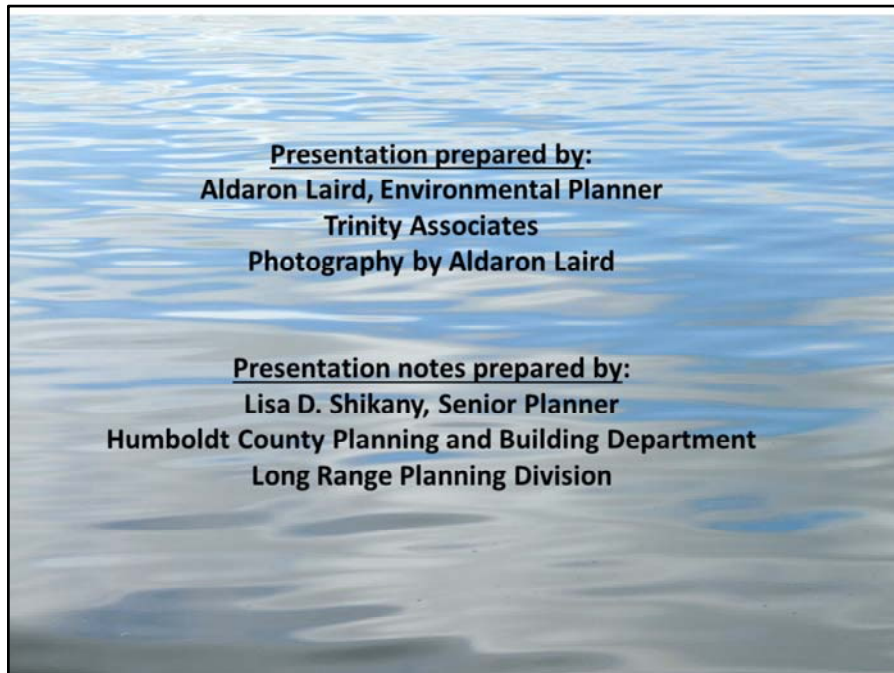




The audience for sea level rise issues includes property owners, residents, business owners, the general public, utility providers, and transportation agencies. Maximizing public participation in the sea level rise adaptation planning process is critical to ultimately adopting a suite of sea level rise policies that will hopefully be successful.

This presentation is available at Humboldt County's Local Coastal Plan Update webpage at the following link: <https://humboldt.gov/1678/Local-Coastal-Plan-Update>



This PowerPoint presentation was prepared by Aldaron Laird, and was presented at the workshop by Mr. Laird, Humboldt County and the California Coastal Commission.

The County, with the assistance of Mr. Laird, prepared the explanatory notes provided in this document for each of the slides.

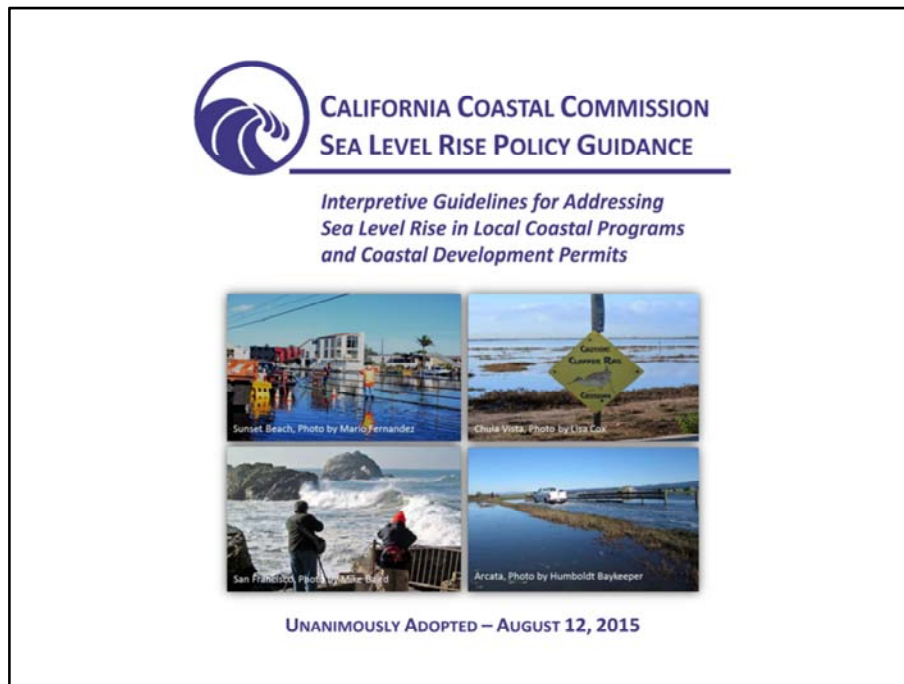
AGENDA

- 5:45 – 6:00: Registration, refreshments and poster session**
- 6:00 – 6:05: Rex Bohn, 1st District Supervisor – Introduction**
- 6:05 – 6:10: John Ford, Planning Director – Introductions and opening remarks**
- 6:10 – 6:30: Aldaron Laird, Consultant – CAR SLR strategic adaptation planning presentation**
- 6:30 – 6:50: Michael Richardson, Supervision Planner – Humboldt Bay Area Plan sea level rise policy and planning process**
- 6:50 – 6:55: John Miller – Humboldt Bay Tsunami Safety Planning**
- 6:55 – 7:00: Bob Merrill, CCC – Residential SLR adaptation policy; specific King Salmon CDP**
- 7:15 – 7:55: Comments Questions**
- 7:55 – 8:00: Closing remarks**
- Adjourn**

This slide provides the agenda for the workshop.

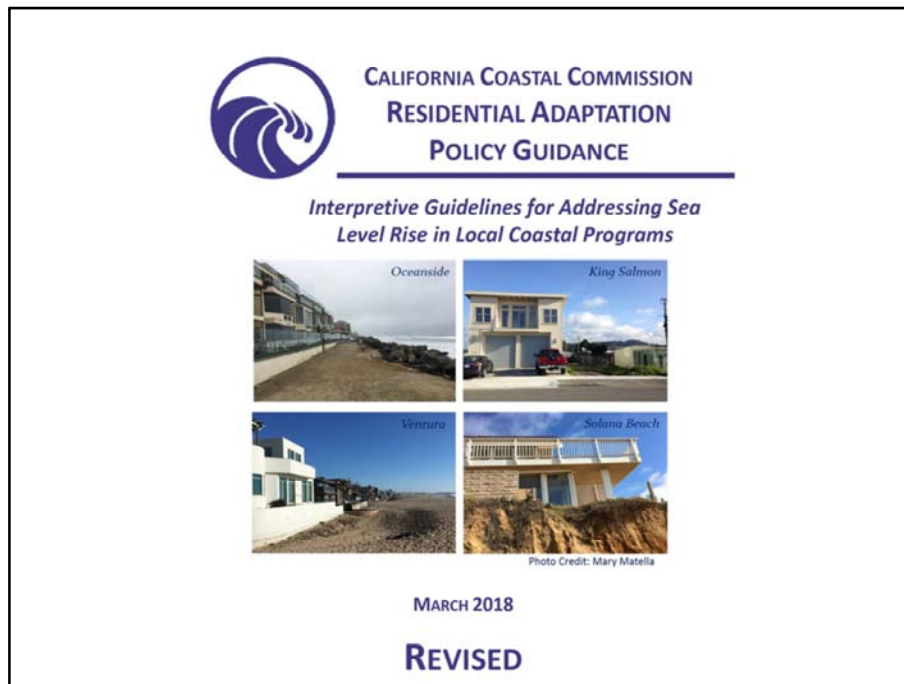


We will discuss why we should plan for sea level rise, when sea level rise will impact us, how sea level rise will impact us, where sea level rise will impact us, what can be done about these sea level rise impacts, and who will address these sea level rise impacts.



The Coastal Commission adopted a sea level rise policy guidance document in August of 2015. This guidance document is advisory, and is not a regulatory document or legal standard of review for the actions that the Commission or local governments may take under the Coastal Act.

As stated in the Introduction of this document, this Guidance provides a framework for addressing sea level rise in Local Coastal Programs (LCPs) and for coastal development permits (CDPs). The intended audience for this guidance document includes the Coastal Commission and Commission staff, local governments, other public agencies, permit applicants, members of the public, and others who are interested in how to implement and comply with the California Coastal Act (Coastal Act) while taking steps to address sea level rise. The California Coastal Commission Sea Level Rise Policy Guidance can be found at the following link: <https://www.coastal.ca.gov/climate/slrguidance.html>



The California Coastal Commission Residential Adaptation Policy Guidance is a next step following the Commission’s 2015 Sea Level Rise Policy Guidance, which sets forth broad principles related to planning for sea level rise. This Residential Adaptation Policy Guidance provides a more in-depth discussion of sea level rise adaptation policies specifically related to residential development, and provides sample policies that cities and counties could modify for use in different community and geologic contexts.

Like the 2015 policy guidance document, this Residential Adaptation Policy Guidance is advisory and not a regulatory document or legal standard of review for the actions that the Commission or local governments may take under the Coastal Act. This document has not yet been adopted by the Coastal Commission. The latest drafts as well as previous drafts are available at the following link:

<https://www.coastal.ca.gov/climate/slr/vulnerability-adaptation/residential/>

Humboldt County Humboldt Bay Area Plan



Projected Inundation Area (Stillwater) on Humboldt Bay
for Mean Monthly Maximum Tide with 6.6 feet (2.0 meters) of Sea Level Rise

Sea Level Rise Vulnerability Assessment

The County's Local Coastal Program (LCP) provides the planning mechanism for implementing sea level rise adaptation strategies. The Humboldt Bay Area Plan (HBAP) is one of six coastal plans that comprise the County's LCP. The County is in the process of updating the HBAP, including adding policies to address sea level rise.

