



# *Wheeler North Reef*

## **Project Introduction**

Construction of a kelp habitat artificial reef  
offshore of San Clemente

## *Today's meeting objective*



- Introduce the project team
- Introduce the project
- Project development
  - Project history and permitting
  - San Clemente site assessment
  - Reef design
  - Reef material: rock source and rock handling
  - Construction methods
  - Construction monitoring and verification of the completed reef

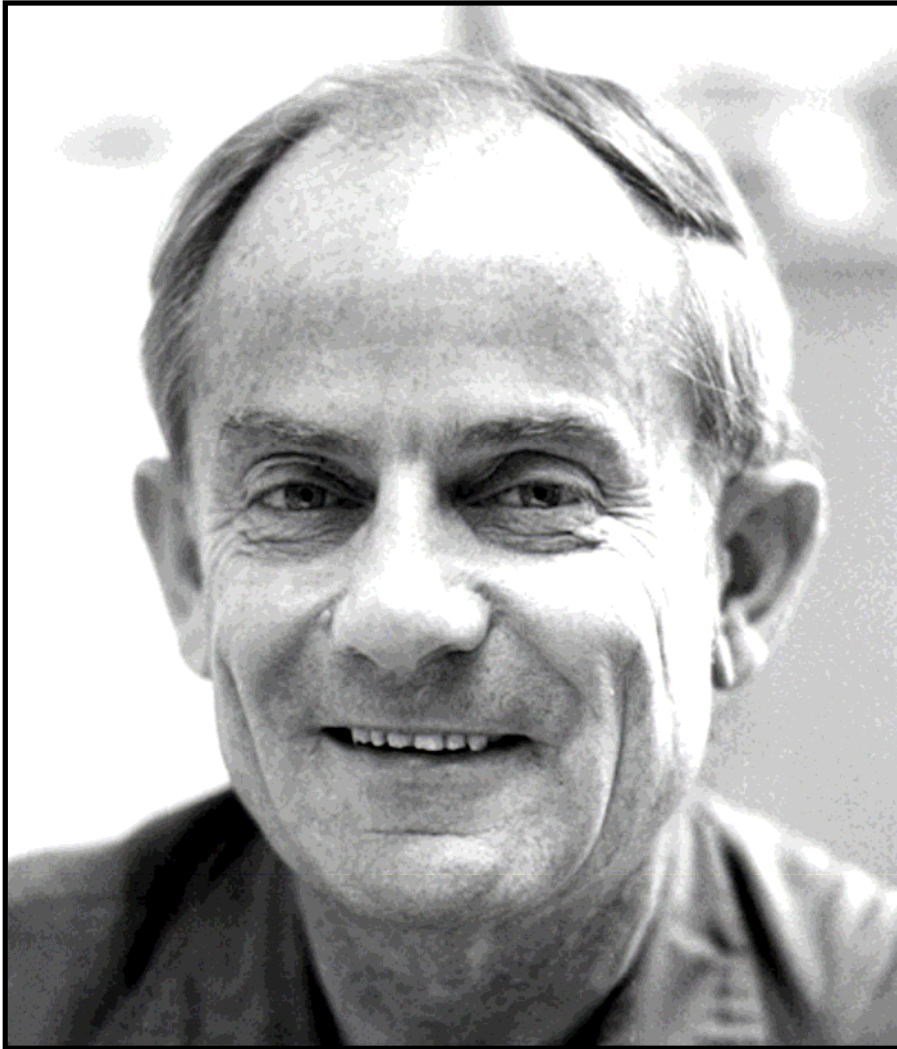
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## *Project team*

- Southern California Edison
- Coastal Environments
- Connolly-Pacific Company
- California Coastal Commission
- UCSB consulting scientists



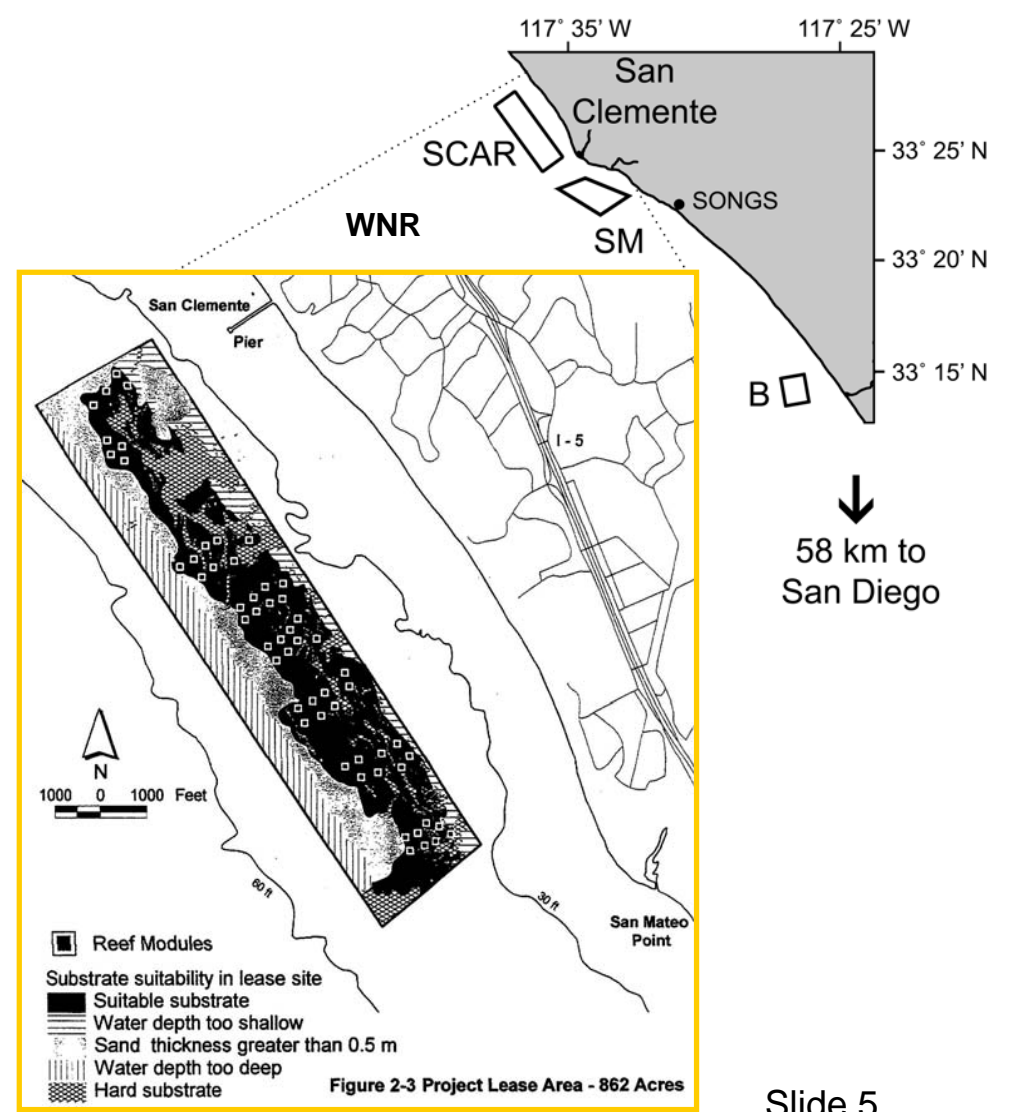


***Wheeler J. North 1922-2002***

“You can’t go by there on Highway 5 without seeing them. I did the background study before any work commenced in 1963. It’s a rotten place to dive. [Laughter] That’s the best way to describe it.”

*-Wheeler J. North, 1998,  
commenting on the oceanographic  
conditions in the waters off  
San Onofre*

# Location of Wheeler North Reef



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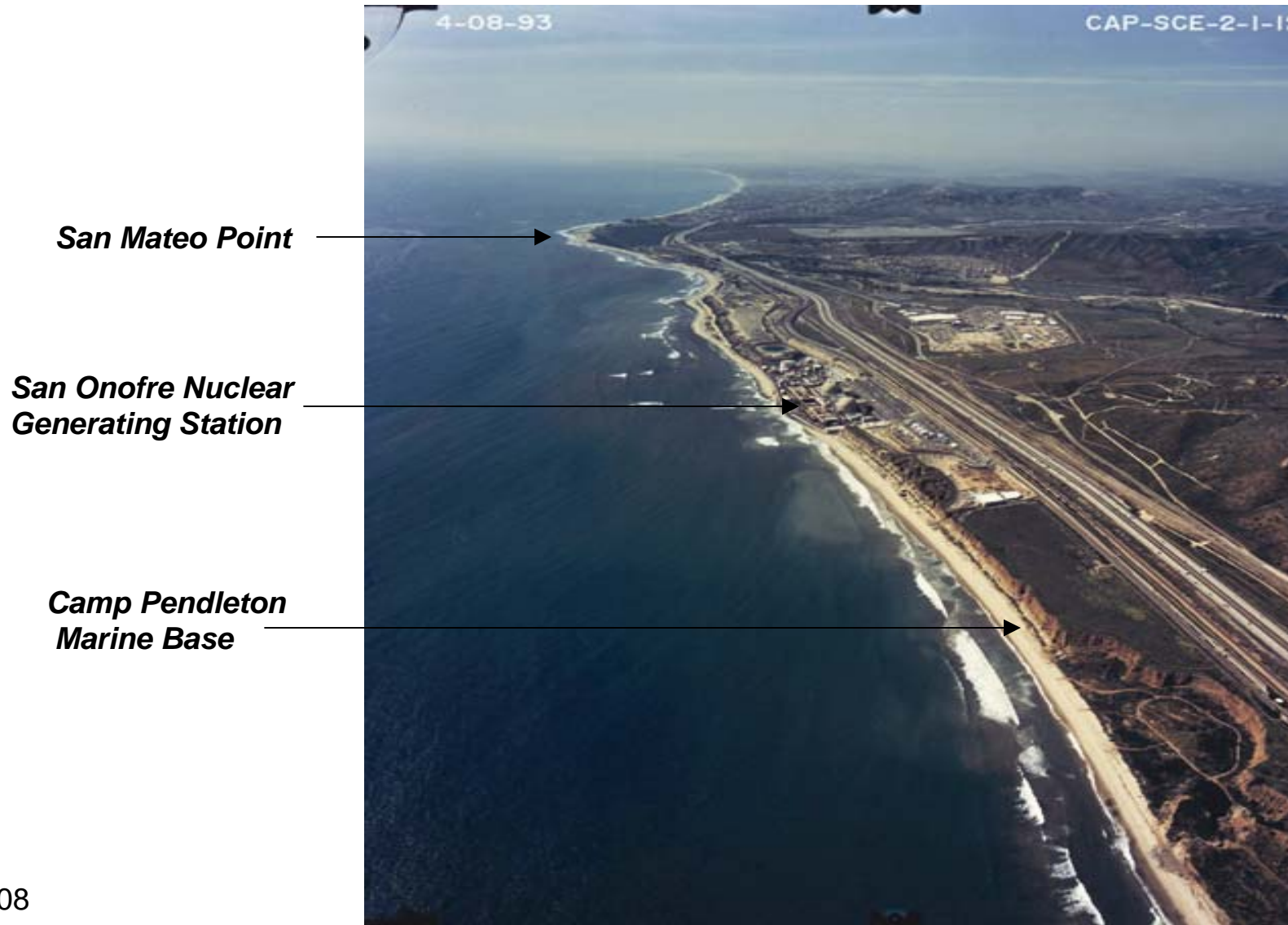
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## *Why a kelp mitigation reef?*

