US Army Corps of Engineers

San Francisco District

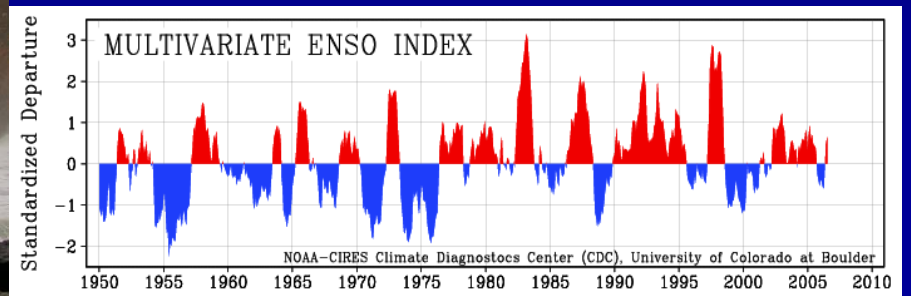
California Harbors

Where Does The Sand Go?

Sand As A Resource

What Affects California's Sand Supply?

Climatic Changes



http://www.cdc.noaa.gov/people/klaus.wolter/MEI/mei.html

Human Induced Changes

Corps Navigation Responsibilities and Sand Management

Corps has built and maintains 25 navigation projects (★) along the CA coast

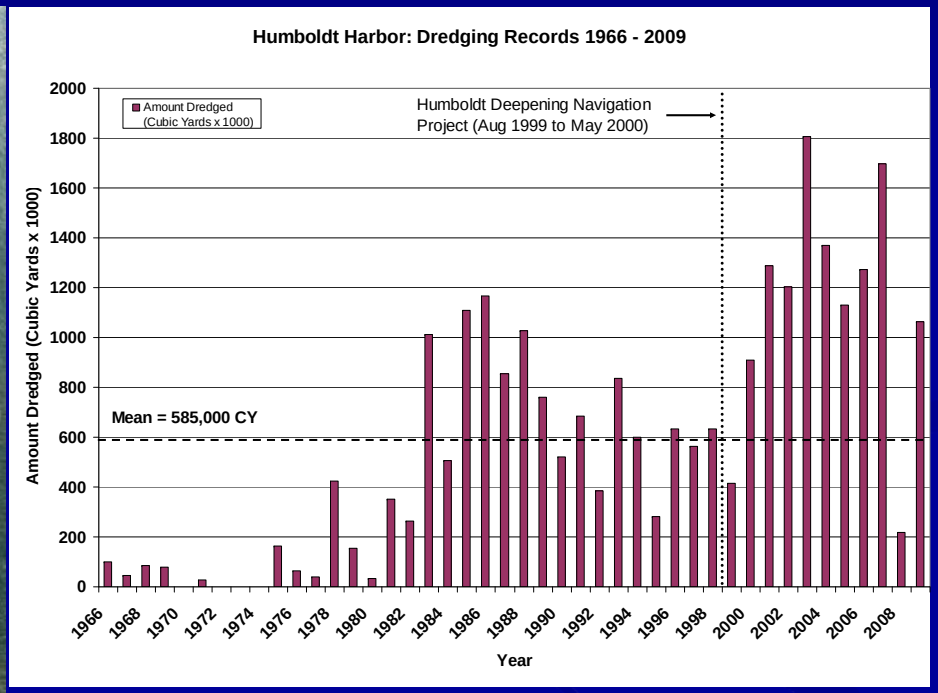
Corps & EPA responsible for designating marine disposal sites

Corps dredges 400 to 600 miles of navigation channels and 4 to 10 million cubic yards of sediment annually in California

Corps maintains 35 miles of navigation structures in California

Corps Dredging Records As A Proxy For Sand Movement

Example: Humboldt Bay



Importance of Location

GOOD:

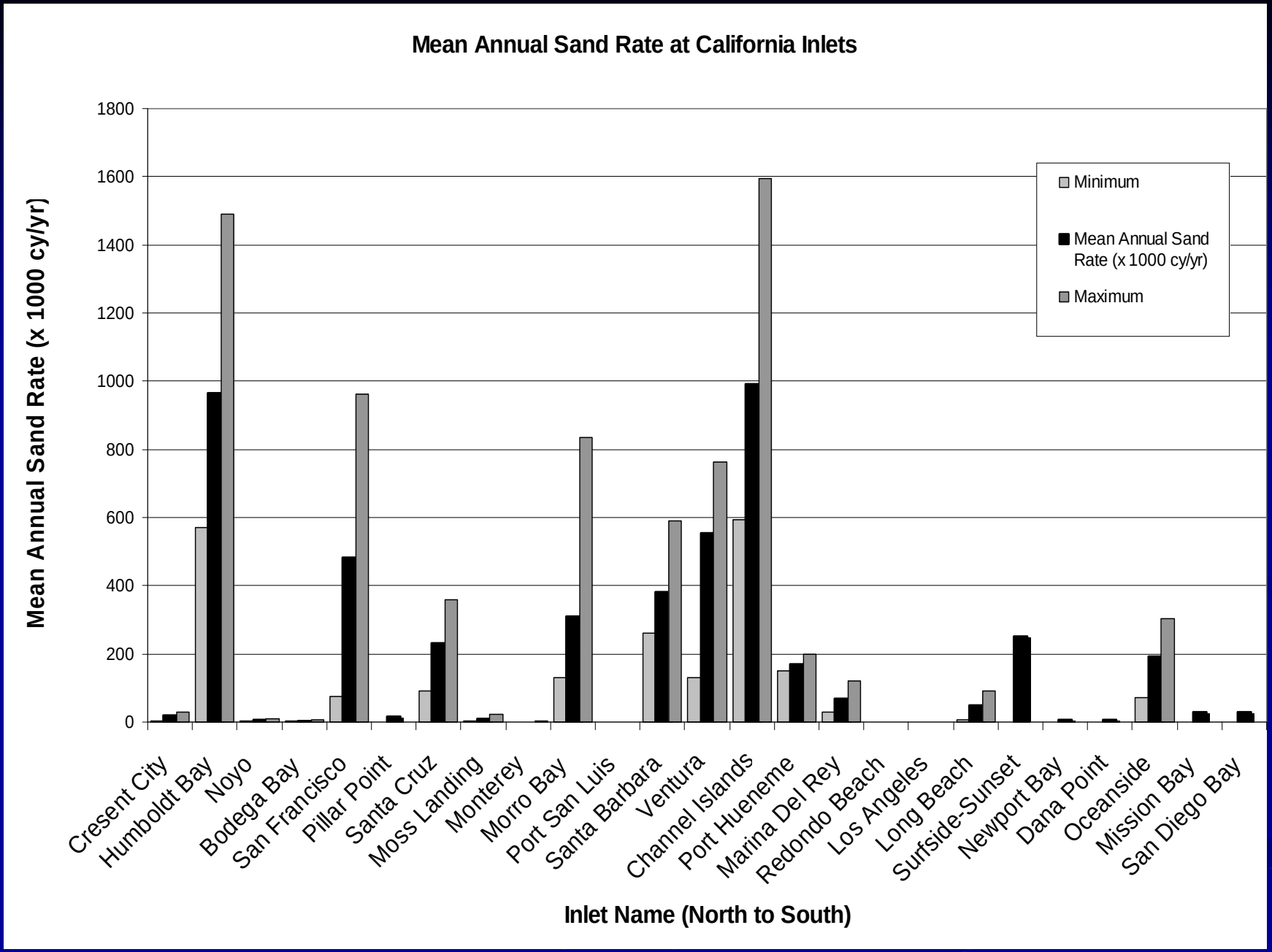
BODEGA BAY HARBOR

(~4,000 CY/YR)

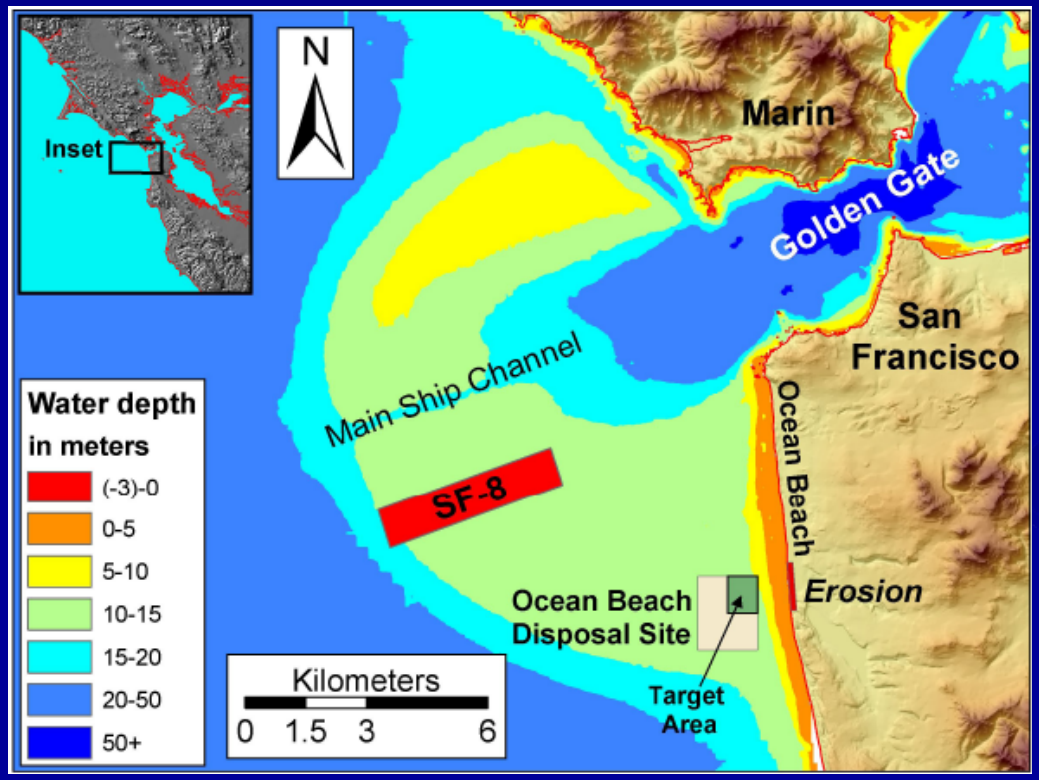
BAD:

VENTURA HARBOR

(~550,000 CY/YR)

