PORT GAMBLE S'KLALLAM TRIBE

S'KLALLAM NATION **WASHINGTON**

CAMPUS DEVELOPMENT UTILITY ANALYSIS

G&O #18478
DECEMBER 2018

Gray & Osborne, Inc.

CONSULTING ENGINEERS

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CHAPTER 1

INTRODUCTION

GENERAL

The Port Gamble S'Klallam Tribe (Tribe) contracted with Gray & Osborne, Inc. to investigate the feasibility of providing sewer, water, and stormwater service to two new planned buildings for the Natural Resources Department and the Justice Center. The buildings are planned to be constructed at the south end of the Tribal Administration Campus. This evaluation of alternatives includes an examination of the current water, sanitary sewer, and drainage systems that will serve the proposed buildings, the capacity of the existing systems, preliminary design for sewer, water, and drainage system extensions to serve the proposed development, and any improvements to the existing system that would be required.

The Tribe completed a "Facilities Assessment and Master Plan" for the Administrative Campus in 2014 (Plan) to guide development within the Campus area for the next 20 years. The Plan identified infrastructure and capacity needs for each of the buildings on the Campus and described new buildings or other improvements to address those needs. The new Judicial Center and Natural Resources Department buildings were included in this document and were planned to be constructed during the 10-year planning period. The buildings have not been designed as of the writing of this report.

PURPOSE

The purpose of this report is to provide the basis of design for the preparation of plans and specifications to construct new water, sanitary sewer, and stormwater improvements for the new buildings proposed at the Tribal Administration Campus. This report will provide general design criteria, future water and sewer flows, future stormwater flows, a preliminary site layout, evaluation of the existing system, recommended improvements, and associated cost estimates.

SCOPE

The scope of work for the Port Gamble S'Klallam Tribe's Predesign Report includes the following items:

- General Design Criteria
- Preliminary Site Layout
- Water System Analysis
- Sewer System Analysis
- Stormwater Management

- Construction Cost Estimates

OVERVIEW

The Port Gamble S'Klallam Tribal Reservation is situated on the north end of the Kitsap Peninsula in western Washington approximately 27 miles northwest of the City of Seattle and 6 miles northwest of the Town of Kingston (Figure 1-1). Figure 1-2 shows the location of the Tribal Administration Campus and the two proposed buildings with their associated parking areas. A new wet lab building, currently under construction, is also indicated on Figure 1-2. In 2014, the Tribal membership included 1,234 people, with an estimated 845 members and their relatives living on the reservation.

The Tribe is not beholden to the requirements of the state agencies that govern public utility systems (Washington State Departments of Health and Ecology). The Tribe has its own standards for service that apply to its sewer and water systems. However, the Tribe intends to meet the requirements of the state agencies to the maximum extent possible to provide adequate service. The Tribe and state requirements for each utility system are discussed further in subsequent chapters.

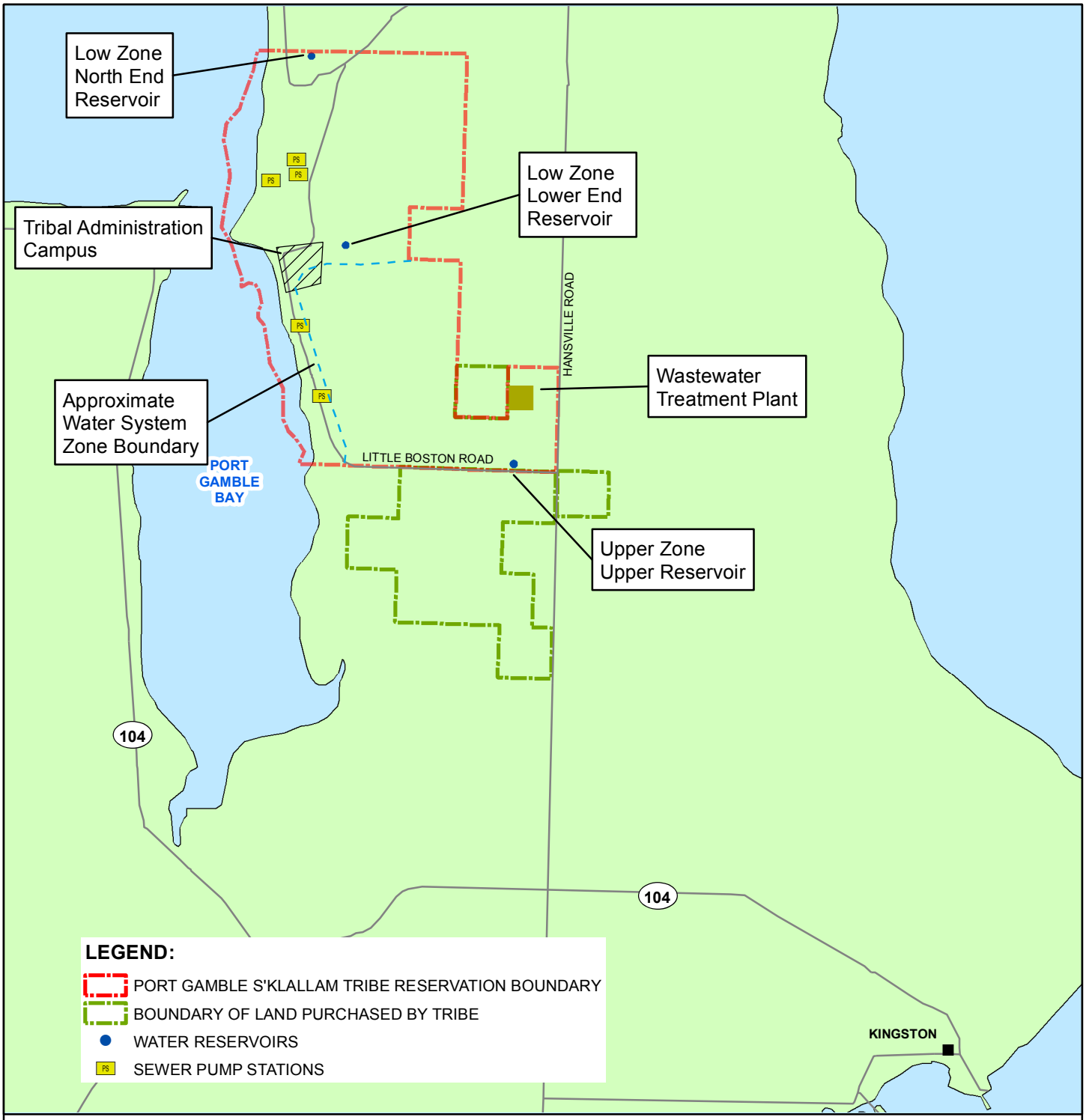
PROPOSED PROJECT

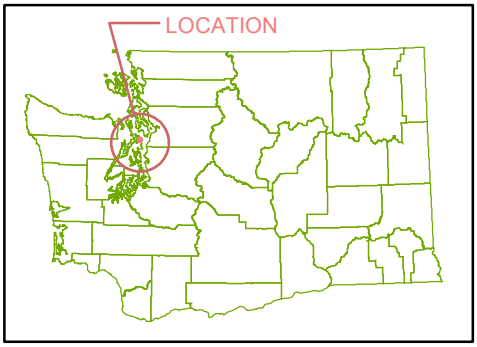
As shown on Figure 1-2, the proposed development will occur within the 12.5-acre Tribal Administration Campus parcel, though the development itself will cover approximately 2 acres of area. The site is situated approximately 80 to 85 feet above sea level, and the site is generally flat or gently sloping. The new buildings will be accessed via new or existing parking area driveways within the Tribal Administration Campus. The proposed buildings are anticipated to be two stories tall with a parking level on each of the ground levels. Existing water and sanitary sewer service are available within the Campus and on Little Boston Road, and an existing drainage swale is located to the southeast of the proposed Natural Resources Department building. The existing utilities on the Campus are shown on a basemap included in Appendix A.

The Tribe has tentative plans for additional development within the Tribal Administration Campus, as shown in the Campus 20-year Master Plan, which includes the reconstruction of the Community Center, expanding the clinic, and construction of a new administrative building.

WATER SYSTEM

Water service to the reservation is supplied by two primary wells and conveyed to three storage reservoirs. One reservoir is located in the upper reservation at the southern end of the reservation and serves the upper pressure zone and the S'Klallam Hill and Bud Purser neighborhoods. The remaining two reservoirs serve the lower zone. The Lower End Reservoir is centrally located in the lower reservation and primarily serves the Tribal Administration Campus. The North End Reservoir is located near the northern





N

0 0.5 1 2 Miles

PORT GAMBLE S'KLALLAM TRIBE

CAMPUS DEVELOPMENT UTILITY ANALYSIS
FIGURE 1-1
VICINITY MAP

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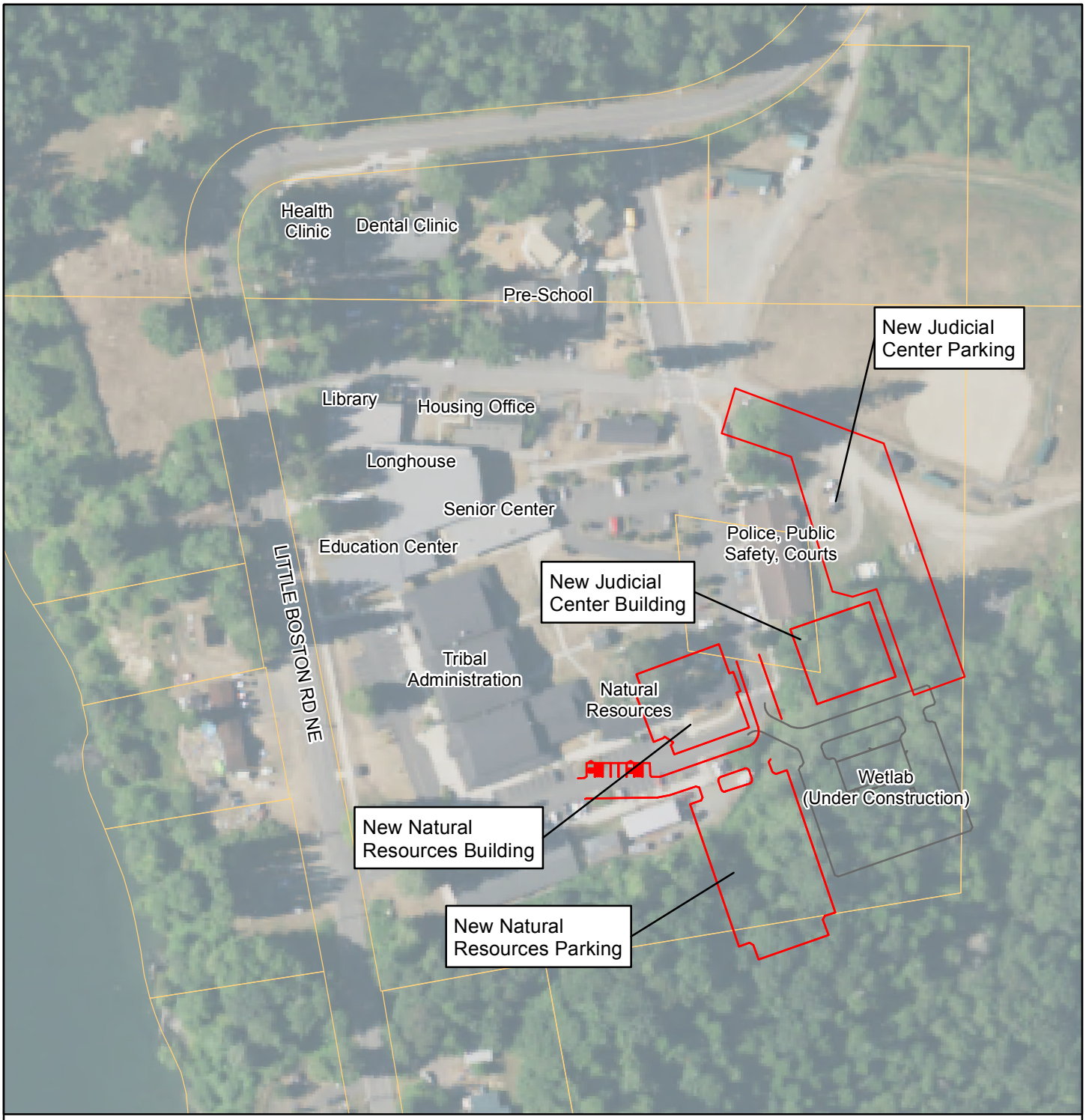
M:\Port Gamble S'Klallam Tribe\18478.00 South Admin Campus Utility Design\GIS\Figures\1-1 vicinity.mxd



LEGEND:

Parcels

Proposed Development

N

0 50 100 200 300 400 500 Feet

PORT GAMBLE S'KLALLAM TRIBE

CAMPUS DEVELOPMENT UTILITY ANALYSIS
FIGURE 1-2
TRIBAL ADMINISTRATION CAMPUS

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reservation boundary and primarily serves the surrounding residential neighborhoods (see Figure 1-1). The commercial zone, which includes the Point Casino, Gliding Eagle Market, the Point Hotel, and Wellness Center, is connected to the Kitsap County PUD system.

To provide water service to the proposed development, the new buildings will be served by connection to the existing 8-inch water main located within the Tribal Administration Campus. The existing system within the Tribal Administration Campus includes mains within both the upper (HGL 441) and lower (HGL 201) zones, connected to the mains on Little Boston Road. The capacity of the existing water system was analyzed to determine if service to the buildings should be provided from the Upper Zone or the Lower Zone, and if any additional improvements are required to provide service.

SEWER SYSTEM

The Tribal Administration Campus is located within the Lower Reservation, which is served by a small diameter septic tank effluent pumping (STEP) sewer collection system. All of the existing connections to the lower reservation system are served by individual on-site septic tanks that discharge to the collection system. Septic tank effluent is conveyed by gravity to five pump stations that pump the flow to a larger pump station located near the intersection of Little Boston Road NE and Eaglewood Lane NE. This pump station pumps sewage to the Tribe's wastewater treatment facility (WWTF), located southeast of the Tribal Administration Campus, near the Point Casino.

The 2013 General Sewer/Wastewater Facility Plan, which was prepared by Gray & Osborne, Inc., determined that Pump Station 2 and the gravity sewers from the Tribal Administration Campus to the pump station have adequate capacity through the 20-year planning period, but this facility plan did not necessarily include the two proposed buildings under consideration. The WWTP near The Point Casino in the Upper Reservation provides sufficient capacity to receive and treat all of the sewage produced on the reservation through the 20-year planning period. The conveyance system downstream of the Campus was analyzed to determine if improvements are necessary to provide sewer service to the new buildings.

STORMWATER MANAGEMENT

The existing stormwater drainage system within the campus consists primarily of piped conveyance, manholes, catch basins, ditches and bioswales. Runoff from most of the buildings on campus is collected in roof drains and conveyed to the piped conveyance system, while runoff from the driveways and parking areas is generally collected in catch basins or adjacent ditches and swales. Runoff generally flows to the west to a system of ditches and culverts along the east side of Little Boston Road, which then discharge to a culvert that crosses the road and flows to Port Gamble Bay. The existing stormwater drainage system within and downstream of the Campus was analyzed to determine its

capacity to treat and convey runoff flow from the new buildings. Additional stormwater facilities were considered to improve conveyance and treatment capacity.

