

Climate Change and Sea Level Rise

2014 Utility Advisory Committee Update

City of Olympia | Public Works, Water Resources
November 2014

Climate Change and Sea Level Rise in Olympia

PRELIMINARY ASSESSMENT OF
SEA LEVEL RISE IN
OLYMPIA, WASHINGTON:
TECHNICAL AND POLICY IMPLICATIONS

June, 1993

City of Olympia
Public Works Department
Policy and Program Development Division
Olympia, Washington

Olympia's Response to
The Challenge of Climate Change



Background Report and
Preliminary Recommendations



September 200

CITY OF OLYMPIA
ENGINEERED RESPONSE TO SEA LEVEL RISE



COAST & HARBOR
ENGINEERING

Resolution No. M-1306 (1991)

Three-part strategy:

- Reduce emissions of greenhouse gases.
- Increase tree cover.
- Prepare for climate change .

RESOLUTION NO. M-1306

A RESOLUTION by the Olympia City Council on City actions to mitigate global warming.

WHEREAS, current evidence indicates that global warming and ozone layer depletion, as well as surface air pollution, are occurring as a result of human activity, and

WHEREAS, although the rate of change and impacts on Olympia are uncertain, the nature of likely impacts on sea level, crops, water supply, energy, forests, and wildlife makes action

Resolution No. M-1550 (2005)

- To ensure Olympia's Comprehensive Plan Energy Policies are implemented as intended;
- To ensure a legacy of sustainability through stabilization and reductions in total energy and greenhouse gas emissions;
- To ensure new growth in the City services are accommodated with zero net increase in greenhouse gas emissions;
- To measure and report energy consumption levels;
- To develop a long term energy plan for the City to reduce greenhouse gas emissions by 2% per year, until 1990 emissions levels are achieved, and
- To promote a greater public understanding of energy use and its climate change impacts through outreach and communication efforts.

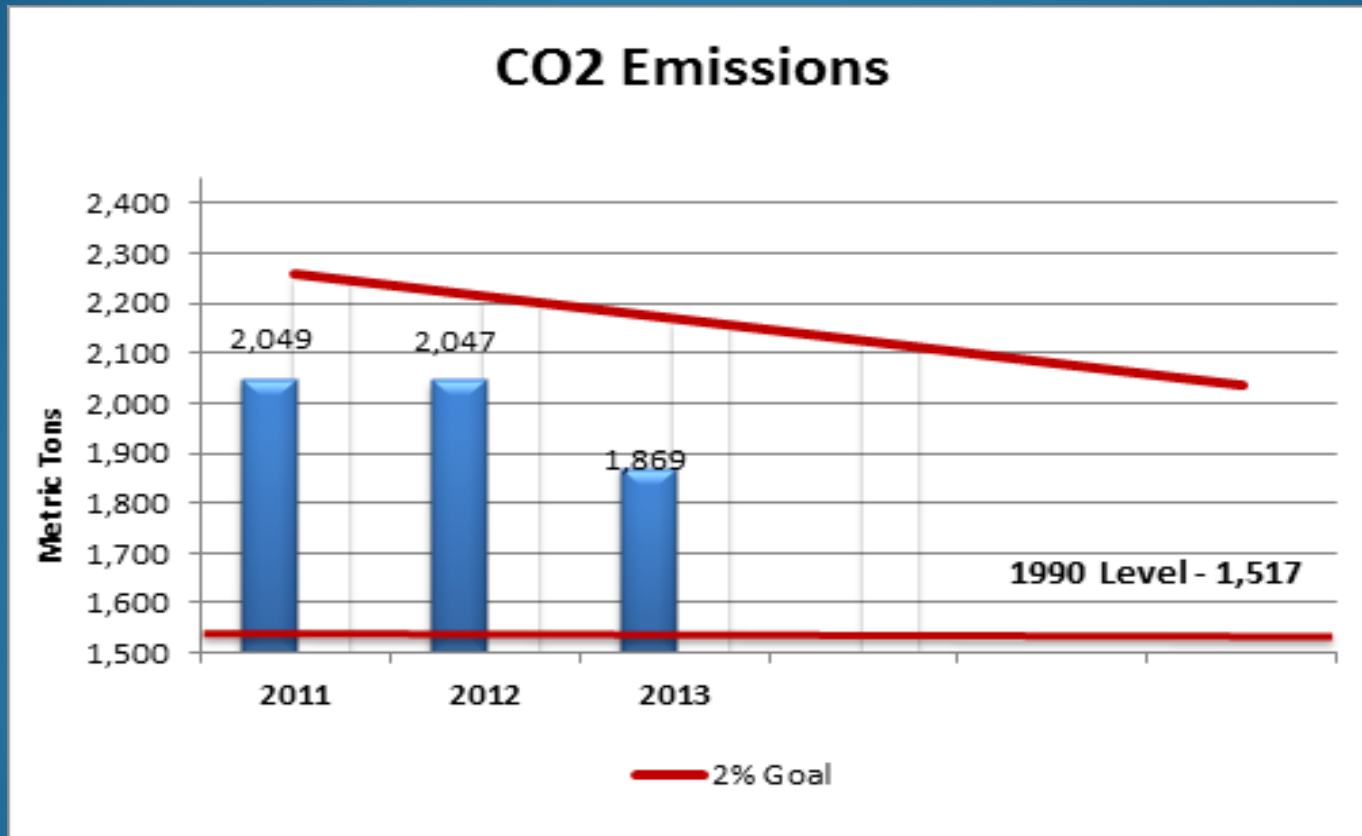
City Policy - 2010

- Protect downtown.
- Understand the implications of 50 inches of sea level rise.
- Use opportunities for new public and private investments to prepare for sea rise.
- Seek opportunities to maintain control of valuable shoreline.

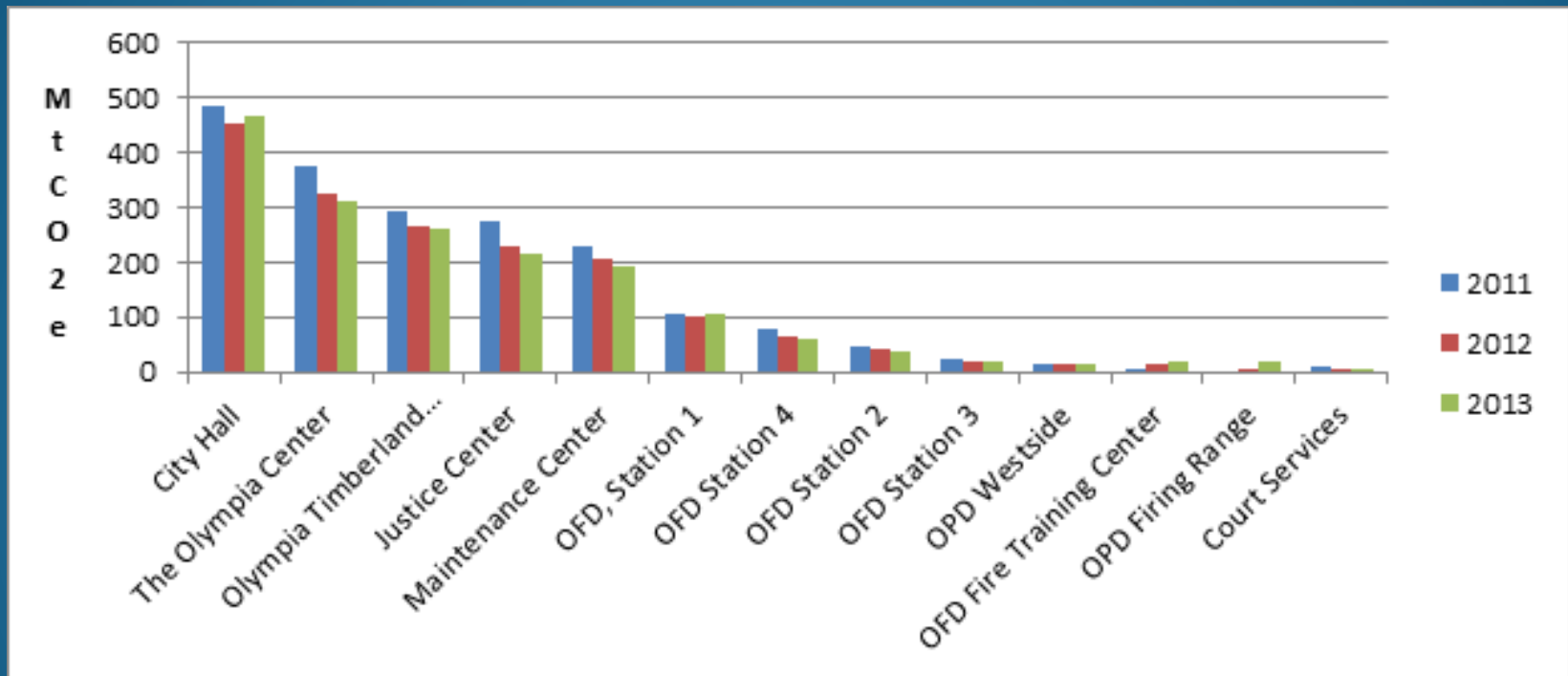
Resolution No. M-1803 (2014)

- A resolution of the city council of the City of Olympia, Washington, regarding the community greenhouse gas inventory completed by Thurston Climate Action Team, and strategies for reducing greenhouse gases.

