ENVIRONMENTAL ASSESSMENT OF PROPOSED GEODUCK HARVEST
ALONG THE SOUTHWESTERN SHORELINE OF WHIDBEY ISLAND
AT THE AUSTIN GEODUCK TRACT (#05200)

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 southwestern shoreline of Whidbey Island is described below.

Proposed Harvest Dates: Periodic harvest from 2020 to 2021

Tract name: Austin geoduck tract (#05200)

Description: (Figure 1, Tract vicinity map)

The Austin geoduck tract is a subtidal area of approximately 94 acres (Table 1) along the southwestern shoreline of Whidbey Island, in Mutiny Bay, in the Central Puget Sound Geoduck Management Region. The tract begins about 700 yards northerly of the northern point of Double Bluff (geographic landmark) and extends northerly about 3,100 yards. The commercial tract area lies between the -26 and -70 foot (MLLW) water depth contours.

The Austin geoduck tract is bounded by a line projected south from a Control Point (CP) on the -26 foot (MLLW) water depth contour at 48º 00.065' N. latitude, 122º 33.316' W. longitude (CP1) southerly along the -26 foot (MLLW) depth contour to a point at 47º 58.715' N. latitude, 122º 33.016' W. longitude (CP2); then northwesterly to a point on the -70 foot (MLLW) depth contour at 47º 58.742' N. latitude, 122º 33.107' W. longitude (CP3); then northerly along the -70 feet (MLLW) depth contour to a point at 47º 59.982' N. latitude, 122º 33.410' W. longitude (CP4); then northeasterly to the point of origin (Figure 2).

This estimate of the tract boundary is made using GIS and the Tulalip Tribes 2015 geoduck survey data. All contours are corrected to MLLW. The -26 and -70 foot water depth contours were mapped by DNR and this information was provided to WDFW in 2001 to estimate tract area. Shoreline data is from DNR, digitized at 1:24000 scale in 1999. The -70 foot (MLLW) water depth contour was used for the deep-water boundary, and the -26 foot (MLLW) contour was used for the shallow boundary, due to eelgrass habitat nearshore of the tract. The latitude and longitude positions are reported in degrees and 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 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 subtidal 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 to strong in the vicinity of the Austin tract. At a water current station located near Mutiny Bay, currents reach a projected maximum flood velocity of 2.1 knots and maximum ebb velocity of 1.5 knots (Tides and Currents software; station #1551; August 11, 2020 to August 11, 2021).

The substrates are highly variable in this tract. While taking geoduck dig samples, divers noted that gravel, shell and cobble were components in the substrate that hindered digging (Table 2). Sand is the dominant surface substrate type, noted on all transects. Transects in the southern portion of the tract had mixtures of sand, pea gravel, shell, cobble and on one transect a boulder. Observations of pea gravel, gravel and shell were substrate types noted on the most northerly transects (Table 3, Figure 3).

Water Quality:

Water quality is good in the vicinity of the Austin geoduck tract. The Washington Department of Health (DOH) has classified the Austin geoduck tract as “Approved” for commercial shellfish harvest.

The Washington State Department of Ecology routinely tests water quality parameters throughout Puget Sound, including marine water monitoring station ADM001-Admiralty Inlet-Bush Point near the Austin tract. During the period of October 1992 through July 2015 (most current data year available), between water depths of 26 to 70 ft. (MLLW), the reported dissolved oxygen concentration ranged from 5.7 to 11.9 mg/L, with a mean value of 8.0 mg/L. The mean pH was 7.8 and the mean salinity was 29.6 psu. The maximum water temperature at this station was 13.4 °C and the minimum temperature recorded was 7.5 °C, with mean temperature of 10.2 °C.

Biota:

Geoduck:

The Austin geoduck tract is a subtidal area of approximately 94 acres. This tract contains a current biomass estimate of 442,089 pounds of geoducks (Table 1). The geoducks on this tract are considered commercial quality (Table 2). The abundance of geoducks on this tract is moderate, with a current estimated mean density of 0.05 geoducks/sq.ft., compared to a Puget Sound tract pre-fishing mean of 0.16 geoducks/sq.ft. (Table 1). Non-standard methods (unequal sample sizes) were used when geoduck dig samples were taken. Sample sizes ranged from 1 to 29 geoducks per dig station. Also note that dig samples were taken in October, November and December when geoducks tend not to be active and have low siphon show. Digging difficulty on geoduck dig stations ranged from “very easy” to “very difficult”. The factors which influenced the “very difficult” ratings were low abundance, and cobble and shell in the substrate (stations 6M and 6 D in the southern portion of the tract). Another factor which was a major hindrance to digging geoducks on 7 out of 12 dig stations was depth of geoducks in the substrate (Table 2). The estimate of mean weight of all geoducks sampled in 2015 was 2.19 pounds/geoduck. This mean weight is similar to the 2000 estimate of 2.23 pounds/geoduck on the Austin tract. Dig station mean weights ranged from 1.27 to 3.55 pounds/geoduck (Table 4). The 2015 weight estimate is used to calculate current biomass in this Environmental Assessment.

The Austin geoduck tract was surveyed in 1970, 2000 and 2015. This tract was harvested from July 2002 to November 2003 and 516,216 pounds were landed. This tract was most recently surveyed in 2015 by the Tulalip Tribes, and it was determined that the tract had recovered to pre-fishing geoduck density and was ready to harvest again. A supplemental survey was conducted in 2017 by WDFW to collect current algae and animal data for this report. A total of 449,619 lbs. have been landed since the 2015 survey. Transect locations and geoduck counts corrected with siphon “show factors” from the 2015 survey are listed in Table 5. A total of 54 transects and dig samples of 97 geoducks from the 2015 survey 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 water 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 geoducks on the study tracts mentioned above was 69 percent. The regeneration research to empirically analyze tract recovery rates is continuing. Over the last decade, regeneration of geoduck tracts may have been affected by illegal harvest or other causes of geoduck mortality.

