ENVIRONMENTAL ASSESSMENT OF PROPOSED GEODUCK HARVEST
ALONG THE SOUTHEASTERN SHORELINE OF THE KITSAP PENINSULA
AT THE ILLAHEE GEODUCK TRACT (#07360)

Commercial geoduck harvest is jointly managed by the Washington Departments of Fish and Wildlife (WDFW) and Natural Resources (DNR) and is coordinated with treaty tribes through harvest management plans. Harvest is conducted by divers from subtidal beds between the -18 foot and -70 foot water depth contours (corrected to mean lower low water, hereafter MLLW). Harvest is rotated throughout Puget Sound in seven geoduck management regions. The fishery, its management, and its environmental impacts are presented in the Puget Sound Commercial Geoduck Fishery Management Plan (DNR & WDFW, 2008) and the Final Supplemental Environmental Impact Statement (WDFW & DNR, 2001). The proposed continued harvest along the southeastern shoreline of the Kitsap Peninsula is described below.

Proposed Harvest Years: 2024-2025

Tract name: Illahee geoduck tract (Tract #07360)

Description: (Figure 1, Tract vicinity map)

The Illahee geoduck tract is a subtidal area of approximately 128 acres (Table 1) along the southeastern shoreline of the Kitsap Peninsula in the South Central Puget Sound Geoduck Management Region.

The Illahee tract is bounded by a line projected along the -18 foot Mean Lower Low Water (MLLW) water depth contour from a control point (CP) at 47°35.606’ N latitude, 122°35.519’ W longitude (CP 1) along the -18 foot (MLLW) water depth contour, northerly to a point on the -18 foot (MLLW) water depth contour at 47°36.010’ N latitude, 122°35.635’ W longitude (CP 2); northerly to a point on the -18 foot (MLLW) water depth contour at 47°36.114’ N latitude, 122°35.703’ W longitude (CP 3); northerly to a point on the -18 foot (MLLW) water depth contour at 47°36.744’ N latitude, 122°35.659’ W longitude (CP 4); then east to a point on the -70 foot (MLLW) water depth contour at 47°36.786’ N latitude, 122°35.469’ W longitude (CP 5); then southerly along the -70 foot (MLLW) water depth contour to a point at 47°36.114’ N latitude, 122°35.555’ W longitude (CP 6); then southerly along the -70 foot (MLLW) water depth contour to a point at 47°36.010’ N latitude, 122°35.558’ W longitude (CP 7); then southerly along the -70 foot (MLLW) water depth contour to a point at 47°35.603’ N latitude, 122°35.451’ W longitude (CP 8); then westerly to the point of origin (Figure 2). These latitude and longitude positons are in WGS84 datum.

This estimate of the tract boundary was made using bathymetry data from the National Oceanic and Atmospheric Administration (NOAA), and the Suquamish Tribe geoduck surveys. All contours are corrected to MLLW. Contour GIS layers from Dale Gombert (WDFW) were generated from NOAA soundings. Shoreline data was from DNR, digitized at 1:24000 scale in 1999. The -70 ft. (MLLW) water depth contour was used for the deep-water boundary, and the -18 ft. contour was used for the shallow boundary. A six acre area near the center of the tract, bounded by control points #2, #3, #6, and #7 (Figure 2), has been removed from the harvest area to ensure that the Illahee Show Plot remains unharvested. No herring spawning habitat was found to be in the vicinity of this tract, therefore the nearshore tract boundary will not be affected by herring spawning habitat. The latitude and longitude positions are reported in decimal minutes to the closest thousandths of a minute. Corner latitude and longitude positions were generated using GIS, and have not been field verified to determine consistency with area estimates, landmark alignments, or water depth contours.

The delineation of the tract boundary will be field verified by DNR prior to any geoduck harvest. Any variance to the stated boundary will be coordinated between WDFW and DNR prior to geoduck harvest.

Substrate:

Geoducks are found in a wide variety of sediments ranging from soft mud to gravel. The most common sediments where geoducks are harvested are sand with varying amounts of mud and/or gravel. The specific sediment type of a bed is primarily determined by water current velocity. Coarse sediments are generally found in areas of fast currents and finer (muddier) sediments in areas of weak currents. The major impact of harvest will be the creation of small holes where the geoducks are removed. The holes fill in within a few days to several weeks and have no long-term effects. The substrate holes refill in areas with strong water currents much faster than in areas with weak water currents. Water currents tend to be moderate and variable in the vicinity of the Illahee tract. In the upcoming year, currents will reach a predicted maximum flood velocity of 5.3 knots and maximum ebb velocity of 5.2 knots (Tides and Currents software; station #1706; Rich Passage West End). Note that although this is the nearest current station to the Illahee tract, the currents are expected to be milder at the tract location northwest of this current station.

Sub-surface substrates were not provided (Table 2). The surface substrates within this tract are mud and sand with mud noted on 31 transects and sand noted on 33 transects, there were 11 transects where both substrates were noted (Table 3).

Water Quality:

Water mixing at this tract is affected by the convergence of currents from Rich Passage and the Puget Sound main basin, which prevents stratification (water layering) and brings deeper nutrient-rich waters to the surface. As a result, the marine waters in this area are well oxygenated and productive. The following data on water quality have been provided from the Washington Department of Ecology (DOE) web site for the Elliot Bay station (ELB 015) at 47.5967° N. latitude; 122.3683° W. longitude. For 2017 (most recently completed data year available), at water depths between 18 and 70 feet, the mean reported dissolved oxygen concentration was 8.1 mg/l with a range from 5.9 mg/l to 12.9 mg/l. The mean salinity at this station in 2017 was 29.1 parts per thousand (ppt) with a range from 26.5 ppt to 30.2 ppt. The mean water temperature at this station in 2017 was 51.8° F with a range from 46.5° F to 58.1° F.

This geoduck tract is classified as "Approved" by DOH. An area classified as "Prohibited" by DOH is westerly and immediately adjacent to the western boundary line of this tract.

Biota:

Geoduck:

The Illahee geoduck tract is approximately 128 acres. The abundance of geoducks on this tract is moderate, with an estimated average density of 0.12 geoducks/sq.ft. This tract contains an estimated 1,941,489 pounds of geoducks (Table 1). On 6 of the 8 dig stations, geoducks are considered commercial quality (Table 2). Digging difficulty ranged from "easy" to "very difficult" to dig.

The average density from the 2021 pre-fishing survey was 0.12 geoducks/sq.ft. The densities ranged from 0.00 on transect #5 to 0.39 on transect #10 (Table 3, Figure 3). The geoducks at the Illahee tract have typical weight, averaging 2.8 pounds, while the average geoduck in Puget Sound is 2.4 pounds. The lowest average whole weight was 1.58 pounds per geoduck at dig station #10 and the highest average whole weight was 3.70 pounds per geoduck at dig station #12 (Table 4). Transect locations, and geoduck counts corrected with siphon "show factors", are listed in Table 5.

Geoducks are managed for long term sustainable harvest. No more than 2.7% of the fishable stocks are harvested (total fishing mortality) each year in each management region throughout Puget Sound. The fishable portion of the total Puget Sound population

includes geoducks that are found in water deeper than -18 feet and shallower than -70 feet (corrected to mean lower low water (MLLW)). Other geoducks which are not harvestable are found inshore and offshore of the harvest areas. Observations in south Puget Sound show that major geoduck populations continue to depths of 360 feet. Additional geoducks exist in polluted areas and are also unavailable for harvest, but continue to spawn and contribute to the total population.

