Summary of Risks and Recommendations
Stonington Borough Fire House and Emergency Operations Center
100 Main Street
Stonington

Description of current flood risk *(all elevations are in feet, NAVD88)*	• The facility is mapped in an AE flood risk zone (BFE of 11') with lowest adjacent grade at 8.34', lowest floor elevation (primary occupied floor and most of the utilities) at 8.78', and elevator shaft at 4.78'. This places all of the lower levels of the facility at risk of a coastal flood that has a 1% chance of occurring in any year. • A VE zone is directly across the street with associated elevation of 14'. • The 0.2 annual chance flood elevation is assumed to be 13.75' (BFE x 1.25). The elevation of 18.6' cited in the FIS is believed unrealistic for the site. In either case, the facility is at risk of severe flooding from the 0.2% annual chance flood. • The facility is located in SLOSH zone 2. • The storm surges from Hurricane Sandy in 2012 and T.S. Irene in 2011 did not flood the facility, although the surge from Sandy reached the edge of the building.
Description of future flood risk *(all elevations are in feet, NAVD88)*	• Climate change is believed to be accelerating sea level rise and increasing the frequency of coastal storm events, which will lead to increasing risk of flooding during storm events. • MHW is 0.84'; therefore, sea level rise will likely not cause daily high tide flooding of the facility in this century.
Description of municipal capabilities to address risks	• The Borough addresses heavy snow buildup, strong wind forecasts, and flood watches and warnings as needed. Borough administration functions can be temporarily carried out in other locations. • The facility was constructed in 2004 and is wet-flood proofed with 7 vents in the truck bay area and dry-flood proofed with flood walls for the utility room. • An elevated berm is located at the rear of the property. The adjacent (higher) church site provides truck storage area during floods.
Description of flood risk reduction design criteria *(all elevations are in feet, NAVD88)* *FFRMS = Federal Flood Risk Management Standard* *FVA= Freeboard Value Approach* *CISA = Climate Informed Science Approach*	• The 0.2% flood elevation of 13.75' represents the design criteria per State requirements for critical facilities. • FFRMS flood risk based on the FVA is 14' (BFE + 3' for critical facilities). • FFRMS flood risk based on the 0.2% is 13.75'. • FFRMS flood risk based on CISA is approximately 12' to 14'. • NYC Resiliency design criteria is BFE + 24" + SLR adjustment of 0.5'-3' = 13.5' to 16'.
Recommendations for building-specific flood risk reduction such as floodproofing, building elevation,	• The facility has been wet and dry-floodproofed to some degree and is considered partly mitigated with regard to flooding. All fully-finished areas are at 2nd floor level

elevation of utilities, sealing of openings, etc.	(elevation 24.98'). • Short-Term: short-term actions are not necessary. • Long-Term: the dry floodproofing should be extended vertically to address increasing flood depth risks. Specifically, the interior flood walls should be increased in height to elevation of 14' to 16'. Additional wet floodproofing may also be needed over time, to address increasing risk.
Planning-level cost estimates	• Short-Term: Not applicable • Long-Term: $10/sf
Recommendations for on or off-site flood risk reduction such as flood walls, berms, raising grade, etc.	• The site generally does not have sufficient space for flood walls, additional berms, or raising grade. Easy access from the road to the garage bays is needed.
Planning-level cost estimates	• Not applicable
Resources	• FEMA 543, Design Guide for Improving Critical Facility Safety from Flooding and High Winds: Providing Protection to People and Buildings (2007), https://www.fema.gov/media-library/assets/documents/8811 • FEMA P-936, Floodproofing Non-Residential Buildings (July 2013), https://www.fema.gov/media-library/assets/documents/34270 • FEMA P-1037, Reducing Flood Risk to Residential Buildings That Cannot Be Elevated (September 2015), https://www.fema.gov/media-library/assets/documents/109669 • FEMA RA-2, Hurricane Sandy Recovery Advisory: Reducing Flood Effects in Critical Facilities (April 2013), https://www.fema.gov/media-library/assets/documents/30966 • FEMA P-942, Mitigation Assessment Team Report: Hurricane Sandy in New Jersey and New York – Building Performance Observations, Recommendations, and Technical Guidance (November 2013), https://www.fema.gov/media-library/assets/documents/85922 • FEMA P-348, Edition 2, Protecting Building Utility Systems from Flood Damage (February 2017) https://www.fema.gov/media-library/assets/documents/3729

Summary of Risks and Recommendations
Stonington Borough Fire House and Emergency Operations Center
100 Main Street
Stonington

Description of current wind risk	• Strong winds are experienced during nor'easters, tropical storms, and other storm events. • According to the Borough, the wind from Hurricane Sandy in 2012 was not as damaging as the wind from T.S. Irene in 2011. • Future wind events can damage the facility's structure or roof if the wind speed exceeds the older codes in place when the building was last upgraded. • Wind can also damage accessory structures.
Description of future wind risk[1]	• Climate change may amplify the frequency and intensity of wind events like hurricanes, but it is not known whether higher wind speeds will be more commonplace.
Description of municipal capabilities to address risks and operate backup facilities	• The Borough addresses heavy snow buildup, strong wind forecasts, and flood watches and warnings as needed.
Description of wind risk reduction design criteria	• Connecticut Building Code Appendix N, 150 mph ultimate/116 mph nominal. • Connecticut is located in FEMA Zone II relative to maximum expected wind speed. The maximum expected wind speed for a three-second gust is 160 miles per hour. This wind speed could occur as a result of either a hurricane or a tornado • Climate change may amplify the frequency and intensity of wind events like hurricanes, but it is not known whether higher wind speeds will be more commonplace to the degree that current building codes are insufficient. Coincidentally, the maximum wind speeds specified in the code are those for Stonington.
Recommendations for wind risk reduction such as load path projects, shutters, etc.	• Shutters are recommended to protect the windows on the second story and the large garage doors. • When the roof is next replaced or upgraded, the 160 mph criteria (or future building code) should be considered.
Planning-level cost estimates	•
Resources	• FEMA 543, Design Guide for Improving Critical Facility Safety from Flooding and High Winds: Providing Protection to People and Buildings (2007), https://www.fema.gov/media-library/assets/documents/8811

1. Connecticut Hazard Mitigation Plan Update, 2014

Summary of Risks and Recommendations
Stonington Borough Fire House and Emergency Operations Center
100 Main Street
Stonington

Description of current snow load risk	• Heavy snow events in 2011, 2013, and 2015 have necessitated monitoring and/or removing snow from buildings. • Future snow events can damage the facility's structure or roof if heavy buildup occurs without melting.
Description of future snow load risk[1]	• Climate change studies have projected a shorter winter season for Connecticut with a decreased overall snowpack. In addition, climate models have indicated that fewer but more intense precipitation events will occur during the winter period with more precipitation falling as rain rather than snow. This change in winter precipitation could result in less frequent but more intense snow storms with heavier snow.
Description of municipal capabilities to address risks and operate backup facilities	• The Borough addresses heavy snow buildup, strong wind forecasts, and flood watches and warnings as needed.
Description of snow load risk reduction design criteria	• Connecticut Building Code Appendix N, Ground Snow Load, 30 psf. • Climate change may decrease overall snow accumulations but could result in wet, dense, heavier snowfalls. It is not known whether current building codes are insufficient. The maximum ground snow load specified in the code is 40 psf for northwest Connecticut.
Recommendations for snow load risk reduction	• Procedures should be developed for removing snow from the roof.
Planning-level cost estimates	• Nominal
	• FEMA P-957, Snow Load Safety Guide (2013), https://www.fema.gov/media-library/assets/documents/83501 • FEMA Snow Load Safety Guidance Flyer (2014), https://www.fema.gov/media-library/assets/documents/29670

1. Connecticut Hazard Mitigation Plan Update, 2014; and State Water Plan, 2017

Memorandum

TO: **File**

FROM: **Emmeline Harrigan, AICP, CFM**

DATE: **April 19, 2017**

RE: **Critical Facililities Assessment**
Location: Stonington Borough Fire Department – 100 Main Street, Stonington Borough

Local Contact: Jeffrey T. Hoadley, Fire Chief
MMI Team: Emmeline Harrigan, Nirdosh Patel

Description of Flooding Risk

Flooded to the edge of the building during Sandy and then receded. The building is wet-flood proofed with (7) vents in the truck bay area and dry-flood proofed with flood walls in the utility room. Built in 2004.

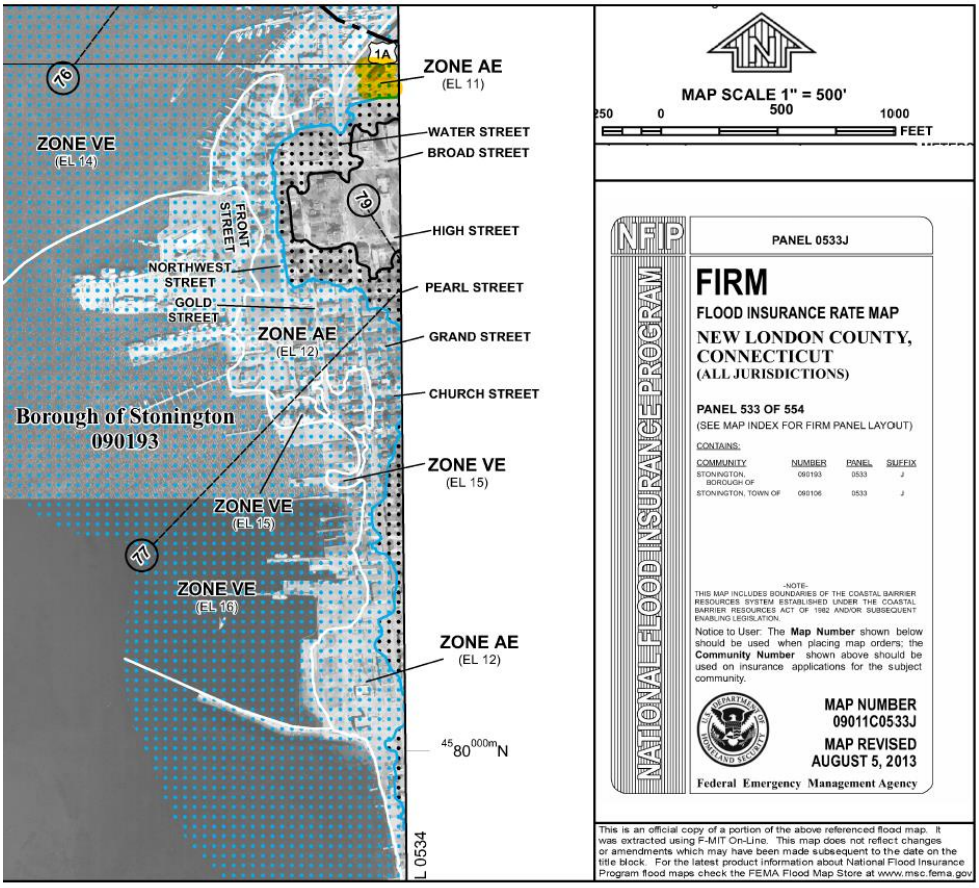
- Grade at 8.34 – 9.03 ft with entry level at 8.48
- 2-story structure with most square footage at the 2nd floor level.
- Elevated berm at the back. Adjacent hilly church site provides truck storage area during floods.
- 1st floor contains (4) truck bays, entry vestibule, 2 utility rooms, and haz-mat shower/W&D area with flood gates/membrane also.

Evaluate Current Vulnerability

- Building plans: Yes, photos on file. Building constructed in 2004.
- FEMA Flood zone: AE-11 NAVD88

- Site Grading: Site grade is higher adjacent to Alpha Avenue and slopes downward towards Main Street
- Lowest Flood Use: Vehicle and equipment storage, utilities at elevation 8.78, Elevator Pit at 4.78.
- Outbuildings: None, Exterior Generator and Fuel tanks.

FEMA Flood Insurance Rate Map



Utility System Descriptions

System	Description	Location(s)	Notes
Utility Room	At grade	Right side of bays	Has 3' flood gates & flood membrane
HVAC	Radiator heater	In vestibule	1.5 ft off grade
A/C Unit	Small unit for elevator equipment	Exterior Alpha Ave side of bldg	In-wall unit for upper level only.
Water heater:	1st floor	In Utility Room	
Furnace:	1st floor	In Utility Room	
Electrical: Panel (primary)	1 panel	In Utility Room	
Electrical into building	Underground	Transformer in planting bed near Main Street entrance	Meter at front door

System	Description	Location(s)	Notes
Electrical: Panels/Sub	For elevator	In 2nd flr mechanical room	
Electrical Outlets/1st flr	4 ft on 1st floor	In bays/all other rooms	
Communications Equipment	1st floor	In separate utility room across the hall	Has 3' flood gates & membrane
Plumbing: Waste	Town Sewer		
Plumbing: Potable	Public Water		
Fuel System: Primary	(1) subterranean propane tank	Gauge & access in the rear yard	For kitchen also.
Fuel System: Secondary	N/A		Prior kitchen removed
Generator:	Large unit	Rear exterior near Alpha Ave.	Two small additional green units? Inverter?
Elevator	Main entry /near stairs	Equipment/2nd floor.	Has small elevator pit.

Identification of Future Vulnerabilities

- Higher elevation flood events

Recommendations for Risk Reductions

Floodproofing Method	Effective?
Wet Floodproofing:	Yes. Already in place for truck bays with flood vents.
Elevation of Utilities:	Possible unless floodwalls are addressed per below instead.
Dry Floodproofing:	Interior floodwalls will need to be increased in height over time
Building Relocation:	No.
Building Elevation:	No, but all fully finished areas are at 2nd floor level.
Sealing of Openings:	N/A
Other Modifications:	N/A

Summary of Risks and Recommendations
Stonington Borough Hall and Public Works
26 Church Street
Stonington

Description of current flood risk *(all elevations are in feet, NAVD88)*	• The facility is mapped in an AE flood risk zone (BFE of 12') with lowest adjacent grade at 8.77', lowest floor elevation of 8.52', utility room at elevation 8.97', and primary (occupied) floor elevation of 11.70'. This places all of the lower levels of the facility at risk of a coastal flood that has a 1% chance of occurring in any year. • The 0.2 annual chance flood elevation is assumed to be 15' (BFE x 1.25). The elevation of 18.6' cited in the FIS is believed unrealistic for the site. In either case, the facility is at risk of severe flooding from the 0.2% annual chance flood. • The facility is located in SLOSH zone 3. • The storm surges from Hurricane Sandy in 2012 and T.S. Irene in 2011 did not flood the facility.
Description of future flood risk *(all elevations are in feet, NAVD88)*	• Climate change is believed to be accelerating sea level rise and increasing the frequency of coastal storm events, which will lead to increasing risk of flooding during storm events. • MHW is 0.84'; therefore, sea level rise will likely not cause daily high tide flooding of the facility in this century.
Description of municipal capabilities to address risks	• The Borough addresses heavy snow buildup, strong wind forecasts, and flood watches and warnings as needed. Borough administration functions can be temporarily carried out in other locations. • The Borough Hall does not have a fixed-in-place generator. Obtaining a generator is a new action listed in the hazard mitigation plan.
Description of flood risk reduction design criteria *(all elevations are in feet, NAVD88)* *FFRMS = Federal Flood Risk Management Standard* *FVA= Freeboard Value Approach* *CISA = Climate Informed Science Approach*	• The 0.2% flood elevation of 15' represents the design criteria per State requirements for critical facilities. • FFRMS flood risk based on the FVA is 15' (BFE + 3' for critical facilities). • FFRMS flood risk based on the 0.2% is 15'. • FFRMS flood risk based on CISA is approximately 13' to 15'. • NYC Resiliency design criteria is BFE + 24" + SLR adjustment of 0.5'-3' = 14.5' to 17'.
Recommendations for building-specific flood risk reduction such as floodproofing, building elevation, elevation of utilities, sealing of openings, etc.	• Elevating the building is not feasible. • Relocating the facility's uses (Borough administration and public works) may be possible, but few areas of the Borough are available at higher elevations. • Short-Term: the utility room should be dry floodproofed because a 1% annual chance flood could cause two feet of flood depth. Even a storm similar to Hurricane Sandy (maximum water surface elevation 9-10 feet in western Connecticut) could flood the utility room if aligned with the

	tide cycle. A design elevation of 15' for the dry floodproofing should be considered. • Long-Term: the occupied lower levels of the building should be wet floodproofed. This will address the current 1% annual chance storm (which could cause a few inches of flooding in the garage) and the FFRMS floods (which could cause 3-4 feet of flooding in the garage).
Planning-level cost estimates	• Short-Term: $10/sf (area of utility room) • Long-Term: $10/sf (footprint of building) + $3,000 for flood vents
Recommendations for on or off-site flood risk reduction such as flood walls, berms, raising grade, etc.	• The site generally does not have sufficient space for flood walls, berms, or raising grade. Easy access from the road to the garage bays is needed.
Planning-level cost estimates	• Not applicable
Resources	• FEMA 543, Design Guide for Improving Critical Facility Safety from Flooding and High Winds: Providing Protection to People and Buildings (2007), https://www.fema.gov/media-library/assets/documents/8811 • FEMA P-936, Floodproofing Non-Residential Buildings (July 2013), https://www.fema.gov/media-library/assets/documents/34270 • FEMA P-1037, Reducing Flood Risk to Residential Buildings That Cannot Be Elevated (September 2015), https://www.fema.gov/media-library/assets/documents/109669 • FEMA RA-2, Hurricane Sandy Recovery Advisory: Reducing Flood Effects in Critical Facilities (April 2013), https://www.fema.gov/media-library/assets/documents/30966 • FEMA P-942, Mitigation Assessment Team Report: Hurricane Sandy in New Jersey and New York – Building Performance Observations, Recommendations, and Technical Guidance (November 2013), https://www.fema.gov/media-library/assets/documents/85922 • FEMA P-348, Edition 2, Protecting Building Utility Systems from Flood Damage (February 2017) https://www.fema.gov/media-library/assets/documents/3729

Summary of Risks and Recommendations
Stonington Borough Hall and Public Works
26 Church Street
Stonington

Description of current wind risk	• Strong winds are experienced during nor'easters, tropical storms, and other storm events. • According to the Borough, the wind from Hurricane Sandy in 2012 was not as damaging as the wind from T.S. Irene in 2011. • Future wind events can damage the facility's structure or roof if the wind speed exceeds the older codes in place when the building was last upgraded. • Wind can also damage accessory structures.
Description of future wind risk[1]	• Climate change may amplify the frequency and intensity of wind events like hurricanes, but it is not known whether higher wind speeds will be more commonplace.
Description of municipal capabilities to address risks and operate backup facilities	• The Borough addresses heavy snow buildup, strong wind forecasts, and flood watches and warnings as needed. Borough administration functions can be temporarily carried out in other locations. • The Borough Hall does not have a fixed-in-place generator. Obtaining a generator is a new action listed in the hazard mitigation plan.
Description of wind risk reduction design criteria	• Connecticut Building Code Appendix N, 150 mph ultimate/116 mph nominal. • Connecticut is located in FEMA Zone II relative to maximum expected wind speed. The maximum expected wind speed for a three-second gust is 160 miles per hour. This wind speed could occur as a result of either a hurricane or a tornado • Climate change may amplify the frequency and intensity of wind events like hurricanes, but it is not known whether higher wind speeds will be more commonplace to the degree that current building codes are insufficient. Coincidentally, the maximum wind speeds specified in the code are those for Stonington.
Recommendations for wind risk reduction such as load path projects, shutters, etc.	• Shutters are recommended to protect the larger windows on the second story and the large garage doors. • When the roof is next replaced or upgraded, the 160 mph criteria (or future building code) should be considered.
Planning-level cost estimates	•
Resources	• FEMA 543, Design Guide for Improving Critical Facility Safety from Flooding and High Winds: Providing Protection to People and Buildings (2007), https://www.fema.gov/media-library/assets/documents/8811

1. Connecticut Hazard Mitigation Plan Update, 2014

Summary of Risks and Recommendations
Stonington Borough Hall and Public Works
26 Church Street
Stonington

Description of current snow load risk	• Heavy snow events in 2011, 2013, and 2015 have necessitated monitoring and/or removing snow from buildings. • Future snow events can damage the facility's structure or roof if heavy buildup occurs without melting.
Description of future snow load risk[1]	• Climate change studies have projected a shorter winter season for Connecticut with a decreased overall snowpack. In addition, climate models have indicated that fewer but more intense precipitation events will occur during the winter period with more precipitation falling as rain rather than snow. This change in winter precipitation could result in less frequent but more intense snow storms with heavier snow.
Description of municipal capabilities to address risks and operate backup facilities	• The Borough addresses heavy snow buildup, strong wind forecasts, and flood watches and warnings as needed. Borough administration functions can be temporarily carried out in other locations. • The Borough Hall does not have a fixed-in-place generator. Obtaining a generator is a new action listed in the hazard mitigation plan.
Description of snow load risk reduction design criteria	• Connecticut Building Code Appendix N, Ground Snow Load, 30 psf. • Climate change may decrease overall snow accumulations but could result in wet, dense, heavier snowfalls. It is not known whether current building codes are insufficient. The maximum ground snow load specified in the code is 40 psf for northwest Connecticut.
Recommendations for snow load risk reduction	• Procedures should be developed for removing snow from the roof.
Planning-level cost estimates	• Nominal
	• FEMA P-957, Snow Load Safety Guide (2013), https://www.fema.gov/media-library/assets/documents/83501 • FEMA Snow Load Safety Guidance Flyer (2014), https://www.fema.gov/media-library/assets/documents/29670

1. Connecticut Hazard Mitigation Plan Update, 2014; and State Water Plan, 2017

Memorandum

TO: **File**

FROM: **Emmeline Harrigan, AICP, CFM**

DATE: **April 19, 2017**

RE: **Critical Facililities Assessment - Stonington Borough Hall, 26 Church Street, Stonington Borough**

Local Contact: Warden Jeff Calahan & Assistant Barbara)
MMI Team: Emmeline Harrigan, Nirdosh Patel

Description of Flooding Risk

Subject to Coastal flooding when the entire Borough floods.

- 2-story structure with most square footage at the 2nd floor.
- Dense mixed-use neighborhood. Large stone wall to right. Very tight site.
- Nirdosh inspected attic area.

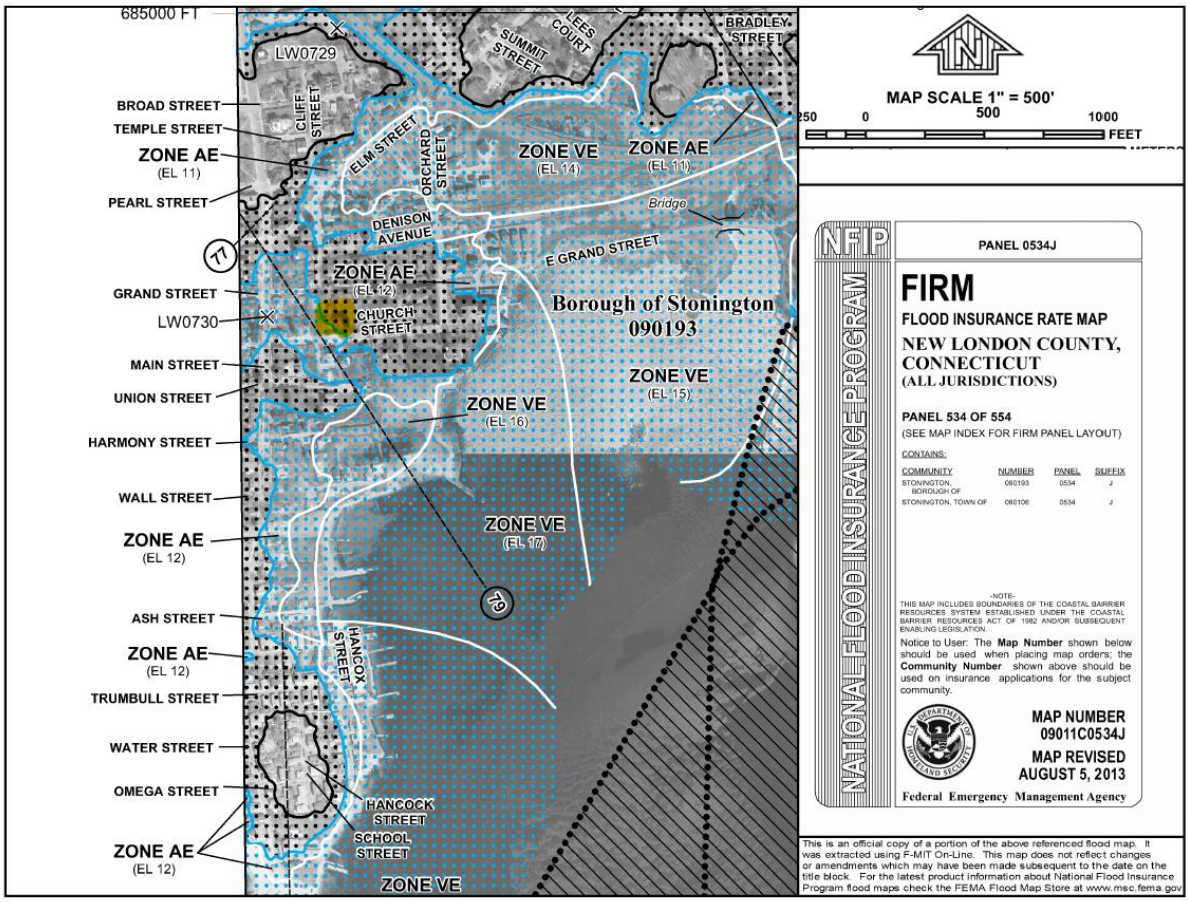
Evaluate Current Vulnerability

- Building Plans: None (Nirdosh took exterior measurements) Built 1940s.
- FEMA Flood Zone: AE-12 NAVD88
- Site Grading: Front is at elevation 11.75 and slopes down to 8.77 at the rear
- Lowest Floor Use: 1st Floor at elevation 11.70 contains truck bays, entry vestibule, a restroom, and elevator.

