Invasive Species Vector Assessment

Japanese stilt grass (*Microstegium vimineum*)

Case Study Sites:

648 & 688 East St. Mount Washington, MA

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1. Executive Summary

Project:	Invasive Species Vector Assessment for Japanese stilt grass
Location:	648 & 688 East St., Mount Washington, MA
Target Species:	Japanese stilt grass (*Microstegium vimineum*)
Survey Area:	648 & 688 East St. properties, roadside swales, culverts, and streams

Invasive species pose a significant threat to the Town of Mount Washington's biodiversity, native habitats, and native species especially in priority habitats where rare species are concerned. Although some invasive species have been present for hundreds of years and spread slowly, species like Japanese stilt grass have only been observed within the past few decades in the northeast and have spread a substantial distance in a relatively brief time since introduction. This case study is intended to provide documented evidence of Japanese stilt grass located at 648 and 688 East Street (The Study Sites) in the Town of Mount Washington and provide an invasive species management plan for these properties. Field surveys and desktop reviews were conducted as a necessity to assess the potential vectors for this species at the study sites and predict areas of future infestation. A comparison of slopes, streams and invasive species presence was conducted to hypothesize the continued spread of this invasive species into significant wetland habitats adjacent to the Study Sites. This research found six accumulating factors that lead to the resulting conclusion that there is a high potential for continued spread of this invasive plant downstream and downslope into priority habitats, wetlands, and particularly the Schenob Brook Drainage Basin ACEC. The accumulating factors are:

1. Proximity to point source stilt grass populations
2. Ability for stilt grass to be shade and sun tolerant
3. High reproductive rates and hydrochory seed dispersal biology
4. Climate change influenced weather events
5. Stormwater management infrastructure
6. Roadside vegetation management

This document includes proposed culvert engineering solutions, permitting requirements and invasive plant management options and strategies for implementation and management of this species over the next ten years. Engineering solutions such as stone check dams and two different, but equally effective invasive management methods have been recommended for the management of Japanese stilt grass on the Study Sites. To achieve control of the stilt grass in these locations and reduce the spread into critical natural resource areas, the management implementations and suggestions offered in this document are suggested to be implemented together. On their own any individual management approach will not be sufficient to slow or control the existing threat of Japanese stilt grass to natural resources in these areas.

2. Background

Invasive species in the continental United States are primarily from continents with similar latitudes and temperate rainforest environmental conditions. Many invasive species were restricted to their respective continents and native habitats until the colonization of North America. Many non-native species have been introduced to native ecosystems not only in North America, but American species are and have proven their ability to become invasive in both Europe and Asia.

The invasive species that is the subject of this study, Japanese stilt grass (*Microstegium vimenium*) is a grass family species (*Poaceae*) native to China, India, Japan, Korea, and Malaysia. The first report of introduction into the United States is from 1918 - 1919 in Tennessee. Unlike many other invasive species introduced for horticultural purposes, this species was introduced accidentally and was historically used as packing material for imported Chinese porcelain. Although the plants used as packing material were long dead, the seeds present in the foreign material remained viable throughout their travels and have since spread in the 106 years since introduction and are currently found as far west as Oklahoma and north into Maine. Currently, Japanese stilt grass occurs in and is known as an invasive species in thirty-four states.

2.1 Japanese Stilt Grass Biology

Japanese stilt grass in North America is primarily associated with moist, acidic neutral soils occasionally with elevated levels of nitrogen. North American habitats where this species is known to occur includes forested and open floodplains, stream banks, moist deciduous woodlands, and areas of frequent disturbances such as roadsides, drainage ditches, swales (Photo 1), hiking trails, as well as game trails. Stilt grass is a disturbance dependent species that can easily become established in North American ecosystems and outcompete native plant species causing a reduction in biodiversity and habitat loss if native competition is reduced by disturbance activities. As this species becomes more established it alters soil chemistry by increasing organic matter in the soil and increasing soil pH.

Photo 1: High-density Japanese stilt grass in roadside drainage swale at 648 East St.

Stilt grass is an annual grass species that is both shade and sun tolerant and can produce 100,000 – 4,000,000 seeds per m^2 (Barden, 1987; Woods, 1989; Gibson et al., 2002; Judge et al., 2008; Warren et al., 2010). A single individual of this species is estimated to produce 100 – 1000 seeds annually per stem (Cheplick, 2010). While not an extremely prolonged period of time, the seeds of this species are reported to retain viability and presence in the soil for 1 – 5 years (Barden, 1987; Gibson et al., 2002; Vidra et al., 2007). The seed dispersal method for this species has adapted with its native habitat to spread via hydrochory, a passive water-based seed dispersal method that can vary from year to year depending on precipitation and flood events. This dispersal mechanism means that seeds of this species can easily float and can be dispersed long distances by drainage ditches, streams, and wetlands especially during high water events (Photo 2). Other dispersal vectors include soil, wildlife, footwear, vehicles, fill dirt, mowing, mulch-hay, and activities associated with construction (Woods 1989, Mehrhoff 2004).

Photo 2: Pink pin flags indicate a Japanese stilt grass occurrence along an intermittent stream bed which connects to a culvert and the roadside drainage swales at 688 East St. During the 2024 survey season this streambed was dryer than normal but the spread of the species due to water flow was evident from the observed and mapped population and its connection to the high-density roadside infestations.

3. Mount Washington Existing Conditions

3.1 General Site Characteristics

The Town of Mount Washington lies in the southwest corner of Berkshire County, Massachusetts, bordering South Egremont, MA to the north, Copake, New York to the west, Sheffield, MA to the east and Salisbury, Connecticut to the south. The town is twenty-two square miles of mostly intact forest land located on a plateau in the middle of the Taconic Mountain range. Four roads lead out of the town with East Street being the only roadway connected to Massachusetts through Egremont to the north and Salisbury, Connecticut to the south. Several state-owned parcels are present within the town boundaries including, Bash Bish Falls State Park, Mount Washington State Forest, Mount Everett State Reservation, Mount Plantain Wildlife Conservation Easement (WCE), and Mount Darby WCE.

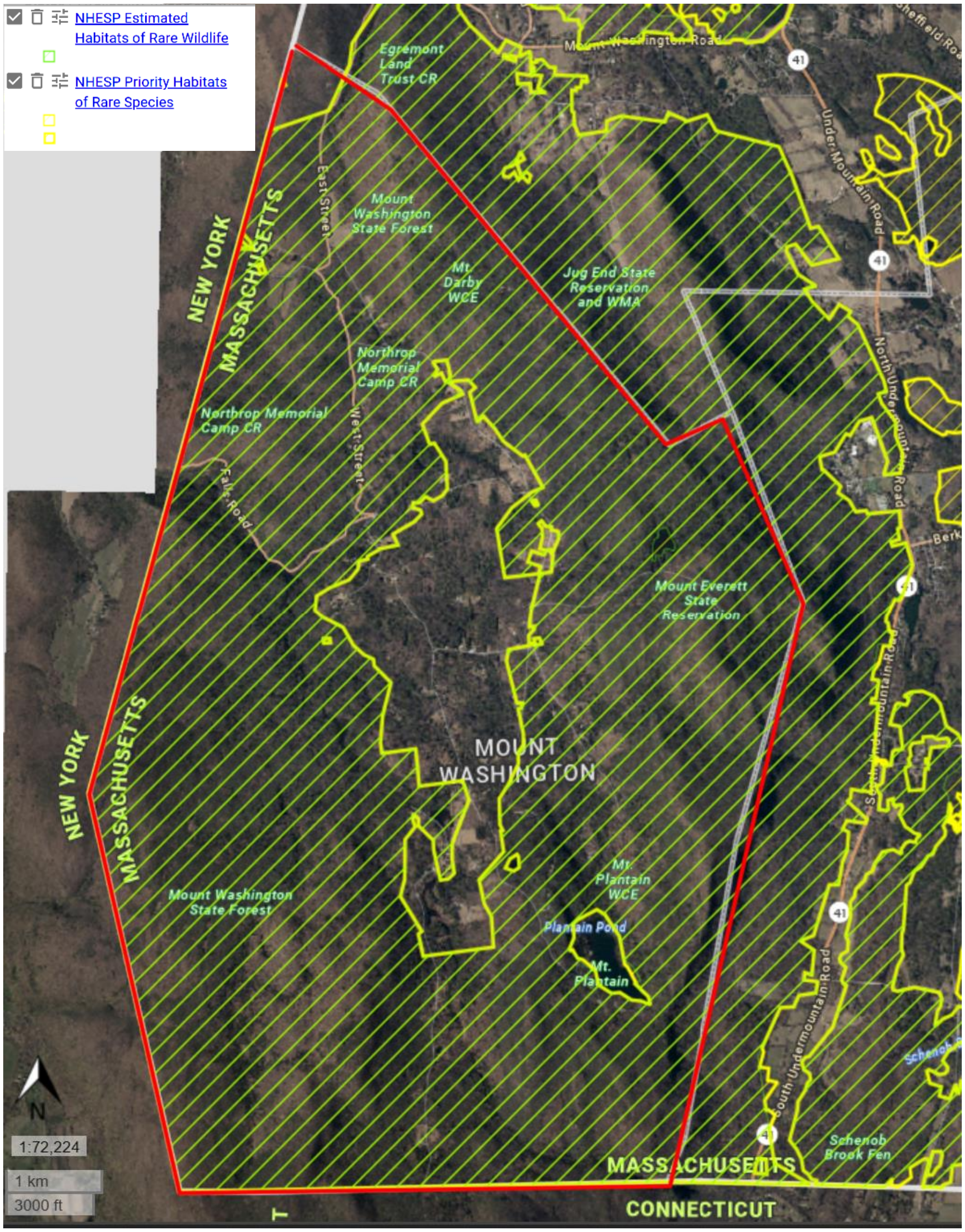
The average annual precipitation for the town is 43 inches and average low (January/February) and high temperatures (July/August) are 10°F to 80°F. Town lands act as a watershed for three states, with several streams and brooks flowing to various tributaries and larger downstream waterways. Notable water courses in Mount Washington include Guilder Brook, City Brook, Lee Pond Brook, Wright Brook, Bash Bish Brook, Ashley Hill Brook, Karner Brook, and Fenton Brook.

The interior forested habitats present in Mount Washington include northern hardwood forests with pockets of Northeastern Interior Dry-Mesic Oak Forest at the edges. Minor other habitat components present in the town include acidic rocky outcrops, Laurentian-Acadian alkaline conifer-hardwood swamps, circumneutral cliffs and talus, acidic cliffs and talus, and Laurentian-Acadian pine hemlock-hardwood forests.

3.2 Priority Habitat in Mount Washington

Massachusetts identifies an area designated as “Priority Habitat” as a location where state-listed rare species, either plants, or animals are known to inhabit, and is codified under the Massachusetts Endangered Species Act (MESA).

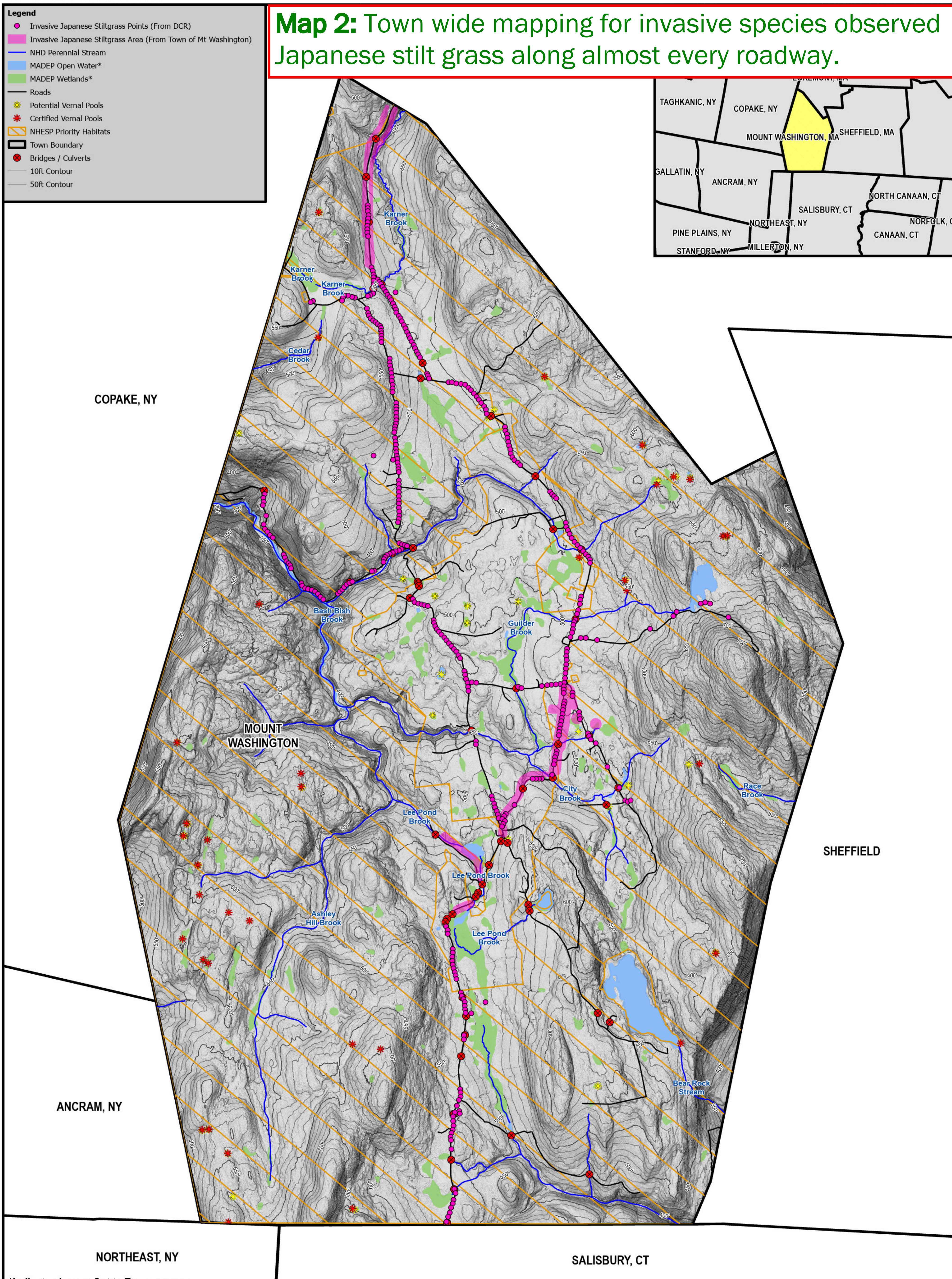
The entirety of Mount Washington is included in state-designated priority and estimated habitat PH 970/EH 734 except for developed areas in the town's center (Map 1). There are two state designated Areas of Critical Environmental Concern (ACEC) within the town boundaries. The first ACEC is Karner Brook Watershed on the northern end of the town and is a source of drinking water supply for the Town of Egremont, MA. On the eastern edge and southern end of the town is the second ACEC named the Schenob Brook Drainage Basin. The Schenob Brook Drainage Basin ACEC encompasses approximately 13,750 acres in the Hudson and Housatonic watersheds, and this particular ACEC is identified by the state of Massachusetts as one of the most significant natural communities in the region. Overall, the entire Schenob Brook Drainage Basin ACEC contains habitat for over forty state-listed rare species, eight of these rare species are dependent on intact and functional wetlands. This applies to special state listed species such as bristly black currant (*Ribes lacustre*) and Jefferson’s salamander (*Ambystoma jeffersonianum*).



Map 1: Estimated and Priority Habitat for Mount Washington depicting much of the town as PH-970/EH-734.

The area excluded from priority habitat in the center portion of Mount Washington is also of environmental concern because it is hydrologically connected to the mapped PH areas. Therefore, the Japanese stilt grass on roadsides can easily spread due to the numerous streams that flow through road culverts into wetlands, priority habitats and ACECs downstream. The Massachusetts Wildlife Natural Heritage & Endangered Species Program (NHESP) lists twenty-four different taxa listed as Special Concern, Threatened, or Endangered in the town of Mount Washington alone (Appendix E). Precipitation in the region is increasing in frequency and intensity (see Section 4.2), and therefore the spread of invasive species via water should be of the highest conservation concern in infested areas that are connected hydrologically to downstream critical natural resources. These rare species are currently threatened by the presence of Japanese stilt grass particularly from the high-density of infestation in the roadside drainage swales that are connected hydrologically to Mount Washington town culverts, streams, brooks, wetlands and ACECs. Observed and mapped locations of this species depict an extensive townwide population distribution with epicenters existing primarily in all the roadside swales throughout the town. Without a habitat management plan for this invasive species, proper knowledge, and use of roadside vegetation Best Management Practices (BMPs), and proper culvert maintenance and sediment catchment basins, the wetlands, biodiversity, rare species and ACECs are all at elevated risk of infestation. Map 2 below depicts previous invasive species mapping recorded GPS locations for Japanese stilt grass locations during the 2017 roadside vegetation survey as well as coordinate locations for every existing culvert throughout the town.

Map 2: Town wide mapping for invasive species observed Japanese stilt grass along almost every roadway.



N

1 inch = 3,000 feet

0 2,000 4,000

Feet

TOWN OF MOUNT WASHINGTON STILT GRASS CASE STUDY

Town-Wide Overview Map

Mount Washington, MA

Resource Areas Reviewed:Areas of Critical Environmental Concern; Census 2000 Streams; Ch. 91 Tidelands Jurisdiction; Environment Justice Populations & Language Overlay; FEMA 100yr Floodplain; Hiking Trails; Interim Wellhead Protection Area; Landfills ([Not]Capped, [Un]Lined, [In]Active, Closed); MADEP Hydrologic Connections; MADEP Oil and/or Hazardous Material Sites with Activity and Use Limitations; MADEP Tier Classified Oil and/or Hazardous Material Sites (21E); MADEP Wetlands; MADFW Coldwater Fisheries Resources; MHC Inventory; NHD Hydrography; NHESP Certified & Potential Vernal Pools; NHESP Priority & Estimated Habitats; NRCS Hydric Soils; Open Space Article 97 Land; Outstanding Resource Water; Public Water Supply; Surface Water Protection Zone; USGS Wild & Scenic Rivers; Watershed Protection Act Zones; WsPA Affected Parcels; Zone II Wellhead Protection Area

BSC GROUP

THIS DOCUMENT IS INTENDED FOR GENERAL PLANNING & INFORMATION PURPOSES ONLY. ALL MEASUREMENTS & LOCATIONS ARE APPROXIMATE.

4. Stilt Grass and Complicating Factors

4.1 Timeline for the Infestation of Japanese Stilt Grass in Mount Washington

Herbarium Records and Origin Infestation

A digital herbarium review for recorded occurrences of stilt grass in Mount Washington and the surrounding towns was conducted to determine a time frame for the origin infestation. According to the digital records present in the Consortium of Northeast Herbaria[1], two observations were made in Mount Washington on East St. between September and November 2007. When this search was expanded to include the bordering town of Salisbury, Connecticut, a record is present from June 2005. Within the same county as Salisbury, the town of Litchfield has the earliest recorded observation of this species from 1993, 20 - 25 miles south of Mount Washington.

2017 and 2024 Mount Washington Roadside Environmental Reviews

In 2017, BSC Group conducted an invasive plant assessment of the roadways within Mount Washington and stilt grass was observed on almost every surveyed roadway except West St. and the southern portion of Plantain Pond Rd. This initial project laid the groundwork for subsequent surveys and the management strategies laid out in this document.

These invasive species assessments made apparent the relationship between roads, streams, invasive species, and forests, BSC Group conducted botanical inventories of various locations throughout the town to determine species composition and level of invasive plant population infestations. Constructed roadways represent habitat fragmentations in the landscape and serve as vectors for invasive plants, pests, and diseases into previously intact ecosystems. Once an introduction occurs on a roadside, post introduction events such as road widening, culvert replacements, and roadside vegetation management activities such as mowing and tree removal can exacerbate spread of an invasive species population.

In 2024, the Town of Mount Washington was awarded a Community Forest Stewardship Grant supported by The Department of Conservation and Recreation (DCR), The Nature Conservancy (TNC), Berkshire Regional Planning Commission, Berkshire Natural Resources Council (BNRC), and the Mount Washington Conservation Commission. This grant recognized the ecologically significant habitats within the town and the threat invasive species pose to these sensitive areas.

On April 2, and June 18, 2024, BSC Group visited several targeted locations throughout the town to assess the potential to implement opportunities to alleviate invasive species spread, storm water runoff and soil erosion associated with the town's roadways. This survey was not an exhaustive survey of the extent of invasive plant populations but was focused on roadway areas primarily along specific culverted sections in seven locations, Karner Brook, Garret Memorial Park, Hatch Hill, DPW, City Brook at East St., Hunts Brook culvert at Whitbeck Rd., and the roadside area on East Street in proximity to the Lee Pond Brook Wetland Complex During this time stilt grass was anecdotally observed far beyond the survey area and escaping into forested woodlands in correlation to stormwater and stream flow. Of the seven sites visited, stilt grass

[1] https://portal.neherbaria.org/portal/

was observed at six. The only site where stilt grass was not immediately present, likely due to very dry conditions, was the Town of Mount Washington Department of Public Works property. However, in the 2017 survey data stilt grass was observed in the wetland adjacent to the DPW yard, which is slightly outside of the 2024 survey area.

4.2 Prevalence of Water

According to the Massachusetts Wildlife Climate Action Tool[2] precipitation since 1991 has increased in the New England by 8% relative to the years between 1901 – 1960 (Walsh et al 2014). In addition to the increase in precipitation, the events are also increasing in intensity. The amount of rain during heavy precipitation events in the United States has shown a statistically significant increase since 1991. Due to increases in rainfall during the heaviest weather events, this has additionally increased flooding making New England one of the regions most affected by these environmental changes[3]. Climate change and higher intensity weather events increase the chances of other environmentally altering events including erosion and flooding which both affect invasive species plant spread on the New England landscape.

The Town of Mount Washington is particularly susceptible to these changes in precipitation due to the topography, number of streams, brooks and waterways that not only connect to smaller wetlands within the town boundaries of Mount Washington but also hydrologically connect to much larger wetland complexes to the east.

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2 https://climateactiontool.org//content/storms-and-floods
3 https://climatechange.chicago.gov/climate-impacts/climate-impacts-northeast

5. Engineering and Roadside Solutions

5.1 Road and Stormwater Infrastructure Engineering

Untreated stormwater runoff contributes to the transportation of stilt grass along East Street. All stormwater runoff on the roadway in front of 648 and 688 East Street is collected, either via country drainage or by existing drainage ditches, and discharged into intermittent streams. These streams then connect into wetland resource areas just beyond the property lines.

The addition of stone check dams along the roadside swales would help to control the flow of water prior to entering the intermittent stream. The existing drainage ditches convey stormwater and, in some instances, slow down its velocity, but they do not provide any stormwater treatment. By adding check dams to both the existing and proposed ditches, the sediment carried by the stormwater will have time to settle, reducing the spread of stilt grass. These check dams will also limit scour and erosion to the drainage ditch.

There are two 24” HDPE culverts which carry the intermittent streams east of East Street. In existing conditions, these culverts outfall directly into the stream. Adding stone outlet protection at the outlet of both culverts would reduce scour and erosion. The outlet protection will also help reduce the transportation of stilt grass into the resource areas.

5.2 Road and Vegetation Maintenance

Guidance for the Best Management Practices (BMPs) of roadside vegetative management is provided on the Massachusetts state website and was created by New Hampshire Department of Transportation (NHDOT)[4]. These BMPs include simple procedures to prevent the spread of non-native/invasive species that have a proclivity to reproduce either asexually by stem and root cuttings and/or sexually via seeds. This BMP document recognizes the role roadside activities play in the spread of invasive plant species and the importance of the considerations of this during roadside vegetation management and construction activities. **Appendix D** lists sixteen, in depth BMPs for implementation of any type of roadside activity.

