# APPENDIX F

# STATE RARE SPECIES PROTECTION PLANS

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FINAL

# Connecticut River Hydrilla Control Research and Demonstration Project Lower Connecticut River, CT

## Species Protection Plan Chapman Pond East Haddam, CT

US Army Corps of Engineers ®
New England District

December 2023

**Chapman Pond Species Protection Plan**

## Table of Contents


1. Introduction ........ 1
   - 1.1 Connecticut River Hydrilla Information ........ 1
   - 1.2 Project Background ........ 1
   - 1.3 Chapman Pond Treatment Site ........ 2
     - 1.3.1 State-Listed Native Plant Species ........ 4
     - 1.3.2 State-Listed Invertebrate Animals ........ 4
     - 1.3.3 State-Listed Vertebrate Animals ........ 4
2. Proposed Treatment Activity ........ 4
   - 2.1 Potential Impacts to Plants of Concern ........ 5
   - 2.2 Potential Impacts to Invertebrates of Concern ........ 5
   - 2.3 Potential Impacts to Vertebrates of Concern ........ 6
3. Conservation Strategy for Endangered, Threatened and Special Concern Species 6
   - 3.1 Herbicide Application Methods and Timing ........ 6
   - 3.2 Considerations for Vertebrates ........ 6
4. References ........ 7

# 1. Introduction

## 1.1 Connecticut River Hydrilla Information

Hydrilla (*Hydrilla verticillata*) was first identified in the Connecticut River near Glastonbury, CT in 2016 and has since spread south to Essex, CT infesting the river's many coves, tributaries, and boat basins. The Connecticut River hydrilla population has been shown to be genetically distinct from other known hydrilla strains (Tippery, Bugbee, and Stebbins 2020), and the plant's biology is therefore largely unknown at this time. Following the discovery of the highly invasive aquatic plant in the Connecticut River in 2016, intensive vegetation surveys were conducted in 2019 and 2020 from Agawam, MA south to Long Island Sound to map the invasion extent. Hydrilla was found as far north as Agawam, MA, confirming that the plant spreads rapidly which poses significant risk to other regional waterbodies (Bugbee and Stebbins 2022). Fragments of the plant, which are easily transported by boats and boat trailers, can sprout roots to establish new populations. Fragments also float and are capable of dispersing via wind and water currents. Due to the importance of the Connecticut River as an environmental resource and driver of the local economy, stakeholders are seeking an aggressive hydrilla management program.

## 1.2 Project Background

The U.S. Army Corps of Engineers (USACE), through its Engineer Research and Development Center's (ERDC) Aquatic Plant Control Research Program, is leading a research and demonstration project to verify the effectiveness of aquatic herbicides registered for use by the U.S. Environmental Protection Agency (USEPA) to reduce and control the spread of the Connecticut River hydrilla safely and selectively. The project has been investigating hydrilla's growth patterns, site-specific water exchange dynamics and evaluating herbicide efficacy in laboratory conditions throughout 2023 to guide operational scale field demonstrations of herbicide efficacy in 2024.

Preliminary laboratory experiments conducted in 2023 evaluated Connecticut River hydrilla control using the aquatic herbicide, florpyrauxifen-benzyl. Results from these experiments indicated that Connecticut River hydrilla has a similar response to florpyrauxifen-benzyl across multiple concentrations and exposure times as dioecious and monoecious hydrilla biotypes. To assess onsite water exchange dynamics, USACE performed a dye study in August 2023. Rhodamine Water Tracer (RWT) dye was applied to the waters in the same manner herbicide would be. The concentrations of the dye in the water were collected after application and then analyzed to determine the half-life of the dye at Chapman Pond. This tracer dye study resulted in a half-life of 18 hours in Chapman Pond when applied at low tide. Based on the results of these preliminary studies, Chapman Pond has been selected as a hydrilla treatment site for ERDC's 2024 field demonstration project utilizing florpyrauxifen-benzyl.

### 1.3 Chapman Pond Treatment Site

Chapman Pond is a large tidal pond that is connected to the Connecticut River by two creeks. It is located in East Haddam, Middlesex County, CT and is centered at 41.439° N, 72.446° W. The treatment area is approximately 50.1 acres with a mean depth of 4.4 to 7.2 feet mean lower low water. The pond is surrounded by land designated for recreation and conservation as part of Chapman Pond Preserve, managed by The Nature Conservancy and East Haddam Land Trust.

Chapman Pond was identified through ERDC's 2023 environmental survey to be significantly hydrilla-dominated, with over 70% hydrilla coverage throughout the waterbody. Submerged and emergent plant surveys were performed on August 29, 2023, in Chapman Pond by Donald J. Padgett, Ph.D., a state-approved aquatic plant botanist. Subtidal and intertidal waters were assessed during this survey to inventory the vascular plants present within the proposed treatment site. Areas were surveyed by airboat, and when possible, on foot along favorable shorelines. For species that were unidentifiable in the field with high certainty, plant fragments were collected and later identified or confirmed using the following resources: Crow & Hellquist (Aquatic and Wetland Plants of Northeastern North America), Gleason & Cronquist (Manual of Vascular Plants of Northeastern United States and Adjacent Canada), and/or Haines (Flora Novae-Angliae) as references.

The littoral zone of Chapman Pond is co-dominated by *Zizania aquatica*, *Peltandra virginica*, *Phragmites australis*, and *Bulboschoenus fluviatilis*. Other plants observed included *Typha angustifolia*, *Pontederia cordata*, *Scirpus cyperinus*, *Schoenoplectus tabermontani*, and sterile *Schoenoplectus cf. pungens*. The open water was dominated by *Hydrilla verticillata*, and included sporadic occurrences of *Trapa natans*, *Ceratophyllum demersum*, *Callitriche*, and *Vallisneria americana*.

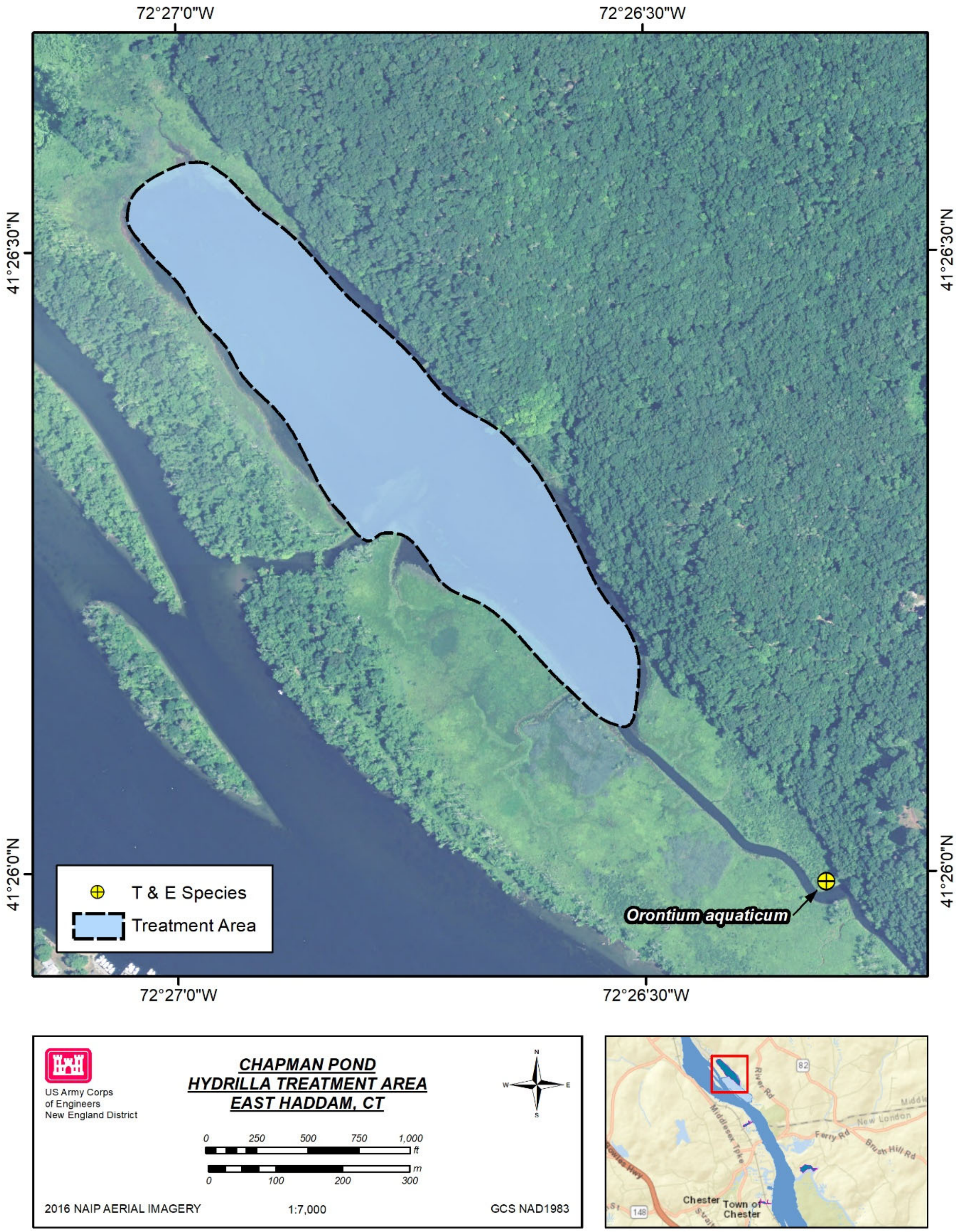


**Figure 1.** Chapman Pond hydrilla treatment area in East Haddam, CT.

### *1.3.1 State-Listed Native Plant Species*

Preliminary assessments of the Natural Diversity Database maps and files identified two state-listed vascular plants that may potentially occur within the delineated Chapman Pond treatment area: awl-leaved arrowhead (*Sagittaria subulata*, state special concern), and torrey bulrush (*Schoenoplectus torreyi*, state threatened). However, submerged and emergent plant surveys performed in 2023 in Chapman Pond did not identify any state-listed native species within the proposed Chapman Pond treatment area. Therefore, these species are not considered to be at risk of negative impact from the proposed treatment actions at this location.