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. The substrates at Austin are highly variable and habitat is available within this tract that may attract certain fish species. The fish observed during the 2017 WDFW supplemental survey were copper rockfish, ratfish, sand lance, sculpins, rock sole, C-O sole, English sole, starry flounder, Pacific sanddabs, speckled sanddabs, unspecified sanddabs, and unspecified fish (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 -24 ft. (MLLW) during a 2017 eelgrass survey. The nearshore tract boundary will be along the -26 ft. (MLLW) water depth to provide a vertical buffer between eelgrass beds and geoduck harvest.

There are no documented prespawner holding areas or herring spawning grounds in the immediate vicinity of the Austin geoduck tract (Figure 4). Geoduck harvest on the Austin tract should have no detrimental impacts on herring.

Surf smelt spawning habitat has not been identified in the vicinity of the Austin geoduck tract. Surf smelt spawning habitat occurs northerly of the Austin geoduck tract at Bush Point (Figure 4). Surf smelt deposit adhesive, semitransparent eggs on beaches that have a specific mixture of coarse sand and pea gravel. Inside Puget Sound, surf smelt spawning is thought to be associated with freshwater seepage, where the water keeps the spawning gravel moist. Eggs are deposited in water a few inches deep, around the time of the high water slack tide. There is substantial vertical separation between the potential surf smelt spawning zone (slack high tide) and geoduck harvest activity on the Austin tract (-26 to -70 feet, MLLW).

Sand lance spawning has been documented south of this tract at Double Bluff. Sand lance populations are widespread within Puget Sound, the Strait of Juan de Fuca and the coastal estuaries of Washington. They are most commonly noted along shorelines of the eastern Strait of Juan de Fuca and Admiralty Inlet. However, WDFW plankton surveys and ongoing exploratory spawning habitat surveys suggest that there are very few, if any, bays and inlets in the Puget Sound basin that will not be found to support sand lance spawning activity. Spawning of sand lance occurs at tidal elevations ranging from +5 feet to about the mean higher high water line. After deposition, sand lance eggs may be scattered over a wider range of the intertidal zone by wave action. The incubation period is about four weeks. Sand lances are an important part of the trophic link between zoolplankton and larger predators in the local marine food webs. Like all forage fish, sand lances are a significant component in the diet of many economically important resources in Washington. On average, 35 percent of juvenile salmon diets are comprised of sand lance. Sand lances are particularly important to juvenile Chinook salmon, where 60 percent of their diets are sand lance. Other economically important species, such as Pacific cod (*Gadus macrocephalus),* Pacific hake (*Merluccius productus*) and dogfish (*Squalus acanthias*) feed heavily on juvenile and adult sand lance. There is substantial vertical separation between sand lance spawning (+5 feet to mean higher high water) and geoduck harvest activity on the Austin tract (-26 to -70 feet, MLLW). Geoduck harvesting on the Austin tract should have no detrimental impacts on sand lance spawning.

NOAA Fisheries Service announced on April 27, 2010 that it was listing canary and yelloweye rockfish as “threatened” and bocaccio as “endangered” under ESA (federal Endangered Species Act). The listings became effective on July 27, 2010. Historic high levels of fishing and water quality are cited as reasons that these rockfish populations are in peril and have been slow to recover. On January 23, 2017; canary rockfish were delisted based on newly obtained samples and genetic analysis (Federal Register 82 FR 7711). Geoduck fishery managers are tracking this process and will take actions necessary to reduce the risk of “take” of any listed rockfish species that could potentially result from geoduck harvest activity.

Two salmon populations, Puget Sound Chinook salmon and Hood Canal summer run chum salmon, were listed by the National Marine Fisheries Service (renamed NOAA 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. Recent recovery and supplementation efforts have reversed the trend of decline in Hood Canal summer run chum salmon stocks. Total escapement for Hood Canal summer run chum salmon has reached historic high levels and risk of extinction has decreased for all stocks (Adicks, K. *et al*., 2007). The Austin 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. There are no major tributaries in the immediate vicinity of the Austin tract, which reduces the risk of geoduck harvest activities on this tract affecting chinook salmon runs. Further vertical separation of geoduck harvest (deeper and seaward of the -18 ft. MLLW contour) from juvenile salmon rearing areas and migration corridors (upper few meters of the water column) reduces or eliminates potential impacts to salmon populations. Charles Simenstad of the University of Washington School of Fisheries stated that the exclusionary principle of not allowing leasing/harvesting in water shallower than -18 ft. (MLLW), the 2+ 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 major impacts 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. The vertical separation between tributaries that support steelhead runs and the Austin tract reduces risk that geoduck harvest will have 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. NOAA Fisheries Service 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 Austin geoduck tract is outside of the critical habitat range of green sturgeon and geoduck harvest at this location will have no adverse effects on ESA recovery efforts for green sturgeon populations.

Invertebrates:

Many different kinds of invertebrates were observed on this tract during the 2017 supplemental survey. The most common and obvious of these invertebrates include: [1] mollusks (geoducks, horse clams, *Mya truncata* clams, moon snails and moon snail egg cases, jingleshell oysters, and various other hardshell clams, *Armina* and clown nudibranchs; [2] echinoderms (sea cucumbers, sunflower stars, blood stars, sun stars, and vermillion stars); [3] Worms (Chaetopterid polychaete tubes, *Sabellid* spp., and *Terebellid* spp; [4] cnidarians (plumed anemones, striped anemones, burrowing anemones, hydroids, and sea pens); [5] crustaceans (graceful crabs, hermit crabs, and giant barnacles); [6] tunicates; and [7] sponges. 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 not observed during the 2017 supplemental survey of the Austin tract.

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 (Figure 5, Potential crab habitat map). Dr. Dave Armstrong at 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 along this tract is approximately 2,470 acres. There were about 408,032 harvestable geoducks in the entire 94 acre tract, from the 2015 survey estimate. With a minimum harvest level of 65 percent, the total number harvested would be about 265,221 geoducks. Approximately 1.18 square feet of substrate is disturbed for every geoduck harvested, so 265,221 x 1.18 = 312,961 square feet of substrate. This equals about 7.2 acres. This is about 0.08 percent of the total available crab habitat in the vicinity of this tract. Based on the low amount of disturbance of potential crab habitat in the vicinity of the tract, the low abundance of Dungeness crab on 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 plant growth to areas shallower than where most geoduck harvest occurs. Aquatic algae observed during the 2017 supplemental geoduck survey (Table 7) include:

> Laminarian algae, *Ulva* spp., Gracilarian algae, *Pterygophora californica,* small foliose red algae and diatoms.