As part of the initial sea level rise planning effort, the County contracted with Aldaron Laird, Trinity Associates, to prepare the Humboldt Bay Area Plan Sea Level Rise Vulnerability Assessment, which identifies what assets in the Humboldt Bay area are vulnerable to, or at risk from, sea level rise. The broad asset categories examined include the existing shoreline, land uses, transportation, utilities, and coastal resources. The report describes the location and characteristics of these assets, the extent and timeframe of exposure of these assets to various sea level rise elevations, and the susceptibility of these assets to tidal inundation (salt water intrusion and flooding). This document can be found at the following link on the County's Local Coastal Plan Update website:

<https://humboldt.gov/DocumentCenter/View/62872/Humboldt-Bay-Area-Plan-Sea-Level-Rise-Vulnerability-Assessment-Report-PDF?bidId=>

King Salmon & Fields Landing Daily High Tide



These next few slides will reveal the potential footprint of various sea level rise elevations in King Salmon and Fields Landing if nothing is done to alter shoreline conditions.

The urban/residential area of Fields Landing has a surface elevation of approximately 6 to 8 feet, and the Fields Landing waterfront has a higher surface elevation of approximately 9 to 11 feet. The residential/commercial area of King Salmon has a surface elevation of approximately 8 to 10 feet. The daily high tide (Mean Higher High Water, MHHW) is 6.5 feet (NAVD 88). This slide shows inundation under today's MHHW.

King Salmon & Fields Landing 1.6 feet Sea Level Rise-Daily High Tide



The daily high tide (Mean High Higher Water, MHHW) elevation with 1.6 feet (0.5 meters) of sea level rise would be 8.1 feet in approximately 25 years based on high projections, and could occur 182+ times per year. This slide shows what this inundation footprint would be, assuming nothing is done to change the shoreline conditions.

The surface elevation of the residential area of Fields Landing is approximately 6-8 feet, the Fields Landing waterfront has a higher surface elevation of approximately 9 to 11 feet, and the King Salmon surface elevation is 8-10 feet.

King Salmon & Fields Landing 1.6 feet Sea Level Rise-Monthly High Tide



The monthly high tide (Mean Monthly Maximum Water, MMMW) elevation with 1.6 feet (0.5) meters of sea level rise would be 9.3 feet in approximately 25 years based on high projections, and could occur 8 times per year or combined with king tides, would be reached or exceeded 12 times a year. This slide shows what this inundation footprint would be, assuming nothing is done to change the shoreline conditions.

The surface elevation of the residential area of Fields Landing is approximately 6-8 feet, the Fields Landing waterfront has a higher surface elevation of approximately 9 to 11 feet, and the King Salmon surface elevation is 8-10 feet.

King Salmon & Fields Landing 1.6 feet Sea Level Rise-King Tide



The king tide (Mean Annual Maximum Water, MMMW) elevation with 1.6 feet (0.5 meters) of sea level rise would be 10.4 feet in approximately 25 years based on high projections, and could occur 4 times per year. This slide shows what this inundation footprint would be, assuming nothing is done to change the shoreline conditions.

The surface elevation of the residential area of Fields Landing is approximately 6-8 feet, the Fields Landing waterfront has a higher surface elevation of approximately 9 to 11 feet, and the King Salmon surface elevation is 8-10 feet.

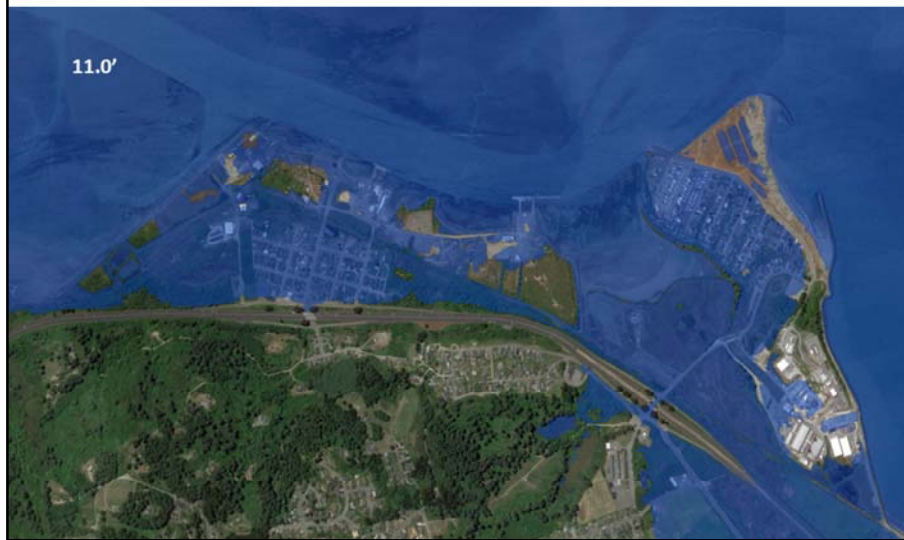
King Salmon & Fields Landing 3.3 feet Sea Level Rise-Daily High Tide



The daily high tide (Mean High Higher Water, MHHW) elevation with 3.3 feet (1 meter) of sea level rise would be 9.8 feet in approximately 50 years based on high projections, and could occur 182+ times per year. This slide shows what this inundation footprint would be, assuming nothing is done to change the shoreline conditions.

The surface elevation of the residential area of Fields Landing is approximately 6-8 feet, the Fields Landing waterfront has a higher surface elevation of approximately 9 to 11 feet, and the King Salmon surface elevation is 8-10 feet.

King Salmon & Fields Landing 3.3 feet Sea Level Rise-Monthly High Tide



The monthly high tide (Mean Monthly Maximum Water, MMMW) elevation with 3.3 feet (1 meter) of sea level rise would be 11.0 feet in approximately 50 years based on high projections, and could occur approximately 8 times per year or combined with king tides, would be reached or exceeded 12 times a year. This slide shows what this inundation footprint would be, assuming nothing is done to change the shoreline conditions.

The surface elevation of the residential area of Fields Landing is approximately 6-8 feet, the Fields Landing waterfront has a higher surface elevation of approximately 9 to 11 feet, and the King Salmon surface elevation is 8-10 feet.

King Salmon & Fields Landing 3.3 feet Sea Level Rise-King Tide



The king tide (Mean Annual Maximum Water, MAMW) elevation with 3.3 feet (1 meter) of sea level rise would be 12.1 feet in approximately 50 years based on high projections, and could occur approximately 4 times per year. This slide shows what this inundation footprint would be, assuming nothing is done to change the shoreline conditions.

The surface elevation of the residential area of Fields Landing is approximately 6-8 feet, the Fields Landing waterfront has a higher surface elevation of approximately 9 to 11 feet, and the King Salmon surface elevation is 8-10 feet.

Why Plan for Sea Level Rise?

- **Update Local Coastal Program to address Sea Level Rise**
- **Humboldt Bay has the Highest Rate of Sea Level Rise on the West Coast ~ 18"/Century**
- **Educate Local Government, Public, and Property Owners**
- **Protect Property, Infrastructure, and Coastal Resources**
- **Advance Planning to Ensure adequate Time for Adaptation**

Governor Brown's Executive Order B-30-15 establishes a California greenhouse gas reduction target of 40 percent below 1990 levels by 2030. The Executive Order requires state agencies to take climate change into account in their planning decisions.

It is important to plan for sea level rise now and into the future, particularly since Humboldt Bay has the highest rate of sea level rise on the west coast due to rising ocean levels in combination with ground subsidence caused by tectonic activity. The current sea level rise planning process will help to identify assets that are vulnerable to sea level rise, with the goal of protecting critical assets to the extent feasible, and ensuring adequate time for the community to otherwise adapt to rising seas. A robust planning process, beginning with updating the County's local coastal program, which functions as the planning framework for development within the coastal zone, will provide a venue for educating local agencies and the community.

King Tide King Salmon



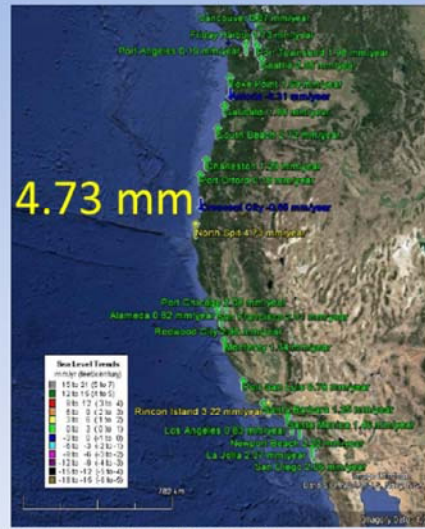
Recent nuisance saltwater flooding in King Salmon during a king tide.

King Tide Fields Landing



Recent nuisance saltwater flooding during a king tide in Fields Landing.

Relative Sea-Level Rise



Relative or Local Mean Sea-Level Rise (RSLR):

- Average sea-level rise measured at a tide gauge relative to a specific point on land (e.g. North Spit Tide Gauge)
- RSLR can be different than GSLR or ReSLR due to local factors such as
 - Local climate and ocean patterns (e.g. ENSO and PDO)
 - Vertical land motion
 - Tide gauge record length

RSLR rates:

- RSLR has been increasing over most of US West Coast consistent with GSLR and ReSLR trends, but at different rates
- Green values range from 0 to 3 mm/yr (all show increasing rates of SLR, constant with ReSLR)
- Yellow values range from 3 to 6 mm/yr (higher than ReSLR)
- Blue values indicate negative RSLR (lower than ReSLR)
- North Spit and Crescent City RSLR appear to be the two extremes

NHE 2013

The north spit tide gage shows the highest rate of relative sea level rise on the West Coast, 18.6 inches per century or 0.186 inches (4.73 millimeters) per year.

