ENVIRONMENTAL ASSESSMENT OF PROPOSED GEODUCK HARVEST
ALONG THE WESTERN SHORELINE OF BAINBRIDGE ISLAND
AT THE AGATE PASSAGE GEODUCK TRACT (#06800)

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 seven 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 between the northeastern shoreline of the Kitsap Peninsula and the northwestern shoreline of Bainbridge Island in southern Agate Passage is described below.

Proposed Harvest Year(s): 2023- 2024

Tract name: Agate Passage (Tract #06800)

Description: (Figure 1, Tract Vicinity map)

The Agate Passage geoduck tract is a subtidal area of approximately 159 acres (Table 1) near Sandy Hook, Kitsap Peninsula in southern Agate Passage, approximately three miles south of Port Madison, and four miles north of Port Orchard in the Central Puget Sound Geoduck Management Region. The tract is adjacent to and shares a common boundary with the Manzanita tract (#07000) to the south.

The Agate Passage tract is bounded by a line projected northeasterly from a point on the -25 foot (MLLW) water depth contour in the southwestern portion of the tract at 47°41.730’ N. latitude, 122°34.465’ W. longitude, Control Point (CP) 1; to a point at 47°41.792’ N. latitude, 122°34.273’ W. longitude (CP 2); to a point at 47°41.792’ N. latitude, 122°34.441’ W. longitude (CP 3); to a point at 47°41.952’ N. latitude, 122°34.552’ W longitude (CP 4) to a point at 47°42.423’ N. latitude, 122°34.314’ W. longitude (CP 5) then easterly to a point on the -25 foot (MLLW) water depth contour along the shoreline of Bainbridge Island at 47°42.421’ N. latitude, 122°34.095’ W. longitude (CP 6); then southerly along the -25 foot (MLLW) water depth contour to a point at 47°41.471’ N. latitude, 122°34.060’ W. longitude (CP 7); 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 (2011 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 -25 ft. (MLLW) water depth contour was used for the shallow boundary, due to herring spawning areas being documented in the vicinity of this tract and the results of the WDFW 2017 eelgrass survey, where no eelgrass was documented deeper than -25 feet (MLLW). The water depth does not reach -70 feet (MLLW) in the vicinity of this tract, so the tract is bounded by the -25 foot (MLLW) water depth contour and the excluded unproductive area in the center of the tract (see geoduck section for more information). 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 very strong in the vicinity of the Agate Passage tract. In Puget Sound, at Agate Passage adjacent to this tract, currents reach a predicted maximum flood velocity of 7.2 knots and maximum ebb velocity of 6.0 knots (Tides and Currents software; station #1641; Agate Passage, south end).

The surface substrate within this tract is primarily sand, which was noted on all 73 of thetransects. Other substrates noted were shell, cobble, rock and sand; listed in order of the frequency of occurrence (Table 3).

Water Quality:

Water quality is good at the Agate Passage geoduck tract. Water mixing at this tract is affected by the convergence of currents from the main basin of Puget Sound and those between the Kitsap Peninsula and the western shoreline of Bainbridge Island, 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 have been provided by the Washington Department of Ecology (DOE) for Puget Sound at the Port Madison station (PMA001). For 2012 (most recently completed data year available), between water depths of 18 and 70 feet, the mean reported dissolved oxygen concentration was 9.3 milligrams per liter (mg/l) with a range between 6.7 mg/l and 14.2 mg/l. The mean salinity at this station was 28.9 parts per thousand (ppt) with a range between 26.4 ppt and 30.0 ppt. The mean water temperature at this station was 50.9° F with a range between 45.3° F and 60.9° F.

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

Biota:

Geoduck:

The Agate Passage geoduck tract is approximately 159 acres. The abundance of geoducks on this tract is low, with a current estimated average density of 0.041 geoducks/sq. ft. This tract currently contains an estimated 1,165,575 pounds of geoducks (Table 1). On all 7 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 stations #66 and 72) included abundance, depth in the substrate, and compact substrate.

The average density prior to harvest from the 2011 pre-fishing survey was 0.090 geoducks/sq. ft., ranging from 0.002 geoducks/sq. ft. on transect #121 to 0.204 geoducks/sq. ft. on transect #66 (Table 3). The geoducks at the Agate Passage tract have an average weight of 4.12 pounds, while the average geoduck in Puget Sound is 2.1 pounds. The lowest average whole weight is 3.38 pounds per geoduck at dig station #66 and the highest average whole weight is 4.63 pounds per geoduck at dig station #36 (Table 4). Station locations and geoduck counts corrected with siphon “show factors” are listed in Table 5.

The Agate Passage geoduck tract was first surveyed in 1968 by WDFW, followed by surveys and acreage changes in 1981, 1992, 1994, and 1995. The most recent survey of 159 acres was conducted by the Suquamish tribe and occurred in 2011. This survey excluded 99 acres in the center of the tract which co-managers agreed was “unproductive”. The biomass estimate from the 2011 survey was 2,578,779 pounds of geoduck, and harvest to date is estimated to be 1,413,204 pounds of geoduck. The results of the 2011 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 feet and shallower than -70 feet (corrected to mean lower low water - MLLW). Other geoducks which are not harvestable are found inshore and offshore of the harvest areas. Observations in south Puget Sound show that major geoduck populations continue to depths of 360 feet. Additional geoducks exist in polluted areas and are also unavailable for harvest, but continue to spawn and contribute to the total population.