The low rate of harvest is due to geoduck's low rate of natural recruitment. WDFW has studied the regeneration rate of geoducks on certain tracts throughout Puget Sound. The estimated average time to regenerate a tract to its original density, after removal of 65 percent of the geoducks, is 55 years. The recovery time for the Illahee tract is unknown. The research to empirically analyze tract recovery rates is continuing.

Fish:

Geoduck beds are generally devoid of rocky outcroppings and other relief features that attract and support many fish species, such as rockfish and lingcod. On geoduck tracts, the bathymetry is typically relatively flat and the substrate is typically composed of soft sediments, which provide few attachments for macroalgae associated with rockfish and lingcod. The fish observed during the surveys at the Illahee tract were various species of flatfish and sculpins (Table 6).

WDFW marine fish managers were asked of their concerns regarding possible impacts of geoduck fishing on groundfish and baitfish. Greg Bargmann of WDFW stated that geoduck fishing would have no long-term detrimental impacts and may have some short-term benefits to flatfish populations by increasing the availability of food. Dan Penttila of the WDFW Fish Management Program recommended that eelgrass beds within the harvest tract be preserved for any spawning herring.

There are no Pacific herring spawning grounds along the southern shoreline of Bainbridge Island in the vicinity of the Illahee tract (Figure 4). A Pacific herring holding area has been identified east of the Illahee tract. Surf smelt and sand lance spawning have also been identified in the vicinity of the Illahee tract. With a horizontal separation from known forage fish spawning sites and a nearshore geoduck harvest restriction of -18 ft. or deeper, geoduck fishing on the Illahee tract should have no detrimental impacts on herring, surf smelt, or sand lance spawning.

NOAA Fisheries Service announced on April 27, 2010 that it was listing canary and yelloweye rockfish as “threatened” and bocaccio as “endangered” under ESA (federal Endangered Species Act). The listings became effective on July 27, 2010. Historic high

levels of fishing and water quality are cited as reasons that these rockfish populations are in peril and have been slow to recover. On January 23, 2017; canary rockfish were delisted based on newly obtained samples and genetic analysis (Federal Register 82 FR 7711). Geoduck fishery managers are tracking this process and will take actions necessary to reduce the risk of "take" of any listed rockfish species that could potentially result from geoduck harvest activity.

Two salmon populations, Puget Sound Chinook salmon and Hood Canal summer run chum salmon, were listed by the National Marine Fisheries Service on March 16, 1999, as threatened species under ESA. Critical habitat for summer run chum salmon populations includes all marine, estuarine, and river reaches accessible to the listed chum salmon between Dungeness Bay and Hood Canal, as well as within Hood Canal. The timing for summer run chum spawning is early September to mid-October. Out-migration of juveniles has been observed in Hood Canal during February and March, though may occur as late as mid-April. The Illahee tract is outside of the critical habitat range for Hood Canal summer run chum salmon.

Critical habitat for Puget Sound Chinook salmon includes all marine, estuarine and river reaches accessible to listed Chinook salmon in Puget Sound. WDFW recognizes 27 distinct stocks of Chinook salmon; 8 spring-run, 4 summer-run, and 15 summer/fall and fall-run stocks. The existence of an additional five spring-run stocks is in dispute. The majority of Puget Sound Chinook salmon emigrate to the ocean as subyearlings.

Major tributaries in the general vicinity of the Illahee geoduck tract, which support Chinook salmon runs, are the Duwamish Waterway/Green River basin and the Lake Washington basin (mouth at Shilshole Bay; with Cedar River, Issaquah Creek, and north Lake Washington tributaries and sub-basins). Three viable runs of Chinook salmon have been identified in the Duwamish Waterway/Green River basin. The status of the spring run of Chinook salmon in the Duwamish Waterway/Green River basin is extinct. The status of the natural summer/fall run of Chinook salmon in the Duwamish Waterway/Green River basin is mixed native and non-native origin; a composite of wild, cultured, or unknown/unresolved production; and healthy with a 5-year geometric mean for total estimated escapement at 4,889 fish. The timing of the Duwamish River run is uncertain and has a 5-year geometric mean for total estimated escapement at 5,216 fish. The status of the summer/fall run in Newaukum Creek is mixed native and non-native origin; wild production; and healthy (NMFS, Appendix E, TM-35, Chinook Status Review).

The production of the Lake Washington summer/fall run of Chinook salmon is natural with a 5-year geometric mean for total estimated escapement at 557 fish. The status of the

natural Cedar River summer/fall run of Chinook salmon is native origin; wild production; with a 5-year geometric mean for total estimated escapement at 377 fish. The status of the mixed summer/fall run of Chinook salmon in Issaquah Creek is non-native origin; a composite of wild, cultured, or unknown/unresolved production; and healthy. The status of the natural summer/fall run of Chinook salmon in the North Lake Washington tributaries is native origin; wild production; with a 5-year geometric mean for total estimated escapement at 145 fish (NMFS, Appendix E, TM-35, Chinook Status Review).

The geographic separation (horizontal) of this tract from known spawning tributaries and vertical separation of geoduck harvest (deeper and seaward of the -18 ft. MLLW contour) from juvenile salmon rearing areas and migration corridors (upper few meters of the water column) reduces or eliminates potential impacts to salmon populations. Charles Simenstad of the University of Washington School of Fisheries stated that the exclusionary principle of not allowing leasing/harvesting in water shallower than -18 ft. MLLW, the 2+ ft. vertically from elevation of the lower eelgrass margin, and within any regions of documented herring or forage fish spawning should, under most conditions, remove the influences of harvest-induced sediment plumes from migrating salmon. Geoduck harvest should have no impact on salmon populations.

On May 7, 2007, NOAA Fisheries Service announced listing of Puget Sound steelhead as "threatened" under the ESA. This listing includes more than 50 stocks of summer- and winter-run steelhead. Steelhead share many of the same waters as Puget Sound Chinook salmon, which are already protected by the ESA, and will benefit from shared conservation strategies. There are no identified streams or rivers in the vicinity of the southern shoreline of Bainbridge Island that support steelhead stocks. The horizontal separation between tributaries that support steelhead runs and the Illahee tract will ensure that geoduck harvest will likely have no impact on steelhead populations.

Green sturgeon have undergone ESA review in recent years, due to depressed populations. NOAA Fisheries Service produced an updated status review on February 22, 2005, and reaffirmed that the northern green sturgeon Distinct Population Segment (DPS) warranted listing as a Species of Concern, however proposed that the Southern DPS should be listed as threatened under the ESA. NMFS published a final rule on April 7, 2006, listing the southern DPS as threatened (71 FR 17757), which took effect June 6, 2006. The green sturgeon critical habitat proposed for designation includes the outer coast of Washington within 110 meters (m) depth (including Willapa Bay and Grays Harbor) to Cape Flattery and the Strait of Juan de Fuca to its United States boundary. Puget Sound proper has been excluded from this critical habitat designation. The Illahee geoduck tract is outside of the critical habitat range of green sturgeon; therefore geoduck

harvest at this location will have no adverse effects on ESA recovery efforts for green sturgeon populations.

