EXHIBIT A
ENVIRONMENTAL ASSESSMENT OF PROPOSED GEODUCK HARVEST
IN PIERCE COUNTY AT THE PENITENTIARY GEODUCK TRACT (#12800)

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 six 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: 2019 - 2020

Tract name: Penitentiary Tract (#12800)

Description (Figure 1, Tract vicinity map):

The Penitentiary tract was surveyed for subtidal geoduck clams in the years 2013, 2015, and 2018 by the Nisqually Tribe and Washington Department of Fish and Wildlife (WDFW), respectively. The tract area is approximately 42 subtidal acres along the southern shoreline of McNeil Island in Balch Passage, South Puget Sound. The tract begins about 870 yards westerly of the McNeil Island penitentiary ferry landing and extends westerly about 1,450 yards. The eastern tract boundary line coincides with a WA Department of Health boundary line for a Prohibited Area.

The entire commercial tract area is between the -18 foot (MLLW, depth corrected to mean lower low water) and the -70 foot (MLLW) water depth contour. The Penitentiary geoduck tract is described by a polygon and is bounded by a line projected easterly from a Control Point (CP) on the -18 foot (MLLW) water depth contour at 47°11.459' N. latitude, 122°40.849' W. longitude (CP 1) along the -18 foot (MLLW) water depth contour to a point at 47°11.531' N. latitude, 122°39.832’ W. longitude (CP 2); then southerly to a point on the -70 foot (MLLW) contour line at 47°11.447’ N. latitude, 122°39.781’ W. longitude (CP 3); then westerly along the -70 foot (MLLW) contour to point at 47°11.354’ N. latitude, 122°40.849’ W. longitude (CP 4), then true north to the point of origin (Figure 2).

This estimate of the tract boundary is made using GIS and field data. All contours are corrected to MLLW. Contour GIS layers from Dale Gombert (WDFW) were generated from NOAA soundings. Shoreline data was from DNR, digitized at 1:24000 scale in

1999. The latitude and longitude positions are reported in 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 Balch Passage. Currents reach a maximum flood velocity of 2.3 knots and maximum ebb velocity of 3.9 knots (Tides and Currents software; Balch Passage station #1826; estimated timeframe June 28, 2019 to June 28, 2020.

The Penitentiary tract has a mix of surface substrate types. Sand was the predominant substrate type on all 32 survey transects. Cobble was the predominant substrate type on 3 transects. Gravel, cobble and boulder were also observed as a co-occurring substrate types.

Water Quality:

Water quality is good at the Penitentiary geoduck tract. Water mixing at this tract is affected by the convergence of currents Pitt Passage, Drayton Passage and the main waterway in the southern basin of Puget Sound. A combination of the converging waters and variable bathymetry promotes mixing of water layers 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 has 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 (most recent data years complete), at water depths between 6 and 23 meters, the mean reported dissolved oxygen concentration was 8.3 mg/l and the range was 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". Easterly of this tract is an area that has been classified by DOH as "Prohibited." No portion of the commercial Penitentiary tract (#12800), described above and shown in Figure 1, lies within the DOH Prohibited area. DNR will verify the health status of this tract prior to commercial geoduck harvests.

Biota:

Geoduck:

The Penitentiary tract was first surveyed in 1980 by WDFW, in 2013 by the Nisqually Tribe, and again in 2015 and 2018 by WDFW. Because harvest had exceeded the biomass estimate made from the 2013 / 2015 surveys, but apparent opportunity remained on the tract, WDFW conducted an in-season survey in 2018. The average weight from the Nisqually 2013 and WDFW 2015 surveys is being used to inform the new biomass estimate along with geoduck densities from the 2018 WDFW in-season transect data. Prior to subsequent harvest, the resulting biomass is 803,730 with a density of 0.16 geoducks/sq.ft. This biomass is considered the new "pre-fishing biomass" for this tract.

Tribal commercial geoduck harvest was initiated in 2016 on this tract and both tribal and state harvest is on-going. A total of 38/2,332 pounds of geoduck have been removed from this tract since the 2018 in-season survey, so we estimate that 421,398 pounds of geoduck and a density of 0.08 geoducks/sq.ft**.** remain.

Geoducks at this location are considered commercial quality, and digging difficulty ranges from very easy to easy (Table 2). The average pre-fishing density range from the 2018 In-season survey was 0.00 geoducks/square foot on transect #3 to 0.21 geoducks/square foot on transect #22 (Figure 3; Table 3). The geoducks on the Penitentiary tract are moderate to heavy weight, averaging 2.75 pounds, compared to the Puget Sound average of 2.1 pounds per geoduck clam. The lowest average whole weight was 2.27 pounds per geoduck at Nisqually Tribe station #3 and the highest average whole weight was 3.11 pounds per geoduck at WDFW station #13 (Table 4). Station locations (latitude and longitude) are found in Table 5.

Geoducks are managed for long term sustainable harvest. No more than 2.7% of the commercially fishable stocks are harvested (total fishing mortality) each year, in each harvest management region, throughout Puget Sound. The fishable portion of the total Puget Sound population includes geoducks that are between the -18 feet and -70 feet water depth contours (MLLW). Other geoducks, which are not harvestable, are found inshore and offshore of the harvest areas. Observations in South Puget Sound show that 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 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. The recovery time for the Penitentiary tract is unknown. Recent surveys in South Puget Sound indicate that the rate of tract recovery may have changed dramatically in the last decade, possibly due to lower recruitment, increased mortality, or a combination of both factors. The regeneration 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 sculpins; various flatfish species including sand dabs, rock sole, and starry flounders; bay pipefish and skate egg cases (Table 6).