The low rate of harvest is due 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 tract to its original density, after removal of 65 percent of the geoducks, is 55 years. The recovery time for the Agate Passage tract is unknown. The 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. The fish observed during the survey at the Agate Passage tract included unspecified flatfish, starry flounder and unspecified sculpin (Table 6).

WDFW marine fish managers were asked of their concerns regarding possible impacts of geoduck fishing on groundfish and baitfish. 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 not observed along this tract deeper than -25 ft. (MLLW) during the 2017 eelgrass survey.

There are Pacific herring, surf smelt and sand lance spawning grounds near the Agate Passage tract (Figure 4 - Fish Spawning Areas Near the Agate Passage Tract #06800), therefore, the nearshore tract boundary will be along the -25 ft. (MLLW) water depth contour to provide a vertical buffer between herring spawning activity and geoduck harvest. Geoduck fishing on the Agate Passage 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 includes all marine, estuarine, and river reaches accessible to the listed chum salmon between Dungeness Bay and Hood Canal, as well as 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 could occur as late as mid-April. The Agate Passage tract is outside of the critical habitat range for Hood Canal summer run chum salmon.

Critical habitat for Puget Sound Chinook salmon includes all marine, estuarine and river reaches accessible to listed Chinook salmon in Puget Sound. WDFW recognizes 27 distinct stocks of Chinook salmon; 8 spring-run, 4 summer-run, and 15 summer/fall and fall-run stocks. The existence of an additional five spring-run stocks is in dispute. The majority of Puget Sound Chinook salmon emigrate to the ocean as subyearlings.

Major tributaries in the general vicinity of the Agate Passage 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 -25 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 Agate Passage tract that support steelhead stocks. The horizontal separation between tributaries that support steelhead runs and the Agate Passage 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 Agate Passage 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, moon snails and unspecified nudibranchs); [2] echinoderms (sea cucumbers, and sea stars); [3] cnidarians (sea pens, and unspecified anemones); and [4] arthropods (Dungeness crabs, red rock crabs, graceful crabs, decorator crabs, and hermit crabs). Geoduck harvest has not been shown to have long-term adverse effects on these invertebrates. Geoduck harvest maydepress 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 may experience peak molt in mid-April, based on data from the Kingston area (Cain, 10/15/01). Dungeness crab were observed on 23 out of 73 transects during the 2011 pre-fishing survey of the Agate Passage 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 (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 foot (MLLW) level. However, the depth does not reach -330 feet in the vicinity of this tract, so calculations were made to the shoreline on either side of this tract. The entire crab habitat within and along this tract is approximately 521 acres. There were about 625,767 harvestable geoducks in the entire 159 acre tract, from the 2011 pre-fishing survey estimate. Harvest of at least 65 percent is required prior to an active tract being placed into recovery status, although this percentage can be significantly higher. Using the 65 percent harvest minimum, the total number harvested would be about 406,749 geoducks. Approximately 1.18 square feet of substrate is disturbed for every geoduck harvested, so 406,749 x 1.18 = 479,963 square feet of substrate. This equals approximately11 acres, which is about 2.1 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:

> Diatoms, Laminarian algae, large brown algae, small green algae, and small red algae

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 and 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 2017 by WDFW divers swimming the entire shoreward boundary of the tract and no eelgrass was documented deeper than -25 ft. (MLLW). The shoreward boundary of this tract will be no shallower than the -25 ft. (MLLW) water depth contour, which should provide sufficient buffer to avoid any harvest impacts to both herring spawning activity and 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: https://www.fisheries.noaa.gov/action/listing-southern-resident-killer-whale-under-esa.

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 “semi-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 Agate Passage 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 the Agate Passage tract located between the northeastern shoreline of the Kitsap Peninsula and the northwestern shoreline of Bainbridge Island. The tract was most recently surveyed in 2011 by the Suquamish Tribe and the current biomass estimate after subsequent harvest was subtracted is 1,165,575 pounds. The commercial tract is presently classified by DOH as “Approved” for shellfish 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.

