The **Wood-Pawcatuck watershed** is vulnerable to flood-related damages, as evidenced by the devastating flooding that occurred in 2010. The Wood-Pawcatuck Watershed Association, working with the watershed municipalities and partner agencies, has developed a **watershed-based management plan** to enhance the resiliency of the watershed communities to future flooding and protect river and stream ecosystems, including water quality and habitat. The following is a **summary of key findings and recommendations** of the watershed plan for the Town of Charlestown.

### Road Stream Crossings
- 7 crossings are hydraulically undersized
- 12 crossings have high geomorphic vulnerability
- 11 crossings have high flood impact potential
- 9 crossings limit or restrict aquatic passage

**Recommendations:**
- Replace and upgrade priority crossings (see table below) to meet flood resilience and aquatic organism passage (AOP) goals
- Consider other upstream and downstream crossings and dams on the same river system
- In general, replace downstream crossings first
- Perform site-specific data collection, geotechnical evaluation, hydrologic and hydraulic evaluation, and structure type evaluation to support design

### Dams
- A single low hazard dam – Burdickville Dam – was assessed in Charlestown, on the Charlestown/Hopkinton border

**Recommendations:**
- Consider dam removal
- Burdickville Dam has been partially breached but may currently prevent passage of some fish species, such as shad
- The impoundment does not appear to support any active uses

### Highest-Ranked High and Intermediate Priority Stream Crossings (Listed by Priority Ranking)

<table>
<thead>
<tr>
<th>Road</th>
<th>Stream</th>
<th>Crossing Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Burlingame State Park - Management Area</td>
<td>Unnamed</td>
<td>Double 24” Concrete Circular Conduit</td>
</tr>
<tr>
<td>Burlingame State Park - Management Area</td>
<td>Unnamed</td>
<td>12” Concrete Circular Conduit</td>
</tr>
<tr>
<td>Narragansett Trail</td>
<td>Unnamed</td>
<td>12” Concrete Circular Conduit</td>
</tr>
<tr>
<td>Buckeye Brook Road</td>
<td>Poquiant Brook</td>
<td>38” and 12” Concrete Circular Conduit (2 total)</td>
</tr>
<tr>
<td>Shumankanuac Hill Road</td>
<td>Unnamed</td>
<td>36” Concrete Circular Conduit</td>
</tr>
<tr>
<td>Saw Mill Road</td>
<td>Unnamed</td>
<td>12” Concrete Circular Conduit</td>
</tr>
<tr>
<td>Burdickville Road</td>
<td>Unnamed</td>
<td>21” Concrete Circular Conduit</td>
</tr>
<tr>
<td>Old Shannock Road</td>
<td>Pawcatuck River</td>
<td>9.4' x 48'W Concrete Bridge</td>
</tr>
</tbody>
</table>

For the complete project plan please visit [http://wpwa.org/flood_resiliency.html](http://wpwa.org/flood_resiliency.html)

Project funding was provided by the National Fish and Wildlife Foundation Hurricane Sandy Coastal Resiliency Competitive Grant Program
Green Infrastructure
A screening-level assessment of potential green infrastructure (GI) retrofit sites was performed within the Wood-Pawcatuck watershed. When applied throughout the watershed, GI can help mitigate flood risk resulting from outdated and undersized storm drainage systems and increase flood resiliency, as well as improve water quality.

Sites Identified for GI Retrofits:
- **Vin Gormley Trailhead Parking**
  - Retrofit parking lot with underground infiltration and a bioretention basin
  - Cost: $123,000
- **St. Mary’s Catholic Church**
  - Install a bioretention practice in the grassed island at the Carolina Back Road and Old Carolina Back Road intersection
  - Cost: $143,000

River Corridor
A detailed geomorphic assessment was performed for approximately 40 miles of rivers and streams in the watershed. Based on the results of the geomorphic assessment, river corridor planning recommendations were developed to identify restoration projects that will reduce flood hazards and downstream sediment loading and improve aquatic habitat.

Recommendations:
- Remove granite blocks confining channel downstream of Route 112 to allow floodplain access; use granite blocks to build in-stream habitat structures
- Protect wetlands, including Indian Cedar Swamp, as well as stream connections to wetlands and floodplains
- Install log jams in select locations along the stream corridor to protect banks, create habitat, and reform meanders

Land Use Policy and Regulations
Municipal land use policies and regulations can help communities become more resilient to flooding by:
- Preserving undeveloped land
- Siting development in locations less vulnerable to flooding, and
- Promoting designs that reduce runoff and are less likely to be damaged in a flood

Recommendations:
A review was conducted of the land use policies, plans, and regulations of the watershed municipalities. Key recommendations of this review include:
- Consider adopting a No Adverse Impact (NAI) Floodplain Management policy
- Amend zoning ordinance to strengthen flood management standards
- Consider implementing fluvial erosion hazard zoning to address riverine erosion hazards
- Consider amendments to the existing conservation/cluster development provisions in the zoning ordinance and subdivision regulations to strengthen flood management provisions
- Amend street and parking lot design standards to reduce impervious cover and remove barriers to LID
- Update design storm precipitation amounts
- Implement road stream crossing standards for new and replacement culverts and bridges
Recommended Actions Summary
Town of Exeter, RI

The Wood-Pawcatuck watershed is vulnerable to flood-related damages, as evidenced by the devastating flooding that occurred in 2010. The Wood-Pawcatuck Watershed Association, working with the watershed municipalities and partner agencies, has developed a watershed-based management plan to enhance the resiliency of the watershed communities to future flooding and protect river and stream ecosystems, including water quality and habitat. The following is a summary of key findings and recommendations of the watershed plan for the Town of Exeter.

Quick Facts - Exeter
- 91% of town within watershed
- Includes portions of the Chipuxet, Chickasheen, Beaver, Usquepaug, Wood, and Queen Rivers and their watersheds
- 63 stream crossings assessed
- 11 dams assessed

Road Stream Crossings
- 25 crossings are hydraulically undersized
- 30 crossings have high geomorphic vulnerability
- 6 crossings have high flood impact potential
- 9 crossings limit or restrict aquatic passage

Recommendations:
- Replace and upgrade priority crossings (see table below) to meet flood resilience and aquatic organism passage (AOP) goals
- Consider other upstream and downstream crossings and dams on the same river system
- In general, replace downstream crossings first
- Perform site-specific data collection, geotechnical evaluation, hydrologic and hydraulic evaluation, and structure type evaluation to support design

<table>
<thead>
<tr>
<th>Road Stream Crossing</th>
<th>Road</th>
<th>Stream</th>
<th>Crossing Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deer Brook Lane</td>
<td>Unnamed</td>
<td>36” Concrete Circular Conduit</td>
<td></td>
</tr>
<tr>
<td>Tarbox Drive</td>
<td>Queens Fort Brook</td>
<td>48” and 24” Concrete Circular Conduit (Total 2)</td>
<td></td>
</tr>
<tr>
<td>Mail Road</td>
<td>Unnamed</td>
<td>12” Concrete Circular Conduit</td>
<td></td>
</tr>
<tr>
<td>Purgatory Road</td>
<td>Unnamed</td>
<td>24” Concrete Circular Conduit</td>
<td></td>
</tr>
<tr>
<td>Wolf Rocks Road</td>
<td>Chipuxet River</td>
<td>5.3’ x 5.9’ Concrete Box Culvert</td>
<td></td>
</tr>
<tr>
<td>Yawgoo Valley Road</td>
<td>Chipuxet River</td>
<td>Triple 48” Concrete Circular Conduit</td>
<td></td>
</tr>
<tr>
<td>William Reynolds Road</td>
<td>Unnamed</td>
<td>12” HDPE Circular Conduit</td>
<td></td>
</tr>
<tr>
<td>Liberty Road</td>
<td>Unnamed</td>
<td>Triple 18” HDPE Circular Conduit</td>
<td></td>
</tr>
<tr>
<td>Punchbowl Road</td>
<td>Unnamed</td>
<td>18” CMP Circular Conduit</td>
<td></td>
</tr>
</tbody>
</table>

High-Ranked High Priority Stream Crossings (Listed by Priority Ranking)

Dams
- 5 high hazard dams, 1 significant hazard dam, and 5 low hazard dams
- Several dams provide recreational or other uses and are undergoing or were recently repaired
- Several dams are recommended for repair or removal due to poor condition and lack of maintenance

Recommendations:
- Breakheart Pond Dam (Breakheart Brook)
  - Located within Arcadia Management Area
  - Downstream watercourse has obstructions to fish passage
  - Dam is in poor condition and repairs are therefore recommended

- Browning Mill Pond Dam (Roaring Brook)
  - RIDEM owns the dam and operates a hatchery downstream
  - Browning Mill Pond has significant public recreational value
  - Repairs are recommended for this deteriorating dam

- Edward’s Pond Dam (Queen River)
  - Owned by Exeter Country Club
  - No apparent active uses of impoundment
  - Consider dam removal

For the complete project plan please visit http://wpwa.org/flood_resiliency.html
Green Infrastructure
A screening-level assessment of potential green infrastructure (GI) retrofit sites was performed within the Wood-Pawcatuck watershed. When applied throughout the watershed, GI can help mitigate flood risk resulting from outdated and undersized storm drainage systems and increase flood resiliency, as well as improve water quality.

