The Politics and Psychology of Structural Mitigation: Centralized and Dispersed

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Today's talk

- Why Americans do not avoid building in hazardous coastal areas.
- Why we instead build densely in hazardous coastal areas and then rely on structural mitigation measures to protect us.
- Why these structural mitigation measures can fail to perform as well as we hoped they would.

Today's talk

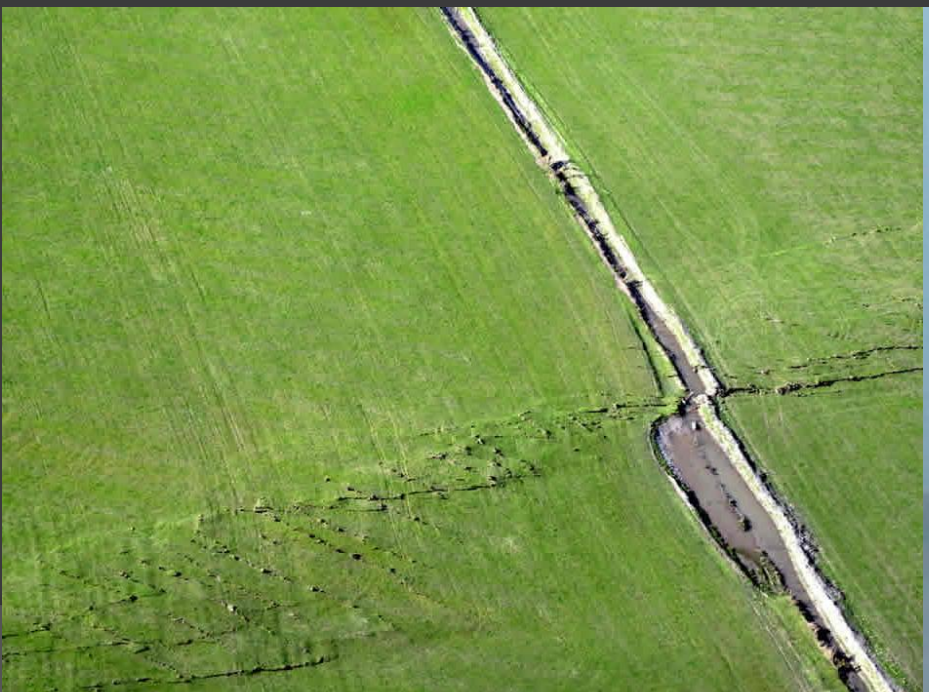
- Large scale, government funded, structural mitigation.
  - Levee system "protecting" New Orleans and neighboring parishes.
  - Hurricane barriers "protecting" Providence, Rhode Island, and New Bedford, Massachusetts.
- Private, structure specific mitigation.
  - Building codes in southern New England.

Constructing Disasters

- Natural disasters are the catastrophic results of the interaction of three systems.
  - Natural/physical environment,
    - Tropical cyclones, earthquakes, tsunamis, etc.
  - Built environment,
    - Buildings and infrastructure.
  - Human systems
    - Governance (political and economic)
    - Social (community supports, community divisions)
    - Cognitive biases and behavioral fallacies

Avoiding Natural Hazards

- The natural sciences can
  - Can show us where high energy events are likely and
  - We could avoid these areas.



Americans do not avoid coastal hazards

- Over half the population in the contiguous 48 states live in coastal communities.
  - 17% of the land area.
- Social scientists show us that Americans develop in risky coastal areas for at least 3 reasons.
  - Waterfront dependent economic activities.
  - Growth coalitions want to maximize the value of coastal land, including wetlands.
  - People find high energy hazard areas aesthetically appealing.

Water dependent economic uses

New Bedford fishing fleet

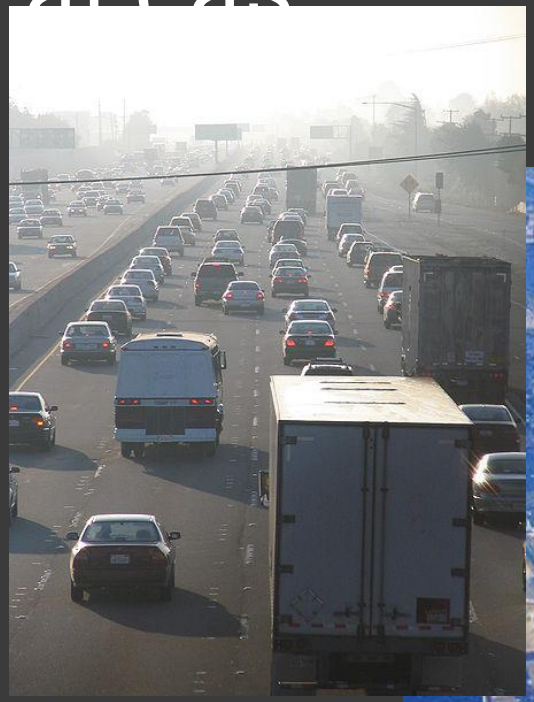
80 percent of all goods consumed

- Galveston

- Gulfport

Creating land value (fill)

Providing transportation infrastructure in urban areas



Maximizing land value (location)

Aesthetically appealing

Growth coalitions

- Growth Coalitions in Coastal Hazard Zones
  - Private land owners
    - try to increase land values by intensifying land use and
    - support government projects that increase their land values.
  - Local and state government
    - Dependent on property taxes.
    - Dependent on campaign contributions.
  - Building trades
    - Must have constant growth to stay employed.
    - Trade unions favor big projects
      - Long-term jobs

American Federalism, growth coalitions & reckless growth

- Land use authority rests with the states.
- States typically delegate land use authority to local government.
- The federal government cannot prohibit land development in hazardous areas.
- But the federal government inevitably pays for most of the clean up and recovery costs after a disaster.
- Local growth coalitions can reap the benefits of hazardous growth and shift the costs of disasters to the rest of the country.

New Orleans

- New Orleans was founded in 1718
  - Against the advice of the Royal Engineer of Louis XIV.
  - It flooded the first year it was settled.
- The growth coalition funded levee systems that contained higher probability, lower consequence storms.
- Growth coalition drains more wetlands and builds more levees.
- Grows into a major metropolitan area.
- Devastated by Hurricane Betsy in 1966.
  - Low probability, high consequence event.

Hurricane Betsy

Providence, Rhode Island

- Founded in 1636 on the hills above the Providence River estuary and
- The Great Salt Cove.
- Cove with early fill in 1848.
- Filled in by 1868.

Central Business District on the Great Salt Cove.

- Providence's growth coalition, show piece urban renewal in the flood plain.

