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The Sea Also Rises

Humboldt County Civil Grand Jury

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STAFF REPORT
HARBOR DISTRICT MEETING
September 8, 2022

TO: Honorable Board President and Harbor District Board Members

FROM: Rob Holmlund, Development Director

DATE: September 2, 2022

TITLE: Consider Adoption of Resolution No. 2022-11 Responding to the 2021-22 Grand Jury Report
"The Sea Also Rises"

STAFF RECOMMENDATION: Adopt Resolution No. 2022-11.

SUMMARY: The Humboldt County Grand Jury issued a report on May 23rd regarding the potential impacts of sea level rise throughout the Humboldt Bay region and calls for a coordinated regional response to address anticipated impacts and hazards. The report requested a response from the Board of Commissioners of the Humboldt Bay Harbor District, as well as from the City of Arcata, City of Eureka, and County of Humboldt. A Resolution and response letter to the Grand Jury can be found in Attachment A.

DISCUSSION: Earlier this year, the Humboldt County Grand Jury issued a report titled "The Sea Also Rises" (Report) (see Attachment B). The Report is the result of an investigation of the topic of sea level rise around Humboldt Bay. In addition to requesting a response from the District, the City of Arcata, City of Eureka, and County of Humboldt are also each requested to respond. Accordingly, District staff coordinated with senior staff of these three other entities to compare notes and collaborate on our various responses. The staff report presented below draws from the staff reports of the City of Arcata and the City of Eureka.

The Grand Jury Report requests a response from the District regarding five of the Report's findings (Findings 3, 4, 5, 8, and 9) and two of its recommendations (Recommendations 1 and 2). With respect to the "Findings" of the Report, section 933.05 of the State Penal Code requires the District to state its agreement, partial agreement, or disagreement with each finding, including an explanation of the reasons for any disagreement. With respect to the "Recommendations" of the Report, the Board is directed to state whether the recommendation has been implemented, will be implemented (and when), will be researched (with details), or will not be implemented (and why).

Staff has prepared a Resolution and a letter to the Grand Jury (Attachment A) responding to the Report Findings and Recommendations as requested. If approved by the Board, the District's

response will be submitted to the Presiding Judge of the Superior Court, as well as the Civil Grand Jury Foreperson. The content below summarizes the letter to the Grand Jury.

Finding 3 states that the four entities (Arcata, Eureka, County, and Harbor District) will need to agree to cost sharing for staff salaries and operational overhead in order to undertake efforts to adapt to sea level rise and to mitigate the impacts of sea level rise. District staff recommends disagreeing with this Finding, as is outlined in the attached letter to the Grand Jury. Collaboration does not require the cost sharing of salaries or operational overhead. Any such cost sharing would be unnecessarily complex and would not guarantee the advancement of sea level rise adaptation/mitigation planning. As stated in Finding 4 below, the costs associated with the SLR mitigation will be significant and the District cannot commit to funding a program or project without fully analyzing the projected financial impact that the action will have on the District. In addition, budget decisions should not be made in this way.

Finding 4 states that “the costs associated with SLR mitigation efforts will be significant and will require the diligent pursuit of Federal, State, and Public funding sources.” Staff recommends agreeing with this Finding, as is outlined in the attached letter to the Grand Jury. The District has been actively pursuing such funding for the past several years and plans to continue to do so into the future.

Finding 5 states that “...there is an urgency to start developing and implementing solutions” to sea level rise based on the results of past studies. Staff recommends agreeing with this Finding, as is outlined in the attached letter to the Grand Jury. The District has been actively developing and implementing solutions for the past several years and plans to continue to do so into the future.

Finding 8 states that sea level rise has the potential to transfer contamination from former industrial sites into the Bay, wetlands, and creeks. Staff recommends agreeing with this Finding, as is outlined in the attached letter to the Grand Jury. The District has been a primary leader in the region in efforts to clean up contaminated sites and plans to continue to do so into the future.

Finding 9 states that levees and other related infrastructure will be overtopped by 2050 if no action is taken by the year 2050, which would lead to the repeated flooding of existing infrastructure, wetlands, and low-lying communities. Staff recommends agreeing with this Finding, as is outlined in the attached letter to the Grand Jury. However, as the letter explains, this topic is complex and requires acknowledgement of vulnerabilities that exist with or without sea level rise. In addition, the assumption is based on the unrealistic assumption that no action has been taken or will be taken in the future to address these issues.

Recommendation 1 of the Report calls on the District Board to vote to affirm a commitment to adapting to and mitigating the adverse effects of sea level rise, and to direct staff to make this commitment a priority in their planning efforts. Staff recommends adopting a Resolution to affirm the City’s commitment.

Recommendation 2 of the Report calls on the District Board to work with elected officials from the Humboldt County Board of Supervisors, Arcata City Council, and the Board of Commissioners of the Humboldt Bay Harbor, Recreation, and Conservation District to form a Humboldt Bay Sea Level Rise Steering Committee, composed of senior members from each entity who have decision-making authority, by December 1, 2022. Staff recommends committing to City participation in the Steering Committee as part of the aforementioned Resolution.

ATTACHMENTS:

- A. Resolution 2022-11 Responding to Grand Jury Report with Attached Letter**
- B. 2021-22 Humboldt Civil Grand Jury Report “The Sea Also Rises”**

***HUMBOLDT BAY HARBOR, RECREATION,
AND CONSERVATION DISTRICT***

RESOLUTION NO. 2022-11

**A RESOLUTION RESPONDING TO THE HUMBOLDT COUNTY CIVIL GRAND JURY REPORT “THE
SEA ALSO RISES”**

WHEREAS, the Humboldt Bay Harbor, Recreation and Conservation District was created in 1973 to oversee planned development of the harbors and ports within Humboldt Bay, as well as to protect the Bay’s natural resources; and

WHEREAS, coastal flooding and erosion hazards have been a concern to the District since its initial creation; and

WHEREAS, many of the levees and flood control structures around Humboldt Bay are aging, in need of maintenance, and subject to failure; and

WHEREAS, sea levels are rising and are modeled to continue to rise into the future, which is expected to increase the future rates, magnitudes, and likelihoods of coastal hazards beyond what has been experienced before; and

WHEREAS, sea level rise will exacerbate coastal flooding and erosion around Humboldt Bay, which will impact public and private investments, infrastructure, and activities; and

WHEREAS, long-term sea level rise projections and vulnerabilities are significant, but there is time to plan, fund and implement adaptation strategies in response to these evolving hazards; and

WHEREAS, the District has consistently sought funding and partnerships to analyze and prepare for sea level rise, including mitigation and adaptation efforts; and

WHEREAS, climate impacts do not respect borders, so effective response to sea level rises require a coordinated effort among private and public landowners and asset managers, staff, elected officials, regional stakeholders, and state and federal agencies; and

WHEREAS, the District has consistently coordinated with organizations and agencies throughout the region to analyze and prepare for sea level rise; and

WHEREAS, the Humboldt County Civil Grand Jury investigated the issue of sea level rise around Humboldt Bay, published their findings in the 2021-2022 Grand Jury Report: “The Sea Also Rises,” and submitted the report to the Harbor District, requesting a response to several of the report findings and recommendations.

