ENVIRONMENTAL ASSESSMENT OF PROPOSED GEODUCK HARVEST
IN PIERCE COUNTY, FOX ISLAND NORTH GEODUCK TRACT (#11200)

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 the -70 foot water depth contours (corrected to mean lower low water, hereafter MLLW). Harvest is rotated around Puget Sound in seven geoduck management regions. The fishery, its management, and its environmental impacts are presented in the Final Supplemental Environmental Impact Statement for the Puget Sound Commercial Geoduck Fishery (WDFW & DNR, 2001) and the Puget Sound Commercial Geoduck Fishery Management Plan (DNR & WDFW, 2008). The proposed harvest in Pierce County is described below.

Proposed Harvest Dates: 2024 - 2025

Tract name: Fox Island North Tract (#11200)

Description (Figure 1, Tract vicinity map):

The Fox Island North tract was surveyed for subtidal geoduck clams in 2017-2018 by the Nisqually and Squaxin Island Tribes. The tract area is approximately 37 subtidal acres along the northwestern shoreline of Fox Island in South Puget Sound (Figure 1). The tract extends along the island's shoreline for about a half a mile.

The entire commercial tract area is between the -20 foot (MLLW, depth corrected to mean lower low water) and the -70 foot (MLLW) water depth contour. The Fox Island North geoduck tract is described by a polygon and is bounded by a line starting from a Control Point (CP) on the -20 foot (MLLW) water depth contour at 47°16.733' N latitude, 122°40.021' W longitude (CP 1) and extending southerly along the -20 foot (MLLW) water depth contour to a point at 47°16.269' N latitude, 122°40.241' W longitude (CP 2); then westerly to a point on the -70 foot (MLLW) contour line at 47°16.229' N latitude, 122°40.360' W longitude (CP 3); then northerly along the -70 foot (MLLW) contour to point at 47°16.859' N latitude, 122°40.168' W longitude (CP 4); then southeasterly to the point of origin (Figure 2).

This estimate of the tract boundary is made using GIS and field data. 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 latitude and longitude positions are in WGS84 datum and reported in degrees decimal minutes to the closest thousandths of a minute.

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 the water current velocity. Coarse sediments are generally found in areas of fast currents and finer (muddier) sediments are found 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 currents.

Water currents are moderately strong in Hale Passage. Currents reach an average maximum flood velocity of 1.4 knots and an average maximum ebb velocity of 1.8 knots (Tides and Currents software; station #1796; Hale Passage).

The Fox Island North tract has relatively uniform substrate on the surface. Sand was the predominant and sole substrate type noted on all 38 survey transects (Table 3). Gravel was noted to exist below the sediment at 1 of 5 dig stations, and shell at 2 of 5 dig stations (Table 2).

Water Quality:

Water quality is good at the Fox Island North geoduck tract. Water mixing at this tract is affected by the high current flow through nearby Tacoma Narrows, 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 by the Washington Department of Ecology (DOE) for Puget Sound at the Gordon Point station (GOR 001) at 47.1833° N latitude; 122.6333° W longitude. The DOE latitude and longitude positions are recorded in decimal degrees. For data years 1996 to 2015 (the most current data set available), at water depths between 6 and 23 meters, the mean reported dissolved oxygen concentration was 8.3 mg/l with a range between 5.8 mg/l and 14.4 mg/l. The mean salinity at this station was 29.1 psu with a range between 26.9 psu and 30.5 psu. The mean water temperature at this station was 10.9° C with a range between 7.5° C and 14.8° C.

This geoduck tract status has been reviewed by the Washington Department of Health (DOH) and the tract has been classified as “approved”.

Biota:

Geoduck:

The Fox Island North tract is approximately 37 acres and the pre-fishing estimate from the 2017- 2018 survey was 791,962 lbs. of geoduck (Table 1), which after subsequent harvest of 324,471 lbs., leaves a current biomass estimate of 467,491 lbs. of geoduck. Digging difficulty was reported to range from very easy to difficult, and divers noted zero difficulty on three of the five dig stations, a score of one at one station, and a three score at the remaining station, (from a range from zero to five in degree of digging difficulty - Table 2). The pre-fishing geoduck density on this tract was 0.207 geoducks per square foot, and after harvest is currently 0.122 geoducks per square foot. The density ranges from the 2017- 2018 survey were 0.034 geoducks per square foot on transect #29 to 0.615 geoducks per square foot on transect #5 (Figure 3; Table 3). The geoducks on the Fox Island North tract are moderate weight, averaging 2.4 pounds, compared to the Puget Sound average of 2.1 pounds per geoduck clam. The lowest average whole weight was 1.44 pounds per geoduck at station #3, and the highest average whole weight was 3.58 pounds per geoduck at station #1 (Figure 3; Table 4).

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 the Salish Sea. 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 Fox Island North 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 or support fish. The bottoms are relatively flat and composed of soft, unstable sediments which provide few attachments for macroalgae and few vertical structures which attract fish. Fish species observed on this tract were unspecified sculpins (Family Cottidae) and unspecified flatfish during a 2008 supplemental survey of the tract by WDFW, Nisqually and Squaxin Island Tribal divers (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 should be preserved for any spawning herring.

