ENVIRONMENTAL ASSESSMENT OF PROPOSED GEODUCK HARVEST
ALONG THE NORTHERLY SHORELINES OF HENDERSON INLET
AT THE HENDERSON INLET GEODUCK TRACT (#16150)

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 annual 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 and Final Supplemental Environmental Impact Statement (WDFW & DNR, May 2001). The proposed harvest along the northerly shorelines of Henderson Inlet is described below.

Proposed Harvest Dates: 2023- 2024

Tract name: Henderson Inlet tract (Tract #16150)

Description: (Figure 1, Tract vicinity map)

The Henderson Inlet geoduck tract is a subtidal area of approximately 175 acres (Table 1) along the northeasterly shoreline of Henderson Inlet in the South Puget Sound Geoduck Management Region. The commercial tract area lies between the minus 18 foot and minus 70 foot (MLLW) water depth contours. The southwest edge of the Henderson Inlet tract is contiguous with the Itsami geoduck tract.

The Henderson Inlet geoduck tract is bounded by a line projected southwesterly from a control point (CP) on the -18 foot (MLLW) water depth contour at 47° 10.720’ N. Latitude, 122° 49.056’ W. Longitude (CP 1) along the -18 foot (MLLW) water depth contour to a point at 47° 10.183’ N. Latitude, 122° 49.543’ W. Longitude (CP 2); then westerly to a point on the -70 foot (MLLW) water depth contour at 47° 10.311’ N. Latitude, 122° 49.933’ W. Longitude (CP 3); then westerly to a point on the -18 foot (MLLW) water depth contour on Itsami Ledge at 47° 10.383’ N. Latitude, 122° 50.258’ W. Longitude (CP 4); then north to a point on the -70 foot (MLLW) water depth contour at 47° 10.613’ N. Latitude, 122° 50.258’ W. Longitude (CP 5); then easterly along the -70 foot (MLLW) water depth contour to a point at 47° 10.867’ N. Latitude, 122° 49.062’ W. Longitude (CP 6); then south to the point of origin (Figure 2). All positions are in WGS84 datum.

Commercial harvests on this tract must be within the designated tract boundary polygon described above. Vessels conducting geoduck harvest operations must remain seaward of a line two hundred yards seaward from and parallel to the line of ordinary high tide, to conform with state statute (RCW 77.60.070). Any variance to the stated boundary line

will be coordinated between WDFW and DNR and will be implemented by DNR for commercial geoduck harvests.

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 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 can be strong in the vicinity of the Henderson Inlet tract. Currents reach an estimated average flood velocity of 1.5 knots and an estimated average ebb velocity of 2.2 knots (Tides and Currents software; station #1846; Dana Passage).

Sub-surface substrates observed during collection of geoduck dig samples include gravel and shell, and characteristics include “compact” (Table 2). The surface substrates within this tract are highly variable with mud predominant on 52 of 72 transects. Sand was predominant on 19 of 72 transects. Shell, cobble, and gravel were also regularly encountered. (Table 3).

Water Quality:

Water quality is good at the Henderson Inlet tract. Water at this tract is affected by strong water currents and turbulence of Dana Passage, which prevents stratification (water layering) and brings deeper, nutrient-rich waters to the surface. As a result, the water quality in this area is high. At a WA Dept. of Ecology water quality station in Henderson Inlet (HND001- Henderson Inlet-Cliff Point), the minimum dissolved oxygen (D.O.) concentration reported between 10/5/92 and 12/18/2006 (most recent data year completed) from a water depth range of 9-11 meters was 4.2 mg/L, with an average D.O. of 7.98 mg/L. D.O. concentrations below 3.0 mg/L for extended periods may cause stress in marine organisms. Maximum water temperatures at this water depth range and within this time frame varied between 6.85 to15.33º C. The acidity at this water depth range and within this time frame varied between a pH of 7.6 to 8.8.

The harvest area within the tract boundary polygon is classified as “Approved” by the Washington Department of Health (DOH) for commercial shellfish harvest. This area has been tested for inorganic arsenic levels (Jerry Borchert, DOH, pers. comm., 7/10/14) and this tract is not currently on the list of approved tracts for exportation of geoducks to China. DNR will verify the health status of the Henderson Inlet tract prior to any state managed commercial geoduck harvest on this tract.

Biota:

Geoduck:

The Henderson Inlet geoduck tract is approximately 175 acres and currently contains an estimated 2,847,544 pounds of geoducks after subtracting harvest of 380 pounds of geoduck from the 2022 pre-fishing biomass estimate (Table 1). This harvest consisted of dig samples for the biomass estimate and test harvest. Geoducks are considered commercial quality on all but one of the dig stations (Table 2). Six geoduck dig stations were rated “easy” to dig. The other dig stations were rated as having “some difficulty” to being “very difficult” to dig. Shell and substrate compactness, low abundance, depth in the substrate, and turbidity were listed as factors that hindered digging.

The geoduck density on this tract is moderate and currently estimated to be 0.133 geoducks/sq.ft. The density on the pre-fishing survey ranged from 0.000 geoducks/sq.ft. on transects 1 and 2 to 0.523 geoducks/sq.ft. on transect 59 (Figure 3, Table 3, Table 4). The weight of geoducks at the Henderson Inlet tract are moderate for Puget Sound, averaging 2.81 pounds. The lowest average whole weight is 2.23 pounds per geoduck at station #12 and the highest average whole weight is 3.31 pounds per geoduck at station #4 (Table 5).

The majority of the dig stations were completed by the Squaxin Tribe in 2014-2015. The pre-fishing survey was then done by WDFW in 2022, at which time two additional dig stations were completed in order to encompass the western part of the tract. 380 pounds were harvested from the tract in 2022 for dig samples and test harvest.

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 for non-Indian harvesters 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 Henderson Inlet 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. The bottoms are relatively flat and composed of soft sediments which provide few attachments for macroalgae, which is also associated with rockfish and lingcod. The fish observed during the survey at the Henderson Inlet tract were snake prickleback, and various species of flatfish, sanddab, sculpin, gadid, eelpout and goby.

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 should be preserved for spawning herring.

No eelgrass was observed along this tract below a depth of -16 feet (MLLW) during the 2022 WDFW eelgrass survey. The Henderson Inlet nearshore tract boundary will be along the -18 foot (MLLW) water depth contour to provide year-round protection to Pacific herring spawning habitat, and to provide a vertical buffer between eelgrass beds and geoduck harvest.

