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**SAN ONOFRE NUCLEAR GENERATING STATION (SONGS)
MITIGATION PROGRAM:****EXECUTIVE DIRECTOR'S DETERMINATION FOR TYPE AND COVER OF HARD
SUBSTRATE FOR THE MITIGATION REEF**

Following is a report on one of the mitigation requirements of Southern California Edison Company's (SCE) coastal development permit for the San Onofre Nuclear Generating Station (SONGS) Units 2 and 3 (permit no. 6-81-330-A, formerly 183-73). The purpose of this report is to present to the Commission for discussion and possible action the Executive Director's determination for the type of hard substrate and the percent cover of hard substrate that is required of the artificial reef to be constructed to mitigate for the loss of kelp forest habitat caused by SONGS operations. *No formal Commission action is required.*

SONGS PERMIT HISTORY

In 1974, the California Coastal Zone Conservation Commission issued a permit (No. 6-81-330-A, formerly 183-73) to Southern California Edison Company for Units 2 and 3 of the San Onofre Nuclear Generating Station (SONGS). A condition of the permit required independent scientific study of the impacts of the operation of Units 2 and 3 on the marine environment offshore from San Onofre, and mitigation of any adverse impacts. Long-term scientific studies conducted by the former independent Marine Review Committee (established by the Coastal Commission in 1974) concluded that the operation of SONGS Units 2 and 3 adversely impacts the San Onofre kelp forest community. The SONGS coastal development permit was amended in 1989 to require Southern California Edison to mitigate this impact by constructing an artificial reef that will provide in-kind replacement for the loss of kelp forest habitat caused by SONGS' operations.

The overall goal of the SONGS artificial reef mitigation project is to compensate for the loss of kelp bed resources including giant kelp, understory algae, invertebrates, and fishes. The project is being done in two phases: a short-term, small-scale, experimental phase followed by a longer-term, larger-scale mitigation phase. The primary purpose of the experimental phase (completed in December 2004) was to determine the substrate types and bottom coverages that best provide: (1) adequate conditions for giant kelp recruitment, growth and reproduction, and (2) adequate

conditions for establishing and sustaining other reef-associated biota, including benthic algae, invertebrates and fishes.

Originally the SONGS permit required that the mitigation reef be constructed of quarry rock, and that the rock cover at least two-thirds of the sea floor within the boundary of the mitigation reef. On April 9, 1997 the Commission approved a permit amendment that authorized the Executive Director to change these requirements if the results of the experimental reef indicated that a different coverage of rock or different type of hard substrate would replace a minimum of 150 acres of medium to high density giant kelp and associated kelp forest biota. Thus, a major objective of the experimental artificial reef was to determine whether substrate coverages less than two-thirds and substrate types other than quarry rock (e.g., rubble concrete) can be used to meet the performance standards for the mitigation reef. Independent contract scientists working for the Commission completed the five-year monitoring of the experimental reef in December 2004 and submitted a final report on the findings and recommendations of the experimental phase to the Executive Director on August 1, 2005. These findings and recommendations form the basis of the Executive Director's decision on the type and percentage cover of hard substrate required for the mitigation reef.

EXECUTIVE DIRECTOR'S DETERMINATION

Type of artificial substrate

The mitigation reef shall be built of quarry rock or rubble concrete having dimensions and specific gravities that are within the range of the rock and concrete boulders used to construct the SONGS experimental artificial reef. The size structure of the material to be used for the mitigation reef may vary from that of the experimental reef provided that the vast majority of material used to construct the mitigation reef are within the size range selected by the sorting procedure used for the experimental reef.

Bottom coverage of artificial substrate

The percent of the bottom covered by quarry rock or rubble concrete on the mitigation reef shall average at least 42%, but no more than 86% (as determined using the uniform point contact method employed by divers during the five-year experimental reef phase). Discrete areas of the mitigation reef may be comprised of substrate that covers less than 42% or more than 86% of the bottom, but the overall average coverage of hard substrate of the 150 acre mitigation reef shall be between 42% and 86%. However, if such areas of low or high coverage are large enough to cause non-compliance with any of the performance standards, then SCE will be required to build a mitigation reef that is larger than the minimum 150 acres.

