Skokomish Nation

# Skokomish Reservation
# Wastewater Facilities Plan Amendment

July 2007

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SKOKOMISH INDIAN TRIBE
MASON COUNTY, WASHINGTON

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# WASTEWATER FACILITIES PLAN AMENDMENT

## FOR THE

## SKOKOMISH INDIAN TRIBE

**July 2007**

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# EXECUTIVE SUMMARY

## INTRODUCTION

Mason County retained the services of Cascade Design Professionals, Inc. and Financial Services Group to amend the Skokomish Tribe Wastewater Master Plan (KCM, 1998), which was approved as a wastewater facilities plan by the Washington Department of Ecology (DOE). This document reflects recent population forecasts, proposed service areas, and changes in technology.

## BACKGROUND AND PURPOSE

The Skokomish Indian Tribe (SIT) Wastewater Master Plan – Final Report was completed in November 1998. The Plan included a preliminary analysis of all the components of a wastewater system for the Reservation, including the existing on-site wastewater systems, flow and load estimates, and wastewater collection, treatment and disposal alternatives. The recommended system included:

1. A pressurized collection system, with grinder pumps, to reduce inflow and infiltration (I/I) in the high groundwater areas.
2. A single, centralized treatment plant, with a complete mix aerated lagoon and clarifier (Biolac) treatment system. Optional treatment systems included the Sequencing Batch Reactor and the recirculating gravel filter. The recommended location was the former WSDOT maintenance yard.
3. Disinfection technologies using ultraviolet radiation.
4. Sludge disposal using land application in the forest on the western hills.
5. Effluent disposal with rapid infiltration north and east of the former WSDOT maintenance yard, or on the WSDOT parcel, toward the back of the property.

Substantial developments have occurred since completion of the November 1998 Plan, thus requiring an amendment to the Master Plan to reflect changed conditions, including water quality, regulatory requirements, engineering technology, and population projections, per WAC 173-240-030(4), 7/11/00. This amendment is intended to be the wastewater facilities plan which, if approved, would be the basis for preparation of final plans and specifications for wastewater facilities for the Reservation.

The Project Definition phase of the Wastewater Facilities Planning phase of the project has been completed and the recommendations of the Project Definition report are as follows:

- Two separate treatment plants are necessary, one located at the Potlatch State Park and one located in that Core Reservation area.
- The recommended collection system is a low-pressure sewer system, using grinder pumps at each connection. However, because of existing infrastructure at Potlatch State Park, the low-pressure system will work in combination with a typical gravity sewer system.

- Wastewater will be treated to Class A standards and disposed of in infiltration basins.

## POPULATION PROJECTIONS

Based on an assessment provided by the Skokomish Tribe and input from the Tribe's wastewater planning committee, population projections and planning assumptions for the reservation were established and used as a basis for estimating current and future wastewater flows and loadings.

Planning assumptions were documented in a memo, which is included in Appendix B. Estimates were developed for two phases of the project:

- Phase 1 which will provide service to at least 2014, and
- Ultimate Build Out which will provide service to at least 2029.

Population estimates for each planning area are shown in Table ES-1.

**Table ES-1. Population Estimates**

| Description | Phase 1 (2014) | Ultimate Build Out (2029) |
|---|---|---|
| | | |
| Potlatch Service Areas | 316 | 897 |
| Core Reservation | 478 | 855 |
| Total | 794 | 1,752 |

## WASTEWATER FLOWS AND LOADINGS

Based on the population estimates and planning assumptions, it was necessary to derive new wastewater flows and loadings for the Skokomish Reservation. Table ES-2 presents a summary of the Phase 1 and Ultimate projections of wastewater flows and loadings for the Potlatch Bubble. Wastewater flows and loadings for the Core Reservation are shown in Table ES-3.

**Table ES-2. Potlatch Bubble**
**Service Area Design Flows and Loadings**

| Design Flows (mgd) | Phase 1 (2014) | Ultimate (2029) |
|---|---|---|
| Average Daily | 0.059 | 0.123 |
| Peak | 0.119 | 0.246 |
| Design Loadings (lb/day) | | |
| Average Daily BOD | 146 | 340 |
| Average Daily TSS | 146 | 340 |

**Table ES-3. Core Area**
**Service Area Design Flows and Loadings**

| Design Flows (mgd) | Phase 1 (2014) | Ultimate (2029) |
|---|---|---|
| Average Daily | 0.094 | 0.151 |
| Peak | 0.188 | 0.302 |
| Design Loadings (lb/day) | | |
| Average Daily BOD | 293 | 394 |
| Average Daily TSS | 233 | 334 |

## ALTERNATIVES

The review of treatment alternatives within this supplemental information is limited to the two separate treatment alternatives that have been identified in previous planning efforts (Project Definition Report) and presented to the Skokomish Tribe Wastewater Planning Committee and the Tri-Party Group.

## SUMMARY OF RECOMMENDATIONS

Based on further development of conveyance, treatment, and disposal alternatives for the Potlatch Bubble and Core Service Areas, a low pressure sewer system, two separate wastewater treatment plants, and soil percolation disposal systems (infiltration basins) are recommended to serve each of these two areas. Of the two treatment plants, one will be located in the Core Reservation at the WSDOT property and the second in the Potlatch Bubble Area will be located in the southwest corner of the current boundaries of Potlatch State Park. Each treatment plant will be capable of producing a Class A reclaimed effluent suitable for unrestricted reuse and will be percolated through the soil in infiltration basins.

## POTLATCH BUBBLE AREA

### Plan Elements

The following are key elements of the recommended plan for the Potlatch Bubble Service Area:

- Initially sewer collection and conveyance must be provided for within the service area, which will consist of a low-pressure sewer system to serve Potlatch State Park, Minerva RV Park, and residences located north of the Minerva RV Park. Conveyance for the Skokomish tɜba’das Housing Project will be a gravity collection system that will convey wastewater to a common point, which will then be pumped to the new treatment facilities. Washington State Parks is redeveloping the collection system within the existing park and Minerva RV Park West

- At the new treatment facilities, wastewater will be treated to Class A standards using a membrane bioreactor (MBR) treatment system. Each facility design has microscreening/grit removal at the headworks, flow equalization, biological treatment (MBR), and ultraviolet light disinfection prior to discharge. The Potlatch facility design has two influent pump stations, operating in series with a standby generator. Solids treatment for Potlatch will be with an aerobic digester and solids will be trucked off-site in liquid form for final dewatering and disposal at the Core Reservation plant.

The basic design data and sizing calculations of each unit process of the treatment works has been developed, which are necessary to consistently achieve the expected efficiencies of the entire plant, while reliably producing the anticipated Class A effluent. Key to successful startup of this plant is that at least 50 percent of the flow comes from residential sources, which is necessary to even out the intermittent flows from the State Park. To achieve this, it is recommended that at least 50 residences be connected to the plant at startup.

- The effluent will be suitable for discharge to an infiltration basin or for unrestricted reuse and disposed of by soil percolation in infiltration beds. The infiltration basins will be located on the west side of Potlatch State Park near the existing drainfields.
- Based on preliminary design criteria, costs were developed for each component of the recommended plan. The total capital cost of the recommended plan is $5,582,000.
- Annual operation and maintenance costs for the recommended plan are $251,000.
- It is recommended that the utility reinvest about $46,000 annually for repair and replacement of equipment

## Project Schedule

It is expected that upon initiation of the design phase it will take a minimum of two to three years to implement this plan, of which 12 months is necessary to complete the design, acquire funding, acquire easements as necessary (for the collection system), and decommission the old septic tanks. It is anticipated that construction and decommissioning will take approximately two years to complete. The treatment plant could be up and running in two years if an alternate delivery approach is used, such as design-build.

## Financial Impact

As discussed in Section 9, the financial impacts of initiating, developing, and constructing the capital improvements have been quantified. Financial Consulting Solutions Group, Inc. evaluated current and available funding sources, developed funding scenarios, identified user rates for two scenarios, and recommended a financial strategy to establish a viable utility based on the program costs presented.

The Tribe, Mason County, and Washington State Parks have already secured grants toward financing the project, which can be used to match funding from other loan programs.

Two basic scenarios for funding the initial capital costs of the system were evaluated. Scenario 1 is based on a obtaining a PWTF loan and contemplates monthly sewer rates as the primary means of funding operations, debt repayment, and capital reinvestment. Scenario 2 assumes that capital costs are grant funded entirely and that monthly sewer rates will fund operations and capital reinvestment.

Under Scenario 1, a loan of $4,542,000 would have to be obtained to supplement available grant funds of $1,350,000, financing a capital cost program totaling $5,890,000 (cost escalated to year of projected spending). Even so, the monthly rate per ERU is significant, and in order to keep monthly rates around $24/month the tribe must supplement the program, in the amount of $162,000 under Scenario 1 (loan funded program) and $71,000 under Scenario 2 (100 percent grant funded program), respectively.

## CORE AREA

### Plan Elements

The following are key elements of the recommended plan for the Core Area:

- Initially sewer collection and conveyance must be provided for within the service area, which will consist of a low-pressure sewer system to serve the central Core Service Area, including commercial and residential properties east of Highway 101, from the north end at Minerva Terrace down to the junction with Highway 106. The collection system will extend east along Reservation Road and down Tribal Center Road. All flow will be pumped by the individual grinder pumps into a common low pressure head system, which will then convey all wastewater to the new treatment facilities.

- At the new treatment facilities, wastewater will be treated to Class A standards and provide reuse through infiltration beds. Each facility design has microscreening/grit removal at the headworks, flow equalization, biological treatment (MBR), and ultraviolet light disinfection prior to discharge. The Core facility design has an effluent pump station, single, radial power distribution with a standby generator. Solids treatment for the Core plant will be with an aerobic digester. Solids will be dewatered with a belt filter press and hauled to a permitted landfill or land application system for final disposal. The belt filter press is sized to dewater all solids trucked in from the Potlatch plant.

  The basic design data and sizing calculations of each unit of the treatment works has been developed which are necessary to consistently achieve the expected efficiencies of each unit and also of the entire plant, reliably producing the anticipated Class A effluent.

  It should be noted that there are no known future developments that will produce industrial wastes; therefore there are no provisions for pretreatment of significant industrial sources. However, the Lucky Dog Casino produces a high strength wastewater which has been accounted for in the biological process sizing.

- The treatment facilities will be located on the southeast corner of the WSDOT site and the infiltration basins (initial only) will be located on the east side of Highway 101 on the Richard Smith property. Siting of the infiltration basins for the ultimate plant has yet to be confirmed.

- Based on preliminary design criteria, costs were developed for each component of the recommended plan. The total capital cost of the recommended plan is $8,923,000.

- Annual operation and maintenance costs for the recommended plan are $386,000. This cost includes plant management and utility billing, assuming they are also managing the Potlatch Bubble plant.

- It is recommended that the utility reinvest about $72,000 annually for repair and replacement of equipment.

## Project Schedule

It is expected that upon initiation of the design phase it will take a minimum of three to four years to implement this plan, of which 18 months is necessary to complete the design, acquire funding, acquire easements as necessary (for the collection system), and decommission the old septic tanks. It is anticipated that construction and decommissioning will take approximately two to three years to complete, depending on how quickly the conveyance piping can be constructed. The treatment plant could be up and running in two years if an alternate delivery approach is used, such as design-build.

## Financial Impact

As previously discussed, the financial impact of initiating, developing, and constructing the capital improvements have been quantified. Financial Consulting Solutions Group, Inc. evaluated current and available funding sources, developed funding scenarios, identified user rates for two scenarios, and recommended a financial strategy to establish a viable utility based on the program costs presented.

The Tribe, Mason County, and Washington State Parks have already secured grants toward financing the project, which can be used to match funding from other loan programs.

Two basic scenarios for funding the initial capital costs of the system were evaluated. Scenario 1 is based on a obtaining a PWTF loan and contemplates monthly sewer rates as the primary means of funding operations, debt repayment, and capital reinvestment. Scenario 2 assumes that capital costs are grant funded entirely and that monthly sewer rates will fund operations and capital reinvestment.

Under Scenario 1, a loan of $7,450,000 would have to be obtained to supplement available grant funds of $2,159,000, financing a capital cost program totaling $9,609,000 (cost escalated to year of projected spending).

Even so, the monthly rate per ERU is significant, and in order to keep monthly rates around $24/month the tribe must supplement the program, in the amount of $678,000 per year under Scenario 1 (loan funded program) and $252,000 per year under Scenario 2 (100 percent grant funded program), respectively.

## IMPLEMENTATION OF THE RECOMMENDED PLAN

### Implementation

The cost to implement a new wastewater conveyance, treatment, and disposal system will result in a severe monthly impact to the rate payer, especially if the tribe does not contribute to the program. Implementing this plan also presents a challenge in that a new utility must be formed to construct and operate the system.

In addition, it cannot be stressed enough the need to pursue every possible grant and loan program, traditional and non-traditional, thereby lessening the financial impact.

The recommended strategy for implementation of this plan should focus on two main areas of activity:

1. Pursuit of project funding assistance
2. Development of a new utility that can implement this program
3. Continue with necessary siting studies and preliminary design, which will provide more accurate cost estimates

Toward this end, it is recommended that the Tribe:

- Pursue all available grant and low cost loan programs

- Begin to form the entity or utility that will operate and maintain the system. Set a realistic, but aggressive schedule to accomplish this.

- Develop sound financial policies addressing utility reserves, capital improvement and replacement funding, debt policies, rate equity, and financial administration.

- Establish and adopt appropriate tribal ordinance and resolutions that implement the formation of the utility and give it the authority to set rates, charge customers, and execute the financial management of the utility.

### For Further Discussion

Additional discussion should occur for the following issues, because they may affect key assumptions for flow and load estimates, process sizing, and financial impacts:

- The ERU used for financial analysis is based on the current density of tribal housing of 4.19 persons/ household and a per capita usage of 100 gallons/day. This ERU may be non-representative for non-tribal residences and as a result, reduces the actual number of non-tribal ERU's. It may be beneficial to conduct the financial analysis with tribal and non-tribal ERU's that are representative of each.

- At the time of publication of this document, results of the geotechnical investigation were just becoming available. Higher rates of infiltration were used in the calculations for this report than are supported by the latest data. This means that larger areas for infiltration basins could be required to serve Phase 1 of sewer development, and additional basin sites may be needed for the ultimate phase than are contemplated in this document. Although the planning level cost estimates presented may also need to be increased, there should be sufficient room in these estimates to accommodate some change.

  Permitting final infiltration basins will require substantial exploration and even testing during design. It is during design that basin sizing will be closely matched with the results of detailed soils analysis and further refinement of projected flows.

- Again, it cannot be emphasized more strongly that successful development of a wastewater treatment system for the Potlatch Bubble depends upon hooking up at least enough homes to balance out the intermittent flows that will be produced by the Potlatch State Park. Compliance with effluent discharge limitations is critical, because “out-of-compliance” overflow basins are not included in the cost estimates. It is recommended that the residential flow component for Potlatch be at least 50 percent of the total flow.

- In addition, because untreated wastewater is being pumped up to the Potlatch Bubble site (elevation 260 feet), it is recommended that finding a lower site, ideally at elevation of Highway 101, would result in significant cost savings. Cost savings would be in the form of two pump stations, several thousand feet of pipe, and lower operation and maintenance costs.

- The t3ba’das (pronounced “Tebadas”) housing project is proceeding at rapid pace and construction will be initiated in August 2007. Currently, the project includes a significant investment in an on-site community drainfield, which is scheduled for construction in late 2007 and early 2008. Therefore, development of a treatment plant for the Potlatch Bubble should be implemented with this in mind and possibly accelerated to avoid spending money on a drainfield system that will be used on a temporary basis.

# SECTION 1
# INTRODUCTION

## BACKGROUND AND PURPOSE

The Skokomish Indian Tribe (SIT) Wastewater Master Plan – Final Report was completed in November 1998. The Plan included a preliminary analysis of all the components of a wastewater system for the Reservation, including the existing on-site wastewater systems, flow and load estimates, and wastewater collection, treatment and disposal alternatives. The recommended system included:

1. A pressurized collection system, with grinder pumps, to reduce inflow and infiltration (I/I) in the high groundwater areas.
2. A single, centralized treatment plant, with a complete mix aerated lagoon and clarifier (Biolac) treatment system. Optional treatment systems included the Sequencing Batch Reactor and the recirculating gravel filter. The recommended location was the former WSDOT maintenance yard.
3. Disinfection technologies using ultraviolet radiation.
4. Sludge disposal using land application in the forest on the western hills.
5. Effluent disposal with rapid infiltration north and east of the former WSDOT maintenance yard, or on the WSDOT parcel, toward the back of the property.

Substantial developments have occurred since completion of the November 1998 Master Plan, including:

1. Advances in treatment technology have led to a revision to the recommended treatment technology.
2. Tribal land use maps have been developed, in addition to a population assessment (SIT, 2006).
3. A Nonpoint Source Assessment and Preliminary Management Plan have been prepared for the Reservation. The plan includes development of wastewater services (SIT, 2006).
4. A total maximum daily load (TMDL) has been approved for fecal coliform in the Skokomish River. The Clean-Up Plan includes development of a wastewater treatment system for the Reservation (Washington Department of Ecology (DOE), 2001).
5. Several fish kills in Hood Canal have been assessed, and attributed to nitrogen loading. The Skokomish River was estimated to be the largest source of nitrogen in the basin (USGS, 2006). The State of Washington has committed substantial resources to improving conditions in the Canal.
6. A recovery plan has been adopted for the Hood Canal Summer Chum ESU (National Marine Fisheries Service, 2007).

This report is intended to amend the Plan to reflect changed conditions, including water quality, regulatory requirements, engineering technology, and population projections, per WAC 173-240-030(4), 7/11/00. The amendment is intended to be the wastewater facilities plan which, if approved, would be the basis for preparation of final plans and specifications for wastewater facilities for the Reservation.

## DEVELOPMENT PROCESS FOR FACILITY PLAN UPDATE

The Hood Canal Coordination Council provided funds to Mason County for a review of wastewater management options for the western shore of Hood Canal from Hoodsport south through the Skokomish Indian Reservation. The County funded an Action Team, consisting of representatives from the Tribe, Hoodsport, Mason County, and Washington State Parks and Recreation. The Action Team facilitated the review, comment and participation of several state agencies to assure a coordinated Tribal, County, and State of Washington involvement and response. The purpose was to assemble data and examine ways to improve Hood Canal water quality which suffers from low dissolved oxygen and fecal contamination, by eliminating existing septic systems. The review was completed in September 2006, and is summarized in the Wastewater Management Alternatives Analysis (2006).

Based on the review, one of the major sources of the water quality problems in Hood Canal is widely presumed to be residential and commercial wastewater along and near the shoreline. The current management technique is conventional septic systems that do not treat for nitrogen. Too much nitrogen reaching Hood Canal results in low dissolved oxygen. Inadequate conventional septic systems also result in fecal contamination, an indicator of unsuitable bacterial contamination.

Mason County secured funding for the Project Definition phase of the Wastewater Facilities Planning phase of the project, and working with the County, Tribe, and WSPRC. Cascade Design Professionals, Inc. prepared the document with coordination by Sharar Consulting and others. The Project Definition Report was presented to the Tribe and Mason County followed by release to the public (March 2007). The Report is included in Appendix J.

The Project Definition Report effort concluded that two separate treatment plants, one located at Potlatch State Park and one at the Core Reservation was the most beneficial solution for the Tribe. While a single treatment plant located at the Core Reservation may be possible, and would certainly be reliable and cost effective, it was determined that the needs of the Tribe will be best met by taking a different, localized approach. The decision to pursue this path took into account not only cost, available land and environmental issues, but also current development goals of the Tribe and their ability to establish, finance, and manage a new wastewater collection and treatment utility.

In addition, the recommended treatment technology, collection system and effluent disposal system were evaluated in the Project Definition Report. The results of that analysis are summarized in the Project Definition Report, and are not duplicated in this Amendment. A brief summary of the results are included in Section 8.

Wastewater service areas were revised very little from the original Plan. Some fine tuning of the service area boundaries was developed with direction from the Tribe’s Wastewater Planning Committee, which included Tribal staff, Tribal Council members and consultants. The service areas were separated into two phases, Phase 1 (2014) and Ultimate Build Out (2029). The separation of the two phases was prepared in response to Tribal direction, as a way to define an initial project that is economically feasible.

The location alternatives for the treatment plants and for effluent disposal (infiltration beds) have been further developed, and are summarized in Section 8, as well. Finally, the level of development of these options was developed from a rudimentary conceptual level to a schematic design level. Financial requirements for development of the systems have also been further developed.

## PROJECT DESCRIPTION

The Skokomish Reservation wastewater system will include two separate systems for collection, treatment and disposal, one for the northern half of the reservation, called the Potlatch Bubble, and the second for the southern half of the reservation, called the Core Area (see Figure 1, Project Location). Each system will be constructed in two phases, to reduce initial capital costs. Both systems may be operated as two separate utilities, sharing or contracting staff time, to reduce costs and increase efficiency. The financial analysis of the systems was developed based on this assumption.

The project location map is shown in Figure 1.

### Potlatch Bubble System

The Potlatch Bubble system includes service to the following areas (see Figure 2):

1. The new Tribal Housing west of Potlatch State Park (Service Area A),
2. The Park (Service Area B), including an expansion of the Park to the north and west of the highway,
3. Minerva RV Park (Service Area C),
4. And a small residential area adjacent to Hood Canal and north of Minerva RV Park in the service area creep (Service Area D).
5. A residential and commercial area that extends from Tillicum Beach to the reservation boundary, and includes Mason County PUD #1 and the Cushman Lake Powerhouse/Tailrace (Service Area E).

Services in this area include grinder pumps, for individual residences in the service area creep, a single large grinder pump for Minerva RV Park, an upgraded lift station in the State Park, and an upgraded lift station for the new Tribal Housing.

The treatment plant for the Potlatch Bubble is located near the existing State Park septic drainfield, on the western edge of the Park. The plant is a Membrane Bioreactor (MBR) plant, the preferred technology to achieve nitrogen removal and Class A effluent standards, with minimal risk of violation. Sludge drying will be off-site, at the Core Area treatment plant.

Effluent disposal will be done with infiltration beds, near the site of the existing Parks drainfield. The highly treated Class A effluent will be infiltrated slowly in a series of several terraced infiltration beds.

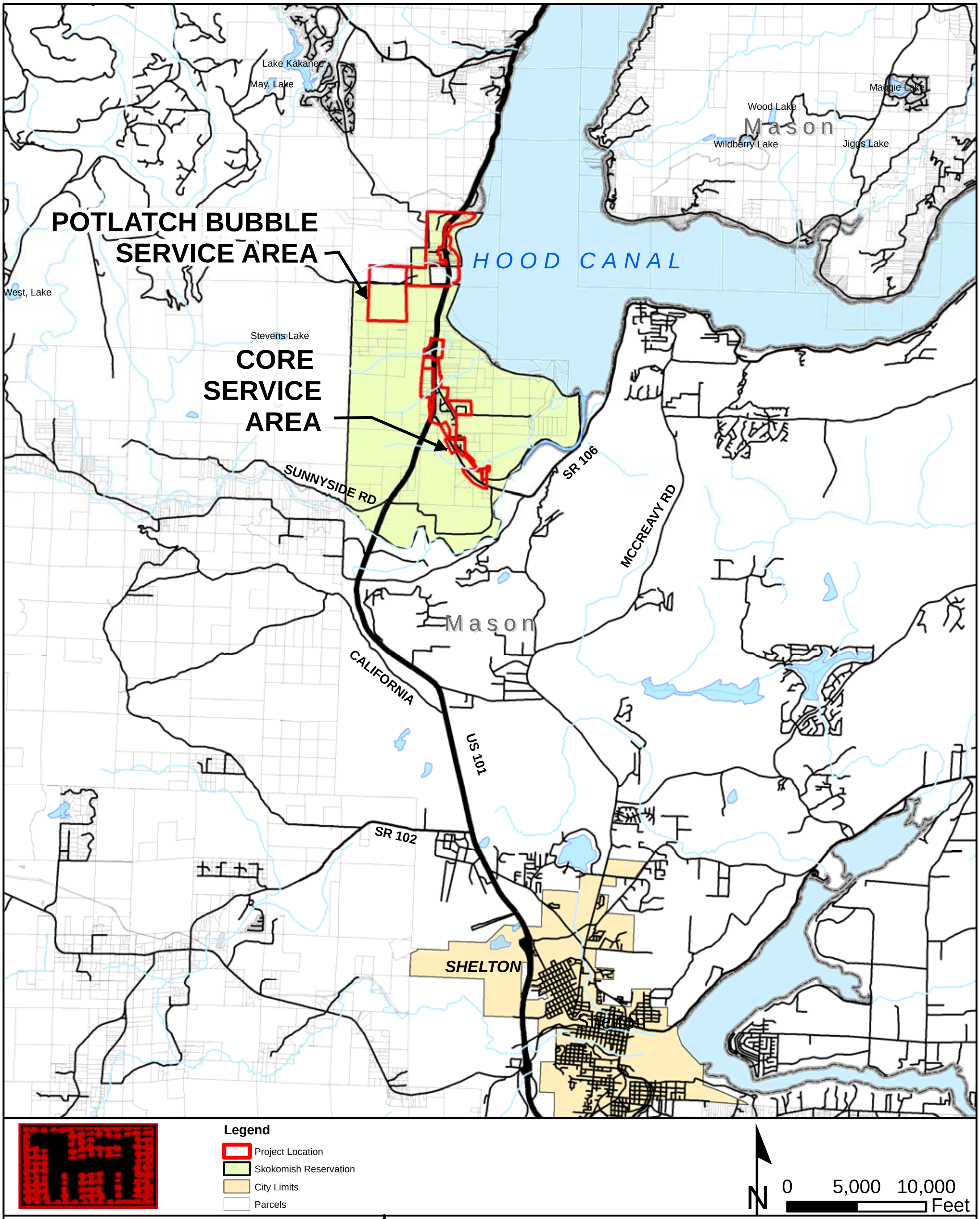
**Core Area System**

The Core Service Areas are shown in Figure 3. The system includes service to residences and businesses on Highway 101 (Service Area G), to a small area identified for commercial development in the near term, located at the intersection of Highway 101 and SR 106 (Service Area H), to the residential area along Reservation Road and Tribal Center Road, extending to the Tribal Center (Service Area J).

Service in this area will be provided with a low pressure system including grinder pumps and a pump station for the Casino.

The treatment plant for the Core Area is located on the west side of Highway 101, at the former site of the WSDOT maintenance yard. The plant is an MBR plant and will include sludge dewatering facilities. Biosolids disposal will be land application to forest land as recommended in the original Master Plan.

Effluent disposal will be done with infiltration beds on the east side of Highway 101, just north of the former WSDOT parcel. The highly treated Class A effluent will be infiltrated slowly in a single infiltration bed on the western edge of the Richard Smith property.



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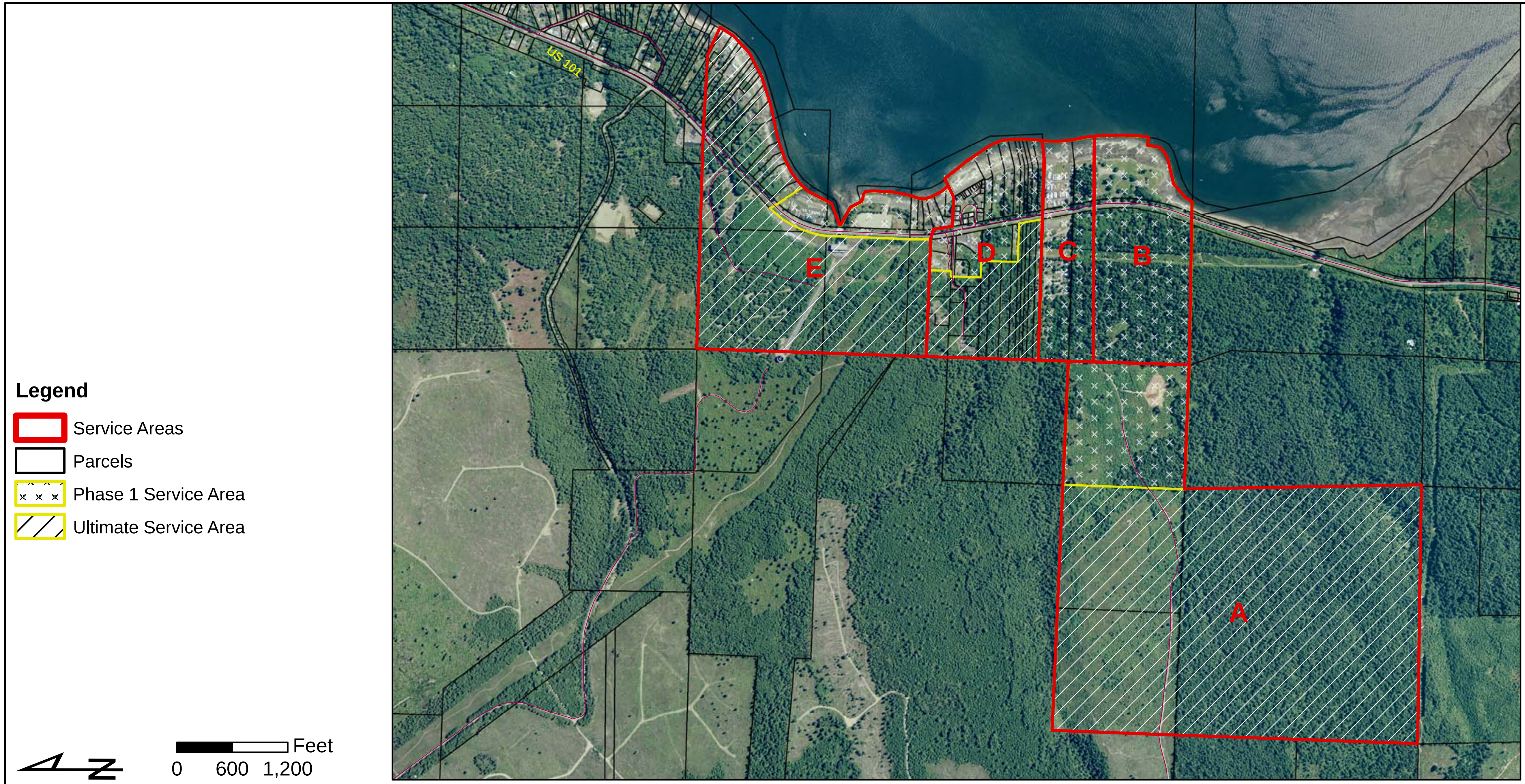
## PROJECT LOCATION
## Skokomish Reservation
## Wastewater System

**Figure 1**



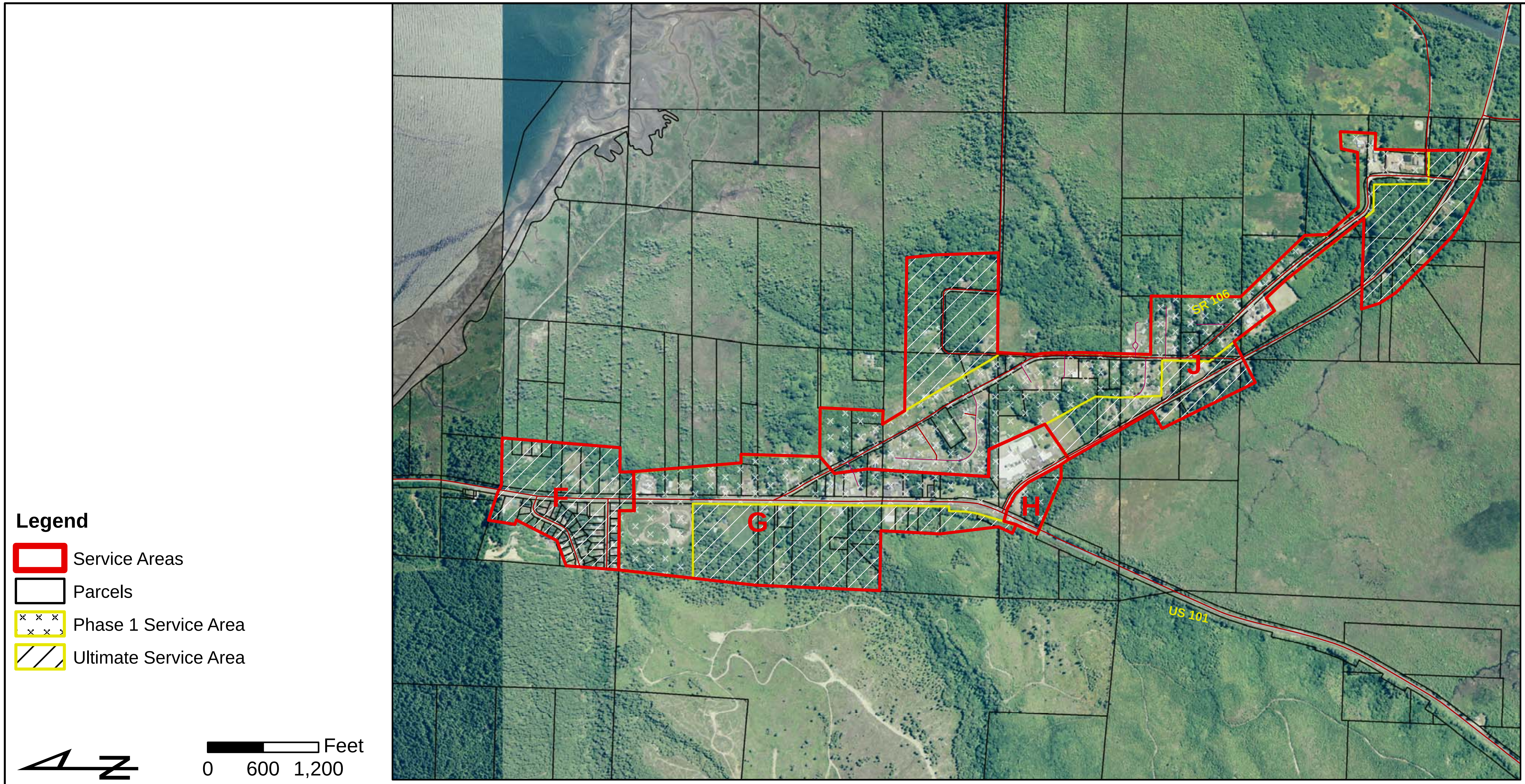
CASCADE DESIGN

**NOTE:**

1. Locations are approximate and must be verified

## FIGURE 2

## Potlatch Bubble Service Area



**NOTE:**

1. Locations are approximate and must be verified

CASCADE DESIGN

FIGURE 3

Core Reservation Service Area

# SECTION 2
# STUDY AREA ENVIRONMENT
# AMENDMENT TO CHAPTER 2 NATURAL AND CULTURAL ENVIRONMENT

The 1998 Wastewater Master Plan documented water quality monitoring, wetland assessments and the status of several stocks of fish in the Skokomish River. The Plan also included a hydrogeologic evaluation of the area. The Plan indicated water quality monitoring results were in violation of Class AA water quality standards for fecal coliform and dissolved oxygen in Skabob Creek, in the Core Area (see Appendix A). Fish populations were depressed, but none were identified as listed endangered under the Endangered Species Act. Shellfish beds had never been closed to harvest for health risks.

Since the Plan was published severe water quality conditions have occurred in the river and in Hood Canal, and several fish have been listed as endangered. Studies show significant impacts of fecal coliform and nitrogen loading to the Skokomish River and Hood Canal. Shellfish beds have been closed to harvest several times. The study results are briefly summarized in this section, along with key elements of the 1998 Master Plan.

## SURFACE WATER IMPACTS – FECAL COLIFORM

A Fecal Coliform (FC) TMDL Study and Clean-Up Plan for the Skokomish River included the following summary of fecal coliform monitoring:

> “Bacterial contamination of fresh and marine waters in the lower Skokomish River basin was found through water quality monitoring programs since 1995 by the Department of Ecology (Ecology), Department of Health (DOH), and the Skokomish Tribe (Tribe). Ecology listed eleven streams in the lower Skokomish River basin under Section 303(d) of the federal Clean Water Act in 1996 for not meeting water quality standards for fecal coliform bacteria. Only eight of these streams were listed in 1998. In all but one year since 1995, DOH has listed the Annas Bay commercial shellfish harvest area as threatened due to FC contamination.” (10)

The Study also documented sources of fecal coliform:

> “Sources of FC pollution in the project area include humans, domestic animals, and wild animals. The domestic livestock population in the lower valley is estimated to include about 500 cattle, and a smaller number of horses, llamas, goats, and chickens (Mason County Conservation District, 2001). Estimates of wild animal populations (e.g. elk, deer, beaver, waterfowl, and other warm-blooded animals) were not obtained.” (10)

Finally, the SIT Nonpoint Source Assessment and Preliminary Management Plan summarized Hood Canal shellfish impacts due to fecal contamination:

> “Tribal, commercial, and recreational harvesters use the Annas Bay shellfish resources. Shellfish beds are located within, and to the south of Potlatch State Park and to the east

> near the town of Union. Commercial shellfish beds near the mouth of the Skokomish River recently closed (August 2005) due to fecal contamination." (9)

Reviewing a USGS study of increased flooding in the 1990's, flooding occurred 3 times in the Skokomish River floodplain to a depth at the gauge (upstream of Highway 101) that approximated the 100 year flood elevation in the FEMA Flood Insurance Study (FIS) (31 ft, NAVD 88). (4) If the FIS were accurate, the flood elevation downstream of SR 106 would have been approximately 22.4 ft NAVD 88. Each of these floods submerged approximately 126 septic systems in the Core Area.

Tribal staff summarized the documented causes of increased flooding in the Skokomish River floodplain. The following excerpt is taken from the Nonpoint Assessment Report and Preliminary Management Plan:

> "In general, human activities have altered the entire natural hydrologic regime in the Skokomish basin. For example, according to research, (Barreca, 1998), forest practices, road building, dikes, levies, and other land use practices have caused filling of the lower river channel with aggregate to over five times background levels. This has increased the frequency and intensity of flood events, increased basin groundwater levels, and caused septic system failures. In addition, tidal fluctuations affect the lower Skokomish River to approximately river mile 1.8 (Seiders et al., 2001) which exacerbates groundwater concerns during high tide and high flood flows events.
>
> "Hydroelectric power generation influences the lower Skokomish system and the Reservation. Ninety (90%) percent of the North Fork Skokomish river flow is diverted through the Cushman Dam project, causing a forty-five percent(45%) reduction of the mainstem Skokomish River flow (KCM, 1997). The flow in the lower North Fork Skokomish River is limited to the non-impounded 60 cubic feet per second (cfs)[1], and the drainage of adjacent slopes, and infrequent releases or spills from the lower dam (EPA, 2004; Golder, 2002). It is believed that this reduction in flow is one of the factors, which has caused a filling of the lower Skokomish River and increased flooding throughout the lower Skokomish basin."

## SURFACE WATER IMPACTS - NITROGEN

In 2006, nitrogen loading was determined to be the cause of several fish kills in the Hood Canal. (1) Nitrogen sources were evaluated for the entire Hood Canal drainage basin, and the Skokomish River was found to be the highest source, by a factor of 2.5. One-hundred and thirty-one metric tons of dissolved inorganic nitrogen (DIN) were estimated to flow into the Canal from the Skokomish River, per year.

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[1] Recent legal findings and Federal Energy Regulatory Commission (FERC) licensing requirements may require 240 CFS be put back into the North Fork Skokomish River. United states of America FERC 107 61,288 June 21, 2004

The fish kills were greatly alarming in that all aquatic life in the Canal was severely impacted, and as many as 1/3 of the fish may have died. (2) The kills led to the development of an initiative by Governor Gregoire to protect water quality throughout Puget Sound including the Hood Canal, called The Sound Partnership. The State of Washington has subsequently made substantial commitments to addressing the health of aquatic life in Hood Canal and in Puget Sound.

## GROUNDWATER IMPACTS

The water table in the Core Area may be within 5 – 6 ft of the ground surface in summer, and near the ground surface in the winter. However, the aquifer in this area is primarily recharged from upland infiltration. (6) But bacterial contamination has occurred in shallower (< 100 ft) water supply wells. There are a total of 37 water supply wells in the Skokomish River floodplain. Flooding can cause fecal and nitrogen contamination of the wells, from existing septic drain fields. The wells are generally 100 to 150 feet deep. (5) See Appendix G for well and failing septic mapping.

Poor soil conditions dominate the Core Reservation Service Area in the Skokomish River floodplain. (5) Poor soil conditions generally impair the operation of the existing septic systems, leading to a risk of groundwater contamination. When septic tank effluent flows into a mound where soils are saturated, nitrogen contaminants remain untreated, and ammonium is leached into the groundwater. Alternatively, when septic tank effluent is discharged into a mound with gravelly coarse sands, the ammonium and organic nitrogen are converted to nitrate, which is leached to the groundwater.

# SECTION 3
# REGULATORY REQUIREMENTS
# AMENDMENT TO CHAPTER 5 REGULATORY REQUIREMENTS

The 1998 Master Plan Chapter on Regulatory Requirements focused primarily on standards for effluent discharge, wastewater solids disposal and septage. Effluent disposal standards have been revised in small ways, to address the changes in effluent disposal designs. Typical infiltration bed designs provide secondary treatment to the effluent. The recommended approach for the Reservation is infiltration of Class A effluent, which does not require further treatment. As such, the regulation governing design and discharge in these types of systems is still being refined.

The current water quality and environmental health conditions in Hood Canal, outlined in Section 2, bring an extremely high level of sensitivity to the protection of water quality in the Canal. The Endangered Species Act and the Federal Clean Water Act both include provisions for enforcement by litigation of “no harm” to the endangered fish in the Canal, and “non-degradation” to water quality in the Canal.

In addition to the Endangered Species Act and the Federal Clean Water Act, the State Legislature identified the lower Hood Canal as “Aquatic Rehabilitation Zone No. 1,” in 2005. And in August 2006, a Memorandum of Understanding (MOU) was adopted by the Tribe, Mason County and the Public Utility District, outlining responsibilities of each party to ensure wastewater systems are planned, constructed and managed in collaboration with the others, with the intent to improve water quality in Hood Canal.

Important regulatory components of the Federal Clean Water Act include the development of TMDL’s for water quality limited surface waters, and a Nonpoint Source Assessment for potential pollution impacts to surface waters. A TMDL has been prepared for the Skokomish River. A wastewater sewer system for the area contributing to the Skokomish River (Core Area) is identified as one component in the Skokomish River Fecal Coliform TMDL Clean-Up Plan (2001). The sewer system is also identified as a component in the SIT Nonpoint Source Assessment and Preliminary Management Plan, which addresses the entire Reservation area (Potlatch Bubble and the Core Area).

An Environmental Assessment (EA) concerning compliance of the Amendment with the Tribal National Environmental Policy Act (NEPA), is being drafted by Adolfson and Associates. This section may be updated once the draft EA is completed.

## SURFACE WATER QUALITY STANDARDS

The TMDL Clean-Up Plan and the Nonpoint Source Assessment include the following summaries of regulatory authority for the Skokomish River and Hood Canal:

Water quality within the Skokomish Indian Reservation is under the jurisdiction of the Skokomish Tribe, which is currently developing water quality standards that will be applicable within tribal lands. (10)

Beyond tribal lands, water quality of the freshwaters of the Skokomish River and the marine receiving waters of Hood Canal are under the jurisdiction of the State of Washington. These waters are classified as Class AA (extraordinary) in Chapter 173-201A-030, WAC: Water Quality Standards for the Surface Waters of the State of Washington. (10) Applicable paragraphs of the Code are included here:

Freshwater standards apply to the Skokomish River where salinity is less than ten parts per thousand (WAC 173-201A-060) and marine water standards apply in the receiving waters where salinity is 10 parts per thousand (ppt) or higher:

> *Freshwater - fecal coliform organism levels shall both not exceed a geometric mean value of 50 colonies/100 ml, and not have more than ten percent of all samples obtained for calculating the geometric mean value exceeding 100 colonies/100 ml.*
>
> *Marine water – fecal coliform organism levels shall both not exceed a geometric mean of 14 colonies/100 ml, and not have more than ten percent of all samples obtained for calculating the geometric mean value exceeding 43 colonies/100 ml.(10)*

EPA and the Skokomish Tribe have federal Clean Water Act authority on the Skokomish Reservation. It is anticipated that they will work with farmers and residents to reduce fecal coliform loading coming from the reservation. (10)

## BIOLOGICAL RESOURCE PROTECTION STANDARDS

Natural resource management and protection authorities, including for Hood Canal Chum and shellfish, is shared between the Tribe and NOAA's National Marine Fishery Service. Two federal court rulings form the basis for Tribal authority and responsibility for natural resource management, the Boldt Decision (1974), and recent rulings upholding treaty-reserved shellfish harvest rights. (11)

In May, 2007 NOAA's National Marine Fisheries Service approved the Hood Canal Chum ESA Salmon Recovery Plan. The needed improvements to water quality in the Canal are substantial in order to restore aquatic health.

For evaluating the quality of water for shellfish harvest, Washington State Department of Health's criteria are similar but are not bound to the 10 ppt salinity threshold since federal guidelines are used as part of the National Shellfish Sanitation Program. (10)

## EFFLUENT DISPOSAL CRITERIA

Though the Tribe has not adopted its own standards or Washington Department of Ecology (WDOE) standards, regulatory direction concerning water quality in this region should meet or exceed effluent discharge requirements that are equivalent to DOE's Class A reclaimed water standards. Class A reclaimed water is of such high quality that its use is unrestricted and direct human exposure (but not routine consumption) is allowed.

The treatment criteria for treated effluent shall meet DOE Class A reclaimed water standards as outlined in DOE's Water Reclamation and Reuse Standards, and summarized in Table 1.

**Table 1. Secondary Effluent Design Criteria for Class A Reclaimed Water**

| Parameter | Monthly Average | Daily Limit |
|---|---|---|
| BOD5 (mg/L) | 10 | |
| TSS (mg/L) | 10 | |
| Turbidity (NTU) | 2 | 5 |
| Total Nitrogen (mg/L) | n/a | 10 |

From the DOE Wastewater Reclamation and Reuse Standards (1978):

"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.

Effluent disposal requirements outlined in the DOE Water Reuse Standards require infiltration beds be setback 500 feet from any drinking water well. Requirements also include standards for reliability, alarms and emergency storage provisions, back up power supplies, and monitoring requirements for some water quality constituents.

# SECTION 4
# LAND USE AND POPULATION
# AMENDMENT TO CHAPTER 2 CULTURAL AND NATURAL ENVIRONMENT

Since the original 1998 Master Plan was prepared, the following land use planning developments have occurred:

1. The Tribe has conducted a population assessment and begun to develop a land use plan.
2. The Tribe has completed planning and design for a substantial new housing development, tɜba'das (pronounced "Tebadas"). The first phase of construction for the new housing has begun.
3. Potlatch State Park has completed a land exchange, to allow the Tribe to construct an access road to the new housing. The exchange included Minerva RV Park property, west of Highway 101, which will allow future expansion of the Park.

In recent years many Tribal members have returned to live on the Reservation, and many more have entered their names on a waiting list (over 70 families) for housing on the Reservation. The non-Indian population north of Potlatch State Park has also grown. And the Tribe operates the Lucky Dog Casino, and is hoping to expand it in the near future.

The growth that has occurred and the planning efforts for future growth are the basis for updates to the population and flow estimates. The planning horizons used to develop the Project Definition Report included 2 phases, called Phase 1, in 5 years, and Ultimate Build Out, in 20 years.

The original Facility Plan included a map of land ownership, divided amongst Tribal, fee status (alienated) and Trust (federal government) ownership. Ownership defines regulatory authority. A brief discussion of ownership is included in Section 3, Regulatory Requirements. For the purposes of this section, the updated land use mapping is sufficient.

## LAND USE PLANNING

A draft map of land use types based on planning efforts developed by the Tribe is shown in Figure 4. The Tribe is in the process of defining the land use types, therefore these maps are subject to change; however, they are sufficient for purposes of this study.

Planning assumptions for the Reservation were developed through input from a Wastewater Planning Committee, set up by the Tribe to support the wastewater planning process. The Committee worked closely with the Tribe's consultant team to develop the growth projections and review the boundaries of the service areas. The Committee met five times in the winter of 2006. The Committee initiated the idea of a phased approach for the implementation of the sewer systems for the Reservation. The planning assumptions were documented by the Tribe's consultant team in a memo, which is included in Appendix B.

### Potlatch Bubble

The Tribal housing development (t3ba'das ) near Potlatch State Park is in its initial phase of construction, with occupancy planned for May 2008. The planned first phase of development of new homes is the basis for Phase 1 growth projections. The ultimate growth projection was based on full build out of the planned Tribal housing.

Growth in Minerva RV Park west was based on State Parks staff comments. Minerva RV Park east is completely built out and cannot grow in the future.

Commercial growth was estimated by the Tribal wastewater planning committee to include two new commercial businesses south of the PUD, with some additional projections for growth to the north, based on acreage. Growth in the service area north of the Public Utility District (PUD), called the community of Potlatch in the Mason County Comprehensive Plan (updated 2005), was estimated to occur at a rate of 1.5% per year. The area is identified as a hamlet, and as such it is targeted for increased density in the future. The area is included in service area E.

### Core Area

The Core Area planning assumptions included:

1. Land near Highway 101 is above the floodplain, and available for development. Land on Reservation Road and SR 106 will not be further developed.
2. Residential growth along Highway 101 will occur at a rate of 2% per year.
3. Commercial growth along Highway 101 will occur in a narrowly defined corridor on Highway 101, approximated on a per acre basis in the general area shown on the land use planning map.
4. The Tribal Center will be relocated along Highway 101, during Phase 1.
5. A new Boys and Girls Club will be constructed near the elementary school, during Phase 1.
6. The Lucky Dog Casino was projected to grow 400% over a period of 5 years, during Phase 1.

## POPULATION

Population estimates from the 1998 Master Plan are included in Appendix C. For this Plan Amendment, updated estimates for current and future population are based upon a population assessment, performed by the Tribe, and on direction for planned growth on the Reservation from the Tribe's wastewater planning committee.

### Potlatch Bubble

Population projections for the Phase 1 (2014) and Ultimate Build Out (2029) planning timelines are shown in Tables 2 and 3.

Population projections for the new housing are based on 4.16 people per household, as was used for all Core Area households. In general, 2.5 people were assumed to live in each mobile home or RV in Minerva RV Park and serviced in Potlatch State Park. All homes north of Minerva RV Park were assumed to have 2.5 people per household.

Parks staff estimated approximately 21 RVs and mobile homes currently occupy Minerva RV Park on the west side of Highway 101. Counts from aerial photos estimated 20 RVs and mobile homes are established in Minerva RV Park on the east side of the highway. The RV Park also includes an office and laundromat on the west side. The west side of the RV Park was acquired by Washington State Parks, and will be re-developed into an RV camping area. Park staff estimated the capacity of the re-developed area would be 66 RVs.

Future commercial development was based on an estimated acreage available in each service area, with 1.3 businesses per acre, and 25 visitors per business. These estimates may be high, but they provide a conservative basis for planning purposes.

**Table 2. Projected Population for Potlatch Area - Phase 1 (2014)**

| Description | Population |
|---|---|
| **Service Area A. Tribal Housing** | |
| Single Family Home | 208 |
| **Total** | **208** |
| **Service Area B. Potlatch State Park** | |
| Residence/Park Office and Shop | 2 |
| **Total** | **2** |
| **Service Area C. Minerva RV Park** | |
| Permanent Residences (east) | 50 |
| **Total** | **50** |
| **Service Area D. Potlatch Bubble Service Area Creep** | |
| Residential (Tillicum Beach Subdivision) | 48 |
| **Total** | **48** |
| **Service Area E. North Reservation Boundary Service Area** | |
| Residential up to Powerhouse | 8 |
| **Total** | **8** |
| **Grand Total** | **316** |

### Table 3. Population for Potlatch Area – Ultimate (2029)

| Description | Population |
|---|---|
| **Service Area A. Tribal Housing** | |
| Single Family Home | 562 |
| **Total** | **562** |
| **Service Area B. Potlatch State Park** | |
| Residence/Park Office and Shop | 2 |
| **Total** | **2** |
| **Service Area C. Minerva RV Park** | |
| Permanent Residences (east) | 50 |
| **Total** | **50** |
| **Service Area D. Potlatch Bubble Service Creep Area** | |
| Residential | 138 |
| **Total** | **138** |
| **Service Area E. North Reservation Boundary Area** | |
| Residential | 145 |
| **Total** | **145** |
| **Grand Total** | **897** |

## Core Area

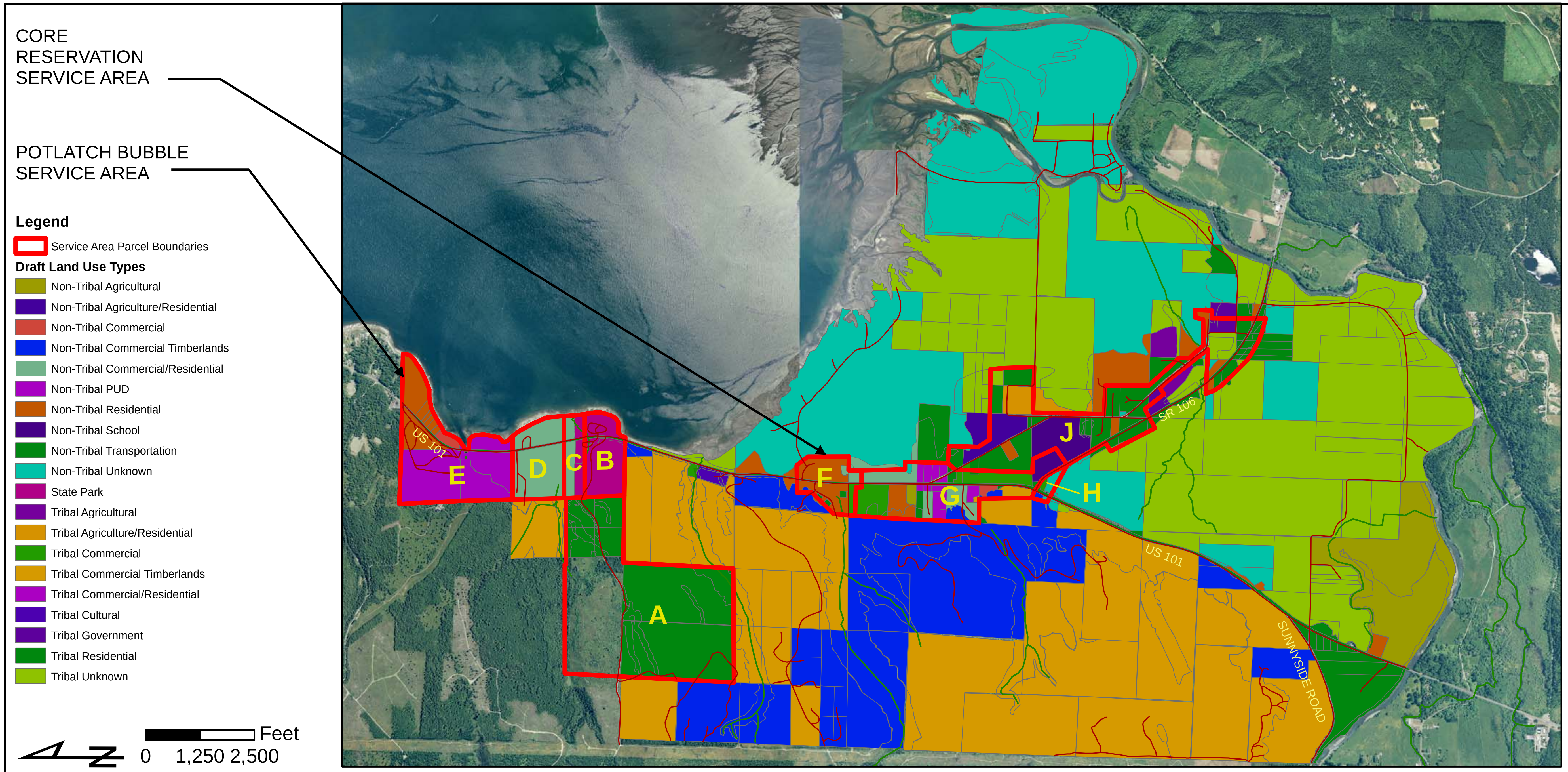
The population growth projections for the Core area are shown in Tables 4 and 5.

**Table 4. Population for Core Area - Phase 1 (2014)**

| Description | Population |
|---|---|
| **Service Area G. Hwy 101 Commercial Area, N. of Hwy 106 to WSDOT Property (Including WSDOT)** | |
| Residential | 29 |
| **Total** | **29** |
| **Service Area J. Reservation Rd & Hwy 106 Mixed Use** | |
| Residential | 449 |
| **Total** | **449** |
| **Grand Total** | **478** |

**Table 5. Population for Core Area - Ultimate (2029)**

| Description | Population |
|---|---|
| **Service Area F. Hwy 101 Residential Area, N. of WSDOT Property** | |
| Residential | 92 |
| **Total** | **92** |
| **Service Area G. Hwy 101 Commercial Area, N. of Hwy 106 to WSDOT Property (Including WSDOT)** | |
| Residential | 197 |
| **Total** | **197** |
| **Service Area J. Reservation Rd & Hwy 106 Mixed Use** | |
| Residential | 566 |
| **Total** | **566** |
| **Grand Total** | **855** |



CASCADE DESIGN

**NOTE:**

1. Locations are approximate and must be verified

FIGURE 4

Land Use
Potlatch Bubble
& Core Area

# SECTION 5
# WASTEWATER FLOWS AND LOADS
# AMENDMENT TO CHAPTER 3 FLOW AND LOAD PROJECTIONS

System design flows are documented in this section. In general, residential use was estimated at 100 gallons per capita per day, and RV residential use was estimated at 80 gallons per capita per day. Equivalent residential units (ERU’s) were developed for utility billing purposes based on an average residential use of 416 gallons per day (4.16 people at 100 gallons per day). However, ERU’s for the Casino were calculated based on BOD loading. Loading assumptions are summarized below.

Future commercial flows were estimated based on estimated acreage available, to ensure the plant would have capacity. However the number of services was not estimated because future commercial development is unknown. Future ERU's may also be less than estimated. The assumed growth of 150 ERU’s at the Casino could substantially affect the utility rate structure, if it does not occur.

## POTLATCH BUBBLE SERVICE AREA

**Table 6. Wastewater Flows for Potlatch Area - Phase 1 (2014)**

| Description | Number of Services | Population | Usage per Capita | Avg Flow (gpd) | ERU's | Peak Flow (gpd) |
|---|---|---|---|---|---|---|
| **Service Area A. Tribal Housing** | | | | | | |
| Single Family Home | 50 | 208 | 100 | 20800 | 50 | 41600 |
| Community Center | 1 | 10 visitors | 15 | 150 | 1 | 300 |
| **Total** | **51** | **-** | | **20950** | **51** | **41900** |
| **Service Area B. Potlatch State Park** | | | | | | |
| Picnic | - | 100 | 5 | 500 | 1 | 1000 |
| Campground w/Central Comfort Station | - | 48 | 35 | 1663 | 4 | 3325 |
| RV Servicing | 1 | 45 | 50 | 2250 | 5 | 4500 |
| RV Hookups | - | 45 | 80 | 3600 | 9 | 7200 |
| Residence/Park Office and Shop | - | 2 | 90 | 180 | 0 | 360 |
| **Total** | **1** | **-** | | **8193** | **19** | **16385** |

### Table 6.  Wastewater Flows for Potlatch Area - Phase 1 (2014), continued

| Description | Number of Services | Population | Usage per Capita | Avg Flow (gpd) | ERU's | Peak Flow (gpd) |
|---|---|---|---|---|---|---|
| **Service Area C. Minerva RV Park (west)** | | | | | | |
| Laundromat | 1 | - | 50 g/load | 1100 | 3 | 2200 |
| Campground w/Central Comfort Station | - | 35 | 35 | 1225 | 3 | 2450 |
| RV Hookups, Westside | - | 165 | 80 | 13200 | 32 | 26400 |
| Residence/Park Office and Shop | - | 2 | 90 | 180 | 0 | 360 |
| **Total** | **1** | | | **15705** | **38** | **31410** |
| **Service Area C. Minerva RV Park (east)** | | | | | | |
| Permanent Residences (east) | 1 | 50 | 80 | 4000 | 10 | 8000 |
| **Total** | **1** | | | **4000** | **10** | **8000** |
| **Service Area D. Potlatch Bubble Service Area Creep** | | | | | | |
| Residential | 19 | 48 | 100 | 4750 | 11 | 9500 |
| **Total** | **19** | | | **4750** | **11** | **9500** |
| **Service Area E. North Reservation Boundary Area** | | | | | | |
| Residential | 3 | 8 | 100 | 750 | 2 | 1500 |
| Waterfront Motel | | | | | | |
| Motel Rooms | 8 | 16 | 80 | 1280 | 3 | 2560 |
| Cabins | 4 | 10 | 50 | 800 | 2 | 1600 |
| RV Spaces | 14 | 35 | 80 | 2800 | 7 | 5600 |
| Staff | | 5 | 15 | 75 | 0 | 150 |
| **Total** | **6** | **-** | | **5705** | **14** | **11260** |
| **Grand Total** | **79** | **-** | | **54428** | **142** | **89695** |

**Table 7. Wastewater Flow for Potlatch Area – Ultimate  (2029)**

| Description | Number of Services | Population | Usage per Capita | Avg Flow (gpd) | ERU's | Peak Flow (gpd) |
|---|---|---|---|---|---|---|
| **Service Area A. Tribal Housing** | | | | | | |
| Single Family Home | 135 | 562 | 100 | 56160 | 135 | 112320 |
| Community Center | 1 | 45 visitors | 15 | 675 | 2 | 1350 |
| **Total** | **136** | **-** | | **56835** | **137** | **113670** |
| **Service Area B. Potlatch State Park** | | | | | | |
| Picnic | - | 100 | 5 | 500 | 1 | 1000 |
| Campground w/Central Comfort Station | - | 48 | 35 | 1663 | 4 | 3325 |
| RV Servicing | 1 | 45 | 50 | 2250 | 5 | 4500 |
| RV Hookups | - | 45 | 80 | 3600 | 9 | 7200 |
| Residence/Park Office and Shop | - | 2 | 90 | 180 | 0 | 360 |
| **Total** | **1** | **-** | | **8193** | **19** | **16385** |
| **Service Area C. Minerva RV Park (west)** | | | | | | |
| Laundromat | 1 | - | 50 g/load | 1100 | 3 | 2200 |
| Campground w/Central Comfort Station | - | 35 | 35 | 1225 | 3 | 2450 |
| RV Hookups, Westside | - | 165 | 80 | 13200 | 32 | 26400 |
| Residence/Park Office and Shop | - | 2 | 90 | 180 | 0 | 360 |
| **Total** | **1** | **-** | | **15705** | **38** | **31410** |
| **Service Area C. Minerva RV Park** | | | | | | |
| Permanent Residences (east) | 1 | 50 | 80 | 4000 | 10 | 8000 |
| **Total** | **1** | **-** | | **4000** | **10** | **8000** |
| **Service Area D. Potlatch Bubble Service Creep Area** | | | | | | |
| Future Commercial | 2 | 25 staff & visitors | 15 gpdpc | 750 | 2 | 1500 |
| Residential | 55 | - | 138 | 13750 | 33 | 27500 |
| **Total** | **57** | **-** | | **14500** | **35** | **29000** |

### Table 7. Wastewater Flow for Potlatch Area – Ultimate (2029), continued

| Description | Number of Services | Population | Usage per Capita | Avg Flow (gpd) | ERU's | Peak Flow (gpd) |
|---|---|---|---|---|---|---|
| **Service Area E. North Reservation Boundary Area** | | | | | | |
| Residential | 58 | 145 | 100 | 14500 | 35 | 29000 |
| Waterfront Motel | | | | | | |
| Motel Rooms | 8 | 16 | 80 | 1280 | 3 | 2560 |
| Cabins | 4 | 10 | 50 | 800 | 2 | 1600 |
| RV Spaces | 14 | 35 | 80 | 2800 | 7 | 5600 |
| Staff | | 5 | 15 | 75 | 0 | 150 |
| PUD #1 | 1 | 5 staff | 35 gpdpc | 175 | 0 | 350 |
| Women's Clubs | 1 | 25 staff & visitors | 15 gpdpc | 375 | 1 | 750 |
| Potlatch Power Plant | 1 | 5 staff | 35 gpdpc | 175 | 0 | 350 |
| Commercial | 6 acres | - | 525 gpd/acre | 3150 | 8 | 6300 |
| **Total** | **64** | **-** | | **23630** | **63** | **47260** |
| **Grand Total** | **260** | **-** | | **122863** | **300** | **245725** |

Note: Future commercial flows for Service Area E were estimated based on estimated acreage available, to ensure the plant would have capacity. However the number of services was not estimated because future commercial development is unknown. Future ERU's may also be less than estimated.

## CORE SERVICE AREA

### Table 8. Wastewater Flow for Core Area - Phase 1 (2014)

| Description | Number of Services | Population | Usage per Capita | Avg Flow (gpd) | ERU's | Peak Flow (gpd) |
|---|---|---|---|---|---|---|
| **Service Area G. Hwy 101 Commercial Area, N. of Hwy 106 to WSDOT Property (including WSDOT)** | | | | | | |
| Tribal Center, including Public & Social Services (future) | 1 | 200 staff & visitors | 15 gpdpc | 3000 | 7 | 6000 |
| Twin Totems/ Lucky Dog | 1 | 800 slots | 45 gpd/slot | 36000 | 206 | 72000 |
| Residential | 7 | 29 | 100 | 2912 | 7 | 5824 |
| **Total** | **9** | **-** | | **41912** | **220** | **83824** |

### Table 8. Wastewater Flow for Core Area - Phase 1 (2014), continued

| Description | Number of Services | Population | Usage per Capita | Avg Flow (gpd) | ERU's | Peak Flow (gpd) |
|---|---|---|---|---|---|---|
| **Service Area J. Reservation Rd & Hwy 106 Mixed Use** | | | | | | |
| Hood Canal School | 1 | 300 students | 15 gpdpc | 4500 | 11 | 9000 |
| Boys & Girls Club and Community Center | 1 | 50 children | 15 gpdpc | 750 | 2 | 1500 |
| Tribal Center, including Health Center | 4 | 120 staff & visitors | 15 gpdpc | 1800 | 4 | 3600 |
| Fire and Natural Resources | 2 | 20 staff & visitors | 15 gpdpc | 300 | 1 | 600 |
| Residential | 108 | 449 | 100 | 44928 | 107 | 89856 |
| **Total** | **118** | **-** | | **52278** | **125** | **104556** |
| **Grand Total** | **127** | **-** | | **94190** | **345** | **188380** |

Note: ERU's for Casino evaluated based on 0.60 mg/l loading rates. An ERU based on loading was estimated based on 0.2 pounds/day BOD per capita.

### Table 9. Wastewater Flow for Core Area - Ultimate (2029)

| Description | Number of Services | Population | Usage per Capita | Avg Flow (gpd) | ERU's | Peak Flow (gpd) |
|---|---|---|---|---|---|---|
| **Service Area F. Hwy 101 Residential Area, N. of WSDOT property** | | | | | | |
| Residential | 22 | 92 | 100 | 9152 | 22 | 18304 |
| **Total** | **22** | | | **9152** | **22** | **18304** |
| **Service Area G. Hwy 101 Commercial Area, N. of Hwy 106 to WSDOT property (including WSDOT)** | | | | | | |
| Tribal Center, including Public & Social Services (future) | 1 | 200 staff & visitors | 15 gpdpc | 3000 | 7 | 6000 |
| Twin Totems/ Lucky Dog | 1 | 800 slots | 45 gpd/slot | 36000 | 206 | 72000 |
| Future Commercial | 30 acres | 30 acres | 525 gpd/acre | 15750 | 38 | 31500 |
| Residential | 47 | 197 | 100 | 19702 | 47 | 39404 |
| **Total** | **49** | **-** | | **74452** | **298** | **148904** |
| **Service Area H. Junction: Hwys 101 & 106** | | | | | | |
| Future Commercial | 6 acres | - | 525 gpd/acre | 3150 | 8 | 6300 |
| **Total** | | **-** | | **3150** | **8** | **6300** |

### Table 9. Wastewater Flow for Core Area - Ultimate (2029), continued

| Description | Number of Services | Population | Usage per Capita | Avg Flow (gpd) | ERU's | Peak Flow (gpd) |
|---|---|---|---|---|---|---|
| **Service Area J. Reservation Rd & Hwy 106 Mixed Use** | | | | | | |
| Hood Canal School | 1 | 450 students | 15 gpdpc | 6750 | 16 | 13500 |
| Boys & Girls Club and Community Center | 1 | 50 children & visitors | 15 gpdpc | 750 | 2 | 1500 |
| Tribal Center, including Health Center | 4 | 5 staff & visitors | 15 gpdpc | 75 | 0 | 150 |
| Fire and Natural Resources | 2 | 20 staff & visitors | 15 gpdpc | 300 | 1 | 600 |
| Residential | 136 | 566 | 100 | 56576 | 136 | 113152 |
| **Total** | **144** | **-** | | **64451** | **155** | **128902** |
| **Grand Total** | **215** | **-** | | **151205** | **483** | **302410** |

# SECTION 6
# EXISTING SYSTEM EVALUATION
# AMENDMENT TO CHAPTER 9 – ON-SITE TREATMENT ALTERNATIVES

The Master Plan evaluation focused primarily on existing septic systems in the Reservation's Core Area. This Amendment focuses primarily on existing systems in the Potlatch Bubble area. Little is known about the existing systems north of Minerva Beach RV Park.

## POTLATCH BUBBLE SERVICE AREA

The existing system in Phase 1 of the Potlatch Bubble service area includes:

- Two community septic systems for Minerva RV Park, one for each side of the highway;
- A network of septic tanks which are combined and pumped to a single drainfield for Potlatch State Park;
- And a new community septic system for the new Tribal housing project, which may not be built, if facilities associated with the new central treatment plant become available.

The systems are described in the following subsections. Modifications to the systems are described in Section 7, Collection System Evaluation.

### Tribal Housing (Service Area A)

The new housing development will be serviced by a wastewater collection system, which conveys wastewater to a centralized septic system and drain field in the northeast corner of service area A. The lift station for the Tribal Housing system is being designed by the Indian Health Service. A general site plan for the system is included in Figure 5.

### Potlatch State Park (Service Area B)

The wastewater system for the Park was assessed by Cascade Design Professionals, Inc. in 2006. The full report of the assessment is included in Appendix D. The system site plan is shown in Figure 6.

In summary, the system includes three septic tanks east of Highway 101, one near the Ranger's Station, one near the shop building and one near the day use restrooms. In addition, three septic tanks are located on the west side of the highway, one at the RV dump tank, a second tank connected to the main pump station, which receives pumped effluent from east of the highway, and one tank near the restrooms, on the north end of the campgrounds.

Wastewater for each of the facilities in the Park is conveyed to a main pump station, located in the entrance to the Park on the west side of the highway. Wastewater from the pump station is lifted to a drainfield, located in the forested hills 0.4 miles to the west. The elevation of the pump station is approximately 22 ft NAVD 88, and of the drain field, 230 ft NAVD 88.

### Minerva RV Park – East (Service Area C)

The land in this area is owned by the Minerva Beach Homeowners Association. The area will not be further developed in the future. State Parks staff estimated 32 RVs are currently located in the park. All of the RV's are connected to a single septic tank, in the southeast corner of the property. Design drawings for the Minerva RV Park – East septic system were not available for this report.

### Minerva RV Park – West (Service Area C)

The wastewater system for the west side of Minerva RV Park was assessed by Cascade Design Professionals, Inc. in 2006. The full report of the assessment is included in Appendix E. The layout of the existing wastewater collection system is shown in Figure 6, in addition to the Potlatch State Park collection system.

The septic tank which serves the laundromat and offices of the Minerva RV Park – West is located behind the laundromat. The tank is pumped to a drainfield, approximately 200 feet west. The pump wet well has a capacity of 1500 gallons, and is in fair condition. There is one single phase, 230V, 1.0 hp submersible pump, with no guide rails. The remainder of the park is served by a gravity collection system which conveys flow to the septic tanks located at the drainfield.

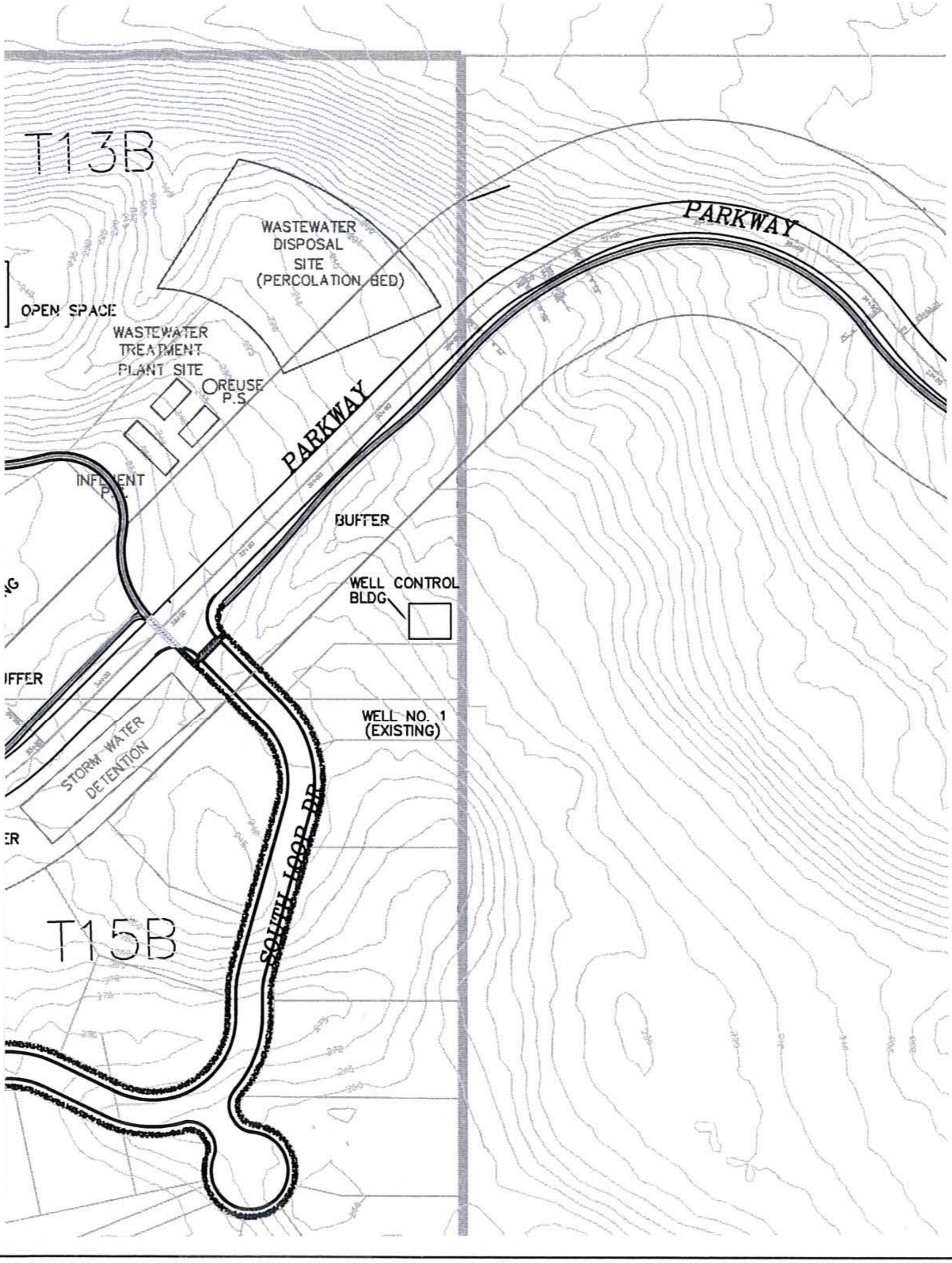
The drainfield is 85 feet wide by 175 feet long, and is serviced by two large septic tanks, with a combined capacity of approximately 1150 gallons. Both tanks appeared to be in good condition, with small amounts of corrosion. Cracks or leaks were not evident. A test pit near the drainfield indicated that western parts of the drainfield are not operating properly, due either to plugging, or broken or improperly graded pipes.

### Potlatch Bubble Service Area Creep (Service Area D)

The existing system for the service area creep is assumed to be individual septic systems. Further investigation is needed for preliminary design. The area was added to the Phase 1 service area after analysis of wastewater flows indicated additional flows were needed to dilute the RV waste from Potlatch State Park.

## CORE SERVICE AREA

The existing wastewater system for the Core Area of the Reservation is individual on-site septic systems. The original Master Facility Plan included a complete assessment of the system. The system has not been evaluated any further since the original Plan was drafted. The assessment characterized 36% of the system as potentially being in failure or at risk of failure. The assessment included a map of known septic failures, which is duplicated in Appendix A.



CASCADE DESIGN
PROFESSIONALS, INC

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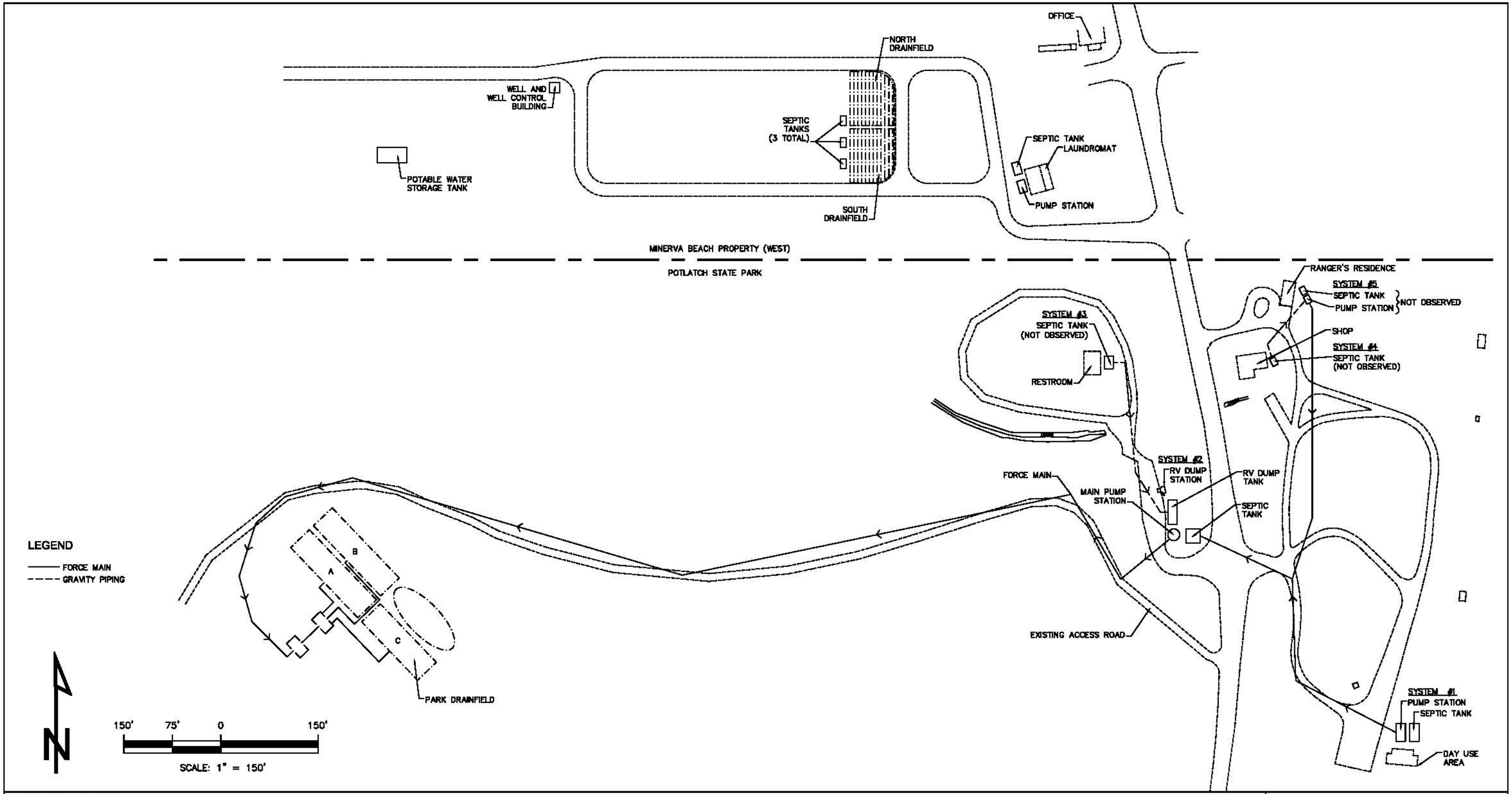
Figure 5.
Wastewater Facilities
Site Plan - T3ba'das Housing



CASCADE DESIGN

**NOTE:**

1. THE COLLECTION SYSTEM WILL BE UPGRADED TO COINCIDE WITH STARTUP OF THE NEW TREATMENT SYSTEM

FIGURE 6
Wastewater Facilities
Site Plan
Minerva Beach/
Potlatch State Park

# SECTION 7
# COLLECTION SYSTEM ANALYSIS
# AMENDMENT TO CHAPTER 6 COLLECTION SYSTEM ALTERNATIVES

## COLLECTION SYSTEM ALTERNATIVES

The 1998 Master Plan evaluated several collection system alternatives for the Skokomish Reservation, including: a conventional gravity system; a small diameter gravity system; a pressure system; and a vacuum system. The recommended system was a pressure system with grinder pumps, which eliminates the need for septic tanks, entirely, thus eliminating inflow and infiltration (I/I). A second option was identified, a septic tank effluent pumping (STEP) system, since Tribal staff were familiar with the operation and maintenance of STEP pumps. However, the risk of I/I is not eliminated with a STEP system.

The collection system layout is outlined in this section, along with a discussion of suspected septic system failures, and the existing water systems. The wastewater collection system layout was developed based on treatment plant siting alternatives presented in Section 8, and planning for a phased implementation of wastewater services, which is presented in this section and in Section 4. A preliminary design model of the collection systems was prepared by E-One, and is included in Appendix H.

## POTLATCH BUBBLE

The Potlatch Bubble service areas include Tribal residential lands, Potlatch State Park, and non-Tribal mixed commercial and residential lands, including Minerva RV Park. The Reservation boundary is approximately 1500 feet west of Highway 101, several hundred feet up a forested slope, for much of the Potlatch Bubble service area. Hood Canal forms the eastern boundary, approximately 600 feet east of Highway 101. New Tribal housing (T3ba'das Project) is planned for the area, at the top of the hills, west of Potlatch State Park, which will extend the service area approximately 1.0 mile to the west.

The sewer collection system for the Potlatch Bubble area will maximize the use of existing centralized collection systems, including Potlatch State Park; Minerva RV Park (east and west); and the planned Tribal Housing. Modifications to the existing systems will be coordinated to allow continued operation while the new system is in construction. Construction phasing and the sewer collection system layout are outlined in the following subsections. The collection system for the Potlatch Bubble is shown in Figures 7 and 8.

### Tribal Housing (Service Area A)

Currently, the housing development is planned to have a typical community septic tank/drain-field system, where wastewater is collected by gravity to a common point and pumped to the septic tank drainfield system. The system modification for this service area includes upgrading the lift station to the septic system, to provide the necessary lift to convey the wastewater to the new treatment plant (approximately 25 ft). Modifications also include construction of approximately 1000 ft of low pressure sewer under the Parkway and under the wastewater treatment plant access road. This piping is in addition to the pipe already planned for the septic tank/drainfield system.

If the construction schedule for the housing system coincides with construction of the new treatment plant, it may be possible to save costs on construction of the septic system and drainfield for this service area, and to upgrade the lift station more cost effectively.

### Potlatch State Park (Service Area B)

The existing septic tanks (3) will be replaced with grinder pumps, and necessary improvements to the conveyance system will be developed by Washington State Parks. Costs for these improvements are not included in the project costs. Park system improvements are assumed to coincide with start-up of the new treatment plant.

The preliminary assessment of the pump station indicated there would be sufficient volume in the wet well to accommodate the proposed connection of the Minerva Beach RV Park systems, as proposed in Phase 1 of the system development. The pumps will be upgraded to accommodate the increased flows and solids associated with the project. Because the system changes include pumping solids, the preliminary review of pumps indicates a second pump station will be required to boost the wastewater to the new treatment plant site, near elevation 260 NAVD 88, 30 feet above the existing drainfields. Cost estimates include two generators, one for each lift station, in case of a power outage. Significant cost savings could be achieved if a treatment plant site could be found at a lower level elevation.

### Minerva RV Park – East (Service Area C)

The modification to the existing system will be to replace the septic tank with an E-One model 2016 grinder pump, and construction of approximately 1600 feet of low pressure sewer to the Potlatch State Park main pump station.

The preliminary layout of the sewer is along Highway 101, which is the only north-south corridor between the RV Park and the State Park. Washington State Parks will be redeveloping the area on the west side of the highway, opposite the RV Park, possibly allowing an alternate, less expensive route for the new sewer.

### Minerva RV Park – West (Service Area C)

The land in this area was recently acquired by Potlatch State Park. Redevelopment plans for the area are not complete. Washington State Parks staff projected the site to include 66 RV sites in the future.

Modifications to the system will include installation of grinder pumps and conveyance to the main pump station in Potlatch State Park. These modifications will be developed by Washington State Parks, and are not included in project costs.

## Potlatch Bubble: Service Area Creep (Service Area D)

The “creep” service area includes the area north of Minerva RV Park to North Tillicum Beach Lane. Approximately 22 homes would be serviced by the new sewer on the east side of the highway. The approximate sewer length is 1500 feet within the residential area.

The initial sewer layout included a sewer main along the Highway 101 corridor, 1550 ft from North Tillicum Beach Lane to the main pump station in Potlatch State Park. However, subsequent review of aerial photos indicate it may be possible to connect Service Area D to the Minerva RV Park sewer main, reducing the length of the collection system by 1000 ft, and eliminating the cost of construction along Highway 101. The new collection system layout will require a cross country easement from Minerva RV Park east extending to the roadway to the north (see Figure 8).

During the development of the Project Definition Report, Service Area D was identified as a Phase 2 (Ultimate Build Out) sewer area, to reduce initial capital costs. However, preliminary design for the Potlatch Bubble treatment plant indicated the need for a total of 50 homes to be connected at start-up, in order to provide a more consistent wastewater flow to the new treatment plant, evening fluctuating flows and loads from the  State Park. Service Area D is the only area which can provide the additional services needed assuming 20 tribal homes at the Tʒba’das development and 20 homes at Minerva East.

There are five remote homes to the west of the highway.  Sewering these homes would require a highway crossing, approximately 2000 ft of sewer with nearly 1000 ft being along Highway 101. The Project Definition Report process did not identify this area as being too costly to service, a closer review appears to indicate it may be.

## Potlatch Bubble: Service Area to North Reservation Boundary (Service Area E)

Service Area E includes the Mason County Public Utility District #1 (PUD) and approximately 26 homes, distributed over a large service area. The initial sewer layout extends 0.6 miles along Highway 101. Individual services are 100 – 400 ft from the highway. Multiple highway crossings will be required to service this area.

The Skokomish Tribe is in the process of procuring a motel/RV resort located on the northeast side of the Cushman Lake powerhouse (just north of the tailrace).   To serve this area, about 2,500 feet of 6-inch diameter pressure sewer would be extended from the Tillicum Beach subdivision, west to Highway 101, and then north along the east side of the highway.  A lane closure may be required to accomplish this construction. There are 6 homes along this alignment and it is assumed that half will be connected in addition to the motel/resort.  As discussed in the Project Definition Report the remainder of this area would be serviced in a Phase 2 (Ultimate Build Out) phase of the project.

## CORE AREA

The Core Area is a low lying area, near Highway 101, SR 106 and the Skokomish River. Cost estimates for sewer construction in the low lying sections of this area include dewatering costs. Special E-One ventilation units for use in floodplain areas are also included, for residences in the floodplain. The collection system for the Core Area is shown in Figures 9 – 11.

### Highway 101 Corridor: Treatment Plant to Reservation Road (Service Area G)

The Core Area Wastewater Treatment Plant is planned for construction on the north end of Service Area G. Highway elevations range from 20 to 40 ft NAVD 88 in this area, rising from around 20 feet near the intersection with Reservation Road to a high near the Plant. The force main conveying wastewater to the Plant from the south will be located on the east side of Highway 101. The highway is the only roadway available to provide access and a corridor for collection system piping to the Plant. The topography limits the staging area available for construction near the highway, rising steeply to the west in some areas, and dropping steeply to the floodplain to the east. Cost estimates assumed a lane closure would be required on Highway 101 to construct this segment of the sewer main.

Approximately 1100 ft of 8 inch diameter low pressure sewer main is needed to connect the sewer main on Reservation Road to the plant. Six services will be connected to this sewer main, on the east side of the highway. The services include small business and residential services. Future development on the east side of the highway can be serviced by this sewer main. And one private well exists east of the highway in this area.

During the development of the Project Definition Report, it was determined that the services on the west side of the highway in Service Area G should be sewered in Phase 2 of the project. The basis of the determination was the low density of the services. Twelve services would require 2300 ft of sewer along the highway, resulting in a high cost per ERU.

### Highway 101 Corridor: Reservation Road to SR 106 (Service Area G)

Highway elevations in this area rise from 20 ft NAVD 88 near the intersection with Reservation Road to around 40 ft at the southern end of the service area, near the intersection with SR 106. The higher elevation area is characterized by Tribal commercial lands on Highway 101, between SR 106 and Reservation Road. Service in this area is a high priority, because the existing septic tank/drainfield system for the Lucky Dog Casino is nearing capacity, and because of the proximity of nearby wells (four). Four services would be connected to the Plant, along with the Casino, by the sewer main in this area. Future commercial development on the east side of Highway 101 could also be serviced.

The higher elevation of the highway, sloping downhill toward Reservation Road, and the distance above the floodplain (~ 18 ft NAVD 88) and high groundwater, may allow construction of a gravity sewer for this area, with a pump station to connect to the low pressure sewer main at Reservation Road. If this approach were used, areas to the south of the intersection with SR 106 would need to be served by an extension from Reservation Road. Cost savings would include the cost of 4 grinder pump services, approximately $20,000. Additional expense would be incurred due to the higher costs for constructing 1700 feet of gravity sewer. The preferred layout for preliminary design was the low pressure sewer due to the fact that little or no cost savings were possible through use of a gravity sewer system. In addition, combining a gravity/pressure system would complicate maintenance . The pressure sewer system has an improved flexibility in construction with no I / I risk.

Note: Gravity sewer construction will be higher than pressure sewer construction because deeper excavations are required and will likely require groundwater dewatering, all of which increase construction cost on a unit cost basis.

### SR 106 Corridor: Highway 101 to Service Area Limits (Service Area G, H & J)

The higher elevation area on SR 106 was included in Service Area G, in the initial layout of the sewer main. The land on SR 106 near Highway 101 is characterized as Tribal cultural land, and includes the Hood Canal School and a future Boys and Girls Club. The initial sewer layout in this area included extending the force main 550 feet south along Highway 101 and 650 feet southeast on SR 106 to service the School, the Club and three future commercial services in Service Area H. In subsequent reviews of the sewer layout it was recognized that an alternate route for the sewer might extend from Reservation Road, through the Hood Canal School property. The alternate route might reduce costs associated with construction of the sewer main along Highway 101 and SR 106. Sewer lengths for each route are approximately the same. The original layout was the basis for the preliminary sewer design, developed by E-One, and is included in the capital cost estimates. Review of the alternate route should include review of impacts to future development on Highway 101 and construction cost savings with further direction from the Tribe.

Elevations drop away to 20 ft NAVD 88 about a mile southeast of the school on SR 106. A total of 14 residences could be serviced along this length of SR 106. The homes are located in two clusters, which can be serviced by sewer extensions from Reservation Road and Tribal Center Road, to minimize the length of sewer needed. A total of 0.7 miles of sewer are needed to service these 14 homes. The estimated capital costs are $363,000, or a cost per ERU of $26,000. During the development of the Project Definition Report it was determined that this area should be serviced during the second phase of the project, to reduce initial project costs.

The area near Tribal Center Road has two wells in close proximity to the existing septic systems, five of which were identified as suspected failures in the 1998 Master Plan.

### Highway 101 Corridor: Sunnyside Road & Skokomish River Road (Service Area K)

Elevations on Highway 101 drop away to 20 ft NAVD 88 about 1.3 miles southwest of the intersection with SR 106. A total of 10 residences could be serviced in this area of Highway 101. To do so would require 2.3 miles of sewer, 1.3 miles of which would be on Highway 101. The estimated capital cost to service this area is $1.5 million, or $150,000 per ERU. During the development of the Project Definition Report service to this area with a centralized treatment plant was determined to be infeasible.

Seven septic systems with suspected problems were identified in this area, in the 1998 Master Plan. Three private wells are located in this area, two of them near problem septic tanks.

**Reservation Road: Highway 101 to Tribal Council Road (Service Area J)**

The largest residential area on the Reservation is located along Reservation Road. Six small cul-de-sacs and one larger “subdivision” are distributed along the length of Reservation Road (0.9 miles). In addition, approximately 34 homes are located along Reservation Road, which will be serviced by this segment of the sewer main. The sewer layout extends the entire length of Reservation Road, allowing an extension southeast toward the existing Tribal Center on Tribal Center Road.

The topography to the west of Reservation Road lies above the floodplain, at elevation 26-34 feet NAVD 88. The elevations to the east are lower, where the land slopes toward the floodplain. Development in this area will be limited, because limited land is available above the floodplain.

**Salish Court “Subdivision” (Service Area J)**

A small subdivision-like development on Salish Road is located on the west side of Reservation Road, approximately 0.3 miles southeast of the intersection with Highway 101. The area lies above the floodplain, and includes a total of 35 residences to be serviced by 2600 ft of sewer. No further development will occur in this area.

Six septic systems with suspected problems were identified in this area, in the 1998 Master Plan. One private well is located in this area, near problem septic tanks.

**Skokomish Indian Flats (Service Area J)**

The road extending into Skokomish Indian Flats is on the east side of Reservation Road, approximately 0.6 miles from the intersection with Highway 101. The most remote home on Skokomish Indian Flats Road is approximately 1800 ft from Reservation Road. A total of seven homes are located on Skokomish Flats Road. Because of the low density of services, the Project Definition Report determined Skokomish Indian Flats should be serviced in Phase 2 of the project, to reduce initial capital costs.

Five septic systems with suspected problems were identified in this area, in the 1998 Master Plan. Four private wells are located in this area, near problem septic tanks.

**Cul-de-Sacs along Reservation Road (Service Area J)**

Three small cul-de-sacs are located on Reservation Road: Twana Court to the west, and Tseelsub Court and Cedar Lane to the east. Approximately 22 residences will be served by 1500 feet of sewer main on these three cul-de-sacs.

Ten septic systems with suspected problems were identified near these cul-de-sacs, in the 1998 Master Plan. Three public wells, and three private wells are located near these cul-de-sacs, near problem septic tanks.

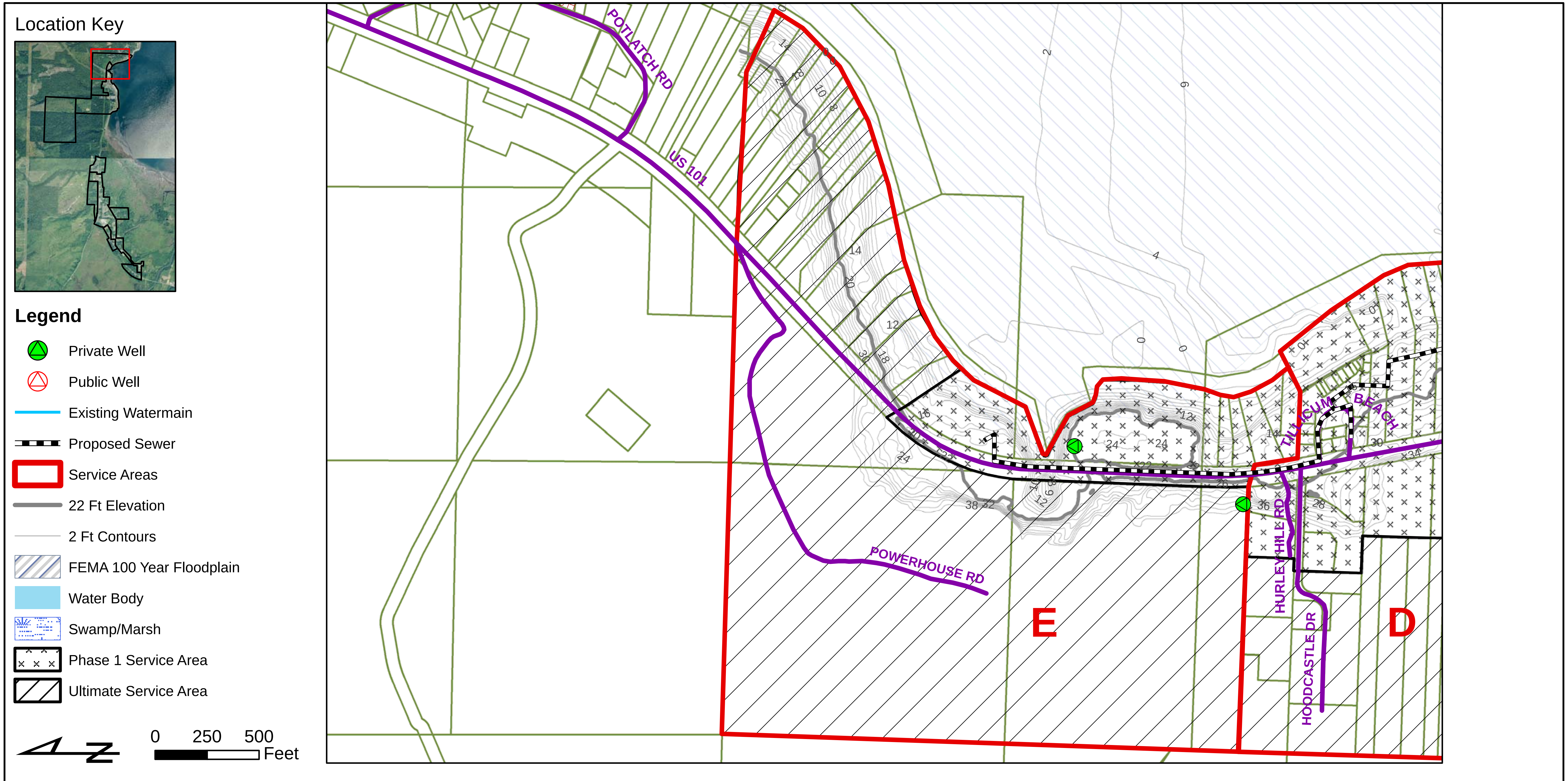
### Tribal Council Road: Reservation Road to SR 106 (Service Area J)

The existing Tribal Center is located over 0.5 miles southeast of the intersection of Reservation Road with Tribal Center Road. Twenty residences are distributed along Tribal Center Road, making the extension of service in this area relatively expensive. However, the waste loads and high public use of the Tribal Center led the Project Definition Report process to determine that the area should be serviced in Phase 1 of the project.

Eleven septic systems with suspected problems were identified in this area, in the 1998 Master Plan. Five private wells are located in this area, near problem septic tanks.

### Minerva Terrace & North Valley Drive (Service Area F)

Two “subdivisions” are located north of the plant location, on Highway 101. The subdivisions are west of the highway, extending upslope over 20 feet above the highway. These “subdivisions” can be serviced by gravity sewer, to the intersection of North Valley Drive and Highway 101. Conveyance from that point would be low pressure sewer 1600 feet south to the Plant. Locating the sewer on the west side of the highway would save the cost of two highway crossings (~$50,000). However, locating the sewer on the east side of the highway would provide service to five additional homes. The Project Definition Report process identified this service area as a Phase 2 extension of service, to reduce initial capital costs. A total of 42 homes will be serviced in these “subdivisions”, along with seven additional homes on the west side of Highway 101.

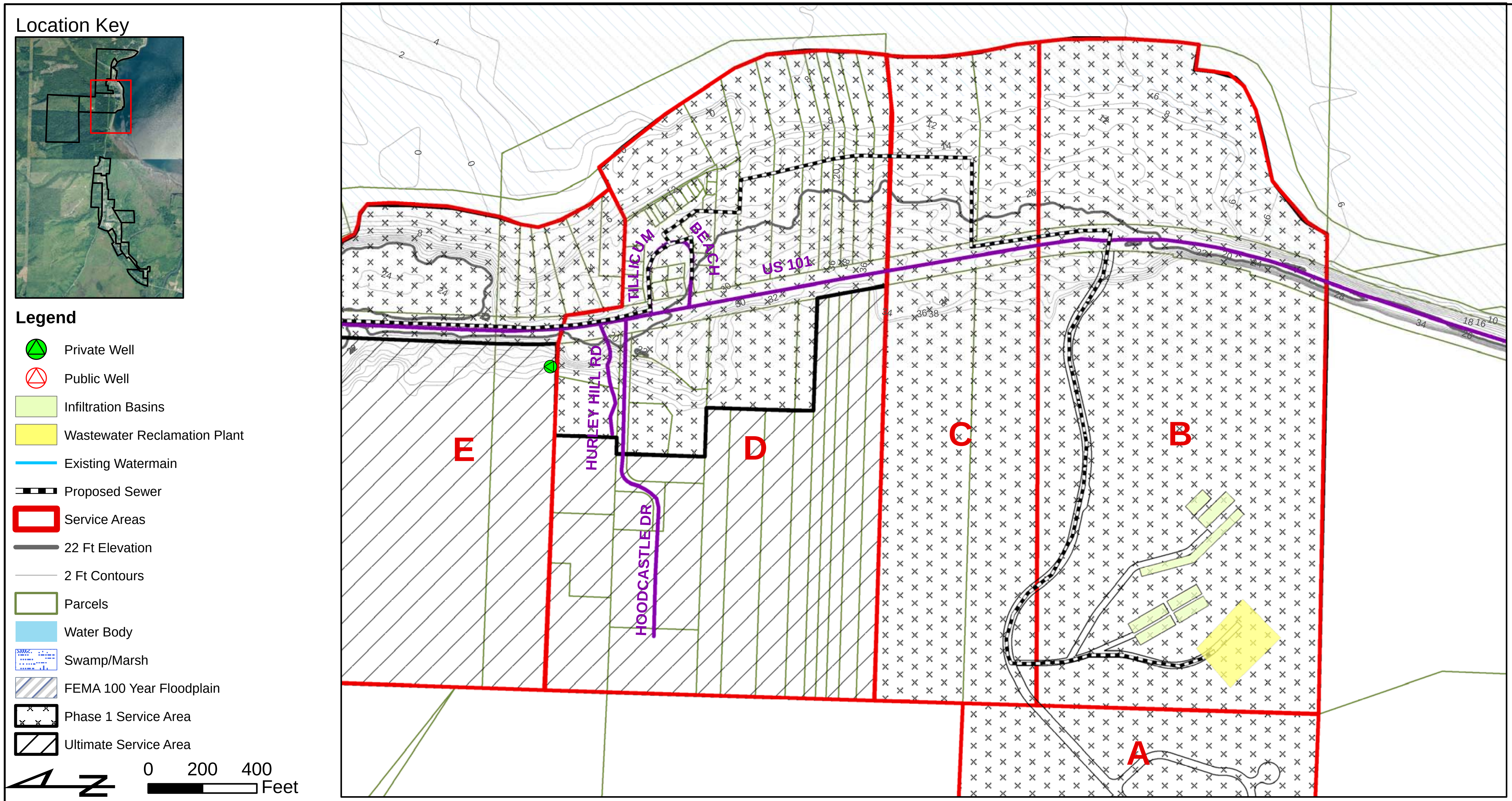


**NOTE:**

1. Locations are approximate and must be verified

FIGURE 7

Wastewater Collection System Potlatch Bubble-North



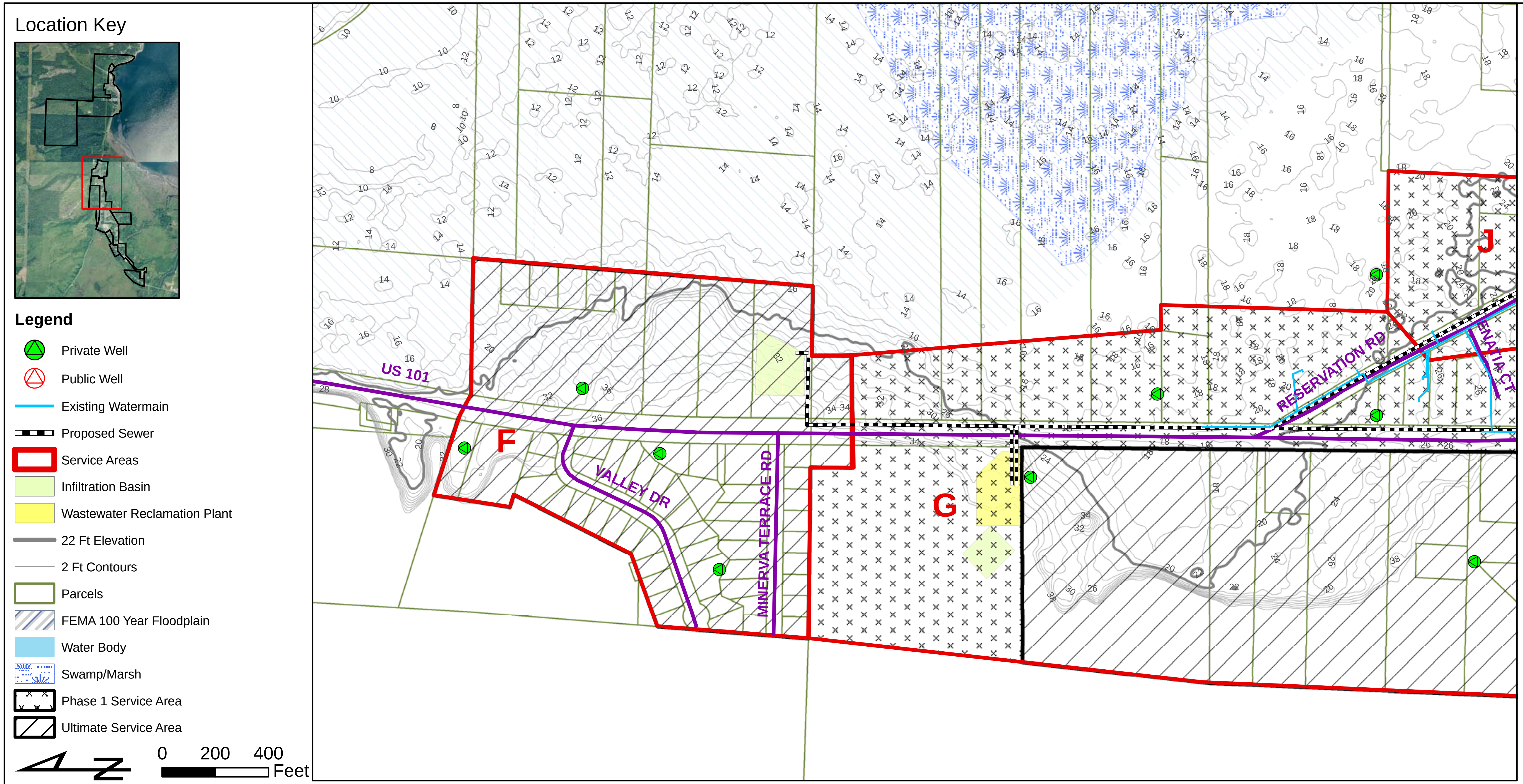
CASCADE DESIGN PROFESSIONALS, INC.

