SAND MINING WITHIN CENTRAL BAY & MIDDLE GROUND

BY HANSON MARINE OPERATIONS

San Francisco Regional Water Quality Control Board

Permit Application

October 2, 2013

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SAN FRANCISCO BAY REGIONAL WATER QUALITY CONTROL BOARD
1515 CLAY STREET, SUITE 1400
OAKLAND, CALIFORNIA 94612

APPLICATION FOR 401 WATER QUALITY CERTIFICATION AND/OR REPORT OF WASTE DISCHARGE

(FORM R2C502-E)

1. **APPLICANT'S NAME** Michael Roth, Hanson Marine Operations	4. **AUTHORIZED AGENT'S NAME AND TITLE** (an agent is not required) Christine Boudreau, Boudreau Associates Llc
2. **APPLICANT'S ADDRESS** 12667 Alcosta Blvd. Suite 400 San Ramon, Ca 94583	5. **AGENT'S ADDRESS** 327 Jersey Street San Francisco, Ca 94114
3. **APPLICANT'S PHONE & FAX NOS.** (email optional) (925) 244 - 6561 Mroth@Lehighcement.Com	6. **AGENT'S PHONE & FAX NOS.** (email optional) 415-296-1155 Cboudreau@Boudreaullc.Com

7. STATEMENT OF AUTHORIZATION

I hereby authorize C. Boudreau to act on my behalf as my agent in the processing of this application and to furnish, upon request, supplemental information in support of this permit application.

[signature] 9.27.13

APPLICANT'S SIGNATURE (This must be signed by the Applicant, not the authorized agent) **DATE**

PROJECT OR ACTIVITY INFORMATION

8. **PROJECT NAME OR TITLE** (See Instructions.)
Hanson Sand Mining Operations: Central Bay And Middle Ground

9. **NAME OF AFFECTED WATERBODY(IES)** (See instructions.) Central Bay And Suisun Channel	10. **PROJECT STREET ADDRESS** (if applicable)

11. **LOCATION OF PROJECT**

San Francisco	____	Region 2 – San Francisco Bay
COUNTY	**CITY/TOWN (or unincorporated)**	**REGIONAL WATER BOARD REGION**

12. **OTHER LOCATION DESCRIPTIONS** (watershed, latitude & longitude, river mile, etc. Attach map. See instructions.)
Sand Mining within Central Bay and at Middle Ground between June 2014 and June 2024. See Project Description Section 1 provided in the permit application information package for detail.

13. **DIRECTIONS TO THE SITE**
See Project Description Section 1 provided in the permit application information package

14. **PROJECT PURPOSE** (Describe the reason or purpose for the overall project. See instructions.)
To mine sand at SLC lease sites within Central Bay and Middle Ground

15. **DESCRIPTION OF ACTIVITY AND ENVIRONMENTAL IMPACTS** (Provide a full, technically accurate description of the entire activity and associated environmental impacts. See instructions.)
Biological Assessments have been prepared and were submitted to USFWS and NMFS. An ITP application was submitted to CDFW. Formal consultations with each of these agencies have been initiated. Hard copies of the BA and Draft ITP will be distributed to RWQCB staff upon request

16. **AVOIDANCE OF IMPACTS** (Describe efforts to avoid and minimize impacts to waters of the State. See instructions.)

See Section 4 provided in the permit application information package

17. **ENVIRONMENTAL DOCUMENTS** (list any non-CEQA environmental documents that have been prepared for the project and/or the project site. Provide the date of the document and the name of the individual, firm, or agency that prepared it. Provide a copy of delineations and endangered species surveys. See instructions.)

See information provided in the permit application information package

DREDGE & FILL INFORMATION

18. The following items must be completed for each action where fill or other material will be temporarily (T) or permanently (P) discharged to a wetland or other waterbody, and where material will be dredged from a waterway (add additional pages as necessary). Provide a map showing the location of each action (See instructions):

Map Location Number	LOCATION (show on plan & indicate waterbody)	REASON FOR ACTION (See instructions)	AMOUNT AND TYPE OF MATERIAL (in cubic yards, see instructions)	SURFACE AREA OF FILL (in acres and/or linear feet; specify (T) or (P); see instructions)
	NA			

MITIGATION

19. **MITIGATION** (Describe the size, type, and functions, and values of the proposed mitigation. Describe success criteria, monitoring, and long-term funding, management, and protection of the mitigation site. Attach a Mitigation Plan if needed. See instructions and contact Regional Board staff for additional assistance.)

To fully mitigate incidental take of CESA protected species that fish screens cannot avoid or minimize, Hanson has committed to purchase shallow water habitat. Mitigation estimates were calculated and approved by CDFW. Liberty Island has been identified as suitable habitat and Hanson is currently coordinating with pertinent entities to purchase 1 acre of habitat for the proposed 10 year sand mining permit.

CEQA

20. **CALIFORNIA ENVIRONMENTAL QUALITY ACT (CEQA) Documents: Indicate the status of CEQA documents prepared for the project (see instructions).**

TYPE OF DOCUMENT	STATUS	DATE COMPLETED (or expected to be complete)	TYPE OF DOCUMENT	STATUS	DATE COMPLETED (or expected to be complete)
Initial Study	In Preparation		Notice of Preparation	-Choose One-	
Draft Environmental Impact Report	-Choose One-		Final Environmental Impact Report	Complete	**10/1/12**
Negative Declaration	-Choose One-		Mitigated Negative Declaration	In Preparation	
Notice of Categorical Exemption Exemption Number:	-Choose One-		Notice of Statutory Exemption Exemption Number:	-Choose One-	
Other (describe)	-Choose One-				
Notice of Determination*	-Choose One-		*Note: A Notice of Determination or Notice of Exemption from the Lead Agency is required before a certification or waiver can be issued.		

Lead Agency: SLC **Contact:** **Telephone:**

State Clearing House Number: _200707_

ADDITIONAL INFORMATION

21. **HAS ANY PORTION OF THE WORK BEEN INITIATED?** YES ☐ NO ☒

IF YES, DESCRIBE THE INITIATED WORK, and explain why it was initiated prior to obtaining a permit. Indicate whether any enforcement action has been taken against the project.

22. **HAS A FEDERAL AGENCY OR THE APPLICANT PROVIDED PUBLIC NOTICE OF THIS APPLICATION FOR WATER QUALITY CERTIFICATION?**

Federal Agency: YES ☒ NO ☐ Date: 4/22/2013 **Type of Notification: Public Notice** **Agency Name and Contact: USACE, Sahrye Cohen**

Applicant: YES ☐ NO ☒ Date: **Type of Notification:** **Media Name and Contact:**

IF PUBLIC NOTICE HAS NOT BEEN MADE, provide the name, address, and phone number (if available) of adjacent property owners, lessees, etc., and any other parties known to be interested in the project:

23. **OTHER PERMITS** (List other local, state or federal licenses, permits, and agreements that will be required for any construction, operation, maintenance, or other actions associated with the project. Attach copies of all draft or final documents. See instructions.)

AGENCY	CONTACT (with phone number)	TYPE OF APPROVAL	PERMIT OR ID NUMBER	DATE APPLIED	STATUS	DATE OF ACTION
US Corps of Engrs.	Sahrye Cohen 415-503-6779	SEction 10	pending		In Review	
-Choose One-					-Choose One-	
-Choose One-					-Choose One-	
-Choose One-					-Choose One-	
-Choose One-					-Choose One-	
BCDC	Brenda Goeden	Individual Major Permit			In Review	
Other or Local Agency					-Choose One-	
Other or Local Agency					-Choose One-	
Other or Local Agency					-Choose One-	

24. **OTHER PROJECTS** (List and describe other projects implemented or planned that are related to the proposed project, or that may impact the same waterbody. See instructions. Add additional sheets if necessary.)

PROJECT NAME	DESCRIPTION	WATERBODY AND WATERSHED	DATE IMPLEMENTED/PLANNED

25. Application is hereby made for a permit or permits to authorize the work described in this application. I certify, under penalty of perjury, that this application is complete and accurate to the best of my knowledge. I further certify that I possess the authority to undertake the work described herein or am acting as the duly authorized agent of the applicant.

[signature] 9.27.13

SIGNATURE OF APPLICANT DATE SIGNATURE OF AGENT DATE

The application must be signed by the person who desires to undertake the proposed activity (Applicant) or a duly authorized agent if the statement in Block 7 has been filled out and signed.

Attach fee deposit (see Instructions page 7) and any additional documents and submit this application to:

SFBRWQCB
Attention: 401 Water Quality Certification
1515 Clay Street, Suite 1400

Oakland, CA 94612

Note: This form, FORM R2C502-E, was designed for electronic use as a Microsoft Word document or template. For assistance using this form or to relay suggestions on how it may be improved, please call 510-622-2330. If you would like a standard, non-electronic form, please call 510-622-2300 and request 401 Application FORM R2C502 – Non-electronic version.

1. PROJECT DESCRIPTION

The project applicant, Hanson Marine Operations (Hanson), proposes to mine sand over the next 10 years from California State Lands Commission leases within Central Bay and Middle Ground (Figure 1-1). Central Bay Leases are comprised of 2,601-acre area consisting of nine (9) parcels of submerged lands that comprise four (4) leases from the (SLC), designated as Mineral Extraction Lease Nos. 709.1, 2036.1, 7779.1, and 7780.1 (Figure 1-2). Middle Ground Leases are comprised of a 367-acre area of submerged lands known as Middle Ground Island Sand Shoals, adjacent to Middle Ground Island in Suisun Bay (Middle Ground, Figure 1-3). Detailed land descriptions produced by California State Lands Commission are provided as Appendix A.

Table 1-1 provides the proposed volumes Hanson is seeking authorization to mine within each area on an annual basis over a 10 year period.

Two marine aggregate companies, Hanson Marine Operations (Hanson), and Jerico[1] currently harvest sand commercially from the San Francisco Bay and the western Delta (the Bay-Delta estuary). The Sand Miners harvest sand from specified areas of San Francisco Bay that are leased from the California State Lands Commission (SLC). Hanson and its predecessor organizations have mined sand historically from the Middle Ground location since 1995. Hanson and Jerico Products Inc. (Jerico-another sand mining business) currently both mine the Middle Ground parcel under separate leases with the Grossi family who own the rights to the Middle Ground area.

The purpose of marine sand mining is to obtain marine aggregate that is primarily used for construction activities within the greater San Francisco Bay area, either as fill and base material or as an ingredient in readymix concrete and hot mix asphalt. Sand obtained from the Bay-Delta estuary is used, for example, in the construction and maintenance of highway and freeway systems, commercial and public buildings, and residential construction. Marine sand mining is a critically important component of the scarce permitted sand reserves in the greater San Francisco Bay area.

Sand mining has occurred within the Bay-Delta estuary for more than seven decades. Channel and harbor dredging to remove sand and other sediment deposits originally began in San Francisco Bay in the 1800s. Sand dredging was necessary to keep shipping channels clear from the high-energy sand waves that accumulated on the Bay floor. Since then, sand mining has evolved beyond dredging to maintain shipping channels and, in fact, today maintenance dredging is a distinct process and enterprise. Commercial sand mining – separate from maintenance dredging – began within the Bay-Delta estuary in the 1930s.

Hanson entered the construction sand mining business in 1999 when it acquired two companies that held the construction sand mining leases and permits which Hanson operates under today. Hanson currently owns one tugboat and one barge used in its sand mining operations. In April 2002, Hanson contracted with Foss Maritime Company (Foss) to mine sand using Hanson's equipment.

Hanson is currently the only sand mining company operating in the Central Bay. Another Central Bay lease, PRC 5871 at Alcatraz Shoals, was leased to RMC and their successor company, CEMEX. However, CEMEX did not apply for renewal of this lease and no sand mining is occurring in this location nor is it anticipated in the future.

[1] Hanson and Jerico are referred to collectively in this document as the "Sand Miners"

Mining in the Bay-Delta estuary allows the Sand Miners, as part of activities that have been ongoing for decades, to continue to provide an adequate supply of sand for their customers within the Bay Area. This supply of sand from the Bay-Delta estuary serves Bay Area customers and reduces the need to import materials by truck from the Central Valley or other diminishing land-based sources and, therefore, reduces traffic over Bay Area highways.

Project Objective – Hanson's project objective is to obtain renewal of all necessary permits and approvals to continue mining sand at an economically viable level in San Francisco Bay for the next 10 years. Table 1-1 provides the proposed annual volumes for each SLC lease.

Within Central Bay, the Applicants are proposing to mine no more than the baseline level of 1,060,656 cy/yr until 2014, when upgrades to diesel engines used to power mining equipment are required to be completed (see 17 Section 4.5, Air Quality of the EIR (CSLC 2012). Beginning in 2014, the Applicant is proposing to mine up to the full amount indicated in Table 1 below, that is, 1,540,000 cy/yr.

Table 1-1: Proposed Annual Permitted Volumes between 2014 and 2024

Location / Lease No.	Applicant Annual Proposed Volume (cy)
Central Bay	
PRC 709.1: Presidio Shoals, Alcatraz, Point Knox Shoals	340,000
PRC 2036.1: Point Knox South	450,000
PRC 7779.1: Point Knox Shoal	550,000
PRC 7780.1: Alcatraz South Shoal	200,000
Central Bay Total	**1,540,000**
Middle Ground	
Grossi family lease	**50,000**
Total Annual Volume for all lease areas	**1,590,000**

