EXHIBIT A

ENVIRONMENTAL ASSESSMENT OF PROPOSED GEODUCK HARVEST
ALONG THE NORTHERLY SHORELINES OF HENDERSON INLET
AT THE ITSAMI GEODUCK TRACT (#16300)

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 six 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: 2019 - 2020

Tract name: Itsami tract (Tract #16300)

Description: (Figure 1, Tract vicinity map)

The Itsami geoduck tract is a subtidal area of approximately 125 acres (Table 1) along the northwesterly shoreline of Henderson Inlet in the South Puget Sound Geoduck Management Region. The southern boundary of the tract begins approximately 350 yards northeasterly of the point at the westerly entrance of Henderson Inlet. The southern tract boundary line continues westerly along the -18 foot water depth contour (corrected to mean lower low water, MLLW; 0.0 tide height) about 735 yards. The tract lies northerly and easterly of this southern boundary line in the vicinity of the Itsami Ledge navigation marker. The commercial tract area lies between the minus 18 foot and minus 70 foot (MLLW) water depth contours.

The Itsami tract is not contiguous with other geoduck tracts in this area. The Itsami geoduck tract is bounded by a line projected easterly from a control point (CP) on the -18 foot (MLLW) water depth contour at 47° 09.992’ N. Latitude, 122° 50.372’ W. Longitude (CP 1) along the -18 foot (MLLW) water depth contour to a point at 47° 10.021’ N. Latitude, 122° 50.881’ W. Longitude (CP 2); then northerly to a point on the -70 foot (MLLW) water depth contour at 47° 10.238’ N. Latitude, 122° 50.906’ W. Longitude (CP 3); then northeasterly along the -70 foot (MLLW) water depth contour to a point at 47° 10.374’ N. Latitude, 122° 50.657’ W. Longitude (CP 4); then due east to a point at 47° 10.374’ N. Latitude, 122° 50.269’ W. Longitude (CP 5); then southerly and easterly along the -18 foot (MLLW) water depth contour to the point at 47° 10.374’ N. Latitude, 122° 50.158’ W. Longitude (CP 6); then due east to a point at 47° 10.374’ N. Latitude, 122° 50.065’ W. Longitude (CP 7); then southerly along the -70 foot (MLLW) water depth contour to the point at 47° 10.256’ N. Latitude, 122° 50.141’ W. Longitude (CP 8); then southwesterly to the point at 47° 10.208’ N. Latitude, 122° 50.214’ W. Longitude (CP 9); then southwesterly to the point at 47° 10.064’ N. Latitude, 122° 50.280’ W. Longitude (CP 10); then due south to the point at 47° 09.992’ N. Latitude, 122° 50.280’ W. Longitude (CP 11); then due west 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 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 can be strong in the vicinity of the Itsami tract. Currents reach a maximum flood velocity of 2.9 knots and maximum ebb velocity of 3.9 knots (Tides and Currents software; station #1846; Dana Passage; projected estimates are within the June 26, 2019 to June 26, 2020 time frame).

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 sand predominant on 48 of 56 transects (Table 3). Mixtures of sand and cobble were noted on 18 transects, sand and shell on 9 transects, mud on 7 transects and boulders on 14 transects. Eighteen transects have cobble as the predominant substrate, which may present a significant hindrance to digging geoducks.

Water Quality:

Water quality is good at the Itsami 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 water acidity at this water depth range and within this time frame varied between a pH of 7.6 to 8.8.

On March 6, 2013 the DOH provided an upgrade notification for the most westerly portion of this tract. 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 to export geoducks to China. More detailed information regarding arsenic can be found at the DOH web site, including a fact sheet found at http://www.doh.wa.gov/Portals/1/Documents/4400/332-146-Arsenic-in-Shellfish.pdf. DNR will verify the health status of the Itsami tract prior to any state managed commercial geoduck harvest on this tract.

Biota:

Geoduck:

The Itsami geoduck tract is approximately 125 acres and contains an estimated 1,504,438 pounds of geoducks (Table 1). The geoduck biomass on this tract is based on a 2018 biological survey. Geoducks are considered commercial quality on all of the dig stations (Table 2). Three 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, averaging 0.121 geoducks/sq.ft. The density on the pre-fishing surveys range from 0.000 geoducks/sq.ft. on transects 46 and 56 to 0.476 geoducks/sq.ft. on transect 24 (Figure 3, Table 3, Table 4). The weight of geoducks at the Itsami tract are moderate for Puget Sound, averaging 2.28 pounds. The lowest average whole weight is 1.67 pounds per geoduck at station #30 and the highest average whole weight is 2.92 pounds per geoduck at station #10 (Table 5).

The Itsami geoduck tract was formerly named Henderson 2. This area was surveyed by WDFW in 1979 and was harvested in 1980-81; 566,000 pounds landed. The tract was resurveyed by WDFW in 1984 and was harvested in 1985; 1,112,000 pounds landed. Post-harvest surveys were conducted in 1986, 1992, and 2011. The 2011 surveyed density was not significantly different than the original pre-fishing survey estimate, and this tract was considered recovered. Commercial harvest began again on this tract by treaty tribes in 2012 and continued until 2016 with 1,657,296 pounds landed. The tract was considered fished down at that point and again placed into recovery status. The tract was surveyed in 2018, originally as a post-harvest survey, during which it was found that there were still commercial densities of geoduck on this tract. This could be due to misreporting or an inaccurate pre-fishing survey.

