CALIFORNIA OCEAN PROTECTION COUNCIL

Staff Recommendation
May 15, 2008
SEA LEVEL RISE: COASTAL INFRASTRUCTURE AND RESOURCES IMPACT PROJECT

File No.: 08-067-01
Project Manager: Christine Blackburn

RECOMMENDED ACTION: Authorization to grant up to $350,000 to the Pacific Institute to conduct the Coastal Infrastructure and Resources Impact project to examine the economic value and number of people, structures, and resources that are potentially at risk due to future sea level rise.

LOCATION: Coastwide

STRATEGIC PLAN OBJECTIVE: Physical Processes and Habitat Structure

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EXHIBITS

Exhibit 1: Figure of relative economic loss in California from accelerated sea level rise

Exhibit 2: "Assessing the costs of adapting to sea-level rise: A case study of San Francisco Bay" (1990)

Exhibit 3: Example of an erosion envelop calculated for coastal Oregon

Exhibit 4: OPC staff recommendation from June 14, 2007

RESOLUTION AND FINDINGS:

Staff recommends that the Ocean Protection Council adopt the following resolution pursuant to Sections 35500 *et seq.* of the Public Resources Code:

"The Ocean Protection Council hereby approves the disbursement of an amount not to exceed $350,000 to the Pacific Institute to conduct the Coastal Infrastructure and Resources Impact project.

This authorization is subject to the condition that prior to disbursement of funds, the Pacific Institute shall submit for the review and approval of the Secretary to the Council a work plan, including schedule and budget."

Staff further recommends that the Council adopt the following findings:

"Based on the accompanying staff report and attached exhibits, the Council hereby finds that:

1. The proposed project is consistent with the purposes of Division 26.5 of the Public Resources Code, the Ocean Protection Act.
2. The proposed is consistent with the Ocean Protection Council's project funding guidelines."

PROJECT SUMMARY:

Climate-induced sea level rise poses a number of risks to coastal areas: flooding and damage to homes and buildings, changes to erosion rates, and the loss of beaches and wetlands. State and local managers need better data about what resources will be at risk if they are to plan and adapt to these changes. For the proposed project, the Pacific Institute will generate maps of coastal California showing several scenarios of future sea level rise and displaying existing and projected infrastructure, populations, and natural resources. Once these data layers exist in the same GIS map, the Pacific Institute will be able to show what structures and resources will be at risk from flooding and erosion. The scenarios for the project will be based on different climate projections for several different time horizons (e.g., high level of carbon emissions for 2100). In addition to showing inundation risk, the project will also include a second order assessment that will generate erosion envelopes – areas between the low and high estimates of future erosion based on rising sea levels and changing wave climates. The project will include an assessment of what resources lie within these envelopes and are therefore threatened by future erosion.

Project outcomes will be:

- GIS maps of potential inundation zones, flooding hazard areas, and erosion envelopes based on future climate change scenarios
- Estimates of the property value of existing public and private infrastructure and of existing populations that will be at risk from these impacts in the future
- Estimates of future infrastructure and populations, based on decadal projections, that will be at risk

The project report will present the value and type of infrastructure, number of people, and demographic breakdown of populations at risk under the different climate scenarios. It will also include the costs of expanding or maintaining existing infrastructure, the cost of protection, and will attempt to quantify the potential risk to wetlands. Finally, the report will outline potential policy options that describe how to plan for and mitigate these impacts.

PROJECT DESCRIPTION:

Project Background:

A number of national studies on the economic cost of sea-level rise impacts suggest that while adapting to climate change will be expensive, substantial investments are already at risk and vulnerable.[1] In 2001, the California Coastal Commission published a broad overview of the

[1] See, for example, Titus, J., R. Park, S. Leatherman, J. Weggle, M. Greene, S. Brown, C. Gaunt, M. Trehan, and G. Yohe, 1992: Greenhouse effect and sea level rise: the cost of holding back the sea. Coastal Management, 19, 219-

implications of sea level rise for the state.[2] The report showed that "the greatest losses are expected to occur where extensive urban infrastructure has been located on or near a beach, coastal bluff or harbor." (A figure from this report is presented in Exhibit 1.) This report, however, did not examine details within the regions of the coast and did not attempt to quantify these impacts.