Cascadia GeoSciences

Humboldt Bay: Sea Level Rise, Hydrodynamic Modeling, and Inundation Vulnerability Mapping

Prepared for
**State Coastal Conservancy, and
 Coastal Ecosystems Institute of Northern California**

Tectonic land level changes and their contribution to sea-level rise, Humboldt Bay region, Northern California

2017 Final Report
 FWS Agreement # 813318J244
 Award # F11AC01092
<http://hbv.cascadiageo.org>

Jason R. Patton^{1,2}, Todd B. Williams³, Jeff Anderson³, Tom H. Leroy⁴, Kyle Weiss⁵, Reed Burgette^{6,8}, Ed Southwick⁷, Whelan Gilkerson³, Eric Nelson⁷, Jay Stallman^{6,8}, Susan Schlosser⁹, Mark Hemphill-Haley², Diane Sutherland¹⁰, Ray Weldon⁹, student volunteers^{2,4}.

1. Cascadia GeoSciences
2. Humboldt State University
3. Northern Hydrology and Engineering
4. Pacific Watershed Associates
5. New Mexico State University
6. University of Oregon
7. US Fish and Wildlife Service
8. Stillwater Sciences
9. California Sea Grant
10. US Forest Service

Final Report
 April 2015

Prepared by
Northern Hydrology & Engineering

Cascadia GeoSciences’ tectonic trends research and the Northern Hydrology & Engineering Relative Sea Level Rise Modeling and Mapping work on Humboldt Bay form the basis or foundation for focused sea level rise vulnerability assessments and adaptation planning.

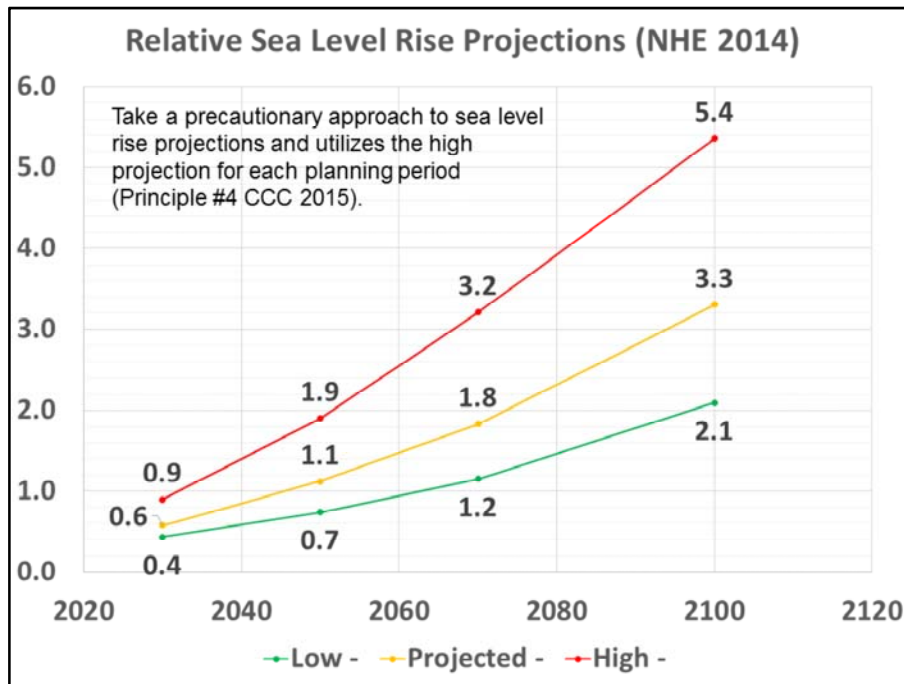
Sea Level Rise Planning on Humboldt Bay

- 1. Shoreline Inventory, Mapping and Sea Level Rise Vulnerability Assessment; 2013**
- 2. Tectonic Land Level Changes on Humboldt Bay; 2014**
- 3. Relative Sea Level Rise Projections; 2014**
- 4. Sea Level Rise, Hydrodynamic Modeling, and Inundation Vulnerability Mapping; 2015**
- 5. Regional Vulnerability Assessment and Adaptation Planning Working Group; 2015**
- 6. Caltrans District 1 Climate Change Pilot Study; 2016**
- 7. Local Coastal Program Sea Level Rise Vulnerability Assessments: Humboldt County, City of Eureka, and City of Arcata; 2015-2018**
- 8. Sea-Level Rise in the Humboldt Bay Region; (Anderson 2018)**

This is a list of some of the documents that have been prepared to address sea level rise on Humboldt Bay. These documents are available through the County's local coastal program update webpage at: <https://humboldt.gov/1678/Local-Coastal-Plan-Update> or through the Humboldt Bay Harbor, Recreation and Conservation District's webpage: <http://humboltdbay.org/humboldt-bay-sea-level-rise-adaptation-planning-project>.

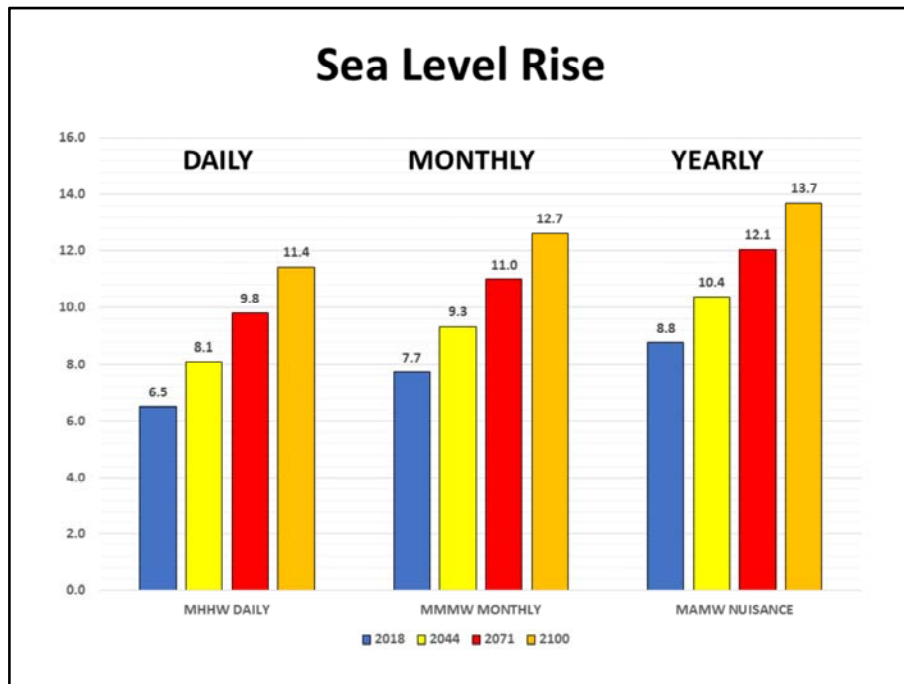


When will sea level rise impact us?



This slide shows the low, projected, and high sea level rise projections around Humboldt Bay: High for 2030 = 0.9 feet, 2050 = 1.9 feet, 2070 = 3.2 feet, and for 2100 = 5.4 feet. The high range is precautionary (would provide greater notice of pending hazard) while low range is conservative (would encumber less area in a hazard zone).

High projections beyond 2050 are constantly being revised upwards, and are now projected to be approximately 6.6 feet or more by 2100 (Griggs 2017). But on Humboldt Bay, the greatest impact in terms of area impacted will occur with the first 3 feet of sea level rise, after which inundation and floodwaters will generally deepen without a substantial increase in the area they cover.



This graph illustrates the impact of sea level rise on three different tidal frequencies during the next 80 years:

- Daily high tide (Mean Higher High Water, MHHW) – occurs 182+ times per year, considered perennial flooding
- Monthly high tide (Mean Monthly Maximum Water, MMMW) – occurs 8+ times per year, considered chronic flooding
- Yearly high tide or king tide (Mean Annual Maximum Water, MAMW) – occurs 4+ times per year, considered nuisance flooding

To put the impacts of these tides into perspective, the surface elevation of the residential area of Fields Landing is approximately 6-8 feet, the Fields Landing waterfront has a higher surface elevation of approximately 9 to 11 feet, and the King Salmon surface elevation is 8-10 feet. With 1.6 feet of sea level rise (0.5 meters) that could occur in approximately 2050, the current MAMW elevation would be reached 125 times per year, and would be exceeded 355 times per year with 3.3 feet (1 meter) of sea level rise expected by approximately 2070. (NHE 2018)

King Tide King Salmon



Recent nuisance saltwater flooding during a king tide in King Salmon.

King Tide Fields Landing



Recent nuisance saltwater flooding during a king tide in Fields Landing.



When will SLR start to affect critical assets in the Humboldt Bay area, and when will the inundation from sea level rise become more than nuisance flooding? This slide shows what future high water elevations could be if we do nothing to protect our communities from sea level rise. For example, in King Salmon and Fields Landing, residential and commercial areas (the surface elevation of the residential area of Fields Landing is approximately 6-8 feet, the Fields Landing waterfront has a higher surface elevation of approximately 9 to 11 feet, and the King Salmon surface elevation is 8-10 feet) currently impacted by king tides (8.8 feet, which occur 4 times per year), could be impacted by tidal inundation greater in elevation than today's king tides on a monthly basis (Mean Monthly Maximum Water or MMMW elevation of 9.3 feet with 1.6 feet of sea level rise) by approximately 2044, and on a daily basis (Mean Higher High Water or MHHW elevation of 9.8 with 3.3 feet of sea level rise) by approximately 2070. To put the impacts of these tides into perspective, the surface elevation of the residential area of Fields Landing is approximately 6-8 feet, the Fields Landing waterfront has a higher surface elevation of approximately 9 to 11 feet, and the King Salmon surface elevation is 8-10 feet.

The residential area of King Salmon is already experiencing nuisance flooding, which will become chronic monthly flooding (shown in yellow) and eventually daily or perennial flooding (shown in red).



How will sea level rise impact us?