FINDINGS AND RECOMMENDATIONS FROM THE EXPERIMENTAL REEF PHASE IN SUPPORT OF THE EXECUTIVE DIRECTOR'S DETERMINATION

The final plan and coastal development permit approved by the Commission in July 1999 was for an experimental artificial reef located off San Clemente, California that tested eight different

reef designs that varied in substrate composition (quarry rock or rubble concrete), substrate coverage (actual coverage was measured higher than the intended nominal coverage of 17%, 34%, and 67%, at 42%, 60% and 86%, respectively), and presence of transplanted kelp (Exhibits 1 and 2). All eight reef designs were represented as individual 40 m x 40 m modules that were replicated in seven locations (i.e., blocks) for a total of 56 artificial reef modules totaling 22.4 acres. The kelp transplant portion of the experiment was successfully completed in 2001 at which time monitoring of the 14 kelp transplant modules was suspended]

The results and the contract scientist's recommendations from the five-year experimental phase are summarized below. The complete 136-page report, *Final Report on the Findings and Recommendations of the Experimental Phase of the SONGS Artificial Reef Mitigation Project* (August 2005) is incorporated herein by reference as Appendix A, which can be downloaded as a PDF file from the Commission's website at:

<http://www.coastal.ca.gov/energy/songs/songs-report-8-1-2005.pdf>

General findings

The results obtained from the five-year experimental phase of the SONGS artificial reef mitigation project indicated that a low relief concrete rubble or quarry rock reef constructed off the coast of San Clemente, CA has a very good chance of providing adequate in-kind compensation for the loss of kelp forest biota caused by the operation of SONGS Units 2 & 3. Specifically, all six artificial reef designs and all seven locations (i.e., blocks) tested showed a near equally high tendency to meet the performance standards established in the coastal permit (see Appendix B) for the mitigation reef. These standards pertain to the amount of artificial substrate that must remain available for colonization on the mitigation reef as well as the abundance and number of species of algae, invertebrates and fish that colonize it.

Substrate type

Artificial reef modules constructed of quarry rock and rubble concrete supported very similar biological communities. Importantly, there was no evidence suggesting that one type of material was consistently better than the other in terms of its ability to meet the performance standards established for the mitigation reef. Different conclusions might be drawn if the sizes and shapes of the two substrate types were to change. For this reason the dimensions and specific gravities of the materials used to construct the 150 acre mitigation reef should be similar to those used in the experimental phase of the SONGS artificial reef mitigation project.

Substrate coverage

A relatively low coverage of hard substrate may be sufficient for meeting some of the performance standards contained in the permit. For example, the standard for giant kelp of four adult plants per 100 m² could conceivably be achieved by placing as few as four boulders per 100 m² of bottom. When determining the minimum coverage of hard substrate for the mitigation reef, however, it is important to recognize that the goal of the artificial reef is to compensate for

losses to an entire kelp forest community of giant kelp, understory algae, invertebrates and fishes.

Data collected during the experimental phase of the SONGS mitigation project indicated that the mitigation reef will have the greatest chance of meeting all the performance standards if it has an average coverage of hard substrate that is at least as high as that of the low coverage artificial reef design tested in the five-year experiment, which averaged 42%. The percent cover of benthic reef algae and invertebrates on the artificial reef modules exhibited a strong positive relationship to the percentage of the bottom covered by artificial substrate. Importantly, there was no evidence that modules with lower coverage of artificial substrate supported a proportionally greater coverage of benthic biota; in fact, there was a weak relationship that suggested the opposite was true. Moreover, results from a boulder transplant experiment showed that natural rock and quarry rock supported similar abundances and species of algae and invertebrates indicating that all else considered equal, an artificial reef will not inherently support more organisms than a similar natural reef. *Collectively these data indicate that the more closely the substrate coverage of an artificial reef mimics that of a natural reef, the more likely the artificial reef will support a biota that is similar in abundance and diversity to that of the natural reef. The mean cover of hard substrate on the two natural reference reefs during 2000–2004 was 49% and 52%, which was intermediate between the low and medium coverage artificial reef designs tested in the experimental phase.*

The different levels of substrate coverage examined differed little in their ability to meet the performance standards. However, artificial reef modules with the low bottom coverage design were near the lower limit of the critical range for some of the performance standards. Moreover, the low coverage designs had the lowest probability (i.e., ~ 50%) of attaining the performance standard for fish standing stock. These results argue that an artificial reef design with a mean bottom coverage much less than the low coverage designs (i.e., 42%) would have a lower probability of meeting some of the performance standards.

The results described above coupled with the overall goal of compensating for losses to all components of the kelp forest community provide compelling reasons to require artificial substrate to cover an average of at least 42% of the bottom of the 150 acre mitigation reef. However, too much hard substrate could cause an artificial reef to produce a community that was substantially different from nearby natural reefs; therefore, the bottom coverage of artificial substrate should not exceed 86%, which was the mean value of the high bottom coverage designs tested in the experimental phase.

Dominance by reef associated fish and invertebrates that results in the reduced abundance of understory algae has been observed on artificial reefs with high bottom relief in California. None of the artificial reef designs tested in the experimental phase of the SONGS artificial reef mitigation project averaged more than 1 m in vertical relief and all were found to be relatively successful in meeting most of the performance standards. Thus, the mitigation reef should maintain the low profile design tested in the experimental phase and the average vertical relief of the 150 acre footprint should not exceed 1 m. The incorporation of a few high relief areas into the design of the mitigation reef may be useful for meeting certain performance standards (e.g.

standing stock of kelp bed fish). If such high relief areas are included in the mitigation reef, then they should be included as acreage that is in addition to the minimum 150 acre footprint.

