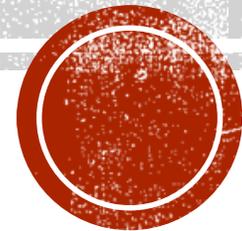


# **CLIMATE CHANGE & HEALTH**

**WHAT WE SHOULD KNOW &  
WHAT WE SHOULD DO**

Rich Wu

East Shore District Health Department



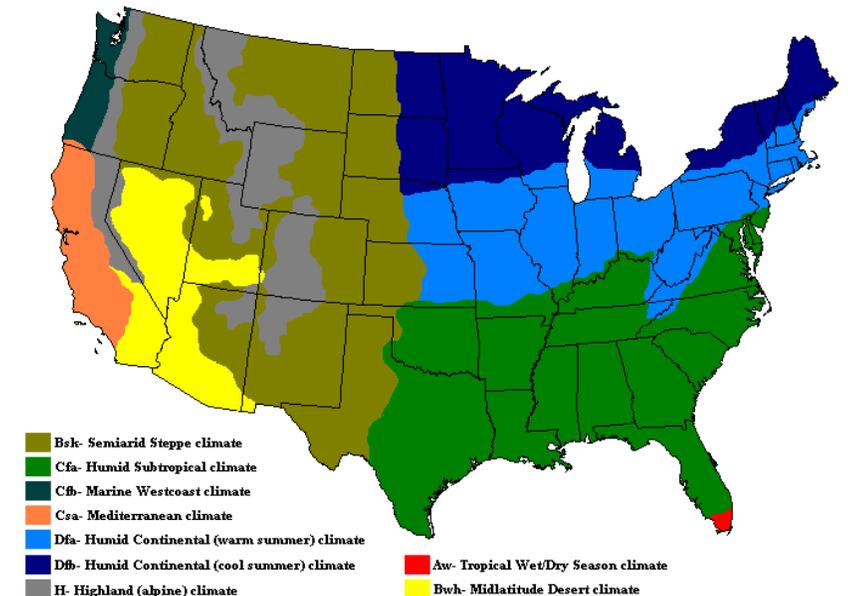
# WHAT IS CLIMATE?

## Climate ≠ Weather

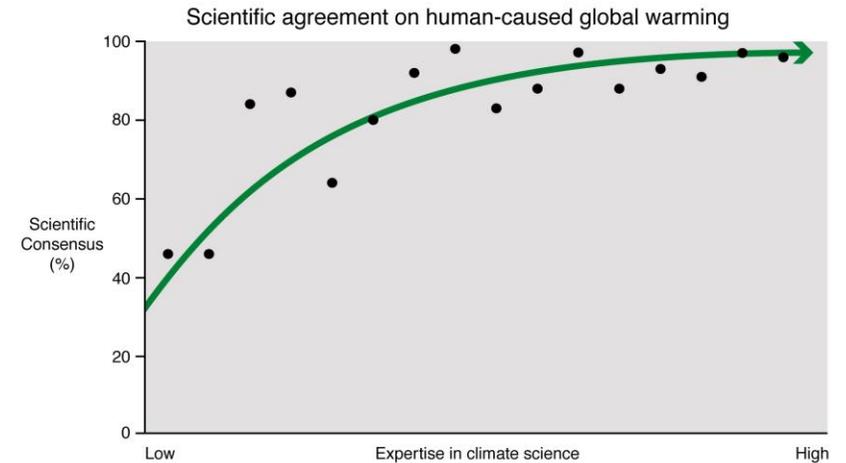
- Climate is the average weather
- Climate changes slowly
- Weather are short-term changes
- Weather can vary greatly within a day



Climate Zones of the Continental United States



# IS CLIMATE CHANGE REAL?



Yes! The researchers agree!

- 97% of researchers agree that humans are causing global warming.

Scientific agencies also agree! (NASA, NOAA, etc.)

