City of Long Beach
Climate Resiliency
Assessment Report

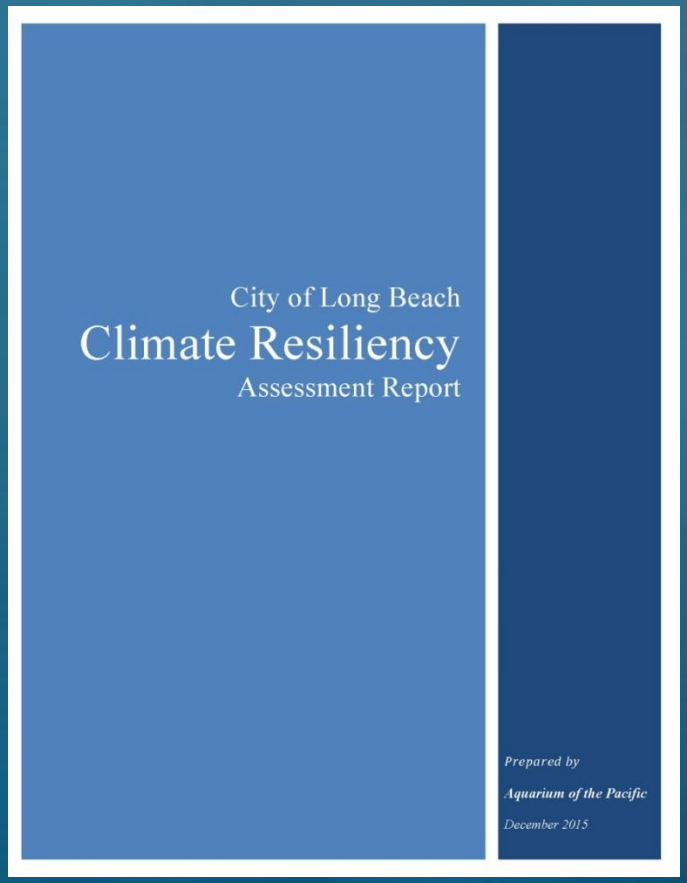
Prepared by the
Aquarium of the Pacific

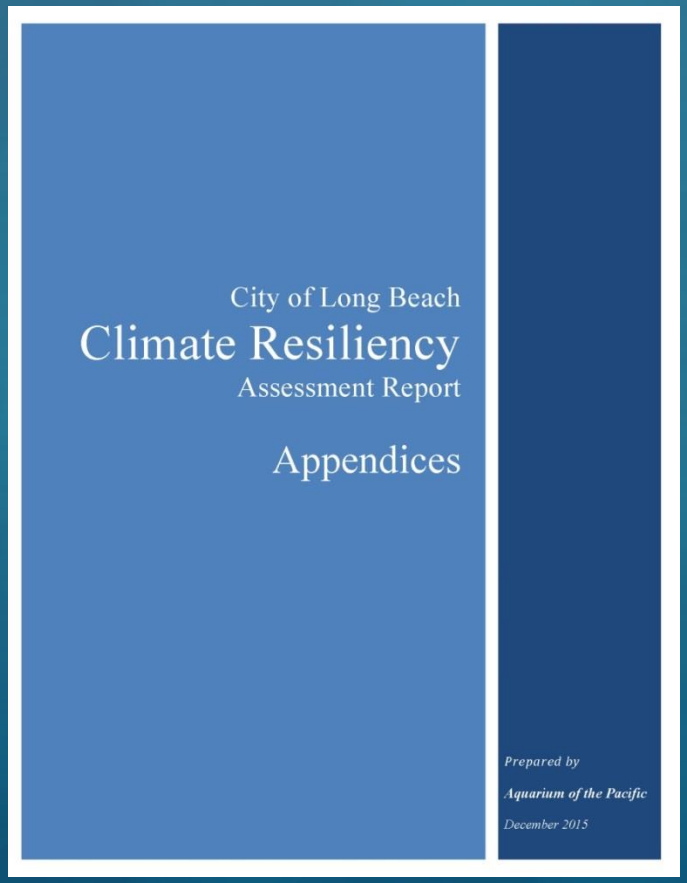
for the
Long Beach City Council

This presentation summarizes the findings of our

Climate Resiliency Assessment Study

Requested by Mayor Robert Garcia





Copies of this report can be found online at:

http://www.aquariumofpacific.org/conservation/2015_city_of_long_beach_report_on_resiliency

Characteristics of a Climate Resilient City

Climate Resilient Cities are generally considered to be those cities that are able to continue to function in the face of challenging circumstances due to climate change, and to recover quickly from disruptions

Dimensions of Community Resilience

- **Leadership** and **Strategy**
  the processes that promote effective leadership, inclusive decision-making, empowered stakeholders, & integrated planning

- **Infrastructure** and **Environment**
  the man-made & natural systems that provide critical services, protect, & connect urban assets enabling the flow of goods, services, & knowledge

- **Economy** and **Society**
  the social and financial systems that enable urban populations to live peacefully, and act collectively

- **Health** and **Well-Being**
  everyone living and working in the city has access to what they need to survive and thrive

Long Beach's *Unfair* Competitive Advantages

- **Long Beach is *Just the Right Size*:**
  Small Enough to be **Manageable** &
  Large Enough to have **National Impact**

- **Members** of the

COMPACT of MAYORS & PIONEERED BY THE ROCKEFELLER FOUNDATION 100 RESILIENT CITIES

- **City Leadership**, **Port of Long Beach** (POLB), **LB Water Department** (LBWD), **LB Transit**, **Health Department** , etc.
  Work Together to Give our City a Head Start

Climate Change Choices

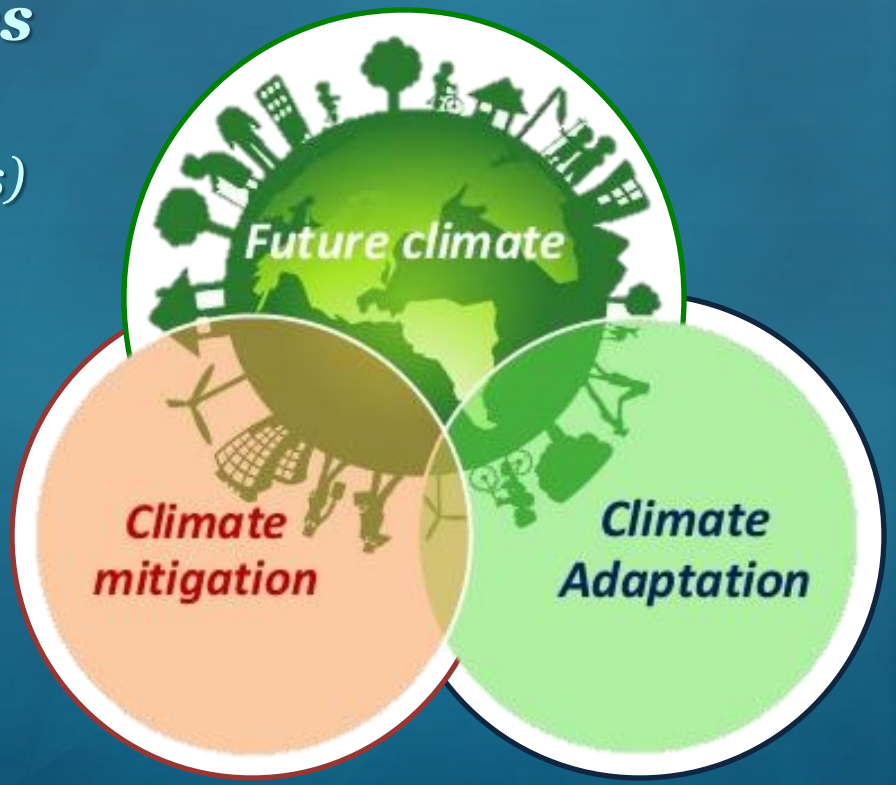
Mitigation

Reducing** the **Driving Forces
of Climate Change
(such as ↓ Greenhouse Gas Emissions)

Adaptation

Adapting to the
Inevitable Changes
that will occur as a
Result of Climate Change

Climate Change Choices

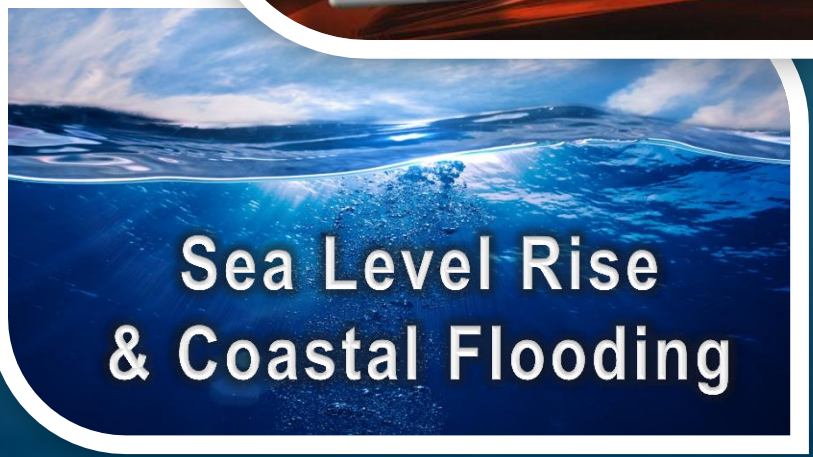


"Avoiding the Unmanageable,
& Managing the Unavoidable"

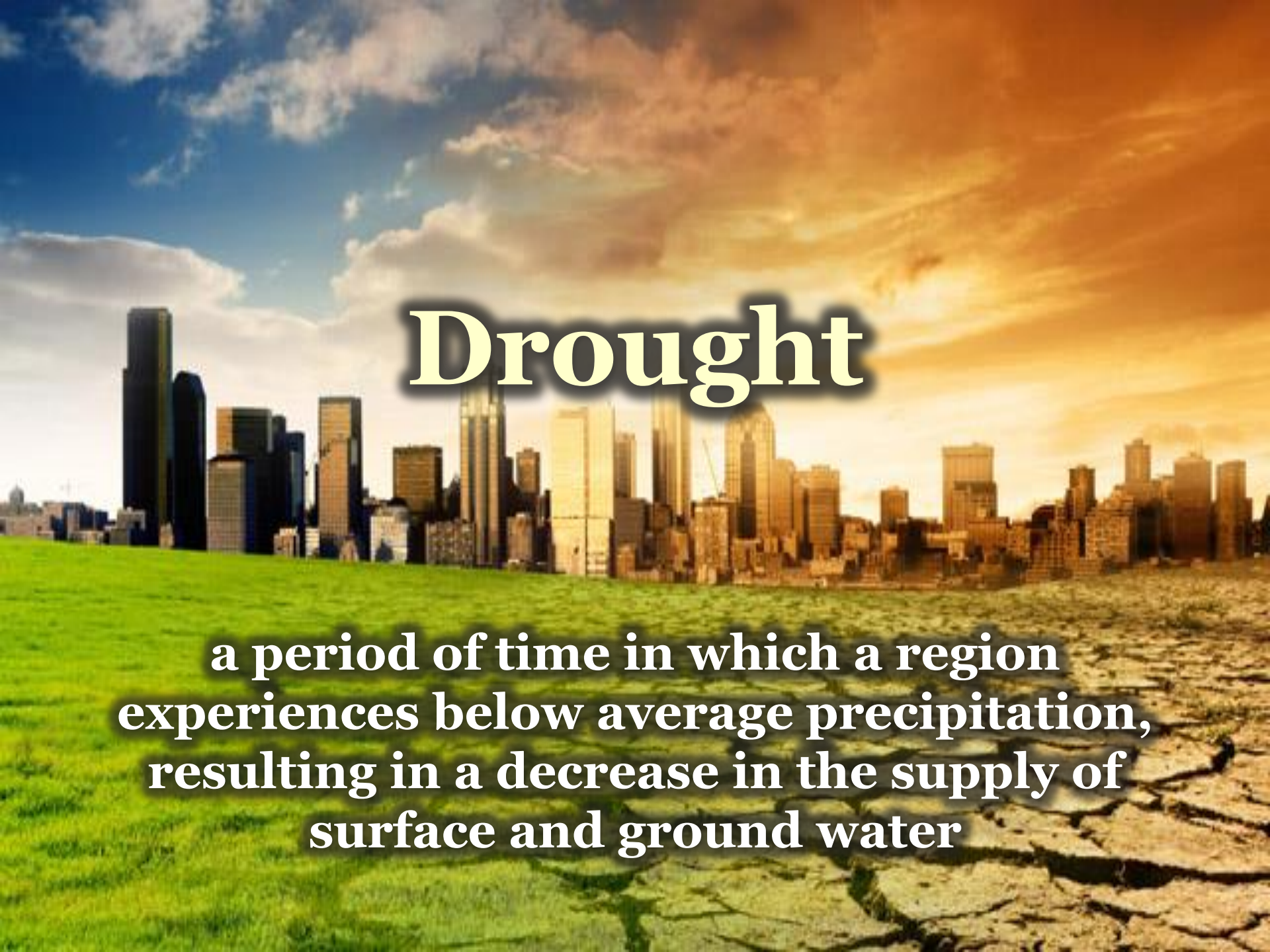
Steps in this Study

- Identify the **Major Threats** of **Climate Change** to the City of Long Beach
- Assess the **Impacts** and **Vulnerabilities** of these Threats to our City
- Review **Plans** and **Efforts Currently Underway** to address these threats
- Explore **Additional Approaches** to **Consider** for reducing our vulnerabilities & increasing resiliency
- **Summarize Findings** & **Suggested Approaches**

