STATE OF CALIFORNIA -- THE RESOURCES AGENCY ARNOLD SCHWARZENEGGER, *Governor*

CALIFORNIA COASTAL COMMISSION
SAN DIEGO AREA
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Filed:	August 25, 2006
49th Day:	October 13, 2006
Staff:	Gary Cannon-SD
Staff Report:	September 27, 2006
Hearing Date:	October 11, 2006

STAFF REPORT AND RECOMMENDATION ON APPEAL

LOCAL GOVERNMENT: City of Encinitas

DECISION: Approved with Conditions

APPEAL NO.: A-6-ENC-06-100

APPLICANT: John and Valerie Zagara

PROJECT DESCRIPTION: Demolish an existing single-family residence and construct approximately 4,424 sq. ft. two-story single-family residence that includes an approximately 1,095 sq. ft. basement, approximately 505 sq. ft. garage on an approximately 5,638 sq. ft. blufftop lot.

PROJECT LOCATION: 282 Neptune Avenue, Encinitas, San Diego County.
APN No. 256-352-08

APPELLANT: Commissioners Patrick Kruer and Steve Padilla

SUMMARY OF STAFF RECOMMENDATION:

The staff recommends that the Commission, after public hearing, determine that substantial issue exists with respect to the grounds on which the appeal has been filed.

SUBSTANTIVE FILE DOCUMENTS: Certified City of Encinitas Local Coastal Program; Appeal Applications by Commissioners Patrick Kruer and Steve Padilla dated 8/25/06; City of Encinitas Case #05-161/DR/CDP; Memo to the Coastal Commission dated January 16, 2003 from Mark Johnsson – Staff Geologist.

I. Appellant Contends That: The City's decision is inconsistent with several provisions of the City's LCP which require that new development on the blufftop be supported by a site specific geotechnical report that addresses the necessary bluff edge setback based on overall site stability and the potential need of shoreline protection over the lifetime of the development. In addition, the appellants contend that the estimated erosion rate relied on by the City is not the most current information available as required by the LCP. Finally, the appellants contend the City failed to require that the bluff face seaward of the proposed residence be protected through the application of an open space easement or comparable measure as required by the LCP.

II. Local Government Action: The coastal development permit was approved by the City of Encinitas Planning Commission on July 20, 2006. Specific conditions were attached which, among other things, require all site runoff to be directed away from the bluff to the street, the removal of all visible portions of an existing upper bluff retaining wall, future removal of any remaining upper bluff retaining wall that subsequently fail with no replacement or repair allowed, prohibition of heavy construction equipment within 25 ft. of the bluff edge, requirement that improvements within 40 ft. of the bluff edge proposed for removal be removed by hand, a prohibition on bluff protection for any improvements within 40 ft. setback area, and requirement that threatened improvements within the 40 ft. setback area be removed when bluff edge retreats to within 1 foot of an improvement.

III. Appeal Procedures. After certification of a municipality's Local Coastal Program (LCP), the Coastal Act provides for limited appeals to the Coastal Commission of certain local government actions on coastal development permit applications. One example is that the approval of projects within cities and counties may be appealed if the projects are located within mapped appealable areas. The grounds for such an appeal are limited to the assertion that "development does not conform to the standards set forth in the certified local coastal program or the [Coastal Act] public access policies." Cal. Pub. Res. Code § 30603(b)(1). Where the local government action is approvable on the basis that the project is located between the sea and the first public road paralleling the sea or within 300 ft. of the mean high tide line, the grounds are limited to those contained in Section 30603(b)(1) of the Coastal Act.

After the local government has taken final action on an appealable project, it must send a notice of that final action (NOFA) to the Commission. Cal. Pub. Res. Code § 30603(d); 14 C.C.R. § 13571. Upon proper receipt of a valid NOFA, the Commission establishes an appeal period, which runs for 10 working days. Cal. Pub. Res. Code § 30603(c); 14 C.C.R. § 13110 and 13111(b). If an appeal is filed during the appeal period, the Commission must "notify the local government and the applicant that the effective date of the local government action has been suspended," 14 C.C.R. § 13572, and it must set the appeal for a hearing no later than 49 days after the date on which the appeal was filed. Cal. Pub. Res. Code § 30621(a).

Section 30625(b)(2) of the Coastal Act requires the Commission to hear an appeal of the sort involved here unless the Commission determines that no substantial issue is raised by the appeal. If the staff recommends "substantial issue" and no Commissioner objects, the

Commission will proceed to a de novo hearing on the merits of the project, either immediately or at a later date, with the hearing held open in the interim.

If the staff recommends "no substantial issue" or the Commission decides to hear arguments and vote on the substantial issue question, proponents and opponents will have 3 minutes per side to address whether the appeal raises a substantial issue. It takes a majority of Commissioners present to find that no substantial issue is raised. If substantial issue is found, the Commission will proceed to a full public hearing on the merits of the project either immediately or at a subsequent meeting. If the Commission conducts a de novo hearing on the permit application, the applicable test for the Commission to consider is whether the proposed development is in conformity with the certified Local Coastal Program.

In addition, for projects located between the sea and the first public road paralleling the sea, Sec. 30604(c) of the Coastal Act requires that, for a permit to be granted, a finding must be made by the approving agency, whether the local government or the Coastal Commission on appeal, that the development is in conformity with the public access and public recreation policies of Chapter 3 of the Coastal Act.

The only persons qualified to testify before the Commission at the "substantial issue" stage of the appeal process are the applicant, persons who opposed the application before the local government (or their representatives), and the local government. Testimony from other persons must be submitted in writing. At the time of the de novo hearing, any person may testify.

IV. Staff Recommendation On Substantial Issue.

The staff recommends the Commission adopt the following resolution:

MOTION: ***I move that the Commission determine that Appeal No. A-6-ENC-06-100 raises NO substantial issue with respect to the grounds on which the appeal has been filed under § 30603 of the Coastal Act.***

STAFF RECOMMENDATION:

Staff recommends a **NO** vote. Failure of this motion will result in a de novo hearing on the application, and adoption of the following resolution and findings. Passage of this motion will result in a finding of No Substantial Issue and the local action will become final and effective. The motion passes only by an affirmative vote of the majority of the Commissioners present.

RESOLUTION TO FIND SUBSTANTIAL ISSUE:

The Commission hereby finds that Appeal No. ***A-6-ENC-06-100*** presents a substantial issue with respect to the grounds on which the appeal has been filed under § 30603 of the Coastal Act regarding consistency with the Certified Local Coastal Plan and/or the public access and recreation policies of the Coastal Act.

V. Findings and Declarations.

The Commission finds and declares as follows:

1. Project Description. The development, as approved by the City involves the demolition of an existing single-family residence and construction of an approximately 4,424 sq. ft. two-story single-family residence that includes an approximately 1,095 sq. ft. basement, approximately 505 sq. ft. garage and a cantilevered second story that extends approximately 7 feet into the City's 40 ft. geologic setback area, on an approximately 5,638 sq. ft. blufftop lot. The proposal also includes a new plexiglass windscreen, an above grade fire pit, exposed aggregate concrete patio, and 4 ft. high plaster fence to be located within the 40 ft. setback area but not closer than 5 ft. from the edge of the bluff. The proposed residence as approved by the City will be located approximately 42 feet from the edge of an approximately 80-ft high coastal bluff. The residence, as approved by the City will be located approximately 10 feet closer to the bluff edge than the existing residence. The existing residence and the residence immediately to the north are located approximately 52 feet from the bluff edge, while the residence to the south is located approximately 35 to 40 ft. from the bluff edge.

The existing single-family residence was constructed prior to enactment of the Coastal Act and, subsequently, no other application for a coastal development permit on the subject site has been reviewed or approved by the Commission. However, a retaining wall structure is located on the face of the upper bluff which the City has required be removed.

The subject site is located on the west side of Neptune Avenue, approximately 9 lots south of Stone Steps, a public access stairway to the beach and approximately 6 blocks north of the Moonlight Beach Park in the City of Encinitas.

2. Geologic Stability. Section 30.34.020(D) of the Implementation Plan states, in part:

> APPLICATION SUBMITTAL REQUIREMENTS. Each application to the City for a permit or development approval for property under the Coastal Bluff Overlay Zone shall be accompanied by a soils report, and either a geotechnical review or geotechnical report as specified in paragraph C "Development Processing and Approval" above. Each review/report shall be prepared by a certified engineering geologist who has been pre-qualified as knowledgeable in City standards, coastal engineering and engineering

geology. The review/report shall certify that the development proposed will have no adverse affect on the stability of the bluff, will not endanger life or property, and that any proposed structure or facility is expected to be reasonably safe from failure and erosion <u>over its lifetime</u> without having to propose any shore or bluff stabilization to protect the structure in the future. Each review/report shall consider, describe and analyze the following: (Ord. 95-04)

1. Cliff geometry and site topography, extending the surveying work beyond the site as needed to depict unusual geomorphic conditions that might affect the site;

2. Historic, current and foreseeable-cliffs erosion, including investigation or recorded land surveys and tax assessment records in addition to land use of historic maps and photographs where available and possible changes in shore configuration and sand transport;

3. Geologic conditions, including soil, sediment and rock types and characteristics in addition to structural features, such as bedding, joints and faults;

4. Evidence of past or potential landslide conditions, the implications of such conditions for the proposed development, and the potential effects of the development on landslide activity;

5. Impact of construction activity on the stability of the site and adjacent area;

6. Ground and surface water conditions and variations, including hydrologic changes caused by the development e.g., introduction of irrigation water to the ground water system; alterations in surface drainage);

7. Potential erodibility of site and mitigating measures to be used to ensure minimized erosion problems during and after construction (i.e., landscaping and drainage design);

8. Effects of marine erosion on seacliffs and estimated rate of erosion at the base of the bluff fronting the subject site <u>based on current and historical data</u>; (Ord. 95-04)

9. Potential effects of seismic forces resulting from a maximum credible earthquake;

10. Any other factors that might affect slope stability;

11. Mitigation measures and alternative solutions for any potential impacts.

> The report shall also express a professional opinion as to whether the project can be designed or located so that it will neither be subject to nor contribute to significant geologic instability throughout the life span of the project. The report shall use a current acceptable engineering stability analysis method and shall also describe the degree of uncertainty of analytical results due to assumptions and unknowns. The degree of analysis required shall be appropriate to the degree of potential risk presented by the site and the proposed project.
>
> In addition to the above, each geotechnical report shall include identification of the daylight line behind the top of the bluff established by a bluff slope failure plane analysis. This slope failure analysis shall be performed according to geotechnical engineering standards, and shall:
>
> - Cover all types of slope failure.
> - Demonstrate a safety factor against slope failure of 1.5.
> - Address a time period of analysis of 75 years.
>
> [. . .] (Emphasis added)

In addition, Public Safety (PS) Policy 1.3 of the City's LUP requires that:

> The City will rely on the Coastal Bluff and Hillside/Inland Bluff Overlay Zones to prevent future development or redevelopment that will represent a hazard to its owner or occupants, and which may require structural measures to prevent destructive erosion or collapse.

In addition, PS Policy 1.6 of the LUP requires that:

> The City shall provide for the reduction of unnatural causes of bluff erosion, as detailed in the Zoning Code, by:
>
> [. . .]
>
> f. Requiring new structures and improvements to existing structures to be set back 25 feet from the inland blufftop edge, and 40 feet from coastal blufftop edge with exceptions to allow a minimum coastal blufftop setback of no less than 25 feet. For all development proposed on coastal blufftops, a site-specific geotechnical report shall be required. The report shall indicate that the coastal setback will not result in risk of foundation damage resulting from bluff erosion or retreat to the principal structure within its economic life and with other engineering evidence to justify the coastal blufftop setback. (Emphasis added)

The project approved by the City is located within the Coastal Bluff Overlay Zone and the residence will be sited approximately 42 ft. from the edge of an approximately 80 ft.-

high coastal bluff that is subject to marine erosion. The appellants assert that the geotechnical report prepared for the subject development is inadequate such that it cannot be determined if the recommended geologic setback of 42 ft. for the proposed home is adequate to meet the standards of the Section 30.34.020(D) of the City's certified IP.

As cited above, Section 30.34.020(D) requires that many factors be analyzed within the geotechnical report for new development on the blufftop, including an estimate of the long-term erosion rate at the site "based on current and historical data". The appellants contend that the erosion rate used by the applicant is not based on the current standard for estimating bluff erosion along the Encinitas shoreline. Instead of completing a site specific analysis to estimate the long-term erosion rate affecting the site, the applicant's geotechnical consultant estimated the erosion rate at the subject site to be approximately 0.33 ft. per year based on a 1976 erosion study of the Encinitas shoreline by Lee, Pickney and Bemis which translates into 24.75 ft of bluff retreat over 75 years ("Sea Cliff Erosion", by L. Lee, C. Pickney and C. Bemis, 1976).

However, the appellants contend that the Coastal Commission's staff geologist has identified the current published state-of-the-art for establishing bluff retreat rates in this area as a FEMA-funded study done as part of a nationwide assessment of coastal erosion hazards [Ref. Benumof and Griggs (1999)]. This report estimates the long-term bluff retreat along the Encinitas shoreline to range from 0.15 to 0.49 feet per year. In the absence of a site-specific analysis, the Commission's staff geologist typically recommends a conservative approach utilizing the highest rate of erosion so as to be sure blufftop development will be adequately sited to avoid the need for future shore/bluff protection. Use of the historic rate measured in the area helps to assure that future increases in the erosion rate due to, among other things, future sea-level rise and increase in significant wave heights as a result of global warming, are considered. Using this highest rate of estimated erosion (0.49 ft. per year), translates into approximately 37 ft. of erosion over 75 years. In response to the appeal, the applicants have contracted with one of the authors of the Benumof and Griggs study (Benjamin T. Benumof, Ph.D., Esq.) to provide site-specific estimates of the erosion rate at the subject site (Ref. Exhibit #7). Staff notes that Dr. Benumof, although the recipient of a Ph.D. in geology, is not a certified engineering geologist as required by the LCP. Based on his site-specific analysis, Dr. Benumof estimates that the long-term bluff retreat rate at the subject site to be 0.23 ft. per year, which translates into approximately 17.25 ft. of erosion over 75 years. The Commission's staff geologist has reviewed this new information for the subject site and concurs with its findings as it relates the long-term erosion rate. Therefore, since the long-term erosion rate identified in the1976 study by Pickney and Bemis, while not "current", is more conservative than the recent site specific study submitted by the applicant, the Commission finds that the subject appeal, as it relates to the long-term erosion rate, does not raise a substantial issue relating to Section 30.34.020(D) of the City's Certified IP.

However, in order to find the appropriate geologic setback for the blufftop home, the Certified LCP requires that not only a long-term erosion rate must be adequately identified but that the geotechnical report also demonstrate that an adequate factor of safety against landsliding of 1.5 will be maintained over 75 years. In this case, the appellants assert that the geotechnical report approved by the City only identified the 1.5 factor of safety under present conditions. The Commission's staff geologist has reviewed the appellants' assertions and the geotechnical reports prepared by the applicants' representative, which were relied on by the City. Based on this review, the Commission's staff geologist has determined that the applicant's geotechnical report has not adequately demonstrated a setback that will prevent reasonable risk of damage within the economic life of the principal structure (see PS Policy 1.6). In order to find the appropriate geologic setback, the above-cited LCP provisions require that not only must an adequate factor of safety against landsliding be shown under present conditions, but that it must also address stability over 75 years (See IP section 30.34.020(D)). Therefore, in estimating an appropriate setback for new blufftop development, it is necessary to first estimate the configuration of the bluff 75 years from now. The simplest way to accomplish this is to assume that the bluff will have the same topographic configuration as at present, but the entire bluff will have migrated landward due to coastal bluff retreat. Applying the site-specific historical long-term average bluff retreat-rate of 0.23 ft/yr, this would mean that the bluff would be 17.25 ft. landward of its current location. Next, it must be demonstrated that the site would have a factor of safety against landsliding of 1.5 or greater. For instance, in this case, if the location of the 1.5 factor of safety for current conditions of 40 ft. (as identified by the applicant's geotechnical report under current conditions) were added to the estimated bluff erosion over 75 years, as identified in the new report by Dr. Benumof (17.25 ft.), the Commission's staff geologist would recommend a geologic setback of approximately 57.25 ft. from the edge of the bluff. In this case, the City only required a setback of 42 ft., which appears to be an insufficient distance to assure the new home is safe from erosion such that it will not need shoreline protection over its lifetime. Thus, based on a review of the geotechnical information by the Commission's staff geologist, the appellants have raised a substantial issue.

The applicant's representative has stated that they have calculated that a factor of safety against landsliding of 1.4 to 1.5 would be maintained after 17.25 feet of erosion. However, no calculations supporting this assertion have been provided. Further, any factor of safety below 1.5 would be inconsistent with the above-cited provisions of the certified LCP.

The applicant's representative has raised objections to Commission staff's interpretation of the LCP requirements as it relates to the application of a 1.5 factor of safety over 75 years. However, Section 30.34.020(D) of the IP is quite specific in that it requires the slope failure analysis to:

- <u>Cover all types of slope failure.</u>
- <u>Demonstrate a safety factor against slope failure of 1.5.</u>
- <u>Address a time period of analysis of 75 years.</u>

The applicant's representative asserts that City has never interpreted the LCP in this manner and "in absence of clear policy direction from the Commission", the City approved the subject setback analyses based on "industry standards that are acceptable to licensed engineers, geologists and other geotechnical professionals, as well as adopted Commission policies." The applicant's representative specifically cites "Commission Policy No. 3" from a document that is posted on the Commission's website titled "Sample Policies for Planners Developing, Amending or Reviewing LCP Policies On Shoreline Protective Structures, Hazards, and Beach Erosion".

However, the document posted on the Commission's website is designed to assist planners in a general way as it relates to these issues and is not the standard of review for new development in Encinitas. In fact, the document that contains this information is prefaced as follows:

> This document has not been reviewed or adopted by the California Coastal Commission. It is not binding on the Commission, its staff, local government, or the public. This manual has been developed for informational purposed only.

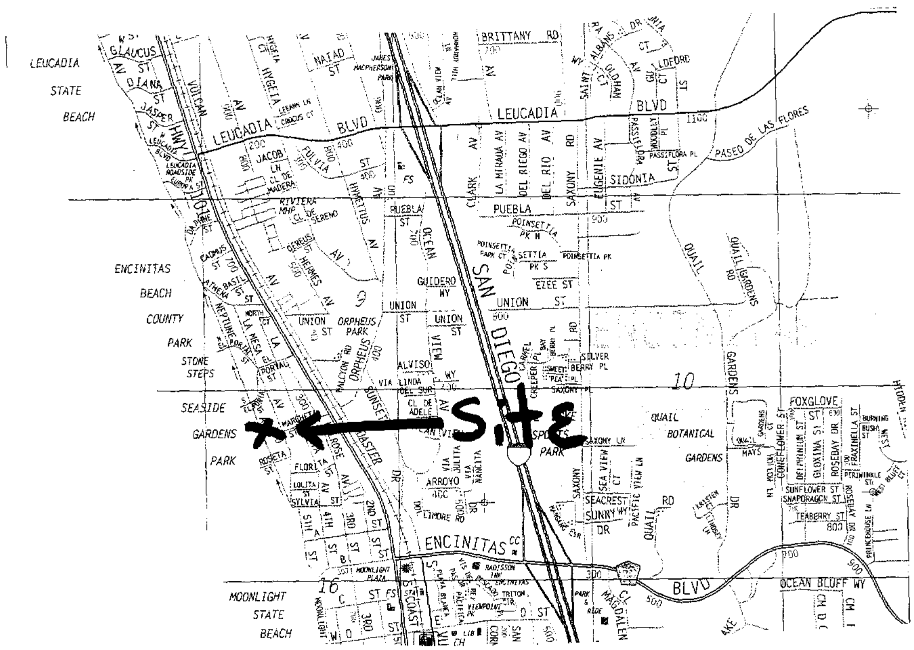
The City's certified LCP is the standard of review along with the public access and recreation policies of the Coastal Act. In addition, the manner in which the Commission has interpreted the Section 30.34.020(D) requirement that the 1.5 factor of stability be evaluated over 75 years is consistent with Commission action in Encinitas and elsewhere along the California coast in determining an adequate setback for new blufftop development so as to assure the new development will not require shoreline protection over its lifetime. In fact, the Commission's staff geologist presented a workshop at the Commission hearing of February 2003 that specifically identified this methodology (Ref. Exhibit #6). In addition, while it is true that Commission staff has never written a letter detailing this interpretation, Commission staff has met with City staff (and their third party geotechnical consultant) on numerous occasions to discuss this interpretation. Additionally, there have been several examples in Encinitas where this methodology has been used by the Commission in establishing a safe setback for new blufftop development (ref. A-6-ENC-01-47/Refold; A-6-ENC-01-47/Conway Associates; and A-6-ENC-02-3/Berg). In Solana Beach which is immediately south of Encinitas and has similar concerns relating to new development on the blufftop, the following permits were approved using the methodology that required a 1.5 factor of safety over a 75 year period: CDP #6-02-95/Becker and CDP #6-04-86/Winkler. Other examples of where this same analyses has been required by the Commission to establish a safe setback for new development in other areas of California includes: CDP #1-05-021/Martin; 1-03-026Gaussoin/Radcliffe and 1-03-028/Rohner; A-1-CRC-02-150/Forest Trust; A-1-MEN-02-029/Shia; A-1-MEN-01-056/ Williams and A-3-04-35/PG&E. As documented by the above referenced reports and by Dr. Johnsson's workshop presentation to the Commission in 2003, the requirements for establishing a safe setback for new development as delineated in Section 30.34.020(D) of the City's certified LCP are not new policies or a new requirement, but are consistent with numerous Commission actions on coastal development permits and appeals throughout the state.

The final issue raised by the appellants involves the conservation of the bluff face seaward of the proposed development with the application of an open space easement so as to help assure future shoreline protective measures are not installed. Public Safety Policy 1.6 of the City's Land Use Plan requires, in part, that:

> The City shall provide for the reduction of unnatural causes of bluff erosion, as detailed in the Zoning Code, by:
>
> [. . .]
>
> g. Permanently conserving the bluff face within an open space easement or other suitable instrument.
>
> [. . .]

The appellants contend that the City should have required the use of an open space easement over the bluff face. The applicant has identified that they do not own the bluffs and, therefore, cannot place an easement over someone else's property. In this case, the bluff face appears to largely be owned by the City. However, staff has reviewed the property records for the subject development including the applicant's own survey of the bluff edge. According to the applicant's property survey, a small portion of the western property line extends over the face of the bluff. Therefore, the City, at a minimum, should have required any portion of the bluff face owned by the applicant to be placed within an open space easement or other device to assure that the applicant or any future owner acknowledges that the area cannot be used for future shoreline protection. Therefore, on this issue, the appellants have also raised a substantial issue.

In summary, based on the information relied on by the City, it appears that an insufficient geologic setback may have been approved such that the approved home may not be safe from erosion and bluff retreat over 75 years and thus, may require shoreline protection at some point over its lifetime, which would be inconsistent with Section 30.34.020(D) of the City's certified IP. In addition, the City should have required that any portion of the bluff face that is owned by the applicant be placed within an open space easement, which would help assure that any future use of the bluff face for shoreline protective devices is not permitted. Therefore, the City's action raises a substantial issue regarding consistency with the requirements of the LCP as asserted by the appellants.



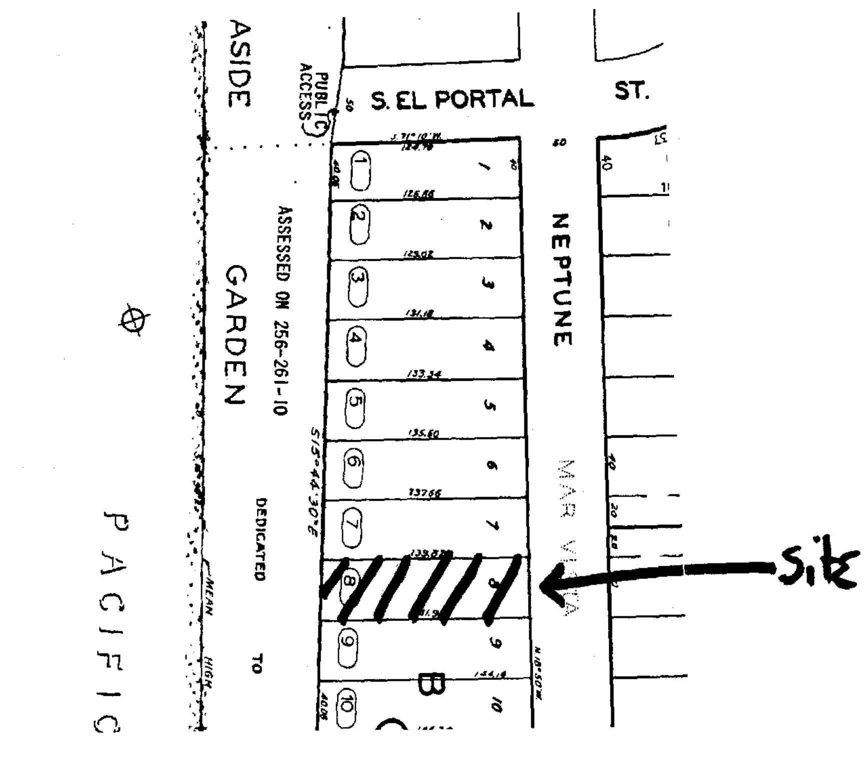


EXHIBIT NO. 1
APPLICATION NO.
A-6-ENC-06-100
Location Map

California Coastal Commission

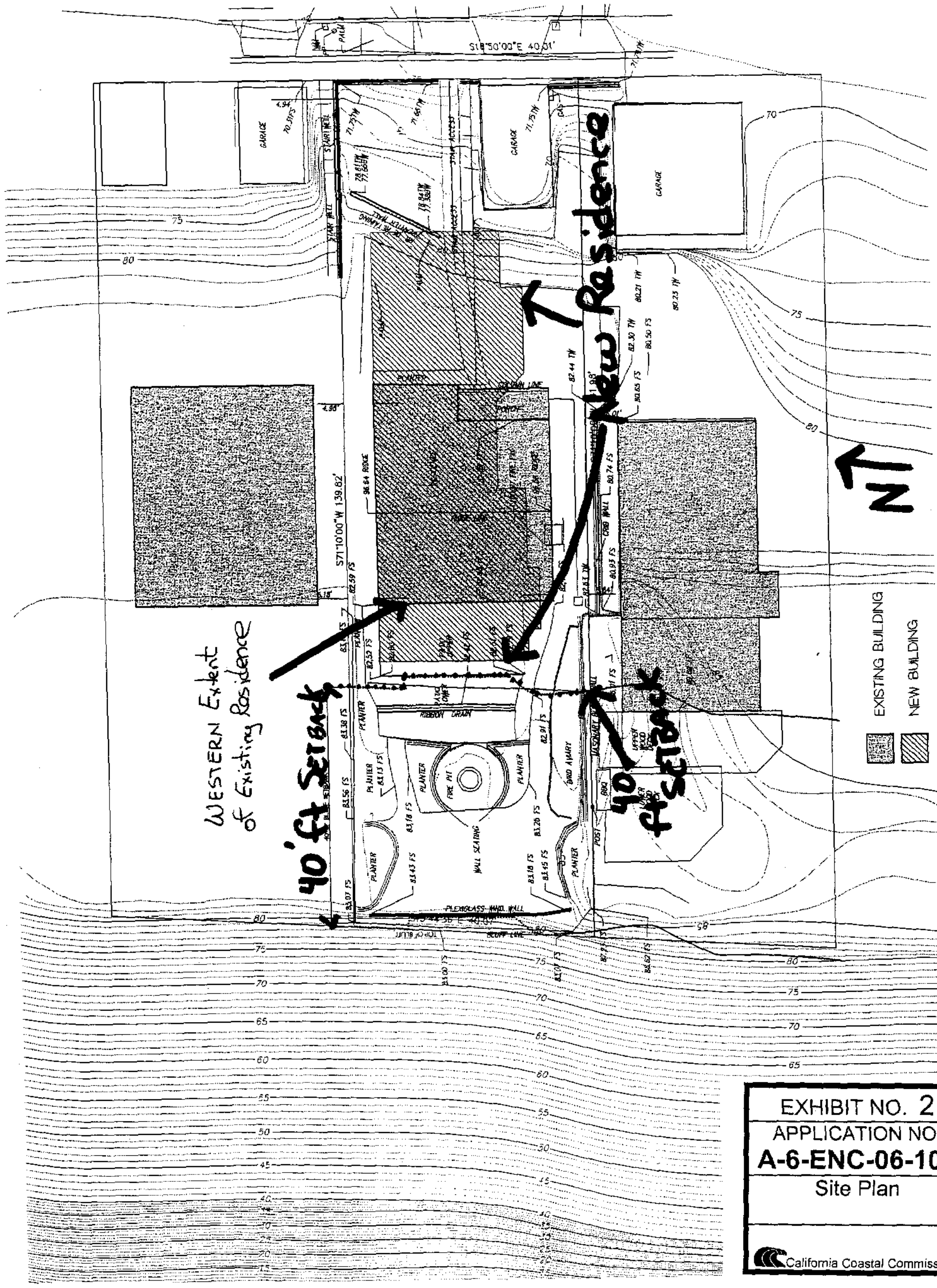


EXHIBIT NO. 2
APPLICATION NO.
A-6-ENC-06-100
Site Plan

California Coastal Commission

RESOLUTION NO. PC 2006-35

A RESOLUTION OF THE CITY OF ENCINITAS PLANNING COMMISSION APPROVING A COASTAL DEVELOPMENT PERMIT FOR THE PROPOSED DEMOLITION OF A SINGLE FAMILY RESIDENCE AND A DESIGN REVIEW PERMIT AND COASTAL DEVELOPMENT PERMIT FOR THE CONSTRUCTION OF A NEW SINGLE FAMILY RESIDENCE WHICH CANTILEVERS 7 FEET WITHIN THE STANDARD 40 FOOT COASTAL BLUFF SETBACK, FOR THE PROPERTY LOCATED AT 282 NEPTUNE AVENUE

(CASE NO.: 05-161 DR/CDP; APN: 256-352-08)

WHEREAS, a request for consideration of a Design Review Permit and Coastal Development Permit was filed by John & Valerie Zagara to allow the demolition of an existing single family residence and the construction of a new single family residence and to allow a second story portion of the structure to cantilever a maximum of 7 feet into the standard 40 foot coastal bluff setback, in accordance with Chapters 30.34 and 30.80 of the Encinitas Municipal Code, for the property located in the R-8 Zone legally described as:

Lot 8, in Block B of Seaside Gardens, in the City of Encinitas, County of San Diego, State of California, according to Map thereof No. 1800, filed in the Office of the County Recorder of San Diego County on August 6, 1924.

WHEREAS, the Planning Commission conducted a noticed public hearing on the application on July 20, 2006, at which time all those desiring to be heard were heard; and

WHEREAS, the Planning Commission considered, without limitation:

1. The July 20, 2006 agenda report(s) to the Planning Commission with attachments;
2. The General Plan, Local Coastal Program, Municipal Code, and associated Land Use Maps;
3. Oral evidence submitted at the hearing;
4. Written evidence submitted at the hearing;
5. Project plans consisting of 9 sheets, including Title Sheet, Conceptual Grading Plan, Site Plan, Basement and First Floor Plan, Second Floor Plan and Roof Plan, North & South Elevations, Elevations & Sections, Building Sections, and Landscape Plan, all stamped received by the City of Encinitas on May 16, 2006; and

WHEREAS, the Planning Commission made the following findings | 30.34 (Special Purpose Overlay Zone) and 30.80 (Coastal Development Perm Municipal Code:

EXHIBIT NO. 3
APPLICATION NO.
A-6-ENC-06-100
City Resolution
Page 1 of 14
California Coastal Commission

single family homes and duplexes; Eight inches (8") for commercial and multi-family residential buildings; and Twelve inches (12") for industrial buildings.