### *1.3.2 State-Listed Invertebrate Animals*

Preliminary assessments of the Natural Diversity Database maps and files identified three state-listed invertebrates that may be present within Chapman Pond: tidewater mucket (*Leptodea ochracea*, state special concern), eastern pondmussel (*Ligumia nasuta*, state special concern), and riverine clubtail (*Stylurus Amnicola*, state threatened). Neither mussel surveys nor insect surveys were completed during the 2023 environmental studies to confirm the presence of these species within Chapman Pond.

### *1.3.3 State-Listed Vertebrate Animals*

Preliminary assessments of the Natural Diversity Database maps and files identified five state-listed vertebrates that may be present within Chapman Pond: shortnose sturgeon (*Acipenser brevirostrum*, state and federally endangered), Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*, state and federally endangered), blueback herring (*Alosa aestivalis*, state special concern), bridle shiner (*Notropis bifrenatus*, state special concern), and the bald eagle (*Haliaeetus leucocephalus*, state threatened). Neither fish nor bird surveys were completed during the 2023 environmental studies to confirm the presence of these species.

## 2. Proposed Treatment Activity

Florpyrauxifen-benzyl (ProcellaCOR EC), an EPA-registered aquatic herbicide (EPA Registration No. 67690-80), is proposed to be applied at a concentration of 48 ppb in Chapman Pond for hydrilla control. The herbicide will be evenly distributed across the entire treatment area delineated in Figure 1 using boat-based, subsurface injection application methods.

Florpyrauxifen-benzyl is a state and federally registered herbicide, and thus has already been approved for application in aquatic environments for the treatment of invasive aquatic plant species. This relatively new systemic herbicide mimics the plant growth hormone, auxin, killing susceptible plants by disrupting the plant cell growth process.

The active ingredient (4-amino-3chloro-6-(4-chloro-2-fluoro-3-methoxyphenyl) 5-fluoro-pyridine-2-benzyl ester) causes excessive plant cell elongation, ultimately resulting in plant cell death in sensitive plant species. Florpyrauxifen-benzyl is absorbed from the water through submerged plant shoots and leaves, and this herbicide has previously been demonstrated to be highly effective at selectively suppressing both dioecious and monoecious invasive hydrilla (Sperry et al. 2021; Mudge et al. 2021; Beets, Heilman, and Netherland 2019; Netherland and Richardson 2016; Richardson, Haug, and Netherland 2016) with relatively short exposure times and lower application rates compared to other herbicides (Wisconsin Department of Natural Resources 2022).

## 2.1 Potential Impacts to Plants of Concern

Neither of the two state-listed plant species of concern (awl-leaved arrowhead (*Sagittaria subulate*), and torrey bulrush (*Schoenoplectus torreyi*)) was identified in vegetation surveys of the proposed treatment area and therefore they will not be negatively impacted by the proposed treatment activity.

## 2.2 Potential Impacts to Invertebrates of Concern

Florpyrauxifen-benzyl poses minimal risk to aquatic invertebrates according to ecotoxicological information required for registration by USEPA. For the model ecotoxicological species, water flea (*Daphnia magna*), the 48-hour EC50 value reported is 49 mg/L [parts per million (ppm)] which is over 1,000-fold greater than the product's maximum use rate of 48 µg/L [parts per billion (ppb)] (SePRO, 2017). Two of the identified invertebrates of concern were freshwater mussel species, the tidewater mucket (*Leptodea ochracea*) and eastern pondmussel (*Ligumia nasuta*). A recent study examined the impacts of florpyrauxifen-benzyl applications on juvenile Fatmucket (*Lampsilis siliquoidea*) and Eastern Lampmussel (*Lampsilis radiata*) and determined that this compound was not acutely toxic to juveniles of these species (Buczek et al., 2020). While potential chronic or sub-lethal effects require further investigation to characterize, this study concluded that the short-term exposure risk of these freshwater mussels to florpyrauxifen-benzyl for the purposes of aquatic weed control are minimal (Buczek et al., 2020). Impacts to the identified mussel species of concern within Chapman Pond are therefore also expected to be minimal, particularly given that florpyrauxifen-benzyl quickly degrades within the environment once applied.

The third identified invertebrate of concern, the riverine clubtail (*Stylurus Amnicola*) is also not expected to be negatively impacted by the proposed treatment activity due to the in-water application methods under consideration. Previous studies have shown florpyrauxifen-benzyl to be essentially nontoxic on an acute basis to bees (Levey, 2022), thus risk of acute impacts to other insect species are also considered to be low. Additionally, this herbicide has been shown to have a relatively low potential for volatility from water due to low vapor pressure (USEPA, 2017) and is not expected to have vapor drift impacts to this insect species should it occur near Chapman Pond at the time of treatment.

### 2.3 Potential Impacts to Vertebrates of Concern

Four fish species of concern were identified as being potentially present within the proposed treatment area. Florpyrauxifen-benzyl is considered to be practically nontoxic to freshwater fish (Wisconsin Department of Natural Resources, 2022; Levey, 2022; USEPA, 2017). Studies of florpyrauxifen-benzyl impacts on fish and aquatic organisms largely did not observe toxicity even when applied up to its functional limit of solubility (Levey, 2022; USEPA, 2017). Further, results of bioaccumulation studies in fish suggested rapid and extensive metabolism of florpyrauxifen-benzyl, indicating that bioaccumulation potential for this herbicide is low (USEPA, 2017). Fish toxicity has not been previously reported in field or laboratory evaluations of florpyrauxifen-benzyl at the proposed application rate (48 ppb) for Chapman Pond. Further, chronic toxicity in these species are also not considered to be a concern as the proposed treatment activity only includes one herbicide application, and florpyrauxifen-benzyl has been shown to rapidly degrade through aerobic aquatic metabolism and aqueous photolysis once applied (USEPA, 2017). Florpyrauxifen-benzyl is considered practically non-toxic to fish on an acute basis [static 96-hour EC50 >120 mg/L for carp (*Cyprinus carpio*)] (SePro, 2017). The risk of acute impacts to bald eagles is also considered to be low. Florpyrauxifen-benzyl has been shown to be non-toxic to multiple bird species with a reported LD50 >2,500 mg/kg bodyweight for Bobwhite quail (*Colinus virginianus*) (Levey, 2022; USEPA, 2017; SePro, 2017). Additionally, because herbicides will be applied using subsurface injection methods, no airborne exposure risks to nearby bald eagles at the time of application are anticipated.

## 3. Conservation Strategy for Endangered, Threatened and Special Concern Species

### 3.1 Herbicide Application Methods and Timing

Strategic herbicide application methods and timing will be employed throughout this demonstration project to minimize the potential risk of impacts to non-target and state-listed species of concern. Florpyrauxifen-benzyl will be applied by licensed applicators at a concentration of 48 ppb in accordance with the product’s USEPA-approved label. A single treatment will be applied during summer of 2024.

### 3.2 Considerations for Vertebrates

Alewife and blueback herring are known to spawn over aquatic vegetation within the proposed treatment area between April 1 and June 30. To minimize potential impacts to these spawning events, the timing of treatment application will be delayed until after July 4, 2024.

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**FINAL**

# Connecticut River
# Hydrilla Control Research and Demonstration Project
# Lower Connecticut River, CT

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## Species Protection Plan
## Chester Boat Basin
## Chester, CT

US Army Corps of Engineers ®
New England District

**December 2023**

**Chester Boat Basin Species Protection Plan**

## Table of Contents

1. Introduction ........ 1

1.1 Connecticut River Hydrilla Information ........ 1
1.2 Project Background ........ 1
1.3 Chester Boat Basin Treatment Site ........ 2

1.3.1 State-Listed Native Plant Species ........ 4
1.3.2 State-Listed Invertebrate Animals ........ 4
1.3.3 State-Listed Vertebrate Animals ........ 4

2. Proposed Treatment Activity ........ 4

2.1 Potential Impacts to Plants of Concern ........ 5
2.2 Potential Impacts to Invertebrates of Concern ........ 5
2.3 Potential Impacts to Vertebrates of Concern ........ 6

3. Conservation Strategy for Endangered, Threatened and Special Concern Species 6

3.1 Herbicide Application Methods and Timing ........ 6
3.2 Considerations for Vertebrates ........ 6

4. References ........ 7

# 1. Introduction

## 1.1 Connecticut River Hydrilla Information

Hydrilla (*Hydrilla verticillata*) was first identified in the Connecticut River near Glastonbury, CT in 2016 and has since spread south to Essex, CT infesting the river's many coves, tributaries, and boat basins. The Connecticut River hydrilla population has been shown to be genetically distinct from other known hydrilla strains (Tippery, Bugbee, and Stebbins 2020), and the plant's biology is largely unknown at this time. Following the discovery of the highly invasive aquatic plant in the Connecticut River in 2016, intensive vegetation surveys were conducted in 2019 and 2020 from Agawam, MA south to Long Island Sound to map the invasion extent. Hydrilla was found as far north as Agawam, MA, confirming that the plant spreads rapidly which poses significant risk to other regional waterbodies (Bugbee and Stebbins 2022). Fragments of the plant, which are easily transported by boats and boat trailers, can sprout roots to establish new populations. Fragments also float and are capable of dispersing via wind and water currents. Due to the importance of the Connecticut River as an environmental resource and driver of the local economy, stakeholders are seeking an aggressive hydrilla management program.