- Compensate for kelp impacts from the San Onofre Nuclear Generating Station
- Build a kelp habitat artificial reef
  - In-kind and in-place (nearby) mitigation
  - Locate in an area suitable for kelp



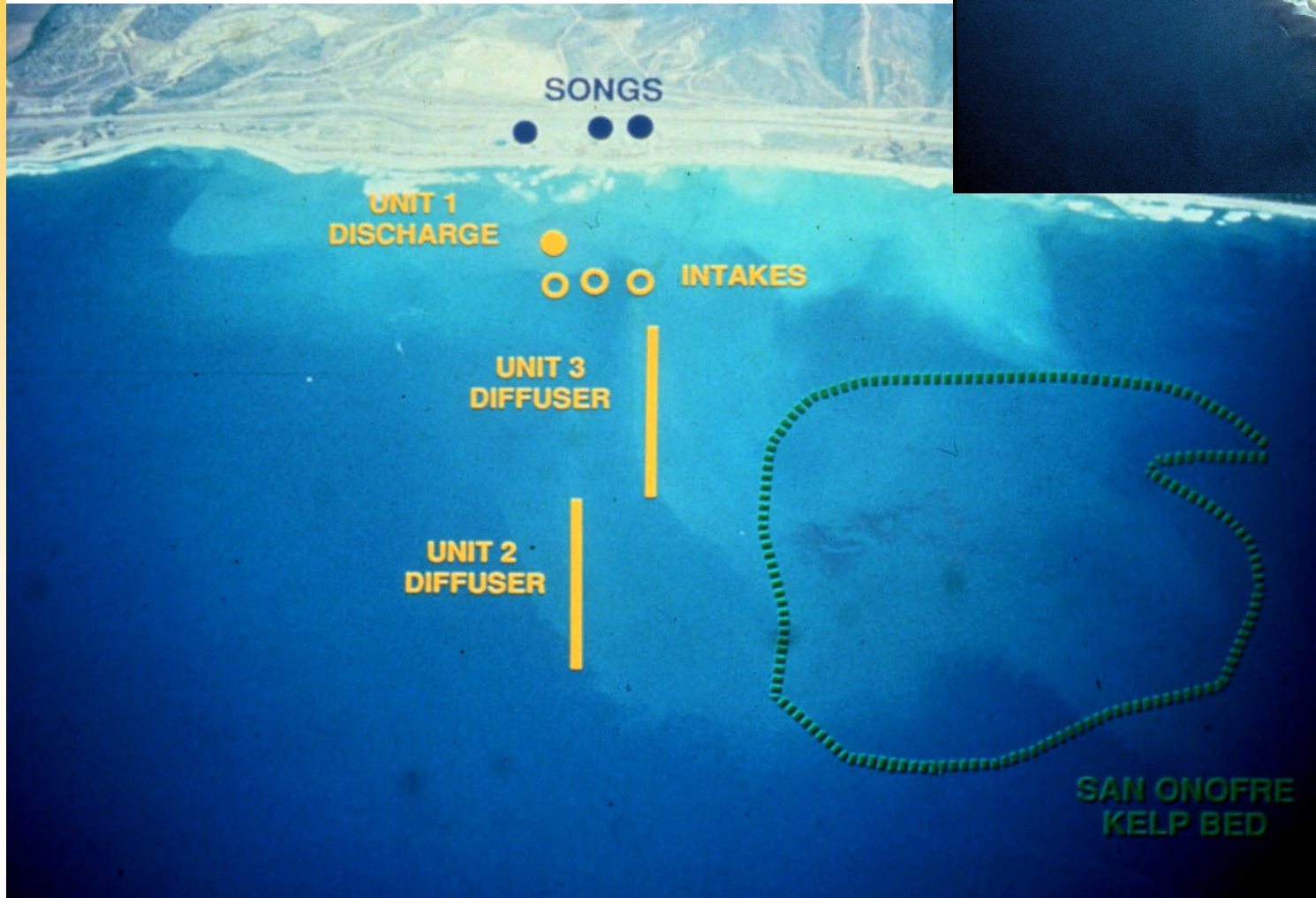
## *The study area - kelp impacts and kelp mitigation*



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# San Onofre Nuclear Generating Station

Cooling system structures  
and nearby  
San Onofre Kelp Bed



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Want more info? Go to SCE website

<http://www.sce.com/PowerandEnvironment/PowerGeneration/MarineMitigation>

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Home > Power & Our Environment > Power Generation > Marine Mitigation

## Power Generation

### Marine Mitigation



*San Onofre Kelp Forest*

The San Onofre Nuclear Generating Station (SONGS) Marine Mitigation Program is a multi-faceted environmental enhancement program intended to mitigate unavoidable impacts to the marine environment resulting from operation of the SONGS Units 2&3 cooling water systems.

The program includes:

- restoring 150 acres of degraded wetlands at San Dieguito Lagoon to mitigate impacts to marine fish populations caused by estimated mortality to fish eggs and larvae;
- improving the in-plant fish protection systems to increase survival of adult fish which enter the cooling water systems;
- constructing an artificial kelp reef to mitigate impacts to the San Onofre Kelp Bed;
- co-funding a marine fish hatchery program intended as supplementary mitigation for kelp impacts; and
- funding for Coastal Commission staff oversight and monitoring of these mitigation projects.

SCE is managing the overall mitigation program. SCE is the plant operator and majority owner of SONGS. SONGS is jointly owned by SCE, San Diego Gas and Electric, and the cities of Anaheim and Riverside, which are funding the mitigation work.

**Keeping You Informed And Involved In The SONGS Marine Mitigation Program**

**Tools & Resources**  
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- Edison SmartConnect™
- Power Generation
  - San Onofre Nuclear Generating Station
  - Big Creek Hydro
  - Mohave Generation Station
  - Marine Mitigation
    - Background
    - Fish Protection Project
    - Kelp Reef Project
    - Fish Hatchery
    - San Dieguito Lagoon Restoration
    - Environmental Impact Reports
- Power Production
- Renewable Energy
- Environmental Commitment
- Electric Transportation
- Transmission Projects
- Managing Peak Demand
- Environmental Education
- California Energy Programs



San Clemente Kelp Mitigation Artificial Reef Project:

## ***Scientific Studies & Regulatory History***

**Phase 1: Siting and design studies**

**5-year biological performance study**

**6-year beach and kelp wrack study**

**Phase 2: Pre-construction sonar and biology studies**

**State and Federal permitting**

## Timeline for kelp reef project

**1976 – 1989:** *Coastal Commission study of San Onofre impacts*

**1991 – 1997:** *Phase 1, General Siting & Design Studies*

**1997 – 1999:** *Project EIR*

**Sept. 1999:** *Phase 1, Construction, 22.4 acres*

**2000 – 2004:** *CCC/UCSB Performance Study*

**2000 – 2005:** *San Clemente Beach & Kelp Wrack Study*

**Sept. 2005 – Feb. 2006:**  
*Phase 2, Site Verification Study, Sonar and Diver Biology Assessment*

**Sept. 2006 – May 2008:**  
*Phase 2, Construction Permits*



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## ***Kelp mitigation – A Coastal Development Permit requirement***

- **One of two major projects designed to offset impacts of the San Onofre Nuclear Generating Station**
  - **Conditions of 1974 Coastal Development Permit - impact studies**
  - **Revised Permit Conditions of 1991 - compensate for marine impacts**
  - **Construct and maintain 150 acres of giant kelp habitat**
  - **Restore 150 acres of wetlands at San Dieguito**
- **22-acre experimental reef built in 1999**



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## ***Phase 1: The Experimental Reef***