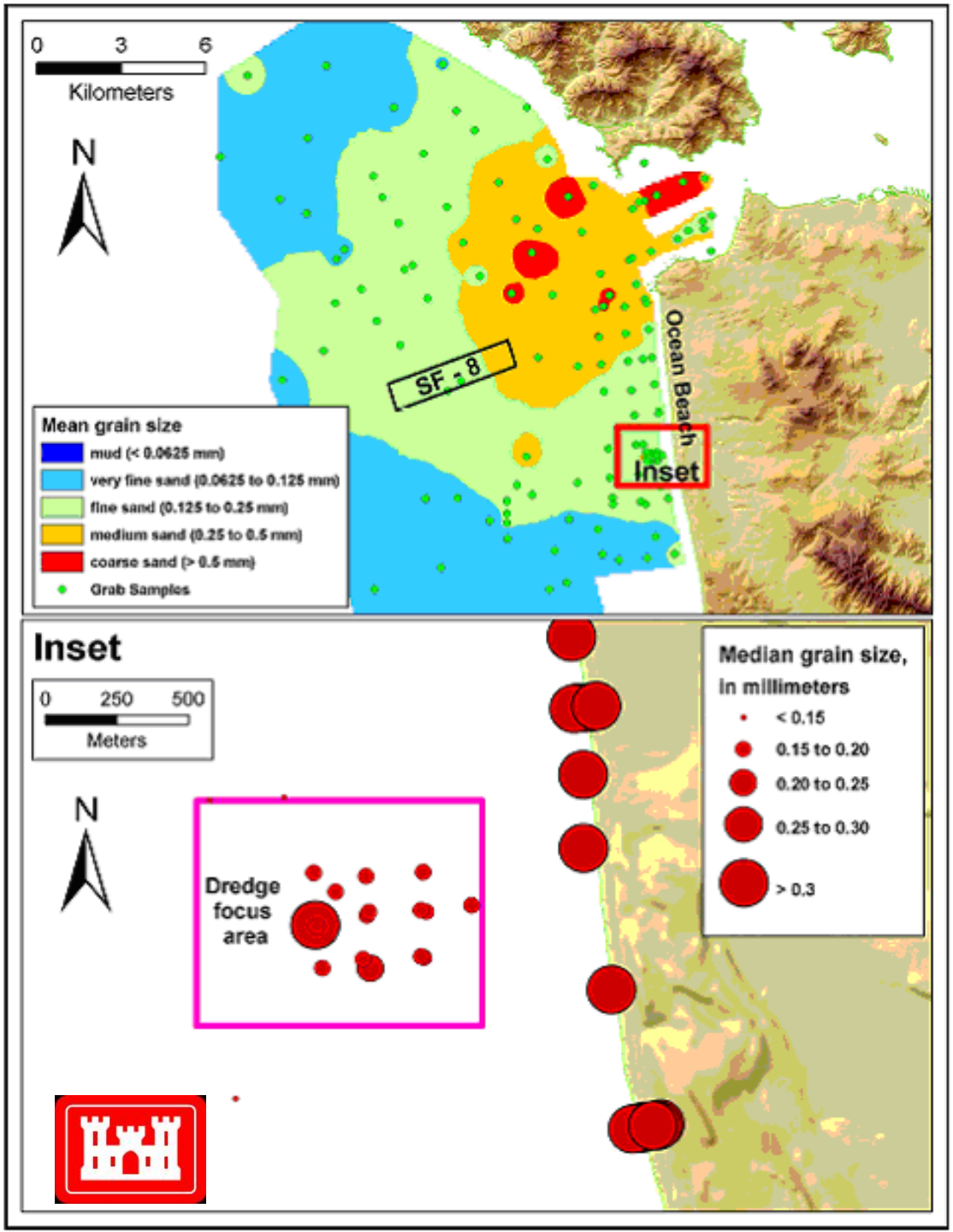

Mean Annual Sand Rate at California Inlets
Mean Annual Sand Rate (x 1000 cy/yr)
1800
1600
1400
1200
1000
800
600
400
200
0
Minimum
Mean Annual Sand Rate (x 1000 cy/yr)
Maximum
Cresent City
Humboldt Bay
Noyo
Bodega Bay
San Francisco
Pillar Point
Santa Cruz
Moss Landing
Monterey
Morro Bay
Port San Luis
Santa Barbara
Ventura
Channel Islands
Port Hueneme
Marina Del Rey
Redondo Beach
Los Angeles
Long Beach
Surfside-Sunset
Newport Bay
Dana Point
Oceanside
Mission Bay
San Diego Bay
Inlet Name (North to South)

Ocean Beach Onshore Placement Demo Project



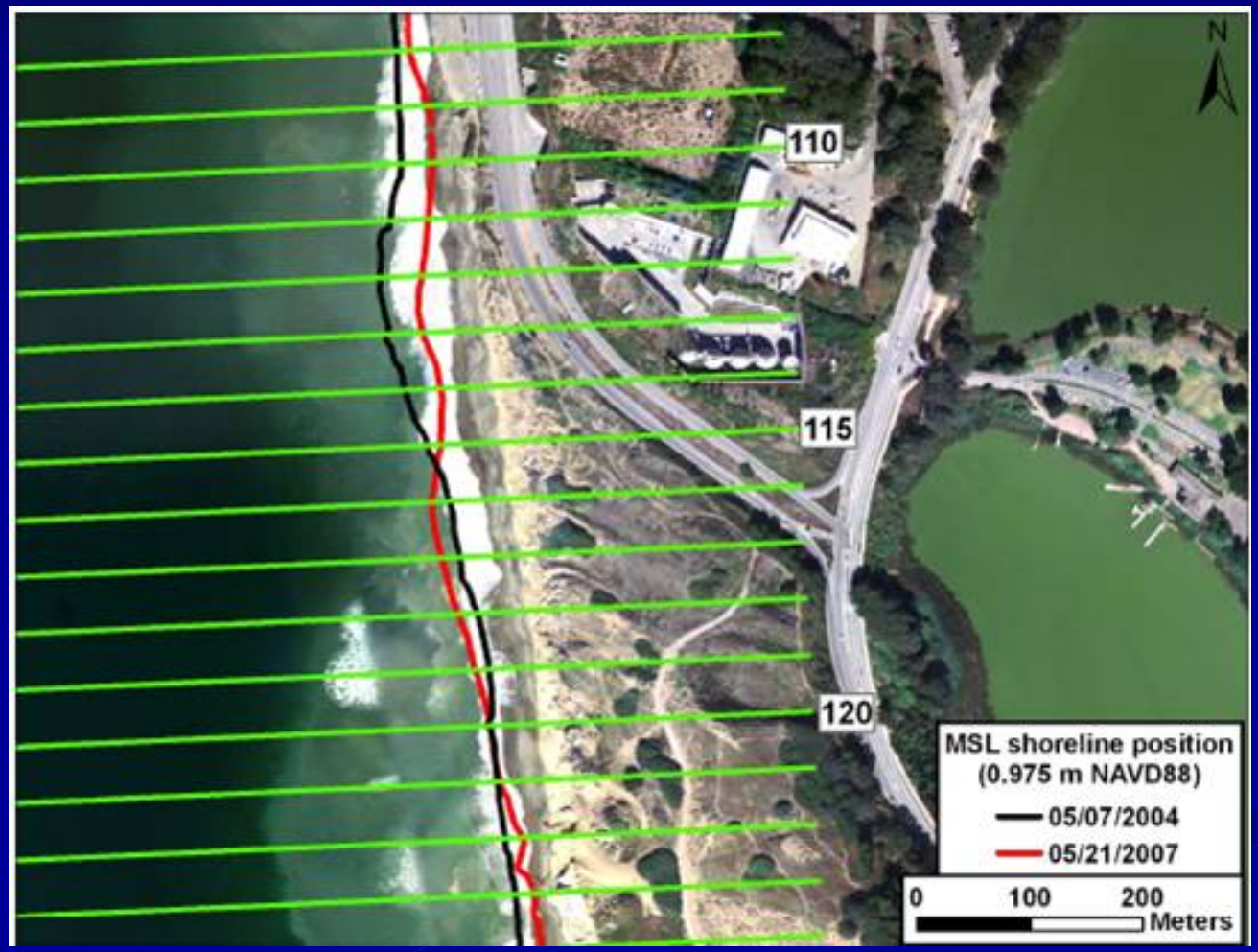
- Tidal range (4’ ~ 6’)
- El Niño and storm surge (1.5’ ~ 2.5’)
- Tidal currents (0.1 ~ 1 m/s)
- NW and SW waves (1 ~ 3 m)
- Sea level rise (0.2 m/100 yr)