There are no known Pacific herring spawning grounds along the shoreline of the Fox Island North tract (WDFW forage fish unit). A pre-spawner holding area is located well east of the tract in Hale Passage and west of the tract in Carr Inlet (Figure 4). Based on a year-round nearshore tract boundary of -20 feet (MLLW) to protect eelgrass habitat, geoduck fishing on the Fox Island North tract should have no detrimental impacts on herring.

Surf smelt spawning habitat has been identified along the entire shoreline of the Fox Island North geoduck tract (WDFW forage fish unit). Surf smelt deposit adhesive, semi-transparent eggs on beaches that have a specific mixture of coarse sand and pea gravel. Inside Puget Sound, surf smelt spawning is thought to be associated with freshwater seepage, where the water keeps the spawning gravel moist. Eggs are deposited in water a few inches deep, around the time of the high water slack tide. There is substantial vertical separation between surf smelt spawning (slack high tide) and geoduck harvest activity (-20 feet to -70 feet, MLLW on the Fox Island North tract), meaning the activity is unlikely to impact surf smelt populations significantly.

Sand lance spawning has been documented in the vicinity of this tract. Sand lance populations are widespread within the Salish Sea. They are most commonly noted along shorelines of the eastern Strait of Juan de Fuca and Admiralty Inlet. However, WDFW plankton surveys and ongoing exploratory spawning habitat surveys suggest that there are very few, if any, bays and inlets in the Puget Sound basin that will not be found to support sand lance spawning activity. Spawning of sand lance occurs at tidal elevations ranging from +5 feet to about the mean higher high water line. After deposition, sand lance eggs may be scattered over a wider range of the intertidal zone by wave action. The incubation period is approximately four weeks. Sand lances are an important part of the trophic link between zooplankton and larger predators in the local marine food webs. Like all forage fish, sand lances are a significant component in the diet of many economically important resources in Washington. On average, 35 percent of juvenile salmon diets are comprised of sand lance. Sand lances are particularly important to juvenile Chinook salmon, where 60 percent of their diets are sand lance. Other economically important species, such as Pacific cod (*Gadus macrocephalus)*, Pacific hake (*Merluccius productus*) and dogfish (*Squalus acanthias*) feed heavily on juvenile and adult sand lance. There is substantial vertical separation between sand lance spawning (+5 feet to mean higher high water) and geoduck harvest activity (-20 feet to -

70 feet, MLLW on Fox Island North). Geoduck harvesting on the Fox Island North tract should have no detrimental impacts on 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 the federal Endangered Species Act. A five year status review reaffirmed the threatened status of Chinook salmon on 8/15/2011 (76FR50448). 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 Fox Island North 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 majority of Puget Sound Chinook salmon emigrate to the ocean as subyearlings.

Streams or tributaries near the Fox Island North geoduck tract are McAllister Creek, Nisqually and Chambers Creek. 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 from the University of Washington School of Fisheries stated that the "exclusionary principle of not allowing leasing/harvesting in water shallower than -18 ft. MLLW, 2 ft. vertically from elevation of 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 Fox Island North that support steelhead stocks. The horizontal separation between tributaries that support steelhead runs and the Fox Island North tract will assure 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, they 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 Fox Island North 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:

Many different types of marine invertebrates which are frequently found on geoduck beds were observed during a 2008 exploratory survey of the Fox Island North tract by WDFW, Nisqually and Squaxin Island Tribal divers. They included: [1] mollusks - horse clams, geoducks, and nudibranchs; [2] crustaceans – ghost shrimp, graceful crabs, red rock crabs, Dungeness crabs, and kelp crabs; [3] echinoderms - ochre sea stars and sunflower sea stars; [4] cnidarians - sea pens, plumed anemones, and striped anemones; and [5] other marine invertebrates including polychaete tube dwelling worms, (Table 6). Geoduck harvest has not been shown to have long-term adverse effects on these invertebrates. Geoduck harvest can depress some local populations of benthic invertebrates; however, most of these populations 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. Dungeness crab were observed on 2 out of 42 transects on the Nisqually tract during the 2015 supplemental survey. Dr. Dave Armstrong at the University of Washington has 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 (https://wildlife.ca.gov/Conservation/Marine/Life-History-Inv-And-Plants). Jensen (2014) and WDFW information (personal comm. WDFW Biologist Don Velasquez, personal comm. 7/23/15) confirm a similar vertical distribution in Puget Sound, though the highest densities are found between the 0 to 360 foot water depth contours.

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 may experience peak molt in mid-April, based on data from the Kingston area (Cain, 10/15/01). Dungeness crab were observed during the 2008 survey of the Fox Island North tract, but since that time Dungeness crab populations in the South Puget Sound in general have been reduced in abundance.

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 Carr Inlet in the vicinity of the tract, deeper than the +1 foot tide level (Figure 5). Dr. Dave Armstrong at the University of Washington has determined that Dungeness crab utilize Puget Sound bottoms from the +1 foot level out to the -330 foot level. The entire crab habitat estimate in the vicinity of this geoduck bed is approximately 243 acres. From the 2017-2018 pre-fishing survey, there was an estimated 333,331 harvestable geoducks on this tract. With a minimum harvest level of 65 percent of these geoducks, the total number harvested would be 216,652 geoducks. Approximately 1.18 square feet of substrate is disturbed for every geoduck harvested, so 216,652 x 1.18 = 255,650 square feet of substrate. This equals 5.9 acres. This is about 2.4 percent of the total available crab habitat in the vicinity of this tract. This represents a low amount of disturbance to the potential crab habitat in the immediate vicinity of this geoduck tract. We conclude that any effects on Dungeness crab will be very minor, if they occur at all.

