ENVIRONMENTAL ASSESSMENT OF PROPOSED GEODUCK HARVEST
ALONG THE WESTERN SHORELINE OF BAINBRIDGE ISLAND
AT THE APPLE TREE COVE GEODUCK TRACT (#06310)

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 -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 (DNR & WDFW, 2008) and the Final Supplemental Environmental Impact Statement (WDFW & DNR, 2001). The proposed harvest along the northeastern shoreline of Kitsap Peninsula is described below.

Proposed Harvest Year(s): 2020-2021

Tract name: Apple Tree Cove geoduck tract (Tract #06310)

Description: (Figure 1, Tract Vicinity map)

The Apple Tree Cove geoduck tract is a subtidal area of approximately 177 acres (Table 1) along the northeastern shoreline of Kitsap Peninsula, approximately six miles north of Port Madison, and near Apple Cove Point in the Central Puget Sound Geoduck Management Region. The tract is adjacent to and shares a common boundary with the Sligo tract (#06300) to the north, and the Kingston tract (#06320) to the south.

The Apple Tree Cove tract is bounded by a line projected northerly along the -20 foot (MLLW) water depth contour from a control point (CP) in the southwestern portion of the tract at 47°47.769’ N. latitude, 122°29.475’ W. longitude (CP 1) to a point at 47°48.843’ N. latitude, 122°28.860’ W. longitude (CP 2); then easterly to a point on the -70 foot (MLLW) water depth contour at 47°48.843’ N. latitude, 122°28.835’ W. longitude (CP 3); then southerly along the -70 foot (MLLW) water depth contour to a point at 47°47.694’ N. latitude, 122°29.210’ W. longitude (CP 4); then northwesterly to the point of origin (Figure 2, Control Points map). These latitude and longitude positions are in WGS84 datum.

This estimate of the tract boundary was made using GIS and the Suquamish Tribe geoduck survey data (2012-2013 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 -70 ft. (MLLW)

water depth contour is used for the deep water boundary, and the -20 ft. (MLLW) water depth contour was used for the shallow boundary, due to eelgrass being documented at a maximum water depth of -18 ft. (MLLW) in the vicinity of the tract. The latitude and longitude positions are reported in WGS84 datum, degrees decimal minutes to the closest thousandths of a minute. Corner latitude and longitude positions were generated using GIS, and have not been field verified to determine consistency with area estimates, landmark alignments, or water depth contours.

The delineation of the tract boundary will be field verified by DNR prior to state monitored geoduck harvests. Any variance to the stated boundary will be coordinated between WDFW and DNR prior to geoduck harvesting episodes.

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 typically sand with varying amounts of mud and/or gravel. The specific sediment type of a geoduck 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 tend to be moderate and variable in the vicinity of the Apple Tree Cove tract. In Puget Sound, at Apple Cove Point, adjacent to this tract, currents reach a predicted maximum flood velocity of 1.3 knots and maximum ebb velocity of 1.2 knots (Tides and Currents software; station #1621; Apple Cove Point; April 7, 2020 through April 7, 2021).

The surface substrate within this tract is primarily sand, which was noted on 57 of the 60 transects. Other substrates noted were cobble, boulder, peagravel and gravel; listed in order of the frequency of occurrence.

Water Quality:

Water quality is good at the Apple Tree Cove geoduck tract. Water mixing at this tract is affected by the convergence of currents from Admiralty Inlet and the main basin of Puget Sound, 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 Port Madison station (PMA001) at 47.7350° N. latitude; 122.6333° W. longitude. The DOE latitude and longitude positions are recorded in decimal degrees. For 2012 (most recently completed data year available),

at a water depth of 33 feet, the mean reported dissolved oxygen concentration was 9.7 milligrams per liter (mg/l) with a range from 7.1 mg/l to 12.5 mg/l. The mean salinity at this station was 28.7 parts per thousand (ppt) with a range from 27.61 ppt to 29.9 ppt. The mean water temperature at this station was 10.7° Celsius (C) with a range from 7.4° C to 14.1° C.

This geoduck tract has been classified by the Washington Department of Health as Approved.

Biota:

Geoduck:

The Apple Tree Cove geoduck tract is approximately 177 acres. The abundance of geoducks on this tract is moderate, with a current estimated average density of 0.08 geoducks/sq.ft. This tract contains a currently estimated 1,270,697 pounds of geoducks (Table 1). On all 4 dig stations, geoducks are considered commercial quality (Table 2). Digging difficulty ranged from “easy” to “difficult” to dig. The factors which influenced a “difficult” rating (dig station #3) included compact mud, and a gravel layer.

The average density prior to harvest from the 2012 and 2013 pre-fishing survey was 0.141 geoducks/sq.ft., ranging from 0.000 geoducks/sq.ft. at station #37 to 0.375 geoducks/sq.ft. at station #32 (Table 3). The geoducks at the Apple Tree Cove tract have an average weight of 2.09 pounds, while the average geoduck in Puget Sound is 2.1 pounds. The lowest average whole weight is 1.2 pounds per geoduck at dig station #3 and the highest average whole weight is 4.8 pounds per geoduck at dig station #2 (Table 4). Station locations and geoduck counts corrected with siphon “show factors” are listed in Table 5.

The Apple Tree Cove geoduck tract was first surveyed in 1980 by WDFW, and then in 2002 the boundary lines were redrawn to include only the commercial tract north of the Kingston Waste Water Treatment Plant. The most current survey of 177 acres occurred in 2012-2013 and was conducted by the Suquamish Tribe. The results of the 2012-2013 survey and subsequent harvests (Table 1) are used in the preparation of this Environmental Assessment.

Geoducks are managed for long term sustainable harvest. No more than 2.7% of the fishable stocks are harvested (total fishing mortality) each year in each management region throughout Puget Sound. The fishable portion of the total Puget Sound population includes geoducks that are found in water deeper than -18 ft. and shallower than -70 ft. (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 on a tract 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 from a tract. The average percentage removal of the tracts mentioned above was 69 percent. 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 and support many fish species, such as rockfish and lingcod. On geoduck tracts, the bathymetry is typically relatively flat and the substrate is typically composed of soft sediments, which provide few attachments for macroalgae associated with rockfish and lingcod. No fish were reported during the survey at the Apple Tree Cove tract (Table 6).

