October 26, 2013

To: Charles Lester and Susan Hansch
From: Gary Griggs

I have spent quite a bit of time reading through the Draft Sea-Level Rise Policy Guidance. Without question, like all Coastal Commission staff documents, it is extremely thorough, detailed, up-to-date, very well-written, and understandable, particularly if you are a scientist who deals with or is experienced in sea-level rise. It was obvious a major research and writing effort for those who put it together.

I have some concerns, however, about who this was written for, and if any of those who I would expect to be the primary users (the planners from 76 local governments) or those who will have to deal directly with this new development, had any input on this. It reads almost like a Ph.D. dissertation in being a document that tries to cover everything about sea-level rise globally, and along the California coast and its future impacts and how to assess those; but is not, at least in my opinion, a document that many if any planners will be able to understand or easily utilize. I don't think there are any incentives in this document that will encourage the staff planners that I have worked with in 4 different local government planning agencies to revise their LCPs. And I don't offer this critique lightly because it is an extremely important issue. But I believe there is a big disconnect between staff who prepared the document and those at the local government level who should be able to use it.

I sense a general approach throughout this document, to summarize somewhat roughly:

Here are the hundreds of things you have to do, here all of the numbers you need to come up with, and all the problems you have to solve, and all of the maps and projections you need to develop, althouogh we really aren't here to help you, but rather we are throwing out all of these challenges and requirements. Here is a long list of references, however, that may be of help if you can understand them.

This general issue came up in the last CCC meeting in Santa Cruz where the Commissioners, as I heard them on several issues, expressed that they expected the staff to be more engaged with applicants in helping them resolve issues or solve problems rather than presenting increasingly higher hurdles the applicants, or in this case, 76 local governments, need to jump over. I sensed that the Commissioners wanted staff to come with solutions worked out rather than making it so difficult for applicants, or local governments in the case of LCPs, that there is just another train wreck at the meeting. I keep asking myself, as I read through the fine detail and expectations and lists of requirements in this document, how are local government planning staffs ever going to complete these tasks? Who is going to help them? Where are they going to get the staff time or funds to hire expertise? What are the incentives? Who is this document really written for? Is this going to encourage local governments to update LCPs with sea-level rise in mind? I see an unfortunate and unnecessary disconnect here. I have to wonder if any local government planning staff were involved or consulted in the preparation of this report?

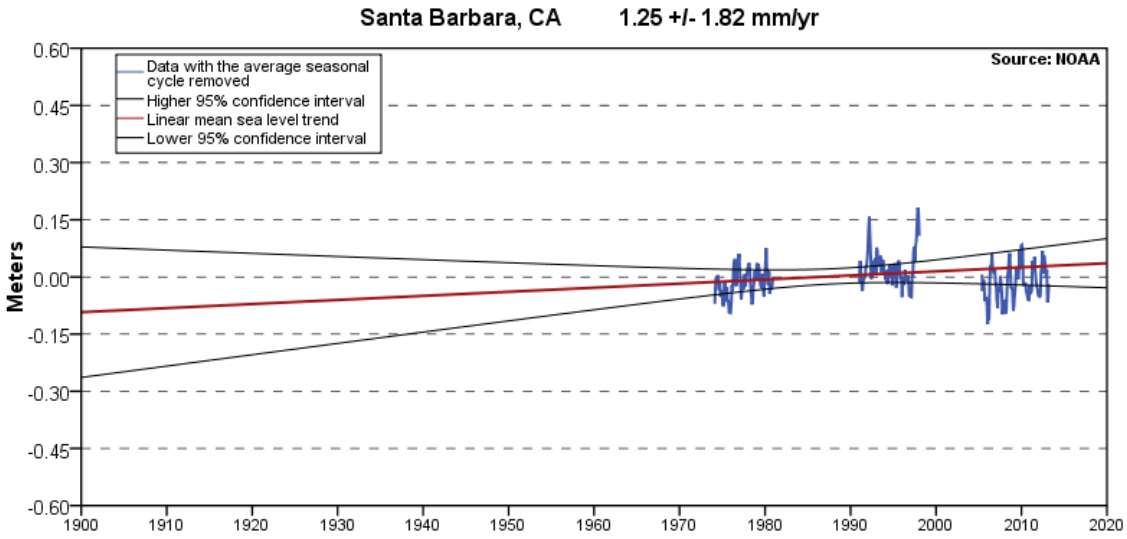
I hope you take this input in a positive way and the time I put into this is reflective of how important I think this issue is and this document can be.