F15A AUTOMATIC FIRE SPRINKLER SYSTEM - SINGLE-FAMILY DWELLINGS AND DUPLEXES: Structures shall be protected by an automatic fire sprinkler system designed and installed to the satisfaction of the Fire Department. Plans for the automatic fire sprinkler system shall be approved by the Fire Department prior to issuance of building permit(s).

F18 CLASS "A" ROOF: All structures shall be provided with a Class "A" roof assembly to the satisfaction of the Encinitas Fire Department.

E1 **ENGINEERING CONDITIONS:**

CONTACT THE ENGINEERING SERVICES DEPARTMENT REGARDING COMPLIANCE WITH THE FOLLOWING CONDITION(S):

E2 All City Codes, regulations, and policies in effect at the time of building/grading permit issuance shall apply.

EG1 **Grading Conditions**

EG3 The owner shall obtain a grading permit prior to the commencement of any clearing or grading of the site.

EG4 The grading for this project is defined in Chapter 23.24 of the Encinitas Municipal Code. Grading shall be performed under the observation of a civil engineer whose responsibility it shall be to coordinate site inspection and testing to ensure compliance of the work with the approved grading plan, submit required reports to the Engineering Services Director and verify compliance with Chapter 23.24 of the Encinitas Municipal Code.

EG5 No grading shall occur outside the limits of the project unless a letter of permission is obtained from the owners of the affected properties.

EG6 Separate grading plans shall be submitted and approved and separate grading permits issued for borrow or disposal sites if located within city limits.

EG7 All newly created slopes within this project shall be no steeper than 2:1.

EG8 A soils/geological/hydraulic report (as applicable) shall be prepared by a qualified engineer licensed by the State of California to perform such work. The report shall be submitted with the first grading plan submittal and shall be approved prior to issuance of any grading permit for the project.

EG9 Prior to hauling dirt or construction materials to any proposed construction site within this project the owner shall submit to and receive approval from the Engineering Services Director for the proposed haul route. The owner shall comply with all conditions and requirements the Engineering Services Director may impose with regards to the hauling operation.

EG10 In accordance with Section 23.24.370 (A) of the Municipal Code, no grading permit shall be issued for work occurring between October 1st of any year and April 15th of the following year, unless the plans for such work include details of protective measures, including desilting basins or other temporary drainage or control measures, or both, as may be deemed necessary by the field inspector to protect the adjoining public and private property from damage by erosion, flooding, or the deposition of mud or debris which may originate from the site or result from such grading operations.

ED1 **Drainage Conditions**

ED2A An erosion control system shall be designed and installed onsite during all construction activity. The system shall prevent discharge of sediment and all other pollutants onto adjacent streets and into the storm drain system. The City of Encinitas Best Management Practice Manual shall be employed to determine appropriate storm water pollution control practices during construction.

ED3 A drainage system capable of handling and disposing of all surface water originating within the project site, and all surface waters that may flow onto the project site from adjacent lands, shall be required. Said drainage system shall include any easements and structures required by the Engineering Services Director to properly handle the drainage.

ED5 The owner shall pay the current local drainage area fee prior to issuance of the building permit for this project or shall construct drainage systems in conformance with the Master Drainage Plan and City of Encinitas Standards as required by the Engineering Services Director.

ES1 **Street Conditions**

ES5 Prior to any work being performed in the public right-of-way, a right-of-way construction permit shall be obtained from the Engineering Services Director and appropriate fees paid, in addition to any other permits required.

ES6 In accordance with Chapter 23.36 of the Municipal Code, the owner shall execute and record a covenant with the County Recorder agreeing not to oppose the formation of an assessment district to fund the installation of right-of-way improvements.

ES7 In accordance with Chapter 23.36 of the Municipal Code, the owner shall execute and record a covenant with the County Recorder agreeing not to oppose the formation of an assessment district to fund the undergrounding of utility facility improvements.

EU1 **Utilities**

EU4 All proposed utilities within the project shall be installed underground including existing utilities unless exempt by the Municipal Code.

ESW1 **Storm Water Pollution Control Conditions**

ESW3 Best Management Practice shall be utilized for storm water pollution control to the satisfaction of the City Engineer. The surface run off shall be directed over grass and landscaped areas prior to collection and discharge onto the street and/or into the public storm drain system. If pipes are used for area drainage, inlets shall be located to allow maximum flow distance over grass and non-erodable landscape areas. A grass lined ditch, reinforced with erosion control blanket, or a rip-rap lined drainage ditch shall be used instead of a concrete ditch where feasible. Hardscaped areas and driveways shall be sloped toward grassy and landscaped areas. Driveways with a grass- or gravel-lined swale in the middle can be used if the site topography does not allow for the discharge of driveway runoff over landscaped areas. The **Grading Plan/Permit Site Plan** shall identify all landscape areas designed for storm water pollution control (SWPC). A note shall be placed on the plans indicating that the BMPs are to be privately maintained and the facilities not modified or removed without a permit from the City.

ESW9 For storm water pollution control purposes, all runoff from all roof drains shall discharge onto grass and landscape areas prior to collection and discharge onto the street and/or into the public storm drain system. Grass and landscape areas designated for storm water pollution control shall not be modified without a permit from the City. A note to this effect shall be placed on the **Grading/Permit Site** plan.

ECB1 Coastal Bluff Conditions

ECB3 If an automatic irrigation system is proposed for this project, it shall be designed to avoid any excess watering. The system shall also be designed to automatically shut off in case of a pipe break. Automatic shut-off system, moisture shut-off sensors, and other advanced controls will be required for the installation of an automatic irrigation system. The automatic irrigation system, shut-off systems, or any other system controls shall not be allowed within the 40-foot coastal bluff setback. Only hand-held irrigation is permitted within the 40-foot coastal bluff setback.

(SEE ATTACHMENT "A")

NOW, THEREFORE, BE IT RESOLVED that the Planning Commission of the City of Encinitas hereby approves application 05-161 DR/CDP subject to the following conditions:

(SEE ATTACHMENT "B")

BE IT FURTHER RESOLVED that the Planning Commission, in its independent judgment, finds that this project is categorically exempt from environmental review pursuant to Section 15303(a) of the California Environmental Quality Act (CEQA) Guidelines, which exempts the construction of up to three single-family residences from environmental review in urbanized areas and Section 15301(l)(1) of the CEQA Guidelines which exempts the demolition of up to three single family residences from environmental review in urbanized areas

PASSED AND ADOPTED this 20th day of July, 2006, by the following vote, to wit:

AYES: Commissioners Chapo, Avis, Snow and Felker

NAYS: None

ABSENT: Commissioner McCabe

ABSTAIN: None

Gene Chapo, Chair of the
Encinitas Planning Commission

ATTEST:

Patrick S. Murphy
Secretary

NOTE: This action is subject to Chapter 1.04 of the Municipal Code, which specifies time limits for legal challenges.

ATTACHMENT "A"
Resolution No. PC 2006-35
Case No. 05-161 DR/CDP

Bluff Setback and Cantilever Portion of a Structure Determination:

The criteria required to be considered in order to approve construction on the coastal bluff maintaining the standard 40 foot setback have been addressed by the Geotechnical Evaluation dated June 16 2005, revised December 15, 2005; Addendum to Geotechnical Evaluation dated March 8, 2006; Clarification of Addendum to Geotechnical Evaluation dated March 24, 2006; and Outstanding Geotechnical Issues, dated April 27, 2006 prepared by GeoTek, Inc. The geotechnical reports were reviewed by a third party geotechnical consultant, Geopacifica, which found that said geotechnical reports provide information to adequately meet the standards of the City of Encinitas Municipal Code, Section 30.34.020C and D. The project includes an enclosed sunroom and open deck at the second story which, including the roof overhang, cantilever a maximum of 7 feet (17.5%) into the bluff setback. The issue of the cantilever portion of the structure was addressed in the December 15, 2005, Geotechnical Evaluation by Geotek, Inc., which report was reviewed and accepted by the third party geotechnical consultant. The geotechnical evaluation noted that the loads imposed by the cantilevered portion will be supported by the building foundation system, which will be constructed in accordance with the 40 foot setback requirement, and the cantilevered portion of the building will not create an unnecessary surcharge to the bluff, nor will it adversely affect or be affected by the bluff.

FINDINGS FOR ALLOWING A PORTION OF A STRUCTURE TO CANTILEVER INTO THE COASTAL BLUFF SETBACK:

STANDARD: In accordance with Sect. 30.34.020 C.(1) of the Municipal Code, the authorized agency must make the following findings of fact, based upon the information presented in the application and during the Public Hearing, in order to approve a project to cantilever:

1. No private or public views would be significantly impacted by the construction of the cantilevered portion of the structure.

   Facts: Pursuant to Section 30.34.020C.1 of the Municipal Code, a **second story** cantilevered portion of a structure is permitted 20% beyond the top edge of the standard 40 foot coastal bluff setback, if demonstrated through standard engineering practices not to create an unnecessary surcharge load upon the bluff area and if a finding can be made that no private or public views would be significantly impacted by the construction of the cantilevered portion of the structure. The project includes an enclosed sunroom and open deck at the second story which, including the roof overhang, cantilever a maximum of 7 feet (17.5%) into the 40 foot coastal bluff setback in conformance with the maximum 20% permitted beyond the top edge of bluff setback.

   Discussion: The subject property is not adjacent to any existing public viewpoints; therefore public views are not affected with the cantilever. The cantilever is proposed further westward than the existing structures to the north and south of the subject site, however, significant views currently enjoyed by the adjacent properties to the north and south are directly to the west, additionally views from side windows are currently blocked by either vegetation or fences, therefore, views from the adjacent properties are not affected with the cantilever portion of the project.

Conclusion: The Planning Commission finds that the proposed cantilever portion of the structure will not significantly impact any existing private or public views.

FINDINGS FOR A COASTAL DEVELOPMENT PERMIT

<u>STANDARD</u>: Section 30.80.090 of the Municipal Code provides that the authorized agency must make the following findings of fact, based upon the information presented in the application and during the Public Hearing, in order to approve a coastal development permit:

1. The project is consistent with the certified Local Coastal Program of the City of Encinitas; and

2. The proposed development conforms with Public Resources Code Section 21000 and following (CEQA) in that there are no feasible mitigation measures or feasible alternatives available which would substantially lessen any significant adverse impact that the activity may have on the environment; and

3. For projects involving development between the sea or other body of water and the nearest public road, approval shall include a specific finding that such development is in conformity with the public access and public recreation policies of Section 30200 et. seq. of the Coastal Act.

Facts: The site is designated as Residential 5.01 - 8.0 du/ac on the Land Use Designation map of the General Plan and is zoned R- 8 on the Zoning Map. Additionally, as the site sits atop the coastal bluff it lies within the Coastal Bluff Overlay zone. The project proposes the demolition of an existing residential unit and the construction of a new two-story single family residence, which maintains a 40 foot setback from the top edge of bluff. The new residence also includes a cantilever portion of the structure at the second story level, which cantilevers a maximum of 7 feet or 17.5% into the standard bluff setback of 40 feet.

The project site does not currently provide access to the shore, and the project does not propose any public access or public recreational facilities.

Policy 1.6 of the Public Safety Element of the General Plan stipulates that all new construction shall be designed and constructed such that it could be removed in the event of endangerment and the applicant shall agree to participate in any comprehensive plan adopted by the City to address coastal bluff recession and shoreline erosion problems in the City.

Discussion: In conformance with Policy 1.6 of the Public Safety Element of the General Plan, the applicant has submitted a statement noting that they agree to participate in any comprehensive plan adopted by the City to address coastal bluff recession and shoreline erosion problems in the City. Additionally, in a memorandum dated February 8, 2006, the project architect notes that the structure can be removed in part or in whole. This is no way represents a commitment on the part of the owner or owner's successors to remove the structure(s) at any time. The project is conditioned to remove an unpermitted landscape wall on the bluff face. With authorization to construct the second story cantilever, the proposed project is in conformance or is conditioned to conform with the development standards of the Municipal Code, the General Plan and the Local Coastal Program. The project will not cause significant negative impacts to the surrounding area and the project will not adversely impact public coastal access.

Public access or public recreational facilities are not feasible given the project site's conditions as a bluff top residential property. Therefore no condition requiring public access is imposed with this approval. Public access to the shore is available in the vicinity with Stone Steps access and Moonlight Beach. Since there was not public access through the property prior to this application, the ability of the public to access the shore is not adversely impacted with this application.

Conclusion: The Planning Commission finds that 1) the project is consistent with the certified Local Coastal Program of the City of Encinitas, 2) required finding No. 2 is not applicable since no significant adverse environmental impact is associated with the project, and 3) the providing of public access or recreational facilities is not feasible or appropriate for a project of this scale.

ATTACHMENT "B"
Resolution No. PC 2006-35
Case No. 05-161 DR/CDP

Applicant: John & Valerie Zagara

Location: 282 Neptune Avenue

SC1 **SPECIFIC CONDITIONS:**

SC2 At any time after two years from the date of this approval, on July 20, 2008 at 5:00 pm, or the expiration date of any extension granted in accordance with the Municipal Code, the City may require a noticed public hearing to be scheduled before the authorized agency to determine if there has been demonstrated a good faith intent to proceed in reliance on this approval. If the authorized agency finds that a good faith intent to proceed has not been demonstrated, the application shall be deemed expired as of the above date (or the expiration date of any extension). The determination of the authorized agency may be appealed to the City Council within 15 days of the date of the determination.

SC5 This project is conditionally approved as set forth on the application and project drawings stamped received by the City on May 16, 2006, consisting of nine sheets including Title Sheet, Conceptual Grading Plan, Site Plan, Basement and First Floor Plan, Second Floor Plan and Roof Plan, North & South Elevations, Elevations & Sections, Building Sections, and Landscape Plan, all designated as approved by the Planning Commission on July 20, 2006, and shall not be altered without express authorization by the Planning and Building Department.

SCA The "exterior" stairs from the basement shall terminate at grade.

SCB The basement exit shall conform to Section 310.4 of the Uniform Building Code; garage doors do not qualify.

SCC The applicant shall comply with the following conditions to the satisfaction of the San Dieguito Water District:

1. The applicant shall show all existing and/or proposed water facilities on the improvement or grading permit plans for San Dieguito Water District approval.
2. The applicant shall comply with the San Dieguito Water District's fees, charges, rules and regulations, including installation of any required on-site and off-site facilities.
3. All water meters shall be located in front of the parcel they are serving and outside of any existing or proposed travel way. Cost of relocation shall be the responsibility of the property owner and/or developer.

SCD The applicant shall install a standard driveway to the satisfaction of the City Engineer. The proposed driveway shall occupy a maximum of 40% of the length of the property frontage. The cross slope of the proposed driveway shall be indicated on the grading plan. The driveway and BMP design shall be reviewed and approved prior to issuance of any grading permit for this project. An encroachment permit shall be obtained for the proposed enhanced pavement within the public right-of-way.

SCE The existing curb, gutter, and sidewalk along the property frontage is in poor condition. The applicant shall sawcut, remove, and replace the curb and gutter and the sidewalk along the property frontage to the satisfaction of the City Engineer.

SCF No runoff shall be allowed to discharge over the bluff. All runoff from the property shall be collected and discharged to Neptune Avenue.

SCG Runoff from all driveway, roof, and hardsurface areas shall be routed to landscape treatment areas for storm water pollution control BMP. The paved areas proposed in the rear of the property shall drain to landscape areas prior to collection and discharge onto Neptune Avenue.

SCH Prior to building permit issuance, plans shall clearly depict that the chimneys proposed in conjunction with the project clearly conform to the height limits in effect at the time of building permit issuance.

SCI As agreed to by the applicant as part of the Citizen Participation Program, 1) the existing dragon palm shall be relocated to the rear of the site or if that is not feasible it shall be donated to the Quail Botanical Gardens; 2) the two palms existing in the front yard shall be relocated to the side of the house; and 3) the orchid cactus shall be maintained in its current location near the southern property line.

SCJ Plans, calculations and cross sections for the temporary shoring and construction shall be provided to the satisfaction of the Engineering Director prior to grading permit issuance.

SCK Prior to final inspection approval of the project, the existing retaining wall on the upper bluff face shall be removed to the satisfaction of the Planning & Building Director and the Engineering Director. Said removal may be limited to the visible portions of the post and board wall and shall be undertaken with direction from the project geotechnical consultant and city staff. Any future failures of the remaining portions of the wall shall be removed as it occurs and no repair or replacement shall be allowed.

SCL As recommended in the project Geotechnical Evaluation, heavy equipment shall not be utilized within 25 of the upper edge of the bluff, lighter equipment such as a mini bobcat may be used within 25 feet of the bluff edge under extreme caution, but not closer than 10 feet to the top of the bluff face. Improvements that require removal of existing materials within the 40 foot bluff setback shall be done my manual labor. Paving shall be sawcut and removed with a mini bobcat as stipulated above.

SCM No bluff protection for improvements within the standard 40 foot coastal bluff setback shall be authorized if said improvements are threatened in the future. Additionally, the improvements shall be monitored and planned retreat of the minor accessory structures shall occur with bluff erosion. When the bluff edge erodes to a point which is within one foot of an improvement, affected improvements shall be relocated eastward in 10 foot increments.

G1 **STANDARD CONDITIONS:**

CONTACT THE PLANNING AND BUILDING DEPARTMENT REGARDING COMPLIANCE WITH THE FOLLOWING CONDITION(S):

G2 This approval may be appealed to the City Council within 15 calendar days from the date of this approval in accordance with Chapter 1.12 of the Municipal Code.

G3 This project is located within the Coastal Appeal Zone and may be appealed to the California Coastal Commission pursuant to Coastal Act Section 30603 and Chapter 30.04 of the City of Encinitas Municipal Code. An appeal of the Planning Commission's decision must be filed with the Coastal Commission within 10 days following the Coastal Commission's receipt of the Notice of Final Action. Applicants will be notified by the Coastal Commission as to the date the Commission's appeal period will conclude. Appeals must be in writing to the Coastal Commission, San Diego Coast District office.

G4 Prior to **building permit issuance**, the owner shall cause a covenant regarding real property to be recorded. Said covenant shall set forth the terms and conditions of this grant of approval and shall be of a form and content satisfactory to the Planning and Building Director. The Owner(s) agree, in acceptance of the conditions of this approval, to waive any claims of liability against the City and agrees to indemnify, hold harmless and defend the City and City's employees relative to the action to approve the project.

G5 Approval of this request shall not waive compliance with any sections of the Municipal Code and all other applicable City regulations in effect at the time of Building Permit issuance unless specifically waived herein.

G7 Prior to issuing a final inspection on framing, the applicant shall provide a survey from a licensed surveyor or a registered civil engineer verifying that the building height is in compliance with the approved plans. The height certification/survey shall be supplemented with a reduced (8 ½" x 11") copy of the site plan and elevations depicting the exact point(s) of certification. The engineer/surveyor shall contact the Planning and Building Department to identify and finalize the exact point(s) to be certified prior to conducting the survey.

G12 Prior to any use of the project site pursuant to this permit, all conditions of approval contained herein shall be completed or secured to the satisfaction of the Planning and Building Department.

G13 The applicant shall pay development fees at the established rate. Such fees may include, but not be limited to: Permit and Plan Checking Fees, Water and Sewer Service Fees, School Fees, Traffic Mitigation Fees, Flood Control Mitigation Fees, Park Mitigation Fees, and Fire Mitigation/Cost Recovery Fees. Arrangements to pay these fees shall be made prior to **building permit issuance** to the satisfaction of the Planning and Building and Engineering Services Departments. The applicant is advised to contact the Planning and Building Department regarding Park Mitigation Fees, the Engineering Services Department regarding Flood Control and Traffic Fees, applicable School District(s) regarding School Fees, the Fire Department regarding Fire Mitigation/Cost Recovery Fees, and the applicable Utility Departments or Districts regarding Water and/or Sewer Fees.

G14 A plan shall be submitted for approval by the Planning and Building Department, the Engineering Services Department, and the Fire Department regarding the security treatment of the site during the construction phase, the on- and off-site circulation and parking of construction workers' vehicles, and any heavy equipment needed for the construction of the project.

G19 Garages enclosing required parking spaces shall be kept available and usable for the parking of owner/tenant vehicles at all times.

L3 All parking areas and driveways shall conform with Chapter 30.54 of the Municipal Code and the City's Offstreet Parking and Design Manual incorporated by reference therein.

DR1 Any future modifications to the approved project will be reviewed relative to the findings for substantial conformance with a design review permit contained in Section 23.08.140 of the Municipal Code. Modifications beyond the scope described therein may require submittal of an amendment to the design review permit and approval by the authorized agency.

DR3 All project grading shall conform with the approved plans. If no grading is proposed on the approved plans, or subsequent grading plans are inconsistent with the grading shown on the approved plans, a design review permit for such grading shall be obtained from the authorized agency of the City prior to issuance of grading or building permits.

BL1 Owner(s) shall enter into and record a covenant satisfactory to the City Attorney waiving any claims of liability against the City and agreeing to indemnify and hold harmless the City and City's employees relative to the approved project. This covenant is applicable to any bluff failure and erosion resulting from the development project.

BL3 An "as-built geotechnical report" shall be submitted to the Planning and Building and Engineering Services Departments, for review and acceptance, prior to approval of the foundation inspection. The report shall outline all field test locations and results, and observations performed by the consultant during construction of the proposed structure(s), and especially relative to the depths and actual location of the foundations. The report shall also verify that the recommendations contained in the Geotechnical Investigation Report, prepared and submitted in conjunction with the application, have been properly implemented and completed.

BL4 An "as-built geotechnical report", reviewed and signed by both the soils/geotechnical engineer and the project engineering geologist, shall be completed and submitted to the City within 15 working days after completion of the project. The project shall not be considered complete (and thereby approved for use or occupancy) until the as-built report is received and the content of the report is found acceptable by the Planning and Building and Engineering Services Departments.

B1 **BUILDING CONDITION(S):**

CONTACT THE ENCINITAS BUILDING DIVISION REGARDING COMPLIANCE WITH THE FOLLOWING CONDITION(S):

B2R The applicant shall submit a complete set of construction plans to the Building Division for plancheck processing. The submittal shall include a Soils/Geotechnical Report, structural calculations, and State Energy compliance documentation (Title 24). Construction plans shall include a site plan, a foundation plan, floor and roof framing plans, floor plan(s), section details, exterior elevations, and materials specifications. Submitted plans must show compliance with the latest adopted editions of the California Building Code (The Uniform Building Code with California Amendments, the California Mechanical, Electrical and Plumbing Codes). These comments are preliminary only. A comprehensive plancheck will be completed prior to permit issuance and additional technical code requirements may be identified and changes to the originally submitted plans may be required.

F1 **FIRE CONDITIONS:**

CONTACT THE ENCINITAS FIRE DEPARTMENT REGARDING COMPLIANCE WITH THE FOLLOWING CONDITION(S):

F2 ACCESS ROADWAY DIMENSIONS: Fire apparatus access roadways shall have an unobstructed paved width of not less than 24 feet, curb line to curb line, or edge of pavement to edge of pavement where no curbs are proposed, and an unobstructed vertical clearance of not less than 13 feet 6 inches. Access roads shall be designed and maintained to support the imposed loads of fire apparatus. Minimum design load is 65,000 lbs. EXCEPTION: Access to one (1) single family residence shall not be less than 16 feet of paved width, curb line to curb line, or edge of pavement to edge of pavement where no curbs are proposed.

F13 ADDRESS NUMBERS: Address numbers shall be placed in a location that will allow them to be clearly visible from the street fronting the structure. The numbers shall contrast with their background, and shall be no less in height than: Four inches (4") for

STATE OF CALIFORNIA -- THE RESOURCES AGENCY ARNOLD SCHWARZENEGGER, *Governor*

CALIFORNIA COASTAL COMMISSION

SAN DIEGO COAST DISTRICT OFFICE
7575 METROPOLITAN DRIVE, SUITE 103
SAN DIEGO, CA 92108-4421
VOICE (619) 767-2370 FAX (619) 767-2384

APPEAL FROM COASTAL PERMIT DECISION OF LOCAL GOVERNMENT

Please Review Attached Appeal Information Sheet Prior To Completing This Form.

SECTION I. Appellant(s)

Name: Commissioner Patrick Kruer

Mailing Address: 7727 Herschel Avenue

City: La Jolla, Ca Zip Code: 92037 Phone: (858) 551-4390

SECTION II. Decision Being Appealed

1. Name of local/port government:

City of Encinitas

2. Brief description of development being appealed:

Demolish existing single-family residence and construct an approximately 4,424 sq. ft. two-story single-family residence with an approximately 1,095 sq. ft. basement that includes an approximately 505 sq. ft. garage on an approximately 5,638 sq. ft. blufftop lot. The new residence is proposed to be setback to approximately 42 feet from the bluff edge. In addition, the proposed second floor will be cantilevered approximately 7 feet into the City's 40 ft. bluff setback area.

3. Development's location (street address, assessor's parcel no., cross street, etc.):

282 Neptune Avenue
Encinitas, Ca 92024
APN 256-352-08

4. Description of decision being appealed (check one.):

RECEIVED
AUG 2 5 2006
CALIFORNIA
COASTAL COMMISSION
SAN DIEGO COAST DISTRICT

☐ Approval; no special conditions

☒ Approval with special conditions:

☐ Denial

Note: For jurisdictions with a total LCP, denial decisions by a local government cannot be appealed unless the development is a major energy or public works project. Denial decisions by port governments are not appealable.

TO BE COMPLETED BY COMMISSION:

APPEAL NO: A-6-ENC-06-10

DATE FILED: 8/25/06

DISTRICT: San Diego

EXHIBIT NO. 4
APPLICATION NO.
A-6-ENC-06-100
Appeal Application of Comm. Kruer
Page 1 of 7
California Coastal Commission

APPEAL FROM COASTAL PERMIT DECISION OF LOCAL GOVERNMENT (Page 2)

5. Decision being appealed was made by (check one):

☐ Planning Director/Zoning Administrator

☐ City Council/Board of Supervisors

☒ Planning Commission

☐ Other

6. Date of local government's decision: July 20, 2006

7. Local government's file number (if any): 05-161 DR/CDP

SECTION III. Identification of Other Interested Persons

Give the names and addresses of the following parties. (Use additional paper as necessary.)

a. Name and mailing address of permit applicant:

John and Valerie Zagara
2041 San Elijo Avenue
Cardiff, Ca 92007

b. Names and mailing addresses as available of those who testified (either verbally or in writing) at the city/county/port hearing(s). Include other parties which you know to be interested and should receive notice of this appeal.

(1)

(2)

(3)

(4)

APPEAL FROM COASTAL PERMIT DECISION OF LOCAL GOVERNMENT
Page 3

State briefly your reasons for this appeal. Include a summary description of Local Coastal Program, Land Use Plan, or Port Master Plan policies and requirements in which you believe the project is inconsistent and the reasons the decision warrants a new hearing. (Use additional paper as necessary.)

See Attachment "A"

Note: The above description need not be a complete or exhaustive statement of your reasons of appeal; however, there must be sufficient discussion for staff to determine that the appeal is allowed by law. The appellant, subsequent to filing the appeal, may submit additional information to the staff and/or Commission to support the appeal request.

SECTION V. Certification

The information and facts stated above are correct to the best of my/our knowledge.

Signed: [signature]
Appellant or Agent

Date: 8/25/06

Agent Authorization: I designate the above identified person(s) to act as my agent in all matters pertaining to this appeal.

Signed: ______________________

Date: ______________________

(Document2)

Zagara Appeal Application
Attachment "A"
August 25, 2006

The coastal permit approved by the City of Encinitas allows for the demolition of an existing single-family residence and construction of an approximately 4,424 sq. ft. two-story single-family residence with an approximately 1,095 sq. ft. basement that includes an approximately 505 sq. ft. garage on an approximately 5,638 sq. ft. blufftop lot. The new residence is proposed to be setback to approximately 42 feet from the bluff edge and will be located closer to the bluff edge than the existing home. In addition, the proposed second floor will be cantilevered approximately 7 feet into the City's 40 ft. bluff setback area.

The development as approved by the City is inconsistent with Section 30.34.020(D) of the City's Certified Implementing Plan (IP) of the Local Coastal Program which requires that a geotechnical report be submitted which documents the development will be stable over 75 years so as to not require "any shore or bluff stabilization to protect the structure in the future". In addition, the project as approved by the City is inconsistent with the requirement of Section 30.34.020(D) that the erosion rate used in the required geotechnical report be based on current and historical data.

Section 30.34.020(D) of the IP states, in part:

> APPLICATION SUBMITTAL REQUIREMENTS. Each application to the City for a permit or development approval for property under the Coastal Bluff Overlay Zone shall be accompanied by a soils report, and either a geotechnical review or geotechnical report as specified in paragraph C "Development Processing and Approval" above. Each review/report shall be prepared by a certified engineering geologist who has been pre-qualified as knowledgeable in City standards, coastal engineering and engineering geology. The review/report shall certify that the development proposed will have no adverse affect on the stability of the bluff, will not endanger life or property, and that any proposed structure or facility is expected to be reasonably safe from failure and erosion over its lifetime without having to propose any shore or bluff stabilization to protect the structure in the future. Each review/report shall consider, describe and analyze the following: (Ord. 95-04)
>
> 1. Cliff geometry and site topography, extending the surveying work beyond the site as needed to depict unusual geomorphic conditions that might affect the site;
>
> 2. Historic, current and foreseeable-cliffs erosion, including investigation or recorded land surveys and tax assessment records in addition to land use of historic maps and photographs where available and possible changes in shore configuration and sand transport;

3. Geologic conditions, including soil, sediment and rock types and characteristics in addition to structural features, such as bedding, joints and faults;

4. Evidence of past or potential landslide conditions, the implications of such conditions for the proposed development, and the potential effects of the development on landslide activity;

5. Impact of construction activity on the stability of the site and adjacent area;

6. Ground and surface water conditions and variations, including hydrologic changes caused by the development e.g., introduction of irrigation water to the ground water system; alterations in surface drainage);

7. Potential erodibility of site and mitigating measures to be used to ensure minimized erosion problems during and after construction (i.e., landscaping and drainage design);

8. Effects of marine erosion on seacliffs and estimated rate of erosion at the base of the bluff fronting the subject site based on current and historical data; (Ord. 95-04)

9. Potential effects of seismic forces resulting from a maximum credible earthquake;

10. Any other factors that might affect slope stability;

11. Mitigation measures and alternative solutions for any potential impacts.

The report shall also express a professional opinion as to whether the project can be designed or located so that it will neither be subject to nor contribute to significant geologic instability throughout the life span of the project. The report shall use a current acceptable engineering stability analysis method and shall also describe the degree of uncertainty of analytical results due to assumptions and unknowns. The degree of analysis required shall be appropriate to the degree of potential risk presented by the site and the proposed project.

In addition to the above, each geotechnical report shall include identification of the daylight line behind the top of the bluff established by a bluff slope failure plane analysis. This slope failure analysis shall be performed according to geotechnical engineering standards, and shall:

- Cover all types of slope failure.
- Demonstrate a safety factor against slope failure of 1.5.
- Address a time period of analysis of 75 years.

[. . .]
(Emphasis added)

The project approved by the City is located within the Coastal Bluff Overlay Zone and the residence will be sited approximately 42 ft. from the edge of an approximately 80 ft.-high coastal bluff subject to marine erosion. The geotechnical report prepared for the subject development was inadequately prepared such that it cannot be determined if the proposed geologic setback of 42 ft. is adequate to meet the standards of the Section 30.34.020(D) of the City's certified IP. The appropriate setback must prevent reasonable risk of damage within the economic life of the principal structure. Thus, in order to find the appropriate geologic setback, the Certified LCP requires that not only must an adequate factor of safety of 1.5 be shown under present conditions, but that it must also demonstrate that an adequate factor of safety of 1.5 will be maintained over 75 years. In this case, the geotechnical report approved by the City only identified the factor of safety under present conditions.