Hurricane of 1938

Hurricane Carol, 1954

New Bedford, Massachusetts

- Severely damaged in 1938, 1944, and 1954.

How could have the growth coalitions produced such disasters?

- Cognitive biases and behavioral fallacies.
- Make it extremely difficult to successfully plan and mitigate for low probability, high consequence events.

Short-term feedback

- Humans learn from short-term feedback.
- But the growth coalition members were getting no short term feedback concerning major natural disasters.
  - Feedback from low probability, high consequence events is rare.
  - For example, in Providence over 50 years passed since its last large scale flooding and the filling of the Great Salt Cove.

Learning from positive feedback

- Growth coalitions looked successful.
  - Intensifying land uses increases economic activity.
  - Positive reinforcement every year without a disaster.
  - The New Orleans levee improvements from the early 20th century were withstanding higher probability storms: 10- or 20-year storms.

Near mistakes, other people's mistakes, and big mistakes

- We often do not take the proper actions after near misses.
  - Hurricanes that veer away or degrade into tropical storms do not prompt action.
  - Tsunamis that do not cause devastation.
- Tsunami warnings in northern California after the Indian Ocean tsunami.
- Often we take actions to defend against the disaster that already happened.

Federal government responds regional disasters

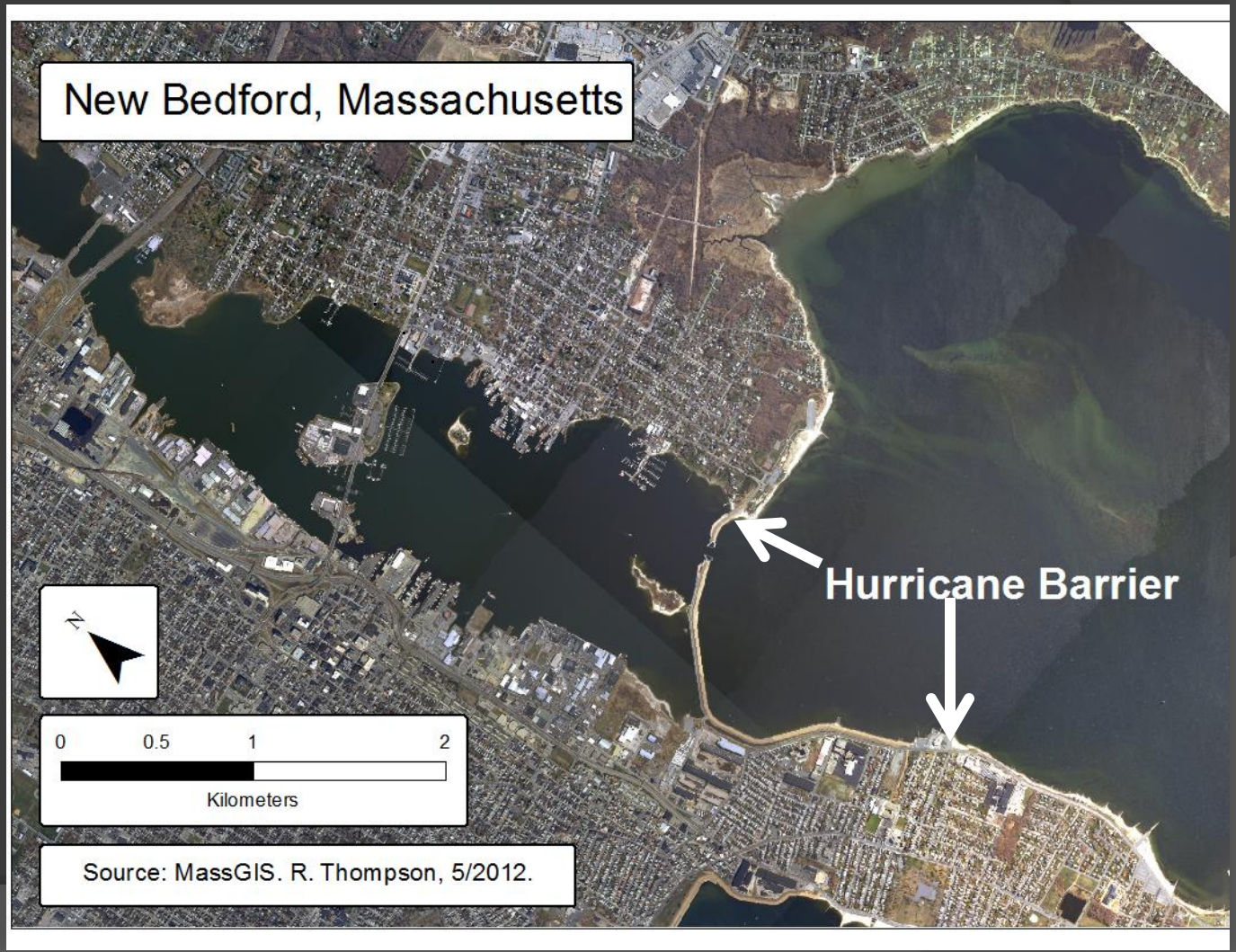
- Politically difficult for the federal government to ignore local suffering,
  - Even essentially self inflicted suffering.
  - Television and elections.
  - In early to mid-20th century, levees were a common response.
- New Bedford and Providence got hurricane barriers after Carol.
- New Orleans got the Hurricane Protection System after Betsy.

Providence barrier flood gates

- Approximately 900 meters long.
- 7.6 meters high.

New Bedford barrier

- 1400 meter main levee.
- Two on land levees.
  - 1400 meters
  - 1750 meters
- 6 meters high



Confidence in the Federal Government

- Hurricane Barriers built when there was a strong confidence in the federal government's ability to get things done.
  - Highly publicized public work projects during President Roosevelt's New Deal.
  - Successfully fighting World War II.
  - The glow of government endeavors such as the space program and the interstate highway system shined bright.

Government failed in New Orleans

Government failed

- During Hurricane Katrina,
  - 50 levee failures.
  - 4 catastrophic failures (collapses) occur before flood waters reached design flood levels.
- Three possible causes for levee failure.
  - Failed to perform up to design specifications.
  - Failure to accurately model the intensity of the event and level of protection needed.
  - Failure to complete or maintain.

The planning fallacy

- We tend to be overly optimistic in our forecasts and assumptions when planning projects
  - Engineers assumed that untested concrete “I” flood wall would perform as designed.
    - They didn’t and there was no backup system.
  - Hurricane Katrina produced much higher storm surge than models predicted, particularly in Mississippi.
  - Funding for finishing the system, let alone maintaining, it was not available in later years.