- **Climate change is occurring,**
- **is very likely caused by human activities, and**
- **poses significant risks for a broad range of human and natural systems.**

- National Research Council (2010)

Cook, J., Oreskes, N., Doran, P. T., Anderegg, W. R., Verheggen, B., Maibach, E. W., . . . Green, S. A. (2016). Consensus on consensus: a synthesis of consensus estimates on human-caused global warming. *Environmental Research Letters*, 11(4), 048002.



# EVIDENCE OF CLIMATE CHANGE: TEMPERATURE

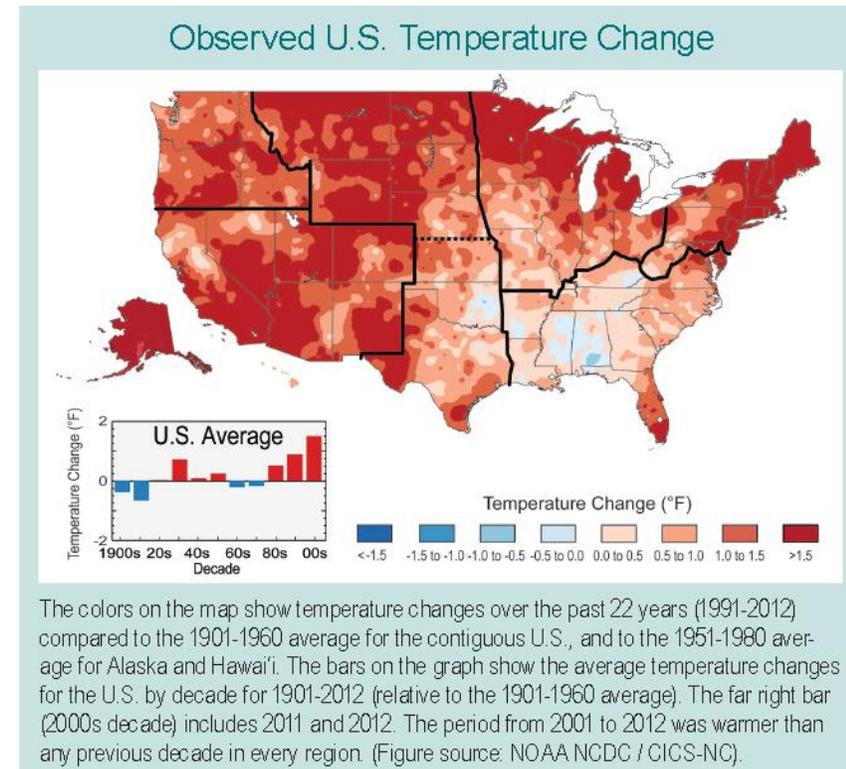
U.S average temperature increased 1.3°F to 1.9°F since 1895

The most recent decade was the hottest decade on record

The first half of 2016 is the hottest first six-month recorded

- Warming is ubiquitous but not uniform in U.S
- Connecticut is a more-affected region

U.S. Global Change Research Program (2014) *National Climate Assessment 2014*



# EVIDENCE OF CLIMATE CHANGE: SEA LEVEL

- **Global sea level increased 8 inches increase since 1880**
- **By April 2016, sea level rise from 1993 is 3.54 inches (NASA)**
- **Local mean sea level increase 0.11 inches per year (According to tide gauge data collected at Bridgeport, CT from 1964 to 2014)**

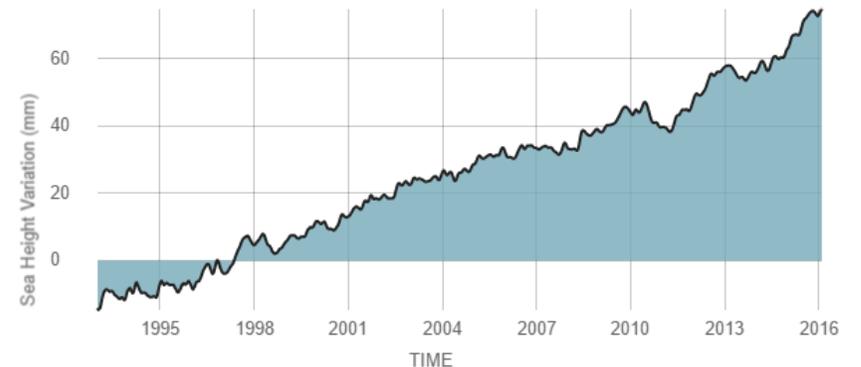
## SATELLITE DATA: 1993-PRESENT

Data source: Satellite sea level observations.  
Credit: NASA Goddard Space Flight Center

