

National Fish and Wildlife Foundation  
 LI Sound Futures Fund 2011 - Implementation - Habitat, Species, Invasives - Submit Final Programmatic Report (Activities)  
 NFWF/Legacy Grant Project ID: 1401.11.028729  
 Grantee Organization: Town of Stratford, Connecticut  
 Project Title: Long Beach West Invasive Species Control (CT)

**Project Period** 10/01/2011 - 04/30/2014  
**Award Amount** \$56,100.00  
**Matching Contributions** \$9,486.00  
**Project Location Description (from Proposal)** The proposed project will occur at Long Beach West in Stratford, CT. Latitude:N 41° 9' 30.7574" Longitude:W 73° 10' 4.2635"

**Project Summary (from Proposal)** Prepare management plan and implement invasives control at a 35-acre barrier beach in Stratford, Connecticut that includes dunes, tidal wetlands and sand flats. Project will restore critical habitats

**Summary of Accomplishments** The Town completed the vegetative mapping of Long Beach West, including natives and invasives. Stratford also created and approved a management plan including invasive species management. Went out to bid for procurement of contractor to implement the recommendations within the management plan. Implemented the Spring and Summer recommendations in the plan to remove invasive vegetation throughout the length of the barrier beach.

**Lessons Learned** Key lessons learned include: ongoing maintenance is required to maintain the die-back of the invasive species, including consistent monitoring of the habitat. We are still feeling the effects of two catastrophic storms that undid much of our earlier mapping work and have prevented some invasive species from germinating and coming back up. Therefore, we haven't had to address as much invasive management as we had initially expected.

Conservation Activities	Development of Invasive Species Mangement Plan, including Area-wide mapping of barrier beach and native plant surveys.
Progress Measures	# of management plans created
Value at Grant Completion	1
Conservation Activities	Removal of invasive species at site
Progress Measures	Acres of habitat restored or enhanced
Value at Grant Completion	0
Conservation Activities	Removal of invasive species at site
Progress Measures	% or acres reduction in invasive species cover
Value at Grant Completion	0

## **Habitat Management Plan for Long Beach, Stratford, CT with emphasis on invasive species control.**

### Background

Long and Pleasure Beaches are a single coastal barrier beach spit or ecosystem. It is the longest spit in the state, nearly 2 miles in length. An Environmental Review Team report for Pleasure Beach was conducted at the request of the City of Bridgeport (report date: May 1984<sup>1</sup>). This report identified the presence of rare plants, rare communities and rare landforms that have limited occurrence on coastal barriers along Long Island Sound. Subsequently, staff from the Coastal Area Management Program of the Connecticut Department of Environmental Protection suggested to William McCann, the former Director of the Stratford Conservation Commission, to request a review of Long Beach. It was anticipated that these two reviews would provide a complete understanding of issues related to coastal process, ecosystem health and management issues. The Long Beach ERT report was published in April 1987<sup>2</sup>. One of the important recommendations in the report was the suggestion that leasing of public lands for cottages be discontinued.

In ???, the Town of Stratford discontinued the leases and while the leases required homeowners to remove their cottages, no leasee complied with that requirement. Although the cottages were vacated, some were vandalized and several were subject to arson. In 200?, , the Trust for Public Lands began raising funds for habitat restoration through cottage removal. The critical funding source would be the \$909,000.00 received under the American Recovery and Reinvestment Act of 2009. Site preparation work began in early 2010 and the project was completed in April 2011, a critical milestone to restoration of the site. Additionally, in 2011 the Town of Stratford received a Long Island Sound Futures Fund grant to develop a management plan and implement invasive species control. This report addresses the final chapter in the restoration of Long Beach; the development of a restoration plan and the removal of invasive species. In this plan, the major landforms and plant communities are identified, the status of state rare plants is discussed, and an eradication plan for invasive plant species is outlined.

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<sup>1</sup> [http://www.ctert.org/ERTWebsite/pdfs/Bridgeport\\_PleasureBeach\\_132.pdf](http://www.ctert.org/ERTWebsite/pdfs/Bridgeport_PleasureBeach_132.pdf)

<sup>2</sup> [http://www.ctert.org/ERTWebsite/pdfs/Stratford\\_LongBeach\\_171.pdf](http://www.ctert.org/ERTWebsite/pdfs/Stratford_LongBeach_171.pdf)

## LANDFORMS



Figure 1. The primary named features of the Long/Pleasure Beach coastal barrier spit.

Long and Pleasure Beaches are political units within a single coastal barrier spit that lies between Oak Bluff Avenue in Stratford and the mouth of Bridgeport Harbor. There are three primary areas referred to in this report; namely Pleasure Beach, Long Beach West (LBW) and Long Beach (figure 1). Most natural coastal barriers in Long Island Sound are narrow (100 to 400 feet wide) with a simple landscape composed of beach and a primary sand dune. LBW and Pleasure Beach support a wide and complex landscape that is extremely rare in Long Island Sound (LIS) and with one exception, originate as a result of human modification. Connecticut beaches similar to this complex include Lynde Point in Old Saybrook, Milford Point in Milford and Russian or Lordship Beach in Stratford. Except for Russian Beach, these wide beaches are the result of the construction of a terminal breakwater designed to intercept along-shore sand movement that would otherwise accumulate in navigation channel. These beaches consist of a series of alternating dunes and swales, a complex called a ridge plain.

The Long Beach/Pleasure Beach complex can be divided into two beach categories: namely prograding (regressive) and retrograding (transgressive) as shown in figure 2. The yellow arrow in figure 2 show the net direction of sediment transport in the nearshore zone. The eastern breakwater associated with Bridgeport Harbor was constructed in 1871 (1,380 feet) and was lengthened to 3,823 feet in 1907/1908. The breakwater prevents the west moving sediment to accumulate in the navigation channel and this sediment collects on the east side of the structure causing the shoreline to increase in width. Gradually the beach grew seaward (prograded) and new primary dunes formed seaward of the older dunes, thus creating an alternating series of dunes and swales called a beach ridge plain. Ridge plains form naturally where sea level is declining; however at this site, the construction of the breakwater was the causal agent. As the beach prograded, the orientation of the shoreline changed or rotated in this case towards a SSE direction.

Since there is little or no change in the shoreline position since 1984, we presume that the beach has prograded to its fullest extent and now the shoreline position is relatively stable. Surplus sediment moving along this shoreline likely flows over the breakwater and appears to move northerly along the western edge of the beach causing the harbor shoreline to prograde to the west. The majority of the beach on the western shore of Pleasure Beach formed after 1933.

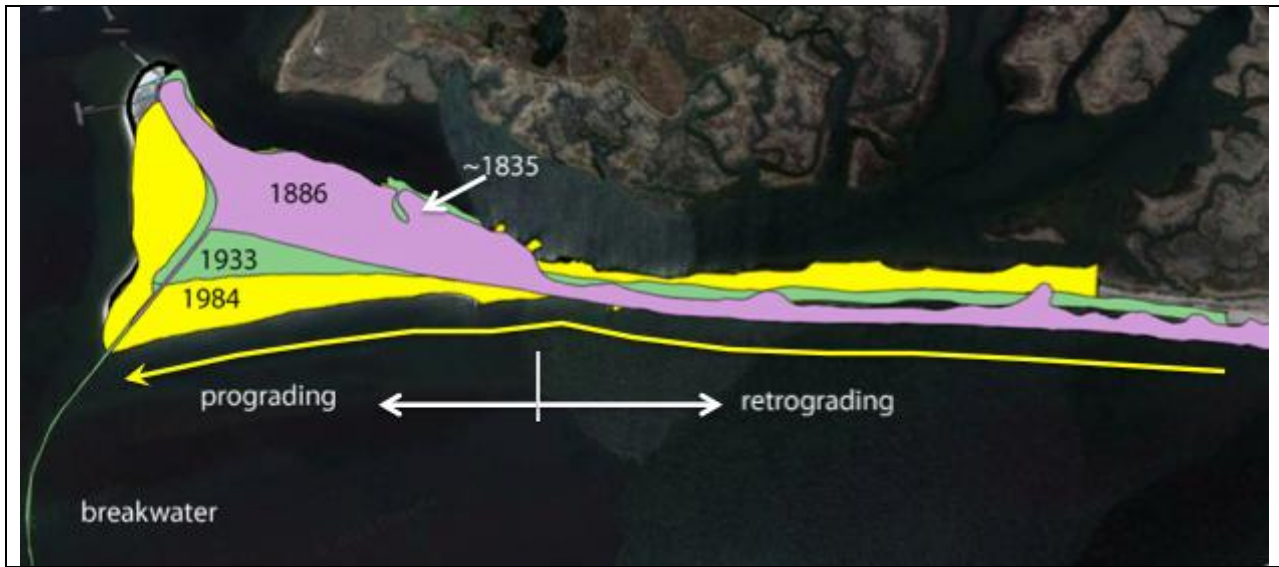


Figure 2. Pleasure Beach and Long Beach West are part of the prograding beach while Long Beach is a retrograding beach. The date ~1835 points to the location of the western end of the barrier in 1835. Construction of a breakwater prior to 1886 has caused the western beach segment to prograde. Prior to 1933, the breakwater was extended further into the Sound allow for addition progradation.

Where the prograding and retrograding beaches intersect, the shore is stable (see figure 2). To the east of this stable node, (see figure 2) where Long Beach is narrow and retrograding, the beach is ‘retreating’ in a landward direction. The actual width of the beach changes little over time. Coastal storm surge can cause waves to overtop the dunes and deposit sand behind the dune in the form of fan-shaped deposits called overwash sands. This deposition widens the beach and new dune formation upon the overwash sands increases beach elevation. These changes are in response to sea level rise and provide a drown-proofing mechanism. In the center of Long Beach, the mean high water shoreline has moved landward 300 feet in nearly 100 years for a rate of ~3 feet/year.

The fastland (upland) landforms have been mapped for the prograding and retrograding beaches. of the beach has been mapped as two major landform types; namely ridge plain and primary dune (figure 3). Several subforms of these habitats are also recognized (Table 1). The landform acreage includes the pre-Hurricane Irene dune extent as derived from 2010 coastal aerial

photography. Table 1 also provides an estimate of the amount of dune habitat eroded by Hurricane Irene.

Two other upland habitats are recognized: the man-made berm that lies between the fastland and tidal wetlands of Lewis Gut on LBW and the area that appears to have compact soils occurring on the east end of LBW and on the north side of the ‘road’. The occurrence of compacted soils is based solely on visual inspection and the predominance of ruderal vegetation.

<b>Table 1. Areal extent (acres) of landforms and subforms at the 3 beach locations.</b>		
<b>Location</b>	<b>Beach Type</b>	<b>Landforms</b>
Pleasure Beach**	prograding (66.4)	eroded dune (6.6)
		ridge plain (58.8)
Long Beach West	prograding (19.3)	eroded dune (1.6)
		primary dune (3.0)
		ridge plain (9.4)
		relict dune (0.6)
		berm (0.4)
		compact soil (4.3)
Long Beach	retrograding (9.1)	eroded dune (2.4)
		primary dune (4.8)
		backbarrier flat (1.9)

\* acres include eroded dune which are expected to reform in several years.

\*\*no landforms are mapped at Pleasure Beach except eroded dunes.





Figure 3. LBW landforms (top photo) include ridge plain (black lines), relict inlet dune (blue), berm (yellow) and eroded dune (white). Long Beach landforms (bottom photo) include primary dune (blue lines), eroded dunes (white) and backbarrier flats (cross hatch). Beach and tidal wetland are present in the imagery but not mapped.

#### Landform Management Recommendations:

It is estimated that approximately 4 acres of dune were eroded during Hurricane Irene. Unlike Hurricane Gloria, which in 1985, struck at low tide, Irene struck at high tide. When Irene made landfall, the storm was downgraded to a tropical storm but Irene was a slow moving storm, and in concert with high tide, created a storm surge that has a return frequency of 10 years. The temporary dune loss at Long Beach and LBW is approximately 33 percent. It is estimated that the erosion caused by Hurricane Gloria, a stronger storm, caused a loss of approximately 50% at The Strand in Waterford. These dunes reformed with little or no loss of dune area and potentially some gain.

Recommendation 1. Dunes are resilient resources and there is no evidence to suggest that replanting dune vegetation is required at Long Beach. Interpretation of the March 29, 2012 Google aerial photographs suggest that little or no dune vegetation was visible in the eroded dune areas. However, our field surveys in summer 2012 found scattered American beachgrass (*Ammophila breviligulata*) plants and so it is likely that these plants will spread jump-starting dune restoration. It is our recommendation that dune restoration be monitored to determine if there are places where planting beachgrass are needed or activities such as pedestrian access (trampling) need to be controlled. Dune recovery can be easily monitored by air photo interpretation. The Coastal Management Program of CT DEEP has recommendations for replanting dunes if needed.

It was noted that the spring deployment of string fence to protect piping plovers and least terns included former dune areas that had eroded. In some cases, the placement of the fence caused the public to walk on healthy dune and thus create new trails. It is recommended that the Conservation Commission and the US Fish & Wildlife Service develop protocols for the placement of fence in order to protect the regeneration of dune.

Hurricanes and nor'easters can cause the formation of inlet through barrier beaches. Typically these will form in gaps in the dunes, perhaps gaps created by pedestrian traffic. An inlet created at Griswold Point in Old Lyme in 1994 led the loss of the entire west end of the beach! Inlets can interrupt the alongshore transport of sand and starve 'downstream' areas such as LBW and Pleasure Beach and cause their erosion and loss. Even though Irene was a tropical storm, we note that the greatest dune losses are on the west side of each groin. It is likely that with winds from the southwest, the groins intensified the wave action in these locations. If Irene had been a stronger storm, it is possible that inlets might have formed at multiple locations and on the west side of groins!

Recommendation 2. Stratford should evaluate the benefit and liability of groins on Long Beach including the role that they might play in dune erosion and inlet formation. There should be an assessment of how to respond to the formation of an inlet across Long Beach following a coastal storm.

At the east end of LBW, an area of 'compact soils' is identified. Elsewhere on LBW, including the disturbance sites at the cottages, the soils are largely aeolian sands. No physical inspection (such as soil pits) was used to define the nature of these compact soils, so their origin and nature is unknown (e.g., historic fill?). Many of the plant species that are colonizing this area are ruderal, opportunistic "weeds", not native to Connecticut. In a few locations that has been some sand deposition and the vegetation resembles that of the natural dune system. The vegetation changes from spring to late summer were dramatic and in September much of this area was carpeted with crabgrass (*Digitaria* sp.). It is too early to predict the fate how natural restoration will proceed here. However, in the section of Pleasure Beach near the radio tower which had been compact soil used for parking, the native vegetation is returning including at least one endangered species.

Recommendation 3. Monitoring vegetation changes in this area to determine if future restoration actions are necessary. It may take a long time for this area to heal and so patience may be needed to avoid implementing unnecessary actions prematurely.