Although Japanese stilt grass is not mentioned specifically in this documentation in terms of roadside management, the BMP practices listed will work to reduce the spread of this species. BMPs for roadside work as represented in **Appendix D** include practices that prevent the introduction and further spread of invasive plants. Some notable practices include, but are not limited to, minimization of soil disturbance, assurance of invasive free materials such as fill, loam, mulch, hay, riprap, and gravel, and at least two years post-construction monitoring for invasive species introductions.

[4] https://www.mass.gov/doc/nhdot-best-management-practices-for-roadside-invasive-plants/download

6. General Overview of Stilt Grass Management Options

There are four General Treatment Technique Types for invasive plant management consideration, as listed in Table 1, Individual control types for each of these categories are listed as detailed in the text following Table 1. Integrated Pest Management strategies indicate that the incorporation of as many of the General Treatment Technique Types as possible increases the success of any management control plan. For example, without cultural controls to eliminate the spread of invasive species to any location, treatment of any existing infestations will be unsuccessful due to continued reintroductions of invasive plants.

Table 1: Japanese Stilt Grass Management Techniques

General Treatment Technique Type	General Treatment Technique Sub Type	Treatment Month	Management Notes
Mechanical	Weed whacking	Late August/Early September	Equipment should be cleaned before moving from one site to another if viable seeds are present
	Hand-pulling	Late August/Early September	Plants should be bagged and disposed of if viable seeds are present
	Mowing	Late August/Early September	Equipment should be cleaned before moving from one site to another if viable seeds are present
	Burning	Late August/Early September	Burning should not be considered an option in fire prone habitats
	Engineering Sedimentation Solutions	Any	Installation of stone check dams should be utilized to reduce erosion, invasive plant spread and slow down the movement of water to allow for settling out of sediments and Japanese stilt grass seeds
Chemical	Foliar	Late August/Early September	Must use a broad-spectrum herbicide
	Pre-emergent	Winter/Spring	Will eliminate native and invasive seeds present in the seed bank
Cultural	Machinery	Any	Cleaning equipment during mowing activities where stilt grass populations are known will assist in limiting the species spread to new locations
	Landowners	Late August/Early September	Informing landowners of this species and how to manage it could aid in reducing the overall stations of this species in the town
	EDRR	Any	Early Detection Rapid Response (EDRR) is a method for managing newly established species to an area and managing them early in the infestation to gain early control
Biological	*Bipolaris microstegii* and *B. drechsleri*	Any	Biological controls for invasive species have the potential to affect native species. This control is a new method for the management of this species.

6.1 Mechanical Control

6.1.1 Weed Whacking

This technique is a suitable control method for stilt grass where the populations are easily accessible such as the roadside. Weed whacking before seed production will interrupt the seed bank and decrease the chances for the spread of this species. Mechanical control consists of severing the flowering/fruiting stems at the appropriate time of the growing season to prevent formation of viable seeds. Care should be taken to clean equipment used for mechanical control especially when the chances of some plants having viable seed is higher. Refer to Appendix D for treatment timing.

6.1.2 Hand Pulling

This method is effective for treating small patches of spreading stilt grass or newly established, low-density populations. Plants are easily pulled from the ground and if done during the appropriate time of year, can interrupt the seedbank if one exists. Areas that are hand-pulled early in the growing season should be monitored so that any additional plants that germinate because of the small hand pulling disturbance can also be removed.

6.1.3 Mowing

When stilt grass populations are extensive and areas are accessible for heavy machinery, mowing can be a viable option for management. Due to the number of potential seeds created by each stem it is imperative that if this management approach is selected it includes follow-up weed whacking or hand pulling to capture any flowering plants that were missed by the mower. Due to the inaccuracy and size of mowers, missed plants are often found around the base of trees, rocks, bottom of slopes and around culverts. See Appendix D for the BMP's regarding this type of management and the use of heavy machinery.

6.1.4 Burning

Where conditions are suitable, burning stilt grass with a propane tank and weed torch can remove above ground vegetation as well as eliminate any viable seed that may be present. This method does have the potential to aggravate the germination of stilt grass seeds present in the soil, but if done at the right time of season newly germinating seedlings will not have enough time to flower and produce seeds due to colder weather. It is also noted that this strategy may encourage seed flushes of stilt grass if this management approach is conducted without follow-up treatments and populations of this invasive species could increase exponentially.

6.1.5 Engineering and Stone Check Dams

As a passive sediment and seed retention mitigation strategy, stone check dams in roadside drainage swales can slow down the velocity of stormwater runoff which will aid in reducing scour and erosion of the drainage ditch, as well as allowing for the gravity separation of suspended solids, limiting the transportation of stilt grass further into critical natural resource areas.

6.2 Specific Chemical Control Options for Grasses

6.2.1 Broad Spectrum Foliar

Chemical control during the growing season for this species is a highly effective way to manage the population. Chemical control efforts should incorporate a broad-spectrum herbicide, preferably wetland approved glyphosate product like Round Up Custom. Solutions of a 53.8% active ingredient herbicide mixed with a non-ionic surfactant in water at a rate of 1% - 1.5% herbicide and 0.25% surfactant can be applied with a targeted approach to roadside populations prior to regular mowing activities. Chemical treatments should be made at least a month in advance of any mowing activities to ensure treated plants can absorb the herbicide and desiccate. If mowing occurs too soon after chemical treatment plants could continue to persist and potentially produce viable seeds.

6.2.2 Pre-Emergent Soil Treatment

Herbicide treatments to the soil to inhibit seed germination are likely highly effective in reducing the number of stems of stilt grass stems that will germinate. This type of treatment, however, will inhibit or eliminate native seeds present in the seed bank which are critical for long-term management of stilt grass infested areas.

6.3 Cultural Controls

6.3.1 Machinery

To prevent further spread of this species in any location it is imperative to follow BMP's (**Appendix D**) to clean heavy machinery before moving it from one location to another. Prioritization of mowing schedules for timing and consideration of mowing unaffected areas before infested areas will lessen the spread of this species from infested sites to non-infested sites.

6.3.2 Landowner Education

It is important to inform residents of any town about movement of Japanese stilt grass via tires, shoes, soil, clothing, animals, and other objects. Especially when people are travelling from a highly infested area like Connecticut to a less infested area, their movement could potentially exacerbate the spread of this species on a regional scale. Informing landowners from all the New England states about this species, through Public Services Announcement strategies may assist in decreasing the rate of spread.

6.3.3 Early Detection Rapid Response (EDRR)

Organizing a group of volunteers or an individual to monitor sites along roadsides as well as non-infested sites for newly establishing populations by posting observations on iNaturalist could assist the town in identifying areas where one of the above listed control methods would be most beneficial.

6.4 Biological Control

6.4.1 *Bipolaris microstegii* and *Bipolaris drechsleri*

Two newly described fungi species discovered in Indiana in 2012 have potential as biocontrol for this invasive species. Species in this genus of fungi have a long history of disease on more familiar crops like corn, oats, rice, and wheat. Studies have continued to show that these fungi can cause declines in population numbers of stilt grass populations. It is unknown how these fungi may or may not affect native organisms, (Warren, 2021), so use of this control should be considered cautiously. Additionally, as this type of control for stilt grass is still being researched this option may not become fully viable for several years.

6.5 Permitting and Compliance

Permitting for control of invasive species is necessary within sensitive habitats to ensure proper control methods are used and so the invasive plant infestation is not exacerbated. Additionally, due to the control methods required to control a species such as Japanese stilt grass, both mechanical and chemical approaches require strategies and project execution that preserve the native vegetative components and carefully eliminate the target invasive species without further disrupting the treatment area.

Areas subject to the Massachusetts Wetland Protection Act (MGL Chapter 131 Section 40) (WPA) and associated Regulations (310 CMR 10.00) would include 100-foot buffer zones to Bordering Vegetated Wetlands (BVWs) and streambanks, 200-foot Riverfront Areas to perennial (flowing year-round) streams, the Bordering Vegetated Wetlands (BVWs), streams, and other waterbodies themselves, and areas subject to flooding. One important note about the jurisdiction of streams is that they are not regulated by the WPA until they flow through and/or from a wetland. From the description of the drainage and conditions at the project sites, it is assumed that the swales running parallel to East Street would not be characterized as streams, while the features flowing perpendicular to East Street and into each of the properties would be jurisdictional intermittent streams. For final design, both banks of each of the stream channels along with any adjacent or receiving wetlands should be delineated for accurate calculation of project-related impacts to the resources. Proposed activities within 100 feet of the streams or other wetlands or directly within the resources (e.g., for scour protection), will require preparation of a Notice of Intent (NOI) application to be filed with the Conservation Commission and copied to the MassDEP Western Regional Office. This will also have to include a quantification of the area to be managed for Japanese stilt grass located in wetlands and streams. Filing under the WPA is required regardless of work on private or public property, by private landowners or public entities. While removal of an invasive species is obviously beneficial to the ecosystem, there is no regulatory exemption in the WPA that allows for removal or alteration of vegetation to occur directly within wetlands and streams without approval. The NOI could be filed as an Ecological Restoration project. However, this type of NOI requires preparation of extra documentation and is often more onerous to complete than a typical NOI. The benefit to using Ecological Restoration is when the project would not be able to otherwise be completed within the performance standards of the WPA. If the area managed for stilt grass is greater than 5,000 square feet within the BVW for example, the Ecological Restoration classification should be pursued. Impacts to wetlands are assumed to be temporary without affecting the soil surface and creating any excavation or fill.

The presence of an ACEC does not affect permitting significantly for a project at this scale. Projects greater than ½ acre in size with state funding or a state agency action may be subject to Massachusetts Environmental Policy Act (MEPA) review which is an intensive effort. Being within an ACEC does place additional protection on BVW under the WPA. The only allowable alteration of BVW would be if the work can be characterized as a "limited project." Work to improve stormwater and drainage on the roadways would be considered a limited project but the vegetation management work in wetlands would have to pursue the Ecological Restoration limited project status.

Work in NHESP Priority Habitat for Rare Species and Estimated Habitat for Rare Wildlife requires compliance with the Massachusetts Endangered Species Act and regulations at 321 CMR 10.00. Rather than a full MESA review, the project activities meet different exemptions at 321 CMR 10.14:

> (8) construction of new stormwater management systems that are designed to improve stormwater management at previously developed sites, provided that the plans for the system are submitted to the Division for prior review, and the Division makes a written determination that such systems will not have an adverse impact on state-listed species or their habitats;
>
> (15) the active management of State-listed Species habitat, including but not limited to mowing, cutting, burning, or pruning of vegetation, or removing exotic or invasive species, for the purpose of maintaining or enhancing the habitat for the benefit of rare species, provided that the management is carried out in accordance with a habitat management plan approved in writing by

the Division

Coordination with NHESP is required along with preparation of a habitat management plan (consistent with this report). Assuming both submittals are accepted, work could proceed without further MESA review.

7. Stilt Grass Assessment

7.1 Purpose of Stilt Grass Assessment

The purpose of the study was to assess the interaction between roadside swales, Japanese stilt grass, stormwater, existing road and stormwater infrastructure construction and maintenance BMPs, and to estimate future areas of infestation for this species. Additionally, this report also identifies potential origins for this species presence in the two locations and provides site specific treatment approaches for management over the next ten years. On a smaller scale, the two study sites offer an opportunity to address potential causes of the stilt grass infestation to be found on these properties which include point sources potentially from private driveway erosion with sediment laden stormwater carrying the stilt grass seed bank into streams and wetlands. Additionally, the Study Sites provide opportunities to address the permitting requirements and working relationship that will be needed between the town and private landowners to slow the spreading infestation as well as to address the management strategies for this species on a broader scale.

7.2 Overview of Study Sites

Two study sites were identified for Japanese stilt grass assessment. Parcels located at 648 and 688 East Street in Mount Washington, MA were chosen as they have hydrological connections to roadside swales, culverts, critical wetlands and ACECs. Both the 648 and 688 East Street study sites are representative of the typical roadside and forested conditions present within proximity to Japanese stilt grass populations in Mount Washington. Although the extent of the Japanese stilt grass population has only been assessed for these two properties, based upon the known existing infestation levels of this species along town roadways as recorded during the 2017 DCR roadside invasive species assessment (Map 2), it is presumed that similar, if not greater, levels of infestation are present on other properties.

7.3 Methods

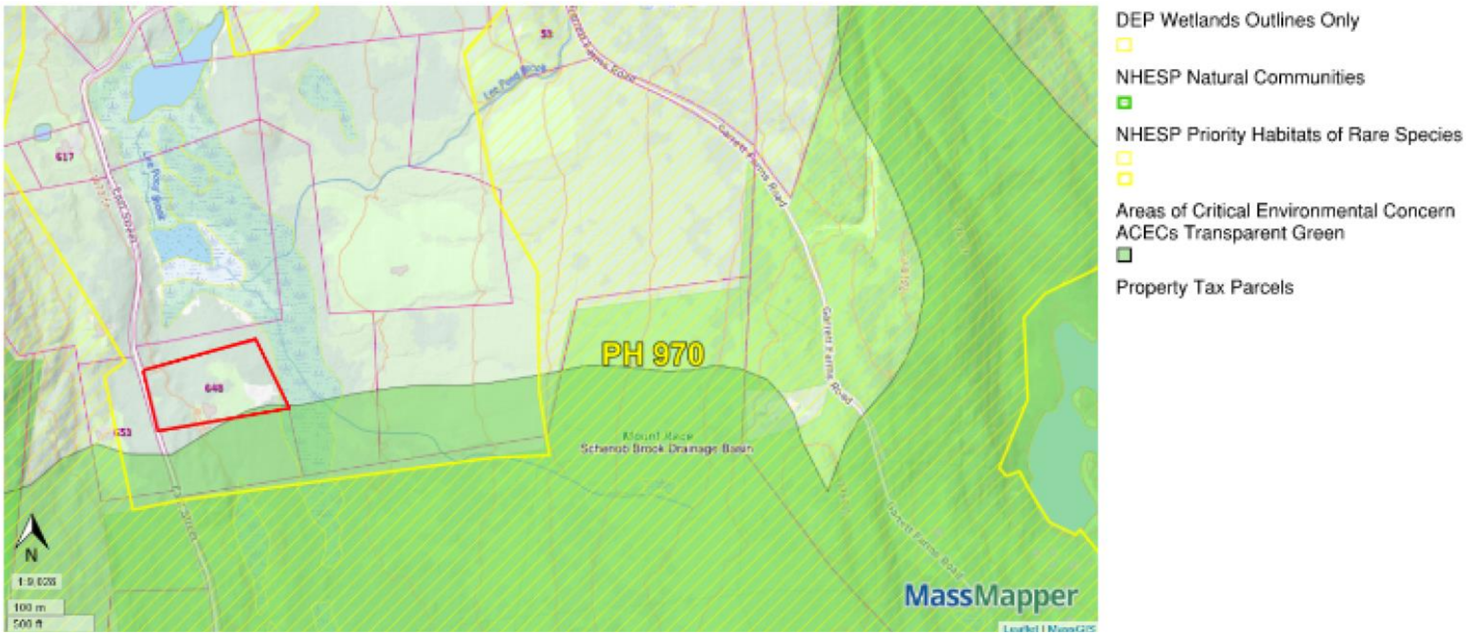
The connection between the spread of Japanese stilt grass, roadside infestations, and potential threats to ACECs and wetlands was determined by GPS locating infestations at the two study sites by a BSC Senior Botanist, analyzing slope with GIS tools for the locations, in field structural and BMP assessments of existing culverts from a BSC Professional Engineer, review of permitting requirements by a BSC Senior Ecologist and Permitting Specialist, and using the gathered information to draw conclusions on the potential ecological threat of this species on natural resources.

Site visits by BSC were conducted on October 1, 2024, and December 10, 2024, to assess the level of Japanese stilt grass infestation and possible roadside culvert improvements to reduce erosion and spread of this species on to the Study Sites.

With GPS data a desktop analysis was conducted on the existing Japanese stilt grass populations to depict areas below the existing infestation elevation and determine areas at considerable risk of future infestation.

7.4 Case Study Site #1: 648 East Street

The property at 648 East Street is a 6-acre parcel near and with hydrological connections to Priority Habitat 970 (Map 3 MassMapper 2025). Additionally, this parcel is bordered by Lee Pond Brook and the associated wetland to the north and east of the property which eventually flows into Mount Washington State Forest and Bash Bish Falls State Park. The property sits at an approximate elevation of 1,675 feet and slopes north to 1,650 feet to meet the edge of Lee Pond Brook's associated wetland. The western edge of the property has approximately 350 feet of road frontage on East Street.



Map 3: Depicts the location of 648 East Street and its relationship to Priority Habitat 970 as well as the Schenob Brook Drainage Basin.

Photo 3 below presents evidence for the connection of roadside stormwater runoff and Japanese stilt grass. High density Japanese stilt grass populations exist along the roadside swale which during rain events feeds into this culvert. Plants in this photo will continue to produce seeds and these seeds will continue to spread further into the woodlands and eventually populate the wetlands and ACECs down slope from this parcel.

Photo 3: This photo of the existing conditions at 648 East St. supports the connection between the culvert, stormwater runoff and Japanese stilt grass infestations. This connection can be clearly observed by the stilt grass populations in the above photo circled in pink.

At least one source population for the stilt grass infestation on 648 East St. can be attributed to a nearby driveway across East St. at 641. Japanese stilt grass has become ubiquitous in the road shoulder and drainage swale south of the 641 driveway and was likely spread uphill to this property by equipment. The property at 641 East Street extends west from East St. and climbs to an elevation of 1,990 feet. This driveway leads to the 641 East Street residence and is on a steep uphill grade. The steepness of this driveway and the existing populations of Japanese stilt grass are creating an additional vector for infestation outside of the roadside swales. Stormwater and sediment that reach East Street when eroded from this driveway continue flowing south along the roadside drainage swale into an unnamed stream. This unnamed stream flows under East Street through a culvert onto the property at 648 East Street where it continues in a stream bed approximately 370 feet into the Lee Pond Brook Wetland BVW (Photo 4). From these photo and others (Appendix A), it becomes apparent that Japanese stilt grass seeds are being deposited along the high-water mark along the edges of increased outflow (Photo 5 and Photo 6) in addition to deposition in natural areas of sediment collection.

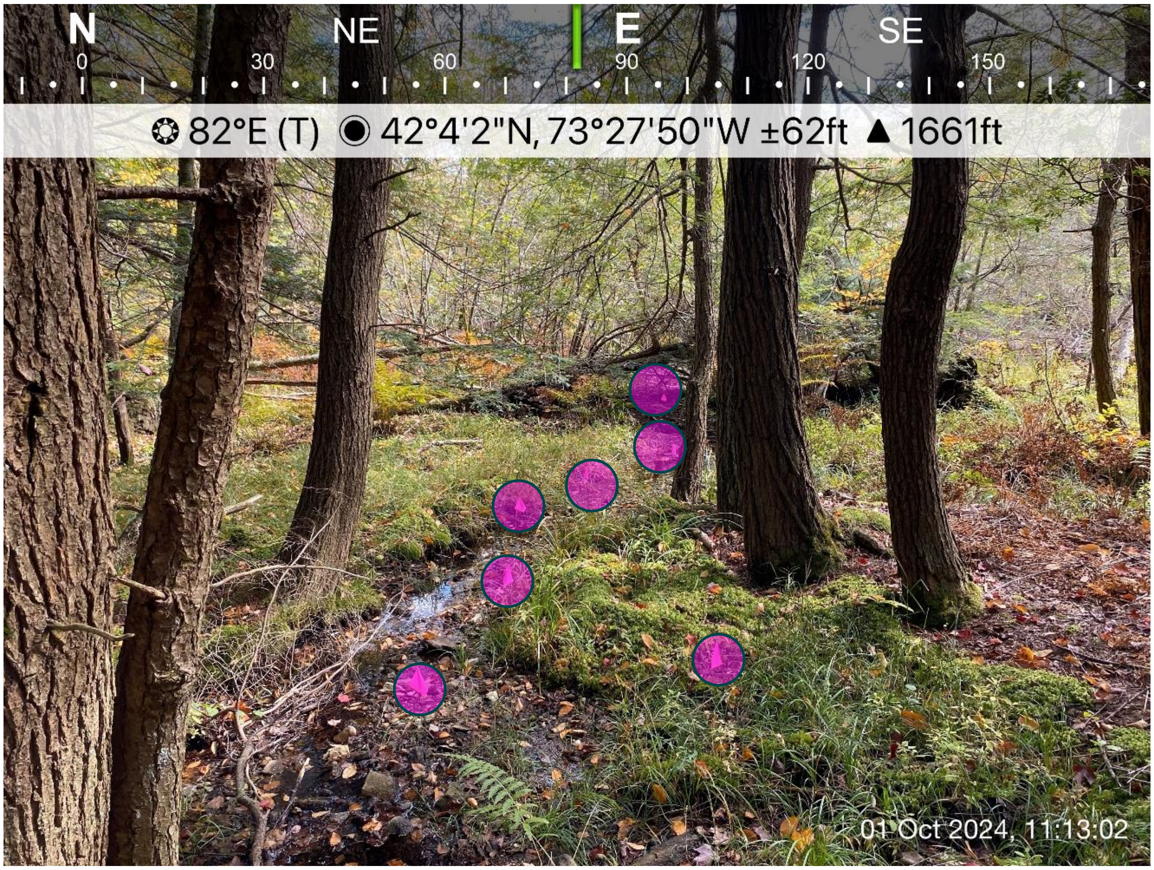


Photo 4: October 1, 2024, depicting the results of the outflow of the culvert at 648 East St. as it approaches the BVW on Lee Pond Brook wetland. Pink circles are used to highlight individual pin flags which represent Japanese stilt grass.

Photo 5: Is from the same proximate location as Photo 4 and depicts the overland flow of water out of the culvert and into the BVW for Lee Pond Brook wetland. The pink oval indicates the approximate location of Photo 4 in relation to Photo 5.