Invertebrates:

Marine invertebrates, which are frequently found on geoduck beds, were also observed on this tract. The most common and obvious of these include: [1] mollusks (geoducks, and horse clams); [2] echinoderms (unspecified sea stars, and ochre sea stars), [3] cnidarians (unspecified anemones, sea pens, and sea whips); [4] arthropods (Dungeness crabs, red rock crabs, hermit crabs, and graceful crabs); and [5] annelid worms (terebellid). Geoduck harvest has not been shown to have long-term adverse effects on these invertebrates. Geoduck harvest may depress some local populations of benthic invertebrates, however most of these populations recover within one year.

WDFW and DNR have studied the effects of geoduck harvest on the population of Dungeness crab at Thorndyke Bay in Hood Canal. The results of 4.6 years of study have shown no adverse effects on crab populations due to geoduck fishing. Dungeness crab were observed on 19 of the 60 transects during the 2021 biological survey. Dungeness crab which are present on the tract may experience peak molt in mid-April, based on data from the Kingston area (Cain, 10/15/01).

To determine the potential impacts to Dungeness crab, the percentage of substrate disturbed during fishing was calculated and compared to the entire crab habitat within the tract and shoreward of the tract, to the +1 ft. level and seaward out to -360 ft. (MLLW) water depth contour (Figure 5, Potential crab habitat map). Dr. Dave Armstrong at the University of Washington has determined that Dungeness crab utilize Puget Sound bottoms from the +1 ft. level out to the -330 ft. level. The entire crab habitat along this tract is approximately 829 acres. There were about 734,184 harvestable geoducks in the entire 134 acre tract, from the 2019/ 2021 pre-fishing survey estimate. With a harvest of 65 percent, the total number harvested would be 477,220 geoducks. Approximately 1.18 square feet of substrate is disturbed for every geoduck harvested, so 477,220 x 1.18 = 563,119 square feet of substrate. This equals about 13 acres. This is about 1.5 percent of the total available crab habitat in the vicinity of this tract. Based on the low amount of disturbance of potential crab habitat in the vicinity of the tract, plus the lack of effects observed at the Thorndyke Bay study, we conclude that any effects on Dungeness crab will be very minor, if they occur at all.

Aquatic Algae:

Large attached aquatic algae are not generally found in geoduck beds in large quantities.

Light restriction often limits algal growth to areas shallower than where most geoduck harvest occurs. Aquatic algae observed during the pre-fishing geoduck survey were identified as "percent cover" instead of identifying individual species. The majority of the tract had little to no algae; the percent algae cover was noted to be 0% on 54 of the 57 transects (Table 7).

John Boettner and Tim Flint, from the WDFW Habitat Division, have stated that as long as geoduck fishing was restricted seaward of the eelgrass beds, they have no concerns about the fishing and that the existing conditions in the fishery SEIS are sufficient to protect fish and wildlife habitat and natural resources. The shallow boundary of geoduck harvest will be set at least two vertical feet seaward of the deepest occurrence of eelgrass to protect all eelgrass along the tract from harvest activities. An eelgrass survey of this tract has yet to be done. However, due to the extremely low percent of algae cover, it is unlikely to be present. Therefore, the geoduck tract nearshore boundary shall be set along the -18 ft. (MLLW) water depth contour.

Marine Mammals:

Several species of marine mammals, including seals, sea lions, and river otters may be observed in the vicinity of this geoduck tract. There have also been sporadic reports of gray whales feeding near Bainbridge Island and rare reports of humpback whales near Bainbridge Island. Killer whales may also be observed in the vicinity of this tract, particularly between November and March. The Southern Resident stock of killer whales resides mainly in the San Juan Islands throughout spring and summer, but incursions south into Puget Sound occur more frequently during winter months (Brent Norberg, NOAA, pers. comm. 5/15/06).

The Southern Resident stock of killer whales was listed as "endangered" under ESA by the National Marine Fisheries Service on November 15, 2005. This is in addition to the designation of this stock in May 2003 as "depleted" under the Marine Mammal Protection Act. More information and a draft conservation plan for this stock can be found at the NOAA website: https://www.fisheries.noaa.gov/action/listing-southern-resident-killer-whale-under-esa.

Hand pick shellfish fisheries, like geoduck harvesting, are considered Category III under the Marine Mammal Authorization Program for Commercial Fisheries. This means that there is a "rare or remote" likelihood of marine mammal "take," (Brent Norberg, NOAA, pers. comm. 5/15/06). Precautions should be taken by commercial divers, when marine mammals are in the area, to be aware of marine mammal movements and behavior to eliminate the remote risk of entanglement with diver hoses and lines.

Birds:

A variety of marine birds are common in Puget Sound and the general vicinity of this tract. The most significant of these are guillemots, murres, murrelets, grebes, loons, scoters, dabbing ducks, black brant, mergansers, buffleheads, cormorants, gulls, and terns. Blue heron, bald eagles, and osprey are also regularly observed. Geoduck harvest does not appear to have any significant effect on these birds or their use of the waters where harvest occurs. A study by DNR and WDFW was conducted at northern Hood Canal to learn the effects of geoduck fishing on bald eagles (Watson et al., 1995). A significant conclusion of this study is that commercial geoduck clam harvest is unlikely to have any adverse impacts on bald eagle productivity.

Other uses:

Adjacent Upland Use:

The upland properties adjacent to the tract are primarily designated as “rural” and “natural” shoreline environmental designations.

To minimize possible disturbance to adjacent residents, harvest vessels are not allowed shoreward of the 200 yards seaward of the ordinary high tide line (OHT). Harvest is allowed only during daylight hours and no harvest is allowed on Saturday, Sunday, or state holidays.

The only visual effect of harvest is the presence of the harvest vessels on the tract. These boats (normally 35-40 feet long) are anchored during harvest and divers conduct all harvest out of sight. Noise from boats, compressors and pumps may not exceed 50 dB measured 200 yards from the noise source, which is 5 dBA below the state noise standard.

Fishing:

The waters around this tract are not prime sport fishing areas, however, some recreational salmon fishing for blackmouth and silvers could occur seasonally in proximity to this geoduck bed. Sport fishing is open year-round for surfperch. Rockfish is closed year-round in this area. Lingcod can only be taken May 1 to June 15 by hook and line or May 21 to June 15 by spearfishing. The WDFW Sport Fishing Rules pamphlet describes additional seasons, size limits, daily limits, specific closed areas, and additional rules for

salmon and other marine fish species. The fishing which does occur should not create any problems for the geoduck harvesting effort in the area.

Geoduck fishing on this tract is managed in coordination with the Central Sound treaty tribes through state/tribal geoduck harvest management plans. The non-Indian geoduck fishery should not be in conflict with any concurrent tribal fisheries.

Navigation:

The Illahee area is used by recreational and commercial vessels traveling in Central Puget Sound, through Rich Passage and Port Orchard. Geoduck harvesting at this site should not result in any significant navigational conflicts. The Washington Department of Natural Resources will notify the local boating community prior to any harvest.

Summary:

Commercial geoduck harvest is proposed for one tract along the southeastern shoreline of the Kitsap Peninsula. The tract was recently surveyed in 2019/ 2021by the Suquamish Tribe. The geoduck biomass estimate for the 128 acre harvest area is 1,941,489 pounds. The commercial tract is presently classified by DOH as “Approved”. The shoreward boundary of the tract will be set along the -18 ft. MLLW water depth contour. The anticipated environmental impacts of this harvest are within the range of conditions discussed in the 2001 Final Supplemental Environmental Impact Statement. No significant impacts are expected from this harvest.