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. Eelgrass was observed along this tract to a maximum depth of -18 ft. (MLLW) during the 2012 eelgrass survey. The nearshore tract boundary will be along the -20 ft. (MLLW) water depth contour to provide a vertical buffer between eelgrass beds and geoduck harvest.

There are no Pacific herring, surf smelt or sand lance spawning grounds near the Apple Tree Cove tract (Figure 4 - Fish Spawning Areas Near the Apple Tree Cove Tract #06310). Geoduck fishing on the Apple Tree Cove tract, under the harvest conditions of this Environmental Assessment, should have no detrimental impacts on Pacific herring, surf smelt or sand lance spawning.

NOAA Fisheries Service announced on April 27, 2010 that it was listing canary and yelloweye rockfish as “threatened” and bocaccio as “endangered” under ESA (federal Endangered Species Act). The listings became effective on July 27, 2010. Historic high levels of fishing and water quality are cited as reasons that these rockfish populations are

in peril and have been slow to recover. On January 23, 2017; canary rockfish were delisted based on newly obtained samples and genetic analysis (Federal Register 82 FR 7711). Geoduck fishery managers are tracking this process and will take actions necessary to reduce the risk of "take" of any listed rockfish species that could potentially result from geoduck harvest activity.

Two salmon populations, Puget Sound chinook salmon and Hood Canal summer run chum salmon, were listed by the National Marine Fisheries Service on March 16, 1999 as threatened species under the federal Endangered Species Act. 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 Apple Tree Cove 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 existence of an additional five spring-run stocks is in dispute. The majority of Puget Sound chinook salmon emigrate to the ocean as subyearlings.

Major tributaries in the general vicinity of the Apple Tree Cove geoduck tract, which support chinook salmon runs, are the Duwamish Waterway/Green River basin and the Lake Washington basin (mouth at Shilshole Bay; with Cedar River, Issaquah Creek, and north Lake Washington tributaries and sub-basins). Three viable runs of chinook salmon have been identified in the Duwamish Waterway/Green River basin. The status of the Spring run of chinook salmon in the Duwamish Waterway/Green River basin is extinct. The status of the natural Summer/Fall run of chinook salmon in the Duwamish Waterway/Green 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 4,889 fish. The timing of the Duwamish River run is uncertain and has a 5-year geometric mean for total estimated escapement at 5,216 fish. The status of the Summer/Fall run in Newaukum Creek is mixed native and non-native origin; wild production; and healthy (NMFS, Appendix E, TM-35, Chinook Status Review).

The production of the Lake Washington Summer/Fall run of chinook salmon is natural with a 5-year geometric mean for total estimated escapement at 557 fish. The status of the natural Cedar River Summer/Fall run of chinook salmon is native origin; wild production; with a 5-year geometric mean for total estimated escapement at 377 fish. The

status of the mixed Summer/Fall run of chinook salmon in Issaquah Creek is non-native origin; a composite of wild, cultured, or unknown/unresolved production; and healthy. The status of the natural Summer/Fall run of chinook salmon in the North Lake Washington tributaries is native origin; wild production; with a 5-year geometric mean for total estimated escapement at 145 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 -20 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+ ft. 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 the Apple Tree Cove tract that support steelhead stocks. The horizontal separation between tributaries that support steelhead runs and the Apple Tree Cove 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 (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 Apple Tree Cove 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:

Marine invertebrates, which are frequently found on geoduck beds, were also observed on this tract. The most common and obvious of these include: [1] mollusks (geoducks, horse clams, and unspecified nudibranchs); [2] echinoderms (sea cucumbers); [3] cnidarians (sea pens, and unspecified anemones); and [4] arthropods (Dungeness crabs, red rock crabs, graceful crabs, and hermit crabs. 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 years of study have shown no adverse effects on crab populations due to geoduck fishing. Dungeness crab were observed on 5 out of 30 transects during the 2012 biological survey of the Apple Tree Cove tract (plant and animal data were not taken during the 2013 portion of this survey). Dungeness crab which are present on the tract may experience peak molt in mid-April, based on data from the Kingston area (Cain, 10/15/01).

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 ft. level and seaward out to -330 ft. (MLLW) water depth contour. The -360 ft. (MLLW) water depth contour was used as a proxy for the -330 ft. (MLLW) water depth contour as no accurate -330 ft. (MLLW) water depth contour was available at the time this document was prepared (Figure 5, Potential Dungeness Crab Habitat Map). Dr. Dave Armstrong of the University of Washington has determined that Dungeness crab utilize Puget Sound bottoms from the +1 ft. level out to the -330 ft. level. The entire crab habitat within and along this tract is approximately 1089 acres. There were about 1,086,483 harvestable geoducks in the entire 177 acre tract, from the 2012-2013 pre-fishing survey estimate. With a harvest of 65 percent, the total number harvested would be about 706,214 geoducks. Approximately 1.18 square feet of substrate is disturbed for every geoduck harvested, so 706,214 x 1.18 = 833,332 square feet of substrate. This equals about 19 acres. This is about 1.8 percent of the total available crab habitat in the vicinity of this tract with the potential for disturbance from geoduck harvest. Based on low observations of Dungeness crab on this tract during the pre-fishing survey, the moderate amount of disturbance of potential crab habitat in the vicinity of the tract, and the lack of effects observed at the Thorndyke Bay study, we conclude that any effects on Dungeness crab 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 algal growth to areas shallower than where most geoduck harvest occurs. Aquatic algae observed during the pre-fishing geoduck survey (Table 7) include:

Laminarian algae, large brown algae, and *Ulva* sp.