Red rock crabs (*Cancer productus*) were observed on 8 of 15 transects done during the 2008 survey of the Fox Island North tract. The crab catch study at Thorndyke Bay in Hood Canal (Armetta Cain, January 1995) found no significant difference in red rock crab catch per unit effort (CPUE) on a tract prior to geoduck fishing, during geoduck fishing, and following geoduck fishing. Based on this study, there is a low potential for impacts to red rock crab populations in the vicinity of this tract.

Aquatic Algae:

Large quantities of attached aquatic algae are not generally found in geoduck beds. Light restriction often limits algal growth to areas shallower than where most geoduck harvest occurs. Red algae, sea lettuce (*Ulva* sp.), Laminarian algae, diatoms, *Agarum* sp., *Gigartina* sp., *Lithothamnion* sp., and Desmarestian algae were the main types observed during the 2008 survey (Table 7).

John Boettner and Tim Flint, from the WDFW Habitat Division, have stated that if geoduck fishing is 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. Nisqually and Squaxin Island Tribal divers conducted eelgrass surveys at the Fox Island North tract as part of the pre-fishing survey. Eelgrass was observed down to a maximum depth of -18 foot level (corrected to MLLW). Therefore, the shallow boundary line of this tract is set at no shallower than the -20 foot level (MLLW) to protect eelgrass habitat.

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 and rare reports of humpback whales in the vicinity of Carr Inlet. 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). More recently, transient pods of killer whales have been sighted in South Puget Sound.

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 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 herons, bald eagles, and ospreys 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 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 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 have a “semi-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). 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 harvest vessels (typically 30-40 feet in overall length) 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:

This is not a prime area for sport fishing, however, some recreational salmon fishing could occur seasonally in proximity to the geoduck bed. The WDFW Sport Fishing Rules pamphlet describes seasons, size limits, daily limits, specific closed areas, and other fishing rules for salmon and other marine fish species. A few small-scale commercial fisheries may take place in the area. 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 state/tribal harvest management plans. The non-Indian geoduck fishery should not be in conflict with any concurrent tribal fisheries.

Navigation:

> This area is not a major navigational route for recreational or commercial vessels traveling between ports in southern Puget Sound. 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 harvests.

Summary:

Commercial geoduck harvest is proposed for the Fox Island North geoduck tract, located along the northwestern shoreline of Fox Island in Pierce County. The geoduck population on the tract was surveyed in 2017 and 2018 and the current tract biomass estimate is based on that survey. The anticipated environmental impacts of this harvest are within the range of conditions discussed in the Final Supplemental Environmental Impact Statement for the commercial geoduck clam fishery. To reduce potential impacts to eelgrass habitat, harvest will be deeper and seaward of the -20 foot (MLLW) contour. Harvest vessels will remain at least 200 yards from OHT during harvest operations. The effects on marine organisms in the vicinity of the tract are expected to be minimal. No other significant impacts are expected from this harvest.

