EXHIBIT A
ENVIRONMENTAL ASSESSMENT OF PROPOSED GEODUCK HARVEST
IN PIERCE COUNTY, WYCKOFF SHOAL GEODUCK TRACT (#12300)

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: 2016 - 2017

Tract name: Wyckoff Shoal Tract (#12300)

Description (Figure 1, Tract vicinity map):

The Wyckoff Shoal tract was re-surveyed for subtidal geoduck clams in the year 2005 by the South Puget Sound treaty tribes. The tract area is approximately 152 subtidal acres (Table 1) along the northwestern shoreline of McNeil Island and the eastern shoreline of Key Peninsula, northerly of Pitt Passage in South Puget Sound. The most southerly point of the tract begins about 1265 yards northeasterly of Pitt Island and the tract extends northwesterly about 1435 yards toward the shoreline of Key Peninsula. The tract extends northerly about 520 yards along the western boundary and about 1200 yards along the eastern boundary. Note that the northern boundary line of the tract is defined by a line projected due west from green can buoy No. 3 on Wyckoff Shoal. The southern boundary line has no specific geographic landmark alignment.

The commercial tract area lies deeper than the -18 foot (MLLW) water depth contour. Commercial geoduck harvest may occur to a maximum water depth of -70 feet (MLLW), though this water depth is never reached on this tract. The Wyckoff Shoal tract is adjacent to and shares a common boundary with the Wyckoff Shoal North (#12200) geoduck tract to the north and the Wyckoff Shoal South (#12400) geoduck tract to the south. The Wyckoff shoal tract is bounded by a line projected from a point on the -18 foot (MLLW) water depth contour in the southwestern corner of the tract at 47°14.067' N. latitude, 122°43.376' W. longitude northerly along the -18 foot (MLLW) water depth contour to a point at 47°14.319' N. latitude, 122°43.328' W. longitude; then easterly to a point on the -18 foot (MLLW) water depth contour at 47°14.319' N. latitude, 122°42.961' W. longitude; then southeasterly along the -18 foot (MLLW) water depth

contour to a point at 47°13.894' N. latitude, 122°42.369' W. longitude; then westerly to the point of origin (Figure 2).

This estimate of the tract boundary is made using GIS and field data (transformed to WGS84 dataset) collected from the 2005 Squaxin Tribe geoduck survey. 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 -18 foot contour was used for the shallow water boundary. This tract, as configured, does not reach -70 foot (MLLW) water depth contour and a specific depth contour does not determine the deep water boundary at this tract. All harvest on this tract will be shallow of the -70 foot (MLLW) water depth. Eelgrass surveys done in the year 2006 reported observations of eelgrass to a depth of -16 feet (MLLW). No herring spawning habitat was found to be in the vicinity of this tract. 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 Pitt Passage, which is south of the Wyckoff Shoal tract. Currents reach a maximum flood velocity of 1.8 knots per hour and maximum ebb velocity of 2.5 knots (Tides and Currents software; station #1831; Pitt Passage, east of Pitt Island; estimated timeframe July 21, 2016 to July 21, 2017). Currents may be moderate in the vicinity of Wyckoff Shoal tract and they tend to weaken northerly and easterly of the shoal.

The Wyckoff Shoal tract has highly variable substrates of sand, mud, shell, and cobble. Sand was present on 30 out of 40 survey transects, mud was observed on 7 transects, and shell was observed on 7 transects.

Water Quality:

Water quality is good at the Wyckoff Shoal geoduck tract. Water mixing at this tract is affected by the convergence of currents from Carr Inlet and Pitt Passage, 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 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, 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". Non-tribal and tribal harvest has been on-going. DNR will verify the health status of this tract prior to commercial geoduck harvests.

Biota:

Geoduck:

The Wyckoff Shoal tract is approximately 152 acres and contains an estimated 1,107,850 pounds of geoducks (Table 1). Geoducks at this location are considered commercial quality, and digging difficulty ranges from easy to moderately difficult (Table 2). The geoduck density is moderate on this tract, compared to other Puget Sound tracts, and is estimated at 0.07 geoducks/sq.ft. based on the 2005 South Sound tribes tract survey and subtracting the estimated number of geoducks that have been harvested on this tract since the 2005 survey. The average density range from the 2005 survey was 0.009 geoducks/square foot at station #2-31 to 0.573 geoducks/square foot at station 1-9 (Figure 3; Table 3). The geoducks on the Wyckoff Shoal tract are large, averaging 2.6 pounds compared to the Puget Sound average of 2.1 pounds per geoduck clam. The lowest average whole weight was 1.98 pounds per geoduck at station #2-9 and the highest average whole weight was 3.61 pounds per geoduck at station #3-26 (Table 4).

Portions of the Wyckoff Shoal tract (#12300) were fished in 1971 to 1980 as part of the old Pitt Passage tracts 1-6, with a reported total catch of 2,160,618 pounds. The tract was

resurveyed by WDFW in 1988 and the tract was divided into ten lease areas. The area (558 acres) was fished again from 1990 to 1991 and a total of 4,754,936 pounds were landed. Seven of the 10 lease areas were re-surveyed by WDFW in 1995. The most recent survey in 2005 (40 transects; positions recorded in Table 5) includes 152 acres of the Wyckoff Shoal geoduck tract (#12300). An analysis of geoduck bed density at Wyckoff Shoal indicates these geoduck beds were recovered to pre-fishing densities, which qualified these tracts for the current round of commercial geoduck harvest.