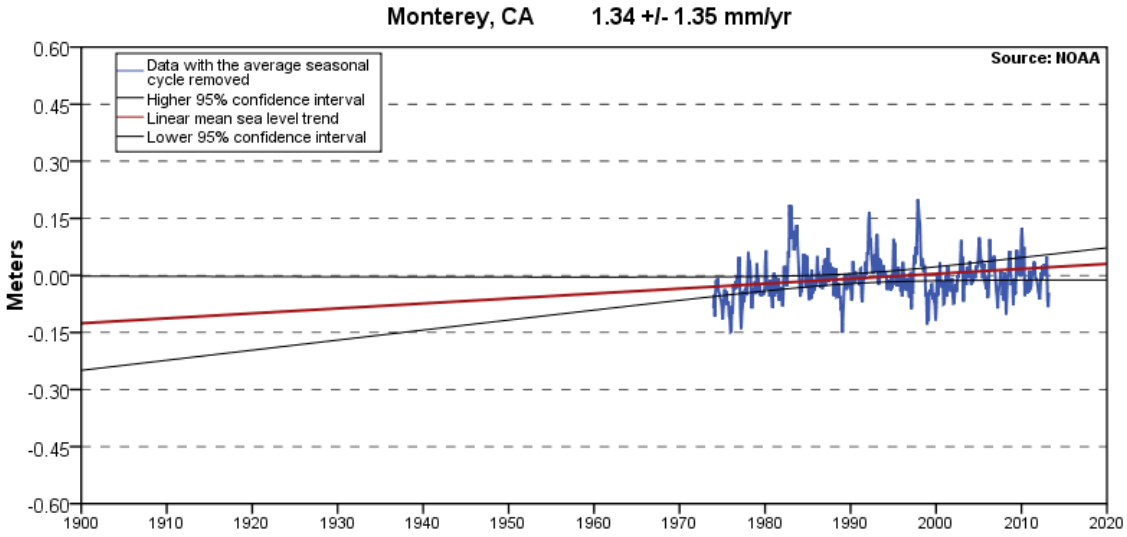
SOME SPECIFIC COMMENTS/QUESTIONS ON DRAFT DOCUMENT- and there could be a lot more specifics but I think the sense of my concerns will probably be clear from what is included, but I ran out of time. In each comment, I included the original passage or statement from the Draft Document in italics and my response in normal type.

P. 6-7. Determine a range of sea-level rise projections relevant to LCP planning area…

"Next, they should modify those projections to account for local conditions."

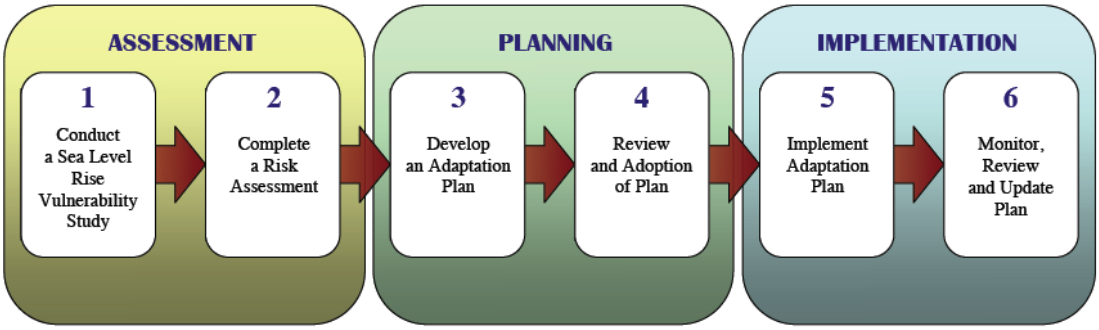
While this is an admirable goal, I think there are two very significant challenges to this goal and I've discussed this in detail later in my comments. 1) there are not enough tide gages along the California coast to provide more details on "local conditions", only 12 gages for 1100 miles of open coastline, or on average one every 90 miles, with some big gaps (Monterey to San Francisco, for example). 2) some of these have short records or discontinuous records (see records for Santa Barbara and Monterey gages below, for example), so modifying regional values is a huge task that very few people would be capable of. This is really asking users to fine-tune something that isn't precise to begin with, and will very likely be changing in the decades ahead. So unless you happen to have a tide gage nearby, where do you go to get data to modify projections for local conditions? This would be an excellent place to recommend the installation of additional tide gages so we can track sea level more locally. I also doubt that that any local planning departments have staff with the tools or skills to figure out how to account for local conditions (e.g. local leveling surveys, bench marks, etc.).