*Construction: Sept. 1999*

*864-acre lease area*

*356 acres suitable substrate*

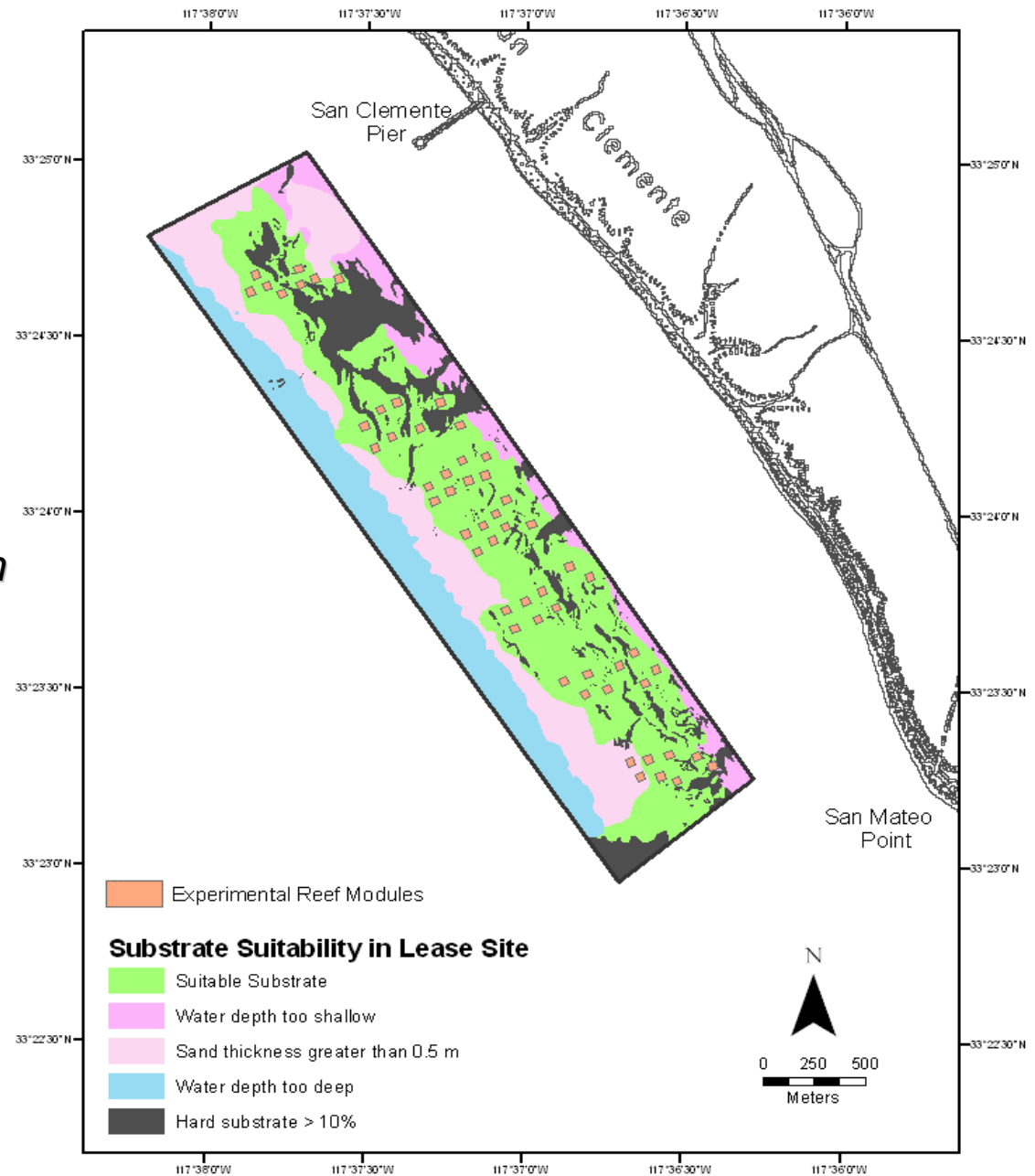
*56 modules - each 40 m x 40 m*

*Testing two materials:  
concrete and quarry rock*

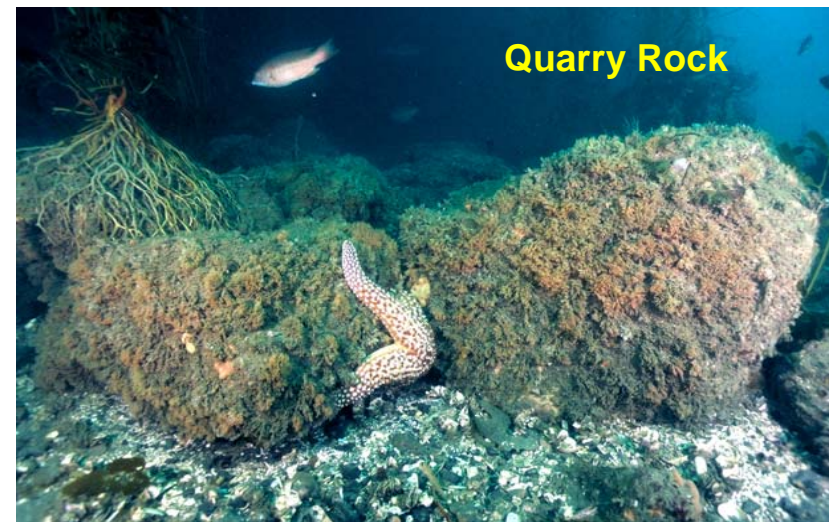
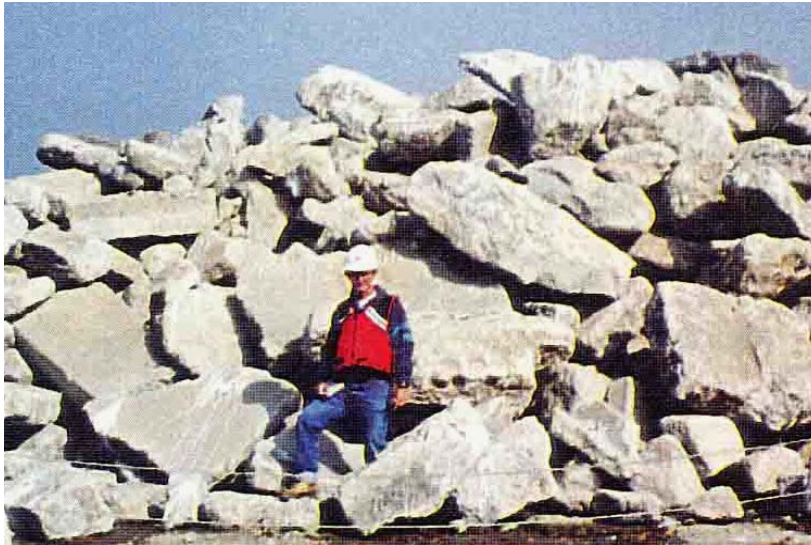
*Testing three material density  
spreads on seafloor:  
17%, 34%, and 67%*

*22.4 acres total*

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**Phase 1: Reef design tests - mono-layer material spread on bottom, bottom coverage, and concrete vs. rock substrate**



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***Phase 1: Construction method – derrick and supply barges – Sept. 1999***



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***Phase 1: Reef canopy***



***Aerial view – 2002  
surface kelp***





*Phase 1: Reef canopy from satellite (circ. 2002)*



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***CCC/UCSB – 2000-2004 kelp habitat assessment - on a Phase 1 reef module***



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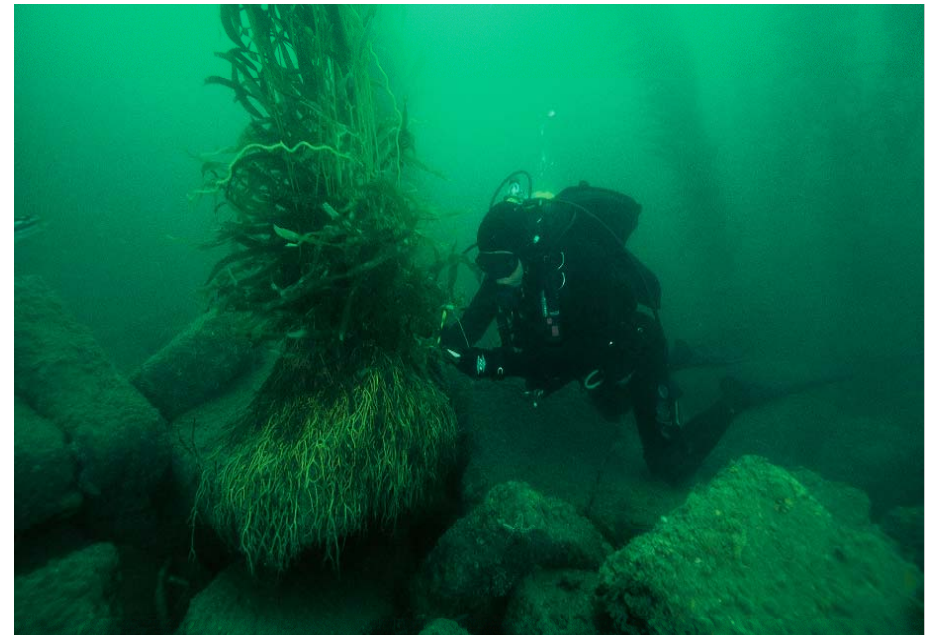
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***The 2000-2004 CCC/UCSB Experimental Phase 1 Study concluded:***

*Sustained kelp growth on a low-profile artificial reef is viable.*

*Well-placed reef substrate will not disappear into the sediment.*

*Minimum bottom density of reef substrate meets performance - mandated kelp coverage.*



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## 2005–2006 Phase 2 pre-construction sonar and biology studies



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## *2005-2006 Sonar and Biological Studies*

### *Conclusions*

- Biological communities have not changed significantly in the San Clemente area – comparing 2006 to 1990's and 2000-2005 data sets.
- The natural seafloor elevations, seafloor types, and rock outcroppings have not changed.
- Assurance that artificial reef materials in the planned polygons will avoid the potential of burial into the sand seafloor.
- Assurance that viable existing hard-substrate biological communities will not be adversely impacted by new reef material placement.
- 2005-2006 study outcome: an accurate map for siting the 127.6-acre build-out Kelp Mitigation Reef.