During the spring of 2012, the string fence used to create a protected area for terns and plovers was expanded to include the area of dune that was eroded during Hurricane Irene. In at least one location, this forced beachgoers to walk over the dune and create a new trail through the dune vegetation. In this area, the former sand/temporary gravel road was removed by storm surge and wave action. The string fence will not interfere with the regrowth of the foreslope dune. American beachgrass will colonize this eroded dune area by rhizomes and new shoots will help to trap aeolian sand and rebuild the dune.

Recommendation 4. The town should meet with those responsible for deployment of the string fence to assure that the fence does not lead to additional dune vegetation by pedestrian traffic or interfere with the rebuilding of the dune. The dune is an essential natural barrier to prevent inlet formation, which could result in the significant loss of barrier beach including habitat for terns and plovers.

## VEGETATION AND PLANT COMMUNITIES

Within each landform are several plant communities, each influenced by coastal dynamics and the land-use history of the site. The extensive area of ridge plain that occurs at the Long Beach West and Pleasure Beach prograding beaches is a rare landform type and this is the best example in Long Island Sound with its greatest extent occurring in the area formerly developed with residential cottages (Long Beach West).

### Primary Dune

The primary dune parallels Long Island Sound from the parking lot west to the terminus of Pleasure Beach in Bridgeport and is shown in Figure 3. The seaward edge of the ridge plain has a primary dune. The primary dune consists of a foreslope, crest and backslope. The foreslope dune is immediately adjacent to the beach strand and receives constant supply of aeolian sand from the beach. Few species have the capacity to grow here where there is active vertical growth of sand. There is also sedimentation on the backslope dune with sedimentation decreasing with increasing distance from the dune crest.

The most important dune plant is American beachgrass (*Ammophilla breviligulata*), a cryptophyte with the perennial bud just below the soil surface. The rhizomes are capable of horizontal growth on the order of eight to ten feet per year. The shoot is capable of elongation at a rate that is dependent upon the amount of sand deposition. Several nodes are produced in a single growing season and these provide a record of sediment deposition. Active sediment deposition protects the perennial bud in the winter from desiccation. In areas with little or not sand deposition such as the ridge plain, *Ammophilla* is replaced by species that are not tolerant of sand deposition.

The primary dune supports a coastal grassland dominated by *Ammophilla*. *Ammophilla* abundance is greatest on the foredune and decreases with increasing distance landward as sediment deposition decreases. The primary plant associates include American beach rocket (*Cakile edentula*), seaside goldenrod (*Solidago sempervirens*), cocklebur (*Xanthium strumarium*), Russian thistle (*Salsola kali*), orach (*Atriplex patula*), and others. On both the foredune and backdune saltmeadow cordgrass (*Spartina patens*) occurs in pure stands.

The backslope habitat starts at the crest of the foredune and extends to the edge of the tidal wetlands that border Lewis Gut. Here the sediment deposition rates are lower than the foredune and species diversity increases. *Ammophila breviligulata* is still dominant here, growing intermingled with *Solidago sempervirens*, *Cakile edentula*, wild lettuce (*Lactuca canadensis*), small flower evening primrose (*Oenothera parviflora* var. *oakesiana*), common milkweed (*Asclepias syriaca*), and horseweed (*Conyza canadensis*), the latter often abundant in large patches. Low thickets of beach rose (*Rosa rugosa*) also occur, growing as near monocultures with a sparse mixture of *Solidago sempervirens*, *Centaurea stoebe* and *Celastrus orbiculatus*.

### Backbarrier Flats

There is a section of Long Beach that is mapped as backbarrier flat (figure 3) which lies landward of the backslope dune. This might be a former storm overwash fan, which receives little or no Aeolian sand. This habitat therefore has a more stable substrate where species such as Other areas are dominated by beach sedge (*Carex silicea*), Gray's flatsedge (*Cyperus grayi*), eastern prickly pear (*Opuntia humifusa*), Virginia pepperweed (*Lepidium virginicum*), *Bromus sterilis*, *Conzia canadensis*, Queen Anne's lace (*Daucus carota*), and Canada toadflax (*Nuttallanthus canadensis*) are prevalent, intermixed with low patches of mosses and lichens.

Other associated plants include poverty brome (*Bromus sterilis*), which can grow in large patches, wormwood (*Artemisia campestris* ssp. *caudata*), poison ivy (*Toxicodendron radicans*), cocklebur (*Xanthium strumarium*), bouncing bet (*Saponaria officinalis*), butter and eggs (*Linaria vulgaris*), quack grass (*Elymus repens*), and goat's beard (*Tragopogon dubius*). Invasive plants occur in patches with tree of heaven (*Ailanthus altissima*) forming small thickets in several areas. Oriental bittersweet (*Celastrus orbiculatus*) and spotted knapweed (*Centaurea stoebe*) are also present, but are infrequent in their distribution.

### Ridge Plain.

The ridge plain occurs exclusively on Long Beach West and Pleasure Beach. This plain consists of alternating low dunes and swales. Cottage construction and other human activities have largely erased this pattern but it is still visible but highly disturbed on the west side of Long Beach West. Here, the soil has been compacted, with asphalt remnants and demolition debris scattered throughout.

The interior dunes and swales are largely inactive with regards to sand deposition, having been isolated from the beach, and so the soils are stable. Located interior seaward or primary dune, a rare vegetation develops, composed of a complex mosaic of herb and grass microcommunities. In the absence of active sedimentation *Ammophila* is sparse or absent. Characteristic species include wormwood (*Artemisia campestris* ssp. *caudata*), beach pinweed (*Lechea maritima*), *Spartina patens*), purple love-grass (*Eragrostis spectabilis*), *Solidago sempervirens*, *Opuntia*

*humifusa*. Other associated plants include *Cyperus grayii*, *Carex silicea*, *Oenothera parviflora* var. *okesiana*, *Conyza canadensis*, *Triplasis purpurea*, sweet everlasting (*Gnaphalium purpureum*), Seaside Spurge (*Euphorbia polygonifolia*), and Bastard Pennyroyal (*Trichostema dichotomum*). In one location, beach needlegrass (*Aristida tuberculosa*), New England blazing star (*Liatris scariosa* var. *novae-anglia*) sickle-leaved golden aster (*Pityopsis falcata*) and bitter panicgrass (*Panicum amarum*) are growing together.



Figure 4. Dune and swales of the ridge plain at Pleasure Beach.

On the western border of Long Beach West, herbaceous vegetation occurs in patches interspersed with small shrub thickets and areas of open sand. Beach plum (*Prunus maritima*) is the most common native shrub, with a few thickets composed solely of *Prunus* (see Appendix A). Other *Prunus* patches are intermixed with invasive species such as *Ailanthus altissima*, bush honeysuckle (*Lonicera* sp.), Japanese honeysuckle (*Lonicera japonica*), privet (*Ligustrum obtusifolia*), *Celastrus orbiculatus*, *Paulownia tomentosa*, *Rhus glabra*, *Populus tremuloides*, and *Toxicodendron radicans*. This habitat extends west onto Pleasure Beach intergrading with areas of minimal sand deposition, stabilized with number of reindeer lichens, cup lichens, and hair cap mosses. There are several patches of Virginia rose (*Rosa virginiana*) on the ridge plain but one of these is probably the largest colony in coastal Connecticut. A few wild black cherry

(*Prunus serotina*) shrubs dot the sand plain. *Prunus serotina* is one of several species of trees that grow in the native forests of coastal barrier beaches in the northeast.

In the area of compacted soil formerly occupied by cottages, the plants are largely opportunistic annuals. Visual dominance of these varies from spring to fall giving this area a very different appearance as the seasons progress. Sandwort (*Arenaria serpyllifolia*), bracted plantain (*Plantago aristata*), and annual knawel (*Scleranthus annuus*) are spring dominants; *Daucus carota* is striking in mid-summer, followed by a dense growth of crabgrass (*Digitaria sanguinalis*) in the fall. Some areas exhibit recent sand accumulation, likely a result of hurricane Irene. Additional plants include *Linaria canadensis*, *Conzia canadensis*, tall tumbleweed (*Sisymbrium altissimum*), *Silene vulgaris*, *Lepidium virginicum*, *Bromus tectorum*, common mullein (*Verbascum thapsus*), yellow oxalis (*Oxalis stricta*), chickweed (*Cerastium* sp.), common wormwood (*Artemisia vulgaris*), six weeks fescue (*Vulpia octoflora*), *Solidago sempervirens*, polkweed (*Phytolacca americana*), and *Toxicodendron radicans*. Invasive species such as *Ailanthus altissima*, *Centaurea stoebe*, and seedlings of black locust (*Robinia pseudoacacia*) are scattered.

Remnant ornamental plantings also occur in the vicinity of the former cottages, the most problematic being *Zoysia* cf. *japonica*, an Asian lawn grass that readily spreads by shallow rhizomes and is difficult to contain and/or eradicate. Other showy ornamentals include lanceleaf tickseed (*Coryeopsis lanceolata*), a tea rose cultivar (*Rosa* sp.), sweet William (*Silene armeria*), stonecrop (*Sedum acre*), Japanese wisteria (*Wisteria floribunda*), trumpet creeper (*Campsis radicans*), and scattered lilac (*Syringa vulgaris*) and mulberry (*Morus* sp.) shrubs. This area also contains a forested border of *Robinia pseudoacacia* trees that grow on the man-made berm that was created along the shore of Lewis Gut. Several other plants associated with the berm include common reed (*Phragmites australis*), *Silene vulgaris*, *Elymus repens*, smooth sumac (*Rhus glabra*), empress tree (*Paulownia tomentosa*), *Toxicodendron radicans*, *Opuntia humifusa*, *Solidago sempervirens*, *Spartina patens*, and *Celastrus orbiculatus*.

Also at the western border of Long Beach West is a small area dominated by switchgrass with scattered *Solidago sempervirens*, *Opuntia humifusum*, *Lepidium virginiana*, *Carex silicea*, and *Conzia canadensis*. In several locations *Panicum amarum* is present.

#### Recommendations:

Removal of the invasive trees eliminate forest habitat. The native trees on Connecticut barrier beaches are *Prunus maritima* and shadbush (*Amelanchier canadensis*). *Juniperus virginiana* is a native evergreen shrub of dune swales that is salt tolerant. The *Juniperus* at Hammonasset State Park is a popular for birders to search for owls. There are only a few scattered *Juniperus* on Long Beach and LBW.

Recommendation 1. Consider purchasing a small number of young *Prunus* and *Amelanchier* to plant on the landward side of the beach. Consider establishing a few small *Juniperus* groves on LBW. These plantings will likely require protection from deer browse until they become established.

The eastern portion of LBW mapped as a compacted soil landform is an area with many ruderal plants and substrate that is not conducive to native plants. There were also rapid seasonal changes in plants in this location including the dominance by crabgrass in late summer. There are some signs of wind blown sand accumulating in this area but it may not be sufficient for the recovery of native plants. It is noted however, that the compacted parking area beyond LBW near the antenna at Pleasure Beach is gradually converting to native plants.

Recommendation 2. Monitor vegetation change particularly at the LBW landform called compacted soil.

#### STATE-LISTED PLANT SPECIES

On Long Beach West, several interior dune ridges contain a number of Connecticut State-listed plants: beach needlegrass (*Aristida tuberculosa*, Endangered), sickle-leaved golden aster (*Pityopsis falcata*, Endangered), (*Panicum amarum* (Threatened), New England blazing star (*Liatrix scariosa* var. *novae-anglia*, Special Concern), Eastern prickly pear (*Opuntia humifusa*, Special Concern). These species are further described below:

*Aristida tuberculosa* is an annual grass occurs on coastal dunes from Virginia north to New Hampshire and in xeric oak-pine sandhills in the southeastern and Gulf coast states, with disjunct locations north to Minnesota and Indiana. This grass is considered rare in Indiana, Threatened in Michigan and Massachusetts, and Endangered in New Hampshire and Connecticut. In Connecticut, *Aristida* is restricted to barrier flats that have formed on a few coastal dunes in Fairfield County. *Aristida tuberculosa* is best recognized in August and September when the plants are mature and start to show the distinctive three-parted twisted awn over one inch in length. On Long Beach West, *Aristida tuberculosa* is restricted to the undisturbed ridge plain associated with the former cottages near the fenced border of Pleasure Beach. Several hundred stems in both large patches and as scattered individuals were observed in August 2012 on an interior dune ridge and a swale behind the primary dune. This species covers the greatest area of all of the listed species.



Figure 5. The twisted awns of *Aristida tuberculosa*.

*Pityopsis falcata* is a perennial composite that grows on open sandy areas and pine barrens along the coast from Massachusetts south to New Jersey, and in the right habitat can be locally abundant. *Pityopsis* is considered Endangered in Connecticut and is rare in Rhode Island. In Connecticut, this plant is restricted to a few dune ridges and swales in Fairfield County and one dry sandy area in New Haven County. Its distinctive foliage and golden yellow flowers that bloom in July and August best recognize this plant. On Long Beach West, *Pityopsis falcata* is restricted to a small area on both sides of two cinder drives associated with the former cottages near the fenced border of Pleasure Beach. Between three and four hundred plants were observed in August 2012.

*Panicum amarum* is a coarse perennial grass that grows on coastal sand dunes from New England south and west to Mexico. *Panicum amarum* is considered Threatened in Connecticut and rare in Rhode Island. In Connecticut, this grass grows on foredunes, backslopes and swales in Fairfield, New Haven Counties and Middlesex Counties. There is a large population at Pleasure Beach discovered in 2012. This grass is best recognized by its clonal growth form and its coarse bluish, green foliage. On Long Beach West, *Panicum amarum* grows in large patches on dune and swale habitat associated with the former cottages near the fenced border of Pleasure Beach. Several clonal patches were observed in August 2012.



Figure 6. *Pityopsis falcata*.

*Liatris scariosa* var. *novae-angliae* is a showy composite that grows in all the New England states except Vermont, extending south and west to New Jersey and Pennsylvania. *Liatris* is considered Endangered in New Hampshire, Rhode Island, and New Jersey; Threatened in New York and Maine; and Special Concern in Massachusetts and Connecticut. In Connecticut, this plant has declined in its distribution occurring in several open sand plains, on bedrock outcrops and on the barrier flat of Long Beach West. Its showy spike of blue flowers that bloom in July and August best recognizes this plant. On Long Beach West, *Liatris scariosa* var. *novae-angliae* is restricted to a small area on both sides of two cinder drives associated with the former cottages near the fenced border of Pleasure beach. Thirteen stems in flower and bud were observed in August 2012, several of which appeared to be browsed by deer.