Shoreline Vulnerability

Erosion and 2 ft of Sea Level Rise

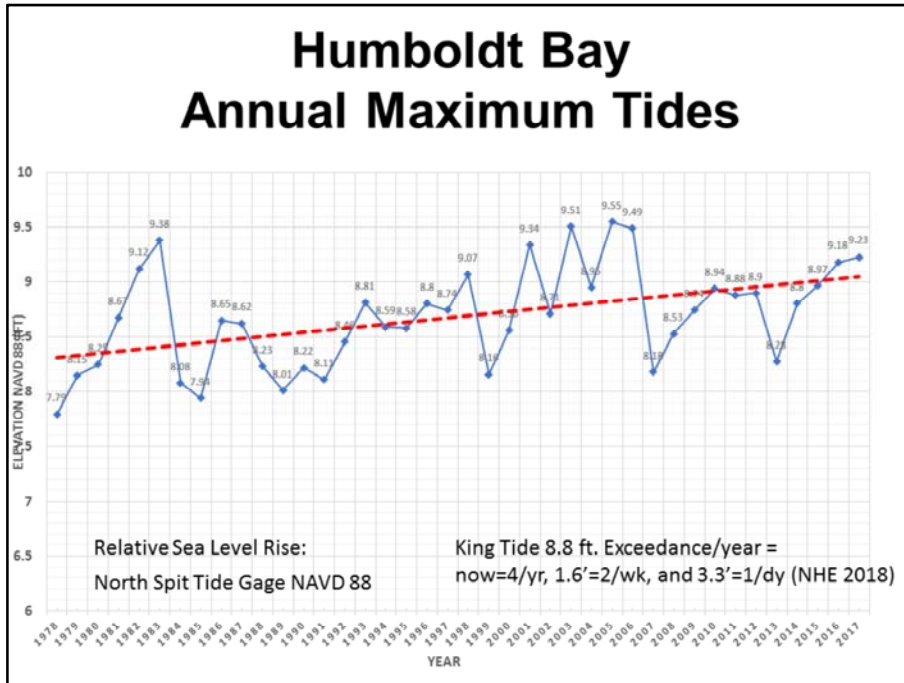


King Salmon has 1.7 miles of shoreline and Fields Landing 1.5 miles of shoreline rated highly vulnerable to sea level rise impacts (shown in red). The shoreline shown in yellow would be overtopped with 3 feet of sea level rise. The area in green is just above three feet. (Laird and Powell 2013)

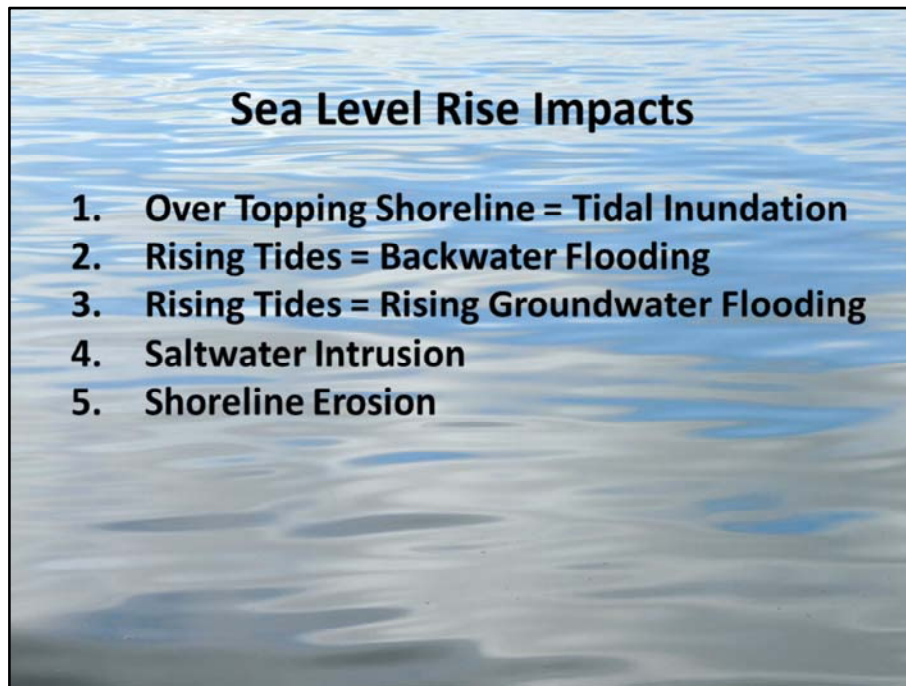


Assets in King Salmon include residential developments, commercial businesses, commercial-recreational boating, PG&E facilities, and coastal resources including beach, canals and dunes.

Fields Landing has many of the same assets with the exception of PG&E facilities and canals, but also includes a public boat launch, the Harbor District dry dock marine repair facility, and inactive commercial docks.



There is a clear sea level rise trend on Humboldt Bay; sea levels have increased 0.8 feet in the past 40 years, which equates to 2.0 feet in 100 years. Mean annual maximum tides (MAMW or king tides) have varied over the past 40 years by 1.8 feet, from 7.75 feet to 9.55 feet. The annual range of water elevation from mean high water (MHW, represented by the wetted shoreline) to MAMW is 3.0 feet. MAMW of 8.8 ft occurs approximately 4 times a year; with 1.6 feet (0.5 meters) of SLR, that elevation would be reached 125 times per year, and with 3.3 feet (1.0 meter) of SLR it would be exceeded 355 times per year. (NHE 2018)



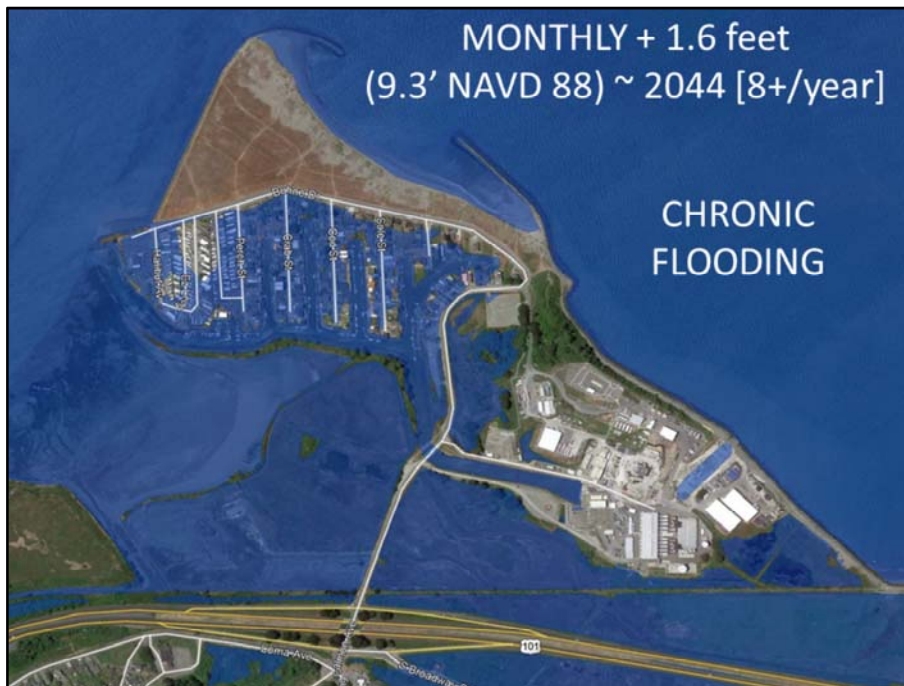
King Salmon and Fields Landing are exposed to a variety of sea level rise impacts. These impacts are listed in order of likely occurrence.



Where will sea level rise impact us?



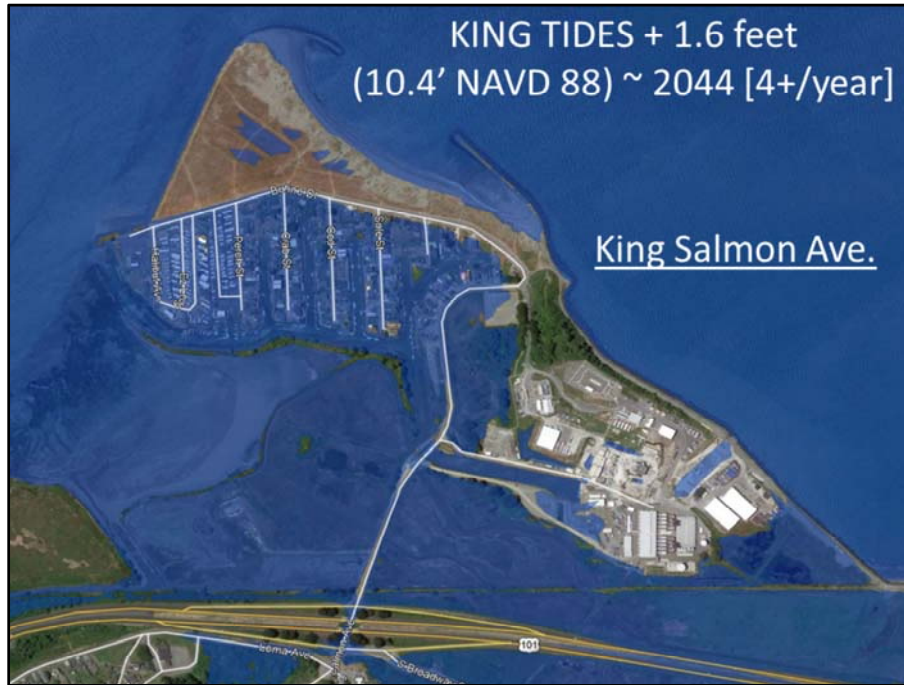
This slide shows the footprint of current king tides in King Salmon. These are the residential and commercial areas and streets in King Salmon that could presently be tidally inundated with saltwater during a king tide approximately 4 times per year, a frequency considered to be nuisance flooding.



This slide shows the areas where tidal inundation during Mean Monthly Maximum tides (MMMW) with 1.6 feet of sea level rise could occur approximately 25 years from now and approximately 8+ times a year, 12 times per year when considering this elevation will be exceeded 4 times a year by a king tide. This inundation frequency would be considered chronic flooding, and would impact developed residential and commercial properties and streets.