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## ***CEQA: Cal. Environ. Quality Act study - results***

- Program Environmental Impact Report (PEIR) prepared by Resource Insights for State Lands and accepted by USACOE
- Phase 2 Construction Impacts are classified into four categories
  - Significant Unavoidable: Air Quality
  - Significant: Air Quality, Construction Material and Kelp on Beaches, Transportation, and Construction Noise
  - Potentially Significant: Recreational and Commercial Fishing
  - Less Than Significant: Coastal Processes, Biological Resources, Energy and Mineral Resources, Water Quality, Land Use and Planning, Public Services, Hazardous Materials, Cultural Resources, Recreation and Aesthetics

## *Permitting the Phase 2 Reef: 2006 - 2008*

- State Permits:
  - Lease agreement amendment from California State Lands Commission
  - Coastal Development Permit from the California Coastal Commission
- Federal Permits:
  - 401 Water Quality Certification
  - 404 U.S. Army Corps of Engineers 404 Permit



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# Reef Design Development, Reef Engineering, Design Verification Monitoring, and Long-term Monitoring

## *Phase 2:*

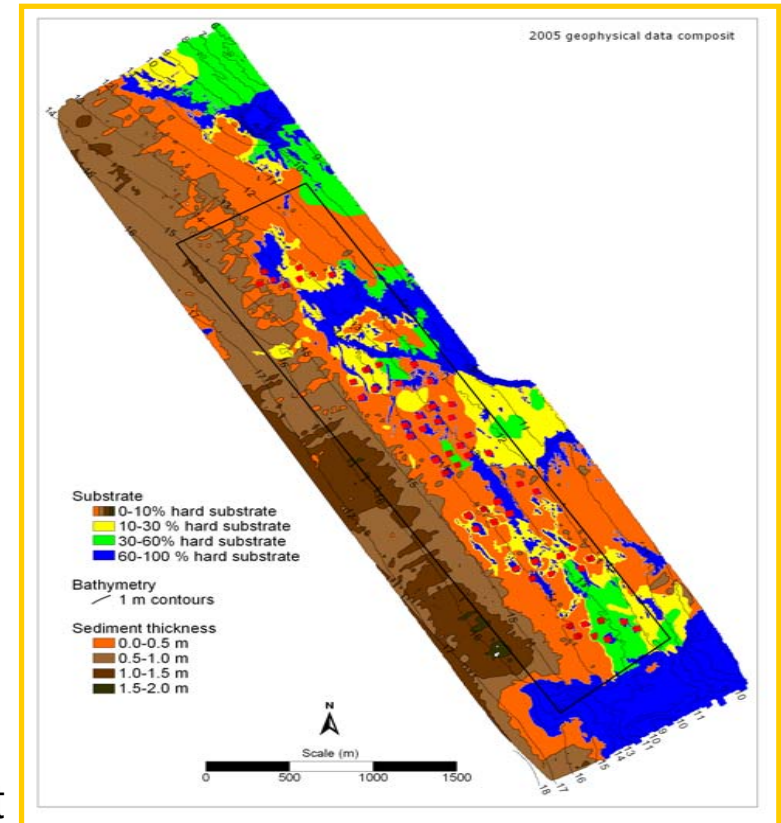
- Siting guidelines
- Reef design
- Materials criteria
- Construction specifications
- Pre-construction monitoring
- Monitoring during construction
- Post-construction monitoring



## *Phase 2: Kelp artificial reef - siting specifications*

### Criteria from the CCC permit:

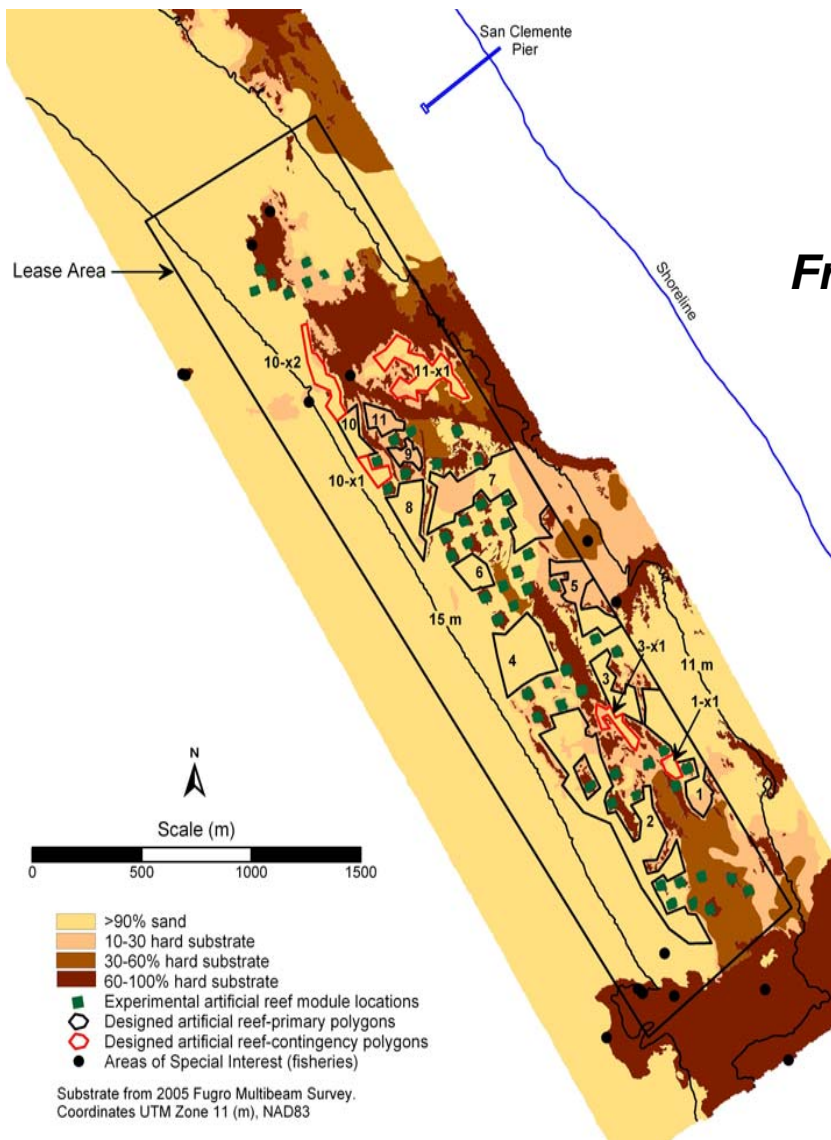
- Suitable kelp growth depths: ~ 11 to 16 m
- A thin (< 0.5 m) layer of sediment on top of bedrock or existing natural hard substrate
- Nearby-persistent natural kelp forests
- Not directly on existing natural hard-bottom substrate
- At a distance from areas with major sediment
- At a distance from areas near wastewater discharge or other human perturbations
- At a distance from areas of historical or cultural resources
- As near as practical to the SONGS-impacted natural kelp reef



## Phase 2: Reef design

**From the 2005 – 06 sonar and diver studies**

- Seafloor characterization map
- Phase 2 reef - 127.6 acres on sand
- Contingency areas - 22.4 acres on sand

