New Hampshire DOT

# Research Record

# Biological Control of Purple Loosestrife in New Hampshire 1997-2001

## Final Report

Prepared by the New Hampshire Department of Agriculture, Markets & Food, in cooperation with the U.S. DOT, Federal Highway Administration

| 1. Report No. | 2. Gov. Accession No. | 3. Recipient's Catalog No. |
|---|---|---|
| FHWA-NH-RD-12323Q | | |

| 4. Title and Subtitle | 5. Report Date |
|---|---|
| Biological Control of Purple Loosestrife in New Hampshire 1997-2001 | March, 2003 |
| | 6. Performing Organization Code |

| 7. Author(s) | 8. Performing Organization Report No. |
|---|---|
| Thomas J. Durkis, State Entomologist | |

| 9. Performing Organization Name and Address | 10. Work Unit No. (TRAIS) |
|---|---|
| State of New Hampshire<br>Dept. of Agriculture, Markets & Food, PO Box 2042, Concord, NH 03302<br>Dept. of Transportation, Bureau of Environment, PO Box 483, Concord, NH 03302 | |
| | 11. Contract or Grant No.<br>12323Q, SPR-0004(021) |

| 12. Sponsoring Agency Name and Address | 13. Type of Report and Period Covered |
|---|---|
| New Hampshire Department of Transportation<br>Bureau of Materials and Research<br>PO Box 483<br>Concord, New Hampshire 03302-0483 | FINAL REPORT |
| | 14. Sponsoring Agency Code |

15. Supplementary Notes

In cooperation with the U.S. DEPARTMENT OF TRANSPORTATION, FEDERAL HIGHWAY ADMINISTRATION

16. Abstract

Purple loosestrife, *Lythrum salicaria*, is an invasive, non-native plant introduced in the United States from Europe and Asia beginning in the early nineteenth century. As the purple loosestrife population expanded, concerns increased about its potential impact in moist habitats. Since the 1950's, a variety of mechanical, cultural, and chemical controls have been employed in an attempt to control the effect of the species on natural and manmade wetlands. These methods were either impractical or abandoned due to ineffectiveness or environmental concerns.

Biological control of weeds utilizes the introduction of natural enemies to reduce population levels of undesirable plants. Biological control is considered a safe, sustainable, cost effective, long-term method for reducing invasive plant populations.

This report summarizes a pilot program instituted by the New Hampshire Department of Agriculture, Markets and Food and the New Hampshire Department of Transportation to control purple loosestrife in New Hampshire wetlands between 1997 and 2001. The program included the screening and selection of candidate insects, rearing, controlled releases and monitoring at numerous sites throughout the state. A total of 130,400 Galerucella spp. leaf-eating beetles were released during the period. The program was successful in establishing viable populations of these beetles at several locations. The release of beetles adjacent to and within areas proposed for future wetland mitigation creation and along NHDOT right-of-ways established diversity in the introduction of biocontrol of loosestrife over a wider region.

It is recommended that biocontrol of this species be maintained and expanded. Community rearing and release is encouraged, and continued monitoring should occur. Further investigations into the possible use of root feeding weevils is recommended.

| 17. Key Words | 18. Distribution Statement |
|---|---|
| Biological control, purple loosestrife, environment, wetlands, invasive, species, Lythrum, salicaria, galerucella, beetles, rearing | No Restrictions. This document is available to the public through the National Technical Information Service (NTIS), Springfield, Virginia, 22161. |

| 19. Security Classif. (of this report) | 20. Security Classif. (of this page) | 21. No. of Pages | 22. Price |
|---|---|---|---|
| UNCLASSIFIED | UNCLASSIFIED | 59 | |

# Biological Control of Purple Loosestrife in New Hampshire 1997-2001

The contents of this report reflect the views of the author who is responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of the New Hampshire Department of Transportation or the Federal Highway Administration at the time of publication. This report does not constitute a standard, specification, or regulation.


## ACKNOWLEDGEMENTS

We would like to acknowledge the following people who have provided assistance, guidance or encouragement in an effort to help make New Hampshire's purple loosestrife program a success. Thank you.

Dr. Paul Parker and Gene Holt USDA APHIS, Marc Laurin NHDOT, Doug Cygan NHDES, Dr. Siegfried Thewke, Jon Janis, Rachel Maccini and Chris Rallis NHDA, M&F, Jack Shimanowski NHCOR, Dan Palmer NJDA, Dr. John Weaver CAPS Coordinator, Barbara McIlroy Upper Valley PL Coalition and all program participants and landowners.





Report prepared by:

Thomas J. Durkis
State Entomologist
NH Dept. of Agr., Markets & Food

# TABLE OF CONTENTS



# List of Tables

## EXECUTIVE SUMMARY

Purple loosestrife, *Lythrum salicaria*, is an invasive, non-native plant introduced in the United States from Europe and Asia beginning in the early nineteenth century. As the purple loosestrife population expanded, concerns increased about its potential impact in moist habitats. Since the 1950's, a variety of mechanical, cultural, and chemical controls have been employed in an attempt to control the effect of the species on natural and manmade wetlands. These methods were either impractical or abandoned due to ineffectiveness or environmental concerns.

Biological control of weeds utilizes the introduction of natural enemies to reduce population levels of undesirable plants. Biological control is considered a safe, sustainable, cost effective, long-term method for reducing invasive plant populations.

This report summarizes a pilot program instituted by the New Hampshire Department of Agriculture, Markets and Food and the New Hampshire Department of Transportation to control purple loosestrife in New Hampshire wetlands between 1997 and 2001. The program included the screening and selection of candidate insects, rearing, controlled releases and monitoring at numerous sites throughout the state. A total of 130,400 Galerucella spp. leaf-eating beetles were released during the period. The program was successful in establishing viable populations of these beetles at several locations. The release of beetles adjacent to and within areas proposed for future wetland mitigation creation and along NHDOT right-of-ways established diversity in the introduction of biocontrol of loosestrife over a wider region.

It is recommended that biocontrol of this species be maintained and expanded. Community rearing and release is encouraged, and continued monitoring should occur. Further investigations into the possible use of root feeding weevils is recommended.

## INTRODUCTION

Purple loosestrife, *Lythrum salicaria,* is an invasive, non-native plant introduced here in the United States from Europe and Asia. Its introduction began in the early nineteenth century, when it was thought to have unintentionally arrived here in contaminated ship ballast. It was also purposely brought here for its medicinal herb value and general plant appeal. By the early 1800's it was well established throughout New England, at least along the coast. Construction of inland waterways in the late 1800's promoted the distribution and expansion of the plant, particularly in New York and throughout the St. Lawrence River Valley. The plant has kept pace with commercial development, spreading naturally as well as being widely distributed by horticultural enterprises.

The plant has characteristics that enable it to become well established in a variety of areas. It can reproduce by both sexual and vegetative means. A single plant can

produce more than 2.5 million seeds each season. The seeds are long lived and easily transported by water, wind, animals and people. Seed banks beneath well-established stands of purple loosestrife can be enormous. Its long flowering season, prolific seed set, strong root stock and ability to tolerate a broad range of climate, soil types, and nutrient levels enables the plant to out compete other plant species.

As purple loosestrife expanded, concerns increased about its potential impact in moist habitats. In the 1950's a variety of mechanical control methods were tried including, flooding, cutting, burning and hand pulling. All of these methods proved to be ineffective, unfeasible or too time consuming. Cultural control methods involving site manipulation by altering pH levels or modifying soil amenities proved ineffective as well. Chemical controls using registered herbicides have reduced loosestrife populations. Although they can be effective in eliminating loosestrife, their use near water is often restricted or prohibited and they do not selectively kill only loosestrife plants. Furthermore, there is concern about potential environmental harm, particularly the long-term effects of repeated herbicide usage and applications near water.

Biological control of weeds utilizes the introduction of natural enemies to reduce population levels of undesirable plants. Biological control is considered a safe, sustainable, cost effective, long-term method for reducing purple loosestrife populations.

In the early 1990's after screening over 120 potential beneficial insects that could be used to control purple loosestrife the US Department of Agriculture received approval for the release of four insects. The four insects were selected because they were found to be host specific, they possessed good survival and reproductive potential and they were considered effective biological control agents. Three of the four candidates have been released here in New Hampshire. They include a very limited number of root-boring weevils, *Hylobius transversovittatus* along with thousands of leaf-feeding beetles, *Galerucella pusilla* and *G. calmariensis.*

## RELEASE PROGRAMS 1997-1999

On February 3, 1996, personnel from the New Hampshire Department of Agriculture Markets and Food (NHDA, M&F) and New Hampshire Department of Transportation (NHDOT) began devising a cooperative project intended to help reduce purple loosestrife, *Lythrum salicaria*, in New Hampshire using biological control agents. Both parties agreed to participate in two designed programs: A USDA-APHIS (Animal Plants Health Inspection Service) multi state purple loosestrife project; and, in a similar, but separate three-year state devised program. The state program required the purchase of leaf-feeding beetles from the New Jersey Department of Agriculture Beneficial Insect Laboratory. Beetles were also acquired from the Mission Plant Protection Center in Mission, Texas and in Niles, Michigan to conduct the USDA-APHIS project. The first year objectives were to compile a list of purple loosestrife locations and prioritizing of sites based on loosestrife population densities and mitigation significance. The next step was to release beneficial insects to control loosestrife populations. The final step was to appraise and report on insect feeding damage observed within the release sites.

Permanent transects were installed prior to any insect releases. The transects were used to aid in gathering baseline data needed to monitor and evaluate existing vegetation and insect dispersal. Each site was mapped and evaluated by a detailed written description of its location. A survey was conducted in each of the sites prior to the release of any control agents. All of the chosen release sites were known NHDOT mitigation sites and all were categorized as marsh or wetland areas. Additionally, these sites' US Army Corps of Engineers and the NH Wetlands Bureau wetland permits had conditions requiring efforts to control invasive species.

The first release of beetles took place on June 4, 1997 when approximately 2500 *Galerucella sp.* adults were released at a site located in Nashua. Later that year additional releases were made in Merrimack and Littleton and by the end of the year a total of 20,000 leaf-feeding beetles had been released.

**Table 1 - *Galerucella sp.* releases 1997**

| Date | Town | County | Location | Source | # Beetles |
|---|---|---|---|---|---|
| 6/4/97 * | Nashua | Hillsborough | Site 1, Rte. 111A E. Dunstable Rd. | N.J.D.A. | 2,500 |
| 6/11/97 * | Nashua | Hillsborough | Site 2, Rte. 111A E. Dunstable Rd. | N.J.D.A. | 2,500 |
| 7/1/97 * | Merrimack | Hillsborough | Camp Sargeant Rd. | Mission, TX | 5,000 |
| 7/2/97 * | Littleton | Grafton | Sewage Treatment Plant | Mission, TX | 10,000 |

* Denotes Mitigation Site **Total 20,000**

In 1998, the year's activities began by scouting for the presence of beetles released the previous year. All of the prior year's release sites were investigated and observations confirmed the successful over wintering and establishment of *Galerucella* leaf-feeding beetles in all release sites. Additional sites were selected to receive beetles and a few past release sites had their beetle populations augmented. A rearing cage was erected at the Merrimack site to aid in beetle egg deposition but the site experienced heavy rainfall and the water levels remained high for several weeks resulting in heavy beetle mortality. At the end of 1998, a total of 32,500 beetles had been released in the five areas of Nashua, Merrimack, Littleton, Bedford and Portsmouth.

In 1998, the NH Department of Environmental Services (DES) established a law (WD-BB-40) that prohibited the sale of purple loosestrife plants in New Hampshire (Appendix A). The NH Department of Agriculture's Plant Industry Division personnel routinely inspect for loosestrife plants when conducting annual nursery inspections. Purple loosestrife plants were occasionally sold under the scientific name *Lythrum virgatum* rather than the more common *L. salicaria.* In order to help resolve any discrepancies in plant labeling and to help determine if the plants were one and the same,

Department of Agriculture personnel volunteered to participate in a USDA-APHIS purple loosestrife DNA survey. Leaf samples were collected from loosestrife plants that were removed from sale during routine nursery inspections in 1998 and 1999. A DNA analysis was performed in order to determine if there were any differences between plants sold in nurseries as *Lythrum salicaria* and *L. virgatum*. Unfortunately, the results of the tests proved to be inconclusive.

**Table 2 - *Galerucella sp.* releases 1998**

| Date | | Town | County | Location | Source | # Beetles |
|---|---|---|---|---|---|---|
| 6/03/98 | * | Bedford | Hillsborough | Center Rd | N.J.D.A. | 5,000 |
| 6/17/98 | * | Nashua | Hillsborough | Site 2, Rte 111A E. Dunstable Rd. | Mission, TX | 1,500 |
| 6/17/98 | * | Merrimack | Hillsborough | Camp Sargeant Rd. | Mission, TX | 1,500 |
| 6/23/98 | * | Portsmouth | Rockingham | Pease Tradeport | Mission, TX | 4,500 |

* Denotes Mitigation Site **Total 12,500**

In 1999, a rearing cage was once again used (on the Portsmouth site) in an attempt to aid in increasing beetle reproduction. Both NHDA and NHDOT personnel continued to monitor beetle activity and document plant damage. The season's beetle releases began on June 2 and ended July 29 with our ninth and final release. New release sites were selected in Keene, New Boston, Bow, Manchester and Nashua. Purple loosestrife flower production in our test sites was noticeably less in 1999. However, beetle feeding damage alone did not account for the drastic flower reduction. In all probability, less than normal precipitation throughout most of the state, and in particular in the southern counties, combined with the noticeably high leaf-feeding beetle activity, most likely contributed to and was the reason for this reduced flowering. A total of 45,500 beetles were released in 1999. Beetles were received from the New Jersey Department of Agriculture and the USDA-APHIS Biological Laboratory in Niles, Michigan. In addition, 5,500 field-collected beetles from Oregon were shipped to NH in July. The Oregon shipment represented the first use of field-collected beetles.

In 1999, the Department of Agriculture in cooperation with members of the Piscataquog Watershed Association released beetles at two infested sites in New Boston, New Hampshire. Experimental transects weren't erected in any of these newly established release sites and the customary plant growth observations were not recorded. Instead these sites were simply used as beetle repositories. By the end of 1999 six of New Hampshire's ten counties had at least one site where *Galerucella* beetles had been released over the previous three years.

**Table 3 - *Galerucella sp.* releases 1999**

| Date | Town | County | Location | Source | # Beetles |
|---|---|---|---|---|---|
| 6/02/99 * | Nashua | Hillsborough | Site 1, Rte. 111A E. Dunstable Rd. | Niles, MI | 5,000 |
| 6/02/99 * | Nashua | Hillsborough | Site 2, Rte. 111A E. Dunstable Rd. | Niles, MI | 5,000 |
| 6/02/99 * | Keene | Cheshire | Rte. 9/10/12 | Niles, MI | 5,000 |
| 6/03/99 * | Portsmouth | Rockingham | Pease Tradeport | N.J.D.A. | 5,000 |
| 6/24/99 | New Boston | Hillsborough | Site 1 | Niles, MI | 10,000 |
| 6/24/99 | New Boston | Hillsborough | Site 2 | Niles, MI | 10,000 |
| 7/29/99 | Bow | Merrimack | I-89 Loop Ramp | Oregon | 2,000 |
| 7/29/99 * | Manchester | Hillsborough | Candia Rd. | Oregon | 1,500 |
| 7/29/99 * | Nashua | Hillsborough | Searles Rd. | Oregon | 2,000 |

* Denotes Mitigation Site **Total 45,500**

## RELEASE PROGRAM 2000

In the year 2000, an Integrated Pest Management (IPM) grant was awarded to the New Hampshire Department of Agriculture, Markets and Food in order to develop a Community Purple Loosestrife IPM Program. It became apparent while attending informational and educational meetings on invasive species that individuals wanted to do more than just learn about these problems. They wanted instead to take an active part in solving them. The Community Purple Loosestrife IPM project was an attempt to address these concerns, however, before the program could be implemented a work force had to be secured. In August 1999, Concord State Prison officials agreed to participate in a beetle-rearing project designed for the 2000 growing season. Their participation in the project provided inmates that would supply the requisite labor needed to rear the beetles. Inmate labor was used to dig, pot and grow purple loosestrife plants, which in turn were used to help rear *Galerucella* beetles. Beetle rearing was accomplished by using the guidelines found in Biological Control of Purple Loosestrife: A Guide for Rearing Leaf-feeding Beetles; University of Minnesota Extension Service (Appendix B). A total of 80 loosestrife plants were grown in wading pools. These plants helped serve as a food source for between 500-1000 beetles that were reared on each sleeved plant. The plants were then made available to program participants and taken to purple loosestrife infested sites where the beetles were released. Out of the 80-sleeved pots, 76 were distributed in the field. The pots containing beetles were released into the field between July 19th and July 21st. There were 28 release sites in 13 towns (Appendix C).

In addition to the prison-rearing program, a number of beetles were purchased from the New Jersey Department of Agriculture (NJDOA) and others received from the USDA-APHIS laboratory in Niles, Michigan. These beetles were released in existing NHDOT mitigation sites where beetles had previously been released, and in new sites located in the towns of Salem and Hudson.