There are no Pacific herring spawning grounds documented along the shorelines of Henderson Inlet or in the vicinity of the Henderson Inlet tract. A herring spawning holding area has been identified easterly of the tract in the vicinity of Johnson Point (Figure 4). Geoduck fishing on the Henderson Inlet tract should have no detrimental impacts on herring spawning.

NOAA Fisheries Service announced on April 27, 2010, that it was listing canary and yellow eye rockfish as “threatened” and bocaccio as “endangered” under the federal Endangered Species Act (ESA). The listings became effective on July 27, 2010. Historic high levels of fishing and poor water quality are cited as reasons that these rockfish populations are in peril and have been slow to recover. 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 the federal Endangered Species Act. 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, and 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 out-migration may be as late as mid-April. The Henderson Inlet 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 sub-yearlings.

Streams or tributaries near the Henderson Inlet geoduck tract are McAllister Creek and Nisqually River (approximately 8 miles from the tract), and Chambers Creek (approximately 16 miles from the tract). Two runs of Chinook salmon have been identified in the Nisqually River basin. The status of the spring/summer run of Chinook salmon in the Nisqually River basin is extinct (NMFS, Appendix E, TM-35, Chinook Status Review). The status of the natural summer/fall run of Chinook salmon in the Nisqually 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 699 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 foot 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 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 ESA, and will benefit from shared conservation strategies. There are no identified streams or rivers in the vicinity of Henderson Inlet that support steelhead stocks. The horizontal separation between tributaries that support steelhead runs and the Henderson Inlet 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 [pdf] (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 Henderson Inlet geoduck tract is outside of the critical habitat range of green sturgeon and geoduck harvest at this location will have no adverse effects on ESA recovery efforts for green sturgeon populations.

Invertebrates:

Many different kinds of invertebrates frequently found on geoduck beds were observed on this tract, including anemones, bivalves, cnidarians, crab, shrimp, echinoderms, gastropods, nudibranchs, sea stars, crustaceans, urchin, and annelid worms (Table 6). Geoduck harvest has not been shown to have long-term adverse effects on these invertebrates. Geoduck harvest can depress populations of some benthic invertebrates, however most of these animals recover within one year.

There is on-going interest from recreational and commercial crab fishers about interactions between geoduck harvest activity and Dungeness crab populations. Dr. Dave Armstrong at the University of Washington determined that Dungeness crab utilize Puget Sound bottoms from the +1 foot level out to the -330 foot level. The California Department of Fish and Wildlife suggest that coastal Dungeness crab can be found in waters as deep as 750 feet (www.dfg.ca.gov/marine/pdfs/response/**crab**.pdf). Jensen (2014) and WDFW information (personal comm. Don Velasquez, 7/23/15) confirms a similar vertical distribution in Puget Sound, though the highest densities are found between the 0 to 360 foot water depth contours.

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 foot level and seaward to mid-channel (Figure 5, Potential crab habitat map). The entire crab habitat along this tract is approximately 581 acres. There are an estimated 1,012,587 harvestable geoducks on this tract, from the 2022 survey. With a harvest of 65 percent, the total number harvested would be 658,182 geoducks. Approximately 1.18 square feet of substrate is disturbed for every geoduck harvested, so 658,182 x 1.18 = 776,654 square feet of substrate, or roughly 18 acres. This is approximately 3.1 percent of the total available crab habitat in the vicinity of this tract.

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. Based on the low amount of disturbance and the lack of effects observed at the Thorndyke Bay study, we conclude that any effects on Dungeness crab populations 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 algae growth to areas shallower than where most geoduck harvest occurs. Aquatic algae observed during the geoduck survey at the Henderson Inlet tract include Laminarian algae; Desmarestian algae; Ulva (sea lettuce); small foliose red algae, Costaria and diatoms (Table 7).

John Boettner and Tim Flint, from the WDFW Habitat Division, have stated that if geoduck fishing remains restricted to 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 is set at least two vertical feet seaward of the deepest eelgrass to protect all eelgrass from harvest activities. No eelgrass was observed during the 2022 survey of the Henderson Inlet tract. The shoreward boundary of this tract will be no shallower than the -18 foot water depth contour (MLLW), which should provide a sufficient buffer for any eelgrass beds in the vicinity of the tract.

Marine Mammals:

Several species of marine mammals, including seals, sea lions, and river otters may be observed in the vicinity of this geoduck tract. Killer whales (*Orcinus orca*) may also be observed in the vicinity of this tract, particularly between November – 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 the federal Endangered Species Act (ESA) by the National Marine Fisheries Service on November 15, 2005. This is in addition to the May 2003 designation of this stock 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 their 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 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 the 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 geoduck clam harvest is unlikely to have any adverse impacts on bald eagle productivity.

Other uses:

Adjacent Upland Use:

The upland properties at Henderson Inlet, along the Henderson Inlet tract have a “rural” shoreline environmental designation.

To minimize possible disturbance to adjacent residents, harvest vessels are not allowed within 200 yards of the ordinary high tide line (OHT) or shallower than -18 feet (MLLW) whichever is farther seaward. Harvest is only allowed during daylight hours, and no harvest is allowed on Saturdays, Sundays, or state holidays.

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

Fishing:

Some recreational salmon fishing could occur seasonally in proximity to the geoduck bed. In recent years, commercial and recreational crab fishing effort has increased in this area. The WDFW Sport Fishing Rules pamphlet describes seasons, size limits, daily limits, specific closed areas, and 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 southern Puget Sound treaty tribes through annual state/tribal harvest management plans. The non-Indian geoduck fishery should not be in conflict with any concurrent tribal fisheries.

Navigation:

Dana Passage is a frequently used navigational route for vessels transiting between ports in southern Puget Sound. The Henderson Inlet Ledge area is avoided by larger vessels since the water depths become shallow near the navigation marker. Most vessel traffic should be northerly of the geoduck tract area. Geoduck harvesting at this site should not result in any significant navigational conflicts. The Department of Natural Resources will notify the local boating community prior to geoduck harvests.

Summary:

Continued commercial geoduck harvest is proposed for the Henderson Inlet geoduck tract located at the mouth of Henderson Inlet. The tract was most recently surveyed in the year 2022. The anticipated environmental impacts of this harvest are within the range of conditions discussed in the Final Supplemental Environmental Impact Statement (2001) for the commercial geoduck clam fishery. To reduce possible impacts to baitfish and eelgrass, harvest will occur deeper and seaward of the -18 foot (MLLW) water depth contour. No significant impacts are expected from this harvest.

