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State of California Sea-Level Rise Guidance

2018 UPDATE



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Executive Summary

THE CLIMATE ACROSS CALIFORNIA

is changing, and the effects, such as rising average temperatures, shrinking mountain snowpack, more intense storms, and higher sea levels are expected to continue and worsen in the coming decades. Sea-level rise is caused by the thermal expansion of warming ocean water and melting of land ice as the Earth warms. It is one of the most obvious manifestations of the trend of climate change and is an immediate and real threat to lives, livelihoods, transportation, economies, and the environment in California.

In April 2017, catalyzed by direction from Governor Brown and the need to ensure that best available science was informing sea-level rise planning decisions in California, a Working Group of the California Ocean Protection Council's Science Advisory Team (OPC-SAT) released a report, entitled "Rising Seas in California: An Update on Sea-Level Rise." The Rising Seas Report was prepared and peer-reviewed by some of the nation's foremost experts in coastal processes, climate and sea-level rise science, observational and modeling science, the science of extremes, and decision-making under uncertainty. The report synthesized the current state of sea-level rise science, including advances in modeling and improved understanding of the processes that could drive extreme global sea-level rise as a result of ice loss from the Greenland and Antarctic ice sheets. The report found that:

- Scientific understanding of sea-level rise is advancing at a rapid pace.
- The direction of sea-level change is clear; sea levels are rising.
- The rate of ice loss from the Greenland and Antarctic ice sheets is increasing, and California

is particularly vulnerable to sea-level rise caused by ice loss from West Antarctica.

- New scientific evidence has highlighted the potential for extreme sea-level rise.
- Probabilities of specific sea-level increases can inform decisions.
- Current policy decisions are shaping our coastal future.
- Waiting for scientific certainty is neither a safe nor prudent option.

The increased understanding of sea-level rise projections and polar ice sheet loss warranted an update to the State's sea-level rise guidance document to ensure decisions were based on the best available science. Additionally, an increased policy focus requiring state and local governments to incorporate climate change into decision making merited an update to address the needs of both state and local audiences.

This updated document, the "State of California Sea-Level Rise Guidance" (Guidance), provides a bold, science-based methodology for state and local governments to analyze and assess the risks associated with sea-level rise, and to incorporate sea-level rise into their planning, permitting, and investment decisions. This Guidance provides:

1. A synthesis of the best available science on sea-level rise projections and rates for California;
2. A step-by-step approach for state agencies and local governments to evaluate those projections and related hazard information in decision making; and
3. Preferred coastal adaptation approaches.

What Has Changed Since the 2013 Update to the Guidance?

New policy context and expanded audience

State agencies were the target audience for the earlier versions of this Guidance, which was initially developed in 2010 and updated in 2013. However, over the past five years, there has been a multitude of policy and legislative directives and mandates focused on improving climate adaptation and resiliency in California at both the state and local level, including:

- Governor Brown's Executive Order B-30-15 directing state agencies to factor climate change into their planning and investment decisions;
- Senate Bill 379 (Jackson) requiring local governments to incorporate climate adaptation and resiliency strategies into their General Plans; and
- Senate Bill 246 (Wieckowski), which established the Governor's Office of Planning and Research's Integrated Climate Adaptation and Resiliency Program to coordinate local and state climate adaptation strategies.

With this increased policy direction and improved understanding of possible impacts, the 2018 Guidance aims to respond to the needs for guidance that can help cities, counties and the State prepare for, and adapt to, sea-level rise.

Significant advances in the scientific understanding of sea-level rise.

- Scenario-based versus probabilistic sea-level rise projections. The 2013 version of the State's sea-level rise guidance provided scenario-based sea-level rise projections based on a 2012 National Research Council report; these scenario-based projections were partially but not fully tied to specific emissions scenarios presented in the Intergovernmental Panel on Climate Change's Fourth Assessment Report and do not include a likelihood of occurrence. Since the 2013 Guidance, the scientific community has made significant progress in producing probabilistic projections of future sea level rise, and the team of scientists advising the Ocean

Protection Council (OPC) on this Guidance strongly recommended that decision-makers use probabilistic projections to understand and address potential sea-level rise impacts and consequences. This updated Guidance thus incorporates probabilistic sea-level rise projections, which associate a likelihood of occurrence (or probability) with sea-level rise heights and rates, and are directly tied to a range of emissions scenarios.

- H++ scenario. The probabilistic projections may underestimate the likelihood of extreme sea-level rise (resulting from loss of the West Antarctic ice sheet), particularly under high emissions scenarios. Therefore, the 2018 update to the Guidance also includes an extreme scenario called the H++ scenario. The probability of this scenario is currently unknown, but its consideration is important, particularly for high-stakes, long-term decisions.

The science on sea-level rise will continue to evolve, possibly significantly, in coming years. Continual updates to our scientific understanding must be expected as observations and models improve, and as the environment continues to change. Planners should remain cognizant of this evolving picture, while at the same time beginning to plan today under this uncertainty. This Guidance is based on the recognition that it is no longer appropriate to assume a static environment in planning and decision making and that communities can nonetheless effectively plan and take action in such changing conditions.