WDFW completed an eelgrass survey at the Austin geoduck tract on September 27, 2000 and August 15, 2017. The entire shallow boundary of the tract was examined. During both surveys, eelgrass was observed frequently along the shoreline to a maximum depth of -24 feet (MLLW). The WDFW Habitat Division have stated that the existing conditions in the fishery SEIS are sufficient to protect fish and wildlife habitat and natural resources (Thurston, 10/16/01). The shallow boundary of geoduck harvest is set at least two vertical feet seaward of the deepest eelgrass to protect all eelgrass from geoduck harvest activities. The shoreward boundary of this tract will be set along the -26 foot (MLLW) water depth contour.

Marine Mammals:

Several species of marine mammals, including gray whales, seals, sea lions, and river otters may be observed in the vicinity of this geoduck tract. Killer whales may also be observed in the vicinity of this tract. The Southern Resident stock of killer whales reside mainly in the San Juan Islands throughout spring and summer, but incursions south into Puget Sound occur more frequently during winter months (Brent Norberg, NOAA, pers. comm. 5/15/06). The Southern Resident stock of killer whales was listed as "endangered" under the federal Endangered Species Act (ESA) by the National Marine Fisheries Service on November 15, 2005. This is in addition to the designation of this stock in May 2003 as "depleted" under the Marine Mammal Protection Act. More information and a draft conservation plan for this stock can be found at the NOAA website (http://www.nwr.noaa.gov/Marine-Mammals/Whales-Dolphins-Porpoise/Killer-Whales/ESA-Act-Status/Listing-Final.cfm). Hand pick shellfish fisheries, like geoduck harvesting, are considered Category III under the Marine Mammal Authorization Program for Commercial Fisheries. This means that there is a "rare or remote" likelihood of marine mammal "take," (Brent Norberg, NOAA, pers. comm. 5/15/06). Precautions should be taken by commercial divers, when marine mammals are in the area, to be aware of marine mammal movements and behavior to eliminate the remote risk of entanglement with diver hoses and lines.

Birds:

A variety of marine birds are common in Puget Sound and the general vicinity of this tract. The most significant of these are guillemots, murres, murrelets, grebes, loons, scoters, dabbing ducks, black brant, mergansers, buffleheads, cormorants, gulls, and terns. Blue heron, bald eagles, and osprey are 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 next to the tract are primarily designated as shoreline residential, rural, and natural environments.

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 water around this tract is not a prime sport fishing area, however, some recreational salmon fishing occurs seasonally in proximity to this geoduck bed. Sport fishing is open year round for surfperch. Rockfish is closed for recreational harvest. Lingcod can only be taken May 1 to June 15 by hook and line and 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 Puget 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 Austin Bay area is used by recreational and commercial vessels traveling through central Puget Sound. Geoduck harvesting at this site is outside of major shipping lanes and 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 southwestern shoreline of the Whidbey Island in Mutiny Bay. The tract was most recently surveyed in 2015 by the Tulalip Tribes and in 2017 a supplementary survey was conducted by WDFW. The current geoduck biomass estimate for the 94 acre harvest area is about 442,089 pounds. 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 -24 feet (MLLW). The shoreward boundary of the tract will be set along the -26 ft. (MLLW) water depth contour to provide a buffer between forage fish spawning habitat and geoduck harvest. The anticipated environmental impacts of this harvest are within the range of conditions discussed in the 2001 Geoduck Fishery Final Supplemental Environmental Impact Statement. No significant impacts are expected from this harvest.

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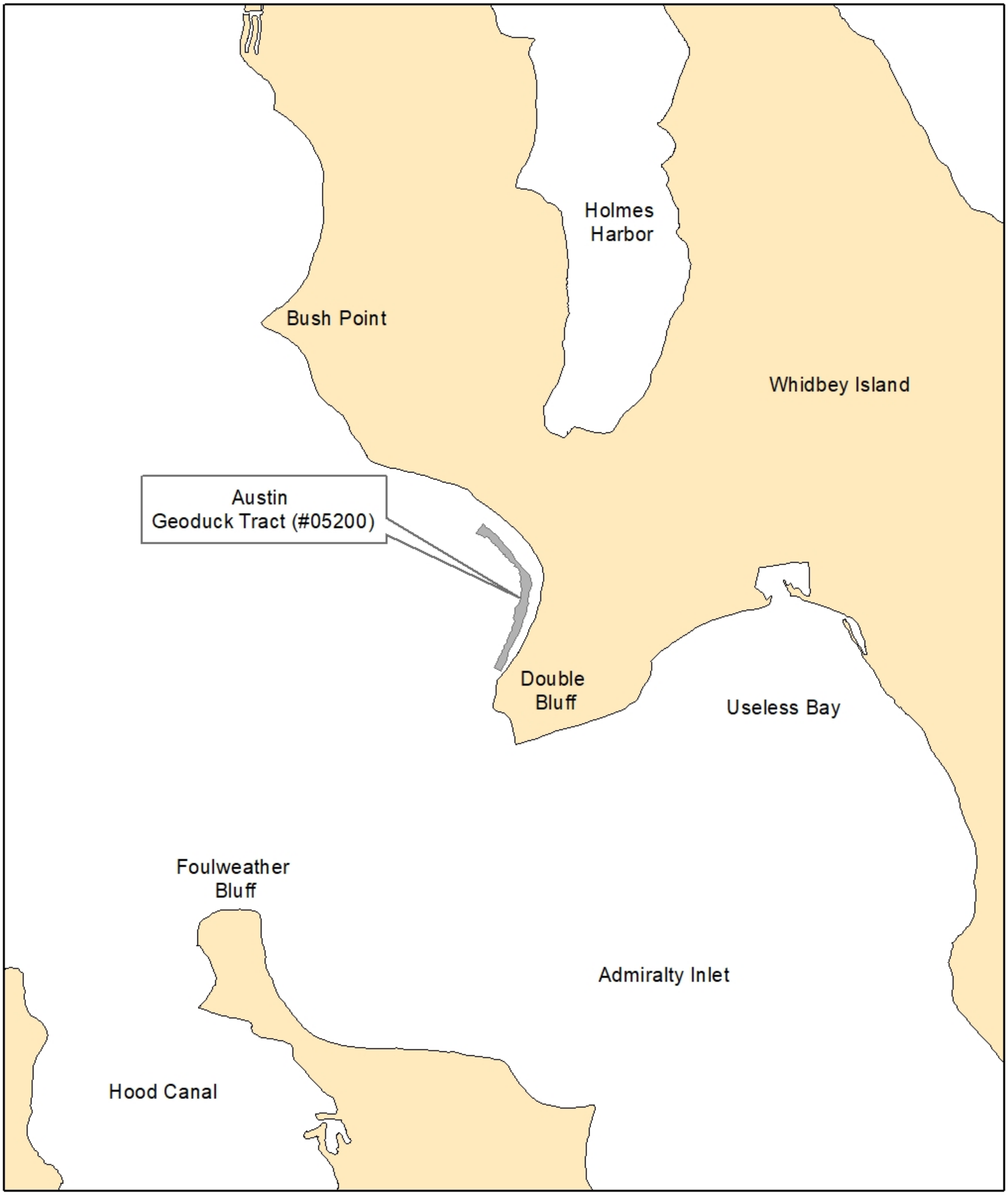
Figure 1. Vicinity Map, Austin Commercial Geoduck Tract #05200