**NOTE:**

1. Locations are approximate and must be verified

## FIGURE 8

## Wastewater Collection System Potlatch Bubble-South



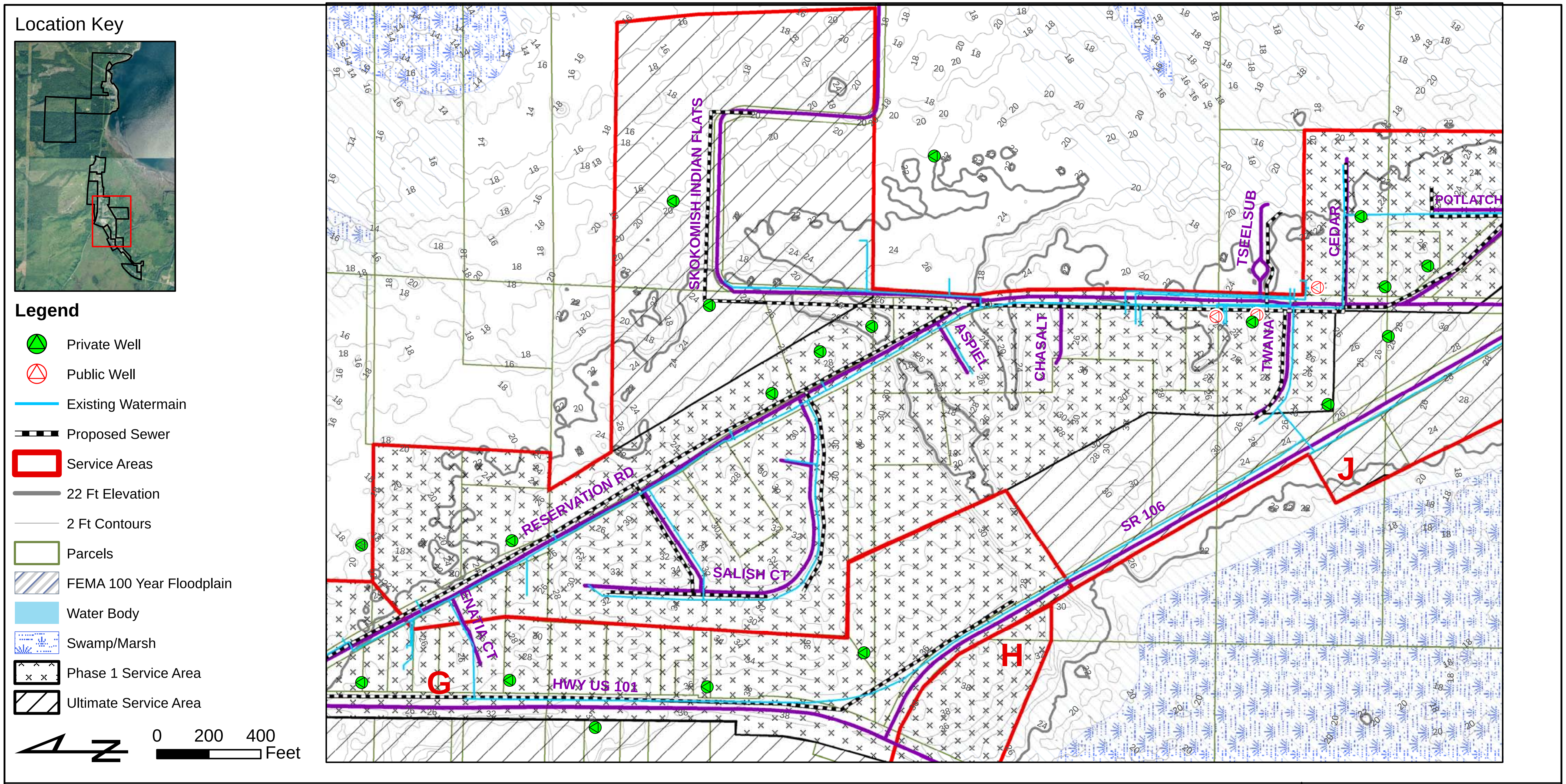
CASCADE DESIGN

**NOTE:**

1. FEMA flood insurance study flood elevations for skokomish river below SR 106 bridge at 22.47 ft.
2. Locations are approximate and must be verified

FIGURE 9

Wastewater
Collection System
Core Area- North



CASCADE DESIGN

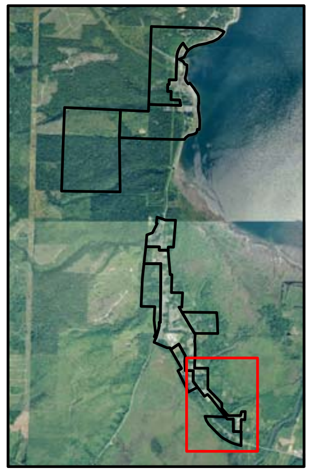
**NOTE:**

1. FEMA flood insurance study flood elevations for skokomish river below SR 106 bridge at 22.47 ft.
2. Locations are approximate and must be verified

FIGURE 10

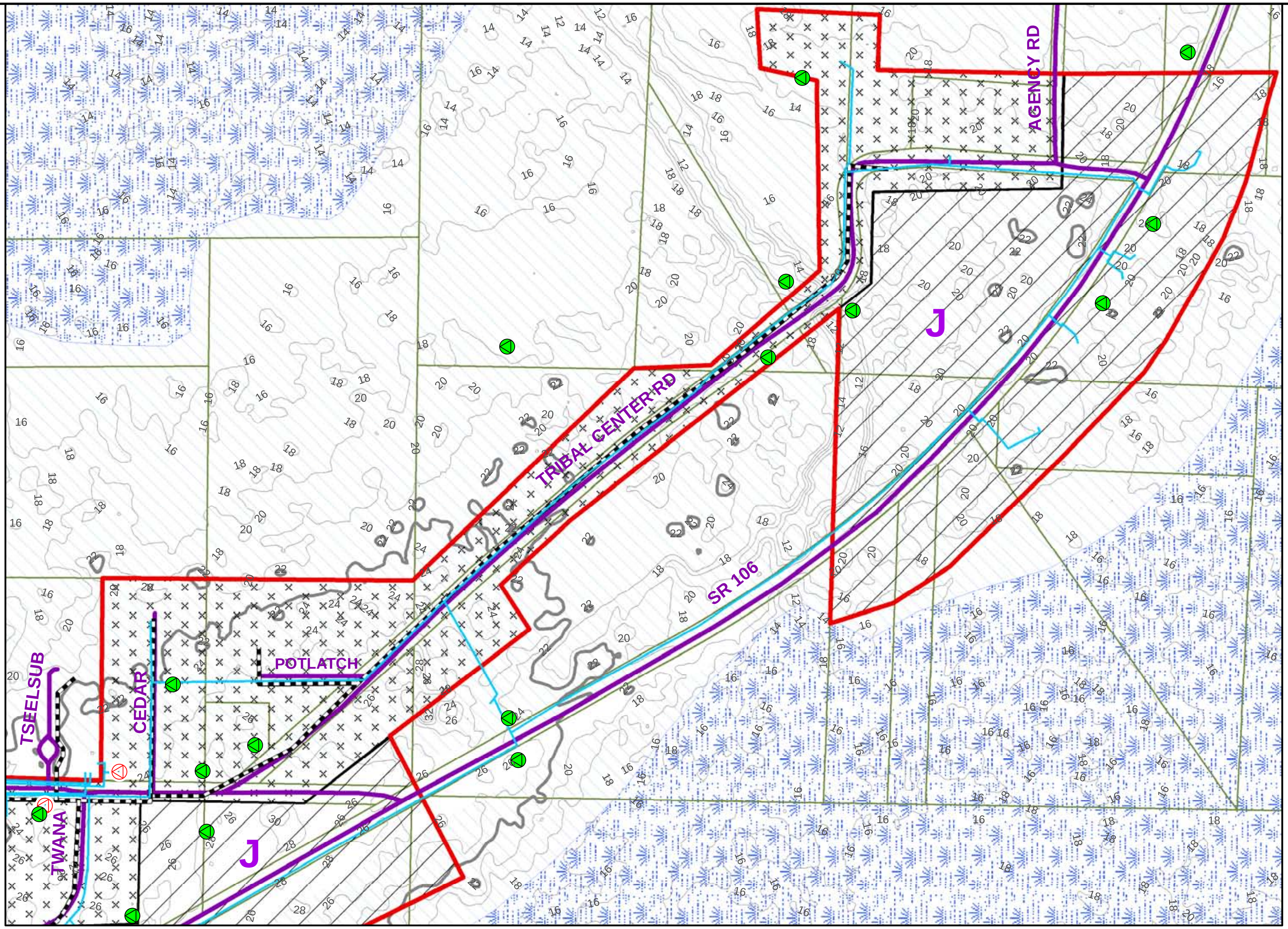
Wastewater
Collection System
Core Area- Central

Location Key



## Legend

- △ Private Well
- △ Public Well
- ─ Existing Watermain
- ▬ Proposed Sewer
- 🟥 Service Areas
- ─ 22 Ft Elevation
- ─ 2 Ft Contours
- ☐ Parcels
- ▬ Water Body
- ▨ Swamp/Marsh
- ▨ Ultimate Service Area
- ☒ Phase 1 Service Area



CASCADE DESIGN

**NOTE:**

1. FEMA flood insurance study flood elevations for skokomish river below SR 106 bridge at 22.47 ft.
2. Locations are approximate and must be verified

FIGURE 11

Wastewater
Collection System
Core Area- South

# SECTION 8
# EVALUATION OF WASTEWATER TREATMENT, SOLIDS TREATMENT & WATER REUSE ALTERNATIVES
# AMENDMENT TO SECTIONS 7 AND 8 PRELIMINARY EVALUATION OF WASTEWATER TREATMENT PLANT ALTERNATIVES AND EFFLUENT DISPOSAL ALTERNATIVES

The 1998 Master Plan recommended a single plant using either the Biolac aerated lagoon system (manufactured by Parkson, Inc.) or a Sequencing Batch Reactor system (SBR), effluent disposal using rapid infiltration, forest irrigation or wetland disposal, and sludge disposal using land application in the forest. The recommended system was revised based on the following changed conditions:

1. Concerns about nitrogen in Hood Canal led to the review of the recommended treatment system, because the Biolac system will not meet the water reuse reliability requirements for effluent standards for nitrogen removal. Both the Biolac and the SBR systems did not meet reclaimed water standards for unrestricted reuse. The technologies were reviewed in the Project Definition process and the results are summarized in this section.
2. In addition, the Project Definition process resulted in the development of two separate treatment and disposal systems. The results are summarized in this section.
3. Effluent disposal technologies including infiltration basin, forest irrigation, and wetland disposal were evaluated during the Project Definition process. The results are summarized in this section.

The plant locations, site plans, design criteria, and schematic diagrams, and the effluent disposal site locations and section drawings, and preliminary design criteria are summarized in this section. The summary is based on meeting the demands of the service area, over the 20-year planning horizon.

Also presented for each alternative is an estimate of probable program costs. The estimates represent complete program capital costs for each alternative and include estimates for construction costs, engineering, permitting, property acquisition/easements and contingencies. Detailed cost estimates are presented in Appendix I.

## EVALUATION OF WASTEWATER TREATMENT TECHNOLOGY

Since the 1998 Master Plan was prepared, the Membrane Bioreactor system (MBR) has become more prevalent and widely accepted as a reliable, cost-effective treatment technology for small flows. Several systems are operating successfully in the Northwest. The MBR system has proven successful in treating to DOE’s Class A standards for reclaimed wastewater.

The MBR design provides a more consistent, high quality effluent, with fewer solids to handle. Wastewater is drawn through membrane filters by applying a suction pressure across the membrane. The pressure differential is generally provided by pumping;

however, some experimental gravity systems are being tested. Pumping increases operation costs. The risk of exceeding water quality standards with the MBR plant is low because the membrane acts as a positive barrier to solids carryover.

In most treatment plant designs, to meet Class A standards the  biological treatment process, such as a sequencing batch reactor (SBR), is followed by an effluent polishing system using a sand filter. The MBR facility does not require advanced treatment because the membrane is a positive barrier that provides this same level of effluent polishing.

MBR treatment technology was selected on a cost and non-cost basis.

Non-cost criteria used for  comparison to other treatment technologies were as follows:

- Land acquisition
- Ease of construction
- Expandability
- Flexibility for meeting future regulations
- Ability to permit and satisfy environmental concerns
- Visual impact
- Ease of operation and maintenance
- Odor potential
- Environmental impact
- Land requirements

The MBR technology is recommended, based on the following non-cost advantages:

1. The MBR system requires less land.
2. Construction complexity and costs for both systems are similar
3. Expandability requirements are similar for both systems.
4. The MBR is more reliable in meeting effluent standards.
5. The visual impacts of both systems are similar. Each can be concealed within a building, hidden by landscaping.
6. The operation and maintenance of the MBR is easier than the SBR.

The comparison of the costs of  treatment alternatives was summarized in the Project Definition Report (Appendix J), and is not summarized here.

## EVALUATION OF COMBINED OR SEPARATE TREATMENT SYSTEMS

The Potlatch Bubble and Core Area collection systems are separated by more than one mile, with Highway 101 being the only corridor connecting the two areas. Providing wastewater services with a single plant would require a  pressurized sewer main to connect the two areas, with little or no expansion of service. The Project Definition process evaluated the costs and benefits of providing wastewater services with a single plant at the former WSDOT maintenance yard, versus construction of two separate plants. The Project Definition process recommended two separate plants, based on the following reasons:

1. Capital and O&M costs of two single plants and one combined plant are not far enough apart to justify a combined plant on cost alone.
2. The Skokomish Tribe is committed to quickly implementing construction of the Potlatch Bubble plant in order to meet the needs of its new t3ba'das housing project scheduled for occupancy in late 2008.

The comparison of the costs of the combined versus separate treatment systems was summarized in the Project Definition Report (Appendix J), and is not summarized here.

## EVALUATION OF EFFLUENT DISPOSAL TECHNOLOGY

Infiltration bed technology is the most efficient means for effluent disposal, in terms of capital and O & M costs, as well as in terms of the land requirements. However, soil percolation requires good geotechnical conditions, in order for it to work. These conditions include good soils, good geologic subsurface conditions and a relatively flat site.  In infiltration bed systems, effluent flows through an array of parallel perforated pipes that are laid in the bottom of a pond or buried in a gravel filled infiltration bed. The flow is distributed evenly across the gravel bed and allowed to percolate into the groundwater. No significant impact to the groundwater would occur, because of the high quality of the effluent.

Forest irrigation is land intensive and has high capital and O & M costs. An economic benefit can be developed from forest irrigation for effluent disposal, which may offset the costs. Land available for forest irrigation for both the Potlatch Bubble and Core Area is high, in elevation, above the proposed treatment plant location, and far away. Costs for pumping water and storing water, during the wet season, appear to be prohibitive.

Wetland augmentation is the discharge of effluent into an existing wetland, "augmenting" the existing water supply.  The existing wetlands on the Skokomish Reservation are Type 1, high quality wetlands. Augmenting the water supply of a Type 1 wetland cannot enhance the quality of the wetland and is not allowed under current DOE guidelines, therefore wetland augmentation is not allowed.

Constructed wetlands may be an option for effluent disposal; however constructed wetlands would not be considered a final point of disposal. Water would be discharged at some point from the constructed wetland, either to a surface water body or to an infiltration basin. In addition, the water quality of a constructed wetland may not consistently meet Class A effluent standards. In addition, water fowl impacts to water quality may cause problems in meeting water quality goals for Hood Canal.

A full review of the wetland disposal issues is included in the Project Definition Report. The review concluded that wetland disposal would not be a good solution, given the quality of the existing wetlands on the Reservation, and the limited area available and potentially poor effluent quality associated with constructed wetlands.

The infiltration basin disposal was found to be preferred over forest irrigation for the following reasons:

1. Infiltration basins require less land than forest irrigation.
2. Construction complexity and costs for both systems are similar.
3. Expandability requirements are similar for both systems.
4. The infiltration basins have a much smaller visual impact than the much larger forest irrigation system.
5. The operation and maintenance of the infiltration basins is significantly less than that required for the forest irrigation system, primarily due to the high energy costs of pumping up to the forest for irrigation. Because of the smaller land requirements of infiltration basins they can be located in closer proximity to the wastewater treatment facility.
6. The forest irrigation system has a bigger environmental impact because more land is required.

## INFILTRATION BASIN DESIGN CRITERIA

The geotechnical study for the Facility Plan Amendment will be completed by the end of July 2007, and will be submitted at that time. The study will include site specific information for both infiltration basin locations on:

1. Soils and their permeability.
2. Geohydrologic evaluation of factors such as:
   a. Depth to groundwater and groundwater movement during different times of the year.
   b. Water balance analysis of the proposed discharge area.
   c. Overall effects of the proposed facility upon the groundwater in conjunction with any other land application facilities that may be present.
   d. Reserve areas for additional subsurface disposal.

Infiltration basin designs were developed to a conceptual level, based on an infiltration rate estimated in the geotechnical study for the Project Definition Report. The design assumes the soils have an infiltration capacity of 2 inches/hour. And the design is based on 10% of that capacity (0.2 in/hour), per EPA guidance. Experience has shown success at these application rates. Requirements for emergency storage have not been addressed. Regulatory guidance on this requirement is needed for each specific project area.

The reader is encouraged to review the very latest hydrogeologic data for both Potlatch and the Core Reservation infiltration basins that became available as this report is published. Higher rates of infiltration were used in the calculations for this report than are supported by these latest data. This means that larger areas for basins could be required to serve the first phase of sewer development, and additional basin sites may be needed for the ultimate phase than are contemplated in this document. Although the planning level cost estimates presented may also need to be increased, there is some room in these estimates to accommodate some change.

Permitting final infiltration basins will require substantial exploration and even testing during design. It is during design that basin sizing will be closely matched with the results of detailed soils analysis and further refinement of projected flows. The hydrogeologic data suggest there are suitable sites for such basins and, while level land near the Potlatch and Core Reservation treatment plant sites is limited, it is available.

## SOLIDS TREATMENT ALTERNATIVES

The 1998 Master Plan includes a description of sludge management alternatives. Sludge, or biosolids, may be stored and dried on-site, or hauled off to reduce the capital cost of the plant. There is an onsite sludge composting program at the Washington Corrections Center in Shelton which may be available to receive the sludge. For purposes of this study, provisions for sludge treatment include sludge stabilization and dewatering sufficient for disposal on land as a Class B biosolids or in a landfill.

## POTLATCH BUBBLE TREATMENT AND DISPOSAL

The Potlatch Bubble treatment plant and effluent disposal design includes a new MBR water reclamation facility located on the western edge of Potlatch State Park. The plant will be located near the Tribe’s new t3ba’das Housing Project and the effluent disposal infiltration basins will be located nearby (see Figure 13).

A summary of components of the treatment plant is provided here. Detailed sizing of unit processes are shown in Table 10 and the site plan for the plant is shown in Figure 12. A schematic hydraulic profile and flow diagram of the plant is shown in Figures 18 and 19. Sections of the infiltration basins are shown in Figure 14.

Treatment plant components:

- Influent Pumping: Based on final siting and topography of the plant, influent pumping may not be necessary for operation of the plant, however, for cost estimating purposes it is included in this evaluation. Influent pumping will consist of submersible pumps which are paced to the incoming wastewater flow. There are two pumps, each sized for the peak hour flow, and therefore, if one pump goes down, the other can function as standby.

- Headworks (screening, grit removal, metering): Headworks consist of a 1/8” rotating drum screen with a bypass bar screen, a vortex grit removal system and an influent magnetic flow meter.

- Secondary Treatment: Membrane Biological Reactor technology will be used as the secondary treatment process and to achieve Class A reclaimed water. This alternative provides an MBR system consisting of a concrete tank with basins that will house the membrane units and provide anoxic and pre-aeration zones. The system will consist of influent and effluent piping, waste pumps, blowers and associated controls to make the installation complete.

- Equalization basins are recommended to attenuate peak hourly flows, because the membranes are sized for peak daily flow.

- Disinfection System: UV disinfection consisting of a 3 bank system containing low pressure high output lamps will be provided. The rated capacity will be 0.10 mgd based on 60% transmittance.

- Infiltration Basins: The infiltration basins are required to be 1.07 acres based on a design application rate of 0.2 inches per hour (in./hr). Phase 1 design includes the use of the reserve State Parks drainfield area, and three terraced infiltration beds (see Figure 13). The infiltration system will include an effluent pump, valve vault, force main, pumps, distribution box, and header system which distributes the effluent flow evenly throughout the infiltration basin.

  Emergency storage requirements will be included after regulatory requirements are established. Test pit data for soils in the proposed area for the infiltration basins will not be available until the end of July 2007.

  The infiltration basins will be secured by a chain-link security fence.

- Solids Handling Facilities: Solids handling will consist of aerobic digesters/storage tank, with decanting capabilities and transportation to the Core Service Area WRP for processing and reuse of the biosolids.

**Table 10. Potlatch Bubble MBR Treatment Plant Design Criteria**

| **Component** | **Phase 1** | **Ultimate** |
|---|---|---|
| Influent Pump Station(s)<br>(1 Standby + 1 Future) | flow proportional pumping | |
| *Capacity, each* | 100 gallons/minute | |
| *Motor* | 5 horsepower (HP) | 10 HP |
| **Headworks** | | |
| **Component** | **Phase 1** | **Ultimate** |
| Influent In-Channel Fine Screens, number | 2 | 3 |
| *Capacity, each* | 0.6 [illegible]d | |
| *Type of screen* | in-channel [illegible]e screen | |
| *Screen opening* | 2 mm | |
| Influent flow measurement, type | ultrasonic | |
| *Downstream of fine screens, 24” side walls* | 3” Parshall flume | |
| Influent sampling, refrigerated | flow paced composite sampler | |

## Table 10. Potlatch Bubble MBR Treatment Plant Design Criteria, continued

**Activated Sludge – Nutrient Removal Treatment, continued**

| Component | Phase 1 | Ultimate |
|---|---|---|
| Equalization & out-of-compliance Basin, number | 1 | 2 |
| *Equalization volume, each (equalize 8 hours of max day)* | 40,000 gallons | |
| *EQ to AB flow distribution box, no. (1 is standby)* | 2 | 4 |
| *Capacity, each (vfd flow control, PLC control)* | 80 gallons per minute (gpm) | |
| *Motor size, each* | 2 | 2 |
| Anoxic/Aeration Combination cyclic Aeration Basins (AB), number | 2 @25,000 gallons, each | 4 @ 25,000 gallons, each |
| *Volume provided by membrane 3 of 4 basins* | 15,000 gallons+/-* in operation | |
| | *Note: *Zenon skid basin volume is ~50% effective due to coarse bubble diffusers.n* | |
| *MCRT, minimum* | 21 days | |
| *Side water depth at maximum monthly average* | 12’ swd, 14’ walls | |
| Aeration blowers, no. (one standby) | 3 | 5 |
| *Capacity, each (peak full speed produces 100 scfm)* | 80 scfm | |
| *Operating pressure* | 7.0 psig | |
| *Motors, each* | 10 horsepower | |
| *Aeration blower control (on vfd’s)* | DO probes/control system | |
| Aeration, type | EPDM fine bubble diffusers | |
| *Aeration sizing for diffusers* | 150 scfm | |
| Mixing, & type | submersible mixers | |
| *Number* | 2 | 4 |
| *Motor size, each* | 2 HP | |
| Membrane Skids, number (standby is storage volume) | 1<br>Zenon | 2<br>Zenon |
| *Volume, each skid (2 basins per skid)* | 5,000 gal | |
| *Total volume in operation at design flow* | 7,500 gal | |
| *Turbidity analyzers, total, continuous effluent monitoring* | 1 per basin | |
| *Effluent (permeate) Flow meters* | 1 per basin | |
| Mixed Liquor (MLSS) Recirculation (MLR) | gravity to Anoxic/EQ | |
| *Recycle to Anoxic Basin (controlled by Anoxic/EQ pumps)* | 130  gpm | |
| *MLSS recirculation., total, maximum* | 0.19 mgd | 0.38 mgd |
| *Magnetic flow meters, 4 inch, number* | 1 | 1 |
| Waste Sludge Pumps, no. (+ 1 uninstalled standby), submersibles in Mixed Liqour Recirculation Wetwell | 1 | 2 |
| *Capacity, each* | 80 gpm | |
| *Motor* | 3 HP | |
| *Flow control type* | time on, total flow off | |
| *Magnetic flow meters, 2 inch, no.* | 1 | 2 |
| Scum Pump, positive displacement, no. (+1 uninstalled standby) | 1 | 1 |
| *Capacity* | 40 gpm | |
| *Motor* | 3 HP | |
| *Control* | manual or level on and level off | |

**Table 10. Potlatch Bubble MBR Treatment Plant Design Criteria, continued**

**Ultraviolet Disinfection System**

| Component | Phase 1 | Ultimate |
|---|---|---|
| Type, IDI horizontal with block-outs for added future modules | Low pressure/low intensity | |
| Number of banks in series (expansion capable on each module) | 3 | |
| *Capacity to treat to Class A standards* | 0.1 mgd | 0.2 mgd |
| *UV design dose, after 8,760 hours lamp operation*<br>*(100% redundant unit is not installed)* | 80,000 μW-sec/cm$^2$ [80 mJ/cm$^2$] | |
| Effluent Refrigerated Sampler | 1 | 1 |

**REUSE WATER SUMP/PUMPS TO REUSE OR INFILTRATION TO GROUNDWATER**

| Component | Phase 1 | Ultimate |
|---|---|---|
| Effluent Reuse Pumps, no (1 is standby + 1 future) | 2 | 3 |
| *Capacity* | 100 gpm | |
| *Motor* | 10 hp | |
| *Effluent flow measurement, type* | 4” mag meter | |
| Utility Water Pumps, no. | 1 | |
| *Capacity* | 60 gpm | |
| *Motor* | 7.5 hp | |
| *System components* | pressure tank, pressure switch | |
| *Operation* | pump on at 80 psig and off at 100 psig | |

**SLUDGE AERATED HOLDING BASIN**

| Component | Phase 1 | Ultimate |
|---|---|---|
| Volume of tank<br>(bolted steel 16’ walls, 14’ swd, 30 ft dia)<br>*or concrete (20’x20’x14’ walls, 12’ depth)* | 12,000 gallons | |
| Aeration blowers, no. (main blowers are standby) | 1 | 2 |
| *Capacity, each* | 180 scfm | |
| *Operating pressure* | 7.0 psig | |
| *Motors* | 10 horsepower | |

**DRAINAGE PUMP STATION**

| Component | Phase 1 | Ultimate |
|---|---|---|
| Pumps, duplex alternating, no | 2 | |
| *Capacity, each* | 120 gallons/minute | |
| *Motor* | 5 horsepower | |

## CORE AREA TREATMENT AND DISPOSAL

The Core Area MBR plant is located on the former WSDOT maintenance facility. It will accommodate up to 140,000 gpd average daily flow, when expanded for service for the the 20-year flow projections. The former WSDOT yard is located on Highway 101, near the northern end of the Core Area (see Figure 15). Effluent disposal will be achieved with infiltration basins, located east of the highway, and north of the WSDOT parcel. The property is known as the Smith Property.

The following is a summary of the new treatment facility's proposed elements. Detailed sizing of unit processes are shown in Table 11. Figures 18 and 19 show a schematic hydraulic profile and flow diagram of the plant, as well. A section of the infiltration basin is shown in Figure 17.

- Headworks (screening, grit removal, metering): Headworks consist of a 1/8" rotating drum screen with a bypass bar screen, a vortex grit removal system and an influent magnetic flow meter.

- Secondary Treatment: Membrane Biological Reactor technology will be used as the secondary treatment process and to achieve Class A reclaimed water. This alternative provides an MBR system consisting of a concrete tank with basins that will house the membrane units and provide anoxic and pre-aeration zones. The system will consist of influent and effluent piping, waste pumps, blowers and associated controls to make the installation complete.

- Equalization basins are recommended to attenuate peak hourly flows, because the membranes are sized for peak daily flow.

- Disinfection System: UV disinfection consisting of a 3 bank system of low pressure high output lamps will be provided. The rated capacity will be 0.10 mgd based on 60% transmittance.

- Infiltration Basins: The infiltration basins are required to be 1.16 acres based on a design application rate of 0.2 in./hr. The infiltration system will include an effluent pump, valve vault, force main, pumps, distribution box, and header system which distributes the effluent flow evenly throughout the infiltration basin.

  Emergency storage requirements will be included after regulatory requirements are established. An abandoned water well is freely flowing on the site, and must be capped prior to construction of the infiltration basins. Soil logs for test pits dug by Hong West for the original Master Plan are in Appendix G.

  The infiltration basins will be secured by a chain-link security fence.

- Solids Handling Facilities: Solids handling consists of aerobic digesters/storage tank, followed by thickening/dewatering by a belt filter press. The solids will then be transported to a landfill for final disposal or can be reused as soil amendment in a permitted biosolids land application program for agricultural production.

### Table 11. Core Area MBR Treatment Plant Design Criteria

| Component | Phase 1 | Ultimate |
|---|---|---|
| Influent Pump Station(s)<br>1 standby + 1 future) | flow proportional pumping | |
| *Capacity, each* | 300 gallons/minute | |
| *Motor* | 10 horsepower | |

**Headworks**

| Component | Phase 1 | Ultimate |
|---|---|---|
| Influent In-Channel Fine Screens, no. | 2 | 3 |
| *Capacity, each* | 0.6 mgd | |
| *Type of screen* | in-channel fine screen | |
| *Screen opening* | 2 mm | |
| Influent flow measurement, type | Ultrasonic | |
| *Downstream of fine screens, <u>24" side walls</u>* | 3" Parshall flume | |
| Influent sampling, refrigerated | flow paced composite sampler | |

**Activated Sludge – Activated Sludge Nutrient Removal Treatment**

| Component | Phase 1 | Ultimate |
|---|---|---|
| Equalization & out-of-compliance Basin, no. | 1 | 2 |
| *Equalization volume, each (equalize 8 hours of max day)* | 70,000 gallons | |
| *EQ to AB flow distribution box, no. (1 is standby)* | 2 | 4 |
| *Capacity, each (vfd flow control, PLC control)* | 200 gallons per minute | |
| *Motor, each* | 3 HP | |
| Anoxic Basins,(AnB), Flow from Influent + MLSS recirculation ,number | 2 | 3 |
| *Volume, total* | 35,000 gallons | 52,000 gallons |
| *Side water depth at max day flow (peak flow)* | 12 (12.5) feet | |
| *Mixers, high speed floating, total no.* | 2 | 4 |
| *Motor* | 2 horsepower | |
| *Detention time @ max mon avg + 3 x mlss recirculation, (Initial: 0.125+0.125x3 mgd) = 0.5 mgd* | 1.7 hours | |
| Aeration Basins, (no.)<br>volume 30,000 gallons each | 2 | 4 |
| Total Aerated Volume, including Membrane Basins | 0.0877 mg | 0.175 mg |
| *Volume provided by membrane 3 of 4 basins* | 15,000 gallons+/-* in operation | |
| | *Note: *Zenon skid basin volume is ~50% effective due to coarse bubble diffusers* | |
| *MCRT, minimum* | 21 days | |
| *Side water depth at max mon avg* | 12' swd, 14' walls | |
| *Aeration blowers, no. (one standby)* | 3 | 5 |
| Capacity, each | 200 scfm | |

**Table 11. Core Area MBR Treatment Plant Design Criteria, continued**

**ACTIVATED SLUDGE – NUTRIENT REMOVAL TREATMENT (Continued)**

| **Component** | **Phase 1** | **Ultimate** |
|---|---|---|
| Operating pressure | 7.0 psig | |
| Motors, each | 10 horsepower | |
| Aeration blower control (on vfd's) | DO probes/control system | |
| Aeration, type | EPDM fine bubble diffusers | |
| *Aeration sizing for diffusers* | 300 scfm | |
| *Mixing, & type* | submersible mixers | |
| Number | 2 | 4 |
| Motor, each | 2 horsepower | |
| Membrane Skids, no. (standby is storage volume) | 1<br>Zenon | 2<br>Zenon |
| *Volume, each skid (2 basins per skid)* | 7,500 gal | |
| *Total volume in operation at design flow* | 15,000 gal | |
| *Turbidity analyzers, total, continuous effluent monitoring* | 1 per basin | |
| *Effluent (permeate) Flow meters* | 1 per basin | |
| Theoretical detention time (total aerated volume, AB + MAB, without MLSS recirculation) | | |
| *At annual average (0.137 mgd)* | 17 hours | |
| *At max monthly average (0.18 mgd)* | 14 hours | |
| Mixed Liquor (MLSS) Recirculation (MLR) | gravity to Anoxic/EQ | |
| *Recycle to Anoxic Basin (controlled by Anoxic/EQ pumps)* | 130 gpm | |
| MLSS recirculation, total, maximum | 0.19 mgd | 0.38 mgd |
| *Magnetic flow meters, 4 inch, no.* | 1 | 1 |
| Waste Sludge Pumps, no. (+ 1 uninstalled standby), submersibles in ML recirculation wetwell | 1 | 2 |
| *Capacity, each* | 80 gpm | |
| *Motor* | 3 horsepower | |
| *Flow control type* | time on, total flow off | |
| *Magnetic flow meters, 2 inch, no.* | 1 | 2 |
| Scum Pump, positive displacement, no. (+1 uninstalled standby) | 1 | 1 |
| *Capacity* | 40 gpm | |
| *Motor* | 3 horsepower | |
| *Control* | manual or level on and level off | |

**Table 11. Core Area MBR Treatment Plant Design Criteria, continued**

| | | |
|---|---|---|
| **ULTRAVIOLET DISINFECTION SYSTEM** | | |
| **Component** | **Phase 1** | **Ultimate** |
| Type, IDI horizontal with block-outs for added future modules, | low pressure/low intensity | |
| Number of banks in series (expansion capable on each module) | 3 | |
| *Capacity to treat to Class A standards* | 0.2 mgd | 0.4 mgd |
| *UV design dose, after 8,760 hours lamp operation*<br>*(100% redundancy of largest unit is not installed)* | 80,000 $\mu$W-sec/cm$^2$ [80 mJ/cm$^2$] | |
| Effluent Refrigerated Sampler | 1 | 1 |
| **REUSE WATER SUMP/PUMPS TO REUSE OR INFILTRATION TO GROUNDWATER** | | |
| **Component** | **Phase 1** | **Ultimate** |
| Effluent Reuse Pumps, no (1 is standby + 1 future) | 2 | 3 |
| *Capacity* | 200 gpm | |
| *Motor* | 10 hp | |
| *Effluent flow measurement, type* | 4” mag meter | |
| Utility Water Pumps, no. | 1 | |
| *Capacity* | 60 gpm | |
| *Motor* | 7.5 hp | |
| *System components* | pressure tank, pressure switch | |
| *Operation* | pump on at 80 psig and off at 100 psig | |
| **SLUDGE AERATED HOLDING BASIN** | | |
| **Component** | **Phase 1** | **Ultimate** |
| Volume of tank<br>(bolted steel 16’ walls, 14’ swd, 30 ft dia) | 36,000 gallons | |
| Alternative material, concrete (20’x20’x14’ walls, 12’ depth) | | |
| Aeration blowers, no. (main blowers are standby) | 1 | 1 |
| *Capacity, each* | 200 scfm | |
| *Operating pressure* | 7.0 psig | |
| *Motors* | 15 horsepower | |
| Pressure Transducer for level indication | 1 | |

**Table 11. Core Area MBR Treatment Plant Design Criteria, continued**

| **SLUDGE THICKENING/DEWATERING** | | |
|---|---|---|
| **Component** | **Phase 1** | **Ultimate** |
| Type | Belt filter press w/ thickening option | |
| *Effective belt width* | 0.8 meter | |
| *Feed rate capacity, max* | 30 gallons/minute dewatering; 60 gpm thickening | |
| *Drive motor* | 3 HP | |
| *Belt tension compressor* | 2 HP | |
| *Utility water booster pump* | 5 HP | |
| Polymer feed systems | (2 feed pumps, 1 neat polymer pump) | |
| Type | wet polymer | |
| Thickener feed pumps, no. (+ 1 un-installed) | 1 | |
| *Capacity, each* | 80 gallon/minute | |
| *Motor* | 7.5 horsepower | |
| *Flow control* | manual set vfd at BFP control panel | |
| *Magnetic flow meter* | 1 at 4 inches | |
| Thickened Sludge Pump, open throat, motor | 7.5 HP | |
| *Dewatering Conveyor* | 2HP | |
| **DRAINAGE PUMP STATION** | | |
| **Component** | **Phase 1** | **Ultimate** |
| Pumps, duplex alternating, number | 2 | |
| *Capacity, each motor* | 120 gallons/minute | |
| *Motor* | 5 HP | |

## PHASE 1 CAPITAL COSTS

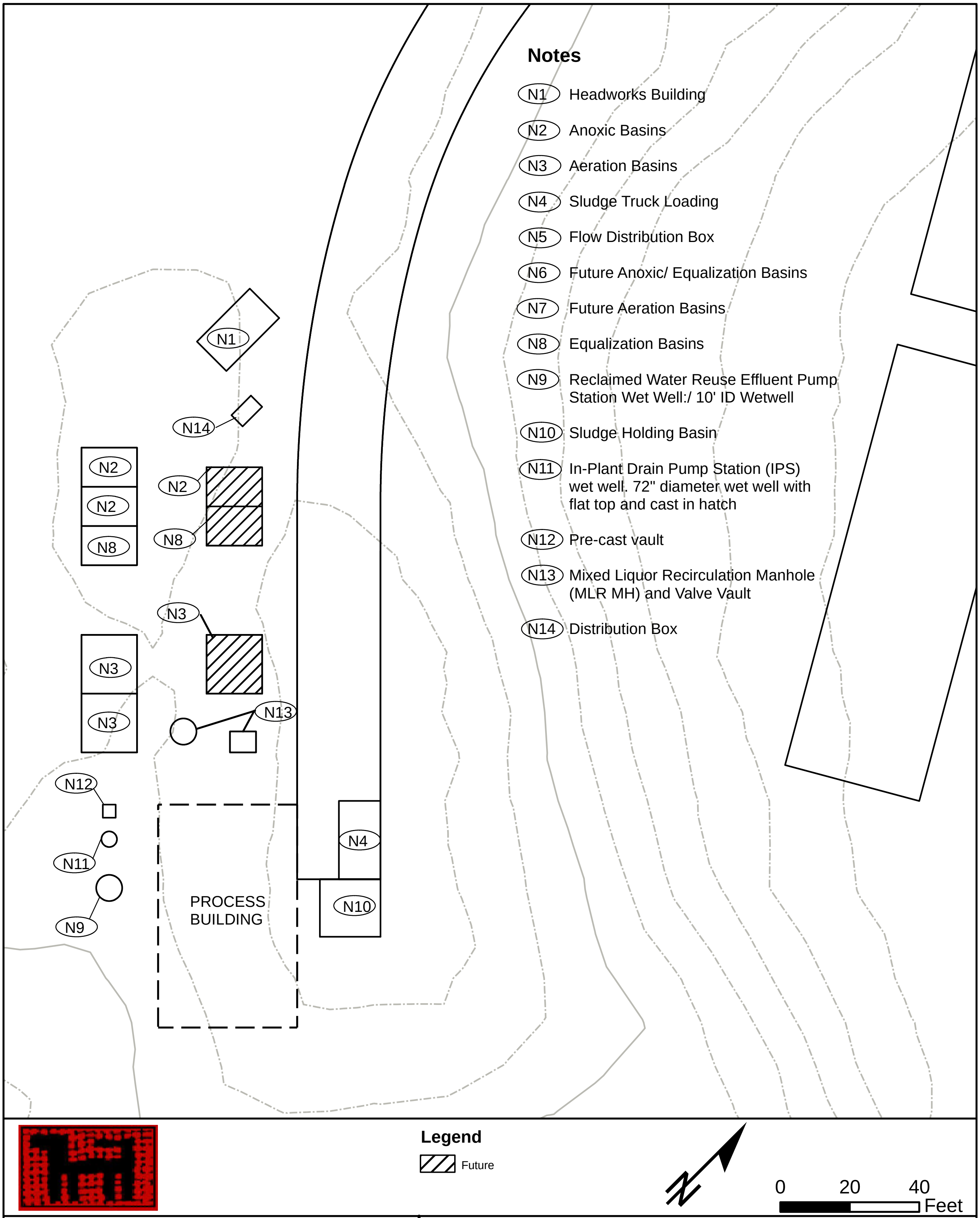
Phase 1 project cost estimates are summarized in Tables 12 and 13. Detailed cost estimates are presented in Appendix I. In general, conveyance costs include the cost of services, force mains and pump stations. Costs for decommissioning of septic tanks is separated for purposes of developing funding alternatives.

### Table 12. Capital Costs - Phase 1 Potlatch Bubble

| **Capital Costs** | | **Comments** |
|---|---|---|
| **Component Installed Costs** | | |
| | | |
| Conveyance | $639,000 | |
| Conveyance for Potlatch Bubble Service Creep | $335,100 | |
| Decommissioning Existing Septic Tanks | $10,000 | |
| Decommissioning for Potlatch Bubble Service Creep | $19,000 | |
| Treatment | $2,303,000 | |
| Disposal | $267,000 | |
| **Subtotal** | **$3,573,100** | |
| Contingency | $893,000 | 25% of Construction Cost |
| **Subtotal Construction** | **$4,466,000** | |
| **Non-construction costs** | | |
| | | |
| Design Engineering | $536,000 | 12% of Construction Cost |
| Assistance During Construction | $357,000 | 8% of Construction Cost |
| Administration | $89,000 | 2% of Construction Cost |
| Design/Admin Contingency | $134,000 | 3% of Construction Cost |
| | | |
| **Subtotal** | **$1,116,000** | |
| **Total Capital Cost** | **$5,582,000** | |

### Table 13. Capital Costs - Phase 1 Core Area

| **Capital Costs** | | **Comments** |
|---|---|---|
| **Component Installed Costs** | | |
| | | |
| Conveyance | $1,752,000 | |
| Decommissioning Existing Septic Tanks | $89,000 | |
| Treatment | $3,550,000 | |
| Disposal | $320,000 | |
| **Subtotal** | **$5,711,000** | |
| Contingency | $1,427,750 | 25% of Construction Cost |
| **Subtotal Construction** | **$7,138,750** | |
| **Non-Construction Costs** | | |
| | | |
| Design Engineering | $856,650 | 12% of Construction Cost |
| Assistance During Construction | $571,100 | 8% of Construction Cost |
| Administration | $142,775 | 2% of Construction Cost |
| Design/Admin Contingency | $214,163 | 3% of Construction Cost |
| **Subtotal** | **$1,784,688** | |
| **Total Capital Cost** | **$8,923,438** | |



**Notes**

| | |
|---|---|
| N1 | Headworks Building |
| N2 | Anoxic Basins |
| N3 | Aeration Basins |
| N4 | Sludge Truck Loading |
| N5 | Flow Distribution Box |
| N6 | Future Anoxic/ Equalization Basins |
| N7 | Future Aeration Basins |
| N8 | Equalization Basins |
| N9 | Reclaimed Water Reuse Effluent Pump Station Wet Well:/ 10' ID Wetwell |
| N10 | Sludge Holding Basin |
| N11 | In-Plant Drain Pump Station (IPS) wet well. 72" diameter wet well with flat top and cast in hatch |
| N12 | Pre-cast vault |
| N13 | Mixed Liquor Recirculation Manhole (MLR MH) and Valve Vault |
| N14 | Distribution Box |

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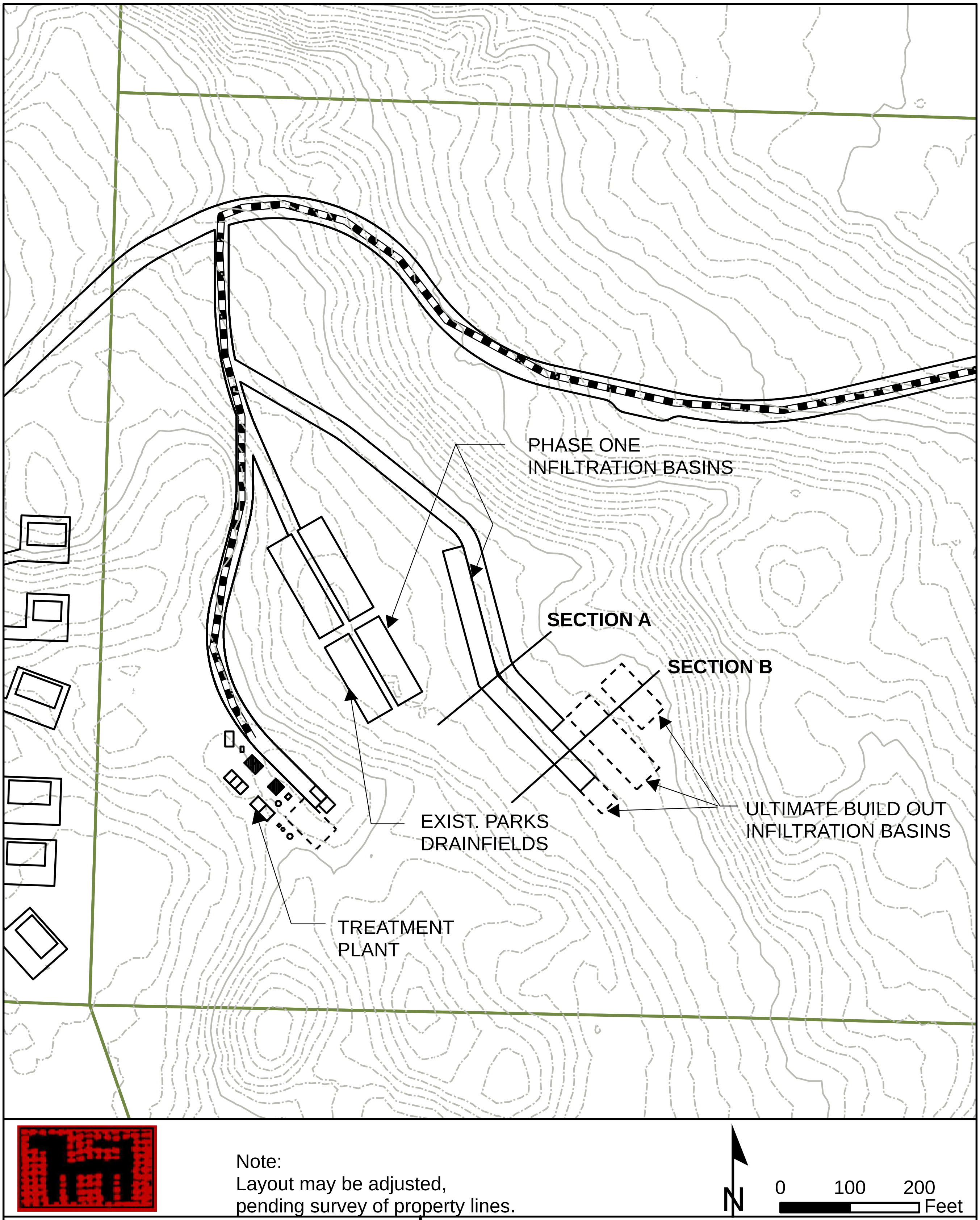
# Wastewater Treatment Plant
# Site Plan
# Potlatch Bubble Area

**Figure 12**



Note:
Layout may be adjusted,
pending survey of property lines.

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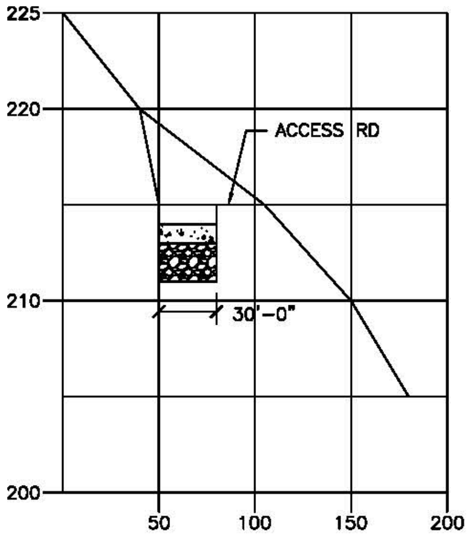
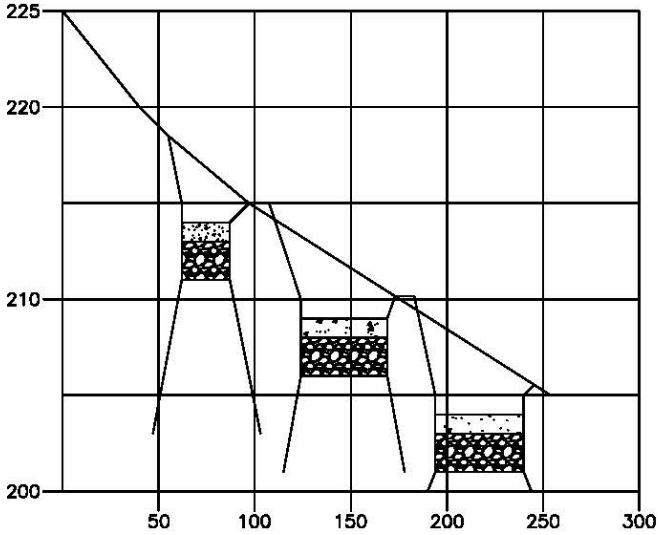
## Infiltration Basin- Site Plan
## Potlatch Bubble

**Figure 13**



PHASE ONE
INFILTRATION BASIN
SECTION A



ULTIMATE BUILD OUT
INFILTRATION BASIN
SECTION B

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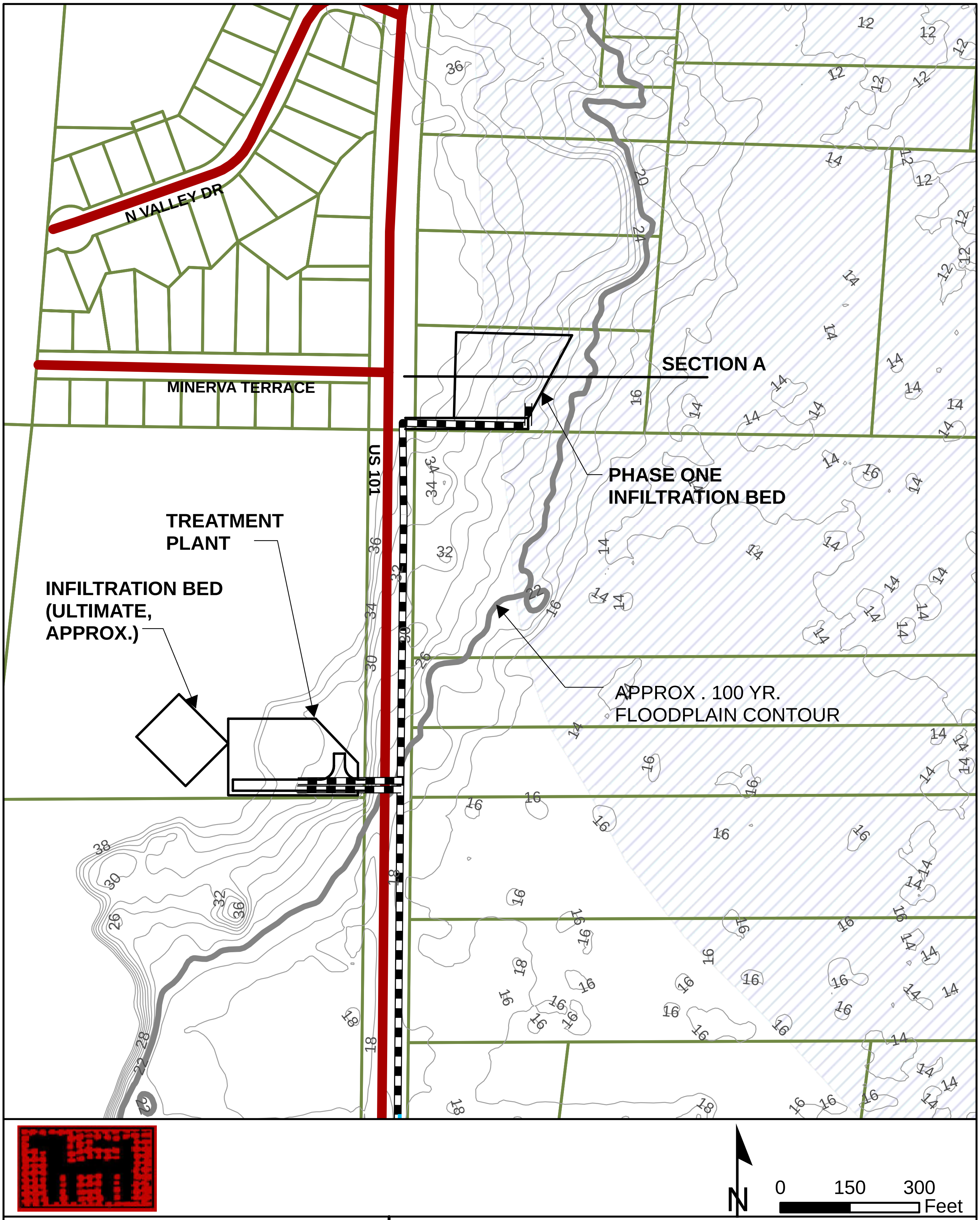
**Potlatch Bubble**
**Infiltration Basin**
**Sections A& B**

**Figure 14**



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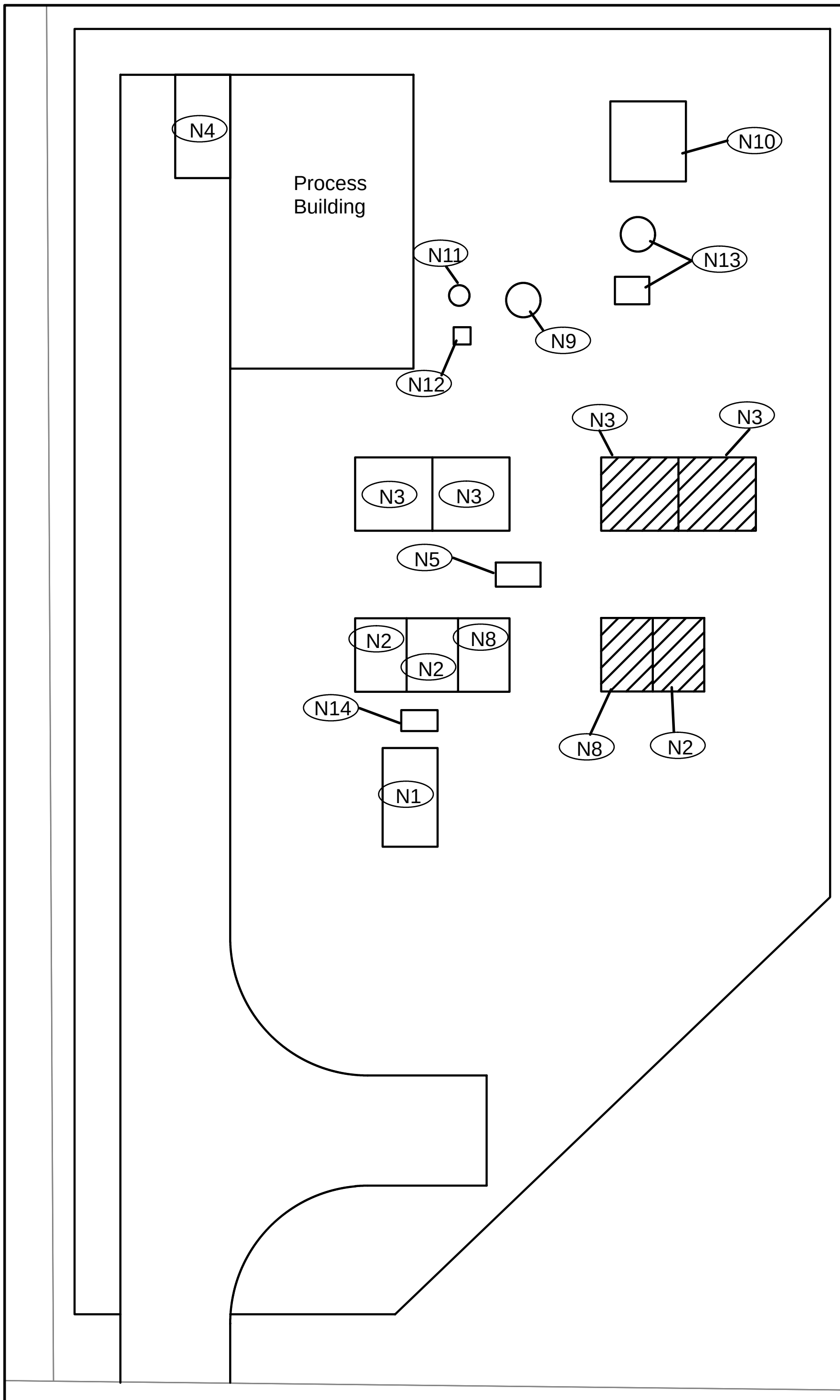
## Wastewater Treatment Facilities
## Site Plan- Core Area

**Figure 15**



**Notes**

| | |
|---|---|
| N1 | Headworks Building |
| N2 | Anoxic Basins |
| N3 | Aeration Basins |
| N4 | Dewatered Sludge Truck Loading |
| N5 | Flow Distribution Box |
| N8 | Equalization Basins |
| N9 | Reclaimed Water Reuse Effluent Pump Station Wet Well:/ 10' ID Wetwell |
| N10 | Sludge Holding Basin |
| N11 | In-Plant Drain Pump Station (IPS) wet well. 72" diameter wet well with flat top and cast in hatch |
| N12 | Pre-cast vault |
| N13 | Mixed Liquor Recirculation Manhole (MLR MH) and Valve Vault |
| N14 | Distribution Box |

**Legend**

| | |
|---|---|
| ☐ | Parcels |
| ▨ | Future |

0 20 40
Feet

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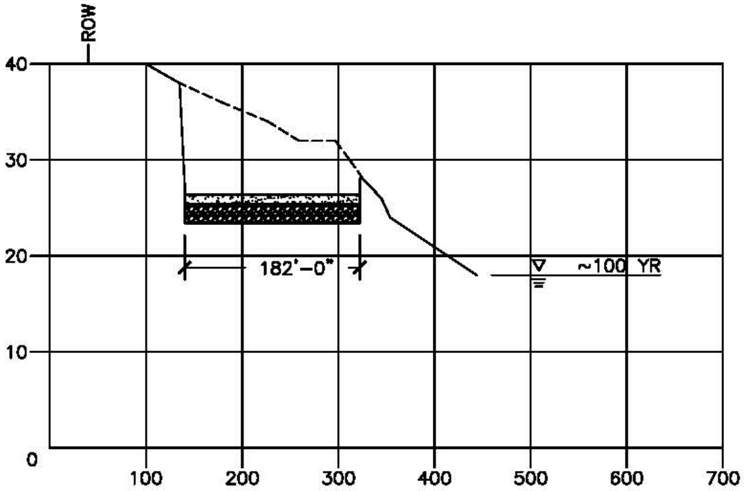
## Wastewater Treatment Plant
## Site Plan- Core Area

**Figure 16**



## PHASE ONE
## INFILTRATION BASIN
## SECTION A

CASCADE DESIGN
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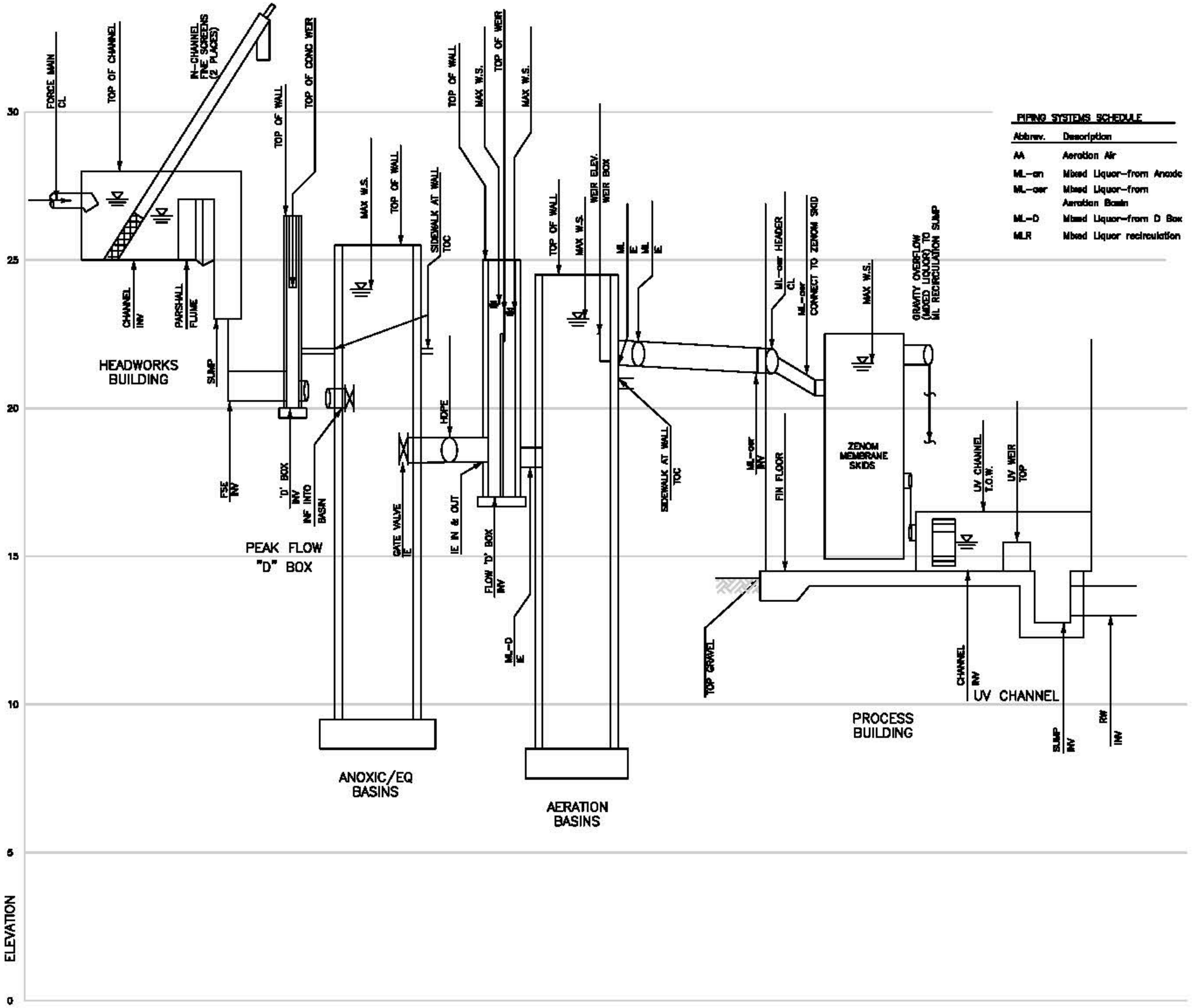
**Core Area**
**Infiltration Basin**
**Section A**

**Figure 17**



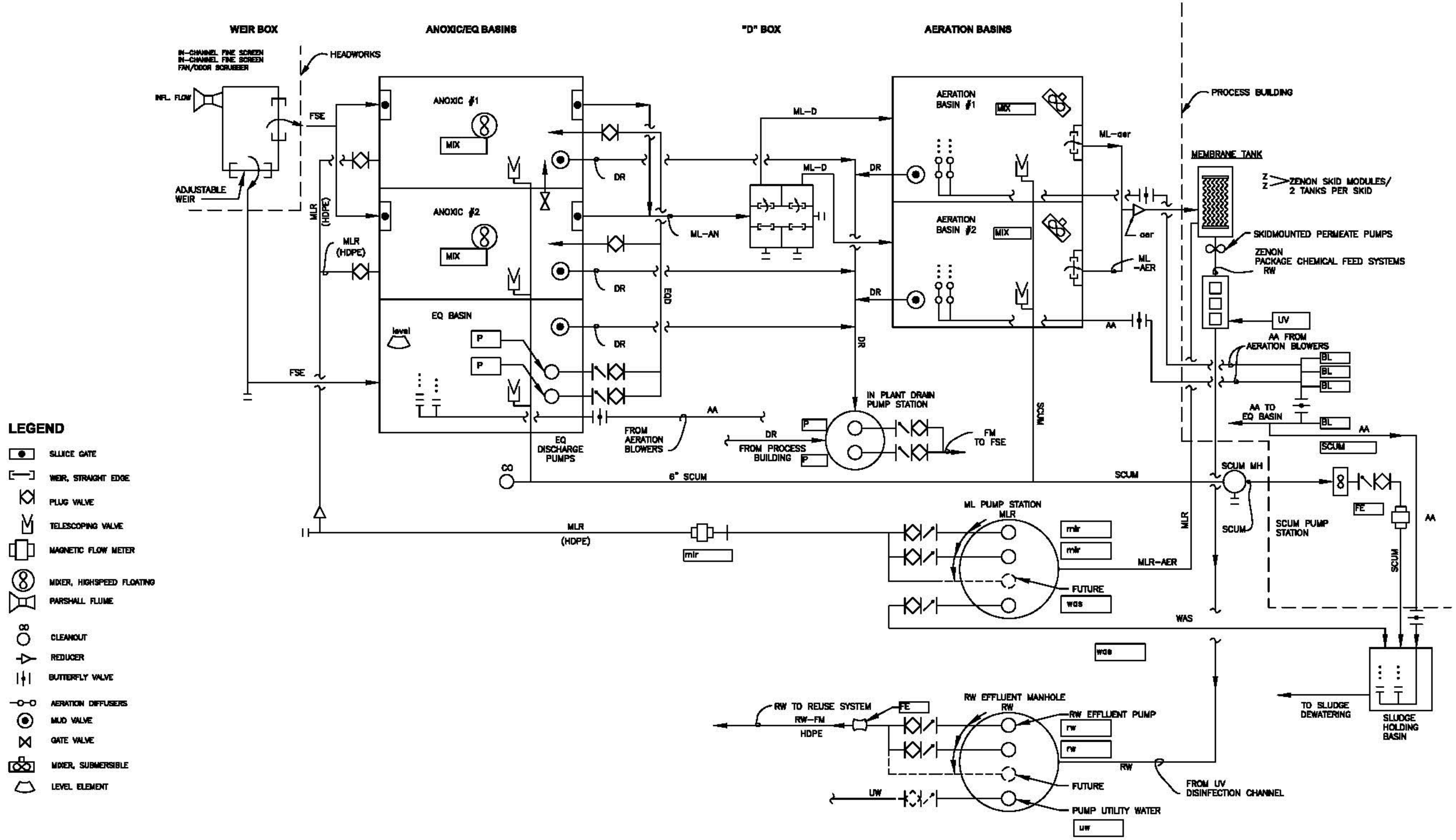
PIPING SYSTEMS SCHEDULE

| Abbrev. | Description |
|---|---|
| AA | Aeration Air |
| ML-an | Mixed Liquor-from Anoxic |
| ML-aer | Mixed Liquor-from Aeration Basin |
| ML-D | Mixed Liquor-from D Box |
| MLR | Mixed Liquor recirculation |

CASCADE DESIGN
PROFESSIONALS INC

FIGURE 18

Treatment Plant Hydraulic Profile Schematic



CASCADE DESIGN

## FIGURE 19

Treatment Plant
Flow Diagram
Schematic

# SECTION 9
# FINANCIAL ANALYSIS – POTLATCH BUBBLE AND CORE RESERVATION AREAS AMENDMENT TO CHAPTER 12 FINANCING

The purpose of the financial section is to evaluate the financial impact of completing the capital program identified in the plan, and outlining necessary steps for the financial execution of the plan. Completing these projections for a start-up system requires relying more heavily on assumptions and estimates than for an existing system with available operating and cost history. Therefore, this section will list the set of assumptions that are used to project financial impacts as well as identify financial issues that may be dealt with in the utility formation process as it progresses.

The Potlatch Bubble and Core Reservation Areas of the Skokomish Indian Tribe are currently served by individual private onsite septic systems. They are two of three areas that are jointly planning for, and evaluating financial feasibility for establishing a sewer utility, including the Hoodsport potential service area. At study time, ownership and management of the two potential sewer service areas on the Skokomish Tribal lands is assumed to be the Skokomish Indian Tribe, and the Hoodsport area would come under ownership and management of Mason County.

This section includes:

Capital Cost Data and Inflationary Projections
Equivalent Residential Unit (ERU) Data and Projections
Utility Management / Financial Policy Assumptions
Available Funding Sources for Capital Projects
Capital Financing Assumptions Used for the Financial Impact Forecast
Capital Financing Scenarios Evaluated
Annual Revenue Needs Forecast
List of Assumptions Used in the Revenue Needs Projection
Capital Facilities Charge Calculation
List of Utility Formation Financial Issues to Consider
Recommended Financial Strategy

## CAPITAL COST DATA AND INFLATIONARY PROJECTIONS

The capital costs identified in this plan are provided in current (2007) dollars. It is anticipated that these projects will be constructed up to the projected 2010 first year of utility operation for the Potlatch Bubble area and 2011 for Core Reservation area. An annual construction cost inflation rate of 4% has been used in forecasting capital costs for financing needs. The following tables show the capital cost timing projection as well as the costs escalated to the year of anticipated spending for the Potlatch Bubble (Table 14) and Core Reservation (Table 15).

### Table 14. Capital Program Summary – Potlatch Bubble

| | 2007 | 2008 | 2009 | Total |
|---|---|---|---|---|
| Conveyance | $ 99,800 | $ 499,000 | $ 922,200 | $ 1,521,000 |
| Decommissioning | | | 46,000 | 46,000 |
| Treatment | 359,800 | 1,799,000 | 1,439,200 | 3,598,000 |
| Disposal | 41,700 | 208,500 | 166,800 | 417,000 |
| Total | $ 501,300 | $ 2,506,500 | $ 2,574,200 | $ 5,582,000 |
| *Escalated Cost* | *$ 501,300* | *$ 2,606,760* | *$ 2,784,255* | *$ 5,892,315* |

### Table 15. Capital Program Summary – Core Reservation

| | 2007 | 2008 | 2009 | 2010 | Total |
|---|---|---|---|---|---|
| Conveyance | $ 136,900 | $ 821,400 | $ 1,095,200 | $ 684,500 | $ 2,738,000 |
| Decommissioning | | | | 139,000 | 139,000 |
| Treatment | 277,400 | 1,664,400 | 2,219,200 | 1,387,000 | 5,548,000 |
| Disposal | 25,000 | 150,000 | 200,000 | 125,000 | 500,000 |
| Total | $ 439,300 | $ 2,635,800 | $ 3,514,400 | $ 2,335,500 | $ 8,925,000 |
| *Escalated Cost* | *$ 439,300* | *$ 2,741,232* | *$ 3,801,175* | *$ 2,627,120* | $ 9,608,827 |

## EQUIVALENT RESIDENTIAL UNIT (ERU) DATA AND PROJECTIONS

Utility operations are expected to begin in the Potlatch Bubble service area in 2010 with a rate basis of 70 ERUs. An additional 52 conversions are projected by 2012. With assumed annual growth of over 2%, about 143 ERUs are projected at year 10 of utility operations.

### Table 16. Summary of ERU Basis- Potlatch Bubble

| ERUs | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 |
|---|---|---|---|---|---|---|---|---|---|---|
| Tribal Housing | 24 | 27 | 30 | 33 | 36 | 39 | 42 | 45 | 48 | 51 |
| Potlatch State Park | 36 | 36 | 57 | 57 | 57 | 57 | 57 | 57 | 57 | 57 |
| Minerva - East | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| Potlatch Bubble Service Creep | 0 | 0 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 |
| Total | 70 | 73 | 122 | 125 | 128 | 131 | 134 | 137 | 140 | 143 |
| Effective Utility Annual Growth Rate | | 4.29% | 67.12% | 2.46% | 2.40% | 2.34% | 2.29% | 2.24% | 2.19% | 2.14% |

Planning estimates project that 345 equivalent residential units (ERUs) will be connected to the Core Reservation sewer system during the first year of operation. No additional connections or growth to the service area are projected in this plan. The projections of average cost per ERU presented in this section are based on 345 ERUs in the Core Reservation potential service area.

## UTILITY MANAGEMENT / FINANCIAL POLICY ASSUMPTIONS

Tribes are not subject to the state laws pertaining to utility rates, finance and management. However, the Tribe is seeking to utilize state funding resources that have requirements for grant and low-cost loan funding eligibility. As such, this financial section evaluates financial needs assuming establishment of a new Tribal sewer utility that adheres to state regulations and industry practice as it relates to utility financial performance and rates. It is important to note that in the utility formation process the Tribe may choose to adopt none, some, or all of the typical utility management and financial standards, or only those that preserve the opportunity to seek out state funding resources.

## AVAILABLE FUNDING SOURCES FOR CAPITAL PROJECTS

Funding capital projects for utility formation requires consideration of unique constraints. In the case of an existing utility there could be cash reserves available either to pay directly for capital or to provide matching funds for low-cost loan programs. Existing cash also allows for short-term cash-flow management for grant programs that operate on a reimbursement basis only. An existing utility has existing revenue to pledge toward loan repayment and that may be made available for debt service that commences before project completion (and therefore utility operation and revenue collection in the case of utility formation).

Since there are no existing utility cash reserves, nor revenue, financing utility formation requires funding sources that provide proceeds upfront and do not require repayment until project completion or utility operation, using these options not only to fund projects but to manage project cash flow during construction. Since many grant/loan programs are reimbursement-based, meaning that they pay the agency only after agency payment for incurred costs, cash flow is a vital consideration in project financing and management.

The following is a summary of the programs and borrowing mechanisms that are available to the Tribe for sewer infrastructure funding.

## GOVERNMENT PROGRAMS

### Environmental Protection Agency (EPA)/ Clean Water Indian Set-Aside Program
(Descriptions Taken from EPA Website)

The Environmental Protection Agency (EPA) manages a grant program for the construction of wastewater treatment facilities for Indian tribes, Alaska Native Villages (ANVs), and tribes on former reservations in Oklahoma. The program is called the Clean Water Indian Set-Aside (ISA) Grant Program. Section 518(c) of the 1987 Amendments to the Clean Water Act established the program and authorized EPA to administer grants in cooperation with the Indian Health Service (IHS). This partnership maximizes the technical resources available through both agencies to address tribal sanitation needs. The ISA Program uses IHS's Sanitation Deficiency System (SDS) to identify high priority wastewater projects for funding.

### State and Tribe Assistance Grants (STAG)

The Environmental Protection Agency administers the STAG program with the intent that it will assist states and tribes in carrying out activities to ensure compliance with environmental laws and standards, and for project outcomes to serve as examples to other jurisdictions. Applications and review processes are administered through regional offices of the EPA. EPA grants have been earmarked to be made available to the Tribe and Mason County in their combined efforts to attract funding to the sewering projects. The grants require a 45% local match for which state grants and loan proceeds are eligible. The Tribe might also consider other Tribal resources for initial matching requirements.

### Clean Water Act Section 106 Tribal Pollution Grant Control Program

Grants under Section 106 of the CWA are intended to assist Indian tribes in carrying out effective water pollution control programs. Federally-recognized Indian tribes or Intertribal Consortia meeting the requirements for Treatment as a State (TAS), as set forth under Section 518 (e) of the Clean Water Act are eligible for these grants. Each member of an Intertribal Consortium must meet the requirements for TAS. Section 106 grants may be used to fund a wide range of water quality activities including: water quality planning and assessments; development of water quality standards; ambient monitoring; development of total maximum daily loads; issuing permits; groundwater and wetland protection; nonpoint source control activities (including nonpoint source assessment and management plans); and Unified Watershed Assessments (UWA) under the Clean Water Action Plan (CWAP). Where a tribe already has an established water pollution control program, it is encouraged to begin implementing specific program elements, e.g., developing nonpoint source controls, developing and revising tribal water quality standards, or developing and implementing groundwater programs.

### Clean Water Act Section 104(B)(3) Water Quality Cooperative Agreements/Grants

Under the authority of Section 104(b)(3) of the Clean Water Act, EPA makes grants to state water pollution control agencies, interstate agencies, municipalities, Indian tribes and other nonprofit institutions to promote the prevention, reduction and elimination of pollution. Further, the Clean Water Action Plan (CWAP), released in February 1998, presents a broad vision of watershed protection, and includes a new, cooperative approach to restoring and protecting water quality. The CWAP asks state, federal, tribal, and local governments to work with stakeholders and interested citizens to: 1) identify watersheds with the most critical water quality problems, and 2) work together to focus resources and implement effective strategies to solve these problems. Priority consideration is being given to implementing the CWAP and projects covering watersheds, and activities addressing stormwater, combined sewer overflows, mining, on-site systems, and animal feeding operations.

Section 104(b)(3) funds are to be used to focus on innovative demonstration and special projects. Among the efforts eligible for funding are research, investigations, experiments, training, environmental technology demonstrations, surveys, and studies related to the causes, effects, extent and prevention of pollution. These activities or projects could fall under one of the following 104(b)(3) funding categories as indicated in guidance to the regions.

### Department of Ecology

The Washington State Department of Ecology lists tribes as being eligible for the water and wastewater financing programs available to utilities.

The Department's Water Quality Financial Assistance Program sponsors three grant and loan programs: the Centennial Clean Water Fund (grant), Federal 319 Programs (grant), and the State Revolving Fund Loan (SRF). Most of the funding goes to wastewater programs. The Centennial Fund grants are available for projects serving 110% of existing capacity (limiting funding of growth) and the SRF is available to fund 20 years of growth (based on Growth Management Act-compliant comprehensive plans). SRF loans require establishment of a reserve that can be built over the first five years of loan repayment, which begins within one year after the initiation of operation or project completion (maximum five years after the first disbursement). The benefit that repayment is delayed until operation or project completion is an important feature of this loan option for utility formation. However, the timeline for planning and design loans begins once those phases are complete, not when the project construction is complete.

When applying for DOE programs, application materials are considered for all three programs. The department awards eligible grants and loans as a package.

Based on the rate impacts presented herein, the financial hardship consideration for the Centennial Grant might apply to the Tribe. The affordability factor for utility rates is a calculation of 1.5% of the area's median income. Any rates that exceed the 1.5% may qualify the rate as unaffordable.

DOE offers another program that might be available for the Tribe's sewering project. A portion of the costs are related to septic tank abandonment and are typically the property owner's (versus the utility's) responsibility. DOE offers a program to loan funds to local governments to establish local loan funds. These loan programs should assist individual property owners and small commercial enterprises by providing loans for water quality improvement projects. Examples listed in the FY 2007 Guidelines - Volume I include lending money to rehabilitate on-site septic systems. Although it does not specifically cite septic system abandonment for sewering, the private on-site costs might qualify and the Tribe should pursue funds from this program to alleviate the cost burden of the portion of financing borne by homeowners and businesses.

### Public Works Trust Fund

Historically the Public Works Trust Fund (PWTF) has been a commonly applied for and used, low-cost revolving-loan fund. It was established by the 1985 State Legislature to provide financial assistance to local governments for public works projects. Eligible projects have included repair, replacement, rehabilitation, reconstruction, or improvement of eligible public works systems to meet current standards for existing users. With recent revisions to the program, utility growth-related projects consistent with 20-year projected needs are now eligible. However, anticipated revisions to the PWTF program are that total funding of the program will continue to be reduced and qualifying projects will be limited to those that provide economic benefit, i.e. are growth-related. Whether PWTF will exist for sewer and water utility funding is currently in question; the Washington State Legislature is looking at the option of totally revising public works financial assistance programs. It is possible that this program will be eliminated altogether. At this point, PWTF loans continue to be a much sought after source of capital construction financing that the Tribe might pursue.

PWTF loans are available at interest rates of 0.5 percent, 1 percent, and 2 percent, with the lower interest rates given to applicants who pay a larger share of the total project costs. The loan applicant must pay a minimum of 5 percent towards the project cost to qualify for a 2 percent loan, 10 percent for a 1-percent loan, and 15 percent for a 0.5 percent loan. The useful life of the project determines the loan term up to a maximum of 20 years. Proceeds from other debt, such as state grants and loans, are eligible to be pledged as matching funds. The Tribe might choose to use non-utility Tribal resources for funds matching if it were to pursue a PWTF loan.

The applicant must be a local government and have an approved long-term plan for financing its public works needs. Tribes may access PWTF loans through agreement with a County or special purpose District. The Skokomish Tribe has already entered into an agreement with Mason County and Mason County PUD #1 related to a combined effort to secure funding for sewer projects in Hoodsport and the two Tribal service areas.

Local governments must compete for PWTF dollars since more funds are requested each year than are available. The Public Works Board evaluates each application and transmits a prioritized list of projects to the legislature. The legislature then indicates its approval by passing an appropriation from the Public Works Assistance Account to cover the cost of the approved loans. Once the Governor has signed the appropriations bill into law, the local governments receiving the loans are offered a formal loan agreement with the appropriate interest rate and term, as determined by the Public Works Board.

PWTF loans are a good option for low-cost financing with the added advantage that loan disbursements largely precede project expenditures. However, loan servicing begins in the year following receipt of the loan (beginning with one year of interest only payment), which means that for a multi-year construction of a new system, project debt repayment could begin before utility operation, and thus also before utility revenues are being generated.

### Community Economic Revitalization Board

Managed by the Department of Community Trade and Economic Development (CTED), this program provides grants and loans to fund public facilities that result in specific private-sector development. Eligible projects include water, sewer, roads, and bridges. There are current legislative efforts to increase State funding of this program, perhaps with a redesignation of PWTF funding similar to what has taken place in 2005 and 2006. In this case, grants and loans for sewer projects with defined economic development benefits might qualify for this type of financial assistance. Federally recognized Indian tribes are eligible for funding.

### Federal USDA Rural Utility Services Loans and Grants

The USDA administers the Rural Utilities Services loan and grant program that includes a Water Environment Program that targets water and wastewater issues for rural communities, defined as having a population of less than 10,000 in a rural area, city or town (includes federally recognized Indian tribes). There is a housing program that might be able to assist individual homeowners with loans, or in the case of low-income seniors, grant funds to make needed on-site improvements.

### Public Debt

Revenue bonds are commonly used to fund utility capital improvements. The bond debt is secured by the future revenues of the issuing utility, and the debt obligation or credit lien would not extend to other Tribal revenue sources. With this limited commitment, revenue bonds typically require security conditions related to the maintenance of dedicated reserves (a bond reserve) and financial performance (annual bond debt service coverage). The Tribe must agree to satisfy these requirements by ordinance as a condition of a bond sale. Revenue bonds typically bear a premium in market interest rates as compared to general obligation backed bond debt. There is no bonding limit, except perhaps the practical limit of a utility's ability to generate sufficient "net revenue" to repay the debt and meet the annual minimum debt service coverage test.

One benefit offered by public debt for a utility formation is that revenue bond debt can be structured to delay debt service payments until revenues commence, through features such as deferred principal maturities and capitalized interest. Thus, debt service could be delayed until the utility is in operation and generating revenues for debt repayment.

## CAPITAL FINANCING ASSUMPTIONS USED FOR THE FINANCIAL IMPACT FORECAST

The combined funding available toward financing sewer infrastructure in the Potlatch Bubble Area, Core Reservation, and Hoodsport potential sewer service areas is summarized in Table 17.

**Table 17. Summary of Current Available Funding**

| | | |
|---|---|---|
| 2003 STAG Grant - Hoodsport | $ | 667,800 |
| 2006 STAG Grant - Hoodsport | | 4,300,000 |
| Centennial Clean Water Fund Grant | | 1,000,000 |
| State Parks - Potlach Grant | | 1,050,000 |
| Total Grant Funds Available | $ | 7,017,800 |

While the STAG grants are being restructured and the costs are in development for the service areas, the current method of allocating available funding for this planning effort is that half is available to Mason County for the Hoodsport sewering project, with the other half available to the Tribe toward the Potlatch Bubble and Core Reservation area sewering projects. The $3,508,900 (of the total $7,017,800) assumed to be available to the Tribe is then further allocated to the Potlatch Bubble and Core Reservation areas based on the current cost estimates used in the planning effort. At this time the Potlatch Bubble costs make up 38% of the total Tribe sewering costs, so that $1.35 million in grant funds are available toward funding the Potlatch Bubble area sewer infrastructure costs and $2.16 million for the Core Reservation area.

With total Potlatch project costs of $5.89 million (escalated to year of projected spending), $4.5 million remains to be financed. With total Core Reservation project costs of $9.6 million (escalated to year of projected spending), $7.45 million remains to be financed. While it is recommended that the Tribe pursue first, all grant funds, and second, all low-cost state loans, it may not be that either will be secured for the total remaining funding need. The two forecast scenarios for each service area presented herein vary by the use of financing options toward funding the system costs identified in this plan.

## CAPITAL FINANCING SCENARIOS EVALUATED

The construction of a new sewer utility presents unique financial challenges as compared to major projects within an existing utility. Noted previously was the cash flow challenge of financing and managing completion of a major construction project without an ongoing revenue source. In addition, a new utility directly faces all costs of the initial system with the corresponding cost recovery burden. In contrast, the initial cost of most collection systems is imposed on development as it occurs, and is not a cost borne through utility rates. As a result, the projected rates for a new system, if they include such costs, are generally dramatically higher than comparable sewer rates in other utilities, and a potential obstacle to public acceptance and affordability.

Two scenarios were developed for funding the initial capital costs of the two systems:

### Scenario 1

Scenario 1 assumes no additional grant funds will be available toward funding the costs presented in this plan. Costs are financed through the use of the existing earmarked grant in conjunction with low-cost state loans (PWTF). The grants are made available on a reimbursement basis, meaning about 60 days of financing must be secured toward the use of available grants. In order to borrow from the PWTF at 0.5% interest, a 15% local match is required. This scenario is structured to show PWTF proceeds available toward the 60-day grant financing need, with grant proceeds available toward the PWTF matching requirement. This scenario also assumes no use of other Tribal resources, so that it represents the total average cost per ERU that would apply if the Tribe treated the utility as an independent financial entity (as is required of non-tribal public utilities). This also provides the planning level cost basis for charging non-Tribal customers of the utility. It is recommended that all available non-utility Tribal funds intended to assist Tribal members with utility rates be targeted at Tribal utility customers as a rate class, rather than reducing reasonable unit-cost-based rates for non-Tribal utility customers. This results in the highest rate outcome and that which might create the most significant affordability barrier to the project. The following tables summarize the financing assumptions used in Scenario 1.

**Table 18. Annual Financing Assumptions for Scenario 1- Potlatch Bubble**

| | 2007 | 2008 | 2009 | Total |
|---|---|---|---|---|
| **Capital Financing Summary** | | | | |
| **Costs to Finance** | $ 501,300 | $ 2,606,760 | $ 2,784,255 | $ 5,892,315 |
| **Funding Sources** | | | | |
| Grant | $ 430,513 | $ 501,989 | $ 417,652 | $ 1,350,154 |
| Other Tribal Resources | - | - | - | - |
| State Loans | 70,787 | 2,104,771 | 2,366,603 | 4,542,161 |
| | $ 501,300 | $ 2,606,760 | $ 2,784,255 | $ 5,892,315 |
| Capital Costs in Current Dollars | $ 501,300 | $ 2,506,500 | $ 2,574,200 | $ 5,582,000 |

**Table 19. Annual Financing Assumptions for Scenario 1- Core Reservation**

| | 2007 | 2008 | 2009 | 2010 | Total |
|---|---|---|---|---|---|
| **Capital Financing Summary** | | | | | |
| **Costs to Finance** | $ 439,300 | $ 2,741,232 | $ 3,801,175 | $ 2,627,120 | $ 9,608,827 |
| **Funding Sources** | | | | | |
| Grant | $ 377,280 | $ 817,101 | $ 570,176 | $ 394,068 | $ 2,158,625 |
| Other Tribal Resources | - | - | - | - | - |
| State Loans | 62,020 | 1,924,131 | 3,230,999 | 2,233,052 | 7,450,202 |
| | $ 439,300 | $ 2,741,232 | $ 3,801,175 | $ 2,627,120 | $ 9,608,827 |
| *Capital Costs in Current Dollars* | *$ 439,300* | *$ 2,635,800* | *$ 3,514,400* | *$ 2,335,500* | *$ 8,925,000* |

## Scenario 2

Scenario 2 is intended to illustrate the minimum rate outcome to the sewer customers if grants were made available for all costs identified in this plan. The resulting rate would be composed of only operating costs, as all capital costs would be funded through grants. In order to satisfy the 60-day financing need for the reimbursement-based grants, other Tribal resources are assumed to be made available (about $458,000 for Potlatch Bubble and $625,000 for Core Reservation). If grants were available for the entire cost, upon completion of final reimbursements, those funds would then be available to the Tribe again for other use. The following tables show the financing assumptions for Scenario 2 for each service area.

**Table 20. Annual Financing Assumptions for Scenario 2 – Potlatch Bubble**

| | 2007 | 2008 | 2009 | Total |
|---|---|---|---|---|
| **Capital Financing Summary** | | | | |
| **Costs to Finance** | $ 501,300 | $ 2,606,760 | $ 2,784,255 | $ 5,892,315 |
| **Funding Sources** | | | | |
| Grant | $ 418,895 | $ 2,260,657 | $ 2,755,078 | $ 5,434,629 |
| Other Tribal Resources* | 82,405 | 346,103 | 29,177 | 457,686 |
| State Loans | - | - | - | - |
| | $ 501,300 | $ 2,606,760 | $ 2,784,255 | $ 5,892,315 |

**Grants are reimbursement-based - assumes 60 day cycle*

**Table 21. Annual Financing Assumptions for Scenario 2 – Core Reservation**

| | 2007 | 2008 | 2009 | 2010 | Total |
|---|---|---|---|---|---|
| **Capital Financing Summary** | | | | | |
| **Costs to Finance** | $ 439,300 | $ 2,741,232 | $ 3,801,175 | $ 2,627,120 | $ 9,608,827 |
| **Funding Sources** | | | | | |
| Grant | $ 367,086 | $ 2,362,832 | $ 3,626,938 | $ 2,627,120 | $ 8,983,976 |
| Other Tribal Resources* | 72,214 | 378,400 | 174,237 | - | 624,851 |
| State Loans | - | - | - | - | - |
| | $ 439,300 | $ 2,741,232 | $ 3,801,175 | $ 2,627,120 | $ 9,608,827 |

**Grants are reimbursement-based - assumes 60 day cycle*

## ANNUAL REVENUE NEEDS FORECAST (20-YEAR)

The annual revenue needs forecast is comprised of the annual operating cost requirement, annual debt service (if any), and any funds collected to establish minimum operating reserve levels. These are the items that are included at a minimum level. There are certain policies related to the long-term financial health of operating a utility that should become a part of the annual rate revenue needs forecast, such as some reserve toward capital repair and replacement - usually based on annual depreciation expense on system assets. In order to minimize what will be a significant financial impact of funding the sewer system at formation, such policies are recommended to be phased-in. The tables presented on the following page summarize the annual revenue needs projection and the cost per ERU based on the two scenarios identified above. Costs are summarized as monthly costs per ERU.

Each of the scenarios includes a line for the Target Tribal Monthly Rate. This is developed based on the industry standard of 1.5% of median income as the threshold for utility rate affordability. The 1999 median income for the Skokomish Tribe was $13,300 annually. The monthly equivalent of 1.5% is a 1999 monthly rate of $16.63. Escalating that amount annually at an inflationary assumption of 3% results in a 2011 “affordable” rate of $23.70. The following section in the summaries, titled Other Tribal Revenue Needed for Target Rate, shows the amount of revenue that the Tribe would need to appropriate annually toward funding utility costs in order to maintain the rate deemed affordable by the 1.5% test.

For example, if the 43 tribal (of 130 total) ERUs in the Potlatch Bubble area paid the $24.41 per month rate in 2012 and the non-tribal customers paid the full cost rate, the Tribe would need to contribute $162,000 from other Tribal resources in Scenario 1 and $71,000 in Scenario 2 in order to meet annual costs. The average cost per ERU once conversion is complete (2012) is $341 for Scenario 1 and $164 for Scenario 2.

For Core Reservation, if all 345 tribal properties paid the $24.41 per month rate in 2012, the Tribe would need to contribute $678,000 from other Tribal resources in Scenario 1 and $252,000 in Scenario 2 in order to meet annual costs. The average cost per ERU once conversion is complete (2012-after all 345 conversions) is $188 and in Scenario 2 is $85.

The minimum affordable rate for potential non-Tribal member Mason County rate-payers is projected to be $66 in 2011, also lower than the projected average cost per ERU in these scenarios.

# Potlatch Bubble

## Table 22. Annual Financial Impact Summary Scenario 1 – Potlatch Bubble

| Annual Revenue Needs Summary | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2017 | 2023 | 2027 |
|---|---|---|---|---|---|---|---|---|---|
| **Non-Capital Costs** | | | | | | | | | |
| Salaries and Benefits | $ - | $ - | $ - | $ 183,040 | $ 188,531 | $ 194,187 | $ 225,116 | $ 268,800 | $ 302,537 |
| Annual Materials and Parts | - | - | - | 35,731 | 36,803 | 37,907 | 43,945 | 52,472 | 59,058 |
| Annual Admin Costs | - | - | - | 8,000 | 8,240 | 8,487 | 9,839 | 11,748 | 13,223 |
| Build-up of Reserves | - | - | - | 18,639 | 559 | 576 | - | - | - |
| | $ - | $ - | $ - | $ 245,410 | $ 234,133 | $ 241,157 | $ 278,900 | $ 333,021 | $ 374,818 |
| **Debt Service** | | | | | | | | | |
| State Loans | $ - | $ - | $ 10,878 | $ 261,772 | $ 260,577 | $ 259,381 | $ 253,405 | $ 246,233 | $ 241,452 |
| Operating Reserve Interest Earnings | $ - | $ - | $ - | $ - | $ 746 | $ 768 | $ 1,335 | $ 1,594 | $ 1,594 |
| Net Annual Costs | $ - | $ - | $ 10,878 | $ 507,182 | $ 493,964 | $ 499,771 | $ 530,969 | $ 577,659 | $ 614,675 |
| **ERU Basis** | | | | **70** | **73** | **122** | **137** | **143** | **143** |
| **Monthly Rate** | | | | **$603.79** | **$563.89** | **$341.37** | **$322.97** | **$336.63** | **$358.20** |
| **Target Tribal Member Monthly Rate**<br>*(set to 1.5% of annually escalated median income)* | | | **$0.00** | **$23.01** | **$23.70** | **$24.41** | **$28.30** | **$33.80** | **$38.04** |
| **Other Tribal Revenue Needed for Target Rate** | | | $ 10,878 | $ 167,263 | $ 175,019 | $ 161,649 | $ 203,323 | $ 230,761 | $ 243,966 |

** 2009 revenue to support debt service before existence of a rate-base - annual total based on ERUs excluding non-tribal customers*

## Table 23. Annual Financial Impact Summary Scenario 2 – Potlatch Bubble

| Annual Revenue Needs Summary | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2017 | 2022 | 2027 |
|---|---|---|---|---|---|---|---|---|---|
| **Non-Capital Costs** | | | | | | | | | |
| Salaries and Benefits | $ 0 | $ 0 | $ 0 | $ 183,040 | $ 188,531 | $ 194,187 | $ 225,116 | $ 260,971 | $ 302,537 |
| Annual Materials and Parts | - | - | - | 35,731 | 36,803 | 37,907 | 43,945 | 50,944 | 59,058 |
| Annual Admin Costs | - | - | - | 8,000 | 8,240 | 8,487 | 9,839 | 11,406 | 13,223 |
| Build-up of Reserves | - | - | - | 18,639 | 559 | 576 | - | - | - |
| | $ 0 | $ 0 | $ 0 | $ 245,410 | $ 234,133 | $ 241,157 | $ 278,900 | $ 323,321 | $ 374,818 |
| **Debt Service** | | | | | | | | | |
| State Loans | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Operating Reserve Interest Earnings | $ - | $ - | $ - | $ - | $ 746 | $ 768 | $ 1,335 | $ 1,548 | $ 1,795 |
| Net Annual Costs | $ 0 | $ 0 | $ 0 | $ 245,410 | $ 233,388 | $ 240,389 | $ 277,564 | $ 321,773 | $ 373,023 |
| **ERU Basis** | | | | **70** | **73** | **122** | **137** | **143** | **143** |
| **Monthly Rate** | $ - | $ - | $ - | **$ 292.15** | **$ 266.42** | **$ 164.20** | **$ 168.83** | **$ 187.51** | **$ 217.38** |
| **Target Tribal Member Monthly Rate**<br>*(set to 1.5% of annually escalated median income)* | | | **$0.00** | **$23.01** | **$23.70** | **$ 24.41** | **$ 28.30** | **$ 32.81** | **$ 38.04** |
| **Other Tribal Revenue Needed for Target Rate** | | | $ 0 | $ 77,513 | $ 78,642 | $ 71,291 | $ 96,967 | $ 117,883 | $ 136,659 |

# Core Reservation

## Table 24. Annual Financial Impact Summary Scenario 1 – Core Reservation

| **Annual Revenue Needs Summary** | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2017 | 2022 | 2027 |
|---|---|---|---|---|---|---|---|---|---|
| **Non-Capital Costs** | | | | | | | | | |
| Salaries and Benefits | $ - | $ - | $ - | $ - | $ 274,560 | **$ 282,797** | $ 327,839 | $ 380,055 | $ 440,588 |
| Annual Materials and Part | - | - | - | - | 57,110 | **58,823** | 68,192 | 79,054 | 91,645 |
| Annual Admin Costs | - | - | - | - | 12,000 | **12,360** | 14,329 | 16,611 | 19,256 |
| Build-up of Reserves | - | - | - | - | 28,247 | **-** | 982 | 1,139 | 1,320 |
| | $ - | $ - | $ - | $ - | $ 371,917 | **$ 353,980** | $ 411,342 | $ 476,858 | $ 552,810 |
| **Debt Service** | | | | | | | | | |
| State Loans | $ - | $ - | $ 9,931 | $ 311,838 | $ 427,994 | **$ 426,033** | $ 416,230 | $ 406,428 | $ 396,625 |
| Operating Reserve Interest Earning | $ - | $ - | $ - | $ - | $ - | **$ 1,130** | $ 1,310 | $ 1,518 | $ 1,760 |
| Net Annual Rate Revenue Need | $ - | $ - | $ 9,931 | $ 311,838 | $ 799,911 | **$ 778,884** | $ 826,263 | $ 881,768 | $ 947,674 |
| **ERU Basis** | | | | | **276** | **345** | **345** | **345** | **345** |
| **Monthly Rate** | | | | | **$241.52** | **$188.14** | **$199.58** | **$212.99** | **$228.91** |
| **Target Tribal Member Monthly Rate**<br>*(set to 1.5% of annually escalated median income)* | | | **$0.00** | **$0.00** | **$23.70** | **$24.41** | **$28.30** | **$32.81** | **$38.04** |
| **Other Tribal Revenue Needed for Target Rate** | | | *$ 9,931* | *$ 311,838* | $ 721,406 | **$ 677,808** | $ 709,089 | $ 745,931 | $ 790,202 |

** 2009 and 2010 revenue to support debt service before existence of a rate-base - there are no non-tribal Core Reservation ERUs*

## Table 25. Annual Financial Impact Summary Scenario 2 – Core Reservation

| **Annual Revenue Needs Summary** | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2017 | 2022 | 2027 |
|---|---|---|---|---|---|---|---|---|---|
| **Non-Capital Costs** | | | | | | | | | |
| Salaries and Benefits | $ 0 | $ 0 | $ 0 | $ 0 | $ 274,560 | **$ 282,797** | $ 327,839 | $ 380,055 | $ 440,588 |
| Annual Materials and Parts | - | - | - | - | 57,110 | **58,823** | 68,192 | 79,054 | 91,645 |
| Annual Admin Costs | - | - | - | - | 12,000 | **12,360** | 14,329 | 16,611 | 19,256 |
| Build-up of Reserves | - | - | - | - | 28,247 | **-** | - | - | - |
| | $ 0 | $ 0 | $ 0 | $ 0 | $ 371,917 | **$ 353,980** | $ 410,360 | $ 475,720 | $ 551,489 |
| **Debt Service** | | | | | | | | | |
| State Loans | $ - | $ - | $ - | $ 0 | $ 0 | **$ 0** | $ 0 | $ 0 | $ 0 |
| Operating Reserve Interest Earnings | $ - | $ - | $ - | $ - | $ 0 | **$ 1,130** | $ 1,965 | $ 2,084 | $ 2,084 |
| Net Annual Rate Revenue Need | $ 0 | $ 0 | $ 0 | $ 0 | $ 371,917 | **$ 352,850** | $ 408,395 | $ 473,635 | $ 549,405 |
| **ERU Basis** | | | | | **276** | **345** | **345** | **345** | **345** |
| **Monthly Rate** | **$ -** | **$ -** | **$ -** | **$ 0.00** | **$ 112.29** | **$ 85.23** | **$ 98.65** | **$ 114.40** | **$ 132.71** |
| **Target Tribal Member Monthly Rate**<br>*(set to 1.5% of annually escalated median income)* | | | | | **$23.70** | **$ 24.41** | **$ 28.30** | **$ 32.81** | **$ 38.04** |
| **Other Tribal Revenue Needed for Target Rate** | | | $ 0 | $ 0 | $ 293,412 | **$ 251,775** | $ 291,221 | $ 337,798 | $ 391,933 |

As indicated in the summaries, the projected average cost per ERU significantly exceeds the affordability threshold. These rates are calculated assuming an "enterprise fund concept", meaning that the sewer utility will fully fund its costs with user rates. In order to bring rates down closer in line with the rates indicated by the affordability test, the Tribe would need to dedicate non-utility Tribal resources to help fund annual utility costs.

## LIST OF ASSUMPTIONS USED IN THE REVENUE NEEDS PROJECTION

The financial forecast is based on numerous assumptions related to costs, financing and customer base. In general, the extent and impact of those assumptions are greater than for improvements serving an existing utility, where existing costs and revenues dampen such effects. The key assumptions used in the forecast of costs and rates include:

| | |
|---|---|
| Capital Construction Costs | As defined in Section 1 |
| Annual Operating Costs | PB $226,771, CR $343,670 first year of operation |
| Capital Reinvestment | Recommended to be phased in once affordable rate levels are established |
| PWTF | 0.5% 20 years (15% matching) |
| General Cost Inflation | 3% annually |
| Construction Cost Inflation | 4% annually |
| Growth | *See ERU section |
| Operating Reserve | Funded to 30 days of annual expenses |

## CAPITAL FACILITIES CHARGE

A Capital Facilities Charge (CFC) is calculated to determine the pro-rata share of costs that a new connection to a utility should pay in order to buy-in to ownership of capacity in the system.

CFCs are a form of connection charge imposed on new customers connecting to the system as a condition of service, in addition to any other costs incurred to connect the customer. Typically, the basis for the CFC is the capital cost a utility will incur or has incurred to provide the system. In the case of utility formation, there are no existing costs and it is based entirely on the facility costs identified in order to construct the infrastructure necessary to provide sewer service. The capital costs identified in this plan and referenced in this section, along with the capacity provided by those improvements, provide the basis for the CFC calculation.

Capacity units for calculating the CFC are commonly expressed in equivalent residential units, or ERUs, based on the typical sewage flow generated by a single family home (1 ERU). For any other development seeking to connect to the system, estimated flow contribution is used to determine a number of ERUs being served, which is then used to determine the level of CFC attributable to the customer. The CFC calculation is then, the total capital costs divided by the total capacity being designed, expressed on an ERU basis.

It is worth noting that although a CFC has been calculated for this plan, the unique circumstance of utility formation where the customer base already exists (as opposed to new development) imposes practical limits on application of the charge. Existing development at utility start-up would not then be charged a CFC, but instead bear their share of capital costs through rates or other charges in order to amortize those costs. The CFC remains potentially applicable for new development (rather than conversion of existing development), and remains a valuable benchmark for determining the level of investment being incurred to provide service.

The following tables summarize the CFC calculation. Under Scenario 1, an average cost of $29,272 per ERU is incurred in the Potlatch Bubble and $19,210 in the Core Reservation, net of currently available grants, to provide sewer service to the potential service areas. In Scenario 2, CFCs are not applicable since all infrastructure is assumed to be grant-funded.