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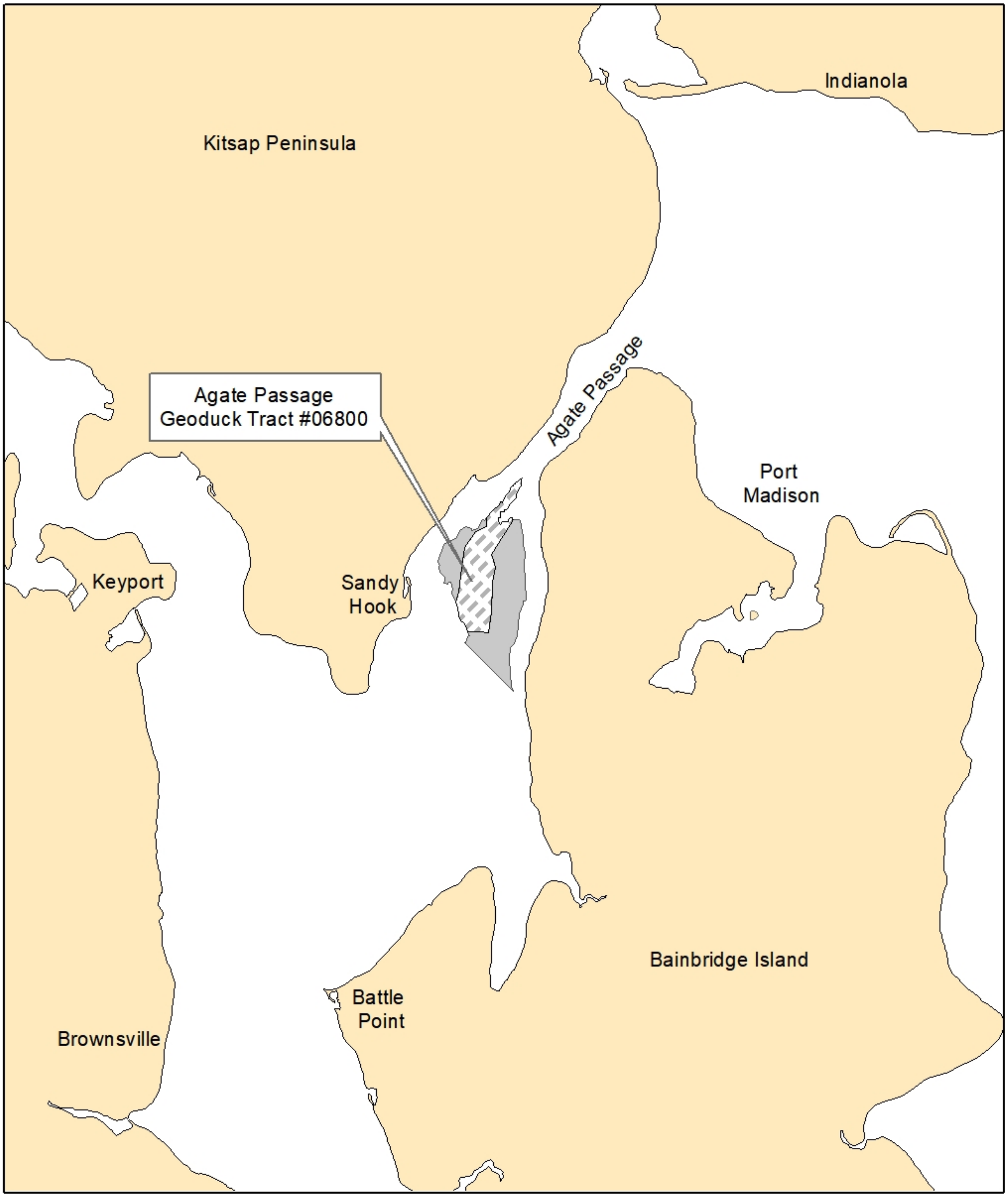
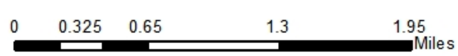
Figure 1. Vicinity Map, Agate Passage Commercial Geoduck Tract #06800



