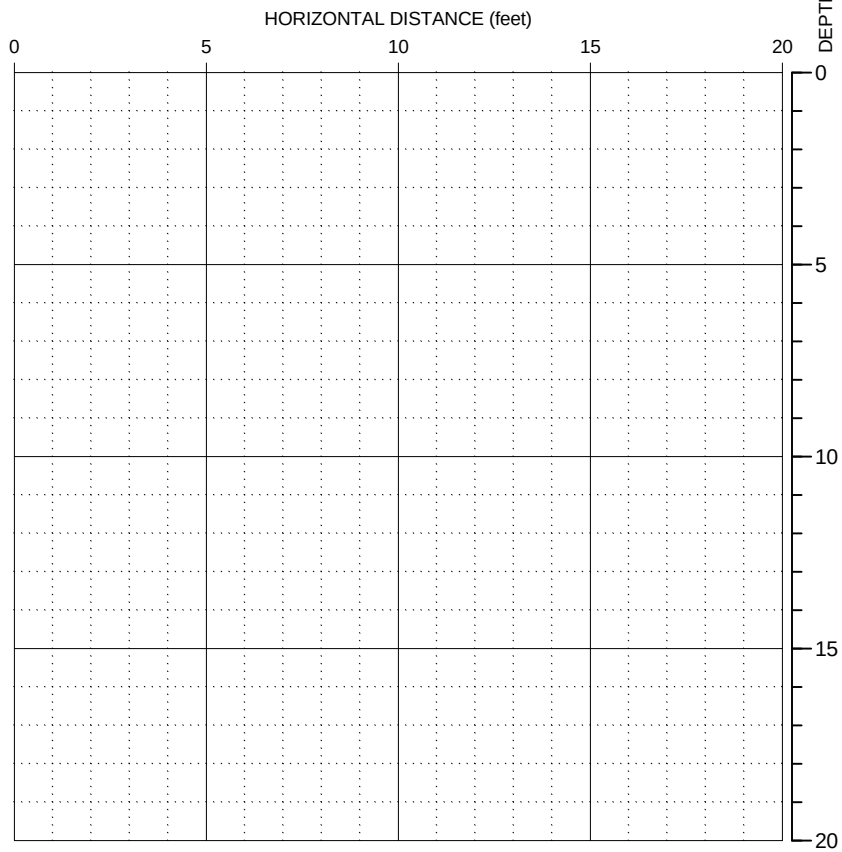
PROJECT NO.: 2003-042 FIGURE: 10

EXCAVATION COMPANY: Island County
EXCAVATING EQUIPMENT: JD 410G Backhoe
SURFACE ELEVATION: ± Feet

LOCATION: 48.04613, 122.57767
DATE COMPLETED: 8/13/03
LOGGED BY: G. Emens

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0		ML	Light brown silt with organics (roots), dry.					
		ML	Light brown, fine sandy silt with gravel, dry to moist.					
5		SP SM	Gray, fine to medium sand with silt, moist.		1	11		
10								
15								
20								

SKETCH OF SIDE OF PIT



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LOG OF TEST PIT
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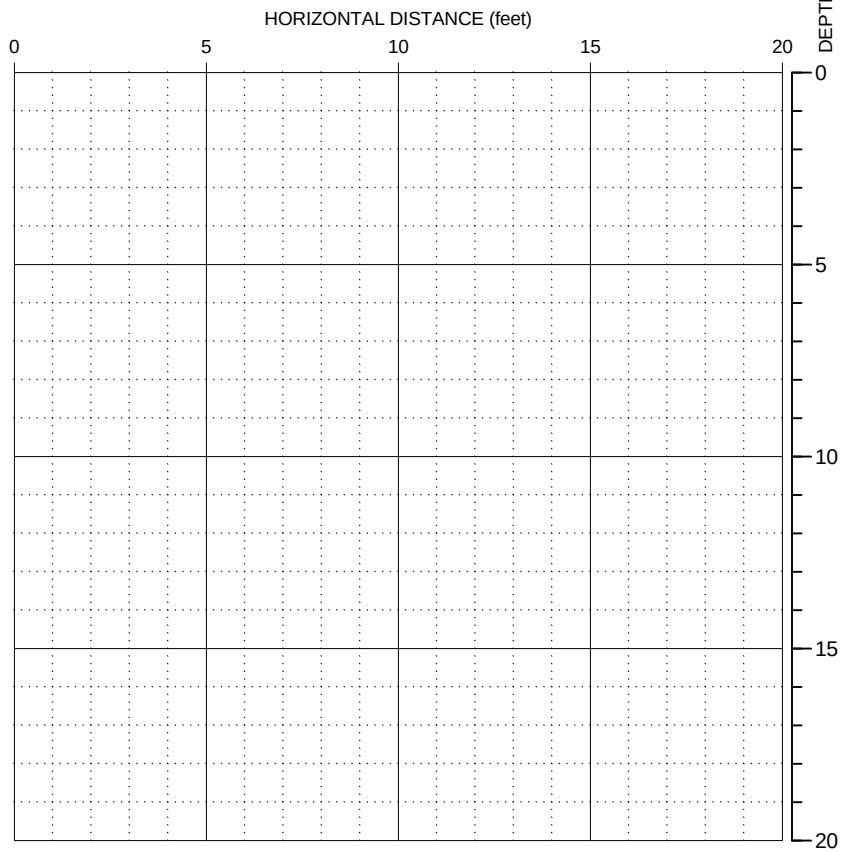
PROJECT NO.: 2003-042 FIGURE: 11