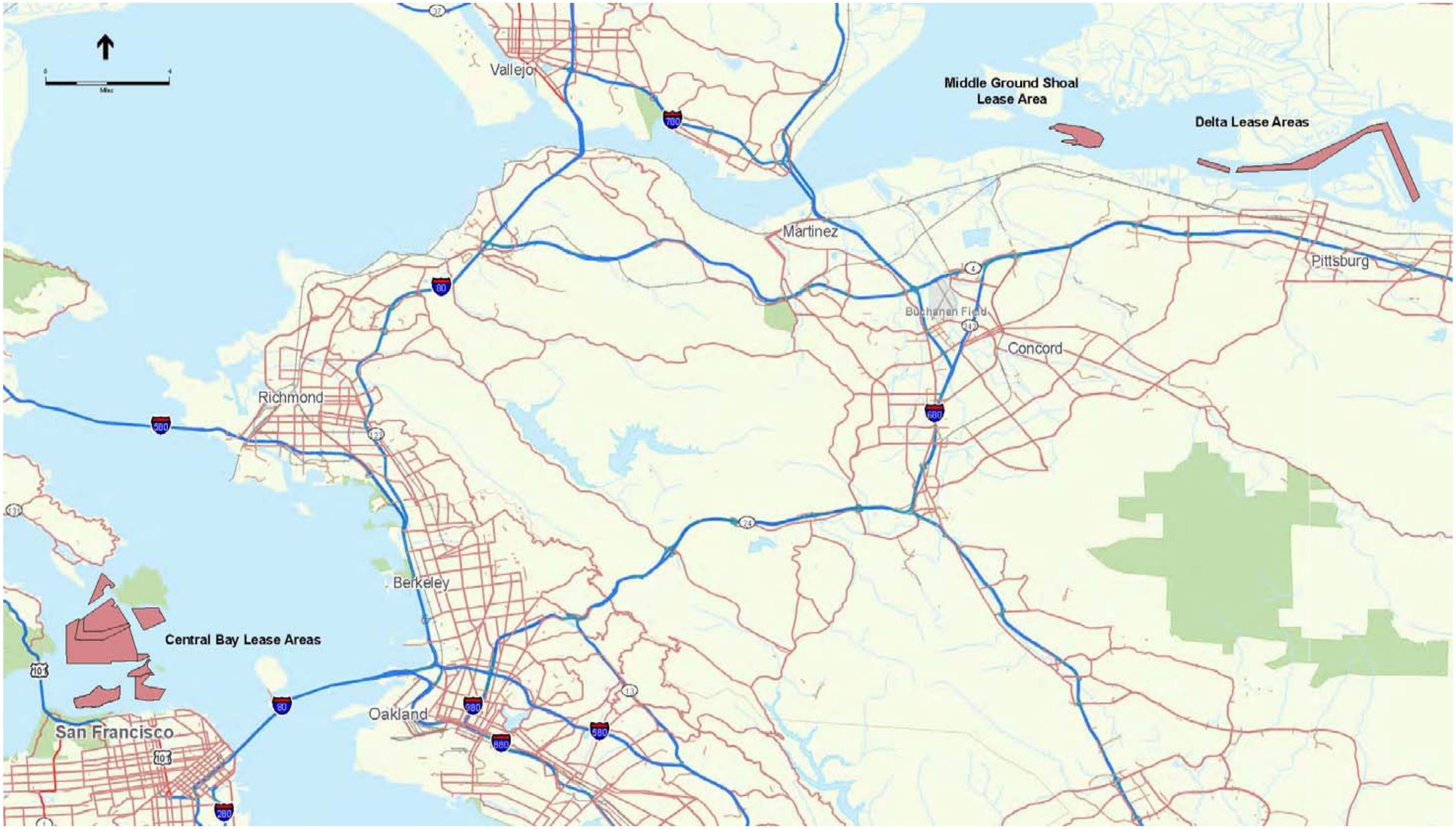
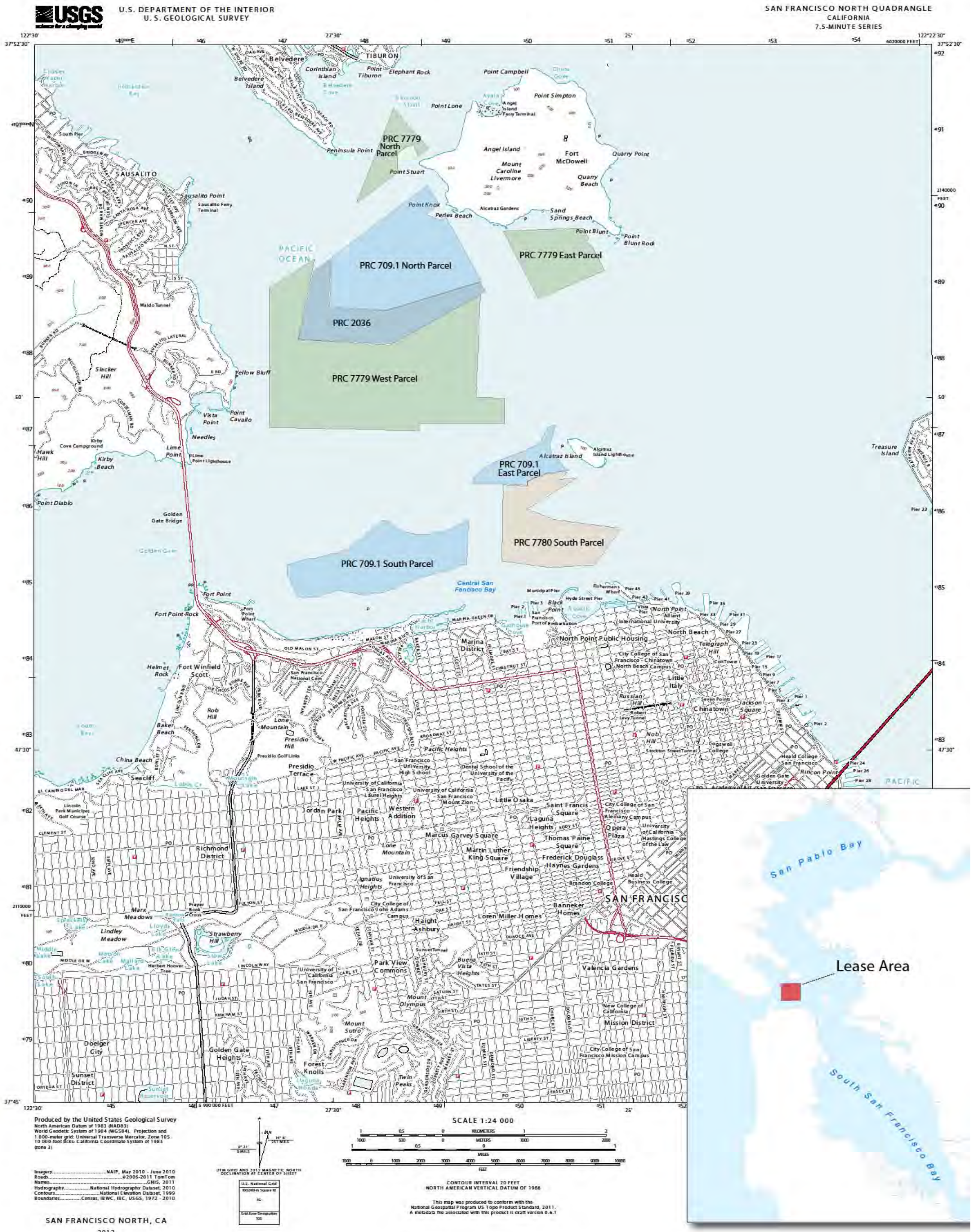


Figure 1-1 Regional Map of Hanson Marine Operations Sand Mining Lease Locations


U.S. DEPARTMENT OF THE INTERIOR
U. S. GEOLOGICAL SURVEY
SAN FRANCISCO NORTH QUADRANGLE
CALIFORNIA
7.5-MINUTE SERIES
PRC 7779 North Parcel
PRC 709.1 North Parcel
PRC 7779 East Parcel
PRC 2036
PRC 7779 West Parcel
PRC 709.1 East Parcel
PRC 7780 South Parcel
PRC 709.1 South Parcel
Angel Island
Alcatraz Island
SAUSALITO
TIBURON
Golden Gate Bridge
SAN FRANCISCO
Treasure Island
San Pablo Bay
Lease Area
South San Francisco Bay
SCALE 1:24 000
SAN FRANCISCO NORTH, CA
2012

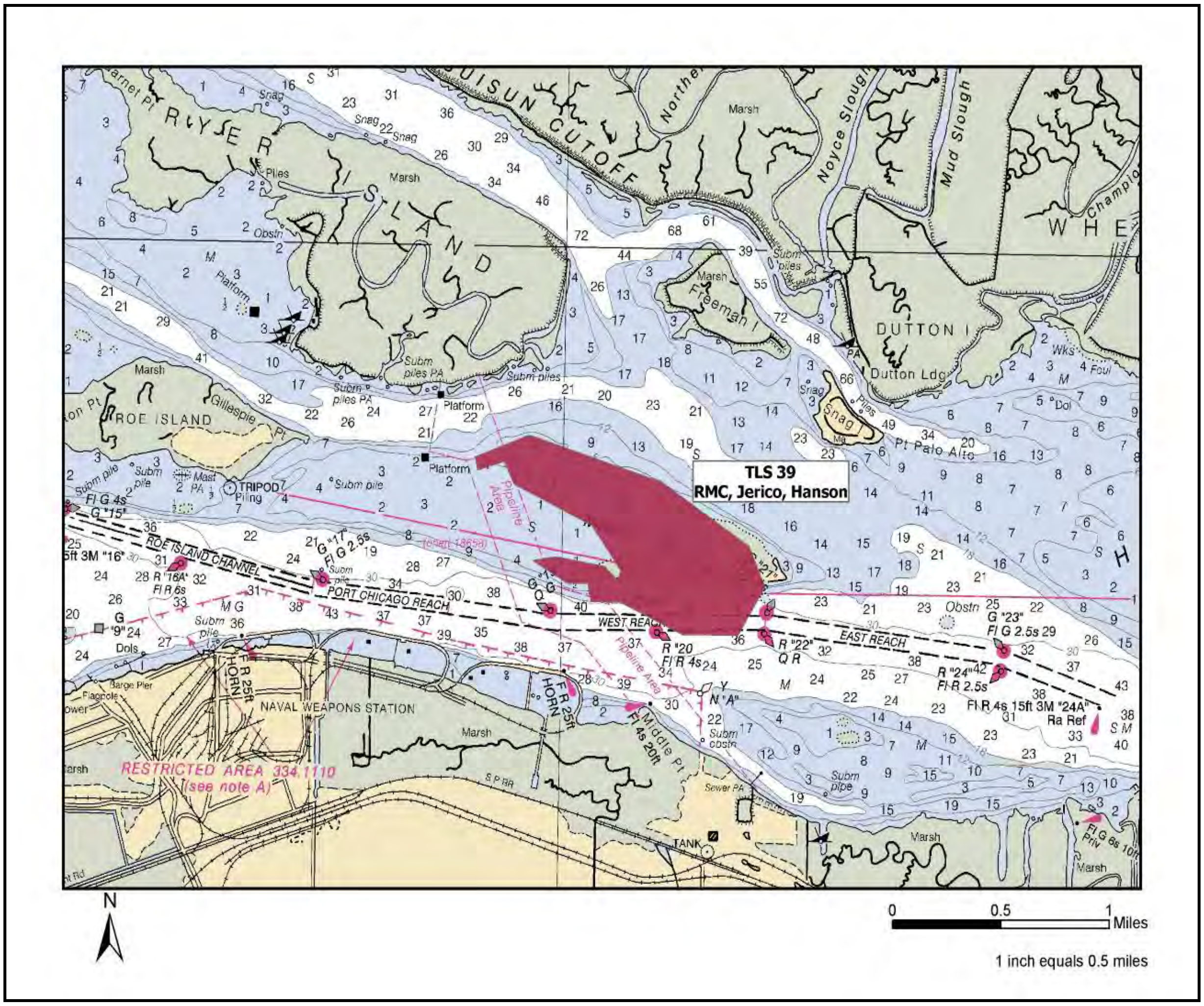


Figure 1-3 –Middle Ground Lease Locations

2. LOCATIONS

Collectively and historically, the Sand Miners harvested sand from three general regions within the Bay-Delta estuary: Central San Francisco Bay, Carquinez Strait, and Suisun Bay (which includes the Middle Ground Shoal region of western Suisun Bay, and the channels of Suisun Bay and New York Slough within the eastern portion of Suisun Bay)(Figure 2-1). The sites in the Carquinez Strait were mined by RMC/CEMEX but are no longer being mined nor are the leases active.

The bottom of the Bay-Delta estuary is owned by the State, held in trust by the State Lands Commission for the people of California, as well as by private parties in some circumstances. The areas specifically addressed in this application are the SLC Central Bay and Middle Ground lease locations, shown in Figure 1-1.

The lease boundaries have recently been subject to a minor adjustment from their original configuration. The California SLC, in consultation with the National Park Service and U.S. Coast Guard, recently completed a review of the historical data relevant to the Central Bay mining lease boundaries and determined that several lease boundaries must be revised to avoid encroaching on federally-held lands at Angel Island and Alcatraz Island. The area reduced by these boundary adjustments is roughly 5 percent of PRC 709 (about 42 of 873 acres were removed) and 1 percent of PRC 7779 (about 20 of 1,357 acres were removed). The land area removed from within the parcels is near the two islands and not where sand mining occurs.

Figure 2-1 – General Areas of Sand Mining

3. CONSTRUCTION METHODS AND EQUIPMENT

There are three general methods of hydraulic sand mining: stationary potholing, trolling, and moving potholing, illustrated with the schematic diagram in Figure 3-1.

- Stationary potholing which is the most common method of mining involves an initial search for an appropriate sand source, followed by "stationary" mining of sand at a site, by burying the drag head into the substrate and controlling the drag head from moving by either anchoring or engine thrust. (Figure -3-1 A).
- Trolling involves mining while moving over a site, generally working back and forth along parallel pathways between markers (Figure 3-1 B). Hanson does not utilize this method of mining.
- Moving potholing may involve mining more than one specific location during a mining event, and may involve some movement within a general site.   Moving potholing is similar to stationary potholing, in that it involves mining in a "stationary" position when an appropriate sand source is found, but also involves mining while moving in search of another appropriate stationary source (Figure 3-1 C). This method is only used when the substrate is particularly challenging to remove.

Hanson currently utilizes one tugboat/barge pair for sand mining, the tug San Joaquin River with the trailing suction hopper barge the Sand Merchant (aka TSG230) , which is equipped with suction mining equipment. The *Sand Merchant* is 230' long by 55' wide, with an approximate cargo capacity of 2,400 cubic yards.   The Sand Merchant can either offload using a conveyor offloading system (dry offload), or hydraulically offload by re-slurrying the cargo and pumping the sand ashore (wet offload). Additional information on the mining equipment used by Hanson is presented in Table 3-1. The Sand Merchant is limited by draft and other practical operating constraints to mining in water with a minimum depth of -20 feet (ft) MLLW, and can mine in water up to about -80 ft MLLW.

The suction mining equipment used in sand mining on the *Sand Merchant* consists of a trailing suction pipe, the "drag arm" assembly (Figure 3-2). The drag arm is comprised of a 24-inch diameter pipe, 120 ft long, hinged in the middle (the knuckle) and mounted through the forward starboard side of the barge using a ball and socket joint (Figure 3-3). A "drag head" is attached to the end of the suction pipe. The drag head's mining face (the open area where the sand is suck into) measuring 36x36 inches is equipped with a 6-inch "grizzly", a square grid to prevent material 6 inches or large from being picked up. This is mounted to the drag head's "visor". The visor is hinged to the body of the drag head, so the mining face is kept flat to the substrate when mining (Figure 3-4) Sand is drawn into the drag arm assembly using a 22-inch centrifugal pump, mounted in the engine room of the barge, capable of pumping 15,000 gallons per minute (gpm).

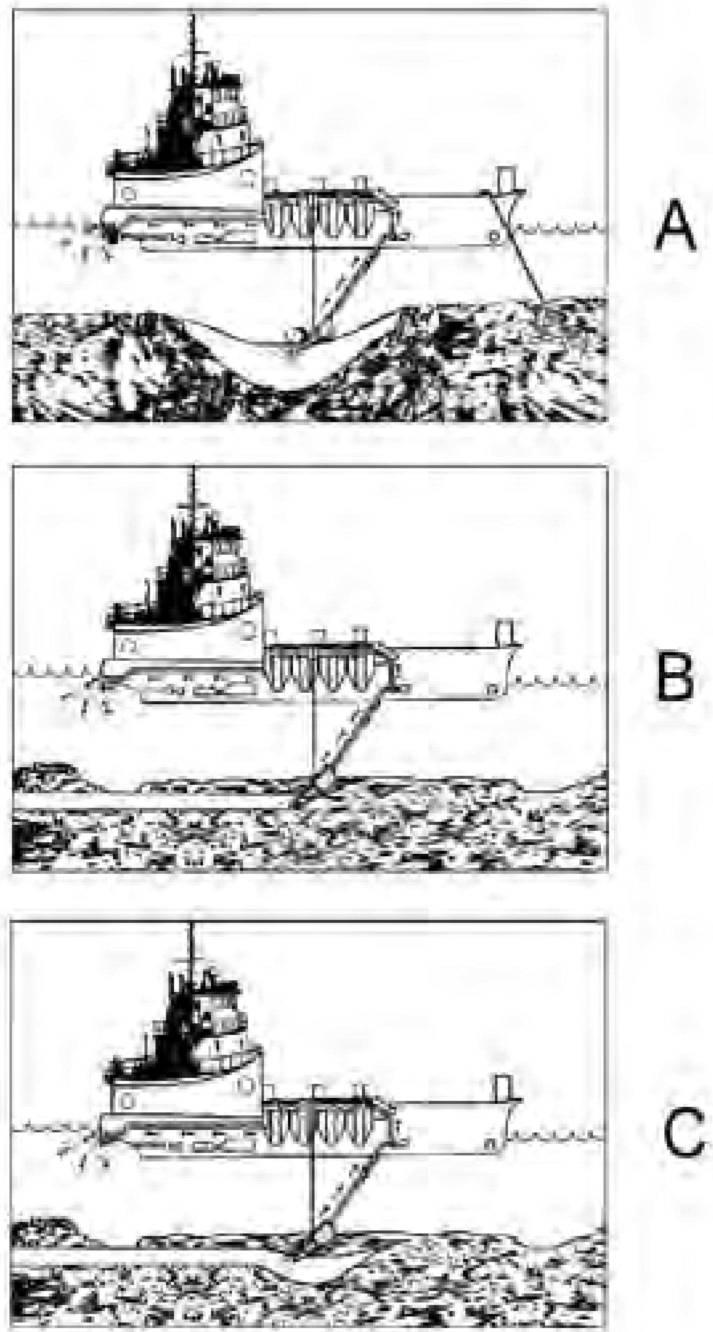


Figure 3-1: Schematic Diagram of Sand Mining Methods: (A) Stationary Potholing, (B) Trolling, (C) Moving Potholing

<u>**Table 3-1: Summary of Hanson Sand Mining Equipment and Operations**</u>

Tugboat	**San Joaquin River**
Length (feet)	64.4
Width (feet)	26.1
Draft (feet)	8
Barge	**Sand Merchant / TSG230**
Type	Hopper
Length (feet)	230
Width (feet)	55
Draft, Loaded (feet)	14
Capacity (cy)	2400
Loading Chute Dimensions (L x W x H)	180’ x 24” x 28”
Loading Chute Gates (number)	10
Screen Mesh on Loading Chute Gates	1/2”x1/2” mesh or 5/16’x5/16” mesh
Drag Arm	
Length (feet)	120
Diameter (inches)	24
Drag Head	
Dimensions (feet, L x W x H)	32”x38”
Jetted	No
Grizzly	Yes, 6 1/2-in openings
Offloading System	
Type	Hydraulic (slurry) and Conveyor
Offloading Sites	Oakland, Martinez ,San Francisco San Rafael (Dutra Materials)
Operations	
Minimum Operating Depth (feet MLLW)	20
Maximum Operating Depth (feet MLLW)	80
Maximum Pumping Capacity (gpm)	15,000
Type of Operation	Potholing and Moving Potholing
Typical sand-water slurries (% composition, sand:water)	17:83 blend and fill; 12:88 coarse

During a mining event, the tug positions the barge above the sand shoal.   Once in position, the drag arm assembly is lowered, using two cable winches, until the drag head is positioned just above the substrate, then the centrifugal pump is primed and the drag head is lowered into the substrate, and mining begins.

