Updated Project Description
Commercial Oyster Shell Mining by Lind Tug and Barge, Inc. within South San Francisco Bay

August 2020

1. PROJECT DESCRIPTION

1.1. Background and History

Lind Tug and Barge, Inc. (LTB) , formerly Morris Tug and Barge, commercially mines historic oyster shell deposits from subtidal areas located within South San Francisco Bay. Oyster shell was harvested as early as 1891 for use in garden walks and other purposes and has been commercially mined from the South Bay since 1924 (Hart 1978). LTB has been mining oyster shell from the South Bay for about 40 years, but the same basic company has been in business for over 90 years, harvesting oyster shells and processing them at the Petaluma plant. From the mid-1920's through the 1980's the largest quantities of oyster shell were mined from the bay for use as a raw material in the manufacture of cement (by companies other than LTB, which never mined shell for cement use; these operations no longer exist). More recently the oyster shell has been primarily processed and used as a high-grade mineral and nutrient supplement in poultry diets, as a soil amendment, for pharmaceuticals, and as an amendment to neutralize livestock waste.

The location of mining and mining methods has remained virtually unchanged over this period. The current mining methods and locations are proposed to remain the same in the future. Oyster shell mining occurs only within the California State Lands Commission (CSLC) designated lease area PRC 5534.1, located in South San Francisco Bay adjacent to the San Mateo Bridge (Figure 1-1). The lease area is approximately 1,560 acres in size (Figure 1-2) within a shallow (water depths are typically 15 feet or less), open water subtidal area of the bay.

The historic oyster shell deposit originated in the Late Quaternary (Holocene) period, approximately 2,300 to 2,500 years ago, when the native oyster *(Ostrea lurida)* population flourished within the bay (the native oyster was small, not much larger than a human fingernail). More recently, pollution virtually eliminated oysters from the bay (Skinner 1962). The historic oyster shell deposits occur primarily in the upper 30 feet of young bay mud deposits and are typically overlaid and intermixed with deposits of fine sediment. Although there is interest in reestablishing oyster populations within the bay, primarily in Central Bay, the fine grained mud substrate and high ambient turbidity and suspended sediment concentrations that occur in the South Bay contribute to unsuitable habitat conditions for oysters within the area of the relic historic oyster shell deposits, and therefore make reestablishing oysters in the area where mining occurs under current environmental conditions unlikely.

Harvest of relic oyster shell from the South Bay lease area allows LTB, as part of activities that have been ongoing for decades, to continue to provide oyster shell products for commercial sale as agricultural soil amendment, calcium food supplement for poultry and livestock and other commercial beneficial uses.

1.2. Purpose, Proposed Action and Oyster Shell Mining Locations

The purpose of oyster shell mining is to harvest relic historic oyster shell deposits from South San Francisco Bay for processing and commercial sale as a soil amendment to neutralize acidic soils and as a calcium and nutrient source, food supplement for poultry diets, as a barn lime source to neutralize livestock waste. Crushed shell is used as a decorative stone, and oyster shell tablets are widely used as a high-quality dietary supplement and source of calcium and nutrients (such as iron, copper, iodine, magnesium, etc.) by humans, and other commercial beneficial uses. Pharmaceutical use of oyster shell calcium has a long history of acceptability and benefit to humans as a dietary supplement and nutrient source due to its texture, digestibility, and solubility. Calcium as a dietary supplement is an essential mineral for maintaining teeth, bone density (osteoporosis), and proper enzyme activity. As a result of these unique physical and chemical characteristics of oyster shell calcium is also used extensively as a dietary supplement and calcium source for livestock and poultry. Although oyster shell mined from San Francisco Bay has been used in the past for a variety of purposes, including the manufacture of cement, oyster shell mined by LTB is currently used primarily as a soil amendment and as a high-grade nutrient additive for poultry diets.

The unique physical properties of oyster shell and the mineral composition have been found to be especially beneficial as a calcium source in poultry diets to aid in eggshell formation. The use of oyster shell as a calcium source and ration supplement to aid egg shell quality and reduce shell breakage has been tested in comparison to conventional limestone as a dietary supplement (B. Spiller, California Polytechnic State University). The use of oyster shell as the source of dietary calcium and other nutrients was found to increase egg production, extend the egg laying duration, increase egg shell durability and reduce shell breakage, and increase egg size and quality when compared to limestone supplements.

