ADDRESSING SEA LEVEL RISE FOR THE TREASURE ISLAND DEVELOPMENT PROJECT

Project Background

- Treasure Island is a man-made island in the middle of San Francisco Bay
- Development plans for Treasure Island and Yerba Buena Island include 6,000 to 8,000 new homes, up to 500 hotel rooms, a 400-slip marina, restaurants, retail and entertainment venues, and nearly 300 acres of parks and open space.

State of Sea Level Rise Discussions

- SLR estimates in published literature and policy papers vary widely
- An observed occurrence of 8-inches over the last century[i]
- Up to 33-inches over next century based on IPCC[ii] high estimates
- High-resolution global altimetry data through the end of 2009 suggest that in the last two decades global mean sea level has increased at a rate close to the upper end of the IPCC projections, corresponding to an increase of 10 inches by 2050 and 30 inches by 2100
- Semi-empirical studies by Rahmstorf[iii] and others have stated that SLR over the next 100 years could be substantially higher - as much as 55-inches by 2100
- 55-inches estimate was adopted by the CALFED Independent Science Board as a plausible/high, value.
- State Executive Order S-13-08 directs the California Resources Agency to request that the National Academy of Sciences convene an independent panel to complete the first California Sea Level Rise Assessment report. This December 2010 report would advise how California communities should plan for sea level rise
- The BCDC in a recently released study[iv] recommended that Bayfront developments address 16-inch SLR by 2050 (mid-term) and a 55-inch SLR value by 2100 (long-term). The California State Coastal Conservancy (SCC) has issued a similar guidance policy[v], based on work by the California Climate Change Center[vi]
- City and County of San Francisco has not issued planning guidance for sea level rise

SLR Strategy for Treasure Island

- **ANALYZE** the specific site conditions at Treasure Island related to tides, wind-wave and storm-wave. A SLR study prepared by Moffatt & Nichol[vii] was based on an exhaustive review of the literature and guidance from regional agencies, and extensive modeling of tidal, wind-wave, and storm-wave processes for the Central Bay
- **CONSTRUCT** flood protection for the mid-to-long term (2075 – 2125)
- **ENABLE** an Adaptive Management Strategy for the long-to-very long term (2100 and beyond)

The 4 separate components of this strategy are:

1. **Construct building pads and vital infrastructure** at elevations 36-inches higher than the present day 100-yr return period water level in the Bay, and add a 6-inch freeboard for finish-floor elevations of

buildings.

- Buildings and transportation infrastructure would not be flooded for water levels 36 inches higher than current Base Flood Elevation, with habitable structures higher by another 6 inches, putting it beyond the 2080 time frame according to the most aggressive sea level rise, and well beyond 2100 according to the highest IPCC projection.

2. **Construct the storm drainage system** to be gravity-drained for SLR up to 16 inches and pumped thereafter
3. **Build a shoreline protection system** to accommodate a mid-term rise in sea level of 16-inches, with development setbacks to allow for adaptation for higher SLR
   - It is not practical to build a high wall around the project for a design condition that may not happen for several decades, because it would pose a visual obstruction and severely limit public access.
4. **Establish an Adaptive Management Strategy** with a long-term funding mechanism to protect against at least 55 inches of SLR, and even higher.
   - The Adaptive Management Strategy will define specific triggers for action, based on observed changes in sea level.
   - Should sea level rise 16 inches, the shoreline edge could be raised to mitigate more frequent wave overtopping and storm drain pumps installed
   - Should sea level rise 36 inches, the shoreline protection system could be hardened to act as a flood barrier (levee or floodwall) for the entire island
   - Development setback distances and funding will enable a variety of future modifications along the shoreline protection system to accommodate at least SLR of 55-inches, and even higher if necessary.
   - Shoreline modifications would likely include a combination of the following strategies depending on desired open space uses and wave runup characteristics at different locations around the island:
     a. Raising the shoreline edge embankment in place to function as a storm surge or flood barrier
     b. Constructing a series of embankments of increasing heights away from the water. Land between sets of embankments can hold periodic wave overtopping that drain out between high tides while creating habitat
     c. Constructing sea walls – particularly at the ferry quay and along Clipper Cove where they would also function as a public amenity
     d. Laying back the shoreline to create cobblestone beaches to limit wave runup and overtopping, creating accessible public amenities

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References

[i] Moffatt & Nichol, *Treasure Island Development Project, Planning For Sea Level Rise, Part I – Background and Projections*, prepared for Treasure Island Community Development, July 2008

[ii] Intergovernmental Panel on Climate Change, 2007. *Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change.* Solomon S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor, and H.L. Miller (eds.). Cambridge University Press.