In addition, the erosion rate used by the geotechnical report approved by the City failed to use current scientific data. Section 30.34.020(D) of the IP requires that geotechnical report analyze "[h]istoric, current and foreseeable-cliffs erosion" and that the estimated rate of erosion of the bluff be based on "current and historical data" [emphasis added]. The applicant's geotechnical report relied on a 1976 erosion study by Lee, Pickney and Bemis which estimated an erosion rate along the Encinitas shoreline of no more than 0.33 ft./yr. ("Sea Cliff Erosion", by L. Lee, C. Pickney and C. Bemis, 1976). However, according to the Coastal Commission's staff geologist, the current published state-of-the-art for establishing bluff retreat rates in this area is a FEMA-funded study done as part of a nationwide assessment of coastal erosion hazards [Ref. Benumof and Griggs (1999)], which estimates the erosion rate along the Encinitas shoreline to be up to 0.49 feet per year. Over 75 years, this translates into a bluff retreat of approximately 37 ft. In this case, the geotechnical report approved by the City failed to adequately calculate a safe setback from the bluff edge because it used an outdated erosion rate and failed to demonstrate that an adequate factor of safety of 1.5 will be maintained over 75 years.

The City only required a setback of 42 ft. which appears to be an insufficient distance to protect the residence over its lifetime.

Another issue raised by the development involves the City's failure to require the subject bluff face to be protected through the application of an open space easement or comparable measure. Public Safety Policy 1.6 of the City's Land Use Plan requires, in part, that:

> The City shall provide for the reduction of unnatural causes of bluff erosion, as detailed in the Zoning Code, by:
>
> [. . .]
>
> g. Permanently conserving the bluff face within an open space easement or other suitable instrument.
>
> [. . .]

In approving the development, the City failed to require the bluff face be conserved within an open space easement or other instrument so as to protect the bluff from future development such as a shoreline protective devices.

In summary, the City's approved permit for demolition of an existing home and construction of an approximately 4,424 sq. ft. two-story single family blufftop residence is inconsistent with the policies of the certified LCP relating to siting of new development so as to assure it will be safe from failure and erosion over its lifetime without requiring shoreline protection and with the policy of the certified LCP as it relates to protection of the bluff face.

STATE OF CALIFORNIA – THE RESOURCES AGENCY ARNOLD SCHWARZENEGGER, *Governor*

CALIFORNIA COASTAL COMMISSION
SAN DIEGO COAST DISTRICT OFFICE
7575 METROPOLITAN DRIVE, SUITE 103
SAN DIEGO, CA 92108-4421
VOICE (619) 767-2370 FAX (619) 767-2384

APPEAL FROM COASTAL PERMIT DECISION OF LOCAL GOVERNMENT

Please Review Attached Appeal Information Sheet Prior To Completing This Form.

SECTION I. Appellant(s)

Name: Commissioner Steve Padilla

Mailing Address: City of Chula Vista, 276 4th Ave.

City: Chula Vista Zip Code: 91910 Phone: (619) 691-5044

SECTION II. Decision Being Appealed

1. Name of local/port government:

City of Encinitas

2. Brief description of development being appealed:

Demolish existing single-family residence and construct an approximately 4,424 sq. ft. two-story single-family residence with an approximately 1,095 sq. ft. basement that includes an approximately 505 sq. ft. garage on an approximately 5,638 sq. ft. blufftop lot. The new residence is proposed to be setback to approximately 42 feet from the bluff edge. In addition, the proposed second floor will be cantilevered approximately 7 feet into the City's 40 ft. bluff setback area.

3. Development's location (street address, assessor's parcel no., cross street, etc.):

282 Neptune Avenue
Encinitas, Ca 92024
APN 256-352-08

4. Description of decision being appealed (check one.):

- ☐ Approval; no special conditions
- ☒ Approval with special conditions:
- ☐ Denial

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CALIFORNIA
COASTAL COMMISSION
SAN DIEGO COAST DISTRICT

Note: For jurisdictions with a total LCP, denial decisions by a local government cannot be appealed unless the development is a major energy or public works project. Denial decisions by port governments are not appealable.

TO BE COMPLETED BY COMMISSION:

APPEAL NO: A-6-ENC-06-100

DATE FILED: 8/25/06

DISTRICT: San Diego

EXHIBIT NO. 5
APPLICATION NO.
A-6-ENC-06-100
Appeal Application of Comm. Padilla
Page 1 of 7
California Coastal Commission

APPEAL FROM COASTAL PERMIT DECISION OF LOCAL GOVERNMENT (Page 2)

5. Decision being appealed was made by (check one):

- ☐ Planning Director/Zoning Administrator
- ☐ City Council/Board of Supervisors
- ☒ Planning Commission
- ☐ Other

6. Date of local government's decision: July 20, 2006

7. Local government's file number (if any): 05-161 DR/CDP

SECTION III. Identification of Other Interested Persons

Give the names and addresses of the following parties. (Use additional paper as necessary.)

a. Name and mailing address of permit applicant:

John and Valerie Zagara
2041 San Elijo Avenue
Cardiff, Ca 92007

b. Names and mailing addresses as available of those who testified (either verbally or in writing) at the city/county/port hearing(s). Include other parties which you know to be interested and should receive notice of this appeal.

(1)

(2)

(3)

(4)

APPEAL FROM COASTAL PERMIT DECISION OF LOCAL GOVERNMENT
Page 3

State briefly your reasons for this appeal. Include a summary description of Local Coastal Program, Land Use Plan, or Port Master Plan policies and requirements in which you believe the project is inconsistent and the reasons the decision warrants a new hearing. (Use additional paper as necessary.)

SEE Attachment "A"

Note: The above description need not be a complete or exhaustive statement of your reasons of appeal; however, there must be sufficient discussion for staff to determine that the appeal is allowed by law. The appellant, subsequent to filing the appeal, may submit additional information to the staff and/or Commission to support the appeal request.

SECTION V. Certification

The information and facts stated above are correct to the best of my/our knowledge.

Signed: [signature]
Appellant or Agent

Date: 8/25/06

Agent Authorization: I designate the above identified person(s) to act as my agent in all matters pertaining to this appeal.

Signed: ______________________

Date: ______________________

(Document2)

Zagara Appeal Application
Attachment "A"
August 25, 2006

The coastal permit approved by the City of Encinitas allows for the demolition of an existing single-family residence and construction of an approximately 4,424 sq. ft. two-story single-family residence with an approximately 1,095 sq. ft. basement that includes an approximately 505 sq. ft. garage on an approximately 5,638 sq. ft. blufftop lot. The new residence is proposed to be setback to approximately 42 feet from the bluff edge and will be located closer to the bluff edge than the existing home. In addition, the proposed second floor will be cantilevered approximately 7 feet into the City's 40 ft. bluff setback area.

The development as approved by the City is inconsistent with Section 30.34.020(D) of the City's Certified Implementing Plan (IP) of the Local Coastal Program which requires that a geotechnical report be submitted which documents the development will be stable over 75 years so as to not require "any shore or bluff stabilization to protect the structure in the future". In addition, the project as approved by the City is inconsistent with the requirement of Section 30.34.020(D) that the erosion rate used in the required geotechnical report be based on current and historical data.

Section 30.34.020(D) of the IP states, in part:

> APPLICATION SUBMITTAL REQUIREMENTS. Each application to the City for a permit or development approval for property under the Coastal Bluff Overlay Zone shall be accompanied by a soils report, and either a geotechnical review or geotechnical report as specified in paragraph C "Development Processing and Approval" above. Each review/report shall be prepared by a certified engineering geologist who has been pre-qualified as knowledgeable in City standards, coastal engineering and engineering geology. The review/report shall certify that the development proposed will have no adverse affect on the stability of the bluff, will not endanger life or property, and that any proposed structure or facility is expected to be reasonably safe from failure and erosion over its lifetime without having to propose any shore or bluff stabilization to protect the structure in the future. Each review/report shall consider, describe and analyze the following: (Ord. 95-04)
>
> 1. Cliff geometry and site topography, extending the surveying work beyond the site as needed to depict unusual geomorphic conditions that might affect the site;
>
> 2. Historic, current and foreseeable-cliffs erosion, including investigation or recorded land surveys and tax assessment records in addition to land use of historic maps and photographs where available and possible changes in shore configuration and sand transport;

3. Geologic conditions, including soil, sediment and rock types and characteristics in addition to structural features, such as bedding, joints and faults;

4. Evidence of past or potential landslide conditions, the implications of such conditions for the proposed development, and the potential effects of the development on landslide activity;

5. Impact of construction activity on the stability of the site and adjacent area;

6. Ground and surface water conditions and variations, including hydrologic changes caused by the development e.g., introduction of irrigation water to the ground water system; alterations in surface drainage);

7. Potential erodibility of site and mitigating measures to be used to ensure minimized erosion problems during and after construction (i.e., landscaping and drainage design);

8. Effects of marine erosion on seacliffs and estimated rate of erosion at the base of the bluff fronting the subject site based on current and historical data; (Ord. 95-04)

9. Potential effects of seismic forces resulting from a maximum credible earthquake;

10. Any other factors that might affect slope stability;

11. Mitigation measures and alternative solutions for any potential impacts.

The report shall also express a professional opinion as to whether the project can be designed or located so that it will neither be subject to nor contribute to significant geologic instability throughout the life span of the project. The report shall use a current acceptable engineering stability analysis method and shall also describe the degree of uncertainty of analytical results due to assumptions and unknowns. The degree of analysis required shall be appropriate to the degree of potential risk presented by the site and the proposed project.

In addition to the above, each geotechnical report shall include identification of the daylight line behind the top of the bluff established by a bluff slope failure plane analysis. This slope failure analysis shall be performed according to geotechnical engineering standards, and shall:

- Cover all types of slope failure.
- Demonstrate a safety factor against slope failure of 1.5.
- Address a time period of analysis of 75 years.

[. . .]
(Emphasis added)

The project approved by the City is located within the Coastal Bluff Overlay Zone and the residence will be sited approximately 42 ft. from the edge of an approximately 80 ft.-high coastal bluff subject to marine erosion. The geotechnical report prepared for the subject development was inadequately prepared such that it cannot be determined if the proposed geologic setback of 42 ft. is adequate to meet the standards of the Section 30.34.020(D) of the City's certified IP. The appropriate setback must prevent reasonable risk of damage within the economic life of the principal structure. Thus, in order to find the appropriate geologic setback, the Certified LCP requires that not only must an adequate factor of safety of 1.5 be shown under present conditions, but that it must also demonstrate that an adequate factor of safety of 1.5 will be maintained over 75 years. In this case, the geotechnical report approved by the City only identified the factor of safety under present conditions.

In addition, the erosion rate used by the geotechnical report approved by the City failed to use current scientific data. Section 30.34.020(D) of the IP requires that geotechnical report analyze "[h]istoric, current and foreseeable-cliffs erosion" and that the estimated rate of erosion of the bluff be based on "current and historical data" [emphasis added]. The applicant's geotechnical report relied on a 1976 erosion study by Lee, Pickney and Bemis which estimated an erosion rate along the Encinitas shoreline of no more than 0.33 ft./yr. ("Sea Cliff Erosion", by L. Lee, C. Pickney and C. Bemis, 1976). However, according to the Coastal Commission's staff geologist, the current published state-of-the-art for establishing bluff retreat rates in this area is a FEMA-funded study done as part of a nationwide assessment of coastal erosion hazards [Ref. Benumof and Griggs (1999)], which estimates the erosion rate along the Encinitas shoreline to be up to 0.49 feet per year. Over 75 years, this translates into a bluff retreat of approximately 37 ft. In this case, the geotechnical report approved by the City failed to adequately calculate a safe setback from the bluff edge because it used an outdated erosion rate and failed to demonstrate that an adequate factor of safety of 1.5 will be maintained over 75 years.

The City only required a setback of 42 ft. which appears to be an insufficient distance to protect the residence over its lifetime.

Another issue raised by the development involves the City's failure to require the subject bluff face to be protected through the application of an open space easement or comparable measure. Public Safety Policy 1.6 of the City's Land Use Plan requires, in part, that:

> The City shall provide for the reduction of unnatural causes of bluff erosion, as detailed in the Zoning Code, by:
>
> [. . .]
>
> g. Permanently conserving the bluff face within an open space easement or other suitable instrument.
>
> [. . .]

In approving the development, the City failed to require the bluff face be conserved within an open space easement or other instrument so as to protect the bluff from future development such as a shoreline protective devices.

In summary, the City's approved permit for demolition of an existing home and construction of an approximately 4,424 sq. ft. two-story single family blufftop residence is inconsistent with the policies of the certified LCP relating to siting of new development so as to assure it will be safe from failure and erosion over its lifetime without requiring shoreline protection and with the policy of the certified LCP as it relates to protection of the bluff face.

STATE OF CALIFORNIA – THE RESOURCES AGENCY GRAY DAVIS, GOVERNOR

CALIFORNIA COASTAL COMMISSION
45 FREMONT, SUITE 2000
SAN FRANCISCO, CA 94105-2219
VOICE AND TDD (415) 904-5200
FAX (415) 904-5400

W11.5

MEMORANDUM

Date: 16 January 2003

To: Commissioners and Interested Parties

From: Mark Johnsson, Staff Geologist

Subject: **Establishing development setbacks from coastal bluffs**

STAFF NOTE

Consistency with section 30253 of the Coastal Act requires that:

> New development shall:
>
> (1) Minimize risks to life and property in areas of high geologic, flood, and fire hazard.
>
> (2) Assure stability and structural integrity, and neither create nor contribute significantly to erosion, geologic instability, or destruction of the site or surrounding area or in any way require the construction of protective devices that would substantially alter natural landforms along bluffs and cliffs.
>
> ...

This section requires that new development be located such that it will not be subject to erosion or stability hazard over the course of its design life. Further, the last clause requires the finding that no seawall, revetment, jetty, groin, retaining wall, or other shoreline protective structure, inasmuch as such a structure would substantially alter natural landforms along bluffs and cliffs, will be needed to protect the development over the course of its design life. The Commission has found on many occasions that siting new development away from eroding bluffs is the preferred means of assuring consistency with this section, and the establishment of bluff-top setbacks for new development is an integral part of most local coastal programs. Further, the State's draft Policy on Coastal Erosion Planning and Response states that avoidance of geologic hazards, such as eroding coastal bluffs, should be the primary means of safeguarding new development.

EXHIBIT NO. 6
APPLICATION NO.
A-6-ENC-06-100
Dr. Johnsson's Coastal Bluff Setback Commission Workshop Memo Feb. 2003
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California Coastal Commission

Accordingly, the determination of what constitutes an adequate setback is a critical component of the analysis of proposals for new development.

Because coastal bluffs are dynamic, evolving landforms, establishing appropriate development setbacks from coastal bluffs is far more challenging than it is for manufactured or natural slopes not subject to erosion at the base of the slope. The mechanisms of coastal bluff retreat are complex, but can be grouped into two broad categories. Bluff retreat may occur suddenly and catastrophically through slope failure involving the entire bluff, or more gradually through grain-by-grain erosion by marine, subaerial, and ground water processes. For both processes, the setback must be adequate to assure safety over the design life of the development.

In an effort to clarify the analytical procedures undertaken by Coastal Commission staff in evaluating proposed development setbacks, the Commission's staff geologist made two presentations at the *California and the World Ocean '02* conference held in Santa Barbara in October 2002. These presentations were combined into a single manuscript to be published in the proceedings volume for that Conference, which is attached to this staff report.

In order to bring these procedures before the Commission, and to further the exposure of them to the public, the staff geologist will brief the Commission on this methodology at the February 2003 hearing. This methodology does not represent a formal policy or position of the Coastal Commission. In fact, there may be other appropriate methodologies to establish development setbacks, and the Commission has the discretion to base a decision on any method that it finds technically and legally valid. Further, as new techniques and information become available, these methodologies may change. Nevertheless, the type of analysis outlined here represents the current analytical process carried out by Coastal Commission staff in evaluating proposals for new development on the California coast, and in recommending action upon those proposals to the Commission. The Commission then makes its decisions on a case-by-case basis, based upon the site-specific evidence related to the particular development proposal.

Attachment: Preprint of manuscript entitled "Establishing development setbacks from coastal bluffs," by Mark J. Johnsson, to appear in *Proceedings, California and the World Ocean, '02*, Orville Magoon, ed., 21 p.

Johnsson, Mark J., *in press*, Establishing Development Setbacks from Coastal Bluffs, *in* Magoon, Orville (ed.) *Proceedings, California and the World Ocean '02.*

Establishing Development Setbacks from Coastal Bluffs

Mark J. Johnsson[1]

Abstract

Responsible development, and California law, requires that coastal development be sited a sufficient distance landward of coastal bluffs that it will neither be endangered by erosion nor lead to the construction of protective coastal armoring. In order to assure that this is the case, a development setback line must be established that places the proposed structures a sufficient distance from unstable or marginally stable bluffs to assure their safety, and that takes into account bluff retreat over the life of the structures, thus assuring the stability of the structures over their design life. The goal is to assure that by the time the bluff retreats sufficiently to threaten the development, the structures themselves are obsolete. Replacement development can then be appropriately sited behind a new setback line. Uncertainty in the analysis should be considered, as should potential changes in the rate of bluff retreat and in slope stability. The deterministic approach presented here is based on established geologic and engineering principals, and similar approaches have been used to establish development setbacks from slope edges throughout the world for some time. Alternative approaches based on probabilistic methods may allow, however, for better quantification of uncertainties in the analysis. Although probabilistic coastal hazard assessment is in its infancy and data needs are large, the approach shows great promise. Developing probabilistic methods for establishing development setbacks should be a goal for future coastal zone management in California.

Introduction

In an era of sea-level rise such as has persisted on Earth for the past ~20,000 years (Curray 1965; Emery and Garrison 1967; Milliman and Emery 1968), the landward recession of coastal bluffs is an inevitable natural process wherever tectonic or isostatic uplift rates are lower than the rate of sea-level rise. New structures should be sited a sufficient distance landward of coastal bluffs that they will neither be endangered by erosion nor require the construction of coastal armoring to protect them from erosion over their design life. Because coastal bluffs are dynamic, evolving landforms, establishing responsible development setbacks from coastal bluffs is far more challenging than it is for manufactured or natural slopes not subject to erosion at the base of slope. Although internationally agreed-upon methods for establishing setbacks from static slopes have been developed, and codified in the International Building Code, no such consensus has emerged with respect to setbacks from dynamic slopes such as coastal bluffs. This paper presents a methodology for establishing such setbacks given the types of data generally available through relatively inexpensive geologic studies.

Relatively little work has been undertaken towards developing rational methodologies for establishing development setbacks from bluffs and cliffs. Coastal development setbacks have generally focused primarily on beach erosion, rather than on coastal bluff recession (*e.g.*, Healy 2002). Generally, the approach has been to simply

[1] Staff Geologist, California Coastal Commission, 45 Fremont Street, Suite 2000, San Francisco, CA 94105. Email: mjohnsson@coastal.ca.gov. The opinions expressed herein are those of the author and do not reflect a formal position of the California Coastal Commission.

extrapolate historic long-term erosion rates into the future, and establish setbacks at a particular predicted future shoreline position. This approach does not work well for shorelines with coastal bluffs, where the setback also must consider the possibility of bluff collapse (see Priest 1999 for a discussion of these issues). Komar and others (2002) presented a methodology for establishing setbacks for use on coasts where the principal hazards are wave runup and storm surge. They showed how their method could be extended to use on coasts with sea cliffs by determining the average number of hours that a sea cliff would be subject to wave attack. Their method does not, however, include a quantitative assessment of bluff stability. Given the significance of the coastal erosion threat in California, where public safety, financial investments, and environmental resources are at stake, and given the call for action urged by such recent national studies as the Heinz Center's FEMA-sponsored studies (The Heinz Center 2000a; 2000b), it is critical that a rational method be established for establishing development setbacks on coastal bluff tops.

The California Coastal Act (California Public Resource Code Sections 30000 *et seq.*) regulates coastal development in California. Section 30253 states, in part, that:

> New development shall:
>
> (1) Minimize risks to life and property in areas of high geologic, flood, and fire hazard.
>
> (2) Assure stability and structural integrity, and neither create nor contribute significantly to erosion, geologic instability, or destruction of the site or surrounding area or in any way require the construction of protective devices that would substantially alter natural landforms along bluffs and cliffs.
>
> ...

This law requires that new development be sited in such a way that it will not be subject to erosion or stability hazard over the course of its design life. Further, the last clause requires the finding that no seawall, revetment, jetty, groin, retaining wall, or other shoreline protective structure will be needed to protect the development over the course of its design life.

The principal challenge in meeting these requirements is predicting the amount and timing of coastal erosion to be expected at a particular site. The landward retreat of coastal bluffs is far from uniform in space or time (Komar 2000). Marine erosion tends to be concentrated at points and headlands due to wave refraction, occurs more quickly in weak rocks, and may vary along a coastline as these and other factors vary (Honeycutt et al. 2002). Further, coastal bluff retreat tends to be temporally episodic due to a variety of external and internal factors.

The mechanisms of coastal bluff retreat are complex (Emery and Kuhn 1982; Sunamura 1983; Vallejo 2002), but can be grouped into two broad categories. Bluff retreat may occur suddenly and catastrophically through slope failure involving the entire bluff, or more gradually through grain-by-grain erosion by marine, subaerial, and ground water processes. The distinction between the two categories may be blurred in some cases—"grains" may consist of relatively large blocks of rock or shallow slumps, for example. Nevertheless, in establishing structural setbacks it is important to evaluate the susceptibility of the bluff to both catastrophic collapse and to more gradual erosion and retreat.

For both slope stability and long-term bluff retreat by "grain-by-grain" erosion, the setback must be adequate to assure safety over the design life of the development. For this reason, it is necessary to specify the design life of the structure. Many Local Coastal Programs (the implementation of the California Coastal Act at the local government level) specify a particular value, although the Coastal Act itself does not. The most commonly assumed design lives for new development range from 50 to 100 years; the most common value is 75 years. The reasoning behind establishing a setback based on the design life is that by the time the bluff retreats sufficiently to threaten the structure, the structure is obsolete and is ready to be demolished for reasons other than encroaching erosion. Replacement development can then be appropriately sited at a new setback, appropriate for conditions at the time of its construction. This process may be thwarted by limitations imposed by parcel size, and Constitutional takings issues may complicate land use decisions. Nevertheless, the only alternative to an armored coast—with all of its attendant impacts—is to continually site, and reposition, development in harmony with coastal erosion as it inevitably moves the shoreline landward.

What follows is the methodology employed by the staff of the California Coastal Commission in evaluating setbacks for bluff top development. I would suggest that this methodology is useful on other coasts with coastal bluffs, as well. This methodology does not represent a formal policy or position of the Coastal Commission. In fact, there may be other appropriate methodologies to establish development setbacks, and the Commission has the discretion to base a decision on any method that it finds technically and legally valid. Any such alternative methods should, however, be at least as protective of coastal zone resources as those outlined here. Further, as new techniques and information become available, these methodologies may change. Nevertheless, the type of analysis outlined here represents the current analytical process carried out by Coastal Commission staff in evaluating proposals for new development on the California coast, and in recommending action upon those proposals to the Commission. The Commission then makes its decisions on a case-by-case basis, based upon the site-specific evidence related to the particular development proposal.

Definition of "Bluff Edge"

Development setbacks normally are measured from the upper edge of the bluff top. Accordingly, a great deal of effort often is focused on defining that "bluff edge." The bluff edge is simply the line of intersection between the steeply sloping bluff face and the flat or more gently sloping bluff top. Defining this line can be complicated, however, by the presence of irregularities in the bluff edge, a rounded or stepped bluff edge, a sloping bluff top, or previous grading or development near the bluff edge. Accordingly, a set of standards for defining the bluff edge is necessary.

Under the California Coastal Act, the bluff edge is defined as:

> ... the upper termination of a bluff, cliff, or seacliff. In cases where the top edge of the cliff is rounded away from the face of the cliff as a result of erosional processes related to the presence of the steep cliff face, the bluff line or edge shall be defined as that point nearest the cliff beyond which the downward gradient of the surface increases more or less continuously until it reaches the general gradient of the cliff. In a case where there is a steplike feature at the top of the cliff face, the landward edge of the topmost riser shall be taken to be the cliff edge..." (California Code of Regulations, Title 14, §13577 (h) (2).

This definition is largely qualitative, and the interpretation of the topographic profile to yield a bluff edge determination at any given coastal bluff may be subject to various interpretations. Accordingly, it may be useful to use more quantitative means to define "bluff edge." One approach, adopted, for example, by the City of Laguna Beach, is to define the bluff edge as that point at which the coastal bluff attains a certain specified steepness. This steepness is equivalent to the first derivative of the topographic profile. Such a definition may, however, be inconsistent with the legal definition above. Further, ambiguous results may be obtained when the upper portion of the bluff fluctuates around the specified steepness value. Better results may be obtained by finding the point at which the second derivative, the rate of change in steepness, of the topographic profile increases sharply. This approach may be amenable to computer analysis, although such analysis is rarely employed.

The position of the bluff edge may be changed by a variety of processes, natural and anthropogenic. Most obvious is the landward retreat of the bluff edge through coastal erosion. A bluff edge also may move seaward, through tectonic processes, but such movement is rare and usually small on human time scales. More significant is the anthropogenic modification of the bluff edge by grading or the construction of structures. A landward shift of the bluff edge commonly occurs through cutting into and removing natural materials during grading operations or the construction of seawalls. Conversely, placing artificial fill on or near the bluff edge generally does not alter the position of the natural bluff edge; the natural bluff edge still exists, buried beneath fill, and the natural bluff edge is used for purposes of defining development setbacks.

Slope Stability

Once the bluff edge is located, the first aspect to consider in establishing development setbacks from the bluff edge is to determine whether the existing coastal bluff meets minimum requirements for slope stability. If the answer to this question is "yes," then no setback is necessary for slope stability considerations. If the answer is "no," then the distance from the bluff edge to a position where sufficient stability exists to assure safety must be found. In other words, we must determine how far back from the unstable or marginally slope must development be sited to assure its safety.

We are guided in this analysis by the industry-accepted standards for artificial slopes (codified in many local grading ordinances), which require that a particular minimum "factor of safety" against landsliding be attained. A more difficult situation is the case of overhanging or notched coastal bluffs, or bluffs undermined by sea caves.

Landslides. Assessing the stability of slopes against landsliding is undertaken through a quantitative slope stability analysis. In such an analysis, the forces resisting a potential landslide are first determined. These are essentially the strength of the rocks or soils making up the bluff. Next, the forces driving a potential landslide are determined. These forces are the weight of the rocks as projected along a potential slide surface. The resisting forces are divided by the driving forces to determine the "factor of safety." A value below 1.0 is theoretically impossible, as the slope would have failed already. A value of 1.0 indicates that failure is imminent. Factors of safety at increasing values above 1.0 lend increasing confidence in the stability of the slope. The industry-standard for new development is a factor of safety of 1.5, and many local grading ordinances in California and elsewhere (including the County of Los Angeles, and the Cities of Irvine, Malibu, and Saratoga, among others) require that artificial slopes meet this factor of safety.

A slope stability analysis is performed by testing hundreds of potential sliding surfaces. The surface with the minimum factor of safety will be the one on which failure is most likely to occur. Generally, as one moves back from the top edge of a slope, the factor of safety against landsliding increases. Therefore, to establish a safe setback for slope stability from the edge of a coastal bluff, one needs to find the distance from the bluff edge at which the factor of safety is equal to 1.5.

Inherent in the calculation of a slope stability analysis is the shape (topographic profile) and geologic makeup of the coastal bluff. There are many ways to calculate the forces involved in slope stability analyses. All methods must consider such factors as rock or soil strength, variations in rock and soil strength values due to different types of materials making up the slope, anisotropy in these values, and any weak planes or surfaces that may exist in the slope (Abramson et al. 1995). More subtly, other factors that must be considered include: pore water pressure, which produces a buoyant force that reduces the resisting forces, the particular failure mechanism that is most likely (*e.g.*, a block slide mechanism vs a circular failure mechanism), and seismic forces. Seismic forces normally are considered through a separate analysis, in which a force equal to 15% of the force of gravity is added to the driving forces. Because seismic driving forces are of short duration, a factor of safety of 1.1 generally is considered adequate to assure stability during an earthquake. This type of analysis is fairly crude, and other methods for evaluating slope stability based on maximum permanent displacement experienced during earthquakes do exist, but the pseudostatic method represents the current standard of practice for most development in California (Geotechnical Group of the Los Angeles Section of the American Society of Civil Engineers 2002). Guidelines for conducting slope stability analyses for review by the California Coastal Commission are presented in Table 1.

Table 1. Guidelines for performing quantitative slope stability analyses

1) The analyses should demonstrate a factor of safety greater than or equal to 1.5 for the static condition and greater than or equal to 1.1 for the seismic condition. Seismic analyses may be performed by the pseudostatic method or by displacement methods, but in any case should demonstrate a permanent displacement of less than 50 mm.

2) Slope stability analyses should be undertaken through cross-sections modeling worst case geologic and slope gradient conditions. Analyses should include postulated failure surfaces such that both the overall stability of the slope and the stability of the surficial units is examined.

3) The effects of earthquakes on slope stability (seismic stability) may be addressed through pseudostatic slope analyses assuming a horizontal seismic coefficient of 0.15g. Alternative (displacement) methods may be useful, but should be in conformance with the guidelines published by the Geotechnical Group, American Society of Civil Engineers, Los Angeles Section (2002).

4) All slope analyses should ideally be performed using shear strength parameters (friction angle and cohesion), and unit weights determined from relatively undisturbed samples collected at the site. The choice of shear strength parameters should be supported by direct shear tests, triaxial shear test, or literature references, and should be in conformance with the guidelines published by the Geotechnical Group, American Society of Civil Engineers, Los Angeles Section (2002).

5) All slope stability analyses should be undertaken with water table or potentiometric surfaces for the highest potential ground water conditions.

6) If anisotropic conditions are assumed for any geologic unit, strike and dip of weakness planes should be provided, and shear strength parameters for each orientation should be supported by reference to pertinent direct sheer tests, triaxial shear test, or literature references.

7) When planes of weakness are oriented normal to the slope or dip into the slope, or when the strength of materials is considered homogenous, circular failure surfaces should be sought through a search routine to analyze the factor of safety along postulated critical failure surfaces. In general, methods that satisfy both force and moment equilibrium, such as Spencer's (Spencer 1967; 1973), Morgenstern-Price (Morgenstern and Price 1965), and General Limit Equilibrium (Fredlund et al. 1981; Chugh 1986) are preferred. Methods based on moment equilibrium alone, such as Simplified Bishop's Method (Bishop 1955) also are acceptable. In general, methods that solve only for force equilibrium, such as Janbu's method (Janbu 1973) are discouraged due to their sensitivity to the ratio of normal to shear forces between slices (Abramson et al. 1995).

8) If anisotropic conditions are assumed for units containing critical failure surfaces determined above, and when planes of weakness are inclined at angles ranging from nearly parallel to the slope to dipping out of slope, factors of safety for translational failure surfaces should also be calculated. The use of a block failure model should be supported by geologic evidence for anisotropy in rock or soil strength. Shear strength parameters for such weak surfaces should be supported through direct shear tests, triaxial shear test, or literature references.

Establishing a safe setback line. Once the stability of the coastal bluff has been assessed, the development setback line to assure safety from marginally stable slopes is simply the line corresponding to a factor of safety of 1.5 (static) or 1.1 (pseudostatic), whichever is further landward. In establishing this line one can either use a single cross section and specify a single distance from the bluff edge at which the factor of safety rises to 1.5 (or 1.1 for the pseudostatic case), or use several cross sections and contour the factors of safety on the bluff top. Then, by choosing the 1.5 contour (or 1.1 for the pseudostatic case, if it lies further landward), a setback line is established. The latter method generally is necessary for large or complicated sites.