WDFW marine fish managers were asked of their concerns of any possible impacts on marine fish that geoduck fishing may have. Marine Fish Managers Greg Bargmann and Duane Day have stated that no problems should occur to marine fish stocks or fisheries due to geoduck fishing. Geoduck harvest should not affect any recreational or commercial groundfish fisheries in the vicinity of this tract. Proposed geoduck harvest at this tract is not in the vicinity of any documented herring spawning grounds, though herring “holding areas” are reported in Drayton Passage along the Shoreline of Anderson Island and northerly of McNeil Island in Carr Inlet (Figure 4). There is no concern among WDFW marine fish managers to this proposed geoduck harvest, as long as the minimum harvest depth of -18 ft. (MLLW) is adhered to.

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 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 Penitentiary tract is outside of the critical habitat range for Hood Canal summer run chum salmon.

Critical habitat for Puget Sound Chinook salmon include 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 Penitentiary geoduck tract are Chambers Creek (approximately 3.7 miles from the tract) and the Nisqually River (approximately 7 miles from the tract). The Puget Sound Chinook Salmon Technical Recovery Team (TRT) did not find any evidence that an independent population of Chinook salmon historically existed in Chambers Creek or other nearby South Sound tributaries (Ruckelshaus et al. 2006). 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 Balch Passage that support steelhead stocks. The horizontal separation between tributaries that support steelhead runs and the Penitentiary tract will assure that geoduck harvest will likely have no impact on steelhead populations.

Green sturgeons 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 Penitentiary 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 marine invertebrates are found on geoduck beds throughout Puget Sound. Marine invertebrates observed during the 2018 survey of Penitentiary tract includes: [1] mollusks - horse clams, geoducks, jingleshell oysters, unspecified hardshell clams, nudibranchs (*Dirona* sp. and *Hermissend*a sp.), nassa snails, and moonsnail egg cases; [2] crustaceans - graceful crabs, red rock crabs, hermit crabs, helmet crabs and decorator crabs,; [3] echinoderms – false ochre stars, leather stars, rose stars, sunflower stars, and sea cucumbers; [4] cnidarians - burrowing anemones, plumed anemones, striped anemones, hydroids, sea pens and sea whips; and [5] other marine invertebrates including chaetopterid tube worms, sabellid tube worms, and terebellid tube 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.

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 year study indicated no adverse effects on crab catch-per-unit-effort due to geoduck fishing. Dungeness crab were not observed on this tract. This area is not considered to have significant Dungeness crab habitat.

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 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 in the vicinity of this geoduck bed is approximately 472 acres. From the most recent survey in 2015, there was an estimated 180,870 harvestable geoducks on this tract. With a minimum harvest level of 65 percent of these geoducks, the total number harvested would be 117,566 geoducks. Approximately 1.18 square feet of substrate is disturbed for every geoduck harvested, so 117,566 x 1.18 = 138,727 square feet of substrate. This equals 3.2 acres. This is about 0.7 percent of the total available crab habitat in the vicinity of this tract. This represents a low amount of disturbance compared to the potential crab habitat in the immediate vicinity of this geoduck tract. Since this tract is on the lower fringe of the principle range of distribution of Dungeness crab in Puget Sound, no Dungeness crab were observed during scuba surveys near Penitentiary, combined with the lack of effects observed on Dungeness crab populations at the Thorndyke Bay study, we conclude that any effects on Dungeness crab will be very minor, if they occur at all.

Red rock crab (*Cancer productus*) were observed on 22 of 32 transects on the Penitentiary 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 the Thorndyke Bay study there is a low potential for impacts to red rock crab populations in the vicinity of this tract.

Algae:

Large quantities of attached algae are not generally found in geoduck beds. Light restriction often limits algae growth to areas shallower than where most geoduck harvest occurs. Sea lettuce (*Ulva* sp.), red algae, Laminarian algae, diatoms, Lithothamnion algae, Gigartina algae, Costaria algae and Desmarestia algae were the main algae types observed during the 2018 survey (Table 7).

WDFW conducted an eelgrass survey along the Penitentiary tract on July 14, 2015. The conclusion of this work was that no eelgrass was observed deeper than the -16 foot water depth contour (corrected to MLLW). The shallow boundary line of this tract is set at no shallower than the -18 foot level (MLLW) to conform with state statute (RCW 77.60.070) and also to provide a 2 foot vertical buffer between eelgrass beds and geoduck harvest.

Marine Mammals:

There are 26 species of whales observed in Washington, though many are infrequent visitors to South Puget Sound. In 1990 and 1991 gray whales (*Eschrichtius robustus*) were often observed in South Puget Sound (1990 – 174 sightings, 1991 – 158 sightings) and may occasionally be in the vicinity of the Penitentiary geoduck tract. Harbor porpoise (*Phocoena phocoena*) and harbor seals (*Phoca vitulina*) are other marine mammals that may be observed on or near geoduck tracts occasionally. Seals are commonly observed on the Penitentiary tract.