[iii] Rahmstorf, S., 2007: *A Semi-Empirical Approach to Projecting Future Sea-Level Rise.* Science Magazine 315, pp. 368-370

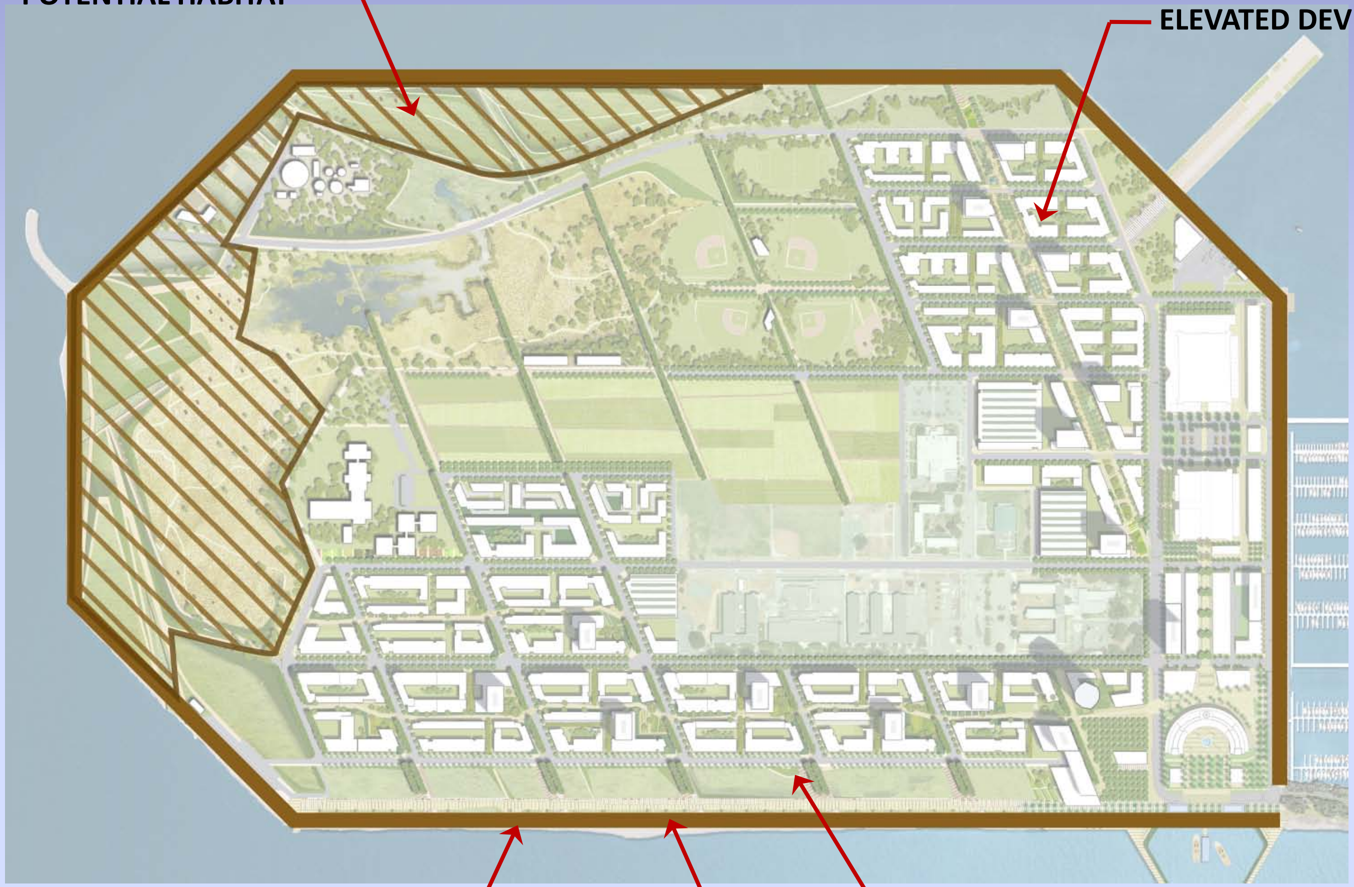
[iv] San Francisco Bay Conservation and Development Commission, *Living With A Rising Bay, Vulnerability and Adaptation in San Francisco Bay and on its Shoreline* April 2009