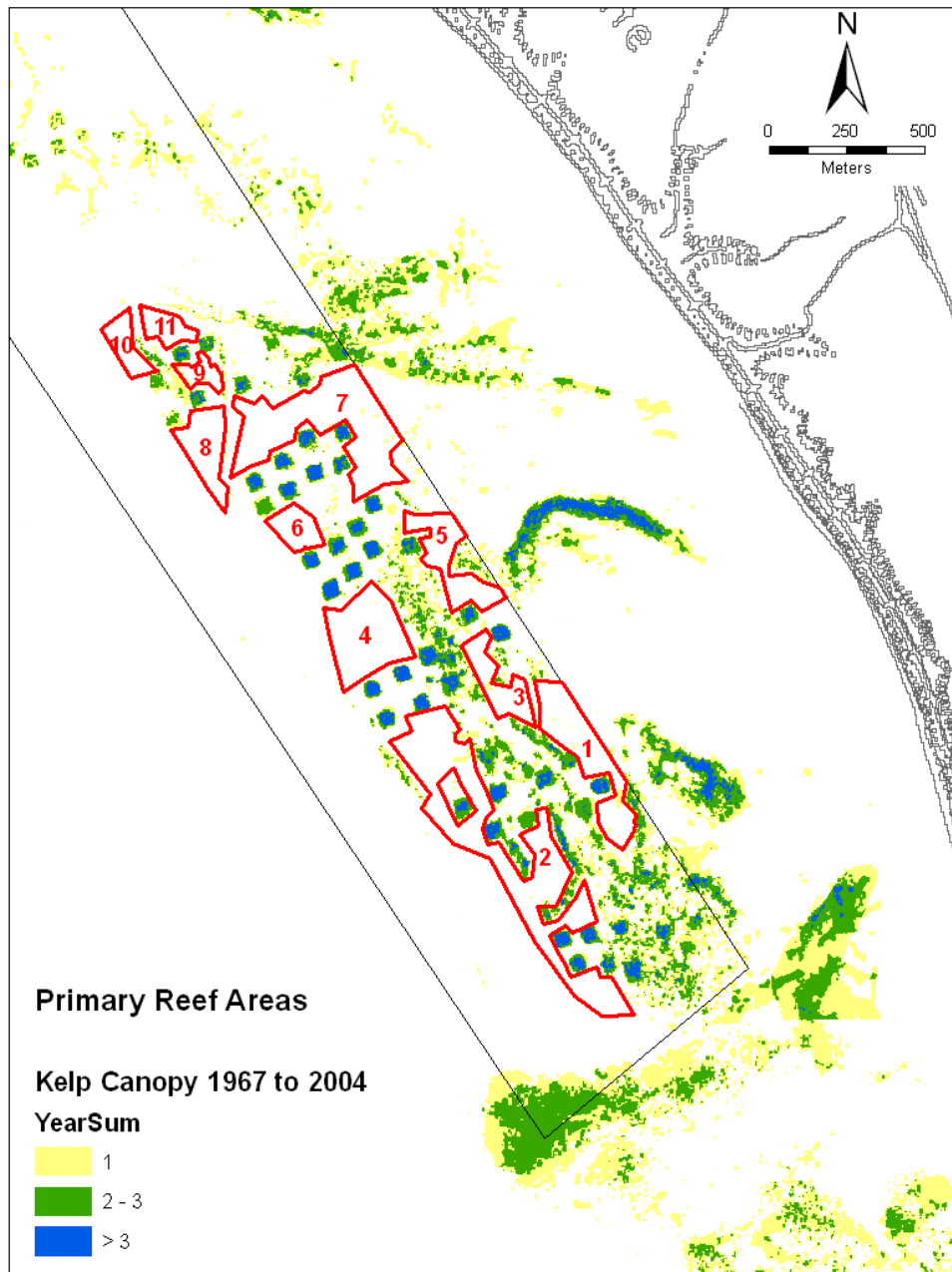


### Phase 2 - siting constraints

- 127.6 acres – in 11 polygons
- Avoid existing kelp
- Avoid Phase 1 modules
- Avoid existing hard bottom
- Avoid special interest areas

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**Phase 2: Reef polygons  
 - overlaid on  
 kelp persistence  
 historical maps**

**Kelp canopy persistence data**  
 - Dr. North's data set  
 - 1967 to 2004

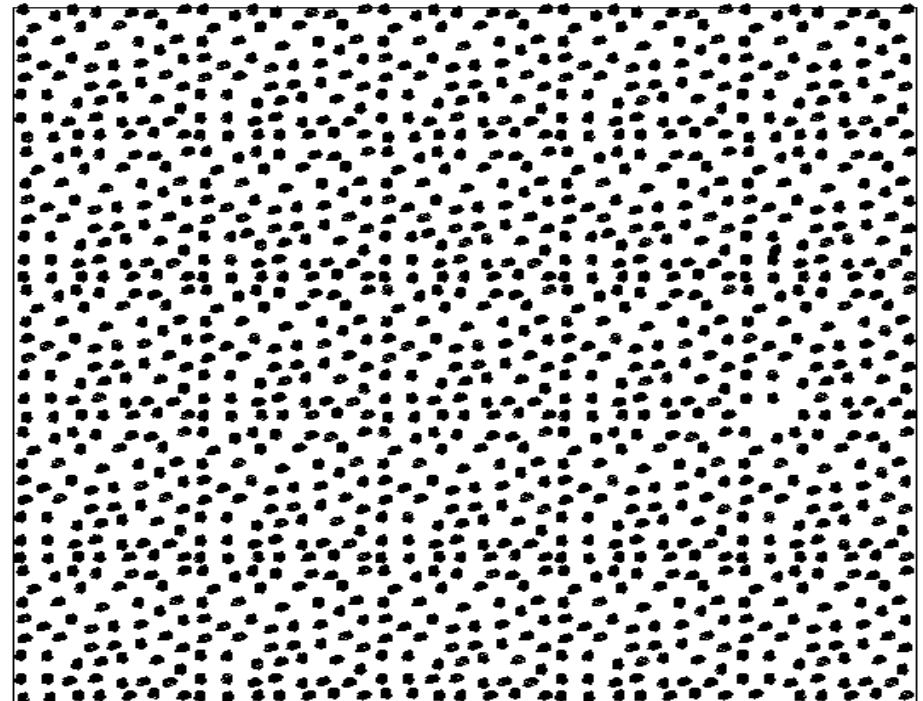
**Phase 2 reef polygons –  
 (red areas) total 127.6 acres**

**Year-sum is the cumulative  
 number of years that kelp has  
 occurred at a location.**

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## *Reef design specifications: Spread or distribution of quarry rock on seafloor*

- **Low-density substrate coverage**
  - 17% rock coverage – engineers method of calculating
  - 42% rock coverage – diving biologists point-contact method of coverage
- **790 tons of rock per acre**



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## *Reef construction areas (reef polygons)*

Area No.	Area (acres)
1	13.3
2	37.5
3	6.5
4	14.1
5	9.2
6	4.1
7	25.8
8	7.5
9	3.5
10	3.8
11	2.4
Total acreage	127.6

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## *Reef materials*

- Sedimentary and volcanic rocks that have been partially metamorphosed
- Heavy: specific gravity = 2.4 to 2.7 (water's sp. grav. = 1.0)



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## *Average reef rocks: 100, 500, and 982 lbs*



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## *Quarried rock dimensions for the Phase 2 Reef*

<b>Parameter</b>	<b>Nominal Dimensions (ft)</b>	<b>Tolerance (ft)</b>	<b>Percent of Quarried Rock At Nominal Dimensions</b>
Length	2	± 1	85
Width	1.5	± 0.5	85
Height	0.5 - 2	+1	85

**Note:** Less than 5% of the boulders shall exceed 3 feet in length.



## *Required material tests*

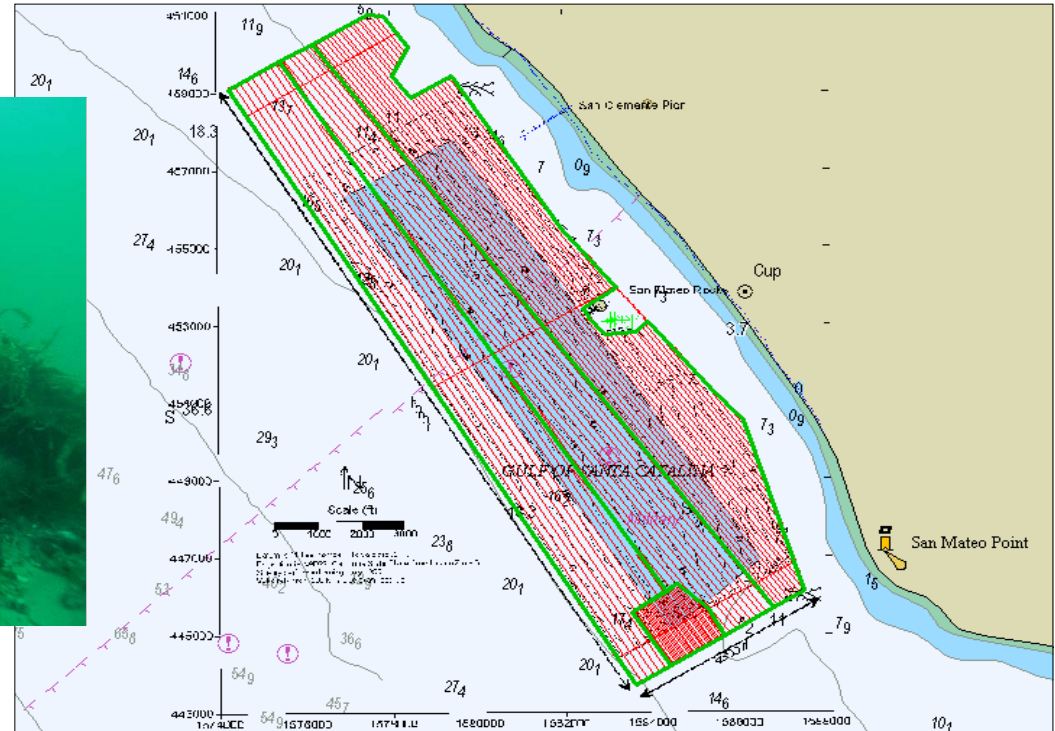
Test	California / *ASTM Test	Requirement
Apparent Specific Gravity	206 / ASTM C127	2.3 minimum
Absorption	206 / ASTM C127	4.2% maximum
Durability Index	ASTM C535	38% maximum at 500 revolutions, 50% maximum at 1000 revolutions