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 primarily 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 Wyckoff Shoal tract is about 14 years. 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. Laminarian algae, red algae, and sea lettuce (Ulva sp.) were macroalgae types observed in the northern portion of this tract, by WDFW, on 4 transects done in 2005. Fish species were not recorded as part of the tribal survey. However, sculpins and sand dabs were observed on this tract, by WDFW, on 4 transects done in 2005. As a proxy for fish likely to be found on Wyckoff Shoal tract (#12300), the fish observed on adjoining Wyckoff North tract #12200 were various flatfish; C-O soles, skates, skate egg cases, sand dabs, starry flounders; and various other fish including sculpins, poachers, and dogfish sharks (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 (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 listing 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. 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 Wyckoff Shoal 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 Wyckoff Shoal geoduck tract are McAllister Creek (approximately 9.9 miles from the tract), Nisqually River (approximately 10.0 miles from the tract), and Chambers Creek (6.4 miles). 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 Pitt Passage that support steelhead stocks. The horizontal separation between tributaries that support steelhead runs and the Wyckoff Shoal 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 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 Wyckoff Shoal 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 were not recorded as part of the 2005 tribal survey of the Wyckoff Shoal tract (#12300). As a proxy for marine invertebrates likely to be found on Wyckoff Shoal tract (#12300), the marine invertebrates observed on adjoining Wyckoff North tract (#12200) include: [1] mollusks - horse clams, geoducks, false geoducks, horse mussels, spiny scallops, unspecified hardshell clams, nudibranchs (*Armina* sp., *Dendronotus* sp., *Hermissenda* sp.), opisthobranchs, moonsnail egg cases, moonsnails, and a stubby squid (*Rossia pacifica*); [2] crustaceans - graceful crabs, red rock crabs, Dungeness crabs, hermit crabs, decorator crabs, ghost shrimp, and unspecified shrimp; [3] echinoderms - sunflower stars, short-spined stars, brittle stars, vermillion stars, spiny stars, leather stars, sand stars, and sand dollars; [4] cnidarians - sea pens, sea whips, plumed anemones, burrowing anemones, and hydroids; and [5] sessile tunicates, tube dwelling polychaete worms, sabellid tube worms, and terebellid tube worms.

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 recorded as being observed on this tract. On the adjoining Wyckoff Shoal N. tract (#12200), Dungeness crab were observed on 9 out of 95 transect stations, or about 10% of the transects done 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 Pitt Passage 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 232 acres. From the most recent survey in 2005, there was an estimated 1,069,000 harvestable geoducks on this tract. With a harvest of 85 percent of these geoducks, the total number harvested would be 908,650 geoducks. Approximately 1.18 square feet of substrate is disturbed for every geoduck harvested, so 908,650 x 1.18 = 1,072,207 square feet of substrate. This equals 24.6 acres. This is about 10.6 percent of the total available crab habitat in the vicinity of this tract. This represents a moderate amount of disturbance 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, few Dungeness crab were observed during scuba surveys near Wyckoff Shoal, 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 30 of 95 transects on the Wyckoff North tract (32% of the transects observations on Wyckoff North tract had red rock crab listed). 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 observations of red rock crab within the Wyckoff North tract there is a potential for impacts to red rock crab populations in the vicinity of this tract. The impacts will likely not be significant if the findings of the Thorndyke Bay study apply to the Wyckoff Shoal tract location. Since the abundance of red rock crab at the Thorndyke Bay study was less (12% of pre-fishing geoduck survey transects had red rock crab observations), it is uncertain that the conclusions will be the same. A post-harvest survey will be conducted on this tract, following geoduck fishing, which should provide better information about relative changes in abundance of red rock crab at this location.

In a note dated July 18, 2005 the WDFW Region 6 Shellfish Manager, Brad Sele, stated that there are no specific shellfish concerns regarding the proposed geoduck harvest in this vicinity.

Aquatic Plants:

Large quantities of attached aquatic plants are not generally found in geoduck beds. Light restriction often limits plant growth to areas shallower than where most geoduck harvest occurs. Aquatic plants observed in the geoduck surveys include: Laminarian algae, Desmarestiales, a diffuse diatom layer, sea lettuce (*Ulva sp.*), and various species of foliose red algae (Table 7).

WDFW conducted eelgrass surveys at the Wyckoff Shoal tract on May 26, May 31, and June 9, 2005. The conclusion of this work was that no eelgrass was observed deeper than the -16 foot level (corrected to MLLW). Therefore, the shallow boundaries of this tract is set at no shallower than the -18 foot level (MLLW) to conform with state statute (RCW 77.60.070).

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 Wyckoff N. 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. There is a major seal haul-out area in nearby Still Harbor, McNeil Island, which is located easterly of the Wyckoff Shoal tract. Seals are commonly observed on the Wyckoff Shoal 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, when whales are in the area, 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.

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. During a geoduck clam survey by WDFW in the vicinity of Wyckoff Shoal; from June to early July, 2005; common murres, gulls, common loons, pigeon guillemots, pelagic cormorants, great blue herons, and a bald eagle were observed in the vicinity of the shoal. 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 south eastern boundary of the Wyckoff Shoal tract is part of the 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 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. Non-Indian geoduck harvest will not infringe on the McNeil Island security buffer.

The upland property on the Key Peninsula along the western boundary of the Wyckoff Shoal tract is designated "Rural 10." 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 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:

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 2016/2017 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:

Pitt Passage is not a major navigational route for recreational or commercial vessels traveling between ports in southern and northern Puget Sound. Pitt Passage is, however, the most convenient route between Drayton Passage and Carr Inlet. The passage is

shallow and is used primarily by small shoal draft boats. 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.

