SAN FRANCISCO BAY
SAND MINING AND SAND STUDIES
WHERE WE'VE BEEN & WHERE WE ARE TODAY

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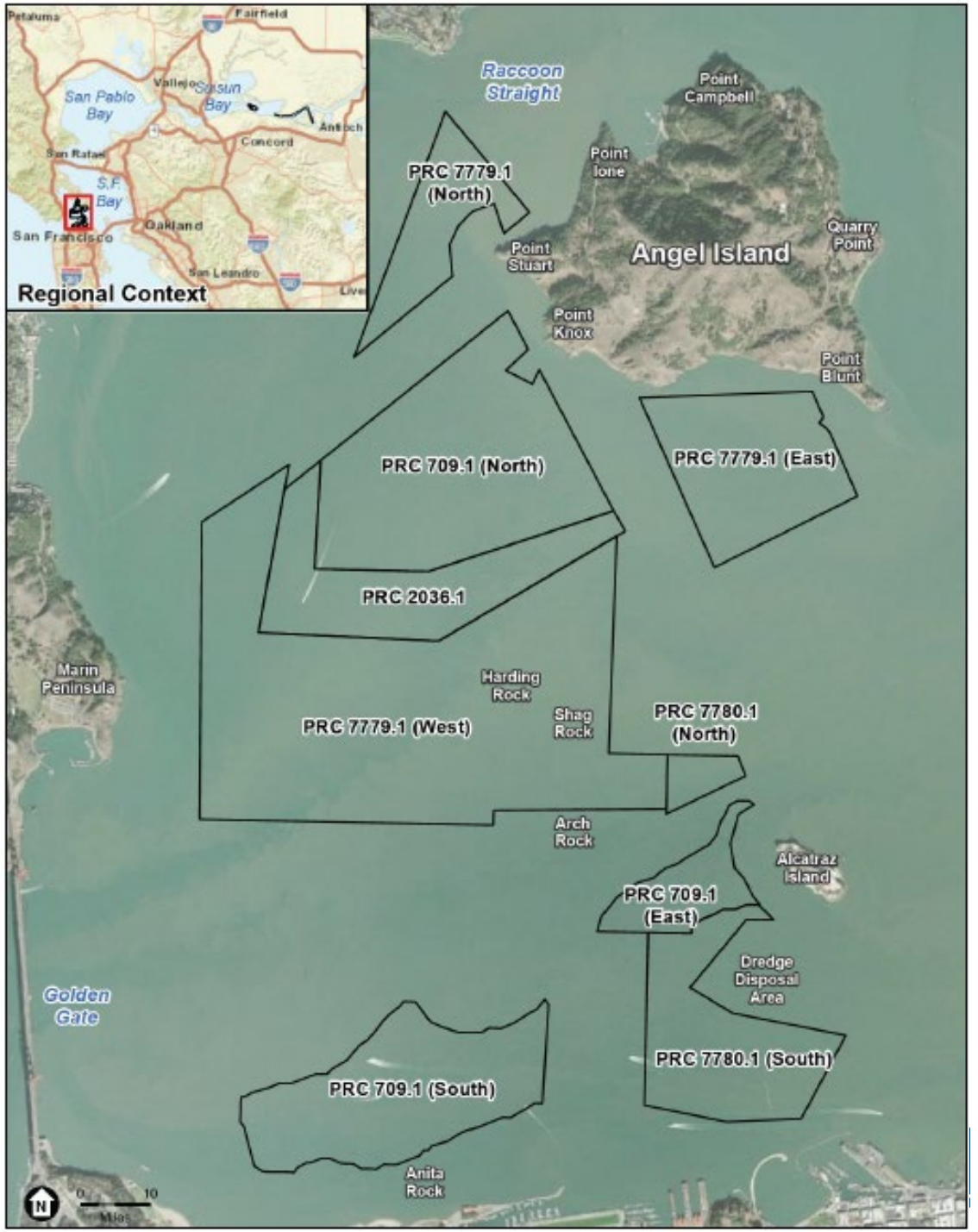
SEDIMENT PROGRAM MANAGER
SAN FRANCISCO BAY CONSERVATION AND DEVELOPMENT COMMISSION
APRIL 16, 2026