In July, the Merrimack, Nashua, Bedford and Manchester release sites were evaluated to determine the degree of beetle feeding damage, the percentage of purple loosestrife coverage and the amount of flowering. On average, the Merrimack site exhibited approximately 37% loosestrife coverage with an average feeding damage of 28% per plant. Although the purple loosestrife coverage remained relatively unchanged from data collected in 1997, it appeared that there was a dramatic decline in the number of flowering stems, which was most likely attributed to beetle feeding damage.

The Bedford site had slightly less loosestrife coverage, however, the flower production was greatly reduced. Releases were, once again, conducted at this site to increase populations and to encourage greater plant feeding damage.

Both of the Nashua sites showed a tremendous decrease in the percentage of purple loosestrife coverage since 1997. Initially, these sites were almost entirely purple loosestrife monocultures, with an average of greater than 75% coverage. By the end of the growing season, the loosestrife density had been reduced to less than 5%. Feeding damage was estimated to be between 75-100%, a dramatic increase when compared to only 5% in 1997.

The Manchester site was also evaluated and showed a very low rate of leaf feeding. This was probably due in part because there was only one release of a small number of beetles at this site the previous year. It appeared that the beetle population was not sufficiently high enough to have any noticeable effect. The density and height data was recorded for the purple loosestrife for the first time from this site.

In summary, the Nashua sites have shown a tremendous reduction in the number of purple loosestrife plants. The introduction of *Galerucella* beetles into these particular mitigation sites has crippled the growth of the shoots and has greatly impacted their flowering potential, thus reducing viable seed and stem production. The Bedford and Merrimack sites both exhibited significant beetle activity. Flower production was down dramatically and stem height continued to decline. Additional beetle releases in the Bedford, Merrimack and Manchester sites were recommended for 2001.

## Table 4 - *Galerucella sp.* releases 2000

| Date | | Town | County | Location | Source | # Beetles |
|---|---|---|---|---|---|---|
| 6/15/00 | | Salem | Rockingham | Rockingham Blvd. | N.J.D.A. | 5,000 |
| 6/16/00 | * | Merrimack | Hillsborough | Camp Sargeant Rd. | Niles, MI | 10,000 |
| 6/22/00 | * | Hudson | Rockingham | Bensons | N.J.D.A. | 5,000 |
| 6/27/00 | * | Bedford | Hillsborough | Center Rd. | N.J.D.A. | 5,000 |
| 7/07/00 | | Bow | Merrimack | I- 89 Loop Ramp | N.J.D.A. | 5,000 |
| 7/13/00 | | Bow | Merrimack | I-89 Loop Ramp | N.J.D.A. | 5,000 |

* Denotes Mitigation Site **Total 35,000**

## RELEASE PROGRAM 2001

In 2001, the Department of Agriculture received approval for two additional IPM purple loosestrife grants. One of the grants extended the funds necessary to continue the Concord prison-rearing program, which was initiated in 2000. The other grant was designed to conduct a number of educational seminars aimed at teaching communities the proper methods for rearing leaf-feeding beetles (Appendix D). Initially the program was aimed at simply instructing individuals on how to grow purple loosestrife plants and rear beetles for their eventual release. However, seminar discussions soon made it apparent that many of the participants would need specialized equipment to successfully implement their rearing projects. The Department of Transportation (DOT) helped purchase no-see-um netting used to construct the sleeves needed to contain the beetles and to purchase beetles used to start the rearing process. Participants were required to mark and map the area of beetle release, and to revisit the release sites for the next two consecutive seasons to ensure beetle establishment and determine the degree of feeding damage (Appendix E). This level of commitment, which participants have willingly chosen to undertake, speaks highly about the confidence they have in using biological controls and their enthusiasm about this project to help solve some of the problems that we are all facing regarding invasive plants.

## Table 5 - *Galerucella sp.* releases 2001

| Date | | Town | County | Location | Source | # Beetles |
|---|---|---|---|---|---|---|
| 6/6/01 | * | Bedford | Hillsborough | Center Rd. | N.J.D.A. | 5,000 |
| 6/13/01 | | Portsmouth | Rockingham | | N.J.D.A. | 500 |
| 6/13/01 | * | Brentwood | Rockingham | Pine Rd. | N.J.D.A. | 750 |
| 6/13/01 | * | Manchester | Hillsborough | Candia Rd. | N.J.D.A. | 1,250 |
| 6/20/01 | | Bow | Merrimack | I-89 | N.J.D.A. | 1,000 |
| 6/20/01 | | Beetle rearing | | | N.J.D.A. | 1,500 |
| 6/27/01 | * | Manchester | Hillsborough | Candia Rd. | N.J.D.A. | 1,400 |
| 6/27/01 | | Beetle rearing | | | N.J.D.A. | 1,000 |
| 7/11/01 | | Bedford | Hillsborough | Rt. 101 | N.J.D.A. | 1,250 |
| 7/11/01 | * | Nashua | Hillsborough | Searles Rd. | N.J.D.A. | 1,250 |
| 7/11/01 | * | Hudson | Hillsborough | Bensons | N.J.D.A. | 1,875 |
| 7/11/01 | | Concord | Merrimack | Clinton St. | N.J.D.A. | 625 |

* Denotes Mitigation Site **Total 17,400**

In addition to the usual cooperative NHDOT and NHDA, M&F beetle releases that were presented in the preceding chart, beetles were also released through the use of the Community Rearing Project and the Concord Prison Rearing program, (Appendix F and G). These two programs helped to increase the number of beetle populations throughout the state.

## SUMMARY

The cooperative NHDA, M&F and NHDOT program released a total of 130,400 beetles during the period of 1997-2001, in six of the state's ten counties. Additional releases in the year 2000 included 76 plants reared at the Concord prison, each containing approximately 500-1500 beetles, which represents 38,000 to 114,000 potential beetle releases. If we combine the year 2000 prison rearing program releases with the total Cooperative NHDA and DOT programs, the number of beetle releases for the period 1997-2000 is estimated to be between 168,400 and 244,400. Unfortunately, the 2001 Community Rearing Program did not fare as well regarding the success in rearing beetles. However, there were a large number of enthusiastic participants in the program. We can expect an even greater number of willing participants to be rearing beetles on plants in future seasons, with the hope of releasing large numbers into the field.

**Table 6 – Summary of NHDA, M&F and NHDOT Cooperative Program**

| Year | # Beetles |
|---|---|
| 1997 | 20,000 |
| 1998 | 12,500 |
| 1999 | 45,500 |
| 2000 | 35,000 |
| 2001 | 17,400 |
| **Subtotal** | **130,400** |
| Community/Prison Programs | 38,000 to 114,000 |
| **Total** | **168,400 to 244,400** |

## CONCLUSIONS

The dissemination of Galerucella spp. leaf-eating beetles for the control of purple loosestrife over the past five years has been successful in establishing viable populations of these beetles in several areas of the State of NH. The initial releases were concentrated in NHDOT wetland mitigation sites which had been markedly invaded by purple loosestrife. The establishment of the beetles at these sites and subsequent control of loosestrife within these areas, most notably at the East Dunstable Road site in Nashua, demonstrates that the Biocontrol Program is a successful and valid method of controlling this invasive plant. The release of beetles adjacent to and within areas proposed for future wetland mitigation creation and along NHDOT right-of-ways established diversity in the introduction of biocontrol of loosestrife over a wider region. The state prison rearing program, and the community rearing and release program have been shown to be successful methods to supplement the purchase of beetles. These programs have also provided the opportunity for the release of the beetles into more communities and have allowed local conservation commission input on the additional release sites.

## RECOMMENDATIONS

The success that has been evident in several Galerucella ssp. release sites demonstrates that biocontrol of purple loosestrife should be maintained and expanded. Community rearing and release should be encouraged and extended. Continued monitoring of these releases should also occur. The release locations should continue to be expanded to include sites in every region of New Hampshire. Further investigations of the possible use of Hylobius transversovittatus, a root feeding weevil, to enhance the control of purple loosestrife should be investigated.

## IMPLEMENTATION PLAN

These goals are to be implemented through the continued purchase and release of beetles from established sources. Releases of the beetles will continue in the following manner: at existing NHDOT wetland mitigation sites to supplement previous releases; at newly established and proposed NHDOT wetland mitigation sites; and, if enough beetles are available, releases at sites along NHDOT Right-of-Way in order to disseminate the beetles over a wider geographical area of NH. A portion of the beetles purchased will also be used to continue the Community Rearing Program. Monitoring of the release sites will be continued. Further outreach will be accomplished by presenting the findings of this program to local and state conservation organizations. Continued gathering of pertinent information which could enhance this program will be made by considering attending appropriate conferences and/or obtaining scientific literature on other similar biocontrol programs.

# Appendix A – NHDES Prohibited Plant Law

ENVIRONMENTAL
Fact Sheet

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

6 Hazen Drive, Concord, New Hampshire 03301 · (603) 271-3503 · www.des.state.nh.us

WD-BB-40 Revised 1999

# Law Prohibits Aquatic Plants

As of January 1, 1998, the sale, distribution, importation, propagation, transportation, and introduction of exotic aquatic plants into the state of New Hampshire is prohibited (RSA 487:16-a). This new law was designed as a tool for lake managers to help prevent the spread of nuisance aquatic plants. It is hoped that by preventing their transport over land, their spread between lakes will be stopped.

The following is a list of prohibited exotic aquatic species in New Hampshire:

| Scientific Name | Common Name |
|---|---|
| *Myriophyllum heterophyllum* | variable milfoil |
| *Myriophyllum spicatum* | Eurasian milfoil |
| *Cabomba caroliniana* | fanwort |
| *Hydrilla verticillata* | hydrilla |
| *Trapa natans* | water chestnut |
| *Myriophyllum aquaticum* | parrot feather |
| *Potamogeton crispus* | curly leaf pondweed |
| *Lythrum salicaria, L. virgatum, L. alatum* | purple loosestrife |
| *Phragmites australis or P. communis* | common reed |
| *Egeria densa* | Brazilian elodea |
| *Hydrocharis morsus-ranae* | frogbit |
| *Butomus umbellatus* | flowering rush |
| *Najas minor* | European naiad |
| *Nymphoides peltata* | yellow floating heart |

There are currently 41 waterbodies in the state with known exotic plant infestations. Milfoil and fanwort have been spreading between New Hampshire's waterbodies since the late 1960's. It is believed that these plants first entered the state's waterbodies from a discarded home aquarium. From there, these nuisance plants have spread to other lakes in the state primarily through boating activities. Water chestnut (*Trapa natans)* was recently discovered in the Nashua River. The other plants listed above have become nuisance species in other states, and may find New Hampshire's waters adequate for infestation.

**How did this law come about?**

Since the mid 1960's, various lakes around the state have been plagued by nuisance aquatic plants such as exotic milfoil and fanwort. Others that do not grow directly in water, but in moist habitats such as roadsides ditches and wetlands, have been spreading rapidly. The pretty purple flower known as purple loosestrife and the tall tufted reed known as common reed are becoming common sights in the state.

To prevent the further spread of these nuisance exotic plants, the NH Department of Environmental Services (DES) has drafted rules to make RSA 487:16-a enforceable. These rules include the above listed prohibited species which are already, or may quickly become, nuisance aquatic plants in New Hampshire.

**Why are these particular plants a problem?**

Plants which are native to a particular area have attracted a variety of predators including insects, animals, or pathogens (viruses/fungi) which prevent out-of-control plant growth. Exotic plants have been introduced into the state from areas that are both inside and outside of the United States. Because they are not native to the state, they have no natural predators to moderate their growth. Exotic species are thus able to flourish unchecked in any suitable habitat.

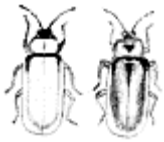
Once established in the state, exotic plants can take over large portions of the ecosystems to which they are introduced. They can cause a decrease in the aesthetic, recreational, and monetary value of New Hampshire's waterbodies. Exotic species can also pose a threat to many native species and valuable wildlife habitats.

**How did these plants find their way to New Hampshire?**

There are a variety of sources that are believed to have introduced exotic plant species into the state. Some of these sources are natural and are hard to control. A natural source may include the widening of the species range due to an increase in disturbed areas. Interstate transport of exotic plants may also occur when seeds and plant pieces become attached to migrating birds and waterfowl.

Other sources revolve around human activities. The sale of aquatic plants, dumping of aquaria into waterbodies, importation of plants for distribution or research, boats, vehicles, and trailers traveling between infested and uninfested waterbodies, and even fishing lures and bait buckets with plant pieces attached can all result in the statewide spread of the nuisance exotic plants. These activities though numerous, are more easily regulated than natural means of transport.

# Appendix B – Beetles Rearing Guide



# Biological Control of Purple Loosestrife: A Guide for Rearing Leaf-feeding Beetles

**Alyson Loos,** Jr. Scientist
**David Ragsdale,** Professor Entomology



## Introduction

Biological control (biocontrol) is using a living organism to control a pest. The goal is to reduce the numbers of the target pest organism, not to eradicate the pest. Biocontrol has been used to effectively control exotic weed and insect pests by introducing natural enemies to an infested area. Two species of beetles in the genus *Galerucella* are used for biocontrol of the exotic wetland weed purple loosestrife (*Lythrum salicaria*).

Purple loosestrife is an aggressive perennial plant of European origin found throughout Canada and the United States. Minnesota currently has over 1,800 known sites infested with purple loosestrife that collectively cover approximately 38,000 acres. Purple loosestrife is a serious concern because it displaces native wetland plants and can become the dominant plant, thereby reducing species diversity and changing the ecosystem of a wetland. A single purple loosestrife plant with multiple stems can produce between one and two million seeds that are easily dispersed along rivers and waterways. Even a few purple loosestrife plants pose a serious threat to an entire wetland.

The leaf-feeding beetles (*Galerucella* spp) reduce the growth and reproduction of purple loosestrife. The adult beetles feed on the leaves of purple loosestrife and lay their eggs. Once the eggs have hatched, the larvae feed on the leaves and stems as they move down into the soil. The larvae cause the most damage to the plant and reduce the number of seeds produced. The leaf-feeding beetles released in Minnesota originated in Germany, and years of host-range screening were conducted to determine host specificity before approval was granted by the United States Department of Agriculture to release these beetles as biological control agents.

The beetles feed primarily upon purple loosestrife and have a low preference for a few native *Decodon* and *Lythrum* species. The risk to these native species was determined to be far greater if we did nothing, because their habitat would be overrun by purple loosestrife.

This publication is a guide to rearing leaf-feeding beetles for biological control of purple loosestrife. Successful establishment of the beetles will reduce the impact of purple loosestrife on native wetland plants.

# Purple Loosestrife

## Identifying

Purple loosestrife stems end with a spike of many individual flowers. Each flower has five to six pink-purple petals (Figure 1). Other key characteristics are: 1) a four-to-six sided stem that can be two-to-six feet tall and woody with several stems arising from a perennial crown root, 2) leaves usually opposite or whorled at the base of the stem, becoming alternate at the top, and 3) a prominent leaf venation with pinnate veins ending in a common vein parallel to, and extending along the entire leaf margin (Figure 2). Don't be confused by purple loosestrife look-a-likes. Information on look-a-likes and replacement alternatives can be found in the *Replacing Loosestrife* section of this publication.

**Figure 1**

**Figure 2**

## Controlling Biologically

The following is a step-by-step guide for growing purple loosestrife, rearing the beetles, and releasing the beetles into a purple loosestrife infested wetland. Because purple loosestrife is a noxious weed, you must obtain permission from the Minnesota Department of Agriculture and Department of Natural Resources to grow these plants.

### *Step 1. Field collection of root crowns*

- Equipment
  - Long-handled round-pointed shovel
  - Extra heavy garbage bags
  - Pruning shears
  - Personal gear (hip or chest waders, gloves & protective eyewear)

Root crowns of purple loosestrife are collected from wetlands and grown in pots to provide a food source for the beetle adults and larvae. Contact your county agriculture inspector for permission to transport root crowns as part of this biological control project before you do any collecting.

## Root crown harvesting

Purple loosestrife root crowns need to be harvested in early spring. Crowns should be collected as soon as wetlands have thawed in late April to early May (before loosestrife buds begin to appear). Shoot growth from purple loosestrife crowns is dependent upon weather conditions. Therefore, it is important to collect and pot root crowns *as soon as possible* in the spring, because it takes between three-to-five weeks before plants are large enough to begin rearing beetles. Northern Minnesotans may want to travel south to find a wetland that has thawed by late April. Another option (if you have access to a cold room facility), is to collect root crowns in the fall and store them over the winter. Dig root crowns after the first hard frost in early October, when flowers have senesced. Root crowns must be moist and can be kept in garbage bags when stored in a cold room facility (approximately 40°F). The keys to storing root crowns over the winter is making sure they are moist and that they receive no light.