Ocean Beach – Erosion Hot Spot

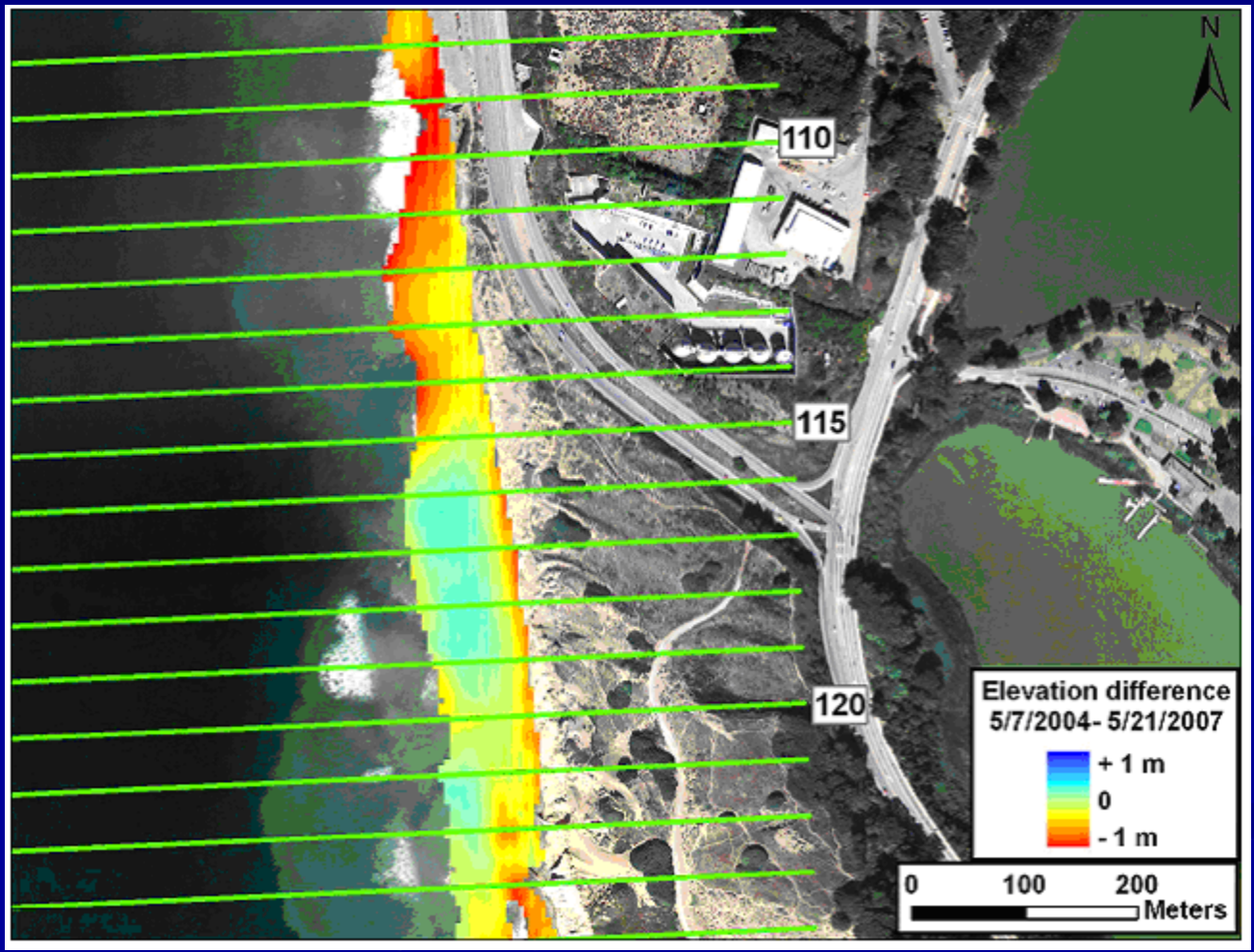


- Available sediment distribution
- Beach sand (~ >0.25 mm)

Comparisons / Shoreline Changes for Ocean Beach



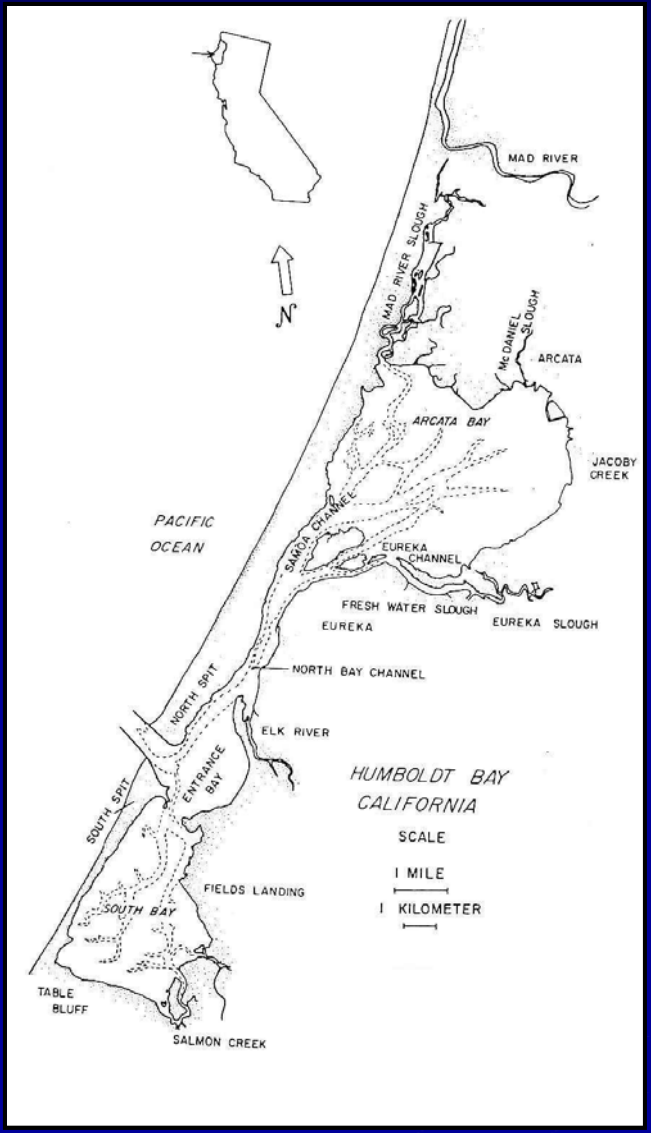
Comparisons / Elevation Changes for Ocean Beach