Lower level Elevator Pit and Utility Room at elevation 8.97

- Outbuildings: None

FEMA Flood Insurance Rate Map



Utility System Descriptions

System	Description	Location(s)	Notes
Utility Room	Lower level (4 steps down	Rear of bay area	Possible flood door? See photos.
HVAC	Radiator heater	In vestibule	No AC except seasonal window unit on 2nd level.
A/C Unit	Small unit for elevator equipment	In 1st flr elevator mechanical room	
Water heater:	Below grade	In Utility Room	
Furnace:	Below grade	In Utility Room	
Electrical: Panel (primary)	1 panel	In Utility Room	
Electrical into building	Overhead Wires	Pole near main entrance sidewalk	Meter at front door
Electrical: Panels/Sub	One gray box near 2 defunct blue boxes	At the front of bay area	

System	Description	Location(s)	Notes
Electrical Outlets/1st flr	3 ft on 1st floor	In bays	Antenna pole at rear of building
Communications Equipment	Upstairs	2nd floor office	
Plumbing: Waste	Town Sewer		
Plumbing: Potable	Public Water		
Fuel System: Primary	(1) Oil tank	In the rear yard	Not strapped down
Fuel System: Secondary	N/A		Prior kitchen removed
Generator:	N/A		Only small/portable
Elevator	Past vestibule/stairwell in hallway.	Small equipment room on 1st floor.	Has small elevator pit.

Identification of Future Vulnerabilities

- Sea Level Rise (long-term)
- Need to better protect external fuel sources
- Mitigate potential utility damage whether through flood barrier or elevation

Recommendations for Risk Reduction

Flood-proofing Method	Effective?
Wet Flood-proofing:	Possible for Garage Bays to prevent hydrostatic pressure.
Elevation of Utilities:	Not possible with building space constraints.
Dry Flood-proofing:	Yes. A) Construct interior floodwall system to protect lower level Utility Room. B) Install flood wall at doorway to elevation
Building Relocation:	No. Limited geography for the Borough and limited non-risk areas.
Building Elevation:	Not possible. Check whether building is a historic resource.
Sealing of Openings:	N/A
Other Modifications:	N/A

Summary of Risks and Recommendations
Old Mystic Fire Department
21 North Stonington Road
Stonington

Description of current flood risk *(all elevations are in feet, NAVD88)*	• The facility is partly mapped in a 0.2% annual chance flood risk zone adjacent to the Whitford Brook floodway (AE elevation 13') with lowest adjacent grade at 16.87 feet, lowest floor elevation of 16.85 feet, and utility room at the same elevation 16.85 feet. This places the lower level of the facility above the elevation of a flood that has a 1% chance of occurring in any year. • Given its position near the head of the Mystic River, the flood risk has a coastal influence and the facility is located in SLOSH zone 2. • The 0.2 annual chance flood elevation is assumed to be 16.25' (BFE x 1.25). The elevation of 18.5' cited in the FIS is believed unrealistic for the site. In either case, the facility is at risk of nominal to shallow flooding from the 0.2% annual chance flood. • The storm surges from Hurricane Sandy in 2012 and T.S. Irene in 2011 did not flood the facility. Likewise, the major flood along Whitford Brook in March 2010 did not flood the facility.
Description of future flood risk *(all elevations are in feet, NAVD88)*	• Climate change is believed to be accelerating sea level rise and increasing the frequency of coastal storm events, which will lead to increasing risk of flooding during storm events. • Likewise, climate change is believed to be increasing the intensity of precipitation events and may also lead to greater overall precipitation in the state, which could increase risks along Whitford Brook. • MHW is 0.84'; therefore, sea level rise will not cause daily high tide flooding of the facility in this century.
Description of municipal capabilities to address risks	• The Fire District and the Town of Stonington address heavy snow buildup, strong wind forecasts, and flood watches and warnings as needed.
Description of flood risk reduction design criteria *(all elevations are in feet, NAVD88)* *FFRMS = Federal Flood Risk Management Standard* *FVA= Freeboard Value Approach* *CISA = Climate Informed Science Approach*	• The 0.2% flood elevation of 16.25' represents the design criteria per State requirements for critical facilities. • FFRMS flood risk based on the FVA is 16' (BFE + 3' for critical facilities). • FFRMS flood risk based on the 0.2% is 16.25'. • FFRMS flood risk based on CISA is approximately 14' to 16'. • NYC Resiliency design criteria is BFE + 24" + SLR adjustment of 0.5'-3' = 15.5' to 18'.
Recommendations for building-specific flood risk reduction such as floodproofing, building elevation,	• Elevating the building is not feasible given the need for rapid vehicle dispatching. • Relocating the facility is not warranted for the flood risk

elevation of utilities, sealing of openings, etc.	profile. However, if the Fire District were to relocate the facility for any other reason, a site should be selected that is not adjacent to a floodway. • Short-Term: Short-term actions are not necessary. • Long-Term: The garage and office areas on the first floor should be wet floodproofed and the interior utility room should be dry floodproofed.
Planning-level cost estimates	• Short-Term: Not applicable. • Long-Term: $10/sf + $3,000 for flood vents
Recommendations for on or off-site flood risk reduction such as flood walls, berms, raising grade, etc.	• A berm or flood wall along the west side of the facility may be possible to protect the site from a severe flood of Whitford Brook, although this is not recommended at the present time. Flood risks should be evaluated periodically over the next several decades to determine whether this would be a helpful measure in addition to the long-term floodproofing suggestions listed above.
Planning-level cost estimates	• Not applicable
Resources	• FEMA 543, Design Guide for Improving Critical Facility Safety from Flooding and High Winds: Providing Protection to People and Buildings (2007), https://www.fema.gov/media-library/assets/documents/8811 • FEMA P-936, Floodproofing Non-Residential Buildings (July 2013), https://www.fema.gov/media-library/assets/documents/34270 • FEMA P-1037, Reducing Flood Risk to Residential Buildings That Cannot Be Elevated (September 2015), https://www.fema.gov/media-library/assets/documents/109669 • FEMA RA-2, Hurricane Sandy Recovery Advisory: Reducing Flood Effects in Critical Facilities (April 2013), https://www.fema.gov/media-library/assets/documents/30966 • FEMA P-942, Mitigation Assessment Team Report: Hurricane Sandy in New Jersey and New York – Building Performance Observations, Recommendations, and Technical Guidance (November 2013), https://www.fema.gov/media-library/assets/documents/85922 • FEMA P-348, Edition 2, Protecting Building Utility Systems from Flood Damage (February 2017) https://www.fema.gov/media-library/assets/documents/3729

Summary of Risks and Recommendations
Old Mystic Fire Department
21 North Stonington Road
Stonington

Description of current wind risk	• Strong winds are experienced during nor'easters, tropical storms, and other storm events. • The winds from Hurricane Sandy in 2012 and T.S. Irene in 2011 did not damage the facility. • Future wind events can damage the facility's structure or roof if the wind speed exceeds the older codes in place when the building was last upgraded. • Wind can also damage accessory structures.
Description of future wind risk[1]	• Climate change may amplify the frequency and intensity of wind events like hurricanes, but it is not known whether higher wind speeds will be more commonplace.
Description of municipal capabilities to address risks and operate backup facilities	• The Fire District and the Town of Stonington address heavy snow buildup, strong wind forecasts, and flood watches and warnings as needed.
Description of wind risk reduction design criteria	• Connecticut Building Code Appendix N, 150 mph ultimate/116 mph nominal. • Connecticut is located in FEMA Zone II relative to maximum expected wind speed. The maximum expected wind speed for a three-second gust is 160 miles per hour. This wind speed could occur as a result of either a hurricane or a tornado • Climate change may amplify the frequency and intensity of wind events like hurricanes, but it is not known whether higher wind speeds will be more commonplace to the degree that current building codes are insufficient. Coincidentally, the maximum wind speeds specified in the code are those for Stonington.
Recommendations for wind risk reduction such as load path projects, shutters, etc.	• Shutters are recommended to protect windows and the large garage doors. • When the roof is next replaced or upgraded, the 160 mph criteria (or future building code) should be considered.
Planning-level cost estimates	•
Resources	• FEMA 543, Design Guide for Improving Critical Facility Safety from Flooding and High Winds: Providing Protection to People and Buildings (2007), https://www.fema.gov/media-library/assets/documents/8811

1. Connecticut Hazard Mitigation Plan Update, 2014

Summary of Risks and Recommendations
Old Mystic Fire Department
21 North Stonington Road
Stonington

Description of current snow load risk	• Heavy snow events in 2011, 2013, and 2015 have necessitated monitoring and/or removing snow from buildings. • Future snow events can damage the facility's structure or roof if heavy buildup occurs without melting.
Description of future snow load risk[1]	• Climate change studies have projected a shorter winter season for Connecticut with a decreased overall snowpack. In addition, climate models have indicated that fewer but more intense precipitation events will occur during the winter period with more precipitation falling as rain rather than snow. This change in winter precipitation could result in less frequent but more intense snow storms with heavier snow.
Description of municipal capabilities to address risks and operate backup facilities	• The Fire District and the Town of Stonington address heavy snow buildup, strong wind forecasts, and flood watches and warnings as needed.
Description of snow load risk reduction design criteria	• Connecticut Building Code Appendix N, Ground Snow Load, 30 psf. • Climate change may decrease overall snow accumulations but could result in wet, dense, heavier snowfalls. It is not known whether current building codes are insufficient. The maximum ground snow load specified in the code is 40 psf for northwest Connecticut.
Recommendations for snow load risk reduction	• Procedures should be developed for removing snow from the roof.
Planning-level cost estimates	• Nominal
Resources	• FEMA P-957, Snow Load Safety Guide (2013), https://www.fema.gov/media-library/assets/documents/83501 • FEMA Snow Load Safety Guidance Flyer (2014), https://www.fema.gov/media-library/assets/documents/29670

1. Connecticut Hazard Mitigation Plan Update, 2014; and State Water Plan, 2017

Memorandum

TO: **File**

FROM: **Emmeline Harrigan, AICP, CFM**

DATE: **April 19, 2017**

RE: **Critical Facililities Assessment - Old Mystic Fire Department, 21 North Stonington Road**

Local Contact: None on site
MMI Team: Emmeline Harrigan, Nirdosh Patel

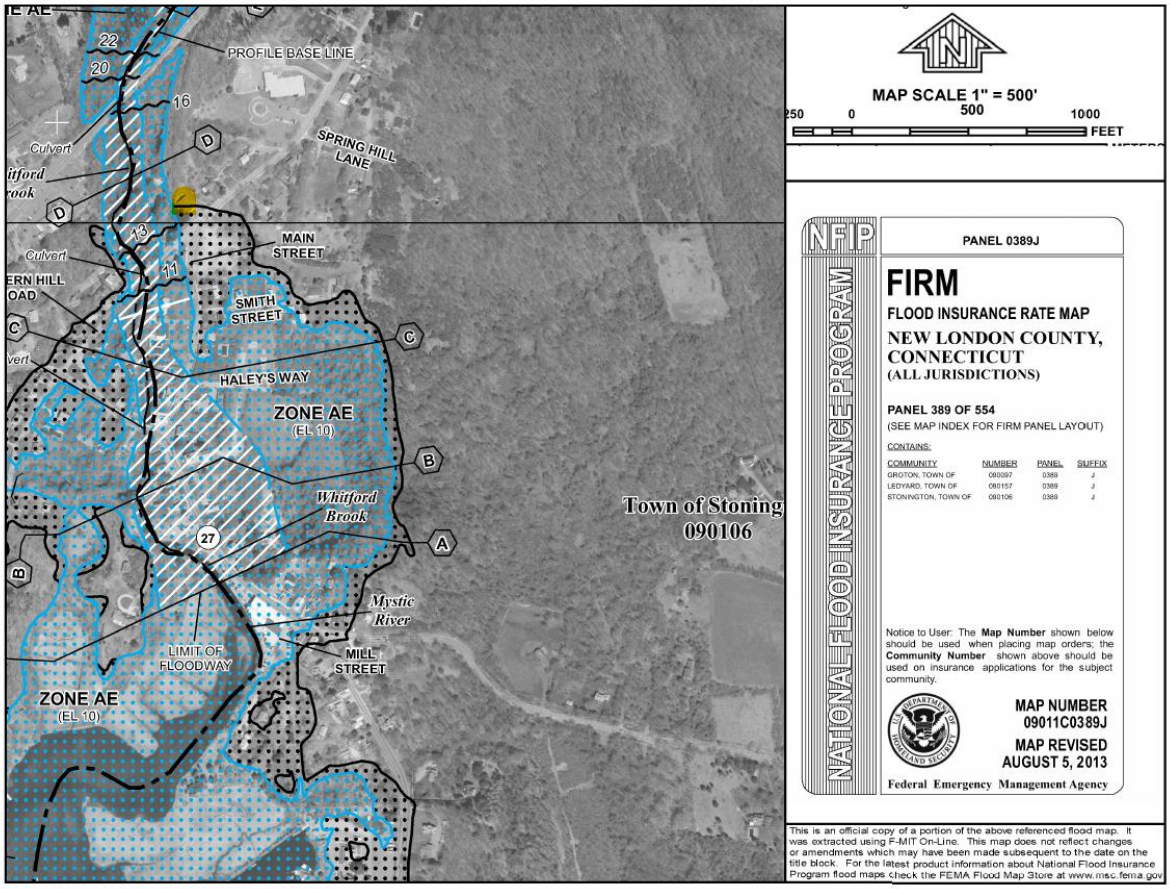
Description of Building Risk

- Adjacent to Whitford Brook floodway. Building appears to be out of mapped flood risk.
- 2 story structure with most square footage at the 2nd floor.
- Building constructed at grade. Large berm/driveway to right. Increased elevation to rear.
- 2nd floor has meetings rooms, TV room, kitchen, bunk area, additional electrical panel.

Evaluate Current Vulnerability

- Building Plan: None (Nirdosh took exterior measurements)
- FEMA Flood Zone: Building is not in. Adjacent riverine flood zone at AE-12 to 13
- Site Grading: Ranges from elevation 16.87 and increased to rear at 23.74 NAVD88.
- Lowest Floor Use: Truck bays, Utility Room, restrooms, and office use at elevation 16.85

FEMA Flood Insurance Rate Map



Utility Service Descriptions

System	Description	Location(s)	Notes
Utility Room	At grade	On 1st floor	Accessed from the inside truck bay area
HVAC: Condensers	At grade	Right rear of building	
Vehicle Exhaust system	On wall	Near Utility Room	
Water heater:	At grade	In Utility Room	
Furnace:	At grade	In Utility Room	
Electrical: Panel (primary)	1 panel	In Utility Room	
Electrical into building	Underground	Pole near driveway	Meter at right rear
Electrical: Panels/Sub	2nd floor	In room off meeting space	
Electrical Outlets/1st flr	1.5 feet above interior grade	Low in meeting space/higher in bays	Antenna pole at rear of building
Communications Equipment	3 ft. off interior grade	In utility room	Radio, internet, and phones
Plumbing: Waste	Town Sewer	Manholes on each side of building	
Plumbing: Potable	Public Water		

System	Description	Location(s)	Notes
Fuel System: Primary	(2) Oil tanks	In utility room	Enclosed by concrete wall
Fuel System: Secondary	(1) Propane tank at grade	Left side of bldg.	Not strapped down
Generator:	Large unit on metal platform	Behind the building	Inverter on wall in utility room
Elevator	N/A		

Identification of Future Vulnerabilities

- Greatest flood threat is adjacent Whitford Brook floodway in greater than 100-year flood height events.

Recommendations of Risk Reduction

Floodproofing Method	Effective?
Wet Floodproofing:	Yes. Can be installed in truck bay area.
Elevation of Utilities:	No additional area available for this space within structure
Dry Floodproofing:	Yes. A) Construct interior floodgate to protect Utility Room. B) Install deployable floodwall system at exterior door C) Construct interior floodgate at entrance to hallway off truck bays
Building Relocation:	No. Fairly new structure.
Building Elevation:	N/A
Sealing of Openings:	No. Only openings are (necessary) doors.
Other Modifications:	N/A

Summary of Risks and Recommendations
Quiambaug Fire Department
50 Old Stonington Road
Stonington

Description of current flood risk *(all elevations are in feet, NAVD88)*	• The facility is mapped in an AE flood risk zone (BFE of 11') with lowest adjacent grade at 3.32 feet and the lowest floor elevation of 6.97 feet (occupied space, utilities, etc). This places the entire facility at risk of a coastal flood that has a 1% chance of occurring in any year. • The 0.2 annual chance flood elevation is assumed to be 13.75' (BFE x 1.25). The elevation of 18.5' cited in the FIS is believed unrealistic for the site. In either case, the facility is at risk of severe flooding from the 0.2% annual chance flood, with significant depth of floodwaters possible in the facility. • The facility is located in SLOSH zone 1. • It is unknown whether the storm surges from Hurricane Sandy in 2012 and T.S. Irene in 2011 flooded the facility.
Description of future flood risk *(all elevations are in feet, NAVD88)*	• Climate change is believed to be accelerating sea level rise and increasing the frequency of coastal storm events, which will lead to increasing risk of flooding during storm events. • MHW is 0.84'; the lowest adjacent grade is likely flooded already at very high tides that coincide with storms or king tides. Therefore, sea level rise will likely cause daily high tide flooding of the facility within this century.
Description of municipal capabilities to address risks	• The Fire District and the Town of Stonington address heavy snow buildup, strong wind forecasts, and flood watches and warnings as needed.
Description of flood risk reduction design criteria *(all elevations are in feet, NAVD88)* *FFRMS = Federal Flood Risk Management Standard* *FVA= Freeboard Value Approach* *CISA = Climate Informed Science Approach*	• The 0.2% flood elevation of 13.75' represents the design criteria per State requirements for critical facilities. • FFRMS flood risk based on the FVA is 14' (BFE + 3' for critical facilities). • FFRMS flood risk based on the 0.2% is 13.75'. • FFRMS flood risk based on CISA is approximately 12' to 14'. • NYC Resiliency design criteria is BFE + 24" + SLR adjustment of 0.5'-3' = 13.5' to 16'.
Recommendations for building-specific flood risk reduction such as floodproofing, building elevation, elevation of utilities, sealing of openings, etc.	• Elevating the building is not feasible. It may be possible to add some office and living spaces on a second story which would protect them from flooding, but this analysis assumes that is beyond the capability of the current structure. • Relocating the facility is recommended. • Short-Term: some combination of wet and dry floodproofing should be pursued in the short term. Utilities should be elevated or placed in a room that can be dry floodproofed. The garage, office, and living spaces should be wet floodproofed with appropriate flood vents installed and resilient furnishings and materials used in the facility.

	• Long-Term: the facility should be relocated. It is not prudent to floodproof the facility to the depths of future flooding that could occur, since the 14'-to-16' elevation range is seven to nine feet above the first-floor elevation.
Planning-level cost estimates	• Short-Term: $10/sf + $3,000 for flood vents • Long-Term: >$10M (depends on land acquisition costs for new site)
Recommendations for on or off-site flood risk reduction such as flood walls, berms, raising grade, etc.	• The site is too low-lying for flood walls, berms, or raising grade.
Planning-level cost estimates	• Not applicable
Resources	• FEMA 543, Design Guide for Improving Critical Facility Safety from Flooding and High Winds: Providing Protection to People and Buildings (2007), https://www.fema.gov/media-library/assets/documents/8811 • FEMA P-936, Floodproofing Non-Residential Buildings (July 2013), https://www.fema.gov/media-library/assets/documents/34270 • FEMA P-1037, Reducing Flood Risk to Residential Buildings That Cannot Be Elevated (September 2015), https://www.fema.gov/media-library/assets/documents/109669 • FEMA RA-2, Hurricane Sandy Recovery Advisory: Reducing Flood Effects in Critical Facilities (April 2013), https://www.fema.gov/media-library/assets/documents/30966 • FEMA P-942, Mitigation Assessment Team Report: Hurricane Sandy in New Jersey and New York – Building Performance Observations, Recommendations, and Technical Guidance (November 2013), https://www.fema.gov/media-library/assets/documents/85922 • FEMA P-348, Edition 2, Protecting Building Utility Systems from Flood Damage (February 2017) https://www.fema.gov/media-library/assets/documents/3729

Summary of Risks and Recommendations
Quiambaug Fire Department
50 Old Stonington Road
Stonington

Description of current wind risk	• Strong winds are experienced during nor'easters, tropical storms, and other storm events. • The winds from Hurricane Sandy in 2012 and T.S. Irene in 2011 did not damage the facility. • Future wind events can damage the facility's structure or roof if the wind speed exceeds the older codes in place when the building was last upgraded. • Wind can also damage accessory structures.
Description of future wind risk[1]	• Climate change may amplify the frequency and intensity of wind events like hurricanes, but it is not known whether higher wind speeds will be more commonplace.
Description of municipal capabilities to address risks and operate backup facilities	• The Fire District and the Town of Stonington address heavy snow buildup, strong wind forecasts, and flood watches and warnings as needed.
Description of wind risk reduction design criteria	• Connecticut Building Code Appendix N, 150 mph ultimate/116 mph nominal. • Connecticut is located in FEMA Zone II relative to maximum expected wind speed. The maximum expected wind speed for a three-second gust is 160 miles per hour. This wind speed could occur as a result of either a hurricane or a tornado • Climate change may amplify the frequency and intensity of wind events like hurricanes, but it is not known whether higher wind speeds will be more commonplace to the degree that current building codes are insufficient. Coincidentally, the maximum wind speeds specified in the code are those for Stonington.
Recommendations for wind risk reduction such as load path projects, shutters, etc.	• Shutters are recommended to protect windows and the large garage doors. • If the facility is relocated per the flood recommendations, the 160 mph criteria (or future building code) should be considered.
Planning-level cost estimates	•
Resources	• FEMA 543, Design Guide for Improving Critical Facility Safety from Flooding and High Winds: Providing Protection to People and Buildings (2007), https://www.fema.gov/media-library/assets/documents/8811

1. Connecticut Hazard Mitigation Plan Update, 2014

Summary of Risks and Recommendations
Quiambaug Fire Department
50 Old Stonington Road
Stonington

Description of current snow load risk	• Heavy snow events in 2011, 2013, and 2015 have necessitated monitoring and/or removing snow from buildings. • Future snow events can damage the facility's structure or roof if heavy buildup occurs without melting.
Description of future snow load risk[1]	• Climate change studies have projected a shorter winter season for Connecticut with a decreased overall snowpack. In addition, climate models have indicated that fewer but more intense precipitation events will occur during the winter period with more precipitation falling as rain rather than snow. This change in winter precipitation could result in less frequent but more intense snow storms with heavier snow.
Description of municipal capabilities to address risks and operate backup facilities	• The Fire District and the Town of Stonington address heavy snow buildup, strong wind forecasts, and flood watches and warnings as needed.
Description of snow load risk reduction design criteria	• Connecticut Building Code Appendix N, Ground Snow Load, 30 psf. • Climate change may decrease overall snow accumulations but could result in wet, dense, heavier snowfalls. It is not known whether current building codes are insufficient. The maximum ground snow load specified in the code is 40 psf for northwest Connecticut.
Recommendations for snow load risk reduction	• Procedures should be developed for removing snow from the roof.
Planning-level cost estimates	• Nominal
Resources	• FEMA P-957, Snow Load Safety Guide (2013), https://www.fema.gov/media-library/assets/documents/83501 • FEMA Snow Load Safety Guidance Flyer (2014), https://www.fema.gov/media-library/assets/documents/29670

1. Connecticut Hazard Mitigation Plan Update, 2014; and State Water Plan, 2017

Memorandum

TO: **File**

FROM: **Emmeline Harrigan, AICP, CFM**

DATE: **April 19, 2017**

RE: **Critical Facililities Assessment - Quiambaug Fire Department, 50 Old Stonington Road, Stonington**

Local Contact: None Available

MMI Team: Emmeline Harrigan, Nirdosh Patel

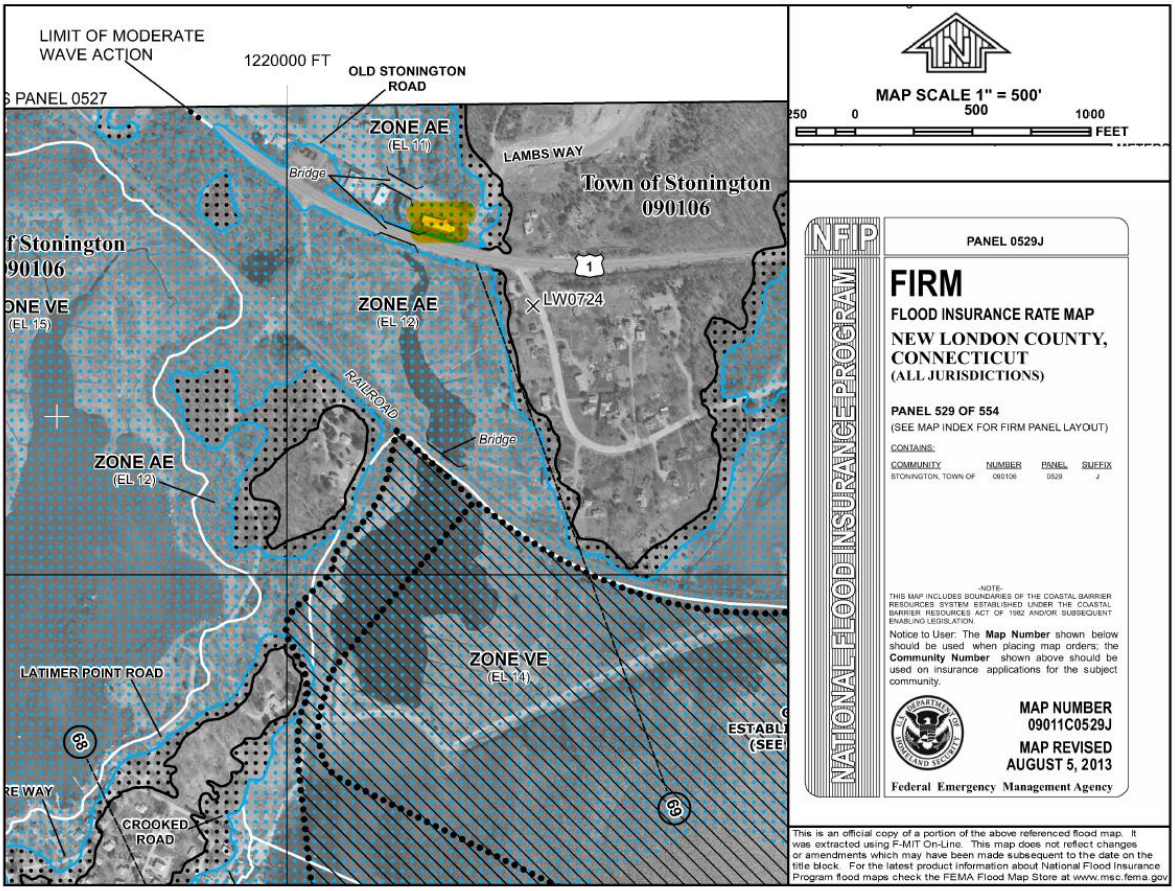
Description of Flooding Risk

This predominantly one story structure is at very low elevation relative to the existing 100-year flood risk and has not implemented any dry or wet flood-proofing measures.

