

**California Coastal Commission**  
**Climate Change and Research Considerations**  
September 29, 2008

INTRODUCTION

Global warming and climate change have the potential to impact and dramatically alter marine and terrestrial resources along California's 1,100 mile-long coastline. The California Coastal Act of 1976 (Coastal Act), establishing the California Coastal Commission (Commission) as a permanent state agency with mandates to, among other things, protect and enhance public access, recreation, wetlands, visual resources, agriculture, commercial and industrial activity, and environmentally sensitive habitats within the coastal zone for the benefit of current and future generations.

The Coastal Act requires all public agencies, most especially the Commission and local governments, to minimize threats to coastal resources and to adopt land use and transportation strategies that minimize energy consumption. The Coastal Act therefore establishes important mechanisms and mandates, both for adapting to the effects of climate change and for mitigating greenhouse gas emissions. With respect to adaptation, the Coastal Act requires (1) minimization of hazards to new development from flooding and erosion; (2) protection of estuaries, wetlands, and other environmentally sensitive habitat areas; (3) protection and promotion of ports and other coastal-dependent activities; and (4) protection of public recreational resources such as beaches. With respect to mitigation, the Coastal Act requires new development to minimize energy consumption and vehicle-miles-traveled, and mandates a variety of "smart growth" strategies, including concentration of development in already developed areas and promotion of non-automobile-dependent patterns of development. Through the adoption of Local Coastal Programs (LCPs) and the review of coastal development permit applications, local governments play a vital role in implementation of these Coastal Act mandates. The following areas of research are crucial to assist the Commission, local governments, and other public agencies in effectively implementing these requirements, which are an essential component to a comprehensive State response to climate change.

OVERVIEW OF EXISTING AND ANTICIPATED CLIMATE-RELATED EFFORTS

The Commission and staff have been concerned for many years about climate change and predictions for changes to the coast. In 1989, the Commission prepared a draft report on "Planning for an Accelerated Sea Level Rise along the California Coast" and in 2001 issued a follow-up report: "Overview of Sea Level Rise and Some Implications for Coastal California." In 2006, Commission staff formed an internal Climate Change Task Force (CCTF), consisting of staff from various divisions and with diverse interests and expertise in climate issues. On Thursday December 14, 2006, the CCTF facilitated a Commission workshop, including presentations by Assembly Member Fran Pavley, Dr. James Berry and Dr. Susanne Moser and covering the main issues with AB 32 (California's Global Warming Solutions Act of 2006): the marine resource impacts from global climate change and awareness and responsiveness of local governments to coastal issues related to climate change. Staff also outlined the numerous Coastal Act policies that support taking action to reduce greenhouse gases and to adapt to the effects of climate change. (For workshop materials see: <http://www.coastal.ca.gov/meetings/mtg-mm6-12.html>).

The Commission staff is completing development of an informational web site that will focus on climate change, the specific challenges it poses to California and other coastal areas, and the Coastal Act policies that provide the foundation for the Commission to consider climate change as part of its decision-making processes regarding development along California's coast. In early 2008, the Commission revised its permit fees and established a Green Building Fee Incentive Program that provides 40% discount on application fees for projects certified by the US Green Building Council's Leadership in Energy and Environmental Design at a gold level or equivalent Green Building certification. The Commission also commented to Land Use Subgroup of the Climate Action Team (LUSCAT) on the California Air Resources Board Scoping Plan.

The Commission anticipates initiating two additional climate-related efforts in 2009. The Commission has applied for funds from the federal Coastal Impact Assistance Program for a project: “Climate Change and the California Coastal Act – Rising to the Challenge: A Guide to Addressing Coastal Act Issues.” The project will develop resources for Commission staff, local governments and others to improve understanding of how to consider climate change in land use and planning decisions, using specific Local Coastal Plan updates and amendments and other projects as case studies. The Commission will also submit a proposal titled “Climate Change and the California Coastal Act - Rising to the Challenge: Planning and Partnering for Reduction, Mitigation and Adaptation” to the NOAA Coastal Services Center as part of the NOAA Coastal Management Fellowship Program. The Commission will be matched with a Fellow, who will work for two years focusing entirely on climate change issues related to the Coastal Act.

Commission staff has already also begun to actively incorporate the consideration of climate change in many of the Commission’s core functions, including: Local Coastal Plans and Coastal Development Permits. The CCTF is planning additional workshops on climate change to be presented at Commission meetings in coming months.

#### FUTURE CLIMATE RESEARCH NEEDS:

The Commission views its responsibilities related to climate change under the Coastal Act as twofold. As noted above, at the same time the agency is developing adaptation policies and strategies, it also must consider policies that contribute to mitigation. Information gained from the research identified below would enable the Commission to more specifically define and better understand the array of coastal impacts from climate change, while informing the Commission’s decisions and clarifying its role in anticipating and responding appropriately to those impacts. Because climate research is evolving, as new research answers some questions, more questions and research needs will likely be identified.