EXCAVATION COMPANY: Island County
EXCAVATING EQUIPMENT: JD 410G Backhoe
SURFACE ELEVATION: ± Feet

LOCATION: 48.00595, 122.55335
DATE COMPLETED: 9/30/03
LOGGED BY: A. Sugar

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0			Brown silty sand with roots, dry (topsoil)					
		ML	Dense olive gray silt and sandy silt, laminated, some roots, dry					
10		SM	Very dense gray silty sand with gravel and cobbles, moist (till)					
20								

SKETCH OF SIDE OF PIT



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WASTEWATER INFILTRATION FEASIBILITY
FREELAND, WASHINGTON

LOG OF TEST PIT
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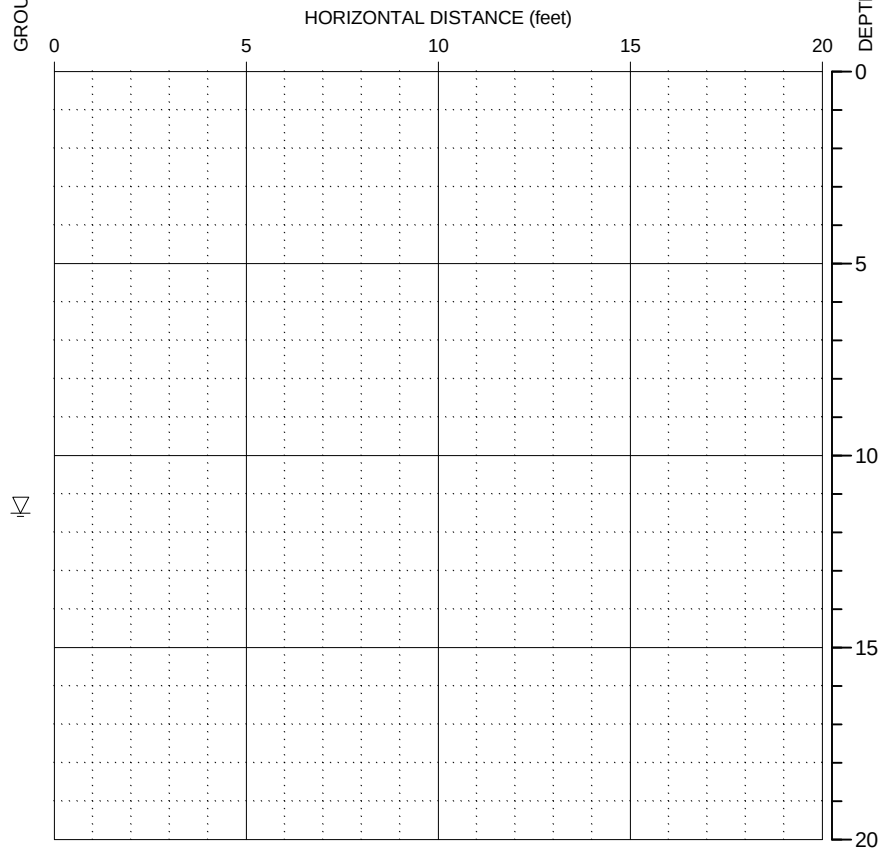
PROJECT NO.: 2003-042 FIGURE: 12

EXCAVATION COMPANY: Island County
EXCAVATING EQUIPMENT: JD 410G Backhoe
SURFACE ELEVATION: ± Feet

LOCATION: 48.00597, 122.55082
DATE COMPLETED: 9/30/03
LOGGED BY: A. Sugar

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0			Brown silty sand with roots, dry (topsoil)					
		SM	Light gray mottled silty sand, dry. Blocky structure with root holes					
		ML	Tan plastic silt, moist to dry					
5			Some fine sand lenses, moist					
			Tan mottled plastic silt, moist					
10			Seepage at 11.5'					▽
15								
20								

SKETCH OF SIDE OF PIT



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HYDROGEOLOGICAL EVALUATION
WASTEWATER INFILTRATION FEASIBILITY
FREELAND, WASHINGTON