Killer whales (*Orcinus orca*) may also be observed in the vicinity of this tract. 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. 6/25/03). Precautions should be taken by commercial divers to be aware of whale movements and behavior to eliminate the remote risk of entanglement with vessel and hoses and lines. No conflicts have been observed between marine mammals and geoduck harvest activity.

Birds:

A variety of marine birds are observed in South Puget Sound. These include birds such as murres, murrelets, grebes, loons, scoters, dabbling ducks, mergansers, buffleheads, cormorants, and gulls. Blue heron are also common along the shores of this area. Geoduck harvest does not appear to have any significant effect on these birds or their use of the waters where harvest occurs. A study by DNR and WDFW was conducted at northern Hood Canal to learn the effects of geoduck fishing on bald eagles (Watson *et al*., 1995). A significant conclusion of this study is that commercial harvest of geoduck is unlikely to have any adverse impacts on bald eagle productivity.

Other uses:

Adjacent Upland Use:

The upland property at McNeil Island along the Penitentiary tract is part of the former McNeil Island Correctional Center and is designated “Rural 40.” The shoreline designation is Conservancy. Use of the correctional facility has been greatly reduced in recent years, and to our knowledge only a small prisoner unit remains active. For security purposes, the correctional center has posted signs which require vessels to stay at least 100 yards away from the shore. Geoduck harvest will not infringe on the McNeil Island security buffer.

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 area is not a prime 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:

Balch Passage is not a major navigational route for commercial vessels traveling between ports in southern Puget Sound, however there is ferry traffic between McNeil Island and the mainland. Recreational vessels commonly use Balch Passage to transit between areas within the South Puget Sound Basin. Geoduck harvesting at this site and within allowed harvest depths should not result in any significant navigational conflicts. The Washington Department of Natural Resources will notify the local boating community prior to harvests.

Summary:

Continued commercial geoduck harvest is proposed for the Penitentiary geoduck tract, located along the southern shoreline of McNeil Island. The geoduck population on the tract was most recently surveyed in the year 2013, 2015, and 2018, and the current tract biomass estimate is based on the most recent surveys and geoduck harvest on the tract in 2018. 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 baitfish and eelgrass, harvest will be deeper and seaward of the -18 foot (MLLW) contour. Harvest vessels will remain at least 200 yards from OHT during harvest operations. There effects on marine invertebrates in the vicinity of the tract are expected to be minimal. No other significant impacts are expected from this harvest.

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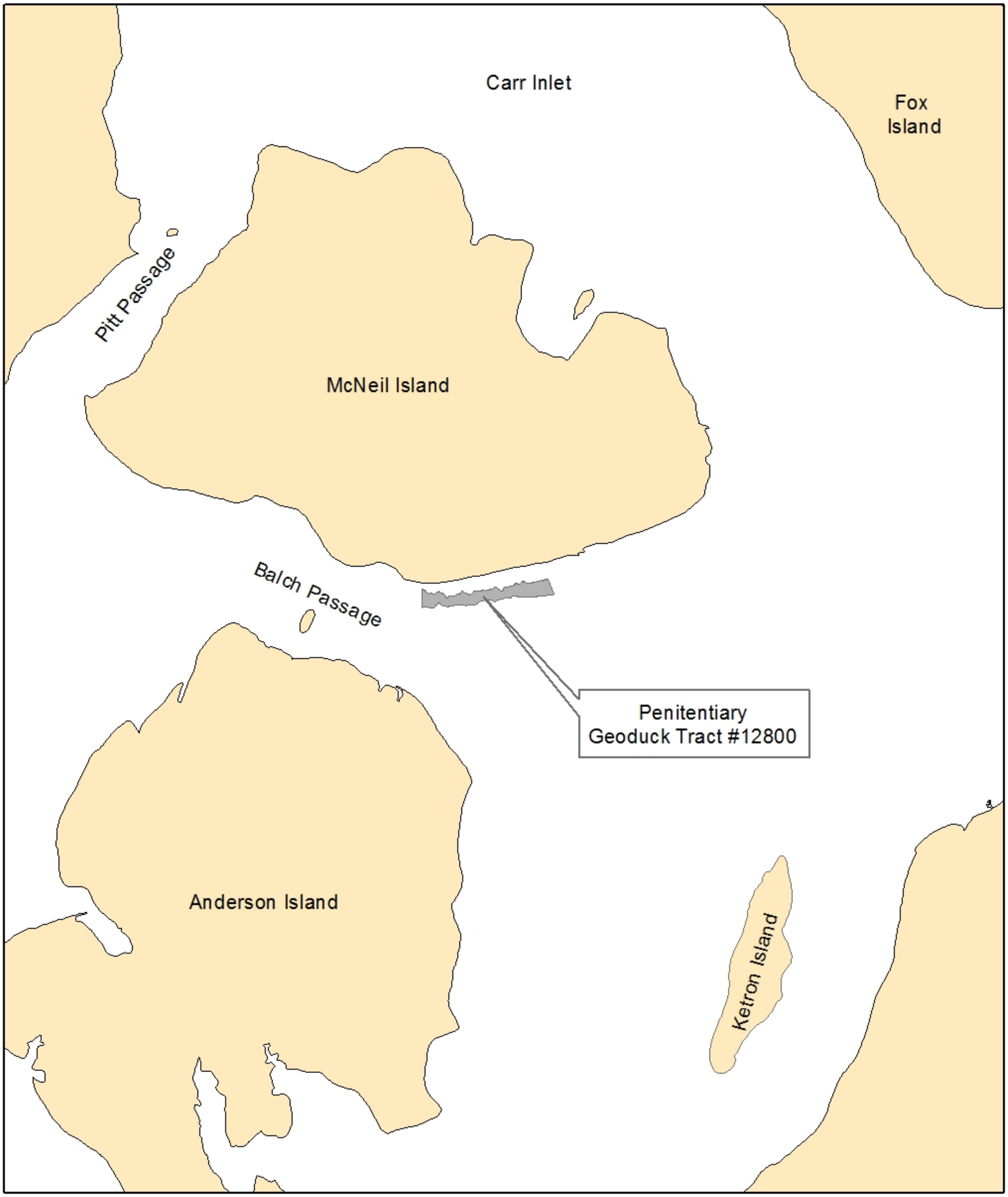
Figure 1. Vicinity Map, Penitentiary Commercial Geoduck Tract #12800



