

Building Coastal Resiliency at Plymouth Long Beach

Department of Marine and Environmental Affairs

December 1, 2016

Plymouth Long Beach & Warren's Cove



- Barrier spit 3 miles long, begins at Warren's Cove & forms Plymouth Harbor
- Shoreline management dates back to 1700's
- Seawalls and revetments at Warren's Cove
- Stone Dike runs the length of Long Beach (ACE)
- Northern part of beach protected from the east & northeast by Brown's Bank and Gurnet/Saquish

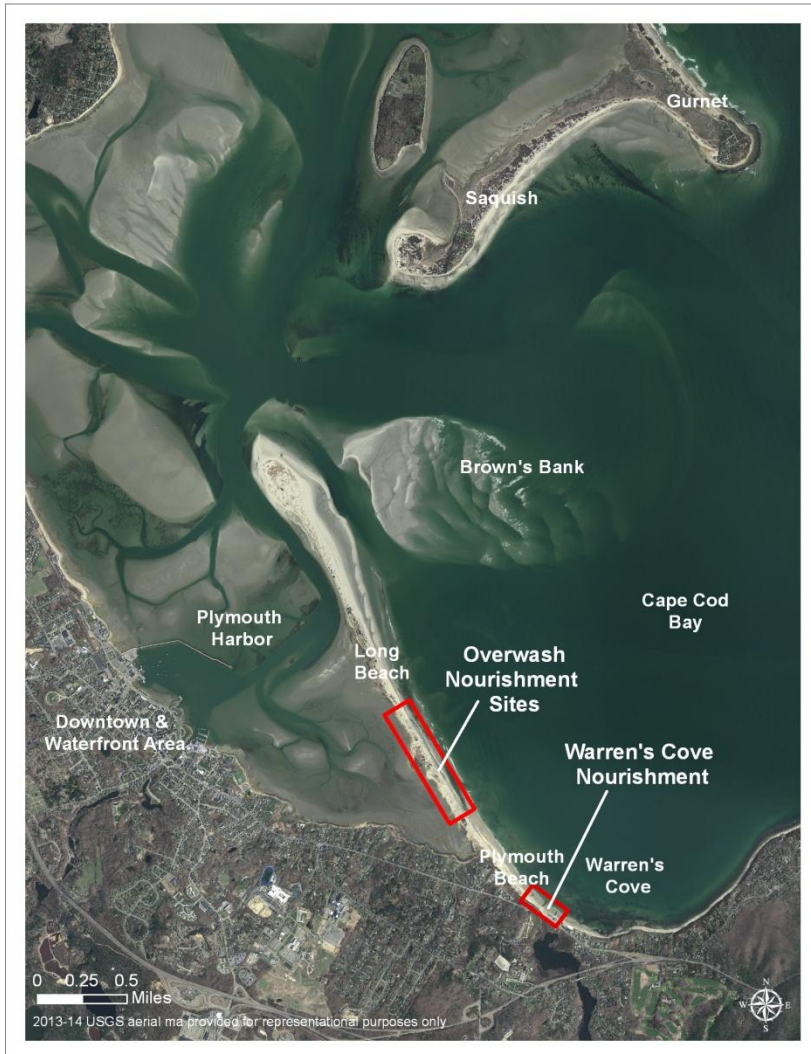
Challenges to Coastal Resiliency



- Deterioration of middle portion of stone dike
- Lack of beach in the southern portion of Long Beach due to scouring along stone dike
- Eroded overwash areas on southern portion of Long Beach
- Erosion of harborside area along navigation channel

Challenges to Coastal Resiliency

- Lack of beach at Warren's Cove due to scour from seawall/revetment
- Seawall failures
- Artificial and natural armoring of coastline to the south



Challenges to Coastal Resiliency

- Deterioration of middle portion of stone dike
- No beach in front of the stone dike in the southern portion of Long Beach due to scouring effect of hard structure
- Erosion of overwash areas in southern portion of Long Beach
- No beach in front of the seawall/revetment at Warren's Cove due to scouring effect
- Failures of seawall at Plymouth Beach
- Erosion at point
- Erosion of harborside area along navigation channel
- Artificial and natural armoring of coastline to the south

Challenges to Coastal Resiliency

- Deterioration of middle portion of stone dike
- No beach in front of the stone dike in the southern portion of Long Beach due to scouring effect of hard structure
- **Erosion of overwash areas in southern portion of Long Beach**
- **No beach in front of the seawall/revetment at Warren's Cove due to scouring effect**
- **Multiple failures of the seawall at Warren's Cove**
- Erosion at point
- Erosion of harborside area along navigation channel
- Artificial and natural armoring of coastline to the south