The potential irony of success

- If early mitigation works.
  - We feel less threatened.
  - We invest more on development.
  - We invest less on mitigation.
- The early parts of New Orleans HPS were done in 1969 when Hurricane Camille hit Mississippi.
  - The HPS performed well.
  - Continued investment slowed and then stalled.
    - The political urgency to spend billions faded.

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Failing to plan for failure

- “When levees do fail, they fail catastrophically—the damage may be more significant than if the levee wasn’t present” (Federal Emergency Management Agency, 2008).

Hurricane protection & growth coalitions

- In New Orleans, Providence, and New Bedford, growth was pursued as if the levees were infallible.
- Structures behind the levees
  - Do not have to purchase federal flood insurance or
  - Built flood resistant structures as required under the federal insurance program.

Hurricane Barriers and the Availability Bias in Providence

- It is easier to believe what is readily available (our own experience) than theoretical disasters.
- The barriers had protected residents,
  - E.g. Hurricane Bob.

Providence's current planning

- Moved highway and redeveloping major sections of the city.
  - No discussion of the possibility of the hurricane barrier failing.
- The Providence barrier has no margin of error for the maximum modeled storm surge.
  - Without taking sea level rise into account.

New Bedford, Massachusetts

- Most economically productive fishing port outside of Alaska.
- Probable staging area for the construction of America's first offshore wind farm.
- No planning for the possibility of the hurricane barrier failing.