\* American Society of Testing and Materials

## Pre-construction assessments

### Sonar and diver-biologist bottom studies

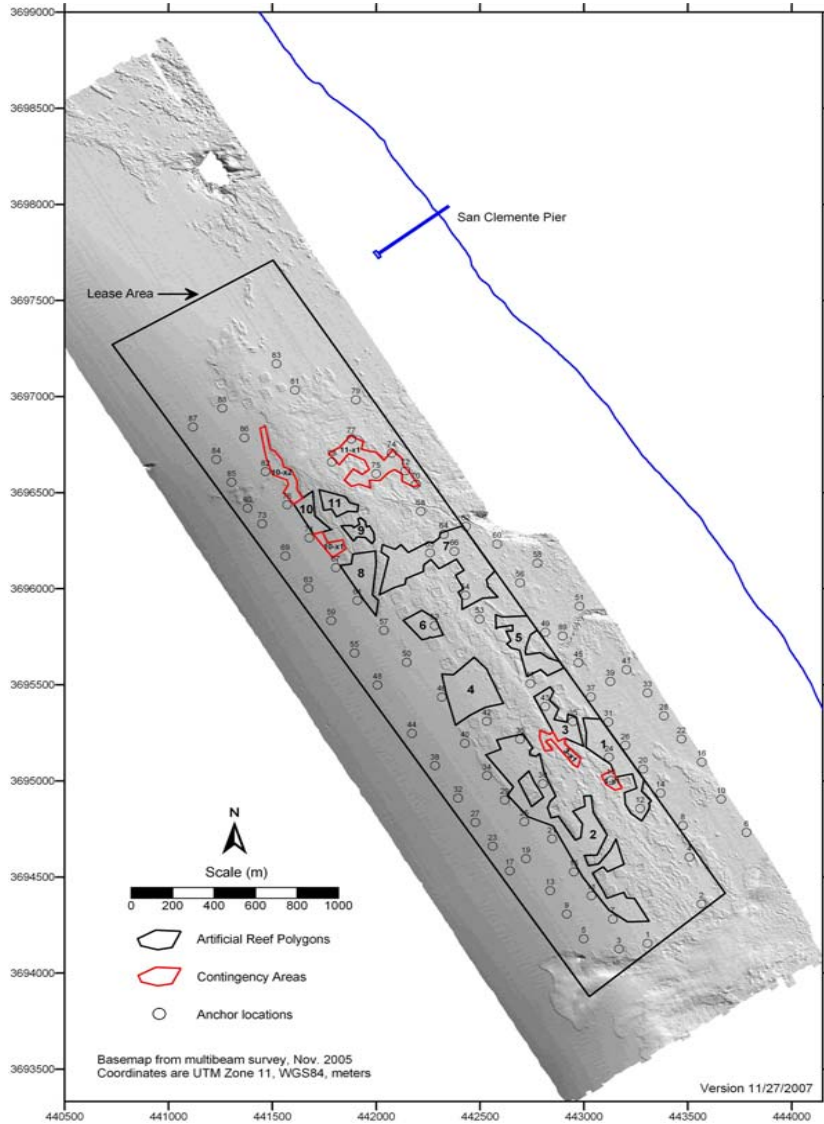
- For sensitive habitats and communities where rocks will be placed
- At anchoring positions for sensitive communities
- To assure that *Caulerpa* (an invasive algae) is not present, as required by State and Federal permits



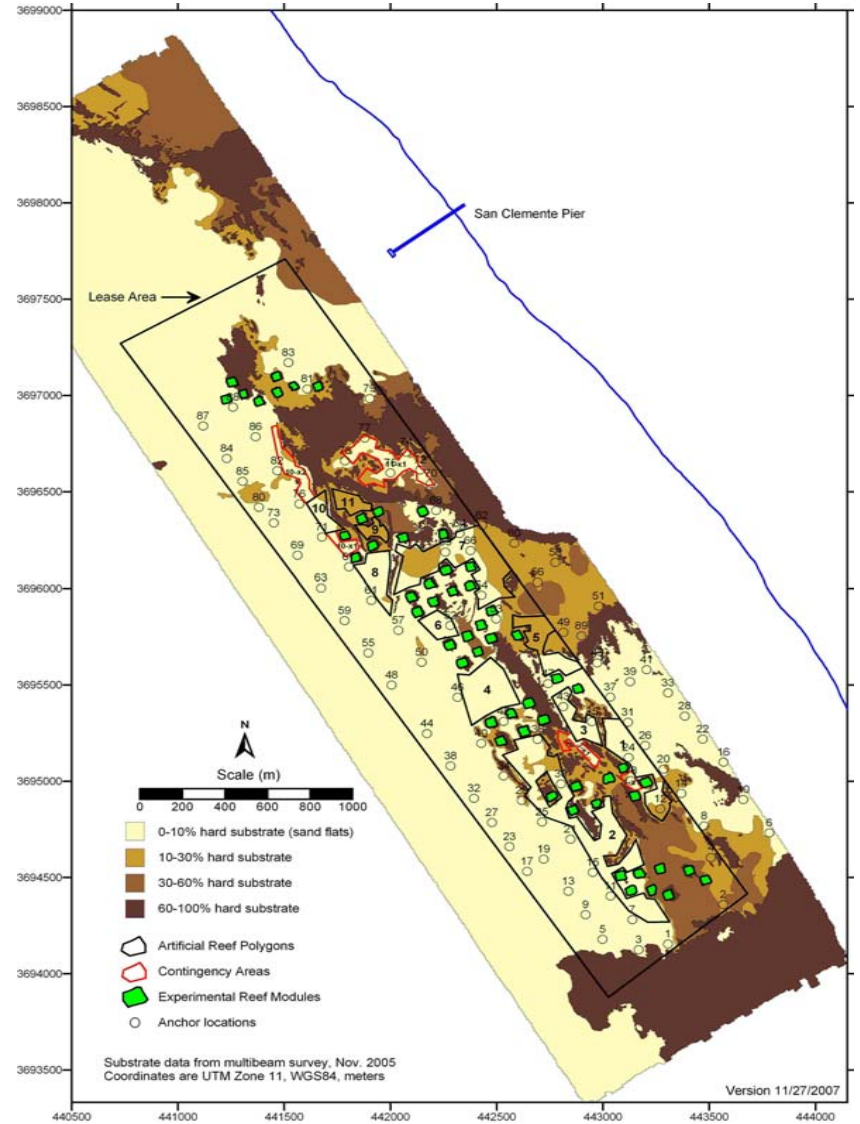
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## Anchor locations in relation to reef polygons



## Anchor locations in relation to substrate



## *Wheeler North Reef*

### *Offshore of San Clemente Beach - Activities: June to Sept. - 2008*

#### Construction

- The tugboat brings a supply barge with reef quarry rocks out to the anchored derrick barge.
- Rocks are dropped into the ocean with a skip-loader from the supply barge.
- Derrick barge will continually re-position itself using the anchor lines and winches.

#### Monitoring

- Diver and sonar assessments



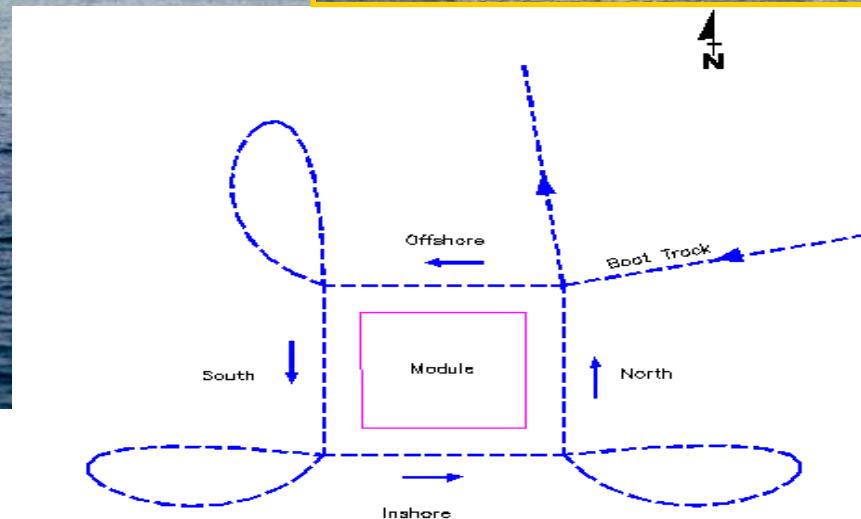
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## *Construction Monitoring Program*

### Constructed Reef – Design Verification

- Divers are deployed to verify sand to substrate ratios and general description of the reef.
- Sonar surveys to assess area of polygons and their boundaries.



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## ***Monitoring the Phase 2 Reef 2008 and Beyond***

### **During construction: June-Oct. 2008**

- Multibeam sonar surveys – bathymetry and rock cover
- Diver ground-truth surveys – verify rock coverage and assess biological communities

### **Post construction verification survey: 1-month after construction**

- Multibeam sonar of all polygon reef areas

### **Beach monitoring study: 4 or 5 years**

- Assess beach for increased kelp wrack and any reef building materials

### **Kelp mitigation reef performance monitoring: 10 years**

- Kelp habitat biological comparison with reference sites
- Kelp density and fish density performance standards
- 40-year physical parameters performance study
- Adaptive management process

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## *Wheeler North Reef – Construction Phase*