[v] California State Coastal Conservancy. *Policy Statement on Climate Change*. Adopted at the June 4, 2009 Board Meeting

[vi] Cayan, D., M. Tyree, M. Dettinger, H. Hidalgo, T. Das, E. Maurer, P. Bromirski, N. Graham, and R. Flick. 2009. *Sea Level Rise Estimates for the California 2009 Climate Change Scenarios Assessment*. California Climate Change Center Report No. CEC-500-2009-014-F, August 2009

[vii] Moffatt & Nichol, *Treasure Island Development Project, Coastal Flooding Study*, prepared for Treasure Island Community Development, April 2009

Treasure Island
Adaptation Strategy For Sea Level Rise



Treasure Island
Adaptation Strategy For Sea Level Rise

Development Setback

+ Institutional Framework

+ Funding Mechanism

=

Plenty of Options

A New San Francisco Neighborhood …
A Regional Destination

Planning For Sea Level Rise
Treasure Island Development Project

Part I - Background And Projections

Prepared for:

Treasure Island Community Development

Prepared By:

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July 2008
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INTRODUCTION AND PURPOSE

The purpose of this document is two-fold:

- To present a summary of the most commonly quoted estimates of sea level rise in the scientific and planning literature.
- To describe the effects that these estimated levels of sea level rise would have on the flood risk to buildings at Treasure Island, based on an assumed freeboard above the existing Base Flood Elevation for the Finished Floor Elevation (FFE) of proposed buildings.

LITERATURE SURVEY

Thousands of peer-reviewed publications on the topic of climate change and associated sea level rise have been published in the past twenty years, and no document of reasonable size could summarize them all. Instead, this memo reviews the following documents, which are widely considered credible. The documents are given in reverse historical order.

A. Mount, J., 2007. *Sea Level Rise and Delta Planning*. Letter from Jeffrey Mount, Chair, CalFED Independent Science Board to Michael Healey, Lead Scientist, CALFED Bay-Delta Program, dated September 6, 2007.

B. Intergovernmental Panel on Climate Change, 2007. *Climate Change 2007: The Physical Science Basis.* Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Solomon S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor, and H.L. Miller (eds.). Cambridge University Press. Also available online at http://www.ipcc.ch/.

C. Rahmstorf, S., 2007: *A Semi-Empirical Approach to Projecting Future Sea-Level Rise.* Science Magazine 315, pp. 368-370.

D. Cayan, D., P. Bromirksi, K. Hayhoe, M. Tyree, M. Dettinger, and R. Flick, 2006. *Projecting Future Sea Level.* California Climate Change Center report number CEC-500-2005-202-SF, dated March 2006.

E. Intergovernmental Panel on Climate Change, 2001. *Climate Change 2001: The Scientific Basis*. Contribution of Working Group I to the Third Assessment Report of the Intergovernmental Panel on Climate Change. Houghton, J.T., Y. Ding, D.J. Griggs, M. Noguer, P. J. van der Linden and D. Xiaosu (eds.). Cambridge University Press. Also available online at http://www.ipcc.ch/.

F. Titus, J. G. and Narayanan, V.K., 1995. The Probability of Sea Level Rise. United States Environmental Protection Agency, Office of Policy, Planning and Evaluation. September 1995.

G. National Research Council, 1987. *Responding to Changes in Sea Level: Engineering Implications.* National Academy Press.

Additional documents, which are less high-profile but which are illustrative of ongoing developments in the scientific, engineering, and planning communities, are listed at the end of this memorandum.

The sea level rise projections described throughout this document relate to eustatic sea level rise – that is, the global average value. Local sea level rise can differ from eustatic sea level rise for two reasons.