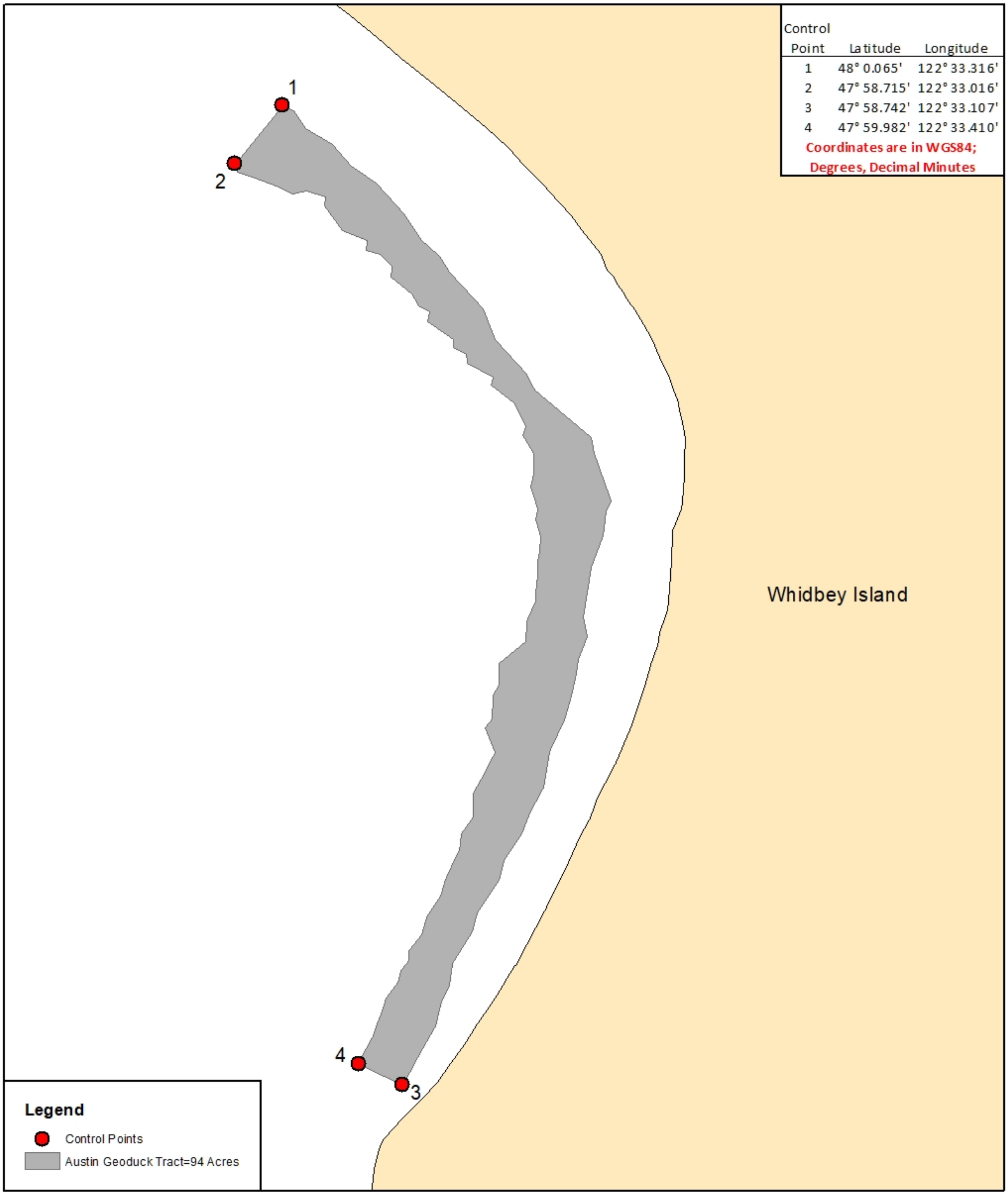
1:100,000

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.