Fleet Greenhouse Gas Emissions



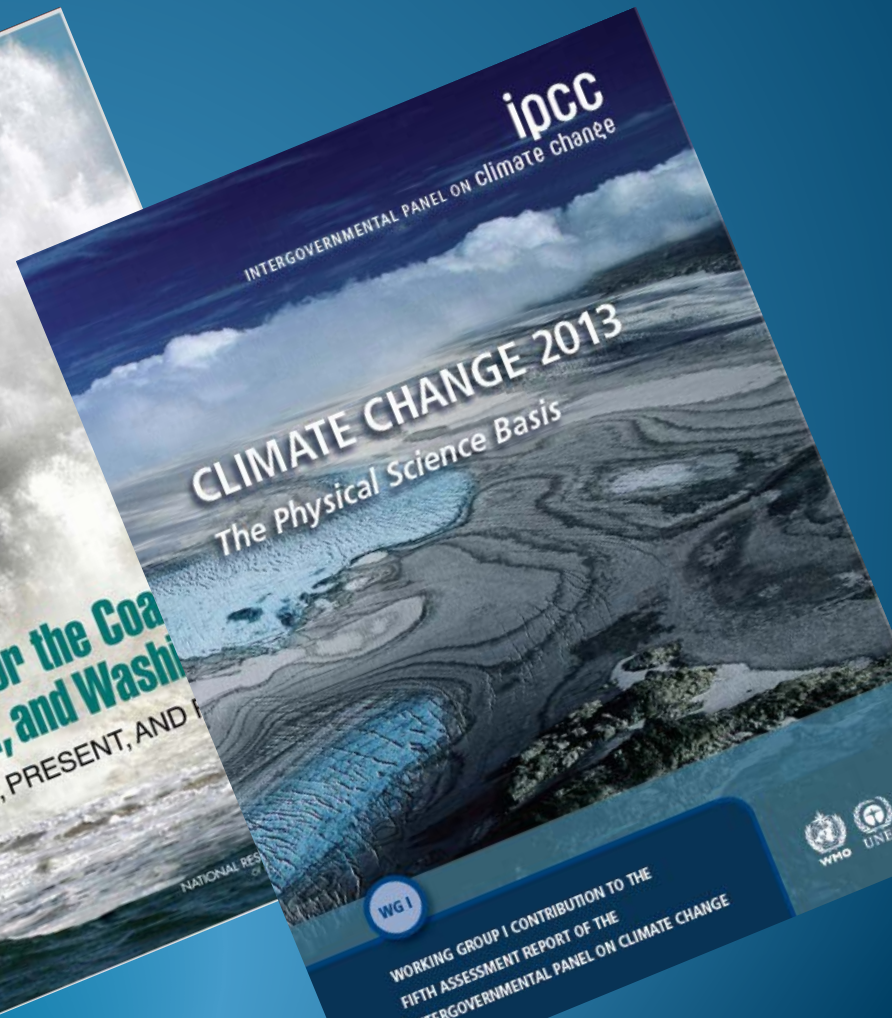
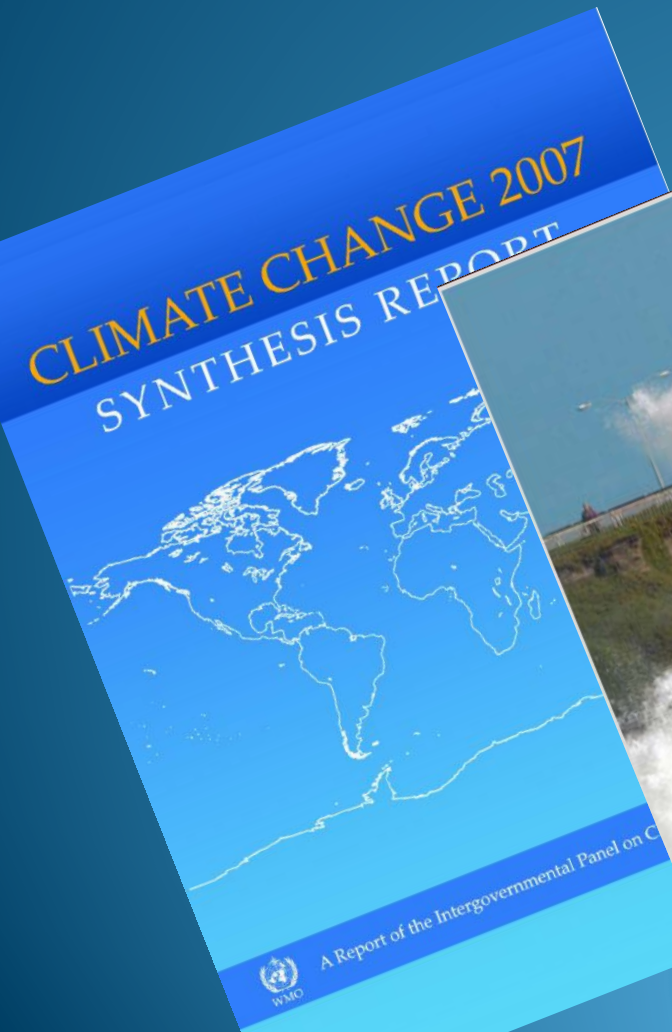
Facilities Greenhouse Gas Emissions



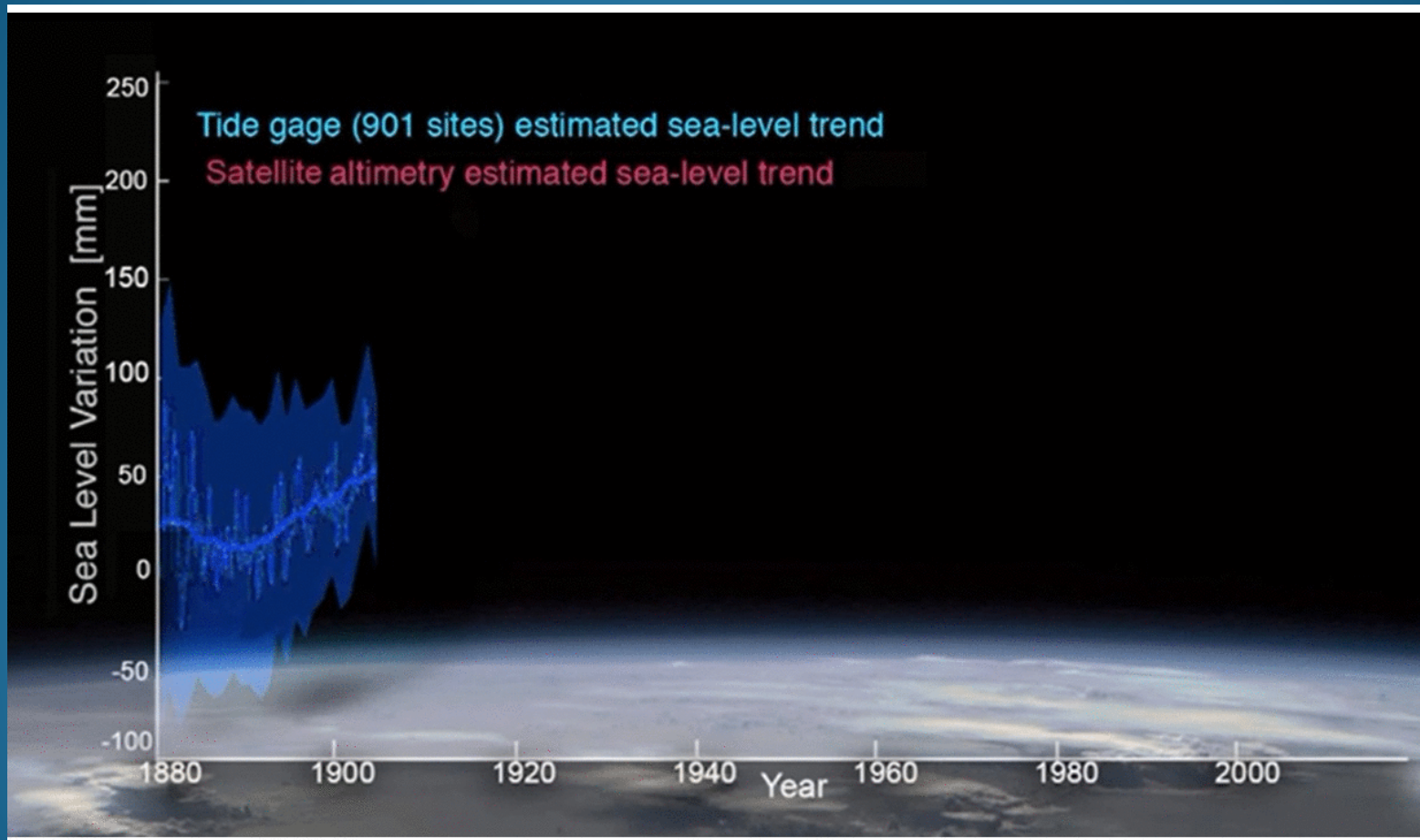
Existing Flooding Extents



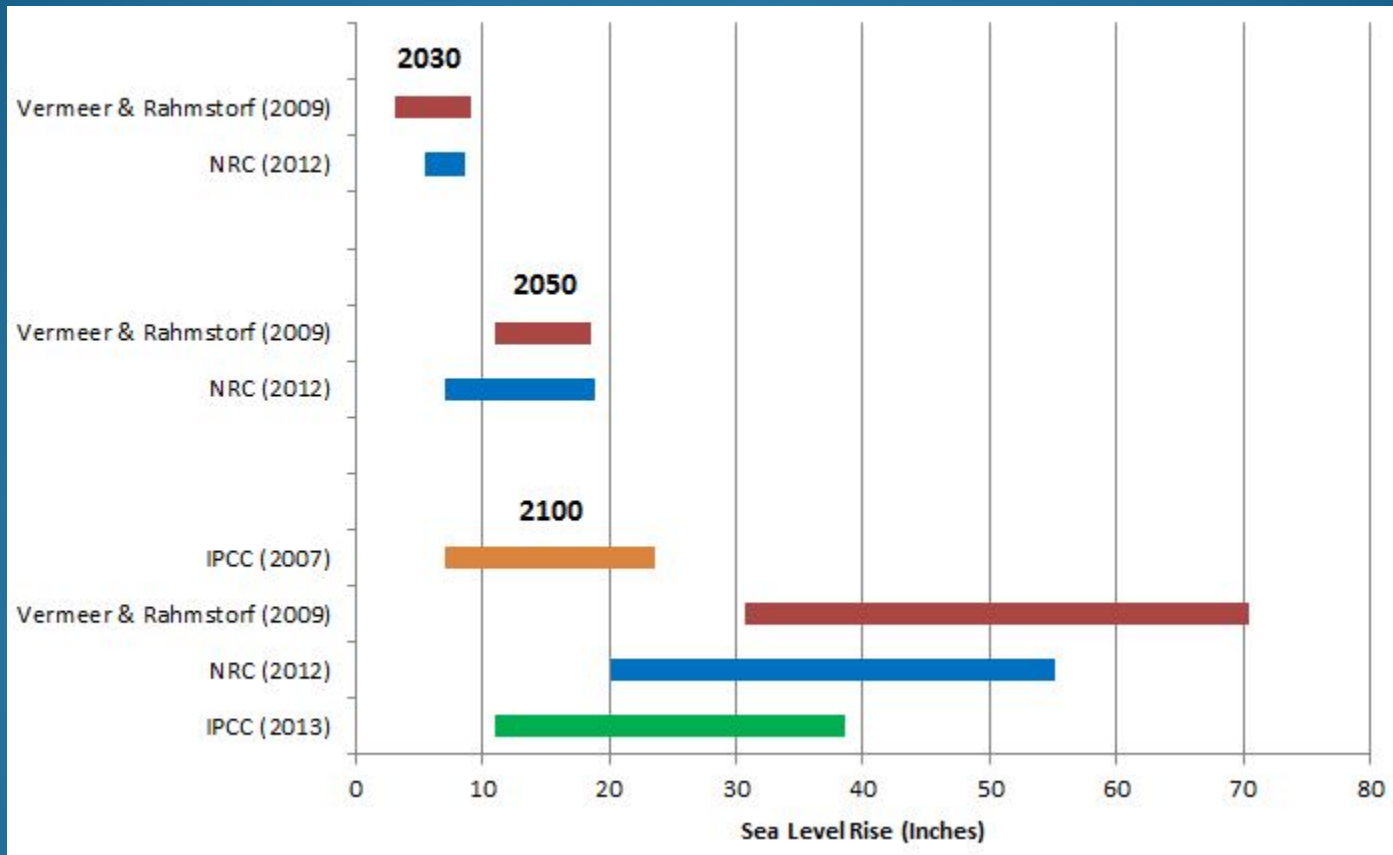
International Panel on Climate Change National Research Council