**NOW, THEREFORE, BE IT RESOLVED BY THE BOARD OF COMMISSIONERS OF THE
HUMBOLDT BAY HARBOR, RECREATION, AND CONSERVATION DISTRICT THAT:**

1. The Board of Commissioners affirms the Humboldt Bay Harbor District's commitment to adapting to and mitigating the adverse effects of sea level rise and directs staff to continue to make this commitment a priority in planning efforts.
2. The Board of Commissioners commits to District staff participation in a future multi-agency Steering Committee to discuss and provide direction regarding regional coordination on sea level rise adaptation and mitigation in the Humboldt Bay region.
3. The responses to the Grand Jury Report, "The Sea Also Rises", attached in Exhibit 1, are hereby adopted by the Board of Commissioners.
4. The Board of Commissioners directs Staff to transmit the attached response to the Grand Jury Report "The Sea Also Rises" to the Presiding Judge of Humboldt County Superior Court.

PASSED, APPROVED AND ADOPTED by the Humboldt Bay Harbor, Recreation and Conservation District Board of Commissioners at a duly called meeting held on the 8th day of September 2022, by the following polled vote:

AYES:

NOES:

ABSENT:

ABSTAIN:

ATTEST:

Greg Dale, President
Board of Commissioners

Richard Marks, Secretary
Board of Commissioners

CERTIFICATE OF SECRETARY

The undersigned, duly qualified and acting Secretary of the HUMBOLDT BAY HARBOR, RECREATION AND CONSERVATION DISTRICT, does hereby certify that the attached Resolution is a true and correct copy of RESOLUTION NO. **2022-11** entitled,

A RESOLUTION RESPONDING TO THE HUMBOLDT COUNTY CIVIL GRAND JURY REPORT “THE SEA ALSO RISES”

as regularly adopted at a legally convened meeting of the Board of Commissioners of the HUMBOLDT BAY HARBOR, RECREATION AND CONSERVATION DISTRICT, duly held on the **8th day of September 2022**; and further, that such Resolution has been fully recorded in the Journal of Proceedings in my office, and is in full force and effect.

IN WITNESS WHEREOF, I have hereunto set my hand this **8th day of September 2022**.

Richard Marks, Secretary
Board of Commissioners

Exhibit 1 to Resolution 2022-11

Honorable Joyce D. Hinrichs
Presiding Judge
Humboldt County Superior Court
825 Fifth Street
Arcata, California 95501

Re: The Board of Commissioners of the Humboldt Bay, Recreation, and Conservation District's Response to the 2021-2022 Grand Jury Report: The Sea Also Rises

Dear Judge Hinrichs:

On behalf of the Board of Commissioners of the Humboldt Bay, Recreation and Conservation District, I am submitting the following response to the Humboldt Civil Grand Jury Report titled "The Sea Also Rises," emailed to the District on May 23, 2022. This letter was presented to and approved by the Board of Commissioners at its regular meeting on September 8, 2022. As requested by the Civil Grand Jury pursuant to Penal Code sections 933 and 933.05, this response indicates whether the District agrees, partially agrees, or disagrees with the Report Findings 3 through 5 and 8 through 9, and responds to Report Recommendations 1 and 2.

Finding 3 – Any SLR adaptation and mitigation regional planning group will incur ongoing costs in salaries, benefits, and overhead that will require the political entities surrounding Humboldt Bay to agree to cost sharing.

Response to Finding 3 – The Board of Commissioners of the Humboldt Bay, Recreation and Conservation District (Board) disagrees with this finding. The Board cannot commit to cost sharing and/or allocation of staff time for a regional planning group. The Board agrees immediate and ongoing commitment to adaptation and mitigation is essential to addressing the threats posed by sea level rise. The Board also agrees regional collaboration is essential to effective planning and implementation of adaptation and mitigation measures. It is for these reasons that the District has been actively participating in several regional and local efforts related to this topic. However, decisions on the region's approach(es) to collaboration on the issue of sea level rise should be made collectively by regional stakeholders. Given the existing regulatory complexity around Humboldt Bay and the diverse array of local, state, federal and tribal stakeholders involved, it should not be assumed creating a new regional governmental entity will be the most effective, efficient, or just approach to regional collaboration.

Finding 4 – The costs associated with SLR mitigation efforts will be significant and will require the diligent pursuit of Federal, State, and Public funding sources.

Response to Finding 4 – The Board agrees with this finding. The District has been, and will continue to diligently pursue funding sources for sea level rise adaptation work. For example, as far back as 2012, the District approved the submittal of a grant from the California Coastal Conservancy to Prepare a Feasibility Study for the Beneficial Reuse of Dredged Materials for Tidal Marsh Restoration and Sea Level Rise Adaptation in Humboldt Bay. Acknowledging the threat of sea level rise to contaminated sites, the District worked to secure funding from a variety of local,

state, and federal sources for the clean-up of the Redwood Marine Terminal II site on the Samoa Peninsula. The District consistently advocates for state and federal granting agencies to ensure grants are earmarked and available and targeted at all project stages so the District can successfully navigate from project development to construction. The District also calls on State and Federal permitting agencies to simplify environmental regulatory processes for restoration and climate resilience projects.

Finding 5 – The decade of studies that defined the areas and physical assets vulnerable to SLR around Humboldt Bay by mid-century clearly indicate there is an urgency to start developing and implementing solutions.

Response to Finding 5 – The District agrees with this finding and contributed to many of the relevant studies. The District is already implementing adaptation solutions, while working towards a comprehensive, phased approach to sea level rise adaptation throughout the Bay's shoreline, with short-, mid-, and long-term adaptation triggers for vulnerable areas and assets based on observed sea level rise thresholds. The District has been actively planning for sea level rise since at least 2011. In that time, the District has held many public meetings on the topic, secured multiple grants, and implemented substantial contaminated site cleanup. The District is currently investing substantial effort into advancing the offshore wind industry, which will not only help our nation transition away from carbon-based energy, but will also bring much needed funding to Humboldt Bay that can be used to adapt to and mitigate for the impacts of sea level rise.

Finding 8 – Former industrial and other contaminated sites around the Bay are susceptible to SLR. As such, SLR could push the contamination into wetlands, creeks, and even Humboldt Bay itself, making it harder to mitigate and clean up.

Response to Finding 8 – The Board agrees with this finding. The District understands the threat of mobilization of soil and groundwater contamination as a result of sea level rise. The District has secured substantial grants from the U.S. Environmental Protection Agency (EPA) to clean up the Redwood Marine Terminal II industrial site. The District has also recently secured additional EPA funds to study the potential of contamination at the RMT I site. The District has also secured a Technical Assistance grant from the EPA to evaluate former mill sites to ensure dioxins and other contaminants are identified and cleaned up as necessary.