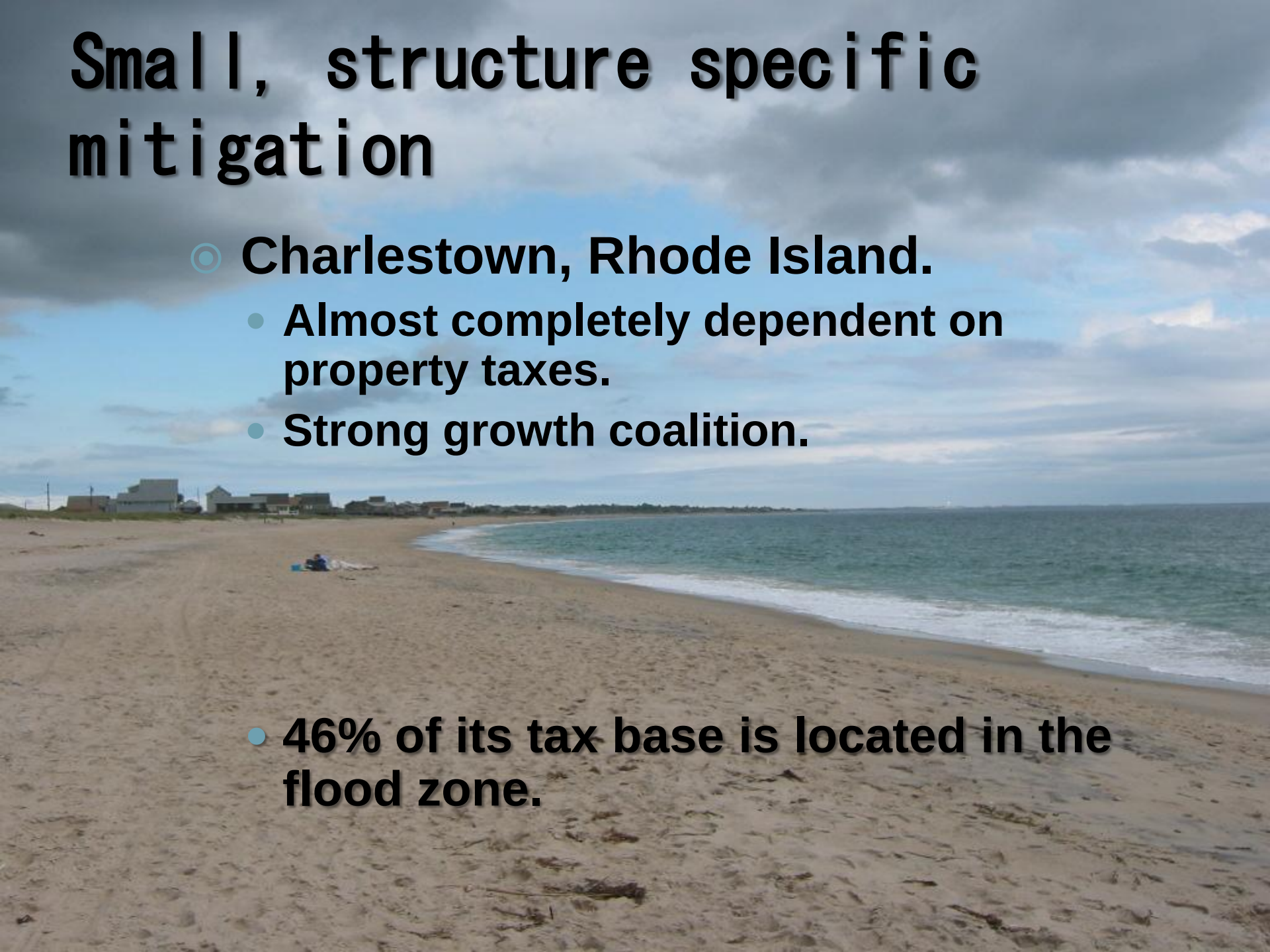
Planning for failure, New Orleans

Planning for resiliance

- Small structure specific mitigation

Small, structure specific mitigation

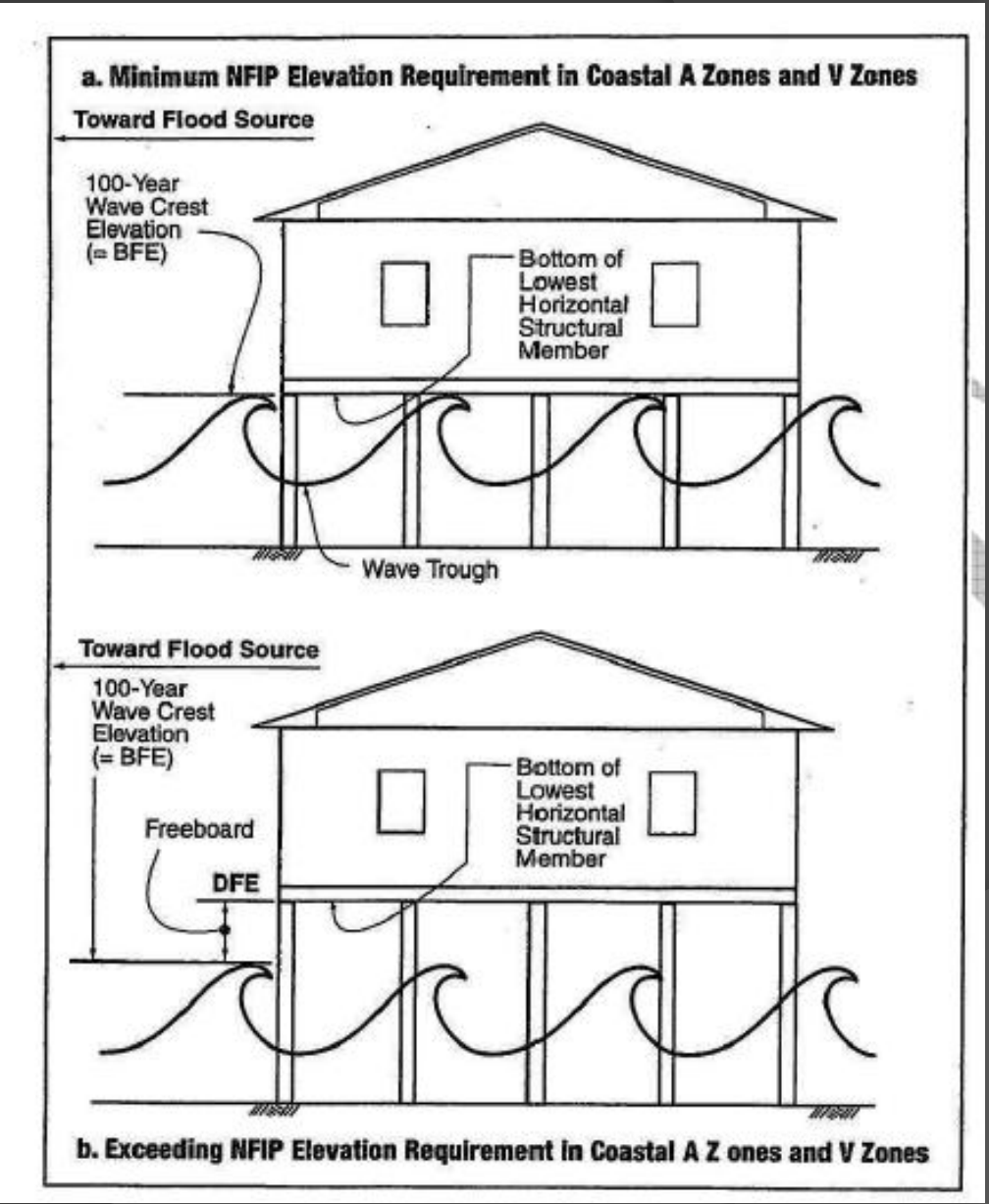
- Charlestown, Rhode Island.
  - Almost completely dependent on property taxes.
  - Strong growth coalition.



  - 46% of its tax base is located in the flood zone.

NFIP

- To participate in National Flood Insurance Program, local government must incorporate federal standards into building code.
- Elevating structures.



Inadequate Freeboard

1938 Charlestown

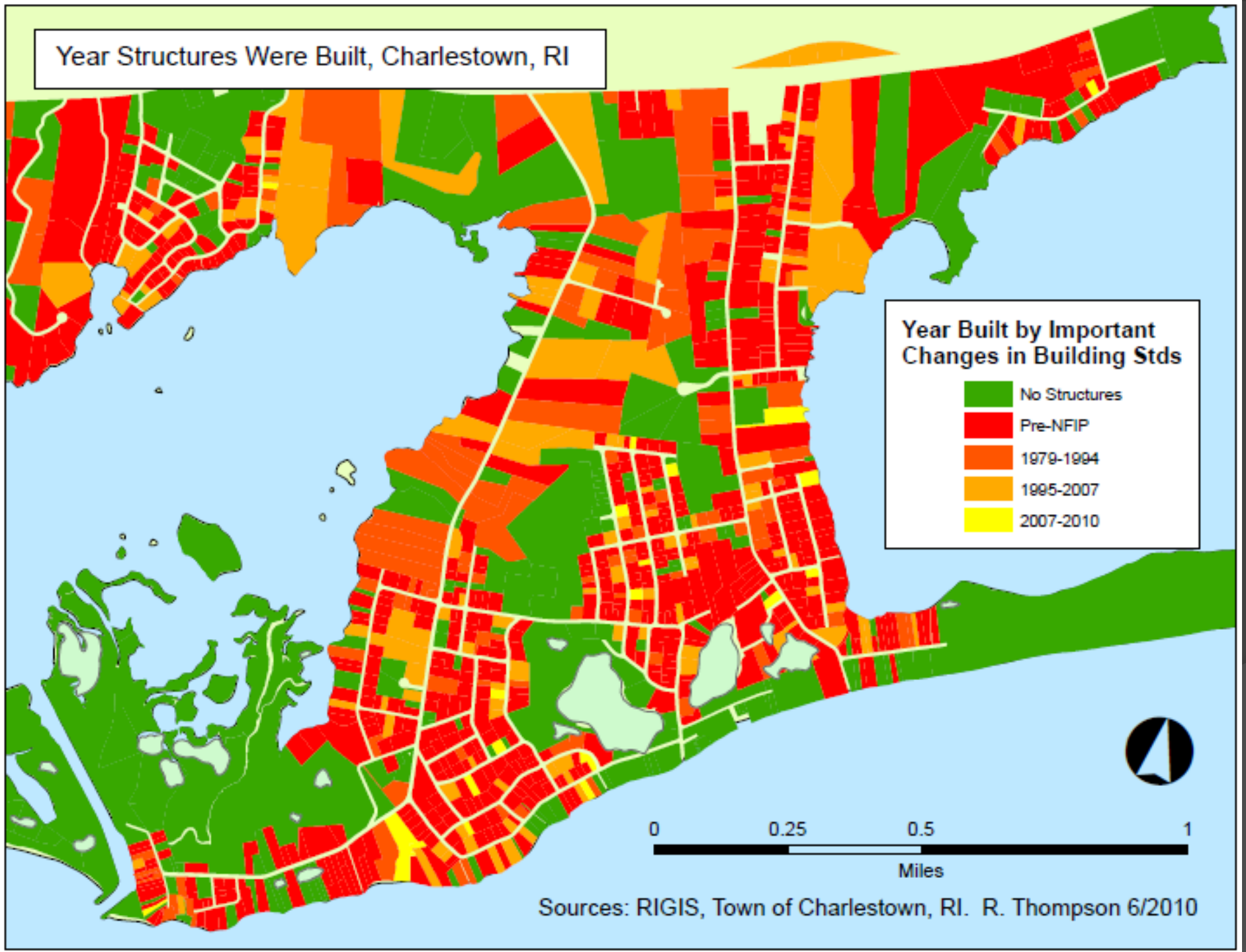
Carol 1954

Interviews with Building Officials

- Town building officials interviewed in Rhode Island and Massachusetts.
- They uniformly believed that new building codes had made their communities much safer from hurricanes.