N W E S

1:60,000

1 inch = 0.95 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 0.325 0.65 1.3 1.95 Miles

Washington Department of FISH and WILDLIFE

Map Date: June 21, 2017
Map Author: O. Working
File: Data\Ocean\Geoduck

Figure 2. Control Points Map, Penitentiary Commercial Geoduck Tract #12800

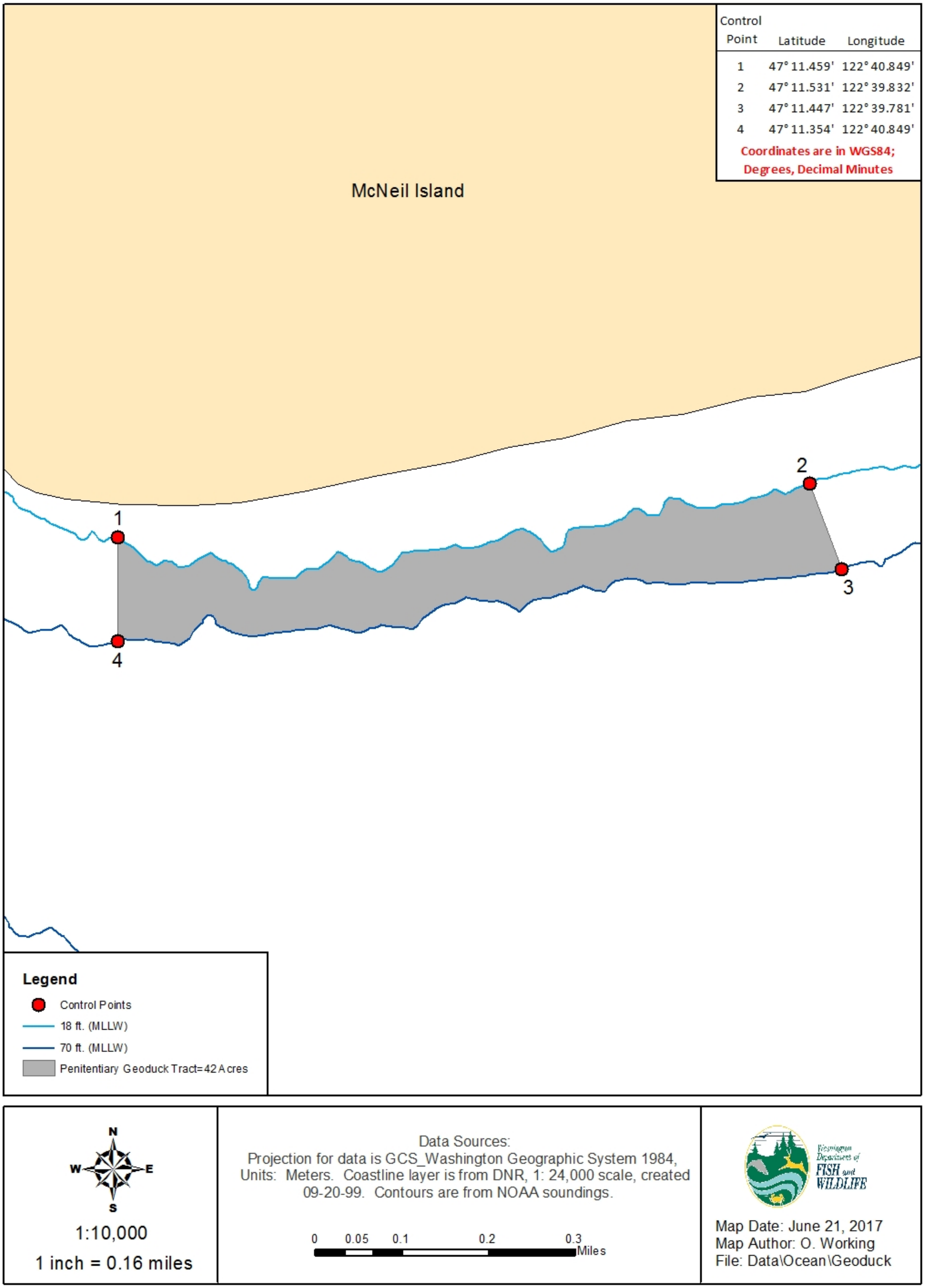
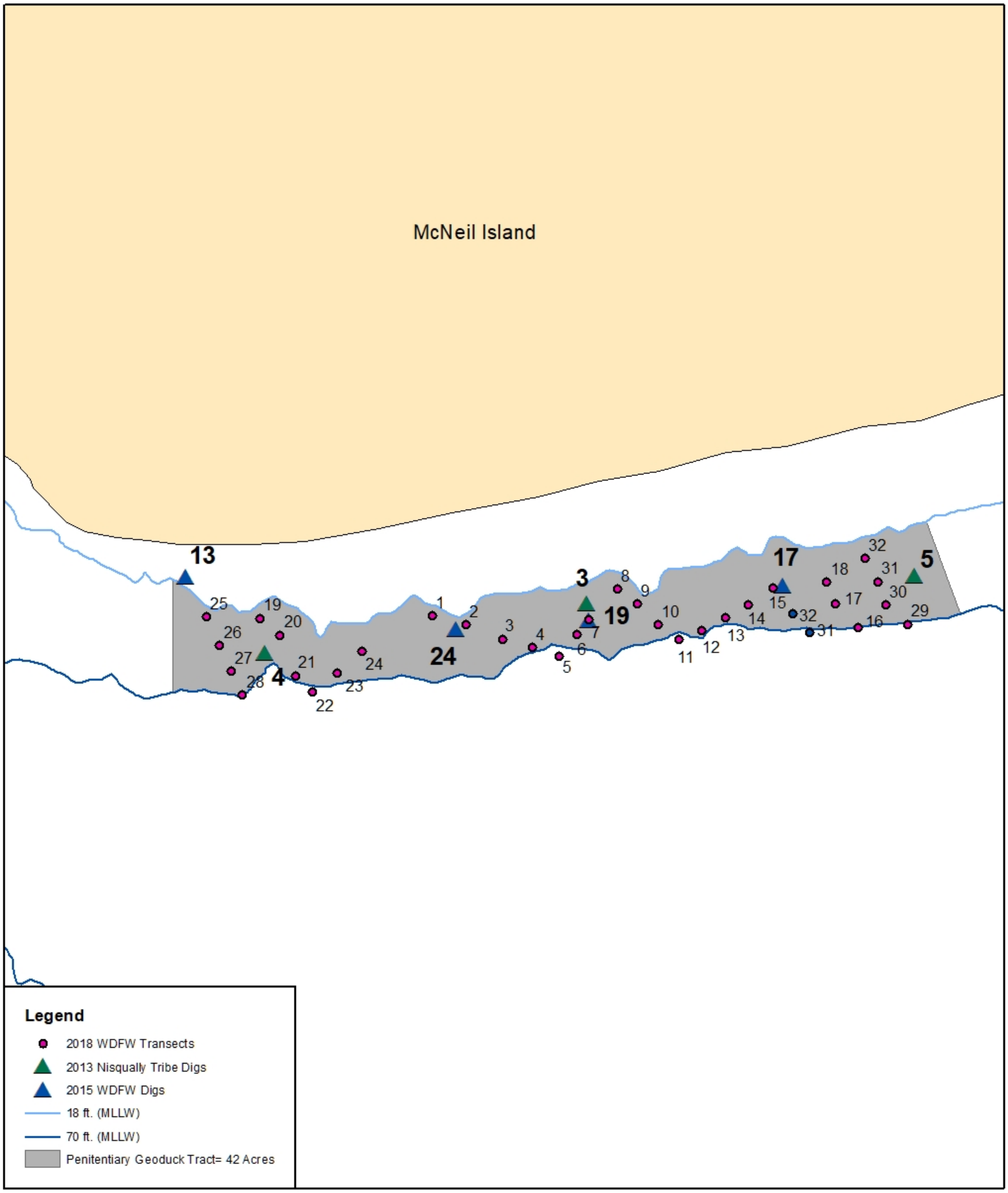