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 primarily to geoduck's low rate of natural recruitment. WDFW has studied the regeneration rate of geoducks on certain previously harvested tracts scattered throughout Puget Sound. The estimated average time to regenerate a new crop of geoducks after removal of 100 percent of the original geoducks is 39 years. The longest regeneration time is 73 years, and the shortest regeneration time is 11 years. In actual fishing 100 percent of the geoducks are never removed. The average percentage removal of the tracts mentioned above was 69 percent. The regeneration research to empirically analyze tract recovery rates is continuing. A detrimental impact to tract regeneration is illegal unreported harvest.

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 also is associated with rockfish and lingcod. The fish observed during the surveys at the Itsami tract were various species of flatfish, sanddabs, sculpins, and gobies.

WDFW marine fish managers were asked of their concerns of any possible impacts on groundfish and baitfish that geoduck fishing would have. 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. No eelgrass has been observed along this tract below a depth of –16 feet (MLLW). The Itsami nearshore tract boundary will be along the -18 foot (MLLW) water depth contour to provide year-round protection to Pacific herring spawning habitat and 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 Itsami 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 Itsami 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 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 rock fish 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 include 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 Itsami 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.

Streams or tributaries near the Itsami 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 Itsami tract will assure that geoduck harvest will likely have no impact on steelhead populations.

Green sturgeon has 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 Itsami 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 were observed which are frequently found on geoduck beds were observed on this tract, including anemones, bivalves, cnidarians, crab, echinoderms, gastropods, nudibranchs, sea stars, crustaceans, and annelid worms (Table 6). Geoduck harvest has not been shown to have long-term adverse effects on these invertebrates. Geoduck harvest can depress 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 has determined that Dungeness crab utilize Puget Sound bottoms from the +1 foot level out to the minus 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) confirm 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 out to –360 foot (MLLW) water depth contour (Figure 5, Potential crab habitat map). The entire crab habitat along this tract is approximately 331 acres. There are about 665,642 harvestable geoducks on this tract, from the 2018 survey estimate. With a harvest of 65 percent, the total number harvested would be 432,345 geoducks. Approximately 1.18 square feet of substrate is disturbed for every geoduck harvested, so 432,345 x 1.18 = 510,167 square feet of substrate. This equals about 11.71 acres. This is about 3.5 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 geoduck surveys include Laminarian algae; Desmarestian algae; Ulva (sea lettuce); small foliose red algae, filamentous brown algae and diatoms (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. This was confirmed by WDFW Habitat Division who stated 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 2011/2012 surveys. The shoreward boundary of this tract will be no shallower than the minus 18 foot water depth contour (MLLW), which should provide 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 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 (http://www.nwr.noaa.gov/Marine-Mammals/Whales-Dolphins-Porpoise/Killer-Whales/ESA-Act-Status/Listing-Final.cfm). 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 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 property at Henderson Inlet, along the Itsami tract is designated a Rural along the western shoreline and Conservancy along the eastern shoreline.

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 Itsami 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 Itsami geoduck tract located along the northern shorelines at the mouth of Henderson Inlet. The tract was most recently surveyed in the year 2018. 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 be deeper and seaward of the -18 foot (MLLW) water depth contour. No significant impacts are expected from this harvest.

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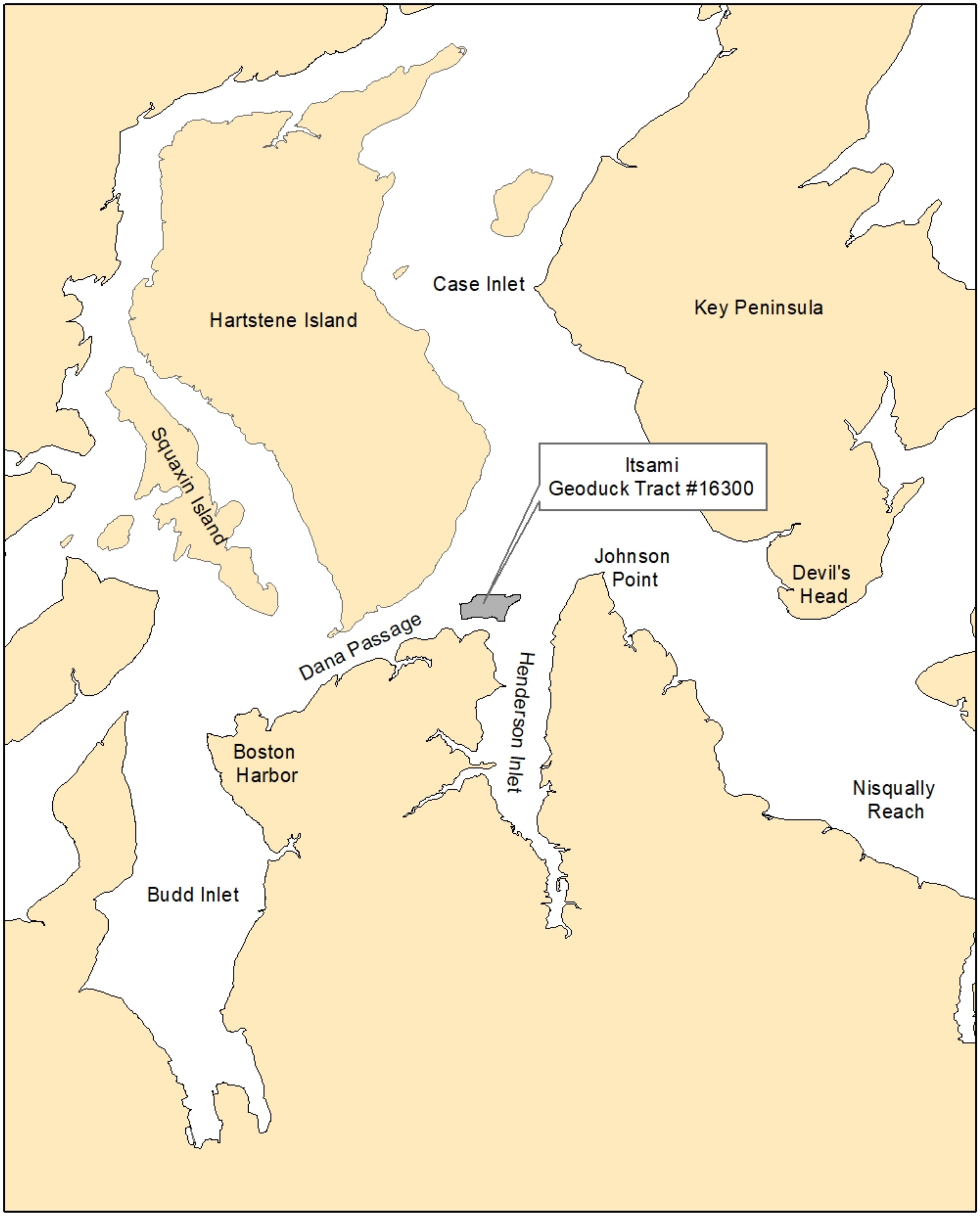
Figure 1. Vicinity Map, Itsami Commercial Geoduck Tract #16300