CENTRAL BAY MINING AREAS

Four Leases

Nine Parcels

2,601 Acres



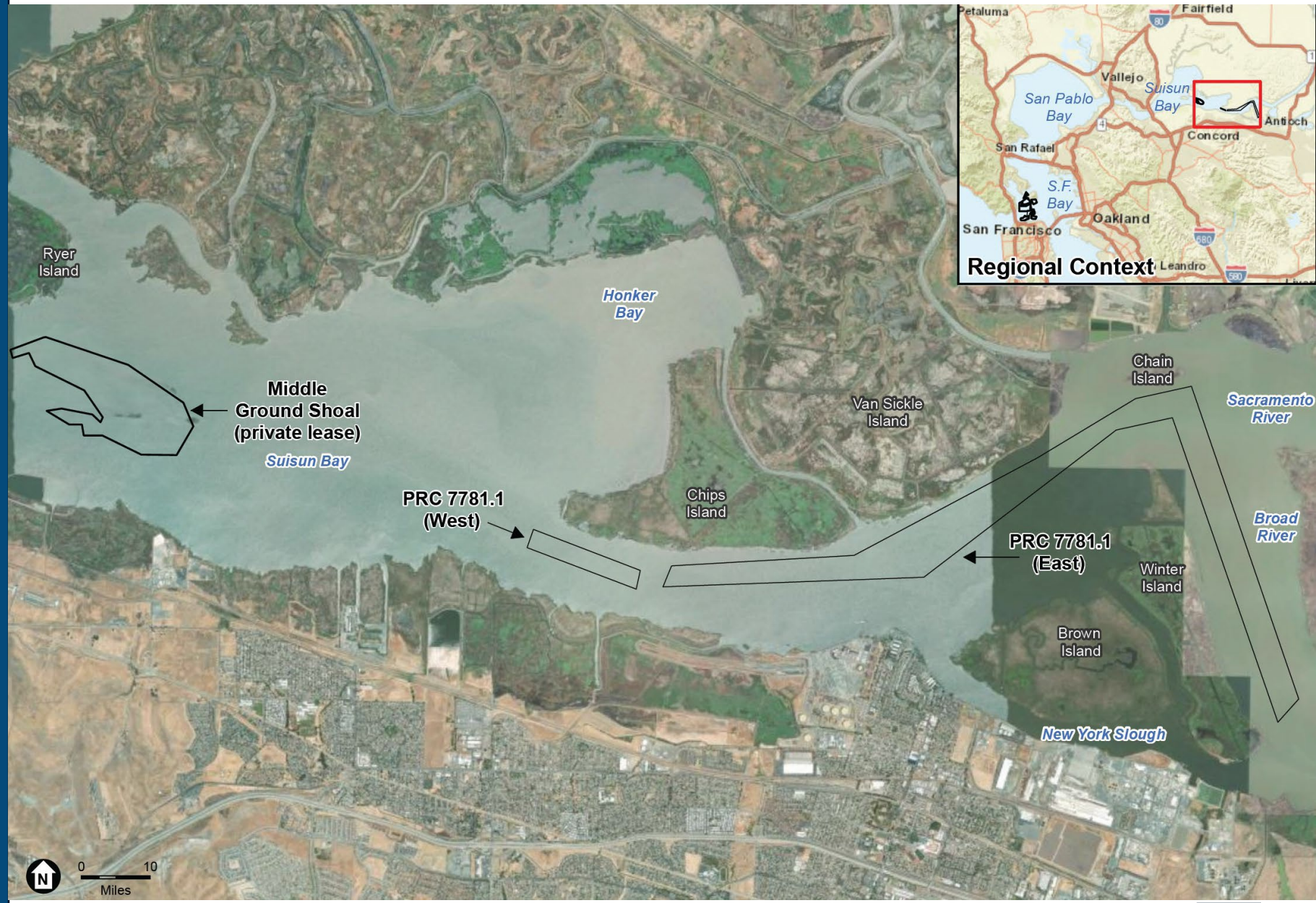
SUISUN BAY MINING AREAS

2 Leases

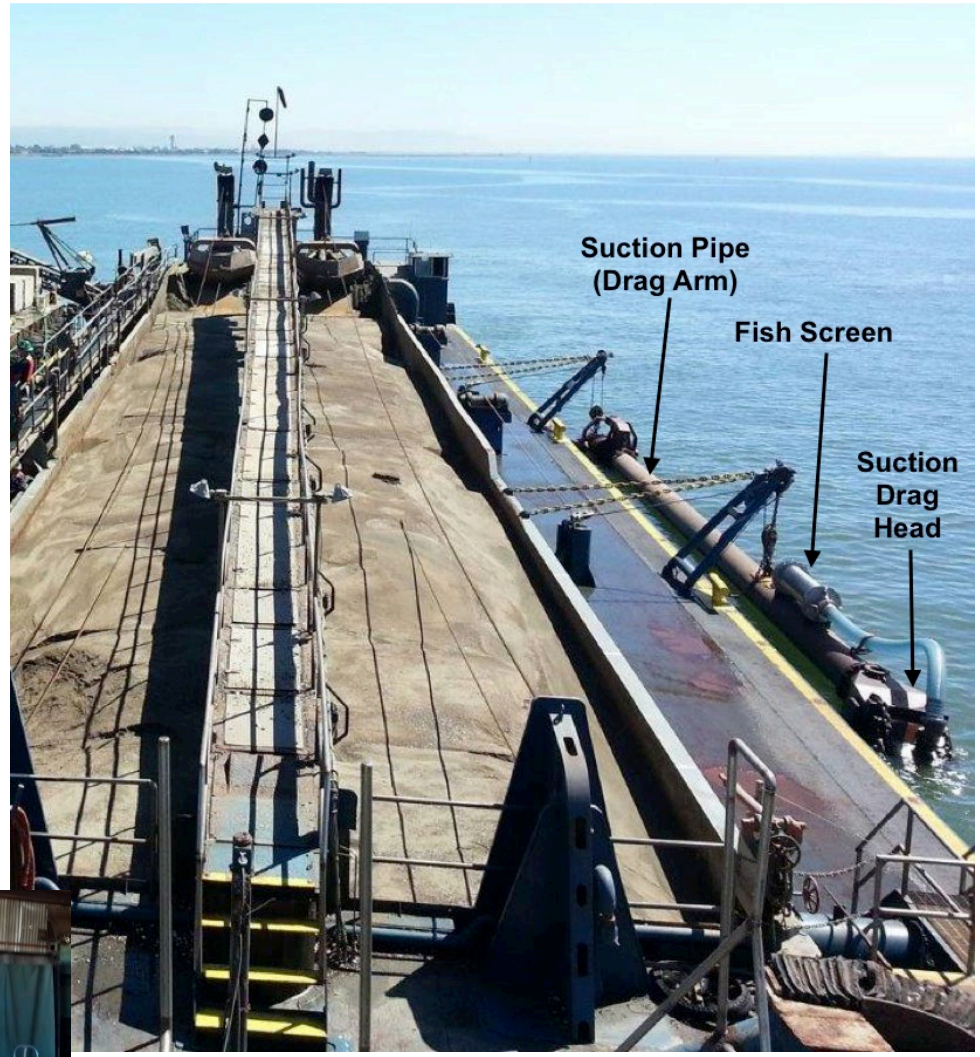
3 Parcels

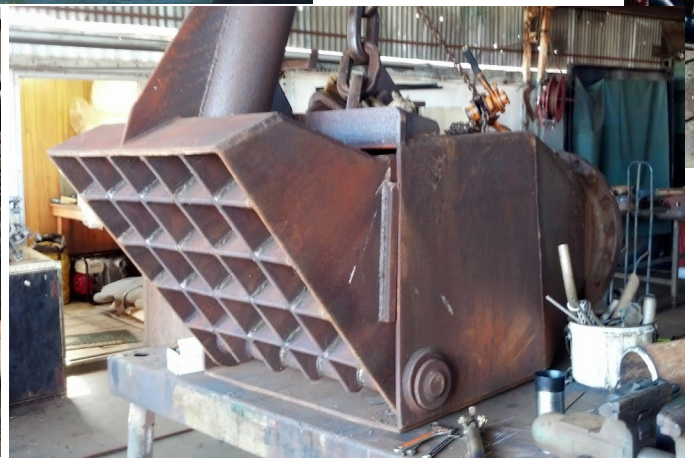
- 2 SLC
- 1 Private

1,363 Acres

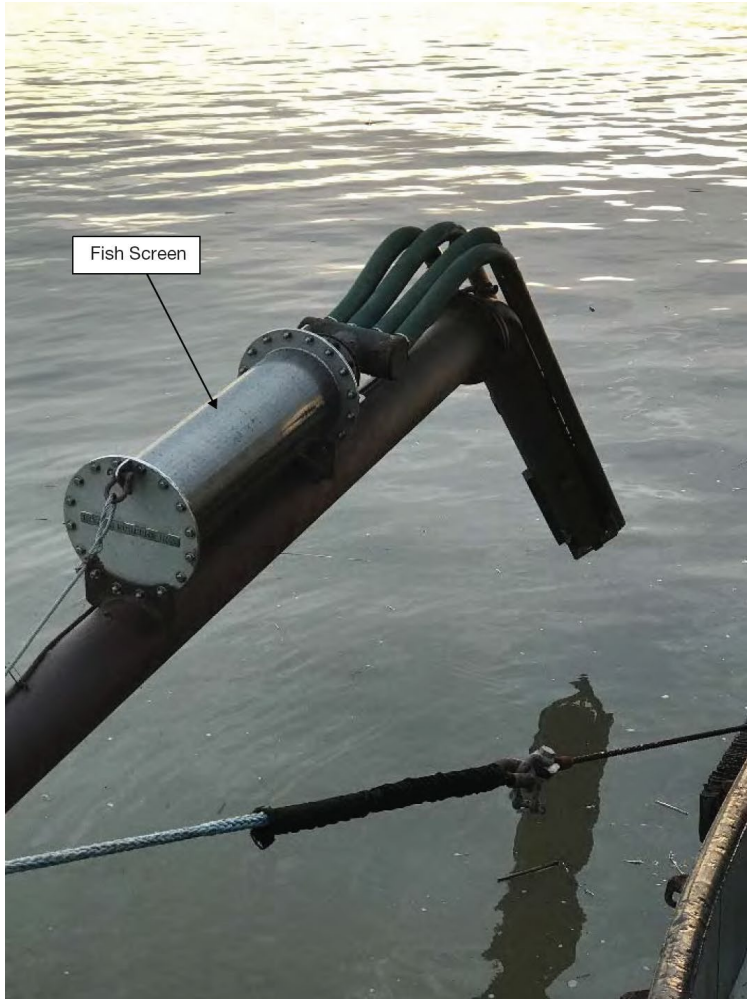


MARTIN MARIETTA
SAND MINING EQUIPMENT





LIND MARINE MINING EQUIPMENT



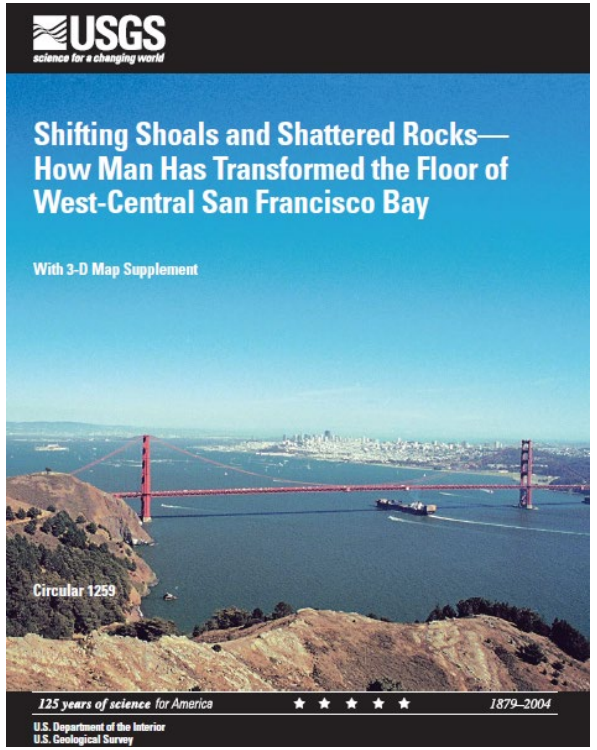
MINING HISTORY

- Mining since 1930’s
- Commission records from 1974
- Multiple small mining companies permitted individually
- CEQA – Negative Declarations

MINING HISTORY

1990's multiple small mining companies consolidated into three – but still held multiple permits

- Lind Marine
- Martin Marietta (previously Hanson Aggregates)
- Suisun Associates



2004 - Shifting Shoals and Shattered Rocks – US Geological Survey, Chin et.al.,

2004-2006 – Investigation of mining activities

- Mining off leases
- Onshore/Offshore companies & royalties
- Mining tracking required

2010-2012 SLC Environmental Impact Report – 2.2 million cubic yards per year

- Mitigation and minimization measures
- Findings of Significant impact to Delta and longfin smelt, air quality, and climate change.
- Statement of overriding considerations
- Challenged in court, SLC prevailed

COMMISSION PERMITTING 2013 - 2015

REQUEST

- 2.2 Million cy total annually
- Four applications:
  - Central Bay – Martin Marietta
  - Suisun Bay – Suisun Associates
  - Middle Ground Shoal – Lind Marine
  - Middle Ground Shoal – Martin Marietta
- Ten-year mining period

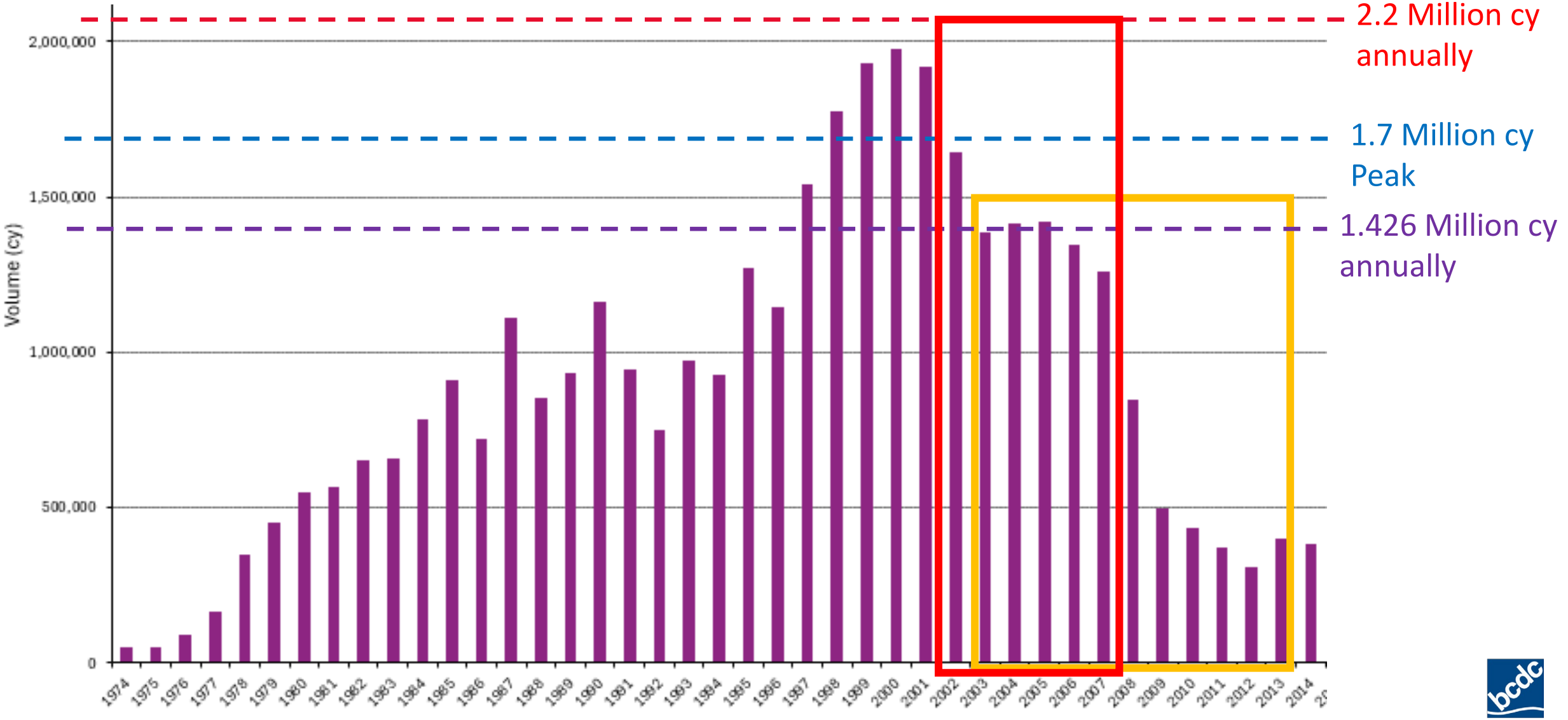
COMMISSION ACTION

1.426 Million cy total annually

- 1.7 Million cy total peak volume

- Three permits issued:
  - 1.14 Mcy Central Bay – Martin Marietta
  - 185,000 cy Suisun Bay – Suisun Associates
  - 100,000 cy Middle Ground Shoal – Lind Marine
- Ten-year mining period
- Studies & Mitigation required:
  - Water quality, benthic habitat, sand transport, supply, budget
  - Installation of fish screens, removal of Bay fill

SAND MINING VOLUMES FOR 10 YEARS CEQA & 2015 PERMITS



2015 COMMISSIONER QUESTIONS

- How much sand in the Bay (volume) and where is it?
- Which areas are in transport and which areas are relic sands?
- Is the sand that is being mined in transport or relic, and what the impacts of mining relic sand?
- What is the impact to active sands (in transport) and the consequences to the Bay's beaches and tides that it feeds?
- If you dig a big hole there and some sediment comes down from the Delta, will it fill in that hole rather than go to the Bay beaches?
- Should there be a modification of mining volume, sites, and conditions?
- What is a sustainable volume for mining? What is "substantial depletion" ?
- What's the impact to benthic life?
- Suggested monitoring the impact of the extraction of relic sand and sand in transport.
- What are the limits of BCDC's authority and jurisdiction in relation to sand mining?