Because the economic costs of flooding are highly site-specific, regional and local analyses are critical for guiding land-use decisions and evaluating adaptive strategies. A focused regional study of sea level rise for the San Francisco Bay was conducted in 1990 by Gleick and Maurer (Exhibit 2).[3] This analysis evaluated the economic impacts of a sea-level rise within the Bay and concluded that a one-meter sea-level rise would threaten existing commercial, residential, and industrial structures valued at $48 billion (in 1990 dollars). Building or strengthening levees and sea walls simply to protect existing high-value development was estimated to require an immediate capital investment of approximately $1 billion (in 1990 dollars)[4] and would require an additional $100 million per year in ongoing maintenance. The report also noted that substantial areas of the Bay, especially wetlands and marshes, were not likely to be protected and would likely be damaged or lost. A similar analysis for the open coastline of California has never been pursued.

Project Details and Scope of Work:

The Pacific Institute is preparing an update of this analysis under the California Energy Commission's Public Interest Energy Research (CEC PIER) program. This existing effort will incorporate improvements in data, changes in economic values, and new climate scenarios—but is primarily focused on the San Francisco Bay region. The additional funding requested from the OPC will allow the Pacific Institute to conduct a more detailed analysis of the open coastline, as well as include an assessment of infrastructure and resources at risk from erosion.

The study will use sea-level rise data and climate scenarios developed by Scripps Institution of Oceanography as part of the ongoing CEC PEIR project and funded by the OPC. These data will be used to produce a set of GIS data layers showing areas at risk of increased flood damage under various climate scenarios.

The economic value of threatened areas will be assessed based on available census, survey, or remotely sensed data. Pacific Institute will introduce a time component into the analysis to evaluate the rate at which sea level will rise and how property values and development will change. Pacific Institute will examine the costs of implementing adaptation strategies for high risk areas. The focus of the adaptation strategies will be on various physical alternatives for coastal protection (e.g., levees, seawalls, etc.) but will also assess the possibility of managed retreat or abandonment.

In some regions along the California coast, particularly near cliffs and coastal bluffs, erosion will

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233. Also see Yohe, G., J. Neumann, P. Marshall, and H. Ameden. 1996. The Economic Cost of Greenhouse-Induced Sea-Level Rise for Developed Property in the United States. Climatic Change, 32(4): 387-410.

[2] California Coastal Commission. 2001. "Overview of Sea Level Rise and Some Implications for Coastal California." San Francisco, CA (June 1, 2001).

[3] Gleick, P.H. and E.P. Maurer. 1990. "Assessing the costs of adapting to sea-level rise: A case study of San Francisco Bay." Pacific Institute for Studies in Development, Environment, and Security, Berkeley, California and the Stockholm Environment Institute, Stockholm, Sweden. 57 pp. with 2 maps.

[4] This estimate does not include the cost of protecting and restoring wetlands, groundwater aquifers, etc.

pose a much greater threat than inundation. To explore the relative importance of erosion and inundation in some areas, the Pacific Institute will partner with a team from Phillip Williams and Associates to compare the flood risk maps with a set of erosion envelopes showing the minimum and maximum extent of erosion impacts due to sea level rise given the likely range of climate change for selected areas (see Exhibit 3 for an example). The calculation of the erosion envelopes will be based on projections of sea level rise, changing wave climates, and wave run-up under different climate scenarios.

The level of detail examined will not be the same for all regions of the coast—the specific level of detail generated will depend on data availability. Some of the required digital data sets exist, but will need to be integrated to provide a comprehensive picture of existing infrastructure, while the digital data for other assets simply do not exist. The additional support from the OPC will permit the Pacific Institute to identify, collect, and incorporate these data to the greatest extent possible, and will allow detailed assessments in some key regions, such as Southern California and/or Monterey Bay.

Assuming data is available for each of these, the data layers that will be examined include:

1) Properties (residential, commercial, and industrial)
2) Populations (demographic breakdown; i.e., race, income, etc.)
3) Infrastructure (freeways, roads, ports, airports, power plants, wastewater facilities, etc.)
4) Wetlands
5) Coastal access points

The final product will include a report on the economic value of areas at risk from sea level rise and erosion, an assessment of various adaptation strategies, and an estimate of the cost of implementing these adaptation strategies. Environmental justice concerns will be an integral part of this discussion, including disproportionate local impacts and responses, and a discussion of who may pay for them.