Sea Level Trends



Global Sea Level Rise Projections



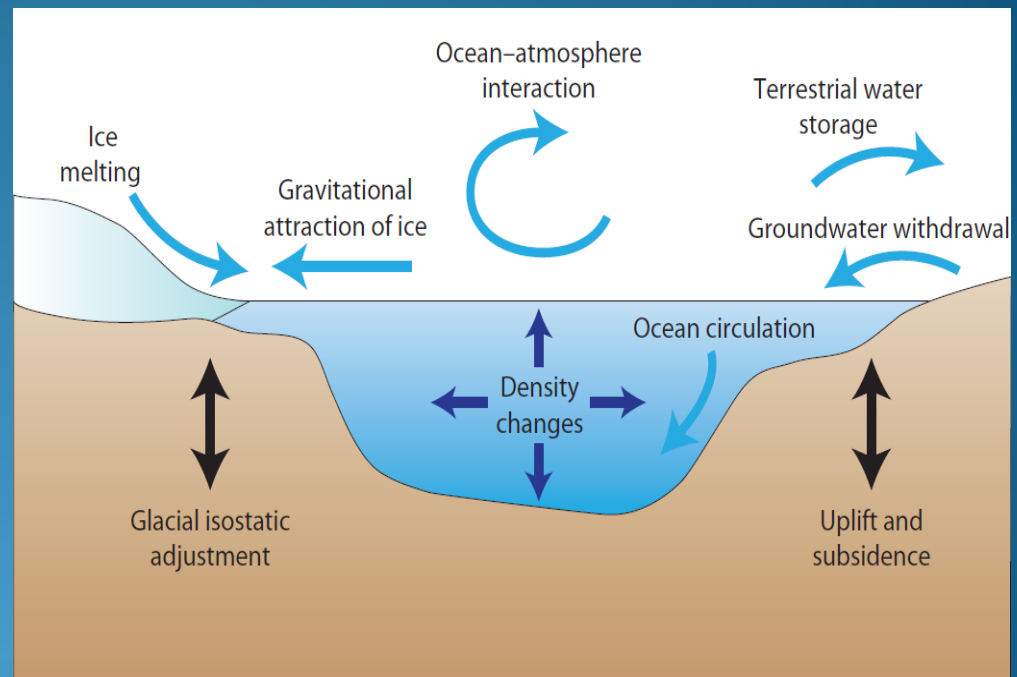
Processes influencing sea level

- Primary Processes

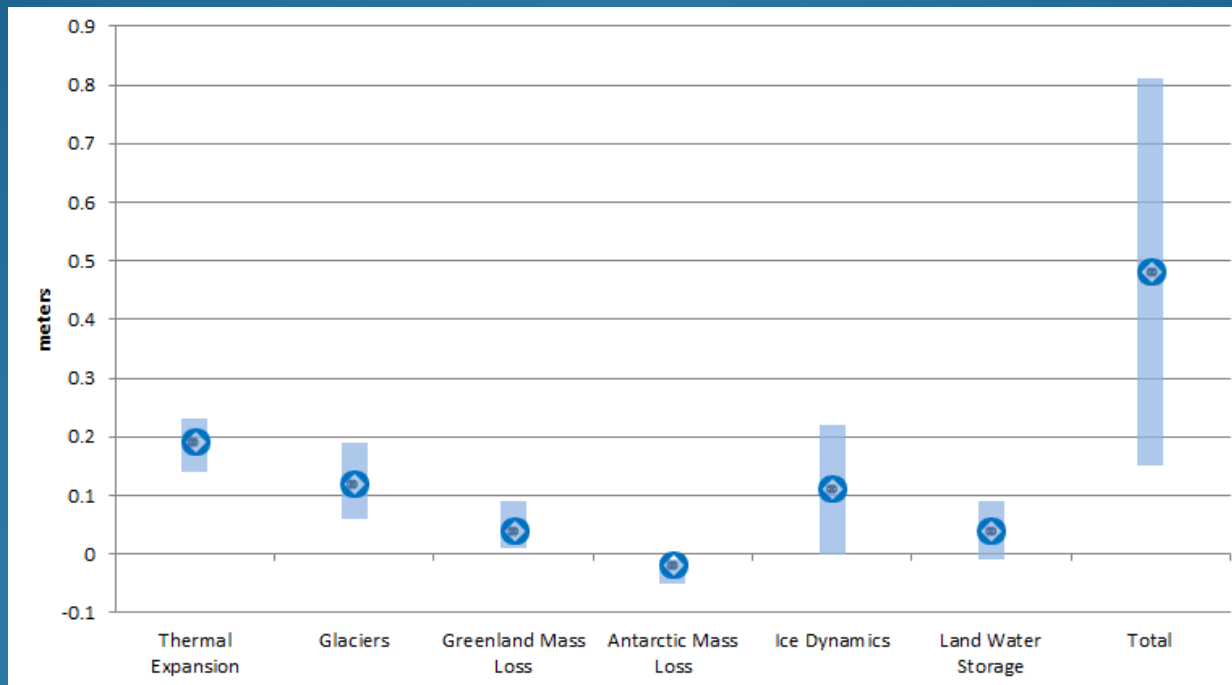
- Thermal Expansion
- Melting Glaciers
- Melting Ice Sheets
- Terrestrial Storage

- Additional Processes

- Weather
- Vertical Land Movement



Sea Level Rise – Relative Contributions of the Various Processes



- 2081 - Assuming greenhouse gas stabilized near current levels

Projected Flooding Extents

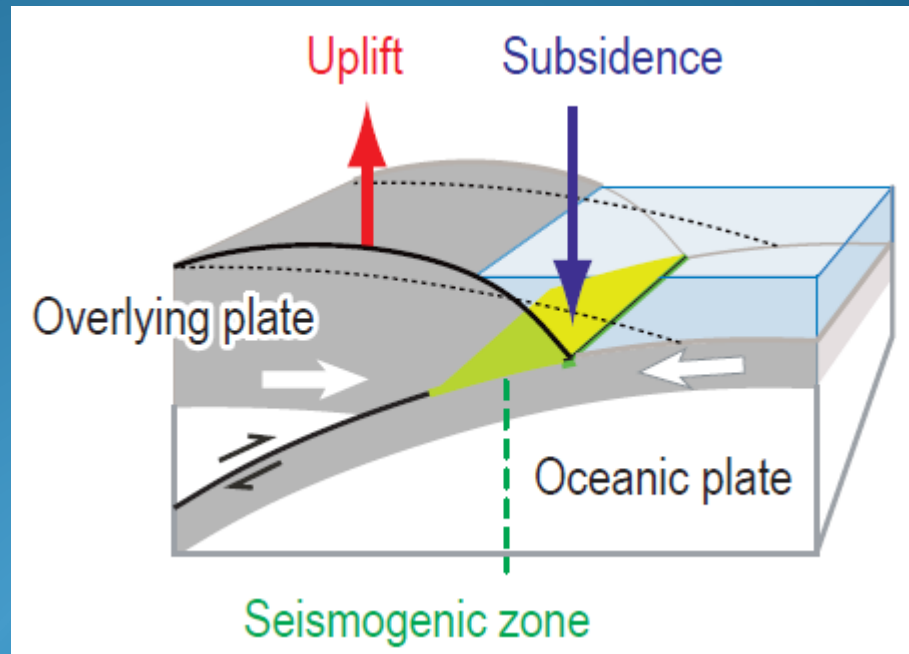


2013 IPCC Report Key Findings

- Global mean sea level rise will continue for many centuries beyond 2100, with the amount of rise dependent on future emissions.
- If Greenhouse gases are curbed, sea level rise will be less than 1 m by 2300.
- If Greenhouse gases are not curbed, sea level rise will be up to 3 m by 2300.
- Larger sea level rise could result from ice sheet flow.
- Near-complete loss of the Greenland ice sheet will occur with warming of between 1°C and 4°C.