## 1.2 Project Background

The U.S. Army Corps of Engineers (USACE), through its Engineer Research and Development Center's (ERDC) Aquatic Plant Control Research Program, is leading a research and demonstration project to verify the effectiveness of aquatic herbicides registered for use by the U.S. Environmental Protection Agency (USEPA) to reduce and control the spread of the Connecticut River hydrilla safely and selectively. The project has been investigating hydrilla's growth patterns, site-specific water exchange dynamics and evaluating herbicide efficacy in laboratory conditions throughout 2023 to guide operational scale field demonstrations of herbicide efficacy in 2024.

Results from a 2023 preliminary laboratory study found that Connecticut River hydrilla was either more sensitive or equally sensitive to diquat dibromide and potassium salt of endothall compared to monoecious and dioecious hydrilla. Both diquat dibromide and potassium salt of endothall are fast-acting herbicides that can provide hydrilla control under exposure times less than 24 hours. To assess water exchange dynamics, USACE performed a dye study in August 2023. Rhodamine Water Tracer (RWT) dye was applied to the waters in the same manner herbicide would be. The concentrations of the dye in the water were collected after application and then analyzed to determine the half-life of the dye at Chapman Pond. This tracer dye study resulted in a half-life of 13.4 hours at Chester Boat Basin when applied at low tide. Based on the results of these preliminary studies, Chester Boat Basin has been selected as a hydrilla treatment site for ERDC's 2024 field demonstration project using diquat dibromide and potassium salt of endothall.

### 1.3 Chester Boat Basin Treatment Site

Chester Boat Basin is a man-made boat basin located in Chester, Middlesex County, CT and centered at 41.424° N, 72.439°W. The treatment area is 4.1 acres with a mean depth range of 4.7 to 7.6 ft mean lower low water. The boat basin is located off the mainstem of the Connecticut River and is surrounded by rural residential area as well as open space that includes wetlands to the south. Chester Boat Basin was identified through ERDC's 2023 environmental studies to be significantly hydrilla-dominated, with over 70% hydrilla coverage throughout the waterbody.

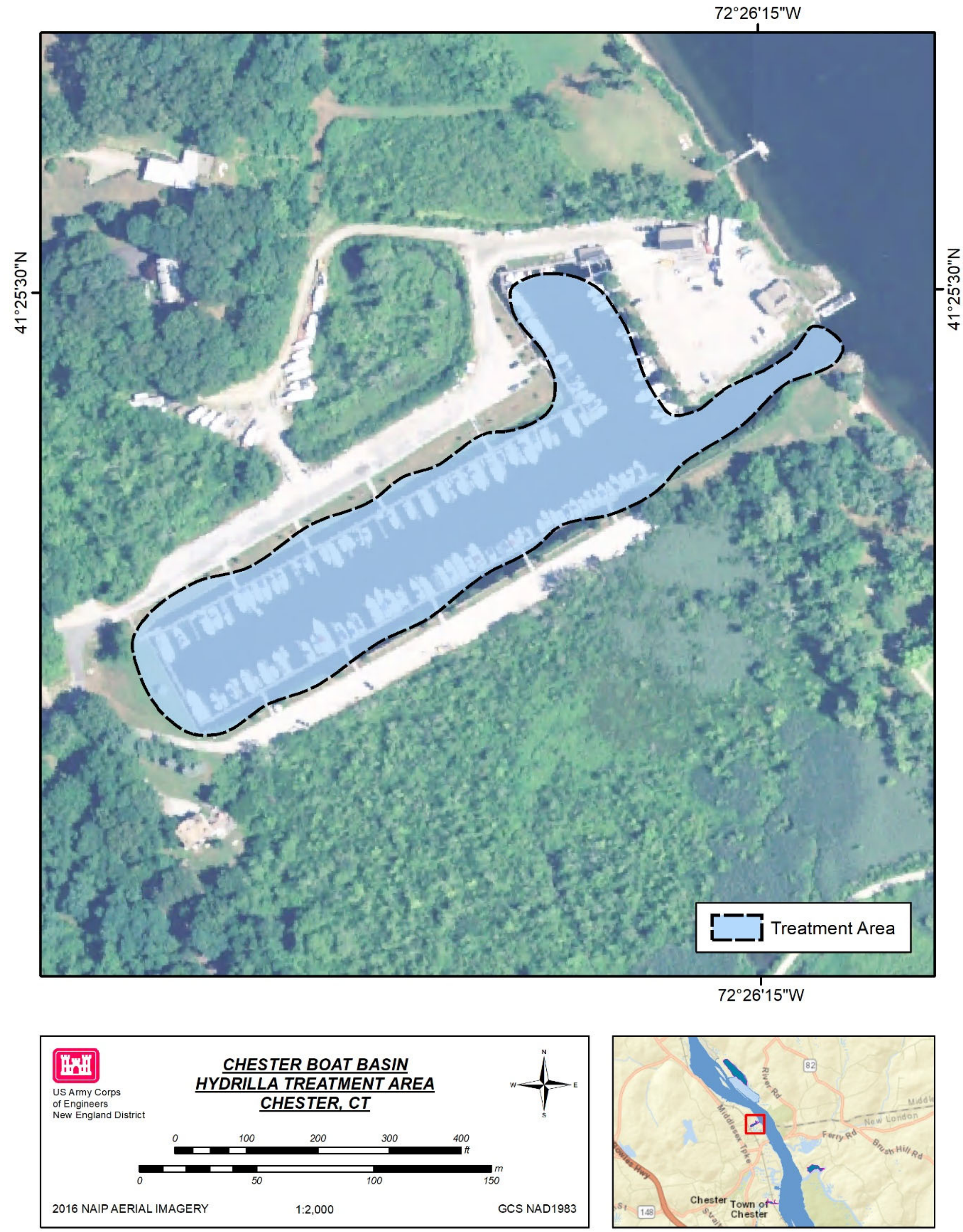


**Figure 1.** Chester Boat Basin hydrilla treatment area in Chester, CT.

### *1.3.1 State-Listed Native Plant Species*

Preliminary assessments of the Natural Diversity Database maps and files identified no state-listed plants within the delineated Chester Boat Basin treatment area. Therefore, aquatic plant surveys were not conducted at this site as there were no species of concern anticipated at this location. Based on field observations, species present included hydrilla, Eurasian milfoil (*Myriophyllum spicatum*), and fanwort (*Cabomba caroliniana*).

### *1.3.2 State-Listed Invertebrate Animals*

Preliminary assessments of the Natural Diversity Database maps and files identified three state-listed invertebrates which may be present within Chester Boat Basin: tidewater mucket (*Leptodea ochracea*, state special concern), eastern pondmussel (*Ligumia nasuta*, state special concern), and riverine clubtail (*Stylurus amnicola*, state threatened). Neither mussel surveys nor insect surveys were completed during the 2023 environmental studies to confirm the presence of these species within Chester Boat Basin.

### *1.3.3 State-Listed Vertebrate Animals*

Preliminary assessments of the Natural Diversity Database maps and files identified no state-listed vertebrate animals within the delineated Chester Boat Basin treatment area. No vertebrate surveys were conducted at this site as there were no species of concern anticipated at this location.

## 2. Proposed Treatment Activity

The proposed treatment activity at Chester Boat Basin includes application of dipotassium salt of endothall at 1.8 ppm plus diquat at 0.36 ppm utilizing the preformulated, USEPA-registered aquatic herbicide, AquaStrike. The herbicide mixture will be evenly distributed across the entire treatment area delineated in Figure 1 using a boat-based, subsurface injection application method.

Dipotassium salt of endothall (7-oxabicyclo [2.2.1] heptane-2,3-dicarboxylic acid) is a state and federally registered aquatic herbicide and has already been approved for application in aquatic sites for the treatment of invasive aquatic plant species. The dipotassium salt of endothall was registered by USEPA for aquatic use in 1960 at application rates between 0.5 and 5.0 ppm for aquatic plant control (Menninger, 2012). Dipotassium salt of endothall is a selective fast-acting herbicide that interferes with plant protein and lipid biosynthesis, disrupting respiration and plant membranes. This herbicide is highly effective for hydrilla control (Netherland, Green, and Getsinger, 1991).

Diquat dibromide is a state and federally registered herbicide approved for application in aquatic sites for invasive aquatic plant control. A Registration Standard for diquat dibromide was issued by the USEPA in June 1986 (USEPA, 1995). The active ingredient ((6,7-dihydrodipyrido (1,2a:2',1'-c) pyrazinediium dibromide) is a fast-acting herbicide that interferes with photosynthesis, disrupts plant cell membranes, and results in plant death within a week of application in sensitive plant species (Wisconsin Department of Natural Resources, 2012a).

Research has shown applications of both dipotassium salt of endothall and diquat to have additive effects in controlling hydrilla (Chiconela and Haller, 2013; Skogerboe et al., 2004; Pennington, Skogerboe, and Getsinger, 2001). Advantages of using herbicide combinations rather than a single material include improved weed control, shorter contact times, and reduced herbicide application rates. For example, one study found that low application rates of both dipotassium salt of endothall (1 ppm active ingredient) and diquat (0.5 ppm active ingredient) resulted in as good or better hydrilla control than dipotassium salt of endothall applied alone at 3 ppm active ingredient (Skogerboe et al., 2004).

## 2.1 Potential Impacts to Plants of Concern

No state-listed plants of concern were identified within the Chester Boat Basin treatment area, therefore there are no anticipated impacts to plant species of concern.

