EBC Connecticut Program:
Coastal Resiliency in Connecticut
Welcome

Dana Huff, P.E.

Chair, EBC Connecticut Chapter

Vice President, Tighe & Bond
Program Introduction

Dana Huff, P.E.

Program Chair & Moderator

Vice President, Tighe & Bond
Establishing Coastal Resiliency Design Criteria

Duncan Mellor, P.E.

Principal Coastal Engineer
Tighe & Bond
Establishing Coastal Resiliency Design Criteria

June 20, 2017

Duncan Mellor, P.E.
What Is Changing?

Global sea level change relative to local land elevation (NOAA NOS)

https://tidesandcurrents.noaa.gov/sltrends/sltrends.html
Post Glacial Rebound (Glacial Isostatic Adjustment)

vertical crustal motions in mm per year via GIA theory

New London subsiding 0.9 mm/yr
Montauk subsiding 1.8 mm/yr
Willetts Pt subsiding 1 mm/yr
NYC subsiding 2.1 mm/yr
Newport rising 0.2 mm/yr

www.sonel.org
Some Land Is Rising

Sea level change relative to local land elevation (NOAA NOS)

970-141 Churchill, Canada

-9.48 +/- 0.57 mm/yr

Data Source: PSMSL
Sea Level Is Rising in Many Areas

New London Relative Sea Level Rise
8461490 New London, Connecticut

Sea level change relative to local land elevation (NOAA NOS)
2.57 +/- 0.22 mm/yr
Satellite Altimetry Sea Level

Altimetry data are provided by NOAA Laboratory for Satellite Altimetry

Change in Sea Level (mm) vs. Year
- TOPEX
- ERS-2
- GFO
- Jason-1
- ENVISAT
- Jason-2

USACE Intermediate Projection
USACE High Projection
NOAA Highest Projection
NOAA Intermediate High Projection
Global Tide Gauge Trend 1.7mm/yr IPCC

Change in Sea Level (inches)

1992 2002 2012 2022 2032 2042 2052 2062 2072 2082 2092
Tide Data & Ocean Oscillation

ROLLING 20 YEAR TIDE DATA TREND ANALYSIS
ALTIMETRY DATA COINCIDES WITH AMO UPSWING 1992-2016

Sea Level Rise Trend Comparison: Long Island Sound

- AMO Warm phase 1860-1880
- AMO Cool phase 1905-1925
- AMO Warm phase 1940-1960 US midwest droughts, Florida rain
- AMO Cool phase 1970-1990

Mid Year of 20 year window

Rate of SLR mm/yr

Ocean Oscillation index

Tide Data & Ocean Oscillation
ROLLING 20 YEAR TIDE DATA TREND ANALYSIS
ALTIMETRY DATA COINCIDES WITH AMO UPSWING 1992-2016

Sea Level Rise Trend Comparison: US East Coast

AMO Warm phase
1940-1960 US midwest droughts, Florida rain

AMO Warm phase
1860-1880

AMO Cool phase 1905-1925

AMO Cool phase 1970-1990

AMO 1995 start warm phase

Rate of SLR mm/yr

Ocean Oscillation Index

Mid Year of 20 year window

Portland - Boston - NYC - Eastport - Key West - Newport - Charleston - Bar Hrb - New London - AMO + PDO/3 - AMO - PDO

Tighe & Bond
Engineers | Environmental Specialists
New Findings

Oct. 30, 2015

NASA Study: Mass Gains of Antarctic Ice Sheet Greater than Losses

A new NASA study says that an increase in Antarctic snow accumulation that began 10,000 years ago is currently adding enough ice to the continent to outweight the increased losses from its thinning glaciers.

The research challenges the conclusions of other studies, including the Intergovernmental Panel on Climate Change’s (IPCC) 2013 report, which says that Antarctica is overall losing land ice.

According to the new analysis of satellite data, the Antarctic ice sheet showed a net gain of 112 billion tons of ice a year from 1992 to 2001. That net gain slowed to 62 billion tons of ice per year between 2003 and 2008.