*Opuntia humifusa* is the only New England representative of the cactus family growing in dry soil and on bedrock outcrops in nearly state east of the Rocky Mountains, with the exception of Maine, New Hampshire, and Vermont. *Opuntia* is considered Endangered in Massachusetts, Special Concern in Connecticut, Rare in Pennsylvania, and Exploitably Vulnerable in New York. In Connecticut, this plant occurs near the coast on coastal dunes and exposed outcrops, with fewer occurrences east of the Connecticut River. *Opuntia* is relatively widespread on Long Beach and Long Beach West on backslope dunes, swales and the relict inlet dune, most abundant in the area of the former cottages on Long Beach West. Several hundred “clumps” were observed in August 2012.

#### Recommendation 1

Apply deer off to *Liatris*; monitor population status every three years (best time is August); important to control shrubs and invasive trees that cast shade; important to

control *Zoysia* grass which could outcompete the listed species and important to remove *Centaurea* that is confined to eastern LBW.

## INVASIVE SPECIES

Long Beach and Long Beach West contain a number of invasive plants. These include trees: *Ailanthus altissima*, *Paulownia tomentosa*, and *Robinia pseudoacacia*; shrubs: *Elageanus orbiculatus*, winged euonymus (*Euonymus alatus*), *Ligustrum obtusifolium*, and *Lonicera morrowii*; vines: *Celastrus orbiculatus* and *Lonicera japonica*; and herbaceous plants: *Centaurea stoebe*, Japanese knotweed (*Fallopia japonica*), and *Phragmites australis*. Several other plants, some introduced by the cottage owners, also have the potential to impact the ecological functions of this site. These include quaking aspen (*Populus tremuloides*), Japanese wisteria (*Wisteria floribunda*), trumpet creeper (*Campsis radicans*), *Aralia hispida*, and Japanese lawn grass (*Zoysia japonica*). The eradication of these plants is an integral part of the restoration of this coastal resource. A detailed invasive plant species control plan can be found in Appendix A. These species are listed as invasive species based upon an on-the-ground assessment such as spreading by vegetative means and occurrence of seedlings.

Four tree species *Ailanthus altissima*, *Paulownia tomentosa*, *Populus tremuloides*, and *Robinia pseudoacacia* are fairly abundant and spreading. These species are a high priority for control. Although most of these trees are salt pruned and appear to be drought stressed, all produce vigorous root sprouts, and two; *Ailanthus* and *Robinia* secrete alleopathic chemicals that inhibit the growth of other plants. This is evidenced by the clonal nature of their growth. Seedlings and saplings are scattered throughout Long Beach West and these trees will continue to spread as long as a seed source is present. Given their presence throughout Pleasure Beach, monitoring their recolonization after control is essential to maintain the integrity of the site.

In most cases, the “cut and paint” method of chemical control will be preferred. Using this method, trees and large shrubs are cut off at their base and an herbicide solution is sprayed or painted onto the exposed surface of the stump. Once cut, smaller trees can be left in place to decay whereas larger boles can be cut and stacked. The objective of this method is to kill both the stump and the root system, minimizing re-sprouting. Seedlings and small saplings can be hand-pulled or sprayed as appropriate.

Invasive woody shrubs and vines are less frequent in their occurrence, mostly intermixed in the *Prunus maritima* thickets on Long Beach West. The greatest threat that these species have is displacing native shrubs, herbaceous vegetation and listed species. Since most invading shrubs are intermixed with native species, the “cut and paint” method will be preferred. Smaller and/or isolated shrubs and vines can either be cut with the stumps sprayed or the above ground foliage can be sprayed carefully minimize wind drift.

For woody plants, we recommend chemical control following the guidelines provided by the Connecticut Invasive Plant Working Group:

[http://www.hort.uconn.edu/cipwg/art\\_pubs/GUIDEguideframe.htm](http://www.hort.uconn.edu/cipwg/art_pubs/GUIDEguideframe.htm).

Of the herbaceous species, the occurrence of *Centaurea stoebe* and *Zoysia* are of greatest concern. Once established, *Centaurea* can easily out-compete native plants through the production and release of catechin, a bioflavonoid that inhibits the growth of other plants. *Centaurea* is a difficult plant to eradicate. The large number of seed produced and the deep taproot make control labor intensive requiring multiple years of effort. Hand pulling is the recommended control method at this site.

*Zoysia* is an introduced species that seems to thrive along Connecticut's coast. Spreading readily by long shallow rhizomes (Figure 7), it can quickly spread and out-compete native plants. Three small populations occur on Long Beach West, likely introduced by former cottage owners to create lawn. Japanese lawn-grass is also difficult to eradicate with multiple treatments of a non-selective herbicide such as Roundup® necessary to ensure its removal. The plants need to be actively growing prior to treatment, with treatment most effective after a period of rain. The thatch should be removed either through mechanical means or a controlled burn, and as new growth emerges, treated again. Additional treatments may be necessary to be most effective.

Another herbaceous plant of concern is *Fallopia japonica*. *Fallopia* is an aggressive plant with thick, spreading rhizomes that are difficult to eradicate. Since this plant occurs only in a few clumps on Long Beach West, we recommend a combination of manual and chemical control also following the guidelines provided by the Connecticut Invasive Plant Working Group:

[http://www.hort.uconn.edu/cipwg/art\\_pubs/GUIDE/guideframe.htm](http://www.hort.uconn.edu/cipwg/art_pubs/GUIDE/guideframe.htm)



Figure 7. Rapid spread of *Zoysia* by rhizomes.

## Appendix A. Invasive Species Control Plan.

For the purposes of invasive species control, Long Beach is divided into two sections (see Figure 1), Area 1 (prograding beach) and Area 2 (retrograding beach). Area 1 is known as Long Beach West (LBW), the location that had been leased for cottage construction and supports beach ridge plain with rare vegetation and five State-listed plant species. Area 2 is narrow barrier beach with primary dune that is migrating landward. The invasive species issues and priorities for each area are described below.



Figure 1. The base image is from 2012 imagery available from Google maps. Area 1 is the highest priority for invasive species control. Base aerial imagery is Google Maps March 29, 2012.

### Methodology:

A reconnaissance was conducted on May 22, 2012 to assess the distribution of invasive species and test methodologies to define the spatial extent on these species (e.g., aerial photo interpretation and delineation with GPS). Aerial photography reviewed included 2005 and 2010 summer false color infrared aerial photography for coastal Connecticut and 2012 aerials (March 29, 2012) available through Google Maps. There were minor geo-referencing differences amongst all of these sources. The Google aerials were used to delineate invasive species as this was post cottage removal. In the removal of cottages, shrubs and trees were removed making this the best base map to estimate the boundaries of invasive trees and shrubs. The Google aerials are leaf off and this increases the difficulty in defining boundaries of shrubs and trees.

Aerial photography was used to delineate ‘islands’ of shrubs/low trees and the one tall tree stand of *Robinia pseudacacia*. Tracklog was used to define boundaries for non-woody plants such as the grass *Zoysia* and the weed *Centaurea stoebe*. There are numerous scattered individuals of *Celastrus orbiculatus*. No attempt was made to record the locations of scattered individuals *Celastrus*.

Quantum GIS (QGIS) software was used to create point and polygon shapefiles. These files are in NAD83 and CT State Plane Coordinates (feet). Area (acres and/or square feet) has been computed using QGIS. For shrubs, square feet are a more useful value than acres since the footprint of the individual islands is small. Some of the islands are but several low trees or shrubs and so area **estimates** are not all that useful for contractors to estimate their work effort.

Some of the larger polygons contain a mix of the native shrub Beach Plum (*Prunus maritima*), which is to be protected, will be intermixed with invasive trees and numerous *Celastrus* vines. This too makes the use of area estimates difficult to use to assess work efforts. There are a few islands dominated by *Prunus maritima* that require little or no control and these are identified on a shapefile.

GPS was used to capture approximate boundaries for the herbaceous invasives such as the grass *Zoysia* and *Centaurea stoebe*. It is recommended that Town engage volunteers to hand pull *Centaurea* beginning at eastern Long Beach West.

**Invasive Species Summary:**

Long Beach and LBW contain a number of invasive plants (Table 1). These include trees: *Ailanthus altissima*, *Paulownia tomentosa*, and *Robinia pseudoacacia*; shrubs: *Elageanus orbiculatus*, winged euonymus (*Euonymus alatus*), *Ligustrum obtusifolium*, and *Lonicera morrowii*; vines: *Celastrus orbiculatus* and *Lonicera japonica*; and herbaceous plants: *Centaurea stoebe*, Japanese knotweed (*Fallopia japonica*), and *Phragmites australis*. Several other plants, some introduced by the cottage owners, also have the potential to impact the ecological functions of this site. These include quaking aspen (*Populus tremuloides*), Japanese wisteria (*Wisteria floribunda*), trumpet creeper (*Campsis radicans*), *Aralia hispida*, and Japanese lawn grass (*Zoysia japonica*). The eradication of these plants is an integral part of the restoration of this coastal resource. These species are listed as invasive species based upon an on-the-ground assessment such as spreading by vegetative means and occurrence of seedlings. Rugose rose (*Rosa rugosa*) has the potential to be an invasive species on barrier beach creating monospecific stands at the exclusion of all other species. There are a number of small but discontinuous shrub islands of this rose but they occupy small areas of backslope dune and are thus considered naturalized and do not warrant control.

Table 1. List of plants determined to be invasive at Long Beach.			
Scientific Name	Common Name	Threat	Comments
<b>Trees</b>			
<i>Ailanthus altissima</i>	Tree of Heavy	High	spreading
<i>Paulownia tomentosa</i>	Empress Tree	Moderate	
<i>Populus tremuloides</i>	Quaking Aspen	High	spreading
<i>Robinia pseudoacacia</i>	Black Locust	High	spreading
<b>Shrubs</b>			
<i>Aralia spinosa</i>	Hercules Club	Moderate	spreading
<i>Eleagnus umbellata</i>	Autumn Olive	Moderate	Few individuals
<i>Euonymus alatus</i>	Burning Bush	Moderate	Few individuals

<i>Ligustrum obtusifolia</i>	Privet	Low	
<i>Lonicera cf. morrowii</i>	Bush honeysuckle	Moderate	Is the dominant forestry understory at Old Black Point Beach
<i>Juniperus sp.</i>	“Carpet Juniper”	Moderate	spreading
<b>Lianas</b>			
<i>Campsis radicans</i>	Trumpet Creeper	High	spreading
<i>Celastrus orbiculatus</i>	Asiatic Bittersweet	High	spreading
<i>Wisteria floribunda</i>	Japanese Wisteria	Moderate	spreading
<b>Herbaceous Plants</b>			
<i>Centaurea stoebe</i>	Spotted Knapweed	High	Spreading, phytotoxin, highly invasive in sand dunes
<i>Fallopia japonicus</i>	Giant Knotweed	High	spreading
<i>Phragmites australis</i>	Common Reed	High	Spreading on flats
<i>Zoysia spp.</i>	Japanese Zoysia	High	Spreading, potential to become dominant plant in open and understory

#### Zone 1 - Long Beach West

There are three discrete subareas within Zone 1 (A, B and C). Zone 1A is the western portion of LBW containing numerous shrub islands, one large stand of *Robinia pseudoacacia*, the turf grass *Zoysia* and the reed grass *Phragmites australis*. Zone 1B is the second highest priority and it contains a few small shrub islands, small colonies of dwarf *Phragmites australis* and *Fallopia*. Zone 1C is largely free of invasive species but there are scattered tree seedlings such as *Populus tremuloides* and scattered individuals of *Celastrus orbiculatus*. The primary control efforts here are to search for and control the listed invasive species.



Figure 2. Shows the three subzones at Long Beach West (Zone 1).

### Zone 1A.

The primary area for invasive species control is LBW, the upland area is approximately 11 acres but the estimate area for invasive species control is listed in Table. The recommended control is to cut and paint all trees and shrubs with the exception of Quaking Aspen (*Populus tremuloides*). Wild black cherry (*Prunus serotina*) and beach plum (*Prunus maritima*) are native and are to be protected and not treated. The few black cherry trees should be be flagged in advance of implementing the recommended controls. To simplify the control plan, it is suggested that any shrub that is not *Prunus maritima* be treated and thus it is not necessary to identify individual trees and shrubs before treating. Identification of *Prunus maritima* is key to applying control measures in Zone 1A. Also identification of *Populus tremuloides* is necessary for it requires a herbicide treatment such as basal injection.



Figure 3. Zone 1A showing the primary control areas: *Robinia pseudoacacia* (green), shrub islands (white), *Zoysia* (yellow), and *Phragmites australis* (lavender). Light blue areas correspond to shrub islands dominated by the native *Prunus maritima* to be protected.

<b>Table 2. Estimated footprint of invasive species control areas in Zone 1A.</b>			
<b>Species/Target</b>	<b>Area</b>	<b>Sites</b>	<b>Treatment</b>
<i>Robinia</i> (trees)	0.65 acres	1	cut & paint
Shrub <b>Islands</b>	71,412 SF (1.63 acres)	24	Cut & paint except for <i>Populus tremuloides</i> (basal injection)
<i>Phragmites</i>	0.42 acres	1	herbicide
<i>Zoysia</i>	7,256 SF	4	herbicide & rake; retreat

A. *Robinia* Stand. Along the north side of LBW is a man-made berm upon which support a linear stand of *Robinia pseudoacacia* with a 0.65 acre footprint. There are a few invasive species associated with this stand including *Lonicera morrowii*, *Eleagnus umbellata* and *Paulownia tomentosa*, which need to be treated.

Recommended control: Cut close to ground; paint stump with herbicide. Cut and stack wood at a designated area. The trees should be cut and the wood stacked at a location approved by the town (consider the upland between this site and the *Phragmites* site to the east).

Rationale: There are numerous seedings throughout the ridge plain and unless the source is

removed, this species will continue to spread and threaten state listed plants and rare coastal vegetation.

- B. Shrub Islands. There are approximately 24 ‘shrub islands’ that contain invasive shrubs and low trees with an estimated area of 1.6 acres. An additional 10 islands have been identified which are dominated by *Prunus maritima* and should not be cut or treated. However any invasive species present in these islands should be treated. A few of the larger islands have numerous *Prunus maritima* within and care should be taken to not cut and treat the *Prunus*. With one exception, any shrub/tree species that is not *Prunus* should be cut and treated. In this regard, the key to a successful control program is the ability to recognize *Prunus*. The one native tree that requires identification is *Populus tremuloides*, which requires a treatment such as basal injection of herbicide. There is a single colony of *Juniperus horizontalis*, which may require a treatment such as picloram and tebuthiuron to the soil.

A complication for the western most portion of shrub islands is the presence of rare plants. The rare plant area should be delineated with stakes and string/rope prior to the start of any work commencing to minimize trampling. Shrub removal should be done in a manner that avoids entering this protected area.