## 2.2 Potential Impacts to Invertebrates of Concern

Three state-listed invertebrate species were identified to be potentially of concern for the proposed treatment area. For the two mussel species (tidewater mucket (*Leptodea ochracea*), eastern pondmussel (*Ligumia nasuta*)), diquat dibromide has not been shown to have acute impacts on most aquatic organisms on which it has been tested when abiding by label application rates (Wisconsin Department of Natural Resources, 2012a). One study tested the impacts of diquat on the New Zealand freshwater mussel (*Hyridella menziesi*) and concluded that diquat dibromide had no significant effects on freshwater mussels and therefore was considered to be non-toxic to these organisms when applied at rates needed to kill most aquatic weeds (Clayton and Severne 2005). Impacts to the identified mussel species of concern within Chester Boat Basin are also expected to be minimal.

A study investigating impacts of dipotassium salt of endothall concentrations ranging from 0.5 to 1000 ppm on juvenile and glochidia fatmucket (*Lampsilis siliquoidea*) concluded that dipotassium salt of endothall was not found to be acutely toxic to fatmucket mussels at the application rates needed for hydrilla treatment. Median lethal concentrations (LC50s) for glochidia mussels were found to be 31.2 ppm for 24 hr. exposure periods and 27.6 ppm for 48 hr. exposure periods. LC50s for juvenile mussels were found to be 214 ppm for 48 hr. exposure periods and 34.4 ppm for 96 hr. exposure periods. Median lethal concentrations were substantially higher (6-34 times higher) than recommended dipotassium salt of endothall application rates for hydrilla treatment (1-5 ppm) (Archambault et al., 2015). Dipotassium salt of endothall has also been tested on dreissenid mussels, specifically zebra and quagga mussels, to evaluate impacts. At the highest concentration applied (5 ppm) maximum mortality of 5% was observed for quagga mussels at 20º C, and 2.5% at 25º C. Zebra mussels had zero mortality to any dipotassium salt of endothall concentration at either temperature regime (Claudi, Taraborelli, and Prescott, 2013).

Given the results of these studies on freshwater mussel species, impacts to the identified mussel species of concern within Chester Boat Basin from the proposed dipotassium salt of endothall and diquat treatment are expected to be minimal.

The third identified invertebrate of concern, the riverine clubtail (*Stylurus amnicola*), is also not expected to be negatively impacted by the proposed treatment activity due to the in-water application methods under consideration. USEPA considers diquat dibromide to be of minimal risk to non-target insects (USEPA, 1995) and one study of dragonflies and damselflies observed that these insects survived after being exposed to diquat concentrations 40 times higher than the recommended maximum field application rate (Gilderhus, 1967). Additionally, when used at recommended application rates, dipotassium salt of endothall does not appear to have significant adverse effects on aquatic insects (Wisconsin Department of Natural Resources, 2012b).

### 2.3 Potential Impacts to Vertebrates of Concern

No state-listed vertebrate animals of concern were identified within the delineated Chester Boat Basin treatment area so no negative impacts to vertebrates of concern are expected from the above-described treatment activity.

## 3. Conservation Strategy for Endangered, Threatened and Special Concern Species

### 3.1 Herbicide Application Methods and Timing

Strategic herbicide application methods and timing will be employed throughout this demonstration project to minimize the potential risk of impacts to non-target and state-listed species of concern. Herbicides will be applied by licensed applicators at allowable concentrations in accordance with the product's USEPA-approved label. Herbicides will be applied directly to the water and evenly distributed across the entire treatment area using boat-based, subsurface injection application methods to minimize airborne exposure risks to non-target species.

### 3.2 Considerations for Vertebrates

Alewife and blueback herring are known to spawn over aquatic vegetation within the proposed treatment area between April 1 and June 30. To minimize potential impacts to these spawning events, the timing of treatment application will be delayed until after July 4, 2024.

## 4. References


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# Connecticut River Hydrilla Control Research and Demonstration Project Lower Connecticut River, CT

**FINAL**

# Species Protection Plan Keeney Cove Glastonbury, CT

US Army Corps of Engineers ®
New England District

**December 2023**

**Keeney Cove Species Protection Plan**

## Table of Contents


1. Introduction ........ 1
   1.1 Connecticut River Hydrilla Information ........ 1
   1.2 Project Background ........ 1
   1.3 Keeney Cove Treatment Site ........ 2
      1.3.1 State-Listed Native Plant Species ........ 4
      1.3.2 State-Listed Invertebrate Animals ........ 4
      1.3.3 State-Listed Vertebrate Animals ........ 4
2. Proposed Treatment Activity ........ 4
   2.1 Potential Impacts to Plants of Concern ........ 5
   2.2 Potential Impacts to Invertebrates of Concern ........ 5
   2.3 Potential Impacts to Vertebrates of Concern ........ 5
3. Conservation Strategy for Endangered, Threatened and Special Concern Species. 6
   3.1 Herbicide Application Methods and Timing ........ 6
   3.2 Considerations for Vertebrates ........ 6
4. Literature Cited ........ 6

# 1. Introduction

## 1.1 Connecticut River Hydrilla Information

Hydrilla (*Hydrilla verticillata*) was first identified in the Connecticut River near Glastonbury, CT in 2016 and has since spread south to Essex, CT infesting the river's many coves, tributaries, and boat basins. The Connecticut River hydrilla population has been shown to be genetically distinct from other known hydrilla strains (Tippery, Bugbee, and Stebbins, 2020), and the plant's biology is therefore largely unknown at this time. Following the discovery of the highly invasive aquatic plant in the Connecticut River in 2016, intensive vegetation surveys were conducted in 2019 and 2020 from Agawam, MA south to Long Island Sound to map the invasion extent. Hydrilla was found as far north as Agawam, MA, confirming that the plant spreads rapidly which poses significant risk to other regional waterbodies (Bugbee and Stebbins, 2022). Fragments of the plant, which are easily transported by boats and boat trailers, can sprout roots to establish new populations. Fragments also float and are capable of dispersing via wind and water currents. Due to the importance of the Connecticut River as an environmental resource and driver of the local economy, stakeholders are seeking an aggressive hydrilla management program.

## 1.2 Project Background

The U.S. Army Corps of Engineers (USACE), through its Engineer Research and Development Center's (ERDC) Aquatic Plant Control Research Program, is leading a research and demonstration project to verify the effectiveness of aquatic herbicides registered for use by the U.S. Environmental Protection Agency (USEPA) to reduce and control the spread of the Connecticut River hydrilla safely and selectively. The project has been investigating hydrilla's growth patterns, site-specific water exchange dynamics and evaluating herbicide efficacy in laboratory conditions throughout 2023 to guide operational scale field demonstrations of herbicide efficacy in 2024.

Preliminary laboratory experiments conducted in 2023 evaluated Connecticut River hydrilla control using the aquatic herbicide, florpyrauxifen-benzyl. Results from these experiments indicated that Connecticut River hydrilla has a similar response to florpyrauxifen-benzyl across multiple concentrations and exposure times as dioecious and monoecious hydrilla biotypes. To assess onsite water exchange dynamics, USACE performed a dye study in August 2023. Rhodamine Water Tracer (RWT) dye was applied to the waters in the same manner herbicide would be. The concentrations of the dye in the water were collected after application and then analyzed to determine the half-life of the dye at Keeney Cove. Due to the limiting effects of the road and narrow culvert on the water flow and exchange, the site was separated into North, Middle, and South sections with a half-life determined for each. The northern section, which is most removed from tidal influence due to its distance from the mainstem of the river, had a dye half-life of approximately 72.4 hours. The middle section had a dye half-life of approximately 17.0 hours, and the southern section had a dye half-life of 10.0 hours. Based on the results of these preliminary studies, Keeney Cove has been selected as a hydrilla treatment site for ERDC's 2024 field demonstration project.

### 1.3 Keeney Cove Treatment Site

Keeney Cove is a tidal cove off the mainstem of the Connecticut River connected by a narrow channel and located in Glastonbury and East Hartford, Hartford County, CT and centered at 41.721° N, 72.629° W. The treatment area is 70.3 acres with a mean depth of 2.7 to 4.5 feet mean lower low water. The cove is transected by two roads with relatively narrow culverts.

Keeney Cove was identified through ERDC's 2023 environmental studies to be severely hydrilla-dominated, with over 70% hydrilla coverage throughout the whole waterbody. Submerged and emergent plant studies were performed on August 31, 2023, in Keeney Cove by Donald J. Padgett, Ph.D., an experienced aquatic botanist. Subtidal and intertidal waters were assessed during this study to inventory the vascular plants present within the proposed treatment site. Areas were surveyed by airboat, and when possible, on foot along favorable shorelines. For species that were unidentifiable in the field with high certainty, plant fragments were collected and later identified or confirmed using the following resources: Crow & Hellquist (Aquatic and Wetland Plants of Northeastern North America), Gleason & Cronquist (Manual of Vascular Plants of Northeastern United States and Adjacent Canada), and/or Haines (Flora Novae-Angliae) as references.

The cove is severely infested with Hydrilla and *Trapa natans* in the northern section. The open water was dominated by *Hydrilla verticillata*, and *Trapa natans*, with occasional *Nuphar variegata*, *Nymphaea odorata*, *Lemna*, *Spirodela polyrhiza*, *Wolffia borealis*, and *Ceratophyllum demersum*. The littoral zone of the northern portion is dominated by *Bulboschoenus fluviatilis*, especially on northern and western shores. Other emergent plants observed included *Persicaria*, sterile *Sagittaria latifolia*, and *Pontederia cordata*.