SAND STUDY PROCESS

Funds Provided

Lind & Martin Marietta

$1.2 Million

Sand Technical Advisory Committee

Agencies and key Interested Parties

Management Questions Formed

Study Scopes Developed

RFQ Posted

Proposals Reviewed

Independent Science Panel

Five subject matter experts

Proposals Reviewed

Scope Revised

Science Teams Identified

Studies Completed

Findings Report Developed

Sand Budget, Supply, Morphological Change and Transport Analysis

- San Francisco Estuary Institute
- Deltares, Netherlands
- US Geological Survey

Sand Transport Modeling

- Anchor QEA

Sand Provenance

- U of Texas, at Austin
- US Geological Survey

SAND STUDIES FINDINGS REPORT

- Overarching Findings
- Regional Findings
- Research Papers
- Key Findings

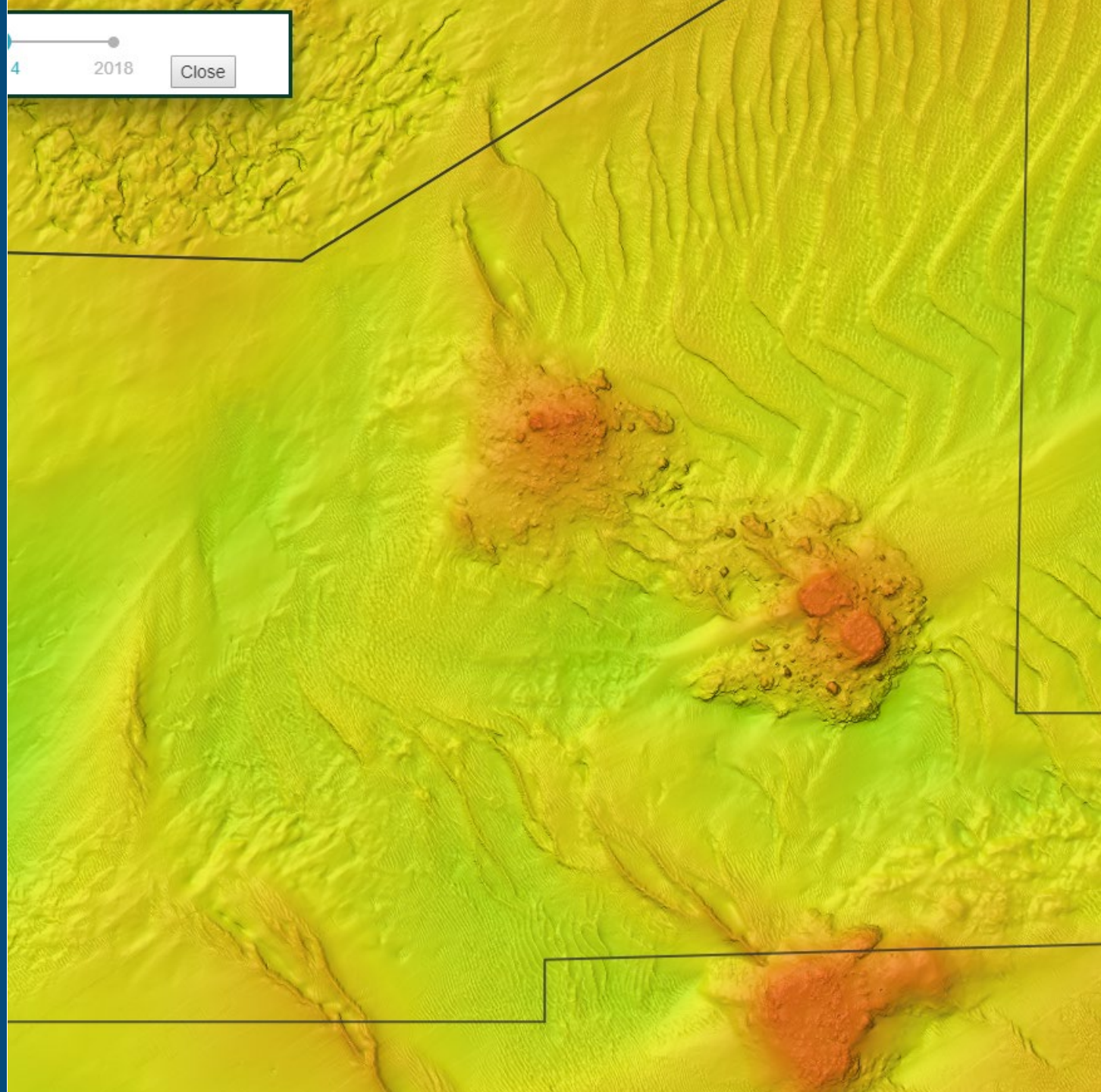
Commissioner Working Group

Charge: Understand the Science Presented in the Sand Studies and potential impacts of mining

Pat Showalter (Chair), Andy Gunther, Barry Nelson

- 7 meetings
- Concluded October 31, 2025

2015 COMMISSIONER QUESTIONS



HOW MUCH SAND IN THE BAY (VOLUME)?

- We were unable to answer this question due to expense of necessary deepwater core collection

HOW MUCH SAND IS ENTERING THE BAY?

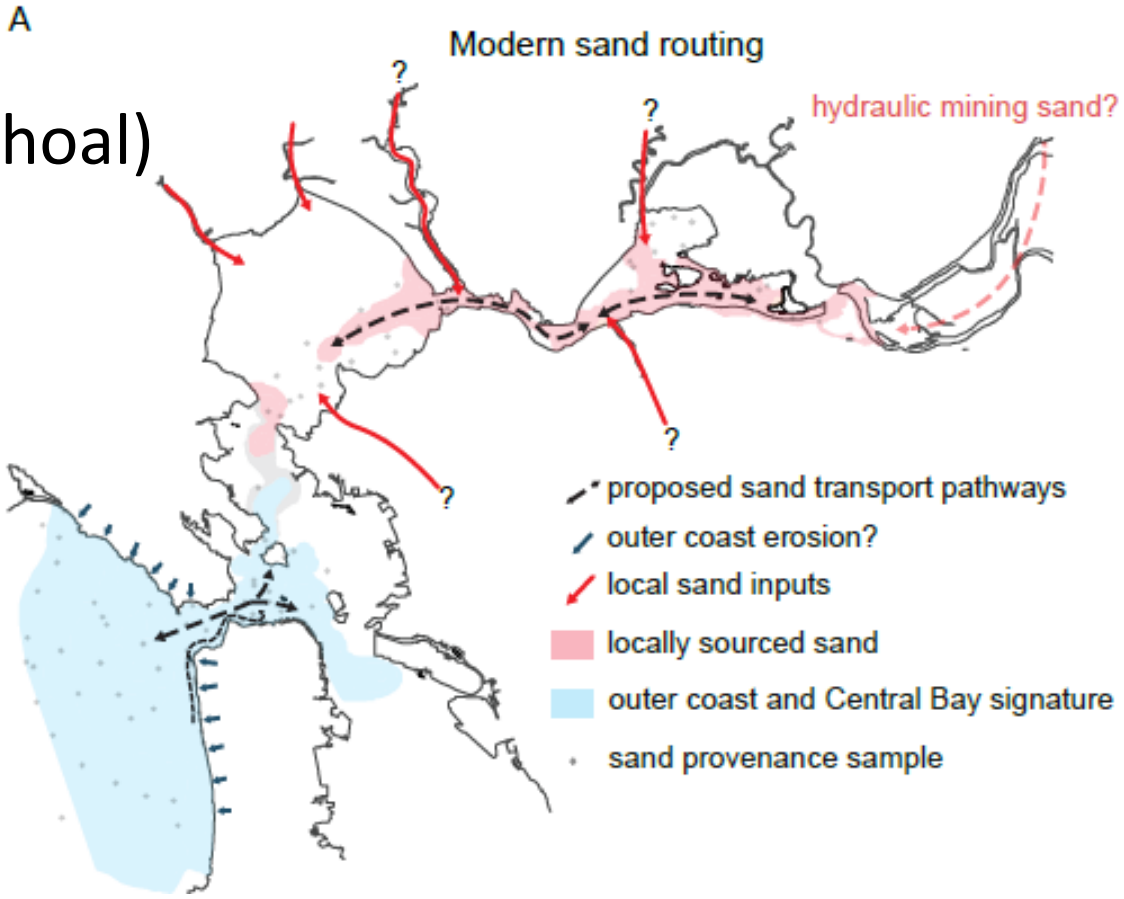
- Sand is **not** currently being supplied from the Delta
- Suisun Bay: Approximately 41,000 Mt/y of sand is being supplied from local tributaries (290,000 Mt/y is mined)
- Central Bay: Approximately 1.02 Mt/y is being supplied from San Pablo Bay, South Bay, and the Pacific Ocean (880,000 Mt/y is mined)

On average, mining (1.2 Mt/yr) removes much more sand than is entering the Bay (0.45 Mt/yr)

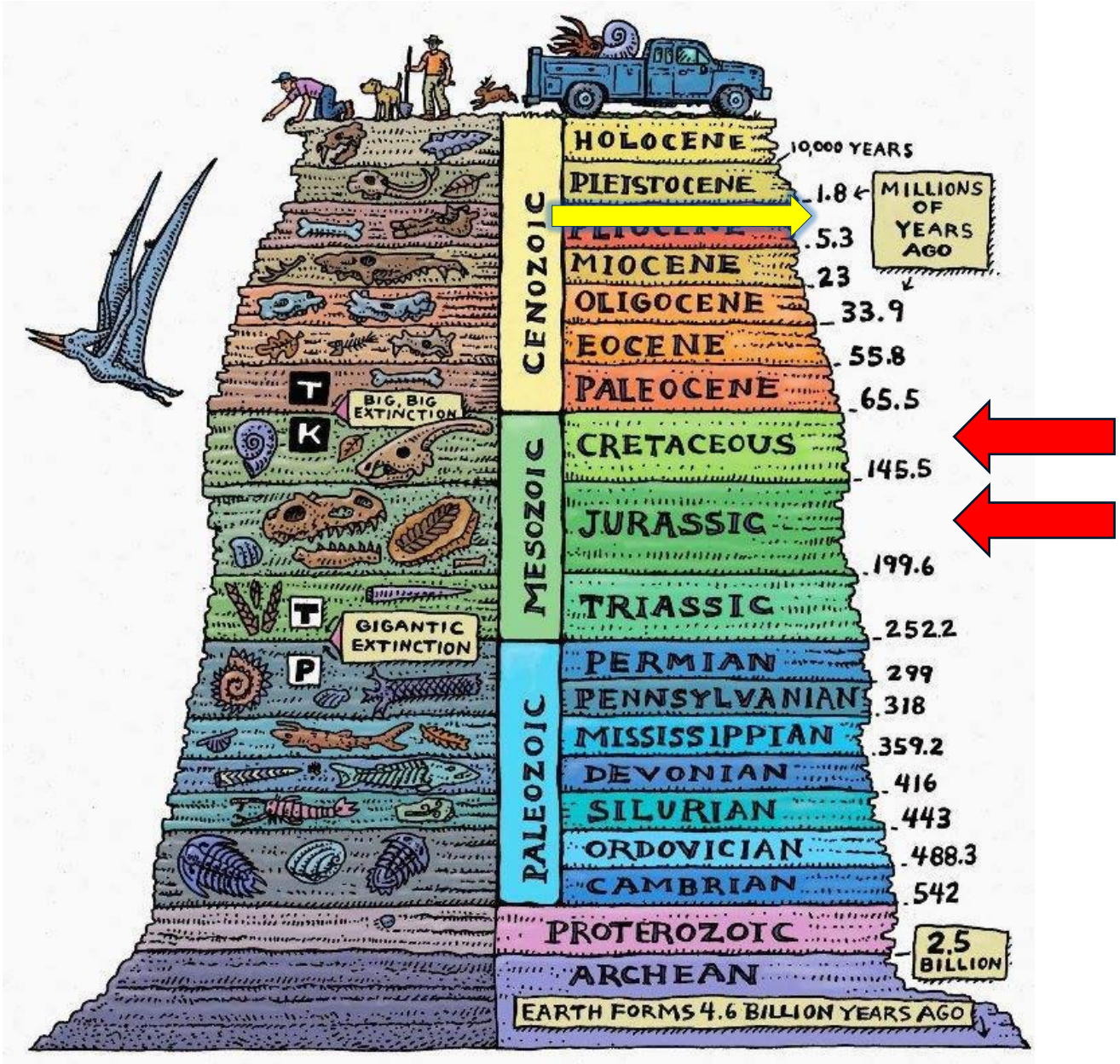
WHERE SAND LOCATED?

