December 22, 2020

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RE Letter of Recommendations for the Zoning Board of Appeals Meeting – Dec. 22, 2020
Climate Change Considerations for the East Arlington Mugar Site

Talking Point 1: FEMA Regulations vs. Neighboring Communities

- **Current design relies solely on regulatory FEMA base flood elevation (Zone AE, 100-yr floodplain, flood elevation of 6.8 ft-NAVD88 elevation)**
    - The site is located in Zone AE **AND** Zone X (500-yr floodplain, FEMA elevation 10.7 ft-NAVD88)
    - FEMA design does not consider Sea Level Rise / Storm Surge Effects due to climate change

- **Neighboring communities HAVE considered these effects in their design**
    - Regional coordination is a crucial component of climate resiliency. Coordination and collaboration across communities, State Agencies, and jurisdictions, can help strengthen resilient designs and implementation.
    - Cambridge & Boston
        - Boston and Cambridge have included coastal flood resilient design that accounts for latest sea-level rise (SLR) and storm surge (SS) projections from the Boston Harbor Flood Risk Model developed by the Woods Hole Group for MassDOT. These projections are currently being updated as part of the Massachusetts Coastal Flood Risk Model (MC-FRM), which will serve as new design standards for buildings and infrastructure projects across the Commonwealth and will be recommended that cities and towns adopt.
            - Prior to the MC-FRM flood elevations being available, the BH-FRM elevations can serve as a minimal estimate of future projections at the proposed site, as the MC-FRM has consistently projected higher elevations for adjacent areas.
        - The City of Cambridge is recommending all new developments build/protect to the 2070 10-yr flood elevation (precipitation or SS/SLR, whichever is higher) and recover from the 2070 100-yr flood elevation (precipitation or SS/SLR, whichever is higher).
        - The table below presents the flood elevations under present and future scenarios that would need to be considered at the site for future development

	Flood Elevation (ft-NAVD88)
FEMA 100-Yr	10.75
FEMA 500-Yr	6.75
2070 100-Yr SLR/SS	10.85
2070 100-Yr Precip	3.55
Mugar Site 2070 100-Yr	12*

Commented [HA1]: Use this from Cambridge tool or FIS flood profile elev.?

*Ground elevation across the site ranges from –2 to 6 ft-NAVD88, which implies that estimated maximum flood elevation approximately 12 ft NAVD88.