- The density of the ocean, and consequently the sea level, is not projected to change uniformly throughout the world. For example, it is projected that the Arctic ocean will rise more rapidly than the global average, while the Southern Ocean will rise less rapidly than the global average.
- Local geologic processes (uplift and subsidence) affect the rate of sea level rise relative to land. For example, as a result of ongoing uplift in northwest Washington, the tide gauge at Neah Bay indicates that the sea level relative to land is currently dropping at a rate of nearly 6 inches per century.

In practice, neither local variations in projected ocean conditions nor local geological processes are expected to measurably affect sea level rise in the San Francisco Bay Area. Consequently, in this region, eustatic sea level rise and local sea level rise relative to the land can be considered interchangeable. This memorandum does not distinguish further between the two.

A. CALFED Bay-Delta Program, 2007

This memorandum was prepared by the CALFED Independent Science Board, a committee consisting of nine respected academics, to examine the array of sea level rise projections available in published reports and, based on current scientific understanding, advise the CALFED Science Program about which projections are most appropriate for incorporating into on-going planning for the Delta. The report does not include any modeling or stand-alone analysis. However, as part of the Delta Vision strategy that is being developed as a guidance and policy document for the California Department of Water Resources, it is being widely quoted as a basis for flood planning in the San Francisco Bay Area.

The conclusions of the Independent Science Board are summarized as follows:

> *"The board recommends that planning efforts use three approaches to incorporate sea level rise uncertainty.*
>
> *First, given the inability of current physical models to accurately simulate historic and future sea level rise, until future model refinements are available, it is prudent to use existing empirically-based models for short to medium term planning purposes. The most recent empirical models project a midrange rise this century of 70-100 cm (28-39 in.) with a full range of variability of 50-140 cm (20-55 in.). It is important to acknowledge that these empirical models also do not include dynamical instability of ice sheets and likely underestimate long term sea level rise.*
>
> *Secondly we recommend adopting a concept that the scientific and engineering community has been advocating for flood management for some time. This involves developing a system that can not only withstand a design sea level rise, but also minimizes damages and loss of life for low-probability events or unforeseen circumstances that exceed design standards.*
>
> *Finally, the board recommends the specific incorporation of the potential for higher-than-expected sea level rise rates into long term infrastructure planning and design. In this way, options that can be efficiently adapted to the potential for significantly higher sea level rise over the next century will be favored over those that use "fixed" targets for design."*

As a clarification, the *current physical models* referenced by the Independent Science Board are the models included in the 2007 IPCC Report (Document B below), while the *most recent empirical models* quoted correspond to the work of Stefan Rahmstorf, Document C below.

B. Intergovernmental Panel on Climate Change, 2007 (AR4)

This report is often referred to as AR4 (the Fourth Assessment Report of the IPCC). It contains an exceptionally detailed synthesis of the available peer-reviewed science of climate change and sea level modeling, and has received contributions and comment from a vast array of respected researchers in the field. The Third Assessment Report (Document E) was released by the IPCC in 2001, and is often referred to as the TAR.

The AR4 gives a widely quoted projection of 18 cm (7 inches) to 59 cm (23 inches) for sea level rise in the 21st century. These are considered 5 to 95 percent ranges. The AR4 includes a second set of projections – from 18 cm (7 inches) to 76 cm (30 inches) – including a scaled-up ice discharge term. The projections cover the period from 1990 to the midpoint of 2090-2099; the AR4 does not provide sea level rise values at intermediate periods (e.g., to 2050).

The models described in the AR4 give reasonable hindcasts of observed sea level rise between 1993 and 2003, although they underpredict observed sea level rise between 1961 and 2003.

The uncertainty in the quoted projections derives from two main sources.

- Different greenhouse gas emission scenarios – the IPCC defines six future scenarios of world population and economy that predict different levels of greenhouse gas emissions. The AR4 stresses that no scenario can be considered more likely than others.
- The second, and larger, uncertainty is associated with limitations to current scientific knowledge. The range of sea level rise projections for a given scenario is based on the range of results from 17 independently developed and peer-reviewed general circulation models (GCMs).