Location of mitigation reef

No areas within the existing project site were found to be unsuitable for supporting kelp forest biota over the long term. It should be noted however, that higher rates of sand burial were observed in the most northern location (block 7), which could cause the amount of reef material deposited in this area to fall below the "90% of the initial" criteria required by the performance standard for hard substrate.¹ These results argue for building the majority of the mitigation reef within the 356 acre project site, preferably away from the northern portion of the site where higher rates of sand burial were observed.

While the overall performance of the seven blocks in meeting the performance standards was similar, significant differences were observed among the blocks for several of the biological variables measured. Such "block effects" are believed to have resulted primarily from species characteristics or competitive interactions that were shaped by initial colonization patterns, rather than inherent differences in the suitability of different blocks to support kelp forest biota. For example, the greater cover of understory algae in blocks 6 and 7 likely resulted from reduced shading by giant kelp, whose recruitment density declined with distance from San Mateo (most likely due to reduced spore dispersal to more distant locations). Similarly, the lower density of the sea fan *Muricea* in blocks 6 and 7 reflected lower initial rates of colonization, which were likely due to limitations on larval dispersal. Such founder effects on the artificial reef will likely diminish over time as new source populations become established and/or extent populations become diminished (i.e., via disturbance), thereby reordering spatial patterns of abundance and species richness of reef biota.

Aerial photographs, testimony from fishermen, and results from this study indicated that much of the natural hard substrate present in the project site serves as suitable habitat for a variety of kelp forest biota, some of which are economically valuable. As per the SONGS coastal development permit, reef construction should minimize the disruption of natural reef and cobble habitats within the project site and avoid placing artificial reef material in hard bottom areas known to support kelp forest biota and commercial and recreational fisheries. Additional diver and sonar surveys of the bottom that are capable of distinguishing different types of consolidated (e.g. mudstone, cobble/boulder, bedrock) and unconsolidated (e.g., sand, shell hash) substrates coupled with analyses of previously collected data (e.g., aerial imagery of kelp, fishing logs) should be done in the build-out site prior to constructing the mitigation reef to avoid placing artificial reef material in areas that are likely to support kelp forest biota and commercial and recreational fisheries

Potential threat of undesirable or invasive species

One of the more notable undesirable or invasive species on shallow artificial reefs in southern California is the sea fan *Muricea* spp. It is known to occur at high densities and exclude kelp, understory algae and other sessile invertebrates. Of particular concern to the SONGS artificial

¹ Performance standard 2.4a.4 of the SONGS permit states, in part: "At least 90 percent of the exposed hard substrate must remain available for attachment by reef biota."

reef mitigation project is the ability of *Muricea* to withstand disturbance and ultimately displace giant kelp, which appears to have happened at nearby Pendleton and Torrey Pines artificial reefs

Data collected on *Muricea* spp. recruitment, growth, and survivorship during the experimental phase of the SONGS artificial reef mitigation project indicated that it is reasonable to expect high densities of large *Muricea* will eventually invade the mitigation reef and adversely affect the abundance of giant kelp and other reef biota. Continuous recruitment of *Muricea* coupled with relatively high survivorship has enabled it to persist at relatively high densities on the experimental reef modules SCAR since 2002. Moreover, the *Muricea* that recruited to experimental reef modules seemed to grow faster than the rate previously reported for the species. Thus, not only is *Muricea* density likely to remain high due to relatively low mortality and constant recruitment, it appears to be growing relatively fast and the size structure of the population will soon be large enough to out compete giant kelp and other sessile organisms for space.

There was no indication that any of the features of reef designed examined during the experimental phase of the SONGS artificial reef mitigation project would deter *Muricea* from becoming established at densities high enough to impair the functions of the reef. Sea fan densities were not significantly affected by the type and bottom coverage of artificial substrate, depth or by position on the reef (i.e., edge vs. middle of module). Data on sea fan survivorship, though limited, suggest that mortality rates of young colonies were largely independent of the bottom cover of quarry rock, rock size, substrate inclination, and local population density. This is important because one might expect rates of mortality to be highest in young stages. Lastly, individual growth (as indicated by population size structure) in *Muricea* was roughly similar on the six different artificial reef designs.