John Boettner and Tim Flint, of 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. An eelgrass survey was done on this tract in 2012 by Suquamish divers swimming the entire shoreward boundary of the tract and eelgrass was documented at a maximum depth of -18 ft. (MLLW). The shoreward boundary of this tract will be no shallower than the -20 ft. (MLLW) water depth contour, which should provide sufficient buffer to avoid any harvest impacts to 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. There have also been sporadic reports of gray whales feeding near the eastern shoreline of the Kitsap Peninsula and rare reports of humpback whales near the eastern shoreline of the Kitsap Peninsula. Killer whales may also be observed in the vicinity of this tract, particularly between November and March. The Southern Resident stock of killer whales resides mainly in the San Juan Islands throughout spring and summer, but incursions south into Puget Sound occur more frequently during winter months (Brent Norberg, NOAA, pers. comm. 5/15/06). 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 herons, bald eagles, and ospreys are also regularly observed. Geoduck harvest does not appear to have any significant effect on these birds or their use of the waters where harvest occurs. A study by DNR and the WDFW was conducted at northern Hood Canal to learn the effects of geoduck fishing on bald eagles (Watson et al., 1995). A significant conclusion of this study is that commercial geoduck clam harvest is unlikely to have any adverse impacts on bald eagle productivity.

Other uses:

Adjacent Upland Use:

The upland properties adjacent to the tract are designated as a “rural” shoreline environmental designation.

To minimize possible disturbance to adjacent residents, harvest vessels are not allowed shoreward of the 200 yards seaward of the ordinary high tide line (OHT). Harvest is allowed only during daylight hours and no harvest is allowed on Saturday, Sunday, or state holidays.

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

Fishing:

The waters around this tract are not prime sport fishing areas, however, some recreational salmon fishing for blackmouth and silvers could occur seasonally in proximity to this geoduck bed. Sport fishing is open year round for surfperch. Rockfish fishing is closed in this area. January 1 to March 31 fishing is catch and release and fly fishing only. Lingcod can only be taken May 1 to June 15 by hook and line or May 21 to June 15 by spearfishing. The WDFW Sport Fishing Rules pamphlet describes additional seasons, size limits, daily limits, specific closed areas, and additional 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 Central Sound treaty tribes through state/tribal geoduck harvest management plans. The non-Indian geoduck fishery should not be in conflict with any concurrent tribal fisheries.

Navigation:

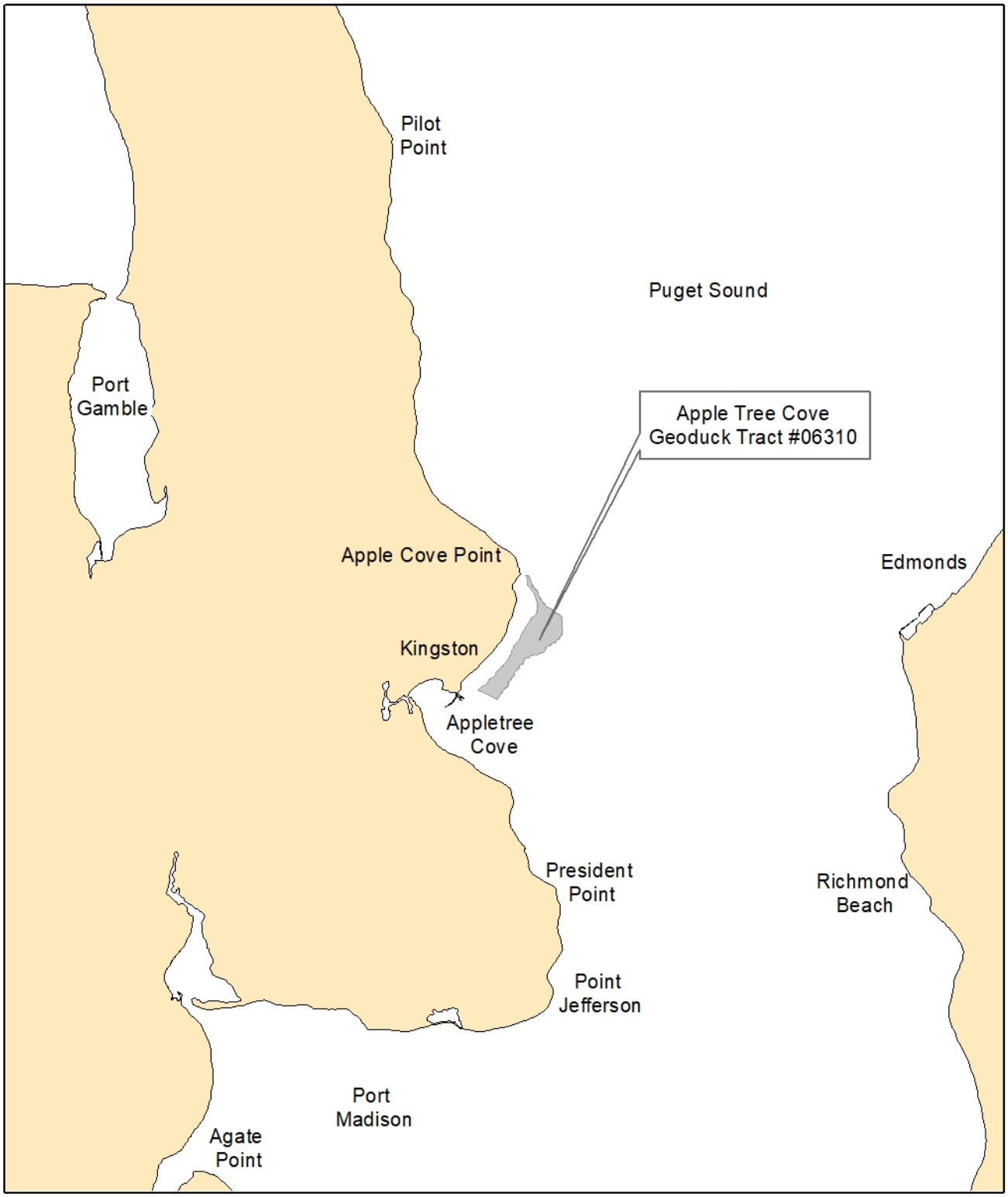
The Apple Cove Point area is used by recreational and commercial vessels traveling in Central Puget Sound. Geoduck harvesting at this site should not result in any significant navigational conflicts. The Washington Department of Natural Resources will notify the local boating community prior to any harvest.