Map Date: October 8, 2018
Map Author: O. Working
File: Data\Ocean\Geoduck

Figure 2. Control Points Map, Austin Commercial Geoduck Tract #05200



Control Point	Latitude	Longitude
1	48° 0.065'	122° 33.316'
2	47° 58.715'	122° 33.016'
3	47° 58.742'	122° 33.107'
4	47° 59.982'	122° 33.410'

Coordinates are in WGS84; Degrees, Decimal Minutes

1:15,000

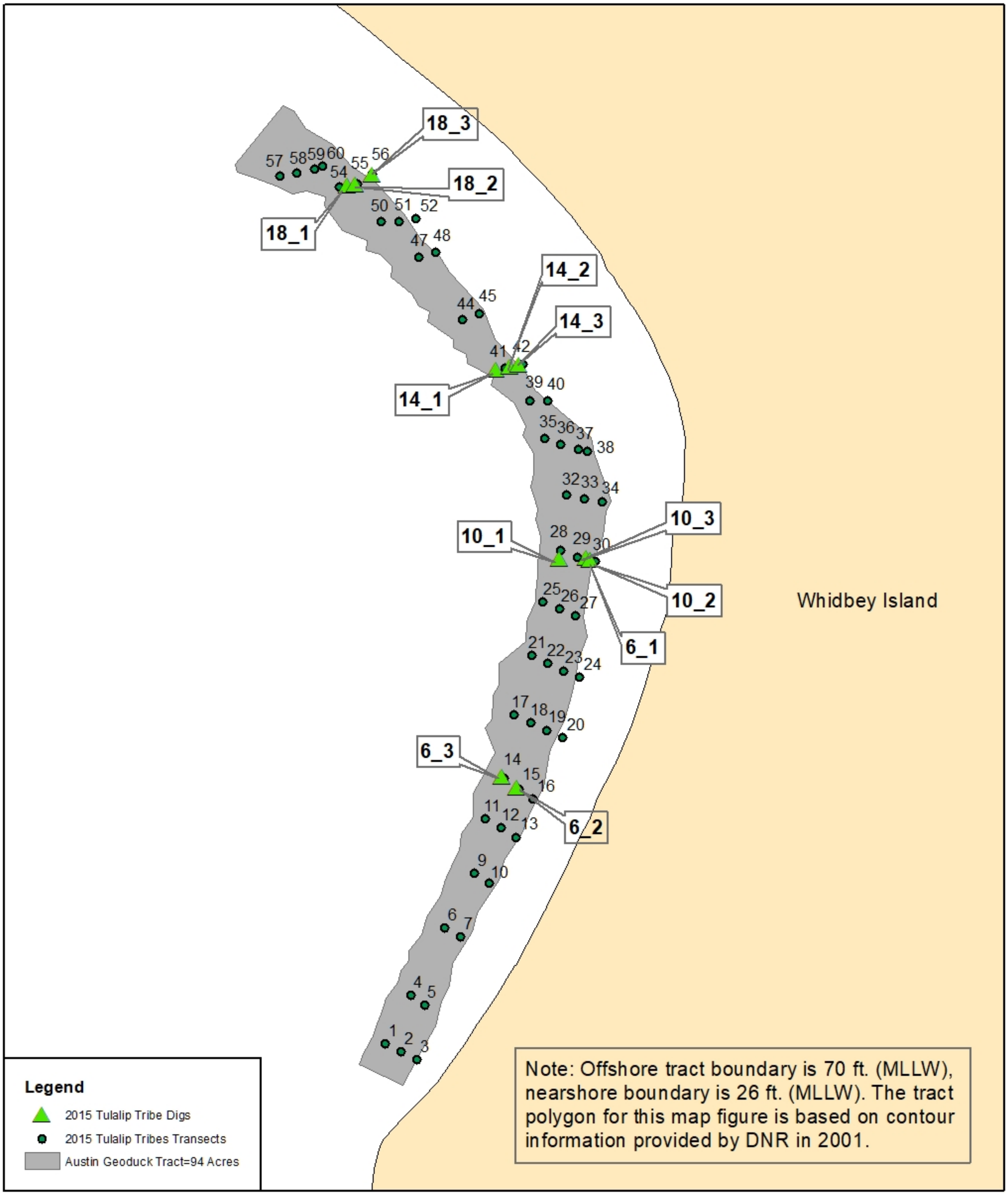
1 inch = 0.24 miles

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

Map Date: October 8, 2018
Map Author: O. Working
File: Data\Ocean\Geoduck

Figure 3. Transect and Dig Station Map, Austin Commercial Geoduck Tract #05200



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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