Climate research needs fall into at least the nine areas below. Just as research needs evolve, there is an evolution of research to application. To complement the identified research areas, the Commission will need resources to effectively bridge gaps between research, policy and application. This bridging effort is stated explicitly in some research needs, but as new research is developed, there will likely be a need for additional resources that will need to be identified in the future.

1. Shoreline Change, Coastal Processes, Physical Oceanography, and Meteorology: The Commission has permit jurisdiction for much of the state’s shoreline development as well as appeal jurisdiction for development between the first public road and the sea. This is the zone where coastal hazards such as coastal bluff retreat, shoreline erosion and coastal flooding are not only possible, but probable, which is why they are of great concern to the Commission and local jurisdictions. The Coastal Act requires that all new development be safe from geologic, flood and fire hazards. Some of main drivers for coastal erosion, flooding, and bluff instability are coastal processes, oceanographic conditions and weather. Climate change has the potential to dramatically modify these factors, so historic trends may no longer be adequate to anticipate future hazards. Additionally, the Coastal Act protects public beach access and recreation; however, seawalls and shoreline protection often threaten beach-related recreation. Research into changing coastal hazards and their likely impacts on coastal resources should be started now, especially since the process of applying research findings to development of practical and applicable policies will take time. Several research needs have been modified from Flick and Bromirski’s “Sea Level and Coastal Change” prepared for the Energy Commission, August 25, 2008.

- Prepare simple coastal flooding maps at various scales for the state, for a range of future sea level rise scenarios, different tidal data, and various storm surge and river flow conditions.
- Develop and implement systematic, state-wide coastal storm monitoring protocols to identify and record significant wave and storm conditions, maximum overtopping, run-up heights, beach erosion (both changes in sand volume and in beach width), and wave-induced bluff erosion to

determine which coastal locations are most vulnerable to future sea level rise. Maintain storm survey data for access by researchers and develop outreach programs for local, regional and state agencies to incorporate analysis from survey results into ongoing hazard planning and adaptation efforts.

- Continue and expand upon studies of extreme coastal oceanographic and atmospheric conditions during previous large storm events and their probability of co-occurrence, with a focus on regional (100 km) scales; disseminate outreach information in reports and maps.
- Determine how best to characterize the near-shore wave environment and develop statewide, historical wave climatology on this basis that is easily available on the Internet. Scripps Institution of Oceanography's CDIP model is the ideal (and only available) platform for this purpose. Develop outreach efforts to local, regional and state agencies to appropriately incorporate historic trends into planning and adaptation for future hazard conditions.
- Continue, expand, and coordinate the existing LIDAR survey programs to systematically survey the entire California coast with sufficient regularity to establish baseline conditions, and identify episodic and chronic changes from and variations in the current baseline; develop outreach products such as reports, maps and digital displays.
- Continue and coordinate the existing local conventional beach survey data gathering operations and collect the data in a central place, accessible for use by other researchers, land use planners, and resource managers.
- Develop beach loss and cliff erosion predictions under various climate change scenarios that can be used to inform policy decisions for future coastal development.
- Research dune creation/restoration and the influences of rising sea level.
- Develop a model relating increase in long-term bluff retreat rate to sea level rise.
- Develop adaptation guidance for new and existing coastal-dependent uses, such as desalination facilities, where intake and discharge wells must be adjusted to changing water levels and shoreline position; what site-specific information will be needed at the siting phase and what technological options can be included in the design phase to insure project longevity during a time of potentially rapid climate and shoreline change.

2. Recreation and Beach Access: Changes in coastal processes and erosion areas will alter current recreation and beach access patterns. While expansion of shoreline armoring may protect backshore areas from ongoing erosion and bluff retreat, it will also reduce available access and threaten beach-related recreation. Research is needed to understand, quantify and identify strategies that address the potential long-term loss of valuable public open space and recreational amenities:

- Inventory and map of both lateral and vertical accessways that can be overlain upon maps of shoreline erosion and beach loss that may occur with different levels of sea rise.
- Consider importance of allowing ambulatory easements and acquiring inland lateral accessways to provide for loss of lateral (i.e. along the shore) shoreline access due to sea level rise.
- Designs for vertical accessways that can adapt to changing bluff conditions.
- Overlay the Coastal Trail on coastal flooding maps noted in Shoreline Change; identify impacts to this state resource; determine vulnerabilities and examine possible options for re-routing and adapting to changing sea level and coastal erosion.
- Overlay key transportation infrastructure (such as Highway 1, US 101) on coastal flooding maps noted in Shoreline Change to identify threats to continuity of these routes in present locations.