Compared to the 2001 IPCC Report, known as the Third Assessment Report or the TAR (Document E), the projections in the 4AR are slightly smaller and significantly narrower. The “headline value” from the TAR was 9 cm to 88 cm (4 to 35 inches) between 1990 and 2100. The reasons for the differences are as follows:

- The projections in the AR4 are to the midpoint of the period 2090 to 2099, while those in the TAR are to 2100.
- The TAR included some small additional contributions (e.g., 0.5 cm additional rise in the 21st century due to permafrost), which are not included in the AR4.
- The modeling uncertainties have been decreased with improved information and modeling capabilities. The TAR uses simple climate models (SCMs) to estimate sea level rise; these are less detailed than the atmosphere-ocean general circulation models (AOGCMs) used in the AR4.

Mechanisms that may lead to sea level rise are not included in the AR4 projections unless there is a broad scientific consensus that they are well and quantitatively understood. That is, the AR4 projections are conservative in a scientific sense, but not in an engineering or planning sense – the AR4 freely admits that it may underpredict as well as overpredict future sea level rise. In particular, the projections do not include potentially large and nonlinear effects such as a potential nonlinear instability and accelerated loss of the Antarctic and Greenland Ice Sheets – because there are no broadly accepted models of these processes. It is not even known whether ice sheet discharge will increase or decrease sea level rise in the short term. The projections do include the best current understanding of polar ice dynamics.

Critics of the IPCC (e.g., reference 1) have generally focused on this scientific conservatism. In particular, many planners have expressed concern that the projections are not sufficiently conservative in an engineering sense, and that the upper limits of the IPCC projections do not represent a worst-case scenario. However, the scientific community generally has not attempted further synthesis of the huge range of available models and potential contributions to future sea level rise, so that few hard numerical predictions of total sea level rise have been published in the peer-reviewed literature since dissemination of the AR4.

C. Rahmstorf, 2007

Stefan Rahmstorf of the Potsdam Institute for Climate Impact Research, Germany developed a semi-empirical approach to predict SLR. This semi-empirical model assumes that the initial rate of sea level rise is proportional to the increase in temperature relative to a previous equilibrium temperature:

$$\frac{dH}{dt} = a\left[T - T_0\right]$$

where H is the global mean sea level, t is time, T is the global mean temperature, T_0 is the previous equilibrium temperature value, and a is an empirically derived proportionality constant. Rahmstorf fits this linear relationship with available observations of global sea level and global mean temperature between 1880 and 2001. This fit provides a proportionality constant, which allows him to use the temperature projections from the IPCC's 2001 *Third Assessment Report* (TAR) to project future sea level rise. An increase of 70-100 cm (28-39 inches) between 1990 and 2100 is obtained by using the best fit to the proportionality constant a and the range of temperature projections from the TAR. An increase of 50-140 cm (20-55 inches) is obtained by adding one standard deviation to the derived value of a. These are the values discussed by the CALFED Independent Science Board (Document A).

Rahmstorf's work is, in part, based on the observation that the TAR underpredicts sea level rise from 1990 to 2006 (reference 2) – the semi-empirical approach describes sea level rise from 1990 to 2006 better than the TAR. Given that the more recent AR4 adequately describes sea level rise from 1993 to 2003, this may not be a strong argument in favor of the semi-empirical approach. In addition, published comments on this paper have argued that it misuses statistical methods (references 3 and 4). However, it has been widely quoted by authors, particularly in the planning and policy fields, who are critical of the IPCC's focus on scientific consensus.

D. California Climate Change Center, 2006

The California Climate Change Center (CCCC) comprises the California Energy Commission, Scripps Institution of Oceanography at the University of California at San Diego, and the University of California at Berkeley. The CCCC report on sea level rise was based on the Atmosphere-Ocean General Circulation Model simulation results prepared by IPCC (AR4). However, at the time the CCCC report was published, the AR4 report was in preparation and only partial results were available. For example, the modeling of sea level rise associated with thermal expansion was complete for only a subset of the emissions scenarios, and the component of sea level rise associated with ice melt had not been finalized for the AR4 report. The CCCC report used additional models (e.g., reference 5) to develop a full range of estimates of eustatic sea level rise. The results (20-80 cm or 8-31 inches between 2000 and

2100) are similar to those in the AR4 report. Given that the AR4 report has now been published, it seems reasonable to treat the sea level rise projections in the CCCC result as superseded.