Recommended control: Cut and paint trees and shrubs. *Celastrus* is common in many of these islands and so control methods may vary from cut and paint to spraying vines with the appropriate herbicide. Figure 4 shows the area that contains state listed plants species. This area should be clearly delineated. Shrub islands on the border should have plants cut and removed in a manner that does not walk through this protection zone. Two islands are within this boundary – a clearly defined route from ingress and egress should be established to minimize impact on the habitat of listed plants species.



Figure 4. Protection zone to be delineated prior to invasive species control in order to avoid trampling the habitat of state listed species.

**Rationale:** All of the non-native shrubs/trees in these islands have the potential to spread at LBW and to simplify the control method it has been recommended that all be cut and treated while protecting the native *Prunus maritima*.

- C. *Phragmites*. There is a 0.42-acre *Phragmites* colony on upland sands. Within this site are a few shrubs and trees namely: *Robinia pseudacacia*, *Eleagnus umbellata* and *Celastrus orbiculatus*.

**Recommended control:** Cut and paint for the trees/shrubs. Treat *Phragmites* with a herbicide and then remove standing growth (e.g., a controlled burn or mow). Retreat any new growth (pump sprayer/spray bottle).

**Rationale:** The *Phragmites* on the dry sands of LBW is not as robust and dense as in brackish wetland areas but this colony is expanding primarily by rhizomes. Treatment will restore habitat for native dune plants.

- D. *Zoysia*. There are two areas with remnant *Zoysia* lawn that are expanding. The larger site is expanding into the adjacent shrub islands. Two small colonies were found on the south side of the former access road and there may be other patches to control. Prior to control, search the adjacent lands to identify and additional colonies that need to be controlled.

Recommended control: Herbicide actively growing plants (early summer) following rain (stimulates growth). Remove thatch and within two weeks retreat any new growth. Retreat as necessary. Japanese lawn-grass is also difficult to eradicate with multiple treatments of a non-selective herbicide such as Roundup® necessary to ensure its removal. The plants need to be actively growing prior to treatment, with treatment most effective after a period of rain. The thatch should be removed either through mechanical means or a controlled burn, and as new growth emerges, treated again. Additional treatments may be necessary to be most effective.

Rationale: These small lawn remnants are actively spreading. They form dense turf, which has the potential to spread throughout the ridge plain and threaten rare plants and rare plant communities.

### Zone 1B.

This zone (4.0+ acres) at the east side of LBW contains a few shrub islands and small patches of *Phragmites australis*. The easternmost shrub island near the groin supports the liana *Wisteria floribunda* growing on the ground. Nearby are a few *Campsis radicans* vines. The primary species in the shrub islands are *Ailanthus altissima* and *Celastrus orbiculatus*. The inverted L-shaped polygon in the middle of Figure 5 contains *Ailanthus* and *Populus tremuloides*. Present in this area is Japanese knotweed (*Fallopia japonica*). There is also a single *Paulownia tomentosa* to be treated east of the *Wisteria* patch.



Figure 5. Zone 1B is the eastern portion of Long Beach West.

Recommended control: Shrubs will be cut and sprayed except for *Populus tremuloides* which requires basal injection of herbicide. *Phragmites* should be treated with herbicide and

this control can probably be done with backpack sprayer. *Campsis* might be controlled through removal of the vines. *Wisteria* should be cut and painted with either glyphosate or triclopyr.

Rationale: All of the target non-native species in this area are showing signs of spreading and are thus considered invasive and warrant control measures.

### Zone 1C.

This zone, nearly 3 acres in extent, is devoid of shrub islands and trees. The dominant plants are grasses and herbs. There are however a few individual shrubs such as *Lonicera morrowii*, *Celastrus orbiculatus* and scattered seedlings such as *Populus deltoides*. In the center of the image (Figure 6), the ‘shrubby’ island is a dense growth of tall *Artemisia vulgaris*. This colony has the potential to spread and dominate the ridge plain and thus should be removed by hand.



Figure 6. Zone 1C is an area which will require spot control of scattered invasive species.

Recommended Control: Walk the area in a systematic manner to locate and control non-native shrubs and tree seedlings. Given the sandy nature of the soils, *Celastrus* and seedlings might be controlled by hand pulling or using a weed wrench. It is expected that there will be seedlings of *Robinia pseudoacacia* that require removal.

Rationale: Seedlings such as *Populus* and *Robinia* if allowed to remain will grow and become future invasive shrublands that will require control and will become a source of seeds that will colonize natural habitat. The few individuals of *Artemisia vulgaris* are very robust (see figure 7) and since they have the potential to spread and displace native vegetation, it is suggested that these plants be hand pulled and then monitored for new growth.



Figure 7. Tall *Artemisia vulgaris* with the native *Artemisia caudata* in the foreground.

## Zone 2.

This zone is nearly 9 acres (see Figure 8) in extent and contains some scattered colonies or individuals of *Eleagnus umbellata*, *Ailanthus altissima*, *Phragmites australis* and *Celastrus orbiculatus*. There is one large shrub island that is 7000 square feet in extent that in the center contains *Ailanthus altissima*, *Populus tremuloides* and *Celastrus orbiculatus*. The east side is *Ailanthus* and the west side is *Celastrus*. On the north side *Phragmites australis* is present but it was not determined if any of this lies in wetland and thus requires a pesticides permit for treatment. It is suggested that this stand of grass not be treated but be assessed for treatment at a future date.



Figure 8. Zone 2.

Recommended Control: Shrubs, with the exception of *Populus*, should be cut and painted. The best treatment for *Celastrus* in the shrub island needs to be determined (e.g., cut and paint versus an herbicide spray). Scattered *Celastrus* plants should be hand pulled or sprayed. As noted in other zones, *Populus* requires a different herbicide treatment such as basal injection.

**Knapweed:** Knapweed (*Centaurea stoebe*) is a biennial herb that is present throughout Long Beach (Zone 2) and is confined to portions (eastern) of Zone 1. It is recommended that Knapweed be controlled by hand pulling and that the initial control focus on Long Beach West. As shown in Figure 9, *Centaurea* is abundant in two locations but otherwise occurs at a series of points with but a few individuals. *Centaurea* occurs in multiple locations on Long Beach and is abundant at many locations. There are few species that co-exist with *Centaurea* that is likely the result of exuding catechin from roots.





Figure 9. Distribution of *Centaurea* at Long Beach West (top image) and Long Beach (bottom image).

Recommended control: Organize volunteers to hand pull plants before the plants set seed. The first priority is to focus on the Long Beach West area first and then time and volunteers available, tackle the Knapweed concentration areas at Long Beach. If plants are in flower, it should be assumed that seeds may be available and thus harvested plants should be bagged and removed offsite.

Volunteers should wear gloves as the phytotoxin can cause an allergic reaction such as a rash. Ideally volunteers would return for several years to harvest any regrowth.

Rationale: *Centaurea* is evidently spreading and where it is abundant, alleopathy is causing a decline in native plant species. Unless this species is controlled, there is a risk that native plant communities and potentially the rare plants will decline in the future. Field observations suggest that there is sand erosion at locations where *Centaurea* is the dominant species.

#### Special Considerations:

The USFWS will need to advise about what if any seasonal restrictions on invasive species control activities are required to avoid impacts to Piping Plover. The LBW activities are remote from Plover nesting. Logistically, it might be desirable from an invasive species control (shrub and trees) at LBW to use small boat access to get equipment on-site such as chain saws and backpack sprayers. Personnel could walk from the Long Beach parking lot to LBW. For cottage removal, the closure window extended to September 15. A late date such as this will make herbicide treatment ineffective.

At Long Beach, there are but a few small *Ailanthus* trees to be cut and painted. These small diameters trees cut be cut with a cordless reciprocating saw. The same is true for the few *Eleagnus* present.

It would be helpful for USFWS to review the proposed control activities and advise on seasonal restrictions. Also, the placement of Osprey platforms at Long Beach West creates potential conflicts between public access in general and potentially invasive species control. It is not expected that invasive species control near platforms will require significant time but control

cannot be done without working in the vicinity of the platforms. Ospreys are not a protected species at this time.

Contractors should consult with the town and Connecticut Department of Energy and Environmental Protection regarding the herbicides proposed to make certain all are allowed and to determine if any permits are required

Appendix B. Images or hyperlinks to images of invasive species on Long Beach.

Species	Image
<p><i>Ailanthus altissima</i> – Tree-of-Heaven; small trees/shrubs; compound leaves.</p>	
<p><i>Aralia spinosa</i> – Devil's Walking Stick</p>	<p><a href="http://plants.usda.gov/java/profile?symbol=arsp2">http://plants.usda.gov/java/profile?symbol=arsp2</a></p>
<p><i>Campsis radicans</i> – Trumpet flower</p>	

*Celastrus orbiculatus* –  
Asiatic Bittersweet



*Centaurea stoebe* -  
Knapweed





*Eleagnus umbellata* –  
Autumn Olive



*Euonymus alata*. – Burning  
Bush



<p><i>Fallopia japonica</i> – Japanese Knotweed</p>	
<p><i>Juniperus horizontalis</i> – Creeping Juniper</p>	<p><a href="http://tinyurl.com/8b76obz">http://tinyurl.com/8b76obz</a></p>
<p><i>Ligustrum obtusifolia</i></p>	<p><a href="http://plants.usda.gov/java/profile?symbol=LIIA">http://plants.usda.gov/java/profile?symbol=LIIA</a></p>
<p><i>Lonicera morrowii</i></p>	<p><a href="http://www.invasive.org/browse/detail.cfm?imgnum=2308047">http://www.invasive.org/browse/detail.cfm?imgnum=2308047</a></p>
<p><i>Paulownia tomentosa</i> – Empress Tree</p>	

*Phragmites australis* –  
Common Reed



*Populus tremuloides* –  
Quaking Aspen



*Robinia pseudoacacia* –  
Black Locust

<http://plants.usda.gov/java/profile?symbol=rops>

*Wisteria floribunda* –  
Japanese Wisteria



*Zoysia* sp. – grass





CT DEP # B-2020  
NYSDEC# 13326

P.O. Box 231 Branford, CT 06405  
Phone:203.245.1212  
Fax:203.245.2981  
www.allhabitat.com

## Treatment Order

RFQ #2013-10

**Client:**

Town of Stratford  
c/o Brian Carey  
2725 Main Street  
Stratford, CT 06615

**Project Location:**

Long Beach West  
Oak Bluff Road  
Stratford, CT 06615

Thank you for selecting All Habitat Services, LLC as your invasive plant control services contractor. We are pleased to have the opportunity and would like to confirm the program activities for the referenced parcel as ordered.

**Phragmites Mulch Mowing**

**Early Season Applications (March-April)**

Zone 1A	\$6,380.00
Zone 1B	\$2,500.00
Zone 1C	\$1,000.00
Zone 2	\$5,200.00

**Late Spring Applications (May-June)**

Zone 1A	\$5,750.00
Zone 1B	\$1,800.00
Zone 1C	\$1,850.00
Zone 2	\$4,700.00

**Warm Season Applications (July-August)**

Zone 1A	\$3,820.00
Zone 1B	\$1,500.00
Zone 1C	\$1,500.00
Zone 2	\$3,200.00

**Biological Monitoring & Reporting (Periodic)**

Zone 1A	\$1,650.00
Zone 1B	\$600.00
Zone 1C	\$450.00
Zone 2	\$1,350.00

See attached table for outline of invasive species to be treated in each zone.

ACCEPTED AND AGREED

\_\_\_\_\_  
David Roach  
General Manager  
All Habitat Services, LLC

\_\_\_\_\_  
Brian Carey  
Conservation Administrator  
Town of Stratford

Zone 1 Schedule of Herbicide Treatment	
<b>Zone 1A</b>	11 Acres
Target Species:	
Black Locust ( <i>Robinia pseudoacacia</i> ), Empress Tree ( <i>Paulownia tomentosa</i> ), Quaking Aspen ( <i>Populus tremuloides</i> ) Tree of Heaven ( <i>Ailanthus altissima</i> ), Autumn Olive ( <i>Eleagnus umbellata</i> ), Bush Honeysuckles ( <i>Lonicera spp.</i> ), Winged Euonymus ( <i>Euonymus alatus</i> ), Border Privet ( <i>Ligustrum obtusifolium</i> ), Devil's Walking Stick ( <i>Aralia spinosa</i> ), Creeping Juniper ( <i>Juniperus horizontalis</i> ), Common Reed ( <i>Phragmites australis</i> ), Japanese Lawn-Grass ( <i>Zoysia spp.</i> ) and Spotted Knapweed ( <i>Centaurea stoebe</i> )	
Proposed Services	Schedule
Early Season Herbicide Applications	March-April
Late Spring Herbicide Applications	May-June
Warm Season Herbicide Applications	July August
Biological Monitoring and Reporting	Periodic
<b>Zone 1B</b>	4 Acres
Target Species:	
Black Locust ( <i>Robinia pseudoacacia</i> ), Quaking Aspen ( <i>Populus tremuloides</i> ) Tree of Heaven ( <i>Ailanthus altissima</i> ), Empress Tree ( <i>Paulownia tomentosa</i> ), Autumn Olive ( <i>Eleagnus umbellata</i> ), Bush Honeysuckles ( <i>Lonicera spp.</i> ), Japanese Wisteria ( <i>Wisteria floribunda</i> ), Trumpet Creeper ( <i>Campsis radicans</i> ) Common Reed ( <i>Phragmites australis</i> ) and Japanese Knotweed ( <i>Fallopia japonica</i> )	
Proposed Services	Schedule
Early Season Herbicide Applications	March-April
Late Spring Herbicide Applications	May-June
Warm Season Herbicide Applications	July August
Biological Monitoring and Reporting	Periodic
Total Services Zone 1B	
<b>Zone 1C</b>	3 Acres
Target Species:	
Black Locust ( <i>Robinia pseudoacacia</i> ), Eastern Cottonwood ( <i>Populus deltoides</i> ) Tree of Heaven ( <i>Ailanthus altissima</i> ), Autumn Olive ( <i>Eleagnus umbellata</i> ), Bush Honeysuckles ( <i>Lonicera spp.</i> ), and Mugwort ( <i>Artemisia vulgaris</i> )	
Proposed Services	Schedule
Early Season Herbicide Applications	March-April
Late Spring Herbicide Applications	May-June
Warm Season Herbicide Applications	July August
Biological Monitoring and Reporting	Periodic
Zone 2 Schedule of Herbicide Treatment	
<b>Zone 2</b>	9 Acres
Target Species:	
Black Locust ( <i>Robinia pseudoacacia</i> ), Quaking Aspen ( <i>Populus tremuloides</i> ), Tree of Heaven ( <i>Ailanthus altissima</i> ), Autumn Olive ( <i>Eleagnus umbellata</i> ), Bush Honeysuckles ( <i>Lonicera spp.</i> ), Common Reed ( <i>Phragmites australis</i> ), and Spotted Knapweed ( <i>Centaurea stoebe</i> )	
Proposed Services	Schedule
Early Season Herbicide Applications	March-April
Late Spring Herbicide Applications	May-June
Warm Season Herbicide Applications	July August
Biological Monitoring and Reporting	Periodic

Account # 30409-6166-12080

\$43,250.<sup>00</sup>

R 33895  
3/12/13

**RFQ No. 2013-10**  
**Exotic Vegetation Control**  
**&**  
**Removal Services for**  
**Long Beach West**

Prepared By:



PO Box 231  
Branford, CT 06443

### Company Background and Project Team

All Habitat Services, LLC is a recognized provider of ecological management services. With a primary emphasis on wildlife habitat enhancement and conservation their diverse work settings encompass aquatic, emergent and terrestrial sites. All Habitat's professional staff of biologists, restoration specialists and ecological technicians are committed to the use of best management practices. Drawing from wide-ranging backgrounds and specializations in insect, plant and wildlife biology provides them with the ability to develop innovative, practical, integrated management solutions using cultural, mechanical, chemical and natural techniques. This dedication to holistic methods is the foundation to executing creative projects that deliver highly beneficial outcomes for the host habitat while minimizing disruption to its dependent wildlife. Our extensive customer base includes numerous conservation organizations, state and federal government agencies, municipalities and private landowners. The success of our work has earned us an excellent reputation for producing quality results. We are well qualified to execute an ecologically appropriate invasive plant management program for this site.