Summary:

Commercial geoduck harvest is proposed for one tract along the northeastern shoreline of the Kitsap Peninsula. The tract was recently surveyed in 2012-2013 by the Suquamish Tribe and the current biomass estimate for the 177 acre harvest area is 1,270,697 pounds. Geoduck harvest on this tract is on-going and a total of 996,723 pounds have been reported since the 2012-2013 biological survey. The commercial tract is presently classified by DOH as “Approved” for shellfish harvest. An eelgrass survey was completed and eelgrass was observed to a maximum depth of -18 ft. (MLLW). The shoreward boundary of the tract will be set at -20 ft. (MLLW) or deeper to provide a buffer between eelgrass, potential forage fish spawning habitat and geoduck harvest. The anticipated environmental impacts of this harvest are within the range of conditions discussed in the 2001 Final Supplemental Environmental Impact Statement. No significant impacts are expected from this harvest.

File: 200414_AppleTreeCove_EA_06310.doc

Figure 1. Vicinity Map, Apple Tree Cove Commercial Geoduck Tract #06310



N
W E
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1:100,000

1 inch = 1.58 miles

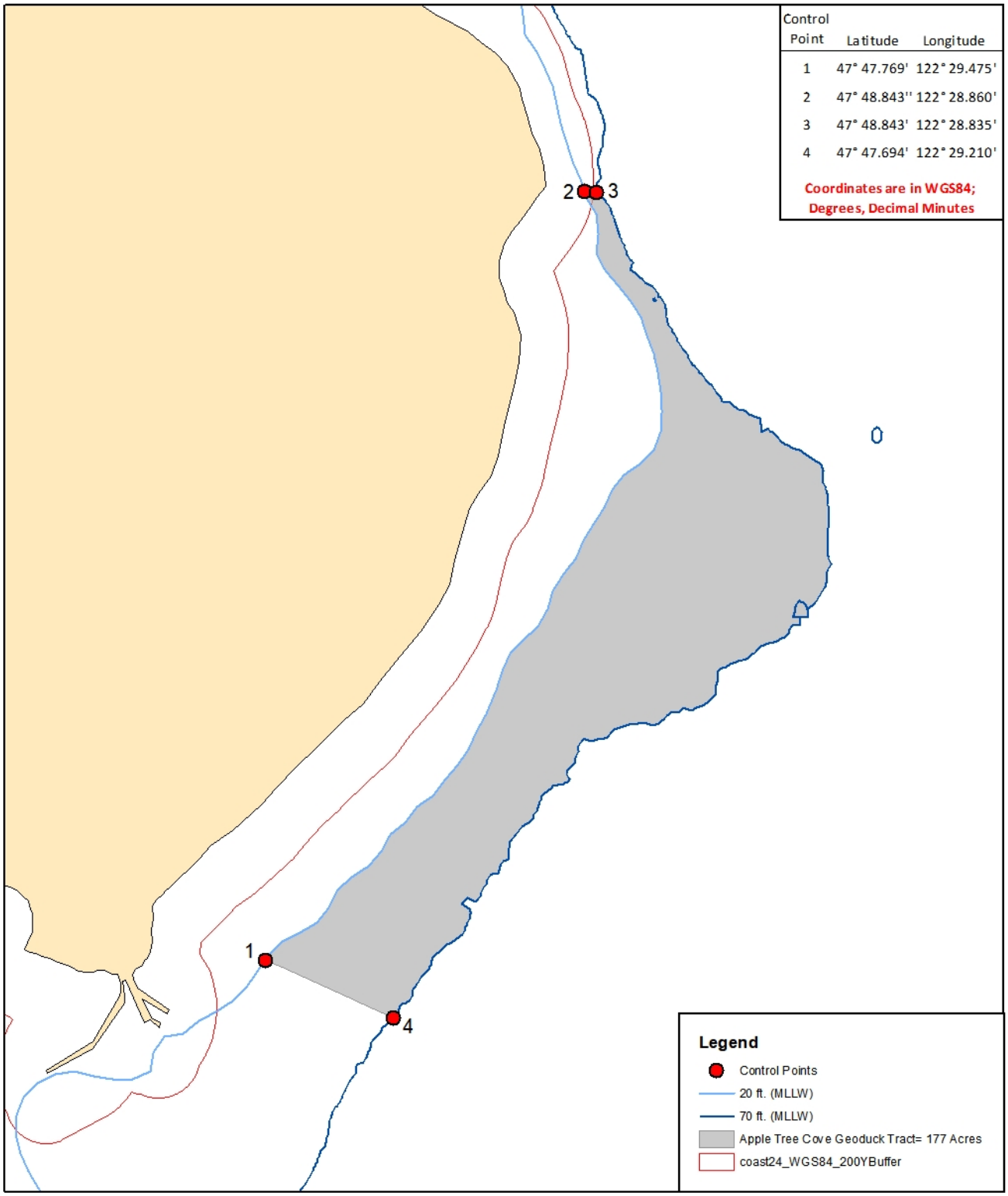
Data Sources:
Projection for data is GCS_Washington Geographic System 1984, Units: Meters. Coastline layer is from DNR, 1: 24,000 scale, created 09-20-99. Contours are from NOAA soundings.