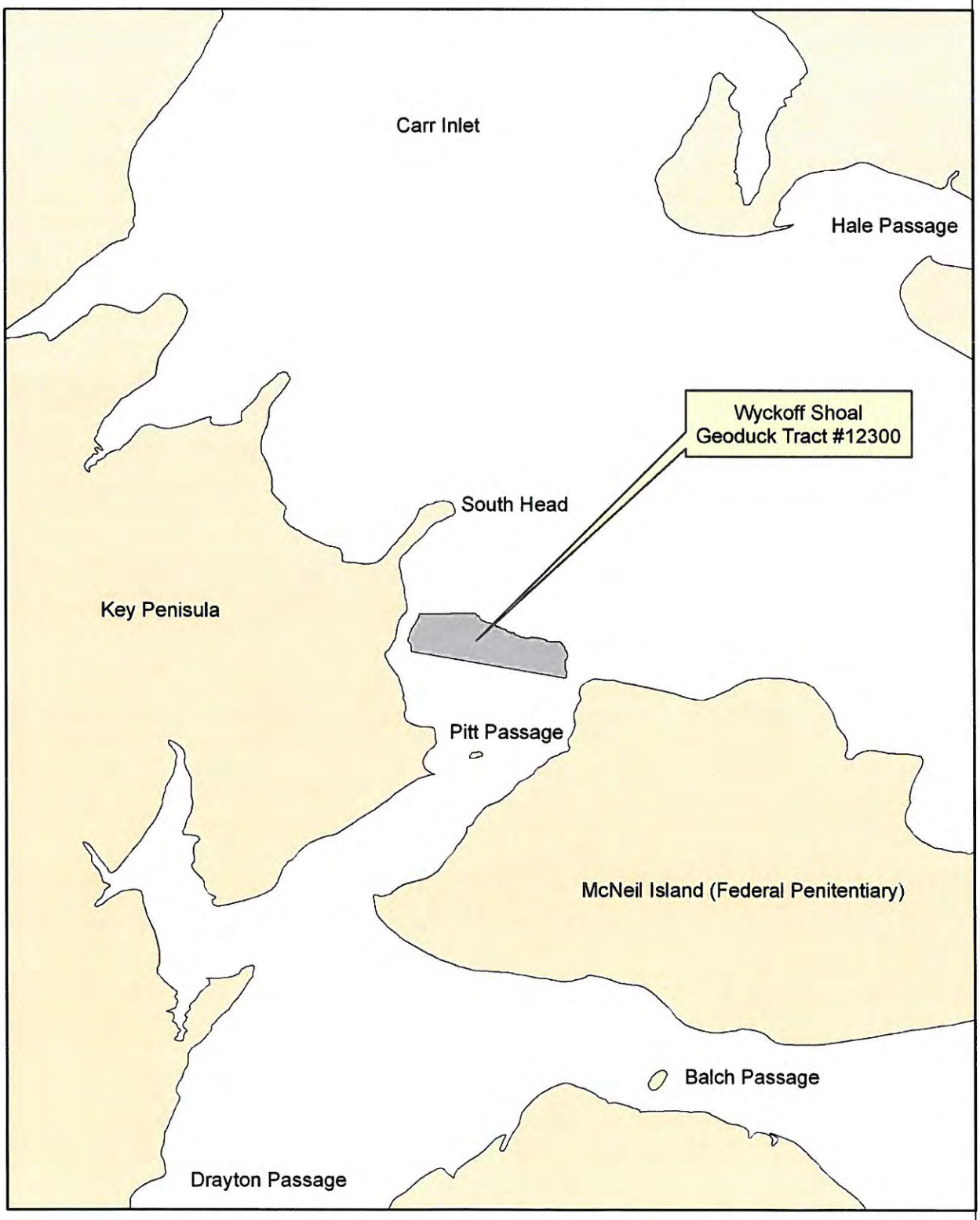
Summary:

Continued commercial geoduck harvest is proposed for the Wyckoff Shoal geoduck tract, located along the northwestern shoreline of McNeil Island. The geoduck population on the tract was most recently surveyed in the year 2005 and the current tract biomass estimate is based on the most recent survey and subsequent harvests. 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 possible 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 are potential impacts to red rock crab populations in the vicinity of this tract, due to the moderate abundance of red rock crab populations, though studies to date have not confirmed that any significant impacts should be expected. A post-harvest survey of this tract will be done to study potential crab impacts and establish a post-harvest geoduck biomass. No other significant impacts are expected from this harvest.