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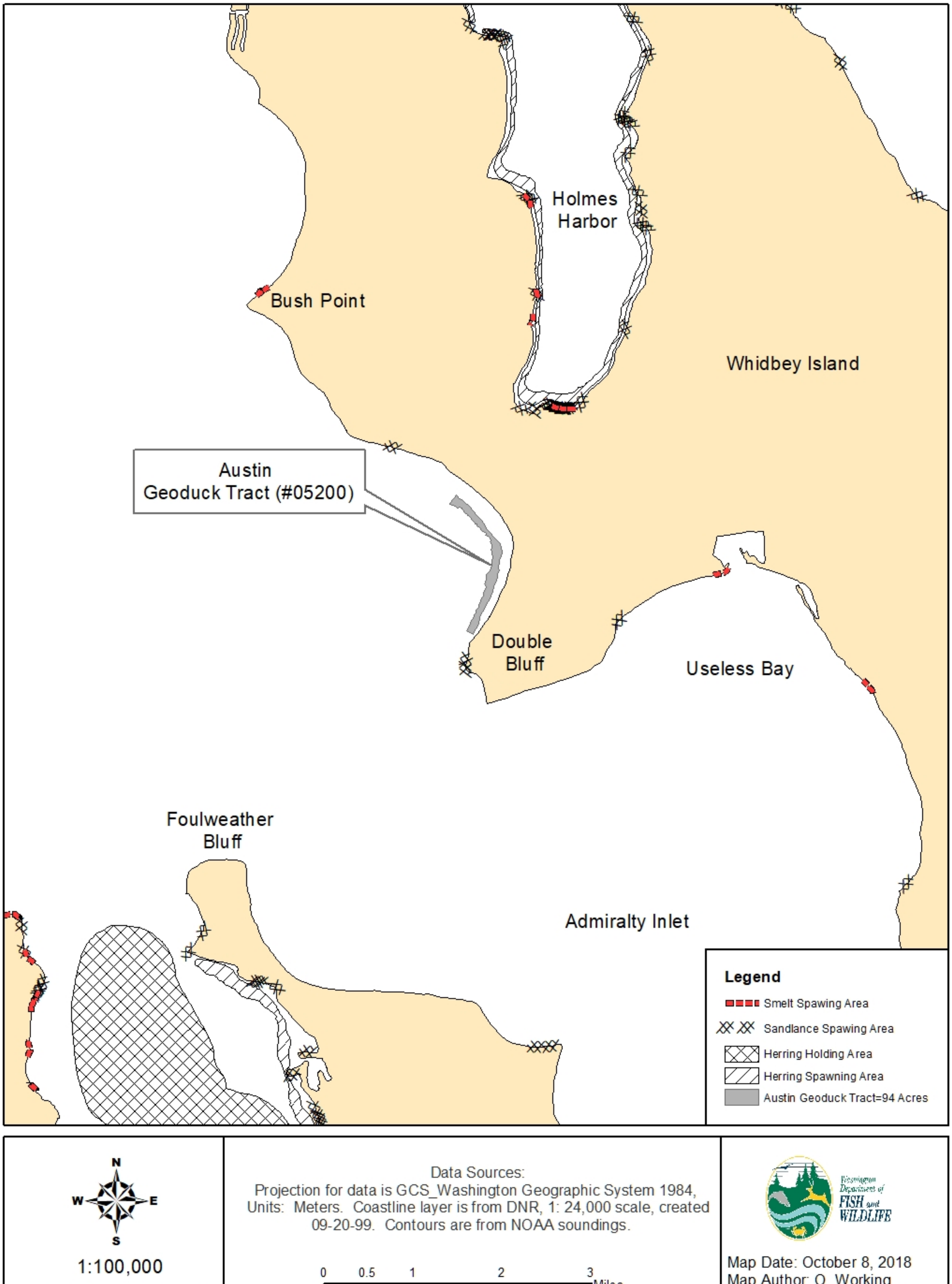
Map Date: October 8, 2018
Map Author: O. Working
File: Data\Ocean\Geoduck

Figure 4. Fish Spawning Areas Near the Austin Commercial Geoduck Tract #05200



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.

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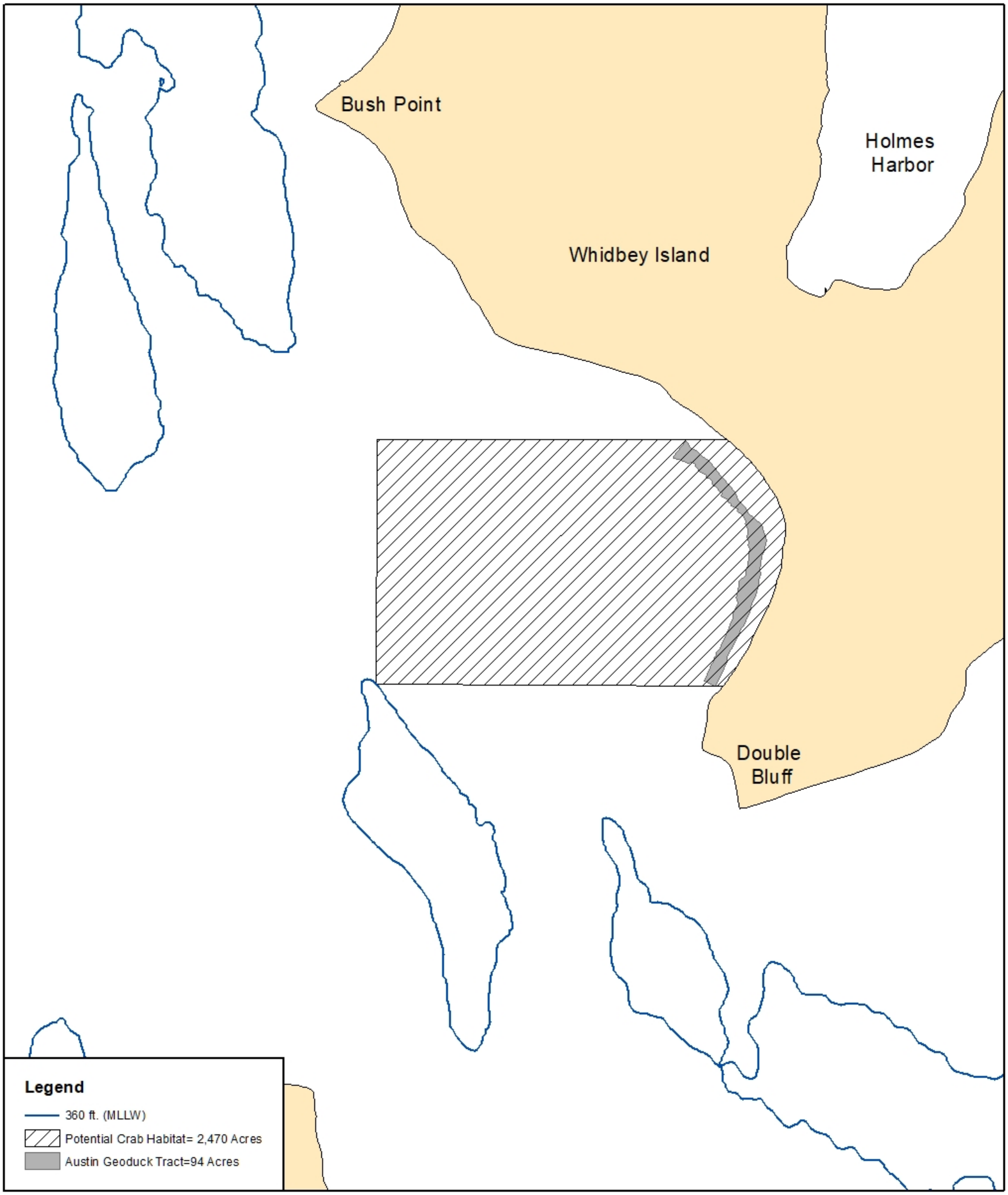
Map Date: October 8, 2018
Map Author: O. Working
File: Data\Ocean\Geoduck

Figure 5. Dungeness Crab Habitat Map, Austin Commercial Geoduck Tract #05200



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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: October 8, 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 plant is listed in *Taxonomer*.