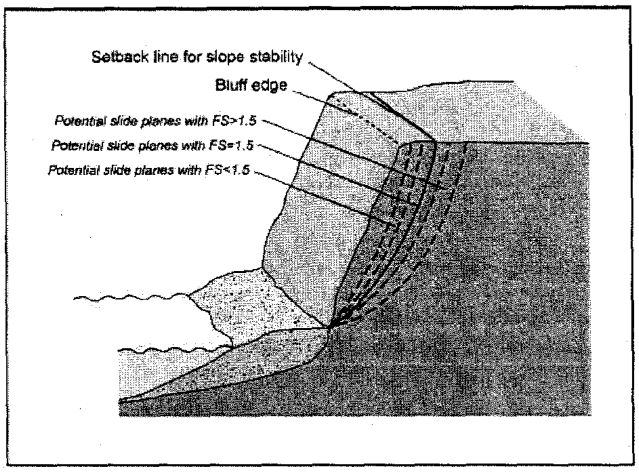

Figure 1. Establishing a development setback for slope stability. The potential slide plane possessing a defined minimum standard of stability is identified, and its intersection with the bluff edge is taken as a minimum development setback. The minimum standard for stability is usually defined as a factor of safety (FS) against sliding of 1.5 for the static case, or 1.1 for a pseudostatic (seismic) case, whichever is further landward.

Block failure of overhanging bluffs and sea caves. Assessing the factor of safety against block failure for overhanging or notched coastal bluffs, or bluffs undermined by sea caves, is far more difficult than conducting a slope stability analysis against landsliding. This is due to several factors, the most important of which are: 1) uncertainty as to the presence of local heterogeneities or planes of weakness, hidden in the bluff, that commonly control block failures, 2) difficulty in assigning shear strength values to such heterogeneities even if they can be identified, and 3) greater complexity in modeling the stress field within a bluff in terms of heterogeneities or planes of weakness as compared to a modeling a homogenous slope. The current state of the science does not allow for the calculation of a factor of safety against block failure for such overhanging or notched coastal bluffs, or bluffs undermined by sea caves, and even makes any form of quantitative assessment of the risk of failure extremely difficult. Promise is shown in mathematical models such as that of Belov and others (1999), but translating such process-oriented models into setback methodologies has not yet been attempted.

Accordingly, establishing appropriate setbacks from overhanging or undermined coastal bluffs is problematic at best. An appropriate conservative approach is to project a vertical plane upward from the rear wall of the overhang, notch, or sea cave, and establish this as the minimum setback line. This approach has been adopted by the City of San Diego, and codified in the City's Local Coastal Program. Although it is certainly possible that failure could occur along a line inclined either seaward or landward from the rear wall of the overhang, notch, or sea cave, a vertical plane would seem to be a good default configuration to assume in the absence of more compelling evidence for another configuration. Further, vertical, bluff-parallel fractures—perhaps related to stress-relief at the free face represented by the bluff face—are a common feature of otherwise homogenous coastal bluffs. In many cases, such a plane will intersect the sloping bluff face seaward of the bluff edge, and no setback from the bluff edge would be necessary to assure stability from block collapse. In cases where the plane intersects the bluff top seaward of a setback line established for landsliding, as discussed above, no additional setback would be necessary to assure stability from block collapse. In the rather rare case, however, in which the plane intersects the bluff top landward of both the bluff edge and any setback line for landsliding, the line of intersection of the plane and the bluff top would be an appropriate setback line for slope stability considerations.

Long Term Bluff Retreat

The second aspect to be considered in the establishment of a development setback line from the edge of a coastal bluff is the issue of more gradual, or "grain by grain" erosion. In order to develop appropriate setbacks for bluff top development, we need to predict the position of the bluff edge into the future. In other words, at what distance from the bluff edge will bluff top development be safe from long-term coastal erosion?

The long-term bluff retreat rate can be defined as the average value of bluff retreat as measured over a sufficient time interval that increasing the time interval has negligible effect on the average value (a statistical basis could be applied to the term "negligible," but this is rarely done). This definition implies that the long-term bluff retreat rate is linear, an assumption that certainly is not valid over time scales of more than a few centuries, or in periods of rapid sea-level change such as the late Pleistocene/early Holocene (Curray 1965; Emery and Garrison 1967; Milliman and Emery 1968). There is some overlap between slope stability issues and long-term bluff retreat issues, in that the "grains" may be fairly large rocks, and in that shallow slumping is a common mechanism for gradual bluff retreat. In addition even gradual bluff retreat tends to be highly episodic due to a host of internal and external factors.

The rate at which gradual bluff retreat occurs generally is measured by examining historic data. This is somewhat problematic in that the historic bluff retreat rate may not accurately predict the future bluff retreat rate (Watson 2002). This is a particularly issue in light of the likelihood of an acceleration in the rate of sea level rise as a result of global warming (Intergovernmental Panel on Climate Change 2001) and the resulting likely increase in bluff retreat rate (Bray and Hooke 1997; Watson 2002).

Nevertheless, historic data currently are our best indicators of future erosion at any given site. Such data may include surveys that identify the bluff edge, in which case the criteria used to identify the bluff edge must be the same in the surveys that are compared. Sufficiently detailed surveys are rare, however, and vertical aerial photography is more commonly used to assess changes in bluff position through time. The best data are those compiled photogrammetrically, whereby distortions inherent to aerial photography (due, for example, to tilting of the camera, variations in the distance from the camera to various parts of the photograph, and differences in elevation across the photograph) are corrected (see, for example, Moore 2000). Sometimes such data have been gathered as parts of specific studies of coastal bluff retreat, but more commonly they are collected as part of other work, and must be sought out for coastal erosion studies.

Coastal bluff retreat tends to be temporally episodic due to a variety of external and internal factors. External factors include tides, episodic wave events (spurred by either local or distant storms), episodic rainfall events (Kuhn 2000), El Niño-Southern Oscillation events (Griggs and Johnson 1983; Griggs 1998; Griggs and Brown 1998; Lajoie and Mathieson 1998; Storlazzi and Griggs 2000), major earthquakes (Plant and Griggs 1990; Griggs and Scholar 1997) and long-term climate change on a multidecadal to century scale (Inman and Jenkins 1999). Internal factors include the autocyclicity inherent to many bluff failure mechanisms (Leighton and Associates Inc. 1979; Hampton and Dingler 1998) and bluff response to continued toe erosion (Sunamura 1992).

Despite the episodic nature of coastal bluff retreat, it is necessary to identify the future long-term bluff retreat rate in order to establish appropriate development setbacks. The episodic nature of bluff retreat makes any calculated rate highly dependent on sampling interval. To illustrate the dependence of calculated long-term bluff retreat rates on sampling interval, it is useful to perform a sensitivity analysis from real data. Unfortunately, there are insufficient data to perform a meaningful analysis for any one site in California. Accordingly, a synthetic data set was created as part of this study.

A Synthetic Data Set. Creating and examining a synthetic data set allows for testing the effects of sampling on the determination of long-term bluff retreat rates. The long-term retreat rate is, by definition, known for the synthetic data set. Further, a synthetic data set can be created that is both longer and more complete than any such data set available from nature. The data set considered here (available upon request from the author) was created for a hypothetical 200-year period, assigned the dates 1800-2000. Figure 2 is a graphical representation of the data set, and charts the progressive retreat of the hypothetical bluff edge through that time period. Although the data are fictitious, they roughly correlate with well-known periods of episodic erosion in coastal California, at least for the second half of the data set.

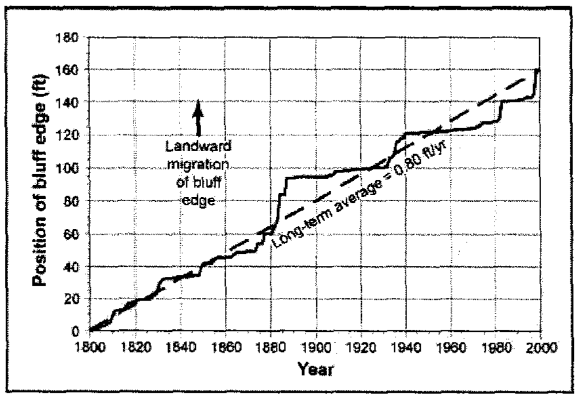

Figure 2. Plot of the position of the top edge of a hypothetical coastal bluff over time. These data represent a synthetic data set that is meant to roughly mimic typical episodic bluff retreat. Although fictitious, the data correlate well with what is know of temporal variations in erosion rate for a typical California bluff experiencing moderate erosion. The data set is far more complete than actual data available at any given site, however, making possible a sensitivity analysis of sampling interval on the calculation of the long-term bluff retreat rate.

Moving averages. A standard statistical method to smooth spikes in data is to average the data over a window of some width, while moving that window through the data set. Figure 3 shows the effect of applying this technique to the synthetic data set, using averaging windows of various widths. The first derivative of the curve representing bluff edge position through time (Figure 2) is the "instantaneous" bluff-retreat rate, and varies from 0 to 15 ft/yr for the synthetic data set (Figure 3). As the averaging window increases in width, the maximum retreat rate values decrease and the minimum values increase, effectively smoothing and broadening the "peaks" representing episodic erosion events. Depending on how the window is centered on the point representing the window average, peaks may be offset in time as well. With the widest sampling windows, peaks are essentially eliminated, and the retreat rate calculated approaches the average long-term retreat rate for the entire data set (0.80

ft/yr). Note that it is only when the window width approaches (and exceeds) 50 years in width that the calculated bluff retreat rate approaches the long-term average rate.

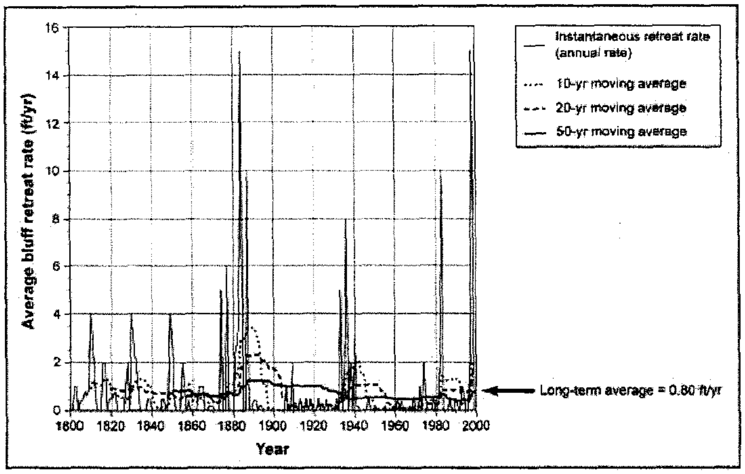

Figure 3. Average annual bluff retreat rate calculated from the synthetic data set using moving averages with various averaging window sizes. Only when data are averaged over ~50 years or more does the calculated annual bluff retreat rate approach the known long-term average for the data set.

Data gathered at intervals. Data regarding bluff edge position are almost always gathered at widely spaced intervals, corresponding to the dates of surveys or photographs. This precludes the use of a moving average technique, which depends on continuous data. Figure 4 shows the calculated bluff retreat rates at regularly spaced intervals of 10, 20, and 50 years. A wide range of values for the bluff retreat rate are obtained at the shorter sampling intervals. Although short sampling intervals give the most information on the variability of bluff retreat, the best estimate of the long-term bluff retreat rate is provided by sampling at long time intervals. Even at these long time intervals, if a statistically greater- or lesser-than-average number of "episodic events" are included in the sample, then the bluff retreat rate calculated for that interval will seriously over- or underestimate actual the long-term average bluff retreat rate.

Principal observations from the synthetic data set. A few simple generalities can be made from this limited analysis. First, instantaneous bluff retreat rates can exceed the long term average rate by a factor of many times. This is also true for data collected at short (= ~10 years for the synthetic data set) time intervals. Second, data collected at relatively short time intervals give useful information on the episodic nature of bluff retreat, but do not provide accurate estimates of long-term average bluff retreat rates. Third, the best estimate of long-term average bluff retreat rate is obtained by sampling over long (= ~50 years for the synthetic data set) time intervals. Finally, in order to accurately estimate the long-term bluff retreat rate, a stochastically appropriate number of episodic events must be included in the sampling interval. These observations, as well as similar observations from real data, lead to the general guidelines for estimating the long-term average bluff retreat rate at a site that are presented in Table 2.

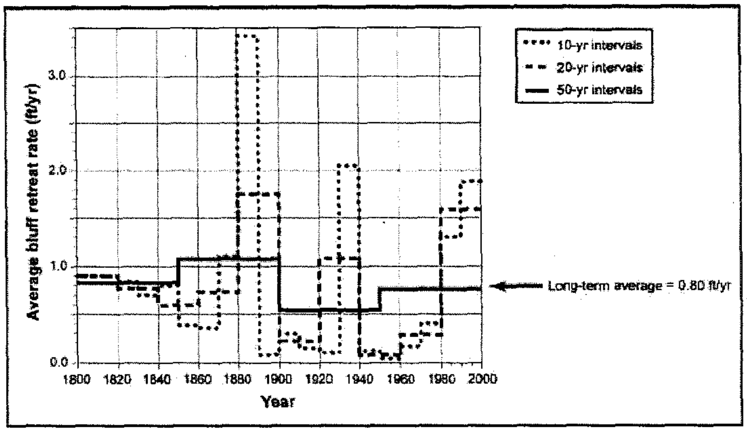

Figure 4. Average annual bluff retreat rate calculated from the synthetic data set using discrete sampling intervals of various sizes. Only when data are sampled at intervals of ~50 years or more does the calculated annual bluff retreat rate approach the known long-term average for the data set.

Establishing setbacks for long-term bluff retreat. Once an historic long-term bluff retreat rate has been estimated, establishing a setback for long-term bluff retreat rate is a simple matter of multiplying that rate, *B*, by the design life of the development, *t*. This is equivalent to predicting the position of the coastal bluff edge at the end of the design life of the structure (Figure 5).

Although this is the usual method of establishing setbacks for long-term bluff retreat in California, inherent assumptions and difficulties must be born in mind. Foremost among these is the necessity of defining the design life of the development. Because the landward retreat of an unarmored shoreline is inevitable and ongoing during a period of relative sea level rise, it is impossible to assure the safety of development from coastal erosion unless a time frame is assigned at the onset. But assigning a design life is difficult, and there is nothing in land use law that requires the abandonment of development at the end of its assigned design life.

Other problems associated with this type of analysis revolve around its inherently historic approach. There is no *a priori* reason to believe that bluff retreat rates are, or will continue to be, linear. This is especially relevant in light of expected acceleration of the historic rate of sea level rise as a result of global warming (Intergovernmental Panel on Climate Change 2001). Further, there is good evidence that erosion rates can be highly variable through time (Jones and Rogers 2002). For all of these reasons it is important to adopt a conservative approach to estimating long-term bluff retreat rates.

Table 2. Guidelines for establishing long-term bluff retreat rates

1) Determine bluff edge positions at as many times as possible, but covering a minimum of about 50 years and extending to the present. Common data sets include vertical aerial photographs, surveys that identify the bluff edge, and detailed topographic maps. These sources must be of sufficient scale or precision to locate accurately the position of the bluff edge to within a few feet.

2) If aerial photographs are used, the best results are obtained through photogrammetric methods, whereby distortions inherent to aerial photography are corrected (orthorectified). Even if photogrammetric methods are not used, the scale of the photographs must be carefully determined by comparison of the image size of known features to their actual size.

3) When comparing bluff edge positions on aerial photographs or unanchored surveys, a "shoreline reference feature" must be identified that has been static through time and is identifiable in each data set. Bluff positions throughout the area of reference can be measured relative to this feature. Common shoreline reference features are road centerlines, structures, large rock outcrops, or trees.

4) When comparing bluff edge positions on surveys, it is critical that the same criteria for the identification of the bluff edge was used in each survey. The Coastal Act definition of a bluff edge can be found in California Code of Regulations, Title 14, § 13577 (h) (2).

5) Although the short-term erosion rate for each time interval between data points provides valuable information regarding the nature of bluff retreat at the site, the long-term erosion rate should be determined from the extreme end-points of the time series examined. This time series should exceed 50 years in length, and should include both relatively quiet periods, such as the 1950's-1960's; and the more erosive subsequent time periods (especially the 1982-1983 and 1997-1998 El Niño winters).

6) In larger study areas, the bluff retreat rate should be determined at intervals along the bluff edge, paying special attention to potential differences in retreat rate between headlands and coves, and amongst areas underlain by differing geologic materials.

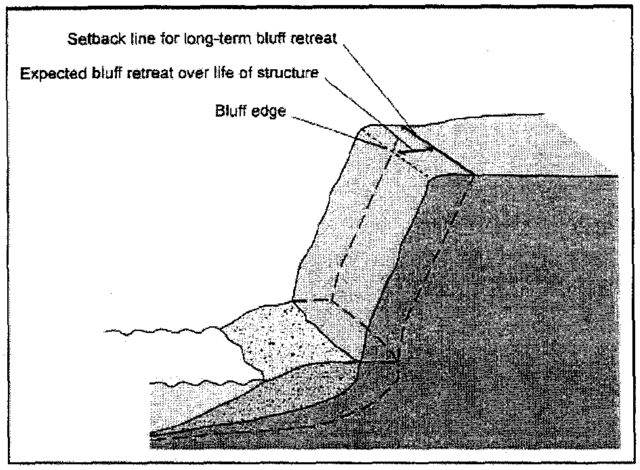

Figure 5. Establishing a development setback for long term bluff retreat. The expected bluff position at the end of the development's useful life is found by multiplying the average annual bluff retreat rate by the design life of the development; this line is taken to represent the minimum setback for long-term bluff retreat.

Uncertainty

There is a great deal of uncertainty in many parts of the analysis discussed above. The deterministic approach outlined here does not deal well with such uncertainty. Various methods have been used to build in some margin for error in establishing safe building setbacks. One approach, commonly used by geologists working in northern California, is to multiply the long-term bluff retreat rate by a factor of safety (used in a different sense than for slope stability), generally ranging from 1.5 to 4.0. More commonly, a simple "buffer" is added to the setback generated by multiplying the long-term bluff retreat rate by the design life of the structure. This buffer, generally on the order of ten feet, serves several functions: 1) it allows for uncertainty in all aspects of the analysis; 2) it allows for any future increase in bluff retreat rate due, for example, to an increase in the rate of sea level rise (Bray and Hooke 1997; Watson 2002); 3) it assures that at the end of the design life of the structure the foundations are not actually being undermined (if that were to be the case the structure would actually be imperiled well before the end of its design life); and 4) it allows access so that remedial measures, such as relocation of the structure, can be taken as erosion approaches the foundations. If a slope stability setback is required (*i.e.*, if the bluff does not meet minimum slope stability standards), that setback can do double duty as this buffer.

Summary: Defining the Total Setbacks for Bluff-Top Development

To define the total development setback, one must combine the two aspects of the setback considered above: the setback to assure safety from landsliding or block failure, and the setback for long-term bluff retreat. The resulting setback assures that minimal slope stability standards are maintained for the design life of the structure.

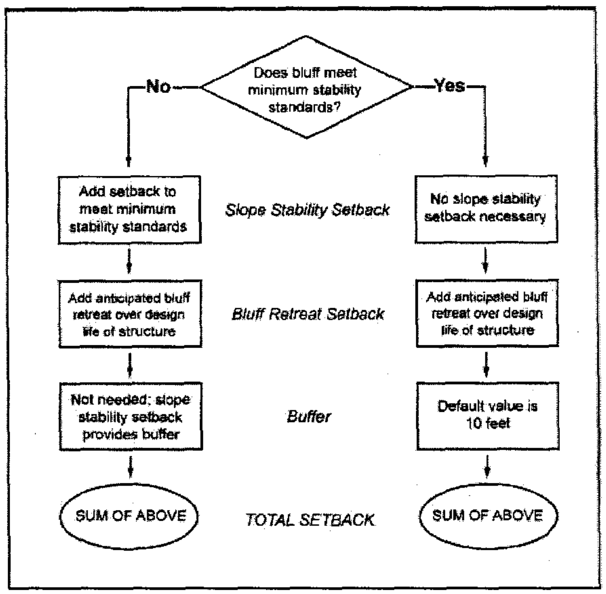

Figure 6. Flowchart for establishing bluff edge setback for development, taking into account stability of the bluff, long-term bluff retreat, and uncertainty in the analysis.

A methodology for combining these setbacks is outlined in Figure 6. First, it must be determined whether the coastal bluff meets minimum slope stability standards. Normally, this will be a factor of safety of 1.5 (static) or 1.1 (pseudostatic). If the answer to this question is "yes," then no setback is necessary to assure slope stability. If the answer is "no," then it is necessary to determine the position on the bluff top where the minimum slope stability standards are attained. This position, as measured relative to the bluff edge, is the setback necessary for slope stability determined as described above. In the case of block failure of an overhanging bluff or collapse of a sea cave, the setback necessary to assure stability from this type of collapse is equivalent to the slope stability setback. Although the current state of the science makes it impossible to quantitatively assess stability relative to this type of failure, a conservative, yet realistic, setback line is the projection of a vertical plane from the rear wall of the overhang or sea cave on the bluff top. If the plane does not intersect the bluff top (*i.e.*, intersects the inclined bluff face seaward of the bluff edge), then no setback for this type of collapse is necessary.

The next step is to determine the expected bluff retreat over the design life of the structure, as described above. This setback is added to the slope stability setback, if any.

Finally, a buffer, generally a minimum of 10 feet, should be added to address uncertainty in the analysis, to allow for any future increase in the long-term bluff retreat rate, to assures that the foundation elements aren't actually undermined at the end of the design life of the development, and to allow access for remedial measures. A buffer is not necessary if the slope stability setback equals or exceeds about ten feet, as it can do "double duty" as both a setback to assure slope stability and a buffer for the purposes listed above.

The total setback is meant to assure that minimum slope stability standards are maintained for the design life of the development. Inherent in this analysis is the assumption that factors affecting slope stability (steepness and shape of the slope, ground water conditions, geometry of rock types exposed in the bluff) will remain constant through the design life of the development, that the future bluff-retreat rate will be linear and of comparable magnitude to the historic rate, and that the nature of erosion processes at the site will remain unchanged. All of these assumptions are potentially flawed, but in the absence of convincing evidence to the contrary, are a means of establishing reasonable development setbacks.

Towards Probabilistic Coastal Erosion Hazard Assessment

The deterministic approach presented above is based on established geologic and engineering principals, and similar approaches have been used to establish development setbacks from slope edges throughout the world for some time. However, the approach suffers from its limited ability to consider uncertainties in the analysis. Probabilistic approaches, on the other hand, inherently consider analytical uncertainties, and allow for a better definition of risk. This type of risk assessment has been routine for decades in the field of hydrology, where design basis and land use priorities are based on the magnitude of the "100-year flood," for example. Probabilistic coastal hazard assessment similarly can be used to quantify the likelihood that the bluff edge will erode to any particular point on a bluff top in a given time. Then, by establishing an acceptable level of risk (for example, a probability of <5% that the bluff edge will reach a certain point over the design life of the development) a setback line can be established that inherently includes uncertainties in the analysis. Just as the seismological community has moved away from deterministic methods towards probabilistic ones, such an approach allows for better consideration of the uncertainties in estimating future coastal erosion.

Probabilistic coastal hazard assessment is in its infancy, and no standardized methods have won acceptance—or even much discussion. The failure of coastal bluffs along Lake Michigan through landsliding has been assessed probabilistically by Chapman and others (2002), through the use of probabilistic slope stability analyses. Lee and others (2001) applied a variety of probabilistic methods to questions of coastal bluff retreat in England. Methods that they evaluated include the simulation of recession of episodically eroding cliffs through Monte Carlo techniques, the use of historical records and statistical experiments to model the behavior of cliffs affected by episodic landslide events, event-tree approaches, and the evaluation of the likelihood of the reactivation of ancient landslides. All of these techniques show promise, but the authors restricted themselves to specific cases. What is needed is the development of probabilistic methods that will work in more general cases, and combine both slope stability and long-term bluff retreat considerations. One way to approach this problem is to consider separately the two aspects of defining a development setback as outlined above.

Probabilistic slope stability analyses already are routine (Mostyn and Li 1993; Yang et al. 1993). In addition to quantifying the probability of slope failure (something not done in a deterministic slope stability analysis, which only establishes whether or not failure will occur), probabilistic slope stability analysis allows for consideration of variability or uncertainty in soil or rock strength parameters (Lumb 1970). Uncertainties in these input parameters are quantified by the standard deviation of each parameter. Then, using Monte Carlo techniques, a probability distribution for the factor of safety associated with any given failure plane is produced. From this, the probability of failure along the chosen potential failure plane can be calculated. The probability of failure is the probability that the factor of safety will be less than 1.0, and can be calculated for any given potential failure surface. By performing such analyses on a variety of potential failure surfaces intersecting different portions of the bluff top, a probability could be assigned to any position on the bluff top quantifying the likelihood that a failure will occur landward of that point.

Although not routine, several possibilities present themselves for developing probabilistic models for gradual, episodic, bluff retreat. Perhaps the simplest method of quantifying uncertainty is the application of a confidence interval to the estimate of the long-term average bluff retreat rate. Each time interval examined in estimating this rate is one sample of the mean value. For normally distributed data (or data that can be transformed to a normal distribution by, for example, a log transform), the sample standard deviation is a traditional estimate of uncertainty. There is a ~68.26% probability that the true mean value will lie within ±1 standard deviation of the sample mean. Different probabilities apply to different multiples of the standard deviation. Thus, uncertainties in the product ($B \times t$), above, can be quantified and contoured on the bluff top. For populations that cannot be shown to be normally distributed (likely the case with the small sample sizes available for bluff retreat rates), a better estimate of uncertainty may be a confidence interval based on Student's t distribution, or on nonparametric statistics.

A second approach to probabilistic assessment of coastal bluff recession is to treat annual bluff retreat in a manner analogous to river floods. Thus, the recurrence interval of a particular amount of annual bluff retreat can be calculated by the formula

$$R = \frac{N+1}{M}$$

where R is the recurrence interval, N is the number of years of record, and M is the rank of the annual bluff retreat in the total data set. For the synthetic data set considered above, there are many duplicate values due to the limited precision with which bluff retreat data are generally reported. Eliminating duplicates, and ranking the annual bluff retreat rates, recurrence intervals can be calculated. These data can be graphed in order to arrive at the expected amount of bluff retreat for any particular recurrence interval (Figure 7). The inverse of the recurrence interval is the annual probability that a given amount of bluff retreat will be exceeded. Such data may be especially valuable in assessing the risk of occurrence of an episodic event sufficient to threaten an existing structure.

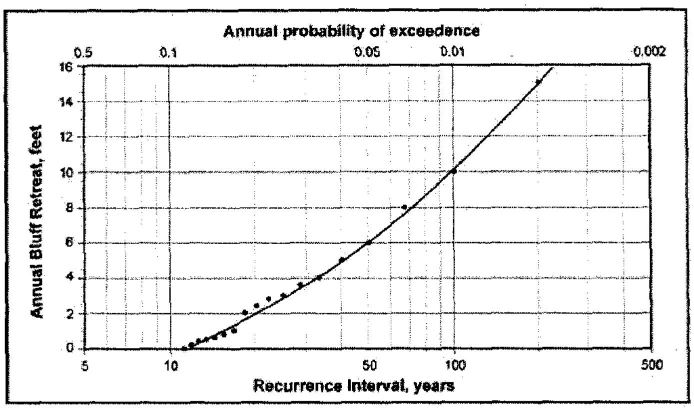

Figure 7. Recurrence interval for annual bluff retreat, calculated for the synthetic data set. The recurrence interval, calculated in a manner analogous to flood recurrence interval, gives the average time between years with a given amount of bluff retreat. The inverse of the recurrence interval is the statistical probability that a given amount of bluff retreat will occur (or be exceeded) in any given year.

The total risk to bluff-top development, which includes both long-term bluff retreat and slope failure, can be calculated by multiplying the probability of slope failure at a given position by the probability that bluff retreat will reach that point by a given time. The geotechnical and planning communities will need to establish what is an acceptable probability, or risk, that the bluff will reach a given point in order to develop setback criteria. Once that probability is established, the setback line can be defined as the locus of points on the bluff top at that probability.

A prime difficulty in applying probabilistic methods to assessing coastal erosion risk will be the difficulty in acquiring sufficiently rich data sets with which to work. More effort is needed at acquiring long, precise data sets on coastal erosion in a variety of geologic conditions throughout the state.

Acknowledgements

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VIA FACSIMILE AND OVERNIGHT MAIL

California Coastal Commission
San Diego Coast District Office
Gary Cannon, Project Planner
Sherilyn Sarb, Deputy Director
7575 Metropolitan Drive, Suite 103
San Diego, CA 92108-4402

Re: Appeal of Permit for Construction of Zagara Residence (282 Neptune, Encinitas California) – Commission Appeal No. A-6-ENC-06-100

Dear Mr. Cannon & Ms. Sarb:

This firm represents John and Valerie Zagara ("Zagara") with respect to the California Coastal Commission's ("Commission") recent appeal of the City of Encinitas' ("City") issuance of a coastal development permit for construction of a single-family home located at 282 Neptune in Encinitas ("Property" or "Project").

The purpose of this letter is to follow-up on the issues we discussed on September 14, 2006, and to help provide Commission Staff with further site-specific information pertinent to demonstrating that there are no "substantial issues" as to the applicable Zagara Property seacliff erosion rate, slope failure analysis, or Staff's request for an open space dedication.

The Zagaras appreciate Commission Staff's concern and comments and are confident that the site-specific data highlighted and referenced below addresses and conforms with the applicable coastal development rules.

The Zagara Property Erosion Rate Is 0.23 ft/yr Based On State-Of-The-Art Data

As stated in the Commission's Appeal Application, "according the Coastal Commission's staff geologist, the current published state-of-the-art for establishing bluff retreat rates in [the Encinitas] area is a FEMA-funded study done as part of a nationwide assessment of coastal hazards [Ref. Benumof and Griggs (1999)]." The site-specific and peer-reviewed results of the Benumof and Griggs (1999) study, which was aimed at investigating the effect of material properties on seacliff erosion at eight sites along the San Diego County coastline by quantifying the relationship between: (a) high-resolution, long-term erosion rates; (b) cliff material properties; and (c) important erosive processes, are published in *Shore & Beach*, Journal of the

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American Shore and Beach Preservation Association, as well as the published Doctoral Thesis of Benjamin T. Benumof. (See *Shore & Beach* Vol. 67, No. 4, October 1999, pp. 29-41, attached hereto as Exhibit "A"; see also Benjamin T. Benumof, *The Dynamics, Kinematics, and Geomorphic Evolution of the San Diego, California Coastline* (1999), UC Santa Cruz [on file with several universities].)

In response to the Commission Staff's September 14, 2006, request (specifically, Dr. Mark Johnson, Commission Geologist) that the Zagaras provide site-specific, geotechnical data in support of their Project, we have compiled the following high-resolution erosion rate data from the Benumof and Griggs study. This data clearly shows that the long-term recession rate at, and adjacent to, the Zagara Property is approximately 7.0 cm/yr (i.e., 0.23 ft/yr), and not 15.0 cm/yr or 0.49 ft/yr (a rate that corresponds with fundamentally distinct coastal cliffs over 400 meters south of the Zagara residence). Thus, if Commission Staff were to recommend that a 0.49 ft/yr erosion rate be applied to the Zagara Project, not only would it be fundamentally unfair, but also arbitrary and capricious, as shown by the following analysis:

- As shown in Table 1 of the Benumof and Griggs study (see Exhibit "A"), the northern boundary of the Encinitas study area, measuring 740 meters alongshore (see Exhibit "B" attached hereto), is: 33 deg 03 min 21.46 sec NORTH; 117 deg 18 min 04.59 sec WEST. This corresponds to the following decimal degree coordinates – 33.05596111; -117.301275 – which, when compared to the decimal degree coordinates of the Zagara Property, allow for the simple calculation of distances alongshore (see directly below).

- Given that the precise location of the Zagara Property is: 33.05390758; -117.30048861, the Zagara Property is located approximately 239 (alongshore) meters south of the northern boundary of the Encinitas study area. (Aerial photographs depicting the location of the northern boundary and the Zagara residence are attached hereto as Exhibit "C".)

- As shown graphically in Exhibit "B", the long-term erosion rate 239 meters south of the northern boundary (i.e., at, and adjacent to, the Zagara Property) is approximately 7.0 cm/yr (0.23 feet/yr), and not 0.49 feet/yr as stated in the Commission's Appeal Application.