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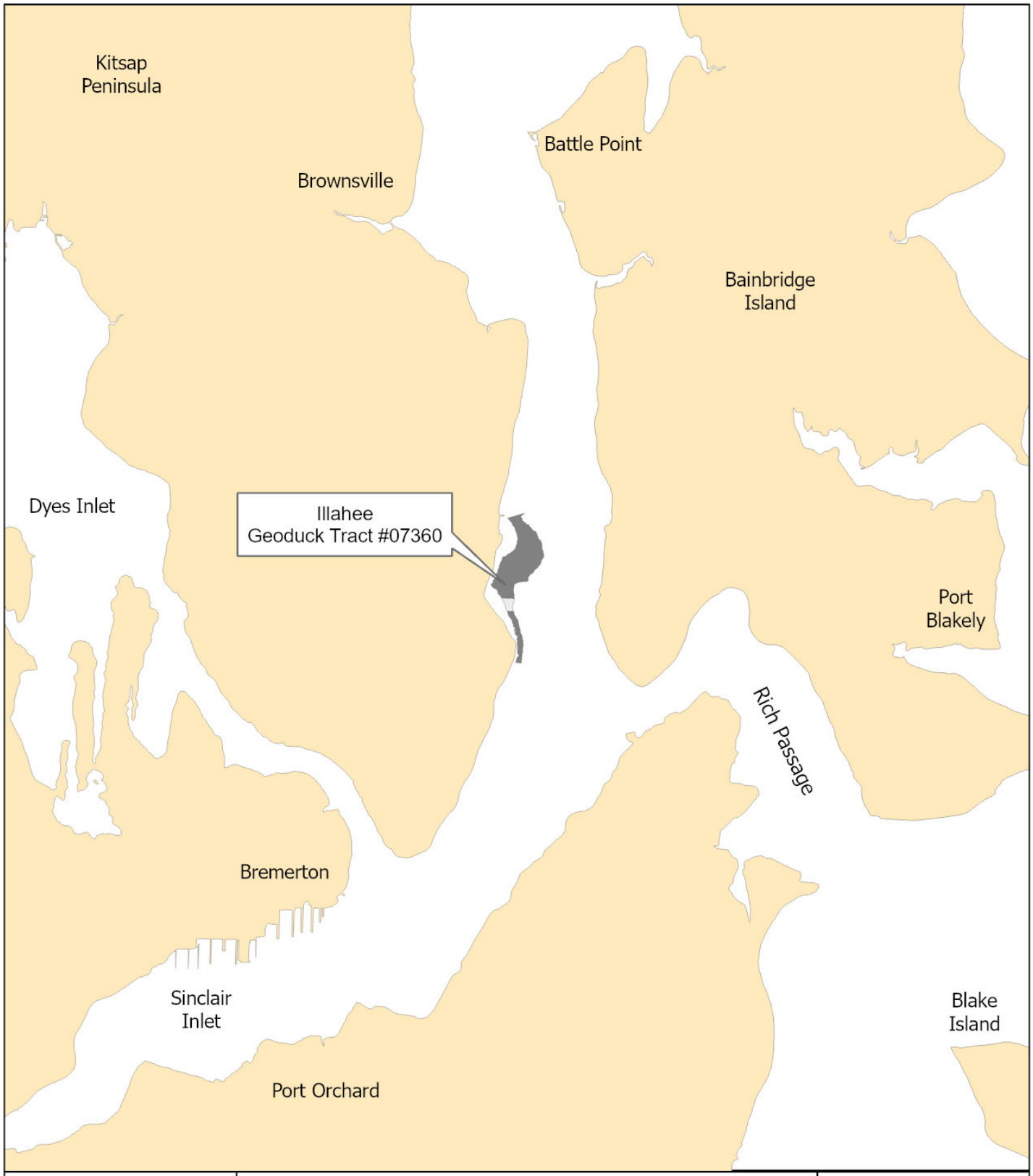
Figure 1. Vicinity Map, Illahee Commercial Geoduck Tract #07360



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1:80,000

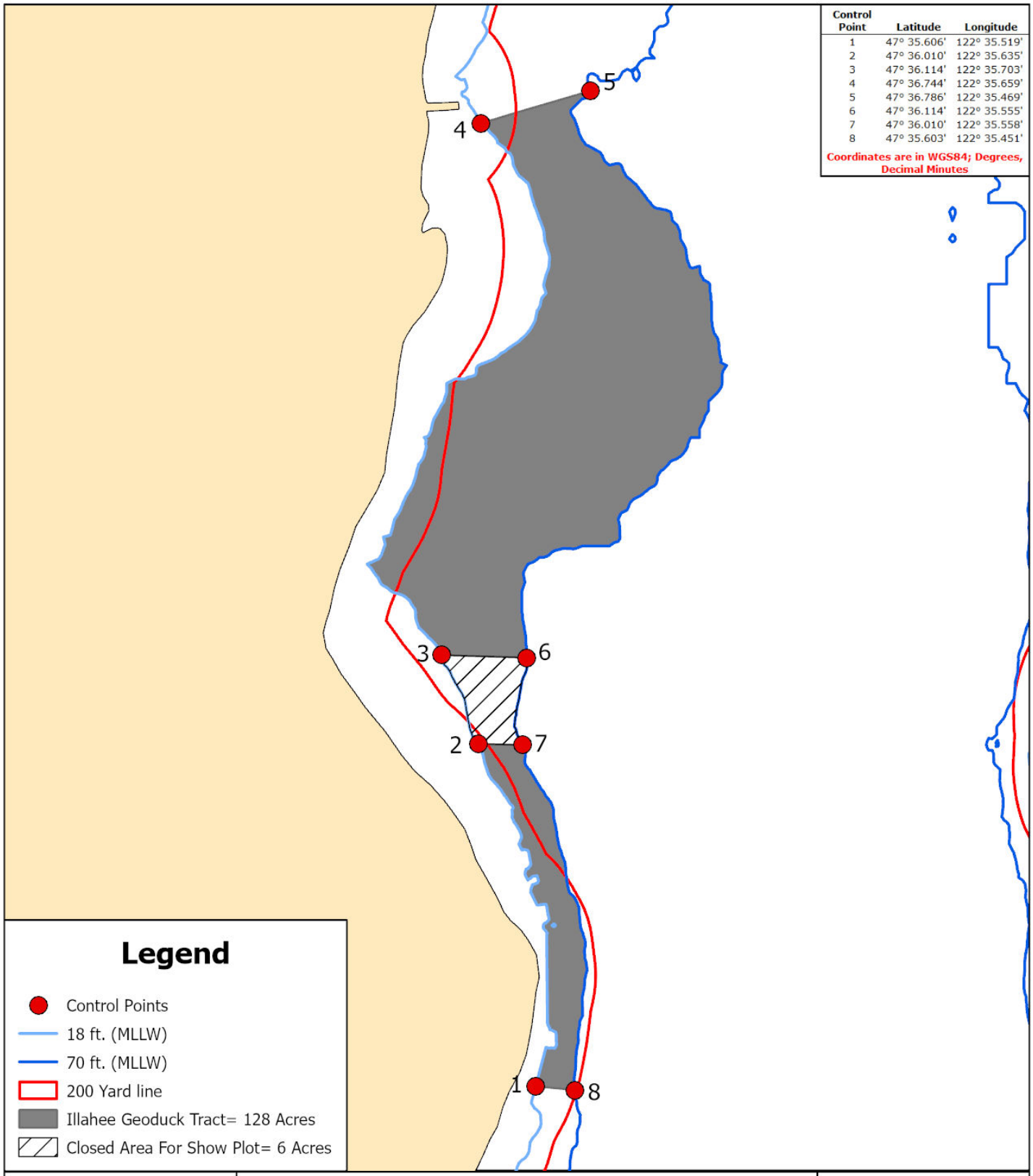
Data Sources:
Projection for data is GCS_Washington Geographic System 1984, Units: Meters. Coastline layer is from DNR, 1: 24,000 scale, created 09-20-99. Contours are from NOAA soundings.