## Root crown digging

Choose a wetland that has easy access for hauling root crowns back to your vehicle. They are heavy! Use the shovel to cut around the outer base of a multi-stemmed loosestrife plant to dig up crowns. Large crowns can be cut (using your shovel) or pulled apart. A plant with six-to-eight stems is the appropriate size for beetle rearing when potted. Clip the old stems at the base and leave them in the wetland. Collect the number of root crowns needed for your project size, and haul them in garbage bags out of the wetland. Use the strongest garbage bags you can find. Wetlands are muddy and wet, so wear appropriate boots and clothes.

## *Step 2. Culturing and maintaining host plants*

To produce plants of sufficient size for beetle rearing, root crowns should be bigger than the size of a softball, and can be trimmed to fit into a 3-gallon pot.

Large potting projects:

- Equipment
    - 22 pots (3-gallon)
    - One bale of potting soil (e.g., Pro-Mix™ 3.8 $ft^3$. compressed soil)
    - Fertilizer (e.g., 1 cup Osmocote™ controlled-release fertilizer or equivalent per Pro-Mix bale)
    - Two 5-6 ft. diameter plastic wading-pools

Dump the entire bale of compressed potting soil into a wading pool and dampen completely with water. Thoroughly mix in the fertilizer. Fill a pot half-full with the fertilized soil, add a root crown, then finish filling with potting soil. After all of the crowns have been potted, water the pots again and rinse out the pools. Find a location in full sunlight where you plan to do your rearing and set the pools side by side. If there is a risk of freezing temperatures, place the pools against a south-facing building where a plastic drape can be used as a cold-frame until the risk of frost is over. Place the pots into the pools and fill the pools half-full with water. Water the pots again, too. **Important:** make three to four holes in the sides of the pools just above the half-full waterline. This will keep the pools from flooding during heavy rains. Once plants begin to grow, keep water in the pool, but do not water the pot directly. Watering the pots washes out the fertilizer and causes algal growth in the

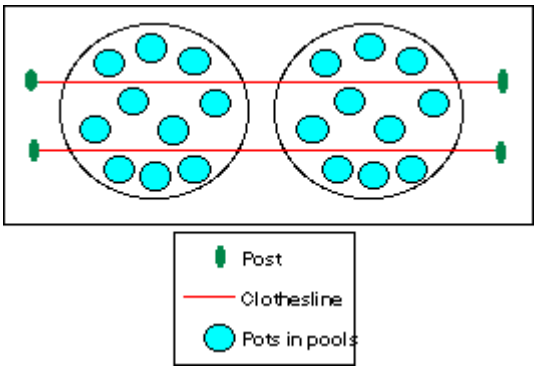
pools. Remember that vegetation underneath the pools (e.g., lawn), will be killed at the site (see Figure 3).

Small potting projects:

- Equipment
  - Three-gallon pots (your desired number)
  - Dishpan (Rubbermaid™) for each pot
  - Potting soil for each pot
  - Fertilizer (2 tsp. Osmocote controlled- release per pot)

Follow the general instructions for large scale potting, only fertilize as recommended and replace the pools with individual dishpans for each pot.

**Figure 3. Top view of the beetle rearing set up**




## Growth of purple loosestrife

Plants will need between three and five weeks to grow to the desired height before beetles can be introduced. Crowns sprout two-to-three weeks after they have been potted in early spring and then grow rather fast. When stems are approximately 12 inches tall, carefully pinch off the tip of each stem with your fingers. This stimulates the growth of lateral buds which the young beetle larvae use as food. When stems are at least 18 inches tall, beetles can be introduced. Placing beetles on plants that are too small, have too few stems, or have stems that are too old (stems with flower buds), reduce the number of insects produced.

### *Step 3. Beetle rearing preparation*

Set up the rearing structure necessary for your project size (large or small). You should assemble the structures and the screen cages *before* you get the beetles.

Assembling large structures:

- Equipment
  - Four steel T-sign posts (7 ft.)
  - Wire (flexible for twisting) or plastic-coated clothesline

Construct two "clotheslines" which will later be used to support the screen cages for beetle rearing. At the site you have chosen for your pools (in full sunlight), drive sign posts in at opposite ends of the pools, and string a wire tightly between each of the two posts about 4 feet above ground (Figure 3).

Assembling small structures:
Insert a 3 foot tomato cage into each pot when buds begin to sprout. The tomato cages will be used later to support the screen cages for beetle rearing.

Assembling screen cages:
Start with a 60 X 54 inch piece of no-see-um cloth or bridal veil material for each screen cage. Sew a 1 inch seam along the 60 inch length of the material for threading a cord through. Fold the 60 inch length in half and sew up the one side to make a 54 inch long cylinder. Thread a sturdy 65 inch cord through the 1 inch seam (tape a pencil to the cord for easy threading) and attach a cord stop. Leave the top end open.

## *Step 4. Beetle rearing*

This section describes a simple beetle-rearing procedure. It also tells you where to get beetles and what to expect once you have set up the rearing cages and added the beetles.

### Beetle supply

Contact the DNR for a site where you can hand-collect the beetles to begin your rearing project. In subsequent years, you may hand- collect in the spring from a wetland site where you have released beetles to start artificial rearing. The beetles are easiest to collect in early May, when they have just emerged and loosestrife is about 12 to 18 inches tall in the wetland. Beetles begin to emerge about the same time crab apple trees and lilacs begin to bloom.

### Introducing the beetles

- Equipment
    - Screen cage for each pot
    - Cable ties
    - Clothes pins/binder clips

Your potted loosestrife plants should be between 12 and 18 inches tall before you introduce the beetles. First, hand pick off any predatory insects and spiders (e.g., ladybugs). **Do not** use insecticides. Cover the plants with the screen cages and cinch the draw cord at the bottom of the screen cage tightly around the upper lip of the pots. **Reminder:** check the screen cages occasionally to make sure they remain tightly cinched and they have not slipped down or blown off. If cages are frequently slipping, duct tape may be used to seal the screen cages around the lip of the pots. Through the open top of the screen cage, add 10 beetles per cage by lightly grabbing the beetles with your fingers. Do not use tweezers to handle the insects. Adult beetles are harmless and docile. Close the cage by twisting the top a few times, folding it over and securing it with a cable tie. For large-scale projects, attach the cage to the "clothesline" with a clothes pin. For small- scale projects, the cages are supported by the tomato cage.

## Beetle Life Cycle

The four life stages found in beetles (egg, larva, pupa, and adult) are described here. These descriptions and Figure 4 below will help you identify the various life stages for future monitoring in the field. Refer to Figure 5 for the approximate amount of time each life stage takes and the relative amount of overlap among the various life stages. *Temperature and weather conditions* will be important factors in the amount of activity you see in the beetles, and the number of days each life stage will take.

**Figure 4. The life stages of beetles**

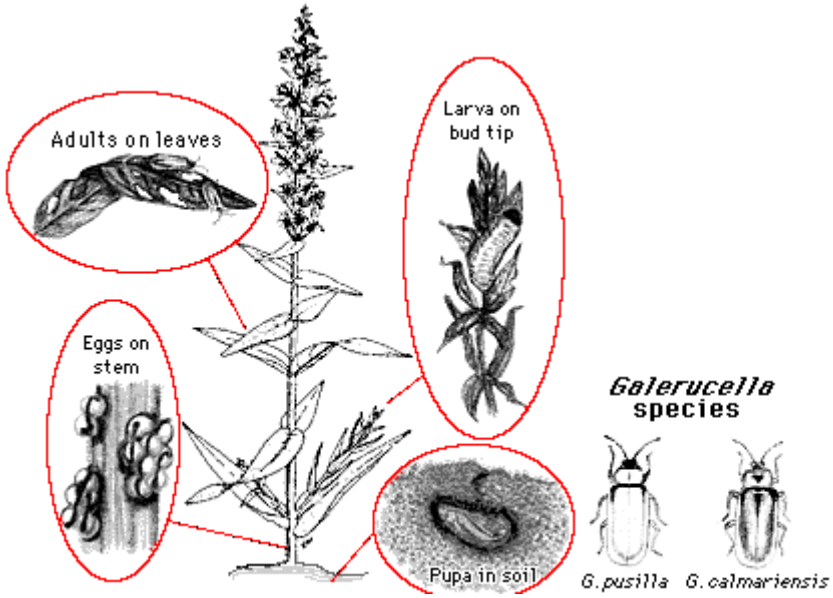
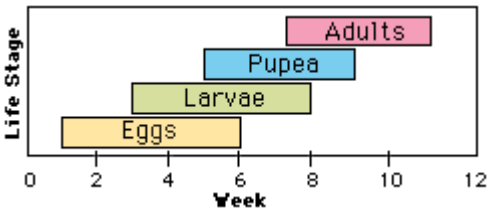



**Figure 5. Developmental time periods for the four life stages of *Galerucella* spp**




## Eggs

Adults aggregate near the top of the plant where feeding damage of small holes in newly expanded leaves is most obvious on each stem (Week 0). Adults begin feeding soon after they have been released into the cages and will live for up to 40 days. Tiny egg masses will be evident on leaves and stems throughout the plant seven-to-ten days after adults have begun feeding. The egg mass (clutch) size will average seven eggs per mass. Females lay an average of 10.5 eggs per day for 30 days or more. Eggs are round and white with frass (beetle excrement) laid over the top of the eggs. As *humidity* is important for egg hatching, make sure pools or dish pans remain half-full with water so the humidity remains as high as possible. Once plants have grown another one-to-two feet, adults are hard to see, but their leaf-feeding damage is easy to spot. If it seems like no beetles are present (indicated by a lack of leaf damage) after the first week, look around the cage, in the lower parts of

the plant, and along the soil for live adults. If there are no adults present, then check the screen cage for holes or other possible means of escape. You may need to recollect adults from the field in order to ensure a successful rearing project.

### Larvae

Eggs hatch two-to-three weeks after they are laid. Although newly hatched larvae are very hard to see, the larval damage is quite evident because they crawl into buds and destroy this tissue. We call this damage "tip-feeding." Tip feeding is easy to spot and is often accompanied by frass which indicates larval presence. Larvae are yellow with a dark head capsule and molt three times, each time increasing in size. Over 80% of the larval growth and damage occurs in the 3rd larval instar. Their feeding damage is described as "window" feeding because the leaf tissue is left brown, thin and translucent. It is unlike adult feeding damage which is described as "skeletonized," where complete holes are made in the leaves, but leaf veins are left intact.

### Pupae

Larvae complete development after two-to-three weeks of feeding. Large, yellow 3rd instar larvae (ca. ¼ inch) wander down the stems of the plant and bury themselves into the soil. When the stems and leaves have relatively few larvae remaining on them and there is little or no green tissue left, then most larvae have formed pupae which are found in the top ½ inch of soil. Excessive water and saturated soil during pupation is detrimental. Once 3rd instar larvae are seen, pools should be no more than half-full of water and allowed to dry up when most leaf tissue is gone from the plants. Never water the pots themselves; only water the pools to sub-irrigate the pots. This allows the top few inches of soil to stay dry, providing a more favorable habitat for pupation.

### Adults

Adults emerge two-to-three weeks after larvae have entered the soil to pupate. They will be light colored (no dark coloration on either their front or back sides) and will tend to aggregate at the top of the cage. Each pot that began with 10 adults will produce between 1,000 and 2,000 beetles. As soon as you start seeing the first new adults emerge, promptly take the pots to the field for release. If a prompt release is not possible (i.e., impermissible weather, weekend, limited time and/or workers), then it is critical to maintain a fresh supply of foliage for the emerging adults until they can be released. Newly emerging adults will *not survive* if larvae have completely defoliated your plant, and especially not if the days are hot. To feed adults, use freshly clipped loosestrife stems collected at a nearby wetland (these can be collected ahead of time and stored in a garbage bag in a refrigerator for several days). Recut the stems (about 12 inch long) with a sharp blade at a 45° angle while submerged in water. Insert the stems into a 1 quart canning jar filled with water. A full bouquet (10-to-12 stems) will keep the beetles from crawling down into the jar, and provide enough food for one-to-two days depending on the number of adults. Put this bouquet into the screen cage by carefully propping it up against dead stems. Since beetles will be emerging from the soil, avoid placing the jar directly on the soil surface.

## *Step 5. Releasing beetles into the wetland*

Once the first new adults have emerged, it is time to take the pots to the wetland. Newly emerged beetles are rather delicate and handling them at this stage is not recommended. Newly emerged adults cannot fly until 24-to-36 h after emergence.

## Choosing a site

The DNR will provide a list of sites that are approved for insect release. An ideal location for releasing beetles is a site that is moderately to heavily infested with purple loosestrife, easily accessed, less prone to spring flooding, and preferably does not have standing water throughout the summer. These criteria will help ensure a good site for subsequent beetle reproduction and monitoring. If your city or township does *adult* mosquito control, check with the appropriate personnel to prevent any fogging or spraying for the remainder of the summer in the wetland you are planning to make your release. In fact, avoiding such areas would be preferable.

## Releasing beetles

- Equipment
    - 7 ft. PVC (3/4 in.) pole (spray-painted orange at the top) or colored surveyor flags

When transporting the pots and screen cages to the site, keep in mind the conditions in which you will be traveling (i.e., distance to site, vehicle's climate conditions, etc.). To make sure beetles arrive in the best condition, avoid jarring, high temperatures and especially avoid tipping the pots over. *Important:* prolonged exposure (over an hour) to intense sunlight and heat is detrimental to the beetles. The simplest way to release adults is to take the entire pot with the screen cage into the field. Place two-to-four pots adjacent to purple loosestrife plants. Break off some nearby loosestrife stems and lay them in the pot so that newly emerged beetles can walk onto fresh foliage. Remove the screen cages and shake out any adults onto nearby foliage. Leave the pots at the site for the remaining beetles to emerge on their own, and mark the site with a PVC pole or flags.

### *Step 6. Reporting*

An appendix is attached to this publication that must be filled out to report each site that you release beetles on, and where you released them on that site. Copy the form and fill out a separate report for *every* release you make and mail the information to Luke Skinner at the DNR.

### *Step 7. Monitoring in the field*

Released adults feed on leaves for a few weeks, but disappear around mid-August to overwinter in the leaf litter and soil near their host plant. High overwintering survival for initial releases will translate into establishing a beetle population capable of flourishing for years.

## Fall (year of release):

Wait at least 4 weeks after the release before recovering your pots to use for rearing next spring. Look for beetle establishment at the site by looking for evidence of adult feeding. *Reminder:* do not expect to see much activity from the beetles the first year. They are not expected to lay eggs and may have already disappeared into the leaf litter and soil to overwinter. Take a photograph when the site where you released the beetles is in full bloom. Choose a photo point that you can easily return to at the *same time* and *place* to take annual photos for monitoring purposes over the years.

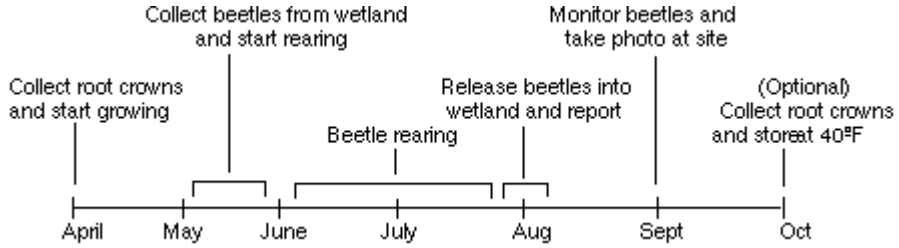
### Spring (following year):

When purple loosestrife stems are 12-to-18 inch tall in the wetlands, monitor your release site(s) for signs of adult feeding. Later, return to the site to observe egg laying and larval feeding. Refer to the descriptions of the life stages discussed earlier. Do not collect beetles from the wetland this first year. These insects need to reproduce two-to-three years before populations are large enough to permit harvesting adults for additional artificial rearing. If you want to continue rearing a second year, contact the University of Minnesota- Department of Entomology, or the Minnesota DNR for where to obtain insects.

### Beetle maintenance

Figure 6 is an overview of the year-round activities needed to maintain a beetle population. The key steps and dates for beetle rearing have also been summarized below for quick reference.

**Figure 6. Year-round activity for rearing *Galerucella* beetles**




| Month | Steps for beetle rearing |
|---|---|
| **January-March** | Contact county agriculture inspector for permission to collect root crowns. |
| **April** | Step 1. Field collection of root crowns<br>Step 2. Culturing and maintaining host plants<br>Step 3. Beetle rearing preparation<br>Contact DNR for site to collect beetles |
| **May** | Collect beetles from wetland site |
| **June-July** | Step 4. Beetle rearing |
| **July-August** | Step 5. Releasing beetles into the wetland<br>Step 6. Reporting. |
| **September** | Step 7. Monitoring in the field and photograph. |

# Removing Loosestrife

If you currently have purple loosestrife or a cultivar growing in your garden, it could contribute to the loss of native wetland vegetation. To remove purple loosestrife properly, dig up the entire plant (roots and all), place in a plastic bag and dispose of it in a landfill. Composting is not advised, as the seeds may not be destroyed and the thick woody stem and roots decompose slowly.