- As clearly evidenced by the Benumof and Griggs (1999) study, the 0.49 feet/yr erosion rate that the Commission references in its Appeal Application corresponds to seacliffs located over 400 meters south of the Zagara Property and just north of Moonlight Beach.

- Given the intrinsic differences between the seacliffs at, and adjacent to, the Zagara Property and those that border and form the boundaries of Moonlight Beach, there is no reasonable basis for applying the 0.49 feet/yr rate here.

In short, it is important to recognize that seacliff erosion rates at any given location along the San Diego County coastline vary relative to their specific location and material properties. Thus, general formulations should only be applied where site-specific information is not accessible or reliable. Here, in light of the fact that the Zagaras have followed Commission Staff's recommendation that site-specific data be provided, the Zagaras are confident that Commission Staff will agree the Project easily conforms with all applicable rules and slope stability formulas.

Slope Stability Analysis

Commission Staff's Appeal Application cites section 30.34.020(D) of the City's Certified Implementing Plan ("IP") of the Local Coastal Program ("LCP"), that requires an applicant to provide a slope stability analysis demonstrating a safety factor of 1.5 and addressing a period of 75 years.

Based on communications with City Staff, the City interprets, and has always interpreted, this section as requiring use of the following formula:

Setback = Erosion Rate x Time Period x Safety Factor

In no case, however, has or will the City allow for development seaward of a 40 foot setback.

Likewise, Policy No. 3, subdivision (a), of the Commission's "Policies for Planners Developing, Amending or Reviewing LCP Policies On Shoreline Protective Structures, Hazards, and Beach Erosion," accessible through the Commission's public website recites this formula. (See Exhibit "D" attached hereto and accessible at www.coastal.ca.gov/la/docs/bear_ch5.pdf, under the link "Resources for Local Governments" and the heading "Hot Topics.")

Commission Staff, however, stated on September 14, 2006, that since late 2003, the Commission has been applying a setback formula derived from Dr. Johnnson's Commission memorandum entitled, "Establishing Development Setbacks From Coastal Bluffs." This formula, although admittedly not a formal policy or position of the Commission[1], appears to

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[1] In the introductory section of the memorandum, Dr. Johnnson states:

> "This methodology does not represent a formal policy or position of the Coastal Commission. In fact, there may be other appropriate methodologies to establish development setbacks, and the Commission has the discretion to base a decision on any method that it finds technically and legally valid. Further, as new techniques and information become available, these methodologies may change. Nevertheless, the type of analysis outlined here represents the current analytical process carried out by Coastal Commission staff in evaluating proposals for new development on the California coast, and in recommending action upon those proposals to the Commission. The Commission then makes its decisions on a case-by-case basis, based upon the site-specific evidence related to the particular development proposal."

require that the applicant: (a) calculate the geologic factor of safety of 1.5 on top of the bluff (in feet); and (b) add the applicable recession rate over 75 years to that calculation. Using this methodology, we calculate that the Zagara bluff, at the end of the Project's design life (i.e., 75 years), will have a factor of safety of 1.4-1.5 behind the 40-foot setback required by the City and well in excess of any anticipated erosion over the next 75 years.

Here, in the absence of a clear policy direction from the Commission, the City granted the Zagara development permit using setback analyses based on industry standards that are acceptable to licensed engineers, geologists, and other geotechnical professionals, as well as adopted Commission policies. Specifically, the bluff edge for the Zagara Local Coastal Devolvement Permit was defined by the attached plan. (See Exhibit "E".) As a result of some slight sloughing at the top of the bluff due to overwatering by the previous owner, the Zagaras conservatively chose to "move" the bluff edge back 3 feet and employ an erosion rate of 0.33 ft/yr based on a study of the Encinitas area by Lee, Pickney and Bemis (1976). As noted above, this rate is fairly conservative as compared to the high-resolution 0.23 ft/yr rate that was documented by Benumof and Griggs' study using state-of-the-art imaging equipment. In addition, the Zagaras consultant, GeoTek, Inc., determined through its slope stability analysis that the proposed building location would not be subjected to, or affected by, failure of the seacliff over the anticipated 75-year lifetime of the Project.

Thus, the Zagaras' Project, as approved by the City, incorporates the required margins of safety, and using the Commission's Policy No. 3 formula (Exhibit "D") and an erosion rate of 0.33 ft/yr, results in a setback of 37.125 feet (0.33 ft/yr x 75 yrs x 1.5).

As an additional factor of safety, however, and in keeping with the City's ban on development that is within 40 feet of the bluff edge, the Zagara permit provides for an extra setback of over 5 feet (for a total of approximately 42.5 feet) from a bluff edge that is: (a) already setback in an effort to be conservative[2]; and (b) uses an erosion rate that is substantially higher than the rate documented by Benumof and Griggs. Thus, Commission Staff should find no substantial issue regarding the Project. Although it is generally accepted that sea level will rise over the next 75 years, it is also highly likely that San Diego County will continue to receive periodic beach nourishment (whether imported or dredged from the nearshore) in an effort to

[2] It should be noted that under the Coastal Act, this added 3 foot setback is not required, as the bluff edge is defined as:

> "... the upper termination of a bluff, cliff, or sea cliff. In cases where the top edge of the cliff is rounded away from the face of the cliff as a result of erosional processes related to the presence of the steep cliff face, the bluff line or edge shall be defined as that point nearest the cliff beyond which the downward gradient of the surface increases more or less continuously until it reaches the general gradient of the cliff." (See Dr. Johnson's memorandum at p. 4.)

Using a less conservative bluff edge position, the Project's total setback is approximately 45 feet. (Exhibit "E".)

combat any marine forcing effects. Likewise, there has been much discussion about the installation of artificial reefs in San Diego County, as well as throughout Southern California, which would also have the effect of reducing marine erosion of seacliffs.

Open Space Easement Issue

Page 4 of the Commission's Appeal states that the City failed to require the subject bluff face to be protected through the application of an open space easement.

Here, however, the Zagaras do not own the bluff face. Rather, as shown on the permitted drawings, the Zagara Property line is at the top of the bluff, and the bluff face is owned by either the State or City. Consequently, it is simply not possible for the Zagaras to grant an easement on the bluff face.

Moreover, as a condition of the City's local coastal permit, the Zagaras have submitted a statement agreeing to participate in any comprehensive plan adopted by the City to address coastal bluff recession and shoreline erosion problems in the City. In addition, prior to issuance of a building permit, the Zagaras have agreed to record a covenant against the Property securing the conditions and requirements of the coastal development permit.

Commission Staff's September 14, 2006, request that the Zagaras "waive" any and all rights that they may have to build shoreline protection in the future is fundamentally unfair and violates the Zagaras' constitutional rights. Moreover, this request is unwarranted based on the site-specific data presented above. Although the Zagaras are opposed to seawalls, Commission Staff's request the Zagaras completely waive their right to apply for shoreline protection in the future would place an unlawful burden on the Zagaras and their heirs.

Conclusion

For more than 18 months, the Zagara Project has been reviewed at length by City staff, as well as the City's independent geotechnical consultant. This comprehensive review includes at least 4 separate evaluations of soils issues and site visits. The Zagaras' building plans are currently complete to contract stage and are ready to build with. Given the site-specific data the Zagaras have provided at the request of Commission Staff, the Zagara Project should not continue to be burdened by the Commission Staff's tentative recommendation that a "substantial" issue or issues exist. In short, the issues raised by Commission Staff are policy issues and not issues related to the technical merits of the City approved permit, the Zagara Property, or the Project's design.

We respectively request that Commission Staff reconsider the Zagara Appeal and allow both City and Commission Staff to work together to resolve any remaining outstanding issues. Any other result would be a violation of well-established land use laws and the Zagaras' constitutional rights.

If you have any questions, please contact me.

Very truly yours,

Benjamin T. Benumof, Ph.D., Esq.

BTB:dt

cc: Mark Johnnson, Commission Geologist
Lesley Ewing, Commission Engineer
Patrick Murphy, City of Encinitas
Diane Langager, City of Encinitas

Exhibit A

The Dependence of Seacliff Erosion Rates on Cliff Material Properties and Physical Processes: San Diego County, California

By

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ABSTRACT

Over the past few decades, rapid population growth along the San Diego County, California, USA, coastline has promoted a substantial increase in cliff-top development, despite limited understanding of the long-term cliff erosion or recession rates and their controlling factors. In particular, the role of seacliff materials in cliff retreat has not been well established.

We investigated the effect of material properties on seacliff erosion at eight sites along the San Diego County coastline by quantifying the relationship between long-term erosion rates, cliff material properties, and important erosive processes. The particular seacliffs display significant variation in rate of erosion, lithology, structure, exposure and susceptibility to marine and non-marine erosive agents. Seacliff erosion rates, generated using softcopy photogrammetry and geographic information system technology, reveal that the San Diego coastline is retreating at mean rates ranging from 3.0 cm/yr (where cliffs consist of well-lithified Cretaceous sandstone) to 43.0 cm/yr (in unlithified Pleistocene sands). To assess the mass strength of cliff materials, a seacliff stability classification system was developed based on engineering practice and designed for geomorphic field investigation. This methodology involves quantification of seacliff resistance via: (1) in-situ measurement of intact rock strength, (2) measurement of the orientation, spacing, width, and continuity of structural discontinuities, and (3) generalized evaluation of the significance of groundwater seepage, weathering, and fatigue. In addition, we evaluated the role of waves in eroding seacliffs through modeling and by making detailed observations (particularly during the October-April storm season, when most erosion occurs). Our findings reveal that the stability of San Diego seacliffs (and probably many other rocky coastlines) is highly dependent on the physical properties of the material (intact rock strength and structure). Statistically significant at the 1.0% level (R^2=0.76), seacliff erosion rates are strongly correlated with intact rock strength. Quantification of cliff structure (joint geometry) in the seacliff stability classification system, enhances stability analyses to the 0.1% level (R^2=0.81). Although we conclude that waves are important mechanisms of seacliff erosion, our studies suggest they are secondary to material properties in influencing the rate of cliff retreat. As a result, any measures taken to minimize cliff erosion along the San Diego County coastline must take into account properties of the cliff material.

Keywords: seacliff erosion, slope stability, rock strength, shorelines, San Diego, California

INTRODUCTION

Along many of the world's developed coastlines, seacliff erosion is an ongoing problem that results in progressive loss of property and the depreciation of property values. Along the 122 km San Diego County, California, USA, coastline, in particular, rapid population growth over the past few decades has promoted a substantial increase in cliff-top development, despite limited understanding of the long-term cliff erosion rates and their controlling factors. Approximately 80% of the coastline from Point Loma to Oceanside (Figure 1) consists of eroding seacliffs (as does much of the western United States). Therefore, the threat of continued eustatic sea-level rise, human impacts on seacliff stability, and reductions in beach sand supply make the understanding of coastal change and its related hazards an important research problem.

Although coastal geologic and geomorphic literature contains many references to rock mass strength and its implications for erosional landform development, a quantitative understanding of the importance of material properties in the long-term retreat of seacliffs has not been undertaken. Previous studies (Shepard and Grant 1947; Lee et al. 1976; Emery and Kuhn 1980, 1982; Turner 1981; Kuhn and Shepard 1984; Kuhn and Osborne 1987; USACE 1991) have been focused primarily on addressing marine and nonmarine mechanisms of seacliff erosion and have been largely qualitative in nature. Other studies, aimed at quantifying various aspects of seacliff erosion, have largely focused on determining seacliff erosion rates (Shepard and Wanless 1971; Lee et al. 1976; Everts 1991; USACE 1991). Until recently, however, technological limitations and the relatively benign (uncharacteristic) climate that existed between 1947 and 1977, produced seacliff erosion rates that were unrepresentative and of questionable accuracy. Prior to the 1980's, the general impression had been that coastal erosion along most of the San Diego County coast had been slow, except where the cliffs consist of unconsolidated alluvium (Kuhn and Shepard 1984). Since 1978, the San Diego coast has experienced many large, destructive coastal storms, such as those of the 1982-83 and 1997-98 El Niño events. These storms have altered earlier perceptions of shoreline erosion.

Our investigative strategy involves characterization of the overall seacliff erosion process by mapping, observing, and quantifying intrinsically- and extrinsically-related cliff erosion variables at eight San Diego County cliff sites and evaluating their relationship to long-term seacliff erosion rates. We define intrinsic variables as physical properties (such as the strength of intact rock and cliff structure) that directly affect seacliff stability and are therefore a controlling influence on seacliff resistance. Extrinsic variables influence intrinsic variables and include factors such as wave energy, offshore bathymetry (exerting control on how wave energy is dispersed or concentrated), and the amount of precipitation and groundwater seepage. Cliff study sites, located along the coasts of Carlsbad, Encinitas, Cardiff, Solana Beach, Del Mar, Torrey Pines, La Jolla, and Sunset Cliffs, are each approximately 700-800 m in alongshore length and possess significant variations in erosion rate, lithology, structure, exposure and susceptibility to marine and terrestrial weathering agents.

Conventional wisdom is that waves are the primary agent for seacliff erosion (impact, abrasion, quarrying of joint-bound blocks) at the base of the cliff (Sunamura 1992; Shih and Komar

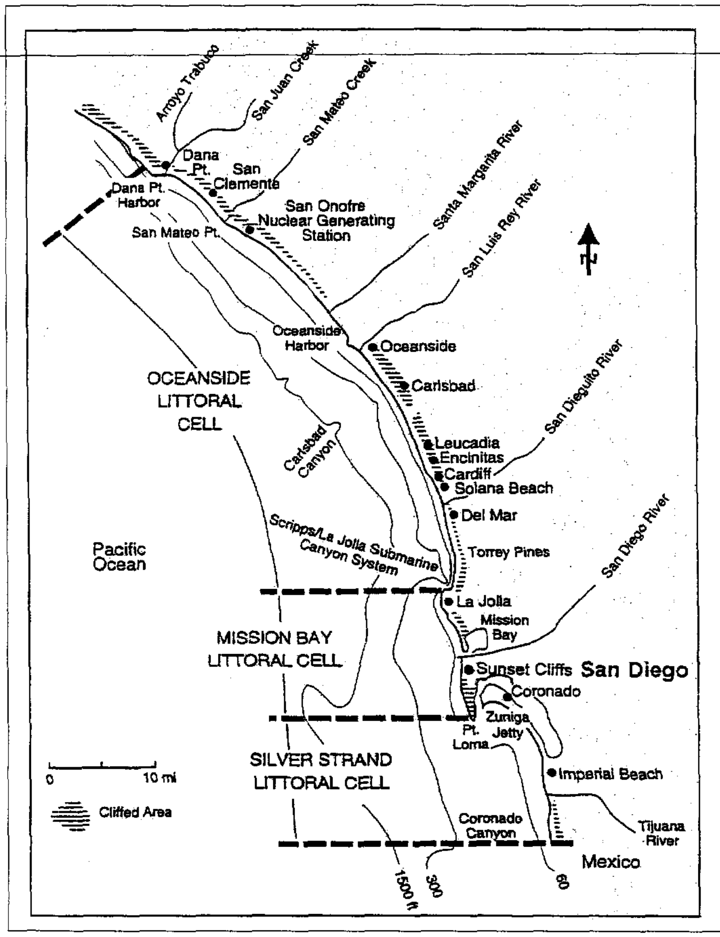

Figure 1. Location map of the San Diego County coastline.

1994). In addition, many researchers have reported seacliff erosion by groundwater and surface runoff (Turner 1981; Vanderhurst et al. 1982; Kuhn and Shepard 1984; Kuhn and Osborne 1987; USACE 1991). We believe, however, that lithology and structural weaknesses of seacliff material are equally important, if not more significant, than marine and non-marine agents in influencing the long-term stability of seacliffs.

GEOLOGIC AND OCEANOGRAPHIC SETTING

The San Diego County coast is characterized by steep, 5 to115 m high seacliffs composed of lithified sedimentary material overlain by unconsolidated marine terrace deposits. In some locations (e.g., Carlsbad), however, seacliffs are almost entirely composed of unlithified Pleistocene marine terrace sands. The majority of the sedimentary rocks exposed in the seacliffs are Eocene siltstones, mudstones, shales, and sandstones capped by Pleistocene marine terrace deposits (Kennedy 1975). Late Cretaceous sandstones, shales, and conglomerates also occur and are exposed in the seacliffs from the Point Loma Peninsula to La Jolla (Kennedy 1975). In general, seacliffs composed of older Cretaceous material are more resistant to erosion than those composed of younger Eocene material, and as a result, account for the occurrence of headlands at both Point La Jolla and Point Loma.

Seacliff structure along the San Diego coastline is largely due to the early Miocene-to-recent history of the North American Plate and Pacific Plate boundary, specifically, the San Andreas Fault system (SAFS). Associated with the SAFS are a number of regionally significant right-lateral faults, including the San Clemente, San Diego Trough, Coronado Bank, Newport-Inglewood/Rose-Canyon (NIRC), and Elsinore (Figure 2). These accommodate a considerable portion of movement along the San Andreas have played a central role in the present morphology and structure of the San Diego coast. Locally, the structure of San Diego seacliffs is most influenced by the NIRC right-lateral, strike-slip fault system that is responsible for creating a steeply-dipping, shore-parallel joint set that occurs in many San Diego seacliffs. However, several northeast striking dip-slip faults have also displaced and fractured seacliffs.

The San Diego County wave climate is complex owing to wave refraction, reflection, and diffraction from offshore islands, submarine canyons, and shallow banks in the Southern California Bight (O'Reilly 1991). In addition, wave climate in San Diego is greatly influenced by climatic conditions over the entire Pacific Ocean and varies depending on whether waves originate as northern-hemisphere swell, southern-hemisphere swell, or are generated from local seas (Moffat and Nichol 1989). Northern hemisphere swells are most common in San Diego in the late fall, winter, and early spring months. The swell is usually a product of specific meteorological disturbances including Aleutian storms, sub-tropical storms north of Hawaii, tropical hurricanes, and strong winds in the Eastern Pacific

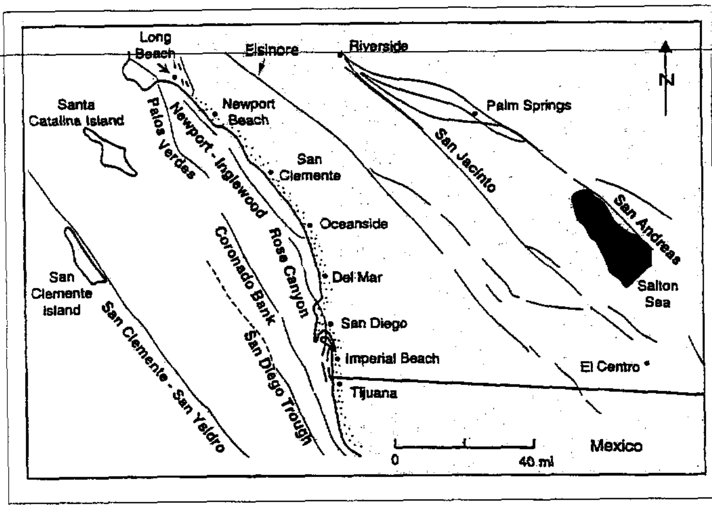

Figure 2. Major fault zones in the San Diego County region.

(Flick 1994). Southern-hemisphere swells, common in San Diego during the summer months, are primarily generated in the South Pacific Ocean by high-latitude Antarctic and Pacific winter storms (Flick 1994). The local, wind-driven swells typically develop rapidly when low pressure systems track near Southern California in the winter months or when strong sea breezes are generated during the spring and summer.

METHODOLOGY

Determination of High-Resolution Seacliff Erosion Rates

Significant advancements in shoreline mapping technology could be applied to examine cliff recession believed associated in great part to the relative increase in the number of severely destructive coastal storms (1978, 1980, 1982-83, 1988, 1992-1994, and 1997-1998). Researchers at the University of California, Santa Cruz (UCSC) Coastal Geology and Imaging Laboratory (CGIL), interested in the determination of high-resolution seacliff recession rates, developed a state-of-the-art, softcopy photogrammetric and geographic information system (GIS) imaging laboratory. This laboratory was funded by the Federal Emergency Management Agency (FEMA), the National Science Foundation (NSF), the Earth Sciences Department and the Institute of Marine Sciences at UCSC, and the United States Geological Survey (USGS). It was developed to determine accurate recession rates by eliminating mapping errors arising from distortion of aerial imagery and ground-control data.

Table 1. San Diego County coastal cliff site locations, mean erosion rates, and erosion rate / amount of erosion standard deviations.

Site	Northern boundary	Southern boundary	Mean recession rate (cm/yr)	StDev recess. rate (cm/yr)	StDev recession (m)
Carlsbad	117 18 14.88 W 33 06 20.90 N	117 18 05.38 W 33 05 57.83 N	43.02	8.23	3.13
Encinitas	117 18 04.59 W 33 03 21.46 N	117 17 54.99 W 33 02 57.70 N	7.70	2.31	1.43
Cardiff	117 17 15.46 W 33 01 37.16 N	117 17 04.84 W 33 01 15.54 N	12.69	3.00	1.86
Solana Beach	117 16 30.96 W 32 59 42.23 N	117 16 25.06 W 32 59 15.63 N	6.24	2.37	1.47
Del Mar N/S	117 16 05.32 W 32 57 41.96 N	117 16 03.07 W 32 57 24.10 N	18.73 (N) 12.54 (S)	4.84	3.00
Torrey Pines	117 15 08.00 W 32 53 41.87 N	117 15 06.49 W 32 53 19.08 N	17.36	4.55	1.91
La Jolla	117 16 22.74 W 32 51 03.20 N	117 16 42.04 W 32 50 50.49 N	3.06	1.50	0.63
Sunset Cliffs	117 15 26.47 W 33 43 25.05 N	117 15 24.09 W 32 43 09.31 N	7.88	3.06	1.28

StDev = Standard deviation; Del Mar N/S = Del Mar North and South

As part of FEMA's program to assess the feasibility and economics of adding erosion-prone ocean front property to the federal flood insurance program, high-resolution, long-term seacliff erosion rates (Figures 3a and 3b, Table 1) were determined for the San Diego County coastline, from the Mexican International Border to Oceanside Harbor. This project is unique in that coastal erosion rates have never been determined so extensively (both temporally and geographically) with high-precision mapping techniques.

Photography flown for the National Oceanic and Atmospheric Administration (NOAA) in 1994 at a scale of 1:24,000 served as base (recent) imagery for the entire coastline. Aerial photographs taken in 1932, 1949, 1952, and 1956 at scales of 1:9600, 1:20,000, 1:12,000, and 1:12,000, respectively, served as historical shoreline data. The landward-most edge of the seacliff served as the erosion reference feature for calculating erosion rates. The steps involved in the application of softcopy photogrammetry to aerial photographs are summarized in Figure 4 (for a general discussion of various photogrammetric techniques, including softcopy photogrammetry, refer to Moore, in press).

Evaluation of Seacliff Stability Along the San Diego County Shoreline

Typically, long-term seacliff erosion rates (Figures 3a and 3b, Table 1) provide the dependent variable necessary for developing an initial understanding of the interaction between erosion rates and material properties. In this study, we expanded our understanding by mapping and measuring rock properties in a wide variety of San Diego lithologies (Table 2) and by documenting the important short-term kinematics of cliff retreat (e.g., wave attack, landslides, surface erosion, groundwater seepage). Our methodology, in part, is adapted from the slope stability classification originally developed by Selby (1980) that allows any rock mass to be placed into one of five categories representing overall rock mass strength. Placement in a specific group is based on numerical ratings given for various strength parameters that include intact rock strength, joint orientation,

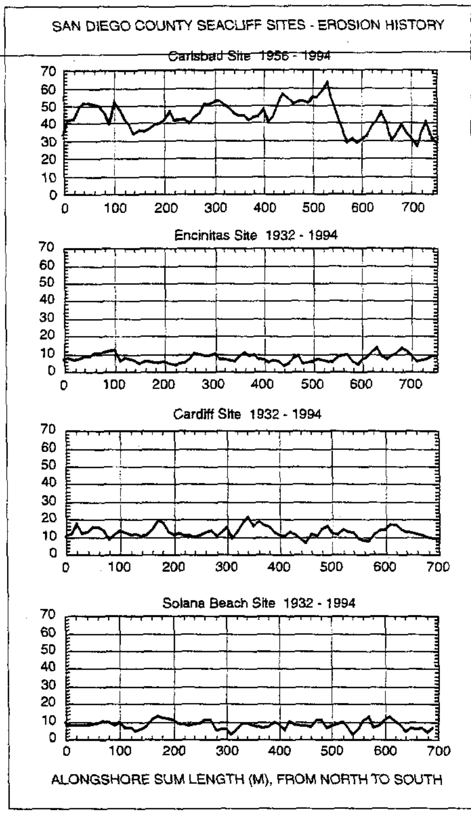

Figure 3a.

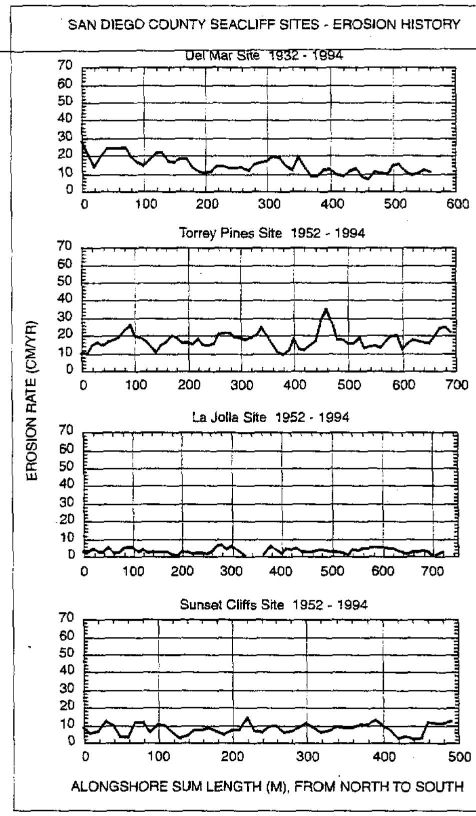

Figure 3b.

Figure 3. Amount of coastal cliff erosion alongshore, from north to south, at the (a) Carlsbad, Encinitas, Cardiff, and Solana Beach sites (b) Del Mar, Torrey Pines, La Jolla, and Sunset Cliffs sites.

joint spacing, joint width, joint continuity, weathering/fatigue, and groundwater seepage. Each parameter is assigned a percentage value representing its relative importance, because all parameters are not considered to be of equal significance in the determination of overall strength. The sum of the weighted values is an estimate of rock mass strength.

Measurement of Intact Rock Strength. The most widely used strength measure in the field of rock mechanics is the unconfined (or uniaxial) compressive strength test. Although accepted by engineers and specialists in rock mechanics, however, unconfined compressive strength tests are expensive, requiring precisely cut cores and elaborate testing equipment. Laboratory tests of this sort falls short of meeting the needs of coastal geologists and geomorphologists, whose studies often cover large field areas and from which it is difficult to collect and transport large numbers of rock samples to a laboratory (Selby 1980). The main disadvantage of testing any rock mechanical properties in the laboratory, though, is that the actual strength test is carried out on a sample that has been removed from its natural state and altered by sample preparation, a condition contrary to that in natural environment. As a result, some geologists, geomorphologists, and engineers have adopted the Schmidt Hammer, a light, portable device, that provides a nondestructive, rapid, and economical means of estimating in situ rock strength (Selby 1980; Ritter 1986; Sunamura 1992).

The Schmidt Hammer, originally designed to conduct nondestructive strength tests on concrete, and utilized in this study (Type-N), measures the height of rebound of a small steel ball after its collision with a surface. The height of rebound depends on elasticity of the surface, which in turn reflects mechanical strength of the material (Figure 5). In other words, because the impact of the hammer mass (through the intermediary of the steel impact plunger) is the impact of a very hard body, rocks can be regarded as yielding bodies (Hucka 1965; Sunamura 1992). In the classification presented herein (Table 2), we adjusted the intact rock strength categories of Selby (1980) in

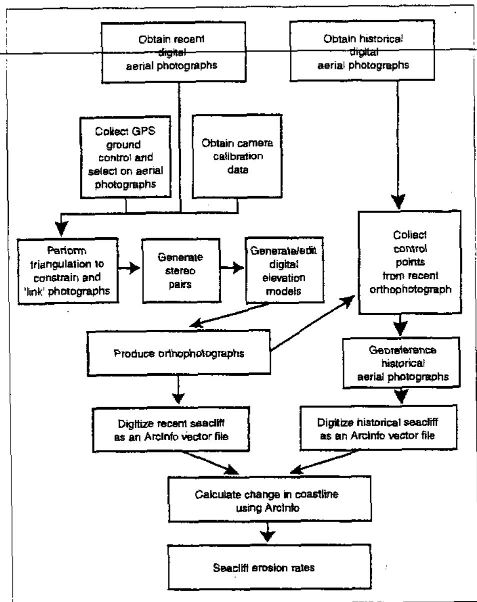

Figure 4. Generalized methodology for the determination of high-resolution seacliff erosion rates using softcopy photogrammetry, GIS, and aerial photography.

Table 2. Rock mass strength classification (modified from Selby 1980)

Parameter	Very Strong	Strong	Moderate	Weak	Very Weak	UNC
Intact rock strength (type-N Schmidt Ham.)	25+ r:20	25-20 r: 18	20-15 r: 14	15-10 r: 10	10-0 r:5	
Weathering	unweathered r: 10	slightly r: 9	Moder. r: 7	highly r: 5	Completely r: 3	
Joint spacing	> 3 m r: 30	3-1 m r:28	1-0.3 m r: 21	300-50 mm r: 15	< 50 mm r: 8	'Infinite' r: 5.5
Joint orientation	Very favorable, steep dips into slope, cross joints interlock r: 20	Favorable, moderate dips into slope r: 18	Fair, horizon. dips, or nearly vertical (hard rocks only) r: 14	Unfav., moderate dips out of slope r: 9	Very unfavorable, steep dips out of slope r: 5	Extremely unfav. UNC r: 3
Width of joints	< 0.1 mm r: 7	0.1-1 mm r: 6	1-5 mm r: 5	5-20 mm r: 4	> 20 mm r: 2	UNC* r: 1
Continuity of joints	None continuous or well cemented r: 7	Few contin. or partially cemented; r: 6	Continuous, no infill r: 5	Continuous, thin infill r: 4	Continuous, thick infill r: 1	Contin. UNC r: 0.5
Outflow of groundwater	None r: 6	Trace, isolated dripping water r: 5	Slight, wet cliff face with drips, point source seeps r: 4	Mod., point source seeps with flowing water r: 3	Great r: 1	
Total Rating	100-91	90-71	70-51	50-26	< 26	–

*UNC = unconsolidated seacliff

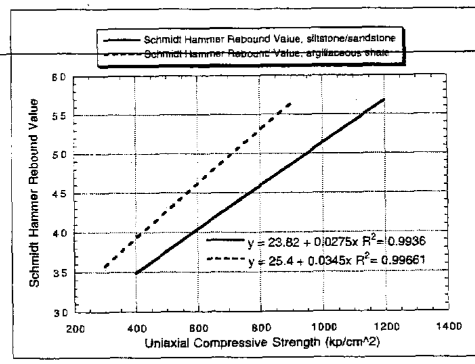

Figure 5. The relationship between uniaxial compressive strength and Schmidt Hammer rebound values for argillaceous shale and siltstone/sandstone (Sunamura 1992).

applying the classification to relatively weak sedimentary rocks rather than stronger igneous varieties.

Measurement of Structural Discontinuities. The most spectacular mass movements associated with San Diego seacliffs are large blockfalls and landslides. These types of mass movements are related in that the attitude, geometry, and spatial distribution of structural discontinuities, including joints, faults, bedding planes, cleavage planes and cracks, influence the magnitude and morphology of each cliff failure. Thus, the overall stability of seacliffs must be assessed by analyzing structural discontinuities in the rock mass in addition to the strength of intact rock itself.