0 0.5 1 2 3 Miles

Washington Department of FISH and WILDLIFE

Map Date: May 24, 2024
Map Author: O. Working
File: Data\Ocean\Geoduck

Figure 2. Control Points Map, Illahee Commercial Geoduck Tract #07360



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1:12,000

Data Sources:
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0 0.07 0.15 0.3 0.45 Miles

Washington Department of FISH and WILDLIFE

Map Date: May 24, 2024
Map Author: O. Working
File: Data\Ocean\Geoduck

Figure 3. Transect and Dig Station Map, Illahee Commercial Geoduck Tract #07360

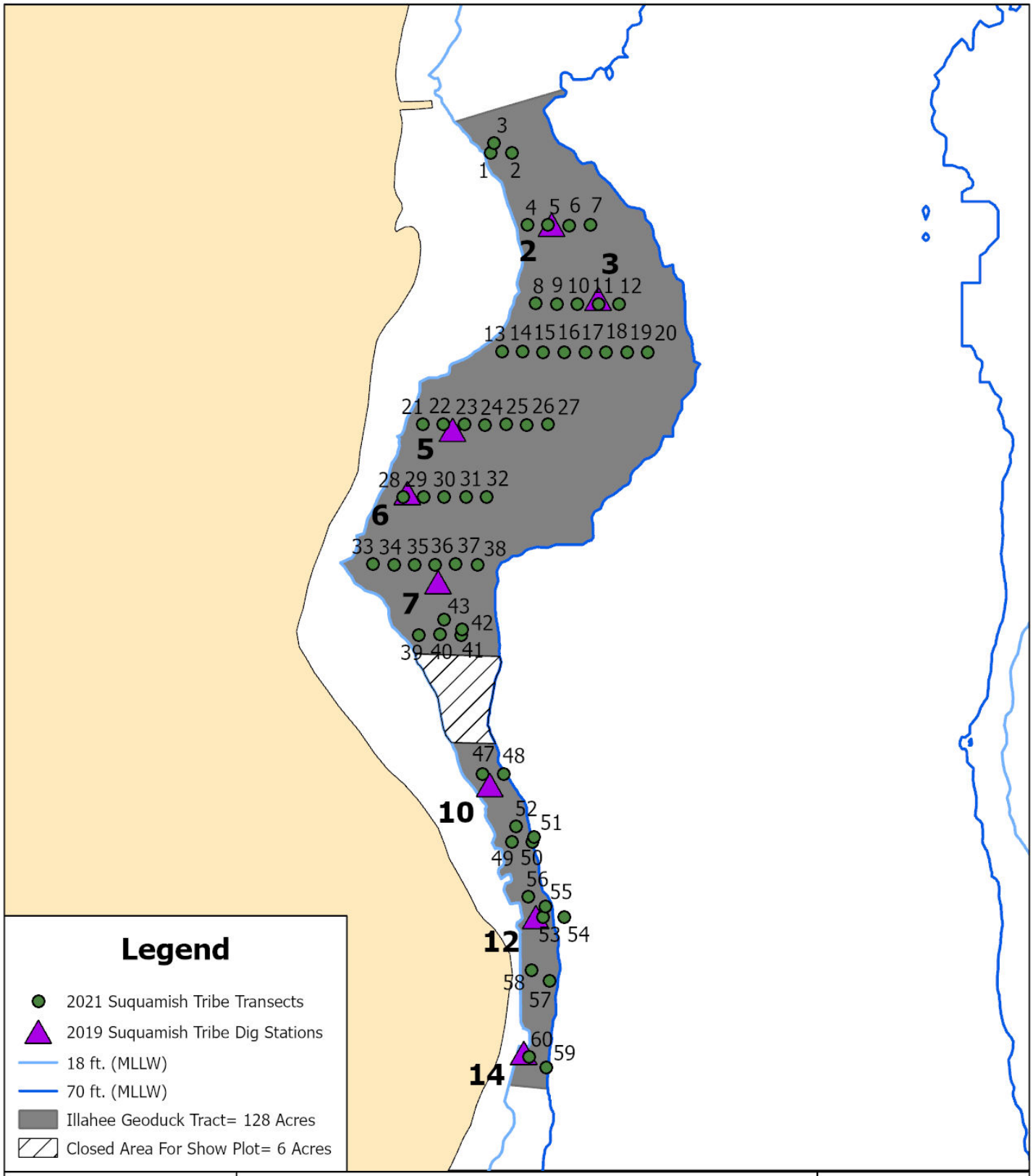


Figure 4. Fish Spawning Areas Near the Illahee Commercial Geoduck Tract #07360

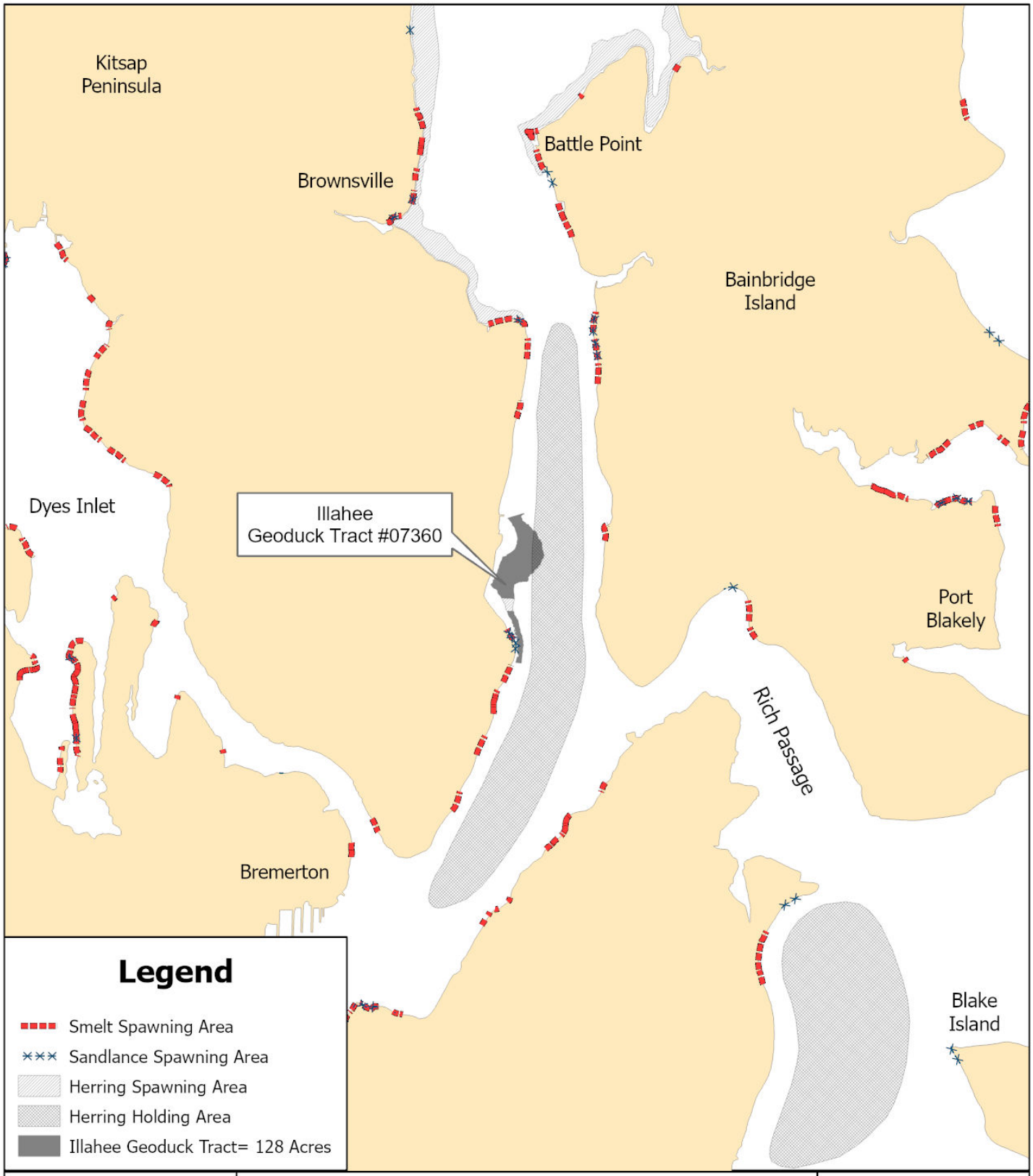
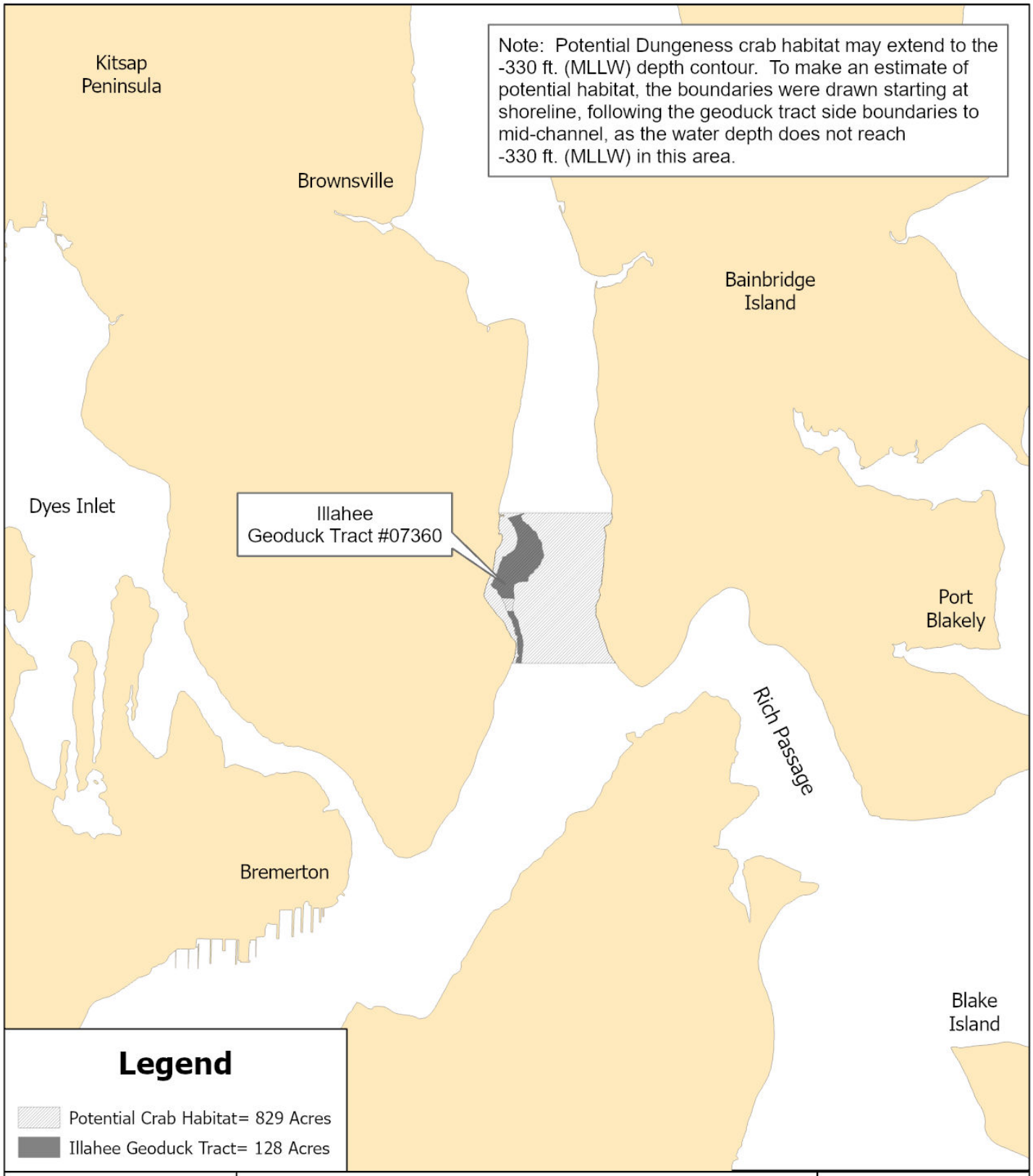


Figure 5. Dungeness Crab Habitat Map, Illahee Commercial Geoduck Tract #07360



EXPLANATION OF SURVEY DATA TABLES

The geoduck survey data for each tract is reported in seven computer-generated tables. These tables contain specific information gathered from transect and dig samples and diver observations. The following is an explanation of the headings and codes used in these tables.

Tract Summary