CHAPTER 2

WATER SYSTEM

EXISTING WATER SYSTEM

The Port Gamble S'Klallam Tribe's water is supplied by two primary wells, treated with chlorination and fluoridation. The combined capacity of these two wells is approximately 200 gpm, or 288,000 gpd. The two wells distribute water to two storage reservoirs that serve the lower residential area (Lower Zone). The combined capacity of the two Lower Zone reservoirs is approximately 220,000 gallons, and they have an overflow elevation of 201 feet.

The wells also pump via a booster station to the Upper Reservoir, which serves the S'Klallam Hill and Bud Purser neighborhoods in the upper reservation (Upper Zone), located near the southeast corner of the reservation, as seen in Figure 2-1. The Upper Zone reservoir has a capacity of 91,000 gallons and an overflow elevation of 441 feet. The Upper and Lower Zones are connected by several PRV stations and a booster station to allow flow between the two areas. A third well, which is located near the commercial area, serves as emergency backup water supply.

The commercial zone, which includes the Point Casino, Gliding Eagle Market, The Point Hotel, and Wellness Center is connected to Kitsap County PUD system.

Several water mains currently run across the Tribal Administration Campus, serving both the Lower Zone and the Upper Zone. The new buildings are located within the Tribal Administration Campus at the same elevation as the rest of the Campus.

Though the Tribe is not beholden to the Washington State Department of Health (DOH) water system requirements, the Tribe intends to meet these requirements to the maximum extent practical, and these guidelines were used in the analysis of the existing water system. The existing water system is able to supply water pressure to meet the Washington State Department of Health (DOH) standard of 30 psi under peak hourly demands for all locations within the Campus. The Tribe has indicated that the water system must meet a standard minimum fire flow requirement of 700 gpm for 2 hours while maintaining a residual pressure of 55 psi (per Resolution No. 03-A-86). DOH also requires that the water system provide a minimum system-wide pressure of 20 psi under maximum day demand with fire flow conditions. The Tribe's fire flow requirement will also need to be accounted for as part of the design alternatives.

FUTURE SALMONBERRIES BOOSTER STATION

The Tribe is in the process of developing water system improvements to provide water service to the planned East Salmonberries development. The development is located

along the east side of Little Boston Road NE, between Salmonberries Lane NE and Hood Canal Drive NE. The 26-home development is at too high of an elevation to be served by the lower zone main in Little Boston Road NE. A study conducted by Gray & Osborne, Inc. determined that a booster station located near the Lower Zone North End Reservoir would be able to provide adequate service pressure and fire flow to the new development. This would require converting the main along Little Boston Road NE to the Upper Zone, connecting it via an 8-inch diameter pipe to the Upper Zone main within the Campus area. The locations of this development and the proposed improvements are shown on Figure 2-2.

For the purposes of this analysis, the East Salmonberries improvements are assumed to be constructed. This development is planned to be completed before 2021, and the Campus improvements will be completed after the East Salmonberries development.

WATER MODEL

A model of the Tribe's water system was developed for this analysis based on as-built drawings, GIS data, and CAD data supplied by the Tribe. The water model is built in the InfoWater platform by Innovyze, Inc., which operates in an ArcMap environment. The model is used to determine peak hour pressures and available fire flows within the Tribe's water service area to comply with DOH and Tribe standards.

WATER SYSTEM DEMANDS

Water system demands in the model were developed using five months of water meter data, from January through May 2018, supplied by the Tribe. The Tribe's water meter data is divided by neighborhood, and an average day demand (ADD) in each neighborhood over the 5-month period was determined. This ADD was input to the model such that water demand in each neighborhood was evenly distributed spatially throughout the neighborhood.

The Tribe has cited a per-ERU average day water usage of 300 gpd. The resulting number of ERUs within the Tribe's system is calculated from the average day demand (ADD) determined by the water meter data, and is 120 ERUs.

The ADD is used to determine maximum day demand (MDD) and peak hour demand (PHD), using guidance from the DOH 2009 Water System Design Manual (DOH Manual). MDD and PHD are used in the modeling as described below.

The DOH Manual recommends an ADD:MDD peaking factor of between 1.5 and 3 in order to determine MDD from ADD. In lieu of specific data to determine the MDD, DOH recommends a peaking factor of 2, or a MDD of at least 300 gpd/ERU, and less than 2,000 gpd/ERU. Because the Tribe's water use data does not include summer water use, which tends to be when the MDD occurs, a more conservative peaking factor of 2.6

North End Reservoir V = 82,200 gal
Base Elev = 171' Overflow = 201' Dia=20'

Port Gamble Bay

Hood Canal

4

Little Boston Rd NE

3

Eaglewood

Booster Station
Duplex 7.5 HP Submersible Pumps
55 GPM @400 Feet TDH
90 GPM @ 155 Feet TDH

Well No. 1 - Ballfield Well
Capacity = 155 GPM
Depth = 437 Feet

Lower End Reservoir V = 138,000 gal
Base Elev = 173' Overflow = 201' Dia=30'

2

1

Campus

Treatment Station

Well No. 2 - Church Well
Capacity = 75 GPM
Depth = 445 Feet

PRV Station

HANSVILLE ROAD

Bud Purser

6

PRV Station

Existing Casino

10 " KITSAP PUD WATER MAIN

PRV Station

Cubby Sparks

Bear Ridge

5

S'Klallam Hill

Emergency Well

LITTLE BOSTON ROAD

Upper Reservoir
V = 91,000 gal Dia = 20'
Base Elev = 374' Overflow = 413'

LEGEND:

- PORT GAMBLE S'KLALLAM TRIBE RESERVATION BOUNDARY
- BOUNDARY OF LAND PURCHASED BY TRIBE
- Upper Zone Mains
- Lower Zone Mains
- KITSAP PUD WATER MAIN
- 1 Field Hydrant Testing Locations

N

0 500 1,000 1,500 2,000 Feet

PORT GAMBLE S'KLALLAM TRIBE

CAMPUS DEVELOPMENT UTILITY ANALYSIS
FIGURE 2-1
EXISTING WATER SYSTEM

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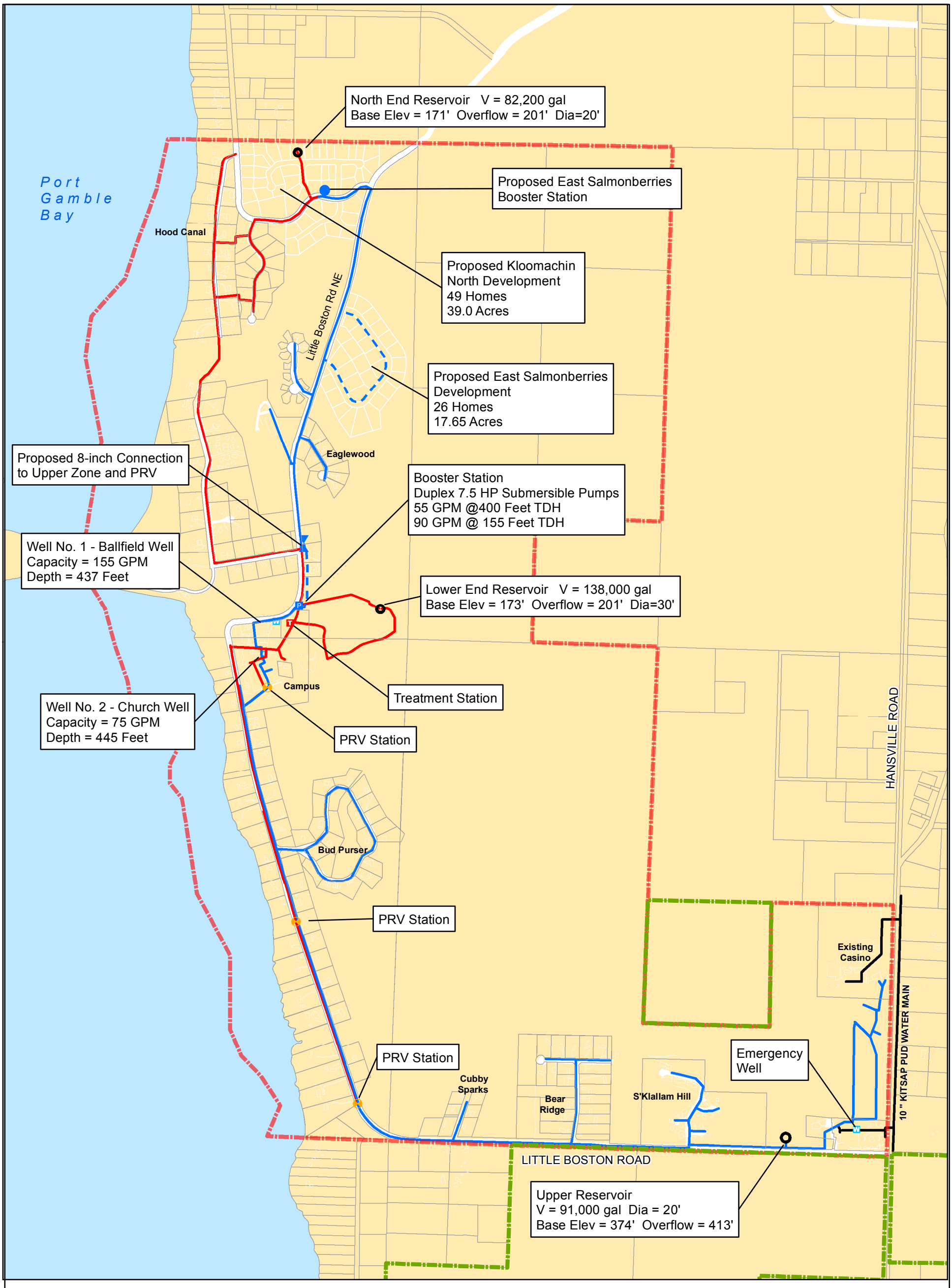

LEGEND:

- PORT GAMBLE S'KLALLAM TRIBE RESERVATION BOUNDARY
- BOUNDARY OF LAND PURCHASED BY TRIBE
- Upper Zone Mains
- Lower Zone Mains
- KITSAP PUD WATER MAIN

N

0 500 1,000 1,500 2,000 Feet

PORT GAMBLE S'KLALLAM TRIBE

CAMPUS DEVELOPMENT UTILITY ANALYSIS
FIGURE 2-2
EAST SALMONBERRIES IMPROVEMENTS

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was selected. MDD was used in the modeling to determine fire flow availability, per DOH requirements.

Peak hour demand is determined using the following equation, from the DOH Manual:

PHD = (MDD/1440)[(C) (N)+F] +18
C = Coefficient associated with ranges of ERUs
N = Number of service connections, ERUs
F = Factor associated with ranges of ERUs
MDD = Maximum day demand (gpd/ERU)
PHD = Peak hour demand (gpm/ERU)

The resulting MDD:PHD peaking factor was determined to be 2.90. PHD was used in the modeling to determine system pressures, per DOH requirements.

CALIBRATION

Hydrant flow testing was conducted in several locations throughout the Tribe's water system during October 2018 to calibrate the water model. The locations of these tests, as well as the measured flows and pressures are presented in Table 2-1. The modeled pressures at these locations are provided in the same table in order to compare the accuracy of the model with the field-observed conditions.

TABLE 2-1

Field Hydrant Testing and Calibration Results

Test No.	Location	Flow (gpm)	Field Pressures (psi)			Model Pressures (psi)			ΔP Difference[(1)] (psi)
			Static	Residual	ΔP	Static	Residual	ΔP	
1	Campus	839	51	40	11	50	35	14.7	-4
2	Campus	964	143	47	96	145	51	94.1	2
3	Salmonberries	839	44	34	10	45	32	12.1	-2
4	Kloomachin	919	45	43	2	43	42	0.5	2
5	Bear Ridge	805	66	37	29	69	40	29.2	0
6[(2)]	Bud Purser	888	124	50	74	125	48	77.2	-3

(1) A positive difference indicates that the pressure drop in the model is less than the observed pressure drop, while a negative difference indicates the opposite.
(2) This test was completed in 2015.

The model closely replicates the field conditions, differing by several psi in each location. The two locations that differ by more than 2 psi are modeled to have a pressure drop greater than the observed drop. The model is therefore slightly more conservative in these locations.

WATER DEMAND

To evaluate alternatives for providing water service, peak hour water demand was projected for the new buildings based on the anticipated fixture counts for each building, which were provided by the Tribe. The Uniform Plumbing Code includes guidance for estimating peak water demands based on fixture counts. Each type of fixture is assigned a number of "fixture units," and the total of the fixture units is then located on a chart that relates fixture units to peak water demand in gallons per minute. The Uniform Plumbing Code fixture unit table and chart are included in Appendix C for reference. The estimated fixture counts, fixture units, and corresponding total peak demand are included in Table 2-2.

TABLE 2-2

New Building Fixture Counts

Fixture Type	Number of Fixtures		Fixture Units per Fixture[(1)]	Total Fixture Units	
	Justice Center	Natural Resources		Justice Center	Natural Resources
Toilets	12	6	2.5	30	15
Sinks	16	10	2	32	20
Urinals	1	2	4	4	8
Showers	3	0	2	6	0
Mop Sinks	4	2	3	12	6
Drinking Fountains	3	2	0.5	1.5	1
Washing Machines	1	0	4	4	0
Dishwashers	2	2	1.5	3	3
Total Fixture Units				92.5	53
Peak Flow (gpm)[(2)]				46	30

(1) From 2015 Uniform Plumbing Code Table A 103.1.
(2) From 2015 Uniform Plumbing Code Chart A 103.1(2).

The total peak water demand estimated for the two new buildings is 76 gpm.

Based on water use data provided by the Tribe for March of 2018 (which was the month with the highest usage between January and May 2018), the water usage for the entire campus is approximately 3,430 gpd. The Tribe has defined one ERU as 300 gpd, so the Campus consists of approximately 11.4 ERUs.

The existing water demand within the Campus is included in Table 2-3.

TABLE 2-3

Existing Campus Water Demands

ERUs	11.4
Average Day Demand (gpd)(1)	3,430
MDD/ADD Peaking Factor(2)	2.6
Maximum Day Demand (gpd)	8,920
PHD/MDD Peaking Factor(2)	2.9
Peak Hour Demand (gpd)	25,870
Peak Hour Demand (gpm)	18

(1) Based on Tribe provided value of 300 gpd per ERU.
(2) Based on guidance in the 2009 DOH Water System Design Manual.

The new buildings will significantly increase the peak hour water demand at the campus. Assuming the new buildings have a peak demand of 76 gpm, the total peak hour demand at the Campus is increased to 94 gpm. It should be noted that the current demand at the Campus includes water use from the existing Justice Center and Natural Resources buildings, whose functions will be replaced by the new buildings. Therefore, the total peak hour water demand at the Campus is likely to be less than 94 gpm, but this analysis is intended to be conservative. Irrigation demand was not included in the analysis.

SERVICE PRESSURE

STATIC CONDITIONS

Table 2-4 provides the estimated elevation and static pressure of each proposed building based on a nominal hydraulic grade line of both 201 feet and 441 feet.

Although DOH only mandates 30 psi during peak hour demand, it has been our experience that pressure below 40 psi tends to garner low water pressure complaints from users. Pressure within the Campus exceeds 50 psi from the Lower Zone, or 138 psi from the Upper Zone. The East Salmonberries booster station is not required to provide adequate peak hour service pressures at the Campus.