Along the San Diego County coast, wide variations occur in average spacing between joints, the nature and degree of joint infilling materials, the physical characteristics of their surfaces, and the degree of their development. One joint set can, therefore, have effects on failure characteristics quite different from those of another set, and the various properties of each of the joint sets must be considered individually in seacliff stability assessments. Measurements of the orientation, spacing, width, and continuity of structural discontinuities were performed using the detailed line survey, as outlined by Piteau and Martin (1977), and according to the slope stability classification of Selby (1980). However, in the classification presented herein (Table 2), we have assigned intermediate ratings for cliffs that are characterized by more than one structural discontinuity category. For example, the majority of seacliff bedrock at the Cardiff site consists of sandy claystone which has an intricate network of tightly-spaced joints (< 50 mm); superimposed on this fracture network is a series of more widely-spaced joints (50 - 300 mm). In this particular case, we assigned a joint spacing rating of '12' since cliff stability is influenced by both closely- and widely-spaced fractures. We also added a structural category to help characterize relatively weak, unconsolidated seacliffs, such as those of the Carlsbad site. These particular cliffs, which are almost entirely composed of unconsolidated marine terrace deposits, have an ëinfinite' number of structural discontinuities.

Measurement of Weathering and Fatigue. Weathering, whether mechanical, chemical, or biological, was evaluated using a generalized scale of mass weathering grades and plays a complex and important role in reducing rock strength.

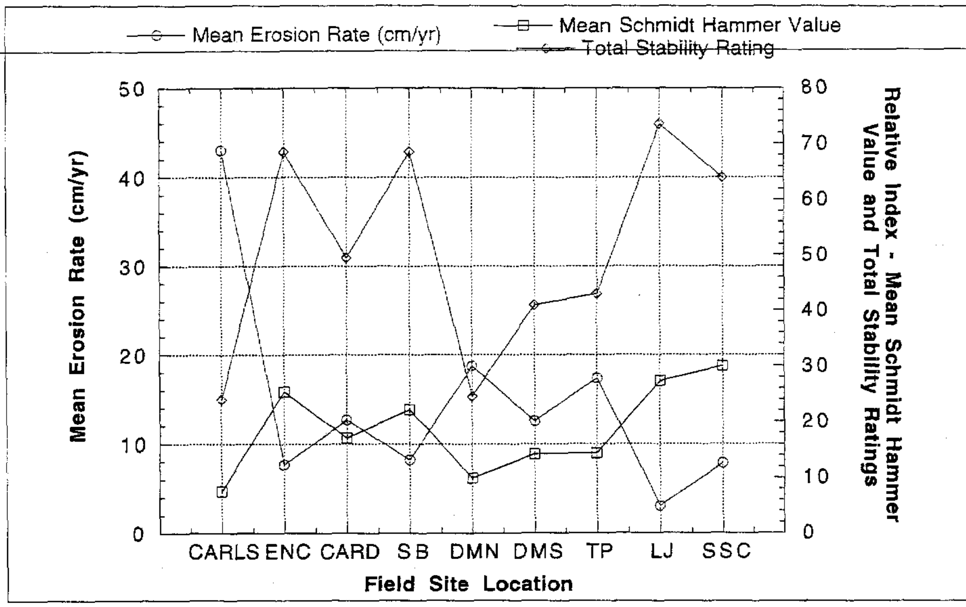

Figure 6. (a) Variation in mean erosion rates, Schmidt Hammer rebound values, and total stability ratings at each of the eight coastal cliff sites.

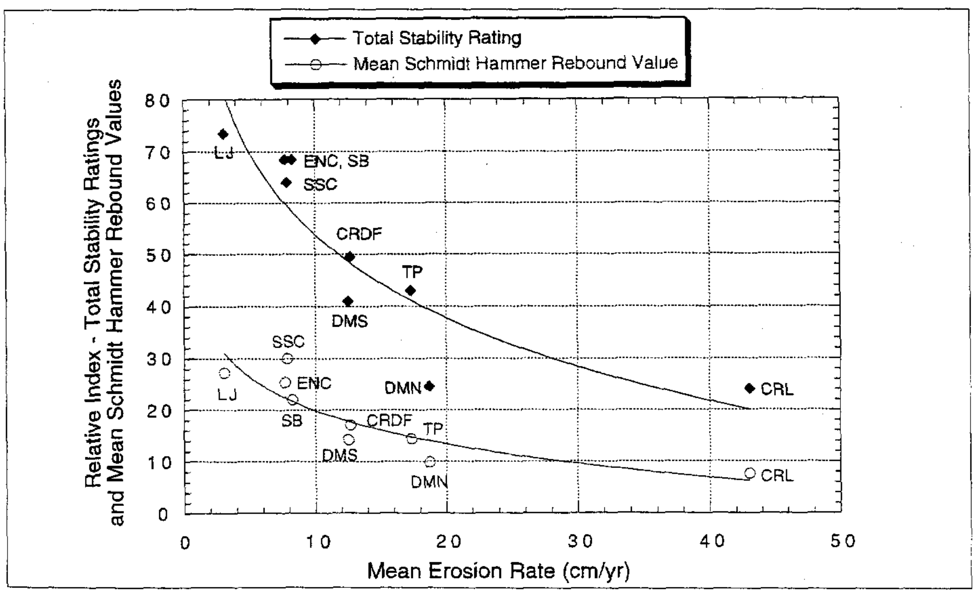

Figure 6. (b) Significance of the relationship between mean erosion rates and Schmidt Hammer rebound values (y = 41.538 - 21.615log(x) R^2 = 0.76494) and total stability ratings (y = 107.24 - 53.365log(x) R^2 = 0.80684) at each of the eight sites; CRL = Carlsbad; ENC = Encinitas; CRDF = Cardiff; SB = Solana Beach; DMN = Del Mar North; DMS = Del Mar South; TP = Torrey Pines; LJ = La Jolla; SSC = Sunset Cliffs.

Figure 7. The La Jolla site on January 30, 1998 showing wave hammering of the cliff face at high tide.

Figure 8. Photograph of the Carlsbad site showing intense gullying of the cliff face.

Figure 9. The rocky, back-beach platform (Del Mar Formation) which outcrops 130 m south of the Del Mar field boundary and provides a barrier to wave erosion.

A generalized scale is appropriate because much of the effect of weathering is subsumed in the other parameters (Selby 1980). For example, the loss of strength and opening of joints in a rock mass is largely a weathering related phenomenon. Similarly, water movement through a rock mass or formation of infill (as opposed to cement) both promotes and is an effect of weathering.

Measurement of Groundwater Seepage. Groundwater seepage, while also important in assessing cliff stability, was evaluated on a generalized scale as well. This was done because of the relatively small differences in amount of groundwater seepage at each site and the great expense and difficulty in obtaining precise measurements. Most groundwater seepage analyses were performed during the wet season (from December 1997 to March 1998) to account for extreme periods of flow, however analyses were also performed under dry conditions to account for temporal variability. Similar to the "strength of intact rock" categories, the "groundwater seepage" categories of Selby (1980) were modified in this classification to better represent the mild, Mediterranean climate of San Diego County.

Porosity and Permeability. Quantifying porosity and permeability for slope stability studies is useful in assessing the susceptibility of a slope to processes such as groundwater flow. Along the San Diego County coast, however, where most seacliffs are moderately well-lithified, the ability of water to flow largely depends on the degree of interconnectedness and opening of fractures as opposed to the permeability of hand specimens. For this reason, we have foregone extensive testing of porosity and permeability in the laboratory and have concentrated on intact rock strength, cliff structure, and relative groundwater seepage measurements.

RESULTS AND DISCUSSION

Importance of Intrinsic and Extrinsic Factors

Intact Rock Strength. The strength of cliff-forming materials along the San Diego County coastline is quite varied (Table 3) and seacliffs have eroded at mean rates ranging from a few centimeters to tens of centimeters per year (Figures 3a and 3b). Much of this variation may be attributed to a strong relationship between cliff erosion rates and intact rock strength (Figures 6a and 6b). This relationship is statistically significant at the 1% level (R^2 = 0.76) and strongly supports the use of the Schmidt Hammer as a rapid, easily-used indicator of seacliff stability. At the La Jolla site, for example, where seacliffs are comprised of relatively high-strength material (moderately well-indurated, fine-grained sandstone and shale) seacliffs have remained essentially stable over much of this century despite being regularly attacked by large waves which break relatively close to the

Table 3. Total stability ratings based on rock mass strength classification

Parameter	CRL	ENC	CRDF	SB	DMN	DMS	TP	LJ	SSC
Intact rock strength	5.0	20.0	14.0	18.0	5.0	5.0	10.0	20.0	20.0
Weathering	5.0	8.0	7.0	8.0	5.0	7.0	5.0	8.0	8.0
Spacing of joints	5.5	23.0	12.0	25.0	5.5	12.0	12.0	25.0	18.0
Joint orientation	3.0	5.0	5.0	5.0	3.0	5.0	5.0	5.0	5.0
Width of joints	1.0	4.5	4.5	4.5	1.0	4.5	4.0	4.5	4.5
Continuity of joints	0.5	4.0	4.0	4.0	0.5	4.0	4.0	6.5	4.5
Groundwater outflow	4.0	4.0	3.0	4.0	4.0	3.5	3.0	4.5	4.0
Total Rating	24.0	68.5	49.5	68.5	24.0	41.0	43.0	73.5	64.0

CRL = Carlsbad; ENC = Encinitas; CRDF = Cardiff; SB = Solana Beach; DMN = Del Mar North; DMS = Del Mar South, TP = Torrey Pines; LJ = La Jolla; SSC = Sunset Cliffs

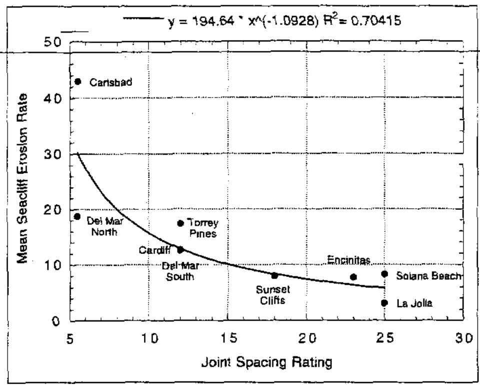

Figure 10 (a).

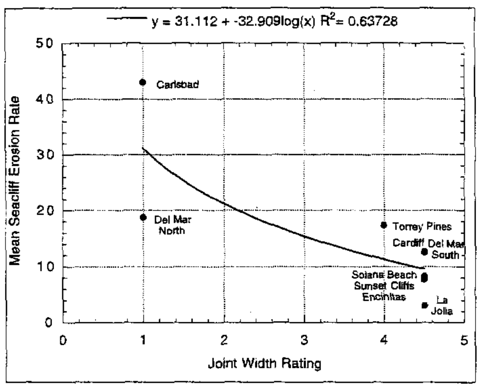

Figure 10 (b).

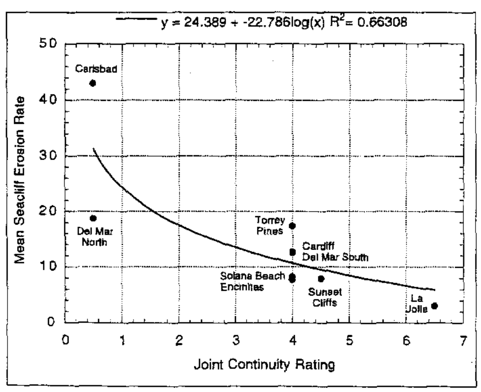

Figure 10 (c).

Figure 10. The relationship between mean seacliff erosion rates and (a) joint spacing ratings, (b) joint width ratings, and (c) joint continuity ratings.

cliffs (Figure 7). In contrast, at South Carlsbad State Beach (Carlsbad site), where seacliffs are composed of extremely weak, poorly-lithified Pleistocene marine terrace deposits (Figure 8) consisting of silty sands (Tan 1986), the mean rate of seacliff retreat is 43 cm/yr. The Carlsbad seacliffs, which are highly susceptible to groundwater and rainfall-induced gullying, landsliding, and slumping, represent the erosion hot-spot or upper end-member of San Diego County seacliff erosion. Where seacliffs are comprised of intermediate strength material, such as at the Cardiff (highly fractured and weathered sandy-claystone) and Torrey Pines (shale containing as much as 25 percent expansive claystone) sites, mean rates of retreat are moderate (13 and 17 cm/yr, respectively).

The cliffs of the Del Mar reach, in particular, reflect a clear relationship between amount of cliff erosion and intact rock strength from north to south. There is a nearly linear decline in erosion rate from north to south (Figure 3b). We believe this difference owes to increasing amounts of the Del Mar Formation, a sandy claystone interbedded with coarse-grained sandstone (Kennedy 1975), and decreasing percentage of poorly-lithified marine terrace deposits, from north to south. The Del Mar Formation, which crops out 130 m south of the northern field boundary (Table 1) as a back-beach platform (Figure 9), becomes a relatively significant portion of the cliff 200 m south of the northern boundary and continues to the southern end. In general, although the Del Mar Formation is not a particularly strong unit, it provides a slightly more resistant barrier to erosion, protecting the cliff base from waves, because it becomes a more important component of the cliff from north to south. As a result, we have divided the Del Mar reach into two sites (northern and southern) for strength testing, due to the extreme variability in cliff composition.

Whereas the cliffs of the Del Mar North reach are composed of weak, poorly-lithified marine terrace deposits, much like the cliffs of Carlsbad site, they have eroded at a lower rate. We attribute this to episodic, short-term attempts at shoreline armoring (e.g., sand-berms) such as placed during the winter of 1997-1998 and refurbishing of cliffs with fill. In addition, the Del Mar North site may be less susceptible to wave erosion over the long term due to the occurrence of offshore reefs and paleo-deltas formed by the San Dieguito River (approximately 1,200 m to the north), one of the largest rivers in San Diego County.

Seacliff Structure. The majority of bedrock failures along the San Diego coast are of the blockfall variety, resulting from wave hammering/quarrying, groundwater seepage, and heaving along weak joint planes. The scale of seacliff failures varies, in part, depending on the attitude, geometry, and spatial distribution of joints. Cliffs with many open joints or other discontinuities (such as at the Sunset Cliffs site) in which waves can compress air and cause recoil are more subject to erosion than those which are relatively free from such openings (such as at the La Jolla site).

Although the strength of intact rock at the Encinitas, Solana Beach, La Jolla, and Sunset Cliffs sites is similar, there are differences in erosion history (Figures 3a and 3b) due largely to variability in joint spacing, joint width, and joint continuity (Figures 10a, 10b, and 10c, respectively). The orientation of joints, although of great significance in the stability of each of these seacliffs, is not a widely variable parameter along the San Diego shoreline (Table 3). Thus, as an individual parameter, joint orientation does not explain variability in rates of cliff erosion since seacliffs have been deformed similarly.

Figure 11. Accelerated cliff retreat at the Sunset Cliffs site due to point-source groundwater seepage and jointing.

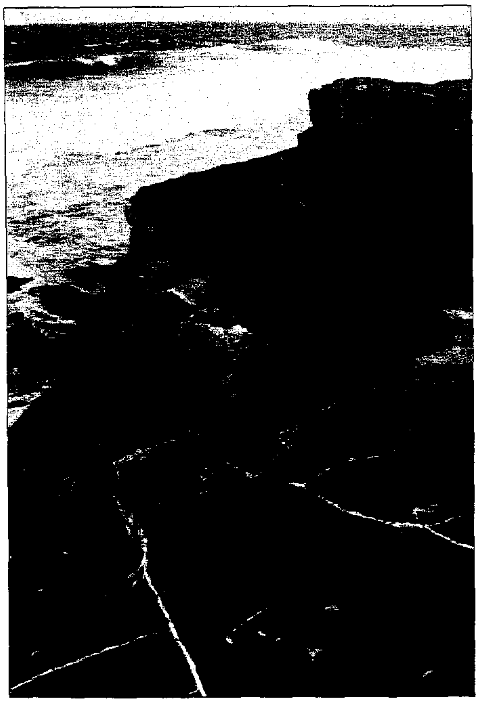

Figure 12. Photograph of the La Jolla site showing well-cemented joints, a significant factor which has lead to increased seacliff stability.

The Sunset Cliffs site, in particular, clearly demonstrates that the degree of joint spacing, joint continuity, and joint infill are of great importance as a control on resistance to erosion and help explain it's variance in erosion rate vs. intact rock strength plots. Although the bedrock consists of the relatively resistant Point Loma Formation, much like that of the La Jolla site, the site is intensively jointed with the majority of joints uncemented (Figures 10a, 10b, and 10c). This has facilitated erosion by groundwater (Figure 11) and has led to significantly more erosion over the last half century than at the La Jolla site. Without accounting for cliff structure at the Sunset Cliffs site, independent analysis of intact rock strength would suggest that the site was (relatively) most resistant to erosion. The La Jolla site, while deformed, is not as heavily jointed as the other sites. Importantly, most joints are well-cemented (Figure 12) and thereby provide a significant increase in cliff stability. As a result, the La Jolla site has eroded little over the last 50 years.

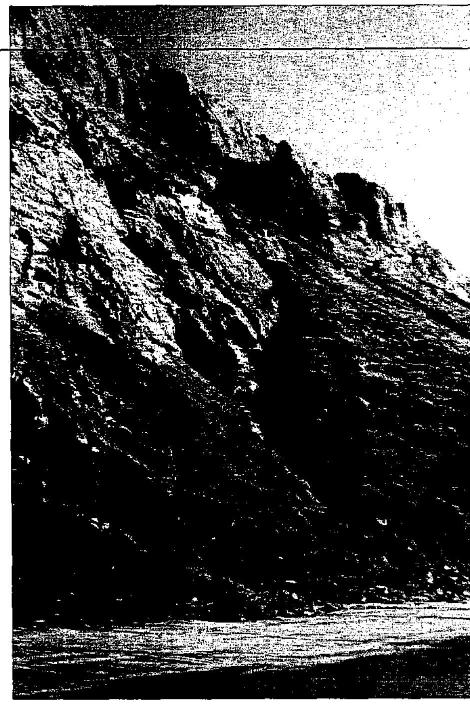

Figure 13. Photograph of the immense, 90-m high Torrey Pines cliffs showing large slide deposits and minimal wave erosion of the cliff base during the 1997-98 El Nino winter.

Erosion of the 90-meter high cliffs along the Torrey Pines site (Figure 13) is also highly dependent on nature of structural discontinuities; these cliffs are largely controlled by the overall strength of the Ardath Shale which, locally, is highly fractured and very permeable. Along this reach, the combination of lithology, geologic structure, and steeply sloping cliff-faces, has created an environment extremely susceptible to erosion by mass-wasting. In general, erosion of the Torrey Pines cliffs is facilitated by a prominent north-south striking, steeply dipping (seaward) joint set and relatively high groundwater seepage. As a result, many small and large mass movements have occurred including translational block slides, slab failures, and slaking. In 1982, just south of the site, a 178-m long section of cliff failed as a deep-seated landslide, and over 1.3 million cubic meters of

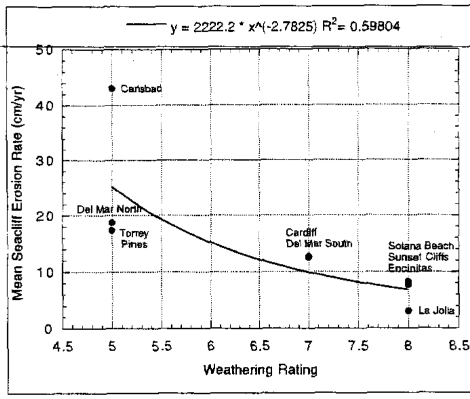

Figure 14. The relationship between mean seacliff erosion rates and weathering ratings.

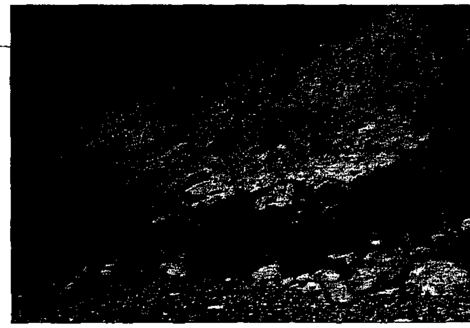

Figure 15. Photograph of a moderate sized slump at the Cardiff site that occurred after four days of heavy rainfall in late February 1998.

rock and soil slid down the cliff face to the beach (Vanderhurst et al. 1982).

When seacliff structure, groundwater seepage, and weathering and fatigue are incorporated into the stability classification system (Table 2), seacliff stability analysis is enhanced (as compared with the individual relationship between erosion rates and intact rock strength). The relationship between mean erosion rates and ëtotal stability ratings' is statistically significant at the 0.1% level ($R^2 = 0.81$). This is largely an outcome of the high statistical significance that exists separately between mean erosion rates and (a) joint spacing, (b) joint width, (c) and joint continuity (Figures 10a, 10b, and 10c, respectively), in addition to (d) intact rock strength (Figures 6a and 6b).

Weathering and Fatigue. Weathering is and important process along the San Diego County coast because it can adversely affect the deformation properties of rocks and can reduce their strength. Shales and mudstones, in particular, are susceptible to drying that creates cracks on bedding and shear planes and reduces shale and mudstone to chips, granules, or smaller particles. Cliff-forming materials rich in clay are susceptible to weathering by hydration of clay minerals. In general, when water is absorbed by clay minerals, water contents decrease the cohesion of clayey material (Ritter 1986). Physicochemical reactions such as the removal of cement by solution can also be important (Turner 1981). The relationship between erosion rates and weathering/fatigue is shown in Figure 14. Although this relationship is not as statistically significant as the relationships between erosion rates and intact rock strength and cliff structure (possibly related to the qualitative nature of our estimations), the importance of weathering in the instability of seacliffs is clear.

Groundwater Seepage. Under certain hydrogeologic conditions, groundwater and rainfall may significantly influence the instability of San Diego seacliffs (Turner 1981; Kuhn and Shepard 1984; Kuhn and Osborne 1987; USACE 1991). At the Sunset Cliffs, Torrey Pines, and Cardiff sites, in particular, high amounts of groundwater seepage, in concert with favorable cliff structure, are responsible for causing numerous blockfalls, slumps, landslides, and subsequent failures of terrace material (Figures 11, 13, and 15, respectively).

Historical records in San Diego County indicate incidents of accelerated seacliff erosion are associated with above normal precipitation. Likewise, Kuhn and Shepard (1984) suggest that heavy rainfall and large waves that accompany severe storms may cause more erosion in a much shorter period than occurs during decades of erosion during relatively benign climatic conditions. Since 1978, rainfall in San Diego County has increased with subsequent accelerated cliff-face retreat, lateral and headward cutting of canyons, and cliff-face gullying of the coastal terrace (Kuhn and Osborne, 1987). In fact, as much as 4-6 m of coastal cliff retreat occurred at numerous San Diego County (Figure 15) locations during the winters of 1982-83 and 1997-98. Each location was notable for the consecutive "cluster" of storms that produced heavy rainfall, ideal for saturation of the cliff and optimal for terrestrial mass-wasting.

Along the majority of the San Diego coast, the primary groundwater source is local rainfall, but elevated groundwater levels from coastal urbanization are common (as much as 100-150 cm/yr of additional groundwater), and have become increasingly significant (Turner 1981; Kuhn and Shepard 1984; USACE 1991). Since the early 1970's, increased urbanization has accelerated coastal cliff erosion in San Diego County via over-watering of non-native vegetation, excessive grading of bluff-tops, and the alteration of natural drainage patterns (Kuhn and Shepard 1984). In general, seacliff stability in San Diego is most affected by groundwater because of differences in permeability between marine terrace deposits and underlying bedrock. The relatively low permeability of bedrock units as compared to that of unconsolidated sandy marine terrace deposits creates a perched water table that slopes toward the seacliff (Turner 1981). As the perched groundwater nears the cliffs, it enters a network of fractures in the bedrock creating high local piezometric pressures. The increased pore pressure along joint surfaces reduces frictional resistance and effective normal stress (Terzaghi 1962). Cliffs are also weakened when groundwater flows through joints and bedding planes and saturates the pores of sedimentary materials. This process, which promotes weathering and solution of cementing material, alters the cohesive and frictional properties of the material, thereby decreasing rock strength (Terzaghi 1962; Turner 1981). Furthermore, clay rich material, such as

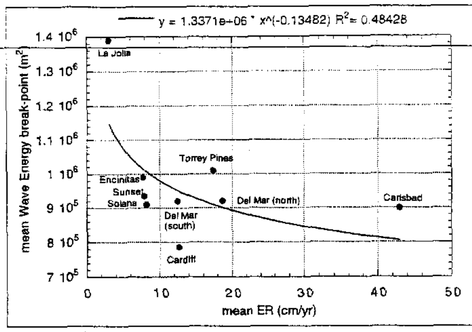

Figure 16. The relationship between seacliff erosion rates and wave energy at the breaker-position at each of the eight San Diego cliff sites studied in this investigation (Benumof et al. in press).

Figure 17. Photograph of the Solana Beach site showing the landward extent of the low tide(0.3 m) wave (1-2 m) run-up.

the Ardath Shale of Torrey Pines, may disintegrate by slaking or may be converted to a slurry when saturated.

Waves as a Cliff-Erosion Mechanism. Upon reaching the nearshore, four principal factors that directly govern the amount and form of wave energy expended against the cliff face. These include wave height, tidal elevation, offshore and beach profile/slope, and beach width/height. Combined, these factors may significantly influence wave run-up and are, therefore, a major control on the hydraulic force received by the cliff face. Resistant headlands, such as Pt. La Jolla, are usually the focal point of increased wave attack because of wave convergence. Submarine canyons, such as La Jolla or Scripps, or other bathymetric depressions, cause wave fronts to diverge so that waves reaching the coast shoreward of the depression are reduced in height while those to either side, where wave energy converges, are somewhat higher. In addition, offshore reefs, sand bars, and deltas dissipate wave energy, so that waves reaching the shore are reduced in height and capacity to erode coastal cliffs.

Critical to evaluating the action of waves in the cliff erosion process is how often and with what force waves reach the base of the seacliff. Large storm waves that occur at high tide are particularly effective in causing basal cliff erosion (Lee et al. 1976; Kuhn and Shepard 1984; USACE 1991; Griggs and Trenhaile 1994) depending on the resistance of cliff material. Beach width, although not a measured parameter in this study, is considered a key extrinsic variable, because in order for the cliff base to be eroded, the subaerial beach must first be removed during the early stage of a storm or storm sequence. By direct compression and shock pressure, and by the abrasive action of wave-carried material, breaking waves cause scour and quarrying of the seacliff after the frontal beach has been eroded (Everts 1991). Thus, the beach serves as a wave-buffer zone, protecting seacliffs and coastal property from direct wave impact.

For quantitatively assessing the importance of waves in the erosion of seacliffs, Benumof et al (in press) investigated the relationship between wave parameters (e.g., height, energy, and power or energy flux) and seacliff erosion rates at each of the eight cliff sites studied in this investigation. Wave parameters were calculated using the California Data Information Program (CDIP) Southern California Refraction-Diffraction Model (SCRDM) and an empirical relationship for breaking wave height. Although they conclude that wave impact and abrasion are important *mechanisms* of seacliff erosion, the study revealed that the distribution of wave energy in 10 m of water and at the breaker-position is inversely related to seacliff erosion rates (Figure 16). As a result, it appears that the stability of San Diego County seacliffs (and probably many others worldwide) is, indeed, most dependent on the nature of the seacliff material itself.

Although quantitative evidence does not exist for the aforementioned inverse relationship at the seacliff face, monitoring of our eight coastal cliff sites (from 1995-present) under a variety of wave conditions has provided qualitative documentation. There is great variation in magnitude of high tide wave impact between the more-erodible sites (Carlsbad, Cardiff, Del Mar, and Torrey Pines) and the more-resistant sites (Encinitas, Solana Beach, La Jolla, and Sunset Cliffs). Similarly, there is great variation in low-tide wave run-up between these sites. In general, wave energy reaching the cliff base at the Carlsbad, Cardiff, Del Mar, and Torrey Pines sites is relatively insignificant at high tide and almost always nonexistent at medium to low tide. In fact, over the course of the 1997-1998 El Nino event, which included the 3-6 m swell of late January and February at 2.0-2.1-m high tides, marine-driven cliff failure was absent at the Carlsbad site except in isolated locations. At the Carlsbad site, the only areas where waves eroded the cliff were where "point-source" spring-sapping (at the beach level) exacerbated the lowering and removal of the back-beach cobble berm, so that wave runup caused localized saturation and scour and removal of basal material. In contrast, waves reaching the cliff base at the Encinitas, Solana Beach, La Jolla, and Sunset Cliffs sites during these same events were extremely powerful, often "shaking" and "rattling" the cliff (Figure 7). In fact, condominium residents in Solana Beach experienced "the shaking of condominium walls at regularly-spaced intervals," on many occasions (Asher 1998). Furthermore, wave attack at the Encinitas, Solana Beach, La Jolla, and Sunset Cliffs sites is not limited to high tides; the negative low tide wave run-up at each of these sites is often within 5 to 10 m of the cliff base (Figure 17).

The striking relationship between wave run-up position at the "more-resistant" vs. "more-erodible" sites suggests that the cliffs of Carlsbad, Del Mar, Torrey Pines, and San Elijo are substantial suppliers of beach sediment. It appears that sediment eroded from weak seacliffs is a source for the construction of relatively wide beaches and consequent temporary protection of the cliff base from wave erosion, a type of "feedback phenomenon." In contrast, because the more-resistant cliffs have a significantly higher intact rock strength and are less susceptible to marine and terrestrial forcing, they do not contribute a significant amount of sediment to the beach system. Consequently, they are more susceptible to wave attack due to the lack of a protective barrier. If this is indeed true, then our findings support those of Osborne (1989) that certain San Diego cliffs contribute as much as 71% of local beach sediment. Although such estimates are subject to variability, such as by short-term climatic fluctuations, there is little doubt that subaerial cliff erosion has been significant in the production of coarse-grained sediment (for moderate- to low-strength cliffs) delivered to many coastal areas of San Diego County during much of the last century.

CONCLUSIONS

The stability of San Diego seacliffs, and probably many other rocky coastlines as well, in response to the forces of marine and terrestrial erosion, is primarily dependent on the physical properties of the material. Erosion of San Diego seacliffs is well predicted ($R^2 = 0.76$) by the relationship between coastal cliff erosion rates and intact rock strength measurements. Although the erosion rate vs. rock strength relationship is evident and is significant at the 1% level, it is enhanced if cliff structure, weathering, and groundwater are incorporated into a stability classification system ($R^2 = 0.81$); complete stability analysis is significant at the 0.1% level. In particular, joints enhance the failure of San Diego seacliffs by providing pathways for water movement (marine or terrestrial) which, in turn, leads to widening of the joint openings. As shown by the difference in erosion rates between the La Jolla and Sunset Cliffs sites, joint spacing, joint width, and degree of joint infill/cement are central factors determining resistance to erosion. The orientation of joints, although of great significance in the stability of some seacliffs (Sunamura 1992), is not a widely variable parameter along the San Diego shoreline. Although we conclude that waves are one of the leading forcing mechanisms of seacliff erosion, our studies suggest they are secondary to material properties in influencing the long-term rate of cliff retreat.

The focus of our future research will be to establish similar quantitative relationships, between seacliff erosion rates and the variables controlling seacliff retreat in other coastal settings. Preliminary results from recent studies we have conducted along the coasts of Santa Cruz and San Mateo Counties, California, suggest that material properties at these locations are also the primary control on seacliff erosion. In addition, we intend to develop a conceptual model to explain the complete and integrated process of seacliff erosion over varying time-scales.