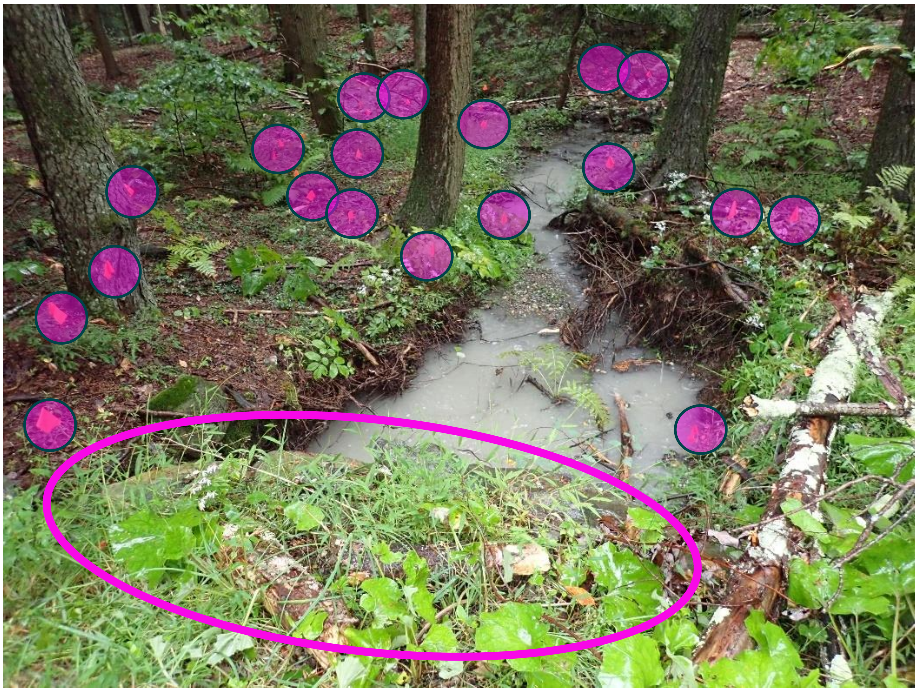
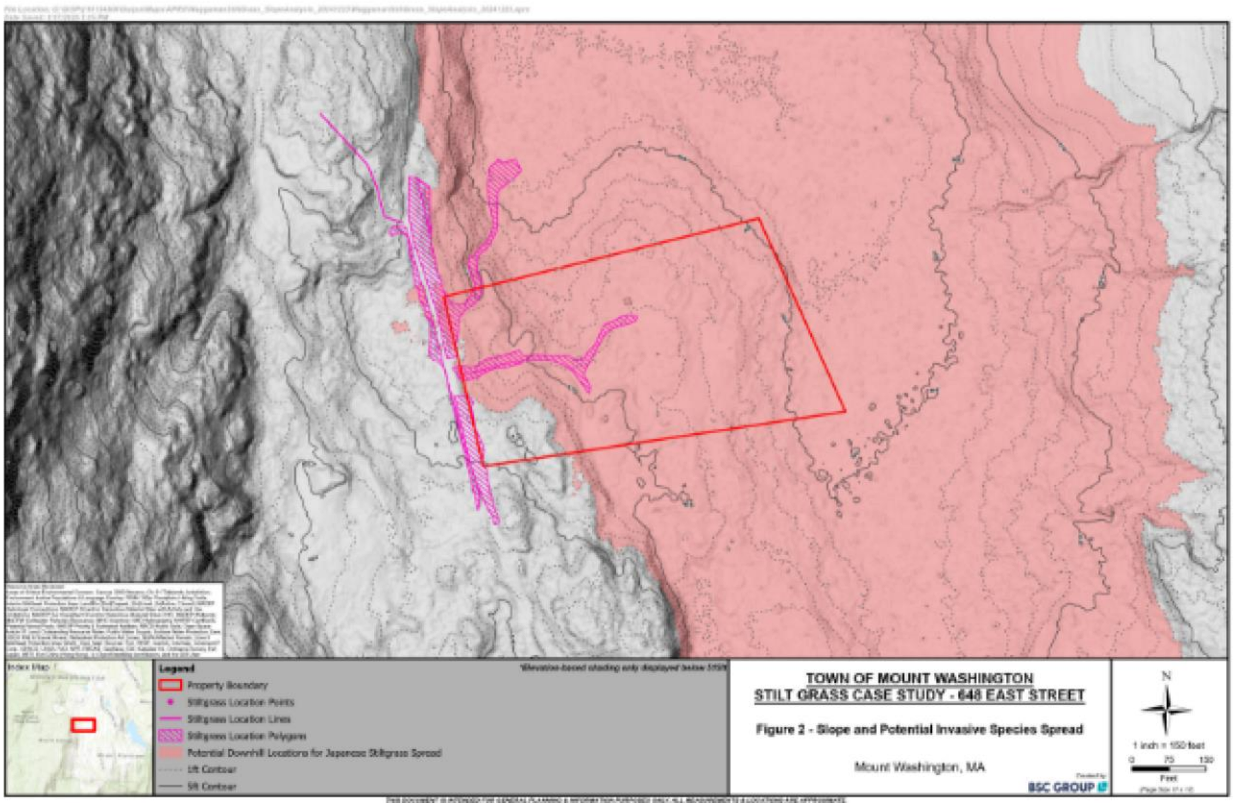


Photo 6: Another depiction of a stormwater, sedimentation, and Japanese stilt grass population expansion. The pink hollow circle in the foreground highlights a clump of stilt grass directly above the drainage culvert along the roadside which is dropping seeds directly into the outflow. The other pink circles call attention to individual pin flags for stilt grass plants and the populations extent. This correlates with the high-water mark/deposition zone for this drainage and moreover shows Japanese stilt grass beginning to take a foothold in a mature shaded forest.

Map 4 below shows 648 East Streets property boundary and the existing extent of the Japanese stilt grass population as of October 2024. A slope analysis of the property, downslope wetlands and the relationship between stilt grass was conducted to determine probable future areas of infestation. On Map 4, the landscape areas down gradient of the elevation of existing stilt grass populations are represented in pink. These are areas identified by this study as at-risk areas for potential spread and colonization by Japanese stilt grass in the future. Based on the results of the field surveys of the extent of the stilt grass population, engineering reviews of the culvert designs and conditions, GIS analysis of slope, and the likelihood of an increase in intensity and quantity of climate change influenced precipitation events, the evidence indicates that without management of and for this invasive species along roadside swales, down slope wetlands and ACECs are at-risk of future infestation.



Map 4: The Japanese stilt grass population extent at 648 East Street is cross-hatched in magenta with zones of future colonization of stilt grass based on slope colored in solid pink.

7.4.1 Treatment Proposal Overview

Based on the invasive plant field survey and GIS landscape assessment occurrences in the bordering roadside swales attached to this property as well as the infestation across East Street uphill on 641 East Street, treatment of this species on the 648 East Street property poses some logistical management issues. Treatment success within the 648 East Street property is possible but without treatment of the source populations of this species, the study property as well as adjacent forests, wetlands, state owned property, and critical habitat in the surrounding area will constantly be at risk of reinfestation.

Effective control of Japanese stilt grass at 648 East Street will require:

1. A combination of engineered sedimentation separation solutions to limit continued introduction of stilt grass seeds, improve water quality and reduce erosion
2. Proper timing of mechanical, hand-pulling or herbicide techniques and vigilant vegetation monitoring
3. Permitting will be required for work in a wetland buffer zone, as addressed in the Permitting section below.

Below are specific recommendations based on the specifics of this property and its location in the landscape.

Environmental Permitting Compliance

For installation of stormwater control measures within Buffer Zone or other areas jurisdictional to the WPA, a Notice of Intent application must be prepared and filed with the Conservation Commission and copied to the MassDEP Western Regional Office. The application would include proposed work to install scour protection/stone within the stream and should include a quantification of the area to be managed for Japanese stilt grass located in wetlands and streams. The stormwater management work can reference limited project provisions and the invasive species management if the area of impact is below 5,000 sf of direct BVW work. If a larger area is needed, Ecological Restoration Limited Project status should be pursued. Since the parcel is not located in NHESP habitat or an ACEC, these two jurisdictions do not require further consideration. Under 5,000 sf of direct work in the stream for scour protection can be permitted by filing a Self-Verification Notification Form under the Massachusetts General Permit with the US Army Corps of Engineers under Section 404 of the Clean Water Act. Since plant management efforts would not excavate or fill the wetlands, those activities would not require reporting or approval.

7.4.2 Treatment Proposal Methods

The methods presented in this section should be implemented together for the best results. Stone check dams for the reduction of erosion and to slow the spread of stilt grass seeds will assist in reducing the spread of this species into already chemically or mechanically treated areas. Both mechanical and chemical treatments are equally effective for control of this species and either can be implemented based on permitting, contractor or landowner preferences.

Engineered Solutions

Engineered solutions can be used to alter storm water and sediment flows, thereby reducing the potential for stilt grass seeds to be carried beyond existing infested areas. Stormwater control measures have been evaluated to improve the overall water quality of the intermittent streams and wetlands and to reduce the transportation of stilt grass. In the locations of the existing drainage ditches, stone check dams have been proposed to slow down the velocity of stormwater runoff which will aid in reducing scour and erosion of the drainage ditch, as well as to allow for the gravity separation of suspended solids, limiting the transportation of stilt grass. Refer to the specific document regarding engineering solutions to this situation BMPs, cost, and plans (Appendix G).

The suggested engineered solutions are based on the existing drainage to and from the 648 property which are described in detail below.

To the west of 648 East Street, the intermittent stream flows to the east, crossing underneath East Street via an existing 24” HDPE culvert, before daylighting on the eastern side of the roadway. The stream continues to flow northeast until it discharges into a wetland resource area. Approximately 200-feet north of the culvert, there is a high point in the road. From this high point, an existing drainage ditch west of the roadway conveys stormwater runoff from the roadway into the culvert, where it is then discharged into the intermittent steam. On the eastern side of the roadway, north of the culvert, there are no existing drainage ditches, any stormwater runoff that flows from the roadway will overland flow directly into the stream. Another high point is located approximately 460-feet south of the culvert. For approximately 125-feet south of the culvert, East Street is crowned, sending runoff to the east and west. There are existing drainage ditches east and west of East Street which will convey stormwater runoff into the culvert on the west, or directly into the stream on the east. The remaining 335-feet or roadway is superelevated to the east. All stormwater runoff on this portion of the roadway will overland flow directly into the intermittent stream or wetland resource areas. Note that on the west side of the roadway in front of 648 East Street the roadway layout is very narrow, for stormwater improvement to be implemented, it is likely that easements or rights of access would be required.

Maintenance of the stormwater control measures shall be conducted as follows: The grassed drainage ditches shall be mowed on an as-needed basis during the growing season so that the grass does not exceed 6 inches. Set the mower blades no lower than 3 to 4 inches above the ground. Do not mow beneath the depth of the design flow during the storm associated with water quality (e.g., if the design flow is no more than 4 inches, do not cut the grass shorter than 4 inches). The grass ditch shall be inspected semi-annually the first year after construction, and at least once a year thereafter. Inspect the grass for growth and the side slopes for signs of erosion and formation of rills and gullies. Plant an alternative grass species if the original grass cover is not successfully established. If grass growth is impaired by winter road salt or other deicer use, re-establish the grass in the spring. Accumulated trash and debris shall be removed from the swale prior to mowing. Hand methods (i.e., a person with a shovel) shall be used when cleaning to minimize the disturbance to vegetation and underlying soils. Check for sediment accumulation on a yearly basis and clean as needed. Check dams shall be inspected after every significant rainfall event. Sediment shall be removed as needed, and damage shall be repaired as needed.

Engineering Solutions Cost Tables

648 East Street:

Proposed Drainage Ditches			
	Length	Price/LF	Total Cost
1	110	$250	$27,500
Total Cost Per New Ditch			**$27,500**

Stone Outlet Protection		
# of Outlets	Price/Outlet	Total Cost
1	$1,200	**$1,200**

Stone Check Dam (Existing Ditch)		
# of Check Dams	Price / Check Dam	Total Cost
6	$2,000	**$12,000**

Mechanical Control

Mechanical control of Japanese stilt grass either by hand pulling or with the use of a weed whacker should be completed before the plant seeds reach maturity. Based on previous observations and ecoregion-based research for this species, mechanical restoration activities should be conducted during the months of late August into mid-September. Weed whacking of this species prior to the proper time period for treatment should not be considered and if hand-pulling is necessary after seeds have reached maturity, all plants should be placed into plastic bags and either disposed of or allowed to desiccate via solarization of the plastic bag and then disposed of.

Mechanical control for this particular property is estimated to take a day or less depending on the exact treatment method and could cost between $75 - $150 per hour/per person for a total treatment cost of $600 - $1,200/acre.

Chemical Control

Chemical control of Japanese stilt grass with a foliar treatment during late August into mid-September will ensure the inability for plants to reach maturity and additionally will kill the plants in place reducing disturbance and the likelihood for increased seed germination the following spring. Applicators should use a wetland approved Glyphosate product, for example Round Up Custom. A wetland approved herbicide should always be considered regardless of habitat but especially when near wetlands and for treatment of stilt grass for its proclivity to occupy wetter environmental conditions such as drainage swales. Herbicide solutions of a Glyphosate product should be mixed at a rate 1% - 1.5% solution (53.8% Active Ingredient AI) and 0.25% non-ionic surfactant with at least a 70% AI to 90% AI product like Aquachem 90 or Chemsurf 90. Solutions and rates are based on 1 gallon of solution.

Chemical control of this species requires the application to be conducted by a Massachusetts licensed pesticide applicator with a Category 2 (Forest Pest) license. Due to the location of the treatment area to critical environmental areas it will be necessary for the contractor to obtain a permit for treatment within sensitive habitats. The hours for this type of treatment will be fewer than the mechanical control option but with the addition of a permit, the cost of chemical, and required herbicide application reporting it will fall within the same range of $600 - $1,200/acre.

Monitoring

Regardless of the treatment method used, follow up monitoring for Japanese stilt grass will be necessary for years 2 – 10. It is likely that reintroduction of this species via seeds will continue without upslope vegetation management in roadside swales. It may be necessary to alter or expand the scope of the treatment area based on any years monitoring results.

Chemical and Mechanical Cost and Timeline Tables

Mechanical

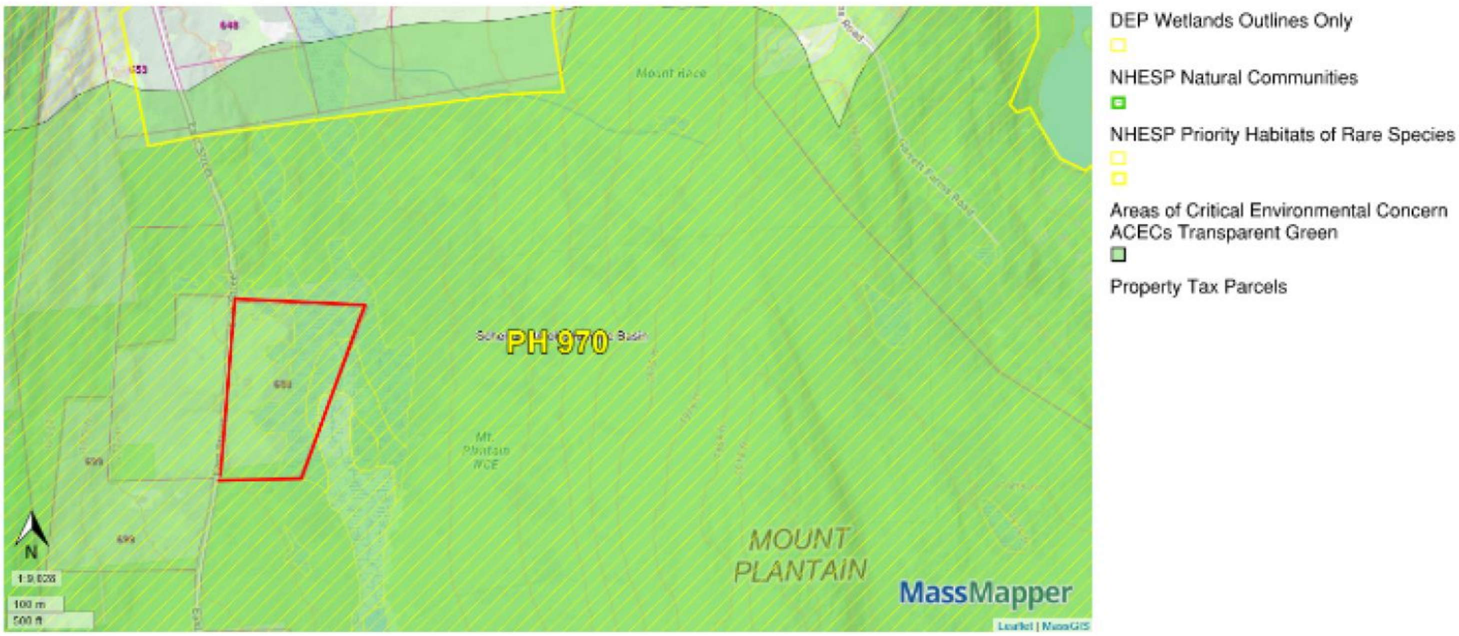
Management Year	Management Treatment Type	Management Sub Type	Treatment Timing	Estimated Cost per Acre
1	Mechanical	Weed whacking	late August/early September	$600 - $1,200
1	Mechanical	Mowing	late August/early September	$600 - $1,200
2	Monitoring	N/A	June/July	$200 - $400
2 – 10	Mechanical	Weed Whacking/Mowing	Late August/Early September	$600 - $1,200
3 – 10	Monitoring	N/A	June/July	$200 - $400
			10 Year Estimated Cost per Acre	**$7,800 - $15,600**

Chemical

Management Year	Management Treatment Type	Management Sub Type	Treatment Timing	Estimated Cost per Acre
1	Chemical	Foliar	late August/early September	$600 - $1,200
1	Mechanical	Mowing	October	$600 - $1,200
2	Monitoring	N/A	June/July	$200 - $400
2 – 10	Chemical or Mechanical	Foliar/Hand Pulling	Late August/Early September	$600 - $1,200
3 – 10	Monitoring	N/A	June/July	$200 - $400
			10 Year Estimated Cost per Acre	**$7,800 - $15,600**

7.5 Case Study #2: 688 East Street

The 688 East Street property is 1,400 feet south of the 648 property on the same side of the street and connected hydrologically through the wetland complex and sits at the bottom of two slopes, with Mount Plantain Wildlife Conservation Easement (WCE) to the east and Mount Ashley to the west. This property is a 14-acre lot at an elevation of 1,660 feet with a substantial portion of the property being designated as part of the Schenob Brook Drainage Basin ACEC (**Map 5 MassMapper 2025**). A culvert under East Street at this location connects the roadside drainage through swales and directs the stormwater runoff into a stream bed on the property that then continues for approximately 300 feet into the wetland within the ACEC (**Photo 7**).



Map 5: Depicts the vulnerability of both Priority Habitat 970 and the Schenob Brook Drainage Basis ACEC to Japanese stilt grass locations along East Street.

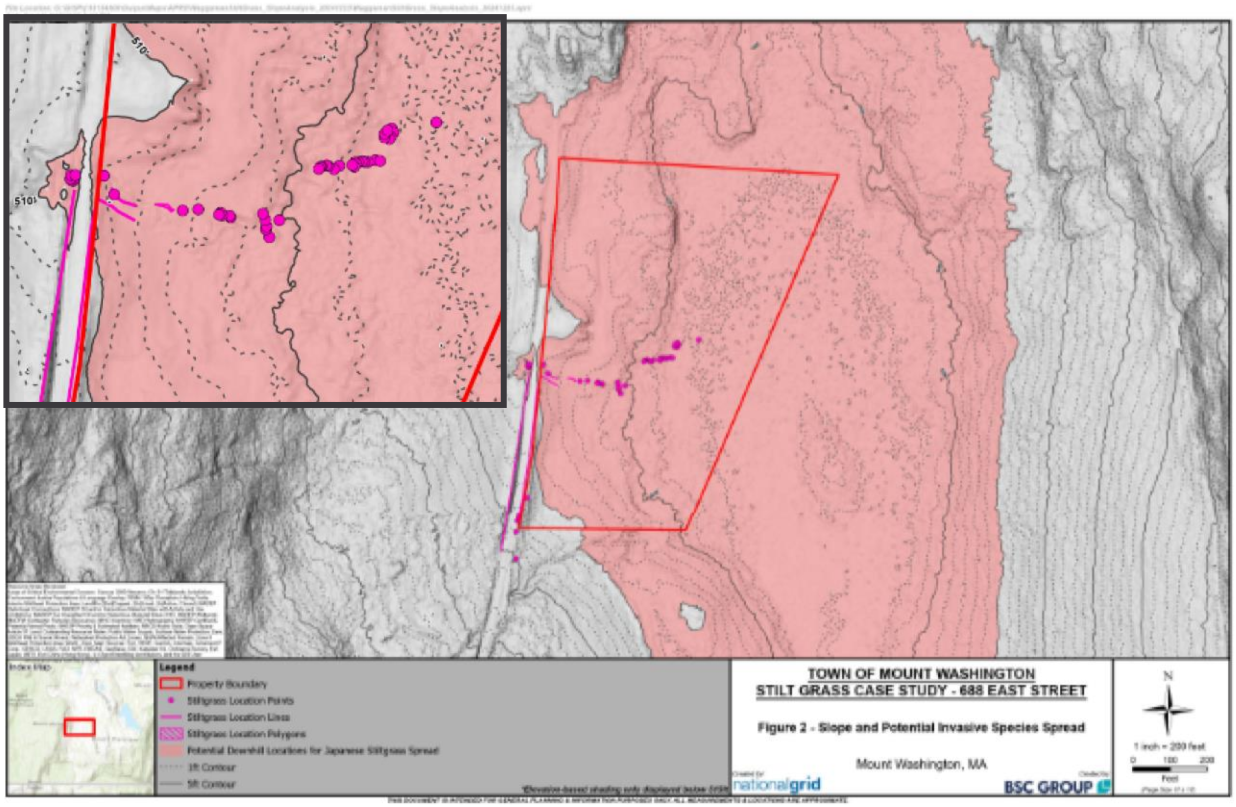
Photo 7: The roadside drainage upslope south of 688 East Street. These locations of high-density Japanese stilt grass are contributing to this species spread from the upslope drainage to the downslope intermittent streams and associated wetlands.

The extent of the Japanese stilt grass population at 688 East Street was observed downstream of the road culvert and in the meadow downgrade of the road shoulder. Individual stilt grass occurrences were recorded (Map 6) from the culvert intake area all the way downstream into the wetland in the stream bed and along the stream bank. Stilt grass populations on this property were at the highest density along the roadside drainage areas and reduced in density and frequency the further the populations were from the road. From the edge of the road to the furthest extent the stilt grass population traveled 550 feet to within 130 of the western edge of the upper reaches of the Schenob Brook Drainage Basin ACEC (Photo 8).

Photo 8: Japanese stilt grass occurrence 550 feet west of the East Street source population and within PH-970 and Schenob Brook Drainage Basis ACEC. Pink circles indicate individual pin flags for single plants.

Based on the field assessment and mapping for this property Japanese stilt grass is at considerable risk of further spread through the roadside swales, culverts and wetlands on this property. Like 648 East Street, treatment on this property could be conducted but success will be inhibited by the continued threat from upslope infestations of the species and the hydrological connections that exist between the roadside swales, the property and the downstream ACEC wetlands.

Map 6 below depicts 688 East Streets property boundary and the existing extent of the Japanese stilt grass population as of October 2024. A slope analysis was conducted on the Japanese stilt grass populations and landscape areas below the invasive elevation are represented in pink. These are the at-risk areas for potential spread and colonization by Japanese stilt grass. Through field visits, engineering reviews of culverts, GIS analysis of slope and the likelihood of an increase in intensity and quantity of climate change influenced precipitation events, the evidence supports that without management of and for this invasive species along roadside swales and for the current extent of the population, down slope wetlands and ACECs are at high risk of infestation.



Map 6: 688 East Street 2024 Japanese stilt grass population extent (magenta dots) and zones of future colonization risk of this species (colored solid pink).

7.5.1 Treatment Proposal Overview

The proposed treatment is based on the invasive plant field survey and GIS landscape assessment occurrences in the bordering roadside swales attached to this property as well as the infestation that continues south on East Street on both the east and west sides of the roadway. These roadsides are directly connected to the drainage and intermittent stream that feeds into the Schenob Brook Drainage Basin ACEC. Treatment success within the 688 East Street property is possible but without treatment of the source populations of this species, the study property as well as the adjacent forests, wetlands, state owned property, and critical habitat in the surrounding ACEC will constantly be at risk of reinfestation.

Below are specific recommendations based on the specifics of this property and its location in the landscape.

Effective control of Japanese stilt grass at 688 East Street will require:

1. A combination of engineered sedimentation separation solutions to limit continued introduction of stilt grass seeds, improve water quality and reduce erosion
2. Proper timing of mechanical, hand-pulling or herbicide techniques and vigilant vegetation monitoring
3. Permitting will be required for work in a wetland buffer zone, the Priority Habitat and ACEC as addressed in the Permitting section below.