Figure 3. Transect/ Dig Station Map, Penitentiary Commercial Geoduck Tract #12800



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1 inch = 0.16 miles

Data Sources:
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Units: Meters. 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

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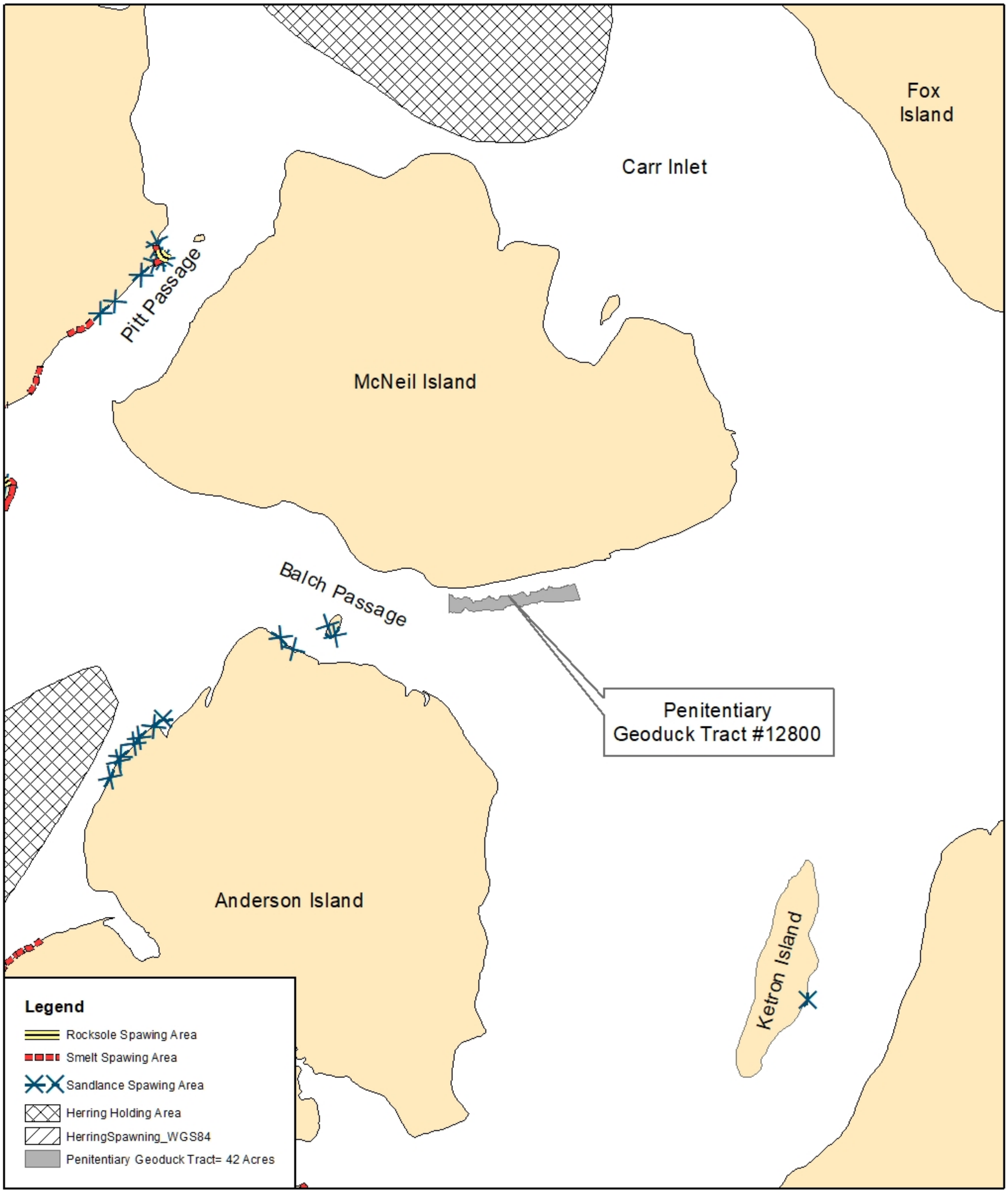
Map Date: June 27, 2018
Map Author: O. Working