“Were essentially in agreement with other studies that show an increase in ice discharge in the Antarctic Peninsula and the Thwaites and Pine island region of West Antarctica,” said Jay Zwally, a glaciologist with NASA Goddard Space Flight Center in Greenbelt, Maryland, and lead author of the study, which was published on Oct. 30 in the Journal of Geology. “Our main disagreement is for East Antarctica and the interior of West Antarctica – there, we see an ice gain that exceeds the losses in the other areas.” Zwally added that his team "measured small height changes over large areas, as well as the large changes observed over smaller areas."

Scientists calculate how much the ice sheet is growing or shrinking from the changes in surface height that are measured by the satellite altimeters. In locations where the amount of new snowfall accumulating on an ice sheet is not equal to the ice flow downward and outward to the ocean, the net change in mass is positive or negative.

https://www.nasa.gov/feature/goddard/nasa-study-mass-gains-of-antarctic-ice-sheet-greater-than-losses
Planning versus Design

Does FEMA mandate including SLR in all HMA applications?
No. FEMA does not mandate the inclusion of estimated SLR for HMA project applications.

FEMA: The International Residential Code (IRC) requires dwellings in floodways to be designed in accordance with ASCE 24-14

Obama Executive Order 11988 January 30, 2015 rev
- Best available climate science methods for SLR
- Non-critical structures BFE + 2'
- Critical structures BFE + 3'
- 500 yr flood elevation

TR-16 Design of new WWT Works, 2016 revision
- Non-critical structures 100yr FE + 2'
- Critical structures 100 yr FE + 3'

http://corpsclimate.us/ccaceslcurves.cfm
https://tidesandcurrents.noaa.gov/sltrends/sltrends.html
CT Specific Issues

Chapter 444 Section 22a Coastal Management Act

- Check this early as engineered shoreline protection may be prohibited
- “Rise in Sea Level” defined as the mean of the most recent decade rise in water level per NOAA Bridgeport or New London tide gauges.

Act does not define if this sea level rise is relative to land, which may be subsiding, or is corrected for project site land rise or subsidence.

Current NOAA 10-year sea level rise rate for New London & Bridgeport tide gauges is -0.001 and 0.004mm/yr respectively relative to land. New London subsiding about 1mm/yr.

The Act 10-year data period covers only half a tidal epoch and the short window may cause significant variability.

CTDEEP permit denials of a coastal design by a licensed engineer can be appealed to the Connecticut Academy of Science & Engineering (CASE), but to date no coastal appeals have been heard.
### Table 1. Components of Sea Level Change

<table>
<thead>
<tr>
<th>Component</th>
<th>Quantity</th>
<th>Source</th>
<th>Where to locate the Information</th>
<th>Certainty</th>
</tr>
</thead>
</table>
| Component I: 
Historical Local 
Relative Sea Level 
Trends | +10.0 to -15.0 millimeters (mm) per year | Measured | NOAA tide gage records | Highly Certain |
| Component II: 
Localized Vertical 
Land Changes 
(Subsidence, 
Isostatic Rebound) | -8.0 (subsidence) to +20.0 (uplift) mm per year | Modeled/Measured | NGS, State Advisor, USGS published subsidence/rebound rates, CO-OPS estimates from tide gage records | |
| Component III: 
20th Century 
Historical Global Sea Level Change | +1.7 to 1.8 mm per year | Measured | Historical global tide gage analyses and global isostatic adjustment models | |
| Component IV: 
Global Sea Level Change since 1993 | +3.1 to 3.3 mm per year | Measured | Series of satellite altimeter missions since 1993 and global tide gage records | |
| Component V: 
Future Climate 
Change Scenarios | Acceleration constant 2 centimeters (cm) per decade increasing by 3 cm per decade each decade | Modeled | IPCC 2007, various research papers since IPCC | |
| Component VI: 
Regional Tidal 
Elevation Surface | Uncertainty of modeled surfaces area-dependent: 16 cm to 45 cm 95% CI | Modeled | VDATUM | Less Certain |