TABLE 2-4

Normal Service Pressure (Under Peak Hour Demand)

Building	Assumed Elevation (ft)	Lower Zone Static Pressure (psi)[(1)]	Upper Zone Static Pressure (psi)[(2)]
Natural Resources	80	52	140
Justice Center	84	50	138

(1) Static pressure is based on the assumed water meter elevation and a water level of 201 feet (hydraulic grade line) in the Lower and North End Reservoirs, depleted of Operational and Equalizing Storage.

(2) Static pressure is based on the assumed water meter elevation and a water level of 441 feet (hydraulic grade line) in the Upper Zone Reservoir, depleted of Operational and Equalizing Storage.

Uniform Plumbing Code recommends that services with pressures in excess of 80 psi include an individual pressure reducing valve (PRV) to protect plumbing inside of the structure. It is recommended that services to the new buildings be connected to the Upper Zone supply with individual PRVs so that plumbing within the buildings is not subject to excessively high pressures.

FIRE FLOW CONDITIONS

In June of 2003, the Tribe drafted Resolution No. 03-A-86 that set forth the required fire flow at 700 gpm for 2 hours with a residual pressure of 55 psi. This resolution is included in the Appendix A. Fire flow for the Tribal Administration Campus was evaluated using a model created in InfoWater. Based on this analysis, a fire flow of 700 gpm at the new buildings will create pressures lower than 55 psi at the hydrant if supplied by the lower zone. The available fire flow at each building is shown in Table 2-5.

TABLE 2-5

Available Fire Flow Under Maximum Day Demand Conditions, without East Salmonberries Booster Station

Building	Assumed Elevation (ft)	Lower Zone		Upper Zone	
		Available Fire Flow (gpm)	Residual Pressure at Available Fire Flow (psi)	Available Fire Flow (gpm)	Residual Pressure at Available Fire Flow (psi)
Natural Resources	80	0	49	420	110
Justice Center	84	0	47	420	108

Under DOH criteria, available fire flow to the site is limited by the 20 psi system-wide pressure constraint. Pressure in the S'Klallam Hill development falls below 20 psi if flow to the Campus exceeds 440 gpm, due to the high elevation at S'Klallam Hill. If fire flow

is supplied from the lower zone, the 55 psi residual pressure cannot be maintained at the hydrant, so no fire flow is available in the lower zone.

The East Salmonberries Booster Station and system improvements were modeled in order to determine if these improvements alone would provide adequate fire flow to the new Campus buildings. Table 2-6 provides these results.

TABLE 2-6

Available Fire Flow Under Maximum Day Demand Conditions, with East Salmonberries Booster Station

Building	Assumed Elevation (ft)	Upper Zone	
		Available Fire Flow (gpm)	Residual Pressure at Available Fire Flow (psi)
Natural Resources	80	1,160	110
Justice Center	84	1,160	108

The East Salmonberries improvements allow for a fire flow availability that exceeds the Tribe's standards. The lower zone was not analyzed in this scenario because the improvements will have no significant impact on the hydraulics in that zone.

The building architect has requested a fire flow availability for the sprinkler system of 1,500 gpm. This is not possible without significant off-site pipeline improvements, even with the East Salmonberries improvements. Note that according to Appendix B of the 2015 International Fire Code, a building fire suppression system's demand does not have to be considered in addition to the system's fire flow requirement, but that the higher of the two flows is the guiding factor in design.

ALTERNATIVES

OPTION 1 – SERVICE FROM UPPER ZONE VIA LOOP

Service may be provided to the new buildings via a looped water main connected to the existing Upper Zone main near the PRV station at the south end of the Campus. A loop is preferred to a dead-end main in order to provide access to fire connections on multiple sides of the proposed buildings. The loop would also provide redundancy in the event that part of the water main is compromised, and is generally better for system water quality.

This option would require the installation of approximately 900 feet of 8-inch diameter water main as shown by the orange line on Figure 2-3. The estimated cost of this alternative is $246,000.

OPTION 2 – SERVICE FROM UPPER ZONE VIA LITTLE BOSTON

Alternatively, service may be provided by a loop connected to the Upper Zone main in the vicinity of the PRV station and along Little Boston Road, to the north of the Campus. This would provide looped service from two separated locations within the water system, which may provide better redundancy if the water system is compromised at one of the ends of the loop.

This alternative would require the installation of approximately 1,000 feet of 8-inch diameter water main, as shown by the purple line on Figure 2-3. The estimated cost of this alternative is $282,000.

OPTION 3 – SERVICE FROM UPPER ZONE VIA STUB

The least expensive alternative would provide service to the proposed buildings via a stub from the Upper Zone main. Though this alternative would reduce the length of new water main by several hundred feet, it would not provide the most robust service. Hydrant and fire connection locations would also be limited to one side of the building. Therefore, this option is not recommended.

This alternative would require the installation of approximately 300 feet of 8-inch diameter water main, as shown by the green line on Figure 2-3. The estimated cost of this alternative is $141,600.

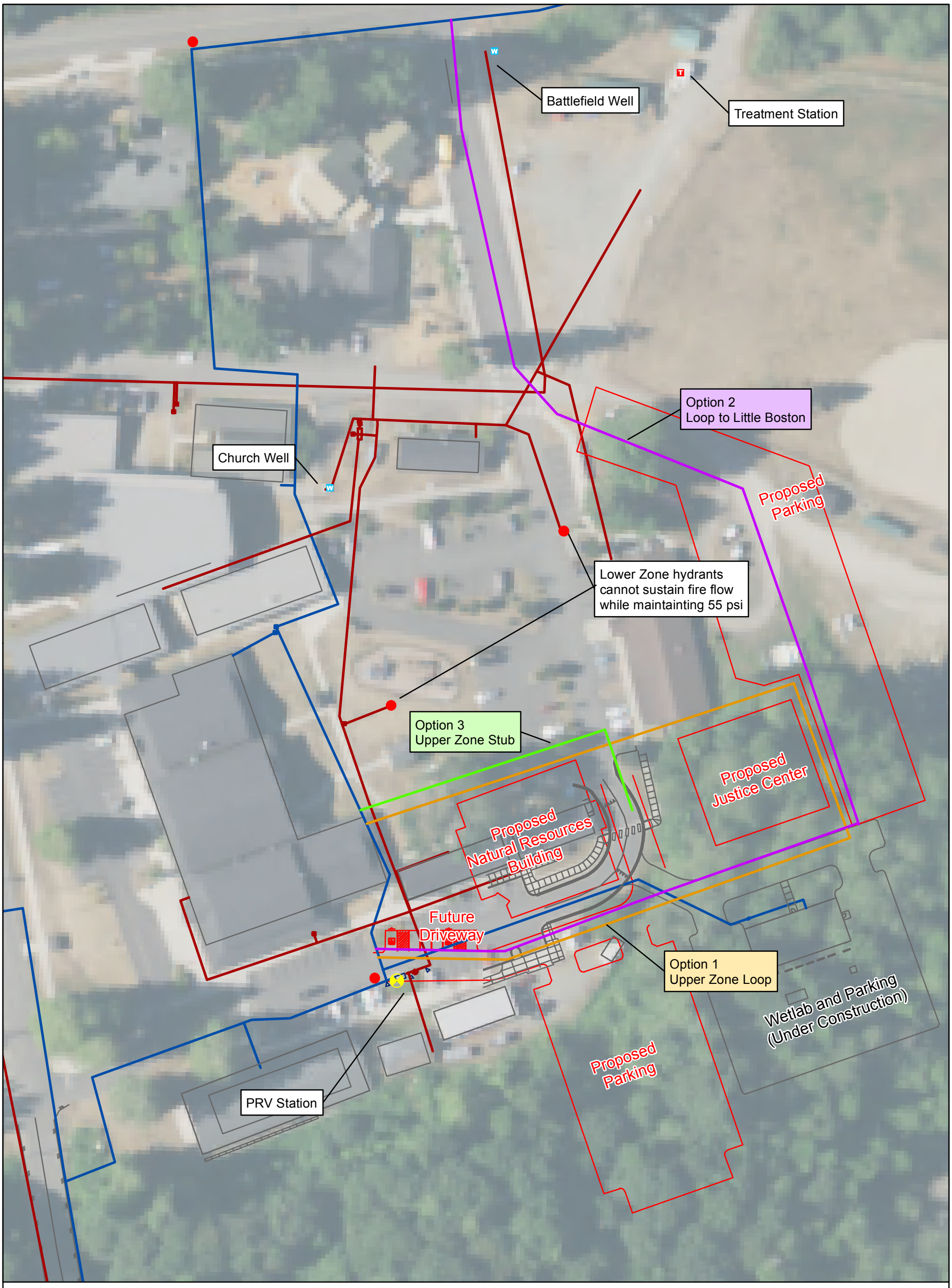
ADDITIONAL IMPROVEMENTS

SYSTEM FIRE FLOW CAPACITY

The architect has stated that 1,500 gpm is required to supply the fire suppression systems within the new buildings. This is more than double the Tribe's adopted standard and is not achievable with the current system in place. In order to provide 1,500 gpm while maintaining a residual pressure of 55 psi at the hydrant and 20 psi in other services in the system, significant offsite improvements would be required. It may be possible that the fire suppression requirement can be reduced by other design means, such as selection of materials. This can be addressed in more detail once the building designs are formally initiated and after the Tribe has completed a Water System Plan.

RECOMMENDATION

The modeling indicates that the existing system is capable of supplying domestic demand to the new buildings at the Tribal Administration Campus and fire demand meeting the Tribe's ordinance once the East Salmonberries project is complete. It is recommended that services and fire hydrants be connected to the Upper Zone main on Campus in order to provide adequate fire flow. Individual PRVs should be provided for each of the new buildings to reduce service pressures below 80 psi.



LEGEND:

- Hydrant
- PRV Station
- Upper Zone Mains
- Lower Zone Mains

N

0 50 100 150 200 Feet

PORT GAMBLE S'KLALLAM TRIBE

CAMPUS DEVELOPMENT UTILITY ANALYSIS
FIGURE 2-3
PROPOSED WATER CONNECTION

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The fire flow availability in the vicinity of the new buildings is the same in any of the three proposed alternatives. Option 1 is recommended, as the sitework necessary to install the proposed water main loop would be mostly incidental to the work required to construct the buildings. Option 2 would require a longer stretch of existing parking area at the north end of the Campus to be disturbed in order to install a main extending north to Little Boston Road.

In order to determine the system improvements required to provide 1,500 gpm of fire flow at the new buildings, it is recommended that the Tribe develop a water system plan. This will provide a more complete system analysis and will assist in identifying specific solutions to provide adequate service to the proposed development.

Cost estimates for the recommended alternatives are provided in Appendix B. The cost of the East Salmonberries improvements is not included in this report.

CHAPTER 3

SEWER SYSTEM

EXISTING SEWER SYSTEM

The Port Gamble S'Klallam Tribe's sewer system is served by two separate collection and treatment systems. The S'Klallam Hill neighborhood is served by a community septic system and drainfield. The Lower Reservation where the Tribal Administration Campus is located, the Upper Reservation, which includes The Point Casino and Gliding Eagle Market, and the Ravenswood commercial area are served by individual, on-site septic tanks connected to a collection system. The collection system conveys all of the septic tank effluent to the Tribe's membrane bioreactor wastewater treatment plant (WWTP) near the Casino for treatment and discharge to an adjacent drainfield as shown in Figure 3-1.

Septic tank effluent from the Lower Reservation is conveyed by 4- to 8-inch diameter PVC gravity sewer pipes to a total of five pump stations. Pump Stations 1 and 2 were constructed in 1996 and have not been significantly upgraded since then.

Pump Station 1 conveys septic tank effluent from the southern end of the Little Boston neighborhood, as well as the Cubby Sparks and Bear Ridge neighborhoods via a 4-inch diameter PVC force main to the gravity sewer in Little Boston Road just south of the Bud Purser neighborhood. This main flows north to Pump Station 2.

Pump Station 2 conveys septic tank effluent from the north end of the Little Boston neighborhood, the Tribal Administration Campus and the Bud Purser neighborhood, as well as sewage flow from Pump Station 1. The pump station discharges to the gravity sewer at the intersection of Little Boston Road and Boston Lane NE. From here, the effluent flows to the north by gravity to the Main Pump Station.

The Main Pump Station conveys all of the septic tank effluent from Pump Station 2, all of the homes along Boston Lane NE, Senior Housing and the Hood Canal and Kloomachin neighborhoods to the Ravenswood Pump Station. The HUD pump station also pumps the septic tank effluent from the Salmonberries neighborhood to the Ravenswood Pump Station.

The Ravenswood Pump Station was installed in 2017 and pumps flow from the HUD and Main Pump Stations to the WWTP via the Cross-Reservation Force Main.

The Tribe is not subject to state requirements for sewer systems mandated by the Washington State Department of Ecology (Ecology). However, the Tribe intends to meet Ecology's requirements to the maximum extent possible, and these requirements were used in the analysis of the sewer system capacity.

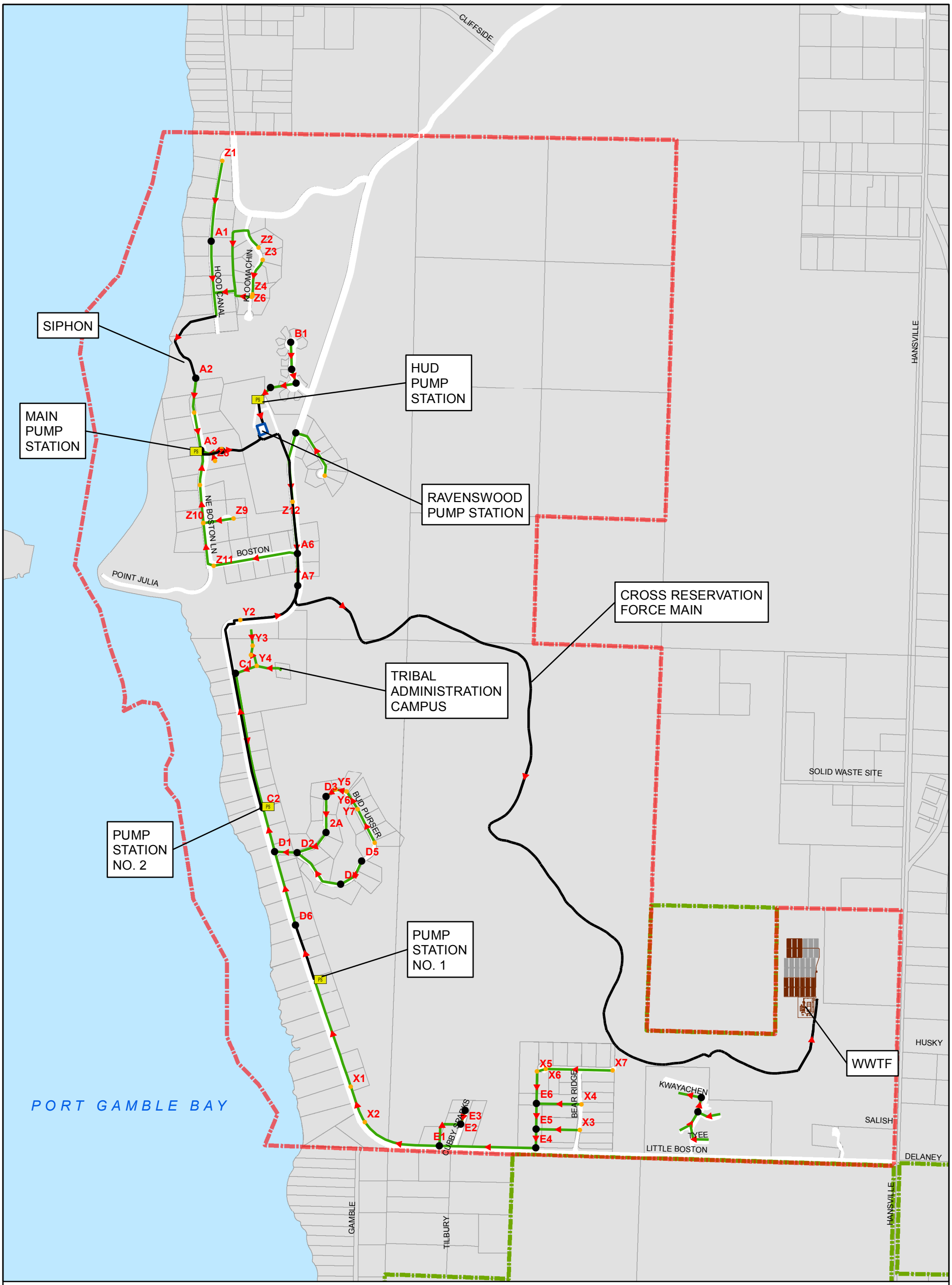
SEWER FLOW RATES

To evaluate the system's capacity to provide sewer service to the proposed Natural Resources Department building and Justice Center building, peak hourly sewage flow rates were determined.