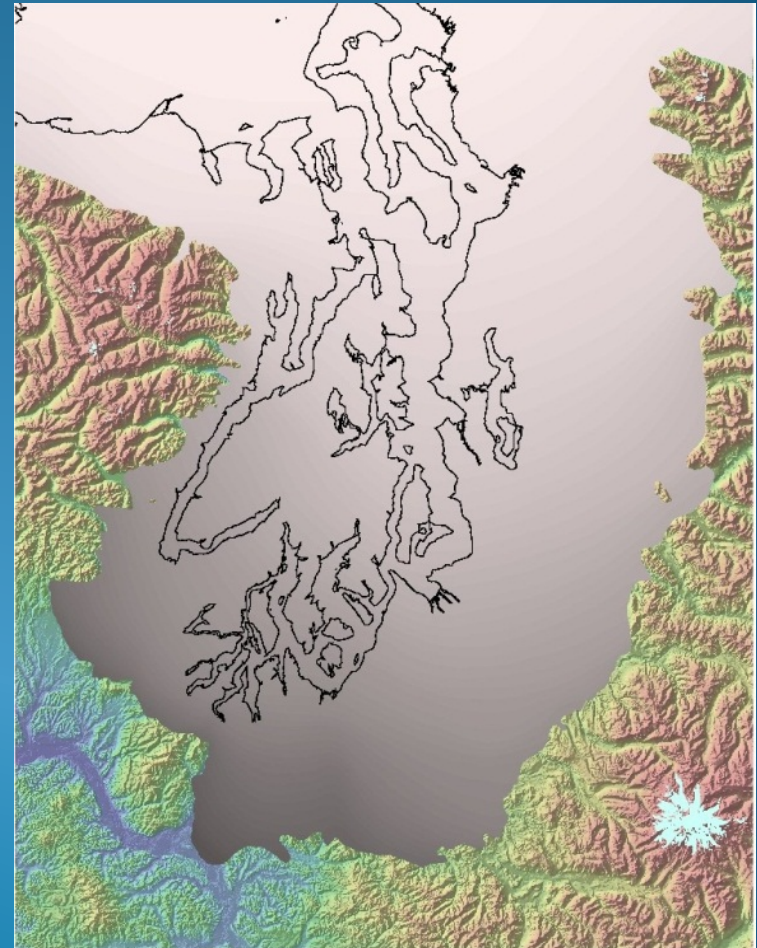
Vertical Land Movement

- Tectonics



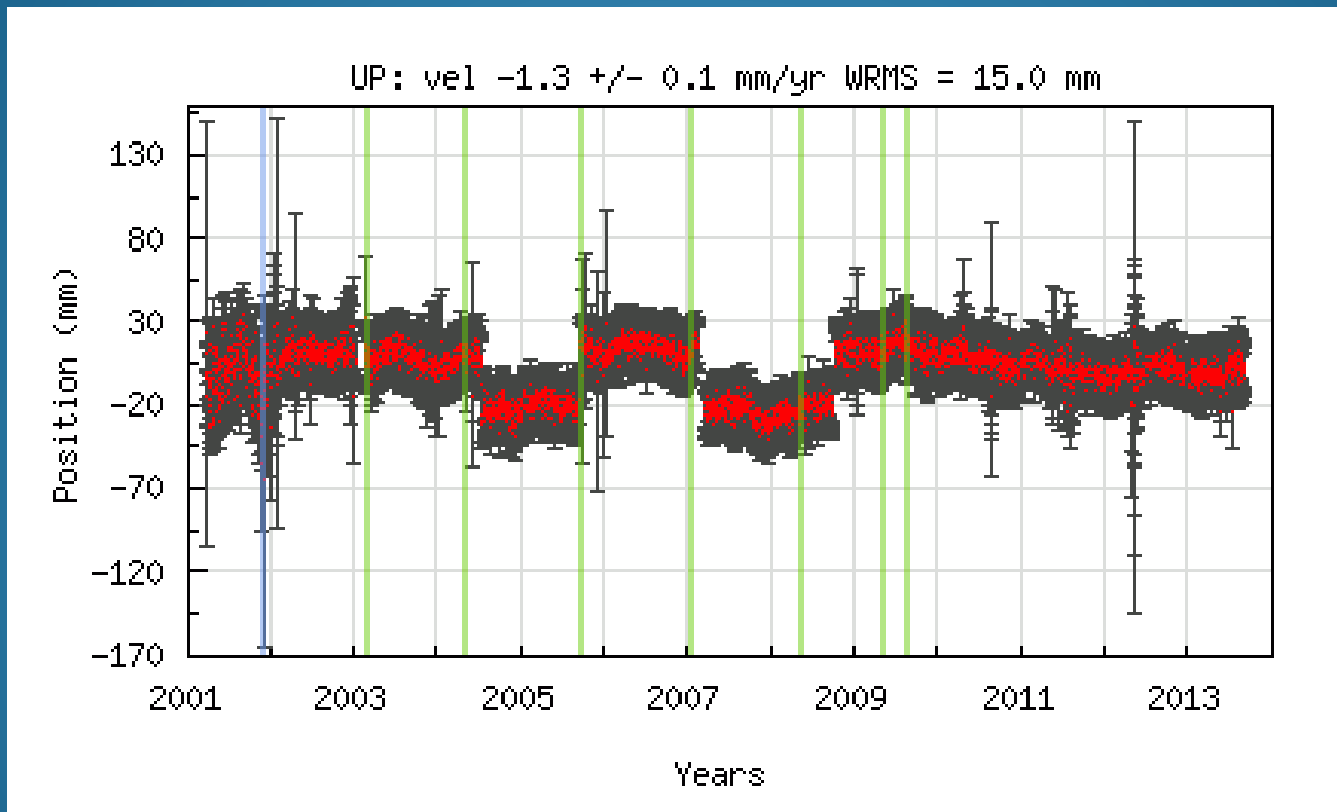
Vertical Land Movement

- Tectonics
- Glacial isostatic adjustment



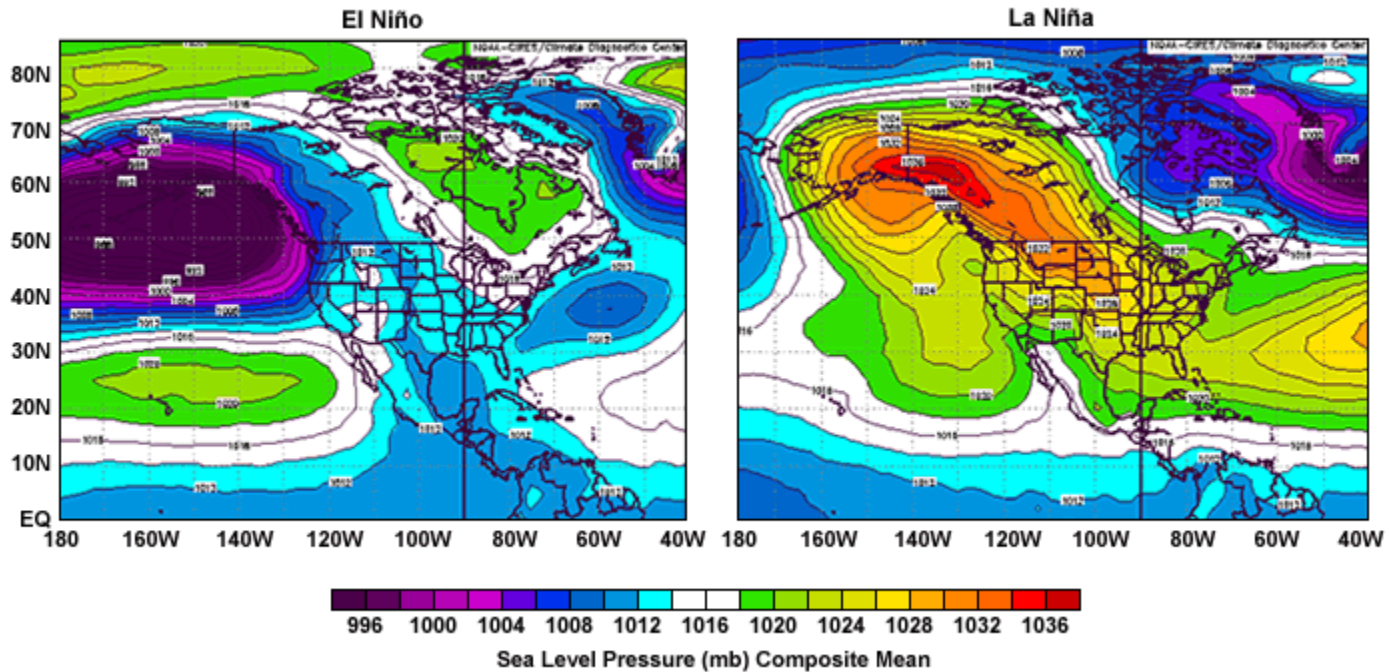
Vertical Land Movement

- Monitoring Olympia's elevations



Importance of El Niño events

Pacific-North America Pattern during Extreme El Niño and La Niña



Importance of Weather

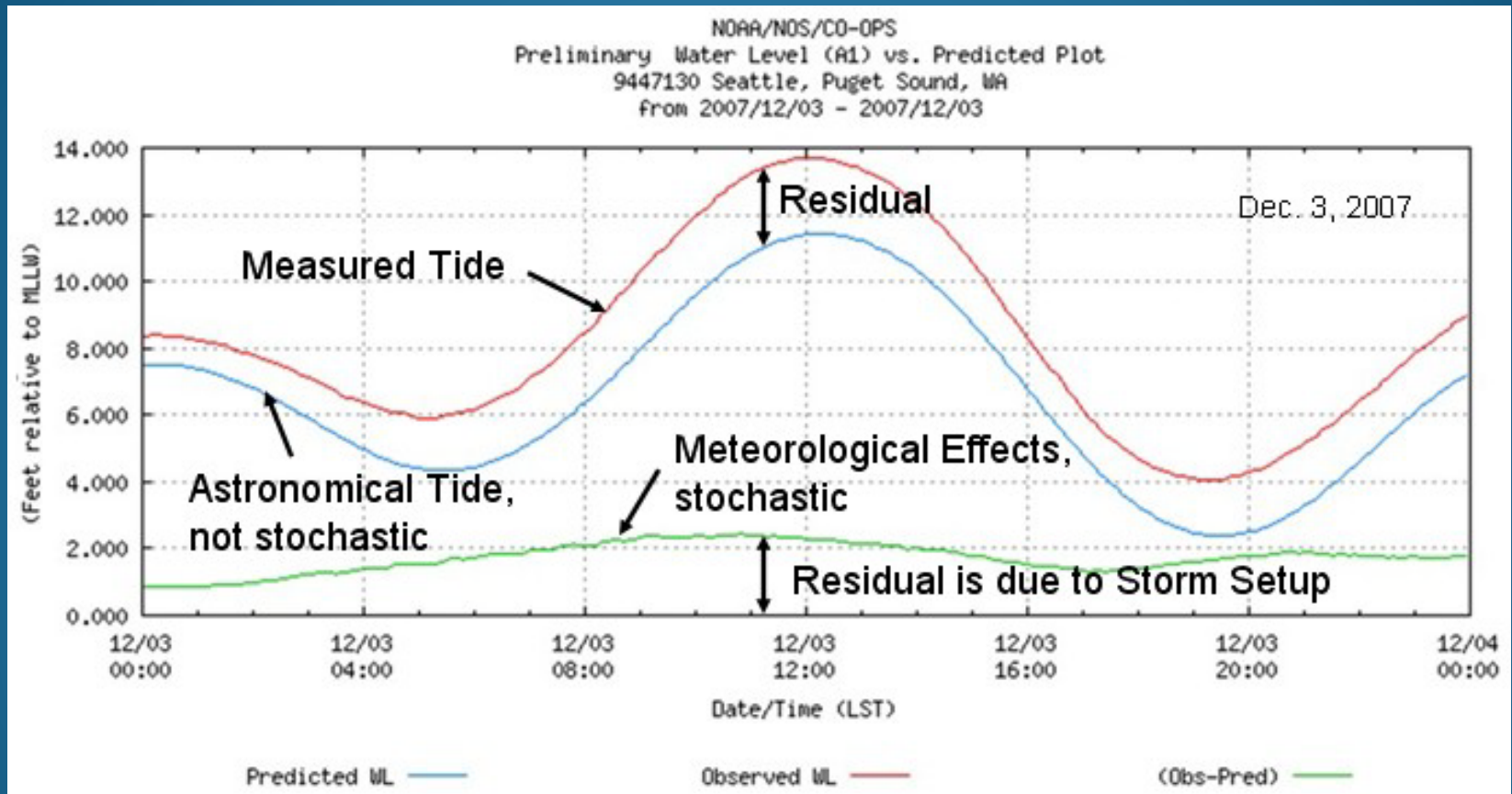


Fiddlehead Marina - December 17, 2012

Tools for Predicting Tides

- Tides are predicted years in advance