Calcium derived from oyster shell has been found to be a superior nutrient and mineral source when compared to inorganic limestone and other sources. San Francisco Bay is the only historic deposit of oyster shell that is currently (since 1962) mined commercially in California. LTB has investigated the potential to use oyster shell from commercial oyster producers within the Pacific Northwest and elsewhere as an alternative source of oyster shell to mining within the bay. Results of these investigations have shown that the quantities of oyster shell available from commercial oyster producers are not adequate to meet the existing or future market demand.

Therefore, there are no alternative current or historic oyster shell sources within California to meet market demand.

As described previously, oyster shell mining occurs within the California State Lands Commission (CSLC) designated lease area PRC 5534.1, located in South San Francisco Bay adjacent to the San Mateo Bridge (Figure 1-1). The lease area is approximately 1,560 acres in size (Figure 1-2) within a shallow (water depths are typically 15 feet or less), open water subtidal area of the bay.

The project was analyzed under CEQA and a Mitigated Negative Declaration (MND) prepared and certified by CSLC in December 2018 (Lind Tug and Barge, Inc. Oyster Shell Mining Project, CSLC MND #795, State Clearinghouse Number #2018062075).

LTB is currently limited by the CSLC lease and other regulatory permits to annual harvest volumes of 80,000 cubic yards. LTB proposes to continue harvest of oyster shells at or below this limit for the remainder of the term of the CSLC lease (through 2028), then plans renewal of the lease at that time.