## RATE OF CHANGE

↑ 3.4

millimeters per year  
margin: ±0.4



NASA : <http://climate.nasa.gov/vital-signs/sea-level/>

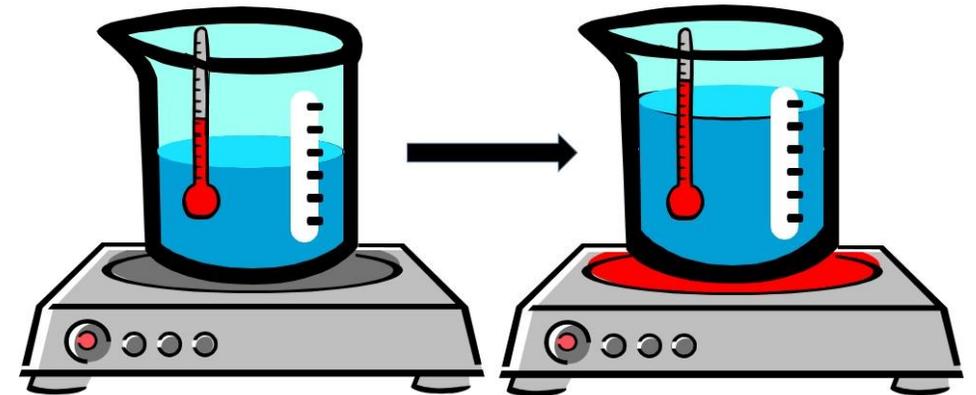


# SEA LEVEL RISE & TEMPERATURE CHANGE

Sea level rise is directly caused by global temperature change

Three primary factors all related with global warming:

- *Thermal expansion* (contribute to more than 50%)
- *Melting of glaciers and polar ice caps*
- *Ice loss from Greenland and West Antarctica*



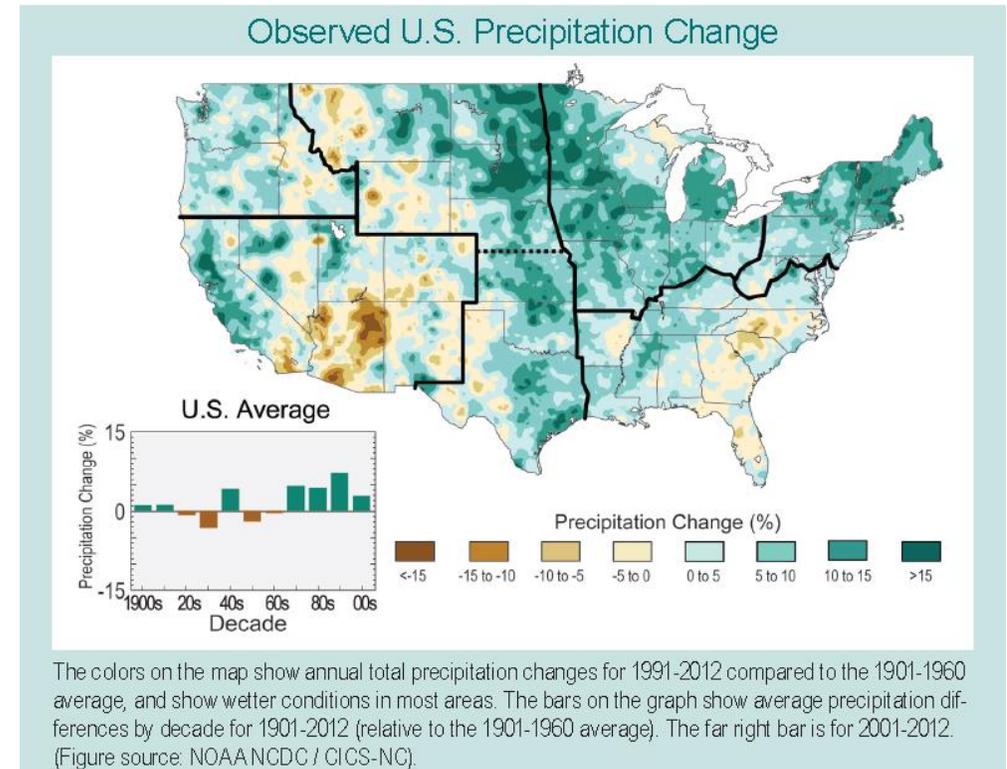
# EVIDENCE OF CLIMATE CHANGE: PRECIPITATION