- Atmospheric models forecast pressure weeks in advance
- NOAA and Emergency Management Organization Warnings
- Stream gages on the Deschutes River

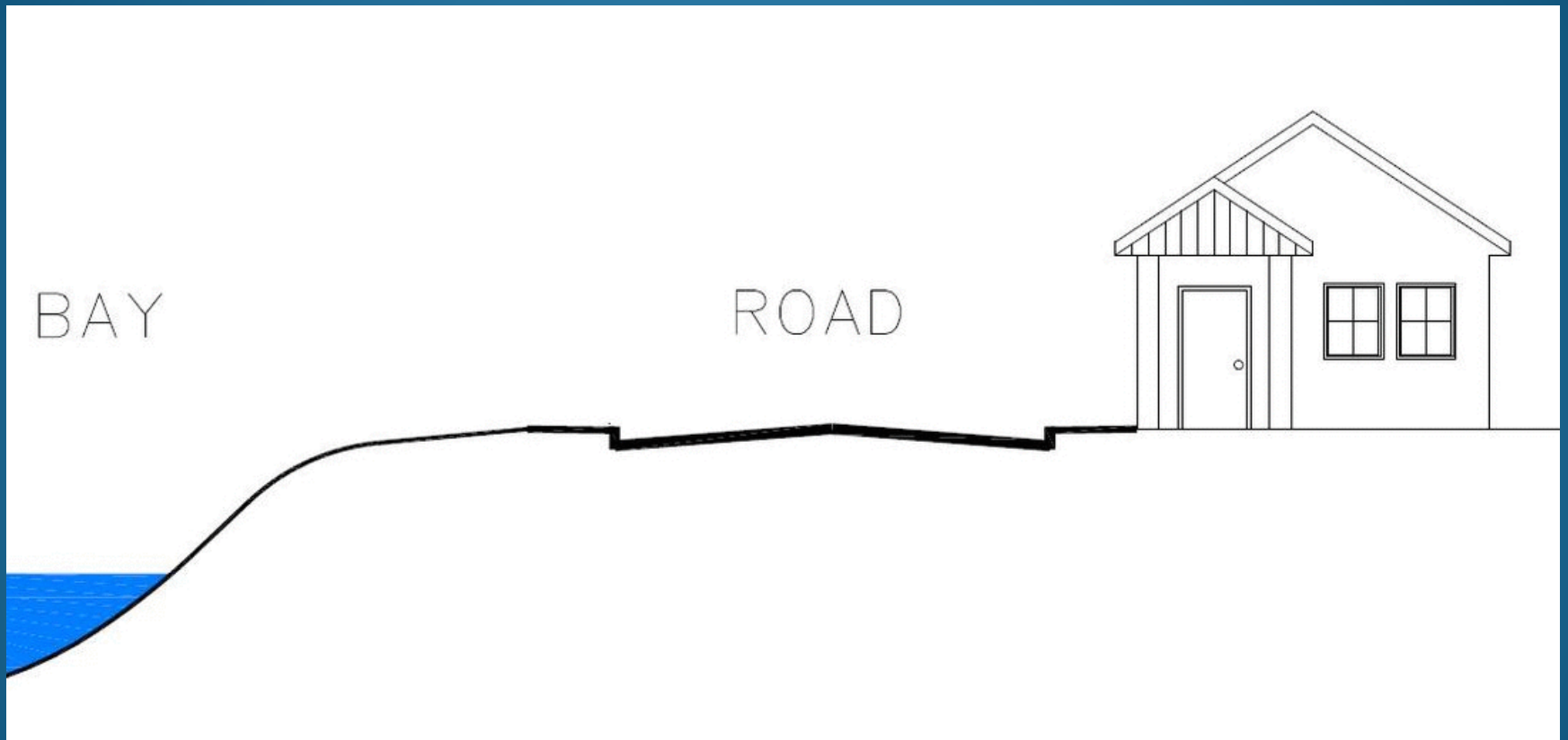
Tacoma NOAA Real Time Tide Data



Flooding Mechanisms

- Inundation of Budd Inlet and Capitol Lake Shorelines
- Pipe Backflow from Budd Inlet and Capitol Lake
- Terrestrial Runoff

Inundation of Budd Inlet and Capitol Lake Shorelines

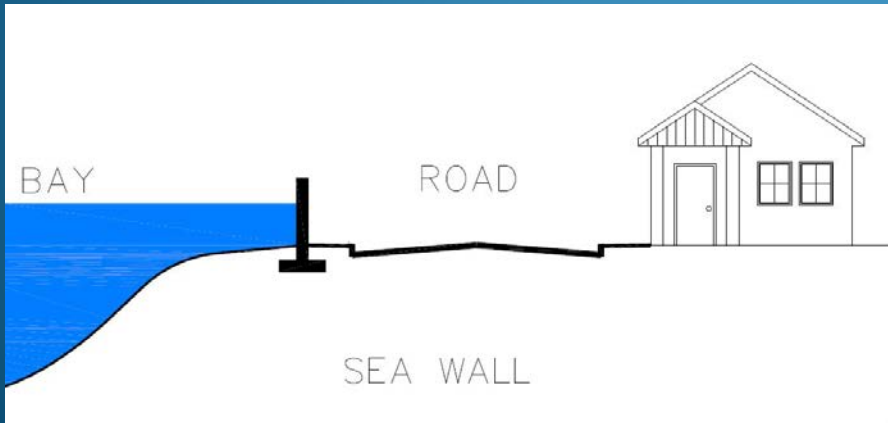
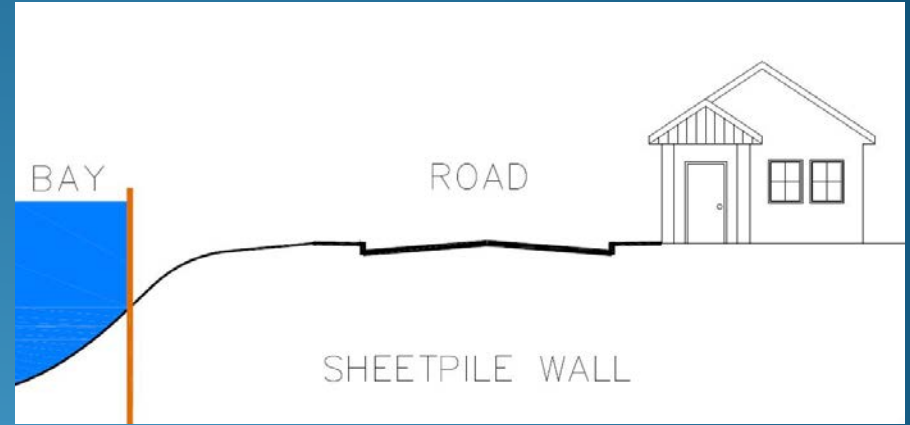
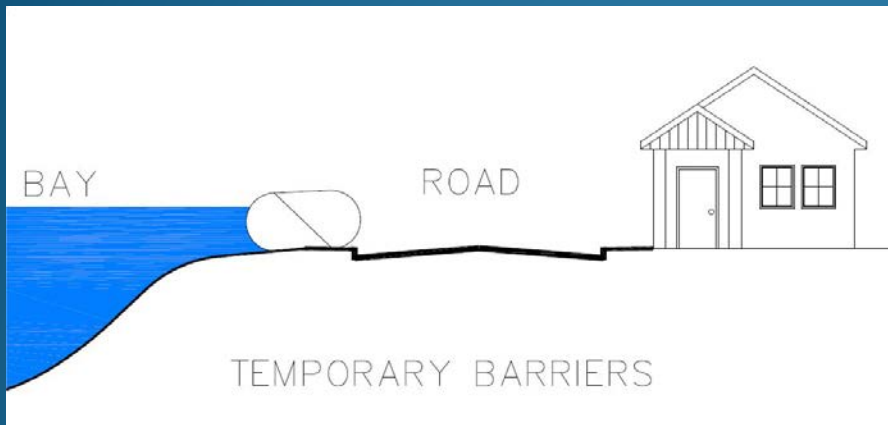