This table is a general summary of survey information for the geoduck tract including estimates of *Tract Size* in acres, average geoduck *Density* in animals per sq.ft., *Total Tract Biomass* in pounds with statistical confidence, and *Total Number of Geoducks*. Mass estimators are reported in average values for *Whole Weight* and *Siphon Weight* in pounds. Geoduck siphon weights are also reported in *Siphon Weight as a percentage of Whole Weight.* Biomass estimates are adjusted for any harvest that may occur subsequent to the pre-fishing survey.

Digging Difficulty

This table presents a station-by-station evaluation of the factors contributing to the difficulty of digging geoduck samples with a 5/8" inside nozzle diameter water jet. Codes for the overall subjective summary of the digging difficulty are given in the *Difficulty* column. An explanation of the codes for the dig difficulty follows:

Code	Degree of Difficulty	Description
0	Very Easy	Sediment conducive to quick harvest.
1	Easy	Significant barrier in substrate to inhibit digging.
2 or	Some difficulty	Substrate may be compact or contain gravel, shell clay; most geoducks still easy to dig.
3	Difficult	Most geoducks were difficult to dig, but most attempts were successful.
4	Very Difficult	It was laborious to dig each geoduck. Unable to dig some geoducks.
5	Impossible	Divers could not remove geoducks from the substrate.