**Table 26. Capital Facilities Charge Calculation- Potlatch Bubble**

| **Capital Facilities *(Connection)* Charge (CFC)** | | |
|---|---|---|
| **Cost Basis** | | |
| **CAPITAL PLAN** | | |
| Total Future Projects | $ | 5,536,000 |
| less: Grants and Contributions | | (1,350,154) |
| **TOTAL FUTURE COST BASIS** | **$** | **4,185,846** |
| | | |
| **Customer Base** | | **ERUs** |
| Existing Equivalent Residential Units | | 70 |
| ERU Capacity Remaining | | 73 |
| **TOTAL CUSTOMER BASE** | | **143** |
| | | |
| **Resulting Charge** | | **Total** |
| Total Cost Basis | $ | 4,185,846 |
| Total Customer Base | | 143 |
| **TOTAL CHARGE PER ERU** | **$** | **29,272** |

**Table 27. Capital Facilities Charge Calculation- Core Reservation**

| **Capital Facilities *(Connection)* Charge (CFC)** | | |
|---|---|---|
| **Cost Basis** | | |
| **CAPITAL PLAN** | | |
| Total Future Projects | $ | 8,786,000 |
| less: Grants and Contributions | | (2,158,625) |
| **TOTAL FUTURE COST BASIS** | **$** | **6,627,375** |
| | | |
| **Customer Base** | | **ERUs** |
| Existing Equivalent Residential Units | | 276 |
| ERU Capacity Remaining | | 69 |
| **TOTAL CUSTOMER BASE** | | **345** |
| | | |
| **Resulting Charge** | | **Total** |
| Total Cost Basis | $ | 6,627,375 |
| Total Customer Base | | 345 |
| **TOTAL CHARGE PER ERU** | **$** | **19,210** |

## LIST OF UTILITY FORMATION FINANCIAL ISSUES TO CONSIDER

The formation of a new sewer utility poses unique financial and administrative challenges that require careful planning and execution. While this plan cannot definitively address all of those issues, it is prudent to identify key issues and concerns to be addressed as a financial action plan is assembled and undertaken. Those issues include:

## Start-up Cash Flow Management

As a new utility, no operating revenues will be generated until after project completion and start-up. Further, typical cycles of billing and receipting are likely to require several months of operation before material revenues can support ongoing activities. This poses several challenges:

- Some assistance sources, such as the Centennial fund, provide assistance through reimbursement after expenses are incurred. The project must therefore have a source of cash flow to fund expenses until reimbursed.
- Some assistance sources, such as the STAG grants, require matching funds which may be sufficient through use of state resources.
- Some sources, such as PWTF, impose debt repayment schedules based on when draws occur. Thus, material debt repayment could be required before the project is completed.
- Assuming issuance of debt, repayment during the first year of operation will be according to a specific schedule, such as PWTF payments which occur annually in June. Depending on when operations commence and the total lead time until debt service payments are due, there might be inadequate time to accumulate initial payments from rates.

## Customer Costs to Connect to the System

In addition to the construction cost of the public system, developed or developing properties will incur costs to retire or decommission existing septic systems and to connect to the public sewer system. Such costs are often directly borne by the developed properties, although there may be the possibility of extending assistance or funding programs for these costs. Due to limitations on the allowed use of public funds for private purpose or benefit, any assistance or funding program should be developed with careful attention to satisfying requirements and restrictions on use of funds.

## Regulating Interim Development

A related issue for a newly forming utility relates to development occurring during the construction of the utility system. The Tribe might consider interim development rules as related to wastewater that allow for temporary facilities in anticipation of the sewer system. For example, holding tanks and truckage of wastewater might be a viable short-term alternative as compared to installing a new onsite disposal system, only to be abandoned upon completion of the sewer utility. Such a transition strategy could allow ongoing development while reasonably mitigating or avoiding duplicative costs.

## Development of Financial Administrative System

A new utility often does not have the benefit of an existing administrative infrastructure to support its day to day financial activities. The Tribe has a water utility, although it has been communicated that the water utility does not have sufficient administrative infrastructure in place. The Tribe would likely establish a sewer administrative infrastructure to springboard an effort to establish a structure that would effectively manage both the potential sewer utility and existing water utility.

The primary challenges for the new utility will be the development of a customer data base, establishment of rates and charges, and evaluation and application of appropriate policies related to the management, operation, and extension of the system. Without any statutory requirements, a significant effort at developing self-regulating rules and policies might be guided by existing statutory requirements from public utilities as well as organizations such as the Native American Water Association and other tribes with sewer utility experience.

## RECOMMENDED FINANCIAL STRATEGY

At this point in the planning process, the financial plan relates to basic elements of funding, cost recovery and administration. The intent is to structure and quantify the basic financial relationships resulting from the planned project. More detailed financial programs would be developed as the project moves forward.

The recommended financial strategy focuses on two areas of activity: pursuit of project funding assistance and development of a cost recovery system. Toward this end, it is recommended that the Tribe:

- Pursue all available grant funds and low-cost loans. A schedule of application cycles and deadlines should be consulted to guide such activities.
- Develop and undertake a utility formation process that considers and evaluates utility formation issues and options and assembles a cohesive policy package for developing the utility. Define a schedule or timeline for activities related to completion of a financial administrative and policy structure for the new utility. Continue to refine the financial forecast as cost estimates become better defined, financing is secured, and guiding policies are codified.
- Develop sound financial policies addressing utility reserves, capital improvement and replacement funding, debt policies, rate equity, financial administration, and rate equity objectives.
- Establish and adopt appropriate Tribal code to implement a system of rates and charges and execute the financial management of the utility.

## REFERENCES

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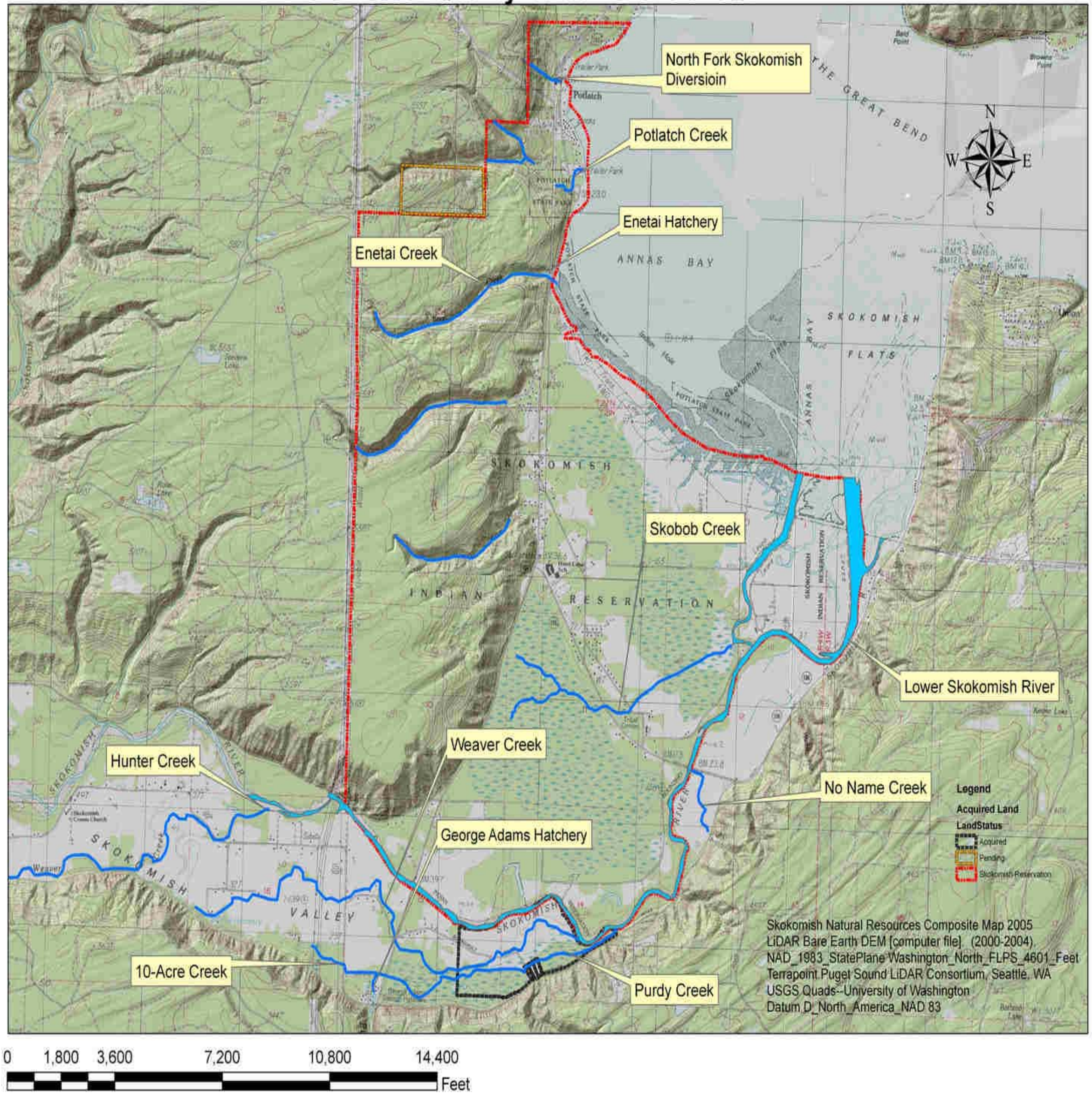
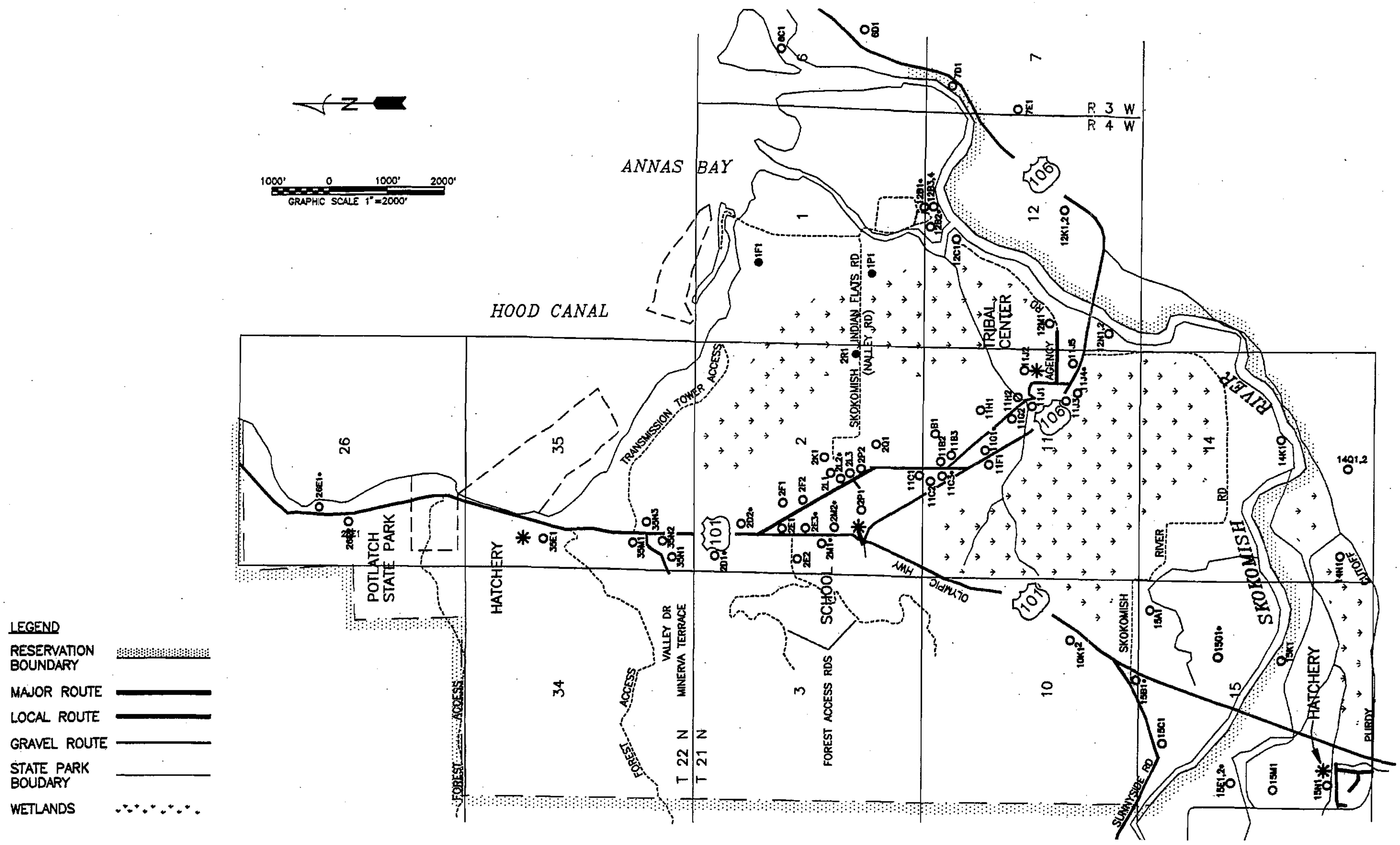
3. Puget Sound Technical Recovery Team, Northwest Fisheries Science Center, Hood Canal Summer Chum ESU Population Identification and Viability Document (draft), February, 2007.
4. Perry, C.A., 2006, Summary of significant floods in the United States and Puerto Rico, 1994 through 1998 water years: U.S.Geological Survey, Scientific Investigations Report SIR-2005-5194.
5. Adolphson Associates, Inc., On-site Sewage System Assessment, Skokomish Wastewater Facility Report, Appendix G, 1994.
6. West, Larry, Hong West & Associates, Inc., Preliminary Hydrogeologic Evaluation, Skokomish Wastewater Facility Report, Appendix F, 1994.
7. Whitehead, R.L., U.S. Geological Survey, GROUND WATER ATLAS of the UNITED STATES, Idaho, Oregon, Washington, HA 730-H, 1994.
8. Seiders, K., G. Hoyle-Dodson, and P. Pickett, Skokomish River Basin Fecal Coliform Bacteria Total Maximum Daily Load Study, Washington Department of Ecology, Publication Number 01-03-014, April, 2001.
9. Skokomish Natural Resources, Skokomish Indian Tribe Non-point Assessment Report and Preliminary Management Plan, 2006.
10. Barreca, Jeannette and Seiders, Keith, Skokomish River Basin Fecal Coliform Total Maximum Daily Load (Water Cleanup Plan) Submittal Report, Washington State Department of Ecology, Water Quality Program, June 2001.
11. Northwest Indian Fisheries Commission, http://www.nwifc.org/.

# Appendix A
## Maps of Water Quality Limited Streams, Well Locations, Failing Septic Systems

# Skokomish Reservation and
# 319 Water Quality Streams of Concern



Skokomish Natural Resources Composite Map 2005
LiDAR Bare Earth DEM [computer file]. (2000-2004).
NAD_1983_StatePlane Washington_North_FLPS_4601_Feet
Terrapoint Puget Sound LiDAR Consortium, Seattle, WA
USGS Quads--University of Washington
Datum D_North_America_NAD 83



● 1F1 Test Well Augered by U.S. Geological Survey

○ 26E1 Approximate location of Well and Number

* No Well Log

HWA
HONGWEST
& ASSOCIATES, INC.

SKOKOMISH WASTEWATER PLAN

WELL LOCATIONS

PROJECT NO.: 94032

FIGURE: 5

Skokomish Indian Tribe
WASTEWATER FACILITY REPORT

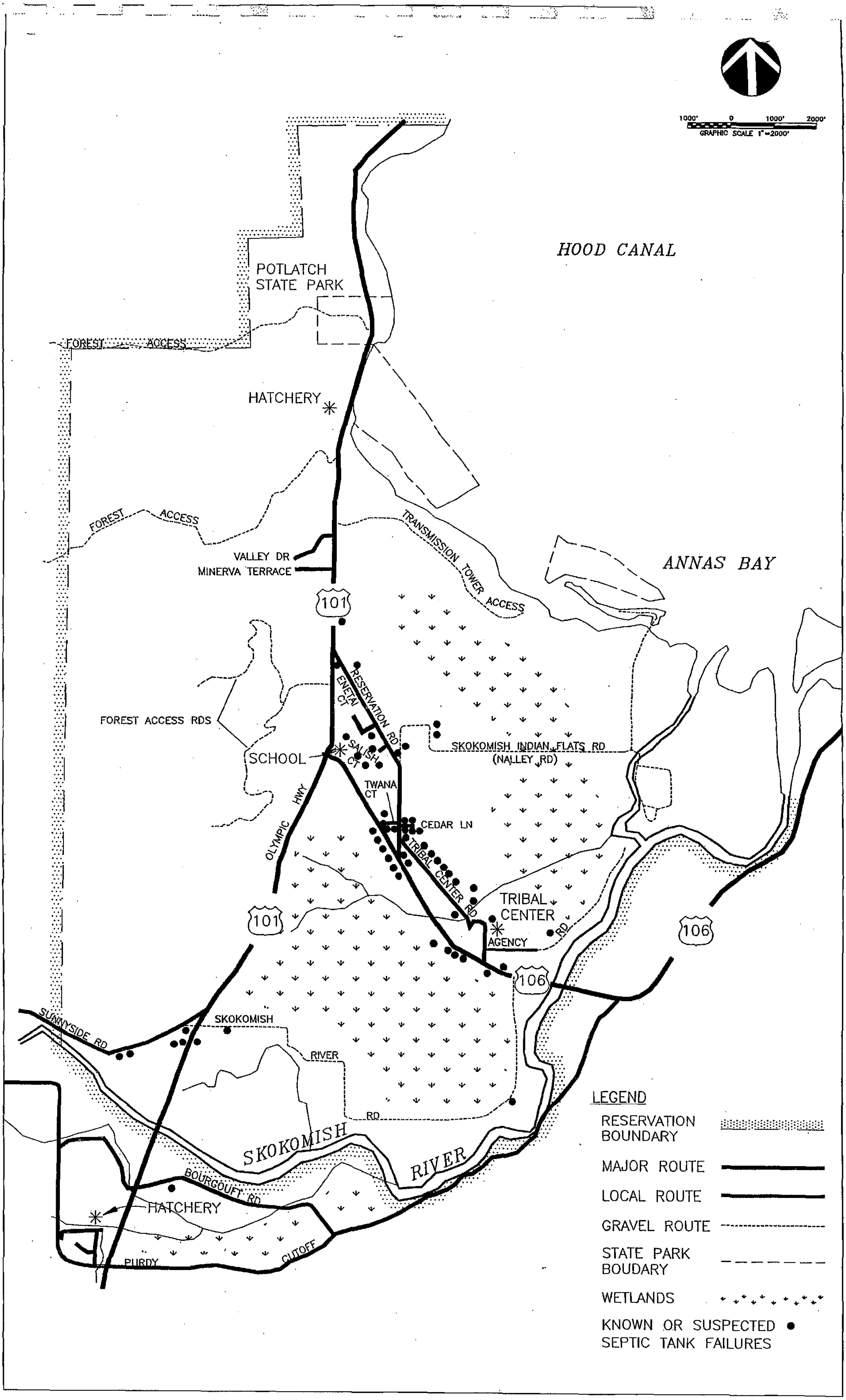


FIGURE 4-1
Problem
on-site sewage systems

# Appendix B

# Wastewater Planning Assumptions, Technical Memo (2006)

# DRAFT WASTEWATER PLANNING ASSUMPTIONS

# FOR CORE RESERVATION AND POTLATCH BUBBLE

## 12/8/06

- **Population**

    1. Population will grow at approximately 1-2 % per year according to Mason County state and tribal census; according to tribal administration, the anticipated growth rate will be 2% annually (see spreadsheet with number of households/current population estimates).

    2. There is a waiting list for housing on the reservation 111 families.

- There has been an increase in younger population with higher household size due to more families with children and extended multi-generational families (assume 4.16 people per household).

- **Land Use**

    1. 1977 Draft Land Use Plan, but no current comprehensive plan (comprehensive master plan for entire Reservation is in progress—on fast track/simultaneous to the wastewater development plan)

    2. Moving the Tribal Center to the WSDOT site has been discussed as possible opportunity in 2008+ (tribal government employment at the Tribal Center is anticipated to double in 5 years to about 200). Assume a major building and several small buildings and treatment facility at the site.

    3. Consider footprint of the MBR facility at the DOT site and potential neighbor impacts

    4. Treatment plant has "first dibs" on the WSDOT site.

    5. If above takes place, consider possible alternative uses for the lower reservation (many options are being evaluated).

    6. Continuing upland residential opportunities primarily in tribal village site (138 homes in new housing development within 15 years—also at new housing site will be community use facilities)

    7. New residential development will not occur in the floodplain except remodels

8. East side of 101 portion of Minerva Beach will remain the same for approx 10 years

9. West side of Minerva Beach will be modified by State Parks over 2-3 (3-5?) years according to a yet-to–be developed comprehensive plan

- **Commercial and Economic Development**

1. Substantial economic development will occur primarily at the intersection of Highway 101 and Highway 106. This will be more economic development than commercial services.

2. Only 6 +/- acres of the 51 at the intersection of 101 and 106 in service area H are developable.

3. Additional economic opportunities are the west side of 101 and perhaps WSDOT site…..potential for other sites immediately north of Potlatch currently in fee status

4. At least four new businesses are anticipated within 20 years (2 large-scale, 2 moderate-scale)

5. The load capacity at the Casino will quadruple within 5 years.

- **Service Areas**

1. Wastewater service will not be planned for the Sunnyside area (service area K) UNLESS a site specific cluster system outside of these planning efforts

2. Wastewater service will not be planned for Area I.

3. Area G –there is economic development potential on both sides of 101. Want to be able to serve with sewer.

4. The east side of 106, south of the intersection will have sewer service in Area J. The area is planned to have a community center, Boys and Girls Club. Assume 50 staff and visitors.

5. The Area E service area for the Potlatch Bubble will be planned to go to the north boundary of the Reservation

- **Wastewater Treatment Areas, Treatment Sites and Methods, Effluent Disposal**

1. Assume we will carry 2 options for the planning: two separate facilities for Potlatch and the Core Reservation, and one facility for Potlatch and the Core.

2. There are several options for sewage treatment for the Potlatch State Park, Minerva Beach and some of the nearby residential and commercial areas (within maybe a half mile north of the northern State Park boundary.as per the service area above which could include Waterfront at Potlatch, PUD, Womens Clubs, Potlatch Power Plant

3. Consider treatment options that produce Class A reclaimed water;

4. Evaluate treatment and disposal options in terms of opportunities to use effluent for economic benefit (forest treatments et.al., using dry/intermittent streambed for disposal, creating catch wetland/lake).

5. The new treatment facilities are to be low visibility and should meet high air quality standards (new FARR guidelines per EPA)

6. The southwest corner of the WSDOT site (14 acres) is the focus of planning for a Treatment Facility. This planning effort will focus on the back part of the DOT site at tow of slope.

7. No direct surface marine discharge will be allowed

8. Upland discharge (spray irrigation) of treated Wastewater should be studied along with wetland disposal in new and/ or constructed wetlands and infiltration

9. First phase of new homes in the new residential housing project (20 homes)will be clustered with an onsite system or use Potlatch Park/Minerva drainfield in newly acquired area with ability at a later date to drain down to the lowland portion of the Potlatch Bubble where the waste from those homes will be treated either at some type of community on-site system or at a sewer treatment facility

10. As new housing is built, provide for the ability to easily connect new houses to the sewer system – sooner or later

11. Some new method of managing wastewater will need to be available as the new homes on the reservation come along by Fall 2008

12. Any future new resort/casino development on the upland area (Simpson / Green Diamond parcels on Rez) would have self-contained wastewater treatment, and should not be included for these planning efforts.

- Phasing of Growth and Sewer Service

    1. Projected residential growth follows housing policy workgroup goals (Growth rate for new residential area includes 138 homes in three phases over 15 years with anticipated overall Reservation annual population growth rates of 2%)

    2. Opportunities exist for expanded commercial development in service areas 2 and 3 by the Tribe along owned and newly acquired properties INCLUDING Twin Totems, Lucky Dog Casino and Hood Canal School #404. As the Tribe provides water and wastewater support, non –tribal owned entities can be tie into tribal system(s), thru incentives, ordinances, codes (Mason County reciprocal connection.)

    *Utility and rate structure(s) can be tasked from the planning effort to provide certain financial assumptions in levys, pay-back debt-servicing.*

# Appendix C

# Population Estimates, 1998 Facility Plan

ATTACHMENT B

## SERVICE AREA AND GROWTH PROJECTIONS

AREA 1:
This is the core priority area of the Reservation for the provision of wastewater treatment.
Current population- 452
Future projection- 710

AREA 2:
This area is residential and commercial. It is one of the prime area for commercial development. Its estimated boundaries extend from the intersection of 101 and 106. where the Tribe owns 90 acres. to the Minerva Area past Joan Pell's place.
This area includes a newly acquired parcel of Tribal land. There are also projection of commercial expansion of Twim Totems and possibly gaming. Gaming would have the potential to require facilities to accomodate to 100 people per day. The Twin Totems expansion would potentially service 2,000 people per day and the laundromat would service 100 loads per day.
Current population- 45
Future projection- 90

AREA 3:
This area is up around Potlatch where a large non-Indian population resides. There is a large trailer park, water-front development, laundromat and a high rate of failing septics. This area has potential to be serviced by the Tribe's system on a revenue basis.

AREA 4:
This area runs along Sunnyside. Presentlyu there are about ten homes. Considerly the distance from the core of the Reservation, this area may be better serviced by an independent system or remain on septics.
Current population- 40
Future projection- 65

AREA 5 and 6:
These areas are currently zoned for forestry-related use. There has been talk of developing them for residential or commercial use. It is an upland site and its hydrology has not been thoroughly researched.

## FACILITIES PRESENTLY OCCUPIED:

Tribal Center
51 staff, daily use, 7:30am to 5:00pm
20 users per day
Activities-
Headstart 40 kids M-Th, Sept.-May
Evergreen 10 people M-Tues. Sept.-May, evenings
Committee and misc. meetings 360 people per month

Smokeshop
2 staff and 10 clients per day

will remain in future

Fisheries
10 staff and 5-10 visitors per day

Gym
20 users per week fall through spring
40 users per day summer

Maintenance shop
6 staff

Shaker Church
30-40 users per week

Twin Totems
11 employees
100 users per day -summer 150/day

## FUTURE FACILITIES PLANNED:

4/94 Tribal Center
25 staff
5 visitors per day
200 users per month for misc. meetings

4/94 Smokeshop
3 staff
5 clients per day

11/94 Health Clinc
14 staff
5,000 clients per year
360 users per month in the Conference room

9/94 Firehall
8 staff
10 clients per day
150 users per month in meeting room

Twin Totems Expansion
16 staff 150-200/day

Laundromat/video store
5 staff

# Appendix D

# Potlatch State Park Assessment, Utilities (Sanitary Sewer) (2006)

# Potlatch State Park Assessment
## Utilities (Sanitary Sewer)

**State of Washington**

**Parks and Recreation Commission**

**December 2006**

**Prepared by**

CASCADE DESIGN
PROFESSIONALS, INC.

# Potlatch State Park Assessment

## State of Washington Parks and Recreation Commission

## Utilities (Sanitary Sewer)

| | |
|---|---|
| **PREPARED FOR:** | Dale Broyles<br>Operations Manager, State of Washington Parks and Recreation Commission |
| **PREPARED BY:** | Herb Fricke/CDP<br>Project Manager |
| **REVIEWED BY:** | Lynn Harnisch/CDP |
| **COPIES:** | File/ CDP |
| **DATE:** | November 28, 2006 |

HERBERT J. FRICKE
26431
EXPIRES JULY 03,

# INTRODUCTION AND SCOPE

This technical memorandum summarizes the property assessment that was completed by Cascade Design Professionals, Inc. whereby site utilities (water and sanitary sewer) were examined in the field and assessed for continued use to serve the site needs, both current and future of Potlatch State Park. The purpose of the assessment was to determine the current condition of the water and sewer systems, and develop a rough understanding of needed improvements for Potlatch State Park

## Site Location

Potlatch State Park is located at 21020 N US Highway 101, Shelton, Washington 98584-9784. The "Day Use" portion of the park is located on the east side of Highway 101 at the southern end of Hood Canal. The campground portion of the park is located on the west side of Highway 101. See site location map below (Figure 1).

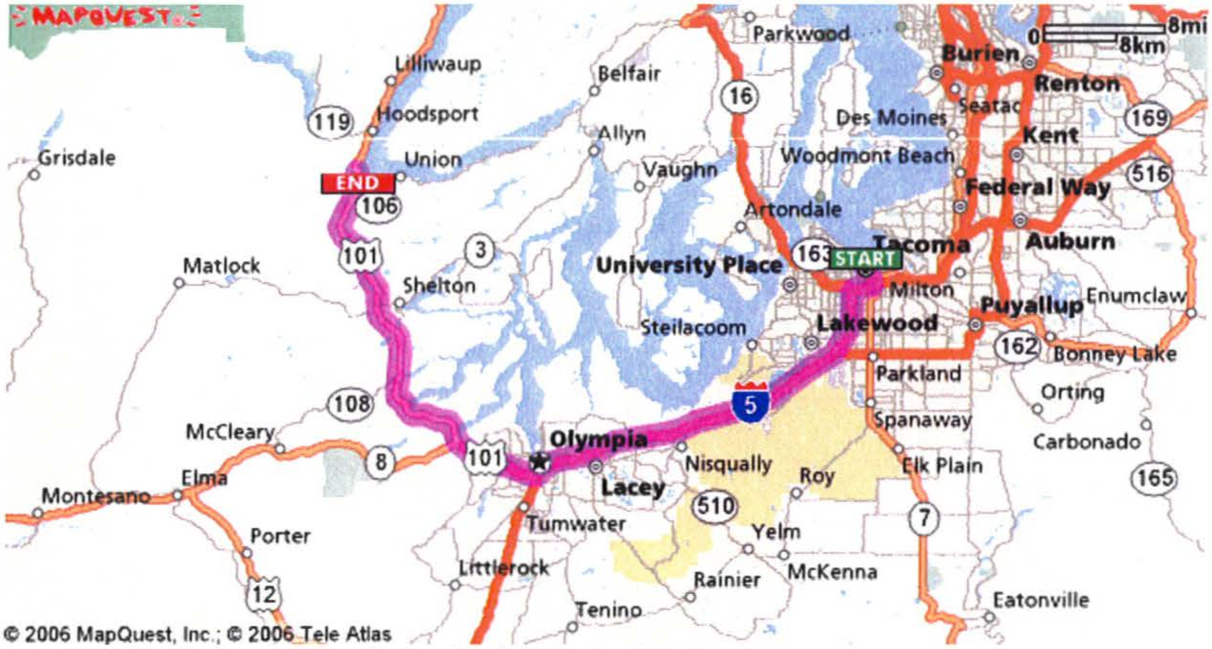


Figure 1: Site location map for Potlatch State Park.

## Field Investigation

Mr. Herb Fricke, P.E., Bob Bushnell, Certified Waste Water Treatment Plant Operator, and John Gray, Registered Geologist conducted a field investigation of the water and sanitary sewer systems on September 28, 2006.

## General Park Sanitary and Water Systems Description and Findings

Sanitary Sewer System: There are five components to the sanitary system.

Area One is the "day use" toilet.
The facilities drain into a septic tank on the north side of the building. This septic tank is made up of one chamber with a "downturned" elbow. Effluent from the septic tank flows to a wetwell, with pumps, located adjacent to the septic tank. This wetwell is circular in shape with a diameter of 4 feet and a total depth of 8 feet. The effective depth, between pump-on and pump-off is approximately 4 feet. The two pumps showed a model number of 100SI05HHF and are driven by Franklin Electric ½ hp, 115 V, single-phase motors. One pump was not operating and when pulled would not rotate even when "bumped". The other pump appeared to be operating effectively. Effluent from this site is pumped to a septic tank located on the west side of Highway 101 near the RV Dump Station.

Area Two is the RV Dump Station and main pump station area.
It is located on the west side of Highway 101 just north of the main entrance to the park. The RV dump station piping connects to a dump tank. This concrete tank is rectangular in shape, 12 feet wide by 19 feet long by 7.5 feet in depth for an effective capacity of 10,000

gallons. This tank is divided into two chambers with the chambers separated by a concrete baffle wall. The effluent from the second chamber flows through a bio-tube filter and into the main pump station wetwell. The filter appeared to be clean and functioning as designed.

A second tank, with a single chamber, located east of the pump station receives effluent from the east side of Highway 101. This concrete tank is 14 feet square and 9.5 feet in depth. The effective depth is 6.67 feet for a capacity of approximately 9,800 gallons. Effluent from this tank flows to the main pump station wetwell.

The main pump station wetwell is a 48-inch diameter flattop manhole, 11 feet in depth with a pump-on depth of 4 feet from the rim for an effective depth of approximately 6 feet to the pump-off level. The capacity is therefore 564 gallons. Based on a calculated maximum inflow from all areas of the park, the pumps would operate once every hour and 26 minutes during periods of peak flow. The submersible pumps are identical and powered by 1-1/2 hp, 230 volt, single-phase motors. The pumps were not pulled, for further inspection, as the presence of a gate valve in the force main was not apparent. Upon inspection of the control panel, it was determined that one of the exterior alarm lights was not working.

Area Three is located at the north end of the campground area on the west side of Highway 101. The septic tank adjacent to the restroom was not inspected by direction of WSPRC Project Manager. The effluent from this area flows to the RV dump tank via gravity according to drawings provided by WSPRC.

Area Four is located on the east side of Highway 101 adjacent to the WSPRC maintenance shop building. From drawings provided by WSPRC, it appears as though the effluent from the septic tank at the shop building flows, via gravity, to a small pump station in a tank adjacent to the Park Ranger office. The size and condition of the septic tank at the maintenance shop was not determined by direction of the WSPRC Project Manager.

Area Five is located at the Park Ranger office on the east side of Highway 101. From drawings provided by WSPRC, it appears as though this system consists of a septic tank and small pump station. Neither feature was inspected as per direction from the WSPRC Project Manager. From drawings provided by WSPRC it appears as though effluent is pumped from this station to the 14 x 14 septic tank near the Main Pump Station.

Effluent from the Main Pump Station is pumped from Area Two to a drainfield located up hill and west of the Main Pump Station. The drainfield is comprised of three separate fields, each 40 feet in width with two fields 150 feet in length and one field 125 feet in length. One test pit was dug adjacent to the drainfields to a depth of 8 feet meeting the requirements of the Washington Department of Health. The subsurface soils were classified as Type 1B to minus 6 feet and Type 1A from 6 feet to 8 feet in depth. See the attached Geological Report for more information.

All five areas with approximate locations of connecting piping and the location of the drainfield with piping to the pump station are shown on the attached Figure 1: Utilities Map.

Effluent from the Day Use Septic Tank was sampled by Mr. Fricke and tested by the Water Management Laboratories, Inc. facility in Tacoma. The test results are attached to this report.

## Assessment of Present Demands/Needs

Based on discussions with the WSPRC, it is understood that the main objective was to evaluate the condition of existing facilities and determine if they are adequate for pumping and disposal of current and future flows. We assessed the condition of the existing utilities; identified basic capacities, and determined potential limitations.

It is also understood that if and when purchased, the Minerva Beach property will continue to be served by the existing septic tank/drainfield system or sewage could be conveyed to Potlatch State Park for treatment in the parks septic tank/drainfield system. In general, it is WSPRC's goal to eliminate existing drainfields within the public areas of the park, which the existing Minerva system will be in, if the property becomes part of the park. See a separate report concerning the Minerva property.

Based on the current layout of the park the maximum population that could be served by the park is estimated to be 178 users per day (Table 1). This population would generate about 9,405 gallons of wastewater per day (gpd). Based on this value of potential flow, the 8500 gpd calculated drainfield capacity would be exceeded by 900 gpd. When the current estimated drainfield percolation rate of 0.5 gal/sf/day is applied, it is estimated that 1,800 sf of additional drainfield surface is necessary.

**Table 1**
**Sewage Use and Drainfield Capacity**

| Description | Number of Sites | Population per Site | Usage Per Capita (gal/unit) | Unit | Quantity (gpd) |
|---|---|---|---|---|---|
| Picnic | 20 | 5 | 5 | | 500 |
| Campground w/Central Comfort Station | 19 | 5 | 35 | Person | 3325 |
| RV Pump | 18 | 2 | 50 | RV | 1800 |
| Utility Spaces | 18 | 2.5 | 80 | Person | 3600 |
| Ranger's Residence/Park Office and Shop | 1 | 2 | 90 | Person | 180 |
| Total | | | | 278 | 9405 |

# Conclusions and Recommendations

## Conclusions

1. All of the septic tanks inspected where found to be in generally good condition, with coatings intact and without significant corrosion. Exfiltration or infiltration was not observed in any of the tanks indicating good structural integrity.
2. It has been determined that the Potlatch State Park drainfield is in need of expansion due to the fact that the current flow into the existing drainfield exceeds its capacity. This expansion will need to include the replacement of the existing distribution valve to accommodate a fourth drainfield. We recommend the installation of monitoring wells to comply with Washington State Department of Health Standards.
3. The faulty exterior alarm light on pump 1 at the Main pump station needs to be replaced.
4. Repair or replace pump #1 at the day use area pump station.
5. Verify existence of a check valve in the immediate vicinity of the Main Pump Station and, if one does not exist, install a check valve on the force main to preclude back-flow if and when the pumps need to be disconnected and pulled for maintenance or replacement.
6. Reroute the force main in the road from the edge of the park area to the drainfield due to future reconstruction of the road leading to the Tribal land to the west. This work needs to be coordinated with the Skokomish Tribal Planning office.

## Design Considerations

Final design for the non-maintenance items previously addressed can be initiated quickly; however, additional information is needed before design can proceed:

- Locate and conduct a topographic survey of a site for potential expansion of the existing drainfield.
- Design the additional drainfield and valve system.
- Install monitoring wells around the perimeter of the drainfield (see attached figure from the Geotechnical and Geological Findings Report, G2 Associates, Inc.).
- Design a new route for the force main to the drainfield after coordination with the Skokomish Tribal Planning office.

## Cost Estimate Summary

Upon careful consideration, we have estimated the cost of recommendations to be as follows:

- Main park drainfield expansion: Approximately $5.00 per square foot for a total of $30,000.00. (Based on previous work completed).
- Replacement of distribution valve: Approximately $2,000.00 (Based on both manufaturer's cost and current labor market value).
- Installation of monitoring wells: Approximately $6,000.00 (Based on 20 ft depth hole auger and casing costs).
- Pump 1 alarm light replacement: Approximately $150.00 (Based on manufacturer's cost).
- Pump 1 replacement: Approximately $1,000.00 (Based on both manufaturer's cost and current labor market value).
- Relocation of the force main to the drainfield area: approximately 1,500 linear feet at $30.00 per foot for a total of $45,000.00
- Engineering design: Approximately $15,000.00 (Based on current market value).
- Administration and Contingency Costs: $25,000.00

Total estimated cost: **$124,150.00**

## Attachments or Enclosures:

Table 1: Daily flow of Effluent vs. Capacity of Drainfields
Figure 1: Utilities Map
Geotechnical and Geological Findings
Results of analysis of two wastewater samples
Photos

**POTLATCH STATE PARK**

Table 1: Daily Flow vs. Capacity of Drainfields

| Description | Number of Sites | Population per Site | Park Population | Usage per Capita (gal/unit) | Unit | Quantity | *Pumped Flow (Q) |
|---|---|---|---|---|---|---|---|
| Picnic | 20 | 5 | 100 | 5 | | 500 | |
| Campground w/Central Comfort Station | 19 | 5 | 95 | 35 | Person | 3325 | |
| RV Dump | 18 | 2 | 36 | 50 | RV | 1800 | |
| Utility Spaces | 18 | 2.5 | 45 | 80 | Person | 3600 | |
| Rangers Residence/Park Office and Shop | 1 | 2 | 2 | 90 | Person | 180 | |
| **Total** | | | 278 | | | 9405 | |

| Drainfield Calculations | | | | |
|---|---|---|---|---|
| **DF** | **Width** | **Length** | **Area** | **[1]Capacity** |
| A | 40 | 150 | 6000 | 3000 |
| B | 40 | 150 | 6000 | 3000 |
| C | 40 | 125 | 5000 | 2500 |
| | | | 17000 | 8500 |

* Confirm with fixture count

Assumptions:

1 Engineered Fine Sand in Drainfield gives 0.5 gal/sf/day

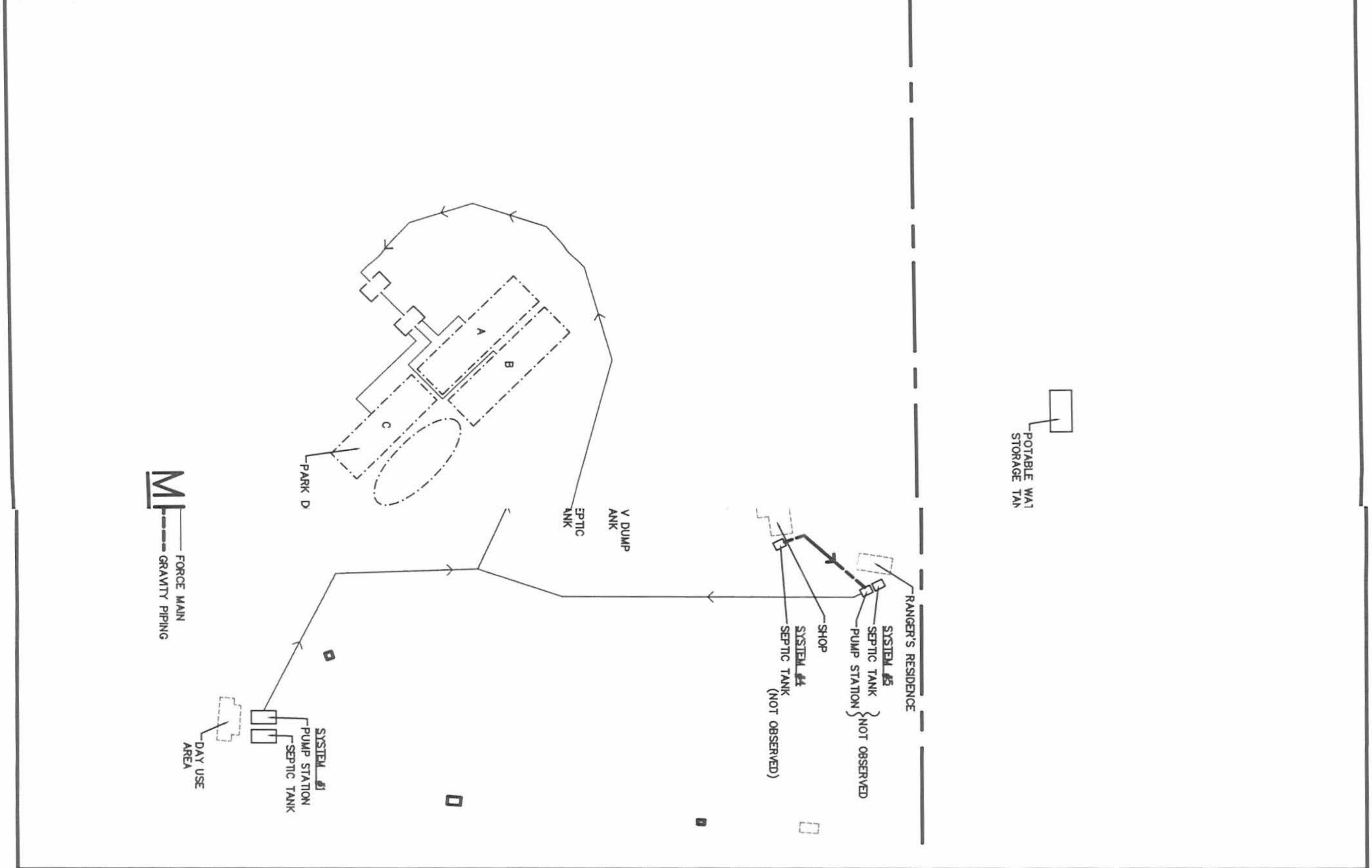
Total Area of Drainfield= 17000 sf

[1]Drainfield Capacity= 8500 gpd

Quantity-Capacity= 905 gpd

Additional Area Needed=(Quan.-Cap.)/(0.5 gal/sf/day)= **1810 additional area (sf)**

G:\2006\06-21 WA Parks\Task 1 - Potlatch State Park & Minerva Beach\Report\Final Report- Potlatch\Potlatch Map.dwg, Model, 12/8/2006 10:55:24 AM, Canon iR C



PROJECT NO.
CD 0621

SHEET 1 OF 1

DRAWING NO.:

1 INCH

| NO. | DATE | DESCRIPTION | BY |
|---|---|---|---|
| | | | |

DESIGNED BY: DRAWN BY: CHECKED BY:

OWNER

**WASHINGTON PARKS & RECREATION COMM.**

7150 CLEANWATER LANE
OLYMPIA, WA 98504
360-902-8543

# POTLATCH STATE PARK UTILITIES MAP

21020 HIGHWAY 101
SHELTON, WASHINGTON

DECEMBER 8, 2006

SCALE: NOT TO SCALE

CASCADE DESIGN
2780 SE Harrison St.
Suite 104
Milwaukie, OR 97222
Voice: 503-652-9090
Fax: 503-652-9091

G2 ASSOCIATES INC. 503-292-7939
GEOLOGY • SOILS • ENVIRONMENTAL • DEVELOPMENT

October 13, 2006

Washington State Parks and Recreation Department
C/O Cascade Design Professionals, LLC
2780 SE Harrison Street
Milwaukie, OR 97222

RE: Geotechnical and Geological Findings
Potlach State Park Septic Treatment Drain Fields
Highway 101, North of Shelton
Mason County, WA

This report follows our collaborative trip on September 28, 2006, and the related inspections of various components of the existing parklands, the existing septic filtration systems and the subsurface geology. This project not only required evaluation of the formal park grounds, but also adjacent geology on the hilltop to the south, and the geology and functioning drain fields located on the private property just north of this park. Those grounds have been referred to as "Minerva" and have functioned for a number of years as a private trailer park facility. These efforts at Minerva and the land south of the park are part of a means for evaluation for a potential land trade.

The park is reportedly a well-used public facility to possibly be upgraded in the near future where needed and practicable for the public benefit. The purpose of this report is to summarize the observations of a professional conversant in soils, geology and engineering based factors that attend the development and modification of land for human-based uses. All field work conducted during this contract was monitored by this writer, whom is a Washington Licensed Geologist, an Oregon Registered Geologist, and an Oregon Engineering Geologist with over 30 years of expertise in these and other related technical specializations. Following are our observations, comments and conclusions for the design engineering needs on this project.

## REGIONAL GEOLOGICAL SETTING

Potlach State Park is located on one of many located along the water front of the peninsulas that form the inland waterways, islands, ridges and Puget Sound waterway system. The sound is a very geologically complex basin, with subduction zones and sediment filled structural features masking the collision of oceanic and continental margin plates. Regional continental glaciation covered, scoured and reshaped the surface of the area, grinding granitic rocks and their associated types to rock dust, sand and rounded gravel deposits, and forming the pebbly beach materials noted throughout this park and along the waterfront across the road. Huge volumes of glacial till deposits (silt, sand and gravel) were naturally processed and washed out by ice glaciers forming islands, while other ridges and lowlands were the eroded core remains of bedrock formations. Glacial activities also formed many of the regional ridges in the distance, carved out water collection basins and lakes, and have been credited with the shaping of berms, mounds, drumlins and other features as far south as Centralia, Washington.

Local geologic observations included the nature of sands, rounded granitic pebbles and the general deposits that remain on the surface in this area. Five backhoe test pit explorations were conducted at key locations within the perimeters of trailer sites, and known drain fields to assess the current conditions of both the soil section and the existing drain fields. For the client's benefit, those units have basically been discussed within this report, rather than in the traditional and more technical manner of tabular documentation.

## TEST EXPLORATION LOCATIONS

As noted above, this project included the performance of five backhoe test pit explorations at the Minerva and south drain field sites as directed. The location of those test sites are depicted on the attached location map, reduced from the actual project plans for your ease of reference in evaluating this project.

## GROUNDWATER ENCOUNTERS

We noted no active groundwater during the performance of these test explorations, or evidence within the soil section of seasonal standing water. The uppermost soil layer found over this site consisted of silty fine sand averaged 6 to 18 inches in maximum thickness. This upper zone included a forest duff zone of decayed wood, occasional boulders and some man-made crushed rock materials depending on the area investigated. This zone is apparently filtering rainfall water and aids in its filtration away from the higher ground, and in a generally easterly direction from all test sites. We have found no indication that ponding water or active groundwater levels rise within these soils to impede the performance of the operational systems.

## UNDERSTANDING THE OPERATING SYSTEMS

The functional systems of the existing park facility will be addressed under another cover, by the project design engineers at Cascade Design Professionals, LLC. We point out that during this investigation, G2 Associates, Inc. has worked along side their representative assessing the subsurface gravel formation that comprises the hilltop drain field, south of the main park features.

The underground piping features within the filtration field at Minerva Park to the north was investigated as designated by the current landowners. This required two the excavation of two test pits, one on the upper west side, with the second on the lower eastern side of the existing drain field. The test location on the uppermost western side at

Minerva presented the surprises of the day based on the drain field construction. For whatever reason, the drain lines were reportedly built in two sections that can be isolated by a valve to drain either to the north or the south. Our test exploration revealed the plastic drain lines are old schedule 20 or less in grade, bear 0.5-inch diameter holes, with the holes turned downward releasing grey water directly into the clean native coarse sandy to pebbly gravel stratum. The lines on the southerly half of the field also bore a slight uphill trend in grade in the single line exposed during this investigation. This indicates a lack of use for the southern half of the piping due to grade issues. The inside of the drain line was nearly clean and basically has not been used much to this date (grade problem or lack of need?). The interesting aspect of this system was that the drain line inverts were at 4.0 feet in depth, more or less. In conversation with the property owners, we could not ascertain a reason why the lines were recessed so deeply. We do anticipate they could work just as well at standard depths of 12 to 18 inches, should replacement be required in the long-term future. This drain field was constructed in an area that had first been stripped of topsoil and graded lower than the natural grade.

Test pits were also conducted at Unit Slips Numbers 84, 88, and 92 located upslope from the main drain field. The sandy gravel soil was also encountered in the same good condition at those locations as well. The topsoil overburden in that area was an average of 18 inches in thickness.

A single test pit was excavated high on the hill at the eastern edge of the main drain field for the State Park in its current configuration and operational mode. Again, the coarse sandy gravel was found to form even the highest of elevations in the area and on this project property. This site was a grass covered meadow setting within an untouched forested environment. The grass growth over this terrain was very even in height and green color attesting to the steady performance of the pumps and filtration system and its construction.

The purpose of this alliance (like previous sites) is to have more than one trained professional reviewing the system conditions. This practice has also permitted G2 to have a handle on the native soils and conditions, to be able to evaluate the composition of the filtration mounds, time to assess the general site topography (which is good), and thus have valuable input for future reference in planning new expansion phases.

## SOIL CLASSIFICATION PER TABLE II (PROVIDED)

To the depths explored during the performance of these test explorations, the fine-grained soil sections noted on the project are Soil Types 3 and 4. Lower soils encountered also possess some porosity characteristics of Type 5 materials as well. We note that high density; low porosity fine sands and silt were also encountered in small amounts but were restricted to the uppermost topsoil zones (where they exist). We encountered none of the rock flour conditions found at the Penrose property. We did not encounter any aquitard or restrictive layers at any of these locations to the depths of exploration. All test explorations conducted at these sites varied between 6 and 8 feet depending on field conditions and soil content and stratification. We do not anticipate the need for soil fracturing prior to new line installations based on the current project knowledge. We have attached a copy of the classification document used for this assessment for your ease of reference.

Based on our discussions this information assessed and provided should meet your current project needs. Please feel free to contact this office should further assistance be required.

Sincerely,

JOHN H. GRAY
E1216

John H. Gray
President
Washington LG 1681
Oregon CEG 1216

Attachments

06211rpt101306.doc

## POTLATCH STATE PARK
### Highway 101, North of Shelton, WA
### TEST PIT EXPLORATIONS #1a/6 and 1b/6 (Minerva)
### September 29, 2006

| | |
|---|---|
| 0 to 0.5 Ft. | Soft/loose, dark brown silt with coarse sand and pebbles. Area graded and this layer is not typical of topsoil for undisturbed areas in this vicinity. Soil Classification Type 5. |
| 0.50 to 4.5 Feet | Moderately dense medium brown silty pebble to cobble gravel, dry. Type 1A Soil Classification. Well drained. |
| 4.5 Feet | Termination due to lack of encounter with the anticipated septic field piping. Gravel is typical of lower elevation alluvium derived from glacial deposition and reworked terrain. Bottom of Test Pit Exploration. |
| | No groundwater encountered to the maximum depth of exploration on this date. |

06211tplogspotlatch092906.doc

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## POTLATCH STATE PARK
### Highway 101, North of Shelton, WA
### TEST PIT EXPLORATION #2/6 (At Space 92, Minerva)
### September 29, 2006

| | |
|---|---|
| 0 to 1.50 Ft. | Loose woody forest floor duff, tan silt beneath. Type 5 Soil Classification. |
| 1.5 to 6.0 Feet | Moderately loose dark brown silty medium to coarse sandy gravel. Soil Classification Type 1B. |
| 6.0 to 8.0 Feet | Dense pebble gravel with cobbles, coarse sand to 20 percent of volume, very well drained. Soil Classification Type 1A/1B. |
| 8.0 Feet | Bottom of Test Pit Exploration. |
| | No groundwater encountered to the maximum depth of exploration on this date. |

06211tplogspotlatch092906.doc

# POTLATCH STATE PARK
## Highway 101, North of Shelton, WA
## TEST PIT EXPLORATION #5/6 (Upper Bench Drain field, State Park)
## September 29, 2006

| | |
|---|---|
| 0 to 0.50 Ft. | Soft/loose, dark brown silt, topsoil. Soil Classification Type 5. |
| 0.5 to 6.0 Feet | Moderately loose silty medium to coarse sandy pebble to small cobble gravel. Well drained. Soil Classification Type 1B. |
| 8.0 Feet | Moderately loose medium to coarse sandy pebble to cobble gravel. Soil Classification Type 1A. |
| 8.0 Feet | Bottom of Test Pit Exploration. |
| | No groundwater encountered to the maximum depth of exploration on this date. |

POTLATCH
STATE PARK


TB016
246 96 5004

WATER
MANAGEMENT
LABORATORIES INC.

1515 80th St. E.
Tacoma, WA 98404
(253) 531-3121

October 10, 2006

Cascade Design Professional Inc.
2780 SE Harrison, Suite 104
Milwaukee, OR 97222
Attn: Herb Fricke

Dear Sir:

Results of analysis of two wastewater samples taken by you on 09-28-06 and received on 09-29-06 at 8:00 a.m. are as follows:

| | **Sample Identification (see page 3)** | |
|---|---|---|
| **Test** | **Sample #1** | **Sample #2** |
| Biochemical Oxygen Demand (mg/L) | 24 | 240 |
| Total Suspended Solids (mg/L) | 70 | 3,080 |
| Total Kjeldahl Nitrogen (mg/L) | 37.1 | 74.3 |
| Total Phosphorus (mg/L) | 3.7 | 11.2 |

Lab Number: 08912523

Samples were analyzed according to Standard Methods for the Examination of Water and Wastewater, 20th Edition.

,

# Appendix E
# Minerva Beach RV Park Property Assessment, Utilities (Sanitary Sewer) (2006)

,

# Minerva Beach RV Park Property Assessment

# State of Washington Parks and Recreation Commission

# Utilities (Sanitary Sewer/Water System)

PREPARED FOR: Dave Broyles
Operations Manager, State of Washington
Parks and Recreation Commission

PREPARED BY: Herb Fricke/CDP
Project Manager

REVIEWED BY: Lynn Harnisch/CDP

COPIES: File/Maggie Witty Rice/CDP

DATE: November 7, 2006

HERBERT J. FRICKE
26431
EXPIRES JULY 03,

## INTRODUCTION AND SCOPE

This technical memorandum summarizes the property assessment that was completed by Cascade Design Professionals, Inc. whereby site utilities (water and sanitary sewer) were examined in the field and assessed for continued use to serve the site needs, both current and future of Minerva Beach RV Park (Minerva) Property. The purpose of the assessment was to determine the current condition of the water and sewer systems, and develop a rough understanding of needed improvements for the Minerva Property. It is understood that the State of Washington is considering a number of options in developing the property and the assessment is the first step the State will undergo in order to select the best option.

### Site Location

Minerva Beach RV Park is located at 21110 N US Highway 101, Shelton, Washington 98584-9784. Take Interstate 5 to US 101 N via EXIT 104 toward Aberdeen/Port Angeles. Follow for 32 miles and end at park. See site location map below (Figure 1).

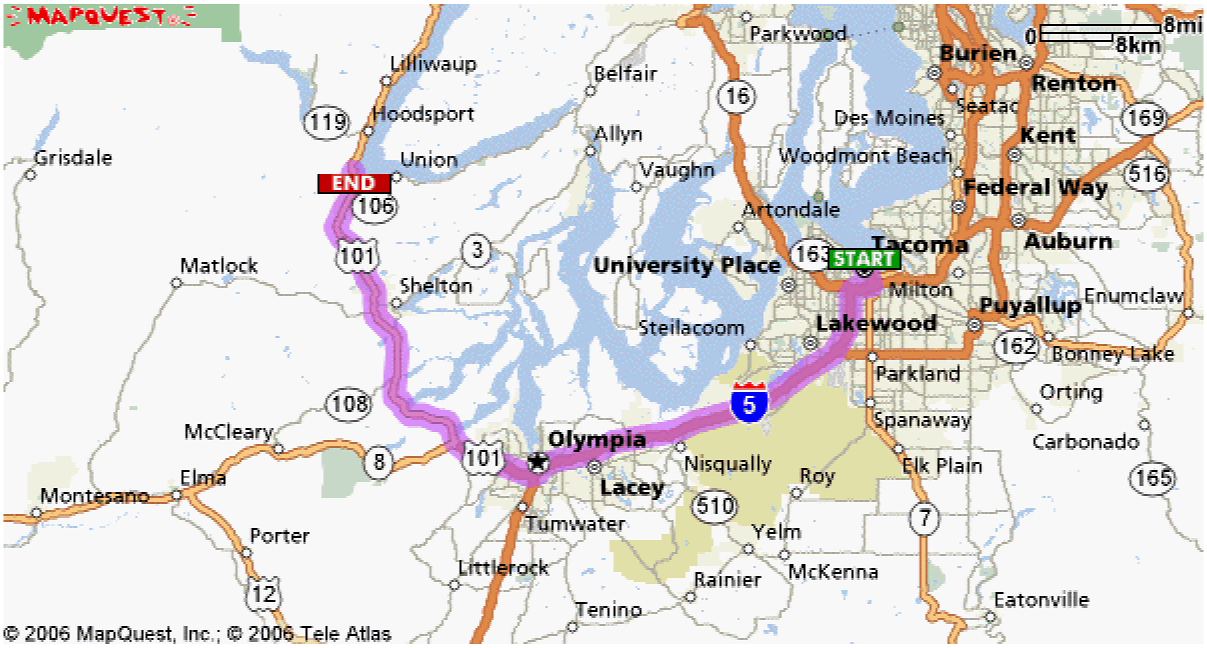

Figure 1: Site location map for the Minerva Beach RV Park Property.

# SECTION 1: Minerva Beach Property

## General Project Description

The following tasks were completed during the site assessment:

### TASK ONE – PRE-DESIGN ANALYSIS OF THE MINERVA PROPERTY

Cascade Design Professionals, Inc. personnel met with WSPRC project manager, a Minerva property manager, and representatives of the Skokomish Indian Tribe during a site visit to the park. The following tasks were accomplished:

1. The septic tanks behind the Laundromat and at the park drainfield were accessed and the contents pumped. The volume of each septic tank was estimated as well as the internal condition of each tank was evaluated. Any evidence of infiltration or exfiltration was noted.

2. The condition of the lift station behind the Laundromat was evaluated, including general condition of the wetwell, the size and condition of the pumps, and the condition of internal level controls and the control panel.

3. At the existing drainfield, four test pits were dug, with the aid of a Client furnished backhoe and operator, around the perimeter of the existing drainfield, as close to the laterals as possible without breaking a pipe. The in-situ condition of the drainfield laterals was noted as well as the presence or absence of moisture and biological scum buildup within the soils that may impede the infiltration of the effluent.

4. The influent was sampled to determine present BOD, N and TSS concentrations. Analysis performed by an independent laboratory.
5. The condition of the existing well pump controls and water storage tank was assessed.

In this report the condition of the existing systems is discussed along with a general assessment of any modifications that may be necessary to bring them up to code and meet current DOH standards. Existing on-site conditions for the drainfield and recommendations for hydraulic loading and sizing requirements was based on the results of the geotechnical evaluation.

## Field Investigation

A field investigation of the water and sanitary sewer systems was completed on September 28, 2006 by Mr. Herb Fricke, P.E., Bob Bushnell, Certified Waste Water Treatment Plant Operator, and John Gray, Registered Geologist.

### Septic Tanks, Pump Stations, and Drainfields

Generally, all visible portions of the septic tanks, pump stations and drainfields were examined, such as the wall coatings, baffles, risers, and electrical systems. In addition, each septic tank was inspected for evidence of infiltration/exfiltration.

Findings of the field investigation are discussed below. An inventory of the system and photographs are included in the appendix:

**Minerva Beach**

1. **Laundromat Pump Station**

   The septic tank is located behind the laundromat at the Minerva Beach private campground north of Potlatch State Park. This system consists of two tanks oriented end to end. See attached tank drawings for orientation.

   The dimensions of tank A are 14 feet long, 12 feet wide, and 6 feet deep. We were unable to open and inspect this tank.

   The dimensions of tank B are 8.5 feet long, 12 feet wide, and 6 feet deep. Tank appears to be in good condition with no failure of coating. No apparent infiltration was noticed possibly due to low groundwater table. The presence of cracks in the tank was not verifiable.

   The system has an 4 foot diameter manhole and is 5 feet deep with a 1500 gallon capacity. The depth to invert is 9 feet. The tank and riser are in fair condition. There is one single phase, 230V, 1.0 hp submersible pump setting on a milk crate/cinder block with no guide rails. A thin rope is attached to the pump for aid in removal, but we decided not to pull the pump by this method because we believed it to be unsafe. The pump, Orenco controls and float switches are in good condition. No maintenance record was found; therefore the last maintenance performed is unknown. It is recommended that pump be pulled for inspection.

2. **Drainfield**
The drainfield is located approximately 200 feet west of the Minerva Beach Laundromat. Dimensions are 85 feet wide by 175 feet long. The drainfield contains 4-inch perforated piping with ½ - inch orifices oriented downward. On the second test pit dug, a pipe was hit at 4 feet depth and it appears to be dry and rarely wet. Additionally, pipe appears to be reverse graded. Vegetation is green in center of drainfield indicating that this part of the drainfield is getting flow and that there is no flow to the west part of the drainfield.

   Either this piping is plugged to the west section of the drainfield or a pipe is broken. More likely, the reverse grade and the ½" orifices preclude effluent from reaching the west end. Average depth of the piping was around 4 feet, which is deeper than normally required.

   The drainfield is serviced by two large septic tanks, each of approximately 4,000 gallons. The tanks were pumped and their condition observed. Both appeared to be in good condition, with small amounts of corrosion. Cracks or leaks were not evident.

3. **Fresh Water Well and Holding Tank**
The Minerva property is served by a Washington State Department of Ecology (DOE) unique well with an 8-inch well casing. The system consists of a submersible pump with a 2-inch flowmeter which is not functioning (the needle appears to be stuck at "9"). The last recorded flow was on September 8, 2005. The motor is a Franklin Electric 10 HP, 230V, single phase, 60 Hz, 44.0 Amp, 3450 rpm with a safety factor of 1.15. The float switches are Warrick Float Switches with a 120 Amp disconnect. One of the 20 Amp breakers is loose.

   The concrete potable water storage tank is approximately 150 feet above the campsite. Dimensions of the concrete storage tank are 12 feet square and 12 feet deep. There is seepage at the bottom left corner of the tank. The schedule-40 inlet and outlet pipes are not weatherized. The outlet valve is either leaking or is significantly sweating.

# Assessment of Future Demands/Needs

Based on discussions with the WSPRC, it is understood that if and when purchased, the Minerva property will continue to be served by the existing septic tank/drainfield system or sewage could be conveyed to Potlatch State Park for treatment in the parks septic tank/drainfield system. In general, it is WSPRC's goal to eliminate existing drainfields within the public areas of the park, which the existing Minerva system will be in, if the property becomes part of the park

Based on the park as-builts, Minerva currently serves 64 RV spaces and 14 camp spaces on the west side of 101. In addition, 49 permanent residences can be served on the east and west side of Hwy 101. The Laundromat has approximately 6 washing machines, a restroom, and a service sink. The park office is shared with the manager's residence.

Based on the current layout of the park the maximum population that could be served by the park is estimated to be 322 people (Table 1). This population would generate about 20,300 gallons of wastewater per day (gpd). Currently, there approximately ___ people living in the park.

If all wastewater were pumped to the parks drainfield, it is estimated that a total flow of 20,300 gallons per day (gpd) is possible (Table 1). This loading would exceed the capacity of the existing park drainfield (estimated capacity of 7,000 gpd) by about 13,000 gpd. Based on the current estimated drainfield percolation rate, an additional 22,400 sf of drainfield surface are is necessary. In addition, based on the condition assessment of the drainfield, approximately ½ of the existing field is not being utilized to its capacity. That this has not been a significant problem to date is likely because the current population served by the drainfield is significantly less than the maximum possible population.

**Table 1**
**Sewage Use and Drainfield Capacity**

| Description | Number of Sites | Population per Site | Usage Per Capita | Unit (gal/unit) | Quantity (gpd) |
|---|---|---|---|---|---|
| Laundromat | 64 | 1 | 15 | Person | 960 |
| Campground w/Central Comfort Station | 14 | 5 | 35 | Person | 2450 |
| RV Hookups | 64 | 2 | 50 | RV | 6400 |
| Permanent Residences | 49 | 2.5 | 80 | Person | 9800 |
| Residence/Park Office and Shop | 1 | 2 | 90 | Person | 180 |
| **Total** | | | | 386.5 | 19790 |

# Conclusions and Recommendations

## Conclusions

1. All of the septic tanks inspected where found to be in generally good condition, with coatings intact and without significant corrosion. Exfiltration or infiltration was not observed in any of the tanks, which indicates that they are not leaking.

2. The Minerva drainfield appears to be partially functioning. Because the west section of the drainfield was found to be dry and because the east section had green vegetation, it appears the only the east section is receiving flow. This condition could be caused by a number of reasons as per previous discussions. Upon visual examination of the uncovered perforated piping it might have been installed with a reverse grade. If this is true, that would explain why flow is not getting to the west section of the drainfield.

   We recommend the existing distribution valves be inspected. If the valves are functioning properly, than the lines should be snaked for potential plugging.
3. If Minerva property reaches maximum buildout population, the existing drainfield is undersized to treat this much wastewater. The current population being served by the drainfield should be verified.
4. The pump at the Laundromat pump station should be removed and inspected by a licensed plumber.
5. The existing water storage tank should be monitored for possible leakage. To do this the valve should be inspected and if necessary, repaired. If water seepage continues to be evident, then the tank should be filled and all inlet and outlet valves closed. The level should be monitored with any drop indicative of a leak.
6. The well pump appears to be functioning properly; however the flowmeter and breaker panel should be repaired.

## Design Considerations

Final design of the above recommendations can be initiated quickly; however, additional information is needed before design can proceed:

- Locate and identify why wastewater is not flowing to the west section of the existing drainfield
- Verify whether the existing water storage tank is leaking
- Conduct a minor topographic survey of a potential alignment for a new force main from the Minerva property to connect to the Potlatch SP sewage system.
- If the Laundromat pump station must stay in service, it should be replaced with a duplex submersible system, equipped with guide rails that would allow easier retrieval for maintenance.
- Evaluate whether Potlatch SP drainfield can treat additional wastewater generated by the Minerva property
- When compared to current Washington DOH standards, the existing drainfield does not comply with the following:
  - Depth of laterals, which are typically 2 to 3 feet deep
  - Use of smaller orifices and snap caps, which are typically oriented at the top of the pipe, such that wastewater exits the lateral vertically hitting the snap caps, which spreads the flow more evenly within the trench.
  - The presence of cleanouts and test ports at the end of each lateral

  - Installation of monitoring wells.


Minerva Beach - Laundromat and Pump Station


Minerva Beach - Laundromat and Pump Station


Minerva Beach - Laundromat and Pump Station


Minerva Beach - Laundromat and Pump Station


Minerva Beach - Laundromat and Pump Station Controls


Minerva Beach – Drainfield Manhole


Minerva Beach – Drainfield Test Pit


Minerva Beach – Drainfield Septic Tank


Minerva Beach – Drainfield Septic Tank


Potlatch State Park – Day Use Area Pump Station


Potlatch State Park – Day Use Area Septic Tank


Potlatch State Park – RV Dump Septic Tank


Potlatch State Park – RV Dump Pump Station


Potlatch State Park – RV Dump Septic Tank Bio-filter


Potlatch State Park – RV Dump Septic Tank Bio-filter


Potlatch State Park – RV Dump Holding Tank


Potlatch State Park – RV Dump Station


Potlatch State Park – RV Dump Station Control Panel


Potlatch State Park – RV Dump Station Control Panel


Minerva Well


Minerva Well Controls


Minerva Well Controls


Minerva Electrical Circuit Breaker


Minerva Well


Minerva Well Control Building


Minerva Well Control Building


Minerva Water Storage Tank


Minerva Water Storage Tank

Table 1: Sewage Use and Drainfield Capacity

| Description | Usage Per Capita | Unit (gal/unit) | Number of Campsites | Number of Units per Campsite | Usage Per Capita | Quantity (gpd) | *Pumped Flow (Q) |
|---|---|---|---|---|---|---|---|
| Laundromat | 50 | Person | 64 | | 100 | 5000 | |
| Campground w/Central Comfort Station | 35 | Person | 14 | 5 | 70 | 2450 | |
| RV Dump | 50 | RV | 64 | 2 | 128 | 6400 | |
| Permanent Residences | 80 | Person | 49 | 2.5 | 122.5 | 9800 | |
| Rangers Residence/Park Office and Shop | 90 | Person | 1 | 2 | 2 | 180 | |
| **Total** | | | | | | 23830 | |

Assume 50% Occupancy

**Drainfield Calculations**

| DF | Width | Length | Area | [1]Capacity |
|---|---|---|---|---|
| North | 65.6 | 87.5 | 5740 | 2870 |
| South | 65.6 | 87.5 | 5740 | 2870 |
| | | | 11480 | 5740 |

* Confirm with fixture count

Assumptions:

1 Engineered Fine Sand in Drainfield gives 0.5 gal/sf/day

Total Area of Drainfield= 11480 sf

[1]Drainfield Capacity= 5740 gpd

Quantity-Capacity= 18090 gpd

# of Mounds=(Quan.-Cap.)/(0.5 gal/sf/day)= **36180 additional area (sf)**

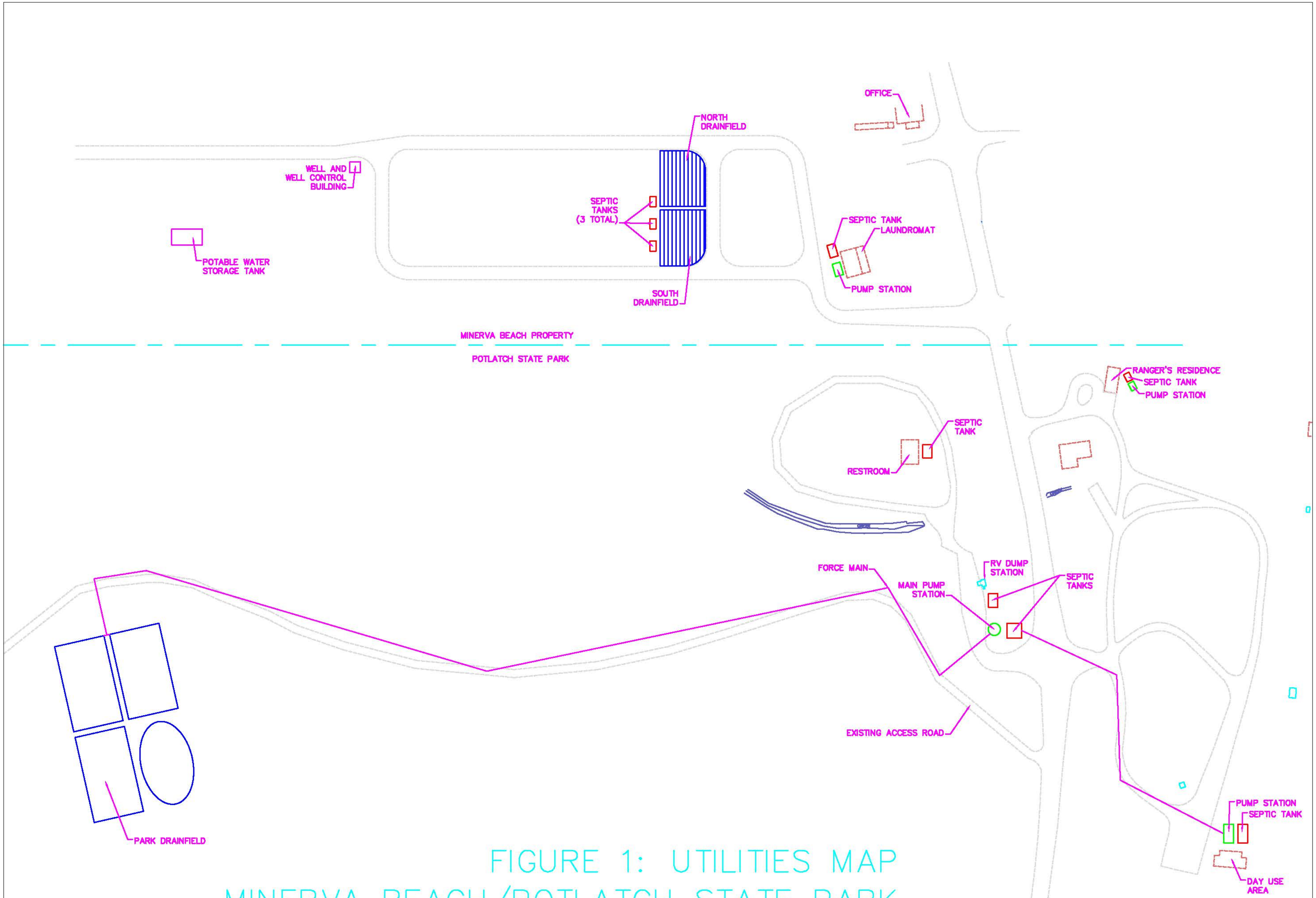

FIGURE 1: UTILITIES MAP

MINERVA BEACH/POTLATCH STATE PARK

| No. | Item | Description | Location | Drainfield Dimensions (ft) | | Tank Dimensions (ft) | | | | | | | Piping | | Equipment | | | | | | | Comments | Photos |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Length | Width | Length | Width | Manhole Diameter | Depth of Tank | Depth to Invert | Capacity (gal) | Condition | Size | Type | Pump Model | Condition | Quantity | Size | Condition | Motor Model | Electrical Req'ts | | |
| **1** | Minerva Laundromat PS | Submersible Pump Station | Behind Minverva Beach Laundromat | | | | | 8 | 5 | 9 | | Fair | 2" dia, schedule 40 PVC | Submersible Pump | | | 1 | 1 HP | | | 1 ph, 230V | Orenco controls in good condition, no mtc record/last mtc unknown, recommend pump be pulled and inspected | Wetwell |
| **Notes** | | | | | | | | | | | | | | Tested Several Times | | | | Setting on milk crate/cinder block, no guide rails | | | | | |
| **2** | Minerva Drainfield | Drainfield (Tank 1) | Approximately 200' west of Minerva Beach Laundromat | 175 | 75 | 8.5 | 12 | | 6 | | | Good | 4" Perf - 1/2" orifices were oriented downward | | | | 1 | | | | | Vegetation is green in center of drainfield | |
| **Notes** | | | | | | | | | | | | No failure of coating, no apparent infiltration (GW is low) | | | | | | | | | | | |
| | | Drainfield (Tank 2) | | | | 14 | 12 | | 6 | | | Good | On second hole, a pipe was hit at 4' deep - appears to be dry and rarely wet, also pipe appears to be reverse graded | | | | 1 | | | | | | |
| **Notes** | | | | | | | | | | | | No excessive corrosion, no apparent infiltration (GW is low) | | | | | | | | | | | |
| **3** | Potlatch SP RV Pump Station | Submersible Pump Station (Pump 1) | | | | | | 4 | 11 | | | | | | | OK | 2 | 1.5 HP, 3450 rpm | | | 1 ph, 230V, 1.1 kW | Bad alarm light (ext.), flow meter functioning | |
| **Notes** | | | | | | | | Wet Well | | | | | | | | Unable to pull and verify size | | | | | | | |
| **4** | Potlatch SP RV Dump Tank | | | | | 19 | 12 | | 7.5 | | 10000 | Good | | | | | | | | | | | |
| **Notes** | | | | | | | | | | | | No infiltration evident | | | | | | | | | | | |
| **5** | Potlach RV PS Wetwell Tank | | | | | 14 | 14 | | 6.7 | 9.5 | | Good | | | | | | | | | | | |
| **Notes** | | | | | | | | | | | | No apparent leaks or infiltration | | | | | | | | | | | |
| **6** | Potlatch Day Use PS | Submersible Pump Station (Pump 1) | | | | | | | | | | | | | 100SI05HHF | Inoperable | 1 | 1 HP | | Franklin Electric | 1 ph, 115V | | |
| **Notes** | | | | | | | | | | | | | | | | Was pulled, disconnected at discharge, when out of wetwell…motor starter was bumped but did not rotate | | | | | | | |
| | | Submersible Pump Station (Pump 2) | | | | | | | | | | | | | 100SI05HHF | Functioning | 1 | 1/2 HP | | Franklin Electric | 1 ph, 115V | | |
| **Notes** | | | | | | | | | | | | | | | | | | | | | | | |

Functioning
Good
OK
Fair
Inoperable

# Appendix F
# Environmental Assessment for WSDOT Maintenance Yard (2005)

# WSDOT-POTLATCH MAINTENANCE YARD ENVIRONMENTAL ASSESSMENT

**October 5, 2005**

# WSDOT-POTLATCH MAINTENANCE YARD ENVIRONMENTAL ASSESSMENT

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*October 5, 2005*
*JK0411*
*Report Oct 5.doc*

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# SIGNATURE

This report, and Pacific Groundwater Group's work contributing to this report, were reviewed by the undersigned and approved for release.

**Janet Knox**
Principal Environmental Geochemist
Washington State Geologist No. 413

# 1.0 INTRODUCTION

The Washington State Department of Transportation formerly operated a maintenance yard near Potlatch, Washington within the boundaries of the Skokomish Indian Reservation (Figure 1). The Skokomish Tribal Nation wishes to make a reasonable and best use of this property.

The Tribe initiated this environmental assessment of the property to investigate the potential presence of contaminants in soil or groundwater.

# 2.0 SUMMARY OF FINDINGS

The following summarizes the work performed under this Environmental Assessment and the analytical results.

- Monitoring well Skok-5 was installed at the WSDOT-Potlatch site. Heaving sand indicating high groundwater yield, were encountered during drilling.
- Groundwater was encountered at approximately 17 feet below ground surface during drilling. Groundwater was not encountered during test pit excavation (5.5 to 7.5 feet in depth).
- Surficial soil, test pit soil, and groundwater samples were collected and analyzed for the site contaminants of concern or a subset. These site contaminants of concern are based on past land use practices and include petroleum hydrocarbons, metals, polyaromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), pesticides, volatile organic compounds (VOCs), the nitrate suite, and coliform.
- PGG does not recommend remedial action at the WSDOT-Potlatch site based on the analytical findings of this Environmental Assessment.
- Analytical results indicate that metals, PAHs, and conventional parameters were detected in surficial soil samples. The concentrations do not exceed Model Toxics Control Act (MTCA) Method A cleanup criteria.
- The surficial soils collected under this scope of work do not have detectable concentrations of PCBs, pesticides, and VOCs. Diesel was detected in the petroleum screening analysis of one surficial soil sample, but was not detected in an analysis specifically for diesel.
- Soil samples collected from the bottom of four test pits do not have detectable concentrations of petroleum compounds.
- Analytical results indicate that total metals and conventional parameters were detected in groundwater samples. The concentration of total arsenic in a sample from monitoring well Skok-3 exceeds the MTCA Method A cleanup level and the concentration of total chromium in the sample exceeds the MTCA Method A cleanup level and the WAC 173-200-040 criteria. The concentration of total barium exceeds the MTCA Method B cleanup level. Concentrations of the remaining metals and conventional parameters analyzed do not exceed MTCA Method cleanup levels or WAC 173-200-040 criteria.
- Analytical results indicate that dissolved metals concentrations do not exceed MTCA cleanup levels or WAC 173-200 criteria.
- Petroleum hydrocarbons, PAHs, PCBs, pesticides, and VOCs were not detected in groundwater samples collected as part of this investigation.
- The findings of the environmental assessment do not indicate the need for further investigation or remedial action. The site is recommended for no further action and closure.
- Due to the close proximity of private wells located immediately east of the site and due to the detection of total (unfiltered) arsenic, barium, chromium, and lead in one well (Skok-3), the Skokomish Indian Tribe will sample the private wells for these metals, as a proactive measure.

## 3.0 SITE OPERATING HISTORY

The Washington State Department of Transportation (WSDOT) formerly operated a maintenance yard near Potlatch, Washington within the boundaries of the Skokomish Indian Reservation (Figure 1). Specifically, the site is located on the west side of State Route 101 at milepost 336.2 and is herein referred to as the WSDOT-Potlatch site (Figure 2).

WSDOT used the 14-acre parcel to store road maintenance equipment and road debris from approximately the 1950s through recent years. The site was also used as a gravel pit. In 1999 WSDOT transported wet soil and debris from two large landslides along Highway 101 to the site and distributed the spoils over most of the area previously excavated for gravel. The debris is in the northern portion of the site and is at least 12-feet thick in most places (Figure 2). Domestic homes that are supplied water from private groundwater wells are located on the east side of Highway 101 opposite the WSDOT-Potlatch site.

The property ownership was transferred to the Skokomish Tribal Nation in 2002. Because of historical use of the site, it is considered a “Brownfield site,” meaning the redevelopment or reuse of the property may be complicated by the presence or potential presence of a hazardous substance, pollutant, or contaminant. The site is underutilized in its current condition.

The Skokomish Tribe wishes to make reasonable and best use of this property. The objectives of this project are to investigate the potential presence of hazardous substances, or contaminants, in soil and groundwater.

### 3.1.1 Previous Investigations and Studies

Previous work at the WSDOT-Potlatch site includes an Underground Storage Tank Site Assessment and Closure and a preliminary Hydrogeologic Study and Groundwater Mounding Analysis.

CEcon Corporation of Tacoma, Washington, were contracted to remove two 1,000 gallon diesel underground storage tanks (USTs) and one 500 gallon unleaded gasoline UST from the WSDOT-Potlatch site. The tanks were removed on April 20, 1995 according to applicable regulations, as we understand. The three tanks had extensive corrosion but no holes were visible. In addition to the UST removal, a gas house was demolished and fuel dispensers were removed. Soil samples were taken from the excavations to assess possible residual contamination. The samples were analyzed for the respective petroleum product most likely to be in the sample based on the fuel type of the UST and/or dispenser. The analytical results indicated the concentrations of gasoline, diesel, BTEX, and lead in the soil samples were below Ecology’s MTCA Method A cleanup levels. The excavations were backfilled with pit run.

A preliminary hydrogeologic study was conducted at the WSDOT-Potlatch site between June 1999 and May 2000 to evaluate the suitability of the site for rapid infiltration of treated municipal effluent. Four groundwater monitoring wells were installed at the site during this study that were monitored for water level and water quality. Test pits and percolation tests were included in the field study. A modeling analysis was also performed to estimate the mounding potential of the aquifer.

The hydrogeologic study indicates the unsaturated zone at the site is 15 – 28 feet thick and groundwater levels vary seasonally by 1 – 4 feet. Coarse, outwash material was identified at the center of the site that is highly permeable. Debris soil imported to the northern portion of the site has low permeability. Another low permeability zone was identified in the south-west portion of the site.

# 4.0 CLEANUP CRITERIA

Model Toxic Control Act (MTCA) Method A cleanup criteria (WAC 173-340-900) were applied to the soil and groundwater analytical data set to provide conservative cleanup levels for sites undergoing routine cleanup actions or for sites with relatively few hazardous substances (WAC 173-340). In addition to MTCA Method A, groundwater data were compared to the Water Quality Standards for Ground Waters of the State of Washington (WAC 173-200-040). Where no Method A cleanup levels are established, Method B cleanup levels were used for comparison.

# 5.0 CONTAMINANTS OF CONCERN

Based on site history the contaminants of concern include:

- Petroleum (gasoline, benzene, ethylbenzene, toluene, and xylenes (BETX); diesel; oil; 1,2-dibromoethane; 1,2-dichloroethane; methyl tertiary butyl ether; and naphthalenes)
- Volatile Organic Compounds (VOCs)
- Metals
- Polyaromatic hydrocarbons (PAHs) from petroleum or creosote sources
- Pentachlorophenol, a wood preservative
- Possibly nitrate and nitrite
- Possibly coliform from former septic system
- Possibly limited pesticides
- Possibly PCBs

# 6.0 BROWNFIELD INVESTIGATION

The Brownfield investigation of soil and groundwater quality at the WSDOT-Potlatch site was performed in general accordance with the Brownfield WSDOT Potlatch Maintenance Yard Environmental Assessment Quality Assurance Project Plan (PGG, 2005). Locations of the surficial soil samples, test pits, and monitoring wells are presented in Figure 2.

Friedman & Bruya, Inc., a Washington state certified laboratory located in Seattle, Washington, provided analytical services for this investigation. They subcontracted some analyses to Analytical Resources, Inc., another Washington certified lab located in Tukwila, Washington. Drilling services were provided by Geotechnical Testing Laboratory, of Olympia, Washington (Appendix A contains the boring logs).

## 6.1 SOIL INVESTIGATION

The soil investigation involved collecting samples of surficial soil and soil within approximately 10 feet of ground surface for analysis of suspected contaminants of concern.

### 6.1.1 Surficial Soil

Surface soil samples were collected by representatives of PGG from five different locations between June 29, 2005 and July 11, 2005 from locations presented in Figure 2. The surficial soil samples are designated SS-1 through SS-5. These locations are consistent with those proposed in the Brownfield WSDOT Potlatch Maintenance Yard Environmental Assessment Quality Assurance Project Plan (QAPP) with the exception of SS-1. The objective of the surface soil sampling was to investigate possible “hot spots.” The sampling design for the surface soil samples was judgmental with locations based on site historic practices and field observations. The surficial soil locations were sampled once under this environmental assessment and one soil sample will be collected at each location.

The locations were selected based on known or suspected use of hazardous substances. The sampling sites were located visually using site landmarks (building slab, debris piles etc.) The rationale for each sample is:

- Sample SS-1 (Figure 2) was intended to be collected in an area where paint chips and debris were observed. However; the asphalt ground cover in the proposed area prevented sampling and the location was moved approximately 25 feet north.
- Sample SS-2 was collected from an area where reportedly oil-contaminated soil removed from a drainfield was stored.
- Sample SS-3 was collected at the base of the sander rack built from creosote logs where stained soil was observed during a preliminary site visit.
- Sample SS-4 was collected near a corrugated metal loader shed where 5-gallon buckets of tar were observed.
- The location for sample SS-5 was intended to be selected in the field based on visual observations of soil staining, odor, or soil storage. Because these conditions were not observed, sample SS-5 was collected near the entry gate to the property which would have experienced the most traffic flow.

Surficial soil samples were submitted to Friedman & Bruya, Inc. (F&BI) for analyses presented in Table 1 and listed below:

- Hydrocarbon identification (HCID) and gasoline, diesel-extended, or BETX, 1,2-Dibromoethane, 1,2-Dichloroethane, Methyl Tertiary-butyl ether, Naphthalenes as indicated by the HCID results (5 samples)
- PAHs, PCBs, pesticides, and metals (4 samples)
- Pentachlorophenol (1 sample)

### 6.1.2 Test Pit Soil

In addition to the surficial samples, soil samples were collected from the bottom of test pits excavated as part of this investigation. The test pits were excavated by a Skokomish Tribe backhoe operator and sampled by a PGG representative between June 29, 2005 and June 30, 2005 at locations presented in Figure 2. These locations are consistent with those proposed in the QAPP. The objectives of the test pits were to characterize and sample soil efficiently and cost-effectively. The sampling design for the test pit samples was judgmental with locations based on site historic practices.

Test pit depths ranged from 5.5 to 7.5 feet below ground surface (bgs). Excavated material was temporarily stored adjacent to the test pit during sample collection. One soil sample was collected from the floor of each test pit near the approximate center. The test pit soil samples are designated BHP- and were submitted to F&BI for analysis of the parameters summarized in Table 1 and presented below:

- HCID and gasoline, diesel-extended, or BETX, 1,2-Dibromoethane, 1,2-Dichloroethane, Methyl Tertiary-butyl ether, Naphthalenes as indicated by the HCID results

Visual and olfactory indications of soil contamination in the floors or sidewalls of the test pits were not noted in the field by representatives of PGG. Geologic logs of the test pit excavations are shown in Appendix A. Groundwater was not encountered by the WSDOT-Potlatch test pits. Following collection of the soil samples from the test pits, they were backfilled with the excavated material.

## 6.2 WELL INSTALLATION

Four groundwater monitoring wells (Skok-1 through Skok-4) installed during previous investigations are present at the WSDOT-Potlatch site. One additional monitoring well (Skok-5) was installed under this scope of work. Well locations are presented in Figure 2. The monitoring well logs and as-builts for the four previous wells, and the newly installed well are included in Appendix A.

Geotechnical Testing Laboratory of Olympia, Washington, provided drilling services. On June 29, 2005, GTL used a hollow stem auger rig to advance 8-inch diameter augers. Soil samples were collected using an 18-inch long split spoon at 5 foot intervals. During drilling, observations were recorded by a PGG representative of subsurface stratigraphy, soil characteristics of split spoon samples, evidence of contamination, blow counts for split spoon penetration, and pertinent driller's comments.

At 25 feet below ground drilling was hampered by heaving sand and at 30 feet below ground the split spoon sampler was blocked, likely by large gravel or cobbles. The augers were retrieved from the borehole and it was allowed to collapse.

They returned to the WSDOT-Potlatch site on July 19, 2005 with a larger drilling rig, abandoned the new well, and drilled and installed the new well, Skok-5. The well was constructed with 2-inch diameter PVC screen and riser pipe as described above. The screened interval in Skok-5 is 18 to 28 feet bgs   Details of the well construction are presented with the geologic log in Figure 3.

## 6.3 GROUNDWATER SAMPLING

Groundwater samples were collected by PGG representatives from the WSDOT-Potlatch monitoring wells Skok-1 through Skok-5 between July 11, 2005 and July 21, 2005. A portable, submersible pump was used to purge and sample the monitoring wells in accordance with the QAPP.

Groundwater samples were submitted to F&BI for analyses presented in Table 2 and listed below:

- HCID and gasoline, diesel-extended, and/or BETX, 1,2-Dibromoethane, 1,2-Dichloroethane, Methyl Tertiary-butyl ether, Naphthalenes as indicated by the HCID results (6 wells).
- PAHs, PCBs, pesticides, metals, volatile organic compounds, nitrates, and coliform (4 wells).

# 7.0 ANALYTICAL RESULTS

Analytical results of surficial soil, test pit soil, and groundwater samples are discussed in the following sections. The data are summarized in Tables 1 and 2 and laboratory reports are presented in Appendix B.

## 7.1 SURFICIAL SOIL

Surficial soil samples identified SS-1 through SS-5 were collected at the WSDOT-Potlatch site from areas where historic use of hazardous substances are known or suspected (Section 6, Figure 2). The samples were analyzed for the contaminants of concern or a subset of the contaminants of concern (Section 5).

### 7.1.1 Petroleum Hydrocarbon

The Hydrocarbon Identification (HCID) analysis was used as a screening tool during this investigation. Sufficient sample volume was collected for NWTPH analysis of gasoline, diesel, and motor oil; however, these analyses were only performed if results of the HCID indicated these parameters were present (Table 1).

The HCID analysis of the surficial soil samples indicated that hydrocarbons were not detectable with the exception of heavy oil in sample SS-1. Motor oil range hydrocarbons were not detected in the NWTPH analysis of SS-1 (Table 1).

### 7.1.2 Metals

The surficial soil samples were analyzed for the RCRA metals. Barium, chromium, and lead were detected in samples SS-1, SS-2, SS-4, and SS-5 in concentrations that do not exceed MTCA Method A cleanup levels. The concentrations of barium in the samples range from 21 to 24 parts per million or micrograms per gram (ug/g), which is equivalent to milligrams per kilogram (mg/kg); a MTCA Method A criteria for barium has not been established; the levels found are much lower than Method B cleanup levels (Table 1). The concentrations of chromium in the sample range from 11 to 15 ug/g and the MTCA Method A criteria for chromium is 2000 ug/g. The concentrations of lead in the surficial soil samples range from 13 to 26 ug/g and the MTCA Method A criteria for lead is 250 ug/g (Table 1).

### 7.1.3 Polyaromatic Hydrocarbon

Polyaromatic Hydrocarbon (PAH) compounds were detected in surficial soil samples SS-4 and SS-5 and were not detected in samples SS-1 and SS-2. Non-carcinogenic PAHs, fluoranthene and pyrene, were detected in SS-1 and SS-5 for which cleanup levels have not been established under MTCA Method A, however the levels found are much lower than the Method B cleanup levels (Table 1). Carcinogenic PAHs were not detected in SS-4, but carcinogenic PAHs chrysene and benzo(k)fluoranthene were detected in SS-5. Because multiple carcinogenic PAHs were detected, under MTCA Method A the total carcinogenic concentration using the toxicity equivalency methodology (WAC 173-340-708) should be calculated and compared to the cleanup level. This analysis indicates the total concentration of carcinogenic PAHs in SS-5 do not exceed the MTCA Method A cleanup level. The results of this calculation are presented in Table 3.

### 7.1.4 Pentachlorophenol

Sample SS-3 was analyzed for pentachlorophenol. The concentration reported for SS-3 is 0.2 ug/g, which is below the normal detection limit (0.3 ug/g). Therefore, this result is considered a non-detect and is qualified with a “j” (Table 1). The detected concentration is lower than the Method B cleanup level (Table 1).

### 7.1.5 Conventional Parameters

Samples SS-1 and SS-2 were analyzed for the nitrate suite and total coliform. MTCA A cleanup levels have not been established for these parameters. The MTCA B cleanup level for nitrate and nitrite are not exceeded. No MTCA B cleanup level has been established for coliform. The total coliform count in sample SS-1 was elevated at 238 CFU/g compared the non-detect result in SS-2 (Table 1).

### 7.1.6 PCBs/Pesticides/VOCs

Surficial soil samples collected at the WSDOT-Potlatch site as part of this investigation did not contain detectable concentrations of PCBs, Pesticides/PCBs, and VOCs (Table 1).

## 7.2 TEST PIT SOILS

Soil samples were collected from the floor of four test pits excavated at the WSDOT-Potlatch site. The HCID analysis was used as a screening tool during this investigation and NWTPH analysis of gasoline, diesel, and motor oil were only performed if results of the HCID indicated these parameters were present. The HCID analysis of the test pit soil samples indicated that hydrocarbons were not detectable (Table 1).

## 7.3 GROUNDWATER

Groundwater samples were collected from the WSDOT-Potlatch monitoring wells Skok-1 through Skok-5 (Figure 2) and were analyzed for a subset of the site contaminants of concern.

### 7.3.1 Petroleum Hydrocarbons

HCID was used as a screening tool to test for the presence of petroleum hydrocarbon compounds in groundwater samples Skok-1 through Skok-5. The results of the HCID analysis indicated that petroleum compounds are not present in the WSDOT-Potlatch groundwater samples. Therefore NWTPH analyses for individual petroleum products were not performed (Table 2).

### 7.3.2 Metals

Total and dissolved RCRA metals were analyzed in the groundwater samples. This discussion begins with total metals results. While some total (unfiltered) metals concentrations exceed cleanup levels, the dissolved (filtered) metals concentrations do not for all wells (Table 2).

Communication with tribal staff has resulted in a proactive response that wells will be monitored surrounding the site for metals.

The results of the total metals analyses indicate that arsenic was detected in samples Skok-3 and Skok-5 at concentrations of 7.6 micrograms per liter (ug/L) which is equivalent to parts per million and 0.6 ug/L respectively. The concentration in the Skok-3 sample exceeds the MTCA Method A cleanup level, 5 ug/L. Barium was detected in all groundwater samples collected under this scope of work and concentrations range from 1.6 ug/L in sample Skok-2 to 581 ug/L in sample Skok-3. A MTCA Method A cleanup level has not been established for barium, however the Method B cleanup level (560 ug/L) is exceeded in Skok-3 (Table 2). The WAC 173-200-040 criteria for barium is 1000 ug/L. Cadmium was detected in samples Skok-3 and Skok-5 at concentrations of 0.3 ug/L and 0.2 ug/L respectively. These concentrations do not exceed the MTCA Method A cleanup level for cadmium (5 ug/L) nor the WAC 173-200-040 criteria for cadmium (10 ug/L). Chromium was detected in all groundwater samples collected during this investigation and concentrations range from 0.7 ug/L in Skok-2 to 150 ug/L in Skok-3. The chromium concentration in Skok-3 exceeds the MTCA Method A cleanup level and WAC 173-200-040 criteria (50 ug/L). The MTCA A cleanup level is based on the hexavalent chromium. If only trivalent chromium is present, the MTCA A cleanup level is 100 ug/L (unless a plating facility is nearby, hexavalent chromium is not expected to be present). The concentrations of chromium in the remaining samples are below the cleanup level and criteria. Lead is present in the Skok-3 sample at 12 ug/L and the Skok-5 sample at 1 ug/L. These concentrations do not exceed the MTCA Method A cleanup level (15 ug/L) or the WAC 173-200-040 criteria (50 ug/L) for lead. Silver was detected in sample Skok-3 and the concentration, 0.3 ug/L, does not exceed the MTCA B cleanup level, 80 ug/L, or the WAC 173-200-040 criteria for silver, 50 ug/L. (A MTCA Method A cleanup level for silver has not been established.) The remaining RCRA metals, mercury and selenium, were not detected in WSDOT-Potlatch groundwater samples (Table 2).

Fewer dissolved RCRA metals were detected in the groundwater samples than total RCRA metals. Dissolved barium was detected in all groundwater samples collected for this investigation and concentrations range from 1 ug/L in Skok-3 to 5.9 ug/L in Skok-1. This concentration does not exceed the MTCA B cleanup level, 560 ug/L. Neither a groundwater cleanup level nor criteria for barium are established under MTCA Method A or WAC 173-200-040. The concentration of dissolved chromium in sample Skok-1, 0.9 ug/L, does not exceed the MTCA Method A cleanup level, 50 ug/L. The remaining RCRA metals were not detected as dissolved metals in the groundwater samples (Table 2).

### 7.3.3 Polyaromatic Hydrocarbons

PAH compounds were not detected in groundwater samples collected at the WSDOT-Potlatch site under this investigation (Table 2).

### 7.3.4 Conventional Parameters

Groundwater samples were analyzed for the nitrate suite, fecal coliform, and one sample was analyzed for total coliform. The concentrations of nitrate in the samples range from 0.08 mg-N/L in sample Skok-2 to 0.717 mg-N/L in sample Skok-1. These concentrations do not exceed the MTCA B cleanup level, 1600 ug/L, or the WAC 173-200-040 criteria for nitrate, 10 mg/L. Fecal coliform was not detected in the groundwater samples and total coliform was not detected in sample Skok-1. MTCA Method A cleanup levels are not established for the conventional parameters analyzed (Table 2).

### 7.3.5 PCBs/Pesticides/VOCs

Groundwater samples collected at the WSDOT-Potlatch site as part of this investigation did not contain detectable concentrations of PCBs, Pesticides/PCBs, and VOCs (Table 2).

## 8.0 CONCLUSIONS

Based on the environmental assessment performed herein, including surface soil, test pit, and groundwater sampling, hazardous substances or contaminants have not be found at levels that exceed appropriate regulatory criteria. The analytical results do not indicate the need for further investigation or remedial action of soil or groundwater. The site is recommended for no further action and closure.

Due to the close proximity of private wells located immediately east of the site and due to the detection of total (unfiltered) arsenic, barium, chromium, and lead in one well (Skok-3), the Skokomish Indian Tribe will sample the private wells for these metals, as a proactive measure.

## 9.0 REFERENCES

Washington State Department of Ecology. December 2000. WDOT – Skokomish Site near Potlatch. Volume 1. Rapid Infiltration Hydrogeologic Study.

Washington State Department of Ecology. December 2000. WDOT – Skokomish Site near Potlatch. Volume 2. Groundwater Mounding Analysis.

# Table 1. Analytical Summary for Surfical Soil Samples and Test Pit Soil Samples
## WSDOT-Potlatch Site Environmental Assessment

| | | MTCA A [MTCA B] | | BHP1-5 6/29/2005 | BHP-3 6/30/2005 | BHP-4 6/30/2005 | BHP-2 6/30/2005 | SS-2 6/29/2005 | SS-1 6/29/2005 | SS-4 6/30/2005 | SS-3 6/30/2005 | SS-5 7/11/2005 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HCID | | | | | | | | | | | | |
| Gasoline | | | | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| Diesel | | | | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| Heavy Oil | | | | ND | ND | ND | ND | ND | D | ND | ND | ND |
| | | | | | | | | | | | | |
| NWTPH | | | | | | | | | | | | |
| Motor Oil Range | ug/g | 2000 | | | | | | | 250 U | | | |
| | | | | | | | | | | | | |
| PCB | | | | | | | | | | | | |
| Aroclor 1221 | ug/g | 1 | (total) | | | | | 0.1 U | 0.1 U | 0.1 U | | 0.1 U |
| Aroclor 1232 | ug/g | 1 | (total) | | | | | 0.1 U | 0.1 U | 0.1 U | | 0.1 U |
| Aroclor 1016 | ug/g | 1 | (total) | | | | | 0.1 U | 0.1 U | 0.1 U | | 0.1 U |
| Aroclor 1242 | ug/g | 1 | (total) | | | | | 0.1 U | 0.1 U | 0.1 U | | 0.1 U |
| Aroclor 1248 | ug/g | 1 | (total) | | | | | 0.1 U | 0.1 U | 0.1 U | | 0.1 U |
| Aroclor 1254 | ug/g | 1 | (total) | | | | | 0.1 U | 0.1 U | 0.1 U | | 0.1 U |
| Aroclor 1260 | ug/g | 1 | (total) | | | | | 0.1 U | 0.1 U | 0.1 U | | 0.1 U |
| Aroclor 1262 | ug/g | 1 | (total) | | | | | 0.1 U | 0.1 U | 0.1 U | | 0.1 U |
| | | | | | | | | | | | | |
| Metals | | | | | | | | | | | | |
| Arsenic | ug/g | 20 | | | | | | 7.0 U | 7.0 U | 7.0 U | | 7.0 U |
| Barium | ug/g | [5600] | | | | | | 21 | 24 | 21 | | 23 |
| Cadmium | ug/g | 2 | | | | | | 1.0 U | 1.0 U | 1.0 U | | 1.0 U |
| Chromium | ug/g | 2000 | | | | | | 11 | 15 | 12 | | 11 |
| Lead | ug/g | 250 | | | | | | 26 | 13 | 17 | | 15 |
| Selenium | ug/g | | | | | | | 10 U | 10 U | 10 U | | 10 U |
| Silver | ug/g | | | | | | | 1.0 U | 1.0 U | 1.0 U | | 1.0 U |
| Mercury | mg/kg | 2 | | | | | | 0.04 U | 0.04 U | 0.05 U | | 0.04 U |
| | | | | | | | | | | | | |
| VOC | | variable | | | | | | ND | ND | | | |
| (individual VOCs provided in Appendix B, no VOCs detected) | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| Non-Carcinogenic PAHs | | | | | | | | | | | | |
| Naphthalene | ug/kg | | | | | | | 50 U | 50 U | 50 U | | 5 U |
| Acenaphthylene | ug/kg | | | | | | | 50 U | 50 U | 50 U | | 5 U |
| Acenaphthene | ug/kg | | | | | | | 50 U | 50 U | 50 U | | 5 U |
| Benzo(g,h,i)perylene | ug/kg | | | | | | | 50 U | 50 U | 50 U | | 5 U |
| Fluorene | ug/kg | | | | | | | 50 U | 50 U | 50 U | | 5 U |
| Phenanthrene | ug/kg | | | | | | | 50 U | 50 U | 50 U | | 5 U |
| Anthracene | ug/kg | | | | | | | 50 U | 50 U | 50 U | | 5 U |
| Fluoranthene | ug/kg | [3200] | | | | | | 50 U | 50 U | 95 | | 14 |
| Pyrene | ug/kg | [2400] | | | | | | 50 U | 50 U | 84 | | 13 |
| | | | | | | | | | | | | |
| Carcinogenic PAHs (See Table 3 for MTCA evaluation of cPAH concentrations) | | | | | | | | | | | | |
| Benzo(a)anthracene | ug/kg | 100 | (total) | | | | | 50 U | 50 U | 50 U | | 5 U |
| Chrysene | ug/kg | 100 | (total) | | | | | 50 U | 50 U | 50 U | | 13 |
| Benzo(b)fluoranthene | ug/kg | 100 | (total) | | | | | 50 U | 50 U | 50 U | | 5 U |
| Benzo(k)fluoranthene | ug/kg | 100 | (total) | | | | | 50 U | 50 U | 50 U | | 13 |
| Benzo(a)pyrene | ug/kg | 100 | (total) | | | | | 50 U | 50 U | 50 U | | 5 U |
| Indeno(1,2,3-cd)pyrene | ug/kg | 100 | (total) | | | | | 50 U | 50 U | 50 U | | 5 U |
| Dibenzo(a,h)anthracene | ug/kg | 100 | (total) | | | | | 50 U | 50 U | 50 U | | 5 U |
| | | | | | | | | | | | | |
| Pentachlorophenol | ug/g | [8.3] | | | | | | | | | 0.2 j | |
| | | | | | | | | | | | | |
| Pesticides/PCB | | | | | | | | | | | | |
| alpha-BHC | ug/kg | | | | | | | 1.7 U | 1.7 U | 1.7 U | | 1.8 U |
| beta-BHC | ug/kg | | | | | | | 1.7 U | 1.7 U | 1.7 U | | 1.8 U |
| delta-BHC | ug/kg | | | | | | | 1.7 U | 1.7 U | 1.7 U | | 1.8 U |
| gamma-BHC (Lindane) | ug/kg | 10 | | | | | | 1.7 U | 1.7 U | 1.7 U | | 1.8 U |
| Heptachlor | ug/kg | | | | | | | 1.7 U | 1.7 U | 1.7 U | | 1.8 U |
| Aldrin | ug/kg | | | | | | | 1.7 U | 1.7 U | 1.7 U | | 1.8 U |
| Heptachlor Epoxide | ug/kg | | | | | | | 1.7 U | 1.7 U | 1.7 U | | 1.8 U |
| Endosulfan I | ug/kg | | | | | | | 1.7 U | 1.7 U | 1.7 U | | 1.8 U |
| Dieldrin | ug/kg | | | | | | | 3.4 U | 3.5 U | 3.5 U | | 3.5 U |
| 4,4'-DDE | ug/kg | | | | | | | 3.4 U | 3.5 U | 3.5 U | | 3.5 U |

|  |  | MTCA A<br>[MTCA B] | BHP1-5<br>6/29/2005 | BHP-3<br>6/30/2005 | BHP-4<br>6/30/2005 | BHP-2<br>6/30/2005 | SS-2<br>6/29/2005 | SS-1<br>6/29/2005 | SS-4<br>6/30/2005 | SS-3<br>6/30/2005 | SS-5<br>7/11/2005 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Endrin | ug/kg |  |  |  |  |  | 3.4 U | 3.5 U | 3.5 U |  | 3.5 U |
| Endosulfan II | ug/kg |  |  |  |  |  | 3.4 U | 3.5 U | 3.5 U |  | 3.5 U |
| 4,4'-DDD | ug/kg |  |  |  |  |  | 3.4 U | 3.5 U | 3.5 U |  | 3.5 U |
| Endosulfan Sulfate | ug/kg |  |  |  |  |  | 3.4 U | 3.5 U | 3.5 U |  | 3.5 U |
| 4,4-DDT | ug/kg | 3000 |  |  |  |  | 3.4 U | 3.5 U | 3.5 U |  | 3.5 U |
| Methoxychlor | ug/kg |  |  |  |  |  | 17 U | 17 U | 17 U |  | 18 U |
| Endrin Ketone | ug/kg |  |  |  |  |  | 3.4 U | 3.5 U | 3.5 U |  | 3.5 U |
| Endrin Aldehyde | ug/kg |  |  |  |  |  | 3.4 U | 3.5 U | 3.5 U |  | 3.5 U |
| gamma Chlordane | ug/kg |  |  |  |  |  | 1.7 U | 1.7 U | 1.7 U |  | 1.8 U |
| alpha Chlordane | ug/kg |  |  |  |  |  | 1.7 U | 1.7 U | 1.7 U |  | 1.8 U |
| Toxaphene | ug/kg |  |  |  |  |  | 170 U | 170 U | 170 U |  | 180 U |
| Conventionals |  |  |  |  |  |  |  |  |  |  |  |
| Total Solids | Percent |  |  |  |  |  | 97.7 | 96 |  |  |  |
| Nitrate | mg-N/kg | [8000] |  |  |  |  | 0.07 | 0.07 |  |  |  |
| Nitrite | mg-N/kg | [8000] |  |  |  |  | 0.11 | 0.11 |  |  |  |
| Nitrate+Nitrite | mg-N/kg |  |  |  |  |  | 0.18 | 0.18 |  |  |  |
| Total Coliform | CFU/g |  |  |  |  |  | 11 U | 238 |  |  |  |

#U = Compound not detected, # is detection limit
#j = value is below normal reporting limits, the value reported is an estimate
ND = not detected; D = detected
BHP- = soil sample collected from the floor of a test pit
SS- = surficial soil sample
MTCA Method B cleanup levels are shown in [] if no MTCA A cleanup level is established and the analyte was detected in samples.