- Less than 20% of the Bay bottom
- Located in deep, high-energy areas
- Suisun channel (and parts of Pinole Shoal)
- Central Bay
- Outer Coast

Sand in Suisun Bay is disconnected
From sand in Central Bay



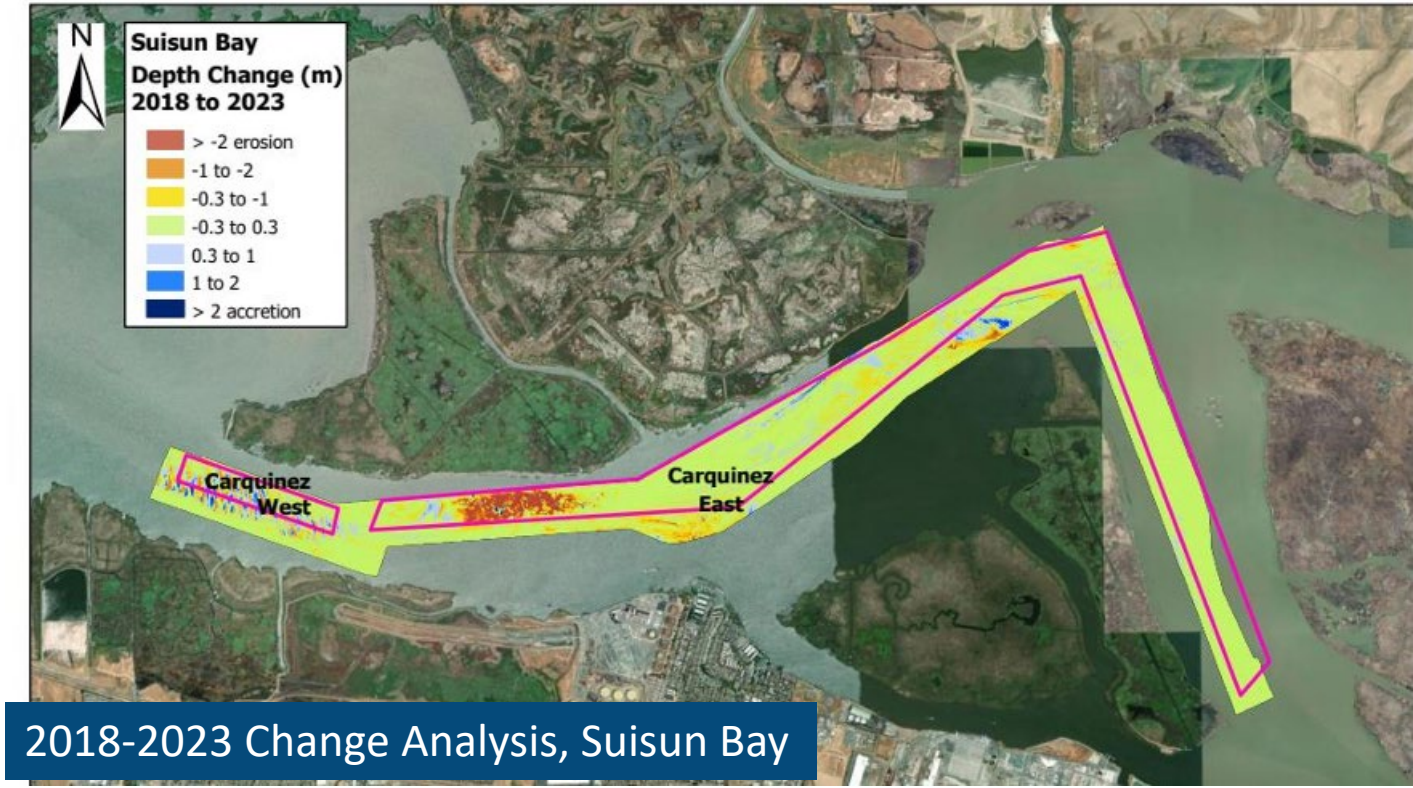
IS THE SAND THAT IS BEING MINED IN TRANSPORT OR RELIC? RELIC



WHAT THE IMPACTS OF MINING RELIC SAND?

If you dig a big hole there and some sediment comes down from the Delta, will it fill in that hole? rather than go to the Bay beaches?

- No, sand is not appreciably entering the Bay
- The mining that occurs will continue to deepen
- Change analysis from 1997 – 2023 documents continued deepening

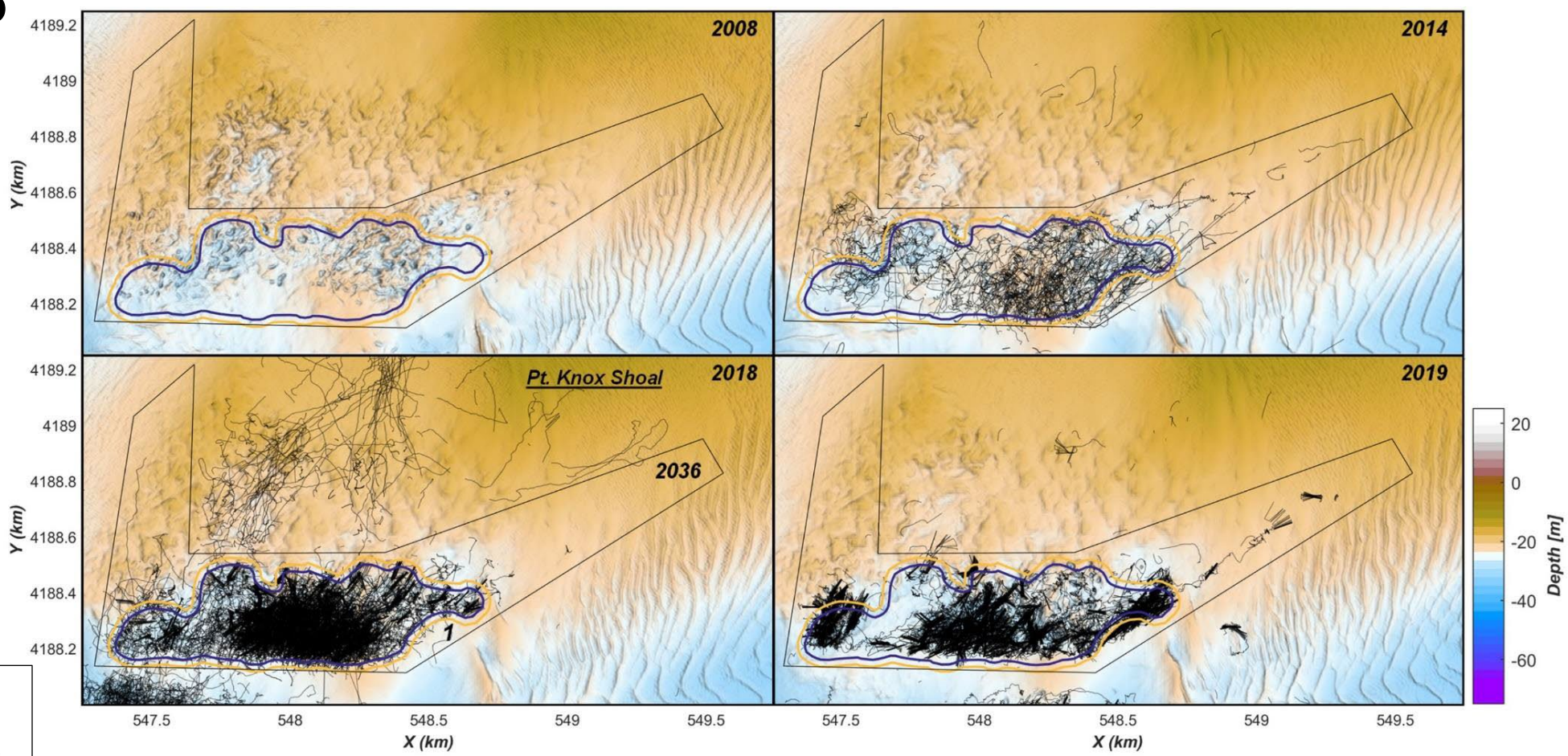


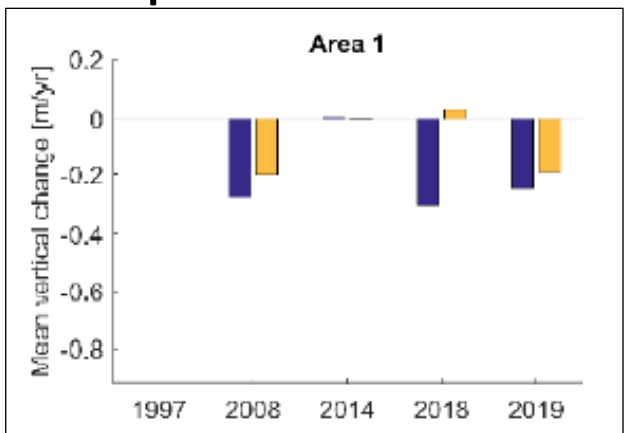
2018-2023 Change Analysis, Suisun Bay

WHAT IS THE IMPACT OF MINING (RELIC) SAND IN TRANSPORT?