1:60,000

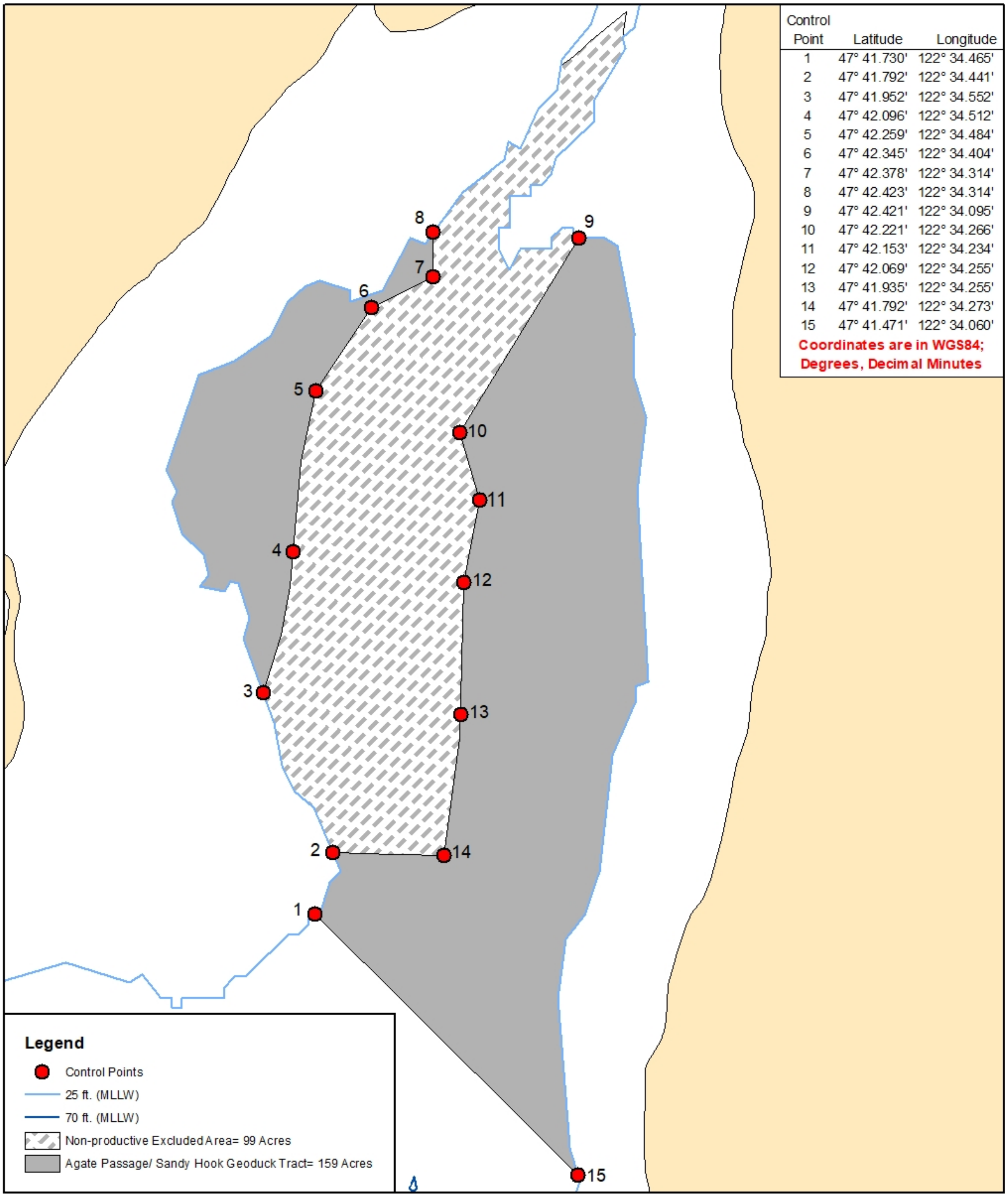
1 inch = 0.95 miles

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.



Map Date: March 26, 2021
Map Author: O. Working
File: Data\Ocean\Geoduck

Figure 2. Control Points Map, Agate Passage Commercial Geoduck Tract #06800



Control Point	Latitude	Longitude
1	47° 41.730'	122° 34.465'
2	47° 41.792'	122° 34.441'
3	47° 41.952'	122° 34.552'
4	47° 42.096'	122° 34.512'
5	47° 42.259'	122° 34.484'
6	47° 42.345'	122° 34.404'
7	47° 42.378'	122° 34.314'
8	47° 42.423'	122° 34.314'
9	47° 42.421'	122° 34.095'
10	47° 42.221'	122° 34.266'
11	47° 42.153'	122° 34.234'
12	47° 42.069'	122° 34.255'
13	47° 41.935'	122° 34.255'
14	47° 41.792'	122° 34.273'
15	47° 41.471'	122° 34.060'