Inundation of Budd Inlet and Capitol Lake Shorelines

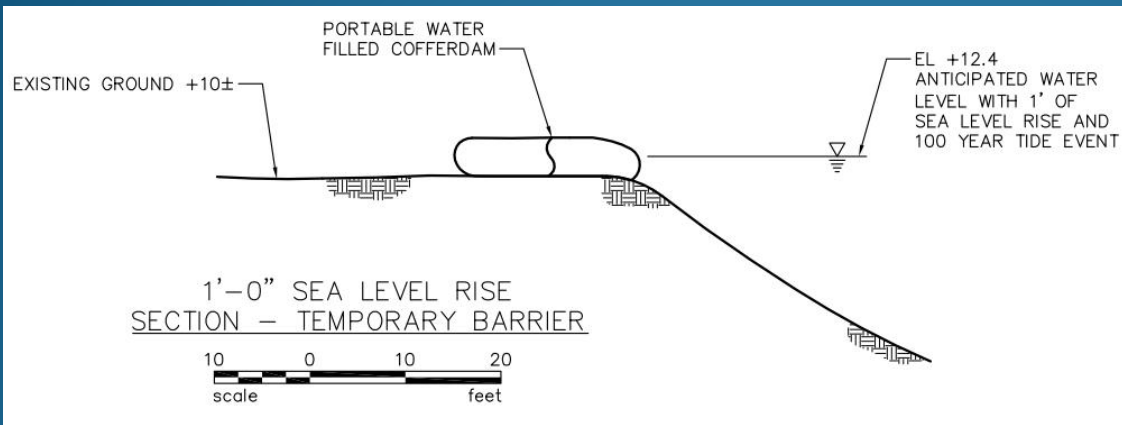


Oyster House - December 17, 2012... 17.6 Foot Tide

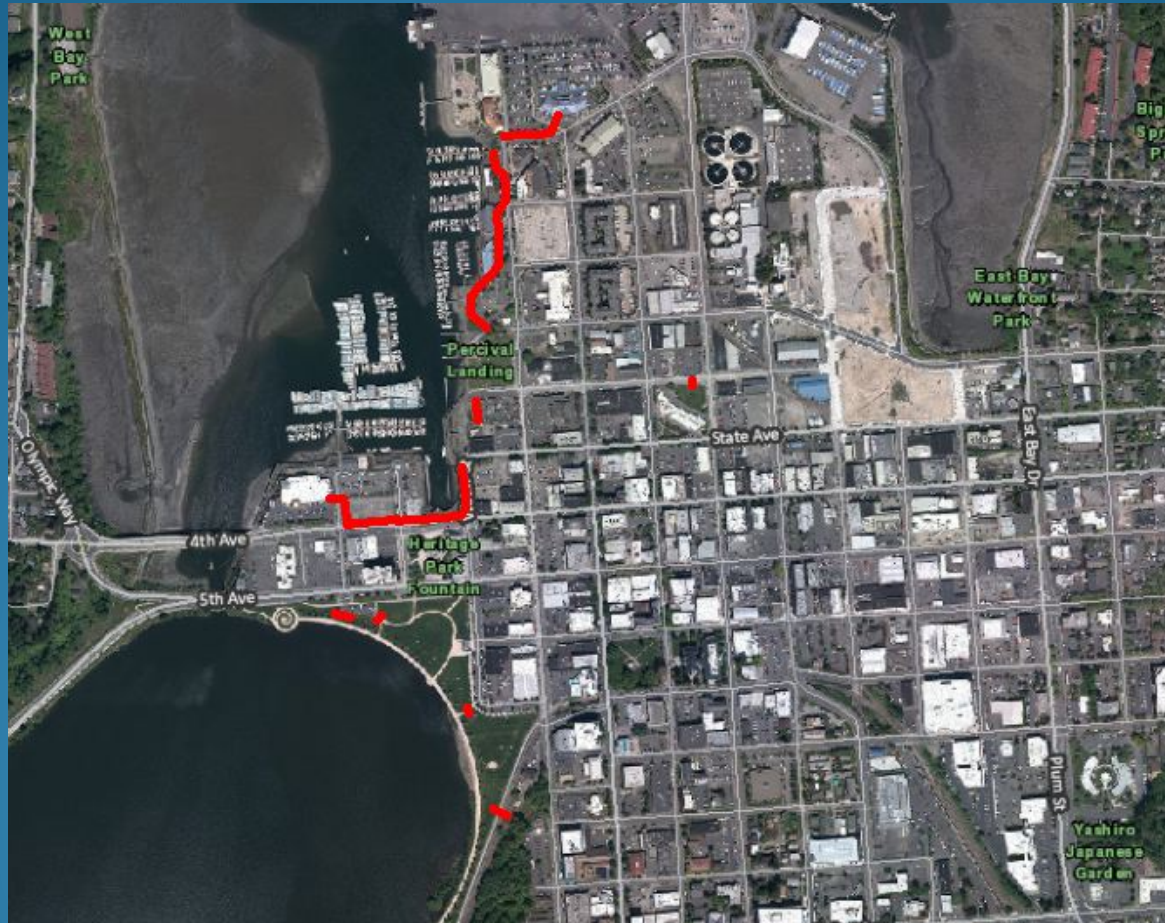
Inundation of Budd Inlet and Capitol Lake Shorelines



Temporary Flood Barriers



Temporary Flood Barriers - Locations



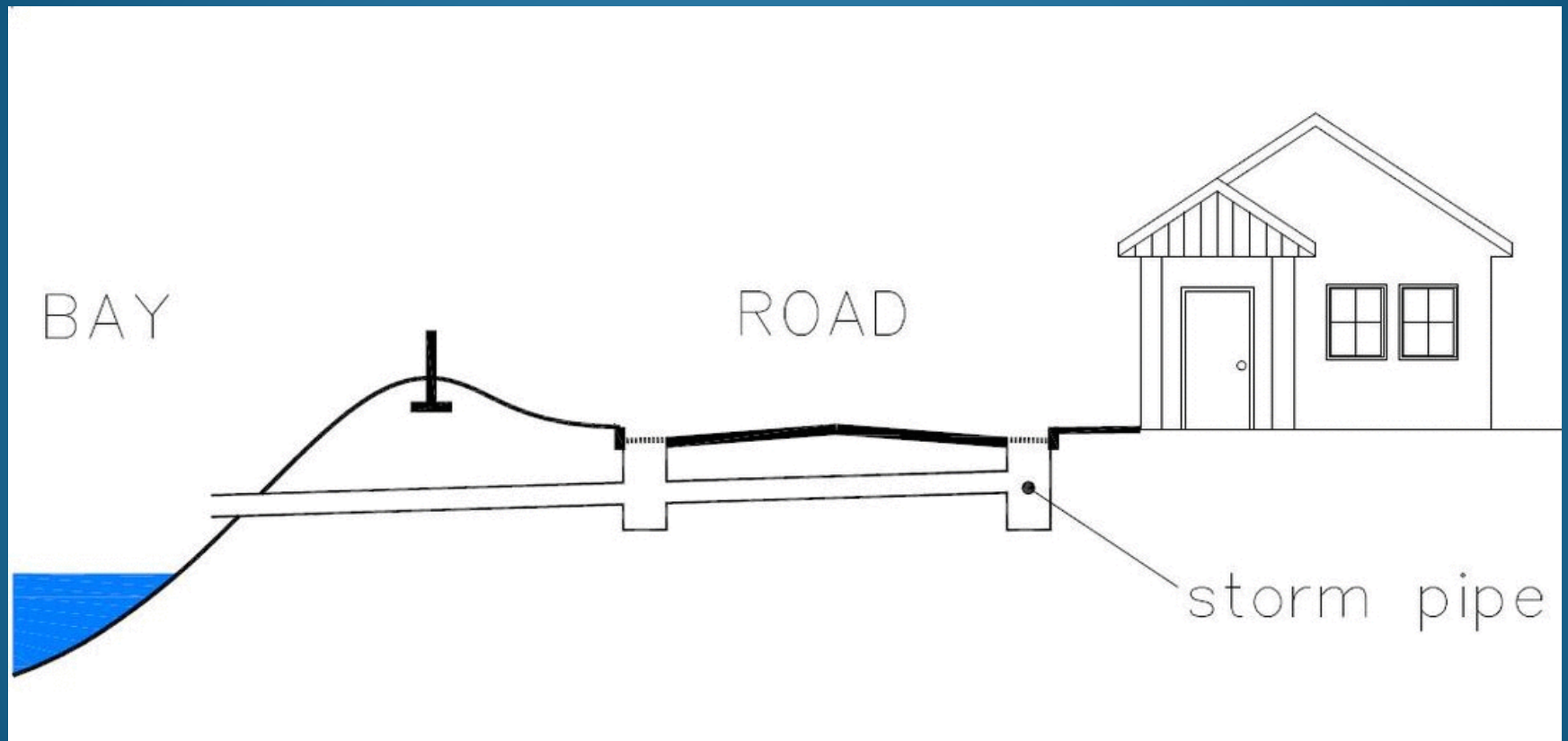
Barrier Locations – 0.25 ft sea level rise



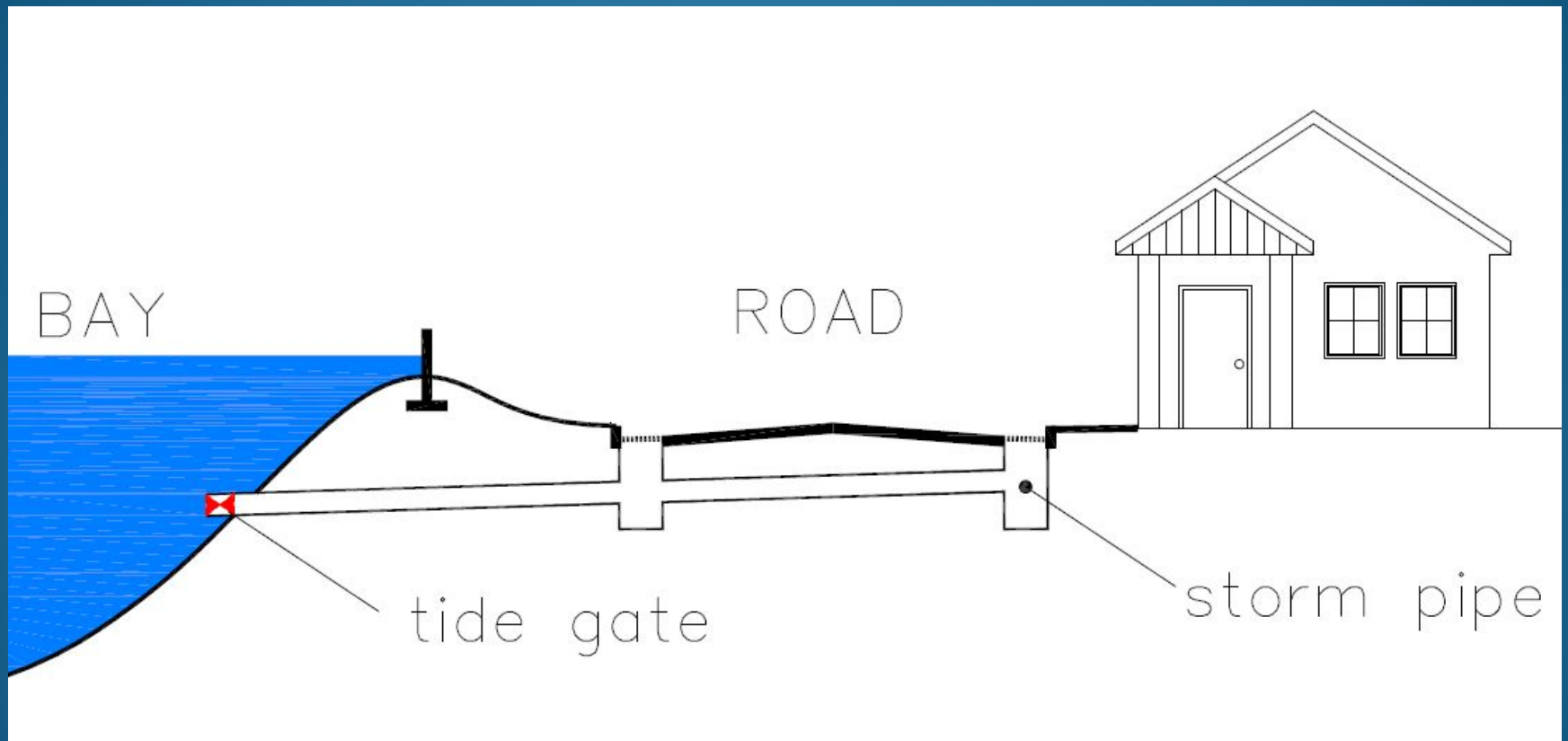
Barrier Locations – 0.5 ft sea level rise and beyond