Lease Area 1:
2008 to 2014
105% replenishment

2014 to 2019
25 - 45% replenishment

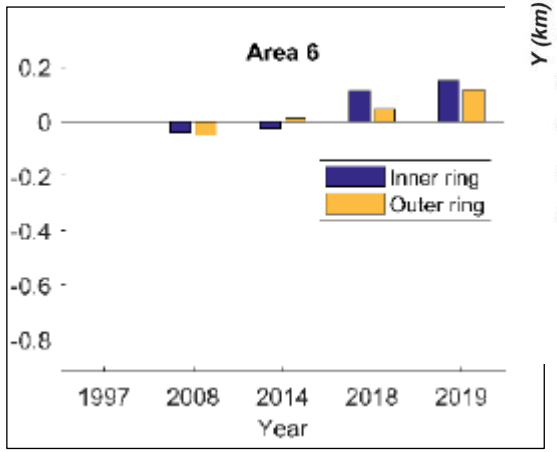


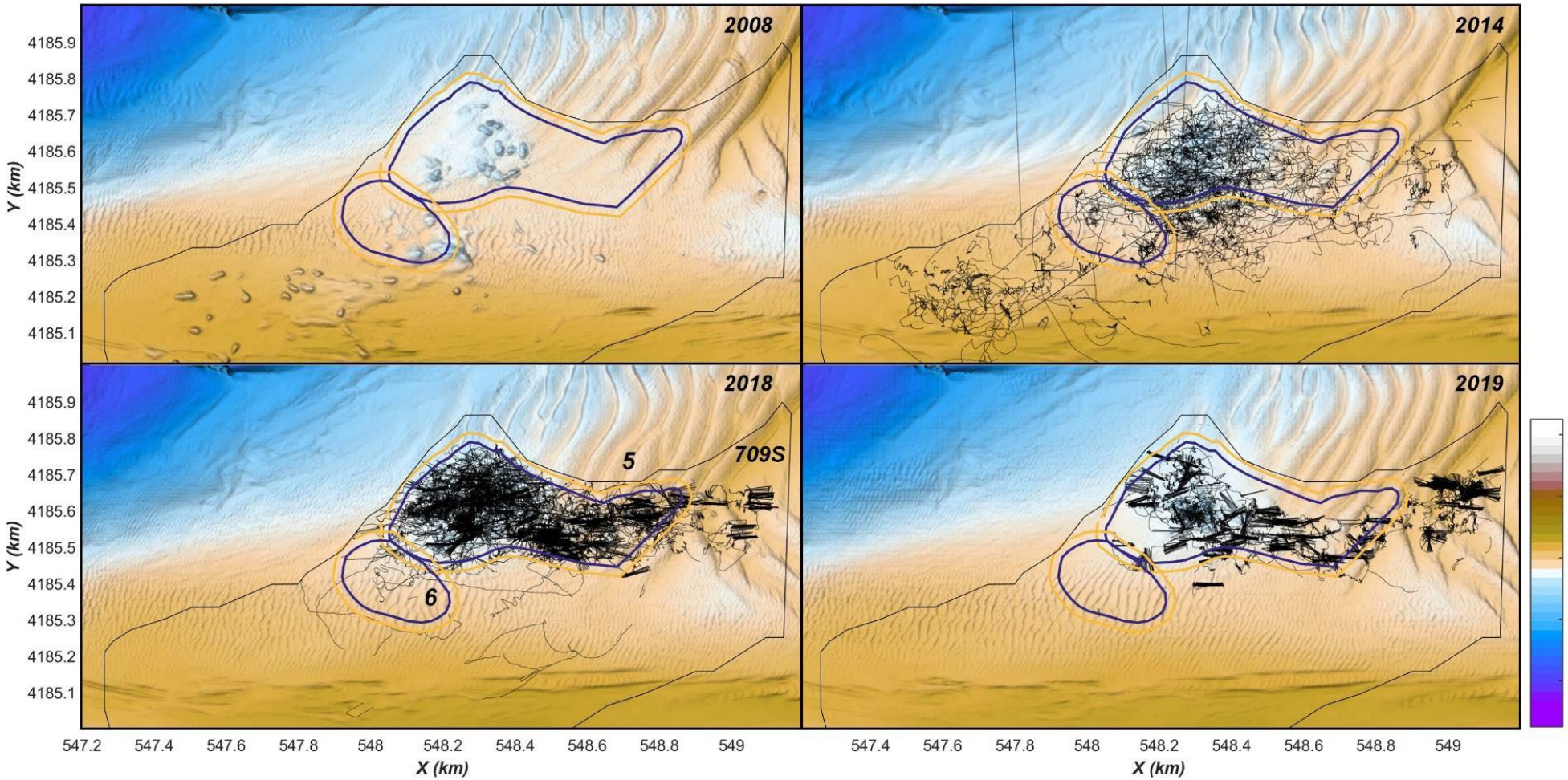


WHAT IS THE IMPACT OF MINING (RELIC) SAND IN TRANSPORT?

Lease Area 6:
2008 to 2014
73 - 84% replenishment

2014 to 2019
84 - 149% replenishment

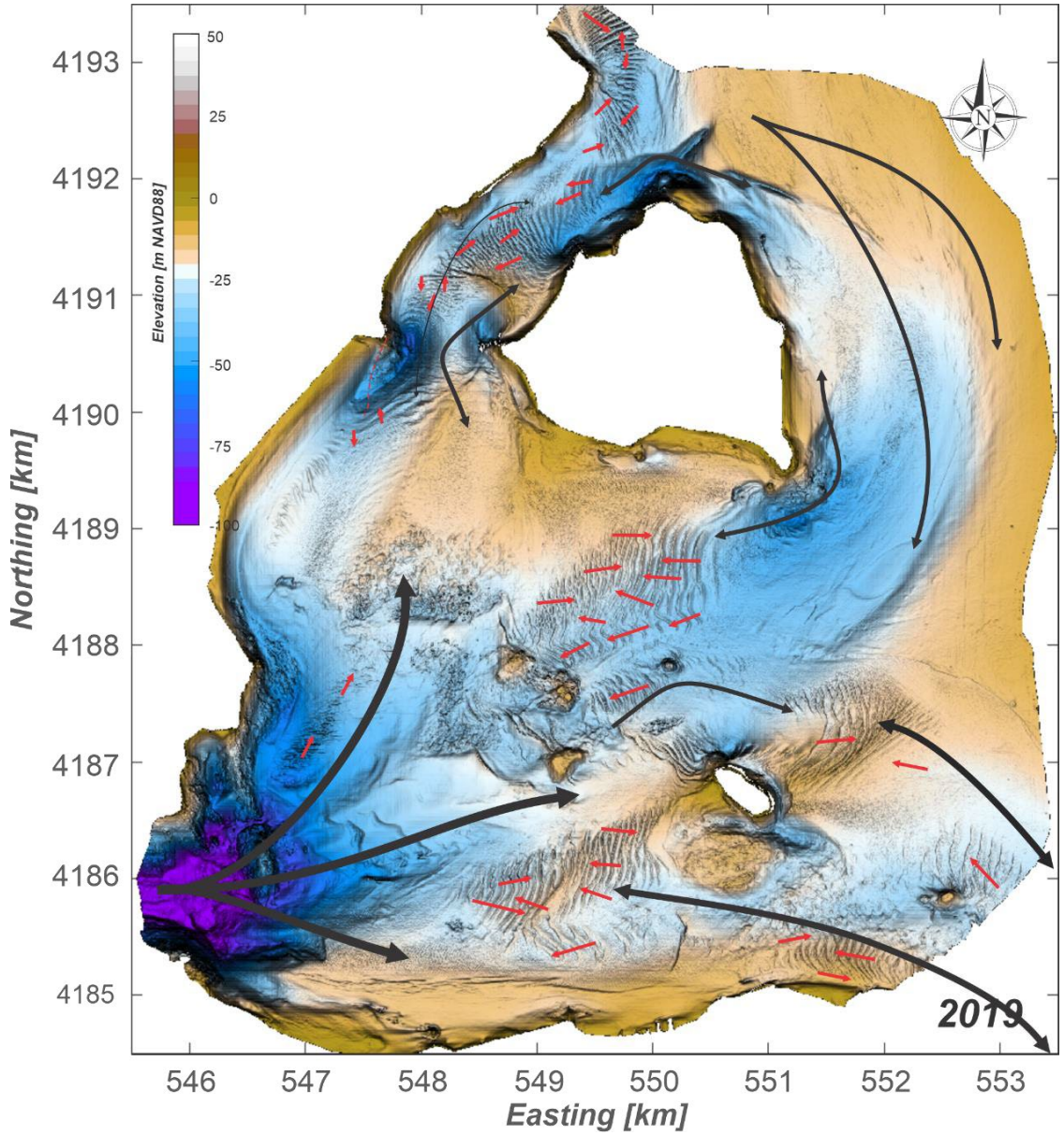




WHAT IS THE IMPACT TO ACTIVE SANDS (IN TRANSPORT) AND THE CONSEQUENCES TO THE BAY'S BEACHES AND TIDES THAT IT FEEDS?

The study scopes did not include analysis of transport and effects to beaches

Sand transport pathways and shoal movement were confirmed and further refined

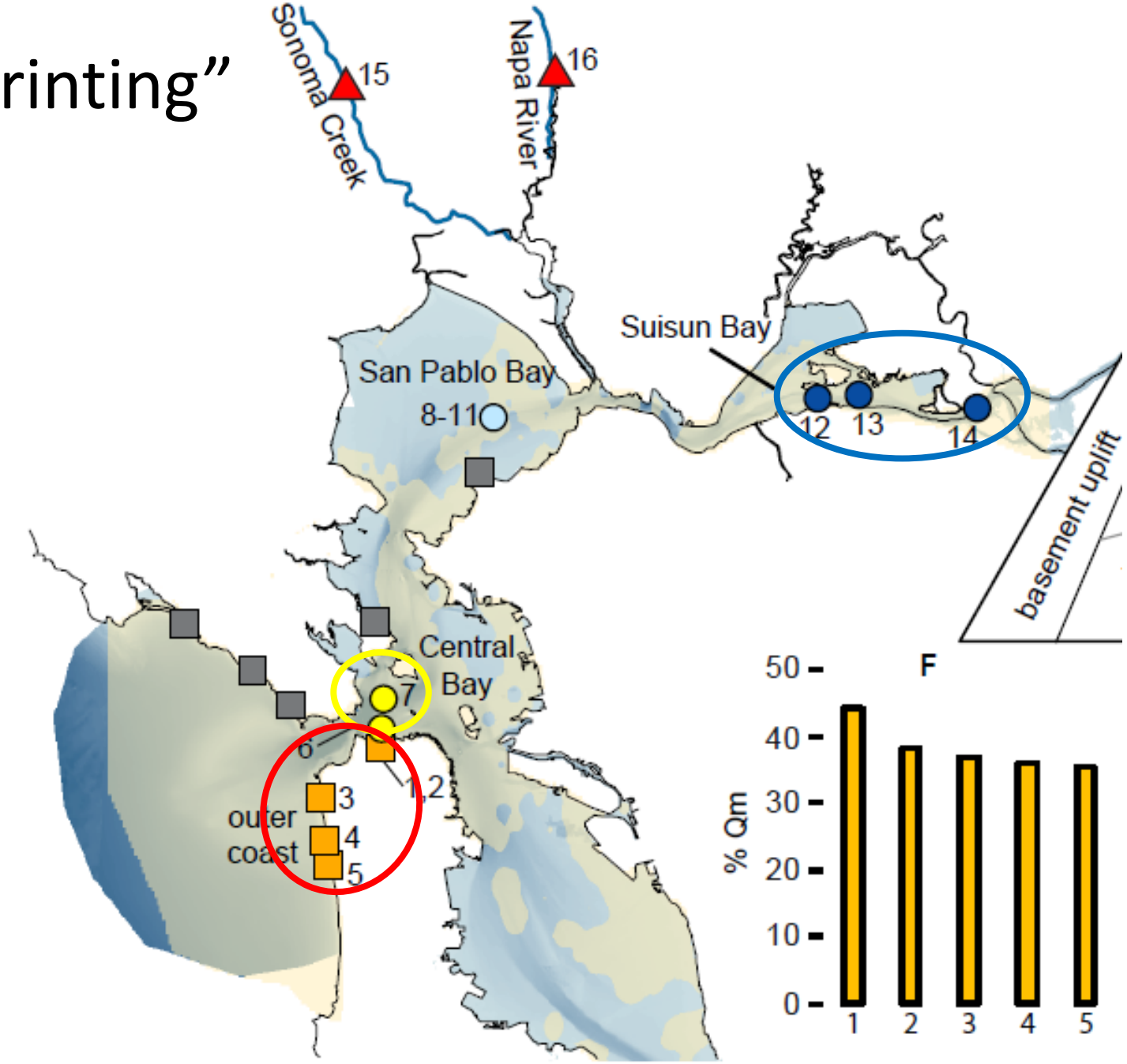


Provenance "Fingerprinting" Study

Suisun Bay sand stays primarily in Suisun and is sourced from the Coast Range and the Sierras

Central Bay has two distinct sand types –

- Southern Central Bay - consistent with Ocean Beach sand
- Northern Central Bay – coarser sands with potential links to headlands



WHAT IS A SUSTAINABLE VOLUME FOR MINING? WHAT IS "SUBSTANTIAL DEPLETION"?