This study will provide critical information for California and national policymakers as they begin to evaluate the costs of unavoidable climate changes and develop adaptation strategies. This information will help decision makers and the public understand and explore the potential risks over the coming decades, the scope and extent of the problem, and how and where to allocate funds for responding to climate change. New suggestions may emerge for how best to manage future coastal and shoreline risks. Additionally, suggestions for new data and methods for future assessments will be presented.

PROJECT GRANTEE:

The Pacific Institute is a 501(c)(3) research organization founded in 1987. The Institute is one of the world's leading independent, non-partisan organizations addressing the science and policy of water and climate change. The Institute combines high-quality research with effective communications and outreach to address the related problems of regional and global environmental degradation, unsustainable development, and political conflict. A major focus of the Institute's efforts has been evaluating the consequences of climate change for California, with a focus on water resources. The Institute did the first assessment of the impacts of sea level rise on the infrastructure of San Francisco Bay in 1990, including an economic assessment of the costs of adaptation. The Institute is known for independent, innovative thinking that cuts across

traditional intellectual disciplines and political boundaries.

The Pacific Institute is a member of the CEC's PEIR climate change research group, which is conducting research on future climate change impacts for all sectors statewide. Tasking them to complete this more comprehensive study of the coastline will ensure that their results benefit not only the work of the OPC, but also continue to inform other statewide projects related to climate change and adaptation.

The Pacific Institute will partner with Philip Williams and Associates (PWA) to generate the erosion envelopes for the coastline. PWA is a consulting firm whose mission is to achieve the protection, enhancement, and restoration of water-dependent ecosystems. The geologists on staff at PWA have extensive knowledge of coastal processes in California and have conducted similar erosion projections for coastal Oregon.

SITE DESCRIPTION:

The assessment will include the full coastline of the state excluding the San Francisco Bay (assessments of the Bay are being conducted by the Pacific Institute under a different grant from the CEC PEIR project). The level of detail provided for specific areas along the coast will depend on the staff's ability to access GIS layers of interest from a variety of different sources.

PROJECT HISTORY:

In June 2007, the OPC approved funding for Scripps Instititution of Oceanography to derive future sea level rise scenarios for California directly from climate model simulations. The Scripps research group, who are completing hourly sea level projections from present day to 2100 for key index stations along the California coast along with wave predictions and run up, will provide their scenarios as the basis for the proposed impacts project. Data from both of these studies will be incorporated with the other projects currently being funded by the CEC PEIR program. All data will be synthesize in scientific papers as well as in an update to the 2006 statewide *Our Changing Climate* report, published by the CEC.

In addition, OPC staff has been working with coastal management agencies and the Resources Agency to coordinate potential future policy actions and to draft a statewide adaptation plan focused on coastal impacts. The data from both of these projects will be critical for outlining the potential impacts to infrastructure, resources, and people and will inform proposed adaptation strategies. Staff anticipates bringing potential adaptation strategies to the OPC for discussion at the November 2008 meeting. The statewide adaptation plan, which will include several other sectors in addition to the coastal impacts, is scheduled to be completed by the end of 2008.

PROJECT FINANCING:

Ocean Protection Council	$350,000
Total Project Cost	**$350,000**

Staff anticipates using $350,000 of the Ocean Protection Council's tidelands oil funds, appropriated to the Secretary of Resources in the FY 04/05 budget for projects authorized

through the Ocean Protection Act. The Resources Agency has entered into an interagency agreement with the Coastal Conservancy to administer these funds on behalf of the Council.

These funds that will be used for this project are a part of a previous $400,000 authorization by the Council in June 2007 (Exhibit 4). The previous authorization, regarding climate change and sea level rise, was specifically focused on creating new data, reports, analyses, and decision tools useful for coastal managers. The staff recommendation stated the OPC staff would seek projects through a Request For Proposal process and bring resulting proposals back for Council approval. Following the June 2007 meeting, OPC staff realized that simply soliciting proposals would not result in projects that specially address the needs of the state. The proposed project is a result of staff working with experts that were already undertaking similar analysis in coordination with the statewide CEC PEIR study. Expanding these existing efforts will leverage funds and provide a better product for state and local managers.

CONSISTENCY WITH CALIFORNIA OCEAN PROTECTION ACT:

The Ocean Protection Act (Division 26.5 of the Public Resources Code) identifies the duties of the Council, which include coordinating activities of state agencies, establishing policies to coordinate the collection of scientific data related to the ocean, and recommending to the legislature changes in law or identifying changes in federal law (Pub. Res. Code Section 35615). The Ocean Protection Trust Fund authorizes the Council to fund projects and activities in aid of these responsibilities (Pub. Res. Code Section 35650(b)(1)).