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Table 1. GEODUCK TRACT SUMMARY

Austin geoduck tract # 05200.

Tract Name	Austin
Tract Number	05200
Tract Size (acres)[a]	94
Density of geoducks/sq.ft.[b]	0.05
Total Tract Biomass (lbs.)[b]	442,089
Total Number of Geoducks on Tract[b]	202,293
Confidence Interval (%)	24.3%
Mean Geoduck Whole Weight (lbs.)	2.19
Mean Geoduck Siphon Weight (lbs.)	N/A
Siphon Weight as a % of Whole Weight	N/A
Number of Transect Stations	54
Number of Geoducks Weighed	97

[a.] Tract area is between the -26 ft. and -70 ft. (MLLW) water depth contours

[b.] Biomass is based on the 2015 Tulalip Tribes pre-fishing geoduck survey biomass of 891,708 lbs minus harvest of 449,619 lbs. through August 11, 2020

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Table 2: DIGGING DIFFICULTY TABLE

Austin geoduck tract #05200, 2015 Tulalip Tribes Pre-fishing geoduck 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)
10D	2	2	0	0	1	1	0	0	Y
10S	1	1	1	0	1	1	0	0	Y
10M	1	1	1	1	0	0	0	0	Y
6S	1	1	2	0	0	0	0	0	Y
6M	4	0	0	0	2	2	0	0	Y
6D	4	0	0	0	2	2	0	0	Y
14D	0	2	2	0	0	0	0	0	Y
14M	0	1	2	0	0	1	0	0	Y
14S	0	1	2	0	0	0	0	0	Y
18D	0	1	2	0	0	0	0	0	Y
18M	0	2	2	0	0	0	0	0	Y
18S	0	1	2	0	0	0	0	0	Y

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

Austin geoduck tract #05200, 2015 Tulalip Tribes Pre-fishing geoduck survey

Transect	Start Depth (ft) [a]	End Depth (ft) [a]	Geoduck Density (no. / sq ft) [b]	Substrate [c]					
				sand	peagravel	gravel	shell	cobble	boulder
1	70	59	0.0459	2	1			1	
2	59	45	0.0474	2	1			1	
3	45	29	0.0563	2	1			1	
4	67	57	0.0400	2	1			1	
5	57	44	0.0637	2	1			1	
6	68	55	0.0222	2	1				
7	55	34	0.0593	2	1				
9	63	51	0.0133	2	1		1		
10	51	30	0.0519	2	1		1		
11	70	60	0.0089	2	1				
12	60	48	0.0074	2	1				
13	48	34	0.0963	2	1				
14	65	56	0.0267	2	1		1	1	
15	56	45	0.0059	2	1		1	1	
16	45	33	0.0696	2	1		1	1	
17	66	64	0.1126	2	1		1	1	
18	64	53	0.1333	2	1		1	1	
19	53	40	0.0207	2	1		1	1	
20	40	26	0.0074	2	1		1	1	
21	68	62	0.0459	2	1				1
22	62	60	0.1719	2	1				
23	60	43	0.1526	2	1		1		
24	43	26	0.2119	2	1		1		
25	69	61	0.1170	2					
26	61	49	0.2207	2					
27	49	34	0.2563	2					
28	69	60	0.3526	2					
29	59	46	0.3156	2					
30	46	26	0.1319	2					
32	55	45	0.1689	2					
33	45	38	0.1481	2					
34	37	29	0.1378	2					
35	68	49	0.3215	2					
36	49	37	0.1630	2					
37	36	30	0.1422	2					
38	30	26	0.0578	2					
39	68	45	0.1807	2					
40	45	28	0.0681	2					
41	70	58	0.2785	2					
42	58	26	0.1185	2					
44	68	58	0.0148	2	1				

Table 3. Continued

Transcect	Start Depth (ft) [a]	End Depth (ft) [a]	Geoduck Density (no. / sq ft) [b]	Substrate [c] sand	peagravel	gravel	shell	cobble	boulder
45	58	39	0.1067	2					
47	65	52	0.0163	2					
48	52	28	0.0578	2					
50	63	54	0.0178	2			1		
51	54	41	0.0904	2		1			
52	41	26	0.0430	2					
54	64	58	0.0696	2			1		
55	58	47	0.1215	2					
56	47	31	0.0652	2					
57	70	68	0.0000	2					
58	68	65	0.0030	2					
59	65	59	0.0519	2	1				
60	59	49	0.0681	2	1				

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: 1 = present ; 2 = dominant

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Table 4: GEODUCK SIZE AND QUALITY

Austin geoduck tract #05200, 2015 Tulalip Tribes Pre-fishing geoduck survey

Dig Station	Number Dug	Avg. Whole Weight (lbs.)	Avg. Siphon Weight (lbs.)*	% of geoducks on station greater than 2 lbs.
10D	29	1.76	-	31%
10S	3	2.73	-	100%
10M	22	2.34	-	68%
6S	4	3.00	-	100%
6M	2	1.27	-	0%
6D	3	1.65	-	0%
14D	10	2.35	-	80%
14M	5	2.09	-	80%
14S	2	2.23	-	100%
18D	6	2.48	-	67%
18M	10	2.51	-	70%
18S	1	3.55	-	100%

*Note: Siphon weights not provided

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Table 5: TRANSECT CORRECTED GEODUCK COUNT AND POSITION TABLE