Active Layer – sand in motion due to tides, currents, and water flow

Sand in storage – sand that is not in motion

Volumes in this table represent active and stored sand down to 90 feet MLLW

WATER QUALITY STUDIES

Required by the Water Board, BCDC and USACE

- MEC Analytical 1993
- NewFields, 2018

Evaluated wastewater from mining

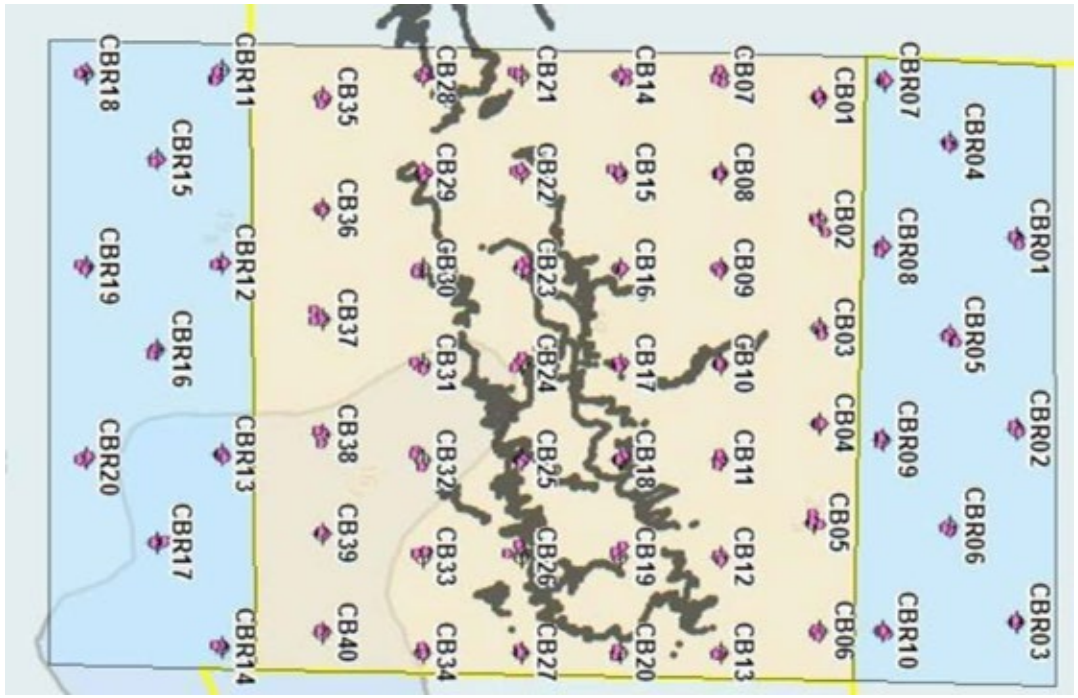
- Water quality criteria were met
- Small excedences in first hour
- No toxicity to mussel larvae

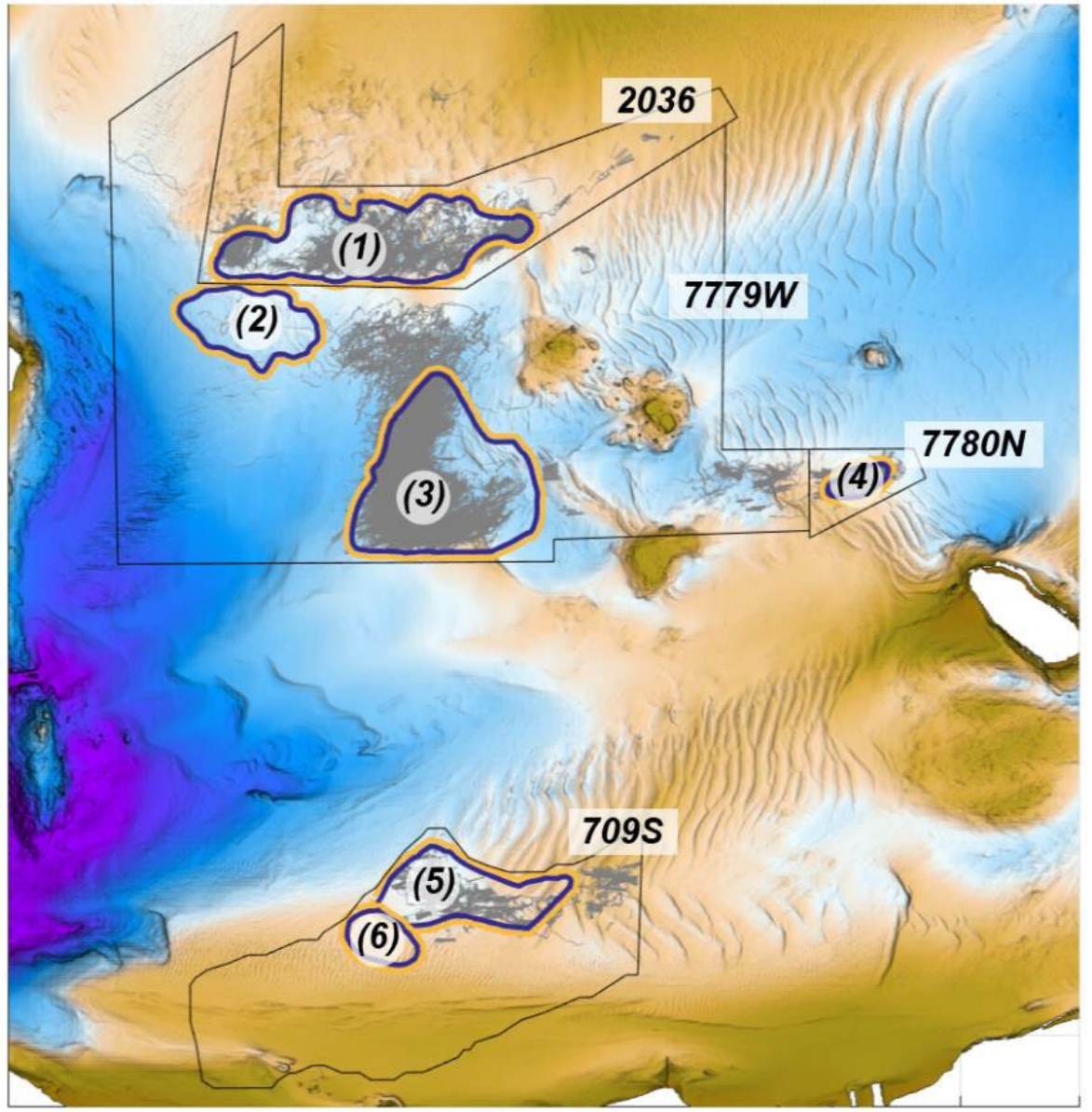
Evaluated turbidity plume

- Background conditions CB less turbid than Suisun
- Turbidity plumes continuous with mining
- Several hundred meters in length, dynamic

WHAT IS THE IMPACT TO BENTHIC LIFE?
Benthic Community Studies

- 2009 – Marine Science Associates (?)
- 2015 – 2018 – NewFields: Before, After, Comparison
- Before, After, Comparison: 4-inch cores





WHAT IS NOT STUDIED -

Effects of repeated mining in same or immediately adjacent areas for multiple years on the bottom dwelling community

Effects to wildlife that relies on these areas for food

- Fish
- Seabirds
- Harbor seals & other marine mammals

Pacific Sand Lance on sand shoal, San Juan Islands, Greene et. Al

WHERE ARE WE NOW?

State Lands Commission

- Certified a supplemental environmental impact report
  - Found no significant changes since last CEQA review in 2012
  - Completed additional modeling effort
- Issued 10-year leases for mining up to 1.7 million cy of sand annually (exclusive of Middle Ground Shoal)
  - Central Bay
  - Suisun Bay

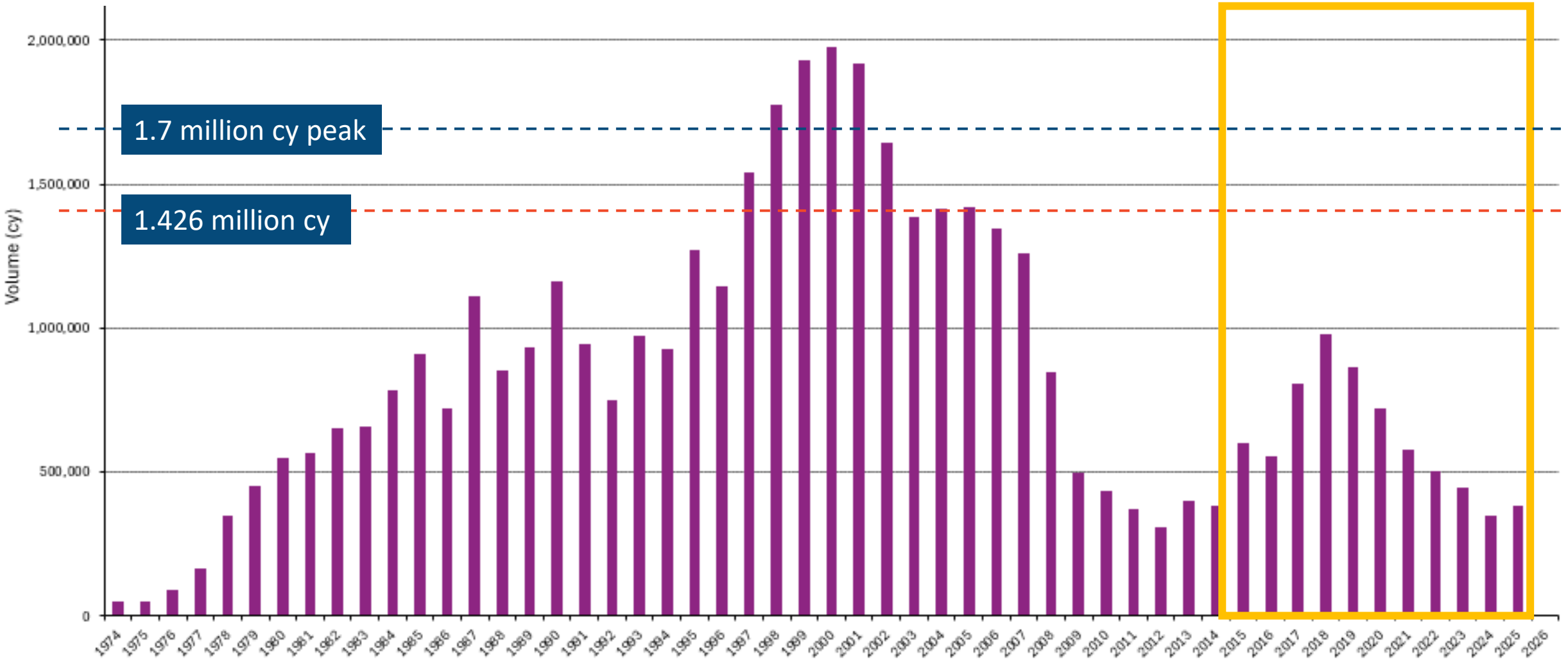
Time Extensions have been issued, addition extension requested through February 2027