The Coastal Infrastructure and Resources Impact Project will support the Council in its coordination of ocean policies and scientific data gathering activities. The project, if funded, will be the second study supported by the OPC that contributes to the climate change research program at the CEC. These data will be made available to all state agencies to use while considering future climate change adaptation strategies along the coast. In addition, the project will directly inform the work of the interagency coastal impacts working group—a team of state personnel and academic advisors who will be drafting the coastal impacts section of the statewide climate change adaptation plan.

In addition, Section 35650(b)(2) authorizes expenditure of Ocean Protection Trust Fund monies for projects that:

> (E) Allow for increased public access to, and enjoyment of, ocean and coastal resources, of those resources
>
> (G) Provide monitoring and scientific data to improve state efforts to protect and conserve ocean resources

This project will provide data that allow coastal managers to assess how public access and coastal resources might change in the future due to sea level rise and climate change. These data can inform adaptation strategies that can be implemented in the near term to ensure that people will be able to continue to enjoy California's coastal resources into the future.

CONSISTENCY WITH OPC'S STRATEGIC PLAN GOAL(S) & OBJECTIVE(S):

The proposed project is consistent with the Council's Five Year Strategic Plan by furthering goals and objectives related to physical processes and habitat structure. Specifically, the proposed project is consistent with Goal D, Objective 3a, "work with the Climate Action Team

to investigate the long-term impacts of sea level rise and develop statewide adaptive management policies that will help agencies deal with these impacts." The proposed study will focused on examining sea level rise and erosion impacts to both natural and manmade resources. The scope of these potential impacts will directly inform a statewide climate change adaptation plan. This plan will lay the foundation for statewide climate change policies and provide tools for agencies to incorporate climate change impacts into their projects and decisions.

CONSISTENCY WITH OPC'S PROJECT FUNDING GUIDELINES:

The proposed project is consistent with the OPC's Project Funding Guidelines adopted June 14, 2007, in the following respects:

Required Criteria

1. **Directly relate to the ocean and coast**: The project is directly focused on coastal resources and how those might change due to changing sea levels as a result of climate change.
2. **Support of the public:** The interagency sea level rise workgroup, which is organized by the OPC, has indicated that these data will be extremely useful to their departments as they discuss and implement adaption strategies along the coast.
3. **Greater-than-local interest:** The project scope is statewide and the findings and policy discussion will have statewide implications for management.

Additional Criteria

4. **Timeliness:** This project must start immediately so that the results can be incorporated into the other studies that are currently underway. In addition, the statewide adaptation plan is scheduled to be completed in late 2008 and these data will be a key component of informing that plan. In addition, funding this project now will allow overall cost savings since Pacific Institute will be able to build from work currently funded by the CEC PIER program.
5. **Innovation:** This will be the first study of its kind conducted in California. The data generated by this study will inform discussions among coastal managers, allowing them to consider a range of innovative solutions to future sea level rise impacts.
6. **Coordination:** This project is being conducted in coordination with several other ongoing studies related to climate change, either funded by the OPC or the CEC PEIR program. Collectively these studies will provide a range of scenarios and impacts that all state agencies can use to individually or collectively assess future impacts and implement strategies to adapt to potential changes.

CONSISTENCY WITH OPC'S 2007/2008 FUNDING PRIORITIES

The topic of climate change was included as one of the priority areas for funding for 2007/2008. Specifically, funding should be expended to identify the types of policy changes California may need to adapt to sea level rise. To ensure that coastal managers implement adaptation strategies and other polices, they need to understand the scope of potential coastal impacts due to sea level rise. Most coastal management agencies are poised and ready to consider climate change and sea

level rise in their decisions, however, understanding the magnitude and range of potential impacts will help to ensure that appropriate strategies are pursued.

COMPLIANCE WITH CEQA

The proposed project is categorically exempt from review under the California Environmental Quality Act ("CEQA") pursuant to 14 Cal. Code of Regulations Section 15306 which exempts projects that involve only data collection, research and resource evaluation activities that will not result in a serious or major disturbance to an environmental resource and which may lead to a project which the Council has not approved, adopted or funded. Staff will file a Notice of Exemption upon approval by the Council.