Sites Identified for GI Retrofits:

- **Exeter Town Animal Shelter**
  - Install bioretention along the northern roadside of South Country Trail to treat approximately one quarter mile of roadway
  - Cost: $107,000

- **Exeter Town Hall**
  - Bioretention and rain garden at parking lot
  - Cost: $103,000

- **Browning Mill Pond Parking Access**
  - Bioretention and forested buffer to protect adjacent Browning Mill Pond
  - Regrade and till parking lot to alleviate some erosional issues and improve infiltration
  - Cost: $32,000

River Corridor
A detailed geomorphic assessment was performed for approximately 40 miles of rivers and streams in the watershed. Based on the results of the geomorphic assessment, river corridor planning recommendations were developed to identify restoration projects that will reduce flood hazards and downstream sediment loading and improve aquatic habitat.

Recommendations:

**Arcadia Management Area south of Ten Rod Road (Upper Wood River)**
- Add wood cover structures along river banks (a.k.a. marginal wood cover) and wood to river to encourage meander formation and sediment storage within artificially straightened channel
- Area is popular for fly fishing
- Area is owned and managed by the Wood-Pawcatuck Watershed Association

Land Use Policy and Regulations
Municipal land use policies and regulations can help communities become more resilient to flooding by:

- Preserving undeveloped land
- Siting development in locations less vulnerable to flooding, and
- Promoting designs that reduce runoff and are less likely to be damaged in a flood

Recommendations:
A review was conducted of the land use policies, plans, and regulations of the watershed municipalities. Key recommendations of this review include:

- The Hazard Mitigation Plan is due to be updated and should address flood-prone areas identified during the 2010 flood and subsequent flood events, including street flooding identified as an issue in 2010
- Consider adopting a No Adverse Impact (NAI) Floodplain Management policy
- Amend zoning ordinance to strengthen flood management standards
- Consider implementing fluvial erosion hazard zoning to address riverine erosion hazards
- Amend street and parking lot design standards to reduce impervious cover and remove barriers to LID
- Update design storm precipitation amounts
- Implement road stream crossing standards for new and replacement culverts and bridges
The Wood-Pawcatuck watershed is vulnerable to flood-related damages, as evidenced by the devastating flooding that occurred in 2010. The Wood-Pawcatuck Watershed Association, working with the watershed municipalities and partner agencies, has developed a watershed-based management plan to enhance the resiliency of the watershed communities to future flooding and protect river and stream ecosystems, including water quality and habitat. The following is a summary of key findings and recommendations of the watershed plan for the Town of Hopkinton.

### Quick Facts - Hopkinton
- 100% of town within watershed
- Includes portions of the Wood, Ashaway, and Pawcatuck Rivers and their watersheds
- 83 stream crossings assessed
- 19 dams assessed within the Town; 6 dams assessed that lie on the border between Hopkinton and adjacent towns (25 dams total)

### Road Stream Crossings
- 21 crossings are hydraulically undersized
- 35 crossings have high geomorphic vulnerability
- 32 crossings have high flood impact potential
- 47 crossings limit or restrict aquatic passage

**Recommendations:**
- Replace and upgrade priority crossings (see table below) to meet flood resilience and aquatic organism passage (AOP) goals
- Consider other upstream and downstream crossings and dams on the same river system
- In general, replace downstream crossings first
- Perform site-specific data collection, geotechnical evaluation, hydrologic and hydraulic evaluation, and structure type evaluation to support design

<table>
<thead>
<tr>
<th>Road Stream Crossing Type</th>
<th>Road</th>
<th>Stream</th>
<th>Crossing Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vuono Road</td>
<td>unnamed</td>
<td>36” HDPE Circular Conduit</td>
<td></td>
</tr>
<tr>
<td>Woodville Road</td>
<td>unnamed</td>
<td>12” Concrete Circular Conduit</td>
<td></td>
</tr>
<tr>
<td>Woodville Alton Road</td>
<td>unnamed</td>
<td>18” Concrete Circular Conduit and 18” CMP Circular Conduit</td>
<td></td>
</tr>
<tr>
<td>Nooseneck Hill Road</td>
<td>unnamed</td>
<td>30”W x 24”H Stone Masonry Box Culvert</td>
<td></td>
</tr>
<tr>
<td>Tomaquag Road</td>
<td>unnamed</td>
<td>48”W x 48”H Concrete Box Culvert</td>
<td></td>
</tr>
<tr>
<td>Clarks Falls Road</td>
<td>Parmenter Brook</td>
<td>Four (4) 24” CMP Circular Conduits</td>
<td></td>
</tr>
<tr>
<td>Harningstuns Crossing</td>
<td>unnamed</td>
<td>Double 24” Concrete Circular Conduit</td>
<td></td>
</tr>
<tr>
<td>Woodville Road</td>
<td>Wood River</td>
<td>123”W x 8”H Concrete Bridge</td>
<td></td>
</tr>
<tr>
<td>Sawmill Road</td>
<td>Brushy Brook</td>
<td>Triple 36” Concrete Circular Conduit</td>
<td></td>
</tr>
</tbody>
</table>

### Highest-Ranked High Priority Stream Crossings (Listed by Priority Ranking)

**Dams**
- 3 high hazard dams, 8 significant hazard dams, and 14 low hazard dams
- 8 dams are considered high priority
- 6 of the dams assessed lie on the border of Hopkinton and either Richmond or Charlestown
- Condition, purpose, and level of community use vary widely between dams

**Recommendations:**
- Consider Dam Repair - High Priority:
  - Harris Pond Dam (Tomaquag Brook Tributary)
  - Wyoming Pond Upper Dam (Wood River)
- Consider Dam Removal – High Priority:
  - Alton Pond Dam (Wood River)
  - Ashaway Line Pond Dam (Ashaway River), Ashaway Mill Pond Dam (Ashaway River), and Bethel Pond Dam (Ashaway River) (collectively consider removal of all 3 dams)
  - Ashville Pond Dam (Blue Pond Brook)
  - Potter Hill Dam (Pawcatuck River)

For the complete project plan please visit http://wpwa.org/flood_resiliency.html
Green Infrastructure

A screening-level assessment of potential green infrastructure (GI) retrofit sites was performed within the Wood-Pawcatuck watershed. When applied throughout the watershed, GI can help mitigate flood risk resulting from outdated and undersized storm drainage systems and increase flood resiliency, as well as improve water quality.

Sites Identified for GI Retrofits:

- **Hopkinton Recreation Department**
  - Linear bioretention practice along roadway
  - Cost: $72,000

- **Trinity Lutheran Church**
  - Bioretention and rain gardens
  - Cost: $61,000

- **U.S. Post Office (Ashaway, RI)**
  - Underground infiltration under public roads
  - Cost: $282,000

- **Chariho Little League**
  - Rain gardens adjacent to parking areas
  - Cost: $39,000

- **Ashaway Elementary School**
  - Underground infiltration and bioretention
  - Cost: $229,000

River Corridor

A detailed geomorphic assessment was performed for approximately 40 miles of rivers and streams in the watershed. Based on the results of the geomorphic assessment, river corridor planning recommendations were developed to identify restoration projects that will reduce flood hazards and downstream sediment loading and improve aquatic habitat.

Recommendations:

- Protect dynamic reaches with high quality habitat, located along the Ashaway River, from encroachment by future development
- Enhance meander development in artificially straightened channels along the Lower Wood and Ashaway Rivers to slow flows, increase flood storage, and conserve or improve habitat
- Coordinate floodplain restoration along the Lower Wood River with site remediation of former Charbert Facility site
- Breach and/or remove confining berm downstream of Bradford Dam to allow floodplain access during high flows and thereby increase flood storage and slow flood flows

Land Use Policy and Regulations

Municipal land use policies and regulations can help communities become more resilient to flooding by:

- Preserving undeveloped land
- Siting development in locations less vulnerable to flooding, and
- Promoting designs that reduce runoff and are less likely to be damaged in a flood

Recommendations:

A review was conducted of the land use policies, plans, and regulations of the watershed municipalities. Key recommendations of this review include:

- Consider adopting a No Adverse Impact (NAI) Floodplain Management policy
- Amend zoning ordinance to strengthen flood management standards
- Consider implementing fluvial erosion hazard zoning to address riverine erosion hazards
- Consider amendments to the existing conservation/cluster development provisions in the zoning ordinance and subdivision regulations to strengthen flood management provisions
- Amend street and parking lot design standards to reduce impervious cover and remove barriers to LID
- Update design storm precipitation amounts
- Implement road stream crossing standards for new and replacement culverts and bridges

View of a typical bioretention cell or rain garden with mature plantings

View of a straightened channel along Ashaway River, with limited habitat or flood storage
The Wood-Pawcatuck watershed is vulnerable to flood-related damages, as evidenced by the devastating flooding that occurred in 2010. The Wood-Pawcatuck Watershed Association, working with the watershed municipalities and partner agencies, has developed a watershed-based management plan to enhance the resiliency of the watershed communities to future flooding and protect river and stream ecosystems, including water quality and habitat. The following is a summary of key findings and recommendations of the watershed plan for the Town of North Kingstown.