Finding 9 – Research studies of SLR impacts around Humboldt Bay indicate that if no action is taken by 2050, monthly maximum high tides will overtop bay barriers and flood existing infrastructure, wetlands and low-lying communities.

Response to Finding 9 – The Board agrees with this finding. However, it is important to note that many areas around Humboldt Bay are already vulnerable to significant flood damage at current water levels, segments of bay barrier have already overtopped, and additional segments will be vulnerable with different amounts of sea level rise, with uncertainty around when sea levels will be reached and overtopping will occur. Many of the levees and flood control structures around Humboldt Bay are aging, in need of maintenance, and subject to failure. These facilities are vulnerable to flooding even without the threat of sea level rise. Therefore, even if sea level rise was not a reality, our region would still need to invest in the aging flood-related infrastructure around Humboldt Bay. As a result, the District is already taking actions to address our regional infrastructure and to adapt to sea level rise. The District is working to time the implementation

of future actions based on observed sea level rise thresholds. It is also important to note low-lying areas around Humboldt Bay are not only going to be affected by overtopping of bay barriers by tides, but also by rising and potentially emergent groundwater, and by reduced stormwater drainage capacity, especially when rainfall events coincide with high ocean water levels. As a result, sea level rise adaptation will be more complex and varied than solely relying on elevation and fortification of tidal barriers.

The Board supports adaptation responses with multiple benefits, such as the use of living shorelines and the beneficial reuse of dredge spoils to allow habitats to migrate/adjust to rising sea levels, and the use of public access trails as shoreline protection. The Board also believes the District's work to support the offshore wind industry is a critical component of the region's efforts to reduce climate change and sea level rise.

Given the amount of work necessary between now and 2050, prioritization of adaptation measures will be critical. The District will strive for thoughtful consideration of the distribution of environmental risks and adaptation benefits in setting priorities, and the meaningful participation of all groups in the decision-making process.

Recommendation 1 – The Grand Jury recommends the Board of Commissioners of the Humboldt Bay Harbor, Recreation, and Conservation District meet and vote to affirm a commitment to adapting to and mitigating the adverse effects of Sea Level Rise, and direct their staffs to make this commitment a priority in their planning efforts.

Response to Recommendation 1 – Combating climate change and preparing for sea level rise have consistently been goals of the District since at least 2011. To formalize this commitment, the Board adopts the Resolution presented above to affirm the District's commitment to adapting to and mitigating the adverse effects of sea level rise and directing staff to make this commitment a priority in their planning efforts.

Recommendation 2 – The Grand Jury recommends the Board of Supervisors along with elected officials from Eureka, Arcata, and the Harbor District form a Humboldt Bay SLR Steering Committee composed of senior members from each entity who have decision-making authority. Per the Grand Jury Report, this committee should be formed no later than December 1, 2022.

Response to Recommendation 2 – The Board implements this recommendation by adopting the Resolution presented above committing to District participation in a Steering Committee to discuss and provide direction regarding regional coordination on sea level rise adaptation and mitigation in the Humboldt Bay region. However, the Board questions whether the Steering Committee should include additional members beyond City, County, and Harbor District representatives. Ultimately, to be effective, regional collaboration must bring together all relevant partners and stakeholders. For instance, regional coordination on adapting the vulnerable lands surrounding the Highway 101 corridor will not be effective without Caltrans at the table.

Although the Board commits to District participation in a Steering Committee, the Board does not agree with associated Recommendations 3 and 4 calling on the Steering Committee to direct the implementation of a regional sea level rise coordination entity/organization based on the conclusions and recommendations in the Humboldt Bay Sea Level Rise Regional Planning

Feasibility Study (Study). The Study is incomplete at this time and has not been shared with the Board or the general public. It should not be a foregone conclusion the Steering Committee will agree with the Study's conclusions and follow its recommendations, including any recommendation for a new regional government entity. The purpose of the Steering Committee should be to use the Study and other input to make independent recommendations on regional collaboration, as part of a larger, ongoing, community discussion about climate change mitigation and resilience.

Thank you for taking on the complex and urgent issue of sea level rise adaptation around Humboldt Bay. Please contact me or Development Director Rob Holmlund if we can be of further assistance.

Sincerely,

Larry Oetker
Executive Director

Cc: Board of Commissioners of the Humboldt Bay, Recreation, and Conservation District

The Sea Also Rises

Background

“Recent estimates of sea-level-rise . . . indicate Humboldt Bay has the highest sea-level-rise rate . . . in California, greater than both global and regional sea-level-rise rates, due to land subsidence in and around the bay. This suggests that global sea-level-rise will impact the Humboldt Bay area faster than other parts of the U.S. West Coast.”¹

The above quote from *California’s 4th Climate Change Assessment* was made possible by the impressive and commendable work of local scientists, engineers, environmental consultants, and professional public planners. These “coastal professionals” have published several studies and reports relating to the timing and adverse effects of sea-level-rise (SLR) to the infrastructure and communities surrounding Humboldt Bay. What’s most impressive is this library of documents dates back a decade and is a testament to the forethought and proactive planning undertaken by this group of concerned coastal professionals.

Their efforts have not gone unnoticed. Through public workshops and presentations over the years, more and more community members have taken an interest in the subject of SLR. Last year alone it was the subject of the third day of the Humboldt Bay Symposium. A non-random public survey conducted in 2021 by the County Planning Department found 62% of respondents feel they are moderately to extremely well informed about SLR around Humboldt Bay. In addition, Cal Poly Humboldt (formerly Humboldt State University) has established the Sea Level Rise Initiative (SLRI) to develop a depository for current and future SLR research.

All this activity came to the attention of the Humboldt County Civil Grand Jury (Grand Jury). Upon investigating the topic of SLR around Humboldt Bay the Grand Jury became convinced that, although slow, SLR must be planned for and mitigation efforts developed now to protect communities and infrastructure. This was made abundantly clear when, during a presentation by a CalTrans official, it was noted that from conception to completion the Willits bypass project spanned forty years.

The Grand Jury is aware that other areas of Humboldt County will also experience the effects of SLR. However, we limited our investigation to the adverse effects SLR poses to the communities

¹*California’s Fourth Climate Change Assessment: North Coast Region Report*, 2018: p.27
www.ClimateAssessment.ca.gov

and infrastructure surrounding Humboldt Bay. After all, this is the well-researched area and the most threatened shoreline on the West Coast.

Summary

For more than a decade local coastal professionals have studied the future impact of sea level rise (SLR) around Humboldt Bay. Their work, documented in several reports available since 2015, indicate that a two-foot increase in Humboldt Bay's shoreline will be possible by 2050 and a three-foot rise may occur as early as 2070. During the past several years these researchers conducted numerous workshops and presentations to inform the public about the threat of SLR to the communities, infrastructure, and environment surrounding the bay.

These outreach efforts have been successful. The public interest in SLR inspired the Humboldt County Civil Grand Jury to investigate why SLR is happening, how damaging its effects will be, and what must be done to adapt to it.