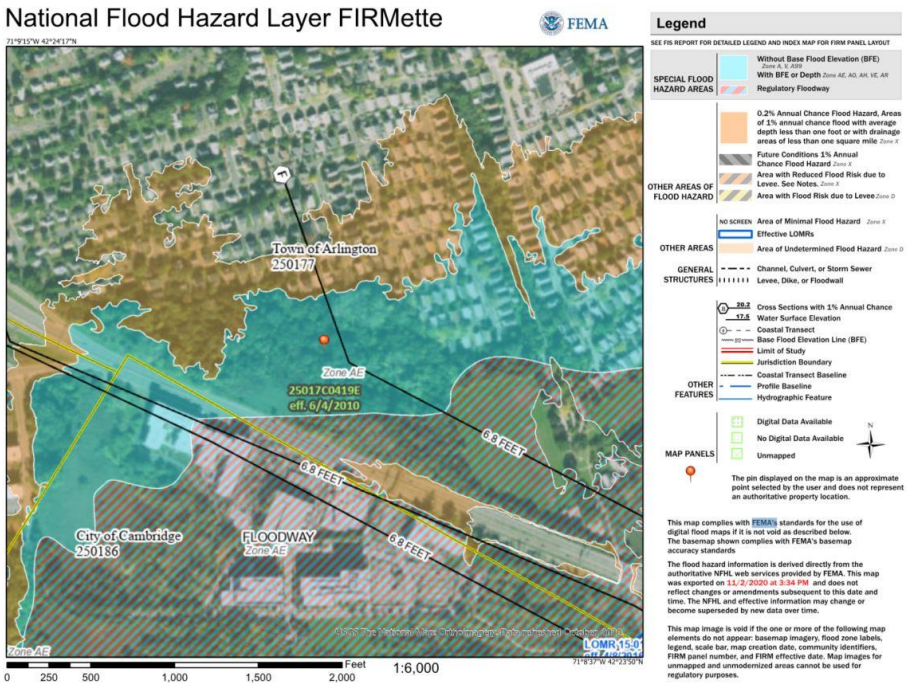

Figure 1. FEMA Flood Map

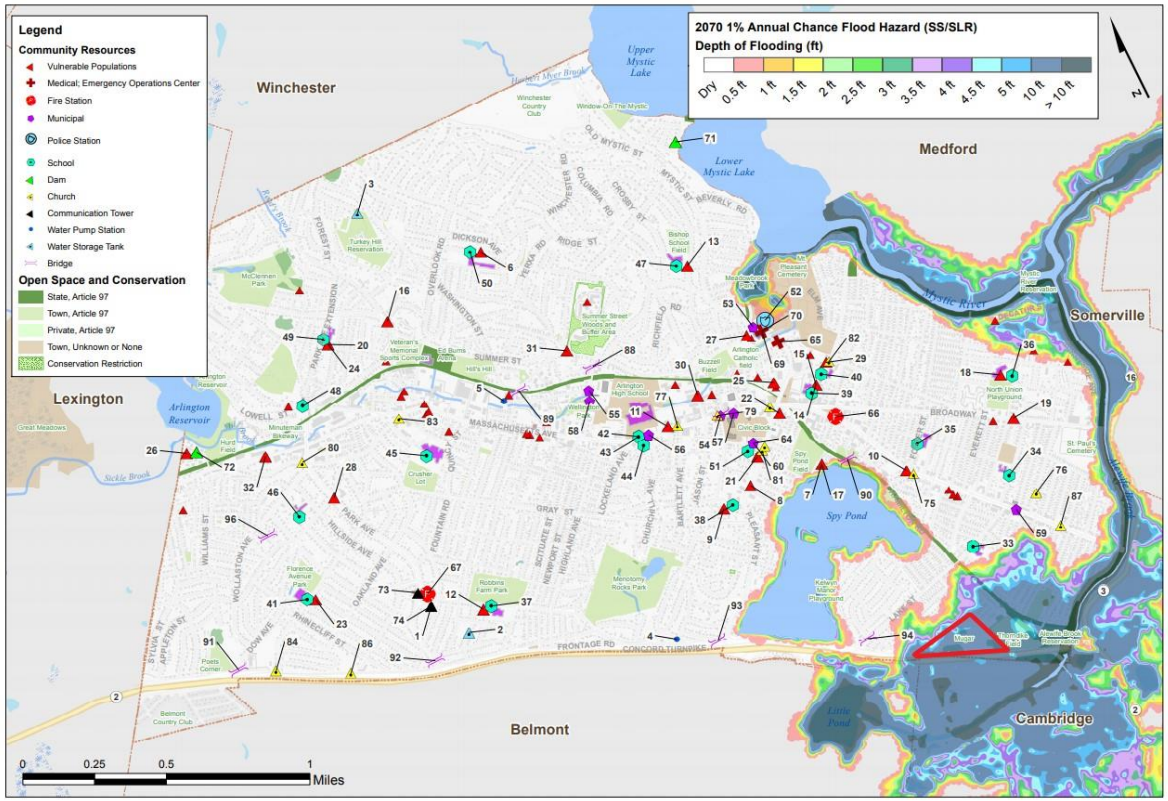

Figure 2. Arlington BH-FRM Map

- Amelia Earhart Dam
  - Affects flood elevations on the Mystic River, Lower Mystic Lake, and Alewife Brook (Little River). The Department of Conservation and Recreation (DCR) is actively undertaking Feasibility Analysis on Raising and Extending the Amelia Earhart Dam and pursuing this effort in coordination with regional resiliency efforts.
  - The BH-FRM results estimated that both the Amelia Earhart Dam (AED) and the Charles River Dam are likely to be flanked 10-15 years before they are likely to be overtopped. This indicates that the local crest elevations and pump systems are more resilient to flood potential than the surrounding landscape. According to the Cambridge Climate Change Vulnerbaility Assessment, the AED is likely to be flanked by 2035 and overtopped by 2045.
  - If the Amelia Earhart Dam is flanked and overtopped, it implies that the coastal flooding from the Boston Harbor will affect the proposed development site, and the site is likely to experience a greater than 20% annual probability of flooding by 2070.
  - There are ongoing efforts for DCR to raise the AED, but the timeline for these improvements at AED are uncertain. Hence the proposed development at Thorndike place should consider these future flooding impacts.

Talking Point 2: Design Storm Depths

- **In the November 2020 Stormwater Report, prepared by the BSC Group, design of the stormwater management system was stated to exceed the provisions of the Department of Environmental Protection (DEP) Stormwater Management Standards.**
  - The site and adjacent areas already see significant flooding from extreme precipitation events that is combination of riverine flooding and piped infrastructure flooding. The proposed development may exacerbate flooding conditions at the site if appropriate stormwater flood mitigation strategies are not designed at the site, especially considering future rainfall conditions.
  - The design storm depth values used for their HydroCAD analysis may meet the rainfall conditions outlined above, but do not consider the increased magnitude of storm events predicted out to the 2070s planning horizon.
- **Future MassDEP Standards – NOAA Plus Method (Solid Blue Line figure X)**
  - The MassDEP Stormwater Advisory Committee Meeting September 22, 2020, MassDEP is considering updating the wetlands regulations to “incorporate the risk observed in the current data to reflect the range of larger storms.”