Environmental Permitting Compliance

For installation of stormwater control measures within Buffer Zone or other areas jurisdictional to the WPA, a Notice of Intent application should be prepared and filed with the Conservation Commission and copied to the MassDEP Western Regional Office. The application would also include proposed work to install scour protection/stone within the stream and will also have to include a quantification of the area to be managed for Japanese stilt grass located in wetlands and streams. The stormwater management work can reference limited project provisions. With the location of the parcel within the ACEC, the invasive species management work will otherwise have to file as an Ecological Restoration Limited Project NOI to permit alteration within BVW.

Coordination with NHESP under MESA will be required for the proposed work in Priority and Estimated Habitat. The stormwater management plans will be submitted to determine if they meet the requirements for the exemption at 321 CMR 10.14 (8). A Habitat Management Plan will also have to be submitted for NHESP approval under 321 CMR 10.14 (15). If either exemption is denied, the project would require MESA review to determine if the project will cause a take to state-listed species.

Direct work in the stream for scour protection (well under 5,000 sf) would also require filing a Self-Verification Notification Form under the Massachusetts General Permit with the US Army Corps of Engineers under Section 404 of the Clean Water Act. Since plant management efforts would not excavate or fill the wetlands, those activities would not require reporting or approval.

7.5.2 Treatment Proposal Methods

Engineered Solutions

Engineered solutions can be used to alter storm water and sediment flows, thereby reducing the potential for stilt grass seeds to be carried beyond existing infested areas. Stormwater control measures have been evaluated to improve the overall water quality of the intermittent streams and wetlands and to reduce the transportation of stilt grass. In the locations of the existing drainage ditches, stone check dams have been proposed to slow down the velocity of stormwater runoff which will aid in reducing scour and erosion of the drainage ditch, as well as to allow for the gravity separation of suspended solids, limiting the transportation of stilt grass. Refer to the specific documents regarding engineering solutions to this situation BMPs, cost, and plans (Appendix F).

The suggested engineered solutions are based on the existing drainage to and from the 688 property which are described in detail below.

Like the conditions of 648 East Street, to the west of 688 East Street the intermittent stream flows to the east, crossing underneath East Street via an existing 24” HDPE culvert, before daylighting on the eastern side of the roadway. This stream discharges into wetland resource areas abutting the property. Approximately 150-feet north of the culvert, there is a high point on East Street. This portion of East Street is slightly crowned, sending stormwater runoff to the east and west. There are no existing drainage ditches on either side of the road in this location. Runoff sent west of the roadway will be captured at a low point by the existing 24” HDPE culvert where it will discharge into an intermittent stream. The next high point on East Street occurs approximately 1,550-feet south of the culvert. Although the surface conditions vary, much of this portion of the roadway is insloped, carrying runoff down the roadway. There are no existing drainage ditches on either side of the road in this location as well.

In the portion of the roadway in front of 688 East Street where there are no existing drainage ditches, re-grading is proposed from the high point in the roadway to the inlet/outlet of the culvert. For both the existing and proposed drainage ditches, 4” of loaming and native seeding is proposed along the bottom width which will reduce ponding within the ditches. Stone outlet protection is proposed at the outlets of both culverts to prevent scouring and erosion, as well as to limit the amount of sediment uptake into the intermittent stream. The stone used for both the check dams and outlet protection is modified rockfill and shall be in compliance with section M2.02.4 of the Commonwealth of Massachusetts Department of Transportation Standard Specifications.

Engineering Solutions Cost Tables

688 East Street:

Proposed Drainage Ditches			
	Length	Price/LF	Total Cost
2	160	$250	$40,000
3	200	$250	$50,000
4	40	$250	$10,000
Total Cost Per New Ditch			**$100,000**

Stone Outlet Protection		
# of Outlets	Price/Outlet	Total Cost
1	$1,200	**$1,200**

Mechanical Control

Mechanical control of Japanese stilt grass either by hand pulling or with the use of a weed whacker should be completed before the plant seeds reach maturity. Based on previous observations and ecoregion-based research for this species, mechanical restoration activities should be conducted during the months of late August into mid-September. Weed whacking of this species prior to the proper time period for treatment should not be considered and if hand-pulling is necessary after seeds have reached maturity, all plants should be placed into plastic bags and either disposed of or allowed to desiccate via solarization of the plastic bag and then disposed of.

Mechanical control for this particular property is estimated to take a day or less depending on the exact treatment method and could cost between $75 - $150 per hour/per person for a total treatment cost of $600 - $1,200/acre.

Chemical Control

Chemical control of Japanese stilt grass with a foliar treatment should be conducted during the same time period as a mechanical control treatment. Interruption of the reproductive cycle of this species will ensure the inability for plants to reach maturity and additionally will kill the plants in place reducing disturbance and the likelihood for seed germination the following spring. A wetland approved Glyphosate product, for example Round Up Custom. A wetland approved herbicide should always be used when near wetlands and especially for this species with its proclivity to occupy wetter environmental conditions such as drainage swales. Herbicide solutions of a Glyphosate product should mixed at a rate of 1% - 1.5% solution (53.8% Active Ingredient AI) and 0.25% non-ionic surfactant with at least a 70% AI to 90% AI product like Aquachem 90 or Chemsurf 90. Solutions are proposed per gallon of water.

Chemical control of this species requires application by a Massachusetts licensed pesticide applicator with a Category 2 (Forest Pest) license. Due to the location of the treatment area to critical environmental areas it will be necessary for the contractor to obtain a permit for treatment within these areas. The cost for this type of treatment will take less time than the mechanical control option but with the addition of the need for a permit, required herbicide application reporting and cost of chemical, a comparable price range of $600 - $1,200/acre should be expected.

Monitoring

Regardless of treatment method, follow up monitoring for Japanese stilt grass will be necessary for years 2 – 10. It is likely that reintroduction of this species via seeds will continue without upslope vegetation management in roadside swales. It may be necessary to alter or expand the scope of the treatment area based on any years monitoring results.

Chemical and Mechanical Cost and Timeline Tables

Mechanical

Management Year	Management Treatment Type	Management Sub Type	Treatment Timing	Estimated Cost per Acre
1	Mechanical	Weed whacking	late August/early September	$600 - $1,200
1	Mechanical	Mowing	late August/early September	$600 - $1,200
2	Monitoring	N/A	June/July	$200 - $400
2 – 10	Mechanical	Weed Whacking/Mowing	Late August/Early September	$600 - $1,200
3 – 10	Monitoring	N/A	June/July	$200 - $400
			10 Year Estimated Cost per Acre	$7,800 - $15,600

Chemical

Management Year	Management Treatment Type	Management Sub Type	Treatment Timing	Estimated Cost per Acre
1	Chemical	Foliar	late August/early September	$600 - $1,200
1	Mechanical	Mowing	October	$600 - $1,200
2	Monitoring	N/A	June/July	$200 - $400
2 – 10	Chemical or Mechanical	Foliar/Hand Pulling	Late August/Early September	$600 - $1,200
3 – 10	Monitoring	N/A	June/July	$200 - $400
			10 Year Estimated Cost per Acre	$7,800 - $15,600

8. Conclusions

8.1 Conclusions Based on Site Visits and Review

A professional based opinion for stilt grasses presence and continued spread on the Study Sites based on topography, regional increases in frequency and intensity of precipitation events, and the specific plant's biology and seed dispersal method is that this species spread is being exacerbated by improper vegetative roadside maintenance activities, and drainage ditch engineering located along the road frontage of both 648 and 688 East Street. The data recorded in 2024 indicates that it is likely that Japanese stilt grass will eventually occupy portions of Lee Pond Brook wetland complex and the Schenob Brook Drainage Basin ACEC to the east. On a town wide scale, practicing roadside vegetation BMPs, reducing erosion and managing vegetation with the consideration of invasive plant species (Appendix D) could reduce the risk of increased infestation of this invasive plant species into critical habitat areas which will ultimately reduce climate resiliency, biodiversity, and water quality.

The study sites of 648 and 688 East Street in the town of Mount Washington represent only a small sample of the total infestation of Japanese stilt grass on a town wide scale. Short-term success at these two sites can be achieved with the management strategies outlined above but these successes on the Study Sites, without first addressing roadside invasive management strategies, will coincide with below average precipitation years and minimal to no flooding and disturbance events.

The two Study Sites represent an opportunity for scientific honing of management skills for this species in a high-quality ecoregion and sensitive habitats. Protocols, permits and management results will create a plan to be shared, learned from and followed on a state-wide and regional scale to address this invasive species rapidly expanding its range into New England. The second opportunity is for the management and protection of critical natural resources on a town wide scale with a roadside management plan and the adherence to vegetation management BMPs and a focus on invasive plant species.

To effectively manage this species on the two study sites, it is imperative that source pollution locations for this species be managed either before or in conjunction with treatment on the study sites. Without proper management of the source of the infestation, management of areas down slope and downstream will always be at risk of infestation. Management of this species in this way will require the implementation of roadside vegetation BMPs by the town, a roadside vegetation management plan specifically for Japanese stilt grass and implementation of this plan for at least 10 years.

8.2 Landscape Scale Stilt Grass Control

Implementation of existing roadside management BMP's will provide the foundation for other invasive plant management treatment types presented in Appendix D and will increase the likelihood of management success. Important to any strategy for the management of Japanese stilt grass is to reduce the anthropogenic spread of the species on the landscape. For example, this type of spread might be reduced with roadside signs calling driver's attention to the spread of this species from state to state, similar to the *Don't Move Firewood* outreach program managed by The Nature Conservancy, which is an effort to reduce the spread of Emerald Ash Borer (EAB) throughout New England and North America.

Additionally, to ensure all stilt grass areas are known prior to the beginning of management activities, the extent of existing populations in Mount Washington should be surveyed and mapped. This survey should include a town wide roadside assessment of stilt grass and an assessment of these populations as they extend onto private property adjacent to the roadside. Landowner permission will be necessary to both survey for this species off public roads and to manage/monitor species in the long-term.

A similar approach of cultural control followed by mechanical or chemical control methods should be initiated and alternated with a series of monitoring and control seasons to effectively manage Japanese stilt grass populations on a larger scale.

9. References

Barden, L.S. 1987. Invasion of *Microstegium vimineum* (*Poaceae*), an exotic, annual, shade-tolerant, C4 grass, into a North Carolina floodplain. American Midland Naturalist 118: 40-45.

Cheplick GP. 2010. Limits to local spatial spread in a highly invasive annual grass (*Microstegium vimineum*). Biological Invasions 12:1759–1771.

Gibson DJ, Spyreas G, Benedict J. 2002. Life history of *Microstegium vimineum* (*Poaceae*), an invasive grass in southern Illinois. Journal of the Torrey Botanical Society 129:207–219.

Judge CA, Neal JC, Shear TH. 2008. Japanese stilt grass (*Microstegium vimineum*) management for restoration of native plant communities. Invasive Plant Science and Management 1:111–119.

Mehrhoff L. 2004. Distribution of Japanese stilt grass, concerns, and potential impacts in New England. Northeastern Weed Science Society Symposium. Japanese Stilt grass (*Microstegium vimineum*) Ecology and Management Workshop.

Redman, D.E. 1995. Distribution and habitat types for Nepal *Microstegium* [*Microstegium vimineum* (Trin.) Camus] in Maryland and the District of Columbia. Castanea 60(3): 270-275.

Vidra RL, Shear TH, Stucky JM. 2007. Effects of vegetation removal on native understory recovery in an exotic-rich urban forest. Journal of the Torrey Botanical Society 134:410–419.

Warren RJ, Wright JP, Bradford MA. 2010. The putative niche requirements and landscape dynamics of *Microstegium vimineum*: an invasive Asian grass. Biological Invasions 13:471–483.

Walsh, J., Wuebbles D, Hayhoe K, Kossin J, Kunkel K, Stephens G, et al. 2014. Chapter 2: Our Changing Climate. Climate Change Impacts in the United States: The Third National Climate Assessment. J. M. Melillo, T. (.C.). Richmond, and G. W. Yohe (eds.). U.S. Global Change Research Program:19-67.

Woods, F.W. 1989. Control of Paulownia tomentosa and *Microstegium vimineum* in national parks. A report to The Great Smoky Mountains National Park.

10. Appendices

Appendix A: Site Photographs

Photo 7: The roadside and culvert at 648 East Street showing overflow from road material into the swale and the collapsing structure around the renovated culvert.

Photo 8: The immediate roadside area on East Street depicting a rather large infestation of mature Japanese stilt grass and sloped so that continued run-off will continue to spread seed into the adjacent forested areas.

Photo 9: Japanese stilt grass deposition by previous stormwater overflow downslope from a drainage. Stilt grass populations were observed to be inhabiting areas where higher than normal stormwater overflow is distributing seeds downslope.

Photo 10: Another example of a country drainage along East Street where sedimentation as well as a seed source for Japanese stilt grass is resulting in expanding infestations of this species into woodlands and wetlands.

Appendix B: Summary of Qualifications

BSC Group, LLC is a multidisciplinary consulting firm providing interdisciplinary design, planning, permitting, and construction phase services for municipal, state, energy, transportation and private sector clients throughout New England for more than 50 years. We have regulatory, wildlife, rare species, habitat specialists, offering a strong team of qualified personnel for projects throughout New England. Our ecological scientists provide siting and permitting; environmental and ecological evaluations including wetland, natural resource, and environmental analyses; vegetation and wildlife surveys and investigations; wetland delineations, restoration, and monitoring; and mitigation design. Specializing in science-based approaches, BSC uses internal experts to establish a high level of credibility with local, state, and federal regulators.

Tom Groves

Senior Botanist

YEARS OF EXPERIENCE

11

EDUCATION

Framingham University
B.S. Wildlife Biology (2014)

University of Massachusetts, Lowell
B.A. English Writing (2006)

REGISTRATIONS

Supervisory Pesticide Applicators License

- NH S-2229958

Pesticide Applicators License

- MA #AL-0052105
- VT #1208-4955

CERTIFICATIONS

OSHA 10-Hour Construction Safety and Health

AFFILIATIONS

- New England Botanical Society Field Trip Program Coordinator, 2024 - Present
- New England Botanical Society Member, 2020 – Present
- Native Plant Trust Plant Conservation Volunteer, 2014 – Present

MEET TOM

Tom is an observant botanist dedicated to learning as much as he can about New England's natural habitats, ecosystems, and most importantly, plants. Over the past 10 years, Tom has been privileged enough to spend most of his time in the varied habitats of New England observing the habitats and flora. This natural habitat immersion and dedicated observation time have helped hone his ability to find rare plants and see the small differences in cryptic and often overlooked species. Tom has been providing ecological restoration advice to national wildlife refuges, state biologists, NRCS, and private landowners in Massachusetts, New Hampshire, and Vermont for the past decade.

Prior to BSC, Tom was responsible for planning, managing, and executing 1,400 acres of habitat restoration work annually on behalf of a Vermont-based forestry company. As a Senior Botanist with BSC Group, Tom has been leading rare plant surveys, ecological restoration mitigation strategies, and permitting of ecological projects with clients like National Grid, Eversource, and Bradley International Airport. Additionally, Tom was a BSC team member working with the City of Stamford, CT to map and prepare invasive management strategies to assist the city in meeting ecological restoration goals.

TOM IS A BOTANIST WHO IS FOREVER INTRIGUED BY THE WORLD AROUND HIM, EXCITED BY NATURAL HABITATS, AND OBSERVANT OF ALL THE SPECIAL COMPONENTS OF THE BIODIVERSITY IN NEW ENGLAND.

PROJECT EXPERIENCE HIGHLIGHTS

Eversource, 400/500 Lines Rebuild Project (Zone 5 of the ECT Program), Ledyard and Preston, CT
Senior Botanist
Oversaw the Atlantic White Cedar mitigation portion of this project including fencing, planting, long-term monitoring, reporting, and vegetation management to ensure compliance with Water Quality Certification (WQC) guidelines.

National Grid, Eversource, and Rhode Island Energy Rare Plant Surveys and Mitigation Guidance for Various Utility Projects
Senior Botanist
Perform rare plant surveys for transmission line companies in Vermont, New Hampshire, Massachusetts, Connecticut, and Rhode Island. Plan, identify, map, and report on rare plants as well as invasive populations in priority habitats in these New England states for reporting to Natural Heritage Programs to support utility line projects.

Bradley International Airport (BDL) Taxi Way Expansion Project, Windsor, CT
Senior Botanist
Surveyed, assessed, and reported on the quality of sand barren habitat in project expansion areas. Data was collected, mapped and a habitat restoration plan was prepared to provide the best ecological restoration options for rare species including lepidopterans, plants, and provide ecological recommendations to BDL and Natural Diversity Data Base (NDDB).

New England Power Company A1/B2 ACR Project Vernon, VT
Senior Botanist
Surveyed, collected seed, and provided recommendations to Vermont Agency of Natural Resources on transplanting of impacted rare plant species within the ROW.

Green Mountain National Forest, Mary Beth Deller, Vermont
Invasive Plant Specialist/Botanist
Provide expert recommendations on prioritization of invasive species treatment areas as well as provide appropriately timed treatments and reports.

Parker River & Great Bay National Wildlife Refuge, Nancy Pau, Portsmouth, NH & Newburyport, MA
Invasive Plant Specialist/Botanist
Work with MA Fish and Wildlife to advise, prepare, and execute invasive plant management practices in the NWRs.

E5/F6 Transmission Line Rare Plant Surveys, National Gride, Various Locations in MA
Lead Botanist
Conducted surveys of rare plants within priority habitat on National Grid ROW.

New England Power Company 3315 PIT/Footer Repair Project Monroe/Littleton, NH
Senior Botanist
Provided rare plant survey work for transmission line projects. Observed and reported a new station for *Carex castanea* (S1).

Eversource 1773 PINCO Rare Plant Survey Wethersfield, CT
Senior Botanist
Provided rare plant survey expertise and mitigation strategies for Eversource. Observed and reported new populations of *Carex typhina* within floodplain habitat.

National Grid, Y151 Transmission Line Rare Plants Surveys, Pelham, NH
Senior Botanist
Botanist for survey of rare plants with Marleigh Sullivan within priority habitat along multiple sections of Y151 ROW in Pelham, NH.

EDUCATOR EXPERIENCE

University of New Hampshire Cooperative Extension
Senior Botanist/Educator
Continuing education instructor for extension office on timber stand improvement and integrated pest management strategies.

Antioch University
Senior Botanist/Educator
Instructor for master's degree program on invasive plants and management strategies.

Rhode Island Nursery and Landscape Association
Senior Botanist/Educator
Continuing education instructor for Introduction to Botany and invasive plant management

University of Rhode Island Cooperative Extension
Senior Botanist/Educator
Continuing education instructor for invasive plant identification and invasive plant management.

Reported New Populations of Rare Plants (S1/S2)

- *Triphora trianthophora* – Dummerston, VT 2018
- *Collinsonia canadensis* –Bennington and Rutland Counties 2022
- *Silene ovata* – Asheville, NC 2021
- *Cypripedium parviflorum var. pubescens* – Cornish, NH 2022
- *Lupinus perennis* – Hudson, NH 2023
- *Viola adunca* – Royalston, MA 2023
- *Carex castanea* – Grafton County, NH 2023
- *Pycnanthemum virginianum* – Charlestown, NH 2023
- *Silene stellata* –Stamford, CT 2023

- *Carex typhina* –Wethersfield, CT 2023
- *Gentianopsis crinita* –Lebanon, NH 2023
- *Hackelia virginiana* –Lebanon, NH 2023
- *Viola lanceolata* –Vernon, VT 2023
- *Polygala polygama* –Vernon, VT 2023
- *Pycnanthemum torrei* – Pelham, NH 2023

New Populations of Uncommon Plants (S3)

- *Celsastrus scandens* – Swanton, VT 2020
- *Spiranthes lucida* – Manchester, VT 2022
- *Dirca palustris* – Arlington, VT 2022
- *Triosteum perfoliatum* – Cullowhee, NC 2022
- *Mimulus alatus* **–** Stamford, CT 2023

AWARDS

- Native Plant Trust - 2014 Marylee Everett Conservation Fellowship
- The Wildlife Society - 2013 Scholarship Awardee for 2-week long Wildlife Techniques course with Castleton State College and VT Fish & Wildlife
- New England Botanical Society - 2022 Les Mehrhoff Botanical Research Award

TABLE 1. RARE PLANTS

Task/Location	Date(s)	Clients	Description	Target Species (bolded species = those observed during survey)
W149 Transmission Line Rare Plant Surveys Walpole, Charlestown, Claremont, Lebanon, Cornish, Hanover, NH	June – September 2023	National Grid	Botanist for survey of rare plants with Marleigh Sullivan within priority habitat along length of W149 ROW in various New Hampshire towns.	▪ **Licorice goldenrod (*Solidago odora*)** ▪ **Climbing fumitory (*Adlumia fungosa*)** ▪ **Virginia mountain mint (*Pycnanthemum virginianum*)** ▪ **Virginia stickseed (*Hackelia* virginiana)** ▪ **Virginia waterleaf (*Hydrophyllum* virginianum)** ▪ **Fringed gentian *(Gentianopsis crinita*)** ▪ **White bear sedge *(Carex albursina*)**
Y151 Transmission Line Rare Plant Surveys Pelham, NH	June – September 2023	National Grid	Botanist for survey of rare plants with Marleigh Sullivan within priority habitat along multiple sections of Y151 ROW in Pelham, NH.	▪ **Bird's foot violet *(Viola pedata)*** ▪ **Licorice goldenrod (*Solidago odora*)** ▪ **Torrey's mountain mint (*Pycnanthemum torrei*)** ▪ **Clasping milkweed (*Asclepias amplexicaulis*)** ▪ **Red three awn (*Aristida longespica* var. geniculata)** ▪ **Common star-grass (*Hypoxis hirsuta*)** ▪ **Late purple American aster (*Symphyotrichum patens*)** ▪ **Anemone meadowrue (*Thalictrum thalictroides*)** ▪ **Wild lupine (*Lupinus perennis*)** ▪ **Eight flowered six weeks grass (*Vulpia octoflora*)**
A1/B2 Rare Plant Survey, Seed Collection and Transplanting Vernon, VT	September 2023	New England Power	Botanist for survey of ROW for known population of *Bartonia virginica* for population assessment, inventory, and seed collection prior to construction phase of transmission line rebuild project. Also found additional S1/S2 species previously unknown to this location. Transplanting of S1 *Viola lanceolata* has been permitted to take place Fall 2024.	▪ **Virginia screwstem (*Bartonia virginica*)** ▪ **Lance-leaved violet (*Viola lanceolata*)** ▪ **Racemed milkwort (*Polygala polygama*)**
I135/J136 Transmission Line Ashburnham, MA	May 2023	National Grid	Botanist for survey with Matt Hickler of ROW for rare plants in priority habitat along sections of ROW.	▪ **American twinflower (*Linnaea borealis*)** ▪ **Sand violet (*Viola adunca*)** ▪ Bartram's Shadbush (*Amelanchier bartramiana*) ▪ Pod-grass (*Scheuchzeria palustris*)
D21 Transmission Line Fall River, MA	August 2023	National Grid	Botanist for survey with Matt Charpentier (Oxbow Associates) of ROW for rare plants in priority habitat along sections of ROW.	▪ **Stiff yellow flax (*Linum medium* var. *texanum*)** ▪ **Philadelphia panic grass *(Panicum philadelphicum* var. *philadelphicum*)** ▪ **Long-leaved redtop-panic grass (*Coleataenia longifolia*)** ▪ Weak rush (*Juncus debilis*)

E5/F6 Transmission Line Rare Plant Surveys Shelburne, Conway, Deerfield, Sunderland, Shutesbury, Ware, West Brookfield, and Buckland, MA	July 2023	National Grid	Lead Botanist for surveys of rare plants withing priority habitat on National Grid ROW.	▪ **American bittersweet (*Celastrus scandens*)** ▪ **American ginseng (*Panax quinquefolius*)** ▪ **Musk monkeyflower (*Erythranthe moschata*)** ▪ Nodding chickweed (*Cerastium nutans*) ▪ Fragile rock-brake (*Cryptogramma stelleri*) ▪ Giant St. John's wort (*Hypericum ascyron*) ▪ Mountain alder (*Alnus viridis*) ▪ Pale green orchid (*Platanthera flava* var. *herbiola*) ▪ Appalachian bristle-fern (*Crepidomanes intricatum*) ▪ Climbing fumitory (*Adlumia fungosa*)
3315 Transmission Line Rare Plant Survey Monroe/Littleton, NH	June – September 2023	National Grid	Lead Botanist for surveys of rare plants withing priority habitat on National Grid ROW.	▪ **Chestnut sedge (*Carex castanea*)** ▪ **Brook lobelia (*Lobelia kalmii*)** ▪ American spurred gentian (*Halenia deflexa*) ▪ Fen grass-of-parnassus (*Parnassia glauca*) ▪ Loesel's wide-lipped orchid (*Liparis loeselii*) ▪ Small dropseed (*Sporobolus neglectus*)
Rare Plant & Habitat Surveys Bradley International Airport Windsor Locks, CT	August 2023	Hoyle & Tanner	Lead Botanist for surveys of rare plants and characterization and assessment of sand barren habitat for rare insect species for runway and taxi way expansion areas.	▪ Low frostweed (*Crocanthemum propinquum*) ▪ Davis' sedge (*Carex davisii*) ▪ Sickle-leaved golden-aster (*Pityopsis falcata*) ▪ Host Plant Surveys ▪ **Blueberries (*Vaccinium spp.*)** ▪ **Cherries (*Prunus spp.*)** ▪ **Rose (*Rosaceae spp.*)**
1773 Line ACR/OPGW Rare Plant Survey Wethersfield, CT	August 2023	Eversource	Lead Botanist for surveys of rare plants within priority habitat on Eversource ROW.	▪ **Cattail sedge (*Carex typhina*)**

TABLE 2. OTHER PLANT VEGETATION SURVEYS/MONITORING

Project/ Location	Dates/Frequency	Client	Task	Description
400/500 Transmission Line Atlantic White Cedar Restoration Project Ledyard, CT	April – October 2023	Eversource	Planting, Fencing Installation and Monitoring	Oversaw selections, planting, fencing, competing vegetation management and monitoring of 1 acre of restoration planting of Atlantic White Cedars for mitigation.
Invasive Plant Mapping and Management Plan Stamford, CT	July 2023	City of Stamford, CT	Invasive species mapping and management plan recommendations	Worked with a team of individuals from BSC to strategize, organize and execute invasive species mapping for all CT listed species in 30+ parks city wide.