All Habitat Services is teaming with Milone & MacBroom, Inc. (MMI), which is one of the largest consulting firms in the northeast providing civilengineering, environmental planning, landscape architecture and land survey services. Founded in 1984, the firm enjoys an excellent reputation for its technical innovation and award-winning designs. The depth and capabilities of their highly experienced staff allows the firm to undertake a full range of projects and to meet complex requirements and challenging project schedules. Among its many capabilities, Milone & MacBroom has extensive in-house expertise in restoration of tidal wetland ecosystems and beach dune areas in the Northeast, including invasive species management <http://www.miloneandmacbroom.com>.

MMI will provide support services such as communication between project stakeholders, specifically piping plover protection and needs with the Town and CTDEEP wildlife biologists, endangered plant species identification as needed during invasive species management implementation, provide recommendations and management for targeted species (as identified in the Habitat Management Plan for Long Beach, Stratford, Connecticut) during the first year of implementation.

### Project Understanding

The Town of Stratford is seeking consultant services to provide exotic vegetation control and removal services for an area known as Long Beach in Stratford, Connecticut. All Habitat Services project team has reviewed the report entitled "Habitat Management Plan for Long Beach, Stratford, CT" prepared by Ronald Roza and Ken Metzler. In this report the existing vegetation communities and habitat types are described in detail and it provides recommendations for invasive plant species management to help maintain, increase, and protect the sites biodiversity. Our project team is familiar with the project site and the ecological sensitivity of both state listed flora and fauna species found on site. The exotic vegetation that is recommended to be controlled includes the following:

- Black Locust
- Bush Honeysuckle
- Autumn Olive
- Empress Tree
- Tree of Heaven
- Asiatic Bittersweet
- Japanese Wisteria

- Artemisia
- Common Reed, and
- Japanese knotweed
- Zoysia

Based on our keen knowledge of the site, the targeted species listed above, and review of the above mentioned report, All Habitat Services offers the following scope of services:

## Scope of Services

### *1.0 Project Coordination*

- 1.1 Coordinate exotic species management with project stakeholders including the Town of Stratford, United States Fish and Wildlife Service, and Connecticut Department of Energy and Environmental Protection.

### *2.0 Exotic Vegetation Control*

- 2.1 The phenological differences of the targeted invasive species provide windows of opportunity to maximize control measures while creating favorable conditions for promoting protection of listed species and opportunities for native release and revegetation. Their characteristic early expression in advance of native species growth allows a sequencing of control activities that limits potential for non-target injury. Early season intervention also suppresses fruit and seed production, limits biomass and provides release for competitive native species. The following customized restoration prescriptions have been selected from the suite of available tools and management techniques, which we will apply in the most effective ways to ensure a successful invasive species management program for these species.

In most cases, herbicide applications should be conducted prior to any cutting. Exceptions would be in areas where foliar applications are impractical due to the height of the plants being too great and where the spray drift cannot be adequately controlled or when best management practices suggest cutting first. Basal bark herbicide application is the preferred technique for trees, tree shrubs and large caliper multi-stem shrubs. Foliar herbicide application preference is for thin invert emulsion carrier formulations conducted using low volume backpack sprayers equipped with a with specialized nozzles to produce ultra fine droplet streams that are selectively applied to the target plant species. In areas where foliar herbicide applications cannot be conducted selectively while the desirable native vegetation is safely shielded from off target injury it will be applied using mechanical wicking and hand wiping techniques.

Herbicide prescriptions will favor target species selective formulations and the application schedule sequencing will favor conducting work in the very early spring, immediately after the invasive species express growth or foliage, targeting rosette stage herbaceous species and prior to native bud break occurring on woody species. Preventing complete foliar expression on targeted woody plant species render them unsuitable for selection as nesting sites by passerine bird species pre-empting potential for nest disturbance issues during the work sequencing. Late spring and mid-summer follow up applications are necessary to target asynchronous expression of

perennial species and warm season annual species. Multiple applications during a season compresses the majority of a multi-year vegetation management schedule into a single season and favorable limits the overall disturbance of the management operation.

The stands of Black Locust (*Robinia pseudoacacia*) which also includes Bush Honeysuckles (*Lonicera spp.*), Autumn Olive (*Eleagnus umbellata*), and Empress Tree (*Paulownia tomentosa*) as well as the Quaking Aspen (*Populus tremuloides*) and Tree of Heaven (*Ailanthus altissima*) are best controlled using basal bark applications of Garlon4® (Triclopyr) mixed in a methylated seed oil carrier. This herbicide penetrates the bark and translocates throughout the plant, killing the root system and preventing resprouting after cutting. These applications are conducted using a low volume backpack sprayer to wet the entire circumference of the bottom foot of the plant stem and around the root collar.

The shrub islands including Asiatic Bittersweet (*Celastrus orbiculatus*), Japanese Wisteria (*Wisteria floribunda*), Mugwort (*Artemisia vulgaris*) will be selectively treated with a low volume 5 gallon per acre thin invert emulsion tank mix of the herbicides Arsenal (Imazapyr), Rodeo (glyphosate) and Escort XP (Metsulfuron methyl) where appropriate. In areas where native grass species are at risk of off target injury we will apply a low volume thin invert emulsion foliar prescription of the selective herbicide Tahoe® 3A (Triclopyr) in a 5% solution. These herbicides will effectively control woody and broadleaved vegetation. This application should be scheduled when plants are in a rapid growth stage prior to flowering and fruit set for effective control and seed suppression.

The Common Reed (*Phragmites australis*) and Japanese Knotweed (*Fallopia japonica*) are best controlled by applying the aquatic herbicide Polaris® (Imazapyr) using a thin invert emulsion application technique. The herbicide will efficiently translocate into the plant's rhizome system, immediately arresting the growth cycle and limiting the extent of their above ground biomass. It will significantly reduce stem density and effectively control the stands. The herbicide will be selectively applied to the *Phragmites* and *Fallopia*, avoiding non-target injury and allowing any suppressed species to flourish once the competition of these species are eliminated.

The Japanese Lawn-Grass (*Zoysia spp.*) is best controlled by applying a tank mix prescription of AquaNeat® (Glyphosate) at a rate of 3 quarts per acre, Oust XP® (Sulfometuron methyl) at a rate of 1 oz. per acre, and Scythe® (Pelargonic Acid, C6-C12 Related Fatty Acids) at a rate of 2 quarts per acre. This combination of products produces rapid "burndown" (Aqua Neat® and Scythe®) for quick kill with (Oust XP®) for soil activity providing extended control of any resprouting rhizomes.

### 3.0 *Identification of Listed Flora Species*

- 3.1 Prior to execution of exotic management control, complete identification of listed flora species and verify locations to protect said species during invasive species management.

Zone 1 Cost of Herbicide Treatment		
Zone 1A	11 Acres	
Target Species:		
Black Locust ( <i>Robinia pseudoacacia</i> ), Empress Tree ( <i>Paulownia tomentosa</i> ), Quaking Aspen ( <i>Populus tremuloides</i> ) Tree of Heaven ( <i>Ailanthus altissima</i> ), Autumn Olive ( <i>Eleagnus umbellata</i> ), Bush Honeysuckles ( <i>Lonicera spp.</i> ), Winged Euonymus ( <i>Euonymus alatus</i> ), Border Privet ( <i>Ligustrum obtusifolium</i> ), Devil's Walking Stick ( <i>Aralia spinosa</i> ), Creeping Juniper ( <i>Juniperus horizontalis</i> ), Common Reed ( <i>Phragmites australis</i> ), Japanese Lawn-Grass ( <i>Zoysia spp.</i> ) and Spotted Knapweed ( <i>Centaurea stoebe</i> )		
Proposed Services	Schedule	Cost
Early Season Herbicide Applications	March-April	\$6,380.00
Late Spring Herbicide Applications	May-June	\$5,750.00
Warm Season Herbicide Applications	July-August	\$3,820.00
Biological Monitoring and Reporting	Periodic	\$1,650.00
Total Services Zone 1A		\$17,600.00
Zone 1B	4 Acres	
Target Species:		
Black Locust ( <i>Robinia pseudoacacia</i> ), Quaking Aspen ( <i>Populus tremuloides</i> ) Tree of Heaven ( <i>Ailanthus altissima</i> ), Empress Tree ( <i>Paulownia tomentosa</i> ), Autumn Olive ( <i>Eleagnus umbellata</i> ), Bush Honeysuckles ( <i>Lonicera spp.</i> ), Japanese Wisteria ( <i>Wisteria floribunda</i> ), Trumpet Creeper ( <i>Campsis radicans</i> ) Common Reed ( <i>Phragmites australis</i> ) and Japanese Knotweed ( <i>Fallopia japonica</i> )		
Proposed Services	Schedule	Cost
Early Season Herbicide Applications	March-April	\$2,500.00
Late Spring Herbicide Applications	May-June	\$1,800.00
Warm Season Herbicide Applications	July-August	\$1,500.00
Biological Monitoring and Reporting	Periodic	\$600.00
Total Services Zone 1B		\$6,400.00
Zone 1C	3 Acres	
Target Species:		
Black Locust ( <i>Robinia pseudoacacia</i> ), Eastern Cottonwood ( <i>Populus deltoides</i> ) Tree of Heaven ( <i>Ailanthus altissima</i> ), Autumn Olive ( <i>Eleagnus umbellata</i> ), Bush Honeysuckles ( <i>Lonicera spp.</i> ), and Mugwort ( <i>Artemisia vulgaris</i> )		
Proposed Services	Schedule	Cost
Early Season Herbicide Applications	March-April	\$1,000.00
Late Spring Herbicide Applications	May-June	\$1,850.00
Warm Season Herbicide Applications	July-August	\$1,500.00
Biological Monitoring and Reporting	Periodic	\$450.00
Total Services Zone 1C		\$4,800.00

Zone 2 Cost of Herbicide Treatment		
Zone 2	9 Acres	
Target Species:		
Black Locust ( <i>Robinia pseudoacacia</i> ), Quaking Aspen ( <i>Populus tremuloides</i> ), Tree of Heaven ( <i>Ailanthus altissima</i> ), Autumn Olive ( <i>Eleagnus umbellata</i> ), Bush Honeysuckles ( <i>Lonicera spp.</i> ), Common Reed ( <i>Phragmites australis</i> ), and Spotted Knapweed ( <i>Centaurea stoebe</i> )		
Proposed Services	Schedule	Cost
Early Season Herbicide Applications	March-April	\$5,200.00
Late Spring Herbicide Applications	May-June	\$4,700.00
Warm Season Herbicide Applications	July-August	\$3,200.00
Biological Monitoring and Reporting	Periodic	\$1,350.00
Total Services Zone 2		\$14,450.00

Total Services Cost	
Total Services Zone 1	\$28,800.00
Total Services Zone 2	\$14,450.00
Total Services	\$43,250.00

We are confident that we can provide highly effective control services and that further management needs should decline significantly. All of these species are identified as persistent invasive plants known for recovering from their prolific seed production. It is advisable to plan for a multi-year control commitment to ensure a successful program for this site.

The above prices are inclusive of all labor, materials, specialized equipment, onboard GIS navigation and spray mapping, mobilization and demobilization costs unless otherwise specified.

#### GPS Technology

All Habitat Services embraces the productivity value of GIS technology. Our spray equipment has on-board GPS navigation, parallel swath systems, variable rate controllers and spray application mapping systems. Project deliverables include completed as sprayed maps in the ESRI shape file format.

#### Performance Guarantee

All Habitat Services Field Supervisors, Team Leaders and Technicians and other project team members take tremendous pride in their work product and strive to achieve the highest possible performance goals. We select the most appropriate chemical prescriptions and techniques available to deliver effective management outcomes for our customers. Our quality control processes include on-board GPS navigation, parallel swath systems, variable rate controllers and spray application mapping systems. At a minimum our quality target species impact standard of 90% or higher is guaranteed. Our post application follow up monitoring and spot application to any remaining target species ensures the effective rate is as close to our commonly shared 100% goal as possible.

#### Invasive Species Identification and Management

All Habitat Services Field Supervisors, Team Leaders and Technicians are trained in invasive plant identification skills and have the ability to recognize invasive species from native shrubs. Our Field Supervisors, Team Leaders and Technicians have taken courses in invasive species identification or

management sponsored by professional associations, IPANE, UCONN, and the CT Agricultural Experiment Station. A project specific identification key review of all invasive and native species, which we expect to encounter on site, is conducted prior to the start of each project.