Evaluate Current Vulnerability

- Building Plans: None, Nirdosh measured building exterior
- FEMA Flood Zone: AE-11 NAVD88
- Site Grading: Slopes to the rear with grade ranges from elevation 3.32 to 6.77 NAVD88 with a ditch behind the building with phragmites
- Lowest Flood Use: Slab building at elevation 6.97 with Kitchen, meeting room, restrooms, small desk area with radio exterior accessed Utility Room
- Outbuildings: Storage container only

FEMA Flood Insurance Rate Map



Utility System Descriptions

System	Description	Location(s)	Notes
Utility Room	At grade	Between Bays and Meeting Room	Accessed from the exterior
HVAC: Condensers	N/A		
A/C – Window or wall units	(1) Window unit	Upper level	
Water heater:	w/furnace	In Utility Room	
Furnace:	1 ft above interior grade	In Utility Room	
Electrical: Panel (primary)	About 3 ft above interior grade	In Hallway adjacent to kitchen	
Electrical into building	OH Wires to corner of bldg		
Electrical: Panels/Sub	N/A		
Electrical Outlets/1st flr	1.5 feet above interior grade		
Communications Equipment	About 3 ft above grade	In Hallway adjacent to kitchen	

System	Description	Location(s)	Notes
Plumbing: Waste	Town Sewer		
Plumbing: Potable	Public Water		
Fuel System: Primary	Oil	Tanks in two rubber tub containment units right side of bays	
Fuel System: Secondary	Propane for Kitchen	Off Kitchen area/rear of building	Not strapped down
Generator:	On pad with adjacent buried oil tank?	Left side/rear portion of building	
Elevator	N/A		

Identification of Future Vulnerabilities

- Sea Level Rise
- Extremely low elevations relative to existing and future floor risk.

Recommendations for Risk Reduction

Floodproofing Method	Effective?
Wet Floodproofing:	Yes. Flood vents can be added in the Truck Bay area with trucks relocated to higher ground.
Elevation of Utilities:	Yes – maybe move to 2nd floor space. Fuel tanks will need to stay at grade, but can be strapped down with shut off valves
Dry Floodproofing:	Yes. A) Construct interior floodwall to protect exterior entrance to Utility Room. B) Exterior floodwall may be an option for a portion of the building, however would need to be quite high since there is an existing 4+ft difference in site grade and 100-year flood height. Future risk reduction may be limited without more significant cost.
Building Relocation:	Area just east of site near Route 1 may be more appropriate with reduced flood risk.
Building Elevation:	Unlikely, but could relocate some uses to a 2nd floor in the short term.
Sealing of Openings:	N/A
Other Modifications:	Generator may need to be on a higher platform for future flood risk reduction.

Summary of Risks and Recommendations
Mystic Fire Department
34 Broadway
Stonington

Description of current flood risk *(all elevations are in feet, NAVD88)*	• The facility is mapped in an AE flood risk zone (BFE of 11') with lowest adjacent grade at 7.96', lowest floor elevation at 8.62', and the next-highest floor and utilities at elevation 9.73'. This places all of the lower levels of the facility (offices, kitchen, utilities) at risk of a coastal flood that has a 1% chance of occurring in any year. • The 0.2 annual chance flood elevation is assumed to be 13.75' (BFE x 1.25). The elevation of 18.5' cited in the FIS is believed unrealistic for the site. In either case, the facility is at risk of severe flooding from the 0.2% annual chance flood. • The facility is located in SLOSH zone 2. • The storm surges from Hurricane Sandy in 2012 and T.S. Irene in 2011 did not flood the facility, although the surge from Sandy was observed in close proximity.
Description of future flood risk *(all elevations are in feet, NAVD88)*	• Climate change is believed to be accelerating sea level rise and increasing the frequency of coastal storm events, which will lead to increasing risk of flooding during storm events. • MHW is 0.84'; therefore, sea level rise will likely not cause daily high tide flooding of the facility in this century.
Description of municipal capabilities to address risks	• The Fire District and the Town of Stonington address heavy snow buildup, strong wind forecasts, and flood watches and warnings as needed. • The Fire District also serves parts of the Town of Groton, and coordination with Groton is therefore necessary. • The facility was constructed relatively recently and appears to have been compliant with the FIRM that was effective at the time. Specifically, the site was regraded to increase its elevation at the time of construction, and the first floor elevation was possibly equal to a previous BFE in the older datum of NGVD29.
Description of flood risk reduction design criteria *(all elevations are in feet, NAVD88)* *FFRMS = Federal Flood Risk Management Standard* *FVA= Freeboard Value Approach* *CISA = Climate Informed Science Approach*	• The 0.2% flood elevation of 13.75' represents the design criteria per State requirements for critical facilities. • FFRMS flood risk based on the FVA is 14' (BFE + 3' for critical facilities). • FFRMS flood risk based on the 0.2% is 13.75'. • FFRMS flood risk based on CISA is approximately 12' to 14'. • NYC Resiliency design criteria is BFE + 24" + SLR adjustment of 0.5'-3' = 13.5' to 16'.
Recommendations for building-specific flood risk reduction such as floodproofing, building elevation, elevation of utilities, sealing of	• Despite the potential that the facility may have been constructed in accordance with a previous BFE, the facility is exposed to flood risk at the present time and increasing risk over time.

openings, etc.	• Short-Term: Outdoor utilities should be elevated. The interior utility room should be dry floodproofed because a 1% annual chance flood could cause a flood depth of one foot or more. Even a storm similar to Hurricane Sandy (maximum water surface elevation 9-10 feet in western Connecticut) could flood the utility room if aligned with the tide cycle. A design elevation of 15' for the dry floodproofing should be considered. • Long-Term: the occupied lower levels of the building should be wet floodproofed. This will address the current 1% annual chance storm and the FFRMS floods (which could cause 3-4 feet of flooding in the offices, kitchen, garage, and other first-floor uses).
Planning-level cost estimates	• Short-Term: $10/sf (area of utility room) + $5,000 for outdoor utilities • Long-Term: $10/sf (footprint of building) + $3,000 for flood vents
Recommendations for on or off-site flood risk reduction such as flood walls, berms, raising grade, etc.	• The site generally does not have sufficient space for flood walls, additional berms, or raising grade. Easy access from the road to the garage bays is needed.
Planning-level cost estimates	• Not applicable
Resources	• FEMA 543, Design Guide for Improving Critical Facility Safety from Flooding and High Winds: Providing Protection to People and Buildings (2007), https://www.fema.gov/media-library/assets/documents/8811 • FEMA P-936, Floodproofing Non-Residential Buildings (July 2013), https://www.fema.gov/media-library/assets/documents/34270 • FEMA P-1037, Reducing Flood Risk to Residential Buildings That Cannot Be Elevated (September 2015), https://www.fema.gov/media-library/assets/documents/109669 • FEMA RA-2, Hurricane Sandy Recovery Advisory: Reducing Flood Effects in Critical Facilities (April 2013), https://www.fema.gov/media-library/assets/documents/30966 • FEMA P-942, Mitigation Assessment Team Report: Hurricane Sandy in New Jersey and New York – Building Performance Observations, Recommendations, and Technical Guidance (November 2013), https://www.fema.gov/media-library/assets/documents/85922 • FEMA P-348, Edition 2, Protecting Building Utility Systems from Flood Damage (February 2017) https://www.fema.gov/media-library/assets/documents/3729

Summary of Risks and Recommendations
Mystic Fire Department
34 Broadway
Stonington

Description of current wind risk	• Strong winds are experienced during nor'easters, tropical storms, and other storm events. • The winds from Hurricane Sandy in 2012 and T.S. Irene in 2011 did not damage the facility. • Future wind events can damage the facility's structure or roof if the wind speed exceeds the older codes in place when the building was last upgraded. • Wind can also damage accessory structures.
Description of future wind risk[1]	• Climate change may amplify the frequency and intensity of wind events like hurricanes, but it is not known whether higher wind speeds will be more commonplace.
Description of municipal capabilities to address risks and operate backup facilities	• The Fire District and the Town of Stonington address heavy snow buildup, strong wind forecasts, and flood watches and warnings as needed. • The Fire District also serves parts of the Town of Groton, and coordination with Groton is therefore necessary.
Description of wind risk reduction design criteria	• Connecticut Building Code Appendix N, 150 mph ultimate/116 mph nominal. • Connecticut is located in FEMA Zone II relative to maximum expected wind speed. The maximum expected wind speed for a three-second gust is 160 miles per hour. This wind speed could occur as a result of either a hurricane or a tornado • Climate change may amplify the frequency and intensity of wind events like hurricanes, but it is not known whether higher wind speeds will be more commonplace to the degree that current building codes are insufficient. Coincidentally, the maximum wind speeds specified in the code are those for Stonington.
Recommendations for wind risk reduction such as load path projects, shutters, etc.	• Shutters are recommended to protect the windows and the large garage doors. • When the roof is next replaced or upgraded, the 160 mph criteria (or future building code) should be considered.
Planning-level cost estimates	•
Resources	• FEMA 543, Design Guide for Improving Critical Facility Safety from Flooding and High Winds: Providing Protection to People and Buildings (2007), https://www.fema.gov/media-library/assets/documents/8811

1. Connecticut Hazard Mitigation Plan Update, 2014

Summary of Risks and Recommendations
Mystic Fire Department
34 Broadway
Stonington

Description of current snow load risk	• Heavy snow events in 2011, 2013, and 2015 have necessitated monitoring and/or removing snow from buildings. • Future snow events can damage the facility's structure or roof if heavy buildup occurs without melting.
Description of future snow load risk[1]	• Climate change studies have projected a shorter winter season for Connecticut with a decreased overall snowpack. In addition, climate models have indicated that fewer but more intense precipitation events will occur during the winter period with more precipitation falling as rain rather than snow. This change in winter precipitation could result in less frequent but more intense snow storms with heavier snow.
Description of municipal capabilities to address risks and operate backup facilities	• The Fire District and the Town of Stonington address heavy snow buildup, strong wind forecasts, and flood watches and warnings as needed. • The Fire District also serves parts of the Town of Groton, and coordination with Groton is therefore necessary.
Description of snow load risk reduction design criteria	• Connecticut Building Code Appendix N, Ground Snow Load, 30 psf. • Climate change may decrease overall snow accumulations but could result in wet, dense, heavier snowfalls. It is not known whether current building codes are insufficient. The maximum ground snow load specified in the code is 40 psf for northwest Connecticut.
Recommendations for snow load risk reduction	• Procedures should be developed for removing snow from the roof.
Planning-level cost estimates	• Nominal
Resources	• FEMA P-957, Snow Load Safety Guide (2013), https://www.fema.gov/media-library/assets/documents/83501 • FEMA Snow Load Safety Guidance Flyer (2014), https://www.fema.gov/media-library/assets/documents/29670

1. Connecticut Hazard Mitigation Plan Update, 2014; and State Water Plan, 2017

Memorandum

TO: **File**

FROM: **Emmeline Harrigan, AICP, CFM**

DATE: **April 19, 2017**

RE: **Critical Facililities Assessment - Mystic Fire Department, 34 Broadway, Stonington**

Local Contact: Frank Hilbert, Fire Chief/Marshall
MMI Team: Emmeline Harrigan, Kishor Patel, Nirdosh Patel

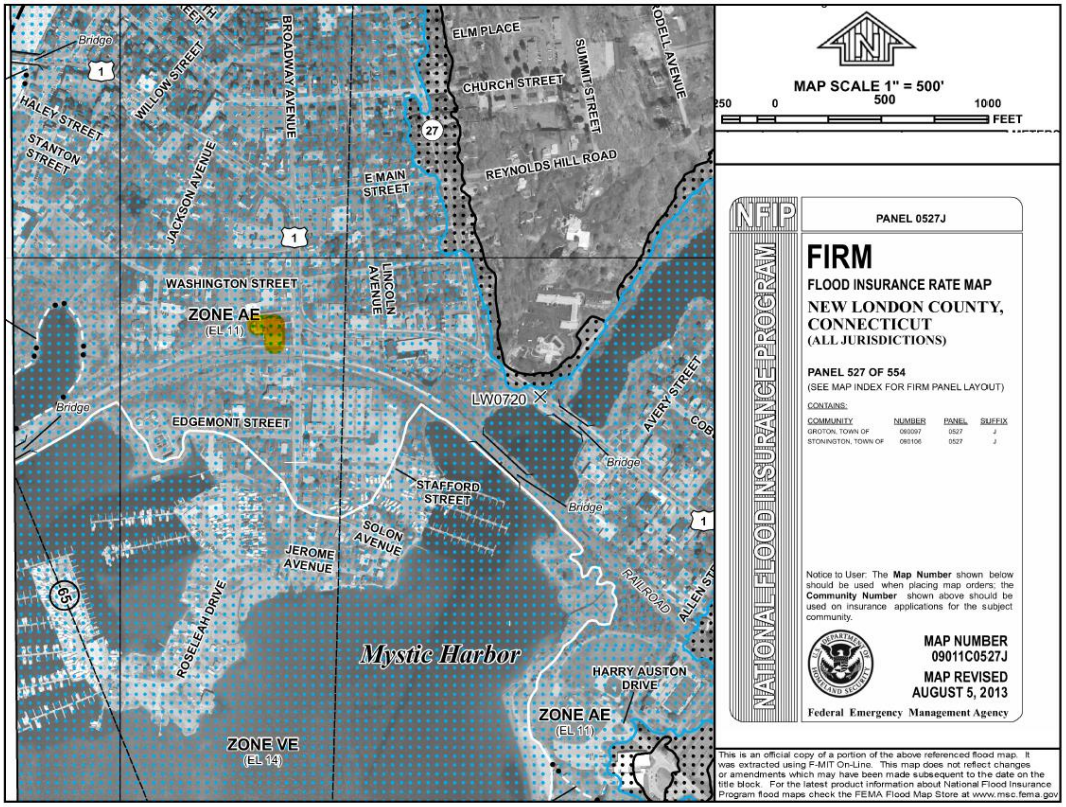
Description of Flood

- Plan indicate construction to FFE-11, but with prior Flood Map/projection (pre-2010 & 2013) so FFE is now at elevation 9.49/Utility area at 9.73 NGVD and the building is no longer compliant.
- Raised rail line berm to the west of the site.

Evaluate Current Vulnerability

- Building Plans: Yes, photos on file, engineering letter on file for roof for solar panels.
- FEMA Flood Zone: AE-11 NAVD88
- Site Grading: Ranges from 7.96 to 10.41 NAVD88, slopes down towards rear. Site was regraded to increase height at the time of construction.
- Lowest Floor Use: 1st floor at elevation 8.62 NAVD88 contains 1st floor district office, kitchen, meeting room, restrooms, dispatch/radio room.
- Outbuildings: Shed and Fire training storage container in rear area.

FEMA Flood Insurance Rate Map



Utility System Descriptions

System	Description	Location(s)	Notes
Utility Room	At grade	Between Bays and Office Area	Accessed from the exterior
HVAC: Condensers	(3) on side (1) at rear	Side at east side of Building Rear near patio area	East side condensers at raised enclosed platform grade.
A/C – Window or wall units	(2) below window height	East side of Building	Seem to be for kitchen area
Water heater:	w/furnace	In Utility Room	
Furnace:	1 ft above interior grade	In Utility Room	
Electrical: Panel (primary)	About 3 ft above interior grade	In Utility Room	
Electrical into building	Transformer in front of bldg.?		
Electrical: Panels/Sub	N/A		
Electrical Outlets/1st flr	1.5 feet above interior grade		
Communications Equipment	Two areas	Utility room & 1st floor communications room	
Plumbing: Waste	Town Sewer		

System	Description	Location(s)	Notes
Plumbing: Potable	Public Water		
Fuel System: Primary	Natural Gas		
Fuel System: Secondary	Propane for Kitchen	Off Kitchen area/east side of building	Not strapped down
Generator:	On pad with adjacent oil tank	In latticed enclosure on west side of building	
Elevator	N/A		

Identification of Future Vulnerabilities

- Sea Level Rise risk
- Subject to 100-year flood height risk and larger storms

Recommendations for Risk Reduction

Flood-proofing Method	Effective?
Wet Flood-proofing:	Yes. Possible in truck bay area.
Elevation of Utilities:	Yes. A) Generator should be on taller pad. May be able to increase pad height and flood wall/gate to a higher level. B) A/C condensers at east elevation may need to be placed on a platform in future years. C) Propane fuel tank cannot be elevated but should be strapped down. D) Transformer in front of building? Will need to be elevated or flood-proofed.
Dry Flood-proofing:	Yes. A) Construct interior floodwall to protect Utility Room. B) Exterior floodwall may be possible to protect other 1st floor spaces such as offices, restrooms, kitchen, dispatch area, and meeting space. C) Flood gates at several exterior doors at each elevation.
Building Relocation:	No
Building Elevation:	Not feasible.
Sealing of Openings:	Vent at utility room would need temporary closure
Other Modifications:	N/A

Summary of Risks and Recommendations
Groton Long Point Police & Fire Headquarters
5 Atlantic Avenue
Groton

Description of current flood risk *(all elevations are in feet, NAVD88)*	• The facility is mapped in an AE flood risk zone (BFE of 11') with lowest adjacent grade at 2.96', the lowest floor elevation of 4.26', and the next floor at elevation 5.75'. The utility room is at elevation 6.21'. This places the entire facility at risk of a coastal flood that has a 1% chance of occurring in any year. • The 0.2 annual chance flood elevation is assumed to be 13.75' (BFE x 1.25). The elevation of 18.2' cited in the FIS is believed unrealistic for the site. In either case, the facility is at risk of severe flooding from the 0.2% annual chance flood, with significant depth of floodwaters possible in the facility. • The facility is located in SLOSH zone 1. • The building and the adjacent parking areas reportedly undergo flooding four to five times per year. • The Hurricane Sandy High Water Mark (HWM) was marked inside the building, and was measured at 1.75 feet above the lowest floor (at approximate elevation 6').
Description of future flood risk *(all elevations are in feet, NAVD88)*	• Climate change is believed to be accelerating sea level rise and increasing the frequency of coastal storm events, which will lead to increasing risk of flooding during storm events. • MHW is 0.95'; the lowest adjacent grade is likely flooded already at very high tides that coincide with storms or king tides. Therefore, sea level rise will likely cause daily high tide flooding of the facility within this century.
Description of municipal capabilities to address risks	• Groton Long Point and the Town of Groton address heavy snow buildup, strong wind forecasts, and flood watches and warnings as needed. • The facility has been partially adapted to mitigate damage from the most frequent flood events, with the utility room two feet higher than the lowest floor and about ½ foot above the next-lowest floor. The furnace bottom is about 3.7 feet above the lowest floor and the generator located outside the building is at approximate elevation 7', about four feet above the lowest grade. These actions have helped avoid damage from the most frequent floods.
Description of flood risk reduction design criteria *(all elevations are in feet, NAVD88)* *FFRMS = Federal Flood Risk Management Standard* *FVA= Freeboard Value Approach* *CISA = Climate Informed Science Approach*	• The 0.2% flood elevation of 13.75' represents the design criteria per State requirements for critical facilities. • FFRMS flood risk based on the FVA is 14' (BFE + 3' for critical facilities). • FFRMS flood risk based on the 0.2% is 13.75'. • FFRMS flood risk based on CISA is approximately 12' to 14'. • NYC Resiliency design criteria is BFE + 24" + SLR adjustment

	of 0.5'-3' = 13.5' to 16'.
Recommendations for building-specific flood risk reduction such as floodproofing, building elevation, elevation of utilities, sealing of openings, etc.	• Elevating the entire building is not feasible, as garage access is necessary from at least one side of the facility (the higher side) but is desired from both sides. It may be possible to relocate more of the facility uses and utilities to the highest parts of the site and the building. • Relocating the facility is recommended. • Short-Term: some combination of additional wet and dry floodproofing should be pursued in the short term. Utilities should be elevated an additional increment, or placed in a room that can be dry floodproofed. The garage, offices, and living spaces should be wet floodproofed with appropriate flood vents installed and resilient furnishings and materials used in the facility. • Long-Term: the facility should be relocated to a higher part of Groton Long Point. It is not prudent to floodproof the facility to the depths of future flooding that could occur, since the 14'-to-16' elevation range is nine to 12 feet above the lowest floor elevations.
Planning-level cost estimates	• Short-Term: $10/sf (footprint of building) + $3,000 for flood vents • Long-Term: >$10M (depends on land acquisition costs for new site)
Recommendations for on or off-site flood risk reduction such as flood walls, berms, raising grade, etc.	• The site is too low-lying for flood walls, berms, or raising grade.
Planning-level cost estimates	• Not applicable
Resources	• FEMA 543, Design Guide for Improving Critical Facility Safety from Flooding and High Winds: Providing Protection to People and Buildings (2007), https://www.fema.gov/media-library/assets/documents/8811 • FEMA P-936, Floodproofing Non-Residential Buildings (July 2013), https://www.fema.gov/media-library/assets/documents/34270 • FEMA P-1037, Reducing Flood Risk to Residential Buildings That Cannot Be Elevated (September 2015), https://www.fema.gov/media-library/assets/documents/109669 • FEMA RA-2, Hurricane Sandy Recovery Advisory: Reducing Flood Effects in Critical Facilities (April 2013), https://www.fema.gov/media-library/assets/documents/30966 • FEMA P-942, Mitigation Assessment Team Report: Hurricane Sandy in New Jersey and New York – Building Performance Observations, Recommendations, and Technical Guidance (November 2013), https://www.fema.gov/media-library/assets/documents/85922

	• FEMA P-348, Edition 2, Protecting Building Utility Systems from Flood Damage (February 2017) https://www.fema.gov/media-library/assets/documents/3729

Summary of Risks and Recommendations
Groton Long Point Police & Fire Headquarters
5 Atlantic Avenue
Groton

Description of current wind risk	• Strong winds are experienced during nor'easters, tropical storms, and other storm events. • The winds from Hurricane Sandy in 2012 and T.S. Irene in 2011 did not damage the facility. • Future wind events can damage the facility's structure or roof if the wind speed exceeds the older codes in place when the building was last upgraded. • Wind can also damage accessory structures.
Description of future wind risk[1]	• Climate change may amplify the frequency and intensity of wind events like hurricanes, but it is not known whether higher wind speeds will be more commonplace.
Description of municipal capabilities to address risks and operate backup facilities	• Groton Long Point and the Town of Groton address heavy snow buildup, strong wind forecasts, and flood watches and warnings as needed.
Description of wind risk reduction design criteria	• Connecticut Building Code Appendix N, 145 mph ultimate/112 mph nominal. • Connecticut is located in FEMA Zone II relative to maximum expected wind speed. The maximum expected wind speed for a three-second gust is 160 miles per hour. This wind speed could occur as a result of either a hurricane or a tornado • Climate change may amplify the frequency and intensity of wind events like hurricanes, but it is not known whether higher wind speeds will be more commonplace to the degree that current building codes are insufficient.
Recommendations for wind risk reduction such as load path projects, shutters, etc.	• Shutters are recommended to protect windows and the large garage doors. • If the facility is relocated per the flood recommendations, the 160 mph criteria (or future building code) should be considered.
Planning-level cost estimates	•
Resources	• FEMA 543, Design Guide for Improving Critical Facility Safety from Flooding and High Winds: Providing Protection to People and Buildings (2007), https://www.fema.gov/media-library/assets/documents/8811

1. Connecticut Hazard Mitigation Plan Update, 2014

Summary of Risks and Recommendations
Groton Long Point Police & Fire Headquarters
5 Atlantic Avenue
Groton

Description of current snow load risk	• Heavy snow events in 2011, 2013, and 2015 have necessitated monitoring and/or removing snow from buildings. • Future snow events can damage the facility's structure or roof if heavy buildup occurs without melting.
Description of future snow load risk[1]	• Climate change studies have projected a shorter winter season for Connecticut with a decreased overall snowpack. In addition, climate models have indicated that fewer but more intense precipitation events will occur during the winter period with more precipitation falling as rain rather than snow. This change in winter precipitation could result in less frequent but more intense snow storms with heavier snow.
Description of municipal capabilities to address risks and operate backup facilities	• Groton Long Point and the Town of Groton address heavy snow buildup, strong wind forecasts, and flood watches and warnings as needed.
Description of snow load risk reduction design criteria	• Connecticut Building Code Appendix N, Ground Snow Load, 30 psf. • Climate change may decrease overall snow accumulations but could result in wet, dense, heavier snowfalls. It is not known whether current building codes are insufficient. The maximum ground snow load specified in the code is 40 psf for northwest Connecticut.
Recommendations for snow load risk reduction	• Procedures should be developed for removing snow from the roof.
Planning-level cost estimates	• Nominal
Resources	• FEMA P-957, Snow Load Safety Guide (2013), https://www.fema.gov/media-library/assets/documents/83501 • FEMA Snow Load Safety Guidance Flyer (2014), https://www.fema.gov/media-library/assets/documents/29670

1. Connecticut Hazard Mitigation Plan Update, 2014; and State Water Plan, 2017

Memorandum

TO: **File**

FROM: **James C. Murac, P.E., CFM**

DATE: **April 25, 2017**

RE: **Critical Facililities Assessment**
Location: Groton Long Point Police & Fire Departments

Local Contact: Officer David Stackpole, Groton Long Point Police Department
MMI Team: Nirdosh Patel
James Murac

Description of Flooding Risk

The Groton Long Point Police and Fire Department is a small two-story structure located near Venetian Harbor, in Groton, CT. The building is located at 5 Atlantic Avenue in Groton, CT, and is vulnerable to two types of flooding.