# Table 2. Analytical Summary for Groundwater Samples
## WSDOT-Potlatch Site Environmental Assessment

| | | MTCA A<br>[MTCA B] | WAC 173-200-040 | Skok-3<br>7/13/2005 | Skok-2<br>7/11/2005 | Skok-4<br>7/11/2005 | Skok-1<br>7/11/2005 | Skok-5<br>7/21/2005 |
|---|---|---|---|---|---|---|---|---|
| HCID | | | | | | | | |
| Gasoline | | | | ND | ND | ND | ND | ND |
| Diesel | | | | ND | ND | ND | ND | ND |
| Heavy Oil | | | | ND | ND | ND | ND | ND |
| | | | | | | | | |
| VOCs | | | | ND | ND | ND | ND | ND |
| (individual VOCs provided in Appendix B, no VOCs detected) | | | | | | | | |
| | | | | | | | | |
| Non-Carcinogenic PAHs | | | | | | | | |
| Naphthalene | ug/L | | | 0.1 U | 0.1 U | 0.1 U | 0.1 U | 0.1 U |
| Acenaphthylene | ug/L | | | 0.1 U | 0.1 U | 0.1 U | 0.1 U | 0.1 U |
| Acenaphthene | ug/L | | | 0.1 U | 0.1 U | 0.1 U | 0.1 U | 0.1 U |
| Benzo(g,h,i)perylene | ug/L | | | 0.1 U | 0.1 U | 0.1 U | 0.1 U | 0.1 U |
| Fluorene | ug/L | | | 0.1 U | 0.1 U | 0.1 U | 0.1 U | 0.1 U |
| Phenanthrene | ug/L | | | 0.1 U | 0.1 U | 0.1 U | 0.1 U | 0.1 U |
| Anthracene | ug/L | | | 0.1 U | 0.1 U | 0.1 U | 0.1 U | 0.1 U |
| Fluoranthene | ug/L | | | 0.1 U | 0.1 U | 0.1 U | 0.1 U | 0.1 U |
| Pyrene | ug/L | | | 0.1 U | 0.1 U | 0.1 U | 0.1 U | 0.1 U |
| | | | | | | | | |
| Carcinogenic PAHs | | | | | | | | |
| Benzo(a)anthracene | ug/L | 0.1 (total) | | 0.1 U | 0.1 U | 0.1 U | 0.1 U | 0.1 U |
| Chrysene | ug/L | 0.1 (total) | | 0.1 U | 0.1 U | 0.1 U | 0.1 U | 0.1 U |
| Benzo(b)fluoranthene | ug/L | 0.1 (total) | | 0.1 U | 0.1 U | 0.1 U | 0.1 U | 0.1 U |
| Benzo(k)fluoranthene | ug/L | 0.1 (total) | | 0.1 U | 0.1 U | 0.1 U | 0.1 U | 0.1 U |
| Benzo(a)pyrene | ug/L | 0.1 (total) | | 0.1 U | 0.1 U | 0.1 U | 0.1 U | 0.1 U |
| Indeno(1,2,3-cd)pyrene | ug/L | 0.1 (total) | | 0.1 U | 0.1 U | 0.1 U | 0.1 U | 0.1 U |
| Dibenzo(a,h)anthracene | ug/L | 0.1 (total) | | 0.1 U | 0.1 U | 0.1 U | 0.1 U | 0.1 U |
| | | | | | | | | |
| PCBs | | | | | | | | |
| Aroclor 1016 | ug/L | 0.1 (total) | | 0.11 U | 0.10 U | 0.10 U | 0.10 U | 0.10 U |
| Aroclor 1242 | ug/L | 0.1 (total) | | 0.11 U | 0.10 U | 0.10 U | 0.10 U | 0.10 U |
| Aroclor 1248 | ug/L | 0.1 (total) | | 0.11 U | 0.10 U | 0.10 U | 0.10 U | 0.10 U |
| Aroclor 1254 | ug/L | 0.1 (total) | | 0.11 U | 0.10 U | 0.10 U | 0.10 U | 0.10 U |
| Aroclor 1260 | ug/L | 0.1 (total) | | 0.11 U | 0.10 U | 0.10 U | 0.10 U | 0.10 U |
| Aroclor 1221 | ug/L | 0.1 (total) | | 0.11 U | 0.10 U | 0.10 U | 0.10 U | 0.10 U |
| Aroclor 1232 | ug/L | 0.1 (total) | | 0.11 U | 0.10 U | 0.10 U | 0.10 U | 0.10 U |
| | | | | | | | | |
| Pesticides/PCB | | | | | | | | |
| alpha-BHC | ug/L | | | 0.0050 U | 0.0050 U | 0.0050 U | 0.0050 U | 0.0050 U |
| beta-BHC | ug/L | | | 0.0050 U | 0.0050 U | 0.0050 U | 0.0050 U | 0.0050 U |
| delta-BHC | ug/L | | | 0.0050 U | 0.0050 U | 0.0050 U | 0.0050 U | 0.0050 U |
| gamma-BHC (Lindane) | ug/L | 0.2 | | 0.0050 U | 0.0050 U | 0.0050 U | 0.0050 U | 0.0050 U |
| Heptachlor | ug/L | | | 0.0050 U | 0.0050 U | 0.0050 U | 0.0050 U | 0.0050 U |
| Aldrin | ug/L | | | 0.0050 U | 0.0050 U | 0.0050 U | 0.0050 U | 0.0050 U |
| Heptachlor Epoxide | ug/L | | | 0.0050 U | 0.0050 U | 0.0050 U | 0.0050 U | 0.0050 U |
| Endosulfan I | ug/L | | | 0.0050 U | 0.0050 U | 0.0050 U | 0.0050 U | 0.0050 U |
| Dieldrin | ug/L | | | 0.010 U | 0.010 U | 0.010 U | 0.010 U | 0.010 U |
| 4,4'-DDE | ug/L | | | 0.010 U | 0.010 U | 0.010 U | 0.010 U | 0.010 U |
| Endrin | ug/L | | | 0.010 U | 0.010 U | 0.010 U | 0.010 U | 0.010 U |
| Endosulfan II | ug/L | | | 0.010 U | 0.010 U | 0.010 U | 0.010 U | 0.010 U |
| 4,4'-DDD | ug/L | | | 0.010 U | 0.010 U | 0.010 U | 0.010 U | 0.010 U |
| Endosulfan Sulfate | ug/L | | | 0.010 U | 0.010 U | 0.010 U | 0.010 U | 0.010 U |
| 4,4-DDT | ug/L | 0.3 | | 0.010 U | 0.010 U | 0.010 U | 0.010 U | 0.010 U |
| Methoxychlor | ug/L | | | 0.050 U | 0.050 U | 0.050 U | 0.050 U | 0.050 U |
| Endrin Ketone | ug/L | | | 0.010 U | 0.010 U | 0.010 U | 0.010 U | 0.010 U |
| Endrin Aldehyde | ug/L | | | 0.010 U | 0.010 U | 0.010 U | 0.010 U | 0.010 U |
| gamma Chlordane | ug/L | | | 0.0050 U | 0.0050 U | 0.0050 U | 0.0050 U | 0.0050 U |
| alpha Chlordane | ug/L | | | 0.0050 U | 0.0050 U | 0.0050 U | 0.0050 U | 0.0050 U |

| | | MTCA A<br>[MTCA B] | | WAC 173-200-040 | Skok-3<br>7/13/2005 | Skok-2<br>7/11/2005 | Skok-4<br>7/11/2005 | Skok-1<br>7/11/2005 | Skok-5<br>7/21/2005 |
|---|---|---|---|---|---|---|---|---|---|
| Toxaphene | ug/L | | | | 0.50 U | 0.50 U | 0.50 U | 0.50 U | 0.50 U |
| | | | | | | | | | |
| Total Metals | | | | | | | | | |
| Arsenic | ug/L | 5 | | | **7.6** | 0.2 U | 0.2 U | 0.2 U | 0.6 |
| Barium | ug/L | [560] | | 1000 | **581** | 1.6 | 9 | 9.3 | 26.8 |
| Cadmium | ug/L | 5 | | | 0.3 | 0.2 U | 0.2 U | 0.2 U | 0.2 |
| Chromium | ug/L | 50 | (100 Cr III) | 50 | **150** | 0.7 | 1.9 | 1.3 | 11 |
| Lead | ug/L | 15 | | | 12 | 1 U | 1 U | 1 U | 1 |
| Mercury | ug/L | 2 | | | 0.1 U | 0.1 U | 0.1 U | 0.1 U | 0.1 U |
| Selenium | ug/L | | | | 1 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U |
| Silver | ug/L | | 80 | 50 | 0.3 | 0.2 U | 0.2 U | 0.2 U | 0.2 U |
| | | | | | | | | | |
| Dissolved Metals | | | | | | | | | |
| Arsenic | ug/L | 5 | | | 0.2 U | 0.2 U | 0.2 U | 0.2 U | 0.2 U |
| Barium | ug/L | [560] | | | 1 | 1.1 | 1.2 | 5.9 | 1.7 |
| Cadmium | ug/L | 5 | | | 0.2 U | 0.2 U | 0.2 U | 0.2 U | 0.2 U |
| Chromium | ug/L | 50 | | | 0.5 U | 0.5 U | 0.5 U | 0.9 | 0.5 U |
| Lead | ug/L | 15 | | | 1 U | 1 U | 1 U | 1 U | 1 U |
| Mercury | ug/L | 2 | | | 0.1 U | 0.1 U | 0.1 U | 0.1 U | 0.1 U |
| Selenium | ug/L | | | | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U |
| Silver | ug/L | | | | 0.2 U | 0.2 U | 0.2 U | 0.2 U | 0.2 U |
| | | | | | | | | | |
| Conventionals | | | | | | | | | |
| Nitrate | mg-N/L | [1600] | | 10 | 0.384 | 0.08 | 0.408 | 0.717 | 0.691 |
| Nitrite | mg-N/L | [1600] | | | 0.033 | 0.010 U | 0.010 U | 0.010 U | 0.010 U |
| Nitrate+Nitrite | mg-N/L | | | | 0.417 | 0.08 | 0.408 | 0.717 | 0.691 |
| Fecal Coliform | CFU/100 mL | | | | 1 U | 1 U | 1 U | 1 U | 1 U |
| Total Coliform | CFU/100 mL | | | | | | | | 1 U |

#U = Compound not detected, # is detection limit

Shaded values indicate detections; bold values indicate compound concentration exceeds MTCA A, MTCA B, and/or WAC 173-200-040 criteria.

MTCA Method B cleanup levels are shown in [] if no MTCA A cleanup level is established and the analyte was detected in samples.

The MTCA A cleanup level for chromium is based on the toxicity of hexavalent chromium. If just trivalent chromium is present, 100 ug/L is the MTCA A cleanup

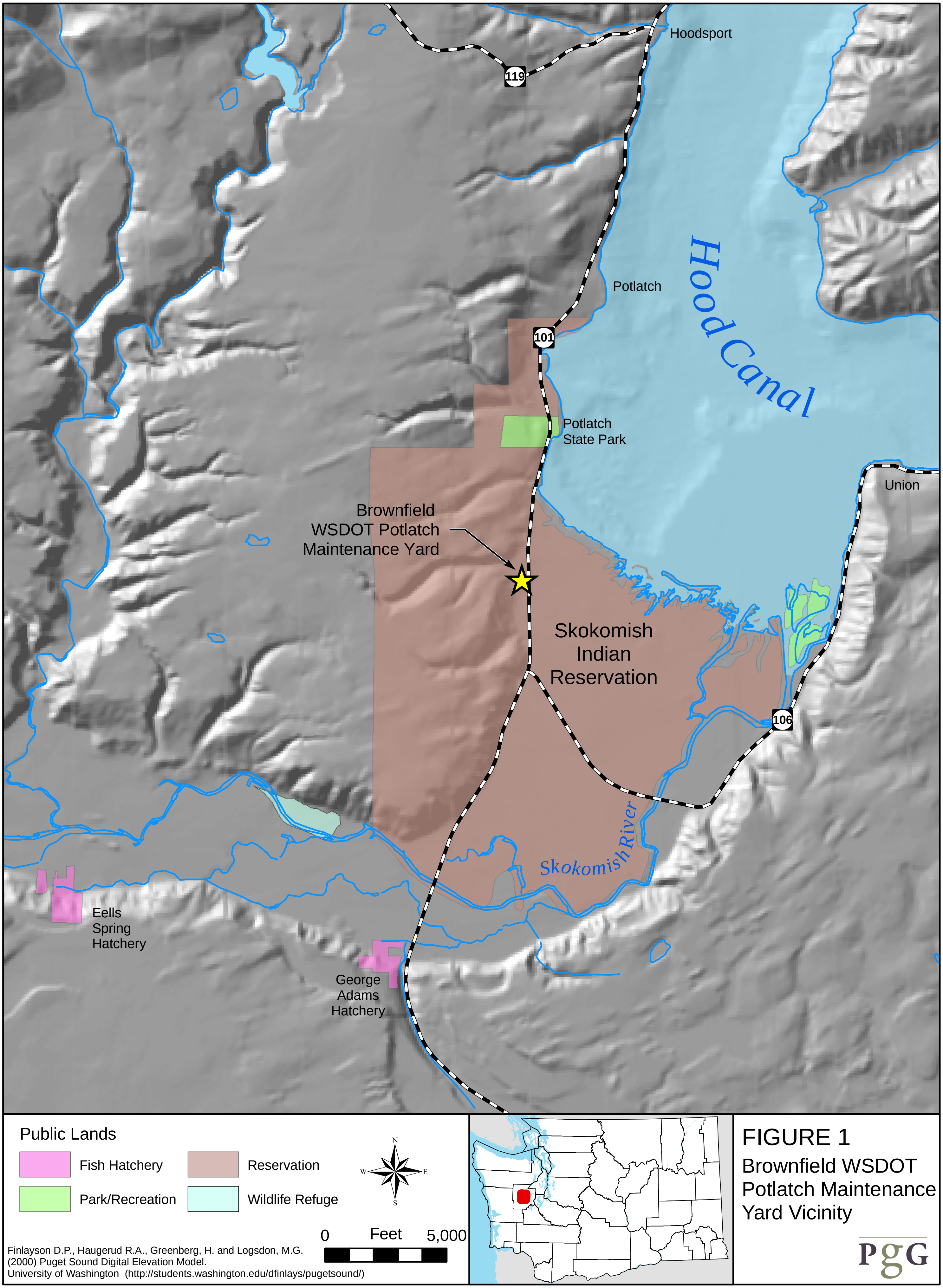
# Table 3. Surficial Soil Samples cPAH Evaluations
## WSDOT-Potlatch Site Environmental Assessment

| | | | cPAH Concentrations (from Table 1) | | | | | Toxicity Equivalent Concentrations (calculated) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | TEF | SS-2 | SS-1 | SS-4 | SS-3 | SS-5 | SS-2 | SS-1 | SS-4 | SS-3 | SS-5 |
| Benzo(a)anthracene | ug/kg | 0.1 | *50* | *50* | *50* | | *5* | 5 | 5 | 5 | | 0.5 |
| Chrysene | ug/kg | 0.01 | *50* | *50* | *50* | | 13 | 0.5 | 0.5 | 0.5 | | 0.13 |
| Benzo(b)fluoranthene | ug/kg | 0.1 | *50* | *50* | *50* | | *5* | 5 | 5 | 5 | | 0.5 |
| Benzo(k)fluoranthene | ug/kg | 0.1 | *50* | *50* | *50* | | 13 | 5 | 5 | 5 | | 1.3 |
| Benzo(a)pyrene | ug/kg | 1 | *50* | *50* | *50* | | *5* | 50 | 50 | 50 | | 5 |
| Indeno(1,2,3-cd)pyrene | ug/kg | 0.1 | *50* | *50* | *50* | | *5* | 5 | 5 | 5 | | 0.5 |
| Dibenzo(a,h)anthracene | ug/kg | 0.4 | *50* | *50* | *50* | | *5* | 20 | 20 | 20 | | 2 |
| Total cPAH Toxicity Equivalent Concentrations (ug/kg): | | | | | | | | 90.5 | 90.5 | 90.5 | | 9.93 |
| Total cPAH Toxicity Equivalent Concentrations (mg/kg): | | | | | | | | 0.09 | 0.09 | 0.09 | | 0.01 |
| MTCA Method A Cleanup Level (mg/kg): | | | | | | | | 0.1 | 0.1 | 0.1 | | 0.1 |

Italic indicates compound not detected, value given is laboratory reporting limit

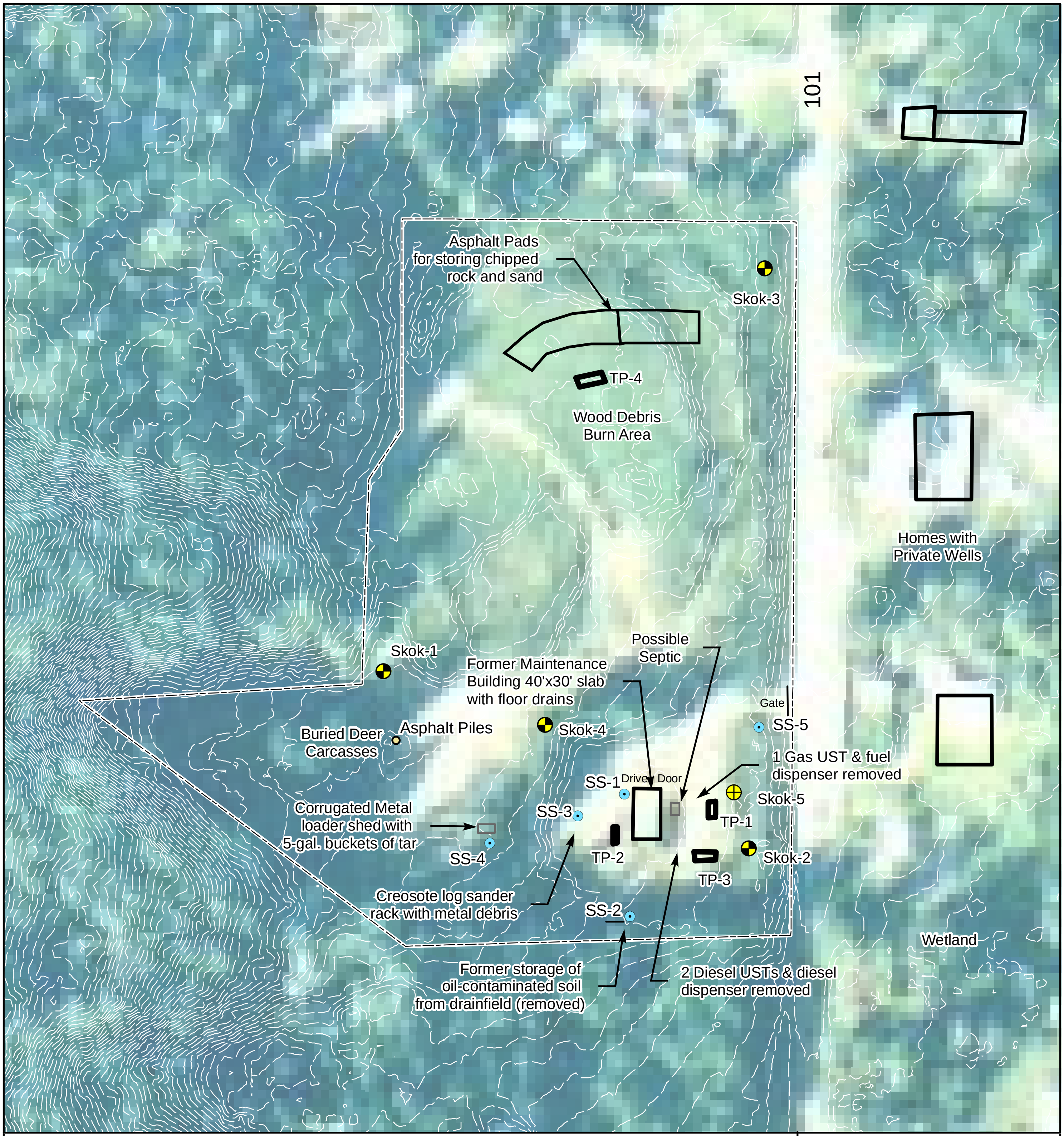
TEF = Toxicity Equivalency Factor

Bold indicates Total cPAH Toxicity Equivalent Concentration exceeds MTCA A cleanup level



Finlayson D.P., Haugerud R.A., Greenberg, H. and Logsdon, M.G. (2000) Puget Sound Digital Elevation Model. University of Washington (http://students.washington.edu/dfinlays/pugetsound/)

FIGURE 1
Brownfield WSDOT Potlatch Maintenance Yard Vicinity



● Existing Monitoring Well (4)

⊕ Proposed Monitoring Well (1)

SS-1 ⊙ Proposed Surface Soil Sample Location (5)

TP-1 ▬ Proposed Test Pit Location (4)

▭ Approximate Property Boundary

2-foot Contours generated from PSLC 2002 LiDAR

N W E S

0 Feet 200

## FIGURE 3

WSDOT Potlatch
Maintenance Yard
Environmental
Assessment

PGG

K:\JANET\JK0411Skokomish\Brownfield\EA\GIS\mxd\detailed_Figure2.mxd - 3/18/2005

# APPENDIX B
# LABORATORY ANALYTICAL REPORTS

# APPENDIX A
# TEST PIT LOGS AND WELL CONSTRUCTION AS-BUILT LOGS

# SKOK-5 GEOLOGIC LOG AND AS-BUILT

| DEPTH | GEOLOGIC LOG | BLOW COUNTS | SAMPLE |
|---|---|---|---|
| 0 | Damp, brown, slightly sandy, fine GRAVEL. | | |
| 5 | Damp, brown, gravelly SAND. | 13<br>7<br>7 | ⧓ |
| 10 | Damp, brown, silty SAND and fine GRAVEL. | 3<br>3<br>4 | ⧓ |
| 15 | Wet, mottled brown, slightly silty, gravelly, coarse SAND. | 4<br>5<br>3 | ⧓ |
| 20 | Wet, brown, silty, SAND and GRAVEL. Material is siltbound (TILL). | 12<br>16<br>18 | ⧓ |
| 25 | Wet, brown, gravelly, coarse SAND. Heaving sand. | 18<br>15<br>16 | ⧓ |
| 30 | Bottom of Boring<br>7/19/2005 | 32/1" | |

**WELL CONSTRUCTION DETAILS**

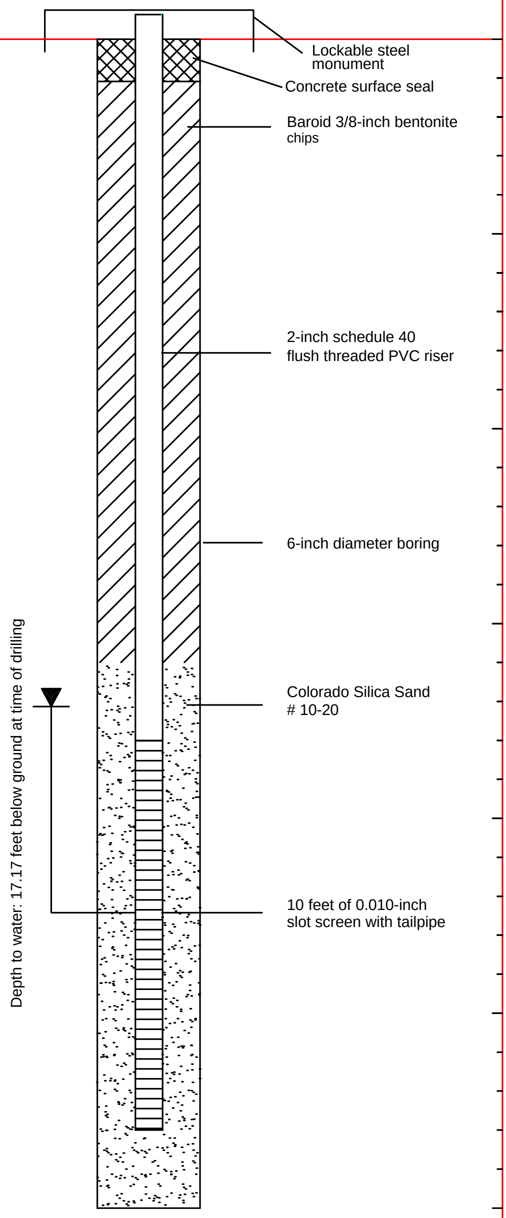


FIGURE 3

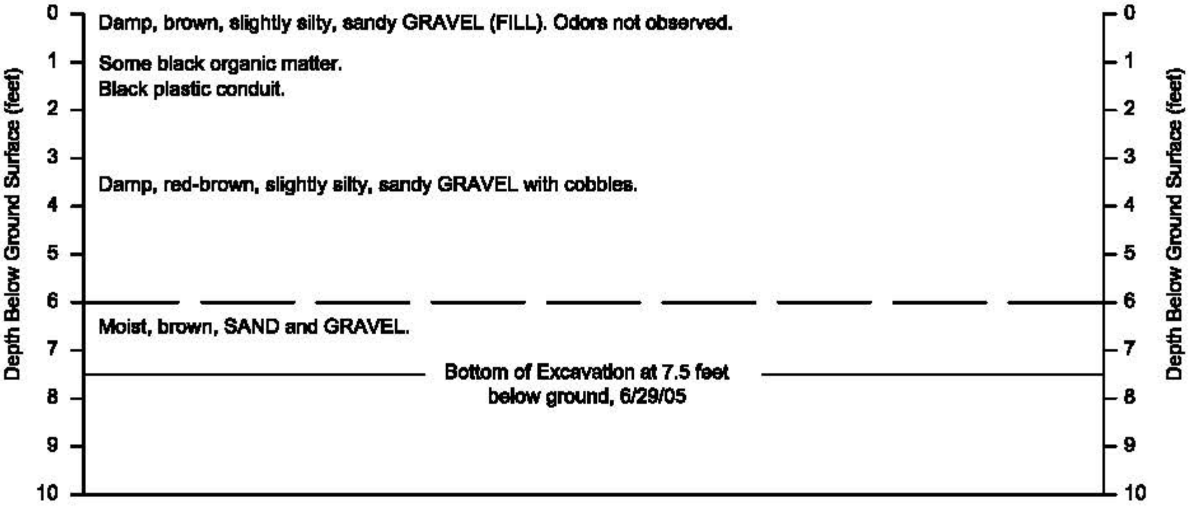
**PROJECT NAME:** WSDOT–Potlatch Environmental Assessment
**WELL IDENTIFICATION NUMBER:** Skok–5
**DRILLING METHOD:** Auger
**DRILLER:** Hal Parks
**FIRM:** Geotechnical Testing Laboratory
**CONSULTING FIRM:** Pacific Groundwater Group
**REPRESENTATIVE:** Linton Wildrick

**LOCATION:** NW¼ NW¼ Sec. 2, T21N, R4W
**INSTALLED:** 7/19/05
**DEVELOPED:** Pumped

PgG

K:\Janet\JK0411SkokomishBrownfieldEA\Skok–5Log.dwg

## Test Pit BHP-1


Damp, brown, slightly silty, sandy GRAVEL (FILL). Odors not observed.

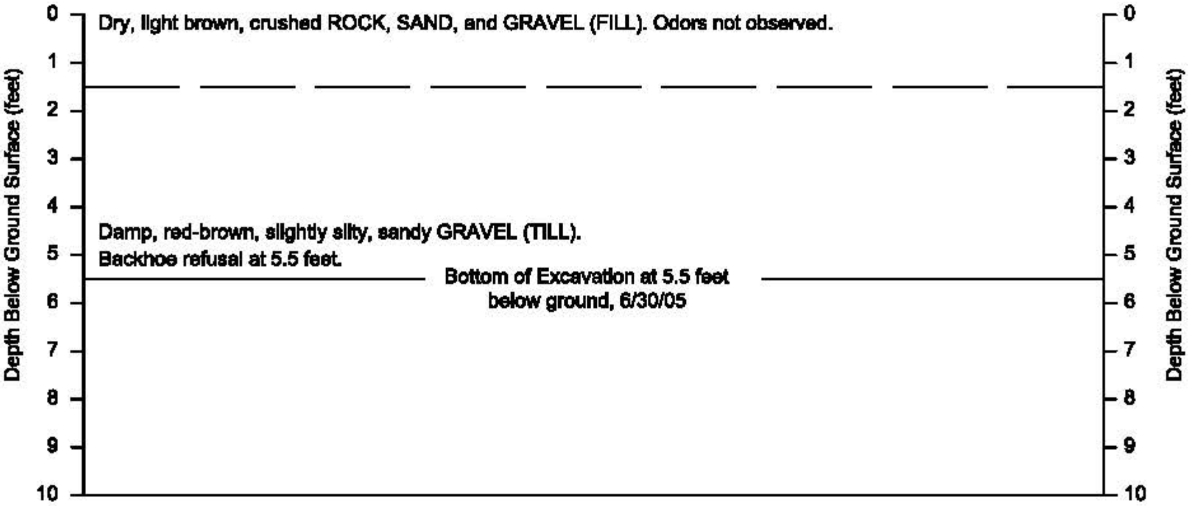
Some black organic matter.
Black plastic conduit.

Damp, red-brown, slightly silty, sandy GRAVEL with cobbles.

Moist, brown, SAND and GRAVEL.

Bottom of Excavation at 7.5 feet
below ground, 6/29/05

## Test Pit BHP-2


Dry, light brown, crushed ROCK, SAND, and GRAVEL (FILL). Odors not observed.

Damp, red-brown, slightly silty, sandy GRAVEL (TILL).
Backhoe refusal at 5.5 feet.

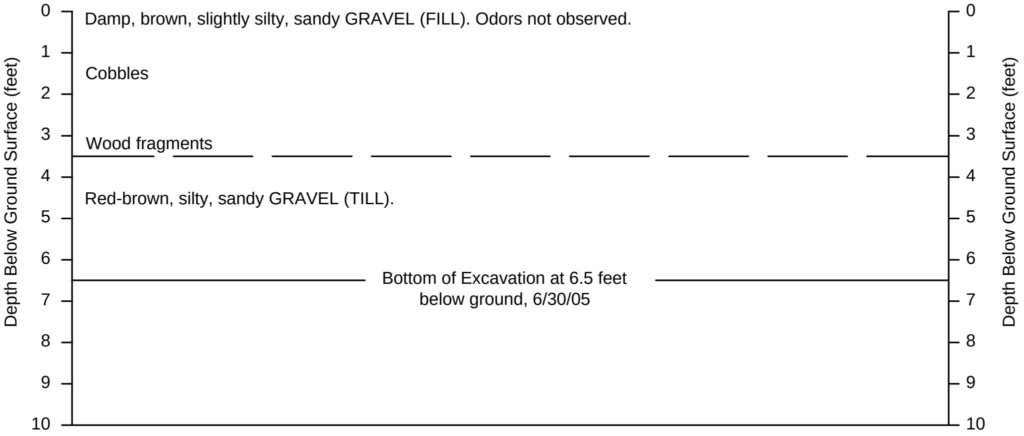
Bottom of Excavation at 5.5 feet
below ground, 6/30/05

LEGEND

FIGURE A-1
WSDOT-Potlatch Test Pit Logs
BHP-1 and BHP-2

JK0411, WSDOT-Potlatch Investigation

## Test Pit BHP-3



Damp, brown, slightly silty, sandy GRAVEL (FILL). Odors not observed.

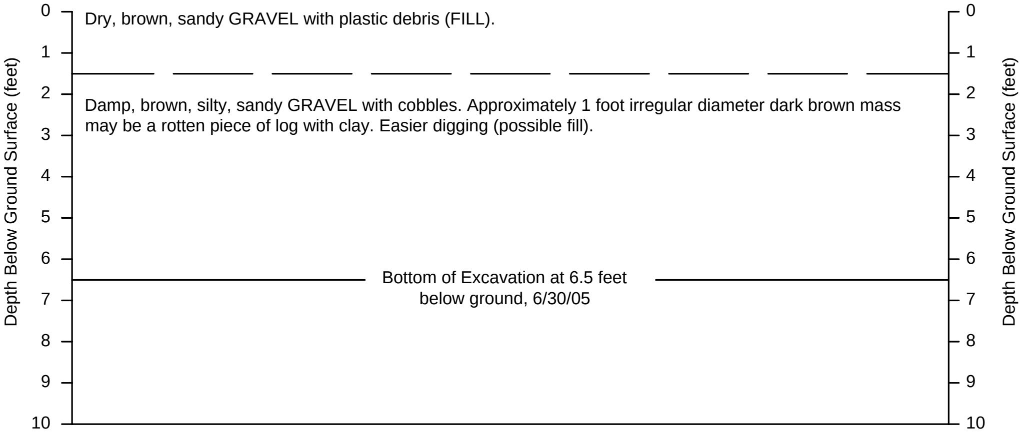
Cobbles

Wood fragments

Red-brown, silty, sandy GRAVEL (TILL).

Bottom of Excavation at 6.5 feet
below ground, 6/30/05

## Test Pit BHP-4



Dry, brown, sandy GRAVEL with plastic debris (FILL).

Damp, brown, silty, sandy GRAVEL with cobbles. Approximately 1 foot irregular diameter dark brown mass may be a rotten piece of log with clay. Easier digging (possible fill).

Bottom of Excavation at 6.5 feet
below ground, 6/30/05

LEGEND

FIGURE A-2
WSDOT-Potlatch Test Pit Logs
BHP-3 and BHP-4 Logs

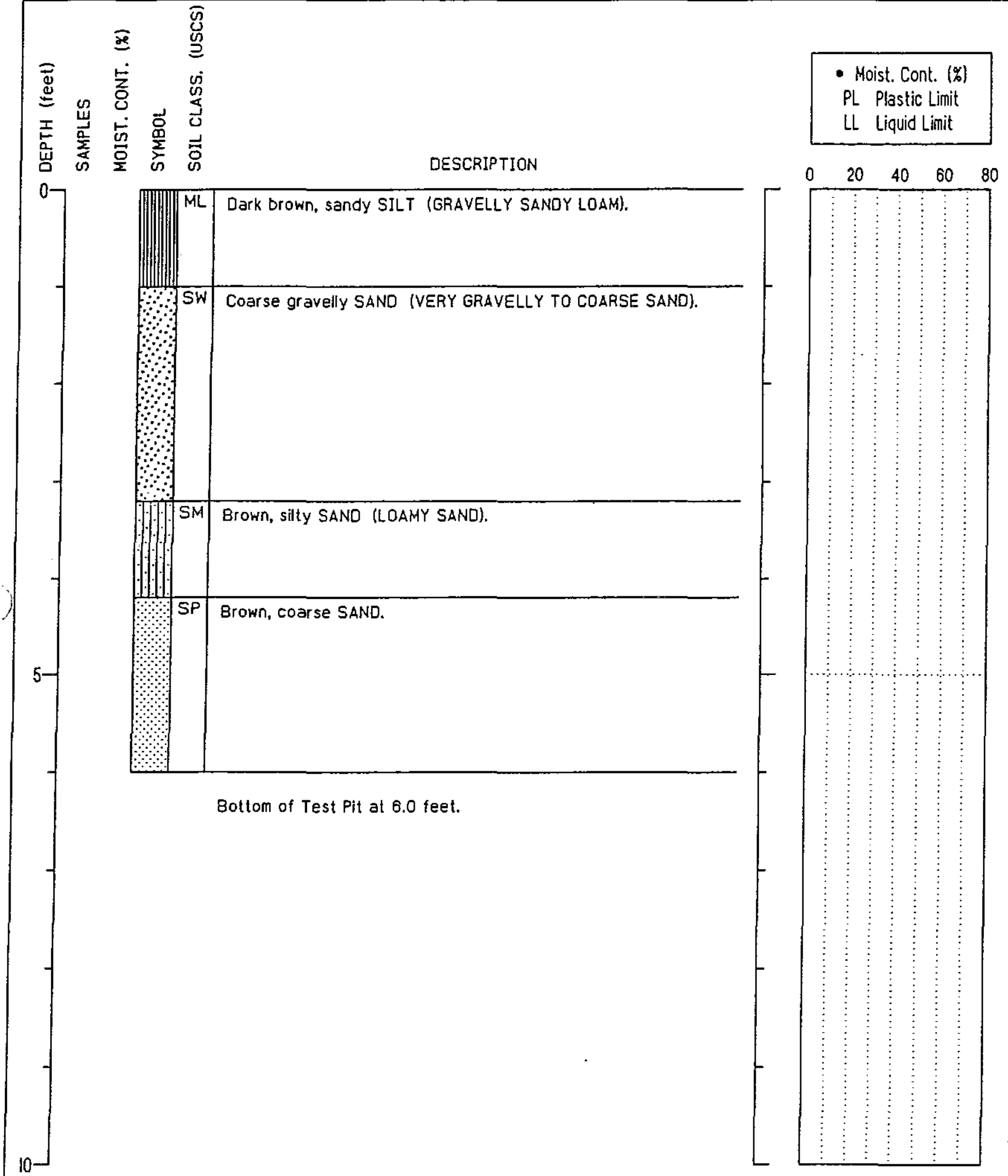
JK0411, WSDOT-Potlatch Investigation

# HONG WEST & ASSOCIATES, INC.

# TEST PIT LOG

EXCAVATION COMPANY:
EXCAVATION METHOD: Backhoe
SAMPLING METHOD:

TOTAL DEPTH: 6.0 Feet
SURFACE ELEVATION: 25± Feet



| | |
|---|---|
| ML | Dark brown, sandy SILT (GRAVELLY SANDY LOAM). |
| SW | Coarse gravelly SAND (VERY GRAVELLY TO COARSE SAND). |
| SM | Brown, silty SAND (LOAMY SAND). |
| SP | Brown, coarse SAND. |

Bottom of Test Pit at 6.0 feet.

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated.

## PROJECT: SKOKOMISH FACILITY PLAN TEST PIT: TP-7

LOCATION: Section 35, SW Corner
DATE COMPLETED: September 7, 1994
LOGGED BY: Derek Sandison

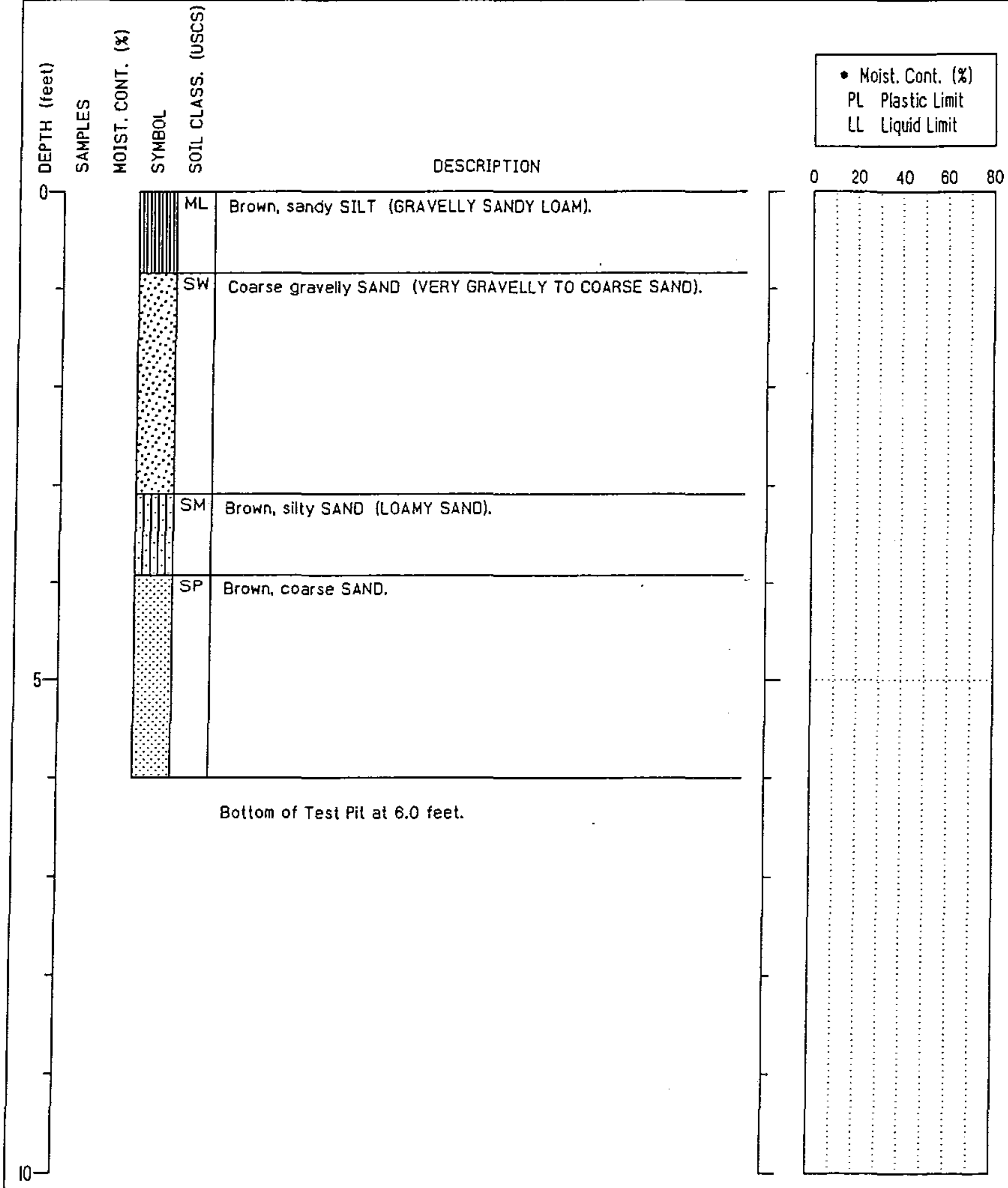
PROJECT NUMBER: 94032

PAGE: 1 OF 1

# TEST PIT LOG

EXCAVATION COMPANY:
EXCAVATION METHOD: Backhoe
SAMPLING METHOD:

TOTAL DEPTH: 6.0 Feet
SURFACE ELEVATION: 25± Feet



| SOIL CLASS. (USCS) | DESCRIPTION |
|---|---|
| ML | Brown, sandy SILT (GRAVELLY SANDY LOAM). |
| SW | Coarse gravelly SAND (VERY GRAVELLY TO COARSE SAND). |
| SM | Brown, silty SAND (LOAMY SAND). |
| SP | Brown, coarse SAND. |

Bottom of Test Pit at 6.0 feet.

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated.

## PROJECT: SKOKOMISH FACILITY PLAN TEST PIT: TP-8

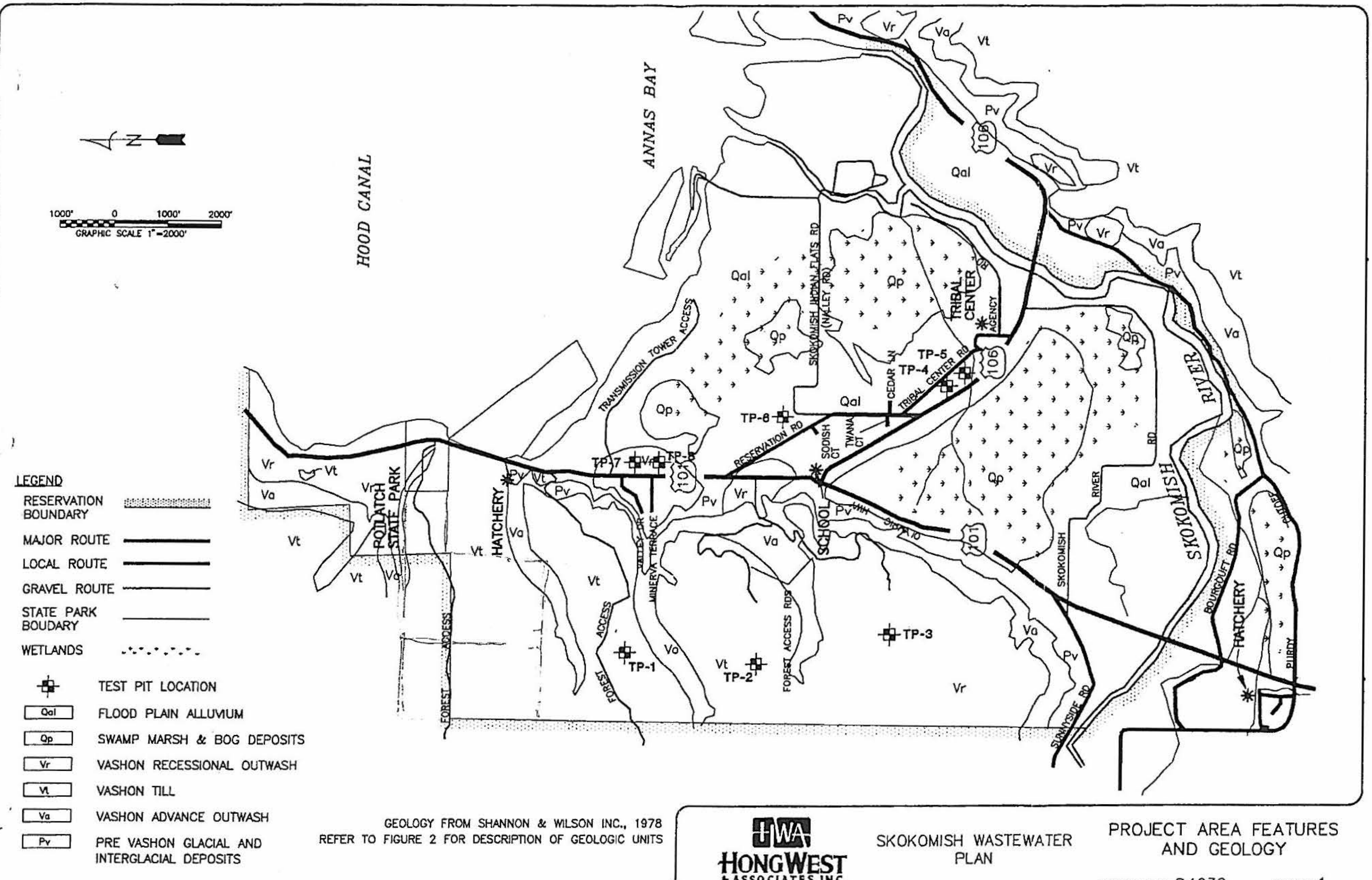
LOCATION: Section 35, SW Corner
DATE COMPLETED: September 7, 1994
LOGGED BY: Derek Sandison

PROJECT NUMBER: 94032

PAGE: 1 OF 1

# Appendix G

# Well Logs for Core Area Infiltration Basin Site, Hong West (1997)



LEGEND

| | |
|---|---|
| ▨ | RESERVATION BOUNDARY |
| ━ | MAJOR ROUTE |
| ━ | LOCAL ROUTE |
| — | GRAVEL ROUTE |
| — | STATE PARK BOUDARY |
| .-.-.-. | WETLANDS |
| ✣ | TEST PIT LOCATION |
| Qal | FLOOD PLAIN ALLUVIUM |
| Qp | SWAMP MARSH & BOG DEPOSITS |
| Vr | VASHON RECESSIONAL OUTWASH |
| Vt | VASHON TILL |
| Va | VASHON ADVANCE OUTWASH |
| Pv | PRE VASHON GLACIAL AND INTERGLACIAL DEPOSITS |

GEOLOGY FROM SHANNON & WILSON INC., 1978
REFER TO FIGURE 2 FOR DESCRIPTION OF GEOLOGIC UNITS

HONGWEST & ASSOCIATES, INC.

SKOKOMISH WASTEWATER PLAN

PROJECT AREA FEATURES AND GEOLOGY

PROJECT NO.: 94032 FIGURE: 1

C:\JOBS\94032\B-001.DWG

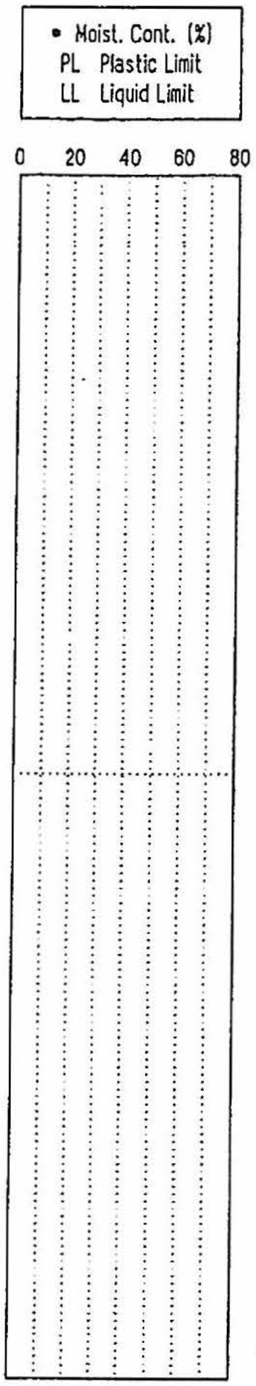
HONG WEST & ASSOCIATES, INC. **TEST PIT LOG**

EXCAVATION COMPANY:
EXCAVATION METHOD: Backhoe
SAMPLING METHOD:

TOTAL DEPTH: 6.0 Feet
SURFACE ELEVATION: 25± Feet

| DEPTH (feet) | SAMPLES | MOIST. CONT. (%) | SYMBOL | SOIL CLASS. (USCS) | DESCRIPTION |
|---|---|---|---|---|---|
| 0 | | | | ML | Dark brown, sandy SILT (GRAVELLY SANDY LOAM). |
| | | | | SW | Coarse gravelly SAND (VERY GRAVELLY TO COARSE SAND). |
| | | | | SM | Brown, silty SAND (LOAMY SAND). |
| 5 | | | | SP | Brown, coarse SAND. |
| 10 | | | | | |

Bottom of Test Pit at 6.0 feet.



NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated.

PROJECT: SKOKOMISH FACILITY PLAN TEST PIT: TP-7

LOCATION: Section 35, SW Corner
DATE COMPLETED: September 7, 1994
LOGGED BY: Derek Sandison

PROJECT NUMBER: 94032

PAGE: 1 OF 1

# HONG WEST & ASSOCIATES, INC.

# TEST PIT LOG

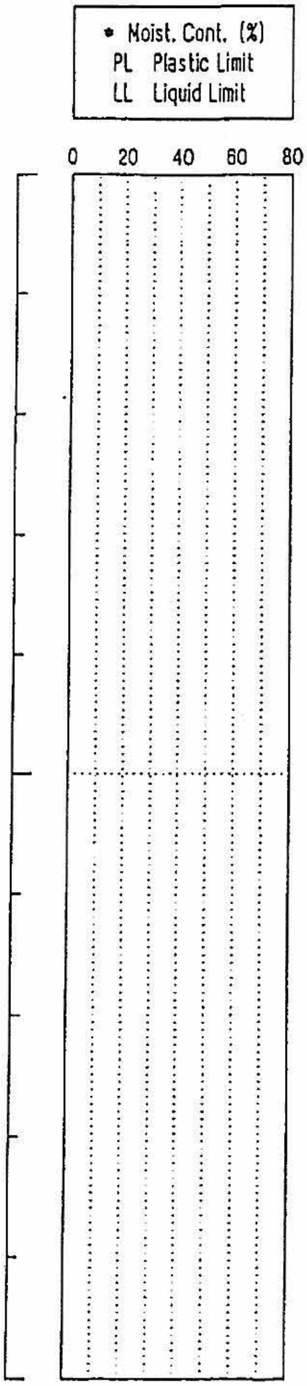
EXCAVATION COMPANY:
EXCAVATION METHOD: Backhoe
SAMPLING METHOD:

TOTAL DEPTH: 6.0 Feet
SURFACE ELEVATION: 25± Feet

| DEPTH (feet) | SAMPLES | MOIST. CONT. (%) | SYMBOL | SOIL CLASS. (USCS) | DESCRIPTION |
|---|---|---|---|---|---|
| 0 | | | ▥ | ML | Brown, sandy SILT (GRAVELLY SANDY LOAM). |
| | | | ⁘ | SW | Coarse gravelly SAND (VERY GRAVELLY TO COARSE SAND). |
| | | | ▥ | SM | Brown, silty SAND (LOAMY SAND). |
| 5 | | | ▨ | SP | Brown, coarse SAND. |

Bottom of Test Pit at 6.0 feet.

10



NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated.

## PROJECT: SKOKOMISH FACILITY PLAN TEST PIT: TP-8

LOCATION: Section 35, SW Corner
DATE COMPLETED: September 7, 1994
LOGGED BY: Derek Sandison

PROJECT NUMBER: 94032

PAGE: 1 OF 1

# Appendix H
# Collection System Modeling, E-One (2007)

Environment One Corporation

# Pressure Sewer Preliminary Cost and Design Analysis For Skokomish Indian Tribe, WA 6-07

**Prepared For:**
**Cascade Design Professionals Inc.**
**2780 SE Harrison Street, Suite 104**
**Milwaukie OR 97222**
**Tel: 503-652-9090**
**Fax: 503-652-9091**
**Prepared By: Keith Blond**
**June 26, 2007**

W:\Engineering Data\AE\Design Assistant Files\Skokomish Indian Tribe, WA 6-07.MDB

Environment One Corporation
2773 Balltown Road
Niskayuna, NY 12309-1090
Phone: (518) 346-6161 ext. 3022
Fax: (518) 346-6188
e-mail: kblond@.eone.com

June 13, 2007

Jane Kelly
Cascade Design Professionals Inc.
2780 SE Harrison Street, Suite 104
Milwaukie, OR 97222

Subject: Skokomish Indian Tribe, WA - Low Pressure Sewer System

Dear Jane;

Environment One is pleased to provide the following preliminary design analysis examining the use of a low pressure sewer system using Environment One Grinder Pumps for Skokomish Indian Tribe, WA. The low pressure sewer approach provides not only a technical solution, but also an economic advantage to be realized with low up front and O&M costs.

## System Analysis

Using the drawings and data you provided, I ran the enclosed preliminary pressure sewer pipe sizing analysis. This was run through our Low Pressure Sewer Design Software that employs our Flow Velocity and Friction Head Loss vs. Pumps in Simultaneous Operation Spreadsheet. Computations are based on the Hazen-Williams formula for friction loss, using calculations of cross-sectional area and flow rate to determine pipe sizes that create ”self-cleaning” velocities of 2.0 fps or higher. A "C" factor of 150, SDR 11 HDPE pipe, and 200 gpd per unit are also used in this analysis.

There are 391 grinder pump stations represented in the following hydraulic model. The model includes 71 zones, each representing a section of the low pressure main and its corresponding hydraulic characteristics. The highest Total Dynamic Head generated in the system is approximately 129 ft. This is below our pump’s continuous-run rating of 185 ft and safely within its intermittent operating range. Flow velocities meet or exceed 2.0 fps throughout the system. These characteristics combined with low retention time indicate that this will be a reliable, low-maintenance system.

General recommendations for valve placement are: cleanout valves at 1,000 to 1,500 ft intervals and at branch ends and junctions; isolation valves at branch junctions; and air release valves at peaks of 25 ft or more and/or at intervals of 2,000 to 2,500 ft.

Quantities of grinder pumps, pipe, and appurtenances are indicated on the cost page. The height of the grinder pump indicated may not be the most appropriate for the specific location or requirements of the project. We recommend you contact your local distributor of Environment One product for additional recommendations. Costs of these items and their installation are also best obtained from sources in your region.

I am looking forward to working with you on this and future projects. Please contact me if you any questions or require additional information.

Best regards,

Keith Blond
LPS System Designer
Environment One Corp.

# PRELIMINARY PRESSURE SEWER - PIPE SIZING AND BRANCH ANALYSIS

Skokomish Indian Tribe, WA 6-07

Prepared By:
Keith Blond

June 26, 2007

| Zone Number | Connects to Zone | Number of Pumps in Zone | Accum Pumps in Zone | Gal/Day per Core | Max Flow per Core | Max Sim Ops | Max Flow (GPM) | Pipe Size (Inches) | Max Velocity (FPS) | Length of Main this Zone | Friction Loss Factor (ft/100ft) | Friction Loss this Zone | Accumulated Friction Loss (Feet) | Max Main Elevation | Minimum Pump Elevation | Static Head (Feet) | Total Dynamic Head (ft) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| his spreadsheet was calculated using pipe diameters for: SDR21PVC | | | | | | | | | | | Friction loss calculations were based on a Constant for inside roughness 150 | | | | | | |
| 1.00 | 2.00 | 3 | 3 | 200.00 | 11.00 | 2 | 22.00 | 1.50 | 3.04 | 933.00 | 2.15 | 20.07 | 138.44 | 50.00 | 16.00 | 34.00 | 172.44 |
| 2.00 | 71.00 | 2 | 5 | 200.00 | 11.00 | 3 | 33.00 | 2.00 | 2.92 | 327.00 | 1.54 | 5.05 | 118.36 | 50.00 | 16.00 | 34.00 | 152.36 |
| 3.00 | 71.00 | 1 | 1 | 200.00 | 11.00 | 1 | 11.00 | 1.25 | 2.00 | 228.00 | 1.17 | 2.67 | 115.99 | 50.00 | 16.00 | 34.00 | 149.99 |
| 4.00 | 5.00 | 3 | 9 | 567.00 | 11.00 | 3 | 33.00 | 2.00 | 2.92 | 699.00 | 1.54 | 10.79 | 101.22 | 50.00 | 16.00 | 34.00 | 135.22 |
| 5.00 | 6.00 | 9 | 18 | 200.00 | 11.00 | 4 | 44.00 | 2.00 | 3.89 | 1,367.00 | 2.63 | 35.93 | 90.43 | 50.00 | 16.00 | 34.00 | 124.43 |
| 6.00 | 8.00 | 4 | 22 | 200.00 | 11.00 | 5 | 55.00 | 3.00 | 2.24 | 347.00 | 0.60 | 2.09 | 54.50 | 50.00 | 16.00 | 34.00 | 88.50 |
| 7.00 | 8.00 | 3 | 3 | 200.00 | 11.00 | 2 | 22.00 | 1.50 | 3.04 | 397.00 | 2.15 | 8.54 | 60.95 | 50.00 | 16.00 | 34.00 | 94.95 |
| 8.00 | 14.00 | 5 | 30 | 200.00 | 11.00 | 5 | 55.00 | 3.00 | 2.24 | 804.00 | 0.60 | 4.85 | 52.40 | 50.00 | 16.00 | 34.00 | 86.40 |
| 9.00 | 12.00 | 3 | 3 | 200.00 | 11.00 | 2 | 22.00 | 1.50 | 3.04 | 844.00 | 2.15 | 18.16 | 73.83 | 50.00 | 16.00 | 34.00 | 107.83 |
| 10.00 | 11.00 | 3 | 3 | 200.00 | 11.00 | 2 | 22.00 | 1.50 | 3.04 | 576.00 | 2.15 | 12.39 | 74.18 | 50.00 | 16.00 | 34.00 | 108.18 |
| 11.00 | 12.00 | 2 | 5 | 200.00 | 11.00 | 3 | 33.00 | 2.00 | 2.92 | 397.00 | 1.54 | 6.13 | 61.79 | 50.00 | 16.00 | 34.00 | 95.79 |
| 12.00 | 13.00 | 1 | 9 | 200.00 | 11.00 | 3 | 33.00 | 2.00 | 2.92 | 357.00 | 1.54 | 5.51 | 55.67 | 50.00 | 16.00 | 34.00 | 89.67 |
| 13.00 | 14.00 | 1 | 10 | 200.00 | 11.00 | 4 | 44.00 | 2.00 | 3.89 | 99.00 | 2.63 | 2.60 | 50.16 | 50.00 | 16.00 | 34.00 | 84.16 |
| 14.00 | 17.00 | 0 | 40 | 200.00 | 11.00 | 6 | 66.00 | 3.00 | 2.69 | 79.00 | 0.85 | 0.67 | 47.55 | 50.00 | 16.00 | 34.00 | 81.55 |
| 15.00 | 16.00 | 3 | 3 | 200.00 | 11.00 | 2 | 22.00 | 1.50 | 3.04 | 317.00 | 2.15 | 6.82 | 58.91 | 50.00 | 16.00 | 34.00 | 92.91 |
| 16.00 | 17.00 | 4 | 7 | 200.00 | 11.00 | 3 | 33.00 | 2.00 | 2.92 | 337.00 | 1.54 | 5.20 | 52.09 | 50.00 | 16.00 | 34.00 | 86.09 |
| 17.00 | 20.00 | 0 | 47 | 200.00 | 11.00 | 6 | 66.00 | 3.00 | 2.69 | 248.00 | 0.85 | 2.10 | 46.89 | 50.00 | 16.00 | 34.00 | 80.89 |
| 18.00 | 19.00 | 3 | 3 | 200.00 | 11.00 | 2 | 22.00 | 1.50 | 3.04 | 149.00 | 2.15 | 3.21 | 53.04 | 50.00 | 16.00 | 34.00 | 87.04 |
| 19.00 | 20.00 | 6 | 9 | 200.00 | 11.00 | 3 | 33.00 | 2.00 | 2.92 | 327.00 | 1.54 | 5.05 | 49.84 | 50.00 | 16.00 | 34.00 | 83.84 |
| 20.00 | 23.00 | 1 | 57 | 200.00 | 11.00 | 7 | 77.00 | 3.00 | 3.14 | 79.00 | 1.12 | 0.89 | 44.79 | 50.00 | 16.00 | 34.00 | 78.79 |
| 21.00 | 22.00 | 3 | 3 | 200.00 | 11.00 | 2 | 22.00 | 1.50 | 3.04 | 248.00 | 2.15 | 5.34 | 52.60 | 50.00 | 16.00 | 34.00 | 86.60 |
| 22.00 | 23.00 | 3 | 6 | 200.00 | 11.00 | 3 | 33.00 | 2.00 | 2.92 | 218.00 | 1.54 | 3.36 | 47.27 | 50.00 | 16.00 | 34.00 | 81.27 |
| 23.00 | 26.00 | 12 | 75 | 200.00 | 11.00 | 7 | 77.00 | 3.00 | 3.14 | 1,251.00 | 1.12 | 14.07 | 43.90 | 50.00 | 16.00 | 34.00 | 77.90 |
| 24.00 | 25.00 | 3 | 3 | 200.00 | 11.00 | 2 | 22.00 | 1.50 | 3.04 | 874.00 | 2.15 | 18.81 | 62.20 | 50.00 | 16.00 | 34.00 | 96.20 |
| 25.00 | 26.00 | 4 | 7 | 200.00 | 11.00 | 3 | 33.00 | 2.00 | 2.92 | 879.00 | 1.54 | 13.56 | 43.39 | 50.00 | 16.00 | 34.00 | 77.39 |
| 26.00 | 27.00 | 1 | 83 | 200.00 | 11.00 | 8 | 88.00 | 4.00 | 2.17 | 159.00 | 0.42 | 0.67 | 29.83 | 50.00 | 16.00 | 34.00 | 63.83 |
| 27.00 | 31.00 | 4 | 87 | 200.00 | 11.00 | 8 | 88.00 | 4.00 | 2.17 | 536.00 | 0.42 | 2.27 | 29.16 | 50.00 | 16.00 | 34.00 | 63.16 |
| 28.00 | 29.00 | 3 | 3 | 200.00 | 11.00 | 2 | 22.00 | 1.50 | 3.04 | 168.00 | 2.15 | 3.61 | 42.07 | 50.00 | 16.00 | 34.00 | 76.07 |
| 29.00 | 30.00 | 6 | 9 | 200.00 | 11.00 | 3 | 33.00 | 2.00 | 2.92 | 327.00 | 1.54 | 5.05 | 38.45 | 50.00 | 16.00 | 34.00 | 72.45 |
| 30.00 | 31.00 | 5 | 14 | 200.00 | 11.00 | 4 | 44.00 | 2.00 | 3.89 | 248.00 | 2.63 | 6.52 | 33.41 | 50.00 | 16.00 | 34.00 | 67.41 |
| 31.00 | 37.00 | 4 | 105 | 200.00 | 11.00 | 8 | 88.00 | 4.00 | 2.17 | 685.00 | 0.42 | 2.90 | 26.89 | 50.00 | 16.00 | 34.00 | 60.89 |
| 32.00 | 33.00 | 3 | 3 | 200.00 | 11.00 | 2 | 22.00 | 1.50 | 3.04 | 168.00 | 2.15 | 3.61 | 43.63 | 50.00 | 16.00 | 34.00 | 77.63 |
| 33.00 | 36.00 | 4 | 7 | 200.00 | 11.00 | 3 | 33.00 | 2.00 | 2.92 | 228.00 | 1.54 | 3.52 | 40.02 | 50.00 | 16.00 | 34.00 | 74.02 |
| 34.00 | 35.00 | 3 | 3 | 200.00 | 11.00 | 2 | 22.00 | 1.50 | 3.04 | 178.00 | 2.15 | 3.83 | 41.83 | 50.00 | 16.00 | 34.00 | 75.83 |
| 35.00 | 36.00 | 2 | 5 | 200.00 | 11.00 | 3 | 33.00 | 2.00 | 2.92 | 97.00 | 1.54 | 1.50 | 38.00 | 50.00 | 16.00 | 34.00 | 72.00 |
| 36.00 | 37.00 | 5 | 17 | 200.00 | 11.00 | 4 | 44.00 | 2.00 | 3.89 | 476.00 | 2.63 | 12.51 | 36.50 | 50.00 | 16.00 | 34.00 | 70.50 |
| 37.00 | 41.00 | 11 | 133 | 200.00 | 11.00 | 9 | 99.00 | 4.00 | 2.44 | 1,738.00 | 0.53 | 9.15 | 23.99 | 50.00 | 16.00 | 34.00 | 57.99 |

Note: This analysis is valid only with the use of progressive cavity type grinder pumps as manufactured by Environment One.

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# PRELIMINARY PRESSURE SEWER - PIPE SIZING AND BRANCH ANALYSIS

Skokomish Indian Tribe, WA 6-07

Prepared By:
Keith Blond

June 26, 2007

| Zone Number | Connects to Zone | Number of Pumps in Zone | Accum Pumps in Zone | Gal/Day per Core | Max Flow per Core | Max Sim Ops | Max Flow (GPM) | Pipe Size (Inches) | Max Velocity (FPS) | Length of Main this Zone | Friction Loss Factor (ft/100ft) | Friction Loss this Zone | Accumulated Friction Loss (Feet) | Max Main Elevation | Minimum Pump Elevation | Static Head (Feet) | Total Dynamic Head (ft) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| is spreadsheet was calculated using pipe diameters for: SDR21PVC | | | | | | | | | | | Friction loss calculations were based on a Constant for inside roughness 150 | | | | | | |
| 38.00 | 39.00 | 5 | 5 | 1470.00 | 11.00 | 3 | 33.00 | 2.00 | 2.92 | 1,202.00 | 1.54 | 18.55 | 57.45 | 50.00 | 16.00 | 34.00 | 91.45 |
| 39.00 | 72.00 | 4 | 9 | 200.00 | 11.00 | 3 | 33.00 | 2.00 | 2.92 | 477.00 | 1.54 | 7.36 | 38.91 | 50.00 | 16.00 | 34.00 | 72.91 |
| 40.00 | 41.00 | 6 | 19 | 200.00 | 11.00 | 5 | 105.00 | 4.00 | 2.59 | 805.00 | 0.59 | 4.73 | 19.56 | 50.00 | 16.00 | 34.00 | 53.56 |
| On 1 | 40.00 | | GPD: | 36000.00 | | GPM: | 50.00 | Type: | | Desc: | | | | | | | |
| 41.00 | 42.00 | 1 | 153 | 200.00 | 11.00 | 10 | 160.00 | 4.00 | 3.94 | 159.00 | 1.28 | 2.04 | 14.83 | 50.00 | 16.00 | 34.00 | 48.83 |
| 42.00 | 70.00 | 8 | 161 | 200.00 | 11.00 | 10 | 160.00 | 4.00 | 3.94 | 924.00 | 1.28 | 11.84 | 12.80 | 50.00 | 16.00 | 34.00 | 46.80 |
| 43.00 | 44.00 | 3 | 3 | 200.00 | 11.00 | 2 | 22.00 | 1.50 | 3.04 | 844.00 | 2.15 | 18.16 | 63.55 | 22.00 | 8.00 | 14.00 | 77.55 |
| 44.00 | 45.00 | 6 | 9 | 200.00 | 11.00 | 3 | 33.00 | 2.00 | 2.92 | 391.00 | 1.54 | 6.03 | 45.39 | 22.00 | 8.00 | 14.00 | 59.39 |
| 45.00 | 46.00 | 9 | 18 | 200.00 | 11.00 | 4 | 44.00 | 2.00 | 3.89 | 304.00 | 2.63 | 7.99 | 39.36 | 22.00 | 8.00 | 14.00 | 53.36 |
| 46.00 | 48.00 | 8 | 26 | 200.00 | 11.00 | 5 | 55.00 | 3.00 | 2.24 | 1,626.00 | 0.60 | 9.81 | 31.36 | 22.00 | 8.00 | 14.00 | 45.36 |
| 47.00 | 48.00 | 2 | 2 | 200.00 | 11.00 | 2 | 22.00 | 1.50 | 3.04 | 273.00 | 2.15 | 5.87 | 27.43 | 22.00 | 8.00 | 14.00 | 41.43 |
| 48.00 | 49.00 | 2 | 30 | 200.00 | 11.00 | 5 | 55.00 | 3.00 | 2.24 | 161.00 | 0.60 | 0.97 | 21.56 | 22.00 | 8.00 | 14.00 | 35.56 |
| 49.00 | 59.00 | 10 | 40 | 200.00 | 11.00 | 6 | 66.00 | 3.00 | 2.69 | 403.00 | 0.85 | 3.41 | 20.58 | 22.00 | 8.00 | 14.00 | 34.58 |
| 50.00 | 51.00 | 3 | 3 | 200.00 | 11.00 | 2 | 22.00 | 1.50 | 3.04 | 127.00 | 2.15 | 2.73 | 37.86 | 22.00 | 8.00 | 14.00 | 51.86 |
| 51.00 | 54.00 | 1 | 4 | 200.00 | 11.00 | 3 | 33.00 | 2.00 | 2.92 | 223.00 | 1.54 | 3.44 | 35.13 | 22.00 | 8.00 | 14.00 | 49.13 |
| 52.00 | 53.00 | 3 | 3 | 200.00 | 11.00 | 2 | 22.00 | 1.50 | 3.04 | 124.00 | 2.15 | 2.67 | 35.50 | 22.00 | 8.00 | 14.00 | 49.50 |
| 53.00 | 54.00 | 2 | 5 | 200.00 | 11.00 | 3 | 33.00 | 2.00 | 2.92 | 74.00 | 1.54 | 1.14 | 32.83 | 22.00 | 8.00 | 14.00 | 46.83 |
| 54.00 | 57.00 | 0 | 9 | 200.00 | 11.00 | 3 | 33.00 | 2.00 | 2.92 | 130.00 | 1.54 | 2.01 | 31.69 | 22.00 | 8.00 | 14.00 | 45.69 |
| 55.00 | 56.00 | 3 | 3 | 200.00 | 11.00 | 2 | 22.00 | 1.50 | 3.04 | 173.00 | 2.15 | 3.72 | 34.55 | 22.00 | 8.00 | 14.00 | 48.55 |
| 56.00 | 57.00 | 1 | 4 | 200.00 | 11.00 | 3 | 33.00 | 2.00 | 2.92 | 74.00 | 1.54 | 1.14 | 30.83 | 22.00 | 8.00 | 14.00 | 44.83 |
| 57.00 | 58.00 | 5 | 18 | 200.00 | 11.00 | 4 | 44.00 | 2.00 | 3.89 | 409.00 | 2.63 | 10.75 | 29.68 | 22.00 | 8.00 | 14.00 | 43.68 |
| 58.00 | 59.00 | 6 | 24 | 200.00 | 11.00 | 5 | 55.00 | 3.00 | 2.24 | 291.00 | 0.60 | 1.76 | 18.93 | 22.00 | 8.00 | 14.00 | 32.93 |
| 59.00 | 59.00 | 1 | 65 | 200.00 | 11.00 | 7 | 77.00 | 3.00 | 3.14 | 1,527.00 | 1.12 | 17.18 | 17.18 | 22.00 | 8.00 | 14.00 | 31.18 |
| 60.00 | 65.00 | 6 | 6 | 200.00 | 11.00 | 3 | 33.00 | 2.00 | 2.92 | 705.00 | 1.54 | 10.88 | 27.43 | 50.00 | 16.00 | 34.00 | 61.43 |
| 61.00 | 62.00 | 3 | 3 | 200.00 | 11.00 | 2 | 22.00 | 1.50 | 3.04 | 98.00 | 2.15 | 2.11 | 31.44 | 50.00 | 16.00 | 34.00 | 65.44 |
| 62.00 | 63.00 | 6 | 9 | 200.00 | 11.00 | 3 | 33.00 | 2.00 | 2.92 | 261.00 | 1.54 | 4.03 | 29.33 | 50.00 | 16.00 | 34.00 | 63.33 |
| 63.00 | 64.00 | 9 | 18 | 200.00 | 11.00 | 4 | 44.00 | 2.00 | 3.89 | 258.00 | 2.63 | 6.78 | 25.30 | 50.00 | 16.00 | 34.00 | 59.30 |
| 64.00 | 65.00 | 6 | 24 | 200.00 | 11.00 | 5 | 55.00 | 3.00 | 2.24 | 327.00 | 0.60 | 1.97 | 18.52 | 50.00 | 16.00 | 34.00 | 52.52 |
| 65.00 | 69.00 | 6 | 36 | 200.00 | 11.00 | 6 | 66.00 | 3.00 | 2.69 | 814.00 | 0.85 | 6.88 | 16.55 | 50.00 | 16.00 | 34.00 | 50.55 |
| 66.00 | 67.00 | 3 | 3 | 200.00 | 11.00 | 2 | 22.00 | 1.50 | 3.04 | 139.00 | 2.15 | 2.99 | 27.29 | 50.00 | 16.00 | 34.00 | 61.29 |
| 67.00 | 68.00 | 6 | 9 | 200.00 | 11.00 | 3 | 33.00 | 2.00 | 2.92 | 238.00 | 1.54 | 3.67 | 24.30 | 50.00 | 16.00 | 34.00 | 58.30 |
| 68.00 | 69.00 | 9 | 18 | 200.00 | 11.00 | 4 | 44.00 | 2.00 | 3.89 | 417.00 | 2.63 | 10.96 | 20.63 | 50.00 | 16.00 | 34.00 | 54.63 |
| 69.00 | 70.00 | 1 | 55 | 200.00 | 11.00 | 7 | 77.00 | 3.00 | 3.14 | 774.00 | 1.12 | 8.71 | 9.67 | 50.00 | 16.00 | 34.00 | 43.67 |
| 70.00 | 70.00 | 0 | 216 | 200.00 | 11.00 | 12 | 182.00 | 6.00 | 2.07 | 387.00 | 0.25 | 0.96 | 0.96 | 50.00 | 16.00 | 34.00 | 34.96 |
| 71.00 | 4.00 | 0 | 6 | 200.00 | 11.00 | 3 | 33.00 | 2.00 | 2.92 | 784.00 | 1.54 | 12.10 | 113.32 | 50.00 | 16.00 | 34.00 | 147.32 |
| 72.00 | 40.00 | 4 | 13 | 200.00 | 11.00 | 4 | 44.00 | 2.00 | 3.89 | 456.00 | 2.63 | 11.99 | 31.55 | 50.00 | 16.00 | 34.00 | 65.55 |

Note: This analysis is valid only with the use of progressive cavity type grinder pumps as manufactured by Environment One.

# PRELIMINARY PRESSURE SEWER - ACCUMULATED RETENTION TIME (HR)

Skokomish Indian Tribe, WA 6-07

Prepared By:
Keith Blond

June 26, 2007

| Zone Number | Connects to Zone | Accumulated Total of Pumps this Zone | Existing Pipe Size | Gallons per 100 Lineal Feet | Length of Zone | Capacity of Zone | Average Daily Flow | Average Fluid Changes per Day | Average Retention Time (Hr) | Accumulated Retention Time (Hr) |
|---|---|---|---|---|---|---|---|---|---|---|
| his spreadsheet was calculated using pipe diameters for: SDR21PVC | | | | | | | | | | |
| 1.00 | 2.00 | 3 | 1.50 | 12.07 | 933.00 | 112.62 | 600 | 5.33 | 4.50 | 16.74 |
| 2.00 | 71.00 | 5 | 2.00 | 18.84 | 327.00 | 61.61 | 1,000 | 16.23 | 1.48 | 12.24 |
| 3.00 | 71.00 | 1 | 1.25 | 9.14 | 228.00 | 20.85 | 200 | 9.59 | 2.50 | 13.26 |
| 4.00 | 5.00 | 9 | 2.00 | 18.84 | 699.00 | 131.71 | 2,901 | 22.03 | 1.09 | 7.81 |
| 5.00 | 6.00 | 18 | 2.00 | 18.84 | 1,367.00 | 257.57 | 4,701 | 18.25 | 1.31 | 6.72 |
| 6.00 | 8.00 | 22 | 3.00 | 40.90 | 347.00 | 141.91 | 5,501 | 38.76 | 0.62 | 5.40 |
| 7.00 | 8.00 | 3 | 1.50 | 12.07 | 397.00 | 47.92 | 600 | 12.52 | 1.92 | 6.70 |
| 8.00 | 14.00 | 30 | 3.00 | 40.90 | 804.00 | 328.80 | 7,101 | 21.60 | 1.11 | 4.78 |
| 9.00 | 12.00 | 3 | 1.50 | 12.07 | 844.00 | 101.87 | 600 | 5.89 | 4.07 | 8.87 |
| 10.00 | 11.00 | 3 | 1.50 | 12.07 | 576.00 | 69.52 | 600 | 8.63 | 2.78 | 9.37 |
| 11.00 | 12.00 | 5 | 2.00 | 18.84 | 397.00 | 74.80 | 1,000 | 13.37 | 1.80 | 6.59 |
| 12.00 | 13.00 | 9 | 2.00 | 18.84 | 357.00 | 67.27 | 1,800 | 26.76 | 0.90 | 4.79 |
| 13.00 | 14.00 | 10 | 2.00 | 18.84 | 99.00 | 18.65 | 2,000 | 107.22 | 0.22 | 3.89 |
| 14.00 | 17.00 | 40 | 3.00 | 40.90 | 79.00 | 32.31 | 9,101 | 281.70 | 0.09 | 3.67 |
| 15.00 | 16.00 | 3 | 1.50 | 12.07 | 317.00 | 38.26 | 600 | 15.68 | 1.53 | 6.20 |
| 16.00 | 17.00 | 7 | 2.00 | 18.84 | 337.00 | 63.50 | 1,400 | 22.05 | 1.09 | 4.67 |
| 17.00 | 20.00 | 47 | 3.00 | 40.90 | 248.00 | 101.42 | 10,501 | 103.54 | 0.23 | 3.58 |
| 18.00 | 19.00 | 3 | 1.50 | 12.07 | 149.00 | 17.98 | 600 | 33.36 | 0.72 | 4.89 |
| 19.00 | 20.00 | 9 | 2.00 | 18.84 | 327.00 | 61.61 | 1,800 | 29.21 | 0.82 | 4.17 |
| 20.00 | 23.00 | 57 | 3.00 | 40.90 | 79.00 | 32.31 | 12,501 | 386.93 | 0.06 | 3.35 |
| 21.00 | 22.00 | 3 | 1.50 | 12.07 | 248.00 | 29.93 | 600 | 20.04 | 1.20 | 5.31 |
| 22.00 | 23.00 | 6 | 2.00 | 18.84 | 218.00 | 41.08 | 1,200 | 29.21 | 0.82 | 4.11 |
| 23.00 | 26.00 | 75 | 3.00 | 40.90 | 1,251.00 | 511.61 | 16,101 | 31.47 | 0.76 | 3.29 |
| 24.00 | 25.00 | 3 | 1.50 | 12.07 | 874.00 | 105.49 | 600 | 5.69 | 4.22 | 9.59 |
| 25.00 | 26.00 | 7 | 2.00 | 18.84 | 879.00 | 165.62 | 1,400 | 8.45 | 2.84 | 5.37 |
| 26.00 | 27.00 | 83 | 4.00 | 67.65 | 159.00 | 107.57 | 17,701 | 164.56 | 0.15 | 2.53 |
| 27.00 | 31.00 | 87 | 4.00 | 67.65 | 536.00 | 362.61 | 18,501 | 51.02 | 0.47 | 2.38 |
| 28.00 | 29.00 | 3 | 1.50 | 12.07 | 168.00 | 20.28 | 600 | 29.59 | 0.81 | 3.95 |
| 29.00 | 30.00 | 9 | 2.00 | 18.84 | 327.00 | 61.61 | 1,800 | 29.21 | 0.82 | 3.13 |
| 30.00 | 31.00 | 14 | 2.00 | 18.84 | 248.00 | 46.73 | 2,800 | 59.92 | 0.40 | 2.31 |
| 31.00 | 37.00 | 105 | 4.00 | 67.65 | 685.00 | 463.41 | 22,101 | 47.69 | 0.50 | 1.91 |
| 32.00 | 33.00 | 3 | 1.50 | 12.07 | 168.00 | 20.28 | 600 | 29.59 | 0.81 | 3.59 |
| 33.00 | 36.00 | 7 | 2.00 | 18.84 | 228.00 | 42.96 | 1,400 | 32.59 | 0.74 | 2.78 |
| 34.00 | 35.00 | 3 | 1.50 | 12.07 | 178.00 | 21.49 | 600 | 27.93 | 0.86 | 3.34 |
| 35.00 | 36.00 | 5 | 2.00 | 18.84 | 97.00 | 18.28 | 1,000 | 54.71 | 0.44 | 2.48 |
| 36.00 | 37.00 | 17 | 2.00 | 18.84 | 476.00 | 89.69 | 3,400 | 37.91 | 0.63 | 2.04 |
| 37.00 | 41.00 | 133 | 4.00 | 67.65 | 1,738.00 | 1,175.78 | 27,701 | 23.56 | 1.02 | 1.41 |
| 38.00 | 39.00 | 5 | 2.00 | 18.84 | 1,202.00 | 226.48 | 7,350 | 32.45 | 0.74 | 1.91 |
| 39.00 | 72.00 | 9 | 2.00 | 18.84 | 477.00 | 89.88 | 8,150 | 90.68 | 0.26 | 1.17 |

Note: This analysis is valid only with the use of progressive cavity type grinder pumps as manufactured by Environment One

# PRELIMINARY PRESSURE SEWER - ACCUMULATED RETENTION TIME (HR)

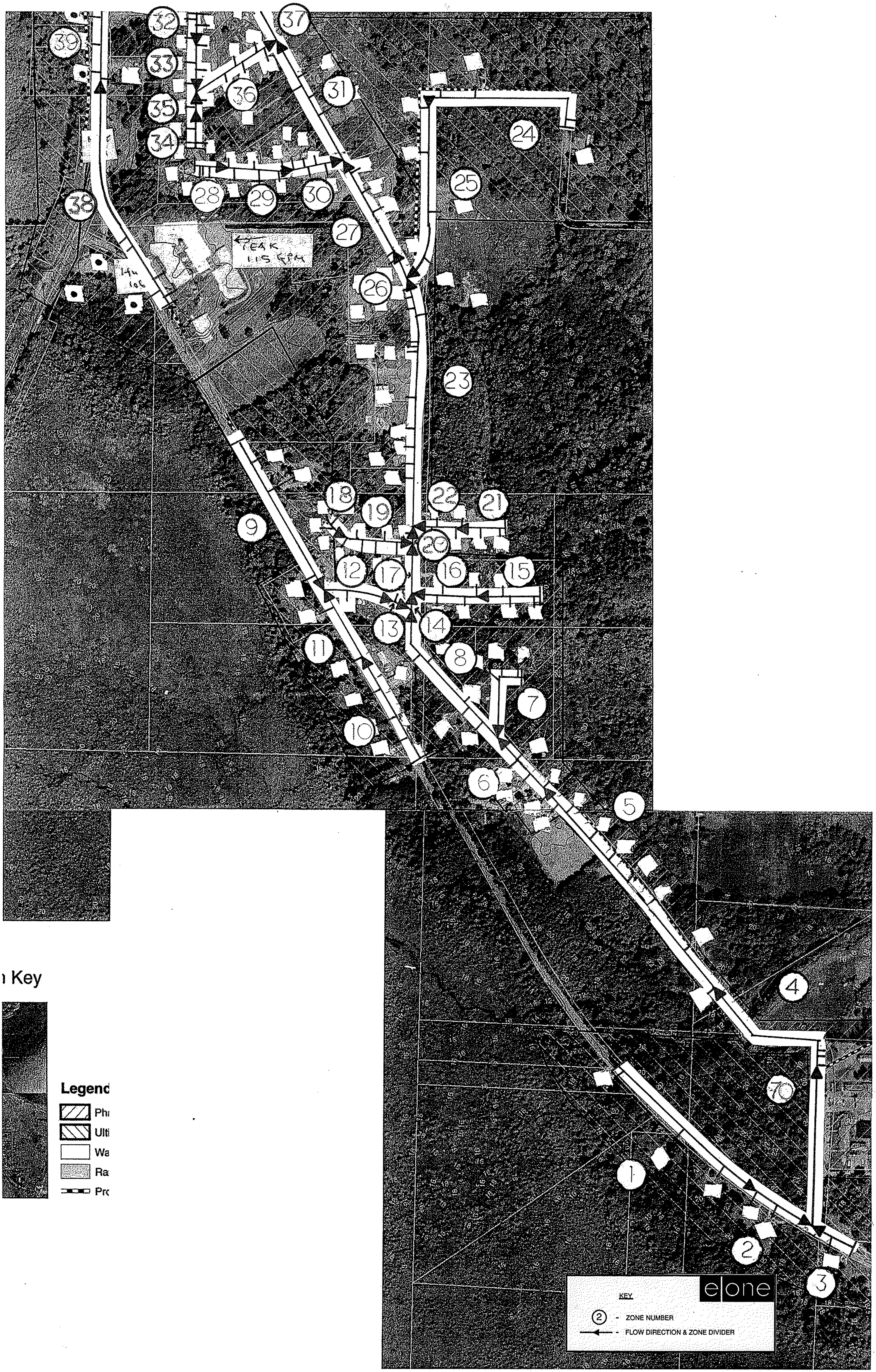
## Skokomish Indian Tribe, WA 6-07

Prepared By:
Keith Blond

June 26, 2007

| Zone Number | Connects to Zone | Accumulated Total of Pumps this Zone | Existing Pipe Size | Gallons per 100 Lineal Feet | Length of Zone | Capacity of Zone | Average Daily Flow | Average Fluid Changes per Day | Average Retention Time (Hr) | Accumulated Retention Time (Hr) |
|---|---|---|---|---|---|---|---|---|---|---|
| is spreadsheet was calculated using pipe diameters for: SDR21PVC | | | | | | | | | | |
| 40.00 | 41.00 | 19 | 4.00 | 67.65 | 805.00 | 544.59 | 46,150 | 84.74 | 0.28 | 0.67 |
| 41.00 | 42.00 | 153 | 4.00 | 67.65 | 159.00 | 107.57 | 74,051 | 688.43 | 0.03 | 0.39 |
| 42.00 | 70.00 | 161 | 4.00 | 67.65 | 924.00 | 625.10 | 75,651 | 121.02 | 0.20 | 0.36 |
| 43.00 | 44.00 | 3 | 1.50 | 12.07 | 844.00 | 101.87 | 600 | 5.89 | 4.07 | 10.42 |
| 44.00 | 45.00 | 9 | 2.00 | 18.84 | 391.00 | 73.67 | 1,800 | 24.43 | 0.98 | 6.34 |
| 45.00 | 46.00 | 18 | 2.00 | 18.84 | 304.00 | 57.28 | 3,600 | 62.85 | 0.38 | 5.36 |
| 46.00 | 48.00 | 26 | 3.00 | 40.90 | 1,626.00 | 664.97 | 5,200 | 7.82 | 3.07 | 4.98 |
| 47.00 | 48.00 | 2 | 1.50 | 12.07 | 273.00 | 32.95 | 400 | 12.14 | 1.98 | 3.89 |
| 48.00 | 49.00 | 30 | 3.00 | 40.90 | 161.00 | 65.84 | 6,000 | 91.13 | 0.26 | 1.91 |
| 49.00 | 59.00 | 40 | 3.00 | 40.90 | 403.00 | 164.81 | 8,000 | 48.54 | 0.49 | 1.65 |
| 50.00 | 51.00 | 3 | 1.50 | 12.07 | 127.00 | 15.33 | 600 | 39.14 | 0.61 | 4.46 |
| 51.00 | 54.00 | 4 | 2.00 | 18.84 | 223.00 | 42.02 | 800 | 19.04 | 1.26 | 3.85 |
| 52.00 | 53.00 | 3 | 1.50 | 12.07 | 124.00 | 14.97 | 600 | 40.09 | 0.60 | 3.52 |
| 53.00 | 54.00 | 5 | 2.00 | 18.84 | 74.00 | 13.94 | 1,000 | 71.72 | 0.33 | 2.92 |
| 54.00 | 57.00 | 9 | 2.00 | 18.84 | 130.00 | 24.49 | 1,800 | 73.48 | 0.33 | 2.59 |
| 55.00 | 56.00 | 3 | 1.50 | 12.07 | 173.00 | 20.88 | 600 | 28.73 | 0.84 | 3.52 |
| 56.00 | 57.00 | 4 | 2.00 | 18.84 | 74.00 | 13.94 | 800 | 57.38 | 0.42 | 2.68 |
| 57.00 | 58.00 | 18 | 2.00 | 18.84 | 409.00 | 77.06 | 3,600 | 46.71 | 0.51 | 2.26 |
| 58.00 | 59.00 | 24 | 3.00 | 40.90 | 291.00 | 119.01 | 4,800 | 40.33 | 0.60 | 1.75 |
| 59.00 | 59.00 | 65 | 3.00 | 40.90 | 1,527.00 | 624.48 | 13,000 | 20.82 | 1.15 | 1.15 |
| 60.00 | 65.00 | 6 | 2.00 | 18.84 | 705.00 | 132.84 | 1,200 | 9.03 | 2.66 | 4.61 |
| 61.00 | 62.00 | 3 | 1.50 | 12.07 | 98.00 | 11.83 | 600 | 50.72 | 0.47 | 4.08 |
| 62.00 | 63.00 | 9 | 2.00 | 18.84 | 261.00 | 49.18 | 1,800 | 36.60 | 0.66 | 3.61 |
| 63.00 | 64.00 | 18 | 2.00 | 18.84 | 258.00 | 48.61 | 3,600 | 74.05 | 0.32 | 2.95 |
| 64.00 | 65.00 | 24 | 3.00 | 40.90 | 327.00 | 133.73 | 4,800 | 35.89 | 0.67 | 2.63 |
| 65.00 | 69.00 | 36 | 3.00 | 40.90 | 814.00 | 332.89 | 7,200 | 21.63 | 1.11 | 1.96 |
| 66.00 | 67.00 | 3 | 1.50 | 12.07 | 139.00 | 16.78 | 600 | 35.76 | 0.67 | 2.64 |
| 67.00 | 68.00 | 9 | 2.00 | 18.84 | 238.00 | 44.84 | 1,800 | 40.14 | 0.60 | 1.97 |
| 68.00 | 69.00 | 18 | 2.00 | 18.84 | 417.00 | 78.57 | 3,600 | 45.82 | 0.52 | 1.37 |
| 69.00 | 70.00 | 55 | 3.00 | 40.90 | 774.00 | 316.54 | 11,000 | 34.75 | 0.69 | 0.85 |
| 70.00 | 70.00 | 216 | 6.00 | 146.54 | 387.00 | 567.10 | 86,651 | 152.80 | 0.16 | 0.16 |
| 71.00 | 4.00 | 6 | 2.00 | 18.84 | 784.00 | 147.72 | 1,200 | 8.12 | 2.95 | 10.76 |
| 72.00 | 40.00 | 13 | 2.00 | 18.84 | 456.00 | 85.92 | 8,950 | 104.17 | 0.23 | 0.90 |

Note: This analysis is valid only with the use of progressive cavity type grinder pumps as manufactured by Environment One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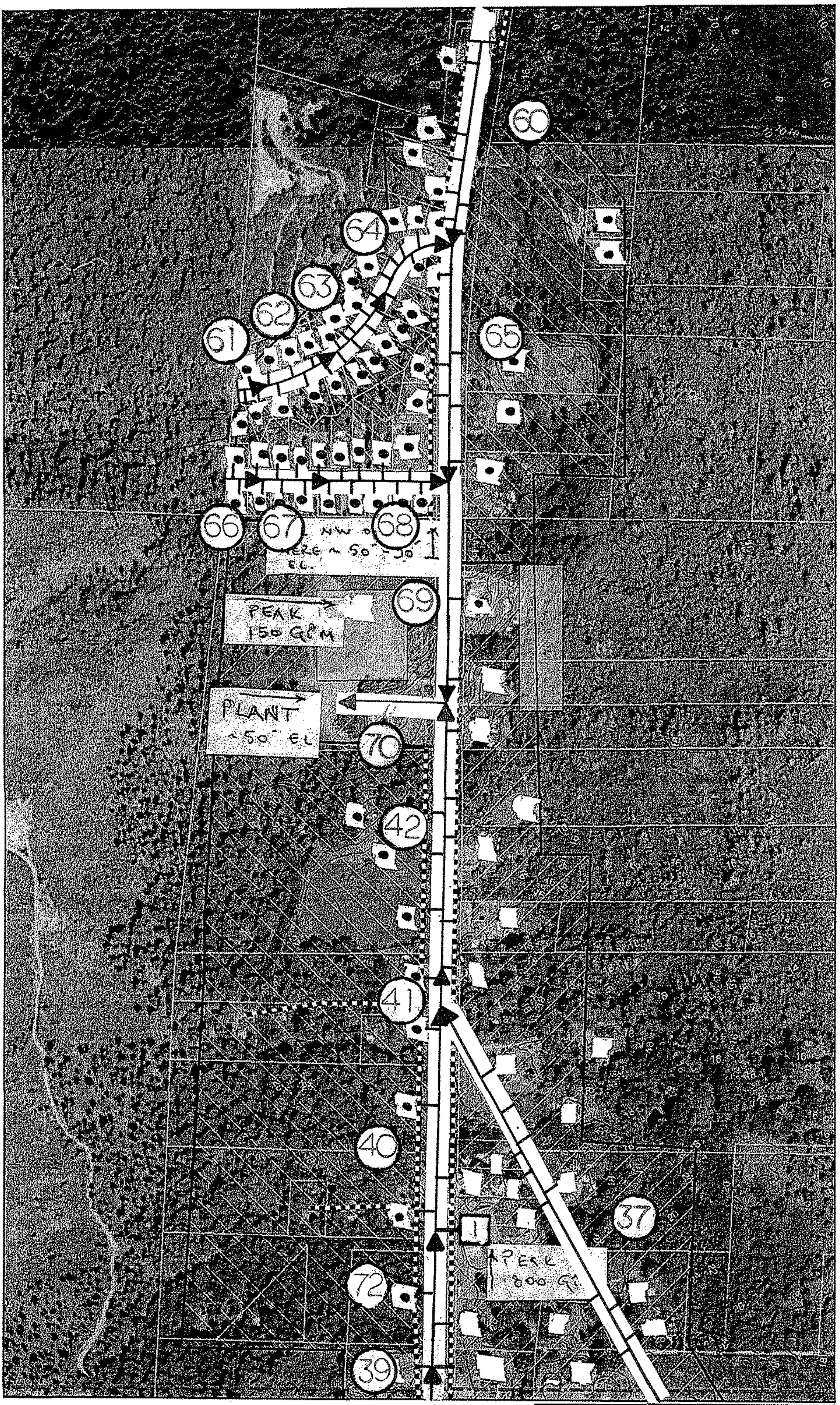

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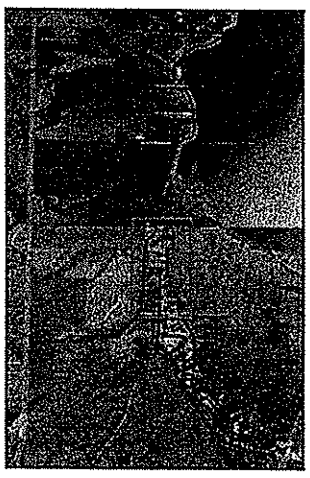

# SKOKOMISH INDIAN TRIBE
# WASTEWATER TREATMENT SYSTEMS
## US 101 CORRIDOR
## SHEET IV OF V

**Legend**

- ▨ Phase 1 Service Area
- ▧ Ultimate Service Area
- ☐ Wastewater Reclamation Plant
- ▒ Rapid Infiltration
- ▭ Proposed Sewer

N

400 Feet

# Appendix I
# Detailed Cost Estimates

## COST ESTIMATE - PHASE 1
## POTLATCH BUBBLE (MBR & INFILTRATION BEDS)

| Item | Description | Unit | Quantity | Unit Cost | Total Cost |
|---|---|---|---|---|---|
| | **CONVEYANCE** | | | | |
| **Conveyance for Tribal Housing (Service Area A)** | | | | | |
| 1 | Upgrade Lift Station | HP | 0.5 | 50000 | $25,000 |
| 2 | 4" PVC (pressure) | | | | |
| | a. Under Existing Road | LF | 1000 | 40 | $40,000 |
| **Subtotal** | | | | | $65,000 |
| **Conveyance from Potlatch State Park (Service Area B)** | | | | | |
| 3 | Lift stations (2) | LS | 2 | 180000 | $360,000 |
| 4 | 4" PVC (pressure) | | | | |
| | a. Under Existing Road | LF | 2300 | 40 | $92,000 |
| | b. Cross country | LF | 250 | 50 | $13,000 |
| **Subtotal** | | | | | $465,000 |
| **Conveyance for Minerva RV Park - east (Service Area C)** | | | | | |
| 5 | E-One pump system (model 2015) | EA | 1 | 13800 | $14,000 |
| 6 | 4 - 6" PVC (pressure) | | | | |
| | a. Under Existing Road | LF | 375 | 40 | $15,000 |
| | b. Adjacent to Hwy 101 (with lane loss) | LF | 600 | 80 | $48,000 |
| 7 | Hwy 101 Crossing | LF | 100 | 300 | $30,000 |
| 8 | Connection to Pressure Main in Potlatch State Park | EA | 1 | 2000 | $2,000 |
| **Subtotal** | | | | | $109,000 |
| **Conveyance for Service Area Creep (Service Area D)** | | | | | |
| 9 | E-One pump system (model 2010) - residential | EA | 19 | 4900 | $93,000 |
| 10 | 1 1/2 - 6" PVC (pressure) | | | | |
| | a. Under Existing Road | LF | 1800 | 40 | $72,000 |
| **Subtotal** | | | | | $165,000 |
| **Conveyance for N. Reservation Boundary Area (Service Area E)** | | | | | |
| 11 | E-One pump system (model 2010) - residential | EA | 3 | 4900 | $15,000 |
| 12 | 1 1/2" -6" PVC (pressure) | LF | 1550 | 80 | $124,000 |
| 14 | Air Vacuum Release | EA | 1 | 800 | $1,000 |
| 15 | Cleanouts | EA | 1 | 50 | $100 |
| | **Connection from Motel to Conveyance System** | | | | |
| 13 | 6" PVC (gravity) - motel service connection | LF | 300 | 40 | $12,000 |
| 16 | Manhole 48" dia. | EA | 1 | 3500 | $4,000 |
| 5 | E-One pump system (model 2015) | EA | 1 | 13800 | $14,000 |
| **Subtotal** | | | | | $170,100 |
| **CONVEYANCE CONSTRUCTION SUBTOTAL** | | | | | $974,100 |
| Contingency - 25% Construction Cost | | | | | $244,000 |
| **CONVEYANCE CONSTRUCTION TOTAL** | | | | | **$1,218,000** |
| Engr, Admin & Anticipated Permitting - 25% Construction Cost | | | | | $305,000 |
| **CONVEYANCE CAPITAL COSTS** | | | | | **$1,523,000** |
| | **DECOMMISSIONING** | | | | |
| **Through out the Potlatch Bubble Service Area** | | | | | |
| 17 | Decommission Tank - Minerva RV Park - east | EA | 1 | 10000 | $10,000 |
| 18 | Decommission Tank - Potlatch Bubble Service Area Creep | EA | 19 | 750 | $14,000 |
| 18 | Decommission Tank - North Reservation Boundary Area | EA | 6 | 750 | $5,000 |
| **Subtotal** | | | | | $29,000 |
| **DECOMMISSIONING CONSTRUCTION SUBTOTAL** | | | | | $29,000 |
| Contingency - 25% Construction Cost | | | | | $7,000 |
| **DECOMMISSIONING CONSTRUCTION TOTAL** | | | | | **$36,000** |
| Engr, Admin & Anticipated Permitting - 25% Construction Cost | | | | | $9,000 |
| **DECOMMISSIONING CAPITAL COSTS** | | | | | **$45,000** |
| | **TREATMENT** | | | | |
| **MBR Treatment at Potlatch State Park** | | | | | |
| 19 | Wastewater Treatment Plant | LS | 1 | 2230000 | $2,230,000 |
| 20 | Generator | HP | 50 | 1000 | $50,000 |
| 21 | Plant Access Road | LF | 450 | 50 | $23,000 |
| **Subtotal** | | | | | $2,303,000 |
| **TREATMENT CONSTRUCTION SUBTOTAL** | | | | | $2,303,000 |
| Contingency - 25% Construction Cost | | | | | $576,000 |
| **TREATMENT CONSTRUCTION TOTAL** | | | | | **$2,879,000** |
| Engr, Admin & Anticipated Permitting - 25% Construction Cost | | | | | $720,000 |
| **TREATMENT CAPITAL COSTS** | | | | | **$3,599,000** |
| | **DISPOSAL** | | | | |
| **Rapid infiltration, near access road in Potlatch State Park** | | | | | |
| 22 | 8" PVC (gravity) | LF | 225 | 40 | $9,000 |
| | a. Under Infiltration Bed Access Road | LF | 800 | 80 | $64,000 |
| | b. Cross Country | LF | 300 | 60 | $18,000 |
| 23 | Infiltration Bed Access Road Improvements | LF | 550 | 50 | $28,000 |
| 24 | Rapid Infitration System | $/G/Day | 59300 | 2.50 | $148,000 |
| **Subtotal** | | | | | $267,000 |
| **DISPOSAL CONSTRUCTION SUBTOTAL** | | | | | $267,000 |
| Contingency - 25% Construction Cost | | | | | $67,000 |
| **DISPOSAL CONSTRUCTION TOTAL** | | | | | **$334,000** |
| Engr, Admin & Anticipated Permitting - 25% Construction Cost | | | | | $84,000 |
| **DISPOSAL CAPITAL COSTS** | | | | | **$418,000** |
| **POTLATCH BUBBLE SYSTEM CONSTRUCTION SUBTOTAL** | | | | | $3,573,100 |
| Contingency - 25% Construction Cost | | | | | $893,000 |
| **POTLATCH BUBBLE SYSTEM CONSTRUCTION TOTAL** | | | | | **$4,466,000** |
| Engr, Admin & Anticipated Permitting - 25% Construction Cost | | | | | $1,116,000 |
| **POTLATCH BUBBLE SYSTEM CAPITAL COSTS** | | | | | **$5,582,000** |

1 Assumed pipe installed when the road is constructed.

# Skokomish Tribe Wastewater Facilities Plan Amendment

**Alternative 1A**

Phase 1 Potlatch Bubble (MBR & Soil Percolation)

Present Worth Analysis

| **Capital Costs** | **Unit Cost $** | **Unit** | **Number Installed** | | **Comments** |
|---|---|---|---|---|---|
| **Component Installed Costs** | | | | | |
| Alternative 1A - Potlatch Bubble | | | | | |
| Conveyance | | | | $639,000 | |
| Conveyance for Potlatch Bubble Service Creep | | | | $335,100 | |
| Decommissiong Existing Septic Tanks | | | | $10,000 | |
| Decommissioning for Potlatch Bubble Service Creep | | | | $19,000 | |
| Treatment | | | | $2,303,000 | |
| Disposal | | | | $267,000 | |
| **Subtotal** | **$0** | | | **$3,573,100** | |
| Contingency | $0 | | | $893,275 | 25% of Construction Cost |
| **Non-component Costs** | | | | | |
| Misc. building modifications | $0 | ls | 1 | $0 | |
| Misc. site modifications | $0 | ls | 1 | $0 | |
| **Subtotal** | **$0** | | | **$0** | |
| **Subtotal Construction** | **$0** | | | **$4,466,000** | |
| **Non-construction costs** | | | | | |
| Design Engineering | $0 | | | $536,000 | 12% of Construction Cost |
| Assistance During Construction | | | | $357,000 | 8% of Construction Cost |
| Administration | | | | $89,000 | 2% of Construction Cost |
| Design/Admin Contingency | | | | $134,000 | 3% of Construction Cost |
| **Subtotal** | **$0** | | | **$1,116,000** | |
| **Total Capital Cost** | **$0** | | | **$5,582,000** | |
| Present Worth O&M | | | | $3,412,090 | |
| Present Worth Replacement cost | | | | $633,910 | |
| Total Present Worth Cost | | | | $9,627,999 | |
| Interest Rate | 4.0% | | | | |
| Term | 20 | yrs | | | |

| | |
|---|---|
| $/ERU | 0 |
| $/Q | 0 |

| **O&M, Energy Costs, and Annual Replacement Cost*** | | | | | |
|---|---|---|---|---|---|
| O&M | Annual Labor Hours | $/hr | Total | Annual Mat'ls & Parts $ | Notes |
| Annual Labor | | | | | |
| | 2080 | $40 | $83,200 | | Potlatch WRP, 1.0 operators full-time, year long |
| | 520 | $40 | $20,800 | | Potlatch infiltration, 0.25 operators full-time, year long |
| | 520 | $40 | $20,800 | | Conveyance, 0.25 FTE, annually |
| | 832 | $30 | $24,960 | | Utility billing, admin 0.40 FTE annually |
| | 832 | $40 | $33,280 | | Plant Management, 0.40 FTE annually |
| | | | | $35,731 | Based on 1% of initial capital cost |
| **Subtotal** | | | **$183,040** | **$35,731** | |
| Energy Use | Annual Run Time | Electrical Unit Cost | Energy Cost | | |
| hp | hours | $/kwh | | | |
| 100 | 5,818 | 0.045 | $19,531 | | Potlatch WRP, total connected load of 100 hp |
| 50 | 5,818 | 0.045 | $9,766 | | Pump stations for conveyance system |
| Biosolids | | | | $3,000 | Liquid sludge hauling and fuel (to Core plant) |
| **Total O&M** | | | | **$251,068** | |
| Replacement Cost | Percent of Const Cost | Future Value | Expected Life | Annual Replacement Amount | Equipment costs associated with WRP and irrigation. Conveyance costs included in Construction costs not included in replacement costs. |
| Mechanical | 40% | $350,000 | 15 | $31,479 | Equipment costs associated with WRP: $700,000 |
| Electrical/I&C | 30% | $108,000 | 10 | $13,315 | Electrical/I&C costs associated with WRP: $360,000 |
| Lift Station Pumps | | $15,000 | 10 | $1,849 | $5000/ea parts and labor |
| **Total Annual Replacement** | | | | **$46,644** | |
| Interest Rate | 4.0% | | | | |

* Subject to change, annual costs do not include escalation, such as inflation

# Appendix J
# Project Definition Report

# Hoodsport-Skokomish Wastewater Project Definitions

March 2007

*Using grant funds made available by the Puget Sound Action Team and the Hood Canal Coordinating Council through the Interagency Commission, this planning document was prepared on behalf of the Skokomish Indian Tribe, Mason County Public Utility District Number One and Mason County by the following individuals and firms:*

| | |
|---|---|
| **Lisa Adolfson**<br>Environmental Issues | ESA Adolfson |
| **Doug Berschauer, PE**<br>Non-sewer Alternatives Engineer | CH2M Hill |
| **Herb Frike, PE**<br>Potlatch and Core Reservation Engineer | Cascade Design, Inc. |
| **Jonathan Ives**<br>Wetlands Utilization | Jones & Stokes |
| **Harry Sellers, PE**<br>Hoodsport Engineer | Gray & Osborne, Inc. |
| **Arnie Sugar, LG, LHG**<br>Soils, Hydrogeology | HWA GeoSciences, Inc. |

**Linda Hoffman**
Program and Project Management

**Art O'Neal**
Program and Project Management

**Mike Sharar**
Program and Project Management

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## Section 5 Technology Selection and Project Definitions for Skokomish Systems

## Section 6 Consolidated Ownership/Operations and Maintenance

## Section 7 Summary Cost Estimates and Schedules

## Section 8 Funding

# 1.0 Introduction and Summary

This report, prepared under the collective supervision of the Skokomish Indian Tribe, Mason County and Mason County PUD #1, defines three wastewater management projects. The projects serve each of three planning areas established in the Memorandum of Understanding (see **Appendix 1.1**) approved by the Tribe, the County, and PUD #1 in August, 2006: the Hoodsport Rural Activity Center, the residential zone known in this report as the Potlatch "Bubble," and the most densely developed commercial and residential areas on the Skokomish Reservation (called "Core Reservation").