The CCCC report goes on to discuss the potential implications of sea level rise for exacerbating storm effects (e.g., high surf combined with high tides) and on the Delta levees. This discussion uses an illustrative sea level rise increase of 30 cm (12 inches) in the 21st century. This illustrative value lies within the range published in the AR4, so that the CCCC report remains current in its discussion of implications.

E. Intergovernmental Panel on Climate Change, 2001

The Third Assessment Report (TAR) of the IPCC, like the fourth, is a detailed synthesis of the available peer-reviewed science. It is similar to the 4AR in being consensus-driven – potential contributions to sea level rise are not included unless there is broad agreement that they are quantitatively understood.

The TAR projects a sea level rise of 9 cm to 88 cm (4 to 35 inches) between 1990 and 2100. As with the 4AR, the largest contribution to the uncertainty is associated with modeling uncertainties, and in particular with the potential for dynamic ice sheet instability. The West Antarctic Ice Sheet (WAIS) is particularly called out in regard to uncertainty.

F. U.S. Environmental Protection Agency, 1995

The focus of this report is on an explicit probabilistic assessment of different sea level rise scenarios for the 21st century. The report bases its modeling on earlier IPCC work (references 6 and 7), and creates a simplified model that captures the dependence of the IPCC projections of sea level rise on 35 major uncertainties. The main contributions to sea level rise in this model are thermal expansion together with ice melt in Greenland, the Antarctic, and small glaciers. The report develops a probability distribution for each of these 35 variables through a literature review and by discussion with a "Delphic" panel of expert reviewers. Finally, through a Monte Carlo experiment, the report develops explicit probability distributions for the potential future sea level rise (specifically, the increase in sea level rise relative to an increase at the current rate). Results are given both for a mix of the future emissions scenarios used by the IPCC in 1990, and for each emission scenario.

The report is careful to state that:

> *"our <u>probability estimates are not based on statistics.</u> Our estimates simply convey what the probability of various rates of sea level rise would be if one is willing to assume that the experts we polled are each equally wise and that their collective wisdom reflects the best available knowledge […] Our projections are less like a statistical weather forecast and more like handicapping a horse race"*

The 5 to 95 percent range for the global average sea level rise, assuming the current global average sea level rise is the central value of 1.8 mm/year given in the AR4, is 14 cm to 86 cm (5 to 34 inches) between 1990 and 2100. The 1 to 99 percent range (the widest range reported) is -4 cm to +112 cm (-2 to +44 inches).

G. National Research Council, 1987

The focus of this document is on the anticipated effects of sea level rise and the recommended responses. The report does not make specific projections of sea level rise:

rather, it adopts three plausible conditions of 50 cm, 100 cm, and 150 cm by 2100 (20, 39, and 59 inches).

DISCUSSION

The projections of sea level rise given in documents A through G are typically for the period 1990 through (approximately) the end of the 21st century. Given that nearly 20 years have passed since the beginning of this period, an obvious question is: *do we have enough data to distinguish between the projections*? Unfortunately, the answer is no: a major reason is that decadal-scale variations in climate, such as the North Atlantic Oscillation (NAO) and the Pacific Decadal Oscillation (PDO), tend to mask long-term changes in global temperature and sea level. A secondary reason is that the projections typically show an acceleration in sea level rise through the 21st century – the differences do not begin to be significant until mid-century.

In developing the estimates of future flood elevations at Treasure Island, it is necessary to select a set of sea level rise projections. We have two comments on this selection. First, it is important to distinguish between scientific projections (such as those in documents B and C, prepared by the IPCC and by Rahmstorf) and illustrative cases (such as those in the document G, by the NRC).