The drag head is buried about 6-18 inches into the sand substrate. Water and sand is drawn into the drag head by the suction of the centrifugal pump from beneath and around the sides of the drag head. A maximum vacuum is regulated at the drag head by a vacuum relief vent (vent pipe), an 8 inch diameter water intake riser pipe on the top of the drag head. Water drawn into the drag head through the substrate creates a sand-water slurry (slurry) that allows the sand to be suspended and sucked up into the hopper barge. If the slurry becomes too dense resulting in increasing vacuum, water will be drawn in through the vent pipe to thin the sand slurry. As sand is withdrawn from the substrate area a “pothole” is created and the entire drag head assembly is continually lowered and pushed into the substrate to maintain its position within the sand substrate. During mining the tug maintains the barge’s position and allows the barge to “rest” on the drag head assembly, effectively forcing the drag head into the substrate using the barge’s weight. Mining is always done in the direction of the current, with the tug and barge “pushing” against the up stream current. This allows the tug to use forward thrust against the current to maintain position and allows the barge to “rest back” on the drag head assembly with the current pushing the drag head into the substrate. The proportion of sand to water in the slurry may vary, depending on the quality and consolidation of sand being mined. Hanson’s mining operations typically experience slurry proportions of approximately 17% sand and 83% water for fill sand and 12 % sand and 88% water for coarse sand.

Figure 3-2. Hopper barge and tug, illustrating hydraulic suction dredge trailing drag arm assembly.

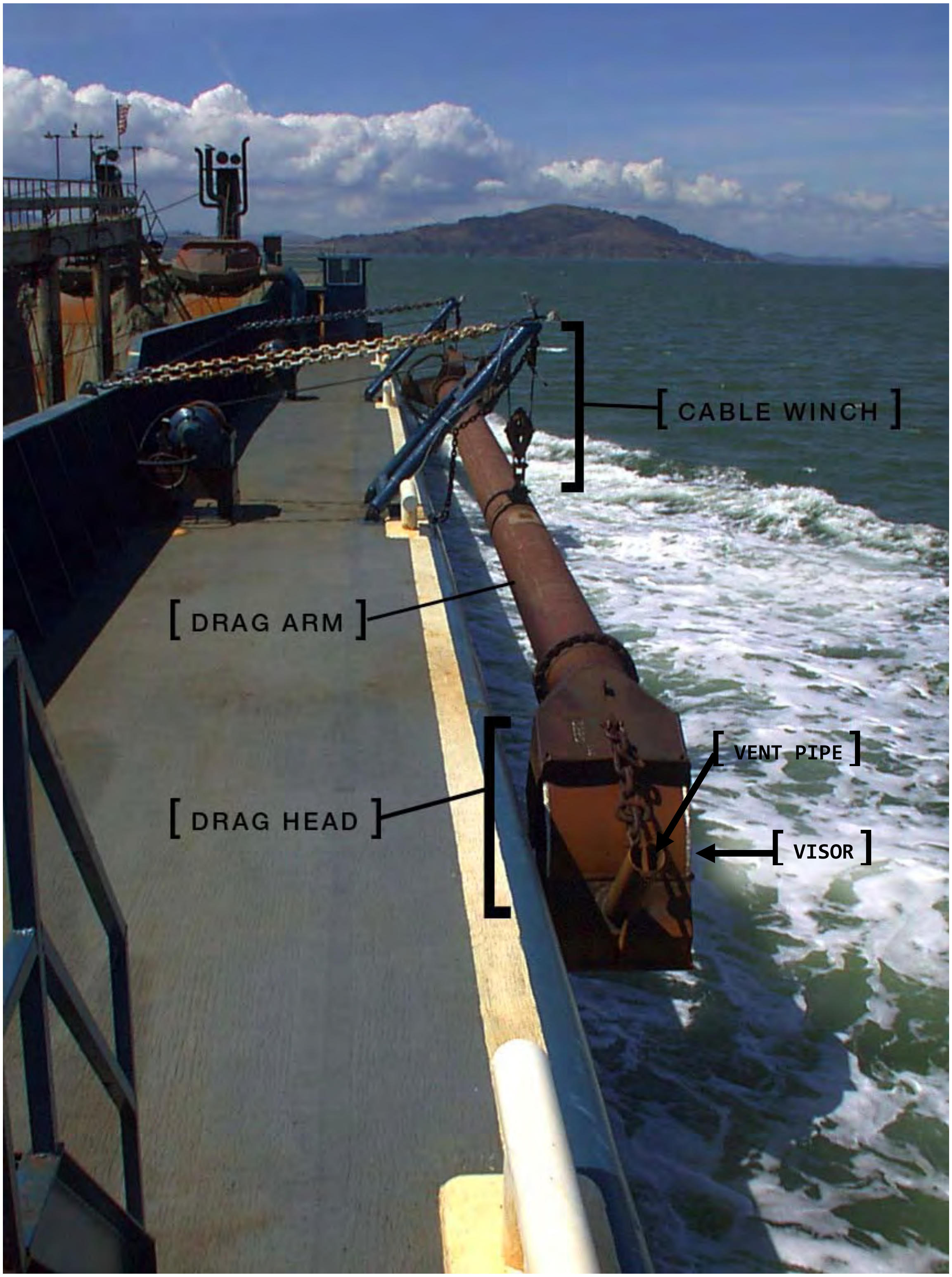


Figure 3-3. Hydraulic suction drag arm and drag head assembly in the retracted position

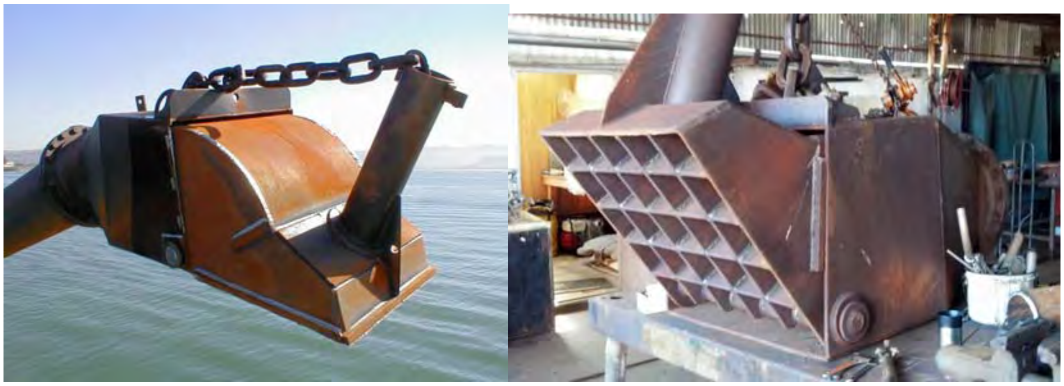


Figure 3-4: Hydraulic suction drag head showing "grizzly and visor" screen used to exclude large material during sand mining

3.1 Mining Site Determination

As mining commences, the dredge operators determine suitability of the sand for mining. Tests include grab samples to determine the gradation of the sand (coarse or fine) and visual observations of the slurry (a dark color indicates high sand to water proportion, signifying either loose, unconsolidated sand and/or finer sand). Vacuum measurements on the drag arm, density measurements of the slurry and pump RPMs give indications of the slurry density as well. The preferred method for sand mining is the "potholing" method. When the operator determines the sand quality is appropriate, the barge will stay in one place and as sand is removed from the mining location the operator will force the drag head to drop and stay buried 6"-18"in the substrate. If the sand becomes unsuitable or the substrate is hard to mine the operator implements two options:

1) Potholing: - The operator will pick up the drag arm and try another location. Before picking up the drag arm the centrifugal pump is turned off and the barge is moved to a new location. At the new location, the drag head is lowered to the substrate again, to "find the bottom" and then picked up no more than 3 feet off the "bottom" and the centrifugal pump is then turned on.(The pump is running "off the bottom" for no more than 30 seconds). The drag head is lowered and pushed into the substrate, to resume mining.

2) Moving Potholing: - The operator leaves the drag head on the sediment surface, with the pump running and drags forward across the sand shoal until suitable substrate is found; then, the barges forward movement is stopped and the current pushes the barge into reverse, pushing the drag head 6"-18" into the substrate again and potholing mining resumes..

3.2 Loading, Discharge, and Offloading Process

The sand-water slurry is loaded into the barge from the drag arm into the loading chute, which runs lengthwise along the centerline of the cargo hopper (Figure 3-5). The loading chute is equipped with ten gates distributed evenly along the bottom of the chute. The gate openings have a screen mesh over the openings to exclude oversized material. The mesh size over the opening varies but is typically between

1/2 inch to 5/16 inch square opening (mesh). The oversize material flows to the end of the chute and is discharged overboard through a pipe extending through the bottom of the barge. The gates in the chute articulate fore and aft and side to side to distribute the sand evenly in the hopper, keeping the barge level.

During loading the water from the sand water slurry is displaced by the accumulating sand in the cargo hopper. The water is discharged through overflow pipes on either side at the rear of the cargo hopper that extend down below the waterline on the outside of the barge. The overflow water can contain fine grained sediments and other material, which do not settle out in the cargo hopper and are returned to the receiving waters. The bottom of the cargo hopper is also fitted with a hopper dewatering system. A pipe along the centerline, at the bottom of the hopper, has five fine mesh screened openings where water that has filtered through the sand is suck in and pumped overboard.

The overflow and overflowed discharge may contain aggregates, fine sediments, aeration bubbles, and plankton, and due to these discharges a visible plume may occur around the barge. Based on the equipment and methods used for sand mining within the estuary, commercial sand characteristically ranges in size from approximately 1 mm to 12 mm (1/2 inch), with larger and smaller particles discharged overboard. The volume of sediment discharged overboard during a typical mining event within the estuary has not been quantified. Details related to discharge plumes are provided in Appendix B.

The *Sand Merchant* has been modified to utilize subsurface discharge pipes to release the overflow below the water line (Figure 3-6). These modifications are intended to reduce any developing discharge plumes by increasing the rate of turbulent mixing, dispersion, and decrease the duration of the overflow plume.

Once mining is completed, the barge is taken to a site for offloading. Figure 3-7 shows sand offloading locations through the Bay. The *Sand Merchant* is equipped with dry offloading capabilities utilize a conveyor belt system or wet offloading capabilities that pump the sand ashore:

- *Wet or pump offloading* - the cargo hopper is flooded with water from the estuary, and the sand-water slurry that is created is pumped ashore into a dewatering pond where the sand is allowed to settle and the water is drained through a weir system. The sand is then stockpiled with a bulldozer or front end loader.

- *Dry offload process* - the hopper barge is equipped with two drag buckets which are pulled across the top of the sand in the cargo hopper pulling the sand to the front of the barge. There is one bucket on either side of the loading chute. The drag buckets feed sand to a transfer conveyer running below the cargo hopper across the barge. From the transfer conveyer, the sand is transferred onto the boom conveyer, which extends overboard to the shore side conveyer system, which stockpiles sand within the yard (Figures 3-8 and 3-9).

Most sand must be washed using fresh water before delivery to the customer to produce a sand product with chloride content appropriate for concrete, generally 0.006% chloride or less by weight of cement. Offloading and sand distribution sites are relatively small (typically 4-5 acres) and have limited capability to stockpile or store sand for an extended period. Therefore, sand mining within the estuary is conducted in response to short-term demand.

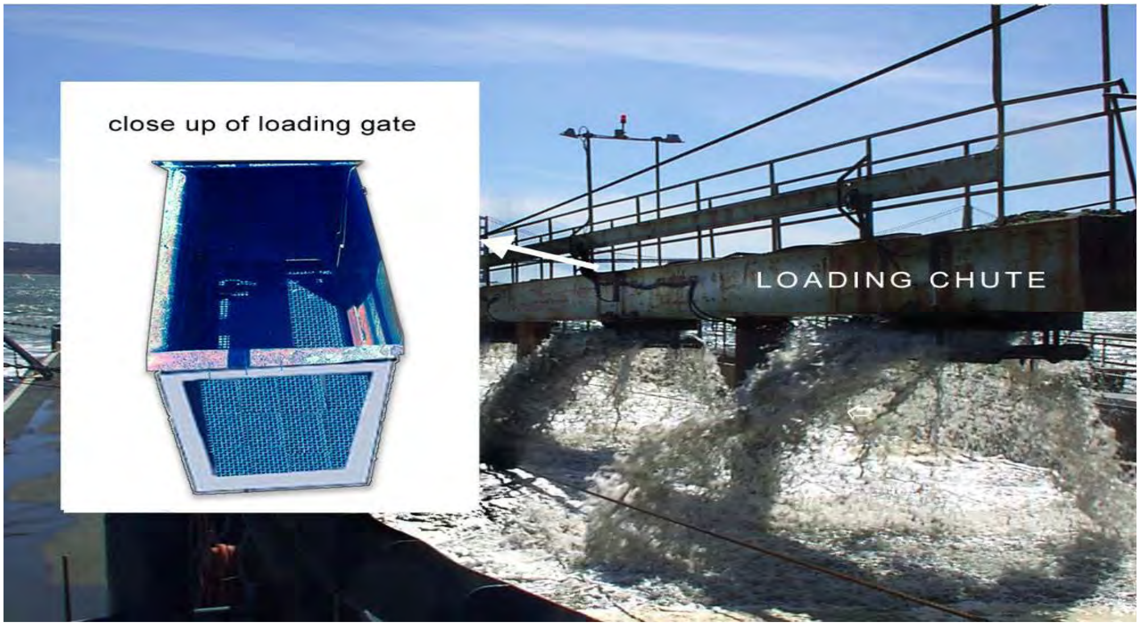


Figure 3-5. Hopper barge loading chute and gate.

Figure 3-6: Sand mining barge equipped with submerged overflow discharge. Note that the discharge is submerged below the waterline when the barge is loaded

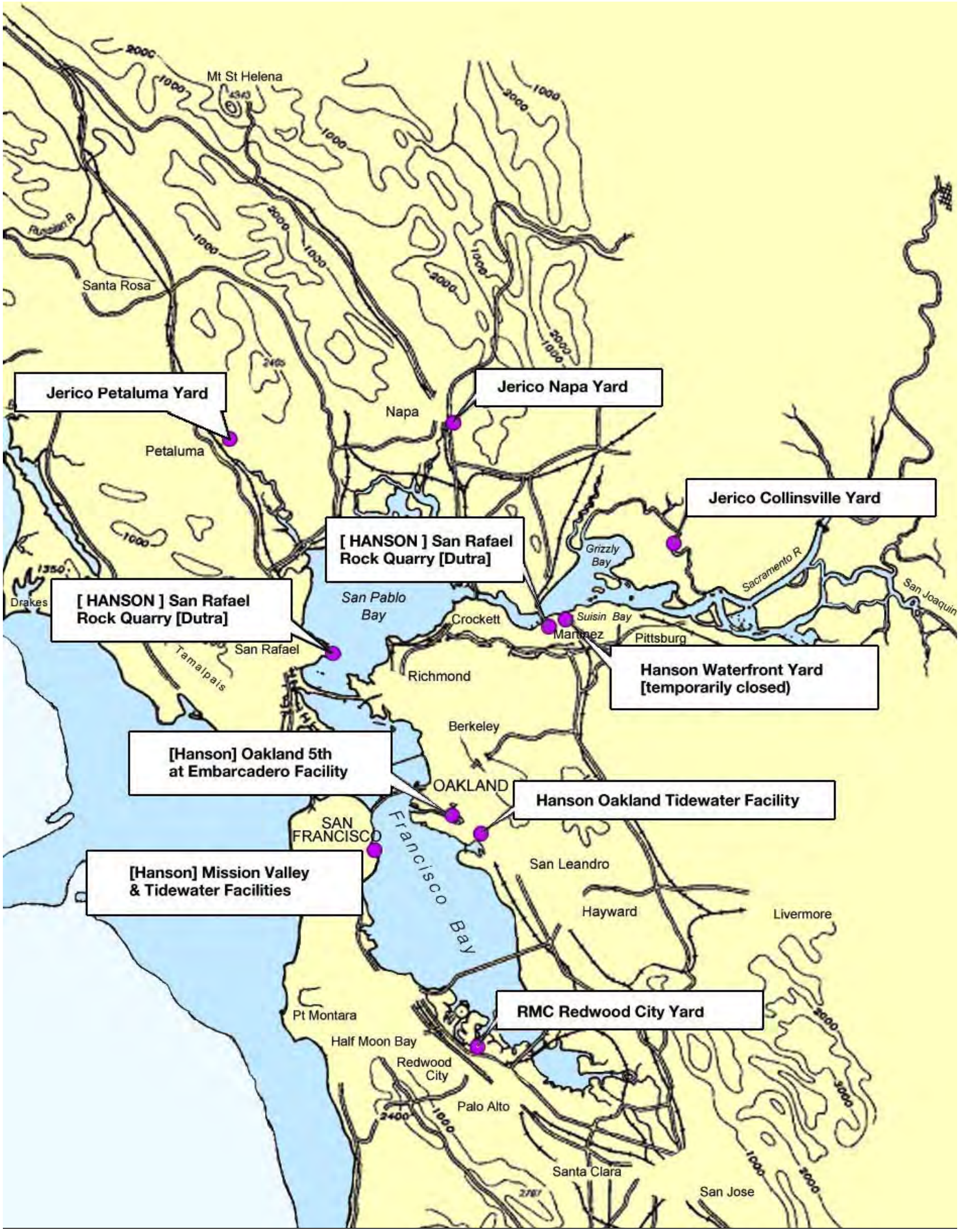


Figure 3-7: Marine sand offload locations within the Bay-Delta estuary

Figure 3-8: Boom conveyor to shore conveyor

Figure 3-9: On-shore conveyor to stock pile

3.3 Characteristics of Mining Events

3.3.1 Water Depth and Location

Sand mining does not occur uniformly within the region or lease areas, but rather mining activity is typically clustered within specific areas, characterized by high river or tidal velocities and sand deposits having a low percentage of fine material (silts, clay, and mud) that make the material suitable for use in construction materials. Due to equipment constraints, such as the barge and tug draft and the drag arm minimum operation depth (due to pipe length and angle during operation), sand mining cannot occur in shallow-water areas, less than -20 ft. Existing permit conditions also limit the areas of mining. Existing permits are listed in Section 6.