## 1.1 Introduction

A grant from the Puget Sound Action Team and the Hood Canal Coordinating Council made this effort financially possible. An array of consultants was chosen by staff representatives of the Tribe, the County and PUD #1 (the "TriParty Staff") using a roster of consultant-submitted statements of qualifications. The following table names the contributors and their areas of responsibility.

| Responsible Organization | Hoodsport RAC | Potlatch "Bubble" | Core Reservation | Program |
|---|---|---|---|---|
| **Sewer System Engineering**<br>Cascade Design, Inc. | | ● | ● | |
| **Sewer System Engineering**<br>Gray and Osborne, Inc. | ● | | | |
| **On-site System Engineering**<br>CH2M Hill, Inc. | ● | | | |
| **Environment and Permitting**<br>ESA Adolfson | ● | ● | ● | |
| **Geology and Hydrology**<br>HWA GeoSciences, Inc. | ● | ● | ● | |
| **Wetland Disposal**<br>Jones and Stokes | | | ● | |
| **Cultural Resources**<br>Wessen and Associates | ● | ● | ● | |
| **Sponsoring Entity**<br>Mason County PUD #1 | ○ | | | ● |
| **Sponsoring Entity**<br>Skokomish Indian Tribe | | ● | ● | ● |
| **Sponsoring Entity**<br>Mason County | ● | | | ● |
| **Program & Project Mngmnt.**<br>• Art O'Neal & Associates<br>• Linda Hoffman Consulting<br>• Mike Sharar Consulting | ● | ● | ● | ● |

Mason County had lead responsibility for the Hoodsport Planning Area and overall fiscal administration. The Skokomish Tribe had lead responsibility for the Potlatch and Core Reservation Planning Areas. The lead agencies and the TriParty Staff guided the consultants' work and the work of staff from the Skokomish Tribe and Mason County.

There are several wastewater management studies that cover all or parts of the Hoodsport-Skokomish Region. These are sited as references in this report and provide substantial planning detail for the future design activities initiated by the Project Descriptions in this report. The following table names these studies, the date of their publication, and whether they are available in the print or CD versions of this report.

| *Title* | *Date* | *Availability* | |
|---|---|---|---|
| | | Print Vers. | CD Vers. |
| **Skokomish Indian Tribe Wastewater Master Plan** *(see Appendix 1.3 CD only)* | **1998** | | ● |
| **Finch Creek Wastewater Feasibility Study** *(see Appendix 1.4 CD only)* | **2000** | | ● |
| **Skokomish Indian Tribe Non-point Assessment Report and Preliminary Management Plan** *(see Appendix 1.2)* | **2006** | ● | ● |
| **Hoodsport-Skokomish Wastewater Management Alternatives Analysis** *(see Appendix 1.5 CD only )* | **2006** | | ● |

It is important to recognize that while this report focuses on descriptions of wastewater management projects, wastewater is only part of the Hood Canal water quality situation. Non-point source activities along freshwater streams tributary to the Canal and storm water management in developed areas also present significant opportunities for water quality improvement. The Skokomish Tribe is engaged with a Non-Point Source Management Plan, Mason County is preparing a storm water management plan and there are Water Resource Inventory Area efforts that, if considered as part of wastewater project design and implementation, can result in very significant water quality improvement.

The Puget Sound Action Team provided federal funds for the recently-completed, Mason County managed Hoodsport-Skokomish Wastewater Management Alternatives Analysis, a review of wastewater management options for the western shore of Hood Canal from Hoodsport south through the Skokomish Tribal Reservation. The Action Team also facilitated the review, comment and participation of several state agencies to assure a coordinated State of Washington involvement and response in the preparation of this useful document.

The Alternatives Analysis assembles data and examines ways to improve Hood Canal water quality which suffers from low dissolved oxygen and fecal contamination. One of the major sources of these problems is widely presumed to be residential and commercial wastewater along and near the shoreline. The current management technique is conventional septic systems that do not treat for nitrogen. Too much nitrogen in Hood Canal results in low dissolved oxygen. Conventional septic systems without adequate soil and geology that blocks the transport of contaminates to the Canal also result in fecal contamination.

During the summer of 2006 as the Hoodsport-Skokomish Wastewater Alternatives Analysis was being finished, Mason County, the Skokomish Tribe and Mason County PUD #1 joined in approving a Memorandum of Understanding (MOU). A reproduction of the Memorandum is found in **Appendix 1.1**.

The MOU is founded on a conclusion that a single wastewater treatment plant will not be the selected alternative for the Hoodsport-Skokomish region. While a single central treatment plant may be possible, and would certainly be reliable and very environmentally effective, it is also very costly and is difficult or impossible to coordinate with growth management laws and regulations. The MOU sets a path for wastewater management that takes a different, more localized approach. Initially, a number of localized solutions involving both very small treatment plant systems and innovative on-site septic and clustered septic systems may prove more workable.

The MOU coordinates wastewater planning activities and assigned planning responsibilities for the planning areas. Washington State Parks, the Puget Sound Action Team, EPA, the Washington State Department of Ecology, Washington State Department of Community, Trade and Economic Development and other agencies are also participating. The first step, is this report's description of three wastewater management projects for each of the three principal population centers identified in the Hoodsport – Skokomish Wastewater Management Alternatives Analysis.

In describing projects for each Planning Area, the Tribe, the PUD and the County are using the Alternatives Analysis and taking into account the complexities of growth management regulations, the concerns and opportunities arising from private and tribal land ownership, and the need to both manage costs and provide long-term solutions. The parties are committed to leaving open the possibility for areas to be interconnected at some future time. Similar design and equipment standards should be employed in all the service areas.

Finding federal, state and private funding support is another important objective of the MOU. All three entities agree their funding efforts are enhanced if there is a coordinated, multi-jurisdictional, non-competitive regional approach that restores and protects water quality. Section 8 of this report discusses funding and the TriParty commitment to pursue assistance jointly and bring equal effort and priority to the completion of each of the wastewater management projects.

Sections 2 through 5 assemble planning data for each of the planning areas and propose a project description. Because both Potlatch and the Core Reservation areas within the Skokomish Reservation, Sections 3, 4 and 5 need to be considered jointly even though separate projects are proposed for Potlatch (Section 3) and the Core Reservation (Section 4).

It is critical that this report be considered a planning document. Its purpose is to set general directions that must be refined and validated in a thorough design process. Accordingly, maps included are not precise with regard to exact boundaries of service areas and cost estimates are general with appropriate planning-level contingencies. A homeowner near the boundary of a proposed service area represented in this report cannot be certain whether their property is included or excluded. Similarly, it is inappropriate to make monthly rate determinations based on this report. While it is entirely clear substantial financial assistance beyond that which is already anticipated will be essential, feasibility will remain an open question at least through completion of Facilities Plans (the next step before Design, Construction and Commissioning).

Public input has played a substantial role in shaping the project descriptions. In the Hoodsport RAC, with the assistance and involvement of Mason County PUD #1, there have been three public meetings during the 3+ months this report has been under preparation. The Skokomish elected Tribal Council and the General Council have been kept closely informed and a special committee of the Tribal Council has provided considerable direction. Mason County's Board of Commissioners and the County's Community Development and Utilities Director have been instrumental in moving the collective, TriParty program forward.

Congressman Norm Dicks, his staff, the federal Environmental Protection Agency and several Washington State agencies, especially the Puget Sound Action Team, the Department of Ecology, the Department of Health, State Parks and Community, Trade and Economic Development have been prompt, thorough and energetic in providing essential assistance.

There is communication, collaborative commitment and action underway at all levels, and the goal of a better Hood Canal is widely embraced.

## 1.2 Summary

Each of the three Planning Areas, Hoodsport RAC, Potlatch "Bubble" and Core Reservation, is not well suited to conventional septic tank wastewater management. They all have comparatively shallow soil columns above soils highly likely to transport septage to the nearest water body that either flows to or is Hood Canal. Although none of the areas is a city or town, they all have one or more fairly dense population centers.

The combination of transmissive soils and greater than traditional rural densitites makes each Planning Area a Hood Canal pollution source. The pollution includes not only bacterial contimation as indicated by higher-than-acceptable levels of fecal coliform, but also the nutrient nitrogen which cannot be effectively treated by septic systems with limited soil columns.

Another shared characteristic is a limited amount of flat, dry land. Comparatively steep slopes flatten into deltas or wetlands that border Hood Canal. There is limited dry area with soil columns offering much treatment opportunity before reaching ground water or impervious soils.

In areas outside the Skokomish Indian Tribe Reservation, Washington State's Growth Management Act applies. Sewer systems with central treatment plants are generally view as urban-style services not suitable in rural conditions. Providing sewer capacity beyond what is needed to serve existing development is inconsistent with the aims of the Growth Management Act.

All of these factors, together with the region's modest to moderate income status, serve to focus wastewater management options. A single plant system to serve all the area from Hoodsport south through the Skokomish Reservation is expensive and not easily permitted under growth management regulations. Continued reliance on traditional septic systems, even though they may be well maintained, does not address the pollution issues.

The TriParty group decided to address each Planning Area individually and find the best combination of approaches in each area while striving to use common technology among the three and work to design and construct so as to allow convenient interconnection of the systems in the future if conditions warrant.

It appears treating wastewater to Class A reclaimed water standards offer the more and best potentials for managing treated wastewater. Class A water can be infiltrated into the ground in areas with proper soil without endangering water supplies. It can be used to irrigate trees or other flora as seasonal conditions require or permit. It can also serve a variety of commercial/industrial water uses where the water cools processes or washes non-food items.

Creating Class A reclaimed water is possible using either a sequencing batch reactor (SBR) with filtration or a membrane bioreactor (MBR). MBR has certain advantages in that it provides a positive physical barrier to many pollutants and it has a comparatively small footprint. While the design phase is when technology decisions are made, MBR is the consensus technology choice for all three Planning Areas.

All three Planning Areas are unsuited for gravity sewers. The current choice for wastewater collection is either septic tank effluent pumping (STEP) or grinder pumps feeding pressurized sewer lines. Some areas are experience difficulties with STEP systems, and Mason County has considerable experience with grinder pumps. The final decision is another question to be answered during design.

Marine discharge of treated water is not seriously considered in the Hoodsport-Skokomish area. Rapid infiltration, irrigation and commercial use of Class A reclaimed water are the favored methods for handling highly treated water. There appear to be areas suitable for rapid infiltration in both Core Reservation and Potlatch. Earlier study suggests a similar opportunity, using pressurize drip discharge, exists in Hoodsport. All areas have irrigation reuse options depending on how far from the treatment site the treated water is pumped. There may also be commercial water reuse options. A decision concerning effluent fate is the most pressing issue in Hoodsport and continues to be an issue in the other two planning areas. This is a high priority matter during preparation of Facilities Plans.

This report indicates that advanced septic systems that require periodic profession inspection and operation have a role in managing Hoodsport's wastewater. For the area characterized as having "moderate risk" for transmission of pollutants to Hood Canal from conventional septic tank effluent that has not had sufficient soil treatment, advanced systems serving 7-residence clusters are proposed. These systems would be operated by a utility, not by home owners, and they would be located on public property. They are proposed to use pressurized drip systems to manage treated water. This well-treated water will receive some additional treatment in the soil column and significantly reduce the risk of pollutants being transported to Hood Canal at a cost lower than the cost of the sewer system and central treatment plant.

The cost of the wastewater management projects defined for each of the three areas is high. With development density lower than most sewered urban areas, the cost of the systems is shared by comparatively few connections. The following table shows the estimated cost to complete each of the defined projects.

| ***Planning Area*** | ***Total Cost to Complete*** |
|---|---|
| Hoodsport RAC | $9,946,702 |
| Potlatch "Bubble" | $3,433,430 |
| Core Reservation | $6,465,030 |
| ***Total*** | $19,845,162 |

This total is a planning level estimate and will undoubtedly change as the projects are subject to more investigation and engineering. Nonetheless, compared with the $7,017,800 in grants remaining available for projects in the Hoodsport-Skokomish region, there is a sizable difference between needs and funding.

The funding problem is further complicated by operating costs currently estimated at more than $75 per month per connection. This leaves little capacity for debt and while maintaining sewer rates at suitable levels. Substantial grant funding will need to be pursued and found to assure the projects are affordable.

The TriParty group is committed to collectively funding the projects on a regional basis. This approach has met with success so far in as much as grant money was secured continue the planning effort and define projects.

The next step is to prepare a Facilities Plan for each of the projects. When these are approved by the Washington Department of Ecology, final design can begin.

**NOTE:**
***As this report is issued, it appears grant funding will be available to complete the Facilities Plans provided the work can be accomplished in a very short time frame. Consequently, the table above does not include the cost of Facilities Plans.***

***Also at the time of publication, the Washington State Legislature and the Governor are considering funding in support of these projects. Congressman Norm Dicks and the United States Environmental Protection Agency are following and actively efforts in the Hoodsport-Skokomish region, and various Washington State departments have been very helpful with both advice and funding.***

If funding is secured and all three projects are aggressively advanced, it appears possible the wastewater management efforts defined here could be in place by early 2010.

-o-

# 2.0 Hoodsport RAC

## 2.1 Existing Information

In the Mason County Comprehensive Plan, the Hoodsport area is designated as a “Rural Activity Center” (RAC), which covers approximately 584 acres. The sources of information which characterize and describe the RAC are found primarily in the *Finch Creek Wastewater Feasibility Study* (Gray & Osborne, Inc., August 2000) and the *Hoodsport-Skokomish Wastewater Management Alternatives Analysis* (Gray & Osborne, Inc., October 2006). The Finch Creek Study focused on two potential sewer service areas: the Finch Creek corridor only and Finch Creek and the shoreline area of Hoodsport. The Alternatives Analysis covered the Hoodsport RAC, the Skokomish Indian Reservation, and the shoreline area in between these two jurisdictions.

**Figures 2.01** through **2.04**, respectively, present the boundaries of the Hoodsport RAC, the two service area alternatives described in the Finch Creek Study, and a population density schematic found in the Alternatives Analysis. In general, this plan will focus on the Hoodsport RAC and Service Area 2. Service Area 1, the Finch Creek corridor, covers a very limited area.

Both the Finch Creek Study and the Alternatives Analysis were prepared to address water quality problems in Hood Canal which are due to nutrient and fecal coliform loading. In part due to inadequate on-site wastewater systems, the nutrient loading, particularly nitrogen, has resulted in low dissolved oxygen concentrations and has led to fish kills in Hood Canal. In addition, elevated fecal coliform levels in Finch Creek resulted in closure by the Washington State Department of Health of public access tidelands at the mouth of Finch Creek to shellfish harvesting. This closure remains in place today.

Several alternatives for collection systems and wastewater treatment have been developed in both the Finch Creek Study and the Alternatives Analysis to address nutrient and fecal coliform loading. The Finch Creek Study considered two service areas and developed design criteria, schematics, and costs for alternatives for both areas. The Alternatives Analysis prepared similar information for all of the Hoodsport RAC. The Alternatives Analysis also considered decentralized wastewater systems and management options to reduce the nutrient and fecal coliform loadings.

**Figure 2.05** summarizes the cost-effective wastewater collection and treatment alternatives considered in both reports. **Figure 2.05** lists the approximate number of equivalent residential units (ERUs), a brief description of the alternative, and the estimated capital and annual operation and maintenance (O&M) costs. The Finch Creek Study was prepared in 2000, and for any use for 2007, these costs would need to be updated.

For each of the service area alternatives, the capital costs per ERU are very high and are not likely affordable without a significant amount of funding assistance. The least cost per ERU in **Figure 2.05** is $26,000 per ERU and the highest cost is $32,500 per ERU. For the Hoodsport RAC, the capital cost per ERU is

$27,400 based on an assumption that the target year would be 2015. Most conventional funding of wastewater treatment facilities is through loan programs. However, the debt service for the loans combined with annual O&M costs likely would result in unaffordable sewer rates.

The Alternatives Analysis considered decentralized on-site systems, such as recircu-lating sand filters and proprietary products for nitrogen removal. The cost of these individual on-site systems ranges from $15,000 (low) to $30,000 (high) with additional O&M costs. The expected installation costs for a recirculating sand filter is $15,000 to $20,000 with $400 to $600 for annual O&M. These costs are less than the capital and O&M costs per ERU for a centralized wastewater collection and treatment facility. However, due to small lot sizes, high groundwater table, and unsuitable soils, the on-site alternatives may not be suitable for all areas of the Hoodsport RAC. As a result, the Alternatives Analysis recommended a combination approach utilizing centralized and decentralized alternatives. The centralized treatment alternatives would focus on the core commercial area, Finch Creek, and possibly a few other selected areas. This area closely follows Service Area 2 as outlined in the Finch Creek Study. The decentralized alternatives would focus on the larger lots which are generally located in the upland areas of the RAC.

### *2.1.1 Population and Land Use*

Population data for the total RAC area are based on a “windshield” survey of the number of housing units within the RAC multi-plied by 2.49 (the number of person per household in Mason County during the 2000 U.S. Census). The number of residential housing units counted was 258 and the total number of commercial businesses was 38 within the RAC. The total estimated population, including both permanent and seasonal residences, is 642. Based on PUD billing records, about 30 percent of County utility customers are seasonal. It is assumed that 30 percent of the Hoodsport RAC residences are also seasonal.

The Finch Creek Study identified two potential sewer service areas. Service Area 1 covers only the Finch Creek corridor and Service Area 2 covers Finch Creek and the commercial area. Both Service Area 1 and Service Area 2 are located within the RAC boundaries.

Based on hydrogeological information provided by HWA GeoSciences, a third area is also developed as an Expanded Service Area 2. The basis of this expanded area is the area identified as the highest risk for contaminant transport to Hood Canal coinciding with existing development. In general, the intent of this expanded area is to include the small lots and near-shore areas where the highest risk exists. This expanded area is shown on Exhibit V and includes Highway 101 south to Hill Creek, Cedar Lane, part of Old Mill Hill Road, the steepest portion of North Schoolhouse Road, and North Hill Road. Each of these areas is located within the boundaries of the Hoodsport RAC. The exact number of residential connections is not known, but the estimate arrived at through the “windshield” survey is shown below:

| | |
|---|---|
| South along Highway 101 (including Cedar Lane) | 16 |
| Old Mill Road | 24 |
| North Schoolhouse Road | 20 |
| North Hill Road | 13 |

| | |
|---|---|
| North Harrison | 10 |
| | 83 |

This expanded area would add approximately 83 residential connections to Service Area 2. Along North Schoolhouse Road, there is a total of 54 residences. However, only 20 of these residences are included in the Expanded Service Area 2 area.

**Figure 2.07a** summarizes the existing population for the RAC and the service area alternatives.

Land use within the Hoodsport RAC is primarily residential. There are a limited number of commercial businesses and public buildings. Each of these is listed in **Figure 2.07b** along with vacant/closed structures. Most of the businesses provide essential local services while a few serve tourists. Most all of these commercial units are located along or near U.S. Highway 101.

Under the County's land use policies for RACs, the standard residential density is one dwelling per 2.5 acres. However, lots platted prior to 1996 are not subject to this density requirement and may be able to develop at an average density of one dwelling unit per acre.

**Figure 2.07c** summarizes the existing lot size based on a survey of County records covering 200 lots. The average lot size was calculated to be 55,666 square feet, or 1.25 acres. In general, smaller lot sizes are located near shoreline areas or the central commercial area of the RAC. Larger parcels are located in upland areas as shown in **Figure 2.01**. Most of the small parcels within the RAC are included in Service Area 2 or the Expanded Service Area 2 as shown in **Figures 2.03** and **2.06**.

### *2.1.2 Flows and Loadings Estimates*

Flows and loadings estimates were developed both in the Finch Creek Study and the Alternatives Analysis for their respective areas. As stated in both reports, unit flows and loadings had to be assumed due to the lack of residential and commercial water use. These assumptions, which would be pertinent to the Hoodsport RAC and Service Area 2, are summarized in **Figure 2.08** The Alternatives Analysis based its assumptions on per capita flow for water usage from other areas within Mason County. Based on data from the Belfair Water District, the daily average water use was about 60 gallons per capita per day (gpcd), and in Lakeland Village, the average use during low irrigation months is 69 gpcd.

The two reports utilize similar unit loading values, but significantly different unit flow values. The Finch Creek Study assumes a significant increase in seasonal tourist activity and accordingly, develops high commercial flows. In the Finch Creek Study, the estimated peak day commercial flow is 31,056 gpd. In the Alternatives Analysis, the estimated peak day commercial flow is only 13,934 gpd, about 45 percent. For the commercial flows, the Alternatives Analysis accounts for all of the restaurant seats and motel rooms, the primary units impacted by tourist activity. The other commercial businesses shown in Table 2-3 are unlikely to be significantly impacted by tourist activity. Of the two estimates, the one presented in the Alternatives Analysis is likely the more accurate one, although it should be re-evaluated as better data become available.

**Figure 2.09** presents both flow and loading estimates for existing conditions. This table presents these estimates both for the Hoodsport RAC, Service Area 2, and the Expanded Service Area 2 based on the unit flows presented in the Alternatives Analysis.

The flows and loading values presented in **Figure 2.09** indicate a wastewater strength concentration covering a range of 350 to 400 mg/L $BOD_5$. Historical values from the County's North Bay-Case Inlet facility suggest that this range is reasonable for planning purposes. Typically, the North Bay-Case Inlet facility has influent $BOD_5$ concentrations from 250 to 350 mg/L. In addition, where commercial flows include restaurants, higher $BOD_5$ concentrations can be expected.

### 2.1.3 Soils

*(The following is an excerpt from a complete report prepared by HWA GeoSciences for this effort. To fully understand the particulars of this report, its sources of information and any limitations concerning its use, please consult the full document included in this report as **Appendix 2.1**.)*

Soils in the Hoodsport RAC area consist of mainly Hoodsport series soils in the upland areas, with isolated pockets of Grove series soils in some drainages, and smaller areas of fine grained (e.g., Cloquallum and Tanwax) and alluvial (e.g., Juno) soils (Ness, 1960). **Figure 2.10** shows the mapped soil units in the Hoodsport RAC planning area.

**Hoodsport soils (Hd, He, Hf)** consist of well-drained, reddish soils on uplands, formed over granitic till that is highly stained by iron and contains considerable metamorphosed and basic igneous gravel and stone. The soil survey report lists Hd soils as having a "very limited" rating for septic tank absorption fields, due to slow water movement and shallow depth to saturated zone. He and Hf soils are also listed as having a "very limited" rating for septic tank **absorption** fields, due to slow water movement, shallow depth to saturated zone, and slope (Ness, 1960).

**Grove series (Gh, Gk)** soils consist of somewhat excessively drained, reddish-brown gravelly soils, that formed on large glacial outwash plains over Vashon glacial drift, modified considerably by inclusions of local basaltic rock and mixed material from the Olympic Mountain glaciers. The soil survey report lists Gh and Gk soils as having a "very limited" rating for septic tank absorption fields, due to "bottom layer seepage" (i.e., soils are too permeable) (Ness, 1960).

**Cloquallum silt loam (Cc)** is a moderately well drained, brown upland soil, developed over silty glacial-lacustrine (lake) sediments. The soil survey report lists Cc soils as having a "very limited" rating for septic tank absorption fields, due to slow water movement and shallow depth to saturated zone (Ness, 1960).

**Tanwax peat (Tb)** consists of brown peat formed in wet areas and bogs. The soil survey report lists Tb soils as having a "very limited" rating for septic tank absorption fields, due to shallow depth to saturated zone, subsidence, slow water movement, and ponding (Ness, 1960).

**Juno Sandy Loam (Jb)** consists of coarse textured, brown to reddish-brown alluvial soils, formed over glacial alluvium in small streams. The soil survey report lists Jb soils as having a “very limited” rating for septic tank absorption fields, due to flooding, bottom layer seepage, and filtering capacity (Ness, 1960).

Although the soil survey lists all soil types present in the RAC area as having “very limited” suitability for septic drainfields, HWA’s opinion is that of the soils present, the Hd Hoodsport soils (5 to 15 percent slopes) have the best septic treatment potential and least off site septic contaminant transport risk. These soils are generally found on the till uplands, on relatively flat land. Steeper Hoodsport soils (He and Hf) have a higher potential to transport contaminants, due to increased slopes. Soils with the highest potential for septic contaminant transport include Grove and Juno soils, which are found in the drainages. The Grove soils pose an increased risk due to excessive permeability. Cloquallum and Tanwax soils have a low potential for transport, but also a low potential for treatment.

### 2.1.4 Geology

*(The following is an excerpt from a complete report prepared by HWA GeoSciences for this effort. To fully understand the particulars of this report, its sources of information and any limitations concerning its use, please consult the full document included in this report as **Appendix 2.1**.)*

**Figure 2.11** shows the mapped geology in the Hoodsport RAC planning area. According to the Logan (2003) unconsolidated sediments mapped in the Hoodsport RAC planning area include the following:

**Qgt - Till, late Wisconsinan (Pleistocene)**. Glacial till deposits generally consist of a compact unsorted mixture of clay, silt, sand, gravel, and boulders, deposited at the base of the Puget lobe of the Cordilleran ice sheet during the latest glaciation. Occasional sand and gravel lenses may be present. Till is commonly referred to as “hardpan” due to its cement-like texture. Till does not provide a favorable infiltration medium, but may be suitable for septic drainfields if sufficient depth of soils and weathered till are present. Till acts as an aquitard that inhibits the flow of ground water, perches water on top of it where overlain by 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 (Logan, 2003).

**Qga - Advance outwash, late Wisconsinan (Pleistocene).** Advance outwash consists mostly of glaciofluvial sand and gravel, with some and lacustrine clay, silt, and sand deposited during the advance of glaciers. Sandy units are commonly thick, well sorted, and fine grained, with interlayered coarser sand, gravel, cobbles and silt (Logan, 2003). Advance outwash is typically permeable, often water-bearing, and denser than recessional outwash, having been overridden by glacial ice. Advance outwash is commonly overlain by till.

**Qgo - Proglacial and recessional outwash, late Wisconsinan (Pleistocene).** Recessional outwash typically includes poorly to moderately sorted, rounded gravel and sand with localized coarser- and finer-grained constituents. Some fine sand, silt, and clay form local overbank sediments may also occur. Recessional outwash thickness varies and is not well known. It most commonly occupies outwash channels scoured into or through till (Logan, 2003). Recessional outwash was not glacially overridden, and is generally poorly consolidated to loose. Typically outwash deposits exhibit moderate to high permeabilities and infiltration rates depending on silt content.

**Qapo - Alpine outwash, pre–late Wisconsinan (Pleistocene).** Alpine outwash consists of stratified sand, gravel, and cobbles, may include peat, silt, and clay, and may be capped by weathered loess. Clasts are generally more rounded than those in till and lack facets and striations.

**Qa - Alluvium (Holocene).** Alluvium may consist of silt, sand, and gravel deposited in streams and alluvial fans, locally may contain Alpine drift, peat, or landslide deposits.

The soils and geologic maps reviewed are not entirely consistent with regard to correlation of mapped glacial deposits with mapped overlying soils. For example, most of the areas mapped as outwash on the geologic maps are mapped as Hoodsport series on the soils maps. The only areas mapped as Grove soils correspond with areas mapped as alluvium on the geologic maps.

Some differences in geologic mapping based on different references also occurs, which is not uncommon. Field verification of soils and geology is therefore recommended prior to design or siting of any facility. **Figure 2.12** shows the mapped geology per Carson (1976), which is similar to the Logan map. The main till/outwash boundary (Qgt to Qga on the Logan map) is interpreted similarly in both maps.

### *2.1.5 Environmental Issues and Permitting*

#### 2.1.5.1 Environmental Issues

The Mason County Comprehensive Plan (updated 2005) mapped a number of sensitive areas on a county-wide basis. Sensitive areas mapping within the study area has not been conducted as part of this project. The sensitive areas mapping, including geologic hazard areas, flood hazard areas, aquifer recharge areas, and surface water and wetlands has been reviewed as part of this project.

Within the Hoodsport study area, the major surface water bodies include Hood Canal, Finch Creek, Hill Creek, and a number of wetlands, particularly near the mouth of Finch Creek and adjacent to Hood Canal. Potential impacts to wetlands and/or water bodies are likely the environmental issue of greatest concern. A field reconnaissance should be conducted prior to siting any treatment or disposal facilities to determine the location and extent of streams and wetlands. Conducting this review early in the process would potentially allow for wetland avoidance by making siting adjustments. Similarly, wetland delineations should be conducted when pipeline routes are determined so that wetland impacts can be avoided, or minimized to the greatest extent possible.

Water quality in Hood Canal has long been a concern. In general, Hood Canal suffers from elevated levels of nutrients and bacteria, and low levels of dissolved oxygen. Finch Creek has also exceeded water quality criteria for fecal coliform bacteria (Gray and Osborne, 2000). Implementation of the wastewater management project is expected to help reduce bacterial and nutrient loading to nearby surface water bodies from suspected poorly-functioning septic systems.

Other issues include potential impacts to groundwater, storm water impacts associated with increased development, and construction impacts to local roads.

#### 2.1.5.2 Permits

**Appendix 2.2** provides a matrix summarizing the various permits that may be required for the Hoodsport Rural Activity Center, Potlatch, and Core Reservation Wastewater Management Planning Areas. Given the general siting information currently available for the projects, a full range of permits that may be required is included. The matrix describes the type of permit, the agency responsible for reviewing the permit, the permit triggger, timelines, agency responsible, and other relevant issues.

Some permit issues of particular note for this project are further described in **Appendix 2.2**. These include permits that could require several months or longer to process, have appeal processes, require potential substantial mitigation for impacts, and/or could be difficult to attain. Requirements for these permits should be identified early and incorporated into the facilities planning process.

Of the potential permits, the permits required from the Corps of Engineers and Department of Ecology would likely represent the longest lead times. Compliance with NEPA is required prior to approval of NEPA funding, which will require completion of all federal requirements, including the Endangered Species Act and Section 106.

### *2.1.6 Cultural Resources*

In the fall of 2006, Mason County contracted with Wessen & Associates, Inc. to assist in planning for a wastewater management system in the Hoodsport "Rural Activity Center" (RAC). Wessen & Associates' role was to prepare an inventory of cultural resources in the Hoodsport RAC and advise in the planning effort so that disturbance to known and suspected cultural resources might be avoided to the fullest possible extent. This section presents the background, goals, methods, findings, and recommendations of that effort. *(**Appendix 2.3** is the complete report with one redaction as required by Washington State law.)*

#### 2.1.6.1 Background

The Hoodsport RAC is located in northeastern Mason County. It includes the commercial 'core' of the community of Hoodsport and residential areas to the north, west, and south (see **Figure 2.13**). Its total area is approximately 1.5 square miles.

The Hoodsport RAC is located within the traditional territory of the Tuwaduq (Twana) People. In early historic times – and for a considerable period prior to them – the Tuwaduq People occupied all of the lands in the immediate vicinity of Hood Canal. Many of their traditional settlements were located along the Hood Canal shoreline, often at or near the mouths of rivers or creeks. They also fished, hunted, and otherwise used a considerable range of lands interior to Hood Canal. Representatives of the Tuwaduq signed the Point-No-Point Treaty in 1855 and subsequently relocated onto the Skokomish Indian Reservation, approximately 2 miles south of the Hoodsport RAC. Their descendants are now usually referred to as the Skokomish Indian Tribe.

There has been only very limited archaeological research within the traditional territory of the Tuwaduq People. Few efforts to locate archaeological sites have been conducted and those which have occurred have generally been limited in their geographic focus. Large scale systematic efforts to identify prehistoric archaeological resources have yet to occur here. Similarly, there have been relatively few detailed studies of particular archaeological sites anywhere along Hood Canal. We currently know that some traditional Tuwaduq settlements near the Hoodsport RAC have been occupied for at least 1,500 to 3,300 years. Other, as yet undated, archaeological sites in the area are probably much older.

### 2.1.6.2 Research Design

The goals of this effort are essentially those stated above in the introduction to this document: "to prepare an inventory of cultural resources in the Hoodsport RAC and advise in the planning effort so that disturbance to known and suspected cultural resources might be avoided to the fullest possible extent". The term 'cultural resources' as used here, refers to archaeological materials. Thus, this study has not addressed the possibility that there may be historic structures in the Hoodsport RAC. To our knowledge, there aren't any and, moreover, our current understanding of the proposed wastewater management actions suggests that historic structures - - if present - - are unlikely to be affected. The focus of this effort has been directed largely toward archaeological resources representing the Native American occupants of the area. It should be noted, however, that archaeological resources representing late 19th and early 20th Century Euro-American occupants of the area could also be present in the Hoodsport RAC.

The results of the inventory effort have been summarized in two maps of the Hoodsport RAC. The first map shows the locations of recorded archaeological sites and settlements known from ethnographic and/or historical sources that may have archaeological manifestations. It is important to note here that the locations of recorded archaeological sites are protected by state and federal laws, and thus this information cannot be released to the general public. In this same regard, the Skokomish Tribal Historic Preservation Office has requested that specific information about the locations of traditional Tuwaduq settlements also not be released to the general public. These requirements, and the paucity of archaeological survey data for the Hoodsport RAC, have led us to develop a second map. The second map identifies zones of archaeological potential within the Hoodsport RAC. These zones have been developed on the basis of the distributions of the above-noted locations and generalizations about the relatively sensitivity of different types of landforms in the study area. In brief, low gradient surfaces in the immediate vicinity of the Hood Canal shoreline and the flood plains of larger creeks are considered to have a relatively high potential for archaeological resources. The vicinities of smaller low gradient creek channels and so-called vista points (i.e., locations that offer sweeping views of the surrounding landscape) are considered to have a moderate potential for archaeological resources. Steep gradient surfaces and low gradient interior surfaces that are not located near creeks or lakes are considered to have a relatively low potential for archaeological resources. The map identifying zones of archaeological potential within the Hoodsport RAC may be released to the general public.

Finally, it is important to emphasize that the study reported here is not an archaeological survey of the Hoodsport RAC. While we have considerable familiarity with this area, no actual on-the-ground inspection for archaeological resources was conducted at this time. Rather, the effort was essentially a literature review and our products are based upon examination of documents on file with the Washington State Department of Archaeology and Historic Preservation, the Skokomish Tribal Historic Preservation Office, other materials in our possession, and archaeological site survey experience in nearby areas.

#### 2.1.6.3 The Cultural Resource Maps

Our map of the locations of recorded archaeological sites and settlements known from ethnographic and/or historical sources that may have archaeological manifestations is presented in **Figure 2.14**. Note first that there are no recorded archaeological sites in the Hoodsport RAC. This condition is undoubtedly related to the fact that there has been almost no archaeological research conducted in the Hoodsport RAC. As such, the absence of recorded archaeological sites should not be seen as suggesting that archaeological resources are unlikely to be present. **Figure 2.14** does indicate that at least three traditional Tuwaduq settlements were located within the Hoodsport RAC. All three were located along the Hood Canal shoreline at the mouths of creeks. Relatively little information is available about any of these places, but at least one is clearly identified as a ‘large winter village’. The other two settlements may have been somewhat smaller. Native American archaeological resources – potentially including artifacts, occupation refuse, and human remains – may be present at any of these locations. We have not specifically identified the early historic Hoodsport Town site in **Figure 2.14**, but it was located in what is essentially the commercial ‘core’ of the modern community of Hoodsport. Late 19th and early 20th Century Euro-American archaeological resources may be present anywhere in this area.

The information in **Figure 2.14**, and the generalizations about the relatively sensitivity of different types of landforms noted earlier, have been used to generate the archaeological sensitivity zones presented in **Figure 2.15**. Two important caveats need to be offered about this map. First, zones based upon landforms have been defined, as the landforms appear on USGS 7.5 minute topographic maps. These are valuable tools, but it is important to emphasize that there may be archaeologically sensitive features in the study area that are too small to be indicated on USGS 7.5 minute topographic maps. The zones shown in **Figure 2.15** are therefore generalizations about probable potential and should not be regard as guarantees that archaeologically sensitive areas are not present within zones here identified as having only a low potential. A second caveat concerns the low gradient surfaces in the immediate vicinity of the Hood Canal shoreline. This area has been indicated as having a relatively high potential for archaeological resources. This study has not documented whether historic filling has occurred along any portion of this shoreline. We raise this issue because we suspect that some locations – such as near the mouth of Finch Creek – may contain fill deposits, and fill deposits are a complicating consideration. At first glance, fill sediments can be expected to be culturally-sterile, and thus documented fill areas should have no potential to contain archaeological resources. The issue is actually more complicated for two reasons. First, experience elsewhere in western Washington has shown that low lying areas with archaeological resources were sometimes filled in order to raise their base level. Thus, potentially significant archaeological resources can be present underneath fill deposits. Second, there are documented cases of archaeological sediments having been used as fill materials in western Washington. This means that it is possible that archaeological materials – including human remains – could be encountered in fill deposits.

The map of zones of archaeological potential within the Hoodsport RAC indicates that high potential areas are limited to the low gradient surfaces in the immediate vicinity of the Hood Canal shoreline and the Finch Creek flood plain. These areas have the highest potential for both Native American and Euro-American archaeological resources. These are also among the most developed (i.e., disturbed) areas in the Hoodsport RAC. The history of historic disturbance may have damaged and/or destroyed archaeological resources in these areas. It would, however, be dangerous to simply assume this. In fact, there are many well documented cases of important archaeological resources having survived in badly disturbed, highly developed landscapes. (Witness the recent events at the graving dock site in Port Angeles.)

Areas thought to have a moderate potential for archaeological resources are also relatively limited within the Hoodsport RAC. They include the vicinities of two smaller low gradient creek channels to the south of Finch Creek and the areas along the tops of slopes that look out over Hood Canal and/or the lower Finch Creek canyon. Some of the latter areas have also experienced significant historic disturbance, and the above-noted caution also applies in these areas.

Finally, a significant amount of the Hoodsport RAC appears to have only a relatively low potential for archaeological resources. Areas thought to have only a relatively low potential include steep surfaces along the margin of Hood Canal and the lower Finch Creek canyon and low gradient interior surfaces in the western portion of the Hoodsport RAC. While we are confident that the latter areas have only a relatively low potential for archaeological resources, we should emphasize that there is a difference between ‘low potential’ and ‘no potential’.

It is possible that that archaeological resources could be encountered in areas we characterize as having a low potential.

#### 2.1.6.4 Resource Management Considerations

The assessments of archaeological resource potential presented here are based upon very limited archaeological and ethnographic data and generalizations about the relative sensitivity of different types of landforms, as they appear on USGS 7.5 minute topographic maps. As already indicated, this study is not an archaeological survey of the Hoodsport RAC and should not be regarded as one. We therefore recommend that an archaeological survey of the areas to be impacted by the waste-water management system be conducted. Having said this, we think that project planners should be aware that – depending upon the system's design – it may prove to be difficult to investigate some portions of the Hoodsport RAC. In particular, we note that much of the high potential areas have been extensively developed and thus, built features such as paved road beds and structures may make effective archaeological inspection difficult. Some of this difficulty may be addressed by test boring portions of the study area, but even the feasibility of this approach is difficult to assess at this time.

As such, while an archaeological survey is an important next step, project planners should recognize that such an effort may not be sufficient to be certain that archaeological resources are not present anywhere in their project area. We therefore think that some degree of archaeological monitoring may be appropriate during the construction of the planned facilities. The specific scope and character of such a monitoring plan should be developed after the results of the archaeological survey are available.

## 2.2 Additional Information

### ***2.2.1 Treatment Soils Can Provide***

*(The following is an excerpt from a complete report prepared by HWA GeoSciences for this effort. To fully understand the particulars of this report, its sources of information and any limitations concerning its use, please consult the full document included in this report as **Appendix 2.1**.)*

HWA GeoSciences' scope of work for this report included using available soils and septic system information to assess which areas in the Hoodsport RAC currently served by conventional septic systems have the highest, moderate and least likely probability of causing Hood Canal contamination.

Criteria contributing to relative risk of transmitting septic contamination to Hood Canal include:

- Soils and geology (soil treatment capacity and permeability)
- Slopes
- Distance to surface water
- Depth to ground water

Several of the criteria are overlapping, for example slopes, distance to surface water, and permeable outwash soils all coincide with the coastal areas and east-west drainages in the planning area.

Soils and geology are described above. Soils with increased risk of contaminant transport and reduced treatment capacity include those that are excessively drained, such as Grove soils. These soil types would provide less treatment than slower draining soils due to less organic content and decreased residence times. Grove soils on steep slopes in and near drainages (e.g., Gk) have an added element of risk due to thinner soil profiles, and steeper hydraulic gradients. Distance to surface water relates directly to potential for septic contaminants to reach Hood Canal. For reference, Chapter 246-272A WAC, On-Site Sewage Systems specifies a setback of 100 feet for drainfields from surface water, and 30 feet from any downgradient site feature that may allow effluent to surface.

Based on these criteria, areas ranked by relative risk of transmitting septic contamination to Hood Canal include:

- Low risk – Upland areas underlain by glacial till and Hoodsport soils, not near surface water drainages.
- Moderate risk – Areas mapped as having outwash soils, but not in or near surface water drainages.
- High risk – Areas within or adjacent to surface water drainages, including the Hood Canal coastline. Most of the areas in and near drainages also contain permeable soils which are more likely to transmit water and contaminants with minimum treatment.

**Figure 2.15** shows mapped geology (Logan, 2003) topography, and land parcels. **Figure 2.16** shows the major geologic contacts, topography, land parcels, and an aerial photograph, to provide some indication of land development status. **Figure 2.17** includes the three risk areas delineated in the Hoodsport RAC.

Wastewater treatment/disposal options for future development include:

- Conventional on site sewage treatment/disposal systems
- Enhanced on site sewage treatment/disposal systems (single residence or combined)
- Conveyance to a centralized waste water treatment facility (including a variety of treatment processes, effluent qualities, and effluent disposal options)

Delineation of areas for varying types or levels of treatment in the planning process may be made qualitatively, based on relative risks as outlined above, or semi-quantitatively, by establishing maximum pollutant (e.g., nitrogen) loading or downgradient concentrations, then performing analytical modeling to predict estimated concentrations for various scenarios, including effluent quality, development density, etc.

### 2.2.2 *Population/Land Use and Predicted Flows and Loadings*

Table 2-6 develops flows and loadings estimates for existing conditions within the RAC, Service Area 2, and the Expanded Service Area 2. Currently, the estimated populations within these respective areas are 642, 139, and 346.

Existing land use is predominantly residential, with a commercial corridor along U.S. Highway 101 and the shoreline. The smallest lot sizes and the highest density development are located within or near Service Area 2. The population density covers a range of two to six homes per acre (refer to **Figure 2.04**).

Future, or predicted, flows and loadings are dependent upon growth within the RAC and changes in land use. In the Alternatives Analysis, an annual growth rate of 3.5 percent was recommended by Mason County for the Hoodsport RAC. This rate was utilized to project population through the year 2025 and resulted in an estimated population of 1,277 for the RAC.

With an area of 584 acres, a 2025 population of 1,277 would result in a density of about 2.2 persons per acre. While approximately one-third of the RAC is characterized by steep slopes, the remaining two-thirds are characterized by a relatively flat plateau. Exhibit IV presents both existing topography and population density. As shown, the south and west areas of the RAC are characterized by low-density development.

The Finch Creek Study did not project population for Service Area 2. As shown in **Figure 2.07a**, the estimated current population is 139. As shown in **Figure 2.04**, it contains the highest density (two to six homes per acre), but is also confined by steep slopes on the uplands side of U.S. Highway 101 and Hood Canal along the shoreline. Without a conversion in land use (e.g., multi-family) and with the existing lot configuration, the high growth rate of 3.5 percent used in the Alternatives Analysis does not appear achievable for Service Area 2.

However, for the purpose of this plan, it is assumed that Service Area 2 and the Expanded Service Area 2 will be served by a central sewer system which will allow a 3.5 percent growth for commercial flows, but only a 1.5 percent growth in population. It is assumed that the higher population growth rates will occur elsewhere in the RAC. These assumptions and any others will need to be confirmed by the Mason County Department of Community Development.

**Figure 2.18a** summarizes the population projections both for the Hoodsport RAC and Service Area 2 through 2025.

**Figure 2.18b** presents future flow and loading estimates for the Hoodsport RAC, Service Area 2, and the Expanded Service Area 2. For the Hoodsport RAC, the estimates follow the work presented in the Alternatives Analysis. For the Service Area 2 alternatives, the estimates are based on the unit values in Table 2-4, a growth estimate of 3.5 percent for commercial flows, and a growth estimate of 1.5 percent for population.

### *2.2.3 Inventory of Applicable Technologies for Treatment Plant*

Any applicable technologies suitable for all, or part of the Hoodsport RAC, will need to be capable of nutrient reduction. Since none of the disposal or reuse options is likely to include direct discharge to Hood Canal, the State's Groundwater Standards, 173-200 WAC, and the Water Reclamation and Reuse Standards, 90.46 RCW, are the most significant standards for any treated effluent from the Hoodsport RAC. Unlike most wastewater treatment facilities, which operate under an NPDES permit, any facility serving the Hoodsport RAC would be regulated by Ecology's State Waste Discharge Permit (SWD).

Based on a meeting with Ecology, the likely effluent limitations for $BOD_5$, TSS, dissolved oxygen, turbidity, total coliform, pH, and total nitrogen are shown in **Figure 2.19**.

The effluent limitations presented in **Figure 2.19** meet the requirements for

Class A reclaimed water to surface percolation ponds or spray irrigation. In addition to the effluent limitations shown in **Figure 2.19**, there would also be groundwater limitations summarized in **Figure 2.20**.

In the Water Reclamation and Reuse Standards, one of the listed commercial and industrial uses for reclaimed water is fish hatchery basins. Specifically, the standards state: "Reclaimed water used as a source for basins at fish hatcheries shall be at all times Class B reclaimed water or better." This reuse option was discussed in the Finch Creek Study since the Washington State Department of Fish and Wildlife operates a fish hatchery located at the mouth of Finch Creek. According to records in 1997 to 1998, the average daily water intake at the hatchery is about 10 mgd with a range of 6 mgd (low) to 16 mgd (high). Based on the flow estimates for Service Area 2 in Table 2-8, the peak day flow of 52,000 gpd would only amount to 5 percent of the average intake. For the Expanded Service Area 2, the peak day flow of 88,000 gpd amounts to 9 percent of the average intake. However, according to Ecology representatives at the Southwest Regional Office, this use of reclaimed water has not yet been implemented in the State of Washington. The expected effluent limitations presented in **Figure 2.19** may need to be modified for this use of reclaimed water. At a minimum, there likely would be a specific concentration for dissolved oxygen and the stricter turbidity standard associated with membrane systems. Other concerns, which are not currently addressed by the reuse standards, are micro-constituents such as pharmaceuticals.

Applicable technologies to meet the requirements in **Figure 2.19**, **Figure 2.20**, and the Water Reclamation and Reuse Standards are the membrane bioreactor (MBR) process with disinfection and the sequencing batch reactor (SBR) with filtration and disinfection. Both technologies have proven capability for nutrient removal and both require a relatively small "footprint," or site area. Both technologies are widely used for the level of flows and loadings presented in **Figure 2.18b**.

MBR facilities are in operation at the Tulalip Tribe, Stillaguamish, and the City of Duvall. Mason County operates SBR facilities at Hartstene Pointe and North Bay-Case Inlet. Among the MBR systems, there are several alternatives, including micro-filters manufactured by Zenon Corporation, and a flat plate design manufactured by Kubota. These MBR alternatives would need to be screened based on flows, capital, and annual O&M costs. There is less variability among SBR manufactured systems.

Between the two applicable technologies, MBR and SBR, the MBR systems have increasingly found greater use in western Washington. For small systems, the MBR systems produce a higher effluent quality and require less annual O&M. However, replacement of the membranes at approximately 10-year intervals is an added cost not found with the SBR systems. In addition to capital and annual O&M costs, both systems should be evaluated against non-cost factors such as the examples listed below:

- Proven reliability for nutrient and total coliform reduction;
- Highest effluent quality;

- Most expansion capability;
- Lowest maintenance requirements;
- Best aesthetics/visibility;
- Best noise and odor control;
- Least operational complexity; and
- Highest regulatory acceptance.

The quantities of flow associated with Service Area 2 (peak day of 52,000 gpd) and the Expanded Service Area 2 (peak day of 88,000 gpd) are well suited both to the MBR and SBR technologies. Which service area alternative that can be implemented will depend on several factors, including costs. The primary technical challenge is not with the treatment technologies, but with identifying a suitable reuse site capable of handling the flow quantities.

### *2.2.4..Inventory of Applicable Technologies for On-site Systems*

*(There are areas in Hoodsport where there is moderate risk of septic tank effluent reaching Hood Canal. Please see sections 2.1.3 and 2.1.4. Because of Hoodsport's Rural Activity Center status, growth from new development is limited. Advanced on-site systems hold promise for handling conventional septic tank pollution that may move to Hood Canal. CH2M Hill provided the following planning level review, presented here in its entirety.)*

#### 2.2.4.1 Non-Sewered Area Wastewater Management

The expanded sewer service area for the Hoodsport RAC encompasses the Finch Creek corridor and that area adjacent to Hood Canal. Upland from this expanded service area, the soils are marginal and have been determined not suitable for conventional septic tank systems. If you divide the Hoodsport RAC into two sections, the smaller western area, and the larger eastern area that extends farther north and south than the western area, the eastern section is the section where there will be a need to install more advanced on site systems outside of the designated sewer service area. *(**Figure 2.25** is a topographic aerial view of this general area with the Expanded Service Area identified.)*

Recent studies in New Zealand (*Nitrogen reduction trials of advanced on-site treatment systems*, Paul Scholes, Environmental Bay of Plenty Regional Council, July 2006) indicate that there are available on site systems that can meet reduced nitrogen requirements. In the study, the AdvanTex system by Orenco (Roseburg, Oregon) consistently met removal rates greater than 80% and a total N effluent concentration below 15 mg/l. While this is less that what can be accomplished with a centralized system, it will allow the soil to provide additional treatment to further reduce nitrogen.

The Orenco AdvanTex system is one of many available advance on-site systems available. Based on the New Zealand study, it appears to be the best among those systems tested. Other advanced systems are appearing in the marketplace. Huber has an on-site membrane system that shows great promise. This system is currently being pilot tested by the Karcher Creek Sewer District (Port Orchard, WA).

Regardless of the type of advance on site system, it is recommended that these systems be clustered to serve a number of homes. There are many reasons why these systems should be clustered. Here are a few of the top reasons for clustering the advance on site systems:

- Clustered systems would be owned and operated by a public agency that would maintain the integrity and water quality of the system
- Public agencies can obtain public funding where private systems are limited on funding options
- Advance on-site systems use biological treatment in an aerobic environment, clustering would help the biological system dampen the flow and load variations that are inherent with an individual on-site system.

The AdvanTex AX100 system will be used as an example for this planning level review. According to available literature, this system is capable of handling an average flow of 2,500 gallons per day (gpd) with a peak flow of 5,000 gpd. Using a peaking factor of 3.5, results in a design flow of just over 1,400 gpd. Based on the flow projections completed for the Hoodsport RAC, that would equate to a 7 equivalent residential units. (ERU) A cluster could be bigger by adding additional units (i.e. 2 units = 14 ERU, 3 units = 21 ERU).

It is possible to reuse existing septic tanks with these clustered systems. In discussions with representatives at Orenco, new septic tanks would not be required if the existing tanks are proven to meet certain leak test criteria. This would help offset the cost of the new systems. The other parts to these clustered systems would include the following:

- Septic Tank (existing or new, depending on leak test)
- Septic Tank Effluent Pump (STEP) system – a separate chamber with existing tanks, integral with new tanks – that would include a pump that would pump septic tank effluent from each residence in the cluster to the treatment unit.
- Treatment Unit – for this example we are assuming an Orenco AdvanTex AX-100.
- Recirculation Pump and holding tank – to keep re-circulating liquid through the treatment system
- Effluent system – diversion box that distributes treatment system effluent between the discharge and recirculation, pump (if necessary for pressurized discharge), and discharge piping (subsurface drip type distribution material can be used – Geoflow or similar product)

The capital costs for the 7 ERU cluster system, based on a full use of a single AdvanTex AX-100 system are detailed in **Figure 2.21**.

The costs developed in **Figure 2.21** are based on installed costs quoted by the manufacturer and similar installations. Costs assume that there would be multiple cluster systems being installed at the same time in the Hoodsport RAC. Costs also assume minimal restoration costs.

Based on the costs in **Figure 2.21**, the range of costs for this cluster system is from $90,000 to $139,000. This would equate to approximately $13,000 to $20,000 per ERU. Adding costs for easements and/or property purchase for the treatment system and discharge would add another $7,000 to $21,000 to the total cost of the system. This would increase the per ERU cost range to $14,000 to $23,000.

Operation and Maintenance (O&M) costs would be on the order of $3,000 to $4,000 per year (does not include septic tank pumping – homeowner's expense). This assumes that there are multiple clustered systems in the area and that the same O&M team that is running the centralized system for the Hoodsport RAC is also operating the advance on-site systems. If this is not the case, the O&M costs would be greater depending on location of the staff.

How will these systems be clustered in the non-sewered area of the Hoodsport RAC is beyond the scope of this planning level work. **Figure 2.22** is an example of how a cluster system might be configured. This example shows the STEP units that would be located at each property. The septic tank effluent would be pumped using a small diameter pipe to a centralized treatment unit. The treated effluent would then be discharged to a pressurized drip system located within the adjacent right of way.

Actual clustering will require further investigation, additional mapping, property investigation, title search, and survey.

#### 2.2.4.2 Storm Water

While the focus has been on wastewater as the primary contributor to water quality issues in Hood Canal, storm water will need to be included in the overall program if the County and the agencies involved want to have a comprehensive effort to address water quality issues. Storm water management including treatment of runoff should be addressed. Other practices such as fertilization of lawns and gardens should be done using methods and applications that minimize the impact on Hood Canal.

## 2.3 Proposed Approach

### 2.3.1 Technologies for Hoodsport /Project Definition

Section 2.2.3 concludes by stating:

> *The primary technical challenge is not with the treatment technologies, but with identifying a suitable reuse site capable of handling the flow quantities.*

Both membrane bioreactor (MBR) and sequencing batch reactor (SBR) with filtration can reliably produce Class A reclaimed water. The greater question at this stage is what to do with the highly treated water.

For the purposes of estimating, MBR technology is presumed both because of its reliability and small footpring, and because it is a technology already supported by Mason County PUD #1 and accepted and used by Mason County in its North Bay utility and soon to be used in its Belfair utility.

During design, decisions concerning effluent will be made. These will be driven by land availability for infiltration, potential use of reclaimed water at the fish hatchery, and irrigation opportunities. With estimated peak daily flows at 88,000 gpd, water volumes are manageable. Class A reclaimed effluent allows the greatest flexibility for reuse or discharge and developing redundant capabilities through multiple fates. Pumping to deliver the Class A water to its fate location and purchase of land will be two significant cost factors. The cost estimate for Hoodsport assumes a lift station with 5,000 feet of force main and $250,000 to purchase land for the treatment plant and effluent fate.

Topography makes gravity sewers in Hoodsport impractical. Grinder pump technology is proposed since it is already used by Mason County wastewater utilities. Septic effluent pumping (STEP) technology could also be used. A selection will need to be made during design based on several factors previously listed including reliability, ease of maintenance, expected performance and cost.

Section 2.2.4 uses the AdvanTex system as an example while noting there are other on-site systems that can provide significant degrees of nitrogen reduction. The planning level estimates in this report suggest that such systems offer a cost advantage over central systems where soil conditions are adequate to make up the difference in nitrogen removal performance. This appears to be the case in Hoodsport. The extent of the use of advanced on-site cluster systems will need to be determined during design.

**Hoodsport Project Definition**
The recommended project for the Hoodsport RAC uses a grinder pump collection system to serve the Expanded Service Area2 (see **Figure 2.06**). The sewer collection system feeds a centrally located MBR treatment facility (see report's CD version **Appendix 1.4** "Finch Creek Wastewater Feasibility Study" for location possibilities) creating Class A reclaimed effluent.

During design final effluent fate must be determined. Among possible options are irrigation of forest land west of the Hoodsport RAC and infiltration of the highly treated water (see report's CD version **Appendix 1.4** "Finch Creek Wastewater Feasibility Study" for location possibilities). Another unexplored possibility is reuse of the highly treated water at the fish hatchery in Hoodsport.

Because of the risk of pollutant transport to Hood Canal, the use of advanced on-site cluster systems is proposed for an area west of the sewer service area along Hood Canal and below the plateau that occupies the western part of the Hoodsport RAC. Utility-owned and operated advanced on-site systems are envisioned with each system serving approximately 7 ERUs. Effluent would be discharged using a pressurized drip system in the public rights of way.

The current cost to complete the Hoodsport RAC project is estimated at $10.1 million in current dollars (please see Section 2.3.2 below for additional detail).

### *2.3.2 Planning Level Costs*

As noted in Section 1, this report is using planning level estimates. A typical approach for developing planning level estimates is to first establish unit costs for parts of the conceptual project such as a cost per lineal foot of 6" sewer pipe or the installed cost of a grinder pump.

Some estimates at this level are "lump sum" based on experience. It is too costly at this stage to estimate quantities of rebar or volumes of concrete. Qualified and experience engineers are a good source for these estimates that, when summed, can provide a construction cost. The construction cost comes with a contingency factor. It is important to note that construction costs are currently very unstable. Rapidly rising prices for Portland cement and steel make construction cost estimating more difficult than normal.

Other cost elements, such as design, project administration and assistance during construction are typically derived as a percentage of the construction cost estimate. Hoodsport and the two other Planning Areas are comparatively small wastewater projects, so the percentages should arguably be larger for these costs since a certain portion of the work is fixed and not proportional to the size of the job. A "rule of thumb" at this planning level of estimating is to multiply the construction estimate by 1.5 to estimate the total project cost.

A Hoodsport RAC cost estimate is presented in **Figure 2.23a**. Gray and Osborne, Inc., developed unit cost and lump sum (LS) estimates for systems to serve Service Area 2 (from the "Finch Creek Wastewater Feasbility Study" done in 2000) and Expanded Service Area 2 that was developed in response to both public input and the predicted soil transport of pollutants to Hood Canal. This report focuses on the Expanded Service Area.

CH2M Hill provided estimates for the advanced cluster septic systems proposed to serve the "moderate transport risk" zone west of the Expanded Sewer Service Area (see **Figure 2.17**). The costs developed are for an advanced cluster system with pressurized drip effluent dispersal serving seven homes. The number of clusters to be installed will need to be addressed during design using additional soils information.

For the purposes of a planning level estimate, six cluster systems are assumed. This number was not provided by an engineer.

**Firgure 2.23a** notes engineer-provided numbers with an asterisk (*). The sources of these can be found by examining the detail sheets in **Figures 2.23b** and **2.23c**. Other numbers are either derived from an engineer's estimate (6 clusters X estimated cost per cluster) or are experienced based (design cost = 12% of estimated construction cost).

The **Figure 2.23a** "bottom line" of ~$10.1 million is 15% less than the "rule of thumb" ($7.685 million X 1.5 = $11.53 miilion) would suggest. The lower estimate is offered because a substantial amount of study already exists to guide work in the Hoodsport RAC. The risk of unknowns is lowered somewhat. Also, if all three Planning Areas are designed by one firm or joint venture as recommended in Section 7, it is reasonable to expect some design cost efficiencies. These efficiencies could also extend to construction if a uniform approach is used.

### *2.3.3 Action Plan/Schedule*

In the late '90s wastewater management strategies for the area now designated as the Hoodsport Rural Activity Center were actively considered. Financing was and continues to be a major hurdle in the path of completing a plan and implementing it. Congressionally sponsored State and Tribal Assistance Grants and a State of Washington grant were "earmarked" for Hoodsport and the Hoodsport-Skokomish region. By 2005 there was more widespread recognition of the importance of Hood Canal as a significant public asset. Regulatory attention was more sharply focused on the Canal's bacterial and nutrient problems. Also, those interested in re-development, particularly in the Hoodsport commercial corridor, recognize wastewater management as an important element.

In 2007 at least two new factors are driving the need to better management of wastewater in the Hoodsport RAC. Congressional and state grants are going unused and there is substantial demand to reprogram the monies. Also, as a result of recent Puget Sound initiatives, there is greater state attention and there are more state resources available for water quality improvements. Consequently, the August, 2006, Memorandum of Understanding among the Skokomish Indian Tribe, Mason County PUD #1 and Mason County (see **Appendix 1.1**) is timely. Efforts to advance wastewater management in the MOU's three Planning Areas, including Hoodsport RAC, are securing assistance to do the vital planning efforts that must precede the design and construction work for which state and federal grants are earmarked. The activity has created a sense of both possibility and urgency to move forward. Along with the obvious need for environmental attention, there is a clear path of opportunity. It is time for action.

For the Hoodsport RAC wastewater management effort, schedule maintenance and project management are like housework: they are never finished. It is very rare that wastewater projects, regardless of how well planned, anticipate all challenges and opportunities. This dynamism has far-reaching impacts including the ability to precisely estimate performance dates, costs, and rate implications. This by no means suggests that schedule, budget and project management should not be carefully tended with the best talent available. It is to suggest that expectations must be managed along with the project, and that clear and frequent communication among owners and service providers is essential.

It appears possible to have a Hoodsport wastewater management effort in place and functioning by early 2010. This will require a high degree of aggressive attention and a fulsome measure of good fortune. In Section 5.5 a series of action steps is presented for the Potlatch and Core Reservation Planning Areas. Using those steps as a basis, a similar list of actions for the Hoodsport RAC is presented below. It is important to note that, although the steps are presented sequentially, there are opportunities to perform some actions concurrently and save time. For example, it is possible to complete design of the non-sewer advanced clustered on-site facilities independent of the sewer system. Also, collection and conveyance elements of the sewer system can be designed independent of the treatment facility once it is properly sited. **Figure 2.24** is a rough "example schedule" illustrating the ways some actions might overlap.

**Action Steps**

1. Prepare a Hoodsport Facilities Plan consistent with the Project Definition that is approvable by the Washington State Department of Ecology.
2. Prepare environmental documentation suitable for guiding elected officials approving the Facilities Plan and for funding that relies on the State Environmental Policy Act (SEPA), the State Environmental Review Process (SERP) for State Revolving Fund loans and National Environmental Policy Act (NEPA) documentation.

3. Carefully plan the Facilities Plan approval process to minimize delay and risk. Mason County approves wastewater Facilities Plans through the County's Comprehensive Plan amendment process. This occurs only once annually in December. Amendments to the Comprehensive Plan require environmental review and a public input process. Coordinating timely review by the Department of Ecology and initiating engineering design (see the next two steps) needs to be managed to avoid overall project delay and avoid design re-work as a result of Ecology review of the Facilities Plan.
4. Seek and secure Ecology approval of the Facilities Plan.
5. Select a design firm using Washington State procurement procedures and federal procurement procedures. This selection process can be conducted concurrently with preceding steps to minimize time loss.
6. With Environmental Protection Agency and Department of Ecology consultation, approve a scope of services, review points, schedule and contract with the selected design firm.
7. Initiate design and promptly prepare an Engineering Report for review and approval by the Washington Department of Ecology. Assure proper coordination with the Environmental Protection Agency and Ecology during the review steps of final design.
8. As design is initiated, determine the facility operator. Involve the operator in the design process and establish an operator training program to be conducted by the designer in a manner timely with plant completion. If the operator is a new organization or new to wastewater operations, operating costs may be incurred well in advance of revenues being generated by the new wastewater facilities. Currently only capital costs are anticipated during the design and construction process. It may be possible to capitalize operator costs during design and training.
9. As facilities are sited during final design, prepare site specific environmental documentation for siting options along with needed mitigation plans.
10. Assure during design that the potential for disturbing cultural resources is recognized and avoid or carefully plan for construction in these areas. Plans must include provision for construction observation by qualified personnel, methods for cost-effectively delaying construction (and continuing in other areas) in the event cultural resources are exposed, and appropriate agreed-upon arrangements are made for curation of resources if necessary. All cultural resource plans must be made with the concurrence of the Tribe and the involvement of the State Historic Preservation Officer as required by state law.
11. As soon as possible, acquire sites and start permitting activities for construction.
12. Determine how the County (or other utility owner) will supervise construction and assign responsibilities/authorities for accepting construction work. Hire or retain

necessary professional services or staff. Also assure plans are prepared for discovery of cultural resources and appropriate response plans are in place to assure sensitive and prompt handling consistent with State of Washington and Tribal requirements.

13. At the 80%-90% design stage, conduct a value engineering process managed by a qualified CVE specialist.
14. At or before the time of design approval but following preparation of plans, specifications and estimates, solicit construction bids in accordance with the construction plan. Bidding procedures must be consistent with federal and state requirements and any special requirements depending on fund sources.
15. With final approval of design, assure necessary permit applications are timely submitted and construction contracts are awarded.
16. Complete construction consistent with the construction plan.
17. Commission new facilities, initiate service, begin revenue stream.

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# 3.0 Potlatch “Bubble” Planning Information

## 3.1 Existing Information

### 3.1.1 Population and Flow Estimates

Wastewater service areas for the Reservation near Potlatch State Park are shown in **Figure 3.01**. The service areas were developed with direction from the Skokomish Indian Tribe (SIT) Wastewater Planning Committee, which included Tribal staff, Tribal Council members and consultants. The service areas were separated into 2 phases, Phase 1 and Ultimate Build Out. The separation of the 2 phases was prepared in response to Tribal direction, as a way to define an initial project that is economically feasible.

Existing land use types based on the Skokomish Indian Tribe’s land use maps are shown in **Figure 3.02**. The Tribe is in the process of defining the land use types, therefore these maps are subject to change. However, they are sufficient for purposes of this study.

Existing population numbers were prepared by Tribal staff, using an updated residential population survey for the intended service areas. Parcel information and a household inventory (manually developed) were provided by the Tribe.

For planning purposes, the population density observed by the Tribe for their tribal-managed housing was assumed to be representative of housing density throughout the Reservation (4.16 per household). Thus, a final estimate of the total population of the Reservation was made based on 4.16 people per household.

Additional information from Washington State Parks and Recreation Commission (WSPRC), Mason County and Mason County PUD #1, was incorporated into the final population and flow estimates for the Reservation. In general, 2.5 people were assumed to live in each mobile home or recreational vehicle (RV) in the Minerva RV Park and serviced in Potlatch State Park.

Growth projections were developed in consultation with the Wastewater Planning Committee which included Tribal staff, Tribal Council members and consultants. The assumptions used as a foundation for the growth projections are included in **Appendix 3.1**. Population estimates were prepared for two planning horizons: five year (Phase 1) and 20 year (Ultimate). **Figures 3.03** and **3.04** show the Potlatch area population and flow projections for the Phase 1 and Ultimate planning timelines.

The plan for Potlatch State Park will be updated in the next five years, after adjacent Tribal lands are developed, and the wastewater project definition is adopted. Future projections for both the State Park and Minerva RV Park are based on full occupancy of existing facilities.

Tribal housing development (T3ba’das Ridge) near Potlatch State Park is in its initial construction phase, with occupancy planned for May 2008. The planned first phase of development of new homes is the basis for this report’s Phase 1 growth projections. The Ultimate growth projection was based on full build-out of the planned Skokomish Tribal housing. Population projections for the new housing are based on 4.16 people per household, as noted earlier.

Growth in the service area north of Minerva RV Park is estimated to be at a rate of 1.5% per year, according to Tribal and Mason County planning estimates (see **Appendix 3.1**). Population per household was assumed to be the same as all Tribal households, or 4.16 people. Commercial growth was assumed to be based on both acreage (north of the powerhouse) and the number of new businesses (south of the powerhouse).

### *3.1.2 Hydrology*

The Skokomish Indian Reservation is located in the lower Skokomish River basin (**Figure 3.05**). Several spring-fed seeps are associated with the lower basin and substantial riverine and estuarine wetlands are located on the Reservation.

The river empties into Annas Bay at the Great Bend of the Hood Canal. Shellfish are harvested in the Bay by Tribal, commercial, and recreational harvesters. Bed locations are in Potlatch State Park, and to the south of the Park, and near the town of Union, in the eastward end of the Bay. Shellfish beds near the mouth of the Skokomish River recently closed due to fecal contamination (Washington Department of Health News Release August 16, 2005). The DOE has determined that the water quality of the river directly influences water quality in the Bay, including shellfish beds.

The lower section of the river (the last 10 miles) is a low gradient floodplain that has extensive wetlands and spring fed seeps. Agricultural activities and residential developments are located on the floodplain. Management practices concerning the floodplain are regulated by the Skokomish Tribe on the Reservation. The Skokomish Indian Tribe has developed a non-point source assessment (see **Appendix 1.1**), and has begun to initiate programs to reduce non-point sources of fecal coliform.

Recent concerns regarding low dissolved oxygen in Hood Canal together with significant fish kills in 2002-2003 and a smaller event in 2004 have prompted major initiatives including enhanced monitoring of the Skokomish River (Preliminary Assessment and Corrective Action Plan (PACA), May, 6 2004). The Puget Sound Partnership (Office of the Governor News Release December, 19, 2005) is an initiative organized by Washington State Governor Christine Gregoire to protect water quality throughout Puget Sound including the Hood Canal.

The natural hydrologic regime in the Skokomish basin has been altered. Research shows that land use practices have caused filling of the lower river channel with aggregate to over five times background levels (Barreca, 1998). The frequency and intensity of flood events has increased, and the water table has risen causing septic system failures.

### *3.1.3 Geology*

The best area for rapid infiltration is in Grove gravelly loam (Gk) soils, with glacial outwash sediments underneath, and no high ground water or surface water issues. Hoodsport soils on the soils maps, or Glacial Till on the geology maps, would not be suitable for rapid infiltration. See **Figure 3.06** for geology mapping, and **Figure 3.07** for soils mapping.

The area of mapped Grove soils in Service Area A is mapped as Glacial Till on geologic maps, with a small pocket of Outwash shown on one map. The geology report (in **Appendix 3.2**) indicates the Grove soils in Service Areas B through E are over Recessional Outwash, which is consistent, and more promising for rapid infiltration.

Areas along the highway are less steep, and therefore more favorable. Slope stability parameters include the slope geometry, soils (density, permeability, saturation, layering, etc.), amount, location and distance of added water, and other site specific variables.

*(Please see* ***Appendix 4.1*** *for more.)*

### 3.1.4 Environmental Issues and Permitting

As described in Section 2.1.5, the Mason County Comprehensive Plan (updated 2005) mapped a number of sensitive areas on a county-wide basis. Sensitive areas mapping within the study area has not been conducted as part of this project. The sensitive areas mapping, including geologic hazard areas, flood hazard areas, aquifer recharge areas, and surface water and wetlands has been reviewed as part of this project.

Within the Potlatch study area, the major surface water bodies include Hood Canal, numerous unnamed streams, and a number of wetlands. Potential impacts to wetlands and/or water bodies are likely the environmental issue of greatest concern. A field reconnaissance should be conducted prior to siting any treatment or disposal facilities to determine the location and extent of streams and wetlands. Conducting this review early in the process would potentially allow for wetland avoidance by making siting adjustments. Similarly, wetland delineations should be conducted when pipeline routes are determined so that wetland impacts can be avoided, or minimized to the greatest extent possible.

Water quality in Hood Canal has long been a concern. In general, Hood Canal suffers from elevated levels of nutrients and bacteria, and low levels of dissolved oxygen. Finch Creek has also exceeded water quality criteria for fecal coliform bacteria (Gray and Osborne, 2000). Implementation of the wastewater management project is expected to help reduce bacterial and nutrient loading to nearby surface water bodies from suspected poorly-functioning septic systems.

Other issues include potential impacts to groundwater, storm water impacts associated with increased development, and construction impacts to local roads.

**Appendix 2.2** provides a matrix summarizing the various permits that may be required for the Hoodsport Rural Activity Center, Potlatch, and Core Reservation Wastewater Management Planning areas. Given the general siting information currently available for the projects, a full range of permits that may be required is included. The matrix describes the type of permit, the agency responsible for reviewing the permit, the permit triggger, timelines, agency responsible, and other relevant issues.

### 3.1.5 Cultural Resources

This report section was prepared by Dr. Gary C. Wessen, a recognized archaeologist. It has been slightly edited here to be consistent with report formatting. The complete report, minus one map redacted to be consistent with state law, is **Appendix 3.3**.

### 3.1.5.1 Background

The Potlatch & Skokomish Indian Reservation (P & SIR) Study Area is located in northeastern Mason County. It consists of four distinct parcels on and near the Skokomish Indian Reservation (see **Figure 3.08**). The northernmost parcel is almost a square mile that includes Potlatch State Park and adjacent areas to the north, south, and west. It includes almost 1 mile of Hood Canal shoreline and much of the slope rising to the upland glacial plain to the west. A second large parcel of slightly more than a square mile includes much of the Highway 101 and 106 corridors and adjacent residential areas on the Skokomish Indian Reservation. It is entirely on the flood plain of the Skokomish River delta. A third parcel is approximately 0.25 square mile along the northern bank of the Skokomish River. It is also on the flood plain. Finally, the fourth parcel is less than 0.25 square mile on the upland glacial plain in the western part of the reservation. There are significant areas of commercial and/or residential development in portions of the first three parcels. The last parcel is currently undeveloped timber land.

The P & SIR Study Area is located within the traditional territory of the Tuwaduq (Twana) People. In early historic times - - and for a considerable period prior to them - - the Tuwaduq People occupied all of the lands in the immediate vicinity of Hood Canal. Many of their traditional settlements were located along the Hood Canal shoreline, often at or near the mouths of rivers or creeks. They also fished, hunted, and otherwise used a considerable range of lands interior to Hood Canal. Representatives of the Tuwaduq signed the Point-No-Point Treaty in 1855 and subsequently relocated onto the Skokomish Indian Reservation. Their descendants are now usually referred to as the Skokomish Indian Tribe.

There has been only very limited archaeological research within the traditional territory of the Tuwaduq People. Few efforts to locate archaeological sites have been conducted and those which have occurred have generally been limited in their geographic focus. Large scale systematic efforts to identify prehistoric archaeological resources have yet to occur here. Similarly, there have been relatively few detailed studies of particular archaeological sites anywhere along Hood Canal. We currently know that some traditional Tuwaduq settlements in the P & SIR Study Area have been occupied for at least 1,500 to 3,300 years. Other, as yet undated, archaeological sites in the area are probably much older.

### 3.1.5.2 Research Design

The goal of this report section is "to prepare an inventory of cultural resources in the P & SIR Study Area and advise in the planning effort so that disturbance to known and suspected cultural resources might be avoided to the fullest possible extent". The term 'cultural resources' as used here, refers to archaeological materials. Thus, this study has not addressed the possibility that there may be historic structures in the P & SIR Study Area. To our knowledge, there are very few and, moreover, our current understanding of the proposed wastewater management actions suggests that historic structures are unlikely to be affected. The focus of this effort has been directed largely toward archaeological resources representing the Native American occupants of the area. It should be noted, however, that archaeological resources representing late 19th and early 20th Century Euro-American occupants of the area could also be present in the P & SIR Study Area.

The results of the inventory effort have been summarized in two maps of the P & SIR Study Area. The first map shows the locations of recorded archaeological sites and settlements known from ethnographic and/or historical sources that may have archaeological manifestations. It is important to note here that the locations of recorded archaeological sites are protected by state and federal laws, and thus this information cannot be released to the general public. In this same regard, the Skokomish Tribal Historic Preservation Office has requested that specific information about the locations of traditional Tuwaduq settlements also not be released to the general public. These requirements have led us to develop a second map. The second map identifies zones of archaeological potential within the P & SIR Study Area. These zones have been developed on the basis of the distributions of the above-noted locations and generalizations about the relatively sensitivity of different types of landforms in the study area. In brief, low gradient surfaces in the immediate vicinity of the Hood Canal shoreline, the Skokomish River and the larger creeks are considered to have a relatively high potential for archaeological resources. The flood plain of the Skokomish River, vicinities of smaller low gradient creek channels, and so-called vista points (i.e., locations that offer sweeping views of the surrounding landscape) are considered to have a moderate potential for archaeological resources. Steep gradient surfaces and low gradient upland surfaces that are not located near creeks or lakes are considered to have a relatively low potential for archaeological resources. The map identifying zones of archaeological potential within the P & SIR Study Area may be released to the general public.

Finally, it is important to emphasize that the study reported here is not an archaeological survey of the P & SIR Study Area. While we have considerable familiarity with this area, no actual on-the-ground inspection for archaeological resources was conducted at this time. Rather, the effort was essentially a literature review and our products are based upon examination of documents on file with the Washington State Department of Archaeology and Historic Preservation, the Skokomish Tribal Historic Preservation Office, other materials in our possession, and prior archaeological site survey experience in this area.

### 3.1.5.3 The Cultural Resource Maps

Our map of the locations of archaeological sites and settlements known from ethnographic and/or historical sources that may have archaeological manifestations is presented in **Figure 3.09**. Note first that there are six archaeological sites in the P & SIR Study Area and eight more are located near it. Further, it is important to emphasize that this inventory is based on only limited archaeological survey efforts. To a large extent, the distribution of the known sites reflects where survey coverage is. Thus, most of the surveys conducted to date have focused upon either the Hood Canal shoreline or the Skokomish River channel. Survey coverage in the interior of the flood plain of the Skokomish River and on the uplands to the west have been quite limited. **Figure 3.09** also indicates that at least 10 traditional Tuwaduq settlements were located within, or near, the P & SIR Study Area. Five were located along the Hood Canal shoreline and another five were along the Skokomish River channel. Relatively limited information is available about many of these places, but several have been identified as large winter villages. Other may have been somewhat smaller locations such as seasonal fish camps. Native American archaeological resources – potentially including artifacts, occupation refuse, and human remains – may be present at any of these locations. We have less information about 19th and early 20th Century Euro-American occupations in the area, but know that a timber-related community was present along the Hood Canal shoreline at Potlatch. (The Potlatch community was developed in the vicinity of an older Tuwaduq settlement.) We also know that there were several mid 19th Century Donation Land Claims on the Skokomish Indian Reservation, although most were abandoned shortly after the reservation was established. Thus, there is also potential 19th and early 20th Century Euro-American archaeological resources in the Potlatch area and elsewhere to the south.

The information in **Figure 3.09**, and the generalizations about the relatively sensitivity of different types of landforms noted earlier, have been used to generate the archaeological sensitivity zones presented in **Figure 3.10**. Two important caveats need to be offered about this map. First, zones based upon landforms have been defined, as the landforms appear on USGS 7.5 minute topographic maps. These are valuable tools, but it is important to emphasize that there may be archaeologically sensitive features in the study area that are too small to be indicated on USGS 7.5 minute topographic maps. The zones shown in **Figure 3.10** are therefore generalizations about probable potential and should not be regarded as guarantees that archaeologically sensitive areas are not present within zones here identified as having only a low potential. A second caveat concerns the low gradient surfaces in the immediate vicinity of the Hood Canal shoreline. This area has been indicated as having a relatively high potential for archaeological resources. This study has not documented the history of filling along this shoreline. We raise this issue because we know that some locations (e.g., near the Cushman No. 2 Powerhouse at Potlatch and in the day use area of Potlatch State Park) contain fill deposits, and fill deposits are a complicating consideration. At first glance, fill sediments can be expected to be culturally-sterile, and thus documented fill areas should have no potential to contain archaeological resources. The issue is actually more complicated for two reasons. First, experience elsewhere in western Washington has shown that low lying areas with archaeological resources were sometimes filled in order to raise their base level. Thus, potentially significant archaeological resources can be present underneath fill deposits. Second, there are documented cases of archaeological sediments having been used as fill materials in western Washington. This means that it is possible that archaeological materials – including human remains – could be encountered in fill deposits.

The map of zones of archaeological potential within the P & SIR Study Area indicates that high potential areas include the low gradient surfaces in the vicinity of the Hood Canal shoreline, the Skokomish River channel and the Skebob Creek channel. These areas have the highest potential for both Native American and Euro-American archaeological resources. These are also among the most developed (i.e., disturbed) areas in the P & SIR Study Area. The history of historic disturbance may have damaged and/or destroyed archaeological resources in these areas. It would, however, be dangerous to simply assume this. In fact, there are many well documented cases of important archaeological resources having survived in badly disturbed, highly developed landscapes. (Witness the recent events at the graving dock site in Port Angeles.)

Areas thought to have a moderate potential for archaeological resources include those portions of the flood plain of the Skokomish River delta that are not in the immediate vicinity of the Hood Canal shoreline, the Skokomish River channel, or other creek channels and areas along the tops of slopes that look out over Hood Canal and/or major creek canyons. Some of the latter areas have also experienced significant historic disturbance (e.g., the Highway 101 and 106 corridors) and the above-note caution also applies in these areas.

Finally, significant portions of the P & SIR Study Area appear to have only a relatively low potential for archaeological resources. Areas thought to have a relatively low potential include steep surfaces along the margin of Hood Canal and low gradient interior surfaces on the upland glacial plain in the western portion of the P & SIR Study Area. While we are confident that the latter areas have only a relatively low potential for archaeological resources, we should emphasize that there is a difference between ‘low potential’ and ‘no potential’. It is possible that archaeological resources could be encountered in areas we characterize as having only a relatively low potential.

### 3.1.5.4 Resource Management Considerations

The assessments of archaeological resource potential presented here are based upon archaeological and ethnographic data and generalizations about the relative sensitivity of different types of landforms, as they appear on USGS 7.5 minute topographic maps. As already indicated, this study is not an archaeological survey of the P & SIR Study Area and should not be regarded as one. We therefore recommend that an archaeological survey of the areas to be impacted by the waste-water management system be conducted. Having said this, we think that project planners should be aware that – depending upon the system’s design – it may prove to be difficult to investigate some portions of the P & SIR Study Area. In particular, we note that some of the high potential areas have been extensively developed and thus, built features such as paved road beds and structures may make effective archaeological inspection difficult. Some of this difficulty may be addressed by test boring portions of the study area, but even the feasibility of this approach is difficult to assess at this time.

As such, while an archaeological survey is an important next step, project planners should recognize that such an effort may not be sufficient to be certain that archaeological resources are not present anywhere in their project area. We therefore think that some degree of archaeological monitoring may be appropriate during the construction of the planned facilities. The specific scope and character of such a monitoring plan should be developed after the results of the archaeological survey are available.

## 3.2 Additional Information

### *3.2.1 Treatment Soils Can Provide*

The Mason County Soil Survey (Ness, 1960) lists all soil types present in the planning area (except Made Land) as having “very limited” suitability for septic drain fields. Similarly, figures prepared by Latourell Associates show soil limitations for use of septic tanks over the entire Potlatch bubble planning area as either moderate or very severe (reproduced in HWA, 1994).

Soils with lower septic treatment capabilities include those that are excessively drained, such as Grove gravelly sandy loam, 5 to15 percent slopes (Gk), and soils formed on steep slopes, such as Hoodsport gravelly sandy loam, 30 to 45 percent slopes (Hf). These soil types would provide less treatment than slower draining soils due to higher permeability, resulting lower effluent residence times, and lower organic content.

HWA’s opinion is that of the three main soil types encountered (Hd, Hf and Gk), the Hd soils have the best septic treatment potential and least off site septic contaminant transport risk. Hf and Gk soils are both associated with surface water or drainages, and have a higher potential for off site septic contaminant transport, due to steep slopes and excessive permeability, respectively. Artificially placed or fill soils are also likely unsuitable.

Other planning criteria for enhanced treatment include distance to surface water, as it relates to potential for septic contaminant transport (e.g., BOD, nutrients, bacteria, etc.) to surface water bodies, particularly Hood Canal. Surface water for the purpose of this discussion includes creeks, intermittent drainages, tide flats, and Hood Canal. The planning area does not appear to contain isolated upland wetlands. **Figure 3.11** shows mapped wetlands and surface water features that are likely to convey septic drain field effluent rapidly and without much treatment to Hood Canal. Enhanced septic treatment (above conventional residential systems) may be considered for areas near surface water or drainages. For reference, Chapter 246-272A WAC, On-Site Sewage Systems specifies a setback of 100 feet for drain fields from surface water, and 30 feet from any down-gradient site feature that may allow effluent to surface.

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# 4.0 Core Reservation Planning Information

## 4.1 Existing Information

### *4.1.1 Population and Flow Estimates*

Core Reservation area population and land use types were assessed in the same way as the Potlatch area (Section 3.1.1). An aerial map of the Core Reservation proposed wastewater service area can be found in the next section of this report, **Figure 5.09**.

Planning assumptions for the Core Reservation area reviewed by the Skokomish Indian Tribe Wastewater Planning Committee are outlined in **Appendix 3.1**. In general, residential growth in this area is limited, due to the presence of the Skokomish River floodplain. Projection of wastewater flows assumed that land near Hwy 101 was above the floodplain, and available for development.

Residential growth was projected along Hwy 101 at a rate of 2% per year. Commercial growth was projected on a per acre basis in a narrowly defined corridor as approximated on the mapping.

The Tribal Center is planned for relocation during Phase 1, as is construction of a new Boys and Girls Club near the elementary school.

The Casino was projected to grow 400% over a period of 5 years, during Phase 1. Core Reservation population and flow estimates are included in **Figures 4.01** and **4.02**.

### *4.1.2 Hydrology*

Section 3.1.3 of this report includes hydrology information for the Core Reservation Planning Area of the Skokomish Reservation.

### *4.1.3 Geology*

Geologic and soils maps for the Skokomish Reservation are included in section 3.1.4.

Two or three sites appear to be favorable for rapid infiltration in the Core Reservation Area.

- Along Hwy 101, on the east side
- Near the top stream banks, east of Hwy 101, where Outwash is the geologic profile
- On the WSDOT property, where Outwash is the geologic profile.

There are also indications that suitable sites are available in or near Potlatch State Park and up on the new Skokomish Housing Area site.

The absence of outwash at the surface indicates low infiltration potential. Areas with outwash near (but not at) the surface (within 10 feet or so) may be suitable for deep systems (ponds, trenches, galleries, etc) but there is no way to determine this from the maps. As was outlined in section 3.1.4, Grove gravelly loam is the soil type favorable for rapid infiltration.

*(Additional soils-related investigations were performed as this report was being finished. See* ***Appendix 4.1*** *for more information about testing done in the Core Reservation Planning Area.)*

### *4.1.4 Cultural Resources*

Section 3.1.6 includes discussion of cultural resources for the Skokomish Reservation.

### 4.1.5 Environmental Issues and Permitting

The environmental and permitting issues associated with the Core Reservation area are very similar to those described for the Hoodsport and Potlatch areas in Sections 2 and 3, specifically 2.1.5 and 3.1.4. Within the Core Reservation study area, the major surface water bodies include Hood Canal, Entai Creek, numerous unnamed streams, and an extensive number of wetlands. Potential impacts to wetlands and/or water bodies are likely the environmental issue of greatest concern. A field reconnaissance should be conducted prior to siting any treatment or disposal facilities to determine the location and extent of streams and wetlands. Conducting this review early in the process would potentially allow for wetland avoidance by making siting adjustments. Similarly, wetland delineations should be conducted when pipeline routes are determined so that wetland impacts can be avoided, or minimized to the greatest extent possible.

**Appendix 2.2** provides a matrix summarizing the various permits that may be required for the Hoodsport Rural Activity Center, Potlatch, and Core Reservation Wastewater Management Planning areas.

## 4.2 Additional Information

### 4.2.1 Treatment Soils Can Provide

Section 3.2.1 includes discussion of soils for the entire Reservation.

### 4.2.2 Wetland Effluent Disposal

*(The Skokomish Indian Tribe is interested in considering the used of wetlands to manage highly treated wastewater. The firm Jones and Stokes was retained to explore this potential on the Skokomish Reservation. The following is a summary of the Jones and Stokes report. The complete report can be found in* ***Appendix*** *4.2)*

The feasibility of using natural or created wetlands is being considered as one of several options for effluent disposal to be evaluated in the update to the Skokomish Tribe Wastewater Facility Plan.

For the purpose of the analysis, it was assumed that the proposed wastewater treatment plant (WWTP) would treat wastewater to a “Class A” reclaimed water quality standard as defined by RCW 90.46 and the “Water Reclamation and Reuse Standards” manual (Washington State Department of Health and Washington State Department of Ecology 1997).

#### NATURAL WETLANDS

The Washington Department of Health and the Washington State Department of Ecology (1997) have developed a manual of Water Reclamation and Reuse Standards manual, including reclaimed water standards for use in wetlands. As a general guideline, discharge of reclaimed water into Category I or to saltwater dominated wetlands is not recommended except where it can be demonstrated that no existing wetland functions would be decreased and that overall net environmental benefits would result from the discharge.

Jones & Stokes conducted a “desktop” review of wetlands in the Core Reservation Area. Wetland information was derived from GIS data and mapping (Skokomish Tribe 2006) based on the

National Wetland Inventory (NWI), and a reservation-wide wetland inventory of Skokomish Tribal lands conducted by Sheldon & Associates (1994). No isolated or highly degraded wetlands (i.e., Category III or IV) wetlands occur in close proximity of the proposed WWTP. However, based on the desktop review, Jones & Stokes investigated four candidate wetland disposal locations in the "North Wetland", a Category I wetland located east of the proposed WWTP, and within one half mile the proposed WWTP. The sites were selected based on considerations of access, distance from the treatment plant, wetland class and condition, soils, and land use, and the possibility that, based on review of aerial photographs, the sites might benefit from reclaimed water. Field investigation revealed that none of the candidate sites were feasible for use of reclaimed water since all sites contained intact wetlands and no overriding net environmental benefit could be achieved from discharging reclaimed water to those sites.

#### CONSTRUCTED WETLANDS

Constructed wetlands are artificial wetlands constructed on non-wetland sites and designed to provide some measure of social or environmental benefit or treatment (i.e., polishing).

#### CONSTRUCTED BENEFICIAL USE WETLANDS

Constructed beneficial use wetlands can be used for recreational, cultural, or environmental benefits. Beneficial use wetlands can also be used as mitigation for the conversion or loss of wetlands caused by the development of a proposed project. Wetlands for this use are usually become "waters of the U.S." (i.e., jurisdictional wetlands).

The required quality of reclaimed water discharged to constructed beneficial use wetlands differs from the use of constructed wetlands for additional wastewater treatment (i.e., treatment wetlands). Reclaimed water discharged to constructed beneficial use wetlands must be Class B or better, while a lesser standard is applicable constructed wetlands used for treatment.

#### CONSTRUCTED TREATMENT WETLANDS

Constructed treatment wetlands are systems that are engineered and constructed in non-wetland sites and managed for the primary purpose of wastewater treatment. Constructed treatment wetlands are considered part of the wastewater collection and treatment system and are not considered "waters of the state" or "waters of the U.S."(i.e., and therefore not jurisdictional wetlands).

### Findings and Recommendations

#### NATURAL WETLANDS

An analysis of the feasibility of using reclaimed water in natural wetland included a review of literature and background GIS information of the Reservation, and field reconnaissance of four candidate wetland sites located in the North Wetland (a Category I wetland) east of Highway 101.

The analysis concluded that none of the four sites were found suitable for discharge for a variety of reasons, but with one overriding conclusion that none of the sites possessed degraded wetland functions or habitat conditions that would benefit from the discharge of reclaimed water.

### CONSTRUCTED BENEFICIAL USE WETLANDS

Beneficial use wetlands can have recognized cultural, recreational, or environmental benefits that are associated more with the use of reclaimed water to achieve those benefits than for the purpose of effluent treatment.

As a next step, the applicability and benefits of using constructed beneficial use wetlands for the Skokomish WWTP project should be determined if the Tribe is interested in using reclaimed water for cultural, educational, or scientific use. This decision should be based on such considerations as the goals and objectives for use of reclaimed wastewater, definable environmental and social benefits to be derived, and engineering considerations such as the location and size of the wetland and cost.

This analysis could include the feasibility and value or using a constructed beneficial wetland as storage in conjunction with a seasonal land application (e.g., to forest land) and infiltration discharge.

### CONSTRUCTED TREATMENT WETLANDS

Constructed treatment wetlands are recognized primarily for their value to treat wastewater rather than to provide wetland functional benefits. Constructed treatment wetlands are usually constructed in an upland setting, with the size and configuration of the wetland based on the desired pollutant reduction prior to discharge. Treatment wetlands require an ultimate discharge of the treated wastewater, either through infiltration, spray irrigation, or as a point discharge to a receiving water.

Class A reclaimed water cannot be achieved using constructed wetlands for treatment unless the effluent from the wetland is filtered prior to discharge (Fricke pers. comm.). The feasibility of using constructed surface-flow and subsurface flow wetlands for treatment, should be explored further if the Tribe chooses to consider discharging effluent of a lesser quality than Class A. For example, a treatment wetland could possibly be used to polish Class D effluent from the WWTP to a Class C quality for discharge.  The feasibility of this analysis would be dependent on type of disposal (e.g., spray irrigation or infiltration) and the water quality requirements. This analysis is largely an engineering exercise based on projected flows, projected quality of effluent to be treated, the desired quality for discharge, land availability, and costs for construction, operation, and monitoring.

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# 5.0 Technology Selection and Project Definitions for Skokomish Systems

## 5.1 Technologies

### *5.1.1 Inventory of Applicable Technologies*

The Wastewater Master Plan (November 1998) identified two acceptable treatment alternatives, the Biolac aerated lagoon system (manufactured by Parkson, Inc.) and the Sequencing Batch Reactor (SBR) system. The Biolac system does not provide adequate nutrient removal, and it can not meet the desired Class A effluent standards.

The Membrane Bioreactor (MBR) system (manufactured by Enviroquip, Zenon, and Koch) has become more prevalent and widely accepted as a reliable, cost-effective treatment technology for small flows. Several systems are operating successfully in the Northwest, as well. In addition, it has proven successful at treating to DOE's Class A standards for reclaimed wastewater Consequently, the MBR and SBR are the preferred alternatives.

Based on current Tribal Council direction, the preferred treatment plant will be a "good neighbor" facility, with low visibility and high air quality (EPA FARR guidelines), including odor control. The plant should optimize the use of space, and be easily upgraded for increased flows as needed for phasing or future growth. Though the Tribe has not adopted its own standards or Washington Department of Ecology (WDOE) standards, regulatory direction concerning water quality in this region should meet or exceed effluent discharge requirements that are equivalent to DOE's Class A reclaimed water standards. Class A reclaimed water is of such high quality that its use is unrestricted and direct human exposure (but not routine consumption) is allowed.

Estimated land area needed for the water reclamation plant and effluent disposal options are in **Figure 5.01**.

Of the area required for the treatment plant approximately 75 percent of the plant will be used for treatment of the wastewater, which includes tanks and equipment for influent pumping, influent screening, flow equalization, bioreactors, membrane skids/cells, and disinfection equipment. Also included are facilities for storing materials, treatment chemicals, operator offices, and laboratory.

As much as 25% of the land for the plant may be needed for sludge management. The Master Plan includes a description of sludge management alternatives. Sludge, or biosolids, may be stored and dried on-site, or hauled off to reduce the capital cost of the plant. There is an on-site sludge composting program at the Washington Corrections Center in Shelton which may be available to receive the sludge. For purposes of this study, provisions of sludge treatment include sludge stabilization and dewatering sufficient for disposal on land or in a landfill.

Criteria used to review the treatment alternatives include:

- Effectiveness and reliability
- Land requirements and future expansion requirements

- Cost and operations and maintenance requirements
- Environmental impacts and aesthetics

### 5.1.1.1 MBR Treatment Plant(s)

The MBR design provides a more consistent, high quality effluent, with fewer solids to handle. Wastewater is drawn through membrane filters by applying a suction pressure across the membrane. The pressure differential is generally provided by pumping; however some experimental gravity systems are being tested. Pumping increases operation costs.

The risk of exceeding water quality standards with the MBR plant is low because the membrane acts as a positive barrier to solids carryover.

### 5.1.1.2 SBR Treatment Plant(s) with Filtration

In most treatment plant designs, to meet Class A standards the SBR is followed by an effluent polishing system using a sand filter. The MBR facility does not require advanced treatment because the membrane is a positive barrier that provides that same level (or better) particle removal as the sand filter. To meet Class A reuse standards, particles are removed down to 5NTU's.

The SBR effluent quality is generally more sensitive to BOD loading in the influent. If the plant is overloaded and low dissolved oxygen conditions occur, the settling characteristics of the sludge may be affected and not enough solids are removed during the settling process. The remaining solids would then have to be removed by the filter, which in turn would affect its performance. However, the membrane in a MBR provides a positive barrier that always prevents solids from passing through in the effluent, even if the biological process is upset from overloading.

The risk of a biological system upset with an SBR is much higher, but with flow equalization and good operator attentiveness, SBR's can be very reliable and consistently produce a high quality effluent. However, effluent quality from an SBR may have BOD, TSS and TKN loading as much as 2 to 3 times the effluent quality from an MBR.

## *5.1.2 Effluent Disposal Technologies*

### 5.1.2.1 Rapid Infiltration

Rapid infiltration is the most efficient means for effluent disposal, in terms of capital and O & M costs, as well as in terms of the land requirements. However, rapid infiltration requires good geotechnical conditions, in order for it to work. These conditions include good soils, good geologic subsurface conditions and a relatively flat site.

In rapid infiltration systems, effluent flows through an array of parallel perforated pipes that are buried in a gravel filled basin. The flow is distributed evenly across the gravel bed and allowed to percolate into the groundwater. No significant impact to the groundwater would occur, because of the high quality of the effluent.

### 5.1.2.2 Forest Irrigation

Forest irrigation is land intensive and has high capital and O & M costs. An economic benefit can be developed from forest irrigation for effluent disposal, which may offset the costs. Land available for forest irrigation for both the Potlatch and Core Area is high above the proposed treatment plant location, and far away. Costs for pumping water and storing water, during the wet season, appear to be prohibitive.

Forest irrigation may be used in a natural forest or plantation (such as hybrid poplar). The effluent must be applied at agronomic rates, appropriate for the trees and depending upon the rate of evapotranspiration. Since uptake varies with weather, age, and season, effluent must be stored. Storage is also land intensive, requiring several acres to store 4 to 6 months of effluent. Storage would consist of a lined lagoon 8 to 10 feet deep.

#### 5.1.2.3 Wetland Use of Treated Effluent

Wetland augmentation is the discharge of effluent into an existing wetland, "augmenting" the existing water supply. The existing wetlands on the Skokomish Reservation are Type 1, high quality wetlands. Augmenting the water supply of a Type 1 wetland cannot enhance the quality of the wetland, therefore wetland augmentation is not allowed.

Constructed wetlands may be an option for effluent disposal; however constructed wetlands would not be considered a final point of disposal. Water would be discharged at some point from the constructed wetland, either to a surface water body or to a rapid infiltration basin. In addition, the water quality of a constructed wetland would not be Class A. Water fowl impacts to water quality would cause problems in meeting water quality goals for Hood Canal.

*(See Section 4.2.2 for details on using wetlands.* ***Appendix 4.2*** *is a technical memorandum by Jones and Stokes.)*

### 5.1.3 Technology Alternatives Considered

Alternatives for wastewater treatment and effluent disposal were developed as follows:

- Alternative 1, Potlatch Bubble – Consisting of four sub alternatives each with conveyance piping and pumping, either of two treatment types (MBR and SBR), and two types of effluent disposal (rapid infiltration and forest irrigation)
- Alternative 2, Core Reservation - Consisting of four sub alternatives each with conveyance piping and pumping, either of two treatment types (MBR and SBR), and two types of effluent disposal (rapid infiltration and forest irrigation)
- Alternative 3, Potlatch and Core Reservation Combined – Consisting of combining Alternatives 1 and 2 together to form one alternative to service both areas.

The configuration of each alterative is shown in **Figures 5.02, 5.03**, and **5.04**, respectively.