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Figure 1. Vicinity Map, Henderson Inlet Commercial Geoduck Tract #16150

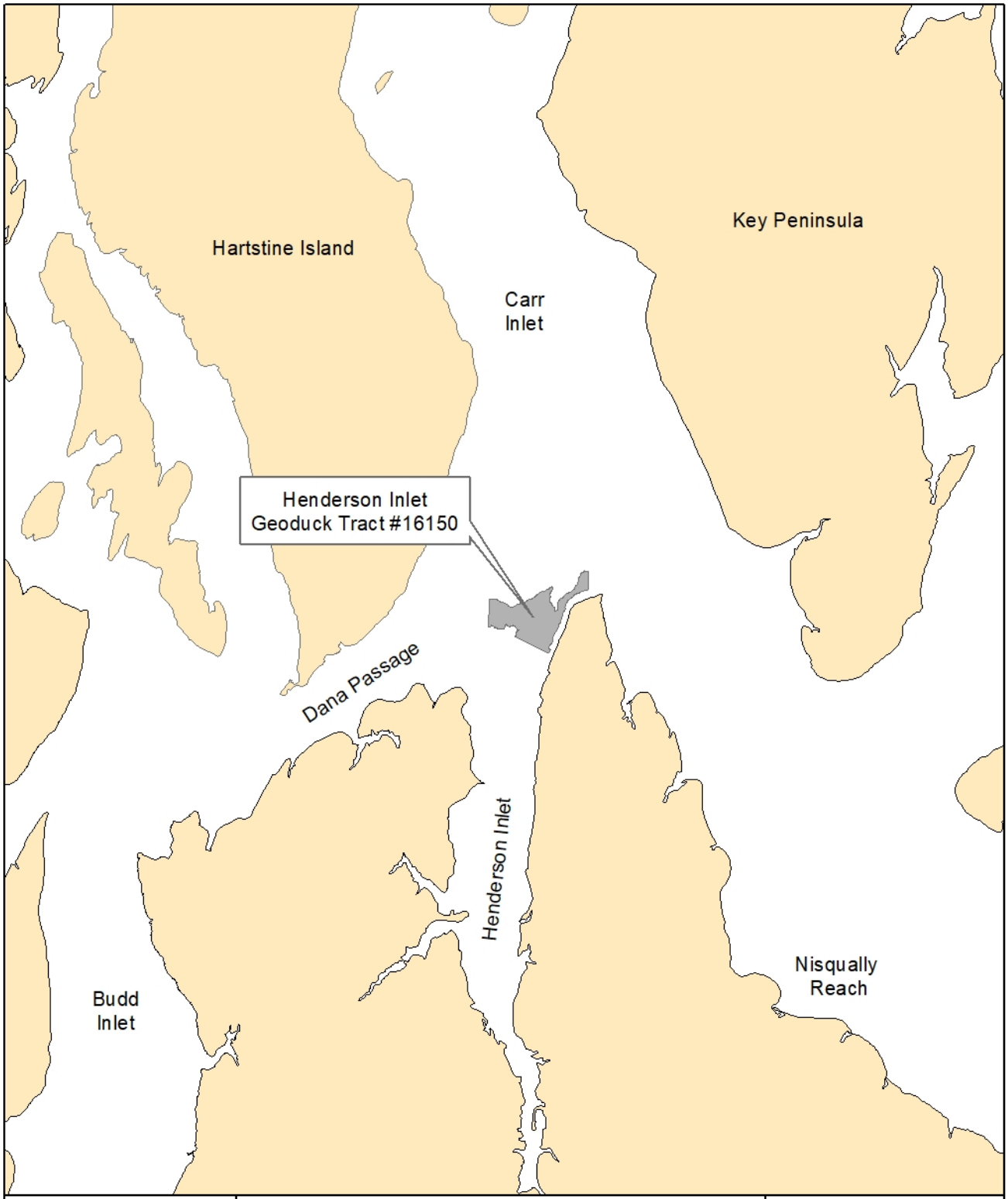
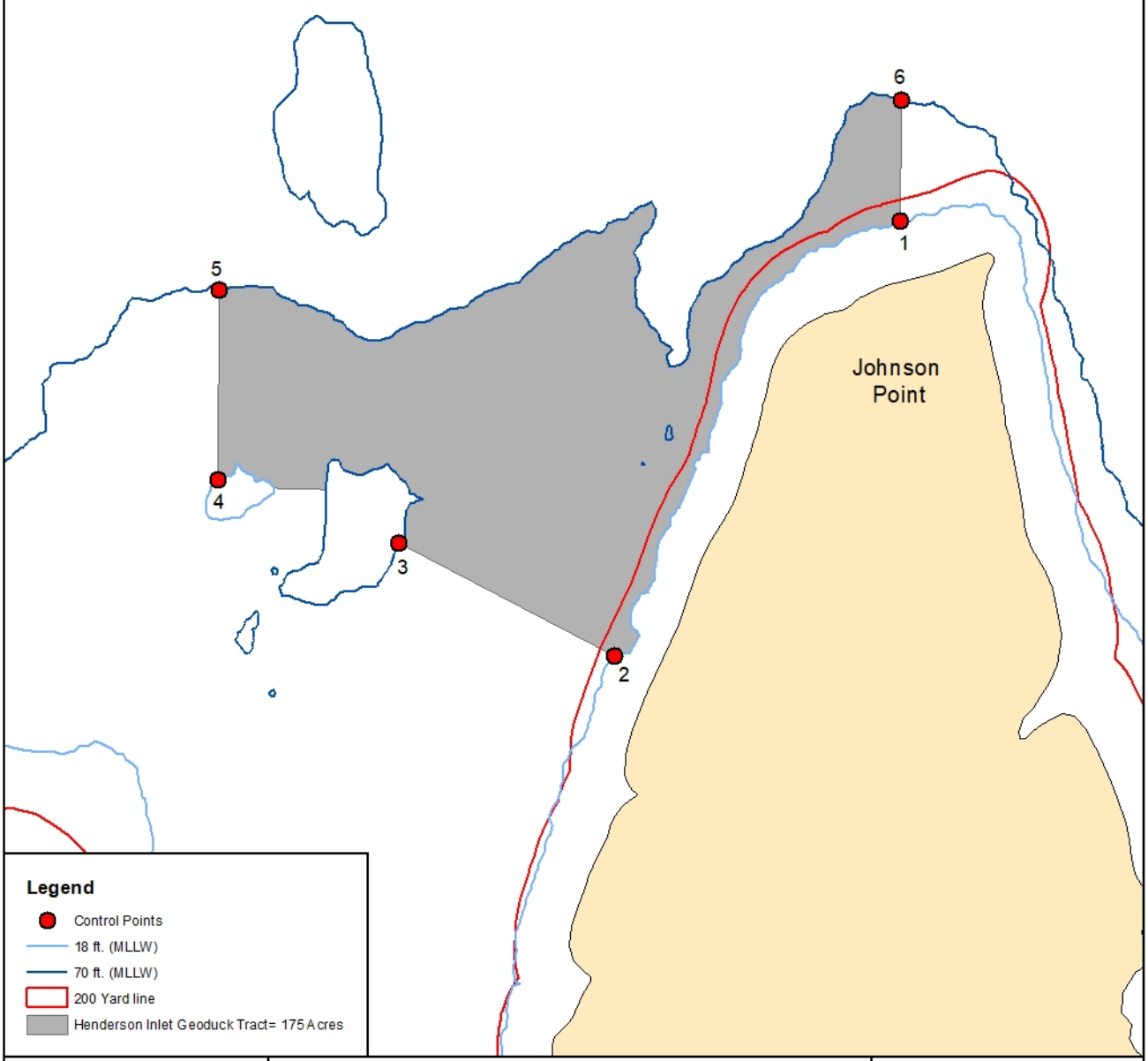