Extended stakeholder engagement in Guidance development.

The 2018 update to the Guidance was developed by OPC, in close coordination with a Policy Advisory Committee with representation from the California Natural Resources Agency, the Governor's Office of Planning and Research, and the California Energy Commission. To improve coordination and consistency in sea-level rise planning, OPC also collaborated closely with state coastal management agencies and other member agencies of the State's Coastal and Ocean Working Group of California's Climate Action Team (CO-CAT). In addition, OPC, with assistance from the Ocean Science Trust

and engagement experts, solicited input from coastal stakeholders including local governments, regional agencies, federal agencies, coastal consultants, environmental groups, Tribes, and others to better understand the needs and concerns related to planning for sea-level rise and related risks across the state.

Sea-level rise risk analysis and decision framework.

This Guidance provides a step-wise approach to help decision makers assess risk by evaluating a range of sea-level rise projections and the impacts or consequences associated with these projections. Depending on the finite factors of a proposed project's location and lifespan, decision makers can evaluate the potential impacts and adaptive capacity of the project across a spectrum of sea-level rise projections. This analysis will enable state agencies and local governments to incorporate the latest sea-level rise projections and related hazard information to consider in different types of decisions across California.

The following steps, outlined in the figure and in more detail below, provide a decision framework to evaluate the consequences and risk tolerance of various planning decisions. This framework should be used to guide selection of appropriate sea-level rise projections, and, if necessary, develop adaptation pathways that increase resiliency to sea-level rise and include contingency plans if projections are exceeded or prematurely reached:

>> STEP 1: *Identify the nearest tide gauge.*

>> STEP 2: *Evaluate project lifespan.*

>> STEP 3: *For the nearest tide gauge and project lifespan, identify range of sea-level rise projections.*

>> STEP 4: *Evaluate potential impacts and adaptive capacity across a range of sea-level rise projections and emissions scenarios.*

>> STEP 5: *Select sea-level rise projections based on risk tolerance and, if necessary, develop adaptation pathways that increase resiliency to sea-level rise and include contingency plans if projections are exceeded.*

Preferred Coastal Adaptation Planning Approaches.

This Guidance expands the preferred coastal adaptation planning approaches identified in OPC's previous guidance, incorporating existing law, expressed policy preferences by the Governor and Legislature, and the goal of fostering consistency across coastal and ocean government agencies. The following is a summary of the new recommendations:

- Adaptation strategies should prioritize protection of vulnerable communities and take into consideration social equity and environmental justice.
- Coastal habitats and public access should be protected and preserved.
- Adaptation strategies should consider the unique characteristics, constraints and values of water-dependent infrastructure, ports and Public Trust uses.
- Acute increases in sea-level rise caused by storm surges, El Niño events, king tides, or large waves should be considered. These events could produce significantly higher water levels than sea-level rise alone and will likely be the drivers of the strongest impacts to coastal communities, ecosystems, and infrastructure.
- Cross-jurisdictional coordination and consistency among permitting entities should be sought in selecting sea-level rise projections. These entities should also prioritize implementation of consistent or complementary adaptation strategies.
- Local conditions, including the diversity of shoreline types, natural conditions, and community characteristics, should be evaluated to inform risk tolerance and adaptation decisions.
- Adaptive capacity should be built into project design and planning.
- Risk assessment and adaptation planning efforts should be conducted at community and regional levels, when possible.

Mapping Tools.

This Guidance also describes and provides links to a variety of geospatial and visualization tools to assist decision makers in understanding the impacts of sea-level rise. The document is accompanied by a library and database of additional resources – hosted on the State Adaptation Clearinghouse and OPC's website – to help visualize change, access funding opportunities, gather policy and scientific background related to specific jurisdictions, and provide additional support to address a challenge of this nature and magnitude. This library and database will be released in mid-2018 when the State Adaptation Clearinghouse is publicly launched.

How Often Will the State of California Sea-Level Rise Guidance be Updated?

Based on recommendations from OPC's Scientific Working Group, OPC anticipates updating the Guidance periodically, and at a minimum of every five years, to reflect the latest scientific understanding of climate change sea-level rise in California. Rapid advances in sea-level rise and climate science, and subsequent release of relevant, peer-reviewed studies from the Intergovernmental Panel on Climate Change (IPCC), state and national climate assessments, and equivalently recognized sources may generate the need for more frequent updates. By incorporating periodic updates at least every five years, this Guidance attempts to establish a strong foundation for sea-level rise planning and decision making at both local, regional, and statewide scales that can be perpetuated in future updates to sea-level rise projections.

In developing this Guidance, the State took intentional action to engage users and decision makers to ensure that the scientific information and policy direction was understandable and useful for sea-level rise planning and adaptation efforts. Going forward, OPC will continue to prioritize opportunities for co-production of future decision-support products by scientists, practitioners, and policy and decision makers to further improve the translation of sea-level rise science into action.