Pipe Backflow Flooding



Pipe Backflow Flooding



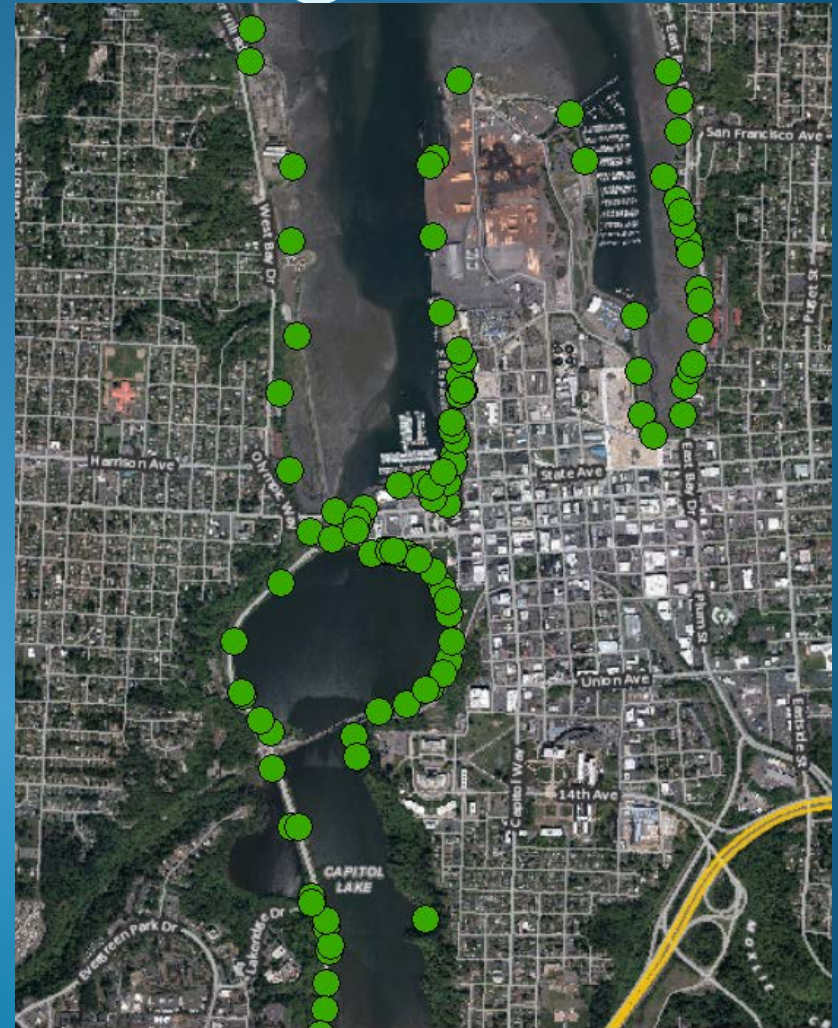
Pipe Backflow Flooding



Budd Bay Cafe

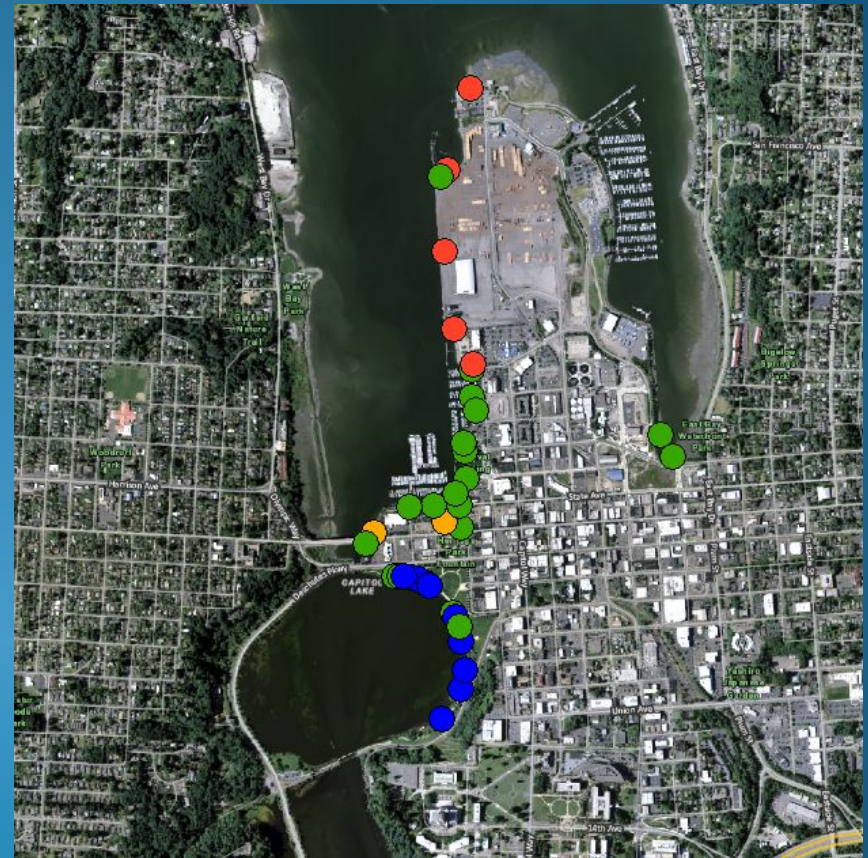
Pipe Backflow Flooding

- 112 known outfalls to Capitol Lake and Budd Inlet within the city limits

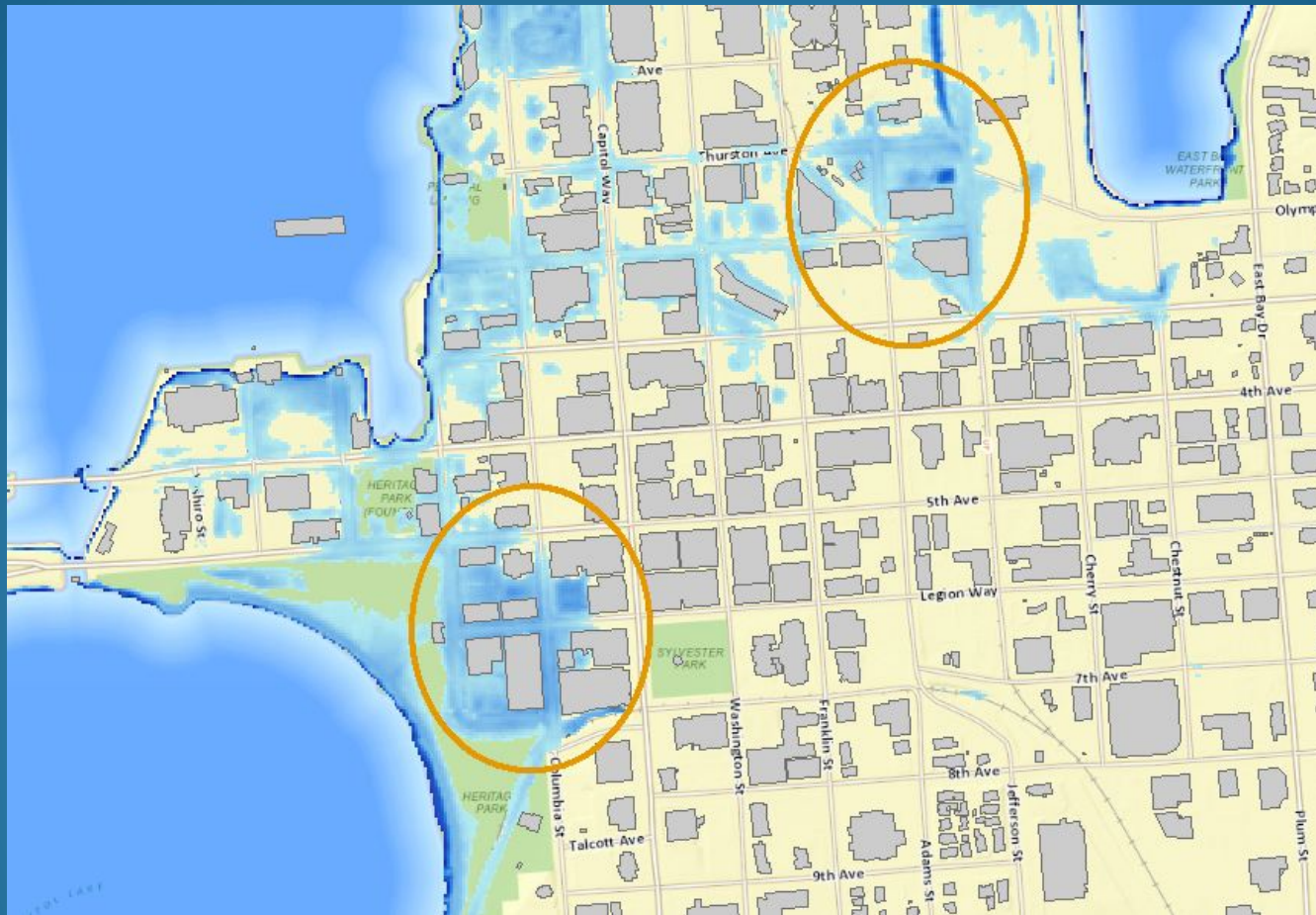


Pipe Backflow Flooding

- Of those piped outfalls, 36 are susceptible to backflow flooding
- 20 City –owned
- 9 State-owned
- 5 Port-owned
- 2 Privately-owned