0 0.5 1 2 3 Miles

Washington Department of FISH and WILDLIFE

Map Date: April 16, 2018
Map Author: O. Working
File: Data\Ocean\Geoduck

Figure 2. Control Points Map, Apple Tree Cove Commercial Geoduck Tract #06310



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1 inch = 0.24 miles

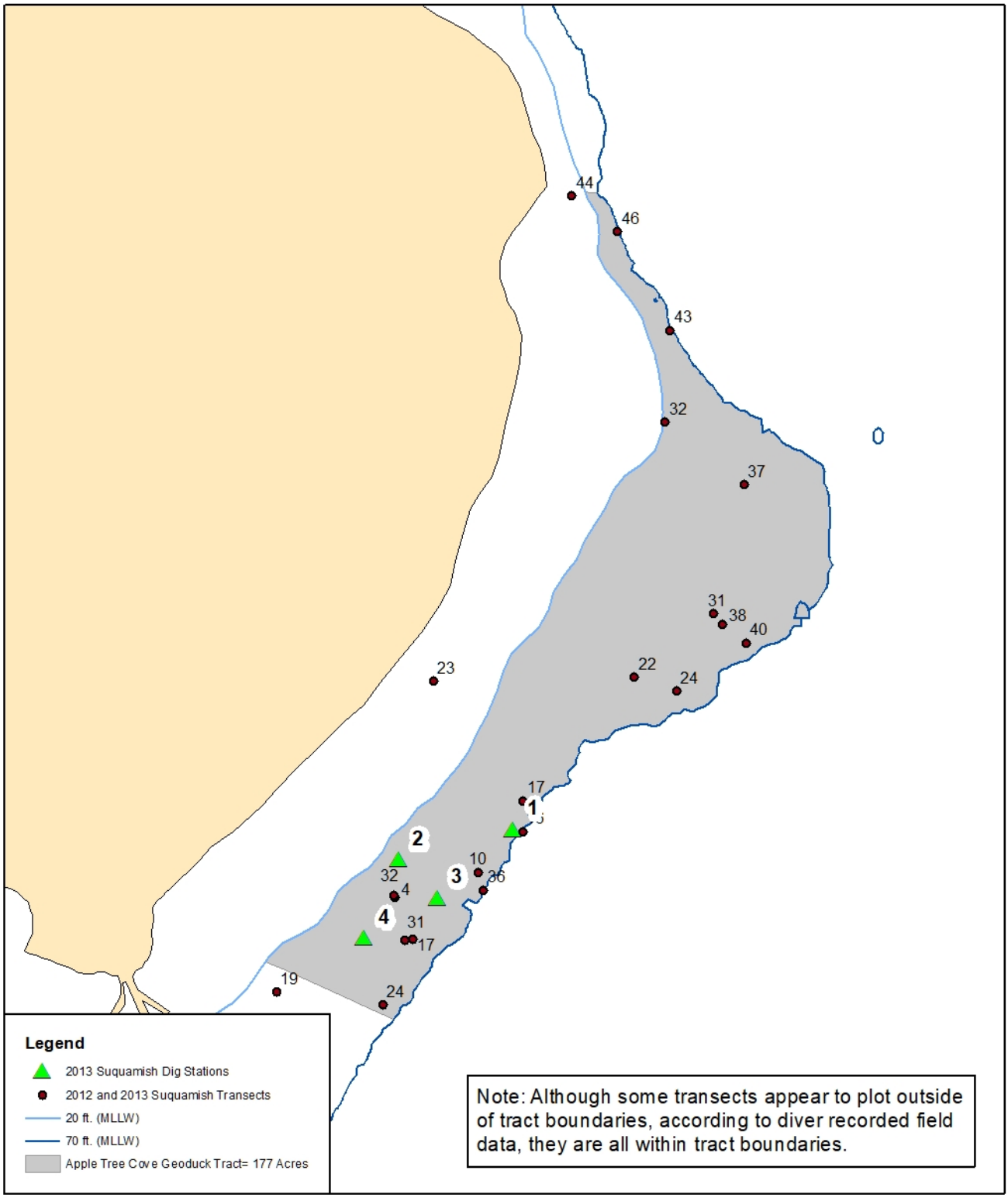
Data Sources:
Projection for data is GCS_Washington Geographic System 1984, Units: Meters. Coastline layer is from DNR, 1: 24,000 scale, created 09-20-99. Contours are from NOAA soundings.

0 0.075 0.15 0.3 0.45 Miles

Washington Department of FISH and WILDLIFE

Map Date: April 14, 2020
Map Author: O. Working
File: Data\Ocean\Geoduck

Figure 3. Transect and Dig Station Map, Apple Tree Cove Commercial Geoduck Tract #06310