### 5.1.4 Recommended Technology

Each alternative was compared on a cost and non-cost basis. Comparison of costs is presented in the following section. Non-cost criteria used in the comparison were as follows:

1. Land acquisition
2. Ease of construction
3. Expandability
4. Flexibility for meeting future regulations
5. Ability to permit and satisfy environmental concerns
6. Visual impact
7. Ease of operation and maintenance

8. Odor potential
9. Environmental Impact
10. Land requirements

Of the technologies considered, it was determined that MBR treatment with rapid infiltration disposal was found to be preferred over SBR and/or forest irrigation for the following reasons:

1. MBR and RI require the least amount of land to acquire because they consume the least amount of land area.
2. Ease of construction for both options is similar
3. Both technology options are similar in their expandability, that is, treatment technology can be designed for a phased expansion. Rapid infiltration beds can also be sized for phased expansion.
4. Each technology is highly reliable and can be easily modified to meet future regulations.
5. MBR does a better job of meeting environmental concerns because it reliably produces a very high quality effluent
6. The SBR and MBR both have small visual impact because they can be easily screened with a building. The RI system has a much smaller visual impact than the much larger forest irrigation system.
7. Operation and maintenance of the MBR is easier than the SBR. The RI system has low O&M requirements when compared to the forest irrigation system.
8. Both technologies are similar in odor potential, because odors from both can be controlled with odor control systems
9. Forest irrigation system has the largest environmental impact because it uses the most land.
10. Both MBR and RI are the least land intensive of the technology options.

The MBR system was identified as the preferred method based on all the non-cost criteria reviewed.

## 5.2 One vs. Two Plants for Potlatch and Core

This report was started on the assumption each of the three Planning Areas (Hoodsport, Potlatch Bubble and Core Reservation) would be handled separately. During planning, the possible advantages of serving the Potlatch Bubble and the Core Reservation were actively discussed. Distance between the two service areas was one important factor (see **Figure 5.05**). Another was operating costs associated with one vs. two treatment plants. A third factor, schedule, emerged as significant.

The following sub-sections capture the discussion and recommendation to develop separate systems for the Potlatch Bubble and the Core Reservation.

### *5.2.1 Capital Cost Comparison*

#### 5.2.1.1 <u>Conveyance Cost Comparison</u>

All costs were developed for the ultimate system development.

The combined treatment alternative requires conveyance of Potlatch area flows to the Core Reservation treatment plant. The total additional cost for conveyance to the combined plant is $1,266,000.

Approximately $600,000 of this additional cost could be saved if the Core Area plant is sited to the east of the WSDOT parcel, allowing the elimination of the pump station to the plant. The cost of a separate plant for the Core Area would also be reduced by relocating the plant (approximately $400,000).

An inventory of the additional conveyance system components needed include:

1. A gravity sewer from the existing Potlatch Park drainfield to connect the new Tribal housing to the main sewer in Hwy 101 (approximately 2000 ft long, estimated at $80,000).
2. The pump station at Potlatch State Park would be redesigned to pump wastewater to the Core Reservation Area treatment plant. The existing pump station will be redesigned regardless of whether a combined or separate treatment system is constructed. Cost impacts for the combined system pump station redesign are associated with increased flows (additional flow from the new housing project) and decreased system headloss (since the pumps no longer discharge upslope in the Park). The increased cost is approximately $50,000.
3. Additional sewer is required to connect the Potlatch Area to the Core Reservation Area treatment plant (0.8 miles, estimated at $536,000).
4. The pump station to lift the flows from Hwy 101 to the treatment plant (assuming the plant is built west of the highway, on the former WSDOT parcel) must be redesigned for the increased flows (estimated at $600,000).

#### 5.2.1.2 Comparison of Treatment/Re-use/Disposal Costs

A single treatment plant would cost less than two separate plants (approximately $310,000, or 4%of the plant costs). The estimated savings is based on a conceptual level review of treatment plant costs. In general, larger facilities have an economy of scale, meaning that a linear increase in capacity does not result in a linear increase in cost.

Effluent disposal costs are approximately $49,000 less for the combined treatment plant, roughly 8% of the total disposal costs. However, the estimates are based on the assumption that the infiltration rates are ½ inch / hour for both the Potlatch and the Core Area. Preliminary geotechnical data suggests the rates may be higher for the Core Area, reducing costs, and potentially difficult to achieve near the Potlatch Area. A favorable infiltration site for the Potlatch Area has not yet been located, however, recent field investigations indicate that some favorable sites may be located at or near Potlatch State Park west of the Park in the new Skokomish Indian Tribe housing area. *(Please see **Appendix 4.1** for the most recent information.)*

### *5.2.2 Operation and Maintenance Cost Comparison*

Operation and maintenance costs for a combined system are approximately 25% less, primarily because of reduced staffing but also because of reduced power costs. The annual operation and maintenance costs for the combined system were estimated at $380,000.

### *5.2.3 Lifecycle Cost Comparison*

Present worth costs for both separate and combined systems were compared in

Figure **5.06**. The alternative with the lowest present worth cost is a combined system with SBR treatment and rapid infiltration effluent disposal.

However, the capital cost for a separate system, MBR and rapid infiltration is only 4% higher (approximately $730,000). The reduced risk of exceeding water quality goals may be considered "worth" the additional capital cost.

The present worth analysis estimates that annual labor and power costs will be 29% more for separate MBR plants, than for a combined SBR plant (approximately $106,000).

#### *5.2.4 Recommended Plant Configuration for Skokomish Reservation*

The most effective system, to achieve water quality goals, facilitate project phasing, and meet "good neighbor" objectives is the separate MBR and rapid infiltration systems.

To facilitate review of the difference in cost and design for combined vs. separate systems, a summary of cost differences for the MBR and rapid infiltration system is provided:

1. Conveyance costs are higher for a combined system ($627,000 if the plant is located east of Hwy 101, or $1,270,000 if located west of Hwy 101),
2. Treatment plant capital costs are higher for separate plants ($310,000),
3. O & M costs are higher for separate treatment plants ($92,000 annually).

Additional field investigation and evaluation is required in locating a good site for a rapid infiltration system for the Potlatch Area. *(Please see **Appendix 4.1** for the latest information.)*

Based on the information outlined above, and concerns that the construction schedule for a combined system may not meet the needs for the new tribal housing development, the recommended system is for separate treatment plants for the Potlatch and Core Reservation service areas.

## 5.3 Proposed Potlatch Project Definition

#### *5.3.1 Project Definition*

The recommended system for the Potlatch service area is a separate MBR treatment plant with a rapid infiltration effluent disposal system.

Tribal review determined this to be the most effective system, to achieve water quality goals, facilitate project phasing and related construction schedules, and to meet "good neighbor" objectives.

A preliminary layout of the conveyance system and phasing of the project is shown in **Figure 5.07**.

#### *5.3.2 Planning Level Costs and Project Phasing*

Phased system costs for the Potlatch Area were developed after reviewing four alternative treatment and disposal systems.

Estimates for the number of services were developed per Section 3.1.2, through the population assessment process. The phased system costs for the Potlatch Area are summarized in **Figure 5.08**. The table includes phased costs for both the Potlatch and Core Areas.

An important element in the process of developing system costs is the cost per service. The cost estimate includes infrastructure costs for hooking up each service, or in some cases each septic tank, for example at Minerva RV Park. The final cost for the entire system is then analyzed using Equivalent Residential Units (ERU's) to distribute costs fairly among users. In this way the Casino flows and loadings can be expressed in terms of ERU's, equalizing the financial burden fairly. By definition, a household is 1 ERU, however homes in Minerva RV Park may be slightly lower than 1 ERU.

Treatment costs for Phase 1 are based on an over-sized plant being constructed, equal to one-half the size needed for the ultimate build out in 20-years. Typical process design for treatment plants provide for redundancy to allow the plant to stay operational during maintenance. Because the Phase 1 flows are less than 50,000 gpd, a package plant would typically be constructed. But package plants can be 10% higher in cost. Further review of this approach to estimating the costs will occur as the project is developed.

## 5.4 Proposed Core Reservation Project Definition

### *5.4.1 Project Definition*

The recommended system for the Core Reservation service area is a separate MBR treatment plant with a rapid infiltration system.

Tribal review determined this to be the most effective system, to achieve water quality goals, facilitate project phasing and related construction schedules, and to meet "good neighbor" objectives.

A map of the Core Area phased conveyance system is shown in **Figure 5.09**.

### *5.4.2 Planning Levels Costs and Project Phasing*

The conveyance system was assumed to be a pressure system or septic tank effluent pumping system (STEP) based on the work done in the 1998 Wastewater Master Plan prepared by KCM. The phased costs for the Core Area are included in **Figure 5.08**.

A discussion on the number of services and ERU's is included in Section 5.3.2.

## 5.5 Combined Potlatch "Bubble" and Core Reservation Action Steps

The Potlatch Housing Project is underway and decisions concerning wastewater management are the highest priority among the various efforts necessary to implement the defined projects serving Potlatch and the Core Reservation. Every effort must be made to avoid costly duplicate or "interim" wastewater management approaches in the Potlatch Planning Area. Further, the Washington State Parks Department is in urgent need of a Potlatch State Park wastewater solution to assure protection of the environment and funding availability.

Further, the Core Reservation project is in need of prompt attention. The Tribe's desire to relocate the Tribal Center and meet expanding economic development centered around the Lucky Dog Casino demand quick and thoughtful management of wastewater issues.

The following steps offer an overview of how the defined projects can be successfully implemented over a three year period.

1. Complete Facilities Plan Amendments to the Department of Ecology approved Skokomish Indian Tribe Wastewater Master Plan for the Potlatch and Core Reservation Project Definitions.
4. Prepare environmental documentation suitable for funding that relies on the State Environmental Policy Act (SEPA), State Environmental Review Process (SERP) for State Revolving Fund loans and National Environmental Policy Act (NEPA) documentation.
5. Seek and secure Ecology approval of the Facilities Plan Amendments.
6. Select a design firm using Washington State procurement procedures and federal procurement procedures.
7. With Environmental Protection Agency and Department of Ecology consultation, approve a scope of services, review points, schedule and contract with the design firm.
8. Design facilities and submit design status reports and final design to the Environmental Protection Agency and Washington Department of Ecology for review and approval.
9. As design is initiated, determine what organization will be the operator. Involve the operator in the design process and establish an operator training program to be conducted by the designer in a manner timely with plant completion.
10. To the greatest extent possible, determine final siting of key facilities in advance of completing final design. Prepare site specific environmental documentation and, if necessary, mitigation plans. Make certain appropriate consideration is given to the potential for disturbing cultural resources and avoid or carefully plan for construction in these areas. As soon as possible acquire sites and initiate necessary permitting activities.
11. Determine the approach for construction supervision and assign responsibilities/authorities for accepting construction work. Hire or retain necessary professional services or staff. Also assure plans are prepared for discovery of cultural resources and appropriate response plans are in place to assure sensitive and prompt handling consistent with State of Washington and Tribal requirements.
12. At or before the time of design approval but following preparation of plans, specifications and estimates, solicit construction bids in accordance with the construction plan. Bidding procedures must be consistent with federal and state requirements and any special requirements depending on fund sources.
13. With final approval of design, assure necessary permit applications are timely submitted and construction contracts are awarded.
14. Complete construction consistent with the construction plan.

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# 6.0 Consolidated Ownership/Operations and Maintenance

## 6.1 Background and Process Overview

One of the principal requirements for every new sewer system is to establish who will own, operate and maintain their particular system. The Skokomish Tribal Council, the Board of PUD # 1 and the Mason County Board of Commissioners began their discussions on these issues at the most general level, as early as July and August of 2006. Since then, the staffs of these elected bodies, meeting as the TriParty Staff, have held a series of discussions to develop answers to the issues. For the purpose of these discussions, the following definitions have been developed:

**Ownership**: The role played by the party who holds the permit for the legal operation of a system; also responsible for the design, development and financing of the system, along with the necessary land acquisition and construction oversight. Once the system has been commissioned, the owner is responsible for setting and maintaining rates sufficient to ensure financial solvency of the system at a minimum and, ideally, a strong credit rating with critical bond rating agencies.

**Operations**: The role played by the party who is charged with the physical operation of the Wastewater Treatment facility, sending periodic bills for service, collecting customer payments, dealing with customers as they come and go on the system, and handling day-to-day financial matters within the budget established by the owner.

**Maintenance**: This is the role played by the party who performs preventive and reactive maintenance to the physical assets of the system, monitoring system performance to ensure compliance within the permit requirements, and making recommendations to the operator regarding plant upgrades and equipment replacement.

Consultants to the TriParty Staff generated a list of possible alternative models for ownership, operation and maintenance. The Tri- Party Staff was able to narrow the list of alternatives just through conversation, some being to complex and time-consuming to establish and others being infeasible from a practical or political perspective. At a subsequent meeting, the consultants facilitated the TriParty Staff's development of set of criteria to be applied to the remaining alternatives (see **Figure 6.1**). These criteria were loosely applied by the TriParty Staff to those alternatives and a few more of them were eliminated. Next, the consultants were asked to develop some possible scenarios around the remaining alternatives, setting a more detailed evaluation of the remaining alternatives. This evaluation was held in early February of this year and, as a result of the Tri-Party Staff's review, the following alternatives were recommended to the elected officials of the three entities for their review and approval.

## 6.2 Criteria for Reviewing Ownership

- Financial capacity
  - Ability to forecast, plan for and finance capital needs
  - Ability to issue debt and maintain suitable capital bond rating
  - Ability to generate revenue (rate-setting willingness/courage)
- Public willingness/acceptance of entity role
- Public willingness/acceptance of project
- Experience and capacity to oversee planning, design, permitting and construction
- Stability of governance and institutional structure
- Relates productively to community vision and intergovernmental (single and multi) objectives
- Regulatory and grant agencies accept owner eligibility and credibility

## 6.3 Criteria for Reviewing Operations and Maintenance

- Staff capacity, training and experience and equipment
- Systems and management methods
- Revenue collection capacity
- Systems
- Ability/willingness to exercise enforcement authority
- Ability and experience to balance cost and operational reliability
- Capacity, authority and ability to execute the plan/vision

## 6.4 Scenarios Considered

The Tri-Party staff developed role scenarios in terms of options for which entity could own and which could operate the recommended wastewater facilities for each planning area. These are summarized below.

### *6.4.1 Hoodsport RAC Central Wastewater Facilities*

- County owns and operates
- County owns and PUD operates under contract with the County
- County owns and contracts with another public or private entity for operations
- County owns in the short term and PUD owns in the longer term. PUD operates with mutual aid agreement for operations among the three entities

### *6.4.2 Core and Potlatch Central Wastewater Facilities*

- Skokomish Indian Tribe owns and operates
- Skokomish Indian Tribe owns and PUD operates under contract with the Tribe
- Skokomish Indian Tribe owns and PUD operates in the short term, then Tribe operates in the longer term, with mutual aid agreement for operations among the three entities

### *6.4.3 Managed On-site Facilities*

- County manages and operates
- PUD manages and operates under contract with owners
- Private entity manages and operates under contract with owners
- Skokomish Indian Tribe manages and operates on Reservation

- Whatever entity operates the central facilities should operate the managed on-site facilities for that area

## 6.4 Recommended Approach

The recommended approach to ownership and operations is based on the entities' understandings of their respective capacities to take on the ownership or operations role and to meet the established criteria for the role.

### *HOODSPORT RAC CENTRAL WASTEWATER FACILITIES*

The recommended approach for the Hoodsport RAC is for the County to finance, design and construct the wastewater facilities and to establish the utility and rates for the system. The County and PUD would consider transfer of ownership after some period of County ownership. Operations would be done by the PUD under contract with the County.

A proposed mutual aid agreement would be executed between the County, Skokomish Tribe and PUD #1. This agreement would provide the terms for providing operations and maintenance assistance among the entities upon request by one of the entities.

### *CORE RESERVATION AND POTLATCH CENTRAL WASTEWATER FACILITIES*

The recommended approach for the Skokomish Reservation Core and Potlatch areas is for the Skokomish Tribe to finance, design and construct the wastewater facilities and to establish the utility and rates for the system. The Tribe would contract with the PUD for operations initially, and the Tribe would operate the facilities in the longer term when it gains the required staff and systems capacity and experience.

As discussed above, a mutual aid agreement executed between the three entities would provide back-up assistance for operations and maintenance among the entities.

### *MANAGED ON-SITE FACILITIES*

The recommended approach for operations of "managed" on-site facilities is for the entity that operates the central facilities to also operate the managed facilities for that area. If the PUD becomes the primary operator of central wastewater facilities, then the PUD would be the primary contract operator for managed on site facilities for the Hoodsport to Skokomish region

### *AGREEMENTS NEEDED*

In order to pursue the approaches recommended above the following agreements would be needed:

- Contract between Mason County and the PUD for the PUD to operate and maintain facilities in the Hoodsport RAC
- Mutual aid intergovernmental agreement between Mason County, the Skokomish Indian Tribe and PUD #1

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# 7.0 Summary Cost Estimates and Schedules

The following table presents a summary of the estimated project costs by stages. Facilities planning is the next step toward completion of the three projects defined in this report. Although the Skokomish Indian Tribe is not compelled to following Washington Department of Ecology's planning procedures (the Tribe is within the federal Environmental Protection Agency's jurisdiction), Skokomish officials have decided to follow the steps set forth in Washington Administrative Code 173.240. Not only will this simplify collective management of the three proposed projects, it also clearly indicates the Skokomish Indian Tribe's intention to meet or exceed both federal and state water quality requirements.

Under 173.240 a Facilities Plan is submitted for review and approval. The Facilities Plan describes in general terms the wastewater management approach, general location of facilities and financial considerations. This is followed by initiation of design and submittal of an Engineering Report that describes treatment processes, facility sizing and other factors that serve as the basis for final design. Ecology approval of the Engineering Report leads to preparation of the final designs, specifications and estimates necessary to secure bids for construction.

In the table below, costs for facilities planning are distinguished from design and design-related activities since grant funding necessitates this distinction. Similarly, design, engineering assistance during construction, permitting and project administration are included under design to make these activities distinct from actual construction as necessitated by grant funding.

The estimates for facilities planning, design, and construction/land acquisition are summed in the total cost to complete column. It is once again important to stress that these are planning level cost estimates. The construction costs are composed of unit cost estimates (such as the cost of a lineal foot of a certain type of pipe multiplied by the estimated feet required) and lump sum estimates for structures, etc. The sum of these construction estimates and a contingency factor of 15% to 25%, comprise the construction cost estimate for a project.

Other cost elements, such as design and project administration, are estimated as percentages of the construction cost. It is very likely that during preparation of an Engineering Report and during final design, construction cost elements will change. Accordingly, these estimates should not be considered final.

## Cost Estimate Summary

| Planning Area | Facilities Plan | Eng. Rpt. & Admin./Design | Construction & Land | Total Cost to Complete |
|---|---|---|---|---|
| Hoodsport RAC | $108,683 | $1,921,340 | $8,025,362 | $9,946,702 |
| Potlatch "Bubble" | --- | $432,180 | $3,001,250 | $3,433,430 |
| Core Reservation | --- | $813,780 | $5,651,250 | $6,465,030 |
| Potlatch+Core Reservation | $175,257 | --- | --- | $0 |
| Total for 3 Planning Areas | $283,940 | $3,167,300 | $16,677,862 | $19,845,162 |

Details behind the numbers presented in the table above can be found in **Figure 7.01**. Three engineering firms developed estimates for this project definition effort. Their estimating approached differed somewhat. The Hoodsport estimates are presented in tabular form in **Figure 2.23a**. The estimates developed by engineers have an asterisk beside them. The numbers for the Potlatch "Bubble" and Core Reservation projects (found in the table at the bottom of **Figure 7.01**) were all prepared by engineers using the technique described above. Consequently, there are slight differences in developing the estimates, but these differences are not consequential at this stage of cost estimating.

During preparation of the Facilities Plans, it is recommended that a common cost estimating approach be used. It is especially important that a common estimating system be used during design. This is easily achieved if a single firm or joint venture is employed as designer.

***NOTE:***
*As this report was being prepared an opportunity for funding a major portion, if not all, of the cost of preparing Facilities Plans arose. It appears that sufficient funding will be available to prepare these plans provided the Tri-Party group (the Skokomish Indian Tribe, Mason County PUD #1 and Mason County) can act quickly enough to meet the timing conditions for use of the money.*

*For this reason the Facilities Plan elements of the table presented above and the table presented in* ***Figure 2.23a*** *are shaded.* ***It is also critical to note that the "Cost to Complete" column in the table above no longer includes numbers in the "Facilities Plan" column.***

Several schedules for the projects defined in this report have been developed. The example schedule for Hoodsport, presented in **Figure 2.24**, indicates the possibility of completion by early 2010. Similar schedules could also apply for the Potlatch "Bubble" and the Core Reservation. However, the greatest urgency surrounds the Potlatch "Bubble."

As noted in Section 5, several factors make the Potlatch effort critical:

- New Skokomish Indian Tribe housing is being constructed in the Potlatch service area. A wastewater project timely completed would avoid the need for interim septic systems serving the new housing.
- Potlatch State Park has funding and is in urgent need of a wastewater project to satisfy legislative concern for improved wastewater management.
- A land transfer involving the Tribe, State Parks and the Minerva Beach Community presents timely opportunity for improved wastewater management.

The Hoodsport and Core Reservation projects also have many factors arguing for their prompt completion. Relocation of the Tribal Center and commercial redevelopment pressures in both Hoodsport and the Core Reservation need wastewater management attention.

Throughout the planning process to develop the project definitions in this report there has been agreement that if at all possible the projects should be designed so as to not preclude the very long term possibility that all three wastewater systems might one day be connected.  Further, if similar design standards, similar equipment and similar operating procedures were designed into the projects, there would likely be cost savings achieved through joint operations (see Section 6).

Because it would be efficient for the three projects to be similarly designed, because the TriParty group has agreed to pursue funding and development of the projects collectively, and because prompt completion is important for all three projects, it is recommended a single design firm or joint venture be retained to engineer all three projects. Assuming a firm or joint venture with sufficient capacity is retained, all three projects could move forward together and benefit from joint equipment selection and other design design decisions being made concurrently rather than sequentially.  Additionally, worked together, the collective effort becomes large enough to enjoy a more favorable bidding climate with larger contractors seeing opportunities to have one vs. three mobilizations, etc.

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# 8.0 Funding

Wastewater management infrastructure is expensive. Regardless of the treatment technology, the underground conveyance systems and treatment facilities involve are comparatively long-lived, but capital intensive. Typically, areas that are more densely populated develop wastewater infrastructure as population increases. In the Hoodsport-Skokomish region, however, no conveyance systems are in place and treatment is generally conventional individual on-site septic systems. This means conveyance must be built in already-built environments with various other buried utilities and/or developed public rights-of-way. This adds to the cost.

The following table lists funding that has already been offered for the Hoodsport-Skokomish region. The funding in the shaded area is spent. The rest of the funding remains available as of early 2007.

**Grants for Hoodsport-Skokomish Wastewater Management**

| | | | |
|---|---|---|---|
| Puget Sound Early Action | $57,000 | Alternatives Study | Spent and completed |
| Puget Sound Action Team-Hood Canal Coordinating Council | $177,320 | Project Definitions | Spent and completed |
| STAG '03 for Hoodsport | $667,800 | Construction | Grantee = PUD<br>(45% needed match $601K) |
| STAG '06 for Hoodsport – Skokomish Region | $4,300,000 | Construction | Grantee = unassigned<br>(45% needed match $3,870K) |
| Centennial Clean Water Fund | $1,000,000 | Design/Construct | Grantee = unassigned |
| State Parks – Potlatch | $1,050,000 | Design/Construct | '06 Leg. Appropriation |
| ***Unused "Earmarked" or Committed Funds*** | **$7,017,800** | | |

All of the funding listed above is in the form of grants. The two State and Tribal Assistance Grants (STAG) require 45% matching funds. Federal money may not be used f6r matching purposes, however state and private grants and loans as well as "in kind" efforts such as allowable staff costs may be suitable for match. Neither State and Tribal Assistance Grant is "under contract" (no specific grant agreement has been established that specifies exactly how the money is to be used and what entity is responsible for its proper management). The '03 money in particular may be at risk for continued re-appropriation.

STAG funds are administered by the Environmental Protection Agency. In the table they are listed as being for construction. It is possible to use these funds for design, but the justification and administration of STAG money for services which are not competitively bid is comparatively complex and is not commonly done in US Region 10.

The Washington State Centennial Clean Water Fund grant may be used for both design and construction and is generally suitable for meeting federal grant match requirements. Like the STAG funding, no contract has been executed for this grant. The $1,050,000 state legislative appropriation listed is money assigned to the Washington State Parks Department for improving wastewater management at Potlatch State Park. It is intended to be obligated by the end of June, 2007, and its expenditure is expected to result in suitable resolution of wastewater management for the park. The State Parks Department has been a willing and active participant in discussions and planning for a wastewater project in the Potlatch Planning Area. The $1,050,000, by current estimates, may be approximately the right amount to cover State Park's appropriate share of the project defined for Potlatch.

As always, grants are more desirable than even zero interest loans. The absence of any existing utility to initiate borrowing, the need for nearly all facilities to be completed and operational before there is any revenue to pay back borrowed money, and the comparatively small number of customers relative to the substantial operating and capital requirements leave limited capacity to handle borrowing as a major sources of funding.

## 8.1 Potential Funding Sources

The TriParty Staff reviewed potential funding sources and completed development of a grant and loan source inventory. The inventory is presented on the next three pages. It is divided into three sections that list relevant sources for planning, designing and constructing wastewater management facilities. Among the most conveniently available loans are those from the Washington Public Works Board that administers the Public Works Trust Fund. Grants are typically available competitively on an annual cycle such as those from the Department of Ecology's Centennial Clean Water Fund.

Federal funding typically requires completion of a National Environmental Policy Act (NEPA) environmental review. Many organizations elect to prepare a State Environmental Policy Act (SEPA) reviews concurrently. See Sections 2.1.5, 3.1.5, 4.1.5 and the related **Appendix 2.2** for additional details.

# Funding Sources Table

TriParty Staff

1/13/07

| Source | Maximum | Match | Interest | Term | Available Grants | Availability of Funds |
|---|---|---|---|---|---|---|
| ***Planning*** | | | | | | |
| **Public Works Trust Fund:**<br>Applications due 5th of each month.<br>Awards occur monthly. | $100,000 | None | 0% | 1-6 years | None | 90 days after approval |
| **Community Development Block Grant: Planning Only**<br>Continuously open, planning only<br>Awards follow staff resources meeting | $35,000 | Should Offer | - | - | Jurisdictions with >51% lower/middle income | 90 days following approval |
| **Community Economic Revitalization Board:** Submit 45 days prior to quarterly meetings in January, March, July and November. Award follows Board meeting. | $50,000 | 10% | - | - | Yes | When grant contract is executed |
| **USDA Rural Development:**<br>Predevelopment Grants[i]<br>Must meet with RD to determine if eligible | $28,000 | None | - | - | Available only if future funding is through RD | When grant contract is executed |
| **USDA Forest Service:** | Funding is cut | | | | | |
| **State Revolving Fund:**<br>Applications due in October<br>Awards announced in January | <50% of funds available | - | 0% - 2.6% | 6 -20 yrs. | | Spring |

| ***Source*** | ***Maximum*** | ***Match*** | ***Interest*** | ***Term*** | ***Available Grants*** | ***Availability of Funds*** |
|---|---|---|---|---|---|---|
| ***Design*** | | | | | | |
| **State Revolving Fund:**<br>Applications due in October<br>Awards announced in January | <50% of funds available | | 0% - 2.6% | 6 -20 yrs. | | Spring |
| **Centennial Clean Water Grant Fund:**<br>Applications due in October<br>Awards announced in January | <50% of funds available | | 0% - 2.6% | 6 -20 yrs. | | Spring |
| **State Revolving Fund:**<br>Applications due in October<br>Awards announced in January | <50% of funds available | - | 0% - 2.6% | 6 -20 yrs. | | Spring |
| **Public Works Trust Fund: Pre-Construction**<br>Applications due 5th of each month.<br>Awards occur monthly. | $1,000,000 | 15%<br>10%<br>5% | 0.5%<br>1.0%<br>2.0% | 20 yrs | | 90 days after approval |
| **State and Tribal Assistance Grants:**<br>Congressional grant administered by EPA | | 45% | - | - | | When grant contract is executed |
| **US Dept. of Commerce: Federal Economic Development Administration** | | | | | | |
| **Bureau of Indian Affairs*** | | | | | | |

## *Construction*

*-continues on next page-*

| | | | | | | |
|---|---|---|---|---|---|---|
| **Public Works Trust Fund: Construction**<br>Applications due in May.<br>Awards occur in August. | $10,000,000 | 15%<br>10%<br>5% | 0.5%<br>1.0%<br>2.0% | 20 yrs | None | May following award |
| **Community Trade and Economic Development: Jobs/Communities**<br>Can be Legislative ear mark | | - | - | - | | |
| **Community Trade and Economic Development: Job Development**<br>Can be Legislative ear mark | | - | - | - | | |

| ***Source*** | ***Maximum*** | ***Match*** | ***Interest*** | ***Term*** | ***Available Grants*** | ***Availability of Funds*** |
|---|---|---|---|---|---|---|
| **Centennial Clean Water Grant Fund: Facility Projects**<br>Applications due in October<br>Awards announced in January | <50% of funds available | - | 0% - 2.6% | 6 -20 yrs. | | Spring |
| **Community Development Block Grant: General Purpose**<br>Apply in November<br>Award by April | $1,000,000 | Should Offer | - | - | Jurisdictions with >51% lower/middle income | June |
| **Community Development Block Grant: Community Investment Fund**[ii]<br>Continuously open<br>Awards follow staff resources meeting | $1,000,000 | Should Offer | - | - | Jurisdictions with >51% lower/middle income | 90 days after approval |
| **Community Economic Revitalization Board:** Submit 45 days prior to quarterly meetings in January, March, July and November. Award follows Board meeting. | $1,000,000 | 10% | - | Tied to cost of 10 yr. bond | | When grant contract is executed |
| **State and Tribal Assistance Grants:**<br>Congressional grant administered by EPA | | 45% | - | - | | When grant contract is executed |
| **Centennial Clean Water Grant Fund: Hardship Facility Projects**<br>Applications due in October<br>Awards announced in January | $10,000,000 | Grant matched by mandatory SRF loan | 0% - 1.5% | 6 -20 yrs. | <$5,000,000 based on hardship | Spring |
| **Centennial Clean Water/State Revolving Fund: Activity**<br>Applications due in October<br>Awards announced in January | $500,000 | Cash, in-kind, other grants/loans | 0% - 1.3% | 5 yrs. | Up to 75% grant based on hardship | Spring |
| **USDA: Tribal Wastewater Assistance*** | $1,000,000 | | | | | |
| **Indian Health Services*** | | | | | | |
| **Private Foundation Assistance** | | | | | | |
| **Tacoma City Light*** | | | | | | |

*Available to Skokomish Tribe

Half of one percent of the money for the Water and Waste grant program is available for Engineering Report and NEPA documentation.

i Must be in top three on County's WA-CERT list.

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The preceding inventory is neither complete nor static. It is a starting point. Public Utility District #1, the Skokomish Tribe and Mason County is each experienced at making application for, being awarded and managing grants and loans. Individuals on the staffs of each entity can make application for and pursue grant and loan opportunities. To aid this effort, it is recommended files of relevant wastewater grant and loan applications and relevant data be actively maintained by some person or position responsible to the TriParty group so as to assure consistency and simplicity when submitting grant and loan applications

## 8.2 Unified Funding Strategy

The TriParty Staff and the elected officials of the three parties to the August Memorandum of Understanding have had frequent and substantial discussion concerning the pursuit of funding. Prior to the February 6, 2007, meeting of elected officials from the PUD, the Tribe and the County, staff used a funding planning tool to consider various approaches for using the grant funds already available and filling in the voids with applications for other assistance. Attempting to fairly allocate existing grant resources among the three planning area projects proved complex and ineffective, not unlike “fitting square pegs in round holes.” Dealing with various stages (pre-design, design, construction) of the three projects in aggregate proved more satisfactory.

The TriParty staff’s review showed better ability to promptly use existing grants and probably better chances and flexibility in getting additional funding by the parties working together. This viewpoint was presented to elected officials on February 6th. Although no specific action was taken, the group reaffirmed an earlier position to pursue funding collectively, not competitively, to fullest extent possible with the understanding that…

> Full commitment exists currently by all entities to this memorandum to plan, design, and implement and operate wastewater solutions all three planning areas although work schedules and completion dates may vary.
>
> *August 31, 2006*
> *Memorandum of Understanding*

The parties recognize that a unified funding approach among the three parties makes efficient use of funding resources, provides a stronger voice in securing funds, and draws on the best talent from each entity to vigorously pursue the common goal of completing projects in all three Planning Areas. The parties will work jointly to secure and manage funding. It is completely clear that the parties to the Memorandum of Understanding do not collectively constitute a corporate entity. As a group they have no ability to execute grant and loan contracts with funding agencies. Agreements will need to be executed by one or more of the parties for each funding opportunity.

The proposed Unified Funding Strategy to pay for the implementation of all three project definitions includes the following:

1. Arrange “fiscal agent” status for one entity
2. Find $160,000 to do pre-design (complete Facilities Plans)
3. Concurrent with the preceding step, fund NEPA/SEPA as required for grants
4. Plan for state and private funding and “in-kind” efforts to serve as

federal match with particular attention to federal eligibility

5. Work through agreements necessary to sign grant contracts for pre-design
6. Arrange management structure and staff  (someone providing on-going attention to TriParty matters) to suit funding strategy and figure out how to pay for it during pre-design, design and construction
7. Pursue construction funding gap on various fronts

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### Figure 2.01

# Hoodsport
# Rural Activity Center (RAC)

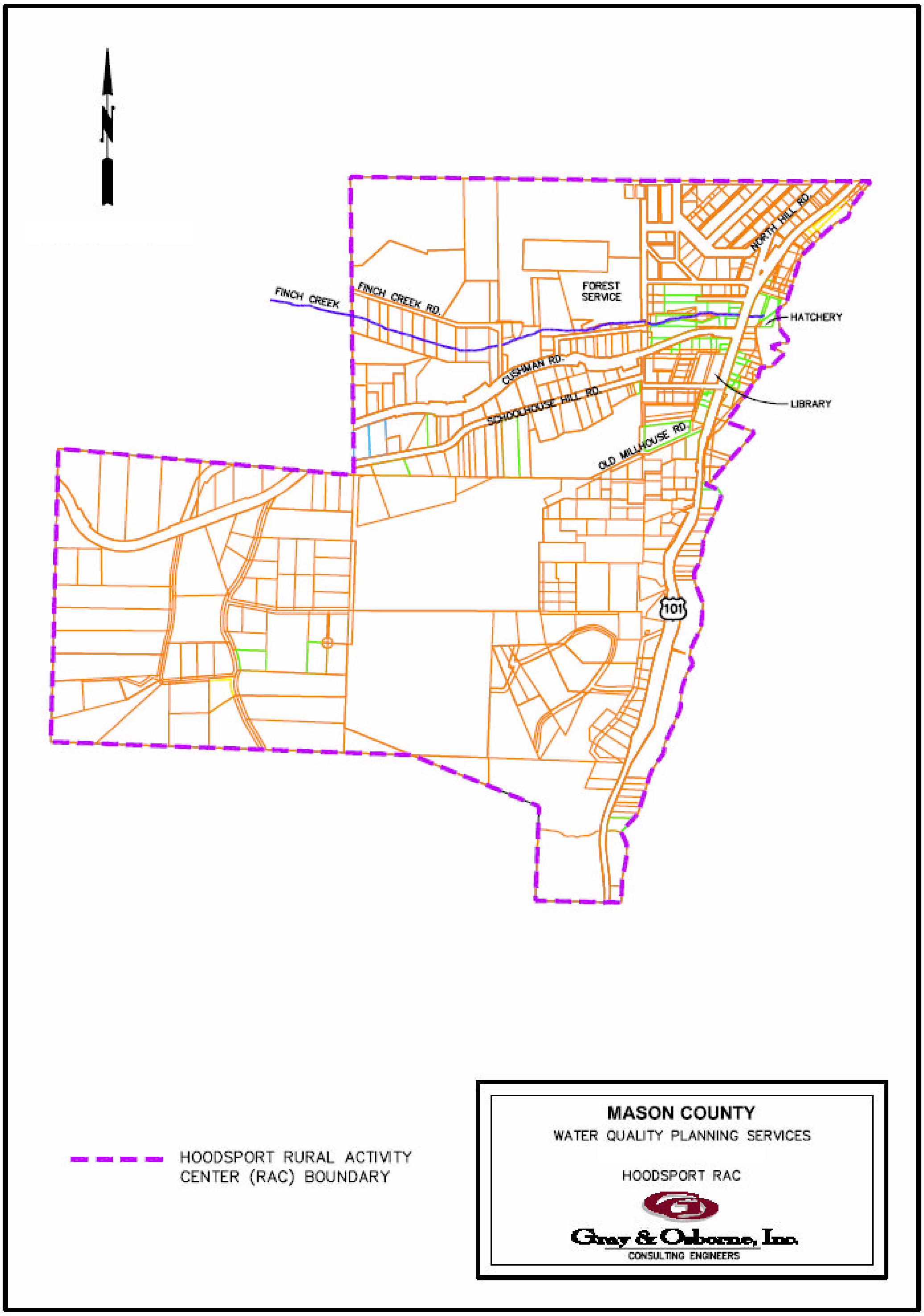
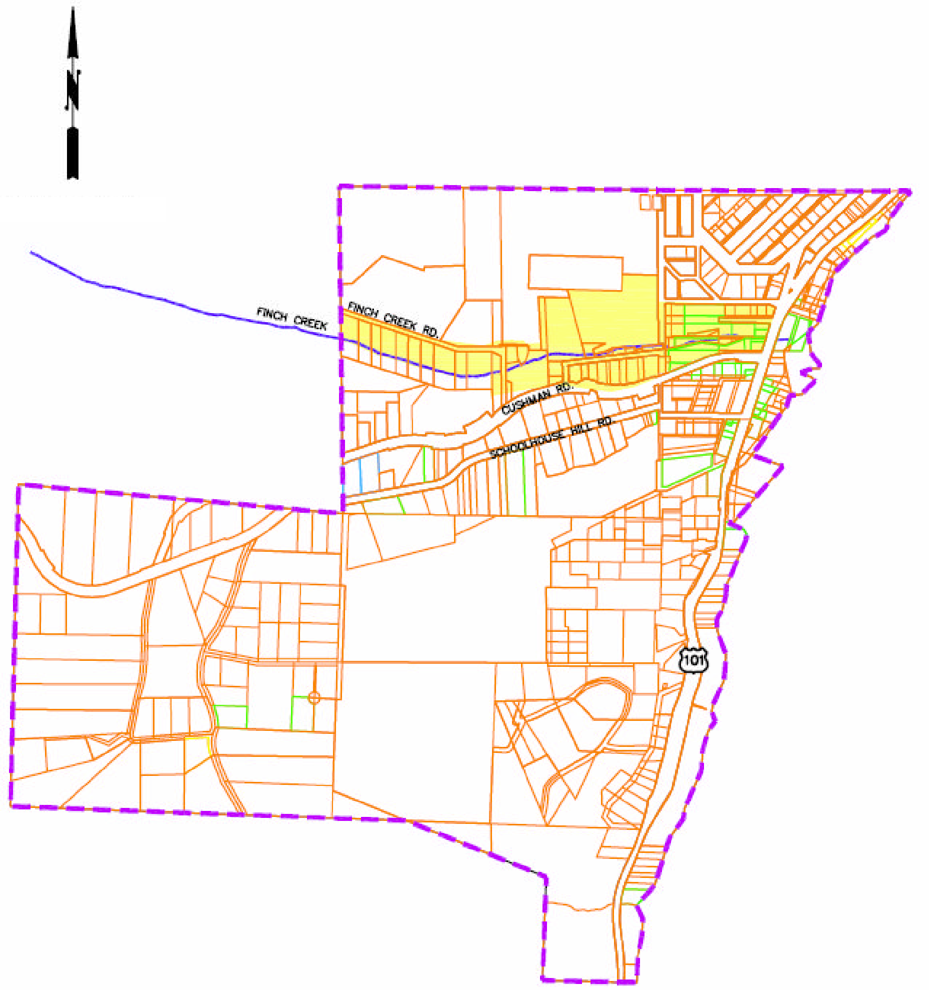


Figure
2.02

## Figure 2.02
# Hoodsport
# Service Area 1 Alternative



HOODSPORT RURAL ACTIVITY CENTER (RAC) BOUNDARY

**MASON COUNTY**
WATER QUALITY PLANNING SERVICES

HOODSPORT RAC WITH SERVICE AREA 1 ALTERNATIVE

Gray & Osborne, Inc.
CONSULTING ENGINEERS

Figure
2.03

### Figure 2.03

# Hoodsport
# Service Area 2 Alternative

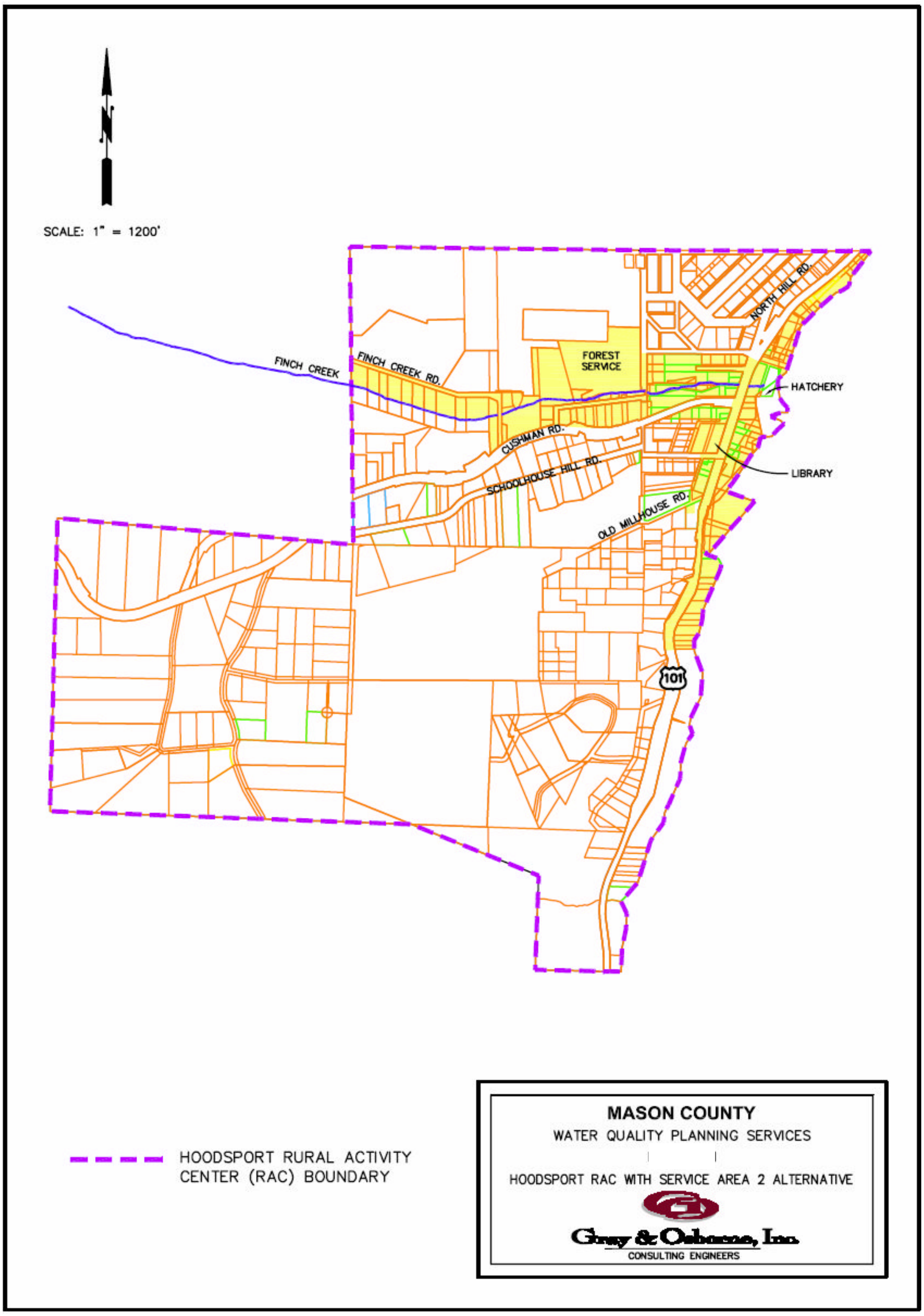


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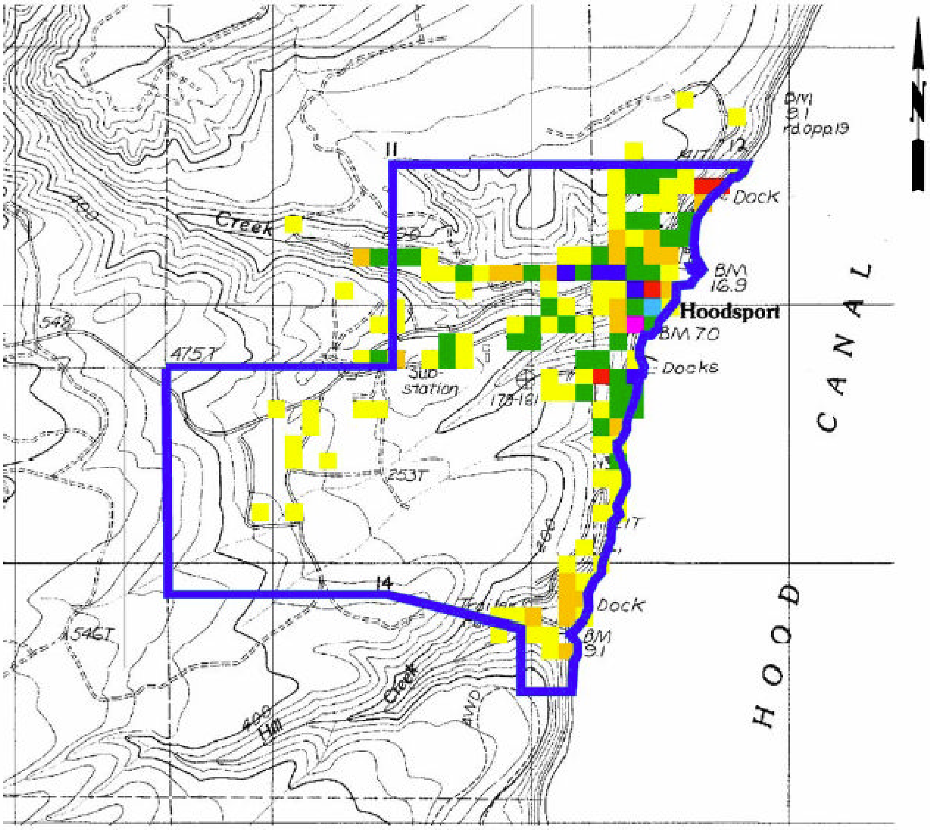
Figure
2.04

## Figure 2.04
# Hoodsport
# Population Density



**LEGEND:**

- 🟨 1 HOME PER ACRE
- 🟩 2 HOMES PER ACRE
- 🟧 3 HOMES PER ACRE
- 🟥 4 HOMES PER ACRE
- 🟦 5 HOMES PER ACRE
- 🟪 6 HOMES PER ACRE
- 🟦 7 HOMES PER ACRE
- ― HOODSPORT RURAL ACTIVITY CENTER (RAC) BOUNDARY

MASON COUNTY
WATER QUALITY PLANNING SERVICES

POPULATION DENSITY

Gray & Osborne, Inc.
CONSULTING ENGINEERS

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Figure
2.05

## Figure 2.05

# Alternative and Cost Summary from Previous Reports

| Service Area | Estimated No. of ERUs | Alternative | Capital Cost | Annual O&M |
|---|---|---|---|---|
| Service Area 1: Finch Creek Corridor (1) | 40 | STEP Collection System, Settling Tank, and Pressurized Drain Field | $1.3 million | $18,560 |
| Service Area 2: Finch Creek Corridor and Commercial Area (2) | 128 | Grinder or STEP Collection System and Water Reclamation Facility | $3.3 million | $86,440-$90,360 |
| Hoodsport RAC (3) | 301 (2005)<br>424 (2015) | Grinder Pump Collection System, MBR or SBR Treatment Facility, and Effluent Reuse | $11.6-$11.8 million | $255,000-$267,000 |

(1) Table 9-1, *Finch Creek Wastewater Feasibility Study* (August 2000).
(2) Table 9-2, *Finch Creek Wastewater Feasibility Study* (August 2000).
(3) Table 8-10, *Hoodsport-Skokomish Wastewater Management Alternatives Analysis* (October 2006).

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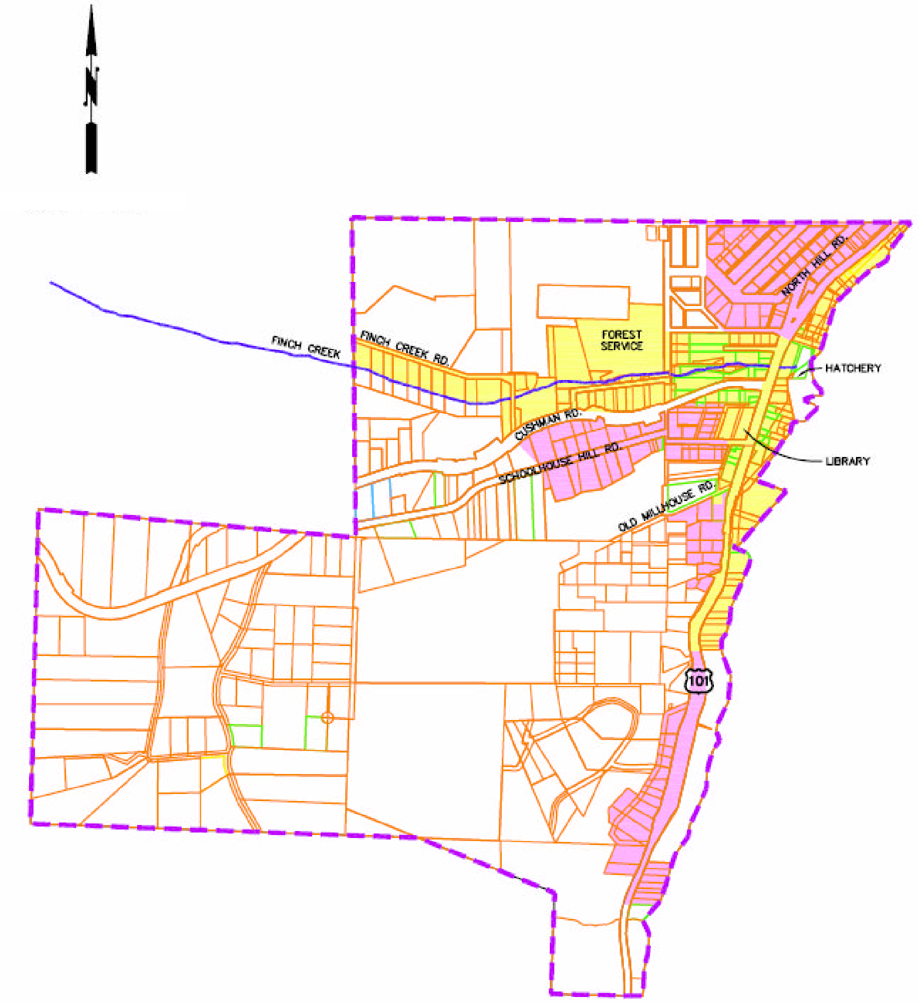
### Figure 2.06

# Hoodsport
## Expanded Service Area 2 Alternative



HOODSPORT RURAL ACTIVITY CENTER (RAC) BOUNDARY

**MASON COUNTY**
WATER QUALITY PLANNING SERVICES

HOODSPORT RAC WITH EXPANDED
SERVICE AREA 2 ALTERNATIVE

Gray & Osborne, Inc.
CONSULTING ENGINEERS

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## Figure 2.07a
# Existing Population

| *Area* | *Existing Population* |
|---|---|
| Service Area 1 | 62 (1) |
| Service Area 2 | 139 (2) |
| Expanded Service Area 2 | 346 (3) |
| Hoodsport RAC | 642 (4) |

(1) Table 6-3, *Finch Creek Wastewater Feasibility Study* (August 2000).
(2) Table 6-3, *Finch Creek Wastewater Feasibility Study* (August 2000).
(3) (83 residences x 2.49 ppc) + 139 population for Service Area 2 = 346.
(4) Table 3-5, *Hoodsport-Skokomish Wastewater Management Alternatives Analysis* (October 2006)

## Figure 2.07b
# Business Types within Hoodsport RAC

| *Business Type* | *Number within the RAC* |
|---|---|
| Restaurant/Eatery | 6 |
| Vacant/Closed | 6 |
| Boutique/Hair Salon | 4 |
| Post Office/Library/Bank | 3 |
| Churches | 2 |
| Clinics | 2 |
| Hardware Store | 2 |
| National Forest/Park Office | 2 |
| Other | 2 |
| Real Estate | 2 |
| RV Storage/Auto Repair | 2 |
| Fire Station | 1 |
| Fish Hatchery | 1 |
| Gas Station | 1 |
| Motel (15 rooms) | 1 |
| Nursery | 1 |
| **Total** | **38** |

## Figure 2.07c
# Hoodsport RAC Existing Lot Sizes (1)

| | *<1/3 acre (2)* | *1/3 to 1 acre* | *1 to 2.5 acres* | *>2.5 acres* | *Total (3)* |
|---|---|---|---|---|---|
| Number of Lots | 51 | 65 | 66 | 18 | 200 |
| Percent | 26 | 32 | 33 | 9 | 100 |

(1) Mason County Assessor records.
(2) Mason County minimum building lot size for siting individual on-site systems: 12,500 square feet or 1/3 acre.
(3) Number of lots available in County's Assessor records.

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## Figure 2.08

# Unit Flows and Loading Values

| | *Report* | |
|---|---|---|
| | ***Alternatives Analysis*** | ***Finch Creek Study (1)*** |
| **Flows: Residential** | | |
| Average Per Capita Flow, gpcd | 65 | 90 |
| Maximum Month Flow, gpcd | 80 | 135 |
| Peaking Factors | | |
| Maximum Day to Average Day | 2.0 | 2.0 |
| Peak Hourly to Average Day | 3.5 | — |
| **Flows: Commercial** | | |
| Equivalent Residential Unit (ERU), gpd | 200 | 198 |
| Restaurant | 50 gpd/seat | — |
| Motel | 65 gpd/room | — |
| Peaking Factors | | |
| Maximum Month to Average Day | 1.25 | 2.0 |
| Maximum Day to Average Day | 2.0 | 2.4 |
| Peak Hourly to Average Day | 3.5 | — |
| **Loadings: Residential** | | |
| $BOD_5$, lbs/capita/day | 0.18 | 0.2 |
| TSS, lbs/capita/day | 0.20 | 0.2 |
| TKN, lbs/capita/day | 0.029 | 50 mg/L |
| Peaking Factors | | |
| Maximum Month to Average Day | 1.25 | 1.5 |
| Peak Day to Average Day | — | 2.0 |
| **Loadings: Commercial** | | |
| $BOD_5$, lbs/ERU/day | 0.45 | 0.43 |
| TSS, lbs/ERU/day | 0.50 | 0.43 |
| TKN, lbs/ERU/day | 0.072 | 0.077 |
| Restaurant | 0.2 lbs/day/seat for $BOD_5$ and TSS;<br>0.032 lbs/day/seat for TKN | 0.2 lbs/day/seat for $BOD_5$ and TSS |
| Motel | 0.26 lbs/day/room for $BOD_5$ and TSS;<br>0.042 lbs/day/room for TKN | 0.26 lbs/day/room for $BOD_5$ and TSS |
| Peaking Factors | | |
| Maximum Month to Average Day | 1.25 | 2.0 |
| Peak Day to Average Day | — | 2.4 |

(1) Service Area 2. For Service Area 1, the design criterion for flow was 360 gpd per bedroom.

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Figure
2.09

## Figure 2.09

# Existing Flows and Loadings Estimates

| | *Hoodsport RAC* | *Service Area 2* | *Expanded Service Area 2* |
|---|---|---|---|
| **Wastewater Flows:** | | | |
| Average Flow, gpd | 48,697 | 16,002 | 29,652 |
| Maximum Month Flow, gpd | 59,935 | 19,695 | 36,495 |
| Maximum Daily Flow, gpd | 97,394 | 32,004 | 59,304 |
| Peak Hour Flow, gpd | 170,439 | 56,006 | 103,782 |
| **Wastewater Loadings:** | | | |
| $BOD_5$: | | | |
| Average, lbs/day | 142 | 54 | 92 |
| Maximum Month, lbs/day | 178 | 68 | 115 |
| TSS: | | | |
| Average, lbs/day | 155 | 55 | 97 |
| Maximum Month, lbs/day | 194 | 69 | 121 |
| TKN: | | | |
| Average, lbs/day | 23 | 8 | 14 |
| Maximum Month, lbs/day | 29 | 10 | 18 |

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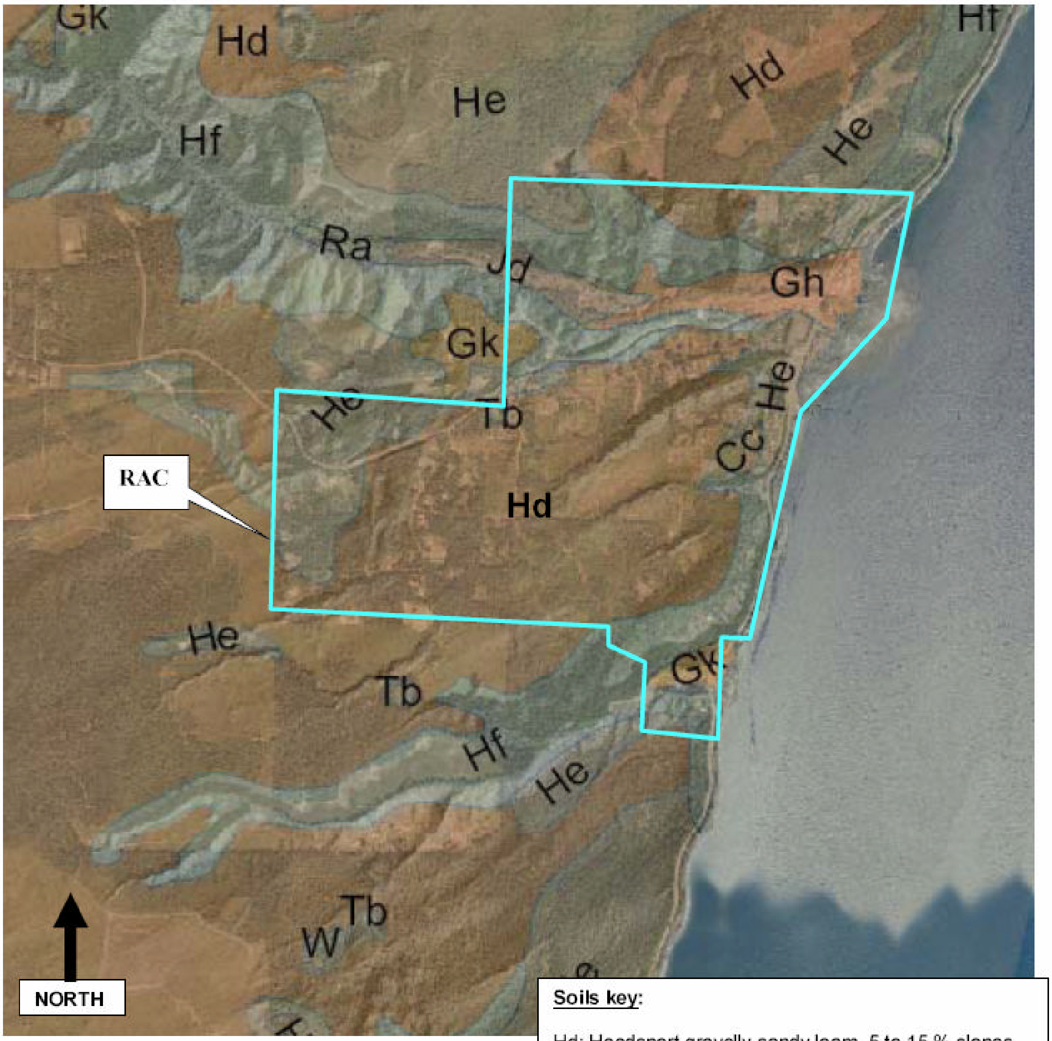
# Figure 2.10
# Soils Map



**Soils key:**

Hd: Hoodsport gravelly sandy loam, 5 to 15 % slopes
He: Hoodsport gravelly sandy loam, 15 to 30 % slopes
Hf: Hoodsport gravelly sandy loam, 30 to 45 % slopes
Gh: Grove gravelly sandy loam, 0 to 5 % slopes
Gk: Grove gravelly sandy loam, 5 to 15 % slopes
Cc: Cloquallum silt loam, 5 to 15 % slopes
Tb: Tanwax peat, 0 to 2 % slopes
Jd: Juno sandy loam, 0 to 3 % slopes

From: Ness, A. 0., and Fowler, R. H., 1960. *Soil Survey Of Mason County, Washington*, Soil Conservation Service, United States Department of Agriculture, Washington Agricultural Experiment Stations.
http://www.or.nrcs.usda.gov/pnw_soil/wa_reports.html

HWA GEOSCIENCES INC.

SOILS MAP

MASON COUNTY
WATER QUALITY PROJECT PLANNING
HOODSPORT RURAL ACTIVITY CENTER

PROJECT NO.
2006-172

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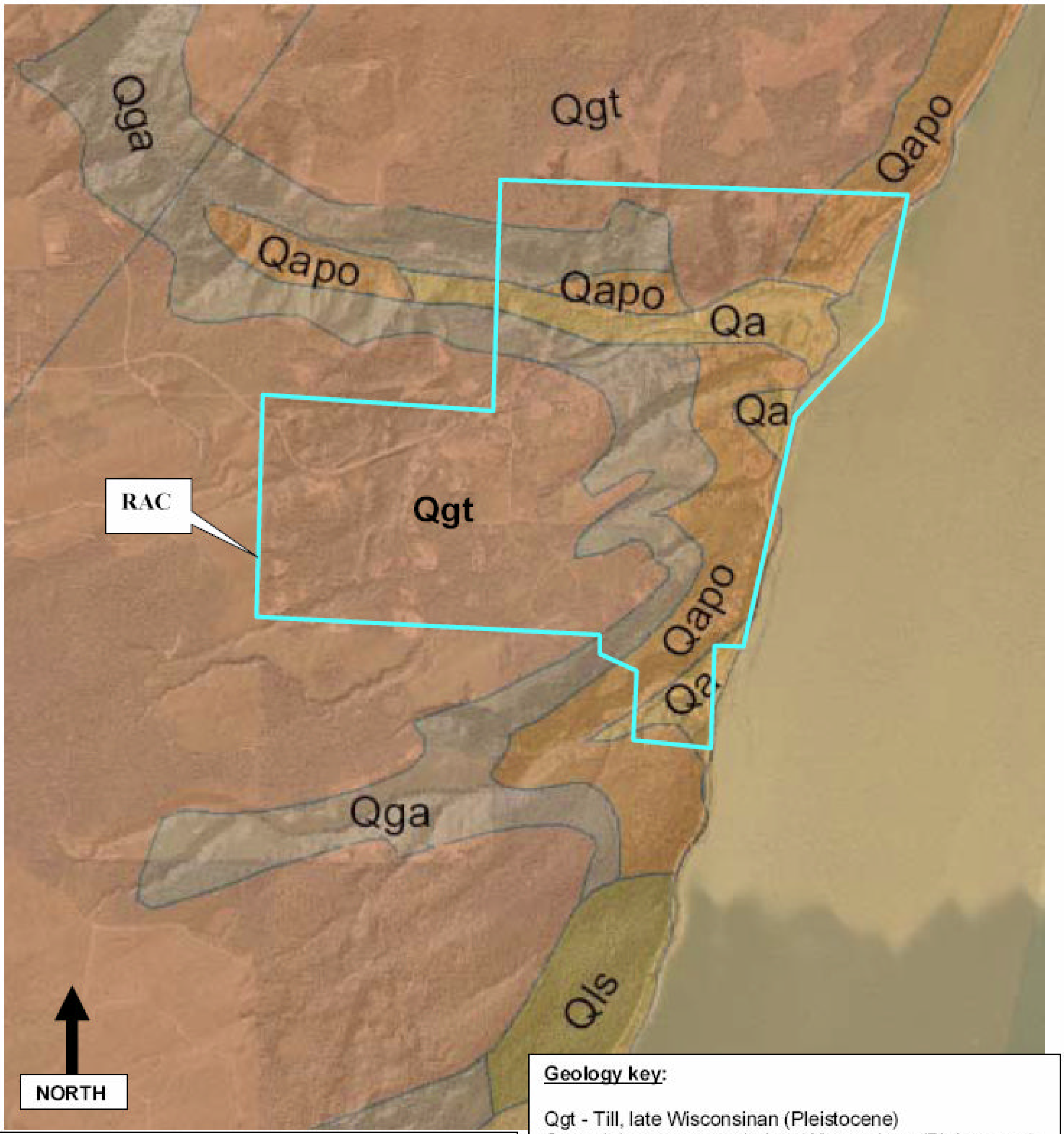
Figure
2.11

## Figure 2.11
# Geologic Map (Logan)



From: Logan, R. L., 2003. *Geologic Map of the Shelton 1:100,000 Quadrangle, Washington.* 45 x 36 in. color sheet, scale 1:100,000, Washington Division of Geology and Earth Resources, Open File Report 2003-15
http://www.dnr.wa.gov/geology/pdf/ofr03-15.pdf

**Geology key:**

Qgt - Till, late Wisconsinan (Pleistocene)
Qga - Advance outwash, late Wisconsinan (Pleistocene)
Qgo - Proglacial and recessional outw
Wisconsinan (Pleistocene)
Qapo - Alpine outwash, pre-late Wisconsinan
(Pleistocene)
Qa - Alluvium (Holocene)

HWA GEOSCIENCES INC.

| | | |
|---|---|---|
| GEOLOGIC MAP (Logan, 2003) | | FIGURE NO. |
| MASON COUNTY<br>WATER QUALITY PROJECT PLANNING<br>HOODSPORT RURAL ACTIVITY CENTER | | PROJECT NO.<br>2006-172 |

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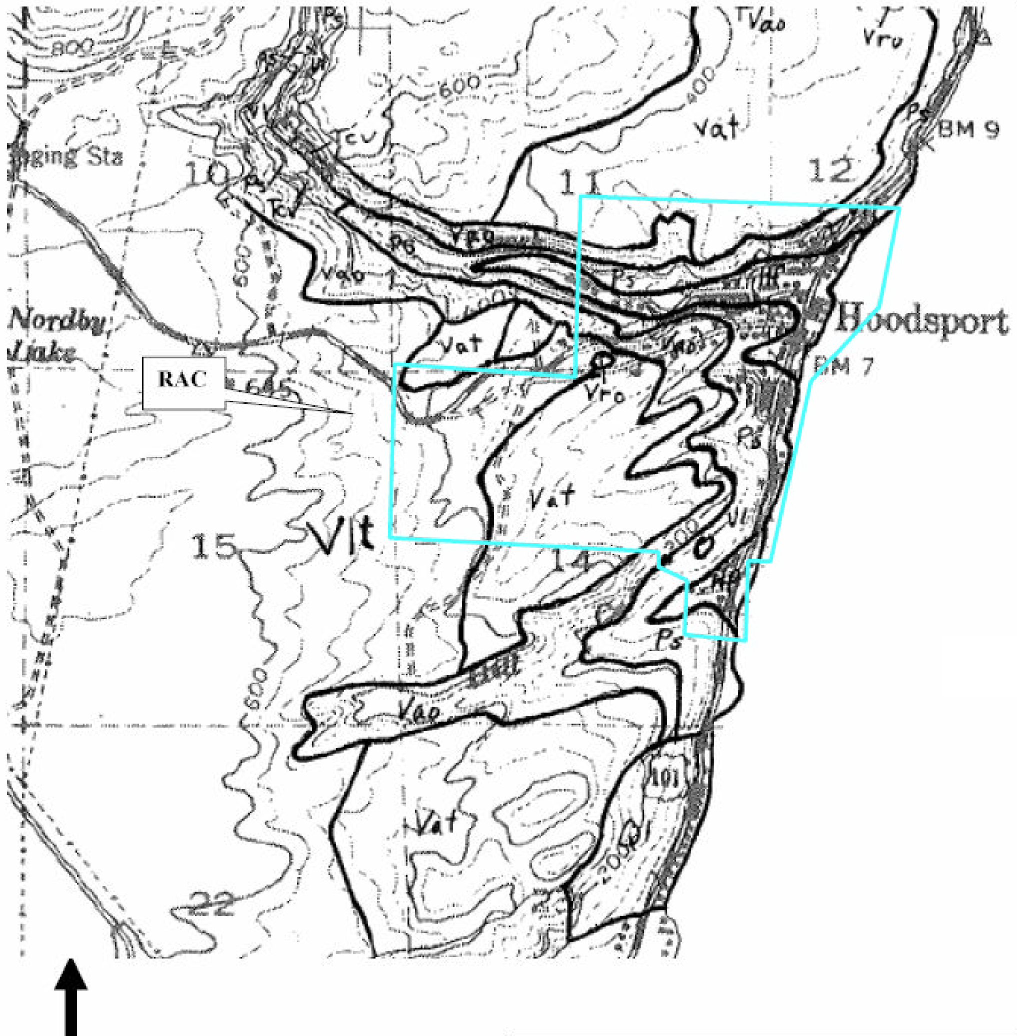
Figure
2.12

## Figure 2.12

# Geologic Map (Carson)



From: Carson, R. J., OFR 76-2. Geologic Map of North Central Mason County, Washington, 1 sheet, scale 1:62,500, Washington Division of Geology and Earth Resources, Open File Report 76-2.

Geology key:

Vat - Ablation Till
Vro - Recessional outwash
Vrd - Recessional outwash - deltas/alluvial fans
Vl - Lacustrine sediments
Ps - Salmon Springs Drift
Hf - Flood plain alluvium

HWA GEOSCIENCES INC.

GEOLOGIC MAP (Carson, 1976)

MASON COUNTY
WATER QUALITY PROJECT PLANNING
HOODSPORT RURAL ACTIVITY CENTER

PROJECT NO.
2006-172

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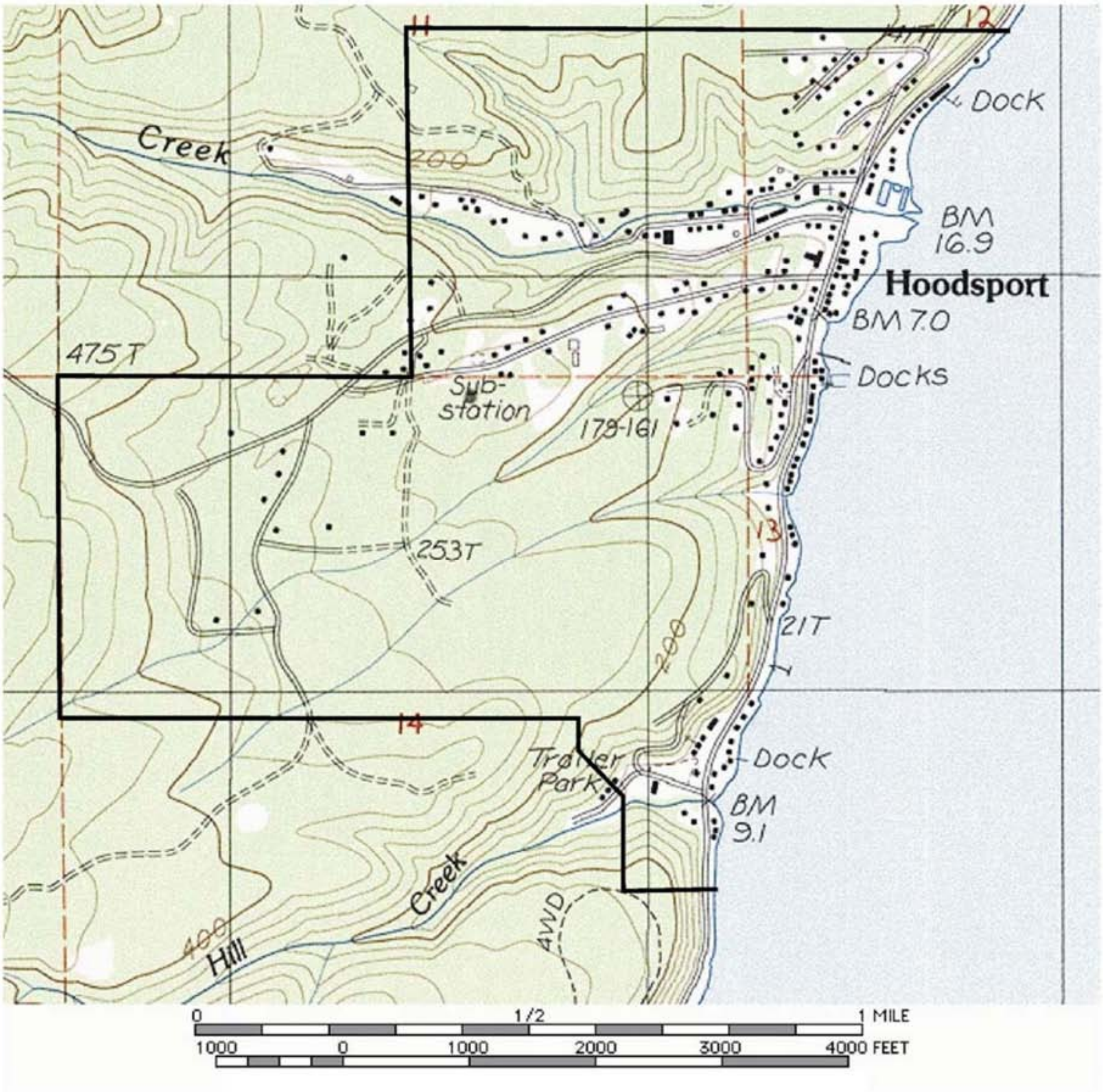
**Figure**
**2.13**

# Figure 2.13



The Hoodsport RAC, Mason County, Washington

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Figure 2.14

**Note:**

**Consistent with Washington State Law, this map is redacted in widely published copies of this report. This map is intended for the use of planning and design professionals in consultation with appropriate Tribal and State historic preservation officials so that known cultural resource sites can be avoided or properly managed in the event of**

Ethnographic sites in the Hoodsport RAC, Mason County, Washington

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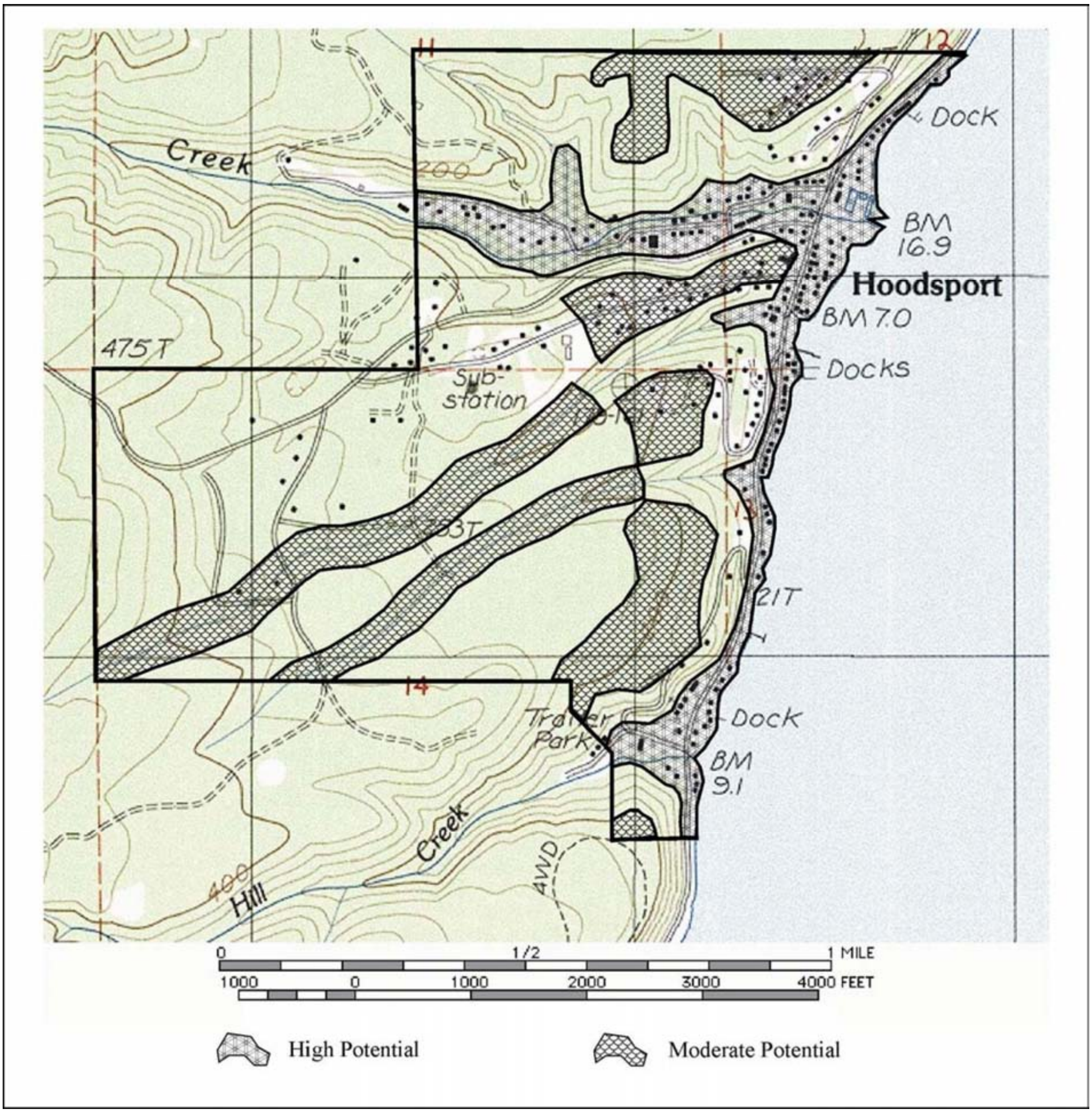
Figure
2.15

# Figure 2.15



Archaeological Potentially Sensitive Zones in the Hoodsport RAC,
Mason County, Washington.

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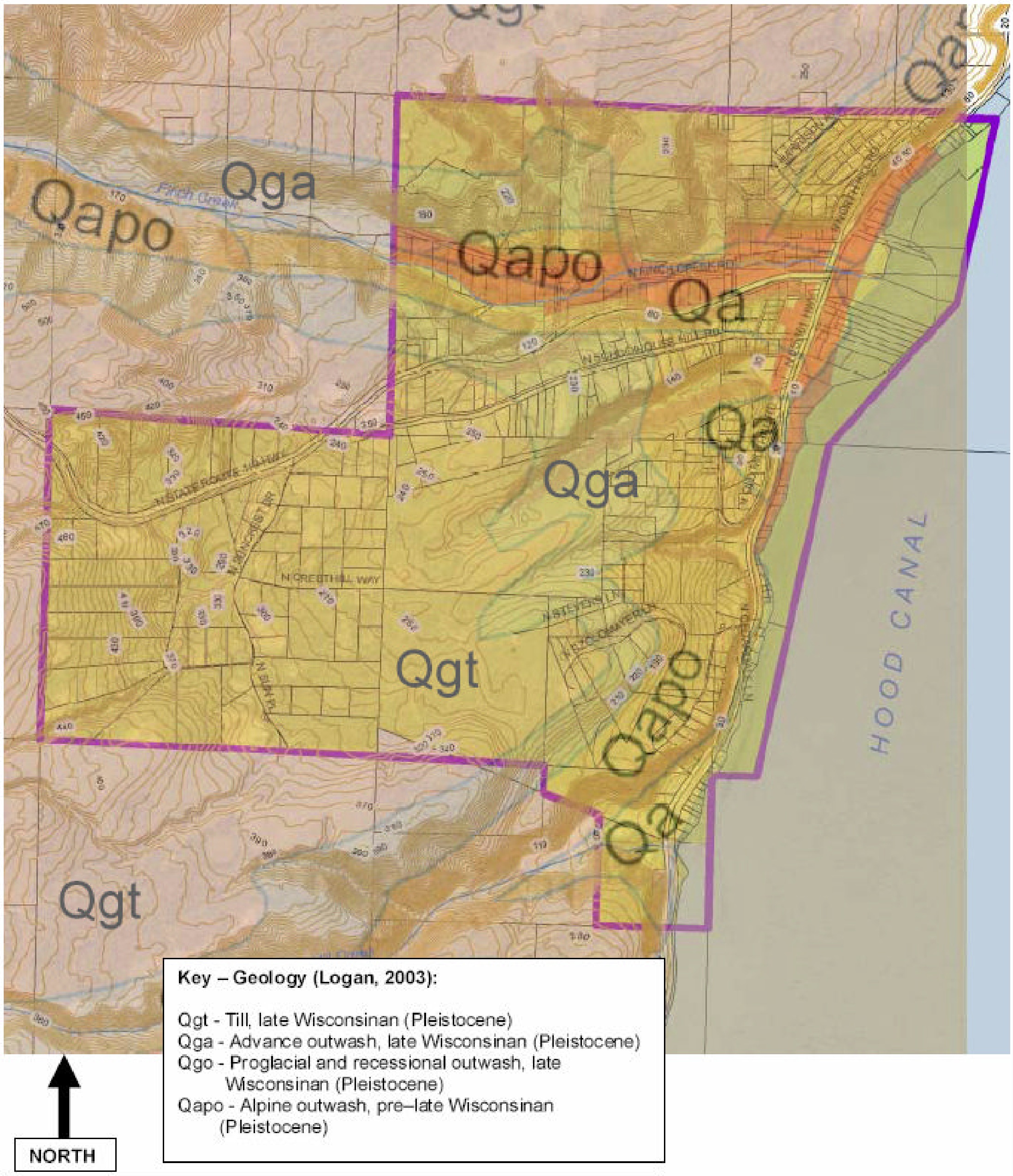
## Figure 2.16
# Topo, Geology & Parcels



**Key – Geology (Logan, 2003):**

Qgt - Till, late Wisconsinan (Pleistocene)
Qga - Advance outwash, late Wisconsinan (Pleistocene)
Qgo - Proglacial and recessional outwash, late Wisconsinan (Pleistocene)
Qapo - Alpine outwash, pre–late Wisconsinan (Pleistocene)

Base mapping by: Mason County (topo & parcels) Geology by Logan, 2003

| | | |
|---|---|---|
| HWA GEOSCIENCES INC. | TOPO, GEOLOGY, & PARCELS | |
| | MASON COUNTY<br>WATER QUALITY PROJECT PLANNING<br>HOODSPORT RURAL ACTIVITY CENTER | PROJECT NO.<br>2006-172 |

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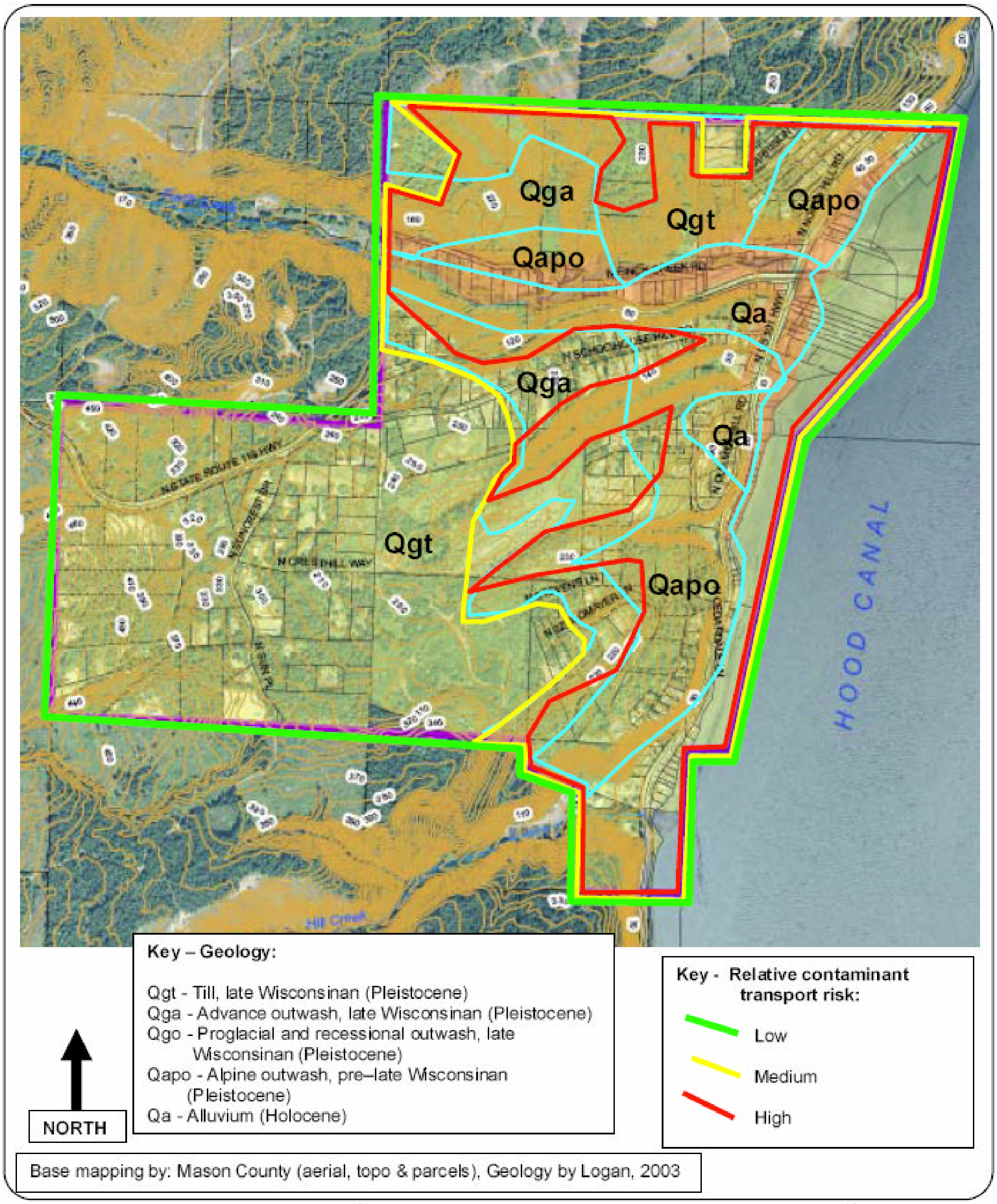
Figure
2.17

# Figure 2.17
# Relative Contaminant Transport Risk



**Key – Geology:**

Qgt - Till, late Wisconsinan (Pleistocene)
Qga - Advance outwash, late Wisconsinan (Pleistocene)
Qgo - Proglacial and recessional outwash, late Wisconsinan (Pleistocene)
Qapo - Alpine outwash, pre–late Wisconsinan (Pleistocene)
Qa - Alluvium (Holocene)

**Key - Relative contaminant transport risk:**

🟩 Low
🟨 Medium
🟥 High

Base mapping by: Mason County (aerial, topo & parcels), Geology by Logan, 2003

HWA GEOSCIENCES INC.

**RELATIVE CONTAMINANT TRANSPORT RISK**

MASON COUNTY
WATER QUALITY PROJECT PLANNING
HOODSPORT RURAL ACTIVITY CENTER

PROJECT NO.
2006-172

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## Figure 2.18a

# Population Projections

| Area | 2005 | 2015 | 2025 |
|---|---|---|---|
| Hoodsport RAC | 642 | 906 | 1,277 |
| Service Area 2 | 139 | 161 | 187 |
| Expanded Service Area 2 | 346 | 401 | 466 |

## Figure 2.18b

# Future Flows and Loadings

| | Hoodsport RAC | | | Service Area 2 | | | Expanded Service Area 2 | | |
|---|---|---|---|---|---|---|---|---|---|
| | Existing | 2015 | 2025 | Existing | 2015 | 2025 | Existing | 2015 | 2025 |
| **Wastewater Flows:** | | | | | | | | | |
| Average Flow, gpd | 48,697 | 68,691 | 96,897 | 16,002 | 20,292 | 26,018 | 29,652 | 35,892 | 44,153 |
| Maximum Month Flow, gpd | 59,935 | 84,543 | 119,258 | 19,695 | 24,975 | 32,022 | 36,495 | 44,175 | 54,609 |
| Maximum Daily Flow, gpd | 97,394 | 137,382 | 193,794 | 32,004 | 40,584 | 52,036 | 59,304 | 71,784 | 88,306 |
| Peak Hour Flow, gpd | 170,439 | 240,418 | 339,139 | 56,006 | 71,022 | 91,063 | 103,782 | 125,622 | 154,535 |
| **Wastewater Loadings:** | | | | | | | | | |
| BOD$_5$: | | | | | | | | | |
| Average, lbs/day | 142 | 20 | 282 | 54 | 69 | 89 | 92 | 109 | 136 |
| Maximum Month, lbs/day | 178 | 250 | 352 | 68 | 87 | 112 | 115 | 136 | 170 |
| TSS: | | | | | | | | | |
| Average, lbs/day | 155 | 220 | 310 | 55 | 71 | 92 | 97 | 119 | 147 |
| Maximum Month, lbs/day | 194 | 274 | 386 | 69 | 89 | 115 | 121 | 149 | 184 |
| TKN: | | | | | | | | | |
| Average, lbs/day | 23 | 32 | 45 | 8 | 11 | 14 | 14 | 18 | 22 |
| Maximum Month, lbs/day | 29 | 40 | 57 | 10 | 13 | 17 | 18 | 22 | 27 |

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## Figure 2.19

# Expected Effluent Limitations

| ***Parameter*** | ***Average Monthly*** | ***Average Weekly*** | ***Location*** |
|---|---|---|---|
| **Oxidized Wastewater** | | | |
| $BOD_5$ | 15 mg/L | 22 mg/L | Final Effluent |
| TSS | 15 mg/L | 22 mg/L | Final Effluent |
| Dissolved Oxygen | Shall be measurably present in effluent | | Secondary Effluent |
| ***Parameter*** | ***Average Monthly*** | ***Sample Maximum*** | ***Location*** |
| **Coagulated and Filtered Wastewater** (1) | | | |
| Turbidity | 2 NTU | 5 NTU | Prior to Disinfection |
| **Disinfected Reclaimed Water** | | | |
| Total Coliform | 2.2 cfu/100 ml | 23 cfu/100 ml | Final Reclaimed Water |
| pH | Shall not be outside of the range of 6 to 9 units | | Final Reclaimed Water |
| Total Nitrogen as N | 10 mg/L | — | Final Reclaimed Water |

(1) Where membrane systems are installed, Ecology is considering a standard for turbidity of 0.2 NTU (average monthly) to 0.5 NTU (sample maximum) and not requiring the coagulation process step.

## Figure 2.20

# Groundwater Limitations

| ***Parameter*** | ***Groundwater Recharge (1) Criteria (sample maximum)*** |
|---|---|
| Nitrate as N | 10 mg/L |
| Nitrite as N | 1 mg/L |
| Arsenic | 10 µg/L |
| Cadmium | 5 µg/L |
| Chromium | 100 µg/L |
| Lead | 50 µg/L |
| Mercury | 2 µg/L |
| Nickel | 100 µg/L |
| Total Dissolved Solids | 500 µg/L |
| Chloride | 250 µg/L |
| Sulfate | 250 µg/L |
| Copper | 1,000 µg/L |
| Manganese | 50 µg/L |
| Silver | 100 µg/L |
| Zinc | 5,000 µg/L |
| pH | 6.5 to 8.5 standard units |
| Iron | 0.3 mg/L |
| Toxics | No toxics in toxic amounts |

(1) The sample maximum is the highest allowable concentration for any sample as measured in the groundwater at the top of the uppermost aquifer beneath or downgradient of the infiltration site.

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### Figure 2.21

# ERU Cluster System Estimated Capital Cost

| *System Type* | *Septic Tank* | *STEP System*[1] | *Piping* | *Treatment* | *Effluent* | *Total* |
|---|---|---|---|---|---|---|
| Existing Septic Tanks (7) | N/A | 7 @ $5,000 each = **$35,000** | **$15,000** | **$20,000** | **$20,000** | **$90,000**<br>($12,860/ERU) |
| New Septic Tanks (7) | 7 @ $12,000 each = **$84,000** | Included with Tank | **$15,000** | **$20,000** | **$20,000** | **$139,000**<br>($19,860/ERU) |

[1] Pump to convey septic tank effluent to treatment system

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## Figure 2.22

# Example Cluster System

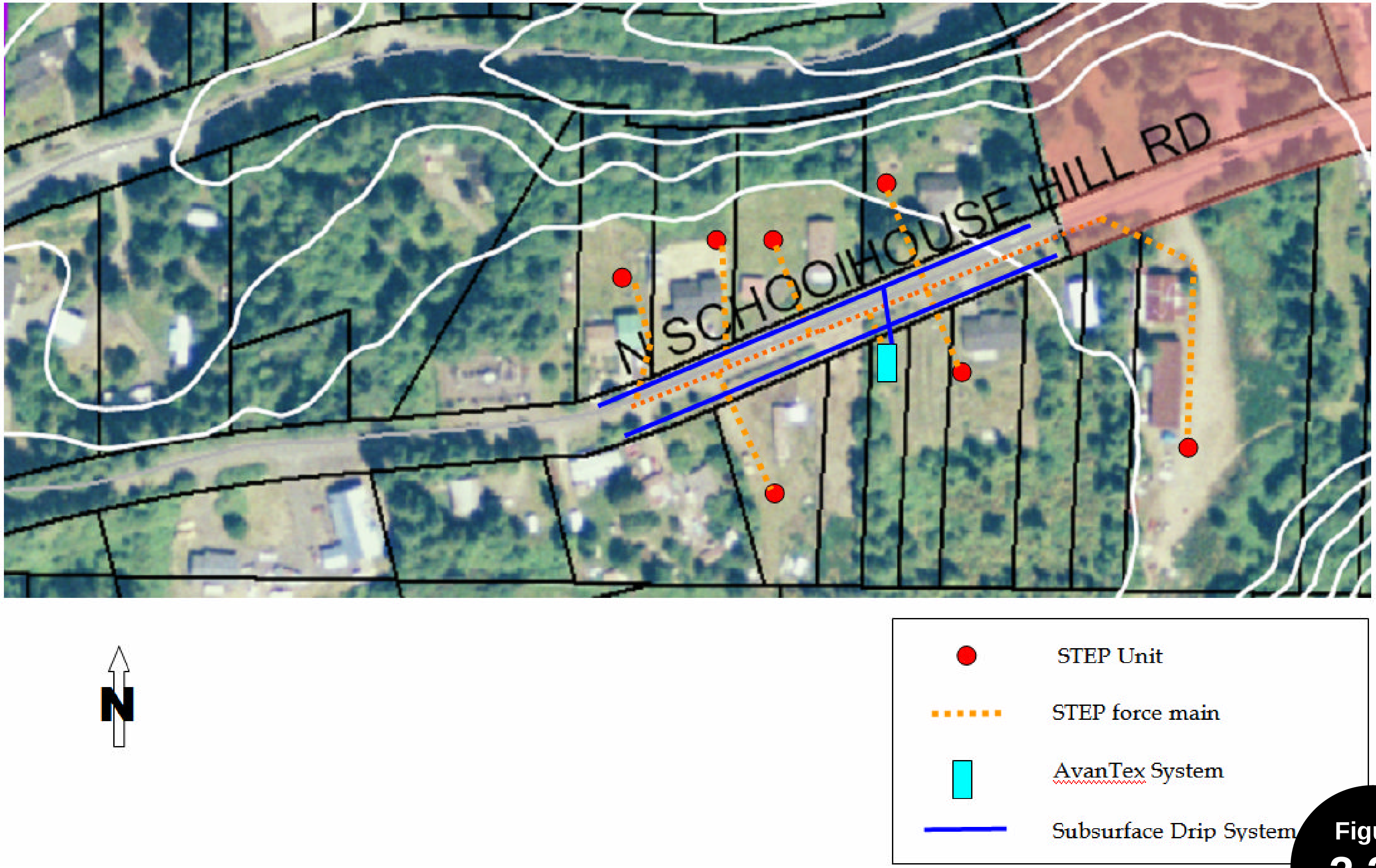

**Figure**
**2.22**

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Figure
2.23a

## Figure 2.23a

# Hoodsport RAC Cost Summary

* = engineer's estimate

| | | Expanded Service Area 2 | Service Area 2 | |
|---|---|---|---|---|
| **Treatment Plant Estimate** | | | | |
| Engineer's Estimate | | $1,860,000 | $1,605,000 | * |
| Contingency | | $279,000 | $240,750 | * |
| 8.3% Sales Tax | | $177,537 | $153,197 | * |
| Construction Cost | | $2,316,537 | $1,998,947 | * |
| **Grinder Pump Collection System Estimate** | | | | |
| Engineer's Estimate | | $2,859,000 | $1,641,700 | * |
| Contingency | | $428,850 | $328,340 | * |
| 8.3% Sales Tax | | $272,892 | $163,513 | * |
| Construction Cost | | $3,560,742 | $2,133,553 | * |
| **Effluent Force Main and Fate Estimate** | | | | |
| Engineer's Estimate | | $715,000 | $715,000 | * |
| Contingency | | $107,250 | $107,250 | * |
| 8.3% Sales Tax | | $68,247 | $68,247 | * |
| Construction Cost | | $890,497 | $890,497 | * |
| **Advanced Cluster On-site Systems** (assumes 6 clusters serving 45 ERUs) | | | | |
| Engineer's Estimate | | $736,071 | | * |
| Contingency | | $110,411 | | |
| 8.3% Sales Tax | | $71,105 | | |
| Construction Cost | | $917,587 | | |
| **Total Construction Cost Estimates** (sums similar lines above) | | | | |
| Engineer's Estimate | | $6,170,071 | $3,961,700 | |
| Contingency | | $925,511 | $676,340 | |
| 8.3% Sales Tax | | $589,780 | $384,957 | |
| Construction Cost | | $7,685,362 | $5,022,997 | |
| **Other Costs to Complete** (some a % of Construction Cost) | | | | |
| Facilites Plan and Env Documentation | | $108,683 | $108,683 | |
| Design Engineering[1] | 12% | $922,243 | $602,760 | |
| Assistance During Const.[2] | 8% | $614,829 | $401,840 | |
| Administration[3] | 2% | $153,707 | $100,460 | |
| Design/Admin Contingency[4] | 3% | $230,561 | $150,690 | |
| Cluster System Land[5] | | $90,000 | | |
| Sewer System Land[6] | | $250,000 | $210,000 | |
| | | $2,370,023 | $1,574,432 | |
| **Total Cost to Complete** | | | | |
| ***Grand Total*** | | $10,055,385 | $6,597,430 | |
| **Annual Operating Costs** (engineer's estimates) | | | | |
| Sewer SystemOperations | | $169,634 | $143,704 | * |
| Cluster System Operations | | $22,500 | | * |
| Total Annual Operating Cost Estimate | | $192,134 | $143,704 | |

## Notes

[1] For large scale projects 10% is commonly used. Small scale projects require a larger percentage of construction costs to pay for design.

[2] Assistance during construction includes not only inspection and change-order tracking, but also operator training, O&M manuals, etc.

[3] Administration covers local agency project management costs

[4] This contingency amount is based on construction cost. It amounts to a 15% contingency on the ~25% of construction that is assigned for design and administration.

[5] See land cost estimate in Section 2.2.4.1, Section 2 Page 15.

[6] This estimate is very preliminary and should be considered a "place holder."