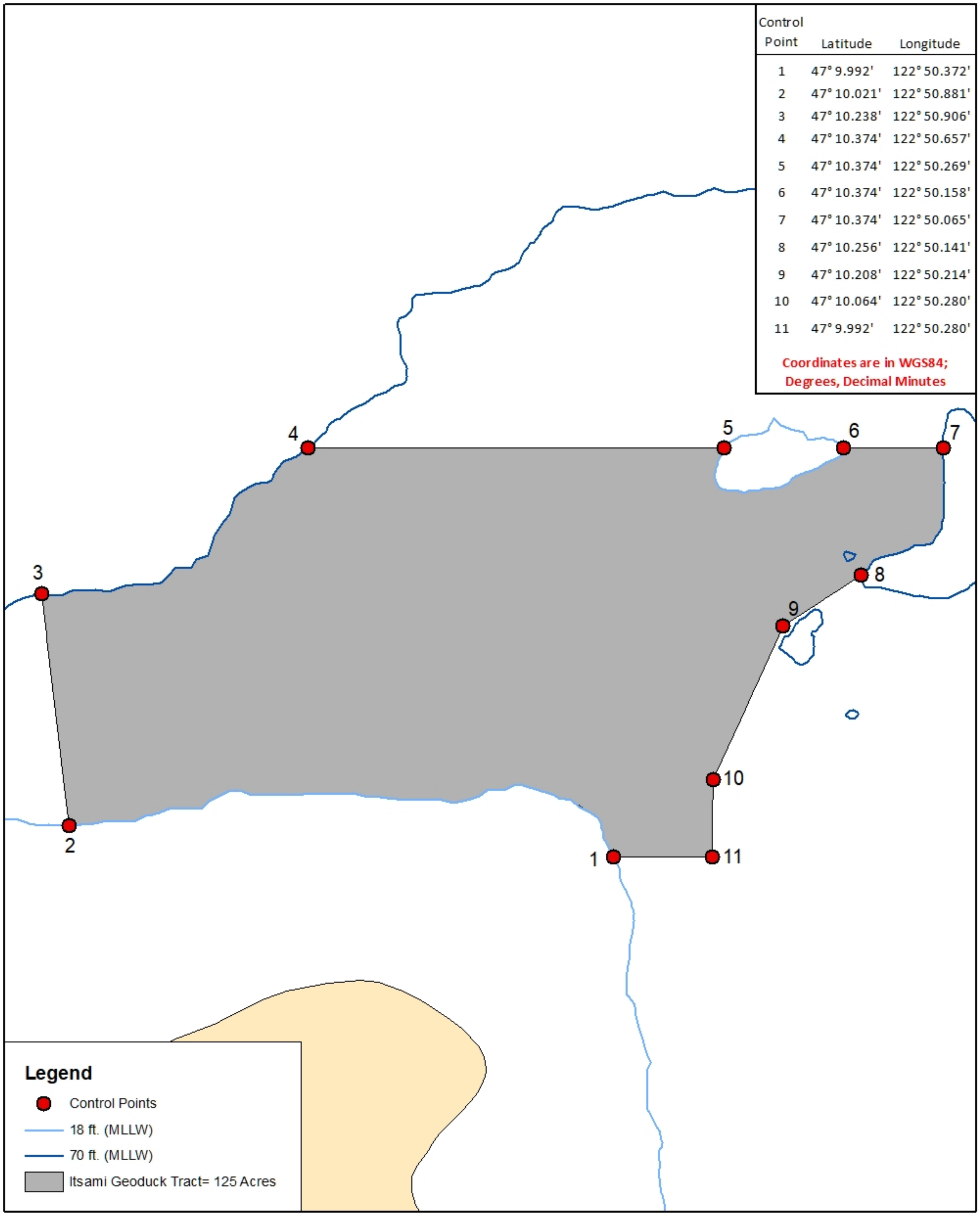
1:150,000
1 inch = 2.37 miles

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

0 0.75 1.5 3 4.5 Miles

Map Date: May 2, 2019
Map Author: O. Working
File: Data\Geoduck

Figure 2. Control Points Map, Itsami Commercial Geoduck Tract #16300



Control Point	Latitude	Longitude
1	47° 9.992'	122° 50.372'
2	47° 10.021'	122° 50.881'
3	47° 10.238'	122° 50.906'
4	47° 10.374'	122° 50.657'
5	47° 10.374'	122° 50.269'
6	47° 10.374'	122° 50.158'
7	47° 10.374'	122° 50.065'
8	47° 10.256'	122° 50.141'
9	47° 10.208'	122° 50.214'
10	47° 10.064'	122° 50.280'
11	47° 9.992'	122° 50.280'