Figure 2. Control Points Map, Henderson Inlet Commercial Geoduck Tract #16150

Control Point	Latitude	Longitude
1	47° 10.720'	122° 49.056'
2	47° 10.183'	122° 49.543'
3	47° 10.311'	122° 49.933'
4	47° 10.383'	122° 50.258'
5	47° 10.613'	122° 50.258'
6	47° 10.867'	122° 49.062'

Coordinates are in WGS84; Degrees, Decimal Minutes



N
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S

1:15,000

1 inch = 0.24 miles

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 0.075 0.15 0.3 0.45 Miles

Washington Department of FISH and WILDLIFE

Map Date: April 27, 2023
Map Author: O. Working
File: Data\Ocean\Geoduck

Figure 3. Transect and Dig Station Map, Henderson Inlet Commercial Geoduck Tract #16150

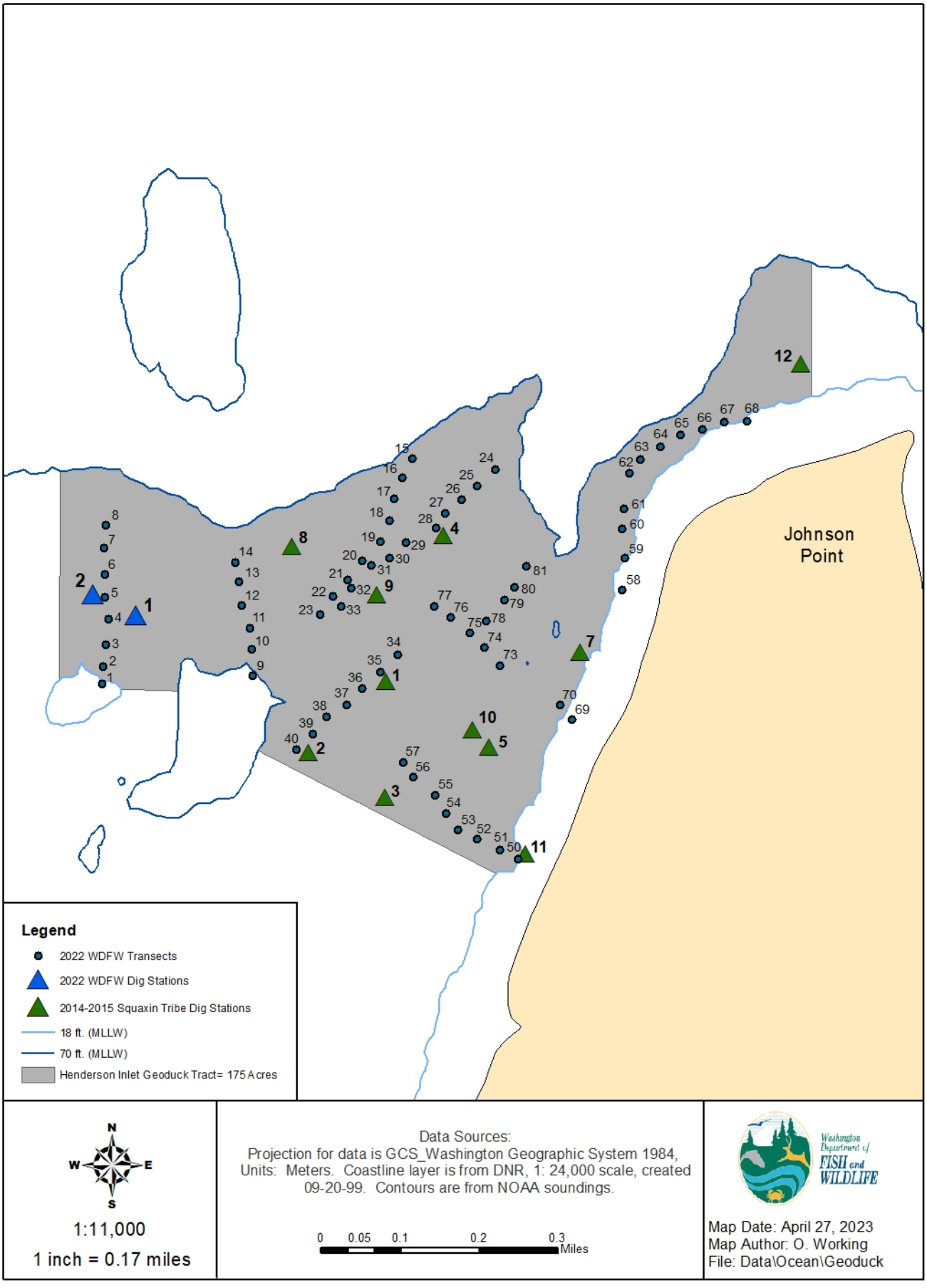
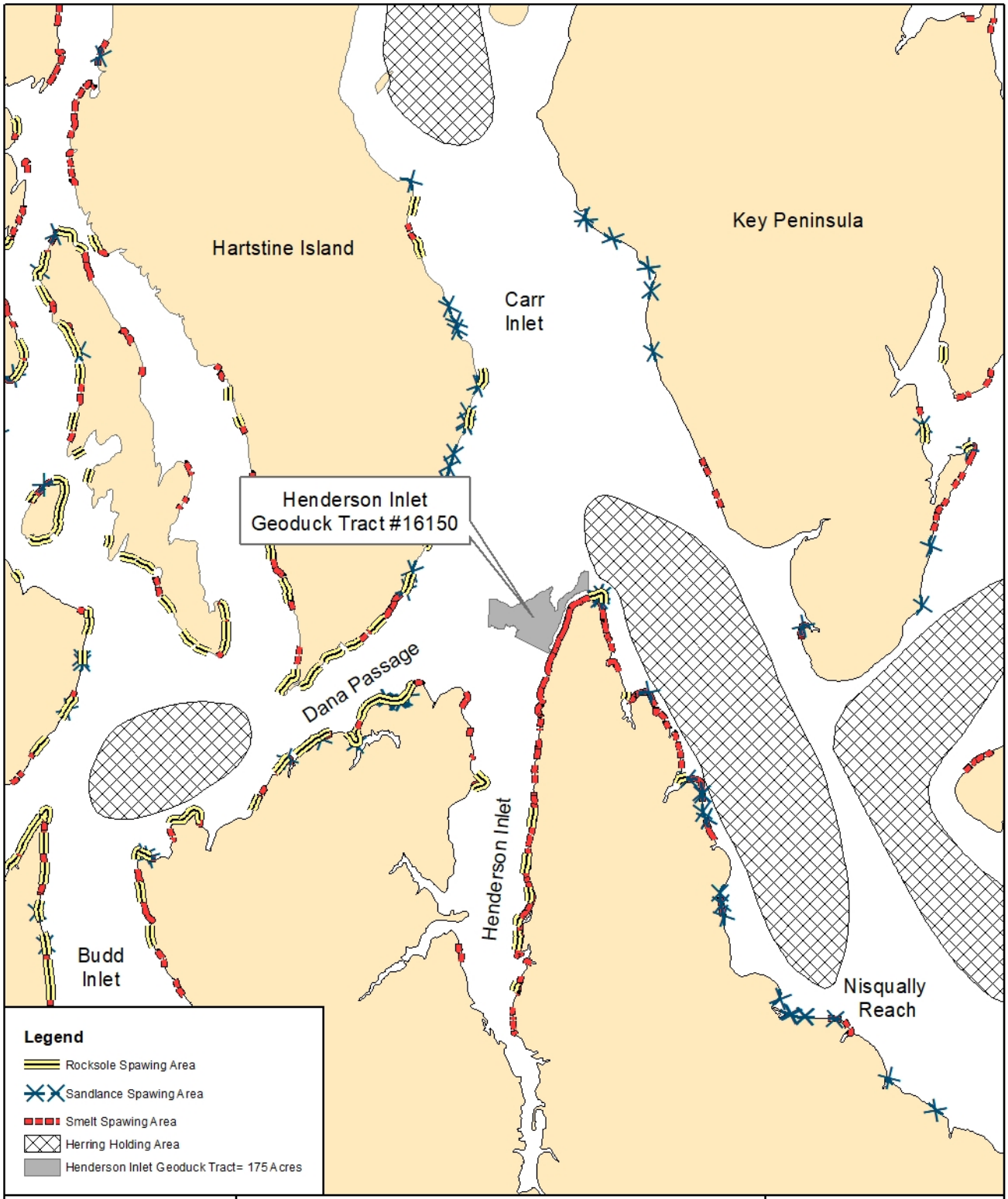