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# Figure 2.23b

### Hoodsport RAC
### Expanded Service Area 2
### MBR Treatment Plant
### Jan. 2007

**Construction:**

| | ITEM | QUANTITY | | UNIT PRICE | AMOUNT |
|---|---|---|---|---|---|
| 1. | Mobilization Demobilization | 1 | LS | $150,000 | $150,000 |
| 2. | Site Work | 1 | LS | $60,000 | $60,000 |
| 3. | Influent and Effluent Flow Monitoring and Sample collection | 1 | LS | $25,000 | $25,000 |
| 4. | MBR Equipment Package incl. Tanks | 1 | LS | $825,000 | $825,000 |
| 5. | UV Disinfection | 1 | LS | $65,000 | $65,000 |
| 6. | Sludge Storage, Blower and Pump | 1 | LS | $40,000 | $40,000 |
| 7. | Operations and Equipment Building | 1 | LS | $160,000 | $160,000 |
| 8. | Generator | 1 | LS | $50,000 | $50,000 |
| 9. | Piping, Valves, and gates | 1 | LS | $200,000 | $200,000 |
| 10. | Misc. Metal | 1 | LS | $35,000 | $35,000 |
| 11. | Electrical | 1 | LS | $200,000 | $200,000 |
| 12. | Coatings | 1 | LS | $30,000 | $30,000 |
| 13. | Restoration | 1 | LS | $20,000 | $20,000 |

| | |
|---|---|
| Engineer's Estimate | $1,860,000 |
| Contingency 15% | $279,000 |
| 8.3% Sales Tax | $177,537 |
| Construction Cost | $2,316,537 |

**Operation and Maintenance:**

| | ITEM | QUANTITY | | UNIT PRICE | AMOUNT |
|---|---|---|---|---|---|
| 1. | Administration | 1 | LS | $10,000 | $10,000 |
| 2. | Labor | 1,040 | HRS | $35 | $36,400 |
| 3. | Power | 220,000 | KwH | $0.07 | $15,400 |
| 4. | Repair and Maintenance | 1 | LS | $15,000 | $15,000 |
| 3. | Membrane Replacement reserves | 1 | LS | $5,000 | $5,000 |
| 4. | Sludge Hauling | 200,000.0 | GAL | $0.18 | $36,000 |
| | Annual Operation and Maintenance Cost Estimate | | | | $117,800 |

### Hoodsport RAC
### Expanded Service Area 2
### Grinder Pump Collection System Cost Estimate
### Jan. 2007

**Construction:**

| | ITEM | QUANTITY | | UNIT PRICE | AMOUNT |
|---|---|---|---|---|---|
| 1. | Mobilization Demobilization | 1 | LS | $180,000 | $180,000 |
| 2. | Traffic Control | 1 | LS | $20,000 | $20,000 |
| 3. | 4-Inch Pressure Sewer | 7,250 | LF | $37 | $268,250 |
| 4. | 3-Inch Pressure Sewer | 4,000 | LF | $32 | $128,000 |
| 5. | 2-Inch Pressure Sewer | 5,650 | LF | $30 | $169,500 |
| 6. | Grinder P.S.'s with CP: Residential and Comm. Equilvalent | 178 | EA | $8,000 | $1,424,000 |
| 7. | Grinder P.S.'s with CP: Commercial | 7 | EA | $20,000 | $140,000 |
| 8. | Side Sewer Stubs | 30 | EA | $1,200 | $36,000 |
| 9. | Mainline Cleanouts | 18 | EA | $1,800 | $32,400 |
| 11. | Abandon Septic Tanks | 184 | EA | $1,200 | $220,800 |
| 12. | Creek Crossings | 3 | EA | $10,000 | $30,000 |
| 14. | Restoration | 1 | LS | $210,000 | $210,000 |

| | |
|---|---|
| Engineer's Estimate | $2,859,000 |
| Contingency 15% | $428,850 |
| 8.3% Sales Tax | $272,892 |
| Construction Cost | $3,560,742 |

**Operation and Maintenance:**

| | ITEM | QUANTITY | | UNIT PRICE | AMOUNT |
|---|---|---|---|---|---|
| 1. | Administration | 1 | LS | $10,000 | $10,000 |
| 2. | Res. Grinder Pump Repair and Maint. | 177 | EA | $84 | $14,868 |
| 3. | Comm. Grinder Pump Repair and Maint. | 7 | EA | $168 | $1,176 |
| 4. | Sewer Pipe | 3.2 | MI | $3,000 | $9,540 |
| | Annual Operation and Maintenance Cost Estimate | | | | $35,584 |

Figure
2.23b

# Figure 2.23c

**Hoodsport RAC**
**Expanded Service Area 2**
**Force Main and Reuse Area**
**Jan. 2007**

**Construction:**

| | ITEM | QUANTITY | | UNIT PRICE | AMOUNT |
|---|---|---|---|---|---|
| 1. | Mobilization Demobilization | 1 | LS | $70,000 | $70,000 |
| 2. | Traffic Control | 1 | LS | $5,000 | $5,000 |
| 3. | 4-Inch Force Main | 5,000 | LF | $30 | $150,000 |
| 4. | Lift Station | 1 | LS | $160,000 | $160,000 |
| 12. | Infiltration Area | 1 | LS | $300,000 | $300,000 |
| 14. | Restoration | 1 | LS | $30,000 | $30,000 |

| | |
|---|---|
| Engineer's Estimate | $715,000 |
| Contingency 15% | $107,250 |
| 8.3% Sales Tax | $68,247 |
| Construction Cost | $890,497 |

**Operation and Maintenance:**

| | ITEM | QUANTITY | | UNIT PRICE | AMOUNT |
|---|---|---|---|---|---|
| 1. | Administration | 1 | LS | $5,000 | $5,000 |
| 2. | Labor | 150 | HRS | $35 | $5,250 |
| 3. | Lift Station Repair and Maintenance | 1 | LS | $3,000 | $3,000 |
| 4. | Force Main | 1.0 | MI | $3,000 | $3,000 |
| | Annual Operation and Maintenance Cost Estimate | | | | $16,250 |

**Advanced On-site Cluster System Cost Extensions**

**Table from Figure 2.21** (engineer's estimates)

| *System Type* | *Septic Tank* | *STEP System[1]* | *Piping* | *Treatment* | *Effluent* | *Total* |
|---|---|---|---|---|---|---|
| Existing Septic Tanks (7) | N/A | 7 @ $5,000 each = **$35,000** | **$15,000** | **$20,000** | **$20,000** | **$90,000**<br>($12,860/ ERU) |
| New Septic Tanks (7) | 7 @ $12,000 each = **$84,000** | Included with Tank | **$15,000** | **$20,000** | **$20,000** | **$139,000**<br>($19,860/ ERU) |

| | | |
|---|---|---|
| Average Estimated Cost for one 7 ERU cluster | $114,500 | based on engineer's estimates |
| Rough estimate ERUs served by advanced clusters | 45 | |
| Estimated number of clusters | 6 | |
| Estimate | $736,071 | based on engineer's estimates |
| Contingency 15% | $110,411 | |
| 8.3% Sales Tax | $71,105 | |
| Sub-total | $917,587 | |
| Land Cost per Cluster (midpoint of estimate) | $14,000 | based on engineer's estimates |
| Total Estimated Land Cost | $90,000 | |
| Construction Cost (including land) | $1,007,587 | |
| Annual Operating Cost @ $3.5K per Cluster | $22,500 | based on engineer's estimates |

Figure
2.23c

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Figure 2.24

# Example Schedule

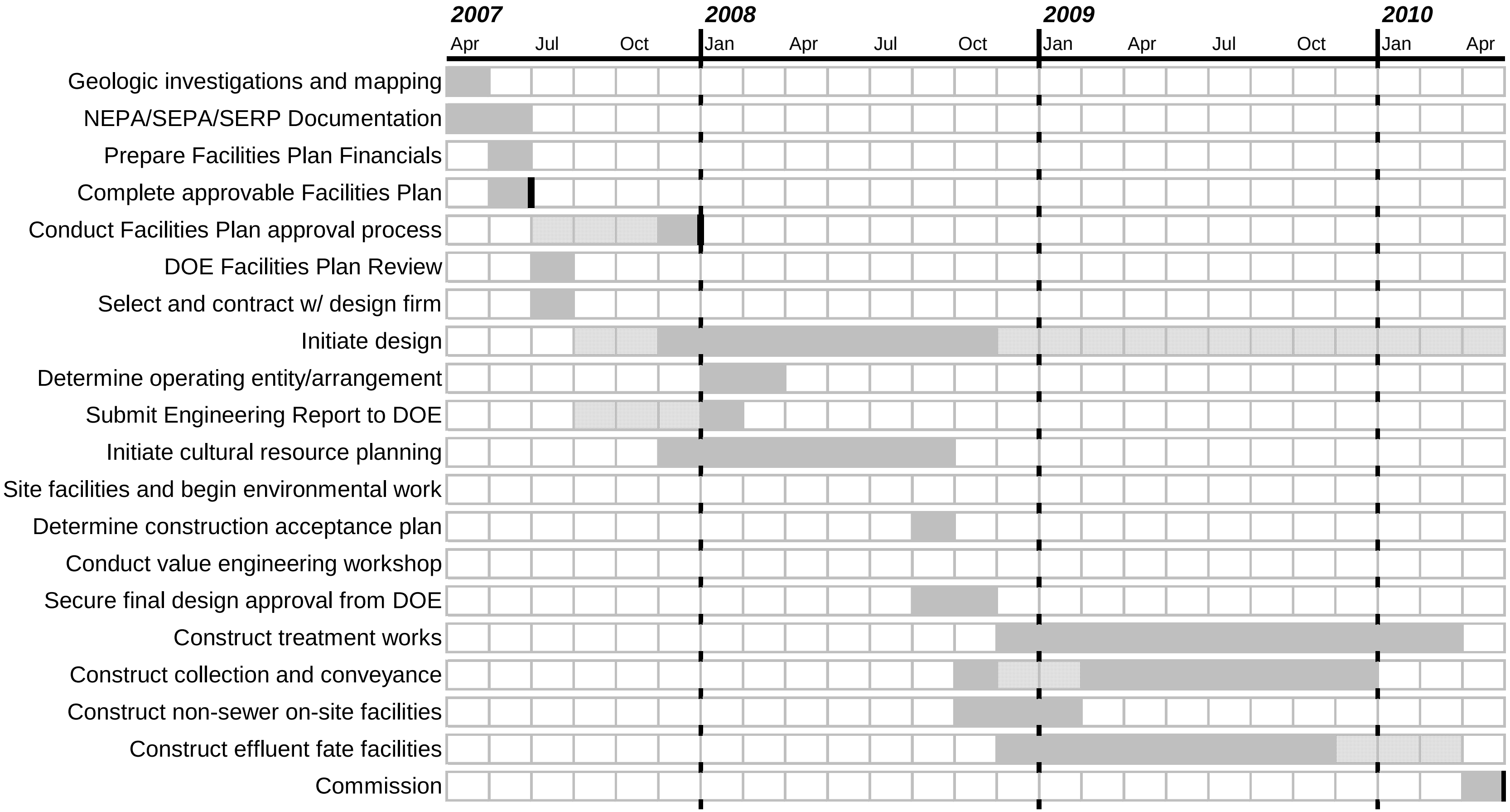

Figure
2.24

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## Figure 2.25

# Hoodsport Expanded Service Area

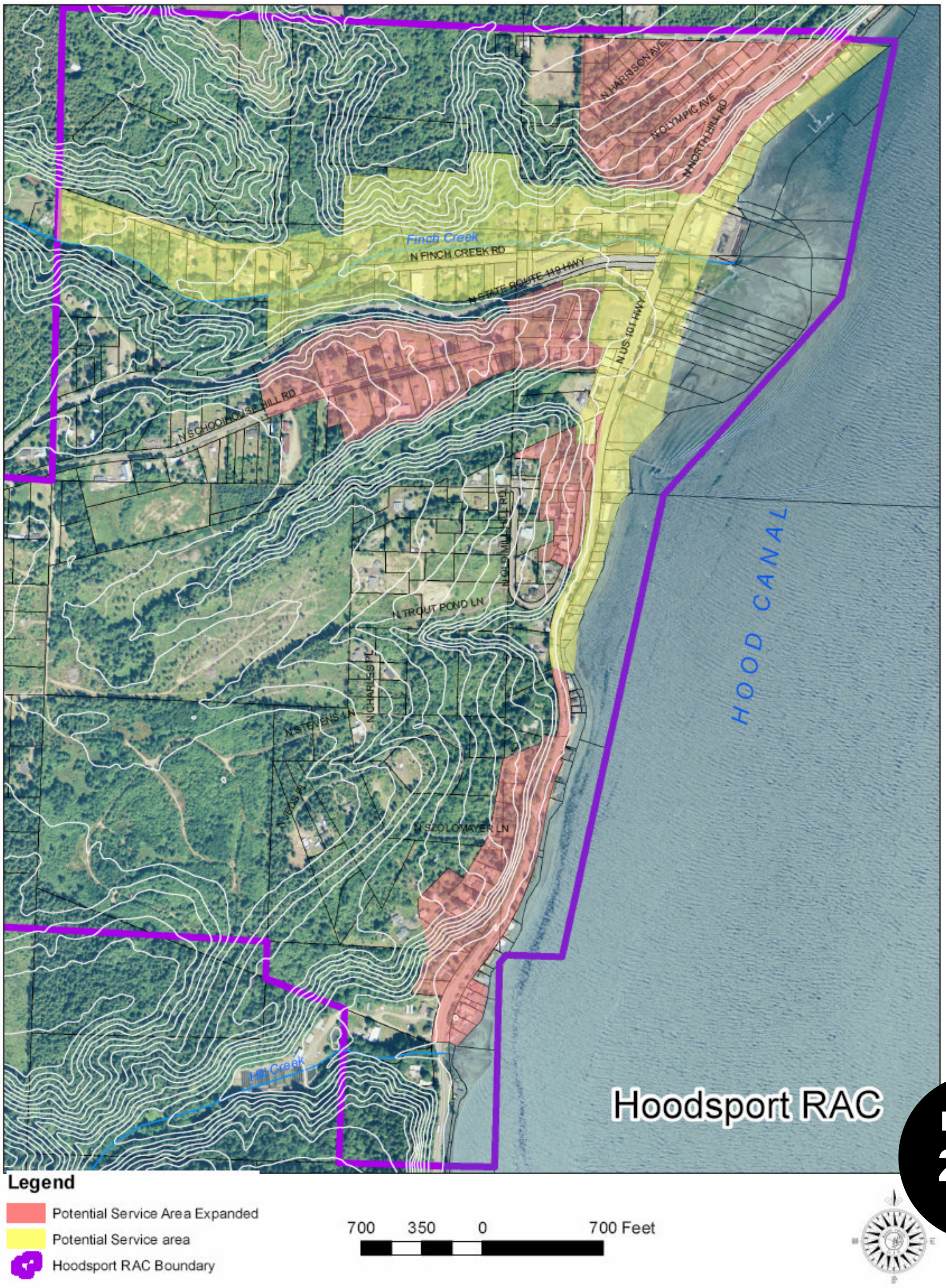

Figure
2.25

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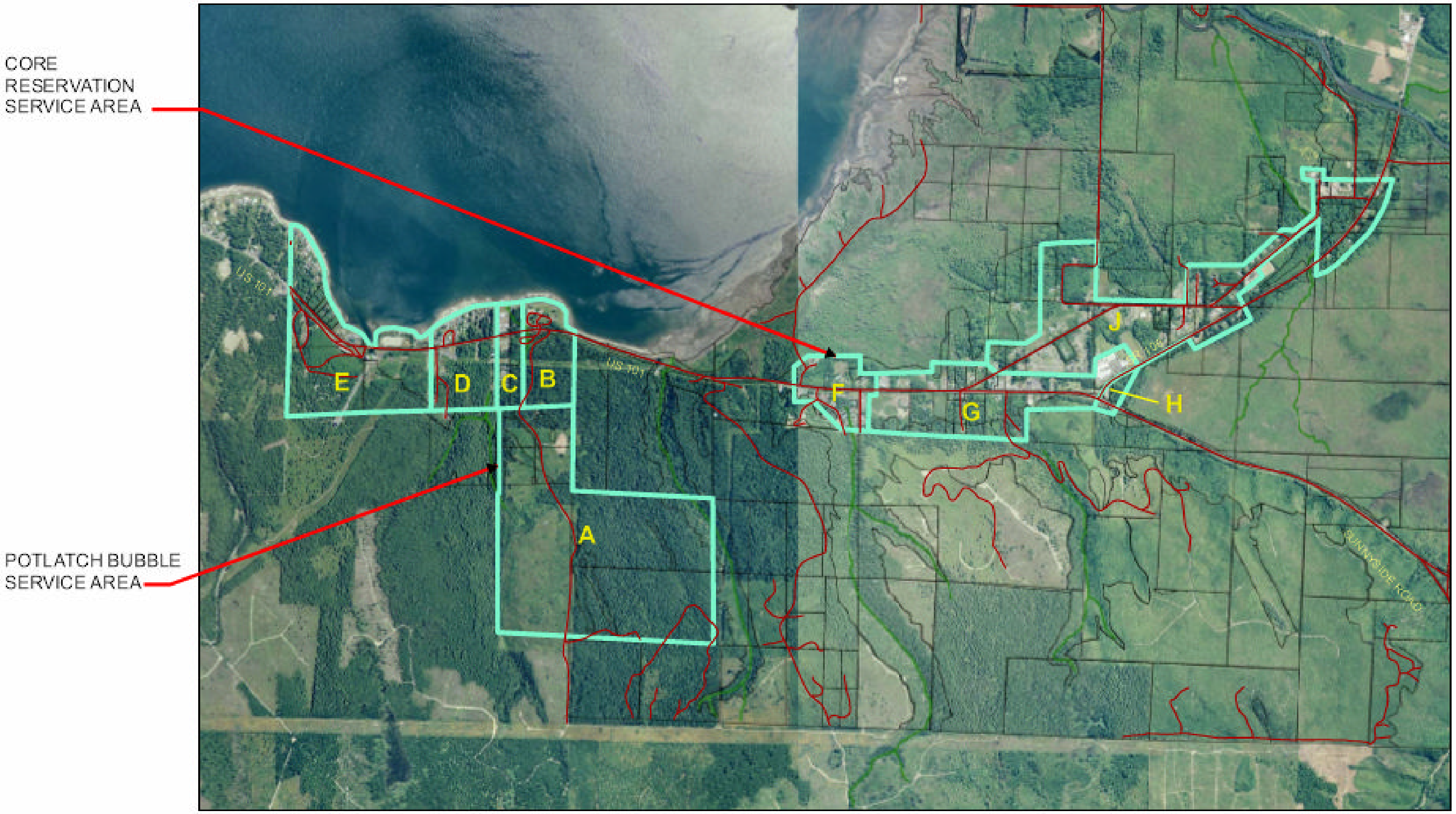
## Figure 3.01



Legend

Service Area Parcel Boundary

▭

0 1,000 2,000 Feet

WASTEWATER SERVICE AREAS*
WITH AERIAL PHOTO
SKOKOMISH RESERVATION

Cascade Design Professionals, 2007

* Based on Skokomish Reservation mapping prepared by the Natural Resources Department of the Skokomish Tribe

Figure
3.01

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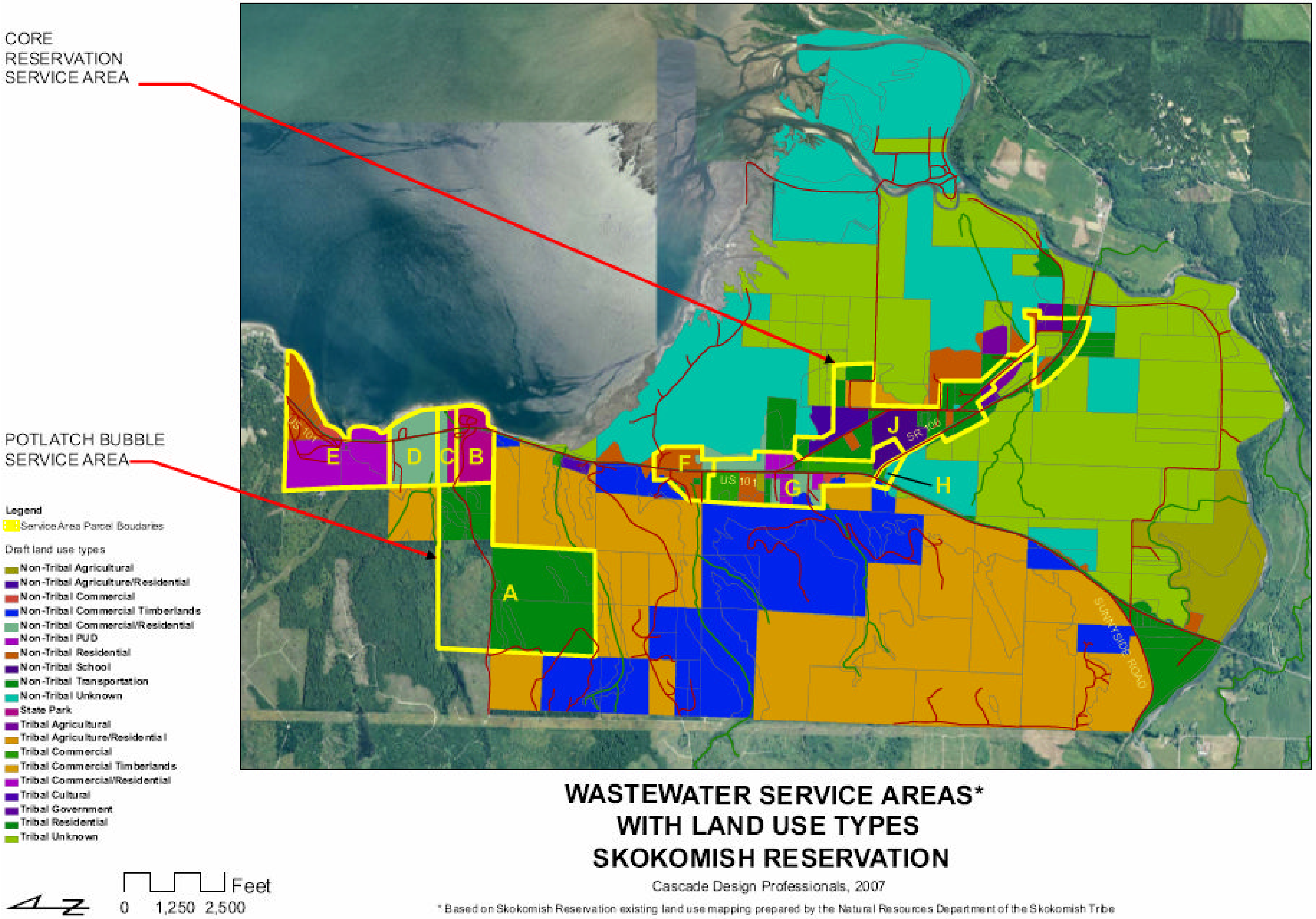
# Figure 3.02



**WASTEWATER SERVICE AREAS***
**WITH LAND USE TYPES**
**SKOKOMISH RESERVATION**

Cascade Design Professionals, 2007

* Based on Skokomish Reservation existing land use mapping prepared by the Natural Resources Department of the Skokomish Tribe

**Figure**
**3.02**

Figure 3.03

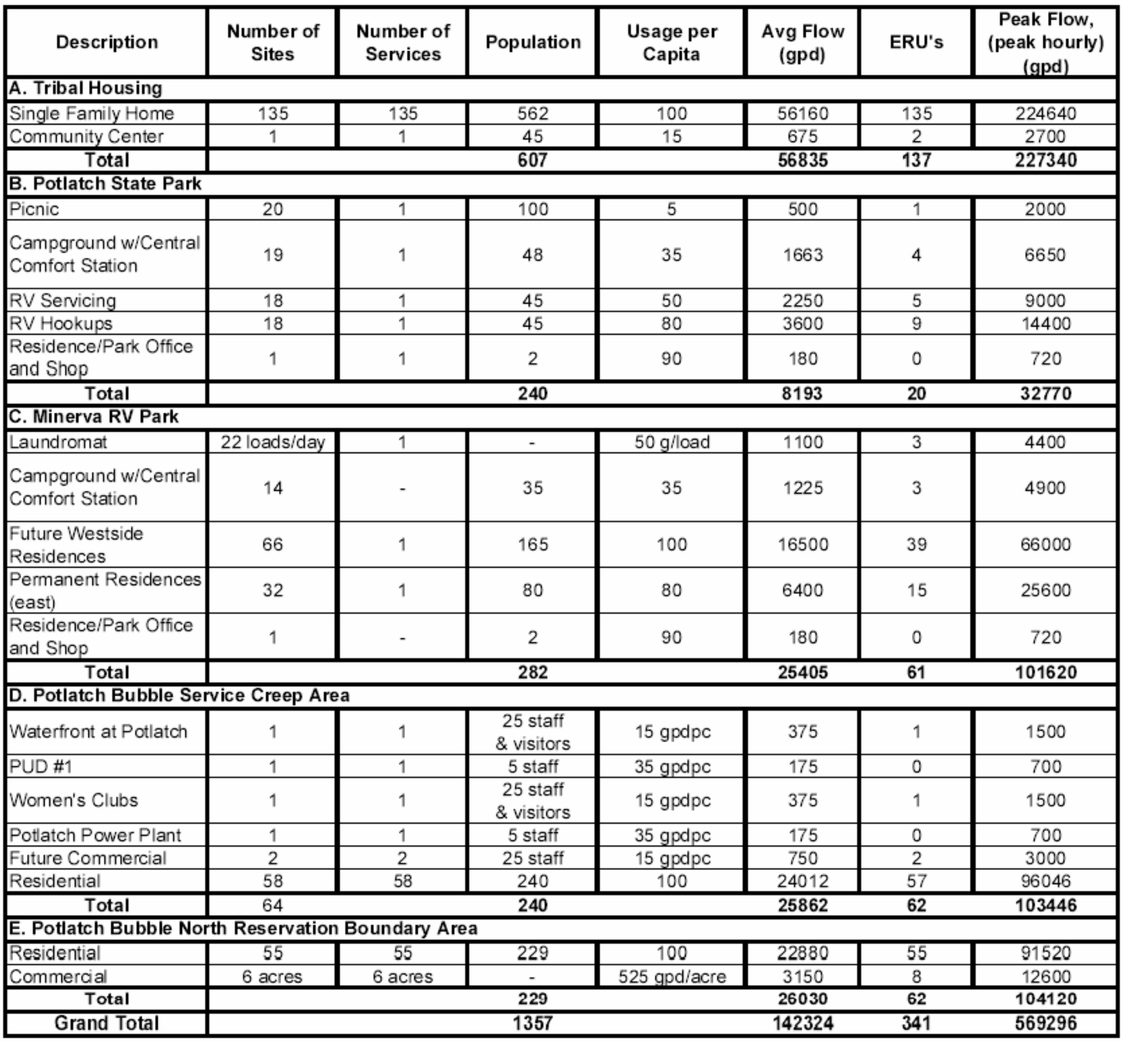
# Wastewater Flow for Potlatch Area – Phase 1

| Description | Number of Sites | Number of Services | Population | Usage per Capita | Avg Flow (gpd) | ERU's | Peak Flow, (peak hourly) (gpd) |
|---|---|---|---|---|---|---|---|
| **A. Tribal Housing** | | | | | | | |
| Single Family Home | 50 | 50 | 208 | 100 | 20800 | 50 | 83200 |
| Community Center | 1 | 1 | 10 | 15 | 150 | 1 | 600 |
| **Total** | | **51** | **218** | | **20950** | **51** | **83800** |
| **B. Potlatch State Park** | | | | | | | |
| Picnic | 20 | 1 | 100 | 5 | 500 | 1 | 2000 |
| Campground w/Central Comfort Station | 19 | 1 | 48 | 35 | 1663 | 4 | 6650 |
| RV Servicing | 18 | 1 | 45 | 50 | 2250 | 5 | 9000 |
| RV Hookups | 18 | 1 | 45 | 80 | 3600 | 9 | 14400 |
| Residence/Park Office and Shop | 1 | 1 | 2 | 90 | 180 | 0 | 720 |
| **Total** | | **5** | **240** | | **8193** | **20** | **32770** |
| **C. Minerva RV Park** | | | | | | | |
| Laundromat | 22 loads/day | 1 | - | 50 g/load | 1100 | 3 | 4400 |
| Campground w/Central Comfort Station | 14 | - | 35 | 35 | 1225 | 3 | 4900 |
| RV's & Mobile Homes (west) | 21 | 1 | 53 | 80 | 4200 | 10 | - |
| Permanent Residences (east) | 32 | 1 | 80 | 80 | 6400 | 15 | 25600 |
| Residence/Park Office and Shop | 1 | - | 2 | 90 | 180 | 0 | 720 |
| **Total** | | **3** | **170** | | **13105** | **31** | **52420** |
| **Grand Total** | | | **627** | | **42248** | **102** | **168990** |

Figure
3.03

## Figure 3.04

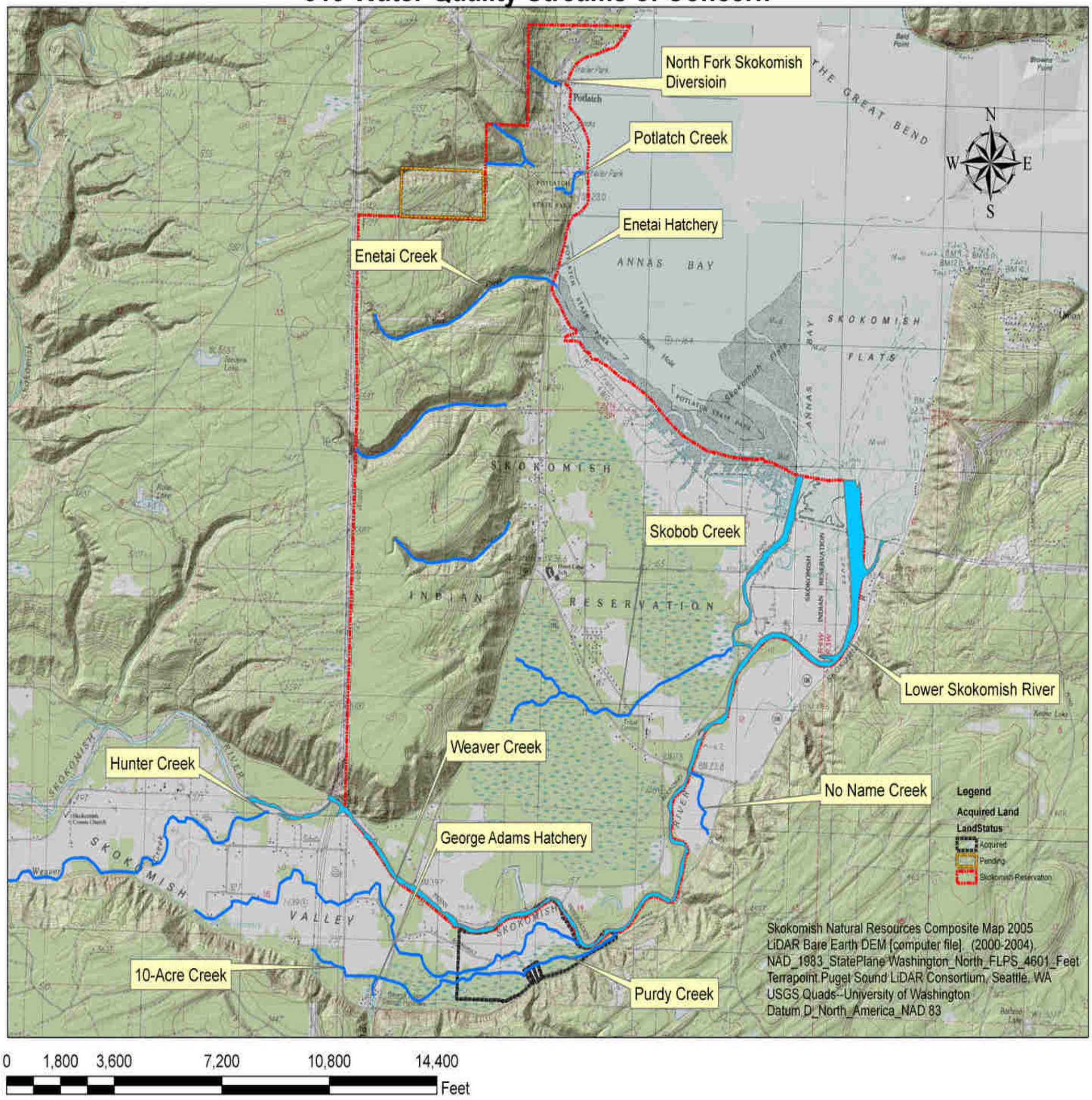
# Wastewater Flows for Potlatch Area - Ultimate



| Description | Number of Sites | Number of Services | Population | Usage per Capita | Avg Flow (gpd) | ERU's | Peak Flow, (peak hourly) (gpd) |
|---|---|---|---|---|---|---|---|
| **A. Tribal Housing** | | | | | | | |
| Single Family Home | 135 | 135 | 562 | 100 | 56160 | 135 | 224640 |
| Community Center | 1 | 1 | 45 | 15 | 675 | 2 | 2700 |
| **Total** | | | **607** | | **56835** | **137** | **227340** |
| **B. Potlatch State Park** | | | | | | | |
| Picnic | 20 | 1 | 100 | 5 | 500 | 1 | 2000 |
| Campground w/Central Comfort Station | 19 | 1 | 48 | 35 | 1663 | 4 | 6650 |
| RV Servicing | 18 | 1 | 45 | 50 | 2250 | 5 | 9000 |
| RV Hookups | 18 | 1 | 45 | 80 | 3600 | 9 | 14400 |
| Residence/Park Office and Shop | 1 | 1 | 2 | 90 | 180 | 0 | 720 |
| **Total** | | | **240** | | **8193** | **20** | **32770** |
| **C. Minerva RV Park** | | | | | | | |
| Laundromat | 22 loads/day | 1 | - | 50 g/load | 1100 | 3 | 4400 |
| Campground w/Central Comfort Station | 14 | - | 35 | 35 | 1225 | 3 | 4900 |
| Future Westside Residences | 66 | 1 | 165 | 100 | 16500 | 39 | 66000 |
| Permanent Residences (east) | 32 | 1 | 80 | 80 | 6400 | 15 | 25600 |
| Residence/Park Office and Shop | 1 | - | 2 | 90 | 180 | 0 | 720 |
| **Total** | | | **282** | | **25405** | **61** | **101620** |
| **D. Potlatch Bubble Service Creep Area** | | | | | | | |
| Waterfront at Potlatch | 1 | 1 | 25 staff & visitors | 15 gpdpc | 375 | 1 | 1500 |
| PUD #1 | 1 | 1 | 5 staff | 35 gpdpc | 175 | 0 | 700 |
| Women's Clubs | 1 | 1 | 25 staff & visitors | 15 gpdpc | 375 | 1 | 1500 |
| Potlatch Power Plant | 1 | 1 | 5 staff | 35 gpdpc | 175 | 0 | 700 |
| Future Commercial | 2 | 2 | 25 staff | 15 gpdpc | 750 | 2 | 3000 |
| Residential | 58 | 58 | 240 | 100 | 24012 | 57 | 96046 |
| **Total** | 64 | | **240** | | **25862** | **62** | **103446** |
| **E. Potlatch Bubble North Reservation Boundary Area** | | | | | | | |
| Residential | 55 | 55 | 229 | 100 | 22880 | 55 | 91520 |
| Commercial | 6 acres | 6 acres | - | 525 gpd/acre | 3150 | 8 | 12600 |
| **Total** | | | **229** | | **26030** | **62** | **104120** |
| **Grand Total** | | | **1357** | | **142324** | **341** | **569296** |

## Figure 3.05

### Skokomish Reservation and 319 Water Quality Streams of Concern



Skokomish Natural Resources Composite Map 2005
LiDAR Bare Earth DEM [computer file]. (2000-2004).
NAD_1983_StatePlane Washington_North_FLPS_4601_Feet
Terrapoint Puget Sound LiDAR Consortium, Seattle, WA
USGS Quads--University of Washington
Datum D_North_America_NAD 83

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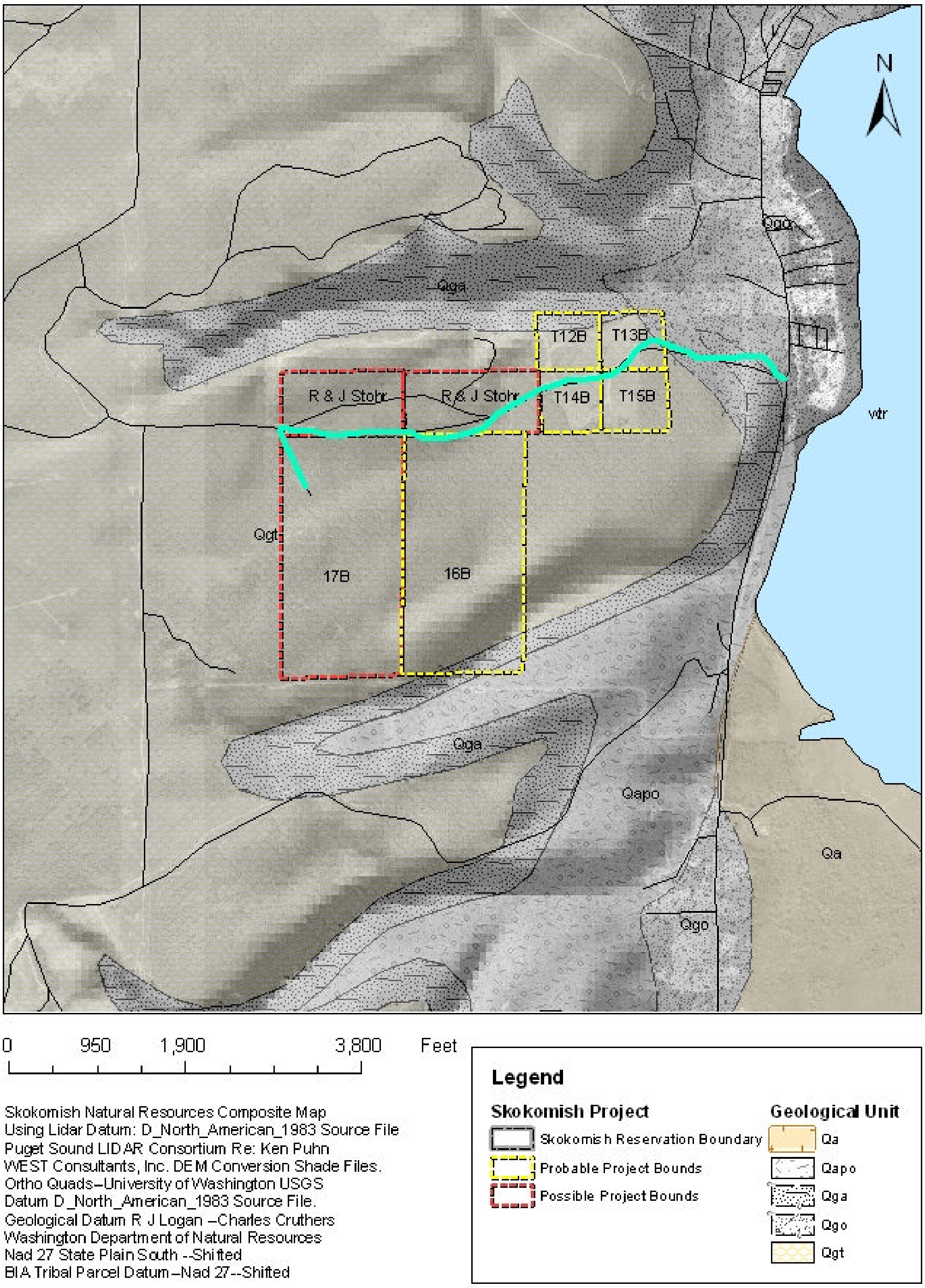
**Figure 3.06**

Figure
3.06

# Skokomish Tribal Housing Project
# Geololgical Profile



Skokomish Natural Resources Composite Map
Using Lidar Datum: D_North_American_1983 Source File
Puget Sound LIDAR Consortium Re: Ken Puhn
WEST Consultants, Inc. DEM Conversion Shade Files.
Ortho Quads–University of Washington USGS
Datum D_North_American_1983 Source File.
Geological Datum R J Logan –Charles Cruthers
Washington Department of Natural Resources
Nad 27 State Plain South --Shifted
BIA Tribal Parcel Datum–Nad 27--Shifted

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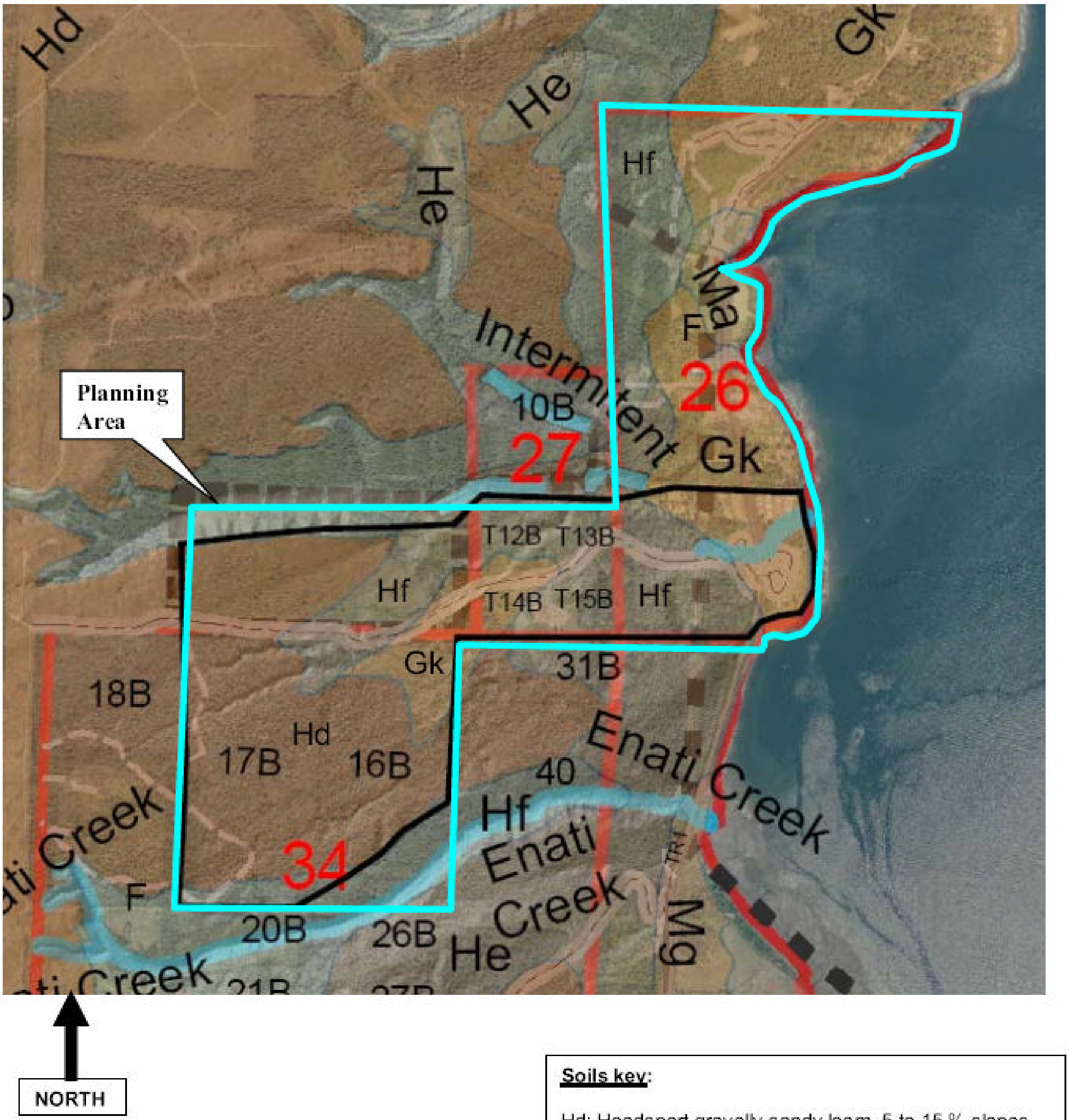
**Figure**
**3.07**

## Figure 3.07
# Soils Mapping



From: Ness, A. 0., and Fowler, R. H., 1960. *Soil Survey Of Mason County, Washington*, Soil Conservation Service, United States Department of Agriculture, Washington Agricultural Experiment Stations.
http://www.or.nrcs.usda.gov/pnw_soil/wa_reports.html

**Soils key:**

Hd: Hoodsport gravelly sandy loam, 5 to 15 % slopes
He: Hoodsport gravelly sandy loam, 15 to 30 % slopes
Hf: Hoodsport gravelly sandy loam, 30 to 45 % slopes
Gh: Grove gravelly sandy loam, 0 to 5 % slopes
Gk: Grove gravelly sandy loam, 5 to 15 % slopes
Ma - Made land

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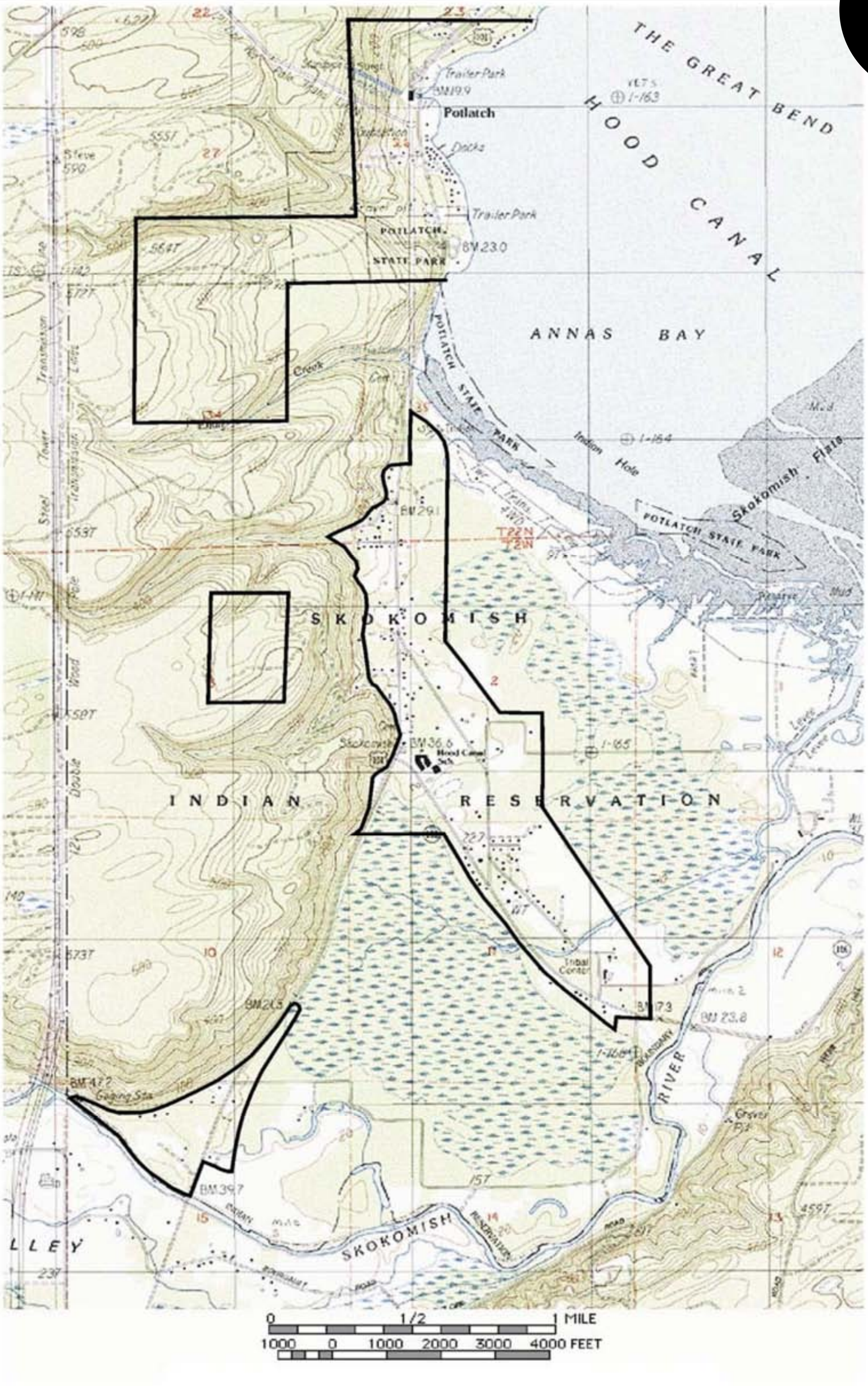
## Figure 3.08



The Potlatch & Skokomish Indian Reservation Study Area, Mason County, WA

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**Figure 3.09**

Figure
3.09

## Note:

**Consistent with Washington State Law, this map is redacted in widely published copies of this report. This map is intended for the use of planning and design professionals in consultation with appro-priate Tribal and State historic preservation officials so that known cultural resource sites can be avoided or properly managed in the event of earth**

Archaeological and ethnographic sites in and near the Potlatch & Skokomish Indian Reservation Study Area, Mason County, WA

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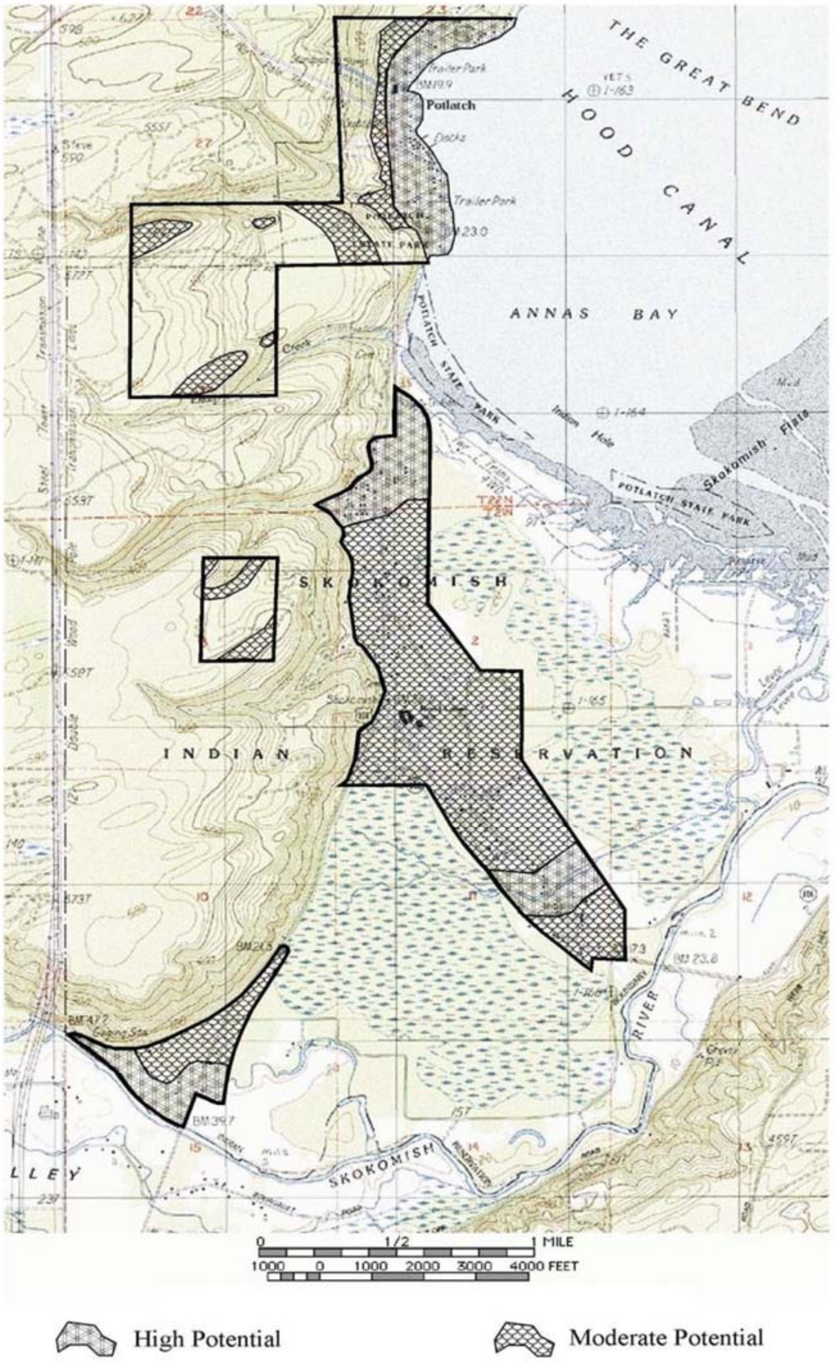
**Figure 3.10**



Archaeological potential zones in the Potlatch & Skokomish Indian Reservation Study Area, Mason County, WA

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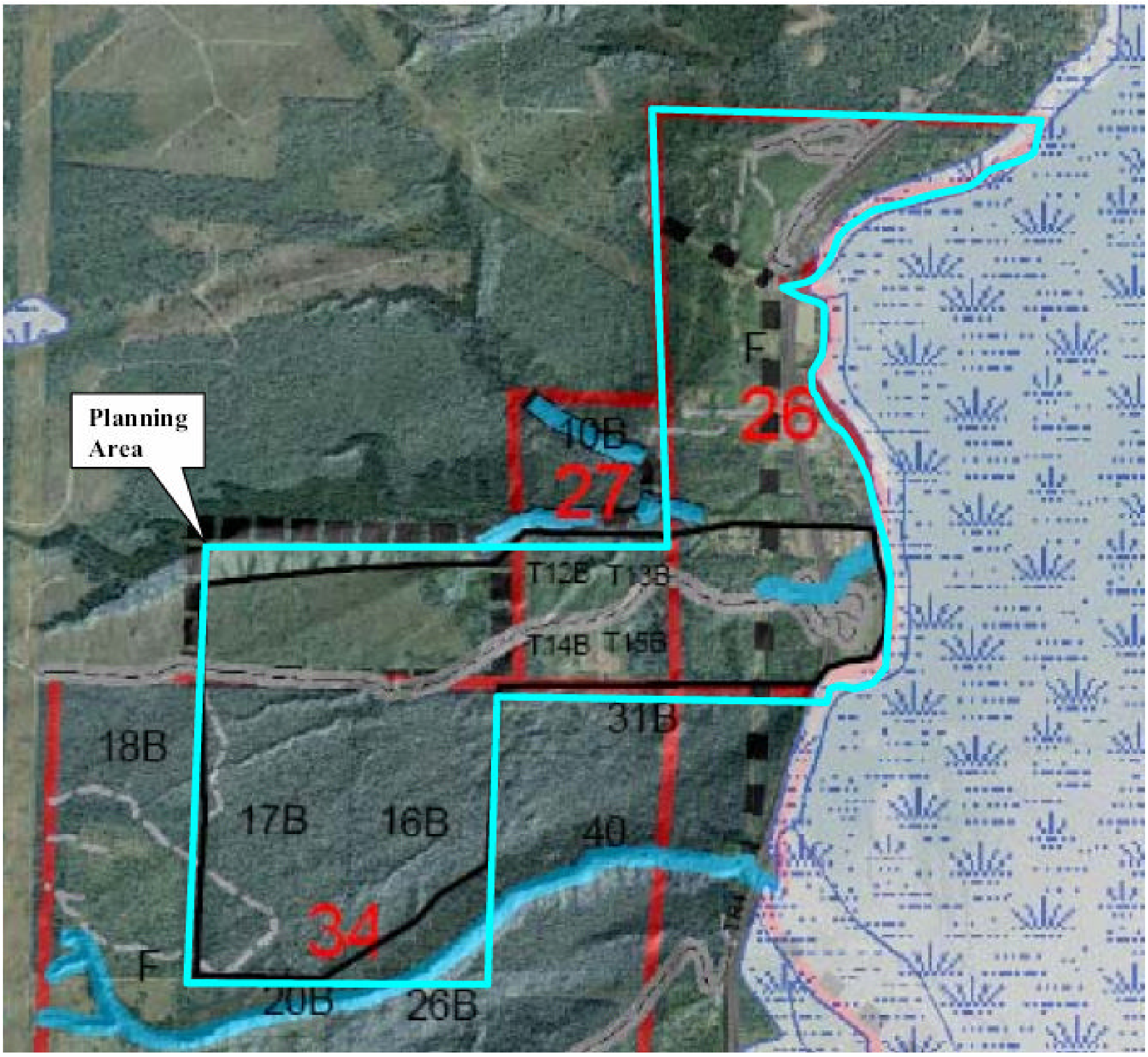
Figure 3.11



**Wetlands**

NORTH

From: Skokomish Tribe GIS Services

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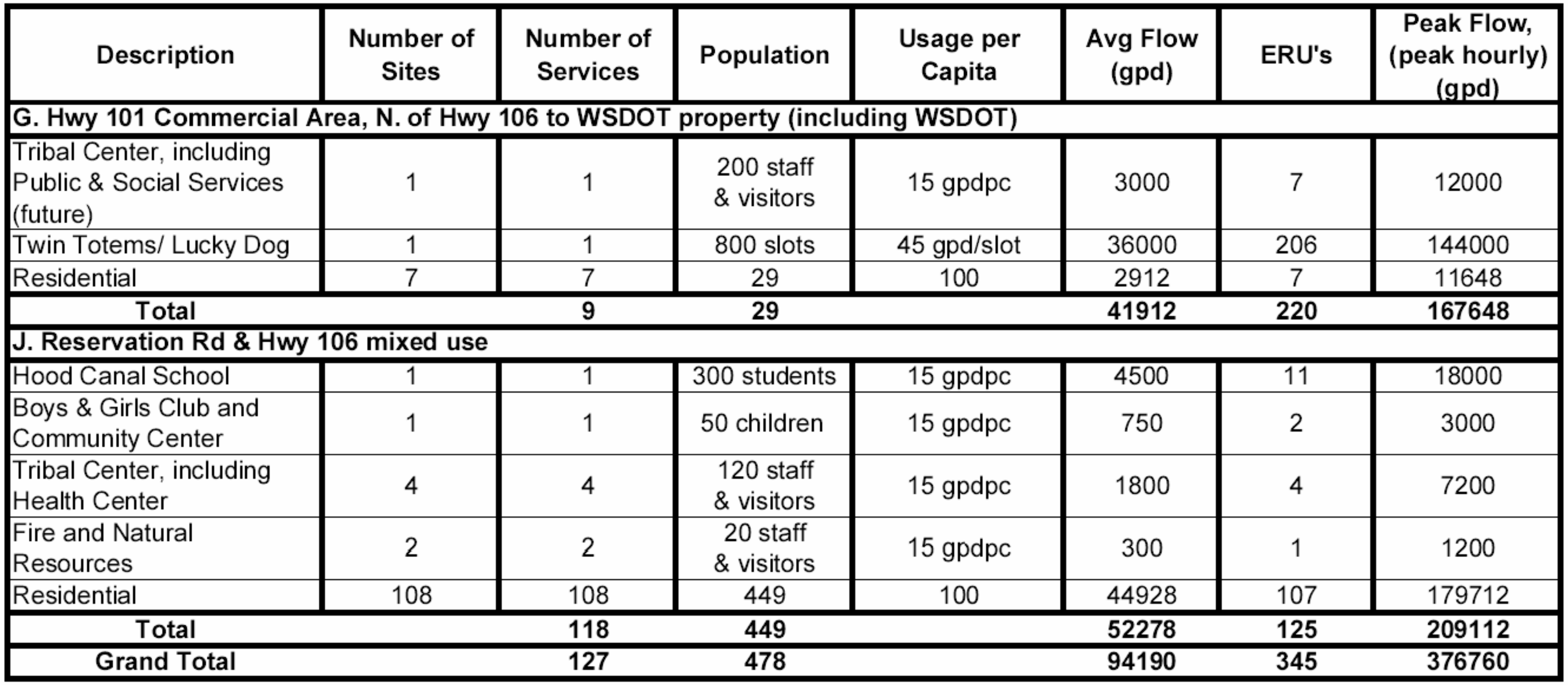
## Figure 4.01

# Wastewater Flow for Core Area – Phase 1



| Description | Number of Sites | Number of Services | Population | Usage per Capita | Avg Flow (gpd) | ERU's | Peak Flow, (peak hourly) (gpd) |
|---|---|---|---|---|---|---|---|
| **G. Hwy 101 Commercial Area, N. of Hwy 106 to WSDOT property (including WSDOT)** | | | | | | | |
| Tribal Center, including Public & Social Services (future) | 1 | 1 | 200 staff & visitors | 15 gpdpc | 3000 | 7 | 12000 |
| Twin Totems/ Lucky Dog | 1 | 1 | 800 slots | 45 gpd/slot | 36000 | 206 | 144000 |
| Residential | 7 | 7 | 29 | 100 | 2912 | 7 | 11648 |
| **Total** | | **9** | **29** | | **41912** | **220** | **167648** |
| **J. Reservation Rd & Hwy 106 mixed use** | | | | | | | |
| Hood Canal School | 1 | 1 | 300 students | 15 gpdpc | 4500 | 11 | 18000 |
| Boys & Girls Club and Community Center | 1 | 1 | 50 children | 15 gpdpc | 750 | 2 | 3000 |
| Tribal Center, including Health Center | 4 | 4 | 120 staff & visitors | 15 gpdpc | 1800 | 4 | 7200 |
| Fire and Natural Resources | 2 | 2 | 20 staff & visitors | 15 gpdpc | 300 | 1 | 1200 |
| Residential | 108 | 108 | 449 | 100 | 44928 | 107 | 179712 |
| **Total** | | **118** | **449** | | **52278** | **125** | **209112** |
| **Grand Total** | | **127** | **478** | | **94190** | **345** | **376760** |

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## Figure 4.02

# Wastewater Flow for Core Area – Ultimate

| Description | Number of Sites | Number of Services | Population | Usage per Capita | Avg Flow (gpd) | ERU's | Peak Flow, (peak hourly) (gpd) |
|---|---|---|---|---|---|---|---|
| **F. Hwy 101 Residential Area, N. of WSDOT property** | | | | | | | |
| Residential | 22 | 22 | 92 | 100 | 9152 | 22 | 36608 |
| **Total** | | **22** | **92** | | **9152** | **22** | **36608** |
| **G. Hwy 101 Commercial Area, N. of Hwy 106 to WSDOT property (including WSDOT)** | | | | | | | |
| Tribal Center, including Public & Social Services (future) | 1 | 1 | 200 staff & visitors | 15 gpdpc | 3000 | 7 | 12000 |
| Twin Totems/ Lucky Dog | 1 | 1 | 800 slots | 45 gpd/slot | 36000 | 206 | 144000 |
| Future Commercial | - | 30 acres | 30 acres | 525 gpd/acre | 15750 | 38 | 63000 |
| Residential | 47 | 47 | 197 | 100 | 19702 | 47 | 78807 |
| **Total** | | **49** | **197** | | **74452** | **299** | **297807** |
| **H. Junction Hwys 101 & 106** | | | | | | | |
| Future Commercial | 6 acres | 6 acres | - | 525 gpd/acre | 3150 | 8 | 12600 |
| **Total** | | | **-** | | **3150** | **8** | **12600** |
| **J. Reservation Rd & Hwy 106 mixed use** | | | | | | | |
| Hood Canal School | 1 | 1 | 450 students | 15 gpdpc | 6750 | 16 | 27000 |
| Boys & Girls Club and Community Center | 1 | 1 | 50 children & visitors | 15 gpdpc | 750 | 2 | 3000 |
| Tribal Center, including Health Center | 4 | 4 | 5 staff & visitors | 15 gpdpc | 75 | 0 | 300 |
| Fire and Natural Resources | 2 | 2 | 20 staff & visitors | 15 gpdpc | 300 | 1 | 1200 |
| Residential | 136 | 136 | 566 | 100 | 56576 | 136 | 226304 |
| **Total** | | **144** | | | **64451** | **155** | **257804** |
| **Grand Total** | | **215** | **289** | | **151205** | **483** | **604819** |

Figure
4.02

## Figure 5.01

# Land Area Requirements for Treatment and Disposal

### All Units in Acres

| *System* | *MBR* | *SBR* | *Rapid Infiltration* | *Irrigation* | *Storage Pond* |
|---|---|---|---|---|---|
| Potlatch | 1.7 | 2.0 | 3.5 | 20.9 | 7.8 |
| Core | 1.8 | 2.2 | 4.4 | 26.1 | 9.8 |
| Combined | 2.0 | 2.4 | 7.9 | 47.0 | 17.6 |

# Figure 5.02

## COMPARISON OF SYSTEM ALTERNATIVES
## SEPARATE SYSTEM - POTLATCH BUBBLE

| Item | Description | Alt 1A | Alt 1B | Alt 1C | Alt 1D |
|---|---|---|---|---|---|
| **CONVEYANCE** | | | | | |
| 1 | Gravity sewer for new Tribal Housing connection | 750 LF pipe , 2 manholes | | | |
| 2 | Potlatch State Park system improvements | Upgrade pump station, 5 commercial services | | | |
| 3 | Minerva RV Park system improvements | 2040 LF pipe, 3 commercial services | | | |
| 4 | Service Area Creep plus North Boundary Area (Area D & E) system improvements | 6250 LF pipe, 113 residential services, 3 commercial services | | | |
| **WASTEWATER TREATMENT** | | | | | |
| 5 | Wastewater Treatment Plant | MBR, 142,300 gpd, 1.7 acres, 1.5 staff, reliable Class A effluent | | SBR, 142,300 gpd, 1.5 staff, less reliable Class A effluent | |
| **DISPOSAL** | | | | | |
| 6 | Effluent Disposal | Rapid infiltration near access road, 2.0 acres, 0.5 staff, beneficial increased flow to unnamed stream | Upslope forest irrigation (27 acres), 20 Hp pump station, storage pond (10 acres), 0.5 staff | Rapid infiltration near access road, 2.0 acres, 0.5 staff, beneficial increased flow to unnamed stream | Upslope forest irrigation (27 acres), 20 Hp pump station, storage pond (10 acres), 0.5 staff |

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# Figure 5.03

## COMPARISON OF SYSTEM ALTERNATIVES
## SEPARATE SYSTEM - CORE AREA

| Item | Description | Alt 2A | Alt 2B | Alt 2C | Alt 2D |
|---|---|---|---|---|---|
| | **CONVEYANCE** | | | | |
| 1 | Hwy 101 (Areas F, G & H) system improvements | 11,500 LF pipe, future tribal center, 47 residential services, 7 commercial services | | | |
| 2 | Reservation Road (Area J) system improvements | 18,150 LF pipe, school, 108 residential services, 9 commercial services | | | |
| | **WASTEWATER TREATMENT** | | | | |
| 3 | Wastewater Treatment Plant | MBR, 151,200 gpd, 1.8 acres, 2.0 staff, reliable Class A effluent | | SBR, 151,200 gpd, 2.2 acres, 2.0 staff, less reliable Class A effluent | |
| | **DISPOSAL** | | | | |
| 4 | Effluent Disposal | Rapid infiltration east of Hwy 101, 2.0 acres, 0.5 staff, beneficial increased flow to northern slough area | Upslope forest irrigation (26 acres), 20 Hp pump station, storage pond (9.8 acres), 0.5 staff | Rapid infiltration east of Hwy 101, 2.0 acres, 0.5 staff, beneficial increased flow to northern slough area | Upslope forest irrigation (26 acres), 20 Hp pump station, storage pond (9.8 acres), 0.5 staff |

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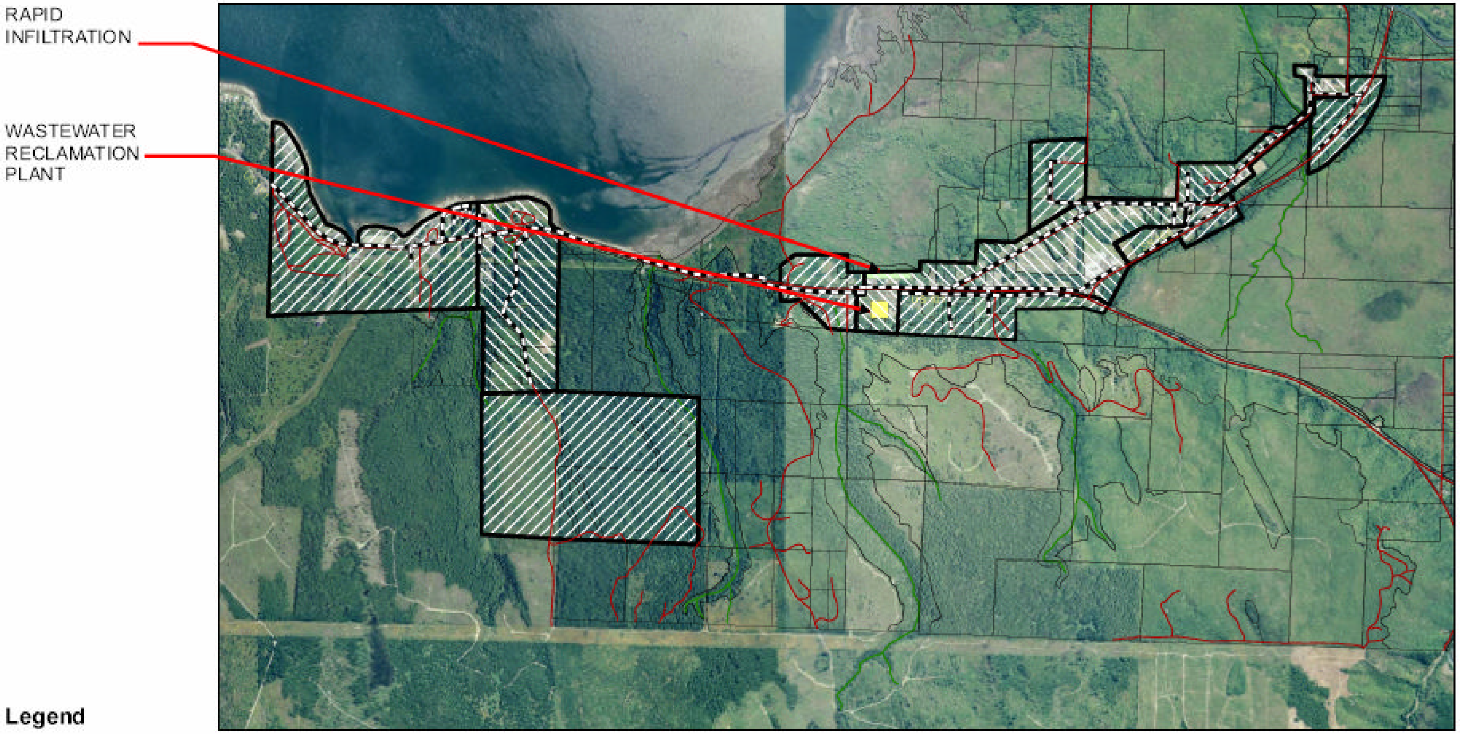
## Figure 5.04

### COMPARISON OF SYSTEM ALTERNATIVES
### COMBINED SYSTEM - CORE AREA

| Item | Description | Alt 3A | Alt 3B | Alt 3C | Alt 3D |
|---|---|---|---|---|---|
| | **CONVEYANCE** | | | | |
| 1 | Gravity sewer for new Tribal Housing connection | 750 LF pipe , 2 manholes | | | |
| 2 | Potlatch State Park system improvements | Upgrade pump station, 5 commercial services | | | |
| 3 | Minerva RV Park system improvements | 2040 LF pipe, 3 commercial services | | | |
| 4 | Service Area Creep plus North Boundary Area (Area D & | 6250 LF pipe, 113 residential services, 3 commercial services | | | |
| 5 | Hwy 101 (Areas F, G & H) system improvements | 11,500 LF pipe, future tribal center, 47 residential services, 7 commercial | | | |
| 6 | Reservation Road (Area J) system improvements | 18,150 LF pipe, school, 108 residential services, 9 commercial services | | | |
| | **WASTEWATER TREATMENT** | | | | |
| 7 | Wastewater Treatment Plant | MBR, 293,500 gpd, 2.0 acres, 2.0 staff, reliable Class A effluent | | SBR, 293,500 gpd, 2.4 acres, 2.0 staff, less reliable Class A effluent | |
| | **DISPOSAL** | | | | |
| 8 | Effluent Disposal | Rapid infiltration east of Hwy 101, 4.0 acres, 0.5 staff, beneficial increased flow to northern slough area | Upslope forest irrigation (55 acres), 35 Hp pump station, storage pond (21 acres), 1.0 staff | Rapid infiltration east of Hwy 101, 4.0 acres, 0.5 staff, beneficial increased flow to northern slough area | Upslope forest irrigation (55 acres), 35 Hp pump station, storage pond (21 acres), 1.0 staff |

# Figure 5.05



**Legend**

- - - - Proposed Sewer

▧ Phase 1 Service Area

▨ Ultimate Service Area

# POTLATCH BUBBLE & CORE RESERVATION SERVICE AREAS

## COMBINED TREATMENT SYSTEMS

Cascade Design Professionals, 2007

N

Feet
0 1,000 2,000

*Based on Skokomish Reservation mapping prepared by the Natural Resources Department of the Skokomish Tribe

Figure
5.05

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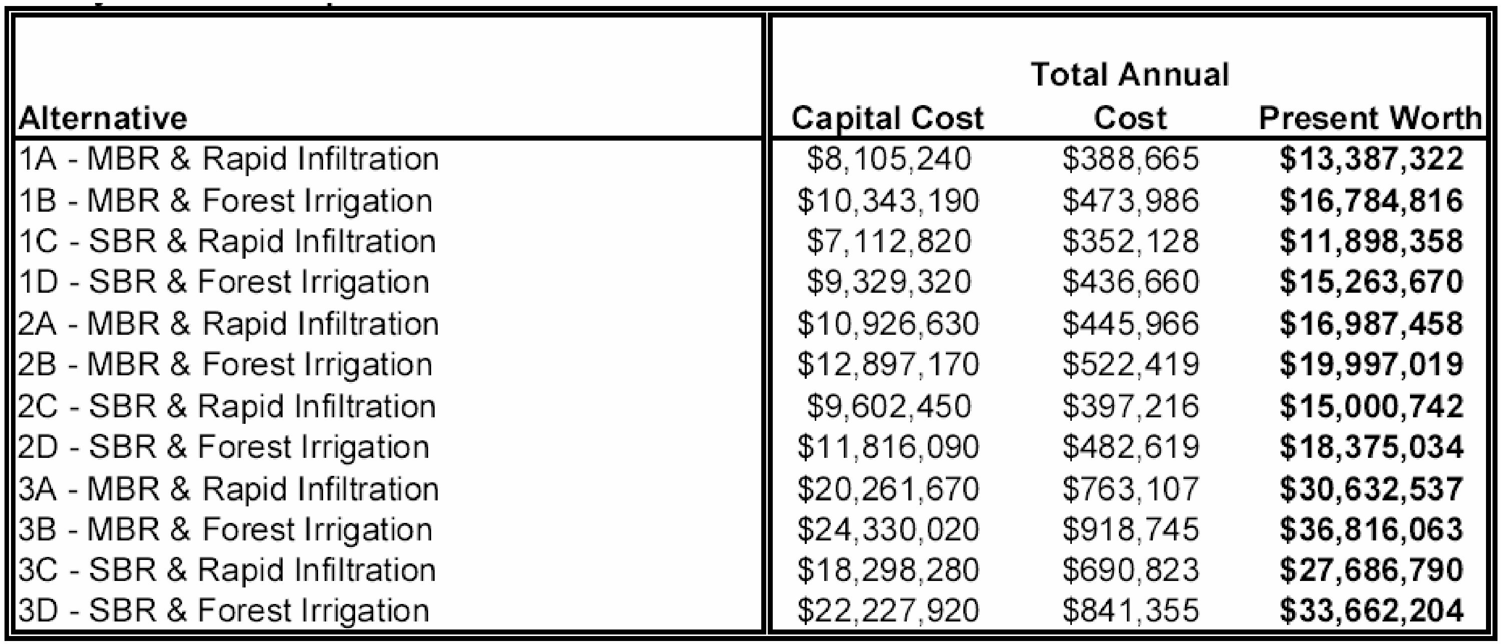
## Figure 5.06

# Life Cycle Cost Comparison



| Alternative | Capital Cost | Total Annual Cost | Present Worth |
|---|---|---|---|
| 1A - MBR & Rapid Infiltration | $8,105,240 | $388,665 | **$13,387,322** |
| 1B - MBR & Forest Irrigation | $10,343,190 | $473,986 | **$16,784,816** |
| 1C - SBR & Rapid Infiltration | $7,112,820 | $352,128 | **$11,898,358** |
| 1D - SBR & Forest Irrigation | $9,329,320 | $436,660 | **$15,263,670** |
| 2A - MBR & Rapid Infiltration | $10,926,630 | $445,966 | **$16,987,458** |
| 2B - MBR & Forest Irrigation | $12,897,170 | $522,419 | **$19,997,019** |
| 2C - SBR & Rapid Infiltration | $9,602,450 | $397,216 | **$15,000,742** |
| 2D - SBR & Forest Irrigation | $11,816,090 | $482,619 | **$18,375,034** |
| 3A - MBR & Rapid Infiltration | $20,261,670 | $763,107 | **$30,632,537** |
| 3B - MBR & Forest Irrigation | $24,330,020 | $918,745 | **$36,816,063** |
| 3C - SBR & Rapid Infiltration | $18,298,280 | $690,823 | **$27,686,790** |
| 3D - SBR & Forest Irrigation | $22,227,920 | $841,355 | **$33,662,204** |

Figure
5.06

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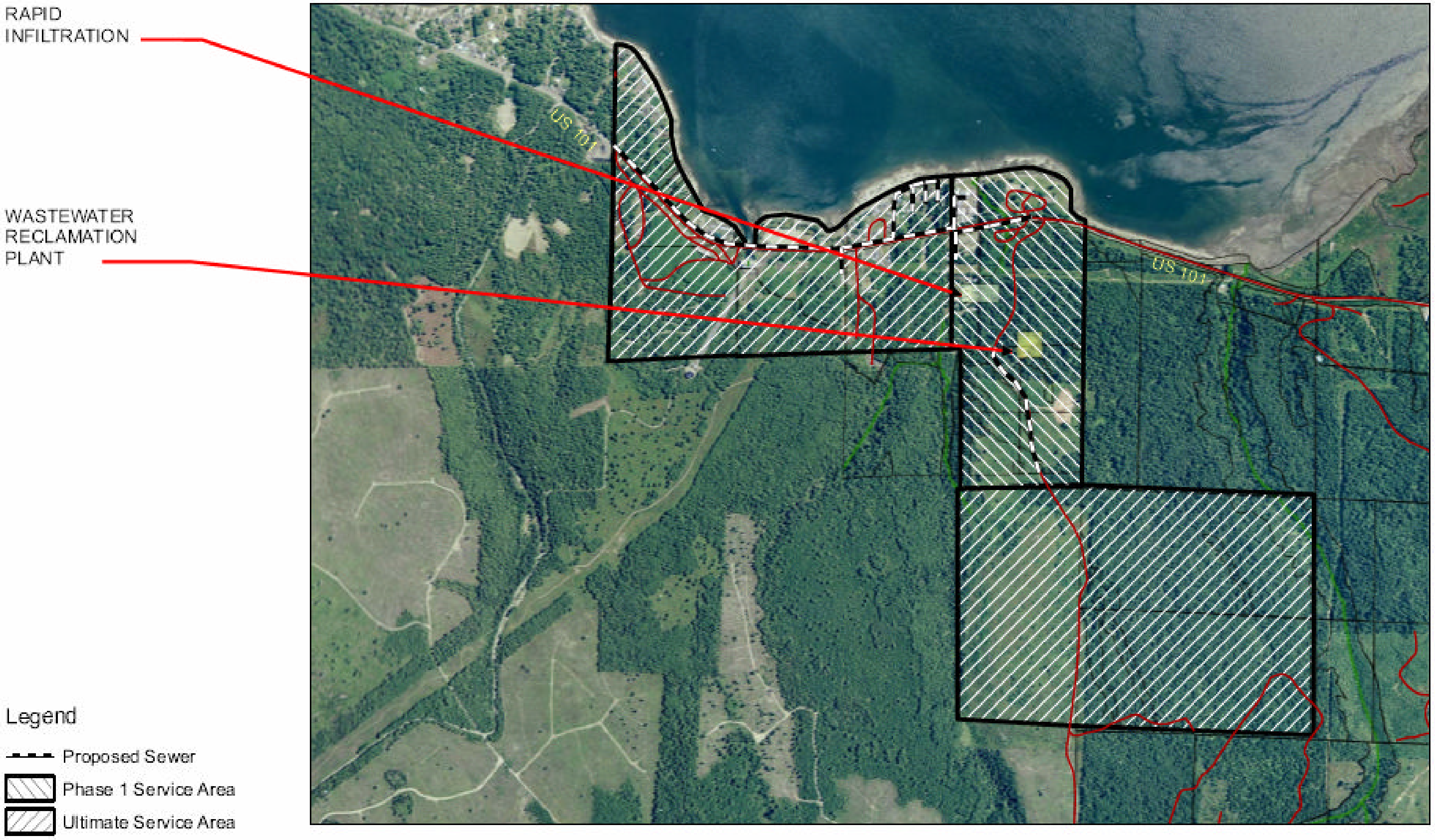
## Figure 5.07



# POTLATCH BUBBLE SERVICE AREA

## SEPARATE TREATMENT SYSTEMS

Cascade Design Professionals, 2007

*Based on Skokomish Reservation mapping prepared by the Natural Resources Department of the Skokomish Tribe

Figure
5.07

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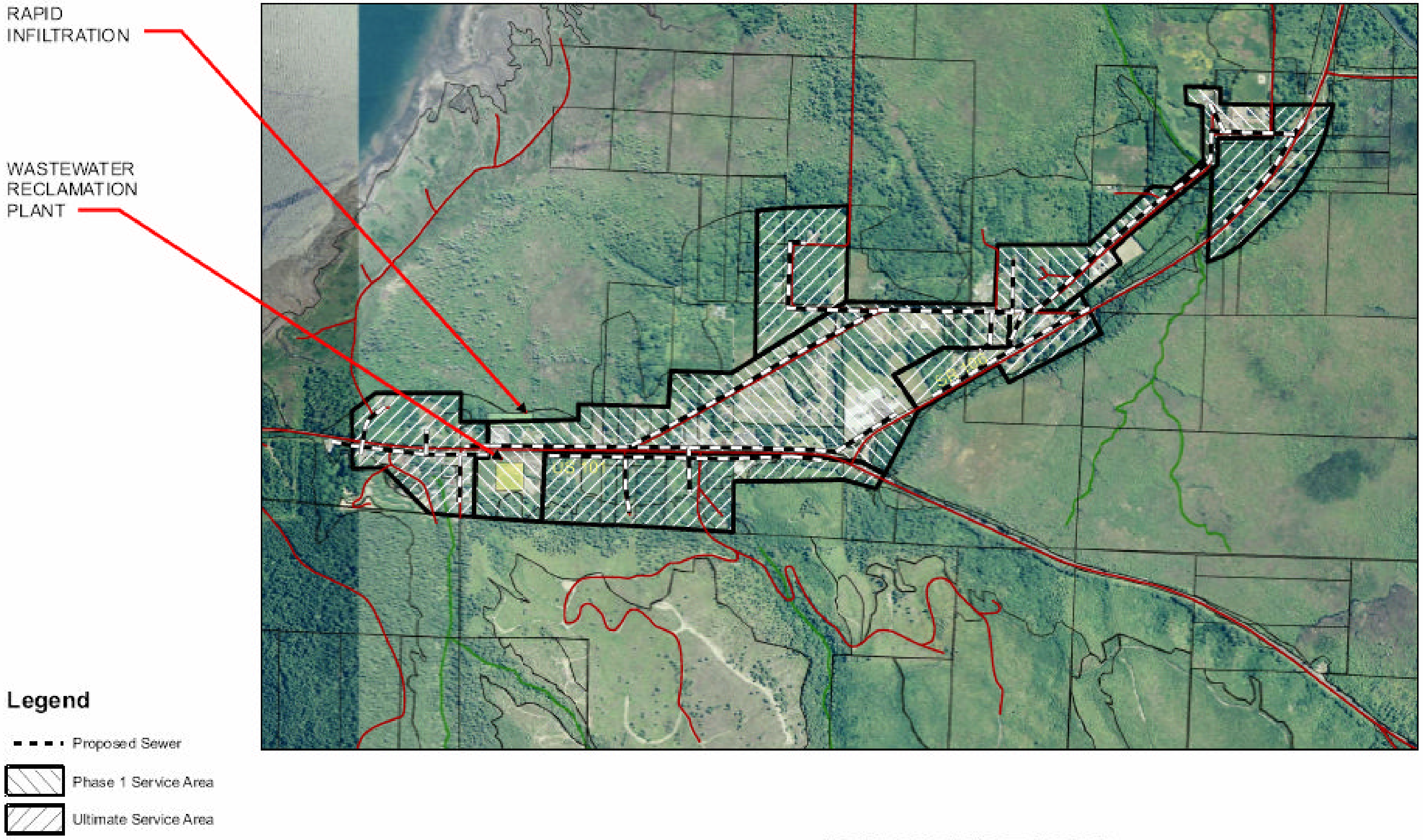
# Figure 5.08

## COST COMPARISONS - PHASED
## (MBR & RAPID INFILTRATION)

| Alt. | Description | Conveyance | Treatment | Disposal | Construction Total | Contingency | Eng, Admin & Perm | Total | Cost / ERU |
|---|---|---|---|---|---|---|---|---|---|
| | | | | PHASE 1 | | | | | |
| 1A | Potlatch Bubble, separate treatment | 294,000 | 1,917,000 | 190,000 | 2,401,000 | 600,250 | 432,180 | 3,433,430 | 33,661 |
| 2A | Core Area, separate treatment | 1,722,000 | 2,565,000 | 234,000 | 4,521,000 | 1,130,250 | 813,780 | 6,465,030 | 18,739 |
| 3A | Combined Treatment | 3,210,000 | 3,546,000 | 317,000 | 7,073,000 | 1,768,250 | 1,273,140 | 10,114,390 | 22,627 |
| | | | | PHASE 2 | | | | | |
| 1A | Potlatch Bubble, separate treatment | 1,208,000 | 1,917,000 | 142,000 | 3,267,000 | 816,750 | 588,060 | 4,671,810 | 19,547 |
| 2A | Core Area, separate treatment | 1,467,000 | 1,539,000 | 114,000 | 3,120,000 | 780,000 | 561,600 | 4,461,600 | 32,330 |
| 3A | Combined Treatment | 2,700,000 | 4,082,000 | 314,000 | 7,096,000 | 1,774,000 | 1,277,280 | 10,147,280 | 26,916 |
| | | | | TOTAL | | | | | |
| 1A | Potlatch Bubble, separate treatment | 1,502,000 | 3,834,000 | 332,000 | 5,668,000 | 1,417,000 | 1,020,240 | 8,105,240 | 23,769 |
| 2A | Core Area, separate treatment | 3,189,000 | 4,104,000 | 348,000 | 7,641,000 | 1,910,250 | 1,375,380 | 10,926,630 | 22,622 |
| 3A | Combined Treatment | 5,910,000 | 7,628,000 | 631,000 | 14,169,000 | 3,542,250 | 2,550,420 | 20,261,670 | 24,589 |

# Figure 5.09



## CORE RESERVATION SERVICE AREA

### SEPARATE TREATMENT SYSTEMS

Cascade Design Professionals, 2007

*Based on Skokomish Reservation mapping prepared by the Natural Resources Department of the Skokomish Tribe

Figure 5.09

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# Figure 7.01

## Hoodsport-Skokomish Facilities Planning Summary

| Activity | Hoodsport | Potlatch | Core Res | Pot + Core |
|---|---|---|---|---|
| Engineering | $24,516 | | | $38,424 |
| Hydrogeology + Survey | $31,500 | $15,750 | $15,750 | $31,500 |
| Environmental Documentation | $30,000 | $30,000 | $30,000 | $60,000 |
| Financial | $22,667 | $22,667 | $22,667 | $45,333 |
| | $108,683 | $68,417 | $68,417 | $175,257 |

**Funding available for Facilities Planning as of March 22, 2007**

## Hoodsport RAC Cost Summary

* = engineer's estimate

| | | Expanded Service Area 2 | Service Area 2 |
|---|---|---|---|
| **Total Construction Cost Estimates** (sums similar lines above) | | | |
| Engineer's Estimate | | $6,170,071 | $3,961,700 |
| Contingency | | $925,511 | $676,340 |
| 8.3% Sales Tax | | $589,780 | $384,957 |
| Construction Cost | | $7,685,362 | $5,022,997 |
| **Other Costs to Complete** (some a % of Construction Cost) | | | |
| Facilites Plan and Env Documentation | | $108,683 | $108,683 |
| Design Engineering | 12% | $922,243 | $602,760 |
| Assistance During Const. | 8% | $614,829 | $401,840 |
| Administration | 2% | $153,707 | $100,460 |
| Design/Admin Contingency | 3% | $230,561 | $150,690 |
| Cluster System Land | | $90,000 | |
| Sewer System Land | | $250,000 | $210,000 |
| | | $2,370,023 | $1,574,432 |
| **Total Cost to Complete** | | | |
| ***Grand Total*** | | $10,055,385 | $6,597,430 |

**Figure 5.08**

### COST COMPARISONS - PHASED

**(MBR & RAPID INFILTRATION)**

| Alt. | | Conveyance | Treatment | Disposal | Construction Total | Contingency | Eng, Admin & Perm | Total | Cost/ERU |
|---|---|---|---|---|---|---|---|---|---|
| **PHASE 1** | | | | | | | | | |
| 1A | Potlatch Bubble, separate treatment | 294,000 | 1,917,000 | 190,000 | 2,401,000 | 600,250 | 432,180 | 3,433,430 | 33,661 |
| 2A | Core Reservation, separate treatment | 1,722,000 | 2,565,000 | 234,000 | 4,521,000 | 1,130,250 | 813,780 | 6,465,030 | 18,739 |
| 3S | Combined Treatment | 3,210,000 | 3,548,000 | 317,000 | 7,075,000 | 1,768,750 | 1,273,500 | 10,117,250 | 22,627 |

Figure
7.01

# Appendix K

# Infiltration Evaluation/Water Quality Project Planning, GeoSciences, Inc. (2007)

HWA GEOSCIENCES INC.
*Geotechnical Engineering · Hydrogeology · Geoenvironmental Services · Inspection and Testing*

July 30, 2007
HWA Project No. 2006-172-600

Gray and Osborne
701 Dexter Avenue North, Suite 200
Seattle, Washington 981091

Attention: Mr. Harry Sellers, P.E.

Subject: **INFILTRATION EVALUATION**
**WATER QUALITY PROJECT PLANNING**
**POTLATCH "BUBBLE" PLANNING AREA**
**MASON COUNTY, WASHINGTON**

Dear Mr. Sellers:

HWA GeoSciences Inc. (HWA) is pleased to submit this effluent disposal/infiltration feasibility review at the Potlatch "Bubble" planning area in Mason County, Washington (Figure 1).

## INTRODUCTION

HWA prepared an infiltration evaluation dated March 8, 2007 to provide a preliminary evaluation of several sites within the Potlatch planning area, for infiltration potential (HWA, 2007). The following report provides additional information based upon supplemental investigations at one selected site within the planning area.

### Goals and Objectives

The goals and objectives of this study were to evaluate the infiltration potential and site suitability of the selected site, by determining soil types and identifying potentially suitable infiltration receptor soils. Figure 1 shows the location of the area investigated, the Potlatch State Park Drainfield.

## SITE EXPLORATIONS

HWA monitored the excavation of two test pits on February 21, 2007, and five test pits on June 12, 2007. Excavation services were provided by the Skokomish Tribe Department of Natural Resources and Lot Hauling of Shelton, Washington, respectively. Figure 2 shows the test pit locations (TP-14 through TP-22). Test pit logs are included in Appendix A. The investigation area is discussed below.

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**Potlatch State Park Drainfield**

The State Parks drainfield is located west and uphill from Highway 101 and the Potlatch State Park Campground. The site is a cleared, grassy area surrounded by forested land, and slopes down to the east. The drainfield area is mapped near the contact between glacial till and outwash by Logan (2003) and Carson (1976) and as glacial till by Shannon & Wilson (1978). The soils map indicates Hoodsport (till-derived) soils in this area (Ness and Fowler, 1960).

HWA previously monitored the excavation of two test pits, designated TP-14 and TP-15, one at either end of the drainfield, at the edge of the cleared area. HWA completed five additional test pits (TP-18 to TP-22) at the site to confirm the nature of outwash soils and assess the lateral extent of the soils. Soils encountered in test pit TP-18 included approximately six feet of topsoil and silty sands and gravel (weathered outwash) over relatively clean gravels and sand (outwash) to depths of up to eight feet below grade. Soils at the remaining test pits included 0.5 to one feet of topsoil over relatively clean sandy gravels (outwash) to depths of up to ten feet below grade. Ground water was not encountered in the test pits at this location, and is likely deep, based on the topography (i.e., upland location, approximate elevation of 200 feet). Ground water gradient at the site is likely to the east, or downslope. We previously observed numerous ground water springs at the base of the hillside along the western side of Highway 101 in the general area south of the State Park (HWA, 2007). This seepage is likely occurring along the advance outwash exposure at the base of the hill.

## INFILTRATION ESTIMATES - METHODS

The Washington State Department of Ecology (Ecology) 2005 *Stormwater Management Manual for Western Washington* recommends utilizing one of three methods for determining infiltration rates: ASTM grain size distribution, USDA textural analysis from soil samples, and in-situ field measurements.

This guidance document is intended primarily for stormwater, and therefore does not apply at this site, but contains results of recent research and principles of hydrogeology which can be used to estimate infiltration rates from other sources (e.g., treated waste water effluent). HWA utilized ASTM grain size distribution and USDA textural analysis to estimate infiltration rates for this project. HWA analyzed 11 soil samples collected from test pits at the State Parks drainfield site for grain size distribution and textural classification in accordance with these methodologies.

The infiltration rates estimated by the grain size methods assume a vertical gradient of 1, with no ground water or perching layers beneath the facility, i.e., no ground water mounding. HWA estimated flow rates for a given area assuming some degree of mounding, by adjustment of the vertical gradient to some value below 1, as described below. We then independently estimated mounding potential by several other analytical methods, also described below.

## 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.

### ASTM Grain Size Distribution

The ASTM grain size distribution method compares infiltration measurements from full-scale infiltration facilities to soil gradation data developed using the ASTM procedure (ASTM D422). Because this method compares data from existing full-scale infiltration facilities, the estimated infiltration rates are presented as estimated long-term infiltration rates. The estimated long-term infiltration rates assume an average degree of long-term facility maintenance, TSS (total suspended solids) control, and site variability in the subsurface conditions.

The ASTM grain size distribution method compares infiltration measurements from full-scale infiltration facilities to the D10, or grain size at which 10% of the sample is finer, of the soil, as measured using the ASTM procedure (ASTM D422). This method is not appropriate for soils with d10 less than 0.05 mm, which includes several samples from on site soils tested, therefore infiltration rates were not estimated using this technique for those samples. Table 1 shows the results of the grain size analyses and Appendix B presents the soil laboratory data.

### USDA Soil Textural Classification

Infiltration rates can be estimated from grain size distribution data using the USDA textural analysis approach. HWA analyzed soil samples collected from test pits for grain size distribution and textural classification in accordance with ASTM test procedures, corrected to approximate the USDA procedures. To determine long-term infiltration rates based on the USDA method, Ecology recommends that the short-term infiltration rates be reduced by a correction factor based on the soil textural classification, average degree of long-term facility maintenance, TSS reduction through pretreatment, and site subsurface variability. Table 1 shows the results of the grain size analyses and Appendix B presents the soil laboratory data.

### Table 1
### Long-Term Infiltration Rates*
### Based On USDA and ASTM Soil Textural Classification

| | | | | Ecology Long Term rates | |
|---|---|---|---|---|---|
| **Test Pit** | **Depth** | **ASTM description** | **USDA Classification** | **ASTM (in/hr)** | **USDA (in/hr)** |
| | **Drainfield** | | | | |
| TP-14 | 2.5 | Poorly graded SAND with gravel | SAND | 6.5 | 2 |
| TP-14 | 8.5 | Well graded GRAVEL with sand | SAND | 4.2 | 2 |
| TP-15 | 3.5 | Poorly graded SAND with gravel | SAND | 1.8 | 2 |
| TP-15 | 5.3 | Well graded GRAVEL with sand | SAND | 5.5 | 2 |
| TP-15 | 6.5 | Poorly graded GRAVEL w/ sand | SAND | 5 | 2 |
| TP-18 | 7.0 | Poorly graded GRAVEL with sand | SAND | 9 | 2 |
| TP-19 | 4.0 | Poorly graded GRAVEL with sand | Loamy SAND | 9 | 0.5 |
| TP-19 | 7.0 | Poorly graded GRAVEL with sand | SAND | 3.5 | 2 |
| TP-20 | 5.0 | Well graded GRAVEL with sand | Sandy LOAM | 9 | 0.5 |
| TP-21 | 8.0 | Well graded GRAVEL with sand | Loamy SAND | 9 | 2 |
| TP-22 | 5.0 | Well graded GRAVEL with sand | SAND | 9 | 2 |

* based on *Stormwater Management Manual for Western Washington*, Ecology, 2005.

## INFILTRATION ESTIMATES - RESULTS

Vertical infiltration is limited by the least permeable layer in the soil profile. HWA did not analyze the fine grained soils (e.g., silts and silty sands) encountered in our explorations. The infiltration rates provided herein should therefore be used in conjunction with the test pit logs (Appendix A) and the mounding analyses (below) to evaluate infiltration feasibility.

Based on HWA's grain size testing, long term infiltration rates for soils encountered at the site are approximately 0.5 to 2 in/hr using the USDA method, and up to 9 in/hr using the ASTM method.

Soils at the State Parks drainfield location were generally granular and consistent in composition, and appear feasible for infiltration ponds or basins. Because infiltration is limited by the least permeable layer in the soil profile, 0.5 in/hr should be used to conservatively estimate site-wide infiltration rates for this preliminary evaluation. Design infiltration rates should be adjusted based on further ground water mounding studies, as recommended below.

## GROUND WATER MOUNDING

Ground water mounding is a local raising of the ground water table due to infiltrating water from the surface. If a ground water mound reaches the infiltration facility, infiltration rates are greatly reduced, and facility failure may occur, depending on flow rates and storage volume.

To evaluate impacts to ground water flow due to the proposed infiltration facility, HWA used several methods, as described below.

**Ecology/ Massmann method**

Based on preliminary infiltration estimates of 0.5 in/hr at the Parks Drainfield site, HWA estimated the area required for infiltration of an assumed 45,000 gallons per day (gpd). We used a variation of Darcy's law, which states $Q = f\,i\,A$, where:

| | |
|---|---|
| Q = discharge | 45,000 gpd |
| f = infiltration rate | 0.5 in/hr |
| i = vertical gradient | see below |
| A = area | see below |

Vertical gradients where depth to ground water is shallow can be estimated using a regression method (based on multiple sites with measured infiltration rates) outlined by Massmann (Ecology, 2005), where the vertical gradient for a pond is described by the following relationship: $i = (Dwt+Dp)/138.62*K^{0.1}) \text{ x } CF$, where:

| | |
|---|---|
| Dwt = depth to water | 50 feet (conservatively assuming perching layers or mounding) |
| Dp = pond depth | assumed 6 feet |
| K = hydraulic conductivity | 100 feet/day (based on unsaturated soils, estimated from grain size testing results) |

CF = a correction factor for pond size, $CF= 0.73(A)^{-0.76}$ where A = area

i = vertical gradient 0.18

This equation generally will result in a calculated gradient of less than 1.0 for moderate to shallow ground water depths (or to a low permeability layer) below the facility, and conservatively accounts for the development of a ground water mound.

Solving for area yielded approximately 1 acre required for infiltration of 58,000 gpd, which is above the design average daily discharge rate of 45,000 gpd. Construction of multiple ponds, as planned, will allow for temporary drainage and maintenance of each pond.

These estimates should be considered preliminary, as ground water depths or potential perching layers have not been determined. Recommendations for additional studies required to support final design are described below.

### Hantush Method

HWA performed preliminary analytical flow modeling based on Hantush (1967) to simulate the maximum height of the water table beneath a rectangular recharge area. The following is a list of assumptions and model input variables used in the flow model:

- Hydraulic conductivity = 100 ft/day
- Specific yield = 0.2, typical for unconfined sand aquifers
- Initial saturated thickness = 20 ft, conservatively assumed in the absence of deeper subsurface information
- Area = 200 x 200 ft (approximately 1 acre)
- Recharge rate = 0.13 ft/day (1.56 in/day)= 45,000 gpd
- Time 3,650 days (10 years)

For the assumed variables at the site, the aquifer mounding predicted with 45,000 gpd discharge was approximately 1.7 feet above pre-infiltration conditions.

This minimal predicted mounding is due to the uniform, high assumed hydraulic conductivity. In actuality, the potential presence of layering and intervening fine grained deposits beneath the infiltration ponds may result in a greater degree of ground water mounding, which can not be modeled using this one-layer analytical model.

## SLOPE STABILITY

A preliminary northeast-southwest slope profile constructed through the drainfield commencing uphill of the drainfield area and extending towards the flat ground in the campground area shows that the slope is approximately 25 to 30 percent. According to the geologic maps described earlier and HWA test pit explorations, the site is underlain by glacial advance outwash deposits. These deposits were glacially over-ridden, and are dense to very dense. Typically, this soil is stable and has high shear strength (internal friction angle of up to 45 degrees). According to Mason County Resource Ordinance (Ordinance No. 77 - 93), Chapter 17.01.100 – Landslide Hazard Area , Section E, Geotechnical Report, Category D, "*Areas with slopes between 15 and 40 percent will require a geological assessment, and may further require a geotechnical report...* ". Therefore, HWA recommends additional soil exploration in the vicinity of the drainfield prior to addition of any new flows to the drainfield area to characterize the soil unit underlying the advance outwash deposits and evaluate the stability of the slope, which extends from the existing drainfield area to the campground area.

## WATER REUSE REGULATIONS

Ecology water reuse standards (1997) stipulate that a 500-foot setback is required between an infiltration facility and ground water or surface water drinking water source. A water well is located west of the existing Parks drainfield (Figure 2). This well is owned by the Skokomish Indian Tribe and is reported to be 260 feet deep. The well log is included in Appendix A. The drillers well log reported gravelly topsoil over gravel to a depth of 67 feet. Silt was reported from 67 to 92 feet, and gravel, sand and silt (possibly glacial till) was reported from 92 to 196 feet. Sand and gravel was recorded from 196 to 260 feet (pre-Vashon outwash deposits). Ground water was reported to be at 196 feet below ground surface (bgs) at time of drilling.

Additional recorded wells in the vicinity include those owned by Potlatch State Park and the Minerva Beach RV Park. Drillers logs for these wells are also included in Appendix A. Figure 2 shows approximate 500 foot distances from the wells. Accurate surveying would be needed to properly site the facility.

## CONCLUSIONS

HWA conducted subsurface investigations at the Washington State Parks drainfield area to assess the suitability of this area for potential wastewater infiltration facility siting and design. The investigations consisted of completing test pits at the property. HWA completed laboratory grain-size analysis of selected soil samples and used the results to estimate infiltration rates and potential ground water mounding at the site.

The Parks drainfield area soils consisted of typically poorly-graded sand and gravels in the site. These soils did not appear to have significant low-permeability layers to the investigation depth of approximately 10 feet bgs.

The infiltration rate based on soil grain size testing data was estimated at 0.5 inches/hour at the Parks property. This value does not account for mounding due to perching layers or shallow ground water beneath the facility. Flow estimates assuming some degree of mounding indicate approximately 1 acre would be necessary to infiltrate the proposed 58,000 gpd. The preliminary predicted site infiltration rate accounting for potential mounding is approximately 0.09 in/hr, or 2.2 in/day. Preliminary ground water mounding estimates for the Parks site did not indicate significant impact from the proposed infiltration volumes.

These estimates should be considered preliminary, for planning purposes. Additional studies recommended for design are described below.

## RECOMMENDATIONS

If this site is selected, HWA recommends an additional hydrogeologic investigation. Soil borings and monitoring wells should be installed and tested to establish ground water levels, quality, aquifer parameters, and to aid in slope stability evaluations. Seasonal ground water changes should be evaluated. Monitoring during one wet season at a minimum is recommended. Additional ground water mounding analysis and modeling to predict flow rates and impacts to nearby surface water features should be performed based on this data.

Pilot infiltration testing would be needed to size the facility for design flows. The pilot test typically entails a 17-24 hour period of infiltration at rates scaled to design flows, into an approximately 100 square-foot pit or 8 foot diameter steel ring excavated to the receptor soils. Discharge and water levels are monitored and long term infiltration rates can be approximated. Construction of multiple infiltration ponds in phases and monitoring peak use and ground water mounding is also an option for facility development.

## REFERENCES

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HWA January 30, 2007. *Infiltration Evaluation, Water Quality Project Planning , Potlatch "Bubble" and Core Reservation Planning Areas, Mason County, Washington.*

Logan, R. L., 2003. *Geologic Map of the Shelton 1:100,000 Quadrangle, Washington.* 45 x 36 in. color sheet, scale 1:100,000, Washington Division of Geology and Earth Resources, Open File Report 2003-15 http://www.dnr.wa.gov/geology/pdf/ofr03-15.pdf

Ness, A.0., and Fowler, R. H., 1960. *Soil Survey Of Mason County, Washington,* Soil Conservation Service, United States Department of Agriculture, Washington Agricultural Experiment Stations. http://www.or.nrcs.usda.gov/pnw_soil/wa_reports.html

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## LIMITATIONS

The conclusions expressed by HWA are based solely on material referenced in this report. Observations were made under the conditions stated. 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, express or implied, is made. Experience has shown that subsurface soil and groundwater conditions can vary significantly over small distances. It is always possible that contamination may exist in areas that were not sampled. 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.

We recommend that HWA be retained to review the plans and specifications to verify that our recommendations have been interpreted and implemented as intended. Sufficient field monitoring, testing and consultation should be provided during construction to confirm that the conditions encountered are consistent with those indicated by explorations, and to provide recommendations should conditions revealed during construction differ from those anticipated. HWA does not practice or consult in the field of safety engineering. We do not direct the contractor's operations, and cannot be responsible for the safety of personnel other than our own on the site.

This study and report have been prepared on behalf of Gray & Osborne and Mason County, for the specific application to the subject property. This report should be provided in its entirety to prospective contractors for bidding and estimating purposes; however, the conclusions and interpretations presented in this report should not be construed as a warranty of the subsurface conditions. We are not responsible for the impacts of any changes in environmental standards, practices, or regulations subsequent to performance of services. We do not warrant the accuracy of information supplied by others, nor the use of segregated portions of this report.

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.

State of Washington
Hydrogeologist
170
Licensed Geologist
Arnon Sugar

Vance Atkins, LG, LHG
Senior Hydrogeologist

Arnie Sugar, LG, LHG
Vice President

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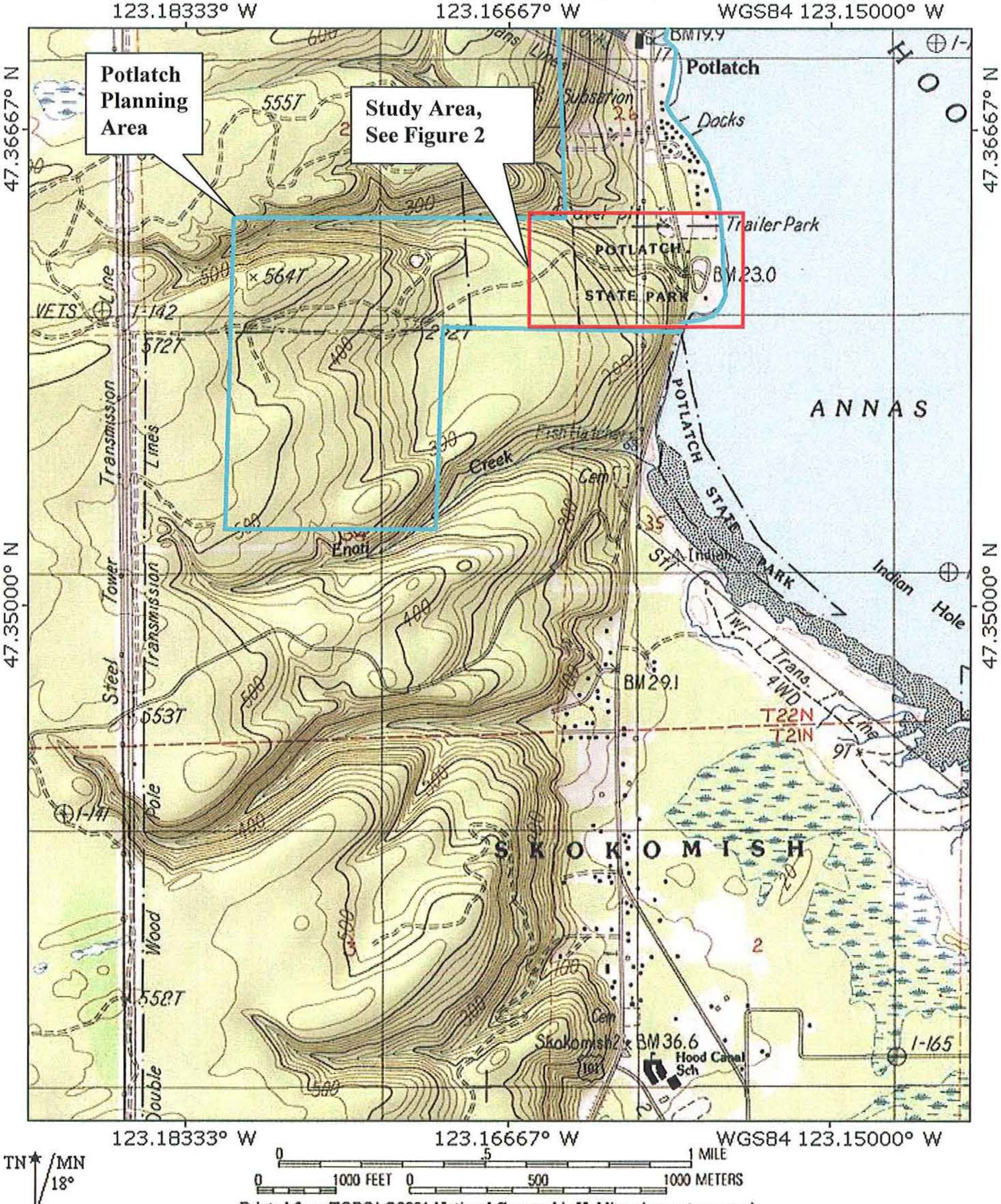

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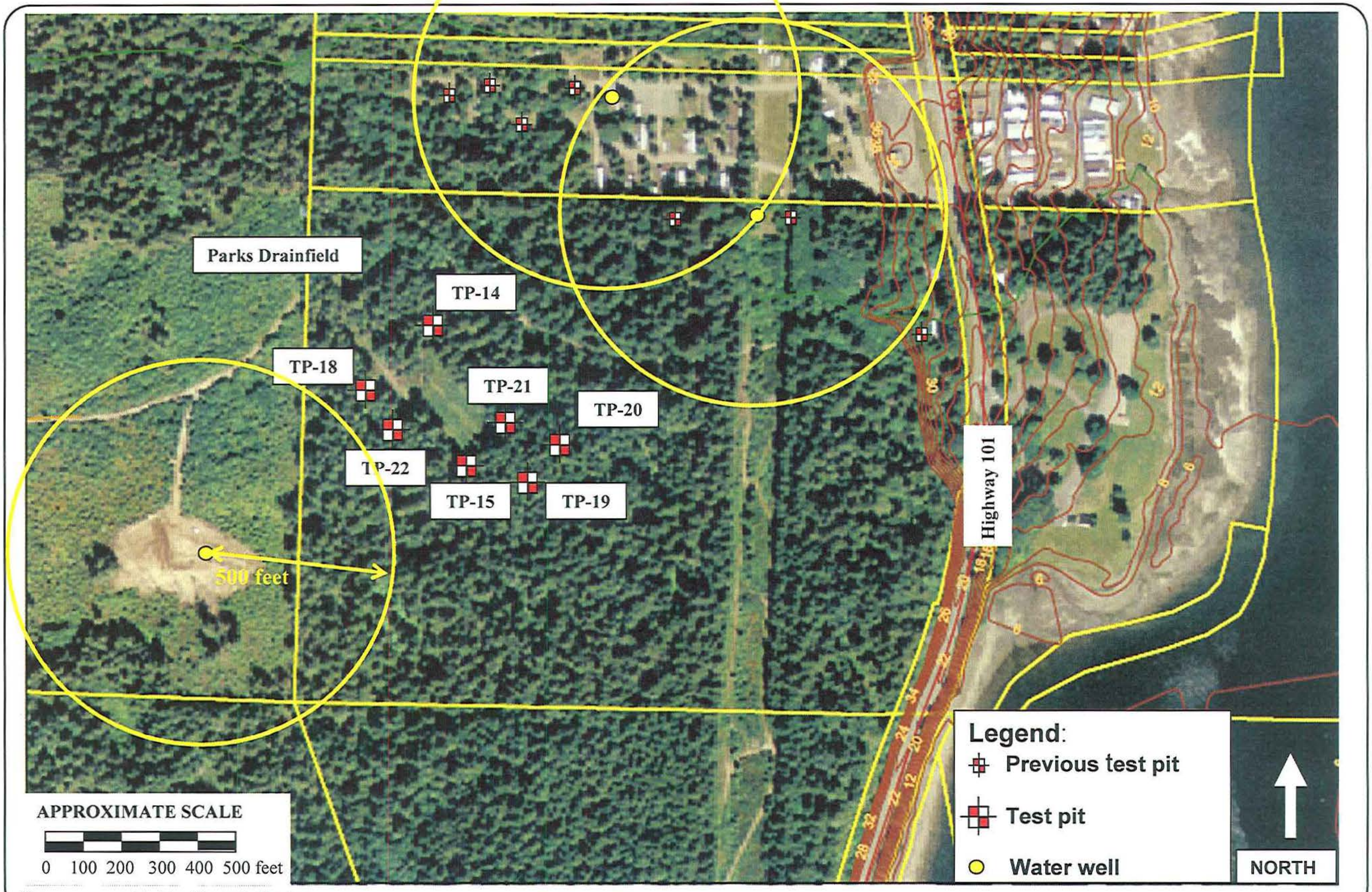
HWA GEOSCIENCES INC.