Coordinates are in WGS84; Degrees, Decimal Minutes

N W E S

1:10,000
1 inch = 0.16 miles

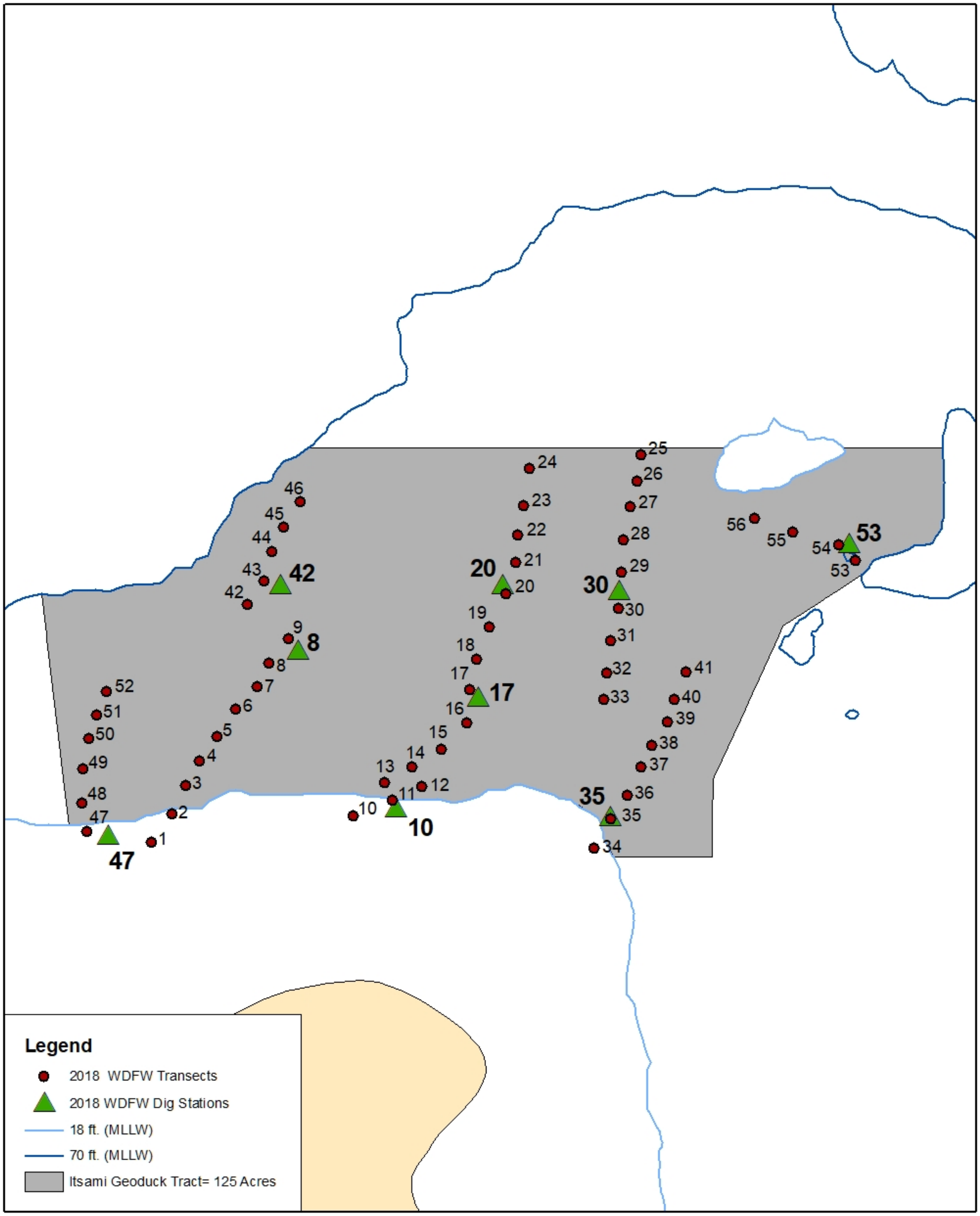
Data Sources:
Projection for data is GCS_Washington Geographic System 1984,
Units: Decimal Degrees. Coastline layer is from DNR, 1: 24,000 scale,
created 09-20-99. Contours are from NOAA soundings.