Date prepared: July 21, 2016

File: 16July21_Wyckoff Shoal_#12300_EA_final.doc

Figure 1. Vicinity Map, Wyckoff Shoal Commercial Geoduck Tract #12300



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1:70,000
1 inch = 1.1 miles

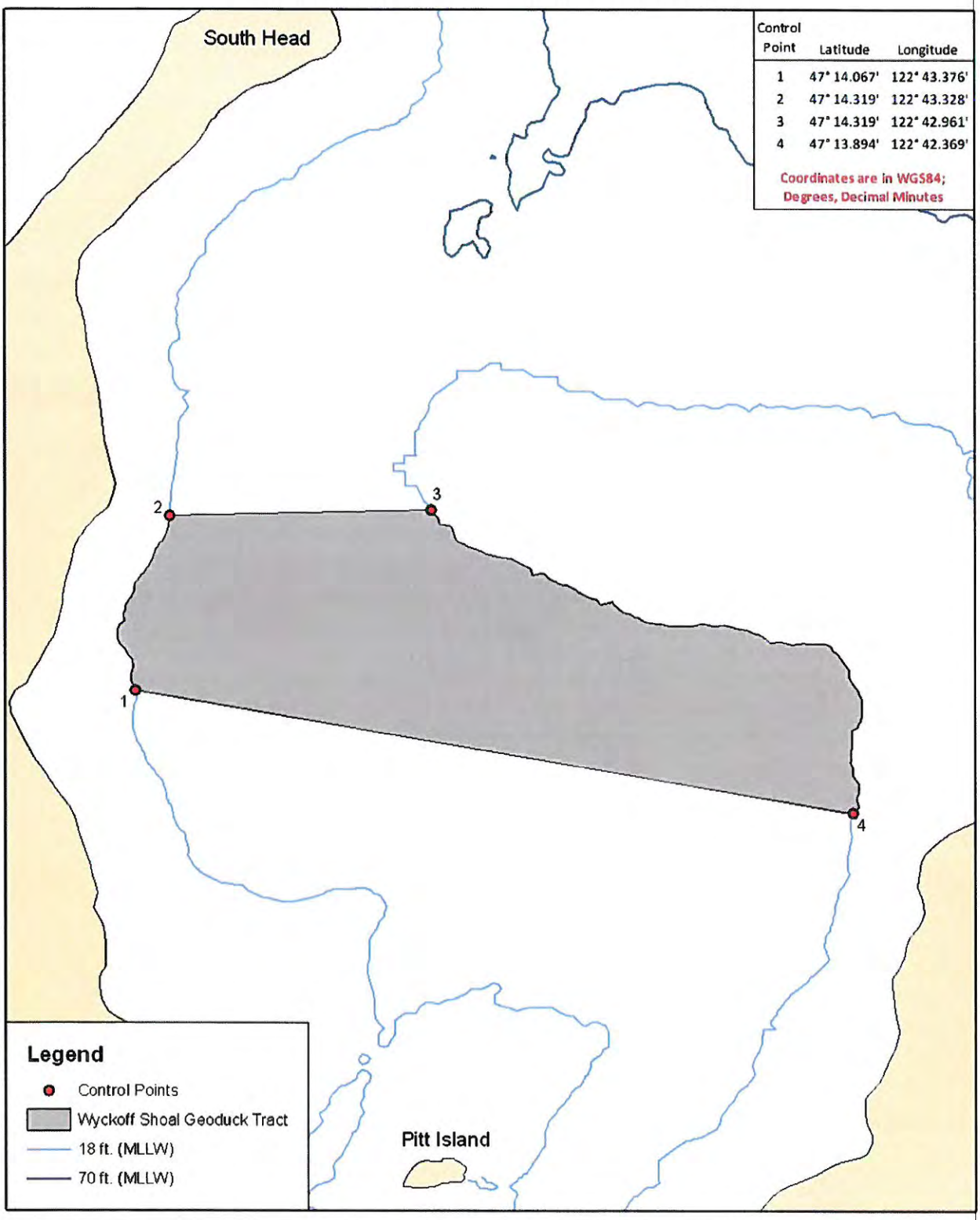
Data Sources:
Projection for data is GCS_Washington Geographic System 1984,
Units: Decimal Degrees. Coastline layer is from DNR, 1: 24,000 scale,
created 09-20-99. Contours are from NOAA soundings.

0 0.5 1 2 3 Miles

Washington Department of FISH and WILDLIFE

Map Date: 29 April, 2010
Map Author: O. Eveningsong
File: Data\Ocean\Geoduck

Figure 2. Control Points Map, Wyckoff Shoal Commercial Geoduck Tract #12300



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1:15,000
1 inch = 0.24 miles

MLLW= Mean Lower Low Water

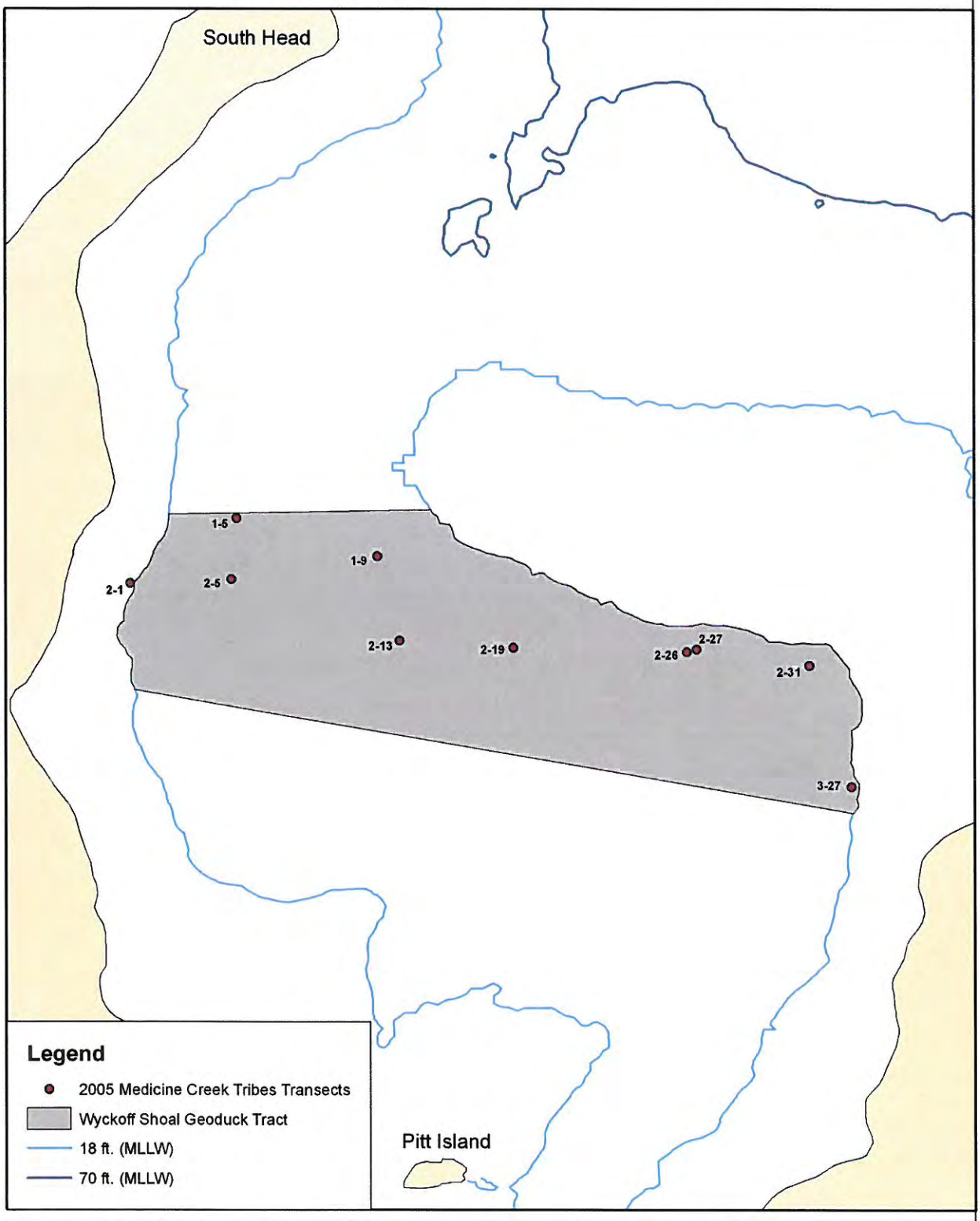
Data Sources:
Projection for data is GCS_Washington Geographic System 1984, Units: Decimal Degrees. Coastline layer is from DNR, 1: 24,000 scale, created 09-20-99. Contours are from NOAA soundings.