The building and the adjacent parking areas undergo nuisance site flooding occurring four to five times per year, per anecdotal reports. Stormwater runoff from roof gutters and impervious parking area flow to catch basins in low point in parking lot. Storm sewer system in parking area drains to harbor to the southeast of the building. During periods of excessively high tides, drainage does not drain or instead surcharges. These floods do not overtop the bulkhead wall, only access area through surcharged drainage.

The entire structure and adjacent parking area is also mapped within a FEMA coastal AE zone 100-year floodplain at elevation 11.0 feet NAVD. Tropical Storm Sandy (2012) High Water Mark (HWM) was recorded inside the building, and measured as 1.75 feet above the Basement Floor (BF).

Evaluate Current Vulnerability

- Building plans: None
- FEMA Flood Zone: Coastal AE Zone @ 11.0 feet NAVD
- Site Grading: Primarily flat, impervious parking on three sides, walkout on all sides
- Lowest Floor Use: Vehicle and equipment storage, utilities
- Outbuildings: None

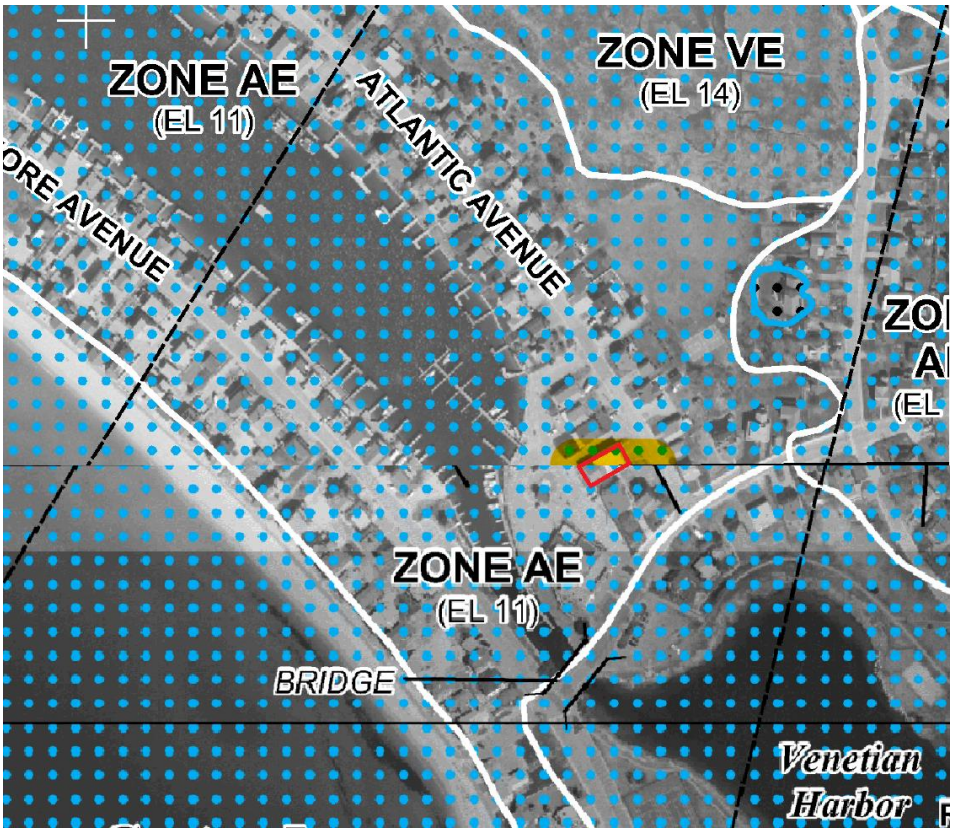
A diesel backup generator is located outside of the building, outside the eastern side of the building. It is elevated approximately 4 feet above the Lowest Adjacent Grade (L.A.G.). All of the utilities and the entire building are located within the FEMA AE zone.

The lowest level of the structure has three primary areas. The lowest basement floor, adjacent to the southern face of the building is close to the adjacent exterior grade because of an overhead bay door. A

raised Utility Platform 2.1 feet above the lower basement floor is located in the center of the building, and the Fire Department garage bays at the northern face of the building.

The basement is partially finished space with sheetrock walls and concrete flooring. The utility room is fully finished space.

FEMA Flood Insurance Rate Map



Utility System Descriptions

System	Description	Location(s)	Vulnerable
Utility Room	Utility Platform in basement elevated 2.1-ft above the basement floor (BF) with Utility Room located in back (also at 2.1-ft above BF)	Lowest level of structure (basement/walkout/first floor)	
A/C – Window or wall units	Window Unit	Second floor	No
Water heater	Indirect Water Heater	Utility room, 2.1-ft above BF)	Yes
Furnace	Boiler, Fuel Oil	Utility room, 3.7-ft above BF	Yes
Electrical: Panel (primary)		Garage bay	Unk
Electrical into building	Underground	Exterior, eastern face, elevated 4-ft above L.A.G.	
Communications Equipment	Phone/Ethernet/Alarm	Utility Area, 4.9-ft above BF	Unk
Plumbing: Waste	Public Sewer	Underground	
Plumbing: Potable	Public Water	Underground	
Fuel System: Primary	Fuel Oil	Tank on Utility Platform	
Generator	Diesel	Exterior, eastern face, elevated 4-ft above L.A.G.	Unk.
Elevator	Exterior elevator, damaged during T.S. Sandy and removed from site	Exterior, walkout, southern face, near parking area	Yes. Damaged and removed.

Identification of Future Vulnerabilities

- Sea Level Rise
- Storm drainage deficiencies (increased rainfall intensities)

Recommendations for Risk Reduction

Sea Level Rise

Floodproofing Method	Effective?
Wet Floodproofing:	Yes. Raise vulnerable utilities above BFE
Elevation of Utilities:	Yes.
Dry Floodproofing:	Yes. A) Construct interior floodwall to protect Utility Platform. B) Exterior floodwall not likely viable due to garage bay door access on two sides.
Building Relocation:	Relocate facility outside of coastal floodplain.
Building Elevation:	Possible but unlikely to be cost effective (Garage bays for firetrucks)
Sealing of Openings:	No. Only openings are (necessary) doors.

Storm Drainage Deficiencies

- Installation of backflow prevention on storm drainage outfalls could help prevent surcharging drainage system from causing nuisance flooding of the building and parking area.
- Installation of stormwater pump to clear parking area

Summary of Risks and Recommendations
Groton Town Hall
45 Fort Hill Road
Groton

Description of current flood risk *(all elevations are in feet, NAVD88)*	• The Town Hall building is mapped in an X zone adjacent to a 0.2% annual chance floodplain associated with the Poquonnock River estuary, indicating an assumption of minimal or negligible flood risk. • The 1% annual chance base flood elevation at the Poquonnock River is 10'. • The 0.2 annual chance flood elevation is assumed to be 12.5' (BFE x 1.25). The elevation of 18.2' cited in the FIS is believed unrealistic for the site. • The lowest adjacent grade at Town Hall is 18.96'. The lowest floor elevation (a basement) is at 12.07' and windows are set at grade, but the window wells are higher than the 0.2% annual chance flood elevation. Therefore, the Poquonnock River estuary does not contribute flood risk to the Town Hall. • The facility is located in SLOSH zone 4. • The Town Hall building has not been flooded. The storm surges from Hurricane Sandy in 2012 and T.S. Irene in 2011 did not flood the facility.
Description of future flood risk *(all elevations are in feet, NAVD88)*	• Climate change is believed to be accelerating sea level rise and increasing the frequency of coastal storm events. This will create slightly increased flood risks, from the current minimal/negligible risk to a low risk of coastal flooding from storm surges traveling up the estuary. • MHW is 0.95'; therefore, sea level rise will not cause daily high tide flooding of the facility in this century.
Description of municipal capabilities to address risks	• The Town addresses heavy snow buildup, strong wind forecasts, and flood watches and warnings as needed.
Description of flood risk reduction design criteria *(all elevations are in feet, NAVD88)* *FFRMS = Federal Flood Risk Management Standard* *FVA= Freeboard Value Approach* *CISA = Climate Informed Science Approach*	• The 0.2% flood elevation of 12.5' represents the design criteria per State requirements for critical facilities. • FFRMS flood risk based on the FVA is 13' (BFE + 3' for critical facilities). • FFRMS flood risk based on the 0.2% is 12.5'. • FFRMS flood risk based on CISA is approximately 11' to 13'. • NYC Resiliency design criteria is BFE + 24" + SLR adjustment of 0.5'-3' = 12.5' to 15'.
Recommendations for building-specific flood risk reduction such as floodproofing, building elevation, elevation of utilities, sealing of openings, etc.	• Elevating the building is not feasible, and floodproofing would be extremely challenging given the presence of the basement and at-grade windows. • Relocating the facility's uses may be possible. • Short-Term: Short-term actions for the facility are not necessary.

	• Long-Term: The low risk coupled with the site layout indicates that use of aesthetically pleasing low berms or flood walls built into walkways could protect this facility from future floods. The Town should monitor sea level rise projections over the next few decades and revisit this concept in the future.
Planning-level cost estimates	• Short-Term: Not applicable • Long-Term: $500/linear foot (cost will vary depending on whether wall or berm is selected)
Recommendations for on or off-site flood risk reduction such as flood walls, berms, raising grade, etc.	• See above; low berms or flood walls built into walkways could protect this facility from future floods.
Planning-level cost estimates	•
Resources	• FEMA 543, Design Guide for Improving Critical Facility Safety from Flooding and High Winds: Providing Protection to People and Buildings (2007), https://www.fema.gov/media-library/assets/documents/8811 • FEMA P-936, Floodproofing Non-Residential Buildings (July 2013), https://www.fema.gov/media-library/assets/documents/34270 • FEMA P-1037, Reducing Flood Risk to Residential Buildings That Cannot Be Elevated (September 2015), https://www.fema.gov/media-library/assets/documents/109669 • FEMA RA-2, Hurricane Sandy Recovery Advisory: Reducing Flood Effects in Critical Facilities (April 2013), https://www.fema.gov/media-library/assets/documents/30966 • FEMA P-942, Mitigation Assessment Team Report: Hurricane Sandy in New Jersey and New York – Building Performance Observations, Recommendations, and Technical Guidance (November 2013), https://www.fema.gov/media-library/assets/documents/85922 • FEMA P-348, Edition 2, Protecting Building Utility Systems from Flood Damage (February 2017) https://www.fema.gov/media-library/assets/documents/3729

Summary of Risks and Recommendations
Groton Town Hall
45 Fort Hill Road
Groton

Description of current wind risk	• Strong winds are experienced during nor'easters, tropical storms, and other storm events. • Future wind events can damage the facility's structure or roof if the wind speed exceeds the older codes in place when the building was last upgraded. • Wind can also damage accessory structures and create windborne debris.
Description of future wind risk[1]	• Climate change may amplify the frequency and intensity of wind events like hurricanes, but it is not known whether higher wind speeds will be more commonplace.
Description of municipal capabilities to address risks and operate backup facilities	• The Town addresses heavy snow buildup, strong wind forecasts, and flood watches and warnings as needed.
Description of wind risk reduction design criteria	• Connecticut Building Code Appendix N, 145 mph ultimate/112 mph nominal. • Connecticut is located in FEMA Zone II relative to maximum expected wind speed. The maximum expected wind speed for a three-second gust is 160 miles per hour. This wind speed could occur as a result of either a hurricane or a tornado • Climate change may amplify the frequency and intensity of wind events like hurricanes, but it is not known whether higher wind speeds will be more commonplace to the degree that current building codes are insufficient.
Recommendations for wind risk reduction such as load path projects, shutters, etc.	• Depending on the future use of the building, shutters are recommended for the most at-risk windows. • If the future use of the building classifies it as a critical facility, the 160 mph criteria (or future building code) should be considered when the roof is next replaced or upgraded.
Planning-level cost estimates	• Nominal
Resources	• FEMA 543, Design Guide for Improving Critical Facility Safety from Flooding and High Winds: Providing Protection to People and Buildings (2007), https://www.fema.gov/media-library/assets/documents/8811

1. Connecticut Hazard Mitigation Plan Update, 2014

Summary of Risks and Recommendations
Groton Town Hall
45 Fort Hill Road
Groton

Description of current snow load risk	• Heavy snow events in 2011, 2013, and 2015 have necessitated monitoring and/or removing snow from buildings. • Future snow events can damage the facility's structure or roof if heavy buildup occurs without melting.
Description of future snow load risk[1]	• Climate change studies have projected a shorter winter season for Connecticut with a decreased overall snowpack. In addition, climate models have indicated that fewer but more intense precipitation events will occur during the winter period with more precipitation falling as rain rather than snow. This change in winter precipitation could result in less frequent but more intense snow storms with heavier snow.
Description of municipal capabilities to address risks and operate backup facilities	• The Town addresses heavy snow buildup, strong wind forecasts, and flood watches and warnings as needed.
Description of snow load risk reduction design criteria	• Connecticut Building Code Appendix N, Ground Snow Load, 30 psf. • Climate change may decrease overall snow accumulations but could result in wet, dense, heavier snowfalls. It is not known whether current building codes are insufficient. The maximum ground snow load specified in the code is 40 psf for northwest Connecticut.
Recommendations for snow load risk reduction	• Procedures should be developed for removing snow from the roof.
Planning-level cost estimates	• Nominal
	• FEMA P-957, Snow Load Safety Guide (2013), https://www.fema.gov/media-library/assets/documents/83501 • FEMA Snow Load Safety Guidance Flyer (2014), https://www.fema.gov/media-library/assets/documents/29670

1. Connecticut Hazard Mitigation Plan Update, 2014; and State Water Plan, 2017

Memorandum

TO: **File**

FROM: **James C. Murac, P.E., CFM**

DATE: **April 25, 2017**

RE: **Critical Facililities Assessment**
Location: Groton Town Hall

Local Contact: Robert Charette, Town of Groton Department of Public Works
MMI Team: Nirdosh Patel
James Murac

Description of Flooding Risk

The Groton Town Hall is a large brick building with multiple two and three story sections located at 45 Fort Hill Road in Groton, CT. The adjacent parking area is within a coastal FEMA X 500-year floodplain. It is possible that the southern corner of the building may touch this zone as well. The elevation of the zone is not indicated, but based upon transect data provided in the Flood Insurance Study (FIS) for Transect 49, the 500-year flood elevation is 18.2 feet. Anecdotal reports indicate that flooding of the building has not been experienced.

Evaluate Current Vulnerability

- Building plans: None
- FEMA Flood Zone: Coastal AE Zone @ 11.0 feet NAVD
- Site Grading: Primarily flat, impervious parking on three sides, basement floor half-underground
- Lowest Floor Use: Office space, I.T. server room, primary utilities, elevator controls
- Outbuildings: None

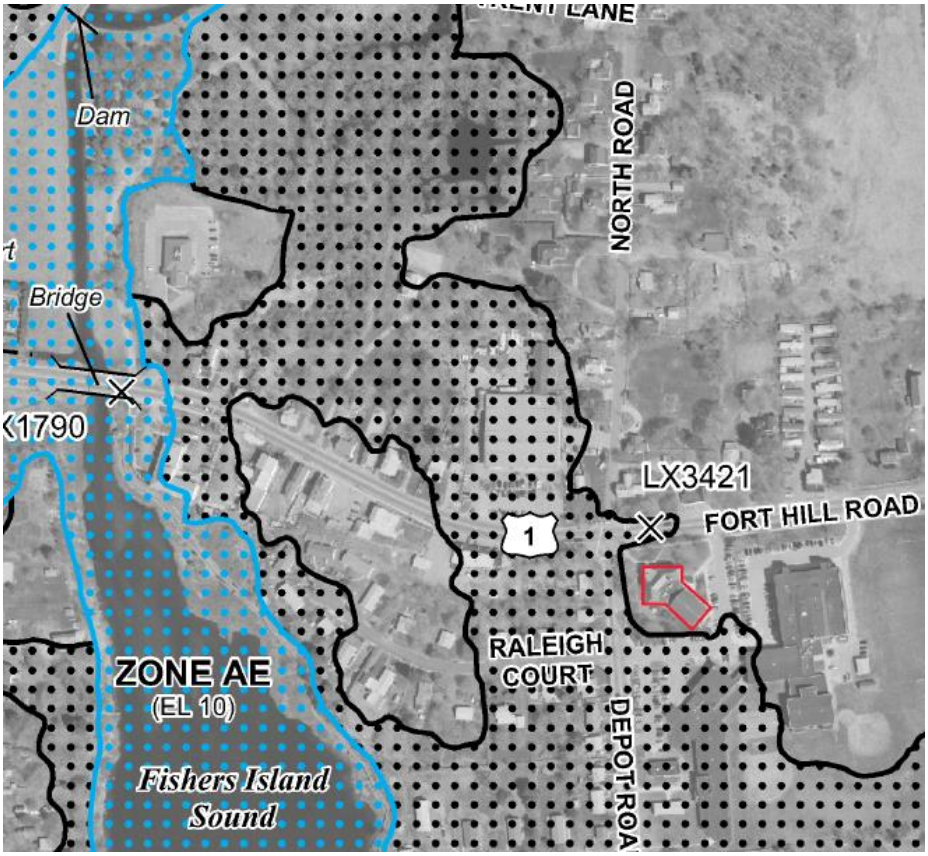
Utilities located on the exterior of the building on the western side include a diesel generator, a concrete fuel oil tank, multiple air conditioning condensers, an electrical transformer, as well as an air handler. All of these utilities are located at grade. The diesel generator is approximately 3.5 feet above the Lowest Adjacent Grade (L.A.G.). A high-voltage electric vehicle charger is located at the southern corner of the building near the parking area, and does appear to be located within the X zone.

The basement has windows located below the adjacent ground elevation, protected by window wells. The sills of those windows are approximately 2.5 feet below the L.A.G.

The basement contains finished space with multiple offices, an I.T. server room, paper files and desk space, equipment storage, and utilities. The utilities are located in two separate rooms. Utility Room 1 contains telecomm, electrical, generator switches, telephone, and fuel oil pump controls.

An elevator control room and Utility Room 2 are both set lower than the basement floor elevation. The Utility Room 2 is approximately 4.5 feet lower than the Basement Floor (BF) elevation, and contains the furnace/boiler, water heater, fire suppression and a sump pump. Utility Room 2 contains a sump pump.

FEMA Flood Insurance Rate Map



Utility System Descriptions

System	Description	Location(s)	Vulnerable
Utility Room 1	Contains electrical and communications equipment	Basement, at BF elevation	
Utility Room 2	Contains furnace, water heater, fire suppression and related controls	Basement, at 4.5-ft below BF elevation	
Elevator Control Room	Contains controls for elevator operation	Basement, at 4-ft below BF elevation	
I.T. Server Room	Contains servers, switches, and communications equipment	Basement, equipment racks located at BF elevation	
A/C	Multiple AC Condensers (3+) and Air Handler	Exterior, western face, at L.A.G.	Yes
Water heater:	Electric	Basement, Utility Room 2, 3-in above floor	Yes
Furnace	Oil Furnace	In Utility Room 2 on 3-in above floor	Yes
Electrical: Panel (primary)	Utility Panels	Located in Utility Room 1	
Electrical into building	Underground	Located in Utility Room 1	
Communications Equipment	Telephone Switch Boards	Located in Utility Room 1	
Plumbing: Waste	Sanitary Sewer	Basement Level, near ceiling	
Plumbing: Potable	Public Water	Utility Room 2	
Fuel System: Primary	Fuel Oil in Concrete Storage Tank	Utility Room 1	
Generator:	Diesel	Exterior of building on western building face, at grade.	
Elevator	Interior full service elevator	Elevator control room at basement level	
Other: Electric Vehicle Charging Station	Exterior	Edge of parking lot, southern corner of building	

Identification of Future Vulnerabilities

- Sea Level Rise
- Increasing precipitation intensities

Recommendations for Risk Reduction

Sea Level Rise

Floodproofing Method	**Effective?**
Wet Floodproofing:	Yes.
Elevation of Utilities:	Yes.
Dry Floodproofing:	Yes. A) Exterior floodwall could provide protection with gasketed bulkheads to protect door access.
Building Relocation:	No.
Building Elevation:	Possible but unlikely to be cost effective
Sealing of Openings:	Yes. Windows in basement level could be sealed to provide added flood protection.
Other Modifications:	Relocate facility outside of coastal floodplain.

Summary of Risks and Recommendations
Groton Municipal Building
295 Meridian Street
Groton

Description of current flood risk *(all elevations are in feet, NAVD88)*	• The Municipal Building is mapped in an X zone adjacent to a 0.2% annual chance floodplain along Birch Plain Creek, indicating an assumption of minimal or negligible flood risk. • The Public Works building is mapped in the 0.2% annual chance floodplain along Birch Plain Creek, indicating as assumption of relatively low flood risk. • The Municipal Building and adjacent parking areas undergo nuisance site flooding which occurs on average once a year, per anecdotal reports. The Public Works building has not been flooded. • MMI determined that the approximate 0.2% annual chance flood elevation associated with Birch Plain Creek is 52.8'. • The lowest adjacent grade at the Municipal Building is 49.54', with the lowest floor elevation at 49.62'. However, the ground surface between the 0.2% annual chance floodplain and the Municipal Building rises to 54.7', which is two feet higher than the 0.2% flood elevation of 52.8'. Therefore, Birch Plain Creek does not contribute flood risk to the Municipal Building.
Description of future flood risk *(all elevations are in feet, NAVD88)*	• Climate change is believed to be increasing the intensity of precipitation events and may also lead to greater overall precipitation in the state, which could increase risks along Birch Plain Creek and in the vicinity of the Municipal Building.
Description of municipal capabilities to address risks	• The City addresses heavy snow buildup, strong wind forecasts, and flood watches and warnings as needed.
Description of flood risk reduction design criteria *(all elevations are in feet, NAVD88)* *FFRMS = Federal Flood Risk Management Standard* *FVA= Freeboard Value Approach* *CISA = Climate Informed Science Approach*	• The FFRMS flood risk based on the 0.2% is 52.8'. • The alternative FRFMS approaches (FVA and the CISA) are not appropriate for this setting, as there is no 1% annual chance flood elevation associated with Birch Plain Creek.
Recommendations for building-specific flood risk reduction such as floodproofing, building elevation, elevation of utilities, sealing of openings, etc.	• Short-Term: Drainage improvements are recommended to decrease nuisance flooding at the Municipal Building. These improvements should be designed for increasing precipitation intensities. • Long-Term: climate change will create slightly increased flood risks to the Public Works facilities. A combination of wet and dry floodproofing for the main building may be prudent in the future. Outbuildings could be made floodable, including the garage building located immediately north of Birch Plain Creek.