LOG OF TEST PIT
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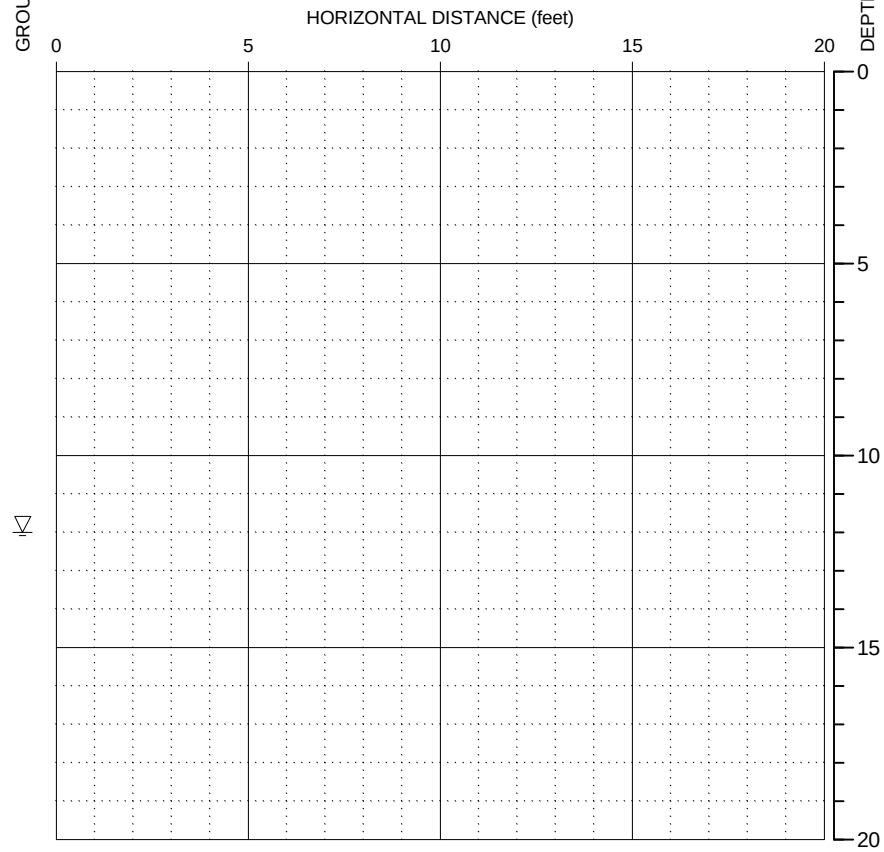
PROJECT NO.: 2003-042 FIGURE: 13

EXCAVATION COMPANY: Island County
EXCAVATING EQUIPMENT: JD 410G Backhoe
SURFACE ELEVATION: ± Feet

LOCATION: 48.00568, 122.54848
DATE COMPLETED: 9/30/03
LOGGED BY: A. Sugar

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0			Brown silty sand with roots, dry (topsoil)					
		ML	Light gray mottled silt with sand, some roots, blocky texture with root holes.					
5		ML	Olive gray plastic silt, moist, some fine sand lenses					
		SP	Olive gray fine sand, moist		S-7	16		
		SP SM	Gray silty fine sand, wet					
10			Gray fine to medium sand, wet					
			Seepage at 12' (2-5 gpm), some caving					▽
15								
20								

SKETCH OF SIDE OF PIT



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HWA GEOSCIENCES INC.

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FREELAND, WASHINGTON

LOG OF TEST PIT
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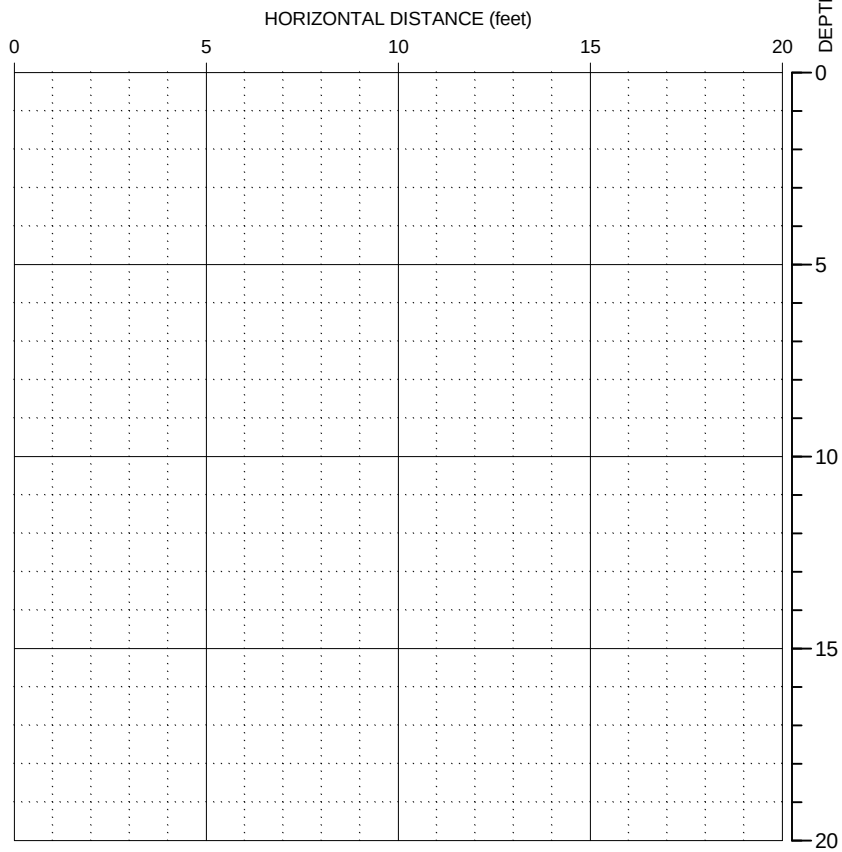
PROJECT NO.: 2003-042 FIGURE: 14