P. 8 and 10- Flowcharts

While I'm sure staff spent considerable time and effort developing these two graphics, I wonder how many people really use these or find them understandable. My first thought when I see flow charts like these is: way too complicated, very intimidating and user unfriendly. I don't think many people really have the patience to follow all of these arrows and try, like being in a maze, to find your way out. Figure 4 on page 38, in contrast, is straightforward and understandable, very similar to what we included in our Sea-Level Rise Adaptation Guide.



From: Adapting to Sea-Level Rise: A Guide for California's Coastal Communities.

P. 28. Under A. **A. BEST AVAILABLE SCIENCE ON SEA-LEVEL RISE**

"The Global Sea Level Rise Scenarios for the United States National Climate Assessment (2012) report provides a set of four global sea-level rise scenarios ranging from 0.2 to 2.0 meters (8 inches to 6.6 feet) reflecting different amounts of future greenhouse gas emissions, ocean warming and ice sheet loss."

It would be useful and important here to attach a date or time frame for these values (e.g. 2100) so there is no misunderstanding.

"*The intermediate-high scenario is based on the average of the high projections from semi-empirical models, which are based on the highest IPCC 4th Assessment Report (AR4) (2007)*

emissions scenario (A1FI)"
I'm sure CCC staff knows that the IPCC 5th Assessment Report is out now out, but may have decided not to get into this new document at this late stage? Not unexpectedly, the 5th Assessment projections are conservative (e.g. lower in this case than NRC Report). Going into the detail of which IPCC models produced which sea-level rise values is almost certainly going to be lost on the planners in every coastal community. They want a number or a range of numbers not an explanation of all of the different climate models and ranges. How does this mesh with the recommendation page 6-7 listed above on *"Next, they should modify those projections to account for local conditions."* What are the projections to use, for example?

In this regard, Figure 8 on page 113 is a great summary and will probably be as detailed as any user needs or wants and also provides the levels of uncertainty that need to be kept in mind.

P. 30. A. BEST AVAILABLE SCIENCE ON SEA-LEVEL RISE
"Areas north of Cape Mendocino could experience rapid subsidence of up to 2 meters (about 6 feet) when there is a large earthquake on this active subduction zone."
With a very large subduction zone earthquake and subsidence, there will also be a large tsunami that will raise sea level to a considerable height very quickly.

P. 31. B. PHYSICAL IMPACTS OF SEA-LEVEL RISE
There is an important impact missing here or not called out, and this same issue actually is more completely explained on P. 66-70 under **V. ADDRESSING SEA-LEVEL RISE IN COASTAL DEVELOPMENT PERMITS**

I believe that this language may go back to the original Coastal Act. There are four impacts listed on p. 31 all of which are valid:
1. **Flooding and inundation**
2. **Erosion**
3. Changes in sediment supply and movement
4. Saltwater intrusion