Figure 4. Fish Spawning Areas Near the Henderson Inlet Commercial Geoduck Tract #16150



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1:90,000
1 inch = 1.42 miles

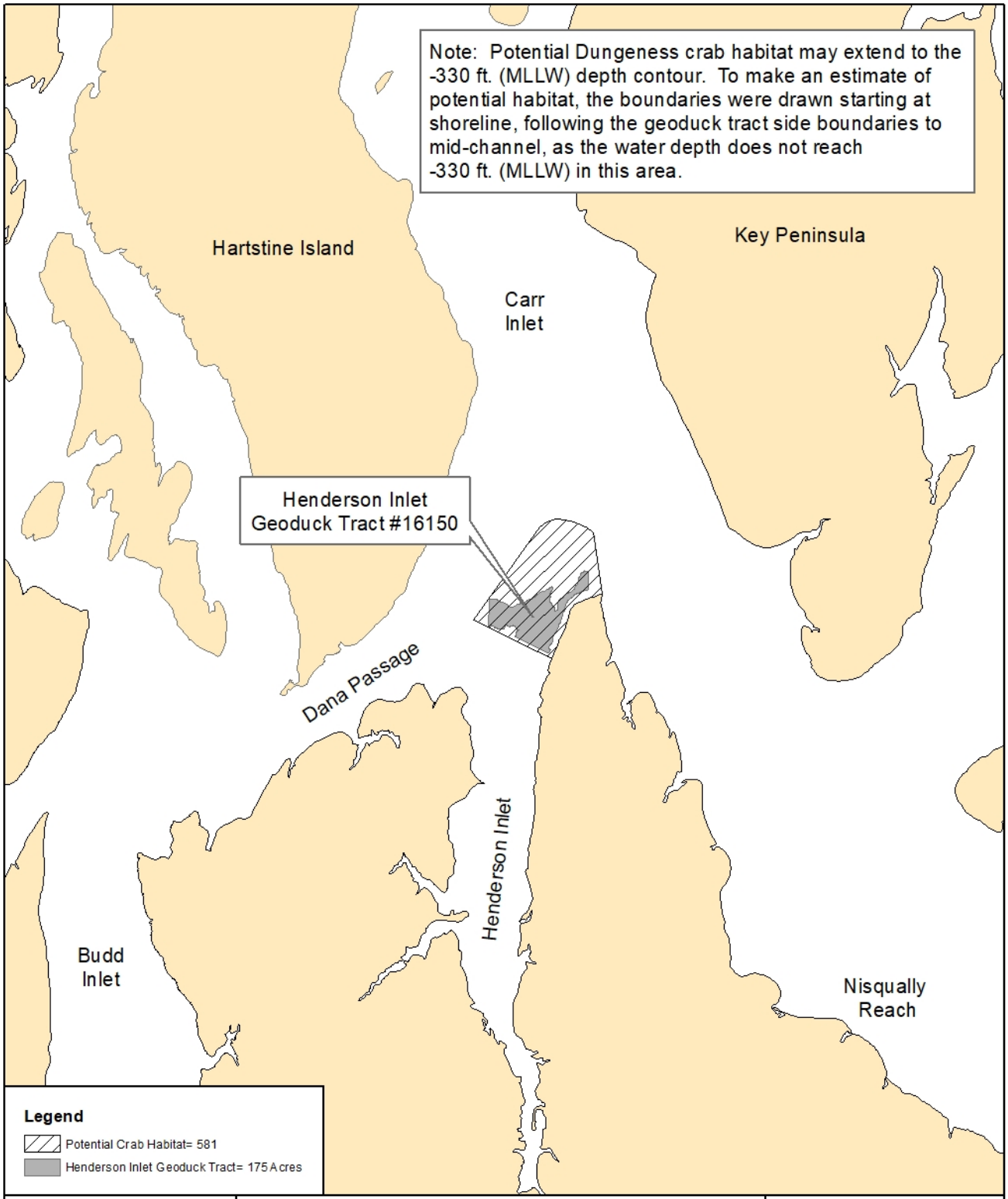
Data Sources:
Projection for data is GCS_Washington Geographic System 1984, Units: Meters. Coastline layer is from DNR, 1: 24,000 scale, created 09-20-99. Contours are from NOAA soundings.