### Project Schedule

Proposed Schedule of Herbicide Applications
<b>Early Season Herbicide Applications (March-April)</b>
Target Species:
Black Locust ( <i>Robinia pseudoacacia</i> ), Empress Tree ( <i>Paulownia tomentosa</i> ), Quaking Aspen ( <i>Populus tremuloides</i> ), Tree of Heaven ( <i>Ailanthus altissima</i> ), Eastern Cottonwood ( <i>Populus deltoides</i> ), Autumn Olive ( <i>Eleagnus umbellata</i> ), Bush Honeysuckles ( <i>Lonicera spp.</i> ), Winged Euonymus ( <i>Euonymus alatus</i> ), Border Privet ( <i>Ligustrum obtusifolium</i> ), Devil's Walking Stick ( <i>Aralia spinosa</i> ), Creeping Juniper ( <i>Juniperus horizontalis</i> ), Japanese Wisteria ( <i>Wisteria floribunda</i> ) and Trumpet Creeper ( <i>Campsis radicans</i> )
<b>Late Spring Herbicide Applications (May-June)</b>
Target Species:
Black Locust ( <i>Robinia pseudoacacia</i> ), Empress Tree ( <i>Paulownia tomentosa</i> ), Quaking Aspen ( <i>Populus tremuloides</i> ), Tree of Heaven ( <i>Ailanthus altissima</i> ), Eastern Cottonwood ( <i>Populus deltoides</i> ), Autumn Olive ( <i>Eleagnus umbellata</i> ), Bush Honeysuckles ( <i>Lonicera spp.</i> ), Winged Euonymus ( <i>Euonymus alatus</i> ), Border Privet ( <i>Ligustrum obtusifolium</i> ), Devil's Walking Stick ( <i>Aralia spinosa</i> ), Creeping Juniper ( <i>Juniperus horizontalis</i> ), Japanese Wisteria ( <i>Wisteria floribunda</i> ), Trumpet Creeper ( <i>Campsis radicans</i> ), Common Reed ( <i>Phragmites australis</i> ), Japanese Knotweed ( <i>Fallopia japonica</i> ), Japanese Lawn-Grass ( <i>Zoysia spp.</i> ), Mugwort ( <i>Artemisia vulgaris</i> ) and Spotted Knapweed ( <i>Centaurea stoebe</i> )
<b>Warm Season Herbicide Applications (July-August)</b>
Target Species:
Black Locust ( <i>Robinia pseudoacacia</i> ), Empress Tree ( <i>Paulownia tomentosa</i> ), Quaking Aspen ( <i>Populus tremuloides</i> ), Tree of Heaven ( <i>Ailanthus altissima</i> ), Eastern Cottonwood ( <i>Populus deltoides</i> ), Autumn Olive ( <i>Eleagnus umbellata</i> ), Bush Honeysuckles ( <i>Lonicera spp.</i> ), Winged Euonymus ( <i>Euonymus alatus</i> ), Border Privet ( <i>Ligustrum obtusifolium</i> ), Devil's Walking Stick ( <i>Aralia spinosa</i> ), Creeping Juniper ( <i>Juniperus horizontalis</i> ), Japanese Wisteria ( <i>Wisteria floribunda</i> ), Trumpet Creeper ( <i>Campsis radicans</i> ), Common Reed ( <i>Phragmites australis</i> ), Japanese Knotweed ( <i>Fallopia japonica</i> ), Japanese Lawn-Grass ( <i>Zoysia spp.</i> ), Mugwort ( <i>Artemisia vulgaris</i> ) and Spotted Knapweed ( <i>Centaurea stoebe</i> )

### Project Budget

Tasks 1 through 3 shall be completed for a lump sum of \$43,250.00.

## References

Jennifer S. Kaufman  
Parks Coordinator  
Mansfield Parks and Recreation  
10 South Eagleville Road  
Storrs-Mansfield, CT 06268  
860-429-3015x204

[KaufmanJS@MANSFIELDCT.ORG](mailto:KaufmanJS@MANSFIELDCT.ORG)

Chemical and mechanical control of invasive tree, shrub, vine and herbaceous species in wetland and terrestrial settings on various properties controlled by Town of Mansfield Parks and Recreation Department. Project objectives ranged from managing invasive plants along recreational trail systems to WHIP grant habitat restoration and revegetation.

Paul Capotosto  
Wetlands Restoration Biologist  
Mosquito Management Supervisor  
CT DEEP Wildlife Div., WHAMM Program  
391 Route 32, N. Franklin, CT 06254  
860-642-7630

[paul.capotosto@ct.gov](mailto:paul.capotosto@ct.gov)

Contract #: 09PSX0228: Chemical and mechanical control of invasive tree, shrub, vine and herbaceous species in wetland and terrestrial settings on various properties controlled by State of Connecticut Department of Energy and Environmental Protection Wildlife Division including Little River, Laurel Marsh and the Housatonic River. Primary project objectives focused on managing the invasive Common Reed species *Phragmites australis* in large plot (aggregates of 500 acres per year) tidal marsh and brackish riverine systems.

Gerard Milne  
CT CERTIFIED FORESTER #007  
CT DEEP - Division of Forestry  
PO Box 161  
Pleasant Valley, CT 06063  
Office: 860-379-7085  
Cell: 860-604-4473  
Fax: 860-379-7103

[Gerard.Milne@ct.gov](mailto:Gerard.Milne@ct.gov)

Chemical control of invasive tree, shrub and vine species, in wetland and terrestrial settings, on various properties controlled by State of Connecticut Department of Energy and Environmental Protection Division of Forestry including Naugatuck, Mohawk & Goodwin State Forests. Project objectives focused on managing invasive species in both pre and post harvest timber plots to release the native shrub layer from invasive dominance due to increased light gaps in the open canopy areas after timber harvests have been conducted.

Suzanne Hoover Paton, Sr. Biologist  
U.S.F.W.S. - Coastal Program  
Southern New England - NY Bight

50 Bend Road  
Charlestown, RI 02813  
Office: 401-364-9124 ext. 39  
Fax: 401-364-0170

[Suzanne\\_Paton@fws.gov](mailto:Suzanne_Paton@fws.gov)

Chemical control of invasive tree, shrub and vine species, in wetland and terrestrial settings on various properties controlled by U.S. Fish & Wildlife Service including Sachuest & Ninigret National Wildlife Refuge and Great Gull Island. Project objectives ranged from managing invasive plants along recreational trail systems to habitat restoration and revegetation.

Monica Williams,  
Wildlife Biologist  
U. S. Fish and Wildlife Service  
Long Island National Wildlife Refuge Complex  
340 Smith Rd. Shirley, NY 11967  
Office: 631.286.0485 Ext. 2154  
Fax: 631.286.4003

[Monica\\_Williams@fws.gov](mailto:Monica_Williams@fws.gov)

Chemical control of invasive tree, shrub, vine and herbaceous species in wetland and terrestrial settings on various properties controlled by U.S. Fish & Wildlife Service including Wertheim National Wildlife Refuge. Primary project objectives focused on managing the invasive Common Reed species *Phragmites australis* in large plot (aggregates of 30 acres per year) tidal marsh and brackish riverine systems.

David Gumbart  
Assistant Director of Land Management  
The Nature Conservancy of Connecticut  
55 Church Street, 3rd Floor  
New Haven, CT 06510-3029  
Direct: 203-568-6290  
Main Office: 203-568-6270  
Fax: 203-568-6271

[dgumbart@tnc.org](mailto:dgumbart@tnc.org)

Chemical control of invasive tree, shrub, vine and herbaceous species in wetland and terrestrial settings on various properties controlled by The Nature Conservancy of Connecticut including the Connecticut River Valley. Primary project objectives focused on managing the invasive Common Reed species *Phragmites australis* in large plot tidal marsh and brackish riverine systems.

R. Bruce Villwock  
Transportation Landscape Designer  
CT Dept. of Transportation  
2800 Berlin Turnpike  
Newington, CT 06131-7546  
Phone: (860) 594-2612  
Fax: (860) 594-2655  
[r.bruce.villwock@ct.gov](mailto:r.bruce.villwock@ct.gov)

Contract # 10PSX0037: Chemical control of invasive tree, shrub, vine and herbaceous species in terrestrial settings on various properties controlled by Connecticut Department of Transportation. Primary project objectives focused on managing selective and non-selective invasive species along divided highways, secondary highways and other specific locations.

Rick Maynard  
Guilford Parks and Recreation Director  
32 Church St  
Guilford, CT  
Office: 203-453-8068  
Fax: 203-453-8456  
[maynardr@ci.guilford.ct.us](mailto:maynardr@ci.guilford.ct.us)

Chemical and mechanical control of invasive tree, shrub, vine and herbaceous species in wetland and terrestrial settings on various properties controlled by controlled by Town of Guilford. Primary project objectives focused on managing the invasive Common Reed species *Phragmites australis* in a tidal marsh.

Chris Filmer  
President  
Darien Land Trust  
10 Harriett Lane  
Darien, CT 06820  
Office: 203-655-2445  
[chris@chrisfilmer.com](mailto:chris@chrisfilmer.com)

Chemical and mechanical control of invasive tree, shrub, vine and herbaceous species in wetland and terrestrial settings on various properties controlled by To Darien Land Trust, Darien, CT. Project objectives focused on managing invasive plants in areas of habitat restoration and revegetation.

Clarke Gifford  
Steep Rock Association, Inc.  
P.O. Box 279  
Washington Depot, CT 06794  
Office: 860-868-9131  
Fax: 866-213-4545  
[steeprockassociation@gmail.com](mailto:steeprockassociation@gmail.com)

Chemical and mechanical control of invasive tree, shrub, vine and herbaceous species in wetland and terrestrial settings on various properties controlled by Steep Rock Association, Inc. Project objectives focused on managing invasive plants in areas of habitat restoration and revegetation.

Experience

David Roach, General Manager

**License History:**

State of Connecticut Department of Environmental Protection

Commercial Applicator Certificate Supervisory EPPC-2

David Roach Certificate # S-3538 Expires: 01/31/2014

Category 5: Aquatic Pests (8 Years)

Category 6: Rights-of-Way (7 Years)

Category 7c: Mosquitoes and Biting Flies (16 Years)

Category 7f: Birds (13 Years)

Category 8: Public Health (7 Years)

State of New York Department of Environmental Conservation

Commercial Pesticide Applicator Certificate

David Roach Certificate # C0832199 Expires: 01/31/2014

Category 5A (8 Years)

Category 8 (8 Years)

State of Rhode Island Department of Environmental Management

Commercial Applicator Certificate

David Roach Certificate # 4695 Expires: 01/31/2013

Category 5: Aquatic (6 Years)

Category 6: Right-of-Way (6 Years)

Category 8: Public Health (6 Years)

State of Massachusetts Department of Agricultural Resources

Commercial Applicator Certificate

David Roach Certificate # 37221 Expires: 12/31/2013

Category 39: Aquatic (3 Years)

**State of Connecticut Department of Energy & Environmental Protection Supervisory License**



ARBORIST/COMMERCIAL SUPERVISORY  
PESTICIDE APPLICATOR CERTIFICATE

ROACH, DAVID P.

42 GODMAN RD

MADISON CT 06443

Cert. No. : S-3538 Expires: 01/31/2014

7F	MOSQUITO
7E	BIRD
8	PUBLIC HEALTH
5	AQUATIC
6	RIGHTS OF WAY

Form No: 16084 Issued: 12/10/2008

**Connecticut Department of Energy & Environmental Protection Operator License Holders**

The following operators are licensed by the state of Connecticut Department of Energy & Environmental Protection to work under the supervision of a certified Supervisory Applicator.

NAME	POSITION	YEARS OF EXPERIENCE	BACKGROOUND/EXPERIENCE
Jaime Lindquist	Operator	5	CT DEEP Operator License O-37545
Philip Minore	Operator	3	CT DEEP Operator License O-39254 ROW Supervisor S-5975
Paul Birdsall	Operator	5	CT DEEP Operator License O-27345
Todd Oppelt	Operator	1	CT DEEP Operator License O-40572
John McKenna	Operator	2	CT DEEP Operator License O-39814

## Project Assignment

## Years of Experience

With This Firm: 12  
With Other Firms: <1

## Education

B.S., Natural Resource  
Management (Magna Cum  
Laude)

University of Connecticut  
Storrs, CT

M.S., Wetland Biology  
Southern Connecticut State  
University  
New Haven, CT

## Training Course

Wetland Classification for  
Mapping & Functional  
Assessment

## License / Certification

Certified ACOE Wetland  
Delineator

Certified Professional Soil  
Scientist

Professional Wetland Scientist

## Computer Capabilities

Geographical Information  
Systems (GIS)

ArcGIS 10.1

Global Positioning Systems

TR-20

Rational Method

APR - Urban Catchment  
Modeling

# MATTHEW J. SANFORD, M.S., ASSOCIATE Senior Environmental Scientist

Mr. Sanford is an Associate/Senior Environmental Scientist. His experience is in the area of natural resources, with specific expertise in GIS modeling, biological inventories; water quality monitoring; watershed planning; vernal pool surveys; wetland delineation, assessment, and functions; inland wetland and tidal wetland mitigation; and peer review services. Mr. Sanford's project experience includes computer modeling and design in ArcGIS and TR-20.

Mr. Sanford is a Professional Wetland Scientist (PWS) and is a certified soil scientist. He has expertise in United States Army Corps of Engineer (USACE) wetland delineations and has conducted USACE delineations in New York, Connecticut, Vermont, and Massachusetts. Mr. Sanford served as Vice President and President of the Connecticut Association of Wetland Scientists (CAWS).

Prior to becoming an employee of MMI, Mr. Sanford worked at the CTDEEP Franklin Office with the Piping Plover and Least Tern breeding project. Work included identifying all breeding pairs of Piping Plovers along the coast of Connecticut (including Long Beach and Pleasure Beach) and tern colonies, establishing nest protection measures, posting signage, securing sites from pedestrian foot traffic, monitoring the clutch sizes, juvenile counts, and statistical trends in breeding success in Connecticut.

Highlights of Mr. Sanford's project experience follow:

### Inland and Tidal Wetland Mitigation Design, Implementation and Post Construction Monitoring

#### **Killingworth Reservoir Wetland Creation Killingworth, Connecticut**

Inspected construction of approximately 6.2 acres of deep marsh, shallow marsh, and scrub/shrub wetlands along the littoral zone of Killingworth Reservoir. Responsibilities included monitoring of proposed grading activities within the creation areas, and observation of the placement of wetland soils and wetland plants within creation area. Provided five years of post construction annual monitoring and report preparation for wetland mitigation area in accordance with the USACE and CTDEEP special permit conditions.

#### **Rockwell Park - Lagoon Wetland Mitigation Bristol, Connecticut**

Inspected the creation of a 1.3 acre open water pond and a 2.2 acre emergent marsh/scrub shrub wetland community within former Phragmites dominated lagoon. Responsibilities included monitoring of proposed grading activities within the creation areas, and observation of the placement of wetland soils and wetland plants within creation area. Provided post construction annual monitoring and report preparation for wetland mitigation in accordance with CTDEEP special permit conditions.

**Professional Affiliations**  
Board of Directors of the  
Connecticut Association of  
Wetland Scientists (CAWS)  
Former President  
Former Vice President  
Society of Wetland Scientists  
Association of Massachusetts  
Wetland Scientists  
Connecticut Entomological  
Society

## **MATTHEW J. SANFORD, M.S. (Continued)**

### **Kleen Energy Systems – Wetland Creation Middletown, Connecticut**

Prepared final design plans for the construction of two vernal pools, large shallow and deep marsh wetland system, and restoration of existing emergent/scrub shrub wetlands. Implemented invasive species management plan for common reed (*Phragmites australis*). Provided construction supervision of the wetland creation areas including placement of organic soils, leaf duff, woody debris, sunning boulders, and plantings.