But a very significant additional impact included in discussion on page 39 and 66-70, which I believe has been responsible for more damage to public and private property over the past 30 years than any of these four is **Wave Impacts**. During the very damaging 1983 El Niño event, which was well documented in CCC reports as well as many others (including Griggs, G.B., and Johnson, R.E., 1983. THE IMPACT OF THE 1983 STORMS ON THE COASTLINE OF NORTHERN MONTEREY BAY, Calif. Geology 36: 163-174; Griggs, G.B. and Fulton-Bennett, K.W., 1987. FAILURE OF COASTAL PROTECTION AT SEACLIFF STATE BEACH, SANTA CRUZ COUNTY, CALIFORNIA, Envir. Manage.11: 175-182; Griggs, G.B., 1994. CALIFORNIA'S COASTAL HAZARDS, Journal of Coastal Research, Special Issue No. 12: 1-15; and Griggs, G.B., Patsch, K.B. and Savoy, L.E., 2005. LIVING WITH THE CHANGING CALIFORNIA COAST (book). University of California Press: 540pp).

The greatest amount of damage during this event was from the combined effects of very large waves arriving during the first 3 months of 1983 at times of ENSO elevated sea levels, high tides and storm surge. Along the shoreline of northern

Monterey Bay, losses in Capitola, Las Olas Drive and Pot Belly Beach, Seacliff State Beach, Beach Drive, Rio del Mar, Via Gaviota/Aptos Seascape, were all from wave impacts on structures. The issue wasn't one of coastal erosion, and while there was some flooding in Capitola and Rio del Mar, the damage was primarily from wave impact. I think this holds true for most of the damage elsewhere in 1983 and will be the case in the immediate future. Wave impact should be included as one of those to be expected and assessed.

While there are areas like Pacifica, Opal Cliffs, or Depot Hill in Capitola, and Isla Vista, which are well recognized for "cliff or bluff erosion", I believe our recent history of storm damage and that which we can expect in the immediate future is from wave impacts at high tides (and elevated sea levels). I don't think this is an issue of semantics but believe that Wave Impact wasn't called out in the original Coastal Act so isn't always recognized or listed as a significant hazard. Attached are a few examples of 1983 Wave Impact damage to public infrastructure and private development.

Seacliff State Beach 1983 – wave impact

Via Gaviota, Aptos Seascape 1983- Wave impact

Via Gaviota, Aptos Seascape 1983 Damage from wave impact


Newport Bay, 1983- Wave impact

p. 31 ***Saltwater intrusion:*** *An increase in sea level could cause saltwater to enter into ground water resources, or aquifers. Existing research suggests that rising sea level is likely to degrade fresh ground water resources in certain areas, but the degree of impact will vary greatly due to local hydrogeological conditions*.
Most coastal aquifers or those exposed along the coast are already intruded by seawater. Because differences in ground water levels and drawdown by overdraft is on the order of dozens or hundreds of feet, in contrast to cm or inches for sea-level rise over at least the next several decades, sea-level rise in all likelihood is not going to be very insignificant factor in increasing sea water intrusion for many years. A search of the literature that I have done provided no solid data on this process other than one recent paper that said it was a wash in the near future.

p. 32 Coastal development (Sections 30235, 30236, 30250, 30253):
The replacement value of property at risk from sea-level rise for the California coast is approximately $36.5 billion (in 2000 dollars, not including San Francisco Bay).
There should be some reference to time period here, e.g. by 2030, 2050, 2100?

p. 35. ***Biological productivity of coastal waters (Section 30230, 30231):*** *Sea-level rise could affect biological productivity of coastal waters by changing the types of habitats that are available, which would alter species compositions, and could potentially affect the entire coastal food chain.*
This statement sounds extreme and from my perspective reduces the credibility of the report,

at least over the short term of the applicability of the Guide. Would even 12-24 inches of sea-level rise really potentially affect the entire food chain? I seriously doubt that this would be the case anywhere on the open coast. There is also virtually nothing that can be done about this scale of change so what it the value of putting this into a policy guidance document and making the document even longer and more overwhelming. Will it affect an LCP or a future project?