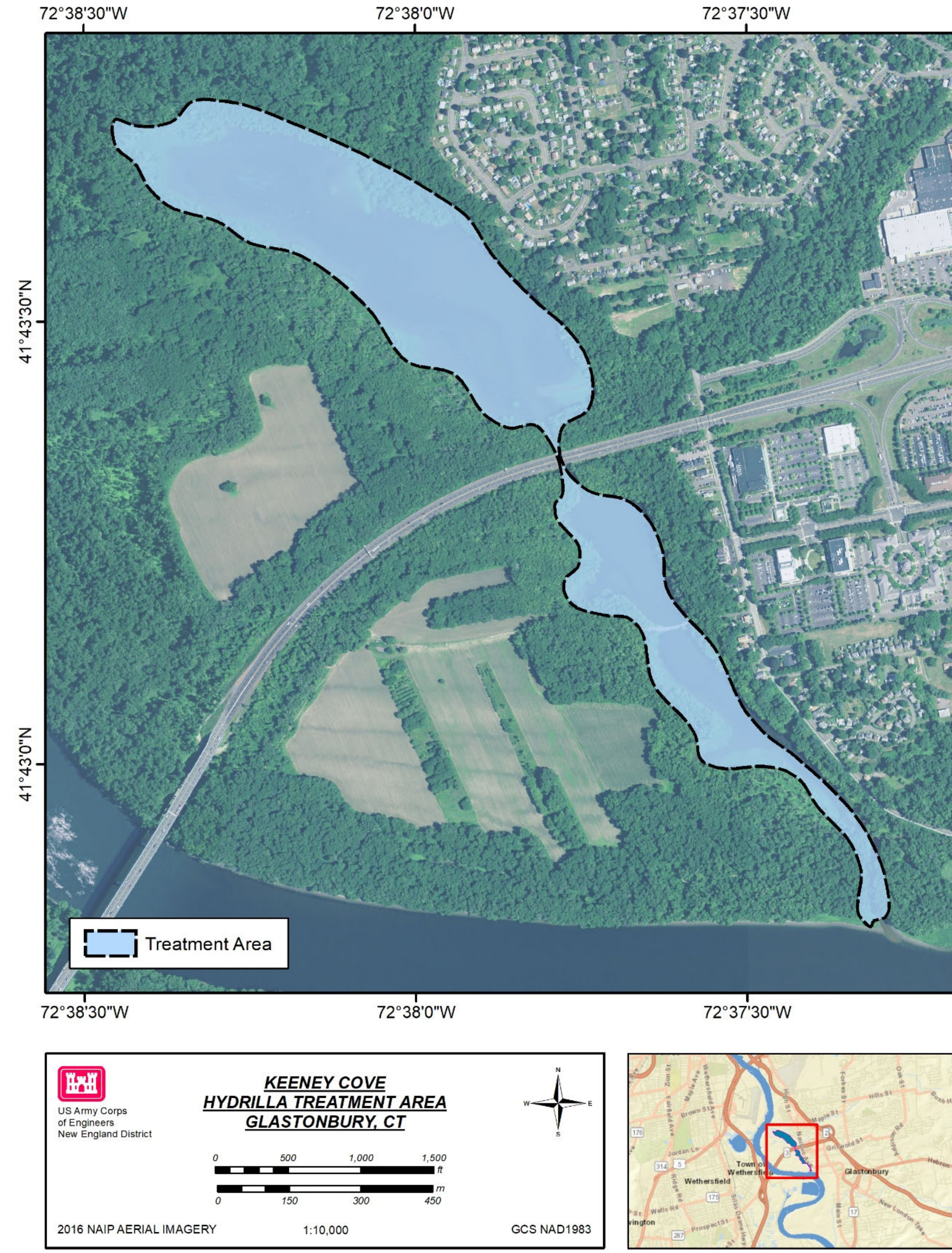


**Figure 1.** Keeney Cove hydrilla treatment area in Glastonbury, CT.

### *1.3.1 State-Listed Native Plant Species*

Preliminary assessments of the Natural Diversity Database maps and files identified three state-listed vascular plants that may potentially occur within the delineated Keeney Cove treatment area: Davis' sedge (*Carex davisii*, state threatened species), cattail sedge (*Carex typhina, s*tate special concern), and northern arrowhead (*Sagittaria cuneata,* state threatened species). Submerged and emergent plant surveys performed in Keeney Cove did not identify any State-listed native species within the proposed Keeney Cove treatment area. Therefore, these species are not considered to be at risk of impact from the proposed treatment actions at this location.

### *1.3.2 State-Listed Invertebrate Animals*

Preliminary assessments of the Natural Diversity Database maps and files identified three state-listed invertebrates, all of which are freshwater mussels that may be present within Keeney Cove: yellow lampmussel (*Lampsilis cariosa*, state endangered), tidewater mucket (*Leptodea ochracea*, state special concern), and eastern pondmussel (*Ligumia nasuta*, state special concern). Mussel surveys were not completed during the 2023 environmental studies to confirm the presence of these species within Keeney Cove.

### *1.3.3 State-Listed Vertebrate Animals*

Preliminary assessments of the Natural Diversity Database maps and files identified four state-listed vertebrates, all of which are fish that may be present within Keeney Cove: shortnose sturgeon (*Acipenser brevirostrum*, state and federally endangered), Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*, state and federally endangered), blueback herring (*Alosa aestivalis*, state special concern), and burbot (*Lota lota,* state endangered). Fish surveys were not completed during the 2023 environmental studies to confirm the presence of these species, however.

## 2. Proposed Treatment Activity

Florpyrauxifen-benzyl (ProcellaCOR EC), an EPA-registered aquatic herbicide (EPA Registration No. 67690-80), is proposed to be applied at a concentration of 48 ppb in Chapman Pond for hydrilla control. The herbicide will be evenly distributed across the entire treatment area delineated in Figure 1 using boat-based, subsurface injection application methods.

Florpyrauxifen-benzyl is a state and federally registered herbicide, and thus has already been approved for application in aquatic environments for the treatment of invasive aquatic plant species. This relatively new systemic herbicide mimics the plant growth hormone, auxin, killing susceptible plants by disrupting the plant cell growth process. The active ingredient (4-amino-3chloro-6-(4-chloro-2-fluoro-3-methoxyphenyl) 5-fluoro-pyridine-2-benzyl ester) causes excessive plant cell elongation, ultimately resulting in plant cell death in sensitive species. Florpyrauxifen-benzyl is absorbed from the water through submerged plant shoots and leaves, and this herbicide has previously been demonstrated to be highly effective at selectively suppressing both dioecious and monoecious invasive hydrilla (Sperry et al., 2021; Mudge et al., 2021; Beets, Heilman, and Netherland, 2019; Netherland and Richardson, 2016; Richardson, Haug, and Netherland, 2016) with relatively short exposure times and lower application rates compared to other herbicides (Wisconsin Department of Natural Resources, 2022).

### 2.1 Potential Impacts to Plants of Concern

Both sedge species identified as species of concern grow above the intertidal zone throughout this project's region and are not inundated by Connecticut River water except during flood events. These two species are not considered to be at risk of negative impacts from the proposed herbicide application which will be confined to Connecticut River waters. Further, florpyrauxifen-benzyl has been demonstrated to have relatively low potential for volatility from water due to low vapor pressure (USEPA, 2017) and the in-water application methods under consideration are not expected to have vapor drift or runoff impacts for the terrestrial plant species of concern. The other state-listed plant species of concern (northern arrowhead, *Sagittaria cuneata*) was not identified in vegetation surveys of the proposed treatment area and is not expected to be negatively impacted by the proposed treatment activity.

### 2.2 Potential Impacts to Invertebrates of Concern

Identified invertebrates of concern included the yellow lampmussel (*Lampsilis cariosa*), tidewater mucket (*Leptodea ochracea*), and eastern pondmussel (*Ligumia nasuta*). A recent study examined the impacts of florpyrauxifen-benzyl applications on juvenile Fatmucket (*Lampsilis siliquoidea*) and Eastern Lampmussel (*Lampsilis radiata*) and determined that this compound was not acutely toxic to juveniles of these species. While potential chronic or sub-lethal effects require further investigation to characterize, this study concluded that the short-term exposure risk of these freshwater mussels to florpyrauxifen-benzyl for the purposes of aquatic weed control are minimal (Buczek et al., 2020). Impacts to the identified mussel species of concern within Keeney Cove are therefore also expected to be minimal, particularly given that florpyrauxifen-benzyl quickly degrades within the environment once applied.

### 2.3 Potential Impacts to Vertebrates of Concern

Four fish species of concern were identified as being potentially present within the proposed treatment area. Florpyrauxifen-benzyl is considered to be practically nontoxic to freshwater fish (Wisconsin Department of Natural Resources, 2022; Levey, 2022; USEPA, 2017). Studies of florpyrauxifen-benzyl impacts on fish and aquatic organisms largely did not observe toxicity even when applied up to its functional limit of solubility (Levey, 2022; USEPA, 2017). Further, results of bioaccumulation studies in fish suggested rapid and extensive metabolism of florpyrauxifen-benzyl, indicating that bioaccumulation potential for this herbicide is low (USEPA, 2017). Fish toxicity has not been previously reported in field or laboratory evaluations of florpyrauxifen-benzyl at the proposed application rate (48 ppb) for Chapman Pond. Additionally, chronic toxicity in these species are also not considered to be a concern as the proposed treatment activity only includes one herbicide application, and florpyrauxifen-benzyl has been shown to rapidly degrade through aerobic aquatic metabolism and aqueous photolysis once applied (USEPA, 2017). Florpyrauxifen-benzyl is considered practically non-toxic to fish on an acute basis [static 96-hour EC50 >120 mg/L for carp (Cyprinus carpio)] (SePro, 2017).

## 3. Conservation Strategy for Endangered, Threatened and Special Concern Species

### 3.1 Herbicide Application Methods and Timing

Strategic herbicide application methods and timing will be employed throughout this demonstration project to minimize the potential risk of impacts to non-target and state-listed species of concern. Florpyrauxifen-benzyl will be applied by licensed applicators at a concentration of 48 ppb in accordance with the product's EPA-approved label. A single treatment will be applied during summer of 2024.