**Road Stream Crossings**
- 1 crossing is hydraulically undersized
- 1 crossing has high geomorphic vulnerability
- All 6 crossings have medium flood impact potential
- 4 crossings limit or restrict aquatic passage

**Recommendations:**
- Replace and upgrade priority crossings (see table below) to meet flood resilience and aquatic organism passage (AOP) goals
- Consider other upstream and downstream crossings and dams on the same river system
- In general, replace downstream crossings first
- Perform site-specific data collection, geotechnical evaluation, hydrologic and hydraulic evaluation, and structure type evaluation to support design

**Dams**
- 2 high hazard dams

**Recommendations:**

**Slocum Road Upper Dam (Chipuxet River Tributary)**
- NOVs were issued in 2011 and 2012; owner indicated that repairs were made but DEM has not confirmed
- Impoundment supports limited recreational use
- Dam removal should be considered if owner is amenable
- Maintain if owner is not amenable to removal

**Slocum Woods Dam (Chipuxet River Tributary)**
- Dam was in good condition in 2013 (last documented inspection)
- Dam is owned by Slocum Woods Homeowners Association and is used for recreational purposes
- The impoundment appears to be used for irrigation for turf farming operations (Sodco)
- No action beyond maintenance is recommended for this dam; this recommendation is low priority

**Quick Facts - North Kingstown**
- 7.3% of town within watershed
- Includes portions of the Chipuxet River and its watershed
- 6 stream crossings assessed
- 2 dams assessed

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**High, Medium, and Low Priority Stream Crossings (Listed by Priority Ranking)**

<table>
<thead>
<tr>
<th>Road</th>
<th>Stream</th>
<th>Crossing Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kayla Ricci Way</td>
<td>Drainage Ditch</td>
<td>24” Concrete Circular Conduit</td>
</tr>
<tr>
<td>Sylvan Court</td>
<td>Unnamed</td>
<td>3.5W x 1.5H Concrete Box Culvert</td>
</tr>
<tr>
<td>Explorer Drive</td>
<td>Unnamed</td>
<td>Five (5) 24” Concrete Circular Conduits</td>
</tr>
<tr>
<td>Indian Corner Road</td>
<td>Chipuxet River</td>
<td>Double 6W x 3H Concrete Box Culvert</td>
</tr>
<tr>
<td>Glen Hill Road</td>
<td>Unnamed</td>
<td>24” Concrete Circular Conduit</td>
</tr>
<tr>
<td>Slocum Road</td>
<td>Unnamed</td>
<td>10.5W x 2.5H Concrete Box Culvert</td>
</tr>
</tbody>
</table>
Green Infrastructure
A screening-level assessment of potential green infrastructure (GI) retrofit sites was performed within the Wood-Pawcatuck watershed. When applied throughout the watershed, GI can help mitigate flood risk resulting from outdated and undersized storm drainage systems and increase flood resiliency, as well as improve water quality.

No site-specific GI retrofit concepts were developed for North Kingstown due to the town’s small land area within the Wood-Pawcatuck watershed and the limited scope of the GI assessment. The Town should incorporate GI approaches into municipal stormwater infrastructure planning and capital improvement plans to address drainage, flooding, and water quality priorities including MS4 Permit requirements, both within and outside of the Wood-Pawcatuck watershed. GI can be implemented on public sites including municipal parking lots and within the public right-of-way.

River Corridor
A detailed geomorphic assessment was performed for approximately 40 miles of rivers and streams in the watershed. Based on the results of the geomorphic assessment, river corridor planning recommendations were developed to identify restoration projects that will reduce flood hazards and downstream sediment loading and improve aquatic habitat.

Recommendations:
**Between Slocum Reservoir Dam and area downstream of Railroad Road (Chipuxet River)**
- Encourage riparian plantings along the left bank of the river where residential properties abut the channel, to reduce risk of erosion and promote high quality habitat

**General Recommendation:** Protect and enhance floodplains, wetlands, and riparian buffers in order to reduce flood impacts and improve habitat.

Land Use Policy and Regulations
Municipal land use policies and regulations can help communities become more resilient to flooding by:
- Preserving undeveloped land
- Siting development in locations less vulnerable to flooding, and
- Promoting designs that reduce runoff and are less likely to be damaged in a flood

Recommendations:
A review was conducted of the land use policies, plans, and regulations of the watershed municipalities. North Kingstown was excluded from the review since it comprises 1 percent or less of the total watershed area and less than 10 percent of the community's land area is within the Wood-Pawcatuck watershed. General recommendations that apply to North Kingstown include:
- Consider adopting a No Adverse Impact (NAI) Floodplain Management policy
- Amend zoning ordinance to strengthen flood management standards
- Consider implementing fluvial erosion hazard zoning to address riverine erosion hazards
- Amend street and parking lot design standards to reduce impervious cover and remove barriers to LID
- Update design storm precipitation amounts
- Implement road stream crossing standards for new and replacement culverts and bridges
The **Wood-Pawcatuck watershed** is vulnerable to flood-related damages, as evidenced by the devastating flooding that occurred in 2010. The Wood-Pawcatuck Watershed Association, working with the watershed municipalities and partner agencies, has developed a **watershed-based management plan** to enhance the resiliency of the watershed communities to future flooding and protect river and stream ecosystems, including water quality and habitat. The following is a **summary of key findings and recommendations** of the watershed plan for the Town of North Stonington.

**Road Stream Crossings**
- 27 crossings are hydraulically undersized
- 29 crossings have high geomorphic vulnerability
- 11 crossings have high flood impact potential
- 43 crossings limit or restrict aquatic passage

**Recommendations:**
- Replace and upgrade priority crossings (see table below) to meet flood resilience and aquatic organism passage (AOP) goals
- Consider other upstream and downstream crossings and dams on the same river system
- In general, replace downstream crossings first
- Perform site-specific data collection, geotechnical evaluation, hydrologic and hydraulic evaluation, and structure type evaluation to support design

### Highest-Ranked High Priority Stream Crossings (Listed by Priority Ranking)

<table>
<thead>
<tr>
<th>Road</th>
<th>Stream</th>
<th>Crossing Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>State Highway 49</td>
<td>Unnamed</td>
<td>24˝ CMP Circular Conduit</td>
</tr>
<tr>
<td>Loin Hill Road</td>
<td>Unnamed</td>
<td>12˝ HDPE Circular Conduit</td>
</tr>
<tr>
<td>Main Street</td>
<td>Shunock River</td>
<td>11’W x 7'H Stone Masonry Bridge</td>
</tr>
<tr>
<td>Mains Crossing</td>
<td>Unnamed</td>
<td>18˝ Concrete Circular Conduit</td>
</tr>
<tr>
<td>Chester Main Road</td>
<td>Unnamed</td>
<td>42˝ CMP Circular Conduit</td>
</tr>
<tr>
<td>Wyassup Road</td>
<td>Unnamed</td>
<td>30˝ CMP Circular Conduit</td>
</tr>
<tr>
<td>Wyassup Road</td>
<td>Unnamed</td>
<td>Double 24˝ CMP Circular Conduits</td>
</tr>
<tr>
<td>Grindstone Hill Road</td>
<td>Wyassup Brook</td>
<td>Double 42˝ CMP Circular Conduit</td>
</tr>
<tr>
<td>Norwich-Westerly Road</td>
<td>Unnamed</td>
<td>36˝ Concrete Circular Conduit</td>
</tr>
<tr>
<td>Ryder Road</td>
<td>Yawbuc Brook</td>
<td>72˝ CMP Circular Conduit</td>
</tr>
<tr>
<td>State Highway 49</td>
<td>Pendleton Hill Brook</td>
<td>Double 24”H x 42”W HDPE-lined Circular Conduit</td>
</tr>
</tbody>
</table>

*Crossing consists of two plastic-lined, elliptical culverts, which were modeled as a box culvert.