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Exhibit B

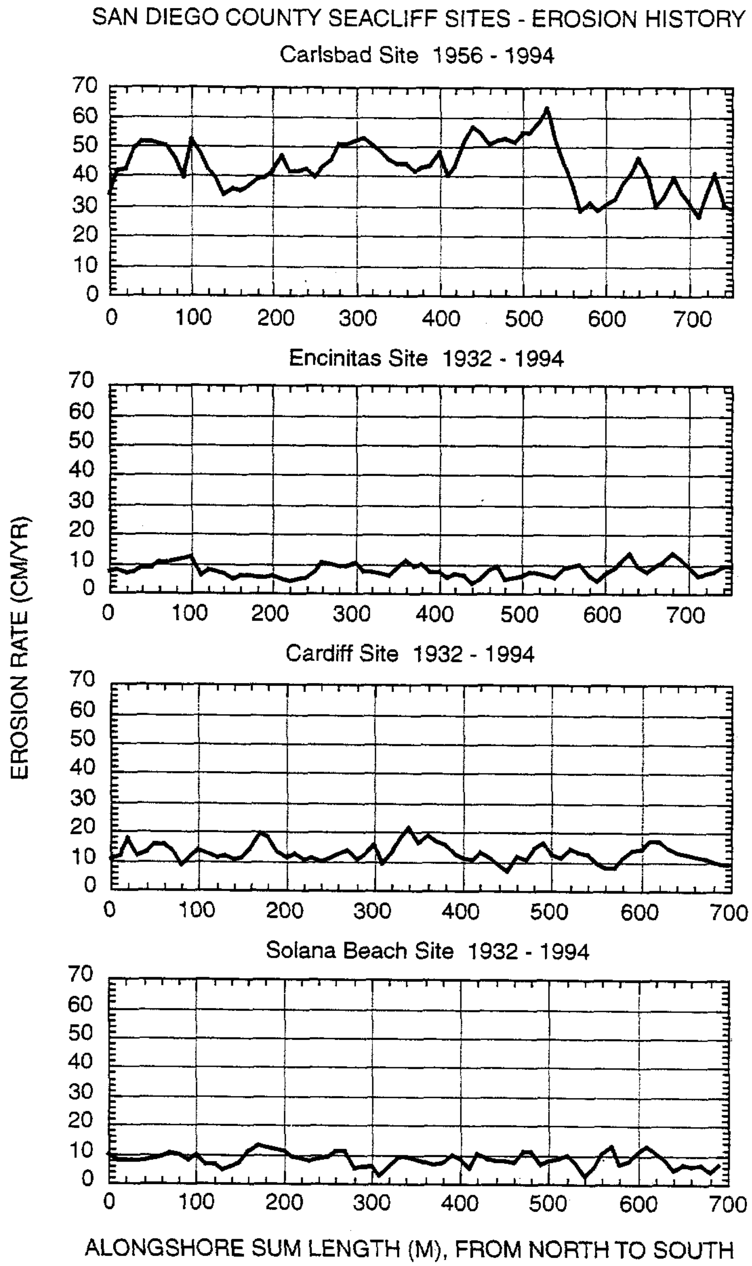

Figure 2.4(a) from Benumof Doctoral Dissertation (1999)

Exhibit C

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Resolution	1 Meter
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Exhibit D

STATE OF CALIFORNIA—THE RESOURCES AGENCY GRAY DAVIS, GOVERNOR

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SAMPLE POLICIES FOR PLANNERS DEVELOPING, AMENDING OR REVIEWING LCP POLICIES ON SHORELINE PROTECTIVE STRUCTURES, HAZARDS, AND BEACH EROSION

Numerous studies of coastline and shoreline processes (some of which are cited in Exhibit A of this document) demonstrate that shoreline protective structures can have deleterious effects on beaches at their base and on more distant beaches due to interruption of sand supplies. There are also beach types that behave differently from one another in terms of erosion and accretion and different methods of shoreline protection that may have more or less applicability in any given situation.

The following sample policies are provided for planners who are working on LCP policies relating to hazards, beach erosion, and shoreline protective devices. They are organized in three parts that address new development, existing development, and long-range planning. These policies stem from Coastal Act sections 30253 and 30235. The discussion following each policy is explanatory only.

This information is intended to provide suggestions and ideas for local governments, however, it must be customized for particular situations and locations. Provision of these sample policies is not intended to represent that these policies are required or that, for any particular jurisdiction, the Coastal Commission would consider these policies adequate to carry out the applicable policies of the Coastal Act.

1. *Policy Guidance*: Ensure that new development will not need a shoreline protective device for the duration of its economic life.

Discussion: Coastal Act section 30253(2) says new development may not "in any way require the construction of protective devices that would substantially alter natural landforms along bluffs and cliffs." Shoreline protective devices can and do substantially alter natural landforms by greatly reducing erosion of the bluffs behind the device and accelerating erosion of the beach seaward of the device and of the bluffs on either side of the device. In addition, construction of shoreline protective devices can involve substantial grading of the bluff.

New development should be sited far enough from the bluff edge, or top of bluff, that it will not require a seawall, revetment or any other bluff alteration for the full life of the development. This is a two step effort — determining a safe distance from the bluff edge for development, and determining the location and configuration of the bluff edge at some time in the future, often taken to be the life of the development.

2. *Policy Guidance*: Define the economic lifetime of structures as a minimum of 75 years (100 years is preferable).

Discussion: While the Coastal Act does not define the economic lifetime of a structure, the Commission's ReCAP effort has shown that most structures last at least 75 years. Economic life may be developed from the general neighborhood character. However, structures will generally remain in good condition with regular repair and maintenance for at least 75 years after construction.

3. *Policy Guidance*: Require all applications for a permit for new blufftop development to include a geologic report of the entire site with special attention to the area of demonstration, i.e., that area which lies 50 feet inland from the edge of the bluff or that area which lies between the top of the bluff and the point at which a line from the toe of the bluff inclined 20 degrees above horizontal intersects the surface, whichever is greater. The geologic report should be required to include a predicted erosion rate and a setback that will ensure the development will not require shoreline protection during its economic life, based on either a or b, below.

a. Develop a long-term annual average erosion rate, multiply this by the economic life of the structure and either multiply that by a safety factor or add a safety factor as a set distance. For example, if the rate of erosion is determined to be 3 inches per year, the economic life of the structure is 100 years, and the safety factor is 1.2, then the minimum setback is 30 feet (3 in. x 100 yrs. = 300 in., 300 in. = 25 feet, 25 feet x 1.2 = 30 feet). If the safety factor were a set distance of, say, 10 feet, and the rate of erosion and economic life of the structure were the same as in the preceding example, then the setback would be 35 feet. The safety factor may vary regionally, based on the quality of the shoreline change data and the size or magnitude of extreme erosion events.

b. Require the geologist to provide 75-year and 100-year setback lines and give the methodology for determining the setback.

Discussion: The erosion rate and setback recommended by the geologist will enable the local government to ensure that new development on bluff tops and cliffs is safe from erosion and will not require shoreline protection during its useful life. The local government and coastal analysts will need information on the methodology both to check the thoroughness of the analysis and to compare it with other projects in the vicinity.

4. *Policy Guidance*: In-fill development, i.e., new development between adjacent developed parcels, should be allowed no closer to the bluff edge than as indicated by the geologic report.

Discussion: In areas where a vacant lot lies between two adjacent developed lots, the applicant will often propose a setback distance comparable to that of the adjoining developed properties. This has been found to be appropriate if:

1) the bluff edge is essentially a straight line and not concave at the location of the vacant lot and,
2) the existing structures are currently set back a distance that would equal the erosion rate appropriate to the economic lifetime of the proposed structure.

However, the required geologic report should still determine the full setback that would be necessary for the life of the development and this should be used in site design if it indicates a greater setback is needed.

5. *Policy Guidance*: Define the bluff edge as the upper termination of a bluff, cliff, or sea cliff. In cases where the top edge of the cliff is rounded away from the face of the cliff as a result of erosion processes related to the presence of the steep cliff face, the bluff line or edge is that point nearest the cliff beyond which the downward gradient of the surface increases more or less continuously until it reaches the general gradient of the cliff. In a case where there is a step-like feature at the top of the cliff face, the landward edge of the uppermost riser is taken to be the cliff edge.

Discussion: There are many instances where the edge of the blufftop is not a clear and there is not a dramatic change from a horizontal to a vertical surface. Often parcels are not horizontal but slope toward the sea, or there may be a stair-stepped configuration, or there may be gullies present which have cut landward back into the bluff top. Because erosion features, such as gullies, may be evidence of weaker, less stable areas, they must be considered when determining the blufftop setback. Where there may be confusion about the location of the blufftop, it may be appropriate to map the blufftop and include the map in the LCP, clearly identifying the date of the determination as a tool of comparison for future references.

6. *Policy Guidance*: Require that blufftop landscaping use drought tolerant, native species.

Discussion: Drought tolerant species do not need as much watering as other species. Adding water to the top of a bluff or bluff face can lead to accelerated bluff failure. Native species are adapted to the harsh conditions of bluff tops (wind, salt spray, etc.)

7. *Policy Guidance*: Define an "area of high geologic hazard" as fault zones and land subject to dangers from liquefaction and other severe seismic impacts, unstable slopes regardless of slope angle, landslides, areas of coastal cliff instability, tsunamis, and slopes steeper than 30%.

Discussion: Coastal Act section 30253(1) states that "new development shall minimize risks to life and property in areas of high geologic hazard." These areas should be identified in the LCP and on adopted maps to enable minimization of risk. Depending on the local geologic structure, the appropriate slope percentage that constitutes an area of geologic hazard may be greater or less than 30 percent.

8. *Policy Guidance*: Accessory structures (e.g. patios, gazebos, etc.), if allowed, should be constructed in such a manner as to be easily relocated landward should they become threatened by shoreline erosion. CDPs authorizing accessory structures should be conditioned with the requirement that the permittee (and all successors in interest) shall remove the accessory structure(s) if threatened by shoreline erosion and that no shoreline protection device shall be allowed for the sole purpose of protecting the accessory structure(s). Accessory structures should not be considered structures for the purposes of shoreline protection as provided in Section 30235 of the Coastal Act.

Discussion: In certain circumstances such as a small parcel it may be appropriate to allow some accessory structures in the setback area. However, unless there is no other developable area large enough for the minimum development consistent with the zone district, this development should only be allowed if conditionally authorized such that, once threatened, it is relocated or removed. There could also be a situation where a permanent structure is proposed to be located significantly landward of the required bluff setback and a temporary structure is proposed between the permanent structure and the bluff setback area. Again, the temporary structure should only be allowed if it can be relocated if threatened by erosion. Armoring should not be used to protect temporary structures.

9. *Policy Guidance*: Ensure that land divisions of coastal fronting property will result in new parcels that can be developed with structures that will not require shoreline protection during a 75 or 100 year economic life. Prohibit land divisions that will result in parcels that are unbuildable, e.g., exclusively areas of high geologic hazard; and that each new parcel has at least the minimum developable area, consistent with the zone district, outside of any high geologic hazard area.

Discussion: Coastal Act section 30106 defines land divisions and lot splits as development. Such divisions should not be authorized if the increase in parcel numbers will increase the demand for shoreline protection. Land divisions should not create unbuildable lots, e.g., entirely on a bluff face, or lots too small to allow for a single-family residence landward of the bluff setback.

10. *Policy Guidance*: Allow new development on sand dunes only when required to avoid a "taking" of property. Establish a sand dune preservation zone district in the zoning ordinance to provide standards for development on sand dunes when such development must be allowed. Site new development on sand dunes 1) landward of the most seaward

line of vegetation, 2) in a way that avoids or minimizes adverse impacts to natural dune formation, and 3) in a way that does not adversely affect sandy beach habitat. Require a geologic report to substantiate the stability and integrity of the dune and a biologic report to identify potential biologic impacts and mitigation therefore. Where there is no vegetation, require a geologic report to establish a line seaward of which no new development will be allowed. Ensure that no new development is allowed seaward of the inland extent of the estimated wave runup from the 100-year design storm. Where existing subdivided lots lie entirely seaward of the most seaward line of vegetation or seaward of the inland extent of the estimated 100 year storm wave runup, allow only minimum development, and limit site cover and site disturbance to the extent necessary for the minimum development.

Discussion: The existence of vegetation on dunes is evidence that some amount of stability exists and that the area is not subject to regular wave runup, although this needs to be substantiated by a geologic report, and a biologic report is needed to identify impacts to flora and/or fauna and to identify mitigation. If there is no vegetation, it is more difficult to intuitively discern the area of stability; in those cases it is imperative that a geologic report determine the inland extent of the wave runup from the 100-year storm. Alternatively, this could already be mapped on the land use plan and zoning maps. There are subdivisions that include lots well onto the beach. If these are in fact legal lots of record, then some development must be allowed. In those cases, the amount of development should be limited to reduce impacts to coastal resources and to limit the amount of loss when the inevitable destructive storm occurs.

Policy Guidance for Existing Development

1. *Policy Guidance*: Allow shoreline protective devices only in the following instances:
a. when required to serve coastal-dependent uses, or
b. when required to protect existing principal structures in danger from erosion, or
c. when required to protect public beaches in danger from erosion, <u>AND</u>,
d. when impacts to shoreline sand supply are mitigated.

Discussion: Coastal Act Section 30235 sets up several tests to determine if shoreline protection is an appropriate response to erosion. First, is the subject property a coastal dependent use, existing structure or public beach? If yes, is there a documented danger from erosion. And, third, if yes, does the proposed protection minimize or eliminate impacts to sand supply. Almost every shore protection structure will have some unavoidable impacts on sand supply, as well as the visual character of the shoreline. For areas where there are accessory buildings seaward of the principal structure, the local government may want to consider adding the language to the LCP to prohibit the use of armoring to protect accessory structures. The Coastal Commission has found that relocating ancillary facilities may be a feasible, less environmentally damaging alternative than constructing a shoreline protective device. In general, accessory structures can usually be relocated, while it is more problematic to relocate the principal residence or building. Shoreline protective devices should only be authorized when necessary and only to protect those structures that cannot feasibly be protected in any other manner and that are or contain the principal use of the site, and when impacts to shoreline sand supply are mitigated. For all situations, the applicant should consider alternatives to shoreline protective devices; for accessory structures relocation should be thoroughly reviewed.

2. *Policy Guidance*: Define principal structures as any primary living quarters, main commercial buildings, and functionally necessary appurtenances to those structures such as septic systems and infrastructure. Facilities such as privately owned, non-coastal dependent pipelines, roads, utilities and accessory structures (e.g. storage sheds, decks, patios, gazebos, walkways, landscaping, etc.) are not considered to be principal structures.

Discussion: The Coastal Act simply uses the words "existing structures" without any qualifications or definitions in Section 30235. By limiting development for which shoreline protective devices may be constructed, coastal armoring and consequent beach erosion may be slowed. The Coastal Commission has found that it is generally feasible to relocate ancillary structures while it is more problematic, although not necessarily infeasible, when considering the principal residence or building. Relocation of ancillary facilities may be environmentally less damaging than a seawall and more protective of coastal resources. Coastal Act section 30235 states that seawalls shall be permitted when required to protect existing structures. If it is feasible to relocate structures, then a seawall is not required for protection.

3. *Policy Guidance*: Require applications to include an analysis of alternatives that are capable of protecting the existing structure from erosion including, but not limited to: a) no action; b) involvement in regional beach nourishment; and/or c) the relocation of the threatened structure. Require the following information also: amount of beach that will be covered by the shoreline protective device; the amount of beach that will be lost over time, through passive erosion; total lineal feet of shoreline protective devices within the littoral cell where the device is proposed; and, the cumulative impact of added shoreline protective devices for the littoral cell within which the proposed device will be located.

Discussion: LCPs should establish thorough and understandable filing requirements that take into account local and regional shoreline situations. This will allow an analysis of cumulative impacts within the littoral cell and allow the impacts of the individual project to be considered in a regional context. This in turn can provide the basis for non-armored responses to coastal bluff erosion.

4. *Policy Guidance*: Define the replacement of residences destroyed by storm waves or bluff failure as "minor development," or require submittal of plans but waive the requirement for actually obtaining a permit if the replacement residence conforms to applicable existing zoning requirements, is for the same use as the destroyed structure, does not exceed either the floor area, height, or bulk of the destroyed structure by more than 10 percent, and if the replacement residence is setback on the parcel at least 60 percent of the minimum bluff edge setback for new structures in the same area with the same geologic structure. Do not allow a structure to be relocated to a wetland, stream, or other sensitive habitat.

Discussion: The Coastal Act states that structures destroyed by a disaster may be replaced without need for a coastal development permit if the structure conforms to applicable existing zoning requirements, is for the same use, does not exceed the floor area, height, or bulk of the destroyed structure by more than 10 percent and if the structure is sited at the same location as the destroyed structure. However, it may be physically impossible, or at least infeasible, to locate the replacement structure in the same location as the destroyed structure because, for example, bluff failure may result in the physical loss of the original location. This means that a coastal development permit would be necessary to relocate the structure away from the original location to a safer location. However, in some cases, a landowner may seek to locate a replacement residence in its original location simply to avoid permit requirements. This could result in the residence not being placed in the safest area on the site. If the relocation is defined as a "minor development," then, while a permit would be required, there would no requirement for a public hearing. Alternatively, the requirement for actually obtaining a permit could be waived. In that case, the applicant would submit plans for review, but no permit would be issued or necessary. Under either of these alternatives, the owner would have an incentive to relocate the structure to a safer location where shoreline protection would not be necessary. This would further the goals of protecting existing structures, reducing the need for shoreline protective structures, and reducing beach erosion. The proposed policy guidance reduces the immediate and future need for shorelines protective structures without causing beach erosion and its relocation provisions may be more economically feasible than reconstructing in the same location with armoring.

5. *Policy Guidance*: Encourage the relocation of threatened structures, rather than constructing shoreline protective devices, by waiving permit filing fees for applications to relocate structures or providing variances from zoning requirements such as side or front yard setbacks, etc.

Discussion: Relocation of a structure away from an eroding bluff or out of the reach of storm waves may provide the applicant with many years of future site use without the costs and effects of long term shoreline protection.

6. *Policy Guidance*: Annually notify in writing all blufftop property owners that the placement of emergency shoreline protective devices shall be allowed only when the need for such protection was in fact caused by a sudden, unexpected occurrence demanding immediate action to prevent or mitigate loss or damage to life, health, property, or essential public services. Emergency permits will become void and the structure authorized by them considered a public nuisance unless the property owner makes an application for a regular coastal development permit within 30 days of the issuance of the emergency authorization.

Discussion: Emergency permits are available as a possible response to a sudden, unexpected occurrence. It is not an emergency if a condition has been known for a long time, but no action is taken to address the condition until it becomes critical. Unfortunately, emergency shoreline protection is often installed during difficult conditions and often cannot be designed or constructed with the same level of care as shoreline protection that is designed and constructed in a timely manner. Annual notices will encourage coastal property owners to plan ahead and should suggest that coastal property owners retain an engineering geologist to assess whether the property is stable or in need of some form of stabilization. Also all emergency permits must be followed up by regular permit applications to ensure that the standards for shoreline protective structures are met and to verify that the emergency device is still needed. It can be quite costly to remedy poorly designed or constructed emergency structures, so proper planning and design initially is important.

7. *Policy Guidance*: Prohibit new shoreline protective structures from extending onto a beach farther than a straight line connecting the nearest corners of adjacent shoreline protective structures, if any. Require new shoreline protective devices to cover the least amount of beach area as is necessary to provide adequate protection for the existing principal structure.

Discussion: If a new shoreline protective structure is designed to fill in between two existing shoreline protective structures, the "in-fill" should only be allowed for one or two urban lots, at a maximum. Since shoreline protection will interfere with shoreline access and sediment transport during some conditions, shore protection structures should be sited as far landward as possible to minimize these effects.

8. *Policy Guidance*: Send notices of shoreline protective device permit applications to all local governments with shoreline within the same littoral cell.

Discussion: The littoral cell is the natural boundary for dealing with beach sand supply and movement. Without knowing the range of shore developments that is proposed for a littoral cell regardless of political jurisdiction, other jurisdictions cannot take any sort of coordinated action to preserve and/or restore beaches.

9. ***Policy Guidance*****: Prohibit additional permanent structures on bluff faces, except for engineered public beach access where no feasible alternative means of public access exists.**

Discussion: New structures such as stairways added to bluff faces could become existing structures eligible for a shoreline protective device when threatened by erosion. This in turn adds to shoreline armoring. Among other things, the Coastal Act protects and encourages public access to beaches. Therefore, local governments should consider prohibiting all new stairways on bluff faces unless no feasible alternative means of public access to a beach exists.

10. ***Policy Guidance*****: Require that blufftop landscaping use drought tolerant native species whenever possible.**

Discussion: Drought tolerant native species do not need as much watering as other species. Adding water to the top of a bluff can lead to accelerated bluff failure. Blufftop landscaping should be designed to minimize irrigation and avoid artificial soil saturation. Native species are adapted to the harsh conditions of bluff tops (wind, salt spray, etc.).

11. ***Policy Guidance*****: Require all existing, non-permitted shoreline protective structures constructed after January 1, 1973 to obtain a coastal development permit. Declare non-permitted shoreline protective structures a public nuisance. Require the property owner to apply for a coastal development permit for such structures no later than one year from the date of certification of this policy by the Coastal Commission. Failure to meet the deadline may result in the local government posting the property with a notice of violation and recording it against the property.**

Discussion: Shoreline protective devices that were built after January 1, 1973, without coastal permits, are illegal. Many of these devices were not built according to standard engineering practices and so may pose a hazard to the public or to the property owner through premature failure. To require these unpermitted structures to obtain a permit would allow for review and possible correction of substandard structures.

12. ***Policy Guidance*****: If an in lieu fee mitigation program exists, require payment of an in lieu fee to support beach nourishment efforts in a manner proportionate to the quantifiable effects of the shoreline protective device on the amount of sand that would have been nourishing the beach in the absence of the shoreline protective device.**

Discussion: The Commission has designed and implemented a methodology for making such a calculation. In many areas with shoreline erosion problems, it may be appropriate to incorporate an analogous methodology into the LCP.

Policy Guidance For Long-Range Planning

1. ***Policy Guidance*: Inventory available studies on local and regional coastal processes and beach resources; participate in studies to fill in information gaps about regional effects of shoreline protective structures on beach erosion and methods to counteract beach erosion. Establish an Overlay or Geologic Hazard Assessment District (include tsunamis) and designate areas of coastal resource significance (e.g., sand dunes and areas of high geologic hazard) on the LUP and zoning maps, to limit in-filling for relatively undeveloped areas and to limit seaward encroachment of development.**

Discussion: This type of information, whether compiled from existing sources or undertaken by the local government itself, will provide a basis for implementing long range solutions, other than armoring, to the hazards associated with shoreline erosion.

2. ***Policy Guidance*: Create and maintain a database/file of geotechnical reports from individual projects for use in analysis of regional effects of shoreline protective structures, including documentation of interference with sand transport, loss of sand from the beach, the amount of beach area already covered by shoreline protection devices, location of such encroachments, and the cumulative impacts of those devices on recreational use.**

Discussion: Such a data base can serve both the local government and applicants by allowed rapid recall of past project information.

3. ***Policy Guidance*: Develop an in-lieu fee mitigation program to allow for mitigation of seawall impacts through payment of an in-lieu fee that is used to replenish beaches in the same littoral cell as the seawall.**

Discussion: In natural areas and/or areas not already stabilized by shoreline protective devices, armoring halts erosion of the area behind the protective device and hence eliminates a source of future beach material, causes increased erosion of the beach seaward of the device, and can interfere with longshore transport of sand within the littoral cell. This type of policy encourages local governments to develop programs for collecting in-lieu fees that can be used to mitigate some of the permanent and adverse effects of armoring on public resources. Such a policy would enable the creation of a fund with which the relevant local government could fund beach nourishment. Utilize information and expertise from the SANDAG (San Diego Association of Governments) and BEACON (Beach Erosion Authority for Control and Nourishment) experiences as appropriate (Contact the Coastal Commission's San Diego or Ventura office for further information).

4. ***Policy Guidance*: Monitor and comment on other jurisdiction's activities which may affect natural sand movement and supply on the local governments beaches.**

Discussion: Ideally there would be a multi-jurisdictional entity that would study shoreline processes, shoreline change and long-term trends and provide a forum to discuss projects that could affect other jurisdictions within the littoral cell. In any event, local tracking of projects will help to keep all jurisdictions aware of activities and provide them an opportunity to comment on projects that may result in adverse effects on their beaches.

5. *Policy Guidance*: Develop a comprehensive shoreline protection program that includes regular shoreline surveys to develop short and long-term shoreline trends, identifying priorities for types of shoreline protection, and developing programs for opportunistic beach nourishment using clean dredge material, clean material from flood control structures, clean excavation material and other innovative sources. Identify which beaches have priority for nourishment.

Discussion: The littoral cell is the most reasonable geographic division for studying shoreline processes and shoreline trends. Since jurisdictional boundaries were not established with concern for littoral cell boundaries, a regional, multi-jurisdictional entity would be the ideal forum for a comprehensive shoreline program. If no such program exists, local jurisdictions can undertake a great deal of useful study and examination of shoreline processes on a smaller and more manageable section of shoreline within their local boundaries. Such program should identify the major factors that influence coastal processes within the cell and concentrate on those factors over which the local jurisdiction has control.

6. *Policy Guidance*: Rank the types of permissible shoreline protective devices in order of least to most potential coastal impact and set forth technical criteria and standards for the structural design of shoreline protective devices.

Discussion: This will depend on the local shoreline characteristics and access considerations.

7. *Policy Guidance*: Encourage voluntary consolidation or purchase of property, or development of a transfer of development credit program as a means to reduce development potential of coastal fronting land.

8. *Policy Guidance*: Seek federal and state funds to conduct the following types of studies: source of harbor deposition material, the impact of beach erosion on beach access, the effect harbor deposition has on beach replenishment downcoast of the harbor; the impact of harbor dredging on potential tsunami hazard, and the direct and indirect costs of harbor dredging to the local government or Harbor District.

LCP Policy Matrix

Local Coastal Program Policies and Ordinances Relating to Shoreline Protective Devices

The matrix below identifies a selection of documents that contain policies about shoreline protective devices. The specific language of each reference (excepting BEACON) is provided in a table following the matrix. Each row in the table corresponds to a cell location on the matrix. For example, the long range planning policies on from the City of Imperial Beach can be found in table row 2b. Unless otherwise identified, all references are to Land Use Plans. Where both Land Use Plan policy and Implementation Plan ordinance sections are listed, as in cell 1a, the Land Use Plan policies are listed first.

	LOCAL COASTAL PROGRAM						
TYPE OF POLICY	a	b	c	d	e	f	g
1 Setbacks for Development on Blufftops and Sand Dunes	San Luis Obispo County *Hazards Policy 6 Coastal Zone Land Use Ordinance Section 23.04.118.*	Malibu/ Santa Monica Mountains *Policies 163 and 164*	Marin County *Natural Dune & Sandy Beach Protection Policy 20*	City of Pismo Beach *Bluff Erosion/ Instability Section, Bluff Top Setbacks Policy S-3*	Humboldt County *North Coast Area Plan Definitions: "Bluff Edge" or "Cliff Edge"*	Mendocino County *Coastal Element Hazards Policy 3.4-7*	City of Encinitas *Hazard Policy 1.6f*
2 Long Range Planning	City of Ventura *15.9 BEACON Program*	City of Imperial Beach *Policy S-11*	City of Newport Beach *Visitor Serving Facility section Policy 1*	Marin County *Policies 7 and 8 Shoreline Protection and Hazards*	City of Encinitas *Hazard Policy 1.7*		
3 Public Access	City of Carpinteria *Policy D.1.6 A.1.1*	Carmel Area of Monterey County *Specific Policies 2.7.4.10*	City of Santa Barbara *Marine Resources Policy 6.5*	Marin County *Policy 4 Marine Protection and Hazards*	Del Monte County *LCP, Zoning Ordinance c.1.*		
4 Existing Development	Santa Barbara County *Seawall and Shoreline*	City of Santa Barbara *Policy 6.3*	San Mateo County *Hazards Component*				

Sample LCP Policies On Shoreline Protective Structures, Hazards, and Beach Erosion

	LOCAL COASTAL PROGRAM						
TYPE OF POLICY	a	b	c	d	e	f	g
	Structures Policy 3.1		*Policy 9.12*				
5 Historical Background/ Basis for Limiting Shoreline Structures	City of Santa Barbara: *Water & Marine Resources section re: Dredging Activities and Seawalls, pg. 3–67 ff.*						
6 Hazard Area	San Luis Obispo County *Hazards Policy 7* *Coastal Zone Land Use Ordinance Section 23.07.080*	City of Sand City *Natural Hazards Policies 4.3.10, 4.3.11*	San Mateo County *Hazards Component Policies 9.1, 9.2, 9.3, 9.10*				
7 New Development	Carmel Area of Monterey County *General and Specific Policy 2.7.3.3*	San Mateo County *Hazards Component Policy 9.11.*	City of Grover Beach *Marine Resource Areas Recommendation, Sand Dunes Policy No. 1*	Marin County *Unit 1, Dune Policies 20 and 21*	Malibu/Santa Monica Mtns. *Bluff and Beach Erosion Policy*	City of Encinitas *Hazards Policy 1.6f.*	

Sample LCP Policies On Shoreline Protective Structures, Hazards, and Beach Erosion

	LOCAL COASTAL PROGRAM						
TYPE OF POLICY	a	b	c	d	e	f	g
8 **Emergency**	Marin City *Policy 7* *Shoreline Protection and Hazards Section*	City of Encinitas *Zoning Ordinance Section 30.34.020, Coastal Bluff Overlay Zone, Subsection E, Temporary Emergency Protection Devices*	San Luis Obispo County *Coastal Zone Land Use Ordinance, Section 23.03.045, Emergency Permits*				
9 **Regional**	BEACON (Beach Erosion Authority for Control Operations and Nourishment), a Joint Powers Authority. Please contact Commission's Ventura office for further information about BEACON.						

LANGUAGE OF POLICIES IDENTIFIED IN LCP TABLE

EXAMPLES OF USEFUL POLICIES RELATING TO SHORELINE HAZARDS, SHORELINE PROTECTIVE DEVICES, & BEACH EROSION (Current as of August 1996)

This is Not Meant to be a Comprehensive List of All Useful LCP Policies.

THE EXAMPLES ARE MEANT TO GIVE COMMISSION AND LOCAL GOVERNMENTS LCP PLANNERS A STARTING POINT FOR DEVELOPING NEW POLICIES. STATE-OF-THE-ART INFORMATION SHOULD BE USED IN DEVELOPING NEW LCP POLICIES. AS NEW LCP POLICIES ARE DEVELOPED THEY CAN BE ADDED TO THIS LIST.