Mixed Sediment Nourishment at Warren's Cove

Challenges at Warren's Cove

- Shoreline armored by seawall and revetment
- Five non-functioning groins
- Damage to Town beach facilities, Eel River, private properties and businesses, Route 3A, and utilities



Challenges at Warren's Cove

- Aging structure is compromised in multiple areas
- Undermining of seawall
- Seawall failures: 2010 and 2016



Challenges at Warren's Cove

Undermining of Seawall (2009, 2010)



Challenges at Warren's Cove

Collapse of Pavement Landward of Undermined Wall (Photo 12/09)



2010 Seawall Failure



2010 Seawall Failure



2010 Seawall Failure



2016 Seawall Failure



2016 Seawall Failure



Impacts to the Eel River

- Storms wash parking lot material into the river, causing flooding to upstream properties.
- Filling of the river and subsequent dredging can damage the stream channel and important fish habitat.



Impacts to Route 3A

- Main route for travel, emergency response and evacuations
- Flooding and closures during coastal storms
- Damage to road and utilities



Recent History of Repairs and Maintenance at Warren's Cove

- 2003 – Repairs to revetment at Pilgrim Sands Motel
- 2006 – Repairs to revetment at Bert's Restaurant
- 2009 – Repairs to undermined seawall
- 2010 – Repairs to another portion of undermined seawall
- 2011-2012– Repairs to failed seawall, rebuilt revetment
- 2012 – Redesigned and constructed stormwater drainage in parking lot
- 2015 – Maintenance to revetment rebuilt in 2012
- 2016 – Stabilization of failed seawall
- Winter 2016-2017 – Repairs to revetment at Pilgrim Sands and Bert's Restaurant

Building Coastal Resiliency in Warren's Cove – Work to Date

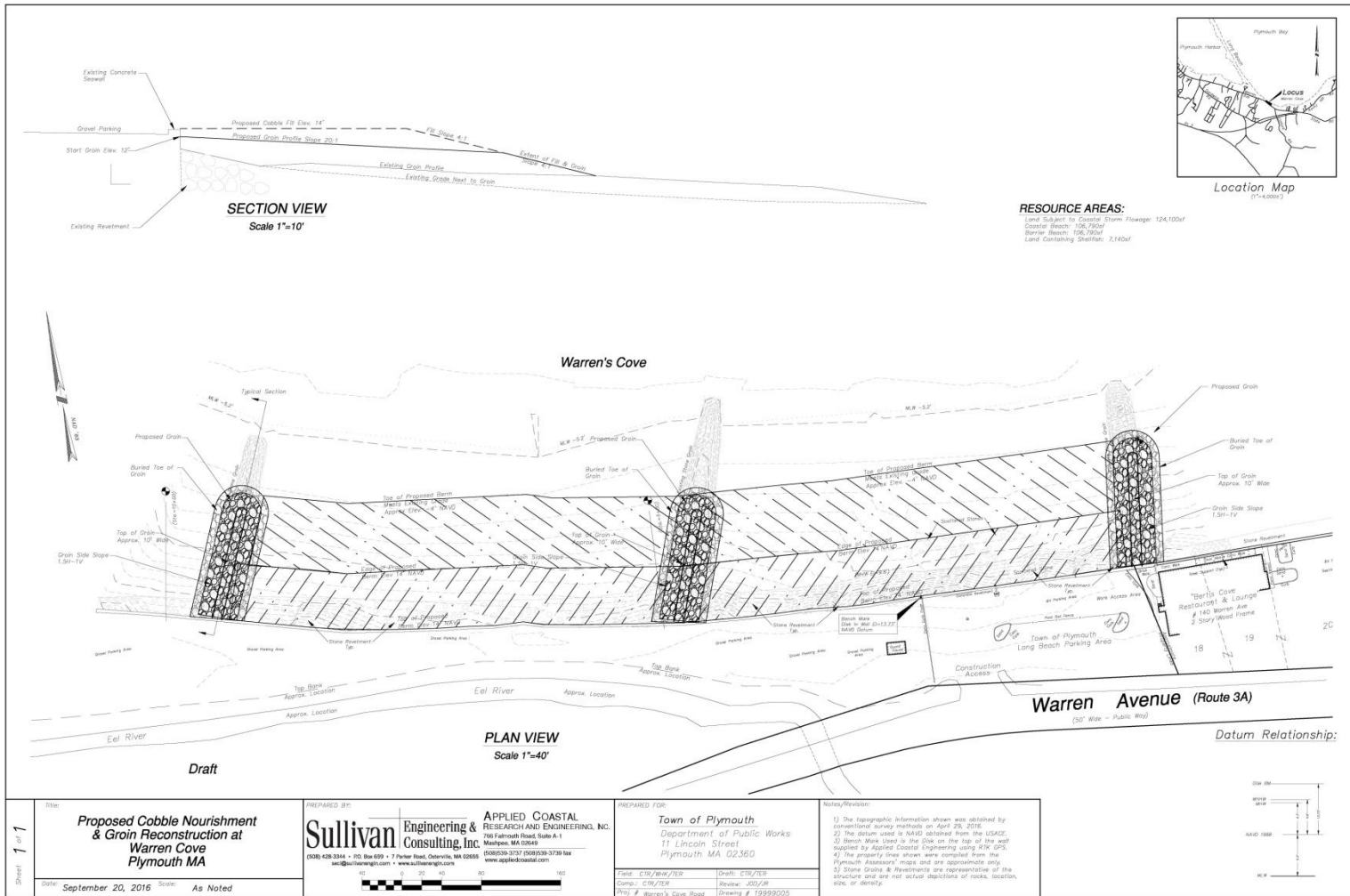
- Feasibility Study
 - Looked at several different alternatives to reduce storm damage
 - Beach nourishment, removal or reuse of groins, underwater reef, dune construction, relocation of the mouth of the Eel River, repair of seawall and revetment
- Preferred Alternative: Mixed-Sediment Nourishment
 - Green infrastructure, soft solution, natural materials
 - Greater longevity with mixed sediment (sand/gravel/cobble mix) than sand alone
 - Easily adaptable for sea level rise by increasing volume by adding more nourishment material
- \$85,798.72 - Funded through CZM FY14 Green Infrastructure Grant (25% match - Town & The Nature Conservancy)