Coordinates are in WGS84; Degrees, Decimal Minutes

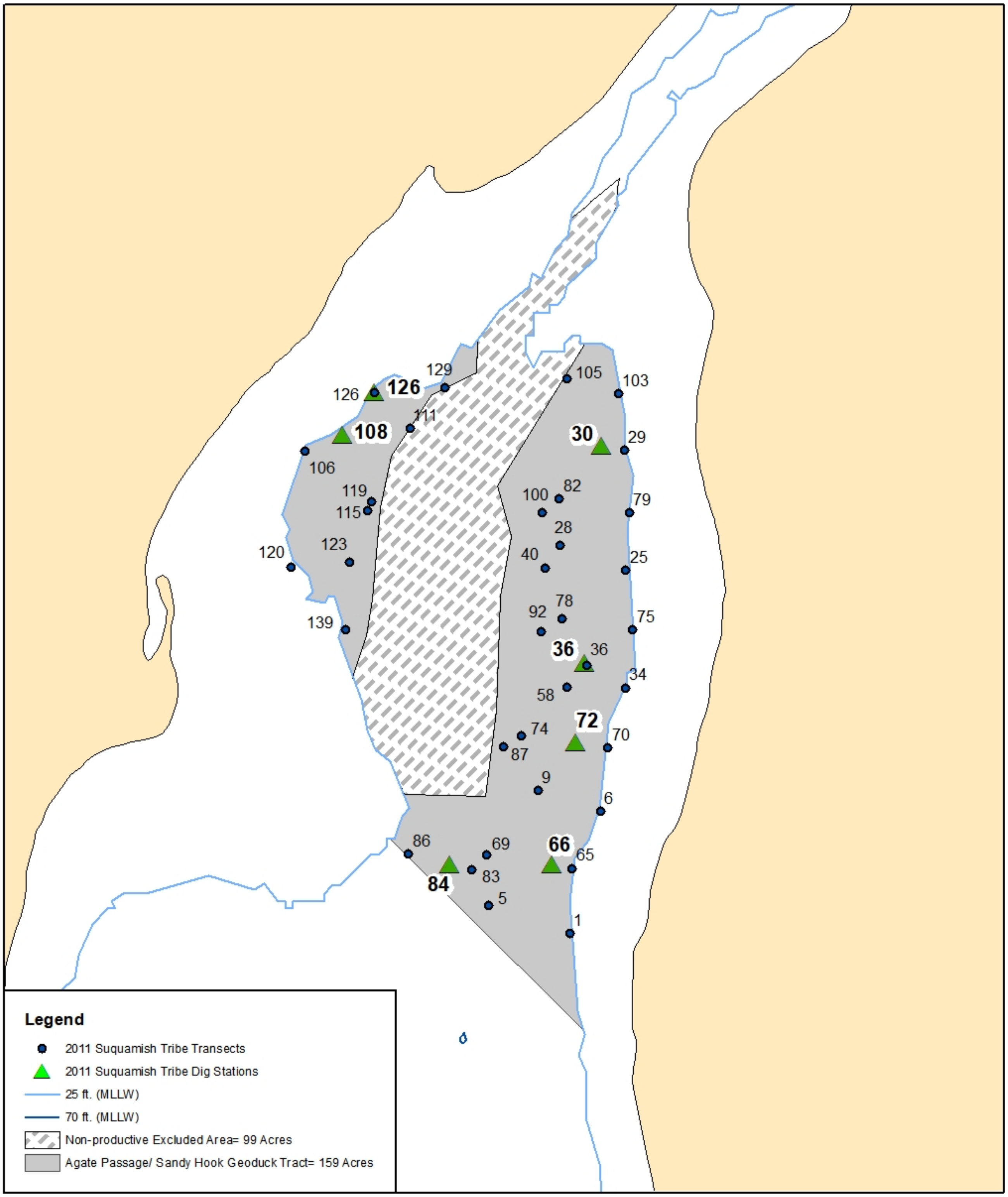
1:11,000

1 inch = 0.17 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 19, 2022
Map Author: O. Working
File: Data\Ocean\Geoduck

Figure 3. Transect and Dig Station Map, Agate Passage Commercial Geoduck Tract #06800



N
W E
S

1:15,000

1 inch = 0.24 miles

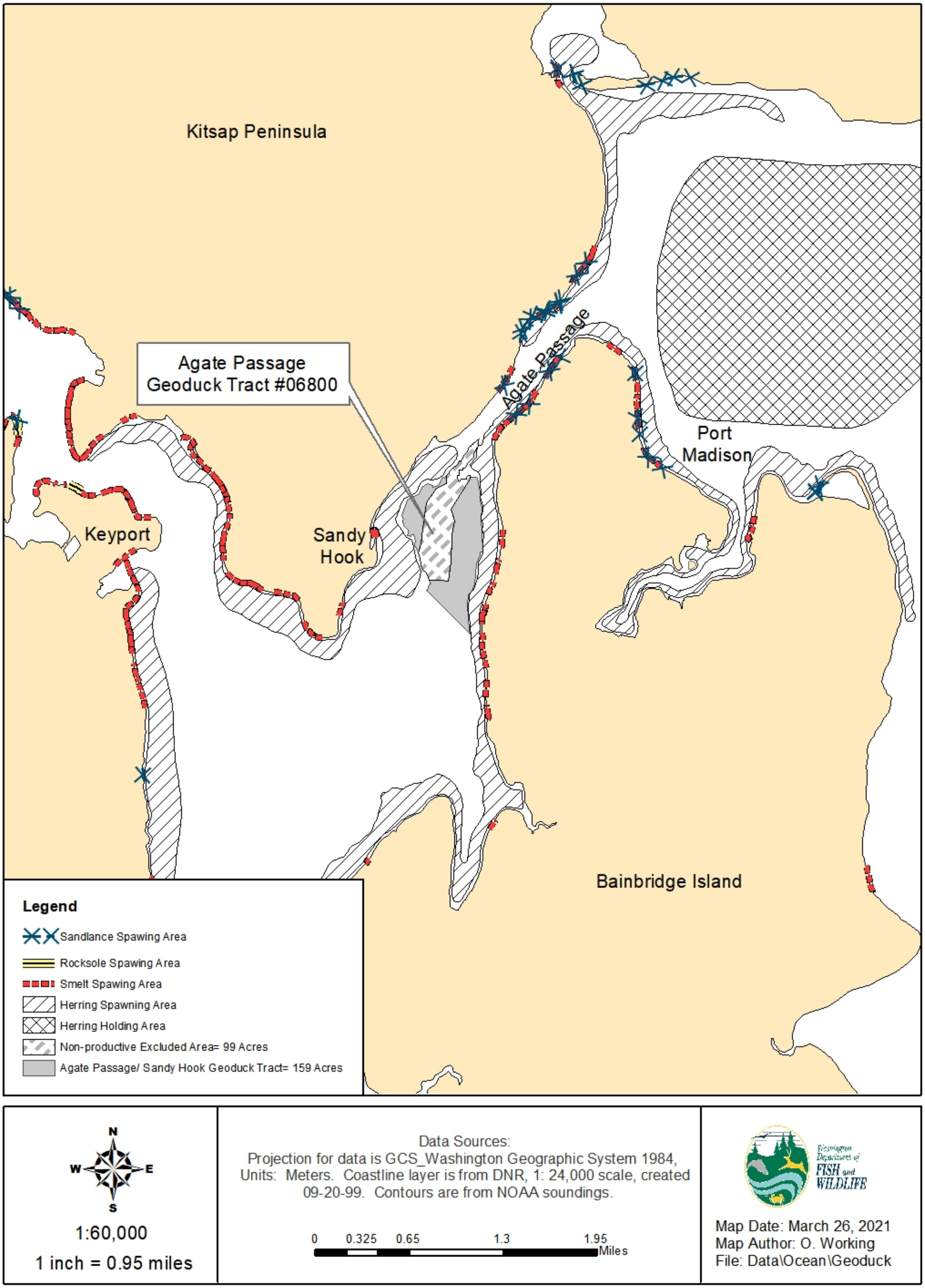
Data Sources:
Projection for data is GCS_Washington Geographic System 1984, Units: Meters. Coastline layer is from DNR, 1: 24,000 scale, created 09-20-99. Contours are from NOAA soundings.