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**Sea Level Rise Components**

- Tide data certain
- Vertical land movement certain
- Altimetry less certain, short data record
- Future SLR acceleration uncertain

*INCORPORATING SEA LEVEL CHANGE SCENARIOS AT THE LOCAL LEVEL, NOAA 2012*
SLR Design Considerations

• Use best available science – it is constantly changing, review carefully, does it make sense? There may be no single design value to select

• What is the tolerance for risk? Occurrence probability x damage costs

• Be aware of the down sides of extreme SLR acceleration projections
  • Loss of property tax revenue due to SLR acceleration mapping
  • Higher seawalls, roads and buildings block ocean views & access
  • Higher structures increase costs, reducing benefit/cost ratios (FEMA)

• Look at the bigger picture – do extreme SLR design values remove the project need? Is abandoning the shoreline reasonable? Is the facility approaching the end of its service life making relocation feasible?

• Evaluate the impacts of SLR ordinances, laws, regulations and funding stipulated design requirements; adjust as needed

• Design with consideration to be adaptable in the future
SLR Design – Short Design Life (20+/- yrs)

Example: Living Shoreline

- Subject to near term changes & storm damage
- SLR not significant over a short design life where wave damage dominates
- Consider near term rate of relative SLR for elevation dependent plantings
- Army Corps General Permit under consideration for expediting living shoreline permitting
SLR Design – Medium Design Life (50+/- yrs)

Example: Timber Pier or Bulkhead

• Design or retrofit to resist submergence & uplift

• Balance design height for SLR against functional uses (including ADA access) and views

• May be relatively easy to design for occasional submergence and overtopping
SLR Design – Longer Design Life (100+/- yrs)

Example: Concrete Seawall Replacement, Hampton, NH

- State SLR mapping showed majority of barrier island including all roads, building flooded by 2100 (6.6’ SLR). Designing for 6.6’ SLR not practical.

- Balanced design height increase selected for SLR considering ocean views, adjacent state seawall.

- Friction slab and walkway design utilized to allow wave overtopping with backfill protection in a cost effective manner.
Norwalk: Washington Village Planning and Implementation

Joseph Canas, P.E., LEED AP, CFM

Project Manager
Tighe & Bond
Post-Sandy Redevelopment of Washington Village

June 20, 2017

Joe Canas, P.E., LEED AP, CFM
Existing Conditions

- Constructed in 1940
- Oldest public housing project in Connecticut
- 136 housing units
- Adjacent to public park
- Within walking distance of train station
- Area subject to localized flooding
Proposed Conditions

- Redevelop Washington Village and adjacent lots
- 273 proposed units
  - 136 subsidized units
  - 137 market rate
- Park improvements planned for separate project
Proposed Conditions
Superstorm Sandy

- Many units flooded by as much as 4 to 5 feet of water
- Norwalk Housing Authority received $30 million Community Development Block Grant from HUD
Why redevelop here?

- Existing community of neighbors
- Public park across the street
- Proximity to services and public transportation
- No other available sites in the area
- Acquisition costs prohibitively expensive
CGS 25-68 requires any state agency proposing an action within a floodplain obtain a Floodplain Management Certification from the Department of Energy and Environmental Protection

Must demonstrate compliance with National Flood Insurance Program requirements and State floodplain management regulations.
## Floodplain Management Strategies

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td>• CT Dept. of Housing considers public housing to be a critical activity,</td>
<td>• Parking was placed at grade beneath the building, and the residential</td>
</tr>
<tr>
<td>therefore must be designed for the 500-year flood</td>
<td>units placed on the floor above</td>
</tr>
<tr>
<td></td>
<td>• Lobby and elevators to be floodproofed to 500-year plus 1’</td>
</tr>
</tbody>
</table>
Floodplain Management Strategies
500-Year Coastal Elevation?