# Replacing Loosestrife

As part of restoration ecology, you can replace your purple loosestrife with an alternative selection of environmentally-friendly perennials.

| Loosestrife look-a-likes |
|---|
| Blazing star (*Liatris spicata*)<br>Blue Vervain (*Verbena hastata*)<br>Fireweed (*Epilobium angustifolium*)<br>Swamp loosestrife (*Decodon verticillatus*)<br>Winged loosestrife (*Lythrum alatum*) |
| **Alternate plantings** |
| Blazing star, Gay feather (*Liatris* spp.)<br>Delphinium (*Delphinium* spp.)<br>False spirea (*Astilbe arendsii*)<br>Foxglove (*Digitalis purpurea*)<br>Lupine (*Lupinus*)<br>Lobelia (*Lobelia cardinalis*)<br>Obedient plant (*Physostegia virginiana*)<br>Salvia (*Salvia superba*)<br>Siberian iris (*Iris*)<br>Spike speedwell (*Veronica spicata*) |

# Contacts


Luke Skinner
Minnesota Department of Natural Resources
500 Lafayette Road, Box 25
St. Paul, Minnesota 55155-4025
phone: (612) 297-3763
e-mail: luke.skinner@dnr.state.mn.us

Dr. David Ragsdale
University of Minnesota
Department of Entomology
219 Hodson Hall
1980 Folwell Ave.
St. Paul, Minnesota 55108
phone: (612) 624-6771
e-mail: ragsd001@maroon.tc.umn.edu

Alyson Loos
University of Minnesota
Department of Entomology
219 Hodson Hall
1980 Folwell Ave.
St. Paul, Minnesota 55108
phone: (612) 624-8718
e-mail: loosx001@gold.tc.umn.edu

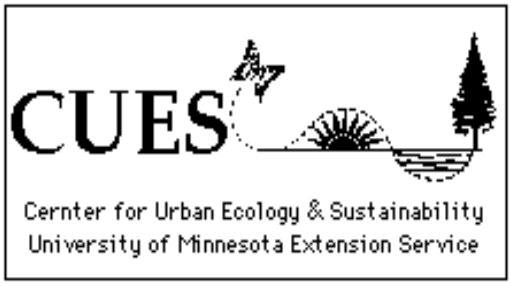
# Acknowledgments

Special thanks to the Minnesota Department of Natural Resources Purple Loosestrife Program and Dr. Bernd Blossey, Director of Biological Control of Non-indigenous Plant Species Program at Cornell University.

---

- Follow this link for a form for recording information on Purple Loosestrife Biocontrol Insect Releases that you can print out and send in.

---





---

This publication may serve as a companion piece to the slide set SS7081, *Biological Control of Loosestrife*.

Produced by Communication and Educational Technology Services, University of Minnesota Extension Service.

# Appendix C – Prison Rearing Releases 2000

# Appendix 3

## Participants
## Prison Rearing Releases
## 2000

| Town | County | Site | Contact |
|---|---|---|---|
| Hanover | Grafton | Wilson's landing | McIlroy, B. |
| Lyme | Grafton | Jack Menge | Milligan, A. |
| Lyme | Grafton | Wilder Refuge | Milligan, A. |
| Enfield | Grafton | Livingston Lodge | St. Damian, E. |
| Orford | Grafton | Reeds Marsh | Schwaegler, S. |
| | | | |
| Merrimack | Hillsborough | Horseshoe Pond | Arthur, R. |
| Amherst | Hillsborough | Site1 | Krantz, A. |
| Amherst | Hillsborough | Dodge Road | Krantz, A. |
| Amherst | Hillsborough | Wilking School | Krantz, A. |
| Amherst | Hillsborough | Great Meadow | Krantz, A. |
| Amherst | Hillsborough | Site 5 | Krantz, A. |
| Amherst | Hillsborough | Site 6 | Krantz, A. |
| New Boston | Hillsborough | Meadow Rd. & 136 | Lombard, L. |
| New Boston | Hillsborough | 75 Hooper Hill Rd. | Lombard, L. |
| New Boston | Hillsborough | Rt. 137 & 77 | Lombard, L. |
| New Boston | Hillsborough | Meadow Rd. & 136 | Lombard, L. |
| Weare | Hillsborough | Great Meadow | Lombard, L. |
| Francestown | Hillsborough | Ferson Road | Proctor, H. |
| Francestown | Hillsborough | Pleasant Pond Rd. | Proctor, H. |
| | | | |
| Brentwood * | Rockingham | Pine Rd. | Cygan, Laurin |
| Brentwood | Rockingham | Exit 8 ramp | Cygan, Laurin |
| Portsmouth | Rockingham | Rt.33, old exit 3 | Cygan, Laurin |
| Portsmouth | Rockingham | Spaulding Trpk. | Cygan, Laurin |
| Portsmouth | Rockingham | Heritage Hill | Twine, M. |
| Newington | Rockingham | Site 1 | O Brien, K. |
| Newington | Rockingham | Site 2 | O Brien, K. |
| Newington | Rockingham | Site 3 | O Brien, K. |
| | | | |
| Tilton | Belknap | Rt. 93 Exit 20 | Cygan |

13 Towns 4 Counties 28 Sites

* Denotes Mitigation Site

# Appendix D – Beetle Rearing Seminars

New Hampshire Department of Agriculture, Markets and Food
Plant Industry Division

# PURPLE LOOSESTRIFE
## Methods for Rearing Leaf-feeding Beetles

**An Educational Seminar for the Control of Purple Loosestrife in New Hampshire's Wetlands**

| Div. of Forests & Lands | Keene State College | N.H. Dept. of | Montshire Museum of Science |
|---|---|---|---|
| Urban Forestry Center | Camp @ Wilson Pond | Fish and Game | One Montshire Road |
| 45 Elwyn Road | Rt. 32 | 2 Hazen Drive | Norwich, VT 05055 |
| Portsmouth, NH 03801 | Swanzey, NH 03446 | Concord, NH 03301 | March 20, 2001 |
| November 28, 2000 | December 12, 2000 | February 13, 2001 | 8:30 AM - 12:00 PM |
| 8:30 AM - 12:00 PM | 8:30 AM - 12:00 PM | 8:30 AM - 12:00 PM | |

**8:30 - 9:00** Registration & Coffee

**9:00 - 9:30** IPM Grant Program Procedure
Robert Bruleigh, Environmentalist I
Thomas Desrosiers, Certification Coordinator

**9:35 - 10:00** **Restoring the Balance and Biological Control of Purple Loosestrife.**
Cornell University Media Services, Film

**10:00 - 10:15** Coffee Break

**10:15 - 10:45** Community Rearing Techniques Tom J. Durkis, State Entomologist
1. Identifying Purple Loosestrife
2. Growing Purple Loosestrife
3. Beetle Rearing
4. Releasing Beetles into the Wetland
5. Field Monitoring
6. Reporting and Data Documentation

**10:45 - 11:00** Cultivar Sterility and Alternative Plantings for Purple Loosestrife
Rachel L. Maccini, Entomologist I

**11:05 - 11:35** Summary Report of the Successful Control of Purple Loosestrife in New Hampshire
Doug Cygan, Senior Environmental Manager, NH Dept. of Transportation

**11:40 - 12:00** Sign up for participation in the project

****The seminars are approved by the Division of Pesticide Control for 2 re-certification credits.**

****Enrollment is limited at all locations. To ensure a place, early registration is encouraged. Please call the New Hampshire Department of Agriculture @ (603) 271-2561.**

# Appendix E – Release site info sheet

**Site location information for release of purple loosestrife biological control insects**

Site Number: _____ Site Name: _____ Date: _____

City: _____ County: _____

Longitude: _____ Latitude: _____ GPS Derived? Y N

Elevation: _____ Township: _____ Range: _____ Sect: _____ Qtr Sect: _____

**Contact Person:**

Name: _____

Address: _____

City: _____

State: _____ Zip: _____

Phone: _____

**Legal Landowner:**

Name: _____

Address: _____

City: _____

State: _____ Zip: _____

Phone: _____

**Road Map to Site**

N

Site and Vegetation Map

N

**Insect Release History**

| Date (mm/dd/yy) | Species | Number and Stage (egg/larva/adult) | Position of Release on Map (1,2,3,4) |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |

# Appendix F – Community Rearing Releases 2001

## Community Purple loosestrife IPM Program
## Releases 2001

| Town | County | Site | Contact |
|---|---|---|---|
| Enfield | Grafton | Livingstone | Wisher, K. |
| Enfield | Grafton | Livingstone | St.Damian, E. |
| Lyme | Grafton | Menge | Mulligan, A. |
| Lyme | Grafton | Wilder wildlife | Mulligan, A. |
| Lyme | Grafton | Nichols Tree Farm | McIlroy |
| Hanover | Grafton | Wilsons Landing | McIlroy |
| Hanover | Grafton | Mink Brook | McIlroy |
| Orford | Grafton | Reeds March | Schwaegler, S. |
| | | | |
| Hudson | Hillsborough | Musquash Brook | Laffin, C. |
| Hudson | Hillsborough | Robinson Road | Laffin, C. |
| Hudson | Hillsborough | Musquash Consv. | Laffin, C. |
| Hudson | Hillsborough | | Laffin, C. |
| Francestown | Hillsborough | Pleasant Rd. | Lombard, L. |
| Francestown | Hillsborough | Ferson Rd. | Lombard, L. |
| Milford | Hillsborough | Rt. 13 | Lombard, L. |
| Nashua | Hillsborough | Spit Brook Rd. | Lombard, L. |
| New Boston | Hillsborough | Bunker Hill Rd. | Lombard, L. |
| New Boston | Hillsborough | Hooper Hill Rd. | Lombard, L. |
| New Boston | Hillsborough | Francestown Rd. | Lombard, L. |
| New Boston | Hillsborough | Greg Mill Bridge | Lombard, L. |
| New Boston | Hillsborough | Meadow Rd. | Lombard, L. |
| New Boston | Hillsborough | Old Coach Rd. | Lombard, L. |
| Weare | Hillsborough | 1387 Stark Hwy. | Lombard, L. |
| Weare | Hillsborough | Great Meadow | Lombard, L. |
| Weare | Hillsborough | Rt. 77 | Lombard, L. |
| | | | |
| Newport | Sullivan | Sugar River | Parssinen |
| | | | |
| Bow | Merrimack | I-89 infield | Wilke, M. |
| | | | |
| N. Hampton | Rockingham | Moor Farm | Wallmar, D. |

# Appendix G – Prison Rearing Releases 2001

## Concord Prison Releases
## 2001

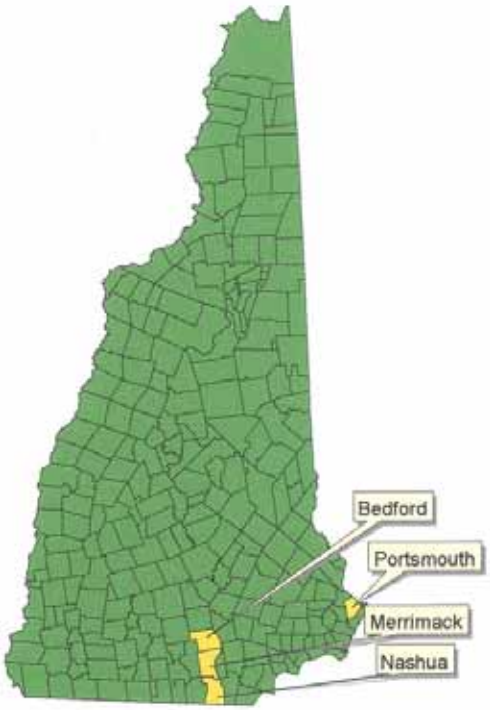
| Town | | County | Site | Contact |
|---|---|---|---|---|
| Littleton | * | Grafton | Sewage Treatment Plant | NHDOT |
| Tilton | * | Belknap | I-93 Exit 20 | NHDOT |
| Tilton | | Belknap | I-93 median | NHDOT |
| Portsmouth | | Rockingham | I-95 | NHDOT |
| Portsmouth | | Rockingham | Spaulding Tpk..I-95 | NHDOT |
| Portsmouth | | Rockingham | Spaulding Tpk. median | NHDOT |