Sand mining locations are concentrated and consistent with the Sand Miners' objectives to find sands with a low percentage of fines, and to mine in areas compatible with the operating depth constraints of the equipment used. Operators typically return frequently to general areas where they have found appropriate sand deposits in the past. The actual locations where sand mining occurs in Central Bay are regulated and/or influenced by a number of factors which include State Lands Commission designated lease areas, navigation restrictions, areas having suitable water depths for mining, areas where sand is known from historical observations to accumulate, and areas having moderately high water velocities resulting in frequent sand movement, replenishment, and scour of fines from sand deposits.

As stated previously, due to equipment constraints, Hanson cannot practically mine in areas with less than -20 ft MLLW of water or in areas with depths greater than approximately -80 ft MLLW of water.

As well as equipment constraints, all recently issued ACOE and BCDC mining permits prohibit sand mining within 200 feet of any shoreline. The permits also prohibit sand mining within 250 feet of any water having a depth of -9 ft MLLW or less or -30 ft MLLW depending on location within the estuary.

3.3.2 Mining Event Duration and Harvest

The duration and timing of individual mining events reflect differences in equipment, weather, conditions of the substrate at the mining site, and type of sand (fill or coarse). Sand mining activity may occur at any time of day. The timing is influenced by tidal schedules, which dictate when loaded barges can navigate to the various offloading locations. Sand mining events generally last from 3 to 5.5 hours. Duration of mining events was examined in the 2004 "Assessment and Evaluation of the Effects of Sand Mining on Aquatic Habitat and Fishery Populations of Central San Francisco Bay and the Sacramento-San Joaquin Estuary", Hanson et al. 2004. In Central Bay, the mean duration of mining events is relatively consistent from month to month. For Hanson's mining operations during the period March 2002 through February 2003, mean event duration was from 3.5 to 4.6 hours, with a maximum duration of 9 hours and a minimum duration of 1 hour. Mean yields from Hanson mining operations were also quite consistent, with monthly means of from 1,931 cy per event to 2,149 cy per event (Hanson et al. 2004).

Once the barge is loaded, it travels to an upland offloading location. Depending on the mining and offloading locations, the entire operation – including loading, unloading and travel time – can take anywhere from 8 to 24 hours, but typically around 10 hours in the Central Bay. Under these circumstances, from an operational perspective, the greatest frequency that the *Sand Merchant* could disturb any single area is two times in any 24-hour period. However, the lease sites have different sand characteristics and it is also likely that the barge will mine an entirely different lease site to harvest a different sand type (coarse to a finer sand) which would further reduce a concentrated impact from mining the substrate.

3.3.3 Seasonal Distribution and Volumes of Mining Events

The amount and seasonal timing of mining volumes are largely dictated by demand for product and the weather (seasonality). Upland inventory space is limited at the offloading facilities and sand is mined in response to demand. Mining volumes may also be indirectly limited by the maximum cubic yardage allowed under the respective leases and permits. The anticipated seasonal monthly distribution of volumes is illustrated in Table 3-2 and Table 3-3. The percentage of annual volumes mined in each month is derived from Hanson's actual historic sand mining activity in the Bay/Delta for the years 2002-2007. The actual seasonal distribution of mining in any given year in the future may vary widely depending on demand.

Table 3-2: Anticipated Central Bay Monthly Mining Volumes (cy)

Source: Sand Mining Industry (Hanson)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul
%	6.6	6.8	7.9	8.0	8.0	10.0	8.1
Volume	101,640	104,720	121,660	123,200	123,200	154,000	124,740

Month	Aug	Sep	Oct	Nov	Dec	TOTAL
%	9.2	10.3	9.6	8.1	7.3	100.0
Volume	141,680	158,620	147,840	124,740	112,420	1,540,000

Table 3-3: Anticipated Middle Ground Monthly Mining Volumes (cy)

Source: Sand Mining Industry (Hanson)

Month	Jan	Feb	Mar	Apr	May	Jun	TOTAL
%	6.6	6.8	7.9	8.0	8.0	10.0	
Volume	3,300	3,400	3,950	4,000	4,000	5,000	
Month	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	
%	8.1	9.2	10.3	9.6	8.1	7.3	100.0
Volume	4,050	4,600	5,150	4,800	4,050	3,650	50,000

4. AVOIDANCE AND MINIMIZATION MEASURES

To avoid and minimize effects on federally listed species and their habitat within the Action Area, the following sections provide avoidance and minimization measures for specified species that will be implemented for each activity listed below.

- Fish screens have been installed on Hanson Mining Equipment as of September 16, 2013. Fish screens will reduce and minimize the risk of take of protected fish.

- When priming the pump or clearing the pipe, the end of the pipe shall be held at a height in the water column no greater than 3 ft off the bottom (NMFS 2006).

- Limited volume per year: existing State and Federal permits regulate the annual volume of sand that can be harvested from each lease area. These limits serve to reduce the potential risk of adverse effects of sand mining on subtidal habitat and aquatic resources (USFWS 2006).

- Water depth limitation to avoid sensitive habitat: in Central Bay, sand mining occurs in relatively deep water (from -30 to -90 ft MLLW). Within the region of Middle Ground Shoal and Suisun Bay, sand mining typically occurs in waters -20 to -45 ft MLLW deep, due to equipment constraints. In addition to equipment constraints, all recently issued ACOE and BCDC mining permits prohibit sand mining within 200 feet of any shoreline. The permits also prohibit sand mining within 250 ft of any water having a depth of -9 ft or less MLLW, or -30 ft MLLW, depending on the location in the estuary (USFWS 2006).

- Limited mining areas: sand mining is restricted to specific CSLC-designated lease areas. Mining is not permitted outside of the lease areas. The lease areas and specific locations within the lease areas where sand deposits occur and mining activity is most frequent are characterized by relatively high river and tidal current velocities, are areas of sediment (sand) accumulations that have a low percentage of fine sediments, and are dynamic areas with frequent natural disturbance, as evidenced by the presence of sand wave formations. These limitations reduce and avoid the risk of mining in sensitive subtidal habitat, located outside the designated lease areas (USFWS 2006).

- Monitoring actual mining locations: current sand mining permits require detailed tracking and accounting of the specific locations of each mining event. Results of the tracking are submitted to BCDC and CSLC quarterly in accordance with permit conditions. Tracking mining locations serves to ensure that mining occurs only within designated lease areas and that mining avoids sensitive subtidal habitat located outside of a lease area (USFWS 2006).

- Establish a 100-foot buffer around hard bottom areas within and adjacent to Central Bay mining leases. Sand mining dredging operations must maintain a sufficient buffer zone around all hard bottom areas, especially Harding, Shag, and Arch rocks, such that dredging equipment does not come into physical contact with these sensitive hard bottom areas. This buffer zone will, at a minimum, be 100 feet from the outward edge of any hard bottom feature. In the event dredging equipment comes into physical contact with any hard bottom area during the term of the leases, it shall be immediately reported to the CSLC, who shall establish a new minimum buffer zone distance.

- Current restrictions on sand mining operations, as specified in the National Marine Fisheries Service Biological Opinion (NMFS 2006) and the U.S. Fish and Wildlife Service Letter of Concurrence (USFWS 2006), serve to avoid and minimize take of delta smelt. Currently there are no Federal restrictions on longfin smelt. Due to similar life stages, however, State delta smelt restrictions and conditions will be applied to both smelt species. These conditions include restrictions on pump priming, limiting the total mining volume, prohibiting mining in areas of shallow water depth and in proximity to shorelines, restricting mining to the designated lease areas which are away from sensitive habitat, and monitoring and reporting the location of each mining event.

- The applicants shall keep the end of the pipe and drag head as close to the bottom as possible, and no more than three feet from the bottom, whenever feasible when priming the pump or clearing the pipe.

- Other avoidance, minimization and mitigation measures may be developed through ongoing processes with USWS, who is currently issuing a Biological Opinion for delta smelt for current sand mining through June 2013. In addition, it is anticipated that USFWS will issue a Biological Opinion for delta smelt for the 10-year period contemplated in this permit application. Other measures may also be developed through the ongoing Incidental Take Permit process with CDFG.

- To fully mitigate incidental take of CESA protected species that fish screens cannot avoid or minimize, Hanson has committed to purchase shallow water habitat. Mitigation estimates were calculated and approved by CDFW. Liberty Island has been identified as suitable habitat and Hanson is currently coordinating with pertinent entities to purchase 1 acre of habitat for the proposed 10 year sand mining permit.

5. PERMITTING

Table 5-1: Permits Associated with Hanson Lease Sites

Agency	Central Bay Lease Permit Number			
	Presidio Shoals	**Point Knox South**	**Point Knox Shoals**	**Alcatraz South Shoal**
CSLC	709.1	2036.1	7779.1	7780.1
ACOE	24305S	2441N	24997N	23573S
BCDC	4-77.17	5-80	12.94.5	M98-19.4
SMGB	See Note 1	See Note 1	See Note 1	See Note 1
RWQCB	Regional Board Order No. 95-177, as Amended by Order No. 00-048 (applies to all parcels)			

Agency	Middle Ground Permit Number
CSLC	N/A
ACOE	24996N and 25653N
BCDC	10-90(M)
SMGB	See Note 1
RWQCB	Regional Board Order No. 95-177, as Amended by Order No. 00-048 (applies to all parcels)

NOTE 1: The SMGB has approval authority over the reclamation plans prepared pursuant to SMARA for the sand mining sites. SMGB adopted resolution 2005-02 in February 2005, approving the reclamation plans for ten marine sand mining leases in the Central Bay, Suisun Bay and western Delta. The SMGB approval of the reclamation plans for the current Central Bay, Suisun Bay and Delta sites is limited to the term of the leases that expired in 2008, and extended pending completion of EIR.

CEQA EIR : California State Lands Commission is the lead agency.

July 10, 2007. Notice of Preparation (NOP) published.
July 30, 2007. Two scoping meetings held in Oakland, California.
July, 27, 2010 – November 27, 2010. Draft EIR released for public review with comments accepted by mail, email, facsimile transmission, and in person at two public meetings held in Berkeley, California on August 23, 2010.
November 16, 2011 – January 3, 2012. Revised Draft EIR released for public review with comments accepted by mail, email, facsimile transmission; 12 written comment sets were received.
January – September 2012. In preparing this Final EIR, the CSLC staff responded to all comments received, obtained additional information as needed to respond to comments, and prepared revisions to the Revised Draft EIR (see Parts II and III).
October 2012: The CSLC certified the Final EIR.

USACE will be permitting for Section 10 (Rivers & Harbor Act) - Current USACE permits for sand mining in the Central Bay have been extended through June 2014.

Biological Assessments and/or Incidental Take Permits were developed and submitted to initiate consultation with NMFS, USFWS, and CDFW, as necessary.

A major permit from the San Francisco Bay Conservation and Development Commission (BCDC) will be required.

REFERENCES

CSLC. 2012. Final Environmental Impact Report for the San Francisco Bay and Delta Sand Mining Project State Clearing House No. 2007072036CSLC EIR NO. 742. Prepared for the California State Lands Commission SEPTEMBER 2012

Hanson, C.H., J. Coil, B. Keller, J. Johnson, J. Taplin, J. Monroe (Hanson Environmental). 2004. Assessment & Evaluation of the Effects of Sand Mining on Aquatic Habitat and Fishery Populations of Central San Francisco Bay and the Sacramento-San Joaquin Estuary. Hanson Environmental, Inc. October 2004.

National Oceanic and Atmospheric Administration National Marine Fisheries Service (NMFS). 2006. Biological and Conference Opinion; Nine U.S. Army Corps of Engineers permits for sand mining in the San Francisco Bay-Delta Estuary, California. File # 151422SWR2005SR00625. Prepared by the National Marine Fisheries Service, Southwest Region. March 9, 2006.

U.S. Fish and Wildlife Service (USFWS). 2006. Letter from Chris Nagano, Deputy Assistant Field Supervisor, to Peter Straub, U.S. Army Corps of Engineers Regulatory Branch, Subject: Informal consultation on sand mining activities in the Sacramento-San Joaquin Estuary (Corps file numbers 25041N, 24913N, 25653N, 24996N, 25669N, 27864N, 27865N, 27866N). FWS File no. 1-1-06-I-0255. January 10, 2006.

APPENDIX A

Lease Location Details

APPENDIX A

NO SCALE

SITE MAP

PRC 709 South Parcel

1983 DATUM (WGS84)
N. Lat. / W. Long.

Latitude: 37-48-48	Longitude: 122-26-30
Latitude: 37-48-48	Longitude: 122-26-32
Latitude: 37-48-46	Longitude: 122-26-36
Latitude: 37-48-45	Longitude: 122-26-38
Latitude: 37-48-45	Longitude: 122-26-40
Latitude: 37-48-44	Longitude: 122-26-42
Latitude: 37-48-43	Longitude: 122-26-46
Latitude: 37-48-42	Longitude: 122-26-50
Latitude: 37-48-41	Longitude: 122-26-52
Latitude: 37-48-40	Longitude: 122-26-54
Latitude: 37-48-39	Longitude: 122-26-55
Latitude: 37-48-38	Longitude: 122-26-58
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Latitude: 37-48-37	Longitude: 122-27-01
Latitude: 37-48-36	Longitude: 122-27-04
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Latitude: 37-49-02	Longitude: [illegible]

PRC 709 S. PARCEL

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Latitude: 37-49-03	Longitude: 122-26-41
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PRC 709 N. PARCEL

1983 DATUM (WGS84)
N. Lat. / W. Long.

Latitude: 37-51-23	Longitude: 122-26-43
Latitude: 37-50-48	Longitude: 122-26-15
Latitude: 37-50-35	Longitude: 122-27-02
Latitude: 37-50-35	Longitude: 122-27-31
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PRC 709 E. PARCEL

1983 DATUM (WGS84)
N. Lat. / W. Long.

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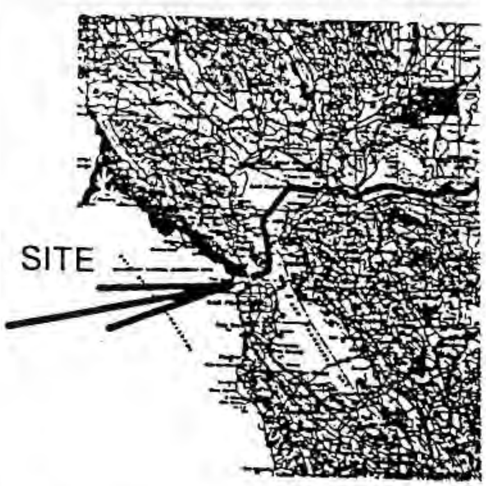
Latitude: 37-49-23	Longitude: 122-25-53

NO SCALE

LOCATION MAP

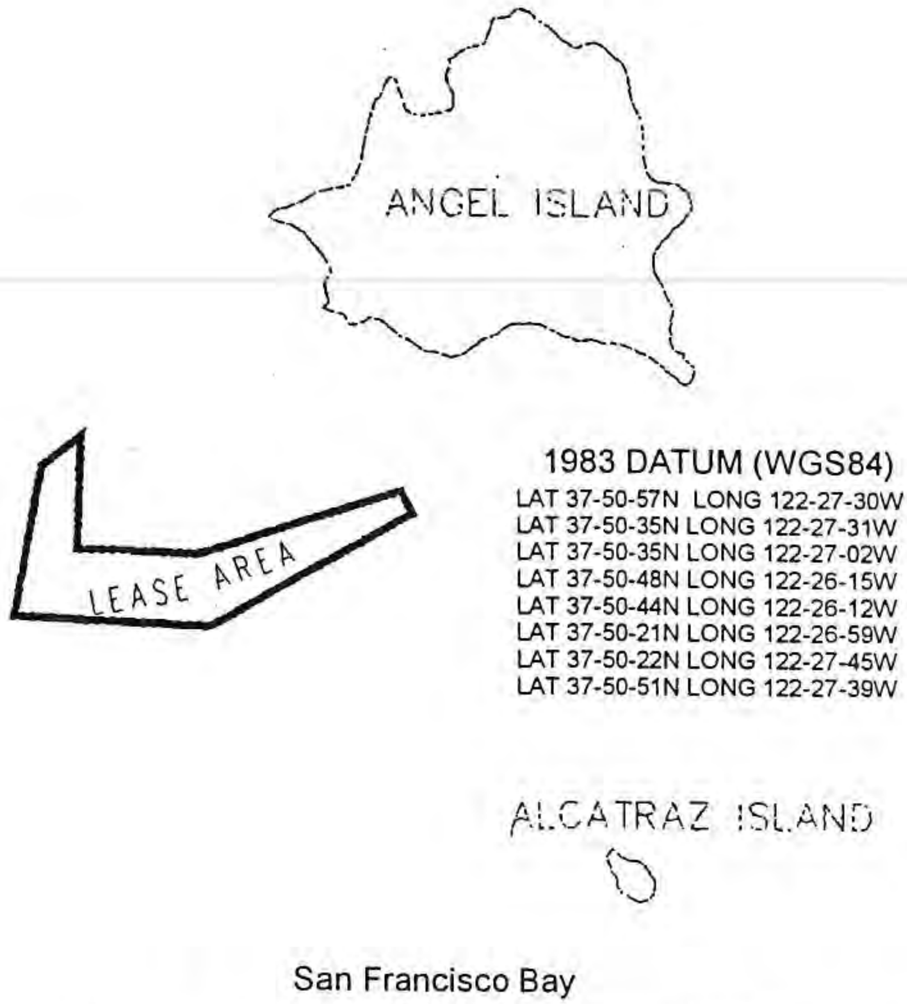


This Exhibit is solely for purposes of generally defining the lease premises, and is not intended to be, nor shall it be construed as, a waiver or limitation of any State interest in the subject or any other property.