0 0.1 0.2 0.4 0.6 Miles

Washington Department of FISH and WILDLIFE

Map Date: July 25, 2011
Map Author: O. Eveningsong
File: Data\Geoduck\EAs

Figure 3. Transect Map, Wyckoff Shoal Commercial Geoduck Tract #12300



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1:15,000
1 inch = 0.24 miles

MLLW= Mean Lower Low Water

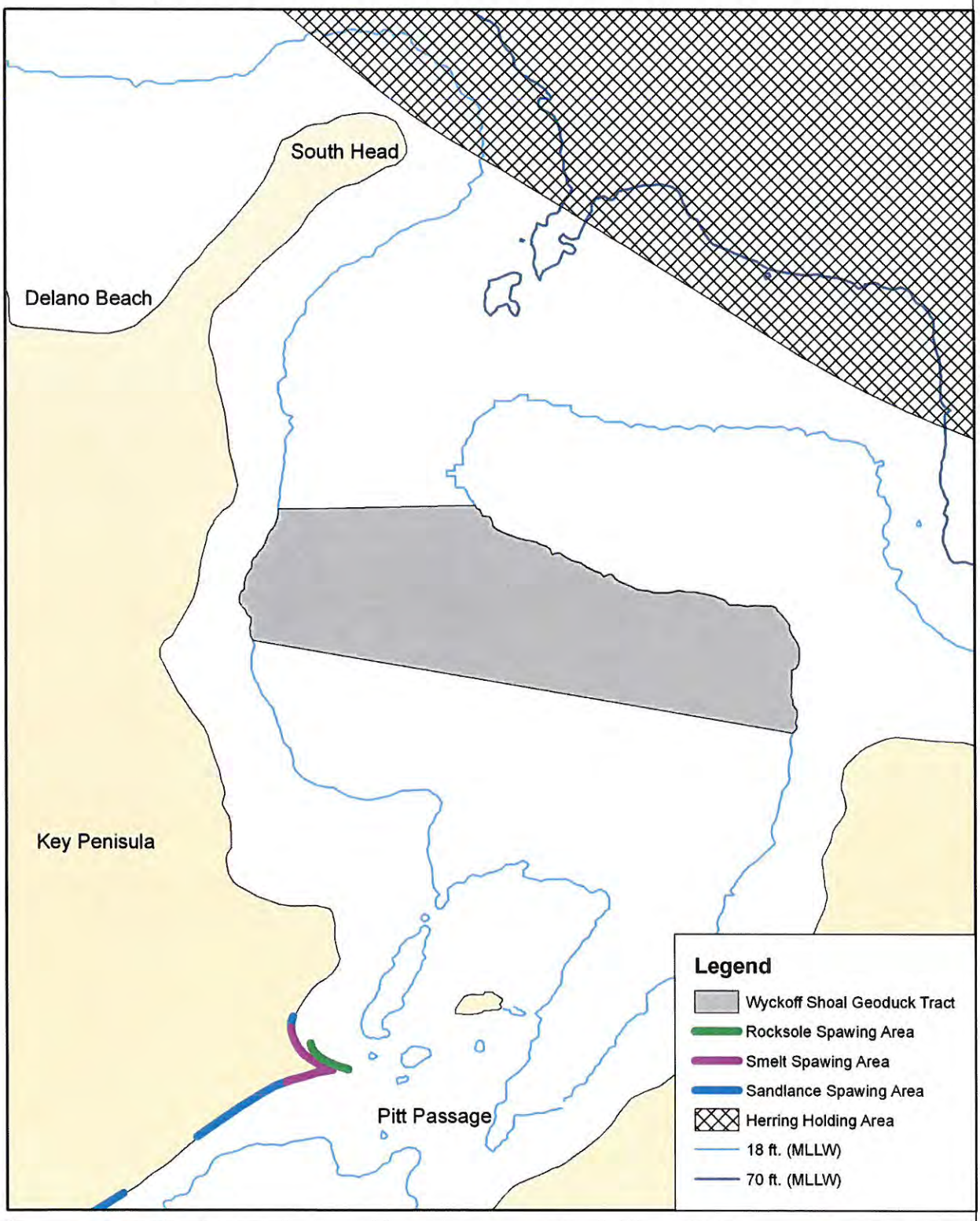
Data Sources:
Projection for data is GCS_Washington Geographic System 1984,
Units: Decimal Degrees. Coastline layer is from DNR, 1: 24,000 scale,
created 09-20-99. Contours are from NOAA soundings.