- Flood Insurance Studies only publish the 100-year coastal flood elevation

- FEMA technical guidance:
  - 500 year elevation = 1.25 x 100 year elevation
  - (or conduct detailed study)

- 500-year using FEMA guidance: 15 NAVD88

- Detailed study: 15 NAVD88
Floodplain Management Strategies

**Requirement**
- CT DEEP policy requires “dry access” from the site to contiguous dry land

**Strategy**
- Elevated bridges between units
- Infrastructure improvements, elevation of Raymond and Day intersection
- Berm across Ryan Park
Floodplain Management Strategies

- Berm across Ryan Park @ El. 12.1
- Raise Intersection of Raymond & Day to El. 12.1
- Elevated Bridges Connecting Buildings
Localized Flooding Strategies

- Installed tide gate on local drainage
- “Stacking” the impervious coverage allowed for more pervious coverage on the site
- Other LID retrofits
  - Porous pavement
  - Rain gardens
Executive Order 13690

- Federal Flood Risk Management Standard, effective January 2015

- Applies to federally funded actions

- Choose one of three compliance paths
  - Build two feet above the 100-year flood elevation for standard projects, three feet above for critical projects
  - Build to the 500-year flood elevation
  - Use best-available, actionable climate science
Intergity of Development

- CGS 25-68d does not allow FM Certifications for projects that increase the intensity of development in the floodplain.
- Agency may ask for an exemption
- Exemption was required for this project because we were going from 136 to 273 units
Floodplain Management Exemption

Must demonstrate the project meets four criteria:

- Project is in the public interest
- Project complies with the National Flood Insurance Program requirements
- Owner is aware of the increased flood insurance premiums
- Demonstrate that project will not cause harm or injury to persons or property
Floodplain Management Exemption

- **Safeguards to prevent injury to persons or property**
  - Dry access
  - Prepared detailed flood contingency plan
  - Coordination with City Emergency Operations Plan
  - Document how cars would be moved off site and parked in City Garages
Floodplain Management Exemption

- Tentative decision to approve Exemption granted by CTDEEP on August 26, 2014
- 30 day appeal period
- Friends of Ryan Park submitted appeal on September 25, 2014
  - 200 signatures obtained, 25 required
Dry Access

Proposed Concept

What the opponents said we were going to do
Misinformation!

Ryan Park Butterfly Garden

How FORP represented it

Reality
CTDEEP Appeal Process

CT DEEP Tentative Decision

Appealed?

Wait for CT DEEP Hearing Officer to be Appointed

Legal Discovery

CT DEEP Public Information Meeting

CT DEEP Hearing (Hartford)

Decision?
CTDEEP Public Information Session

- South Norwalk Community Center
- Site walk before information session
- Project team introduced the project
- Members of public allowed to speak, limited to three minutes each
CT DEEP Hearing

- CT DEEP, Hartford

- Two sessions: December 18, 2014 and January 6, 2015

Support
- CT DEEP Staff
- CT Dept. of Housing
- Norwalk Redevelopment Agency
- Norwalk Housing Authority + Attorneys
- Trinity Financial + Attorneys
- Tighe & Bond

Opposition
- Friends of Ryan Park (self-representing)
April 30, 2015 CT DEEP Hearing Officer rules in favor of Department of Housing

June 23, 2015 Friends of Ryan Park files appeal
- Hearing officer didn’t consider alternatives

April 20, 2016 Connecticut Superior Court dismisses appeal

20 day appeal period passes without incident
Timeline

10/29/12: Superstorm Sandy

2012

2013

2014

12/18/14: CTDEEP Hearing Begins

09/25/14: FORP Files Appeal

08/26/14: CTDEEP Tentative Decision

05/15/14: CTDEEP FM Cert Filed

04/01/14: CDBG Award

2015

01/06/15: CTDEEP Hearing Closed

04/30/15: CTDEEP Determination Upheld

06/23/15: FORP Files Appeal

2016

04/20/16: FORP Appeal Denied
Now What?