Building Coastal Resiliency in Warren's Cove – Work to Date

- Design and Permitting
 - Final design for mixed-sediment nourishment
 - Preparation of permit documents
- \$93,350.00 - Funded through CZM FY16 Green Infrastructure Grant (25% match by the Town)



Draft Design for Mixed-Sediment Nourishment at Warren's Cove



Building Coastal Resiliency in Warren's Cove – Next Steps

- Complete the permitting process for mixed-sediment nourishment project
- Repair 2016 seawall failure
- Construction of mixed-sediment nourishment project
- Post-construction monitoring

Benefits of Building Coastal Resiliency in Warren's Cove

- Protection for access to 23 private properties, including 17 structures, on Long Beach
- Increased protection for 2 businesses abutting Warren's Cove seawall/revetment
- Reduce damage to and closures of Route 3A – main route for traffic in this area, evacuation route for Pilgrim Nuclear Power Plant, main route for emergency response
- Reduce storm damage to public parking area and facilities at Plymouth Beach
- Reduce negative impacts to the Eel River & flooding of upstream properties

Cobble Nourishment of Eroded Overwash Areas on Long Beach

Challenges at Long Beach

- No beach in front of stone dike in southern part of beach
- Wave energy is not dissipated at stone dike, water rushes over the beach to harborside
- Funnel effect in eroded overwash areas leads to increased water velocity and further erosion



Eroded Overwash Areas at Long Beach

2008



2013



Nourishment of Overwash Areas



- 11 project areas
- Permitting by Dept Marine & Environmental Affairs
- Constructed by the Department of Public Works
- \$441,756 - Funded through a CZM Green Infrastructure Grant (37% Town match)

Nourishment of Overwash Areas

- Brought eroded overwash areas up to grade of surrounding areas.
- Used a mix of sand, gravel and cobble similar to the substrate in the eroded areas
- Greater longevity compared to sand alone



Nourishment of Overwash Areas

Project Area 1



Building Coastal Resiliency on Long Beach– Next Steps

- Post-construction monitoring of overwash nourishment project – Ongoing
- Repair southern portion of stone dike (Army Corps of Engineers) – Winter 2016-17
- Reconstruct middle section of stone dike (ACE)
- Beach nourishment on seaward side of dike
- Marsh restoration on harborside

Benefits of Building Coastal Resiliency on Long Beach

- The barrier beach is more resilient to storm damage.
- Increased protection for Plymouth Harbor and the downtown/waterfront area.
 - Historic, economic and natural resources
- Protection for the access road to recreational areas as well as 23 private properties, including 17 with structures

Project Partners

- Massachusetts Office of Coastal Zone Management
- The Nature Conservancy

Discussion