* Denotes Mitigation Site

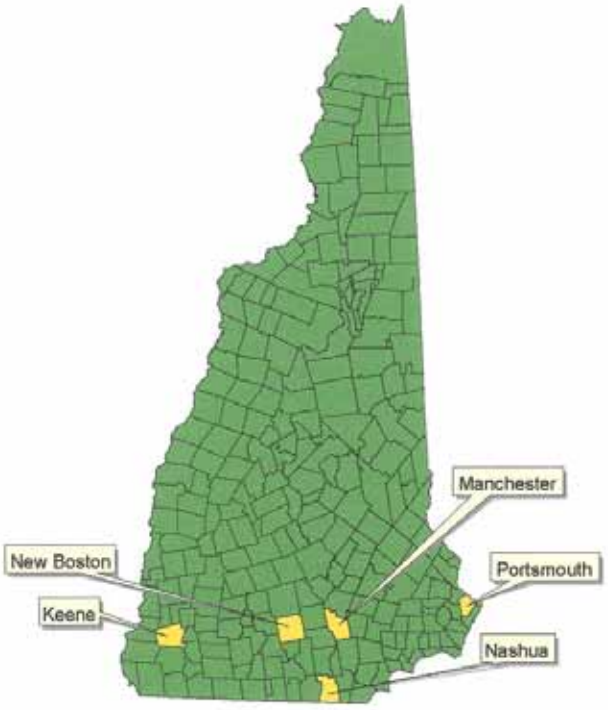
# Appendix H - Release Site Maps

# DOT and NHDA Galerucella spp. Coop. Release Sites

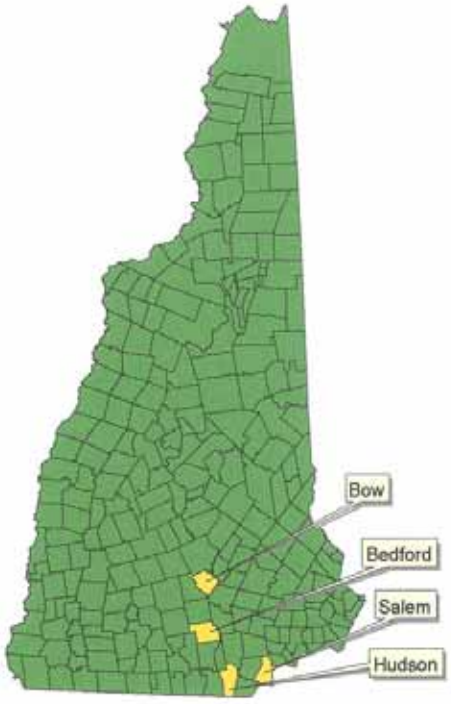

1997




1998

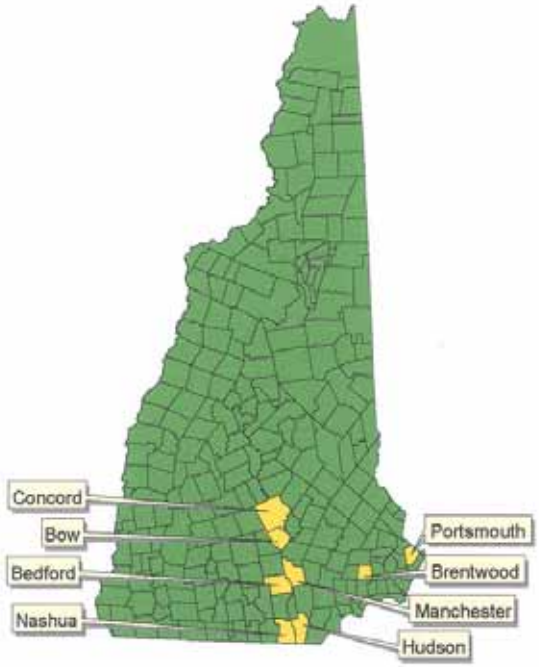



1999

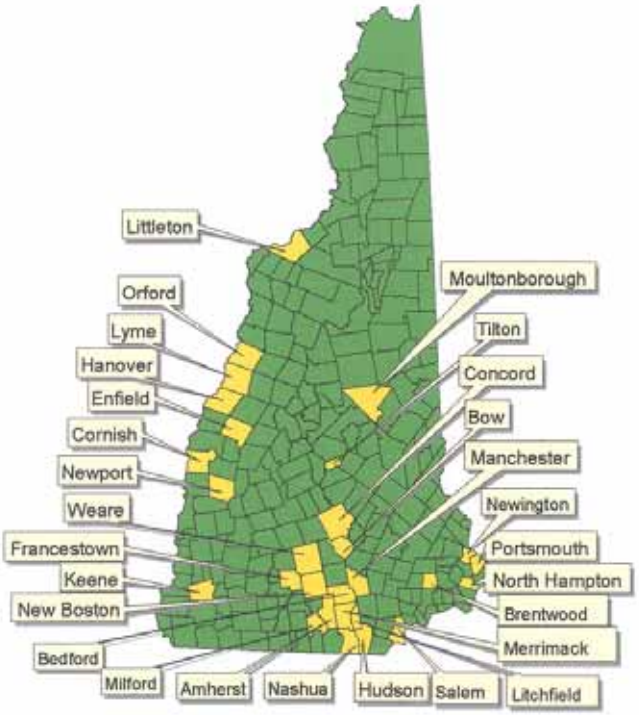



2000

# DOT and NHDA Galerucella spp. Coop. Release Sites

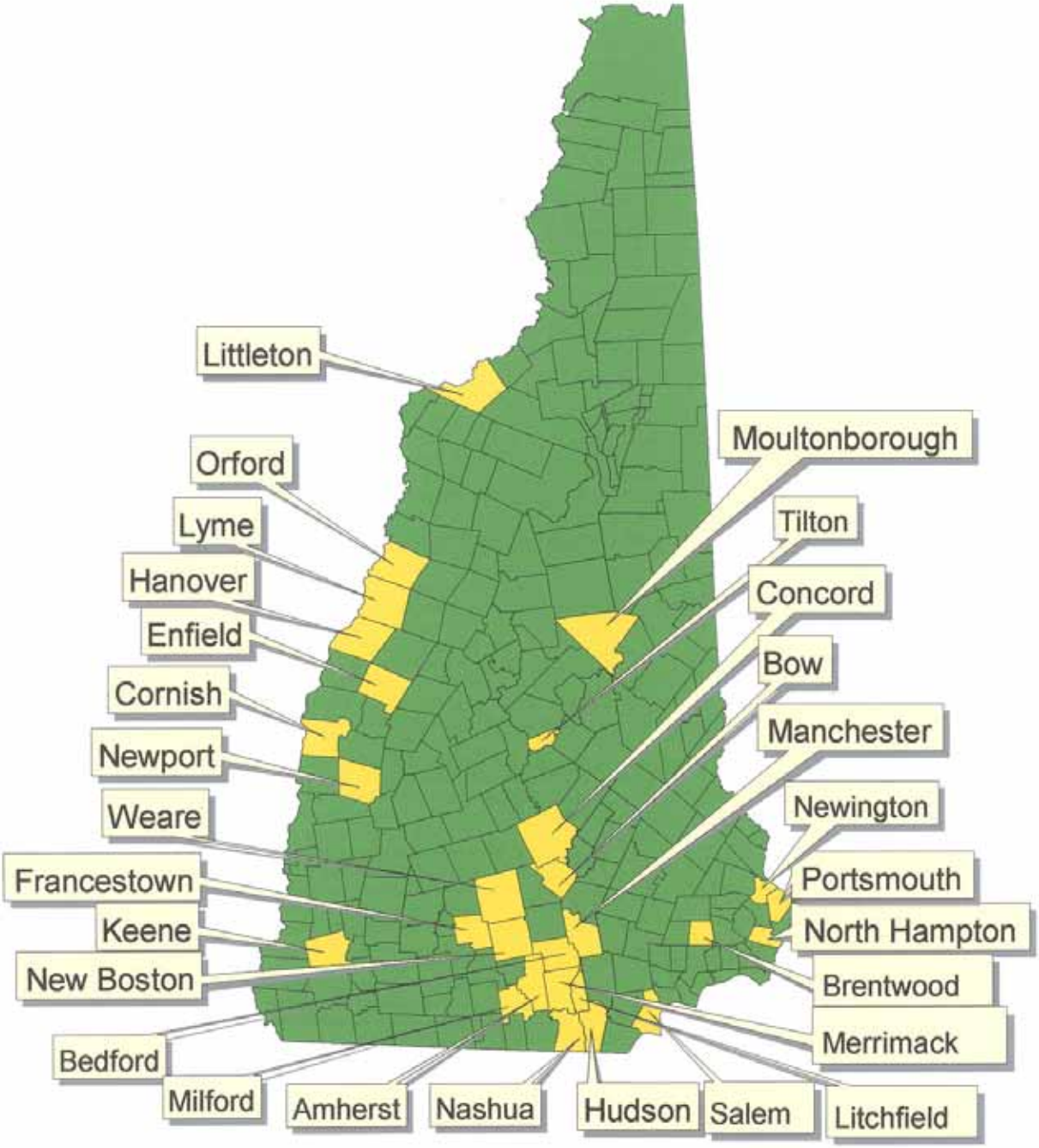



2001



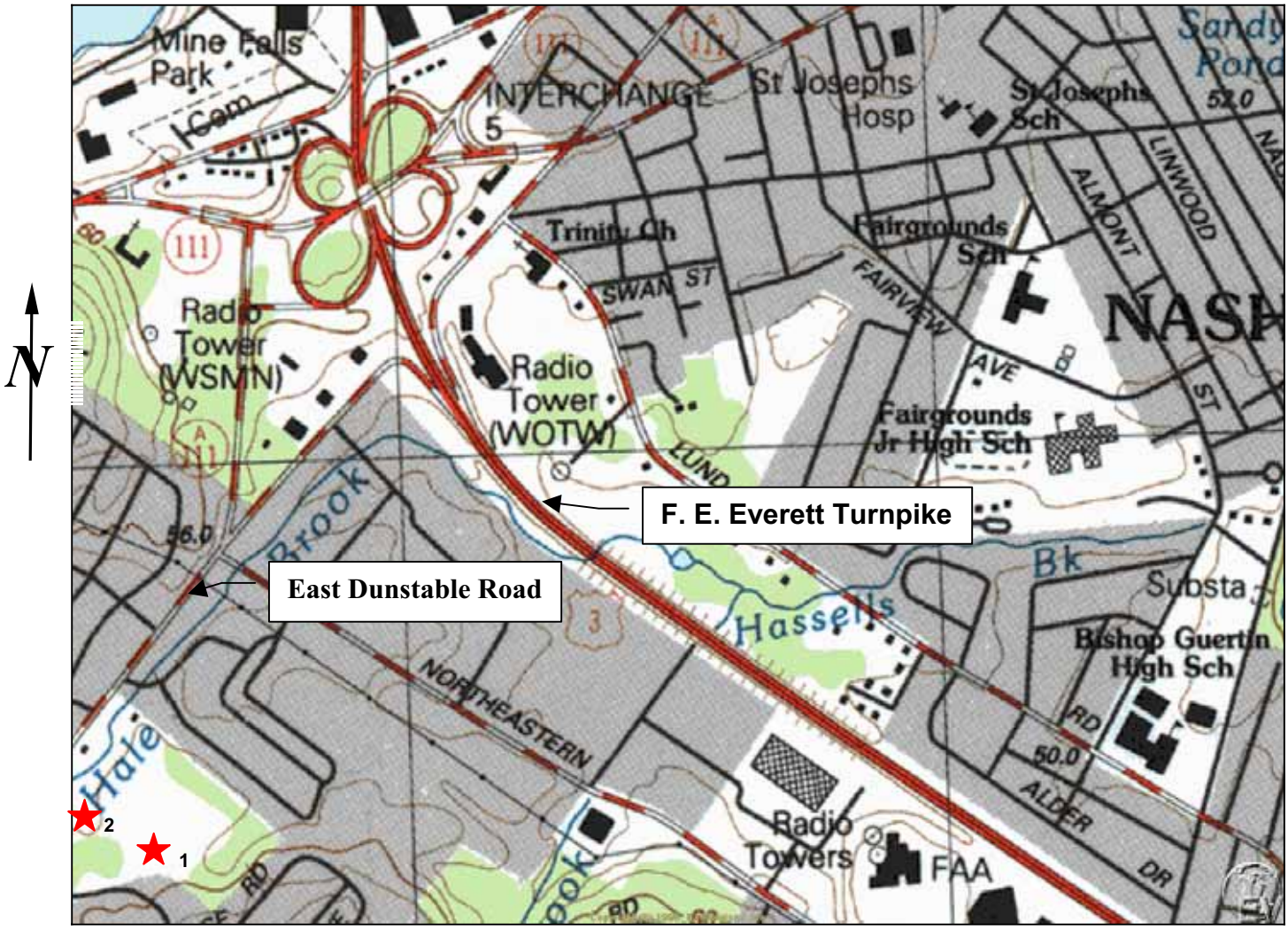

1997-2001

# 1997-2001 Galerucella spp. Release Sites



| DATE | TOWN | LOCATION | # BEETLES |
|---|---|---|---|
| 6/04/97 | Nashua | Site 1, Rte. 111A Dunstable Rd. | 2,500 |
| 6/11/97 | Nashua | Site 2 , Rte. 111A Dunstable Rd. | 2,500 |
| 7/01/97 | Merrimack | Camp Sargeant Rd. | 5,000 |
| 7/02/97 | Littleton | Sewage Treatment Plant | 10,000 |
| 6/03/98 | Bedford | Center Rd. Mit. Site | 5,000 |
| 6/17/98 | Nashua | Site 2, Rte 111A Dunstable Rd. | 1,500 |
| 6/17/98 | Merrimack | Camp Sargeant Rd | 1,500 |
| 6/23/98 | Portsmouth | Pease Mit. Site | 4,500 |
| 6/02/99 | Nashua | Site 1, Rte. 111A Dunstable Rd. | 5,000 |
| 6/02/99 | Nashua | Site 2, Rte 111A Dunstable Rd | 5,000 |
| 6/02/99 | Keene | Rte. 9/10/12 | 5,000 |
| 6/03/99 | Portsmouth | Pease Mit. Site | 5,000 |
| 6/24/99 | New Boston | Site 1 | 10,000 |
| 6/24/99 | New Boston | Site 2 | 10,000 |
| 7/29/99 | Bow | I-89 Loop Ramp | 2,000 |
| 7/29/99 | Manchester | Candia Rd. | 1,500 |
| 7/29/99 | Nashua | Searles Rd. | 2,000 |
| 6/15/00 | Salem | Rockingham Blvd. | 5,000 |
| 6/16/00 | Merrimack | Camp Sargeant Rd. | 10,000 |
| 6/22/00 | Hudson | Bensons | 5,000 |
| 6/27/00 | Bedford | Center Rd. Mit. Site | 5,000 |
| 7/07/00 | Bow | I-89 Loop Ramp | 5,000 |
| 7/13/00 | Bow | I-89 Loop Ramp | 5,000 |
| 6/06/01 | Bedford | Center Road Mit Site | 5,000 |
| 6/13/01 | Portsmouth | ? | 500 |
| 6/13/01 | Brentwood | Pine Road | 750 |
| 6/13/01 | Manchester | Candia Rd | 1,250 |

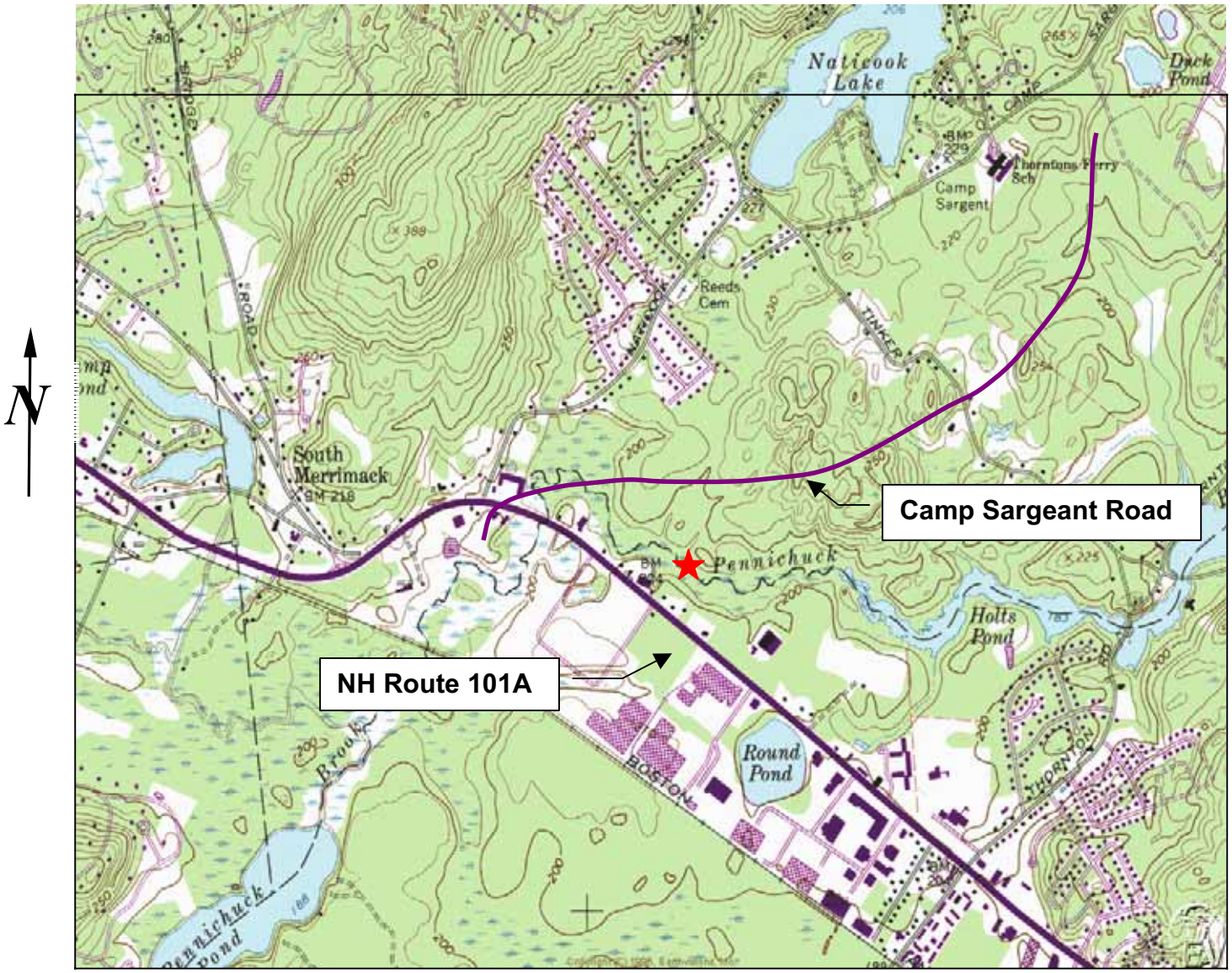
| DATE | TOWN | LOCATION | # BEETLES |
|---|---|---|---|
| 6/20/01 | *Rearing Purposes* | | 1,500 |
| 6/20/01 | Bow | I-89 | 1,000 |
| 6/27/01 | *Rearing Purposes* | | 1,000 |
| 6/27/01 | Manchester | Candia Rd | 1,400 |
| 7/11/01 | Bedford | Rt. 101 | 1,250 |
| 7/11/01 | Nashua | Searles Rd | 1,250 |
| 7/11/01 | Hudson | Bensons | 1,875 |
| 7/11/01 | Concord | Clinton St. | 625 |
| Summer 2001 | Tilton | I-93 Exit 20 | Unknown number. Beetles released were reared on individual purple loosestrife plants. |
| Summer 2001 | Tilton | I-93 Median | |
| Summer 2001 | Portsmouth | I-95 | |
| Summer 2001 | Portsmouth | Spaulding Tpk I-95 | |
| Summer 2001 | Portsmouth | Spaulding Tpk median | |
| 6/04/02 | Manchester | Candia Rd? | 3,700 |
| *6/04/02* | *Rearing Purposes* | | 1,300 |
| 6/11/02 | Manchester | Candia Rd | 5,000 |
| 6/18/02 | Littleton | Sewage Treatment Plant | 2,500 |
| *6/18/02* | *Rearing Purposes* | | 2,500 |
| 6/25/02 | Portsmouth | Pease Mit Site? | 4,500 |
| *6/25/02* | *Rearing Purposes* | | 500 |
| 7/02/02 | Brentwood | Pine Road | 5,000 |
| 7/09/02 | Salem | ? | 5,000 |
| 7/16/02 | Hudson | Bensons | 2,500 |
| 7/16/02 | Merrimack | Camp Sargeant Rd | 2,500 |
| 7/23/02 | Tilton | I-93 Exit 20 | 2,500 |
| 7/23/02 | Littleton | Sewage Treatment Plant | 2,500 |