0 0.1 0.2 0.4 0.6 Miles

Washington Department of FISH and WILDLIFE

Map Date: 30 April, 2010
Map Author: O. Eveningsong
File: Data\Ocean\Geoduck

Figure 4. Fish Spawning Areas Near the Wyckoff Shoal Commercial Geoduck Tract #12300



N
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1:20,000
1 inch = 0.32 miles

MLLW= Mean Lower Low Water

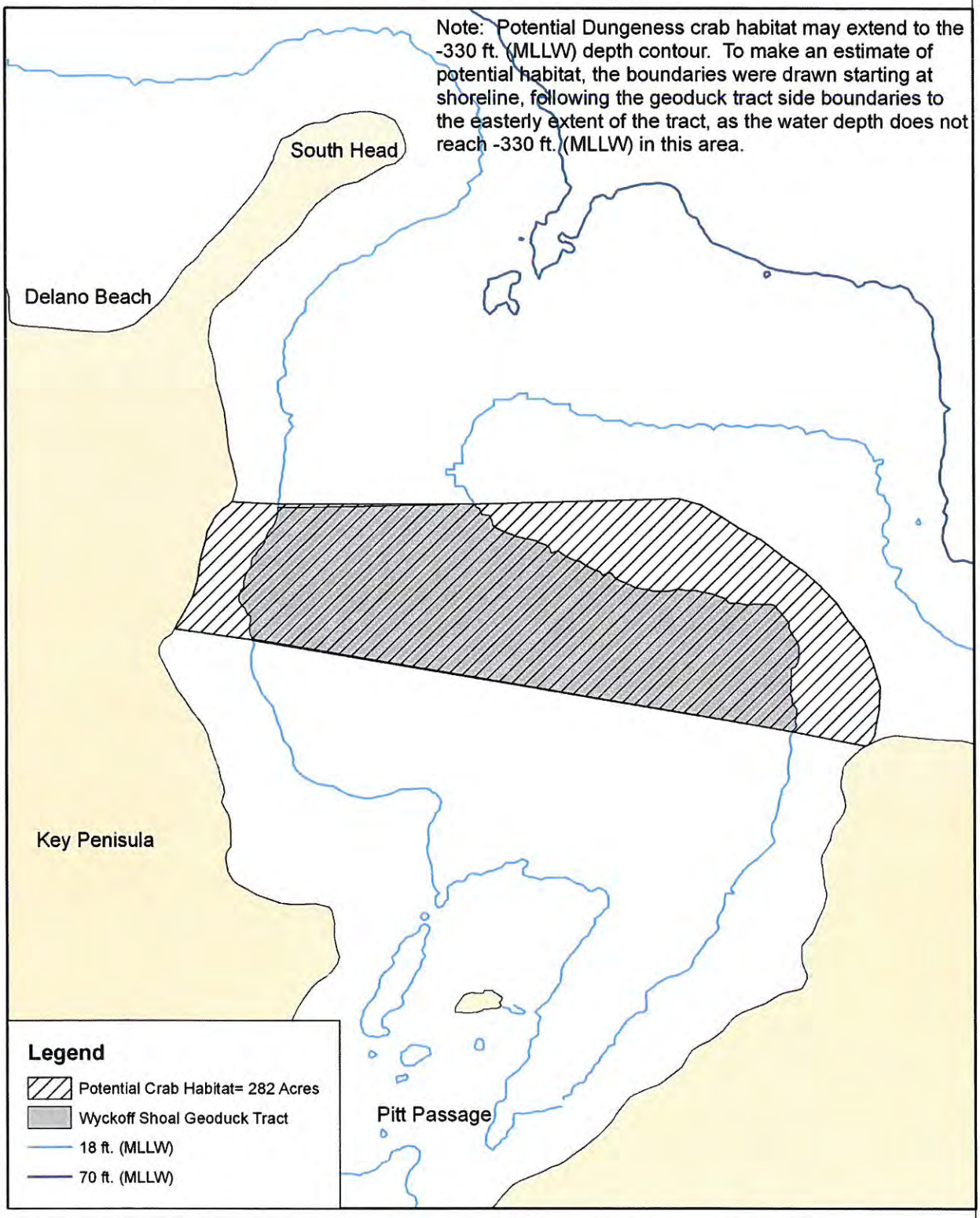
Data Sources:
Projection for data is GCS_Washington Geographic System 1984,
Units: Decimal Degrees. Coastline layer is from DNR, 1: 24,000 scale,
created 09-20-99. Contours are from NOAA soundings.

0 0.15 0.3 0.6 0.9 Miles

Washington Department of FISH and WILDLIFE

Map Date: 29 April, 2010
Map Author: O. Eveningsong
File: Data\Ocean\Geoduck

Figure 5. Potential Dungeness Crab Habitat Map, Wyckoff Shoal Commercial Geoduck Tract #12300



N
W E
S

1:20,000
1 inch = 0.32 miles

MLLW= Mean Lower Low Water

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 0.15 0.3 0.6 0.9 Miles

Washington Department of FISH and WILDLIFE

Map Date: 30 April, 2010
Map Author: O. Eveningsong
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 Plants Observed

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

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Table 1. GEODUCK TRACT SUMMARY

Wyckoff Shoal geoduck tract #12300.