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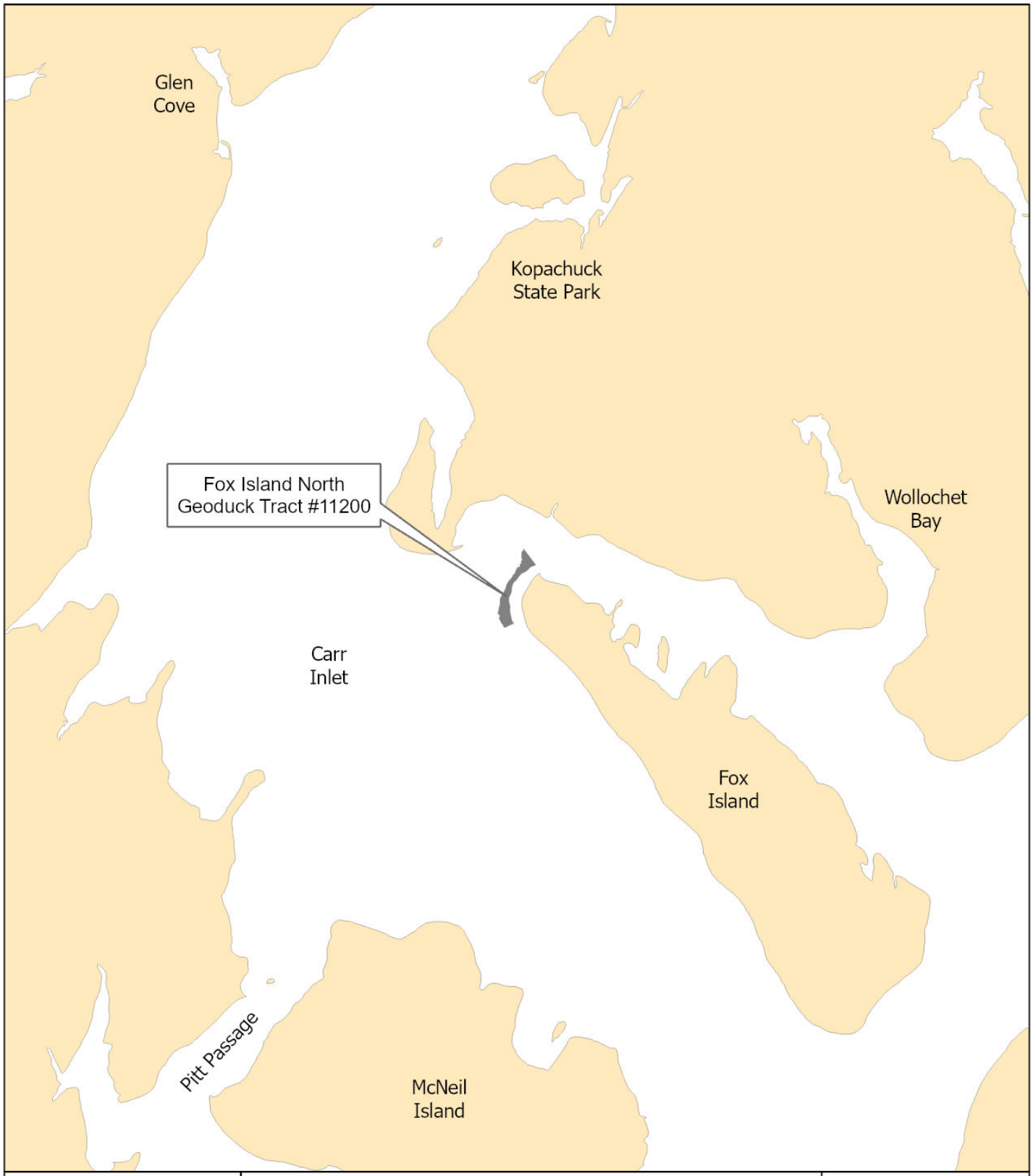
Figure 1. Vicinity Map,
Fox Island North Commercial Geoduck Tract #11200



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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: June 18, 2024
Map Author: O. Working
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Figure 2. Control Points Map, Fox Island North Commercial Geoduck Tract #11200