Base sewage flow rates were estimated using the peak water use estimate determined in Chapter 2. Typically, 80 to 100 percent of winter water consumption will enter the sewer system. For the purpose of this evaluation, it is conservatively assumed that approximately 95 percent of winter water use is discharged to the sewer system. The resulting peak wastewater flow rate for the proposed buildings is 95 percent of 76 gpm, which equals 72 gpm.

Based on water use data provided by the Tribe for March of 2018 (which was the month with the highest usage between January and May 2018), the water usage for the entire campus is approximately 3,430 gpd. This is multiplied by 95 percent to obtain a wastewater flow of approximately 3,260 gpd. The 2013 Sewer Plan defined one ERU as 171 gpd, so the Campus consists of approximately 19 ERUs.

Peak hour flow for the existing campus, which is used to size sewer collection systems, was calculated by multiplying the total base flow by a diurnal peaking factor plus peak hour infiltration and inflow (I/I). A diurnal peaking factor of 4.0 was used for this calculation, based on guidance in Ecology's 2008 Orange Book for sewer design. As presented in the 2013 Sewer Plan, the peak hour I/I entering the lower reservation collection system is estimated by subtracting the base wastewater flow to the WWTP from the estimated peak hourly flow at the WWTP and is approximately 438 gallons per acre per day. The peak hour I/I per acre is then multiplied by the total acreage served by the proposed sewer system expansion. Table 3-1 shows the wastewater flow rates for the existing Campus.



LEGEND:

- PUMP STATIONS
- CLEANOUT
- MANHOLE
- FORCEMAIN
- GRAVITY
- PORT GAMBLE S'KLALLAM TRIBE RESERVATION BOUNDARY
- BOUNDARY OF LAND PURCHASED BY TRIBE
- PARCELS

N

0 500 1,000 1,500 2,000 Feet

PORT GAMBLE S'KLALLAM TRIBE

CAMPUS DEVELOPMENT UTILITY ANALYSIS
FIGURE 3-1
EXISTING SEWER SYSTEM

Gray & Osborne, Inc.
CONSULTING ENGINEERS

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TABLE 3-1

Existing Campus Wastewater Flow Rates

Base Flow (gpd)(1)	3,260
Number of ERUs(2)	19
Diurnal Peaking Factor(3)	4
Peaked Base Flow (gpd)	13,040
Peak Hour I/I (gpad)(2)	438
Acres	12
Peak Hour I/I (gpd)	5,256
Peak Hour Flow (gpd)	18,296
Peak Hour Flow (gpm)	12.7

(1) From 2018 water use data.
(2) From 2013 Sewer Plan
(3) From the Department of Ecology Orange Book.

The new buildings will significantly increase the peak wastewater flow rate. Assuming the new buildings have a peak wastewater flow of 72 gpm, the total peak hour wastewater flow from the Campus is increased to 85 gpm. Similar to the water analysis, it should be noted that the current flow from the Campus includes sewage from the existing Justice Center and Natural Resources buildings, whose functions will be replaced by the new buildings. Therefore, the total peak hour wastewater flow from the Campus is likely to be slightly less than 85 gpm.

PROPOSED COLLECTION SYSTEM

As discussed previously, the existing Lower Reservation collection system is a small diameter septic tank effluent collection system and the buildings within the campus are served by several septic tanks. As a result, the new buildings will be connected to their own side sewers and septic tanks which will discharge to the existing sewer mains within the Campus. It appears that the new buildings within the Campus will be able to achieve gravity discharge to the sewer main in the same manner as the adjacent existing buildings.

The sewer system layout within the Campus is shown on Figure 3-2. The new 6-inch diameter side sewers will flow to the existing side sewers located to the north of the buildings, within the Campus. An existing septic tank that currently serves the existing Natural Resources building may be used for the new building if the capacity is large enough. A new septic tank will likely be necessary for the Justice Center building, which will connect to the sewer system within the driveway along the eastern edge of the Campus. The minimum recommended slope for a 6-inch side sewer is 2 percent. At this slope, a 6-inch side sewer has capacity for 422 gpm, which is sufficient for the projected flow.

The septic system will be sized and designed by the building engineer when the building design is completed. A preliminary sizing analysis is conducted to provide an estimate of the necessary tank volume required to provide the two buildings with septic systems.

In order to size the septic system, average daily wastewater flows were determined based on guidance from the Department of Health's 2009 Water Design Manual. The manual provides an estimated water demand per employee in an office building. It is assumed that a visitor would use roughly 1/5 of the water demand that an employee would use per day. The Tribe provided estimated counts of employees and average daily visitors for the buildings, which are presented in Table 3-2.

TABLE 3-2

Estimated Employee and Visitor Average Daily Wastewater Flows

	Justice Center	Natural Resources	Water Use per Person (gpd)	Wastewater Flow (gpd)[1]	
				Justice Center	Natural Resources
Employees	14	44	15	200	630
Visitors	35	0	35	100	0
Total				**300**	**630**

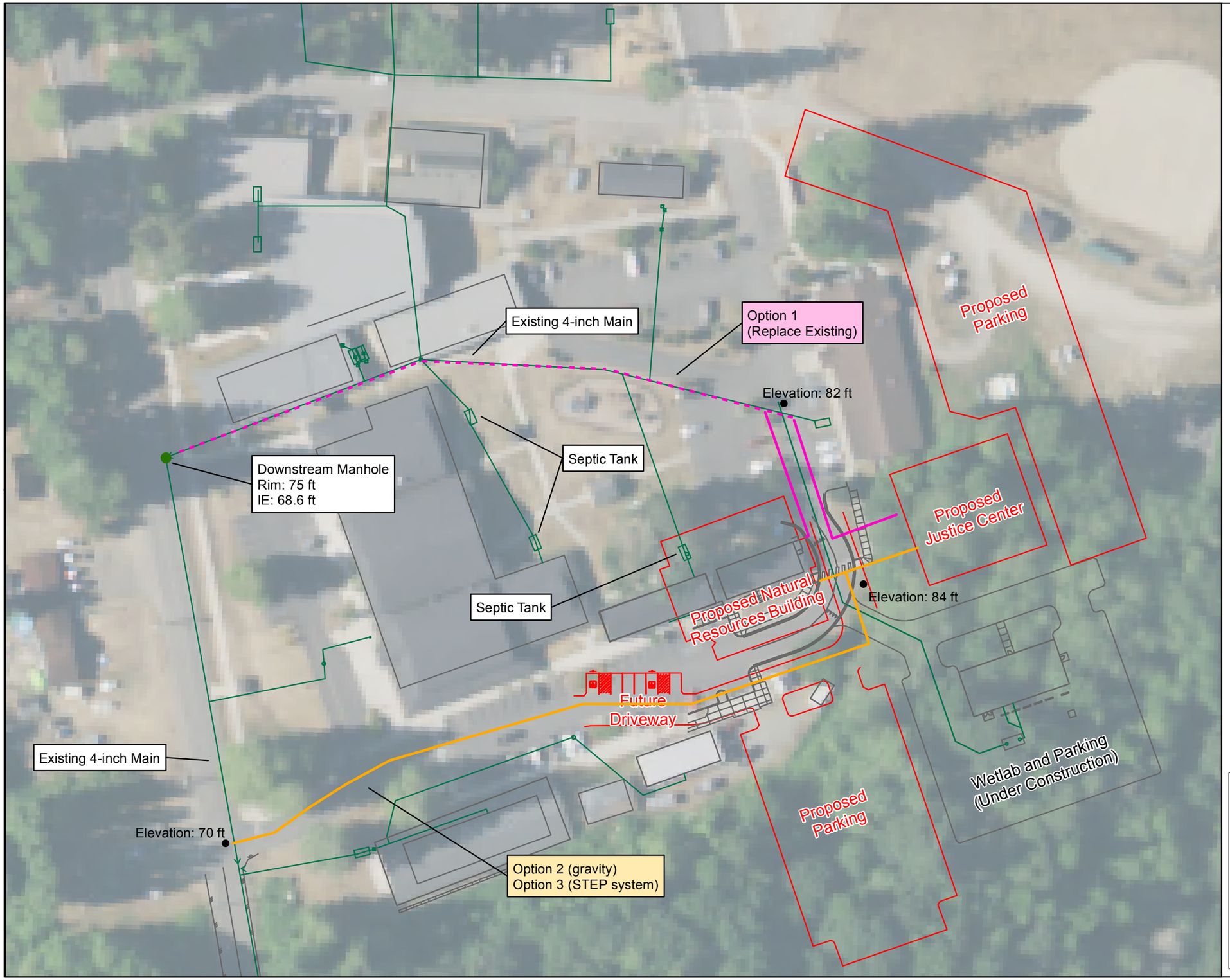
(1) Equal to 95 percent of the water use per person.

EPA guidance from the "Onsite Wastewater Treatment and Disposal Systems Design Manual," (EPA, 1980) indicates that septic tank volume should be approximately equal to two to three times the daily wastewater flow. Using three times as a conservative estimate, the Justice Center would need a septic tank volume of approximately 1,000 gallons, while the Natural Resources Building would require a volume of approximately 2,000 gallons.

EVALUATION OF DOWNSTREAM COLLECTION SYSTEM

Per Ecology guidelines, the gravity sewers should have a minimum of 3 feet of cover. Typically, to facilitate access, the minimum recommended manhole depth is 6 feet. The minimum recommended slope for a gravity sewer main is 0.5 percent, while the recommended slope for a side sewer is 2 percent.

The downstream analysis includes the gravity system extending from the Campus to Pump Station 2. The existing gravity system includes 4-inch diameter sewer mains within the campus, which convey flow to a 4-inch diameter sewer main within Little Boston Road. This main conveys flow to Pump Station 2, located just north of the intersection with Bud Purser Lane. As of 2013, the estimated peak influent flow to this pump station was 57 gpm, per the Sewer Facility Plan. With the addition of the new



LEGEND:

- Sewer Conveyance
- Proposed Development

N

0 50 100 150 200 Feet

PORT GAMBLE S'KLALLAM TRIBE

CAMPUS DEVELOPMENT UTILITY ANALYSIS
FIGURE 3-2
ON-CAMPUS SEWER SYSTEM

Gray & Osborne, Inc.
CONSULTING ENGINEERS

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buildings, the peak flow to the pump station may increase to 129 gpm (57 gpm + 72 gpm).

Per Ecology guidelines, the minimum recommended pipe slopes for side sewers and mains are presented in Table 3-3 below.

TABLE 3-3

Minimum Pipe Slope and Capacity

Pipe Diameter	Slope	Capacity(1)
6-Inch Main	0.5%	211 gpm
8-Inch Main	0.5%	454 gpm
6-Inch Side Sewer	2%	422 gpm
Existing 4-Inch Main	2%	143 gpm

(1) Based on Manning's Equation using a roughness (n) value of 0.011 for PVC pipes.

The rim elevation at the manhole in Little Boston Road is approximately 75 feet, while the pump station is located at an elevation of approximately 44 feet, 31 feet lower. If a consistent slope is assumed over the 1,500-foot length of the conveyance system from the Campus to the pump station, an average slope of 2 percent is achieved. The 4-inch diameter gravity main therefore should have capacity for 143 gpm, as noted in Table 3-3. This is adequate for the existing peak flow in addition to the projected peak flow from the proposed buildings, though the main will be at 90 percent capacity. There are no required improvements to the gravity system outside of the Campus area as a result of the proposed development at this time. However, it is recommended that the 4-inch gravity main within Little Boston Road be increased to an 8-inch main in the future in order to provide better capacity and reliability.

Pump Station 2 has a capacity of 220 gpm. The new buildings within the Campus will increase the flow to the pump station, but the increased peak flow is not expected to exceed the pump station's capacity. No improvements to the pump station will be required as a result of this proposed development.

ALTERNATIVES

OPTION 1 – NORTH ROUTE

Sewage from the new buildings could be collected in septic tanks and conveyed north through a 6-inch side sewer to discharge in the existing sewer line that runs east to west through the campus. This option is indicated with a pink line on Figure 3-2. The existing side sewer line is currently 4 inches in diameter, and it is recommended that the line be replaced with a 6-inch diameter main (pink dashed line). The existing side sewer line discharges to an existing manhole within Little Boston Road, which has a rim elevation

of 74.94 and an invert elevation of 68.54 (6.4-foot drop). This manhole is connected to the existing 4-inch gravity main in Little Boston Road.

The required length of new 6-inch diameter gravity main replacing the existing 4-inch diameter side sewer is approximately 500 feet. With a slope of 0.5 percent, the drop required along this main is 2.5 feet. The ground level drops from 82 feet to 74.94 feet along the pipe alignment, resulting in a drop of 7 feet and a slope of 1.4 percent, so the minimum slope for the new 6-inch diameter main through the Campus can likely be achieved. The new pipe would also need to connect to the existing side sewer connections that flow to the existing 4-inch pipe. The elevations of these side sewers are currently unknown.

The estimated cost of this alternative is $180,000.

OPTION 2 – WEST ROUTE

Sewer service could alternatively be provided by a 6-inch diameter gravity main installed along the alignment of or adjacent to the proposed driveway area, which is located to the southwest of the Natural Resources Building. This is indicated with an orange line on Figure 3-2.

The required length of new 6-inch diameter gravity main is approximately 600 feet. With a slope of 0.5 percent, the drop required along this main is 3 feet. The exact elevation of the pipe within Little Boston Road in this location is unknown; however, the ground elevation drops from 80 feet to 70 feet along the alignment, resulting in a slope of 1.6 percent. Therefore, it should be feasible to maintain the required 0.5 percent slope along a 6-inch main from the building side sewers to the pipe in the road. There are no other side sewers to connect to along this alignment.

The estimated cost of this alternative is $159,600. The cost estimate assumes that the driveway area will be disturbed. If the new main can be installed adjacent to the driveway and less asphalt is disturbed, the cost would be reduced.

OPTION 3 – STEP SYSTEM

This option provides sewer service to the new buildings by a septic tank effluent pumping (STEP) system that includes a 2-inch diameter force main along the new driveway, discharging to the existing 4-inch diameter gravity main within Little Boston Road. The STEP system would serve both buildings through a single septic tank and pumping system. The Wet Lab building, which is currently under construction, is designed to have a STEP system, which flows north to an existing 4-inch diameter side sewer within the campus, as shown on Figure 3-2. If a STEP system is used for the new buildings, it is recommended to direct the force main to the west, discharging to the gravity main in Little Boston Road. This would prevent the need to replace the 4-inch diameter side

sewer within the Campus, routing the increased peak flow directly to the downstream gravity system.