BSC GROUP

Kathryn Eagan, PE

Transportation Engineer
Senior Associate

YEARS OF EXPERIENCE

11

EDUCATION

MS, Environmental Engineering
Northeastern University

BS, Civil Engineering
Merrimack College

REGISTRATIONS

Professional Engineer

- MA #54123 (2018)

CERTIFICATIONS

- MA Certified Soil Evaluator
- NHDOT LPA Training
- 10-hour OSHA Construction Safety and Health

AFFILIATIONS

- WTS Boston
- Boston Society of Civil Engineers Section/ASCE
- American Council of Engineering Companies (ACEC)

MEET KATHRYN

Kathryn is a member of BSC's transportation engineering group with experience in a variety of projects for municipalities and state agencies, including MassDOT, MBTA, Massport, and DCR. She possesses strong project management skills, with experience on all sizes of projects, including managing several $1+ million contracts.

Kathryn's portfolio of transportation projects includes roadway, pedestrian, parking lot and shared-use path facilities. These projects have involved civil/site design, grading and utilities design, stormwater and drainage system design, hydraulic modeling and design, and ADA accessibility design. Additionally, Kathryn has assisted with the preparation of Design Justification Workbooks, Functional Design Reports, Hydraulic Reports, Stormwater Management Reports, SWPPPs, EPA Notices of Intent (NOI), and Early Environmental Coordination for Design.

PROJECT EXPERIENCE HIGHLIGHTS

MassDOT/City of Peabody Independence Greenway, Peabody, MA

Project Manager

Responsible for the design of a 1.25-mile-long segment of the Independence Greenway from Lt. Ross Park to Peabody Road. The project includes the design of two pedestrian bridges, one over Route 1 and the other over Proctor Brook. This segment of the trail is within abandoned MBTA ROW, under a 99-year lease with the City, MassDOT ROW, along Route 1, Interstate 95, and Lowell Street, and City of Peabody along Peabody Road. Due to the complexity of the project, close coordination with MassDOT, MBTA, the City of Peabody, and abutters is crucial. BSC is providing survey, shared-use path design, traffic engineering, utilities/stormwater design, hydraulic design, structural design, landscape design, ROW plans, and permitting. Kathryn provides shared-use path design, hydraulic design, stormwater and utility design, and cost estimating to support the project. Additionally, Kathryn is responsible for preparing the MassDOT schedule and coordinating all design submissions.

Design and Permitting Services for the Southern New England Trunkline Trail, Franklin, MA

Transportation Designer

Responsible for permitting and design services to construct a concrete culvert to serve as a tunnel to provide a connection under Prospect Street in Franklin for the DCR's Southern New England Trunkline Trail. Helped prepare conceptual design scenarios, obtained borings and investigated historic resources, and circuited with utility companies to reach consensus on a final design.

DCR Neponset Greenway Tenean Beach to Victory Road, Boston, MA

Project Engineer

Responsible for the design of a segment of the Neponset River Greenway from Tenean Beach to Victory Road. The project requires close coordination with the DCR, the City of Boston, and MassDOT. BSC is providing survey, trail alignment design, traffic engineering, utilities/stormwater design, and permitting. Kathryn is providing stormwater and BMP design to support the project.

Wheelchair Curb Ramp Inventory for MassDOT, Statewide, MA

Field Data Engineer

Responsible for the collection of curb ramp data throughout MassDOT's District 5 region in southeastern Massachusetts. Kathryn collected data in accordance with project specifications utilizing the application developed for the project to seamlessly upload and download survey data while also interacting with the firm's IT staff to provide quality control for the project.

MBTA Parking Lot Improvements, Various Locations, MA

Transportation Engineer

Responsible for the design and construction of parking lot improvements at three MBTA stations including: Campello Commuter Rail Station in Brockton, Montserrat Commuter Rail Station in Beverly, and North Quincy Red Line Station in Quincy. Design services included schematic, permit, and construction drawing submittals, site layout with grading, design of drainage improvements, ADA compliant wheelchair ramps and accessible spaces, revised parking layout to maximize the total number of spaces in the lot, and preparation of drainage report, cost estimate, and specifications. Construction services include site visits, shop drawing review, and support for necessary field changes.

Plan for Accessible Transit Infrastructure (PATI) Phase II and III, MBTA, Statewide, MA

Transportation Engineer

Responsible for collecting field data for MBTA's bus stops as well as subway and commuter rail stations to determine the accessibility and safety at each bus stop or station to inform a comprehensive plan for evaluating the barriers to access within the MBTA's public infrastructure assets. In addition to conducting a high-level survey of the accessibility status of all bus stops and stations, Kathryn trained and provided field supervision of BSC college-level civil engineering interns.

MBTA's Design Guide for Access, Greater Boston, MA

Project Engineer

Responsible for the development of the Accessibility Design Guide, a master document for the MBTA's policies and guidelines to contractors, stakeholders, and the public on the standards for all stations, right of way, and signage. Kathryn developed the project's schedule and contributed to the engineering review element of the design guide.

Patton Road Proposed Sidewalk, Devens, MA

Transportation Engineer

Provided engineering services for the design of a sidewalk to connect pedestrians to Mirror Lake recreational area. The design included sidewalk layout, retaining wall design, guardrail layout, and ADA compliant wheelchair ramps.

Hydraulic Study, Tisdell Brook, Colrain, MA

Transportation Engineer

Provided engineering services for the hydraulic modeling of portions of Tisdell Brook and West Branch of North River using HEC-RAS, including creating existing and proposed condition models for various potential bridge replacement options for Adamsville Road over Tisdell Brook and writing a hydraulic report.

MassDOT, Stormwater Improvements, Various Locations, MA

Transportation Engineer/Project Manager

As part of the Statewide Stormwater Improvements contract, BSC completed 36 assignments for MassDOT. Kathryn worked on all 36 assignments, which included preparing 29 assessment reports for impaired waterbodies, engineering design of stormwater improvements for 22 locations, BMP inspections, culvert inspections, IDDE inspections, GIS mapping of MassDOT stormwater infrastructure in Waltham and Lexington, and peer reviews of the stormwater design for MassDOT TIP projects. Stormwater Improvements were designed and constructed on Interstate 84, Interstate 90, Interstate 93, Interstate 95, Route 3, Route 3A, Route 6, Route 12, Route 18, Route 20, Route 68, Route 70, Route 122, and Route 146. Design services included schematic, permit, and construction drawing submittals; site layout with grading, design of drainage improvements using HydroCAD and SWMM; and preparation of drainage report, cost estimate, and specifications. Construction services include site visits, shop drawing review, and support for necessary field changes.

Hydraulic Study, Fox Brook, Colrain, MA
Transportation Engineer
Provided engineering services for the hydraulic modeling of portions of Fox Brook and North River using HEC-RAS, including creating existing and proposed condition models for various potential bridge replacement options for Call Road over Fox Brook and writing a hydraulic report.

MassDOT, Bridge Replacement, West Brookfield, MA
Transportation Engineer
Responsible for the 100% highway design submission associated with a bridge replacement project. Kathryn contributed to the preparation of construction plans, proposed roadway profile, typical sections, cross sections, and retaining wall design, as well as compiled cost estimates, the functional design report and horizontal alignment reports.

MassDOT, East New Lenox Road over Sackett Brook Bridge Replacement, Pittsfield, MA
Transportation Engineer
Responsible for the 75% highway design submission, including construction plans, proposed roadway profile, typical sections, cross sections, and right of way plans. Kathryn prepared cost estimates, the functional design report, design exception report, and horizontal alignment reports.

MBTA Parking Lot Improvements – Acceleration Program, Various Locations, MA
Project Engineer
Responsible for the design and construction of parking lot improvements at six MBTA stations including: Andover Commuter Rail Station in Andover, Beachmont Blue Line Station in Revere, Islington Commuter Rail Station in Norwood, Orient Heights Blue Line Station in East Boston, Wellington Orange Line Station, and West Natick Commuter Rail Station in Natick. To expedite the design-build process, BSC was retained by the MBTA's On-Call contractor to provide design services. Design services include schematic, permit, and construction drawing submittals; site layout with grading, design of drainage improvements, ADA compliant wheelchair ramps and accessible spaces, revised parking layout to maximize the total number of spaces in the lot; and preparation of drainage report, cost estimate, and specifications. Construction services include site visits, shop drawing review, and support for necessary field changes.

MassDOT, District 5 Best Management Practices Inspection Program, Various Locations, MA
Project Engineer
Responsible for the coordination and inspection of yearly Best Management Practices (BMPs) located throughout MassDOT's District 5, including gathering record plans, setting up necessary traffic control, field inspecting BMPs during wet and dry conditions, and compiling a final report summarizing findings and recommendations.

MassDOT, Culvert Inspection Program, Various Locations, MA
Project Engineer
Responsible for the coordination and yearly inspection of culverts located throughout MassDOT's Districts 3, 4, and 5, including gathering record plans, setting up necessary traffic control, field inspecting culverts, and compiling a final report summarizing findings and recommendations.

CTDOT, Route 31 Reconstruction, Coventry, CT
Transportation Engineer
Responsible for the final design submission and construction services. Kathryn contributed to the design process, including sidewalk, drainage, and landscape design, and the design of a precast concrete box culvert alternative to an existing culvert along Route 31. Kathryn also compiled cost estimates, special provisions, and electronically submitted the project.

MassDOT, Crosby Corner Wetland Mitigation, Concord, MA
Transportation Engineer
Responsible for the final design submission, including the construction plan, grading plan, and construction access plan. Kathryn prepared the design schedule, design checklists, cost estimate, and special provisions.

DCR, Clippership Trail, Medford, MA
Transportation Engineer/Project Manager
During the design phase, prepared a stormwater report, drainage plans, cost estimate, and special provisions, as a drainage subconsultant to CSS, for the final design submission, including the design of an infiltration trench to reduce runoff rates from the proposed trail. During the bid process and construction, BSC became the Prime and Kathryn is the Project Manager. Responsibilities include managing the six subconsultants, obtaining MassDOT easements and Access Permit, preparing bid documents, responding to bidder questions. Future responsibilities include reviewing submittals,

responding to RFIs, attending weekly construction meetings, and preparing construction reports.

MassDOT, County Road over Ironwork Brook Bridge Replacement, Highway Design and Hydraulic Study, Sheffield, MA

Highway/Hydraulics Lead Engineer

Provided engineering services for the highway design and hydraulic modeling of Country Road over Ironwork Brook. Highway design included preparing construction plans, proposed roadway profile, typical sections, cross sections, and right of way plans. Kathryn prepared cost estimates, the functional design report, design justification workbook, and horizontal alignment reports. Hydraulic modeling was performed using HEC-RAS, including creating existing and proposed condition models for various potential bridge replacement options and writing a hydraulic report.

BSC GROUP

Diana
Walden

Senior Environmental Scientist
Senior Associate

YEARS OF EXPERIENCE

24

EDUCATION

MS, Wildlife and Fisheries Conservation
University of Massachusetts Amherst

BS, Environmental Studies and Biology
St. Lawrence University

CERTIFICATIONS

- Electrical Safety Certified
- 10-hour OSHA Construction Site Safety and Health

AFFILIATIONS

- Association of Massachusetts Wetland Scientists (AMWS), Vice President

MEET DIANA

Diana has extensive project experience assisting clients with the wetland, waterways, and protected species permitting and regulatory processes at the state and local levels in Massachusetts, New Hampshire, and Connecticut. Her skills include wetland ecology and delineation, wildlife conservation and habitat evaluations, and assessment of instream habitat and aquatic communities. Her project work and experience has been gained through utility, public, and private sector clients, and she regularly provides services involving environmental compliance inspection of construction, stormwater issues, and sediment and erosion control best management practices. Work at the federal level has included permitting with the US Army Corps of Engineers, US EPA and USFWS, and US Coast Guard. She has demonstrated experience identifying development restrictions on project sites and working with clients on design and mitigation alternatives.

PROJECT EXPERIENCE HIGHLIGHTS

DCR, Hammond Pond Parkway, Newton, MA
Environmental Scientist
Responsible for the preparation of environmental permits for Phase 1 corridor improvements along the DCR Hammond Pond Parkway. Travel lanes will be removed to accommodate a shared trail, a landscaped buffer, and formalized sidewalk. Prepared the Notice of Intent and presented to the Newton Conservation. Prepared the Project Notification Form for MHC review. Supported BSC Civil and Transportation engineers in permit and design needs, including stormwater management.

MassDOT, Environmental Compliance for Construction, Multiple Locations
Environmental Scientist & Project Manager
Responsible for managing and serving as environmental monitors/wetland specialists for active construction, annual monitoring and reporting on inland and coastal wetland mitigation areas, reviewing potential compliance issues and mitigation design amendments, preparing requests for Certificates of Compliance and correspondence with agencies, reviewing reports and designs submitted to the division, wetland plantings and enhancement, invasive species management, and stormwater operation and maintenance inspections. Several projects required evaluation of stream restoration elements and confirming bank and channel profiles were met.

Route 2 Wildlife Tunnel Monitoring, MassDOT, Concord, MA

Environmental Scientist

Provides oversight for the effort to collect wildlife camera data, sand pad tracking surveys, and road mortality surveys for a wildlife tunnel at the Route 2 corridor. The project consists of a multi-year survey and reporting effort with significant amounts of data analysis on an annual basis. The data includes the number and types of species using the tunnel, successful passage, and direction of use. Annual reports are prepared and distributed to regulatory agencies.

MBTA, Station Parking Lot Improvements, Multiple Locations

Environmental Scientist

Responsible for the preparation of environmental permit assessments and applications for improvements at five MBTA station parking lots. Required permits have included Orders of Conditions for work and stormwater improvements in Land Subject to Coastal Storm Flowage and 100-ft Buffer Zones to wetlands, and a Chapter 91 Minor Modification for work in historic filled tidelands.

National Grid, N192 Cable Replacement, Salem & Beverly, MA

Environmental Scientist

Provides oversight and contributes to preparation of environmental permits for the replacement of an existing underground electric transmission cable with a new cable in an alternative location. The project also includes the removal of a submarine cable in Beverly Harbor. Permit contributions include Notices of Intent for both municipalities, and a joint 401 WQC and Chapter 91 dredge permit for the removal of the submarine cable.

CTDOT, Wetland Mitigation Monitoring, Windsor, CT

Wetland Scientist

Responsible for preparation and implementation of a five-year wetland mitigation site monitoring and management plan. Compliance with federal and state success standards requires survey and documentation of woody species, assessing planted and volunteer species, and determining coverage, progression, and control measures of invasive species. Monitoring includes standard USACOE data plots, point transects, review of restored stream stability, extensive data analysis and annual reporting. During the years of monitoring, several state-listed turtle species were observed and recorded in an area without previously mapped habitat.

DCR, Neponset River Greenway, Boston, MA

Environmental Scientist

Responsible for the preparation of permit applications for environmental permits for a section of the DCR Neponset River Greenway. The project will be constructed in collaboration with MassDOT and will include a section of boardwalk crossing intertidal and salt marsh habitat, realignment at several intersections and multi-use trail construction adjacent to the embankment of I-93. Prepared the early environmental coordination checklist and NEPA Categorical Exclusion required for MassDOT projects. Also prepared the Notice of Project Change with MEPA, Notice of Intent with Boston Conservation Commission, 401 WQC, Chapter 91 Waterways License, and a PCN with USACOE. Other project coordination included FHWA Programmatic GARFO/NMFS review for Essential Fish Habitat and federally listed species.

City of Waltham, Trapelo Rd Improvements & Culvert Replacement, Waltham, MA

Environmental Scientist

Responsible for the preparation of environmental permits for the replacement of the culvert carrying Beaver Brook under Trapelo Road in Waltham. Notices of Intent were prepared for Waltham and Belmont, and a Pre-Construction Notification was prepared under the USACOE Massachusetts General Permit. The project also includes the potential for a flood control wall and evaluation of the subsequent hydrologic changes to upstream wetlands. Coordination for construction access permits with DCR was also required.

National Grid, Crushed Culvert Replacement, Barre, MA

Environmental Scientist

Provides oversight for the preparation of environmental permits for the replacement of a crushed culvert in a private driveway also serving as a utility access road. Performed resource area delineation, identifying a ponded area serving as vernal pool breeding habitat. A Notice of Intent was prepared, demonstrating compliance with stream crossing standards to the extent practicable. Measures were included to prevent drainage of the vernal pool while creating improved hydraulic capacity and installing native stream substrate in the new culvert. A 401 WQC application was required due to the project location in an Outstanding Resource Water contributing watershed. A Pre-Construction Notification was also prepared under the USACOE Massachusetts General Permit.

MassDOT, Route 3 Realignment, Duxbury, MA
Environmental Scientist

Responsible for the permitting and part of MassDOT's owner's representative team for the Base Technical Concept (BTC) and selection of the Design Build team for the realignment of Route 3 and replacement of a set of overpass bridges. Responsible for the permit process for the BTC from early environmental coordination checklist, Categorical Exclusion, 401 WQC, and a PCN with USACOE. Wetlands along the route were delineated; categorized by Cowardin community type; described by vegetative species, soils, and hydrologic features; and evaluated for functions and values. Oversaw installation of groundwater monitoring wells and prepared the required wetland replication and restoration design details. Transitioning into an oversight role for the Environmental Monitor team during the construction phase

DCR, SNETT Pedestrian Tunnel, Franklin, MA
Environmental Scientist

Responsible for the preparation of environmental permits for a pedestrian tunnel under an existing public roadway on the DCR Southern New England Trunkline Trail. Resource area delineation, jurisdictional review, Notice of Intent preparation, Self-Verification Form submittal, and USFWS consultation were provided. Supported BSC Civil and Transportation engineers in permit and design needs, including stormwater management and bid documents.

Tennessee Gas Pipeline, Pipeline Class Change, Framingham, MA
Environmental Scientist

Responsible for compliance oversight and wetland science for a ½ mile replacement of existing natural gas pipeline. Multiple inspections were performed each week during construction and followed by post construction and stabilization monitoring. Provided advisement on BMPs, erosion and sediment control, wetland restoration, and stabilization practices. Roost tree surveys and consultation were also provided for compliance with USFWS 4(d) rule for the Northern long-eared bat.

Tennessee Gas Pipeline, AC Mitigation Permitting and Monitoring, Multiple Locations, RI
Environmental Scientist

Responsible for the preparation of a Request for Preliminary Determination with the RIDEM Office of Water Resources for alternating current mitigation installation in wetlands, perimeter wetlands and riverbank wetlands along existing ROW. The project also required state-listed rare species surveys and reporting. BSC also performed required construction compliance monitoring, advising on erosion and sediment controls and restoration measures.

Elementary School Feasibility and Schematic Design Phases, Marblehead, MA
Environmental Scientist

Completed analysis of various sites being considered for a new or expanded elementary school. Evaluation included wetland delineation and habitat assessment for several greenfield and park sites. Data gathered through field visits and desktop review was used to develop environmental resource maps and permitting assessment matrices for each site under consideration. State, local and federal environmental permit programs were considered in the assessment. Presentations were made to the planning committees.

Western Massachusetts Electric Co. for Eversource Energy (formerly Northeast Utilities), Pittsfield Greenfield Area Solution Projects, Multiple Municipalities, Western MA
Scientist & Permitting Specialist

Supports the Project Management Team for multiple maintenance and upgrade projects in Western Massachusetts. Responsibilities include contributing to the development of project execution plans, work scopes, schedules, permitting assessments, preparation of municipal presentations, and initial resource assessments. Contributions were also made to the alternative's analysis for the DPU petition.

Tennessee Gas Pipeline (TGP), Exposed Gas Pipeline Stabilization, Reading and Tolland, MA, and Pembroke, NH
Environmental Scientist

Responsible for the resource delineation, stream assessment, and permitting associated with the remediation of three separate sections of exposed natural gas pipeline within stream channels. In Tolland, BSC prepared a request for authorization of emergency action with MassDEP to restore flow to an original channel and provide cover over the exposed pipe. BSC evaluated the proposed impacts and identified justification for habitat enhancement in the original stream. In Reading, BSC prepared a NOI, responded to multiple Conservation Commission requests for subsequent information, provided coordination, and attended several public meetings. BSC also provided topographic survey, and an engineering calculation and assessment of the extent of backwater ponding. Both projects also required preparation of an SV form to the US Army Corps of Engineers. In Pembroke, BSC obtained a minor impact Standard Dredge and Fill Permit with NHDES and coordinated with NH Natural Heritage Bureau for implementing BMPs that protected state-listed species in the construction area.

Wetland Replication Area for Residential Development, Dover, MA
Wetland Scientist

Performed monitoring and compliance during the construction of a small wetland replication area. Components included evaluating the soil to confirm the base design elevation, discussions with contractors on preserving existing plant material, approving species substitutions, and preparing the baseline monitoring report to MassDEP. BSC completed two years of monitoring and reporting, bringing the property into compliance with the Administrative Consent Order.

Residential Development, DiPlacido Development, Norfolk, MA
Wetland & Wildlife Scientist

Responsible for MESA coordination with NHESP. Developed a construction phase turtle protection plan for an approved development in Eastern box turtle habitat. Obtained a Scientific Collection Permit and provided inspection and contractor training during the installation of exclusion barriers and a moveable access gate. Performed multiple days of visual sweeps to ensure turtles were not trapped within the development footprint after the enclosure was installed.