Conclusions and Recommendations for Ocean Beach

- Plan onshore placement demo project
- Prepare a draft report (9/30/09)
- Target construction timeline (summer 2011)
- Numerical modeling (ERDC, CMS-FLOW & CMS-WAVE, tide, wave, longshore and onshore-offshore sediment transport, 2D/3D), (USGS)

Humboldt Bay Nearshore Placement Demo Project



- Develop nearshore placement site
- Lessons learned from Ocean Beach
- Beneficial reuse of dredged material
- Establish monitoring plan
- Proposed numerical approaches

High Energy System

- Swell (NW, winter and summer)
- Wind wave (SW, winter; N summer)
  (H: 3 ~ 13 ft; T: 12 ~ 16 s)
- Tidal range (5’ ~ 7’)
- Tidal current
  (1.5 ~ 2.5 ft/s)

Beach Erosion

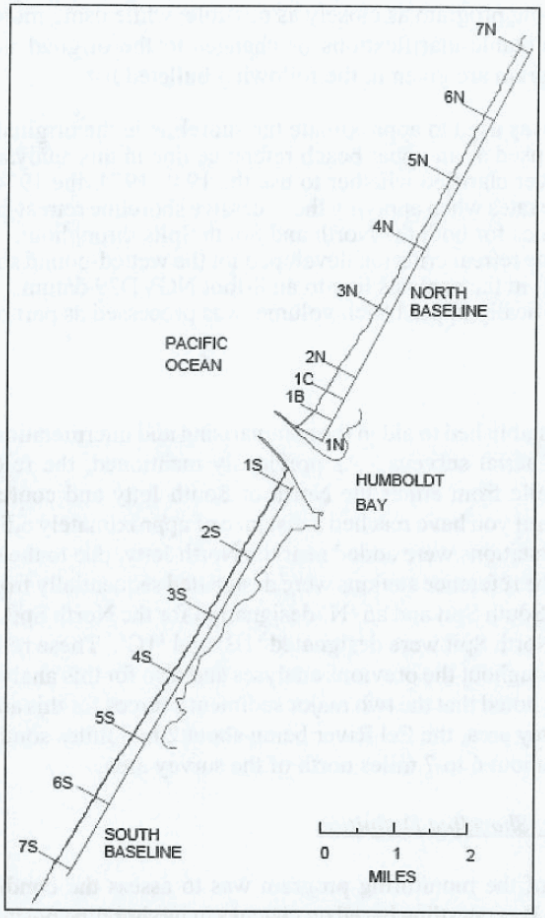


Figure 5. Reference Stations used for Analysis for the Monitoring Program

- USACE aerial photo (1992-2005)
- Erosion of North Spit
- Accretion of South Spit

Entrance Channel Maintenance

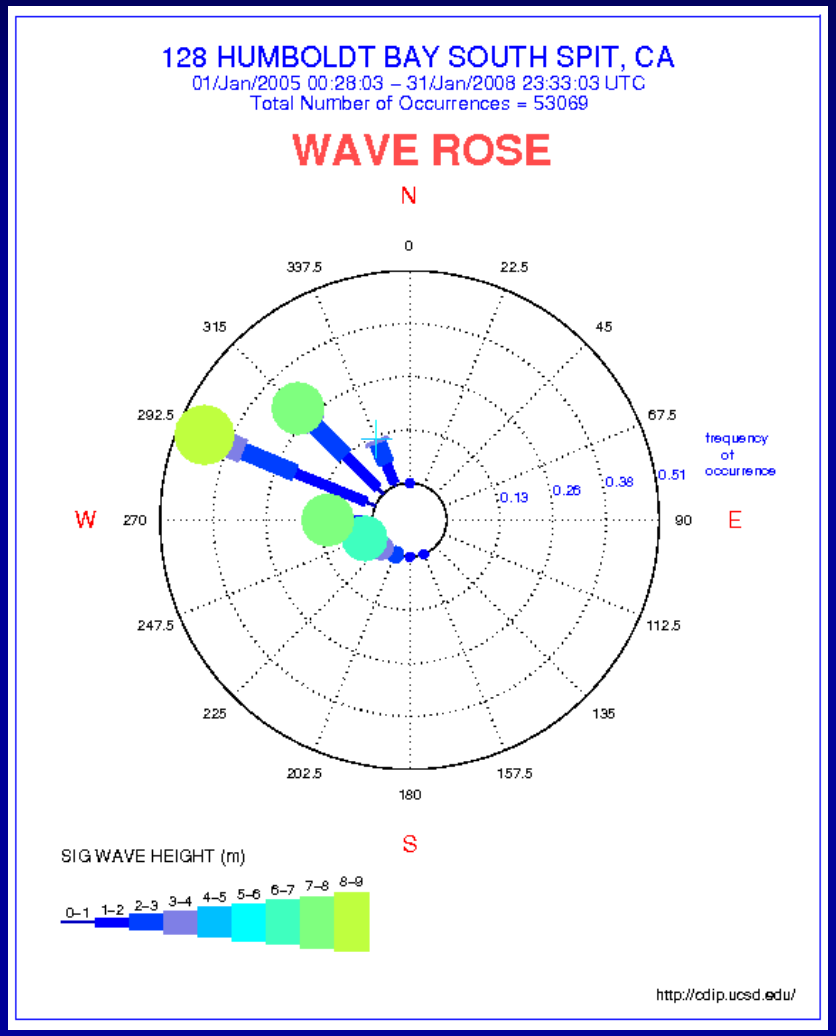
- USACE Maintained 1881
- Northern, CA
  - 225 mi. N of SF Bay
  - 156 mi. S of Coos Bay, OR
- Deep draft harbor (-48 ft MLLW)
- Annually 1,000,000 cy (>95% sand)

Tide

Table 1	
TIDAL DATA – North Spit, CA 9418767	
LENGTH OF SERIES: 19 YEARS TIDAL EPOCH: 1983-2001	
Highest Recorded Water (1/26/83)	9.4 feet
Mean Higher High Water (MHHW)	6.9 feet
Mean High Water (MHW)	6.2 feet
Mean Tide Level (MTL)	3.7 feet
Mean Sea Level (MSL)	3.7 feet
Mean Low Water (MLW)	1.3 feet
Mean Lower Low Water (MLLW)	0.0 feet
Lowest Recorded Water (1/19/88)	-3.2 feet