**Dams**
- 1 significant hazard dam and 2 low hazard dams

**Recommendations:**
- **Green River Pond Dam (Green Fall River Tributary)**
  - Consider formalizing breach and replacing downstream culvert
  - The dam has not been maintained and is partially breached; current uses are unknown
  - The culvert downstream of this impoundment is likely undersized and contributing to backwater flooding
- **Lewis Pond Dam (Pawcatuck River Tributary)**
  - Consider dam removal
  - Current uses are unknown; owner may use impoundment as a cattle watering hole
- **Spaulding Pond Dam (Wyassup Brook)**
  - Consider dam removal
  - The impoundment supports recreational uses
  - Once the dams on the Ashaway River are removed, removal of this dam would become a higher priority

For the complete project plan please visit [http://wpwa.org/flood_resiliency.html](http://wpwa.org/flood_resiliency.html)
Green Infrastructure

A screening-level assessment of potential green infrastructure (GI) retrofit sites was performed within the Wood-Pawcatuck watershed. When applied throughout the watershed, GI can help mitigate flood risk resulting from outdated and undersized storm drainage systems and increase flood resiliency, as well as improve water quality.

Sites Identified for GI Retrofits:

- **Wheeler High School**
  - Install two bioretention basins at the front of the building
  - Cost: $81,000

- **Wheeler Library**
  - Install two bioretention basins to treat runoff from the parking area, roof, and driveway
  - Cost: $53,000

- **North Stonington Elementary and Administration**
  - Install multiple bioretention areas within parking lot islands and adjacent to administration building
  - Cost: $212,000

River Corridor

A detailed geomorphic assessment was performed for approximately 40 miles of rivers and streams in the watershed. Based on the results of the geomorphic assessment, river corridor planning recommendations were developed to identify restoration projects that will reduce flood hazards and downstream sediment loading and improve aquatic habitat.

Recommendations:

**Upstream of Puttker Road to confluence with Shingle Mill Pond Brook (Green Fall River)**

- Protect corridor from encroachment by development to protect valuable archaeological sites and areas with good habitat potential
- Install log jams along channel margins to encourage meander formation downstream of Puttker Road and thereby reduce flood impacts

Land Use Policy and Regulations

Municipal land use policies and regulations can help communities become more resilient to flooding by:

- Preserving undeveloped land
- Siting development in locations less vulnerable to flooding, and
- Promoting designs that reduce runoff and are less likely to be damaged in a flood

Recommendations:

A review was conducted of the land use policies, plans, and regulations of the watershed municipalities. Key recommendations of this review include:

- Consider adopting a No Adverse Impact (NAI) Floodplain Management policy
- Amend zoning regulations to strengthen flood management standards
- Consider implementing fluvial erosion hazard zoning to address riverine erosion hazards
- Consider amendments to the existing conservation/cluster development provisions in the zoning and subdivision regulations to strengthen flood management provisions
- Amend street and parking lot design standards to reduce impervious cover and remove barriers to LID
- Update design storm precipitation amounts
- Implement road stream crossing standards for new and replacement culverts and bridges
The Wood-Pawcatuck Watershed is vulnerable to flood-related damages, as evidenced by the devastating flooding that occurred in 2010. The Wood-Pawcatuck Watershed Association, working with the watershed municipalities and partner agencies, has developed a watershed-based management plan to enhance the resiliency of the watershed communities to future flooding and protect river and stream ecosystems, including water quality and habitat. The following is a summary of key findings and recommendations of the watershed plan for the Town of Richmond.

**Quick Facts - Richmond**
- 100% of town within watershed
- Includes portions of the Wood, Beaver, Pawcatuck, Usquepaug, and Queen Rivers and their watersheds
- 61 stream crossings assessed
- 10 dams assessed, 5 of which lie on the border between Richmond and Hopkinton

**Road Stream Crossings**
- 21 crossings are hydraulically undersized
- 31 crossings have high geomorphic vulnerability
- 24 crossings have high flood impact potential
- 22 crossings limit or restrict aquatic passage

**Recommendations:**
- Replace and upgrade priority crossings (see table below) to meet flood resilience and aquatic organism passage (AOP) goals
- Consider other upstream and downstream crossings and dams on the same river system
- In general, replace downstream crossings first
- Perform site-specific data collection, geotechnical evaluation, hydrologic and hydraulic evaluation, and structure type evaluation to support design

**Dams**
- 2 high hazard dams, 3 significant hazard dams, and 5 low hazard dams
- 8 of the 10 dams are considered High or Intermediate priority for recommended actions

**Recommendations:**
- **Alton Pond Dam (Wood River)**
  - Consider dam removal
  - Downstream-most dam on the Wood River, restricting aquatic passage to the river
  - Replacement or reconfiguration of the Church Street Bridge would be required to accommodate dam removal
- **DeCoppett Pond Dam (Beaver River)**
  - Consider dam removal
  - The dam is located on the Beaver River, which is one of the most valued cold water streams in RI and has a known population of Brook Trout
  - The impoundment does not appear to support any active uses; dam is deteriorating
- **Wood River Junction Dam (Meadow Brook)**
  - Consider dam removal
  - Dam in generally poor condition and not maintained
- **Tug Hollow Pond Dam (Beaver River)**
  - Consider dam removal to restore connectivity and water quality to this high-value stream

**Highest-Ranked High Priority Stream Crossings (Listed by Priority Ranking)**

<table>
<thead>
<tr>
<th>Road</th>
<th>Stream</th>
<th>Crossing Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>New London Turnpike</td>
<td>Unnamed</td>
<td>Double 24&quot; CMP Circular Conduit</td>
</tr>
<tr>
<td>Buttonwood Road</td>
<td>Unnamed</td>
<td>36&quot; Concrete Circular Conduit</td>
</tr>
<tr>
<td>New London Turnpike</td>
<td>Unnamed</td>
<td>42&quot; CMP Circular Conduit</td>
</tr>
<tr>
<td>Hillsdale Road</td>
<td>Beaver</td>
<td>Double 36&quot; CMP Circular Conduit + Overflow Conduit</td>
</tr>
<tr>
<td>Shannock Hill Road</td>
<td>Beaver</td>
<td>12&quot; x 4H Concrete Bridge</td>
</tr>
<tr>
<td>Schoolhouse Road</td>
<td>Beaver</td>
<td>8&quot; x 4H Concrete Box Culvert</td>
</tr>
<tr>
<td>New London Turnpike</td>
<td>Beaver</td>
<td>46&quot; CMP Circular Conduit</td>
</tr>
<tr>
<td>Unnamed</td>
<td>Beaver</td>
<td>13&quot; x 4H Concrete Bridge</td>
</tr>
<tr>
<td>Pine Hill Road</td>
<td>Meadow Brook</td>
<td>7&quot; x 3H Concrete Box Culvert</td>
</tr>
</tbody>
</table>
Green Infrastructure
A screening-level assessment of potential green infrastructure (GI) retrofit sites was performed within the Wood-Pawcatuck watershed. When applied throughout the watershed, GI can help mitigate flood risk resulting from outdated and undersized storm drainage systems and increase flood resiliency, as well as improve water quality.

Sites Identified for GI Retrofits:
- **Richmond Elementary School**
  - Install bioretention basins in school lawn
  - Cost: $188,000
- **Richmond Police Department**
  - Underground infiltration under parking lots
  - Cost: $41,000
- **Rhode Island State Police Barracks**
  - Install bioretention basin next to barracks
  - Cost: $39,000
- **Wyoming Dam Fishing Access**
  - Bioretention and Pervious Pavers to promote infiltration and prevent erosion
  - Modify boat ramp with articulated concrete block matting to prevent erosion and sediment transport to river
  - Cost: $161,000

River Corridor
A detailed geomorphic assessment was performed for approximately 40 miles of rivers and streams in the watershed. Based on the results of the geomorphic assessment, river corridor planning recommendations were developed to identify restoration projects that will reduce flood hazards and downstream sediment loading and improve aquatic habitat.