Globally, SLR results from the melting of glaciers in Greenland and Antarctica and the expansion of ocean volume due to increasing water temperatures. In addition, land subsidence around Humboldt Bay increases the impact of rising seas. Humboldt Bay has a sinking land mass problem resulting in relative sea level rise greater than anywhere else on the West Coast.

With three feet of SLR around Humboldt Bay, the unincorporated communities of King Salmon and Field's Landing will experience significant monthly flooding. Fairhaven/Finntown will see its septic tank systems fail. In addition, three feet of SLR will affect:

- The only access road to King Salmon
- PG&E's Humboldt Bay Generating Station and the interim spent nuclear fuel site
- Highway 101 as it traverses South Bay, Elk River Slough, and Arcata Bay
- Highway 255 on the Mad River Bottoms
- Approximately 12 miles of railroad and the current and future sections of the Humboldt Bay Trail within the Humboldt Bay Area Plan (HBAP) planning area
- Approximately 9.6 miles of municipal water transmission lines
- The Truesdale pump station, seven wastewater lift stations, and 10.5 miles of sewer lines
- 30 electrical transmission towers and 113 transmission poles
- Sections of the South and North Jetties (867 ft. and 1,214 ft. respectively)
- Three of the 10 bulk cargo/commercial docks
- Several contaminated sites, including former pulp mills (Simpson in Fairhaven, Sierra Pacific in Manila) and former Southern Pacific Railyard (Arcata)
- 52 Wiyot cultural sites

The above list shows the scope of the problem SLR presents. Coastal professionals who have studied SLR recognize that the many entities responsible for addressing this issue must collaborate on implementing solutions. This was confirmed in a recently conducted survey of 107 coastal professionals in which 95% agreed that collaboration was essential. For example, reinforcing a shoreline dike in one section of the bay is not a solution if a neighboring dike crumbles from poor maintenance, allowing bay water to inundate the area these dikes are designed to protect.

In September 2022, the conclusion of a study conducted by the County's Planning Department is expected to recommend the collaborative approach that should be pursued to address SLR around Humboldt Bay. It may be as simple as an informal working group or as formal as a newly created regional agency. Whatever recommendation is forthcoming, the Grand Jury recommends it should be established as soon as possible due to timing and cost factors.

All projects planned along California's coast require permits from regulatory agencies. Depending on the project, multiple permits are often required. These take time (often years) and are a common complaint among planners and project engineers. In addition, SLR mitigation and adaptation projects are extremely costly. Therefore, the Grand Jury recognizes that our locally elected state officials should be asked to help expedite our SLR plans and assist the County in securing funding from all available sources: state, national, and non-profit foundations.

The Grand Jury believes SLR planning needs to be a priority among all elected officials in the County. The County of Humboldt; the cities of Arcata and Eureka; and the Humboldt Bay Harbor, Recreation, and Conservation District should formally state their immediate and continuous support for, and commitment to, SLR mitigation and adaptation efforts.

Glossary

Terms:

Adaptation: Adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which minimizes harm or takes advantage of beneficial opportunities.

Coastal professionals: Individuals in careers related to coastal and ocean issues: scientists, educators, engineers, environmental consultants, professional public planners, and public employees in state agencies that are responsible for the protection of California's environment.

Hydrologic Unit: a surface drainage area or a groundwater basin or a combination of both.

Inundation: Inundation as used in this report is a form of tidal flooding. Intertidal areas are those lands above the lowest tide and below the highest tide elevations that periodically experience tidal inundation. Areas that are below the lowest tide elevation are submerged lands, and thus are permanently inundated.

King Tide: The highest predicted high tide of the year at a coastal location. It occurs when the orbits and alignment of the Earth, moon, and sun combine to produce the greatest tidal effects of the year.

Mean sea level: The average relative sea level over a period, such as a month or a year, long enough to average out transients such as waves and tides.

Relative sea level: Combination of regional sea level measured by a tide gauge and the vertical land motion of the land measured with GPS.

Sea level: The height of the ocean relative to land; tides, wind, atmospheric pressure changes, heating, cooling, and other factors cause sea level changes.

Storm surge: A rise above normal water level on the open coast due to the action of wind stress on the water surface. Storm surge resulting from a hurricane also includes the rise in water level due to atmospheric pressure reduction as well as that due to wind stress.

Subsidence: Sinking or down-warping of a part of the earth's surface; can result from seismic activity, changes in loadings on the earth's surface, fluid extraction, or soil settlement.

Tectonic: Of or relating to the structure of the earth's crust and the large-scale processes that take place within it.

Thermal Expansion: The process whereby water increases in volume due to an increase in temperature

Tidelands: Lands which are located between the lines of mean high tide and mean low tide.

Vulnerability: The extent to which a species, habitat, ecosystem, or human system is susceptible to harm from sea level rise impacts. More specifically, the degree to which a system is exposed to, susceptible to, and unable to cope with, the adverse effects of sea level rise, and tidal extremes.

Acronyms:

CCC: California Coastal Commission

CDP: Coastal Development Permit

HBAP: Humboldt Bay Area Plan

IPCC: Intergovernmental Panel on Climate Change

LCP: Local Coastal Plan/Local Coastal Program

NOAA: National Oceanic and Atmospheric Administration

OPC: Ocean Protection Council

SLR: Sea Level Rise

Methodology

The Grand Jury conducted interviews with individuals knowledgeable on the subject of SLR in Humboldt Bay. They included professional public planners from Humboldt County, Arcata, and Eureka; officials from Humboldt County, the Humboldt Bay Harbor, Recreation and Conservation District, The Coastal Commission, The Coastal Conservancy; environmental consultants; scientists; a tribal representative; the director of a local non-profit organization; and a state legislative analyst.

The Grand Jury also read SLR related reports and powerpoint presentations published by and for the County since 2015 as well as news reports on the current status of worldwide climate change.

Discussion

Climate change due to global warming has already caused severe wildfires, droughts and storms. SLR is less obvious today but will be just as destructive in the years to come. (See the appendix for a discussion of the latest climate change predictions.)

The National Oceanic and Atmospheric Administration (NOAA) earlier this year claimed “*by 2050, moderate (typically damaging) flooding is expected to occur ten times as often as it does today . . .*”² And, climate scientists in all disciplines agree that the question is **not** if sea level will increase to a certain height, but when. Therefore, it is useful to begin our discussion with the science behind SLR.

The Science of SLR

Sea levels are rising worldwide. This is due to increasing global temperature. The rise in global temperature contributes to rising sea levels in two different ways: 1) the melting of glaciers and ice on land which adds more water to the oceans; and 2) the thermal expansion of water due to an increase in water temperature.

The movement of tectonic plates can increase, decrease or have no impact on the way SLR is experienced in a given area. If the area being measured is on a tectonic plate that is being uplifted, i.e. Crescent City, relative sea level rise will be reduced. In areas where the tectonic plate is subducting, i.e. Humboldt Bay, relative sea level rise will be increased due to subsidence, i.e. the lowering of the ground level. Subsidence may also occur by the land sinking due to the

² “2022 Sea Level Rise Technical Report”. *National Ocean Service*.

compaction of soil caused by the weight of buildings and other development, as well as by mineral and water extraction.