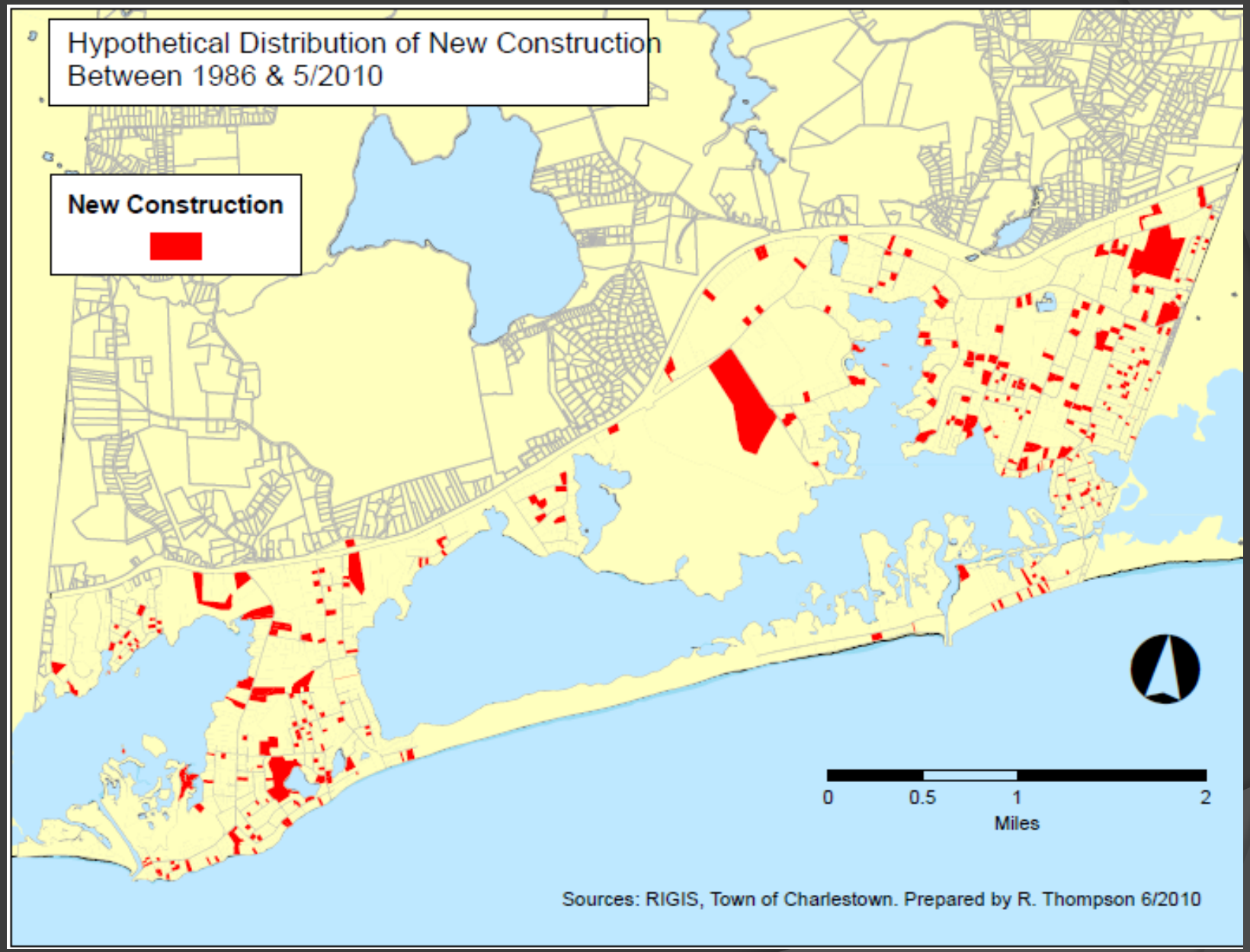
The planning fallacy

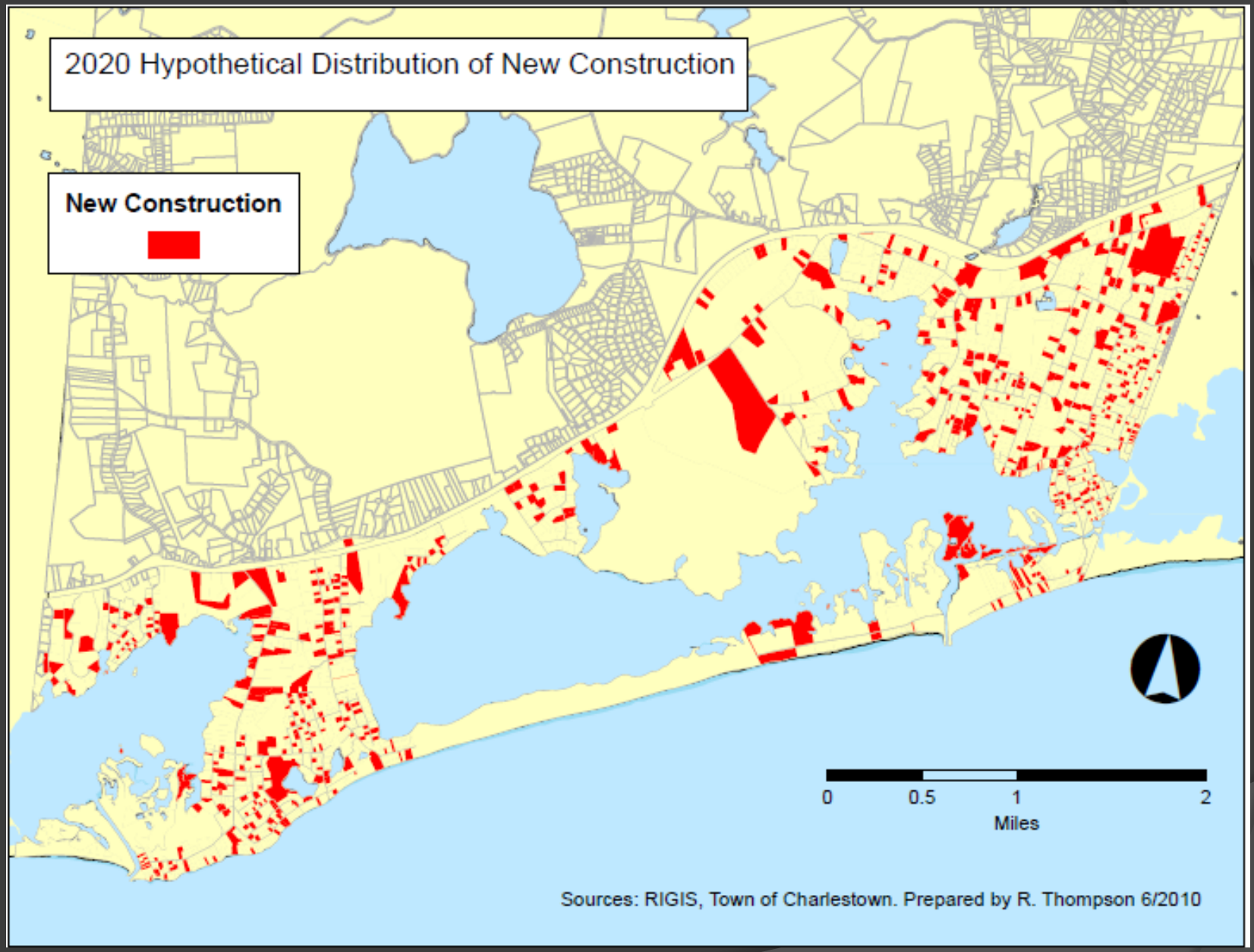
- Failing to account for all three systems in a natural disaster (natural, built, and human).
- Failing to account for the likelihood that older homes that do not have the mitigation measures will damage newer, up to code houses.
- Houses with inadequate elevation become projectiles and battering rams,
- Destroying homes with the required elevation.