Given the above results it is unclear what features, if any, can be incorporated into the design of the mitigation reef to deter the invasion of Muricea, and still provide adequate habitat for a natural kelp forest community. Additional insight into the factors controlling the distribution and abundance of Muricea may be obtained through continued monitoring of the experimental reef modules, and correlative studies and small-scale manipulative experiments involving sites that vary greatly in sea fan abundance. Remediation will be required in the event that Muricea invades the mitigation reef and reaches densities and sizes that are large enough to impair the important functions of the reef community. Cost effective and environmentally acceptable methods for managing Muricea should be explored and developed during the interim period prior to the construction of the mitigation reef to insure the goal of in-kind compensation for the loss of kelp forest habitat at San Onofre caused by the operation of SONGS Units 2 and 3.

NEXT STEPS

If the Commission agrees with the Executive Director's determination contained in this report, the Executive Director will issue his determination to SCE and SCE will develop its preliminary mitigation reef plan for review and approval.

Following the approval of the preliminary plan, SCE will develop the final plan and environmental analyses for the mitigation reef and submit to the Commission the final mitigation plan in the form of a coastal development permit application. The Commission will hold a public hearing to consider the application for the construction of the full-scale mitigation reef.

Exhibit 1: Project Site

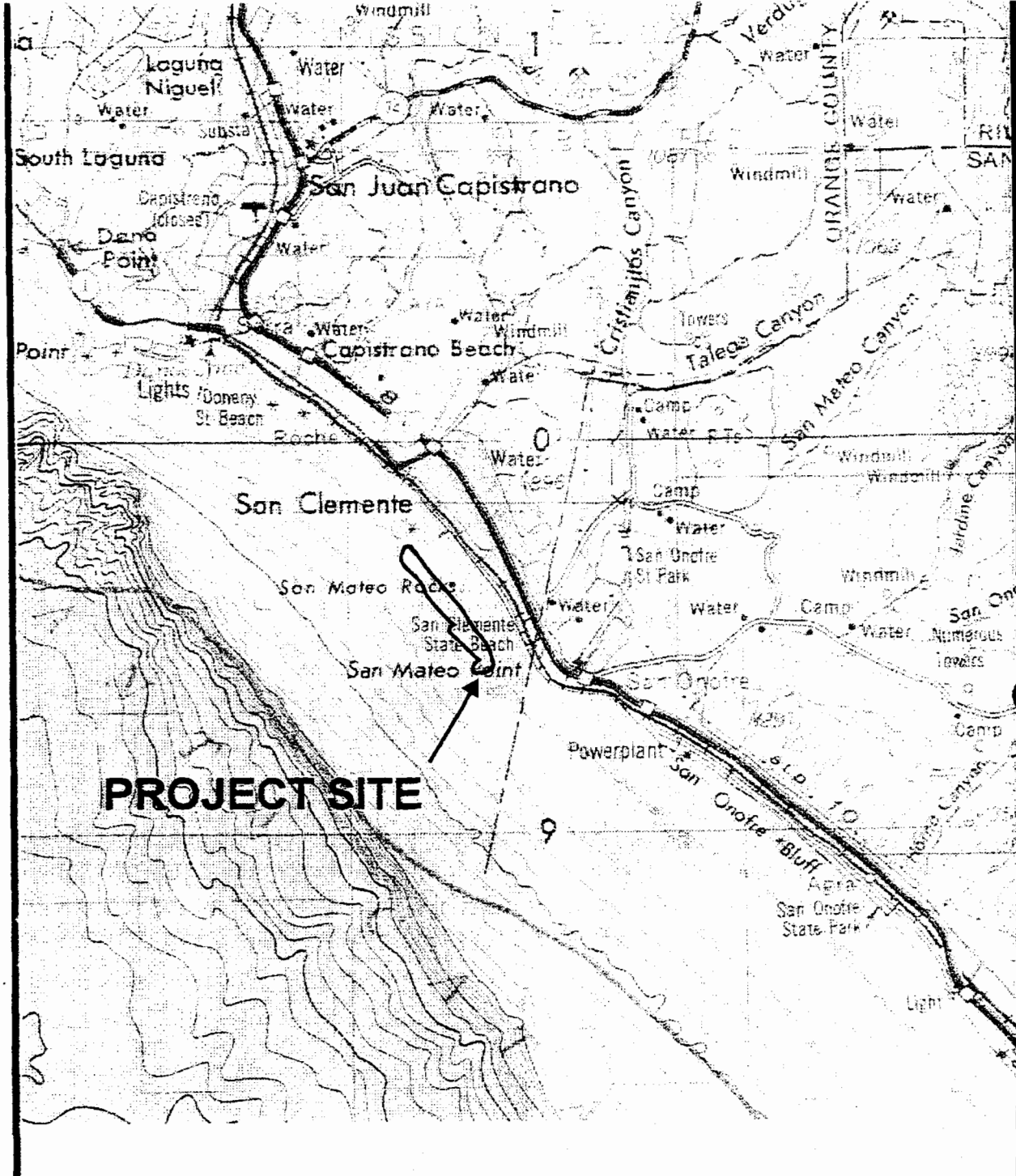
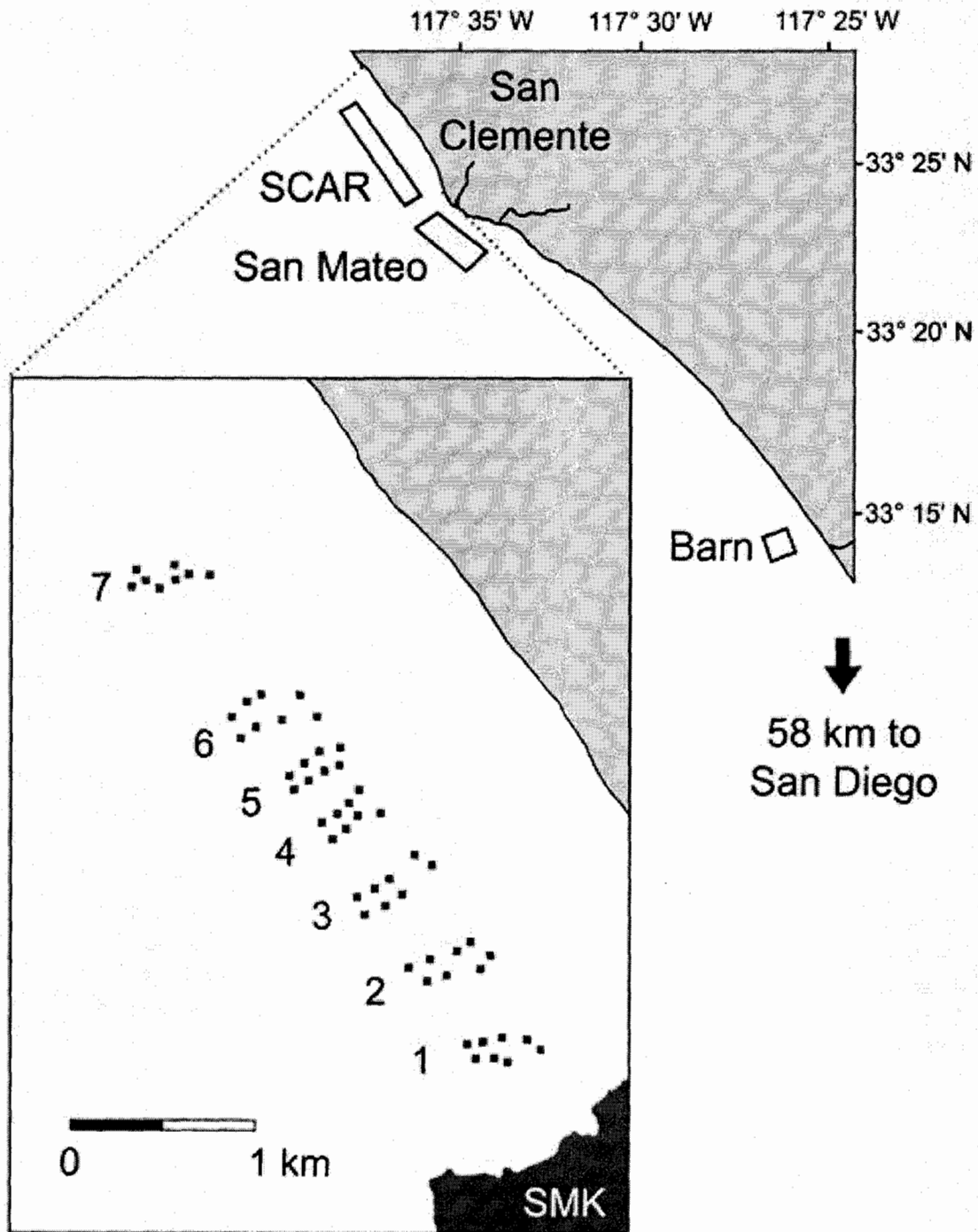