- Construction documents under way for site and off-site roadway improvements
- City has awarded Master Plan design services for Ryan Park
- FORP “improvements” relocated by Parks Dept. to FORP’s President’s front yard
Joseph Canas, PE, LEED AP, CFM
Project Manager
Tighe & Bond, Inc.
1000 Bridgeport Avenue
Shelton, CT 06484
Sea Level Change & Risk-Informed Decision-making

Kevin Knuuti, P.E., D.C.E.

Presentation available on the Presentations website as a separate link.
Coastal Resiliency Challenges and Planning in Fairfield

Jonathan Richer, P.E., Tighe & Bond

&

Joseph Michelangelo, P.E., Town of Fairfield
Coastal Resiliency Challenges and Planning in Fairfield, Connecticut

June 20, 2017

Presentation Team
Joseph Michelangelo, P.E., Director of Public Works, Town of Fairfield
Jonathan Richer, P.E., Project Manager, Tighe & Bond
Outline

- Background
- Hurricane Sandy
- Repair & Recovery
- Planning for the Future
- Questions
Background

881 acres historically flood prone

Beach Area Structures:
- 2,771 Residential Buildings
- 264 Commercial Buildings
- 212 Residential Condominiums
Total = 3,247 Structures

Town of Fairfield Flood and Erosion Control Board
Background

How does Fairfield flood?

Town of Fairfield Flood and Erosion Control Board
How does Fairfield flood?
Hurricane Sandy

Hurricane Sandy

FEMA Grants Secured for Immediate Repair Projects

- Penfield Pavilion
- South Benson Marina Fishing Pier
- Southport Beach Seawall/Breakers
- Pine Creek Navigational Channel Re-Establishment
- Fairfield Beach Road Seawall & Timber Bulkhead
- Pine Creek Dike
- Southport Beach Concession Foundation
- Sasco Beach Concession Foundation
- Ye Yacht Yard Restroom/Storage Building Foundation
- Pequot Avenue Bridge Scour Protection
Planning for the Future

HUD/CT DOH CDBG-DR Construction Grants

- Pine Creek Dike Culvert Repair
- Wastewater Treatment Plant (WWTP) Outfall Repair
- WWTP Hardening Project
- WWTP Microgrid Project
- Penfield Pavilion Repairs
- Shoreline Resiliency at Penfield Beach
Planning for the Future

Pine Creek Dike Culvert
- 48-inch CMP culvert
- 310-Acre watershed
- Culvert partially collapsed during Hurricane Sandy
- Vastly undersized for drainage area
- Contributing area was flooded for more than a week even with emergency pumping
- 36” main outfall from Fairfield WWTP approximately 12” below existing culverts
Planning for the Future

- **Pine Creek Dike Culvert**
  - Solution was two 48-inch culverts, two 60-inch “emergency” culverts
  - Self-Regulating Tide Gates on 48-inch culverts
  - Manual sluice gates on emergency culverts
  - Triple Wall Polypropylene pipe for corrosion protection
Planning for the Future

But First...

- HUD Environmental Permitting
  - NEPA Checklist
  - 8 Step Process for Work in Floodplain
  - Environmental Assessment
  - Several rounds of notices
- CTDEEP OLISP Structures, Dredging & Fill, Tidal Wetlands & 401 Water Quality Certificate
- ACOE General Permit
- CTDEEP IWRD Flood Management Certification
Planning for the Future

**WWTP Hardening Project**

- 9.0 MGD WWTP
- Adjacent critical facilities include Fairfield County Fire Training School, Conservation Building and Animal Control
- Plant was partially inundated during Hurricane Sandy, nearly catastrophic
- Entire Town affected if plant incapacitated
**Planning for the Future**