Most people think of SLR as a problem when barriers get overtopped. They often overlook inundation that occurs when water seeps through the barriers. Few realize that even with well-maintained barriers, sea water will permeate through the barriers and intrude into the ground water on the other side. This process is known as salt water intrusion and must be considered when protecting our threatened areas.

SLR Projections for Humboldt Bay: 2000-2100

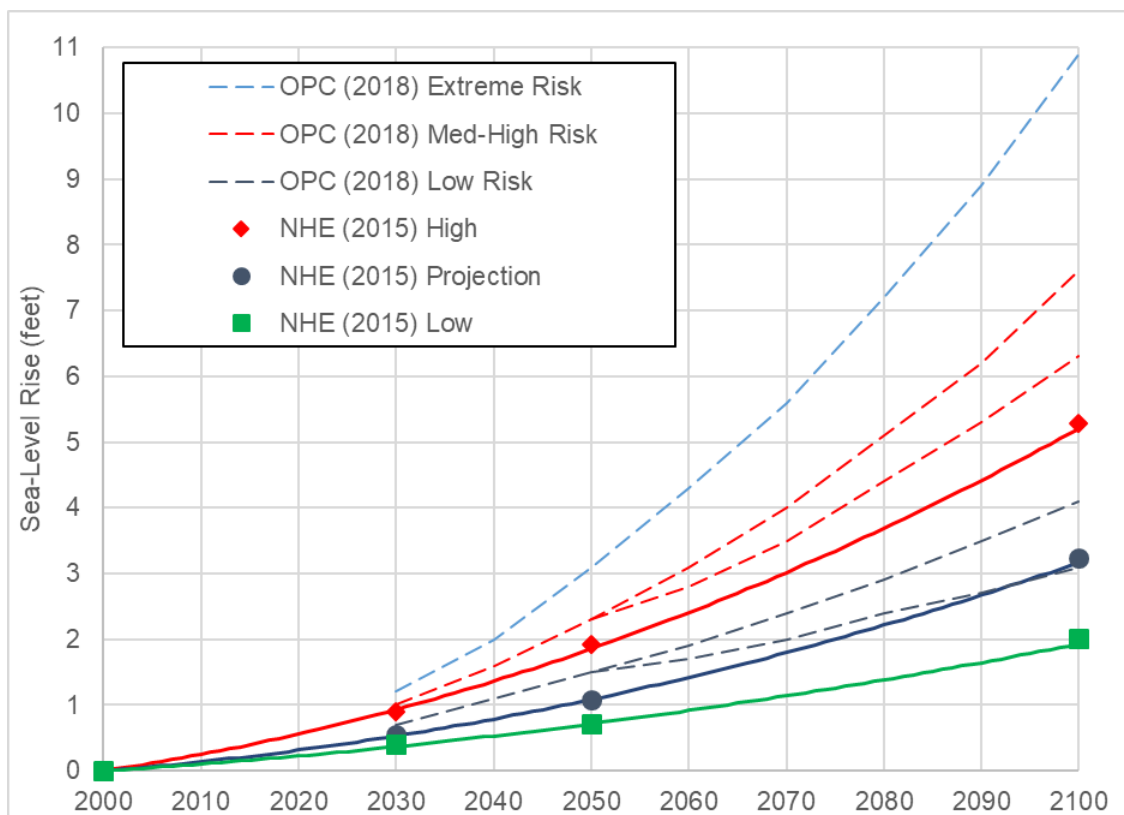


Figure 1 (above) is a combination of data developed by Northern Hydrology and Engineering in 2014 based on the science available at that time and prediction data from the Ocean Protection Council in 2018 (note, SLR is measured in feet).

Vulnerabilities³

The expected impacts of SLR throughout Humboldt Bay include such things as shoreline breaching and overtopping, backwater effects in tributaries draining into the bay, reduced efficiency of shoreline water control structures, rising groundwater levels, and saltwater intrusion.

Seventy-five percent of Humboldt Bay's shoreline (77 miles) is artificial. 41 of those miles are earthen dikes and 11 miles are railroad beds. These were constructed between 1890 and 1915. Of those 41 miles of earthen dikes, only 11.7 miles are fortified. Salt marsh plains (natural shoreline infrastructure) can reduce wave energy and therefore offer protection to shoreline structures such as dikes. There are 18.1 miles of natural shoreline with attached salt marsh plains which represents 44.5% of the diked shoreline.

When breached, the 25.7 miles of highly vulnerable shoreline structures will expand the tidal inundation footprint of Humboldt Bay by 52% or nearly 9,000 acres. Breaching of dikes has already begun partially due to lack of, or deferred, maintenance. King Tides have also been a contributor. In addition to the dikes, there are 62 tide gates whose effectiveness can be compromised by rising sea levels. Areas impacted the most will include the Eureka Slough (7.13 miles), South Bay (5.1 miles), Mad River Slough (4.4 miles) and Arcata Bay and its railroad shoreline (4.0 miles).



Dike overtopped during a King Tide inundating lands on South Bay⁴

³ Data in this section comes from: *Humboldt Bay Area Plan: Sea Level Rise Vulnerability Assessment*, 2018

⁴ Photo by Aldaron Laird

There are approximately 11.4 miles (28%) of the 41 miles of diked shoreline that are vulnerable to being breached with 2.0 feet of SLR. That would increase to 23.4 miles (57%) with 3.0 feet of SLR.

Humboldt Bay's landmass is subsiding at a rate of 0.14 inches per year⁵ at the North Spit and sea level is rising due to glacial melting and the thermal expansion of water. The Grand Jury believes immediate action must be taken. The longer we wait, the greater the adverse effects of SLR.

Three shoreline communities are presently being impacted by the increases in SLR. They are the unincorporated areas of King Salmon, Fields Landing and Fairhaven/Finntown. High tides and especially King Tides are impacting King Salmon and Fields Landing, causing flooding and damage. Fairhaven/Finntown are not yet impacted by tidal actions, but because they do not have a wastewater treatment plant and instead rely on septic and leach field systems, they are finding those systems become nonfunctional at very high tides. Property values within these communities are suffering because of these impacts.