Abundance refers to the relative geoduck abundance; a zero (0) indicates that geoducks were very sparse, a one (1) indicates that they were moderately abundant and a two (2) indicates that they were very abundant. *Depth* refers to the depth that the geoducks were found in the substrate. A zero (0) indicates that they were shallow, a one (1) indicates that they were moderately deep and a two (2) indicates that they were very deep. The columns labeled *Compact*, *Gravel*, *Shell*, *Turbidity* and *Algae* refer to factors that contribute to digging difficulty by interfering with the digging process. A zero (0) in one of these columns indicates that the factor was not a problem, a one (1) indicates that the

factor caused moderate difficulty and a two (2) indicates that the factor caused a significant amount of difficulty when digging. *Compact* refers to the compact or sticky nature of a muddy substrate. *Gravel* and *Shell* refer to the difficulty caused by these substrate types. *Turbidity* refers to the turbidity within the water near the dig hole caused by the digging activity. High turbidity makes it difficult to find the geoduck siphon shows. The difficulty of digging associated with turbidity varies with the amount of tidal current present. Therefore, the turbidity rating refers only to the conditions occurring when the sample was collected. *Algae* refers to algal cover, which also makes it difficult for the diver to find geoduck siphon shows. Because algal cover varies seasonally, this value only applies to the conditions when the sample was collected. The *Commercial* column gives a subjective assessment of whether or not it would be feasible to harvest geoducks on a commercial basis at the given station.

Transect Water Depths, Geoduck Densities and Substrate Observations

This table reports findings for each transect. *Start Depth* and *End Depth* (corrected to MLLW) are given for each transect. *Geoduck Density* is reported as the average number of geoducks per square foot for each 900 square foot transect. *Substrate Type* and *Substrate Rating* refer to evaluations of the substrate surface. A two (2) rating indicates that the substrate type is predominant. A one (1) rating indicates the substrate type was present.

Geoduck Weights and Proportion Over 2 Pounds

This table summarizes the size and quality of the geoducks at each of the stations where dig samples were collected. Weight values for any geoduck dig samples that were damaged during sampling to the extent that water loss occurred, are excluded from calculations. The *Number Dug* column lists the number of geoducks collected. The *Avg. Whole Weight (lbs.)* column gives the average sample weight of whole geoduck clams for each dig station. The *Avg. Siphon Weight (lbs.)* column gives the average weight of the siphons of the geoducks for each dig station. The percentage of geoducks greater than two pounds is given in the *% Greater than 2 lbs.* column.

Transect - Corrected Geoduck Count and Position Table

This table reports the diver *Corrected Count*, the geoduck siphon *Show Factor* used to correct the count, and the *Latitude/Longitude* position of the start point of each survey transect. Raw (observed) siphon counts are "corrected" by dividing diver observed counts for each transect with a siphon "show" factor (See WDFW Tech. Report FPT00-01 for explanation of show factor) to estimate the sample population density. Transect positions are reported in degrees and decimal minutes to the thousandth of a minute, datum WGS84.

Most Common and Obvious Animals Observed

This table summarizes the animals, other than geoducks, that were observed during the geoduck survey, and reports the total number of transects on which they were present (*# of Transects Where Observed)*. This is qualitative presence/absence data only, and only animals that can be readily seen by divers at or near the surface of the substrate are noted. The *Group* designation allows for the organization of similar species together in the table. Whenever possible, the scientific name of the animal is listed in *Taxonomer*, and a generally accepted *Common Name* is also listed. Many variables may make it difficult for divers to notice other animals on the tract, including but not limited to poor visibility, diver skill, animals fleeing the divers, animal size, or cryptic appearance or behavior (in crevasses or under rocks).

Most Common and Obvious Algae Observed

This table summarizes marine algae observed during the geoduck survey, and reports the total number of transects on which they were seen (*# of Transects Where Observed)*. This is qualitative presence/absence data only, and only for macro algae, with the exception of diatoms. At high densities diatoms form a "layer" on or above the substrate surface that is readily visible and obvious to divers. Other types of phytoplankton are not sampled and are rarely noted. Whenever possible, the scientific name or a general taxonomic grouping of each plant is listed in *Taxonomer*.

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Table 1. GEODUCK TRACT SUMMARY

Illahee geoduck tract # 07360.

Tract Name	Illahee
Tract Number	07360
Tract Size (acres)[a]	128
Density of geoducks/sq.ft[b]	0.123
Total Tract Biomass (lbs.)[b]	1,941,489
Total Number of Geoducks on Tract[b]	688,245
Confidence Interval (%)	21.6%
Mean Geoduck Whole Weight (lbs.)	2.82
Mean Geoduck Siphon Weight (lbs.)[c]	N/A
Siphon Weight as a % of Whole Weight[c]	N/A
Number of 900 sq.ft. Transect Stations	57
Number of Geoducks Weighed	80

a. Tract area is between the -18 ft. and -70 ft. (MLLW) water depth contours. 6 acre area eliminated to maintain the unharvested show plot.

b. Biomass is based on the 2019/2021 Suquamish Tribe Pre-fishing survey.

Table 2. DIGGING DIFFICULTY TABLE

Illahee geoduck tract #07360, 2019 Suquamish Tribe pre-fishing survey.

Dig Station	Difficulty (0-5)	Abundance (0-2)	Depth (0-2)	Compact (0-2)	Gravel (0-2)	Shell (0-2)	Turbidity (0-2)	Algae (0-2)	Commercial (Y/N)
2	1	1	These data were not provided						Y
3	1	2							Y
5	3	1							Y
6	3	0							N
7	4	0							N
10	2	1							Y
12	1	2							Y
14	1	2							Y

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Table 3. TRANSECT WATER DEPTHS, GEODUCK DENSITIES, AND SUBSTRATE OBSERVATIONS

Illahee geoduck tract #07360, 2021 Suquamish Tribe pre-fishing survey.

				Substrate[c]	
Transect	Start Depth (ft.)[a]	End Depth (ft.)[a]	Geoduck Density (no. / sq.ft.) [b]	mud	sand
1	26	45	0.0161	Yes	No
2	45	61	0.0087	Yes	No
3	68	62	0.0025	Yes	No
4	20	44	0.0049	Yes	Yes
5	44	50	0.0012	Yes	No
6	50	51	0.0062	Yes	No
7	51	57	0.0099	No	No
8	20	29	0.1262	No	Yes
9	29	34	0.3427	No	Yes
10	34	42	0.3935	No	Yes
11	42	49	0.2512	Yes	Yes
12	49	63	0.2264	Yes	Yes
13	21	30	0.0908	No	Yes
14	30	30	0.1725	Yes	Yes
15	30	37	0.2462	Yes	Yes
16	37	40	0.2422	Yes	Yes
17	40	52	0.2396	Yes	No
18	52	49	0.0882	Yes	No
19	49	58	0.1215	Yes	No
20	59	63	0.0849	Yes	No
21	23	33	0.0346	No	Yes
22	33	40	0.0519	Yes	Yes
23	41	45	0.0606	Yes	No
24	45	48	0.0470	Yes	No
25	48	54	0.0606	Yes	No
26	54	55	0.0531	Yes	No
27	56	62	0.0371	No	No
28	23	38	0.0669	Yes	Yes
29	38	46	0.0335	Yes	Yes
30	46	48	0.0392	Yes	No
31	48	52	0.0312	Yes	No
32	52	54	0.0196	Yes	No
33	28	39	0.0635	Yes	Yes
34	39	48	0.0542	Yes	No
35	48	51	0.0588	Yes	No
36	51	55	0.0242	Yes	No
37	55	58	0.0254	Yes	No
38	58	66	0.0196	No	No
39	28	35	0.2527	No	Yes
40	35	40	0.2008	No	Yes
41	40	48	0.1535	No	Yes
42	48	60	0.1254	Yes	No
43	59	59	0.0986	No	No
47	26	40	0.2509	No	Yes
48	40	58	0.2010	No	Yes
49	23	50	0.2035	No	Yes
50	51	58	0.2047	No	Yes
51	60	51	0.1261	No	Yes