TYPE OF POLICY	JURISDICTION
Setbacks for Development on Blufftops and Sand Dunes **1a**	<u>**San Luis Obispo County, Hazards Policy 6**</u>: New development or expansion of existing uses on blufftops shall be designed and set back adequately to assure stability and structural integrity and to withstand bluff erosion and wave action for a period of 75 years without construction of shoreline protection structures which would require substantial alterations to the natural landforms along bluffs and cliffs. A site stability evaluation report shall be prepared and submitted by a certified engineering geologist based upon an on-site evaluation that indicates that the bluff setback is adequate to allow for bluff erosion over the 75-year period. Specific standards for the content of geologic reports are contained in the Coastal Zone Land Use Ordinance. [THIS POLICY SHALL BE IMPLEMENTED PURSUANT TO SECTION 23.04.118 OF THE CZLUO] *CCC Staff comment: This policy is straightforward and, like many of the County's policies, specifically calls out the section of the Implementation Plan (zoning ordinance) which implements the policy, making it very easy to move from the policy directly to the particular requirements of the implementing ordinance.* <u>**San Luis Obispo County Coastal Zone Land Use Ordinance (CZLUO), Section 23.04.118, Blufftop Setbacks**</u>: ...The required setback shall be the larger of the two required by subsections a. and b. of this section. **a. Stringline setback method:** Where 50 percent of the lots adjacent to the coastline within 300 feet of the site are developed at the time of application, no part of a proposed new structure, including decks, shall be located closer to the seaward property line of the site that the greatest distance determined by either of the following: **(1)** A line between the most seaward portions of the structures on the adjacent lots; or

TYPE OF POLICY	JURISDICTION
	(2) Where there is substantial variation of land from between adjacent lots, the average setback of structures o the adjoining lots shall be used. **b. Bluff retreat setback method:** New development or expansion of existing uses on blufftops shall be designed and set back from the bluff edge a distance sufficient to assure stability and structural integrity and to withstand bluff erosion and wave action for a period of 75 years without construction of shoreline protection structures that would in the opinion of the Planning Director require substantial alterations to the natural landforms along bluffs and cliffs. A site stability evaluation report shall be prepared and submitted by a certified engineering geologist based upon an on-site evaluation that indicates that the bluff setback is adequate to allow for bluff erosion over the 75-year period. The report shall accompany the land use permit application, and shall contain the following information: **(1)** Historic, current and foreseeable cliff erosion, including investigation of recorded land surveys and tax assessment records in addition to the use of historic maps and photographs, where available, and possible changes in shore configuration and sand transport. **(2)** Cliff geometry and site topography, extending the surveying work beyond the site as needed to depict unusual geomorphic conditions that might affect the site and the proposed development. **(3)** Geologic conditions, including soil, sediment and rock types and characteristics in addition to structural features such as bedding, joints, and faults. **(4)** Evidence of past or potential landslide conditions, the implications of such conditions for the proposed development, and the potential effects of the development on landslide activity. **(5)** Wave and tidal action, including effects of marine erosion on seacliffs. **(6)** Ground and surface water conditions and variations, including hydrologic changes caused by the development (e.g., introduction of sewage effluent and irrigation water to the groundwater system; alterations in surface drainage). **(7)** Potential effects of seismic forces resulting from a maximum credible earthquake. **(8)** Effects of the proposed development including sighting and design of structures, septic system, landscaping, drainage, and grading, and impacts of construction activity on the stability of the site and adjacent area. **(9)** Potential erodibility of the site and mitigation measures proposed to minimize erosion problems during and after construction. Such measures may include but are not limited to landscaping an drainage design. **(10)** The area of demonstration of stability shall include the base, face, and top of all bluffs and cliffs. The extent of the bluff top considered should include the area between the face of the bluff and a line described on the bluff top by the intersection of a plane inclined a 20-1/4 degree angle from the horizontal passing through the toe of the

TYPE OF POLICY	JURISDICTION
	bluff or cliff, or 50 feet inland from the edge of the cliff or bluff, whichever is greater. **(11)** Any other factors that may affect slope stability.
Setbacks for Development on Blufftops and Sand Dunes **1b**	**Malibu/Santa Monica Mountains** **Policy 163**: Continue to require an engineering report on all proposed bluff-top development to insure geologic stability, adequate structural setback and appropriate mitigation of on-site runoff. **Policy 164**: On blufftops, new development shall be set back a minimum of 25 feet from the top of the bluff or at a stringline drawn between the nearest corners of adjacent structures, whichever distance is greater, but in no case less than would allow a 75-year useful life for the structure.
Setbacks for Development on Blufftops and Sand Dunes **1c**	**Marin County, Natural Dune & Sandy Beach Protection Policy 20**: Development of other shorefront lots within the Stinson Beach and Seadrift areas shall assure preservation of the natural sand dune formation in order to protect environmentally sensitive dune habitat and vegetation and to maintain the natural protection from wave runup that such natural dunes provide. Where no dunes are evident, any new development on shorefront lots shall be set back behind the first line of terrestrial vegetation to the maximum extent feasible, in order to minimize the need for protective works, to protect sandy beach habitat, and to provide a buffer area between private and public use areas in order to protect both the scenic and visual character of the beach, and the public right to access the use and enjoyment of dry sand areas.
Setbacks for Development on Blufftops and Sand Dunes **1d**	**City of Pismo Beach, Bluff Erosion/Instability Section, Bluff Top Setbacks Policy S-3**: All structures shall be set back a safe distance from the top of the bluff in order to retain the structures for a minimum of 100 years, and to neither create nor contribute significantly to erosion, geologic instability or destruction of the site or require construction of protective devices that would substantially alter natural landforms along bluffs and cliffs.
Setbacks for Development on Blufftops and Sand Dunes **1e**	**Humboldt County North Coast Area Plan Definitions, "Bluff Edge" or "Cliff Edge:"** is the upper termination of a bluff, cliff or seacliff. When the top edge of the cliff is rounded away from the face of the cliff as a result of erosional processes related to the presence of the steep cliff face, the edge shall be defined as that point nearest the cliff beyond which the downward gradient of the land surface increases more or less continuously until it reaches the general gradient of the cliff. In a case where there is a step like feature at the top of the cliff face, the landward edge of the topmost riser shall be taken to be the cliff edge.

TYPE OF POLICY	JURISDICTION
Setbacks for Development on Blufftops and Sand Dunes **1f**	**<u>Mendocino County Coastal Element Hazards Policy 3.4-7</u>** The County shall require that new structures be set back a sufficient distance from the edges of bluffs to ensure their safety from bluff erosion and cliff retreat during their economic life spans (75 years). Setbacks shall be of sufficient distance to eliminate the need for shoreline protective works. Adequate setback distance will be determined from information derived from the required geologic investigation and from the following setback formula: Setback (meters) = Structure life (years) x retreat rate (meters/year) The retreat rate shall be determined from historical observation (e.g., aerial photographs) and/or from a complete geotechnical investigation.
Setbacks for Development on Blufftops and Sand Dunes **1g** **Setbacks for Development on Blufftops and Sand Dunes** **1g** **(cont'd)**	**<u>City of Encinitas Hazard Policy 1.6f</u>** The City shall provide for the reduction of unnatural causes of bluff erosion, as detailed in the Zoning Code, by:… Requiring new structures and improvements to existing structures to be set back…40 feet from coastal blufftop edge with exceptions to allow a minimum coastal blufftop setback of no less than 25 feet. For all development proposed on coastal blufftops, a site-specific geotechnical report shall be required. The report shall indicate that the coastal blufftop setback will not result in risk of foundation damage resulting from bluff erosion or retreat to the principal structure within its economic life and with other engineering evidence to justify the coastal blufftop setback. On coastal bluffs, exceptions to allow a minimum setback of not less than 25 feet shall be limited to additions or expansions to existing principal structures which are already located seaward of the 40 foot coastal blufftop setback, provided the proposed addition or expansion is located no further seaward than the existing principal structure, is set back a minimum of 25 feet from the coastal blufftop edge, and the applicant agrees to remove the proposed addition or expansion, either in part or entirely, should it become threatened in the future. In all cases, all new construction shall be specifically designed and constructed such that it could be removed in the event of endangerment and the applicant shall agree to participate in any comprehensive plan adopted by the City to address coastal bluff recession and shoreline erosion problems in the City This does not apply to minor structures that do not require a building permit, except that no structures, including walkways, patios, patio covers, cabanas, windscreens, sundecks, lighting standards, walls, temporary accessory building not exceeding 200 square feet in area, and similar structures shall be allowed within five feet from the bluff top edge… .

TYPE OF POLICY	JURISDICTION
Long Range Planning 2a	**City of Ventura, 15.9, BEACON Programs**: Continue to support the educational, legislative and research programs of the Beach Erosion Authority for Control Operations and Nourishment (BEACON). 15.9.1: Provide City support and/or sponsor new legislation to mitigate regional sand transport and supply impacts. 15.9.2: Provide City support for the acquisition of grant funds to conduct regional sand resource studies. 15.9.3: Provide City support for sand supply research programs, such as the California Storm and Tidal Wave Study conducted in San Diego County by the U.S. Army Corps of Engineers.
Long Range Planning 2b	**City of Imperial Beach, Policy S-11** The City should protect property by: **a)** Creating artificial dunes pursuant to SANDAG technical specifications. **b)** Developing a coastal shoreline protection device ordinance for the design and construction of seawalls and revetments. **c)** Developing erosion management measures such as irrigation controls, landscaping ordinances, and other measures suitable to the changing nature of the Imperial Beach shoreline. **d)** Working in coordination with SANDAG and other coastal cities in developing a regional beach replenishment program and continuing to implement the adopted "Shoreline Preservation Strategy for the San Diego Region."
Long Range Planning 2c	**City of Newport Beach LUP (1/9/90 version, p. 33) Visitor Serving Facilities section, Policy No. 1**: Proposals for the construction of anti-erosion structures, offshore breakwaters, or future marinas shall be examined in light of their potential ability to conflict with the City's mandate to preserve in its natural state the ocean beaches, water, surf action, and coastal shoreline in a manner that will ensure their availability for continued public use and enjoyment.
Long Range Planning 2d	**Marin County Policies 7 and 8, Shoreline Protection and Hazards** **7.** Because revetments, seawalls or other shoreline protective works can be detrimental to maintenance of natural shoreline processes and can interfere with visual enjoyment and coastal access, such works are discouraged. The County of Marin through the LCP and other documentation has identified those coastal areas potentially subject to significant wave and run-up erosion. **8.** It shall be County policy to encourage property owners subject to ocean-front erosion hazards to develop responses to such hazards prior to emergency conditions. Where contiguous properties are subject to generally similar erosion hazards, joint program development should occur.

TYPE OF POLICY	JURISDICTION
Long Range Planning **2e**	**<u>City of Encinitas Hazard Policy 1.7</u>** The City shall develop and adopt a comprehensive plan, based on the Beach Bluff Erosion Technical Report prepared by Zeiser Kling Consultants Inc., (dated January 24, 1994), to address the coastal bluff recession and shoreline erosion problems in the City. Said plan shall include, at minimum, components that deal with all the factors affecting the bluffs in Encinitas. These include, but are not limited to, minimum blufftop setback requirements for new development/redevelopment; alternatives to shore/bluff protection such as beach sand replenishment; removal of threatened portions of a residence or the entire residence or underpinning of existing structures: addressing bluff stability and the need for protective measures over the entire bluff (lower, mid and upper); impacts of shoreline structures on beach and sand areas as well as mitigation for such impacts; impacts of groundwater and irrigation on bluff stability; and, visual impacts of necessary/required protective structures. If a comprehensive plan is not submitted to, reviewed and approved by the Coastal Commission as an amendment to this land use plan by November 17, 1995, then no additions or expansions to existing structures shall be permitted on coastal blufftop lots except for minor additions or expansions that comprise no greater than a 10 percent increase above the existing gross floor area or 250 square feet whichever is greater, provided such additions/expansions are located at least 40 feet from the coastal blufftop edge, the addition /expansion is constructed in a manner so that it could be removed in its entirety, and the applicant agrees, in writing, to participate in any comprehensive plan adopted by the City to address coastal bluff recession and shoreline erosion problems in the City. In addition, until such a comprehensive plan is approved by the City of Encinitas and the Coastal Commission as an amendment to the LCP, the City shall not permit the construction of seawalls, revetments, breakwaters, cribbing, or similar structures for coastal erosion except under circumstances where an existing principal structure is imminently threatened and, based on a thorough alternatives analysis, an emergency coastal development permit is issued and all emergency measures authorized by the emergency coastal development permit are designed to eliminate or mitigate adverse impacts on local shoreline sand supply.
Public Access **3a**	**<u>City of Carpinteria, Policy D. 1.6</u>**: A bluff top hiking/biking trail corridor at least 20 feet in width, or wider if necessary to accommodate separated bikeway and pedestrian lanes or to accommodate constraints (such as existing vegetation, uneven terrain or ESHA buffers) shall be located so as to ensure that continuous trail access can be maintained over a period of time equivalent to the design life of proposed adjacent development (100 years). The necessary width of the corridor shall be based on the bluff retreat determined on a site-specific basis, pursuant to Policy A.1.1. **<u>A. 1.1</u>**: As part of any development proposed on the Bluffs that may be affected by coastal bluff retreat during the

TYPE OF POLICY	JURISDICTION
	design life span (100 years) of the development and, or which, by virtue of its proposed location may constrain potential relocation of public access or existing development including the railroad tracks subject to coastal rate of bluff retreat, the project applicant(s) will be required to submit geotechnical studies assessing the *site-specific rate of* bluff retreat. Geotechnical studies shall include the relevant geologic cross-section and shall calculate the bluff recession rate based on the most erodible portion of the bluff (generally, the marine terrace) and shall be performed by a qualified engineering geologist experienced in coastal process analysis. Structures shall be set back a sufficient distance so as to protect the structure from bluff retreat during its anticipated life span (100 years) and so as to protect bluff top coastal access amenities and existing development including any future need to relocate *the railroad tracks* located between the proposed development and the bluff edge for an equivalent life span (100 years), to the maximum extent feasible and to avoid the installation of shoreline protective devices on the beach and bluff. Open space and/or active and passive recreational uses (e.g., trails) are the only acceptable uses located within this setback with the exception of existing development, such as railway transportation.
Public Access **3b**	**Carmel Area of Monterey County Specific Policies 2.7.4.10, pg. 38** Revetments, groins, seawalls, or retaining walls, and other such construction that alters natural shoreline processes shall be permitted only where required for the protection of existing development. These structures shall not impede lateral beach access and shall respect, to the greatest degree possible, natural landform and visual appearance.
Public Access **3c**	**City of Santa Barbara Marine Resources Policy 6.5** seawalls, revetments, bulkheads and all other permitted structures shall not encroach upon any beach area to a degree which impedes lateral access along the beach at any tide condition.
Public Access **3d**	**Marin County LUP, Policy 4** Construction of shoreline protection measures otherwise permitted by LCP policies shall accommodate previously existing shoreline access.
Public Access **3e** **Public Access** **3e** **(cont'd)**	**Del Monte County LCP/Zoning Ordinance C. 1 and LCP Policy 11** **C. Lateral Access** **1.** New development along the immediate shoreline shall provide lateral access by access easements along the shoreline, inland of the mean high tide to the first line of vegetation or to the crest of the paralleling bluff in areas of coastal bluffs. No permit shall be issued for a project which obstructs lateral access on the immediate shoreline, inland of the mean high tide to the first line of vegetation, or the crest of the paralleling bluff. Exceptions to these requirements would be for the placement of navigational aids or shoreline protective devices to protect existing structures (i.e.,

TYPE OF POLICY	JURISDICTION
	Section 21.35.040(B) (2). **11.** No permit shall be issued for a project which obstructs lateral access on the immediate shoreline, inland of the mean high tide line to the first line of vegetation, or the crest of the paralleling bluff. The exception would be for the placement of navigational aids or shoreline protective devices to protect existing structures, i.e., houses, roadways, and parking areas.
Existing Development **4a**	**Santa Barbara County, Seawall and Shoreline Structures, Policy 3.1**: Seawalls shall not be permitted unless the County has determined that there are no other less environmentally damaging alternatives reasonably available for protection of existing principal structures. The County prefers and encourages non-structural solutions to shoreline erosion problems, including beach replenishment, removal of endangered structures and prevention of land divisions on shorefront property subject to erosion; and, will seek solutions to shoreline hazards on a larger geographic basis than a single lot circumstance. Where permitted, seawall design and construction shall respect to the degree possible natural landforms. Adequate provision for lateral beach access shall be made and the project shall be designed to minimize visual impacts by the use of appropriate colors and materials.
Existing Development **4b**	**City of Santa Barbara, Policy 6.3** **Policy 6.3**: Seawalls, revetments and bulkheads shall not be permitted unless the City has determined that they are necessary to, and will accomplish the intent of protecting existing principal structures, and that there are not less environmentally or aesthetically damaging alternatives such as relocation of structures, sand augmentation, groins, drainage improvements, etc. Determinations permitting such structures shall be based upon the findings and recommendations of geology, soils and engineering reports prepared by licensed and registered professionals in those fields.
Existing Development **4c**	**San Mateo County, Hazards Component, Policy 9.12**: Limited Protective Shoreline Structures: **a)** Permit construction of shoreline structures such as retaining walls, groins, revetments, and breakwaters only in accordance with the following conditions when: (1) necessary to serve coastal-dependent uses, to protect existing development, or to protect public beaches in danger of erosion, (2) designated to eliminate or mitigate adverse impacts on local shoreline sand supply, and (3) non-structural methods (e.g., artificial nourishment) have been proved to be infeasible or impracticable. **b)** Protect existing roadway facilities which provide public access to beaches and recreational facilities when

TYPE OF POLICY	JURISDICTION
	alternatives routes are not feasible and when protective devices are designed in accordance with the requirements of this Component and other LCP policies.
Historical Background/ Basis for Limiting Shoreline Structures 5	**City of Santa Barbara:** Water and Marine Resources section re: Dredging Activities and Seawalls, pg. 3–67 ff. Dredging activities are of major significance for the City's shoreline. Development of the Harbor beginning in the late 1920s, while providing facilities for the commercial fishing industry and recreational opportunities for generations of local citizens and visitors, was achieved not without environmental costs. Serious problems associated with sand accretion and beach erosion occurred from he outset. The littoral transport of beach sand was arrested by emplacement of the Breakwater. Sand impoundment occurs within the Harbor for the same reason. The sand that deposits at the Harbor site would, if not removed, accumulate to the point of filling in the Harbor. Downcoast beaches have never fully recovered from the initial blockage of easterly sand-movement. Replenishment of sand for beaches to the east is dependent upon Harbor dredging efforts. Without this artificial nourishment, downcoast beaches are exposed to wave attack and shoreline erosion ensues. Sand is normally transported downcoast by the longshore current and deposited by the energy-generating forces of wave refraction. This phenomenon of littoral drift is limited to the breaker and near-breaker zones. Thus, when shoreline structures, such as breakwaters and groins, intercept the littoral drift and curtail sand supply, artificial nourishment becomes imperative…
Hazard Area 6a	**San Luis Obispo County, Hazards Policy 7**: The GSA combining designation in coastal areas of the county is amended to include all coastal bluffs and cliffs greater than 10 feet in vertical relief and that are identified in the Assessment and Atlas of Shoreline Erosion (DNOD, 1977) as being critical to future or present development. Maps clearly distinguish the different geologic and seismic hazards which the county covers by the GSA combining designation. These hazards shall include steep slopes, unstable slopes, expansive soils, coastal cliff and bluff instability, active faults, liquefaction and tsunami. [THIS POLICY SHALL BE IMPLEMENTED BY DESIGNATING GSA AREAS ON THE COMBINING DESIGNATION MAPS AND PURSUANT TO SECTION 23.07.080 OF THE CZLUO.] **San Luis Obispo County Coastal Zone Land Use Ordinance (CZLUO), Section 23.07.080, Geologic Study Area (GSA):** A Geologic Study Area combining designation is applied by the Official Maps (Part III) of the Land Use Element, to areas where geologic and soil conditions could present new developments and their users with potential hazards to life and property. These standards are applied where the following conditions exist:

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	. . . . **d. Erosion and stability hazard — coastal bluffs.** Areas along the coast with coastal bluffs and cliffs greater than 10 feet in vertical relief that are identified in the Coastal Erosion Atlas, prepared by the California State Department of Navigation and Ocean Development (1977), in accordance with Hazards Policy No. 7 of the Local Coastal Plan.
Hazard Area **6b**	**City of Sand City, Natural Hazards Policies,)** **4.3.10**: Encourage the clustering of developments away from potentially hazardous areas and condition project permits based upon recommendations presented in the geologic report. **a)** South of Bay Avenue, in no event shall the setback be less than 200 feet from the mean high water line. The mean high water line shall be established and adopted by the City as a part of the Implementation Plan for this area. **b)** An active recreation beach zone and public amenity zone shall be established between the mean high water line and the building envelope. Uses allowed in the active beach and public amenity zones are described in Policy 6.4.1 of this Plan. **4.3.11**: No development will be allowed in the tsunami runup zone, unless adequately mitigated. The tsunami run-up zone and appropriate mitigation, if necessary, will be determined by the required site-specific geological investigation. *Coastal Commission Staff Comment: These policies apply to a shoreline composed largely of sand dunes with little in the way of "typical" vertical coastal bluffs. Thus the 200 foot setback mentioned in a) should not be construed as applying to development on top of a " typical" vertical coastal bluff.*
Hazard Area **6c**	**San Mateo County, Hazards Component Policies**: **9.1 Definition of Hazard Areas** : Define hazardous areas as fault zones and land subject to dangers from liquefaction and other severe seismic impacts, unstable slopes, landslides, coastal cliff instability, flooding, tsunamis, fire, and steep slopes (over 30%) **9.2 Designation of Hazard Areas** : Designate hazardous areas in the Coastal Zone as those delineated on the Geotechnical Hazards Synthesis Map, the Floodway Boundary and Floodway Maps and Flood Insurance, Rate Maps adopted under Chapter 35.5 of the San Mateo County Zoning Regulations, and the Natural Hazards Map in the Natural Hazards Chapter of the General Plan.

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Hazard Area **6c** **(cont'd)**	**9.3 Regulation of Geologic Hazard Areas**: Apply the following regulations of the Resource Management (RM) Zoning Ordinance to designated geologic hazard areas: **a.** Section 6324.6 - Hazards to Public Safety Criteria **b.** Section 6326.2 - Tsunami Inundation Area Criteria **c.** Section 6326.3 - Seismic Fault/Fracture Area Criteria. Require geologic reports prepared by a certified engineering geologist consistent with "Guidelines for Geologic/Seismic Reports" (CDMG Notes #370 for all proposed development. **d.** Section 6326.4 - Slope Instability Area Criteria. **9.10 Geological Investigation of Building Sites**: Require the County Geologist or an independent consulting certified engineering geologist to review all building and grading permits in designated hazardous areas for evaluation of potential geotechnical problems and to review and approve all required investigations for adequacy. As appropriate and where not already specifically required, require site specific geotechnical investigations to determine mitigation measures for the remedy of such hazards as may exist for structures of human occupancy and/or employment other than those considered accessory to agriculture as defined in Policy 5.6. "Hazards areas" and "hazards" are defined as those geotechnical hazards shown on the current Geotechnical Hazards Synthesis Maps of the General Plan and the LCP Hazards Maps. A copy of the report of all geologic investigations required by the California Division of Mines and Geology shall be forwarded to that agency.
New Development **7a**	**Carmel Area of Monterey County, General and Specific Policies** **2.7.3.3**: New land divisions which create commitment to new or intensified development shall be approved only where it can be demonstrated that development of each proposed parcel and construction of the proposed access roads will neither create nor significantly contribute to erosion, geologic instability, flooding, or fire hazard, not require construction of new protective devices which would substantially alter natural landforms.
New Development **7b**	**San Mateo County, Hazards Component, Policy 9.11**: Locate new development (with the exception of coastal dependent uses or public safety recreational facilities) in areas where beach erosion hazards are minimal and where no additional shoreline protection is needed.
New Development	**City of Grover Beach, Marine Resource Areas, Sand Dunes, Policy 1**: No development shall be allowed in the vegetated dune areas; development adjacent to vegetated dunes shall be sited and designed to prevent impacts which

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7c	would significantly degrade the vegetated dunes. Retaining fences, walls, or other structures or earth moving activities shall be allowed only to protect existing structures.
New Development **7d**	**<u>Marin County, Unit 1, LCP Policies on Natural Dune and Sandy Beach Protection</u>** <u>Policy 20</u>: Development of other shorefront lots within the Stinson Beach and Seadrift areas shall assure preservation of the natural sand dune formations in order to protect environmentally sensitive dune habitat and vegetation and to maintain the natural protection from wave runup that such natural dunes provide. Where no dunes are evident, any new development on oceanfront lots shall be set back behind the first line of terrestrial vegetation to the maximum extent feasible, in order to minimize the need for protective works, to protect sandy beach habitat, and to provide a buffer area between private and public use areas in order to protect both the scenic and visual character of the beach, and the public right of access to the use and enjoyment of dry sand areas.
New Development **7d** **(cont'd)**	<u>**Policy 21**</u>: No additional subdivision of beachfront lots shall be permitted n recognition of the cumulative negative impacts such divisions would have on both public and private use of the beach, except if a finding is made that such a subdivision will be consistent with the above policy. Similarly, the erection of fences, signs, or other structures seaward of any existing or proposed development and the modification of any dune or sandy beach area shall not be permitted except as provided in Chapter III of the LCP in order to protect natural shoreline processes, the scenic and visual character of the beach, and the public and private use of dry sand areas in accordance with Section 30211 of the Coastal Act.
New Development **7e**	**<u>Malibu/Santa Monica Mountains, Bluff and Beach Erosion Policy 165</u>**: No further permanent structures shall be permitted on a bluff face, except for engineered stairways or accessways to provide beach access where no feasible alternative means of public access exists.
New Development **7f**	**<u>City of Encinitas Hazards Policy 1.6f</u>**: The City shall provide for the reduction of unnatural causes of bluff erosion, as detailed in the Zoning Code, by:... Requiring new structures and improvements to existing structures to be set back...40 feet from coastal blufftop edge with exceptions to allow a minimum coastal blufftop setback of no less than 25 feet. For all development proposed on coastal blufftops, a site-specific geotechnical report shall be required. The report shall indicate that the coastal blufftop setback will not result in risk of foundation damage resulting from bluff erosion or retreat to the principal structure within its economic life and with other engineering evidence to justify the coastal blufftop setback. On coastal bluffs, exceptions to allow a minimum setback of not less than 25 feet shall be limited to additions or

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	expansions to existing principal structures which are already located seaward of the 40 foot coastal blufftop setback, provided the proposed addition or expansion is located no further seaward than the existing principal structure, is set back a minimum of 25 feet from the coastal blufftop edge, and the applicant agrees to remove the proposed addition or expansion, either in part or entirely, should it become threatened in the future. In all cases, all new construction shall be specifically designed and constructed such that it could be removed in the event of endangerment and the applicant shall agree to participate in any comprehensive plan adopted by the City to address coastal bluff recession and shoreline erosion problems in the City This does not apply to minor structures that do not require a building permit, except that no structures, including walkways, patios, patio covers, cabanas, windscreens, sundecks, lighting standards, walls, temporary accessory building not exceeding 200 square feet in area, and similar structures shall be allowed within five feet from the bluff top edge… .
Emergency **8a**	**<u>Marin County Policies 7 and 8, Shoreline Protection and Hazards</u>** **7.** The County of Marin through the LCP and other documentation has identified those coastal areas potentially subject to significant wave and run-up erosion. **8.** It shall be County policy to encourage property owners subject to ocean-front erosion hazards to develop responses to such hazards prior to emergency conditions. Where contiguous properties are subject to generally similar erosion hazards, joint program development should occur.
Emergency **8b**	**<u>City of Encinitas, Section 30.34.020, Coastal Bluff Overlay Zone, Subsection E, Temporary Emergency Protection Devices</u>**: Notwithstanding other regulations of the City, the City Manager or his/her designee may permit the installation of temporary emergency protection/retention facilities (such as riprap, walls, erosion control devices, etc.) on or at the base of a coastal bluff if: **1.** Enclosed or principal buildings at the top of an ocean bluff are threatened by a potential bluff failure/collapse. **2.** The threat is imminent. A statement of a State-licensed engineer or engineering geologist establishing an imminent threat may be required if the City Engineer is not able to determine the imminent threat. **3.** Documentation shall be provided that the proposed temporary protection is the minimum necessary to address the emergency and to assure minimal encroachment onto sandy beach area. In addition, construction access and staging plans shall be submitted which document that no public beach parking areas will be utilized for the interim storage of materials or equipment and that overnight storage of equipment or materials will not be permitted on the sandy beach.
Emergency	**<u>San Luis Obispo County, Section 23.03.045, Emergency Permits, Coastal Zone Land Use Ordinance</u>**: The

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8c	purpose of this section is to establish procedures for the issuance of emergency permits in situations that constitute an emergency as defined by this section. Emergency permits may be granted by the Planning Director as provided by this section, in accordance with Section 30624 of the Coastal Act and Sections 13329 of Title 14 of the California Administrative Code. **a.** Emergency defined. For the purposes of this section, an emergency is a sudden, unexpected occurrence demanding immediate action to prevent or mitigate loss or damage to life, health, property or essential public services. **b.** Permit procedure. In cases of such emergency, the Planning Director may issue an emergency permit in accordance with the following provisions: **(1)** Applications in cases of emergencies shall be made to the Planning Director in writing if time allows, or by telephone or in person if time does not allow. . . . . **(6)** Within 30 days of the notification required in subsection b(1) of this section, the property owner shall apply for a land use permit as required by this title and any construction permits required by Title 19 of this code. Failure to file the applications and obtain the required permits shall result in enforcement action pursuant to Chapter 23.10 of this code. **(7)** The Planning Director shall not issue an emergency permit for any work to be undertaken on any tidelands, submerged lands, or on public trust lands, whether filled or unfilled; requests for emergency work in these areas shall be referred to the California Coastal Commission.
Regional 9	**BEACON (Beach Erosion Authority for Control Operations and Nourishment)**, a Joint Powers Authority among the cities of Carpinteria, Oxnard, Port Hueneme, Santa Barbara, and San Buenaventura (Ventura), and the counties of Santa Barbara and Ventura; please contact the Commission's Ventura office for further information.

Exhibit A

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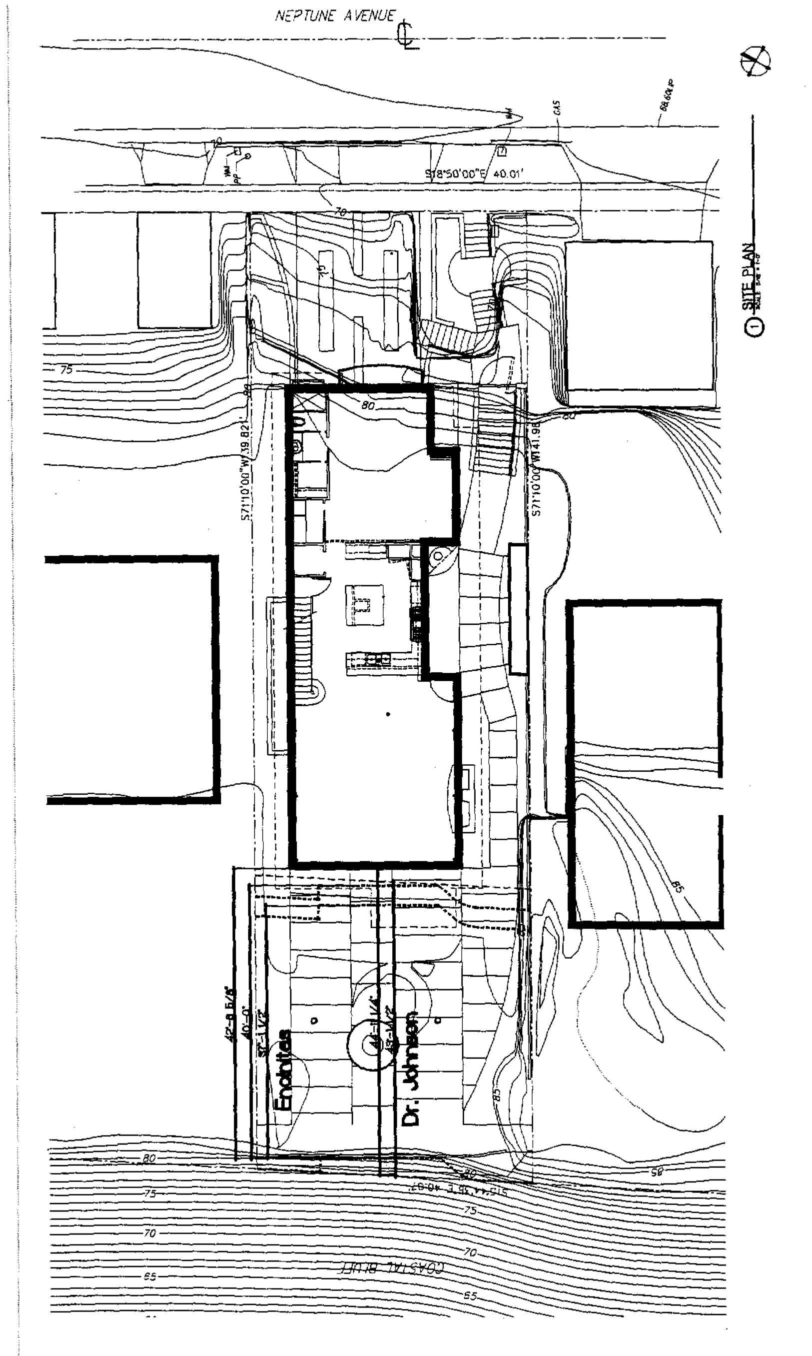
Exhibit E


NEPTUNE AVENUE
SITE PLAN
Encinitas
Dr. Johnson
COASTAL BLUFF