Second, the science of climate change and sea level rise is evolving and improving. This does not necessarily lead to a narrower spread of projections over time. For example, ice sheet dynamics is a very active research field (e.g., references 8 and 9): improving measurement techniques could potentially highlight new mechanisms that were not previously understood. However, it does argue that more recent projections should normally be given more weight than those made earlier. For example, document D, the 2006 CCCC report was prepared using interim results of the 2007 AR4 which are effectively superseded by the final version of that document. This is not a criticism of this report, and it does not suggest that the planning recommendations based on those interim results should be rejected: however, it is recognition that science progresses. Similarly, the 1995 EPA report was based on IPCC projections from the early 1990s – which have been superseded by the 2001 TAR and the 2007 AR4. We therefore focus on the most recent documents B (IPCC AR4) and C (Rahmstorf's semi-empirical model). Document A (CALFED Bay-Delta Program) uses the results of these documents and does not provide an independent assessment.

IMPLICATIONS FOR TREASURE ISLAND

The attached Figure 1 illustrates the different projections of sea level rise from 1990 to 2120. Intermediate values (between 1990 and 2100), and values past 2100, are evaluated using a quadratic fit to the end values and the start or end rates of change specified in the different documents.

All projections start at zero in 1990. This is also a convenient start date for investigating the effects of sea level rise on the base flood elevation, because the Mean Lower Low Water datum – used in the estimation of coastal flooding – is based on the 1983-2001 tidal epoch. 1990 is close to the midpoint of this tidal epoch. It is not necessary to "normalize" the projections by setting the increase in sea level to the present day (2008) or the projected construction date.

The curves in Figure 1 show projections from the following reports:

A. CALFED Bay-Delta Program, 2007. This report does not include independently-generated projections. Rather, it recommends use of the uppermost projection given by Rahmstorf (Document C). Figure 1 highlights the curve corresponding to this recommended projection.

B. Intergovernmental Panel on Climate Change, 2007. This report provides low, mid-level, and high values for six independent emissions scenarios, with and without a scaled-up ice discharge term. Thus, in principal, a total of 36 different estimates are available. Figure 1 shows the low and high values for the different scenarios including the scaled-up ice discharge term.

C. Rahmstorf, 2007. This paper includes four projections: low and high values based on the low and high temperature projections of the TAR (IPCC 2001), with and without inclusion of a statistical uncertainty in an empirically derived proportionality constant. Figure 1 shows all four curves.

Figure 1 also shows the low, mid-level, and high values of the 2100 sea level rise projected or used for illustration in the other documents D through G summarized above. As discussed above, some of these documents can be considered superseded as a result of continuing improvements in the science of climate modeling; others provide specific values of sea level rise for illustration, not as scientific projections. The end-point values are given for comparison only.

Finally, the figure shows how sea level would increase if there were no acceleration, based on the current (1961-2003) global average increase of 1.8 mm/year (IPCC 2007).

We assume the Base Flood Elevation (BFE) at Treasure Island resulting from coastal processes will increase in future as the sea level rises. That is, for example, when the sea level rises 6-inches above its 1990 value, the BFE will also rise 6-inches above its current value. (As mentioned above, 1990 is near the mid-point of the tidal epoch used in flood analysis, therefore this is an appropriate base year). Discussions so far have indicated that the Finish Floor Elevation (FFE) for the buildings at Treasure Island will be located 3.5 feet above the BFE. This includes a 3-feet of allowance for future sea level rise, plus 0.5 feet of freeboard. Consequently, when the sea level has increased by 3 feet above its 1990 level, 0.5 feet of freeboard will be available for the buildings. At some point before this occurs, it will be necessary to construct additional protection against coastal flooding, such as a low perimeter berm and upgrades to the pump systems. The layout of the Treasure Island development will allow space for this additional protection, although it will not be constructed initially.

Even with the most aggressive projection of sea level rise, the increase in sea level reaches 3 feet around 2075; for all projections other than Rahmstorf's high values, this increase is not reached until after 2100. (The NRC values are similar to Rahmstorf's, but these were always intended to be illustrative). Consequently, it can be anticipated that additional perimeter protection and associated pump system upgrades will not be needed until the 2070s. It is perfectly possible that they will not be needed until well into the 22nd century. Ample notice of the need to begin construction of the upgrades will be available.

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Sea Level Rise Projections

Current Peer-Reviewed Literature

Curves show increases based on current peer-reviewed literature; detailed curve shapes by M&N Additional ranges in 2100 are from superseded analyses or published illustrative values.