Primary Threats of Climate Change

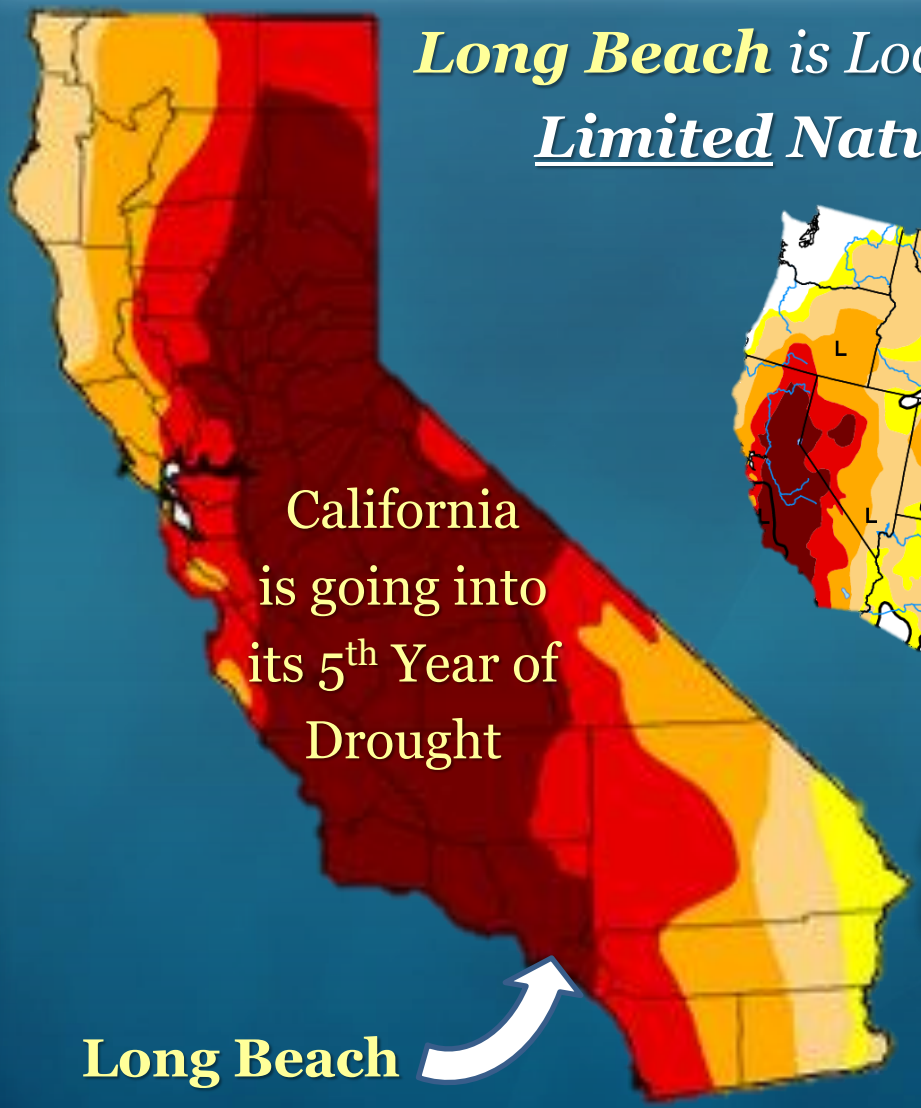


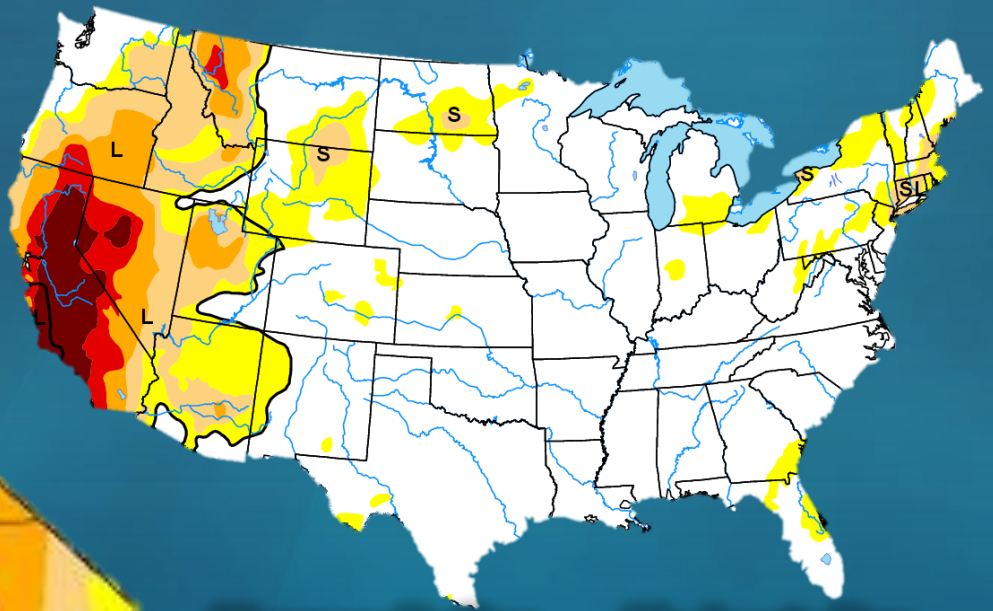
Overview of the Climate Change Threats to Long Beach


Drought
a period of time in which a region experiences below average precipitation, resulting in a decrease in the supply of surface and ground water

Impacts of Drought on Long Beach

***Long Beach** is Located in a **semi-arid** region with **Limited** Natural Freshwater Supplies*



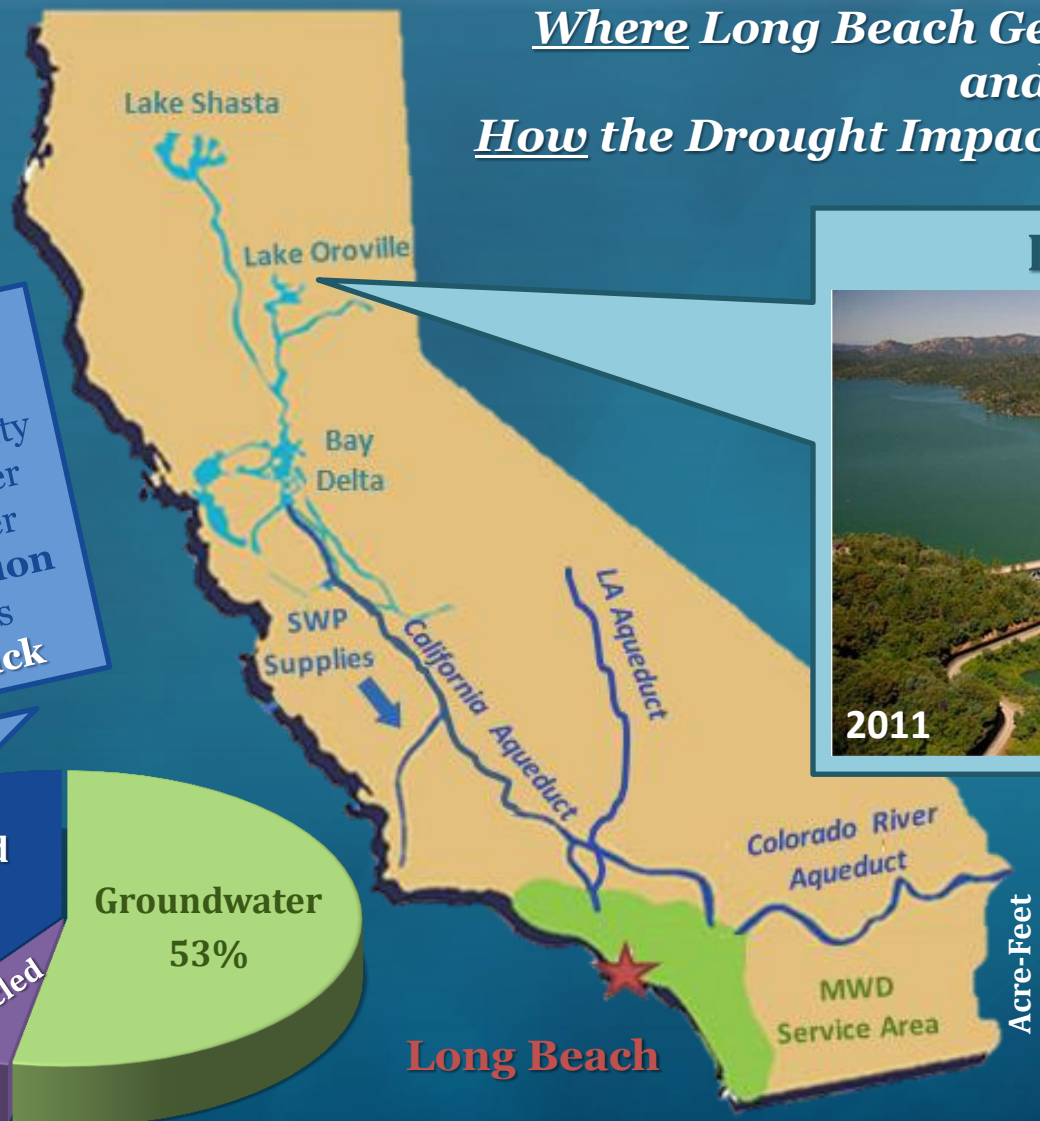


Abnormally Dry
Moderate Dry
Severe Drought
Extreme Drought
Exceptional Drought

US Drought Monitor (January 5, 2016)

Impacts of Drought on Long Beach

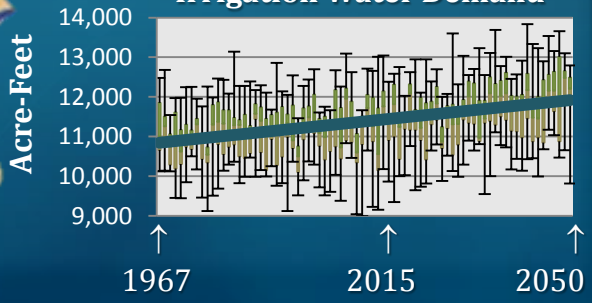
***Where* Long Beach Gets it's Water From**
and
***How* the Drought Impacts Our Water Supply**



Imported Sources get the majority of their water from winter **precipitation** stored as **snowpack**

Lake Oroville

Estimated Residential Irrigation Water Demand



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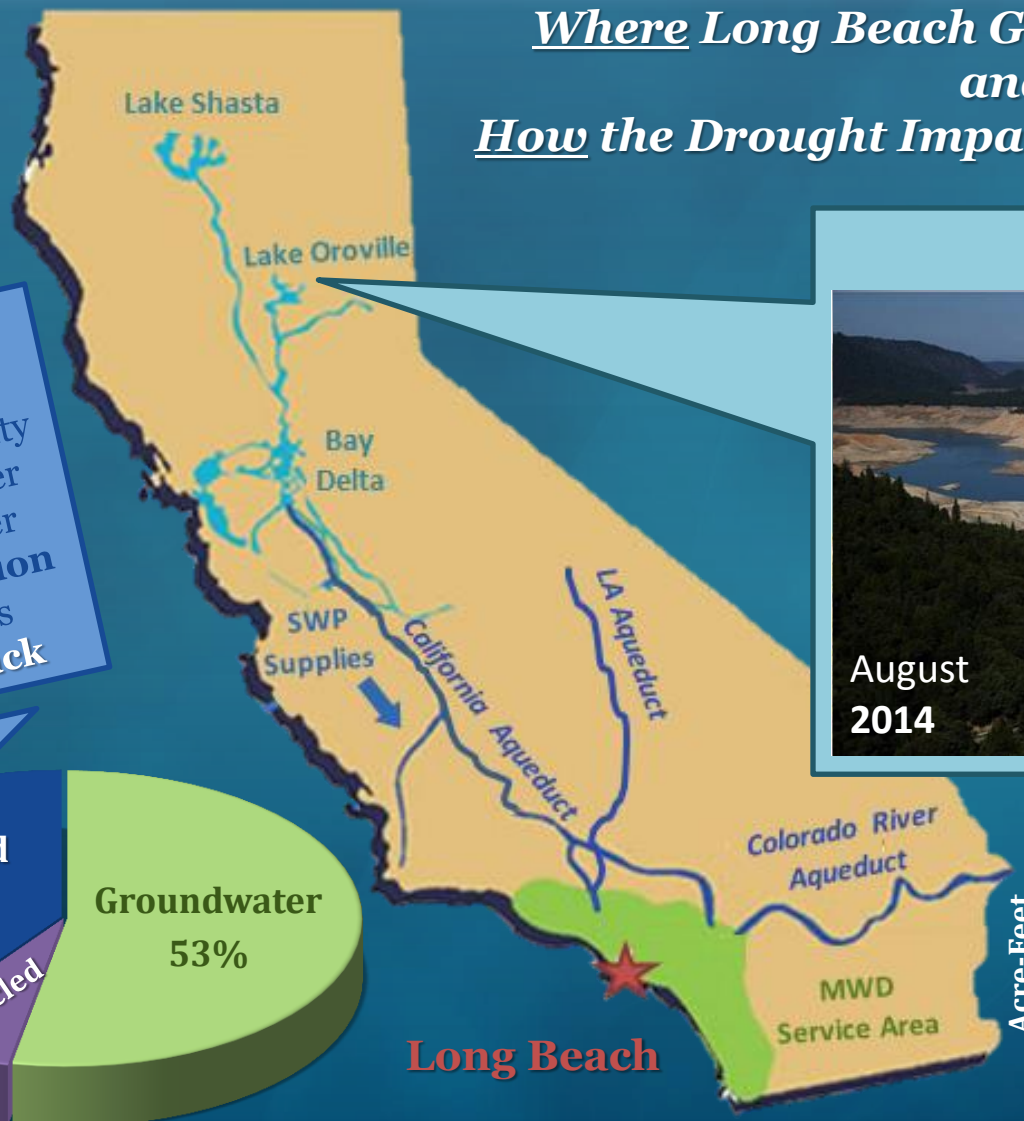