Archeological and paleontological resources (Section 30244): *Archeological or paleontological resources could be put at risk by inundation, flooding, or by an increase in erosion due to sea-level rise. Areas of traditional cultural significance to California Native American tribes, including villages, religious and ceremonial locations, middens, burial sites, and other areas, could be at risk from sea-level rise. For example, the Santa Barbara Channel area has thousands of archaeological sites dating over 13,000 years that are at risk of being destroyed or altered from small amounts of sea-level rise*.
I have a similar response as to the statement just above. Why include this in a policy document? I also seriously doubt that there are thousands of archaeological sites within a few feet of sea level; if there were they would have been destroyed by now during past ENSO winters with high tides, storm surge, elevated sea levels and large waves, or by human impacts.

P. 39. Identify potential physical sea-level rise impacts in LCP planning area.

Consider how sea-level rise could interact with or exacerbate the following local water conditions: seasonal erosion, tidal range, surge, increased water levels from atmospheric forcing due to an El Niño Southern Oscillation (ENSO) or Pacific Decadal Oscillation (PDO), and waves, usually from a 100-year storm event (i.e. an eroded shoreline condition), in addition to the local sea-level rise projections.
For most open coast areas, all of the specific impacts are included in this list, and rather than expect 76 different local government planning departments to make assessments, guesses, or just give up, it would be more sensible and effective, based on the work and measurements that have been made by coastal oceanographers and geologists, to simply list what reasonable or expected values are for each of these parameters (ENSO, storm surge, wave run-up, etc.) and help the staff out.

This statement on page 40 is a good example of this:
As part of the LCP, document in the Land Use Plan the current and future hazard areas in maps, GIS products, graphics, tables, charts, figures, descriptions, or other means. This process should be repeated for each planning horizon defined in Step 1. Evaluation of current and future conditions includes assessment of the following topics. Appendix B includes methodologies for these analyses.

Appendix B sounds like the solution, but Appendix B is 28 pages long and contains figures and tables that will be very confusing to all but a few scientists: Figure 9, Figure 10, table on p. 124, Table 7 and 8, 9 and 10, for example These are really not understandable or user-friendly if you are a planner with no science or ocean or sea-level background.

P. 41-42. Table 4 lists a number of sea-level rise mapping tools. I think that many of these don't have the topographic precision to be very useful for sea-level rise of the range we are expecting in the near-term future: e.g. 6 to 12 inches over the next several decades. Are these really of the

resolution that is going to be helpful for localized land use decisions? CoSMoS- a numerical modeling system to predict coastal flooding. Again, are planners at local level going to have the skills or experience to use this model?

From our experience in performing a Sea-Level Rise Vulnerability Assessment for the City of Santa Barbara (which is referenced in the Draft Report), the single most important tool, but that I can't find mention of in the CCC Draft Guidance, is the newest statewide LiDAR data. This is very precise, covers nearly all developed coastal area of the state, and with some GIS skills, which most planning departments now have, precise elevations for virtually any coastal community can now be delineated and along with a sea-level rise value, can be used to develop future land use designations and decisions. The community will know very accurately which areas will be flooded and then inundated by what time frame. I am attaching one of these images from Santa Barbara city shoreline for an idea of what LiDAR can produce with more accuracy and less experience required. Blue is present high tide, green is high tide with 100 yr storm and ~2050 sea level rise, red is 100 yr. event with 2100 sea-level rise.

Santa Barbara shoreline with inundation levels

P. 43 *Step 3 - Assess potential risks from sea-level rise to coastal resources and development in LCP planning area/segment*.

Will the resource/development be harmed if environmental conditions change just a small amount? What are the physical characteristics of resource/asset? (E.g. geology, soil characteristics, hydrology, coastal geomorphology, topography, bathymetry, land cover, land use, etc.). Do any of those characteristics make the resource especially sensitive?

iii. Are there amounts of sea-level rise that cause sensitivity to sea-level rise to increase?

These questions are extremely fine-scale and detailed. We don't know the sea-level rise elevations for the future well enough to answer these questions. A "*small amount*" of sea-level rise? What does this mean? Do we have the elevation control to answer this? Do soil

characteristics really matter? Again, this to me is a very large shopping list and there are really much simpler ways to go about this and still arrive at a useful and guiding LCP.