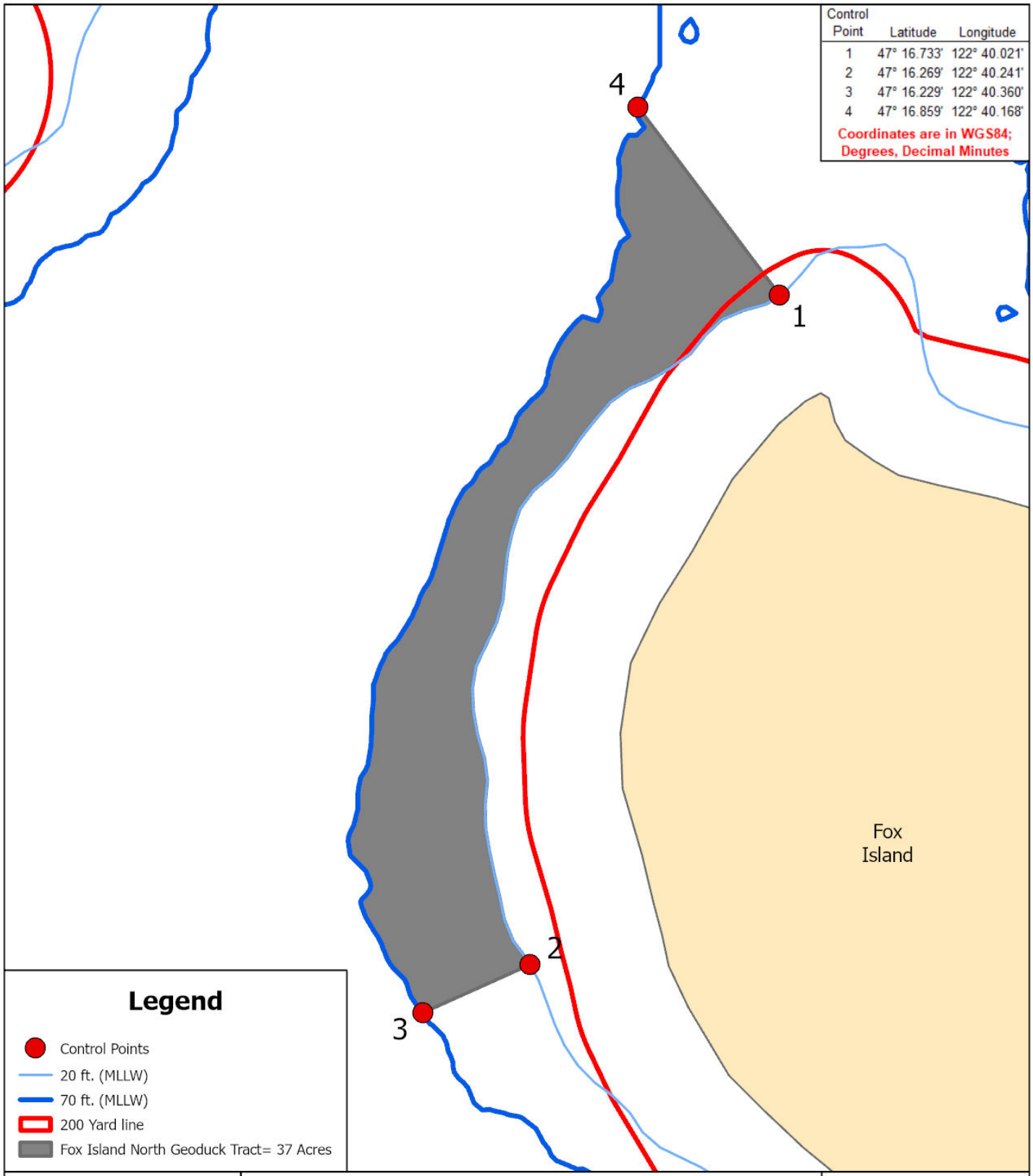

Figure 3. Transect and Dig Station Map, Fox Island North Commercial Geoduck Tract #11200

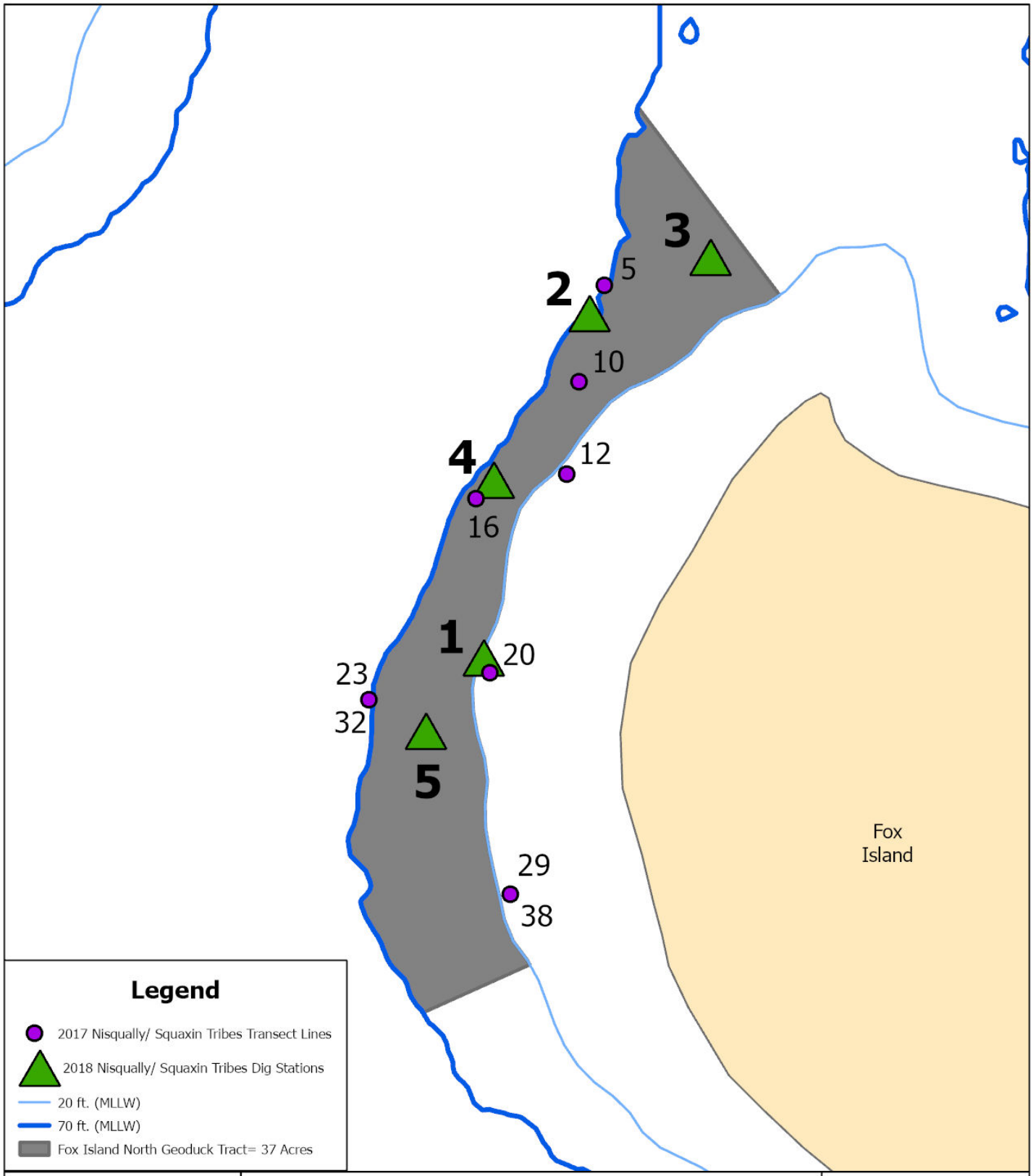

Figure 4. Fish Spawning Areas Near the Fox Island North Commercial Geoduck Tract #11200