### 3.2 Considerations for Vertebrates

Alewife and blueback herring are known to spawn over aquatic vegetation within the proposed treatment area between April 1 and June 30. To minimize potential impacts to these spawning events, the timing of treatment application will be delayed until after July 4, 2024.

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FINAL

# Connecticut River
# Hydrilla Control Research and Demonstration Project
# Lower Connecticut River, CT

## Species Protection Plan
## Selden Cove
## Lyme, CT

US Army Corps
of Engineers ®
New England District

December 2023

**Selden Cove Species Protection Plan**

## Table of Contents


1. Introduction ........ 1

1.1 Connecticut River Hydrilla Information ........ 1

1.2 Project Background ........ 1

1.3 Selden Cove Treatment Site ........ 2

1.3.1 State-Listed Native Plant Species ........ 4

1.3.2 State-Listed Invertebrate Animals ........ 4

1.3.3 State-Listed Vertebrate Animals ........ 4

2. Proposed Treatment Activity ........ 4

2.1 Potential Impacts to Plants of Concern ........ 5

2.2 Potential Impacts to Invertebrates of Concern ........ 5

2.3 Potential Impacts to Vertebrates of Concern ........ 6

3. Conservation Strategy for Endangered, Threatened and Special Concern Species. 6

3.1 Herbicide Application Methods and Timing ........ 6

3.2 Considerations for Non-Target Plants ........ 6

3.3 Considerations for Vertebrates ........ 6

4. References ........ 7

# 1. Introduction

## 1.1 Connecticut River Hydrilla Information

Hydrilla (*Hydrilla verticillata*) was first identified in the Connecticut River near Glastonbury, CT in 2016 and has since spread south to Essex, CT infesting the river's many coves, tributaries, and boat basins. The Connecticut River hydrilla population has been shown to be genetically distinct from other known hydrilla strains (Tippery, Bugbee, and Stebbins 2020), and the plant's biology is therefore largely unknown at this time. Following the discovery of the highly invasive aquatic plant in the Connecticut River in 2016, intensive vegetation surveys were conducted in 2019 and 2020 from Agawam, MA south to Long Island Sound to map the invasion extent. Hydrilla was found as far north as Agawam, MA, confirming that the plant spreads rapidly which poses significant risk to other regional waterbodies (Bugbee and Stebbins 2022). Fragments of the plant, which are easily transported by boats and boat trailers, can sprout roots to establish new populations. Fragments also float and are capable of dispersing via wind and water currents. Due to the importance of the Connecticut River as an environmental resource and driver of the local economy, stakeholders are seeking an aggressive hydrilla management program.

## 1.2 Project Background

The U.S. Army Corps of Engineers (USACE), through its Engineer Research and Development Center's (ERDC) Aquatic Plant Control Research Program, is leading a research and demonstration project to verify the effectiveness of aquatic herbicides registered for use by the U.S. Environmental Protection Agency (USEPA) to reduce and control the spread of the Connecticut River hydrilla safely and selectively. The project has been investigating hydrilla's growth patterns, site-specific water exchange dynamics and evaluating herbicide efficacy in laboratory conditions throughout 2023 to guide operational scale field demonstrations of herbicide efficacy in 2024.

Results from a 2023 preliminary laboratory study indicated that Connecticut River hydrilla was either more sensitive or equally sensitive to potassium salt of endothall compared to monoecious and dioecious hydrilla. Potassium salt of endothall is a fast-acting herbicide that can provide hydrilla control under exposure times less than 24 hours. To assess onsite water exchange dynamics, USACE performed a dye study in August 2023. Rhodamine Water Tracer (RWT) dye was applied to the waters in the same manner herbicide would be. The concentrations of the dye in the water were collected after application and then analyzed to determine the half-life of the dye at Selden Cove. This tracer dye study resulted in a half-life of 12.2 hours in Selden Cove when applied at low tide.

### 1.3 Selden Cove Treatment Site

Selden Cove is a cove off the Connecticut River located in Lyme, Middlesex County, CT and centered at 41.411° N, 72.417° W. The treatment area is 16.1 acres with a mean tidal depth of 1.4 to 4.4 feet mean lower low water. The cove is connected to the main stem of the Connecticut River by Selden Creek to the west and south and is approximately 0.25 miles from the river. It is abutted by rural residential area as well as recreation and conservation land that is part of Selden Neck State Park, managed by CTDEEP.

Selden Cove was identified through ERDC's 2023 environmental studies to be significantly hydrilla-dominated, with over 70% hydrilla coverage throughout the waterbody. Submerged and emergent plant studies were performed August 28-29, 2023, in Selden Cove by Donald J. Padgett, Ph.D., a state-approved aquatic plant botanist. Subtidal, and intertidal waters were assessed during this study to inventory the vascular plants present within the proposed treatment site. Areas were surveyed by airboat, and when possible, on foot along favorable shorelines. For species that were unidentifiable in the field with high certainty, plant fragments were collected and later identified or confirmed using the following resources: Crow & Hellquist (Aquatic and Wetland Plants of Northeastern North America), Gleason & Cronquist (Manual of Vascular Plants of Northeastern United States and Adjacent Canada), and/or Haines (Flora Novae-Angliae) as references.

The littoral zone of this tidally influenced cove is dominated by *Zizania aquatica* and *Pontederia cordata*. Other plants observed included *Peltandra virginica*, *Lythrum salicaria*, *Iris cf. pseudacorus*, *Sagittaria latifolia* and *Phragmites australis*. The open water was dominated by *Hydrilla verticillata*, and included sporadic occurrences of *Trapa natans*, *Ceratophyllum demersum*, *Spirodela polyrhiza*, *Vallisneria americana*, and *Myriophyllum spicatum*. At low tide, a large island-like mudflat becomes exposed within Selden Cove.

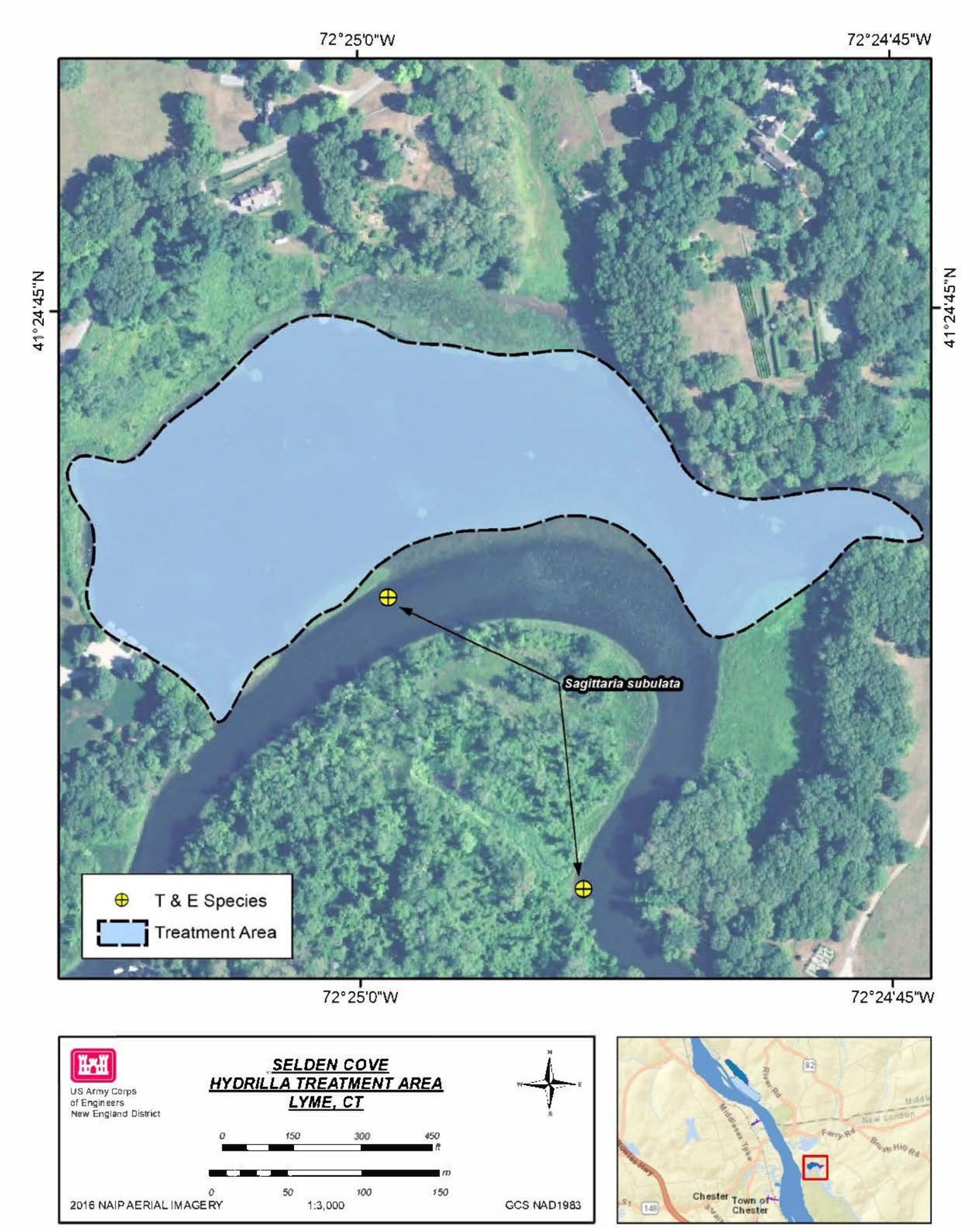


**Figure 1.** Selden Cove hydrilla treatment area in Lyme, CT.

#### *1.3.1 State-Listed Native Plant Species*

Preliminary assessments of the Natural Diversity Database maps and files identified six state-listed vascular plants that may potentially occur within the delineated Selden Cove treatment area: beck's water-marigold (*Bidens beckii*, state special concern), parker's pipewort (*Eriocaulon parkeri*, state endangered), small yellow pond lily (*Nuphar microphylla*, state special concern), golden club (*Orontium aquaticum*, state special concern), awl-leaved arrowhead (*Sagittaria subulata*, state special concern), and torrey bulrush (*Schoenoplectus torreyi*, state threatened). Submerged and emergent plant surveys identified awl-leaved arrowhead (*Sagittaria subulata*) specimens were present just outside the proposed treatment area, located on the exposed mudflat within Selden Cove which emerges at low tide. No individuals of *Orontium aquaticum*, *Bidens beckii, Eriocaulon parkeri, Nuphar microphylla*, or *Schoenoplectus torreyi* were observed in or around Selden Cove.