Capitol Lake and East Bay



Backflow Prevention Devices

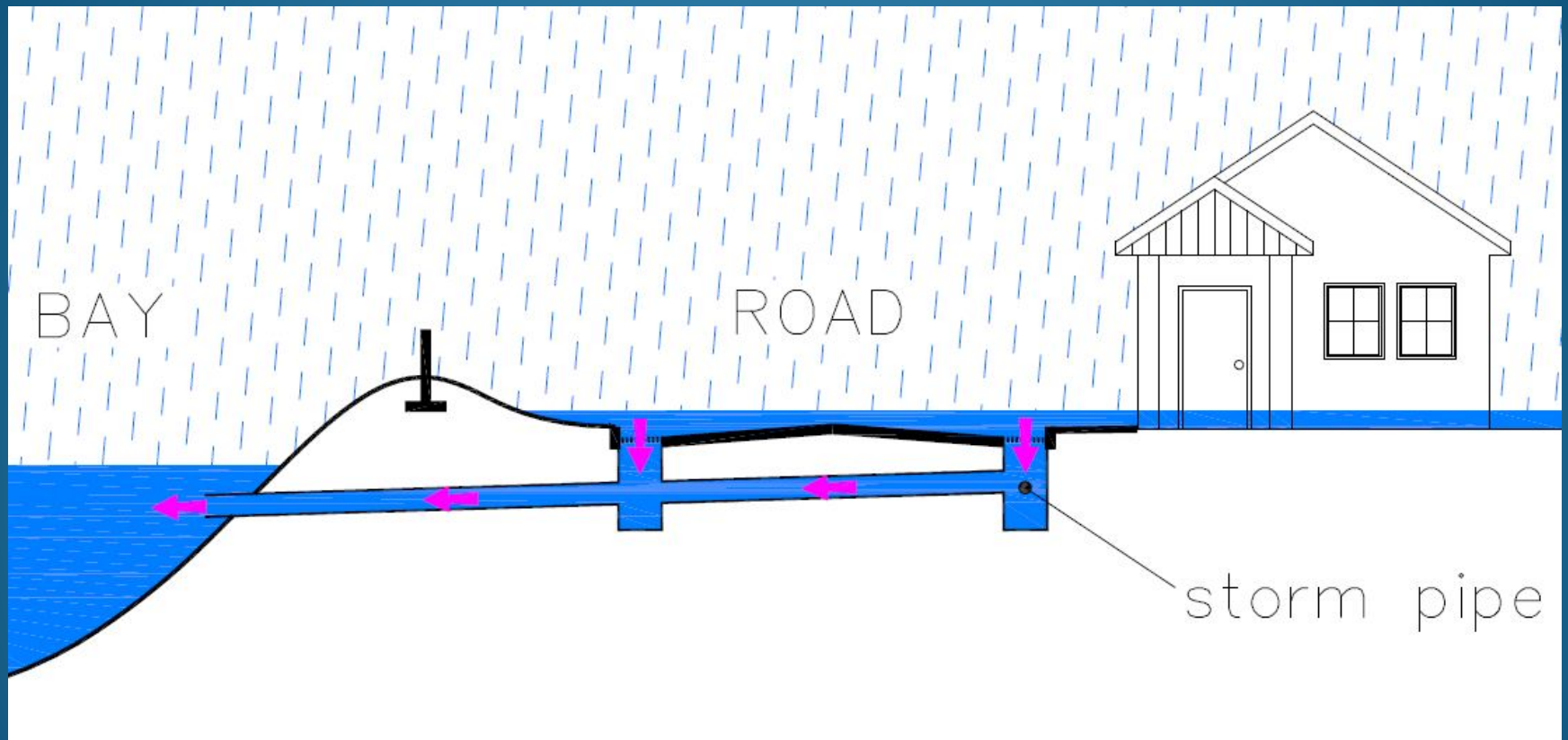


Flap tide gates & Gate valve



Pinch valve "duck bill"

Terrestrial Runoff Flooding



Inundation of Budd Inlet and Capitol Lake Shorelines



Capitol Lake

2014 Work Plan Tasks

- Survey shoreline elevations
- Survey vulnerable structures elevations
- Identify combined sewer catch basins vulnerable to flooding
- Purchase temporary barriers and practice placement

Additional Short-term Tasks

- Design strategic tide gates
- Modify drainage system for the Capitol Lake to eliminate need to pump 20-acre basin
- Perform geotechnical and hydrogeological investigations to determine need for sheetpiling

Medium-term Tasks

(0.25 to 0.5 inches of sea level rise)

- Modify elevations of Heritage Park
- Install permanent flood barriers on western shore of peninsula
- Consolidate peninsula drainage systems
- Disconnect flood-prone streets from the Moxlie Creek drainage system
- Purchase pumps to handle downtown runoff during high tides

Long-term Tasks

- Raise barriers building on existing foundations
- Construct pump stations for consolidated drainage systems and Moxlie Creek.

Latest on Climate Change

- The earth is definitely warming
- It is extremely likely the cause is anthropogenic
- We need to act now. If changes are not made soon, there may be severe widespread and irreversible impacts (e.g. melting ice sheets)
- We need to base policy on science not economics

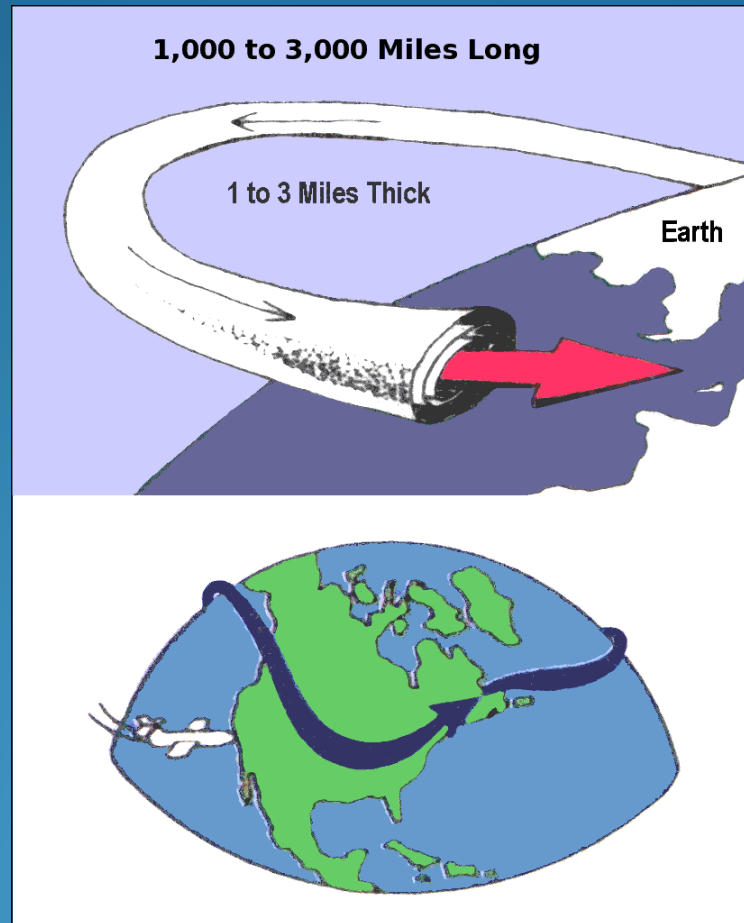
Pacific Northwest Climate Science Conference

We can expect:

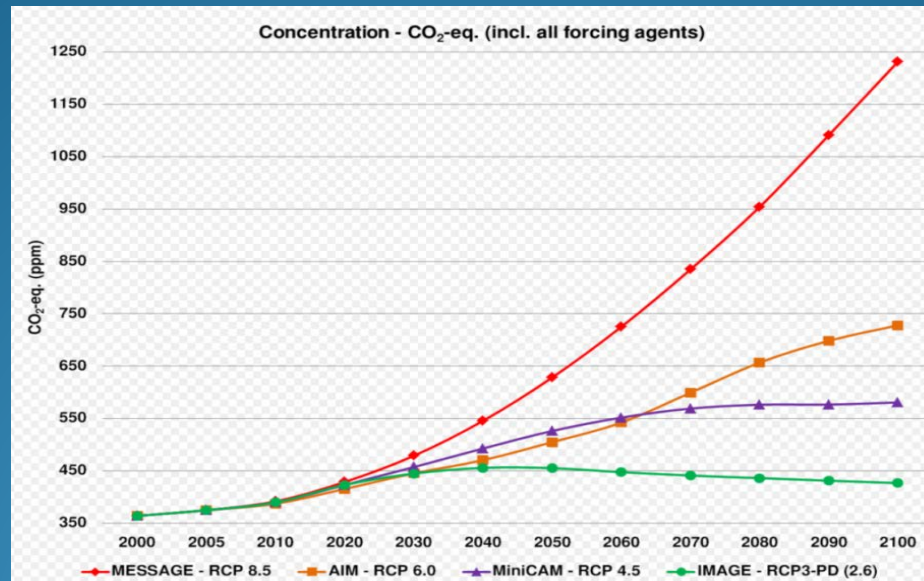
- Increased wildfires
- Increased drought
- Decreased snow pack
- Increased winter stream flows
- Decreased summer stream flows
- Increased precipitation (up to +3%/yr)
- Increased storm intensities (up to +10%)
- Increased uncertainties for agriculture



Pacific Northwest Climate Science Conference



International Panel on Climate Change



	2081-2100
Scenario	Temperature Change (°C)
RCP2.6	1.0 (0.3 to 1.7)
RCP4.5	1.8 (1.1 to 2.6)
RCP6.0	2.2 (1.4 to 3.1)
RCP8.5	3.7 (2.6 to 4.8)

There is hope

- If we act before the end of the century to eliminate fossil fuels as energy sources we can keep global warming to 2°C and avoid the most catastrophic effects of climate change.

Eric Christensen
City of Olympia
360.570.3741
echriste@ci.olympia.wa.us