0 0.45 0.9 1.8 2.7 Miles

Washington Department of FISH and WILDLIFE

Map Date: April 27, 2023
Map Author: O. Working
File: Data\Ocean\Geoduck

Figure 5. Dungeness Crab Habitat Map, Henderson Inlet Commercial Geoduck Tract #16150



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

Henderson Inlet geoduck tract #16150.

Tract Name	Henderson Inlet
Tract Number	16150
Tract Size (acres)[a]	175
Density of geoducks/sq.ft[b]	0.134
Total Tract Biomass (lbs.)[b]	2,875,885
Total Number of Geoducks on Tract[b]	1,022,526
Confidence Interval (%)	21.62%
Mean Geoduck Whole Weight (lbs.)	2.81
Mean Geoduck Siphon Weight (lbs.)[c]	0.62
Siphon Weight as a % of Whole Weight[c]	22%
Number of 900 sq.ft. Transect Stations	72
Number of Geoducks Weighed	126

[a.] Tract area is between the -18 ft. and -70 ft. (MLLW) water depth contours

[b.] Pre-fishing biomass of 2,876,265 was based on the 2022 WDFW Pre-fishing survey, using the 2014- 2015 Squaxin Tribe digs. Harvest of 380 pounds was subtracted as of April 27, 2023

[c.] Siphon weight measured on only 2 of 14 dig stations.

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Table 2. DIGGING DIFFICULTY TABLE

Henderson Inlet geoduck tract #16150, 2014- 2015 Squaxin Tribe digs and 2022 WDFW pre-fishing survey.

Survey Party	Dig Date	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)
SQUAXIN	9/4/2014	1	0	2	0	0	0	0	2	0	Y
SQUAXIN	9/4/2014	2	0	1	0	0	0	0	2	0	Y
SQUAXIN	9/4/2014	3	0	2	0	0	0	0	2	0	Y
SQUAXIN	8/6/2014	4	1	2	0	0	0	0	2	0	Y
SQUAXIN	8/6/2014	5	0	2	0	0	0	0	2	0	Y
SQUAXIN	6/24/2014	7	2	2	0	0	1	1	0	0	Y
SQUAXIN	11/25/2014	8	2	1	0	1	0	2	1	0	Y
SQUAXIN	1/20/2015	9	0	2	0	0	0	0	2	0	Y
SQUAXIN	1/20/2015	10	0	2	0	0	0	0	2	0	Y
SQUAXIN	1/20/2015	11	4	1	1	1	2	1	2	0	N
SQUAXIN	1/27/2015	12	2	2	0	0	1	1	0	0	Y
WDFW	6/23/2022	1	2	2	0	0	0	1	0	0	Y
WDFW	6/23/2022	2	1	2	0	0	0	0	0	0	Y

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

Henderson Inlet geoduck tract #16150, 2022 WDFW pre-fishing survey.

Survey Date	Transect	Start Depth (ft.) [a]	End Depth (ft.) [a]	Geoduck Density (no. / sq.ft.) [b]	Substrate [c]				
					sand	mud	cobble	gravel	shell
6/21/2022	1	18	26	0.0000	1		1	2	
6/21/2022	2	26	35	0.0000	2		1	1	
6/21/2022	3	35	39	0.0485	2		1	1	
6/21/2022	4	39	42	0.2535	2		1	1	1
6/21/2022	5	42	49	0.5089	2		1	1	1
6/21/2022	6	49	55	0.2181	2		1	1	1
6/21/2022	7	55	60	0.1398	2		1	1	1
6/21/2022	8	61	69	0.2237	1	2		1	
6/21/2022	9	70	65	0.0093		2			
6/21/2022	10	65	54	0.0615		2			
6/21/2022	11	54	51	0.0634		2			
6/21/2022	12	52	57	0.0913		2			1
6/21/2022	13	57	66	0.1286		2			1
6/21/2022	14	66	69	0.1044	1	2			
6/22/2022	15	70	63	0.0786		2			
6/22/2022	16	63	55	0.0894		2			
6/22/2022	17	55	48	0.1402		2			
6/22/2022	18	47	44	0.1695		2			
6/22/2022	19	44	44	0.1079		2			
6/22/2022	20	44	43	0.1526		2			
6/22/2022	21	42	42	0.1433		2			
6/22/2022	22	42	45	0.1217		2			
6/22/2022	23	46	52	0.1217		2			
6/22/2022	24	70	53	0.0247		2			
6/22/2022	25	53	45	0.0555		2			
6/22/2022	26	45	42	0.0863		2			
6/22/2022	27	42	41	0.1110		2			
6/22/2022	28	41	40	0.0925		2			
6/22/2022	29	40	39	0.0524		2			
6/22/2022	30	39	41	0.0385		2			
6/22/2022	31	41	42	0.0370		2			
6/22/2022	32	42	43	0.0401		2			
6/22/2022	33	43	44	0.0339		2			
6/23/2022	34	44	46	0.0573		2			
6/23/2022	35	46	47	0.0556		2			
6/23/2022	36	49	49	0.0538		2			
6/23/2022	37	49	51	0.0694		2			
6/23/2022	38	51	54	0.0347		2			
6/23/2022	39	54	56	0.0590		2			
6/23/2022	40	56	59	0.0625		2			
6/28/2022	50	18	45	0.0496	1	2			
6/28/2022	51	45	44	0.0766		2			
6/28/2022	52	44	45	0.0406		2			