    - This NOAA Plus Method takes 90% of the NOAA Atlas 14 Estimates Upper Confidence Interval. This method will increase the stormwater basin size at most locations.
- **Future Statewide RMAT Climate Resilience Design Standards**
    - Expected in 2021 are the release of the Climate Resilience Design Standards and Guidelines on ResilientMA.org, development by the Resilient MA Action Team (RMAT). Led by the Executive Office of Energy and Environmental Affairs (EEA) and the Massachusetts Emergency Management Agency (MEMA), the RMAT is an inter-agency steering committee responsible for implementation, monitoring, and maintenance of the State Hazard Mitigation and Climate Adaptation Plan (SHMCAP). These design standards and guidance are for State projects and expected as a resource for MVP projects and other grants.
    - While not regulatory for this project, these Standards will be implemented statewide and provide recommendations for design for extreme precipitation.
    - Climate resilient design for the average level of effort, as proposed by the RMAT Standards, include percent increases for NOAA Atlas 14 Estimates.
      These percent increases for the mid- (2030/2050) and late-century (2070/2090) show greater design storm depths then used by the BSC Group. A comparative representation of the precipitation depths discussed in this letter is shown in Figure 3, below.

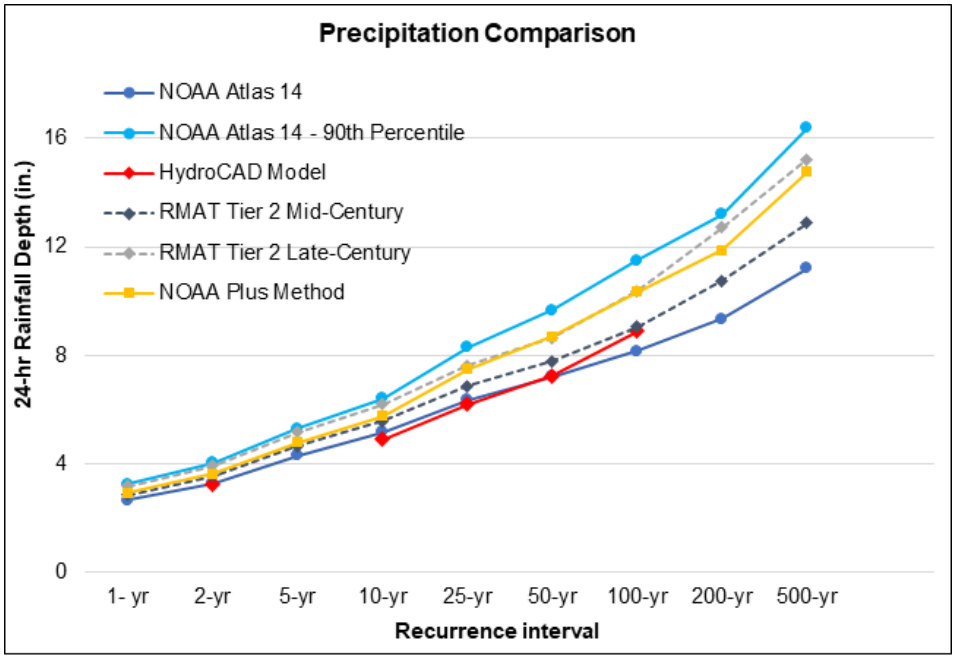

Figure 3. Comparison of Design Storm Depths

Recurrence Interval	NOAA Atlas 14 (in)	HydroCAD Model (in)	NOAA Plus (in)	RMAT Tier 2 Mid-Century (in)	RMAT Tier 2 Late Century (in)
2-yr	3.27	3.23	3.618	3.53	3.92
10-yr	5.16	4.90	5.76	5.57	6.19
25-yr	6.34	6.20	7.47	6.85	7.61
50-yr	7.21	7.23	8.703	7.79	8.65
100-yr	8.16	8.89	10.35	9.06	10.36

Talking Point 3: Other Design Issues

- **Deployable Flood Barriers**
  - Not recommended for precipitation flooding due to the time it takes to put them together and it can also exacerbate flooding at the site
  - Very expensive to retrofit due to the depth of flooding that could occur due to the structural load
- **Buildings and structures within the scope of the IBC and proposed to be located in any flood hazard area must be designed in accordance with ASCE 24.**
  - All residential structures (Flood design class 2) shall have a minimum elevation of lowest floor as the BFE + 1 ft. or the DFE, whichever is higher.

- **Compensatory Flood Storage**
  - "Arlington requires compensatory flood storage to be provided at a 2 to 1 ratio for any flood storage lost. In order to provide this compensatory flood storage, the project will minimize the area of Bordering Land Subject to Flooding impacted and regrade a portion of the project property southeast of the proposed building as shown on the Plans.
    - Have not reviewed the plans or backup calculations as they were not provided, however, the table below was provided

Commented [HA2]: How??

Elevations	Existing Incremental Available Flood Stoage (CU.FT.)	Incremental Available Flood Stoage with No Compensatory Storage (CU.FT.)	Incremental Flood Storage Change w/No Compensatory Storage (CU.FT.)	Proposed Incremental Compensatory Storage (CU.FT.)	Ratio of Compensatory Storage to Storage Lost
5.0 - 6.0	67.0	0.0	-67.0	144.5	2.2
6.0 - 6.8	7,454.0	4,806.8	-2,647.2	5,990.0	2.3