### **Rentschler Field Parking and Traffic Circulation Improvement Project – Wetland Restoration East Hartford, Connecticut**

Prepared invasive species management plan for common reed (*Phragmites australis*), purple loosestrife, and Japanese knotweed as part of the proposed wetland restoration areas. The wetland restoration includes two acres of emergent and scrub shrub wetland, riparian zone plantings, and half acre wet meadow/ scrub shrub wetland restoration. Prepared final design plans and technical specifications for restoration implementation. Provided construction oversight for management of invasive species and replanting of wetland restoration areas.

### **State Office of Policy and Management – Somers Reforestation Wetland Restoration Enfield, Connecticut**

Prepared final design plans and technical specifications for the replanting of five acres of wet meadow with trees and shrubs as part of existing permit conditions associated with construction of Rentschler Field. Provided construction oversight for the implementation of mitigation plan. Completed three years of post construction annual monitoring for the mitigation site.

### **MacKenzie Reservoir Wetland Creation Wallingford, Connecticut**

As part of the dredging of MacKenzie Reservoir to restore public water supply, the state and federal agencies required wetland mitigation. An existing maintained lawn area approximately ½ acre in size was converted to a scrub shrub, wet meadow, shallow marsh wetland community. Provided construction inspection services for the placement of sunning boulders, woody stumps, large woody debris, and plantings within new wetland.

### **Falcon Park Flood Storage Basin and Outlet Control Structure Meriden, Connecticut**

Prepared final design and technical specifications for the construction of a one acre floodplain storage basin adjacent to Harbor Brook. Project design includes grading areas for small open water zones, shallow and deep marsh zones as well as scrub shrub wetland zones. Large woody debris, woody stumps, and sunning boulders specified to enhance habitat features. Preparation of long term invasive species management plan and remedial measures plans.

### **Bride Brook Estates East Lyme Connecticut**

Inspected the creation of a 5,000 square foot emergent marsh/scrub shrub wetland

## **MATTHEW J. SANFORD, M.S. (Continued)**

community within upland field to compensate for permitted wetland impacts for proposed development. Responsibilities included monitoring of proposed grading activities within the creation areas, and observation of the placement of wetland soils and wetland plants within creation area.

### **Edgewood Park - Duck Pond Freshwater Tidal Marsh Restoration New Haven, Connecticut**

Provided regulatory permit support services for OLISP and USACE permits. Prepared final design and technical specifications for duck pond improvements including grading plans, planting plans, and invasive species management. Provided construction inspection services for implementation of grading, sunning boulders and plantings.

### **Concrete Park Bronx River Salt Marsh Restoration Project II Bronx, New York**

Installed two pressure induced water level recorders within tidally influenced Bronx River. Prepared design plans for proposed salt marsh restoration area, including grading and planting plans.

### **Greens Farms Academy – Tidal Marsh and Riparian Zone Restoration Westport, Connecticut**

Prepared final design plans and specifications for the management of common reed (*Phragmites australis*) and the planting of high marsh tidal plants and salt spray tolerant riparian zone vegetation within a maintained lawn area within school grounds. Provided construction oversight including common reed removal by excavation and planting of tidal and riparian zone vegetation.

### **Old Field Creek – Tidal Marsh Restoration West Haven, Connecticut**

Developed a sediment sampling plan for proposed dredging of Old Field Creek. Performed GIS and field work, including sediment sampling. Assessed tidal vegetation communities upstream and downstream of old tidegate. Determined likely vegetation community changes if self regulating tide gates were installed. Assisted in the preparation of OLISP permits and provided limited construction oversight.

### **Pocantico River and Tidal Marsh Restoration Project Sleepy Hollow, New York**

Completed sediment samples within river. Installed water level transducers to determine tidal influences. Assessed riparian zone habitats determine existing conditions. Identified invasive species and potential management methods for said species. Assisted ERC with tidal macroinvertebrate surveys within river. Assessed potential impacts to the existing tidal wetlands associated with realigning the river to enhance tidal flushing and river conditions.

### **Russell Peterson Marsh Restoration Study Wilmington, Delaware**

Evaluated the alternatives to restoring freshwater marshes within the Peterson Marsh Wildlife Refuge. The environmental, cultural, aesthetic, and economical benefits of marsh restoration were analyzed and documented in a report.

## **MATTHEW J. SANFORD, M.S. (Continued)**

### **Wetland Mitigation Details and Restoration Planting Plans**

**Connecticut, Maine, New Hampshire, Massachusetts**

Prepared numerous planting plans and details for a variety of projects in the New England Region including treatment wetland basins, streambank stabilization projects, wetland restoration projects, upland buffer enhancement areas, and salt-marsh restoration areas.

### **Harbor Brook River Restoration Project**

**Meriden, Connecticut**

Environmental services for the evaluation of alternative methods of reducing flood damages within the Harbor Brook corridor and developed specific recommendations for river restoration improvements, including bank stabilization, water quality, and fish habitat.

### **Invasive Species Management and Revegetation Plans**

#### **Chicopee River Canal Path Phase II**

**Chicopee, Massachusetts**

Delineated bordering vegetated wetlands and watercourses along proposed greenway in accordance with Chicopee wetland regulations. Identification and mapping of invasive plant vegetation along corridor using Global Positioning Systems and developed an invasive species management plan to manage said species. Completed Notice of Intent for local Conservation Commission.

#### **Rentschler Field – Parking and Traffic Circulation Project**

**East Hartford, Connecticut**

Prepared invasive species management plan for common reed (*Phragmites australis*), purple loosestrife, and Japanese knotweed. Provided construction inspection services during invasive species management implementation.

#### **Harbor Brook Flood Control and Linear Trail Project**

**Meriden, Connecticut**

Prepared extensive invasive species management plan for a variety of flora species along a four mile corridor of Harbor Brook. Invasive species management plan prepared in support of the state and federal permit applications.

#### **Penobscot River Restoration Project**

**Maine**

Prepared Invasive Species Control Plan for three project sites located along the Penobscot River. The plan identified protocols for establishing target species, methods for monitoring, control and management strategies, and reporting requirements.

#### **Farmington Invasive Species Management Plan**

**Farmington, Connecticut**

Prepared detailed invasive species management plans for several town owned parcels. Field surveys were completed at each site and a primary invasive species map was prepared. Probable construction costs estimates were prepared as well.

## **MATTHEW J. SANFORD, M.S. (Continued)**

### **Hunter Haven Wetland & Riparian Zone Invasive Species Management Project Stratford, Connecticut**

Prepared detailed invasive species management plans for the Hunter Haven wetlands and riparian zone. A field survey documenting existing invasive species and preferred management strategies was provided to Town.

### **Rockwell Park Invasive Species Management Project Bristol, Connecticut**

Mapped invasive specie limits within park and prepared maps to for bidding of invasive species management services. Provided inspection services during management of invasive vegetation. Continued monitoring of invasive vegetation is planned over several years.

### **Cheshire Academy Invasive Species Management Plan Cheshire, Connecticut**

A detailed invasive species management plan was prepared for the campus per the Town's Inland Wetland and Watercourse permit conditions.

### **38 Dorset Lane Farmington, Connecticut**

Prepared a revegetation plan for private residence that cleared native and invasive vegetation on the Farmington Land Trust property. Area was restored using native trees and shrubs.

### **Rentschler Field Parking and Traffic Circulation Improvement Project East Hartford, Connecticut**

Prepared CTDEP Inland Wetlands, 401 Water Quality Certification, and Flood Management Certification permit applications for new parking areas at the stadium. Permits were successfully obtained.

### **Listed Specie Flora and Fauna Surveys**

#### **Construction of New Chemical Feed Building, University of Connecticut Mansfield, Connecticut**

Biological survey completed for endangered, threatened, and special concern species including American kestrel and eastern hognose snake. Prepare vegetative community mapping and summary of findings.

#### **Construction of Hoop Barn and Cow Feed Area, University of Connecticut Mansfield, Connecticut**

Biological survey completed for endangered, threatened, and special concern species including American kestrel, horned lark, savannah sparrow, and northern spring salamander. Prepare vegetative community mapping and summary of findings.

#### **Construction of New Waste Water Treatment Facility, University of Connecticut Mansfield, Connecticut**

Biological survey completed for endangered, threatened, and special concern species including southern bog lemming. Prepare site analysis and summary of findings.

## **MATTHEW J. SANFORD, M.S. (Continued)**

### **Harbor Brook Flood Control and Linear Trail Project**

#### **Meriden, Connecticut**

Identified potential eastern box turtle habitat near Hanover Pond in Meriden. Coordinated with CTDEEP wildlife biologists on developing a turtle management plan. The detailed turtle management plan was prepared and submitted as part of the CTDEEP permit applications.

### **Farmington Canal Greenway**

#### **Cheshire, Connecticut**

Completed wood turtle, eastern box turtle, and eastern ribbon snake surveys along 8,000 linear foot section of planned greenway. Habitat blocks were identified and a management plan for said species was developed in coordination with CTDEEP wildlife biologists.

### **Farmington Linear Trail**

#### **Farmington, Connecticut**

Completed flora survey along proposed trail route, with specific emphasis on finding CT State listed special concern New England Grape. We were assisted by Lauren Brown – Botanist.

### **Quinnipiac River Trail Phase III**

#### **Wallingford, Connecticut**

Completed flora survey along proposed trail route, looking specifically for CT endangered specie False Mermaid Weed. Prepared summary of findings and GIS mapping depicting the colony limits of False Mermaid Weed. Worked with CTDEP to find alternative methods for minimizing impacts to the colonies.

### **Lifestyles Development**

#### **Cheshire Connecticut**

Biological survey of Box Turtle and Wood Turtle habitat along the Ten Mile River. Also conducted a flora survey of surrounding habitats.

### **Southington Linear Trail**

#### **Southington, Connecticut**

Conducted biological surveys for box turtle habitat along a proposed linear trail extension. Developed best management practices plan for protecting box turtles that may be encountered along the project limits.

### **Silm Shad Point ADA Compliant Fishing Access Project**

#### **Holyoke, Massachusetts**

Conducted biological surveys on existing point bar for listed species such as Sandbar Willow per the regulatory conditions. No sandbar willows were found, however these species were planted as part of the landscaping and mitigation plans for the site.

### SERVICES PROVIDED

- Survey
- Tide Gate Structure Design
- Water Quality Assessment
- 2-D Hydrodynamic Modeling
- Permitting
- Public Outreach
- Construction Inspection

### CLIENT INFORMATION

State of Connecticut  
Department of Energy and  
Environmental Protection

## OLD FIELD CREEK RESTORATION West Haven, Connecticut

Old Field Creek discharges to a lagoon adjacent to New Haven Harbor. The stream and surrounding tidal wetlands had been degraded in numerous aspects, impacting public access, recreation, fin and shellfish resources, water and sediment quality, waterfowl habitat, and wetland vegetation. The beach and dune area are considered one of the State's most important piping plover habitats.

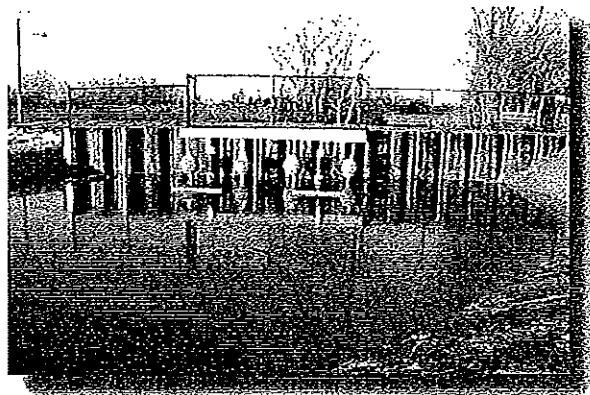
Milone & MacBroom, Inc. studied the existing salt marsh, tidal regime, water quality, and salinity, and conducted extensive two-dimensional hydrodynamic modeling of the system. The firm was then contracted to develop design plans for habitat improvements and restoration of the tidal marsh. Improvements included removal of an existing jetty, excavation of a new channel and design of self-regulating tide gates and support structures. Installation of the tide gates required removal and relocation of an existing culvert and construction of steel sheet pile support structure. Construction was completed in 2009.



*August 2008*



*January 2009*



## SERVICES PROVIDED

- Survey
- Wetland Design
- Mitigation Planning
- Permitting
- Construction Oversight

## CLIENT INFORMATION

Connecticut Water Company  
Clinton, Connecticut

# KILLINGWORTH WETLAND MITIGATION

## Killingworth, Connecticut

Increasing demands on the Connecticut Water Company Guilford system required the Connecticut Water Company to expand their supply system yield by raising the dam at the Killingworth Reservoir, a supply impoundment located on Blueberry Brook.

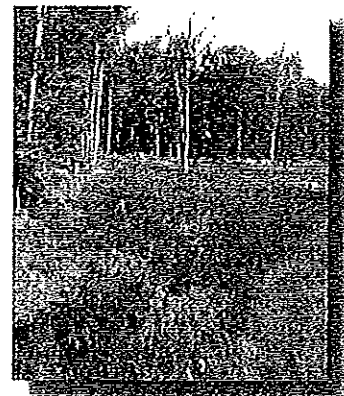
As mitigation for unavoidable impacts to the environment, in particular, the flooding and filling of wetlands surrounding the current reservoir and dam, a program of wetland enhancement and inventory was undertaken. The total area of existing wetlands impacted by the project was 5.2 acres of littoral fringe wetlands that were originally created by the reservoir. Milone & MacBroom, Inc. developed a mitigation strategy to offset the wetland impacts, developed the wetland design plans, oversaw construction, and is implementing the thru year monitoring program.

Mitigation wetlands total 6.2 acres, all of which were created along the fringe of the modified reservoir. These wetlands were designed to mimic the natural littoral fringe wetlands that were impacted. They consisted of three wetland communities including floating-leaved aquatic beds (e.g. deep marsh), emergent marsh (e.g. shallow marsh), and scrub-shrub wetlands.

Construction of the 6.2 acre mitigation wetland was completed under the supervision of Milone & MacBroom, Inc. wetland scientists. The project team monitored the construction of the wetlands including the proposed grading requirements, wetland soil amendments, hydrology, and wetland plantings. Subsequently, Milone & MacBroom, Inc. undertook a 3-year post construction monitoring program to ensure that the created wetlands met the intended design goals and permit conditions.