Recommendations:
- **Downstream of undersized culvert at Route 138 (Meadow Brook)**
  - Replace undersized culvert at Rte. 138 (Kingstown Road) with larger bottomless arch culvert that spans full channel width
  - Add roughness elements in channel to encourage aggradation and reduce incision
- **Village of Carolina along Route 112 (Upper Pawcatuck River)**
  - Breach granite bank/berm that confines the channel and cuts off side channel access to allow access to floodplain
  - Use granite from berm to construct instream structures

Land Use Policy and Regulations
Municipal land use policies and regulations can help communities become more resilient to flooding by:
- Preserving undeveloped land
- Siting development in locations less vulnerable to flooding, and
- Promoting designs that reduce runoff and are less likely to be damaged in a flood

Recommendations:
A review was conducted of the land use policies, plans, and regulations of the watershed municipalities. Key recommendations of this review include:
- Consider adopting a No Adverse Impact (NAI) Floodplain Management policy
- Amend zoning ordinance to strengthen flood management standards
- Consider implementing fluvial erosion hazard zoning to address riverine erosion hazards
- Consider amendments to the existing conservation/cluster development provisions in the zoning ordinance and subdivision regulations to strengthen flood management provisions
- Amend street and parking lot design standards to reduce impervious cover and remove barriers to LID
- Update design storm precipitation amounts
- Implement road stream crossing standards for new and replacement culverts and bridges

Typical rain garden detail.
Bermed, straightened reach of Pawcatuck River along Route 112
The Wood-Pawcatuck watershed is vulnerable to flood-related damages, as evidenced by the devastating flooding that occurred in 2010. The Wood-Pawcatuck Watershed Association, working with the watershed municipalities and partner agencies, has developed a watershed-based management plan to enhance the resiliency of the watershed communities to future flooding and protect river and stream ecosystems, including water quality and habitat. The following is a summary of key findings and recommendations of the watershed plan for the Town of South Kingstown.

**Quick Facts - South Kingstown**
- 46% of town within watershed
- Includes portions of the Pawcatuck, Chickasheen, Chipuxet, Usquepaug, and Queen Rivers and their watersheds
- 44 stream crossings assessed
- 6 dams assessed

**Road Stream Crossings**
- 18 crossings are hydraulically undersized
- 16 crossings have high geomorphic vulnerability
- 5 crossings have high flood impact potential
- 27 crossings limit or restrict aquatic passage

**Recommendations:**
- Replace and upgrade priority crossings (see table below) to meet flood resilience and aquatic organism passage (AOP) goals
- Consider other upstream and downstream crossings and dams on the same river system
- In general, replace downstream crossings first
- Perform site-specific data collection, geotechnical evaluation, hydrologic and hydraulic evaluation, and structure type evaluation to support design

**Highest-Ranked High Priority Stream Crossings (Listed by Priority Ranking)**

<table>
<thead>
<tr>
<th>Road</th>
<th>Stream</th>
<th>Crossing Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peckham Farm Road</td>
<td>Unnamed</td>
<td>20” Concrete Circular Conduit</td>
</tr>
<tr>
<td>Ministerial Road</td>
<td>Mink Brook</td>
<td>12” Concrete Circular Conduit</td>
</tr>
<tr>
<td>South County Trail</td>
<td>Unnamed</td>
<td>Double 28” Concrete Circular Conduit</td>
</tr>
<tr>
<td>Plains Road</td>
<td>Unnamed</td>
<td>24” Concrete Circular Conduit</td>
</tr>
<tr>
<td>Flagg Road</td>
<td>Unnamed</td>
<td>24” Concrete Circular Conduit</td>
</tr>
<tr>
<td>Worden Pond Family Campground</td>
<td>Alewife Brook</td>
<td>Triple 12” HDPE Circular Conduit</td>
</tr>
<tr>
<td>Walking Path</td>
<td>Unnamed</td>
<td>Triple 36”H x 48”W Concrete Box Culvert</td>
</tr>
<tr>
<td>Liberty Road</td>
<td>Unnamed</td>
<td>36” Concrete Circular Conduit</td>
</tr>
<tr>
<td>Glen Rock Road</td>
<td>Unnamed</td>
<td>30” Concrete Circular Conduit</td>
</tr>
<tr>
<td>Ministerial Road</td>
<td>Alewife Brook</td>
<td>24” CMP Circular Conduit</td>
</tr>
</tbody>
</table>

**Dams**
- 1 significant hazard dam and 5 low hazard dams
- All of the dams are deteriorating or in disrepair
- Glen Rock Reservoir Dam, the downstream-most dam on the Usquepaug River, completely prevents fish passage to the Usquepaug River

**Recommendations:**
- Glen Rock Reservoir Dam (Usquepaug River)
  - Repair deteriorating structure
  - Install aquatic organism passage structure to permit fish passage to the Usquepaug
- Glen Rock Upper, Middle, and Lower Pond Dams (Glen Rock Brook)
  - Consider removal if supported by the owner
- Great Swamp Goose Marsh Dam (Pawcatuck River)
  - Repair dam
  - Maintain impoundment within Great Swamp Management Area (provides bird habitat)
- Yawgoo Pond Dam (Chickasheen River)
  - Construct a small rock ramp or nature-like fishway up the spillway to allow for fish passage

For the complete project plan please visit [http://wpwa.org/flood_resiliency.html](http://wpwa.org/flood_resiliency.html)
Green Infrastructure

A screening-level assessment of potential green infrastructure (GI) retrofit sites was performed within the Wood-Pawcatuck watershed. When applied throughout the watershed, GI can help mitigate flood risk resulting from outdated and undersized storm drainage systems and increase flood resiliency, as well as improve water quality.

Sites Identified for GI Retrofits:

- **Tennis Courts at Boss Arena, URI**
  - Install rain gardens in the lawn between the arena and tennis courts
  - Cost: $44,000

- **Parking lot at Boss Arena, URI**
  - Underground infiltration in main parking lot
  - Cost: $557,000

- **Courthouse Center for the Arts**
  - Retrofit drainage swale and parking lot with bioretention basins
  - Cost: $121,000

- **Tuckertown Park**
  - Bioretention
  - Cost: $169,000

- **West Kingston Elementary School**
  - Bioretention and underground infiltration
  - Cost: $122,000

River Corridor

A detailed field geomorphic assessment was performed for approximately 40 miles of rivers and streams in the watershed. Based on the results of the geomorphic assessment, river corridor planning recommendations were developed to identify restoration projects that will reduce flood hazards and downstream sediment loading and improve aquatic habitat. While field geomorphic assessments were not conducted within South Kingstown, these recommendations apply in the town and throughout the watershed.

Recommendations:

- Protect existing wetlands as well as stream connections to wetlands and floodplains
- Remove floodplain constraints, such as levees or berms, where possible
- Protect and enhance riparian buffers
- Install log jams in select locations along the stream corridor to protect banks, create habitat, and reform meanders (where human conflicts with meander formation are not present)
- Avoid or limit alterations that will straighten or channelize stream channels
- Consider removing bank armoring where possible once a protected river corridor is established

Land Use Policy and Regulations

Municipal land use policies and regulations can help communities become more resilient to flooding by:

- Preserving undeveloped land
- Siting development in locations less vulnerable to flooding, and
- Promoting designs that reduce runoff and are less likely to be damaged in a flood

Recommendations:

A review was conducted of the land use policies, plans, and regulations of the watershed municipalities. Key recommendations of this review include:

- Consider adopting a No Adverse Impact (NAI) Floodplain Management policy
- Amend zoning ordinance to strengthen flood management standards
- Consider implementing fluvial erosion hazard zoning to address riverine erosion hazards
- Amend zoning ordinance and subdivision regulations to require all development projects to comply with LID standards and the Rhode Island Stormwater Design and Installation Standards Manual
- Amend street and parking lot design standards to reduce impervious cover and remove barriers to LID
- Update design storm precipitation amounts
- Implement road stream crossing standards for new and replacement culverts and bridges
The Wood-Pawcatuck watershed is vulnerable to flood-related damages, as evidenced by the devastating flooding that occurred in 2010. The Wood-Pawcatuck Watershed Association, working with the watershed municipalities and partner agencies, has developed a watershed-based management plan to enhance the resiliency of the watershed communities to future flooding and protect river and stream ecosystems, including water quality and habitat. The following is a summary of key findings and recommendations of the watershed plan for the Town of Sterling.