0 0.05 0.1 0.2 0.3 Miles

Washington Department of FISH and WILDLIFE

Map Date: May 2, 2019
Map Author: O. Working
File: Data\Geoduck

Figure 3. Transect and Dig Station Map, Itsami Commercial Geoduck Tract #16300



1:10,000

1 inch = 0.16 miles

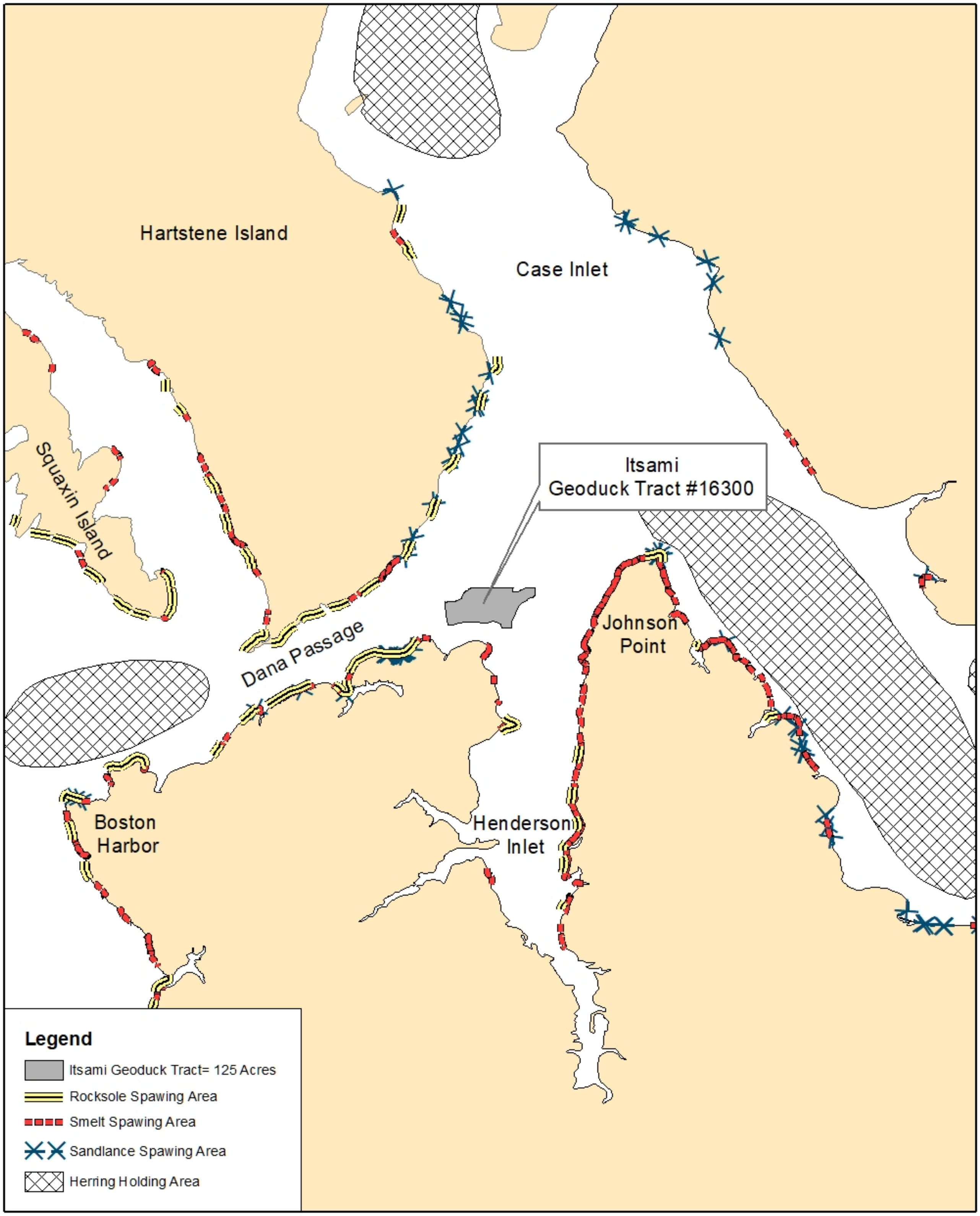
Data Sources:
Projection for data is GCS_Washington Geographic System 1984,
Units: Decimal Degrees. Coastline layer is from DNR, 1: 24,000 scale,
created 09-20-99. Contours are from NOAA soundings.