EXCAVATION COMPANY: Island County
EXCAVATING EQUIPMENT: JD 410G Backhoe
SURFACE ELEVATION: ± Feet

LOCATION: 48.02965. 122.58058
DATE COMPLETED: 9/30/03
LOGGED BY: A. Sugar

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0			Light gray, brown and rust mottled silty sand with roots, dry (topsoil)					
		SM	Light gray rust motled silty sand with gravel and cobbles, few roots, dry (weathered till)					
5		SM	Light gray rust mottled silty sand with gravel, dry. Less silt than above (weathered till)					
		SM	Dense gray silty sand with gravel, dry (till). Few massive gray silt layers					
10								
15								
20								

SKETCH OF SIDE OF PIT



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HWA GEOSCIENCES INC.

HYDROGEOLOGICAL EVALUATION
WASTEWATER INFILTRATION FEASIBILITY
FREELAND, WASHINGTON

LOG OF TEST PIT
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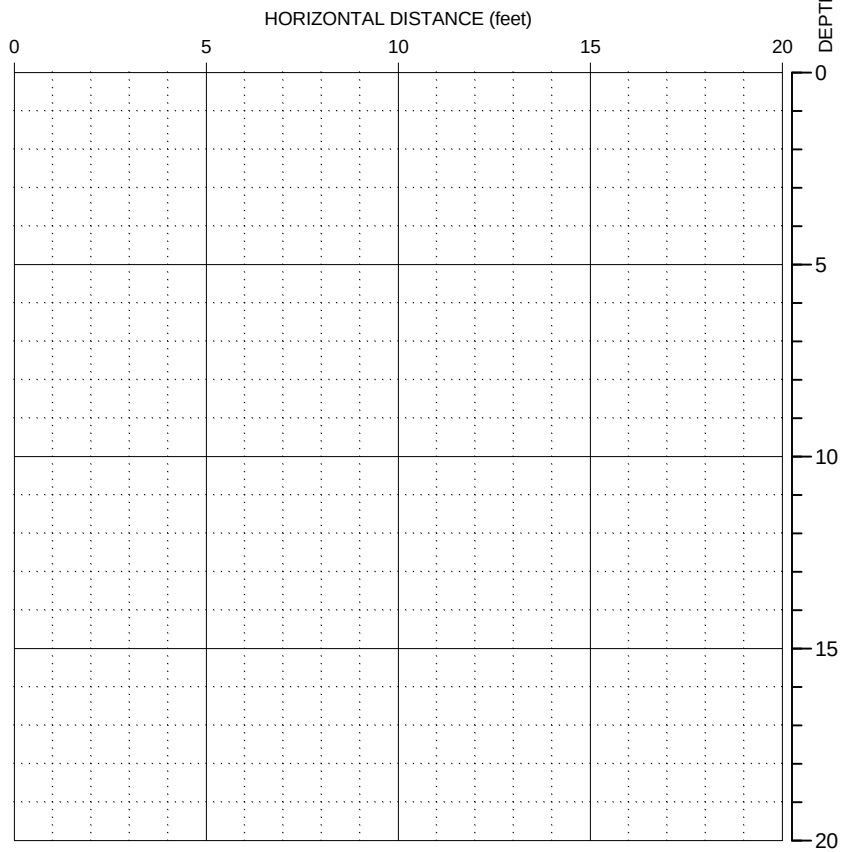
PROJECT NO.: 2003-042 FIGURE: 15

EXCAVATION COMPANY: Island County
EXCAVATING EQUIPMENT: JD 410G Backhoe
SURFACE ELEVATION: ± Feet

LOCATION: 48.02556. 122.57994
DATE COMPLETED: 9/30/03
LOGGED BY: A. Sugar

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0			Light brown rust mottled silty sand with roots, dry (topsoil)					
		SM	Dense, light gray/brown rust mottled silty sand with gravel, dry (weathered till)					
		SP SM	Light gray silty fine sand, few small gravel, dry					
5		SM	Light gray rust mottled silty sand with gravel and cobbles, dry (till)					
10								
15								
20								