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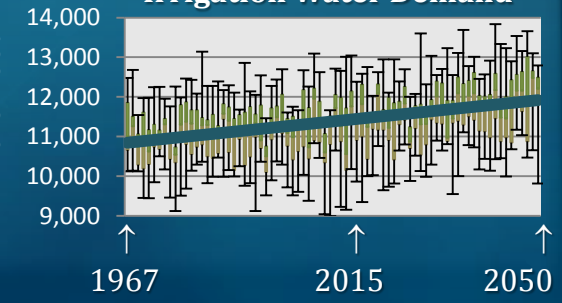
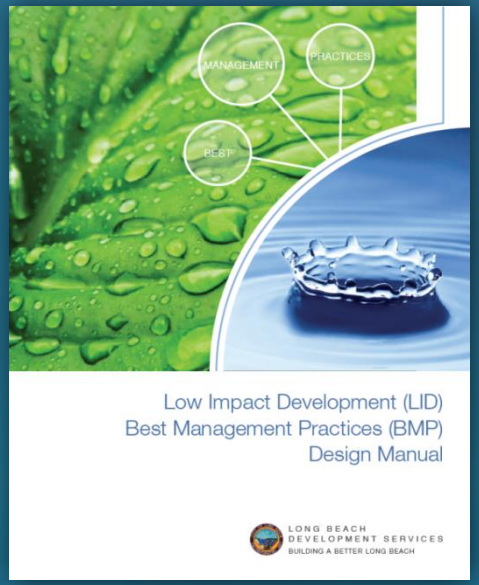


Plans and Efforts Currently Underway

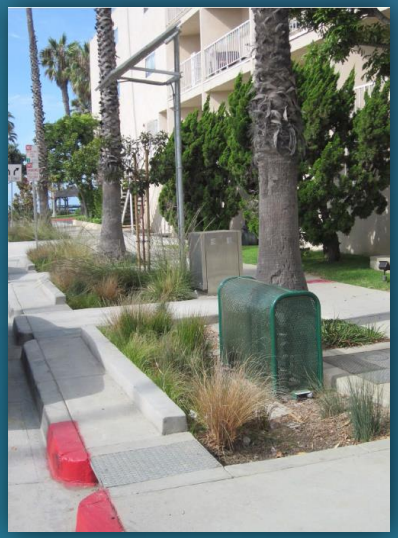
Long Beach's ***Outstanding Water Department***
has helped us to become a ***Leader in Water Conservation***

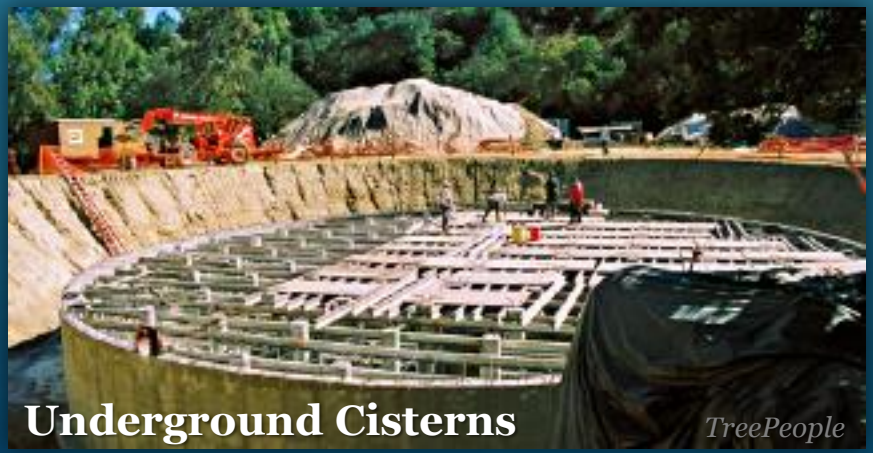


Additional Approaches to Consider

Enforce the 2010 Landscape Ordinance (ORD-10-0031)

Stormwater Capture Strategies





Underground Cisterns

TreePeople

Drought Summary

Climate is Warming and Demand for Water is Increasing

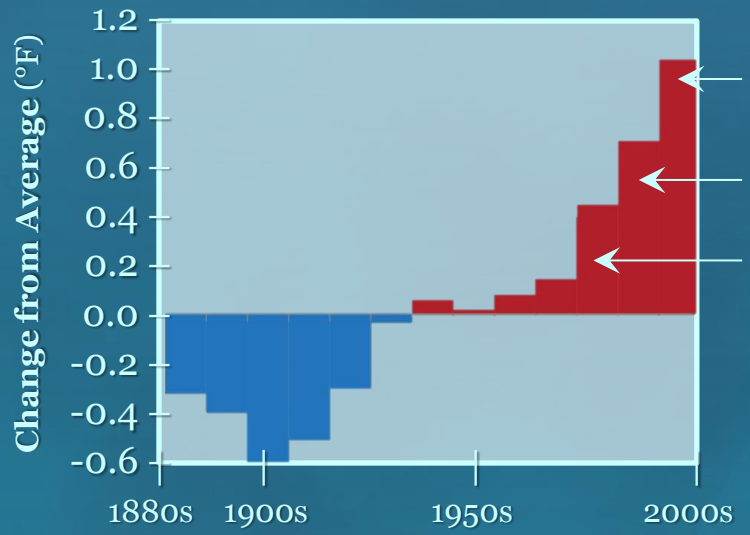
Some strategies for coping:

- **Continue move to drought-tolerant landscaping**
- **Continue to ↑ use of recycled water**
- **Promote capture & retention of stormwater on site**


C F
Extreme Heat
generally considered to be temperatures that are substantially hotter than average for a given time of year in a specific location

Global Impacts of Extreme Heat

Global Temperature Change: Decade Averages

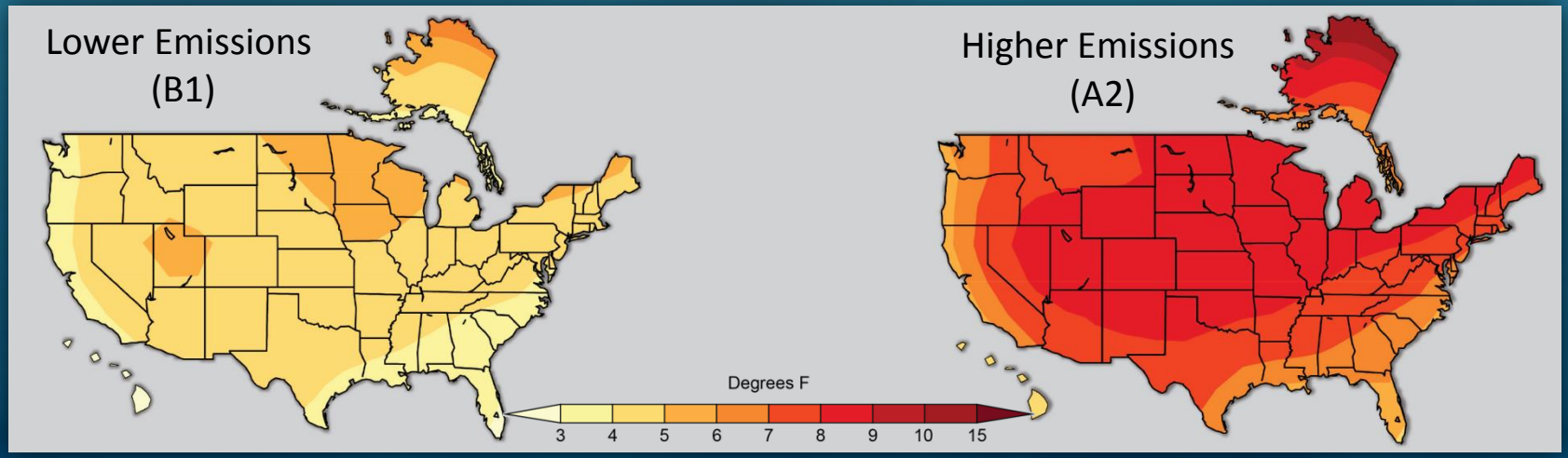


2000's: each year is Warmer than the 1990s average

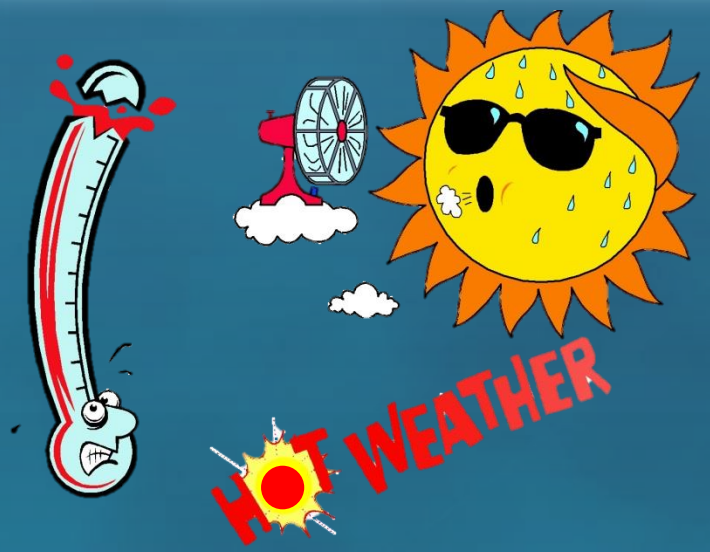
1990's: every year is Warmer than the 1980s average