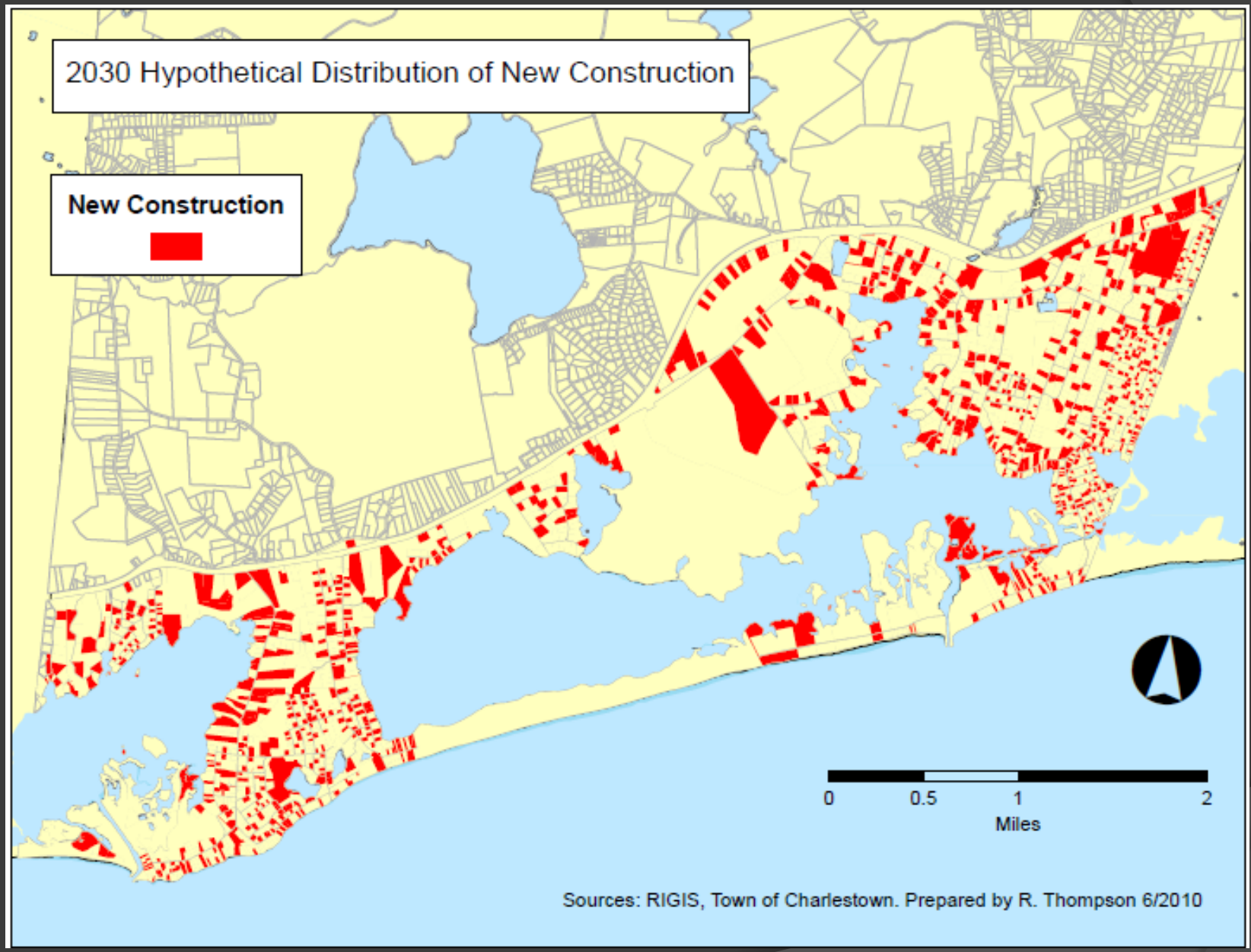

Year Structures Were Built, Charlestown, RI
Year Built by Important Changes in Building Stds
No Structures
Pre-NFIP
1979-1994
1995-2007
2007-2010
0
0.25
0.5
1
Miles
Sources: RIGIS, Town of Charlestown, RI. R. Thompson 6/2010