Exhibit 2: San Clemente Artificial Reef (SCAR) location and layout



Appendix A: Final Reef Report

The *Final Report on the Findings and Recommendations of the Experimental Phase of the SONGS Artificial Reef Mitigation Project*, dated August 1, 2005, is incorporated herein by reference and can be found on the Commission's website at:

<http://www.coastal.ca.gov/energy/songs/songs-report-8-1-2005.pdf>

B. CONDITION C: KELP REEF MITIGATION

NOTE: The following text of revised Condition C includes key elements of the Commission's 1991 permit condition. Site assessment, site selection, and performance standards and monitoring are substantially the same as the 1991 condition. The changes that the Commission approved on April 9, 1997 are:

1. Clarification and modification of the condition as it relates to the two phases of the reef (experimental and mitigation reef). These changes include more specifics about the goals of the experimental reef.
2. Reduction of the size of the reef required in the 1991 permit condition from 300 acres of medium-to high-density kelp to 150 acres of medium-to high-density kelp and the addition of \$3.6 million to OREHP to fund a mariculture/fish hatchery program.

Mitigation for losses to kelp bed resources through the construction of an artificial reef will occur in two phases, an initial experimental phase followed by a mitigation phase.

1.0 EXPERIMENTAL REEF

The permittee shall, using qualified professionals and in consultation with the Executive Director, select a site and construct an experimental artificial reef for kelp to determine the optimal reef design for mitigating resource losses at the San Onofre Kelp bed (SOK) caused by SONGS' operation. The experimental reef shall test the design parameters necessary to provide a persistent giant kelp forest and associated ecosystem.

1.1 Site Assessment

The permittee shall select at least three potential sites and conduct pre-construction site assessments at these potential sites.

The permittee shall obtain sufficient information about each potential experimental reef site to allow the permittee to determine which site best meets the final site selection criteria described below. This information shall be used in both the site selection and design of the experimental reef. Necessary information shall include: (1) a description of existing biota at the site, (2) a reasonable prediction of the likelihood that a healthy kelp bed will be established and persist at the site, (3) a reasonable prediction of the extent of rock burial due to sediment deposition and/or sinking into soft sediment that could be expected at the site, and (4) a prediction of the effect of the proposed reef on local sand transport and local beach profiles.

1.2 Final Site Selection

Selection of the actual experimental reef site from among the potential sites shall be based on, but not limited to, the following criteria:

1. Location as close as possible to the SOK, and preferably between Dana Point (Orange Co.) and Carlsbad (San Diego Co.), but outside the influence of the SONGS discharge plume and water intake, and away from Camp Pendleton.
2. Minimal disruption of natural reef or cobble habitats and sensitive or rare biotic communities.
3. Suitable substrate with low mud and/or silt content (e.g., hard-packed fine to coarse grain sand, exposed cobble or bedrock without a persistent kelp biological community, or cobble or bedrock covered with a thin layer of sand).
4. Location at a depth locally suitable for kelp growth and recruitment.
5. Location near a persistent natural kelp bed.
6. Location away from sites of major sediment deposition.
7. Minimal interference with uses such as vessel traffic, vessel anchorages, commercial fishing, mariculture, mineral resource extraction, cable or pipeline corridors.
8. Location away from power plant discharges, waste discharges, dredge spoil deposition sites, and activities of the U. S. Marine Corps.
9. Location that will not interfere with or adversely affect resources of historical or cultural significance such as shipwrecks and archeological sites.

1.3 Experimental Reef Design and Final Plan

The permittee shall submit a preliminary plan describing the location and design of the experimental reef to the Executive Director for review and approval. Following the Executive Director's approval of the preliminary plan, but no later than June 30, 1997, the permittee shall apply for a coastal development permit for construction of an experimental reef for kelp. The coastal development permit application shall include an experimental reef plan that specifies the design and construction methods of the experimental reef. The design of the reef shall allow for identification of those parameters important to the establishment of a persistent, healthy giant kelp forest and associated ecosystem.

The primary goal of the experimental reef shall be to test several different substrate types and configurations to determine which of these can best provide: (1) adequate conditions for giant kelp recruitment, growth, and reproduction and (2) adequate conditions to

establish a community of reef-associated biota. Information gained from the experimental reef will be used in designing the mitigation phase of Condition C. This will help to ensure full compensation for kelp bed losses in a cost-effective manner.

The total areal extent (as measured at the ocean bottom and equal to the surface area within the perimeter of the reef's outermost hard substrate/sand interface area, as installed by the permittee) of the experimental reef shall be a minimum of 16.8 acres.

1.4 Experimental Reef Construction

The experimental reef shall be constructed within 12 months of approval of the coastal development permit for the experimental reef. A post-construction survey shall be carried out by the permittee to demonstrate that the experimental reef was built to approved specifications. If the Executive Director determines that the reef was not built to specifications, the permittee shall modify the reef to meet the approved specifications within 90 days of the post-construction survey. Extension of this time limit may be granted by the Executive Director for good cause.

1.5 Experimental Reef Monitoring

The experimental reef shall be monitored independent of the permittee (as per Condition D) for 5 years. A monitoring plan will be developed by Commission scientists pursuant to Condition D. The independent monitoring program for the experimental reef shall be designed to assess the effectiveness of alternative reef designs, materials and management techniques. Monitoring shall be conducted with funds provided by the permittee through Condition D and shall include the monitoring and management of any additional experiments deemed necessary by the Executive Director. Successful completion of the experimental reef does not depend on the achievement of performance standards. However, information on the performance of different module designs will be used to identify those designs that would be likely to meet the performance standards for the mitigation reef. This information will be used to design the most cost-effective mitigation reef that is likely to meet the performance standards listed in Section 2 below.