SKETCH OF SIDE OF PIT



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LOG OF TEST PIT
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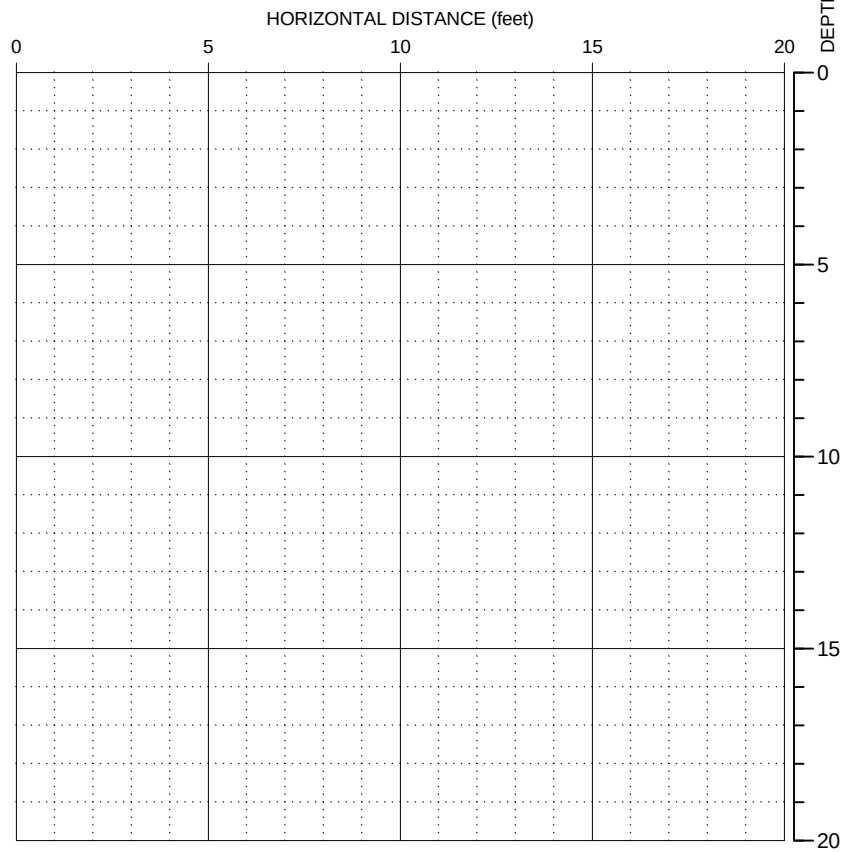
PROJECT NO.: 2003-042 FIGURE: 16

EXCAVATION COMPANY: Island County
EXCAVATING EQUIPMENT: JD 410G Backhoe
SURFACE ELEVATION: ± Feet

LOCATION: 48.02228. 122.57738
DATE COMPLETED: 9/30/03
LOGGED BY: A. Sugar

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0			Brown silty sand with roots, dry (topsoil)					
		SP SM	Light brown silty sand and clean sand, few roots, dry					
		SP SM	Dense, cemented, light brown rust mottled silty sand with gravel and cobbles, dry. Diamict stuctutre with faint layering (weathered till)					
5				X	S-4	4		
			Dense light gray silty sand with gravel and cobbles, moist (weathered till)					
10			Seepage at 9.5', 3-5 gpm					▽
15								
20								

SKETCH OF SIDE OF PIT



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LOG OF TEST PIT
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PAGE: 1 of 1

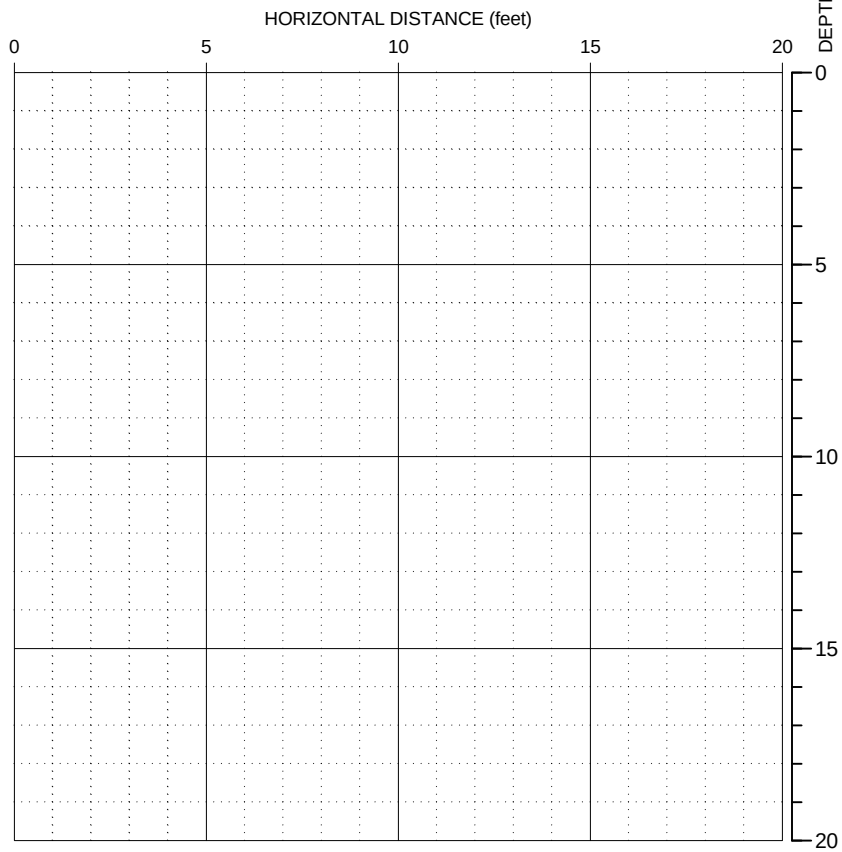
PROJECT NO.: 2003-042 FIGURE: 17

EXCAVATION COMPANY: Island County
EXCAVATING EQUIPMENT: JD 410G Backhoe
SURFACE ELEVATION: ± Feet