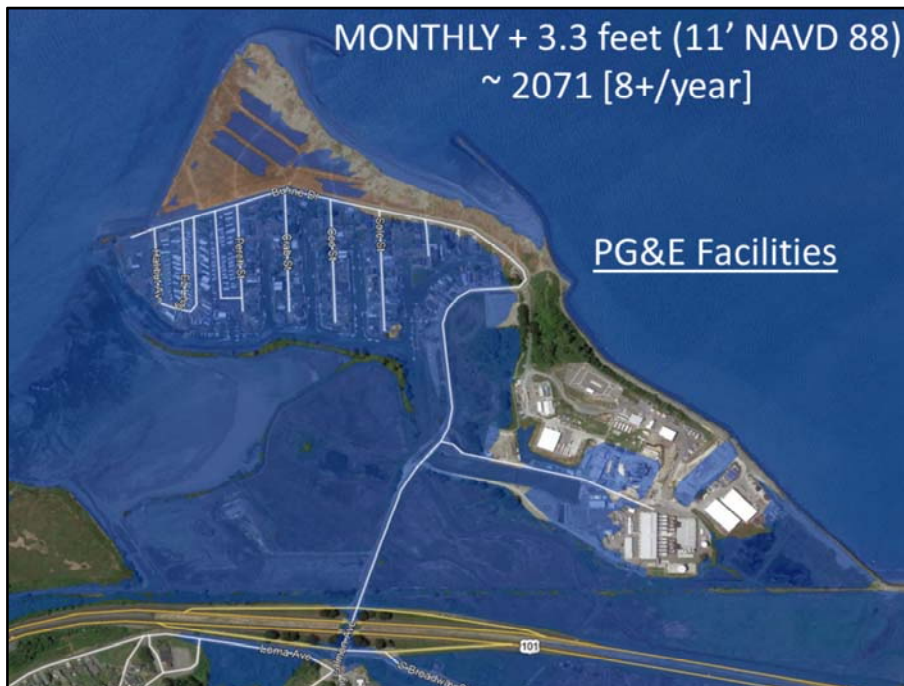
This slide shows where tidal inundation by saltwater could occur approximately 50 years from now and approximately 182+ times a year (Mean Higher High Water plus 3.3 feet), a frequency that would be considered perennial or daily inundation. Inundation would impact developed residential and commercial properties and streets, including King Salmon Avenue.



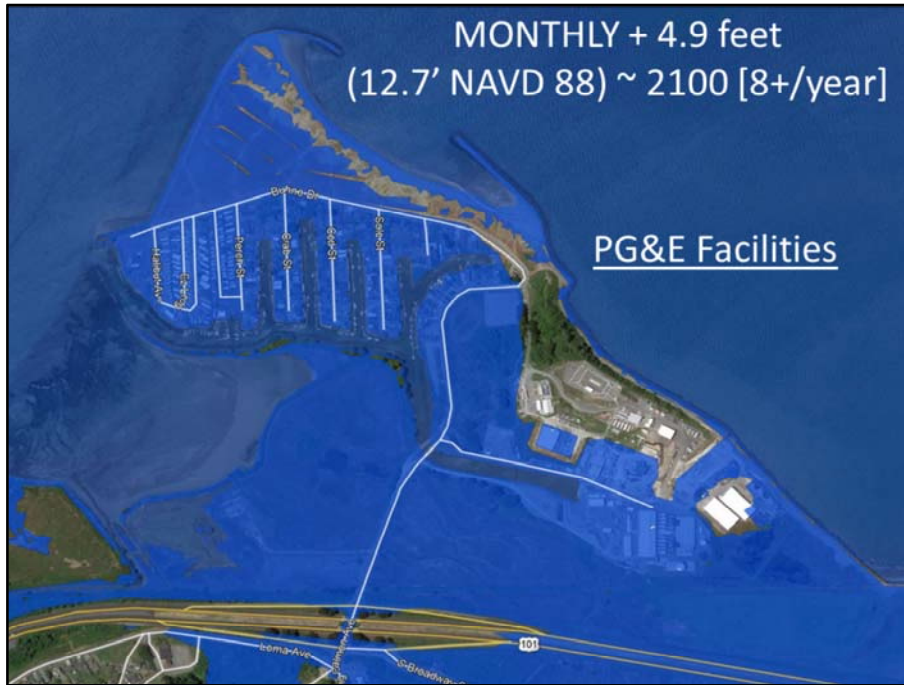
King Salmon Avenue provides access to King Salmon, and is critical to the future of this community. Access will become interrupted on a nuisance basis when it could become inundated approximately 4 times a year during a king tide with 1.6 feet of sea level rise in approximately 25 years.



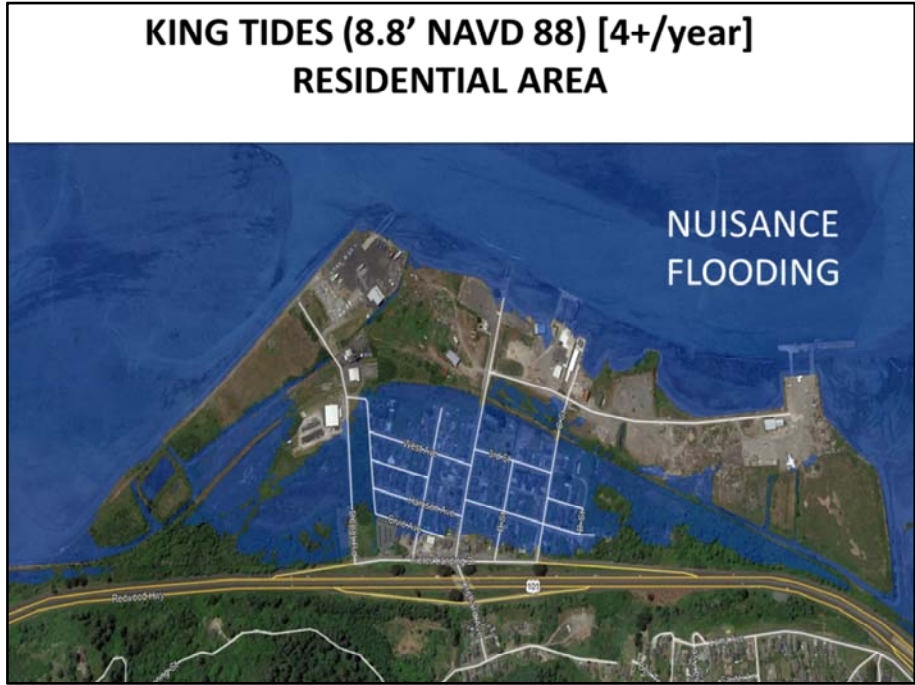
In approximately 50 years when we could see up to 3.3 feet of sea level rise, King Salmon Avenue could be tidally inundated once a month.



This slide shows the inundation footprint of monthly tides with 3.3 feet (1 meter) of sea level rise, expected by approximately 2070. Privately owned (PG&E) and publically owned (Humboldt Community Services District and the Harbor District) utilities are critical to King Salmon as well as other communities in Humboldt County. Sea level rise impacts to individual services in King Salmon will likely need to be addressed by approximately 2040. Impacts to the PG&E Humboldt Bay Generating Station will likely need to be addressed by approximately 2070.

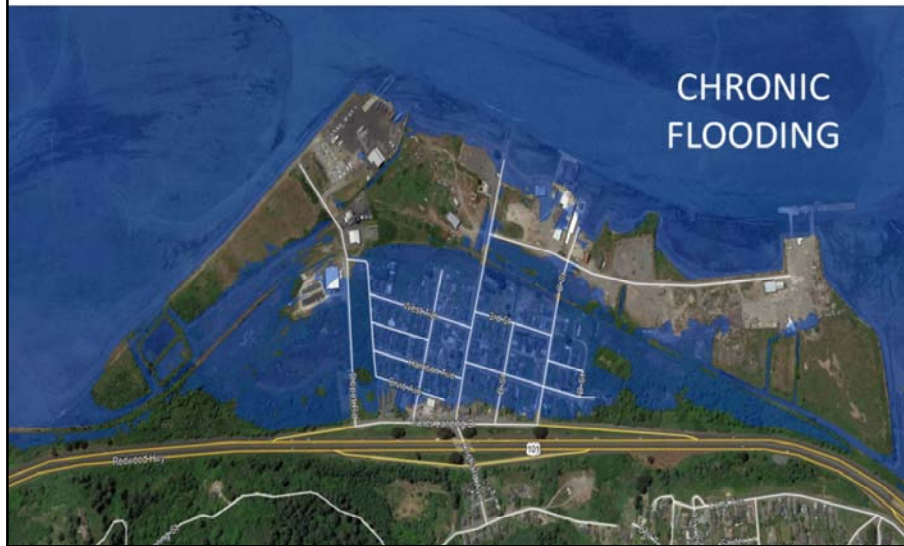


All of PG&E's electrical generating facilities in King Salmon, with the exception of the interim spent fuel storage site, could be tidally inundated approximately once a month by the year 2100 with 4.9 feet of sea level rise.



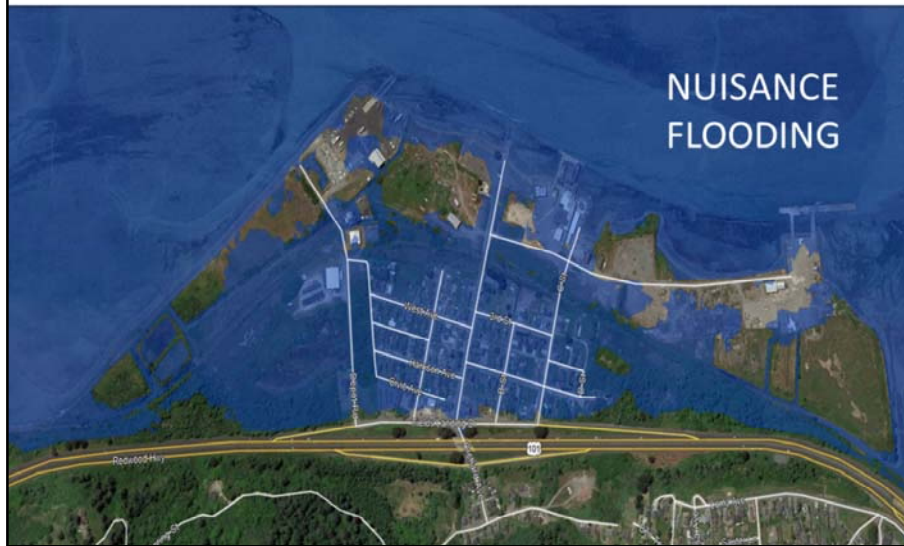
These are the residential and commercial areas and streets in Fields Landing that could currently be tidally inundated with saltwater during a king tide, primarily from backwater inundation via stormwater pipes.