**Quick Facts - Sterling**
- 22% of town within watershed
- Includes portions of the Wood River and its watershed
- 6 stream crossings assessed
- 1 dam assessed

### Road Stream Crossings
- All 6 crossings are hydraulically undersized
- All 6 crossings have high geomorphic vulnerability
- 3 crossings limit or restrict aquatic passage

**Recommendations:**
- Replace and upgrade priority crossings (see table below) to meet flood resilience and aquatic organism passage (AOP) goals
- Consider other upstream and downstream crossings and dams on the same river system
- In general, replace downstream crossings first
- Perform site-specific data collection, geotechnical evaluation, hydrologic and hydraulic evaluation, and structure type evaluation to support design

<table>
<thead>
<tr>
<th>Road Stream Crossing</th>
<th>Stream</th>
<th>Crossing Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cedar Swamp Road</td>
<td>Wood River</td>
<td>5'W x 4'H Stone Masonry Box Culvert</td>
</tr>
<tr>
<td>Newport Road</td>
<td>Carson Brook</td>
<td>3'W x 1.5'H Stone Masonry Box Culvert</td>
</tr>
<tr>
<td>Gallup Homestead Road</td>
<td>Unnamed</td>
<td>20” Concrete Circular Conduit</td>
</tr>
<tr>
<td>Gallup Homestead Road</td>
<td>Unnamed</td>
<td>12” Concrete Circular Conduit</td>
</tr>
<tr>
<td>Pachaug Trail</td>
<td>Wood River</td>
<td>9'W x 3'H Timber Bridge</td>
</tr>
<tr>
<td>Brown Road</td>
<td>Wood River</td>
<td>8'W x 6'H Stone Masonry Bridge</td>
</tr>
</tbody>
</table>

### Dams
- 1 significant hazard dam assessed
- Only a portion of Sterling was assessed; other dams outside the Wood-Pawcatuck watershed may impact flooding in other parts of the town

**Recommendations:**
- Porter Pond Dam (Wood River)
  - Consider dam removal
  - Dam is not being maintained and is in disrepair
  - Owner of dam could not be identified
  - Impoundment supports limited recreational uses

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For the complete project plan please visit [http://wpwa.org/flood_resiliency.html](http://wpwa.org/flood_resiliency.html)

Project funding was provided by the National Fish and Wildlife Foundation Hurricane Sandy Coastal Resiliency Competitive Grant Program
Green Infrastructure

A screening-level assessment of potential green infrastructure (GI) retrofit sites was performed within the Wood-Pawcatuck watershed. When applied throughout the watershed, GI can help mitigate flood risk resulting from outdated and undersized storm drainage systems and increase flood resiliency, as well as improve water quality.

No site-specific GI retrofit concepts were developed for Sterling due to the town’s small land area and limited development within the Wood-Pawcatuck watershed and the limited scope of the GI assessment. The Town should incorporate GI approaches into municipal stormwater infrastructure planning and capital improvement plans to address drainage, flooding, and water quality priorities including MS4 Permit requirements, both within and outside of the Wood-Pawcatuck watershed. GI can be implemented on public sites including municipal parking lots and within the public right-of-way.

River Corridor

A detailed field geomorphic assessment was performed for approximately 40 miles of rivers and streams in the watershed. Based on the results of the geomorphic assessment, river corridor planning recommendations were developed to identify restoration projects that will reduce flood hazards and downstream sediment loading and improve aquatic habitat. While field geomorphic assessments were not conducted within Sterling, these recommendations apply in the town and throughout the watershed.

Recommendations:

- Protect existing wetlands as well as stream connections to wetlands and floodplains
- Remove floodplain constraints, such as levees or berms, where possible
- Protect and enhance riparian buffers
- Install log jams in select locations along the stream corridor to protect banks, create habitat, and reform meanders (where human conflicts with meander formation are not present)
- Avoid or limit alterations that will straighten or channelize stream channels
- Consider removing bank armoring where possible once a protected river corridor is established

Land Use Policy and Regulations

Municipal land use policies and regulations can help communities become more resilient to flooding by:

- Preserving undeveloped land
- Siting development in locations less vulnerable to flooding, and
- Promoting designs that reduce runoff and are less likely to be damaged in a flood

Recommendations:

A review was conducted of the land use policies, plans, and regulations of the watershed municipalities. Key recommendations of this review include:

- Amend zoning and subdivision regulations to require that all new development and redevelopment projects comply with LID standards consistent with the Connecticut Stormwater Quality Manual
- Consider amendments to the zoning and subdivision regulations to promote reduction of impervious surfaces and remove barriers to use of LID
- Consider adopting a No Adverse Impact (NAI) Floodplain Management policy
- Amend Floodplain Management Ordinance to strengthen flood management standards
- Consider implementing fluvial erosion hazard zoning to address riverine erosion hazards
- Update design storm precipitation amounts
- Implement road stream crossing standards for new and replacement culverts and bridges
Recommended Actions Summary
Town of Stonington, CT

The Wood-Pawcatuck watershed is vulnerable to flood-related damages, as evidenced by the devastating flooding that occurred in 2010. The Wood-Pawcatuck Watershed Association, working with the watershed municipalities and partner agencies, has developed a watershed-based management plan to enhance the resiliency of the watershed communities to future flooding and protect river and stream ecosystems, including water quality and habitat. The following is a summary of key findings and recommendations of the watershed plan for the Town of Stonington.

Quick Facts - Stonington
- 11% of town within watershed
- Includes portions of the Pawcatuck and Shunock Rivers and their watersheds
- 12 stream crossings assessed
- 2 dams assessed

Road Stream Crossings
- 4 crossings are hydraulically undersized
- 4 crossings have high geomorphic vulnerability
- 5 crossings have high flood impact potential
- 7 crossings limit or restrict aquatic passage

Recommendations:
- Replace and upgrade priority crossings (see table below) to meet flood resilience and aquatic organism passage (AOP) goals
- Consider other upstream and downstream crossings and dams on the same river system
- In general, replace downstream crossings first
- Perform site-specific data collection, geotechnical evaluation, hydrologic and hydraulic evaluation, and structure type evaluation to support design

<table>
<thead>
<tr>
<th>Road Stream Crossing Type</th>
<th>Road/Stream</th>
<th>Crossing Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Broad Street Pawcatuck River</td>
<td>14.5'H x 74'W Concrete Bridge</td>
<td></td>
</tr>
<tr>
<td>West Arch Street Unnamed</td>
<td>18&quot; Circular Concrete Culvert</td>
<td></td>
</tr>
<tr>
<td>Stillman Avenue Pawcatuck River</td>
<td>11'H x 117W Concrete Bridge</td>
<td></td>
</tr>
<tr>
<td>White Rock Road Pawcatuck River</td>
<td>10'H x 227W Stone Masonry Bridge</td>
<td></td>
</tr>
<tr>
<td>Railroad Pawcatuck River</td>
<td>22'H x 115W Concrete Bridge</td>
<td></td>
</tr>
<tr>
<td>Elmridge Avenue Unnamed</td>
<td>24'H x 42'W Stone Masonry Box Culvert</td>
<td></td>
</tr>
<tr>
<td>Westerly Bypass Unnamed</td>
<td>25'H x 189W Concrete Bridge</td>
<td></td>
</tr>
<tr>
<td>Somersett Drive Unnamed</td>
<td>36&quot; Circular Concrete Culvert</td>
<td></td>
</tr>
<tr>
<td>Canterbury Lane Unnamed</td>
<td>36&quot; Circular Concrete Culvert</td>
<td></td>
</tr>
<tr>
<td>Timber Ridge Drive Unnamed</td>
<td>36&quot; Circular Concrete Culvert</td>
<td></td>
</tr>
<tr>
<td>Fairview Drive Unnamed</td>
<td>48&quot; Circular Concrete Culvert</td>
<td></td>
</tr>
</tbody>
</table>

Dams
- 1 significant hazard dam, 1 low hazard dam

Recommendations:
- Liepold Pond Dam (Pawcatuck River)
  - The dam is being maintained. Ongoing maintenance is recommended.
  - The owner has indicated a desire to maintain the impoundment for private uses
- Stillmanville Dam (Pawcatuck River)
  - The concrete structure does not prevent fish passage or have a significant impact on flow regime
  - Consider removal to provide river restoration benefits

For the complete project plan please visit [http://wpwa.org/flood_resiliency.html](http://wpwa.org/flood_resiliency.html)

Project funding was provided by the National Fish and Wildlife Foundation Hurricane Sandy Coastal Resiliency Competitive Grant Program.
Land Use Policy and Regulations

Municipal land use policies and regulations can help communities become more resilient to flooding by:

- Preserving undeveloped land,
- Siting development in locations less vulnerable to flooding, and
- Promoting designs that reduce runoff and are less likely to be damaged in a flood.

Recommendations:

A review was conducted of the land use policies, plans, and regulations of the watershed municipalities. Key recommendations of this review include:

- Implement the recommendations of the Town’s Community Coastal Resiliency Plan, when complete
- Update the regional hazard mitigation plan annex, and reference the Wood-Pawcatuck Flood Resiliency Management Plan in municipal planning documents
- Consider adopting a No Adverse Impact (NAI) Floodplain Management policy
- Consider amendments to zoning regulations to further strengthen flood management standards
- Consider implementing fluvial erosion hazard zoning to address riverine erosion hazards
- Amend street and parking lot design standards to reduce impervious cover and remove barriers to LID
- Update design storm precipitation amounts
- Implement road stream crossing standards for new and replacement culverts and bridges

Green Infrastructure

A screening-level assessment of potential green infrastructure (GI) retrofit sites was performed within the Wood-Pawcatuck watershed. When applied throughout the watershed, GI can help mitigate flood risk resulting from outdated and undersized storm drainage systems and increase flood resiliency, as well as improve water quality.