- **Average annual precipitation over U.S. increase 5% since 1900.**
- **Northeast** (8%), Midwest (9%), and southern Great Plains (8%) are regions with most increase.

- Ubiquitous but not uniform again!

The pattern of precipitation will also change.

- More intermittent heavy downpour.
- More drought.
- More rain, less snow.



# WILL CLIMATE CHANGE STOP IN THE NEAR FUTURE?

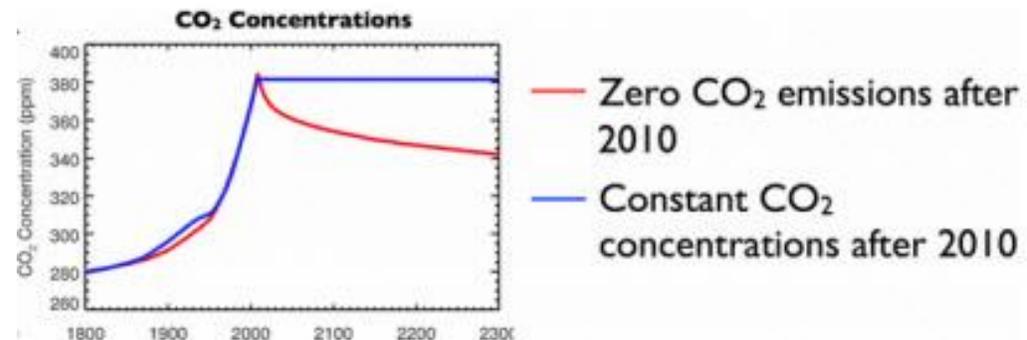
**Sadly, no.**

**Climate change will **NOT STOP**.**

- Some of the greenhouse gases persist for a long time in the atmosphere.
- Sea water has not yet fully expand even temperatures remain the same.

The additional future warming will be a result of our current and future emissions.

We can still take steps to slow down the acceleration of climate change.



# WHAT WOULD THE CLIMATE BE? - PROJECTIONS

- Temperature: additional 2°F to 4°F increase in next few decades
- Sea Level: 0.31 to 1.04 feet increase by 2030, 0.41 to 2.19 feet increase by 2050.
- Precipitation: may increase 5 to 10%, by 2100.



# WHAT WOULD THE CLIMATE BE? - UNCERTAINTIES

**All projections are inherited with uncertainties.**

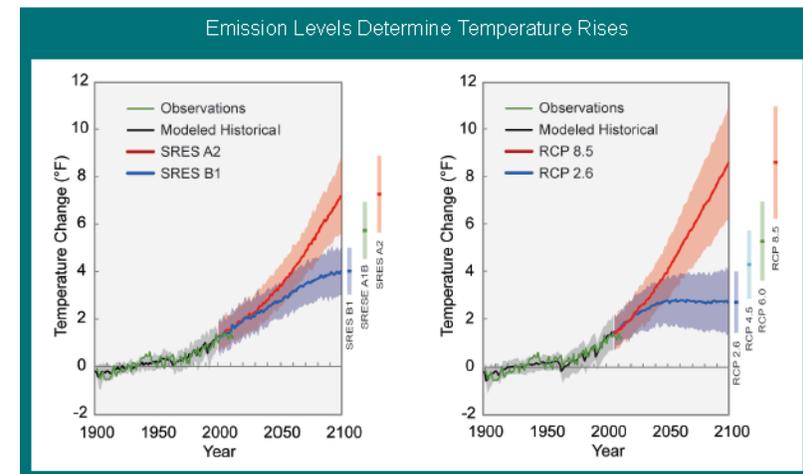
The wide range of projections are because of different **models** and **scenarios** applied.