- **WWTP Hardening Project**
  - 2,300 LF of sheet pile wall, 600 LF of earthen berm proposed
  - Two pump stations sized for 100-Year storm
  - Flood barrier at 500-Year flood elevation (more than 3’ above 100-Year)
  - Microgrid will allow facilities to operate in “island mode”
  - Application being reviewed for CTDEEP Dam Safety Permit
Planning for the Future

HUD/CT DOH CDBG-DR Planning Grants

- South Benson Pump Station Study
- Riverside Drive Flood Mitigation Study
- Downtown Flooding and Drainage Study
- Engineered Beaches
- Pine Creek Dike Elevation Study
South Benson Pump Station Study
- 170-Acre watershed
- Existing storm drainage system very flat
- Surcharges in rainfall events greater than 1-Year Storm
- Lacks capacity to discharge storm surge flooding
Planning for the Future

- South Benson Pump Station Study
  - 80 MGD Pump Station
  - Discharge two feet of storm surge flooding in 24 hours
  - Relay approx. 2 Miles of storm main to 0.5% slope
  - New outfall to Ash Creek
Planning for the Future

- **FEMA – Pre-Disaster Mitigation Grant Program**
  - WWTP Generator Replacement
  - Mill River Pump Station Generator Replacement
Flood Prevention Master Plan

- New dikes and flood walls, raising of existing dikes
- Estimated project cost of $27M
- Creates continuous physical barrier against 100-Year storm
Questions?

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Funding Municipal Resiliency: Accessing FEMA’s Hazard Mitigation Assistance Grants

Gemma Fabris, CFM

State Hazard Mitigation Officer
Connecticut Department of Emergency Services and Public Protection
Funding Municipal Resiliency: Accessing FEMA’s Hazard Mitigation Assistance Grants

Gemma Fabris, CFM
State Hazard Mitigation Officer
Connecticut Department of Emergency Services and Public Protection
Division of Emergency Management and Homeland Security
1111 Country Club Rd, Middletown, CT
How to get the Money

- Be pro-active
- Find the right grant
- Speak the language
- Know Your Benefits
- Provide Justification
Don’t Do It Alone

Engage Others:

• Public Works
• Planning and Zoning
• Conservation
• Economic Development
• Fire Dept.

• Local Council of Governments (COG’s)
• State/Tribal Historic Preservation Office (S/THPO)
• State NFIP Coordinator
• State Hazard Mitigation Officer (SHMO)
• Neighboring Communities

Involve your federal, state and local representatives
Be Like Lady Bird

One Project: One Objective (highway beautification)

“Where flowers bloom so does hope.”
Know Your Benefits
(multiple)

Project Advantages

- Provides Habitat
- Conserves Water
- Reduces Maintenance Costs
- Reduces Carbon Dioxide Emissions
- Controls Erosion
FEMA Priority: Project reduces vulnerability to future disasters through planning or implementation.
Know Your Eligibility

- Make sure your project is eligible under that specific agencies grant program guidelines

Dredging a navigable waterway would be under USACE’s purview
FEMA HMA Programs
Natural Hazards/Disasters
HMGP Funding

**HMGP FUNDS (RELIANT UPON A DISASTER)**

- **Series 1**
  - DR-4023: $8,789,169, 2011
  - DR-4046: $12,773,052, 2011
  - DR-4087: $11,945,300, 2012
  - DR-4106: $4,612,581, 2013
  - DR-4213: $1,363,925, 2015
  - DR-4106: $0, 2016

- **Series 2**
PDM and FMA Funding

Annual (non-disaster) Grants

2014 2015 2016

$0 $500,000 $1,000,000 $1,500,000 $2,000,000 $2,500,000

2014: Competitive, online e-Grants application
FEMA Grant Format

• Narrative/Damage Description (describe past damages, benefits)
• Scope of Work (What you are proposing to do)
• Time Line
• Budget (engineering or contractor estimates)
• Cost Share
• Demonstrate Cost Effectiveness (BCA tool)
• Include supporting documentation (sources, photos, flood maps, GIS Coordinates)
Get the Science Behind It

• Integration of climate change adaptation into programs
• Can include sea level rise estimates.
• Provides greater justification
• Multiple project benefits garner a wider range of support
USACE SLR Model

Estimated Relative Sea Level Change Projections - Gauge: 8461490, New London, CT

- USACE High
- USACE Int
- USACE Low

RSLC in feet (NAVD88)

Year

2000 2010 2020 2030 2040 2050 2060 2070 2080 2090 2100
Why Invest in Mitigation?