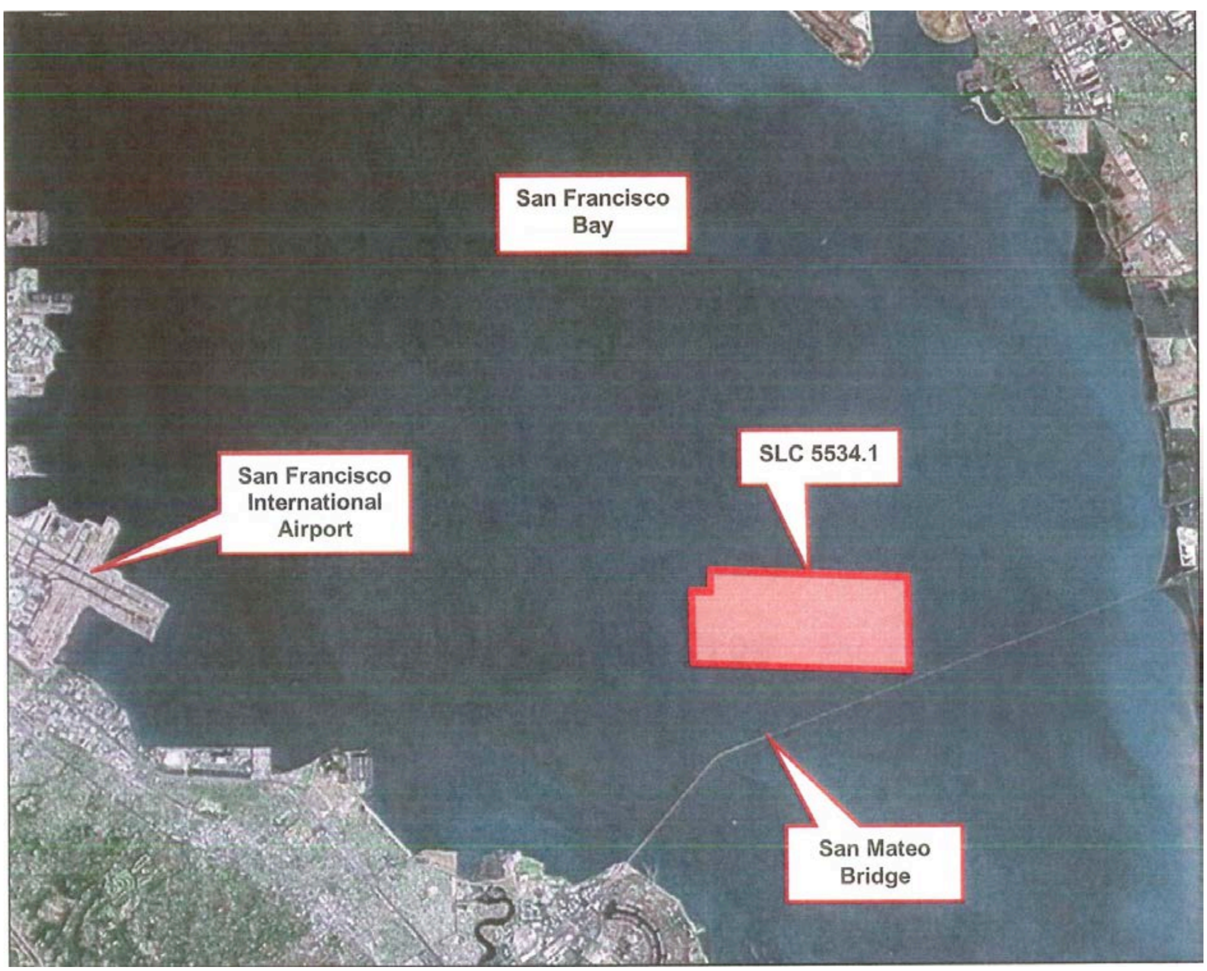


Figure 1-1 – Oyster Shell Mining Vicinity Map

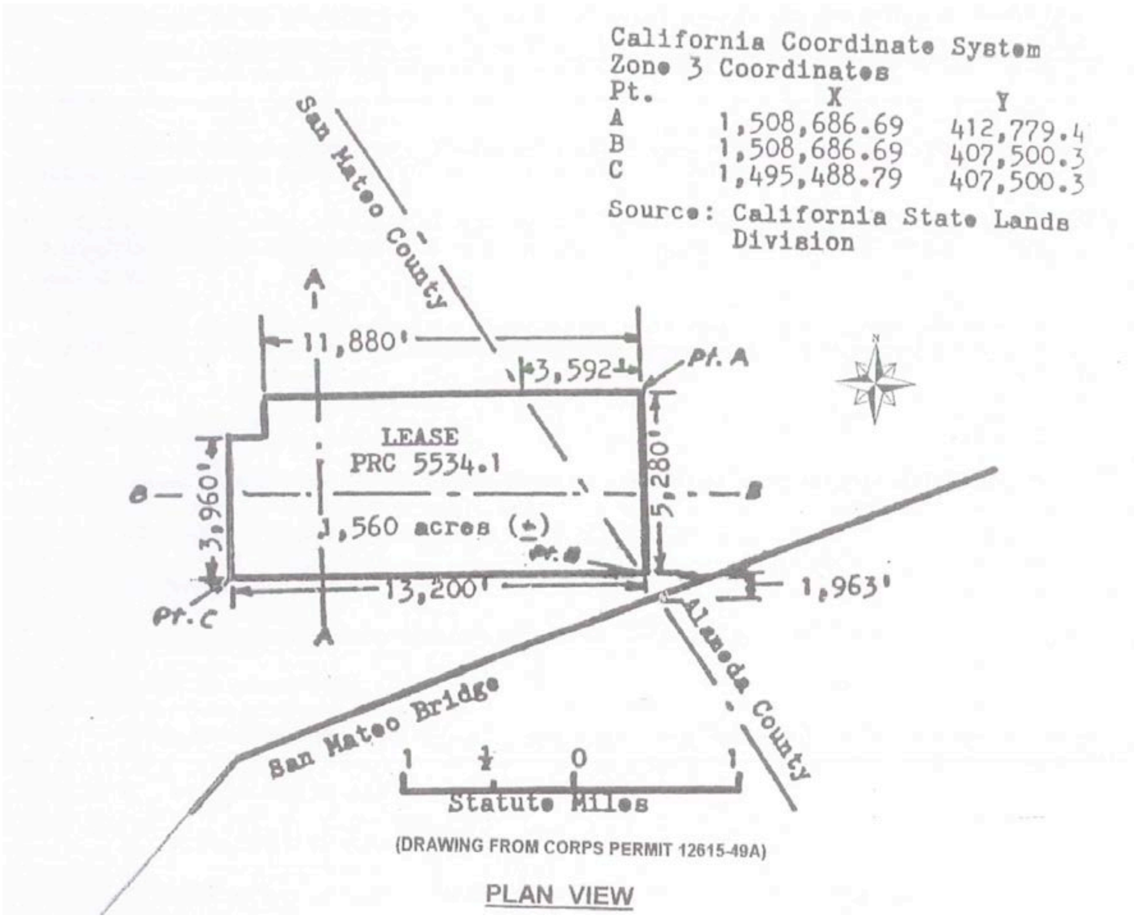


Figure 1-2 – Oyster Shell CSLC Lease Details

1.3. Oyster Shell Mining Methods and Equipment

1.3.1. Oyster Shell Mining Methods and Equipment

LTB mines oyster shell deposits using a hydraulic suction dredge, which mines and washes the shell, then places the shell into an adjacent hopper barge. Historically, the Tug/Oyster Shell Dredge "SOUTH BAY" and its oyster shell barge (Figure 1-3) were used. The SOUTH BAY, originally called a "BSP" (barge self propelled), was constructed for service in the Aleutian Islands in the 1940's, then modified in the 1960's for service as an oyster shell dredge. This wooden vessel was recently retired at the end of 2013, and a new shell dredge, custom designed exclusively to harvest oyster shells from South San Francisco Bay, was placed into service (Figure 1-4). This new shell dredge employs the same mining and washing methods as the SOUTH BAY, but with newer and more efficient equipment.