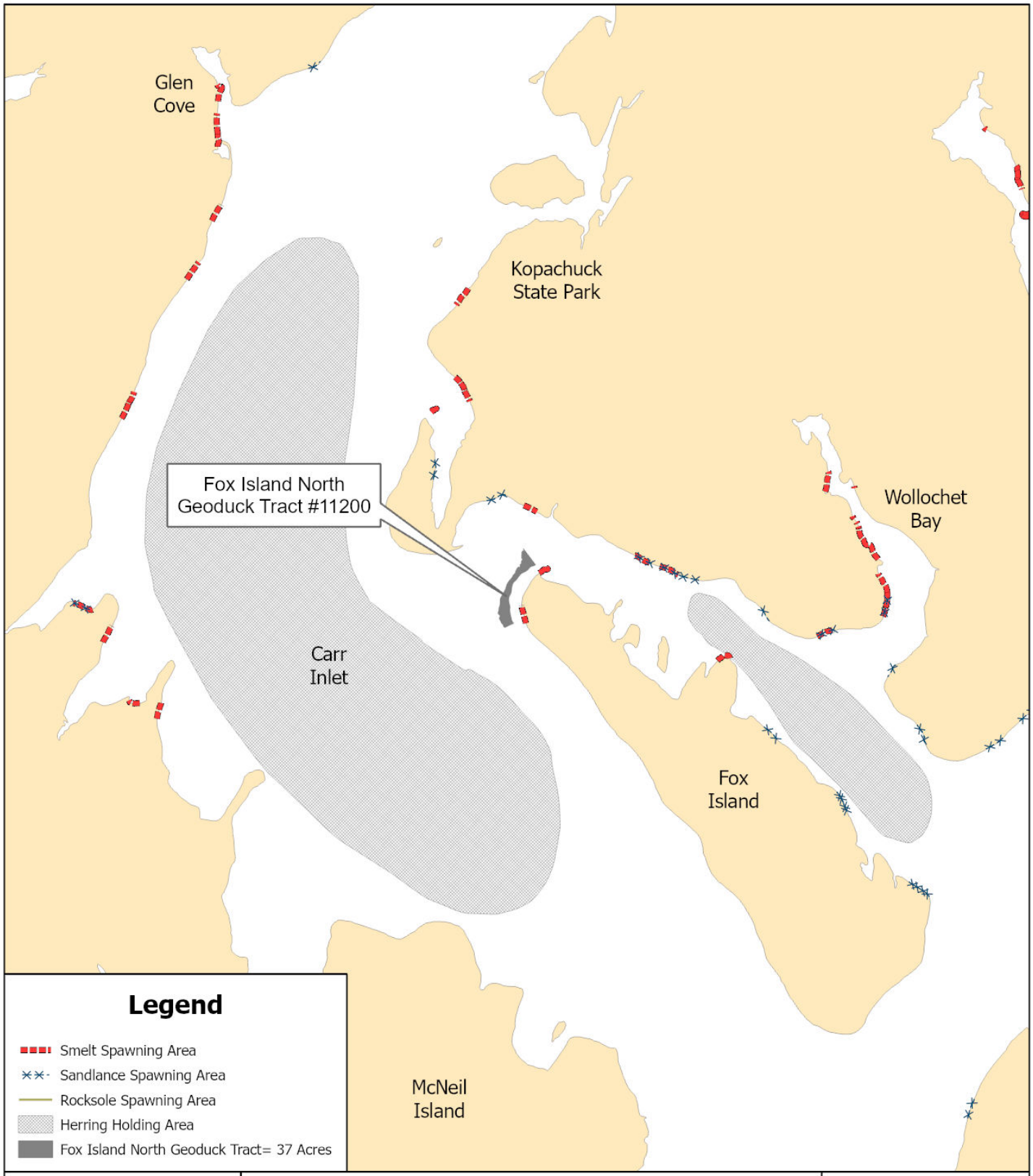

Figure 5. Potential Dungeness Crab Habitat Map, Fox Island North Commercial Geoduck Tract #11200