The estimated cost of this alternative is $181,000. The cost estimate assumes that the driveway area will be disturbed. If the new main can be installed adjacent to the driveway and less asphalt is disturbed, the cost would be reduced.

SUMMARY AND RECOMMENDED ALTERNATIVE

TABLE 3-4

Minimum Pipe Slope and Capacity

	Pipe Diameter	Pipe Length	Drop	Connection
Option 1	6-inch	500 feet	2.5 feet	Manhole at Little Boston
Option 2	6-inch	600 feet	3 feet	Direct to Little Boston 4-Inch Gravity
Option 3	2-inch force main	600 feet	N/A	Direct to Little Boston 4-Inch Gravity

The recommended option to provide sewer service to the new buildings is Option 2. As part of the driveway to the south of the proposed buildings will be repaved during construction, this option will result in less additional ground disturbance, as compared to Option 1. Additionally, there are no other side sewers to coordinate along this alignment. The cost of Option 2 is anticipated to be less than the cost of the STEP system in Option 3, and less ongoing maintenance is required.

Based on the capacity analysis, no improvements to the 4-inch gravity main within Little Boston Road are required to accommodate the increase in flow from the proposed buildings. It is recommended that this main be upsized to 8 inches in the future to provide greater capacity and reliability. Pump Station 2 has adequate capacity for the increased flows, so no improvements to the pump station are required.

Cost estimates for the recommended alternatives are provided in Appendix B.

CHAPTER 4

STORMWATER MANAGEMENT

EXISTING STORMWATER CONTROLS

Existing stormwater infrastructure on site includes catch basins and storm drain piping to the north and west of the project site. The existing system north of the proposed Justice Center collects flows from approximately 1 acre of parking area and driveways, as well as some additional flow from approximately 0.25 acres of building roofs. This runoff is directed to a drainage swale located just to the south of the proposed buildings, which also conveys flow from approximately 1 acre of lawn, and 2.3 acres of native forest upslope.

The drainage system located to the west of the project site consists of catch basins, piping, and rain gardens or swales, which collect and convey flows to the west away from the project site. Runoff from a larger portion of the existing Campus area is directed toward this system or to the swales downstream of this system along Little Boston Road. An 18-inch culvert located to the southwest of the Campus crosses below Little Boston Road, conveying runoff to Port Gamble Bay. The existing stormwater infrastructure on site is shown on Figure 4-1.

The off-site runoff from the vegetated area upslope of the site to the east may reach the project area or the existing drainage swale, but this volume is likely to be small, as the native vegetation is anticipated to retain most runoff. Offsite area has been included in the capacity analysis as a measure of conservativeness. The overall basin for the project area is shown on Figure 4-2.

PROPOSED DEVELOPMENT

The proposed development occupies approximately 2 acres of the total parcel. The project site is bordered by native forested areas to the south and east and by existing buildings and paved areas within the Campus to the north and west. Sensitive areas are not known to be present onsite, though a small stream is located approximately 400 feet downslope of the project site to the southwest, which drains to Port Gamble Bay, approximately 500 feet to the west of the site.

The new impervious surface onsite consists of the proposed building roofs and their associated parking areas.

The existing and proposed land cover for the project site is summarized below in Table 4-1.

TABLE 4-1

Existing and Proposed Land Cover

	Existing Area (ac)	Proposed Area (ac)	Change (ac)
Asphalt Roads/Parking	0.758	2.147	1.389
Sidewalks	0.069	0.096	0.030
Roofs	0.189	0.659	0.470
Lawn/Landscaping	0.344	0.390	0.046
Native Vegetation	1.931	0	-1.931
Total	**3.290**	**3.290**	**--**

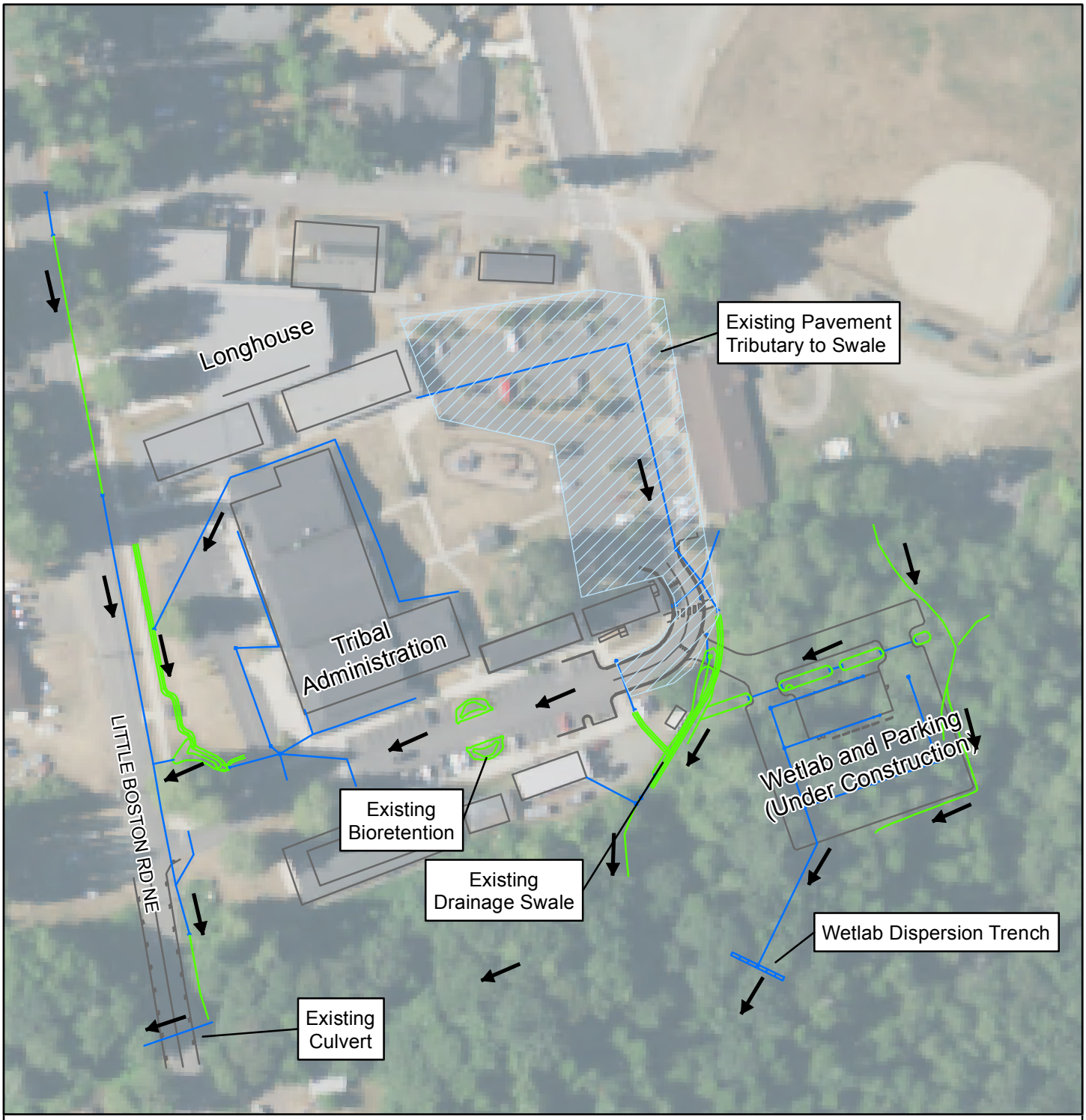
APPLICABLE REQUIREMENTS

The Tribe has not adopted a stormwater management manual at this point, however, the 2014 Department of Ecology Stormwater Management Manual for Western Washington (Manual) was used to develop a stormwater management plan for the new buildings. The Manual includes guidance and best management practices (BMPs) that reflect the latest research into stormwater treatment and detention methods, and following the guidelines of this manual will help to protect downstream receiving water and wildlife habitat. While the Tribe is not beholden to the requirements of the Manual, the Tribe intends to meet the requirements to the maximum extent practical in order to protect the quality of the nearby water bodies.

The Manual includes thresholds to determine the extent of stormwater controls required for new developments and redeveloped sites, as demonstrated on Figure 4-3. The project site qualifies as a redevelopment site under the Manual's definition – a redevelopment site must have 35 percent or greater existing impervious coverage, prior to the proposed site improvements. Of the 12.5-acre parcel, approximately 5 acres are impervious coverage – gravel and paved driveways, rooftops, and other structures. This results in an existing impervious coverage of greater than 35 percent.

The proposed improvements will result in a net addition of approximately 2 acres of impervious land cover. This exceeds the threshold of 5,000 square feet of new impervious land cover. All Minimum Requirements will apply to the new and replaced impervious area onsite. Flow control is recommended for all of the new impervious surfaces, though the proximity of the site to a large waterbody (Port Gamble Bay) may be leveraged if runoff can be discharged directly through a stabilized conveyance system to the bay and downstream properties are not adversely impacted. Treatment is recommended for any new pollution generating impervious surfaces (PGIS).

The total new PGIS includes all of the new or replaced parking and driveway areas – approximately 1.584 acres (1.389 acres new, and 0.195 acres replaced) – which would be subject to the treatment requirement.



LEGEND:

- Ditch/Swale
- Stormwater Conveyance
- Flow Direction

N

0 25 50 100 150 200 Feet

PORT GAMBLE S'KLALLAM TRIBE

CAMPUS DEVELOPMENT UTILITY ANALYSIS
FIGURE 4-1
EXISTING STORM SYSTEM

Gray & Osborne, Inc.
CONSULTING ENGINEERS

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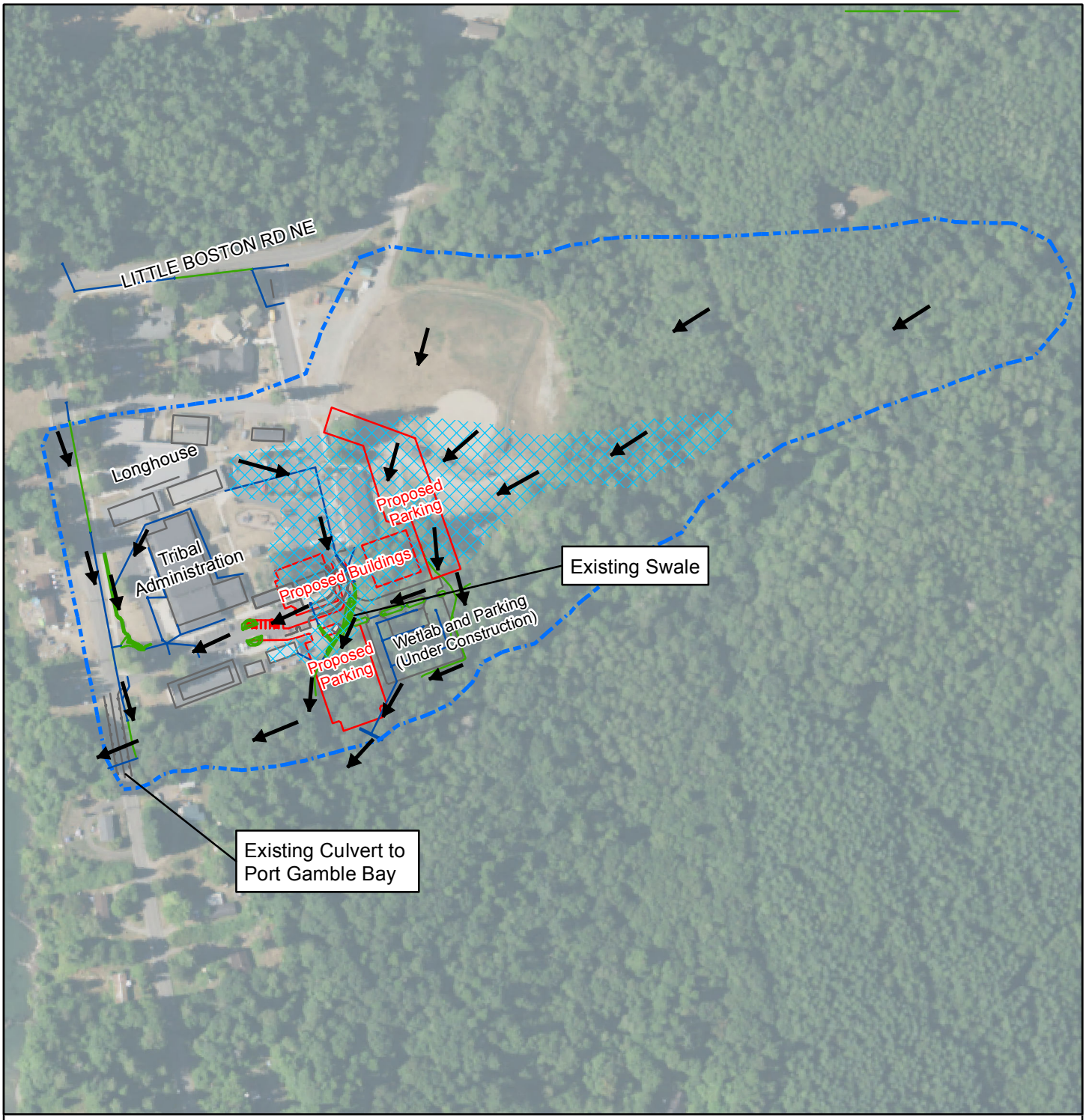

LEGEND:

- Basin Tributary to Existing Drainage Swale
- Basin Tributary to Existing Culvert
- Ditch/Swale
- Stormwater Conveyance
- Flow Direction