Source: National Oceanographic and Atmospheric Administration (NOAA), Datum = MLLW

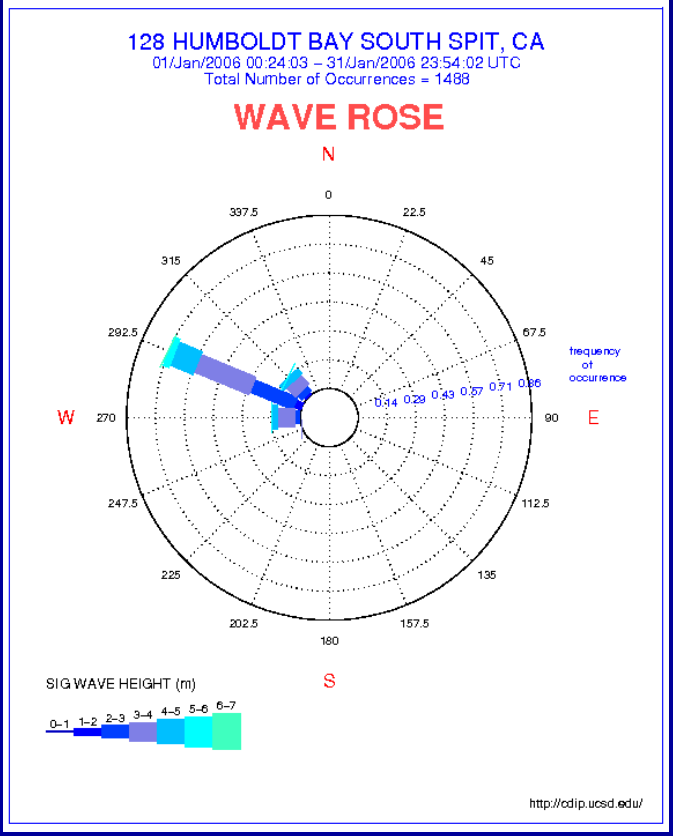
Wave



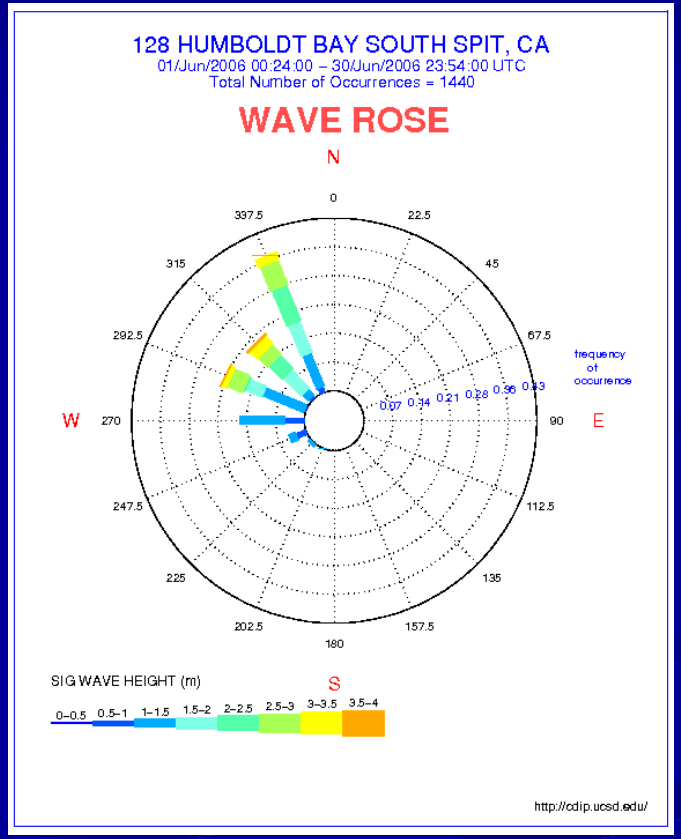
- **Joint Probability Analysis:**
- **Significant Wave Height**
- **Peak Period**
- **Different windows of wave approach**