File: Data\Ocean\Geoduck

Figure 4. Fish Spawning Areas Near the Penitentiary Commercial Geoduck Tract #12800



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1 inch = 0.95 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 0.325 0.65 1.3 1.95 Miles

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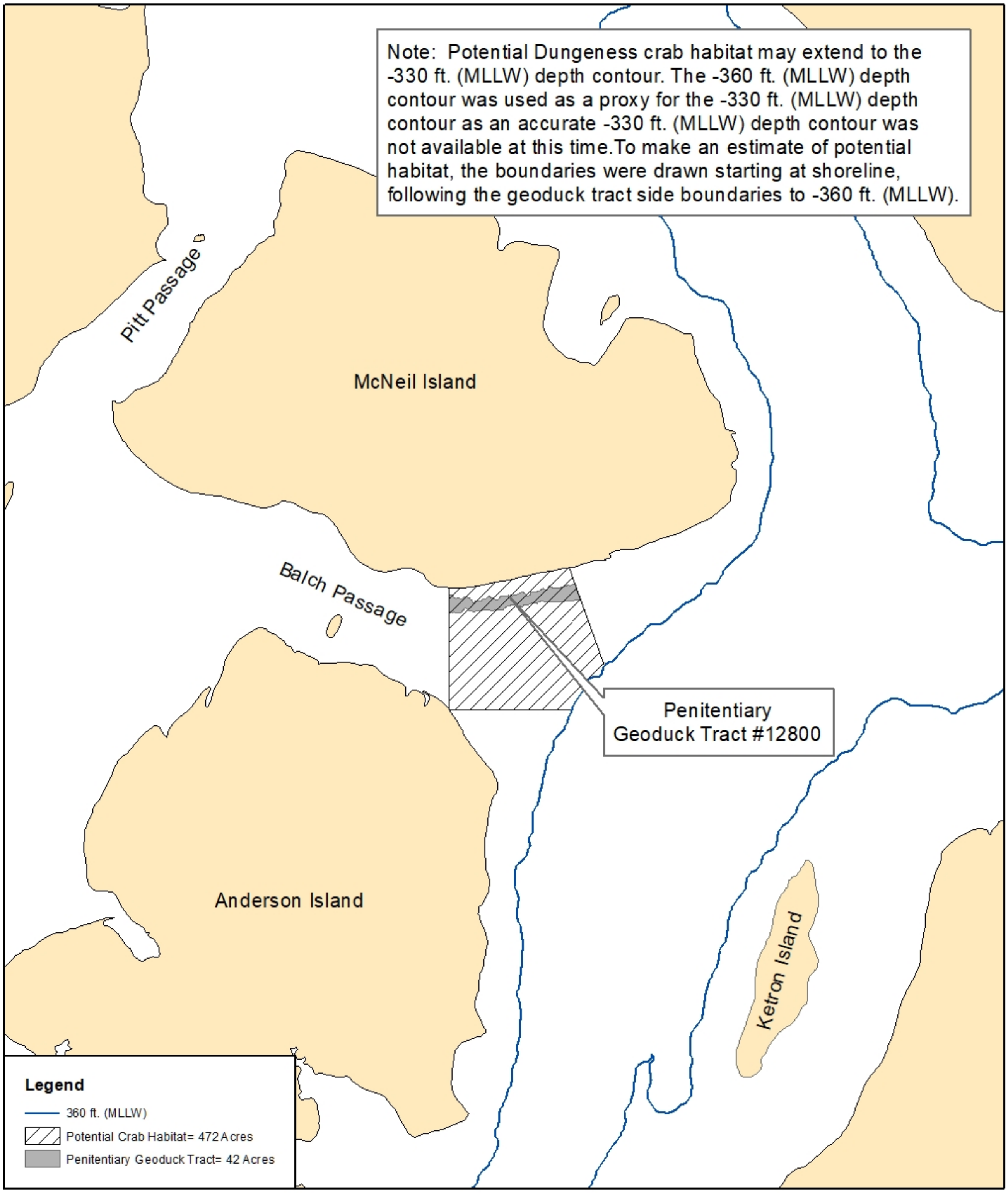
Map Date: June 27, 2018
Map Author: O. Working
File: Data\Ocean\Geoduck