These are just a few examples of the difficulties in ever developing an updated LCP by attempting to follow these recommendations.

The guidelines are summarized in ***4.1 Planning and Locating New Development***
There are 21sections or lists of recommendations included. Read this list carefully and try to imagine what it would take in terms of human hours and skills to accomplish all of these. Some of these are virtually impossible to complete with any degree of certainty that the outcomes have meaning:

Include sea-level rise in tsunami hazard assessments: *Sea-level rise should be included in tsunami hazard assessments, including in tsunami wave run-up calculations.*
We don't know tsunami inundation elevations or areas with any degree of certainty simply because there is so little historical record, and quite honestly, there have been only a handful of damaging tsunamis in California over the past 200 years. There isn't agreement on tsunami runup although there are models. But we are talking about meters to be damaging. Now we need to add cm of sea level rise on a scale of meters of runup, where there is high uncertainty. It just doesn't make sense. We can be very precise but is it accurate?

Require "soft" or "living" shorelines: *On appropriate shorelines, require new development to use "soft solutions" or "living shorelines" as an alternative to the placement of shoreline protection to enhance natural resource areas, dune restoration, sand nourishment, etc*.
How much of California's outer exposed coast does this really apply to? For those areas where most of storm damage and flooding have occurred in the past, soft or living shorelines simply aren't going to be effective. Broad Beach was approved to have a soft sandbagged shoreline and it was destroyed with the first storm waves.

Establish a beach nourishment program and protocols: *New policies may be needed to address increased demand or need for beach nourishment with sea-level rise. Policies could establish a beach nourishment program and protocols for conducting beach nourishment, including measures to minimize adverse biological resource impacts from deposition of material, including measures such as timing or seasonal restrictions and identification of environmentally preferred locations for deposits*.

From the SANDAG project experience, I think this is a misguided and very expensive and short-term approach that should be recognized as such. Beach survey data from SANDAG 1 ($17.5 million and 2,000,000 cubic yards) show most of the sand was gone within a year or two, or within one storm at Torrey Pines, and this shouldn't have come as a surprise. I've not seen the beach surveys from SANDAG 2, but I would be surprised if it responded any differently. Look at data and description of SANDAG 1 in: Patsch, K. and Griggs, G., 2006. Littoral Cells, Sand Budgets and Beaches: Understanding California's Shoreline. Institute of Marine Sciences, University of California Santa Cruz and California Department of Boating and Waterways. 39p. I think the Coastal Commission should think carefully about whether they want to be encouraging beach nourishment as a solution to sea-level rise. There is no evidence that this is going to be effective along the areas where there are no or only very narrow beaches today, which are the areas where nourishment has been done in the past. If sand didn't remain

there under natural conditions, why should it remain there if it is artificially added?

p. 68-69 2.1 Analyze relevant sea-level rise impacts.
Previous paragraph lists: *Impacts associated with sea-level rise generally include erosion, inundation, flooding, wave impacts, and saltwater intrusion.* The impacts listed beneath this heading include: **Geologic stability, Erosion, Flooding and Inundation,** and **Other Impacts**. However, **Wave Impacts**, listed in the preceding paragraph, is not included. I've discussed this earlier and why I believe this is one of the most important hazards to evaluate based on past El Nino events.

P. 72. *Identify all hazards that may impact the proposed project site or proposed development. Such hazards can include shoreline erosion, bluff erosion, flooding, inundation, elevated ground water, and saltwater intrusion*.
Again Wave Impact should be included here, and is far more significant in the near term future and will affect far more investment and development than saltwater intrusion.