Exibit A
PRC 709
Mineral Extraction
San Francisco
Bay
San Francisco Co.

NO SCALE

SITE MAP



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LOCATION MAP

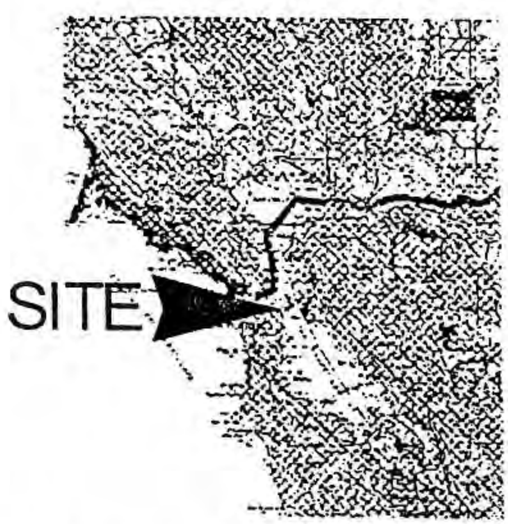

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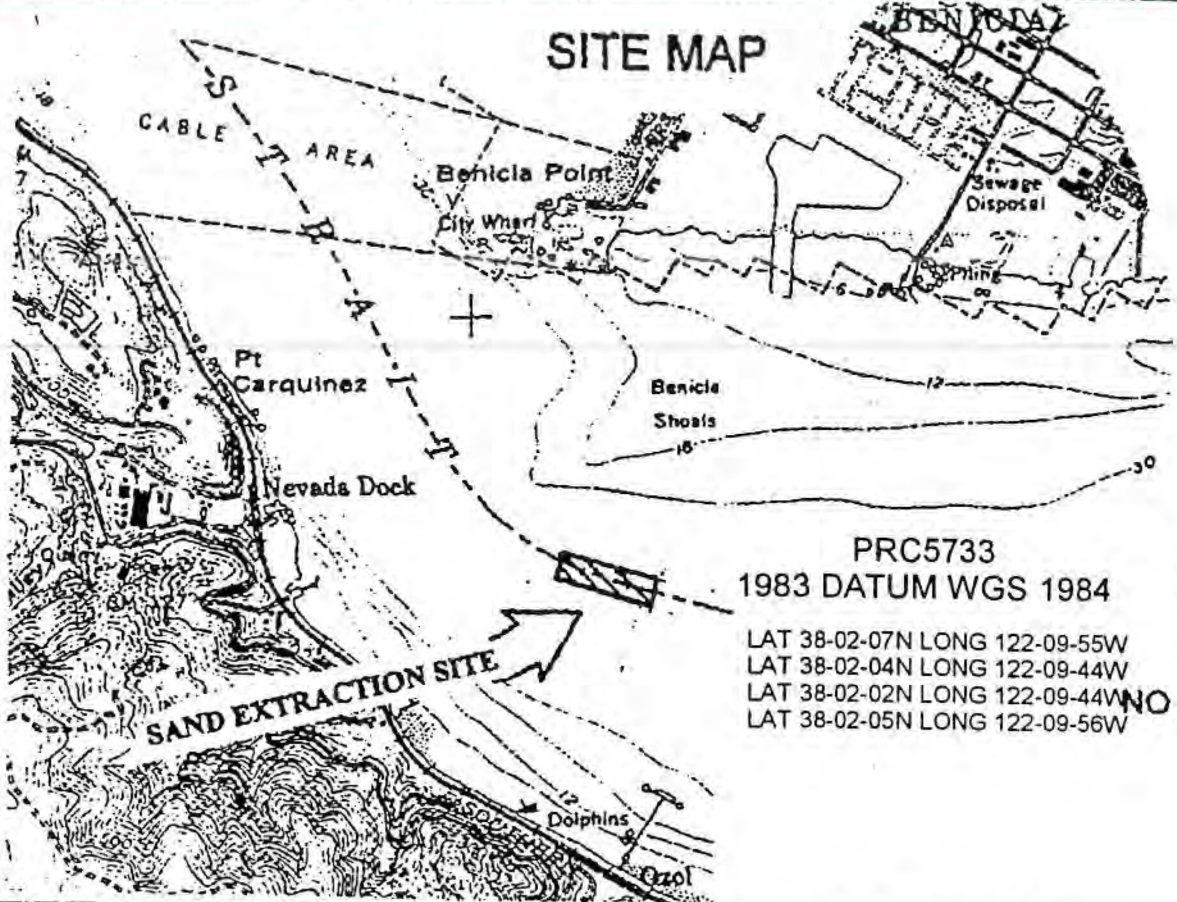
Exhibit A
PRC 2036
Sand & Gravel Extraction
San Francisco Bay
Vic. of Angel Island
San Francisco & Marin Counties.

SITE MAP



PRC5733
1983 DATUM WGS 1984

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LAT 38-02-04N LONG 122-09-44W
LAT 38-02-02N LONG 122-09-44W
LAT 38-02-05N LONG 122-09-56W

NO SCALE

LOCATION MAP

NO SCALE

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EXHIBIT "A"

PRC 5733

Dredging Application

Carquinez Strait

Contra Costa and
Solano Counties

RL 5/5/97

SITE MAP

PRC5871
1983 DATUM WGS 84

LAT 37-49-47N LONG 122-26-44W
LAT 37-49-48N LONG 122-26-04W
LAT 37-49-34N LONG 122-26-04W
LAT 37-49-34N LONG 122-26-03W
LAT 37-49-33N LONG 122-26-07W
LAT 37-49-30N LONG 122-26-12W
LAT 37-49-28N LONG 122-26-14W
LAT 37-49-26N LONG 122-26-16W
LAT 37-49-23N LONG 122-26-17W
LAT 37-49-23N LONG 122-26-04W
LAT 37-48-49N LONG 122-26-04W
LAT 37-48-49N LONG 122-26-10W
LAT 37-49-20N LONG 122-26-10W
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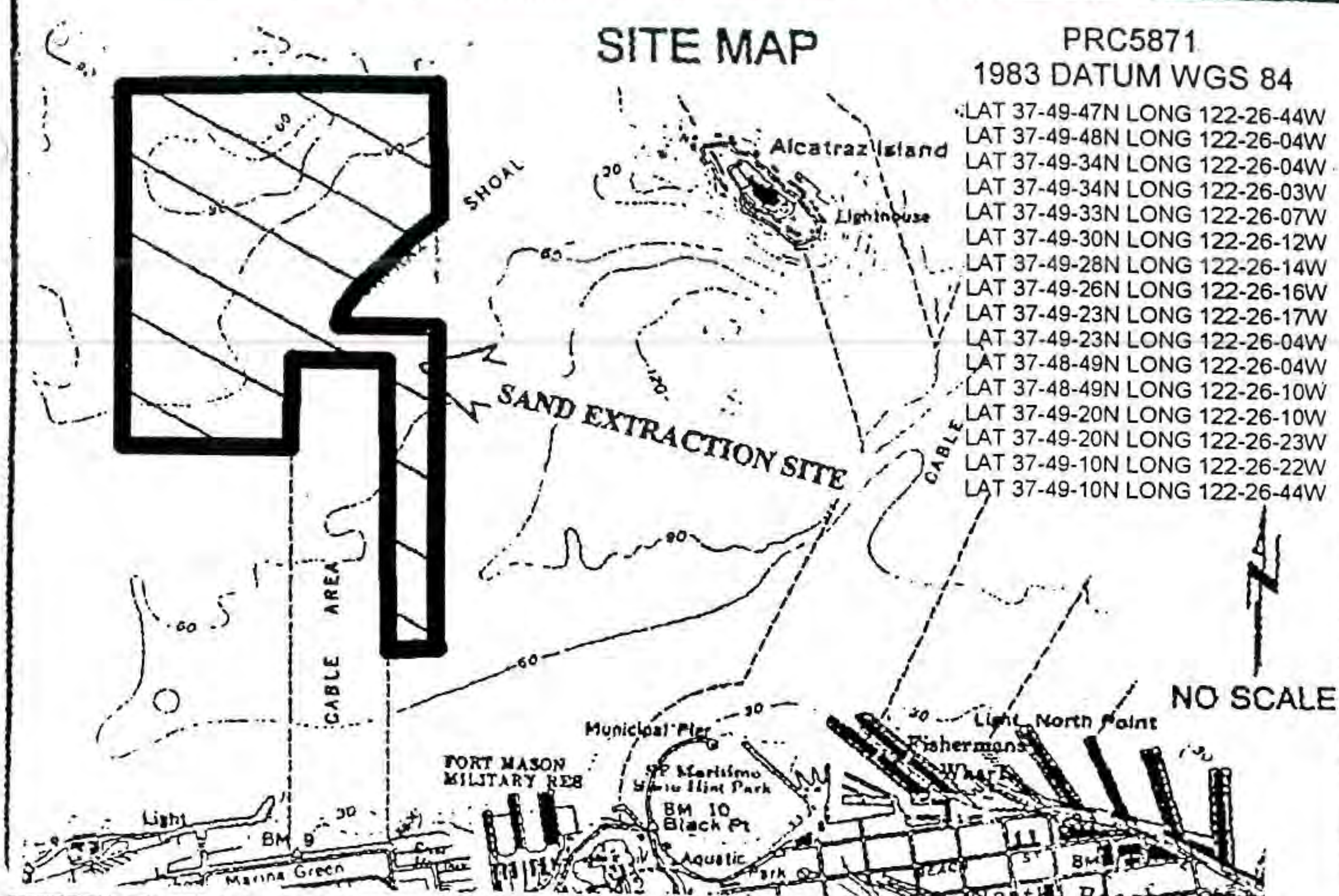

LOCATION MAP

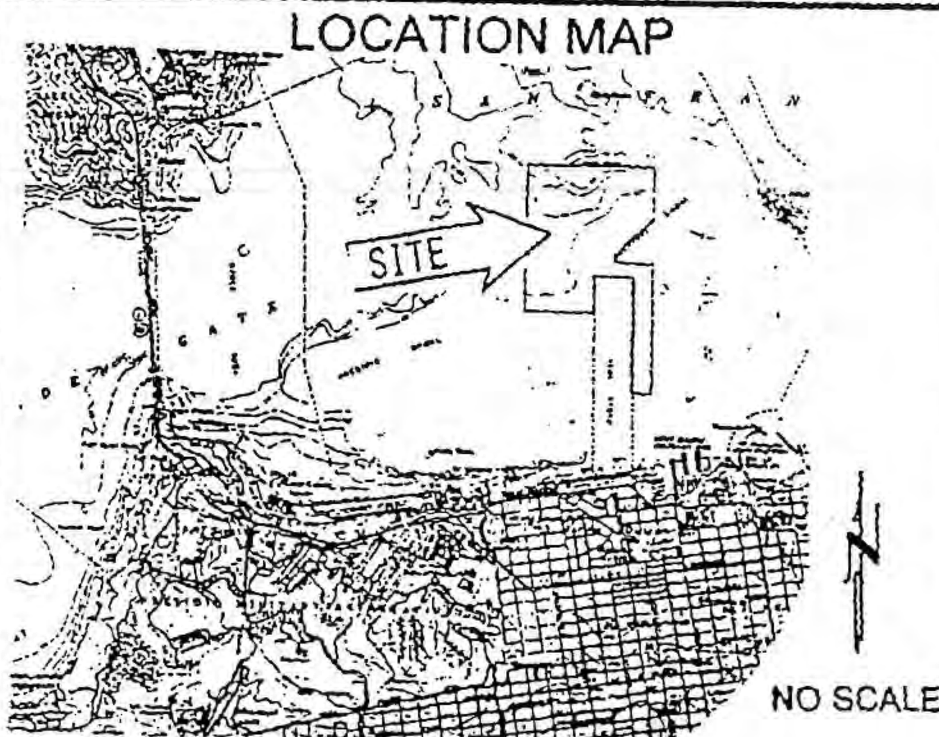

EXHIBIT "A"

PRC 5871

Dredging Application

San Francisco Bay
Vicinity of
Alcatraz Shoals
San Francisco County

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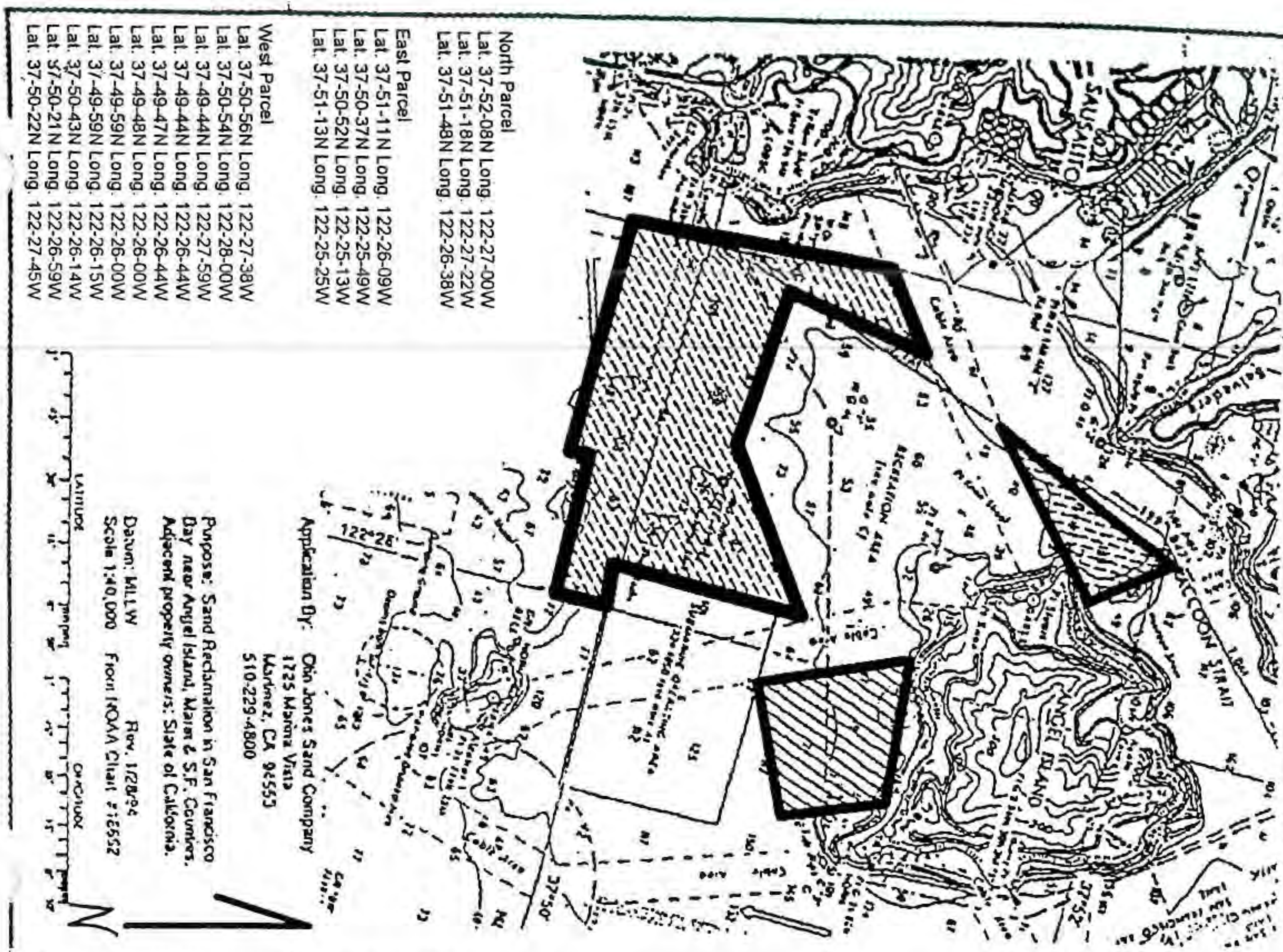