**MONTHLY 1.6' (9.3' NAVD 88) 2044 [8+/year]
RESIDENTIAL AREA**



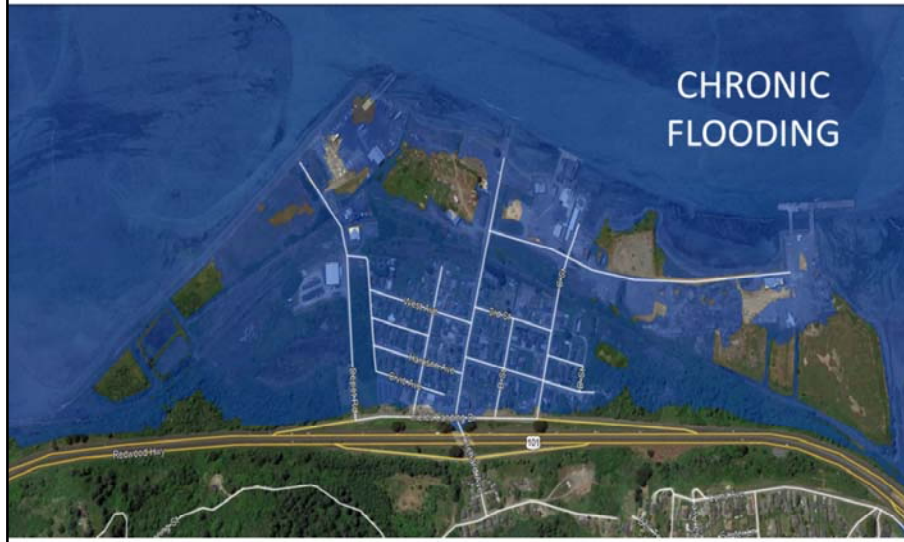
This slide shows the footprint of tidal inundation by saltwater in Fields Landing with mean monthly maximum water (MMMW) plus 1.6 feet (0.5 meters) of sea level rise that could occur approximately 25 years from now and approximately 8+ times a year, 12 times per year when the MMMW elevation is exceeded by king tides 4 times per year. The flooding frequency would be considered chronic, and would occur via two limited pathways and backwater inundation. Inundation would impact developed residential and commercial properties, public facilities, and streets.

**KING TIDES 1.6' (10.4' NAVD 88) 2044 [4+/year]
WATERFRONT AREA**



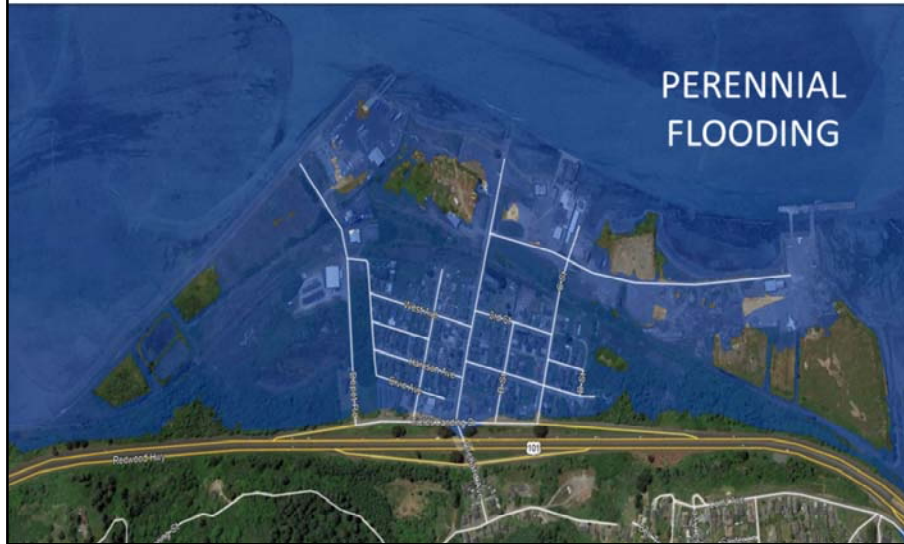
This slide shows the footprint of tidal inundation by saltwater in Fields Landing with 1.6 feet of sea level rise and a king tide, predicted to occur approximately 25 times years from now, and which could occur approximately 4+ times a year which would be considered nuisance inundation. Inundation would occur via overtopping the waterfront, other pathways such as the North Coast Railroad Authority right-of-way north and south of Fields Landing, and backwater inundation, and could impact developed residential, commercial, coastal-dependent industrial, and public facility properties, as well as streets. At this point, king tides will be overtopping the shoreline and waterfront, and inundating residential areas, presenting a critical threshold.

**MONTHLY + 3.3' (11.0' NAVD 88) 2071 [8+/year]
WATERFRONT AREA**



This slide shows the footprint of tidal inundation by saltwater in Fields Landing that could occur with monthly (MMMW) tides and 3.3 feet (1 meter) of sea level rise anticipated to occur approximately 50 years from now, and approximately 8+ times a year (12 times per year with the inclusion of king tides which would exceed the elevation of MMMW 4 times per year). This inundation frequency would be considered to be chronic inundation, and would occur via overtopping the waterfront and two pathways, impacting developed residential and commercial properties, public facilities, and streets.

**DAILY + 4.9' (11.4' NAVD 88) 2094 [182+/year]
WATERFRONT AREA**



This slide shows where tidal inundation by saltwater could occur in Fields Landing with daily high tides (Mean Higher High Water, MHHW) plus 4.9 feet (1.5 meters) of sea level rise approximately 80 years from now, 182+ times a year, which would be considered perennial inundation.



What can be done about these sea level rise impacts?

EDUCATION

- **Convey what areas and assets are vulnerable to sea level rise.**
- **Identify critical infrastructures and services that are at risk from sea level rise.**
- **Disclose range of sea level rise rates for daily and monthly high tides, and king tides.**
- **Explore adaptation strategies and measures.**

The County is working to educate the community regarding sea level rise and these listed areas of concern. This workshop is one component of community outreach and education. The County's webpage on sea level rise has numerous documents that provide important information on sea level rise: <https://humboldt.gov.org/1678/Local-Coastal-Plan-Update>. Future Planning Commission, Board of Supervisors, and Coastal Commission public hearings to consider adoption of sea level rise policies for the Humboldt Bay Area Plan will also provide opportunities to obtain information and provide public input.

SEA LEVEL RISE ADAPTATION GOALS

- **Residential/Commercial Property/Developments:**
Sustain use/value as long as possible
- **Access Infrastructure:**
Maintain access as long as possible
- **Utility Infrastructure:**
Maintain services as long as possible
- **Coastal Access/Recreation:**
Maintain access and uses as long as possible

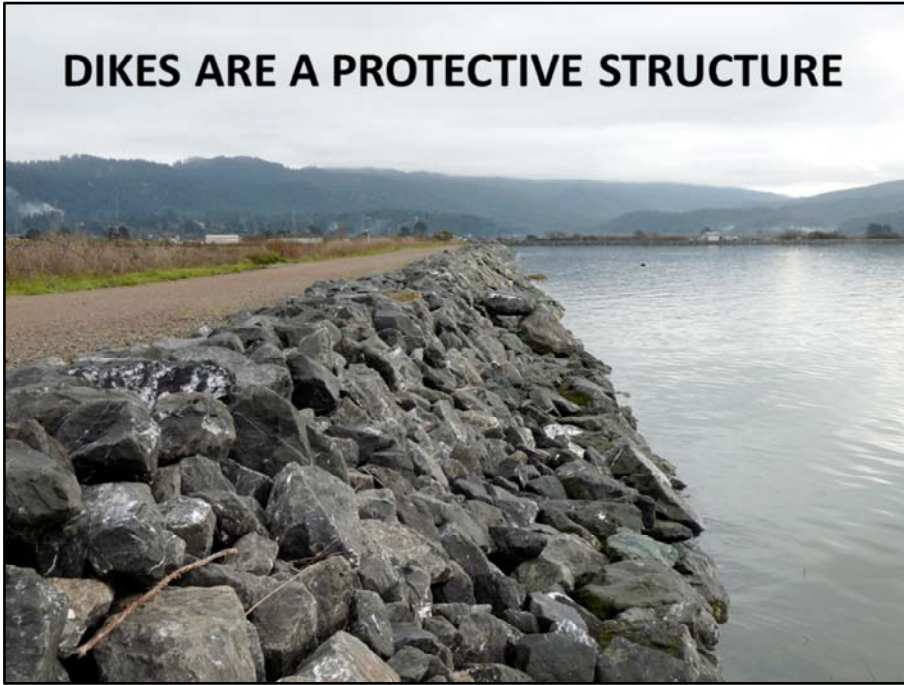
This slide provides a list of some of the potential goals for addressing sea level rise impacts to the various types of assets at risk.



Existing and future development each require different sea level rise adaptation strategies. Existing development can be defended or protected through “hard” shoreline protection, such as dikes, sheet piling, sea walls, and other types of bulwarks. It can also be protected by moving the sea level rise hazard further away from existing development through the use of “soft” shoreline protection such as beach nourishment and living shorelines, to buffer wave action. Sea level rise impacts to existing development can also be addressed by managed retreat, including the removal and possibly relocation of existing development.