Figure 1-3: Historic Shell Tug/Dredge "SOUTH BAY"

Figure 1-4: New Shell Dredge Engaged in Dredging

The shell dredge harvests oyster shell using the "trailing suction method of trolling" (Figure 1-5). A tugboat is used to push the shell dredge and shell hopper barge to the lease area, and to propel the barges as mining occurs. Shell deposits are mined from near the substrate surface (typically within approximately 2-3 feet of the surface) by slowing trolling over the deposits within the lease area between 1-2 nautical miles per hour (knots).

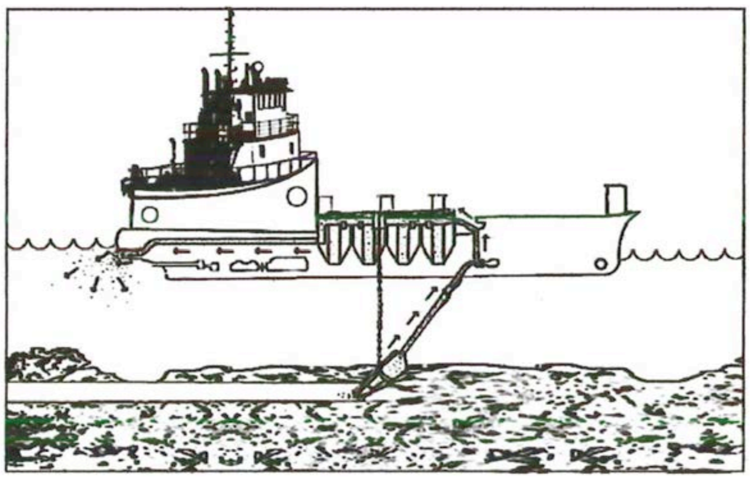


Figure 1-5: Schematic diagram of "trailing suction trolling" method used by Lind Tug and Barge while shell dredging.

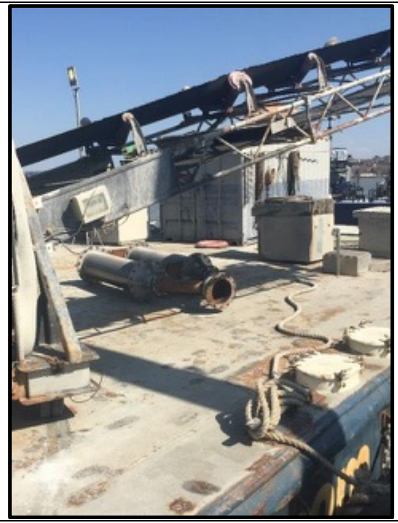
[A] Current Dredge Suction Pipe, Drag Head (Left) and Washed Oyster Shell Conveyor (Right)	 
[B] Rotating Trommel Screen for Washing and Screening Oyster Shell	
[C] Fish Screen Mounted on Suction Pipe	