LOCATION: 48.02678. 122.57509
DATE COMPLETED: 9/30/03
LOGGED BY: A. Sugar

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0			Light brown rust mottled sand with gravel and roots, dry (topsoil)					
		SP	Light brown fine to coarse sand, gravel and cobbles with roots to 4', dry					
5		SP	Tan fine to medium sand, dry. 4-4.5' has light gray color					
		SP SM	Light gray silty fine to medium sand with gravel and cobbles, moist					
				X	S-8	6		
10			Getting denser					
15								
20								

SKETCH OF SIDE OF PIT



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WASTEWATER INFILTRATION FEASIBILITY
FREELAND, WASHINGTON

LOG OF TEST PIT
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PROJECT NO.: 2003-042 FIGURE: 18

EXCAVATION COMPANY: Island County
EXCAVATING EQUIPMENT: JD 410G Backhoe
SURFACE ELEVATION: ± Feet

LOCATION: 48.02430. 122.57440
DATE COMPLETED: 9/30/03
LOGGED BY: A. Sugar

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0			Light brown silty sand with gravel and roots (topsoil)					
		SP	Light brown rust mottled fine to coarse sand with gravel and cobbles, dry. Roots to 3'					
5		SP SM	Very dense, light gray silty fine sand, dry.					
		SM	Very desne light gray silty fine sand and silt, dry (till)					
10								
15								
20								

SKETCH OF SIDE OF PIT

HORIZONTAL DISTANCE (feet)

0 5 10 15 20

DEPTH (feet)

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HWA GEOSCIENCES INC.

HYDROGEOLOGICAL EVALUATION
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FREELAND, WASHINGTON

LOG OF TEST PIT
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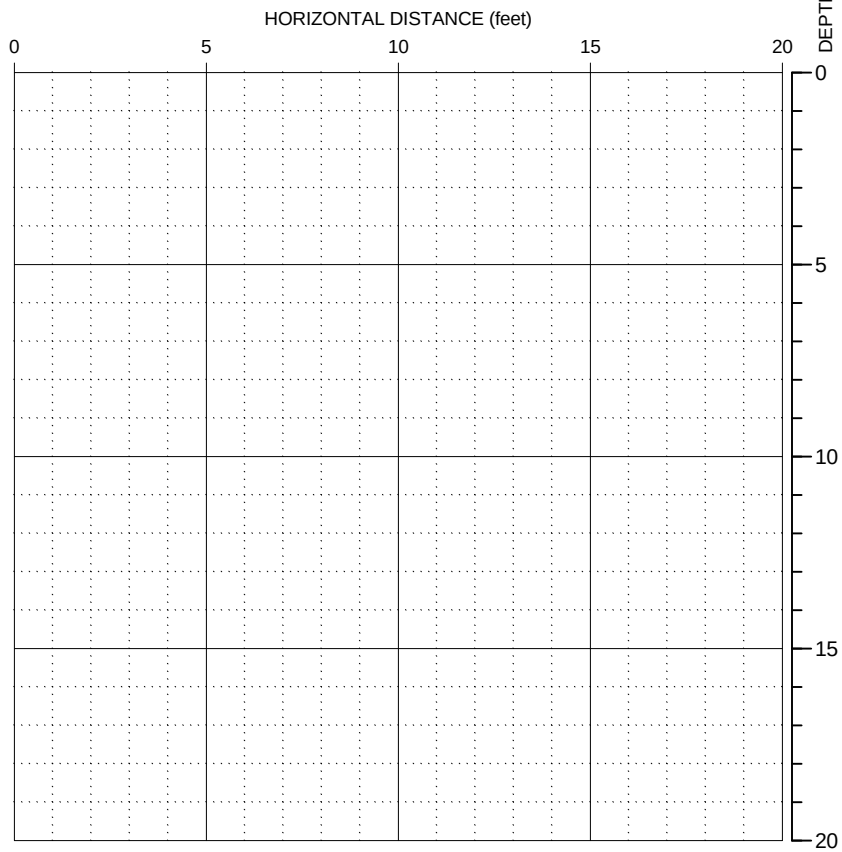
PROJECT NO.: 2003-042 FIGURE: 19

EXCAVATION COMPANY: Island County
EXCAVATING EQUIPMENT: JD 410G Backhoe
SURFACE ELEVATION: ± Feet

LOCATION: 48.03410. 122.56290
DATE COMPLETED: 9/30/03
LOGGED BY: A. Sugar

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0			Yellowish orange silty sand with roots, dry (topsoil). Garbage at surface (bottles, plastic, etc.) to 1'					
		SM	Orange silty sand and silt, dry					
		SP SM	Light gray silty sand with gravel and cobbles (weathered till) Roots to 4'					
5				X	S-4	5		
		SM	Very dense olive gray silty sand with gravel and cobbles, moist (till)					
10								
15								
20								

SKETCH OF SIDE OF PIT



NOTE: For a proper understanding of the nature of subsurface conditions, this exploration log should be read in conjunction with the text of the geotechnical report. This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