0 0.075 0.15 0.3 0.45 Miles

Washington Department of FISH and WILDLIFE

Map Date: March 26, 2021
Map Author: O. Working
File: Data\Ocean\Geoduck

Figure 4. Fish Spawning Areas Near the Agate Passage Commercial Geoduck Tract #06800



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: March 26, 2021
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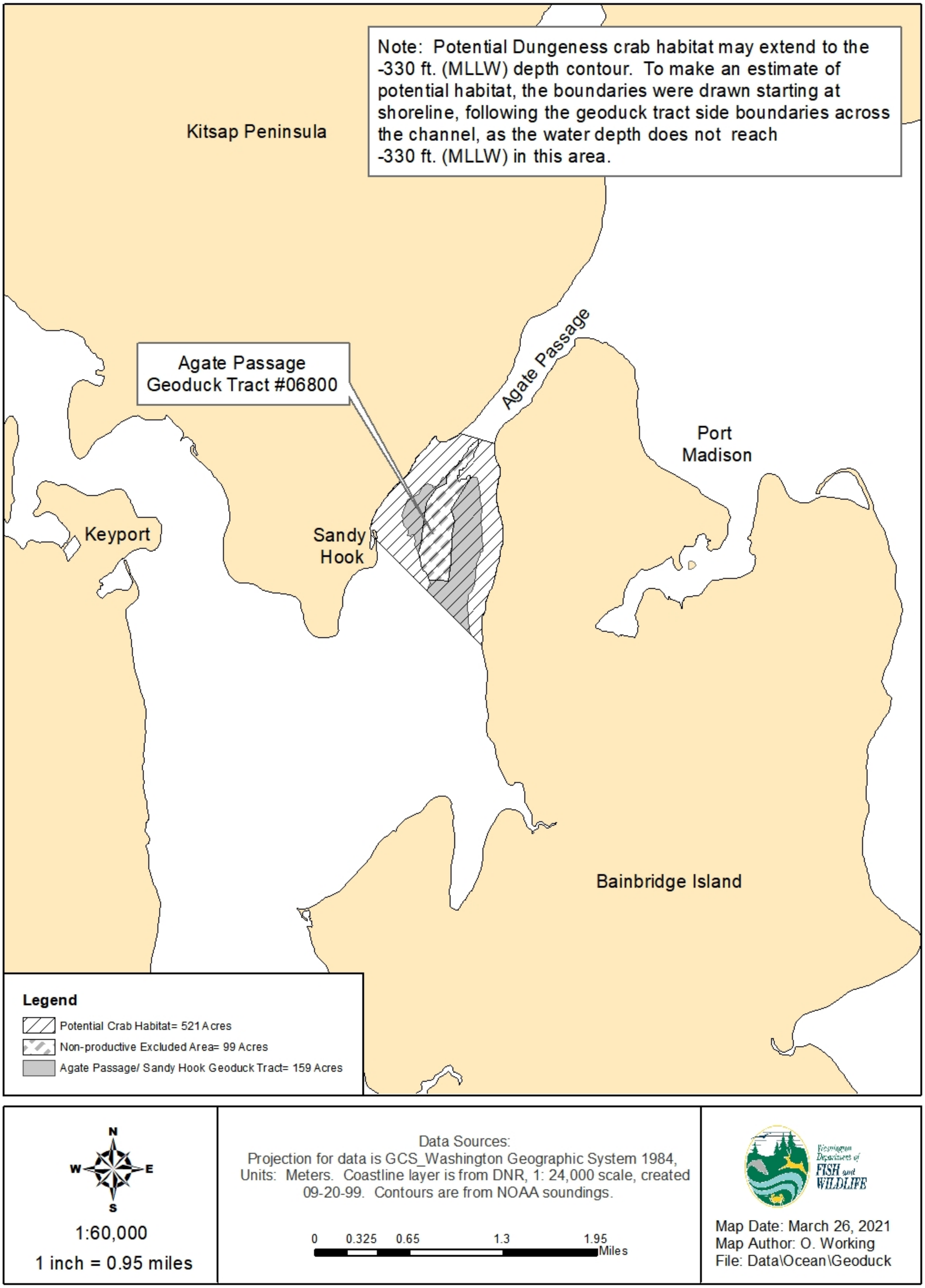
File: Data\Ocean\Geoduck

Figure 5. Dungeness Crab Habitat Map, Agate Passage Commercial Geoduck Tract #06800



Data Sources:
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Washington Department of Fish and Wildlife

Map Date: March 26, 2021
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

Agate Passage geoduck tract # 06800.