Other areas impacted by a three-foot rise in sea level were listed in the summary section above. Due to the number and importance of these items, the list is repeated here:

- The only access road to King Salmon
- PG&E's Humboldt Bay Generating Station and the interim spent nuclear fuel site
- Highway 101 as it traverses South Bay, Elk River Slough, and Arcata Bay
- Highway 255 on the Mad River Bottoms
- Approximately 12 miles of railroad and the current and future sections of the Humboldt Bay Trail within the Humboldt Bay Area Plan (HBAP) planning area
- Approximately 9.6 miles of municipal water transmission lines
- The Truesdale pump station, seven wastewater lift stations, and 10.5 miles of sewer lines
- 30 electrical transmission towers and 113 transmission poles
- Sections of the South and North Jetties (867 ft. and 1,214 ft. respectively)
- Three of the 10 bulk cargo/commercial docks
- Several contaminated sites, including former pulp mills (Simpson in Fairhaven, Sierra Pacific in Manilla) and former Southern Pacific Railyard (Arcata)
- 52 Wiyot cultural sites

⁵ Patton et. al 2017

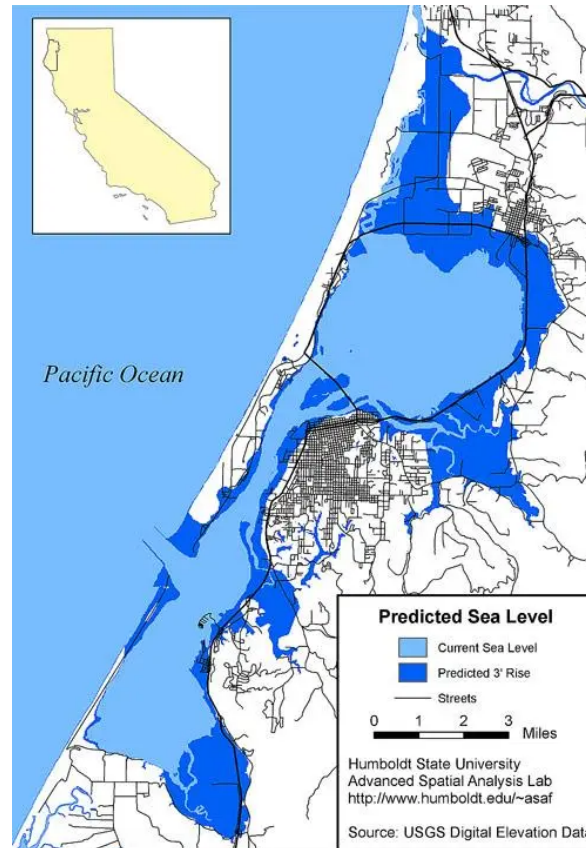


Figure 2 Predicted inundation of Humboldt Bay with three feet of SLR.

Getting Organized

There is considerable public interest in SLR. In the past two years there have been over 24 articles in local media. Staff planners at Humboldt County, Arcata, and Eureka have worked to educate the public about this issue. The Humboldt County Planning Department alone has helped fund numerous studies and held informational meetings to educate the public and all involved stakeholders. Between 2018 and 2022, the Planning Department has helped sponsor at least 22 public workshops. In June and July 2021, in cooperation with the California Coastal Commission (CCC) and Cal Poly Humboldt, the Planning Department sought feedback from people living in areas vulnerable to SLR. They conducted a non-random survey of over 500 county residents on their opinions and concerns about SLR. Almost half the participants believed SLR was now impacting Humboldt Bay and their lives.

In 2018, Cal Poly Humboldt established the Sea Level Rise Initiative⁶ as a collaboration between the University and interested parties representing a broad spectrum of public and private groups

⁶www.digitalcommons.humboldt.edu/hsuslri

including tribes, academics, professionals, local government agencies, and community and nonprofit groups. Undergraduate and graduate students participate through research and reports. Along with the University library, the Initiative acts as a collection for interdisciplinary research, SLR studies, and theses.

The SLR Initiative also helps organize the Humboldt Bay Symposium, a public 2-3 day workshop held every two years, where the general public can learn about the latest developments on a variety of current issues related to the Humboldt Bay ecosystem from a collaboration of local parties. The 2021 Symposium titled “Sustainable Blue Economy” devoted its entire third day to the issue of SLR.

The Osher Lifelong Learning Institute (OLLI) at Cal Poly Humboldt has held a series of classes on SLR led by Aldaron Laird and Jerry Rhode. They were so popular that OLLI created a Special Sea Level Rise Interest Group that meets monthly.

Humboldt County is fortunate to have a variety of nonprofit organizations also involved with the issue of SLR. These organizations all have dedicated staff and volunteers to bring public awareness to this subject. Included in this group are Humboldt Baykeeper, Northcoast Environmental Center, Friends of the Dunes, Friends of the Arcata Marsh, and the Surfrider Foundation.

In February 2020, the Humboldt County Planning Department received a grant for \$100,000 from the CCC for the *Humboldt Bay Sea Level Rise Regional Planning Feasibility Study*. This study will be completed by September 30, 2022. According to the grant proposal, the goal of this project is “... to develop options for SLR adaptation planning in the Humboldt Bay region that will foster a cooperative and coordinated regional approach to the identification, funding and implementation of various SLR adaption (protection, accommodation, and retreat) policies, strategies, and measures, with resulting regulatory and financial benefits.”⁷ The study includes creating an inventory of all critical assets affected by one meter or more of SLR, a survey of the affected stakeholders, and a study of all the “...federal, state, and local governmental jurisdictions with regulatory authority over the development or public trust responsibilities for natural resources.”⁸ Among coastal professionals surveyed during the Regional Feasibility Study, 70% have an overall perception SLR is already impacting the Humboldt Bay region.

Six tidally influenced drainage areas or hydrologic units divide Humboldt Bay’s 102 miles of shoreline, and these units do not correspond to jurisdictional boundaries. Each hydraulic unit has an interlocking variety of local regulatory agencies and ownership, both public and private,

⁷ Humboldt County Planning Department grant application to the California Coastal Commission awarded on 11/13/2019.

⁸ *ibid*

making cooperation difficult. But SLR adaptation and planning must consider each hydraulic unit as a whole. Treating only one area of a hydrologic unit can cause unintended damage in another section of the same unit. The eroding forest area south of Fairhaven on the North Spit is an example of erosion caused by reflective waves bouncing off the sea wall across from the entrance of the harbor.

A vast majority of our local coastal professionals agree that coordination of SLR planning and adaptation is needed. The County's Regional Feasibility Study will discuss the various ways agencies and jurisdictions can work together to implement a regional strategy. There are many regional options available. Special Districts or Joint Powers Agencies can be created. With the approval of the California State Legislature, San Mateo County created the San Mateo County Flood and Sea Level Rise Resiliency District with county-wide taxing authority to generate funds for SLR adaptation and mitigation. Another example is the San Francisco Bay Conservation and Development Commission (BCDC), a precursor to the California Coastal Act of 1976.

Partnership agreements may be written with Memorandums of Understanding and Public Works Asset Base Plans. An existing agency, like the Humboldt Bay, Harbor, Recreation and Conservation District, can be reconfigured to head coordinated efforts on SLR. All of these options would allow for planning and regional implementation of projects across jurisdictional boundaries. With a regional agency and approach, Local Coastal Plans (LCP) must be updated to include cooperating and complementary approaches.

Obstacles

Coastal professionals interviewed by the Grand Jury noted two major hurdles confronting attempts to combat the adverse effects of SLR: Permitting and Funding.