Tract Name	Wyckoff Shoal
Tract Number	12300
Tract Size (acres) [a]	152
Density of geoducks/sq.ft. [b]	0.07
Total Tract Biomass (lbs.) [b]	1,107,850
Total Number of Geoducks on Tract [b]	430,836
Confidence Interval (%)	27.0%
Mean Geoduck Whole Weight (lbs.)	2.57
Mean Geoduck Siphon Weight (lbs.)	N/A
Siphon Weight as a % of Whole Weight	N/A
Number of 900 sq. ft. Transect Stations	40
Number of Geoducks Weighed	75

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

[b.] Biomass is based on the 2005 Medicine Creek Tribes pre-fishing geoduck survey biomass of 2,748,333 lbs. minus harvest of 1,640,483 pounds through June 16, 2016

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Table 2: DIGGING DIFFICULTY TABLE

Wyckoff Shoal geoduck tract #12300, 2005 Medicine Creek 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)
1-9	0	1	0	1	0	0	0	0	Y
2-3	0	1	0	1	0	0	0	0	Y
2-9	0	1	0	1	0	0	0	0	Y
2-15	1	0	0	1	0	0	1	1	Y
2-21	0	0	0	0	0	0	1	1	Y
2-26	2	1	0	0	1	2	0	0	Y
3-26	2	2	0	0	0	2	0	0	Y

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

Wyckoff Shoal geoduck tract #12300, 2005 Medicine Creek Tribes pre-fishing survey.

Transect	Start Depth (ft.) [a]	End Depth (ft.) [a]	Geoduck Density (no. / sq.ft.) [b]	Substrate [c]					
				mud	sand	peagravel	gravel	shell	cobble
1-4	50	55	0.0595	1					
1-5	54	55	0.0640	1					
1-6	55	48	0.1949	1					
1-7	48	42	0.3083	1					
1-8	42	40	0.4479		1				
1-9	27	32	0.5730		1				
1-10	32	33	0.3723		1				
1-11	33	27	0.4334		1				
1-12	27	23	0.2269		1				
2-1	18	34	0.0843		1				
2-2	34	51	0.0675		1				
2-4	51	53	0.2893		1				
2-5	54	55	0.2566		1				
2-6	55	56	0.2457		1				
2-7	56	54	0.0805		1				
2-9	54	50	0.1913		1				
2-10	50	45	0.1805		1				
2-11	45	43	0.0935		1				
2-12	43	42	0.0261		1				
2-13	38	37	0.0478	1					
2-14	37	39	0.1740	1					
2-15	39	39	0.0870	1					
2-16	39	38	0.2153		1				
2-17	38	41	0.2609		1				
2-18	41	43	0.2435		1				
2-19	43	45	0.1892		1				
2-20	45	47	0.1065		1				
2-21	47	45	0.2305		1				
2-22	45	41	0.1044		1				
2-23	41	33	0.0696		1				
2-24	33	32	0.0739		1				
2-25	32	30	0.1522		1				
2-26	30	32	0.0109		1				
2-27	29	31	0.1002		1			1	
2-28	31	33	0.0657		1			1	
2-29	33	26	0.0250		1			1	
2-30	26	22	0.0125		1			1	
2-31	22	19	0.0094		1			1	
3-26	38	41	0.0182		1			1	1
3-27	41	20	0.0591		1			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: GEODUCK SIZE AND QUALITY

Wyckoff Shoal geoduck tract #12300, 2005 Medicine Creek Tribes pre-fishing survey.

Dig Station	Number Dug	Avg. Whole Weight (lbs.)	Avg. Siphon Weight (lbs.)	% of geoducks on station greater than 2 lbs.
1-9	12	2.21	N/A	58%
2-3	12	2.43	N/A	75%
2-9	11	1.98	N/A	55%
2-15	11	2.50	N/A	82%
2-21	10	3.11	N/A	100%
2-26	10	2.30	N/A	50%
3-26	10	3.61	N/A	70%

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Table 5: TRANSECT CORRECTED GEODUCK COUNT AND POSITION TABLE

Wyckoff Shoal geoduck tract #12300, 2005 Medicine Creek Tribes pre-fishing survey.

Transect	Corrected Count	Show Factor [a]	Latitude [b]	Longitude [b]
1-4	54	0.54		
1-5	58	0.38	47° 14.319	122° 43.159
1-6	175	0.38		
1-7	277	0.38		
1-8	403	0.38		
1-9	516	0.38	47° 14.266	122° 42.962
1-10	335	0.38		
1-11	390	0.38		
1-12	204	0.38		
2-1	76	0.58		
2-2	122	0.58		
2-4	260	0.58		
2-5	231	0.51	47° 14.234	122° 43.166
2-6	221	0.51		
2-7	145	0.51		
2-9	172	0.51		
2-10	162	0.51		
2-11	84	0.51		
2-12	23	0.51		
2-13	43	0.51	47° 14.148	122° 42.931
2-14	157	0.51		
2-15	78	0.51		
2-16	194	0.51		
2-17	235	0.51		
2-18	219	0.51		
2-19	170	0.51	47° 14.381	122° 42.772
2-20	96	0.51		
2-21	207	0.51		
2-22	94	0.51		
2-23	63	0.51		
2-24	67	0.51		
2-25	137	0.51		
2-26	10	0.51	47° 14.133	122° 42.528
2-27	90	0.71	47° 14.136	122° 42.515
2-28	59	0.71		
2-29	23	0.71		
2-30	11	0.71		
2-31	8	0.71	47° 14.114	122° 42.356
3-26	16	0.73		
3-27	53	0.73	47° 13.944	122° 42.298

[a.] Daily siphon show factor from Still Harbor show plot was used to correct combined geoduck counts

[b.] Latitude and longitude positions are in degrees and decimal minutes (NAD27), and have not been transformed into WGS84 datum

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Table 6: MOST COMMON AND OBVIOUS ANIMALS OBSERVED

Wyckoff Shoal geoduck tract #12200, proxy for animals likely to be found on the Wyckoff Shoal tract (#12300).