LOCATION MAP

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Exhibit A
PRC 7779
Dredging Application
Olin Jones Sand Company
San Francisco Bay
SAN FRANCISCO & MARIN COUNTIES

NO SCALE

SITE MAP

T#	1983 Datum(WGS84) N. Lat./W. Longs.	
509	Latitude 37-49-59	Longitude 122-26-00
781	Latitude 37-49-47	Longitude 122-26-00
782	Latitude 37-49-55	Longitude 122-25-40
783	Latitude 37-49-59	Longitude 122-25-42

T#	1983 Datum(WGS84) N. Lat./W. Longs.	
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233	Latitude: 37-49-29	Longitude: 122-25-39
234	Latitude: 37-49-28	Longitude: 122-25-42
235	Latitude: 37-49-28	Longitude: 122-25-45
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784	Latitude: 37-48-48	Longitude: 122-26-04
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99	Latitude: 37-49-03	Longitude: 122-25-13
98	Latitude: 37-49-07	Longitude: 122-25-42
97	Latitude: 37-49-12	Longitude: 122-25-53
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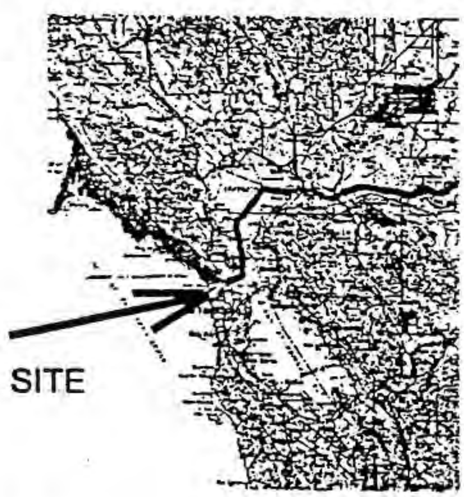
95	Latitude: 37-49-25	Longitude: 122-25-32

NO SCALE

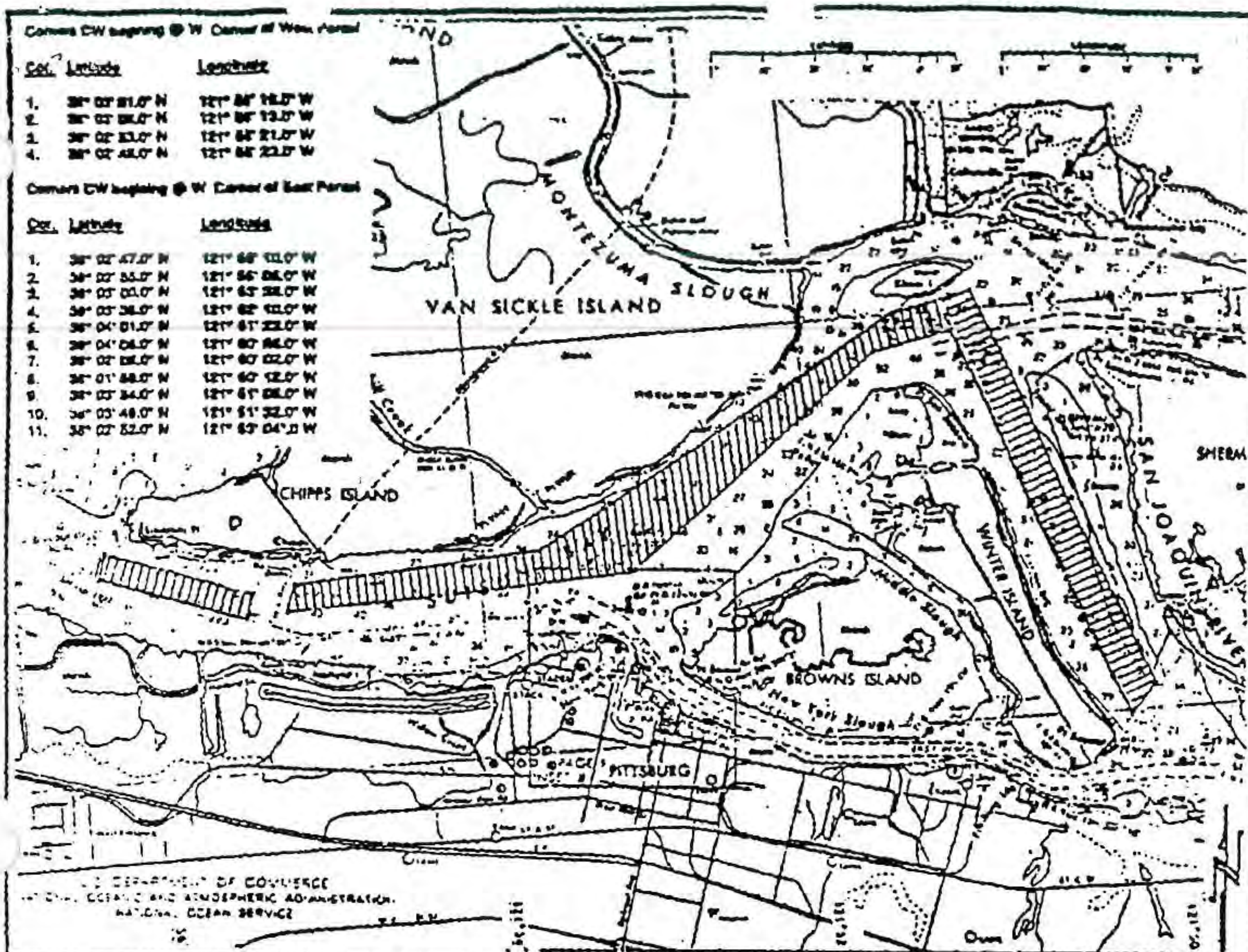
LOCATION MAP



This Exhibit is solely for purposes of generally defining the lease premises, and is not intended to be, nor shall it be construed as, a waiver or limitation of any State interest in the subject or any other property.

Exhibit A
PRC 7780
Mineral Extraction
San Francisco Bay
SAN FRANCISCO CO.

rl 5/5/98



LOCATION MAP

EXHIBIT "A"

PRC 7781

Dredging Application
Olin Jones Sand Company
Suisun Bay
SOLANO, SACRAMENTO &
CONTRA COSTA COUNTIES

This Exhibit is solely for purposes of generally defining the lease premises, and is not intended to be, nor shall it be construed as, a waiver or limitation of any State interest in the subject or any other property.

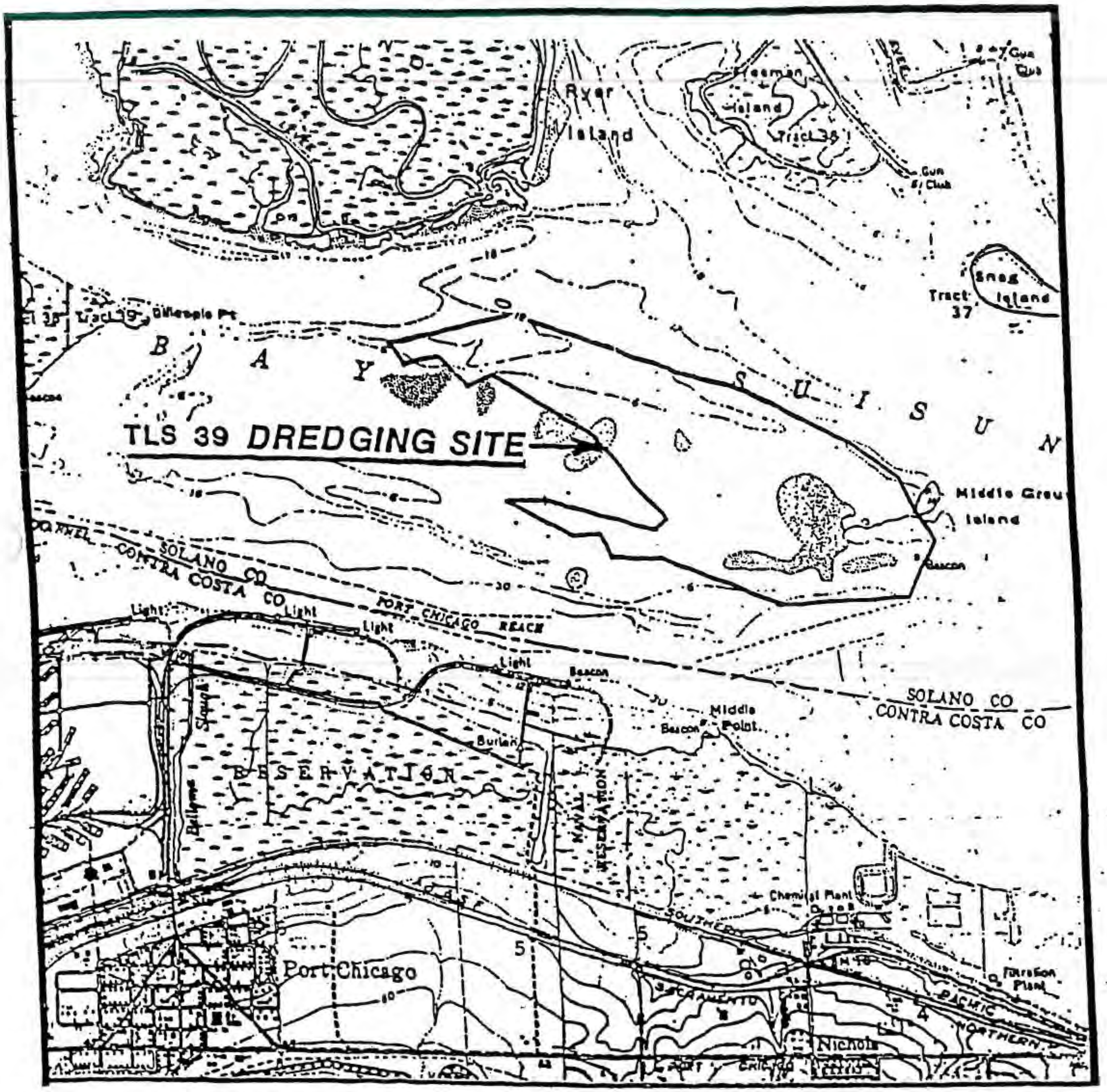


Exhibit B: Site Map

PORT CHICAGO, CALIF. · HONKER BAY, CALIF.

SE/4 CARQUINEZ STRAIT 15' QUADRANGLE · SW/4 PITTSBURG 15' QUADRANGLE

1000 0 1000 2000 3000 4000 FEET

Location:
Suisun Bay, Solano County

APPENDIX B

OVERFLOW PLUME CHARACTERISTIC

1. Characteristics of the Overflow Plume

During sand mining operations overflow “plumes” of fine suspended sediment and other material (e.g. entrained air bubbles) are created within the water body adjacent to the barge (Figures 1-13 1-14, and 1-15). Sediment plumes caused by sand mining can be defined as those particles suspended into the water column during the sand mining operation that do not rapidly settle following discharge back into the estuary. The degree of sediment resuspension, plume size, concentration and duration of the plume depends on many site and operational specific factors. Data presented in the literature on the characteristics of suspended sediment plumes from sand mining and dredging operations similar to those occurring within the estuary are summarized below. Information characterizing the suspended sediment plume will be used to ascertain the effects of plume exposure on protected fish inhabiting the estuary.

This section discusses the characteristics of the overflow plumes resulting from sand mining. Plume characteristics include the size, location and depth of the plume; suspended sediment concentrations within the overflow plumes, as described from data collected in previous studies; plume composition; and a comparison of overflow plume suspended sediment concentrations with background (ambient) conditions.

Figure 1-13: Sand mining overflow plume within Central Bay showing suspended sediment, entrained air bubbles, and other material

Figure 1-14: Sand mining overflow plume within Suisun Bay and Middle Ground Shoal (note similarity in turbidity between overflow and receiving waters)

Figure 1-15: Sand mining overflow plume and natural turbidity at ebb tide within Central Bay

1.1.1. Plume Size and Depth

The size and depth of an overflow plume is partly determined by the concentration and grain size (and specific gravity) of sediment particles and other materials discharged as part of the overflow during sand mining. Current velocity and direction also play a large role in determining plume characteristics. MEC and Cheney (1990) conducted a series of studies designed to characterize the overflow plume during sand mining within Central Bay (Figure 1-16). The overflow plume dimensions are characteristically narrow, as determined by tide and current velocity. On ebb and flood tides, the plumes are typically narrow in width and long in length. During slack tides, the plumes extend over a wider area and are less drawn out.

Generally the overflow plume during sand mining is approximately 300 feet or less in width and trails away from the sand mining barge with the prevailing water currents (MEC and Cheney 1990). MEC and Cheney (1990) observed that plumes generally dissipate within approximately 3,000 feet of a sand mining operation. The rate of plume dispersal is related to the settling rate of the particles and turbulent mixing within the receiving waters. Goodwin and Michaelis (1984) observed sediment plumes from dredging operations in Tampa Bay, Florida to be characteristically long and narrow during strong ebb and flood tidal conditions, with wider plumes displaying lower sediment concentration decline rates during slack tides or in areas of low currents, and therefore low mixing.

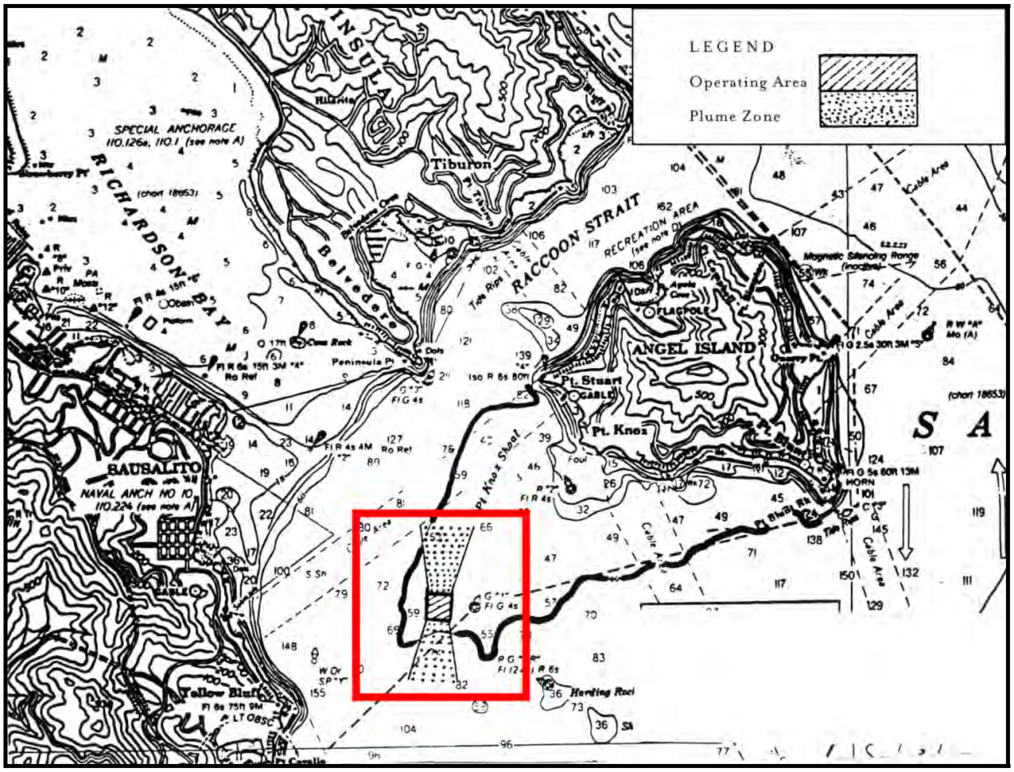


Figure 1-16: Area on Point Knox Shoal within Central Bay where overflow plume studies were conducted by MEC (1990).

1.1.2. Plume Composition

The visible plumes around the sand mining barge created during sand mining operations are composed primarily of fine sediments (silt and clay), aeration bubbles, dissolved materials and plankton. The suspended sediment concentration within the plumes is one of the primary focuses of a biological effects assessment. Overflow plumes typically have an increased suspended sediment concentration and elevated turbidity. The elevated turbidity, however, may not be directly related to increased suspended sediment concentrations, which are measured by weight/volume (mg/l). Increased turbidity associated with the plumes may be formed largely by aeration bubbles and silt/clay particles: there is not necessarily any correlation of turbidity with increased suspended sediment concentration. The material within the overflow plume associated with sand mining originates from the sand substrate. No chemicals or other materials are added to the overflow plume during sand mining.