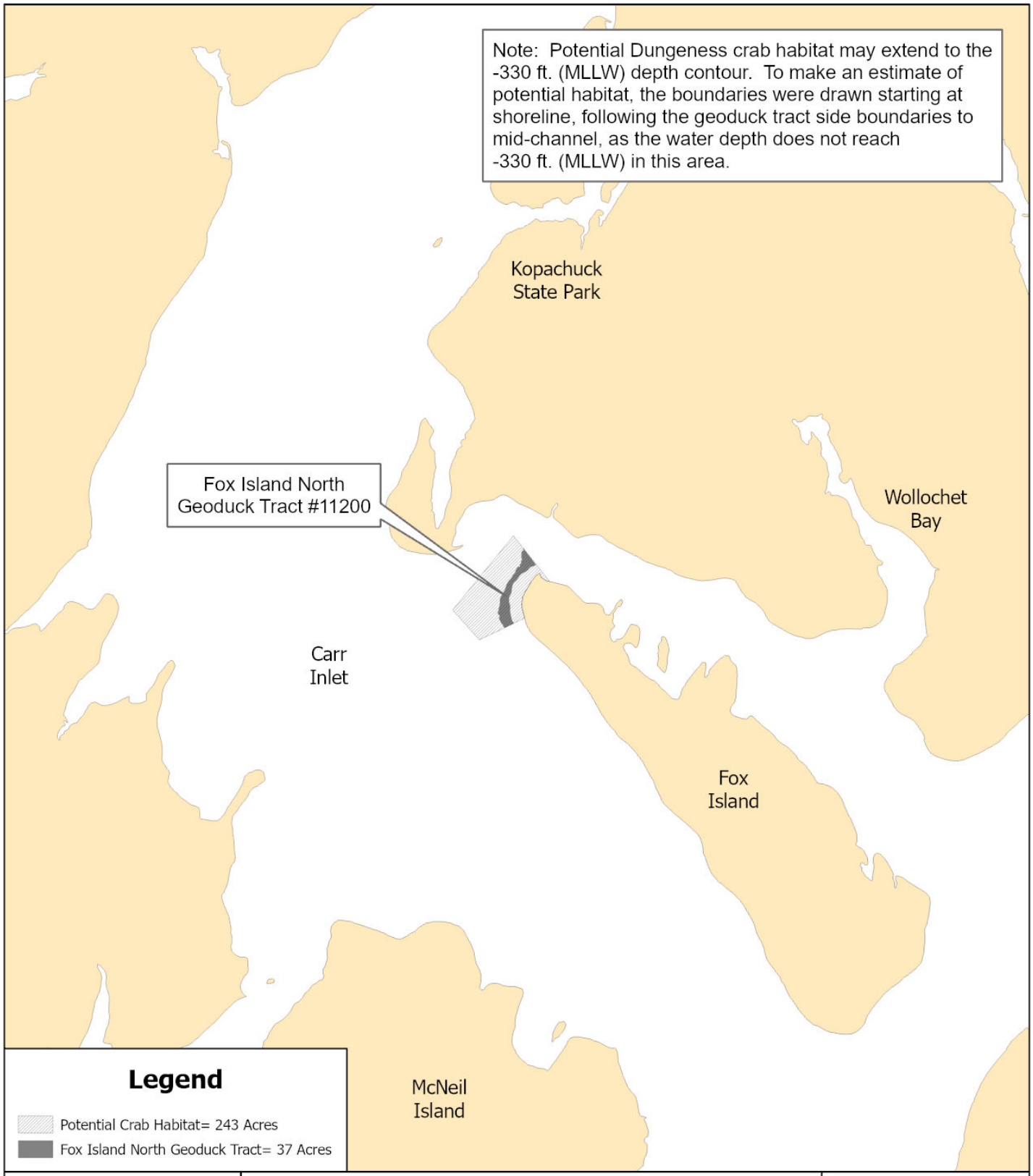

Table 1. GEODUCK TRACT SUMMARY

Fox Island North geoduck tract # 11200

Tract Name	Fox Island North
Tract Number	11200
Tract Size (acres) [a]	37
Density of geoducks/sq.ft. [b]	0.122
Total Tract Biomass (lbs.) [b]	467,491
Total Number of Geoducks on Tract [b]	196,752
Confidence Interval (%)	24.0%
Mean Geoduck Whole Weight (lbs.)	2.38
Mean Geoduck Siphon Weight (lbs.)	N/A
Siphon Weight as a % of Whole Weight	N/A
Number of 900 sq.ft. Transect Stations	38
Number of Geoducks Weighed	51

[a.] Tract area is between the -20 ft. and -70 ft. (MLLW) water depth contours

[b.] Based on the 2017/ 2018 Nisqually/Squaxin Pre-fishing Survey biomass of 791,962 lbs, minus harvest of 324,471 lbs through July 22, 2024

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Table 2. DIGGING DIFFICULTY TABLE

Fox Island North geoduck tract # 11200, 2017- 2018 Nisqually and Squaxin Island Tribes 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)
1	0	2	0	0	0	0	0	0	Y
2	1	0	0	0	0	1	0	0	Y
3	3	0	1	0	2	2	0	0	N
4	0	0	0	0	0	0	0	0	Y
5	0	0	0	0	0	0	0	0	Y

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

Fox Island North geoduck tract # 11200, 2017- 2018 Nisqually and Squaxin Island Tribes Pre-fishing Survey

Survey Date	Transect	Start Depth (ft.) [a]	End Depth (ft.) [a]	Geoduck Density (no. / sq.ft.) [b]	Substrate [c] sand
8/17/2017	1	26	35	0.0813	2
8/17/2017	2	35	41	0.2304	2
8/17/2017	3	41	56	0.3211	2
8/17/2017	4	56	67	0.4607	2
8/17/2017	5	67	70	0.6152	2
8/17/2017	6	27	25	0.1463	2
8/17/2017	7	26	26	0.2331	2
8/17/2017	8	26	22	0.0420	2
8/24/2017	9	43	66	0.3644	2
8/24/2017	10	66	58	0.4889	2
8/24/2017	11	58	40	0.4474	2
8/24/2017	12	40	20	0.1348	2
8/24/2017	13	20	38	0.1319	2
8/24/2017	14	38	53	0.3867	2
8/24/2017	15	53	70	0.2356	2
8/24/2017	16	70	60	0.2859	2
8/24/2017	17	61	46	0.2356	2
8/24/2017	18	45	29	0.1644	2
8/24/2017	19	29	26	0.0933	2
8/24/2017	20	26	20	0.0978	2
10/2/2017	21	28	42	0.1380	2
10/2/2017	22	42	60	0.2424	2
10/2/2017	23	60	66	0.1684	2
10/2/2017	24	66	54	0.2626	2
10/2/2017	25	54	46	0.3468	2
10/2/2017	26	46	38	0.1448	2
10/2/2017	27	38	30	0.0909	2
10/2/2017	28	30	27	0.1111	2
10/2/2017	29	27	21	0.0337	2
10/2/2017	30	28	42	0.0938	2
10/2/2017	31	42	60	0.2123	2
10/2/2017	32	60	66	0.1728	2
10/2/2017	33	66	54	0.1580	2
10/2/2017	34	54	46	0.2272	2
10/2/2017	35	46	38	0.0938	2
10/2/2017	36	38	30	0.0642	2
10/2/2017	37	30	27	0.0494	2
10/2/2017	38	27	21	0.0444	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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Fox Island North geoduck tract # 11200, 2017- 2018 Nisqually and Squaxin Island Tribes Pre-fishing Survey