Austin geoduck tract #05200, 2015 Tulalip Tribes Pre-fishing geoduck survey

Transect	Corrected Geoduck Count per 900 sq. ft. Transect	Geoduck Siphon Show Factor [a]	Latitude [b]	Longitude [b]
1	41	0.75	47.9795	-122.5509
2	43	0.75	47.9793	-122.5503
3	51	0.75	47.9792	-122.5498
4	36	0.75	47.9806	-122.5501
5	57	0.75	47.9804	-122.5496
6	20	0.75	47.9822	-122.5489
7	53	0.75	47.9820	-122.5484
9	12	0.75	47.9835	-122.5480
10	47	0.75	47.9833	-122.5475
11	8	0.75	47.9847	-122.5476
12	7	0.75	47.9845	-122.5471
13	87	0.75	47.9843	-122.5466
14	24	0.75	47.9857	-122.5470
15	5	0.75	47.9855	-122.5465
16	63	0.75	47.9852	-122.5460
17	101	0.75	47.9872	-122.5467
18	120	0.75	47.9870	-122.5462
19	19	0.75	47.9868	-122.5456
20	7	0.75	47.9867	-122.5451
21	41	0.75	47.9885	-122.5462
22	155	0.75	47.9884	-122.5457
23	137	0.75	47.9882	-122.5451
24	191	0.75	47.9881	-122.5445
25	105	0.75	47.9898	-122.5459
26	199	0.75	47.9896	-122.5453
27	231	0.75	47.9895	-122.5447
28	317	0.75	47.9910	-122.5453
29	284	0.75	47.9908	-122.5447
30	119	0.75	47.9907	-122.5441
32	152	0.75	47.9922	-122.5451
33	133	0.75	47.9922	-122.5445
34	124	0.75	47.9921	-122.5439
35	289	0.75	47.9936	-122.5460
36	147	0.75	47.9934	-122.5454
37	128	0.75	47.9933	-122.5445
38	52	0.75	47.9933	-122.5448
39	163	0.75	47.9944	-122.5465
40	61	0.75	47.9944	-122.5459
41	251	0.75	47.9951	-122.5474
42	107	0.75	47.9953	-122.5468
44	13	0.75	47.9962	-122.5489
45	96	0.75	47.9964	-122.5483
47	15	0.75	47.9977	-122.5504

Table 5. Continued

Transect	Corrected Geoduck Count per 900 sq. ft. Transect	Geoduck Siphon Show Factor [a]	Latitude [b]	Longitude [b]
48	52	0.75	47.9978	-122.5499
50	16	0.75	47.9985	-122.5518
51	81	0.75	47.9985	-122.5512
52	39	0.75	47.9985	-122.5506
54	63	0.75	47.9992	-122.5532
55	109	0.75	47.9993	-122.5526
56	59	0.75	47.9995	-122.5521
57	0	0.75	47.9994	-122.5553
58	3	0.75	47.9995	-122.5547
59	47	0.75	47.9996	-122.5541
60	61	0.75	47.9997	-122.5538

[a.] Densities were calculated using the default 0.75 show factor
[b.] Latitude and longitude are in WGS84 datum, decimal degrees

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Table 6: MOST COMMON AND OBVIOUS ANIMALS OBSERVED

Austin geoduck tract #05200, 2017 WDFW Supplemental geoduck survey

# of Transects where Observed	Group	Common Name	Taxonomer
1	ANEMONE	BURROWING ANEMONE	*Pachycerianthus fimbriatus*
10	ANEMONE	PLUMED ANEMONE	*Metridium* spp.
8	ANEMONE	STRIPED ANEMONE	*Urticina* spp.
10	ASCIDIAN	SESSILE TUNICATE	Unspecified Tunicate
1	BIVALVE	HARDSHELL CLAMS	*Veneridae* spp.
16	BIVALVE	HORSE CLAM	*Tresus* spp.
5	BIVALVE	HORSE MUSSEL	*Modiolus rectus*
3	BIVALVE	JINGLESHELL OYSTER	*Pododesmus macrochisma*
6	BIVALVE	TRUNCATED MYA	*Mya truncata*
7	CNIDARIA	HYDROIDS	Unspecified Hydroid
13	CNIDARIA	SEA PEN	*Ptilosarcus gurneyi*
1	CRAB	DECORATOR CRAB	*Oregonia gracilis*
3	CRAB	GRACEFUL CRAB	*Cancer gracilis*
13	CRAB	HERMIT CRAB	Unspecified hermit crab
7	CUCUMBER	SEA CUCUMBER	*Parastichopus californicus*
2	FISH	C-O SOLE	*Pleuronichthys coenosus*
1	FISH	COPPER ROCKFISH	*Sebastes caurinus*
1	FISH	FISH	Unspecified Fish
5	FISH	PACIFIC SANDDAB	*Citharichthys sordidus*
6	FISH	RATFISH	*Hydrolagus colliei*
4	FISH	ROCK SOLE	*Lepidopsetta bilineata*
1	FISH	SANDDAB	*Citharichthys* spp.
12	FISH	SCULPIN	Unspecified Cottidae
14	FISH	SPECKLED SANDDAB	*Citharichthys stigmaeus*
3	FISH	STARRY FLOUNDER	*Platichthys stellatus*
2	GASTROPOD	MOON SNAIL	*Polinices lewisii*
2	GASTROPOD	MOON SNAIL EGGS	*Polinices lewisii* egg case
1	MISC	GIANT BARNACLE	*Balanus nubilis*
4	MISC	SPONGE	Unspecified Porifera
1	NUDIBRANCH	ARMINA	*Armina californica*
1	NUDIBRANCH	CLOWN NUDIBRANCH	*Tritonia catalinae*
3	SEA STAR	BLOOD STAR	*Henricia leviuscula*
1	SEA STAR	SUN STAR	*Solaster* spp.
5	SEA STAR	SUNFLOWER STAR	*Pycnopodia helianthoides*
1	SEA STAR	VERMILLION STAR	*Mediaster aequalis*
12	WORM	ROOTS	Chaetopterid polychaete tubes
7	WORM	SABELLID TUBE WORM	*Sabellid* spp.
1	WORM	TEREBELLID TUBE WORM	*Terebellid* spp.

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Table 7: MOST COMMON AND OBVIOUS ALGAE OBSERVED

Austin geoduck tract #05200, 2017 WDFW Supplemental geoduck survey

# of Transects Where Observed	Taxonomer
1	Diatoms
1	*Pterygophora californica*
1	*Laminaria* spp.
1	*Gracilaria* spp.
5	*Ulva* spp.
15	Small Red Algae

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