## EXPLORATION LOCATIONS

MASON COUNTY
WATER QUALITY PROJECT PLANNING
POTLATCH BUBBLE PLANNING AREA

FIGURE NO.
1

PROJECT NO.
2006-172-600



Base map provided by Cascade Design

HWA GEOSCIENCES INC.

EXPLORATION LOCATIONS
PARKS DRAINFIELD

MASON COUNTY
WATER QUALITY PROJECT PLANNING
POTLATCH BUBBLE PLANNING AREA

FIGURE NO.
2

PROJECT NO.
2006172-600

HWA GEOSCIENCES INC.
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July 30, 2007
HWA Project No. 2006-172-600

Gray and Osborne
701 Dexter Avenue North, Suite 200
Seattle, Washington 981091

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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.

### ASTM Grain Size Distribution

The ASTM grain size distribution method compares infiltration measurements from full-scale infiltration facilities to soil gradation data developed using the ASTM procedure (ASTM D422). Because this method compares data from existing full-scale infiltration facilities, the estimated infiltration rates are presented as estimated long-term infiltration rates. The estimated long-term infiltration rates assume an average degree of long-term facility maintenance, TSS (total suspended solids) control, and site variability in the subsurface conditions.

The ASTM grain size distribution method compares infiltration measurements from full-scale infiltration facilities to the D10, or grain size at which 10% of the sample is finer, of the soil, as measured using the ASTM procedure (ASTM D422). This method is not appropriate for soils with d10 less than 0.05 mm, which includes several samples from on site soils tested, therefore infiltration rates were not estimated using this technique for those samples. Table 1 shows the results of the grain size analyses and Appendix B presents the soil laboratory data.

### USDA Soil Textural Classification

Infiltration rates can be estimated from grain size distribution data using the USDA textural analysis approach. HWA analyzed soil samples collected from test pits for grain size distribution and textural classification in accordance with ASTM test procedures, corrected to approximate the USDA procedures. To determine long-term infiltration rates based on the USDA method, Ecology recommends that the short-term infiltration rates be reduced by a correction factor based on the soil textural classification, average degree of long-term facility maintenance, TSS reduction through pretreatment, and site subsurface variability. Table 1 shows the results of the grain size analyses and Appendix B presents the soil laboratory data.

### Table 1
### Long-Term Infiltration Rates*
### Based On USDA and ASTM Soil Textural Classification

| | | | | Ecology Long Term rates | |
|---|---|---|---|---|---|
| Test Pit | Depth | ASTM description | USDA Classification | ASTM (in/hr) | USDA (in/hr) |
| | Drainfield | | | | |
| TP-14 | 2.5 | Poorly graded SAND with gravel | SAND | 6.5 | 2 |
| TP-14 | 8.5 | Well graded GRAVEL with sand | SAND | 4.2 | 2 |
| TP-15 | 3.5 | Poorly graded SAND with gravel | SAND | 1.8 | 2 |
| TP-15 | 5.3 | Well graded GRAVEL with sand | SAND | 5.5 | 2 |
| TP-15 | 6.5 | Poorly graded GRAVEL w/ sand | SAND | 5 | 2 |
| TP-18 | 7.0 | Poorly graded GRAVEL with sand | SAND | 9 | 2 |
| TP-19 | 4.0 | Poorly graded GRAVEL with sand | Loamy SAND | 9 | 0.5 |
| TP-19 | 7.0 | Poorly graded GRAVEL with sand | SAND | 3.5 | 2 |
| TP-20 | 5.0 | Well graded GRAVEL with sand | Sandy LOAM | 9 | 0.5 |
| TP-21 | 8.0 | Well graded GRAVEL with sand | Loamy SAND | 9 | 2 |
| TP-22 | 5.0 | Well graded GRAVEL with sand | SAND | 9 | 2 |

* based on *Stormwater Management Manual for Western Washington*, Ecology, 2005.

## INFILTRATION ESTIMATES - RESULTS

Vertical infiltration is limited by the least permeable layer in the soil profile. HWA did not analyze the fine grained soils (e.g., silts and silty sands) encountered in our explorations. The infiltration rates provided herein should therefore be used in conjunction with the test pit logs (Appendix A) and the mounding analyses (below) to evaluate infiltration feasibility.

Based on HWA's grain size testing, long term infiltration rates for soils encountered at the site are approximately 0.5 to 2 in/hr using the USDA method, and up to 9 in/hr using the ASTM method.

Soils at the State Parks drainfield location were generally granular and consistent in composition, and appear feasible for infiltration ponds or basins. Because infiltration is limited by the least permeable layer in the soil profile, 0.5 in/hr should be used to conservatively estimate site-wide infiltration rates for this preliminary evaluation. Design infiltration rates should be adjusted based on further ground water mounding studies, as recommended below.

## GROUND WATER MOUNDING

Ground water mounding is a local raising of the ground water table due to infiltrating water from the surface. If a ground water mound reaches the infiltration facility, infiltration rates are greatly reduced, and facility failure may occur, depending on flow rates and storage volume.

To evaluate impacts to ground water flow due to the proposed infiltration facility, HWA used several methods, as described below.

### Ecology/ Massmann method

Based on preliminary infiltration estimates of 0.5 in/hr at the Parks Drainfield site, HWA estimated the area required for infiltration of an assumed 45,000 gallons per day (gpd). We used a variation of Darcy's law, which states $Q = f\ i\ A$, where:

| | |
|---|---|
| $Q$ = discharge | 45,000 gpd |
| $f$ = infiltration rate | 0.5 in/hr |
| $i$ = vertical gradient | see below |
| $A$ = area | see below |

Vertical gradients where depth to ground water is shallow can be estimated using a regression method (based on multiple sites with measured infiltration rates) outlined by Massmann (Ecology, 2005), where the vertical gradient for a pond is described by the following relationship: $i = (Dwt+Dp)/138.62*K^{0.1})$ x CF, where:

| | |
|---|---|
| Dwt = depth to water | 50 feet (conservatively assuming perching layers or mounding) |
| Dp = pond depth | assumed 6 feet |
| K = hydraulic conductivity | 100 feet/day (based on unsaturated soils, estimated from grain size testing results) |

CF = a correction factor for pond size, $CF= 0.73(A)^{-0.76}$ where A = area

| | |
|---|---|
| i = vertical gradient | 0.18 |

This equation generally will result in a calculated gradient of less than 1.0 for moderate to shallow ground water depths (or to a low permeability layer) below the facility, and conservatively accounts for the development of a ground water mound.

Solving for area yielded approximately 1 acre required for infiltration of 58,000 gpd, which is above the design average daily discharge rate of 45,000 gpd. Construction of multiple ponds, as planned, will allow for temporary drainage and maintenance of each pond.

These estimates should be considered preliminary, as ground water depths or potential perching layers have not been determined. Recommendations for additional studies required to support final design are described below.

### Hantush Method

HWA performed preliminary analytical flow modeling based on Hantush (1967) to simulate the maximum height of the water table beneath a rectangular recharge area. The following is a list of assumptions and model input variables used in the flow model:

- Hydraulic conductivity = 100 ft/day
- Specific yield = 0.2, typical for unconfined sand aquifers
- Initial saturated thickness = 20 ft, conservatively assumed in the absence of deeper subsurface information
- Area = 200 x 200 ft (approximately 1 acre)
- Recharge rate = 0.13 ft/day (1.56 in/day)= 45,000 gpd
- Time 3,650 days (10 years)

For the assumed variables at the site, the aquifer mounding predicted with 45,000 gpd discharge was approximately 1.7 feet above pre-infiltration conditions.

This minimal predicted mounding is due to the uniform, high assumed hydraulic conductivity. In actuality, the potential presence of layering and intervening fine grained deposits beneath the infiltration ponds may result in a greater degree of ground water mounding, which can not be modeled using this one-layer analytical model.

## SLOPE STABILITY

A preliminary northeast-southwest slope profile constructed through the drainfield commencing uphill of the drainfield area and extending towards the flat ground in the campground area shows that the slope is approximately 25 to 30 percent. According to the geologic maps described earlier and HWA test pit explorations, the site is underlain by glacial advance outwash deposits. These deposits were glacially over-ridden, and are dense to very dense. Typically, this soil is stable and has high shear strength (internal friction angle of up to 45 degrees). According to Mason County Resource Ordinance (Ordinance No. 77 - 93), Chapter 17.01.100 – Landslide Hazard Area , Section E, Geotechnical Report, Category D, "*Areas with slopes between 15 and 40 percent will require a geological assessment, and may further require a geotechnical report…* ". Therefore, HWA recommends additional soil exploration in the vicinity of the drainfield prior to addition of any new flows to the drainfield area to characterize the soil unit underlying the advance outwash deposits and evaluate the stability of the slope, which extends from the existing drainfield area to the campground area.

## WATER REUSE REGULATIONS

Ecology water reuse standards (1997) stipulate that a 500-foot setback is required between an infiltration facility and ground water or surface water drinking water source. A water well is located west of the existing Parks drainfield (Figure 2). This well is owned by the Skokomish Indian Tribe and is reported to be 260 feet deep. The well log is included in Appendix A. The drillers well log reported gravelly topsoil over gravel to a depth of 67 feet. Silt was reported from 67 to 92 feet, and gravel, sand and silt (possibly glacial till) was reported from 92 to 196 feet. Sand and gravel was recorded from 196 to 260 feet (pre-Vashon outwash deposits). Ground water was reported to be at 196 feet below ground surface (bgs) at time of drilling.

Additional recorded wells in the vicinity include those owned by Potlatch State Park and the Minerva Beach RV Park. Drillers logs for these wells are also included in Appendix A. Figure 2 shows approximate 500 foot distances from the wells. Accurate surveying would be needed to properly site the facility.

## CONCLUSIONS

HWA conducted subsurface investigations at the Washington State Parks drainfield area to assess the suitability of this area for potential wastewater infiltration facility siting and design. The investigations consisted of completing test pits at the property. HWA completed laboratory grain-size analysis of selected soil samples and used the results to estimate infiltration rates and potential ground water mounding at the site.

The Parks drainfield area soils consisted of typically poorly-graded sand and gravels in the site. These soils did not appear to have significant low-permeability layers to the investigation depth of approximately 10 feet bgs.

The infiltration rate based on soil grain size testing data was estimated at 0.5 inches/hour at the Parks property. This value does not account for mounding due to perching layers or shallow ground water beneath the facility. Flow estimates assuming some degree of mounding indicate approximately 1 acre would be necessary to infiltrate the proposed 58,000 gpd. The preliminary predicted site infiltration rate accounting for potential mounding is approximately 0.09 in/hr, or 2.2 in/day. Preliminary ground water mounding estimates for the Parks site did not indicate significant impact from the proposed infiltration volumes.

These estimates should be considered preliminary, for planning purposes. Additional studies recommended for design are described below.

## RECOMMENDATIONS

If this site is selected, HWA recommends an additional hydrogeologic investigation. Soil borings and monitoring wells should be installed and tested to establish ground water levels, quality, aquifer parameters, and to aid in slope stability evaluations. Seasonal ground water changes should be evaluated. Monitoring during one wet season at a minimum is recommended. Additional ground water mounding analysis and modeling to predict flow rates and impacts to nearby surface water features should be performed based on this data.

Pilot infiltration testing would be needed to size the facility for design flows. The pilot test typically entails a 17-24 hour period of infiltration at rates scaled to design flows, into an approximately 100 square-foot pit or 8 foot diameter steel ring excavated to the receptor soils. Discharge and water levels are monitored and long term infiltration rates can be approximated. Construction of multiple infiltration ponds in phases and monitoring peak use and ground water mounding is also an option for facility development.

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HWA January 30, 2007. *Infiltration Evaluation, Water Quality Project Planning , Potlatch "Bubble" and Core Reservation Planning Areas, Mason County, Washington.*

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Shannon & Wilson, Inc. 1978. *Generalized Geologic Map, Skokomish Indian Reservation, Mason County, Washington*, Report #W-3302-01.

## LIMITATIONS

The conclusions expressed by HWA are based solely on material referenced in this report. Observations were made under the conditions stated. 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, express or implied, is made. Experience has shown that subsurface soil and groundwater conditions can vary significantly over small distances. It is always possible that contamination may exist in areas that were not sampled. 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.

We recommend that HWA be retained to review the plans and specifications to verify that our recommendations have been interpreted and implemented as intended. Sufficient field monitoring, testing and consultation should be provided during construction to confirm that the conditions encountered are consistent with those indicated by explorations, and to provide recommendations should conditions revealed during construction differ from those anticipated. HWA does not practice or consult in the field of safety engineering. We do not direct the contractor's operations, and cannot be responsible for the safety of personnel other than our own on the site.

This study and report have been prepared on behalf of Gray & Osborne and Mason County, for the specific application to the subject property. This report should be provided in its entirety to prospective contractors for bidding and estimating purposes; however, the conclusions and interpretations presented in this report should not be construed as a warranty of the subsurface conditions. We are not responsible for the impacts of any changes in environmental standards, practices, or regulations subsequent to performance of services. We do not warrant the accuracy of information supplied by others, nor the use of segregated portions of this report.

We appreciate the opportunity to provide our services. Please feel free to call us if you have any questions or need more information.

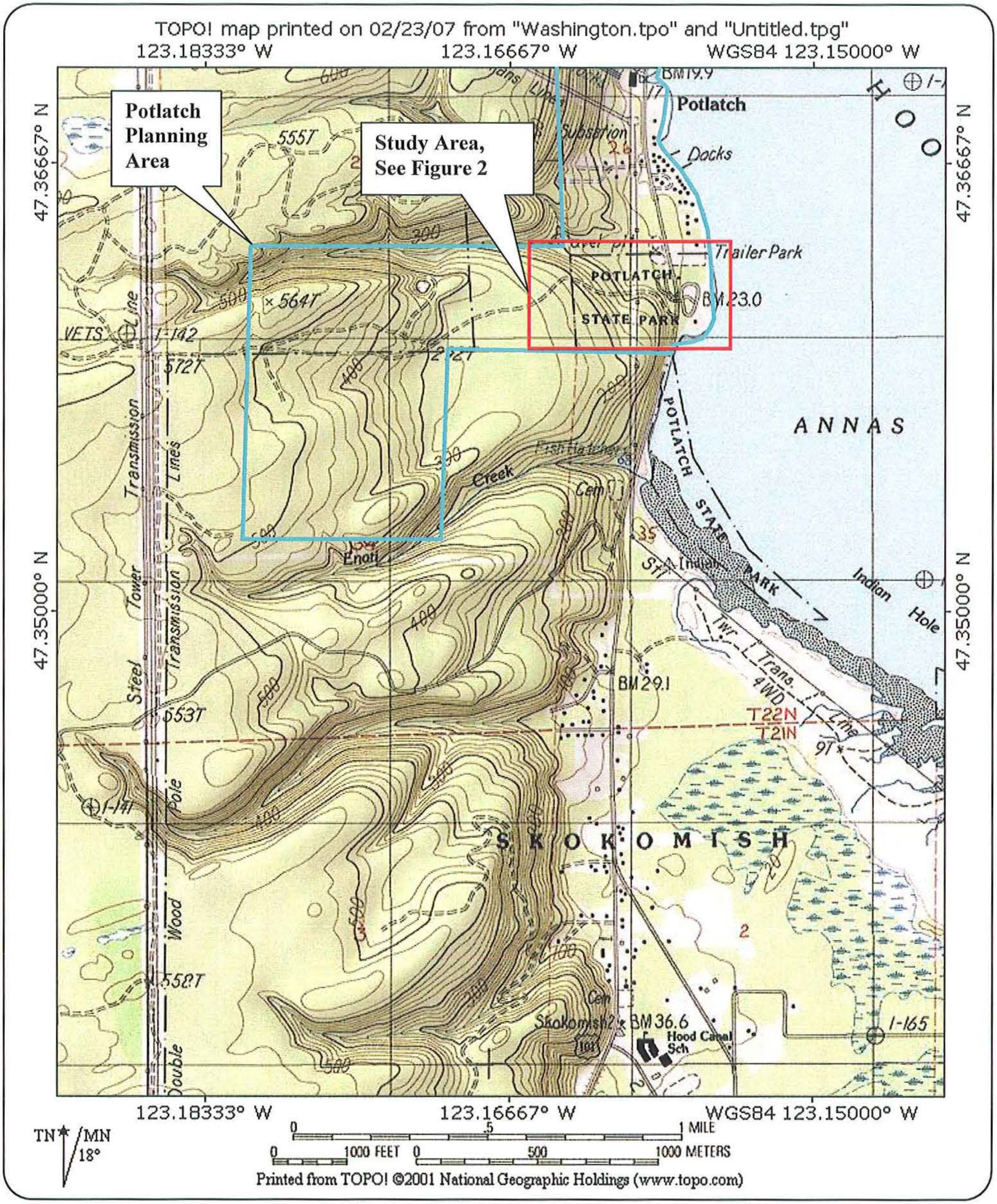
Sincerely,

HWA GEOSCIENCES INC.

State of Washington
Hydrogeologist
170
Licensed Geologist
Arnon Sugar

Vance Atkins, LG, LHG
Senior Hydrogeologist

Arnie Sugar, LG, LHG
Vice President



TOPO! map printed on 02/23/07 from "Washington.tpo" and "Untitled.tpg"

**Potlatch Planning Area**

**Study Area, See Figure 2**

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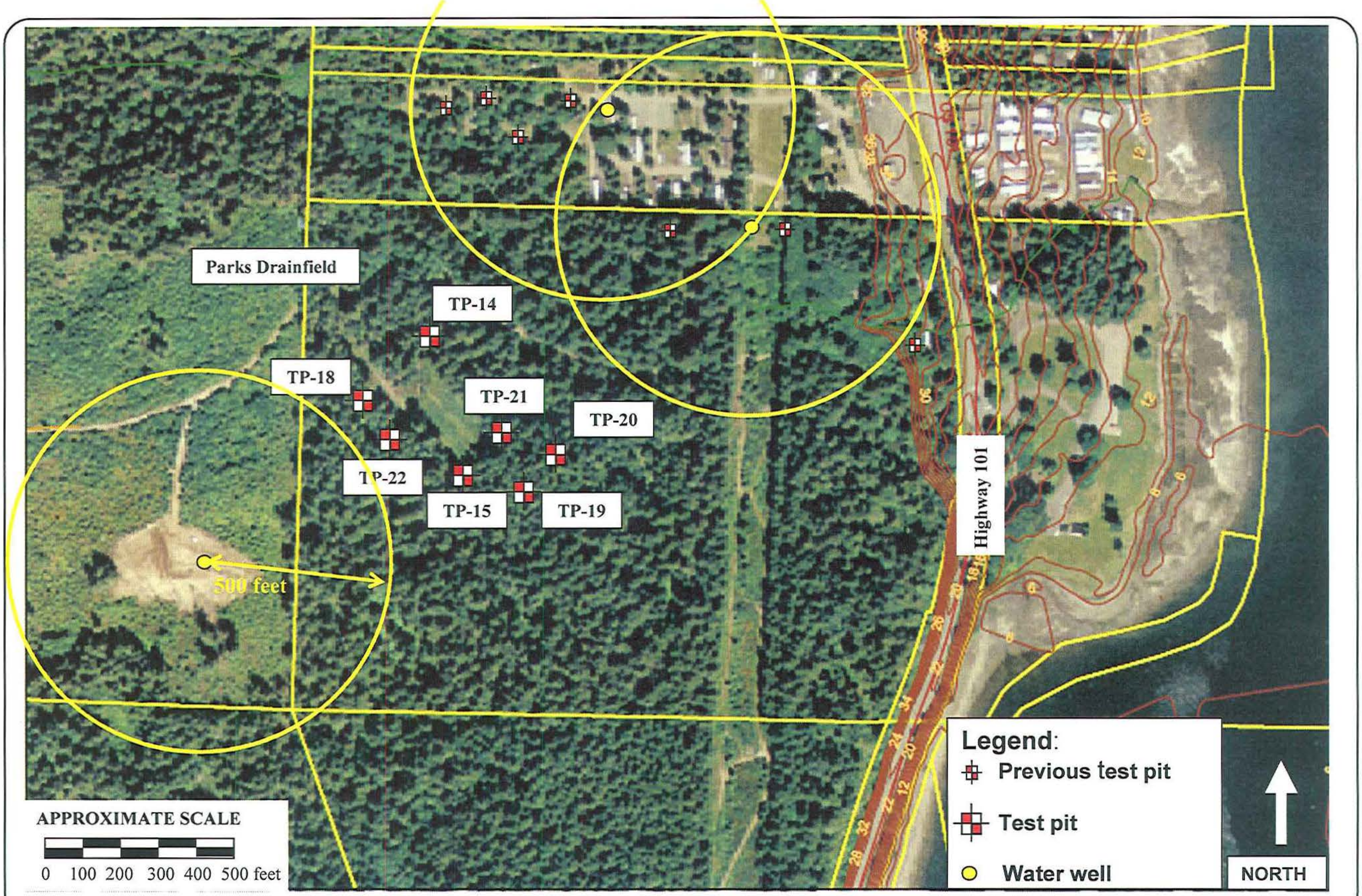
HWA GEOSCIENCES INC.

**EXPLORATION LOCATIONS**

MASON COUNTY
WATER QUALITY PROJECT PLANNING
POTLATCH BUBBLE PLANNING AREA

FIGURE NO.
**1**

PROJECT NO.
**2006-172-600**



Base map provided by Cascade Design

HWA GEOSCIENCES INC.

EXPLORATION LOCATIONS
PARKS DRAINFIELD

MASON COUNTY
WATER QUALITY PROJECT PLANNING
POTLATCH BUBBLE PLANNING AREA

FIGURE NO.
2

PROJECT NO.
2006172-600

HWA GEOSCIENCES INC.
*Geotechnical Engineering • Hydrogeology • Geoenvironmental Services • Inspection and Testing*

July 27, 2007
HWA Project No. 2006-172-700

Gray and Osborne
701 Dexter Avenue North, Suite 200
Seattle, Washington 981091

Attention: Mr. Harry Sellers, P.E.

Subject: **INFILTRATION EVALUATION**
**WATER QUALITY PROJECT PLANNING**
**CORE RESERVATION PLANNING AREA**
**MASON COUNTY, WASHINGTON**

Dear Mr. Sellers:

HWA GeoSciences Inc. (HWA) is pleased to submit this effluent disposal/infiltration feasibility review at the Core Reservation planning area in Mason County, Washington.

## INTRODUCTION

HWA's soils and hydrogeologic evaluation dated January 30, 2007 provides a general evaluation of soil septic treatment capability and infiltration potential based on geologic, soils, and physiographic criteria in the planning area, based on review of existing geologic and hydrogeologic data (HWA, 2007a). HWA's infiltration evaluation dated March 8, 2007 summarizes site specific explorations conducted at selected sites within the Potlatch and Reservation planning areas, for evaluation of infiltration potential (HWA, 2007b). Areas investigated included three site in the Potlatch planning area, and four site sin the Core reservation area, including the Richard Smith Property and the WSDOT site.

The following report presents the results of additional investigations at two sites in the Core Reservation area, the Richard Smith property and an area near Dry Bed Creek.

### Goals and Objectives

The goals and objectives of this study were to evaluate the infiltration potential and site suitability of the selected sites, by determining soil types, shallow ground water depths, and identifying potentially suitable infiltration receptor soils. Figure 1 shows the location of the areas investigated at the North Reservation Area; Figures 2 shows the sampling locations (TP-4, TP-25 through TP-30 and BH-3).

## SITE EXPLORATIONS

HWA monitored the excavation of six test pits on June 13, 2007 and one soil boring on July 11, 2007. Excavation services were provided by Lot Hauling of Shelton, Washington, and soil boring services were provided by Boart Longyear of Puyallup, Washington. Figure 2 shows the test pit and boring locations. Test pit and boring logs are included in Appendix A. The investigation areas are discussed below.

### Richard Smith Property

HWA monitored the excavation of four test pits at the Richard Smith property designated TP-25 though TP-28. HWA previously completed test pit TP-4 at this location (HWA, 2007). Figure 2 shows the test pit locations.

This area is mapped as recessional outwash (Logan, 2003, Shannon & Wilson, 1978). Soils are mapped as Grove soils (outwash-derived) (Ness and Fowler, 1960). Test pits TP-4 and TP-25 though TP-28 encountered 0.5 to one foot of gravelly topsoil and fill over sands and gravels with silty layers (outwash). Boring BH-3 encountered gravel to a depth of approximately seven feet below ground surface (bgs), with silty sand with gravel and sand with gravel underlying to a depth of 30 feet bgs (outwash).

Ground water was not encountered in any of the test pits. Ground water was encountered at boring BH-3 at a depth of 19 feet bgs. Shallow ground water in this area drains to Hood Canal, to the east.

The Richard Smith Property contained abundant debris at the surface, including demolition debris, automobiles, and other refuse. Portions of the site appeared to have been graded or filled, as evidenced by test pit TP-4. It is possible that outwash soils exist at shallower depths in other parts of this site unaffected by local grading and filling. Infiltration ponds or basins may be feasible at this site, provided the extent of fill and potential soil or ground water contamination from historic site use are addressed (i.e., Phase I-II environmental site assessment).

### Dry Bed Creek Area

An intermittent drainage located northwest of the proposed treatment plant site is known locally as Dry Bed Creek. The drainage is mapped as Alpine Outwash, with Advance Outwash mapped further upstream (Logan, 2003). Another reference shows this area as Recessional Outwash, Glacial Drift, and Advance Outwash mapped further upstream (Carson, 1976).

HWA visited the Dry Bed Creek area on December 6, 2006, and observed bank exposures in the steeply incised, dry channel consisting of stratified clean sands and gravels, with some thin layers of silty sand, consistent with the mapped designation of glacial outwash. Local residents report the channel rarely contains any water; even after heavy precipitation events, it flows for a few days, then dries out. HWA observed glacial till in an excavation just north and outside the edge of the channel, more consistent with Carson (1976) than the Logan (2003) map, and suggesting the outwash may only crop out at and near the channel in this area.

HWA monitored the excavation of two test pits near the mouth of the creek on June 13, 2007. Test pit TP-29, located at the east end of Valley Road, adjacent to Dry Bed Creek also encountered approximately one foot of gravelly topsoil over gravels with silty layers. Test pit TP-30, completed adjacent to Dry Bed Creek near the base of a bluff encountered gravelly sand with silt to a depth of seven feet bgs (possible mass wasting deposits from the bluff) overlying oxidized silty sands. Ground water was not encountered in any of the test pits.

## INFILTRATION ESTIMATES - METHODS

The Washington State Department of Ecology (Ecology) 2005 *Stormwater Management Manual for Western Washington* recommends utilizing one of three methods for determining infiltration rates: ASTM grain size distribution, USDA textural analysis from soil samples, and in-situ field measurements.

This guidance document is intended primarily for stormwater, and therefore does not apply at this site, but contains results of recent research and principles of hydrogeology which can be used to estimate infiltration rates from other sources (e.g., treated waste water effluent). HWA utilized ASTM grain size distribution and USDA textural analysis to estimate infiltration rates for this project. HWA analyzed ten soil samples collected from test pits and the soil boring at the North Reservation areas for grain size distribution and textural classification in accordance with these methodologies.

The infiltration rates estimated by the grain size methods assume a vertical gradient of 1, with no ground water or perching layers beneath the facility, i.e., no ground water mounding. HWA estimated flow rates for a given area assuming some degree of mounding, by adjustment of the vertical gradient to some value below 1, as described below. We then independently estimated mounding potential by several other analytical methods, also described below.

### 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.

## ASTM Grain Size Distribution

The ASTM grain size distribution method compares infiltration measurements from full-scale infiltration facilities to soil gradation data developed using the ASTM procedure (ASTM D422). Because this method compares data from existing full-scale infiltration facilities, the estimated infiltration rates are presented as estimated long-term infiltration rates. The estimated long-term infiltration rates assume an average degree of long-term facility maintenance, TSS (total suspended solids) control, and site variability in the subsurface conditions.

The ASTM grain size distribution method compares infiltration measurements from full-scale infiltration facilities to the D10, or grain size at which 10% of the sample is finer, of the soil, as measured using the ASTM procedure (ASTM D422). This method is not appropriate for soils with d10 less than 0.05 mm, which includes several samples from on site soils tested, therefore infiltration rates were not estimated using this technique for those samples. Table 1 shows the results of the grain size analyses and Appendix B presents the soil laboratory data.

## USDA Soil Textural Classification

Infiltration rates can be estimated from grain size distribution data using the USDA textural analysis approach. HWA analyzed soil samples collected from test pits for grain size distribution and textural classification in accordance with ASTM test procedures, corrected to approximate the USDA procedures. To determine long-term infiltration rates based on the USDA method, Ecology recommends that the short-term infiltration rates be reduced by a correction factor based on the soil textural classification, average degree of long-term facility maintenance, TSS reduction through pretreatment, and site subsurface variability. Table 1 shows the results of the grain size analyses and Appendix B presents the soil laboratory data.

### Table 1
### Long-Term Infiltration Rates*
### Based On USDA and ASTM Soil Textural Classification

| | | | | Ecology Long Term Rates | |
|---|---|---|---|---|---|
| **Test Pit/ Boring** | **Depth, ft bgs** | **ASTM description** | **USDA Classification** | **ASTM (in/hr)** | **USDA (in/hr)** |
| | **North Reservation** | | | | |
| TP-4 | 8 | Poorly graded SAND with gravel | Sand | 9 | 2 |
| TP-25 | 6.0 | Silty GRAVEL with sand | Sandy LOAM | 0.8 | 0.25 |
| TP-26 | 5.0 | Poorly graded SAND with silt and gravel | Loamy SAND | 2.0 | 0.5 |
| TP-27 | 5.0 | Well graded GRAVEL with sand | SAND | 6.5 | 2 |
| TP-27 | 7.0 | Well graded GRAVEL with silt and sand | Loamy SAND | 2.0 | 0.5 |
| TP-28 | 5.0 | Silty GRAVEL with sand | Sandy LOAM | 0.8 | 0.25 |
| TP-29 | 7.0 | Poorly graded GRAVEL with sand | SAND | 6.5 | 2 |
| BH-3 | 15 | Well graded SAND with silt and gravel | Loamy SAND | 0.8 | 0.5 |
| | 20** | Well graded SAND with silt and gravel | Loamy SAND | 0.8 | 0.5 |
| | 25** | Poorly graded SAND with silt and gravel | Loamy SAND | 3.5 | 0.5 |

* based on *Stormwater Management Manual for Western Washington*, Ecology, 2005.
** Saturated soils (aquifer)

## INFILTRATION ESTIMATES - RESULTS

Vertical infiltration is limited by the least permeable layer in the soil profile. HWA did not analyze the fine grained soils (e.g., silty sands) encountered in our explorations. The infiltration rates provided herein should therefore be used in conjunction with the test pit logs (Appendix A) and the mounding analyses (below) to evaluate infiltration feasibility.

Based on HWA's grain size testing, long term infiltration rates for most soils encountered at the site are approximately 0.25 to 0.5 in/hr using the USDA method, and between 0.8 and 9 in/hr using the ASTM method.

Soils at the Richard Smith site (Test pits TP-4, TP-25 through TP-28) were generally granular and consistent in composition, and appear feasible for infiltration ponds or basins. Because infiltration is limited by the least permeable layer in the soil profile, 0.25 in/hr should be used to conservatively estimate site-wide infiltration rates for this preliminary evaluation. Design infiltration rates should be further adjusted based on ground water mounding evaluations, as described below.

Soils at the Dry Bed Creek test pit location TP-29 were also generally granular, but the feasibility of this site is limited due to the lateral limitations of the bluff and finer-grained deposits to the north (TP-30), the narrow valley profile, and the presence of a drinking water well adjacent south of the test pit locations (see 'Water Reuse Regulations,' below).

## GROUND WATER MOUNDING

Ground water mounding is a local raising of the ground water table due to infiltrating water from the surface. If a ground water mound reaches the infiltration facility, infiltration rates are greatly reduced, and facility failure may occur, depending on flow rates and storage volume.

Evaluation of ground water mounding is best accomplished by understanding ground water levels, gradient, and aquifer characteristics. Mounding potential can be predicted by 1) measuring shallow ground water levels during pilot infiltration testing; or 2) performing predictive ground water flow modeling.

Ecology completed a rapid infiltration study and ground water mounding analysis at the WSDOT Skokomish site, located southwest of the Richard Smith site west of Highway 101 (Ecology, 2000a, b). Ecology installed four ground water monitoring wells at the site, and also completed five test pits and five short-term falling head percolation tests to evaluate site suitability for infiltration.

Ecology encountered ground water at the site at depths of 15 to 28 feet bgs, and reported seasonal fluctuations of 1.5 to 3.6 feet. Ecology estimated permeabilities at the site of 350-400 feet/day (likely outwash sands and gravels), although lower permeabilities (60 feet/day) were estimated for soils observed in the western-most monitoring well, which was completed in finer grained deposits (possible mass-wasting deposits). Percolation rates in the coarse soils were reported at over 60 in/hr for coarse soils and 0.125 inches/hour in fine-grained soils at the site (Ecology, 2000a). Short-term falling head percolation tests, according to subsequent Ecology guidance (2005) *"are not recommended ... These small-scale infiltration tests tend to seriously overestimate infiltration rates and, based on recent TAC* [technical advisory committee] *experience, are considered unreliable."*

Ecology performed mounding analysis for the site utilizing an assumed daily discharge rate of 500,000 to 700,000 gpd, over areas ranging from 100 to 2500 square feet. Several scenarios were modeled, utilizing different infiltration trench geometries, and calculated ground water mounding at the site ranged from approximately seven to ten feet in coarse-grained soils, and approximately 39 feet in fine-grained soils (Ecology, 2000b). This modeling was focused on predicting mound formation and height, and assumed all of the infiltrated water reaches ground water. Ecology recommended additional geological exploration and pilot infiltration testing to establish design infiltration rates.

To evaluate ground water mounding potential at the Richard Smith site, HWA used several methods, as described below.

**Ecology/ Massmann Method**

Based on preliminary infiltration estimates of 0.25 in/hr at the Richard Smith site, HWA estimated the area required for infiltration of an assumed 50,000 gallons per day (gpd). We used a variation of Darcy's law, which states Q = f i A, where:

| | |
|---|---|
| Q = discharge | 50,000 gpd |
| f = infiltration rate | 0.25 in/hr |
| i = vertical gradient | see below |
| A = area | see below |

Vertical gradients where depth to ground water is shallow can be estimated using a regression method (based on multiple sites with measured infiltration rates) outlined by Massmann (Ecology, 2005), where the vertical gradient for a pond is described by the following relationship: $i = (Dwt+Dp)/138.62*K^{0.1}) \text{ x } CF$, where:

| | |
|---|---|
| Dwt = depth to water | 19 feet (based on BH-3) |
| Dp = pond depth | assumed 6 feet |
| K = hydraulic conductivity | 50 feet/day (based on unsaturated soils, estimated from grain size testing results) |
| CF = a correction factor for pond size, CF= $0.73(A)^{-0.76}$ where A = area | |
| i = vertical gradient | 0.09 |

This equation generally will result in a calculated gradient of less than 1.0 for moderate to shallow ground water depths (or to a low permeability layer) below the facility, and conservatively accounts for the development of a ground water mound.

Solving for area yielded approximately 3.5 acres required for infiltration of 50,000 gpd. Based on our preliminary evaluations, the proposed pond area of approximately one acre may need to be supplemented in order to provide sufficient storage and infiltration capacity for planned daily and peak flows, and allow for temporary drainage and maintenance of pond facilities. Recommendations for additional studies required to support final design are described below.

**Hantush Method**

HWA performed preliminary analytical flow modeling based on Hantush (1967) to simulate the maximum height of the water table beneath a rectangular recharge area. The following is a list of assumptions and model input variables used in the flow model:

- Hydraulic conductivity = 50 ft/day
- Specific yield = 0.25, typical for unconfined sand aquifers
- Initial saturated thickness = 20 ft (Ecology, 2000)

- Area = 200 x 200 ft (approximately 1 acre)
- Recharge rate = 0.15 ft/day (1.8 in/day) = 50,000 gpd
- Time 3,650 days (10 years)

For the assumed variables at the site, the aquifer mounding predicted with 50,000 gpd discharge was approximately 3.5 feet above pre-infiltration conditions and mounding with 95,500 gpd discharge (predicted maximum rates) was approximately 6 feet above pre-infiltration conditions.

This predicted mounding is due to the relatively high assumed hydraulic conductivity and shallow ground water table. In actuality, the potential presence of layering and intervening fine grained deposits beneath the infiltration ponds as observed in boring BH-3 will likely result in a greater degree of ground water mounding, which can not be modeled using this one-layer analytical model. The presence of a shallow ground water table beneath the site also increases the risk of mounding impacts to the facility.

**Analytical Modeling / Mounding Analysis**

To evaluate impacts to ground water flow due to the proposed drainfield, HWA performed preliminary analytical ground water flow modeling. An analytical model called WinFlow was used to simulate 2-dimensional (horizontal) flow in the vicinity of the airport (Environmental Simulations Inc., 2003). The software simulates two-dimensional steady-state and transient ground water flow using established analytical functions, and simulates the effects of wells, uniform recharge, circular recharge/discharge areas, and line sources or sinks. The model depicts the flow field using streamlines, particle-traces, and contours of hydraulic head (water levels). Model documentation, governing equations, and references are available upon request.

The following is a list of assumptions and model input variables used in the flow model:

- Aquifer top = 13 feet (site grade is approximately 32 feet, depth to ground water in BH-3 was 19 feet)
- Aquifer bottom = -17 feet (assuming a 30 foot thick aquifer (Ecology, 2000)
- Porosity = 0.30 (typical for sands and gravels)
- Hydraulic conductivity, K = 50 ft/day (estimated from grain size testing, and consistent with Ecology, 2000a)
- Storage = 0.25 (typical for an unconfined aquifer)
- Reference head = 100 (arbitrary, to calibrate model to existing conditions)
- Gradient = 0.003, at 0 degrees (east)
- Constant head at Hood Canal and adjoining wetlands = 0 feet
- Proposed drainfield = 1 acre (circular, radius of 118 feet)
- Pond infiltration = 50,000 gpd = 0.000106 ft/min/acre

The model was initially run in steady state condition to calibrate to observed conditions. Figure 3 shows the model output under pre-infiltration conditions. Ground water flow was then modeled under effluent discharge conditions (50,000 gpd), shown on Figure 4. The predicted head distribution with 50,000 gpd discharge was approximately 2.5 feet above preexisting conditions. Predicted head distribution with 95,500 gpd discharge (estimated peak flows) was approximately four feet above preexisting conditions. The predicted mounding is consistent with the Hantush model.

## WATER REUSE REGULATIONS

Ecology water reuse standards (1997) stipulate that a 500-foot setback is required between an infiltration facility and ground water or surface water drinking water source. A water well is present at the northwest corner of the Richard Smith site (Figure 2). This well was observed to be a flowing artesian well and is not currently in use. The well log is included in Appendix A. The well is 331 feet deep, and the drillers well log reported gravelly topsoil over approximately 136 feet of 'conglomerate' (possibly dense recessional outwash deposits overlying advance outwash deposits). The well log reported approximately 180 feet of fine-grained silt and clay deposits overlying coarse 'conglomerate' (pre-Vashon non-glacial lacustrine and outwash deposits). If the facility is sited at the Smith property, the well should be properly abandoned according to Washington State regulations.

## CONCLUSIONS

HWA conducted subsurface investigations at two sites in the Core Reservation Planning area to assess the suitability of those areas for potential wastewater infiltration facility siting and design.

The investigations consisted of completing test pits and borings at the Richard Smith property and Dry Bed Creek site. Soils at the two sites primarily consisted of sands and gravels with silty layers. Ground water was encountered at 19 feet bgs in a boring completed at the Richard Smith property.

The Smith property was selected for further evaluation due to the presence and extent of outwash soils. HWA completed laboratory grain-size analysis of selected soil samples and used the results to estimate infiltration rates and potential ground water mounding at the site.

The infiltration rate based on soil grain size testing data was estimated at 0.25 inches/hour at the site. This value does not account for mounding due to perching layers or shallow ground water beneath the facility. Flow estimates assuming some degree of mounding indicate approximately 3.5 acres would be necessary to infiltrate the proposed 50,000 gpd. Additional mounding analyses estimated long-term ground water mounding of approximately 2.5 to 3.5 feet above existing ground water levels.

These estimates should be considered preliminary, for planning purposes. Additional studies recommended for design are described below.

## RECOMMENDATIONS

If this site is selected, HWA recommends more detailed on-site hydrogeologic and environmental investigations. Borings and monitoring wells should be installed and tested to establish ground water levels, gradients, quality, and aquifer parameters. Seasonal ground water changes should be evaluated. Monitoring during one wet season at a minimum is recommended. A ground water mounding analysis and modeling to predict flow rates and impacts to nearby surface water features should be performed based on the new information. A Phase I (and possibly II) Environmental Site Assessment should also be conducted prior to any property purchase, or to evaluate impacts of infiltration over potentially contaminated soils or ground water.

Water infiltrated at the Richard Smith or WSDOT sites will likely discharge in the low-lying wetlands east of the sites. There are currently no developed structures east of the Richard Smith property (between the site and Hood Canal). Additional studies may be required to evaluate the impacts of the additional flow to this area.

Pilot infiltration testing would be needed to size the facility for design flows. The pilot test typically entails a 17-24 hour period of infiltration at rates scaled to design flows, into an approximately 100 square-foot pit or 8 foot diameter steel ring excavated to the receptor soils. Discharge and water levels are monitored and long term infiltration rates can be approximated. Construction of multiple infiltration ponds in phases and monitoring peak use and ground water mounding is also an option for facility development.

## REFERENCES

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## LIMITATIONS

The conclusions expressed by HWA are based solely on material referenced in this report. Observations were made under the conditions stated. 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, express or implied, is made. Experience has shown that subsurface soil and groundwater conditions can vary significantly over small distances. It is always possible that contamination may exist in areas that were not sampled. 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.

We recommend that HWA be retained to review the plans and specifications to verify that our recommendations have been interpreted and implemented as intended. Sufficient field monitoring, testing and consultation should be provided during construction to confirm that the conditions encountered are consistent with those indicated by explorations, and to provide recommendations should conditions revealed during construction differ from those anticipated. HWA does not practice or consult in the field of safety engineering. We do not direct the contractor's operations, and cannot be responsible for the safety of personnel other than our own on the site.

This study and report have been prepared on behalf of Gray and Osborne and Mason County, for the specific application to the subject property. This report should be provided in its entirety to prospective contractors for bidding and estimating purposes;

however, the conclusions and interpretations presented in this report should not be construed as a warranty of the subsurface conditions. We are not responsible for the impacts of any changes in environmental standards, practices, or regulations subsequent to performance of services. We do not warrant the accuracy of information supplied by others, nor the use of segregated portions of this report.

◆

We appreciate the opportunity to provide our services. Please feel free to call us if you have any questions or need more information.

Sincerely,

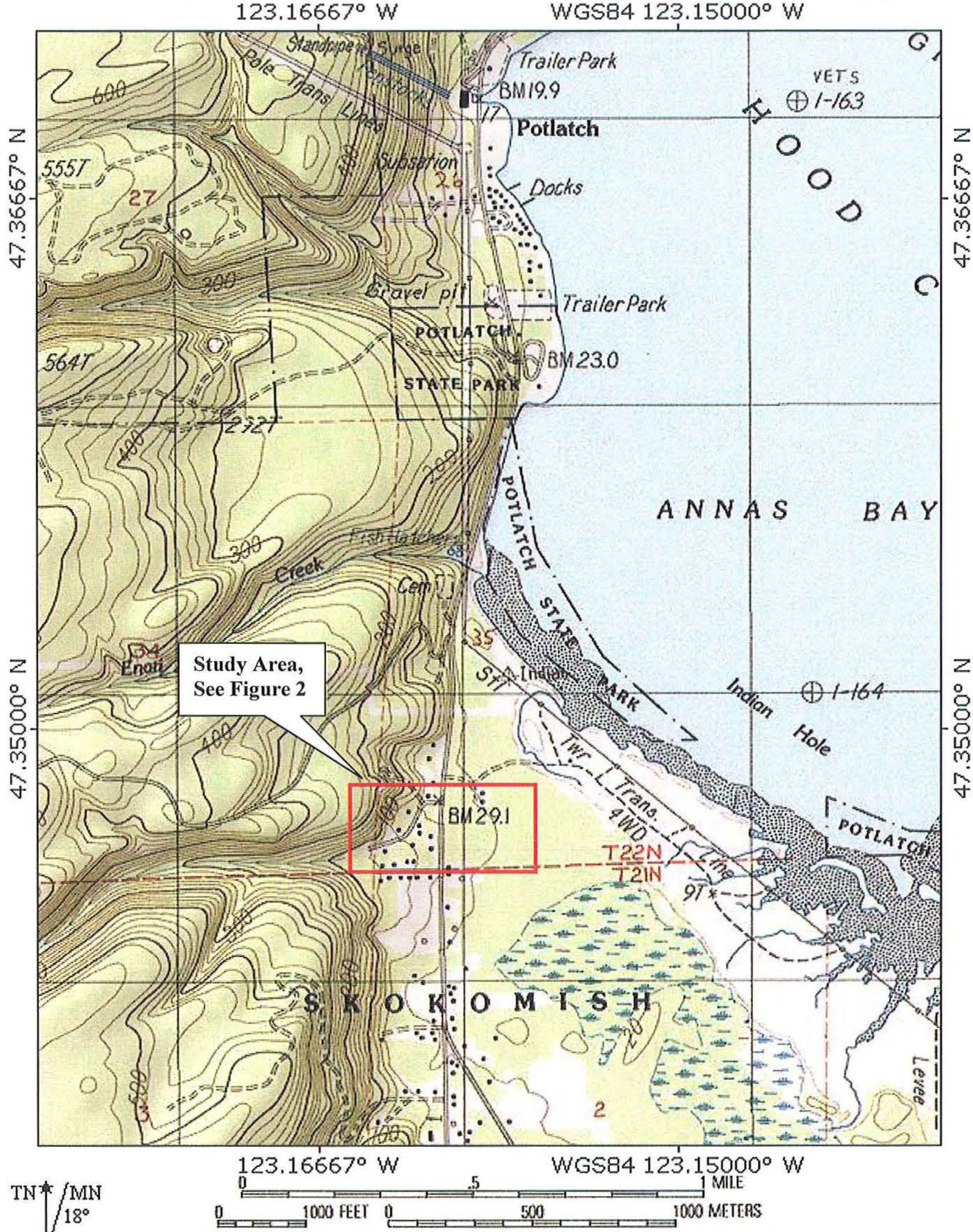
HWA GEOSCIENCES INC.

State of Washington Licensed Geologist
Hydrogeologist
170
Arnon Sugar

Vance Atkins, LG, LHG
Senior Hydrogeologist

Arnie Sugar, LG, LHG
Vice President

TOPO! map printed on 07/20/07 from "Washington.tpo" and "Untitled.tpg"



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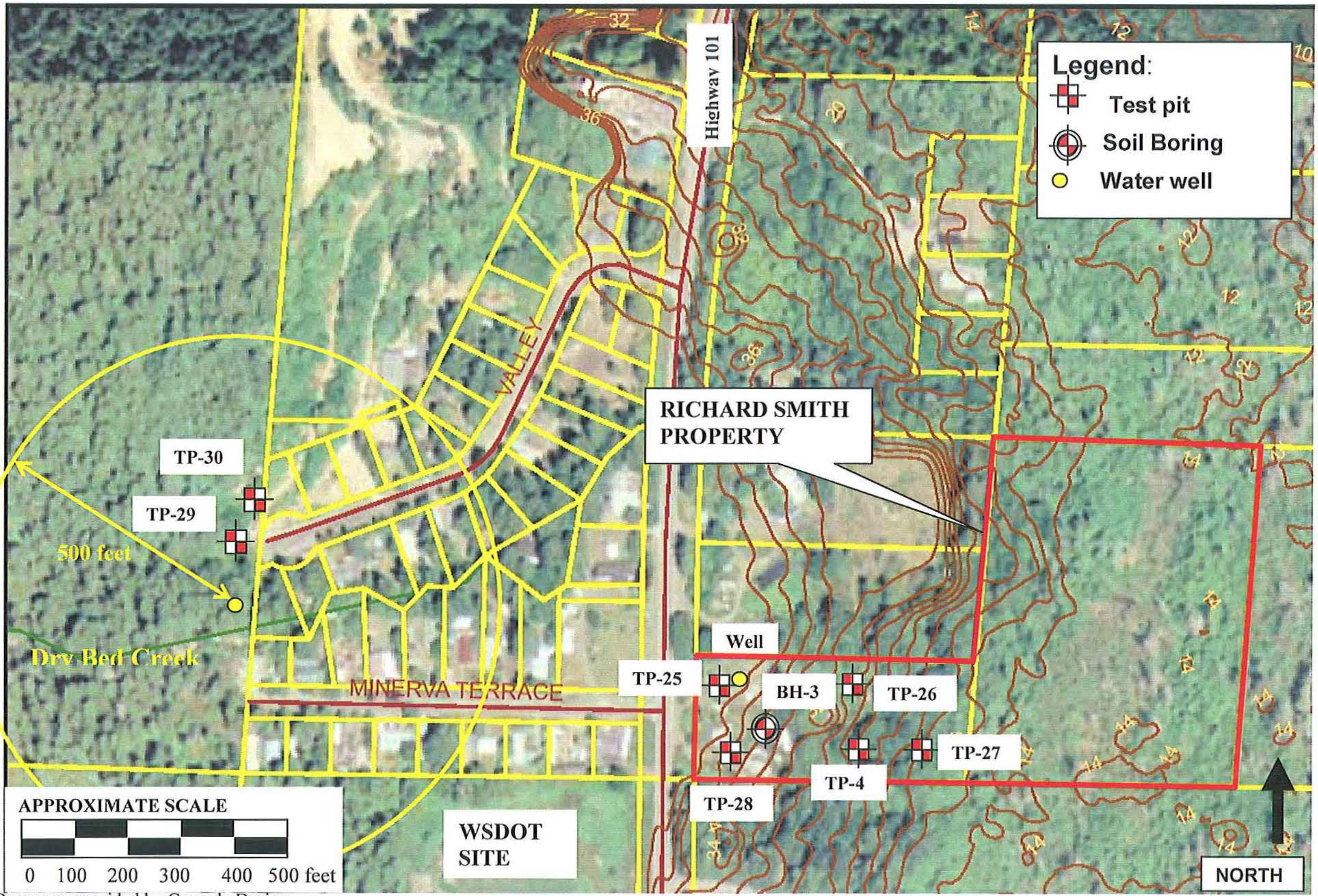
SITE VICINITY

MASON COUNTY
WATER QUALITY PROJECT PLANNING
CORE RESERVATION PLANNING AREA

FIGURE NO.
1

PROJECT NO.
2006-172-700



Base map provided by Cascade Design

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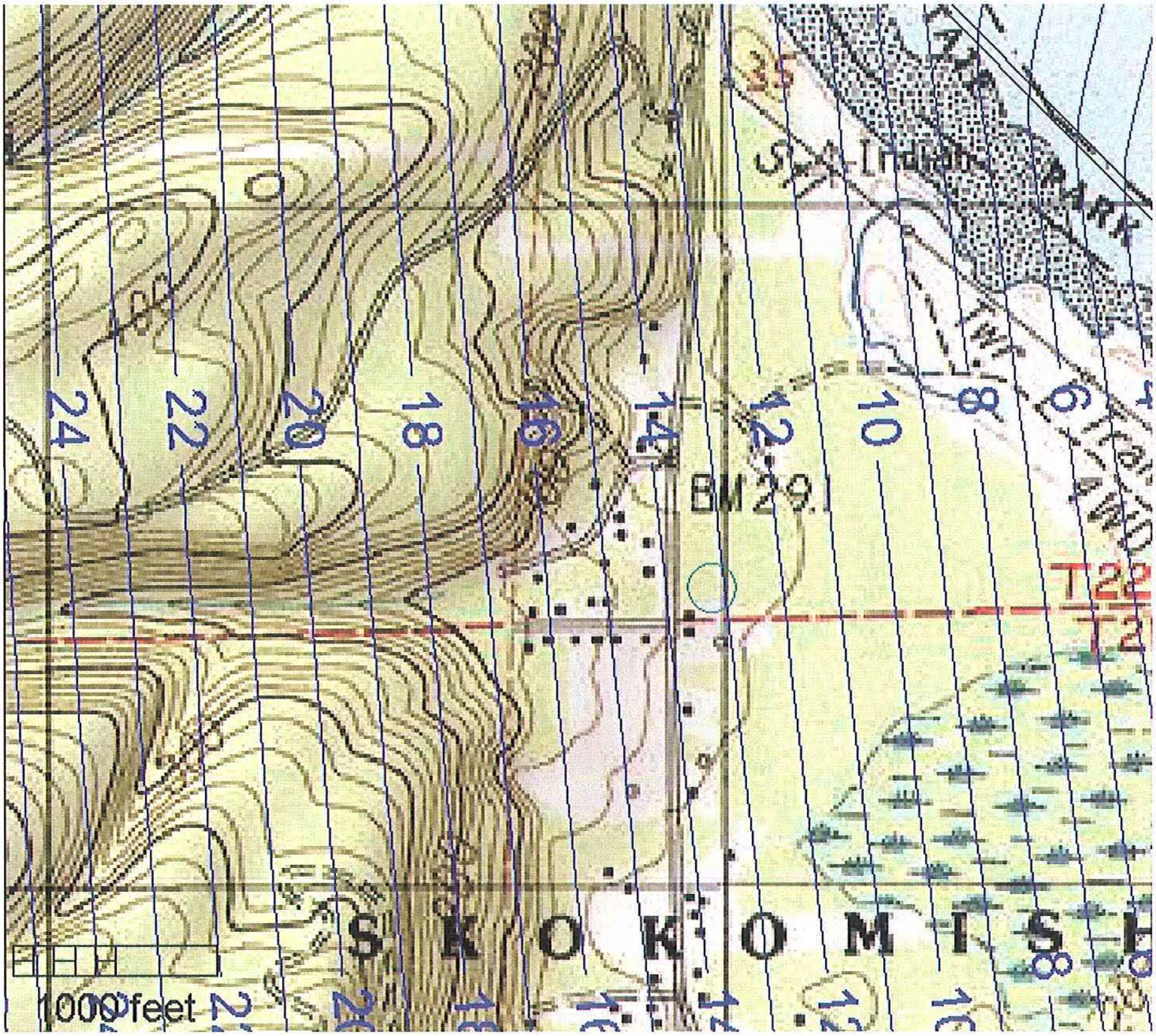
## EXPLORATION LOCATIONS

MASON COUNTY
WATER QUALITY PROJECT PLANNING
CORE RESERVATION PLANNING AREA

FIGURE NO.
2

PROJECT NO.
2006172-700



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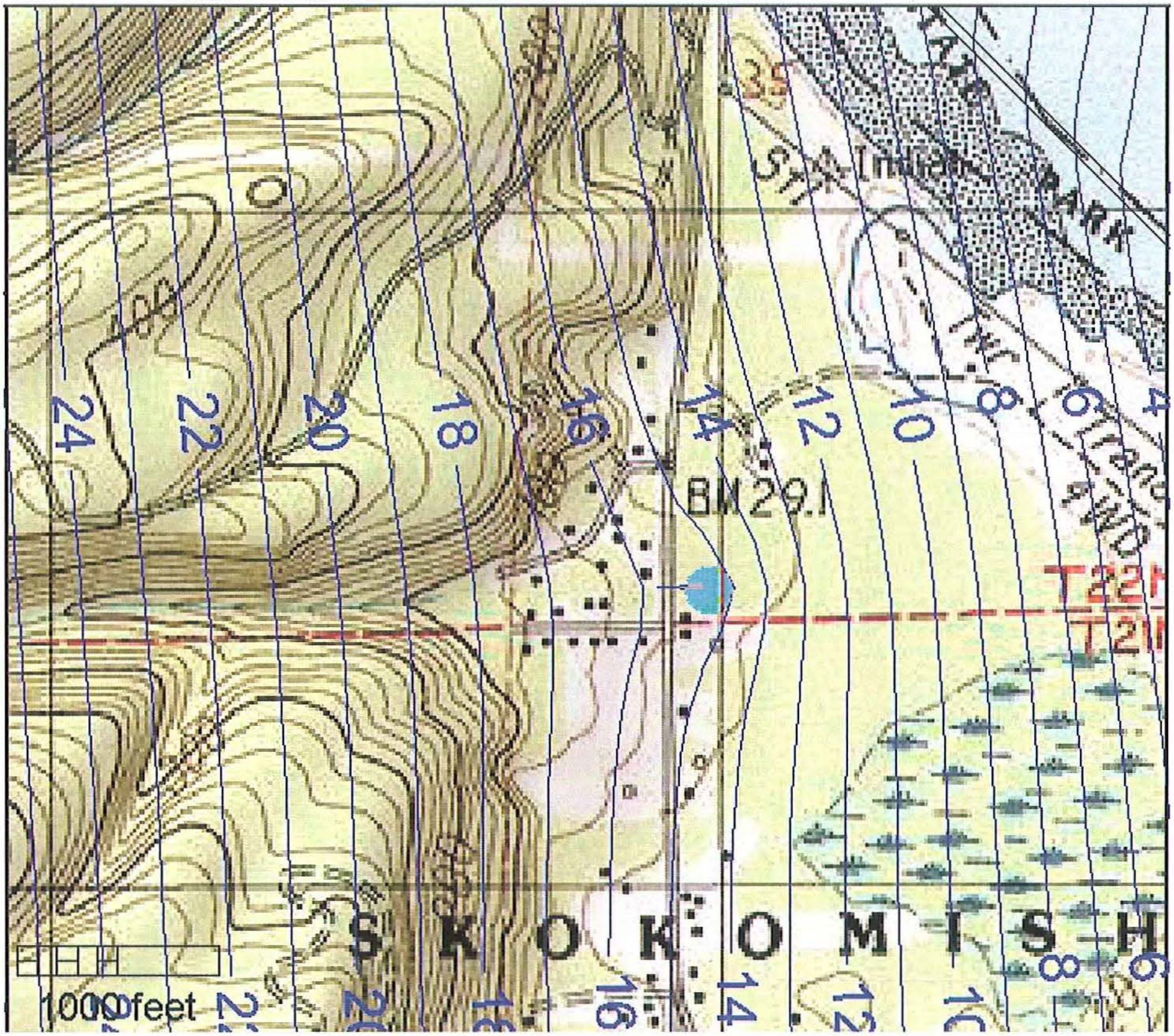
## MOUNDING MODEL - PREEXISTING CONDITION

MASON COUNTY
WATER QUALITY PROJECT PLANNING
CORE PLANNING AREA

FIGURE NO.
**3**

PROJECT NO.
**2006-172-500**



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**MOUNDING MODEL - 50,000 GPD INFILTRATION**

MASON COUNTY
WATER QUALITY PROJECT PLANNING
CORE PLANNING AREA

FIGURE NO.
**4**

PROJECT NO.
**2006-172-500**

# APPENDIX A

# TEST PIT AND BORING LOGS

## 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<br>More than 50% Retained on No. 200 Sieve Size | Gravel and Gravelly Soils<br>More than 50% of Coarse Fraction Retained on No. 4 Sieve | Clean Gravel (little or no fines) | GW | Well-graded GRAVEL |
| | | | GP | Poorly-graded GRAVEL |
| | | Gravel with Fines (appreciable amount of fines) | GM | Silty GRAVEL |
| | | | GC | Clayey GRAVEL |
| | Sand and Sandy Soils<br>50% or More of Coarse Fraction Passing No. 4 Sieve | Clean Sand (little or no fines) | SW | Well-graded SAND |
| | | | SP | Poorly-graded SAND |
| | | Sand with Fines (appreciable amount of fines) | SM | Silty SAND |
| | | | SC | Clayey SAND |
| Fine Grained Soils<br>50% or More Passing No. 200 Sieve Size | Silt and Clay | Liquid Limit Less than 50% | ML | SILT |
| | | | CL | Lean CLAY |
| | | | OL | Organic SILT/Organic CLAY |
| | 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<br>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<br>Approx. Compressive Strength (tsf) |
| SG | Specific Gravity |
| TC | Triaxial Compression |
| TV | Torvane<br>Approx. Shear Strength (tsf) |
| UC | Unconfined Compression |

## SAMPLE TYPE SYMBOLS

| | |
|---|---|
| ⊠ | 2.0" OD Split Spoon (SPT)<br>(140 lb. hammer with 30 in. drop) |
| I | Shelby Tube |
| ▣ | 3-1/4" OD Split Spoon with Brass Rings |
| ○ | Small Bag Sample |
| ▚ | Large Bag (Bulk) Sample |
| ▯ | Core Run |
| ◿ | Non-standard Penetration Test<br>(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. |

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## LEGEND OF TERMS AND SYMBOLS USED ON EXPLORATION LOGS

PROJECT NO.: 2006-172-22 FIGURE: A-1

LEGEND 2006172.GPJ 7/27/07

EXCAVATION COMPANY: Skokomish DNR
EXCAVATING EQUIPMENT: Case 580 backhoe
SURFACE ELEVATION: ± Feet

LOCATION: See Figure 2
DATE COMPLETED: 1/25/07
LOGGED BY: A. Sugar

| DEPTH (feet) | SYMBOL | USCS SOIL CLASS. | DESCRIPTION | SAMPLE TYPE | SAMPLE NUMBER | MOISTURE CONTENT (%) | OTHER TESTS | GROUNDWATER |
|---|---|---|---|---|---|---|---|---|
| 0<br>2 | | SM | Brown, silty SAND with gravel, moist | | | | | |
| | | SP | Seam of gray fine to coarse SAND with gravel. | | | | | |
| 4 | | ML<br>SM | Brown, SILT, silty SAND, and large woody debris [fill]<br>Reddish brown, silty SAND with gravel and silt, moist | | | | | |
| 6 | | ML | Brown SILT | ○ | | | | |
| | | ML<br>SM | | | | | | |
| 8 | | SP | Reddish brown, fine to coarse SAND, few gravel, moist | ○ | | 6 | | |
| 10 | | | Test pit terminated at about 10 feet below the ground surface.<br>No ground water encountered during this exploration. | | | | | |
| 12 | | | | | | | | |

PHOTOGRAPH OF TEST 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.

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Mason County Wastewater
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Mason County
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# LOG OF TEST PIT
## TP-4

PAGE: 1 of 1

PROJECT NO.: 2006-172-22 FIGURE: A-2

EXCAVATION COMPANY: Lot Hauling
EXCAVATING EQUIPMENT: Case 580 backhoe
SURFACE ELEVATION: ± Feet

LOCATION: See Figure 2
DATE COMPLETED: 6/12/07
LOGGED BY: V. Atkins

| DEPTH (feet) | SYMBOL | USCS SOIL CLASS. | DESCRIPTION | SAMPLE TYPE | SAMPLE NUMBER | MOISTURE CONTENT (%) | OTHER TESTS | GROUNDWATER |
|---|---|---|---|---|---|---|---|---|
| 0 | | | Dark brown silty sand TOPSOIL with organic material and roots. | | | | | |
| | | GM | Yellow-red silty GRAVEL with sand, gravels to 2", loose to medium dense, occasional cobbles, some slough/caving.<br>(Outwash) | | | | | |
| 6 | | | As above, with silty layers | | TP-25-6 | 14 | | |
| | | GP | Sandy GRAVEL, trace silt, gravel to 2", moist, much sloughing/caving. | | | | | |
| 8 | | | Test pit completed to 8 feet bgs (slough).<br>Ground water not encountered. | | TP-25-8 | | | |
| 10 | | | | | | | | |
| 12 | | | | | | | | |

PHOTOGRAPH OF TEST 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.

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Infiltration Evaluation
Mason County
Washington

## LOG OF TEST PIT
## TP-25

PAGE: 1 of 1

PROJECT NO.: 2006-172-22 FIGURE: A-3

EXCAVATION COMPANY: Lot Hauling
EXCAVATING EQUIPMENT: Case 580 backhoe
SURFACE ELEVATION: ± Feet

LOCATION: See Figure 2
DATE COMPLETED: 6/12/07
LOGGED BY: V. Atkins

| DEPTH (feet) | SYMBOL | USCS SOIL CLASS. | DESCRIPTION | SAMPLE TYPE | SAMPLE NUMBER | MOISTURE CONTENT (%) | OTHER TESTS | GROUNDWATER |
|---|---|---|---|---|---|---|---|---|
| 0 | | GM | Dark brown gravelly TOPSOIL with organic material and roots. | | | | | |
| | | GW | Brown to brownish yellow coarse sandy GRAVEL, trace silt, cobbly, decreasing roots.<br>(Outwash) | | | | | |
| | | SP<br>SM | Brown SAND with silt and gravel, medium sand lenses, moist, medium dense, some slough. | | TP-26-5 | 11 | | |
| | | GP | Brown to yellow-brown sandy GRAVEL, much slough. | | | | | |
| 8 | | | Test pit completed to 8 feet bgs (slough).<br>Ground water not encountered. | | TP-26-8 | | | |

PHOTOGRAPH OF TEST 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.

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Mason County
Washington

LOG OF TEST PIT
TP-26

PAGE: 1 of 1

PROJECT NO.: 2006-172-22 FIGURE: A-4

EXCAVATION COMPANY: Lot Hauling
EXCAVATING EQUIPMENT: Case 580 backhoe
SURFACE ELEVATION: ± Feet

LOCATION: See Figure 2
DATE COMPLETED: 6/12/07
LOGGED BY: V. Atkins

| DEPTH (feet) | SYMBOL | USCS SOIL CLASS. | DESCRIPTION | SAMPLE TYPE | SAMPLE NUMBER | MOISTURE CONTENT (%) | OTHER TESTS | GROUNDWATER |
|---|---|---|---|---|---|---|---|---|
| 0 | | | Dark brown gravelly TOPSOIL with organic material and roots. | | | | | |
| | | GW | Well graded brown to yellow-brown GRAVEL with sand, occasional coarse sandy layers, somewhat stratified/imbricated, occasional tree roots.<br>(Outwash) | | | | | |
| | | | Brown to yellow-brown sandy GRAVEL with fine to medium sand layers, trace silt, cobbles, moist. | | TP-27-5 | 4 | | |
| | | GW<br>GM | Brown to yellow-brown silty GRAVE with sand and silt layers, moist, sloughing. | | TP-27-7 | 8 | | |

Test pit completed to 7 feet bgs (slough).
Ground water not encountered.

PHOTOGRAPH OF TEST 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.

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Infiltration Evaluation
Mason County
Washington

## LOG OF TEST PIT
## TP-27

PAGE: 1 of 1

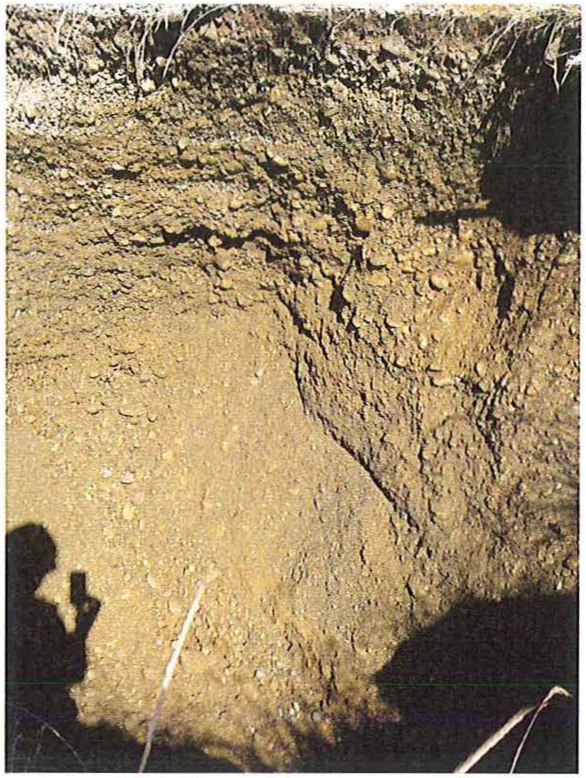
PROJECT NO.: 2006-172-22 FIGURE: A-5

EXCAVATION COMPANY: Lot Hauling
EXCAVATING EQUIPMENT: Case 580 backhoe
SURFACE ELEVATION: ± Feet

LOCATION: See Figure 2
DATE COMPLETED: 6/12/07
LOGGED BY: V. Atkins

| DEPTH (feet) | SYMBOL | USCS SOIL CLASS. | DESCRIPTION | SAMPLE TYPE | SAMPLE NUMBER | MOISTURE CONTENT (%) | OTHER TESTS | GROUNDWATER |
|---|---|---|---|---|---|---|---|---|
| 0 | | | Dark brown gravelly TOPSOIL with organic material and roots. | | | | | |
| 2<br>4 | | GP | Brown coarse sandy GRAVEL to 2", dry to moist.<br>(Outwash)<br>Sloughing | | | | | |
| 6 | | GM | Red-brown silty GRAVEL with sand, silty layers, moist. | | TP-28-5 | 11 | | |
| | | GP | Sandy GRAVEL with medium sand layers, moist, caving. | | | | | |
| 8 | | | Test pit completed to 7 feet bgs (slough).<br>Ground water not encountered. | | TP-28-7 | | | |
| 10 | | | | | | | | |
| 12 | | | | | | | | |

PHOTOGRAPH OF TEST 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.

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Infiltration Evaluation
Mason County
Washington

## LOG OF TEST PIT
## TP-28

PAGE: 1 of 1

PROJECT NO.: 2006-172-22 FIGURE: A-6

EXCAVATION COMPANY: Lot Hauling
EXCAVATING EQUIPMENT: Case 580 backhoe
SURFACE ELEVATION: ± Feet

LOCATION: See Figure 2
DATE COMPLETED: 6/12/07
LOGGED BY: V. Atkins

| DEPTH (feet) | SYMBOL | USCS SOIL CLASS. | DESCRIPTION | SAMPLE TYPE | SAMPLE NUMBER | MOISTURE CONTENT (%) | OTHER TESTS | GROUNDWATER |
|---|---|---|---|---|---|---|---|---|
| 0 | | | Dark brown gravelly TOPSOIL with organic material and roots. | | | | | |
| | | GP | Brown to yellow-brown sandy GRAVEL, occasional silty layer, cobbles, moist.<br>(Outwash) | | | | | |
| 2 | | | | | | | | |
| 4 | | | | | | | | |
| 6 | | | Brown medium to coarse GRAVEL with sand, moist, medium dense, occasional boulder, sloughing. | | | | | |
| | | | | | TP-29-7 | 6 | | |
| 8 | | | | | | | | |
| | | | Test pit completed to 9 feet bgs (slough).<br>Ground water not encountered. | | TP-29-9 | | | |
| 10 | | | | | | | | |
| 12 | | | | | | | | |

PHOTOGRAPH OF TEST 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.

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Mason County Wastewater
Infiltration Evaluation
Mason County
Washington

## LOG OF TEST PIT
## TP-29

PAGE: 1 of 1

PROJECT NO.: 2006-172-22 FIGURE: A-7

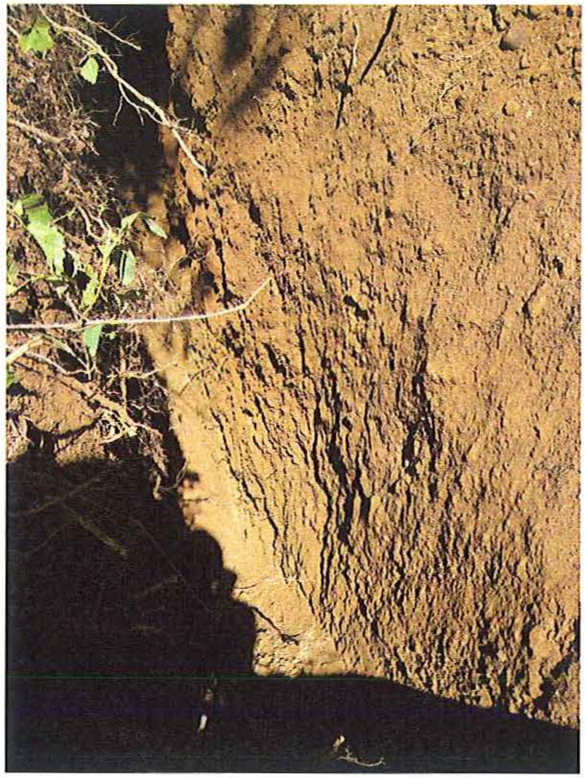
EXCAVATION COMPANY: Lot Hauling
EXCAVATING EQUIPMENT: Case 580 backhoe
SURFACE ELEVATION: ± Feet

LOCATION: See Figure 2
DATE COMPLETED: 6/12/07
LOGGED BY: V. Atkins

| DEPTH (feet) | SYMBOL | USCS SOIL CLASS. | DESCRIPTION | SAMPLE TYPE | SAMPLE NUMBER | MOISTURE CONTENT (%) | OTHER TESTS | GROUNDWATER |
|---|---|---|---|---|---|---|---|---|
| 0 | | | Brown sandy/gravelly TOPSOIL with organic material and roots. | | | | | |
| | | SP | Brownish yellow gravelly SAND with silt, moist, | | | | | |
| | | SM | Brownish yellow gravelly silty SAND, slightly cemented/oxidized, moist. | | | | | |
| 8 | | | Test pit completed to 8 feet bgs.<br>Ground water not encountered. | | TP-30-8 | | | |

0
2
4
6
8
10
12

## PHOTOGRAPH OF TEST 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.

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Mason County Wastewater
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Mason County
Washington

## LOG OF TEST PIT
## TP-30

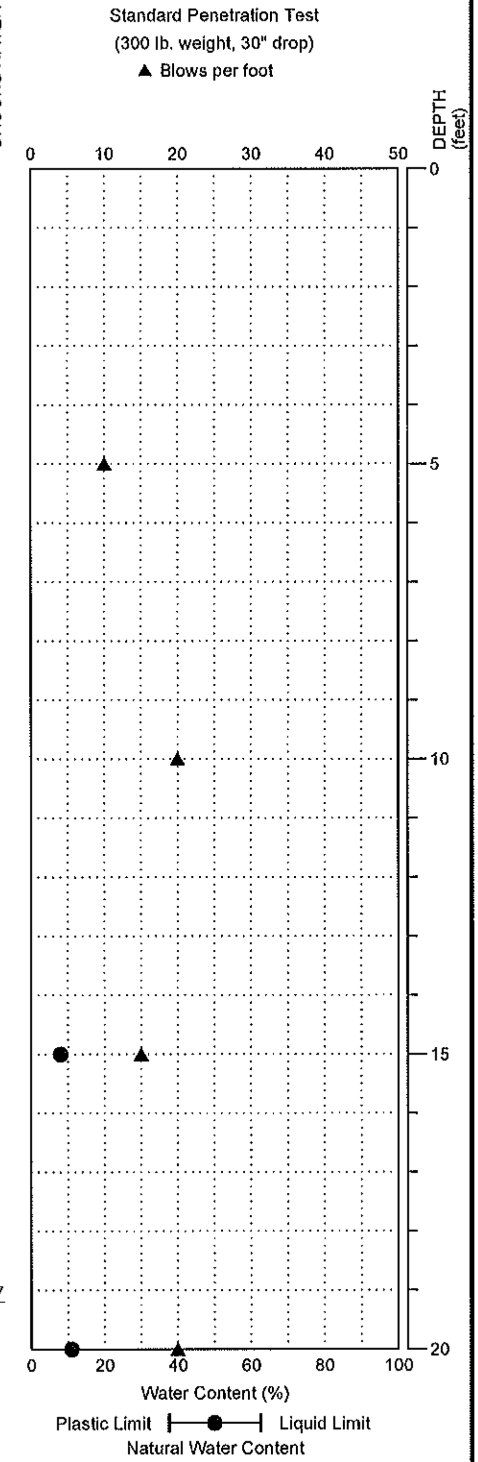
PAGE: 1 of 1

PROJECT NO.: 2006-172-22 FIGURE: A-8

DRILLING COMPANY: Boart Longyear
DRILLING METHOD: Mobile B-59 HSA w/ Cathead
SAMPLING METHOD: D&M Sampler
SURFACE ELEVATION: ± feet

LOCATION: See Figure 2
DATE STARTED: 7/11/2007
DATE COMPLETED: 7/11/2007
LOGGED BY: V. Atkins

| DEPTH (feet) | SYMBOL | USCS SOIL CLASS | DESCRIPTION | SAMPLE TYPE | SAMPLE NUMBER | PEN. RESISTANCE (blows/6 inches) | OTHER TESTS | GROUNDWATER |
|---|---|---|---|---|---|---|---|---|
| 0 | | GP | Brown coarse GRAVEL, dry. See test pit logs for shallow lithology. | | | | | |
| 5 | | | No recovery | | 5 | 4/5/5 | | |
| | | SM | Red-brown silty SAND with gravel, loose, moist, trace mottling. (Outwash) | | | | | |
| 10 | | | | | 10 | 14/11/9 | | |
| | | SW<br>SM | Red-brown fine to coarse SAND with gravel and silt lenses, loose, moist. | | | | | |
| 15 | | | | | 15 | 22/10/5 | | |
| | | | Brown fine to coarse SAND with silt and gravel, medium dense. moist grading wet. | | | | | |
| | | | Wet | | | | | ∇ |
| 20 | | | | | | | | |



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.

NOTE: 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.

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Infiltration Evaluation
Mason County
Washington

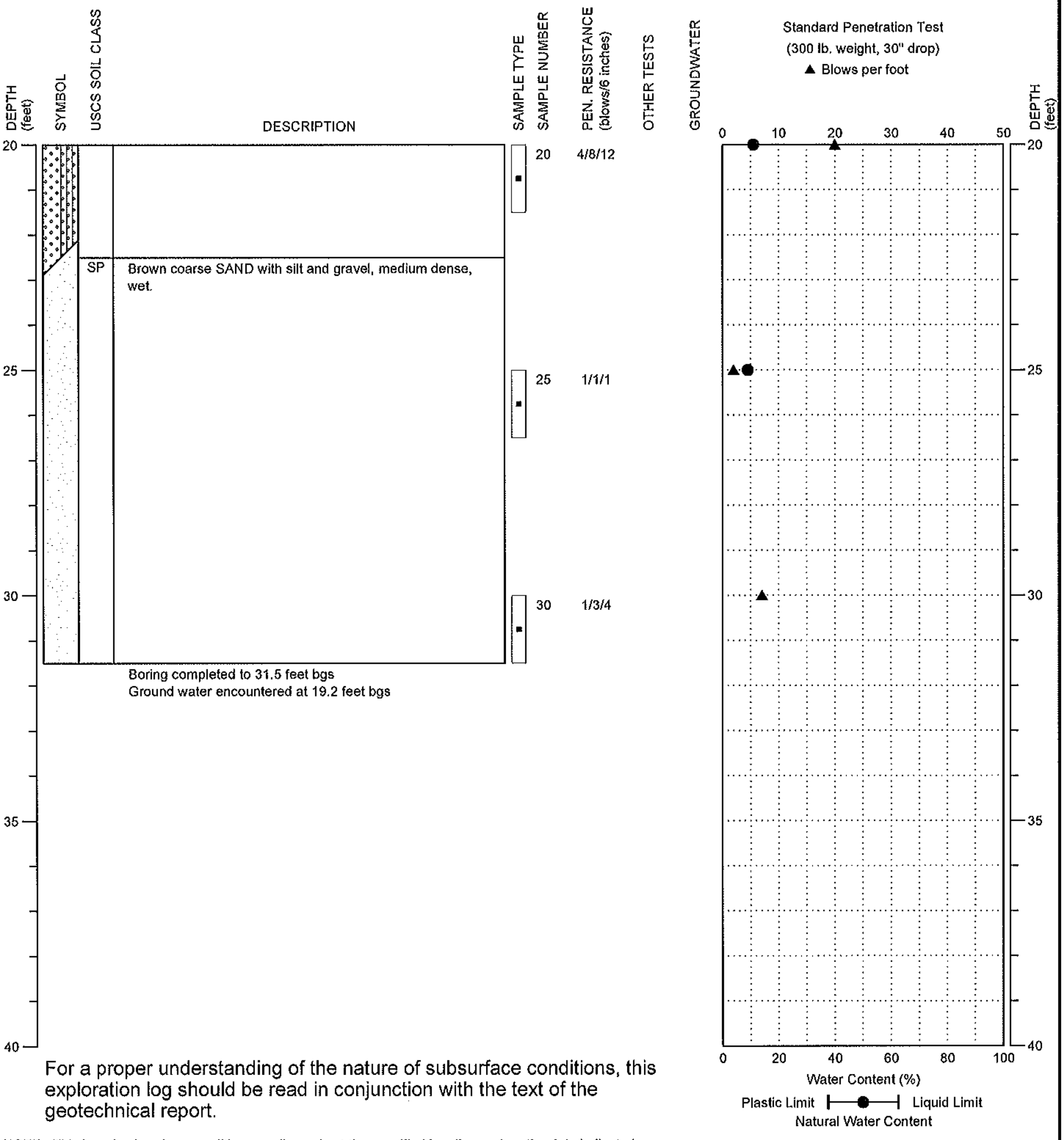
BORING:
BH-3

PAGE: 1 of 2

PROJECT NO.: 2006-172-22 FIGURE: A-9

DRILLING COMPANY: Boart Longyear
DRILLING METHOD: Mobile B-59 HSA w/ Cathead
SAMPLING METHOD: D&M Sampler
SURFACE ELEVATION: ± feet

LOCATION: See Figure 2
DATE STARTED: 7/11/2007
DATE COMPLETED: 7/11/2007
LOGGED BY: V. Atkins



SP Brown coarse SAND with silt and gravel, medium dense, wet.

| | |
|---|---|
| 20 | 4/8/12 |
| 25 | 1/1/1 |
| 30 | 1/3/4 |

Boring completed to 31.5 feet bgs
Ground water encountered at 19.2 feet bgs

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.

NOTE: 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.

Mason County Wastewater
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Mason County
Washington

BORING:
BH-3

PAGE: 2 of 2

PROJECT NO.: 2006-172-22 FIGURE: A-9

File Original and First Copy with Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

# WATER WELL REPORT
## STATE OF WASHINGTON

Application No. ..........
Permit No. ..........

**(1) OWNER:** Name John Smith Address Rt.5 Box500 Shelton, Wa

**(2) LOCATION OF WELL:** County Mason — SW ¼ SW ¼ Sec 35 T. 22 N., R. 4 W.M.

Bearing and distance from section or subdivision corner

**(3) PROPOSED USE:** Domestic ☑ Industrial ☐ Municipal ☐
Irrigation ☐ Test Well ☐ Other ☐

**(4) TYPE OF WORK:** Owner's number of well (if more than one) ..........
New well ☑ Method: Dug ☐ Bored ☐
Deepened ☐ Cable ☑ Driven ☐
Reconditioned ☐ Rotary ☐ Jetted ☐

**(5) DIMENSIONS:** Diameter of well 6 inches.
Drilled 331 ft. Depth of completed well 331 ft.

**(6) CONSTRUCTION DETAILS:**

**Casing installed:** 6 " Diam. from 0 ft. to 331 ft.
Threaded ☐ ..........” Diam. from .......... ft. to .......... ft.
Welded ☑ ..........” Diam. from .......... ft. to .......... ft.

**Perforations:** Yes ☐ No ☑
Type of perforator used..........
SIZE of perforations .......... in. by .......... in.
.......... perforations from .......... ft. to .......... ft.
.......... perforations from .......... ft. to .......... ft.
.......... perforations from .......... ft. to .......... ft.

**Screens:** Yes ☐ No ☑
Manufacturer's Name..........
Type.......... Model No..........
Diam. .......... Slot size .......... from .......... ft. to .......... ft.
Diam. .......... Slot size .......... from .......... ft. to .......... ft.

**Gravel packed:** Yes ☐ No ☑ Size of gravel: ..........
Gravel placed from .......... ft. to .......... ft.

**Surface seal:** Yes ☑ No ☐ To what depth? 18 ft.
Material used in seal bentonite
Did any strata contain unusable water? Yes ☐ No ☐
Type of water?.......... Depth of strata..........
Method of sealing strata off..........

**(7) PUMP:** Manufacturer's Name..........
Type: .......... H.P. ..........

**(8) WATER LEVELS:** Land-surface elevation above mean sea level.......... ft.
Static level Flowing ft. below top of well Date..........
Artesian pressure .......... lbs. per square inch Date..........
Artesian water is controlled by.......... (Cap, valve, etc.)

**(9) WELL TESTS:** Drawdown is amount water level is lowered below static level
Was a pump test made? Yes ☐ No ☑ If yes, by whom? ..........
Yield: gal./min. with ft. drawdown after hrs.
" " " "
" " " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

| *Time* | *Water Level* | *Time* | *Water Level* | *Time* | *Water Level* |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| | | | | | |

Date of test ..........
Bailer test 45 gal./min. with 40 ft. drawdown after 1 hrs.
Artesian flow Seeping g.p.m. Date 10-11-77
Temperature of water.......... Was a chemical analysis made? Yes ☐ No ☐

**(10) WELL LOG:**

Formation: *Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.*

| MATERIAL | FROM | TO |
|---|---|---|
| Gravelly topsoil | 0 | 8 |
| Conglomerate brown | 8 | 48 |
| " permeable " | 48 | 54 |
| Conglomerate " | 54 | 140 |
| " gray | 140 | 144 |
| Sand, silt & Clay Brown | 144 | 310 |
| (Permeable) | | |
| Clay blue | 310 | 323 |
| Conglomerate blue-black | 323 | 331 |
| Permeable | | |

RECEIVED
NOV 1 1977
DEPARTMENT OF ECOLOGY
SOUTHWEST REGIONAL OFFICE

Work started 8-31, 1977 Completed 10-11, 1977

**WELL DRILLER'S STATEMENT:**

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME Arcadia Drilling Co. (Person, firm, or corporation) (Type or print)
Address Rt3 Box 477 Shelton Wa
[Signed] Howard B [illegible] (Well Driller)
License No. 0477 Date 10-11, 1977

(USE ADDITIONAL SHEETS IF NECESSARY)

S. F. No. 7356—OS—(Rev. 4-71).

# APPENDIX B

# LABORATORY TESTING

# APPENDIX B

## LABORATORY TESTING

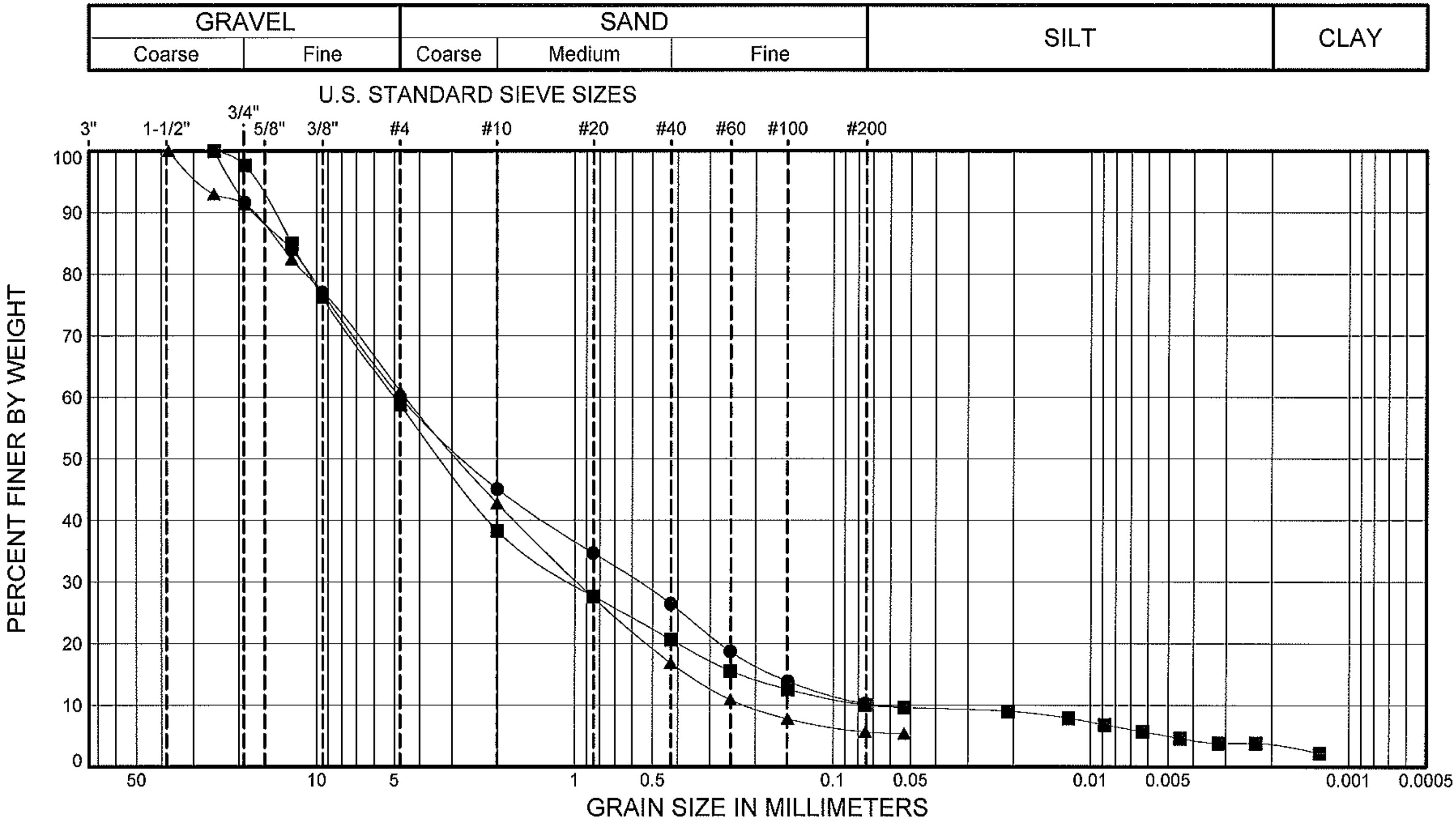
Representative soil samples obtained from the borings were returned to the HWA laboratory for further examination and testing. Laboratory tests were conducted on selected soil samples to characterize certain properties of the on-site soils. Laboratory tests, as described below, included determination 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.



| SYMBOL | SAMPLE | | DEPTH (ft) | CLASSIFICATION OF SOIL- ASTM D2487 Group Symbol and Name | % MC | LL | PL | PI | Gravel % | Sand % | Fines % |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ● | BH-3 | 15 | 15.0 - 16.5 | (SW-SM) Brown, well graded SAND with silt and gravel | 8 | | | | 40.0 | 49.8 | 10.2 |
| ■ | BH-3 | 20 | 20.0 - 21.5 | (SW-SM) Light brown, wel graded SAND with silt and gravel | 11 | | | | 41.3 | 48.7 | 10.0 |
| ▲ | BH-3 | 25 | 25.0 - 26.5 | (SP-SM) Brown, poorly graded SAND with silt and gravel | 9 | | | | 39.0 | 55.3 | 5.6 |

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Infiltration Evaluation
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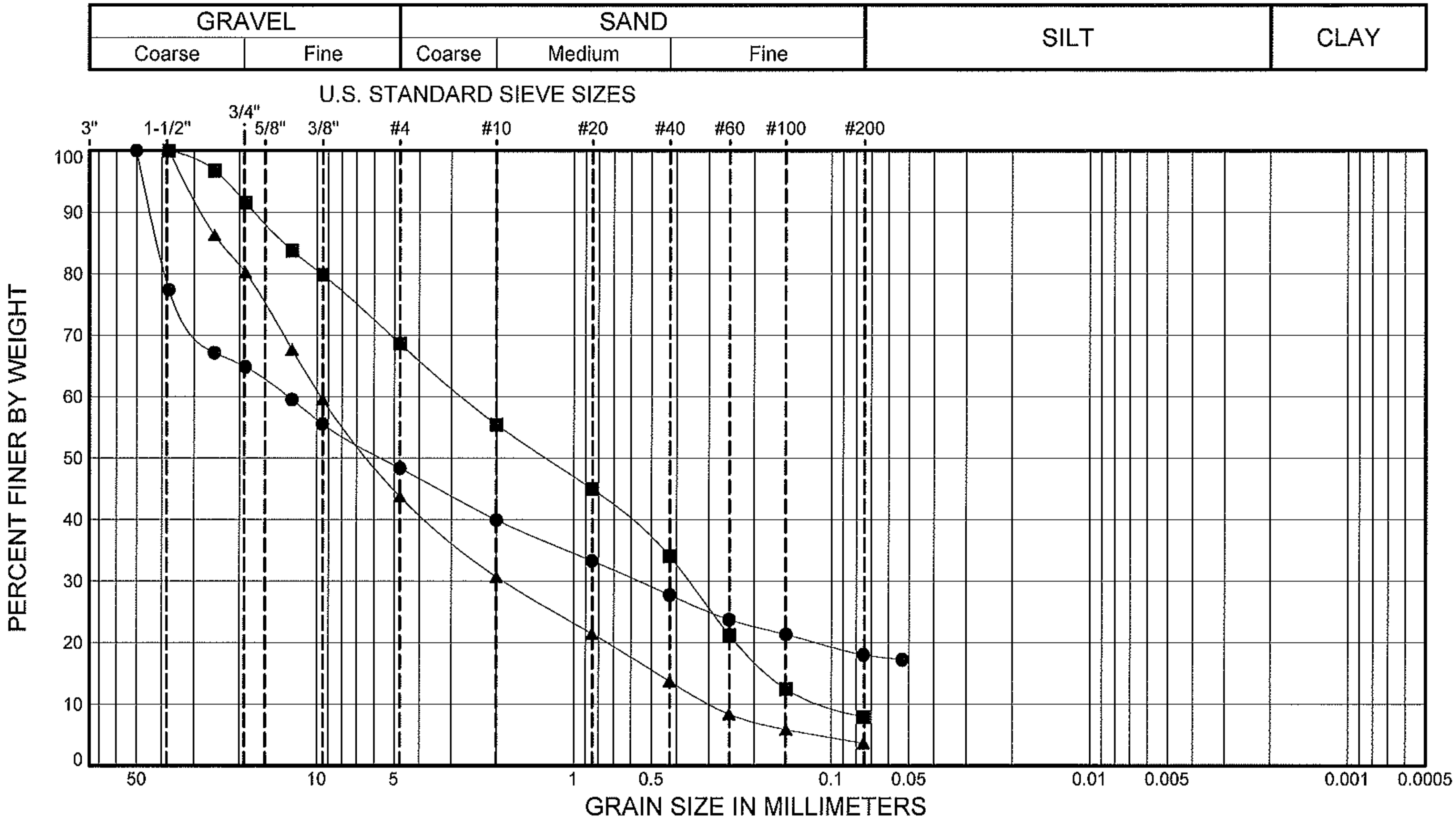
# PARTICLE-SIZE ANALYSIS OF SOILS METHOD ASTM D422

PROJECT NO.: 2006-172-22 FIGURE: B-1



| SYMBOL | SAMPLE | | DEPTH (ft) | CLASSIFICATION OF SOIL- ASTM D2487 Group Symbol and Name | % MC | LL | PL | PI | Gravel % | Sand % | Fines % |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ● | TP-25 | TP-25-6 | | (GM) Brown, silty GRAVEL with sand | 14 | | | | 51.7 | 30.3 | 18.0 |
| ■ | TP-26 | TP-26-5 | | (SP-SM) Brown, poorly graded SAND with silt and gravel | 11 | | | | 31.4 | 60.7 | 7.9 |
| ▲ | TP-27 | TP-27-5 | | (GW) Brown, well graded GRAVEL with sand | 4 | | | | 56.3 | 40.1 | 3.6 |

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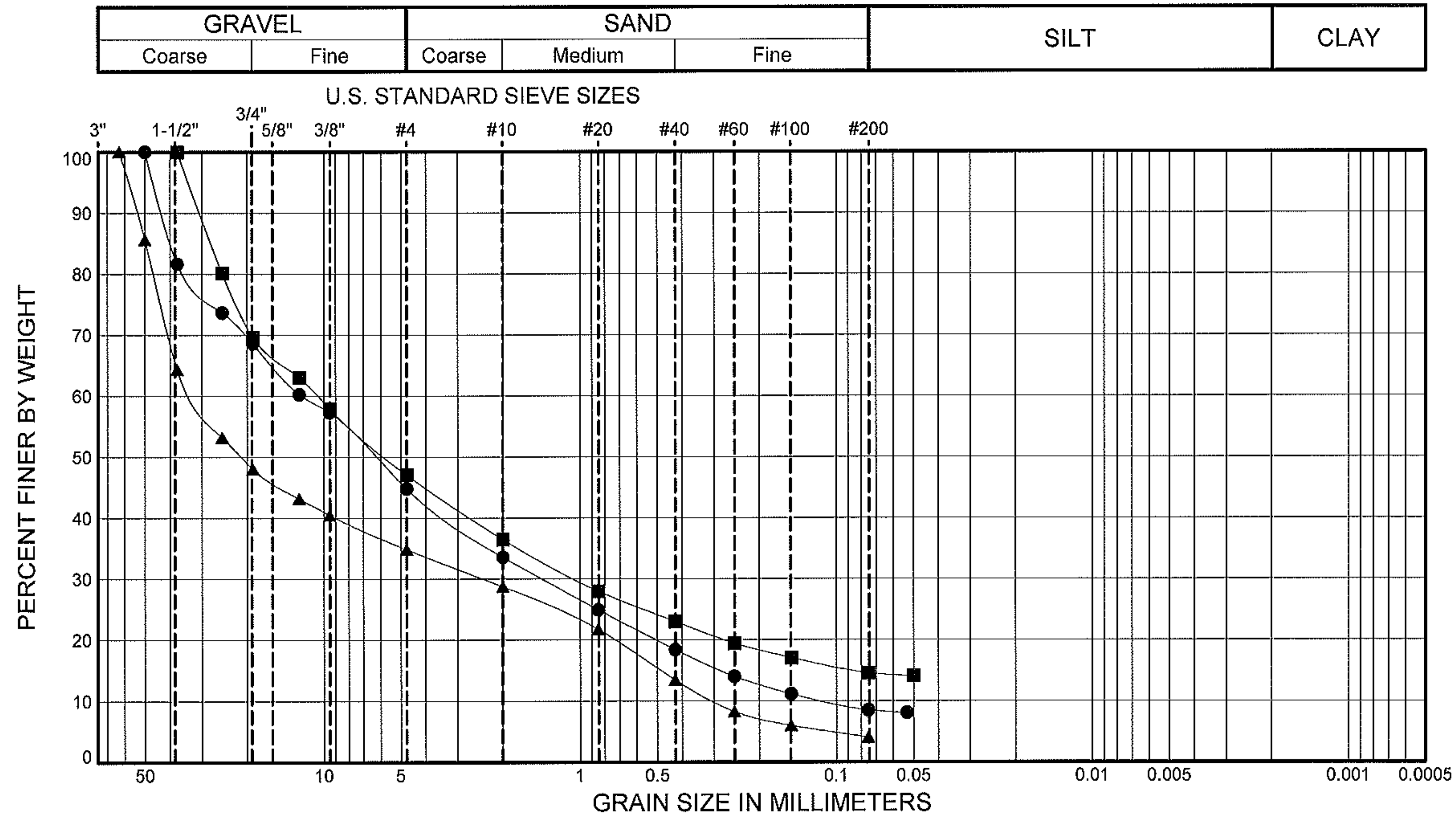
Washington

# PARTICLE-SIZE ANALYSIS OF SOILS METHOD ASTM D422

PROJECT NO.: 2006-172-22 FIGURE: B-2



| SYMBOL | SAMPLE | | DEPTH (ft) | CLASSIFICATION OF SOIL- ASTM D2487 Group Symbol and Name | % MC | LL | PL | PI | Gravel % | Sand % | Fines % |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ● | TP-27 | TP-27-7 | | (GW-GM) Reddish brown, well graded GRAVEL with silt and sand | 8 | | | | 55.2 | 36.3 | 8.5 |
| ■ | TP-28 | TP-28-5 | | (GM) Brown, silty GRAVEL with sand | 11 | | | | 52.9 | 32.5 | 14.5 |
| ▲ | TP-29 | TP-29-7 | | (GP) Brown, poorly graded GRAVEL with sand | 6 | | | | 65.2 | 30.8 | 4.0 |

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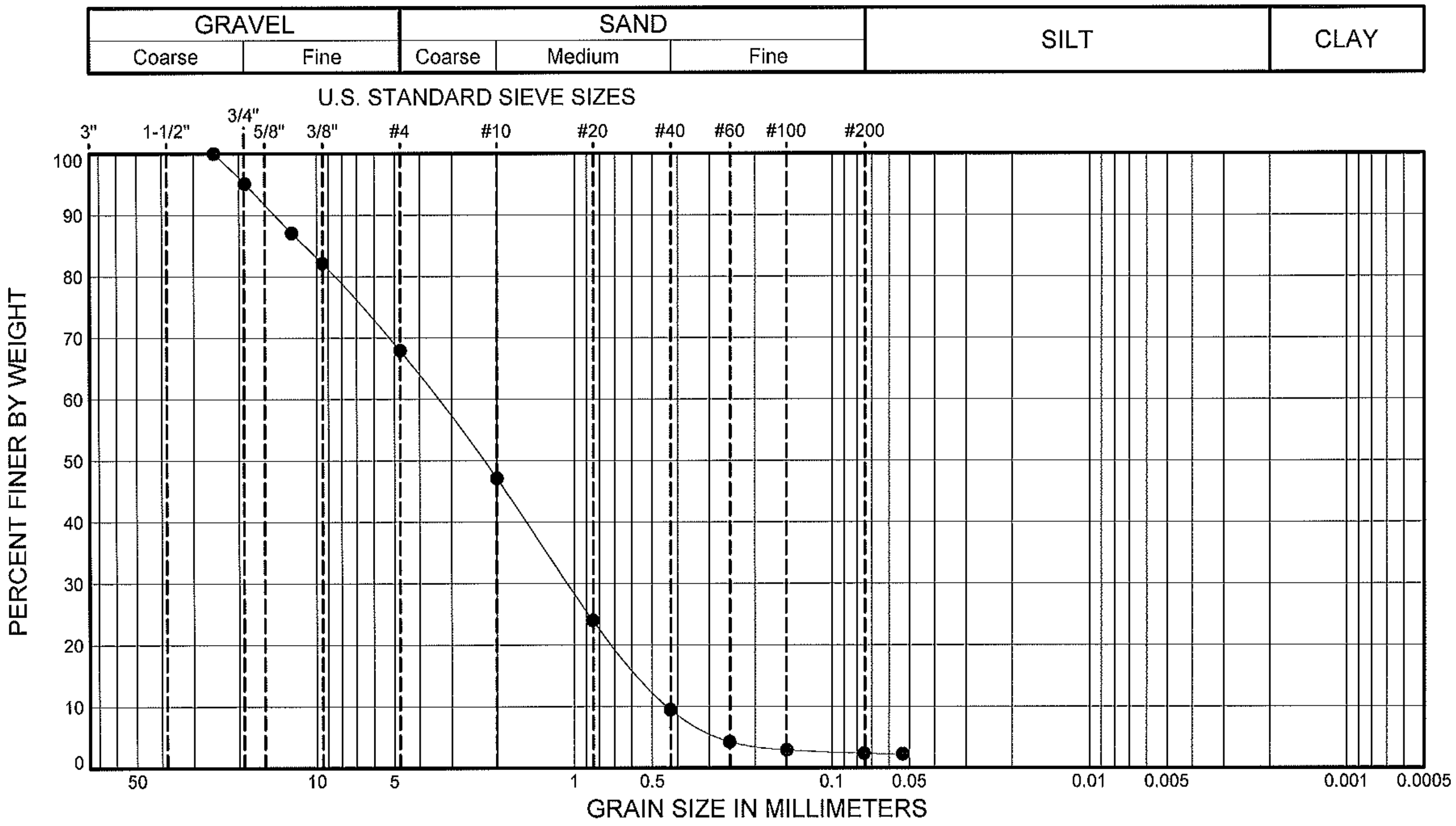
Mason County
Washington

## PARTICLE-SIZE ANALYSIS OF SOILS METHOD ASTM D422

PROJECT NO.: 2006-172-22 FIGURE: B-3



| SYMBOL | SAMPLE | | DEPTH (ft) | CLASSIFICATION OF SOIL- ASTM D2487 Group Symbol and Name | % MC | LL | PL | PI | Gravel % | Sand % | Fines % |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ● | TP-4 | | 8.0 - 8.5 | (SP) Brown, poorly graded SAND with gravel | 6 | | | | 32.1 | 65.5 | 2.3 |

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# PARTICLE-SIZE ANALYSIS OF SOILS METHOD ASTM D422

PROJECT NO.: 2006-172-22 FIGURE: B-4