#### *1.3.2 State-Listed Invertebrate Animals*

Preliminary assessments of the Natural Diversity Database maps and files identified two state-listed freshwater mussels that may be present within Selden Cove: tidewater mucket (*Leptodea ochracea*, and eastern pondmussel (*Ligumia nasuta*, state special concern). Mussel surveys were not completed during the 2023 environmental studies to confirm the presence of these species within Selden Cove.

#### *1.3.3 State-Listed Vertebrate Animals*

Preliminary assessments of the Natural Diversity Database maps and files identified one state-listed vertebrate that may be present within Selden Cove, the wood turtle (*Glyptemys insculpta*, state special concern). Turtle surveys were not completed to determine the presence of this species.

## 2. Proposed Treatment Activity

The proposed treatment activity at Selden Cove includes the application of dipotassium salt of endothall at 5 ppm using the USEPA-registered aquatic herbicide, Aquathol K. The herbicide will be evenly distributed across the entire treatment area delineated in Figure 1 using a boat-based, subsurface injection application method.

Dipotassium salt of endothall (7-oxabicyclo [2.2.1] heptane-2,3-dicarboxylic acid) is a state and federally registered selective herbicide and has already been approved for application for aquatic sites for the treatment of invasive aquatic plant species. The dipotassium salt of endothall was registered by the USEPA for use in aquatic environments in 1960 at application rates between 0.5 – 5.0 ppm for aquatic plant control (Menninger, 2012). Dipotassium salt of endothall is a selective fast-acting herbicide that interferes with plant protein and lipid biosynthesis, disrupting respiration and plant membranes in sensitive plant species. This herbicide is highly effective and extensively used for hydrilla control in the US (Netherland, Green, and Getsinger, 1991).

## 2.1 Potential Impacts to Plants of Concern

Submerged and emergent plant surveys identified awl-leaved arrowhead (*Sagittaria subulata*) specimens were present just outside the proposed treatment area, located on the exposed mudflat island within Selden Cove that emerges at low tide. Dipotassium salt of endothall can negatively impact some sensitive non-target native aquatic plants (Parsons et al. 2004; Menninger, 2012). However, dipotassium salt of endothall disrupts plant membranes at the point of contact but generally do not affect carbohydrate stored structures such as roots and tubers. Awl-leaved arrowhead is a perennial plant that spreads using stolons, or horizontal stems that spread along or just below the sediment surface. Sub-surface stolons are therefore not expected to be impacted by dipotassium salt of endothall. Consequently, awl-leaved arrowhead plants that may be temporarily impacted by herbicide exposure may be able to regrow from underground structures following treatment as well as in following growing seasons.

## 2.2 Potential Impacts to Invertebrates of Concern

Identified invertebrates of concern included the tidewater mucket (*Leptodea ochracea*) and eastern pondmussel (*Ligumia nasuta*). One study of a similar freshwater mussel species investigated impacts of dipotassium salt of endothall concentrations ranging from 0.5 to 1000 ppm on juvenile and glochidia fatmucket (*Lampsilis siliquoidea*). Median lethal concentrations (LC50s) for glochidia mussels were found to be 31.2 ppm for 24 hr. exposure periods and 27.6 ppm for 48 hr. exposure periods. LC50s for juvenile mussels were found to be 214 ppm for 48 hr. exposure periods and 34.4 ppm for 96 hr. exposure periods. Median lethal concentrations were substantially higher (6-34 times higher) than recommended application rates for hydrilla treatment (1-5 ppm), and this study concluded that dipotassium salt of endothall was not found to be acutely toxic to fatmucket mussels at the application rates needed for hydrilla treatment (Archambault et al., 2015).

Additionally, dipotassium salt of endothall was also tested on dreissenid mussels, specifically zebra and quagga mussels, to evaluate impacts. At the highest concentration applied (5 ppm) maximum mortality of 5% was observed for quagga mussels at 20º C, and 2.5% at 25º C. Zebra mussels had zero mortality to any dipotassium salt of endothall concentration at either temperature regime (Claudi, Taraborelli, and Prescott, 2013). Given the results of these two studies on freshwater mussel species, impacts to the identified mussel species of concern within Selden Cove from the proposed dipotassium salt of endothall treatment are expected to be minimal.

### 2.3 Potential Impacts to Vertebrates of Concern

Preliminary assessments identified the state-listed wood turtle (*Glyptemys insculpta*) may be present within Selden Cove. One study of dipotassium salt of endothall impacts on eastern spiny softshell turtles (*Apalone spinifera spinifera*) exposed these aquatic turtles to test concentrations ranging from 0, 5, 25, and 125 ppm, for 96 hours and were then monitored for six weeks post-exposure. Even at 5 and 25 times the maximum dipotassium salt of endothall application rate, no observable toxic effects were recorded for any of the turtles, and none of the test turtles died during any part of the exposure/post-exposure portions of the experiment (Paul and Simonin, 2007). Unlike eastern spiny softshell turtles, wood turtles are not strictly aquatic, occupying both land and water habitats. Therefore, wood turtles have a lower exposure risk than the aquatic softshell turtles on which dipotassium salt of endothall was tested. Given the results of Paul and Simonin's (2007) study and the in-water herbicide application methods proposed for Selden Cove, the risk of negative impacts to wood turtles from the above proposed treatment will be minimal.

## 3. Conservation Strategy for Endangered, Threatened and Special Concern Species

### 3.1 Herbicide Application Methods and Timing

Strategic herbicide application methods and timing will be employed throughout this demonstration project to minimize the potential risk of impacts to non-target and state-listed species of concern. Dipotassium salt of endothall will be applied by licensed applicators at a concentration of 5 ppm in accordance with the product's USEPA-approved label. Additionally, treatment will only be applied once in 2024 to minimize both acute and chronic exposure risk to non-target submerged plants, as well as state listed aquatic vertebrates and invertebrates.

### 3.2 Considerations for Non-Target Plants

Submerged and emergent plant surveys confirmed the presence of awl-leaved arrowhead (*Sagittaria subulata*) just outside the proposed treatment area. These populations may experience low-dose herbicide exposure after treatment due to natural dissipation from water exchange process. However, collecting data on awl-leaved arrowhead response coupled with measured herbicide concentrations after treatment will be critical to inform future hydrilla management operations in Connecticut.

### 3.3 Considerations for Vertebrates

Alewife and blueback herring are known to spawn over aquatic vegetation within the proposed treatment area between April 1 and June 30. To minimize potential impacts to these spawning events, the timing of treatment application will be delayed until after July 4, 2024.

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FINAL

# Connecticut River
# Hydrilla Control Research and Demonstration Project
# Lower Connecticut River, CT

## Species Protection Plan
## Portland Boat Works
## Portland, CT

US Army Corps
of Engineers ®
New England District

December 2023

**Portland Boat Works Species Protection Plan**

## Table of Contents

1. Introduction ........................................................................................ 1
   1.1 Connecticut River Hydrilla Information ........................................................ 1
   1.2 Project Background ............................................................................ 1
   1.3 Portland Boat Works Treatment Site ........................................................... 2
      1.3.1 State-Listed Native Plant Species ....................................................... 4
      1.3.2 State-Listed Invertebrate Animals ....................................................... 4
      1.3.3 State-Listed Vertebrate Animals ......................................................... 4
2. Proposed Treatment Activity ......................................................................... 4
   2.1 Potential Impacts to Plants of Concern ....................................................... 5
   2.2 Potential Impacts to Invertebrates of Concern ................................................ 5
   2.3 Potential Impacts to Vertebrates of Concern .................................................. 5
3. Conservation Strategy for Endangered, Threatened and Special Concern Species 6
   3.1 Herbicide Application Methods and Timing ..................................................... 6
   3.2 Considerations for Vertebrates ............................................................... 7
4. References .......................................................................................... 7

# 1. Introduction

## 1.1 Connecticut River Hydrilla Information

Hydrilla (*Hydrilla verticillata*) was first identified in the Connecticut River near Glastonbury, CT in 2016 and has since spread south to Essex, CT infesting the river's many coves, tributaries, and boat basins. The Connecticut River hydrilla population has been shown to be genetically distinct from other known hydrilla strains (Tippery, Bugbee, and Stebbins 2020), and the plant's biology is therefore largely unknown at this time. Following the discovery of the highly invasive aquatic plant in the Connecticut River in 2016, intensive vegetation surveys were conducted in 2019 and 2020 from Agawam, MA south to Long Island Sound to map the invasion extent. Hydrilla was found as far north as Agawam, MA, confirming that the plant spreads rapidly which poses significant risk to other regional waterbodies (Bugbee and Stebbins 2022). Fragments of the plant, which are easily transported by boats and boat trailers, can sprout roots to establish new populations. Fragments also float and are capable of dispersing via wind and water currents. Due to the importance of the Connecticut River as an environmental resource and driver of the local economy, stakeholders are seeking an aggressive hydrilla management program.