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1 inch = 0.24 miles

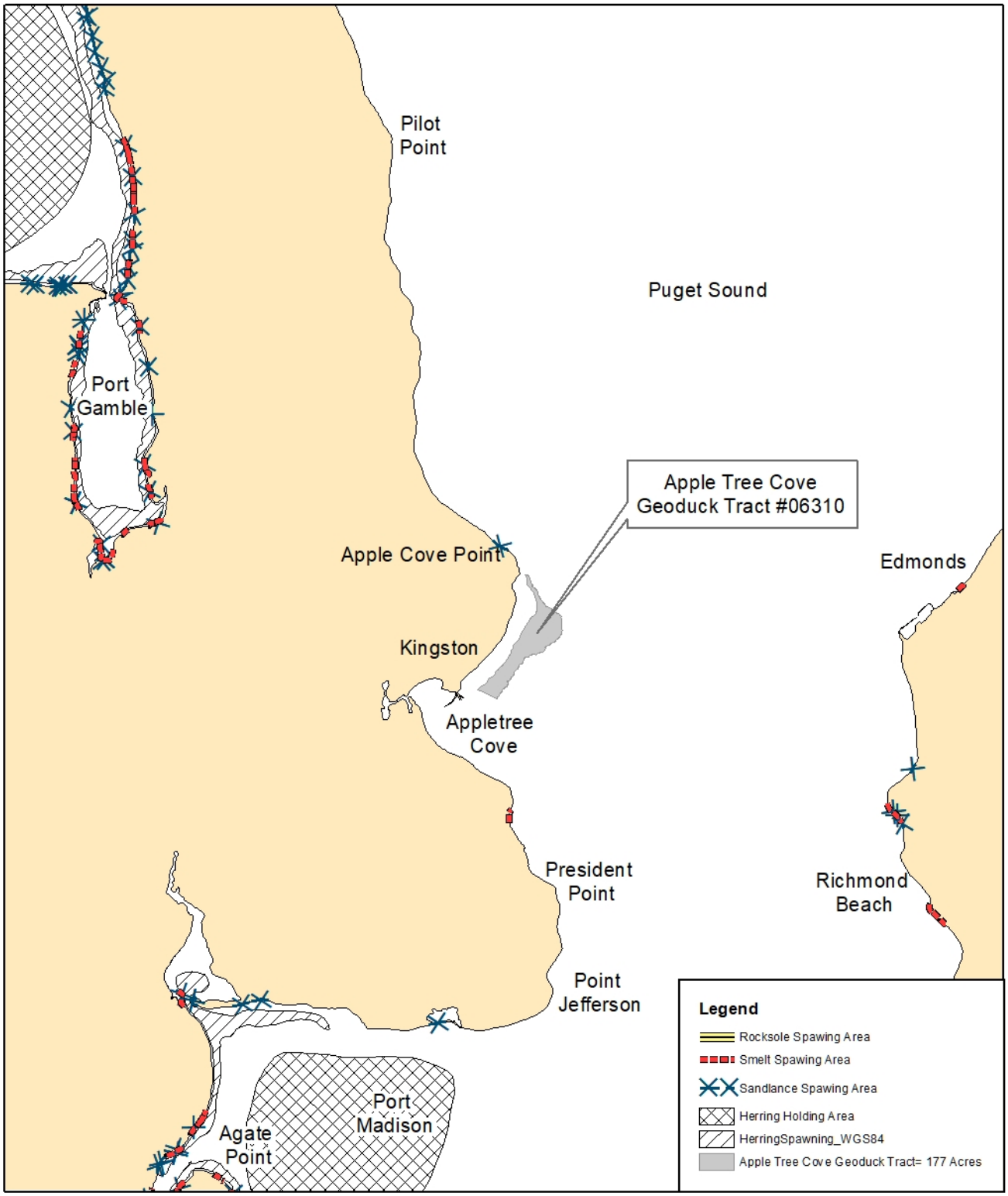
Data Sources:
Projection for data is GCS_Washington Geographic System 1984, Units: Meters. Coastline layer is from DNR, 1: 24,000 scale, created 09-20-99. Contours are from NOAA soundings.

0 0.075 0.15 0.3 0.45 Miles

Washington Department of FISH and WILDLIFE

Map Date: April 16, 2018
Map Author: O. Working
File: Data\Ocean\Geoduck

Figure 4. Fish Spawning Areas Near the Apple Tree Cove Commercial Geoduck Tract #06310



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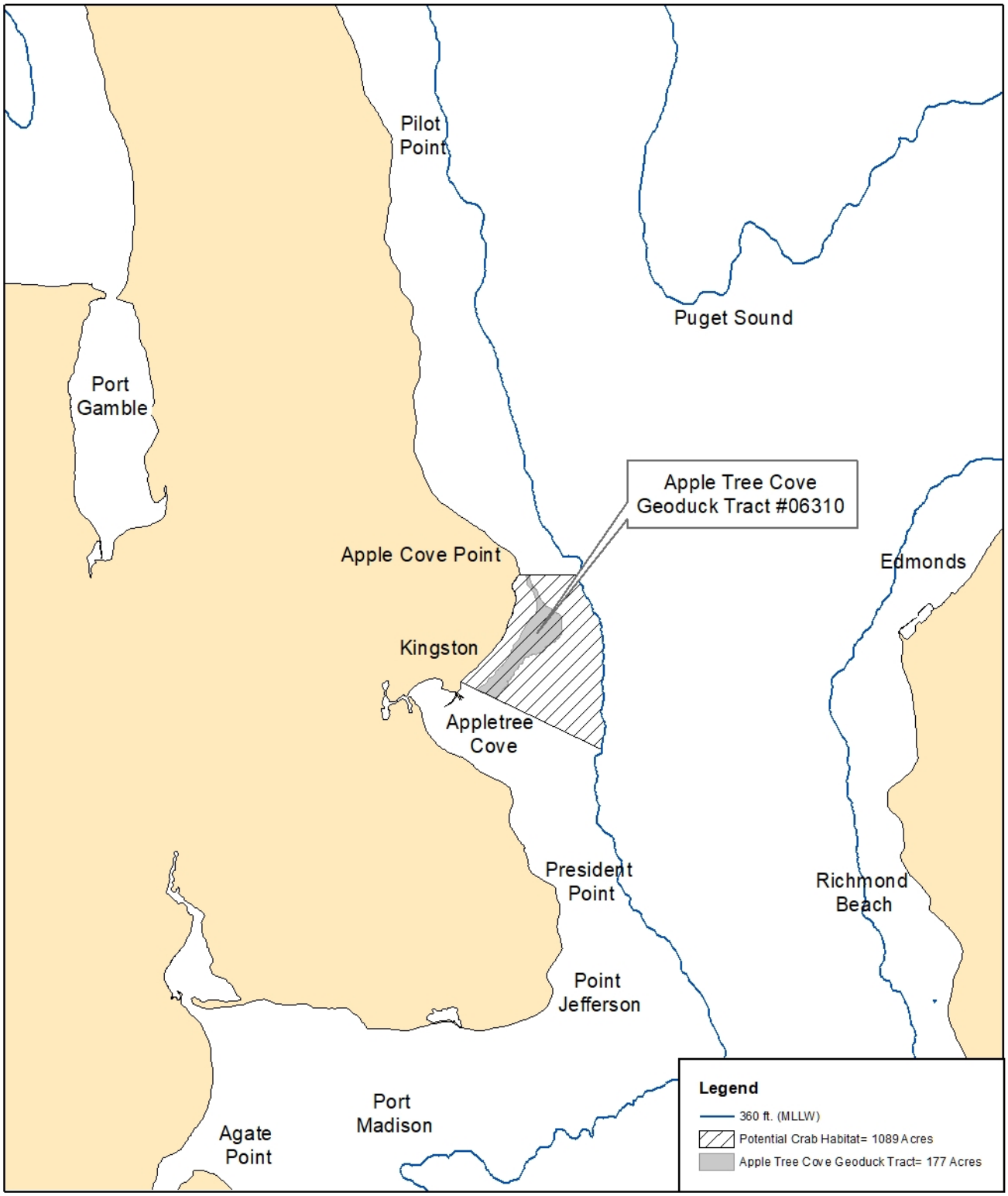
0 0.5 1 2 3 Miles

Washington Department of FISH and WILDLIFE

Map Date: April 16, 2018
Map Author: O. Working
File: Data\Ocean\Geoduck

Figure 5. Dungeness Crab Habitat Map, Apple Tree Cove Commercial Geoduck Tract #06310



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0 0.5 1 2 3 Miles

Washington Department of FISH and WILDLIFE

Map Date: April 16, 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

Apple Tree Cove geoduck tract # 06310.