Planning-level cost estimates	• Short-Term: $50,000 - $100,000 (Municipal Building) • Long-Term: $5/sf + $3,000 for flood vents (Public Works buildings)
Recommendations for on or off-site flood risk reduction such as flood walls, berms, raising grade, etc.	• The site likely has sufficient space for flood walls, berms, or raising grade. Specifically, a flood wall could be constructed along the southern edge of the Public Works site, running between the garage outbuilding and Birch Plain Creek, turning north at each end to meet higher grade.
Planning-level cost estimates	• $500 per linear foot for Public Works site
Resources	• FEMA 543, Design Guide for Improving Critical Facility Safety from Flooding and High Winds: Providing Protection to People and Buildings (2007), https://www.fema.gov/media-library/assets/documents/8811 • FEMA P-936, Floodproofing Non-Residential Buildings (July 2013), https://www.fema.gov/media-library/assets/documents/34270 • FEMA P-1037, Reducing Flood Risk to Residential Buildings That Cannot Be Elevated (September 2015), https://www.fema.gov/media-library/assets/documents/109669 • FEMA RA-2, Hurricane Sandy Recovery Advisory: Reducing Flood Effects in Critical Facilities (April 2013), https://www.fema.gov/media-library/assets/documents/30966 • FEMA P-942, Mitigation Assessment Team Report: Hurricane Sandy in New Jersey and New York – Building Performance Observations, Recommendations, and Technical Guidance (November 2013), https://www.fema.gov/media-library/assets/documents/85922 • FEMA P-348, Edition 2, Protecting Building Utility Systems from Flood Damage (February 2017) https://www.fema.gov/media-library/assets/documents/3729

Summary of Risks and Recommendations
Groton Municipal Building
295 Meridian Street
Groton

Description of current wind risk	• Strong winds are experienced during nor'easters, tropical storms, and other storm events. • Future wind events can damage the facility's structure or roof if the wind speed exceeds the older codes in place when the building was last upgraded. • Wind can also damage accessory structures and create windborne debris.
Description of future wind risk[1]	• Climate change may amplify the frequency and intensity of wind events like hurricanes, but it is not known whether higher wind speeds will be more commonplace.
Description of municipal capabilities to address risks and operate backup facilities	• The City addresses heavy snow buildup, strong wind forecasts, and flood watches and warnings as needed.
Description of wind risk reduction design criteria	• Connecticut Building Code Appendix N, 145 mph ultimate/112 mph nominal. • Connecticut is located in FEMA Zone II relative to maximum expected wind speed. The maximum expected wind speed for a three-second gust is 160 miles per hour. This wind speed could occur as a result of either a hurricane or a tornado • Climate change may amplify the frequency and intensity of wind events like hurricanes, but it is not known whether higher wind speeds will be more commonplace to the degree that current building codes are insufficient.
Recommendations for wind risk reduction such as load path projects, shutters, etc.	• Shutters are recommended for the most at-risk windows. • When the roof is next replaced or upgraded, the 160 mph criteria (or future building code) should be considered.
Planning-level cost estimates	• Nominal
Resources	• FEMA 543, Design Guide for Improving Critical Facility Safety from Flooding and High Winds: Providing Protection to People and Buildings (2007), https://www.fema.gov/media-library/assets/documents/8811

1. Connecticut Hazard Mitigation Plan Update, 2014

Summary of Risks and Recommendations
Groton Municipal Building
295 Meridian Street
Groton

Description of current snow load risk	• Heavy snow events in 2011, 2013, and 2015 have necessitated monitoring and/or removing snow from buildings. • Future snow events can damage the facility's structure or roof if heavy buildup occurs without melting.
Description of future snow load risk[1]	• Climate change studies have projected a shorter winter season for Connecticut with a decreased overall snowpack. In addition, climate models have indicated that fewer but more intense precipitation events will occur during the winter period with more precipitation falling as rain rather than snow. This change in winter precipitation could result in less frequent but more intense snow storms with heavier snow.
Description of municipal capabilities to address risks and operate backup facilities	• The City addresses heavy snow buildup, strong wind forecasts, and flood watches and warnings as needed.
Description of snow load risk reduction design criteria	• Connecticut Building Code Appendix N, Ground Snow Load, 30 psf. • Climate change may decrease overall snow accumulations but could result in wet, dense, heavier snowfalls. It is not known whether current building codes are insufficient. The maximum ground snow load specified in the code is 40 psf for northwest Connecticut.
Recommendations for snow load risk reduction	• Procedures should be developed for removing snow from the roof.
Planning-level cost estimates	• Nominal
	• FEMA P-957, Snow Load Safety Guide (2013), https://www.fema.gov/media-library/assets/documents/83501 • FEMA Snow Load Safety Guidance Flyer (2014), https://www.fema.gov/media-library/assets/documents/29670

1. Connecticut Hazard Mitigation Plan Update, 2014; and State Water Plan, 2017

Memorandum

TO: **File**

FROM: **James C. Murac, P.E., CFM**

DATE: **April 25, 2017**

RE: **Critical Facililities Assessment**
Location: Groton Municipal Building and Public Works Garages

Local Contact: Timothy Umrysz, City of Groton Director of Public Works
MMI Team: Nirdosh Patel
James Murac

Description of Flooding Risk

The Groton Municipal Building (MB) is a two story brick structure which shares property with multiple Public Works (PW) garages and a sand storage (SS) shed located to the south. The complex is located on at 295 Meridian Street, in Groton, CT. Collectively, the structures are vulnerable to two types of flooding.

The Municipal Building and adjacent parking areas undergo nuisance site flooding which occurs on average once a year, per anecdotal reports. Stormwater runoff from roof gutters and impervious parking areas flow to catch basins in low points in the parking lot, which discharge at multiple points to wetland systems to the south and east. These wetland systems are associated with an unnamed brook. Reports of the flooding indicate that water levels rise in the brook, causing the drainage structures to surcharge. The drive-in basement/garage area beneath the City Hall structure is then subject to flooding from this surcharged stormwater.

The Public Works garage buildings to the south of the Municipal Building are mapped within a freshwater FEMA X 500-year floodplain. The elevation of the zone is not indicated. Anecdotal reports indicate that flooding of the building has not been experienced.

Evaluate Current Vulnerability

- Building plans: Yes
- FEMA Flood Zone: Freshwater X Zone
- Site Grading: Primarily flat, impervious parking on all sides, drive-in basement/garage below grade
- Lowest Floor Use: Garage, utilities, storage
- Outbuildings: Public works garages

Municipal Building (MB)

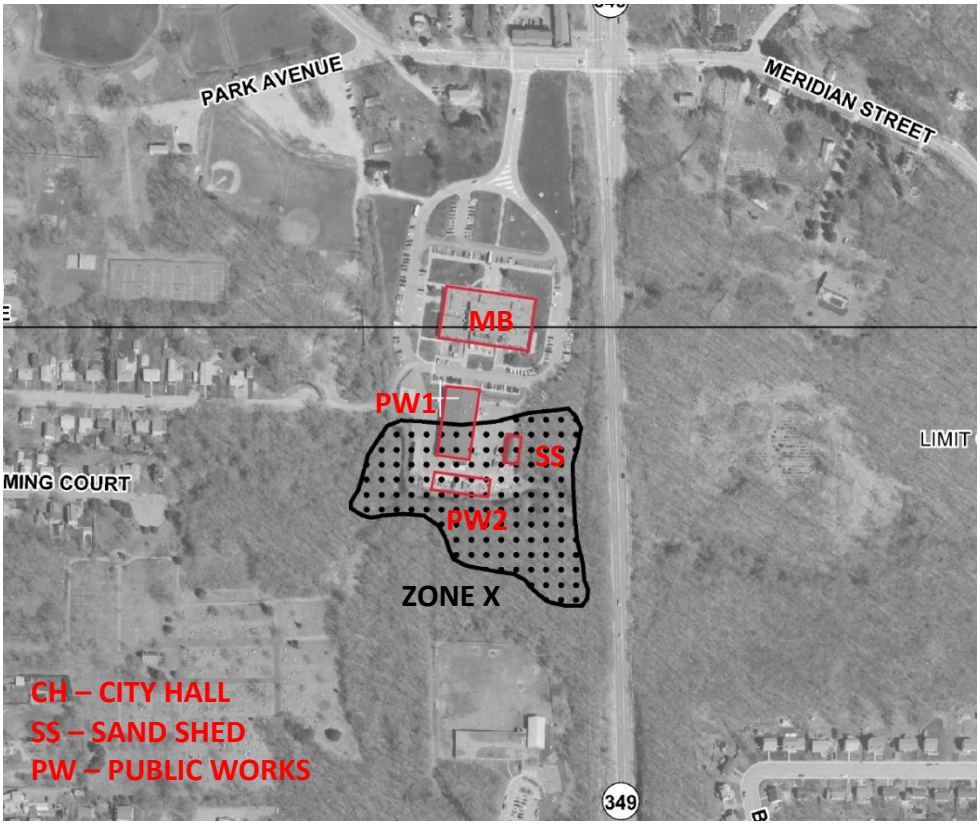
The Municipal Building has a drive-under garage/basement which is used for storage, for training and cleaning exercises for the Police Department, and to house utilities. The basement is unfinished, with

concrete floors is and concrete block partitions into many different use areas, and contains bathrooms. A water heater, electrical panels, air handler, and the Millstone Emergency Alert System controls are located in the basement.

Public Works (PW) Garages

A diesel backup generator is located outside the main Public Works PW1 to the west, elevated approximately 2.5 feet above the Lowest Adjacent Grade (L.A.G.), located within the FEMA X zone. Other vulnerable utilities located within the FEMA X zone include multiple air conditioning condensers located at grade, and an electrical transformer located at grade. Equipment inside the garages include vehicle and equipment storage.

FEMA Flood Insurance Rate Map



Utility System Descriptions – City Hall

System	Description	Location(s)	Vulnerable
A/C	Exterior	Exterior, roof	
Water heater	Electric	Basement, at BF elev	
Furnace	None	-	
Electrical: Panel (primary)	Transformer, underground	Exterior, southern face at grade	
Communications Equipment 1	Satellite Dishes and Radio Towers	Exterior, southern face at grade	
Communications Equipment 2	Radio equipment and Millstone Emergency Broadcast system	Basement, 0.75-ft above BF	
Plumbing: Waste	Public Sewer		
Plumbing: Potable	Public Water		
Fuel System: Primary	Concrete fuel storage tank used to fill onsite equipment	Exterior, southwestern corner of building at grade	
Generator	Diesel generator	Exterior, southern face of building, 3.5 feet above grade	

Utility System Descriptions – Public Works Garages

System	Description	Location(s)	Vulnerable
A/C	Condenser	Exterior, western face, at grade	
Water heater	Unk		
Furnace	Unk		
Electrical into building	Underground, transformer	Exterior, western face, at grade	
Communications Equipment	Unk		
Plumbing: Waste	Public Sewer		
Plumbing: Potable	Public Water		
Fuel System: Primary	Unk		
Generator	Diesel	Exterior, western face 3.5 feet above grade	

Identification of Future Vulnerabilities

- Increasing precipitation intensities

Recommendations for Risk Reduction

Storm Drainage Deficiencies

- Installation of backflow prevention on storm drainage outfalls could help prevent surcharging drainage system from causing nuisance flooding of the building and parking area.
- Installation of stormwater pump to clear parking area or to clear basement of floodwater
- Regrading of driveway aprons to prevent flooding water from flowing towards the building basement

Summary of Risks and Recommendations
New London Fire Headquarters and EOC
289 Bank Street
New London

Description of current flood risk *(all elevations are in feet, NAVD88)*	• The facility is mapped in a 0.2% annual chance flood zone with protection from the 1% annual chance flood provided by a flood protection system. The adjacent AE and VE elevations as 11' and 12', respectively. • The lowest adjacent grade is 6.52', lowest floor and utility elevations are 7.22', and the next-highest floor and utilities are at elevation 22.11'. • The 0.2 annual chance flood elevation is assumed to be 13.75' (BFE x 1.25). The elevation of 17.9' cited in the FIS is believed unrealistic for the site. In either case, the facility is at risk of severe flooding from the 0.2% annual chance flood if it exceeds the height of the flood protection system. • The facility is located in SLOSH zone 1. • The storm surges from Hurricane Sandy in 2012 and T.S. Irene in 2011 did not flood the facility, since they were lower than the flood protection system. • The more pressing concern for the City is the fact that stormwater flooding of the facility occurs several times per year. Stormwater can surcharge up from floor drains and sanitary facilities. The problem was noted in the City's hazard mitigation plan in 2012.*
Description of future flood risk *(all elevations are in feet, NAVD88)*	• Climate change is believed to be accelerating sea level rise and increasing the frequency of coastal storm events, which will lead to increasing risk of flooding during storm events. • MHW is 1.05'; therefore, sea level rise will likely not cause daily high tide flooding of the facility in this century, although sea level rise could render stormwater drainage systems inoperable during high tides.
Description of municipal capabilities to address risks	• The City addresses heavy snow buildup, strong wind forecasts, and flood watches and warnings as needed. • Continued maintenance of the City's flood protection system is required to keep the facility mapped outside the 1% annual chance flood.
Description of flood risk reduction design criteria *(all elevations are in feet, NAVD88)* *FFRMS = Federal Flood Risk Management Standard* *FVA= Freeboard Value Approach* *CISA = Climate Informed Science Approach*	• The 0.2% flood elevation of 13.75' represents the design criteria per State requirements for critical facilities. • FFRMS flood risk based on the FVA is 14' TO 15' (AE or VE BFE + 3' for critical facilities). • FFRMS flood risk based on the 0.2% is 13.75'. • FFRMS flood risk based on CISA is approximately 12' to 15'. • NYC Resiliency design criteria is BFE + 24" + SLR adjustment of 0.5'-3' = 13.5' to 16' (based on the AE) or 14.5 to 17' (based on the VE).

Recommendations for building-specific flood risk reduction such as floodproofing, building elevation, elevation of utilities, sealing of openings, etc.	• Despite the protection from the flood protection system, the facility is exposed to increasing risk over time. • Short-Term*: The surcharging stormwater problems must be addressed with a combination of backflow prevention and pumping systems. Site grading can be used to help prevent overland flow of stormwater toward the building. In addition, the utility rooms should be dry floodproofed to provide an extra level of protection. • Long-Term: the occupied lower levels of the building should be wet floodproofed. This will make the building more resilient if flooding overtops the flood protection system. If the City has an opportunity to relocate the fire headquarters, a site outside a 1% or 0.2% annual chance flood zone should be selected.
Planning-level cost estimates	• Short-Term*: $5,000 - $10,000 for backflow prevention and minor grading modifications + $10/sf (for utility room) • Long-Term: $10/sf (footprint of building) + $3,000 for flood vents
Recommendations for on or off-site flood risk reduction such as flood walls, berms, raising grade, etc.	• The site is already protected by a flood protection system, along with adjacent parts of downtown New London.
Planning-level cost estimates	• Not applicable
Resources	• FEMA 543, Design Guide for Improving Critical Facility Safety from Flooding and High Winds: Providing Protection to People and Buildings (2007), https://www.fema.gov/media-library/assets/documents/8811 • FEMA P-936, Floodproofing Non-Residential Buildings (July 2013), https://www.fema.gov/media-library/assets/documents/34270 • FEMA P-1037, Reducing Flood Risk to Residential Buildings That Cannot Be Elevated (September 2015), https://www.fema.gov/media-library/assets/documents/109669 • FEMA RA-2, Hurricane Sandy Recovery Advisory: Reducing Flood Effects in Critical Facilities (April 2013), https://www.fema.gov/media-library/assets/documents/30966 • FEMA P-942, Mitigation Assessment Team Report: Hurricane Sandy in New Jersey and New York – Building Performance Observations, Recommendations, and Technical Guidance (November 2013), https://www.fema.gov/media-library/assets/documents/85922 • FEMA P-348, Edition 2, Protecting Building Utility Systems from Flood Damage (February 2017) https://www.fema.gov/media-library/assets/documents/3729

*Recommendations should be coordinated with ongoing City efforts to address flooding problems

Summary of Risks and Recommendations
New London Fire Headquarters and EOC
289 Bank Street
New London

Description of current wind risk	• Strong winds are experienced during nor'easters, tropical storms, and other storm events. • The winds from Hurricane Sandy in 2012 and T.S. Irene in 2011 did not damage the facility. • Future wind events can damage the facility's structure or roof if the wind speed exceeds the older codes in place when the building was last upgraded. • Wind can also damage accessory structures.
Description of future wind risk[1]	• Climate change may amplify the frequency and intensity of wind events like hurricanes, but it is not known whether higher wind speeds will be more commonplace.
Description of municipal capabilities to address risks and operate backup facilities	• The City addresses heavy snow buildup, strong wind forecasts, and flood watches and warnings as needed.
Description of wind risk reduction design criteria	• Connecticut Building Code Appendix N, 145 mph ultimate/112 mph nominal. • Connecticut is located in FEMA Zone II relative to maximum expected wind speed. The maximum expected wind speed for a three-second gust is 160 miles per hour. This wind speed could occur as a result of either a hurricane or a tornado • Climate change may amplify the frequency and intensity of wind events like hurricanes, but it is not known whether higher wind speeds will be more commonplace to the degree that current building codes are insufficient.
Recommendations for wind risk reduction such as load path projects, shutters, etc.	• Shutters are recommended to protect the windows and the large garage doors. • When the roof is next replaced or upgraded, the 160 mph criteria (or future building code) should be considered.
Planning-level cost estimates	•
Resources	• FEMA 543, Design Guide for Improving Critical Facility Safety from Flooding and High Winds: Providing Protection to People and Buildings (2007), https://www.fema.gov/media-library/assets/documents/8811

1. Connecticut Hazard Mitigation Plan Update, 2014

Summary of Risks and Recommendations
New London Fire Headquarters and EOC
289 Bank Street
New London

Description of current snow load risk	• Heavy snow events in 2011, 2013, and 2015 have necessitated monitoring and/or removing snow from buildings. • Future snow events can damage the facility's structure or roof if heavy buildup occurs without melting.
Description of future snow load risk[1]	• Climate change studies have projected a shorter winter season for Connecticut with a decreased overall snowpack. In addition, climate models have indicated that fewer but more intense precipitation events will occur during the winter period with more precipitation falling as rain rather than snow. This change in winter precipitation could result in less frequent but more intense snow storms with heavier snow.
Description of municipal capabilities to address risks and operate backup facilities	• The City addresses heavy snow buildup, strong wind forecasts, and flood watches and warnings as needed.
Description of snow load risk reduction design criteria	• Connecticut Building Code Appendix N, Ground Snow Load, 30 psf. • Climate change may decrease overall snow accumulations but could result in wet, dense, heavier snowfalls. It is not known whether current building codes are insufficient. The maximum ground snow load specified in the code is 40 psf for northwest Connecticut.
Recommendations for snow load risk reduction	• Procedures should be developed for removing snow from the roof.
Planning-level cost estimates	• Nominal
Resources	• FEMA P-957, Snow Load Safety Guide (2013), https://www.fema.gov/media-library/assets/documents/83501 • FEMA Snow Load Safety Guidance Flyer (2014), https://www.fema.gov/media-library/assets/documents/29670

1. Connecticut Hazard Mitigation Plan Update, 2014; and State Water Plan, 2017

Memorandum

TO: **File**

FROM: **James C. Murac, P.E., CFM**

DATE: **April 25, 2017**

RE: **Critical Facililities Assessment**
Location: New London Fire Headquarters and Emergency Operations Center

Local Contact: Battalion Chief Nichols
MMI Team: Nirdosh Patel
James Murac

Description of Flooding Risk

The New London Fire Headquarters is a two story brick building located at 289 Bank Street in New London, CT. The building is vulnerable to two types of flooding.

The entire building and grounds is located within a coastal FEMA X 500-year floodplain. The elevation of the zone is not indicated, but based upon transect data provided in the Flood Insurance Study (FIS) for Transect 49, the 500-year flood elevation is 17.9 feet. Anecdotal reports indicate that coastal flooding of the building has not been experienced in recent years, likely due to the protection provided by the levee.

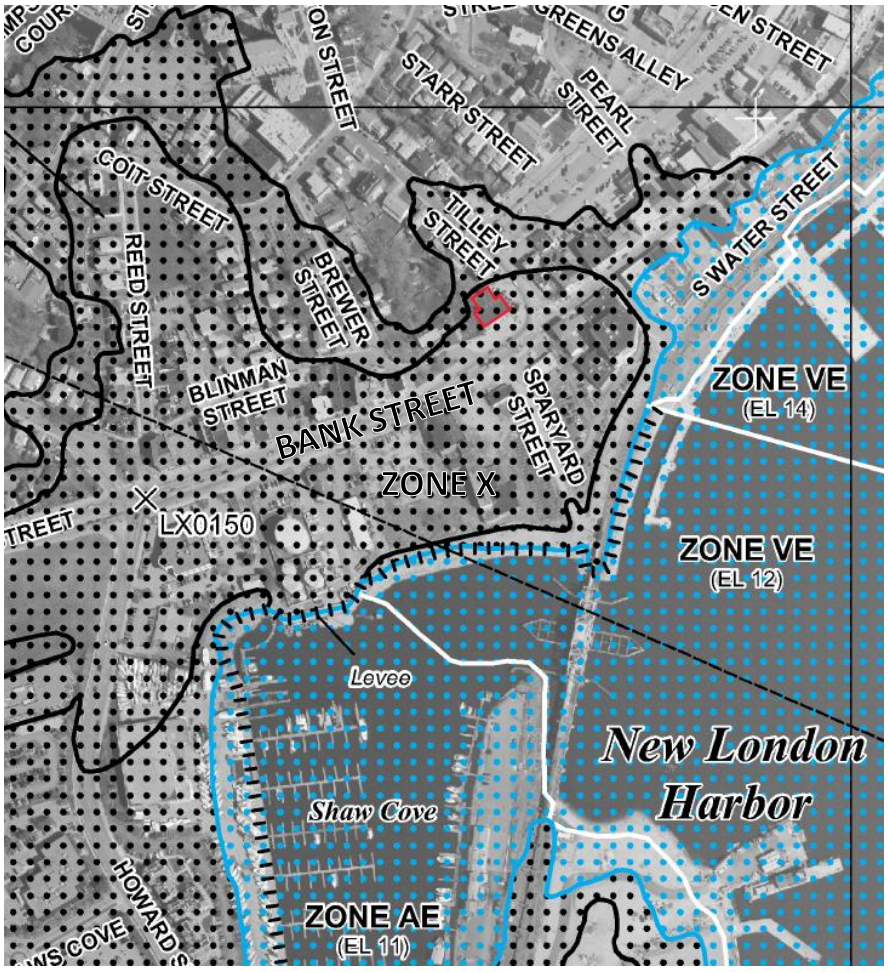
The building also is vulnerable to flooding from street drainage that surcharges through the floor drains located in the garage bays and kitchen, and a urinal located on the first floor. While the flooding does not typically destroy any utilities it does provide a health concern especially in the kitchen actively used for food preparation.

Evaluate Current Vulnerability

- Building plans: None
- FEMA Flood Zone: Coastal X Zone, protected by Levee
- Site Grading: Primarily flat, impervious parking on three sides, basement floor half-underground
- Lowest Floor Use: Garage bays, bathroom, kitchen, recreational area, gym.
- Outbuildings: Storage Shed

Utilities located on the exterior of the building include a diesel generator on the western side of the building, as well as window-unit style air conditioners on the first floor and second. The building has two exterior-access utility rooms. Utility Room 1 located on the northern face of the building contained an old generator which has since been removed, and no other active utilities. Utility Room located on the western building face contained the furnace and water heater.

FEMA Flood Insurance Rate Map



Utility System Descriptions

System	Description	Location(s)	Vulnerable
Utility Room 1	No active utilities	Exterior access only, Northern building face	
Utility Room 2	Furnace and water heater	Exterior access only, western building face	
A/C	Multiple Window units on first and second level		
Water heater:	Tank-style, natural gas	Utility Room 2	Yes
Furnace	Water boiler, natural gas	Utility Room 2	Yes
Electrical: Panel (primary)	Circuit Breakers	Utility Room 2	
Plumbing: Waste	Sanitary Sewer		
Plumbing: Potable	Public Water		
Fuel System: Primary	Natural Gas		
Kitchen	Commercial-grade kitchen appliances	Lowest level of building	Yes
Generator:	Natural Gas	Exterior on north side of building	

Identification of Future Vulnerabilities

- Sea Level Rise
- Increasing precipitation intensities

Recommendations for Risk Reduction

Sea Level Rise

Floodproofing Method	Effective?
Wet Floodproofing:	Yes.
Elevation of Utilities:	Yes.
Dry Floodproofing:	Yes. A) Exterior floodwall could provide protection with gasketed bulkheads to protect door access.
Building Relocation:	Not likely to be cost effective
Building Elevation:	Possible but unlikely to be cost effective (Garage bays for firetrucks)
Sealing of Openings:	No
Other Modifications:	Relocate facility outside of coastal floodplain.