Sites Identified for GI Retrofits:

- **West Vine Street School**
  - Install rain gardens near the school building and around the bus loop
  - Cost: $22,000

**River Corridor**

A detailed geomorphic assessment was performed for approximately 40 miles of rivers and streams in the watershed. Based on the results of the geomorphic assessment, river corridor planning recommendations were developed to identify restoration projects that will reduce flood hazards and downstream sediment loading and improve aquatic habitat.

Recommendations:

- Protect existing wetlands as well as stream connections to wetlands and floodplains
- Remove floodplain constraints, such as levees or berms, where possible
- Protect and enhance riparian buffers
- Install log jams in select locations along the stream corridor to protect banks, create habitat, and reform meanders (where human conflicts with meander formation are not present)
- Avoid or limit alterations that will straighten or channelize stream channels
- Consider removing bank armoring where possible once a protected river corridor is established

**Conceptual view of a typical floodplain cross section.**

**Infiltration Rain Garden**

A screening-level assessment of potential green infrastructure (GI) retrofit sites was performed within the Wood-Pawcatuck watershed. When applied throughout the watershed, GI can help mitigate flood risk resulting from outdated and undersized storm drainage systems and increase flood resiliency, as well as improve water quality.

Sites Identified for GI Retrofits:

- **West Vine Street School**
  - Install rain gardens near the school building and around the bus loop
  - Cost: $22,000

**View of a typical bioretention cell or rain garden with mature plantings.**
The Wood-Pawcatuck watershed is vulnerable to flood-related damages, as evidenced by the devastating flooding that occurred in 2010. The Wood-Pawcatuck Watershed Association, working with the watershed municipalities and partner agencies, has developed a watershed-based management plan to enhance the resiliency of the watershed communities to future flooding and protect river and stream ecosystems, including water quality and habitat. The following is a summary of key findings and recommendations of the watershed plan for the Town of Voluntown.

**Quick Facts - Voluntown**
- 21% of town within watershed
- Includes portions of the Ashaway and Wood River watersheds
- 7 stream crossings assessed
- 1 dam assessed

**Road Stream Crossings**
- 4 crossings are hydraulically undersized
- 4 crossings have high geomorphic vulnerability
- 1 crossing has high flood impact potential
- 2 crossings limit or restrict aquatic passage

**Recommendations:**
- Replace and upgrade priority crossings (see table below) to meet flood resilience and aquatic organism passage (AOP) goals
- Consider other upstream and downstream crossings and dams on the same river system
- In general, replace downstream crossings first
- Perform site-specific data collection, geotechnical evaluation, hydrologic and hydraulic evaluation, and structure type evaluation to support design

**Dams**
- 1 significant hazard dam

**Recommendations:**
- Green Falls Reservoir Dam (Green Fall River)
  - Recommended action is to maintain dam in its current state; this dam is considered a low priority
  - Impoundment is located in the Pachaug State Forest and has significant public recreational value
  - Dam is in fair condition

**High, Intermediate, and Low Priority Stream Crossings (Listed by Priority Ranking)**

<table>
<thead>
<tr>
<th>Road</th>
<th>Stream</th>
<th>Crossing Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bailey Pond Road</td>
<td>Carson Brook</td>
<td>Double 30” CMP Circular Conduit</td>
</tr>
<tr>
<td>Sand Hill Road</td>
<td>Unnamed</td>
<td>12” CMP Circular Conduit</td>
</tr>
<tr>
<td>Tom Wheeler Road</td>
<td>Unnamed</td>
<td>24” Concrete Circular Conduit</td>
</tr>
<tr>
<td>Sand Hill Road</td>
<td>Green Fall River</td>
<td>36” Stone Masonry Box Culvert</td>
</tr>
<tr>
<td>Green Fall Road</td>
<td>Unnamed</td>
<td>36” Stone Masonry Box Conduit</td>
</tr>
<tr>
<td>Sand Hill Road</td>
<td>Peg Mill Brook</td>
<td>6W x 7H Stone Masonry Box Culvert</td>
</tr>
<tr>
<td>Green Fall Road</td>
<td>Unnamed</td>
<td>10W x 4.4W Stone Masony Box Culvert</td>
</tr>
</tbody>
</table>

For the complete project plan please visit [http://wpwa.org/flood_resiliency.html](http://wpwa.org/flood_resiliency.html)

Project funding was provided by the National Fish and Wildlife Foundation Hurricane Sandy Coastal Resiliency Competitive Grant Program
Green Infrastructure
A screening-level assessment of potential green infrastructure (GI) retrofit sites was performed within the Wood-Pawcatuck watershed. When applied throughout the watershed, GI can help mitigate flood risk resulting from outdated and undersized storm drainage systems and increase flood resiliency, as well as improve water quality.

No site-specific GI retrofit concepts were developed for Voluntown due to the limited development and protected nature of the land within the Wood-Pawcatuck watershed and the limited scope of the GI assessment. The Town should incorporate GI approaches into municipal stormwater infrastructure planning and capital improvement plans to address drainage, flooding, and water quality priorities including MS4 Permit requirements, both within and outside of the Wood-Pawcatuck watershed. GI can be implemented on public sites including municipal parking lots and within the public right-of-way.

River Corridor
A detailed field geomorphic assessment was performed for approximately 40 miles of rivers and streams in the watershed. Based on the results of the geomorphic assessment, river corridor planning recommendations were developed to identify restoration projects that will reduce flood hazards and downstream sediment loading and improve aquatic habitat. While field geomorphic assessments were not conducted within Voluntown, these recommendations apply in the town and throughout the watershed.

Recommendations:
- Protect existing wetlands as well as stream connections to wetlands and floodplains
- Remove floodplain constraints, such as levees or berms, where possible
- Protect and enhance riparian buffers
- Install log jams in select locations along the stream corridor to protect banks, create habitat, and reform meanders (where human conflicts with meander formation are not present)
- Avoid or limit alterations that will straighten or channelize stream channels
- Consider removing bank armoring where possible once a protected river corridor is established

Land Use Policy and Regulations
Municipal land use policies and regulations can help communities become more resilient to flooding by:
- Preserving undeveloped land
- Siting development in locations less vulnerable to flooding, and
- Promoting designs that reduce runoff and are less likely to be damaged in a flood

Recommendations:
A review was conducted of the land use policies, plans, and regulations of the watershed municipalities. Key recommendations of this review include:
- Amend zoning and subdivision regulations to require that all new development and redevelopment projects comply with LID standards consistent with the Connecticut Stormwater Quality Manual
- Consider amendments to the zoning and subdivision regulations to promote reduction of impervious surfaces and remove barriers to use of LID
- Consider adopting a No Adverse Impact (NAI) Floodplain Management policy
- Amend Floodplain Management Ordinance to strengthen flood management standards
- Consider implementing fluvial erosion hazard zoning to address riverine erosion hazards
- Update design storm precipitation amounts
- Implement road stream crossing standards for new and replacement culverts and bridges
Recommended Actions Summary
Town of West Greenwich, RI

The Wood-Pawcatuck watershed is vulnerable to flood-related damages, as evidenced by the devastating flooding that occurred in 2010. The Wood-Pawcatuck Watershed Association, working with the watershed municipalities and partner agencies, has developed a watershed-based management plan to enhance the resiliency of the watershed communities to future flooding and protect river and stream ecosystems, including water quality and habitat. The following is a summary of key findings and recommendations of the watershed plan for the Town of West Greenwich.

Quick Facts – West Greenwich
- 51% of town within watershed
- Includes portions of the Wood, Usquepaug, and Queen Rivers and their watersheds
- 21 stream crossings assessed
- 2 dams assessed

Road Stream Crossings
- 10 crossings are hydraulically undersized
- 12 crossings have high geomorphic vulnerability
- 14 crossings limit or restrict aquatic passage

Recommendations:
- Replace and upgrade priority crossings (see table below) to meet flood resilience and aquatic organism passage (AOP) goals
- Consider other upstream and downstream crossings and dams on the same river system
- In general, replace downstream crossings first
- Perform site-specific data collection, geotechnical evaluation, hydrologic and hydraulic evaluation, and structure type evaluation to support design

<table>
<thead>
<tr>
<th>Road Stream Crossing</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Highest-Ranked High and Intermediate Priority Stream Crossings (Listed by Priority Ranking)</strong></td>
<td></td>
</tr>
<tr>
<td>Tillinghast Pond Road</td>
<td>Coney Brook</td>
</tr>
<tr>
<td>Hazard Road</td>
<td>Wood River</td>
</tr>
<tr>
<td>Falls River Road</td>
<td>Wood River</td>
</tr>
<tr>
<td>Henry Brown Road</td>
<td>Fisherville Brook</td>
</tr>
<tr>
<td>Plain Meeting House Road</td>
<td>Phillips Brook</td>
</tr>
<tr>
<td>Henry Brown Road</td>
<td>Unnamed</td>
</tr>
<tr>
<td>Plain Meeting House Road</td>
<td>Breakheart Brook</td>
</tr>
<tr>
<td>Beaver Hill Road</td>
<td>Breakheart Brook</td>
</tr>
<tr>
<td>Liberty Hill Road</td>
<td>Kelley Brook</td>
</tr>
</tbody>
</table>