Dig Station	Number Dug	Avg. Whole Weight (lbs.)	Avg. Siphon Weight (lbs.)	% of geoducks on station greater than 2 lbs.
1	10	3.58	N/A	100%
2	10	2.34	N/A	70%
3	10	1.44	N/A	33%
4	11	2.03	N/A	64%
5	10	2.42	N/A	80%

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Table 5. TRANSECT CORRECTED GEODUCK COUNT AND POSITION TABLE

Fox Island North geoduck tract # 11200, 2017- 2018 Nisqually and Squaxin Island Tribes Pre-fishing Survey

Survey Date	Transect	Corrected Count	Show Factor [a]	Latitude [b]	Longitude [b]
8/17/2017	1	60	0.820		
8/17/2017	2	170	0.820		
8/17/2017	3	237	0.820		
8/17/2017	4	340	0.820		
8/17/2017	5	454	0.820	47.27892	-122.66995
8/17/2017	6	108	0.820		
8/17/2017	7	172	0.820		
8/17/2017	8	31	0.820		
8/24/2017	9	246	0.75		
8/24/2017	10	330	0.75	47.2778	-122.67033
8/24/2017	11	302	0.75		
8/24/2017	12	91	0.75	47.27673	-122.67050
8/24/2017	13	89	0.75		
8/24/2017	14	261	0.75		
8/24/2017	15	159	0.75		
8/24/2017	16	193	0.75	47.27642	-122.67202
8/24/2017	17	159	0.75		
8/24/2017	18	111	0.75		
8/24/2017	19	63	0.75		
8/24/2017	20	66	0.75	47.27442	-122.6717
10/2/2017	21	41	0.66		
10/2/2017	22	72	0.66		
10/2/2017	23	50	0.66	47.27407	-122.67373
10/2/2017	24	78	0.66		
10/2/2017	25	103	0.66		
10/2/2017	26	43	0.66		
10/2/2017	27	27	0.66		
10/2/2017	28	33	0.66		
10/2/2017	29	10	0.66	47.27188	-122.67125
10/2/2017	30	19	0.45		
10/2/2017	31	43	0.45		
10/2/2017	32	35	0.45	47.27407	-122.67373
10/2/2017	33	32	0.45		
10/2/2017	34	46	0.45		
10/2/2017	35	19	0.45		
10/2/2017	36	13	0.45		
10/2/2017	37	10	0.45		
10/2/2017	38	9	0.45	47.27188	-122.67125

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

[b.] Latitude and longitude are in decimal degrees (WGS84)

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Table 6. MOST COMMON AND OBVIOUS ANIMALS OBSERVED

Fox Island North geoduck tract # 11200, 2017- 2018 Nisqually and Squaxin Island Tribes Pre-fishing Survey

# of Transects where Observed	Group	Common Name	Taxonomer
3	Bivalve	Horse Clam	*Tresus spp.*
10	Cnidarian	Sea Pen	*Ptilosarcus gurneyi*
3	Cnidarian	Plumed Anemone	*Metridium spp.*
1	Cnidarian	Striped Anemone	*Urticina spp.*
6	Crab	Dungeness Crab	*Metacarcinus magister*
8	Crab	Red Rock Crab	*Cancer productus*
2	Crab	Graceful Crab	*Cancer gracilis*
1	Crab	Kelp Crab	*Pugettia spp.*
7	Echinoderm	Sunflower Sea Star	*Pycnopodia helianthoides*
1	Echinoderm	Ochre Star	*Pisaster ochraceus*
2	Echinoderm	Echinoderm	Unspecified Echinoderm
5	Fish	Flatfish	Unspecified Flatfish
2	Fish	Sculpin	Unspecified *Cottidae*
6	Gastropod	Nudibranch	Unspecified Nudibranch
2	Polychaete	Tube Worm	Unspecified *Serpulidae*
1	Shrimp	Ghost Shrimp	Unspecified Ghost Shrimp

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Table 7. MOST COMMON AND OBVIOUS ALGAE OBSERVED

Fox Island North geoduck tract # 11200, 2017- 2018 Nisqually and Squaxin Island Tribes Pre-fishing Survey

# of Transects where observed	Taxonomer
3	*Laminaria* spp.
5	*Ulva* spp.
3	*Gracilaria spp.*
2	Unspecified small red algae

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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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