1.1.3. Sediment Concentrations Within the Plume

As part of the sand mining overflow plume study conducted within Central Bay (Figure 1-16) MEC and Cheney (1990) measured suspended sediment concentrations inside plumes created by overflow during sand mining operations. MEC and Cheney (1990) noted that the overflow from the barge appeared to have elevated levels of fine particulate material when compared to receiving waters, creating a well developed plume in the direction of tidal flow (Figure 1-15). The plume monitoring identified the plume zone both vertically and horizontally within the water column. The water sampling conducted within the plume was divided into three separate procedures to characterize (1) the vertical distribution of the plume within the water column, (2) suspended sediment concentrations within and outside of the plume, and (3) along a longitudinal gradient within the plume. Data related to the characteristics of the plume included:

- Water sampling to determine suspended sediment concentrations immediately astern of the tugboat (Figure 1-17): Water samples were taken at five foot vertical intervals. This test was designed to assess the vertical distribution of the plume to a depth of 50 feet within the water column;
- Secchi disk readings were taken within two of the plumes
- Literature data on the settling rate of fine sediment was compiled; and
- Data on the composition of mined sediment was compiled.

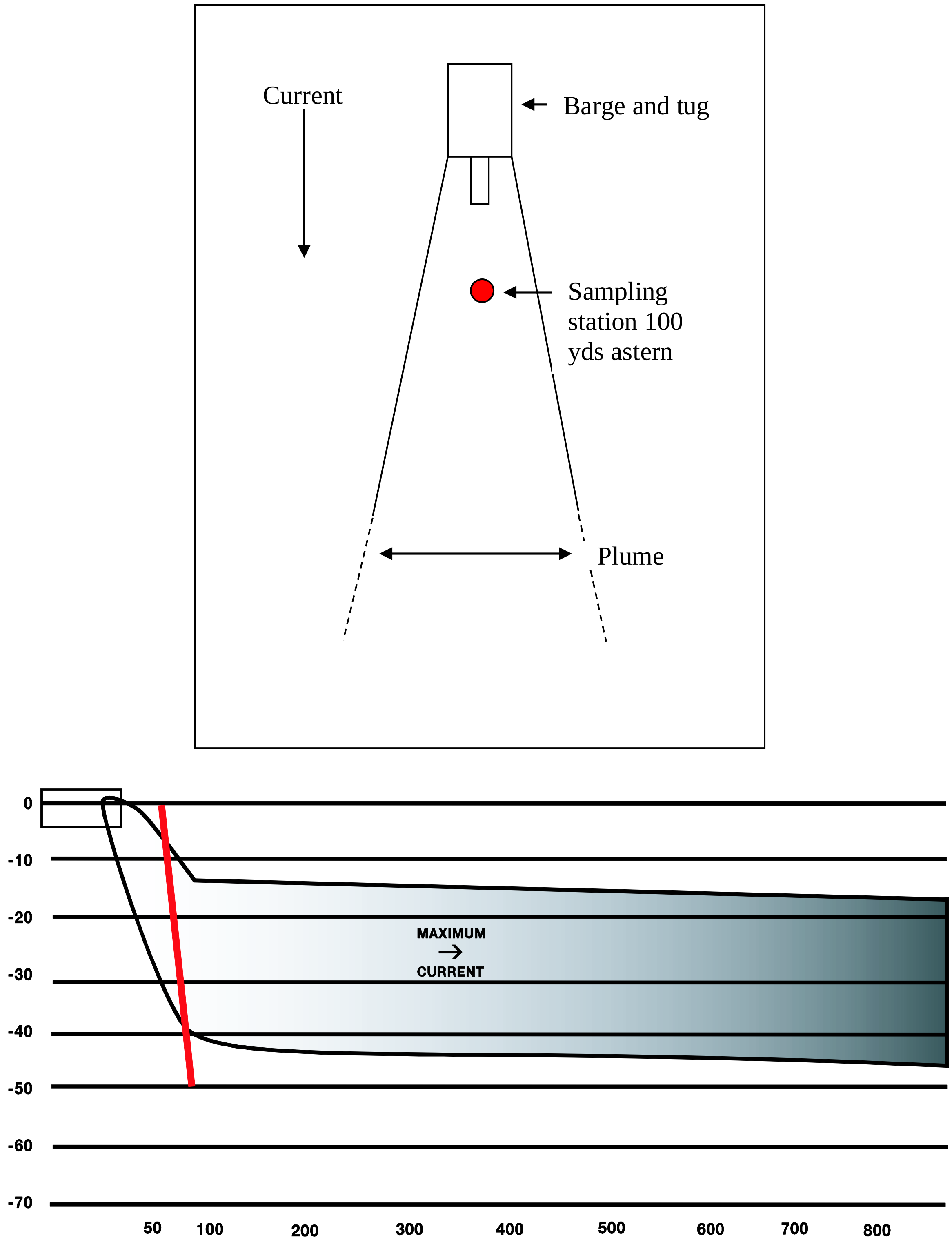


Figure 1-17: Vertical profile sampling of the overflow plume during sand mining (MEC 1990)

As part of the sand mining overflow plume study, MEC and Cheney (1990) collected sediment samples from Central Bay Shoal and barge to determine the percentage of fines. Sediment sampling locations are shown in Figure 1-18. Results of these tests (Table 1-6) are consistent with other surveys showing that sand is mined from areas that typically contain less than 10% fine materials (Figure 1-19). The results of these surveys also show the variability in sediments, and the percentage of fines within an area as reflected in the data for Site E. Areas, such as Site E, having a higher percentage of fines (>10%) would not be suitable for commercial sand mining and would be avoided during mining. During a sand mining event operators typically search an area for suitable sand deposits (based on both the quality and quantity of sand at a site).

The occurrence of sediments within an area of the estuary is dependent on a variety of factors including current velocity and turbulence. High velocity and turbulence scour fine sediments from an area while providing bedload transport by larger sand and gravel particles. Gradients in water velocity and turbulence result in “sorting” of particles in the sedimentary deposits, resulting in deposits of nearly pure sand in one location (high turbulence and velocity) while other locations may be characterized by sediments rich in silt and clay (low turbulence and velocity). In zones of high velocity and turbulence, only the larger particles (sand in the case of San Francisco Bay) will deposit. In zones of low velocity and turbulence, sand, as well as the smaller particles (silts and clays) will settle to the bottom. As a result of these physical processes, sand mining has historically occurred preferentially in areas of the estuary characterized by moderately high current velocities, typically in deeper channel and depositional areas, while avoiding shallow water low velocity areas where the deposition of fines is greater.

Plumes from sand mining activities increase existing concentrations of suspended sediments before dispersing to background levels. The time required for the concentration to return to background levels is a function of:

- The length of time for the water body affected by a plume to return to an un-impacted condition. This is directly dependent on water body current velocities (flushing time); and
- Time taken for sediment to settle out of suspension. Settlement is dependent, in part, on characteristics such as water depth, salinity and turbulence. Sediment characteristics such as structure, grain size, shape and density will also directly affect settling times.

MEC and Cheney (1990) measured suspended sediment concentrations along a longitudinal transect through the plume (Figure 1-20). Water samples were taken from a set depth of 20 feet starting up current of the barge and at two-minute intervals as the research vessel moved from outside the plume into the plume (MEC and Cheney 1990). This test ran for 24 minutes and the research vessel would typically finish at least 800 yards astern of the barge at the end of the sampling cycle. Sampling was carried out in the mid-line (center) of the plume (Figure 1-20).

Table 1-6: Summary of difference in suspended sediment concentrations (mg/l) between sample points moving downstream through centerline of plume (MEC 1993).

Date: 5/17			**Date: 5/22**	
Tide: Ebb			**Tide: Ebb**	
Distance (m)	**TSS difference (mg/l)**		**Distance (m)**	**TSS difference (mg/l)**
0	25		0	41
-50	-18		-100	-20
-100	8		-200	-8
-200	-11		-300	8
-300	-11		-400	-25
-400	-14		-500	-31
-500	-15		-600	-29
-600	-3		-700	-19
-700	12		-800	10
-800	-23		-900	15
			-1000	0
			-1200	6
Date: 6/11			**Date: 6/14**	
Tide: Flood			**Tide: Ebb**	
Distance (m)	**TSS difference (mg/l)**		**Distance (m)**	**TSS difference (mg/l)**
0	1		0	-1
-100	4		-50	2
-200	16		-100	2
-300	43		-200	7
-400	25		-300	8
-500	85		-400	5
-600	12		-500	-3
-700	7		-600	2
-800	1		-700	-3
-900	25		-800	3

Note: Differences in suspended sediment concentrations were calculated as the difference between the ambient or background concentration measured upstream out of the influence of the overflow plume minus the concentration at each point along the centerline of the plume. Positive values of the TSS difference indicate that the suspended sediment concentration in the plume is less than the background concentration and negative differences indicate that the concentration in the plume is greater than background upstream and downstream (ambient) of the plume and within the overflow plume near the surface and near the bottom (vertical differences in suspended sediment contents.

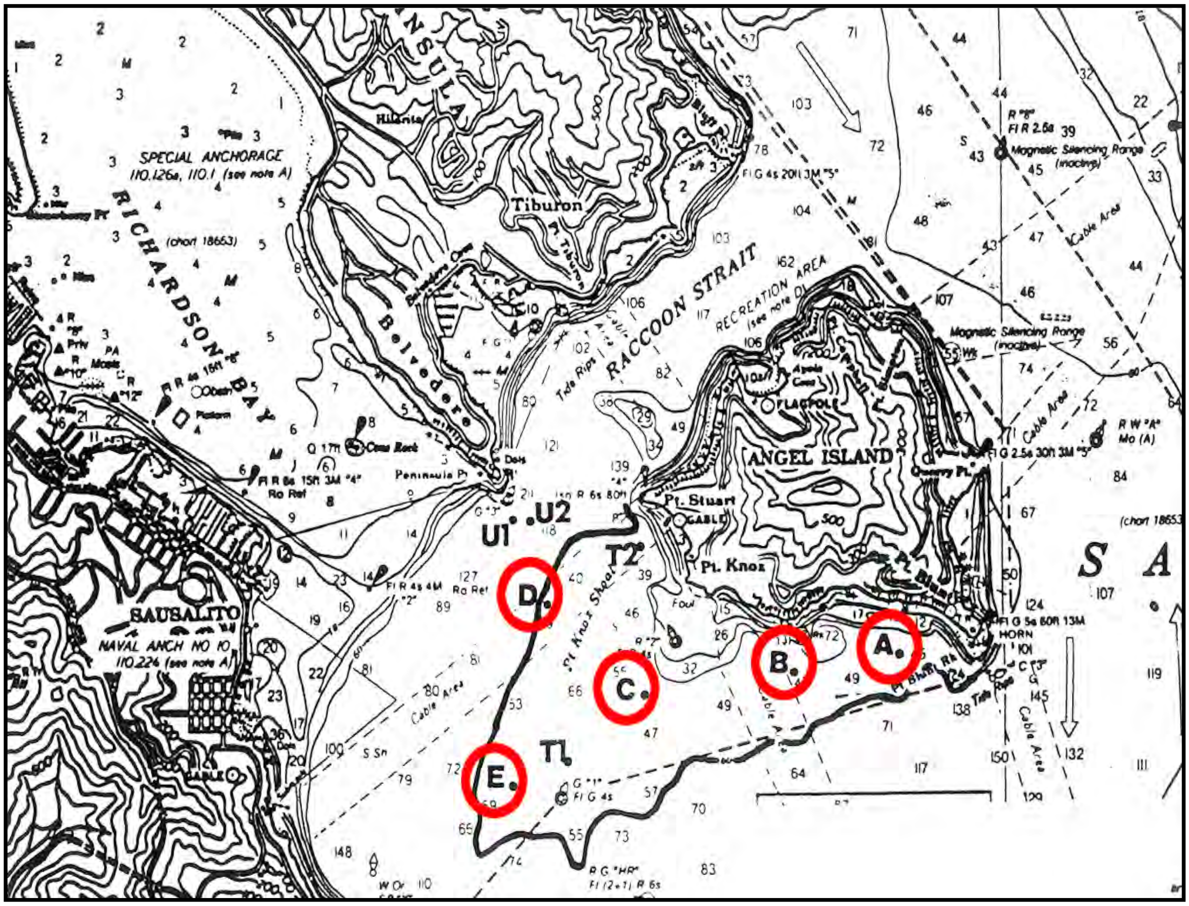
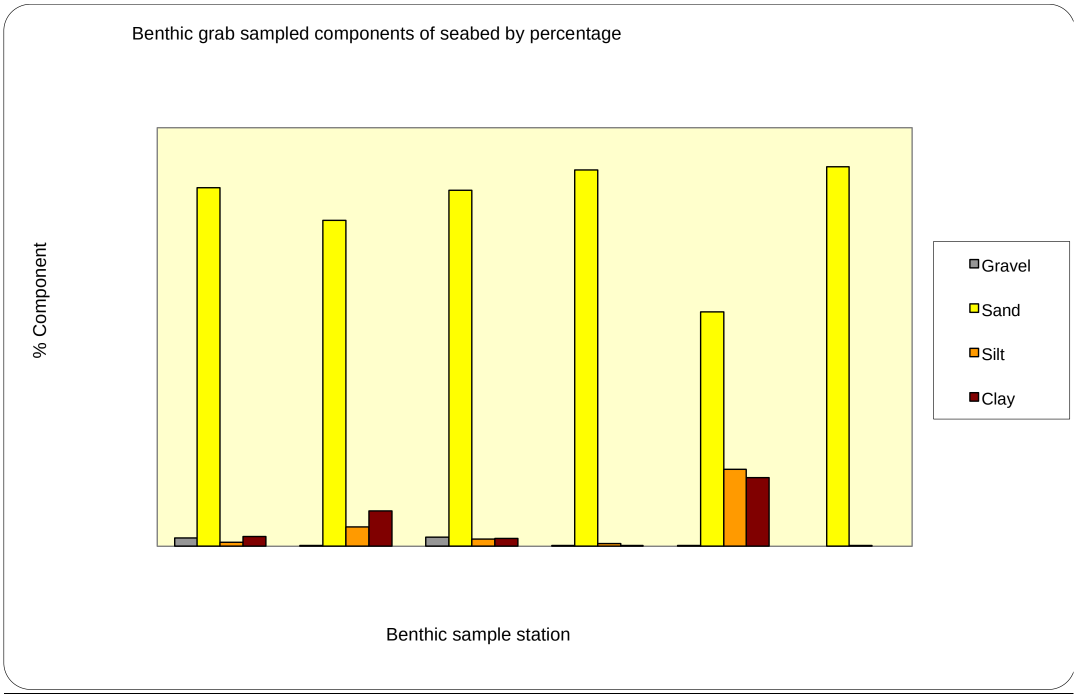


Figure 1-18:
Sampling locations for seabed inorganic composition study (MEC 1990).