N

0 50 100 200 300 400 500 Feet

PORT GAMBLE S'KLALLAM TRIBE

CAMPUS DEVELOPMENT UTILITY ANALYSIS
FIGURE 4-2
OVERALL DRAINAGE BASINS

Gray & Osborne, Inc.
CONSULTING ENGINEERS

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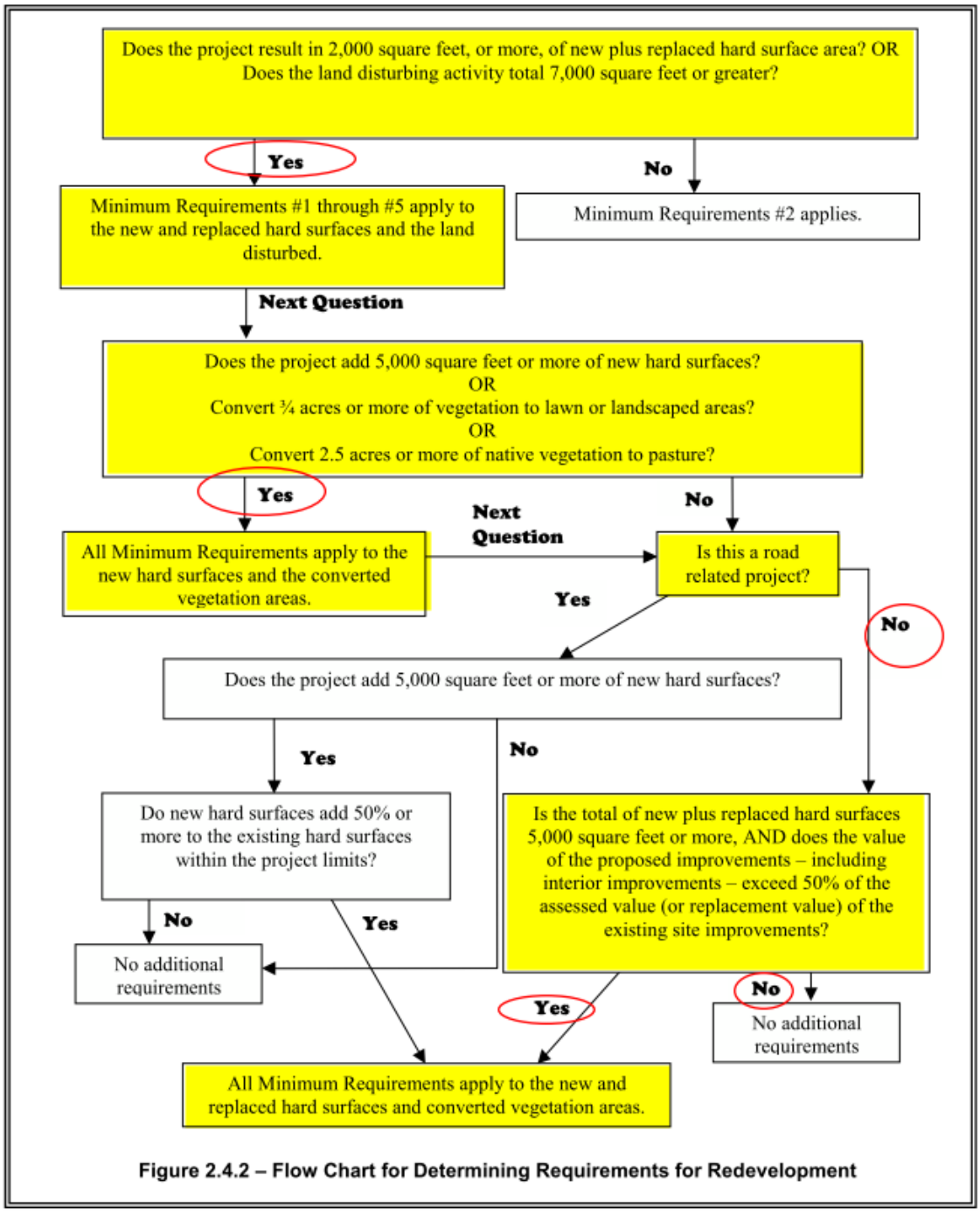


Figure 2.4.2 – Flow Chart for Determining Requirements for Redevelopment

FIGURE 4-3

Minimum Requirements Flow Chart

STORMWATER TREATMENT

The new rooftops and structures do not count as PGIS, and as such are exempt from treatment requirements. The new roadways and parking areas are likely to count as PGIS, depending on how frequently they are used. If any roadways are to be used as occasional maintenance access, without regular daily travel, they may be considered as non-PGIS; otherwise, treatment is required for the new roadways and driveways.

LOW IMPACT DEVELOPMENT STANDARDS

The Manual includes guidelines and requirements for the implementation of low impact development (LID) methods in new project sites. It is recommended that LID BMPs be installed to the extent practicable onsite.

For disturbed lawn and landscape areas, BMP T5.13 Post-Construction Soil Quality and Depth should be met. This entails the installation of 8 inches or more of topsoil with a minimum organic matter content of 10 percent or more and a pH matching that of the native soil. This can be met through mulching or composting.

The preferred BMPs for rooftops include downspout dispersion or downspout infiltration. If sufficient land is available to employ these techniques, they should be considered. The alternative of piping downspout runoff to a downstream swale is acceptable if the volume of runoff from the roofs does not overwhelm the capacity of the downstream conveyance.

The preferred BMPs for stormwater flow control for the other hard surfaces on site (pavement and gravel) include full dispersion, permeable pavement, bioretention and infiltration, or sheet flow dispersion. Due to the saturated nature of the soils in the vicinity of the campus, these are considered infeasible. It is expected that permeable pavement or bioretention would be unable to infiltrate any significant amount of runoff.

It is recommended that runoff be collected, treated, and conveyed to the downstream drainage system that discharges to Port Gamble Bay to prevent ponding within the Campus.

TREATMENT OPTIONS

Biofiltration Swale

Runoff from the new paved access roadways and the Justice Center Parking area could be collected and routed to the existing swale along the south of the site for treatment. The proposed Natural Resources Parking area is situated on top of the existing swale, so using this swale is not an option if this parking area is to be constructed at the same time as the other improvements. This parking area is proposed as a potential future phase.

The size required for the potential treatment swale will depend on site conditions. The required water quality flow rate for the existing parking area, new Justice Center parking area, and associated driveways was determined in Ecology's hydrology modeling program WWHM2012 as 0.203 cfs.

The Manual includes general sizing guidance for treatment swales in Volume 5, Section 9.4. Following these guidelines, an appropriately sized swale for the water quality flow rate would need to have bottom dimensions of approximately 4' by 122', assuming a slope along the length of the swale of 1.5 percent. With side slopes of 3H:1V and a total depth of 1 foot, this would result in top dimensions of 128' by 10'. The swale may be oriented in any direction and does not need to be straight along its length.

Changing any parameter will result in a slightly differently sized swale. The Manual requires a minimum bottom width of 2 feet and a minimum bottom length of 100 feet. Increasing the width would reduce the required length. The Manual also requires side slopes of at least 3H:1V and a longitudinal slope of 1.5 percent to 2.5 percent. Reducing the side slopes or increasing the longitudinal slope would also increase the required length of the swale.

The existing swale has bottom dimensions of 4' by approximately 141', interrupted by a 25-foot long culvert, and is 1-foot deep with 3:1 side slopes. The swale has a slope of 0.5 percent above the culvert, but the channel steepens below the culvert to approximately 4 percent. The existing swale treats and conveys runoff from a total area of 5.59 acres, much of which is non-pollution generating. The length of the swale is sufficient to treat runoff from the new Justice Center Parking area and the existing parking area, as well as surface runoff from the surrounding lawn and building roofs. The Manual requires a minimum slope of 1.5 percent, though the existing swale has a slope of 0.5 percent. The minimum slope is to ensure that the swale drains adequately and that water does not pond within the swale during lower flows. The Tribe has not noticed ponding within this swale, and the existing slope of the swale is likely adequate to drain flows effectively.

Once the future Natural Resources Parking area is completed, it will displace the existing swale. A larger treatment facility will be required to address runoff from all new and existing pavement areas that are tributary to the existing swale. If three separate swales are constructed, the required size of each is included in Table 4-2.

Alternatively, the Natural Resources Parking area could be configured such that the entry driveway includes a bridge over the existing swale, and the swale can be preserved. The Natural Resources Parking area would still require its own treatment area, but the other parking areas could be addressed without additional bioswales.

TABLE 4-2

Biofiltration Swale Sizing

	WQ flow (cfs)	Biofiltration Swale Size (at top of swale)
Justice Parking	0.0971	105' x 7'
Natural Resources Parking	0.0706	101' x 6'
Existing Parking	0.1063	115' x 8'

Bioretention Pond/Rain Garden

Alternatively, runoff from the two parking areas could be managed using separate bioretention treatment systems, one in each location. Bioretention ponds treat runoff using percolation through an engineered soil layer, and runoff can infiltrate to the subgrade or exit the pond through an underdrain that can discharge to the existing conveyance system. The design guidance for this type of facility is included in section BMP T7.30 in the Manual. The bioretention areas were sized using the WWHM, and the area for each facility is included in Table 4-3. Runoff from adjacent non-pollution generating areas should be prevented from reaching the treatment facilities, as they are most efficient when treating concentrated, polluted runoff.

TABLE 4-3

Bioretention Pond Sizing

	Bioretention Pond Area (sqft)(1)
Justice Parking	1,250
Natural Resources Parking	970
Existing Parking	1,390

(1) Assumes a ponding depth of 1 foot and additional freeboard depth of 0.5 feet.

The bioretention facilities can be incorporated into the parking areas as landscape islands, similar to the bioretention facilities that currently exist in the parking area to the south of the existing Natural Resources Building. The potential locations of the three bioretention areas are shown on Figure 4-4. The bioretention facilities for the new parking areas are shown as large islands within the parking lots. These may be divided into smaller islands to provide better access and circulation within the lots, if desired.

FLOW CONTROL

The Manual allows direct discharge to exempt waterbodies in lieu of providing flow control. Port Gamble Bay as a saltwater body is eligible for this exemption, pursuant to the following requirements:

> *"Direct discharge to the exempt receiving water does not result in the diversion of drainage from any perennial stream classified as Types 1, 2, 3, or 4 in the State of Washington Interim Water Typing System, or Types "S", "F", or "Np" in the Permanent Water Typing System, or from any category I, II, or III wetland; and*
>
> *"Flow splitting devices or drainage BMP's are applied to route natural runoff volumes from the project site to any downstream Type 5 stream or category IV wetland:*
>
> > *"Design of flow splitting devices or drainage BMP's will be based on continuous hydrologic modeling analysis. The design will assure that flows delivered to Type 5 stream reaches will approximate, but in no case exceed, durations ranging from 50% of the 2-year to the 50-year peak flow.*
> >
> > *"Flow splitting devices or drainage BMP's that deliver flow to category IV wetlands will also be designed using continuous hydrologic modeling to preserve pre-project wetland hydrologic conditions unless specifically waived or exempted by regulatory agencies with permitting jurisdiction; and*
>
> *"The project site must be drained by a conveyance system that is comprised entirely of manmade conveyance elements (e.g., pipes, ditches, outfall protection, etc.) and extends to the ordinary high water line of the exempt receiving water; and*
>
> *"The conveyance system between the project site and the exempt receiving water shall have sufficient hydraulic capacity to convey discharges from future build-out conditions (under current zoning) of the site, and the existing condition from non-project areas from which runoff is or will be collected; and*
>
> *"Any erodible elements of the manmade conveyance system must be adequately stabilized to prevent erosion under the conditions noted above."*
>
> – Manual Volume I, Section 2.5.7

The downstream conveyance system includes a swale and a culvert. The swale was modeled in XP Storm to determine if the conveyance is adequate for the projected 100-year runoff following development of the site. The 100-year peak flow was determined to be 2.66 cfs using the Santa Barbara Unit Hydrograph method.

TABLE 4-4

Existing and Proposed Flow Rates

	Existing Flow (cfs)	Proposed Flow (cfs)
100-year to Swale	1.46	2.66
100-year to Culvert	15.6	16.9

It does not appear that infiltration would be feasible on site due to the native soil types. Alternatively, detention basins, vaults, or pipes could be used to provide flow control, or native area could be set aside to be used for dispersion.

The existing culvert that crosses Little Boston Road near the southwest corner of the campus currently conveys most of the drainage flow from the southern half of the campus. The culvert is an 18-inch diameter CMP pipe with a slope of 4.6 percent and is capable of conveying approximately 21 cfs.

The existing ditch at the southeast corner of the campus currently has capacity for approximately 3.3 cfs within the 1-foot deep channel. The ditch conveys runoff from the southeast corner of the campus, excluding the new Wet Lab building, as runoff from this area is dispersed to the south of the ditch. The ditch discharges to a natural drainage course, which flows west to the Bay.

If conveyance of the detained runoff extending to the high water mark of Port Gamble Bay cannot be provided, a flow spreader must be installed at the end of the outfall.

ALTERNATIVES

OPTION 1 – EXISTING SWALE AND NEW BIORETENTION PONDS

Option 1 includes bioretention areas to be constructed within each parking area to treat polluted runoff. The existing swale is able to convey and treat runoff from the new Justice Center and Natural Resources buildings, along with the Justice Center parking area, but will be displaced by the Natural Resources parking area. Once the additional Natural Resources parking area is completed, the existing drainage swale will be disturbed and will no longer be available for treatment or conveyance. At this point, treatment will need to be provided for the existing parking and new Justice Center and Natural Resources parking areas. Treatment facilities will need to be installed in each parking area at the time of construction.

If the Natural Resources parking area will not be completed for several years after the new buildings are constructed, the existing drainage swale can be used for conveyance of runoff from the new buildings and the Justice Center parking area. During construction of the parking area, the swale should be replaced with piped conveyance and the drainage systems that flow to the swale should be connected. The new piped conveyance should be 18 inches in diameter at a slope of at least 0.5 percent or 12 inches in diameter at a slope of at least 1 percent in order to convey the tributary flow.

Figure 4-4 indicates the overall size required and possible locations for the bioretention ponds associated with each parking area. The bioretention areas may be split up to treat smaller basins within each parking area, and to better incorporate the facilities into the landscaping plan of the parking areas.

The estimated cost of this option is $297,600. Note that this does not include the cost of installing general stormwater collection and conveyance elements within the parking areas, as the design of the collection system will be completed at a later point. The cost includes the installation of bioretention ponds in three locations, as shown on Figure 4-4, piping and structures associated with these facilities, and piping to replace the existing drainage swale.

OPTION 2 – MAINTAIN EXISTING SWALE

Option 2 involves maintaining the existing drainage swale to treat runoff from the existing parking area and the new Justice Center Parking area. The Natural Resources Parking area will need to be constructed such that it does not displace the existing swale. This would require a bridge over the swale, and will require that the parking area be smaller than the outline shown on Figure 4-4.

Runoff within the new Natural Resources Parking area will be addressed using a bioretention pond within the parking lot, as shown in Figure 4-4.

The estimated cost of this option is $115,200. Note that this does not include the cost of installing general stormwater collection and conveyance elements within the parking areas, as the design of the collection system will be completed at a later point. It also does not include the cost of a bridge over the existing swale, which may be significant. The cost includes the installation of a bioretention pond in the Natural Resources Parking area and piping and structures associated with this facility.

RECOMMENDATION

If the existing drainage swale can be maintained, Option 2 could be used to provide stormwater management for the new buildings. The cost of the stormwater elements is less than in Option 1, but the cost of a bridge to span the existing swale may increase the cost such that the cost of the two options is more comparable.