2.0 MITIGATION REEF

In addition to construction of the 16.8-acre experimental reef, the permittee shall be responsible for the construction of at least 133.2 acres of artificial reef (yielding a minimum of 150 acres of artificial reef hereafter referred to as the "mitigation reef") that meets the performance standards listed below as mitigation for the resource losses at the San Onofre Kelp bed (SOK) caused by operation of the SONGS. The larger artificial reef may be an expansion of the experimental reef or may be established in a different location, provided that the larger reef shall be located in the vicinity of SONGS, but outside

the influence of SONGS discharge plume and water intake. The selection of a site for the larger artificial reef shall be based on the final site selection criteria stated in Section 1.2 above.

The purpose of the mitigation reef is to provide kelp bed community resources to replace the resources lost due to the operation of SONGS Units 2 and 3. Thus, the mitigation reef shall be designed to replace the lost and damaged resources at the San Onofre kelp bed and result in production of a persistent giant kelp forest and associated ecosystem.

2.1 Mitigation Reef Design and Planning

Within six months after completion of independent monitoring of the experimental reef, the permittee shall submit a preliminary plan describing the location and design of the mitigation reef to the Executive Director for review and approval. The type of hard substrate and the percent cover of hard substrate proposed in the preliminary plan for the mitigation reef shall be determined by the Executive Director.

The Executive Director will consult with the Coastal Commission scientists, scientific advisors, resource agencies, and others as appropriate to evaluate whether the preliminary plan meets the goals set forth in Section 2.2 below. Within one month following the Executive Director's determination that the preliminary plan meets the specified criteria, the permittee shall initiate development of a final mitigation plan along with appropriate CEQA and/or NEPA environmental impact analyses necessary in connection with local, State or other agency approvals.

Within twelve months of the Executive Director's approval of a preliminary plan for the mitigation reef, the permittee shall submit a final mitigation plan to the Coastal Commission in the form of a coastal development permit application. The final plan shall specify location, depth, overall hard substrate coverage, size and dispersion of reef materials, and reef relief and shall substantially conform to the preliminary plan approved by the Executive Director.

2.2 Mitigation Reef Goals

The primary goals of the mitigation reef shall be to provide adequate conditions for a community of reef-associated biota similar in composition, diversity and abundance to the San Onofre kelp bed that compensate for the losses incurred by SONGS operations.

2.3 Mitigation Reef Construction

The permittee shall construct the reef in accordance with the final plan in the approved coastal development permit. The permittee shall begin construction of the reef no later

than 6 months after Commission approval of a coastal development permit for the reef. The permittee shall complete a post-construction survey to demonstrate that the reef was built to approved specifications. If the Executive Director determines that the reef was not built to specifications, the permittee shall modify the reef to meet the approved specifications within 90 days of the post-construction survey. Extension of this time limit may be granted by the Executive Director for good cause.

2.4 Monitoring

After construction of the mitigation reef is completed, the reef will be monitored, managed, and, if necessary, remediated. The following sections describe the basic tasks required for monitoring the mitigation reef pursuant to this Condition. Condition D specifies that the permittee shall provide funds to the Commission or an independent entity designated by the Executive Director for the purpose of completing the monitoring, as specified below.

A monitoring plan for the mitigation reef shall be developed by the Commission staff scientists pursuant to Condition D. The monitoring plan shall be completed within six months of approval of a coastal development permit for the mitigation reef proposed in a final plan developed pursuant to this condition. The monitoring plan shall provide an overall framework to guide the monitoring work. The monitoring plan shall describe the sampling methodology, analytical techniques, and methods for measuring performance of the mitigation reef relative to the performance standards identified below.

Monitoring independent of the permittee shall be implemented in accordance with Condition D to: (1) determine whether the performance standards of this condition are met (i.e., whether the mitigation reef successfully replaces the lost and damaged resources in the San Onofre Kelp bed), (2) if necessary, determine the reasons why any performance standard has not been met, and (3) develop recommendations for appropriate remedial measures. The permittee shall be responsible for fully implementing any remedial measures deemed necessary by the Executive Director.

Following completion of construction the mitigation reef shall be monitored for a period equivalent to the operating life of SONGS. The independent monitoring program for the mitigation reef shall be designed to assess whether the performance standards have been met. If these standards are met after ten years following the completion of construction, then monitoring can be reduced to annual site inspections. The permittee shall undertake necessary remedial actions based on the monitoring results and annual site inspections for the full operating life of the SONGS Units 2 and 3.