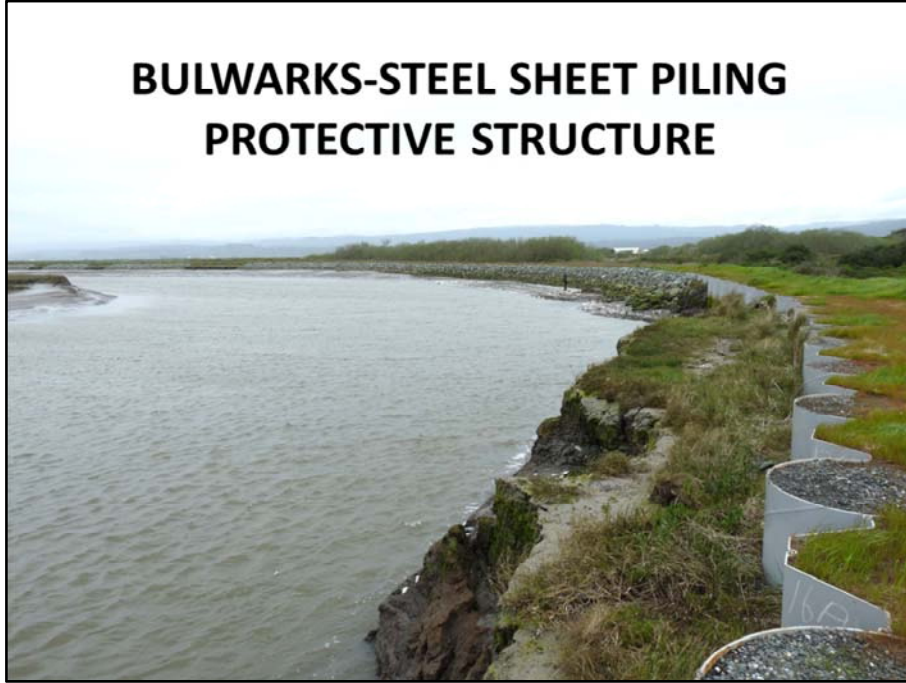
The Coastal Commission preferred adaptation strategy for future development is to avoid siting development in an area that could be impacted by sea level rise. If this is not possible, development can be designed in such a way as to accommodate sea level rise, such as constructing a residence with the habitable portion on the second floor, with the bottom floor designed to withstand flooding.

DIKES ARE A PROTECTIVE STRUCTURE



Dikes are one type of protective “hard” shoreline structure. They require a relatively large footprint that will generally expand as a dike gets taller. A dike can cost in the neighborhood of \$2.7 million to construct, with a number of factors determining the actual cost.

BULWARKS-STEEL SHEET PILING PROTECTIVE STRUCTURE



Steel sheet piling is another type of “hard” protective shoreline structure. It will generally have a smaller footprint than a dike. There may be height limitations for this type of structure. Steel sheet piling could potentially be used in combination with a dike.

COMPOSITE SHEET PILING



Composite sheet pile is another “hard” form of shoreline fortification. Like steel sheet piling, it will generally have a smaller footprint than a dike, and there may be height limitations. It may be possible to use composite sheet piling in combination with a dike.

CONSTRUCT TIDAL PATHWAY BARRIERS



One possible option for addressing sea level rise in King Salmon would be to construct a dike across the entrance to the tributary canals that provide access to numerous private docks, as shown with a red line, to block the sea level rise inundation pathway via these canals. The dike would need to be approximately one-half mile long, and would eliminate boat access to the bay from these canals, a key amenity for the homes with docks located on the canals.

To eliminate sea level rise inundation pathways in Fields Landing, fill could potentially be placed in the low-lying areas shown in orange, requiring approximately 20 acres of fill.

CONSTRUCT TIDAL PATHWAY BARRIERS



As sea levels continue to rise, in addition to the one-half mile canal dike in King Salmon, King Salmon Avenue could be elevated to function as a dike for a distance of approximately 0.75 miles as shown with a red line. Furthermore, approximately 4 acres of an abandoned canal shown in orange near the PG&E power plant could be filled to further block inundation pathways.

In addition to filling the approximately 20 acres in Fields Landing, approximately 1.3 miles of dike could be constructed in the location shown with a red line to further block inundation pathways.

CONSTRUCT TIDAL PATHWAY BARRIERS



As sea levels increase in elevation into the future, further protection will be required if King Salmon and Fields Landing are to remain viable communities. A dune dike approximately 0.5 miles long would be required in King Salmon as shown in yellow. A sea wall, dike or other type of bulwark approximately 1.7 miles long would be required in Fields Landing, as shown in yellow

LOW-LYING AREAS & RISING GROUNDWATER



Installing hard barriers is not the only solution for addressing sea level rise impacts. “Soft” armoring which uses natural infrastructure like beaches, dune systems, wetlands and other systems to buffer coastal areas and move sea level rise impacts further away from development is another option, where appropriate. Structures can be modified/reconstructed such as elevating the livable floor area to accommodate inundation while remaining in their original location. Ultimately, retreat and relocation may be the only viable option.

Even if a structure can be protected by a barrier, natural buffer, or accommodation, rising groundwater remains a threat. Rising groundwater can impact access to development due to roadway flooding, and can impact utility infrastructure that provides wastewater, water, communication or power services, and is thus also a significant issue for sustaining development in the face of sea level rise.



Who will address these sea level rise impacts?

Humboldt County Humboldt Bay Area Plan



Projected Sea Level Rise Inundation Zone (Stillwater) on Humboldt Bay
for Mean Monthly Maximum Tide with 3.3 feet (1.0 meter) of Sea Level Rise

Sea Level Rise Adaptation Policy Framework

Humboldt County's Local Coastal Program (LCP), and specifically the Humboldt Bay Area Plan (HBAP, one of six coastal plans that comprise the County's LCP), provides the planning framework for development within the coastal zone that insures development is consistent with the California Coastal Act. The County's LCP is currently silent on sea level rise.

The County is in the process of updating the HBAP to provide sea level rise (SLR) adaptation goals, policies, and implementation measures for the Humboldt Bay area. There has been a significant amount of work completed on SLR on Humboldt Bay, and the County has made good progress toward planning for SLR. A draft SLR policy options document (HBAP Sea Level Rise Adaptation Policy Background Study August 2018) was recently released and is available, along with other SLR documents, at the County's LCP update webpage at the following link: <https://humboldt.gov/1678/Local-Coastal-Plan-Update>. This workshop is part of the public outreach to provide input into these policies, which are a work in progress.

Implementing a consistent SLR approach is complicated by the fact that there are three local jurisdictions with LCPs that cover various portions of the Humboldt Bay area (Arcata, Eureka and Humboldt County). In addition, the Coastal Commission retains coastal development permit (CDP, required for all development in the coastal zone) jurisdiction over tidelands, public trust lands and submerged lands which comprise almost the entire shoreline of Humboldt Bay, in all three local jurisdictions; the local jurisdictions have permit jurisdiction in the remaining portion of the coastal zone. The Coastal Commission uses LCPs as guidance only when considering CDPs, meaning they are not required to comply with a local jurisdiction's LCP policies. Instead, the Commission relies on Chapter 3 of the Coastal Act as the basis for issuing CDPs. Thus, regardless of the Coastal Commission's certification of the County's LCP, including sea level rise policies in the HBAP, the Commission is not required to follow the policies they certify as being in compliance with the Coastal Act. The majority of the area where future sea level rise shoreline protection policies could potentially be implemented are located in Coastal Commission jurisdiction. With the Coastal Commission not being required to implement County LCP policies, implementation of HBAP sea level rise policies within Coastal Commission's jurisdiction is uncertain. The County's hope is that the Coastal Commission will rely fully on the HBAP SLR policies when considering approval of a CDP, and that local jurisdictions will coordinate their sea level rise policies, thereby providing a consistent SLR planning effort.

Another complicating factor in addressing sea level rise is that some of the adaptation measures require not only CDPs, but also permits from a number of state and federal agencies.

Sea Level Rise Adaptation Partners

- **Humboldt County Planning-LCP Land Use Planning Authority**
- **Humboldt County Public Works-Environmental Services**
- **Humboldt County Public Works-Road Maintenance**
- **Private and Public Property Owners**
- **HCSO-Water/Sewer Services**
- **PG&E-Energy**
- **HBHRCD-Boat Launch/Dry Dock/Dunes/Beach/Jetties**
- **CCC-Regulates Coastal Development in Retained Jurisdiction**
- **CCC-Fund Sea Level Rise Adaptation Planning**
- **OPC-Fund Sea Level Rise Adaptation Planning**
- **SCC-Fund Coastal Access and Habitat Restoration**

There will be many agencies to partner with, now and into the future, in our sea level rise adaptation planning efforts. This slide provides a list of some of those partners, some of which can provide funding to support sea level rise planning and adaptation implementation.



The LCP sea level rise policies are intended to increase the County's adaptive capacity to address sea level rise impacts. This slide lists some key points that need to be considered as sea level rise strategies are developed. A fundamental consideration is the fact that the County lacks the capacity to implement sea level rise strategies for assets that are privately owned or that are the responsibility of another agency.

SOME ASSETS CAN RELOCATE



One element of a sea level rise adaptive strategy to consider is that as inundation impacts increase, what assets can be relocated and how can sea level rise policies facilitate this relocation.

RELOCATE KING SALMON & FIELDS LANDING?