Permitting:

All regulatory agencies are authorized to decide what projects can or cannot be permitted in areas under their jurisdiction. Depending on the specific project, the number of permits required can be daunting and the application process complicated, expensive, and time consuming. For example, SLR mitigation projects proposed for Humboldt Bay could need permits from multiple regulatory agencies, such as:

Humboldt County Planning Department
Arcata Planning Department

Eureka Planning Department
Humboldt Bay Harbor, Recreation and Conservation District
California Department of Fish and Wildlife
U.S. Army Corps of Engineers
California Coastal Commission
US Fish & Wildlife Service
State Lands Commission
Regional Water Quality Control Boards

Of all the potential permits needed, the most difficult one to obtain is the Coastal Development Permit (CDP) issued by the CCC. The CCC is responsible for enforcing the provisions of the California Coastal Act of 1976. It has direct authority over 75% of Humboldt Bay's shoreline and can overrule permit decisions it ceded to local jurisdictions when approving their LCPs. Although the planners the Grand Jury interviewed generally find the regional CCC's local staff cooperative and helpful, the CCC as a whole is often criticized for contradictory rules; changing or adding application requirements mid-stream; returning applications to applicants multiple times for further documentation; and, after months (or years) working to satisfy the CCC's requirements, see the application denied. Therefore, a consensus exists that our local CCC staff must be active participants in the regional SLR mitigation agency created. Their input, support, and timely advice will be crucial for speeding up permit approvals.

Funding:

Most of the research to date concerning the timing and adverse effects of SLR in Humboldt Bay was funded by grants from the CCC and the Coastal Conservancy. Once a regional SLR mitigation agency is established, the political entities involved must finance its ongoing operations. Cost sharing formulas will need to be developed like those currently in place to financially support Humboldt County's Local Area Formation Commission (LAFCO).

These ongoing costs are only the tip of the iceberg. SLR mitigation projects will be extremely costly and far exceed the capacity of local agencies to self-finance. For example, it has been estimated the cost to repair or enlarge shoreline dikes could average \$2 million per mile. There are 41 miles of shoreline dikes around Humboldt Bay. Also, according to a CalTrans official, the recently completed Willits bypass project alone cost \$300 million.

No California coastal area can be expected to finance SLR mitigation projects without dependable sources of funding. Concerted efforts are necessary to seek out Federal, State, and non-profit foundation grants and funding. The challenge is to ensure our county gets its fair share of the funds distributed through such programs. Humboldt County will be competing with much

larger counties and regions (i.e. the San Francisco Bay area) that are sure to request a large percentage of the monies available.

The opportunities for Humboldt County to successfully compete for SLR mitigation funds are three-fold. First, Humboldt Bay has the most vulnerable SLR coastline on the West Coast and should have top priority when funds are allocated. Second, State Senator Mike McGuire is the Senate Pro-Tem leader with considerable influence. He also sits on the Senate's budget subcommittee that will allocate climate change mitigation funds so his active support for funding SLR mitigation efforts around Humboldt Bay should produce positive results. And third, a regional voice speaks louder than multiple local voices.

For these three reasons the Grand Jury was encouraged when interviewing a senior legislative analyst who is optimistic that Humboldt County is well positioned in the competition for SLR mitigation funding. For example, consider the wording in recently passed legislation.

The California Sea Level Rise Mitigation and Adaptation Act of 2021 requires the Ocean Protection Council (OPC) to create a California sea level rise state and regional support collaborative whose mandate is to determine how to allocate up to \$100 million annually to support SLR planning efforts statewide. Part of section 30973(a) in the act describes the priority the collaborative must use when allocating funds:

"...priority shall be given to those local and regional governments that have agreed most effectively and urgently to plan for and implement actions to address sea level rise."

Due to the decade of work documenting SLR adverse effects on the communities, infrastructure, and environment surrounding Humboldt Bay, the county is far ahead of most California coastal areas in identifying and planning SLR mitigation actions. We must establish a regional agency to speak in a unified voice when seeking SLR mitigation funding.

Findings

F1. There is significant public interest in when and how Sea Level Rise (SLR) will impact life around Humboldt Bay.

F2. The Grand Jury agrees with the coastal professionals who deal with SLR mitigation and adaptation planning who are nearly unanimous (95%) in the belief that all entities must collaborate to successfully find solutions to the adverse effects SLR poses to the infrastructure and communities surrounding Humboldt Bay.

F3. Any SLR adaptation and mitigation regional planning group will incur ongoing costs in salaries, benefits, and overhead that will require the political entities surrounding Humboldt Bay to agree to cost sharing.

F4. The costs associated with SLR mitigation efforts will be significant and will require the diligent pursuit of Federal, State, and Public funding sources.

F5. The decade of studies that defined the areas and physical assets vulnerable to SLR around Humboldt Bay by mid-century clearly indicate there is an urgency to start developing and implementing solutions.

F6. All SLR collaboration efforts will benefit by including the permitting agencies who have the final decision on whether projects may proceed.

F7. Successful SLR mitigation efforts will benefit from the full support of our local California State Senator and Assembly Member.

F8. Former industrial and other contaminated sites around the Bay are susceptible to SLR. As such, SLR could push the contamination into wetlands, creeks, and even Humboldt Bay itself, making it harder to mitigate and clean up.

F9. Research studies of SLR impacts around Humboldt Bay indicate that if no action is taken by 2050, monthly maximum high tides will overtop bay barriers and flood existing infrastructure, wetlands and low lying communities.

Recommendations:

R1. The Grand Jury recommends the Board of Supervisors, the City Councils of both Arcata and Eureka, and the Board of Commissioners of the Humboldt Bay Harbor, Recreation, and Conservation District (Harbor District) each meet and vote to affirm a commitment to adapting to and mitigating the adverse effects of Sea Level Rise, and direct their staffs to make this commitment a priority in their planning efforts. These individual meetings and commitments should occur by September 30, 2022. (F1, F5, F9)

R2. The Grand Jury recommends the Board of Supervisors along with elected officials from Arcata, Eureka, and the Harbor District form a Humboldt Bay SLR Steering Committee composed of senior members from each entity who have decision-making authority. This committee should be formed no later than December 1, 2022. (F5)

R3. The Grand Jury recommends the Humboldt Bay SLR Steering Committee direct the implementation of a regional SLR coordination entity based on the conclusions and recommendations in the *Humboldt Bay Sea Level Rise Regional Planning Feasibility Study*. The recommended approach shall be selected no later than July 1, 2023. (F2)

R4. Once the Humboldt Bay SLR Steering Committee determines the best regional approach to implement, the Civil Grand Jury recommends the regional organization chosen be formed by July 1, 2024 and include the following stated goals:

a) seek input from all major stakeholders including, but not limited to, local and county agencies, agriculture, fishermen, aquaculture, Tribal groups, owners and occupants of threatened land, regulatory agencies, environmental groups, academia, SLR consultants, PG&E, and CalTrans; (F1, F6)

b) research and aggressively seek sources of SLR mitigation funding by State, Federal, and Public programs; (F4)

c) share the operating costs (salaries and office expenses) associated with its efforts; (F3)

d) triage the order in which mitigation/adaptation actions can be implemented; (F5, F8)

e) analyze the low-lying communities of King Salmon, Fields Landing and Fairhaven/Finntown and develop a planned retreat process for these threatened areas or find ways to successfully save them; (F5, F9)

f) solicit definitive input from regulatory agencies with jurisdiction over threatened areas so that implementation of mitigation/adaptation actions are not delayed by the permitting process; (F6, F7)

g) hold semi-annual public presentations (also available on Zoom) of the organization's activities; (F1) and

h) start mitigation projects on or before July 1, 2025. (F5)