Douglas Conservation Commission, Douglas, MA
Wetland Scientist

Responsible for reviewing wetland delineation and performing habitat evaluation on behalf of the Conservation Commission on several parcels proposed for development. On one parcel, several vernal pools were certified using obligate and facultative indicators and actual habitat of the spotted turtle (previously state-listed) was identified in an area not previously mapped by the NHESP. Certification and rare species observation forms as well as photodocumentation were supplied to the NHESP. In a second parcel, actual eastern box turtle habitat was identified in an area not previously mapped and rare species observation forms and photodocumentation were supplied to NHESP.

Tennessee Gas Pipeline (TGP), RT&E Species Compliance and Monitoring, Western/Central MA
Environmental Scientist & Wildlife Inspector

Responsible for submitting simple MESA reviews followed by preparation of an annual utility Operation and Maintenance Plan to NHESP for maintenance activities in wood and Eastern box turtle habitat. Applied for a Scientific Collecting Permit to handle and relocate the protected species. Helped coordinate staff and participated in a multiple week effort to visually sweep work areas ahead of equipment and review installation of turtle barriers. Multiple individuals of both species were located, and documentation was submitted to NHESP.

Tennessee Gas Pipeline, Rare Plant Evaluations for Hydrostatic Test Activities and Yearly Vegetation Management Plans
Environmental Scientist

Supported plant survey protocol preparation and accompanying BSC botanists approved by NHESP to perform surveys in work locations identified as having potential habitat for a number of state-listed plant species. The surveyed species have included foxtail sedge, barren strawberry, white adder's-mouth, pink pyrola, showy lady's slipper, hairy-fruited sedge, swamp dock, Cornel-leaved aster, the small whorled pogonia, climbing fern, and the dwarf scouring-rush. BSC scientists took GPS points, photos, and identifying characteristics for populations, and flagged the locations in the field. The NHESP Rare Species Observation Forms were prepared.

National Grid, Construction Mat Retrieval, Heath, MA
Environmental Scientist

Contributed to the preparation of a Memorandum of Understanding and Administrative Order of Consent between National Grid and MassDEP to retrieve two dozen timber construction mats that were dispersed off-ROW, into a forested stream following a flood event. Supported the reconnaissance effort to locate and map the construction mats and access routes and delineate adjacent resource areas. Prepared a retrieval-phase protection plan for state-listed wildlife species and contributed to the required wildlife monitoring.

MassDOT Erosion and Sediment Control Field Guide
Environmental Scientist

Responsible for the preparation of MassDOT's Erosion and Sediment Control Field Guide. The field guide is designed to be used by contractors in the field and introduces to erosion and sediment controls, regulatory programs, and suggests Best Management Practices by key topics, including Prevention, Runoff Control Practices and Devices, Erosion Control Practices and Devices, Sediment Control Practices and Devices, Good Housekeeping and General Operations, and Project Close-Out. For ease of use in the field, the Field Guide includes an Erosion and Sediment Control Practice Matrix. The Field Guide is available for download from the MassDOT web site.

CTDOT Route 3 Putnam Bridge Restoration Monitoring, Glastonbury/Wethersfield, CT

Project Manager & Quality Assurance

Managed and provided quality assurance for the 5-year effort to monitor the Route 3 Putnam Bridge Restoration Project. BSC performs monitoring which identifies the yearly success of plantings and revegetation post-restoration efforts. Annual reports are prepared each year for monitoring through communication with Office of Environmental Planning contacts at CTDOT. This coordination includes working with CTDOT and directing necessary and appropriate controls for invasive species and implementation of corrective measures.

Nathan Hale Greenway, Coventry and Bolton, CT

Environmental Scientist

Responsible for the completion of a baseline assessment along the abandoned Route 6 corridor in the Towns of Coventry and Bolton, CT. Field data collected will be used to conduct an alternative analysis of routing options for the greenway. The focus of the project is to develop a preferred alignment for the Greenway followed by the preliminary design that has been publicly vetted and supported by stakeholders and includes an understanding of construction costs.

National Grid, Park Street Substation, Gardner, MA

Environmental Scientist

Served as the main environmental inspector for weekly compliance monitoring for the construction of a new substation, demolition of an existing substation and removal of tap line structures. Completed and distributed the inspection reports and photo documentation on a weekly basis. Responsible for contractor training, maintaining the SWPPP, and communicating updates or field changes to the project team and local permitting authority. The project was granted a Certificate of Compliance with the Gardner Conservation Commission.

Vernal Pool Investigation and Restoration, Andover, MA

Wetland Scientist

Responsible for investigating the presence of certification criteria for a vernal pool feature on a proposed redevelopment site. Following identification of obligatory species, BSC was responsible for working with the design firm to create a mitigation plan to restore a portion of the overwintering, forested upland habitat. The restoration plan included invasive species management, removal of impervious material, native plantings, and placing woody debris.

Uxbridge High School Design, Uxbridge, MA

Environmental Scientist

Provided resource area evaluation and permitting for a new high school. A new population of a state listed species was discovered on site and coordination with NHESP was proactive and productive. Developed the permitting strategy and provided guidance for the design in order to minimize impacts to resource areas. Obtained the Conservation and Management Permit (CMP) with NHESP, which included a detailed vegetation management plan, a construction phase protection plan, and an agreement for a Conservation Restriction on a portion of the site. Provided SWPPP and turtle training to the contractor and provided oversight on SWPPP inspections.

Northeast Utilities Independent Environmental Inspector Services, CT

Lead Independent Environmental Inspector & Project Manager

Provided inspection services and management for the Connecticut Siting Council (CSC) for over 100 miles of new construction, reconstruction, and/or upgrades of multiple electric transmission line projects ranging from 3-5 miles (Bethel-Norwalk) to 70 miles (Middletown to Norwalk) and included the CT portion of Greater Springfield Reliability Project. The projects included inspection of underground and overhead line installation, construction of transition and switching stations and expansion of substations. Underground construction consisted of installing Cross-Linked Polyethylene (XLPE) cable duct banks as well as High Pressure Fluid Filled (HPFF) pipeline and afforded experience with jack and bore and Horizontal Directional Drill (HDD) installation points in addition to standard construction. Major responsibilities include coordinating the efforts of a team of inspectors, distributing a series of weekly inspection reports to the Siting Council and the communities involved, and acting as a liaison between all parties.

Pickering Middle School, Feasibility and Schematic Design Phases, Lynn, MA
Environmental Scientist

Provided ecological assessments and permitting implications for a new public middle school. Completed analysis of various sites being considered for the new Pickering School in Lynn. Directed and reviewed environmental resource maps and performed site visits to develop comparable permitting assessments and timelines for each site under consideration. Advised on site opportunities and constraints to development of a school facility.

Greenfield Town Hall Annex, Feasibility Study, Greenfield, MA
Wetland Scientist

Completed an existing conditions site evaluation and wetlands delineation property. BSC teamed with the Architect to conduct a study of the feasibility of expanding the Town Hall to twice the original size and improving the landscape and parking surrounding an expanded building. A summary of permitting processes was prepared and included in a Feasibility Report provided to the Town for use in obtaining funding for planned improvements.

Alford Road Bride Replacement, Alford Brook Alford, MA
Wetland Scientist

Responsible for permitting and supporting the design consultant for the replacement of the bridge deck, installation of new abutments and associated approach work. BSC delineated and documented the wetlands and watercourse and performed general habitat assessment in the mapped state-listed species habitat. BSC was responsible for preparing the early environmental coordination, associated documents, local/tribal historical coordination letters and water quality data form. BSC drafted a 401 Water Quality Certification application which was determined not to be necessary when design changes avoided all work in wetlands and waterways.

Wetland Impact Review, Route 9 Bridge, MassDOT, Framingham, MA
Wetland Scientist

Responsible for assessing post-construction conditions of the Sudbury River and adjacent wetlands and preparing a report and mitigation/restoration plans for inadvertent impacts. Restoration techniques included interspersing bioengineering features, creating shade, and “softening” an armored bank through live staking and plantings. BSC also contributed to enforcement coordination with MassDEP.

Stream Impact Review and restoration, Route 110, Amesbury, MA
Wetland Scientist

Evaluated construction -related impacts to a stream and adjacent Bordering Vegetated Wetland which were more extensive than the amount authorized by permits. Evaluated pre-construction conditions, existing conditions, and is assisting MassDOT with recommendations for mitigation, including techniques to restore habitat and increase heterogeneity in the stream. Rock vanes, log deflectors, coir log terraces and live staking of riparian vegetation were designed. Compliance monitoring continues with annual reporting, invasive species management, and evaluation of riparian enhancement and plantings.

Stream Restoration Evaluation, Shaker Mill Brook Becket, MA
Wetland Scientist

Responsible for evaluating the potential for fish passage at a series of step pools created during the removal of a crushed bridge culvert. The bridge had been replaced with an open bottom arch culvert and natural substrate had been restored. Permitting agencies questioned whether fish passage would be possible during low flow. Peer review was provided to determine whether a low-flow channel and thalweg had been effectively established and whether the grades between steps would allow fish passage as documented by the literature.

Invasive Species Management Plan, Needham, MA
Wetland Scientist

Responsible for developing Invasive Species Control and Monitoring Plans for the restoration of a buffer zone to wetlands on a recently acquired, open space parcel (2+acres). The management plan included specific recommendations to control Asiatic bittersweet, buckthorn, and Japanese knotweed, among other species. Features of the restoration plan also included replanting the area with native species, wildlife enhancement, and a footpath.

Post-Construction Wetland Monitoring on Route 44, MassDOT, Carver, MA
Wetland Scientist

Monitored wetland replication areas created for the Route 44 Relocation Project in Carver, Plympton, Plymouth, and Kingston, MA. Typical considerations include presence of invasive species and signs of sufficient hydrology, as well as evaluation of whether some areas inadvertently function as open water. Semi-annual monitoring is conducted with annual reporting submitted to state (MassDEP), and federal (U.S. Army Corps of Engineers) permitting agencies. BSC also recently coordinated and released Galerucella beetles for the biological control of purple loosestrife.

Preparation of a Template SWPPP, MassDOT-Highway Division

Environmental Scientist

Provided support for the development of a template Storm Water Pollution Prevention Plan (SWPPP) to be used for all MassDOT Highway Division projects falling under the jurisdiction of the National Pollutant Discharge Elimination System (NPDES) stormwater program and requiring coverage under the General Permit for Large and Small Construction Activities in Massachusetts. Duties for this project included preparing an extensive environmental site data form complete with detailed instructions on how to procure the required information. The template covered the requirements of the CGP, as well as MassDOT's performance standards and contained all the necessary instructions to the contractor in order to bring their project into compliance.

Blackstone River Bikeway for MassDOT and Department of Conservation and Recreation, Central MA

Environmental Scientist & Project Manager

Provided services for wetland delineation, natural resource evaluation and permitting efforts for the design of a significant portion (16 miles) of a proposed multi-use trail through five communities in the Blackstone Valley in Central Massachusetts. The project's intent was to promote access and appreciation for the natural and cultural resources of the Blackstone River and Canal. While the scope and design was altered significantly in the years following, BSC collaborated on drafts for a Single EIR, multiple NOIs, a wetland variance with MADEP, a 401 WQC, an individual permit with the USACE, and MESA project review with NHESP. Due to the amount of wetland and floodplain disturbance anticipated, the project involved initial siting, developing, and designing creative alternatives for wetland mitigation, as well as compensatory flood storage. Coordination with NHESP was necessary for preventing takes and developing mitigation for a number of rare species, including wood turtle, triangle floater, and odonates.

Route 31 Reconstruction, Coventry, CT

Environmental Scientist

Provided environmental services for permitting highway and traffic engineering for the design of the realignment of Route 31 through the historic South Coventry Village to eliminate a substandard curve for the Connecticut Department of Transportation (ConnDOT). The project included multiple culvert replacements/ expansions as well as installing a natural substrate in one of the replacement culverts. The project also designed step-pool features in a short section of a stream. Creating these features required evaluating stream flow and velocity, significant coordination with project engineers, choosing appropriate materials, and specifying careful installation. Obtained permits included the Inland Wetlands and Watercourses Permit, Flood Management Certification, 401 WQC, and PGP Category II screening with USACE.

Beach Road Over Lagoon Pond Bascule Bridge Replacement, Oak Bluffs/Tisbury, MA

Environmental Scientist

Responsible for environmental permitting for the replacement of the bascule bridge carrying Beach Road over Lagoon Pond in Oak Bluffs/Tisbury, MA. Necessary permits included US Coast Guard Bridge Permit, Individual Section 404 with USACOE, 401 WQC, and 4(f) and 6(f) reviews. Additional tasks included design review to avoid or minimize impacts, and development of mitigation options for unavoidable impacts to resource areas (eel grass beds, salt marsh). The final plan included salt marsh replication, eelgrass restoration, and preparation of educational signage. Managed staff in salt marsh replication area design, planting, and annual monitoring and reporting. BSC also provided survey, bathymetry, preparation of environmental construction specifications.

National Grid, Cooks Pond Substation, Vernon St. Substation, Webster St. Substation, Worcester, MA

Environmental Scientist

Contributed to NOI and Construction Stormwater Pollution Prevention Plan (SWPPP) preparation and obtaining permits for upgrades to several existing Substations. Served as the environmental inspector for weekly compliance monitoring at Vernon St. and Cooks Pond.

Riverfront Park, Millers River, Orange, MA

Wetland Scientist

Provided services for the delineation of inland bank and associated riverfront area and the preparation of environmental permits to support the design of a municipal waterfront park in Orange. Key project issues included the incorporation of Low Impact Development and the redevelopment of riverfront area under the Rivers Protection Act and Wetlands Protection Act. Necessary permits included NOI/Order of Conditions, Chapter 91 License for work in the river, and PGP Category II review with the USACE. The project also required submittal of a MESA review application to the NHESP and extensive coordination due to adjacent habitat for state-listed freshwater mussels, odonates, and fish.

Tennessee Gas Pipeline (TGP), MSA Operation and Maintenance Activities, Multiple Central and Northern MA Municipalities

Environmental Scientist & Wildlife Inspector

Responsible for desktop or field evaluation of resources at typical maintenance activity locations along the existing pipeline corridor. Work has ranged from notifying towns of anomaly evaluation &repair under the WPA utility maintenance exemption, providing WPA permitting for new pig launcher and receivers, and submitting for coverage under federal and state permit programs for hydrostatic test water discharges. Preparation of mitigation plans for various state-listed (or formerly listed) species has been required along with MESA review and coordination with the NHESP. Responsibilities also included obtaining Scientific Collecting Permits, providing sweeps/surveys and compliance with conditions for listed species.

Millers River Park and Pedestrian Bridge Project, Athol, MA

Wetland Scientist

Prepared environmental permits associated with the design of a public use park and pedestrian bridge crossing the Millers River in Athol. Work included wetland resource delineation and the preparation of environmental permits to support the design and construction. Permitting issues included obtaining the Notice of Intent/Order of Conditions and Chapter 91 license, and MESA project review with NHESP due to the presence of habitat for state-listed species, specifically wood turtles. Wood turtle surveys resulted in documentation of several individuals to NHESP. The work also involved identifying and mapping vegetative communities, and specific types of habitats (including nesting areas), and providing mitigation for any potential impacts from the placement or construction of the pedestrian bridge.

Windle Mills Redevelopment Project, Millbury, MA

Environmental Scientist

Provided environmental services for field delineation, design consultation, wetland rehabilitation plan, and filing of the Notice of Intent (NOI) for the redevelopment of an historic mill complex adjacent to the Blackstone River. The project required the submittal of an NOI with the Millbury Conservation Commission for work in jurisdictional areas. A wetland rehabilitation plan was developed to enhance the interests of the Wetlands Protection Act provided by wetlands associated with a former mill pond. The plan included control of the invasive species Phragmites australis and planting of native species, while taking the presence of contaminants in the substrate into consideration.

National Grid, New England East-West Solutions (NEEWS) Interstate Reliability Project (IRP), Millbury, MA-West Farnum (N. Smithfield), RI

Wetland & Wildlife Scientist

Contributed to wetland delineation and vernal pool investigations on portions of a 15+ mile section of cross-country ROW for construction of a new 345-kV transmission line. Contributions were made to the extensive alternatives analysis sections of the EFSB Petition, mitigation alternatives and language, draft Notices of Intent (NOI) for five towns, wildlife habitat evaluation, SWPPP, and Conservation and Management Permit application, including an in-depth construction phase wood turtle protection plan and restoration plan. Now that the project is in construction phase, Diana has provided environmental monitoring, including for stream relocation at one of the structures and rare species sweeps.

National Grid, Plainville Substation, Plainville, MA

Environmental Scientist

Responsible for preparing the draft of a Construction Stormwater Pollution Prevention Plan for approximately 34 acres of land disturbance associated with the construction of a new substation facility. Additional activities covered include new concrete foundations for equipment and an ancillary building; upgrades to existing transmission lines; the construction of a paved access drive; and minor repairs to the existing cart path road.

National Grid, Q143/R144 Clearance Improvement Project, Millbury, MA to MA/RI State Line

Ecological Scientist

Contributed to compliance with National Grid's Operation and Maintenance (O&M) Plan with NHESP by assisting with wood turtle training for National Grid and their contractors. Project activities include ground clearance improvements and structure replacements/repairs on two existing 115 kV transmission lines through identified state-listed habitat.

National Grid, Whitins Pond New Tap Line, Northbridge/Uxbridge, MA
Environmental Scientist

Performed and coordinated wetland delineation of approximately one mile of an existing right-of-way for a new line proposed within an unused portion of the easement. Wetlands and important features were recorded with GPS. Due diligence for resource areas, protected species, and historical properties was also provided. Work also included significant coordination with engineers on structure locations, and early permitting strategy for obtaining Orders of Conditions from two towns, DTE approval, and coverage under the MA PGP.

National Grid, Amphibian Survey within a Vernal Pool, Westford, MA
Environmental Scientist

Provided environmental services for project affording work with the state-listed blue spotted salamander, as well as more common amphibian species such as spotted salamanders, wood frogs and spring peepers. A pit fall/minnow trap study was performed which required site preparation, trapping, and handling of salamanders and frogs in and adjacent to a vernal pool located on a potential project site. The overall purpose of the project was to identify the migration patterns of the majority of individuals using the pool for breeding to determine whether the proposed substation construction would have an impact to critical adjacent habitat.

National Grid, Distribution and Feeder Line Maintenance/Removal Project, Blackstone-Millville, MA and Uxbridge-Douglas, MA
Environmental Scientist

Provided environmental expertise for delineating wetlands along several miles of roadway as well as a portion of ROW adjacent to a substation for line upgrades and substation work. Responsibilities included recording the location of wetlands and resource areas in relation to specific poles and preparation of a notification package to the local Conservation Commissions. Installation of new poles in one portion of the project necessitated the filing of an RDA and a successful presentation of the project at a public hearing. Removal of a cross-country feeder line was also a necessary piece of the project, and work included developing access and mitigation plans for poles that were in the floodplain, riverfront area, and wetlands associated with the Mumford and Blackstone Rivers.

Northeast Utilities System, Preparation of SWPCP, Middletown, CT
Environmental Scientist

Provided environmental services for the development of a Storm Water Pollution Control Plan (SWPCP) for a pole relocation project. A registration was also prepared and submitted for coverage under the General Permit for Stormwater and Dewatering Wastewaters from Construction Activities. The project involved new clearing on a steep, rocky site with direct tributaries to the Connecticut River. Extensive and stringent controls were required for this environmentally sensitive and erosion-prone site.

Tennessee Gas Pipeline, New Hampshire On-Call Operation and Maintenance Permitting and Environmental Services, Londonderry, Hooksett, Salem, Pelham, and Allenstown, NH
Environmental Scientist

Provided environmental expertise for the preparation and submittal of a number of Standard Dredge and Fill applications with municipalities and the New Hampshire DES Wetlands Bureau for projects involving natural gas pipeline cathodic protection maintenance and anomaly repair. Projects have included extensive coordination with the New Hampshire Natural Heritage Bureau, threatened and endangered species mitigation, and NH Prime Wetland screening. Several projects were considered “major” projects and required public meetings due to presence of prime wetlands or in a location identified as an Exemplary Natural Community (swamp white oak /river birch floodplain). The project in the Exemplary Community required survey and relocation of wild garlic and several years of subsequent monitoring. BSC also prepared Permit by Notification applications for the coverage of several, more recent, maintenance projects. Work also included serving as the environmental inspector during the actual construction activities within wetlands.

Tennessee Gas Pipeline, Hydrostatic Test Permits, Pittsfield and Westfield, MA and Trumbull, CT
Environmental Scientist

Responsible for preparing applications to the USEPA for the necessary hydrostatic testing of two existing TGP lateral pipeline systems in MA. Coverage was obtained under the NPDES Remediation and Miscellaneous Contaminated Sites General Permit. Work locations were identified as having potential habitat for a number of state-listed plant species, and surveys were required for compliance with a previously approved Operation & Maintenance Plan. In CT, BSC prepared applications for coverage under the General Permit for the Discharge of Hydrostatic

Pressure Testing Wastewater with the CTDEEP. Coordination was provided between TGP and the laboratory staff contracted for sampling and analysis. Project logs were developed, and effluent violation reports were prepared as necessary.

Tennessee Gas Pipeline Company, Lincoln Meter Station, Lincoln, MA
Environmental Scientist

Responsible for delineation and assessment of wetland systems, correspondence regarding cultural resources with the State Historical Preservation Officer and obtaining clearance from the Natural Heritage and Endangered Species Program.

Tennessee Gas Pipeline, Karner Blue Butterfly and Wild Lupine Survey, Bethlehem, NY
Environmental Scientist

Responsible for outlining the survey area and preparing transects in order to identify and monitor the wild lupine population, the sole food source of Karner blue butterfly larvae. As part of the survey, the presence or absence of adult and larvae Karner blue butterflies was also determined. The Karner blue is a state-listed species in NY as well as a federally endangered species. As a permit condition for recent construction on the nearby pipeline right-of-way, the surveys have been performed for several years, and monitoring reports were provided to the NY Endangered Species Unit and the U.S. Fish and Wildlife Service.

El Paso Global Networks, Statewide Fiber Optic Projects, MA, CT, and NY
Environmental Scientist

Participated in a proposed linear project within an existing corridor that required significant background research, fieldwork, and siting evaluation. Work included filing an expanded ENF with the MEPA Unit, correspondence with the MA NHESP, Natural Diversity Data Base in CT, the NY Endangered Species Unit, the U.S. Fish and Wildlife Service, the National Park Service; cooperation with the MADEP, NY DEC, and CT DEP; preparation of Notices of Intent with multiple towns in Massachusetts; and preparation of the USACE Individual 404 Permit, and the MA DEP 401 Water Quality Certification applications. It also required over 100 miles of linear wetland delineation, GPS data collection and mapping, alternatives analysis, and providing advice on construction timing/methods.

El Paso Corporation, Preparation of an Environmental Construction Manual
Environmental Scientist

Provided environmental expertise for the compilation and preparation of a draft Environmental Construction Manual for use by environmental inspectors and personnel at El Paso Corporation. The project involved compiling, organizing, and formatting information on biological and cultural resources; construction BMPs; restoration specifications in upland, wetland, residential, and agricultural areas; spill management; material storage; hydrostatic testing procedures; and permitting information including applicable Nationwide Permits.

NSTAR Pole Replacement Project, Lexington and Burlington, MA
Environmental Scientist

Responsible for field delineation of several wetland systems along a previously existing right-of-way for the replacement of multiple utility poles. The work also required the use of a GPS unit in order to locate the wetland boundaries and structures and the preparation of notification packets for both towns.