The following performance standards shall be used in measuring the success of the mitigation reef to determine whether remediation is necessary:

a. Substrate

1. The reefs shall be constructed of rock, concrete, or a combination of these materials, as determined from results of the experimental reef to be suitable for sustaining a kelp forest and a community of reef-associated biota similar in composition, diversity and abundance to the San Onofre kelp bed.
2. The total areal extent of the mitigation reef (including the experimental reef and all larger artificial reefs) shall be no less than 150 acres.
3. At least two-thirds (67 percent) of the 150-acre mitigation reef area shall be covered by exposed hard substrate. Should the results of the experimental reef indicate that a different coverage of hard substrate is necessary or adequate to meet this goal (as determined by the Executive Director), the Executive Director may change the coverage requirement.
4. At least 90 percent of the exposed hard substrate must remain available for attachment by reef biota. The permittee shall be required to add sufficient hard substrate to the mitigation reef to replace lost or unsuitable hard substrate, if at any time the Executive Director determines that more than 10 percent of the hard substrate within the reef has become covered by sediment, or has become unsuitable for growth of attached biota due to scouring, and there is no sign of recovery within three years. The Commission scientists in accordance with Condition D shall initiate surveys to monitor the amount and distribution of exposed hard substrate. These surveys shall begin immediately after construction is complete and continue for at least ten years.

b. Kelp bed

The artificial reef(s) shall sustain 150 acres of medium-to-high density giant kelp. For purposes of this condition, medium-to-high density giant kelp is defined as more than 4 adult *Macrocystis pyrifera* plants per 100 m² of substrate, as determined by down-looking sonar surveys or equivalent monitoring techniques in accordance with Condition D. If the average area of medium to high density giant kelp falls below 150 acres, then the reason for this failure shall be determined by independent monitoring overseen by Commission scientists. The permittee shall implement any remedial measures deemed necessary by the Executive Director.

The permittee's remediation requirement shall include the funding of independent studies that are necessary to determine the reasons for lack of kelp coverage as well as feasible corrective action, as determined by the Executive Director. If the failure is due to insufficient hard substrate, the corrective action shall entail the permittee adding more hard substrate to the reef.

If sufficient hard substrate appears to be available but kelp recruitment is low, then corrective action could include the permittee funding independent studies of kelp recruitment that are designed to determine the best method of establishing kelp on the reef. The Executive Director shall determine whether such studies are necessary.

The method determined by the Executive Director most likely to be a successful and reliable corrective action for low kelp abundance shall be implemented by the permittee until kelp coverage meets this performance standard; however, kelp establishment or augmentation methods shall not be required for more than a total of five years. If oceanographic conditions are unfavorable to kelp during part of this period, the Executive Director may defer the effort to establish kelp.

c. Fish

The standing stock of fish at the mitigation reef shall be at least 28 tons and the following performance standards shall hold:

1. The resident fish assemblage shall have a total density and number of species similar to natural reefs within the region.
2. Fish reproductive rates shall be similar to natural reefs within the region.
3. The total density and number of species of young-of-year fish (fish less than 1 year old) shall be similar to natural reefs within the region.
4. Fish production shall be similar to natural reefs within the region.

d. Benthos

1. The benthic community (both algae and macroinvertebrates) shall have coverage or density and number of species similar to natural reefs within the region.
2. The benthic community shall provide food-chain support for fish similar to natural reefs within the region.
3. The important functions of the reef shall not be impaired by undesirable or invasive benthic species (e.g., sea urchins or *Cryptoarachnidium*).

Independent monitoring data collected concurrently at natural kelp bed reference sites within the region shall be used by Commission scientists to determine the similarity for each variable listed above. The standard of comparison (i.e., the measure of similarity to be used and the method for determining the statistical significance of differences) shall be specified in the monitoring plan. If the standards listed above are not met within ten years after reef construction, then the permittee shall undertake those remedial actions the Executive Director deems appropriate and feasible.

Permit 6-81-330-A (SONGS Units 2 & 3)

Commission Approval of Amendments: April 9, 1997

Commission Approval of Revised Findings & Conditions: May 14, 1997

The permittee shall insure that the performance standards and goals set forth in this condition will be met for at least the length of time equivalent to the full operating life of SONGS Units 2 and 3.³ Upon completion of ten years of independent monitoring that demonstrate the mitigation reef is in compliance of the performance standards, the permittee shall be fully responsible for funding independent annual site inspections, which will serve to identify any noncompliance with the performance standards. The monitoring plan (specified above) shall describe the requirements and methods of the annual site inspections.

The Executive Director may also use any other information available to determine whether the performance standards are being met. If information from the annual site inspections or other sources suggests the performance standards are not being met, then the permittee shall be required to fund an independent study to collect the information necessary to determine what remediation is needed. The Executive Director shall determine the required remedial actions based on information from the independent study. The permittee shall be required to implement any remedial measures determined necessary by the Executive Director in consultation with state and federal resource agencies, as well as provide funds for independent monitoring that evaluates the success of the required remediation. As described under the funding option (Condition D) of this permit, the cost of remediation shall not be limited if the permittee elects to implement the mitigation reef.