Storm Drainage Deficiencies

- Installation of backflow prevention on floor drains and sewer discharge could help prevent surcharging drainage system from causing nuisance flooding in building.
- Regrading of sidewalk and driveway apron to prevent floodwaters in Bank Street from reaching garage bay doors.
- Installation of sump pump to clear parking area or to clear basement of floodwater

Summary of Risks and Recommendations
Quaker Hill Fire Company
17 Old Colchester Road
Waterford

Description of current flood risk *(all elevations are in feet, NAVD88)*	• The fire company is partly mapped in a 0.2% annual chance flood risk zone adjacent to the Smith Cove/Hunts Brook estuary. The 0.2% zone is associated with two sources of flooding: coastal flooding from the estuary, and flooding caused by an unnamed tributary of the estuary that flows toward the southeast within a culvert beneath Sunshine Road, bisecting the two parts of the site. The AE zone at Smith Cove/Hunts Brook has a base flood elevation of 10'. • Given its position along the Thames River, the facility is located in SLOSH zone 3. • The 0.2 annual chance flood elevation is assumed to be 12.5' (BFE x 1.25). The elevation of 18' cited in the FIS is believed unrealistic for the site. In either case, the facility is at risk of nominal to shallow flooding from the 0.2% annual chance flood. • The lowest adjacent grade is 11.96', the lowest floor elevation is 11.06', and the next highest floor is at 14.44'. This places the lower levels of the facility *above* the elevation of a flood that has a 1% chance of occurring in any year, but *slightly lower* than the 0.2% annual chance flood elevation. • The storm surges from Hurricane Sandy in 2012 and T.S. Irene in 2011 did not flood the facility. • Anecdotal reports indicate that flood waters from the estuary have reached the property on one occasion in recent memory, where water levels were approximately ten feet away from the eastern building corner. • The secondary garage has undergone nuisance flooding originating from the unnamed tributary stream. According to anecdotal reports, the culvert is undersized and prone to overtopping, which causes water to enter the secondary garage.
Description of future flood risk *(all elevations are in feet, NAVD88)*	• Climate change is believed to be accelerating sea level rise and increasing the frequency of coastal storm events, which will lead to increasing risk of flooding during storm events. • Likewise, climate change is believed to be increasing the intensity of precipitation events and may also lead to greater overall precipitation in the state, which could increase risks along the unnamed brook. • MHW is 1.05'; therefore, sea level rise will not cause daily high tide flooding of the facility in this century.
Description of municipal capabilities	• The Fire Company and the Town of Waterford address heavy

to address risks	snow buildup, strong wind forecasts, and flood watches and warnings as needed.
Description of flood risk reduction design criteria *(all elevations are in feet, NAVD88)* *FFRMS = Federal Flood Risk Management Standard* *FVA= Freeboard Value Approach* *CISA = Climate Informed Science Approach*	• The 0.2% flood elevation of 12.5' represents the design criteria per State requirements for critical facilities. • FFRMS flood risk based on the FVA is 13' (BFE + 3' for critical facilities). • FFRMS flood risk based on the 0.2% is 12.5'. • FFRMS flood risk based on CISA is approximately 11' to 14'. • NYC Resiliency design criteria is BFE + 24" + SLR adjustment of 0.5'-3' = 12.5' to 15'.
Recommendations for building-specific flood risk reduction such as floodproofing, building elevation, elevation of utilities, sealing of openings, etc.	• The site has a complex flood risk profile due to the placement of the unnamed stream in a culvert that bisects the site combined with the coastal flood risk from Smith Cove/Hunts Brook. • Elevating the building is not feasible given the need for rapid vehicle dispatching and the sloping grade with several interior floor levels. • Short-Term: Wet floodproofing should be used for the floor located below the estimated 0.2% annual chance flood elevation of 12.5'. • Long-Term: Relocating the facility will eventually be warranted due to the combination of stream/culvert and coastal/storm surge flood risk, coupled with the significant expense associated with replacing the very long culvert.
Planning-level cost estimates	• Short-Term: $10/sf + $3,000 for flood vents • Long-Term: >$10M (depends on land acquisition costs for new site)
Recommendations for on or off-site flood risk reduction such as flood walls, berms, raising grade, etc.	• Increasing the capacity of the culvert will help reduce the frequency of overtopping, but will not eliminate the risk because a stream would still bisect the site. • Another possible option for reducing risk could be construction of berms along each side of Sunshine Road, which could keep overflowing stream floodwaters from flooding the facilities. However, the berms would affect vehicle access.
Planning-level cost estimates	• Not applicable
Resources	• FEMA 543, Design Guide for Improving Critical Facility Safety from Flooding and High Winds: Providing Protection to People and Buildings (2007), https://www.fema.gov/media-library/assets/documents/8811 • FEMA P-936, Floodproofing Non-Residential Buildings (July 2013), https://www.fema.gov/media-library/assets/documents/34270 • FEMA P-1037, Reducing Flood Risk to Residential Buildings That Cannot Be Elevated (September 2015), https://www.fema.gov/media-library/assets/documents/109669

	• FEMA RA-2, Hurricane Sandy Recovery Advisory: Reducing Flood Effects in Critical Facilities (April 2013), https://www.fema.gov/media-library/assets/documents/30966 • FEMA P-942, Mitigation Assessment Team Report: Hurricane Sandy in New Jersey and New York – Building Performance Observations, Recommendations, and Technical Guidance (November 2013), https://www.fema.gov/media-library/assets/documents/85922 • FEMA P-348, Edition 2, Protecting Building Utility Systems from Flood Damage (February 2017) https://www.fema.gov/media-library/assets/documents/3729

Summary of Risks and Recommendations
Quaker Hill Fire Company
17 Old Colchester Road
Waterford

Description of current wind risk	• Strong winds are experienced during nor'easters, tropical storms, and other storm events. • The winds from Hurricane Sandy in 2012 and T.S. Irene in 2011 did not damage the facility. • Future wind events can damage the facility's structure or roof if the wind speed exceeds the older codes in place when the building was last upgraded. • Wind can also damage accessory structures.
Description of future wind risk[1]	• Climate change may amplify the frequency and intensity of wind events like hurricanes, but it is not known whether higher wind speeds will be more commonplace.
Description of municipal capabilities to address risks and operate backup facilities	• The Fire Company and the Town of Waterford address heavy snow buildup, strong wind forecasts, and flood watches and warnings as needed.
Description of wind risk reduction design criteria	• Connecticut Building Code Appendix N, 145 mph ultimate/112 mph nominal. • Connecticut is located in FEMA Zone II relative to maximum expected wind speed. The maximum expected wind speed for a three-second gust is 160 miles per hour. This wind speed could occur as a result of either a hurricane or a tornado • Climate change may amplify the frequency and intensity of wind events like hurricanes, but it is not known whether higher wind speeds will be more commonplace to the degree that current building codes are insufficient.
Recommendations for wind risk reduction such as load path projects, shutters, etc.	• Shutters are recommended to protect windows and the large garage doors. • When the roof is next replaced or upgraded, the 160 mph criteria (or future building code) should be considered.
Planning-level cost estimates	•
Resources	• FEMA 543, Design Guide for Improving Critical Facility Safety from Flooding and High Winds: Providing Protection to People and Buildings (2007), https://www.fema.gov/media-library/assets/documents/8811

1. Connecticut Hazard Mitigation Plan Update, 2014

Summary of Risks and Recommendations
Quaker Hill Fire Company
17 Old Colchester Road
Waterford

Description of current snow load risk	• Heavy snow events in 2011, 2013, and 2015 have necessitated monitoring and/or removing snow from buildings. • Future snow events can damage the facility's structure or roof if heavy buildup occurs without melting.
Description of future snow load risk[1]	• Climate change studies have projected a shorter winter season for Connecticut with a decreased overall snowpack. In addition, climate models have indicated that fewer but more intense precipitation events will occur during the winter period with more precipitation falling as rain rather than snow. This change in winter precipitation could result in less frequent but more intense snow storms with heavier snow.
Description of municipal capabilities to address risks and operate backup facilities	• The Fire Company and the Town of Waterford address heavy snow buildup, strong wind forecasts, and flood watches and warnings as needed.
Description of snow load risk reduction design criteria	• Connecticut Building Code Appendix N, Ground Snow Load, 30 psf. • Climate change may decrease overall snow accumulations but could result in wet, dense, heavier snowfalls. It is not known whether current building codes are insufficient. The maximum ground snow load specified in the code is 40 psf for northwest Connecticut.
Recommendations for snow load risk reduction	• Procedures should be developed for removing snow from the roof.
Planning-level cost estimates	• Nominal
Resources	• FEMA P-957, Snow Load Safety Guide (2013), https://www.fema.gov/media-library/assets/documents/83501 • FEMA Snow Load Safety Guidance Flyer (2014), https://www.fema.gov/media-library/assets/documents/29670

1. Connecticut Hazard Mitigation Plan Update, 2014; and State Water Plan, 2017

Memorandum

TO: **File**

FROM: **James C. Murac, P.E., CFM**

DATE: **April 25, 2017**

RE: **Critical Facililities Assessment**
Location: Waterford, Quaker Hill FD

Local Contact: Vincent Ukleja
MMI Team: Nirdosh Patel
James Murac

Description of Flooding Risk

The Quaker Hill Fire Department is a three story structure which includes a secondary storage garage as well as a small storage shed on the property. The primary structure is located at 17 Old Colchester Road, in Waterford, CT. Collectively, the structures are vulnerable to two types of flooding.

The primary building is also mapped within a freshwater FEMA X 500-year floodplain associated with the tidally influenced flooding of the Hunts Brook estuary. The elevation of the zone is not indicated. Anecdotal reports indicate that flood waters from the estuary have reached the property on one occasion in recent memory, where water levels were approximately ten feet away from the eastern building corner.

The secondary storage garage is has undergone minor nuisance flooding originating from a small brook to the west of its driveway. This brook enters a culvert approximately 20 feet away from the structure, where it then flows eastward beneath Sunshine Road to its discharge in Smith Cove. According to anecdotal reports, this culvert is undersized and prone to overtopping, which causes the structure to back up and enter the secondary storage structure.

Evaluate Current Vulnerability

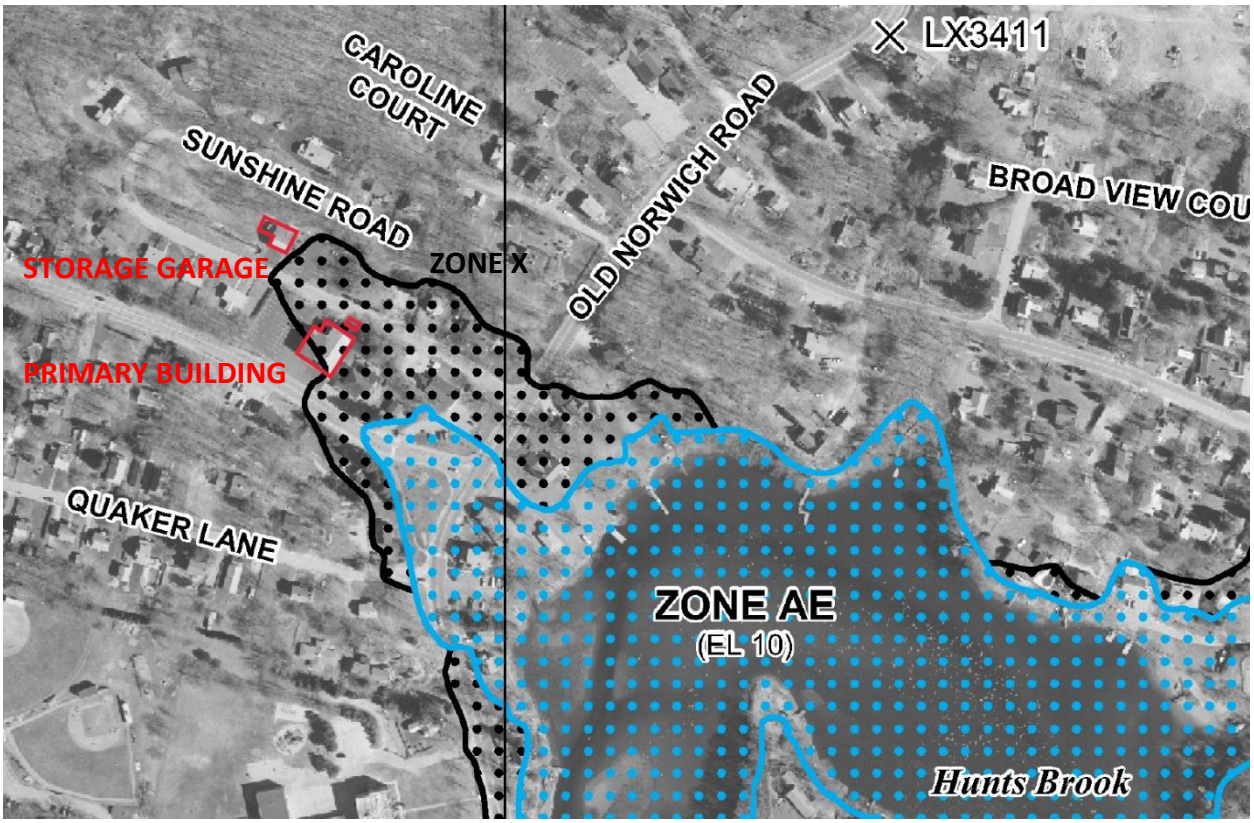
- Building plans: None
- FEMA Flood Zone: Coastal AE Zone @ 10.0 feet NAVD
- Site Grading: Impervious parking on three sides, basement floor half-underground
- Lowest Floor Use: Finished space, recreation area, full commercial kitchen, bathroom
- Outbuildings: Secondary storage garage, small storage shed

The primary building is a three-story structure with a finished walkout basement. The garage bay doors are on the second level, with administrative offices on the third level. The basement level contains a finished recreational room, a full commercial kitchen, a walk-in refrigerator, bathroom, and a sub-basement utility room that is accessed from the exterior only. The Basement Floor (BF) elevation is a 2-foot step down from the Lowest Adjacent Grade (L.A.G.). The sub-basement utility room is located

approximately 4-feet above the BF. An exterior 1,000 gallon propane tank is located in the FEMA X-zone, and should be anchored to prevent flotation. The storage shed is located in the X-zone as well.

The secondary building is a one-story storage building with two garage bay doors and a covered pavilion. The garage has heat and one bathroom.

FEMA Flood Insurance Rate Map



Utility System Descriptions – Primary Building

System	Description	Location(s)	Vulnerable
Sub-Basement Utility Room	Exterior-access room with generator, fuel storage	Located at northwestern corner, elevated approx. 4-ft above BF	
Fuel (Primary)	Fuel Oil, heating and generator	Sub Basement Util Room	
Fuel (Secondary)	Propane, kitchen	1,000 gallon exterior, eastern corner	Yes, in FEMA X zone, should be anchored to prevent flotation
A/C	(2x) Condensers	Exterior, eastern face	
Water heater:		2nd Floor	
Furnace	(2x) Boilers, Fuel Oil	2nd Floor	No
Electrical into building	Circuit Breaker	Basement	
Plumbing: Waste	Public Water		
Plumbing: Potable	Public Sewer		
Generator:	Diesel	Sub Basement Util Room	
Other: Commercial Kitchen	Ranges, ovens, griddles, walk in refrigerator	Basement	
Other: Breathing Air Cylinder Recharging Station	Oxygen purification, compression, tank refill	2nd Floor	

Utility System Descriptions – Storage Garage

System	Description	Location(s)	Vulnerable
Fuel (Primary)	Fuel Oil		
Water heater:			
Furnace	Boiler, Fuel Oil	Elevated inside garage bay, mounted to ceiling	no
Electrical into building			
Plumbing: Waste	Sanitary		
Plumbing: Potable	Public		

Identification of Future Vulnerabilities

- Sea Level Rise
- Increasing precipitation intensities

Recommendations for Risk Reduction

Sea Level Rise

Floodproofing Method	**Effective?**
Wet Floodproofing:	Yes.
Elevation of Utilities:	Yes.
Dry Floodproofing:	Yes. A) Exterior floodwall could provide protection with gasketed bulkheads to protect door access. B) Exterior driveway apron modifications to prevent floodwaters in street from entering site
Building Relocation:	No.
Building Elevation:	Unlikely to be cost effective based upon vulnerability and building size/use.
Sealing of Openings:	No.

Storm Drainage Deficiencies

- Work with the Town of Waterford to conduct assessment of the condition and conveyance capacity of the culvert in question, with the eventual goal of replacement, if necessary.
- Installation of sump pump to clear garage floor of floodwater
- Regrading of driveway aprons to prevent flooding water from flowing towards the building basement

Summary of Risks and Recommendations
Chesterfield Fire Company
1606 Hartford New London Turnpike
Montville

Description of current flood risk *(all elevations are in feet, NAVD88)*	• The facility is mapped in Zone X (minimal flood risk) adjacent to the Latimer Brook floodplain (AE elevation 131') with lowest adjacent grade at 132.56', lowest floor elevation of 134.17', and utility room at the same elevation 134.15'. This places the lower level of the facility above the elevation of a flood that has a 1% chance of occurring in any year. • The 0.2 annual chance flood elevation based on the FIS is 132'. As such, the facility is at very low risk of flooding (within ½ foot) from the 0.2% annual chance flood. • The southeastern Connecticut flood of March 2010 did not flood the facility. • Based on ground topography and the FEMA mapping, it appears that the site may have been subject to filling and grading in the past, which may have reduced its flood risk.
Description of future flood risk *(all elevations are in feet, NAVD88)*	• Climate change is believed to be increasing the intensity of precipitation events and may also lead to greater overall precipitation in the state, which could increase risks along Latimer Brook.
Description of municipal capabilities to address risks	• The Fire Company and the Town of Montville address heavy snow buildup, strong wind forecasts, and flood watches and warnings as needed.
Description of flood risk reduction design criteria *(all elevations are in feet, NAVD88)* *FFRMS = Federal Flood Risk Management Standard* *FVA= Freeboard Value Approach* *CISA = Climate Informed Science Approach*	• The 0.2% flood elevation of 132' represents the design criteria per State requirements for critical facilities. • FFRMS flood risk based on the FVA is 134' (BFE + 3' for critical facilities). • FFRMS flood risk based on the 0.2% is 132'. • The CISA approach is not possible in inland flood settings until an appropriate method is established for projecting increases in riverine flood levels. • NYC Resiliency design criteria is BFE + 24" + SLR adjustment (zero in this inland case) = 133'.
Recommendations for building-specific flood risk reduction such as floodproofing, building elevation, elevation of utilities, sealing of openings, etc.	• The first floor elevation and utility room elevation are above the FFRMS FVA and above the 0.2% flood elevation. • Short-Term: Short-term actions are not necessary. • Long-Term: Long-term actions are not necessary.
Planning-level cost estimates	• Short-Term: Not applicable. • Long-Term: Not applicable.
Recommendations for on or off-site flood risk reduction such as flood walls, berms, raising grade, etc.	• A berm or flood wall along the southwest side of the facility may be considered in the future if the need arises. Raising the entire parking area on fill could also accomplish flood protection goals while also creating additional dry areas

	during a major flood.
Planning-level cost estimates	• Not applicable
Resources	• FEMA 543, Design Guide for Improving Critical Facility Safety from Flooding and High Winds: Providing Protection to People and Buildings (2007), https://www.fema.gov/media-library/assets/documents/8811 • FEMA P-936, Floodproofing Non-Residential Buildings (July 2013), https://www.fema.gov/media-library/assets/documents/34270 • FEMA P-1037, Reducing Flood Risk to Residential Buildings That Cannot Be Elevated (September 2015), https://www.fema.gov/media-library/assets/documents/109669 • FEMA RA-2, Hurricane Sandy Recovery Advisory: Reducing Flood Effects in Critical Facilities (April 2013), https://www.fema.gov/media-library/assets/documents/30966 • FEMA P-942, Mitigation Assessment Team Report: Hurricane Sandy in New Jersey and New York – Building Performance Observations, Recommendations, and Technical Guidance (November 2013), https://www.fema.gov/media-library/assets/documents/85922 • FEMA P-348, Edition 2, Protecting Building Utility Systems from Flood Damage (February 2017) https://www.fema.gov/media-library/assets/documents/3729

Summary of Risks and Recommendations
Chesterfield Fire Company
1606 Hartford New London Turnpike
Montville

Description of current wind risk	• Strong winds are experienced during nor'easters, tropical storms, and other storm events. • The winds from Hurricane Sandy in 2012 and T.S. Irene in 2011 did not damage the facility. • Future wind events can damage the facility's structure or roof if the wind speed exceeds the codes in place when the building was last upgraded. • Wind can also damage accessory structures.
Description of future wind risk[1]	• Climate change may amplify the frequency and intensity of wind events like hurricanes, but it is not known whether higher wind speeds will be more commonplace.
Description of municipal capabilities to address risks and operate backup facilities	• The Fire Company and the Town of Montville address heavy snow buildup, strong wind forecasts, and flood watches and warnings as needed.
Description of wind risk reduction design criteria	• Connecticut Building Code Appendix N, 145 mph ultimate/112 mph nominal. • Connecticut is located in FEMA Zone II relative to maximum expected wind speed. The maximum expected wind speed for a three-second gust is 160 miles per hour. This wind speed could occur as a result of either a hurricane or a tornado • Climate change may amplify the frequency and intensity of wind events like hurricanes, but it is not known whether higher wind speeds will be more commonplace to the degree that current building codes are insufficient.
Recommendations for wind risk reduction such as load path projects, shutters, etc.	• Shutters are recommended to protect the numerous small windows of the critical rooms in this "ranch" style building. • When the roof is next replaced or upgraded, the 160 mph criteria (or future building code) should be considered.
Planning-level cost estimates	•
Resources	• FEMA 543, Design Guide for Improving Critical Facility Safety from Flooding and High Winds: Providing Protection to People and Buildings (2007), https://www.fema.gov/media-library/assets/documents/8811

1. Connecticut Hazard Mitigation Plan Update, 2014

Summary of Risks and Recommendations
Chesterfield Fire Company
1606 Hartford New London Turnpike
Montville

Description of current snow load risk	• Heavy snow events in 2011, 2013, and 2015 have necessitated monitoring and/or removing snow from buildings. • Future snow events can damage the facility's structure or roof if heavy buildup occurs without melting.
Description of future snow load risk[1]	• Climate change studies have projected a shorter winter season for Connecticut with a decreased overall snowpack. In addition, climate models have indicated that fewer but more intense precipitation events will occur during the winter period with more precipitation falling as rain rather than snow. This change in winter precipitation could result in less frequent but more intense snow storms with heavier snow.
Description of municipal capabilities to address risks and operate backup facilities	• The Fire Company and the Town of Montville address heavy snow buildup, strong wind forecasts, and flood watches and warnings as needed.
Description of snow load risk reduction design criteria	• Connecticut Building Code Appendix N, Ground Snow Load, 30 psf. • Climate change may decrease overall snow accumulations but could result in wet, dense, heavier snowfalls. It is not known whether current building codes are insufficient. The maximum ground snow load specified in the code is 40 psf for northwest Connecticut.
Recommendations for snow load risk reduction	• Procedures should be developed for removing snow from the roof.
Planning-level cost estimates	• Nominal
Resources	• FEMA P-957, Snow Load Safety Guide (2013), https://www.fema.gov/media-library/assets/documents/83501 • FEMA Snow Load Safety Guidance Flyer (2014), https://www.fema.gov/media-library/assets/documents/29670

1. Connecticut Hazard Mitigation Plan Update, 2014; and State Water Plan, 2017

Memorandum

TO: **File**

FROM: **Noah Slovin, CFM**

DATE: **5/5/2017**

RE: **Chesterfield Fire Department – Critical Facililities Assessment**

Observations by Noah and Nirdosh

- Building plans available (N)
- Building is adjacent to narrow X-0.2% annual chance zone (covering part of parking lot) adjacent to AE zone, BFE 131 ft.
- FFE is 134.17'.
- Grading around site:
  - Grading toward southwest - water flows away from front of building to back. Parking lot in back is lower than Grassy Hill Road - water flow from road into lot.
- 1st floor contains:
  - Garage with fire engines
  - Utility Room
  - Kitchen
  - Office Space
  - Bingo Hall & Meeting Room
- Any exterior outbuildings
  - Shed adjacent to pond at the back of the building
- Adjacent Berms: No
- Building constructed in 1996

System	Description	Location(s)	Notes
Utility Room	Furnace Room Well Room	South side of building, back of the garage, left door South side of building, back of garage, middle door	Wall vents to outside 2 furnaces Hot water expansion tank Well tank Communications Floor Drains
HVAC: Condensers			
A/C	2 large external AC/heat units (York LX Series - 14 SEER, 125,000 Btu, 81% AFUE Gas, Package Air Conditioner)	Southwest side of building, outside Bingo Hall	Not yet installed. Ground Level

	Daikin Air Conditioner Outdoor Compressor Outdoor Compressor	Outside Bingo Hall "Alcove" between garages	Elevated on metal legs 2 ft above grade Wall mounted, 1.5 ft above grade
Water heater:			
Furnace:			
Electrical: Panel (primary)	Yes	South Side of Garage (main building)	
Electrical into building	Underground	Route 85 side of building	
Electrical: Panels/Sub			
Electrical Outlets/1st flr			2.5 feet above ground 2 ft above ground
Communications Equipment	Yes Additional	Tank Room In Garage	4+ feet above ground 3 ft above ground
Plumbing: Potable	Well	Tank in room at back of garage (main building)	
Plumbing: Waste	Town		
Fuel System: Primary	Oil	Southwest side of building, outside kitchen	On cement block, 6" above gravel strip, another 6" above parking lot (curbed)
Fuel System: Secondary	Propane	Southwest side of building, outside kitchen	On cement block, 6" above gravel strip, another 6" above parking lot (curbed) Not strapped. 3 Additional tanks in "alcove" between main building and auxiliary garage
Fuel System: Vehicles	Diesel	Southwest side of building, outside kitchen	Tank inside protective metal crib. Chained.
Generator:	4 or 5 "boxes" (maybe for town) Indoor Standby Generator	South of building, across parking lot, adjacent to Grassy Hill Road. 1 of 3 doors at back of main garage	On fill at elevation of road. ~3 ft higher than parking lot. Appears to be mapped in AE zone. 4" off floor Vents to outside
Elevator			

Summary of Risks and Recommendations
Yantic Fire Company No. 1
151 Yantic Road
Norwich

Description of current flood risk *(all elevations are in feet, NAVD88)*	• The facility is mapped in an AE flood risk zone (BFE of 112.5') adjacent to the Yantic River floodway with lowest adjacent grade at 110.77', the lowest floor elevation (basement) of 101.8', and the lowest utilities are at elevation 102.4'. The facility's primary non-basement level (includes garages and office space) is elevation 111.57'. This places the entire facility at risk of a riverine flood that has a 1% chance of occurring in any year, with likelihood of the basement filling with water and one foot of water covering the garage floor. • The 0.2 annual chance flood elevation is 120' as depicted in in the FIS. The facility is at risk of severe flooding from the 0.2% annual chance flood, with significant depth of floodwaters possible in the primary non-basement level. • According to the hazard mitigation plan (2012), the site is frequently flooded.
Description of future flood risk *(all elevations are in feet, NAVD88)*	• Climate change is believed to be increasing the intensity of precipitation events and may also lead to greater overall precipitation in the state, which could increase risks along the Yantic River.
Description of municipal capabilities to address risks	• The Fire Company and the City of Norwich address heavy snow buildup, strong wind forecasts, and flood watches and warnings as needed. • According to the hazard mitigation plan (2012), the Fire Department moves equipment out of the building when major floods are forecast.
Description of flood risk reduction design criteria *(all elevations are in feet, NAVD88)* *FFRMS = Federal Flood Risk Management Standard* *FVA= Freeboard Value Approach* *CISA = Climate Informed Science Approach*	• The 0.2% flood elevation of 120' represents the design criteria per State requirements for critical facilities. • FFRMS flood risk based on the FVA is 115.5' (BFE + 3' for critical facilities). • FFRMS flood risk based on the 0.2% is 120'. • The CISA approach is not possible in inland flood settings until an appropriate method is established for projecting increases in riverine flood levels. • NYC Resiliency design criteria is BFE + 24" + SLR adjustment (zero in this inland case) = 114.5'.
Recommendations for building-specific flood risk reduction such as floodproofing, building elevation, elevation of utilities, sealing of openings, etc.	• Elevating the building is not feasible given the need for rapid vehicle dispatching. • Elevating the interior ground floor (garage and office area) by one foot would potentially avoid damage to the ground floor during a 1% flood. Continued operations during a flood would likely be impossible, however.