COMGas, Natural Gas Pipeline Installation Project, Sutton-Northbridge, MA
Environmental Scientist

Documented and classified each wetland resource area and coordinated with BSC surveyors to locate the wetlands using GPS technology. Provided services for delineating wetlands along public roadways for several miles in the towns of Sutton and Northbridge in order to develop mitigation plans and permit the installation of a natural gas pipeline within the vicinity of several wetland systems.

Water Line Project; Habitat Evaluation/Nocturnal Bird Survey, Montville, CT
Wetland & Wildlife Scientist

Evaluated habitat along the mile-long, cross-country route of a water supply pipeline for the City of New London. Coordination with the CTDEP's Natural Diversity Database indicated that habitat for state-listed species (e.g. Henry's elfin, Whip-poor-will and Northern Saw-whet Owl) was located in the vicinity of the project. The work involved obtaining protocol approval and performing call-back surveys and passive listening for the nocturnal bird species, resulting in positive identification of the Whip-poor-will. Diana coordinated the final report, identifying potential habitat and providing mitigation/construction timing recommendations.

Habitat Evaluation and Wood Turtle Survey, East Brookfield, MA
Wetland & Wildlife Scientist

Evaluated a 90-acre sand and gravel operations site recently designated as estimated habitat for the wood turtle. The work involved identifying and mapping vegetative cover and specific types of habitats, making determinations on which areas of the site were most valuable to the study species, and evaluating connectivity to surrounding features. Evening nesting and meander surveys were performed throughout the peak nesting season to attach thread bobbins to individuals and track their movement on site. While wood turtle individuals were not encountered during the survey, tracks of several turtle species were monitored and recorded. Significant coordination with NHESP was necessary in order to approve tracking protocol, obtain a scientific collection permit, and develop habitat maps and a report. A second year of pre-nesting season survey was recently completed as requested by NHESP.

Eightmile River Wild and Scenic Study, East Haddam, Lyme, Salem, CT

Contributed to the initial assessment of the habitat available in the Eightmile River, which is under study for wild and scenic designation with the National Park Service. The evaluation also included biological (electro-shock) surveys of the fish communities present in the watershed and instream habitat mapping. The project has afforded experience in developing a reference fish community and analyzing relationships between the hydro morphologic features and physical attributes of a stream and the abundance and species of fish that utilize the habitat.

Inland Wetlands and Waterways Commission, Orange, CT

Wetland Scientist

Responsible for performing a wildlife habitat evaluation on behalf of the Inland Wetlands Commission for a parcel proposed for subdivision development. Several vernal pools were confirmed using obligate and facultative indicators and evidence of the state-listed blue spotted salamander breeding on site was gathered. A report was submitted to the Commission evaluating the potential physical effects of the proposed work on the wetland habitat.

PUBLICATIONS

Walden, D.L., S. Morawski, and I. E. Hegemann. “Mitigation Measures for Rare Species During

Necessary Maintenance Activities Within Existing Utility Rights-of-Way”. *Environmental Concerns in Rights-of-Way Management 8th International Symposium.* Eds. J. W. Goodrich-Mahoney, L. Abrahamson, J. Ballard and S. Tikalsky. Elsevier Science Ltd. 2008

Walden, D.L. and Mayhew, A.C. “Effects of Wood Chip Cover on Revegetation Following Rights-of-Way Clearing and Construction”. For Environmental Concerns in Rights-of-Way Management 9th International Symposium 2009. In Progress.

Appendix C: Engineering Solutions, Assessment and Plans

This report has been conducted at a 30% conceptual design level for grant funding purposes. A final engineering design, cost estimate. and specifications would be required prior to the construction of any of the proposed drainage improvements.

Existing Conditions:
East Street in Mount Washington, Massachusetts is a rural dirt road that currently utilizes country drainage to facilitate stormwater runoff from the roadway. Two locations have been identified where stormwater run-off is affecting the water quality of nearby wetland resource areas, they are in the vicinity of 648 and 688 East Street. The surface material of the driveways for both 648 and 688 East Street is dirt as well, and stormwater runoff on these driveways is also facilitated by country drainage. Due to the surface material of dirt roads and driveways being unstabilized, stormwater run-off often increases erosion and sediment runoff, which can negatively affect water quality of nearby wetland resources areas.

On both properties, 648 and 688 East Street, there are intermittent streams that discharge into wetland resource areas at the borders of the property.

To the west of 648 East Street, the intermittent stream flows to the east, crossing underneath East Street via an existing 24" HDPE culvert, before daylighting on the eastern side of the roadway. The stream continues to flow northeast until it discharges into a wetland resource area. Approximately 200-feet north of the culvert, there is a high point in the road. From this high point, an existing drainage ditch west of the roadway conveys stormwater runoff from the roadway into the culvert, where it is then discharged into the intermittent steam. On the eastern side of the roadway, north of the culvert, there are no existing drainage ditches, any stormwater runoff that flows from the roadway will overland flow directly into the stream. Another high point is located approximately 460-feet south of the culvert. For approximately 125-feet south of the culvert, East Street is crowned, sending runoff to the east and west. There are existing drainage ditches east and west of East Street which will convey stormwater runoff into the culvert on the west, or directly into the stream on the east. The remaining 335-feet or roadway is superelevated to the east. All stormwater runoff on this portion of the roadway will overland flow directly into the intermittent stream or wetland resource areas.

Similar to the conditions of 648 East Street, to the west of 688 East Street the intermittent stream flows to the east, crossing underneath East Street via an existing 24" HDPE culvert, before daylighting on the eastern side of the roadway. This stream discharges into wetland resource areas abutting the property. Approximately 150-feet north of the culvert, there is a high point on East Street. This portion of East Street is slightly crowned, sending stormwater runoff to the east and west. There are no existing drainage ditches on either side of the road in this location. Runoff sent west of the roadway will be captured at a low point by the existing 24" HDPE culvert where it will discharge into an intermittent stream. The next high point on East Street occurs approximately 1,550-feet south of the culvert. Although the surface conditions vary, most of this portion of the roadway is insloped, carrying runoff down the roadway. There are no existing drainage ditches on either side of the road in this location as well.

Stilt grass, an invasive species, is present along East Street and it is being transported by stormwater runoff into the intermittent stream and wetlands.

Both existing 24" HDPE culverts have not been designed with any outlet protection, and they discharge directly into the intermittent streams. This has a negative effect on the overall water quality of the streams and wetlands because sediment uptake, scour, and erosion are more likely to occur.

Proposed Conditions:
Stormwater control measures have been evaluated at both properties to improve overall water quality of the intermittent streams and wetlands and to reduce the transportation of stilt grass. In the locations of the existing drainage ditches, stone check dams have been proposed to slow down the velocity of stormwater

runoff which will aid in reducing scour and erosion of the drainage ditch, as well as to allow for the gravity separation of suspended solids, limiting the transportation of stilt grass. In the portion of the roadway in front of 688 East Street where there are no existing drainage ditches, re-grading is proposed from the high point in the roadway to the inlet/outlet of the culvert. For both the existing and proposed drainage ditches, 4” of loaming and native seeding is proposed along the bottom width which will reduce ponding within the ditches. Stone outlet protection is proposed at the outlets of both culverts to prevent scour and erosion, as well as to limit the amount of sediment uptake into the intermittent stream. The stone used for both the check dams and outlet protection is modified rockfill and shall be in compliance with section M2.02.4 of the Commonwealth of Massachusetts Department of Transportation Standard Specifications. See Figure 1 for the gradation requirements for the modified rockfill used for the proposed drainage improvements.
Figure 1: Gradation Requirements for Modified Rockfill (MassDOT Specification)

Table M2.02.4-1: Gradation Requirements for Modified Rockfill

Size of Stone (in.)	Passing Percentages
8	95-100
4	0-25
2 ½	0-5

On the west side of the roadway in front of 648 East Street the roadway layout is very narrow, for stormwater improvement to be implemented, it is likely that easements or rights of access would be required.

Maintenance of the stormwater control measures shall be conducted as follows:

The grassed drainage ditches shall be mowed on an as-needed basis during the growing season so that the grass does not exceed 6 inches. Set the mower blades no lower than 3 to 4 inches above the ground.

Do not mow beneath the depth of the design flow during the storm associated with water quality (e.g., if the design flow is no more than 4 inches, do not cut the grass shorter than 4 inches).

The grassed ditch shall be inspected semi-annually the first year after construction, and at least once a year thereafter. Inspect the grass for growth and the side slopes for signs of erosion and formation of rills and gullies. Plant an alternative grass species if the original grass cover is not successfully established. If grass growth is impaired by winter road salt or other deicer use, re-establish the grass in the spring.

Accumulated trash and debris shall be removed from the swale prior to mowing. Hand methods (i.e., a person with a shovel) shall be used when cleaning to minimize the disturbance to vegetation and underlying soils. Check for sediment accumulation on a yearly basis and clean as needed.
Check dams shall be inspected after every significant rainfall event. Sediment shall be removed as needed, and damage shall be repaired as needed.

Japanese stilt grass Management

The proposed drainage improvements will not remove any existing stilt grass. These improvements will reduce the transportation of stilt grass seeds and debris that are carried by stormwater runoff to new locations. Invasive removal measures are necessary in conjunction with these drainage improvements to fully remove the stilt grass. Japanese stilt grass management should be complimented by proper roadside vegetation management and construction activities. Management of this species should consist of either mechanical or chemical control options with intermittent years of monitoring for property specific Japanese stilt grass recommendations refer to the report *Invasive Species Vector Assessment Japanese stilt grass (Microstegium vimineum) Case Study Sites: 648 & 688 East St. Mount Washington, MA*

Opinion of Cost

The opinion of cost was generated using prices provided by the MassDOT Construction Project Estimator Weighted Bid Prices. These prices include the cost of materials and the cost of labor. The total price per drainage ditch includes the cost of earth excavation, loaming and seeding the ditch, any ordinary borrow that may be necessary depending on the conditions of the existing soil, the stones for each check dam, and filter fabric for each check dam. A cost of $250 was calculated for each linear foot of the proposed ditch. The opinion of cost also includes the cost for each check dam that is proposed at the existing drainage ditches, this price was calculated to be $2,000 per each check dam. The total price per stone outlet protection included the cost of stone as well as the cost of filter fabric. The cost per stone outlet protection was calculated as $1,200. Based on the price of each drainage feature, the total cost of the proposed drainage improvements is approximately $142,000. The tables below show a breakdown of the prices described above.

648 East Street:

Proposed Drainage Ditches			
	Length	Price/LF	Total Cost
1	110	$250	$27,500
Total Cost Per New Ditch			**$27500**

Stone Outlet Protection		
# of Outlets	Price/Outlet	Total Cost
1	$1,200	**$1,200**

Stone Check Dam (Existing Ditch)		
# of Check Dams	Price / Check Dam	Total Cost
6	$2,000	**$12,000**

688 East Street:

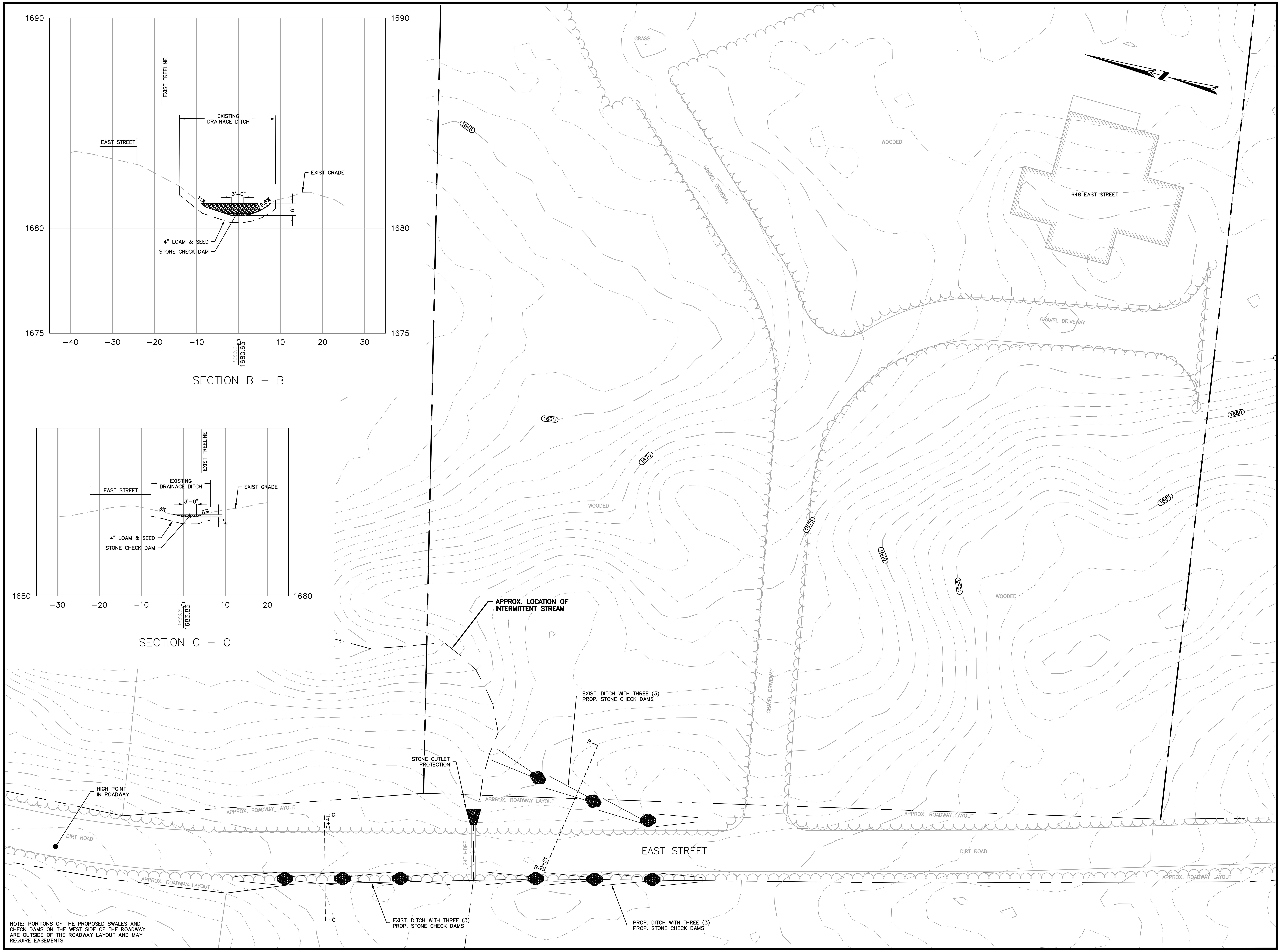
Proposed Drainage Ditches			
	Length	Price/LF	Total Cost
2	160	$250	$40,000
3	200	$250	$50,000
4	40	$250	$10,000
Total Cost Per New Ditch			**$100,000**

Stone Outlet Protection		
# of Outlets	Price/Outlet	Total Cost
1	$1,200	**$1,200**


FLOW ARROW

EXISTING CONDITION: NO OUTLET PROTECTION

PROPOSED CONDITION: STONE OUTLET PROTECTION



Conceptual Design

NOT FOR CONSTRUCTION

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648 EAST STREET

IN

MOUNT WASHINGTON
MASSACHUSETTS

STORMWATER IMPROVEMENTS

JANUARY 10, 2024

REVISIONS:

PREPARED FOR:

MACKENZIE WAGGAMAN
603 EAST STREET
MOUNT WASHINGTON, MA 01258

BSC GROUP
BUILD | SUPPORT | CONNECT
803 Summer Street
Boston, Massachusetts
02127
617 896 4300

SCALE: 1" = 20'

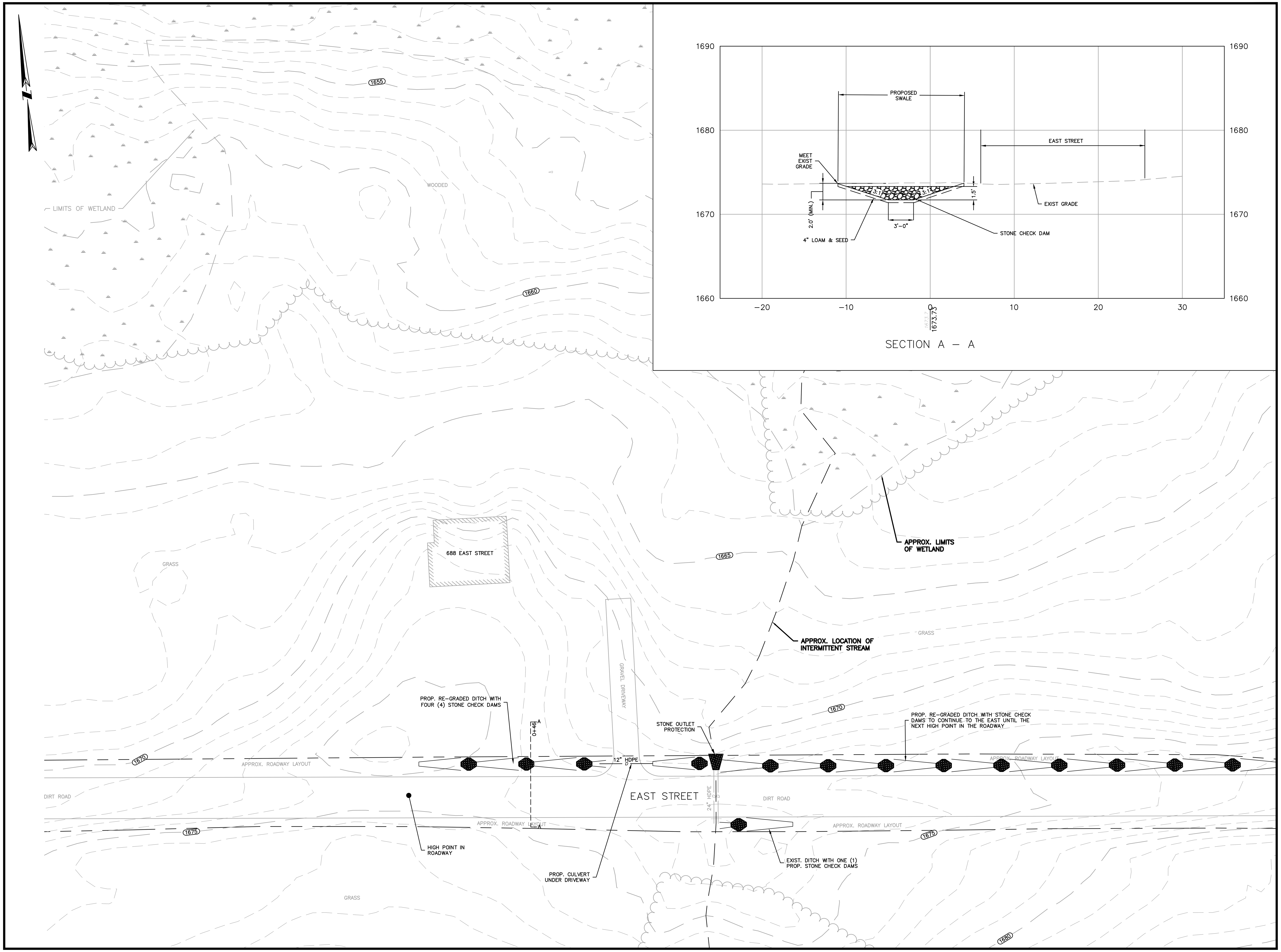
0 10 20 40 FEET

FILE: P:\010134800\TRANSPORTATION\DRAWINGS

DWG. NO:

JOB. NO: 0101348.00

1 OF 2



Conceptual Design

NOT FOR CONSTRUCTION

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688 EAST STREET

IN

MOUNT WASHINGTON
MASSACHUSETTS

STORMWATER
IMPROVEMENTS

JANUARY 10, 2024

REVISIONS:

PREPARED FOR:

MACKENZIE WAGGAMAN
603 EAST STREET
MOUNT WASHINGTON, MA 01258

BSC GROUP
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SCALE: 1" = 20'

0 10 20 40 FEET

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DWG. NO:

JOB. NO: 0101348.00

Appendix D: Mechanical and Chemical Stilt Grass Management Timetables

Mechanical Management

Management Year	Management Treatment Type	Management Sub Type	Treatment Timing	Notes
1	Cultural	Landowners	ASAP	Must be implemented prior to any other management control strategies
1	Cultural	EDRR	ASAP	Can be implemented at any time during management but preferably before any other management activities take place
1	Cultural	Machinery	ASAP	Protocols around cleaning of town machinery used for roadside mowing and or culvert replacement should be cleaned prior to movement to a new area.
1	Mechanical	Weed whacking	late August/early September	Pre-treatment of any roadside areas outside machine mowing capability
1	Mechanical	Mowing	late August/early September	Mowing roadside areas where stilt grass occurs only during this time of the season.
2	Monitoring	N/A	June/July	Monitoring is necessary to make adjustments to work boundaries and determine level of management success or failure
2 – 10	Mechanical	Weed whacking/Mowing	Late August/Early September	In years 2 – 10 mechanical control treatments should be confined to the late August/early September period to reduce seed production and followed by a June/July monitoring of the locations for new infestations.

Chemical Management

Management Year	Management Treatment Type	Management Sub Type	Treatment Timing	Notes
1	Cultural	Landowners	ASAP	Must be implemented prior to any other management control strategies
1	Cultural	EDRR	ASAP	Can be implemented at any time during management but preferably before any other management activities take place
1	Cultural	Machinery	ASAP	Protocols around cleaning of town machinery used for roadside mowing and or culvert replacement should be cleaned prior to movement to a new area.
1	Chemical	Foliar	late August/early September	Chemical treatment of roadsides and forested locations can be completed with backpack sprayers and a 1 – 1.5% solution of a wetland approved herbicide and non-ionic surfactant in a 0.25% solution.
1	Mechanical	Mowing	October	Areas that have been chemically treated should only be mowed at least a month after completion of the chemical treatment.
2	Monitoring	N/A	June/July	Monitoring is necessary to make adjustments to work boundaries and determine level of management success or failure
2 – 10	Chemical or Mechanical	Foliar/Hand Pulling	Late August/Early September	In years 2 – 10 if chemical control is effective based on monitoring events it may be possible to continue treatment with a low impact mechanical control option or Hand Pulling. If high density seed flushes are observed it will be necessary to follow-up with a similar chemical control treatment to Year 1.

Appendix E: Permitting Assessment and Requirements

BSC GROUP

MEMORANDUM

1 MERCANTILE STREET, SUITE 610, WORCESTER, MA 01608 - www.bscgroup.com

TEL 508-792-4500

To:	Mack Waggaman	**Date:**	January 15, 2025
From:	Diana Walden, Tom Groves BSC Group	**Proj. No.**	101348.00
Re	Permitting Implications for Stormwater Management and Invasive Species Control East Street, Mount Washington, MA		

1. Existing Environmental Resources for Consideration

BSC used publicly available MassGIS data layers (MassMapper) to understand environmental constraints for the site, representing known resources and designations. We have performed a desktop review of the information, including an evaluation of protected open space, known habitat for rare, threatened, and endangered species, surface water protection areas, and jurisdictional areas under the Massachusetts Wetlands Protection Act. Specific data layers that were evaluated include, but are not limited to the following:

- Color Orthophoto Imagery
- USGS Topographic Maps
- Protected Open Space (including Article 97 Protection)
- Massachusetts Historical Commission Inventory Points and Areas
- MassDEP Wetlands 1:12,000 and Hydrologic Connections
- National Hazard Flood Layer – FEMA (Federal Emergency Management Agency) – area not included
- NHESP Priority Habitats of Rare Species & Estimated Habitat of Rare Wildlife
- NHESP Certified & Potential Vernal Pools.
- Areas of Critical Environmental Concern
- Wellhead Protection Areas (Zone I, Zone II, IWPA)
- Surface Water Supply Protection Areas (ZONE A, B, C)
- Outstanding Resource Waters
- Division of Fisheries and Wildlife Coldwater Fish Resource (CFR)
- NHESP/TNC BioMap[1]

While many of the resources and sensitive features such as the Schenob Brook Drainage Basin ACEC and NHESP Priority and Estimated Habitat are well known through your research, BSC wanted to note a few additional items.