Figure 5. Dungeness Crab Habitat Map, Penitentiary Commercial Geoduck Tract #12800



1:60,000

1 inch = 0.95 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 0.325 0.65 1.3 1.95 Miles

Washington Department of FISH and WILDLIFE

Map Date: June 27, 2018
Map Author: O. Working
File: Data\Ocean\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

Penitentiary geoduck tract # 12800.

Tract Name	Penitentiary
Tract Number	12800
Tract Size (acres)[a]	42
Density of geoducks/sq.ft.[b]	0.08
Total Tract Biomass (lbs.)[b]	421,398
Total Number of Geoducks on Tract[b]	153,370
Confidence Interval (%)	29.26%
Mean Geoduck Whole Weight (lbs.)	2.75
Mean Geoduck Siphon Weight (lbs.)	0.62
Siphon Weight as a % of Whole Weight	23%
Number of Transect Stations	32
Number of Geoducks Weighed	56

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

b. Biomass is based on the 2013 Nisqually Tribe and 2015 WDFW dig samples and 2018 WDFW In-season geoduck survey biomass of 803,730 pounds minus harvest of 382,332 pounds through June 28, 2019

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Table 2: DIGGING DIFFICULTY TABLE

Penitentiary geoduck tract # 12800, 2013 Nisqually Tribe and 2015 WDFW Pre-fishing geoduck surveys

Survey Party	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)
WDFW	13	1	2	0	1	0	0	0	0	Y
WDFW	17	0	2	2	0	0	0	0	1	Y
WDFW	24	0	2	0	0	0	0	0	0	Y
NISQ	3	0	0	0	0	1	0	0	0	y
NISQ	4	0	0	0	0	1	0	0	0	y
NISQ	5	0	0	0	0	0	0	0	0	y

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

Penitentiary geoduck tract # 12800, 2018 WDFW In-season geoduck survey

Transect	Start Depth (ft) [a]	End Depth (ft) [a]	Geoduck Density (no. / sq ft) [b]	Substrate [c] sand	gravel	cobble	boulder
1	18	26	0.0008	2			
2	26	36	0.0009	2			
3	37	53	0.0008	2			
4	53	68	0.0009	2			
5	68	51	0.0016	2			
6	52	35	0.0018	2			
7	35	20	0.0024	2			
8	20	37	0.0008	2			
9	37	49	0.0010	2			
10	49	64	0.0010	2			
11	64	61	0.0014	2			
12	61	51	0.0016	2			
13	51	42	0.0017	2			
14	42	29	0.0022	2			
15	29	20	0.0025	2			
16	70	48	0.0020	2			
17	48	32	0.0023	2			
18	31	19	0.0028	2			
19	18	26	0.0016	2			
20	27	53	0.0010	2	1	1	
21	53	64	0.0013	2	1	1	
22	64	49	0.0019	2	1	1	
23	50	32	0.0025	2			
24	32	18	0.0034	2		1	
25	18	27	0.0018	2	1	1	1
26	27	43	0.0014	2	1	1	
27	43	66	0.0012	2	1	1	
28	70	51	0.0021	2			
29	52	48	0.0019	2			
30	48	36	0.0024	2			
31	36	29	0.0026	2			
32	29	21	0.0032	2			

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

b. Densities were calculated using a daily siphon show factor

c. Substrate codes: 1 = present ; 2 = dominant

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Table 4: GEODUCK SIZE AND QUALITY

Penitentiary geoduck tract # 12800, 2013 Nisqually Tribe and 2015 WDFW Pre-fishing geoduck surveys

Survey Party	Dig Station	Number Dug	Avg. Whole Weight (lbs.)	Avg. Siphon Weight (lbs.)	% of geoducks on station greater than 2 lbs.
WDFW	13	9	3.11	0.93	89%
WDFW	17	10	2.72	0.73	80%
WDFW	24	9	2.69	0.58	89%
NISQ	3	9	2.27	0.48	56%
NISQ	4	9	2.65	0.51	67%
NISQ	5	10	2.89	0.44	90%