Required Responses

Pursuant to Penal Code sections 933 and 933.05, The Humboldt County Civil Grand Jury requests responses from the following bodies within 90 days:

- Humboldt County Board of Supervisors **(F3, F4, F5, F8, F9, R1, R2)**
- The Arcata City Council **(F3, F4, F5, F8, F9, R1, R2)**
- The Eureka City Council **(F3, F4, F5, F8, F9, R1, R2)**
- The Board of Commissioners of the Humboldt Bay Harbor, Recreation, and Conservation District **(F3, F4, F5, F8, F9, R1, R2)**

Invited Responses

- State Senator Mike McGuire
- State Assembly Representative Jim Wood
- Melissa Kraemer, North Coast Regional Director, California Coastal Commission:

Appendix

The California Coastal Commission's SLR guidance document published in 2015 recommended that all coastal communities use the high greenhouse gas emission projections when updating their LCPs. This report has done so when presenting the adverse impacts of SLR around Humboldt Bay.

The question in 2022 is whether or not the projections developed almost a decade ago are still valid. (As the graph on page six indicates, SLR high projections have increased between 2015 and 2018.) The 2015 Paris Accord based future SLR projections on the assumption nations would decrease their greenhouse gas emissions to limit global warming to no more than 2.0 degrees celsius (3.6°F) by 2100 and set a goal of limiting warming to only 1.5°C (2.7°F) by the

end of the century. Unfortunately, recent data suggests these goals are rapidly becoming unachievable.

In November 2021, the United Nations' Environment Program based in Nairobi issued its latest Emissions Gap Report which measures the difference between planned carbon cuts and what is actually needed to avoid devastating warming. It noted that current plans will reduce global greenhouse gas emissions by 3.2 billion tons by 2030, but emissions need to shrink another 14.3 billion tons to limit temperature rises to 2°C, and 30.9 billion tons to keep warming to 1.5°C. It said, *“plans to cut greenhouse gas emissions are nowhere near deep enough to prevent the planet from warming a catastrophic 2.7°C by the end of the century.”*⁹

Then in April of this year the Intergovernmental Panel on Climate Change (IPCC) issued an alarming report on the shortfall between promised emissions cuts versus the actual reduction nations have so far achieved.¹⁰ The report states *“projected global emissions from (national pledges) place limiting global warming to 1.5°C (2.7°F) (by 2100) beyond reach and make it harder after 2030 to limit warming by 2°C (3.6°F).”*¹¹

The report authors also claim with “high confidence” that without greater efforts by countries and corporations to cut greenhouse gas emissions the planet will, on average, be 2.4°C to 3.5°C (4.3°F to 6.3°F) warmer by 2100.

Those temperatures are alarming. Melting glaciers in Greenland and Antarctica contribute to SLR and global temperatures now are causing concern. News reports earlier this year informed us that Antarctica's ice shelves are melting. The Thwaites ice shelf, the size of Florida, in western Antarctica could disintegrate within ten years. This past March, in eastern Antarctica, which scientists thought was less affected by global warming, the Conger ice shelf, which is the size of New York City, disintegrated within days. Failing ice shelves such as these are important because they act as “bottle-stoppers” holding back the immense land-based glaciers behind them.

Lack of aggressive actions to limit greenhouse gas emissions isn't the only problem that will contribute to more frequent flooding by the middle of the next decade. Even now we are witnessing “bomb cyclones”, extreme weather events like the massive storm that hit the Pacific Northwest last year resulting in major flooding.¹² And if this isn't enough, the earth has a “moon wobble” problem.

⁹ *The Week* magazine, 11/5/2021: p.9

¹⁰ *Climate Change 2022: Mitigation of Climate Change*, IPCC, 4/4/2022

¹¹ *ibid*

¹² <https://www.climatesignals.org/climate-signals/intense-cyclone-hurricane-typhoon-frequency-increase#more>

News reports in 2021 informed us that the moon wobbles back and forth on an 18-year cycle. At one side of the cycle the moon's gravitational pull on oceans is stronger than the other side. We are presently in the trough of the cycle where tides are mildly affected. By 2030 we will begin witnessing the peak of the cycle when tides will be larger and stronger resulting in more flooding along the earth's coastlines.¹³

The April IPCC report tried to assure readers that all is not lost. It states, "*on technological and cost considerations alone, mitigation of emissions to limit warming to 1.5°C (2.7°F) is feasible . . .*" However, the report goes on to say that to achieve this goal worldwide coal usage must be slashed 95%, oil consumption by 60%, and natural gas consumption by 45% by 2050. (An unlikely scenario based on the tepid effort, to date, to reduce greenhouse gasses.)

Jim Skea, co-chair of the IPCC working group, noted "there is increased evidence of climate action" referring to technologies and policies that do exist to enable sharp reductions in emissions – if the political will exists to implement them.

As examples of these promising technologies, the IPCC report mentions the increased adoption of alternative energy sources as their costs continue to decline. The report noted that between 2010-2019 the cost of both solar energy and lithium-ion batteries declined 85% and wind energy by 55% making them cheaper options than conventional energy sources in many cases.

Also noted were efforts to decrease the amount of methane gas released into the atmosphere. Methane, although less of a greenhouse gas contributor by volume than carbon dioxide, creates 30 times the greenhouse effect as carbon dioxide. Capping the release of methane from dormant oil wells and the extraction and transportation of natural gas (referred to as "fugitive emissions") would have a noticeable impact on decreasing global warming.

Other mitigation measures are being discussed with differing opinions on their feasibility and advisability. These include such things as developing methods to extract carbon dioxide from the atmosphere, planting or replanting forests to absorb CO₂ as it is produced, and turning more acreage into the production of biofuels (vegetable matter) to burn rather than fossil fuels.

Co-chair Skea spoke for the IPCC when he said: "*It's now or never, if we want to limit global warming to 1.5°C. Without immediate and deep emission reductions across all sectors, it will be impossible.*"¹⁴

¹³ www.npr.org/2021/07/14/1015800103/a-study-predicts-record-flooding-in-the-2030s-and-its-partly-because-of-the-moon

¹⁴ "It's now or never: UN climate reports' 4 urgent takeaways", *National Geographic*, 4/4/2022. <http://www.nationalgeographic.com>

Optimists and pessimists alike will have to wait for the answer to the question of how disruptive climate change will be and how it will affect SLR in the short term and throughout this century. Meanwhile, the Grand Jury believes we should adhere to the adage: “hope for the best, but prepare for the worst”.

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