	• Relocating the facility is recommended. • Short-Term: Given the lowest adjacent grade of 110.77' and the primary floor elevation of 111.57' in relation to the BFE of 112.5', the most appropriate short-term recommendation is to eliminate the basement and move its functions to higher levels, and elevate equipment on the primary floor as much as possible. • Long-Term: the facility should be relocated. It is not prudent in the long term to additionally floodproof the facility to the depths of future flooding that could occur, since the 0.2% annual chance flood elevation is five feet above the primary non-basement floor elevation.
Planning-level cost estimates	• Short-Term: >$100,000 (relocation of utility equipment & associated changes to utility systems, clearing and filling of basement, renovation of other spaces to accommodate lost basement and upper-level spaces due to utilities) • Long-Term: >$10M (depends on land acquisition costs for new site)
Recommendations for on or off-site flood risk reduction such as flood walls, berms, raising grade, etc.	• The site is too tightly arranged and too close to the floodway for effective flood walls, berms, or raising grade. • Such work might protect structure, but ingress/egress would still be a problem during flood events, and as this is a critical emergency response facility that isn't acceptable
Planning-level cost estimates	• Not applicable
Resources	• FEMA 543, Design Guide for Improving Critical Facility Safety from Flooding and High Winds: Providing Protection to People and Buildings (2007), https://www.fema.gov/media-library/assets/documents/8811 • FEMA P-936, Floodproofing Non-Residential Buildings (July 2013), https://www.fema.gov/media-library/assets/documents/34270 • FEMA P-1037, Reducing Flood Risk to Residential Buildings That Cannot Be Elevated (September 2015), https://www.fema.gov/media-library/assets/documents/109669 • FEMA RA-2, Hurricane Sandy Recovery Advisory: Reducing Flood Effects in Critical Facilities (April 2013), https://www.fema.gov/media-library/assets/documents/30966 • FEMA P-942, Mitigation Assessment Team Report: Hurricane Sandy in New Jersey and New York – Building Performance Observations, Recommendations, and Technical Guidance (November 2013), https://www.fema.gov/media-library/assets/documents/85922 • FEMA P-348, Edition 2, Protecting Building Utility Systems from Flood Damage (February 2017) https://www.fema.gov/media-

	library/assets/documents/3729

Summary of Risks and Recommendations
Yantic Fire Company No. 1
151 Yantic Road
Norwich

Description of current wind risk	• Strong winds are experienced during nor'easters, tropical storms, and other storm events. • The winds from Hurricane Sandy in 2012 and T.S. Irene in 2011 did not damage the facility. • Future wind events can damage the facility's structure or roof if the wind speed exceeds the older codes in place when the building was last upgraded. • Wind can also damage accessory structures.
Description of future wind risk[1]	• Climate change may amplify the frequency and intensity of wind events like hurricanes, but it is not known whether higher wind speeds will be more commonplace.
Description of municipal capabilities to address risks and operate backup facilities	• The Fire Company and the City of Norwich address heavy snow buildup, strong wind forecasts, and flood watches and warnings as needed.
Description of wind risk reduction design criteria	• Connecticut Building Code Appendix N, 145 mph ultimate/112 mph nominal. • Connecticut is located in FEMA Zone II relative to maximum expected wind speed. The maximum expected wind speed for a three-second gust is 160 miles per hour. This wind speed could occur as a result of either a hurricane or a tornado • Climate change may amplify the frequency and intensity of wind events like hurricanes, but it is not known whether higher wind speeds will be more commonplace to the degree that current building codes are insufficient. Coincidentally, the maximum wind speeds specified in the code are those for Stonington.
Recommendations for wind risk reduction such as load path projects, shutters, etc.	• Shutters are recommended to protect windows and the large garage doors. • If the facility is relocated per the flood recommendations, the 160 mph criteria (or future building code) should be considered.
Planning-level cost estimates	•
Resources	• FEMA 543, Design Guide for Improving Critical Facility Safety from Flooding and High Winds: Providing Protection to People and Buildings (2007), https://www.fema.gov/media-library/assets/documents/8811

1. Connecticut Hazard Mitigation Plan Update, 2014

Summary of Risks and Recommendations
Yantic Fire Company No. 1
151 Yantic Road
Norwich

Description of current snow load risk	• Heavy snow events in 2011, 2013, and 2015 have necessitated monitoring and/or removing snow from buildings. • Future snow events can damage the facility's structure or roof if heavy buildup occurs without melting.
Description of future snow load risk[1]	• Climate change studies have projected a shorter winter season for Connecticut with a decreased overall snowpack. In addition, climate models have indicated that fewer but more intense precipitation events will occur during the winter period with more precipitation falling as rain rather than snow. This change in winter precipitation could result in less frequent but more intense snow storms with heavier snow.
Description of municipal capabilities to address risks and operate backup facilities	• The Fire Company and the City of Norwich address heavy snow buildup, strong wind forecasts, and flood watches and warnings as needed.
Description of snow load risk reduction design criteria	• Connecticut Building Code Appendix N, Ground Snow Load, 30 psf. • Climate change may decrease overall snow accumulations but could result in wet, dense, heavier snowfalls. It is not known whether current building codes are insufficient. The maximum ground snow load specified in the code is 40 psf for northwest Connecticut.
Recommendations for snow load risk reduction	• Procedures should be developed for removing snow from the roof.
Planning-level cost estimates	• Nominal
Resources	• FEMA P-957, Snow Load Safety Guide (2013), https://www.fema.gov/media-library/assets/documents/83501 • FEMA Snow Load Safety Guidance Flyer (2014), https://www.fema.gov/media-library/assets/documents/29670

1. Connecticut Hazard Mitigation Plan Update, 2014; and State Water Plan, 2017

Memorandum

TO: **File**

FROM: **Noah Slovin, CFM**

DATE: **May 4, 2017**

RE: **Yantic Fire Department – Critical Facililities Assessment**

Inspected with Nirdosh
No local personnel to meet with

According to the hazard mitigation plan (2012), the Yantic Fire Engine Company No. 1 is frequently flooded and the Fire Department moves equipment out of this building when major floods are forecast. Also according to the plan, the City is continuing to explore ways to mitigate flooding in this area.

- Building plans available: NO
- Site is located in the AE Flood zone (BFE 113) bordering a floodway.
- FFE is BASEMENT.
- Grading around site:
    - Main Building:
        - Ground floor slightly above grade, grading directs flow away from garage, amine doors
        - North side: grading more minor. 4 ft wide grassy strip, protected by curb, between basement window and ungraded parking lot.
        - East side: patio area. Train tracks direct water toward building. Slight rise at building creates channel through patio. Grading directs water to drainage grate between patio and parking area. Bulkhead door located here.
    - Auxiliary Building
        - Parking lot grading away from building
        - Patio area on north side: no grading
- Basement:
    - YES
    - Fully furnished with carpeting, electronics
    - Utility Room
    - Access inside building and through bulkhead on east side of building (at patio between building and train track berm.
- Ground Floor:
    - Garage – (2?) emergency vehicles
    - Restrooms
    - Office Space
    - Auxiliary Building - garage
- Exterior buildings:
    - Secondary garage southeast of main building
        - Houses two emergency vehicles
        - Electric in underground
        - No visible fuel tanks

        - Could not access building
    - Storage Shed
        - External electric outlets ~2 ft above grade
        - Back is right at edge of railroad berm and bridge
- Adjacent Berms: Railroad tracks on northeast edge of property form partial berm
- Site Description:
    - Main building:
        - Old stone structure on north end, later addition on south end.
        - Basement
        - 2.5 stories above ground, and a tower
        - Wood paneling inside. Carpeting in basement. Plaster wall in basement.
        - Railroad berm upstream
            - Crest forms 0.2% annual chance storm
            - Barrier – Floodway upstream, AE zone downstream
            - Main building is in AE zone
    - Auxiliary Building
        - Newer structure
        - On slab. 1.5 story (attic)
        - Possible utilities in attic space
        - Back wall right on edge of floodway

System	Description	Location(s)	Notes
Utility Room	Walk-in unfinished room in finished basement. Behind locked door.	Basement Level (full story below grade)	- Utilities elevated 6" above ground level - Sump with permanent pump - Water Heater - Furnace - Secondary electric panel (HVAC control panel?; 4' above grade) - Communication panel (4' above grade) - HVAC
HVAC: Condensers		In basement, hanging from ceiling	
A/C – Window or wall units	Window Units		
Water heater:	TriangleTube Phase III	In Basement	Boiler ~ 1 ft above floor 1 tank is lower 1 tank is ~ 1 ft above fl
Furnace:	MEGA brand	In Basement	1 ft above floor Steam heating - floor panels and rediators
Electrical: Panel (primary)	"Rescue Panel 1"	First Floor	3 ft above floor
Electrical into building	Main Building: overhead Auxiliary Garage: ground Shed: ground	Northwest corner	Connects at first floor ceiling height.
Electrical: Panels/Sub	HVAC Control Unit?	Basement	4 ft above floor
Electrical Outlets/1st flr		In extension garage	2.5 ft above floor
Communications Equipment	Communications Panel Siren	In Basement Tower - 34d Floor	4 ft above ground Siren control, heater, etc
Plumbing: Waste	Municipal System		
Plumbing: Potable	Municipal System		
Fuel System: Primary	Propane	Tank located on river side of building (East Side).	No straps
Fuel System: Secondary	Diesel	Under generator, 6" above grade	For generator
Generator:	Cummins Power	On river side of building (east side)	Diesel powered 2 ft above grade (on top of diesel tank)

Recommendations:

- Relocate utilities to upper floors
- Floodproof basement
    - Remove carpeting
    - Replace sheetrock internal walls
- Consider filling basement
- Relocate auxiliary building to road side of the lot
- Consider constructing floodwalls or berms
- Consider placing auxiliary building on fill

The Yantic Volunteer Fire Department Building provides historic resource value to the City of Norwich, and the structure itself is worth preservation. The most significant vulnerabilities at this site are:

1. The auxiliary garage and the shed adjacent to the Yantic River floodway
2. The basement of the main building

Mitigation of these vulnerabilities can be accomplished as follows:

1. Relocate the auxiliary garage and shed to the north side of the lot (protected by the railroad berm), across the street to the abandoned mill property, or to the western edge of the Fire Department lot. Consider elevating the structures on fill.
2. Elevate all utilities in the main building basement to the second story or higher
3. Fill or floodproof the main building basement
4. Construct a protective floodwall or berm around the buildings, leaving as much room for the river to flood as possible.
5. Consider turning the southeastern ends of the property into a lower-elevation floodplain, relieving some of the flood risk for the property and for properties farther downstream (note, this may also be applicable to additional abandoned properties downstream of the fire department).

Summary of Risks and Recommendations
Occum Fire Department
44 Taftville-Occum Road
Norwich

Description of current flood risk *(all elevations are in feet, NAVD88)*	• The facility is partly mapped in an AE flood risk zone (BFE of 63.5') and partly in the 0.2% annual chance floodplain, not far from the Shetucket River floodway, with lowest adjacent grade at 63.6'', the lowest floor elevation (basement) of 57.4', and the lowest utility room at elevation 57.4'. This places the facility at risk of a riverine flood that has a 1% chance of occurring in any year, with possibility of the basement filling with water if floodwaters flow over the lowest adjacent grade. • The 0.2 annual chance flood elevation is 67' as depicted in in the FIS. The facility is at risk of flooding from the 0.2% annual chance flood, with three feet of floodwaters possible in the facility's primary non-basement level of 64'. • According to the City, the facility has not flooded.
Description of future flood risk *(all elevations are in feet, NAVD88)*	• Climate change is believed to be increasing the intensity of precipitation events and may also lead to greater overall precipitation in the state, which could increase risks along the Shetucket River.
Description of municipal capabilities to address risks	• The Fire Company and the City of Norwich address heavy snow buildup, strong wind forecasts, and flood watches and warnings as needed.
Description of flood risk reduction design criteria *(all elevations are in feet, NAVD88)* *FFRMS = Federal Flood Risk Management Standard* *FVA= Freeboard Value Approach* *CISA = Climate Informed Science Approach*	• The 0.2% flood elevation of 67' represents the design criteria per State requirements for critical facilities. • FFRMS flood risk based on the FVA is 66.5' (BFE + 3' for critical facilities). • FFRMS flood risk based on the 0.2% is 67'. • The CISA approach is not possible in inland flood settings until an appropriate method is established for projecting increases in riverine flood levels. • NYC Resiliency design criteria is BFE + 24" + SLR adjustment (zero in this inland case) = 65.5'.
Recommendations for building-specific flood risk reduction such as floodproofing, building elevation, elevation of utilities, sealing of openings, etc.	• Elevating the building is not feasible given the need for rapid vehicle dispatching. • Relocating the facility is recommended. • Short-Term: Given the lowest adjacent grade of 63.6' and the primary floor elevation of 64' in relation to the BFE of 63.5', the most appropriate short-term recommendation is to eliminate the basement and move its functions to higher levels. • Long-Term: the facility should be relocated. It is not prudent in the long term to additionally floodproof the facility to the

	depths of future flooding that could occur, since the 0.2% annual chance flood elevation is three feet above the primary non-basement floor elevation.
Planning-level cost estimates	• Short-Term: >$100,000 (relocation of utility equipment & associated changes to utility systems, clearing and filling of basement, renovation of other spaces to accommodate lost basement and upper-level spaces due to utilities) • Long-Term: >$10M (depends on land acquisition costs for new site)
Recommendations for on or off-site flood risk reduction such as flood walls, berms, raising grade, etc.	• The Shetucket River floodplain and floodway are too extensive for effective flood walls, berms, or raising grade.
Planning-level cost estimates	• Not applicable
Resources	• FEMA 543, Design Guide for Improving Critical Facility Safety from Flooding and High Winds: Providing Protection to People and Buildings (2007), https://www.fema.gov/media-library/assets/documents/8811 • FEMA P-936, Floodproofing Non-Residential Buildings (July 2013), https://www.fema.gov/media-library/assets/documents/34270 • FEMA P-1037, Reducing Flood Risk to Residential Buildings That Cannot Be Elevated (September 2015), https://www.fema.gov/media-library/assets/documents/109669 • FEMA RA-2, Hurricane Sandy Recovery Advisory: Reducing Flood Effects in Critical Facilities (April 2013), https://www.fema.gov/media-library/assets/documents/30966 • FEMA P-942, Mitigation Assessment Team Report: Hurricane Sandy in New Jersey and New York – Building Performance Observations, Recommendations, and Technical Guidance (November 2013), https://www.fema.gov/media-library/assets/documents/85922 • FEMA P-348, Edition 2, Protecting Building Utility Systems from Flood Damage (February 2017) https://www.fema.gov/media-library/assets/documents/3729

Summary of Risks and Recommendations
Occum Fire Department
44 Taftville-Occum Road
Norwich

Description of current wind risk	• Strong winds are experienced during nor'easters, tropical storms, and other storm events. • The winds from Hurricane Sandy in 2012 and T.S. Irene in 2011 did not damage the facility. • Future wind events can damage the facility's structure or roof if the wind speed exceeds the older codes in place when the building was last upgraded. • Wind can also damage accessory structures.
Description of future wind risk[1]	• Climate change may amplify the frequency and intensity of wind events like hurricanes, but it is not known whether higher wind speeds will be more commonplace.
Description of municipal capabilities to address risks and operate backup facilities	• The Fire Company and the City of Norwich address heavy snow buildup, strong wind forecasts, and flood watches and warnings as needed.
Description of wind risk reduction design criteria	• Connecticut Building Code Appendix N, 145 mph ultimate/112 mph nominal. • Connecticut is located in FEMA Zone II relative to maximum expected wind speed. The maximum expected wind speed for a three-second gust is 160 miles per hour. This wind speed could occur as a result of either a hurricane or a tornado • Climate change may amplify the frequency and intensity of wind events like hurricanes, but it is not known whether higher wind speeds will be more commonplace to the degree that current building codes are insufficient. Coincidentally, the maximum wind speeds specified in the code are those for Stonington.
Recommendations for wind risk reduction such as load path projects, shutters, etc.	• Shutters are recommended to protect windows and the large garage doors. • When the roof is next replaced or upgraded, the 160 mph criteria (or future building code) should be considered.
Planning-level cost estimates	•
Resources	• FEMA 543, Design Guide for Improving Critical Facility Safety from Flooding and High Winds: Providing Protection to People and Buildings (2007), https://www.fema.gov/media-library/assets/documents/8811

1. Connecticut Hazard Mitigation Plan Update, 2014

Summary of Risks and Recommendations
Occum Fire Department
44 Taftville-Occum Road
Norwich

Description of current snow load risk	• Heavy snow events in 2011, 2013, and 2015 have necessitated monitoring and/or removing snow from buildings. • Future snow events can damage the facility's structure or roof if heavy buildup occurs without melting.
Description of future snow load risk[1]	• Climate change studies have projected a shorter winter season for Connecticut with a decreased overall snowpack. In addition, climate models have indicated that fewer but more intense precipitation events will occur during the winter period with more precipitation falling as rain rather than snow. This change in winter precipitation could result in less frequent but more intense snow storms with heavier snow.
Description of municipal capabilities to address risks and operate backup facilities	• The Fire Company and the City of Norwich address heavy snow buildup, strong wind forecasts, and flood watches and warnings as needed.
Description of snow load risk reduction design criteria	• Connecticut Building Code Appendix N, Ground Snow Load, 30 psf. • Climate change may decrease overall snow accumulations but could result in wet, dense, heavier snowfalls. It is not known whether current building codes are insufficient. The maximum ground snow load specified in the code is 40 psf for northwest Connecticut.
Recommendations for snow load risk reduction	• Procedures should be developed for removing snow from the roof.
Planning-level cost estimates	• Nominal
Resources	• FEMA P-957, Snow Load Safety Guide (2013), https://www.fema.gov/media-library/assets/documents/83501 • FEMA Snow Load Safety Guidance Flyer (2014), https://www.fema.gov/media-library/assets/documents/29670

1. Connecticut Hazard Mitigation Plan Update, 2014; and State Water Plan, 2017

Memorandum

TO: **File**

FROM: **Noah Slovin, CFM**

DATE: **April 24, 2017**

RE: **Occum Fire Department, Norwich CT – Critical Facililities Assessment**

Inspected with with Nirdosh. Met with Chief Bob LaChapelle.

- Building plans available: **No**
- Site is located in the AE Flood zone (partial)
  - BFE is 63 feet NAVD88
- FFE is 57.4 feet (basement) or 64.0 (main floor).
- Grading around site: insignificant
- 1st floor contains: Firefighting vehicles and equipment, electric panels
- Exterior outbuildings: two storage sheds
  - Attached garage
- Adjacent Berms: None

Bob noted plans to switch the station to natural gas, and remove the oil tank from the back.

He is interested in constructing a new shed to house the inflatable boat, but is concerned about where he will be allowed to place it because of the floodplain.

System	Description	Location(s)	Notes
Furnace / Boiler Room	Furnace Room	Basement (access through bulkhead doors	Has water level alarm
Utility Closet	Open. Fuse boxes, communication box, backup power box	within attached garage	
Exhaust Removal	Pymovent Exhaust Removal System	Within garage, secured to wall	Approximately 10 feet above grade
HVAC: Condensers			
A/C – wall units	Mitsubishi condenser	South side, first floor, outside wall Others on attached garage roof	1 ft above grade
Furnace & Boiler	Buderus Logano GE315	Basement furnace room	
Electrical: Panel (primary)		Attached garage	
Electrical into building	Overhead lines	Northwest corner, 2nd floor	Low wiring contained in metal tubes on outside wall on north side of building, between 1 and 3 feet above grade
Electrical: Panels/Sub			
Electrical Outlets/1st flr	Outdoor outlets Indoor Outlets	South side wall, next to air conditioner -	3 ft above grade 4 feet above grade
Communications Equipment	Communication Panel	Attached garage	2 feet above grade Communication antennae on roof and pole in parking lot (south side)
Plumbing: Waste	Public Sewer		
Plumbing: Potable	Public Distribution		
Fuel System: Primary	Oil	Tank on east side of attached garage	Contained in cement block
Fuel System: Secondary			
Generator:	Kohler	East side of building Transfer switch in attached garage	2.5 feet above grade
Elevator	None		

Summary of Risks and Recommendations
Norwich Public Works
50 Clinton Avenue
Norwich

Description of current flood risk *(all elevations are in feet, NAVD88)*	• The facility is mapped in the 0.2% annual chance floodplain. The adjacent AE flood risk zone has a BFE of 96', and the floodway of the Yantic River is across the road to the south. • The lowest adjacent grade is 98.3', the lowest floor elevation is 98.8', and the lowest utility room is at elevation 99.9'. This verifies that the facility is at low risk of a riverine flood that has a 1% chance of occurring in any year. • The 0.2 annual chance flood elevation is 101' as depicted in in the FIS. The facility is at risk of approximately two feet of flooding from the 0.2% annual chance flood. • According to the City, the facility has not flooded.
Description of future flood risk *(all elevations are in feet, NAVD88)*	• Climate change is believed to be increasing the intensity of precipitation events and may also lead to greater overall precipitation in the state, which could increase risks along the Shetucket River.
Description of municipal capabilities to address risks	• The City of Norwich addresses heavy snow buildup, strong wind forecasts, and flood watches and warnings as needed. • Sandbags are available and have been deployed during flood warnings.
Description of flood risk reduction design criteria *(all elevations are in feet, NAVD88)* *FFRMS = Federal Flood Risk Management Standard* *FVA= Freeboard Value Approach* *CISA = Climate Informed Science Approach*	• The 0.2% flood elevation of 101' represents the design criteria per State requirements for critical facilities. • FFRMS flood risk based on the FVA is 99' (BFE + 3' for critical facilities). • FFRMS flood risk based on the 0.2% is 101'. • The CISA approach is not possible in inland flood settings until an appropriate method is established for projecting increases in riverine flood levels. • NYC Resiliency design criteria is BFE + 24" + SLR adjustment (zero in this inland case) = 98'.
Recommendations for building-specific flood risk reduction such as floodproofing, building elevation, elevation of utilities, sealing of openings, etc.	• Elevating the building is not feasible given the need for vehicle dispatching and maintenance. • Relocating the facility is not warranted, but any plans to relocate the facility should target a location of lower risk. • Short-Term: Given the somewhat flashy nature of flooding along the Yantic River and the elevation of the first floor and utility room between the BFE and 0.2% annual chance flood elevation, the utility room should be dry floodproofed. • Long-Term: the facility should be wet floodproofed. This may not be excessively challenging, given the existing construction of the building.
Planning-level cost estimates	• Short-Term: $10/sf (utility room)

	• Long-Term: $5/sf (footprint of building) + $3,000 for flood vents
Recommendations for on or off-site flood risk reduction such as flood walls, berms, raising grade, etc.	• The Yantic River floodplain and floodway are too extensive – and the site too sprawling – for effective flood walls, berms, or raising grade.
Planning-level cost estimates	• Not applicable
Resources	• FEMA 543, Design Guide for Improving Critical Facility Safety from Flooding and High Winds: Providing Protection to People and Buildings (2007), https://www.fema.gov/media-library/assets/documents/8811 • FEMA P-936, Floodproofing Non-Residential Buildings (July 2013), https://www.fema.gov/media-library/assets/documents/34270 • FEMA P-1037, Reducing Flood Risk to Residential Buildings That Cannot Be Elevated (September 2015), https://www.fema.gov/media-library/assets/documents/109669 • FEMA RA-2, Hurricane Sandy Recovery Advisory: Reducing Flood Effects in Critical Facilities (April 2013), https://www.fema.gov/media-library/assets/documents/30966 • FEMA P-942, Mitigation Assessment Team Report: Hurricane Sandy in New Jersey and New York – Building Performance Observations, Recommendations, and Technical Guidance (November 2013), https://www.fema.gov/media-library/assets/documents/85922 • FEMA P-348, Edition 2, Protecting Building Utility Systems from Flood Damage (February 2017) https://www.fema.gov/media-library/assets/documents/3729

Summary of Risks and Recommendations
Norwich Public Works
50 Clinton Avenue
Norwich

Description of current wind risk	• Strong winds are experienced during nor'easters, tropical storms, and other storm events. • The winds from Hurricane Sandy in 2012 and T.S. Irene in 2011 did not damage the facility. • Future wind events can damage the facility's structure or roof if the wind speed exceeds the older codes in place when the building was last upgraded. • Wind can also damage accessory structures.
Description of future wind risk[1]	• Climate change may amplify the frequency and intensity of wind events like hurricanes, but it is not known whether higher wind speeds will be more commonplace.
Description of municipal capabilities to address risks and operate backup facilities	• The City of Norwich addresses heavy snow buildup, strong wind forecasts, and flood watches and warnings as needed.
Description of wind risk reduction design criteria	• Connecticut Building Code Appendix N, 145 mph ultimate/112 mph nominal. • Connecticut is located in FEMA Zone II relative to maximum expected wind speed. The maximum expected wind speed for a three-second gust is 160 miles per hour. This wind speed could occur as a result of either a hurricane or a tornado • Climate change may amplify the frequency and intensity of wind events like hurricanes, but it is not known whether higher wind speeds will be more commonplace to the degree that current building codes are insufficient. Coincidentally, the maximum wind speeds specified in the code are those for Stonington.
Recommendations for wind risk reduction such as load path projects, shutters, etc.	• Debris generation is a concern due to the presence of outbuildings and equipment stored outdoors. Protocols should be in place for securing anything that can become windborne. • When the roof is next replaced or upgraded, the 160 mph criteria (or future building code) should be considered.
Planning-level cost estimates	•
Resources	• FEMA 543, Design Guide for Improving Critical Facility Safety from Flooding and High Winds: Providing Protection to People and Buildings (2007), https://www.fema.gov/media-library/assets/documents/8811

1. Connecticut Hazard Mitigation Plan Update, 2014

Summary of Risks and Recommendations
Norwich Public Works
50 Clinton Avenue
Norwich

Description of current snow load risk	• Heavy snow events in 2011, 2013, and 2015 have necessitated monitoring and/or removing snow from buildings. • Future snow events can damage the facility's structure or roof if heavy buildup occurs without melting.
Description of future snow load risk[1]	• Climate change studies have projected a shorter winter season for Connecticut with a decreased overall snowpack. In addition, climate models have indicated that fewer but more intense precipitation events will occur during the winter period with more precipitation falling as rain rather than snow. This change in winter precipitation could result in less frequent but more intense snow storms with heavier snow.
Description of municipal capabilities to address risks and operate backup facilities	• The City of Norwich addresses heavy snow buildup, strong wind forecasts, and flood watches and warnings as needed.
Description of snow load risk reduction design criteria	• Connecticut Building Code Appendix N, Ground Snow Load, 30 psf. • Climate change may decrease overall snow accumulations but could result in wet, dense, heavier snowfalls. It is not known whether current building codes are insufficient. The maximum ground snow load specified in the code is 40 psf for northwest Connecticut.
Recommendations for snow load risk reduction	• Procedures should be developed for removing snow from the roof.
Planning-level cost estimates	• Nominal
Resources	• FEMA P-957, Snow Load Safety Guide (2013), https://www.fema.gov/media-library/assets/documents/83501 • FEMA Snow Load Safety Guidance Flyer (2014), https://www.fema.gov/media-library/assets/documents/29670

1. Connecticut Hazard Mitigation Plan Update, 2014; and State Water Plan, 2017

Memorandum

TO: **File**

FROM: **Noah Slovin, CFM**

DATE: **April 24, 2017**

RE: **Norwich Public Works Garage – Critical Facililities Assessment**

Inspected with with Nirdosh.