0 0.05 0.1 0.2 0.3 Miles

Washington Department of Fish and Wildlife

Map Date: May 2, 2019
Map Author: O. Working
File: Data\Geoduck

Figure 4. Fish Spawning Areas Near the Itsami Commercial Geoduck Tract #16300



N W E S

1:100,000
1 inch = 1.58 miles

Data Sources:
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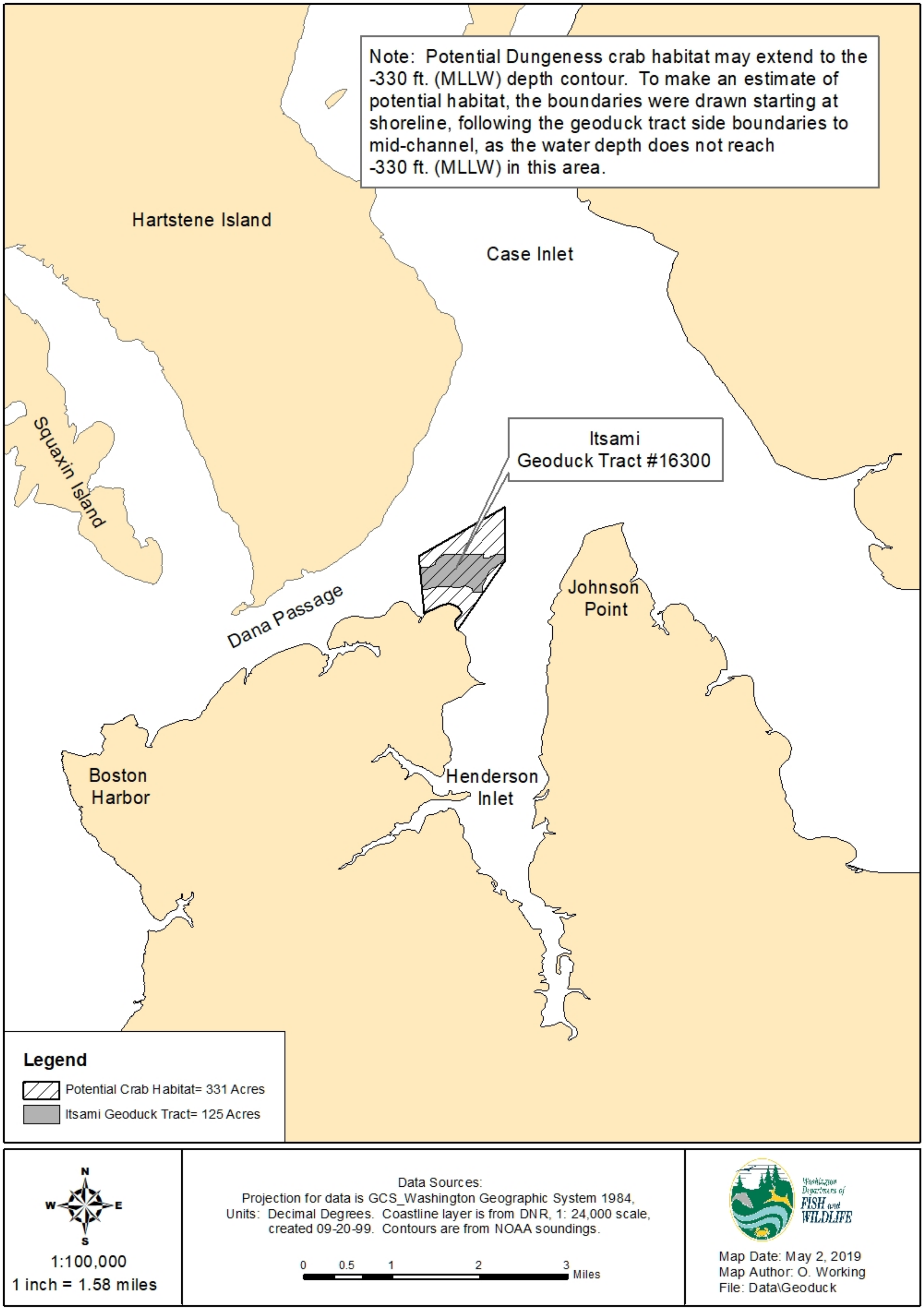
created 09-20-99. Contours are from NOAA soundings.

0 0.5 1 2 3 Miles

Washington Department of FISH and WILDLIFE

Map Date: May 2, 2019
Map Author: O. Working
File: Data\Geoduck

Figure 5. Potential Dungeness Crab Habitat Map, Itsami Commercial Geoduck Tract #16300



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

Washington Department of FISH and WILDLIFE

Map Date: May 2, 2019
Map Author: O. Working
File: Data\Geoduck

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	Some difficulty	Substrate may be compact or contain gravel, shell or 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 algae is listed in *Taxonomer*.

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Table 1. GEODUCK TRACT SUMMARY

Itsami geoduck tract # 16300.

Tract Name	Itsami
Tract Number	16300
Tract Size (acres)a	125
Density of geoducks/sq.ftb	0.121
Total Tract Biomass (lbs.)b	1,504,438
Total Number of Geoducks on Tractb	660,230
Confidence Interval (%)	23.84%
Mean Geoduck Whole Weight (lbs.)	2.28
Mean Geoduck Siphon Weight (lbs.)	0.41
Siphon Weight as a % of Whole Weight	18%
Number of 900 sq.ft. Transect Stations	56
Number of Geoducks Weighed	92

a. Tract area is between the -18 ft. and -70 ft. (MLLW) water depth contours
b. Biomass is based on the 2018 WDFW Pre-fishing geoduck survey biomass of 1,515,642 lbs. minus harvest of 11,204 lbs. through June, 2019

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Table 2: DIGGING DIFFICULTY TABLE

Itsami geoduck tract #16300, 2011 and 2012 WDFW and Squaxin Tribe pre-fishing surveys.

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)
6/4/2018	8	3	1	1	1	1	1	0	0	Y
6/4/2018	10	2	1	1	0	0	1	1	0	Y
6/4/2018	17	3	2	1	1	1	2	0	0	Y
6/4/2018	20	1	2	1	1	0	0	0	0	Y
6/4/2018	42	4	2	1	0	1	2	1	0	Y
6/4/2018	53	2	2	1	2	0	0	0	0	Y
6/5/2018	30	1	1	1	1	0	0	0	0	Y
6/5/2018	35	2	2	0	1	0	1	1	0	Y
6/5/2018	47	1	2	0	1	0	1	0	0	Y