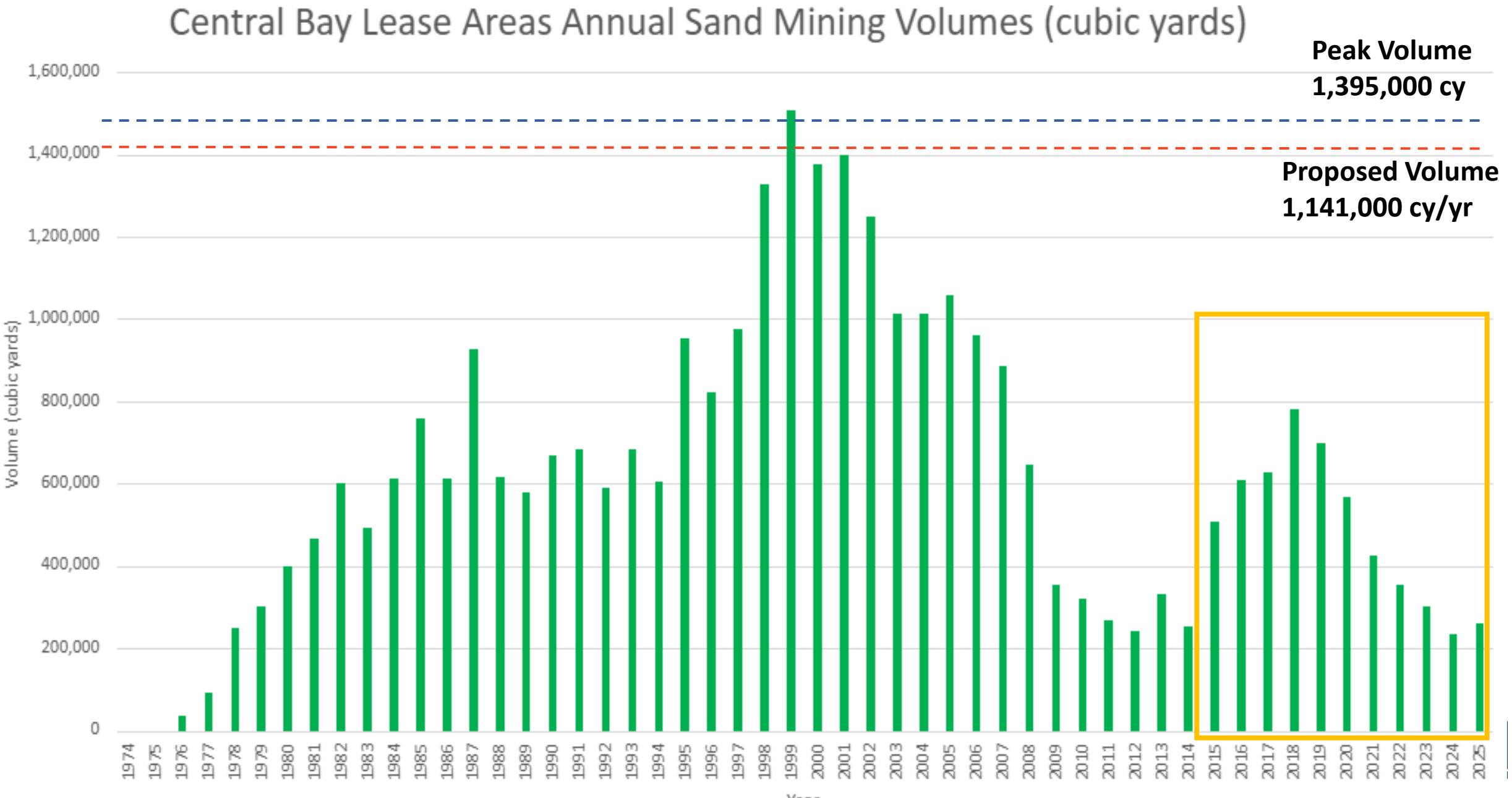
Water Board, Cal Fish and Wildlife, US Fish and Wildlife, National Marine Fisheries Service, and USACE in process

BCDC in pre-application discussions – application expected end of April

- Commission Public Hearing and Vote – Winter 2026/7

TEN YEARS OF MINING & CURRENT REQUEST




Central Bay Lease Areas Annual Sand Mining Volumes (cubic yards)
Peak Volume
1,395,000 cy
Proposed Volume
1,141,000 cy/yr
Volume (cubic yards)
1,600,000
1,400,000
1,200,000
1,000,000
800,000
600,000
400,000
200,000
0
1974
1975
1976
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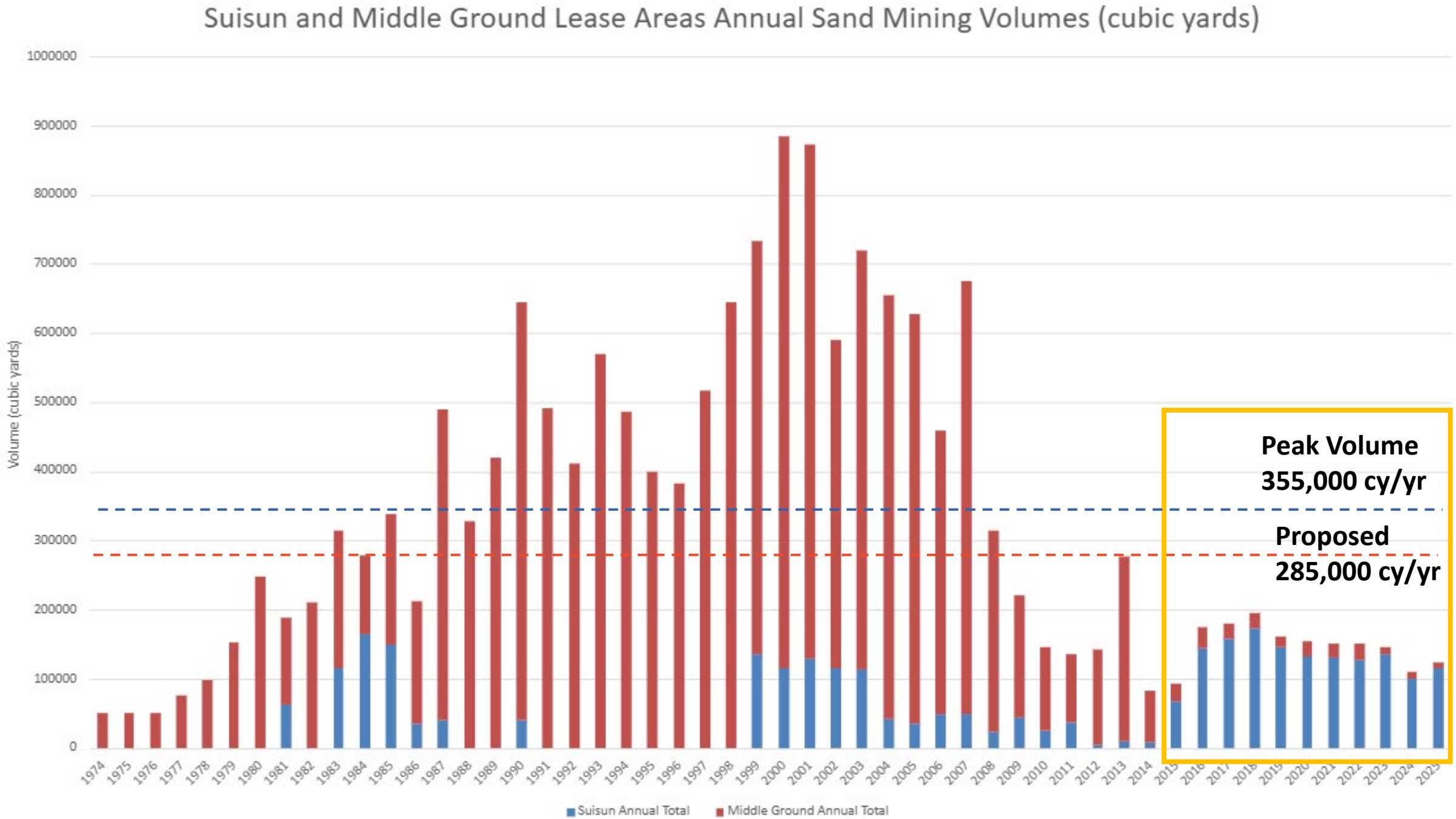
Suisun and Middle Ground Lease Areas Annual Sand Mining Volumes (cubic yards)
Volume (cubic yards)
1000000
900000
800000
700000
600000
500000
400000
300000
200000
100000
0
1974
1975
1976
1977
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2021
2022
2023
2024
2025
Peak Volume
355,000 cy/yr
Proposed
285,000 cy/yr
Suisun Annual Total
Middle Ground Annual Total

QUESTIONS?

THANK YOU

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EXTRA SLIDES WITH DETAILS IF NEEDED FOR BRIEFING

SAND STUDIES QUESTIONS

Is sand mining at existing lease areas, at permitted levels, having a measurable or demonstrable impact on sediment transport and supply within San Francisco Bay?

- What is a sustainable number? What is “substantial depletion”?

What are the anticipated physical effects of sand mining at permitted levels on sand transport and supply within San Francisco Bay and the outer coast?

- What is the impact to active sands and the consequences to the beaches and tides that it feeds?
- What’s the impact to relic sands? How much is the volume and where is it?

Are there other feasible sand mining approaches to consider in San Francisco Bay?

- Should there be a modification of volume and site and conditions?

INDEPENDENT SCIENCE PANEL KEY FINDINGS PRESENTED TODAY BY MEMBERS OF THE INDEPENDENT SCIENCE PANEL

1. The volume of mined sand is significant relative to the Bay sand budget (it represents the largest outflow of sand from the Bay), including the net sand discharge to the ocean. Additionally, sand is mined faster than it is replenished; therefore, sand is a non-renewable resource over the long term.

2. Suisun Bay sand is not replenished; thus, it is a finite resource, and the bed is being lowered. The bathymetric, modeling, and budget studies all support this. Sand mining effects in lease areas appear to be highly localized, with effects diminishing with distance from the event location. The effect is pronounced in areas of negligible sand transport such as Suisun Bay, where the depressions caused by mining persist in the bed over time.

INDEPENDENT SCIENCE PANEL KEY FINDINGS

3. Central Bay sand is relic (i.e., deposited between 20,000 and 6,000 years ago as sea levels rose, and the river discharge point migrated through the Bay to its present location in the Delta) and is part of a large bay-ocean reservoir of sand. Sands derived from the watersheds of the Sacramento and San Joaquin Rivers are no longer a significant source to the Bay and ocean, and large volumes of sand do not move through the system during times of high flows (e.g., wet winters), as was previously assumed. Effects of mining to beaches and ecologically important shoals remain unquantified.

4. San Francisco Bay and the Pacific Ocean share a common pool of sand which sand mining reduces. In each tidal cycle, a huge amount of sand is transported between the Bay and the ocean effectively linking the two sand deposits into a shared pool. The size of this shared pool of sand, and thus the significance of the reduction due to mining, is unknown.

INDEPENDENT SCIENCE PANEL KEY FINDINGS PRESENTED TODAY BY MEMBERS OF THE INDEPENDENT SCIENCE PANEL

1. The volume of sand mined it represents the largest outflow of sand from the Bay, including the sand discharge to the ocean
2. Sand is mined faster than it is replenished and a non-renewable resource
3. The Sacramento San Joaquin rivers are no longer a significant source of sand
4. Sand does not move through the system during high water flow
5. Central Bay sand is relic and was deposited when the Bay was a river.
6. Central Bay and the Pacific Ocean share a common pool of sand, which mining reduces.
7. Large amounts of sand move between the Golden Gate and the Central Bay each tide cycle, linking the pool.
8. The size of the pool is unknown, and thus the reduction of the pool through mining is unknown.
9. Effects of mining on beaches and ecology remain unquantified.
10. Suisun Bay sand is not replenished, and the bed is getting lower
11. Suisun Bay sand mining appears to be highly local and where there is no transport, the mined areas are getting deeper over time