**NASHUA**
**East Dunstable Road**

BIO-CONTROL RELEASE AREA

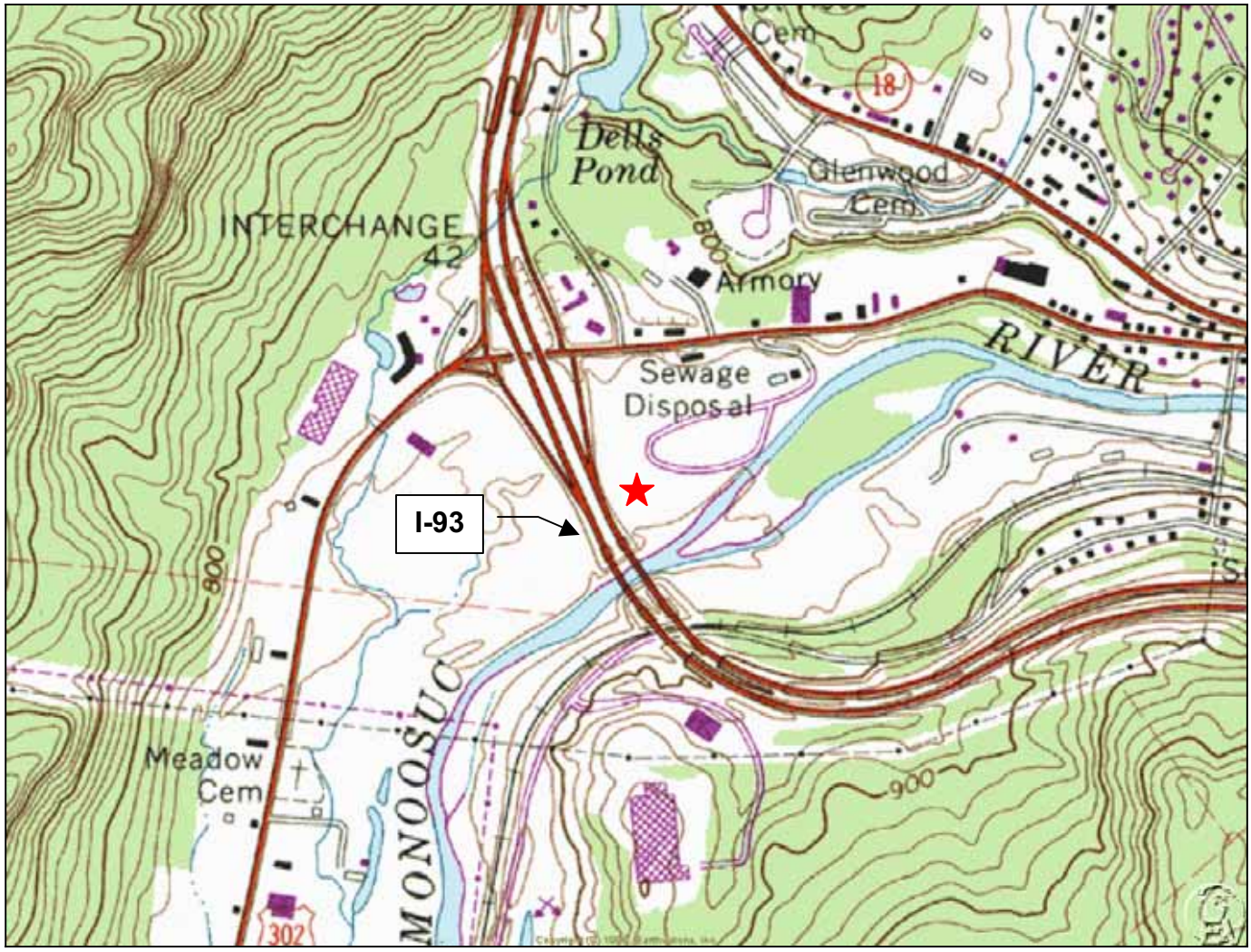
Two release points within the East Dunstable Road (TSA-1) Wetland Mitigation Site. Release point 2 is ±250 feet southeast of East Dunstable Road. Release point 1 is ±950 feet southeast of East Dunstable Road. The mitigation site is located ±3,500 feet south of the F. E. Everett Turnpike's (US Route 3) Exit 5.




**MERRIMACK**
**Camp Sargeant Road**

BIO-CONTROL RELEASE AREA

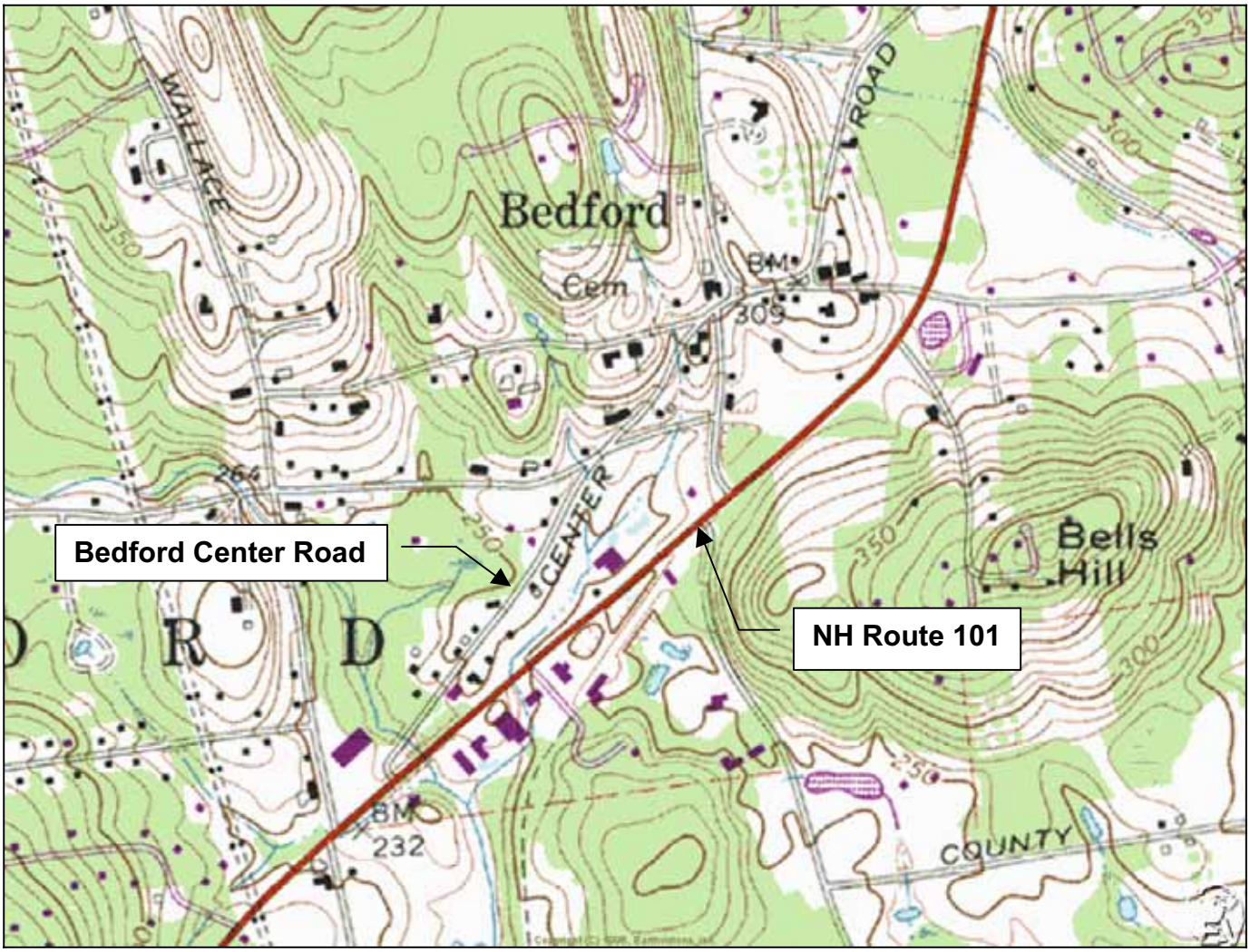
Released within the Camp Sargeant Road Wetland Mitigation Site. Release point is ±900 feet southeast of Camp Sargeant Road. The mitigation site is located ±2,500 feet northeast of the intersection of NH Route 101A with Camp Sargeant Road.




**LITTLETON**

BIO-CONTROL RELEASE AREA

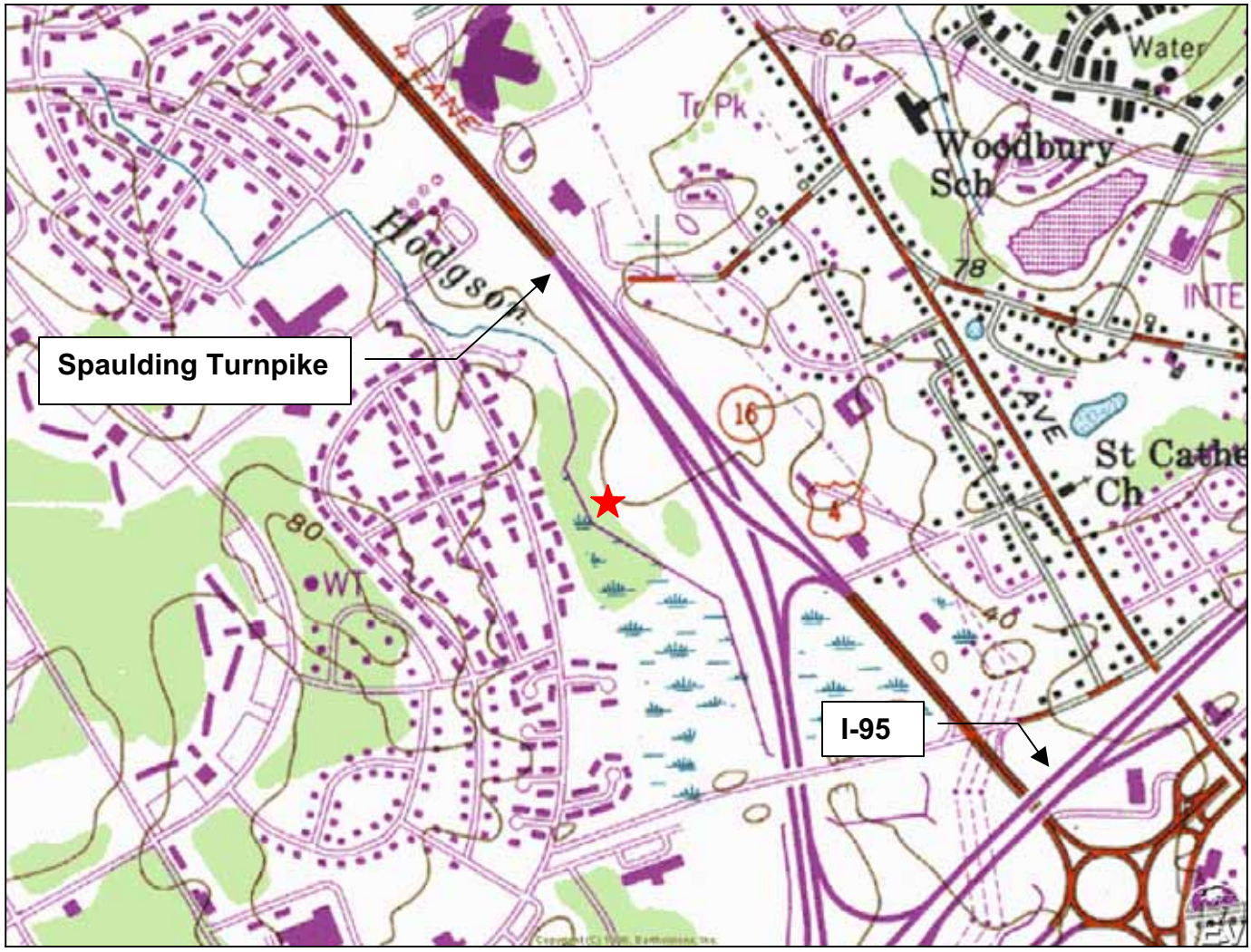
Released within the Littleton Wetland Mitigation Area located ±750 feet south of NH Route 302 (Main Street).




**BEDFORD**

BIO-CONTROL RELEASE AREA

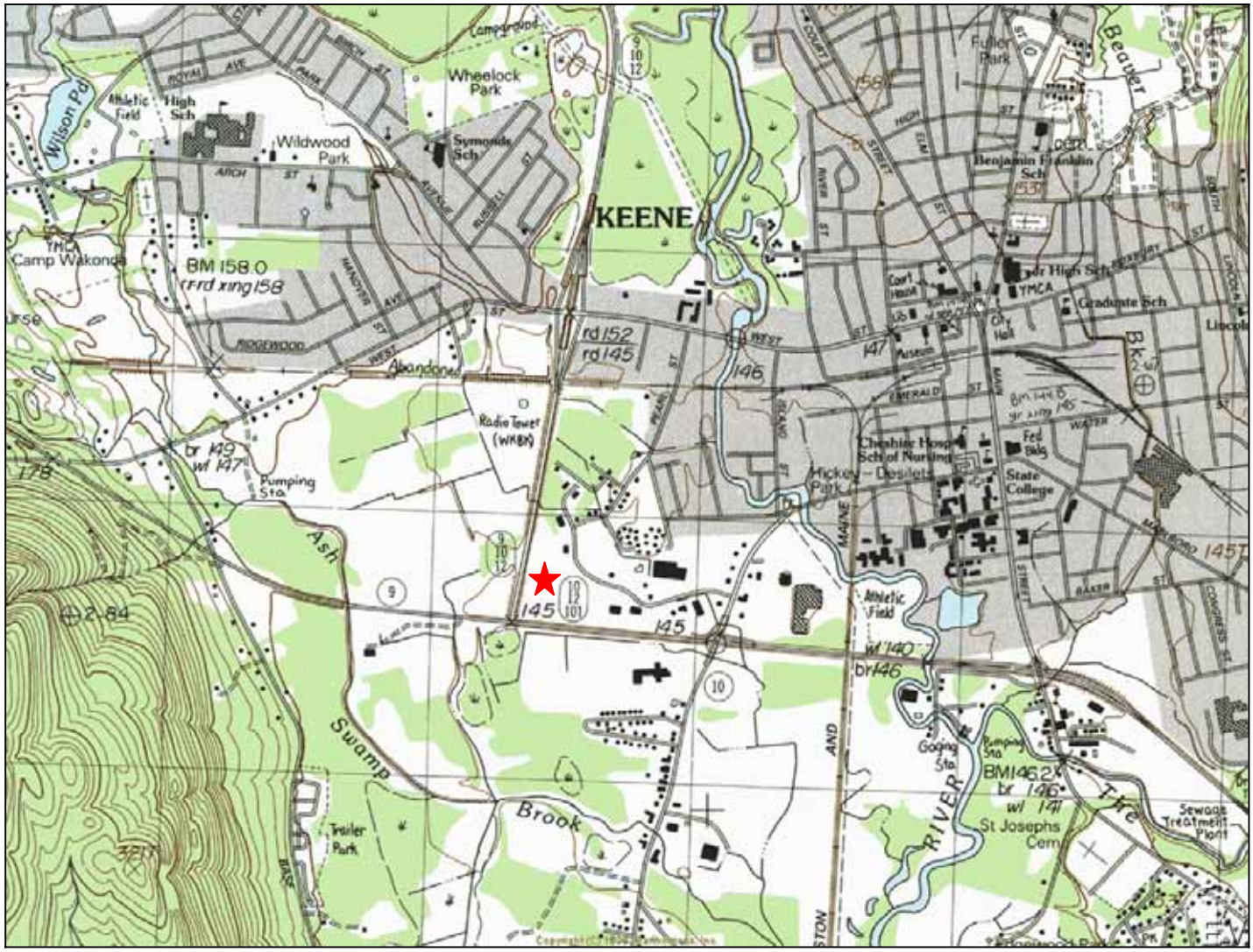
Released within the Bedford Center Road Wetland Mitigation Site located ±150 feet southeast of Bedford Center Road.