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

Itsami geoduck tract #16300, 2018 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	shell	cobble	gravel	hardpan	boulder
4/30/2018	1	19	21	0.1018	2						
4/30/2018	2	21	23	0.0189	2						
4/30/2018	3	23	26	0.0138	2						
4/30/2018	4	26	30	0.0113	2						
4/30/2018	5	31	37	0.0239	2						
4/30/2018	6	37	40	0.0352	2						
4/30/2018	7	40	44	0.1659	2						
4/30/2018	8	45	48	0.1923	2						
4/30/2018	9	49	50	0.2187	2						1
4/30/2018	10	18	18	0.2426	2						
4/30/2018	11	18	23	0.0251	2			1			1
4/30/2018	12	23	24	0.1056	2			1			1
4/30/2018	13	24	27	0.1194	2						1
4/30/2018	14	26	27	0.2011	2						1
4/30/2018	15	27	26	0.0616	2				1		1
5/1/2018	16	25	27	0.0630	2			1	1		1
5/1/2018	17	28	30	0.1488	2			1	1	1	1
5/1/2018	18	31	33	0.1019	2						
5/1/2018	19	33	38	0.3619	2						
5/1/2018	20	38	39	0.2211	2				1		
5/1/2018	21	39	37	0.0054	2			1	1		
5/1/2018	22	37	40	0.0255	2			1	1		1
5/1/2018	23	40	49	0.4115	2			1	1		
5/1/2018	24	49	54	0.4758	2			1	1		
5/1/2018	25	42	34	0.0241	2		1			1	
5/1/2018	26	34	32	0.1233	2		1			1	1
5/1/2018	27	32	37	0.2386	2				1		1
5/1/2018	28	36	38	0.1300	2		1				
5/1/2018	29	38	39	0.1139	2						
5/1/2018	30	39	40	0.1742	2						
5/1/2018	31	39	43	0.1608	2						
5/1/2018	32	43	48	0.0791	2	1					
5/1/2018	33	48	47	0.1193		2					
5/2/2018	34	18	22	0.0330	2						
5/2/2018	35	22	32	0.0473	2	1	1				
5/2/2018	36	32	40	0.0502	1	2					
5/2/2018	37	40	45	0.0559		2					
5/2/2018	38	46	47	0.0717		2					
5/2/2018	39	47	50	0.0516		2					
5/2/2018	40	51	47	0.0502		2					
5/2/2018	41	47	43	0.1792	1	2					
5/2/2018	42	59	61	0.3226	2		1				
5/2/2018	43	61	63	0.1520	2		1	1			
5/2/2018	44	63	65	0.0616	2		1	1			

Table 3. Continued

Survey Date	Transect	Start Depth (ft.) [a]	End Depth (ft.) [a]	Geoduck Density (no. / sq.ft.) [b]	Substrate [c] sand	mud	shell	cobble	gravel	hardpan	boulder
5/2/2018	45	65	63	0.0143	2			1			
5/2/2018	46	64	66	0.0000	2			1			
5/3/2018	47	18	29	0.2669	2						
5/3/2018	48	29	30	0.1701	2			1			
5/3/2018	49	31	36	0.0499	2			1			1
5/3/2018	50	36	40	0.0390	2			1			
5/3/2018	51	40	43	0.0780	2			1			
5/3/2018	52	44	50	0.0640	2			1			1
5/3/2018	53	70	41	0.1623	2						
5/3/2018	54	41	37	0.1873	2						
5/3/2018	55	37	28	0.2122	2		1		1		
5/3/2018	56	28	20	0.0000	1		1	1	2		1

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

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

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

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Table 4: TRANSECT CORRECTED GEODUCK COUNT AND POSITION TABLE

Itsami geoduck tract #16300, 2018 WDFW pre-fishing survey.

Survey Date	Transect	Corrected Count	Show Factor [a]	Latitude [b]		Longitude [b]	
4/30/2018	1	92	0.884	47	10.006	122	50.804
4/30/2018	2	17	0.884	47	10.032	122	50.785
4/30/2018	3	12	0.884	47	10.059	122	50.772
4/30/2018	4	10	0.884	47	10.082	122	50.759
4/30/2018	5	21	0.884	47	10.105	122	50.743
4/30/2018	6	32	0.884	47	10.130	122	50.725
4/30/2018	7	149	0.884	47	10.151	122	50.705
4/30/2018	8	173	0.884	47	10.173	122	50.694
4/30/2018	9	197	0.884	47	10.196	122	50.676
4/30/2018	10	218	0.884	47	10.031	122	50.616
4/30/2018	11	23	0.884	47	10.045	122	50.579
4/30/2018	12	95	0.884	47	10.058	122	50.552
4/30/2018	13	107	0.884	47	10.062	122	50.586
4/30/2018	14	181	0.884	47	10.076	122	50.561
4/30/2018	15	55	0.884	47	10.093	122	50.533
5/1/2018	16	57	0.829	47	10.117	122	50.510
5/1/2018	17	134	0.829	47	10.148	122	50.507
5/1/2018	18	92	0.829	47	10.177	122	50.500
5/1/2018	19	326	0.829	47	10.207	122	50.489
5/1/2018	20	199	0.829	47	10.238	122	50.473
5/1/2018	21	5	0.829	47	10.267	122	50.464
5/1/2018	22	23	0.829	47	10.293	122	50.462
5/1/2018	23	370	0.829	47	10.320	122	50.457
5/1/2018	24	428	0.829	47	10.355	122	50.451
5/1/2018	25	22	0.829	47	10.368	122	50.347
5/1/2018	26	111	0.829	47	10.343	122	50.351
5/1/2018	27	215	0.829	47	10.319	122	50.357
5/1/2018	28	117	0.829	47	10.288	122	50.363
5/1/2018	29	103	0.829	47	10.258	122	50.365
5/1/2018	30	157	0.829	47	10.224	122	50.368
5/1/2018	31	145	0.829	47	10.194	122	50.375
5/1/2018	32	71	0.829	47	10.164	122	50.379
5/1/2018	33	107	0.829	47	10.139	122	50.382
5/2/2018	34	30	0.775	47	10.000	122	50.391
5/2/2018	35	43	0.775	47	10.028	122	50.375
5/2/2018	36	45	0.775	47	10.050	122	50.360
5/2/2018	37	50	0.775	47	10.076	122	50.347
5/2/2018	38	65	0.775	47	10.096	122	50.337
5/2/2018	39	46	0.775	47	10.118	122	50.322
5/2/2018	40	45	0.775	47	10.139	122	50.316
5/2/2018	41	161	0.775	47	10.165	122	50.305
5/2/2018	42	290	0.775	47	10.228	122	50.714
5/2/2018	43	137	0.775	47	10.250	122	50.699
5/2/2018	44	55	0.775	47	10.277	122	50.691
5/2/2018	45	13	0.775	47	10.300	122	50.680
5/2/2018	46	0	0.775	47	10.324	122	50.665
5/3/2018	47	240	0.712	47	10.016	122	50.864