3. Ecosystem and Habitat Shifts: Global temperature increases from 2.5° to 10.4°F (1.4° to 5.8°C) are predicted by 2100, with warming in the United States expected to be higher. Ecosystem consequences of this warming trend include sea-level rise that will inundate beach, dune, and wetland habitat areas; changes in precipitation patterns; increased risk of flooding, fires, and droughts; habitat loss; shifts in species distributions, and loss of biodiversity. Early research indicates that the make-up of natural communities may dramatically change due to changes in temperature and precipitation. In some cases

changes have occurred already as species that have historically inhabited the same ecosystem react differently, i.e. migrate in different directions. Approximately 20-30% of plant and animal species assessed so far are likely to be at increased risk of extinction if increases in global average temperature exceed 2.7° to 4.5°F (1.5° to 2.5°C).<sup>1</sup> The Commission, ecologists, public trust agencies that own and manage wildlife habitat, and conservation practitioners are all grappling with how to recalibrate their strategies in the face of climate change. The Commission needs better information on habitat responses to climate change and areas of highest vulnerability to continue to protect coastal and marine resources.

- Easily updatable maps showing sea level rise under various climate change scenarios and locations of coastal squeeze – where sea level rise and existing development will squeeze out habitats such as beaches, coastal bluffs, dunes, and wetlands.
- Study of discharge from ocean desalination facilities with special attention on effluent pH, and evaluation of cumulative ocean acidification from current and proposed desalination plants.
- Assistance in focusing available and future research on habitat shifts so it can be used to inform coastal policy and application.
- Identification of the most vulnerable coastal habitats and species (state and federally listed species and CNPS 1B species) across the coastal zone. Projections for habitats and species under various climate change scenarios.
- Research extinction vulnerability under various climate change scenarios and assess both measures to avoid and prevent extinctions and means for allowing habitat shift (e.g. buffers, land purchases, freeway over and underpasses).
- Identify methods to promote and encourage species and habitat migration, such as migration corridors.
- Support coordination of efforts to map vulnerable biodiversity hotspots, coastal organisms occupying habitats at the edges of their ranges and optimal migration areas.
- Identify the state's most pristine and the most impacted watersheds and analyze potential impacts of various climate change scenarios to the state's watersheds. Such watersheds are extremely valuable and should be afforded high protection.
- Research impacts of increased fires on coastal habitats, identify what planning and permit tools can be used to reduce threat of fire or impacts of fire, and assist with post-fire restoration efforts.
- Research impacts of increased drought conditions and identify what planning and permit tools can be used to ameliorate drought impacts.
- Research impacts from increase in pests and invasive species under various climate change scenarios; evaluate response of invasive species to climate change and how their spread may interfere with natural habitat shifts.
- Studies of changes in vegetation patterns for coastal prairie, maritime chaparral, and oak woodland resulting from climate change, expanding upon the 2003 study of coastal sage scrub.<sup>2</sup> Such studies contribute to determinations of potential impacts of development on natural resources and support permit and LCP protection of coastal resources.
- Identify wetlands that are at risk of flooding and permanent inundation due to sea level rise or inadequate sediment supply. Identify ways to add sediment to wetlands for vertical accretion with sea level rise; identify pilot projects where experiments could be undertaken effectively.

4. Water Quality: The Commission addresses impacts of development on water quality pursuant to policies of the California Coastal Act and Coastal Nonpoint Source Pollution Control Program (Section 6217 of the Coastal Zone Act Reauthorization Amendments). Since 2000 the Commission has been a leader in implementing the state's Nonpoint Source Pollution Control Program in coordination with state

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<sup>1</sup> Intergovernmental Panel on Climate Change. April 2007. Special Report on Emission Scenarios

<sup>2</sup> Smith, J., and H. Galbraith. 2003. Climate Change and California Ecosystems: Potential Impacts and Adaptation Options. California Energy Commission: Sacramento. 1-16

water pollution control agencies. State and federal agencies rely on implementation of approved technological solutions (Best Management Practices or BMPs) to protect coastal water quality, since the application of quantitative discharge standards to all sources of polluted runoff is impractical. As such the designs of BMPs are based on pollutants typical of certain land uses and long term records of precipitation rates and estimated runoff volumes. With predicted changes to rainfall timing, duration and intensity, research will be needed to redesign BMPs to effectively protect water quality. For example, if rainfall patterns change so that storms are less frequent, but more intense, it may be necessary to increase the size of BMPs designed to hold water for a specific time in order to accomplish effective treatment.

- Assessment of all currently applied BMPs to identify design changes needed to address future hydraulic and hydrologic conditions.
- Periodic evaluation of hydraulic or hydrologic-sensitive BMPs to insure continued effectiveness, with special focus on hydro-modification management efforts.
- Assessment of the impacts of climate change on the amounts of pollutants that will be transported to coastal waters under various scenarios of BMP implementation.