Table 3. Continued

Transect	Start Depth (ft.)[a]	End Depth (ft.)[a]	Geoduck Density (no. / sq.ft.) [b]	Substrate[c] mud	Substrate[c] sand
52	51	31	0.2197	No	Yes
53	20	55	0.1898	No	Yes
54	55	60	0.1898	No	Yes
55	60	47	0.2260	No	Yes
56	47	31	0.2584	No	Yes
57	21	63	0.1645	No	Yes
58	70	35	0.1788	No	Yes
59	21	64	0.1538	No	Yes
60	64	30	0.1753	No	No

[a.] All depths are corrected to mean lower low water (MLLW)

[b.] Densities were calculated using a daily siphon show factor

[c.] Substrate ratings: Yes = present; No = not observed

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Table 4. GEODUCK SIZE AND QUALITY

Illahee geoduck tract #07360, 2019 Suquamish Tribe pre-fishing survey.

Dig Station	Number Dug	Avg. Whole Weight (lbs.)	Avg. Siphon Weight (lbs.)	% of geoducks on station greater than 2 lbs.
2	10	2.84	N/A*	100%
3	10	2.36	N/A*	70%
5	10	2.59	N/A*	80%
6	10	3.02	N/A*	80%
7	10	2.75	N/A*	100%
10	10	1.58	N/A*	10%
12	10	3.70	N/A*	100%
14	10	3.74	N/A*	100%

*Siphon weights not taken

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Table 5. TRANSECT CORRECTED GEODUCK COUNT AND POSITION TABLE

Illahee geoduck tract #07360, 2021 Suquamish Tribe pre-fishing survey.

Transect	Corrected Count	Show Factor[a]	Latitude[b]	Longitude[b]
1	13	0.898	47° 36.708	122° 35.594
2	7	0.898	47° 36.709	122° 35.557
3	2	0.898	47° 36.721	122° 35.589
4	4	0.898	47° 36.625	122° 35.526
5	1	0.898	47° 36.625	122° 35.490
6	5	0.898	47° 36.625	122° 35.453
7	8	0.898	47° 36.627	122° 35.417
8	102	0.898	47° 36.532	122° 35.509
9	277	0.898	47° 36.532	122° 35.471
10	318	0.898	47° 36.533	122° 35.435
11	203	0.898	47° 36.533	122° 35.398
12	183	0.898	47° 36.534	122° 35.362
13	69	0.844	47° 36.474	122° 35.565
14	131	0.844	47° 36.475	122° 35.529
15	187	0.844	47° 36.475	122° 35.493
16	184	0.844	47° 36.475	122° 35.456
17	182	0.844	47° 36.476	122° 35.419
18	67	0.844	47° 36.476	122° 35.383
19	106	0.969	47° 36.477	122° 35.346
20	74	0.969	47° 36.478	122° 35.311
21	28	0.899	47° 36.385	122° 35.701
22	42	0.899	47° 36.386	122° 35.664
23	49	0.899	47° 36.387	122° 35.627
24	38	0.899	47° 36.387	122° 35.591
25	49	0.899	47° 36.388	122° 35.555
26	43	0.899	47° 36.388	122° 35.518
27	30	0.899	47° 36.389	122° 35.482
28	58	0.963	47° 36.299	122° 35.732
29	29	0.963	47° 36.300	122° 35.695
30	34	0.963	47° 36.300	122° 35.659
31	27	0.963	47° 36.300	122° 35.622
32	17	0.963	47° 36.302	122° 35.585
33	55	0.963	47° 36.218	122° 35.781
34	47	0.963	47° 36.218	122° 35.744
35	51	0.963	47° 36.219	122° 35.707
36	21	0.963	47° 36.220	122° 35.672
37	22	0.963	47° 36.221	122° 35.636
38	17	0.963	47° 36.221	122° 35.598
39	219	0.963	47° 36.136	122° 35.697
40	174	0.963	47° 36.137	122° 35.661
41	133	0.963	47° 36.137	122° 35.623
42	84	0.744	47° 36.144	122° 35.622
43	66	0.744	47° 36.155	122° 35.654
47	201	0.890	47° 35.974	122° 35.579
48	161	0.890	47° 35.974	122° 35.542
49	163	0.890	47° 35.894	122° 35.525
50	164	0.890	47° 35.895	122° 35.489
51	101	0.890	47° 35.900	122° 35.486

Table 5. Continued

Transect	Corrected Count	Show Factor[a]	Latitude[b]	Longitude[b]
52	176	0.890	47° 35.912	122° 35.518
53	152	0.890	47° 35.806	122° 35.467
54	152	0.890	47° 35.807	122° 35.430
55	181	0.890	47° 35.819	122° 35.463
56	207	0.890	47° 35.830	122° 35.494
57	138	0.932	47° 35.731	122° 35.453
58	150	0.932	47° 35.743	122° 35.485
59	129	0.932	47° 35.628	122° 35.454
60	147	0.932	47° 35.640	122° 35.485

[a.] Daily siphon show factor was used to correct geoduck counts
[b.] Latitude and longitude are in degrees and decimal minutes and are in WGS84 datum; not all transect positions were provided.

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Table 6. MOST COMMON AND OBVIOUS ANIMALS OBSERVED

Illahee geoduck tract #07360, 2021 Suquamish Tribe pre-fishing survey.

# of Transects where Observed	Group	Common Name	Taxonomer
3	ANEMONE	ANEMONE	Unspecified anemone
11	BIVALVE	HORSE CLAM	*Tresus spp.*
10	CNIDARIA	SEA PEN	*Ptilosarcus gurneyi*
1	CNIDARIA	SEA WHIP	*Stylatula elongata*
19	CRAB	DUNGENESS CRAB	*Cancer magister*
16	CRAB	RED ROCK CRAB	*Cancer productus*
11	CRAB	GRACEFUL CRAB	*Cancer gracilis*
3	CRAB	HERMIT CRAB	Unspecified hermit crab
4	FISH	SCULPIN	Unspecified Cottidae
9	FISH	FLATFISH	Unspecified flatfish
1	FISH	STARRY FLOUNDER	*Platichthys stellatus*
3	GASTROPOD	NUDIBRANCH	Unspecified nudibranch
1	SEA STAR	SEA STAR	Unspecified sea star
1	SEA STAR	OCHRE STAR	*Pisaster ochraceus*
6	WORM	TEREBELLID TUBE WORM	*Terebellid spp.*

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Table 7. MOST COMMON AND OBVIOUS ALGAE OBSERVED

Illahee geoduck tract #07360, 2021 Suquamish Tribe pre-fishing survey.

# of Transects where observed	Taxonomer

No algae were recorded by species, but visual estimates of percent cover were made. The majority of the tract had little to no algae, and the % algae cover was noted to be 0% on 54 of the 57 transects.

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