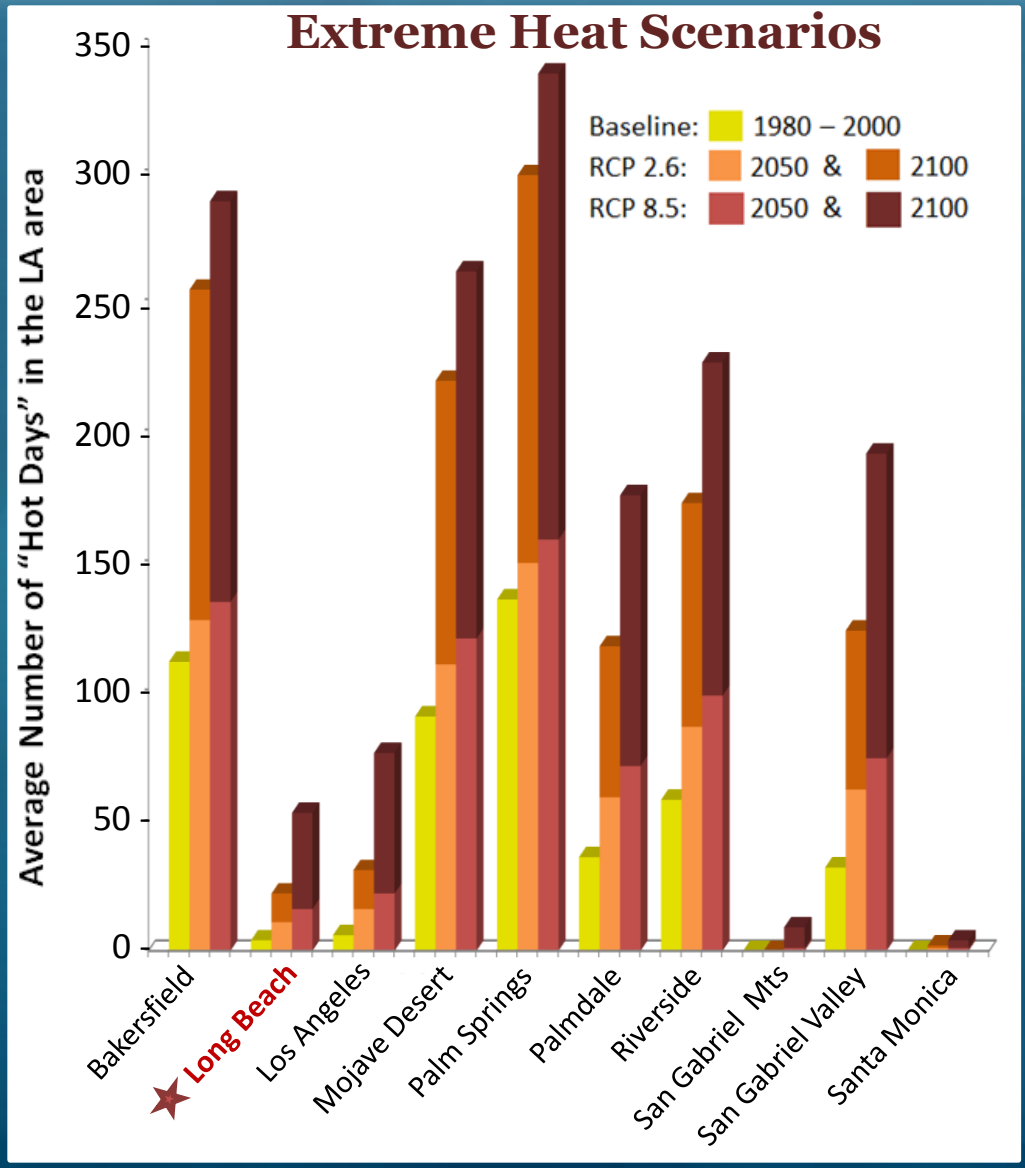
1980's: Warmest Decade on Record at the time

Projected Temperature Changes (2100)

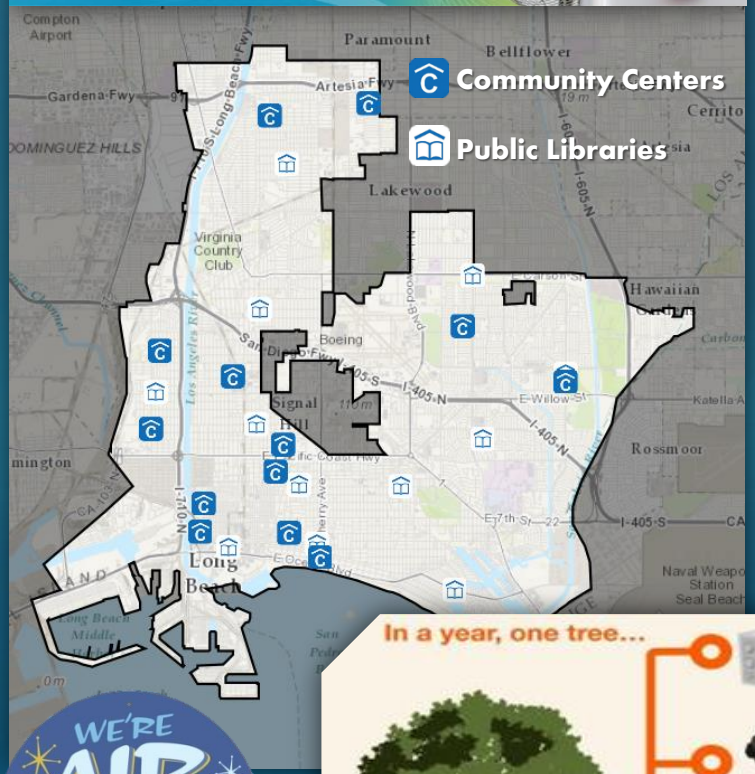


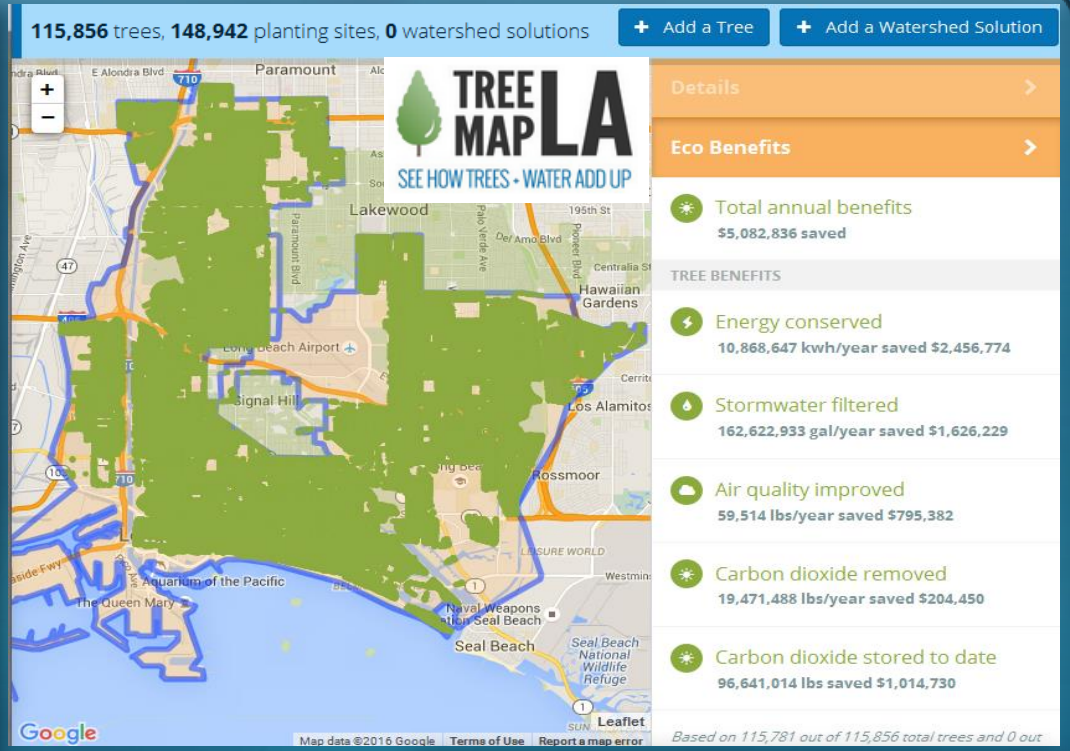
Local Impacts of Extreme Heat

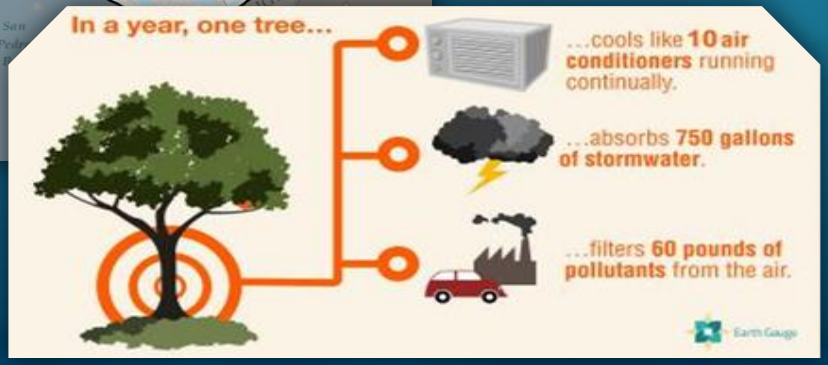




Plans and Efforts Currently Underway







Additional Approaches to Consider

Long Beach (and the greater LA Region) should plan for an
↑ in Average Temperature and **Responses to an ↑ in the # of Hot Days**

Expanding the number (and locations) of **Cooling Centers**,
adding **more Trees**, **Shade Structures**, and **other Green adaptations**
would create **Cooler Micro-Climates** and provide **Refuge from the Heat**

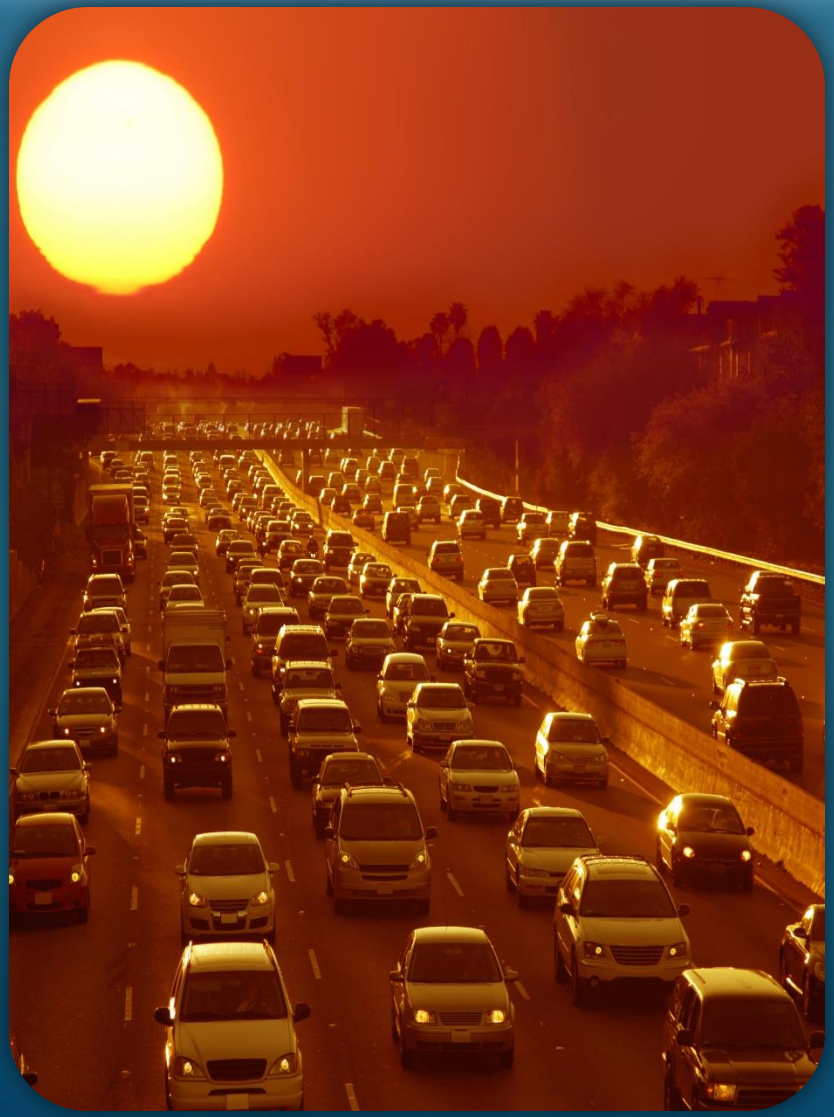
Shade Structures

Green Roofs

Cool Roofs

Cool Pavements

Extreme Heat Summary



- **Cooling centers** are currently the most effective method to provide residents with some relief on hot days
- To become a climate-resilient city, Long Beach should continue planning for these extreme heat events and the hot days that come with it
- Strategies such as the cooling centers are one effective solution to heat, but should not be solely relied upon (additional actions must also be taken)
- Further Planning & Action must be taken to help the community stay safe against Extreme Heat Events

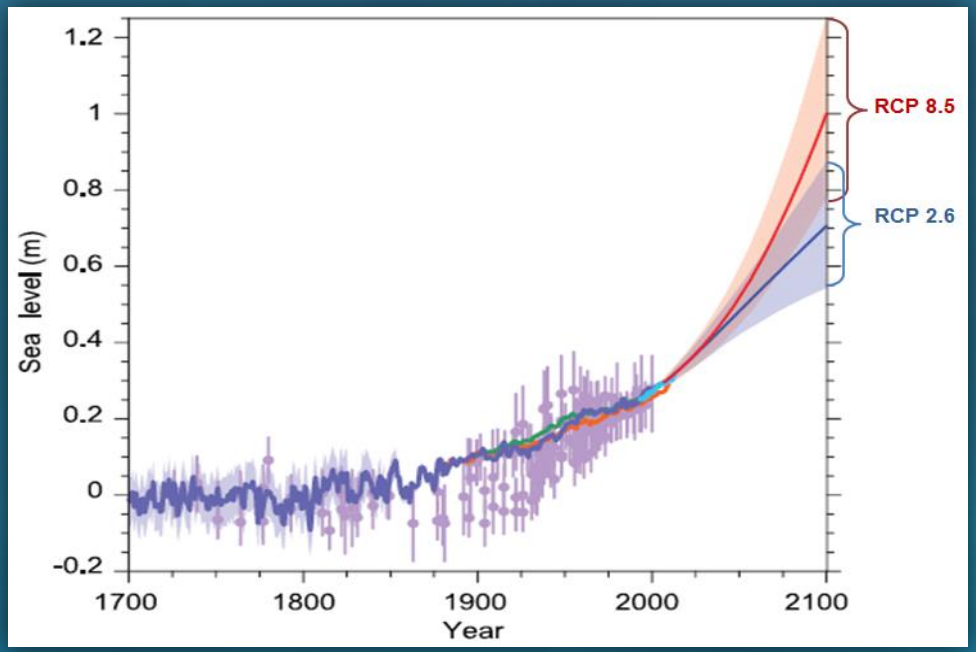
Sea Level Rise (SLR) & Coastal Flooding

"**Coastal flooding**" is a **temporary condition** caused by **storms** and/or **very high tides**,