Change Analysis 1997 -2019

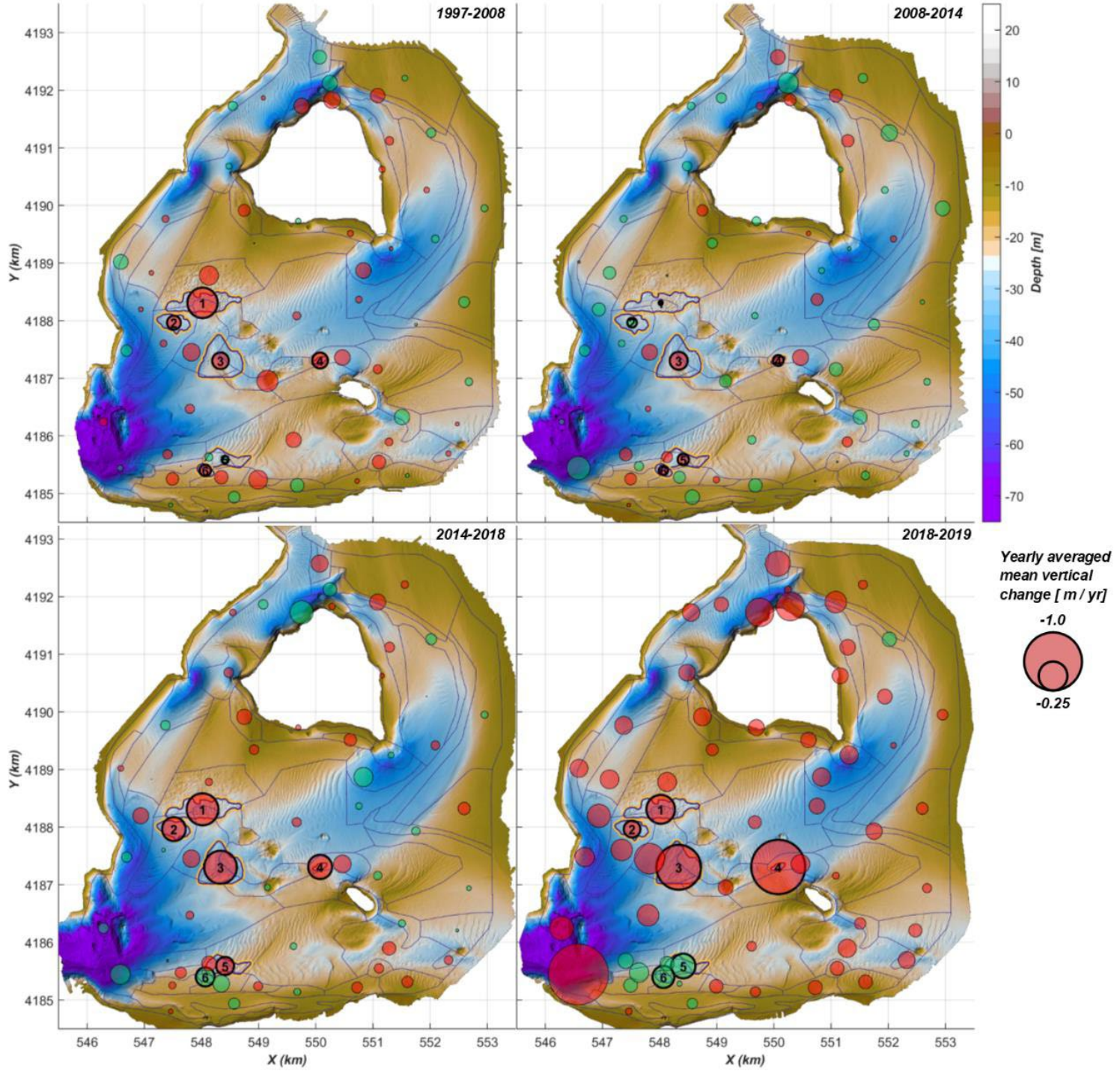
Red circles: Erosion - yearly averaged vertical change in meters per year

Green circles: Deposition - yearly averaged vertical change in meters per year

Yearly average vertical change is corresponded with mining intensity

Higher mining years = greater deepening

Lower mining years = less deepening

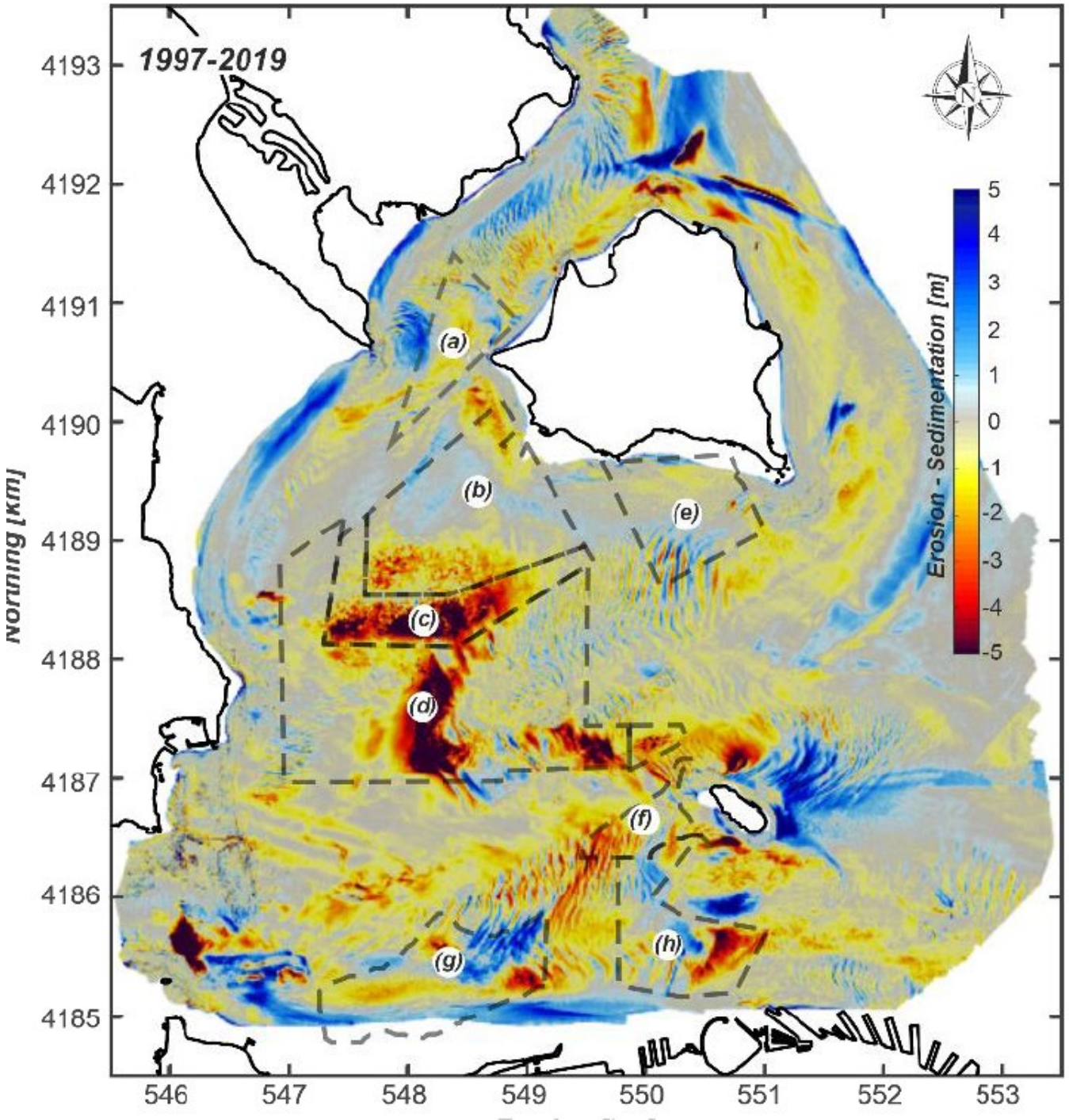


Changes in the depth of the Bay Bottom from 1997 – 2019

Yellow, orange and red areas show erosion

Blues show deposition of sediment

Note the areas shown in red within the lease areas have been deepened as much as 15 meters (49 feet) by mining

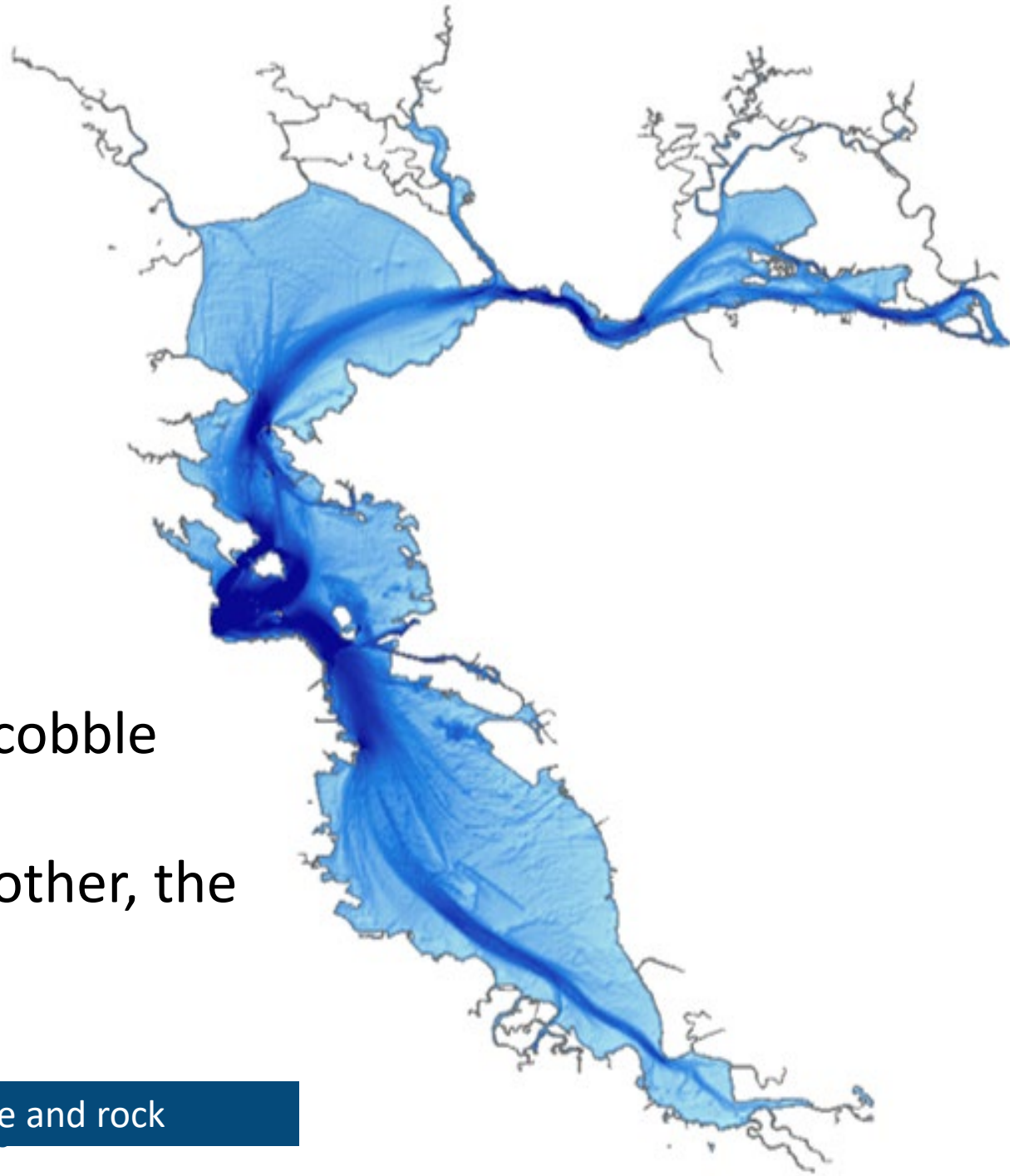


SUBTIDAL BAY:

A Complex mix of:

- Embayments
- Deep water channelss
- Shoals
- Sand waves
- Wide mudflats
- Rock outcroppings (pinnacles) and cobble

That are all interconnected….to each other, the Delta & Pacific



Approximately 80% mud, silt, clay – 17% sand – 3% cobble and rock

WHAT ELSE DID WE LEARN?

The Bay floor is lowering, with all embayments eroding over time

The areas of mining are “eroding” more quickly than other areas of Central Bay

Mining and navigation dredging remove more sand and mud than any other process, including natural erosion, and more sand is being removed from the Bay than is coming in

We have a new understanding of sand transport in the Bay – rather than being a river-like system with sand traveling downstream to the ocean, we have two disconnected sand systems – Suisun Bay and the Central Bay/Pacific Ocean complex

There are regional and local scale considerations to mining activities and transport

Mining areas have loss of bedforms, which in turn change the habitat forms and function