Tract Name	Apple Tree Cove
Tract Number	06310
Tract Size (acres)[a]	177
Density of geoducks/sq.ft.[b]	0.079
Total Tract Biomass (lbs.)[b]	1,270,697
Total Number of Geoducks on Tract[b]	608,882
Confidence Interval (%)	21.1%
Mean Geoduck Whole Weight (lbs.)	2.38
Mean Geoduck Siphon Weight (lbs.)	N/A
Siphon Weight as a % of Whole Weight	N/A
Number of Transect Stations	30
Number of Geoducks Weighed	66

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

[b.] Biomass is based on the 2012 and 2013 Suquamish Tribe Pre-fishing survey biomass of 2,267,420 lbs. minus total harvest of 996,723 lbs. through April 7, 2020

*No siphon weights taken

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Table 2: DIGGING DIFFICULTY TABLE

Apple Tree Cove geoduck tract # 06310, 2013 Suquamish Tribe Pre-fishing geoduck survey

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)
10/14/2013	1	0	2	0	0	0	0	0	0	Y
10/14/2013	2	2	1	0	0	0	0	0	0	Y
10/14/2013	3	3	2	0	2	2	0	0	0	Y
10/14/2013	4	0	2	0	0	0	0	0	0	Y

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

Apple Tree Cove geoduck tract # 06310, 2012 and 2013 Suquamish Tribe Pre-fishing geoduck surveys

Date	Transect	Start Depth (ft) [a]	End Depth (ft) [a]	Geoduck Density (no. / sq ft) [b]	Substrate [c]				
					sand	pea gravel	gravel	cobble	boulder
7/25/2012	13	21	27	0.0859	Y				
7/25/2012	14	27	35	0.1052	Y				
7/25/2012	15	35	45	0.1289	Y				
7/25/2012	17	45	53	0.0593	Y				
9/5/2012	19	31	37	0.1659	Y				
9/5/2012	20	37	41	0.2385	Y				
9/5/2012	21	41	45	0.2400	Y				
9/5/2012	22	45	51	0.2133	Y				
9/5/2012	23	52	57	0.2667	Y				
9/5/2012	24	57	64	0.1985	Y				
9/5/2012	26	32	36	0.0430	Y			Y	
9/5/2012	27	36	39	0.1259	Y			Y	
9/5/2012	28	39	40	0.2089	Y			Y	
9/5/2012	29	40	43	0.1289	Y			Y	Y
9/5/2012	30	43	45	0.3037	Y				
9/5/2012	31	45	47	0.1881	Y				
9/6/2012	32	20	29	0.3748	Y				
9/6/2012	33	29	34	0.3407	Y				
9/6/2012	34	34	40	0.1793	Y				
9/6/2012	35	40	44	0.0593	Y				
9/6/2012	36	44	45	0.0163	Y				
9/6/2012	37	45	45	0.0000	Y				
9/7/2012	38	46	48	0.1052	Y				
9/7/2012	39	48	56	0.2252	Y	Y			Y
9/7/2012	40	56	64	0.2593	Y				
9/7/2012	42	54	55	0.2859	Y				
9/7/2012	43	55	62	0.3081	Y				
9/7/2012	44	27	36	0.0667	Y				
9/7/2012	45	36	42	0.1185	Y		Y	Y	
9/7/2012	46	42	62	0.2281	Y				
9/6/2013	2	20	22	0.0178	Y				
9/6/2013	3	22	25	0.0519	Y				
9/6/2013	4	25	30	0.0741	Y				
9/6/2013	6	24	30	0.0844	Y				
9/6/2013	7	30	33	0.0696	Y			Y	
9/6/2013	8	33	43	0.0015			Y	Y	Y
9/6/2013	9	40	54	0.1452	Y				Y
9/6/2013	10	54	64	0.1852	Y				Y
9/6/2013	12	22	29	0.0415	Y				
9/6/2013	13	29	36	0.0919					
9/6/2013	14	36	47	0.1230	Y			Y	Y
9/6/2013	15	47	56	0.1304	Y				

Table 3. Continued

Date	Transect	Start Depth (ft) [a]	End Depth (ft) [a]	Geoduck Density (no. / sq ft) [b]	Substrate [c]				
					sand	pea gravel	gravel	cobble	boulder
9/6/2013	16	56	66	0.1230	Y				
9/9/2013	17	48	60	0.1511	Y				
9/9/2013	19	25	30	0.0489	Y				
9/9/2013	20	30	35	0.0593	Y				
9/9/2013	21	35	41	0.1244	Y				
9/9/2013	22	41	47	0.0622	Y				
9/9/2013	23	47	53	0.0607	Y				
9/9/2013	24	53	59	0.1081	Y				
9/9/2013	27	22	25	0.0430	Y			Y	
9/9/2013	28	25	29	0.1393	Y				
9/9/2013	29	29	34	0.1215					
9/9/2013	30	34	39	0.1511	Y				
9/9/2013	31	39	45	0.2533	Y				
9/9/2013	32	26	31	0.1067	Y				
9/9/2013	33	31	37	0.0252	Y			Y	Y
9/9/2013	34	37	45	0.0830	Y			Y	
9/9/2013	35	45	52	0.2163	Y	Y			
9/9/2013	36	52	60	0.2859	Y				