"**Inundation**" is a **permanent condition** caused by **relative sea level rise**

Global Impacts of Sea Level Rise (SLR)

Impacts of SLR are NOT Universal, they Vary by Location



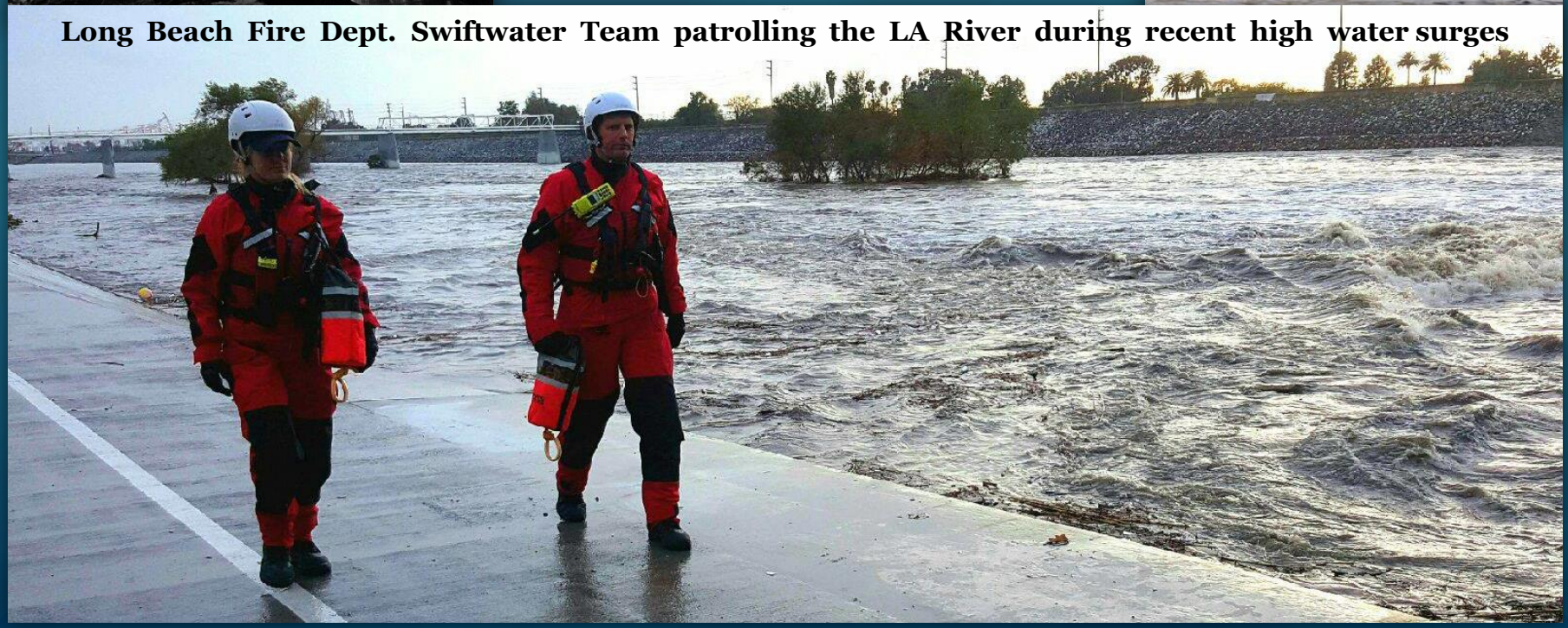
Future Sea Level Rise (SLR) estimates relative to 2000 sea level estimates (NRC 2012)

Year	Global	North West Coast	California Coast	Los Angeles
2030	3-9 *in* (8-23*cm*)	-2-9 *in* (-4-23*cm*)	2-12 *in* (4-30*cm*)	**1.8-12***in* (4.6-30.0*cm*)
2050	7-19 *in* (18-48*cm*)	-1-19 *in* (-3-48*cm*)	5-24 *in* (12-61*cm*)	**5-23.9***in* (12.7-60.8*cm*)
2100	20-55 *in* (50-140*cm*)	4-56 *in* (10-143*cm*)	17-66 *in* (42-167*cm*)	**17.4-65.6***in* (44.2-166.5*cm*)

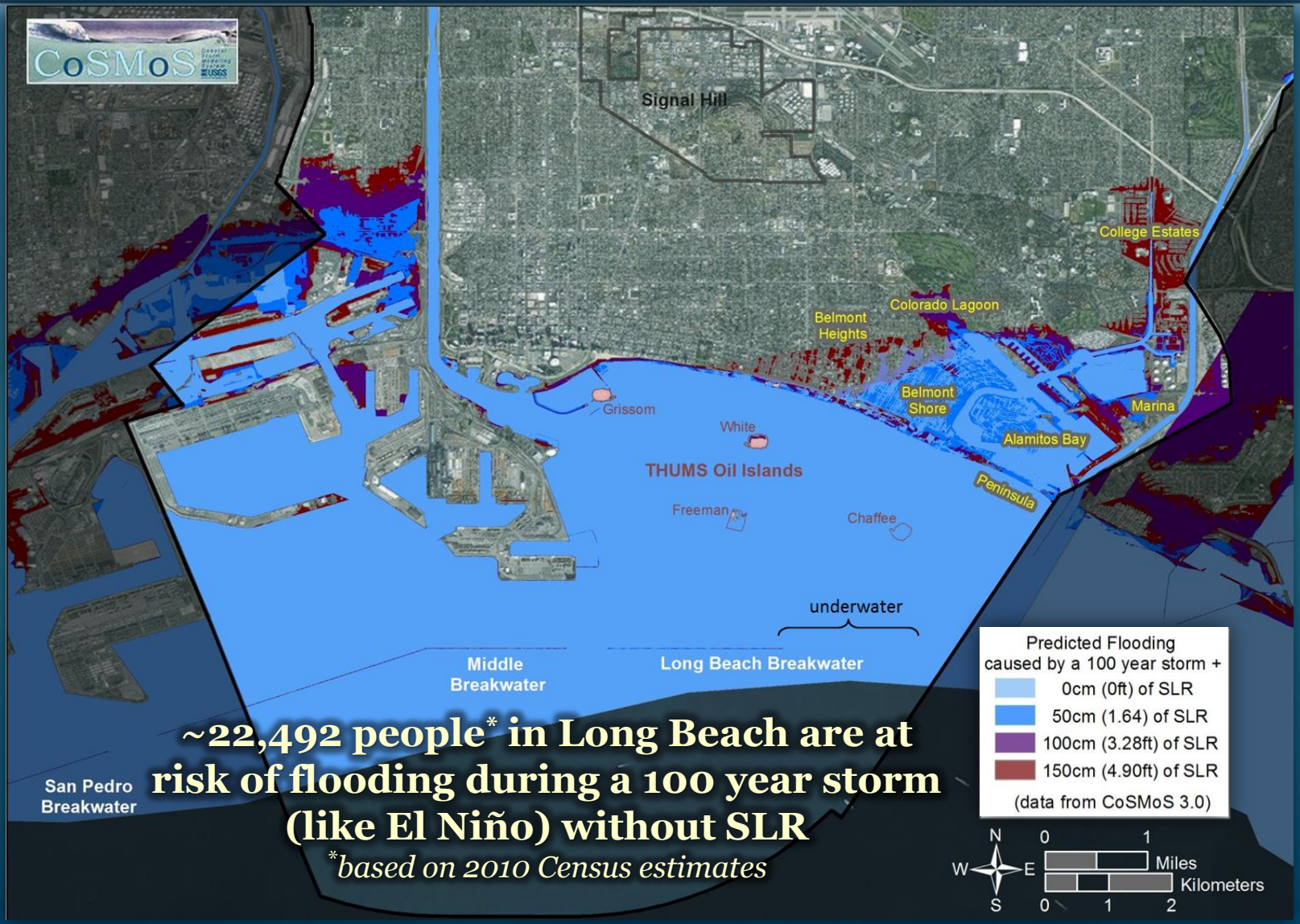
Impacts SLR & Flooding on Long Beach

Past & Current Flooding
from Stormwater
&
High Water Surges
(especially during El Niño Events)

Long Beach Fire Dept. Swiftwater Team patrolling the LA River during recent high water surges



CoSMoS 3's Predicted Impacts of a 100 year storm + SLR



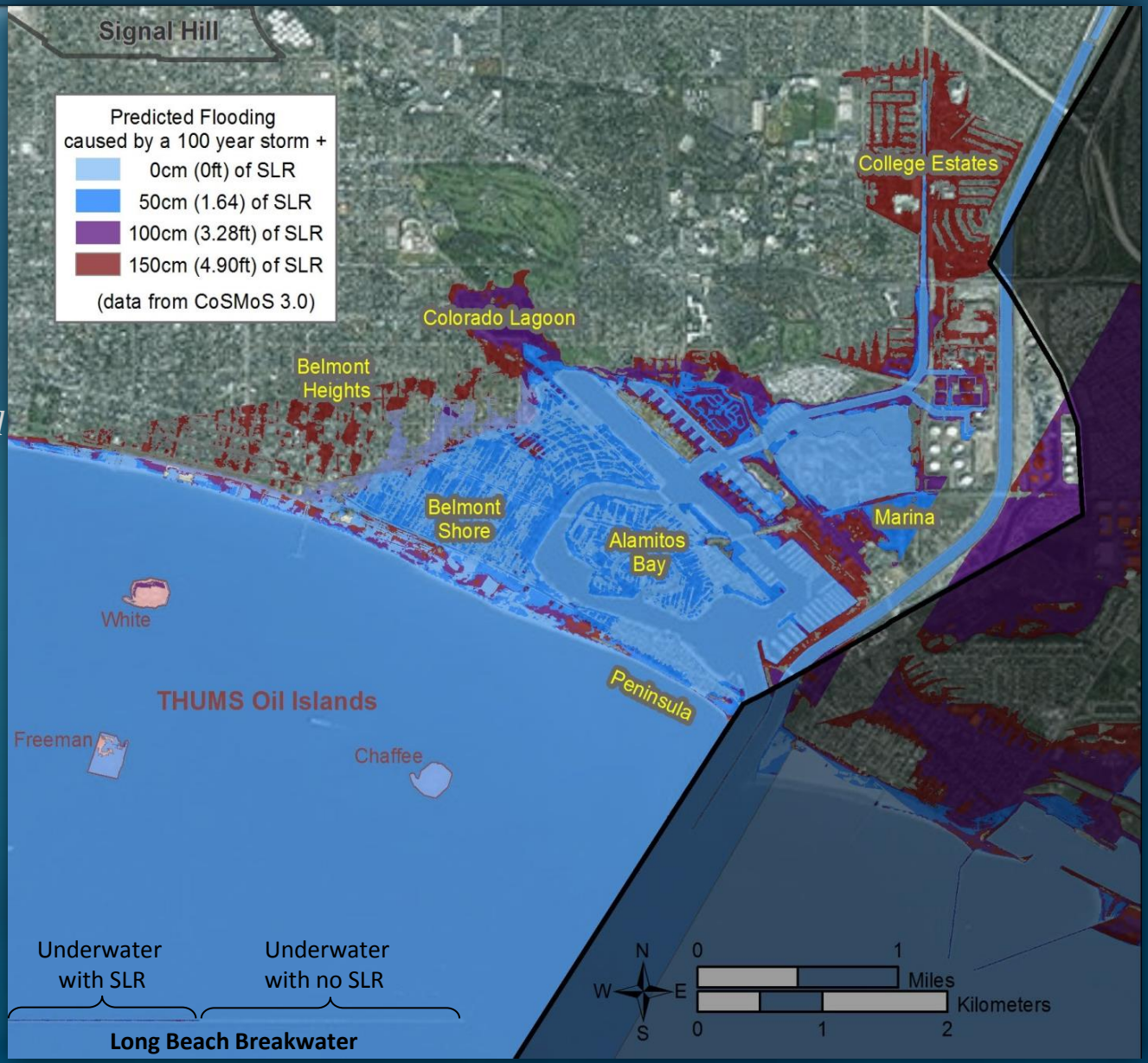
Belmont Shore Area (SE Long Beach)

Extensive Flooding is predicted for SE Long Beach during a 100-year storm, including the *backside of the Peninsula, Alamitos Bay, Belmont Shore, & the lot North of the Marina*