Annual 2005-2008

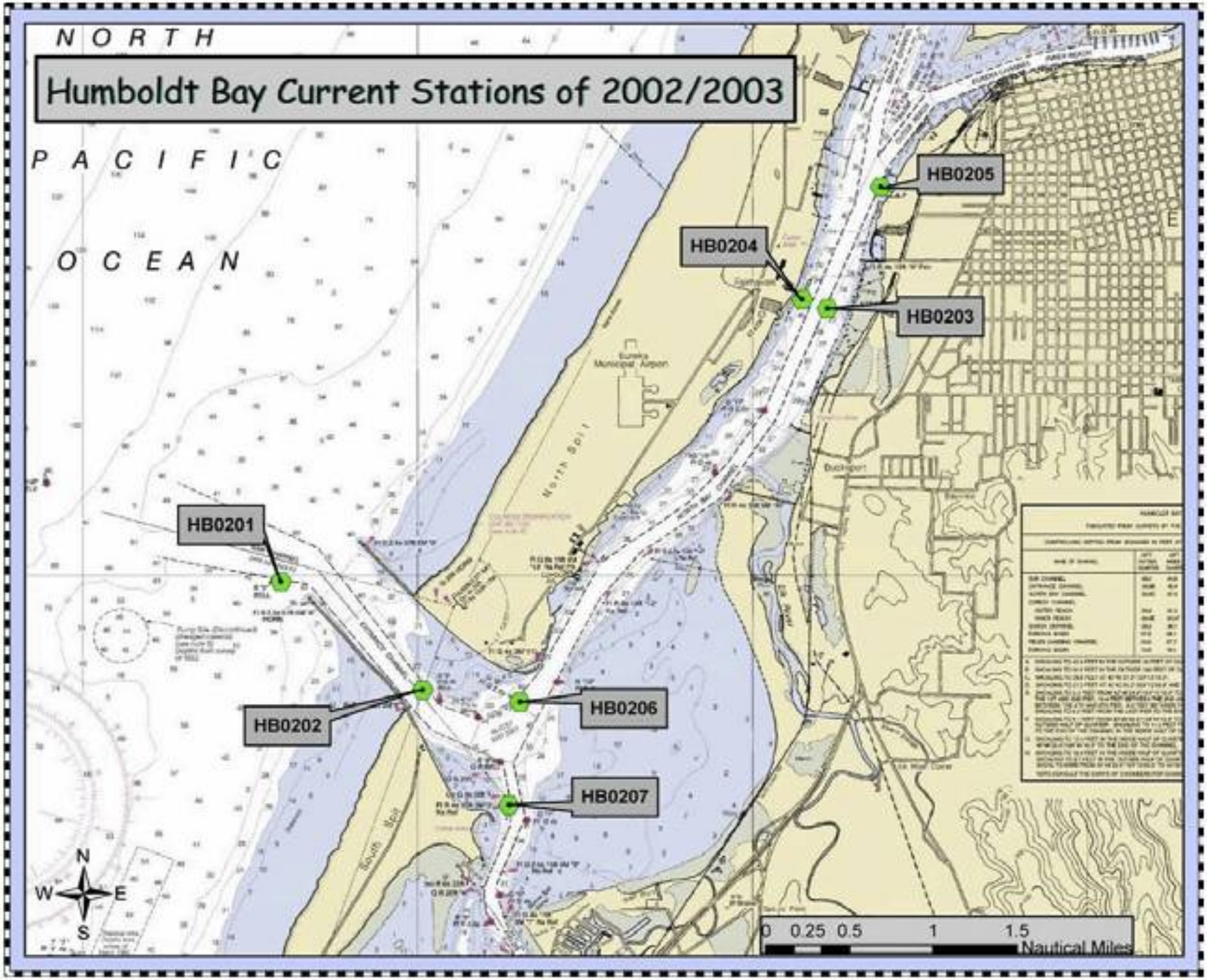
Wave



Winter 2006

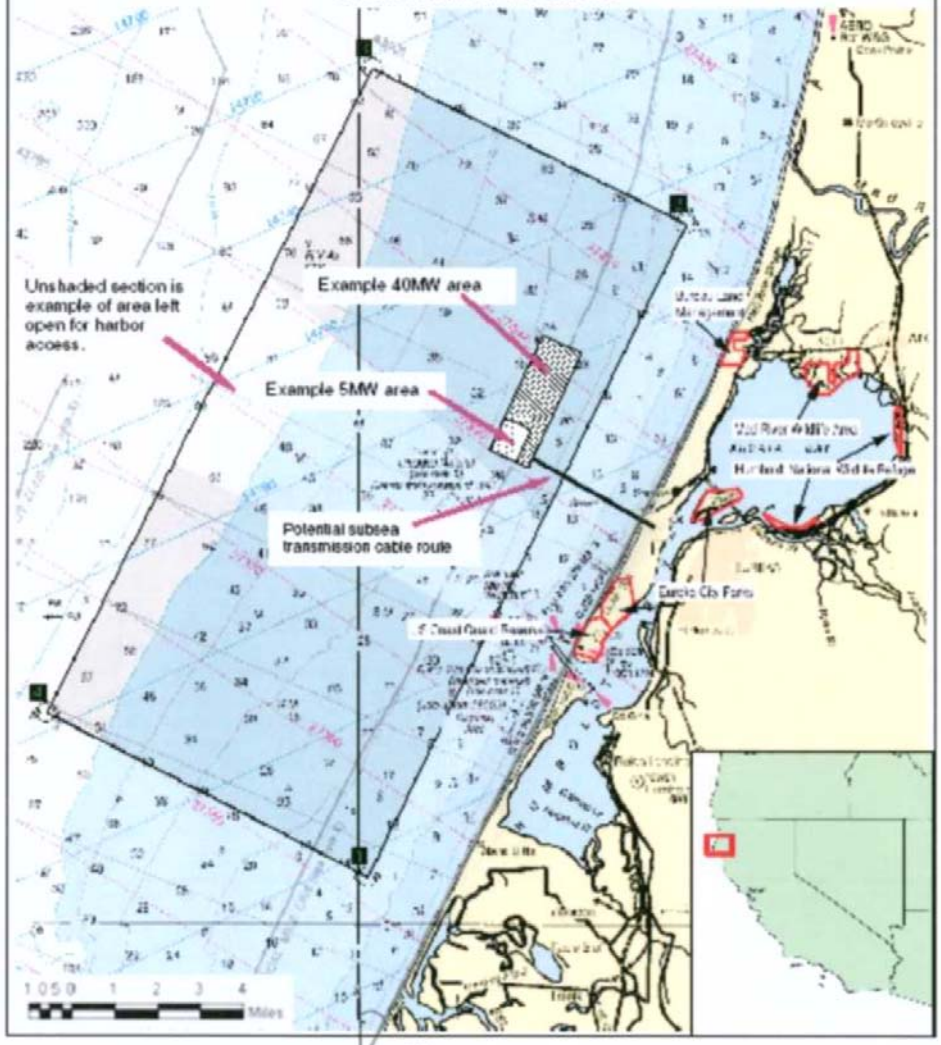


Summer 2006


Humboldt Bay Current Stations of 2002/2003
NORTH
PACIFIC
OCEAN
HB0205
HB0204
HB0203
HB0201
HB0202
HB0206
HB0207
N
W
E
S
0 0.25 0.5 1 1.5
Nautical Miles