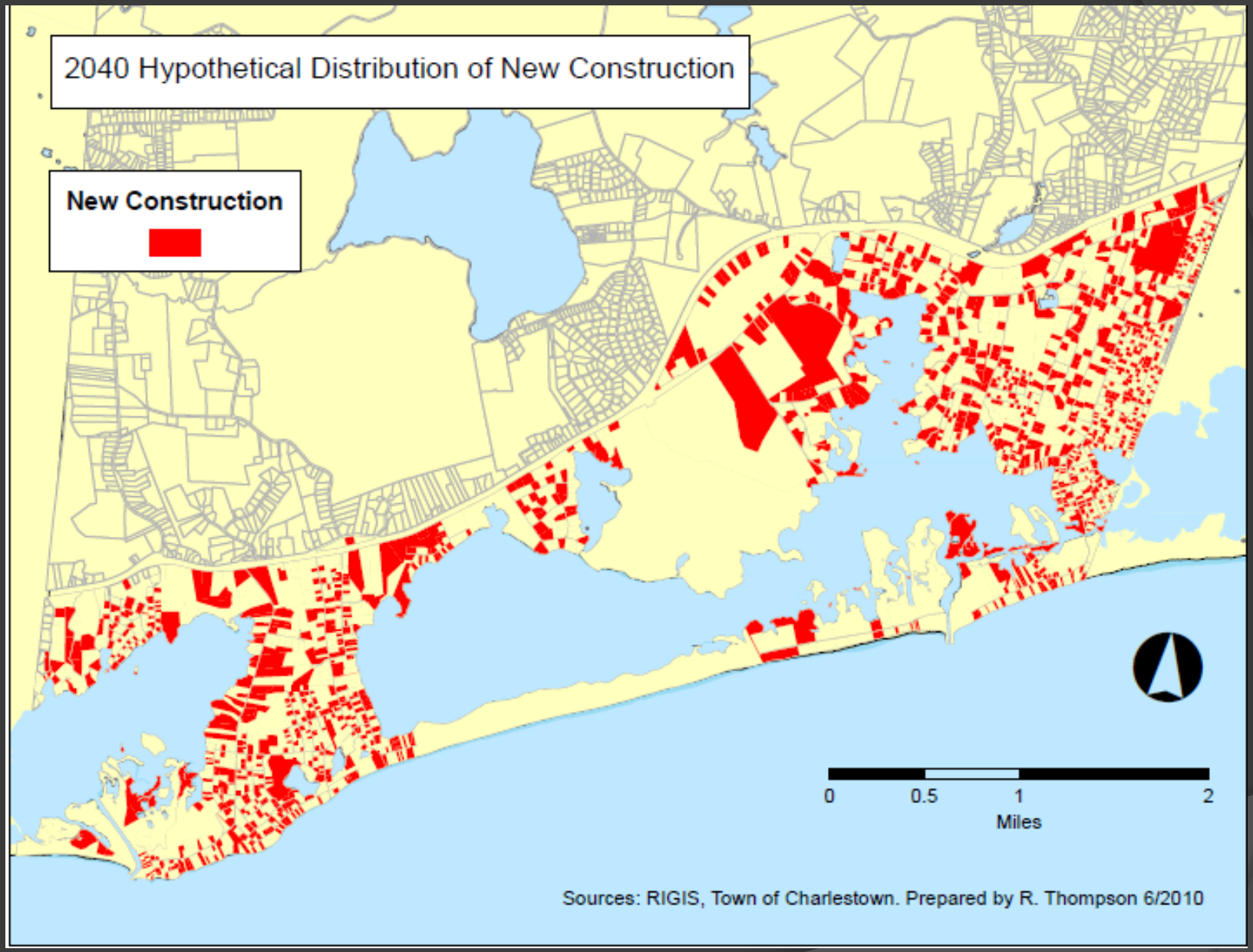
The pace of structure specific, private mitigation

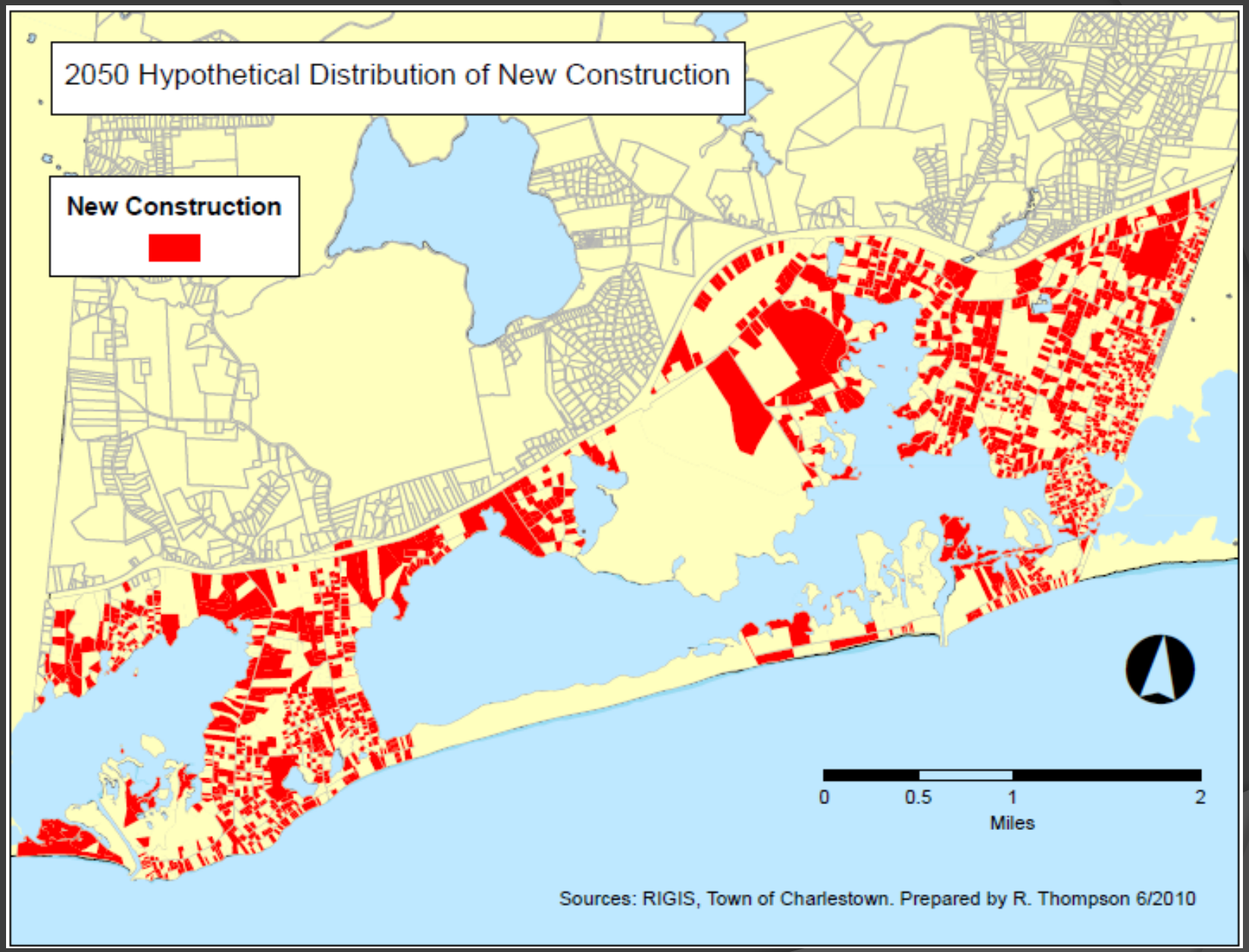
- Built a GIS model using building permit data for 24 years for 250 randomly selected parcels.
- No existing structures were elevated in 24 years.
- However, new structures (tear downs) had to meet elevation requirements in place at the time of construction.