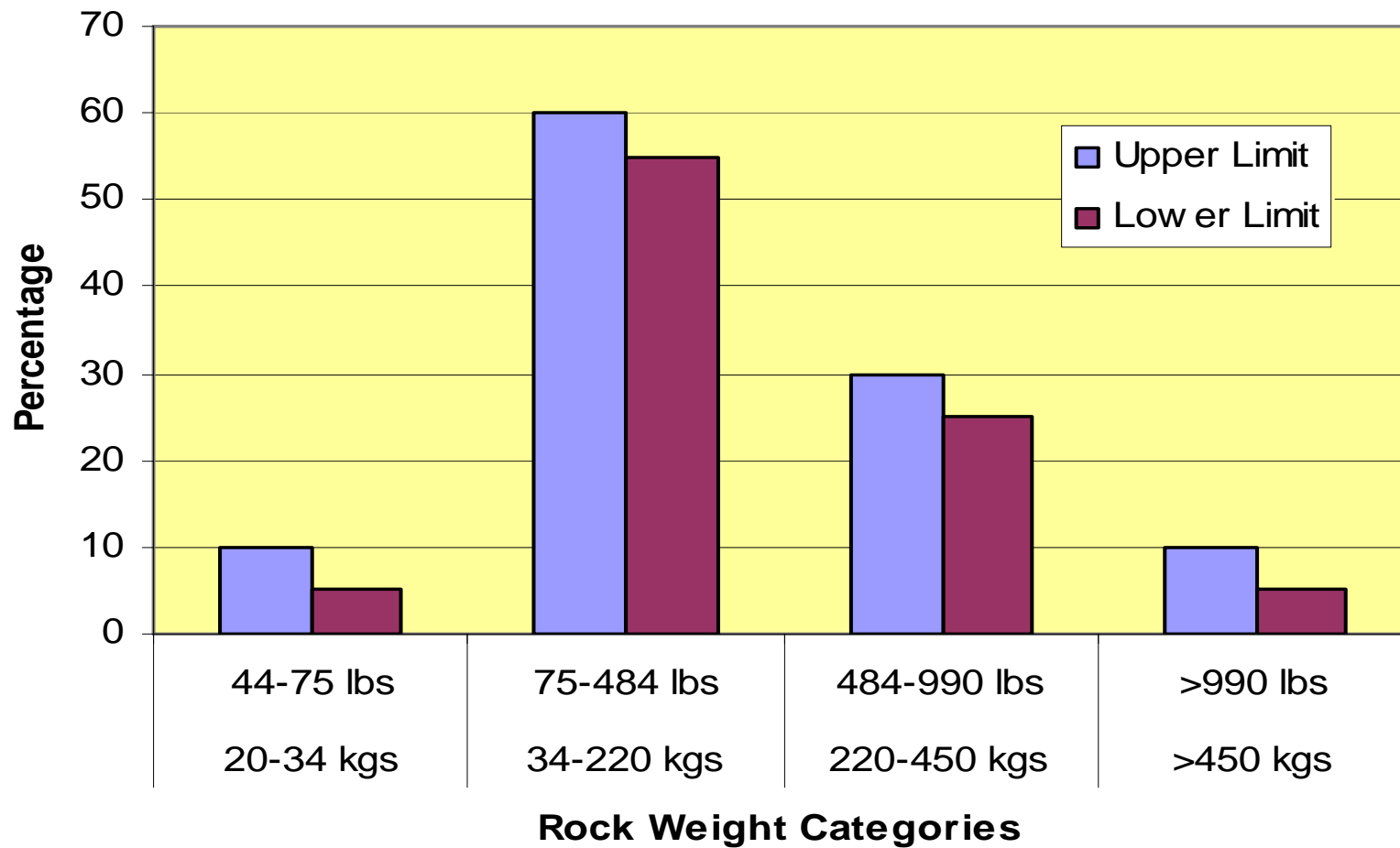
# Source of Rocks, Rock Handling, and Construction Methods

- The rock sizes required for the reef
- Rock operations at Pebbly Beach Quarry
- Reef material handling at San Clemente
- Communications with fellow mariners

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### Rock Weight Distribution Range





## ***Mining the reef material - loader at rock face***



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***Pebbly Beach Rock Quarry, Catalina Island  
Breaker (right), Grizzly (left)***



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## *Grizzly with loader*



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## ***Kelp reef rock stockpile***



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## *Barge loading equipment* *Stiff-leg crane*



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## *Derrick barge "Long Beach"*



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## *Tug boat*



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## ***Crew boat***

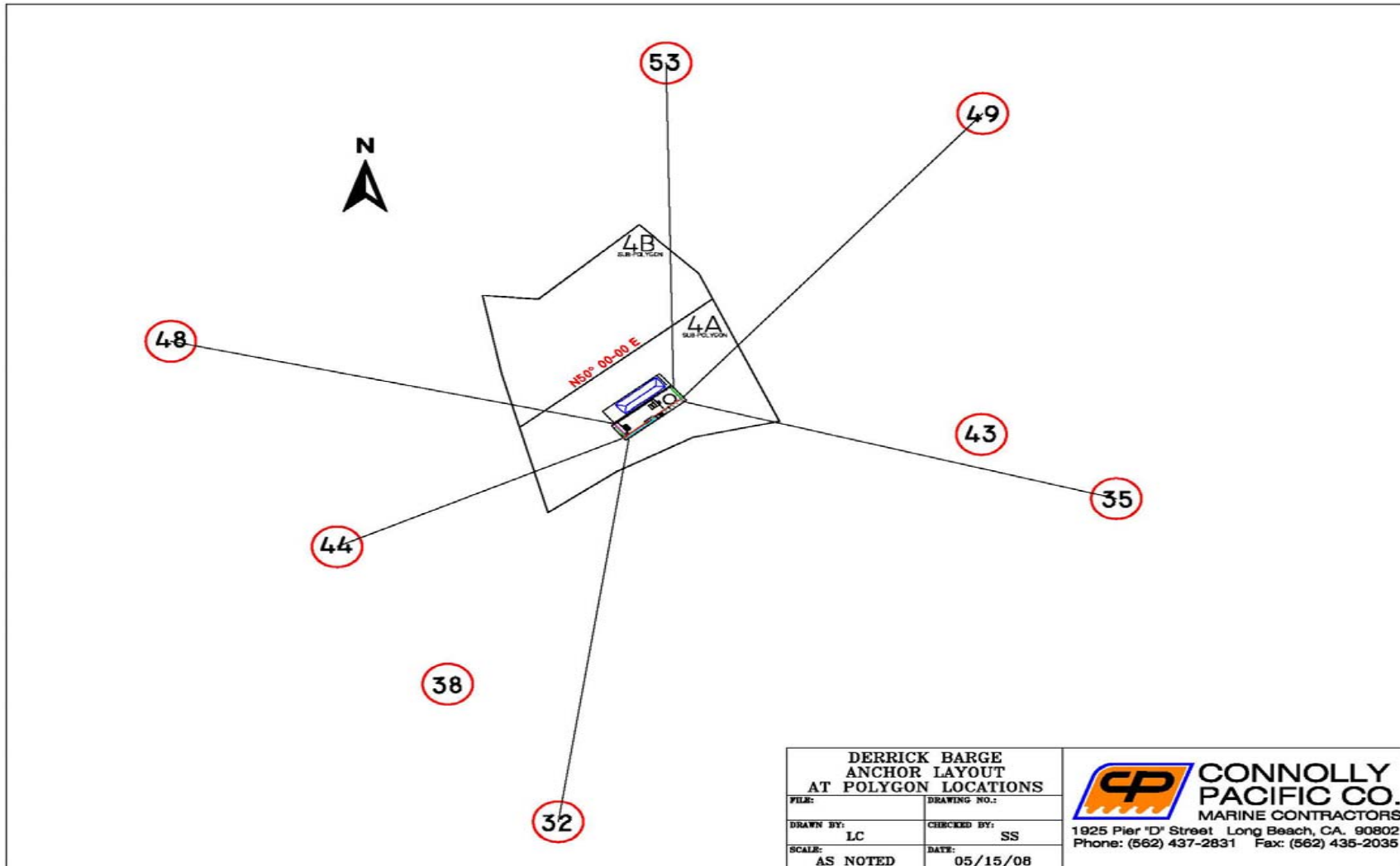


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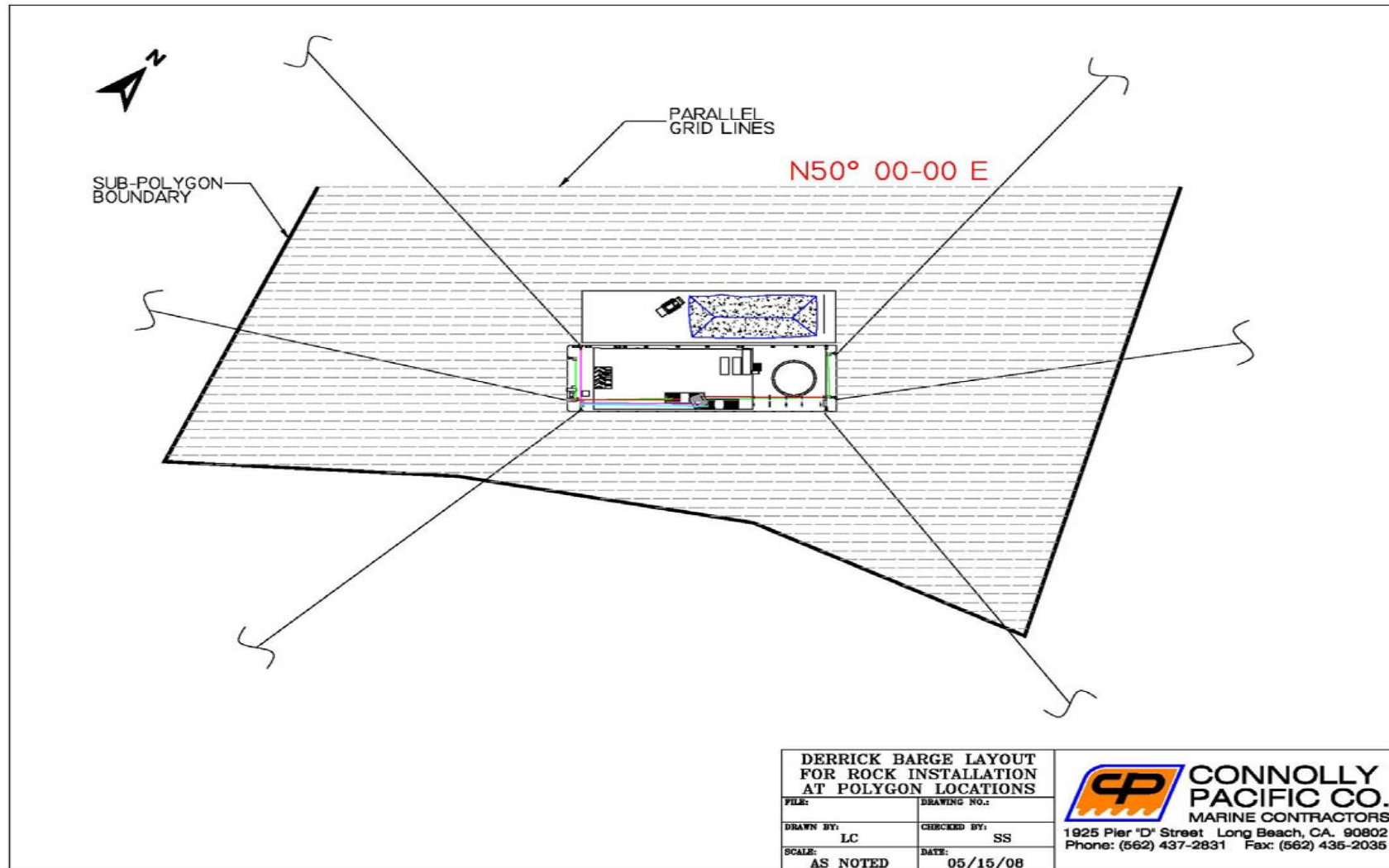
## Sub-polygon with anchor spread