# of Transects where Observed	Group	Common Name	Taxonomer
79	ANEMONE	BURROWING ANEMONE	*Pachycerianthus fimbriatus*
56	ANEMONE	PLUMED ANEMONE	*Metridium senile*
47	ASCIDIAN	SESSILE TUNICATE	*Cribrinopsis fernaldi*
13	BIVALVE	HARDSHELL CLAMS	*Veneridae spp.*
26	BIVALVE	HORSE CLAM	*Tresus spp.*
11	BIVALVE	FALSE GEODUCK	*Panomya spp.*
1	BIVALVE	HORSE MUSSEL	Unspecified Bivalve
1	BIVALVE	SPINY SCALLOP	*Chlamys hastata*
1	CEPHALOPOD	STUBBY SQUID	*Rossia pacifica*
7	CNIDARIA	SEA PEN	*Ptilosarcus gurneyi*
22	CNIDARIA	SEA WHIP	*Stylatula elongata*
17	CNIDARIA	HYDROIDS	Unspecified Hydroid
9	CRAB	DUNGENESS CRAB	*Cancer magister*
30	CRAB	RED ROCK CRAB	*Cancer productus*
41	CRAB	GRACEFUL CRAB	*Cancer gracilis*
71	CRAB	HERMIT CRAB	Unspecified hermit crab
1	CRAB	DECORATOR CRAB	*Pugettia spp.*
3	CRAB	DECORATOR CRAB	*Oregonia gracilis*
11	FISH	FLATFISH	Unspecified flatfish
1	FISH	SKATE	Unspecified Raja spp.
25	FISH	SCULPIN	Unspecified Cottid
4	FISH	DOGFISH SHARK	*Squalus acanthias*
2	FISH	POACHER	Unspecified Agonidea
10	FISH	FISH	Unspecified fish
13	FISH	STARRY FLOUNDER	*Platichthys stellatus*
1	FISH	C-O SOLE	*Pleuronichthys coenosus*
74	FISH	SANDDAB	*Citharichthys spp.*
1	FISH EGGS	SKATE EGG CASE	Raja spp. egg case
5	GASTROPOD	MOON SNAIL	*Polinices lewisii*
29	GASTROPOD	MOON SNAIL EGGS	Polinices lewisii egg case
1	GASTROPOD	NUDIBRANCH	Unspecified nudibranch
2	MISC	SAND DOLLAR	*Dendraster excentricus*
33	MISC	OPISTHOBRANCH	Unspecified Opisthobranch
12	NUDIBRANCH	DENDRONOTUS	*Dendronotus spp.*
9	NUDIBRANCH	ARMINA	*Armina californica*
18	NUDIBRANCH	HERMISSENDA	*Hermissenda crassicornis*
62	SEA STAR	SUNFLOWER STAR	*Pycnopodia helianthoides*
80	SEA STAR	SAND STAR	*Luidia foliolata*
13	SEA STAR	SHORT-SPINED STAR	*Pisaster brevispinus*
1	SEA STAR	LEATHER STAR	*Dermasterias imbricata*
1	SEA STAR	VERMILLION STAR	*Mediaster aequalis*
49	SEA STAR	BRITTLE STAR	*Ophiopholis aculeata*
1	SEA STAR	SPINY STAR	*Hippasteria spinosa*
50	SHRIMP	GHOST SHRIMP	Unspecified ghost shrimp
5	SHRIMP	SHRIMP	Unspecified shrimp

Table 6: Continued

# Of Transects Where Observed	Group	Common Name	Taxonomer
1	URCHIN	SEA URCHIN	Unspecified sea urchin
1	WORM	ROOTS	Chaetopterid polychaete tubes
24	WORM	TEREBELLID TUBE WORM	*Terebellid spp.*
50	WORM	SABELLID TUBE WORM	*Sabellid spp.*

Note: The animal observation data provided in this table are from the WDFW 2005 geoduck survey of Wyckoff North geoduck tract #12200, which is adjacent to and north of the Wyckoff Shoal geoduck tract #12300. There were no animal data provided from the 2005 Medicine Creek Tribes geoduck survey, but this data is assumed to be representative of the species found on both tracts.

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Table 7: MOST COMMON AND OBVIOUS PLANTS OBSERVED

Wyckoff Shoal geoduck tract #12200, proxy for plants likely to be found on the Wyckoff Shoal tract (#12300).

# of Transects where observed	Taxonomer
9	Unspecified small red algae
40	Unspecified large red algae
9	*Desmarestia spp.*
38	Diatoms
65	*Laminaria spp.*
59	*Ulva spp.*

Note: The animal observation data provided in this table are from the WDFW 2005 geoduck survey of Wyckoff North geoduck tract #12200, which is adjacent to and north of the Wyckoff Shoal geoduck tract #12300. There were no animal data provided from the 2005 Medicine Creek Tribes geoduck survey, but this data is assumed to be representative of the type of species found on both tracts.

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