Dams
- 2 low hazard dams
- Both dams are considered low priority dams

Recommendations:
**Hazard Pond Dam (Falls River)**
- Consider dam removal
- There are no known uses of the impoundment
- Next dam downstream on the Wood River (Barberville Pond Dam) should be considered for removal

**Kasella Farm Pond Dam (Breakheart Brook)**
- Current use of the impoundment is unknown
- Dam recently reconstructed to build a road across crest, but needs repair (crest is not compacted)
- Removal should be considered and could be achieved by enlarging the culverts beneath the roadway to sufficiently drain the impoundment, thereby maintaining the roadway

For the complete project plan please visit [http://wpwa.org/flood_resiliency.html](http://wpwa.org/flood_resiliency.html)
Green Infrastructure
A screening-level assessment of potential green infrastructure (GI) retrofit sites was performed within the Wood-Pawcatuck watershed. When applied throughout the watershed, GI can help mitigate flood risk resulting from outdated and undersized storm drainage systems and increase flood resiliency, as well as improve water quality.

No site-specific GI retrofit concepts were developed for West Greenwich due to the limited scope of the GI assessment. The Town should incorporate GI approaches into municipal stormwater infrastructure planning and capital improvement plans to address drainage, flooding, and water quality priorities including MS4 Permit requirements, both within and outside of the Wood-Pawcatuck watershed. GI can be implemented on public sites including municipal parking lots and within the public right-of-way.

River Corridor
A detailed field geomorphic assessment was performed for approximately 40 miles of rivers and streams in the watershed. Based on the results of the geomorphic assessment, river corridor planning recommendations were developed to identify restoration projects that will reduce flood hazards and downstream sediment loading and improve aquatic habitat. While field geomorphic assessments were not conducted within West Greenwich, these recommendations apply in the town and throughout the watershed.

Recommendations:
- Protect existing wetlands as well as stream connections to wetlands and floodplains
- Remove floodplain constraints, such as levees or berms, where possible
- Protect and enhance riparian buffers.
- Install log jams in select locations along the stream corridor to protect banks, create habitat, and re-form meanders (where human conflicts with meander formation are not present)
- Avoid or limit alterations that will straighten or channelize stream channels
- Consider removing bank armor where possible once a protected river corridor is established

Land Use Policy and Regulations
Municipal land use policies and regulations can help communities become more resilient to flooding by:
- Preserving undeveloped land
- Siting development in locations less vulnerable to flooding, and
- Promoting designs that reduce runoff and are less likely to be damaged in a flood

Recommendations:
A review was conducted of the land use policies, plans, and regulations of the watershed municipalities. Key recommendations of this review include:
- Update and integrate the Town hazard mitigation plan and comprehensive plan to address flood-prone areas
- Consider adopting a No Adverse Impact (NAI) Floodplain Management policy
- Amend zoning ordinance to strengthen flood management standards
- Consider implementing fluvial erosion hazard zoning to address riverine erosion hazards
- Consider amendments to the existing conservation/cluster development provisions in the zoning ordinance and subdivision regulations to strengthen flood management provisions
- Amend street and parking lot design standards to reduce impervious cover and remove barriers to LID
- Implement road stream crossing standards for new and replacement culverts and bridges
The Wood-Pawcatuck watershed is vulnerable to flood-related damages, as evidenced by the devastating flooding that occurred in 2010. The Wood-Pawcatuck Watershed Association, working with the watershed municipalities and partner agencies, has developed a watershed-based management plan to enhance the resiliency of the watershed communities to future flooding and protect river and stream ecosystems, including water quality and habitat. The following is a summary of key findings and recommendations of the watershed plan for the Town of Westerly.

Road Stream Crossings
- 15 crossings are hydraulically undersized
- 21 crossings have high geomorphic vulnerability
- 19 crossings have high flood impact potential
- 18 crossings limit or restrict aquatic passage

Recommendations:
- Replace and upgrade priority crossings (see table below) to meet flood resilience and aquatic organism passage (AOP) goals
- Consider other upstream and downstream crossings and dams on the same river system
- In general, replace downstream crossings first
- Perform site-specific data collection, geotechnical evaluation, hydrologic and hydraulic evaluation, and structure type evaluation to support design

<table>
<thead>
<tr>
<th>Road</th>
<th>Stream</th>
<th>Crossing Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forrestal Drive</td>
<td>Unnamed</td>
<td>Double 32” Concrete Circular Conduit</td>
</tr>
<tr>
<td>Westerly-Bradford Road</td>
<td>McGowan Brook</td>
<td>24” CMP Circular Conduit</td>
</tr>
<tr>
<td>Broad Street</td>
<td>Pawcatuck River</td>
<td>74’W x 14.5’H Concrete Bridge</td>
</tr>
<tr>
<td>Potter Hill Road</td>
<td>Unnamed</td>
<td>6’ CMP Circular Conduit</td>
</tr>
<tr>
<td>White Rock Road</td>
<td>Unnamed</td>
<td>Triple 24’ Concrete Circular Conduit</td>
</tr>
<tr>
<td>Ross Hill Road</td>
<td>Perry Healy Brook</td>
<td>12” CMP Circular Conduit</td>
</tr>
<tr>
<td>Hiscox Road</td>
<td>Unnamed</td>
<td>32” Concrete Circular Conduit</td>
</tr>
<tr>
<td>Spring Brook Road</td>
<td>Unnamed</td>
<td>1.5H x 5W Stone Masonry Box Culvert</td>
</tr>
<tr>
<td>Boom Bridge Road</td>
<td>Unnamed</td>
<td>3H x 2.5W Stone Masonry Arched Conduit</td>
</tr>
<tr>
<td>Stillman Avenue</td>
<td>Pawcatuck River</td>
<td>11H x 117’W Concrete Bridge</td>
</tr>
</tbody>
</table>

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Green Infrastructure

A screening-level assessment of potential green infrastructure (GI) retrofit sites was performed within the Wood-Pawcatuck watershed. When applied throughout the watershed, GI can help mitigate flood risk resulting from outdated and undersized storm drainage systems and increase flood resiliency, as well as improve water quality.

Sites Identified for GI Retrofits:

- **Grace United Methodist Church**
  - Bioretention adjacent to parking lot
  - Cost: $36,000

- **Bradford School**
  - Underground infiltration and green roof demonstration project
  - Cost: $219,000 ($56,000 for underground infiltration)

- **State Street School**
  - Bioretention and rain gardens
  - Cost: $83,000

- **Westerly High School**
  - Underground infiltration under parking area
  - Cost: $29,000

- **Tower Street School and Community Center**
  - Bioretention along parking area perimeter
  - Cost: $18,000

**River Corridor**

A detailed geomorphic assessment was performed for approximately 40 miles of rivers and streams in the watershed. Based on the results of the geomorphic assessment, river corridor planning recommendations were developed to identify restoration projects that will reduce flood hazards and downstream sediment loading and improve aquatic habitat.

Recommendations:

- **Downstream of Bradford Dam; Downstream of Boom Bridge to top of former White Rock Dam impoundment (Pawcatuck River)**
  - Remove berm on left bank to restore floodplain connection and reduce flood impacts

- **Downstream of Potter Hill Dam in Ashaway (Pawcatuck River)**
  - Install instream structures to narrow channel, sort and store sediment, and provide cover for aquatic organisms

- **At former location of White Rock Dam to Route 78 Bridge (Pawcatuck River)**
  - Install riparian plantings on right bank near gravel pit to slow or halt bank erosion

**Land Use Policy and Regulations**

Municipal land use policies and regulations can help communities become more resilient to flooding by:

- Preserving undeveloped land
- Siting development in locations less vulnerable to flooding, and
- Promoting designs that reduce runoff and are less likely to be damaged in a flood

Recommendations:

A review was conducted of the land use policies, plans, and regulations of the watershed municipalities. Key recommendations of this review include:

- Consider developing a coastal resiliency plan to better protect public infrastructure from coastal flooding and sea level rise
- Consider adopting a No Adverse Impact (NAI) Floodplain Management policy
- Amend zoning ordinance to strengthen flood management standards
- Consider implementing fluvial erosion hazard zoning to address riverine erosion hazards
- Amend street and parking lot design standards to reduce impervious cover and remove barriers to LID
- Update design storm precipitation amounts
- Implement road stream crossing standards for new and replacement culverts and bridges
- Reference the Wood-Pawcatuck Flood Resiliency Management Plan in municipal planning documents