Table 3. Continued

Survey Date	Transect	Start Depth (ft.) [a]	End Depth (ft.) [a]	Geoduck Density (no. / sq.ft.) [b]	Substrate [c]				
					sand	mud	cobble	gravel	shell
6/28/2022	53	44	43	0.0676		2			
6/28/2022	54	42	42	0.0902		2			
6/28/2022	55	42	41	0.1059		2			
6/28/2022	56	41	41	0.1240		2			
6/28/2022	57	40	41	0.1149		2			1
6/28/2022	58	18	26	0.4710	2			1	1
6/28/2022	59	26	34	0.5229	2			1	1
6/28/2022	60	34	40	0.4733	2			1	1
6/28/2022	61	39	46	0.4079	2			1	1
6/28/2022	62	46	66	0.2299	2			1	
6/28/2022	63	66	62	0.3020	2			1	
6/28/2022	64	62	52	0.3223	2				
6/28/2022	65	51	48	0.3944	2		1		
6/28/2022	66	48	42	0.1285	2			1	
6/28/2022	67	41	35	0.2073	2			1	1
6/28/2022	68	35	28	0.1397	2			1	1
6/29/2022	69	18	39	0.1667	2			1	1
6/29/2022	70	39	64	0.1387	2			1	
6/29/2022	73	57	47	0.1060		2			
6/29/2022	74	47	44	0.1122		2			
6/29/2022	75	45	43	0.1216		2			
6/29/2022	76	43	43	0.1262		2			
6/29/2022	77	43	41	0.1247		2			
6/29/2022	78	43	45	0.1060		2			
6/29/2022	79	45	49	0.0686		2			
6/29/2022	80	49	53	0.0655		2			
6/29/2022	81	52	65	0.0374		2			

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

[b.] Densities were calculated using show factors from the Taylor Bay showplot

[c.] Substrate ratings: 1 = present; 2 = predominant; blank = not observed

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Table 4. TRANSECT CORRECTED GEODUCK COUNT AND POSITION TABLE

Henderson Inlet geoduck tract #16150, 2022 WDFW pre-fishing survey.

Survey Date	Transect	Corrected Count	Show Factor	Latitude [a]		Longitude [a]	
6/21/2022	1	0	0.596	47	10.380	122	50.189
6/21/2022	2	0	0.596	47	10.399	122	50.188
6/21/2022	3	44	0.596	47	10.423	122	50.184
6/21/2022	4	228	0.596	47	10.451	122	50.181
6/21/2022	5	458	0.596	47	10.475	122	50.189
6/21/2022	6	196	0.596	47	10.500	122	50.189
6/21/2022	7	126	0.596	47	10.530	122	50.193
6/21/2022	8	201	0.596	47	10.555	122	50.191
6/21/2022	9	8	0.596	47	10.394	122	49.946
6/21/2022	10	55	0.596	47	10.423	122	49.949
6/21/2022	11	57	0.596	47	10.446	122	49.953
6/21/2022	12	82	0.596	47	10.471	122	49.967
6/21/2022	13	116	0.596	47	10.497	122	49.972
6/21/2022	14	94	0.596	47	10.518	122	49.979
6/22/2022	15	71	0.721	47	10.638	122	49.698
6/22/2022	16	80	0.721	47	10.617	122	49.713
6/22/2022	17	126	0.721	47	10.593	122	49.725
6/22/2022	18	153	0.721	47	10.569	122	49.732
6/22/2022	19	97	0.721	47	10.524	122	49.774
6/22/2022	20	137	0.721	47	10.502	122	49.797
6/22/2022	21	129	0.721	47	10.484	122	49.820
6/22/2022	22	110	0.721	47	10.463	122	49.839
6/22/2022	23	110	0.721	47	10.546	122	49.746
6/22/2022	24	22	0.721	47	10.643	122	49.535
6/22/2022	25	50	0.721	47	10.610	122	49.592
6/22/2022	26	78	0.721	47	10.595	122	49.616
6/22/2022	27	100	0.721	47	10.579	122	49.643
6/22/2022	28	83	0.721	47	10.562	122	49.657
6/22/2022	29	47	0.721	47	10.545	122	49.705
6/22/2022	30	35	0.721	47	10.528	122	49.731
6/22/2022	31	33	0.721	47	10.519	122	49.759
6/22/2022	32	36	0.721	47	10.493	122	49.791
6/22/2022	33	31	0.721	47	10.473	122	49.806
6/23/2022	34	52	0.64	47	10.421	122	49.713
6/23/2022	35	50	0.64	47	10.402	122	49.740
6/23/2022	36	48	0.64	47	10.383	122	49.769
6/23/2022	37	63	0.64	47	10.365	122	49.792
6/23/2022	38	31	0.64	47	10.351	122	49.824
6/23/2022	39	53	0.64	47	10.331	122	49.846
6/23/2022	40	56	0.64	47	10.314	122	49.871
6/28/2022	50	45	0.493	47	10.200	122	49.508

Table 4. Continued

Survey Date	Transect	Corrected Count	Show Factor	Latitude [a]		Longitude [a]	
6/28/2022	51	69	0.493	47	10.210	122	49.538
6/28/2022	52	37	0.493	47	10.221	122	49.576
6/28/2022	53	61	0.493	47	10.230	122	49.607
6/28/2022	54	81	0.493	47	10.248	122	49.626
6/28/2022	55	95	0.493	47	10.268	122	49.645
6/28/2022	56	112	0.493	47	10.287	122	49.682
6/28/2022	57	103	0.493	47	10.303	122	49.699
6/28/2022	58	424	0.493	47	10.500	122	49.353
6/28/2022	59	471	0.493	47	10.535	122	49.350
6/28/2022	60	426	0.493	47	10.568	122	49.355
6/28/2022	61	367	0.493	47	10.590	122	49.353
6/28/2022	62	207	0.493	47	10.629	122	49.347
6/28/2022	63	272	0.493	47	10.645	122	49.330
6/28/2022	64	290	0.493	47	10.659	122	49.298
6/28/2022	65	355	0.493	47	10.673	122	49.266
6/28/2022	66	116	0.493	47	10.680	122	49.231
6/28/2022	67	187	0.493	47	10.688	122	49.196
6/28/2022	68	126	0.493	47	10.690	122	49.159
6/29/2022	69	150	0.713	47	10.356	122	49.427
6/29/2022	70	125	0.713	47	10.371	122	49.448
6/29/2022	73	95	0.713	47	10.413	122	49.546
6/29/2022	74	101	0.713	47	10.432	122	49.572
6/29/2022	75	109	0.713	47	10.448	122	49.597
6/29/2022	76	114	0.713	47	10.464	122	49.629
6/29/2022	77	112	0.713	47	10.476	122	49.656
6/29/2022	78	95	0.713	47	10.462	122	49.571
6/29/2022	79	62	0.713	47	10.485	122	49.543
6/29/2022	80	59	0.713	47	10.500	122	49.527
6/29/2022	81	34	0.713	47	10.523	122	49.508