[a.] All depths are corrected to mean lower low water (MLLW)
[b.] Densities were calculated using the default 0.75 show factor
[c.] Substrate codes: Y = present ; Blank = not present

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Table 4: GEODUCK SIZE AND QUALITY

Apple Tree Cove geoduck tract # 06310, 2013 Suquamish Tribe Pre-fishing geoduck survey

Dig Date	Dig Station	Number Dug	Avg. Whole Weight (lbs.)	Avg. Siphon Weight (lbs.)*	% of geoducks on station greater than 2 lbs.
2/12/2013	1	5	1.94	N/A	40%
2/12/2013	2	8	1.34	N/A	0%
2/12/2013	3	11	1.20	N/A	0%
2/12/2013	4	11	1.42	N/A	0%
2/12/2013	5	8	1.84	N/A	13%
2/12/2013	6	5	2.53	N/A	100%
2/12/2013	7	10	1.62	N/A	10%
2/12/2013	8	8	2.45	N/A	63%
2/12/2013	9	5	3.24	N/A	100%
10/14/2013	1	10	1.92	N/A	50%
10/14/2013	2	10	3.35	N/A	100%
10/14/2013	3	10	1.58	N/A	10%
10/14/2013	4	10	3.46	N/A	100%

*Siphon weights not taken

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Table 5: TRANSECT CORRECTED GEODUCK COUNT AND POSITION TABLE

Apple Tree Cove geoduck tract # 06310, 2012 and 2013 Suquamish Tribe Pre-fishing geoduck surveys

Transect Date	Transect	Corrected Geoduck Count per 900 sq. ft. Transect	Geoduck Siphon Show Factor [a]	Latitude [b]	Longitude [b]
7/25/2012	13	77	0.75		
7/25/2012	14	95	0.75		
7/25/2012	15	116	0.75		
7/25/2012	17	53	0.75	47.8000	122.4826
9/5/2012	19	149	0.75		
9/5/2012	20	215	0.75		
9/5/2012	21	216	0.75		
9/5/2012	22	192	0.75	47.8029	122.4789
9/5/2012	23	240	0.75	47.8027	122.4858
9/5/2012	24	179	0.75	47.8026	122.4775
9/5/2012	26	39	0.75		
9/5/2012	27	113	0.75		
9/5/2012	28	188	0.75		
9/5/2012	29	116	0.75		
9/5/2012	30	273	0.75		
9/5/2012	31	169	0.75	47.8044	122.4763
9/6/2012	32	337	0.75	47.8088	122.4781
9/6/2012	33	307	0.75		
9/6/2012	34	161	0.75		
9/6/2012	35	53	0.75		
9/6/2012	36	15	0.75		
9/6/2012	37	0	0.75	47.8074	122.4753
9/7/2012	38	95	0.75	47.8042	122.4759
9/7/2012	39	203	0.75		
9/7/2012	40	233	0.75	47.8038	122.4751
9/7/2012	42	257	0.75		
9/7/2012	43	277	0.75	47.8109	122.4780
9/7/2012	44	60	0.75	47.8140	122.4815
9/7/2012	45	107	0.75		
9/7/2012	46	205	0.75	47.8132	122.4799
9/6/2013	2	16	0.75		
9/6/2013	3	47	0.75		
9/6/2013	4	67	0.75	47.79771	-122.48692
9/6/2013	6	76	0.75		
9/6/2013	7	63	0.75		
9/6/2013	8	1	0.75		
9/6/2013	9	131	0.75		
9/6/2013	10	167	0.75	47.79834	-122.48407
9/6/2013	12	37	0.75		
9/6/2013	13	83	0.75		
9/6/2013	14	111	0.75		
9/6/2013	15	117	0.75		
9/6/2013	16	111	0.75	47.7993	-122.4826
9/9/2013	17	136	0.75	47.79675	-122.48625

Table 5. Continued

Transect Date	Transect	Corrected Geoduck Count per 900 sq. ft. Transect	Geoduck Siphon Show Factor [a]	Latitude [b]	Longitude [b]
9/9/2013	19	44	0.75	47.79547	-122.49087
9/9/2013	20	53	0.75		
9/9/2013	21	112	0.75		
9/9/2013	22	56	0.75		
9/9/2013	23	55	0.75		
9/9/2013	24	97	0.75	47.79524	-122.48722
9/9/2013	27	39	0.75		
9/9/2013	28	125	0.75		
9/9/2013	29	109	0.75		
9/9/2013	30	136	0.75		
9/9/2013	31	228	0.75	47.79674	-122.48654
9/9/2013	32	96	0.75	47.79776	-122.48694
9/9/2013	33	23	0.75		
9/9/2013	34	75	0.75		
9/9/2013	35	195	0.75		
9/9/2013	36	257	0.75	47.79793	-122.48389

[a.] The default 0.75 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

Apple Tree Cove geoduck tract # 06310, 2012 Suquamish Tribe Pre-fishing geoduck survey

# of Transects where Observed	Group	Common Name	Taxonomer
4	ANEMONE	ANEMONE	Unspecified anemone
2	BIVALVE	HORSE CLAM	*Tresus* sp.
5	CRAB	DUNGENESS CRAB	*Cancer magister*
5	CRAB	HERMIT CRAB	Unspecified hermit crab
2	CRAB	GRACEFUL CRAB	*Cancer gracilis*
2	CRAB	RED ROCK CRAB	*Cancer productus*
6	CUCUMBER	SEA CUCUMBER	*Parastichopus californicus*
1	NUDIBRANCH	NUDIBRANCH	Unspecified nudibranch
2	SEA PEN	SEA PEN	*Ptilosarcus gurneyi*

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Table 7: MOST COMMON AND OBVIOUS PLANTS OBSERVED
Apple Tree Cove geoduck tract # 06310, 2012 Suquamish Tribe Pre-fishing geoduck survey

# of Transects Where Observed	Taxonomer
11	*Laminaria* sp.
2	Large brown algae
7	*Ulva* sp.

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