**PORTSMOUTH**

BIO-CONTROL RELEASE AREA

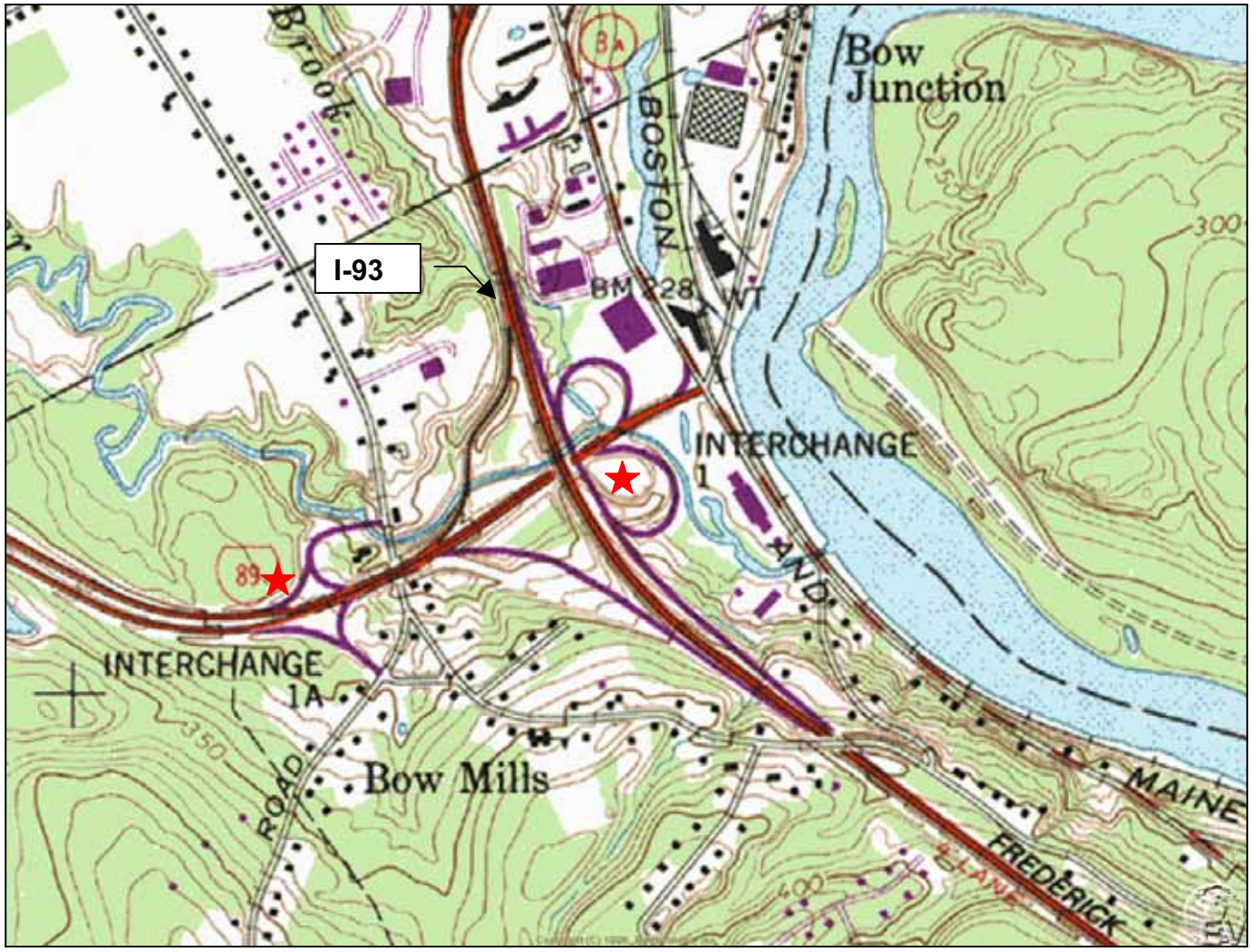
Released within the Pease Wetland Mitigation Site located ±450 feet west of the Spaulding Turnpike's (NH Route 16) southbound I-95 on-ramp.




**KEENE**

BIO-CONTROL RELEASE AREA

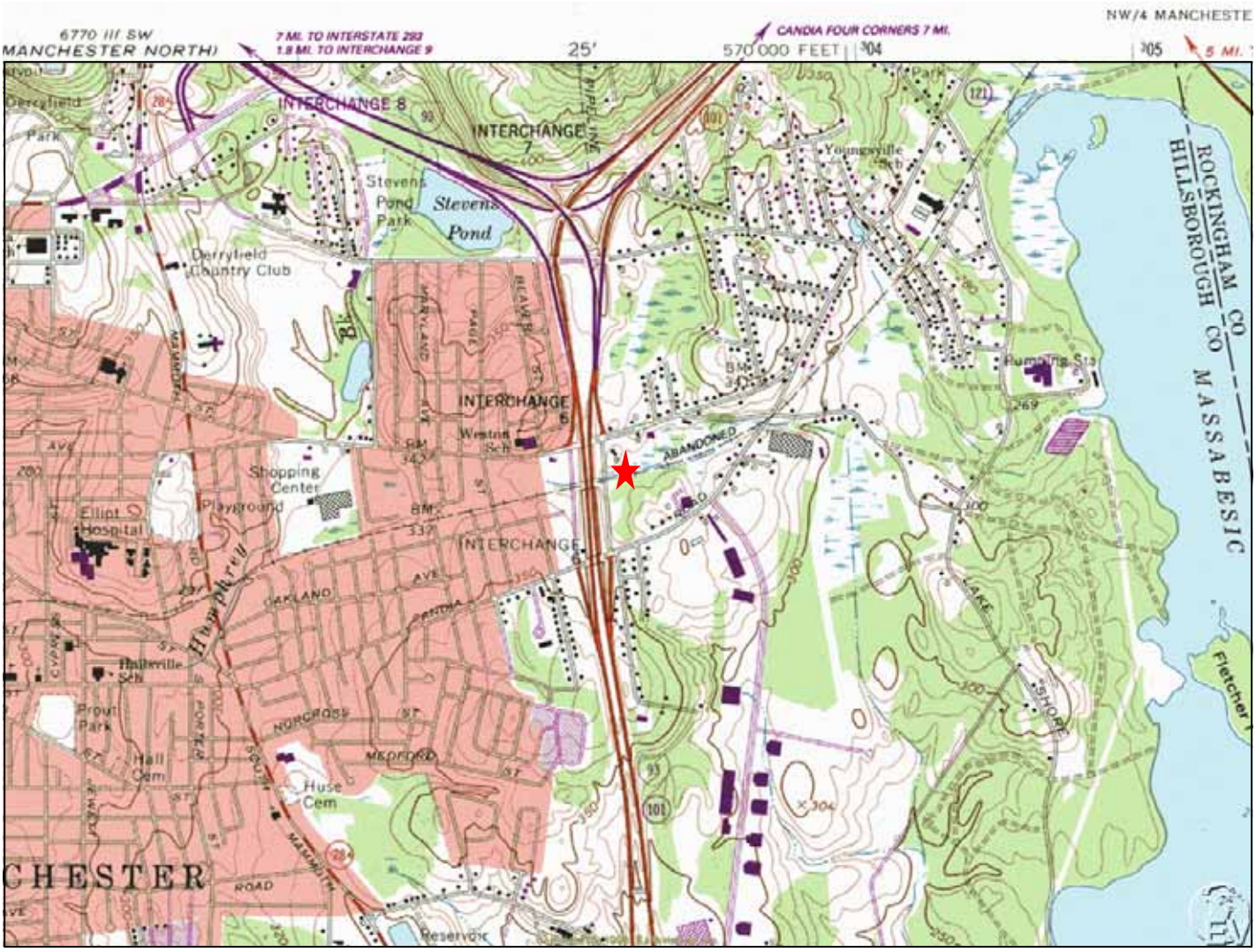
Released along the edges of existing field (old corn field). Located within the State Right-of Way, east of NH Routes 9/10/12 just prior to its intersection with NH Route 9 and NH Routes 10/12/101. The field is proposed to be converted into a wetland/floodplain mitigation site as part of the Keene-Swanzey project.




**BOW**

BIO-CONTROL RELEASE AREA

Released within the I-89 eastbound Exit 1 loop ramp to I-93 northbound.

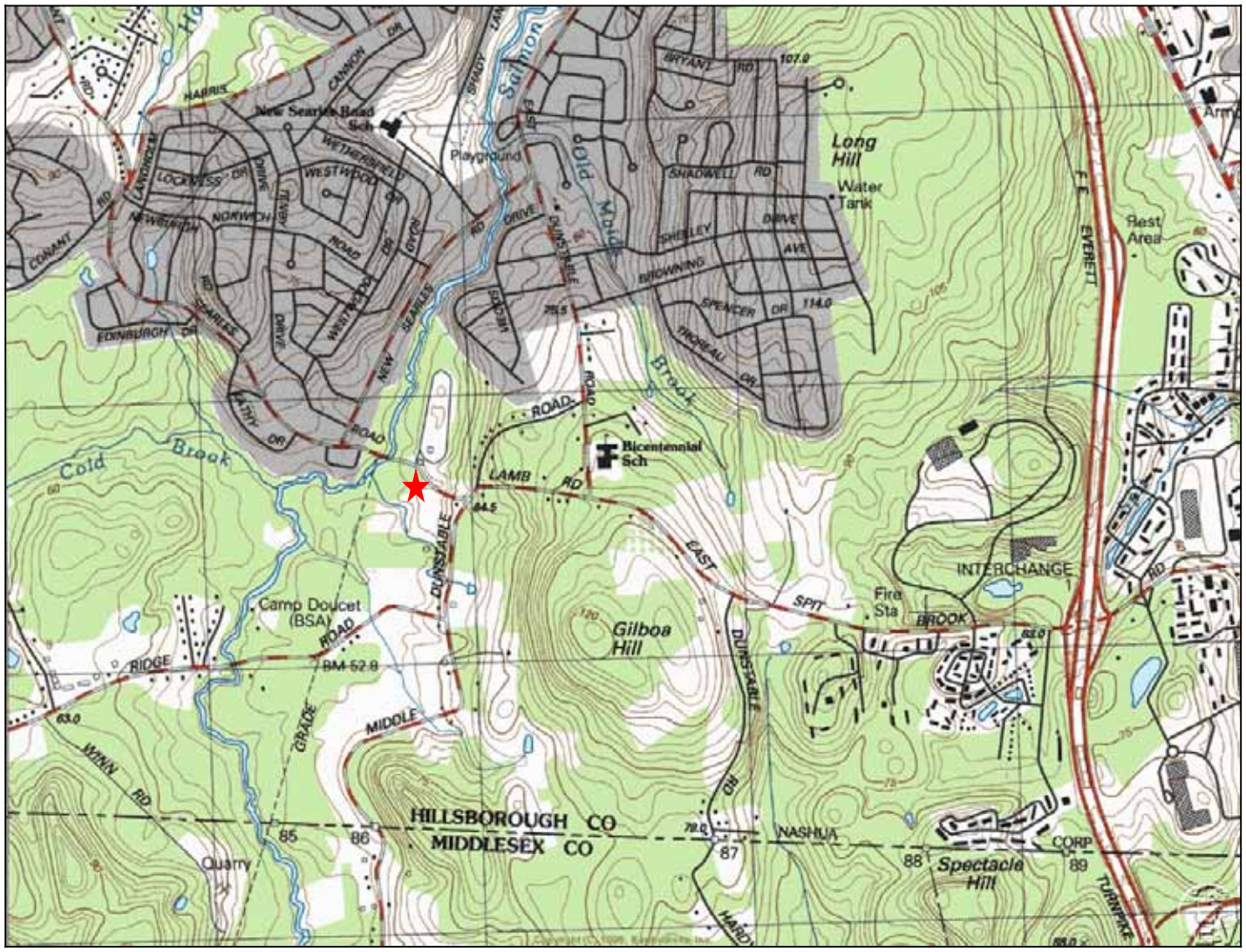



N

## MANCHESTER

BIO-CONTROL RELEASE AREA

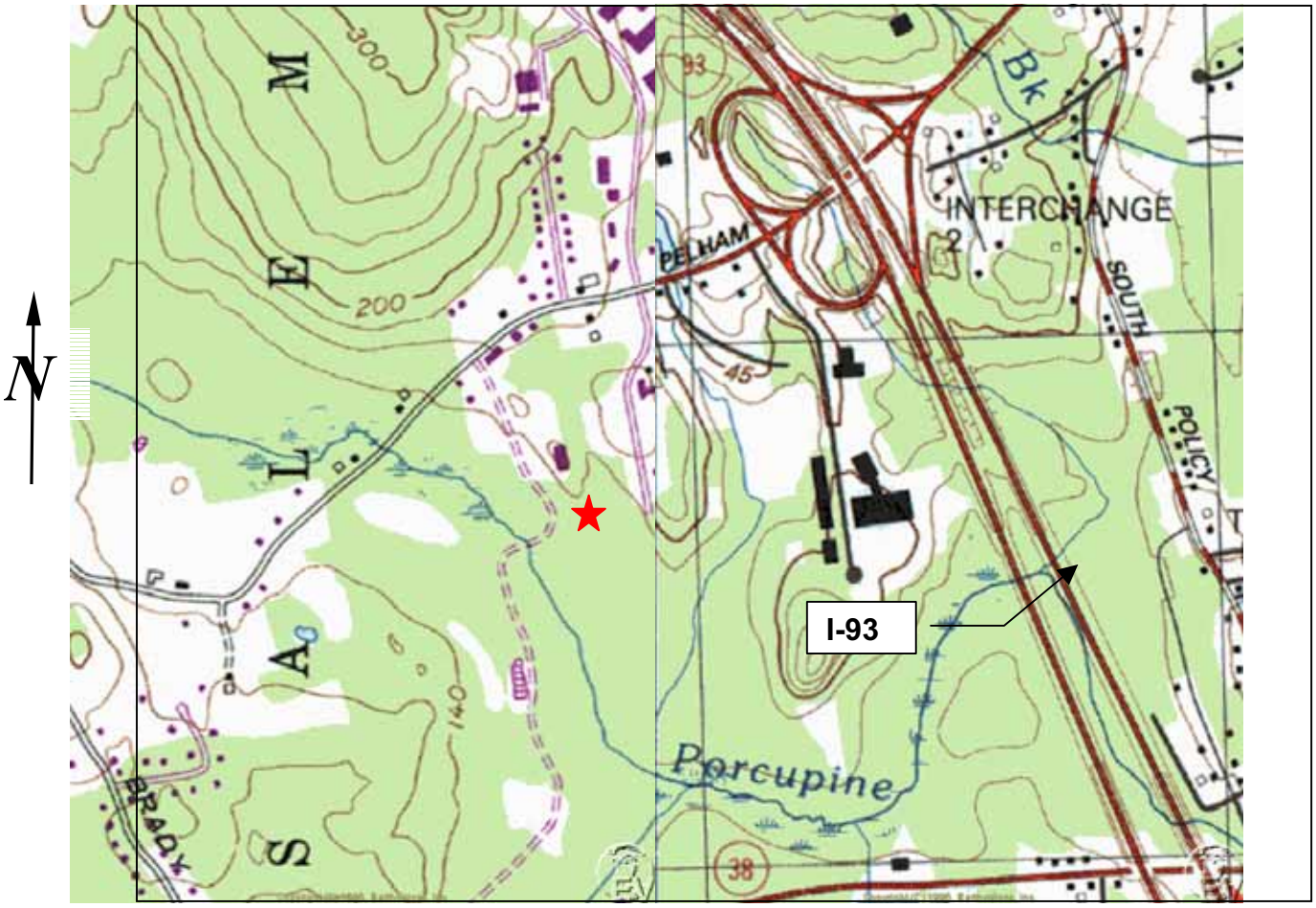
Released along the edge of the recreational trail (abandoned rail corridor) ±100 feet east of the I-93 Exit 6 northbound Frontage Road (connecting Candia Road to Hanover Street).




**NASHUA**
**SEARLES ROAD**

BIO-CONTROL RELEASE AREA

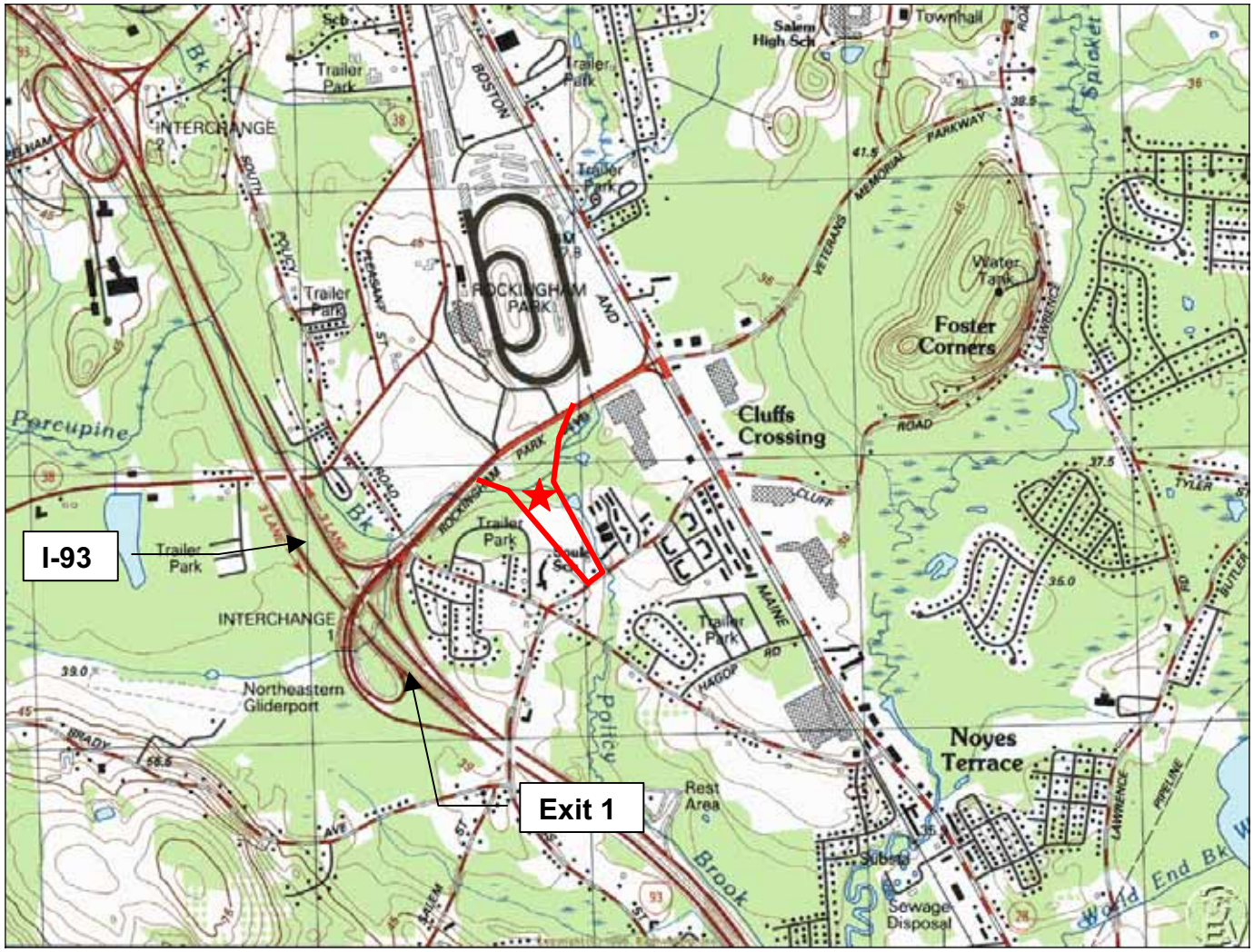
Released north of Searles Road within the Searles Road Wetland Mitigation Site. The wetland mitigation site is ±1.5 miles west of Exit 1 of the F. E. E. Turnpike (Spit Brook Road).