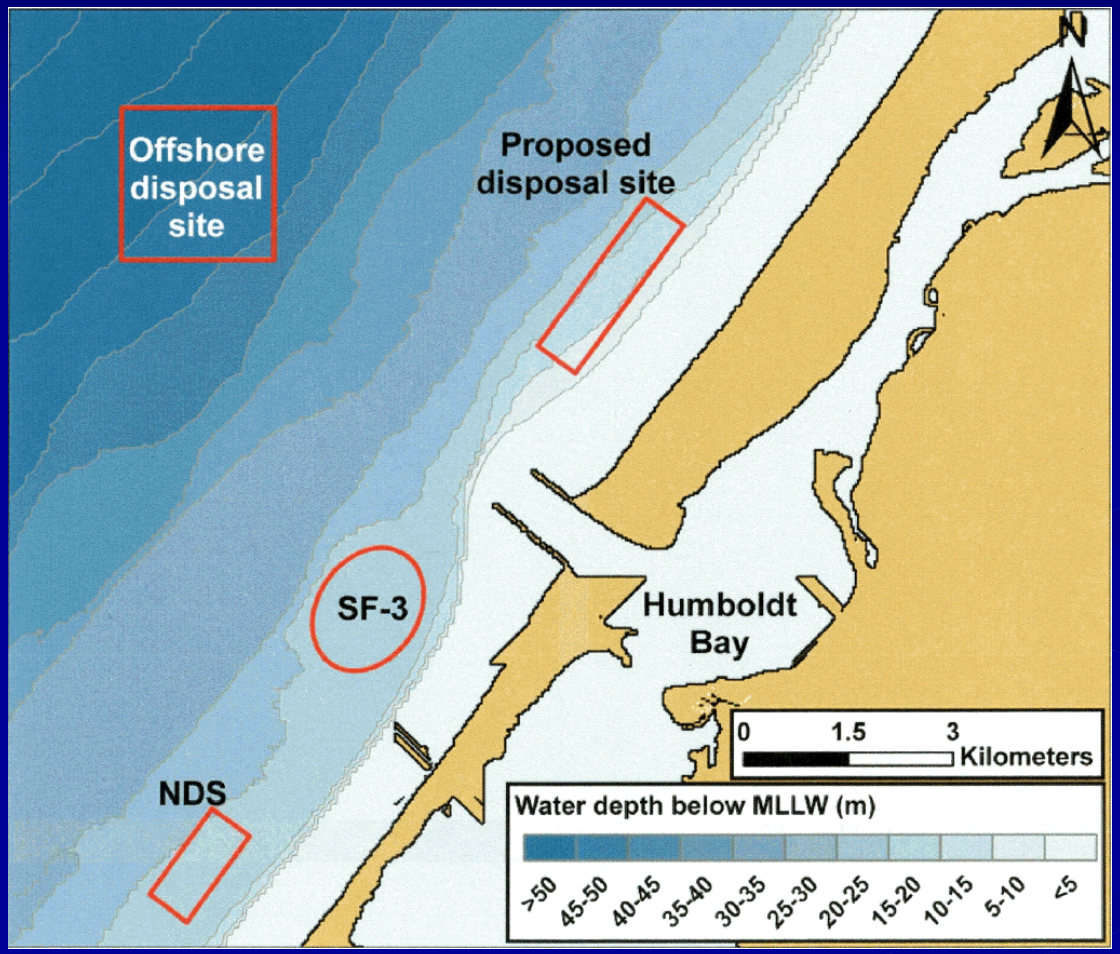
PG&E Humboldt WaveConnect Project

Permit application boundary shows proposed area of investigation. Actual project would occupy smaller area. Possible footprints of 5MW and 40MW projects are shown below for reference.



Water depth in fathoms: 1 fathom = 6 feet
Source: NOAA chart # 18620

Dredge Disposal Sites Map

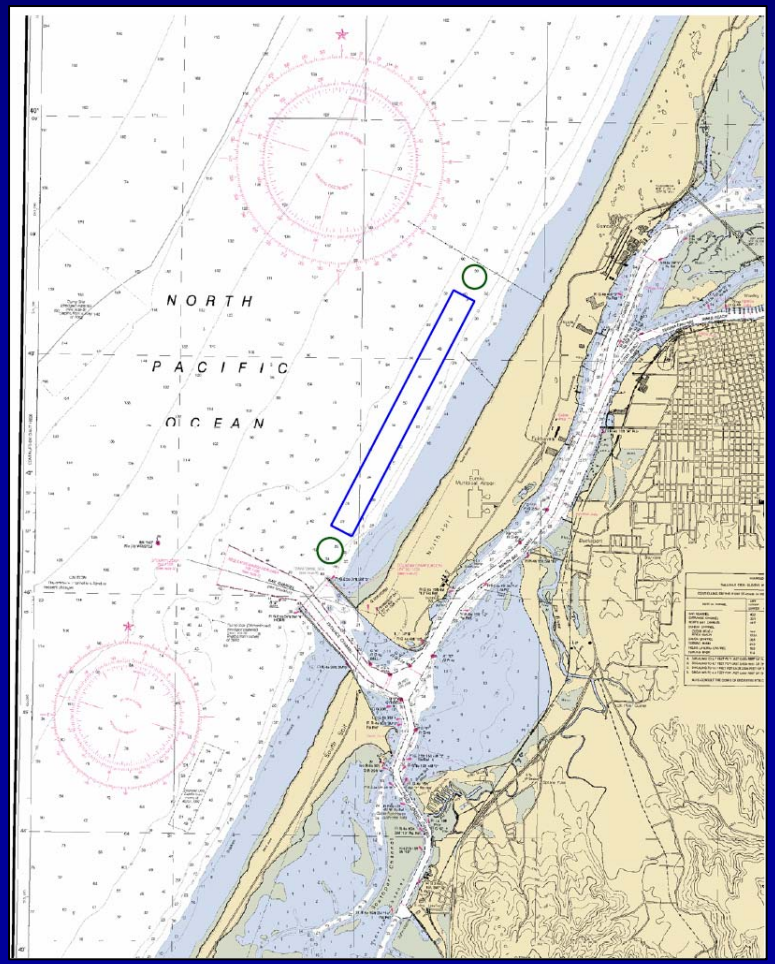


- SF-3
  1940 ~ 1988
  60’ ~ 90’ depth
- NDS
  1988 and 1989
  50’ ~ 60’ depth
- HOODS
  > 1989
  160~ 180’ depth
  non-dispersive
  50 x 10^6 cy capacity
  (60% left)

Nearshore Project Benefits

- Nourish north spit
- Increase wave protection
- Reduce dredge disposal at HOODS
  - Maintain littoral cell
  - Reduce maintenance costs
- Improve recreation (surf, beach)
- Restore Habitat (snowy plover)

Proposed Nearshore Demo Project



- Preliminary development (800,000 ~ 1,000,000 cy placement)
- Area: 3 mi x ¼ mi
- Sediment deposition: ~ 1.0 ft
- 2 control cells (N & S)
- Hopper dredge *Essayons (USACE)*

Demo Project Monitoring / Modeling

- Control Cells
  - Sediment samples pre and post placement
  - Biological Survey (crabs)
- Bathymetric Survey

Suggested Future Activities

- Field monitoring program (USGS / local university)
  - Beach response and sediment transport
- Numerical modeling (ERDC)
  - CMS-FLOW and CMS-WAVE

Thank You – Questions?

- Craig Conner: 415-503-6903
- California Coastal Sediment Management Workgroup http://dbw.ca.gov/csmw/csmwhome.htm
- Regional Sediment Management Program: http://www.wes.army.mil/rsm/
- James Zoulas: 415-503-6923
- Frank Wu: 415-503-6902