Tract Name	Agate Passage
Tract Number	06800
Tract Size (acres)[a]	159
Mean density of geoducks/sq.ft.[b]	0.041
Total Tract Biomass (lbs.)[b]	1,165,575
Total Number of Geoducks on Tract[b]	282,839
Confidence Interval (%)	13.53%
Mean Geoduck Whole Weight (lbs.)	4.12
Mean Geoduck Siphon Weight (lbs.)	0.94
Siphon Weight as a % of Whole Weight	22.83%
Number of Transect Stations	73
Number of Geoducks Weighed	70

a. Tract area is between the -25 ft. (MLLW) water depth contours

b. Biomass is based on the 2011 Suquamish Tribe Pre-fishing geoduck survey biomass estimate of 2,578,779 lbs. minus total harvest of 1,413,204 lbs. through February 15, 2023

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Table 2. DIGGING DIFFICULTY TABLE

Agate Passage geoduck tract # 06800, 2011 Suquamish Tribe 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)
108	1	1	1	0	0	0	0	0	Y
36	1	1	1	0	0	0	0	0	Y
66	4	2	2	2	0	0	0	0	Y
84	3	2	1	0	1	1	0	0	Y
72	4	2	2	0	0	0	0	0	Y
126	1	1	1	0	0	0	0	1	Y
30	1	2	1	0	0	0	0	0	Y

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

Agate Passage geoduck tract # 06800, 2011 Suquamish Tribe pre-fishing geoduck survey

Transect	Start Depth (ft) [a]	End Depth (ft) [a]	Geoduck Density (no. / sq ft) [b]	Substrate					
				mud	sand	gravel	shell	cobble	rock
1	25	32	0.1319		Y				
2	32	42	0.1259		Y				
3	42	41	0.0756		Y				
4	41	46	0.0741		Y		Y		
5	46	44	0.0163		Y		Y		
6	26	29	0.0444		Y			Y	
7	29	50	0.1452		Y				
8	50	44	0.0652		Y		Y	Y	
9	44	40	0.0815		Y		Y		
25	25	33	0.1526		Y				
26	33	44	0.1852		Y				
27	44	47	0.1259		Y				
28	47	45	0.0785		Y				
30	28	34	0.0948		Y				
31	34	31	0.0519		Y		Y	Y	
34	25	33	0.0844		Y				
35	33	41	0.1704		Y				
36	41	42	0.1541		Y				
40	42	39	0.0696		Y			Y	
41	39	39	0.0652		Y			Y	
58	39	42	0.0978		Y				
59	42	42	0.1259		Y				
60	42	42	0.1067		Y		Y		
65	25	35	0.1837		Y				
66	35	44	0.2044		Y				
67	44	42	0.1289		Y				
68	42	38	0.1481		Y		Y		
69	38	40	0.0963		Y		Y		
70	32	34	0.1496		Y	Y	Y		
71	34	42	0.0637		Y		Y		Y
72	42	45	0.1556		Y				
73	45	43	0.0711		Y				
74	43	41	0.1052		Y				
75	29	38	0.0267		Y				
76	38	40	0.1496		Y				
77	40	43	0.1319		Y				
78	43	42	0.0430		Y				Y
79	26	32	0.0474		Y				
80	32	39	0.0370		Y				
81	39	42	0.0963		Y				

Table 3. Continued

Transect	Start Depth (ft) [a]	End Depth (ft) [a]	Geoduck Density (no. / sq ft) [b]	Substrate					
				mud	sand	gravel	shell	cobble	rock
82	42	41	0.1170		Y				
83	45	50	0.1348		Y		Y		
84	50	51	0.1467		Y		Y		Y
85	51	47	0.0356		Y		Y		Y
86	47	38	0.0548		Y		Y	Y	Y
87	42	41	0.0859		Y		Y		
100	53	46	0.1141		Y				
101	46	41	0.1259		Y				
103	28	32	0.1348		Y				
104	32	31	0.0889		Y				
105	31	24	0.0904		Y				
106	25	28	0.0667		Y				
107	28	34	0.0637		Y				
108	34	35	0.0844		Y				
109	35	35	0.0889		Y				
110	35	35	0.1096		Y				
111	35	45	0.1200		Y				
115	28	32	0.0459		Y				
116	32	33	0.0133	Y	Y				
117	33	34	0.0148	Y	Y				
118	34	30	0.0607		Y				
119	30	42	0.1215		Y				
120	25	28	0.0059	Y	Y				
121	28	28	0.0015	Y	Y				
122	28	28	0.0252		Y				
123	28	42	0.0474		Y				
126	26	27	0.0400		Y		Y		
127	27	29	0.0193		Y		Y		
128	29	30	0.0415		Y		Y		
129	30	39	0.0385		Y		Y		
139	25	38	0.0533		Y				

[a.] All depths are corrected to mean lower low water (MLLW)
[b.] Densities were calculated using the default 0.75 show factor

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Table 4. GEODUCK SIZE AND QUALITY

Agate Passage geoduck tract # 06800, 2011 Suquamish Tribe pre-fishing geoduck survey