HYDROGEOLOGICAL EVALUATION
WASTEWATER INFILTRATION FEASIBILITY
FREELAND, WASHINGTON

LOG OF TEST PIT
TP-19

PROJECT NO.: 2003-042 FIGURE: 20

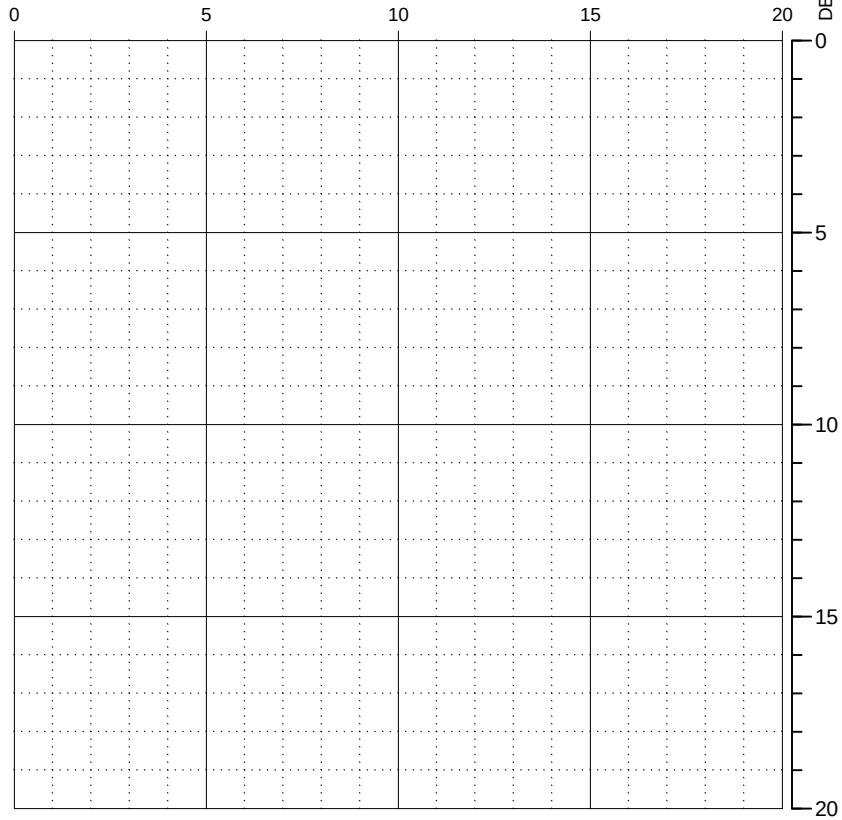
EXCAVATION COMPANY: Island County
EXCAVATING EQUIPMENT: JD 410G Backhoe
SURFACE ELEVATION: ± Feet

LOCATION: 48.03252. 122.55340
DATE COMPLETED: 9/30/03
LOGGED BY: A. Sugar

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0			Brown silty sand with roots and organics, (topsoil)					
		SM	Very dense yellowish orange silty fine sand with gravel and cobbles, dry					
		SM	Very dense light gray silty sand with gravel and cobles, dry					
5		SM	Very dense olive gray silty sand with gravel and cobles, dry (till)					
10								
15								
20								

SKETCH OF SIDE OF PIT

HORIZONTAL DISTANCE (feet)



NOTE: For a proper understanding of the nature of subsurface conditions, this exploration log should be read in conjunction with the text of the geotechnical report. This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