**SALEM**

BIO-CONTROL RELEASE AREA

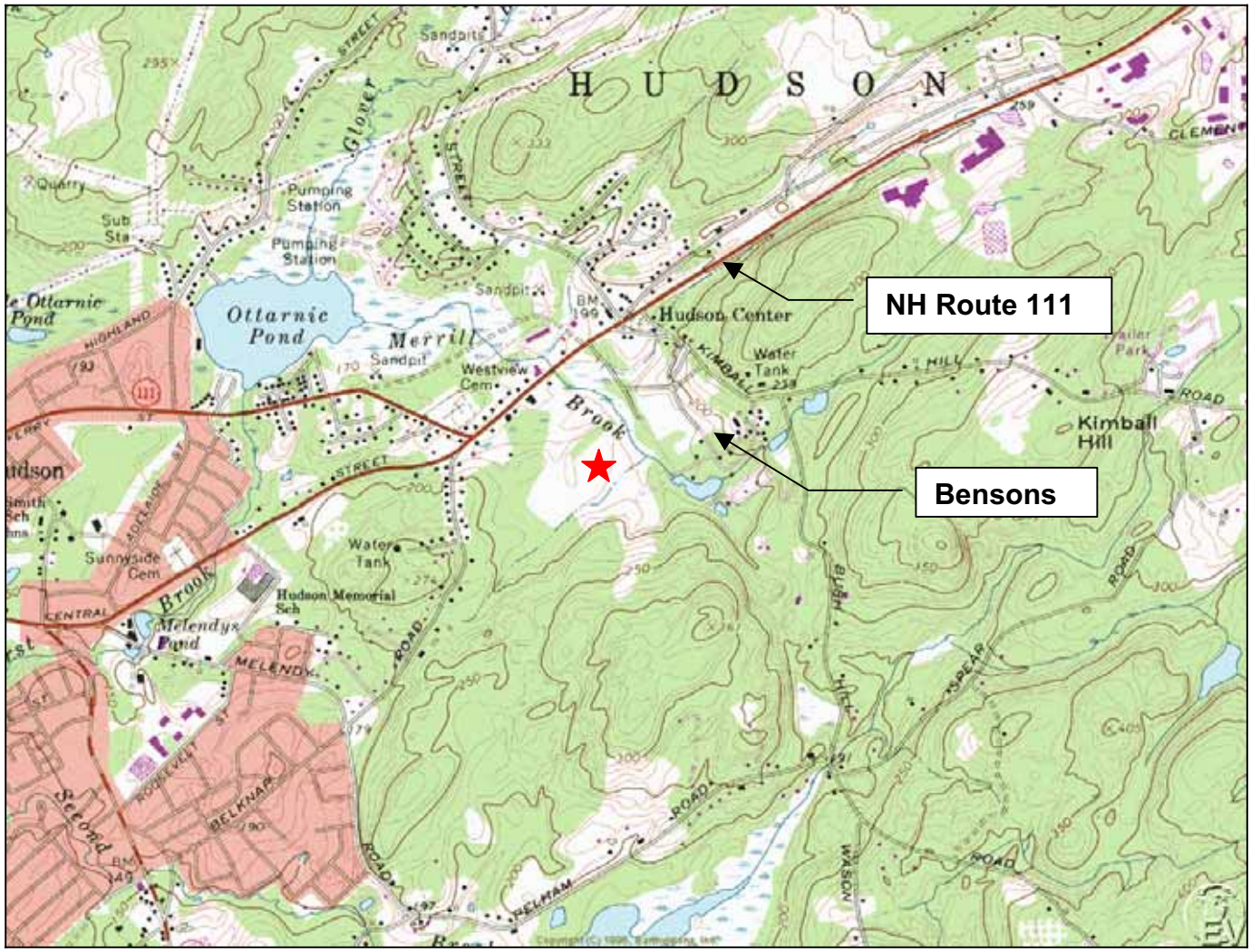
Released along the edges of Porcupine Brook Prime Wetlands at the Pelham Road wetland mitigation site located 2,500 feet from I-93 Exit 2.




**SALEM**

BIO-CONTROL RELEASE AREA

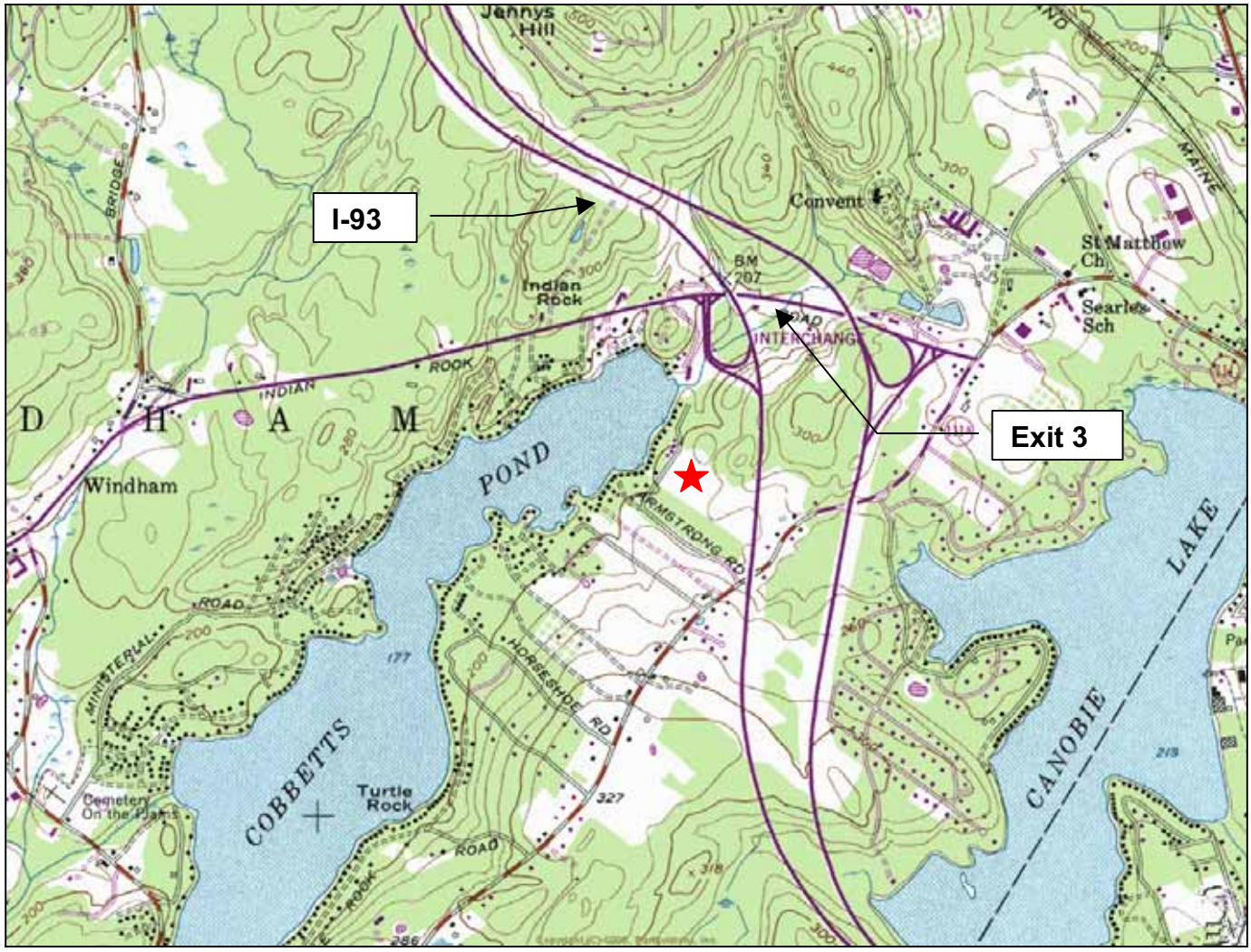
Release site is located on the southerly side of Rockingham Boulevard just across from the Rockingham Mall. Take Exit 1 off I-93.




**HUDSON**

BIO-CONTROL RELEASE AREA

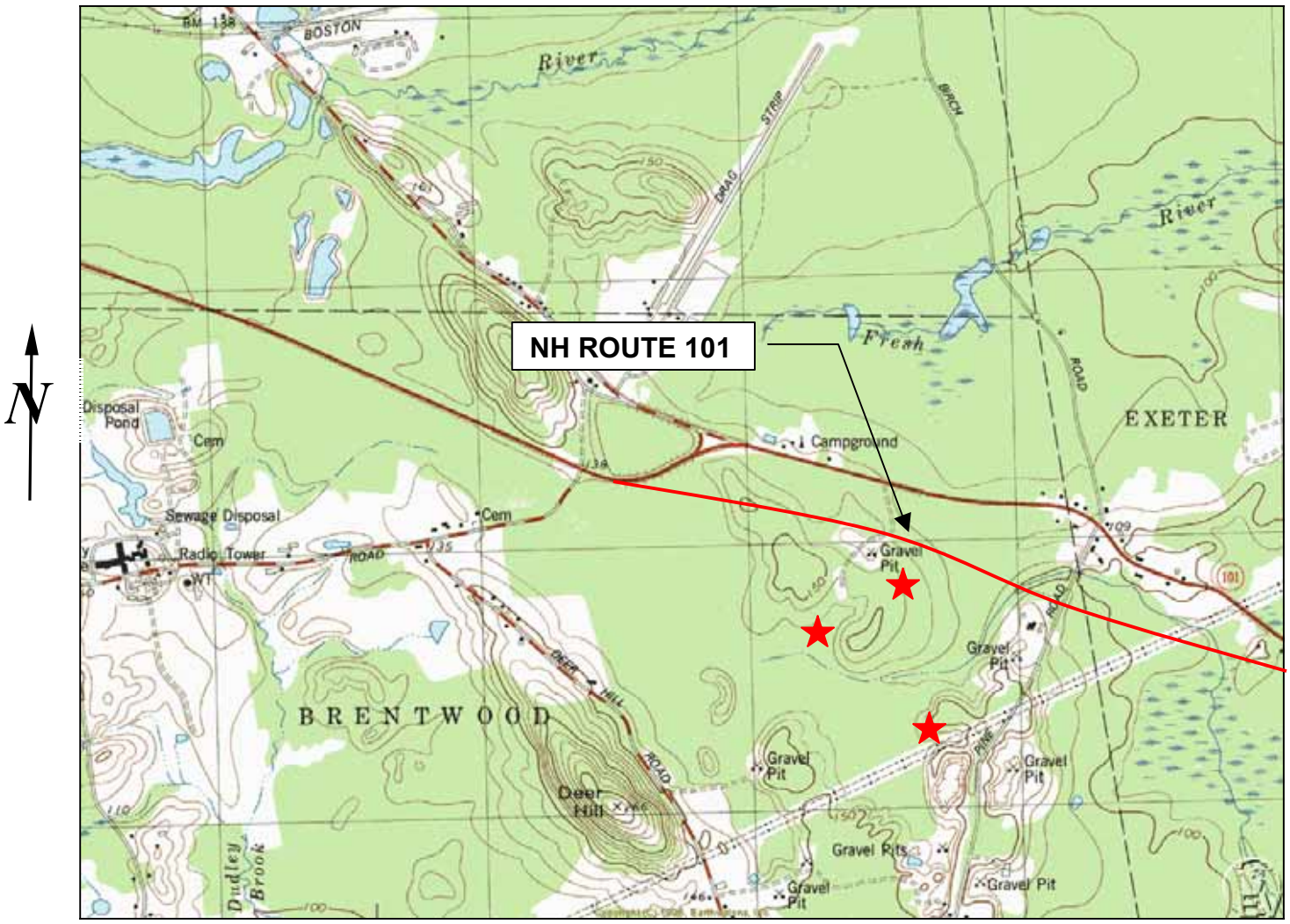
Released at proposed Bensons wetland mitigation site located in Hudson off NH Route 111.




**WINDHAM**

BIO-CONTROL RELEASE AREA

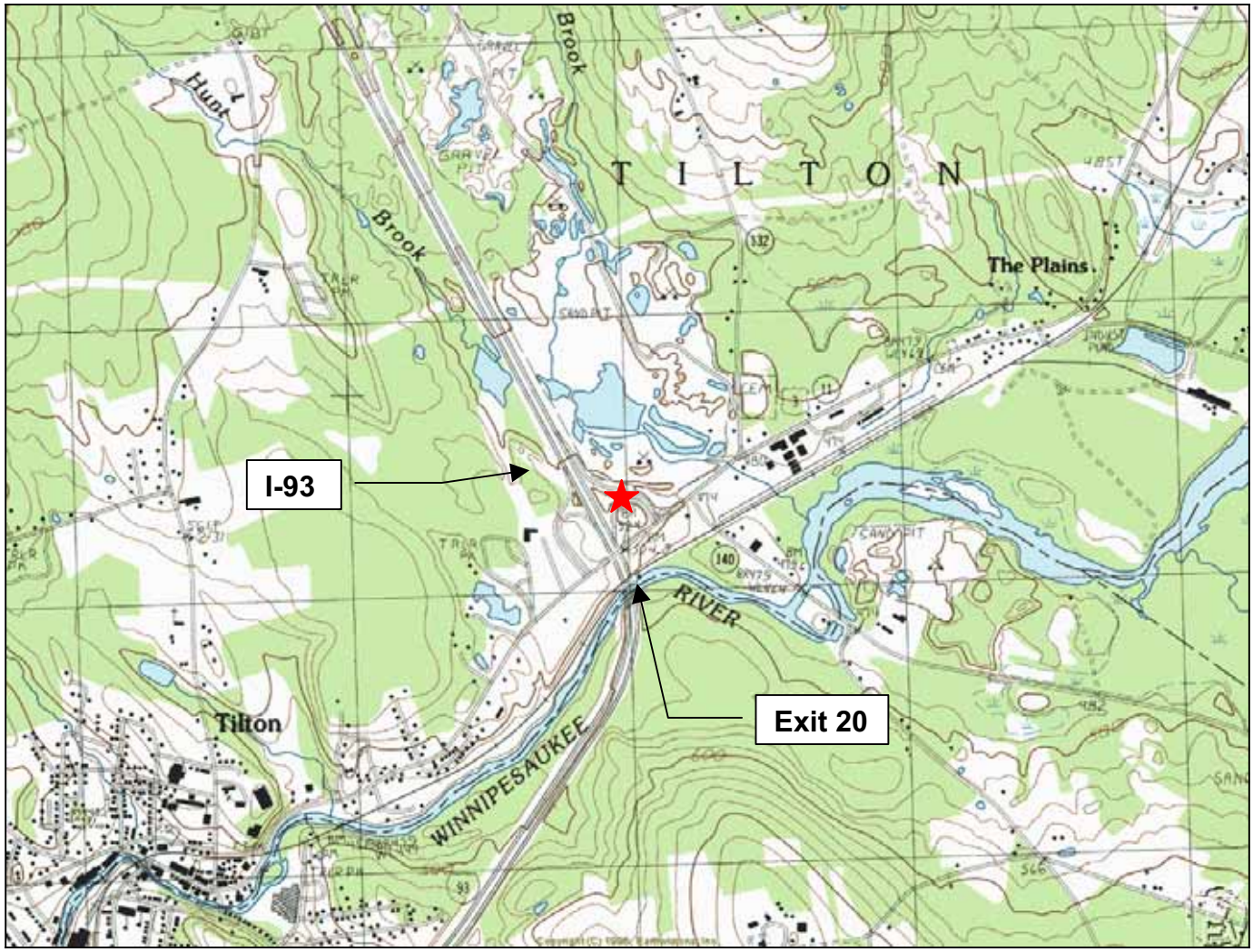
Released off Armstrong Road proposed wetland mitigation site. West of I-93 Exit 3




**BRENTWOOD**

BIO-CONTROL RELEASE AREA

Released at two locations within the Pine Road wetland mitigation site. South of NH Route 101.




**TILTON**

BIO-CONTROL RELEASE AREA

Released in Exit 20 northbound off-ramp infield. East of I-93 Exit 20.