Figure 1-6: Oyster Shell Mining Equipment
Source: LTB / CSLC Mitigated Negative Declaration

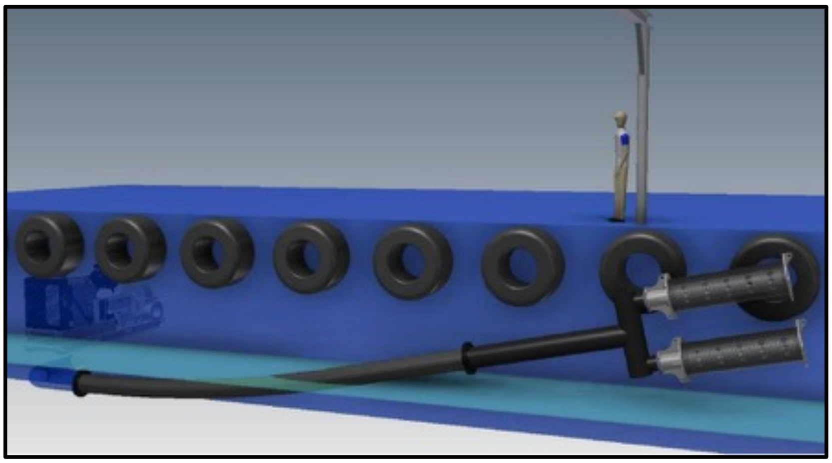
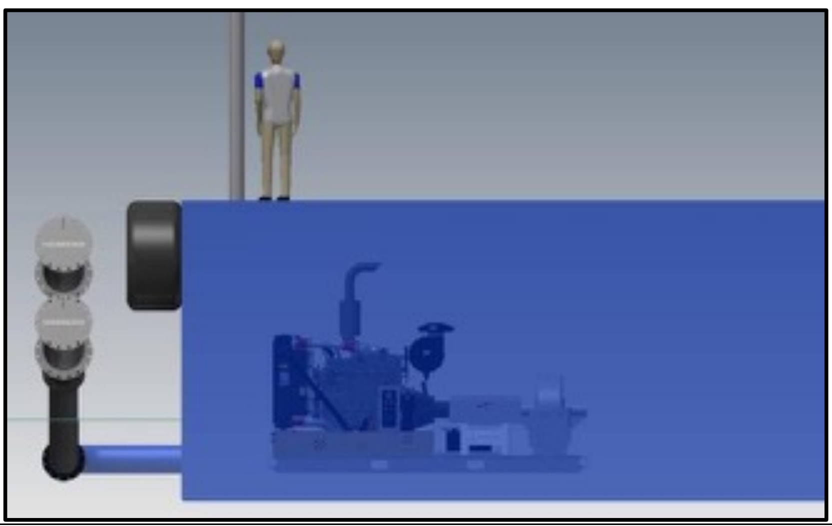
[D] Dual Fish Screen Assembly Used for Rinse Water	
[E] Conceptual Fish Screen Design with Diesel Engine, Electric Motor, Centrifugal Pump, and Rinse Water Intake Hose (Side and Front Views)	 

Figure 1-6 (cont): Oyster Shell Mining Equipment
Source: LTB / CSLC Mitigated Negative Declaration

During mining, a 12” diameter suction pipe equipped with a 24-inch x 32-inch drag head (Figure 1-6A Left) is lowered to the bottom (water depths in the mining area typically range from 8-15 feet deep) and into the substrate approximately 2-3 feet below the surface (reducing potential entrainment of species). The suction pipe is mounted on the side of the barge and raised and lowered by an electric winch. The suction is connected to the shell pump (12 inch diameter pumping approximately 6,000 gpm), which transports a shell, water, and silt slurry from the bay bottom up to the barge.

The slurry contains approximately 50 percent shell, 45 percent water, and 5 percent silt; the ratios vary depending on characteristics of the localized shell-sediment deposits. Most of the water used to make the slurry is drawn through the interstices of the shell substrate itself; however, a small 4-inch diameter line on top of the drag head enables water from above the substrate to enter the drag head to facilitate formation of the slurry. To protect against entraining any adult or juvenile fish or other organisms into the drag head through this line, a single stationary positive barrier cylindrical fish screen is mounted on the suction pipe (Figure 1-6C).