Survey Date	Transect	Corrected Count	Show Factor [a]	Latitude [b]		Longitude [b]	
5/3/2018	48	153	0.712	47	10.042	122	50.869
5/3/2018	49	45	0.712	47	10.074	122	50.868
5/3/2018	50	35	0.712	47	10.103	122	50.862
5/3/2018	51	153	0.712	47	10.125	122	50.855
5/3/2018	52	45	0.712	47	10.147	122	50.846
5/3/2018	53	35	0.712	47	10.269	122	50.147
5/3/2018	54	70	0.712	47	10.284	122	50.162
5/3/2018	55	58	0.712	47	10.296	122	50.205
5/3/2018	56	146	0.712	47	10.308	122	50.241

[a.] Daily siphon show factor was used to correct combined geoduck counts

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

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Table 5: GEODUCK SIZE AND QUALITY

Itsami geoduck tract #16300, 2018 WDFW pre-fishing survey.

Dig Date	Dig Station	Number Dug	Avg. Whole Weight (lbs.)	Avg. Siphon Weight (lbs.)[a]	% of geoducks on station greater than 2 lbs.
6/4/2018	8	15	2.00	0.44	50%
6/4/2018	10	12	2.92	0.47	82%
6/4/2018	17	11	2.46	0.50	64%
6/4/2018	20	11	2.41	0.39	70%
6/4/2018	42	11	1.87	0.33	18%
6/4/2018	53	11	2.26	0.40	64%
6/5/2018	30	11	1.67	0.29	30%
6/5/2018	35	11	2.66	0.47	82%
6/5/2018	47	11	2.04	0.36	45%

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Table 6: MOST COMMON AND OBVIOUS ANIMALS OBSERVED

Itsami geoduck tract #16300, 2018 WDFW pre-fishing survey.

# of Transects where Observed	Group	Common Name	Taxonomer
32	ANEMONE	BURROWING ANEMONE	*Pachycerianthus fimbriatus*
19	ANEMONE	PLUMED ANEMONE	*Metridium* spp.
34	ANEMONE	STRIPED ANEMONE	*Urticina* spp.
6	BIVALVE	HARDSHELL CLAMS	*Veneridae* spp.
3	BIVALVE	HEART COCKLE	*Clinocardium nuttalli*
40	BIVALVE	HORSE CLAM	*Tresus* spp.
2	BIVALVE	JINGLESHELL OYSTER	*Pododesmus macrochisma*
17	BIVALVE	PIDDOCK	Unspecified Pholadidae
44	CNIDARIA	SEA PEN	*Ptilosarcus gurneyi*
11	CNIDARIA	SEA WHIP	*Stylatula elongata*
10	CRAB	DECORATOR CRAB	*Oregonia gracilis*
4	CRAB	GRACEFUL CRAB	*Cancer gracilis*
40	CRAB	HERMIT CRAB	Unspecified hermit crab
28	CRAB	RED ROCK CRAB	*Cancer productus*
1	CUCUMBER	ORANGE CUCUMBER	*Cucumaria miniata*
3	CUCUMBER	SEA CUCUMBER	*Parastichopus californicus*
1	FISH	BAY PIPEFISH	*Syngnathus leptorhynchus*
2	FISH	COD	*Gadid* spp.
1	FISH	FLATFISH	Unspecified flatfish
1	FISH	SAND LANCE	*Ammodytes hexapterus*
1	FISH	SAND SOLE	*Psettichthys melanostictus*
10	FISH	SANDDAB	*Citharichthys* spp.
16	FISH	SCULPIN	Unspecified Cottidae
6	FISH	STARRY FLOUNDER	*Platichthys stellatus*
7	GASTROPOD	MOON SNAIL	*Polinices lewisii*
26	GASTROPOD	MOON SNAIL EGGS	*Polinices lewisii* egg case
27	GASTROPOD	NASSA SNAILS	*Nassarius* spp.
3	GASTROPOD	NUDIBRANCH	Unspecified nudibranch
5	MISC	SPONGE	Unspecified Porifera
16	NUDIBRANCH	ARMINA	*Armina californica*
5	NUDIBRANCH	DENDRONOTUS	*Dendronotus* spp.
2	NUDIBRANCH	DIRONA	*Dirona albolineata*
2	NUDIBRANCH	ROSY TRITONIA	*Tritonia diomedea*
2	SEA STAR	BLOOD STAR	*Henricia leviuscula*
3	SEA STAR	BRITTLE STAR	Unspecified brittle star
2	SEA STAR	FALSE OCHRE STAR	*Evasterias troschelli*
12	SEA STAR	LEATHER STAR	*Dermasterias imbricata*
1	SEA STAR	RAINBOW STAR	*Orthasterias koehleri*
4	SEA STAR	SHORT-SPINED STAR	*Pisaster brevispinus*
1	SHRIMP	SHRIMP	Unspecified shrimp
29	WORM	ROOTS	Chaetopterid polychaete tubes
35	WORM	SABELLID TUBE WORM	*Sabellid* spp.
2	WORM	TEREBELLID TUBE WORM	*Terebellid* spp.

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Table 7: MOST COMMON AND OBVIOUS ALGAE OBSERVED

Itsami geoduck tract #16300, 2018 WDFW pre-fishing survey.

# of Transects where observed	Taxonomer
22	Desmarestia spp.
11	Diatoms
1	Filamentous brown algae
28	Laminaria spp.
51	Small red algae
33	Ulva spp.

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