September 2005



September 2006

### SERVICES PROVIDED

- Dredging
- Marsh Restoration
- Permitting
- Construction Phase Services

### CLIENT INFORMATION

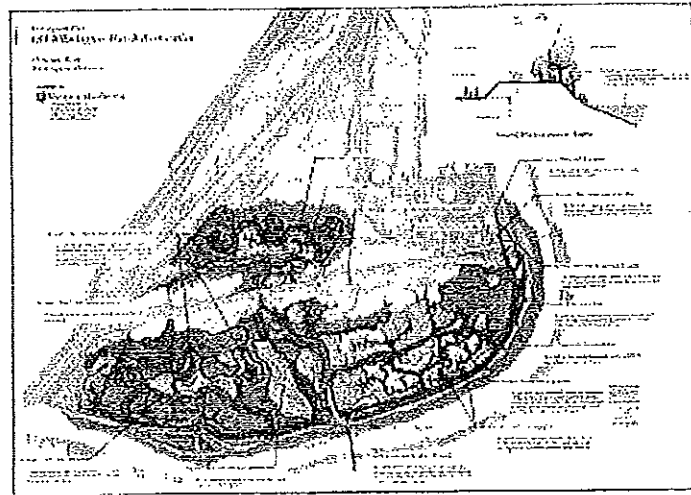
Riverfront Development Corporation

## **RUSSELL W. PETERSON URBAN WILDLIFE REFUGE MARSH RESTORATION / DREDGING Wilmington, Delaware**

The Peterson Marsh, also known as the Old Wilmington Marsh, is a component of the Russell W. Peterson Urban Wildlife Refuge. The marsh is comprised of 202 acres of tidal freshwater wetland located along the Christina River south of the City of Wilmington. Milone & MacBroom, Inc. was contracted to identify restoration objectives, evaluate restoration alternatives, develop preliminary design plans, and prepare state and federal regulatory permit applications.

Over the years, the Peterson Marsh has been subjected to a number of direct and indirect disturbances that have reduced its value to fish and wildlife. Of greatest significance has been the disturbance of hydrologic regime within the marsh. Installation of a railroad track across the center of the marsh and the subsequent filling in of culverts beneath the tracks has reduced tidal inflow to the northern portion of the marsh.

Milone & MacBroom, Inc. was retained by Riverfront Development Corporation (RDC) to analyze, model, and assess restoration alternatives for the aggraded marsh. Pursuant to study recommendations, RDC contracted Milone & MacBroom, Inc. to develop engineering design plans, assist with regulatory permitting, and provide construction phase services to implement improvements in the marsh. The primary component of the restoration plan was excavation and disposal of approximately 100,000 cubic yards of sediment from the marsh's surface. Design plans included one-foot contour grading plans, as well as a sediment disposal plan and numerous hydraulic modifications within the marsh tributary system. The project was constructed in 2005 and was named "Project of the Year" in an EDC publication.



### SERVICES PROVIDED

- Survey
- Wetland Delineation
- Hydrodynamic Modeling
- Regulatory Permitting
- Engineering Design
- Wetland Restoration Design

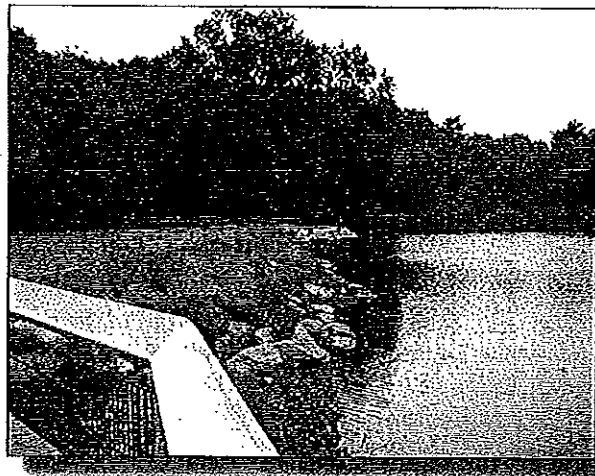
### CLIENT INFORMATION

Connecticut Fund for the  
Environment  
New Haven, Connecticut

## WEST RIVER DUCK POND TIDAL WETLAND RESTORATION New Haven, Connecticut

The duck pond located in Edgewood Park became one of the primary restoration areas within the West River Tidal Marsh Restoration project. The restoration improvements included regarding of areas to support freshwater tidal wetland vegetation, placement of random boulders for wildlife, construction of boardwalks along pond edge and through tidal wetland, and planting of wetland herbaceous plugs to help restore the marsh system.

In addition, the restoration included the treatment and management of common reed (*Phragmites australis*) a non native invasive species. Construction commenced in the winter of 2012 and final planting occurred in June 2012.



### SERVICES PROVIDED

- Wetlands
- Permitting

### CLIENT INFORMATION

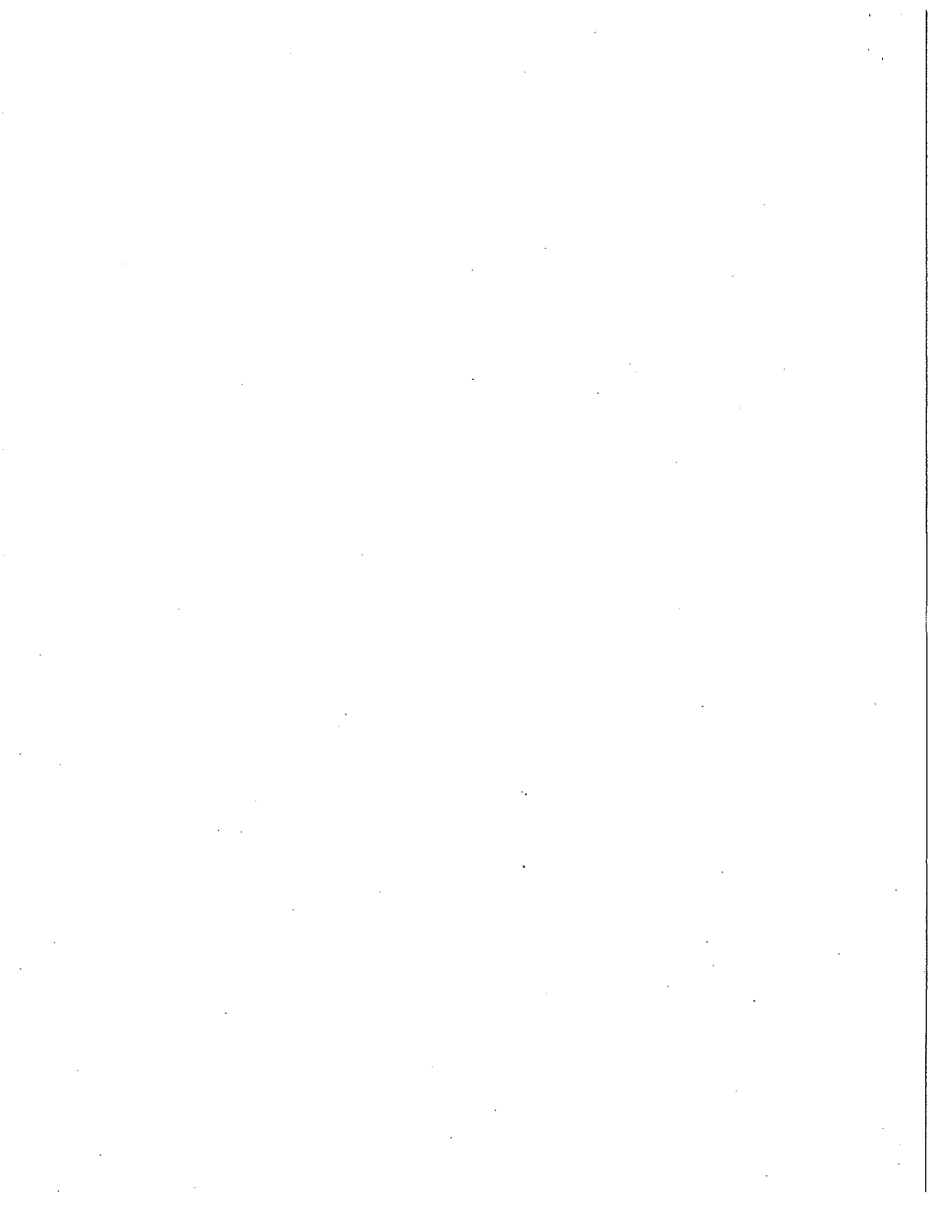
State of Connecticut  
Office of Policy and  
Management  
Hartford, Connecticut

## RENTSCHLER FIELD WETLAND MITIGATION & INVASIVE SPECIES CONTROL East Hartford, Connecticut

The State Office of Policy and Management retained Milone & MacBroom, Inc. to assist in the preparation of environmental permits associated with the expansion of their current parking facilities located at Rentschler Field Stadium. Milone & MacBroom, Inc. assisted in the preparation of Connecticut Department of Energy and Environmental Protection 401 Water Quality Certificate, Inland Wetlands, and Flood Management Certification permit applications. In addition to state permits, a United States Army Corps of Engineers 404 Individual Permit application was also prepared. Milone & MacBroom, Inc. also provided final design plans.

As part of the permit application, OPM was required to mitigate for proposed wetland impacts associated with the expansion of their parking facilities. The selected wetland mitigation includes restoring a heavily common reed (*Phragmites australis*) infested two acre emergent marsh and scrub shrub wetland system near the new parking facility. The mitigation plan requires that the *Phragmites* within the wetland be sprayed in the September with the pesticide "Habitat". September is an optimal time because the plants are beginning to translocate nutrients down into their root system and will carry the herbicide into the rhizome. Following the herbicide application the *Phragmites* will be mowed after the first killing frost. This process will be repeated for three years or until eradication has been achieved. Subsequent herbicide applications will most likely occur during the spring (mid to late May) with mowing being completed after the first killing frost. Following eradication of *Phragmites*, OPM will create microtopography within the wetland to support native shrubs and trees.





## Final Programmatic Report Narrative

### 1. Summary of Accomplishments

In four to five sentences, provide a brief summary of the project's key accomplishments and outcomes that were observed or measured.

The Town of Stratford completed the mapping of all of the vegetative communities along the stretch of Long Beach West. The mapping of vegetation included both the native and invasive plant species. The habitat specific mapping was then used to create a site specific habitat management plan including a focus on the removal of invasive plant species. The Town of Stratford went out to bid for the procurement of habitat management contractor to implement the recommendations that were directly outlined in the site specific management plan. The project was able to implement the Spring and Summer recommendations in the management plan to remove invasive vegetation throughout the length of the barrier beach. However, complete removal of invasives and planting of native species has been delayed due to two catastrophic storms that impacted Long Beach West. The project is slated to be completed in Fall 2013 after the complete growing season has past. Follow up monitor by the Town of Stratford staff will continue through out the 2014 growing season.

### 2. Project Activities & Outcomes

#### Activities

- Describe and quantify (using the approved metrics referenced in your grant agreement) the primary activities conducted during this grant.
- 1) Stratford completed and adopted the management plan and area-wide mapping for invasive and native species on Long Beach West. Activities completed include: Mapping of existing floral communities; Development of summary report of plant species and approximate aerial coverage; Generated list of invasive plant species and develop control measures Plan; Developed short and long-term invasive plant management plan; Identified native plant species and mapped areal coverage; determined condition of each native species colony and establish fixed plots in each floral community and non-vegetated areas for evaluation of applied management measures.
  - 2) Conducted early season and late spring vegetative invasive plant management and removal. The Town is now in the process of following up with the late spring vegetation treatment and removal. Spot spraying and removal of invasive vegetation will continue through the fall. Due to the impacts from Superstorm Sandy, sand has covered much of the former habitat area so that both invasive and native species have not yet germinated or come up. All Habitat Services of Branford, Connecticut is the contractor that was selected to complete the removal of the invasive vegetation at the Site.

#### Outcomes

The Town completed and adopted the management plan and area-wide mapping for invasive and natives species on Long Beach West. The management plan is and will continue to be implemented by the Town's Conservation Administration as part of an ongoing effort to maintain the progress made possible by LISFF funds.

At this time, however, we cannot quantify the acres of habitat restored or enhanced or % or acres reduction in invasive species cover due to the impact of Sandy on Long Beach West. We have requested an extension of our project period in order to achieve these outcomes. A final report will be issued by the contractor detailing the extensive removal of the invasive vegetation at the site and the total acres restored.

### **3. Lessons Learned**

Describe the key lessons learned from this project, such as the least and most effective conservation practices or notable aspects of the project's methods, monitoring, or results. How could other conservation organizations adapt their projects to build upon some of these key lessons about what worked best and what did not?

At this time, due to the delay in achieving actual habitat restoration, we cannot provide meaningful lessons learned about the project. However, Stratford would be pleased to amend this report upon conclusion of the project so that other conservation organizations can learn from our project.

### **4. Dissemination**

Briefly identify any dissemination of lessons learned or other project results to external audiences, such as the public or other conservation organizations.

Since project results have not yet been accomplished, Stratford has not yet issued any reports to the public. When the project has been completed, however, we will issue a project summary to the public that will be made available on the Town's website, and will be sent to CT's Beardsley Zoo- who contributed volunteers for the project- for inclusion in their communications.

### **5. Project Documents**

The following documents have been uploaded to Easygrants:

- Completed Long Beach West Management Plan
- Photos of Long Beach West species management areas.

Long Beach West – Long Island Sound Future Fund Grant  
Town of Stratford



**Photograph #1**

**Description of Photograph:**

View of vegetation die back from herbicide treatment. .

**Site Location:**

Long Beach West  
Stratford, Connecticut

**Photograph Taken By:**

Brian Carey

**Date of Photograph:**

July 3<sup>rd</sup>, 2013



**Photograph #2**

**Description of Photograph:**

Flower Prickly Pear Cactus

**Site Location:**

Long Beach West  
Stratford, Connecticut

**Photograph Taken By:**

Brian Carey

**Date of Photograph:**

July 3<sup>rd</sup>, 2013

Long Beach West – Long Island Sound Future Fund Grant  
Town of Stratford



**Photograph #3**

**Description of Photograph:**

Area of beach grass being re-established after removal of invasive vegetation. .

**Site Location:**

Long Beach West  
Stratford, Connecticut

**Photograph Taken By:**

Brian Carey

**Date of Photograph:**

July 3<sup>rd</sup>, 2013



**Photograph #4**

**Description of Photograph:**

View of bittersweet die back at Long Beach West

**Site Location:**

Long Beach West  
Stratford, Connecticut

**Photograph Taken By:**

Brian Carey

**Date of Photograph:**

July 3<sup>rd</sup>, 2013

Long Beach West – Long Island Sound Future Fund Grant  
Town of Stratford



**Photograph #5**

**Description of Photograph:**

View phragmites die back along Long Beach West.

**Site Location:**

Long Beach West  
Stratford, Connecticut

**Photograph Taken By:**

Brian Carey

**Date of Photograph:**

July 3<sup>rd</sup>, 2013



**Photograph #6**

**Description of Photograph:**

Knottweed die back associated herbicide treatment.

**Site Location:**

Long Beach West  
Stratford, Connecticut

**Photograph Taken By:**

Brian Carey

**Date of Photograph:**

July 3<sup>rd</sup>, 2013