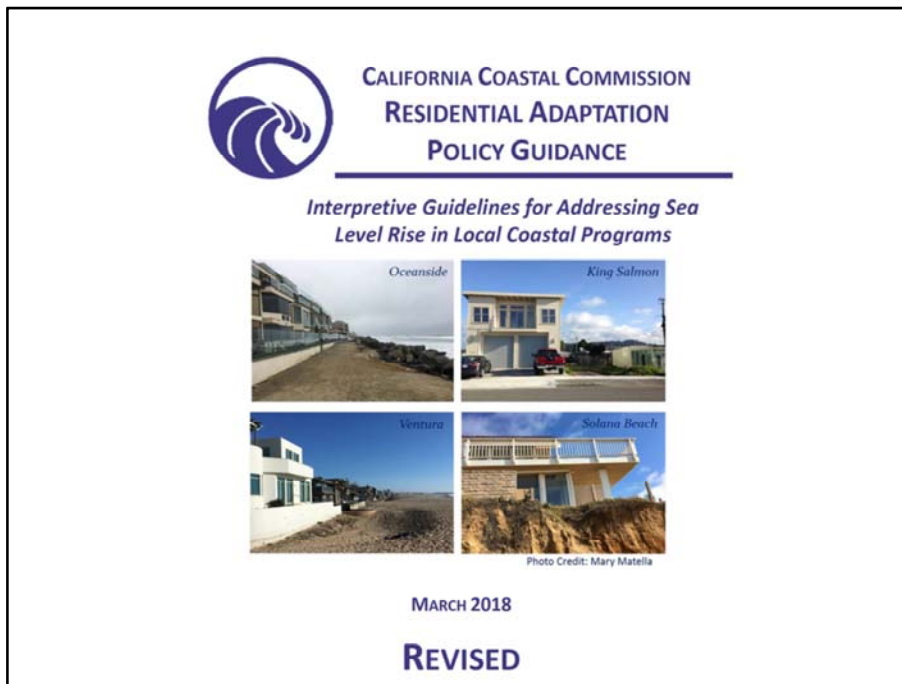


Some assets, such as the entire communities of King Salmon or Fields Landing, present a challenge as it is virtually impossible to relocate these communities and retain their essence. So, what do we do? We, as well as other coastal communities, are wrestling with these types of difficult questions as we move forward with a strategy to address sea level rise.

Information we obtain from this workshop, a future workshop to address sea level rise in Fairhaven and Finn Town, and any other public input we receive will contribute to a final sea level rise policy draft. The final draft will be completed and ready for Planning Commission hearings by the end of this year, a requirement of the Coastal Commission grant funding we received for this work.

The Planning Commission will hold a series of public hearings anticipated to occur over several months, presenting a great opportunity for public participation. The Planning Commission will make policy recommendations to the Board of Supervisors, who will hold another series of public hearings, providing another opportunity for public involvement. After approval by the Board, the Coastal Commission will hold one or more public hearings, an opportunity once again for public involvement.

Once the policies receive final approval from the Coastal Commission, we will see how they work. Addressing sea level rise will be an iterative approach, where we learn what works, what doesn't, and make adjustments and improvements as needed.



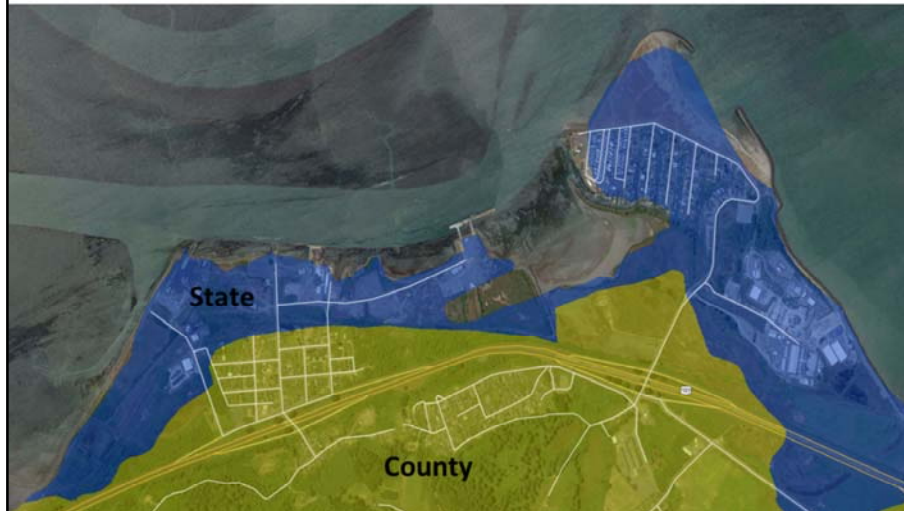
Bob Merrill, District Manager of the California Coastal Commission North Coast District Office, Bob.Merrill@coastal.ca.gov, (707) 826-8950, presented the Coastal Commission's perspective on sea level rise. The information in the following slides is a combination of what Mr. Merrill presented at this workshop, what Melissa Kraemer, Supervising Analyst, Coastal Commission North Coast District office, presented at the Fairhaven/Finn Town workshop, and information provided by the County

The Commission has both a regulatory aspect (issuing coastal development permits), and also works with coastal cities and counties to create a local coastal program that carries out the policies of the Coastal Act. The Commission's mission is to protect coastal resources, not just dunes, sensitive habitats or scenic coastal views, but also coastal-dependent lands and land uses that must be near the ocean to function. The Coastal Commission has a role in sea level rise planning under the state Coastal Act, and is working with 76 coastal cities and counties across the state that are also thinking about sea level rise and coastal development.

Sea level rise is a worldwide problem and we can either do nothing, or take steps now while there is still time, to address its impacts. The Coastal Commission and the Ocean Protection Council have given the County grant funding to help the County address the issue of sea level rise.

The Coastal Commission has produced some sea level rise guidance documents. The SLR Residential Adaptation Policy Guidance, designed to help cities and counties to develop policies to grapple with these issues, is currently under review and will probably be adopted by the end of the year. There is an earlier document called the Sea Level Rise Guidance Document that looks at sea level rise issues more generally. Both documents are available on Coastal Commission's website: <https://www.coastal.ca.gov/climate/slr/>

COASTAL ZONE JURISDICTIONS: State and County



This slide shows the approximate areas of Coastal Commission (State, shown in blue) and County (shown in yellow) coastal development permit (CDP) jurisdiction in King Salmon and Fields Landing. Although the County's local coastal program, specifically the Humboldt Bay Area Plan (HBAP), includes both Coastal Commission and County CDP jurisdiction, the County does not have CDP jurisdiction in the blue area, which is the area of state retained jurisdiction. The shoreline or other areas in King Salmon and Fields landing where tidal barriers would likely be build are in the Coastal Commission's jurisdiction, while the more inland areas are in the County's jurisdiction.

The Coastal Act provides for split permit jurisdiction, where there are parts of the Coastal Zone where the Commission issues CDPs and parts where the County is responsible for CDPs (see slide #57 for further discussion on coastal zone jurisdictions). In general, tidelands, public trust lands and submerged lands are Coastal Commission jurisdiction. When the County issues a CDP, it relies on its local coastal program (LCP). The Coastal Commission uses the County's LCP as guidance only, and relies on Chapter 3 of the Coastal Act as the basis for issuing CDPs. County-issued permits can be appealed to the Commission.

There is always a lot of discussion about the Commission and the local government having an adversarial relationship. When the legislature established the Coastal Act, they tried to create a partnership where local government would be responsible for preparing the local coastal programs and the Commission would review them to make sure they incorporate the appropriate policies to protect the coast.

SEA LEVEL RISE ADAPTATION STRATEGIES

- 1. Avoid Sitting Development in Hazard Areas**
- 2. Design for the Hazard (accommodation)**
- 3. Move Development Away from Hazards (managed realignment/retreat)**
- 4. Move Hazards Away from Development (soft or natural protection)**
- 5. Build Barriers to Protect from Hazards (hard protection)**

As listed in the Coastal Commission's Draft Residential Adaptation Policy Guidance, proactive adaptation strategies generally fall into the categories listed on this slide, though some strategies combine elements of more than one of these five strategies.

When new development is considered, the Commission looks at ways to design development to be resilient to flood hazards, with the most obvious being to avoid placing development in areas where there are flood hazards. Thus, the Coastal Commission considers #1 on the list, avoidance, to be the ideal adaptation strategy. The Coastal Act requires that risks to life and property be minimized, hazards related to flood and other hazards be avoided, and promotes development that does not require shoreline protection. It is important to consider how long a development will exist. If the life of a development will be over 100 years, the Commission expects 5.5 feet of sea level rise at that time, which must be considered when designing a new structure for a flood hazard area.

Where there is existing development, accommodation, #2 on the list, is more feasible than #1, at least in the short term. It is also time to start looking at managed retreat, strategy #3, since despite the use of other strategies, rising groundwater will still cause flooding. There are potential programs to assist with managed retreat, such as buyout programs and transfers of development rights (TDRs) to help relocate existing development and direct new development away from areas impacted by sea level rise.

Beach nourishment, living shorelines, and other strategies can be used to move hazards away from development, strategy #4. Regarding strategy #5, the Coastal Commission does not consider hard barriers as the most preferred strategy. This is because they prevent the escape of stormwater runoff and groundwater, can impact coastal access, do not address utilities or groundwater, and pose potential conflicts with the Coastal Act which allows shoreline protection, but generally only for development that existed when the Act was adopted in 1977. The Coastal Commission has been recognizing that it may be appropriate to allow "hard" barriers where there is a checkerboard of old and new development, contingent on providing mitigation for resource impacts, but generally this is not a long term solution.

COASTAL DEVELOPMENT PERMIT ACCOMMODATION STANDARDS



The Coastal Commission is not interested in taking private property without compensation. Although not developing in areas impacted by sea level rise is the safest choice, it is not always the only choice. There are structures along the coast that have been designed with habitable space elevated above sea level rise projections, a sea level rise accommodation strategy. This slide shows a home in King Salmon that provides an example of this type of construction. The habitable portion of the home is on the second floor. The first floor walls are reinforced concrete walls and breakaway walls. When inundated, the entire structure will not be destroyed. Utilities, storage cabinets, etc. are elevated to minimize potential damage. A lot of development will need to accommodate sea level rise in the short term, with the more difficult issue being what to do in the long term.

It is important to keep in mind that this kind of accommodation does not address sea level rise impacts to roadways that provide access to a residence, nor does it address impacts to the various utilities that support a residence. While the residence itself may be able to accommodate sea level rise, access to the residence and lack of utilities may become the factor that makes a residence impacted by sea level rise uninhabitable.

Addressing sea level rise will require a collaborative effort involving a host of agencies. The Coastal Commission wants to work together with the County to address short term and long term impacts of sea level rise. We do have some time, a few decades to work through solutions.