[a.] Latitude and longitude are in degrees and decimal minutes and WGS84 datum

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Table 5. GEODUCK SIZE AND QUALITY

Henderson Inlet geoduck tract #16150, 2014- 2015 Squaxin Tribe digs and 2022 WDFW pre-fishing survey.

Survey Party	Dig Date	Dig Station	Number Dug	Avg. Whole Weight (lbs.)	Avg. Siphon Weight (lbs.)[a]	% of geoducks on station greater than 2 lbs.
SQUAXIN	9/4/2014	1	11	2.92		73%
SQUAXIN	9/4/2014	2	10	2.87		70%
SQUAXIN	9/4/2014	3	10	3.23		100%
SQUAXIN	8/6/2014	4	9	3.31		78%
SQUAXIN	8/6/2014	5	11	2.31		55%
SQUAXIN	6/24/2014	7	11	2.56		82%
SQUAXIN	11/25/2014	8	12	2.96		91%
SQUAXIN	1/20/2015	9	10	2.76		70%
SQUAXIN	1/20/2015	10	10	3.25		90%
SQUAXIN	1/20/2015	11	10	2.76		100%
SQUAXIN	1/27/2015	12	10	2.23		60%
WDFW	6/23/2022	1	11	2.28	0.52	64%
WDFW	6/23/2022	2	11	3.08	0.74	82%

[a.] Siphon weights not taken on Squaxin digs.

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Table 6. MOST COMMON AND OBVIOUS ANIMALS OBSERVED

Henderson Inlet geoduck tract #16150, 2022 WDFW pre-fishing survey.

# of Transects where Observed	Group	Common Name	Taxonomer
67	ANEMONE	BURROWING ANEMONE	*Pachycerianthus fimbriatus*
21	ANEMONE	PLUMED ANEMONE	*Metridium* spp.
14	ANEMONE	STRIPED ANEMONE	*Urticina* spp.
4	ASCIDIAN	SESSILE TUNICATE	Unspecified Tunicate
23	BIVALVE	HORSE CLAM	*Tresus* spp.
1	BIVALVE	PIDDOCK	Unspecified Pholadidae
3	BIVALVE	TRUNCATED MYA	*Mya truncata*
10	CNIDARIA	HYDROIDS	Unspecified Hydroid
43	CNIDARIA	SEA PEN	*Ptilosarcus gurneyi*
56	CNIDARIA	SEA WHIP	*Stylatula elongata*
23	CRAB	DECORATOR CRAB	*Oregonia gracilis*
45	CRAB	GRACEFUL CRAB	*Cancer gracilis*
28	CRAB	HERMIT CRAB	Unspecified hermit crab
40	CRAB	RED ROCK CRAB	*Cancer productus*
5	CUCUMBER	SEA CUCUMBER	*Parastichopus californicus*
1	FISH	BUFFALO SCULPIN	*Enophrys bison*
1	FISH	C-O SOLE	*Pleuronichthys coenosus*
1	FISH	COD	*Gadid* spp.
5	FISH	EELPOUT	Unspecified Zoarcidae
1	FISH	ENGLISH SOLE	*Parophrys vetulus*
1	FISH	FISH	Unspecified Fish
4	FISH	FLATFISH	Unspecified flatfish
7	FISH	GOBIE	Unspecified Gobiidae
1	FISH	GREAT SCULPIN	*Myoxcephalus polyacanthocehalus*
2	FISH	GUNNEL	*Pholis* spp.
24	FISH	SANDDAB	*Citharichthys* spp.
28	FISH	SCULPIN	Unspecified Cottidae
1	FISH	SNAKE PRICKLEBACK	*Lumpenus sagitta*
6	FISH	STARRY FLOUNDER	*Platichthys stellatus*
2	GASTROPOD	MOON SNAIL	*Polinices lewisii*
18	GASTROPOD	MOON SNAIL EGGS	*Polinices lewisii* egg case
7	GASTROPOD	NASSA SNAILS	*Nassarius* spp.
2	MISC	SPONGE	Unspecified Porifera
14	NUDIBRANCH	ARMINA	*Armina californica*
40	NUDIBRANCH	DENDRONOTUS	*Dendronotus* spp.
5	NUDIBRANCH	DIAMONDBACK TRITONIA	*Tritonia festiva*
27	NUDIBRANCH	ROSY TRITONIA	*Tritonia diomedea*
9	SEA STAR	FALSE OCHRE STAR	*Evasterias troschelli*
9	SEA STAR	LEATHER STAR	*Dermasterias imbricata*
1	SEA STAR	SHORT-SPINED STAR	*Pisaster brevispinus*
1	SEA STAR	SUN STAR	*Solaster* spp.
1	SHRIMP	GHOST SHRIMP	Unspecified ghost shrimp
2	SHRIMP	SHRIMP	Unspecified shrimp
1	URCHIN	PURPLE URCHIN	*Strongylocentrotus purpuratus*
25	WORM	ROOTS	Chaetopterid polychaete tubes
36	WORM	SABELLID TUBE WORM	*Sabellid* spp.
18	WORM	TEREBELLID TUBE WORM	*Terebellid* spp.

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Table 7. MOST COMMON AND OBVIOUS ALGAE OBSERVED

Henderson Inlet geoduck tract #16150, 2022 WDFW pre-fishing survey.

# of Transects where observed	Taxonomer
1	*Costaria costada*
7	*Desmarestia spp.*
3	Diatoms
43	*Laminaria* spp.
70	*Ulva* spp.
43	Small red algae

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