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## Sub-polygon with grid lines



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***Loader placing rock for reef – from the supply barge***

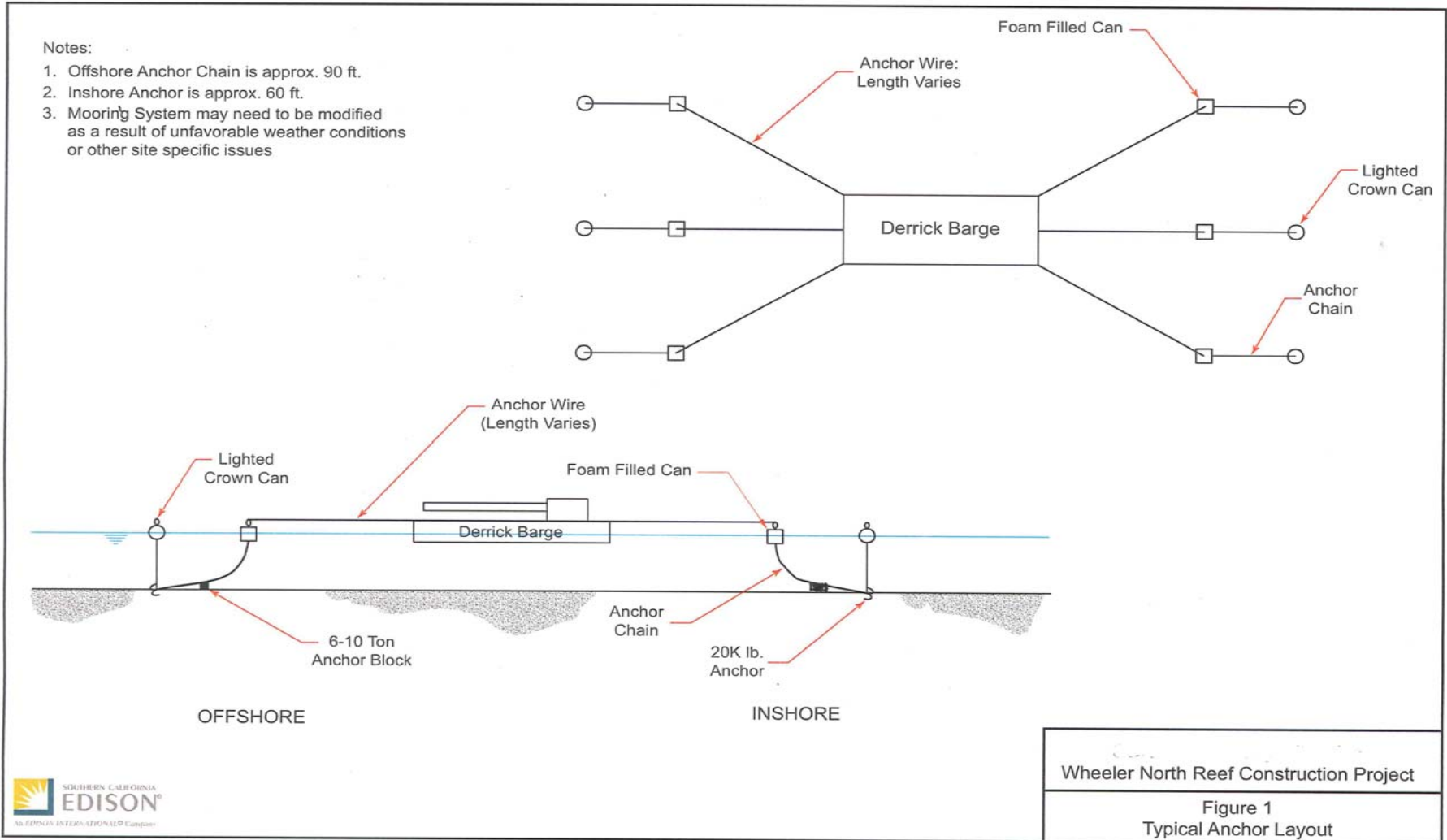


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# Typical anchor layout

- Six point anchoring plan with surge gear
- Precautions: no boating or recreational activities within 200 yards of operations



# Two safety flyers



CONNOLLY-PACIFIC CO.  
 CONTRACTORS  
 BERTH D40  
 1925 PIER D STREET  
 LONG BEACH, CALIFORNIA 90802-1069  
 PHONE: (562) 437-2831  
 FAX: (562) 435-2035

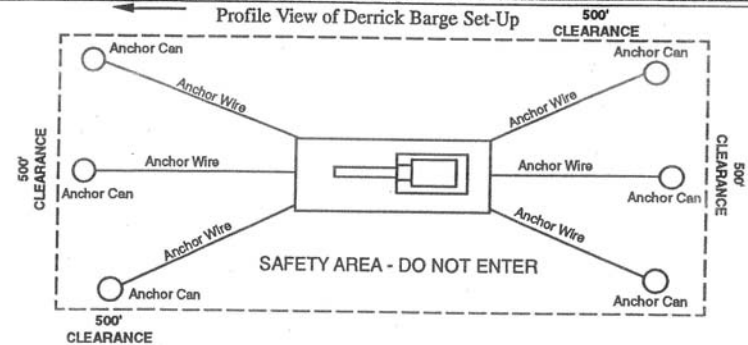
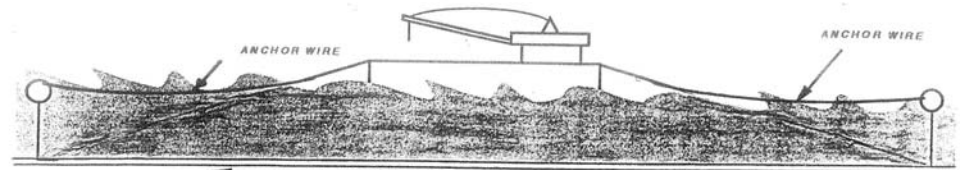
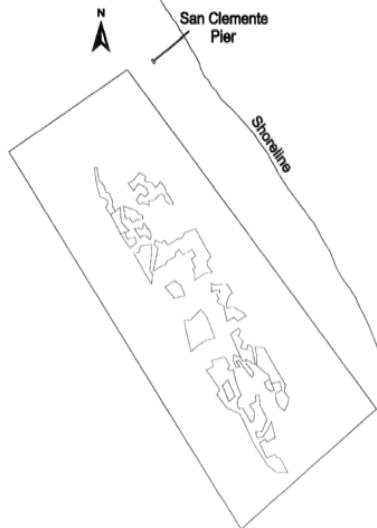
## ALERT TO BOATERS! MARINE CONSTRUCTION ACTIVES

On or about June 9, 2008 Connolly Pacific Co. will be offshore of San Clemente performing rock replacement and dive operations on the Wheeler North Reef. This project is to be completed by the end of September 2008

The diagram below indicates the locations that work will be conducted. Please avoid crossing areas where workboats, barges, and derrick barge are present.

The diagram on the reverse side shows the approximate configuration of anchor gear with relationship to the derrick barge. When transiting the area use caution and remain outside the anchor spread, that is, always put the anchor buoys between your vessel and the derrick barge.

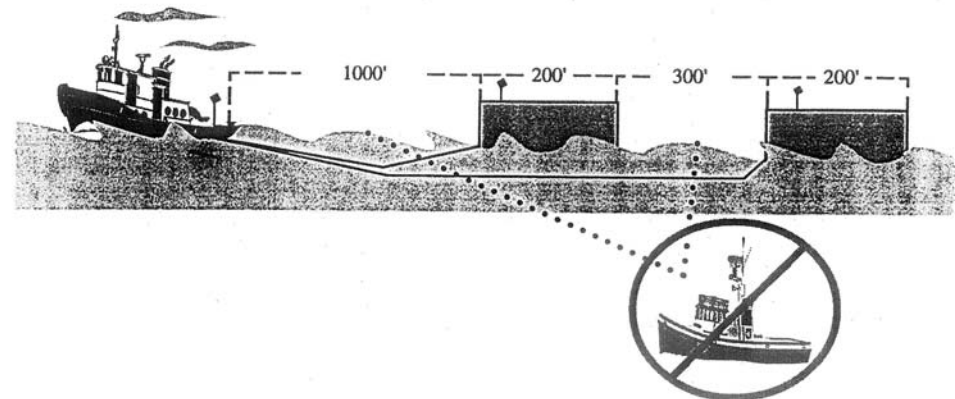
This project is listed in the U.S. Coast Guard Local Notice to Mariners, which gives appropriate call signs and frequencies for the derrick barge and tug boats working on this project. Thank you for your cooperation.



## CAUTION:

Do not cross tow wire of tug & tow. Barges and boat are marked by towing shapes (Diamond). Consult...

"Rules of the Road" and "Local Notice To Mariners".



# Questions & Answers

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