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Table 5: TRANSECT CORRECTED GEODUCK COUNT AND POSITION TABLE

Penitentiary geoduck tract # 12800, 2018 WDFW In-season geoduck survey

Transect	Corrected Geoduck Count per 900 sq. ft. Transect	Geoduck Siphon Show Factor [a]	Latitude [b]	Longitude [b]
1	110	0.915	47° 11.432	122° 40.496
2	35	0.915	47° 11.424	122° 40.450
3	66	0.915	47° 11.412	122° 40.401
4	348	0.915	47° 11.405	122° 40.360
5	256	0.915	47° 11.398	122° 40.323
6	87	0.915	47° 11.418	122° 40.300
7	19	0.915	47° 11.432	122° 40.284
8	31	0.915	47° 11.461	122° 40.247
9	162	0.915	47° 11.448	122° 40.219
10	267	0.915	47° 11.429	122° 40.191
11	313	0.915	47° 11.416	122° 40.162
12	310	0.915	47° 11.425	122° 40.131
13	224	0.915	47° 11.437	122° 40.099
14	107	0.915	47° 11.450	122° 40.069
15	20	0.915	47° 11.466	122° 40.037
16	389	0.915	47° 11.432	122° 39.920
17	127	0.915	47° 11.453	122° 39.952
18	24	0.915	47° 11.473	122° 39.964
19	228	0.868	47° 11.425	122° 40.730
20	70	0.868	47° 11.410	122° 40.702
21	44	0.868	47° 11.373	122° 40.679
22	63	0.868	47° 11.358	122° 40.656
23	262	0.868	47° 11.376	122° 40.623
24	166	0.868	47° 11.397	122° 40.591
25	5	0.775	47° 11.425	122° 40.802
26	1	0.775	47° 11.399	122° 40.783
27	1	0.775	47° 11.375	122° 40.767
28	295	0.775	47° 11.354	122° 40.750
29	253	0.775	47° 11.453	122° 39.883
30	205	0.775	47° 11.472	122° 39.897
31	59	0.775	47° 11.475	122° 39.895
32	54	0.775	47° 11.496	122° 39.913

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

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

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Table 6: MOST COMMON AND OBVIOUS ANIMALS OBSERVED

Penitentiary geoduck tract # 12800, 2018 WDFW In-season geoduck survey

# of Transects where Observed	Group	Common Name	Taxonomer
12	ANEMONE	BURROWING ANEMONE	*Pachycerianthus fimbriatus*
1	ANEMONE	PLUMED ANEMONE	*Metridium* spp.
3	ANEMONE	STRIPED ANEMONE	*Urticina* spp.
1	ASCIDIAN	SESSILE TUNICATE	Unspecified Tunicate
4	BIVALVE	HARDSHELL CLAMS	*Veneridae* spp.
21	BIVALVE	HORSE CLAM	*Tresus* spp.
1	BIVALVE	JINGLESHELL OYSTER	*Pododesmus macrochisma*
1	BIVALVE	PIDDOCK	Unspecified Pholadidae
3	CNIDARIA	HYDROIDS	Unspecified Hydroid
4	CNIDARIA	SEA PEN	*Ptilosarcus gurneyi*
1	CNIDARIA	SEA WHIP	*Stylatula elongata*
5	CRAB	DECORATOR CRAB	*Oregonia gracilis*
2	CRAB	GRACEFUL CRAB	*Cancer gracilis*
1	CRAB	HELMET CRAB	*Telmessus cheiragonus*
29	CRAB	HERMIT CRAB	Unspecified hermit crab
22	CRAB	RED ROCK CRAB	*Cancer productus*
6	CUCUMBER	SEA CUCUMBER	*Parastichopus californicus*
1	FISH	BAY PIPEFISH	*Syngnathus leptorhynchus*
1	FISH	FLATFISH	Unspecified flatfish
1	FISH	ROCK SOLE	*Lepidopsetta bilineata*
3	FISH	SANDDAB	*Citharichthys* spp.
10	FISH	SCULPIN	Unspecified Cottidae
4	FISH	STARRY FLOUNDER	*Platichthys stellatus*
1	GASTROPOD	MOON SNAIL EGGS	*Polinices lewisii* egg case
8	GASTROPOD	NASSA SNAILS	*Nassarius* spp.
5	NUDIBRANCH	DIRONA	*Dirona albolineata*
10	NUDIBRANCH	HERMISSENDA	*Hermissenda crassicornis*
3	SEA STAR	FALSE OCHRE STAR	*Evasterias troschelli*
11	SEA STAR	LEATHER STAR	*Dermasterias imbricata*
2	SEA STAR	ROSE STAR	*Crossaster papposus*
3	SEA STAR	SUNFLOWER STAR	*Pycnopodia helianthoides*
22	WORM	ROOTS	Chaetopterid polychaete tubes
22	WORM	SABELLID TUBE WORM	*Sabellid* spp.

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Table 7: MOST COMMON AND OBVIOUS ALGAE OBSERVED
Penitentiary geoduck tract # 12800, 2018 WDFW In-season geoduck survey

# of Transects Where Observed	Taxonomer
1	*Costaria costada*
12	*Desmarestia* spp.
15	Diatoms
2	*Lithothamnion* spp.
9	*Laminaria* spp.
1	Large red algae
18	*Ulva* spp.
32	Small red algae
1	*Gigartina* spp.

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