5. Sequestration: Coastal forests, tidal marshes and wetlands are being considered for biological sequestration of carbon. To evaluate the effectiveness of these projects and the potential mitigation benefits from various restoration options, the Commission needs more information on biological sequestration:

- Evaluate ability of various ecosystems to sequester carbon; considering shifts in possible greenhouse gas emissions (such as methane or nitrous oxide).
- Develop predictive tools to quantify potential CO<sub>2</sub> sequestration in tons per acre per year for different wetland, vegetation, or, soil types, and geographic regions (northern, central or southern California) to determine sequestration benefits from various wetland restoration options.
- Survey of actions by other states and nations that are using natural systems for sequestration.

6. Green Building: Many opportunities for long-term greenhouse gas reduction and climate mitigation occur during the construction phase of development. Implementation of green building practices in new development can influence climate change over the decades that the building is in use. Recognizing the importance of introducing green building practices into coastal development, the Commission has implemented the Green Building Fee Incentive Program. Research in support of Green Building includes:

- Database of the green building policies and practices implemented by local governments in the coastal zone and development of LCP policies that can be used to promote broader implementation of effective green building efforts appropriate to the coast.

7. Smart Growth: The Coastal Act incorporates many of the fundamental principles of smart growth, such as the concentration of new development in or adjacent to already developed areas; the protection of agricultural lands, environmentally sensitive habitat, and recreational resources; the minimization of vehicle miles traveled and energy consumption; and the encouragement of public transit and other non-automobile dependent modes of transportation. In order to accomplish these objectives and meet CEQA obligations, the Commission and local governments need better information to assess transportation- and energy-related effects of new development. Because most current traffic modeling is based on the assumption that most travel will be by automobile, it is ill-suited for evaluating either the transportation impacts of development that are attempting to reduce automobile dependence or for evaluating the effectiveness of strategies to minimize traffic generation.

- Tools to evaluate the transportation and energy demands associated with different types, patterns, and locations of development.

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- Identify effective strategies for minimizing vehicle miles traveled and energy consumption for different types, patterns and locations of development.
- Develop tools to quantify values of smart growth practices for coastal development.
- Survey of other states and nations that are using smart growth for climate mitigation.
- Mapping of areas where smart growth practices have the highest (and lowest) potential for success.

8. Alternative Energy: California utilities will be including alternative and renewable energy systems into their energy portfolios to meet emission goals set by AB 32. Wave energy, tidal power and offshore wind farms are all being considered and yet little information exists about how these systems will impact coastal resources. The Commission will need to examine a variety of alternative energy systems in the coming years, and will need information on the possible environmental impacts that can occur:

- Noise outputs from various mechanical systems, both new systems and systems that have been in operation for several years, and how marine species will respond to this new potential stressor.
- Impacts from sub-sea DC power cables.
- Study of wave energy and the potential to alter coastal processes due to the resulting drop in nearshore wave energy; alteration in sediment transport patterns if wave energy systems reduce “summer” season wave energy critical for beach build-up while having minimal impact on “winter” season wave energy that carries sediment offshore.
- Evaluate potential biological and visual impacts from wind “farms” and possible mitigation strategies to avoid and/or minimize these impacts.
- Evaluate strategies to minimize impacts of once-through cooling systems.
- Evaluate potential impacts of increased nuclear power generation plants along the coast, and risks associated with sea level rise.

9. Policy Research: The Coastal Act sets forth specific mandatory statewide policies to guide coastal development. Each coastal jurisdiction is required to develop an LCP (a land use plan and implementing ordinances) that is consistent with and adequate to carry out these policies. Once certified by the Commission as meeting requirements of the Coastal Act, most coastal permit authority is delegated to the local jurisdiction under the terms of the LCP. However, the Commission has continuing responsibilities. The Commission continues to issue permits in areas without a certified LCP and also retains permanent permit authority in certain areas (e.g. tidelands, submerged lands and trust lands). Additionally, the Commission monitors and evaluates - and hears appeals resulting from - local coastal permit decisions and also certifies any amendments to existing LCPs. Because LCPs are essential to the implementation of state requirements at the local level; it is critical that they be updated to reflect new science, new coastal management techniques and measures to address impacts of climate change.

- Identify which LCPs have adequate policies, in need of update and material for those updates.
- Research examples of policies and ordinances that implement measures to avoid and mitigate impacts of climate change that can provide guidance for local governments.
- Survey of other states and nations that are using land use policies for climate change mitigation or adaptation and the effectiveness of these methods.

In conclusion, the Commission appreciates this opportunity to provide input into the research needs for the State. The Commission staff would like to participate in any process and on any interagency teams evaluating and prioritizing the research needs identified by state and local agencies.