The slurry is pumped to the raised rear of a large rotating trommel screen for washing and screening (Figure 1-6B). In the trommel screen, additional water is added through spray bars. The additional wash water is supplied from a wash pump (12 inch diameter pumping approximately 3,700 gpm) through an intake hose through the side of the barge. This intake is equipped with a pair of stationary positive barrier cylindrical fish screens (Figure 1-6D & E). As the trommel rotates, silt falls from the shells, and the water and silt release back to the Bay through a pipe extending through the bottom of the shell dredge (approximately 5 feet underwater). Excess water and silt released in this manner results in a localized suspended sediment plume during mining. The suspended sediment concentrations and aerial extent of the plume vary based on a number of factors including the quantity of silt and mud associated with a specific shell deposit, tidal currents, and naturally occurring ambient suspended sediment concentration within the South Bay in the area where mining occurs.

The washed shell is then conveyed to a hopper barge from the trommel using a 24” conveyor belt (Figure 1-6A Right). The barge is kept "trim" (level) at all times by moving the conveyor from side to side, and by re-positioning the barge next to the shell dredge. Once the hopper barge is loaded, the tugboat pushes the loaded barge and shell dredge to Mare Island in Vallejo, where the dredge is moored between mining events. The loaded hopper barge is transported by tug to one of two shell processing sites in Petaluma on the Petaluma River or Collinsville (along Montezuma Slough upstream of Suisun Bay), operated by an affiliate of LTB, Lind Marine Incorporated (LMI). At the offload site, a hydraulic excavator is used to scoop the shell from the hopper barge to a conveyor system that stockpile the shell for processing at the processing facility (see Figures 1-7, 1-8). The processed shell is bagged or loaded into bulk trucks for distribution to accommodate market demand for the shell product in California and the western U.S.

Figure 1-7. Shore stockpile of oyster shells.

Figure 1-8. Closeup of oyster shells.

1.4. Characteristics of Oyster Shell Mining Events

1.4.1. Spatial Distribution / Depth of Mining Events

Oyster shell mining does not occur uniformly throughout the entire lease area. Mining is limited, in part, by shallow water depths occurring within portions of the lease area, which preclude significant mining activities unless timing of the event coincides with high tide. Therefore, mining activities occur more frequently in the deeper water portions of the lease area located along the western border of the lease where water depths at MLLW typically range from 7 to 13 feet. As a result of wind fetch occurring within the south Bay, shallower areas within the lease are typically characterized by higher waves and more difficult conditions to effectively conduct shell mining. Oyster shell harvest is therefore functionally limited to those areas of the lease where water depths are greater and wave activity is reduced, thereby allowing more efficient harvest.

To help assess current bathymetric conditions within the lease area and changes to bathymetric conditions, periodic bathymetry surveys have been conducted in the lease area. Appendix A includes the results of these surveys, which include the results of a single-beam survey of the lease conducted in early 2014 by Bay Marine Services. The survey represents depths relative to MLLW in the lease area. Appendix A also includes data from a 2005 single-beam bathymetry survey conducted under contract with the U.S. Geological Survey (USGS), and plotted by eTrac Engineering LLC with the lease area overlaid in 2007. Note that the 2005 survey shows depths in meters, and the 2014 survey shows depths in feet. Comparison between these surveys shows that some portions of the lease area experienced only minor changes in bathymetry. The western area of the lease where mining mostly occurs shows a slight increase in depth (0-2 feet); however areas where mining does not typically occur aslo showed slight changes in bathymetry, so actual potential effects of mining are not clear of conclusive based on these surveys. (CSCL MND, 2018)

To continue to develop information on bathymetric trends, LTB proposed to conduct ongoing periodic bathymetric surveys beginning in 2019, then in 2022 and 2026 to better evaluate bathymetric trends in the lease area. A survey was conducted by eTrac Engineering in October 2019; these results are also shown in Appendix A. Comparison with this latest survey is being conducted currently, and will be provided when it is complete.