Both Lee Pond Brook, located to the north of 648 East Street, and an unnamed tributary to Becker Pond, which flows through the eastern side of the parcel at 688 East Street, are mapped as perennial streams and Coldwater Fisheries Resources (CFR). CFRs have been determined to support coldwater fish species through sampling by the Division of Fisheries and Wildlife (MassWildlife). Coldwater species are typically more sensitive to alterations to stream flow, water quality and temperature, and direct discharges to CFRs are included with the Stormwater Standards and regulations as Critical Areas.

While it is meant as a conservation planning tool and not a regulatory feature, multiple core habitats of the BioMap are present in the area. The area just south and extending north in corridors to the eastern and western sides of 648 East Street (and fully including 688 East Street), are marked as:

- Rare Species Core Habitat: Areas critical to the long-term conservation of our most vulnerable species

[1] BioMap is produced by MassWildlife and The Nature Conservancy with support from the Executive Office of Energy & Environmental Affairs. https://biomap-mass-eoeea.hub.arcgis.com/

and their habitats.
- Critical Natural Landscape: Large landscapes minimally impacted by development and buffers to core habitats and coastal areas, both of which enhance connectivity and resilience.

Corridors of Forest Core are also located to the east and west of the area, including bordering the eastern boundary of both parcels. Forest Core areas are considered the "most intact forests of Massachusetts, least impacted by development and essential for animals and plants dependent on remote habitat".

Figures depicting the mapped environmental resources have been printed from MassMapper and included for your reference.

2. Compliance of Town Roadway Activities with WPA and MESA

As you noted, the WPA is more often applied to proposed projects but can be used for enforcement and violations. Candidly, existing roadways across Massachusetts are notoriously difficult to bring into compliance under MassDEP regulatory Stormwater Standards. Many rural areas operate with "country drainage" and there is little available roadway right-of-way space to design and construct appropriately-sized stormwater control measures (basins, swales, etc), without affecting private property or needing easements. The Stormwater Standards do recognize this and qualify redevelopment work as needing to meet the standards to the "maximum extent practicable". This requirement can be enforced on a broad, somewhat discretionary scale of accepting a statement that nothing better can be done, to requiring a fairly robust alternatives analysis of what was evaluated but ultimately rejected. In our experience, MassDEP reviewers have been shifting towards the latter approach in recent years.

However, each project located in areas jurisdictional to the WPA should bring an opportunity for this evaluation and review, and documentation of point source stormwater discharges resulting in sedimentation to downgradient resource areas is also a cause for review and remediation under the WPA.

For a simplified description, areas subject to the WPA would include 100-ft buffer zones to Bordering Vegetated Wetlands (BVWs) and streambanks, 200-ft Riverfront Areas to perennial streams, the BVWs, streams and other waterbodies themselves, and areas of flooding. One important note about the jurisdiction of streams is that they are not regulated by the WPA until they flow through and/or from a wetland. If upgrades and roadway repairs have been made along steep, ephemeral channels that have not been documented as having associated wetland vegetation and soils, they may not yet be jurisdictional resources.

WPA Applicability to Work Outside of Jurisdictional Areas

If the initial work had not occurred in a jurisdictional area, the WPA regulations still state:

> 310 CMR 10.02(2)(d) Activities Outside the Areas Subject to Protection under M.G.L. c. 131, § 40 and the Buffer Zone: *Any activity proposed or undertaken outside the areas specified in 310 CMR 10.02(1) and outside the Buffer Zone is not subject to regulation under M.G.L. c. 131, § 40 and does not require the filing of a Notice of Intent* ***unless and until***[1] *that activity actually alters an Area Subject to Protection under M.G.L. c. 131, § 40. In the event that the issuing authority determines that such activity has in fact altered an Area Subject to Protection under M.G.L. c. 131, § 40, it may require the filing of a Notice of Intent and/or issuance of an Enforcement Order and shall impose such*

[1] Unless and until emphasis added – meaning the documentation of sedimentation in downgradient jurisdictional streams and wetlands could require the review of the work performed outside of jurisdictional areas.

conditions on the activity or any portion thereof as it deems necessary to contribute to the protection of the interests identified in M.G.L. c. 131, § 40.

WPA Exempt Activities

For proposed work in either 100-ft Buffer Zone or 200-ft Riverfront Area, the following activity is classified as an exempt minor activity which does not need to file an application under the WPA.

> 310 CMR 10.02 (2)(b).2. p: *Pavement repair, resurfacing, and reclamation of existing roadways within the right-of-way configuration provided that the roadway and shoulders are not widened, no staging or stockpiling of materials, all disturbed road shoulders are stabilized within 72 hours of completion of the resurfacing or reclamation, and no work on the drainage system is performed, other than adjustments and/or repairs to respective structures within the roadway.*

Direct impacts to other resources such as BVWs, jurisdictional waterbodies, and even floodplain are not included in the exemption. The regulations also requires that even the exempt activities are performed "*in a manner so as to reduce the potential for any adverse impacts to the resource area during construction, and with post-construction measures implemented to stabilize any disturbed areas*".

WPA Permittable Activities

As indicated in previous correspondence, you have identified several types of roadway projects and activities that are considered "limited projects" per 310 CMR 10.53(3):

> (f) Maintenance and improvement of existing public roadways, but limited to widening less than a single lane, adding shoulders, correcting substandard intersections, and improving inadequate drainage systems
>
> (k) The routine maintenance and repair of road drainage structures including culverts and catch basins, drainage easements, ditches, watercourses and artificial water conveyances to insure flow capacities which existed on the effective date of 310 CMR 10.51 through 10.60 (April 1, 1983).

This is not an exemption from filing or review of an application, but it does allow the issuing authority the discretion to permit these types of activities without a Variance, even if they cannot fully meet the WPA performance standards for each of the resources they are impacting. The issuing authority should still consider alternatives, measures to avoid adverse impacts, and opportunities to restore and mitigate.

You have also correctly noted that even with limited project status, "*no such project may be permitted which will have any adverse effect on specified habitat sites of Rare Species, as identified by procedures established under 310 CMR 10.59*" which would require following protocol under MESA and coordination with NHESP to confirm.

MESA Exempt Activities

The MESA regulations do allow for a number of activities that can be considered exempt from NHESP review and the most applicable are included here:

> 321 CMR 10.14: Exemptions from Review for Projects or Activities in Priority Habitat
>
> (7) repair, replacement or maintenance of existing, properly maintained stormwater detention basins or other stormwater management systems;
>
> (8) construction of new stormwater management systems that are designed to improve stormwater management at previously developed sites**, provided that the plans for the system are submitted to the Division for prior review,** and the Division makes a written determination that such systems will not have an adverse impact on state-listed species or their habitats;

It would be a matter of NHESP interpretation whether the country drainage would be either “properly maintained” or a “stormwater management system”. Per (8), upgrades should be at least reviewed by NHESP.

An additional exemption allows for work along paved roadways but does not include dirt roadways.

> (12) the maintenance, repair or replacement, but not widening, of existing paved roads, shoulder repair that does not exceed four feet from an existing travel lane, paved and unpaved driveways and paved and unpaved parking areas…

Federal Wetland (Waters of the US) Considerations

One consideration that is often overlooked when working through the state WPA and permitting is whether the activity also requires any reporting with the US Army Corps of Engineers under Section 404 of the Clean Water Act. Direct wetland and waterbody impacts up to 5,000 square feet should be submitted under the Massachusetts General Permit as a Self-Verification Notification Form. Greater impacts and/or stream crossing replacements that can’t meet Stream Crossing Standards would require a Pre-Construction Notification and written approval.

Summary

Projects that were performed beyond or outside the jurisdiction of the WPA that have a documented alteration to an area within jurisdiction, should be required to submit an after-the-fact filing and/or address the violation. Sediment deposition will be a clearer example of an alteration than spreading invasive species, but there is an avenue for investigating that interpretation. Even if exempt, an activity must still minimize adverse impacts and stabilize the project area. Even if an allowable limited project type in a jurisdictional area, filing and review of an application is required. Even if a redevelopment project, stormwater standards should still be met to the extent practicable. Stormwater Standards 8 and 9 are also required regardless of redevelopment project status. These state:

> 8. A plan to control construction related impacts including erosion, sedimentation and other pollutant sources during construction and land disturbance activities (construction period erosion, sedimentation and pollution prevention plan) shall be developed and implemented.
>
> 9. A long-term operation and maintenance plan shall be developed and implemented to ensure that the stormwater management system functions as designed.

BSC would concur with your recommendation that the Town prepare a standing Order of Conditions that addresses the type of roadway maintenance and upgrade projects that need to occur in and adjacent to resource areas. The filing should also include an erosion and sediment/pollution control plan and an operation and maintenance plan with protective and best management measures to be referenced for the projects and ongoing maintenance. With few exceptions, coordination with NHESP for work in Priority and Estimated Habitats is required.

3. Permitting Implications for Proposed Stormwater Remediation and Stilt Grass Management

To add to general permitting section/discussion:

Areas subject to the Massachusetts Wetland Protection Act (MGL Chapter 131 Section 40) (WPA) and associated Regulations (310 CMR 10.00) would include 100-foot buffer zones to Bordering Vegetated Wetlands (BVWs) and streambanks, 200-foot Riverfront Areas to perennial (flowing year round) streams, the BVWs, streams, and other waterbodies themselves, and areas subject to flooding. One important note about the jurisdiction of streams is that they are not regulated by the WPA until they flow through and/or from a wetland. From the description of the drainage and conditions at the project sites, it is assumed that the swales running parallel to East Street would not be characterized as streams, while the features flowing perpendicular to East Street and into each of the properties would be jurisdictional intermittent streams. For final design, both banks of each of the stream channels along with any adjacent or receiving wetlands should be delineated for accurate calculation of project-related impacts to the resources. Proposed activities within 100 feet of the streams or other wetlands or directly within the resources (eg for scour protection), will require preparation of a Notice of Intent application to be filed with the Conservation Commission and copied to the MassDEP Western Regional Office. This will also have to include a quantification of the area to be managed for Japanese stilt grass located in wetlands and streams. Filing under the WPA is required regardless of work on private or public property, by private landowners or public entities. While removal of an invasive species is obviously beneficial to the ecosystem, there is no regulatory exemption in the WPA that allows for removal or alteration of vegetation to occur directly within wetlands and streams without approval. The NOI could be filed as an Ecological Restoration project. However, this type of NOI requires preparation of extra documentation and is often more onerous to complete than a typical NOI. The benefit to using Ecological Restoration is when the project would not be able to otherwise be completed within the performance standards of the WPA. If the area managed for stilt grass is greater than 5,000 square feet within the BVW for example, the Ecological Restoration classification should be pursued. Impacts to wetlands are assumed to be temporary without affecting the soil surface and creating any excavation or fill.

The presence of an Area of Critical Environmental Concern doesn’t affect permitting significantly for a project at this scale. Projects greater than ½ acre in size with state funding or a state agency action may be subject to Massachusetts Environmental Policy Act (MEPA) review which is an intensive effort. Being within an ACEC does place additional protection on BVW in particular under the WPA. The only allowable alteration of BVW would be if the work can be characterized as a “limited project”. Work to improve stormwater and drainage at the roadways would be considered a limited project but the management work in wetlands would have to pursue the Ecological Restoration limited project status.

Work in NHESP Priority Habitat for Rare Species and Estimated Habitat for Rare Wildlife requires compliance with the Massachusetts Endangered Species Act and regulations at 321 CMR 10.00. Rather than a full MESA review, the project activities appear to meet different exemptions at 321 CMR 10.14:

> (8) construction of new stormwater management systems that are designed to improve stormwater management at previously developed sites, provided that the plans for the system are submitted to the Division for prior review, and the Division makes a written determination that such systems will not have an adverse impact on state-listed species or their habitats;
>
> (15) the active management of State-listed Species habitat, including but not limited to mowing, cutting, burning, or pruning of vegetation, or removing exotic or invasive species, for the purpose of maintaining or enhancing the habitat for the benefit of rare species, provided that the management is carried out in accordance with a habitat management plan approved in writing by the Division

Coordination with NHESP is required along with preparation a habitat management plan (likely consistent with this report). Assuming both submittals are accepted, work could proceed without further MESA review.

<u>Permitting for activities at 648 East Street</u>

For installation of stormwater control measures within Buffer Zone or other areas jurisdictional to the WPA, a Notice of Intent application should be prepared and filed with the Conservation Commission and copied to the MassDEP Western Regional Office. The application would also include proposed work to install scour protection/stone within the stream and will also have to include a quantification of the area to be managed for Japanese stilt grass located in wetlands and streams. The stormwater management work can reference limited project provisions and the invasive species management work will otherwise have to stay below 5,000 sf of direct BVW work. If a larger area is needed, the Ecological Restoration Limited Project status should be pursued. Since the parcel is not located in NHESP habitat or an ACEC, they don't require further considerations. Direct work in the stream for scour protection (well under 5,000 sf) would also require filing a Self-Verification Notification Form under the Massachusetts General Permit with the US Army Corps of Engineers under Section 404 of the Clean Water Act. Since plant management efforts would not excavate or fill the wetlands, those activities would not require reporting or approval.

<u>Permitting for activities at 688 East Street</u>

For installation of stormwater control measures within Buffer Zone or other areas jurisdictional to the WPA, a Notice of Intent application should be prepared and filed with the Conservation Commission and copied to the MassDEP Western Regional Office. The application would also include proposed work to install scour protection/stone within the stream and will also have to include a quantification of the area to be managed for Japanese stilt grass located in wetlands and streams. The stormwater management work can reference limited project provisions, With the location of the parcel within the ACEC, the invasive species management work will otherwise have to file as an Ecological Restoration Limited Project NOI in order to permit alteration within BVW.

Coordination with NHESP under MESA will be required for the proposed work in Priority and Estimated Habitat. The stormwater management plans will be submitted to determine if they meet the requirements for the exemption at 321 CMR 10.14 (8). A Habitat Management Plan will also have to be submitted for NHESP approval under 321 CMR 10.14 (15). If either exemption is denied, the project would require MESA review to determine if the project will cause a take to state-listed species.

Direct work in the stream for scour protection (well under 5,000 sf) would also require filing a Self-Verification Notification Form under the Massachusetts General Permit with the US Army Corps of Engineers under Section 404 of the Clean Water Act. Since plant management efforts would not excavate or fill the wetlands, those activities would not require reporting or approval.

Appendix F: New Hampshire Department of Transportation BMPs for Roadside Invasive Species

BMP Number	BMP Description
	Soil Disturbance and Stabilization
1	Minimize soil disturbance whenever possible. Invasive plants readily colonize areas of disturbed soil. Monitor recent work sites for the emergence of invasive plants for a minimum of two years after project completion.
2	Stabilize disturbed soils as soon as possible by seeding and/or using mulch, hay, riprap, or gravel that is free of invasive plant material. The seeds of native species should be used whenever possible. Species on the prohibited invasive plant list should never be planted.
3	Materials such as fill, loam, mulch, hay, riprap, and gravel should not be brought into project areas from sites where invasive plants are known to occur. If the absence of invasive plant parts in these materials cannot be guaranteed, recent work sites should be monitored for the emergence of invasive plants for a minimum of two years after project completion.
	Movement and Maintenance of Equipment
4	If work in areas containing invasive plants cannot be avoided, then the movement of maintenance and construction equipment should be from areas not infested by invasive plants to areas infested by invasive plants whenever possible. This is especially important during ditch cleaning and shoulder scraping activities.
5	Locate and use staging areas that are free of invasive plants to avoid spreading seeds and other viable plant parts.
6	If equipment must be used in areas where invasive plants occur, all equipment, machinery, and hand tools should be cleaned of all visible soil and plant material before leaving the project site. Equipment should be cleaned at the site of infestation. Acceptable methods of cleaning include, but are not limited to: • Portable washing station that contains runoff from washing equipment (containment must be in compliance with wastewater discharge regulations). • High pressure air. • Brush, broom, or other hand tools (used without water).
7	If equipment must be used in areas containing Japanese knotweed, phragmites, or purple loosestrife, aboveground plant material should be cut and properly disposed of (see BMP #11) prior to the start of work. If excavation occurs in these areas, see BMPs #13-16.
	Mowing
8	These invasive plants can sprout from stem and root fragments: purple loosestrife, phragmites, and Japanese knotweed. Mowing these plants should be avoided whenever possible. Staking roadside populations of these plants as “do not mow” is one way to accomplish this. If these plants are cut, all plant material must be rendered nonviable and extra care should be taken to avoid spreading plant fragments (see BMP #11).
9	In areas where invasive plants occur and the plants listed in BMP #8 (purple loosestrife, phragmites, and Japanese knotweed) are not present, an attempt should be made to mow the right-of-way prior to seed maturation (August 1st). This could be accomplished by identifying specific roads that are either heavily infested with invasive plants or roads that are in sensitive habitat areas and making those roads a priority in the mowing schedule.
10	Mowing equipment should be cleaned at least daily, as well as prior to transport (see BMP #6). This is particularly important if mowing occurs after seed maturation (after August 1st).
	Disposal of Plants
11	When invasive plants are cut or removed for roadside maintenance, construction, or control of plants, the spread of viable plant material must be avoided by rendering plant material nonviable. The following methods can be used to destroy plant material:

	• Drying/Liquefying: For large amounts of plant material or for plants with rigid stems, place the material on asphalt, tarps, or heavy plastic, and cover with tarps or heavy plastic to prevent the material from blowing away. For smaller amounts of plant material or for plants with pliable stems, bag the material in heavy duty (3-mil or thicker) garbage bags. Keep plant material covered or bagged for at least one month. Material is nonviable when it is partially decomposed, very slimy, or brittle. Once material is nonviable, it can be disposed of in a landfill or brush pile. Recommended for: Japanese knotweed, purple loosestrife, phragmites. • Brush Piles: Plant material from most invasive plants can be piled on site to dry out. However, when piling purple loosestrife, phragmites, and Japanese knotweed, care must be taken to pile stems so that cut surfaces are not in contact with the soil. Recommended for: Woody shrubs, trees, and vines; spotted knapweed; large quantities of purple loosestrife, phragmites, and Japanese knotweed. NOT recommended for: any invasive plant with seeds or fruit attached unless plants can be piled within the limits of the infestation. • Burying: Plant material from most invasive plants can be buried a minimum of three feet below grade. This method is best used on a job site that already has disturbed soils. Recommended for: any invasive plant. NOT recommended for: Japanese knotweed, unless other options are not feasible, and knotweed can be buried at the site of infestation at least five feet below grade. • Burning: Plant material should be taken to a designated burn pile. (All necessary permits must be obtained before burning.) Recommended for: any invasive plant, especially purple loosestrife, phragmites, Japanese knotweed. Herbicide: Herbicide applications must be conducted by a licensed applicator with a permit from the NH Department of Agriculture Division of Pesticide Control. Recommended for: any invasive plant, especially purple loosestrife, phragmites, Japanese knotweed.
12	Invasive plant material must be covered during transport.
Excavated Material	
13	Excavated material taken from sites that contain invasive plants cannot be used away from the site of infestation until all viable plant material is destroyed. Excavated material from areas containing invasive plants may be reused within the exact limits of the infestation.
14	Any excavated material that contains viable plant material and is not reused within the limits of the infestation must be stockpiled on an impervious surface until viable plant material is destroyed OR the material must be disposed of by burying a minimum of three feet below grade. Japanese knotweed must be buried at least five feet below grade.
15	Whenever possible, excavation should be avoided in areas containing Japanese knotweed, purple loosestrife, and phragmites. If excavation does occur in these areas, the BMPs described in Section II must be followed.
16	Soil and other materials containing invasive plants must be covered during transport.

Appendix G: Rare, Threatened and Endangered Species in Mount Washington as listed by NHESP

Most Recent Observation	Species Common Name	Species Scientific Name	Taxonomic Group	MESA Status	Wetland Indicator Status* if known, and Habitat
Historic	American twinflower	*Linnaea borealis*	Plant	SC	**FAC** – alpine or subalpine zones, forests, talus and woodlands
2018	Aborvitae	*Thuja occidentalis*	Plant	E	**FACW** – cliffs, balds, fens, forests, ridges, shores of rivers and lakes, swamps and woodlands
2022	Big-leaved holly	*Ilex montana*	Plant	E	**FACU** – forests, talus and rocky slopes, woodlands
1900's	bristly black currant	*Ribes lacustre*	Plant	SC	**FACW** – forests, shores of rivers and lakes, swamps, and wetland margins
2014	climbing fumitory	*Adlumia fungosa*	Plant	SC	cliffs, balds, ledges, ridges, balds and forests
1941	culver's-root	*Veronicastrum virginicum*	Plant	T	**FAC** – forests, meadows and fields
2015	downy arrow-wood	*Viburnum rafinesqueanum*	Plant	E	forests and woodlands
1919	Fogg's goosefoot	*Chenopodium foggii*	Plant	E	cliffs, balds, ledges, ridges, woodlands, and balds
2014	great blue lobelia	*Lobelia siphilitica*	Plant	E	**FACW** – marshes, meadows, fields, shores of rivers and lakes, swamps, and wetland margins
1998	herodias underwing moth	*Catocala herodias*	Moth	SC	pitch pine – scrub oak communities
1914	Houghton's flatsedge	*Cyperus houghtonii*	Plant	E	ridges or ledges, shores of rivers and lakes and woodlands
2013	Jefferson salamander	*Ambystoma jeffersonianum*	Amphibian	SC	forests and rocky areas with cover and duff layers. Breeding is in upland vernal pools and shrub swamps
1908	large-bracted tick-trefoil	*Desmodium cuspidatum*	Plant	T	forests and woodlands
2019	lyre-leaved rock-cress	*Arabidopsis lyrata*	Plant	E	**FACU** - cliffs, balds, ledges, ridges and balds
1881	Michaux's sandwort	*Sabulina michauxii*	Plant	T	cliffs, balds, ledges, ridges and balds
1908	nodding chickweed	*Cerastium nutans*	Plant	E	**FACU** – woodlands forests, ridges, and rocky slopes
1923	pale green orchid	*Platanthera flava* var. *herbiola*	Plant	T	**FACW** – floodplains, forest edges, marshes, grasslands, swamps, and wetland margins
1983	purple clematis	*Clematis occidentalis*	Plant	SC	forests, ridges, ledges and shores of rivers and lakes
1913	purple tiger beetle	*Cicindela purpurea*	Beetle	SC	upland habitats with sparse vegetation with dry sandy soils
2020	Rand's goldenrod	*Solidago randii*	Plant	E	cliffs, balds, ledges, mountain ledges and shores of rivers and lakes
1999	round-leaved shadbush	*Amelanchier sanguinea*	Plant	SC	cliffs, balds, ledges, forest edges, meadows, fields, and shores of rivers and lakes
2012	small-flowered buttercup	*Ranunculus micranthus*	Plant	E	forests, ridges, ledges and woodlands
2018	smooth rock-cress	*Borodinia laevigata*	Plant	SC	cliffs, balds, or ledges, forests, ridges, rocky slopes and woodlands
2004	Tuckerman's pondweed	*Potamogeton confervoides*	Plant	T	**OBL** – lakes and ponds

***Wetland Status FAC:** equally likely to occur in wetlands vs. non-wetlands **FACU:** Usually occurs in non-wetlands, but may occasionally occur in wetlands **FACW**: Usually occurs in wetlands, but may occasionally occur in non-wetlands **OBL**: Almost always occurs in wetlands. Sections of this table highlighted in blue represent rare species associated directly with wetland habitat.