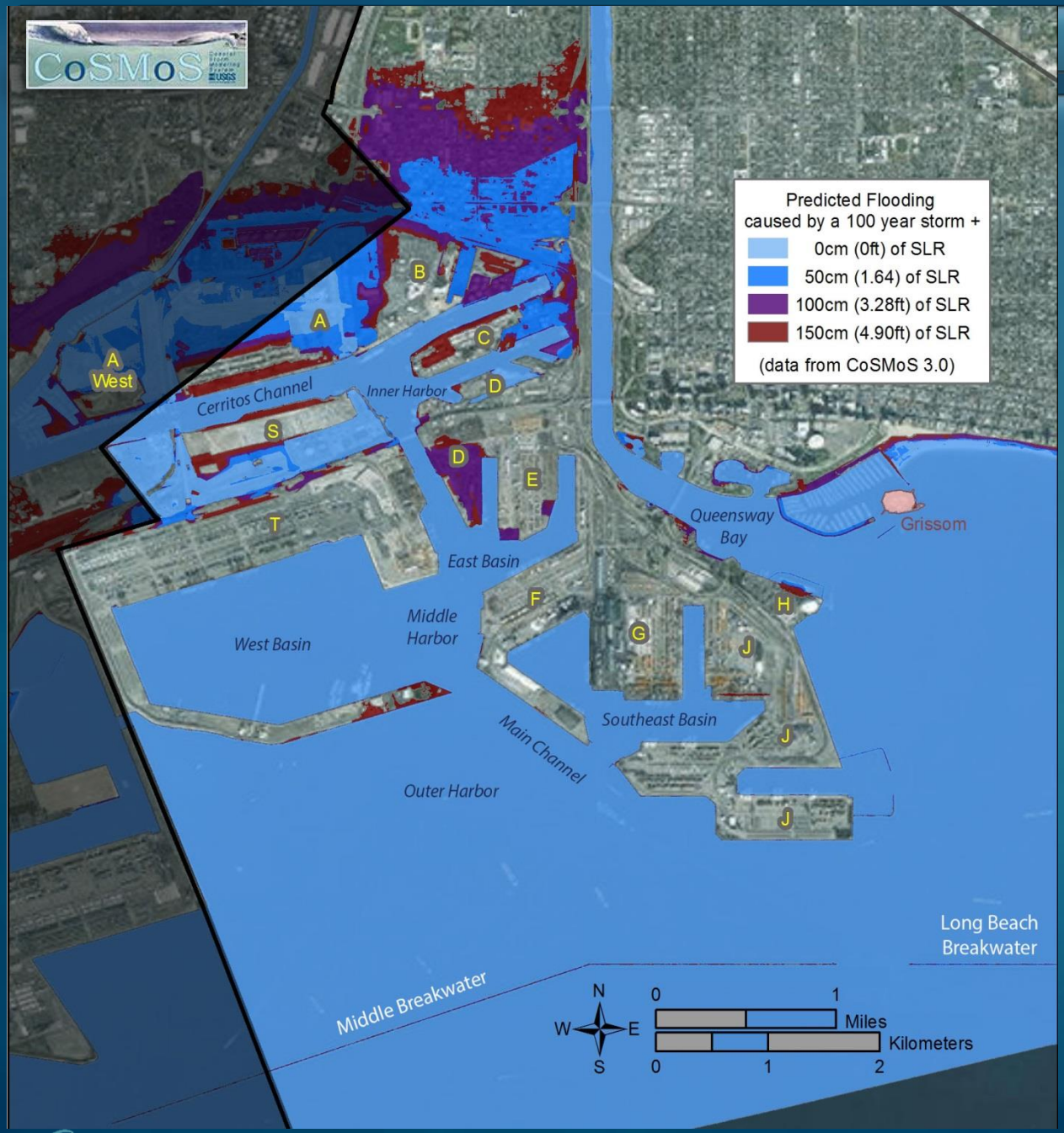
As Sea Level Rises to *50cm,* flooding expands to cover almost the *entire Peninsula, all of Belmont Shore, Alamitos Bay, the Marina, & large portions of the beach south of Belmont Shore*

With 100*cm* of SLR flooding expands to cover *most of the beach, Colorado Lagoon, & large portions between the Marina & Colorado Lagoon*

With 150*cm* of SLR, the *Belmont Heights & College Estates areas begin flooding*



POLB Area



Extensive Flooding is predicted during a 100 year storm for large portions of northern section of the Port of Long Beach (POLB), including *Piers A*, *A West*, *D*, *E*, & *S*, along with portions of the *Long Beach Shore Marina* & the *SW stretch of beach* (located just E of the Marina & N/NE of Grissom Island)

As sea level rises to *50cm,* flooding expands to cover more of *Piers A*, *D*, *E*, & *S*, and begins to flood *Pier B* (& areas N of the pier), & a *larger stretch of the beach*.

With 100*cm* of SLR flooding expands to cover a larger area north of *Pier B*, and most of *Long Beach Shore Marina*.

With 150*cm* of SLR, flooding expands throughout the port and covers *almost all of beach* (from the LB Shore Marina to the Peninsula)

Weaknesses with CoSMoS 3's Flood Model

While *CoSMoS 3* is currently the most robust coastal flood hazard model available, it has some limitations that could impact the accuracy of its flood predictions for the LB area:

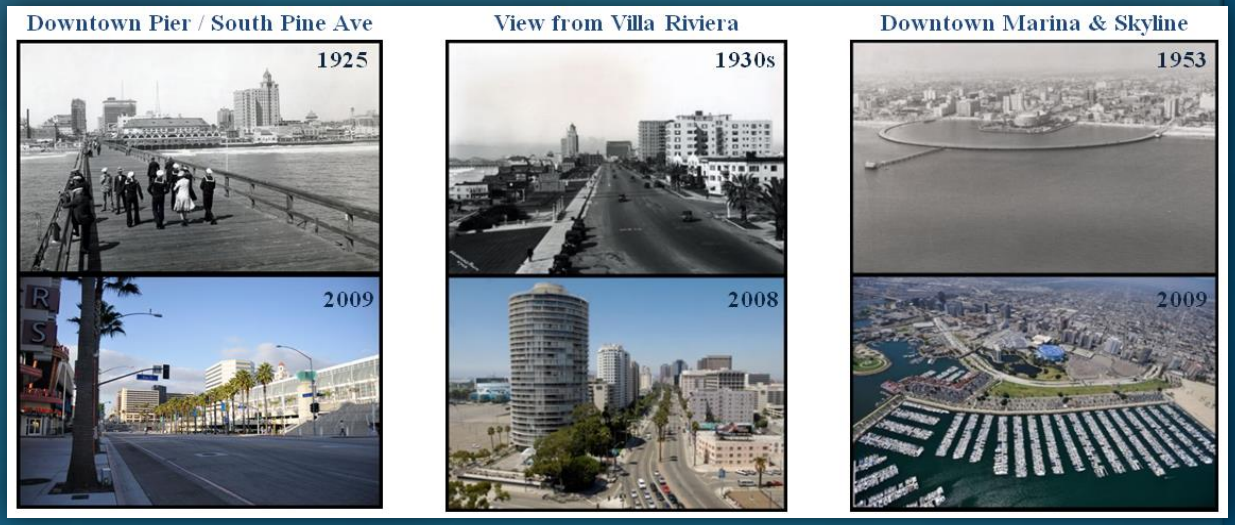
- **Total Water Level** (**TWL**)—their 100 year storm data are based on a TWL proxy, but LB is highly responsive to southern swell which is unrepresented by the TWL proxy
- **Waves**—it is unclear how they calculated waves inside the breakwater.
- **Flooding**—the ocean side model appears to use a static (bathtub) method
- **XBeach model implementation—** it appears they were running a hydrostatic (long wave only) model, which is not ideal for the Long Beach area.
- **Beach**—It appears *CoSMoS 3* included a few profiles, but it is unclear whether the beach width, elevation, and berming are complete for the Long Beach area.
- **Validation**—it is unclear how the model's output for Long Beach compared to the actual flooding experienced during the January 2010 storm.
- **Bathymetry**—it is unclear what bathymetry data were used. How recently these data were collected and the accuracy of them are critical to model reliability.

Weaknesses with CoSMoS 3's Flood Model

Additionally, it does not appear that *CoSMoS 3.0* included Beach Change
- important because water run-up acts much differently on beaches than on pavements

This may be an important flaw in the model's design because currently the majority of California's coastlines have been so extensively developed and modified that they are now classified as "urban systems" (rather than natural ones).

For example, here in LB, the original beach line (prior to coastal development) was located where Pine Ave meets the Convention Center everything from there seaward (~1mile) was built up



Once these systems have been altered to this extent, they are no longer able to be saved through natural system responses (like beach retreats); instead humans must act to adapt these areas to withstand the anticipated environmental changes.

Plans and Efforts Currently Underway

Storm Preparedness & Emergency Alerts

Additional Approaches to Consider

1. Conduct a **Comprehensive Review** of **Existing Studies** & **Historical Accounts**

2. Delineate **Historically Flooded**, **Inundated**, & **Damaged Areas**

3. Collect **Additional Data** and Perform a **Long Beach Specific Hydrodynamic Costal Flood Hazard Assessment**

   - Be careful in selecting the model to make predictions upon which to base adaptation strategies

   - Long Beach needs a dynamic model that incorporates detailed bathymetry and coastal topography in evaluating and selecting adaptation strategies

4. Perform a **Comprehensive Review ALL Infrastructure** & **Assets** at Risk of Flooding

SLR & Coastal Flooding Summary

- **Storm Waves** superimposed upon **High Tides** will continue to be the **dominant threat** to our coastal environments over the next few decades just as they have been over the past century

- We have to prepare for **Greater Temporary Coastal Flooding**, **Erosion**, & **Eventual Permanent Inundation of Low-lying Areas**

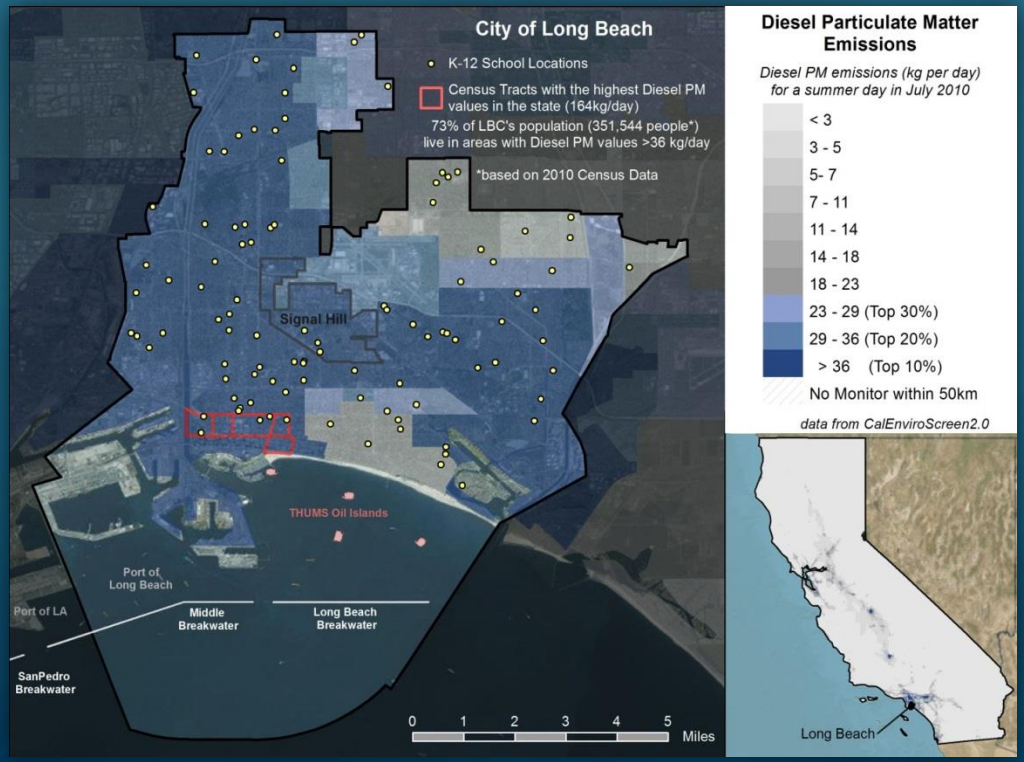
- These are already problems that will ↑ in **Intensity** & **Extend** to a **Larger Geographical Area** as sea level continues to rise

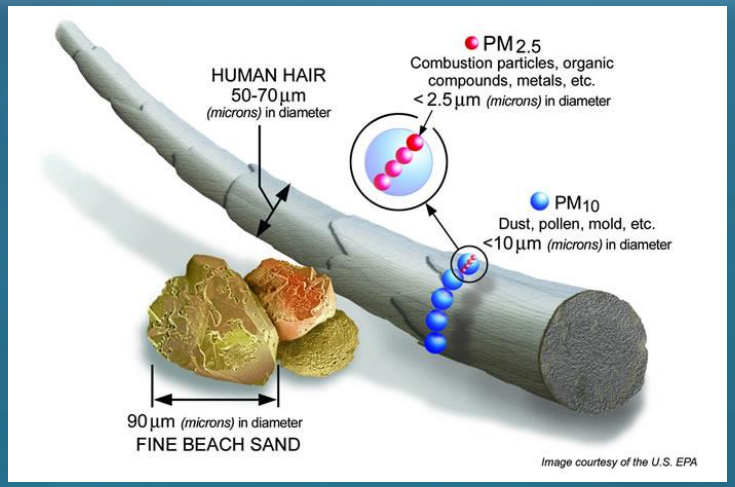
Deteriorating Air Quality

California currently has the **Worst Air Quality** in the nation, with >90% of the population living in areas that violate state air quality standards for ground-level ozone and small particles