Dig Station	Number Dug	Avg. Whole Weight (lbs.)	Avg. Siphon Weight (lbs.)	% of geoducks on station greater than 2 lbs.
108	10	4.28	1.00	100%
36	10	4.63	0.93	100%
66	10	3.38	0.73	90%
84	10	4.25	1.09	90%
72	10	3.73	0.96	100%
126	10	4.55	0.95	100%
30	10	4.03	0.93	90%

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Table 5. TRANSECT CORRECTED GEODUCK COUNT AND POSITION TABLE

Agate Passage geoduck tract # 06800, 2011 Suquamish Tribe pre-fishing geoduck survey

Transect	Corrected Geoduck Count per 900 sq. ft. Transect	Geoduck Siphon Show Factor [a]	Latitude [b]	Longitude [b]
1	119	0.75	47.69344	122.56823
2	113	0.75		
3	68	0.75		
4	67	0.75		
5	15	0.75	47.69402	122.57102
6	40	0.75	47.69627	122.56729
7	131	0.75		
8	59	0.75		
9	73	0.75	47.6967	122.56944
25	137	0.75	47.70183	122.56664
26	167	0.75		
27	113	0.75		
28	71	0.75	47.70236	122.56891
30	85	0.75		
31	47	0.75		
34	76	0.75	47.69912	122.56655
35	153	0.75		
36	139	0.75	47.69978	122.56816
40	63	0.75	47.70182	122.5694
41	59	0.75		
58	88	0.75	47.6991	122.56855
59	113	0.75		
60	96	0.75		
65	165	0.75	47.69493	122.56821
66	184	0.75		
67	116	0.75		
68	133	0.75		
69	87	0.75	47.69519	122.57114
70	135	0.75	47.69772	122.5671
71	57	0.75		
72	140	0.75		
73	64	0.75		
74	95	0.75	47.69794	122.57007
75	24	0.75	47.70046	122.56636
76	135	0.75		
77	119	0.75		
78	39	0.75	47.70067	122.56879
79	43	0.75	47.70316	122.56658
80	33	0.75		
81	87	0.75		
82	105	0.75	47.70344	122.56897
83	121	0.75	47.69483	122.57162
84	132	0.75		

Table 5. Continued

Transect	Corrected Geoduck Count per 900 sq. ft. Transect	Geoduck Siphon Show Factor [a]	Latitude [b]	Longitude [b]
85	32	0.75		
86	49	0.75	47.69516	122.5738
87	77	0.75	47.69769	122.57065
92	103	0.75	47.70037	122.56947
93	89	0.75		
100	124	0.75	47.70311	122.56956
101	113	0.75		
103	121	0.75	47.70589	122.56704
104	80	0.75		
105	81	0.75	47.70621	122.56882
106	60	0.75	47.70438	122.57769
107	57	0.75		
108	76	0.75		
109	80	0.75		
110	99	0.75		
111	108	0.75	47.70497	122.57414
115	41	0.75	47.70304	122.57549
116	12	0.75		
117	13	0.75		
118	55	0.75		
119	109	0.75	47.70326	122.57539
120	5	0.75	47.7017	122.57806
121	1	0.75		
122	23	0.75		
123	43	0.75	47.70185	122.57606
126	36	0.75	47.70576	122.57537
127	17	0.75		
128	37	0.75		
129	35	0.75	47.70593	122.57299
139	48	0.75	47.70029	122.57614

[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

Agate Passage geoduck tract # 06800, 2011 Suquamish Tribe pre-fishing geoduck survey

# of Transects where Observed	Group	Common Name	Taxonomer
26	ANEMONE	ANEMONE	Unspecified anemone
53	BIVALVE	HORSE CLAM	*Tresus spp.*
46	CNIDARIA	SEA PEN	*Ptilosarcus gurneyi*
1	CNIDARIA	CNIDARIAN	Unspecified cnidarian
15	CRAB	HERMIT CRAB	Unspecified hermit crab
23	CRAB	DUNGENESS CRAB	*Cancer magister*
38	CRAB	RED ROCK CRAB	*Cancer productus*
34	CRAB	GRACEFUL CRAB	*Cancer gracilis*
5	CRAB	DECORATOR CRAB	*Pugettia spp.*
12	CUCUMBER	SEA CUCUMBER	*Parastichopus californicus*
48	FISH	FLATFISH	Unspecified flatfish
6	FISH	STARRY FLOUNDER	*Platichthys stellatus*
9	FISH	SCULPIN	Unspecified Cottidae
4	GASTROPOD	MOON SNAIL	*Polinices lewisii*
17	GASTROPOD	NUDIBRANCH	Unspecified nudibranch
4	MISC	SPONGE	Unspecified Porifera
44	SEA STAR	SEA STAR	Unspecified sea star
26	SEA STAR	SUNFLOWER STAR	*Pycnopodia helianthoides*
7	SHRIMP	SHRIMP	Unspecified shrimp
17	WORM	TUBE WORM	Unspecified Serpulidae tubeworm

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Table 7. MOST COMMON AND OBVIOUS ALGAE OBSERVED

Agate Passage geoduck tract # 06800, 2011 Suquamish Tribe pre-fishing geoduck survey

# of Transects Where Observed	Taxonomer
8	Diatoms
1	*Laminaria* spp.
6	small red algae
9	small green algae
10	small brown algae
5	small mixed algae

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