Whether we can effectively reduce greenhouse gas emission matters.

There are always things to learn.

**Models are in COMPLETE AGREEMENT about the trend of climate change !**

U.S. Global Change Research Program (2014) *National Climate Assessment 2014*



# HEALTH IMPACT : AIR QUALITY & RESPIRATORY DISEASES (ASTHMA)

Climate change reduce air quality by increasing ground-level ozone, more particulate matter (PM)

Temperature change and increased CO<sub>2</sub> increase plant-based allergens

Both reduced air quality and increased allergens increased Asthma risk

- CT adult lifetime asthma prevalence experience a whopping 41.7% increase from 10.8% in 2000 to 15.3% in 2010,
- In our survey, this spring 12% of Branford residents reported that they suffered from asthma.



# HEALTH IMPACT: HUMAN INFECTIOUS DISEASE

## Insect-borne disease

- Mosquitoes-West Nile Virus, Eastern Equine Encephalitis, Zika Virus
- Increased temperature will enhance transmission
- The effect of increased rainfall can go both ways
- Ticks which carry Lyme disease, Babesiosis, Anaplasmaosis, are also affected and is likely to a wider geographic distribution.



**There will be emergence and re-emergence of infectious disease agents caused by climate change.**

**They are not signs of system failure but a sign of changing nature.**



# HEALTH IMPACT: FOOD-BORNE DISEASE (VIBRIO)

Vibrio is widely spread through consumption of raw shellfish, especially oysters

- They can cause Vibriosis with symptoms like diarrhea, stomach cramps, nausea, vomiting, headache, fever, chills

Connecticut first confirmed source of a *Vibrio* outbreak in 2013

- Vibrio infection has a seasonal pattern: 80% occur between May and October

Levels of *Vibrio* bacteria is **strongly correlated with warm water temperature**

New protocols are developed to prevent Vibrio infection

- Industrial harvesting: using ice slurry to internal temperature of 50°F within 3h
- Recreational harvesting: icing shellfish and cooked to an internal temperature of at least 145°F is recommended

Connecticut department of agriculture bureau of aquaculture: Techniques and Practices for Vibrio Reduction-Connecticut (2016)



# HEALTH IMPACT: WATER QUALITY & QUANTITY

Increased temperature and evaporation from the soil increase water demand

- Fresh water withdrawals will increase

Change in precipitation pattern worsen water quality

- Both drought (low flows) & downpour (high flow) are bad to water quality

Salt water intrusion in wells and fresh bodies of water

**We will have less and worse fresh water**



# HEALTH IMPACT: DEATH TOLLS

By 2030, how many people will die each year worldwide because of climate change?

- Hundreds? /Thousands? /Tens of thousands? /Hundreds of thousands? /Millions?
- What's your guess?

WHO: **250,000** additional deaths per year, between 2030 and 2050

Some organization like Climate Vulnerable Forum believe there are as much as **400,000** deaths per year

IPCC. Summary for Policymakers. In: Edenhofer O, R. Pichs-Madruga, Y. Sokona, E. Farahani, S. Kadner, K. Seyboth, A. Adler, I. Baum, S. Brunner, P. Eickemeier, B., Kriemann JS, S. Schlömer, C. von Stechow, T. Zwickel and J.C. Minx editors. Climate Change 2014, Mitigation of Climate Change Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge, United Kingdom and New York, NY, USA.: Cambridge University Press; 2014.



# HEALTH IMPACT: ENVIRONMENTAL JUSTICE

## Disparity exists.

- Malnutrition, malaria, diarrhea and heat stress are causes of death.

Most of people in developed countries like U.S don't have to worry about them any more

But some communities around us may still have these problems

Socially disadvantaged communities

- are **DISPROPORTIONALLY** burdened.
- are also the **LEAST** able to adapt.