Impacts of Air Quality on Long Beach

- **Ground-level Ozone** & **Airborne Particles** are the 2 pollutants that pose the greatest threat to human health
- Airborne Particles get trapped in the lungs, enter the blood stream, & negatively impact health
- ↑ **Temperature** → ↑ **Smog** & ↓ **Air Quality**

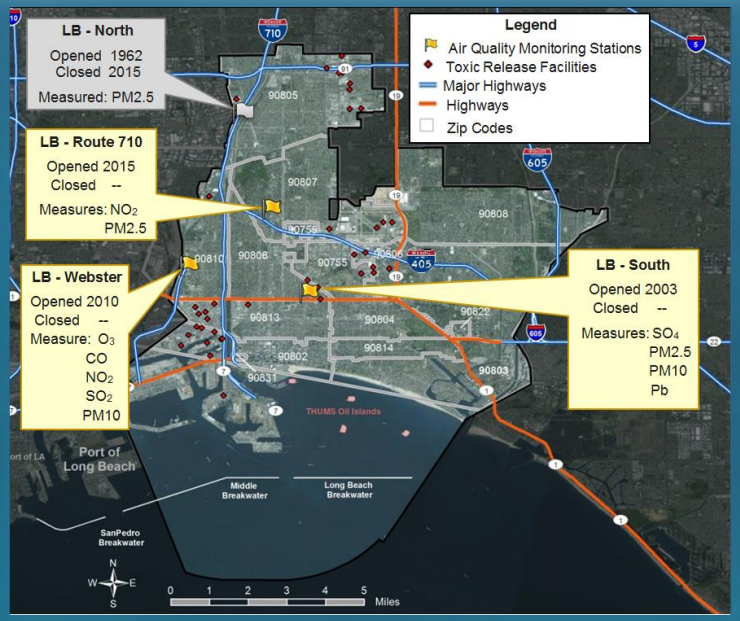




- **73%** of Long Beach has **Diesel PM** emission values > those of 90% of CA
- LB's air quality is impacted by the **Ports**, **Oil Refineries**, & the **405** & **710** freeways
- While **Significant Improvements** have been made in the last decade, the Greater LA area is still the **5th Most Polluted City** in U.S.

according to 2015 State of the Air report

Plans and Efforts Currently Underway



➢ Air Quality Monitoring Stations

LB currently has 3 Air Quality Monitoring Stations, all located in west-central LB along the 710 corridor

➢ Green Space Initiatives

Planting 10,000 trees by 2020
↑ Green Space
LA River Revitalization Plan

➢ Increasing Mobility

Mobility Element Report
Bicycle Master Plan
Pedestrian Master Plan

➢ Complying with Regulations

2006 Global Warming Solutions Act
2008 Sustainable Communities & Climate Protection Act
2015 Carbon Target & Adaptation (CA Executive Order B-30-15)

➢ Port of Long Beach's Efforts

Clean Air Action Plan
Green Flag Program
Technology Advancement Program
Green Ports Policy

Since 2006,
Diesel Emissions
from POLB activities have by
↓75%

Additional Approaches to Consider

- Install **Additional Data Monitoring Stations** throughout City
  not just near 710 freeway
- Study **Pollution Effects in Long Beach** alone
  most studies evaluate South Coast Basin
- **Inform & Engage the Public on Protection**
  especially for children, the elderly, those who work outdoors, etc.
- ↑ Efforts to **Promote Alternative Transportation Methods**
  - *70% of air pollution in the region is related to mobile sources*
  - *While there are many initiatives in place to promote mobility, more efforts need to be made to get people out of their cars & into public transportation or to use alternative transportation methods*
  - *Newer, more efficient emission standards, combined with the Ports efforts to promote zero-emissions freight transport systems will help a great deal*
  - *The City should continue work with the ports to promote zero-emissions freight transport systems will help*

Air Quality Summary

While the effects of Climate Change
on air quality have not been studied broadly

It is thought that **Future Air Quality will be Worse**
due to ↑temperatures, persistent droughts, ↑economic activity, & ↑populations

However, largescale Green Measures *could* Prevent this

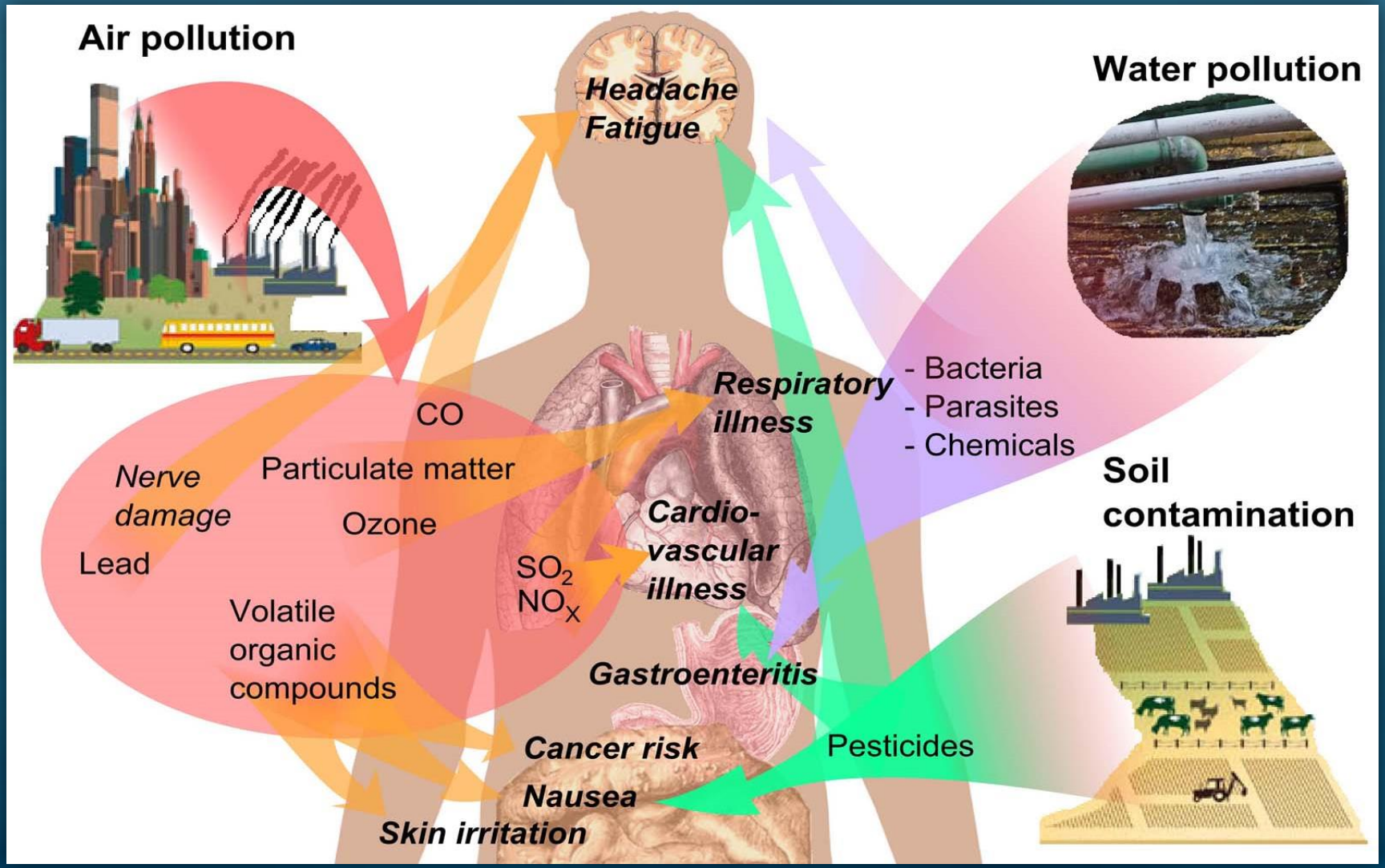
Public Health & Social Vulnerability

Climate Change is arguably our **Biggest** Health Threat

The poor, elderly, very young, homeless, & those with compromised health are **most vulnerable** to the impacts of climate change

Health Effects of Climate Change Threats

The Effects of these Threats on Human Health can be Deadly



Local Impacts of Climate Change Threats

- **Drought** has already led to ↑ in **Food Costs** & **Water Rationing**, & can also lead to **Food** & **Water Contamination,** & **Vector-borne Diseases**


Vulnerable populations: Everyone, especially those with limited finances

- **Heat** can lead to **Cramps**, **Exhaustion**, & eventually **Heat Stroke**


Vulnerable populations: children, elderly, athletes, homeless, low-income residents & those without AC living in areas with ↑ Heat Island Effect & minimal Trees

- **Coastal Flooding** can lead to **Potable Water Contamination**, **Impaired Water Bodies** from **Sewage Overflows**, **Flood Damage**, & **Mold**

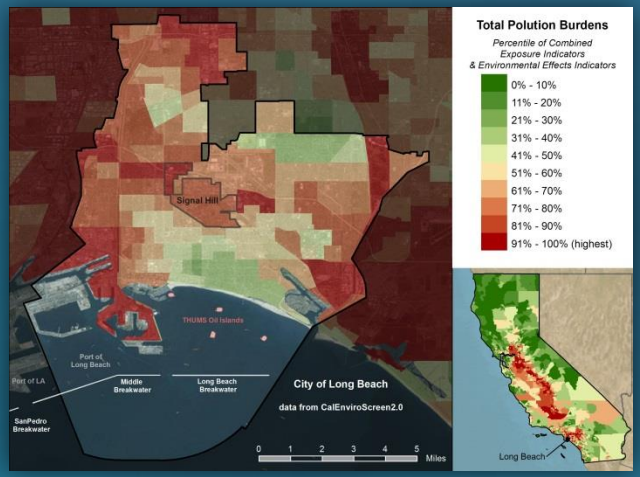

Vulnerable populations: everyone can be affected by Contaminated Water, Flood Damage, & Mold

- **Deteriorating Air Quality** worsens **Asthma** and **Cancer rates**.


Vulnerable populations: children, elderly, & those living, working, or going to school near freeways & ports

CalEnviroScreen 2.0's Scores for Long Beach

Pollution Burdens: the potential degree of exposures to pollutants & the adverse environmental conditions caused by pollution



Total **Pollution Burden** Scores = average percentiles of

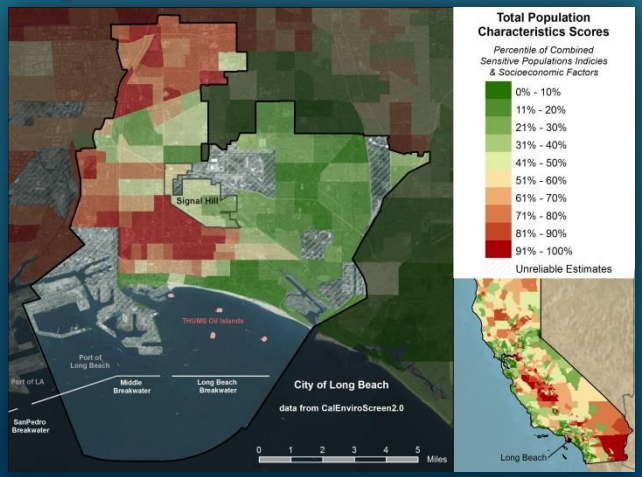
7 Exposures Indicators :

- *Ozone Concentrations*
- *PM2.5 Concentrations*
- *Diesel PM emissions*
- *Pesticide Use*
- *Toxic Releases from Facilities*
- *Traffic Density*
- *Drinking Water Contaminants*

& **5 Environmental Effects Indicators** :

- *Cleanup Sites*
- *Impaired Water Bodies*
- *Groundwater Threats*
- *Solid Waste Sites & Facilities*
- *Hazardous Waste Facilities & Generators*

Population Characteristics: biological traits, health status, or community characteristics that → ↑ vulnerability to pollution



Total **Population Characteristics** Scores = average percentiles of

3 Sensitive Population Indicators :

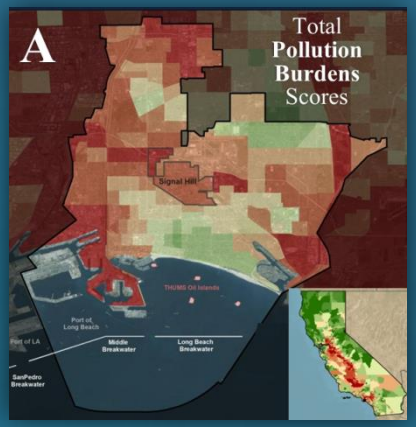
- *High Risk Age Groups (<10 & >65 years old)*
- *Asthma*
- *Low Birth Weights*