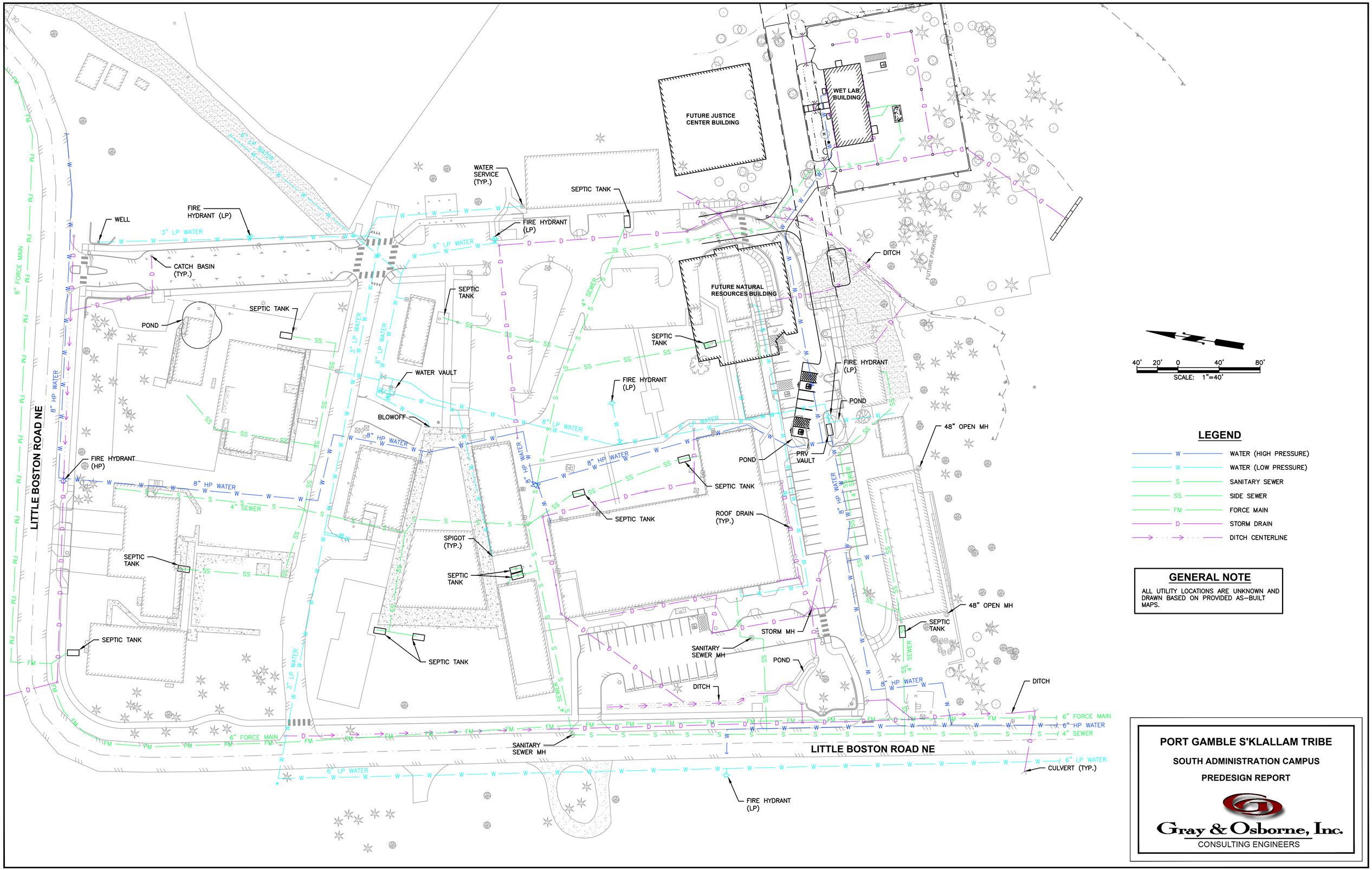
If the Natural Resources Parking area needs to be larger and will displace the existing swale, or if a bridge is too expensive, Option 1 can be used in order to fully provide treatment to all new parking areas and to provide conveyance to the downstream channel that discharges to Port Gamble Bay. Therefore, the selection of stormwater management methods will likely be driven by the site needs and not necessarily by the capacity of the existing system.

No improvements are necessary to the downstream culvert that crosses Little Boston Road, as it appears to have sufficient capacity for the increased flow from the new development.

Cost estimates for the recommended improvements are provided in Appendix B.

APPENDIX A

CAMPUS UTILITY BASE MAP



LEGEND

- W — WATER (HIGH PRESSURE)
- W — WATER (LOW PRESSURE)
- S — SANITARY SEWER
- SS — SIDE SEWER
- FM — FORCE MAIN
- D — STORM DRAIN
- DITCH CENTERLINE

GENERAL NOTE

ALL UTILITY LOCATIONS ARE UNKNOWN AND DRAWN BASED ON PROVIDED AS-BUILT MAPS.

PORT GAMBLE S'KLALLAM TRIBE

SOUTH ADMINISTRATION CAMPUS

PREDESIGN REPORT

Gray & Osborne, Inc.
CONSULTING ENGINEERS

M:\Port Gamble S'klallam Tribe\18478.00 South Admin Campus Utility Design\Planset\XREF\X_BASEMAP-UTILITIES.dwg, 12/18/2018 4:18 PM, KEVIN AGUILAR

APPENDIX B

PRELIMINARY COST ESTIMATES

PORT GAMBLE S'KLALLAM TRIBE
SOUTH ADMIN CAMPUS UTILITY DESIGN
PRELIMINARY CONSTRUCTION COST ESTIMATE - WATER OPTION 1
December 18, 2018

ITEM NO.	ITEM	QUANTITY		UNIT PRICE	AMOUNT
1	Mobilization and Demobilization	1	LS	$ 15,000.00	$ 15,000.00
2	Unexpected Site Changes	1	LS	$ 5,000.00	$ 5,000.00
3	Traffic Control	1	LS	$ 5,000.00	$ 5,000.00
4	Clearing and Grubbing	1	LS	$ 5,000.00	$ 5,000.00
5	Excavation Safety Systems	1	LS	$ 2,500.00	$ 2,500.00
6	Temporary Erosion Control	1	LS	$ 2,500.00	$ 2,500.00
7	Unsuitable Excavation	70	CY	$ 75.00	$ 5,250.00
8	Locate Existing Utilities	1	LS	$ 5,000.00	$ 5,000.00
9	Foundation Gravel	0	TN	$ 45.00	$ -
10	Bank Run Gravel	130	TN	$ 30.00	$ 3,900.00
11	8-inch PVC C900 Water Main Pipe and Fittings (Incl. Bedding)	900	LF	$ 80.00	$ 72,000.00
12	Fire Hydrant Assembly	2	EA	$ 5,000.00	$ 10,000.00
13	8-inch Gate Valves	3	EA	$ 2,000.00	$ 6,000.00
14	Connection to Existing System	2	EA	$ 5,000.00	$ 10,000.00
15	Service Connection	2	EA	$ 2,000.00	$ 4,000.00
16	Asphalt Trench Patch	20	TN	$ 150.00	$ 3,000.00
17	Crushed Surfacing Top Course	10	TN	$ 30.00	$ 300.00
18	Crushed Surfacing Base Course	30	TN	$ 30.00	$ 900.00
19	Cement Concrete Sidewalk	10	SY	$ 40.00	$ 400.00
20	General Restoration	1	LS	$ 2,000.00	$ 2,000.00

Subtotal: ……	$ 158,000.00
Contingency (30%): ……	$ 47,000.00
TOTAL ESTIMATED CONSTRUCTION COST: ……	**$ 205,000.00**
Engineering, Construction Management, and Administration (20%): ……	$ 41,000.00
TOTAL ESTIMATED PROJECT COST: ……	**$ 246,000.00**

PORT GAMBLE S'KLALLAM TRIBE
SOUTH ADMIN CAMPUS UTILITY DESIGN
PRELIMINARY CONSTRUCTION COST ESTIMATE - WATER OPTION 2
December 18, 2018

ITEM NO.	ITEM	QUANTITY		UNIT PRICE	AMOUNT
1	Mobilization and Demobilization	1	LS	$ 20,000.00	$ 20,000.00
2	Unexpected Site Changes	1	LS	$ 5,000.00	$ 5,000.00
3	Traffic Control	1	LS	$ 5,000.00	$ 5,000.00
4	Clearing and Grubbing	1	LS	$ 5,000.00	$ 5,000.00
5	Excavation Safety Systems	1	LS	$ 2,500.00	$ 2,500.00
6	Temporary Erosion Control	1	LS	$ 2,500.00	$ 2,500.00
7	Unsuitable Excavation	80	CY	$ 75.00	$ 6,000.00
8	Locate Existing Utilities	1	LS	$ 5,000.00	$ 5,000.00
9	Foundation Gravel	0	TN	$ 45.00	$ -
10	Bank Run Gravel	140	TN	$ 30.00	$ 4,200.00
11	8-inch PVC C900 Water Main Pipe and Fittings (Incl. Bedding)	1,000	LF	$ 80.00	$ 80,000.00
12	Fire Hydrant Assembly	2	EA	$ 5,000.00	$ 10,000.00
13	8-inch Gate Valves	3	EA	$ 2,000.00	$ 6,000.00
14	Connection to Existing System	2	EA	$ 5,000.00	$ 10,000.00
15	Service Connection	2	EA	$ 2,000.00	$ 4,000.00
16	Asphalt Trench Patch	60	TN	$ 150.00	$ 9,000.00
17	Crushed Surfacing Top Course	40	TN	$ 30.00	$ 1,200.00
18	Crushed Surfacing Base Course	110	TN	$ 30.00	$ 3,300.00
19	Cement Concrete Sidewalk	10	SY	$ 40.00	$ 400.00
20	General Restoration	1	LS	$ 2,000.00	$ 2,000.00

Subtotal: ……	$	181,000.00
Contingency (30%): ……	$	54,000.00
TOTAL ESTIMATED CONSTRUCTION COST: ……	**$**	**235,000.00**
Engineering, Construction Management, and Administration (20%): ……	$	47,000.00
TOTAL ESTIMATED PROJECT COST: ……	**$**	**282,000.00**

PORT GAMBLE S'KLALLAM TRIBE
SOUTH ADMIN CAMPUS UTILITY DESIGN
PRELIMINARY CONSTRUCTION COST ESTIMATE - WATER OPTION 3
December 18, 2018

ITEM NO.	ITEM	QUANTITY		UNIT PRICE	AMOUNT
1	Mobilization and Demobilization	1	LS	$ 10,000.00	$ 10,000.00
2	Unexpected Site Changes	1	LS	$ 5,000.00	$ 5,000.00
3	Traffic Control	1	LS	$ 5,000.00	$ 5,000.00
4	Clearing and Grubbing	1	LS	$ 5,000.00	$ 5,000.00
5	Excavation Safety Systems	1	LS	$ 2,500.00	$ 2,500.00
6	Temporary Erosion Control	1	LS	$ 2,500.00	$ 2,500.00
7	Unsuitable Excavation	30	CY	$ 75.00	$ 2,250.00
8	Locate Existing Utilities	1	LS	$ 5,000.00	$ 5,000.00
9	Foundation Gravel	0	TN	$ 45.00	$ -
10	Bank Run Gravel	50	TN	$ 30.00	$ 1,500.00
11	8-inch PVC C900 Water Main Pipe and Fittings (Incl. Bedding)	300	LF	$ 80.00	$ 24,000.00
12	Fire Hydrant Assembly	1	EA	$ 5,000.00	$ 5,000.00
13	8-inch Gate Valves	2	EA	$ 2,000.00	$ 4,000.00
14	Connection to Existing System	2	EA	$ 5,000.00	$ 10,000.00
15	Service Connection	2	EA	$ 2,000.00	$ 4,000.00
16	Asphalt Trench Patch	10	TN	$ 150.00	$ 1,500.00
17	Crushed Surfacing Top Course	20	TN	$ 30.00	$ 600.00
18	Crushed Surfacing Base Course	40	TN	$ 30.00	$ 1,200.00
19	Cement Concrete Sidewalk	10	SY	$ 40.00	$ 400.00
20	General Restoration	1	LS	$ 2,000.00	$ 2,000.00

Subtotal: ……	$	91,000.00
Contingency (30%): ……	$	27,000.00
TOTAL ESTIMATED CONSTRUCTION COST: ……	**$**	**118,000.00**
Engineering, Construction Management, and Administration (20%): ……	$	23,600.00
TOTAL ESTIMATED PROJECT COST: ……	**$**	**141,600.00**

PORT GAMBLE S'KLALLAM TRIBE
SOUTH ADMIN CAMPUS UTILITY DESIGN
PRELIMINARY CONSTRUCTION COST ESTIMATE - SEWER OPTION 1
December 18, 2018

ITEM NO.	ITEM	QUANTITY		UNIT PRICE	AMOUNT
1	Mobilization and Demobilzation	1	LS	$ 12,000.00	$ 12,000.00
2	Unexpected Site Changes	1	LS	$ 5,000.00	$ 5,000.00
3	Traffic Control	1	LS	$ 5,000.00	$ 5,000.00
4	Clearing and Grubbing	1	LS	$ 2,000.00	$ 2,000.00
5	Excavation Safety Systems	1	LS	$ 2,500.00	$ 2,500.00
6	Temporary Erosion Control	1	LS	$ 2,500.00	$ 2,500.00
7	Unsuitable excavation	60	CY	$ 75.00	$ 4,500.00
8	Locate Existing Utilities	1	LS	$ 5,000.00	$ 5,000.00
9	Foundation Gravel	20	TN	$ 45.00	$ 900.00
10	Bank Run Gravel	210	TN	$ 30.00	$ 6,300.00
11	6-Inch PVC Sanitary Sewer Pipe (Incl. Bedding)	500	LF	$ 50.00	$ 25,000.00
12	6-Inch PVC Sanitary Side Sewer Pipe (Incl. Bedding)	250	LF	$ 50.00	$ 12,500.00
13	Connection to Existing System	2	EA	$ 5,000.00	$ 10,000.00
14	Side Sewer Connection	6	EA	$ 2,000.00	$ 12,000.00
15	Asphalt Trench Patch	10	TN	$ 150.00	$ 1,500.00
16	Crushed Surfacing Top Course	10	TN	$ 30.00	$ 300.00
17	Crushed Surfacing Base Course	20	TN	$ 30.00	$ 600.00
18	Cement Concrete Sidewalk	50	SY	$ 40.00	$ 2,000.00
19	General Restoration	1	LS	$ 5,000.00	$ 5,000.00

Subtotal: ……	$ 115,000.00
Contingency (30%): ……..	$ 35,000.00
TOTAL ESTIMATED CONSTRUCTION COST: ……..	**$ 150,000.00**
Engineering, Construction Management, and Administration (20%): ……	$ 30,000.00
TOTAL ESTIMATED PROJECT COST: ……	**$ 180,000.00**

PORT GAMBLE S'KLALLAM TRIBE
SOUTH ADMIN CAMPUS UTILITY DESIGN
PRELIMINARY CONSTRUCTION COST ESTIMATE - SEWER OPTION 2
December 18, 2018

ITEM NO.	ITEM	QUANTITY		UNIT PRICE	AMOUNT
1	Mobilization and Demobilzation	1	LS	$ 10,000.00	$ 10,000.00
2	Unexpected Site Changes	1	LS	$ 5,000.00	$ 5,000.00
3	Traffic Control	1	LS	$ 5,000.00	$ 5,000.00
4	Clearing and Grubbing	1	LS	$ 2,000.00	$ 2,000.00
5	Excavation Safety Systems	1	LS	$ 2,500.00	$ 2,500.00
6	Temporary Erosion Control	1	LS	$ 2,500.00	$ 2,500.00
7	Unsuitable excavation	60	CY	$ 75.00	$ 4,500.00
8	Locate Existing Utilities	1	LS	$ 5,000.00	$ 5,000.00
9	Foundation Gravel	20	TN	$ 45.00	$ 900.00
10	Bank Run Gravel	200	TN	$ 30.00	$ 6,000.00
11	6-Inch PVC Sanitary Sewer Pipe (Incl. Bedding)	600	LF	$ 50.00	$ 30,000.00
12	6-Inch PVC Sanitary Side Sewer Pipe (Incl. Bedding)	100	LF	$ 50.00	$ 5,000.00
13	Connection to Existing System	2	EA	$ 5,000.00	$ 10,000.00
14	Side Sewer Connection	2	EA	$ 2,000.00	$ 4,000.00
15	Asphalt Trench Patch	30	TN	$ 150.00	$ 4,500.00
16	Crushed Surfacing Top Course	20	TN	$ 30.00	$ 600.00
17	Crushed Surfacing Base Course	60	TN	$ 30.00	$ 1,800.00
18	Cement Concrete Sidewalk	10	SY	$ 40.00	$ 400.00
19	General Restoration	1	LS	$ 2,000.00	$ 2,000.00