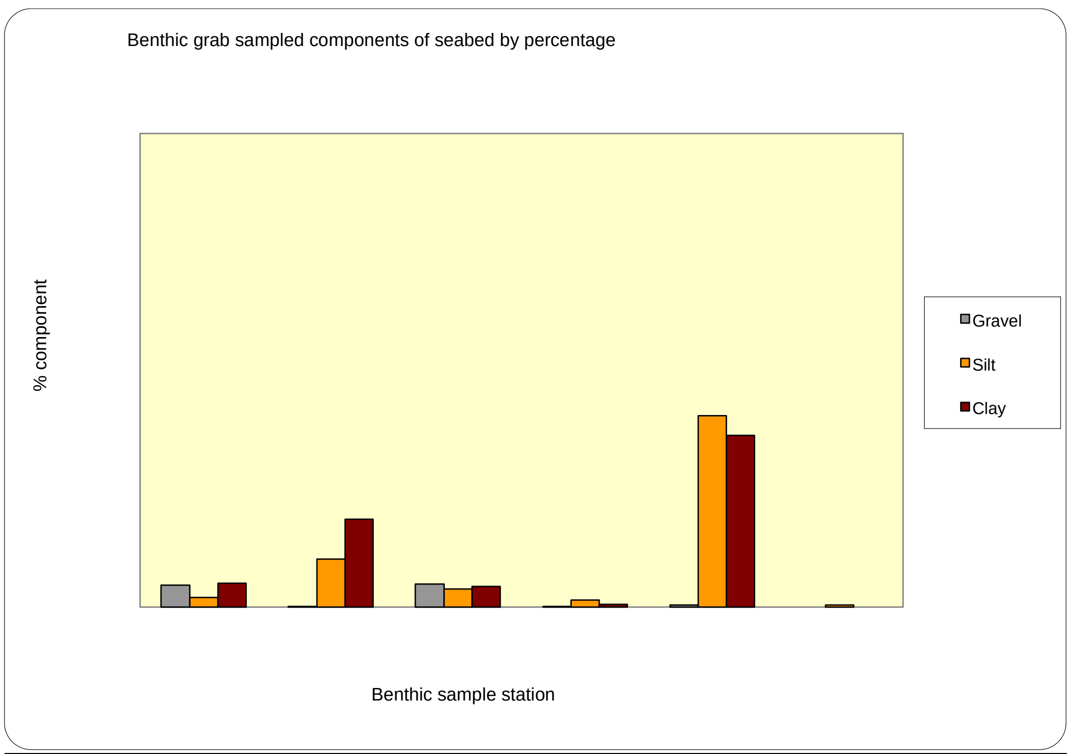


Figure 1-19: Results of sediment sampling showing the percentage distribution of substrate size with (A) and without (B) sand component (MEC 1990)

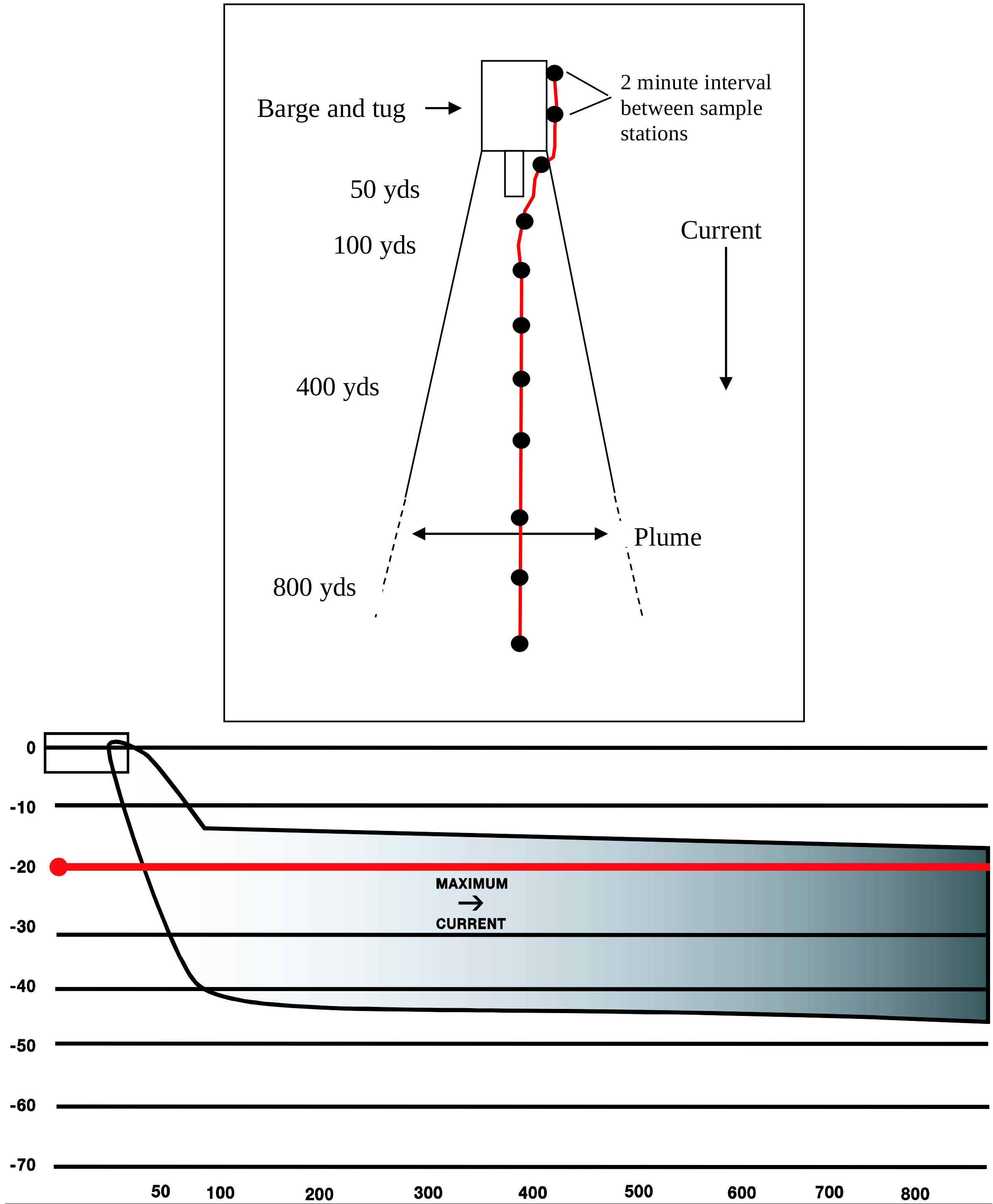


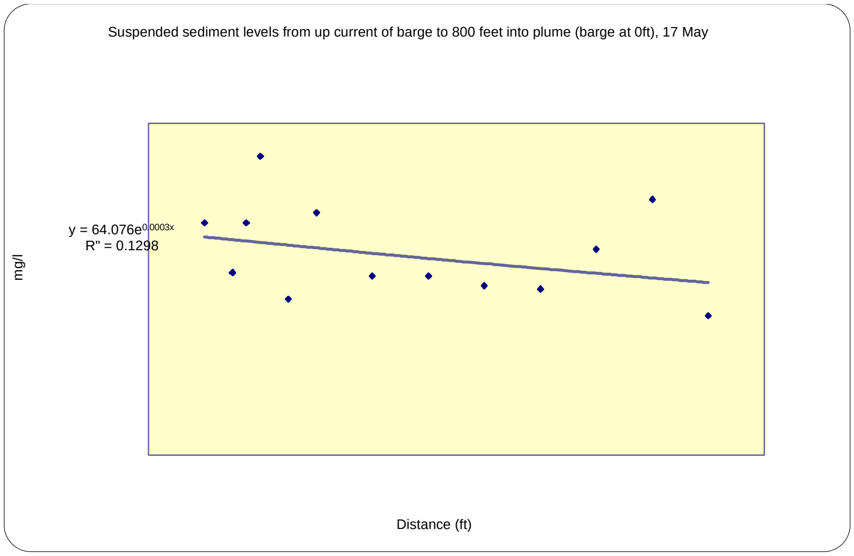
Figure 1-20: Longitudinal analysis of plume sediment concentration (MEC 1990)

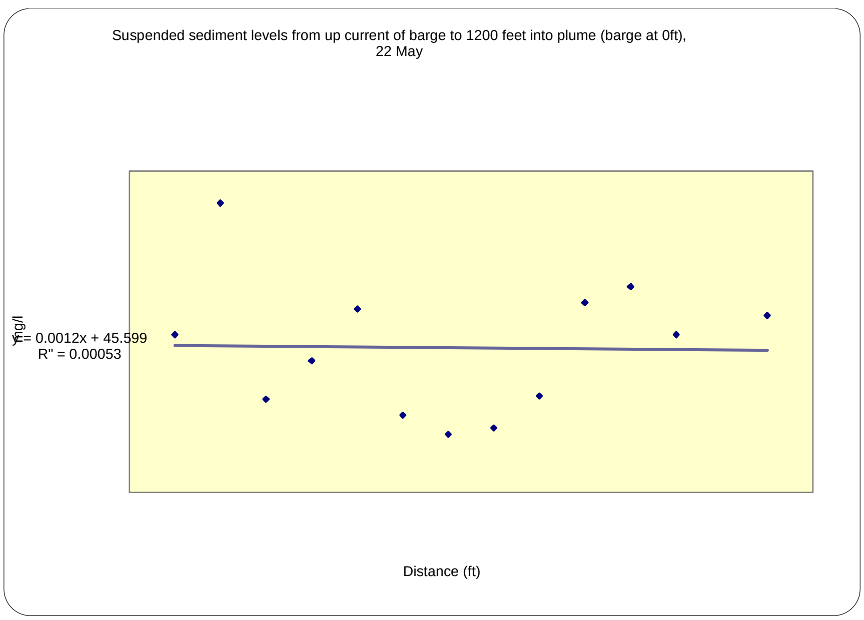
Results of the longitudinal survey conducted by MEC and Cheney (1990) showed no clear pattern or trend in suspended sediment concentrations from the overflow discharge point to 800-1200 feet astern of the barge (Figure 1-21). In two instances (May 17 and May 22) there were increases in suspended sediment concentrations immediately astern of the barge, but in two instances (June 11 and June 14) these increases did not occur and there were actually declines of suspended sediment concentrations measured in the June 14 sampling. Samples taken farther astern of the barge yielded inconsistent results and are characterized by a high degree of variability. The high degree of variability in the MEC and Cheney (1990) results may be a result of the turbulence in the wake of the barge/tugboat. As noted above, the location of sampling sites within the overflow plume were selected based on aerial observations of the plume at the water surface and may or may not represent an accurate location for the plume at a depth of 20 feet. Only the plume measured on June 11 showed a trend upward in suspended sediment concentrations within the plume area, but note the recording of 100 mg/l at mid-point, which may be skewing the data. Table 1-7 gives a summary of the difference in suspended sediment concentrations between sample points moving downstream along the center line within the four plumes. These data on suspended sediment differences between sample points within the plume also show no clear pattern in suspended sediment concentration change from the overflow discharge point to 800-1200 foot astern of the sand mining barge.

A subsequent study was conducted by MEC in 1993 recording overflow plume sediment concentrations at two locations, Pt Knox and Presidio Shoals, on three occasions over three months. These plumes were measured at four points:

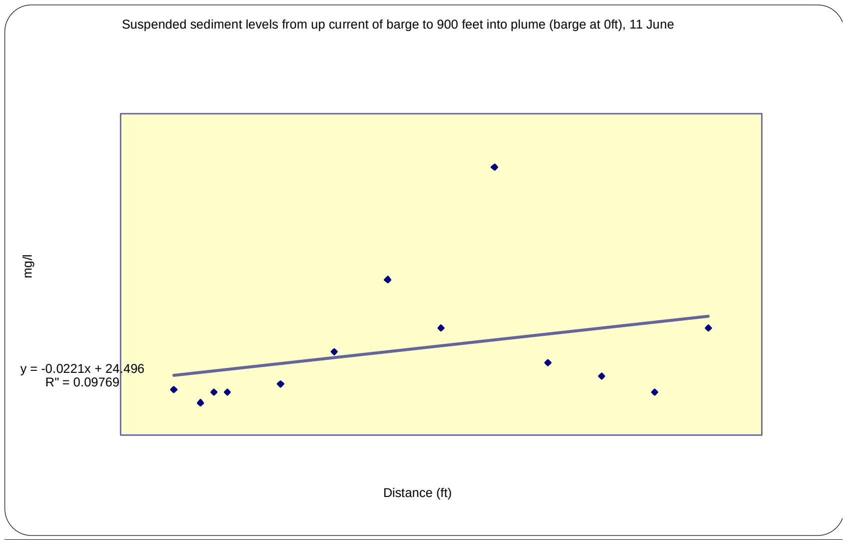
- Upstream of the plume representative of ambient conditions;
- 30 m downstream of the point of discharge, within the “head” of the plume;
- Mid-point in the plume; and
- Downstream location outside the plume representing ambient conditions.

The three plumes studied, on June 2nd, June 30th – July 1st and August 19th-20th, were sampled both at the surface and at the bottom to give an understanding of sediment concentration differences at varying depths in the water column, both in and out of the overflow plume (Tables 1-6 and 1-7). The MEC (1993) study shows a clear pattern of higher surface suspended sediment concentration levels in the area immediately astern of the tugboat/barge, a general trend towards decreasing surface suspended sediment concentration in the mid-point of the plume, and an increase in suspended sediment concentration immediately above the bottom at the mid-point of the plume (Figure 1-22). Results of the MEC (1993) study help explain the inconsistent results of the MEC 1990 study, in which sediment sampling was conducted at only one depth. The single-depth study, characterized by inconsistent patterns of suspended sediment concentrations at a 20-foot depth (Figure 1-21) may be reflecting slightly varying settlement rates as a result of currents and turbulence and would not record the rapid deposition of sediments on the substrate shown in the MEC (1993) data. Again, however, there are instances in the 1993 data that are not entirely consistent with the





<u>Figure 1-21: Results of longitudinal analysis of plume suspended sediment concentration decline with distance from barge (MEC 1990)</u>



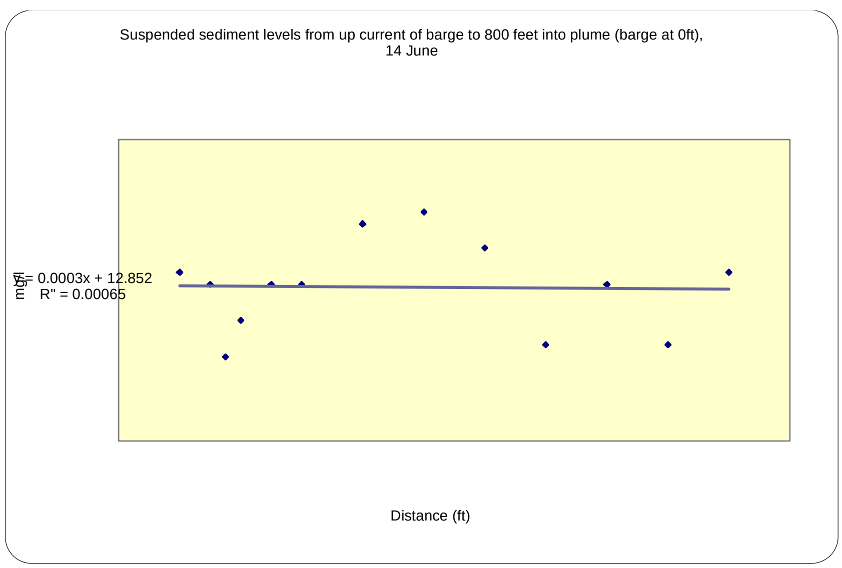


Figure 1-22: Results of longitudinal analysis of plume suspended sediment concentration decline with distance from barge (MEC 1990)

Table 1-7: Concentrations of total suspended solids (TSS) in mg/l (ppm) in receiving waters (MEC 1993)

		STATION	
Location	**Depth**	**Presidio Shoal**	**Point Knox Shoal**
Survey 1 (June 2)			
Upstream (Ambient)	Surface	29	12
	Bottom	29	12
30 m Downstream (Plume)	Surface	24	10
	Bottom	29	7
Midpoint (Plume)	Surface	9	6
	Bottom	72	10
Downstream (Ambient)	Surface	7	9
	Bottom	38	8
Survey 2 (June 30-July 1)			
Upstream (Ambient)	Surface	34	9
	Bottom	78	13
30 m Downstream (Plume)	Surface	17	12
	Bottom	28	19
Midpoint (Plume)	Surface	34	16
	Bottom	67	18
Downstream (Ambient)	Surface	38	8
	Bottom	70	14
Survey 3 (August 18-19)			
Upstream (Ambient)	Surface	8	8
	Bottom	36	12
30 m Downstream (Plume)	Surface	18	5
	Bottom	39	12
Midpoint (Plume)	Surface	12	12
	Bottom	38	14
Downstream (Ambient)	Surface	6	ND
	Bottom	17	16

EPA Method: 160.2
MRL (Method Reporting Limit): 5
ND = None Detected at or above the Method Reporting Limit

general trend, suggesting that currents or turbulence contributed to the observed variability in results of those plume studies. As noted earlier, recent advances in suspended sediment monitoring and mapping technologies are available and can be used to provide more detailed information on overflow plume dynamics, sediment concentrations, areal extent, and dissipation following completion of a mining event. In the absence of more refined plume data, the environmental analysis presented in this ITP application relies on the best data available and worst-case assumptions regarding plume exposure.

In the studies reviewed, suspended sediment levels increased immediately behind the mining craft, but the overflow plume suspended sediments were observed to settle and disperse rapidly down current. A visible plume of increased turbidity may persist beyond the point at which suspended sediment concentrations have returned to baseline levels. This “slick” (far field plume) may be composed of dissolved and colloidal clay particles, entrained aeration bubbles, and organic particles. The plume generated by discharge of fines from the barge appears to be relatively narrow in response to river and tidal currents. These data suggest that the overflow plume and the area of re-deposition of sediments may be limited to an area of approximately 500-1000 meters in length and 100 meters in width, depending to some extent on current velocity.

Results of the MEC (1990, 1993) studies of sand mining within Central Bay showed an incremental increase in suspended sediment concentrations within the overflow plume ranging from approximately 5 to 30 mg/l. The highest suspended sediment concentrations observed were approximately 100 mg/l. Similar data is not available for sand mining in Carquinez Strait, Middle Ground Shoal, or Suisun Bay.

The overflow plume resulting from sand mining is present for the duration of active mining and for a period of time after a mining event has been completed and the residual overflow plume dissipates. Results of field studies indicate that the overflow plume typically dissipates within 3-4 hours. The worst-case condition assumes that typical mining events occur over a 3-5.5 hour period with a 3-4 hour dissipation period. Therefore, the maximum expected duration of exposure to an overflow plume would be 6 to 9.5 hours.[1]

[1] Note: The exposure duration was established based on the observed distribution of reported mining durations and around the mean duration for actual mining events documented by Hanson *et al.* (2004).