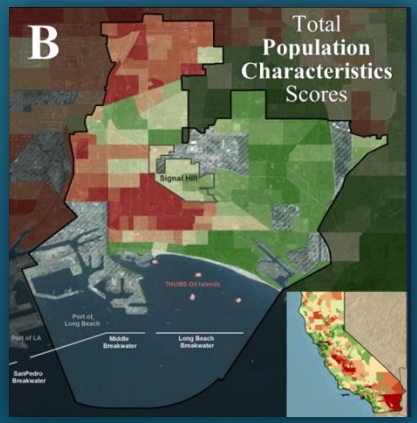
& **4 Socioeconomic Factor Indicators** :

- *High School Education*
- *Linguistic Isolation*
- *Poverty*
- *Unemployment*

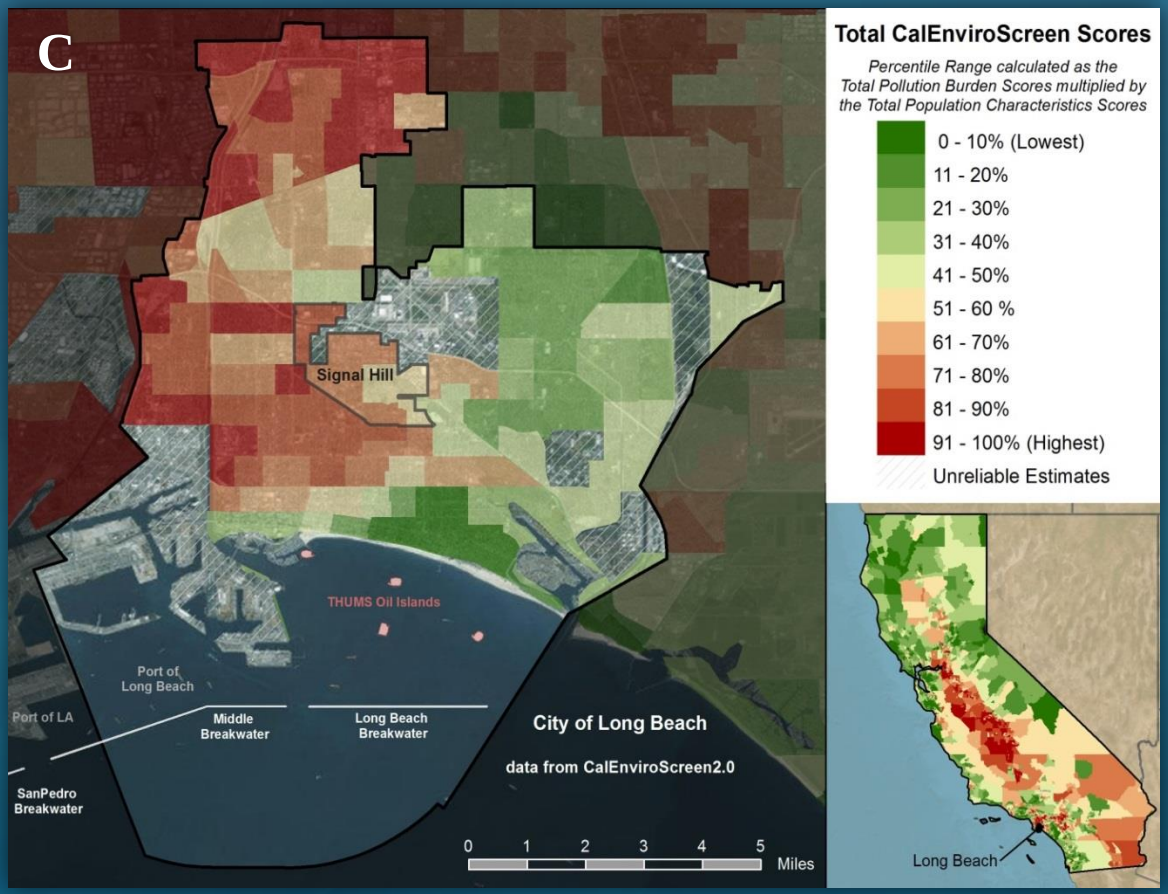
CalEnviroScreen 2.0's Scores for Long Beach

Total Pollution Burdens x Total Population Characteristics = Total CES Scores





A x B = C



Total CES Score Map (C) closely resembles the Total Population Characteristics Scores Map (B), Indicating that the **disadvantaged communities** in west-central & northern Long Beach are **disproportionately <u>more</u> vulnerable** to the risks associated with pollution & climate change

Plans and Efforts Currently Underway

- **CALGreen Building Code**

Enforcing measures to ↓ the Heat Island Effect by providing Shade, using Alternative Hardscape & High-albedo materials, & the use of Green & Cool Roofs

- **HEAL Zone**

Encourages residents of the North LB area to Walk, Bike, & make Healthier Choices for their lives to prevent diseases such as diabetes & heart disease

COALITION FOR A Healthy NORTH LONG BEACH

- **Livable West Long Beach** Implementation Plan

LIVABLE WEST LONG BEACH
THE WEST LONG BEACH LIVABILITY IMPLEMENTATION PLAN

Improve the Quality of Life for those communities in West Long Beach which receive a disproportionate impact from nearby Port activities

- **Cooling Centers**

Additional Approaches to Consider

- Include **Health Issues** as part of the **Sustainable City Action Plan (SCAP)**
- **Invite Public Health & Local Health Organizations** to participate in the **Development & Implementation of the SCAP**
- **Engage the Public** in **Climate Change Resilience** by **Identifying Health Benefits**

Public Health & Social Vulnerability Summary

Creating a **Healthy Environment** is a **Critical Step** in Making a **Resilient City**

In the case of Public Health, it is a matter of Life and Death

Building Climate Resilient Communities

Engaging the Full Fabric of the Community

- Engage the Diverse Communities in Long Beach
- Develop a Shared Value of Resilience within the City
  - Experts in science, social science, and communication will work side-by-side mentoring community leaders to better understand the issues, & develop agreed upon methods & approaches to engage communities within Long Beach
- Develop Unique, Tailored Messages for each Community

Empowering the Grass Tops to Connect to Grassroots

Modeled after NOAA's Climate Resilience Toolkit approach, the Aquarium will gather Leaders & Stakeholders from selected Communities to participate in a Series of Workshops that will better prepare them to Make Decisions, Communicate, & Plan for the Future

Workshop Topics: *Understanding Climate Change*

Local impacts and vulnerabilities

Risks, Costs and Solutions

The Aquarium will provide Experts & Connections to existing Resources to help develop understanding; provide Opportunities to Workshop & Dialogue about Climate Resilience Issues, Risks, Costs & Solutions; & we will follow up with Community Leaders & provide necessary Support & Mentorship for them to communicate back to their communities.

climate change adaptation toolkit

We're helping you build resilience, now help us get the word out.

A Broader Strategy

- **Long Beach Council Member District Nights**
  - The Aquarium will provide structured educational experiences for these and other community facing events

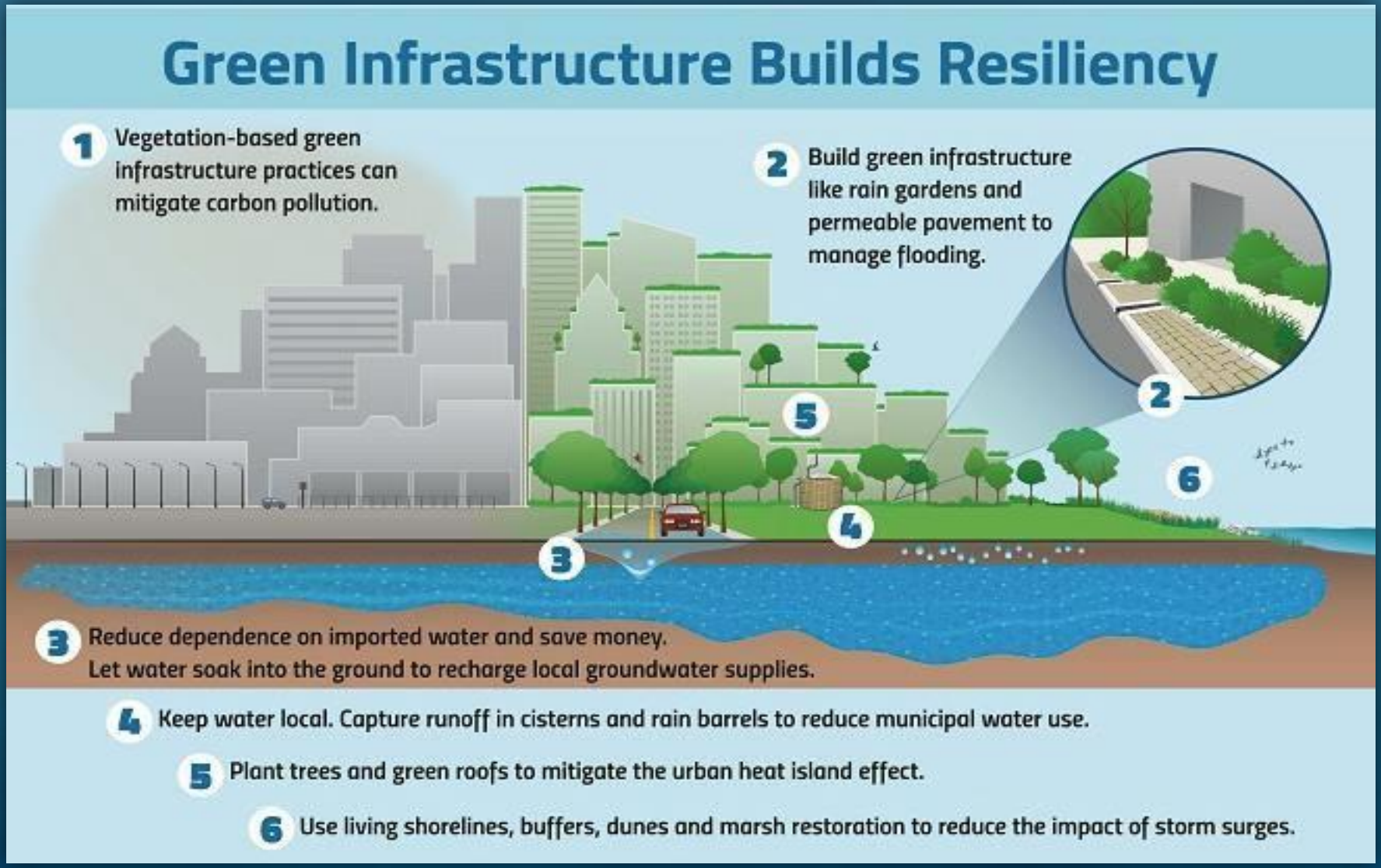
- **Supporting City of Long Beach Administration to Build Climate Resiliency**

- **Media Campaign**

  - Local print media engagement
  - Social media outreach

Report Summary & Conclusions

Summary of Additional Approaches



Summary Additional Approaches

We recommend that the City of Long Beach form a **Climate Resilience Team**, made up of local government representatives, key stakeholders, scientists, etc.

We recommend that the Climate Resilience Team use the results of this Report to move through the following steps:

1. Complete a Risk Assessment
2. Develop an Adaptation Plan
3. Review, Adopt, and Implement Plan
4. Implementation of Plan
5. Monitoring, Review, and Update of Plan

Conclusions

Thanks to the actions of **Mayor Robert Garcia**, the City Manager & City Council, Long Beach is taking the important first steps towards becoming a city that Rebounds & Thrives during Climate Change & Extreme Weather-related events

We hope this report will help the City achieve its goal of becoming a Climate Resilient Community

Acknowledgements

The Aquarium of the Pacific's Climate Resilience project team would like to acknowledge the following people for their help with this report:

Dr. **Alex Hall**
UCLA Professor of Atmospheric and Oceanic Sciences

Dr. **Alex Norman** & **William J. Crampon**
Re-Thinking Long Beach

Alyssa Edwards
Florida International University

Dr. **Elizabeth Rhoades**
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Dr. **Garry Griggs**
Director of UCSC's Institute of Marine Sciences and Distinguished Professor of Earth Sciences

Kevin R. Durkee
Senior Meteorologist at South Coast Air Quality Management District (SCAQMD)

Jonathan Parfrey
Executive Director of Climate Resolve, and founder of LARC

Drs. **Juliette Hart** & **Phyllis Grifman**
& the rest of the AdaptLA & USC Sea Grant team

Kathy Parsons

Matthew Lyons
Long Beach Department of Water

Dr. **Patrick Barnard**
USGS Scientist and creator of the CoSMoS 1-3 coastal flooding models

Drs. **Reinhard Flick** & **Timu Gallien**
Scripps Institute of Oceanography

Thank You