## 1.2 Project Background

The U.S. Army Corps of Engineers (USACE), through Engineer Research and Development Center's (ERDC) Aquatic Plant Control Research Program, is leading a research and demonstration project to verify the effectiveness of aquatic herbicides registered for use by the U.S. Environmental Protection Agency (USEPA) to reduce and control the spread of the Connecticut River hydrilla safely and selectively. The project has been investigating hydrilla's growth patterns, site-specific water exchange dynamics and evaluating herbicide efficacy in laboratory conditions throughout 2023 to guide operational scale field demonstrations of herbicide efficacy in 2024.

Results from preliminary laboratory studies in 2023 indicated Connecticut River hydrilla was either more sensitive or equally sensitive to diquat compared to monoecious and dioecious hydrilla. Diquat dibromide is a fast-acting herbicide that can provide hydrilla control under very short exposure times. To assess onsite water exchange dynamics, USACE performed a dye study in August 2023. Rhodamine Water Tracer (RWT) dye was applied to the waters in the same manner herbicide would be. The concentrations of the dye in the water were collected after application and then analyzed to determine the half-life of the dye at Portland Boat Works. This tracer dye study resulted in a half-life of 21 minutes in Portland Boat Works when applied at low tide. Based on the results of these preliminary studies, Portland Boat Works has been selected as a hydrilla treatment site for ERDC's 2024 field demonstration project.

### 1.3 Portland Boat Works Treatment Site

Portland Boat Works is an operating marina located in Portland, Middlesex County, CT and centered at 41.562° N, 72.624° W. The treatment area is 0.6 acres with a mean depth of 0.9 to 3.2 feet mean lower low water. The marina is located along the shore of the main stem of the Connecticut River. Portland Boat Works was identified through ERDC's 2023 environmental studies to be significantly hydrilla-dominated, with over 70% hydrilla coverage throughout the waterbody.


**Figure 1.** Portland Boat Works hydrilla treatment area in Portland, CT.

### *1.3.1 State-Listed Native Plant Species*

Preliminary assessments of the Natural Diversity Database maps and files identified no state-listed plants within the delineated Portland Boat Works treatment area. Aquatic plant surveys were not conducted at this site as there were no species of concern anticipated at this location.

#### *1.3.2 State-Listed Invertebrate Animals*

Preliminary assessments of the Natural Diversity Database maps and files identified three state-listed invertebrates that may be present within Portland Boat Works: tidewater mucket (*Leptodea ochracea*, state special concern), eastern pondmussel (*Ligumia nasuta*, state special concern), and cobra clubtail (*Gomphus vastus*, state special concern). Neither mussel surveys nor insect surveys were completed during the 2023 environmental studies to confirm the presence of these species within Portland Boat Works.

#### *1.3.3 State-Listed Vertebrate Animals*

Preliminary assessments of the Natural Diversity Database maps and files identified six state-listed vertebrates that may be present within Portland Boat Works: shortnose sturgeon (*Acipenser brevirostrum*, state and federally endangered), Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*, state and federally endangered), blueback herring (*Alosa aestivalis*, state special concern), spotted turtle (*Clemmys guttata*, state special concern), northern leopard frog (*Rana pipiens*, state special concern), and the bald eagle (*Haliaeetus leucocephalus*, state threatened). Neither fish nor bird surveys were completed during the 2023 environmental studies to confirm the presence of these species.

## 2. Proposed Treatment Activity

The proposed treatment activity at Portland Boat Works includes the application of diquat dibromide, a USEPA-registered aquatic herbicide, at a concentration of 370 ppb in sequential treatments no less than 14 days apart. The herbicide will be evenly distributed across the entire treatment area delineated in Figure 1 using a boat-based, subsurface injection application method.

Diquat dibromide is a state and federally registered herbicide approved for application in aquatic sites for invasive aquatic plant control. A Registration Standard for diquat dibromide was issued by the EPA in June 1986 (U.S. EPA, 1995). The active ingredient ((6,7-dihydrodipyrido (1,2a:2',1'-c) pyrazinediium dibromide)) is a fast-acting herbicide that interferes with photosynthesis, disrupts plant cell membranes, and results in plant death within a week of application in sensitive plant species (Wisconsin Department of Natural Resources, 2012a).

## 2.1 Potential Impacts to Plants of Concern

No state-listed plants of concern were identified within the Portland Boat Works treatment area, therefore there are no anticipated impacts to plant species of concern.

## 2.2 Potential Impacts to Invertebrates of Concern

Three state-listed invertebrate species were identified to be potentially of concern for the proposed treatment area. For the two mussel species (tidewater mucket (*Leptodea ochracea*), eastern pondmussel (*Ligumia nasuta*)), diquat dibromide has not been shown to have acute impacts on most aquatic organisms on which it has been tested when abiding by label application rates (Wisconsin Department of Natural Resources, 2012). One study tested the impacts of diquat on the New Zealand freshwater mussel (*Hyridella menziesi*) and concluded that diquat had no significant effects on freshwater mussels and, therefore, was considered to be non-toxic to these organisms when applied at rates needed to kill most aquatic weeds (Clayton and Severne, 2005). Impacts to the identified mussel species of concern within Portland Boat Works are also expected to be minimal.

The third identified invertebrate of concern, the cobra clubtail (*Gomphus vastus*), is also not expected to be negatively impacted by the proposed treatment activity due to the in-water application methods under consideration. The EPA considers diquat to be of minimal risk to non-target insects (USEPA, 1995) and one study of dragonflies and damselflies observed that these insects survived after being exposed to diquat concentrations 40 times higher than the recommended maximum field application rate (Gilderhus, 1967).

## 2.3 Potential Impacts to Vertebrates of Concern

Six state-listed vertebrate animals were identified as potentially present within the proposed Portland Boat Works treatment area. For the three fish species of concern (shortnose sturgeon (*Acipenser brevirostrum*), Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*), blueback herring (*Alosa aestivalis*)), studies have found that diquat has relatively low toxicity to fish and does not appear to significantly bioaccumulate in fish tissue (Bureau of Land Management 2005). The results of acute exposure studies on freshwater fish have been summarized as “slightly toxic to practically non-toxic for diquat dibromide” (Hartless and Lin, 2010). No adverse effects are anticipated for the fish species of concern given that the proposed application rates are within the concentration limits specified on the EPA-approved herbicide label and that dosages will be spread apart by a minimum of two weeks, minimizing the risk of chronic exposure and impacts.

The spotted turtle (*Clemmys guttata*) was identified as a state listed species which may potentially be impacted by the proposed herbicide treatment. One study on diquat toxicity to the eastern spiny softshell turtle (*Apalone spinifera spinifera*) monitored these aquatic turtles over time as they were exposed to a range of in-water herbicide concentrations. This study did not observe any toxic effects to any of the turtles and none of the turtles used in the experiment died during either the exposure or post-exposure monitoring portions of the test. This study concluded that softshell turtles were not sensitive to diquat (Paul and Simonin, 2007). Given that the spotted turtle is also an aquatic turtle, the risk of toxic impacts of the above-described treatment activity is therefore also considered minimal.

One study of diquat impacts on the northern leopard frog (*Rana pipiens*) found that in a 16-day exposure period, adverse effects were observed at 5mg/L concentrations, however no adverse effects were observed at 2mg/L concentrations (Dial and Dial, 1987). Both concentrations are substantially higher than the proposed treatment application rate in Portland Boat Works so the risk of negative impacts to this species is expected to be minimal should they be present at the time of treatment. Additionally, the northern leopard frog is a semi-terrestrial species, utilizing aquatic environments for winter hibernation and breeding in the spring, but spending summer months primarily out of the water feeding in grasslands and woodlands (U.S. Fish & Wildlife Service, n.d.). Given the timing of the proposed treatment activity (late July through early August) adult northern leopard frogs are not anticipated to be present in the aquatic environment in which the treatment will be applied, further minimizing the risk of potential impacts to these species.

The risk of acute impacts to bald eagles (*Haliaeetus leucocephalus*) from the proposed treatment activity is also expected to be low. Because herbicides will be applied using subsurface injection methods, no airborne exposure risks to nearby bald eagles at the time of application are anticipated. While diquat dibromide has been found to be moderately toxic to birds in acute oral exposure studies (USEPA, 1995; Bureau of Land Management, 2005; Emmett, 2002), many of these studies were conducted at much higher concentrations than what will be applied to Portland Boat Works. Additionally, risks to piscivorous birds such as bald eagles was found to be low given that bioaccumulation in fish species is also low (Bureau of Land Management, 2005).

## 3. Conservation Strategy for Endangered, Threatened and Special Concern Species

### 3.1 Herbicide Application Methods and Timing

Strategic herbicide application methods and timing will be employed throughout this demonstration project to minimize the potential risk of impacts to non-target and state-listed species of concern. Diquat will be applied by licensed applicators at a concentration of 370 ppb in accordance with the product's EPA-approved label. Herbicide will be applied directly to the water and evenly distributed across the entire treatment area using boat-based, subsurface injection application methods to minimize airborne exposure risks to non-target species. Additionally, sequential treatment will be applied no less than 14 days apart to minimize both acute and chronic exposure risk to non-target submerged plants, as well as state listed aquatic vertebrates and invertebrates.

### 3.2 Considerations for Vertebrates

Alewife and blueback herring are known to spawn over aquatic vegetation within the proposed treatment area between April 1 and June 30. To minimize potential impacts to these spawning events, the timing of treatment application will be delayed until after July 4, 2024. This timing is also expected to minimize potential exposure risks for northern leopard frogs (*Rana pipiens*) which are more likely to be in upland environments during this time.

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