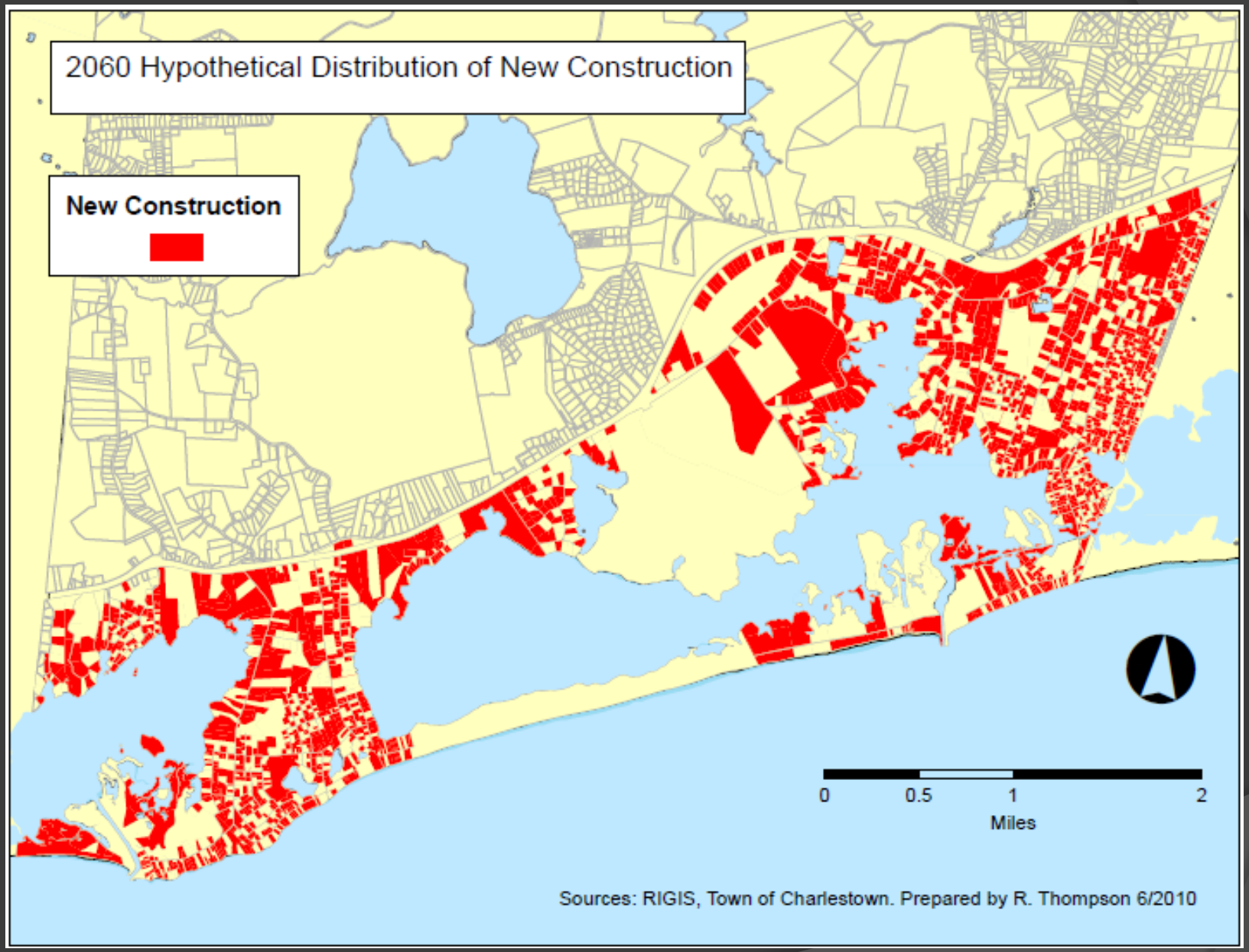

Hypothetical Distribution of New Construction
Between 1986 & 5/2010
New Construction
0
0.5
1
2
Miles
Sources: RIGIS, Town of Charlestown. Prepared by R. Thompson 6/2010


2020 Hypothetical Distribution of New Construction
New Construction
0
0.5
1
2
Miles
Sources: RIGIS, Town of Charlestown. Prepared by R. Thompson 6/2010


2030 Hypothetical Distribution of New Construction
New Construction
0
0.5
1
2
Miles
Sources: RIGIS, Town of Charlestown. Prepared by R. Thompson 6/2010


2040 Hypothetical Distribution of New Construction
New Construction
0
0.5
1
2
Miles
Sources: RIGIS, Town of Charlestown. Prepared by R. Thompson 6/2010


2050 Hypothetical Distribution of New Construction
New Construction
0
0.5
1
2
Miles
Sources: RIGIS, Town of Charlestown. Prepared by R. Thompson 6/2010


2060 Hypothetical Distribution of New Construction
New Construction
0
0.5
1
2
Miles
Sources: RIGIS, Town of Charlestown. Prepared by R. Thompson 6/2010

What might we find in 2060

- Over 50 years, approximately 56% of the structures would be built to the 2007 standards.
- This doesn’t take sea level rise into account.

Should mitigation speed up?

- Building officials opposed imposing current code requirements on existing structures.
- Part of growth coalition.
  - Expensive mitigation requirements would hurt building trades.
  - Expensive elevation would hurt property values and tax base.
- Fallacy of small samples.
  - There hadn’t been a serious hurricane in over 50 years, so the risk no longer existed.
- Yearly feedback learning.
  - Extensive storm mitigation was wasted money.

Reducing vulnerability

- Reassess levees' level of protection taking sea level rise into account.
- Federal government should pressure local government to plan for the failure of levee systems.
  - Include properties behind levees in the National Insurance Flood Programs.

    Require structure specific, private mitigation on older structures.
    - E.g., require the elevation of structures at the time of sale.
  - Pre-disaster mitigation grants to elevate or flood proof the ground floor for important infrastructure such as that serving the New Bedford fishing fleet.


The End
Arigato Gozaimasu

Why don’t owners voluntarily invest in mitigation?

Status quo option

- When faced with uncertainty, people tend to stick with the status quo.
  - Why invest if you might never need it?
  - Deferring a decision is not viewed as permanent.
  - Insurance is often mandated.

Exaggerated discounting.

- We tend to over value immediate benefits and over discount future benefits.
- Investing in elevating one's residence has an uncertain and probably distant benefit.
- A renovated kitchen, produces benefits immediately.

Federal government pays

- Pays damages for private home and business owners who have National Flood Insurance.
- Provides aid to towns for lost property taxes.