1.4.2. Temporal Distribution and Duration of Mining Episodes

Shell mining activity may occur at any time of the day, depending on tides, currents, winds, weather, the size of the hopper barge being loaded, intermittent delays/breakdowns, transit times to the lease, etc. Actual mining and pumping duration with the current dredge configuration averages approximately 80 percent of the total time of operation. Transit time between the lease area and one of the two land-based facilities (Petaluma or Collinsville) is approximately 8 hours (empty barge) to 12 hours (loaded barge) one way depending on the onshore facility used. It takes 6 hours to over 24 hours to fill a barge depending on the size of the barge, and 6-8 hours to offload at the delivery site. Product demand dictates the frequency and number of mining events that occur. Limited land-based storage of mined shell product and demand dictate the mining event frequency.

Use of new, more efficient equipment and larger volume barges has resulted in fewer mining events needed to meet demand, even though the duration of individual events has increased. For example, the estimated number of mining events required to mine 80,000 c.y. of shell is as follows: the historical dredge *South Bay* operations required approximately 91 mining events over 910 hours annually; new mining equipment and barge configurations require only about 28 mining events over an estimated 409 hours to mine the maximum annual volumes. These reductions in time and number of mining events result in fewer local temporal disturbances, and significantly lower fuel consumption and associated air emissions associated with vessel transit and mining compared to the historic operations.

1.4.3. Mining Volumes and Seasonal Distribution

The amount and seasonal timing of mining volumes are largely dictated by demand for shell product; seasonality has very little influence, as the majority of the product is used for agricultural feed supplement. Mining volumes may also be indirectly limited by the maximum cubic yardage allowed under the respective leases and permits. The current annual permitted volumes of shell that can be harvested from the shell lease is 80,000 c.y. (40,000 tons). Table 1-1 shows the actual annual volumes of shell mined by LTB from 2006-2019.

Table 1-2 illustrates the actual average monthly volume distribution for the period 2006-2017, and a projected future distribution of mining events for a total annual volume of 80,000 c.y. The proposed project evaluated in this ITP application is based on a relatively flat seasonal distribution of volumes, and a total annual volume of up to 40,000 tons / 80,000 cubic yards. Seasonal distribution from 2006-2017 was relatively constant, with monthly totals ranging between 6.4 and 10.5% of total annual volumes.

For future events, LTB proposes to alter the seasonal distribution of mining episodes to avoid sensitive spawning periods for longfin smelt and the presence of their larvae in the mining area by ceasing mining for two full months during a period between February and June of each year . LTB proposes to cease mining activity in these months to prevent larval or life stage of these species of concern within the South Bay from being entrained through mining activity. The actual two month curtailment period will be selected each year by January 31 through notice to CDFW. Mining would be spread throughout the remaining months, with periods of inventory buildup and recovery if required to maintain appropriate of shell.

Table 1-1. Actual Shell Mining Volumes – 2006-2019

YEAR	TONS MINED	CUBIC YARDS MINED	# OF MINING EPISODES
2006	32,771	65,542	67
2007	31,809	63,618	61
2008	29,916	59,832	59
2009	27,758	55,516	54
2010	33,108	66,216	61
2011	31,255	62,510	59
2012	33,196	66,392	68
2013	36,017	72,034	64
2014	32,394	64,788	50
2015	29,509	59,018	31
2016	30,838	61,676	34
2017	26,120	52,240	18
2018	24,115	48,230	16
2019	22,485	44,970	13

Table 1-2. Average/Projected LTB Monthly Mining Volumes

Month	Avg Volumes (2006-2017)			Projected Future Volumes		
	tons	Cubic yards	% Annual Total	tons	Cubic yards	% Annual Total
Jan	3,066	6,132	9.8	6,240	12,480	15.6
Feb	3,287	6,574	10.5	0	0	0
Mar	2,486	4,972	8.0	0	0	0
Apr	2,573	5,146	8.2	6,240	12,480	15.6
May	2,491	4,982	8.0	2,560	5,120	6,4
Jun	2,958	5,916	9.5	6,240	12,480	15.6
Jul	2,554	5,108	8.2	0	0	0
Aug	3,035	6,070	9.7	6,240	12,480	15.6
Sep	2,060	4,120	6.6	0	0	0
Oct	2,370	4,740	7.6	6,240	12,480	15.6
Nov	1,986	3,972	6.4	0	0	0
Dec	2,358	4,716	7.6	6,240	12,480	15.6
TOTAL	**31,224**	**62,448**	**100.0**	**40,000**	**80,000**	**100.0**