HYDROGEOLOGICAL EVALUATION
WASTEWATER INFILTRATION FEASIBILITY
FREELAND, WASHINGTON

LOG OF TEST PIT
TP-20

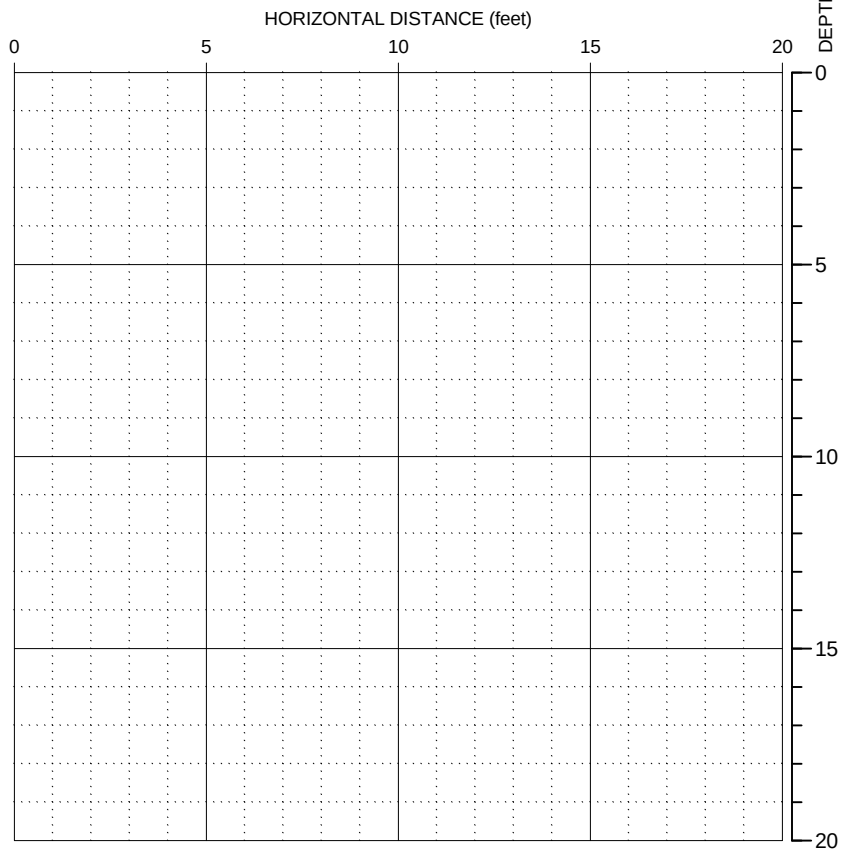
PROJECT NO.: 2003-042 FIGURE: 21

EXCAVATION COMPANY: Island County
EXCAVATING EQUIPMENT: JD 410G Backhoe
SURFACE ELEVATION: ± Feet

LOCATION: 48.02894. 122.56054
DATE COMPLETED: 9/30/03
LOGGED BY: A. Sugar

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0			Brown silty sand with roots, dry (topsoil)					
		SM	Tan mottled silty fine sand with gravel, dry (weathered till)					
			Dense gray mottled silty fine sand with gravel and cobbles, dry					
5		SM	Very dense olive gray silty sand with gravel and cobles, dry (till)					
10								
15								
20								

SKETCH OF SIDE OF PIT



NOTE: For a proper understanding of the nature of subsurface conditions, this exploration log should be read in conjunction with the text of the geotechnical report. This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

HYDROGEOLOGICAL EVALUATION
WASTEWATER INFILTRATION FEASIBILITY
FREELAND, WASHINGTON

LOG OF TEST PIT
TP-21

PROJECT NO.: 2003-042 FIGURE: 22

APPENDIX M.
HYDRAULIC PROFILE CALCULATIONS

Date:	12/12/2003	
Peak Hour Flow, mgd:	1.84	
Peak Hour Flow, cfs:	2.85	
Peak Day Flow, mgd:	0.89	Peak hour flows equalized to peak day flows in WWTP
Peak Day Flow, cfs:	1.38	
Datum:	NAVD29	

weir elevations are fixed (red numbers); in general, at peak flows, weirs are set to have 3 inches fall on downstream (conservatism)

IMPORTANT: if making changes to the spreadhseet, make sure the weir elevations have 3 inches downstream at peak flows!

Description	Number	Diameter, ft	Length, ft	Area, sf	Hyd Radius, ft	Velocity, fps	V^2/2g, ft	(Hazen-William	K	Delta H, ft	Invert El, ft	WS,ft	TOW, ft	Overflow?
Land application basins											142.00	143.00	145.00	
Effluent pipeline exit loss	1	0.83		0.55	0.21	2.53	0.10		1.00	0.10				
Effluent pipeline	1	0.83	10560	0.55	0.21	2.53	0.10	120		31.20				
Effluent pipeline - minor losses	100	0.83		0.55	0.21	2.53	0.10		0.25	2.48				
Magnetic flow meter	1	0.83		0.55	0.21	2.53	0.10		0.50	0.05				
Effluent pipeline entrance loss	1	0.83		0.55	0.21	2.53	0.10		1.00	0.10				
Clearwell											102.00	108.00	111.00	
Pipeline exit loss	1	0.83		0.55	0.21	2.53	0.10		1.00	0.10				
Pipeline	1	0.83	25	0.55	0.21	2.53	0.10	120		0.07				
Pipeline - minor losses	5	0.83		0.55	0.21	2.53	0.10		0.25	0.12				
Pipeline entrance loss	1	0.83		0.55	0.21	2.53	0.10		1.00	0.10				
Chlorine contact basin effluent weir	1		3							0.17	108.50	108.67		
Chlorine contact basins											102.00	108.67	111.00	
Pipeline exit loss	1	0.83		0.55	0.21	2.53	0.10		1.00	0.10				
Pipeline	1	0.83	100	0.55	0.21	2.53	0.10	120		0.30				
Magnetic flow meter	1	0.83		0.55	0.21	2.53	0.10		0.50	0.05				
Pipeline - minor losses	25	0.83		0.55	0.21	2.53	0.10		0.25	0.62				
Pipeline entrance loss	1	0.83		0.55	0.21	2.53	0.10		1.00	0.10				
Aerobic membrane basins											100.00	111.00	118.00	
Intermediate weir	1		3							0.17	111.50	111.67		
Anoxic basins											100.00	112.00	118.00	
Pipeline exit loss	1	0.83		0.55	0.21	2.53	0.10		1.00	0.10				
Pipeline	1	0.83	50	0.55	0.21	2.53	0.10	120		0.15				
Pipeline - minor losses	10	0.83		0.55	0.21	2.53	0.10		0.25	0.25				
Pipeline entrance loss	1	0.83		0.55	0.21	2.53	0.10		1.00	0.10				
Flow splitter box weir	1		4							0.22	113.00	113.22		
Influent flow splitter box											100.00	113.22	118.00	