P. 81. Figure 6. In Box 2. Wave Impact should be includes as a hazard.

p. 86. VI. ADDITIONAL RESEARCH NEEDS

This is a large list of topics that can be useful for researchers in this discipline, although my guess is that most of them won't read this document and see this list. I won't get into the specifics of each of these although they raise a number of important questions, many of which probably aren't likely to be answered any time soon. Dedicated funding to study these would insure that at least some of them are undertaken.

p. 109-110. **A.4. Approaches for Projecting Future Global Sea-Level Rise.** *Despite these challenges, sea-level rise projections are needed for many coastal management efforts and scientists have employed a variety of techniques to model sea-level rise, including:*

1. Extrapolation of historic trends;

2. Modeling the physical conditions that cause changes in sea level; and

3. Relating sea level to other climatic conditions that can be fairly well projected (empirical or semi-empirical method)

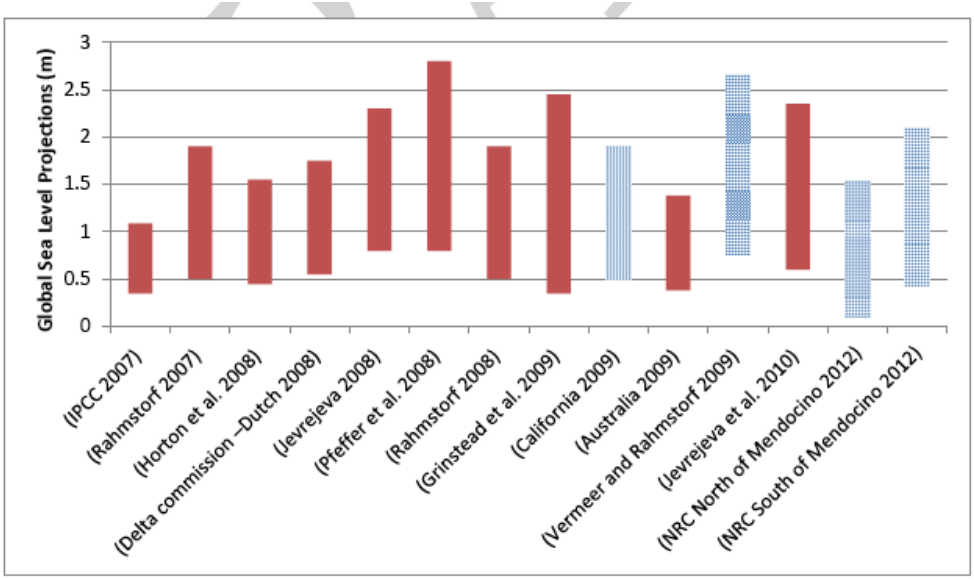
There are strengths and weaknesses to each approach, and users of any sea-level rise projections should recognize that there is no perfect approach for anticipating future conditions.

This is very important perspective that is tucked away in the Appendix and should be explained in the Guidance document where specific sea-level rise values need to be selected or determined for application throughout the LCP updates. The upfront expectation is that somehow the planner from local government has to determine the correct value, but here the reality is explained that "there is no perfect approach" but lots of different methods that have been used by very experienced scientists. So what is the planner to do? Is all of the detailed explanation of these 3 different approaches really useful for these planners? Again, a

conversation with some of these people in the trenches isn't too late to follow up on. I think its clear that none of the local government planners I have worked with would have a clue, or the time to go any further on this.

Is this information really useful for local government planners: *Semi-empirical projections of sea-level rise through relationships between water level and radiative forcing such as those from Grinsted et al., 2009, Jevrejeva et al., 2010, Katsman et al. 2011, Rahmstorf et al., 2012, Meehl et al., 2012, Schaeffer et al., 2012 and Zecca & Chiari, 2012 have shown general agreement with the projections by Vermeer and Rahmstorf (2009). The Grinsted et al. projections have a wider range than those from Vermeer and Rahmstorf, while the Jevrejeva et al., projections are slightly lower. All semi-empirical methods project that sea level in 2100 is likely to be much higher than linear projections of historic trends and the projections from the 2007 IPCC.*

Figure 8 (which is an excellent addition to this guidance and should be up front in the body of the report) makes this quandary very clear.



I believe that the best and most useful approach is to go with the NRC report projections for 2030, 2050 and 2100, and don't try to specify locally specific differences. Perhaps 25 or 30 years from now this may make sense when we have more data and trends are clearer.