Reduces future damage to infrastructure and private property from various natural hazards (flooding, drought, tropical storms, severe winter weather, etc) through:

• Acquisition
• Flood Proofing
• Elevation
• Green Infrastructure incorporated into street repair can reduce storm water run off
Mitigation Activities Can Reduce:

• Aquifer depletion
• Power loss
• Disruption of economy, loss of business
• Effects of drought
• Damage to public and private property
• Pollution
• Environmental damage
Where to get the Information

- Local and/or State Natural Hazard Mitigation Plan
- City Departments (Public Works, Fire etc.)
- Councils of Government
- CT Open Source Data (GIS)
Other Sources of Data/Information

- [https://www.fema.gov/hazard-mitigation-assistance](https://www.fema.gov/hazard-mitigation-assistance) (FEMA HMA)
- NOAA Center for Operational Oceanographic Products and Services’ Mean Annual SLR Trend Data [http://tidesandcurrents.noaa.gov/sltrends/sltrends.shtml](http://tidesandcurrents.noaa.gov/sltrends/sltrends.shtml); and
- USACE Climate Change Adaptation Sea Level Change Curves [http://corpsclimate.us/ccaceslcurves.cfm](http://corpsclimate.us/ccaceslcurves.cfm); and
- [https://www.ncdc.noaa.gov/data-access](https://www.ncdc.noaa.gov/data-access) (National Climactic Data Center/NOAA)
- [http://nsidc.org/data/search/](http://nsidc.org/data/search/) (snow and ice data)
- [https://www.fema.gov/benefit-cost-analysis](https://www.fema.gov/benefit-cost-analysis)
Building for Coastal Resiliency

David Chapman, P.E.

Senior Vice President
Blakeslee Arpaia Chapman
Scarborough WWTF Flood Proofing Project

Narragansett RI

By
David R. Chapman, PE
Blakeslee Arpaia Chapman, Inc.
200 North Branford Road
Branford Ct 06405
dchapman@bac-inc.com
Site Location
The Cast of Characters

Owner: The Town of Narragansett
Engineer: RT Group of North Kingstown RI
Contractor: Blakeslee Arpaia Chapman, Inc.
  Branford CT
Concrete Subcontractor: Mt. Hope Builders, Inc.
  Bristol, RI
Contractor’s Engineer: Geisser Engineering Corp.
  Riverside, RI
Project

- Provide Flood and Surge Protection with Rip-Rap and Steel Sheet Pile Berm
- Provide Concrete Flood Wall near Main Building
- Collect and Filter Surface Runoff in New Vault
- Establish New Discharge for Surface Run Off
- Minor Misc Site Improvements
- Contract Value $1,375,520
Existing Site
Proposed Site Plan
Steel Sheeting Elevation
Sheeting & Wall Cross Section
Filter System/ Vault
Actual Construction
Driving Sheets
Rip-Rap & Earth Berm
Design vs. Actual
Cap
Drainage Penetrations
Concrete Wall
Design Vs. Actual
Outfall
Versa Lock wall
The Vault Structure

- No pictures – still in production
- Used to collect run off and filter out particulates
- Filter system uses 18 inch thick sand bed
- Explored using baffles, but it was felt that it would be too time consuming for approval.
- Due to concern about the wall near the vault, it is being used as a dead man for added tie backs
Thank you

- Contact Info for questions

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EBC Connecticut Program:
Coastal Resiliency in Connecticut