# HEALTH IMPACT: COASTAL HAZARD

- More intense hurricanes (Tropical Storm Irene & Hurricane Sandy)
- More frequent flooding
- More common beach erosion
- Key factor: **Sea level rise**



Consequences: acute injuries, drowning, exposure to pathogens, property loss, etc.

There will be both short-term and long-term effects.



# HEALTH IMPACT: HARMFUL ALGAL BLOOMS (HABS)

Health problems: acute intoxication from contaminated shellfish and finfish, respiratory irritation, toxin in drinking water

Ecological problems: night-time oxygen depletion kill fishes, increased turbidity suppress aquatic plant

Nutrient over-enrichment (fertilizer runoff, industrial, urban)

Rising temperature favor HABS

- High temperature and little wind result in water stratification
- Rising sea level, summer drought, increased fresh water use lead to rising salinity



# WHAT CAN WE DO?

*Don't be worried, we are champions of adaptation.*

Individually:

- Reduce personal carbon footprint is a practical and immediate way.
- Be aware of the changes (Emerging disease)
- Be prepared to extreme events (Hurricanes, floods)
- Expand your vision

**There are more we can do if we work collectively!**



# TOWN OF BRANFORD COASTAL RESILIENCE PLAN (OVERVIEW)

Risk is the product of community vulnerability and frequency.

- Frequency will increase, we have to reduce vulnerability.

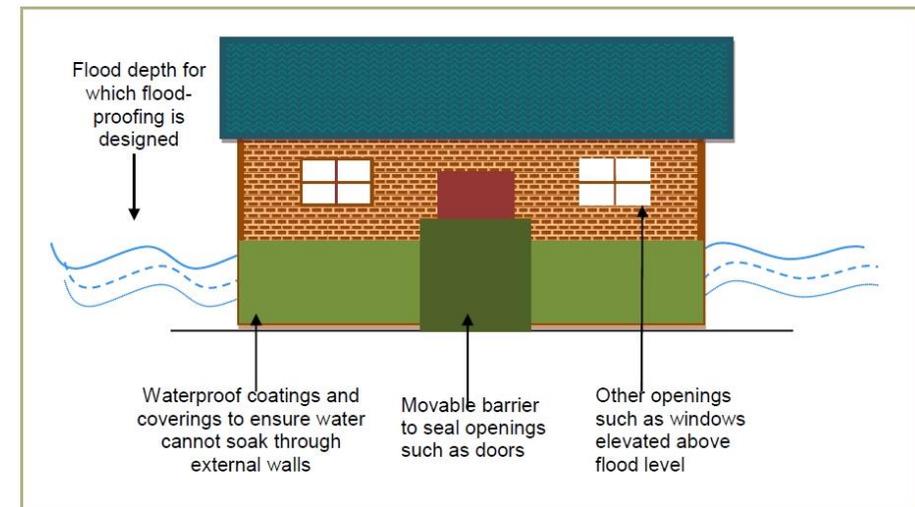
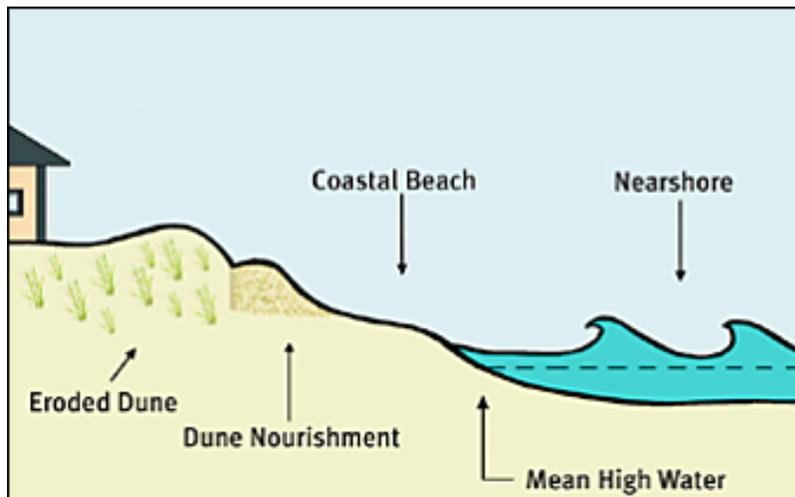
Our goal:

- Increased resilience to coastal hazards (ability to resist, absorb, recover from and adapt from disasters)
- Planning and increased adaptation



# TOWN OF BRANFORD COASTAL RESILIENCE PLAN (COASTAL RESILIENCE TOOLBOX)

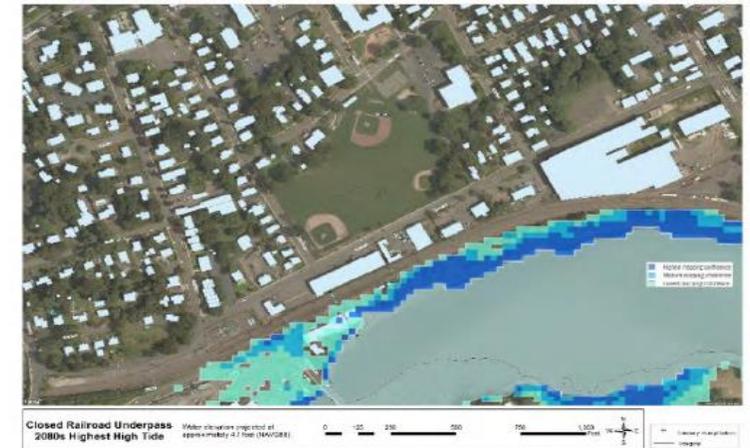
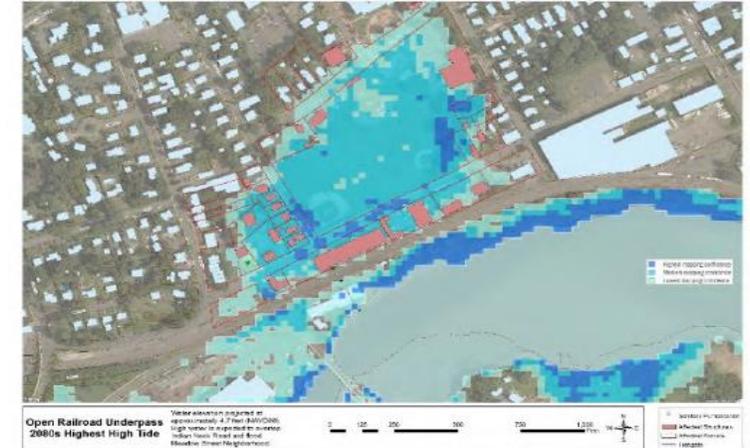
- Shoreline protection (hard, soft, hybrid)
- Infrastructure improvement, retrofits and hardening
- Home and business protection
- Regulatory tools
- Coastal realignment/retreat



# TOWN OF BRANFORD COASTAL RESILIENCE PLAN (EXAMPLE)

Meadow Street neighborhood

- A low-clearance underpass (cattle crossing)
- Allows floodwater come in



Floodable neighborhood (top) and Flood Gate at the Underpass (bottom) during a projected 2080s high tide.

Alternative Description	Modeled Outcome	Approximate Cost to Town (\$)	Approximate Cost to Residents (\$)
<b>Floodable Neighborhood</b>	Some structures already elevated, but additional elevations would be necessary. Critical facilities such as the pumping station, electrical substation, and emergency shelter, may need to be protected or relocated.	1,800,000 to 2,300,000	9,300,000
<b>Flood Wall at Underpass</b>	Should be minimally disruptive and protect the neighborhood through 2050s category 2 storms. Additional elevation of the railroad would be required to remove the neighborhood from the FEMA hazard zone	813,000 (Without railroad elevation)	Uncertain; would depend on SD/SI requirements



**WE ARE LIVING IN A  
CHANGING WORLD, DO NOT  
BE LEFT BEHIND!**

**Thank you!**