Subtotal: ……	$ 102,000.00
Contingency (30%): ……..	$ 31,000.00
TOTAL ESTIMATED CONSTRUCTION COST: ……	**$ 133,000.00**
Engineering, Construction Management, and Administration (20%): …….	$ 26,600.00
TOTAL ESTIMATED PROJECT COST: ……	**$ 159,600.00**

PORT GAMBLE S'KLALLAM TRIBE
SOUTH ADMIN CAMPUS UTILITY DESIGN
PRELIMINARY CONSTRUCTION COST ESTIMATE - SEWER OPTION 3
December 18, 2018

ITEM NO.	ITEM	QUANTITY		UNIT PRICE	AMOUNT
1	Mobilization and Demobilzation	1	LS	$ 12,000.00	$ 12,000.00
2	Unexpected Site Changes	1	LS	$ 5,000.00	$ 5,000.00
3	Traffic Control	1	LS	$ 5,000.00	$ 5,000.00
4	Clearing and Grubbing	1	LS	$ 2,000.00	$ 2,000.00
5	Excavation Safety Systems	1	LS	$ 2,500.00	$ 2,500.00
6	Temporary Erosion Control	1	LS	$ 2,500.00	$ 2,500.00
7	Unsuitable excavation	60	CY	$ 75.00	$ 4,500.00
8	Locate Existing Utilities	1	LS	$ 5,000.00	$ 5,000.00
9	Foundation Gravel	20	TN	$ 45.00	$ 900.00
10	Bank Run Gravel	200	TN	$ 30.00	$ 6,000.00
11	2-Inch Low Pressure Force Main	600	LF	$ 45.00	$ 27,000.00
12	6-Inch PVC Sanitary Side Sewer Pipe (Incl. Bedding)	100	LF	$ 50.00	$ 5,000.00
13	Connection to Existing System	2	EA	$ 5,000.00	$ 10,000.00
14	Side Sewer Connection	2	EA	$ 2,000.00	$ 4,000.00
15	STEP Pump System	1	LS	$ 15,000.00	$ 15,000.00
16	Asphalt Trench Patch	30	TN	$ 150.00	$ 4,500.00
17	Crushed Surfacing Top Course	20	TN	$ 30.00	$ 600.00
18	Crushed Surfacing Base Course	60	TN	$ 30.00	$ 1,800.00
19	Cement Concrete Sidewalk	10	SY	$ 40.00	$ 400.00
20	General Restoration	1	LS	$ 2,000.00	$ 2,000.00

Subtotal: ……	$ 116,000.00
Contingency (30%): ……	$ 35,000.00
TOTAL ESTIMATED CONSTRUCTION COST: ……	**$ 151,000.00**
Engineering, Construction Management, and Administration (20%): ……	$ 30,200.00
TOTAL ESTIMATED PROJECT COST: ……	**$ 181,200.00**

PORT GAMBLE S'KLALLAM TRIBE
SOUTH ADMIN CAMPUS UTILITY DESIGN
PRELIMINARY CONSTRUCTION COST ESTIMATE - STORMWATER OPTION 1
December 18, 2018

ITEM NO.	ITEM	QUANTITY		UNIT PRICE	AMOUNT
1	Mobilization and Demobilization	1	LS	$ 20,000.00	$ 20,000.00
2	Unexpected Site Changes	1	LS	$ 5,000.00	$ 5,000.00
3	Traffic Control	1	LS	$ 5,000.00	$ 5,000.00
4	Clearing and Grubbing	1	LS	$ 5,000.00	$ 5,000.00
5	Excavation Safety Systems	1	LS	$ 2,500.00	$ 2,500.00
6	Temporary Erosion Control	1	LS	$ 5,000.00	$ 5,000.00
7	Unsuitable Excavation	10	CY	$ 75.00	$ 750.00
8	Locate Existing Utilities	1	LS	$ 5,000.00	$ 5,000.00
9	Foundation Gravel	10	TN	$ 45.00	$ 450.00
10	Bank Run Gravel	390	TN	$ 30.00	$ 11,700.00
11	12-inch Diam. Storm Pipe (incl. Bedding)	50	LF	$ 70.00	$ 3,500.00
12	8-inch Diam. Perf Storm Pipe (incl. Bedding)	400	LF	$ 60.00	$ 24,000.00
13	18-inch Diam. Storm Pipe (incl. Bedding)	200	LF	$ 80.00	$ 16,000.00
14	Connection to Existing System	2	EA	$ 5,000.00	$ 10,000.00
15	Type 1 Catch Basin	3	EA	$ 2,500.00	$ 7,500.00
16	Type 2 Catch Basin	2	EA	$ 4,000.00	$ 8,000.00
17	Bioretention Soil Mix	210	CY	$ 60.00	$ 12,600.00
18	Bark or Woodchip Mulch	30	CY	$ 50.00	$ 1,500.00
19	Bioretention Area Curb Inlet	25	EA	$ 150.00	$ 3,750.00
20	Bioretention Area Planting	3,610	SQFT	$ 10.00	$ 36,100.00
21	Asphalt Trench Patch	10	TN	$ 150.00	$ 1,500.00
22	Crushed Surfacing Top Course	10	TN	$ 30.00	$ 300.00
23	Crushed Surfacing Base Course	20	TN	$ 30.00	$ 600.00
24	Cement Concrete Sidewalk	10	SY	$ 40.00	$ 400.00
25	General Restoration	1	LS	$ 5,000.00	$ 5,000.00

Subtotal: ……	$	191,000.00
Contingency (30%): ……	$	57,000.00
TOTAL ESTIMATED CONSTRUCTION COST: ……	**$**	**248,000.00**
Engineering, Construction Management, and Administration (20%): ……..	$	49,600.00
TOTAL ESTIMATED PROJECT COST: ……	**$**	**297,600.00**

PORT GAMBLE S'KLALLAM TRIBE
SOUTH ADMIN CAMPUS UTILITY DESIGN
PRELIMINARY CONSTRUCTION COST ESTIMATE - STORMWATER OPTION 2
December 18, 2018

ITEM NO.	ITEM	QUANTITY		UNIT PRICE	AMOUNT
1	Mobilization and Demobilization	1	LS	$ 10,000.00	$ 10,000.00
2	Unexpected Site Changes	1	LS	$ 5,000.00	$ 5,000.00
3	Traffic Control	1	LS	$ 2,500.00	$ 2,500.00
4	Clearing and Grubbing	1	LS	$ 2,500.00	$ 2,500.00
5	Excavation Safety Systems	1	LS	$ 2,500.00	$ 2,500.00
6	Temporary Erosion Control	1	LS	$ 2,500.00	$ 2,500.00
7	Unsuitable Excavation	10	CY	$ 75.00	$ 750.00
8	Locate Existing Utilities	1	LS	$ 5,000.00	$ 5,000.00
9	Foundation Gravel	10	TN	$ 45.00	$ 450.00
10	Bank Run Gravel	100	TN	$ 30.00	$ 3,000.00
11	12-inch Diam. Storm Pipe (incl. Bedding)	50	LF	$ 70.00	$ 3,500.00
12	8-inch Diam. Perf Storm Pipe (incl. Bedding)	110	LF	$ 60.00	$ 6,600.00
13	Type 1 Catch Basin	1	EA	$ 2,500.00	$ 2,500.00
14	Type 2 Catch Basin	1	EA	$ 4,000.00	$ 4,000.00
15	Bioretention Soil Mix	60	CY	$ 60.00	$ 3,600.00
16	Bark or Woodchip Mulch	10	CY	$ 50.00	$ 500.00
17	Bioretention Area Curb Inlet	8	EA	$ 150.00	$ 1,200.00
18	Bioretention Area Planting	1,000	SQFT	$ 10.00	$ 10,000.00
19	Asphalt Trench Patch	10	TN	$ 120.00	$ 1,200.00
20	Crushed Surfacing Top Course	10	TN	$ 30.00	$ 300.00
21	Crushed Surfacing Base Course	20	TN	$ 30.00	$ 600.00
22	Cement Concrete Sidewalk	10	SY	$ 40.00	$ 400.00
23	General Restoration	1	LS	$ 5,000.00	$ 5,000.00

Subtotal: ……	$	74,000.00
Contingency (30%): ……..	$	22,000.00
TOTAL ESTIMATED CONSTRUCTION COST: ……	**$**	**96,000.00**
Engineering, Construction Management, and Administration (20%): ……..	$	19,200.00
TOTAL ESTIMATED PROJECT COST: ……	**$**	**115,200.00**

APPENDIX C

2015 UNIFORM PLUMBING CODE
WATER DEMAND GUIDANCE

TABLE A 103.1
WATER SUPPLY FIXTURE UNITS (WSFU) AND MINIMUM FIXTURE BRANCH PIPE SIZES[3]

APPLIANCES, APPURTENANCES, OR FIXTURES[2]	MINIMUM FIXTURE BRANCH PIPE SIZE[1,4] (inches)	PRIVATE	PUBLIC	ASSEMBLY[6]
Bathtub or Combination Bath/Shower (fill)	½	4.0	4.0	–
¾ inch Bathtub Fill Valve	¾	10.0	10.0	–
Bidet	½	1.0	–	–
Clothes Washer	½	4.0	4.0	–
Dental Unit, cuspidor	½	–	1.0	–
Dishwasher, domestic	½	1.5	1.5	–
Drinking Fountain or Water Cooler	½	0.5	0.5	0.75
Hose Bibb	½	2.5	2.5	–
Hose Bibb, each additional[7]	½	1.0	1.0	–
Lavatory	½	1.0	1.0	1.0
Lawn Sprinkler, each head[5]	–	1.0	1.0	–
Mobile Home, each (minimum)	–	12.0	–	–
Sinks	–	–	–	–
Bar	½	1.0	2.0	–
Clinical Faucet	½	–	3.0	–
Clinical Flushometer Valve with or without faucet	1	–	8.0	–
Kitchen, domestic	½	1.5	1.5	–
Laundry	½	1.5	1.5	–
Service or Mop Basin	½	1.5	3.0	–
Washup, each set of faucets	½	–	2.0	–
Shower per head	½	2.0	2.0	–
Urinal, 1.0 GPF Flushometer Valve	¾	3.0	4.0	5.0
Urinal, greater than 1.0 GPF Flushometer Valve	¾	4.0	5.0	6.0
Urinal, flush tank	½	2.0	2.0	3.0
Wash Fountain, circular spray	¾	–	4.0	–
Water Closet, 1.6 GPF Gravity Tank	½	2.5	2.5	3.5
Water Closet, 1.6 GPF Flushometer Tank	½	2.5	2.5	3.5
Water Closet, 1.6 GPF Flushometer Valve	1	5.0	5.0	8.0
Water Closet, greater than 1.6 GPF Gravity Tank	½	3.0	5.5	7.0
Water Closet, greater than 1.6 GPF Flushometer Valve	1	7.0	8.0	10.0

For SI units: 1 inch = 25 mm

Notes:

1 Size of the cold branch pipe, or both the hot and cold branch pipes.

2 Appliances, appurtenances, or fixtures not included in this table shall be permitted to be sized by reference to fixtures having a similar flow rate and frequency of use.

3 The listed fixture unit values represent their total load on the cold water building supply. The separate cold water and hot water fixture unit value for fixtures having both cold and hot water connections shall be permitted to each be taken as three-quarters of the listed total value of the fixture.

4 The listed minimum supply branch pipe sizes for individual fixtures are the nominal (I.D.) pipe size.

5 For fixtures or supply connections likely to impose continuous flow demands, determine the required flow in gallons per minute (gpm) (L/s) and add it separately to the demand in gpm (L/s) for the distribution system or portions thereof.

6 Assembly [Public Use (see Table 422.1)].

7 Reduced fixture unit loading for additional hose bibbs is to be used where sizing total building demand and for pipe sizing where more than one hose bibb is supplied by a segment of water distribution pipe. The fixture branch to each hose bibb shall be sized on the basis of 2.5 fixture units.

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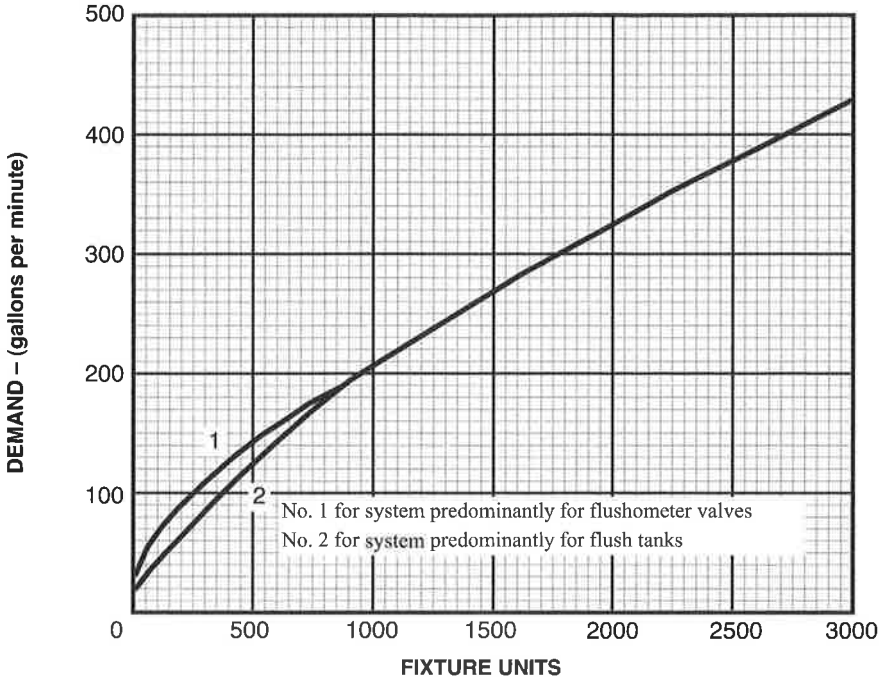
CHART A 103.1(1)
ESTIMATE CURVES FOR DEMAND LOAD



For SI units: 1 gallon per minute = 0.06 L/s

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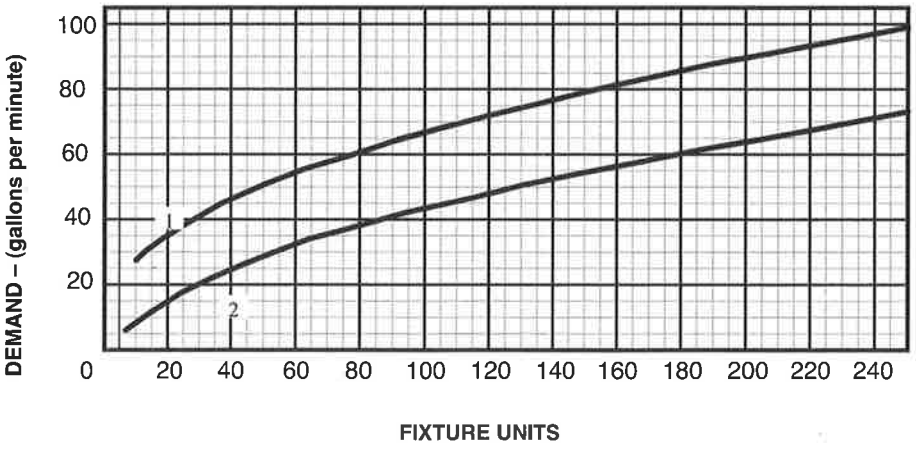
CHART A 103.1(2)
ENLARGED SCALE DEMAND LOAD



For SI units: 1 gallon per minute = 0.06 L/s