The City's Department of Public Works offices and garage are located in the 0.2% annual chance floodplain of the Yantic River on the periphery of the 1% annual chance floodplain. This facility is located on the north side of Clinton Avenue and is susceptible to flood damage. According to the 2012 hazard mitigation plan, the City stores sandbags at this facility which they deploy to protect the structure when major floods are forecast.

- Building plans available: DPW staff were not able to locate
- Site is located in the 0.2% Flood zone – nearby BFE is 96 ft NAVD88.
- FFE is 98.8'.
- Grading around site: None
- 1st floor contains: offices, garage, utilities
- Exterior outbuildings:
    - 2 Sand Domes
    - 1 on-site gas station
    - Cell Tower (AT&T) in back of building
    - Small low utility closet by road
    - Cage with assorted construction materials and 2 propane tanks (with chain) in back
    - Storage Shed (With vent) in northeast corner of building
    - 4 Shipping containers in back
    - Secondary Garage in Back on adjacent site
- Adjacent Berms: None
- Building Material: Cement Block walls inside, corrugated metal outside
- Other Features:
    - Air compressor - 6 inches above grade in garage
    - Office: contains documents, equipment at floor level
    - Box marked for gas storage in back left corner of garage
    - Gas station (gasoline and diesel) in parking lot, back left

System	Description	Location(s)	Notes
Boiler Room	Separate entrance	Southwest Corner of Building	-Kohler Fast Response II Backup Generator (oil) -The Bigelow Co. Furnace (oil)\ -Boiler and tank -Elevated hot water tank -Backflow prevention system
HVAC: Condensers	Multiple	In main Garage	Suspended on metal platforms from ceiling 12 feet above grade
A/C – wall units	Wall Units above windows	Front side of building (offices)	
Water heater:	Boiler & Tank Hot water tank Boiler & Tank	Boiler Room Boiler Room Main garage above bathrooms	1 ft above grade on wooden box 4.5 ft above grade on metal crib 8 ft up on internal roof
Furnace:	The Bigelow Company	Boiler Room	Oil 1 foot above grade Very old
Electrical: Panel (primary)		alcove in main garage	4 boxes. Includes generator switch. Lowest is 1 ft above grade
Electrical into building	Underground	Northwest corner of building	
Electrical: Panels/Sub		-In main garage next to air compressor & comms -Main garage next to soda machine	3 ft above grade 5 ft above grade
Electrical Outlets/1st flr		Boiler Room Offices	1.5 ft above grade 1 ft above grade
Communications Equipment	Communications box (multiple)	Main garage on wall with offices	3 ft above grade One is exposed (no cover
Plumbing: Waste	Public Waste		
Plumbing: Potable	Public Water		
Fuel System: Primary	Oil		
Fuel System: Secondary	Oil		
Generator:	Kohler Fast Response II	Boiler Room	Oil

			2 ft above grade Battery pack is 6 inches above grade
Elevator	None		

Other Features:

Summary of Risks and Recommendations
Preston Public Works
423 Route 2
Preston

Description of current flood risk *(all elevations are in feet, NAVD88)*	• The facility is mapped in an X zone adjacent to an unnumbered A zone along the headwaters of Shewville Brook, indicating an assumption of relatively low flood risk. • MMI determined that the approximate base flood elevation at the point nearest to the public works facility building is 123', which is lower than the lowest adjacent grade at 125.37 feet, lowest floor elevation of 125.79 feet, and utility room at elevation 126.29 feet. • The 0.2 annual chance flood elevation for a non-coastal unnumbered A zone cannot reasonably be estimated. However, it is likely that the 0.2% flood elevation would be one to five feet higher than the base flood, which could create some flood risk for the facility. • The flood of March 2010 did not flood the facility.
Description of future flood risk *(all elevations are in feet, NAVD88)*	• Climate change is believed to be increasing the intensity of precipitation events and may also lead to greater overall precipitation in the state, which could increase risks along the headwaters of Shewville Brook.
Description of municipal capabilities to address risks	• The Town addresses heavy snow buildup, strong wind forecasts, and flood watches and warnings as needed.
Description of flood risk reduction design criteria *(all elevations are in feet, NAVD88)* *FFRMS = Federal Flood Risk Management Standard* *FVA= Freeboard Value Approach* *CISA = Climate Informed Science Approach*	• FFRMS flood risk based on the FVA is 126' (BFE + 3' for critical facilities). • The 0.2% floodplain FRFMS approaches is not possible here. • The CISA approach is not possible in inland flood settings until an appropriate method is established for projecting increases in riverine flood levels. • NYC Resiliency design criteria is BFE + 24" + SLR adjustment (zero in this inland case) = 125'.
Recommendations for building-specific flood risk reduction such as floodproofing, building elevation, elevation of utilities, sealing of openings, etc.	• Elevating the building is not feasible. • Relocating the facility's uses may be possible. • Short-Term: Short-term actions for the facility are not necessary. However, the Town should work with FEMA to establish base flood elevations along Shewville Brook. If base flood elevations are higher than 123', actions may be recommended. • Long-Term: climate change will create slightly increased flood risks, with the FFRMS FVA flood elevation at the first floor elevation. A combination of wet and dry floodproofing for the main building may be prudent in the future. Outbuildings should be made floodable (especially the lower floor of the storage building) and fuel tanks should be secured. Relocation of some structures and uses (for

	example, the small shed at the western edge of the site, or the large storage building) within the site may be feasible.
Planning-level cost estimates	• Short-Term: Not applicable • Long-Term: $5/sf (footprint of building) + $3,000 for flood vents
Recommendations for on or off-site flood risk reduction such as flood walls, berms, raising grade, etc.	• The site likely has sufficient space for flood walls, berms, or raising grade along the edge of the A zone, although the cost of such action is not justifiable at this time.
Planning-level cost estimates	• Not applicable
Resources	• FEMA 543, Design Guide for Improving Critical Facility Safety from Flooding and High Winds: Providing Protection to People and Buildings (2007), https://www.fema.gov/media-library/assets/documents/8811 • FEMA P-936, Floodproofing Non-Residential Buildings (July 2013), https://www.fema.gov/media-library/assets/documents/34270 • FEMA P-1037, Reducing Flood Risk to Residential Buildings That Cannot Be Elevated (September 2015), https://www.fema.gov/media-library/assets/documents/109669 • FEMA RA-2, Hurricane Sandy Recovery Advisory: Reducing Flood Effects in Critical Facilities (April 2013), https://www.fema.gov/media-library/assets/documents/30966 • FEMA P-942, Mitigation Assessment Team Report: Hurricane Sandy in New Jersey and New York – Building Performance Observations, Recommendations, and Technical Guidance (November 2013), https://www.fema.gov/media-library/assets/documents/85922 • FEMA P-348, Edition 2, Protecting Building Utility Systems from Flood Damage (February 2017) https://www.fema.gov/media-library/assets/documents/3729

Summary of Risks and Recommendations
Preston Public Works
423 Route 2
Preston

Description of current wind risk	• Strong winds are experienced during nor'easters, tropical storms, and other storm events. • Future wind events can damage the facility's structure or roof if the wind speed exceeds the older codes in place when the building was last upgraded. • Wind can also damage accessory structures and create windborne debris.
Description of future wind risk[1]	• Climate change may amplify the frequency and intensity of wind events like hurricanes, but it is not known whether higher wind speeds will be more commonplace.
Description of municipal capabilities to address risks and operate backup facilities	• The Town addresses heavy snow buildup, strong wind forecasts, and flood watches and warnings as needed.
Description of wind risk reduction design criteria	• Connecticut Building Code Appendix N, 145 mph ultimate/112 mph nominal. • Connecticut is located in FEMA Zone II relative to maximum expected wind speed. The maximum expected wind speed for a three-second gust is 160 miles per hour. This wind speed could occur as a result of either a hurricane or a tornado • Climate change may amplify the frequency and intensity of wind events like hurricanes, but it is not known whether higher wind speeds will be more commonplace to the degree that current building codes are insufficient.
Recommendations for wind risk reduction such as load path projects, shutters, etc.	• Debris generation is a concern due to the presence of outbuildings and equipment stored outdoors. Protocols should be in place for securing anything that can become windborne. • When the roof is next replaced or upgraded, the 160 mph criteria (or future building code) should be considered.
Planning-level cost estimates	• Nominal
Resources	• FEMA 543, Design Guide for Improving Critical Facility Safety from Flooding and High Winds: Providing Protection to People and Buildings (2007), https://www.fema.gov/media-library/assets/documents/8811

1. Connecticut Hazard Mitigation Plan Update, 2014

Summary of Risks and Recommendations
Preston Public Works
423 Route 2
Preston

Description of current snow load risk	• Heavy snow events in 2011, 2013, and 2015 have necessitated monitoring and/or removing snow from buildings. • Future snow events can damage the facility's structure or roof if heavy buildup occurs without melting.
Description of future snow load risk[1]	• Climate change studies have projected a shorter winter season for Connecticut with a decreased overall snowpack. In addition, climate models have indicated that fewer but more intense precipitation events will occur during the winter period with more precipitation falling as rain rather than snow. This change in winter precipitation could result in less frequent but more intense snow storms with heavier snow.
Description of municipal capabilities to address risks and operate backup facilities	• The Town addresses heavy snow buildup, strong wind forecasts, and flood watches and warnings as needed. • Snow removal equipment is houses at this facility.
Description of snow load risk reduction design criteria	• Connecticut Building Code Appendix N, Ground Snow Load, 30 psf. • Climate change may decrease overall snow accumulations but could result in wet, dense, heavier snowfalls. It is not known whether current building codes are insufficient. The maximum ground snow load specified in the code is 40 psf for northwest Connecticut.
Recommendations for snow load risk reduction	• Procedures should be developed for removing snow from the roof.
Planning-level cost estimates	• Nominal
	• FEMA P-957, Snow Load Safety Guide (2013), https://www.fema.gov/media-library/assets/documents/83501 • FEMA Snow Load Safety Guidance Flyer (2014), https://www.fema.gov/media-library/assets/documents/29670

1. Connecticut Hazard Mitigation Plan Update, 2014; and State Water Plan, 2017

Memorandum

TO: **File**

FROM: **Noah Slovin, CFM**

DATE: **5/4/2-17**

RE: **Preston Public Works Garage – Critical Facililities Assessment**

Noah Slovin

- Building plans available (Y/N)
- Site is located adjacent to a Zone A Flood Zone.
- Site consists of multiple structures
    - Main Building
    - Fuel Shed
    - Storage Building (closer to floodplain)
    - Lean-to 1
    - Lean-to 2
    - Shed (west of lean-to 1, adjacent to floodplain)
- Grading around Site
    - Gravel parking area, some degraded cement
    - General grading to west toward Shewville Brook
    - Main Building
        - East side backs sports fields about 2ft above DPW grade
        - Grading down to west away from building
    - Storage Building
        - Built into hill. East side ground level is second floor.
        - Grading away from building on all sides
- 1st floor contains:
    - Main Building
        - Garage
        - Utilities
        - Office
        - Storage
        - Vehicle Cleaning Room
    - Fuel Shed
        - Gasoline Pump
        - Diesel Pump
        - Buried Tanks
    - Storage Building
        - Basement
        - Drums (contents unknown)
        - Portable tank (Snyder Industries Tank) & engine (Honda GX160 5.5 hp)
        - Equipment storage
        - Electric box, switches, outlets - 3 ft above grade
    - Lean-to 1

        - Sand
    - Lean-to 2 (Sand)
        - Sand
    - Shed
        - Unknown
        - Has lights on outside - electric in through utility pole?
- No Adjacent Berms or other Flood Control Structures

System	Description	Location(s)	Notes
Utility Room	Utilities and lounge area	Main Building 1st Floor Southeast Corner	Boiler Well storage tank
HVAC: Condensers	Modine, Ceiling Mounted	Main Garage	
A/C	Wall Unit	Office - back to Garage	3 ft above grade
Water heater:		Utility Room	On wood block 6" above grade
Furnace:	Clean Burn Energy Systems: CB-2500 Structure with Oil tank 2 ft above ground, furnace mounted above it, 10 ft a.g.		
Electrical: Panel (primary)		Main Building, Garage	4 ft above ground
Electrical into building	Underground	South Side of Main Building	Meter & Building Engry at 4 ft above grade
Electrical: Panels/Sub			
Electrical Outlets/1st flr			4 feet above grade
Communications Equipment	Transmitters	South side of building	
Plumbing: Waste			
Plumbing: Potable	Well Water WELL-X-TROL	Utility Room	On wood block 6" above grade
Fuel System: Primary			
Fuel System: Secondary			
Generator:	Yes	South of Main Building. Located on earth at level of ball field	Power into building: wires in metal pipes along retaining wall of ballfield. Located on field level
Other	Flammable Storage	Main Garage, East Wall	

Summary of Risks and Recommendations
Sprague Town Hall
1 Main Street
Sprague

Description of current flood risk *(all elevations are in feet, NAVD88)*	• The facility is mapped mostly within the AE zone (elevation 84') associated with the Beaver Brook, although some backwater effects from the Shetucket River may influence flood levels. A floodway along Beaver Brook is immediately adjacent to the northern wing of the Town Hall, whereas the southern end (Public Works) is mapped in the 0.2% annual chance zone. • The 0.2 annual chance flood elevation from the FIS is 89.4'. • For the Town Hall, the lowest adjacent grade is 81.79', the first floor elevation is 82.05', and the lowest utility room is at 80.75' (this is a half-size basement beneath the Public Works wing). • For the Public Works wing, the lowest adjacent grade is 82.19', the first floor elevation is 80.36', and the lowest utility room is at 80.75' (this is a half-size basement beneath the Public Works wing). • The flood of March 2010 did not flood the facility.
Description of future flood risk *(all elevations are in feet, NAVD88)*	• Climate change is believed to be increasing the intensity of precipitation events and may also lead to greater overall precipitation in the state, which could increase risks along Beaver Brook and the Shetucket River.
Description of municipal capabilities to address risks	• The Town addresses heavy snow buildup, strong wind forecasts, and flood watches and warnings as needed.
Description of flood risk reduction design criteria *(all elevations are in feet, NAVD88)* *FFRMS = Federal Flood Risk Management Standard* *FVA= Freeboard Value Approach* *CISA = Climate Informed Science Approach*	• The 0.2% flood elevation of 89.4' represents the design criteria per State requirements for critical facilities. • FFRMS flood risk based on the FVA is 87' (BFE + 3' for critical facilities). • FFRMS flood risk based on the 0.2% is 89.4'. • The CISA approach is not possible in inland flood settings until an appropriate method is established for projecting increases in riverine flood levels. • NYC Resiliency design criteria is BFE + 24" + SLR adjustment (zero in this inland case) = 86'.
Recommendations for building-specific flood risk reduction such as floodproofing, building elevation, elevation of utilities, sealing of openings, etc.	• Elevating the building is not feasible due to its complex construction (with separate floors in each wing) and various uses. • Relocating the facility's uses may be possible in the very long term, although the Town has stated that this is not desired. • Relocating uses within the existing structure may be an effective adaptation option. Critical uses can be located on the second story of the Town Hall. • Short-Term: The main utility room is more than three feet

	below the BFE, and it should be eliminated. The utility room should be relocated to a higher level, of which there may be several choices depending on the wing of the building that is selected. There are a number of different utilities, utility rooms, and locations (one at the northwest corner serving the senior center, oil & diesel tanks at grade outside the half-basement, emergency power, propane tank across the parking lot adjacent to the river); these should be consolidated when possible during the transition to a higher level. • Long-Term Option 1: Eventually, all remaining floors below the 0.2% flood elevation should be wet floodproofed. This would include at a minimum the floors at elevations 80.36' and 82.05'. Floodproofed materials should extend vertically at least to the 0.2% flood elevation of 89.4' plus whatever freeboard is needed, which would largely mean that the entire vertical extents of these lower levels (floor to ceiling) would be floodproofed.
Planning-level cost estimates	• Short-Term: $50,000-$10,000 to relocate utilities and fill basement • Long-Term Option 1: $10/sf + $3,000 for flood vents
Recommendations for on or off-site flood risk reduction such as flood walls, berms, raising grade, etc.	• Long-Term Option 2: The site layout is not ideal for protection with a flood wall, but it could possibly be accomplished by installing a wall along Beaver Brook, turning east along Main Street, and meeting higher grade at Brookside Avenue. Openings would need to be installed for the various garage bays and pedestrian access, and closure structures would need to be provided for those openings.
Planning-level cost estimates	• $1,000 per linear foot depending on complexity. Height, and number of openings
Resources	• FEMA 543, Design Guide for Improving Critical Facility Safety from Flooding and High Winds: Providing Protection to People and Buildings (2007), https://www.fema.gov/media-library/assets/documents/8811 • FEMA P-936, Floodproofing Non-Residential Buildings (July 2013), https://www.fema.gov/media-library/assets/documents/34270 • FEMA P-1037, Reducing Flood Risk to Residential Buildings That Cannot Be Elevated (September 2015), https://www.fema.gov/media-library/assets/documents/109669 • FEMA RA-2, Hurricane Sandy Recovery Advisory: Reducing Flood Effects in Critical Facilities (April 2013), https://www.fema.gov/media-library/assets/documents/30966 • FEMA P-942, Mitigation Assessment Team Report: Hurricane Sandy in New Jersey and New York – Building Performance

	Observations, Recommendations, and Technical Guidance (November 2013), https://www.fema.gov/media-library/assets/documents/85922 • FEMA P-348, Edition 2, Protecting Building Utility Systems from Flood Damage (February 2017) https://www.fema.gov/media-library/assets/documents/3729

Summary of Risks and Recommendations
Sprague Town Hall
1 Main Street
Sprague

Description of current wind risk	• Strong winds are experienced during nor'easters, tropical storms, and other storm events. • The winds from Hurricane Sandy in 2012 and T.S. Irene in 2011 did not damage the facility. • Future wind events can damage the facility's structure or roof if the wind speed exceeds the older codes in place when the building was last upgraded. Solar panels are located on the facility, as well. • Wind can also damage accessory structures.
Description of future wind risk[1]	• Climate change may amplify the frequency and intensity of wind events like hurricanes, but it is not known whether higher wind speeds will be more commonplace.
Description of municipal capabilities to address risks and operate backup facilities	• The Town addresses heavy snow buildup, strong wind forecasts, and flood watches and warnings as needed.
Description of wind risk reduction design criteria	• Connecticut Building Code Appendix N, 140 mph ultimate/108 mph nominal. • Connecticut is located in FEMA Zone II relative to maximum expected wind speed. The maximum expected wind speed for a three-second gust is 160 miles per hour. This wind speed could occur as a result of either a hurricane or a tornado • Climate change may amplify the frequency and intensity of wind events like hurricanes, but it is not known whether higher wind speeds will be more commonplace to the degree that current building codes are insufficient. Coincidentally, the maximum wind speeds specified in the code are those for Stonington.
Recommendations for wind risk reduction such as load path projects, shutters, etc.	• Shutters are recommended to protect windows. • When the roof is next replaced or upgraded, the 160 mph criteria (or future building code) should be considered. This will need to be carefully coordinated with the use of solar panels.
Planning-level cost estimates	•
Resources	• FEMA 543, Design Guide for Improving Critical Facility Safety from Flooding and High Winds: Providing Protection to People and Buildings (2007), https://www.fema.gov/media-library/assets/documents/8811

1. Connecticut Hazard Mitigation Plan Update, 2014

Summary of Risks and Recommendations
Sprague Town Hall
1 Main Street
Sprague

Description of current snow load risk	• Heavy snow events in 2011, 2013, and 2015 have necessitated monitoring and/or removing snow from buildings. • Future snow events can damage the facility's structure, roof, or solar panels if heavy buildup occurs without melting.
Description of future snow load risk[1]	• Climate change studies have projected a shorter winter season for Connecticut with a decreased overall snowpack. In addition, climate models have indicated that fewer but more intense precipitation events will occur during the winter period with more precipitation falling as rain rather than snow. This change in winter precipitation could result in less frequent but more intense snow storms with heavier snow.
Description of municipal capabilities to address risks and operate backup facilities	• The Town addresses heavy snow buildup, strong wind forecasts, and flood watches and warnings as needed.
Description of snow load risk reduction design criteria	• Connecticut Building Code Appendix N, Ground Snow Load, 30 psf. • Climate change may decrease overall snow accumulations but could result in wet, dense, heavier snowfalls. It is not known whether current building codes are insufficient. The maximum ground snow load specified in the code is 40 psf for northwest Connecticut.
Recommendations for snow load risk reduction	• Procedures should be developed for removing snow from the roof. This will need to be carefully coordinated with the use of solar panels.
Planning-level cost estimates	• Nominal
Resources	• FEMA P-957, Snow Load Safety Guide (2013), https://www.fema.gov/media-library/assets/documents/83501 • FEMA Snow Load Safety Guidance Flyer (2014), https://www.fema.gov/media-library/assets/documents/29670

1. Connecticut Hazard Mitigation Plan Update, 2014; and State Water Plan, 2017

Memorandum

TO: **File**

FROM: **Noah Slovin CFM**

DATE: **April 21, 2017**

RE: **Sprague Town Hall and Department of Public Works – Critical Facililities Assessment**

Inspected with with Nirdosh. Met with First Selectman Cathy Osten

- Building plans available: No. First Selectman suggested Facilities manager may have but they were not available.
- Site is located in the AE Flood zone (84 ft BFE).
- FFE is unknown.
- Grading appears to direct water away from building. On the west side water is directed to a drainage divot within the retaining wall alongside the brook.
- 1st floor contains:
    - Senior Center
        - Utility closet
        - Kitchen
        - Garage
        - Animal Control office
    - Town Hall Offices
    - Department of Public Works - partial basement
        - Diesel Tank
        - Oil Tank
        - Utility closet (3 furnaces)
        - Storage
- No exterior outbuildings
- Adjacent Features
    - Building parking lot is built on fill and protected from the brook by a retaining wall
    - Retaining wall extends about" above parking lot grade, but includes a drainage divot
    - A run-of-river dam-like structure, partially breached, is located to the west of the drainage divot. The dam creates an island within the brook, with water flowing around the east and west ends. A high water event will largely be directed into a low floodplain on the west bank of the river, but water will also flow through the smaller breach on the east side, adjacent to the parking lot.

System	Description	Location(s)	Notes
Utility Room	3 furnaces Hot water tank Electrical Panel? Cement floor Cement Block Walls	Within ½ basement under the DPW.	Window vent to outside - Floodwater access point
HVAC: Condensers		Elevated on metal structure at 2nd floor window level above wooden shed/lean-to	
A/C	Window Units	First and second floors, all building sides	
Water heater & Furnace	3x Buderus Logano GE315	In DPW ½ basement	On cement blocks approximately 5" above grade
Secondary Furnaces	Unknown	Vents and stacks at southeast end of building imply furnaces	
Electrical: Panel (primary)		In DPW ½ basement	Approximately 4 ft above grade
Electrical into building	Overhead Wires	Connection at southeast corner	
Electrical: Panels/Sub	Elevator Control	Utility Closet in Senior Center	
Electrical Outlets/1st flr	4 feet high	Senior Center first floor	
Communications Equipment		Unknown	
Plumbing: Waste	Town Sewer		
Plumbing: Potable	Public Water		
Fuel System: Primary	Oil	In wooden shed	
Fuel System: Secondary	Propane	Next to brook. Pipeline through parking lot to generator	No Straps
Fuel System: Vehicles	Diesel	In Wooden Shed	
Generator:	Kohler Likely Propane	Backside of building, north of wooden shed.	On concrete pad: 0.5 to 1 ft above grade. Additional 2 feet of generator base.
Portable Generator	Trailer unit	Located in back of building Propane tank sits next to it.	No straps on propane
Elevator	Hydraulic Elevator	In Senior Center	Control Panel in Senior Center